A N N E X C

FLOOD INFLOW
TO THE PROPOSED DAMSITES

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C 1 INTRODUCTION

This ANNEX presents the results of the study of flood hydrographs at the proposed damsites. The estimated hydrographs for varying probability of exceedence provide for the design of dams in ANNEX P and the estimate of flood control effect by dams in ANNEX D.

Appropriate flow record is unavailable for the transposition of flood hydrograph to the proposed damsites, while rainfall records are available for a long period and the relationship between rainfall and run-off has been analyzed for the areas covering most of the proposed damsites. Under these conditions, rainfall records were analyzed for the probable storm rainfalls in the catchment areas of the proposed dams and for the construction of typical storm hyetograph for each river basin.

The probable storm rainfall fitted to the typical hyetograph was converted to a probable flood hydrograph at each proposed damsite by means of the storage-function method.

C 2 RAINFALL ANALYSIS

C 2.1 Available Record

MOC has operated 222 raingauges over the country (Ref. C 1). Of these, 12 gauges were chosen for this study in and near the catchment areas of the proposed dams as shown in Fig. C 1 and Table C 1 together with the catchment area of proposed dam allotted to each raingauge.

The selected raingauges have relatively long records ranging between 19 and 47 years. The annual maximum 3-day continuous rainfall records are available for most of the stations before 1965 (Ref. C 2), while daily records are available for more recent years (Ref. C 1). There are many interruptions in the records. The duration of rainfall records is shown in Fig. C 2.

C 2.2 Probable 3-day Rainfall

Table C 2 shows the duration of annual maximum continuous rainfall between 1966 and 1976 at 10 raingauges, each representing the catchment area of a proposed dam. The daily rainfall before and after the continuous rainfall was disregarded in preparing this table. Three-day rainfall is predominant being more than 50 % among the annual maximum continuous rainfall. Therefore, 3-day continuous rainfall is taken up for the analysis of annual maxima.

It was assumed that the annual maximum 3-day rainfall had occured concurrently at all the raingauge sites in the catchment area of each proposed dam in estimating the basin rainfall for the years before 1965, as no daily record is available.

For 1966-1976, the basin storm rainfall was calculated based on the 3-day rainfall corresponding to the annual maximum flood. The interrupted record at a raingauge was estimated based on a correlation with nearby raingauge.

The estimate of annual maximum 3-day rainfall in the catchment area of each proposed dam is shown in Tables C 3 to C 12.

The estimated annual maxima of 3-day rainfall in the catchment area of each proposed dam were plotted on a log-normal paper as shown in Fig. C 3 and the probable rainfall was obtained as shown in Table C 13.

C 2.3 Storm Hyetograph

The hourly rainfall records at flood time are scarce. The raingauges having hourly rainfall records were selected as shown in Fig. C 4 and the typical hyetograph were derived for each river basin. The flood periods and raingauges incorporated in the analysis are shown in Table C 14.

The hourly rainfalls at a selected raingauge were expressed as the percentage to the total rainfall of a storm. The hourly rainfall percentage was accumulated for the whole storm period. The time corresponding to the accumulated hourly rainfall percentage at a raingauge was whether added or deducted by a certain number of hours so that the time corresponding to the accumulated hourly rainfall percentage of 50 % at every raingauge is identical each other for a river basin. Then, the accumulated hourly rainfall percentage at an arbitrary time was averaged for all the raingauged in the river basin. The result plotted on a square paper was regarded as a basin average rainfall percentage mass-curve of the specific flood. The basin average rainfall percentage mass-curve for all the studied floods were compared and a typical basin average rainfall percentage mass-curve was drawn for each river basin as shown in Fig. C 5. The typical storm rainfall hyetograph can be obtained from the mass-curve. It is shown assuming the total storm rainfall of 1,000 mm for each river basin in Table C 15.

Given the total storm rainfall, the corresponding hyetograph can be obtained by dividing the figures in Table C 15 by 1,000 mm and multiplying by the total storm rainfall. Fig. C 6 shows the hyetographs assumed for the 100-year storm rainfall in each river basin.

C 3 FLOOD ANALYSIS

The storage function method assumes the following relationships among the basin rainfall, basin storage and outflow from the basin (Ref. C 5).

$$S = KQ^{p} \quad \text{------------------------} \quad (C\ 1)$$

$$ds/dt = frA - Q \quad \text{--------------------} \quad (C\ 2)$$

where,
- S : Apparent storage volume in the basin
- f : Coefficient of inflow
- r : Average rainfall in the basin
- A : Basin area
- Q : Direct outflow from the basin excluding the base flow
- t : Time
- K,p : Storage coefficients

There is a certain time lag between the rainfall and outflow. Equations C 1 and C 2 can be applied also for a river channel by replacing the term of basin rainfall by the inflow from tributaries.

The flood forecasting system covering the Han river basin has been operated since 1974. The basin model utilized by the system was established by a JICA team (Ref. C 3). UNDP/ADB Nagdong River Basin Development Project Feasibility Study estimated the flood discharges over the Nagdong river basin in 1976 (Ref. C 4). These previous studies applied the storage function method dividing the river basins to 300 km^2 to 1,500 km^2. Data in these studies were used in the present analysis. The base flow was assumed to be 0.01 $m^3/s/km^2$. For the Seomjin river basin, the storage coefficients was estimated based on the following equations (Ref. C 5) :

$$K = 119\ I^{-0.3} \quad \text{----------------} \quad (C\ 3)$$

$$p = 0.175^{-0.235} \quad \text{----------------} \quad (C\ 4)$$

where, I : Average gradient between the peak of the basin and the outlet of the basin

The storage coefficients resulted from Eqs. C 3 & C 4 appeared reasonable falling among the values in the previous study for the Nagdong river, though these equations were empirical based on the data in the Tone river basin in Japan. The storage coefficients, coefficient of inflow and base flow used for the present study are shown in Table C 16.

There are 3 proposed dams located in the catchment areas of existing dams. The flood control effects by these dams are measured as the increased flood control effect at the existing dams in ANNEX D. The flood inflow at the existing dam is calculated as the outflow from the proposed dam, controled or uncontroled, and the inflow from the residual area between the existing and proposed dams, both being affected by the storage in the river channel upstream of the existing dam. Assuming the basin models in Fig. D 6, the storage coefficient and other data necessary for the analysis are presented in Table C 18. It is assumed that the average rainfall in the residual area is equal to that in the catchment area of the proposed dam.

The probable flood hydrographs at the proposed damsites are illustrated in Fig. C 7, and the estimated peak discharges are tabulated in Table C 18.

The flood hydrographs of 100-year return period for the existing Hwacheon, Soyanggang and Andong dams are as shown in Fig. C 8.

REFERENCES

C 1 HYDROLOGICAL ANNUAL REPORT IN KOREA, 1961-1976, MOC

C 2 HYDROLOGICAL DATA IN KOREA, 1963, MOC

C 3 SURVEY REPORT OF KOREAN RIVERS (Korean), 1974, MOC/ISWACO

C 4 UNDP/ADB NAGDONG RIVER BASIN DEVELOPMENT PROJECT FEASIBILITY STUDY, 1976, NIPPON KOEI CO., LTD.

C 5 REVISED EDITION OF RIVER AND SABO ENGINEERING CRITERIA OF MINISTRY OF CONSTRUCTION (Japanese), 1977, JAPANESE ASSOCIATION OF RIVER ENGINEERING

Table C 1 RAINGAUGES SELECTED FOR ESTIMATE OF BASIN STORM RAINFALL

Name of Dam	Name of Raingauge	Type of gauge	Allocated Area (km^2)	Beginning of Record	Number of Data (1)
Han River Basin					
Bamseonggol	57 Seohwa	C	442	1916	44
	62 Hwacheon	A	141	1927	28
	Total		583		
Inje	59 Girin	A	484	1926	27
	60 Changchon	A	559	1934	27
	Total		1,043		
Hongcheon	16 Yangpyeong	A	77	1914	41
	50 Hongcheon	A	1,216	1916	37
	54 Gapyeong	C	47	1916	36
	Chuncheon	C	133	1913	43
	Total		1,473		
Gujeol	46 Jinbu	C	101	1937	19
Dalcheon	29 Chungju	A	147	1917	44
	30 Goesan	A	1,201	1916	38
	Total		1,348		
Ganhyeon	24 Weonju	C	261	1914	39
	25 Hoengseong	A	919	1916	42
	Total		1,180		
Nagdong River Basin					
Bonghwa	187 Hyeondong	A	1,105	1926	33
Imha	190 Cheongsong	A	561	1914	42
	192 Yeongyang	A	669	1916	39
	Total		1,230		
Hamyang	157 Unbong	A	264	1931	26
Seomjin River Basin					
Juam	130 Gurye	A	213	1916	43
	134 Boseong	A	598	1917	38
	128 Suncheon (2)	C	199	1914	47
	Total		1,010		

Remarks ; (1) Number of annual maximum 3-day rainfall records
(2) Outside basin
C : Convensional gauge, A : Automatic gauge

Table C 2 DURATION OF ANNUAL MAXIMUM CONTINUOUS RAINFALL

Unit : day

Raingauge	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Han River Basin											
57 Seohwa	3	3	3	3	4	5	3	2	-	5	3
59 Girin	3	2	3	2	3	3	-	-	2	-	4
50 Hongcheon	-	3	3	2	1	3	3	2	2	2	3
46 Jinbu	3	1	3	3	4	4	3	3	-	-	3
30 Goesan	3	3	3	3	3	2	2	2	2	3	3
25 Hoengseong	6	2	1	3	3	3	3	2	-	2	3
Nagdong River Basin											
187 Hyeondong	3	3	3	6	3	-	3	3	-	-	3
192 Yeongyang	-	3	3	4	3	2	3	2	2	3	3
157 Unbong	4	1	1	7	3	2	4	3	5	3	4
Seomjin River Basin											
134 Boseong	2	2	1	2	3	3	3	2	-	2	2

Remarks ; - : Data not available

Table C 3 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, BAMSEONGGOL DAMSITE

Year	Beginning Date	57 Seohwa W = 0.758	62 Hwacheon W = 0.242	Weighted Mean
1916	Jun 12	-	213.8	213.8
1917	Sep 2	-	139.0	139.0
1918	Aug 15	-	213.9	213.9
1919	Jul 5	-	126.3	126.3
1920	Jul 5	-	174.0	174.0
1921	Aug 28	-	93.8	93.8
1922	Aug 21	-	172.0	172.0
1923	Jul 20	-	175.0	175.0
1924	Jul 18	-	189.2	189.2
1925	Jul 15	-	462.5	462.5
1926	Jul 16	-	227.0	227.0
1927	Jul 12	149.1	266.7	177.6
1928	Sep 3	81.7	-	81.7
1929	Aug 15	154.6	-	154.6
1930	Jul 16	261.5	-	261.5
1931	Jul 23	113.2	-	113.2
1932	Aug 29	225.2	183.0	215.0
1933	Sep 1	111.8	-	111.8

Remarks ; W : Weight

Table C 3 Continued (2)

Year	Beginning Date	57 Seohwa W = 0.758	62 Hwacheon W = 0.242	Weighted Mean
1934	Sep 4	101.3	97.3	100.3
1935	Jul 20	593.4	278.0	517.1
1936	Aug 25	156.2	166.5	158.7
1937	Jul 18	150.7	183.0	158.5
1938	Jul 5	-	132.0	132.0
1939	May 9	85.2	73.5	82.4
1940	Sep 1	298.5	320.5	303.8
1941	Aug 9	114.0	-	114.0
1957	Aug 18	-	102.4	102.4
1958	Sep 3	-	131.5	131.5
1959	Aug 30	-	201.8	201.8
1960	Jun 28	-	112.6	112.6
1961	Aug 30	-	110.4	110.4
1962	Sep 6	-	135.7	135.7
1963	Jul 12	162.3	-	162.3
1964	Jul 1	165.7	-	165.7
1965	Jul 13	-	461.7	461.7
1966	Jul 23	258.8	175.8	238.7

Remarks ; W : Weight

Table C 3 Continued (3)

Year	Beginning Date	57 Seohwa W = 0.758	62 Hwacheon W = 0.242	Weighted Mean
1967	Jul 19	168.6	135.5	160.6
1968	Jul 16	337.7	170.3	297.2
1969	Jul 28	193.7	236.8	204.1
1970	Jul 4	166.0	80.1	145.2
1971	Aug 10	125.2	-	125.2
1972	Aug 16	332.5	108.5	278.3
1973	Aug 27	58.8	-	58.8
1974	Aug 22	-	113.3	113.3
1975	Jul 24	98.6	-	98.6
1976	Aug 13	264.3	225.6	254.9

Remarks ; W : Weight

Table C 4 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, INJE DAMSITE

Unit : mm

Year	Beginning Date	59 Girin W = 0.464	60 Changchon W = 0.536	Weighted Mean
1926	Jul 15	262.7	(235.6)	243.2
1927	Jul 12	248.9	(223.2)	235.2
1928	Sep 3	96.8	(87.6)	91.8
1929	Aug 14	142.8	(128.6)	135.2
1930	Jul 16	279.5	(250.6)	264.0
1931	Aug 18	123.5	(111.4)	117.0
1932	Aug 29	164.0	(147.5)	155.2
1933	Jul 28	110.9	(100.1)	105.1
1934	Aug 9	109.5	(98.9)	103.8
1935	Jul 21	337.2	(302.1)	318.4
1936	Aug 25	217.7	203.5	210.1
1937	Sep 25	84.7	(76.8)	80.4
1938	Sep 6	98.2	(88.8)	93.2
1939	May 22	71.9	(65.3)	68.4
1940	Jul 4	411.0	(368.0)	387.9
1941	Jul 5	165.0	(148.4)	156.1
1957	Jul 5	(210.5)	189.0	199.0
1958	Sep 3	(287.4)	257.7	271.5

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 4 Continued (2)

Unit : mm

Year	Beginning Date	59 Girin W = 0.464	60 Changchon W = 0.536	Weighted Mean
1959	Aug 30	(191.3)	171.9	180.9
1960	Jun 26	(192.6)	173.1	182.2
1961	Apr 4	(81.2)	73.6	77.1
1963	Jul 23	141.7	272.1	211.6
1964	Aug 9	183.3	(164.8)	173.4
1965	Jul 13	602.3	394.4	490.9
1966	Jul 22	324.9	378.2	353.5
1967	Jul 11	108.4	101.6	104.8
1968	Jul 14	143.3	45.3	90.8
1969	Jul 29	219.9	407.5	320.5
1970	Sep 15	177.5	130.2	152.1
1971	Aug 9	126.8	60.0	91.0
1972	Aug 16	(328.1)	294.0	309.8
1973	Aug 17	(95.4)	86.3	90.5
1974	Jul 8	160.1	104.6	130.4
1975	Jul 15	(157.8)	142.0	149.3
1976	Aug 13	367.7	227.2	292.4

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 5 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, HONGCHEON DAMSITE

Unit : mm

Year	Beginning Date	16 Yangpyeong W = 0.052	50 Hongcheon W = 0.826	54 Gapyeong W = 0.032	Chuncheon W = 0.090	Weighted Mean
1913	Aug 16	(146.6)	(131.2)	(135.6)	133.5	132.3
1914	Mar 5	(152.7)	(137.5)	(143.5)	141.0	138.8
1915	Jul 24	379.6	(273.5)	(316.1)	304.1	283.1
1916	Jun 13	204.5	181.4	(199.3)	193.7	184.3
1917	Sep 2	(189.6)	177.5	(191.0)	185.9	179.3
1918	Aug 14	(244.2)	264.3	366.0	(351.3)	274.3
1919	Jul 5	(211.3)	229.7	(231.8)	(251.6)	230.8
1920	Aug 2	(221.1)	240.0	(245.9)	(264.0)	241.4
1921	Aug 4	(83.7)	95.6	(47.5)	(90.8)	93.0
1922	Aug 20	187.0	136.9	217.0	(210.4)	148.7
1923	Jul 9	(129.5)	143.8	(113.7)	(148.6)	142.5
1924	Jul 23	289.5	229.1	275.5	258.3	236.4
1925	Jul 15	332.0	395.1	483.4	469.0	401.3
1926	Jul 16	287.5	258.3	(308.2)	(285.9)	263.9
1927	Aug 27	(158.8)	174.5	(155.9)	(185.4)	174.1
1928	Jul 16	(101.7)	114.5	(73.5)	(113.5)	112.4
1929	Jun 26	(183.5)	119.6	171.4	178.5	129.9
1930	Jul 11	(150.3)	165.6	(143.7)	(174.8)	164.9
1931	Aug 18	183.8	171.6	(217.5)	210.9	177.2
1932	Aug 29	(142.6)	157.5	177.0	(172.6)	158.7

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 5 Continued (2)

Unit : mm

Year	Beginning Date	16 Yangpyeong W = 0.052	50 Hongcheon W = 0.826	54 Gapyeong W = 0.032	Chuncheon W = 0.090	Weighted Mean
1933	Jul 28	(190.6)	125.0	(192.3)	187.1	136.2
1934	Jun 28	(57.2)	67.8	(9.3)	(57.5)	64.4
1935	Jul 20	264.0	379.8	411.5	384.6	375.2
1936	Sep 9	(206.4)	224.6	(224.8)	(245.5)	225.5
1937	Jul 18	197.0	143.7	(197.4)	191.9	152.5
1938	Sep 2	(125.5)	139.5	(107.8)	(143.5)	138.1
1939	May 10	(56.5)	67.0	(8.2)	(56.5)	63.6
1940	Jul 19	(359.2)	384.6	(392.0)	(437.4)	388.3
1941	Aug 21	(144.9)	159.9	(135.9)	(167.9)	159.1
1957	Jul 15	(203.4)	(188.9)	(208.8)	202.7	191.5
1958	Jul 1	(149.3)	(134.0)	(139.1)	136.8	135.2
1959	Aug 30	(180.3)	(165.5)	(179.1)	174.6	167.5
1960	Jun 26	(164.4)	(149.3)	(158.6)	155.2	150.9
1961	Aug 29	(171.5)	(156.5)	(167.8)	163.9	158.3
1962	Sep 5	(153.7)	88.3	(144.7)	142.1	98.3
1963	Jul 23	(212.6)	(198.3)	(220.8)	214.0	201.2
1964	Jul 15	(421.8)	(411.0)	483.4	469.0	419.1
1965	Jul 13	(501.5)	(491.9)	(593.2)	566.1	502.3
1966	Jul 23	383.5	(291.0)	347.5	325.2	300.7
1967	Aug 20	(136.1)	150.7	(123.2)	(156.9)	149.6

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 5 Continued (3)

Unit : mm

Year	Beginning Date	16 Yangpyeong W = 0.052	50 Hongcheon W = 0.826	54 Gapyeong W = 0.032	Chuncheon W = 0.090	Weighted Mean
1968	Aug 14	150.0	170.2	110.9	50.0	156.4
1969	Aug 1	(194.9)	(180.3)	(197.9)	192.4	182.7
1970	Aug 3	47.8	224.7	47.1	100.8	198.7
1971	Aug 9	143.5	109.0	145.8	153.4	116.0
1972	Aug 17	399.0	377.0	186.0	(181.1)	354.4
1973	Aug 4	91.3	73.0	(79.1)	(63.7)	73.3
1974	Aug 3	(188.7)	206.0	(199.2)	(223.2)	206.4
1975	Jul 15	67.5	159.9	143.8	(141.2)	152.9
1976	Aug 13	197.0	302.0	(202.5)	(338.3)	296.6

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 6 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, GUJEOL DAMSITE

Unit : mm

Year	Beginning Date	46 Jinbu W = 1.0	Year	Beginning Date	46 Jinbu W = 1.0
1937	Sep 25	100.7	1966	Jul 23	317.0
1938	Sep 2	142.1	1967	Sep 2	178.1
1939	May 12	38.7	1968	Jul 14	171.5
1940	Sep 1	160.7	1969	Jul 29	168.7
1941	Aug 11	74.2	1970	Sep 2	158.8
1960	Sep 17	61.6	1971	Jul 10	99.4
1961	Aug 7	120.5	1972	Aug 17	473.3
1963	Jul 23	267.4	1973	Aug 16	64.0
1965	Jul 13	198.3	1976	Aug 13	239.2

Remarks ; W : Weight

Table C 7 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, DALCHEON DAMSITE

Unit : mm

Year	Beginning Date	29 Chungju W = 0.109	30 Goesan W = 0.891	Weighted Mean
1916	Jun 13	(199.7)	204.6	204.1
1917	Jul 3	(182.9)	191.7	190.7
1918	Jun 30	(227.5)	225.9	226.1
1919	Jul 4	347.2	265.3	274.2
1920	Jul 5	308.9	287.7	290.0
1921	Jul 5	173.9	188.5	186.9
1922	Jul 28	273.7	313.2	308.9
1923	Jul 4	347.2	(317.7)	320.9
1924	Jul 23	129.3	135.2	134.6
1925	Jul 16	188.1	222.4	218.7
1926	Jul 20	(337.1)	310.0	313.0
1927	May 1	(66.3)	102.3	98.4
1928	Sep 3	109.5	127.2	125.3
1929	Jun 26	94.2	125.8	122.4
1930	Jul 11	231.2	208.5	211.0
1931	Sep 10	(127.2)	149.0	146.6
1932	Sep 22	130.5	162.0	158.6
1933	Jun 25	(45.7)	86.5	82.1

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 7 Continued (2)

Unit : mm

Year	Beginning Date	29 Chungju W = 0.109	30 Goesan W = 0.891	Weighted Mean
1934	Jul 21	(251.1)	244.0	244.8
1935	Jul 20	126.9	118.4	119.3
1936	Aug 14	(215.9)	217.0	216.9
1937	Jul 18	(143.6)	161.6	159.6
1938	Jul 6	137.0	167.3	164.0
1939	Sep 6	-	50.0	50.0
1940	Jul 23	(145.1)	162.7	160.8
1941	Jul 5	86.4	160.5	152.4
1959	Jul 5	300.4	(281.8)	283.8
1960	Jun 28	251.7	(244.5)	245.3
1961	Jul 6	173.5	(184.5)	183.3
1962	Sep 5	82.2	(114.5)	111.0
1963	Jul 23	150.5	(166.9)	165.1
1964	Aug 6	228.0	(226.3)	226.5
1965	Jul 20	(115.2)	139.8	137.1
1966	Jun 24	94.2	122.7	119.6
1967	Jun 1	46.2	93.2	88.1
1968	Jul 14	158.3	203.3	198.4

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 7 Continued (3)

Unit : mm

Year	Beginning Date	29 Chungju W = 0.109	30 Goesan W = 0.891	Weighted Mean
1969	Aug 2	256.0	222.2	225.9
1970	Jul 17	42.2	109.0	101.7
1971	Jun 26	76.5	111.2	107.4
1972	Aug 17	214.5	147.7	155.0
1973	Jun 28	81.7	77.6	78.0
1974	May 18	122.8	96.0	98.9
1975	Sep 14	194.6	220.7	217.9
1976	Aug 13	136.0	232.7	222.2

Remarks ; W : Weight

Table C 8 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, GANHYEON DAMSITE

Unit : mm

Year	Beginning Date	24 Weonju W = 0.221	25 Hoengseong W = 0.779	Weighted Mean
1914	Jul 29	151.8	(172.5)	167.9
1915	Jul 24	162.8	(179.6)	175.9
1916	Jun 13	141.9	204.4	190.6
1917	Sep 2	(52.3)	107.9	95.6
1918	Jul 8	165.8	183.2	179.4
1919	Jul 3	195.6	(200.9)	199.7
1920	Jul 5	(493.0)	393.8	415.7
1921	Jul 13	(101.0)	139.5	131.0
1922	Sep 10	(101.4)	139.8	131.3
1923	Jul 23	(269.2)	248.6	253.1
1924	Jul 23	164.0	138.0	143.7
1925	Jul 16	(182.5)	192.4	190.2
1926	Jul 26	(217.5)	215.1	215.6
1927	Aug 27	61.5	128.9	114.0
1928	Sep 2	(93.7)	134.8	125.7
1929	Jun 26	(65.5)	116.5	105.2
1930	Jul 11	(215.1)	213.5	213.8
1931	Apr 26	115.5	128.3	118.3

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 8 Continued (2)

Year	Beginning Date	24 Weonju W = 0.221	25 Hoengseong W = 0.779	Weighted Mean
1932	Aug 29	-	67.0	67.0
1933	Jul 28	297.2	144.5	178.2
1934	May 7	151.3	77.4	93.7
1935	Jul 20	224.1	345.6	318.7
1936	Aug 9	564.0	420.4	452.1
1937	Aug 24	(78.6)	125.0	114.8
1938	Jul 6	166.5	(182.0)	178.6
1939	Jun 7	-	56.5	56.5
1940	Jul 18	(406.8)	337.9	353.1
1941	Aug 9	(31.5)	94.4	80.5
1958	Sep 3	(353.8)	303.5	314.6
1959	Jul 5	(212.6)	211.9	212.1
1960	Jun 27	(165.0)	181.0	177.5
1961	Aug 7	(37.8)	98.5	85.1
1962	Sep 5	(151.7)	172.4	167.8
1963	Jul 24	(186.5)	195.0	193.1
1964	Aug 6	(391.6)	328.0	342.0
1965	Jul 10	(147.4)	169.6	164.7

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 8 Continued (3)

Unit : mm

Year	Beginning Date	24 Weonju W = 0.221	25 Hoengseong W = 0.779	Weighted Mean
1966	Jul 23	200.0	341.0	309.8
1967	Sep 2	77.0	129.9	118.2
1968	Jul 14	183.6	196.0	193.3
1969	Jul 28	186.8	209.6	204.6
1970	Jul 16	165.3	163.8	164.1
1971	Jun 30	(122.6)	153.5	146.7
1972	Aug 18	303.0	333.0	326.4
1973	Aug 16	(12.8)	82.3	66.9
1974	Jul 7	163.9	(180.3)	176.7
1975	Jul 26	54.2	153.5	131.6
1976	Aug 12	438.0	247.5	289.6

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 9 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, BONGHWA DAMSITE

Unit : mm

Year	Beginning Date	187 Hyeondong W = 1.0	Year	Beginning Date	187 Hyeondong W = 1.0
1926	Aug 4	177.1	1957	Jul 30	154.5
1927	Aug 8	89.5	1958	Jul 1	124.4
1928	Sep 15	125.5	1959	Jul 6	187.4
1929	Jun 26	141.0	1960	Jun 27	113.0
1930	Jul 17	293.0	1961	Aug 2	104.5
1931	Apr 26	132.5	1962	Aug 15	100.4
1932	Aug 22	102.0	1963	Jul 25	140.8
1933	Aug 3	135.2	1965	Jul 26	338.0
1934	Jul 20	265.9	1966	Jun 24	115.0
1935	Jul 20	156.0	1967	Jun 27	60.5
1936	Aug 26	342.0	1968	Jul 14	146.0
1937	May 19	128.2	1969	Aug 2	117.5
1938	Sep 2	157.7	1970	Aug 5	197.0
1939	Jun 24	71.0	1972	Aug 17	214.2
1940	Sep 3	180.0	1973	Aug 2	38.0
1941	Aug 23	193.3	1976	Aug 13	147.3

Remarks ; W : Weight

Table C 10 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, IMHA DAMSITE

Year	Beginning Date	190 Cheongsong W = 0.456	192 Yeongyang W = 0.544	Weighted Mean
1914	Aug 2	154.8	(177.1)	166.9
1915	Sep 7	161.4	(186.5)	175.0
1916	Jun 21	221.4	260.2	242.5
1917	Sep 2	(106.5)	108.7	107.7
1918	Jun 30	179.1	204.5	192.9
1919	Jul 4	176.0	255.0	219.0
1920	Jul 18	136.5	181.8	161.1
1921	Jul 5	(140.8)	157.3	149.8
1922	Jul 5	163.5	185.7	175.6
1923	Jun 28	56.5	75.1	66.6
1924	Jul 21	(125.0)	134.9	130.4
1925	Jul 9	191.7	171.5	180.7
1926	Jul 17	(77.8)	67.9	72.4
1927	Jul 1	(81.4)	73.0	76.8
1928	Sep 14	(69.3)	55.9	62.0
1929	Jun 26	(124.7)	134.4	130.0
1930	Jul 17	(135.7)	150.1	143.6
1931	Apr 26	(102.5)	103.0	102.8
1932	Aug 30	82.0	98.0	90.7
1933	Jun 29	137.3	150.5	144.5
1934	Jul 21	(182.6)	216.6	201.1

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 10 Continued (2)

Unit : mm

Year	Beginning Date	190 Cheongsong W = 0.456	192 Yeongyang W = 0.544	Weighted Mean
1935	Aug 21	113.4	83.0	96.9
1936	Aug 10	(213.5)	260.4	239.0
1937	May 19	(85.9)	79.5	82.4
1938	Jul 6	115.7	126.4	121.5
1939	Aug 10	(94.4)	91.5	92.8
1940	Jul 21	(127.7)	138.7	133.7
1941	Aug 20	(93.2)	89.8	91.4
1962	Aug 16	78.8	(69.4)	73.7
1963	Jul 16	132.6	139.3	136.2
1964	Aug 9	(213.5)	260.4	239.0
1965	Jul 20	(148.0)	167.5	158.6
1967	Sep 3	108.0	101.6	104.5
1968	Aug 15	160.0	150.6	154.9
1969	Sep 14	174.7	210.5	194.2
1970	Jul 4	203.0	195.4	198.9
1971	Jun 30	(131.3)	143.8	138.1
1972	Aug 17	167.0	251.4	212.9
1973	Jul 27	(116.5)	122.8	119.9
1974	May 16	(92.8)	89.2	90.8
1975	Jul 5	143.2	170.8	158.2
1976	Aug 12	(160.8)	185.7	174.4

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 11 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, HAMYANG DAMSITE

Unit : mm

Year	Beginning Date	157 Unbong W = 1.0	Year	Beginning Date	157 Unbong W = 1.0
1931	Aug 2	166.3	1964	Jul 16	139.9
1932	Aug 2	275.8	1965	Jul 20	239.9
1933	Jul 24	214.3	1966	Jul 21	198.8
1934	Jul 19	426.0	1967	Jun 24	82.3
1935	Sep 8	110.8	1968	Jul 31	154.0
1936	Aug 26	188.8	1969	Jul 17	206.8
1937	Apr 13	88.2	1970	Jul 15	158.7
1938	May 27	134.6	1971	Jul 20	132.1
1939	Aug 28	66.6	1972	Jul 8	190.6
1940	Jul 6	182.5	1973	Aug 2	123.6
1941	Jun 29	239.9	1974	Jul 2	138.6
1962	Sep 6	133.4	1975	Jul 5	127.0
1963	Jun 17	243.7	1976	Jun 7	148.7

Remarks ; W : Weight

Table C 12 ANNUAL MAXIMUM 3-DAY BASIN RAINFALL, JUAM DAMSITE

Unit : mm

Year	Beginning Date	130 Gurye W = 0.211	134 Boseong W = 0.592	137 Suncheon W = 0.197	Weighted Mean
1914	Jul 27	(116.1)	(184.7)	157.1	164.8
1915	Sep 6	(140.0)	(213.1)	196.1	194.3
1916	Sep 4	(131.2)	(202.7)	181.8	183.5
1917	Sep 13	(92.0)	148.2	(107.2)	128.3
1918	Jul 25	(154.9)	214.0	(197.3)	198.2
1919	Jun 10	(105.1)	161.9	(125.9)	142.8
1920	Jun 28	(258.7)	322.5	(345.9)	313.6
1921	Jul 10	(101.4)	158.0	(120.6)	138.7
1922	Jul 24	156.1	213.6	(222.5)	203.2
1923	Jun 19	(133.9)	192.0	(167.2)	174.8
1924	Jul 21	(122.4)	180.0	(150.7)	162.1
1925	Jul 17	(183.1)	243.5	237.7	229.6
1926	May 26	(156.1)	245.0	222.4	221.8
1927	Aug 8	(116.7)	174.0	(142.5)	155.7
1928	Aug 27	(215.6)	277.5	(284.3)	265.8
1929	Aug 16	(55.5)	110.0	(54.8)	87.6
1930	Jun 24	(153.4)	180.0	218.0	181.9
1931	May 14	(101.4)	158.0	(120.6)	138.7

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 12 Continued (2)

Unit : mm

Year	Beginning Date	130 Gurye W = 0.211	134 Boseong W = 0.592	137 Suncheon W = 0.197	Weighted Mean
1932	Aug 2	232.8	277.2	286.0	269.6
1933	Jun 28	212.5	219.3	(314.7)	236.7
1934	May 17	(265.9)	330.0	(356.2)	321.6
1935	Sep 8	(122.9)	180.5	(151.4)	162.6
1936	Aug 26	171.2	223.0	(247.2)	216.8
1937	Apr 11	(262.8)	326.8	(351.8)	318.2
1938	May 27	135.4	228.1	182.2	199.5
1939	Aug 29	(133.9)	192.0	(167.2)	174.8
1940	Jun 23	(218.0)	280.0	(287.7)	268.4
1941	Jun 29	(132.9)	191.0	(165.8)	173.8
1957	Jul 24	(121.4)	(190.9)	165.7	171.3
1958	Sep 4	(127.2)	(197.9)	175.2	178.5
1959	Sep 15	(93.4)	(157.5)	119.9	136.6
1960	Sep 16	(154.2)	(230.1)	219.3	211.9
1961	May 9	(178.9)	(259.6)	259.8	242.6
1962	Sep 5	183.4	231.1	297.1	234.0
1963	Jun 17	218.7	324.6	379.6	313.1
1964	Aug 31	145.3	169.0	(204.8)	171.1

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 12 Continued (3)

Unit : mm

Year	Beginning Date	130 Gurye W = 0.211	134 Boseong W = 0.592	137 Suncheon W = 0.197	Weighted Mean
1965	Aug 10	(104.2)	161.0	124.7	141.9
1966	Aug 30	(166.1)	322.1	238.8	272.8
1967	Jun 25	84.7	110.0	86.2	100.0
1968	Aug 23	32.7	91.6	51.5	71.3
1969	Aug 1	132.5	252.9	161.2	209.4
1970	Jul 14	93.4	167.8	118.0	142.3
1971	Aug 18	65.2	166.9	98.0	131.9
1972	Jul 1	(154.4)	(230.4)	219.7	212.2
1973	Aug 16	(52.4)	106.8	(50.4)	84.2
1974	May 17	(211.9)	(299.0)	313.7	283.5
1975	Apr 25	(83.2)	139.0	(94.5)	118.5
1976	Jun 7	175.9	186.0	227.5	192.0

Remarks ; W : Weight, ( ) : Estimated by correlation with other station

Table C 13 PROBABLE 3-DAY RAINFALL IN PROPOSED DAM CATCHMENT AREAS

Unit : mm

Return Period	5-yr	10-yr	20-yr	50-yr	100-yr	200-yr
Han River Basin						
Bamseonggol	246	304	363	442	505	569
Inje	266	340	418	526	612	705
Hongcheon	270	333	397	484	552	623
Gujeol	254	346	447	595	720	858
Dalcheon	239	290	340	407	460	513
Ganhyeon	258	323	389	479	551	625
Nagdong River Basin						
Bonghwa	213	264	315	385	440	497
Imha	187	222	257	302	336	371
Hamyang	250	310	375	460	530	610
Seomjin River Basin						
Juam	247	290	331	384	424	464

Table C 14 DATA CONCERNING HOURLY RAINFALL RECORD COLLECTED FOR HYETOGRAPH STUDY

1. HAN RIVER BASIN

Flood Period	Jul 10-14, 1965	Jul 22-26, 1966	Aug 17-10, 1976
25 Hoengseong	0	0	0
29 Chungju		0	
30 Goesan	0	0	0
47 Imgye			0
56 Inje	0	0	0
57 Seohwa			0
59 Girin	0	0	0
60 Changchon	0	0	
62 Hwacheon	0		0

2. NAGDONG RIVER BASIN

Flood Period	Aug 1-4, 1969	Sep 14-16, 1969	Sep 22-24, 1971	Jul 3-4, 1971	Jul 8-12, 1971	Aug 17-20, 1972
153 Chahwang				0	0	0
155 Macheon				0	0	0
156 Hamyang		0				
187 Hyengdong	0	0	0			
188 Gilan				0	0	0
190 Cheongsong	0	0	0			0
192 Yeongyang						0
210 Subi				0	0	0

3. SEOMJIN RIVER BASIN

Flood Period	Jul 20-22, 1971	Jul 3-5, 1972	Jul 9-12, 1972	Jul 24-26, 1972	Jul 7-10, 1976
132 Dongbog		0	0	0	
134 Boseong	0	0	0		0

Remarks ; 0 : Data collected

Table C 15 ESTIMATED HOURLY INTENSITY OF STORM RAINFALL

Time h	Intensity mm/h	Time h	Intensity mm/h	Time h	Intensity mm/h	Time h	Intensity mm/h	Time h	Intensity mm/h	Time h	Intensity mm/h
					1. HAN RIVER BASIN						
0-12	1	36-38	9	45-46	16	52-53	30	59-60	50	66-67	27
12-28	2	38-40	10	46-47	17	53-54	31	60-61	60	67-68	20
28-29	3	40-41	11	47-48	18	54-55	32	61-62	70	68-72	10
29-30	4	41-42	12	48-49	20	55-56	33	62-63	60		
30-34	5	42-43	13	49-50	25	56-57	34	63-64	35		
34-35	6	43-44	14	50-51	28	57-58	35	64-65	30		
35-36	7	44-45	15	51-52	29	58-59	45	65-66	28		
					2. NAGDONG RIVER BASIN						
0- 5	1	13-27	10	31-35	40	39-41	80	44-46	15	51-64	2
5-10	2	27-29	15	35-37	50	41-42	60	46-47	10	64-72	1
10-12	4	20-30	20	37-38	60	42-43	30	47-49	5		
12-13	7	30-31	30	38-39	70	43-44	20	49-51	3		
					3. SEOMJIN RIVER BASIN						
0- 5	0.1	21-22	0.8	31-33	15	40-44	25	51-52	80	56-57	25
5-10	0.2	22-25	1	33-34	17	44-47	30	52-53	50	57-63	10
10-15	0.3	25-27	11	34-35	18	47-49	40	53-54	40	63-69	5
15-20	0.5	27-29	13	35-36	19	49-50	50	54-55	35	69-71	4
20-21	0.7	29-31	14	36-40	20	50-51	70	55-56	30	71-72	2

Remarks ; 72-hour rainfall is assumed to be 1,000 mm.

Table C 16 STORAGE COEFFICIENTS AND OTHER CONSTANTS FOR THE CATCHMENT AREAS OF THE PROPOSED DAMS

Name of Dam	A(km^2)	K	P	F	Base Flow (m^3/s)
HAN RIVER BASIN					
Bamseonggol	583	34.971	0.456	0.67	5.8
Inje	1,043	31.233	0.498	0.67	10.4
Hongcheon	1,473	31.016	0.501	0.67	14.7
Gujeol	101	31.018	0.501	0.67	10.1
Dalcheon	1,348	25.458	0.584	0.67	13.5
Ganhyeon	1,180	37.682	0.430	0.67	11.8
NAGDONG RIVER BASIN					
Bonghwa	1,105	32.16	0.49	0.6	11.1
Imha	1,230	28.26	0.54	0.6	12.3
Hamyang	264	38.19	0.43	0.9*	2.6
SEOMJIN RIVER BASIN					
Juam	1,010	33.00	0.48	0.9	10.1

Source : Ref. C 3 for the Han river basin and
Ref. C 4 for the Nagdong river basin

Remarks ; * : JICA team's modification Symbols referred to Eqs. C 1 & C 2

Table C 17 STORAGE COEFFICIENTS AND OTHER CONSTANTS FOR THE RESIDUAL AREAS BETWEEN EXISTING AND PROPOSED DAMS

Residual Area	A (km^2)	K	P	F	Base Flow (m^3/s)	Lag Time (h)
Bamseonggol - Hwacheon						
HB 1	1,565	29.762	0.517	0.67	15.7	
HB 2	1,753	35.335	0.452	0.67	17.5	
HC 1	-	129.398	0.6	1	-	1.69
HC 2	-	126.305	0.6	1	-	1.46
Inje-Soyanggang						
SB 2	1,001	30.018	0.501	0.67	10.0	
SB 3	659	48.379	0.354	0.67	6.6	
SC	-	180.182	0.6	1	-	2.37
Bonghwa-Andong						
AB 2	483	34.45	0.46	0.6	4.8	
AC	-	293.14	0.6	1	-	1.95

Remarks ; For symbols, see Eqs. C 1 & C 2 and Fig. D 6.

Table C 18 PROBABLE FLOOD PEAK DISCHARGE AT PROPOSED DAMSITES

Unit : m^3/s

Return Period	5-yr	20-yr	50-yr	100-yr	200-yr	Past Maximum
HAN RIVER BASIN						
Bamseonggol	1,250	2,000	2,500	2,900	3,400	3,000
Inje	2,400	4,100	5,400	6,400	7,500	5,000
Hongcheon	3,400	5,400	6,800	7,900	9,000	7,100
Gujeol	200	400	600	700	900	450
Dalcheon	2,600	3,950	4,900	5,600	6,400	3,700
Ganhyeon	2,700	4,500	5,800	6,750	7,800	5,400
NAGDONG RIVER BASIN						
Bonghwa	2,100	3,450	4,400	5,100	5,900	3,800
Imha	1,900	2,900	3,500	4,000	4,500	2,700
Hamyang	950	1,600	2,050	2,400	2,800	1,850
SEOMJIN RIVER BASIN						
Juam	2,800	4,100	4,900	5,550	6,200	4,000

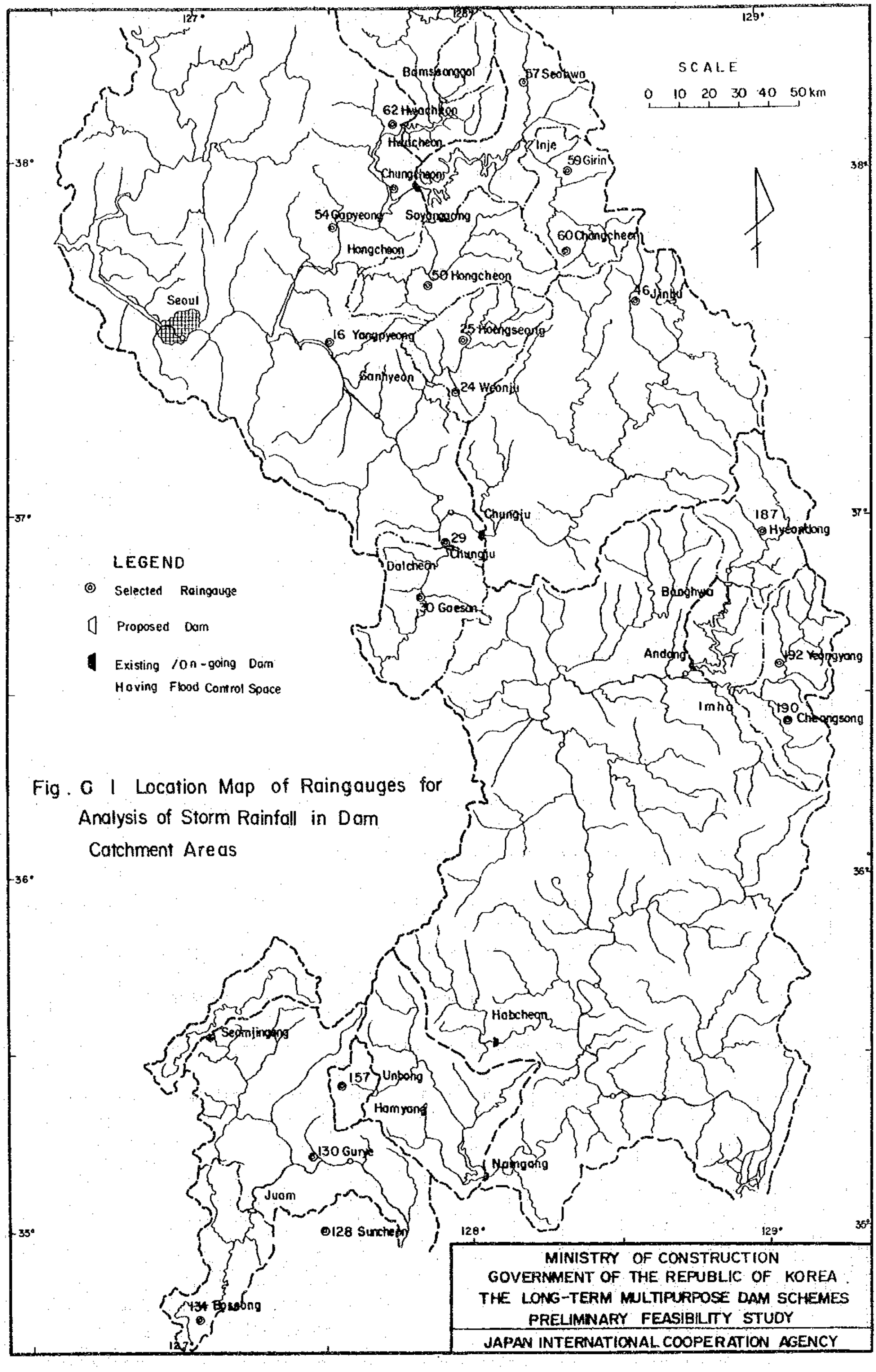

Fig. G 1 Location Map of Raingauges for Analysis of Storm Rainfall in Dam Catchment Areas

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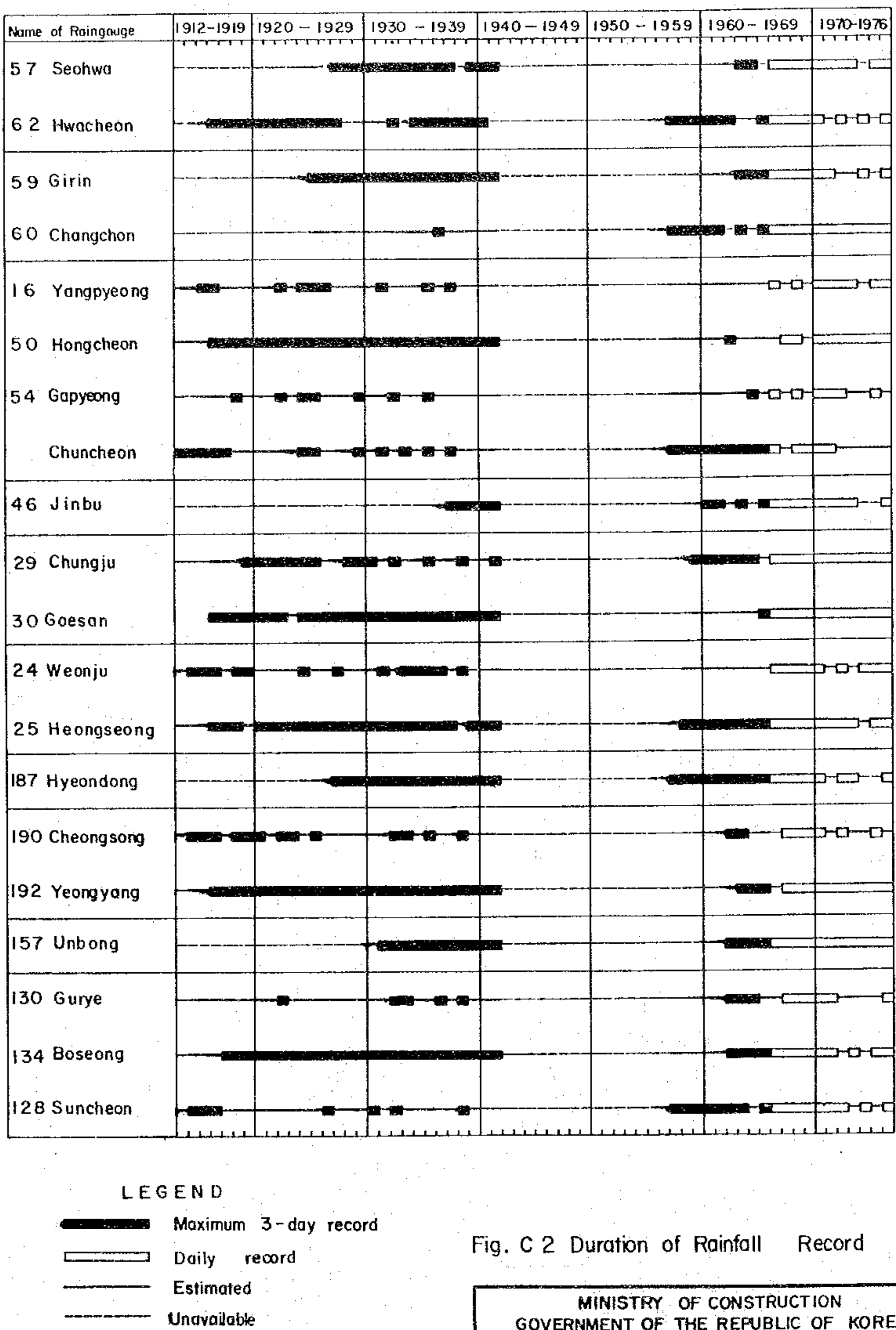

Fig. C 2 Duration of Rainfall Record

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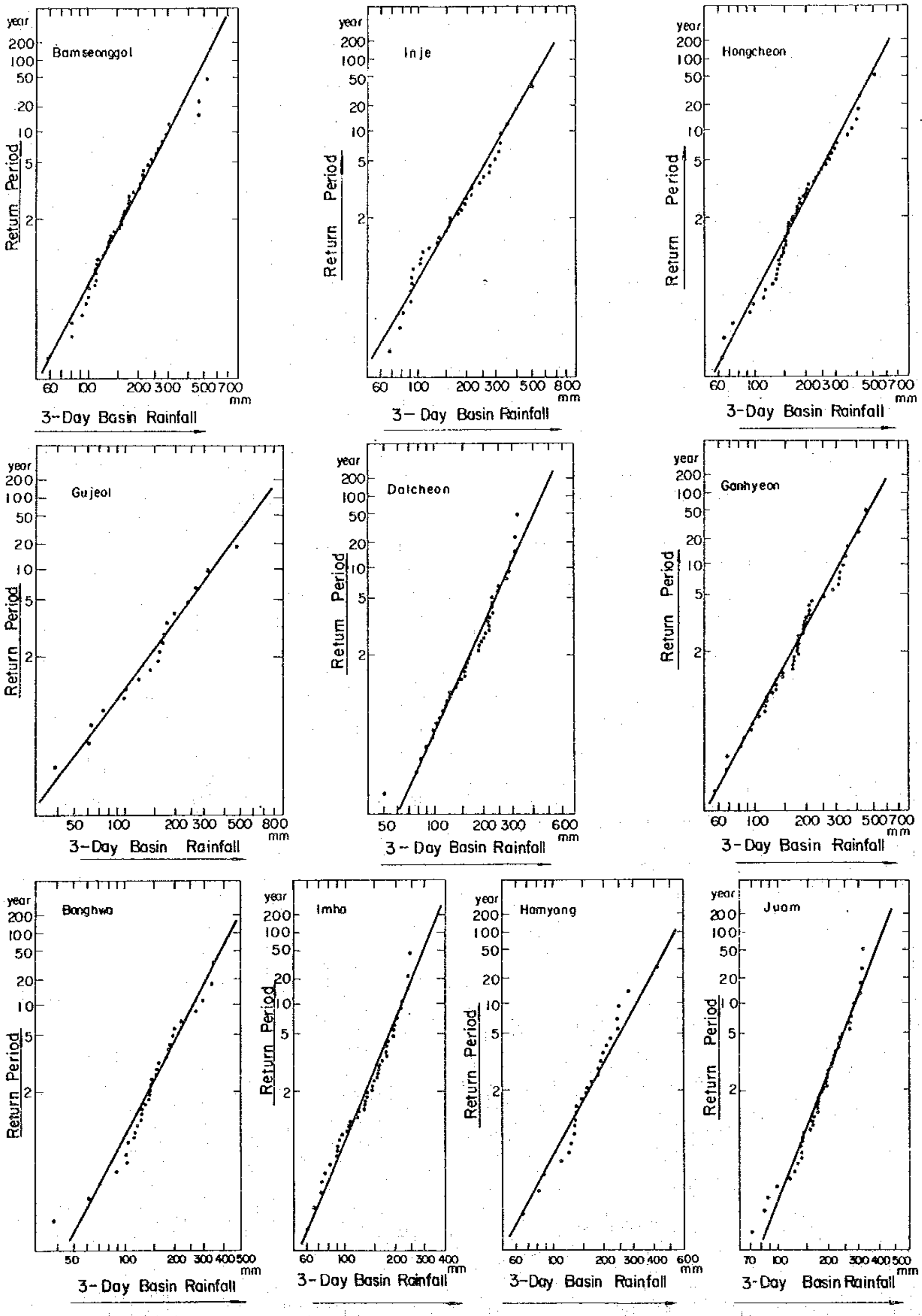

Fig . C 3 Probability Distribution of 3-day Basin Rainfall

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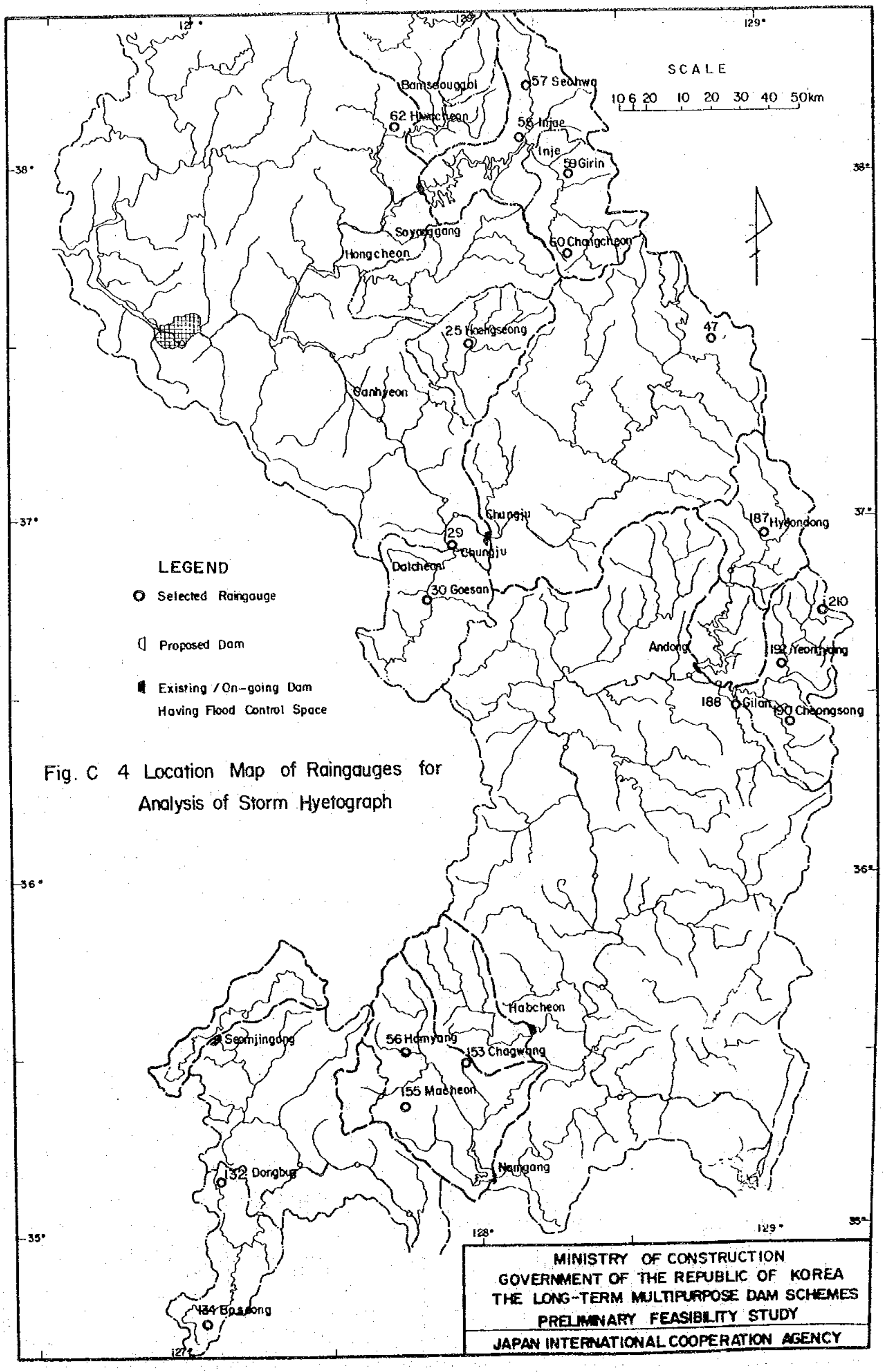

Fig. C 4 Location Map of Raingauges for Analysis of Storm Hyetograph

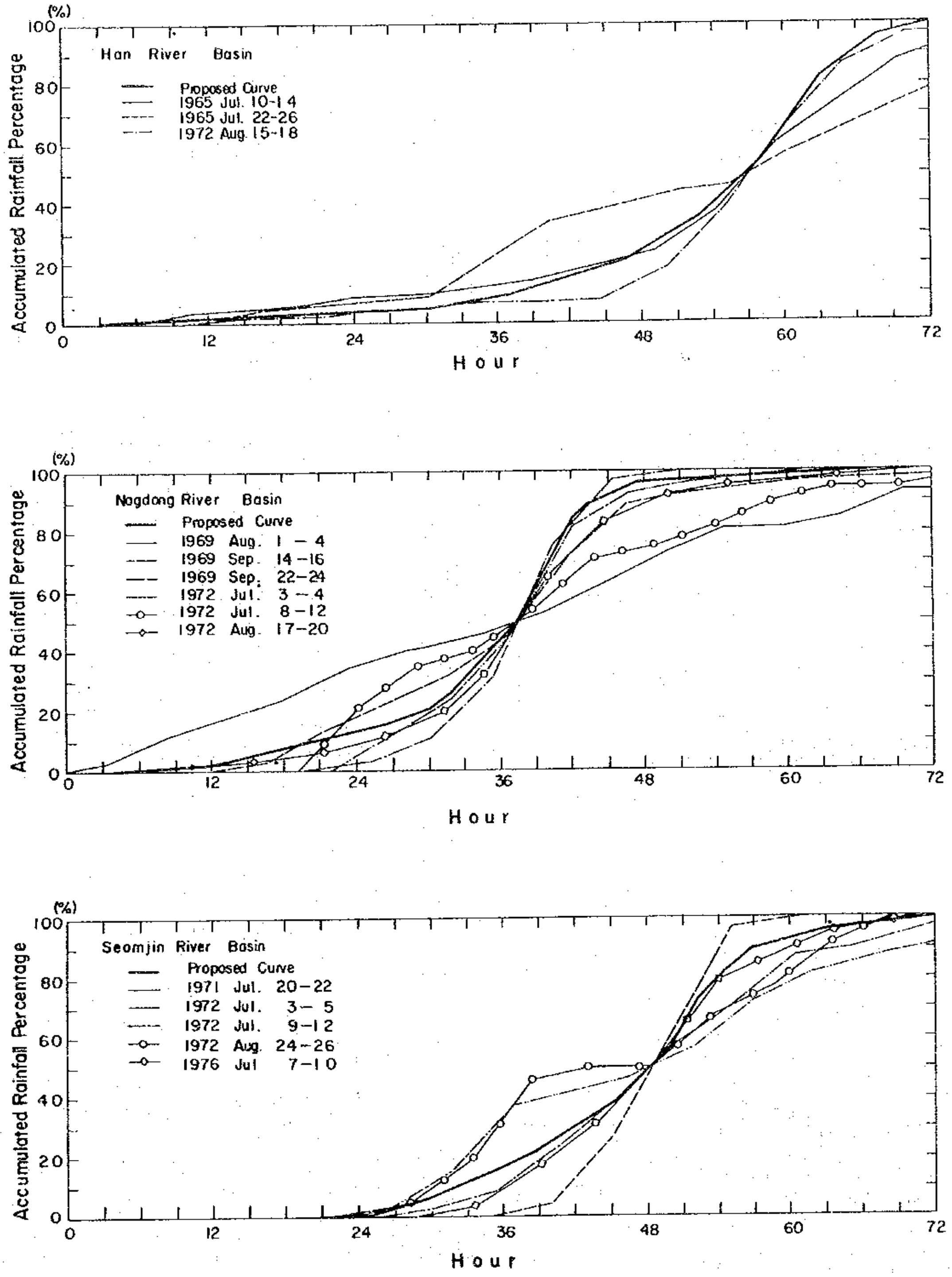

Fig. C 5 Mass Curves of Storm Rainfall Percentage

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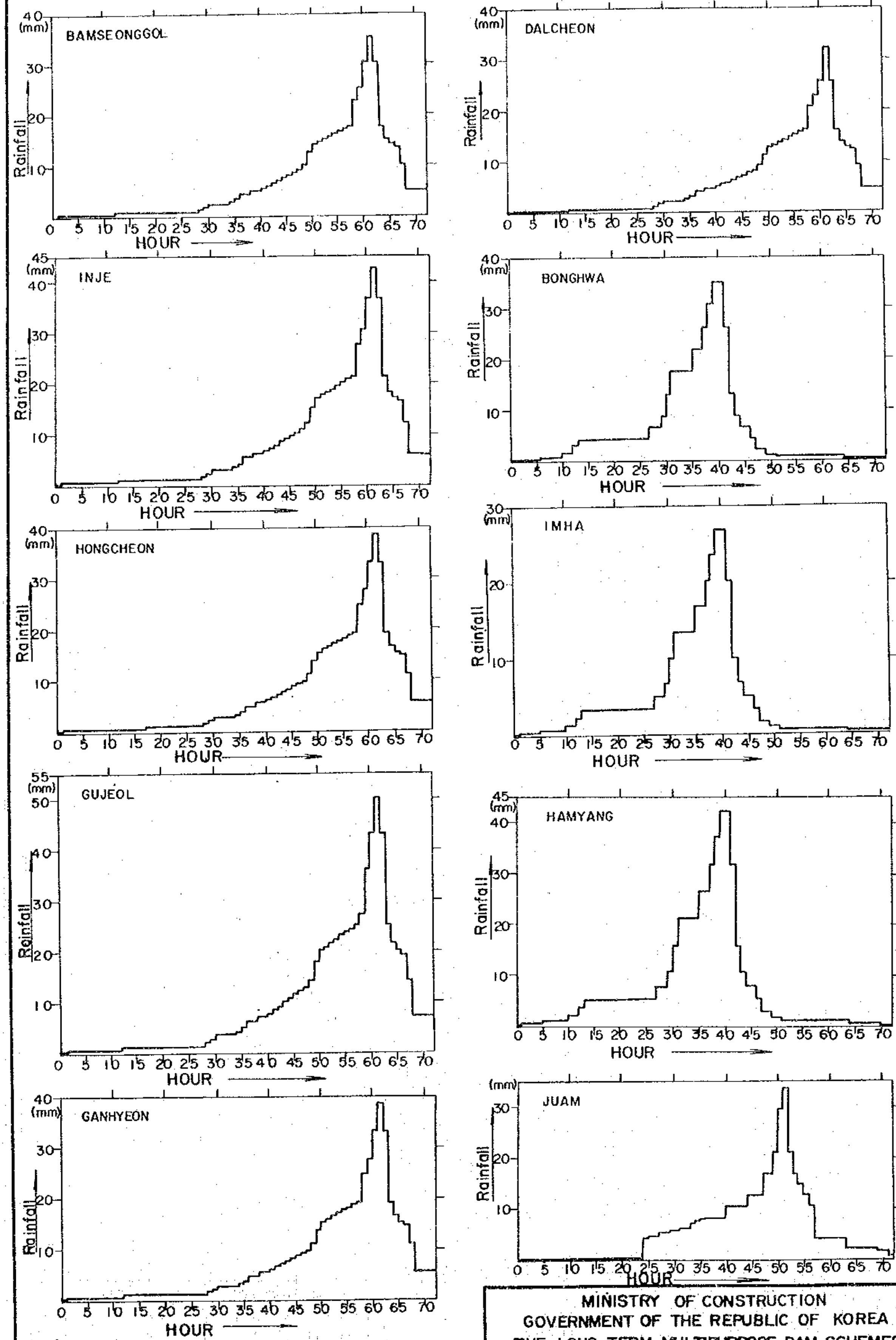

Fig. C 6 Typical 100-Year Storm Hyetograph

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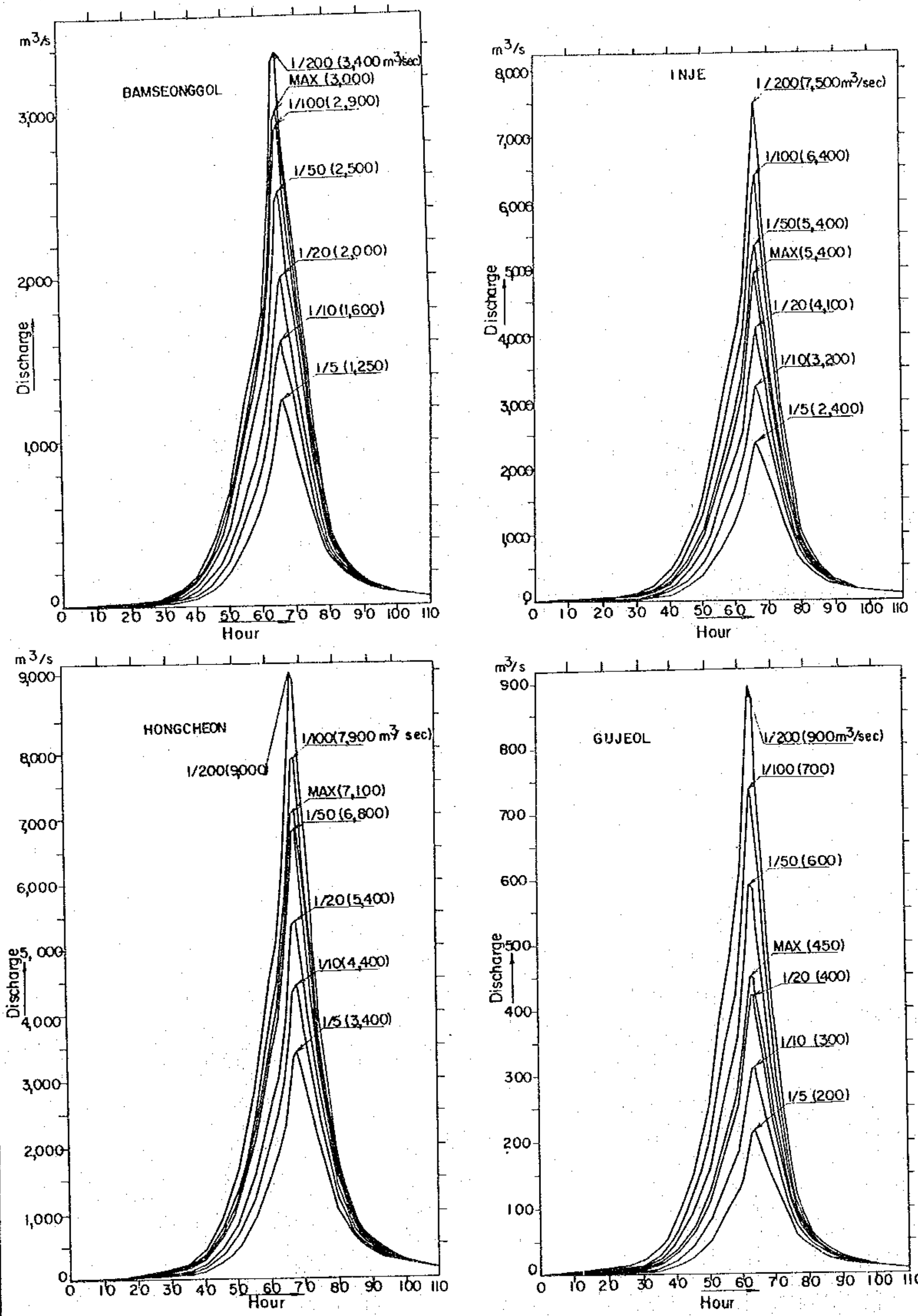

Fig. C 7 Probable Flood Hydrographs at Proposed Dam Sites

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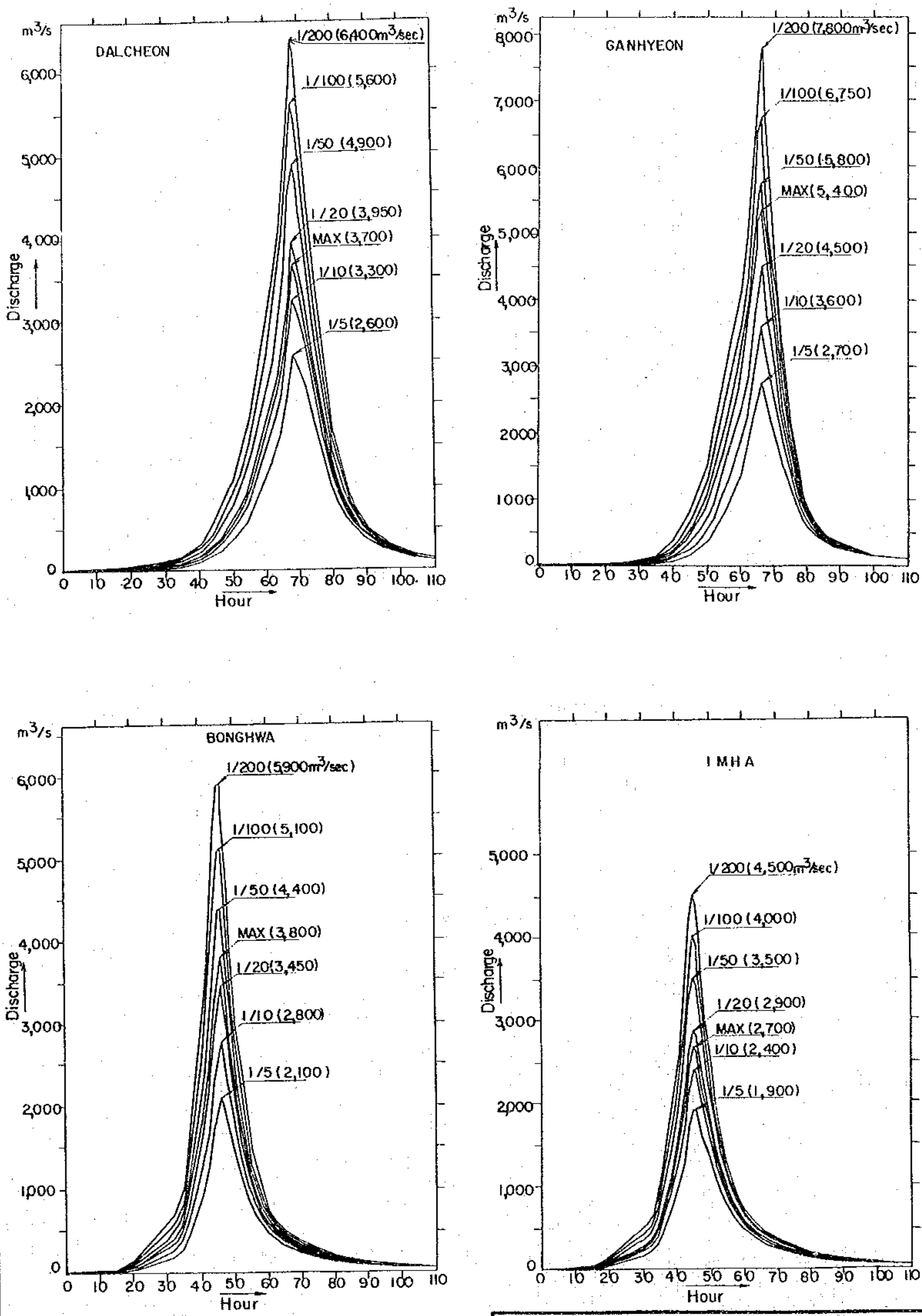

Fig. C 7 (Continued 2)

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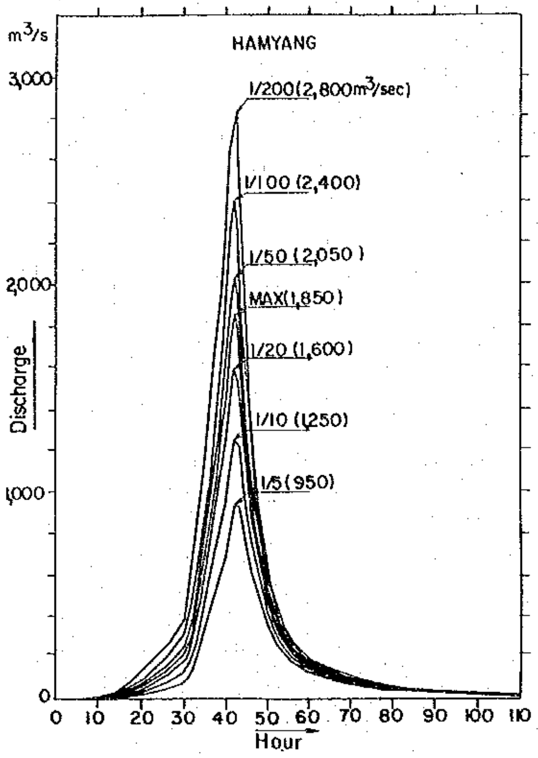

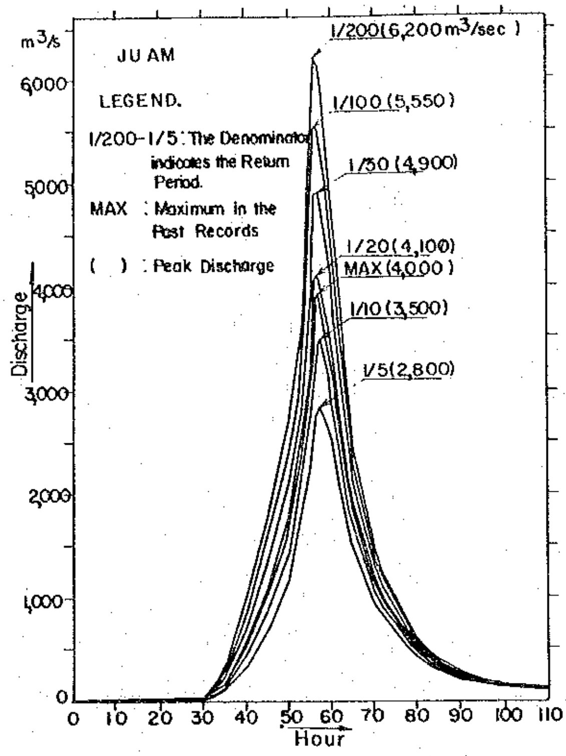

Fig. C 7 (Continued 3)

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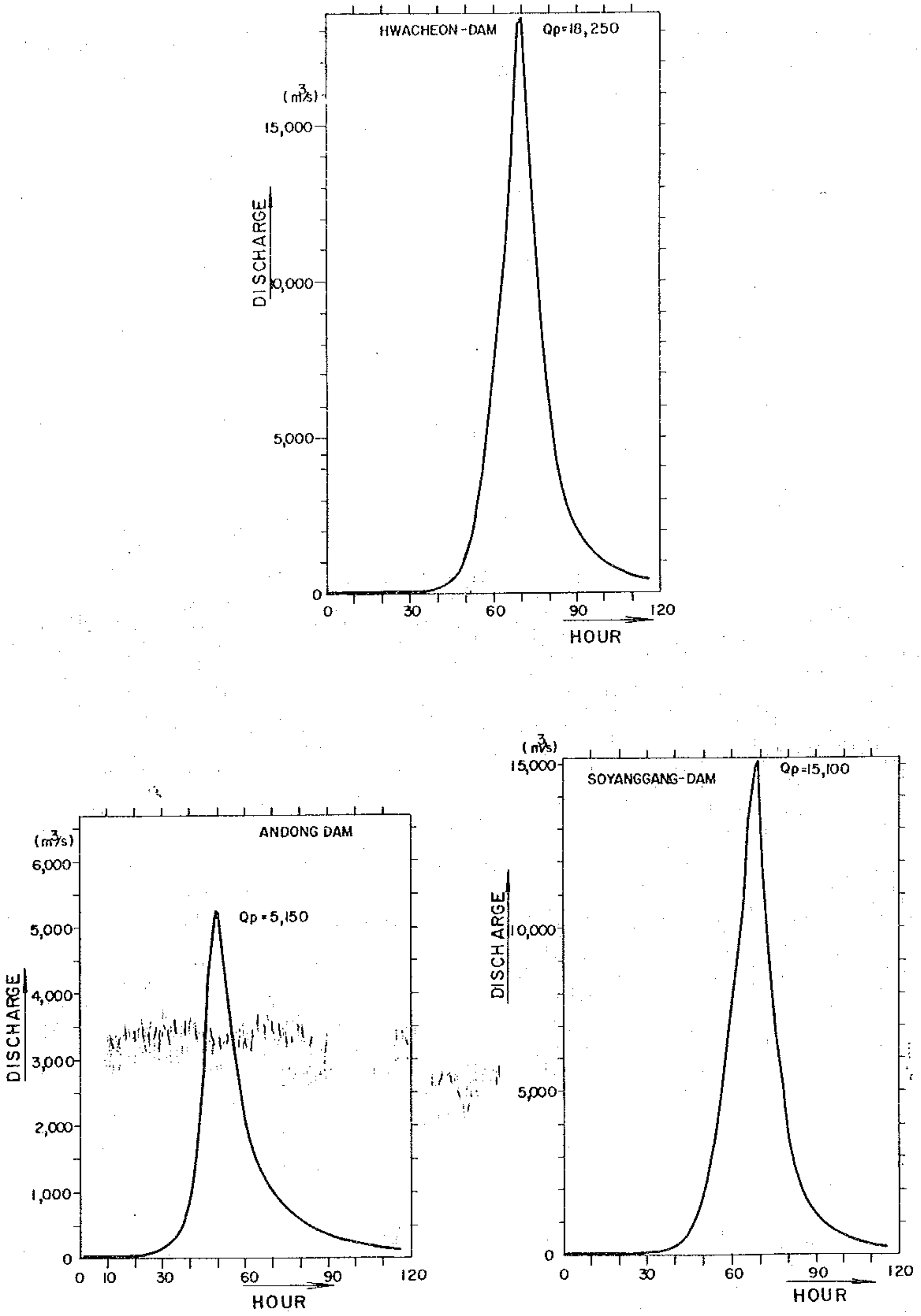

Fig. C 8 100-Year Flood Hydrographs at Three Existing Dams

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A N N E X   D

FLOOD CONTROL EFFECT
BY THE PROPOSED DAMS

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LIST OF FIGURES

D 1 INTRODUCTION

This ANNEX presents the results of a study on the physical effect of flood control by the proposed dams. The probable flood hydrographs constructed in ANNEX C were incorporated in this study. The flood control effect in this ANNEX is expressed as the reduction in the flood water level, or in a few cases in the reduction in the basin storm rainfall and utilized for the study of flood control benefit by the proposed dams in ANNEX N.

The flood vulnerable areas downstream of the proposed damsites were divided into stretches along the river. Probability distribution of annual maximum water levels in each stretch was estimated based on the water level record. The effect of dam operation to the downstream reaches was estimated as a reduction in the catchment area assuming an empirical relationship between the catchment area and peak flood discharge. The assumed reduction in the catchment area resulted reduction in peak flood discharge in an arbitrary stretch. The reduction in the water level in the stretch was estimated by means of rating curve.

D 2 RIVER STRETCHES AND HYDROLOGICAL DATA

D 2.1 River Stretch Division

The flood vulnerable areas downstream of the proposed damsites were divided into river stretches as shown in Fig. D 1, taking into account the availability of long water level record and rating curve at a water level gauge representing each stretch. The length along the river and the boundary of river stretches are described in Table D 1 and some details of the water level gauge representing each river stretch are as shown in Table D 2.

D 2.2 Rating Curve

The rating curves were available for most of representing gauges from Refs. D 1 to D 4 as shown in Table D 2. For the Moggye (S-3) and Nagdong (NA-4) gauges, the rating curves were estimated based on the river cross sections. The rating curves incorporated in this study are shown in Fig. D 2.

The flood control effect in the river stretches N-2, S-6 and NA-7 where no rating curve was available was estimated as the reduction in 3-day basin storm rainfall (for justification of 3-day rainfall, see ANNEX C).

D 2.3 Probability Distribution of Flood Water Level

The annual maximum water level records were available for the representing gauges as shown in Fig. D 3. The water levels taken from Refs. D 6 and D 7 are listed in Table D 3. Annual maximum 3-day rainfalls are listed in Table D 4 for the gauges where no rating curve is available.

The annual maximum water levels and annual maximum 3-day rainfalls were plotted on log-normal paper as shown in Fig. D 4 and Fig. D 5.

The flood water levels are affected by Soyanggang dam at Indogyo, Goan and Cheongpyeong since 1972, by Namgang dam at Jindong since 1970, and by Seomjingang dam at Songjeong since 1966. These data were excluded in plotting on Fig. D 4.

The flood water level for an arbitrary probability of exceedence was read off from Fig. D 4 and it was converted to the corresponding flood discharge by means of the rating curve in Fig. D 2. The water levels and discharges at the representing gauges for selected probability of exceedence are shown in Table D 5 (3-day basin rainfalls for 3 gauges where no rating curve is available).

D 3 FLOOD REDUCTION AT DAMSITES

D 3.1 Dam Operation Method

The constant ratio - constant rate method was assumed for the flood control operation of the proposed dams. In this method, the outflow from a dam is kept at a constant ratio (hereafter referred to as the reduction ratio) to the flood inflow until the inflow reaches the peak and thereafter the outflow is kept constant. The flood control operation starts when the inflow increases to a certain rate. Therefore, the constant ratio is determined for the portion of discharge exceeding over the abovementioned rate.

The relationship between the inflow and outflow hydrographs in the constant ratio - constant rate operation can be seen in Fig. D 6. When a design flood inflow hydrograph is fixed, the reduction ratio m is so determined that the volume between the inflow and outflow hydrographs equals to the flood control space in the reservoir.

D 3.2 Alternative Flood Control Spaces of Proposed Dams

In this study the flood control spaces of proposed dams were determined for the values of m to be 0.2, 0.5 and 0.8, assuming 100-year flood inflow hydrographs estimated in ANNEX C. The alternative flood control spaces of proposed dams thus determined are listed in Table D 6. In this table, it is assumed that the flood control operation starts when inflow exceeds over 0.2 $m^3/s/km^2$.

D 3.3 Flood Control Space and Reduction Ratio of Existing Dams.

Table D 7 shows the catchment area, flood control space, design flood peak inflow and corresponding outflow of the existing dams which seem to affect to the basin - wide flood control. The reduction ratios of these dams were calculated as the ratios of outflow to inflow except that the ratios were estimated based on the 100-year flood hydrographs in ANNEX N for the Hwacheon, Soyanggang and Andong dams.

D 3.4 Reduction Ratio of Existing Dam Affected by Proposed Dam

Three proposed dams are located in the catchment area of existing dams; Bamseonggol for Hwacheon, Inje for Soyanggang and Bonghwa for Andong, respectively. The flood control effect of these proposed dams appears as increase in the flood reduction ratio at the existing dam.

The reduction ratios of existing dams were calculated taking into account the flood reduction by the proposed dam in the upstream reaches. The mathematical model of series of dams and the calculated flood hydrographs are illustrated in Fig. D 6.

The flood inflow into a proposed dam is cut at a reduction ratio by the dam. The outflow from the proposed dam thus reduced is joined by the flood flow from the residual area between the proposed and existing dams. The outflow mixed with the residual flow reaches to the existing dam being subject to the retardation by the channel storage. The flood inflow into the existing dam is more or less smaller than that expected under without proposed-dam condition. The reduced inflow is controlled by the flood control space of the existing dam.

The flood reduction ratios by the existing dams affected by the proposed dams were estimated as shown in Table D 8.

The proposed Gujeol and Hamyang dams also have existing dams in the downstream; Chungju and Namgang, respectively. These proposed dams are regarded as effective only upstream of the existing dams, because their flood control spaces are small compared with those in the existing dams.

D 4 DOWNSTREAM EFFECT OF PROPOSED DAMS

D 4.1 Assumptions

In estimating the flood control effect of the proposed dams to the downstream reaches, the assumptions proposed by KOR 16 (Ref. D 5) were employed.

According to the Myers-Garris formula, the flood peak discharge is proportional to the square root of the catchment area. If the flood reduction by a dam is regarded as a reduction in the catchment area, the flood reduction ratio at a gauge in the downstream reaches can be expressed by the following equation :

$$K = \sqrt{1 - (1 - m^2)\ a/A} \quad \text{- - - - - - - - - -} \quad (D\ 1)$$

Where, K : Flood reduction ratio at gauge

A : Catchment area of the gauge

a : Catchment area of a dam located upstream of the gauge

m : Flood reduction ratio at the damsite

If many dams are involved the sum of values of $(1-m^2)$ a for all the dam replaces $(1-m^2)$ a in Equation D 1.

The following rainfall reduction ratio was introduced for the representing gauge having no rating curve, assuming that a dam would retain rainfall in the catchment area up to the flood control space utilized to reduce the flood at the dam :

$$L = 1 - V/(R.A) \quad \text{- - - - - - - - - - - - -} \quad (D\ 2)$$

Where, L : Reduction ratio of basin average rainfall in the catchment area of the gauge

R : Basin average storm rainfall

V : Flood control space utilized for the flood reduction at the dam

The flood reduction ratios (K and L values) were calculated for each representing water level gauge, under the conditions that the existing dams and one of the proposed dams were in operation and only the existing dams were in operation in Tables D 9 and D 10. The existing dams assumed are the Hwacheon, Soyanggang and Chungju dams in the Han river basin, the Andong, Habcheon, and Namgang dams in the Nagdong river basin and the Seomjingang dam in the Seomjin river basin.

D 4.2 Flood Reduction by Proposed Dams

The reduced flood discharge by dam can be calculated by multiplying the flood reduction ratio in Tables D 9 and D 10 to the flood discharge under without-dam condition in Table D 5. Thus, the reduced flood discharge was converted to a reduced flood water level by means of rating curve in Fig. D 2. The reduced probable flood peak discharge and corresponding water level are shown in Table D 11 for the present condition (affected by the existing dams).

The flood water level reduction by each proposed dam for selected probability of exceedence was calculated as shown in Tables D 12 and D 13.

REFERENCES

D 1 SURVEY REPORT OF KOREAN RIVERS (Korean), 1974, MOC/ISWACO

D 2 UNDP/ADB NAGDONG RIVER BASIN DEVELOPMENT PROJECT FEASIBILITY STUDY, 1976, NIPPON KOEI CO., LTD.

D 3 EPB/ISWACO CHUNGJU MULTIPURPOSE PROJECT FEASIBILITY REPORT, 1976, ENGINEERING CONSULTANTS INC.

D 4 USAID/MOC/ISWACO RECONNAISSANCE REPORT WATER RESOURCES STUDY HAN RIVER BASIN, 1971, HRBS

D 5 UNDP/FAO LAND AND WATER RESOURCES PLANNING IN THE NAGDONG RIVER BASIN, 1971, KOR 16

D 6 HYDROLOGICAL DATA IN KOREA, 1963, MOC

D 7 HYDROLOGICAL ANNUAL REPORT IN KOREA, 1961-1976, MOC

Table D 1 DESCRIPTION OF RIVER STRETCHES

River Stretch	Stretch Length (km)	Stretch Description
Lower Han River		
D - 0	17.0	Junggokchondong - Hengju
D - 1	42.5	Haengju - Wangsukcheon
D - 2	13.5	Wangsukcheon-Paldang Dam
Total	73.0	
North Han River		
N - 1	43.3	Paldang Dam - Hongcheon Confluence
N - 2 (1)	34.0	Hongcheon Confluence - Euiam Dam
(2)	8.3	Euiam Backwater End - Chuncheon Dam
(3)	11.8	Soyang River up to Soyanggang Dam
(4)	22.5	Chuncheon Backwater End - Hwacheon Dam
(5)	6.5	Hwacheon Backwater End - Bamseonggol Damsite
Sub-total	83.1	
Total	126.4	
South Han River		
S - 2	38.0	Paldang Backwater End - Seom River Confluence
S - 3	55.0	Seom River Confluence - Dalcheon Damsite
S - 4	60.5	Chungju Backwater End - Pyeongchang River Confluence
S - 5	98.3	Pyeongchang River Confluence - Gujeol Damsite
S - 6	27.0	Seom River up to Ganhyeon Damsite
Total	278.8	
Nagdong River		
NA - 1	35.0	Jucheon Confluence - Nam River Confluence
NA - 2	79.3	Nam River Confluence - Geumho River Confluence
NA - 3	53.3	Geumho River Confluence - Gam River Confluence
NA - 4	57.0	Gam River Confluence - Naesong River Confluence
NA - 5 (1)	58.5	Naesong River Confluence - Banbyeon River Confluence
(2)	13.8	Andong Backwater End - Bonghwa Damsite
Sub-total	72.3	
NA - 6	23.0	Banbyeon River up to Imha Damsite
NA - 7	57.3	Namgang Dam Backwater End - Hamyang Damsite
Total	377.2	
Seomjin River		
SE - 1	88.4	Main Stream up to Juam Damsite

Table D 2 DESCRIPTION OF REPRESENTING WATER LEVEL GAUGES

River Stretch	Name of Gauge	River (km)	Catchment Area (km^2)	Duration of Record (yr)	Discharge Rating Curve
Lower Han River					
D - 0 & D - 1	4 Indogyo	43.4	24,753	50	Ref. D 3
D - 2	8 Goan	84.8	23,613	49	Ref. D 3
North Han River					
N - 1	26 Cheongpyeong	110.3	10,061	46	Ref. D 4
N - 2	29 Chuncheon	152.5	7,885	48	Unavailable
South Han River					
S - 2	11 Yeoju	141.1	11,036	50	Ref. D 3
S - 3	15 Moggye	180.6	8,434	52	Estimated
S - 4	18 Yeongweol	301.7	4,239	44	Ref. D 1
S - 5	24 Jeongseon	379.6	1,682	34	Ref. D 1
S - 6	12 Ganhyeon	176.6	1,174	11	Unavailable
Nagdong River					
NA - 1	113 Jindong	83.1	20,311	43	Ref. D 2
NA - 2	130 Hyeonpung	144.8	14,001	50	Ref. D 1
NA - 3	136 Waegwan	194.0	11,074	40	Ref. D 2
NA - 4	141 Nagdong	242.5	9,369	47	Estimated
NA - 5	151 Andong	337.3	3,590	45	Ref. D 2
NA - 6	152 Imha		1,361	14	Ref. D 1
NA - 7	118 Sancheong		1,310	14	Unavailable
Seomjin River					
SE - 1	92 Songjeong	39.6	4,256	41	Ref. D 1

Table D 3 ANNUAL MAXIMUM WATER LEVELS AT REPRESENTING GAUGES

Unit : m above zero

	4 Indogyo D-0&1		8 Goan D-2		26 Cheong-pyeong, N-1		11 Yeoju S-2		15 Moggye S-3	
1915					Jul 25	9.61		6.66		
1916							Jun 16	9.04		
1917			Sept 5	7.62	Sept 4	8.18	Jul 4	8.65	Jul 1	7.98
1918	Aug 17	9.15	Aug 17	9.46	Aug 17	10.70	Jul 1	9.21		
1919	Jul 7	9.10	Jul 7	11.08	Jul 6	8.48	Jul 7	10.90	Jul 7	9.48
1920	Jul 9	10.15	Jul 7	13.56	Jul 8	10.06	Jul 8	11.40	Jul 8	9.79
1921	Jul 7	7.05	Jul 7	8.65	Jul 22	4.76	Jul 7	10.08	Jul 7	8.18
1922	Jul 30	9.90	Jul 30	12.75	Aug 23	10.94	Jul 29	12.22	Jul 29	10.74
1923	Aug 2	8.07	Aug 1	9.47	Aug 1	11.52	Jul 21	9.18	Jul 21	7.37
1924	Jul 26	9.20	Jul 25	10.50	Jul 24	10.80	Jul 25	9.07	Jul 25	6.58
1925	Jul 18	12.26	Jul 18	19.38	Jul 18	17.10	Jul 18	12.20	Jul 17	10.71
1926	Jul 22	9.50	Aug 6	11.05	Jul 21	10.62	Aug 6	10.83	Jul 22	9.81
1927	Jul 15	8.50	May 3	10.24	Jul 15	11.75	May 3	6.81	May 3	4.29
1928	Oct 17	5.22	Sept16	6.79	Sept 5	5.14	Sept16	7.26	Sept16	4.98
1929	Aug 18	4.95	Aug 18	6.60	Aug 18	6.81	Aug 18	4.40	Aug 18	3.49
1930	Jul 14	9.60	Jul 14	12.20	Jul 19	11.02	Jul 14	10.39	Jul 12	8.37
1931	Aug 20	7.60	Aug 20	9.00	Aug 20	8.50	Apr 28	7.56	Apr 28	5.27
1932	Aug 31	7.90	Aug 31	10.26	Aug 31	12.00	Aug 24	6.15	Aug 24	4.19
1933	Jul 30	8.05	Jul 30	9.37	Jul 29	6.88	Aug 5	7.70	Aug 4	5.39
1934	Jul 24	7.43	Jul 24	9.10	Aug 24	6.46	Jul 23	9.63	Jul 23	8.54
1935	Jul 23	10.25	Jul 23	12.70	Jul 23	12.59	Jul 23	8.66	Jul 23	6.49
1936	Aug 12	10.60	Aug 12	14.55	Aug 28	11.58	Aug 12	12.20	Aug 12	11.84
1937	Jul 20	7.45	Jul 20	9.03	Jul 19	7.61	Jul 20	8.19	Jul 8	5.79
1938	Oct 15	5.78	Sept 5	8.15	Jul 13	4.80	Jul 5	6.70	Sept 4	6.19
1939	May 14	1.98	May 13	3.50	May 11	3.36	Apr 6	2.00	May 14	1.49
1940	Jul 21	10.45	Sept 4	13.60	Sept 4	13.95	Jul 21	9.57	Jul 24	6.80
1941										
1942										
1943										
1944										
1945										
1946			Jul 12	6.65					Jun 25	8.00
1947	Aug 7	8.90	Aug 7	10.46			Aug 6	8.30		
1948	Jun 13	5.22					Jul 3	8.10	Aug 6	6.00
1949									Jul 30	7.00
1950									Sept 8	3.66
1951										
1952	Jul 30	8.10							Jul 29	9.98
1953	Jul 7	7.60							Jul 7	6.55
1954	Jul 29	7.86	Jul 29	9.02				6.58	Aug 4	7.20
1955	Jul 4	7.15	Jul 4	8.28			Jul 13	6.27	Jul 13	4.85
1956	Jul 20	8.88	Jul 16	9.95	Jul 19	9.14	Jun 23	8.60	Jul 16	8.01
1957	Jul 10	6.90	Jul 18	7.76	Jul 18	7.30	Jul 20	7.23	Jul 24	7.04
1958	Oct 6	9.50	Sept 6	11.40	Sept 6	10.20	Sept 5	10.26	Sept 6	9.78
1959	Oct 1	9.05	Jul 8	11.12	Sept 1	11.50	Jul 8	11.52	Jul 8	11.03
1960	Jun 30	6.85	Jun 29	8.20	Jun 28	7.72	Jun 29	7.88	Jun 29	7.92
1961	Jul 20	6.10	Jul 13	7.00	Aug 17	7.02	Jul 11	7.30	Jul 11	7.52

Table D 3 Continued (2)

Unit : m above zero

	4 Indogyo D-0&1		8 Goan D-2		26 Cheong-pyeong, N-1		11 Yeoju S-2		15 Moggye S-3	
1962	Oct 9	7.10	Sept 9	8.60	Aug 18	6.60		6.50	Sept24	5.18
1963	Jul 26	8.40	Jul 25	10.44	Jul 25	10.44	Jul 26	7.46	Jul 26	7.49
1964	Aug 13	8.35	Aug 12	10.12		11.00	Aug 9	8.79	Aug 9	7.47
1965	Jul 16	10.80	Jul 16	15.27	Jul 16	16.70	Jul 16	8.22	Jul 17	8.51
1966	Jul 26	10.78	Jul 20	14.42	Jul 26	14.40	Jul 24	7.78	Jul 24	6.50
1967	Jul 20	6.60	Jul 20	8.12	Jul 20	9.20	Sept 4	5.59	Sept 4	4.98
1968	Aug 24	7.86	Aug 24	8.20	Aug 23	8.56	Aug 24	6.95	Jul 17	6.25
1969	Jul 31	9.42	Jul 31	11.30	Jul 31	14.23	Aug 8	8.37	Aug 4	8.72
1970	Oct 18	9.02	Sept18	10.97	Sept17	13.05	Sept18	6.80	Sept18	8.70
1971	Aug 12	6.53	Aug 12	8.30	Aug 11	7.81	Jul 22	6.99	Jul 22	6.00
1972	Aug 19	11.24	Aug 20	15.94	Aug 20	15.20	Aug 20	11.28		16.00
1973	Aug 30	4.97	Sept 1	7.40	Aug 31	7.50	Jul 1	4.28	Jul 1	3.37
1974	Jul 10	5.65	Jul 9	8.34	Aug 3	6.10	Jul 9	7.58	Jul 9	6.90
1975	Sept17	7.40	Jul 28	8.60	Jul 28	7.75	Jul 28	8.20	Jul 28	7.50
1976	Apr 19	8.40	Aug 14	9.41	Aug 14	5.75	Aug 15	9.20		10.60

Table D 3 Continued (3)

Unit : m above zero

	18 Yeongweol S-4		24 Jeongseon S-5		113 Jindong NA-1		130 Hyeonpung NA-2		136 Waegwan NA-3	
1916			Aug 10	10.12						
1917	Sept 4	3.48								
1918	Jul 10	4.56	Jul 12	7.27			Aug 20	6.09		
1919	Jul 6	7.42	Jul 6	7.42			Jul 8	9.91		
1920	Jul 8	8.63	Jul 8	9.45			Jul 21	11.15		
1921	Jul 6	7.39	Jul 6	7.39	Sept 2	6.68	Sept 1	6.91		
1922	Jul 29	6.53	Jul 29	6.94	Jul 8	8.42	Jul 8	9.42		
1923	Jul 20	5.75	Jul 20	8.36	Jul 27	7.03	Jul 26	7.65		
1924	Jul 25	3.31	Jul 24	4.36	Jul 27	9.00	Jul 26	10.06	Jul 26	7.45
1925	Jul 17	9.00	Jul 17	10.67	Jul 13	10.81	Jul 13	12.64	Jul 13	8.20
1926	Aug 5	5.90	Aug 5	7.70	Jul 24	8.87	Jul 23	8.26	Jul 23	6.61
1927	May 2	3.50	May 2	5.60	Aug 10	6.39	Aug 11	5.32	Aug 11	4.55
1928	Sept16	4.40	Sept15	7.22	Sept25	4.80	Sept25	4.96	Sept24	2.52
1929	Jul 2	3.36	Jul 2	4.60	Jun 29	8.00	Jul 3	7.45	Jul 3	5.60
1930	Jul 19	8.20	Jul 18	13.67	Jul 10	8.15	Jul 9	9.20	Jul 9	6.92
1931	Apr 28	4.85	Apr 28	7.44	Aug 20	7.27	Aug 6	7.37	Aug 6	6.28
1932	Sept 1	2.48	Jul 20	2.70	Aug 5	5.83	Aug 26	4.79	Aug 25	4.33
1933	Aug 3	4.80	Aug 4	7.98	Jul 2	10.36	Jul 2	10.61	Jul 3	7.39
1934	Jul 23	4.80	Jul 23	7.13	Jul 25	11.23	Jul 24	13.71	Jul 24	10.43
1935	Jul 22	5.60	Jul 22	7.82	Sept10	5.82	Jul 24	5.09	Jul 24	4.10
1936	Aug 28	11.50	Aug 28	15.00	Aug 29	11.40	Aug 29	12.95	Aug 29	9.60
1937	Jul 28	3.50	Jul 27	6.00	Apr 15	7.13	Apr 16	6.07	Jul 10	5.11
1938	Sept 4	5.60	Sept 4	7.60	May 31	6.31	Jul 10	5.61	Jul 9	4.80
1939	Apr 13	1.98	Aug 3	2.50	Sept10	3.15	May 15	2.22	May 13	2.20
1940	Jul 24	5.60	Sept 3	8.60	Jul 25	7.77	Jul 25	7.96	Jul 25	6.47
1941							Jul 7	8.86	Jul 7	6.76
1942										
1943										
1944										
1945										
1946	Jun 25	7.05								
1947										
1948							Aug 1	13.25		
1949	Jun 20	3.50					Sept20	6.90		
1950										
1951										
1952							Aug 31	4.96		
1953							Jul 6	10.55		
1954	Sept14	6.30			Jul 25	9.92			Aug 4	6.65
1955					Jul 15	9.35	Jul 15	9.56	Aug 21	5.45
1956	Jul 25	5.40			Jul 21	8.62	Jul 21	9.32	Jul 21	7.35
1957	Jul 17	3.40			Aug 3	10.80	Aug 4	11.04	Aug 4	7.95
1958	Sept 5	7.70			Sept 7	9.99	Sept 7	10.70	Sept 7	8.22
1959	Jul 7	6.30			Sept18	9.54	Sept18	9.57	Jul 9	8.06
1960	Jun 29	2.72			Sept19	7.84	Jul 1	7.46	Jun 30	6.94
1961					Jul 13	8.94	Jul 12	9.32	Jul 12	7.99

Table D 3 Continued (4)

Unit : m above zero

	18 Yeongweol S-4		24 Jeongseon S-5		113 Jindong NA-1		130 Hyeonpung NA-2		136 Waegwan NA-3	
1962					Aug 29	8.25	Aug 29	7.30	Aug 29	5.45
1963	Jul 26	3.46			Jun 21	9.98	Jul 27	9.47	Jul 28	7.60
1964	Sept19	2.49			Aug 18	8.57		9.27	Jul 19	7.10
1965	Jul 16	5.64			Jul 23	11.59	Jul 23	12.78	Jul 23	9.28
1966	Jul 24	3.80			Jul 25	7.21	Jul 24	8.02	Jul 24	6.68
1967	Sept 3	2.47	Sept 4	2.80	Jul 4	5.95	Jul 4	6.26	Jul 3	5.32
1968	Jul 17	4.25	Aug 26	3.56	Aug 17	9.92	Aug 17	9.91	Jul 17	6.84
1969	Jul 31	6.10	Aug 3	3.43	Aug 5	9.06	Sept17	10.05	Sept16	7.75
1970	Sept18	7.15	Sept17	5.60	Jul 19	9.20	Jul 18	10.00	Jul 18	7.94
1971	Aug 6	6.90	Aug 11	5.20	Jul 2	7.48	Jul 2	8.85	Jul 2	6.89
1972	Mar 30	3.91	Jun 05	8.19	Aug 21	9.15		10.50		
1973	May 3	1.87	Sept11	2.38	Aug 4	6.50	Aug 4	7.80	Aug 4	5.52
1974	Apr 8	2.95	Jul 9	5.10	Jul 7	8.78	Jul 8	9.25	May 21	7.05
1975				6.75	Jul 13	7.84	Sept13	8.25	Jul 7	6.89
1976			Aug. 15	4.80	Aug 8	6.20	Aug 7	7.18	Aug 7	6.03

Table D 3 Continued (5)

Unit : m above zero

	151 Andong NA-5		152 Imha NA-6		92 Songjeong SE-1	
1917					Aug 12	11.30
1918					Aug 19	10.53
1919					Sept 3	11.41
1920					Jul 20	12.73
1921					Jul 11	10.08
1922					Jul 26	10.50
1923					Jul 22	9.82
1924	Jul 25	4.00			Jul 23	14.48
1925	Jul 12	5.22			Jul 10	13.40
1926	Jul 22	3.80			Jul 23	12.53
1927	Apr 21	2.43			Aug 10	9.72
1928	Sept25	1.93				
1929	Jun 29	3.51			Jun 29	9.87
1930	Jul 19	6.40			Aug 22	13.58
1931	Jul 26	3.59			Aug 4	13.91
1932	Sept 1	2.26			Aug 5	13.56
1933	Jul 2	4.53			Jul 26	15.28
1934	Jul 23	7.67			Jul 21	15.45
1935	Jul 23	2.47			Sept 9	8.99
1936	Aug 28	7.85			Aug 28	15.30
1937	Jul 9	3.18			Apr 14	12.80
1938	Jun 13	2.83			May 29	9.30
1939	May 13	1.67			Sept 1	6.50
1940	Jul 24	4.18			Jul 9	11.50
1941	Aug 23	4.05				
1942						
1943						
1944						
1945						
1946	Jun 27	3.23				
1947	Jun 29	4.08				
1948						
1949						
1950						
1951						
1952	Sept12	3.39				
1953	Jul 5	3.97				
1954	Sept14	4.98				
1955	Jul 14	4.90				
1956	Jul 21	4.90				
1957	Aug 3	4.90			Aug 3	11.90
1958	Sept 6	4.35			Sept 6	11.32
1959	Sept17	6.50			Sept17	7.90
1960	Jun 29	4.29			Jun 29	8.10
1961	Aug 4	5.05				
1962	Sept 7	3.00			Jun 21	11.80

Table D 3 Continued (6)

Unit : m above zero

	151 Andong NA-5		152 Imha NA-6		92 Songjeong SE-1	
1963	Jul 26	4.15	Jun 20	2.80	Jun 20	12.32
1964	Jul 18	3.78	Jul 17	3.30	Sept 1	8.03
1965	Jul 22	4.59	Jul 22	4.50	Jul 12	9.92
1966	Jul 24	3.00	Jul 24	1.87	Aug 31	11.72
1967	Jul 3	3.80	Sept 3	8.16	Jun 28	5.24
1968	Aug 17	3.36	Aug 16	2.60	Aug 16	6.89
1969	Sept16	4.40	Aug 4	3.83		
1970	Jul 5	4.90	Jul 5	5.44	Jul 17	10.12
1971	Jul 1	3.65	Jul 1	3.4	Jul 22	7.23
1972	Aug 20	6.20	Sept14	4.9	Jul 11	10.30
1973	Aug 3	2.55	Aug 3	3.90	Aug 4	7.40
1974	Jul 7	3.62	Jul 7	4.60	May 20	10.20
1975	Jul 6	2.75	Jul 6	3.85	Jul 11	11.00
1976	Aug 28	3.50	Aug 6	4.2	Jun 8	11.40

Table D 4 ANNUAL MAXIMUM 3-DAY BASIN RAINFALLS AT REPRESENTING GAUGES

Unit : mm

Year	29 Chuncheon N - 2	12 Ganhyeon S - 6	118 Sancheong NA - 7
1914		152	
1915		163	78
1916	194	173	182
1917	186	144	109
1918	257	175	202
1919		196	168
1920	259	394	349
1921	66	153	126
1922	159	318	208
1923	120	255	149
1924	258	151	224
1925	469	285	243
1926	236	202	186
1927	266	95	145
1928	99	158	118
1929	179	113	267
1930	279	301	193
1931	211	122	160
1932	142	95	277
1933	187	221	248
1934	108	114	371
1935	385	285	131
1936	218	492	207
1937	192	123	105
1938	108	147	156
1939	90	103	75
1940	350	315	180
1941	98	87	268
1957	165		
1958	175	304	89
1959	183	212	181
1960	147	181	145
1961	116	99	185
1962	139	172	215
1963	194	250	276
1964	241	271	127
1965	480	177	251
1966	293	271	200
1967	103	104	93
1968	149	190	215
1969	175	198	182
1970	131	165	179
1971	122	154	129
1972	245	318	194
1973	73	82	127
1974	126	164	166
1975	123	104	167
1976	271	343	151

Table D 5 PROBABLE FLOOD WATER LEVEL AND DISCHARGE UNDER WITHOUT-DAM CONDITION

	4 Indogyo D - 0&1		8 Goan D - 2		26 Cheong-pyeong N - 1		29 Chuncheon N - 2	11 Yeoju S - 2	
p	WL	Q	WL	Q	WL	Q	R	WL	Q
0.005	12.85	38.20	19.80	35.39	18.35	21.95	528	14.50	22.81
0.01	12.25	34.45	18.30	31.91	17.60	19.54	471	13.70	20.18
0.02	11.80	31.12	17.10	28.05	16.80	17.81	419	12.95	18.14
0.05	11.05	27.13	15.25	24.79	15.20	14.68	350	11.80	14.82
0.1	10.45	24.05	13.85	21.60	13.90	12.35	299	10.85	12.23
0.15	9.85	21.07	12.75	19.03	12.95	10.79	267	10.20	10.81
0.2	9.75	20.51	12.20	17.73	12.15	9.58	245	9.80	9.92
0.4	8.60	15.23	10.30	13.31	10.15	6.78	189	8.55	7.30
0.6	7.70	12.02	9.05	10.25	8.70	5.10	154	7.50	5.29
0.8	6.75	9.04	7.65	7.28	7.25	3.68	118	6.35	3.61
0.9	6.05	7.21	6.80	5.42	6.30	2.96	98	5.60	2.32

	15 Moggye S - 3		18 Yeongweol S - 4		24 Jeongseon S - 5		12 Ganhyeon S - 6	113 Jindong NA - 1	
p	WL	Q	WL	Q	WL	Q	R	WL	Q
0.005	18.30	20.45	15.00	10.32	21.50	5.95	605	15.45	19.50
0.01	16.60	17.62	13.40	9.06	18.90	5.07	535	14.55	18.10
0.02	15.00	14.94	11.90	7.83	16.65	4.27	474	13.65	15.60
0.05	12.80	11.31	9.90	6.28	13.65	3.28	391	12.25	13.80
0.1	11.10	9.06	8.35	5.02	11.35	2.41	328	11.25	11.40
0.15	10.15	7.82	7.50	4.62	10.05	2.00	292	10.60	9.15
0.2	9.40	7.00	6.90	3.87	9.20	1.76	268	10.05	8.06
0.4	7.50	5.02	5.25	2.55	6.85	1.06	203	8.80	6.02
0.6	6.20	3.89	4.25	1.98	5.40	0.71	160	7.80	4.61
0.8	5.00	2.98	3.25	1.16	4.00	0.42	123	6.75	3.24
0.9	4.20	2.45	2.30	1.10	3.25	0.29	100	6.05	2.51

Remarks; WL : Flood water level (El m)

Q : Flood discharge ($10^3 m^3/s$)

R : 3-day basin rainfall (mm)

p : Probability of exceedence

Table D 5 Continued (2)

p	130 Hyeonpung NA - 2 WL	Q	131 Waegwan NA - 3 WL	Q	141 Nagdong NA - 4 WL	Q	151 Andong NA - 5 WL	Q	152 Imha NA - 6 WL	Q
0.005	14.70	15.28	12.80	13.55	10.55	11.00	9.40	6.62	8.00	4.50
0.01	14.20	12.50	11.95	12.19	10.30	9.85	8.55	5.91	7.40	3.80
0.02	13.95	11.41	11.15	10.92	9.95	8.72	7.85	5.35	6.80	3.20
0.05	13.20	9.27	10.15	9.38	9.60	7.86	6.80	4.44	5.95	2.20
0.1	12.45	8.12	9.20	7.79	9.00	6.75	6.00	3.73	5.30	1.82
0.15	11.65	7.10	8.60	6.75	8.45	6.22	5.55	3.32	4.85	1.55
0.2	10.85	6.19	8.20	6.06	8.00	5.74	5.20	3.05	4.55	1.35
0.4	8.95	4.28	6.80	3.71	6.85	4.91	4.20	2.19	3.75	0.88
0.6	7.60	3.10	5.80	2.20	6.00	4.29	3.55	1.61	3.20	0.61
0.8	6.30	2.04	4.80	1.08	5.15	3.70	2.90	1.12	2.65	0.38
0.9	5.45	1.42	4.20	0.69	4.55	3.28	2.50	0.86	2.30	0.23

p	118 Sancheong NA - 7 R	92 Songjeong SE - 1 WL	Q
0.005	460	16.75	11.50
0.01	416	16.15	10.70
0.02	377	15.65	9.90
0.05	321	14.95	9.20
0.1	279	14.20	8.20
0.15	253	13.85	7.90
0.2	236	13.30	7.20
0.4	189	12.65	6.80
0.6	157	10.65	4.70
0.8	125	9.30	3.60
0.9	106	8.40	2.90

Remarks; WL : Flood water level (El.m)

Q : Flood discharge ($10^3 m^3/s$)

R : 3-day basin rainfall (mm)

p : Probability of exceedence

Table D 6 ALTERNATIVE FLOOD CONTROL SPACES OF PROPOSED DAMS

Unit : $10^6 m^3$

Name of Dam	m=0.2	m=0.5	m=0.8	Name of Dam	m=0.2	m=0.5	m=0.8
Bamseonggol	110	60	20	Ganhyeon	245	130	45
Inje	245	130	45	Bonghwa	145	80	30
Hongcheon	310	165	60	Imha	115	60	20
Gujeol	30	15	5	Hamyang	65	35	10
Dalcheon	225	120	40	Juam	200	105	35

Remarks ; m : Reduction ratio for flood control operation

Table D 7 FLOOD CONTROL SPACE AND REDUCTION RATIO OF EXISTING DAMS

Name of Dam	Catchment Area (km^2)	Flood Control Space ($10^6 m^3$)	Peak Inflow (m^3/s)	Maximum Outflow (m^3/s)	Reduction Ratio ; m
Hwacheon	3,901	215	(9,488)	(5,428)	
Soyanggang	2,703	500	10,500	5,500	
Chungju	6,648	600	27,000	20,000	0.74
Andong	1,588	150	5,000	3,400	
Habcheon	925	72	5,100	2,690	0.53
Namgang	2,285	42	10,570	2,000*	0.19
Seomjingang	763	32	3,268	1,868	0.57

Remarks ; * Additional 5,400 m^3/s is diverted to the Sacheon bay, () : 1969 record

Table D 8 REDUCTION RATIOS OF EXISTING DAMS AFFECTED BY PROPOSED DAMS

Reduction Ratio of Proposed Dam	0.2	0.5	0.8	1.0
Hwacheon with Bamseonggol	0.64	0.66	0.67	0.68
Soyanggang with Inje	0.14	0.23	0.28	0.31
Andong with Bonghwa	0.10	0.18	0.25	0.29

Table D 9 FLOOD REDUCTION RATIOS AT REPRESENTING GAUGES, HAN RIVER

	Existing Dams only	Existing Dams + A Proposed Dam				
		Bam-seonggol	Inje	Hong-cheon	Dalcheon	Gan-hyeon
				m = 0.2		
4 Indogyo, D-0&1	0.834	0.829	0.828	0.799	0.802	0.806
8 Goan, D-2	0.825	0.820	0.819	0.788	0.791	0.795
26 Cheongpyeong, N-1	0.741	0.727	0.725	0.639		
29 Chuncheon, N-2	0.847	0.823	0.794			
11 Yeoju, S-2	0.853				0.781	0.790
15 Moggye, S-3	0.812				0.716	
12 Ganhyeon, S-6	1					0.691
				m = 0.5		
4 Indogyo, D-0&1	0.834	0.831	0.831	0.807	0.809	0.812
8 Goan, D-2	0.825	0.822	0.822	0.796	0.798	0.802
26 Cheongpyeong, N-1	0.741	0.734	0.733	0.662		
29 Chuncheon, N-2	0.847	0.835	0.819			
11 Yeoju, S-2	0.853				0.797	0.805
15 Moggye, S-3	0.812				0.738	
12 Ganhyeon, S-6	1					0.836
				m = 0.8		
4 Indogyo, D-0&1	0.834	0.832	0.832	0.821	0.822	0.823
9 Goan, D-2	0.825	0.823	0.823	0.811	0.812	0.814
26 Cheongpyeong, N-1	0.741	0.737	0.737	0.704		
29 Chuncheon, N-2	0.847	0.843	0.837			
11 Yeoju, S-2	0.853				0.827	0.830
15 Moggye, S-3	0.812				0.778	
12 Ganhyeon, S-6	1					0.943

Gujeol

	m = 0.2	m = 0.5	m = 0.8
18 Yeongweol, S-4	0.989	0.991	0.996
24 Jeongseon, S-5	0.971	0.977	0.989

Remarks ; (1) Basin rainfall reduction ratios for 29 Chuncheon and 12 Ganhyeon.

(2) Existing dams are the Hwacheon, Soyanggang and Chungju dams.

(3) There is no dam affecting 18 Yeongweol and 24 Jeongseon.

(4) Blank : no effect by proposed dam.

Table D 10 FLOOD REDUCTION RATIOS AT REPRESENTING GAUGES, NAGDONG AND SEOMJIN RIVERS

	Existing Dams only	Existing Dams + A Proposed Dam: Bonghwa	Imha	Hamyang	Juam
			m = 0.2		
113 Jindong , NA-1	0.887	0.884	0.854		
130 Hyeonpung, NA-2	0.947	0.942	0.901		
136 Waegwan, NA-3	0.932	0.926	0.873		
141 Nagdong, NA-4	0.919	0.912	0.848		
151 Andong, NA-5	0.771	0.750	0.516		
152 Imha, NA-6	1		0.364		
118 Sancheong, NA-7	1			0.880	
92 Songjeong, SE-1	0.938				0.807
			m = 0.5		
113 Jindong, NA-1	0.887	0.885	0.861		
130 Hyeonpung Na-2	0.947	0.944	0.911		
136 Waegwan, NA-3	0.932	0.928	0.886		
141 Nagdong, NA-4	0.919	0.914	0.864		
151 Andong, NA-5	0.771	0.756	0.581		
152 Imha, NA-6	1		0.568		
118 Sancheong, NA-7	1			0.935	
92 Songjeong, SE-1	0.938				0.837
			m = 0.8		
113 Jindong, NA-1	0.887	0.886	0.875		
130 Hyeonpung, NA-2	0.947	0.945	0.930		
136 Waegwan, NA-3	0.932	0.930	0.910		
141 Nagdong, NA-4	0.919	0.917	0.893		
151 Andong, NA-5	0.771	0.765	0.687		
152 Imha, NA-6	1		0.821		
118 Sancheong, NA-7	1			0.977	
92 Songjeong, SE-1	0.938				0.891

Remarks ; (1) Basin rainfall reduction ratio for 118 Sacheon

(2) Existing dams are the Andong and Habcheon dams for the Nagdong river and Seomjingang dam for the Seomjin river

(3) Blank : no effect by proposed dam

Table D 11 REDUCED FLOOD DISCHARGE AND WATER LEVEL UNDER THE PRESENT CONDITION

p	4 Indogyo (D-1, D-1) (K=0.834) WL (m)	Q ($10^3m^3/s$)	8 Goan (D-2) (K=0.825) WL (m)	Q ($10^3m^3/s$)	26 Cheong-pyeong (N-1) (K-0.741) WL (m)	Q ($10^3m^3/s$)	29 Chuncheon (N-2) (K=0.847) R (m)	Yeoju (S-2) (K=0.853) WL (m)	Q ($10^3m^3/s$)
0.005	11.95	31.86	17.15	29.20	16.00	16.26	447	13.45	19.46
0.01	11.35	28.73	15.90	26.33	15.10	14.48	399	12.65	17.21
0.02	10.80	25.95	14.50	23.14	14.40	13.20	355	12.00	15.47
0.05	10.15	22.63	13.55	20.45	13.00	10.88	296	11.00	12.64
0.1	9.65	20.06	12.25	17.82	11.85	9.15	253	10.05	10.43
0.15	9.10	17.57	11.35	15.70	11.05	8.00	226	9.45	9.22
0.2	9.00	17.11	10.90	14.63	10.35	7.10	208	9.10	8.46
0.4	7.90	12.70	9.40	10.98	8.65	5.02	160	8.00	6.23
0.6	7.05	10.02	8.25	8.46	7.35	3.78	130	7.05	4.51

p	15 Moggye (S-3) (K=0.812) WL (m)	Q ($10^3m^3/s$)	18 Yeongweal (S-4) (K-1.000) WL (m)	Q ($10^3m^3/s$)	24 Jeongseon (S-5) (K=1.000) WL (m)	Q ($10^3m^3/s$)	12 Gangyeon (S-6) (K=1.000) R (mm)
0.005	16.00	16.61	15.00	10.32	21.55	5.95	605
0.01	14.65	14.43	14.40	9.06	18.90	5.07	535
0.02	13.30	12.13	11.85	7.83	16.60	4.27	474
0.05	11.20	9.18	9.90	6.28	13.65	3.28	391
0.1	9.70	7.36	8.35	5.02	11.30	2.41	328
0.15	8.75	6.35	7.90	4.62	10.05	2.00	292
0.2	8.15	5.68	6.90	3.87	9.25	1.76	268
0.4	6.35	4.08	5.25	2.55	6.75	1.06	203
0.6	5.30	3.16	4.50	1.98	5.35	0.71	160

Remarks; p : Probability of exceedence
K : Flood reduction ratio at gauge
WL : Flood water level (m)
Q : Flood discharge ($10^3m^3/s$)

Table D 11 Continued (2)

p	113 Jindong (NA-1) (K=0.887) WL (m)	Q $(10^3m^3/s)$	130 Hyeonpung (NA-2) (K=0.947) WL (m)	Q $(10^3m^3/s)$	136 Waegwan (NA-3) (K=0.932) WL (m)	Q $(10^3m^3/s)$	141 Nagdong (NA-4) (K=0.919) WL (m)	Q $(10^3m^3/s)$
0.005	14.30	17.30	14.55	14.47	12.20	12.63	10.30	10.11
0.01	13.80	16.05	14.05	11.84	11.40	11.36	10.05	9.05
0.02	12.85	13.84	13.75	10.81	10.60	10.18	9.70	8.01
0.05	11.60	12.24	12.90	8.78	9.75	8.74	9.30	7.22
0.1	11.30	10.11	12.10	7.69	8.90	7.26	8.55	6.20
0.15	10.05	8.12	11.35	6.72	8.35	6.29	7.95	5.72
0.2	9.50	7.15	10.55	5.86	7.95	5.65	7.40	5.28
0.4	8.35	5.34	8.65	4.05	6.65	3.46	6.30	4.51
0.6	7.40	4.09	7.45	2.94	5.65	2.05	5.50	3.94

p	151 Andong (NA-5) (K=0.771) WL (m)	Q $(10^3m^3/s)$	152 Imha (NA-6) (K=1.000) WL (m)	Q $(10^3m^3/s)$	118 Sancheong (NA-7) (K=1.000) R (mm)	92 Songjeong (SE-1) (K=0.938) WL (m)	Q $(10^3m^3/s)$
0.005	7.60	5.10	8.00	4.50	460	16.25	10.79
0.01	6.95	4.56	7.40	3.80	416	15.70	10.04
0.02	6.45	4.12	6.80	3.20	377	15.10	9.29
0.05	5.65	3.42	5.90	2.20	321	14.45	8.63
0.1	5.00	2.88	5.27	1.82	279	13.80	7.69
0.15	4.65	2.56	4.86	1.55	253	13.40	7.41
0.2	4.40	2.35	4.55	1.35	236	12.85	6.75
0.4	3.60	1.69	3.76	0.88	189	12.35	6.38
0.6	3.05	1.24	3.20	0.61	157	10.30	4.41

Remarks; p : Probability of exceedence
K : Flood reduction ratio at gauge
WL : Flood water level (m)
Q : Flood discharge $(10^3m^3/s)$

Table D 12 FLOOD WATER LEVEL REDUCTION BY PROPOSED DAM, HAN RIVER

Return Period Flood Reduction		50 yr $Q(m^3/s)$	50 yr H(m)	100 yr $Q(m^3/s)$	100 yr H(m)	200 yr $Q(m^3/s)$	200 yr H(m)
Bamseonggol							
4 Indogyo	(m=0.2)	150	0.00	170	0.05	190	0.05
(D-0, D-1)	(m=0.5)	90	0.00	100	0.05	120	0.05
	(m=0.8)	60	0.00	70	0.05	80	0.05
8 Goan	(m=0.2)	140	0.05	160	0.05	180	0.10
(D-2)	(m=0.5)	80	0.00	100	0.00	110	0.05
	(m=0.8)	50	0.00	70	0.00	70	0.05
25 Cheongpyeong	(m=0.2)	250	0.15	270	0.15	300	0.15
(N-1)	(m=0.5)	130	0.05	140	0.05	150	0.05
	(m=0.8)	70	0.05	80	0.00	80	0.00
29 Chuncheon	(m=0.2)	R = 10 (mm)		R = 11 (mm)		R = 12 (mm)	
(N-2)	(m=0.5)	R = 5 (mm)		R = 6 (mm)		R = 6 (mm)	
	(m=0.8)	R = 2 (mm)		R = 2 (mm)		R = 2 (mm)	
Inje							
4 Indogyo	(m=0.2)	180	0.00	210	0.05	230	0.05
(D-0, D-1)	(m=0.5)	90	0.00	100	0.05	120	0.05
	(m=0.8)	60	0.00	70	0.05	80	0.05
8 Goan	(m=0.2)	170	0.05	200	0.05	220	0.10
(D-2)	(m=0.5)	80	0.00	100	0.00	110	0.05
	(m=0.8)	50	0.00	70	0.00	70	0.05
26 Cheongpyeong	(m=0.2)	290	0.20	310	0.20	350	0.20
(N-1)	(m=0.5)	150	0.05	160	0.05	170	0.05
	(m=0.8)	70	0.05	80	0.00	80	0.00
29 Chuncheon	(m=0.2)	R = 22 (mm)		R = 25 (mm)		R = 28 (mm)	
(N-2)	(m=0.5)	R = 12 (mm)		R = 13 (mm)		R = 15 (mm)	
	(m=0.8)	R = 4 (mm)		R = 5 (mm)		R = 5 (mm)	

Table D 12 Continued (2)

Return Period Flood Reduction		50 yr Q(m^3/s)	H(m)	100 yr Q(m^3/s)	H(m)	200 yr Q(m^3/s)	H(m)
Hongcheon							
4 Indogyo	(m=0.2)	1,990	0.20	1,200	0.20	1,340	0.25
(D-0, D-1)	(m=0.5)	840	0.15	930	0.15	1,030	0.20
	(m=0.8)	400	0.10	450	0.05	500	0.10
8 Goan	(m=0.2)	1,040	0.45	1,180	0.55	1,310	0.60
(D-2)	(m=0.5)	810	0.35	930	0.40	1,030	0.45
	(m=0.8)	390	0.20	450	0.15	500	0.20
26 Cheongpyeong	(m=0.2)	1,820	1.10	1,190	1.10	2,230	1.15
(N-1)	(m=0.5)	1,410	0.80	1,540	0.85	1,730	0.90
	(m=0.8)	660	0.40	720	0.40	810	0.40
Gujeol							
18 Yeongweol	(m=0.2)	90	0.05	100	0.10	110	0.10
(S-4)	(m=0.5)	70	0.05	80	0.10	90	0.10
	(m=0.8)	30	0.00	40	0.05	40	0.00
24 Jeongseon	(m=0.2)	120	0.30	150	0.35	170	0.50
(S-5)	(m=0.5)	100	0.25	120	0.30	140	0.45
	(m=0.8)	50	0.10	60	0.15	70	0.20
Dalcheon							
4 Indogyo	(m=0.2)	990	0.20	1,100	0.20	1,220	0.25
(D-0, D-1)	(m=0.5)	770	0.15	860	0.10	960	0.20
	(m=0.8)	370	0.10	410	0.05	460	0.10
8 Goan	(m=0.2)	950	0.40	1,090	0.50	1,210	0.55
(D-2)	(m=0.5)	760	0.30	870	0.35	960	0.40
	(m=0.8)	360	0.15	420	0.15	460	0.20
11 Yeoju	(m=0.2)	1,300	0.45	1,450	0.55	1,650	0.65
(S-2)	(m=0.5)	1,010	0.30	1,130	0.40	1,280	0.50
	(m=0.8)	470	0.15	520	0.20	600	0.25
15 Moggye	(m=0.2)	1,430	0.95	1,690	1.00	1,970	1.15
(S-3)	(m=0.5)	1,100	0.70	1,310	0.80	1,520	0.90
	(m=0.8)	510	0.30	600	0.35	700	0.40

Table D 12 Continued (3)

Return Period Flood Reduction		50 yr Q(m³/s)	H(m)	100 yr Q(m³/s)	H(m)	200 yr Q(m³/s)	H(m)
Ganhyeon							
4 Indogyo	(m=0.2)	870	0.20	960	0.15	1,070	0.20
(D-0, D-1)	(m=0.5)	680	0.15	760	0.10	840	0.15
	(m=0.8)	340	0.10	380	0.05	420	0.10
8 Goan	(m=0.2)	840	0.35	960	0.45	1,060	0.45
(D-2)	(m=0.5)	640	0.25	740	0.35	820	0.35
	(m=0.8)	310	0.10	360	0.15	390	0.15
11 Yeoju	(m=0.2)	1,140	0.40	1,270	0.45	1,440	0.55
(S-2)	(m=0.5)	870	0.30	970	0.35	1,100	0.45
	(m=0.8)	410	0.10	460	0.20	530	0.20
12 Ganhyeon	(m=0.2)	R = 146 (mm)		R = 165 (mm)		R = 187 (mm)	
(S-6)	(m=0.5)	R = 78 (mm)		R = 88 (mm)		R = 99 (mm)	
	(m=0.8)	R = 27 (mm)		R = 30 (mm)		R = 34 (mm)	

Remarks; m : Flood reduction ratio at dam site

H : Flood water level reduction

Q : Flood discharge reduction

R : Storm rainfall reduction

Table D 13 FLOOD WATER LEVEL REDUCTION BY PROPOSED DAM, NAGDONG AND SEOMJIN RIVER

Return Period Flood Reduction		50 yr $Q(m^3/s)$	 H(m)	100 yr $Q(m^3/s)$	 H(m)	200 yr $Q(m^3/s)$	 H(m)
Bonghwa							
113 Jindong	(m=0.2)	50	0.00	50	0.00	60	0.00
(NA-1)	(m=0.5)	30	0.00	30	0.00	40	0.00
	(m=0.8)	20	0.00	20	0.00	20	0.00
130 Hyeonpung	(m=0.2)	60	0.05	70	0.00	80	0.00
(NA-2)	(m=0.5)	40	0.05	40	0.00	50	0.00
	(m=0.8)	30	0.05	30	0.00	30	0.00
135 Waegwan	(m=0.2)	70	0.05	70	0.05	80	0.05
(NA-3)	(m=0.5)	50	0.00	50	0.00	60	0.00
	(m=0.8)	20	0.00	20	0.00	30	0.00
141 Nagdong	(m=0.2)	60	0.05	70	0.00	80	0.00
(NA-4)	(m=0.5)	40	0.05	50	0.00	60	0.00
	(m=0.8)	10	0.00	20	0.00	20	0.00
151 Andong	(m=0.2)	110	0.15	120	0.15	140	0.15
(NA-5)	(m=0.5)	80	0.10	90	0.10	100	0.10
	(m=0.8)	30	0.05	40	0.05	40	0.05
Imha							
113 Jindong	(m=0.2)	520	0.30	590	0.25	650	0.25
(NA-1)	(m=0.5)	410	0.25	470	0.25	510	0.25
	(m=0.8)	190	0.10	210	0.10	240	0.20
130 Hyeonpung	(m=0.2)	530	0.15	580	0.15	700	0.10
(NA-2)	(m=0.5)	420	0.10	450	0.10	550	0.05
	(m=0.8)	200	0.05	220	0.05	260	0.00
136 Waegwan	(m=0.2)	650	0.40	720	0.50	800	0.50
(NA-3)	(m=0.5)	500	0.30	560	0.40	620	0.40
	(m=0.8)	240	0.10	270	0.20	300	0.20
141 Nagdong	(m=0.2)	620	0.30	700	0.20	780	0.15
(NA-4)	(m=0.5)	480	0.25	540	0.15	610	0.10
	(m=0.8)	220	0.10	250	0.05	290	0.00

Table D 13 Continued (2)

Return Period Flood Reduction		50 yr Q(m^3/s)	 H(m)	100 yr Q(m^3/s)	 H(m)	200 yr Q(m^3/s)	 H(m)
Imha							
151 Andong	(m=0.2)	1,360	1.60	1,510	1.75	1,680	1.95
(NA-5)	(m=0.5)	1,010	1.15	1,130	1.30	1,250	1.45
	(m=0.8)	440	0.50	500	0.55	550	0.65
152 Imha	(m=0.2)	2,040	2.55	2,420	2.80	2,860	3.00
(NA-6)	(m=0.5)	1,380	2.50	1,640	1.60	1,940	1.35
	(m=0.8)	570	0.40	680	0.55	810	0.35
Hamyang							
118 Sancheong	(m=0.2)	R = 45 (mm)		R = 50 (mm)		R = 55 (mm)	
(NA-7)	(m=0.5)	R = 25 (mm)		R = 27 (mm)		R = 30 (mm)	
	(m=0.8)	R = 9 (mm)		R = 10 (mm)		R = 11 (mm)	
Juam							
92 Songjeong	(m=0.2)	1,300	1.15	1,410	1.15	1,510	1.15
(SE-1)	(m=0.5)	1,000	0.80	1,080	0.80	1,160	0.80
	(m=0.8)	470	0.35	510	0.35	540	0.40

Remarks; m : Flood reduction ratio at Dam site
Q : Flood water level reduction
H : Flood discharge reduction
R : Storm rainfall reduction

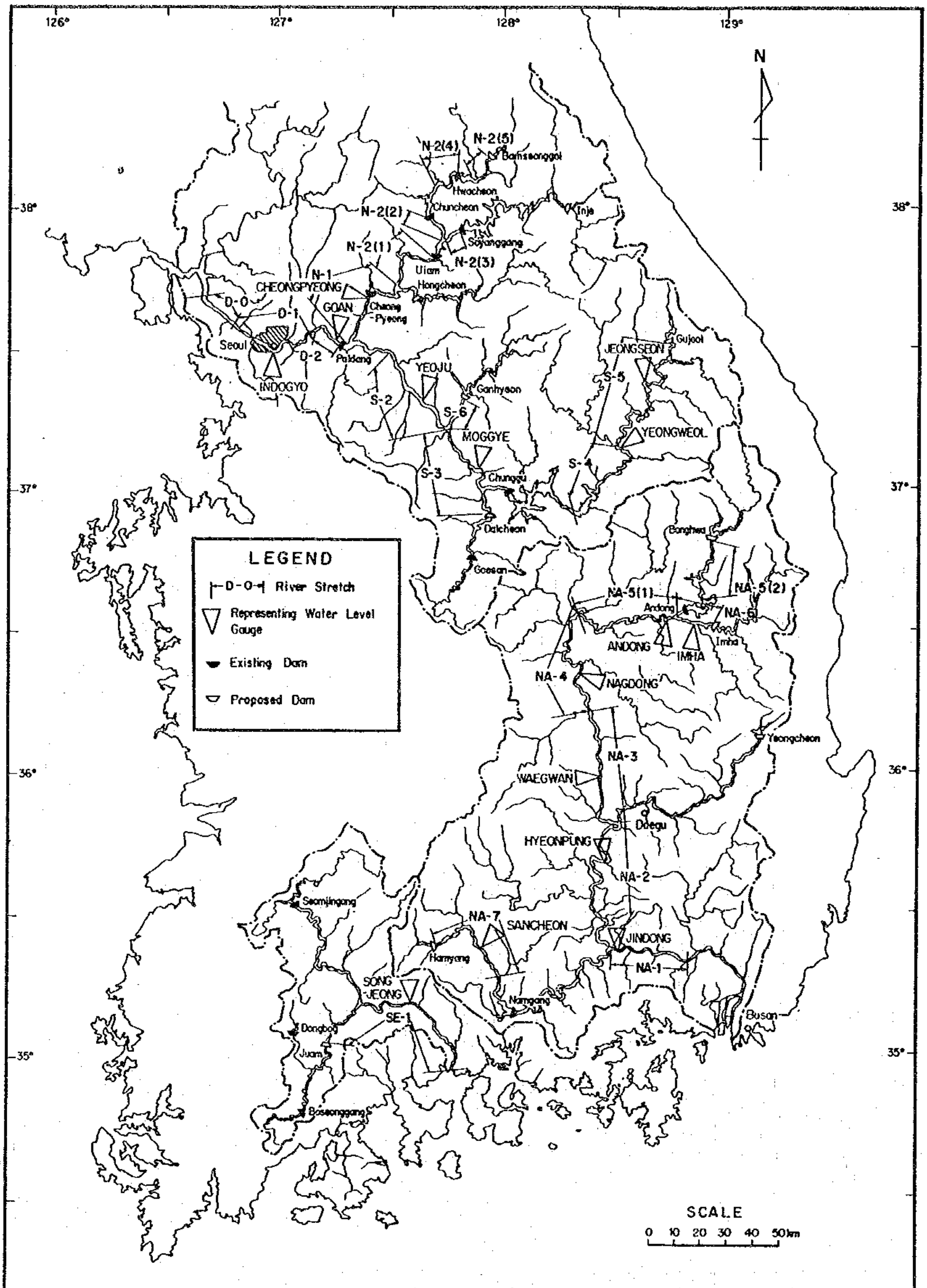

Fig. D 1 River Stretches and Representing Water Level Gauges for Flood Study

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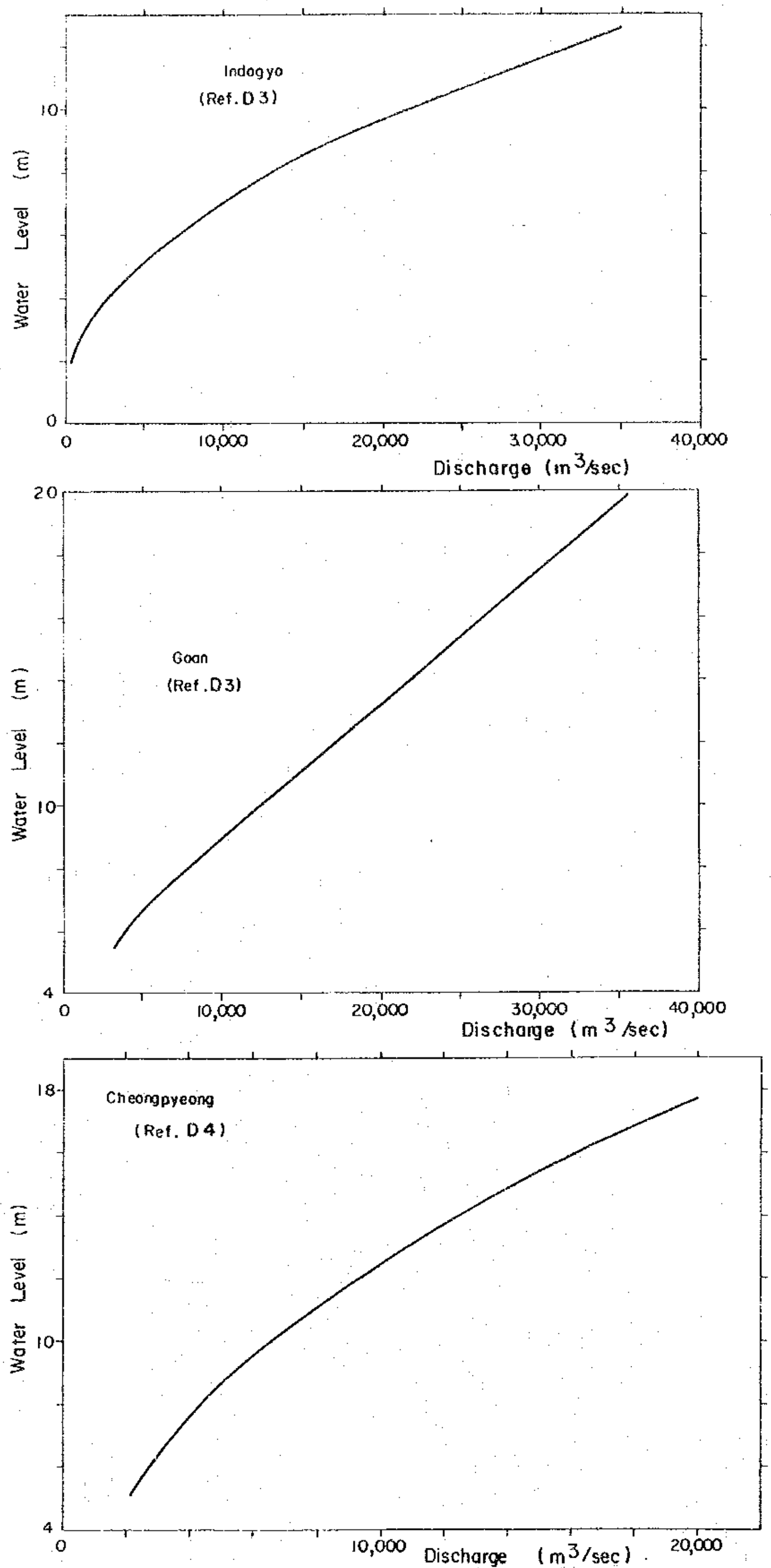

Fig. D 2 Discharge Rating Curves at Representing Water Level Gauges

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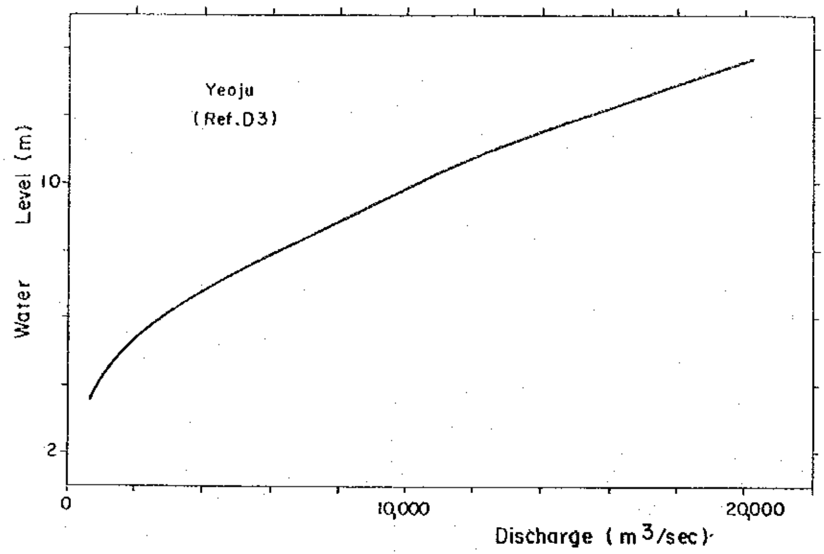

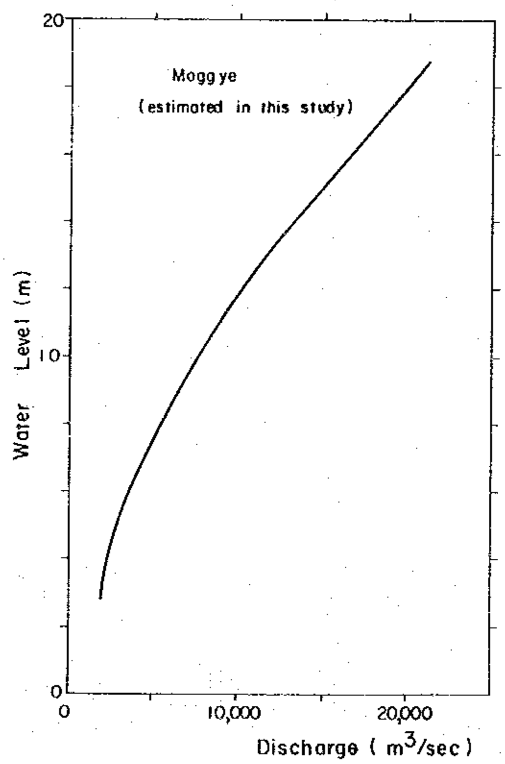

Fig. D 2 Continued (2)

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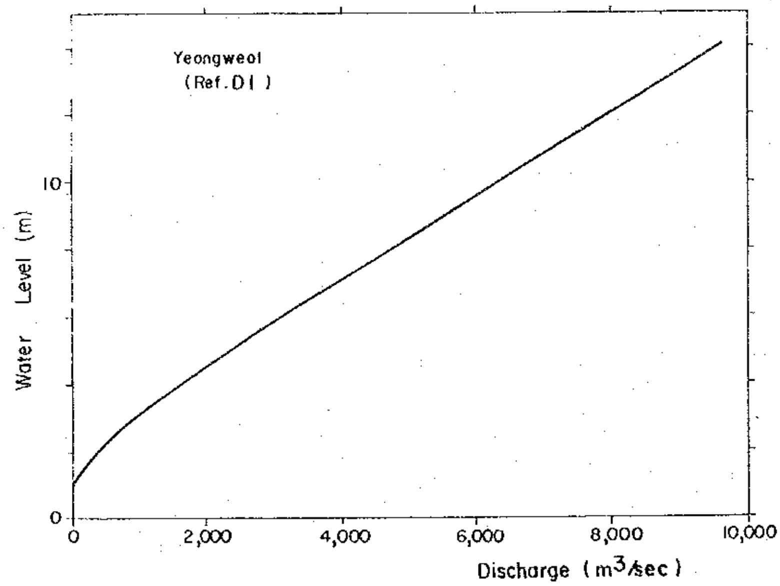

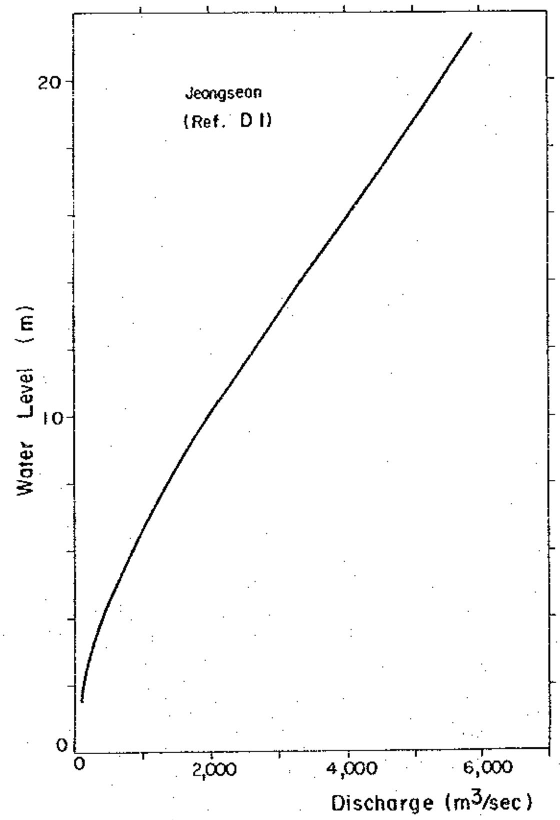

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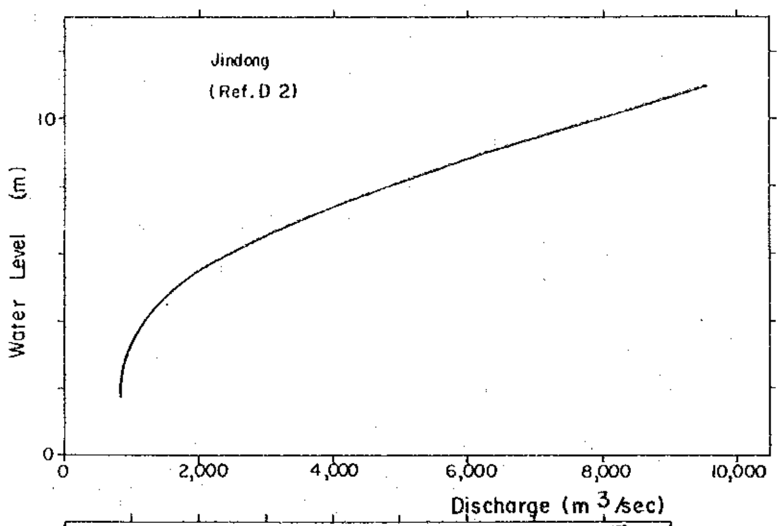

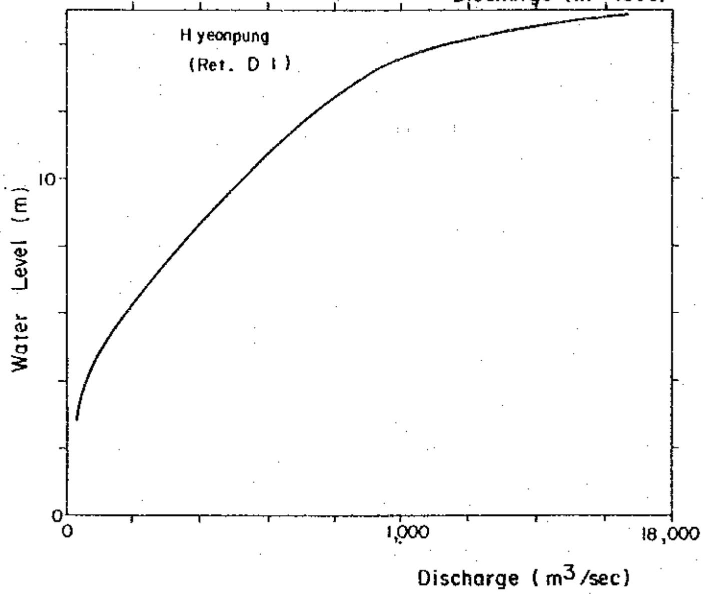

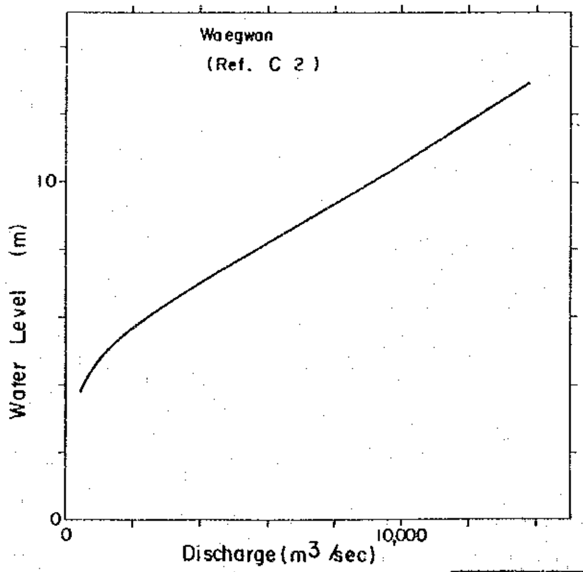

Fig. D 2 Continued (4)

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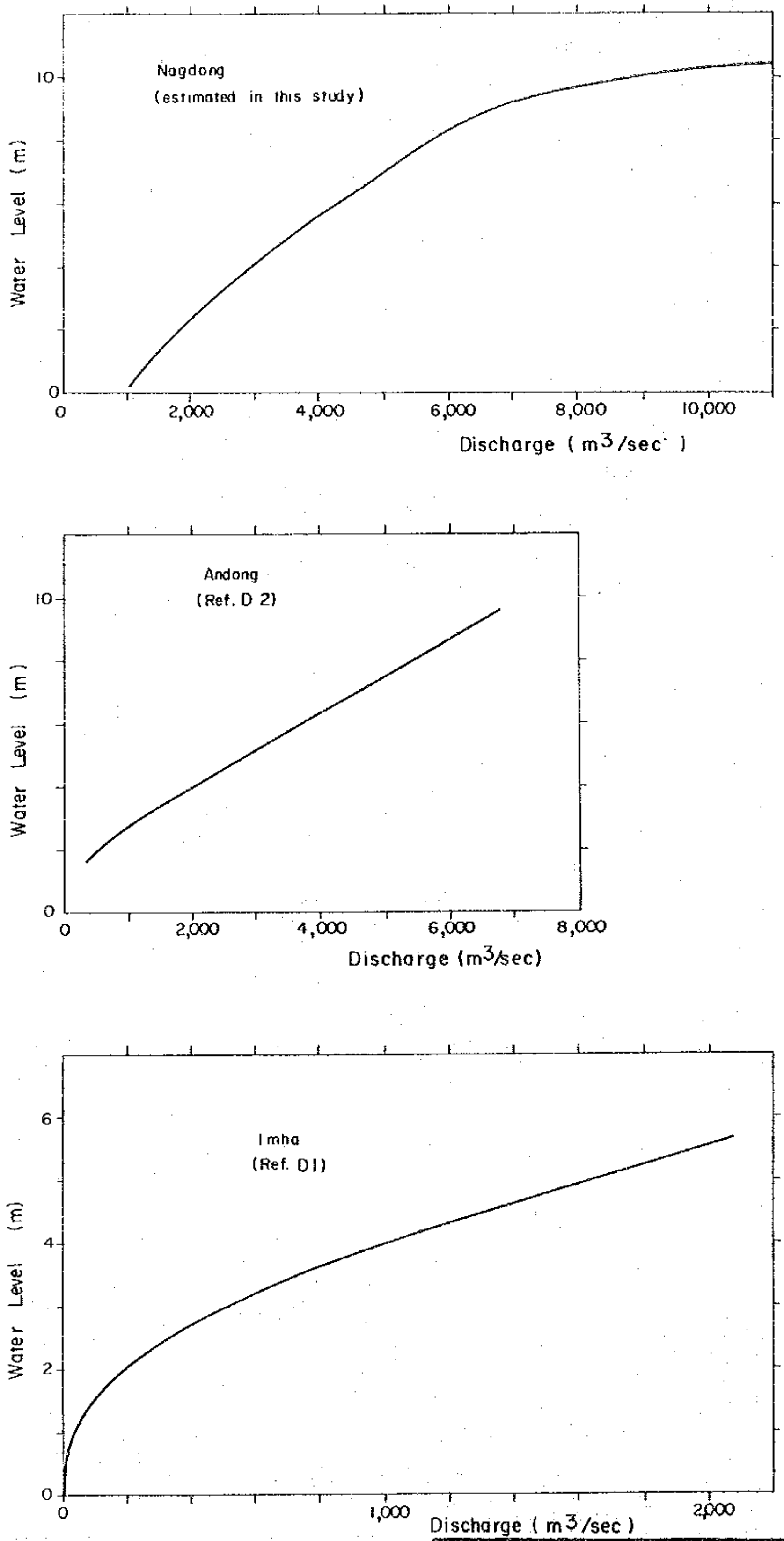

Fig. D 2 Continued (5)

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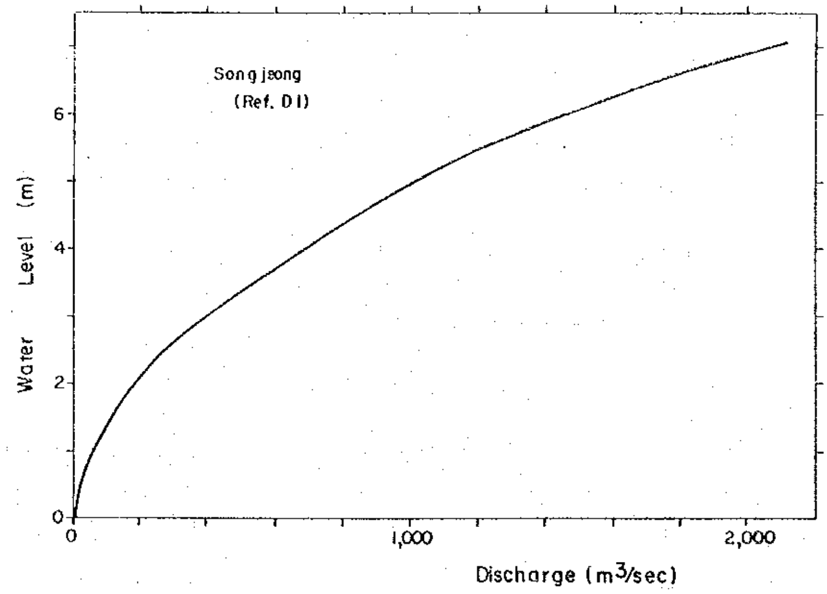

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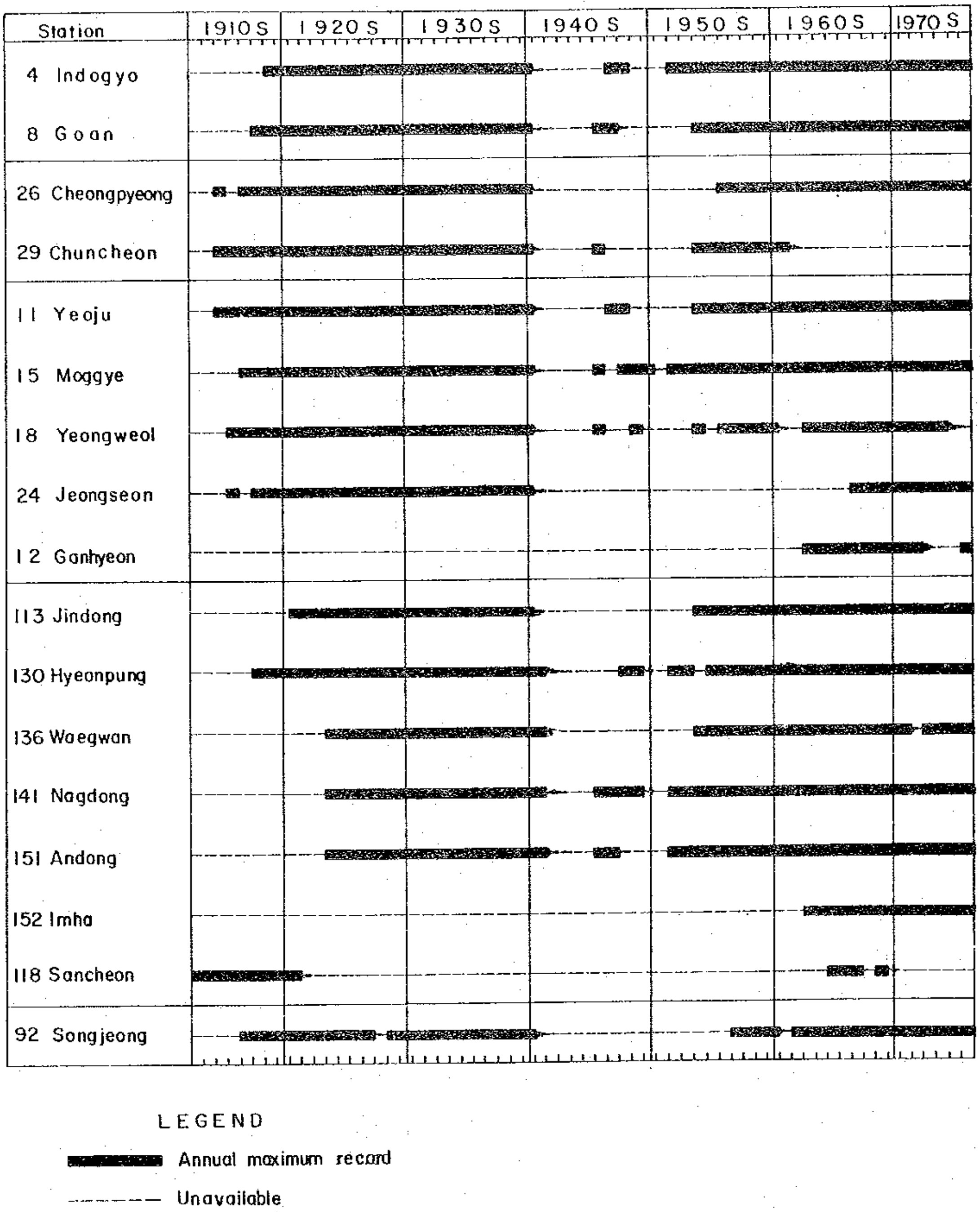

Fig. D 3 Duration of Annual Maximum Water Level Records

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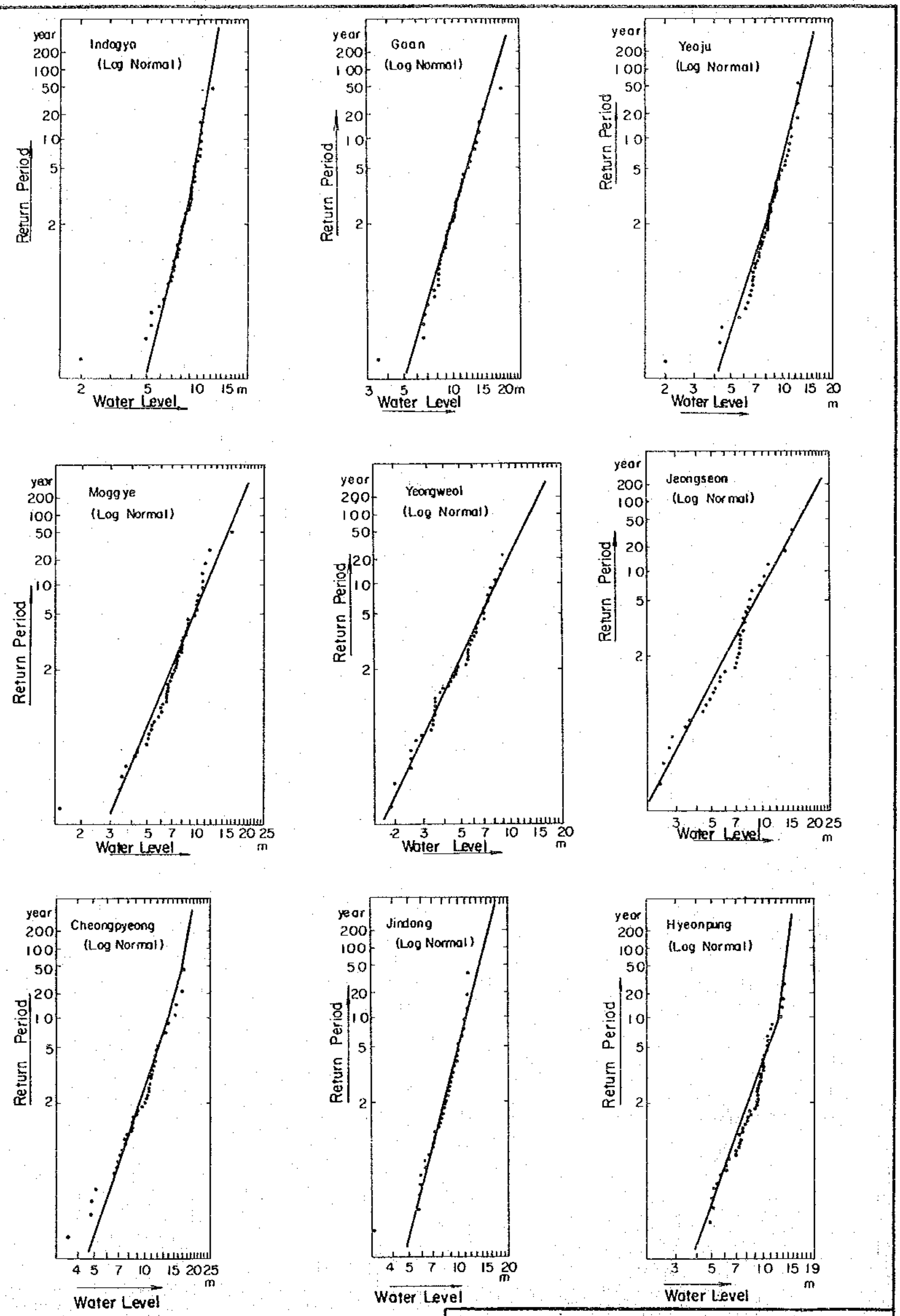

Fig. D 4 Probability Distribution of Annual Maximum Water Level

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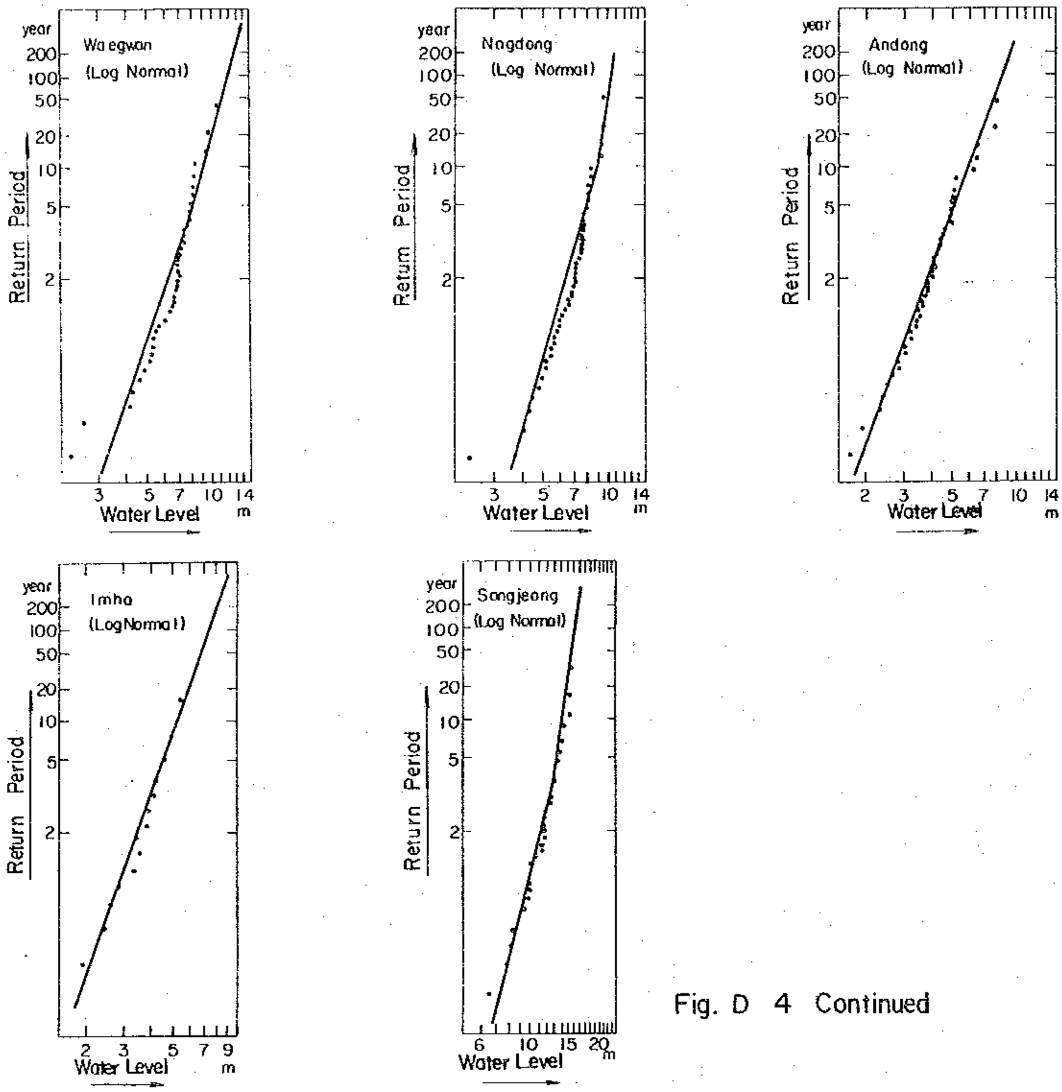

Fig. D 4 Continued

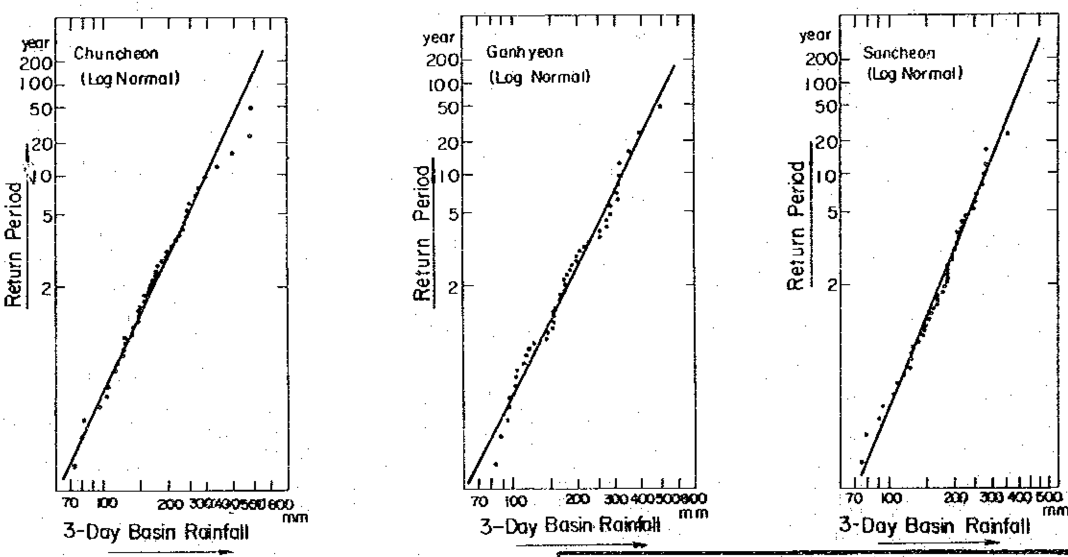

Fig. D 5 Probability Distribution of Annual Maximum 3-DAY RAIN FALL

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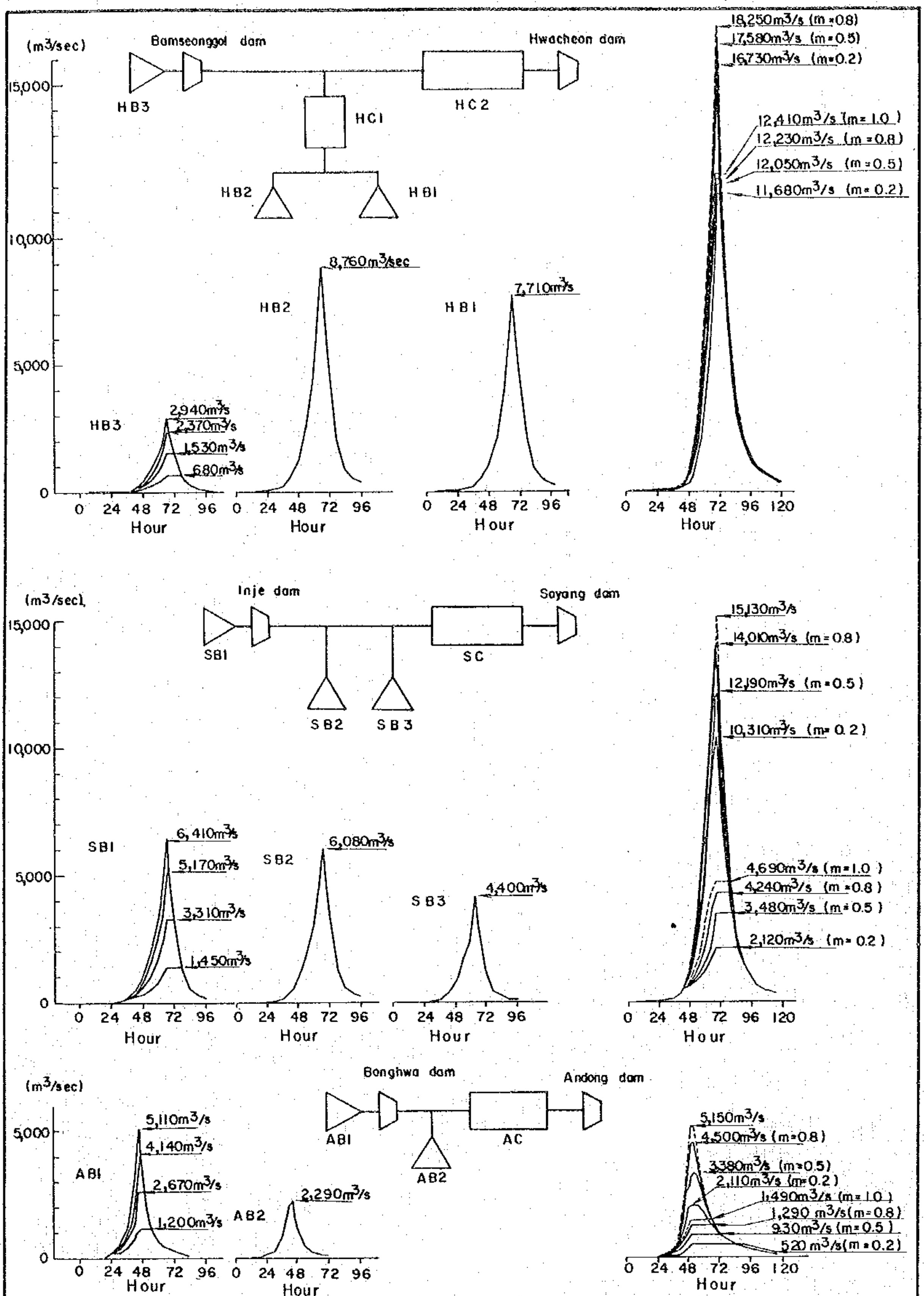

Fig. D 6 Flood Control by Existing Dam Affected by Proposed Dam

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