KINGDOM OF THAILAND
MINISTRY OF AGRICULTURE AND COOPERATIVES
ROYAL IRRIGATION DEPARTMENT

PRE-FEASIBILITY STUDY ON THE SAKAE KRANG RIVER BASIN IRRIGATION PROJECT

ANNEX

MARCH 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

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HYDROLOGY

1. SAKAE KRANG BASIN HYDROLOGY

1.1 Climate

The Sakae Krang river basin is characterized by two pronounced seasons, one dry from November to April, the other wet during the rest of the year. Aerial rainfall distribution in the basin affected by the topography is relatively small. Average annual rainfall ranges from 1,300 mm in the western watershed to 1,000 mm in the eastern plain of the basin, of which about 90% is concentrated during wet season. September is generally the month of haviest precipitation during the prevailing southwest monsoon season.

The temperature differentials within the basin are relatively small. Based on the data at Nakhon Sawan, mean temperature is about 28.5°C. The coolest month is December with the mean monthly temperature of 25.2°C while the hottest one is April with 31.9°C.

The prevailing wind direction over the basin is south and relatively constant during the months of February through October. The average relative humidity varies from 61% to 82% at average annual value is 70% at Nakhon Sawan. Mean annual pan evaporation is 2,089 mm with monthly variations of 260 mm in April and 128 mm in September.

Meteorological station under the Ministry of Communications is located at Nakhon Sawan. Among hydrological gaging stations under the RID within the basin, the stations at Ct-5A, Ct-7 and Ct-9 furnish meteorological data of temperature, evaporation and wind speed. These data are summarized in Table I-1 and Table I-2.

1.2 Rainfall

1.2.1 Rainfall records

Rainfall data are collected from 50 gaging stations located between latitude from 15°-0' N to 16°-15' N and longitude from 99°-0' E to 100°-15' E to cover the whole Sakae Krang river basin. All these stations are operated by RID. Average monthly rainfall is listed in Table I-3. As shown in the Fig. I-1, the distribution of gaging stations is not even. Many stations are located along the Chao Phraya river and downstream of the Sakae Krang Basin. The rainfall stations located within the basin are only 12 in number.

Periods of observation and code number of gaging station are shown in Fig. I-2. Rainfall records are available from 1920 to 1982. Generally speaking, raingage network is thin for the west half or up-stream area of the basin and observation period for these stations are short. Hourly rainfall records are available at station 12081 (CT-5A).

1.2.2 Rainfall characteristics

(1) Average monthly rainfall

Average monthly rainfalls for the 12 stations located within the basin are as follows.

(mm)

Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
67	169	142	130	171	279	159	48	7	8	14	32

Note: 12 stations are 12081, 26072, 26270, 26281, 69012, 69022, 69032, 69042, 69062, 69090, 69110, 69121.

Average annual rainfall of above stations is 1,226 mm. Seasonal fluctuation of rainfall is very large and average monthly rainfall ranges from 7 mm in December to 279 mm in September.

(2) Aerial distribution of rainfall

Aerial distribution of annual rainfall amount is not remarkable. Generally, it can be said that western area has greater amount of rainfall, about 1,300 mm/year and eastern area has about 1,000 mm/year or less.

Within the Sakae Krang basin, distribution is almost even varying from 1,150 mm/year at downstream to 1,350 mm/year at upstream area.

1.2.3 Correlation

Among 50 rainfall gaging stations, 22 stations are selected for the correlation analysis from the standpoint that the stations are located within or adjacent to the Sake Krang river basin and have longer observation period with shorter data missing period. Results of correlation calculation on the monthly rainfall are shown in Table I-4. Most of the stations show correlation rate between 70 to 80%. There is no station which shows extremely low or high correlation rate. It is considered that the rainfall pattern is sufficiently even and raingage record is highly reliable.

1.2.4 Daily rainfall probability

Selecting 19 rainfall gaging stations of having more than 30 years complete observation data, the maximum daily rainfall probability was calculated by the Iwai method and the results are shown in Table I-5 for each stations.

The maximum value of daily rainfall intensity is determined as follows.

Return Period (1/year)	Rainfall Intensity (mm/day)	Rainfall Station (Code No.)
1/5	141.7	69052
1/10	166.4	"
1/20	189.0	"
1/50	217.3	"
1/100	238.0	"
1/200	260.4	12042
1/500	295.7	"
1/1000	323.0	"

Rainfall stations of 69052 and 12042 are located at southern and northern outside of the Sake Krang basin, respectively.

The maximum daily rainfall intensity of 303.3 mm/day was recorded at rainfall gaging station of 04170 on Sep. 28, 1956. This value corresponds to the return period of 1/500 years.

1.3 Streamflow

1.3.1 Streamflow records

There are seven gaging stations within the basin. The locations and periods of runoff observation are shown in Fig. I-1 and Fig. I-3. The station CT-5A on the Mae Wong river is equipped recently with the automatic water level recorder which is being operated by IRD. Other stations are equipped with the staff gages and operated by RID. All these stations are rated by current matter measurements, where river stage versus discharges are plotted to establish rating curves every year. These rating curves are used to convert daily gage height readings to daily discharges. Records of monthly runoff at CT-5A, CT-7 and CT-9 are summarized in Table I-6.

(1) Reliability of runoff records

Double mass curves of the recorded river runoff and rainfall are shown in Fig. I-4. The curves for the stations of CT-3, CT-4, CT-6 and CT-8 show large fluctuations of runoff rate, which indicates the disturbance of irrigation water intake at upstream of these stations. The curve of the CT-7 station shows minor fluctuation in the runoff rate over the observation period. The runoff data at stations of CT-5A and CT-9 are considered fairly accurate for the watershed runoff analysis since they show relatively constant runoff rate in the double mass curve over the observation period.

1.3.2 Streamflow characteristics

Streamflow in the Sakae Krang basin is characterized by large fluctuation of runoff amount between dry and wet seasons and by small runoff rates throughout the year. Runoff record of CT-7 gaging station at downstream of the proposed Khlong Pho dam shows often zero runoff in April. In an extremely dry year of 1977 water year, the CT-7 recorded zero runoff for successive 3 months from February until April.

The average annual runoff rates during observation period are about 15 to 27%.

Name of River	Observation Period	Average Annual Runoff Rate	Gaging Station
Mae Wong	1970/1982	0.271	CT-5A
Khlong Pho	1975/1982	0.212	CT-7
Thap Salao	1977/1982	0.151	CT-9

It is considered that the vegetation coverage and geological condition of watershed affect considerably to the average runoff rate of these rivers. Watershed of the Mae Wong river is covered by comparatively thick forest and alluvial or diluvial deposit is not formed within the drainage area of CT-5A. On the contrary, in the watersheds of CT-7 and CT-9, the forest cover is rough and thin and alluvial or diluvial sand layers are widely formed within the drainage area.

1.4 Sedimentation

Sediment load is one of the major factors to define the reservoir dimension. Sediment inflow is usually calculated from bed load and suspended load. As for the bed load inflow estimation, data on the gradation analysis on the river bed material are available at CT-5A of the Mae Wong river. Conditions and assumption for bed load calculations are as follows.

1. Analysis point : CT-5A
   Drainage area : 936 km^2
2. Gradiation analysis : 9 samples
   Existing data : 8 samples
   Additional analysis : 1 sample
3. River cross section : Rectangular shape, width 90 m
4. River roughness coefficient : n = 0.035
5. River discharge rating curve of 1983 is to be applied.
6. Specific gravity of bed load: 2.68
7. Average 65% grain size : 0.86 mm
8. Formula applied : Sato, Kikkawa, Ashida formula

$$q\beta \cdot \left(\frac{\sigma}{\rho} - 1\right) \cdot g = U_*^3 \cdot \phi \cdot f \cdot \left(\frac{\tau o}{\tau c}\right)$$

where $q\beta$: bed load per unit river width per unit hour, expressed by volume (m^3/sec/m)

τc: critical tractive force

$\phi = 0.623\left(\frac{1}{40n}\right)^{3.5}$ for $n \leq 0.025$

$\phi = 0.625$ for $n \geq 0.025$

Based on the gradation analysis and the calculation of $q\beta$ (m^3/sec/m), the relation between bed load $Q\beta$ (t/day) and the corresponding average river discharge Q (m^3/sec) is plotted in log-log scale as shown in Fig. I-5 and it is expressed by following formula.

$$Q\beta = 2.02 \times 10^{-2} \times Q^{1.77}$$

where $Q\beta$: Bed load t/day

Q: Average river discharge m^3/sec

As for the suspended load, 49 samples of suspend load are available during June, October and November, 1983. Same procedures as applied for the bed load were taken and the relation between the suspended load and the river runoff discharge is expressed as follows.

$$Qs = 1.34\ Q^{1.83}$$

where Qs: Suspended load t/day

Q: Average river discharge m^3/sec

In order to calculate the average total sediment inflow, the year of 1978 is selected as the representative average year from 1969 to 1982. Applying daily discharge at CT-5A in 1978, the sediment inflow per year is calculated.

Bed load	2,026 t	0.8 $m^3/km^2/yr$
Suspended load	178,951 t	71.3 $m^3/km^2/yr$
Total		72.1 $m^3/km^2/yr$

Bed load is considered too small, which may be becuase of shortage of available data. In application of this result to the design of reservoir, appropriate safety measurement should be considered.

1.5 Water Quality

According to the "United State Department of Agriculture", the irrigation water quality is classified into four grades with respect to the sodium hazard (S1-S4) depending on the sodium-absorption ratio (SAR) and the salinity hazard (C1-C4) depending on the electric conductivity (EC). Results of water quality analysis on the samples taken from each dam sites are summarized in Table I-7. All samples are classified into C1-S1 class except the sample from the Khlong Pho dam site which is classified into C2-S1. Based on this quality analysis, the river waters are all within the tolerable limit and suitable for irrigation. In fact, no adverse effects have been reported by using the river water for irrigation during past years.

Among other items of quality analysis, high PH values for all rivers and high Ca contents for the Khlong Pho river are noted. It will be necessary to investigate the existence of lime stone within drainage areas of proposed dam sites.

2. RUNOFF ANALYSIS

2.1 Methodology for Analysis

Observation periods of river runoff are limited only for 6 to 13 years at CT-5A, CT-7 and CT-9 within the Sakae Krang river basin. Required runoff records for the water balance analysis are for about 30 years or more. Longterm runoff analysis is necessary to generate the streamflow from rainfall records.

(1) Runoff model

Correlation analysis was firstly tried between river runoff and rainfall records, but did not show applicable results. Because the analysis does not meet with the seasonal base flow fluctuation especially during dry season. Tank model analysis is then executed.

(2) Runoff record

The runoff records utilized for the analysis are at CT-5A, CT-7 and CT-9 for generation of runoff models at the Mae Wong, the Khlong Pho and the Thap Salao rivers, respectively. Because runoff records at these stations show high reliability based on the double mass curve analysis.

(3) Rainfall record

As for the rainfall to be applied for the model and to generate the longterm runoff, the Thiesen polygon method was used among 4 stations of 63042, 12081(CT-5A), 26281(CT-7) and 69121/19092(CT-9). The distances between these stations are so far that the polygon becomes too large to devide the drainage area. So that the polygon compornents are formed by only one or two rainfall stations.

Three tank models are analysed under the combination of following runoff and rainfall records. Basic unit period for analysis was selected at 10 days.

River	Runoff Record	Rainfall Record	Drainage Area
Mae Wong	CT-5A	63042/12081	936 km^2
Khlong Pho	CT-7	26281/12081	403 "
Thap Salao	CT-9	69090/69121	541 "

Note: Stations 69090 and 69121 are located at almost same location but observation period is different.

2.2 Runoff Model

Tank model is composed of a series of storage tanks and runoff outlets at each tanks. For the analysis of the said rivers, a model of four storage tanks is introduced. Second tank has no runoff outlets but works to give lag time in the runoff calculation.

Simulation calculations were conducted by computer until obtaining adequate accuracy between the observed streamflow records and calculated runoff. The results of calculations and determined models are shown in Table I-8, Fig. I-6 and Fig. I-7. It should be noted that the tank model determined for the Mae Wong river at CT-5A has no outlet in the basement of the forth tank. While other two models for the Khlong Pho and Thap Salao rivers have outlet holes in the basement of fourth tank. This indicates the existance of permeable layers in the drainage areas for these two rivers. In the course of tank model calculation, the evaporation data was adopted from the ovservation at Nakhon Sawan.

2.3 Streamflow Generation

(1) Rainfall generation

In the absence of longterm runoff records required for the reservoir operation study, it is necessary to generate the streamflow by applying tank models. Prior to the streamflow generation, the rainfalls have to be generated for the period of no rainfall observation. Based on the results of rainfall correlation analysis, following stations were selected to supplement the deficit of data. Simulated rainfalls are shown in Table I-9.

Rainfall Station	Supplemental Station	Correlation Rate	Tank Model
63042	69022	0.68	Mae Wong River
12081	12042	0.81	Mae Wong River
26281	69022	0.78	Khlong Pho River
69121	26072	0.78	Thap Salao River
69092	26072	0.76	Thap Salao River

(2) Streamflow generation

Streamflow generation was conducted for the period of 29 years from 1954 to 1982. The results of simulation are shown in Table I-10.

3. FLOOD ANALYSIS

3.1 Methodology for Analysis

Purposes of flood analysis is to define the design flood for dam spillway and to clarify the effect of flood control by reservoir.

A large volume of water behind a dam could cause considerable damage to property and loss of life, if the impounded water is suddenly released in case of failure of the dam. Flood studies therefore, particularly the selection of inflow design flood to size the spillway and surcharge storage is of importance in the design of large dams.

The derivation of the inflow design flood for the proposed dams consists of the determination of a design storm estimated from enveloping observed maximum flood for various drainage area, rational formula adopted for probable point rainfall in the region and from the unit hydrograph study. Comparing the amount of flood derived from the above three methods, the maximum flood value is applied as the spillway design flood.

3.2 Design Flood for Dam

3.2.1 Creager envelope

The annual maximum flood discharge records were collected from 8 gaging stations in the Sakae Krang river basin and 60 gaging stations in 6 river basins in the Central Chao Phraya Plain. These rivers are the Yom, the Nam, the Mae Klong, the Ping, the Pasak and the Chao Phraya rivers. The collected data are listed in Table I-11.

The specific discharges ($m^3/sec/km^2$) of the maximum floods for each station versus drainage area are plotted in log-log scale as shown in Fig. I-8. The envelope to cover the whole flood points gives the Creager's envelope expressed as follows.

$$q = C \times A^{(A^{-0.04} - 1)}$$

where q: Specific discharge ($m^3/sec/km^2$)

C: Coefficient 9.0

A: Drainage area (km^2)

Evaluating from the range of floods collected as shown in Fig. I-8, the above curve will be adoptable for the drainage area between 300 km^2 and 10,000 km^2. The design floods calculated by this formula for proposed dam sites are as follows.

Dam	DA (km^2)	q ($m^3/sec/km^2$)	Design Flood (m^3/sec)
Upper Mae Wong	612	2.11	1,290
Lower Mae Wong	930	1.75	1,630
Khlong Pho	394	2.53	1,000
Huai Rang	76	4.52	340
Upper Huai Rang	41	5.39	220
Khun Kaew	162	3.53	570
Lower Khun Kaew	219	3.17	700

3.2.2 Flood probability

Flood probability was also analysed for annual maximum flood recorded in the Sakae Krang Basin. Among gaging stations in the basin, CT-7 gaging station having drainage area of 403 km^2 gives maximum flood scale for each return period. The number of samples utilized for probability calculation is only 7 at CT-7 and as many as 14 at CT-5A, therefore, the accuracy will be limited within for shorter return period. The results of probability calculations are shown in Table I-12. Taking the results on CT-7 from Table I-12, the calculated floods with different return periods are shown below.

(Unit: m^3/sec)

Dam	Return Period		
	1/10	1/100	1/200
Upper Mae Wong	480	1,010	1,210
Lower Mae Wong	730	1,530	1,830
Khlong Pho	310	650	780
Huai Rang	60	130	150
Upper Huai Rang	30	70	80
Khun Kaew	130	270	320
Lower Khun Kaew	170	360	430

3.2.3 Rational formula

Rational formula was applied to derive a peak flood discharge from the rainfall intensity with different probability.

$$q = \frac{1}{3.6} \times f \times Re$$

where q : specific discharge ($m^3/sec/km^2$)

f : runoff rate 0.8

Re: rainfall intensity within concentration time (mm/hr)

$$Re = \frac{R24}{24} \times \left(\frac{24}{Tp}\right)^n$$

where R24 : daily rainfall (mm/day)

Tp : flood concentration time (hr)

n : coefficient

$$Tp = C \times A^{0.22} \times Re^{-0.35}$$

where C : coefficient 800

A : drainage area (km^2)

Daily rainfall intensity R24 with different probability was obtained from probability calculations of the 19 raingage stations having more than 30 years of records out of 50 gaging stations in and around the basin. The results are presented in Table I-5. Coefficients C and n are obtained from hourly and daily rainfall and river discharge records converted from automatic water level gagings at CT-5A, as shown in Fig. I-9 and Fig. I-10. Probable floods calculated by these formulae are summarized in Table I-13. Selecting several representative return periods from the Table I-13, the calculated floods by the rational formula are summarized as follows.

(Unit : m^3/sec)

Dam	Return Period		
	1/10	1/100	1/200
Upper Mae Wong	857	1,334	1,481
Lower Mae Wong	1,237	1,962	2,167
Khlong Pho	587	894	989
Huai Rang	140	201	220
Upper Huai Rang	82	115	125
Khun Kaew	271	400	439
Lower Khun Kaew	355	526	578

3.2.4 Unit hydrograph

(1) Hourly data

Hourly rainfall and river runoff data are available from automatic gaging recorders equipped at CT-5A station. Analysing these hourly data, folloiwng 5 flood patterns are selected to choose greater rainfall intensity and larger total rainfall.

No.	Flood	Peak Rainfall (mm/hr)	Total Rainfall (mm)	Runoff Height (mm)
1.	Jul. 7, 1980	43.4	43.6	0.5
2.	Jul. 31 - Aug. 1, 1980	58.0	63.1	1.6
3.	Aug. 8 - 9, 1981	40.0	72.2	0.5
4.	Nov. 7 - 8, 1981	29.0	164.7	112.0
5.	Oct. 11 - 12, 1983	23.6	82.8	139.0

Among these flood patterns, the flood on Nov. 7 - 8, 1981 shows good correlation between fainfall and runoff pattern and has the largest total rainfall. For the analysis of unit hydrograph, therefore, the representative flood pattern was selected to be of Nov. 7 - 8, 1981 flood.

(2) Formula

Following unit hydrograph formulae derived by Dr. Nakayasu are adopted for the analysis,

$$Qp = \frac{0.2778 \times A \times RO}{0.3 \times tp + tk}$$

$$\frac{Q}{Qp} = \left(\frac{t}{tp}\right)^{2.4} \qquad \text{for } t = 0 \text{ to } t = tp$$

$$\frac{Q}{Qp} = 0.3^{(t-tp)/tk} \qquad \text{for } t = tp \text{ to } t = tp + tk$$

$$\frac{Q}{0.3 \times Qp} = 0.3^{\{t-(tp+tk)\}/(1.5+tk)}$$

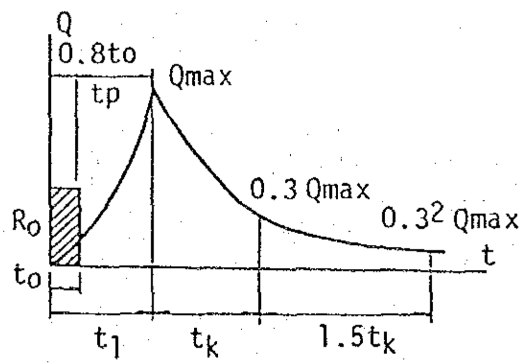
for t = tp + tk to t = tp + 2.5 = tk

$$\frac{Q}{0.3^2 \times QP} = 0.3^{\{t-(tp+tk+1.5xtk)\}/(2.0xtk)}$$

for more than t = tp + 2.5 x tk

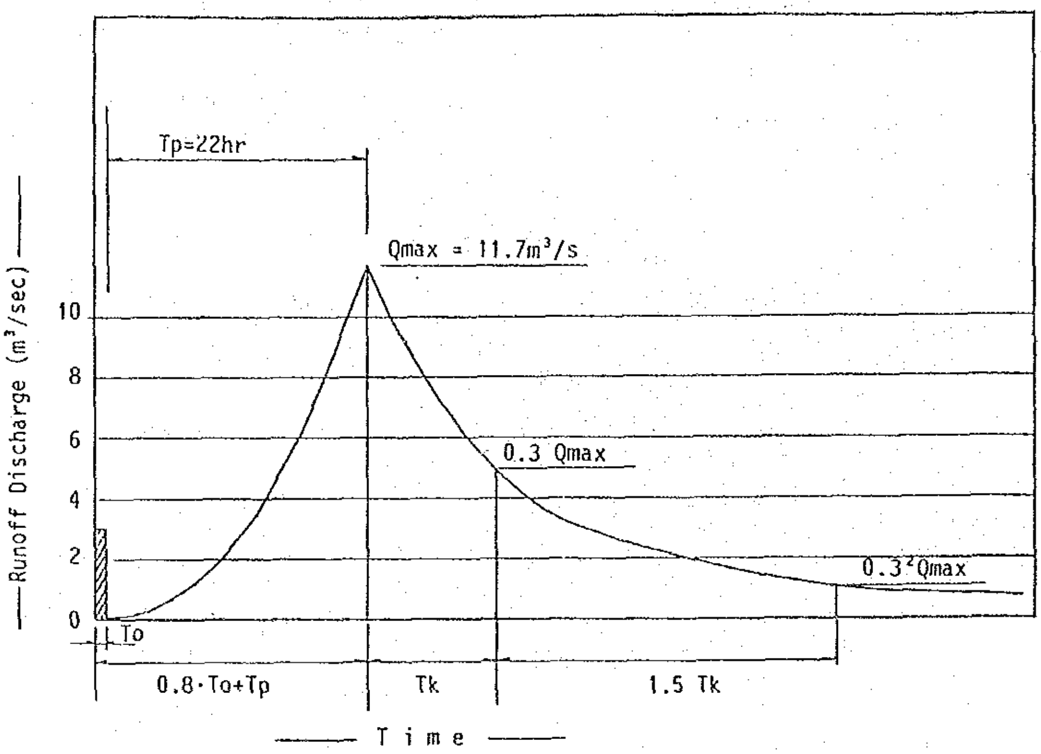
$tk = TG \times \alpha$

where,
A : Drainage area (km^2)
Ro : Unit rain (mm) for the unit duration (hr)
tp : Basic lag (hr) from the beginning of rain to the peak of unit hydrograph
tk : Period (hr) from the peak to the time of $Q = 0.3 \times Qp$
TG : Lag time (hr)
α : Coefficient



(3) Unit hydrograph

Based on the relations between peak flow and peak rainfall intensity on the hourly streamflow and rainfall data, the lag time TG is assumed at 22 hr and coefficient α is taken at 0.7. Calculated flood curve and recorded flood on Nov. 7 - 8, 1981 are shown in Fig. I-11 and Table I-14. The obtained unit hydrograph is as follows.



(4) Calculation of 200-year flood

For the calculation of 200-year flood by unit hydrograph, daily rainfall intensity of 260 mm/day is applied as it has 200-year probability as shown in Table I-5. The daily rainfall of 260 mm/day is then distributed into hourly intensity to form hourly rainfall pattern in accordance with the following 2 cases.

Case 1 Proportionally distributed to the recorded rainfall pattern on Nov. 7 - 8, 1981

Case 2 Hourly rainfall pattern having peak rainfall intensity at the end of rainfall.

Hourly Rainfall Distribution (mm/hr)

Case	1	2	3	4	5	6	7	8	9	10	11	12
Nov.7-8	9.2	4.8	11.4	0	0	1.2	3.0	0	0	0	0	0
1	15.8	8.2	19.2	17.8	0	0	2.1	5.1	0	0	0	4.6
2	7.2	7.3	7.4	7.7	7.8	8.0	8.3	8.5	8.7	9.2	9.5	9.8

Case	13	14	15	16	17	18	19	20	21	22	23	24
Nov.7-8	13.6	16.1	1.8	29.0	5.2	3.8	1.8	6.2	10.8	6.8	4.5	9.5
1	23.3	27.7	3.1	49.8	8.9	6.5	3.1	10.6	18.5	11.7	7.7	16.3
2	10.6	11.2	11.8	13.8	15.5	18.5	31.9	12.6	10.2	8.9	8.1	7.5

Flood calculations are shown in Table I-15 and Fig. I-12. The results are summarized as follows.

Case	Peak Flood ($m^3/sec/km^2$)
1	1.49
2	1.50

The peak specific flood discharge of 1.50 $m^3/sec/km^2$ is applied for spillway design flood.

3.2.5 Design flood for dam

(1) Spillway design flood

Spillway design flood is determined by selecting maximum peak flood scale among several floods derived from various methods. As for the flood probability, 200-year return period is adopted. Comparison of flood scale is made in terms of specific discharge ($m^3/sec/km^2$) as follows. Flood derived from rational formula gives the maximum flood scale.

Dam	Drainage Area (km^2)	Peak Flood ($m^3/sec/km^2$)			
		(1)	(2)	(3)	(4)
Upper Mae Wong	612	2.11	1.98	2.44	1.50
Lower Mae Wong	930	1.75	1.98	2.33	1.50
Khlong Pho	394	2.53	1.98	2.51	1.50
Huai Rang	76	*	1.98	2.89	1.50
Upper Huai Rang	41	*	1.98	3.04	1.50
Khun Kaew	162	*	1.98	2.71	1.50
Lower Khun Kaew	219	*	1.98	2.64	1.50

(1) Creager envelope

(2) Flood probability (200-year) at CT-7

(3) Rational formula (200-year)

(4) Unit hydrograph

* Creager envelope is effective for drainage area of 300 to 10,000 km^2

(a) Recorded maximum daily rainfall

The daily rainfall intensity applied for the calculation of 200-year flood by rational formula is 260 mm/day which is derived from probability calculation on the raingage station 12042. The recorded maximum daily rainfall intensity is 303 mm/day at raingage station 04170 which has 21 years of observation period and is located outside of the Sakae Krang basin, about 110 km and 64 km away from the Lower Mae Wong and Lower Khun Kaew dam sites, respectively. The value of 303 mm/day is equivalent to the rainfall probability scale of about 500-year return period. The flood derived from 303 mm/day rainfall intensity by rational formula is as follows.

Flood by Recorded Maximum Rainfall

Dam	A (km^2)	Re (mm/hr)	q ($m^3/sec/km^2$)
Upper Mae Wong	612	12.9	2.87
Lower Mae Wong	930	12.5	2.78
Khlong Pho	394	13.3	2.96
Huai Rang	76	14.9	3.31
Upper Huai Rang	41	15.6	3.47
Khun Kaew	162	14.1	3.13
Lower Khun Kaew	219	13.9	3.09

(b) Spillway design flood for concrete dam

Flood derived from the recorded maximum rainfall gives greater values of specific discharge than those derived from the 200-year rainfall intensity. The spillway design flood for concrete dam is determined as follows.

Dam	Drainage Area (km^2)	Specific Discharge ($m^3/sec/km^2$)	Spillway Design Flood (m^3/sec)
Upper Mae Wong	612	2.87	1,760
Lower Mae Wong	930	2.78	2,590
Khlong Pho	394	2.96	1,170
Huai Rang	76	3.31	250
Upper Huai Rang	41	3.47	140
Khun Kaew	162	3.13	510
Lower Khun Kaew	219	3.09	680

(c) Spillway design flood for fill-type dam

In case of fill-type dam, the flood over topping from the dam crest is considered more serious than in case of concrete dam. The spillway design flood is taken to be 20% increased from the 200-year flood obtained by rational formula. The spillway design flood is then determined as follows.

Dam	Drainage Area (km^2)	Specific Discharge (1) ($m^3/sec/km^2$)	(2)	(3)	Spillway Design Flood (m^3/sec)
Upper Mae Wong	612	2.87	2.44	2.90	1,770
Lower Mae Wong	930	2.78	2.33	2.80	2,600
Khlong Pho	394	2.96	2.51	3.01	1,190
Huai Rang	76	3.31	2.89	3.47	260
Upper Huai Rang	41	3.47	3.04	3.65	150
Khun Kaew	162	3.13	2.71	3.25	530
Lower Khun Kaew	219	3.09	2.64	3.17	69-

Where (1) : Derived from 303 mm/day

(2) : Derived from 260 mm/day

(3) : (2) × 1.2

3.3 Flood Control

3.3.1 Flood damage

Data on the flood damages caused by the floods in 1981 and 1983 were obtained from provincial offices at Nakhon Sawan and Uthai Thani and are summarized in Tables I-16 and I-17. In Nakhon Sawan province, damaged sub-districts are Mae Lae, Huai Nam Horm, Wang Sarn and Muban Lat Yao in case of November, 1981 flood. Four persons were lost in Lan Sak and Muban Uthai Thani District in 1981. Five persons were lost in Sawang Arom, Lan Sak and Thap Than District in 1983. The number of damaged houses are 58 in 1981 and 134 in 1983.

In case of November, 1981 flood, 310,000 rais of farm lands (7% of the total area of Uthai Thani Province) were flooded and 70,000 rais of them were damaged. In case of 1983 floods, 151,000 rais of farm land were damaged. Public facilities such as roads, bridges, weirs, government offices, temples, etc. were also damaged.

Although every district gets flood damages, three districts (Lan Sak, Sawang Arom and Thap Than) seem to have heavier damages. They are surrounded by Khlong Pho and Thap Salao Rivers.

To repair the flood damages in 1983, the Uthai Thaini Provincial Office had, at first, spent about 1.2 million Baht from its temporary reserve and later spent about 18.0 million Baht, which was granted by the Local Administrative Department.

3.3.2 Flood control

Flood control is not primary purpose for the Project, however, it is realized that incidental flood control could be attained from the operation of the reservoir especially with such floods which occur in the early part of wet season. Based on the reservoir operation simulation discussed in Annex V, flood control effects were studied through the comparison of with reservoir and without reservoir conditions.

The results of study are summarized in Table I-18. In case of the Upper Mae Wong dam, simulation of reservoir operation from 1954 to 1981 shows that there is no spillout from the reservoir for 15 years out of 28 years except for irrigation purpose. When the reservoir is at full storage level, the spillout occurs, however, the annual peak flood scales are considerably reduced as it is shown in the comparison of the annual maximum and second maximum flood for the conditions of with and without reservoir.

In other expression, about 146 MCM/year, 74% of average total annual inflow of 196.3 MCM/year is regulated by the reservoir and the maximum flood scale will be reduced into 79% in case of the Upper Mae Wong dam. These are summarized as follows.

Dam	Ave. Annual Inflow (MCM/yr)	Regulated by Dam (MCM/yr)	Regulated Percent (%)	Ave. Max. Flood (m^3/sec)	Max. Flood with Dam (m^3/sec)	Reduced Percent (%)
Under Mae Wong	196.3	146.0	74	38.4	30.4	21
Lower Mae Wong	298.3	229.0	77	58.3	45.8	21
Khlong Pho	87.3	46.3	53	19.7	18.1	8

4. WATER RESOURCES

4.1 Available streamflow

The average annual discharges at upstream watershed of the Mae Wong river (CT-5A), the Khlong Pho river (CT-7) and the Thap Salao river (CT-9), were estimated from the actual runoff records and generated streamflow by tank models. The runoff discharges are summarized as follows.

Results of Runoff Analysis (1954-1982)

River	Station	Average Basin Rainfall (mm)	Average Annual Discharge (MCM/km^2)	Average Runoff Rate (%)
Mae Wong River	CT-5A	1,294.6	0.316	24.4
Khlong Pho River	CT-7	1,283.5	0.217	16.9
Thap Salao & Khok Khwai Rivers	CT-9	1,346.5	0.231	17.2

The Mae Wong river is known to be effluent streams which continues to flow even during extremely dry periods. The upper portion of the Mae Wong river watershed is extensively forested while the watershed forest of other rivers are relatively thin.

Monthly river runoff simulated by runoff models are summarized as follows.

Average Monthly River Runoff (1954-1982)

(Unit: 1,000 m^3/km^2)

River	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Mae Wong	2.4	9.6	18.7	18.0	31.8	73.3	103.2	36.2	11.2	5.8	3.5	2.7
Khlong Pho	0.6	3.0	12.7	16.1	19.4	51.3	70.7	29.9	5.9	3.4	2.3	1.6
Thap Salao	1.9	4.4	11.5	12.7	16.1	48.7	90.4	29.5	5.9	4.3	3.3	2.6

The river runoff is characterized by long low flow period from December to July. Reliable amount of water resource supplied by the river is limited only during four months from August to November. About 80% of total annual runoff occurs during these months.

4.2 Groundwater

Flat and low lying area at downstream of the basin is formed by the alluvial deposits consisting of loose to unconsolidated layers of sand, gravel, silt and clay. Average thickness of the alluvial deposits is approximately 50 m above foundation rocks. Of these, sand and gravel layers are potential aquifer of groundwater. At present, no data are available on the productive capacity of the groundwater in the whole basin, however, the preliminary study was conducted by the RID during 1973 to 1978. The study covers the area bounded latitude between N-15-15-00 and N-15-45-00, longitude between E-99-45-00 and E-100-15-00.

4.2.1 Classification of groundwater zone

Based on the results of test wells and experimental bore holes and assuming from the geological formation of the basin, the groundwater is approximately classified into four zones as shown in Fig. I-13. The data on test wells and bore holes are summarized in Table I-19.

Zone I — Unconsolidated aquifer in active flood plain located along right side of the Chao Phraya river and consists of sand and gravel. Groundwater yield tests show the yield of more than 2.3 cum/min.

Zone II — Low terrace of the Sakae Krang basin and unconsolidated aquifer, located adjacent to the Zone I.

Zone III — High terrace of the basin consists of sand lens interbedded with silty clay. Yield is about 0.1-0.2 cum/min. It is located along the right side of the Sakae Krang river.

Zone IV — Semi-consolidated rocky pediment consists of lateritic soil and clay. No groundwater potential.

4.2.2 Groundwater flow and potential productivity

The downstream area of the basin is a part of vast flood alluvial plain of the Chao Phraya river. The groundwater flows from north to south along the Chao Phraya river, supplemented by the flow from the western watershed. The groundwater flow is partly blocked by massive rocks of quartz feldspathic tuff rising in the plain. Figure I-13 shows the estimated flow directions of groundwater.

The potential productivity of the groundwater is roughly estimated from each zone assuming the effective void ratio of aquifer at 0.2 and average thickness from the data on test wells and experimental bore holes.

Zone	Average Thickness (m)	Unit Productivity (MCM/sq.km)
I	37	7.5
II	20	4.0
III	14	2.8

4.2.3 Groundwater quality

Chemical analysis on the samples obtained form the bore holes were conducted in the said study. It should be noted that 18 samples out of 53 were found unsuitable because of excessive of electric conductivity and sodium absorption ratio. Certain correlations or tendency on the depth or locations among these samples of unsuitable quality is not determinable as the number of samples are not sufficient. It is necessary to continue the observation on the seasonal variation of groundwater quality to clarify the potential productivity for irrigation.

Table I-1 METEOROLOGICAL DATA FOR THE PERIOD 1951-1980 AT NAKHON SAWAN

Lat 15-48 N
Long 100-10 E

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Temperature (°C)													
Mean	25.6	28.3	30.7	31.9	30.6	29.6	29.0	28.5	28.0	27.9	26.7	25.2	28.5
Mean Max	32.2	34.5	36.7	37.9	36.1	34.5	33.8	33.1	32.2	32.0	31.5	31.1	33.8
Mean Min	17.7	21.0	23.7	25.3	25.1	24.7	24.3	24.1	23.9	23.5	21.0	18.2	22.7
Ext Max	37.0	39.8	41.2	42.5	42.7	41.0	38.9	37.8	36.3	35.9	35.7	35.8	42.7
Ext Min	6.1	12.0	14.2	17.0	20.3	21.4	20.9	20.9	20.4	18.4	11.9	8.2	6.1
Relative Humidity (%)													
Mean	63.0	62.0	61.0	61.0	70.0	74.0	75.0	78.0	82.0	80.0	73.0	67.0	70.0
Mean Max	87.3	86.9	87.3	86.5	89.1	90.5	91.5	92.9	95.5	94.7	92.4	89.9	90.4
Mean Min	41.3	40.3	39.1	40.8	51.2	56.6	58.4	62.0	66.4	63.3	53.9	45.9	51.6
Dew-Point (°C)													
Mean	17.1	19.3	21.2	22.7	23.8	23.9	23.8	24.0	24.4	23.7	20.8	17.9	21.9
Evaporation (mm)													
Mean - Pan	150.6	174.9	232.8	260.3	218.9	184.1	174.3	153.2	127.7	138.8	132.8	140.5	2088.9
Wind (knots)													
Prevailing wind	E	S	S	S	S	S	S	S	S	S	E	N	-
Mean wind speed	3.7	4.8	6.3	6.4	5.4	5.5	5.0	4.4	3.2	3.0	3.4	3.5	-
Max wind speed	33NE	58S	62N	60N	70S	50S	52S	45SSW	65N	54NE	27NW	27E	70S
Sunshine Duration (hr)													
Mean	264.1	242.9	249.0	259.2	243.0	186.2	174.2	169.0	158.7	228.6	256.8	275.5	2707.2
Cloudiness (0-8)													
Mean	3.0	3.3	3.3	4.0	5.6	6.4	6.7	6.9	6.6	5.4	4.2	3.4	4.9

Table I-2 METEOROLOGICAL DATA AT CT5-A , CT-7 and CT-9

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Temperature (° C)													
Mean													
CT-5A(1969～1983)	20.6	22.3	24.9	27.0	26.9	26.1	26.3	25.9	25.5	24.8	22.9	21.0	24.5
CT-7 (1975～1983)	21.5	24.3	27.8	29.0	30.3	28.0	27.8	27.3	26.9	25.6	22.7	20.8	26.0
CT-9 (1977～1983)	22.1	24.2	26.4	29.1	28.3	27.5	27.5	27.1	26.4	24.9	23.3	21.2	25.7
Wind (km/hr)													
Mean Wind Speed													
CT-5A(1973～1983)	1.08	1.46	1.67	2.00	1.91	1.43	1.30	1.06	0.98	0.90	0.83	0.96	1.30
CT-7 (1975～1983)	0.75	0.87	1.44	1.74	1.95	1.12	1.32	1.21	0.79	0.58	0.55	0.62	1.08
CT-9 (1977～1983)	0.97	1.37	1.85	2.11	2.60	1.51	1.93	2.01	1.15	0.85	0.79	0.91	1.50
Evaporation (mm)													
Mean - Pan													
CT-5A(1973～1983)	83.7	89.5	117.3	130.8	120.3	93.4	91.8	75.4	80.7	79.8	75.6	79.2	1,117.5
CT-7 (1975～1983)	77.8	89.0	120.8	136.4	127.9	107.8	122.1	103.5	91.8	88.2	76.6	73.8	1,215.7
CT-9 (1977～1983)	80.1	90.9	124.4	131.9	136.8	90.3	95.6	84.8	70.4	67.5	65.1	74.1	1,111.9

Table I-3 (1) AVERAGE MONTHLY RAINFALL AND MAXIMUM DAILY RAINFALL

Code	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total	Maximum Daily Rainfall
04012	56.3	137.9	92.8	122.0	147.0	278.3	175.6	24.5	3.6	4.2	5.8	41.1	1,088.9	144.1 (Oct. 3, 1959)
04022	53.6	129.4	110.5	120.5	133.2	250.7	129.6	20.8	1.9	4.4	9.5	29.4	1,007.2	200.7 (May 5, 1954)
04032	66.4	119.0	94.9	113.2	129.7	250.8	130.9	24.0	2.0	4.4	16.9	33.3	1,003.3	137.8 (Oct. 18, 1952)
04042	68.2	115.9	119.8	104.7	139.0	243.0	133.6	29.0	5.4	7.6	23.1	32.2	1,017.9	242.5 (Apr. 8, 1946)
04052	53.6	123.8	105.2	97.0	138.2	255.0	132.2	31.8	4.8	9.9	18.0	25.9	1,003.2	240.0 (Apr. 8, 1946)
04062	68.8	122.0	102.5	126.1	149.3	261.6	144.5	30.3	6.8	9.2	17.1	34.0	1,073.3	195.9 (Apr. 27, 1979)
04080	68.0	141.5	95.3	138.3	167.0	281.5	135.1	30.8	9.4	11.6	18.6	42.3	1,131.7	142.2 (Sep. 18, 1972)
04100	49.2	94.3	85.0	119.8	132.9	279.6	140.9	32.6	6.7	9.2	8.9	36.5	996.5	142.5 (Oct. 6, 1966)
04110	45.6	131.4	94.7	122.4	139.0	288.8	139.7	31.2	10.4	8.0	9.9	32.0	1,050.5	147.2 (Oct. 6, 1966)
04120	59.0	115.8	82.8	126.8	143.4	298.6	148.4	33.0	12.7	7.1	13.5	38.7	1,076.7	174.6 (Sep. 18, 1972)
04130	59.6	99.9	87.3	137.6	136.0	279.9	139.3	32.8	8.6	14.2	13.1	27.2	1,041.9	167.8 (Oct. 6, 1966)
04140	48.2	109.5	95.2	136.7	136.6	284.1	132.0	33.9	6.5	5.1	10.1	23.9	1,021.5	155.6 (Oct. 6, 1966)
04150	56.6	97.1	69.5	134.1	131.2	257.1	125.6	26.6	5.5	8.6	7.6	27.9	941.1	134.5 (Aug. 29, 1976)
04160	67.0	143.4	105.0	146.2	181.8	309.2	158.2	31.3	7.1	8.1	18.8	42.9	1,207.4	216.4 (Aug. 23, 1971)
04170	59.2	127.8	93.3	129.8	147.8	305.3	147.5	32.2	6.5	9.9	12.9	20.4	1,083.6	303.3 (Sep. 28, 1959)
04180	41.8	96.6	81.0	128.1	141.1	261.8	119.9	26.5	3.9	17.8	4.8	13.5	928.0	150.8 (Jan. 11, 1974)
04200	48.7	80.6	72.0	110.0	100.3	226.2	89.0	23.1	1.5	5.4	5.7	7.8	773.3	124.4 (Sep. 18, 1972)
04250	44.8	134.4	103.7	126.8	148.9	238.7	134.2	41.7	3.7	8.7	11.0	25.8	1,022.4	145.3 (Oct. 13, 1970)
04260	39.7	119.5	92.2	125.2	138.2	239.4	140.0	38.9	5.6	5.0	10.9	20.5	975.0	141.3 (Oct. 6, 1966)
04270	38.1	116.3	83.9	138.5	149.4	233.3	128.1	35.6	7.6	5.7	9.4	17.2	963.1	98.6 (May 6, 1976)
04290	50.3	123.8	102.4	141.3	147.2	253.5	147.0	31.8	5.0	5.7	9.8	24.8	1,066.1	182.0 (Sep. 4, 1959)

Table I-3 (2) AVERAGE MONTHLY RAINFALL AND MAXIMUM DAILY RAINFALL

Code	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total	Maximum Daily Rainfall
04300	27.9	98.8	85.9	90.6	123.5	231.0	112.2	16.9	6.0	0.4	8.7	15.5	784.1	167.2 (Sep.18 1972)
04310	31.0	107.6	102.8	100.6	133.6	233.6	89.2	27.5	6.3	0	18.7	11.8	814.3	163.8 (Sep. 18 1972)
04320	48.0	133.8	86.8	123.2	157.4	259.3	144.9	36.3	4.3	4.9	8.3	32.6	1,042.6	175.0 (May 5 1976)
04330	57.9	133.8	102.7	114.5	157.1	255.1	130.6	38.5	7.7	7.2	16.2	29.8	1,051.0	150.4 (Oct.6 1986)
04340	28.9	125.4	85.2	154.0	120.9	255.3	126.5	22.6	1.8	0.3	5.1	8.2	920.3	207.2 (May 6 1976)
04361	38.5	125.4	90.2	109.5	125.6	232.7	130.2	32.3	3.8	4.3	12.5	24.8	935.7	127.8 (Sep. 21 1965)
12022	35.8	134.1	136.1	126.5	142.8	239.0	129.8	28.7	3.1	6.5	11.9	12.9	991.4	150.7 (May 5 1976)
12042	66.1	169.4	162.2	166.9	178.1	168.0	138.1	35.6	4.2	6.6	13.0	23.7	1,222.7	209.4 (Sep. 29 1978)
12081	57.0	193.3	140.0	145.1	178.1	321.3	169.9	38.4	8.3	12.9	9.1	39.4	1,320.6	135.6 (Jul. 3 1970)
12091	48.2	177.5	168.8	149.8	139.5	275.2	95.3	69.7	0	0	10.4	12.4	1,164.7	178.0 (May 21 1980)
13112	111.9	200.4	97.7	102.9	161.9	220.6	144.5	33.0	3.9	4.6	20.9	54.2	1,044.5	141.5 (Nov. 12 1967)
26013	70.0	135.8	138.7	153.0	184.5	261.5	146.4	20.7	4.9	8.5	21.3	26.7	1,166.2	161.1 (Sep. 6 1931)
26042	52.1	112.9	102.5	127.6	173.1	239.2	140.2	24.2	2.6	6.8	12.9	23.6	1,123.4	176.4 (Sep. 16 1953)
26052	86.4	123.8	122.4	143.1	166.5	247.1	148.9	29.3	2.9	5.0	17.0	26.5	1,089.9	186.0 (Apr. 28 1947)
26062	50.4	115.9	116.3	120.9	162.9	237.7	97.5	22.4	2.2	7.3	11.2	18.8	1,073.5	184.0 (Sep. 13 1938)
26072	67.4	149.3	126.5	139.7	172.0	247.1	171.9	31.9	6.5	10.5	21.0	28.8	1,131.4	254.0 (Oct.24 1952)
26170	45.1	121.9	96.7	123.9	176.9	241.2	120.9	40.9	3.1	8.8	6.4	29.3	1,015.1	163.5 (Oct. 6 1966)

Table I-3 (3) AVERAGE MONTHLY RAINFALL AND MAXIMUM DAILY RAINFALL

Code	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total	Maximum Daily Rainfall
26270	91.5	171.3	117.8	107.4	184.6	211.0	107.2	49.1	3.3	9.4	8.1	9.7	1,063.0	88.7 (Nov. 7 1981)
26281	37.1	215.4	121.7	124.9	156.7	263.5	177.5	95.4	10.4	0.6	6.8	25.4	1,193.7	270.0 (Nov. 7 1981)
63042	78.0	142.9	177.7	240.1	251.1	244.9	115.5	27.9	6.7	6.0	12.4	36.7	1,378.6	123.0 (Mar. 31 1941)
69012	69.5	129.6	125.0	135.3	164.2	279.9	165.6	35.2	5.6	4.5	12.5	27.7	1,154.0	208.7 (Oct. 6 1966)
69022	70.6	147.8	115.4	147.4	184.9	310.5	140.7	41.6	4.9	7.2	10.8	38.0	1,228.4	148.9 (Oct. 20 1961)
69032	64.0	116.8	118.1	121.3	149.8	263.9	136.3	27.3	3.7	6.2	10.7	25.3	1,059.7	210.0 (Apr. 13 1928)
69042	70.5	154.8	149.5	148.2	196.8	317.7	191.6	38.3	5.6	9.7	17.5	34.7	1,337.1	252.5 (Aug. 31 1924)
69052	141.9	214.5	193.9	191.1	176.5	397.2	248.4	55.3	21.5	4.9	14.2	68.5	1,814.5	190.0 (Oct. 1 1963)
69062	76.3	139.9	127.8	135.0	182.3	269.0	152.4	42.3	5.6	5.2	9.1	21.7	1,166.1	121.6 (Sep. 21 1978)
69090	71.8	205.9	189.2	108.0	165.8	349.0	226.1	50.7	14.6	26.0	23.7	55.3	1,440.3	121.6 (May 15 1970)
69110	75.8	177.4	138.0	127.5	205.6	236.0	105.5	23.4	1.8	0.6	11.9	35.7	1,208.2	88.0 (Apr. 24 1977)
69121	50.8	223.8	231.6	125.2	115.2	276.1	167.7	100.1	7.7	1.8	24.2	39.4	1,365.4	198.0 (Nov. 7 1981)

Table I-4 CORRELATION COEFFICIENTS ON MONTHLY RAINFALL

Code \ Code	04032	04062	04180	04200	12022	12042	12081	26013	26042	26052	26062	26072	26281	63042	69012	69022	69032	69042	69052	69090	69110	69121
04032		0.908	-	-	0.607	0.664	0.731	0.783	0.779	0.784	0.701	0.755	0.575	0.600	0.855	0.847	0.835	0.810	0.657	0.760	0.804	0.556
04062	0.915		0.686	0.694	0.608	0.684	0.719	0.781	0.774	0.799	0.698	0.755	0.655	0.598	0.848	0.839	0.841	0.810	0.671	0.756	0.790	0.575
04180	-	0.727		0.800	-	-	-	-	-	-	-	-	0.609	-	0.690	0.682	0.558	0.662	0.581	-	-	-
04200	-	0.763	0.848		-	-	-	-	-	-	-	-	0.568	-	0.624	0.452	0.659	0.721	0.677	-	-	-
12022	0.639	0.639	-	-		-	0.559	0.594	0.598	0.536	0.575	0.576	0.328	0.480	0.608	0.607	0.542	0.694	0.570	0.648	-	-
12042	0.714	0.697	-	-	0.716		0.745	0.734	0.710	0.696	0.743	0.704	0.547	0.654	0.659	0.693	0.654	0.716	0.660	0.730	0.722	0.540
12081	0.791	0.777	-	-	0.684	0.806		0.712	0.697	0.595	0.720	0.724	0.776	0.574	0.647	0.738	0.650	0.656	0.657	0.853	0.865	0.663
26013	0.802	0.796	-	-	0.633	0.761	0.769		0.839	0.757	0.754	0.749	0.664	0.665	0.762	0.793	0.742	0.765	0.682	0.650	0.746	0.543
26042	0.799	0.797	-	-	0.635	0.741	0.785	0.851		0.810	0.718	0.761	0.614	0.626	0.783	0.840	0.769	0.821	0.663	0.662	0.755	0.487
26052	0.804	0.820	-	-	0.580	0.732	0.743	0.781	0.827		0.673	0.743	0.564	0.568	0.806	0.805	0.796	0.774	0.593	0.594	0.633	0.626
26062	0.723	0.724	-	-	0.621	0.776	0.794	0.781	0.748	0.718		0.277	0.622	0.369	0.680	0.759	0.701	0.728	0.616	0.721	0.765	0.523
26072	0.781	0.781	-	-	0.621	0.741	0.791	0.779	0.788	0.777	0.371		0.664	0.542	0.744	0.786	0.736	0.762	0.690	0.741	0.705	0.671
26281	0.685	0.727	0.724	0.713	0.561	0.682	0.837	0.749	0.731	0.701	0.749	0.757		0.518	0.633	0.707	0.609	0.637	0.499	-	-	-
63042	0.645	0.651	-	-	0.538	0.627	0.667	0.706	0.670	0.623	0.452	0.602	0.673		0.596	0.618	0.593	0.593	0.482	0.224	0.784	0.480
69012	0.867	0.862	0.731	0.708	0.644	0.699	0.746	0.735	0.805	0.826	0.712	0.755	0.706	0.650		0.845	0.823	0.825	0.634	0.644	0.769	0.468
69022	0.864	0.857	0.730	0.599	0.647	0.728	0.793	0.819	0.856	0.833	0.788	0.816	0.781	0.677	0.861		0.863	0.847	0.644	0.760	0.875	0.643
69032	0.853	0.858	0.658	0.759	0.587	0.698	0.763	0.767	0.796	0.817	0.736	0.770	0.740	0.652	0.836	0.881		0.835	0.615	0.716	0.805	0.608
69042	0.828	0.830	0.726	0.790	0.724	0.749	0.753	0.798	0.800	0.804	0.751	0.794	0.716	0.646	0.842	0.865	0.854		0.652	0.736	0.661	0.595
69052	0.650	0.640	0.649	0.747	0.612	0.694	0.745	0.668	0.657	0.610	0.645	0.700	0.603	0.533	0.645	0.653	0.627	0.666		0.647	0.124	0.463
69090	0.810	0.788	-	-	0.705	0.784	0.872	0.700	0.751	0.726	0.767	0.781	-	0.482	0.718	0.791	0.783	0.792	0.752		0.815	0.572
69110	0.861	0.857	-	-	0.630	0.788	0.900	0.806	0.818	0.771	0.842	0.796	-	0.854	0.855	0.913	0.877	0.762	0.324	-		0.831
69121	0.659	0.667	-	-	0.518	0.652	0.725	0.648	0.619	0.734	0.666	0.755	-	0.626	0.624	0.731	0.723	0.695	0.466	-	0.867	

Note: ① / ② 1 Excluding no rainfall month
2 Using all data

Table I-5 DAILY RAINFALL PROBABILITY BY IWAI METHOD

Unit : mm/day

Code	1/5	1/10	1/20	1/50	1/100	1/200	1/500	1/1000	No. of Sample
				Return Period					
04022	111.7	133.5	154.0	180.0	199.3	218.5	243.8	263.1	1921-1981 N=42
04032	97.8	111.2	123.2	137.7	148.1	158.1	170.8	180.2	1921-1982 N=43
04042	111.8	130.6	148.0	169.7	185.6	201.2	221.6	237.0	1921-1981 N=50
04052	113.4	135.2	156.9	186.3	209.3	233.0	265.8	291.7	1921-1981 N=45
04062	121.7	142.8	162.3	186.6	204.4	221.9	244.7	261.9	1921-1982 N=49
04160	116.7	137.3	157.6	184.5	205.2	226.5	255.4	278.0	1933-1981 N=49
12022	99.5	114.9	128.8	145.8	158.1	169.9	185.2	196.5	1921-1982 N=40
12042	121.2	148.2	174.2	208.2	234.2	260.4	295.7	323.0	1921-1982 N=38
26013	103.4	120.9	138.0	160.9	178.6	196.8	221.6	241.1	1921-1982 N=57
26042	112.1	132.2	151.1	175.1	193.0	210.8	234.2	252.0	1921-1982 N=48
26052	118.6	140.2	161.6	190.1	212.3	235.1	266.3	290.8	1921-1982 N=45
26062	116.9	136.8	154.9	177.2	193.4	209.1	229.4	244.6	1920-1982 N=41
26072	110.4	132.2	153.9	183.0	205.7	229.2	261.4	286.9	1931-1982 N=45
63042	85.1	101.1	116.5	136.5	151.6	166.9	187.3	203.1	1923-1982 N=38
69012	118.9	136.4	152.6	172.7	187.3	201.7	220.4	234.5	1920-1982 N=54
69022	111.0	125.1	137.4	152.0	162.2	171.8	183.9	192.7	1921-1982 N=51
69032	126.3	144.0	159.7	178.4	191.6	204.3	220.3	232.0	1921-1982 N=44
69042	117.0	142.1	167.0	200.5	226.7	253.7	290.8	320.1	1921-1982 N=48
69052	141.7	166.4	189.0	217.3	238.0	258.3	284.7	304.6	1922-1982 N=33

Table I-6 (1) MONTHLY RUNOFF RECORD AT CT-5A, D.A. 936 km^2

(Unit : cum/s)

Water Year	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1969	14.89	20.86	45.02	60.82	246.08	760.50	591.00	670.28	117.26	46.59	19.89	14.86	2,608.05
1970	17.34	158.05	285.05	124.53	499.04	574.74	1456.00	666.84	608.41	137.32	61.96	40.48	4,629.76
1971	34.08	98.05	148.21	207.80	352.89	746.68	1181.60	547.60	126.33	70.24	35.09	26.02	3,574.59
1972	13.24	9.20	8.68	45.90	63.14	781.05	1683.00	942.69	509.24	165.29	74.70	63.84	4,359.97
1973	34.80	39.64	364.32	218.88	203.14	867.94	1390.00	461.88	214.60	120.38	69.56	61.98	4,101.12
1974	122.42	143.90	101.07	96.32	345.96	186.33	2406.00	1081.00	216.98	190.10	90.22	58.08	6,714.35
1975	44.04	169.93	253.98	150.93	163.88	861.00	1440.00	645.00	222.88	121.40	61.87	46.72	4,181.63
1976	32.70	177.42	51.17	56.75	249.63	955.00	1038.00	1167.89	120.06	60.56	24.29	15.09	3,948.56
1977	25.58	48.77	21.42	37.76	63.17	302.74	286.88	102.06	37.98	21.34	15.40	15.80	978.90
1978	15.45	94.83	68.46	389.37	288.42	973.82	1729.82	255.98	98.09	48.01	20.59	13.84	3,966.68
1979	16.05	54.93	311.04	77.99	85.51	1119.71	601.80	92.87	42.70	25.05	13.60	8.00	2,449.25
1980	14.20	831.37	-	251.90	290.65	945.00	2386.59	329.80	101.45	59.70	43.75	36.75	-
1981	53.15	170.95	218.10	203.10	301.40	639.40	1044.25	-	266.95	69.85	32.10	23.60	-
1982	25.28	104.10	178.69	148.64	199.05	292.00	669.90	158.94	85.75	59.05	40.79	38.67	2,000.86
Mean	33.02	155.43	158.09	147.91	239.43	834.49	1278.92	545.60	197.76	85.35	43.13	33.12	3,626.14

Note: - : Missing Data

Table I-6 (2) MONTHLY RUNOFF RECORD AT CT-7 AND CT-9

CT-7 D.A. 403 km^2

(Unit : cum/s)

Water Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1975	6.58	13.85	34.89	39.51	47.48	234.78	625.84	250.63	34.39	13.40	6.67	3.82	1,311.84
1976	1.76	15.12	2.99	2.13	11.10	328.12	193.43	240.16	6.33	2.31	0.78	0.04	804.27
1977	2.81	3.32	2.91	0.39	0	6.45	13.09	7.94	2.40	0.18	0	0	39.49
1978	0	75.81	32.30	141.15	30.22	208.48	826.36	57.54	16.24	7.30	3.42	0.28	1,399.11
1979	0	2.44	241.64	1.24	0.89	1157.91	149.64	27.71	15.78	10.59	7.81	8.41	1,624.06
1980	0	68.32	262.51	208.27	116.70	439.05	1072.66	182.85	62.19	40.50	29.97	28.44	2,511.46
1981	4.25	58.65	43.50	107.55	53.35	189.25	336.22	-	124.95	66.20	43.40	39.38	-
1982	1.73	12.87	41.40	12.38	10.55	27.45	194.80	62.08	35.76	12.83	4.82	1.11	417.78
Mean	2.14	31.30	82.77	64.08	33.79	323.94	426.51	118.42	37.26	19.16	12.11	10.18	1,158.29

CT-9 D.A. 541km^2

Water Year	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1977	8.11	10.24	6.81	6.40	9.03	40.54	67.28	19.50	6.84	4.33	4.10	3.56	186.74
1978	3.14	74.87	62.50	266.18	73.89	245.85	459.16	68.14	21.98	9.24	5.46	3.38	1293.79
1979	5.01	7.40	44.04	21.80	13.00	209.29	95.51	12.09	4.88	3.03	2.47	2.17	420.69
1980	2.10	133.62	394.79	73.50	97.73	271.99	1094.46	177.39	43.25	20.62	11.91	12.50	2333.86
1981	6.19	42.38	57.02	65.22	32.61	315.28	480.81	1237.77	169.38	61.38	29.89	25.75	2523.68
1982	17.67	32.64	44.50	20.22	20.24	51.11	261.63	100.04	35.99	18.80	10.53	7.17	620.54
Mean	7.03	50.19	101.61	75.55	41.08	189.01	409.81	269.16	47.05	19.57	10.73	9.09	1229.88

Note :- Missiing Data

Table I-7 RESULTS OF WATER QUALITY ANALIYSIS

Sample No.	Location	Date	B ppm	NO_2 ppm	PH	EC×10^6 at 25°C	Irrigation class	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	SSP	SAR	RSC meg./l	Fe (Iron) Total	Fe (Iron) Dissolved
								Milliequivalent per litre (Lower figure in ppm)													
1	Upper Mae Wong Dam	17,12 1984	0	0	7,9	79	C1 - S1	0.41 8	0.09 1	0.25 5	<0.01 < 1	0	0.75 46	0.07 2	0.02 1	<0.01 0.24	33	0.5	0.25	< 0.01 0.05	0 0
2	Lower Mae Wong Dam	〃	0	0	7.7	100	C1 - S1	0.43 9	0.21 2	0.29 7	0.01 < 1	0	0.91 55	0.05 2	0.03 1	0.01 0.38	31	0.5	0.27	0.02 0.30	< 0.01 0.05
3	Khlong Pho Dam	〃	0	0.77	7.7	260	C2 - S1	1.19 24	0.57 7	0.80 18	0.10 4	0	2.41 147	0.12 4	0.09 4	<0.01 0.24	31	0.8	0.65	0.02 0.40	0 0
4	Upper Huai Rang Dam	〃	0	0.02	7.4	70	C1 - S1	0.16 3	0.06 1	0.40 9	0.04 2	0	0.52 32	0.08 3	0.08 4	0.01 0.40	64	1.2	0.30	0.02 0.30	0.01 0.15
5	Lower Huai Rang Dam	〃	0	0.01	7.7	75	C1 - S1	0.21 4	0.09 1	0.45 10	0.06 2	0	0.64 39	0.08 3	0.03 1	0.01 0.41	60	1.2	0.34	0.02 0.45	0.01 0.25
6	Upper Khun Keaw Dam	〃	0	0	7.5	55	C1 - S1	0.15 3	0.04 < 1	0.40 9	0.04 2	0	0.48 29	0.07 2	0.03 1	<0.01 0.14	68	1.3	0.29	< 0.01 0.05	0 0
7	Lower Khun Keaw Dam	〃	0	0.01	7.5	140	C1 - S1	0.56 11	0.40 5	0.40 9	0.04 2	0	1.32 80	0.07 2	0.02 1	0.01 0.62	29	0.6	0.36	0.04 0.80	0.02 0.40
8	Changwat NakhonSawan	〃	0	0.01	7.1	170	C1 - S1	0.62 12	0,39 5	0.68 15	0.08 3	0	1.70 104	0.12 4	0.03 1	<0.01 0.17	40	1.0	0.69	0.03 0.50	< 0.01 0.05
9	Sawang Arom	〃	0	0.01	7.5	160	C1 - S1	0.60 12	0.32 4	0.70 16	0.15 6	0	1.38 84	0.23 8	0.06 3	<0.01 0.18	43	1.0	0.46	0.03 0.50	< 0.01 0.10
10	Nong Chang	〃	0	0.27	7.2	170	C1 - S1	0.58 12	0.39 5	0.83 19	0.08 3	0	1.61 98	0.10 3	0.06 3	0.01 0.54	46	1.2	0.64	0.04 0.80	0.02 0.40

Table 1-8 RESULTS OF TANK MODEL ANALYSIS

Stream gage station CT-5A, D.A. 936 km

Water	Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
R	(mm)	1,707.5	1,093.1	1,172.9	1,455.3	1,811.6	1,379.0	1,332.9	975.8	1,329.9	1,111.0
Qo	(m^3/s)	4,629.76	3,574.59	4,359.97	4,101.12	6,714.35	4,181.63	3,948.56	978.9	3,966.68	2,449.25
Fo		0.250	0.302	0.343	0.260	0.342	0.280	0.273	0.093	0.275	0.203
Qc	(m^3/s)	6,226.27	2,580.06	2,449.58	4,242.82	5,069.67	3,651.33	4,174.38	1,736.21	4,278.16	3,147.04
Fc		0.337	0.218	0.193	0.269	0.258	0.244	0.289	0.164	0.297	0.261
Qc/Qo		1.34	0.72	0.56	1.03	0.76	0.87	1.06	1.77	1.08	1.28

Water	Year	/1 1980	/2 1981	1982	Mean
R	(mm)	/1 1,248.5	/2 1,019.6	1,138.4	1,290.4
Qo	(m^3/s)	5,291.16	3,023.0	2,000.86	3,786.13
Fo		0.391	0.274	0.162	0.271
Qc	(m^3/s)	5,087.59	2,176.51	2,998.52	3,678.32
Fc		0.376	0.197	0.243	0.263
Qc/Qo		0.96	0.72	1.50	0.97

Where ; R - Annual Rainfall
Qo- Observed Annual Runoff
Fo- Runoff Rate of Qo
Qc- Calculated Annual Runoff
Fc- Runoff Rate of Qc

Note ; /1 - Excluding Nov.
/2 - Excluding Jan.

Stream gage station CT-7, D.A. 403 km

Water	Year	1975	1976	1977	1978	1979	1980	1981	1982	Mean
R	(mm)	1,445.2	1,334.3	824.3	1,189.0	932.1	1,364.8	1,622.4	1,124.6	1,229.6
Qo	(m^3/s)	1,311.84	804.27	39.49	1,399.11	1,624.06	2,511.46	1,622.44	417.78	1.216.32
Fo		0.195	0.129	0.010	0.253	0.374	0.395	0.214	0.080	0.212
Qc	(m^3/s)	1,555.181	1,278.07	236.085	937.105	1,096.847	1,500.493	1,906.313	755.974	1,158.259
Fc		0.231	0.205	0.061	0.169	0.252	0.236	0.252	0.144	0.202
Qc/Qo		1.19	1.59	5.98	0.67	0.68	0.60	1.17	1.81	0.95

Stream gage station CT-9, D.A. 541 km

Water	Year	1977	1978	1979	1980	1981	1982	Mean
R	(mm)	1,044.9	1,302.8	847.3	1,579.0	1,723.2	1,311.9	1,301.5
Qo	(m^3/s)	186.74	1,293.79	420.69	2,333.86	2,523.68	620.54	1,229.88
Fo		0.029	0.159	0.079	0.236	0.234	0.076	0.151
Qc	(m^3/s)	529.91	1,405.73	942.19	2,159.0	2,246.47	1,875.69	1,526.50
Fc		0.081	0.172	0.178	0.218	0.208	0.228	0.187
Qc/Qo		2.84	1.09	2.24	0.93	0.89	3.02	1.24

Table I-9(1) CALCULATED MONTHLY RAINFALL FOR RUNOFF ANALYSIS AT CT.5-A

(Unit; mm)

Water Year	Apr.	May	Jun	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1954	21.9	254.4	195.2	196.8	234.9	275.4	106.1	2.0	0	1.7	0	76.6	1365.0
1955	164.2	161.9	210.5	185.8	197.4	268.8	76.1	48.1	0	0	85.9	55.9	1454.6
1956	181.9	254.0	96.4	141.6	201.9	200.9	135.1	24.7	0	0	47.1	39.6	1323.2
1957	105.1	73.6	153.8	231.4	197.0	235.9	91.2	44.8	0	0.4	47.1	64.5	1244.8
1958	90.4	101.2	135.6	195.7	167.5	192.1	92.1	22.4	0	0	44.2	40.3	1081.5
1959	64.5	106.6	95.1	182.8	186.1	248.3	60.9	8.3	0	0.4	0	0	953.0
1960	33.2	124.3	205.1	130.7	146.2	163.6	134.5	40.8	0.4	0	86.7	111.2	1176.7
1961	129.8	307.3	150.9	189.8	267.0	223.7	248.9	2.5	5.6	5.1	25.5	5.1	1561.2
1962	27.8	142.4	163.3	183.9	183.6	279.8	136.3	26.6	2.9	0	28.4	32.4	1207.4
1963	81.1	106.1	145.1	165.0	106.7	221.4	238.0	100.1	0	50.0	26.4	46.5	1286.4
1964	85.1	214.8	128.9	156.9	181.2	291.8	279.3	57.8	31.2	0	69.6	29.3	1525.9
1965	41.2	166.7	187.1	152.5	193.5	193.7	157.6	74.2	0	81.2	34.2	36.1	1318.0
1966	49.0	205.4	205.9	165.3	205.8	181.7	166.5	73.0	53.4	30.9	24.1	0	1316.0
1967	101.4	142.2	156.6	127.7	219.3	202.1	134.7	50.9	0	0	80.1	22.6	1237.6
1968	84.4	111.5	142.1	179.4	176.8	161.1	61.1	0.8	0	53.5	0	53.7	1024.4
1969	47.8	116.8	164.1	173.9	179.9	274.1	179.6	34.3	0	0	26.0	45.0	1241.5
1970	54.4	232.9	177.3	252.9	335.2	316.6	235.1	40.3	25.0	0.4	5.3	32.1	1707.5
1971	74.5	196.0	127.4	109.9	216.0	222.8	130.2	5.6	0	0	9.2	1.5	1093.1
1972	22.1	136.7	145.8	100.6	151.0	237.8	199.3	62.2	44.3	0	0	73.0	1172.9
1973	39.4	285.1	252.6	214.7	138.3	247.4	94.4	14.5	0	3.0	1.4	137.2	1455.3
1974	133.1	179.4	106.1	180.5	154.1	400.6	302.2	65.6	15.6	128.3	62.0	84.1	1811.6
1975	66.1	194.5	128.2	167.0	201.1	224.8	198.6	100.4	18.2	0	25.7	54.4	1379.0
1976	36.8	285.5	106.8	107.6	248.4	286.8	168.8	44.9	5.5	16.0	0	25.8	1332.9
1977	111.8	153.4	62.8	128.3	133.3	224.7	83.6	8.9	14.5	0.3	44.2	0	975.8
1978	54.6	218.1	132.4	232.3	234.7	322.4	118.8	0.7	0	5.6	10.0	0.3	1329.9
1979	40.2	174.0	212.3	95.4	124.5	417.7	22.6	0	0	0	1.7	22.6	1111.0
1980	86.1	114.1	207.7	216.1	177.6	446.1	187.0	7.4	0.6	0	0	13.5	1456.2
1981	75.0	102.0	143.7	152.8	261.8	155.9	128.4	197.5	0	0	0	0	1217.1
1982	9.0	179.5	100.6	181.9	176.3	324.5	117.7	173.0	0	9.4	0	22.2	1138.4
Mean	72.8	173.8	153.1	168.9	193.0	256.6	147.7	40.5	7.5	13.3	27.0	38.8	1294.6

Table I-9(2) CALCULATED MONTHLY RAINFALL FOR RUNOFF ANALYSIS AT CT.7

(Unit; mm)

Water Year	Apr.	May	Jun	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1954	36.7	208.7	214.7	168.5	226.7	223.4	97.1	17.5	0	0	0	128.8	1322.1
1955	93.8	173.4	186.3	235.8	221.1	282.5	98.1	76.2	0	0	70.0	71.1	1508.3
1956	155.7	240.8	143.2	142.6	194.5	240.7	168.8	32.0	0	0	46.6	87.8	1452.7
1957	67.1	71.6	122.3	119.6	194.1	266.6	143.2	21.4	0	22.9	69.4	19.5	1117.7
1958	58.6	116.2	148.4	178.5	143.9	212.9	86.5	12.2	0	0	45.1	53.1	1055.4
1959	87.2	123.2	95.1	169.6	138.5	282.5	99.9	38.3	0	0	20.4	24.4	1079.1
1960	58.5	141.0	166.9	214.2	192.4	201.9	156.6	69.3	0	0	69.3	65.4	1335.4
1961	111.7	241.9	126.5	110.2	148.7	173.8	241.4	0	0	0	13.7	0	1167.9
1962	61.9	125.5	124.5	86.9	185.3	342.8	157.2	13.9	0	0	15.4	15.1	1128.5
1963	31.6	110.2	77.7	113.2	139.9	217.4	190.4	82.5	0	27.1	33.9	55.0	1078.9
1964	86.9	202.3	142.7	250.8	141.6	294.8	203.2	61.0	36.7	0	76.0	73.2	1569.2
1965	33.2	139.8	138.7	99.7	213.1	229.9	144.6	52.3	18.6	63.0	37.0	46.4	1216.3
1966	67.1	221.1	189.5	130.4	241.9	155.5	210.6	67.5	42.8	16.7	13.1	0	1356.2
1967	113.7	146.7	130.8	131.8	147.7	261.6	130.5	84.9	0	0	58.1	49.5	1255.3
1968	75.7	148.7	133.0	162.3	145.2	155.0	113.9	16.9	0	48.3	0	52.5	1051.5
1969	96.6	132.6	178.6	193.3	111.1	329.0	150.8	37.7	0	17.2	34.2	85.0	1366.1
1970	95.4	224.5	242.8	192.2	252.0	255.3	203.3	28.3	32.5	23.7	43.4	66.6	1660.0
1971	118.4	157.4	98.0	138.6	234.2	241.9	163.6	3.0	33.6	0	34.5	17.0	1240.2
1972	121.9	98.1	154.2	99.8	189.1	278.9	222.4	121.1	53.6	0	16.7	88.7	1444.5
1973	49.0	262.4	208.9	127.8	118.2	269.4	85.0	35.0	0	1.7	23.0	92.8	1273.2
1974	107.4	208.7	122.8	162.6	149.9	336.8	273.3	65.3	18.3	123.3	52.4	86.0	1706.8
1975	26.3	241.4	144.2	153.4	256.9	204.0	285.5	84.5	3.5	0	6.6	38.9	1445.2
1976	47.1	259.5	97.0	113.6	265.6	288.3	191.9	57.9	0	0	0	13.4	1334.3
1977	69.5	127.6	84.5	55.9	137.7	175.1	94.0	8.1	15.2	1.7	40.4	14.6	824.3
1978	54.1	214.8	128.3	247.8	127.8	248.8	162.5	0	0	3.0	1.9	0	1189.0
1979	11.3	155.5	142.5	53.5	68.9	464.4	11.6	0	0	0	0.8	23.6	932.1
1980	58.5	155.9	208.7	166.9	135.6	379.2	170.1	18.4	0	0	30.5	41.0	1364.8
1981	59.5	200.3	174.5	178.1	156.7	230.2	221.0	368.7	0	0	16.5	16.9	1622.4
1982	23.3	211.8	87.7	113.1	127.2	300.7	145.2	23.7	35.3	6.0	0	50.6	1124.6
Mean	71.6	174.5	145.3	148.6	172.6	260.1	159.4	51.6	10.0	12.2	30.0	47.5	1283.5

Table I-9(3) CALCULATED MONTHLY RAINFALL FOR RUNOFF ANALYSIS AT CT.9

(Unit; mm)

Water Year	Apr.	May	Jun	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1954	0	154.8	150.6	149.0	213.2	282.7	130.2	0	0	0	0	110.1	1190.6
1955	163.3	174.4	188.2	211.8	183.6	229.2	26.5	118.2	0	0	102.0	69.2	1466.4
1956	86.6	230.5	72.7	181.6	190.6	229.0	189.8	26.7	0	29.9	0	103.4	1340.8
1957	86.5	50.0	186.3	140.6	180.8	419.6	164.0	39.5	0	41.9	0	86.0	1395.2
1958	0	116.2	201.6	122.6	143.1	374.2	143.9	0	0	0	0	99.3	1200.9
1959	60.6	138.4	128.3	259.5	143.4	369.5	132.0	29.0	0	0	0	0	1260.7
1960	0	144.1	162.9	177.7	145.3	183.1	259.4	69.2	0	0	40.5	0	1182.2
1961	108.0	187.5	96.5	108.0	211.3	206.4	252.6	0	36.5	0	0	33.5	1240.3
1962	149.4	92.6	153.8	188.4	172.8	343.4	110.8	31.5	0	0	36.2	35.2	1314.1
1963	74.9	123.1	104.6	118.9	213.9	250.1	303.3	80.8	0	0	0	27.5	1297.1
1964	99.4	183.4	185.0	230.1	239.1	425.6	207.5	61.1	0	0	105.8	0	1737.0
1965	24.7	148.6	91.4	67.5	295.3	291.4	150.4	56.0	0	103.8	28.9	32.0	1290.0
1966	57.4	151.8	93.9	147.0	181.6	96.5	358.1	82.4	73.4	0	0	0	1242.1
1967	107.6	221.9	108.8	84.9	78.6	217.5	147.4	71.3	0	0	31.4	41.8	1111.2
1968	215.0	183.0	156.9	266.2	119.3	120.0	152.5	26.7	0	80.4	0	40.5	1360.5
1969	66.0	107.2	168.5	99.4	121.6	343.5	77.7	39.9	0	10.0	17.1	73.9	1124.8
1970	90.8	302.2	238.0	210.1	303.4	373.6	308.4	32.0	53.0	2.2	23.5	23.6	1960.8
1971	67.2	236.0	278.9	80.4	190.6	295.9	240.7	2.1	3.5	26.0	34.5	118.1	1573.9
1972	74.4	52.3	205.1	28.0	91.5	482.5	259.5	146.4	30.9	0	34.4	30.5	1435.5
1973	9.8	328.5	167.9	71.1	79.2	224.3	129.7	32.7	0	0	32.9	30.6	1106.7
1974	122.9	209.2	76.7	159.3	208.8	374.1	340.6	51.2	0	117.7	0	57.7	1718.2
1975	117.5	245.3	134.5	159.2	147.4	222.8	209.3	131.5	56.0	0	0	92.0	1515.5
1976	124.7	205.1	107.1	121.7	171.1	179.5	170.5	29.7	0	0	0	64.7	1174.1
1977	159.9	84.6	83.7	80.9	157.6	233.9	131.2	21.5	8.2	4.2	54.7	25.3	1044.9
1978	51.6	284.1	146.6	297.8	57.0	239.6	187.1	27.7	0	0	12.5	0	1302.8
1979	62.2	61.8	247.8	43.8	76.1	283.2	10.3	0	0	0	19.2	42.9	847.3
1980	41.1	233.2	320.0	143.1	216.2	224.3	277.3	36.9	0	0	58.6	28.3	1579.0
1981	91.0	288.9	123.7	162.1	54.7	350.0	141.3	404.4	0	0	0	107.1	1723.2
1982	8.0	251.0	320.0	23.5	129.8	325.5	138.6	37.5	38.2	6.8	0	33.0	1311.9
Mean	80.0	179.0	162.0	142.6	162.7	282.4	184.5	58.1	10.3	14.6	21.8	48.5	1346.5

Table I-10 (1) MONTHLY RIVER RUNOFF SIMULATED BY TANK MODEL (1,000 cum/sq.km)
THE MAE WONG RIVER AT GAGING STATION : CT-5A

Water Year	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1954	2.0	4.5	55.7	45.4	70.3	80.6	127.4	10.6	4.8	4.0	3.1	2.4	411
1955	2.2	6.3	26.4	41.9	51.6	86.1	91.6	13.7	5.2	4.4	4.0	3.5	337
1956	3.3	17.7	54.4	15.4	30.6	71.5	63.0	20.5	5.9	5.1	4.4	3.7	296
1957	3.3	2.8	7.4	25.8	68.5	93.6	78.7	8.1	5.1	4.4	3.6	3.2	304
1958	2.5	2.5	2.8	14.3	30.6	55.8	60.4	10.1	4.4	3.6	3.0	2.3	192
1959	1.5	1.2	2.9	4.4	28.1	73.0	79.7	6.0	3.0	2.2	1.3	0.4	204
1960	0.0	0.0	5.2	20.8	18.9	33.0	57.5	11.8	2.5	1.7	1.3	1.0	154
1961	0.7	10.6	79.4	21.8	70.6	104.9	119.5	39.8	4.6	3.9	3.1	2.2	461
1962	1.2	0.9	8.0	18.3	42.7	70.5	126.4	18.1	3.6	2.9	2.1	1.3	296
1963	0.6	0.5	1.7	10.9	17.6	31.4	114.6	53.4	3.8	3.0	2.3	1.5	241
1964	0.8	2.5	17.2	19.3	25.1	68.2	166.9	71.0	7.0	4.0	3.4	2.8	388
1965	1.9	1.6	14.8	24.2	30.4	69.4	81.7	26.7	4.7	4.0	3.8	3.0	266
1966	2.3	3.0	28.5	35.9	50.2	90.6	55.3	23.3	5.9	5.2	4.5	3.6	308
1967	2.8	2.8	10.2	16.9	21.7	73.4	81.6	17.5	5.4	4.6	4.1	3.4	244
1968	2.7	2.5	3.5	16.7	55.3	44.0	36.0	5.2	4.0	3.5	2.8	2.2	178
1969	1.4	1.9	4.2	5.6	22.7	70.2	54.6	61.9	10.8	4.3	1.8	1.4	241
1970	1.6	14.6	26.3	11.5	46.1	53.1	134.4	61.6	56.2	12.7	5.7	3.7	427
1971	3.1	9.1	13.7	19.2	32.6	68.9	109.1	50.5	11.7	6.5	3.2	2.4	330
1972	1.2	0.8	0.8	4.2	5.8	72.1	155.4	87.0	47.0	15.3	6.9	5.9	402
1973	3.2	8.6	33.6	20.2	18.8	80.1	128.3	42.6	19.8	11.1	6.4	5.7	379
1974	11.2	13.3	9.3	8.9	31.9	172.0	222.1	99.8	20.0	17.5	8.3	5.4	620
1975	4.1	15.8	23.4	14.0	15.2	79.8	133.0	59.4	20.5	11.2	5.7	3.9	386
1976	3.0	16.4	4.7	5.2	23.0	88.2	95.8	107.8	11.1	5.6	2.2	1.4	364
1977	2.4	4.5	2.0	3.5	5.8	27.9	26.5	9.4	3.5	2.0	1.4	1.5	90
1978	1.4	8.8	6.3	35.9	26.6	89.9	159.7	20.9	9.1	4.4	1.9	1.3	366
1979	1.5	5.1	28.7	7.2	7.9	103.4	55.6	8.6	3.9	2.3	1.3	0.7	226
1980	1.3	76.7	31.1	23.3	26.8	87.2	220.3	30.4	9.4	5.5	4.0	3.4	520
1981	4.9	15.8	23.9	18.8	27.8	59.0	96.4	59.4	24.6	6.4	3.0	2.2	342
1982	2.3	9.6	16.5	13.7	18.4	27.0	61.8	14.7	7.9	5.5	3.8	3.6	185
Mean	2.4	9.0	18.7	18.0	31.8	73.3	103.2	36.2	11.2	5.8	3.5	2.7	316

Note 1954 - 1968 : generate by tank model

1969 - 1982 : observed at CT-5A

Table I-10(2) MONTHLY RIVER RUNOFF SIMULATED BY TANK MODEL
(1,000 cum/sq.km)
THE KHLONG PHO RIVER AT GAGING STATION CT-7

Water Year	Apr.	May	Jun	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1954	0.9	1.2	23.1	32.2	36.2	48.2	56.3	16.0	4.2	3.1	1.8	0.9	224.2
1955	0.7	0.8	14.3	26.1	50.9	71.4	70.3	27.0	5.0	3.8	2.9	2.3	275.5
1956	1.6	8.1	27.5	23.4	26.5	46.4	54.4	28.5	5.3	4.1	3.1	2.2	231.1
1957	1.7	1.0	0.9	1.9	17.7	41.4	61.5	21.5	3.6	2.5	1.9	0.9	156.7
1958	0	0	1.4	17.3	22.7	27.7	38.8	10.7	2.6	1.5	0.8	0	123.6
1959	0	0	0.1	2.3	15.7	33.0	55.5	19.3	2.9	1.8	0.8	0	131.6
1960	0	0	3.9	21.2	36.0	44.4	50.6	24.2	4.1	3.0	2.2	1.5	191.1
1961	0.6	6.1	23.7	14.5	15.8	25.5	44.4	28.8	3.9	2.8	1.6	0.4	168.3
1962	0	0	0.1	3.9	10.4	57.8	95.4	23.2	3.2	2.1	1.0	0.1	197.0
1963	0	0	0.1	0.2	6.2	22.7	45.0	37.3	2.9	2.2	1.2	0.3	118.1
1964	0	0.8	14.0	25.4	38.0	50.2	99.8	39.1	8.8	3.9	3.1	2.6	285.8
1965	1.3	0.9	3.5	8.6	14.0	39.3	50.9	26.9	4.1	3.1	2.5	1.5	156.6
1966	0.8	1.7	20.2	26.4	28.0	47.9	47.8	30.4	5.3	4.1	3.0	1.6	217.3
1967	0.6	0.6	5.6	7.7	15.2	36.0	53.3	25.9	4.1	2.9	2.0	1.2	155.0
1968	0.2	0.3	2.8	10.3	23.4	26.5	28.4	10.2	2.5	1.7	0.7	0	107.1
1969	0	0	5.0	23.5	23.9	40.7	76.2	28.1	3.9	2.9	2.0	0.8	207.1
1970	0.5	1.8	30.1	44.1	46.2	73.1	60.3	37.4	8.5	4.8	3.8	3.0	313.6
1971	2.4	2.1	2.4	10.2	19.5	65.8	52.8	23.6	4.9	3.9	2.8	1.6	191.9
1972	0.6	0.6	2.5	9.6	18.0	41.8	90.2	41.9	15.4	4.1	2.9	2.2	229.8
1973	1.1	4.7	32.0	35.7	20.9	29.7	47.5	16.1	4.2	3.0	2.0	1.1	198.0
1974	0.7	3.1	12.6	12.0	19.4	61.5	138.0	54.0	10.2	4.7	4.3	3.6	324.3
1975	1.4	3.0	7.5	8.5	10.2	50.3	134.2	53.7	7.4	2.8	1.4	0.8	281.2
1976	0.4	3.2	0.6	0.5	2.4	70.3	41.5	51.5	1.4	0.5	0.2	0	172.4
1977	0.6	0.7	0.6	0.1	0	1.4	2.8	1.7	0.5	0	0	0	8.5
1978	0	16.3	6.9	30.3	6.5	44.7	177.2	12.3	3.5	1.6	0.7	0.1	300.0
1979	0	0.5	51.8	0.3	0.2	248.2	32.1	5.9	3.4	2.3	1.7	1.8	348.2
1980	0	14.6	56.3	44.7	25.0	94.1	230.0	38.6	12.9	8.5	6.4	6.1	537.2
1981	0.9	12.6	9.3	23.1	11.4	40.6	72.1	119.2	24.9	14.2	9.3	8.4	345.9
1982	0.4	2.8	8.9	2.7	2.3	5.9	41.8	13.3	7.7	2.8	1.0	0.2	89.6
Mean	0.6	3.0	12.7	16.1	19.4	51.3	70.7	29.9	5.9	3.4	2.3	1.6	216.8

Note 1954 - 1974 : generated by tank model
1975 - 1982 : observed at CT-7

Table I-10(3) MONTHLY RIVER RUNOFF SIMULATED BY TANK MODEL

(1,000 cum/sq.km)

THE THAP SALAO RIVER AT GAGING STATION CT-9

Water Year	Apr.	May	Jun	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1954	0.1	0	1.4	5.0	11.2	52.9	84.6	5.7	3.2	2.4	1.5	0.9	168.8
1955	1.1	2.6	19.3	9.4	29.4	53.5	43.5	6.5	4.5	3.6	3.2	2.9	179.6
1956	2.2	3.4	6.7	4.7	20.5	54.9	62.1	16.9	5.2	4.4	3.6	3.1	187.6
1957	2.7	1.9	4.1	6.7	18.1	68.3	160.9	11.8	5.2	4.4	3.7	3.1	291.0
1958	2.1	1.4	4.6	8.9	7.1	49.5	122.3	10.2	4.5	3.7	2.7	2.0	218.9
1959	1.5	1.3	2.6	7.5	31.9	66.2	121.5	13.9	4.7	3.8	2.8	1.8	259.4
1960	0.6	0.2	1.7	5.3	9.1	20.9	82.2	23.8	3.9	3.2	2.4	1.5	154.9
1961	0.7	1.7	4.7	1.5	6.7	40.0	90.4	25.7	3.8	3.1	2.2	1.3	181.7
1962	0.9	0.9	1.1	5.4	16.9	72.6	95.1	6.5	3.9	3.1	2.3	1.5	210.3
1963	0.8	0.7	0.8	1.0	6.2	45.3	129.0	47.9	4.2	3.4	2.4	1.5	243.1
1964	0.8	1.7	7.6	29.6	48.1	105.8	153.8	43.7	5.6	4.8	4.1	3.5	409.1
1965	2.5	2.0	3.3	2.4	8.0	76.3	91.1	18.0	4.9	4.7	3.9	3.1	220.2
1966	2.4	2.7	2.5	4.2	8.1	25.5	49.3	58.4	6.2	5.1	4.1	3.0	171.5
1967	2.3	3.5	6.6	4.1	3.6	8.5	49.2	8.2	4.5	3.7	2.8	2.0	99.1
1968	3.3	11.5	11.8	25.1	47.9	9.8	15.9	8.2	5.0	4.6	3.8	3.0	149.9
1969	2.2	1.9	3.0	5.2	4.2	45.5	69.3	6.8	4.2	3.4	2.5	1.7	150.0
1970	1.5	5.4	53.2	55.5	87.3	101.6	124.3	74.0	8.2	6.4	5.4	4.3	527.0
1971	3.6	4.9	15.0	64.5	9.3	84.0	73.9	29.3	7.1	6.2	5.5	4.9	308.2
1972	4.4	4.0	5.7	5.8	4.3	63.4	163.9	50.7	10.1	6.7	5.8	4.9	329.7
1973	3.8	9.6	48.9	13.7	5.4	12.6	60.5	8.1	5.7	4.9	4.1	3.1	180.3
1974	2.4	5.3	6.3	5.2	27.0	84.2	176.2	72.9	6.4	6.8	5.5	4.7	402.8
1975	1.4	6.7	16.8	17.2	9.6	53.3	181.2	36.2	9.2	7.2	6.1	5.4	350.2
1976	4.8	7.7	9.2	7.2	9.0	37.1	27.6	12.9	7.1	6.2	5.2	4.5	138.6
1977	1.3	1.6	1.1	1.0	1.4	6.5	10.8	3.1	1.0	0.6	0.7	0.6	29.7
1978	0.5	11.5	10.0	42.5	11.8	39.3	73.3	10.9	3.5	1.1	0.9	0.5	205.8
1979	0.8	1.2	7.0	3.5	2.1	33.4	15.3	1.9	0.7	0.5	0.4	0.4	67.1
1980	0.3	21.3	63.0	11.7	15.6	43.4	174.8	28.3	6.9	3.3	1.9	2.0	372.7
1981	0.9	6.8	9.1	10.4	5.2	50.4	76.8	197.7	27.1	9.4	4.8	4.0	402.5
1982	2.8	5.2	7.1	3.2	3.2	8.2	41.8	16.0	5.7	3.0	1.7	1.1	99.1
Mean	1.9	4.4	11.5	12.7	16.1	48.7	90.4	29.5	5.9	4.3	3.3	2.6	231.3

Note 1954 - 1976 : generated by tank model

1977 - 1982 : observed at CT-9

Table I-11 (1) ANNUAL MAXIMUM RIVER DISCHARGE

1. Sakae Krang River Basin

Water Year	Date	Q (cms)	SQ (ℓ/s/km^2)
CT. 5A (DA = 936 km^2)			
1969	Nov.5	117.0	125
1970	Oct.1	283.0	302
1971	Oct.29	367.0	392
1972	Oct.6	230.0	246
1973	Sep.30	141.0	151
1974	Sep.26	493.0	527
1975	Oct.15	162.0	173
1976	Nov.2	329.0	351
1977	Oct.30	55.0	59
1978	Oct.1	592.0	632
1979	Aug.26	321.4	343
1980	May.22	403.7	431
1981	Nov.8	703.0	751 (max)
1982	Oct.15	86.1	92
CT. 5 (DA = 930 km^2)			
1968	Mar.2	72	77
1969	Nov.5	400	430 (max)
1970	Oct.14	155	167
CT. 6 (DA = 588 km^2)			
1969	Nov.5	62.6	106
1970	Oct.31	213	362
1971	Oct.27	107	182
1972	Oct.6	196	333
1973	Sep.22	52.5	89
1974	Oct.12	363	617 (max)
1975	Oct.16	219	372
CT. 7 (DA = 403 km^2)			
1975	Nov.11	67	166
1976	Sep.8	45	112
1977	-	-	-
1978	Oct.3	171.4	425
1979	Sep.26	203.0	504
1980	Oct.1	184.0	457
1981	Nov.8	304.9	757 (max)
1982	Oct.21	25.4	63
CT. 4 (DA = 1,382 km^2)			
1975	Oct.19	81	59
1976	Nov.4	110	80
1977	Sep.23	35	25
1978	Oct.2	121	88
1979	Sep.28	107	77
1980	Oct.3	92.2	67
1981	Nov.9	260.6	189 (max)
1982	Oct.18	46.8	34

Table I-11 (2) ANNUAL MAXIMUM RIVER DISCHARGE

CT. 3 (DA = 670 km^2)

1967	Oct.3	31.3	47	
1968	May.6	23.2	35	
1969	Nov.5	63.0	94	
1970	Oct.1	155.0	231	(max)
1971	Oct.28	68.0	101	
1972	Oct.6	135.0	201	

CT. 9 (DA = 541 km^2)

1977	Oct.8	7.3	13	
1978	Oct.2	58.3	108	
1979	Sep.26	42.8	79	
1980	Oct.1	129.8	240	
1981	Nov.1	174.6	323	(max)
1982	Oct.20	55.6	103	

CT. 8 (DA = 3,256 km^2)

1975	Oct.11	161.9	50	
1976	Nov.8	121	37	
1977	Sep.26	6.6	2	
1978	Oct.6	196.6	60	(max)

2. Other River Basin

Station	DA (km^2)	Water Year	Date	Max Q (cms)	Specific Q ($1/s/km^2$)
YOM River Basin					
Y.1	7,590	1939	Aug.26	2,940	387
Y.2	5,512	1952	Sep.20	3,300	599
Y.3A	13,583	1974	Aug.19	1,643	121
Y.4	17,731	1980	Sep.10	576	32
Y.6	12,658	1961	Sep.12	3,112	246
Y.11	5,542	1957	Sep.1	2,708	489
Y.13	382	1961	Aug.22	832	2178
Y.14	12,131	1973	Sep.1	4,060	335
Y.20	5,410	1973	Aug.28	3,000	555
Y.26	785	1980	Sep.7	386	492
NAM River Basin					
N.1	4,609	1963	Sep.12	2,800	608
N.2	16,862	1952	Sep.22	4,050	240
N.4	19,384	1961	Sep.12	2,166	112
N.6A	13,173	1963	Sep.14	5,260	399
N.13	8,993	1963	Sep.13	4,350	484
N.17	1,156	1973	Aug.27	1,843	1,594
N.22	4,761	1980	Sep.11	867	182
N.23	16,336	1970	Aug.25	3,636	223
N.24	1,861	1980	Sep.7	680	365

Table I-11 (3) ANNUAL MAZIMUM RIVER DISCHARGE

Station	DA	Water Year	Date	Max Q	Specific Q
	(km^2)			(cms)	($1/s/km^2$)
N.26	17,350	1970	Aug.26	2,645	152
N.27	19,549	1966	Aug.27	1,592	81
N.28	476	1971	Jul.14	580	1,218
N.28A	368	1978	Aug.13	720	1,957
N.33	2,463	1978	Aug.13	2,196	892
N.42	2,107	1980	Jul.24	1,020	484
MEA KLONG River Basin					
K.4	26,441	1953	Aug.24	6,000	227
K.6	11,010	1962	Sep.20	2,746	249
K.8	26,421	1961	Aug.28	4,363	165
K.9	6,902	1974	Aug.21	3,958	573
K.10	7,008	1974	Aug.21	3,294	470
K.11	26,449	1974	Aug.21	3,592	136
K.13	4,042	1966	Sep,10	3,146	778
K.17	1,355	1968	Oct,22	954	704
K.19	8,437	1972	Sep.20	2,770	328
K.20	11,184	1972	Sep.20	2,251	201
K.22A	321	1982	Jul.3	438	1,364
K.27	1,921	1974	Oct.13	438	228
K.28	183	1981	Nov.7	323	1,765
PiNG River Basin					
P.1	6,355	1973	Aug.25	729	115
P.4A	1,902	1973	Aug,24	739	389
P.5	1,569	1973	Aug.26	376	240
P.13	1,765	1973	Aug.24	1,251	709
P.14	3,853	1960	Aug.21	1,030	267
P.14A	3,909	1962	Oct.2	647	166
P.19A	14,023	1973	Sep.21	1,888	135
P.21	515	1975	Sep.22	96	186
P.22	135	1963	Oct.27	63	467
P.23	1,777	1960	Dec.3	420	236
P.24	616	1964	Oct.4	421	683
P.28	1,261	1973	Aug.24	503	399
P.29	1,970	1973	Sep.20	470	239
PASAK River Basin					
S.2	14,522	1964	-	1,519	105
S.6	1,006	1956	Aug.14	825	820
S.7	177	1972	Sep.18	167	2,034
S.9	14,374	1978	Oct.3	3,254	226
S.10	268	1980	Sep.7	444	1,657
S.12	471	1978	Sep.22	173	367
S.13	359	1978	Sep.30	287	799
CHAO PARAYA River Basin					
C.1	118,816	1942	Sep.24	6,500	55
C.2	110,569	1961	Oct.13	4,721	43

Table I-12 FLOOD PROBABILITY AT CT-7

(Unit : cms)

Dam	1/10	1/20	1/100	1/200	1/500	1/1,000
Specific Discharge (cms/km^2)	0.78	1.02	1.65	1.97	2.43	2.82
Upper Mae Wong	480	630	1,010	1,210	1,490	1,730
Lower Mae Wong	730	950	1,530	1,830	2,260	2,620
Khlong Pho	310	400	650	780	960	1,110
Huai Rang	60	80	130	150	190	210
Upper Huai Rang	30	40	70	80	100	120
Khun Kaew	130	170	270	320	390	460
Lower Khun Kaew	170	220	360	430	530	620

Specific discharge at CT.7 is applied

		Return Period						
Station	N	1/5	1/10	1/20	1/100	1/200	1/500	1/1,000
CT.4	8	110	147	186	292	345	422	468
CT.5A	14	484	640	801	1,210	1,405	1,679	1,902
CT.6	7	440	596	764	1,213	1,436	1,760	2,030
CT.7	7	560	778	1,015	1,651	1,968	2,429	2,815
CT.9	6	234	330	434	716	857	1,063	1,236

N : Number of samples
Unit : $l/s/m^2$

Table I-13 PROBABLE FLOOD BY RATIONAL FORMULA

(1) Upper Mae Wong Dam — Drainage Area 612 km^2

		1/10	1/20	1/100	1/200	1/500	1/1,000
Max.R24	mm/day	166	189	238	260	296	323
n		0.49	0.43	0.36	0.34	0.30	0.28
Tp	hr	28.7	27.0	24.6	23.7	22.6	21.8
Re	mm/hr	6.3	7.5	9.8	10.9	12.6	13.8
q	cms/km^2	1.40	1.67	2.18	2.42	2.80	3.07

(2) Lower Mae Wong Dam — Drainage Area 930 km^2

		1/10	1/20	1/100	1/200	1/500	1/1,000
Max.R24	mm/day	166	189	238	260	296	323
n		0.49	0.43	0.36	0.34	0.30	0.28
Tp	hr	32.0	30.1	27.3	26.3	25.0	24.2
Re	mm/hr	6.0	7.1	9.5	10.5	12.2	13.4
q	cms/km^2	1.33	1.58	2.11	2.33	2.71	2.98

(3) Khlong Pho Dam — Drainage Area 394 km^3

		1/10	1/20	1/100	1/200	1/500	1/1,000
Max.R24	mm/day	166	189	238	260	296	323
n		0.49	0.43	0.36	0.34	0.30	0.28
Tp	hr	25.5	24.1	22.0	21.3	20.2	19.6
Re	mm/hr	6.7	7.9	10.2	11.3	13.0	14.2
q	cms/km^2	1.49	1.76	2.27	2.51	2.89	3.16

(4) Huai Rang Dam — Drainage Area 76 km^2

		1/10	1/20	1/100	1/200	1/500	1/1,000
Max.R24	mm/day	166	189	238	260	296	323
n		0.49	0.43	0.36	0.34	0.30	0.28
Tp	hr	16.5	15.8	14.5	14.1	13.5	13.1
Re	mm/hr	8.3	9.4	11.9	13.0	14.7	15.9
q	cms/km^2	1.84	2.09	2.64	2.89	3.27	3.53

(5) Upper Huai Rang Dam — Drainage Area 41 km^2

		1/10	1/20	1/100	1/200	1/500	1/1,000
Max.R24	mm/day	166	189	238	260	296	323
n		0.49	0.43	0.36	0.34	0.30	0.28
Tp	hr	14.0	13.4	12.4	12.1	11.6	11.3
Re	mm/hr	9.0	10.1	12.6	13.7	15.3	16.6
q	cms/km^2	2.00	2.24	2.80	3.04	3.40	3.69

(6) Khun Kaew Dam — Drainage Area 162 km^2

		1/10	1/20	1/100	1/200	1/500	1/1,000
Max.R24	mm/day	166	189	238	260	296	323
n		0.49	0.43	0.36	0.34	0.30	0.28
Tp	hr	20.1	19.2	17.6	17.0	16.3	15.8
Re	mm/hr	7.5	8.7	11.1	12.2	13.9	15.1
q	cms/km^2	1.67	1.93	2.47	2.71	3.09	3.36

(7) Lower Khun Kaew Dam — Drainage Area 219 km^2

		1/10	1/20	1/100	1/200	1/500	1/1,000
Max.R24	mm/day	166	189	238	260	296	323
n		0.49	0.43	0.36	0.34	0.30	0.28
Tp	hr	21.8	20.7	19.0	18.4	17.5	17.0
Re	mm/hr	7.3	8.4	10.8	11.9	13.6	14.8
q	cms/km^2	1.62	1.87	2.40	2.64	3.02	3.29

FLOOD ANALYSIS BY NAKAYASU METHOD

D	HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
7	4	9.2	6.4	0.629E-02	10.040
7	5	4.8	3.4	0.332E-01	10.235
7	6	11.2	7.8	0.878E-01	10.726
7	7	10.4	7.3	0.175E+00	11.729
7	8	0.0	0.0	0.299E+00	13.446
7	9	0.0	0.0	0.464E+00	16.004
7	10	1.2	0.8	0.671E+00	19.507
7	11	3.0	2.1	0.925E+00	24.064
7	12	0.0	0.0	0.123E+01	29.787
7	13	0.0	0.0	0.158E+01	36.761
7	14	0.0	0.0	0.199E+01	45.063
7	15	2.7	1.9	0.245E+01	54.773
7	16	13.6	9.5	0.296E+01	66.042
7	17	16.1	11.3	0.354E+01	79.150
7	18	1.8	1.3	0.418E+01	94.400
7	19	29.0	20.3	0.488E+01	112.125
7	20	5.2	3.6	0.564E+01	132.799
7	21	3.8	2.7	0.647E+01	156.775
7	22	1.8	1.3	0.737E+01	184.349
7	23	6.2	4.3	0.834E+01	215.801
7	24	10.8	7.6	0.937E+01	251.453
8	1	6.8	4.8	0.105E+02	291.665
8	2	4.5	3.1	0.117E+02	336.777
8	3	9.5	6.6	0.108E+02	373.406
8	4	9.4	6.6	0.997E+01	408.436
8	5	2.4	1.7	0.922E+01	432.621
8	6	1.3	0.9	0.853E+01	447.337
8	7	0.0	0.0	0.789E+01	468.198
8	8	0.0	0.0	0.729E+01	495.305
8	9	0.0	0.0	0.675E+01	526.960
8	10	0.0	0.0	0.624E+01	560.558
8	11	0.0	0.0	0.577E+01	600.632
8	12	0.0	0.0	0.534E+01	647.242
8	13	0.0	0.0	0.493E+01	700.452
8	14	0.0	0.0	0.456E+01	756.297
8	15	0.0	0.0	0.422E+01	798.563
8	16	0.0	0.0	0.390E+01	823.484
8	17	0.0	0.0	0.361E+01	852.278
8	18	0.0	0.0	0.339E+01	844.629
8	19	0.0	0.0	0.322E+01	835.785
8	20	0.0	0.0	0.305E+01	827.703
8	21	0.0	0.0	0.290E+01	823.211
8	22	0.0	0.0	0.275E+01	815.074
8	23	0.0	0.0	0.261E+01	795.959
8	24	0.0	0.0	0.248E+01	771.635
9	1	0.0	0.0	0.235E+01	745.373
9	2	0.0	0.0	0.223E+01	709.381
9	3	0.0	0.0	0.212E+01	663.452
9	4	0.0	0.0	0.201E+01	617.726
9	5	0.0	0.0	0.191E+01	573.665
9	6	0.0	0.0	0.181E+01	533.397
9	7	0.0	0.0	0.172E+01	496.955
9	8	0.0	0.0	0.163E+01	463.542
9	9	0.0	0.0	0.155E+01	433.588
9	10	0.0	0.0	0.147E+01	406.534
9	11	0.0	0.0	0.140E+01	381.530

D	HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
9	12	0.0	0.0	0.133E+01	358.316
9	13	0.0	0.0	0.126E+01	336.877
9	14	0.0	0.0	0.120E+01	317.349
9	15	0.0	0.0	0.113E+01	299.531
9	16	0.0	0.0	0.108E+01	283.108
9	17	0.0	0.0	0.103E+01	268.143
9	18	0.0	0.0	0.990E+00	254.651
9	19	0.0	0.0	0.952E+00	242.255
9	20	0.0	0.0	0.915E+00	230.694
9	21	0.0	0.0	0.880E+00	219.789
9	22	0.0	0.0	0.846E+00	209.426
9	23	0.0	0.0	0.814E+00	199.584
9	24	0.0	0.0	0.783E+00	190.251
10	1	0.0	0.0	0.753E+00	181.393
10	2	0.0	0.0	0.724E+00	172.974
10	3	0.0	0.0	0.696E+00	164.971
10	4	0.0	0.0	0.669E+00	157.377
10	5	0.0	0.0	0.644E+00	150.234
10	6	0.0	0.0	0.619E+00	143.577
10	7	0.0	0.0	0.595E+00	137.320
10	8	0.0	0.0	0.573E+00	131.504
10	9	0.0	0.0	0.551E+00	126.113
10	10	0.0	0.0	0.529E+00	121.007
10	11	0.0	0.0	0.509E+00	116.155
10	12	0.0	0.0	0.490E+00	111.557
10	13	0.0	0.0	0.471E+00	107.240
10	14	0.0	0.0	0.453E+00	103.189
10	15	0.0	0.0	0.435E+00	99.363
10	16	0.0	0.0	0.419E+00	95.760
10	17	0.0	0.0	0.403E+00	92.391
10	18	0.0	0.0	0.387E+00	89.208
10	19	0.0	0.0	0.372E+00	86.165
10	20	0.0	0.0	0.358E+00	83.245
10	21	0.0	0.0	0.344E+00	80.437
10	22	0.0	0.0	0.331E+00	77.737
10	23	0.0	0.0	0.319E+00	75.140
10	24	0.0	0.0	0.306E+00	72.643
11	1	0.0	0.0	0.295E+00	70.242
11	2	0.0	0.0	0.283E+00	67.932
11	3	0.0	0.0	0.272E+00	65.711
11	4	0.0	0.0	0.262E+00	63.576
11	5	0.0	0.0	0.252E+00	61.522
11	6	0.0	0.0	0.242E+00	59.547
11	7	0.0	0.0	0.233E+00	57.647
11	8	0.0	0.0	0.224E+00	55.821
11	9	0.0	0.0	0.215E+00	54.064
11	10	0.0	0.0	0.207E+00	52.375
11	11	0.0	0.0	0.199E+00	50.750
11	12	0.0	0.0	0.192E+00	49.188
11	13	0.0	0.0	0.184E+00	47.686
11	14	0.0	0.0	0.177E+00	46.241
11	15	0.0	0.0	0.170E+00	44.852
11	16	0.0	0.0	0.164E+00	43.516
11	17	0.0	0.0	0.158E+00	42.231
11	18	0.0	0.0	0.152E+00	40.995
11	19	0.0	0.0	0.146E+00	39.807

D	HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
11	20	0.0	0.0	0.140E+00	38.664
11	21	0.0	0.0	0.135E+00	37.565
11	22	0.0	0.0	0.130E+00	36.509
11	23	0.0	0.0	0.125E+00	35.492
11	24	0.0	0.0	0.120E+00	34.515
12	1	0.0	0.0	0.115E+00	33.575
12	2	0.0	0.0	0.111E+00	32.672
12	3	0.0	0.0	0.107E+00	31.802
12	4	0.0	0.0	0.103E+00	30.967
12	5	0.0	0.0	0.986E-01	30.163
12	6	0.0	0.0	0.0	28.779
12	7	0.0	0.0	0.0	27.741
12	8	0.0	0.0	0.0	26.317
12	9	0.0	0.0	0.0	25.002
12	10	0.0	0.0	0.0	24.426
12	11	0.0	0.0	0.0	23.873
12	12	0.0	0.0	0.0	23.262
12	13	0.0	0.0	0.0	22.554
12	14	0.0	0.0	0.0	22.073
12	15	0.0	0.0	0.0	21.610
12	16	0.0	0.0	0.0	21.165
12	17	0.0	0.0	0.0	20.558
12	18	0.0	0.0	0.0	19.251
12	19	0.0	0.0	0.0	17.827
12	20	0.0	0.0	0.0	17.408
12	21	0.0	0.0	0.0	15.199
12	22	0.0	0.0	0.0	14.655
12	23	0.0	0.0	0.0	14.224
12	24	0.0	0.0	0.0	13.943
13	1	0.0	0.0	0.0	13.380
13	2	0.0	0.0	0.0	12.534
13	3	0.0	0.0	0.0	11.985
13	4	0.0	0.0	0.0	11.610
13	5	0.0	0.0	0.0	10.918
13	6	0.0	0.0	0.0	10.259
13	7	0.0	0.0	0.0	10.090
13	8	0.0	0.0	0.0	10.000

Table I-14 UNIT HYDROGRAPH SIMULATION

FLOOD ANALYSIS BY NAKAYASU METHOD

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
1	1	15.8	11.1	0.411E-02	0.045
1	2	8.2	5.7	0.217E-01	0.264
1	3	19.2	13.4	0.574E-01	0.815
1	4	17.8	12.5	0.115E+00	1.939
1	5	0.0	0.0	0.196E+00	3.864
1	6	0.0	0.0	0.303E+00	6.731
1	7	2.1	1.5	0.439E+00	10.656
1	8	5.1	3.6	0.605E+00	15.764
1	9	0.0	0.0	0.802E+00	22.177
1	10	0.0	0.0	0.103E+01	29.993
1	11	0.0	0.0	0.130E+01	39.297
1	12	4.6	3.2	0.160E+01	50.179
1	13	23.3	16.3	0.194E+01	62.807
1	14	27.7	19.4	0.232E+01	77.495
1	15	3.1	2.2	0.273E+01	94.583
1	16	49.8	34.9	0.319E+01	114.446
1	17	8.9	6.2	0.369E+01	137.616
1	18	6.5	4.5	0.423E+01	164.488
1	19	3.1	2.2	0.482E+01	195.395
1	20	10.6	7.4	0.545E+01	230.650
1	21	18.5	12.9	0.613E+01	270.614
1	22	11.7	8.2	0.685E+01	315.691
1	23	7.7	5.4	0.762E+01	366.262
1	24	16.3	11.4	0.705E+01	407.300
2	1	0.0	0.0	0.652E+01	446.528
2	2	0.0	0.0	0.603E+01	473.441
2	3	0.0	0.0	0.558E+01	489.519
2	4	0.0	0.0	0.516E+01	512.172
2	5	0.0	0.0	0.477E+01	541.469
2	6	0.0	0.0	0.441E+01	575.428
2	7	0.0	0.0	0.408E+01	611.177
2	8	0.0	0.0	0.377E+01	653.724
2	9	0.0	0.0	0.349E+01	703.114
2	10	0.0	0.0	0.323E+01	759.392
2	11	0.0	0.0	0.298E+01	818.118
2	12	0.0	0.0	0.276E+01	861.084
2	13	0.0	0.0	0.255E+01	883.936
2	14	0.0	0.0	0.236E+01	910.520
2	15	0.0	0.0	0.222E+01	895.562
2	16	0.0	0.0	0.210E+01	878.646
2	17	0.0	0.0	0.200E+01	861.949
2	18	0.0	0.0	0.190E+01	848.594
2	19	0.0	0.0	0.180E+01	830.503
2	20	0.0	0.0	0.171E+01	799.424
2	21	0.0	0.0	0.162E+01	761.753
2	22	0.0	0.0	0.154E+01	721.197
2	23	0.0	0.0	0.146E+01	668.981
2	24	0.0	0.0	0.139E+01	620.590
3	1	0.0	0.0	0.132E+01	575.740
3	2	0.0	0.0	0.125E+01	534.281

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
3	3	0.0	0.0	0.119E+01	496.477
3	4	0.0	0.0	0.113E+01	462.412
3	5	0.0	0.0	0.107E+01	431.234
3	6	0.0	0.0	0.101E+01	403.464
3	7	0.0	0.0	0.963E+00	378.508
3	8	0.0	0.0	0.914E+00	355.446
3	9	0.0	0.0	0.868E+00	334.017
3	10	0.0	0.0	0.823E+00	314.231
3	11	0.0	0.0	0.782E+00	296.267
3	12	0.0	0.0	0.742E+00	279.927
3	13	0.0	0.0	0.704E+00	264.875
3	14	0.0	0.0	0.673E+00	251.207
3	15	0.0	0.0	0.647E+00	238.567
3	16	0.0	0.0	0.622E+00	226.647
3	17	0.0	0.0	0.598E+00	215.436
3	18	0.0	0.0	0.575E+00	204.834
3	19	0.0	0.0	0.553E+00	194.758
3	20	0.0	0.0	0.532E+00	185.188
3	21	0.0	0.0	0.512E+00	176.113
3	22	0.0	0.0	0.492E+00	167.501
3	23	0.0	0.0	0.473E+00	159.314
3	24	0.0	0.0	0.455E+00	151.530
4	1	0.0	0.0	0.438E+00	144.144
4	2	0.0	0.0	0.421E+00	137.206
4	3	0.0	0.0	0.405E+00	130.758
4	4	0.0	0.0	0.389E+00	124.709
4	5	0.0	0.0	0.374E+00	119.105
4	6	0.0	0.0	0.360E+00	113.931
4	7	0.0	0.0	0.346E+00	109.032
4	8	0.0	0.0	0.333E+00	104.376
4	9	0.0	0.0	0.320E+00	99.964
4	10	0.0	0.0	0.308E+00	95.830
4	11	0.0	0.0	0.296E+00	91.959
4	12	0.0	0.0	0.285E+00	88.305
4	13	0.0	0.0	0.274E+00	84.869
4	14	0.0	0.0	0.263E+00	81.616
4	15	0.0	0.0	0.253E+00	78.487
4	16	0.0	0.0	0.244E+00	75.478
4	17	0.0	0.0	0.234E+00	72.584
4	18	0.0	0.0	0.225E+00	69.802
4	19	0.0	0.0	0.217E+00	67.126
4	20	0.0	0.0	0.208E+00	64.553
4	21	0.0	0.0	0.200E+00	62.078
4	22	0.0	0.0	0.193E+00	59.698
4	23	0.0	0.0	0.185E+00	57.410
4	24	0.0	0.0	0.178E+00	55.209
5	1	0.0	0.0	0.171E+00	53.092
5	2	0.0	0.0	0.165E+00	51.057
5	3	0.0	0.0	0.158E+00	49.100
5	4	0.0	0.0	0.152E+00	47.217

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
5	5	0.0	0.0	0.147E+00	45.407
5	6	0.0	0.0	0.141E+00	43.666
5	7	0.0	0.0	0.135E+00	41.992
5	8	0.0	0.0	0.130E+00	40.383
5	9	0.0	0.0	0.125E+00	38.835
5	10	0.0	0.0	0.120E+00	37.346
5	11	0.0	0.0	0.116E+00	35.914
5	12	0.0	0.0	0.111E+00	34.537
5	13	0.0	0.0	0.107E+00	33.213
5	14	0.0	0.0	0.103E+00	31.940
5	15	0.0	0.0	0.991E-01	30.716
5	16	0.0	0.0	0.953E-01	29.538
5	17	0.0	0.0	0.916E-01	28.406
5	18	0.0	0.0	0.881E-01	27.317
5	19	0.0	0.0	0.848E-01	26.269
5	20	0.0	0.0	0.815E-01	25.262
5	21	0.0	0.0	0.784E-01	24.294
5	22	0.0	0.0	0.754E-01	23.363
5	23	0.0	0.0	0.725E-01	22.467
5	24	0.0	0.0	0.697E-01	21.606
6	1	0.0	0.0	0.670E-01	20.777
6	2	0.0	0.0	0.645E-01	19.981
6	3	0.0	0.0	0.0	18.529
6	4	0.0	0.0	0.0	17.463
6	5	0.0	0.0	0.0	15.960
6	6	0.0	0.0	0.0	14.576
6	7	0.0	0.0	0.0	14.017
6	8	0.0	0.0	0.0	13.480
6	9	0.0	0.0	0.0	12.872
6	10	0.0	0.0	0.0	12.157
6	11	0.0	0.0	0.0	11.691
6	12	0.0	0.0	0.0	11.243
6	13	0.0	0.0	0.0	10.812
6	14	0.0	0.0	0.0	10.198
6	15	0.0	0.0	0.0	8.796
6	16	0.0	0.0	0.0	7.257
6	17	0.0	0.0	0.0	6.844
6	18	0.0	0.0	0.0	4.420
6	19	0.0	0.0	0.0	3.865
6	20	0.0	0.0	0.0	3.434
6	21	0.0	0.0	0.0	3.168
6	22	0.0	0.0	0.0	2.587
6	23	0.0	0.0	0.0	1.685
6	24	0.0	0.0	0.0	1.112
7	1	0.0	0.0	0.0	0.736
7	2	0.0	0.0	0.0	0.0

Table I-15 (1) UNIT HYDROGRAPH CALCULATION -UPPER MAE WONG DAM- Case 1

FLOOD ANALYSIS BY NAKAYASU METHOD

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
1	1	15.8	11.1	0.625E-02	0.069
1	2	8.2	5.7	0.330E-01	0.401
1	3	19.2	13.4	0.873E-01	1.238
1	4	17.8	12.5	0.174E+00	2.947
1	5	0.0	0.0	0.297E+00	5.872
1	6	0.0	0.0	0.461E+00	10.228
1	7	2.1	1.5	0.667E+00	16.193
1	8	5.1	3.6	0.919E+00	23.955
1	9	0.0	0.0	0.122E+01	33.701
1	10	0.0	0.0	0.157E+01	45.578
1	11	0.0	0.0	0.197E+01	59.716
1	12	4.6	3.2	0.243E+01	76.252
1	13	23.3	16.3	0.295E+01	95.441
1	14	27.7	19.4	0.352E+01	117.762
1	15	3.1	2.2	0.415E+01	143.729
1	16	49.8	34.9	0.485E+01	173.913
1	17	8.9	6.2	0.561E+01	209.123
1	18	6.5	4.5	0.643E+01	249.957
1	19	3.1	2.2	0.732E+01	296.924
1	20	10.6	7.4	0.828E+01	350.497
1	21	18.5	12.9	0.931E+01	411.227
1	22	11.7	8.2	0.104E+02	479.727
1	23	7.7	5.4	0.116E+02	556.575
1	24	16.3	11.4	0.107E+02	618.936
2	1	0.0	0.0	0.991E+01	678.548
2	2	0.0	0.0	0.916E+01	719.444
2	3	0.0	0.0	0.847E+01	743.876
2	4	0.0	0.0	0.784E+01	778.301
2	5	0.0	0.0	0.725E+01	822.822
2	6	0.0	0.0	0.670E+01	874.426
2	7	0.0	0.0	0.620E+01	928.749
2	8	0.0	0.0	0.573E+01	993.405
2	9	0.0	0.0	0.530E+01	1068.459
2	10	0.0	0.0	0.490E+01	1153.979
2	11	0.0	0.0	0.453E+01	1243.219
2	12	0.0	0.0	0.419E+01	1308.510
2	13	0.0	0.0	0.388E+01	1343.237
2	14	0.0	0.0	0.359E+01	1383.635
2	15	0.0	0.0	0.337E+01	1360.903
2	16	0.0	0.0	0.320E+01	1335.197
2	17	0.0	0.0	0.304E+01	1309.824
2	18	0.0	0.0	0.288E+01	1289.532
2	19	0.0	0.0	0.273E+01	1262.040
2	20	0.0	0.0	0.260E+01	1214.811
2	21	0.0	0.0	0.246E+01	1157.567
2	22	0.0	0.0	0.234E+01	1095.937
2	23	0.0	0.0	0.222E+01	1016.590
2	24	0.0	0.0	0.211E+01	943.054
3	1	0.0	0.0	0.200E+01	874.899
3	2	0.0	0.0	0.190E+01	811.897

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
3	3	0.0	0.0	0.180E+01	754.450
3	4	0.0	0.0	0.171E+01	702.685
3	5	0.0	0.0	0.162E+01	655.307
3	6	0.0	0.0	0.154E+01	613.107
3	7	0.0	0.0	0.146E+01	575.184
3	8	0.0	0.0	0.139E+01	540.139
3	9	0.0	0.0	0.132E+01	507.574
3	10	0.0	0.0	0.125E+01	477.508
3	11	0.0	0.0	0.119E+01	450.210
3	12	0.0	0.0	0.113E+01	425.379
3	13	0.0	0.0	0.107E+01	402.505
3	14	0.0	0.0	0.102E+01	381.734
3	15	0.0	0.0	0.993E+00	362.527
3	16	0.0	0.0	0.946E+00	344.414
3	17	0.0	0.0	0.909E+00	327.377
3	18	0.0	0.0	0.874E+00	311.267
3	19	0.0	0.0	0.841E+00	295.956
3	20	0.0	0.0	0.809E+00	281.412
3	21	0.0	0.0	0.778E+00	267.622
3	22	0.0	0.0	0.748E+00	254.536
3	23	0.0	0.0	0.719E+00	242.095
3	24	0.0	0.0	0.692E+00	230.266
4	1	0.0	0.0	0.665E+00	219.043
4	2	0.0	0.0	0.640E+00	208.499
4	3	0.0	0.0	0.615E+00	198.701
4	4	0.0	0.0	0.592E+00	189.508
4	5	0.0	0.0	0.569E+00	180.993
4	6	0.0	0.0	0.547E+00	173.130
4	7	0.0	0.0	0.526E+00	165.685
4	8	0.0	0.0	0.506E+00	158.610
4	9	0.0	0.0	0.487E+00	151.906
4	10	0.0	0.0	0.468E+00	145.623
4	11	0.0	0.0	0.450E+00	139.742
4	12	0.0	0.0	0.433E+00	134.188
4	13	0.0	0.0	0.416E+00	128.968
4	14	0.0	0.0	0.400E+00	124.024
4	15	0.0	0.0	0.385E+00	119.269
4	16	0.0	0.0	0.370E+00	114.697
4	17	0.0	0.0	0.356E+00	110.300
4	18	0.0	0.0	0.342E+00	106.071
4	19	0.0	0.0	0.329E+00	102.005
4	20	0.0	0.0	0.316E+00	98.095
4	21	0.0	0.0	0.304E+00	94.334
4	22	0.0	0.0	0.293E+00	90.718
4	23	0.0	0.0	0.281E+00	87.240
4	24	0.0	0.0	0.271E+00	83.895
5	1	0.0	0.0	0.260E+00	80.679
5	2	0.0	0.0	0.250E+00	77.586
5	3	0.0	0.0	0.241E+00	74.612
5	4	0.0	0.0	0.232E+00	71.752

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
5	5	0.0	0.0	0.223E+00	69.001
5	6	0.0	0.0	0.214E+00	66.356
5	7	0.0	0.0	0.206E+00	63.812
5	8	0.0	0.0	0.198E+00	61.366
5	9	0.0	0.0	0.190E+00	59.013
5	10	0.0	0.0	0.183E+00	56.751
5	11	0.0	0.0	0.176E+00	54.575
5	12	0.0	0.0	0.169E+00	52.483
5	13	0.0	0.0	0.163E+00	50.471
5	14	0.0	0.0	0.157E+00	48.536
5	15	0.0	0.0	0.151E+00	46.676
5	16	0.0	0.0	0.145E+00	44.886
5	17	0.0	0.0	0.139E+00	43.165
5	18	0.0	0.0	0.134E+00	41.511
5	19	0.0	0.0	0.129E+00	39.919
5	20	0.0	0.0	0.124E+00	38.389
5	21	0.0	0.0	0.119E+00	36.917
5	22	0.0	0.0	0.115E+00	35.502
5	23	0.0	0.0	0.110E+00	34.141
5	24	0.0	0.0	0.106E+00	32.832
6	1	0.0	0.0	0.102E+00	31.574
6	2	0.0	0.0	0.980E-01	30.363
6	3	0.0	0.0	0.0	28.157
6	4	0.0	0.0	0.0	26.537
6	5	0.0	0.0	0.0	24.254
6	6	0.0	0.0	0.0	22.150
6	7	0.0	0.0	0.0	21.301
6	8	0.0	0.0	0.0	20.484
6	9	0.0	0.0	0.0	19.560
6	10	0.0	0.0	0.0	18.474
6	11	0.0	0.0	0.0	17.766
6	12	0.0	0.0	0.0	17.085
6	13	0.0	0.0	0.0	16.430
6	14	0.0	0.0	0.0	15.497
6	15	0.0	0.0	0.0	13.366
6	16	0.0	0.0	0.0	11.027
6	17	0.0	0.0	0.0	10.400
6	18	0.0	0.0	0.0	6.717
6	19	0.0	0.0	0.0	5.873
6	20	0.0	0.0	0.0	5.219
6	21	0.0	0.0	0.0	4.814
6	22	0.0	0.0	0.0	3.931
6	23	0.0	0.0	0.0	2.560
6	24	0.0	0.0	0.0	1.690
7	1	0.0	0.0	0.0	1.118
7	2	0.0	0.0	0.0	0.0

Table I-15 (2) UNIT HYDROGRAPH CALCULATION -LOWER MAE WONG DAM- Case 1

FLOOD ANALYSIS BY NAKAYASU METHOD

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
1	1	15.8	11.1	0.265E-02	0.029
1	2	8.2	5.7	0.140E-01	0.170
1	3	19.2	13.4	0.370E-01	0.525
1	4	17.8	12.5	0.737E-01	1.249
1	5	0.0	0.0	0.126E+00	2.489
1	6	0.0	0.0	0.195E+00	4.333
1	7	2.1	1.5	0.282E+00	6.860
1	8	5.1	3.6	0.389E+00	10.149
1	9	0.0	0.0	0.516E+00	14.278
1	10	0.0	0.0	0.665E+00	19.309
1	11	0.0	0.0	0.836E+00	25.299
1	12	4.6	3.2	0.103E+01	32.305
1	13	23.3	16.3	0.125E+01	40.434
1	14	27.7	19.4	0.149E+01	49.890
1	15	3.1	2.2	0.176E+01	60.892
1	16	49.8	34.9	0.205E+01	73.679
1	17	8.9	6.2	0.238E+01	88.596
1	18	6.5	4.5	0.273E+01	105.896
1	19	3.1	2.2	0.310E+01	125.794
1	20	10.6	7.4	0.351E+01	148.490
1	21	18.5	12.9	0.395E+01	174.219
1	22	11.7	8.2	0.441E+01	203.239
1	23	7.7	5.4	0.491E+01	235.797
1	24	16.3	11.4	0.454E+01	262.216
2	1	0.0	0.0	0.420E+01	287.471
2	2	0.0	0.0	0.388E+01	304.797
2	3	0.0	0.0	0.359E+01	315.148
2	4	0.0	0.0	0.332E+01	329.732
2	5	0.0	0.0	0.307E+01	348.594
2	6	0.0	0.0	0.284E+01	370.456
2	7	0.0	0.0	0.263E+01	393.470
2	8	0.0	0.0	0.243E+01	420.861
2	9	0.0	0.0	0.225E+01	452.658
2	10	0.0	0.0	0.208E+01	488.890
2	11	0.0	0.0	0.192E+01	526.697
2	12	0.0	0.0	0.178E+01	554.357
2	13	0.0	0.0	0.164E+01	569.069
2	14	0.0	0.0	0.152E+01	586.184
2	15	0.0	0.0	0.143E+01	576.553
2	16	0.0	0.0	0.135E+01	565.664
2	17	0.0	0.0	0.129E+01	554.914
2	18	0.0	0.0	0.122E+01	546.317
2	19	0.0	0.0	0.116E+01	534.670
2	20	0.0	0.0	0.110E+01	514.661
2	21	0.0	0.0	0.104E+01	490.409
2	22	0.0	0.0	0.991E+00	464.300
2	23	0.0	0.0	0.941E+00	430.684
2	24	0.0	0.0	0.893E+00	399.530
3	1	0.0	0.0	0.847E+00	370.656
3	2	0.0	0.0	0.804E+00	343.965
3	3	0.0	0.0	0.764E+00	319.627
3	4	0.0	0.0	0.725E+00	297.697
3	5	0.0	0.0	0.688E+00	277.625
3	6	0.0	0.0	0.653E+00	259.747
3	7	0.0	0.0	0.620E+00	243.681
3	8	0.0	0.0	0.588E+00	228.834
3	9	0.0	0.0	0.559E+00	215.037
3	10	0.0	0.0	0.530E+00	202.299
3	11	0.0	0.0	0.503E+00	190.735
3	12	0.0	0.0	0.478E+00	180.215
3	13	0.0	0.0	0.453E+00	170.524
3	14	0.0	0.0	0.433E+00	161.724
3	15	0.0	0.0	0.417E+00	153.587
3	16	0.0	0.0	0.401E+00	145.913
3	17	0.0	0.0	0.385E+00	138.695
3	18	0.0	0.0	0.370E+00	131.870
3	19	0.0	0.0	0.356E+00	125.383
3	20	0.0	0.0	0.343E+00	119.222
3	21	0.0	0.0	0.329E+00	113.380
3	22	0.0	0.0	0.317E+00	107.836
3	23	0.0	0.0	0.305E+00	102.565
3	24	0.0	0.0	0.293E+00	97.554
4	1	0.0	0.0	0.282E+00	92.799
4	2	0.0	0.0	0.271E+00	88.332
4	3	0.0	0.0	0.261E+00	84.181
4	4	0.0	0.0	0.251E+00	80.286
4	5	0.0	0.0	0.241E+00	76.679
4	6	0.0	0.0	0.232E+00	73.348
4	7	0.0	0.0	0.223E+00	70.193
4	8	0.0	0.0	0.214E+00	67.196
4	9	0.0	0.0	0.206E+00	64.356
4	10	0.0	0.0	0.198E+00	61.694
4	11	0.0	0.0	0.191E+00	59.202
4	12	0.0	0.0	0.183E+00	56.850
4	13	0.0	0.0	0.176E+00	54.638
4	14	0.0	0.0	0.170E+00	52.543
4	15	0.0	0.0	0.163E+00	50.529
4	16	0.0	0.0	0.157E+00	48.592
4	17	0.0	0.0	0.151E+00	46.729
4	18	0.0	0.0	0.145E+00	44.938
4	19	0.0	0.0	0.139E+00	43.215
4	20	0.0	0.0	0.134E+00	41.558
4	21	0.0	0.0	0.129E+00	39.965
4	22	0.0	0.0	0.124E+00	38.433
4	23	0.0	0.0	0.119E+00	36.960
4	24	0.0	0.0	0.115E+00	35.543
5	1	0.0	0.0	0.110E+00	34.180
5	2	0.0	0.0	0.106E+00	32.870
5	3	0.0	0.0	0.102E+00	31.610
5	4	0.0	0.0	0.981E-01	30.398
5	5	0.0	0.0	0.943E-01	29.233
5	6	0.0	0.0	0.907E-01	28.112
5	7	0.0	0.0	0.872E-01	27.034
5	8	0.0	0.0	0.839E-01	25.998
5	9	0.0	0.0	0.807E-01	25.001
5	10	0.0	0.0	0.776E-01	24.043
5	11	0.0	0.0	0.746E-01	23.121
5	12	0.0	0.0	0.717E-01	22.235
5	13	0.0	0.0	0.690E-01	21.382
5	14	0.0	0.0	0.663E-01	20.563
5	15	0.0	0.0	0.638E-01	19.774
5	16	0.0	0.0	0.614E-01	19.016
5	17	0.0	0.0	0.590E-01	18.287
5	18	0.0	0.0	0.567E-01	17.586
5	19	0.0	0.0	0.546E-01	16.912
5	20	0.0	0.0	0.525E-01	16.264
5	21	0.0	0.0	0.505E-01	15.640
5	22	0.0	0.0	0.485E-01	15.041
5	23	0.0	0.0	0.467E-01	14.464
5	24	0.0	0.0	0.449E-01	13.910
6	1	0.0	0.0	0.432E-01	13.376
6	2	0.0	0.0	0.415E-01	12.864
6	3	0.0	0.0	0.0	11.929
6	4	0.0	0.0	0.0	11.243
6	5	0.0	0.0	0.0	10.275
6	6	0.0	0.0	0.0	9.384
6	7	0.0	0.0	0.0	9.024
6	8	0.0	0.0	0.0	8.678
6	9	0.0	0.0	0.0	8.287
6	10	0.0	0.0	0.0	7.827
6	11	0.0	0.0	0.0	7.527
6	12	0.0	0.0	0.0	7.238
6	13	0.0	0.0	0.0	6.961
6	14	0.0	0.0	0.0	6.565
6	15	0.0	0.0	0.0	5.663
6	16	0.0	0.0	0.0	4.672
6	17	0.0	0.0	0.0	4.406
6	18	0.0	0.0	0.0	2.846
6	19	0.0	0.0	0.0	2.488
6	20	0.0	0.0	0.0	2.211
6	21	0.0	0.0	0.0	2.040
6	22	0.0	0.0	0.0	1.665
6	23	0.0	0.0	0.0	1.085
6	24	0.0	0.0	0.0	0.716
7	1	0.0	0.0	0.0	0.474
7	2	0.0	0.0	0.0	0.0

Table I-15 (3) UNIT HYDROGRAPH CALCULATION -KHLONG PHO DAM- Case 1

FLOOD ANALYSIS BY NAKAYASU METHOD

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
1	1	7.2	5.0	0.411E-02	0.021
1	2	7.3	5.1	0.217E-01	0.130
1	3	7.4	5.2	0.574E-01	0.422
1	4	7.7	5.4	0.115E+00	1.005
1	5	7.9	5.5	0.176E+00	2.008
1	6	8.0	5.6	0.303E+00	3.572
1	7	8.3	5.8	0.439E+00	5.850
1	8	8.5	5.9	0.605E+00	9.012
1	9	8.7	6.1	0.802E+00	13.236
1	10	9.2	6.4	0.103E+01	18.718
1	11	9.5	6.6	0.130E+01	25.663
1	12	9.8	6.9	0.160E+01	34.294
1	13	10.6	7.4	0.194E+01	44.846
1	14	11.2	7.8	0.232E+01	57.573
1	15	11.8	8.3	0.273E+01	72.746
1	16	13.8	9.7	0.319E+01	90.659
1	17	15.5	10.8	0.367E+01	111.634
1	18	18.5	12.9	0.423E+01	136.036
1	19	31.9	22.3	0.482E+01	164.307
1	20	12.6	8.8	0.545E+01	196.947
1	21	10.2	7.1	0.613E+01	234.391
1	22	8.9	6.2	0.685E+01	277.041
1	23	8.1	5.7	0.762E+01	325.279
1	24	7.5	5.2	0.705E+01	372.453
2	1	0.0	0.0	0.652E+01	418.770
2	2	0.0	0.0	0.603E+01	464.365
2	3	0.0	0.0	0.558E+01	509.130
2	4	0.0	0.0	0.516E+01	553.111
2	5	0.0	0.0	0.477E+01	596.227
2	6	0.0	0.0	0.441E+01	638.269
2	7	0.0	0.0	0.408E+01	679.095
2	8	0.0	0.0	0.377E+01	713.558
2	9	0.0	0.0	0.349E+01	756.117
2	10	0.0	0.0	0.323E+01	791.515
2	11	0.0	0.0	0.298E+01	824.398
2	12	0.0	0.0	0.276E+01	853.917
2	13	0.0	0.0	0.255E+01	879.396
2	14	0.0	0.0	0.236E+01	900.133
2	15	0.0	0.0	0.222E+01	914.208
2	16	0.0	0.0	0.210E+01	919.884
2	17	0.0	0.0	0.200E+01	913.995
2	18	0.0	0.0	0.190E+01	883.203
2	19	0.0	0.0	0.180E+01	845.962
2	20	0.0	0.0	0.171E+01	804.262
2	21	0.0	0.0	0.162E+01	759.016
2	22	0.0	0.0	0.154E+01	710.656
2	23	0.0	0.0	0.146E+01	659.413
2	24	0.0	0.0	0.139E+01	617.265
3	1	0.0	0.0	0.132E+01	568.906
3	2	0.0	0.0	0.125E+01	529.049
3	3	0.0	0.0	0.119E+01	492.444
3	4	0.0	0.0	0.113E+01	458.859
3	5	0.0	0.0	0.107E+01	428.077
3	6	0.0	0.0	0.101E+01	399.931
3	7	0.0	0.0	0.963E+00	374.276
3	8	0.0	0.0	0.914E+00	351.004
3	9	0.0	0.0	0.869E+00	330.281
3	10	0.0	0.0	0.825E+00	311.612
3	11	0.0	0.0	0.782E+00	294.469
3	12	0.0	0.0	0.742E+00	278.662
3	13	0.0	0.0	0.704E+00	264.052
3	14	0.0	0.0	0.673E+00	250.543
3	15	0.0	0.0	0.647E+00	237.883
3	16	0.0	0.0	0.622E+00	225.908
3	17	0.0	0.0	0.598E+00	214.583
3	18	0.0	0.0	0.575E+00	203.873
3	19	0.0	0.0	0.553E+00	193.747
3	20	0.0	0.0	0.532E+00	184.176
3	21	0.0	0.0	0.512E+00	175.130
3	22	0.0	0.0	0.492E+00	166.584
3	23	0.0	0.0	0.473E+00	158.512
3	24	0.0	0.0	0.455E+00	150.891
4	1	0.0	0.0	0.438E+00	143.698
4	2	0.0	0.0	0.421E+00	136.913
4	3	0.0	0.0	0.405E+00	130.519
4	4	0.0	0.0	0.389E+00	124.497
4	5	0.0	0.0	0.374E+00	118.834
4	6	0.0	0.0	0.360E+00	113.521
4	7	0.0	0.0	0.346E+00	108.552
4	8	0.0	0.0	0.333E+00	103.956
4	9	0.0	0.0	0.320E+00	99.691
4	10	0.0	0.0	0.308E+00	95.671
4	11	0.0	0.0	0.296E+00	91.873
4	12	0.0	0.0	0.285E+00	88.277
4	13	0.0	0.0	0.274E+00	84.970
4	14	0.0	0.0	0.263E+00	81.617
4	15	0.0	0.0	0.253E+00	78.488
4	16	0.0	0.0	0.244E+00	75.479
4	17	0.0	0.0	0.234E+00	72.585
4	18	0.0	0.0	0.225E+00	69.803
4	19	0.0	0.0	0.217E+00	67.127
4	20	0.0	0.0	0.208E+00	64.553
4	21	0.0	0.0	0.200E+00	62.079
4	22	0.0	0.0	0.193E+00	59.699
4	23	0.0	0.0	0.185E+00	57.410
4	24	0.0	0.0	0.178E+00	55.209
5	1	0.0	0.0	0.171E+00	53.093
5	2	0.0	0.0	0.165E+00	51.057
5	3	0.0	0.0	0.158E+00	49.100
5	4	0.0	0.0	0.152E+00	47.219
5	5	0.0	0.0	0.147E+00	45.408
5	6	0.0	0.0	0.141E+00	43.667
5	7	0.0	0.0	0.135E+00	41.993
5	8	0.0	0.0	0.130E+00	40.383
5	9	0.0	0.0	0.125E+00	38.835
5	10	0.0	0.0	0.120E+00	37.346
5	11	0.0	0.0	0.116E+00	35.914
5	12	0.0	0.0	0.111E+00	34.539
5	13	0.0	0.0	0.107E+00	33.214
5	14	0.0	0.0	0.103E+00	31.940
5	15	0.0	0.0	0.991E-01	30.716
5	16	0.0	0.0	0.953E-01	29.538
5	17	0.0	0.0	0.916E-01	28.406
5	18	0.0	0.0	0.881E-01	27.317
5	19	0.0	0.0	0.848E-01	26.270
5	20	0.0	0.0	0.815E-01	25.263
5	21	0.0	0.0	0.784E-01	24.294
5	22	0.0	0.0	0.754E-01	23.363
5	23	0.0	0.0	0.725E-01	22.467
5	24	0.0	0.0	0.697E-01	21.606
6	1	0.0	0.0	0.670E-01	20.779
6	2	0.0	0.0	0.645E-01	19.981
6	3	0.0	0.0	0.0	18.903
6	4	0.0	0.0	0.0	17.861
6	5	0.0	0.0	0.0	16.855
6	6	0.0	0.0	0.0	15.875
6	7	0.0	0.0	0.0	14.928
6	8	0.0	0.0	0.0	14.009
6	9	0.0	0.0	0.0	13.111
6	10	0.0	0.0	0.0	12.240
6	11	0.0	0.0	0.0	11.393
6	12	0.0	0.0	0.0	10.557
6	13	0.0	0.0	0.0	9.740
6	14	0.0	0.0	0.0	8.941
6	15	0.0	0.0	0.0	8.139
6	16	0.0	0.0	0.0	7.341
6	17	0.0	0.0	0.0	6.547
6	18	0.0	0.0	0.0	5.697
6	19	0.0	0.0	0.0	4.806
6	20	0.0	0.0	0.0	3.819
6	21	0.0	0.0	0.0	2.288
6	22	0.0	0.0	0.0	1.654
6	23	0.0	0.0	0.0	1.149
6	24	0.0	0.0	0.0	0.717
7	1	0.0	0.0	0.0	0.338
7	2	0.0	0.0	0.0	0.0

Table I-15 (4) UNIT HYDROGRAPH CALCULATION -UPPER MAE WONG DAM- Case 2

FLOOD ANALYSIS BY NAKAYASU METHOD

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
1	1	7.2	5.0	0.625E-02	0.031
1	2	7.3	5.1	0.330E-01	0.198
1	3	7.4	5.2	0.873E-01	0.641
1	4	7.7	5.4	0.174E+00	1.528
1	5	7.8	5.5	0.297E+00	3.052
1	6	8.0	5.6	0.461E+00	5.429
1	7	8.3	5.8	0.667E+00	8.890
1	8	8.5	5.9	0.919E+00	13.694
1	9	8.7	6.1	0.122E+01	20.114
1	10	9.2	6.4	0.157E+01	28.443
1	11	9.5	6.6	0.197E+01	38.998
1	12	9.8	6.9	0.243E+01	52.114
1	13	10.6	7.4	0.295E+01	68.149
1	14	11.2	7.8	0.352E+01	87.480
1	15	11.8	8.3	0.415E+01	110.545
1	16	13.8	9.7	0.485E+01	137.765
1	17	15.5	10.8	0.561E+01	169.640
1	18	18.5	12.9	0.643E+01	206.722
1	19	31.9	22.3	0.732E+01	249.682
1	20	12.6	8.8	0.828E+01	299.282
1	21	10.2	7.1	0.931E+01	356.182
1	22	8.9	6.2	0.104E+02	420.993
1	23	8.1	5.7	0.116E+02	494.296
1	24	7.5	5.2	0.107E+02	565.981
2	1	0.0	0.0	0.991E+01	636.365
2	2	0.0	0.0	0.916E+01	705.654
2	3	0.0	0.0	0.847E+01	773.677
2	4	0.0	0.0	0.783E+01	840.512
2	5	0.0	0.0	0.725E+01	906.032
2	6	0.0	0.0	0.670E+01	969.919
2	7	0.0	0.0	0.620E+01	1031.958
2	8	0.0	0.0	0.573E+01	1091.897
2	9	0.0	0.0	0.530E+01	1149.001
2	10	0.0	0.0	0.490E+01	1202.794
2	11	0.0	0.0	0.453E+01	1252.762
2	12	0.0	0.0	0.419E+01	1297.620
2	13	0.0	0.0	0.388E+01	1336.337
2	14	0.0	0.0	0.359E+01	1367.849
2	15	0.0	0.0	0.337E+01	1389.240
2	16	0.0	0.0	0.320E+01	1397.863
2	17	0.0	0.0	0.304E+01	1389.915
2	18	0.0	0.0	0.288E+01	1342.123
2	19	0.0	0.0	0.273E+01	1285.533
2	20	0.0	0.0	0.260E+01	1222.164
2	21	0.0	0.0	0.246E+01	1153.409
2	22	0.0	0.0	0.234E+01	1079.920
2	23	0.0	0.0	0.222E+01	1002.050
2	24	0.0	0.0	0.211E+01	930.404
3	1	0.0	0.0	0.200E+01	864.513
3	2	0.0	0.0	0.190E+01	803.947

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
3	3	0.0	0.0	0.180E+01	748.322
3	4	0.0	0.0	0.171E+01	697.286
3	5	0.0	0.0	0.162E+01	650.510
3	6	0.0	0.0	0.154E+01	607.737
3	7	0.0	0.0	0.146E+01	568.752
3	8	0.0	0.0	0.139E+01	533.389
3	9	0.0	0.0	0.132E+01	501.899
3	10	0.0	0.0	0.125E+01	473.528
3	11	0.0	0.0	0.119E+01	447.476
3	12	0.0	0.0	0.113E+01	423.457
3	13	0.0	0.0	0.107E+01	401.255
3	14	0.0	0.0	0.102E+01	380.725
3	15	0.0	0.0	0.983E+00	361.488
3	16	0.0	0.0	0.946E+00	343.291
3	17	0.0	0.0	0.909E+00	326.081
3	18	0.0	0.0	0.874E+00	309.806
3	19	0.0	0.0	0.841E+00	294.419
3	20	0.0	0.0	0.809E+00	279.874
3	21	0.0	0.0	0.778E+00	266.129
3	22	0.0	0.0	0.748E+00	253.142
3	23	0.0	0.0	0.719E+00	240.876
3	24	0.0	0.0	0.692E+00	229.294
4	1	0.0	0.0	0.665E+00	218.364
4	2	0.0	0.0	0.640E+00	208.054
4	3	0.0	0.0	0.615E+00	198.338
4	4	0.0	0.0	0.592E+00	189.186
4	5	0.0	0.0	0.569E+00	180.581
4	6	0.0	0.0	0.547E+00	172.507
4	7	0.0	0.0	0.526E+00	164.956
4	8	0.0	0.0	0.506E+00	157.973
4	9	0.0	0.0	0.487E+00	151.491
4	10	0.0	0.0	0.468E+00	145.383
4	11	0.0	0.0	0.450E+00	139.611
4	12	0.0	0.0	0.433E+00	134.147
4	13	0.0	0.0	0.416E+00	128.969
4	14	0.0	0.0	0.400E+00	124.025
4	15	0.0	0.0	0.385E+00	119.270
4	16	0.0	0.0	0.370E+00	114.698
4	17	0.0	0.0	0.356E+00	110.301
4	18	0.0	0.0	0.342E+00	106.073
4	19	0.0	0.0	0.329E+00	102.006
4	20	0.0	0.0	0.316E+00	98.096
4	21	0.0	0.0	0.304E+00	94.335
4	22	0.0	0.0	0.293E+00	90.719
4	23	0.0	0.0	0.281E+00	87.241
4	24	0.0	0.0	0.271E+00	83.896
5	1	0.0	0.0	0.260E+00	80.680
5	2	0.0	0.0	0.250E+00	77.587
5	3	0.0	0.0	0.241E+00	74.613
5	4	0.0	0.0	0.232E+00	71.752

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
5	5	0.0	0.0	0.223E+00	69.002
5	6	0.0	0.0	0.214E+00	66.357
5	7	0.0	0.0	0.206E+00	63.913
5	8	0.0	0.0	0.198E+00	61.366
5	9	0.0	0.0	0.190E+00	59.014
5	10	0.0	0.0	0.183E+00	56.751
5	11	0.0	0.0	0.176E+00	54.576
5	12	0.0	0.0	0.169E+00	52.484
5	13	0.0	0.0	0.163E+00	50.472
5	14	0.0	0.0	0.157E+00	48.537
5	15	0.0	0.0	0.151E+00	46.676
5	16	0.0	0.0	0.145E+00	44.887
5	17	0.0	0.0	0.139E+00	43.166
5	18	0.0	0.0	0.134E+00	41.511
5	19	0.0	0.0	0.129E+00	39.920
5	20	0.0	0.0	0.124E+00	38.389
5	21	0.0	0.0	0.119E+00	36.918
5	22	0.0	0.0	0.115E+00	35.503
5	23	0.0	0.0	0.110E+00	34.141
5	24	0.0	0.0	0.106E+00	32.833
6	1	0.0	0.0	0.102E+00	31.574
6	2	0.0	0.0	0.980E-01	30.363
6	3	0.0	0.0	0.0	28.725
6	4	0.0	0.0	0.0	27.142
6	5	0.0	0.0	0.0	25.613
6	6	0.0	0.0	0.0	24.124
6	7	0.0	0.0	0.0	22.685
6	8	0.0	0.0	0.0	21.287
6	9	0.0	0.0	0.0	19.924
6	10	0.0	0.0	0.0	18.600
6	11	0.0	0.0	0.0	17.313
6	12	0.0	0.0	0.0	16.043
6	13	0.0	0.0	0.0	14.801
6	14	0.0	0.0	0.0	13.587
6	15	0.0	0.0	0.0	12.367
6	16	0.0	0.0	0.0	11.155
6	17	0.0	0.0	0.0	9.949
6	18	0.0	0.0	0.0	8.657
6	19	0.0	0.0	0.0	7.303
6	20	0.0	0.0	0.0	5.803
6	21	0.0	0.0	0.0	3.477
6	22	0.0	0.0	0.0	2.513
6	23	0.0	0.0	0.0	1.744
6	24	0.0	0.0	0.0	1.090
7	1	0.0	0.0	0.0	0.514
7	2	0.0	0.0	0.0	0.0

Table I-15 (5) UNIT HYDROGRAPH CALCULATION -LOWER MAE WONG DAM- Case 2

FLOOD ANALYSIS BY NAKAYASU METHOD

D	.HR	RAINFALL	EFF.RAIN.	UNIT-HYD.	DISCHARGE
1	1	7.2	5.0	0.265E-02	0.013
1	2	7.3	5.1	0.140E-01	0.084
1	3	7.4	5.2	0.370E-01	0.271
1	4	7.7	5.4	0.737E-01	0.647
1	5	7.8	5.5	0.126E+00	1.293
1	6	8.0	5.6	0.195E+00	2.300
1	7	8.3	5.8	0.282E+00	3.766
1	8	8.5	5.9	0.389E+00	5.807
1	9	8.7	6.1	0.514E+00	8.521
1	10	9.2	6.4	0.665E+00	12.050
1	11	9.5	6.6	0.836E+00	16.522
1	12	9.8	6.9	0.103E+01	22.078
1	13	10.6	7.4	0.125E+01	28.972
1	14	11.2	7.8	0.149E+01	37.065
1	15	11.8	8.3	0.176E+01	46.833
1	16	13.8	9.7	0.205E+01	58.365
1	17	15.5	10.9	0.238E+01	71.869
1	18	18.5	12.9	0.273E+01	87.579
1	19	31.9	22.3	0.310E+01	105.779
1	20	12.6	8.8	0.351E+01	126.793
1	21	10.2	7.1	0.395E+01	150.899
1	22	8.9	6.2	0.441E+01	179.356
1	23	8.1	5.7	0.491E+01	209.412
1	24	7.5	5.2	0.494E+01	239.782
2	1	0.0	0.0	0.420E+01	269.601
2	2	0.0	0.0	0.389E+01	298.954
2	3	0.0	0.0	0.359E+01	327.773
2	4	0.0	0.0	0.332E+01	356.088
2	5	0.0	0.0	0.307E+01	383.846
2	6	0.0	0.0	0.284E+01	410.912
2	7	0.0	0.0	0.263E+01	437.195
2	8	0.0	0.0	0.243E+01	462.583
2	9	0.0	0.0	0.225E+01	486.781
2	10	0.0	0.0	0.208E+01	509.570
2	11	0.0	0.0	0.192E+01	530.740
2	12	0.0	0.0	0.178E+01	549.743
2	13	0.0	0.0	0.164E+01	566.146
2	14	0.0	0.0	0.152E+01	579.496
2	15	0.0	0.0	0.143E+01	588.558
2	16	0.0	0.0	0.135E+01	592.212
2	17	0.0	0.0	0.129E+01	589.421
2	18	0.0	0.0	0.122E+01	568.597
2	19	0.0	0.0	0.116E+01	544.622
2	20	0.0	0.0	0.110E+01	517.775
2	21	0.0	0.0	0.104E+01	488.647
2	22	0.0	0.0	0.991E+00	457.513
2	23	0.0	0.0	0.941E+00	424.523
2	24	0.0	0.0	0.893E+00	394.170
3	1	0.0	0.0	0.847E+00	366.255
3	2	0.0	0.0	0.804E+00	340.596
3	3	0.0	0.0	0.764E+00	317.031
3	4	0.0	0.0	0.725E+00	295.409
3	5	0.0	0.0	0.688E+00	275.592
3	6	0.0	0.0	0.653E+00	257.472
3	7	0.0	0.0	0.620E+00	240.956
3	8	0.0	0.0	0.588E+00	225.974
3	9	0.0	0.0	0.559E+00	212.633
3	10	0.0	0.0	0.530E+00	200.614
3	11	0.0	0.0	0.503E+00	189.577
3	12	0.0	0.0	0.478E+00	179.401
3	13	0.0	0.0	0.453E+00	169.994
3	14	0.0	0.0	0.433E+00	161.297
3	15	0.0	0.0	0.417E+00	153.147
3	16	0.0	0.0	0.401E+00	145.438
3	17	0.0	0.0	0.385E+00	138.146
3	18	0.0	0.0	0.370E+00	131.252
3	19	0.0	0.0	0.356E+00	124.733
3	20	0.0	0.0	0.343E+00	118.571
3	21	0.0	0.0	0.329E+00	112.747
3	22	0.0	0.0	0.317E+00	107.245
3	23	0.0	0.0	0.305E+00	102.048
3	24	0.0	0.0	0.293E+00	97.142
4	1	0.0	0.0	0.282E+00	92.511
4	2	0.0	0.0	0.271E+00	88.143
4	3	0.0	0.0	0.261E+00	84.027
4	4	0.0	0.0	0.251E+00	80.150
4	5	0.0	0.0	0.241E+00	76.504
4	6	0.0	0.0	0.232E+00	73.084
4	7	0.0	0.0	0.223E+00	69.885
4	8	0.0	0.0	0.214E+00	66.926
4	9	0.0	0.0	0.206E+00	64.180
4	10	0.0	0.0	0.198E+00	61.592
4	11	0.0	0.0	0.191E+00	59.147
4	12	0.0	0.0	0.183E+00	56.832
4	13	0.0	0.0	0.176E+00	54.639
4	14	0.0	0.0	0.170E+00	52.544
4	15	0.0	0.0	0.163E+00	50.530
4	16	0.0	0.0	0.157E+00	48.592
4	17	0.0	0.0	0.151E+00	46.730
4	18	0.0	0.0	0.145E+00	44.938
4	19	0.0	0.0	0.139E+00	43.215
4	20	0.0	0.0	0.134E+00	41.559
4	21	0.0	0.0	0.129E+00	39.966
4	22	0.0	0.0	0.124E+00	38.433
4	23	0.0	0.0	0.119E+00	36.960
4	24	0.0	0.0	0.115E+00	35.543
5	1	0.0	0.0	0.110E+00	34.181
5	2	0.0	0.0	0.106E+00	32.870
5	3	0.0	0.0	0.102E+00	31.610
5	4	0.0	0.0	0.981E-01	30.398
5	5	0.0	0.0	0.943E-01	29.233
5	6	0.0	0.0	0.907E-01	28.112
5	7	0.0	0.0	0.872E-01	27.035
5	8	0.0	0.0	0.839E-01	25.998
5	9	0.0	0.0	0.807E-01	25.002
5	10	0.0	0.0	0.776E-01	24.043
5	11	0.0	0.0	0.746E-01	23.121
5	12	0.0	0.0	0.717E-01	22.235
5	13	0.0	0.0	0.690E-01	21.383
5	14	0.0	0.0	0.663E-01	20.563
5	15	0.0	0.0	0.638E-01	19.775
5	16	0.0	0.0	0.614E-01	19.017
5	17	0.0	0.0	0.590E-01	18.287
5	18	0.0	0.0	0.567E-01	17.586
5	19	0.0	0.0	0.546E-01	16.912
5	20	0.0	0.0	0.525E-01	16.264
5	21	0.0	0.0	0.505E-01	15.640
5	22	0.0	0.0	0.485E-01	15.041
5	23	0.0	0.0	0.467E-01	14.464
5	24	0.0	0.0	0.449E-01	13.910
6	1	0.0	0.0	0.432E-01	13.377
6	2	0.0	0.0	0.415E-01	12.864
6	3	0.0	0.0	0.0	12.169
6	4	0.0	0.0	0.0	11.499
6	5	0.0	0.0	0.0	10.851
6	6	0.0	0.0	0.0	10.220
6	7	0.0	0.0	0.0	9.611
6	8	0.0	0.0	0.0	9.019
6	9	0.0	0.0	0.0	8.441
6	10	0.0	0.0	0.0	7.880
6	11	0.0	0.0	0.0	7.335
6	12	0.0	0.0	0.0	6.797
6	13	0.0	0.0	0.0	6.271
6	14	0.0	0.0	0.0	5.756
6	15	0.0	0.0	0.0	5.240
6	16	0.0	0.0	0.0	4.726
6	17	0.0	0.0	0.0	4.215
6	18	0.0	0.0	0.0	3.658
6	19	0.0	0.0	0.0	3.094
6	20	0.0	0.0	0.0	2.459
6	21	0.0	0.0	0.0	1.473
6	22	0.0	0.0	0.0	1.065
6	23	0.0	0.0	0.0	0.739
6	24	0.0	0.0	0.0	0.462
7	1	0.0	0.0	0.0	0.219
7	2	0.0	0.0	0.0	0.0

Table I-15 (6) UNIT HYDROGRAPH CALCULATION -KHLONG PHO DAM- Case 2

Table I-16 FLOOD DAMAGE TO AGRICULTURE IN LAT YAO DISTRICT, NAKHON SAWAN PROVINCE

No	Name of Sub-District (Tambon)	Village	Plant	Cultivated Area Before Flood (rai)	Cultivated Area Before Flood (ha)	Damage Area (rai)	Damage Area (ha)	Damage Area (%)	Remarks
1.	Lat Yao	14	rice	11,339	1,814	7,806	1,249	69	
2.	Nong Nom Wao	1	"	205	33	131	21	64	
3.	Nong Yao	9	"	9,971	1,595	6,534	1,045	66	
4.	Soi Lakosn	9	"	8,896	1,423	5,692	911	64	
5.	Wong Ma	11	"	4,257	681	2,831	453	67	
6.	Wang Nuang	8	"	5,194	831	3,272	524	63	Nov. 7-25 1981
7.	Nab Kae	6	"	2,993	479	2,155	345	72	
8.	Huai Nam Horm	9	"	23,200	3,712	14,327	2,292	62	
9.	Mae Wong	5	"	7,532	1,205	3,039	486	40	
10.	Wang Sarn	9	"	8,532	1,365	8,532	1,365	100	
11.	Mae Lae	8	"	17,951	2,872	14,688	2,350	82	
12.	Ban Sai	1	"	859	137	547	88	64	
	Sub-Total	90		100,929	16,149	71,554	11,449	71	
1.	Mae Lae	4	*	11,000	1,760	5,500	880	50	
2.	Mae Wong	3	*	9,200	1,472	4,600	736	50	
3.	Wang Sarn	3	*	9,200	1,472	4,600	736	50	
4.	Wang Ma	3	*	9,000	1,440	4,500	720	50	
5.	Wang Muang	3	*	6,500	1,040	3,250	520	50	
6.	Nab Kae	4	*	6,600	1,056	3,300	528	50	
7.	Soi Lakom	4	*	5,800	928	2,900	464	50	
8.	Huai Nam Horm	4	*	16,300	2,608	8,100	1,296	50	Oct. 10-22 1983
9.	Lat Yao	12	*	11,600	1,856	5,800	928	50	
10.	Nong Nom Wao	5	*	7,500	1,200	3,750	600	50	
11.	Nong Yao	4	*	9,100	1,456	4,550	728	50	* rice, mung bean
12.	Noen Kee Lek	2	*	3,200	512	1,600	256	50	
13.	Ban Sai	2	*	1,300	208	650	104	50	
	Sub-Total	52		106,300	17,008	93,100	14,896	50	

Source: Agricultural Office of Lat Yao District, Nakhon Sawan Province

Table I-17 (1) FLOOD DAMAGES IN UTHAI THANI PROVINCE

Nov. 8 - 20, 1981

District (Ampho)			Uthai Thani	Nong Kya Yang	Nong Chang	Thap Than	Sawang Arom	Ban Rai	Lan Sak	Highway	Total
Flooding Area	Sub-District (Tambon)		13	9	10	10	4	7	3	-	56
	Village (Ban)		65	49	46	83	28	32	26	-	329
Damage to People	Total Household		1	-	692	2,323	943	228	1,233	-	5,420
	Total Population		2	-	3,218	9,815	3,171	824	6,068	-	23,098
	Dead		1	-	-	-	-	-	3	-	4
	Injured		-	-	-	-	-	-	-	-	-
	Missing		-	-	-	-	-	-	-	-	-
Number of Damaged Households	Totally Damaged		1	-	-	16	-	-	36	-	53
	Partially Damanged		-	-	-	-	-	-	3	-	3
Flooded Farmland	Rice	(Rai)	12,213	34,281	7,297	139,775	17,128	2,495	11,672	-	224,861
		(ha)	1,954	5,485	1,168	22,364	2,740	399	1,868		35,978
	Crop	(Rai)	965	-	10	54,150	4,936	13,972	12,243	-	86,276
		(ha)	154	-	2	8,664	790	2,236	1,959		13,804
Damaged Farmland	Rice	(Rai)	12,213	3,100	7,297	5,814	9,856	1,578	8,080	-	47,938
		(ha)	1,954	496	1,168	930	1,577	252	1,293		7,670
	Crop	(Rai)	965	-	10	2	3,136	9,530	8,418	-	22,061
		(ha)	154	-	2	0	502	1,525	1,347		3,530
Public Utility	Road	Number	62	28	52	66	18	37	45	8	316
		Distance (km)	69.3	14.4	137.8	156.8	88	93.3	39.1	29.3	627.9
	Bridge		2	1	8	16	2	5	25		59
	Weir		27	-	1	19	-	3	5		55
	Government Office		1	-	-	-	-	-	-		1
	Temple		1	-	-	-	-	-	-		1
	Others		11	-	-	-	-	-	8		19
Livestock (Cattle, etc.)			54	-	-	-	-	7	75		136
Domestic Fowls (Chicken, etc.)			54,606	9,130	-	5,500	7,971	665	3,063		80,935

Data Source; Uthai Thani Provincial Office

Table I-17 (2) FLOOD DAMAGES IN UTHAI THANI PROVINCE

Au. 15 - Nov. 20, 1983

District (Ampho)		Uthai Thani	Nong Kya Yang	Nong Chang	Thap Than	Sawang Arom	Ban Rai	Lan Sak	Total
Flooding Area	Sub-District (Tambon)	12	8	8	30	4	8	3	54
	Village (Ban)	54	39	37	51	38	66	28	313
Damage to People (To be helped with consumer goods)	Total Household	3,207	-	1,085	1,259	4,175	-	2,830	12,559
	Total Population	17,173	-	2,584	5,454	21,437	-	8,945	55,593
	Dead	-	-	-	1	3	-	1	5
	Injured								
	Missing								
Number of Damanged Households		2	0	5	120	0	3	3	133
Flooded Farmland	Rice (Rai)								
	Rice (ha)								
	Crop (Rai)								
	Crop (ha)								
Damaged Farmland	Rice (Rai)	42,354	10,967	7,705	16,168	29,623	24,294	20,083	151,194
	Rice (ha)								
	Crop (Rai)								
	Crop (ha)								
Public Utility	Road Number	44	10	21	35	27	68	26	251
	Road Distance (km)	127	3	13	17	100	40	71	370
	Bridge	1		1	2	3	33	9	50
	Weir		1	2			5	1	8
	Government Office								
	Temple								
	Others								
Livestock (Cattle, etc.)		16	0	0	0	62	7	6	91
Domestic Fowls (Chicken, etc.)		3,017	0	0	0	9,042	323	1,842	14,224

Source: See Ref. 3

Table I.18(1) FLOOD CONTROL BY RESERVOIR

Upper Mae Wong Dam C.A. 612 km²

Year	Reservoir Inflow	Spillout from Dam		Maximum & Second Maximum Flood			
		Irrigation	Flood	With Reservoir	Without Reservoir	With Reservoir	Without Reservoir
	(10^3m^3)	(10^3m^3)	(10^3m^3)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
1954	252,670	109,980	174,013	37.5	37.8	27.7	28.1
1955	213,787	68,635	106,137	28.2	30.0	24.9	25.1
1956	171,771	138,960	24,248	9.8	19.2	8.1	18.6
1957	185,642	150,068	48,593	24.1	25.8	20.7	24.3
1958	116,393	198,990	0	-	16.6	-	16.1
1959	123,066	188,638	0	-	24.5	-	23.3
1960	100,889	103,462	0	-	14.9	-	13.0
1961	276,604	124,330	0	-	30.0	-	26.9
1962	180,551	185,143	0	-	35.0	-	28.5
1963	149,092	151,817	0	-	31.5	-	27.9
1964	237,770	101,236	24,780	15.7	44.9	13.0	38.1
1965	164,010	178,744	0	-	20.9	-	19.4
1966	188,901	128,448	24,395	17.1	24.6	9.6	23.4
1967	149,342	185,027	0	-	21.2	-	21.1
1968	108,018	241,579	0	-	15.3	-	14.5
1969	155,223	109,138	0	-	29.0	-	16.9
1970	259,107	132,502	0	-	34.6	-	32.6
1971	195,739	127,781	17,379	20.1	46.9	-	24.1
1972	252,292	100,071	114,720	39.7	43.3	22.0	42.2
1973	239,413	173,510	48,410	8.7	42.6	7.9	41.8
1974	376,447	108,432	251,336	93.4	93.8	31.7	80.7
1975	236,001	114,837	104,533	23.9	43.3	17.4	30.1
1976	215,392	126,271	84,675	59.2	59.6	13.6	29.4
1977	57,336	265,041	0	-	11.3	-	7.7
1978	221,866	121,629	0	-	65.9	-	36.3
1979	182,121	230,201	0	-	64.5	-	26.3
1980	282,827	95,263	0	-	108.8	-	40.5
1981	204,074	127,815	57,411	18.3	38.8	14.1	29.4
Mean	196,298	146,019	38,594				

Table I.18(2) FLOOD CONTROL BY RESERVOIR

Lower Mae Wong Dam C.A. 930 km²

Year	Reservoir Inflow	Spillout from Dam		Maximum & Second Maximum Flood			
		Irrigation	Flood	With Reservoir	Without Reservoir	With Reservoir	Without Reservoir
	(10^3m^3)	(10^3m^3)	(10^3m^3)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
1954	383,959	225,009	196,869	43.6	57.5	26.7	37.0
1955	324,873	171,319	80,492	35.2	45.6	27.8	38.1
1956	261,026	218,694	0	-	29.1	-	28.2
1957	282,104	243,805	24,862	20.0	39.3	8.8	37.0
1958	176,872	281,073	0	-	25.2	-	24.5
1959	187,012	274,675	0	-	37.2	-	35.4
1960	153,313	140,621	0	-	22.6	-	19.8
1961	420,330	250,149	0	-	45.6	-	40.9
1962	274,367	281,533	0	-	53.2	-	43.4
1963	226,561	231,910	0	-	47.8	-	42.4
1964	361,317	190,228	0	-	68.2	-	57.9
1965	249,232	274,163	0	-	31.8	-	29.5
1966	287,056	234,890	0	-	37.3	-	35.6
1967	226,942	273,514	0	-	32.2	-	32.1
1968	164,146	232,549	0	-	23.3	-	22.0
1969	235,878	170,945	0	-	44.1	-	25.6
1970	393,741	233,218	0	-	52.6	-	49.5
1971	297,447	220,168	0	-	71.2	-	36.7
1972	383,385	166,338	63,716	21.3	65.9	17.6	64.1
1973	363,815	272,889	25,716	7.0	64.8	4.4	63.6
1974	572,052	176,230	341,013	141.4	142.5	55.4	122.6
1975	358,629	204,281	104,120	30.7	65.8	25.4	45.8
1976	327,313	212,026	97,130	89.3	90.5	12.9	44.7
1977	87,127	331,550	0	-	17.1	-	11.8
1978	337,149	223,608	0	-	100.2	-	55.2
1979	276,753	301,683	0	-	98.0	-	40.0
1980	429,787	169,810	0	-	165.4	-	61.5
1981	310,113	206,232	38,632	23.8	58.9	12.3	44.7
Mean	298,296	229,039	34,733				

Table I.18(3) FLOOD CONTROL BY RESERVOIR

Khlong Pho Dam C.A. 394 km²

Year	Reservoir Inflow	Spillout from Dam Irrigation	Spillout from Dam Flood	Maximum & Second Maximum Flood With Reservoir	Without Reservoir	With Reservoir	Without Reservoir
	(10^3m^3)	(10^3m^3)	(10^3m^3)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
1954	88,103	39,344	58,305	8.3	10.0	7.1	8.9
1955	111,793	32,309	46,959	14.2	15.5	13.1	13.5
1956	88,294	30,738	26,164	7.9	9.3	6.4	8.2
1957	60,673	71,246	0	-	11.2	-	9.9
1958	48,679	57,577	0	-	6.3	-	6.0
1959	51,840	43,743	0	-	10.5	-	8.0
1960	77,915	36,976	0	-	8.1	-	7.7
1961	63,690	60,016	0	-	7.6	-	7.0
1962	77,602	54,354	0	-	19.3	-	15.8
1963	46,857	42,709	0	-	7.1	-	6.8
1964	113,166	30,638	0	-	18.1	-	14.8
1965	61,844	61,368	0	-	8.3	-	8.0
1966	85,080	45,471	0	-	7.6	-	7.6
1967	60,849	52,724	0	-	8.9	-	8.7
1968	42,013	60,292	0	-	4.4	-	4.4
1969	82,499	44,063	0	-	16.4	-	11.1
1970	124,431	36,251	17,222	5.8	13.6	5.2	11.9
1971	74,317	48,543	12,083	3.9	14.7	3.8	10.5
1972	92,363	41,252	16,924	5.5	14.9	5.4	13.5
1973	77,219	53,061	4,976	2.8	7.7	2.4	7.6
1974	127,976	30,979	51,971	18.2	22.4	16.8	21.4
1975	110,520	43,239	46,831	22.4	25.0	11.8	24.8
1976	67,029	72,910	0	-	18.6	-	13.6
1977	9,222	31,950	0	-	7.3	-	0.5
1978	111,985	57,877	0	-	55.0	-	20.0
1979	142,749	95,701	28,805	24.9	109.2	8.5	14.9
1980	211,686	23,192	114,191	67.8	68.1	18.5	28.6
1981	132,968	32,104	76,760	24.7	25.6	21.1	22.0
Mean	87,263	47,522	17,900				

Table I-19 TEST WELL AND BORE HOLE RESULTS

Code No.	Deth to Bed Rock (m)	Aquifer Thickness (m)	Aquifer	
			( ) :	maximum yield cum/min
TW1	56.8	47.1	(8.6)	medium to coarse sand, gravel
TW2	45.6	26.7	(1.6)	fine to coarse sand, gravel with clay lens
TW3	42.5	24.9	(2.7)	medium to coarse sand, gravel
TW4	42.0	27.0	(1.6)	gravel and sand
TW5	63.8	37.9	(8.2)	coarse gravel, medium sand, rock particles
TW6	56.3	41.0	(1.4)	fine to coarse sand, gravel
EB1	43.0	-		dry well
EB2	50.0	20.0		gravel and very coarse sand
EB3	53.0	15.0		gravel and coarse sand
EB4	30.5	-		dry well
EB5	67.5	-		dry well
EB6	58.0	34.5		gravel and medium to coarse sand
EB7	40.0	-		dry well
EB8	46.3	4.5		gravel and sand
EB9	107.0	6.0		fine gravel and coarse sand
EB10	18.5	6.0		medium to coarse sand and gravel
EB11	20.8	13.8		gravel and coarse sand
EB12	11.7	-		dry well
EB13	15.0	-		dry well
EB14	25.8	-		dry well
EB15	34.0	21.0		gravel and medium to coarse sand
EB16	31.0	-		dry well
EB17	31.0	-		dry well
EB18	76.5	-		dry well
EB19	24.0	7.5		gravel and medium to coarse sand
EB20	49.5	8.7		coarse sand
EB21	48.0	8.7		medium sand and gravel
EB22	60.0	35.0		coarse sand and gravel
EB23	57.0	37.0		medium sand and corse gravel
EB24	36.0	14.0		medium sand and fine gravel
EB25	48.0	30.0		coarse sand and gravel
EB26	24.0	-		dry well
EB27	-	-		dry well
EB28	52.1	18.0		-
EB29	80.5	41.1		coarse gravel, coarse sand
EB30	106.4	35.9		gravel, coarse and fine sand
EB31	97.3	55.7		gravel, coarse sand
EB32	30.0	15.0		gravel, coarse sand
EB33	27.0	1.5		gravel, coarse sand
EB34	39.5	19.5		gravel, coarse and fine sand
EB35	42.5	27.0		gravel, coarse and fine sand

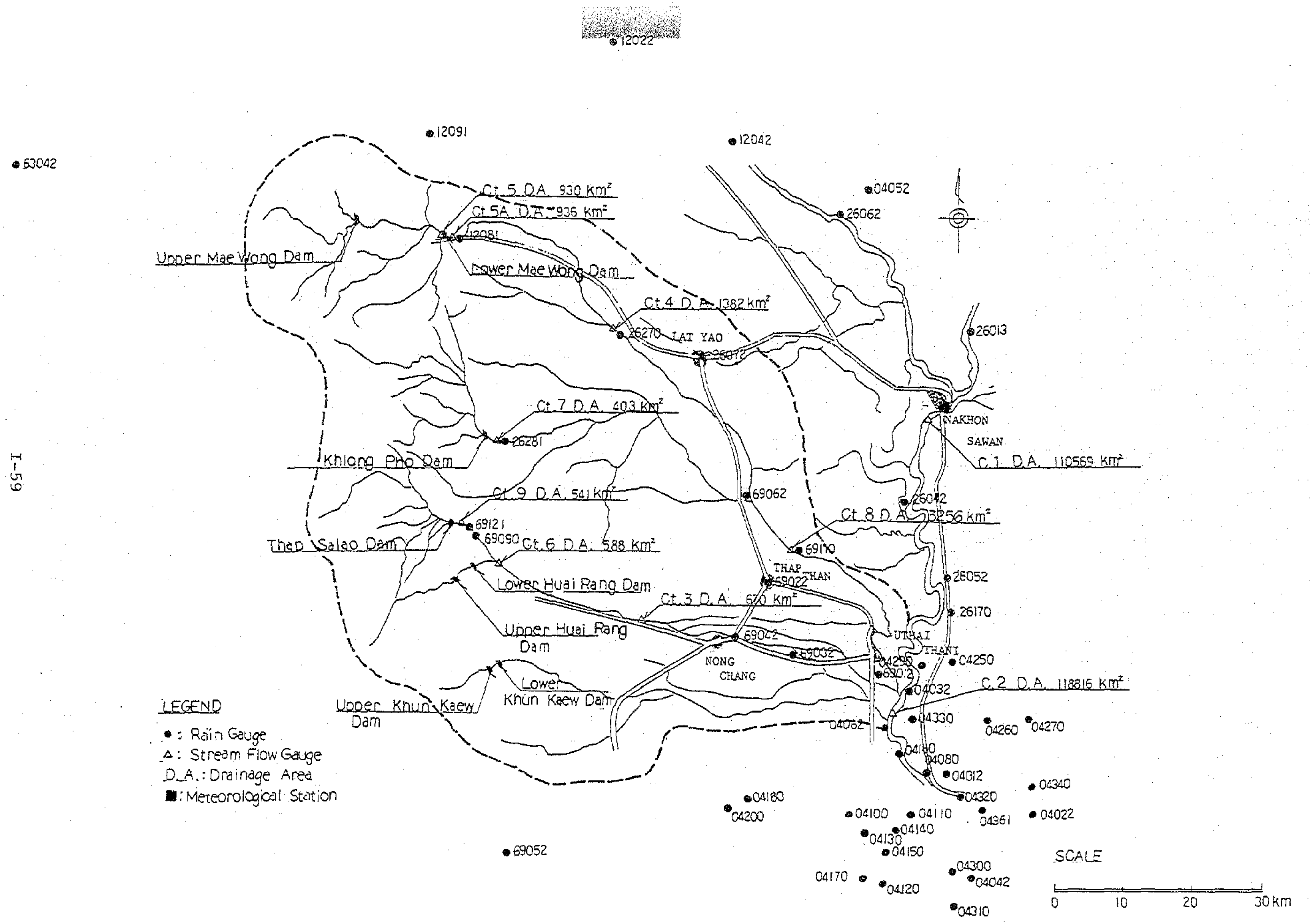


Fig. I-1 Location of Meteorological and Hydrological Stations

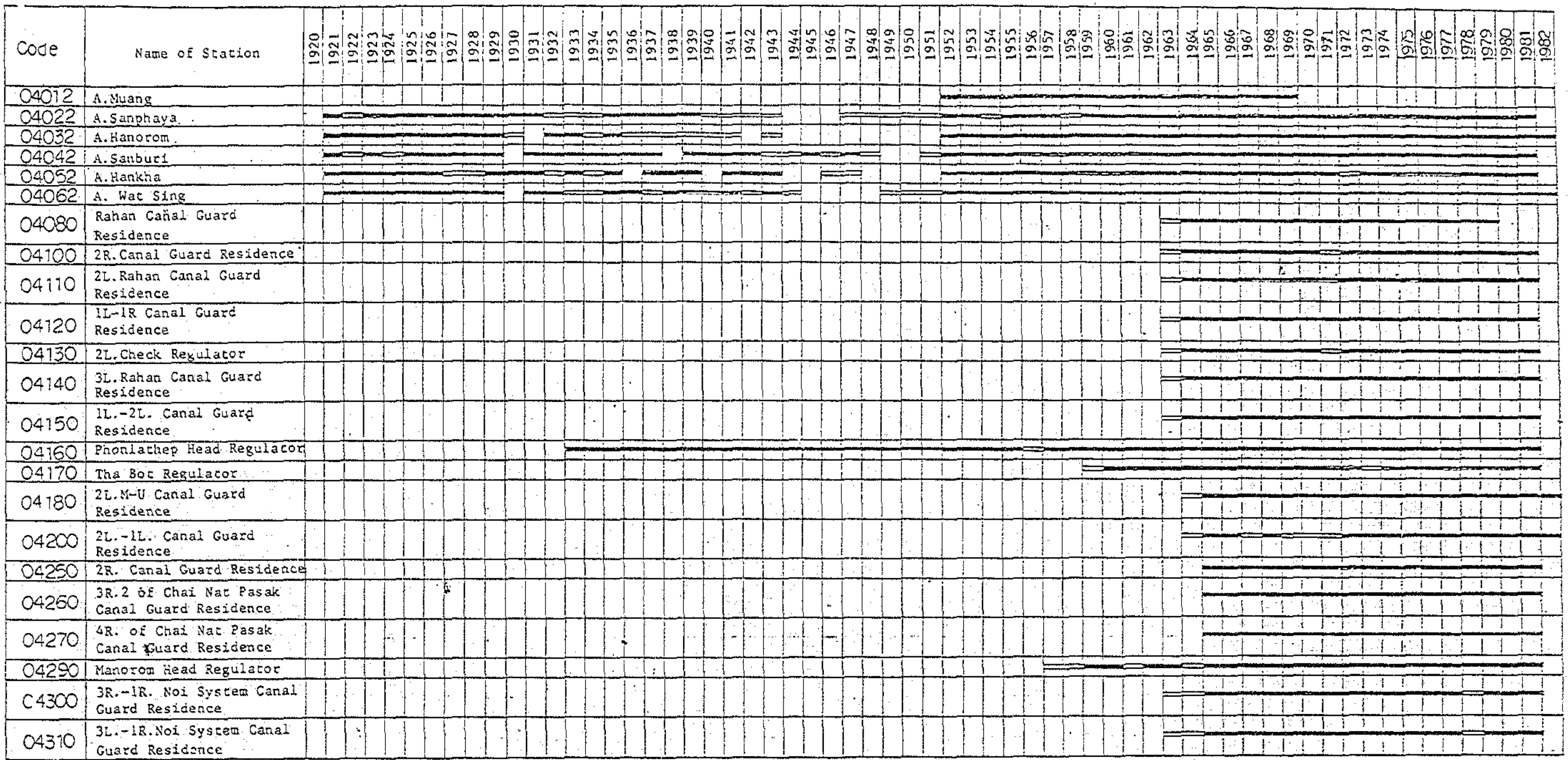


Fig. I-2(1) Raingage Station and Period of Observation

: OBSERVATION WITH LACK OF DATA
: OBSERVATION WITHOUT LACK OF DATA

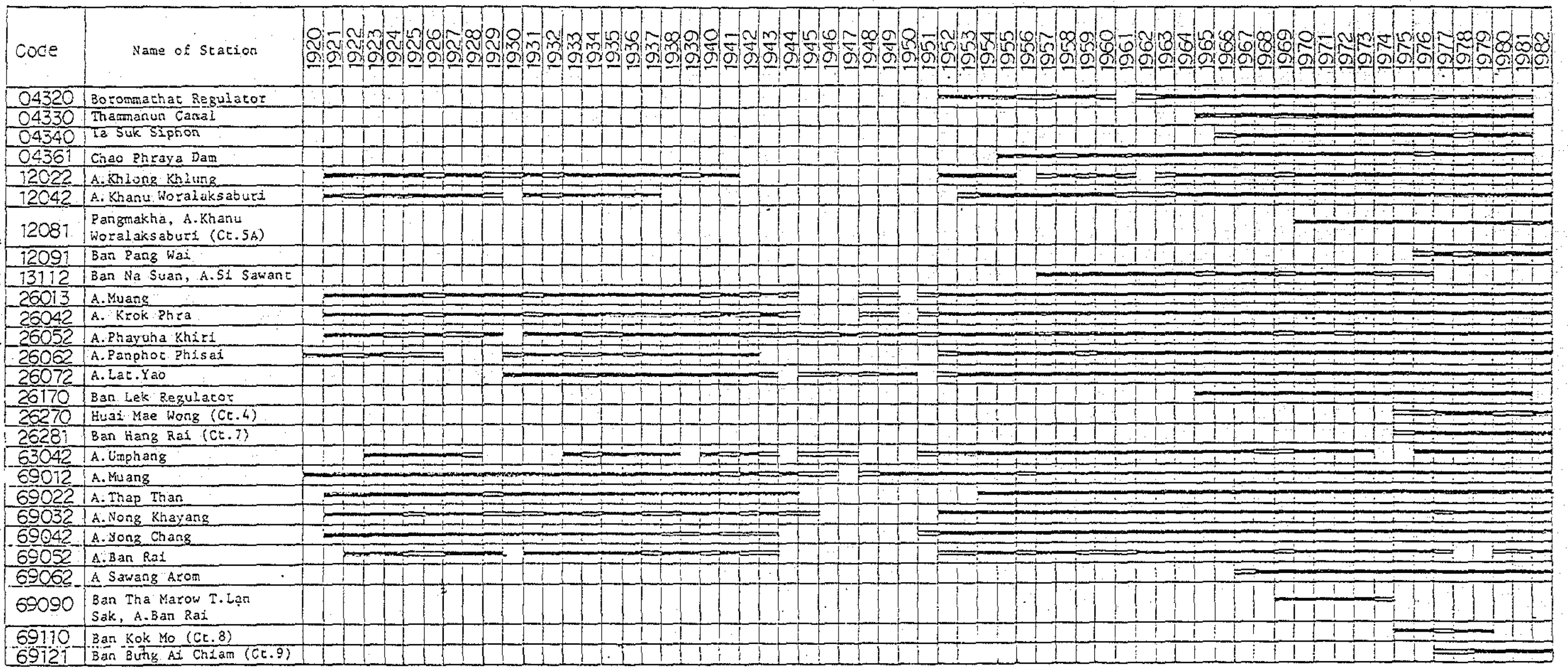


Fig. I-2(2) Raingage Station and Period of Observation

: OBSERNATION WITH LACK OF DATA
: OBSERVATION WITHOUT LACK OF DATA

Code	River	Name of Station	D.A. km²
C.1	Chao Phraya	Wat Phikun Ngam	118,816
C.2	Chao Phraya	Khai Chira Prawat	110,569
Ct.3	Sakae Krang (Huai Thap Salao)	Ban Prada Hak	670
Ct.4	" " (Nam Wang Ma)	San Chao Kai To	1,382
Ct.5	" " (Mae Wong)	Ban Hin Dat	930
Ct.5A	" " (Mae Wong)	Ban Pang Mokha	936
Ct.6	" " (Huai Thap Salao)	Ban Tha Manao	588
Ct.7	" " (Khlong Pho)	Ban Hang Rai	403
Ct.8	" " (Mae Wong)	Ban Khok Mo	3,256
Ct.9	" " (Huai Thap Salao)	Ban Bung Ai Chiam	541

Code	River	Nam of Station	D.A. Km²
C.1	Chao Phraya	Wat Phikun Ngam	118,816
C.2	Chao Phrayo	Khai Chira Prawat	110,569
Ct.3	Sakae Krang (Huai Thap Salao)	Ban Prada Hak	670
Ct.4	" " (Nam Wang Ma)	San Chao Kai To	1,382
Ct.5	" " (Mae Wong)	Ban Hin Dat	930
Ct.5A	" " (Mae Wong)	Ban Pang Makha	936
Ct.6	(Huai Thap Salao)	Ban Tha Manao	588
Ct.7	" " (Khlong Pho)	Ban Hong Rai	403
Ct.8	" " (Mae Wong)	Ban Khok Mo	3,256
Ct.9	" " (Huai Thap Salao)	Ban Bung Ai Chiam	541

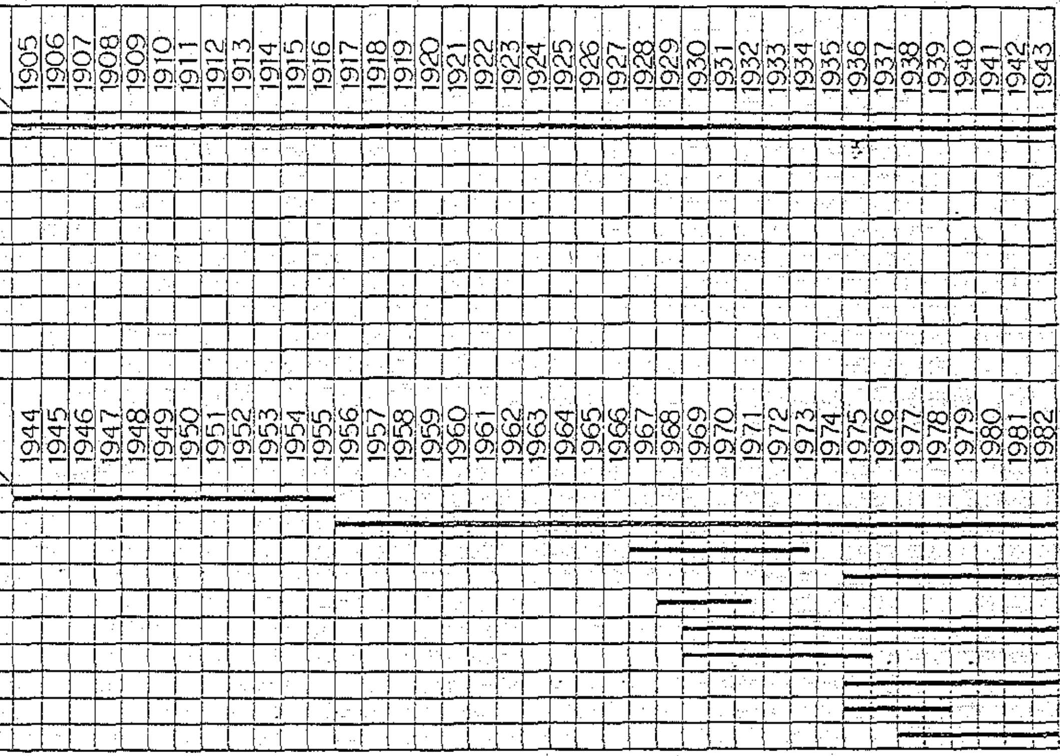


Fig. I-3 Stream Gaging Station and Period of Observation

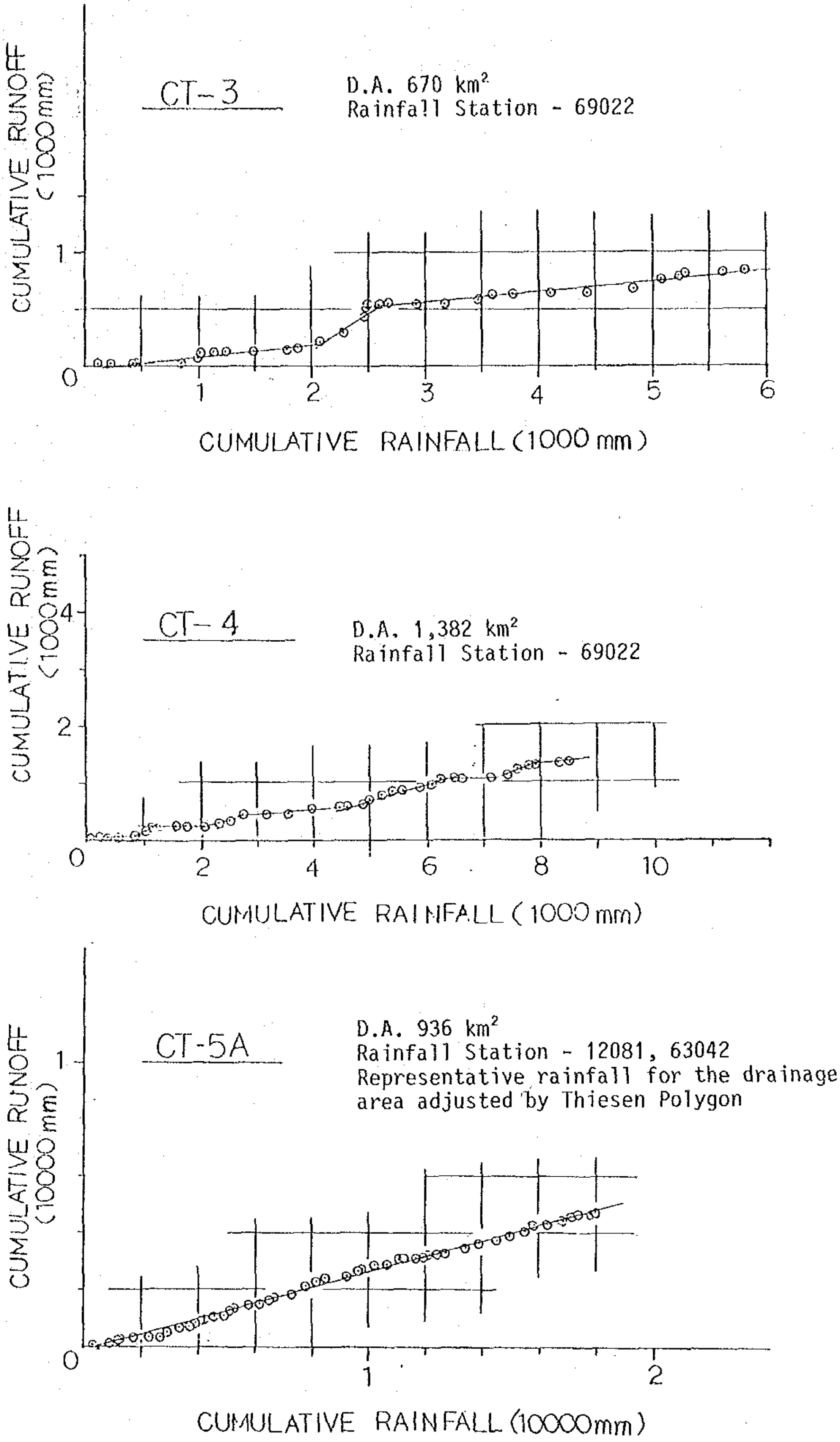
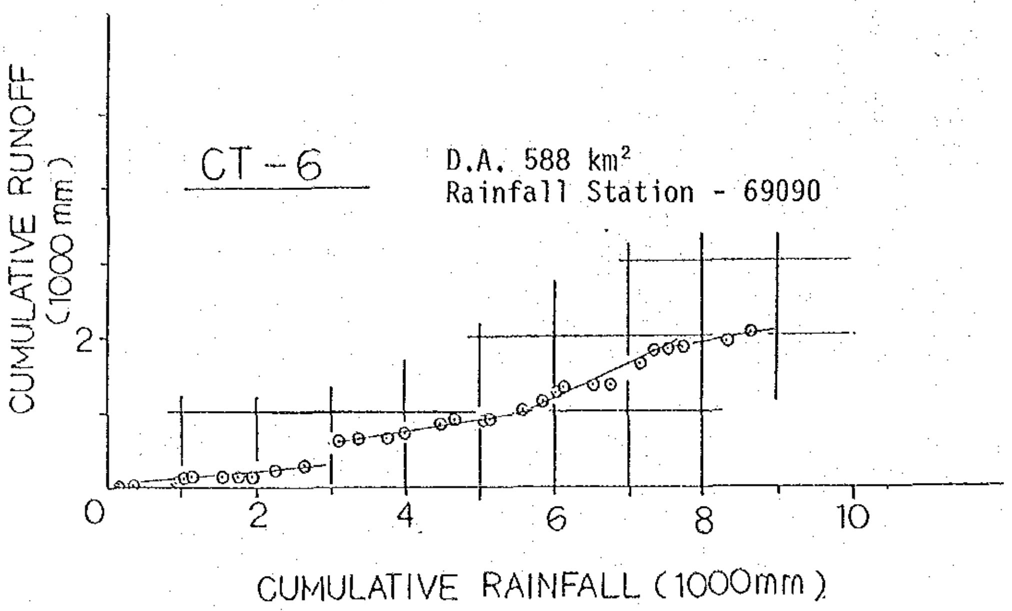


Fig. I-4(1) Double Mass Curve for Runoff and Rainfall



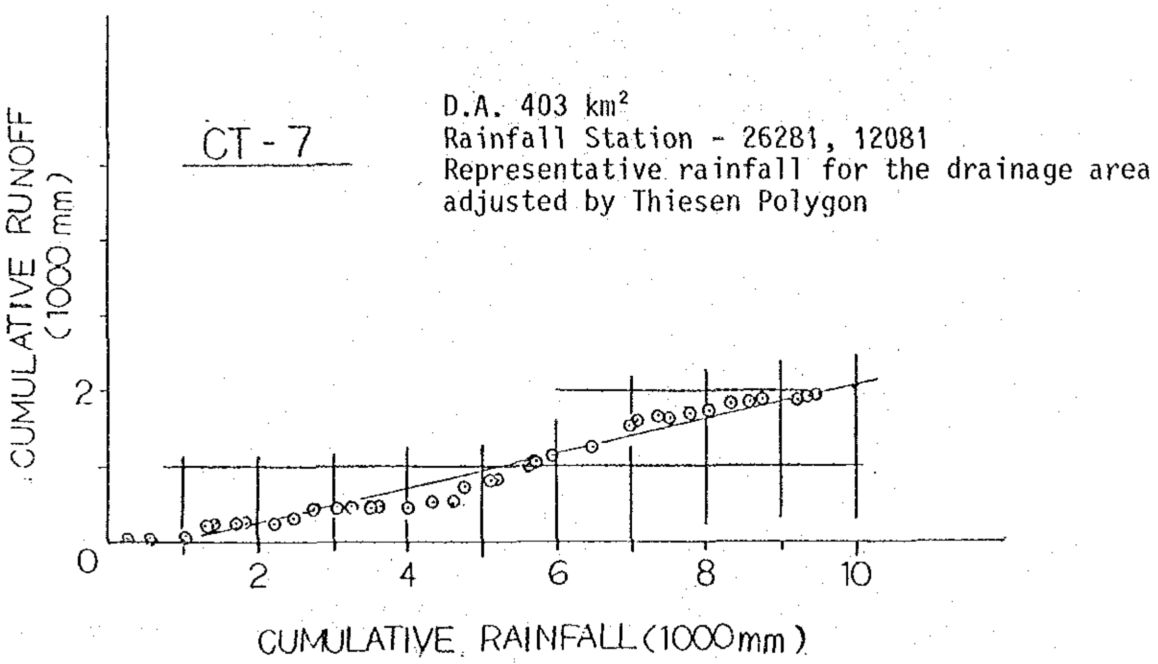
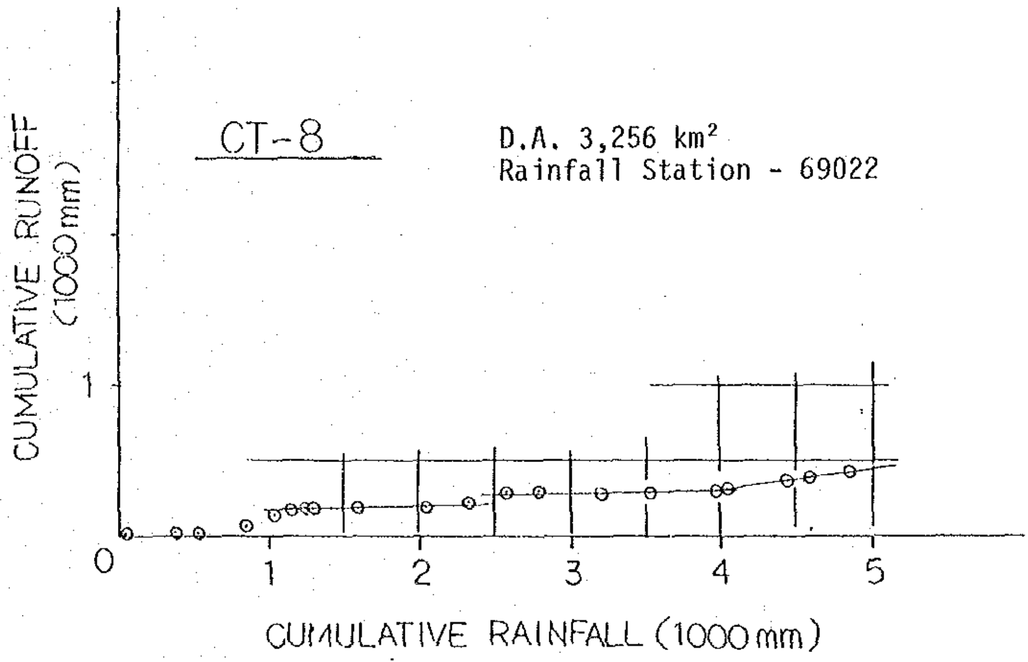


Fig. I-4(2) Double Mass Curve for Runoff and Rainfall



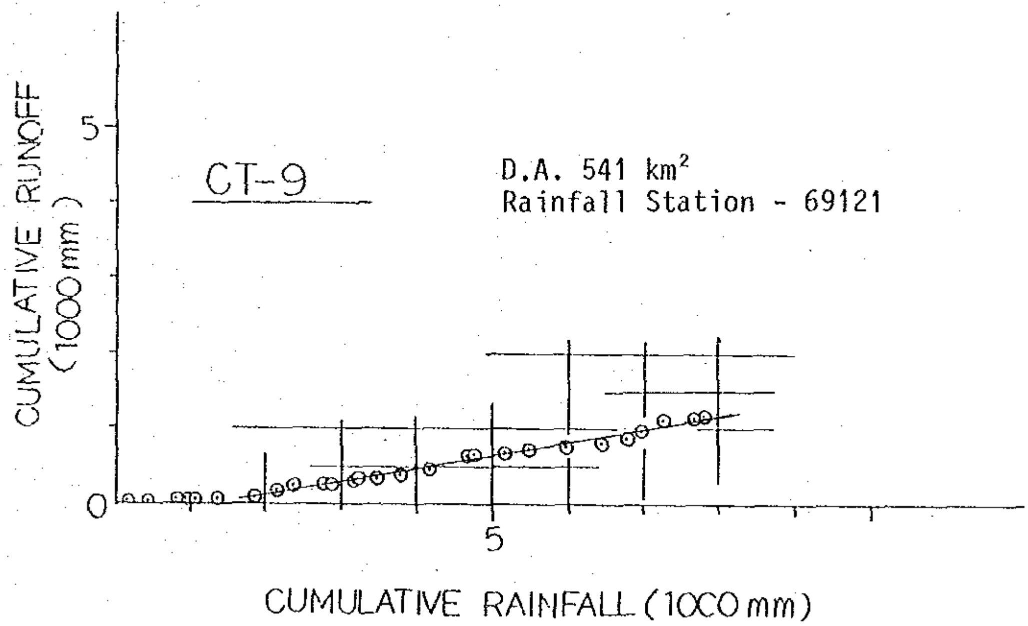


Fig. I-4(3) Double Mass Curve for Runoff and Rainfall

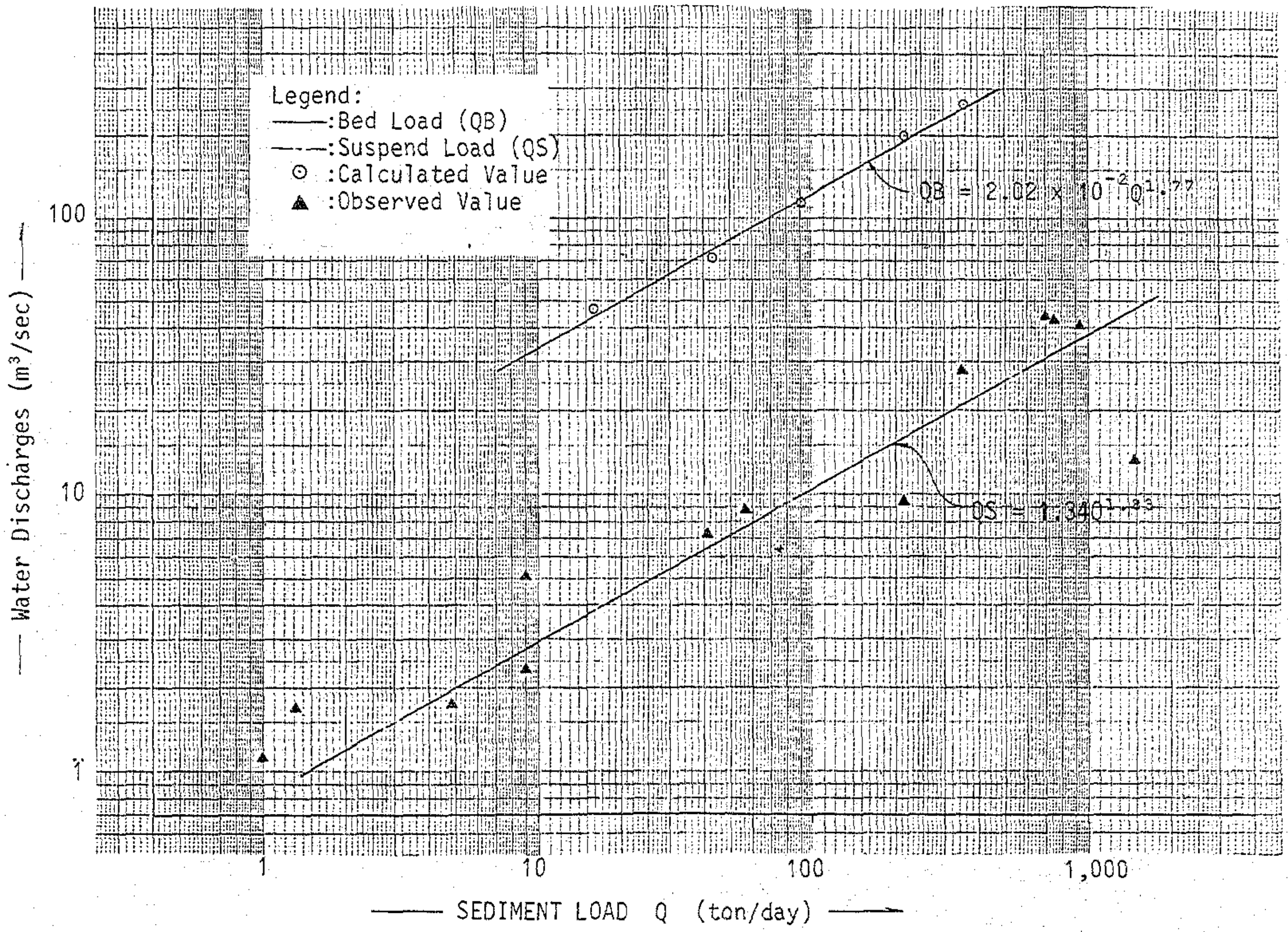


Fig. I-5 Sediment Load Distribution