

GOVERNMENT OF MALAYSIA

**FEASIBILITY STUDY
ON
THE TANJONG KARANG IRRIGATION
DEVELOPMENT AND MANAGEMENT PROJECT**

ANNEXES

JUNE 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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ABBREVIATIONS

Plans

5MP : Fifth Malaysia Plan, 1986-1990

Irrigation Compartment

BT : Bagan Terap
PB : Panchang Bedena
PP : Pasir Panjang
SB : Sungai Burong
SK : Sekinchan
SL : Sungai Leman
SN : Sungai Nipah
SS : Sawah Sempadan

Organizations

AICPLC : Area Inter-agency Coordination,
Planning and Liaison Committee
BPM : Agricultural Bank of Malaysia
(Bank Pertanian Malaysia)
DICPLC : District Inter-agency Coordination,
Planning and Liaison Committee
DID : Drainage and Irrigation Department
DOA : Department of Agriculture
EPU : Economic Planning Unit
FAMA : Federal Agricultural Marketing Authority
FDC : Farmers Development Center
FDSc : Farmers Development Sub-center
FO : Farmer's Organization
FOA : Farmer's Organization Authority
JICA : Japan International Cooperation Agency
JPT : Jabatan Parit dan Tali Air (DID)
JKR : Jabatan Kerja Raja
KADA : Kambu Agricultural Development Authority
LPN : National Paddy and Rice Board

MARDI : Malaysian Agricultural Research and Development
Institute
MOA : Ministry of Agriculture
MADA : Muda Agricultural Development Authority
PBLS : Northwest Selangor Integrated Agricultural
Development Project
PMP : Farm Mechanization Center, FOA
MOMU : Main Conveyance System Operation and Maintenance
Unit
NWMTC : National Water Management Training Centre, DID

CONVERSION FACTORS

	Metric to Imperial	Imperial to Metric
Length	1 cm = 0.394 inch 1 m = 3.28 feet 1 km = 0.621 mile	1 inch = 2.54 cm 1 feet = 30.48 cm 1 mile = 1.609 km
Area	1 sq.m = 10.76 sq.ft 1 ha = 2.471 acres 1 sq.km = 0.386 sq.mile	1 sq.ft = 0.0929 sq.m 1 acre = 0.4047 ha 1 sq.mile = 2.59 sq.km
Volume	1 lit = 0.22 gal (imp) 1 cu.m = 35.3 cu.ft 1 mil cu.m = 811 acre-ft	1 cu.ft = 28.32 lit 1 gal (imp) = 4.55 lit 1 acre-ft = 1,233.5 cu.m
Weight	1 kg = 2.20 lb 1 ton = 0.984 long ton	1 lb = 0.4536 kg 1 long ton = 1.016 ton
Derived Measures	1 cu.m/s = 35.3 cusec 1 ton/ha = 891 lb/acre 1 cu.m/s = 19.0 mgd	1 cusec = 0.0283 cu.m/s 1 lb/acre = 1.12 kg/ha 1 mgd = 0.0526 cu.m/s
Temperature	$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 5/9$	$^{\circ}\text{F} = 1.8 \times ^{\circ}\text{C} + 32$
Local Measures	1 lit = 0.22 gantang 1 kg = 1.65 kati 1 ton = 16.5 pikul	1 gantang = 4.55 lit 1 kati = 0.606 kg 1 pikul = 60.6 kg

ANNEX A

Hydrology and Water Resources

**ANNEX A
HYDROLOGY AND WATER RESOURCES**

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1. METEOROLOGICAL DATA

1.1 Precipitation

There are 21 meteorological stations in and around the Bernam river basin, out of which 10 stations are located in the upstream basin of the Bernam River Headworks (BRH), one station in the downstream basin and the remaining 10 stations are located in the project area. The locations of these stations are shown in Fig. A-1.

Based on the isohyetal map, three stations, No.3813158, No. 3814156 and No.3615001, are selected for the estimate of basin rainfall taking into account their location and quality of available data. Monthly rainfall data of these three stations are summarized for 23 years from 1961 to 1983, as shown in Tables A-1 to A-3. Reliability of these rainfall data was analyzed by mean of double mass curve method. Linear relationship is found among these data as shown in Fig. A-2. It is judged that these rainfall data are reliable enough.

In the project area, two stations, No.3411016 in Sungai Burong and No.3610001 in Sungai Nipah, are representative. The data of No.3411016 are used for the estimate of effective rainfall in three upstream compartments, Sawah Sempadan, Sungai Burong and Sekinchan, and the data of No.3610001 are for the remaining. These are used for the water balance study of the project. The effective rainfall are summarized on 5-day base for 10 years from 1975 to 1984 and shown in Tables A-4 and A-5.

1.2 Evaporation

There are two stations where evaporation data are available. One is No.3710306 in Bagan Terap and the other is No.3516322 at Kuala Kubu Baru. The former is used for the estimate of water requirement by crops in the project area and the latter is for the estimate of runoff from the Bernam river basin. Monthly pan evaporation at No.3710306 is summarized as shown in Table A-6 for nine years from 1975 to 1983. Based on the data for 10 years from 1975 to 1984, the daily mean pan evaporation at No.3516322 is calculated as shown below.

											unit: mm/day
<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sept</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
5.6	5.9	5.7	5.0	4.9	4.7	4.7	4.6	4.7	4.6	4.4	5.1

1.3 Other Meteorological Data

Other meteorological data such as temperature, humidity, sunshine hour and wind velocity are available for six years from 1980 to 1985 at No. 3511201 in Tanjong Karang. These data are summarized in Tables A-7 to A-10 on monthly basis.

2. RUNOFF OF BERNAM RIVER

2.1 Available Data

There are three gauging stations in the Bernam river basin. These are No. 3813411, No. 3814416 and No. 3615412 as shown in Fig. A-1. Among these stations, No. 3813411 (so-called the SKC bridge station) is the nearest to BRH. It locates about 17 km upstream from BRH. The catchment area at the station is 1,090 sq.km. The river course at the station is straight and the cross section is almost symmetrical. The site is favourable for discharge measurement. The measurement is carried out by DID every one or two weeks and the water level in the river is recorded by a water level recorder. Based on these data, a rating curve has been developed and the water level is converted to the discharge. The data are seemed reliable and acceptable for analyzing the runoff of the Bernam river.

Discharge record are available since 1961, although there are some interruptions in 1976 and in short periods in several years. Five-day mean discharge at the SKC bridge station is shown in Table A-11, and monthly mean discharge is summarized in Table A-12.

Main water source of the project is the runoff of the Bernam river. The Bernam river water is taken at BRH and the Bagang Terap pumphouse. BRH is located at 130 km upstream from the estuary of the Bernam river and the pumphouse at 62 km upstream. The catchment area of the river is 1,260 sq.km at BRH and 1,960 sq.km at the pumphouse. There are no discharge records at these sites, which should be estimated from the discharge records at the SKC bridge station.

2.2 Supplement of Discharge Data

2.2.1 Method and procedure

In order to supplement the interruptions of discharge records at the SKC bridge station, the Tank Model method is adopted. The Tank Model consisting of four storage tanks is adopted as shown in Fig. A-3. Each tank has a several holes for runoff at different height and a hole for infiltration at a bottom. It is interpreted that the upper two tanks

contribute to the surface runoff, the third tank furnishes to the intermediate runoff, and the bottom tank gives base flow. Rain water is poured into and stored in the first tank. Some of the water evaporates from the first tank and the remaining infiltrates into the second tank. When the water level in the first tank reaches the holes, water starts outflowing. These processes are the same in other tanks. The coefficient of discharge of each hole is determined by trial and error basis so that the estimated runoff becomes similar to the actual one.

2.2.2 Data used for Tank Model method

The data required for simulation by the Tank Model method are basin rainfall and evaporation. The rainfall data of No.3813158, No.3814156 and No.3615001 are available for the estimation of the basin rainfall in the catchment area of SKC bridge station. The basin rainfall is calculated on 5-day basis for a period from 1961 to 1983 by the following equation.

$$R = \sum a_i \cdot R_i / A$$

where, R : basin rainfall (mm)
R_i : point rainfall (mm)
a_i : commanded area of raingauging station (sq.km)
A : catchment area (1,090 sq.km)

On the above equation, the commanded areas of rain gauging stations of No.3813158, No.3814156 and No.3615001 are estimated at 70 sq.km, 740 sq.km and 280sq.km, respectively. The 5-day basin rainfall is calculated as shown in Table A-13 and monthly rainfall is summarized in Table A-14. Evaporation data are available at No.3516322 at Kuala Kubu Baru.

2.2.3 Results of simulation

The results of the runoff simulation are shown in Fig. A-4 together with the observed discharge at the SKC bridge station. The simulated runoff pattern is very similar to the actual one. The runoff coefficients of both the simulated and actual discharges are also compared as shown in Table A-15. Both coefficients show very similar figures. It is judged

from these analysis that the results of simulation are applicable to supplement the interruptions of records. Five-day mean runoff supplemented is shown in Table A-16 and monthly mean discharge is summarized in Table A-17.

2.3 Runoff at BRH

In order to estimate the runoff at BRH from the runoff at the SKC bridge station, discharge was measured at two sites, one is in the Bernam river at just downstream reach of BRH and the other is in the Feeder Canal at just downstream reach of the intake. Discharge at BRH is the sum of discharge at these two sites. Correlation between the discharge at the SKC bridge station and the discharge at BRH is examined as shown in Fig. A-5. It is known from the figure that the discharge at BRH increases by around 10% of that at the SKC bridge station. The runoff at BRH is thus estimated by multiplying 1.1 by the runoff at the SKC bridge station. The 5-day mean runoff at BRH is shown in Table A-18 and monthly mean discharge is summarized in Table A-19. The average monthly mean discharge for recent 10 years from 1975 to 1984 is as follows:

Monthly Mean Discharge for Recent 10 Years

												unit: cu.m/s
<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sept</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Mean</u>
33.4	30.5	33.8	46.3	49.6	37.6	32.7	26.3	42.1	60.8	72.7	61.4	43.9

2.4 Runoff at Bagan Terap

No discharge records are available for the runoff from the catchment between BRH and the Bagan Terap pumphouse. Discharge measurement was conducted at a site, as shown in Fig. A-1, in one of the tributaries of the Bernam river in the driest month in 1986. At the site of measurement, a catchment area is 106 sq.km. In order to estimate a base flow, the measurement was carried out at the lowest tide. The results of observation are shown below.

<u>Date</u>	<u>Observed Discharge</u> (cu.m/s)	<u>Specific Discharge</u> (lit/s/sq.km)
Sept. 12	0.29	2.7
Sept. 13	0.30	2.8

The catchment area between BRH and the Bagan Terap pumphouse is about 700 sq.km. The base flow from the catchment is therefore estimated at about 2.0 cu.m/s.

2.5 Probable Flood Discharge at BRH

Discharge records at the SKC bridge station are used to estimate the probable flood discharge at BRH. The annual peak flood at the SKC bridge station is shown in Table A-20. The maximum annual peak flood for 21 years is 606 cu.m/s, which occurred in 1971. The second biggest is 537 cu.m/s in 1980. The annual peak discharge at the SKC bridge station is plotted on a log-normal paper as shown in Fig. A-6. The probable flood discharge is estimated by applying Gumbel method as shown in below.

Probable Flood Discharge and C-Value of CREAGER'S Curve

<u>Return Period</u> (years)	<u>Discharge</u> (cu.m/s)	<u>C-Value</u>
5	354	5
10	441	6
20	524	7
50	632	9
100	713	10
200	793	11

Then, probable flood discharge at the SKC bridge station is converted into that at BRH, using Creager's equation, which is expressed as follows:

$$q = 46 \cdot C \cdot A^{(0.894 A^{-1})}$$

where, q : specific runoff (cu.ft/s/sq.mile)
 A : catchment area (sq.mile)
 C : coefficient depending upon the characteristics of the drainage basin

Creager's C-value is calculated by substituting the specific runoff of the provable flood and the catchment area at the SKC bridge station to the Creager's equation. Then the specific runoff at BRH coping with each recurrence period is calculated and the probable flood discharge at BRH is

estimated by multiplying the specific runoff with the catchment area at BRH. The results are shown below.

<u>Return Period</u> (year)	<u>Probable Flood at BRH</u> (cu.m/s)
10	480
20	560
50	720
100	800

Probable flood discharge was also estimated based on the DID's regional flood curves which are presented in "Hydrological Procedure No.4, Magnitude and Frequency of Flood in Peninsular of Malaysia". From these curves, the probable flood discharges at BRH are estimated at about 600 cu.m/s once in 50 years and 700 cu.m/s once in 100 years, respectively. It is therefore judged that the probable flood discharges estimated above are reasonable.

3. SUPPLEMENTAL DATA ON FUNCTION OF THE SWAMP

3.1 Continuous Observation of Rainfall and Groundwater Level

Two lines were opened in the swamp forest, and a rainfall recorder, six water level recorders and four water level gauges were installed. The locations of these equipment are shown in Fig. A-7. Through these equipment, continuous records of rainfall and groundwater level became available as shown in Table A-21 and illustrated in Figs. A-8 and A-9.

3.2 Estimate of Seepage Flow from the Swamp

In order to know the coefficient of permeability of the peat soils, permeability tests were carried out in the swamp along the above two lines. Firstly, holes were dug by a hand auger with casing of a polyvinyl chloride pipe. Then, the groundwater was drained and the elevation of the groundwater table and time required to rise the groundwater level were measured. The coefficient of permeability of the peat soil was calculated by the following equation.

$$k = (2.30 r_o / 4t) \log_{10} (s_o / s_t)$$

Where, r_o : radius of boring hole.

t : time required for rising groundwater table from s_o to s_t .

s_o : water table measured from the initial groundwater surface just after drain.

s_t : water table measured from the initial groundwater surface after t .

The results of tests are shown in Table A-22 and summarized in Table A-23. The coefficient of permeability of peat soil ranges from 9.4×10^{-3} cm/s to 9.7×10^{-4} cm/s and the average is 2.5×10^{-3} cm/s.

Seepage flow from the swamp can be analyzed by using above two kinds of data and applying the Hooghoudt's formula. The Hooghoudt's formula is presented by the following equation.

$$Q_o = (H_o^2 - h_o^2) k / L - Q_i$$

Where, Q_o : seepage to canal

H_o : depth of groundwater at the point L apart from the canal

h_o : depth of groundwater at the canal point

k : permeability coefficient

L : distance from the canal to the point of H_o

Q_i : seepage passing through the point of H_o .

The analysis was made under the following assumptions and conditions. The result of analysis is shown in Table A-24.

- The thickness of the peat layer is 5 m and impermeable layer lies underneath the peat layer.
- Seepage is totally caught by the Main Canal, since the Main Canal runs along the border of peat area and clayey soil area.
- In case of the Feeder Canal and the Tengi river, seepage comes from their both sides, because of the peat swamp extending in both sides of them.
- The hydraulic gradient of the groundwater in perpendicular to the main conveyance system is the same as that on the MSL line.

As seen in Table A-24, seepage flow to the main conveyance system is estimated at 0.77 lit/s/km. The length of the Main Canal along the swamp is 36 km and that of the Feeder Canal and Tengi river is 39 km. Seepage flow to the existing drain is also calculated with the same manner as the main conveyance system. It is estimated at 3.56 lit/s/km. The length of the existing drain is about 12 km in total. From these figures, the total seepage flow from the swamp to the main conveyance system in the dry season of 1986 is estimated at 131 lit/s as shown below.

Seepage flow along the Main Canal

$$0.77 \text{ lit/s/km} \times 36 \text{ km} = 28 \text{ lit/s}$$

Seepage flow along the Feeder Canal and the Tengi river

$$0.77 \text{ lit/s/km} \times 39 \text{ km} \times 2 = 60 \text{ lit/s}$$

Seepage from the existing drain

$$3.56 \text{ lit/s/km} \times 12 \text{ km} = 43 \text{ lit/s}$$

$$\text{Total seepage flow} \quad 131 \text{ lit/s}$$

TABLES

Table A-1 MONTHLY RAINFALL AT NO.3813158

Unit: MM

Station Name: Ladang Trolak, Perak, No.: 3813158

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1961	164	166	253	211	148	156	355	181	354	232	385	347	2,956
1962	143	131	322	503	314	92	72	270	186	366	260	93	2,756
1963	234	49	182	124	313	143	165	275	219	431	665	223	3,028
1964	274	135	340	275	127	329	355	179	418	342	320	153	3,253
1965	66	107	444	294	277	141	80	289	198	350	229	321	2,800
1966	211	150	426	298	126	231	160	254	408	276	490	302	3,355
1967	398	132	303	434	335	228	24	127	211	507	564	91	3,359
1968	84	99	204	350	430	185	178	179	188	334	233	473	2,941
1969	266	300	228	326	337	101	88	192	164	667	373	176	3,223
1970	288	95	393	325	400	150	110	243	129	271	421	359	3,187
1971	331	126	220	253	133	73	90	191	241	294	353	360	2,669
1972	53	164	221	304	371	284	41	183	234	434	349	146	2,789
1973	175	186	257	462	473	256	141	247	207	657	420	292	3,779
1974	75	177	159	184	281	164	122	63	207	109	314	250	2,106
1975	188	181	230	269	230	124	367	109	215	130	215	437	2,698
1976	110	129	300	435	112	375	173	171	185	273	253	117	2,636
1977	59	183	95	158	181	90	34	193	133	540	274	240	2,182
1978	140	165	129	242	339	103	119	142	261	211	291	225	2,369
1979	113	243	216	452	153	142	199	192	318	142	459	64	2,697
1980	116	160	368	225	398	175	108	290	298	153	342	224	2,859
1981	137	191	144	309	499	149	63	129	266	205	273	141	2,507
1982	105	167	279	432	401	49	143	201	282	321	518	153	3,053
1983	38	69	236	117	200	178	217	194	479	273	248	168	2,417
Mean	164	153	259	304	286	171	148	196	253	327	359	234	2,853
9 YEARS 75-83	112	166	222	294	279	154	158	180	271	250	319	197	2,602

Table A-2 MONTHLY RAINFALL AT NO.3814156

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1961	89	111	212	400	160	254	343	177	386	317	312	232	2,999
1962	75	111	154	206	173	215	38	254	178	357	411	147	2,324
1963	87	33	77	53	369	234	145	209	178	593	493	222	2,698
1964	114	64	277	204	115	169	387	118	317	414	217	191	2,591
1965	68	192	347	215	224	143	80	264	190	304	265	338	2,663
1966	69	202	72	286	141	345	130	234	342	197	406	347	2,776
1967	235	137	100	240	210	102	63	103	180	372	449	75	2,271
1968	144	84	135	244	370	385	339	244	142	278	196	376	2,942
1969	60	73	289	225	484	139	118	293	63	529	194	170	2,642
1970	222	122	204	197	324	106	228	161	184	297	334	330	2,715
1971	245	115	138	194	112	256	85	243	292	267	273	492	2,716
1972	53	178	263	235	334	331	59	242	310	359	397	191	2,937
1973	171	264	85	454	399	197	179	232	420	438	274	306	3,424
1974	45	133	127	302	335	105	216	73	314	145	259	144	2,200
1975	143	128	269	292	184	50	224	121	295	111	348	371	2,537
1976	65	126	60	249	75	366	160	205	125	283	161	252	2,127
1977	127	83	152	54	80	225	80	143	105	533	165	109	1,856
1978	61	120	243	382	171	9	80	51	250	318	228	73	1,986
1979	60	256	133	347	172	305	275	93	258	121	370	42	2,432
1980	101	114	94	73	271	105	183	246	357	214	221	243	2,224
1981	42	130	232	405	237	71	100	102	251	176	179	57	1,984
1982	135	95	206	522	204	82	119	244	310	266	79	354	2,619
1983	35	25	198	21	70	217	291	246	220	173	152	47	1,697
Mean	107	126	177	252	227	191	171	187	247	307	278	222	2,493
9 YEARS	86	120	177	261	163	159	168	161	241	244	212	172	2,163

Unit: MM

Station Name: Ladang Bedford, Slim River, Perak, No.: 3814156

Table A-3 MONTHLY RAINFALL AT NO.3615001

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1961	129	104	289	280	175	153	200	148	409	128	376	480	2,876
1962	225	187	341	405	361	207	62	230	181	379	456	157	3,196
1963	168	82	224	171	325	237	138	341	304	485	671	209	3,359
1964	284	75	299	322	232	231	382	185	348	304	231	293	3,189
1965	61	114	239	378	285	98	117	298	324	423	387	431	3,160
1966	185	200	266	401	152	387	135	337	423	392	362	430	3,676
1967	308	174	110	480	271	111	180	217	312	368	456	108	3,100
1968	116	170	103	370	315	256	209	349	248	329	268	339	3,078
1969	155	209	248	295	474	289	98	379	125	501	332	357	3,466
1970	404	119	282	288	401	114	131	156	209	291	285	243	2,928
1971	337	119	349	197	329	138	166	221	293	186	386	452	3,178
1972	91	210	222	275	234	163	41	194	349	459	651	142	3,037
1973	190	123	185	576	529	251	142	203	243	614	265	200	3,526
1974	27	241	151	303	298	117	192	127	332	117	265	213	2,386
1975	158	145	265	256	288	110	356	63	277	90	350	247	2,606
1976	134	102	359	169	89	338	203	351	94	422	329	138	2,729
1977	117	199	113	276	319	207	91	233	175	588	393	132	2,846
1978	97	132	174	319	264	81	163	60	254	450	393	159	2,549
1979	82	304	197	392	186	238	177	67	443	276	482	92	2,940
1980	103	139	366	253	522	312	325	296	239	319	323	262	3,463
1981	122	347	133	420	406	110	71	119	374	338	347	113	2,903
1982	134	81	327	461	393	124	96	404	179	442	567	100	3,310
1983	46	110	166	142	304	123	320	222	255	229	184	288	2,391
Mean	160	161	235	323	311	191	174	226	278	354	381	243	3,039
9 YEARS	111	173	233	298	308	183	200	201	255	351	374	170	2,860

Station Name: Ladang Escot, Selangor, No.: 3615001

Unit: MM

75-83

Table A-4 (1/2) FIVE-DAY EFFECTIVE RAINFALL AT NO.3411016

YEAR: 1975												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	33.0	13.0	0.	3.0	0.	0.	0.	46.0	13.0	0.	22.0	0.
6-10	0.	90.0	0.	5.0	0.	0.	11.0	0.	84.0	66.0	0.	6.0
11-15	62.0	0.	0.	58.0	0.	11.0	9.0	0.	0.	0.	7.0	5.0
16-20	0.	5.0	27.0	8.0	21.0	0.	31.0	0.	56.0	0.	94.0	0.
21-25	7.0	10.0	0.	20.0	0.	0.	59.0	0.	29.0	0.	0.	21.0
26-END	0.	0.	30.0	0.	48.0	0.	0.	0.	4.0	25.0	3.0	54.0
TOTAL	102.0	118.0	57.0	94.0	69.0	11.0	110.0	46.0	186.0	91.0	126.0	86.0

YEAR: 1976												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	80.0	0.	0.	26.0	4.0	48.0	0.	44.5	26.0	128.0	0.
6-10	0.	0.	35.0	0.	0.	0.	11.0	0.	4.0	49.0	16.5	0.
11-15	0.	0.	25.0	55.0	5.0	20.0	0.	5.5	0.	34.0	0.	5.0
16-20	0.	0.	20.0	15.5	0.	0.	0.	53.0	14.5	13.0	25.0	0.
21-25	0.	0.	5.0	12.5	0.	0.	1.0	32.0	55.5	0.	0.	17.0
26-END	0.	0.	25.0	15.5	21.0	13.0	9.0	40.0	27.5	23.5	0.	40.0
TOTAL	0.	80.0	110.0	98.5	52.0	37.0	69.0	130.5	146.0	145.5	169.5	62.0

YEAR: 1977												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	13.5	0.	0.	0.	0.	0.	45.0	0.	37.0	4.5	28.0
6-10	0.	11.0	0.	7.0	0.	4.5	6.0	33.0	58.0	74.0	16.0	19.5
11-15	0.	35.5	0.	3.5	45.0	18.0	133.5	58.0	0.	7.0	26.0	0.
16-20	0.	0.	0.	33.0	0.	22.0	0.	5.0	15.0	4.0	44.0	0.
21-25	0.	0.	0.	0.	9.0	3.0	0.	33.0	46.0	0.	13.5	24.0
26-END	0.	20.0	0.	112.0	0.	23.0	0.	0.	97.5	14.5	15.0	18.5
TOTAL	0.	80.0	0.	155.5	54.0	70.5	139.5	174.0	216.5	136.5	119.0	90.0

YEAR: 1978												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	0.	45.0	0.	0.	14.0	0.	3.5	5.0	0.	110.5	107.0
6-10	46.5	0.	0.	0.	66.0	20.5	8.0	2.0	15.5	26.5	71.5	76.0
11-15	33.5	20.0	13.0	4.0	0.5	0.	0.	33.0	20.0	0.	70.5	0.
16-20	9.0	0.	0.	0.	0.	63.5	0.	0.	110.0	55.0	6.0	8.5
21-25	48.0	0.	30.0	0.	0.	0.	0.	0.	76.5	41.0	0.	63.5
26-END	0.	74.0	29.5	0.	0.	79.0	28.0	22.0	0.	25.5	0.	0.
TOTAL	137.0	94.0	117.5	4.0	66.5	177.0	36.0	60.5	227.0	148.0	258.5	255.0

YEAR: 1979												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	40.0	0.	0.	0.	0.	0.	0.	0.	13.0	0.	52.5	76.5
6-10	17.5	6.0	0.	0.	0.	38.5	20.5	0.	0.	42.5	0.	0.
11-15	0.	1.0	0.	0.	0.	32.0	2.5	0.	0.	153.5	33.5	3.5
16-20	0.	5.5	0.	0.	0.	10.5	16.0	22.0	11.0	14.0	52.5	6.5
21-25	5.5	23.0	0.	175.5	0.	0.	50.5	0.	0.	32.0	22.5	0.
26-END	0.	0.	0.	44.0	50.5	0.	0.	58.5	36.5	43.0	68.0	0.
TOTAL	63.0	35.5	0.	219.5	50.5	81.0	89.5	80.5	60.5	285.0	229.0	86.5

Table A-4 (2/2) FIVE-DAY EFFECTIVE RAINFALL AT NO.3411016

YEAR: 1980		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	3.5	0.	59.5	65.0	42.0	50.5	0.	9.5	8.5	64.0	57.0	43.0
6-10	5.5	0.	2.0	41.5	132.0	1.0	6.5	14.5	28.5	58.5	0.	25.0
11-15	0.	0.	17.0	14.0	62.0	6.0	0.	0.	0.	16.5	5.5	0.
16-20	38.0	23.5	0.	0.5	45.5	7.5	22.0	58.5	0.	0.	0.	5.0
21-25	0.	0.	8.5	63.5	0.	9.5	67.0	0.	37.0	20.5	46.0	127.0
26-END	0.	45.5	8.5	0.5	3.5	0.3	28.0	22.5	10.0	59.0	6.0	1.5
TOTAL	47.0	69.0	95.5	185.0	285.0	74.8	123.5	105.0	84.0	218.5	114.5	201.5

YEAR: 1981		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	32.0	30.5	7.5	0.5	69.5	0.	0.	0.	31.0	0.	8.0	10.5
6-10	67.0	5.0	0.	23.0	39.5	2.5	3.5	0.	63.0	0.	31.5	0.
11-15	0.	47.5	0.	14.0	0.	0.	20.5	0.	1.0	143.5	0.	66.0
16-20	4.5	0.	7.5	133.5	8.5	0.	0.	4.5	18.0	56.5	41.0	0.
21-25	0.	10.0	0.	0.	0.	0.	48.5	35.0	0.	0.	12.5	0.
26-END	0.	25.5	36.5	0.	81.5	0.	0.	16.5	2.5	6.5	56.0	98.0
TOTAL	103.5	118.5	51.5	171.0	199.0	2.5	70.5	56.0	115.5	206.5	149.0	174.5

YEAR: 1982		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	38.5	20.5	30.0	0.	15.5	13.5	5.0	18.0	3.0	4.0	1.5
6-10	0.	0.	57.0	20.0	38.5	0.	8.0	4.5	0.	7.5	63.0	0.
11-15	0.	0.	0.	10.0	0.	62.5	0.	5.5	0.	15.5	32.0	5.5
16-20	9.5	0.	66.0	2.0	0.	0.	60.5	1.0	3.5	33.5	20.5	20.5
21-25	0.	0.	19.5	26.5	7.5	0.	1.5	22.0	0.	0.	35.5	0.
26-END	10.5	0.	1.5	53.5	25.5	6.0	0.	0.	11.5	29.0	129.5	30.0
TOTAL	20.0	38.5	164.5	142.0	71.5	84.0	83.5	38.0	33.0	88.5	284.5	57.5

YEAR: 1983		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	51.0	0.	0.	0.	23.0	0.	22.5	8.5	78.5	11.5	20.5	0.
6-10	9.5	0.	0.	0.	8.5	4.5	15.5	0.	10.0	18.0	0.	21.5
11-15	3.5	0.	0.	0.	2.5	25.0	0.	33.0	30.0	13.5	0.	52.0
16-20	0.	3.0	10.5	0.	22.5	12.5	108.0	0.5	90.0	5.5	0.	32.0
21-25	0.	6.5	0.	52.0	3.5	0.	0.	28.5	0.	22.5	1.5	44.5
26-END	0.	0.	0.	45.0	64.0	0.	0.	62.0	48.0	75.0	20.0	2.0
TOTAL	64.0	9.5	10.5	97.0	124.0	42.0	146.0	132.5	256.5	146.0	42.0	152.0

YEAR: 1984		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	18.5	137.5	59.5	22.5	77.5	3.0	37.5	0.	5.5	10.0	5.5	87.0
6-10	0.	123.5	0.	20.5	18.5	0.	0.	11.5	0.	0.	21.0	35.5
11-15	27.5	36.5	24.5	37.5	43.5	28.0	68.0	0.	5.0	4.0	13.5	21.0
16-20	10.5	51.0	110.5	50.0	0.	4.0	9.0	0.	32.5	3.0	7.5	57.0
21-25	23.5	0.	0.5	0.	72.5	0.	72.0	79.5	30.0	69.0	81.5	3.5
26-END	80.5	93.5	4.5	0.	3.5	0.	0.	0.5	0.	14.0	8.0	16.0
TOTAL	160.5	442.0	199.5	130.5	215.5	35.0	186.5	91.5	73.0	100.0	137.0	220.0

Table A-5 (1/2) FIVE-DAY EFFECTIVE RAINFALL AT NO.3610001

YEAR: 1975		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	61.0	2.0	19.5	0.	0.	22.0	1.5	0.	37.5	0.	10.0	0.
6-10	3.0	99.0	0.5	0.	0.	0.	17.5	4.0	36.5	0.	0.	0.5
11-15	0.	0.	0.	59.5	0.	20.0	0.	0.	0.	0.	8.0	7.5
16-20	0.	0.	0.	44.0	4.0	0.	20.0	0.5	6.5	0.	80.5	0.
21-25	0.	2.0	0.	6.5	0.	0.	51.0	8.0	13.0	31.0	0.	57.0
26-END	0.	17.0	69.5	0.	55.0	0.	15.0	13.0	11.0	57.5	9.5	59.0
TOTAL	64.0	120.0	89.5	110.0	59.0	42.0	105.0	25.5	104.5	88.5	108.0	124.0

YEAR: 1976		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	0.	6.0	0.	31.0	26.0	91.0	0.	1.0	58.5	0.	58.5
6-10	12.0	0.	10.5	0.	0.	5.5	0.	0.	0.	17.0	55.0	0.
11-15	2.5	3.5	53.5	22.0	0.	4.0	8.5	0.	0.	6.0	8.5	46.0
16-20	0.	0.	0.	11.5	0.	0.	0.	15.5	0.	7.5	10.0	32.5
21-25	0.	0.	3.5	32.5	0.	17.5	7.5	78.0	4.0	0.	0.	24.5
26-END	0.	32.5	30.0	33.0	25.0	17.5	9.5	42.0	2.0	13.5	0.	42.0
TOTAL	14.5	36.0	103.5	99.0	56.0	70.5	116.5	135.5	7.0	102.5	73.5	203.5

YEAR: 1977		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	23.5	11.0	0.	7.5	0.	56.0	0.	0.	0.	42.5	36.5	35.0
6-10	0.	25.5	0.	0.	0.	39.0	0.	0.	39.5	87.0	19.5	23.0
11-15	0.	3.0	5.5	0.	35.0	0.	51.5	0.	0.	12.5	0.	0.
16-20	0.	0.	0.	0.	0.	0.	0.	2.5	3.5	49.0	20.5	5.0
21-25	0.	19.5	0.	0.	0.	22.0	0.	10.5	31.5	18.0	10.0	61.5
26-END	29.5	4.0	0.	0.	0.	29.5	11.0	27.0	162.5	0.5	0.5	0.
TOTAL	53.0	63.0	5.5	7.5	35.0	146.5	62.5	40.0	237.0	209.5	87.0	124.5

YEAR: 1978		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	0.	18.5	12.5	1.5	0.	0.	0.	0.	0.	36.5	29.0
6-10	21.5	0.	3.5	35.0	39.0	9.5	0.	0.	3.5	40.0	74.0	63.0
11-15	68.0	4.5	8.5	0.	0.	0.	12.5	61.0	8.5	0.	93.0	35.0
16-20	5.0	23.5	0.	0.5	0.	1.5	3.5	54.0	14.5	0.	0.	10.0
21-25	9.5	6.0	20.5	5.5	0.	0.	0.	0.	22.5	20.0	0.	5.0
26-END	0.	23.0	39.5	63.5	0.	10.5	0.	37.0	0.	38.0	0.	0.
TOTAL	104.0	57.0	90.5	117.0	40.5	21.5	16.0	152.0	49.0	98.0	203.5	142.0

YEAR: 1979		UNIT: MM										
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	50.0	0.	0.	0.	0.	10.0	0.	10.0	15.0	0.	0.	0.
6-10	5.0	20.0	0.	15.0	0.	15.0	0.	0.	20.0	5.0	30.0	0.
11-15	0.	30.0	15.0	95.0	30.0	45.0	0.	10.0	0.	80.0	20.0	0.
16-20	0.	149.0	1.0	0.	0.	15.0	0.	0.	35.0	5.0	15.0	0.
21-25	10.0	90.0	20.0	85.0	5.0	0.	75.0	5.0	0.	105.0	20.0	5.0
26-END	0.	0.	45.0	75.0	35.0	0.	5.0	70.0	15.0	40.0	115.0	0.
TOTAL	65.0	289.0	81.0	270.0	70.0	85.0	80.0	95.0	85.0	235.0	200.0	5.0

Table A-5 (2/2) FIVE-DAY EFFECTIVE RAINFALL AT NO.3610001

YEAR: 1980												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	5.0	0.	35.0	0.	0.	5.0	0.	0.	15.0	0.	30.0	45.0
6-10	30.0	0.	25.0	35.0	80.0	10.0	0.	0.	0.	0.	10.0	50.0
11-15	10.0	0.	20.0	120.0	5.0	0.	5.0	10.0	0.	5.0	10.0	0.
16-20	0.	5.0	5.0	0.	20.0	10.0	45.0	30.0	5.0	5.0	5.0	65.0
21-25	0.	5.0	0.	0.	20.0	0.	65.0	15.0	40.0	0.	60.0	0.
26-END	0.	0.	55.0	20.0	5.0	0.	20.0	0.	15.0	20.0	25.0	70.0
TOTAL	45.0	10.0	140.0	175.0	130.0	25.0	135.0	55.0	75.0	30.0	140.0	230.0

YEAR: 1981												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	5.0	5.0	40.0	20.0	25.0	0.	0.	0.	5.0	0.	85.0	0.
6-10	0.	0.	5.0	30.0	0.	0.	0.	0.	40.0	8.0	20.0	2.0
11-15	0.	0.	25.0	80.0	10.0	0.	0.	0.	3.0	95.0	6.0	43.0
16-20	0.	0.	0.	0.	10.0	0.	0.	45.0	10.0	59.0	13.5	0.
21-25	5.0	20.0	30.0	15.0	10.0	5.0	10.0	0.	40.0	0.	20.0	0.
26-END	0.	0.	45.0	45.0	85.0	0.	40.0	45.0	10.0	20.0	31.0	20.0
TOTAL	10.0	25.0	145.0	190.0	140.0	5.0	50.0	90.0	108.0	182.0	175.5	65.0

YEAR: 1982												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	6.5	24.0	0.	12.0	0.	0.	38.0	6.0	2.0	22.5	21.0	15.0
6-10	0.	0.	6.5	51.0	56.0	0.	14.0	6.5	11.0	0.	73.5	0.
11-15	0.	0.	0.	6.	5.0	7.0	31.0	0.	0.	9.0	29.0	80.0
16-20	0.	0.	22.0	20.0	0.	0.	138.0	0.	4.5	4.0	23.0	62.0
21-25	0.	8.0	1.0	14.0	11.0	28.0	10.0	4.0	0.	17.0	28.0	80.5
26-END	0.	0.	25.0	11.0	37.0	0.	0.	28.0	0.	69.0	48.0	68.0
TOTAL	6.5	32.0	54.5	108.0	109.0	35.0	231.0	44.5	17.5	121.5	222.5	305.5

YEAR: 1983												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	54.0	0.	0.	0.	55.0	0.	0.	0.	35.0	50.0	25.0	0.
6-10	6.0	24.0	6.0	0.	4.0	3.0	10.0	10.0	10.0	10.0	0.	15.0
11-15	1.0	0.	2.0	0.	0.	17.0	20.0	35.0	5.0	15.0	0.	15.0
16-20	0.	0.	19.0	0.	0.	27.0	65.0	0.	10.0	0.	0.	25.0
21-25	0.	0.	0.	38.0	22.5	0.	0.	5.0	0.	10.0	15.0	30.0
26-END	0.	0.	0.	96.0	6.0	0.	15.0	0.	45.0	55.0	35.0	0.
TOTAL	61.0	24.0	27.0	134.0	87.5	47.0	110.0	50.0	105.0	140.0	75.0	85.0

YEAR: 1984												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	150.0	35.0	25.0	0.	0.	13.0	0.	0.	26.0	68.0	19.5
6-10	5.0	60.0	0.	25.0	90.0	5.0	10.0	33.0	7.0	21.0	23.5	0.
11-15	10.0	0.	5.0	10.0	20.0	25.0	10.0	0.	0.	38.5	44.0	12.9
16-20	115.0	95.0	20.0	20.0	0.	0.	2.5	0.	33.5	40.0	46.0	33.0
21-25	0.	0.	15.0	0.	15.0	0.	48.0	0.	6.0	23.5	0.	22.0
26-END	70.0	55.0	15.0	0.	5.0	5.0	0.	15.0	0.	8.0	0.	26.0
TOTAL	200.0	360.0	90.0	80.0	130.0	35.0	83.5	48.0	46.5	157.0	181.5	113.4

Table A-6 MONTHLY PAN EVAPORATION AT NO.3710306

Unit: mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1975	167.8	152.3	173.9	166.1	160.7	143.3	152.7	165.8	157.0	164.5	135.0	131.5	1870.6
1976	167.0	164.2	176.3	169.4	161.9	140.9	165.3	170.5	150.5	153.8	126.9	148.1	1894.3
1977	153.6	137.5	183.7	168.9	160.7	141.4	167.8	146.1	142.5	173.9	144.4	170.8	1891.3
1978	142.9	148.5	-	152.9	157.8	157.8	155.5	153.3	148.3	145.1	139.7	158.6	-
1979	180.0	159.6	179.1	165.2	189.6	164.0	156.7	170.3	135.0	163.2	134.2	154.9	1951.8
1980	146.7	161.6	178.0	143.8	162.7	156.3	158.4	155.0	131.8	132.9	151.7	118.5	1797.4
1981	132.0	145.8	176.0	148.9	132.6	171.5	170.0	-	119.5	150.0	140.2	139.0	-
1982	151.5	142.0	154.5	162.2	140.1	151.5	140.1	150.5	154.0	167.6	139.1	127.3	1780.4
1983	180.8	147.5	179.0	154.8	155.0	160.0	171.1	166.9	153.6	139.5	151.3	127.5	1887.0
Mean	158.0	151.0	175.1	159.1	157.9	154.1	159.7	159.8	143.5	154.5	140.3	141.8	1854.8
Daily													
Mean	5.1	5.4	5.7	5.3	5.1	5.1	5.2	5.2	4.8	5.0	4.7	4.6	-

Remarks: Station Name: Rumah Pam JPT Bagan Terap, Station No. 3710306

Table A-7 MONTHLY MEAN TEMPERATURE AT NO.3511201

Unit: °C

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1980	-	-	-	-	-	-	-	-	27.8	28.1	28.1	27.7	27.9
1981	27.0	28.0	28.1	28.4	28.2	28.2	27.7	28.0	27.7	28.1	28.3	27.8	28.0
1982	27.3	27.8	27.9	28.2	28.0	27.6	27.1	27.4	27.8	27.7	27.9	27.7	27.7
1983	27.8	28.1	28.7	29.4	28.7	28.0	27.4	27.9	27.5	27.7	28.2	27.5	28.1
1984	27.3	26.5	27.9	27.9	28.0	27.4	27.0	27.1	27.5	27.3	27.7	27.3	27.4
1985	27.3	27.8	27.5	-	-	-	-	-	-	-	-	-	27.5
Mean	27.3	27.6	28.0	28.5	28.2	27.8	27.3	27.6	27.7	27.8	28.0	27.6	27.8

Remarks: Station Name: Tanjong Karang, Station No. 3511201

Table A-8 MONTHLY MEAN HUMIDITY AT NO.3511201

Unit: %

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1980	-	-	-	-	-	-	-	-	75.7	76.8	78.9	76.0	76.9
1981	75.3	73.8	73.9	77.4	79.1	75.2	73.4	72.1	77.6	78.6	80.9	76.9	76.2
1982	75.3	74.7	78.7	78.2	81.2	80.5	79.5	75.1	75.6	79.2	80.9	79.6	78.2
1983	75.2	75.2	74.0	77.8	80.7	75.1	77.5	75.2	75.2	76.4	72.8	75.9	75.9
1984	76.7	79.3	74.9	74.8	75.8	77.3	82.3	76.1	74.2	75.9	76.4	78.2	76.8
1985	75.3	77.9	77.1	-	-	-	-	-	-	-	-	-	76.8
Mean	75.6	76.2	75.7	77.1	79.2	77.1	78.2	74.6	75.6	77.4	78.0	77.3	76.8

Remarks: Station Name: Tanjong Karang, Station No. 3511201

Table A-9 MONTHLY MEAN SUNSHINE HOUR AT NO.3511201

Unit: hours/day

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1980	-	-	-	-	-	-	-	-	5.4	5.3	4.8	4.2	4.9
1981	4.7	7.0	8.2	6.8	5.5	8.1	7.0	7.5	4.6	6.2	4.4	5.6	6.3
1982	6.6	8.0	6.7	6.8	6.8	6.6	6.8	5.5	6.0	6.3	5.9	5.3	6.4
1983	6.7	8.3	7.7	5.6	6.7	6.3	6.8	5.0	5.5	5.7	6.3	4.3	5.8
1984	4.5	3.5	6.6	6.1	6.6	6.4	6.4	6.7	6.2	4.9	6.2	5.4	5.8
1985	8.4	6.5	5.5	-	-	-	-	-	-	-	-	-	6.8
Mean	6.2	6.7	6.9	6.3	6.4	6.9	6.8	6.2	5.5	5.7	5.5	5.0	6.2

Remarks: Station Name: Tanjung Karang, Station No. 3511201

Table A-10 MONTHLY MEAN WIND VELOCITY AT NO.3511201

Unit: m/s

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1980	-	-	-	-	-	-	-	-	0.69	0.85	0.45	0.31	0.56
1981	0.27	0.59	0.45	1.64	1.46	1.13	1.34	1.88	1.78	1.64	1.56	1.11	1.24
1982	1.27	1.74	1.86	1.71	1.36	1.06	1.40	1.58	1.70	1.59	1.20	0.78	1.44
1983	1.15	1.50	1.69	1.43	1.15	0.90	0.74	1.13	1.05	1.11	1.09	0.26	1.10
1984	0.19	0.30	0.86	0.64	0.87	0.71	0.47	0.24	0.55	0.86	0.64	0.53	0.57
1985	0.36	0.54	0.77	-	-	-	-	-	-	-	-	-	0.56
Mean	0.65	0.93	1.13	1.35	1.21	0.95	0.99	1.21	1.15	1.21	0.99	0.60	1.03

Remarks: Station Name: Tanjung Karang, Station No. 3511201

Table A-11 (1/4) FIVE-DAY MEAN DISCHARGE AT SKC BRIDGE STATION

YEAR: 1961												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	0.	0.	0.	0.	0.	0.	103.47	63.80	68.61	72.14	69.51
6-10	0.	0.	0.	0.	0.	0.	0.	73.99	88.00	62.58	91.89	51.29
11-15	0.	0.	0.	0.	0.	0.	0.	54.77	65.60	63.68	59.33	61.86
16-20	0.	0.	0.	0.	0.	0.	0.	50.77	103.28	62.61	72.20	83.42
21-25	0.	0.	0.	0.	0.	0.	0.	40.58	74.28	70.25	96.81	114.32
26-END	0.	0.	0.	0.	0.	0.	0.	35.84	65.94	98.05	122.08	108.77
AVERAGE	0.	0.	0.	0.	0.	0.	0.	57.65	76.82	71.84	85.74	82.41

YEAR: 1962												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	118.01	37.41	45.23	29.43	37.15	40.96	45.14	21.30	40.89	40.42	104.92	92.05
6-10	77.73	31.97	31.92	20.65	99.58	52.75	33.15	19.78	50.75	47.95	131.11	70.00
11-15	54.20	32.01	44.37	93.85	139.15	45.96	25.72	29.28	33.58	125.78	142.31	66.18
16-20	92.97	26.59	56.19	100.09	113.74	39.17	24.61	37.96	57.07	149.14	157.20	53.03
21-25	68.78	31.02	102.41	52.29	60.61	40.27	21.16	42.50	62.52	140.11	157.43	47.51
26-END	45.22	41.85	52.53	56.25	43.07	42.43	20.89	58.53	36.63	83.53	104.51	53.47
AVERAGE	75.15	32.88	61.64	73.76	89.02	43.59	28.20	35.65	46.91	97.36	132.91	63.38

YEAR: 1963												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	69.56	27.46	19.77	16.56	21.05	63.94	28.45	21.53	39.31	36.07	132.69	166.64
6-10	54.14	23.83	25.14	14.69	42.61	47.78	28.81	90.15	29.08	83.94	176.57	130.62
11-15	41.80	26.23	30.99	15.84	29.14	42.12	34.76	58.85	29.91	116.75	155.80	96.72
16-20	38.04	24.88	23.94	19.91	53.87	26.70	28.44	36.22	55.99	126.23	159.12	75.53
21-25	44.09	20.13	24.85	16.62	74.46	28.07	18.41	43.01	81.10	132.49	186.73	65.18
26-END	32.16	18.27	30.27	17.53	46.94	48.04	31.66	52.03	49.80	89.73	163.79	56.18
AVERAGE	46.17	23.84	25.31	17.19	44.75	42.78	28.53	50.35	47.53	97.28	162.45	97.11

YEAR: 1964												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	55.99	31.24	54.60	25.72	51.65	27.42	39.77	73.06	66.59	36.78	127.35	103.79
6-10	46.33	33.84	54.08	26.36	62.56	25.47	51.78	41.41	106.93	42.33	94.70	80.30
11-15	51.37	42.04	29.18	46.44	44.57	32.12	82.61	43.42	117.21	51.78	98.22	115.47
16-20	93.59	36.91	30.12	41.43	55.10	43.87	57.52	32.42	88.97	43.67	75.14	76.58
21-25	66.14	27.71	47.64	33.07	55.44	34.42	57.27	32.42	56.47	90.43	81.25	59.89
26-END	39.12	27.05	28.90	63.50	28.28	47.84	88.68	31.64	40.04	111.76	119.51	54.82
AVERAGE	58.20	33.35	39.57	39.73	45.69	35.19	63.74	42.05	79.37	64.37	99.36	80.94

YEAR: 1965												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	53.78	26.32	27.52	64.79	77.66	46.16	29.92	43.03	56.14	61.94	110.31	59.34
6-10	44.35	22.22	21.12	64.93	84.41	51.53	32.03	45.14	58.26	41.15	94.87	66.29
11-15	35.68	39.65	26.72	47.65	115.77	37.78	34.15	47.26	60.37	50.85	69.56	96.84
16-20	31.46	36.35	19.64	74.22	119.92	45.82	36.26	49.37	62.49	82.01	101.70	128.52
21-25	29.90	28.37	33.34	76.08	125.08	38.98	38.38	51.49	64.60	78.82	103.12	139.16
26-END	29.49	25.36	61.76	71.62	52.73	31.73	40.70	53.82	66.72	97.59	86.28	111.07
AVERAGE	37.12	30.02	32.07	66.65	92.51	42.01	35.42	48.53	61.43	69.66	94.31	100.55

YEAR: 1966												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	69.54	44.62	34.93	14.17	67.27	39.40	38.39	26.24	37.86	122.22	96.23	102.40
6-10	63.77	38.58	40.29	21.79	54.71	67.44	46.44	40.94	28.27	114.91	100.32	98.65
11-15	73.51	30.74	47.71	69.91	39.57	57.05	82.53	47.36	44.34	90.22	102.60	105.45
16-20	64.10	55.60	82.46	48.87	39.44	37.37	52.56	35.25	51.38	79.42	120.24	106.82
21-25	57.20	77.80	72.47	86.95	36.61	51.29	34.06	44.37	66.14	67.61	135.30	91.58
26-END	49.41	40.89	74.72	93.11	31.19	40.58	27.18	65.46	83.74	73.71	114.01	136.76
AVERAGE	62.49	48.45	59.44	77.47	44.34	48.85	46.23	43.99	51.96	90.79	111.45	107.91

Table A-11 (2/4) FIVE-DAY MEAN DISCHARGE AT SKC BRIDGE STATION

YEAR: 1967												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	126.87	91.57	66.41	45.05	67.80	37.39	26.37	16.67	19.75	44.59	112.06	113.95
6-10	114.92	63.98	46.92	72.29	95.80	31.07	22.01	14.60	17.95	36.43	115.46	72.78
11-15	101.21	55.39	59.35	63.51	70.66	29.96	20.05	16.44	26.74	49.71	135.35	56.30
16-20	89.03	59.51	39.86	39.32	95.87	48.94	22.90	25.08	48.45	31.39	137.29	58.26
21-25	81.16	57.81	41.05	58.85	98.99	31.20	24.28	24.30	37.12	51.94	112.61	59.38
26-END	92.45	65.12	36.71	92.70	52.32	24.01	16.98	19.33	40.58	117.40	143.77	39.82
AVERAGE	100.67	65.60	47.85	62.61	79.34	33.76	21.93	19.43	31.77	57.25	126.09	65.88

YEAR: 1968												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	33.10	27.59	15.25	16.69	95.14	76.50	43.92	26.79	50.73	56.22	103.95	49.47
6-10	31.10	29.57	12.82	15.83	53.21	71.25	34.49	32.13	51.51	64.36	77.37	74.75
11-15	29.25	22.00	12.18	20.45	73.13	100.91	30.87	34.34	43.79	76.92	52.03	87.48
16-20	26.78	23.92	12.92	17.16	123.06	75.05	44.41	27.49	67.85	61.90	68.39	91.49
21-25	28.33	17.15	14.73	25.03	99.21	43.08	75.08	29.05	42.22	54.90	59.34	52.18
26-END	27.05	13.55	19.25	58.77	90.15	41.50	34.10	55.30	49.74	83.41	58.36	96.04
AVERAGE	29.20	21.92	14.37	25.65	89.02	68.05	43.50	34.86	50.97	66.87	69.91	75.91

YEAR: 1969												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	110.83	49.68	39.35	54.77	106.20	56.30	33.45	23.67	67.79	66.49	75.46	106.18
6-10	77.60	34.71	26.91	30.80	75.21	43.79	34.71	17.43	54.97	62.21	86.55	78.28
11-15	58.15	32.55	30.55	29.30	69.72	59.14	27.74	24.77	27.26	145.91	90.76	84.54
16-20	60.25	31.60	26.46	42.86	92.38	49.75	25.68	36.36	31.87	165.81	87.19	80.84
21-25	41.34	63.05	27.92	35.36	111.99	48.04	21.05	59.44	29.44	123.31	69.75	51.51
26-END	44.83	69.23	44.51	72.20	90.99	33.73	16.19	69.60	34.60	115.13	88.54	73.48
AVERAGE	64.83	45.21	33.21	44.92	91.95	48.46	26.92	39.54	40.99	113.21	83.04	78.95

YEAR: 1970												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	59.56	43.64	25.43	39.33	104.48	55.34	42.27	21.98	33.53	87.87	54.59	96.07
6-10	94.90	33.77	22.06	57.75	81.80	35.09	22.68	21.84	50.47	178.56	96.34	88.43
11-15	96.05	28.44	26.02	38.59	75.68	34.30	20.34	60.59	60.32	138.33	98.86	80.50
16-20	81.97	23.72	35.31	42.83	56.99	31.93	21.28	25.97	49.73	90.64	79.75	92.64
21-25	45.41	32.21	22.47	75.93	90.33	32.87	28.45	21.26	95.87	57.81	98.80	103.50
26-END	63.71	29.42	45.34	66.26	67.68	39.47	38.57	38.72	46.94	41.07	99.64	86.63
AVERAGE	73.28	31.59	29.98	61.65	79.11	38.17	29.24	31.95	56.14	97.18	88.00	91.14

YEAR: 1971												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	214.52	49.66	59.29	44.27	22.71	22.63	25.39	28.97	50.32	25.55	52.31	0.
6-10	350.88	32.44	31.50	34.36	21.41	18.71	18.41	18.79	75.57	22.10	188.92	0.
11-15	143.91	27.72	34.40	26.63	27.84	19.24	18.64	43.78	82.39	26.33	145.12	159.91
16-20	105.33	26.63	49.72	20.73	28.28	21.25	17.70	27.09	62.61	36.34	75.54	125.38
21-25	65.56	45.91	40.87	19.14	33.63	22.52	17.02	124.00	92.10	44.15	103.67	142.84
26-END	54.84	45.37	30.61	31.66	48.13	29.97	26.32	56.57	39.24	51.13	0.	133.44
AVERAGE	152.58	36.36	43.99	29.46	30.91	22.39	20.76	50.08	63.67	34.81	114.91	140.06

YEAR: 1972												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	103.89	46.19	22.66	44.86	75.86	56.42	30.27	18.44	48.60	132.47	128.76	151.48
6-10	87.82	49.99	24.27	38.86	61.68	38.05	26.49	18.18	40.29	71.28	131.63	74.37
11-15	63.94	32.95	44.15	58.52	95.68	53.21	23.06	20.08	73.39	202.23	122.83	63.70
16-20	44.74	26.84	35.83	64.98	75.98	94.90	28.90	21.22	44.68	114.34	257.93	75.09
21-25	37.09	37.32	24.76	53.05	107.48	95.74	21.15	28.32	40.73	86.93	223.05	110.90
26-END	34.43	31.45	22.39	70.76	89.60	44.48	20.40	29.94	46.51	141.71	121.95	57.59
AVERAGE	61.10	38.70	28.79	55.18	84.55	63.80	24.90	22.93	49.03	125.37	164.36	87.85

Table A-11 (3/4) FIVE-DAY MEAN DISCHARGE AT SKC BRIDGE STATION

YEAR: 1973												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	45.57	21.60	27.10	63.20	107.13	200.65	62.04	92.21	74.31	70.51	171.13	187.47
6-10	38.37	21.63	27.46	0.	80.51	113.66	36.20	73.31	85.35	44.19	143.24	273.32
11-15	29.69	16.85	48.29	0.	132.15	63.79	35.74	87.52	68.01	91.26	142.19	155.80
16-20	35.37	20.07	31.42	0.	92.04	45.08	26.36	41.99	80.52	76.83	124.43	119.76
21-25	30.94	19.33	26.99	131.63	76.86	88.45	29.70	38.77	69.93	222.66	158.89	91.78
26-END	23.61	34.52	36.40	212.56	179.72	96.74	55.60	49.06	52.67	266.18	202.75	64.92
AVERAGE	34.06	23.96	32.92	146.24	113.61	101.36	41.41	63.81	71.80	133.04	157.10	146.14

YEAR: 1974												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	52.62	67.53	25.20	25.59	99.53	37.87	37.78	0.	0.	52.48	40.50	72.55
6-10	43.18	32.57	52.40	61.32	102.23	33.26	26.10	0.	0.	40.12	35.12	66.90
11-15	34.78	23.24	42.82	49.91	104.90	27.60	32.56	23.61	0.	37.44	47.18	68.64
16-20	30.46	41.11	50.56	75.55	115.45	42.43	31.43	23.30	73.40	38.02	89.28	73.47
21-25	28.42	82.73	22.66	77.69	79.63	46.01	0.	23.90	72.79	35.07	70.34	66.01
26-END	32.85	89.81	20.66	110.41	55.09	67.48	0.	25.83	63.29	36.35	77.92	75.07
AVERAGE	36.92	46.62	53.60	70.14	90.14	42.44	32.06	23.76	69.28	39.80	60.06	70.59

YEAR: 1975												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	85.68	46.22	59.99	74.52	0.	0.	28.65	34.82	0.	0.	0.	0.
6-10	98.25	29.92	30.35	33.55	0.	0.	29.09	34.57	0.	0.	0.	0.
11-15	68.37	57.72	39.43	30.20	0.	30.00	25.79	0.	0.	0.	0.	0.
16-20	62.17	67.26	30.50	55.23	0.	38.09	90.55	0.	0.	0.	0.	0.
21-25	47.65	33.02	30.92	87.90	0.	24.19	140.15	0.	0.	0.	0.	0.
26-END	43.39	39.01	55.34	94.77	0.	37.60	83.50	0.	0.	0.	0.	0.
AVERAGE	66.80	45.06	50.66	72.56	0.	32.75	66.84	34.76	0.	0.	0.	0.

YEAR: 1976												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6-10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11-15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16-20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21-25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26-END	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
AVERAGE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

YEAR: 1977												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	0.	0.	22.69	18.05	20.42	23.65	19.59	16.19	23.12	79.08	104.83	52.46
6-10	0.	0.	22.17	18.20	20.99	44.01	24.33	16.24	18.06	130.52	78.61	70.83
11-15	0.	29.25	12.94	20.15	48.43	31.17	28.29	15.79	16.65	208.92	97.40	92.53
16-20	0.	23.29	22.27	25.24	20.04	33.28	0.	17.00	16.61	164.86	21.17	58.38
21-25	0.	20.96	22.29	25.22	20.49	22.24	0.	0.	16.85	140.55	94.29	45.83
26-END	0.	43.63	18.32	24.57	32.33	20.24	0.	44.43	46.02	174.16	82.42	32.04
AVERAGE	0.	27.66	22.67	21.95	29.37	29.18	24.39	19.13	22.89	150.47	92.10	57.82

YEAR: 1978												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	16.07	10.22	2.51	17.27	41.41	19.43	9.77	6.57	9.34	11.05	57.06	29.17
6-10	16.89	12.42	10.36	17.65	52.21	17.87	14.58	7.81	10.63	8.90	49.05	43.68
11-15	17.06	12.50	12.57	19.75	62.55	15.40	12.07	12.84	10.38	11.86	61.74	30.41
16-20	22.55	15.05	12.37	28.02	41.34	12.09	11.14	9.76	7.67	14.34	78.54	21.10
21-25	16.41	9.92	14.87	43.89	73.97	11.55	14.81	8.35	21.09	26.34	55.35	19.80
26-END	12.93	10.16	14.42	37.75	20.13	10.74	10.95	7.93	12.04	53.36	39.51	15.79
AVERAGE	16.85	11.93	12.42	30.34	41.23	14.51	12.18	9.17	11.86	22.02	53.47	26.31

Table A-11 (4/4) FIVE-DAY MEAN DISCHARGE AT SKC BRIDGE STATION

YEAR: 1979												UNIT: CMS	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1-5	16.52	15.09	14.51	54.66	51.18	26.90	16.13	21.65	39.99	23.10	66.69	73.16	
6-10	16.18	11.11	0.	35.81	34.11	60.67	14.19	19.69	50.32	25.23	71.95	54.39	
11-15	13.80	10.76	0.	65.86	46.00	61.14	20.61	15.86	69.70	34.45	73.22	36.85	
16-20	10.86	13.55	0.	25.74	21.32	27.78	21.84	18.95	72.82	36.85	153.53	31.56	
21-25	10.90	32.52	0.	32.21	17.31	21.02	67.21	24.50	38.71	42.07	101.36	28.81	
26-END	10.23	31.74	0.	41.17	23.14	18.44	45.06	25.64	33.80	72.94	103.99	24.19	
AVERAGE	12.99	17.33	14.51	39.56	33.04	35.99	31.30	21.20	50.89	40.03	95.12	40.94	

YEAR: 1980												UNIT: CMS	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1-5	23.14	13.35	32.84	21.31	42.25	29.79	15.64	34.84	27.34	42.92	32.19	60.35	
6-10	20.72	10.94	33.39	23.54	65.32	33.28	13.28	23.75	36.69	67.16	30.33	144.14	
11-15	16.40	9.26	19.60	23.19	62.27	22.91	12.22	23.05	24.22	70.04	32.92	134.62	
16-20	14.19	6.30	24.86	17.52	52.19	34.61	26.84	19.19	37.81	231.58	44.81	60.95	
21-25	13.24	11.70	0.	16.12	20.02	22.30	20.86	76.37	68.71	58.92	64.43	48.30	
26-END	17.42	25.55	0.	40.27	34.19	21.73	33.95	39.63	46.32	36.61	73.61	41.10	
AVERAGE	17.52	12.76	33.67	23.82	47.27	27.43	20.90	36.25	40.18	82.99	46.38	86.84	

YEAR: 1981												UNIT: CMS	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1-5	49.26	36.09	31.83	39.34	56.19	40.29	21.73	15.10	22.05	20.48	28.15	47.30	
6-10	47.56	29.32	21.31	62.70	72.12	37.24	17.69	11.92	81.07	26.12	29.76	75.92	
11-15	34.52	29.07	21.96	54.81	62.14	31.10	21.99	10.62	62.78	42.25	58.20	50.46	
16-20	31.58	47.05	14.35	71.09	51.08	24.58	18.07	9.76	49.84	70.11	39.37	33.75	
21-25	29.55	27.74	19.51	68.35	90.56	22.68	17.96	14.18	36.38	35.19	98.23	26.96	
26-END	24.73	48.54	17.72	38.97	76.76	33.87	20.43	23.72	29.07	37.31	65.70	24.36	
AVERAGE	35.83	35.21	21.33	55.23	78.26	34.96	19.67	14.53	46.20	38.54	56.57	42.52	

YEAR: 1982												UNIT: CMS	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1-5	23.10	13.56	25.46	16.42	72.46	55.25	23.19	13.71	23.30	48.91	78.69	114.29	
6-10	19.80	20.92	23.13	37.49	61.96	42.72	17.36	18.67	15.22	46.71	74.38	66.14	
11-15	26.16	34.32	23.60	28.82	45.69	32.16	14.35	20.71	27.32	54.39	86.35	51.17	
16-20	18.10	18.36	14.52	97.43	43.91	33.39	14.36	25.35	43.21	69.41	104.28	0.	
21-25	17.75	16.36	23.13	91.20	88.18	20.61	22.89	38.77	40.72	49.59	77.92	28.13	
26-END	14.29	13.99	25.65	60.76	90.49	16.66	13.76	22.75	40.41	53.36	99.64	29.89	
AVERAGE	19.69	21.06	22.24	55.32	67.72	33.47	17.53	23.31	31.70	53.72	86.88	58.59	

YEAR: 1983												UNIT: CMS	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1-5	35.66	17.12	18.07	14.33	30.23	21.82	13.29	56.88	41.59	32.20	36.74	0.	
6-10	32.22	14.99	13.56	12.26	22.64	13.05	15.84	43.26	58.55	29.70	50.93	0.	
11-15	25.09	15.17	17.50	11.71	27.63	24.04	17.38	28.78	75.10	27.63	44.48	0.	
16-20	22.58	20.27	17.83	9.69	24.30	30.96	15.38	28.52	115.01	30.83	0.	0.	
21-25	20.10	15.88	16.86	11.66	26.56	17.95	48.59	19.75	66.94	34.85	0.	30.98	
26-END	17.54	14.28	23.08	17.49	19.49	13.70	26.22	24.55	41.03	38.32	0.	23.55	
AVERAGE	25.27	16.44	18.15	12.74	24.96	20.25	22.99	33.33	66.37	32.45	44.05	26.52	

Table A-13 (1/4) FIVE-DAY BASIN RAINFALL

YEAR: 1961												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	13.30	0.	54.40	47.90	60.90	28.30	1.00	31.30	145.30	41.70	50.80	5.00
6-10	76.90	2.20	32.60	89.50	29.90	66.30	100.20	68.80	42.80	44.90	16.70	11.10
11-15	0.20	22.20	2.00	46.20	55.00	99.10	17.50	16.30	27.20	48.50	14.80	45.30
16-20	7.30	74.70	15.70	14.60	7.20	8.60	5.50	25.80	79.40	50.20	77.60	80.70
21-25	2.30	13.80	105.20	61.30	0.60	19.60	88.10	3.10	37.10	40.50	137.10	110.60
26-END	4.70	0.	25.10	97.80	5.80	0.	95.40	25.50	58.60	37.80	37.00	48.70
TOTAL	105.20	112.90	235.00	357.30	163.40	221.90	307.70	170.80	390.40	263.60	334.00	301.40

YEAR: 1962												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	32.60	3.10	59.00	82.80	63.30	44.60	7.80	1.00	47.20	59.80	59.30	20.40
6-10	0.	1.20	29.90	66.50	80.10	42.60	11.70	28.30	24.20	48.20	43.20	8.00
11-15	34.20	13.40	21.40	50.60	42.50	9.40	4.50	68.30	0.10	61.90	150.60	30.50
16-20	44.20	3.80	24.10	19.70	37.30	34.00	4.70	22.90	65.10	129.70	93.90	8.80
21-25	6.50	73.70	62.20	13.30	2.90	39.20	1.40	93.60	39.80	11.60	33.20	4.80
26-END	0.50	37.00	16.40	43.70	4.60	36.20	17.10	34.70	3.00	52.70	33.10	74.30
TOTAL	118.60	132.60	213.00	276.60	230.70	205.40	47.20	246.80	179.40	363.90	413.30	146.80

YEAR: 1963												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	52.20	2.60	1.20	14.30	19.30	44.30	2.60	46.80	10.00	12.70	131.40	125.80
6-10	16.50	0.	47.30	2.10	63.30	23.80	28.30	62.00	5.30	205.90	75.40	18.40
11-15	1.70	30.60	26.30	42.00	38.10	36.40	38.10	3.30	21.00	104.10	103.80	20.40
16-20	39.80	1.70	3.60	6.80	65.70	7.40	0.	46.40	92.10	129.80	87.30	14.80
21-25	7.50	7.70	14.50	12.00	79.30	62.90	30.70	20.80	67.50	25.70	91.60	36.20
26-END	0.20	4.40	28.60	11.10	88.60	54.70	45.40	47.90	17.70	76.90	60.60	3.30
TOTAL	117.90	47.00	122.00	88.30	354.30	229.50	145.10	247.20	213.60	555.10	550.10	218.90

YEAR: 1964												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	18.60	5.90	90.30	25.60	19.20	11.90	38.70	24.20	139.50	18.80	7.10	34.80
6-10	6.70	12.50	15.40	42.60	47.50	14.00	67.50	0.60	67.60	41.90	58.30	71.80
11-15	67.60	12.50	9.00	56.90	1.50	24.70	71.60	28.60	65.30	13.20	26.00	73.50
16-20	56.90	28.40	33.60	20.70	65.40	55.60	31.80	0.70	28.30	119.10	20.70	10.00
21-25	2.30	7.10	135.20	22.30	10.90	77.00	118.40	17.20	3.00	61.90	73.00	19.40
26-END	16.00	5.20	3.20	71.50	1.60	12.00	56.00	68.10	24.10	126.40	42.80	6.10
TOTAL	166.60	71.60	286.70	239.60	146.10	195.20	384.00	139.40	331.80	381.30	227.90	215.60

YEAR: 1965												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	43.80	2.40	50.10	53.80	47.70	22.00	12.80	3.90	43.00	19.30	41.20	26.40
6-10	0.	1.80	1.50	20.80	47.00	0.50	21.90	47.20	25.30	18.40	9.00	93.60
11-15	0.	115.60	0.20	68.40	32.10	38.50	14.20	54.00	4.20	37.80	97.00	65.70
16-20	4.10	24.40	48.90	25.80	114.20	61.80	18.60	33.30	35.10	96.40	61.20	118.60
21-25	7.60	22.40	57.00	51.10	2.30	5.70	0.	128.10	36.50	72.90	57.60	38.20
26-END	11.00	0.30	136.90	42.00	0.	3.40	22.10	8.50	81.60	93.00	26.50	18.80
TOTAL	66.50	166.90	274.60	261.90	243.30	131.90	89.60	275.00	225.70	337.80	294.50	361.30

YEAR: 1966												UNIT: MM
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	9.90	47.70	12.20	79.60	43.60	118.40	6.90	28.80	0.	83.80	54.80	30.80
6-10	20.30	0.	29.90	42.50	5.00	64.40	77.50	85.90	4.60	32.40	67.00	57.60
11-15	22.80	14.10	19.80	20.60	63.80	13.70	35.20	20.20	51.90	22.80	75.20	49.60
16-20	20.40	112.50	106.50	20.90	5.80	44.30	3.10	18.60	150.70	38.90	95.70	45.40
21-25	30.30	24.70	40.40	127.60	15.70	57.90	3.30	76.90	48.20	25.90	71.30	60.50
26-END	4.50	0.	129.90	25.70	9.10	49.80	13.40	31.80	112.20	48.80	36.80	123.20
TOTAL	108.20	199.00	352.70	316.90	143.00	348.50	139.40	262.20	367.60	252.60	400.80	367.10

Table A-13 (2/4) FIVE-DAY BASIN RAINFALL

YEAR: 1967												UNIT:	MM	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	49.30	0.	4.70	92.40	68.00	7.50	13.10	6.60	0.80	45.90	85.10	9.40		
6-10	21.20	31.10	8.30	41.10	70.80	9.10	15.30	6.40	23.20	40.10	97.00	2.60		
11-15	33.80	24.70	20.50	11.80	34.50	54.50	18.60	25.80	43.70	38.70	61.30	3.10		
16-20	14.70	19.60	21.50	16.20	28.00	39.20	40.50	23.80	88.20	43.10	70.80	34.70		
21-25	58.00	23.40	14.40	125.50	32.70	0.	0.20	26.30	17.30	86.50	79.30	33.40		
26-END	67.80	48.60	21.50	27.40	0.70	3.20	3.10	45.60	43.10	125.30	64.70	1.50		
TOTAL	264.80	146.80	96.90	314.40	234.70	113.50	90.80	134.50	216.30	379.60	458.20	84.70		
YEAR: 1968												UNIT:	MM	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	0.20	11.10	0.	44.10	47.00	108.00	22.20	15.50	44.80	55.40	43.00	19.60		
6-10	12.20	18.60	0.90	17.60	39.70	135.00	25.10	37.70	14.90	32.80	6.30	123.30		
11-15	48.50	43.40	11.70	75.90	101.10	43.80	17.40	62.00	39.30	35.70	21.00	71.00		
16-20	23.20	25.30	20.80	33.20	59.00	27.50	190.60	0.70	20.70	28.80	85.10	4.90		
21-25	23.70	0.	47.40	51.60	70.60	12.80	12.00	85.70	21.90	47.30	30.40	13.40		
26-END	25.50	8.70	27.10	60.90	43.30	12.60	28.40	66.10	31.00	95.60	31.40	141.40		
TOTAL	133.30	107.10	107.90	283.30	360.70	339.70	295.70	267.70	172.60	295.60	217.20	373.60		
YEAR: 1969												UNIT:	MM	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	23.30	25.00	4.60	29.20	100.40	13.10	49.50	3.70	34.70	70.00	14.70	18.50		
6-10	16.00	2.30	15.50	3.10	57.90	14.20	13.40	0.	0.40	58.40	63.90	85.70		
11-15	22.30	9.60	40.70	40.40	86.50	101.40	31.90	62.10	0.10	195.20	32.70	46.10		
16-20	4.60	10.20	6.70	4.10	106.30	17.50	3.20	63.50	3.80	72.30	31.00	23.20		
21-25	0.	71.40	30.90	73.60	103.30	9.10	0.	41.40	5.80	101.20	34.40	12.40		
26-END	31.60	4.50	71.70	99.30	24.90	20.20	13.00	138.10	41.20	34.00	65.00	33.10		
TOTAL	97.80	123.00	170.10	249.70	472.50	175.50	111.00	308.80	86.00	531.10	241.70	219.00		
YEAR: 1970												UNIT:	MM	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	78.20	0.20	66.40	11.60	69.90	1.10	31.80	22.30	34.70	72.50	106.70	55.30		
6-10	74.40	0.80	0.70	20.90	82.40	6.50	2.80	32.70	40.50	117.20	66.40	4.90		
11-15	53.30	0.10	34.10	8.90	9.30	9.20	4.20	23.40	37.90	13.60	35.00	97.20		
16-20	0.	0.	38.50	42.10	99.10	37.40	64.30	13.30	28.40	64.60	59.20	70.40		
21-25	33.40	117.70	13.50	39.10	27.20	30.20	54.90	8.40	37.70	6.40	54.00	41.10		
26-END	36.60	1.30	141.00	106.10	61.40	27.10	38.00	65.50	8.10	19.30	5.80	40.90		
TOTAL	273.90	120.10	294.20	228.70	349.30	111.50	196.00	165.60	187.30	293.60	327.10	309.80		
YEAR: 1971												UNIT:	MM	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	217.00	5.80	40.10	93.50	5.50	23.40	15.30	48.90	88.20	4.20	18.90	108.00		
6-10	1.80	0.10	4.50	5.30	22.60	0.60	0.20	11.60	70.30	33.10	131.00	84.20		
11-15	24.40	1.10	43.00	9.00	51.80	34.00	12.50	66.30	36.80	21.00	21.30	100.40		
16-20	0.40	5.30	83.70	3.30	22.30	25.60	7.90	42.00	31.60	61.50	27.50	40.20		
21-25	2.00	47.60	49.20	36.00	51.50	119.20	4.10	63.10	60.40	35.30	91.30	61.70		
26-END	28.70	57.80	22.00	51.80	16.10	12.20	68.30	2.20	2.00	93.20	17.80	79.20		
TOTAL	274.30	117.10	242.50	198.90	169.80	214.40	106.30	234.10	289.30	246.30	307.80	473.70		
YEAR: 1972												UNIT:	MM	
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	0.	60.10	0.	53.70	82.40	18.00	2.60	5.20	53.30	49.40	43.00	61.80		
6-10	39.20	63.60	55.00	0.10	22.90	3.60	0.80	22.70	68.20	104.90	45.40	9.40		
11-15	5.20	3.50	18.40	63.60	36.10	98.60	8.60	19.10	59.00	67.50	121.30	15.90		
16-20	0.	14.20	39.20	23.20	103.00	95.60	26.30	16.70	14.10	12.90	157.50	48.30		
21-25	9.00	27.30	3.60	53.10	52.90	33.10	0.	122.10	62.10	60.60	15.00	35.50		
26-END	9.50	16.60	49.00	56.50	14.10	22.60	15.40	40.60	58.80	94.50	77.20	5.70		
TOTAL	63.50	185.30	165.20	250.20	311.40	271.50	53.70	226.40	315.50	389.80	459.40	176.60		

Table A-13 (3/4) FIVE-DAY BASIN RAINFALL

YEAR: 1973												UNIT: MM		
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	13.20	31.80	44.90	117.50	37.60	38.50	21.50	66.80	111.60	110.90	14.00	89.20		
6-10	7.80	20.90	17.10	39.40	107.40	81.20	2.90	34.20	67.30	42.90	62.10	137.90		
11-15	4.20	2.60	107.40	36.40	27.60	0.10	34.30	59.20	62.00	61.00	35.00	21.20		
16-20	72.40	7.20	31.40	77.90	54.80	21.90	1.10	17.60	36.30	119.20	27.00	21.80		
21-25	17.10	29.00	13.00	124.10	116.20	36.10	12.60	18.50	81.50	77.80	65.80	4.90		
26-FEB	61.50	132.00	28.80	89.20	94.40	57.10	94.80	29.50	2.60	86.00	77.60	3.40		
TOTAL	176.20	223.50	242.60	488.50	438.00	214.90	167.70	225.80	361.30	497.80	281.50	278.40		
YEAR: 1974												UNIT: MM		
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	1.80	6.30	40.40	46.70	93.40	14.60	4.80	11.70	95.30	34.10	22.60	19.30		
6-10	0.	12.20	34.00	53.70	41.50	23.60	29.00	19.40	38.90	0.	7.60	14.10		
11-15	0.	0.	10.90	18.40	85.30	26.70	47.90	10.00	47.50	2.60	59.70	21.00		
16-20	0.	22.00	8.30	42.10	15.70	23.80	25.00	7.70	49.40	31.70	111.30	56.60		
21-25	13.10	62.80	0.	71.30	77.00	34.70	46.40	28.60	37.70	16.70	51.00	0.80		
26-FEB	28.00	0.30	13.20	63.10	9.20	16.90	50.80	8.90	42.90	50.30	11.90	57.00		
TOTAL	42.90	163.60	106.80	295.50	322.10	140.30	203.90	86.30	311.70	135.60	264.10	168.80		
YEAR: 1975												UNIT: MM		
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	26.30	10.70	51.30	27.70	19.20	1.00	9.00	0.50	101.90	6.80	33.50	6.40		
6-10	38.40	25.00	36.80	68.70	52.40	10.10	19.70	18.50	37.40	24.00	41.70	110.60		
11-15	26.60	58.40	16.60	7.30	33.30	1.00	15.60	0.60	5.10	0.	77.60	64.20		
16-20	13.60	16.40	12.30	62.90	43.60	51.40	142.80	25.50	46.20	8.10	100.50	17.10		
21-25	0.10	25.60	2.60	42.70	17.70	0.	43.90	21.20	82.10	0.30	46.60	89.70		
26-FEB	4.90	0.	50.10	71.90	47.60	6.80	36.10	39.20	12.60	67.80	41.70	55.60		
TOTAL	149.90	136.10	169.70	261.20	213.80	70.30	267.10	105.50	285.50	107.00	341.60	343.60		
YEAR: 1976												UNIT: MM		
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	53.90	68.10	8.50	36.80	30.30	144.10	50.60	0.	1.30	119.10	64.80	2.40		
6-10	18.10	0.60	54.40	48.90	15.00	64.60	22.00	0.	20.70	83.90	57.00	147.80		
11-15	13.10	13.60	116.70	64.70	30.10	43.00	39.40	25.30	8.30	44.80	20.60	2.30		
16-20	0.70	1.10	26.20	40.80	0.80	4.60	0.	36.80	26.40	19.80	29.40	9.50		
21-25	0.	52.40	76.60	24.70	0.20	59.10	44.30	93.20	20.60	12.30	8.00	32.30		
26-FEB	0.	4.40	12.30	30.60	4.60	44.00	15.60	85.20	43.60	38.30	30.00	19.50		
TOTAL	85.60	120.20	295.00	240.50	81.00	359.40	171.90	240.50	120.90	318.20	209.80	213.80		
YEAR: 1977												UNIT: MM		
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	28.80	11.40	25.50	9.60	5.40	12.70	1.30	20.90	0.30	110.70	38.80	2.20		
6-10	24.40	15.40	0.	6.50	20.20	101.80	33.10	24.50	5.90	131.50	27.80	39.20		
11-15	31.50	41.80	1.90	32.10	60.70	39.40	42.10	0.	0.50	65.80	18.20	29.90		
16-20	0.	0.	22.40	43.50	8.70	30.30	0.	46.90	5.60	101.40	54.20	26.70		
21-25	9.10	20.90	9.80	16.90	11.70	4.50	0.	20.50	18.10	74.80	35.30	23.70		
26-FEB	26.20	29.90	13.40	15.40	41.30	23.10	3.40	56.80	94.30	63.50	56.40	1.40		
TOTAL	120.00	119.40	75.80	118.00	146.00	211.60	75.90	169.60	124.70	547.70	230.70	123.10		
YEAR: 1978												UNIT: MM		
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
1-5	0.20	0.	7.00	39.10	53.90	3.30	2.90	1.50	59.20	16.80	27.80	8.00		
6-10	21.00	30.50	15.30	60.10	55.40	13.10	54.20	0.70	19.70	24.40	61.60	47.10		
11-15	10.60	39.10	45.70	25.00	57.90	4.10	9.40	40.40	23.90	20.10	64.00	8.00		
16-20	40.90	53.60	25.60	42.20	1.60	7.10	8.80	8.80	29.40	75.00	46.10	25.80		
21-25	1.00	0.	43.00	168.10	33.30	1.30	58.80	6.40	108.30	117.60	44.40	6.70		
26-FEB	1.60	3.40	11.00	22.50	3.80	5.00	9.80	1.40	11.20	91.50	30.60	9.40		
TOTAL	75.30	126.20	156.60	357.00	205.90	33.90	103.90	59.20	251.70	345.40	274.50	105.00		

Table A-13 (4/4) FIVE-DAY BASIN RAINFALL

YEAR: 1979 UNIT: MM

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	14.00	4.50	0.	45.10	43.40	33.70	0.	2.60	67.70	5.60	65.00	5.60
6-10	23.30	53.50	17.70	24.40	36.40	160.60	3.70	17.10	65.20	6.10	119.50	1.70
11-15	23.20	38.40	2.70	10.90	57.50	68.70	56.60	1.00	85.50	35.10	51.60	1.90
16-20	0.	125.40	107.70	0.	0.	8.20	79.40	10.50	61.00	25.30	109.90	26.50
21-25	0.	55.00	71.40	95.40	0.	6.00	102.90	46.60	14.70	46.20	13.80	13.70
26-END	8.90	10.90	24.30	46.40	37.00	0.40	2.40	15.70	15.40	42.20	44.70	7.30
TOTAL	69.40	267.70	229.30	222.20	174.30	277.60	245.00	93.50	309.50	162.50	404.50	56.70

YEAR: 1980 UNIT: MM

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	12.70	18.50	55.50	10.70	59.10	46.50	2.80	36.00	72.20	29.20	28.80	90.10
6-10	15.90	44.10	52.20	25.30	59.90	23.00	0.50	4.40	31.00	99.90	10.70	78.70
11-15	36.50	0.	5.60	21.90	104.00	22.20	6.60	36.40	6.80	43.00	33.10	65.40
16-20	18.50	23.10	53.10	0.20	36.30	34.70	76.40	42.40	70.10	49.00	87.40	7.30
21-25	6.50	25.70	6.70	20.00	23.40	34.30	43.20	137.40	68.50	14.50	67.80	3.20
26-END	12.50	12.10	34.30	51.60	55.80	2.00	85.40	5.20	6.90	2.00	27.20	2.00
TOTAL	102.60	123.50	207.90	129.70	343.50	162.70	214.90	261.80	255.50	237.60	255.00	246.70

YEAR: 1981 UNIT: MM

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	16.40	36.70	9.00	174.50	64.30	28.80	0.	0.	49.20	3.00	4.60	26.80
6-10	28.90	1.20	0.70	66.40	40.50	0.70	4.60	0.	136.00	103.10	27.90	32.60
11-15	0.30	62.90	43.40	41.50	61.10	4.80	18.10	0.	34.10	74.50	103.30	2.50
16-20	0.	26.40	9.40	58.90	16.10	0.	16.00	0.90	32.70	20.40	73.30	0.
21-25	10.40	47.90	17.00	41.30	72.00	13.80	24.10	30.80	23.60	9.90	5.60	0.
26-END	12.70	14.70	29.50	19.70	43.30	33.50	27.80	77.00	8.60	8.50	13.60	15.10
TOTAL	68.70	189.80	108.00	402.80	297.30	86.60	90.60	108.70	284.20	219.40	228.30	77.00

YEAR: 1982 UNIT: MM

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	2.60	17.10	34.40	55.00	83.30	50.60	18.10	45.00	36.40	59.60	52.00	43.00
6-10	4.30	24.10	86.40	50.20	41.80	0.	33.40	39.20	2.40	26.10	40.70	77.20
11-15	66.60	24.60	4.10	82.00	17.40	32.30	5.30	67.00	25.60	88.10	57.80	37.40
16-20	13.30	0.	33.80	210.40	26.20	1.50	38.40	77.30	65.30	32.30	18.50	42.60
21-25	8.10	29.70	64.60	55.50	75.30	0.	19.40	41.30	34.70	21.50	15.00	21.00
26-END	38.40	0.60	36.40	48.00	21.30	6.20	0.	12.70	110.70	87.50	48.70	54.90
TOTAL	133.30	96.10	259.70	501.10	265.30	90.60	114.60	282.50	275.10	315.10	232.70	276.10

YEAR: 1983 UNIT: MM

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	5.10	6.40	30.20	5.10	19.30	31.20	43.20	132.10	28.20	5.00	51.80	15.00
6-10	18.20	0.	4.90	1.20	26.50	9.00	37.60	17.90	66.40	4.70	22.70	8.20
11-15	0.10	9.50	21.80	9.90	34.50	84.10	29.60	43.90	87.10	43.10	39.80	76.50
16-20	2.80	17.60	42.50	0.	36.10	54.20	94.70	1.80	36.40	33.40	25.40	8.80
21-25	0.	5.40	4.60	4.70	2.90	0.	9.10	12.80	0.30	58.50	0.	1.70
26-END	12.10	10.80	23.90	40.20	19.40	12.00	79.20	28.60	27.20	49.10	26.80	6.80
TOTAL	38.30	49.70	192.20	58.20	138.60	190.50	294.00	237.10	245.60	193.80	166.50	117.00

Table A-14 MONTHLY MEAN BASIN RAINFALL

Unit: mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1961	105.2	112.9	235.0	357.3	163.4	221.9	307.7	170.8	390.4	263.6	334.0	301.4	2963.6
1962	118.6	132.6	213.0	276.6	230.7	205.4	47.2	248.8	179.4	363.9	413.3	146.8	2576.3
1963	117.9	47.0	122.0	88.3	354.3	229.5	145.1	247.2	213.6	555.1	550.1	218.9	2889.0
1964	168.6	71.6	286.7	239.6	146.1	195.2	284.0	139.4	331.8	381.3	227.9	215.6	2787.8
1965	66.5	166.9	274.6	261.9	243.3	131.9	89.6	275.0	225.7	337.8	294.5	361.3	2729.0
1966	108.2	199.0	332.7	316.9	143.0	348.5	139.4	262.2	367.6	252.6	400.8	367.1	3238.0
1967	264.8	146.8	96.9	314.4	234.7	113.5	90.8	134.5	216.3	379.6	458.2	84.7	2535.2
1968	133.3	107.1	107.9	283.3	360.7	339.7	295.7	267.7	172.6	295.6	217.2	373.6	2954.4
1969	97.8	123.0	170.1	249.7	472.5	175.5	111.0	308.8	86.0	531.1	241.7	219.0	2786.2
1970	273.9	120.1	294.2	228.7	349.3	111.5	196.0	165.6	187.3	293.6	327.1	309.8	2857.1
1971	274.3	117.1	242.5	198.9	169.8	214.4	106.3	234.1	289.3	248.3	307.8	473.7	2876.5
1972	63.5	185.3	165.2	250.2	311.4	271.5	53.7	226.4	315.5	389.8	459.4	176.6	2868.5
1973	176.2	223.5	242.6	486.5	438.0	214.9	167.7	225.8	361.3	497.8	281.5	278.4	3594.2
1974	42.9	163.6	106.8	295.3	322.1	140.3	203.9	86.3	311.7	135.6	264.1	168.8	2241.4
1975	149.9	136.1	169.7	281.2	213.8	70.3	267.1	105.5	285.5	107.0	341.6	343.6	2471.3
1976	85.8	120.2	295.0	240.5	81.0	359.4	171.9	240.5	120.9	318.2	209.8	213.8	2457.0
1977	120.0	119.4	75.8	118.0	148.0	211.8	79.9	169.6	124.7	547.7	230.7	123.1	2068.7
1978	75.3	126.2	156.6	357.0	205.9	33.9	103.9	59.2	251.7	345.4	274.5	105.0	2094.6
1979	69.4	267.7	229.8	222.2	174.3	277.6	245.0	93.5	309.5	162.5	404.5	56.7	2512.7
1980	102.6	123.5	207.9	129.7	343.5	162.7	214.9	261.8	255.5	237.6	255.0	246.7	2541.4
1981	68.7	189.8	108.0	402.8	297.3	86.6	90.6	108.7	284.2	219.4	228.3	77.0	2161.4
1982	133.3	96.1	259.7	501.1	265.3	90.6	114.6	282.5	275.1	315.1	232.7	276.1	2842.2
1983	38.3	49.7	198.2	58.8	138.6	190.5	294.0	237.1	245.6	193.8	166.5	117.0	1928.1
Mean	124.1	136.7	199.6	267.8	252.5	191.2	170.4	197.9	252.2	320.5	309.6	228.5	2651.0

Table A-15 COMPARISON OF SIMULATED AND
ACTUAL RUNOFF COEFFICIENT

Year	Runoff Actual	Coefficient Simulated
1961	-	0.704
1962	0.732	0.586
1963	0.572	0.549
1964	0.591	0.568
1965	0.634	0.532
1966	0.591	0.567
1967	0.676	0.596
1968	0.484	0.528
1969	0.616	0.575
1970	0.599	0.543
1971	0.567 ^{/1}	0.532
1972	0.679	0.580
1973	0.664 ^{/1}	0.620
1974	-	0.547
1975	-	0.456
1976	-	0.513
1977	0.555 ^{/1}	0.442
1978	0.307 ^{/1}	0.443
1979	0.405 ^{/1}	0.488
1980	0.439 ^{/1}	0.471
1981	0.534	0.502
1982	0.408 ^{/1}	0.482
1983	-	0.478

Remarks: ^{/1} = There is interruption of recording less than 20 days.

- = There is interruption of records more than 20 days.

Table A-16 (1/4) SUPPLEMENTED FIVE-DAY MEAN DISCHARGE AT SKC BRIDGE STATION

YEAR: 1961												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	125.72	59.91	49.76	63.71	103.19	48.55	43.95	80.19	63.80	68.61	72.14	69.51
6-10	132.62	53.54	49.56	69.46	87.43	57.73	65.25	73.99	88.00	62.58	91.89	51.29
11-15	97.89	51.17	46.42	85.29	89.55	90.09	53.29	54.77	65.60	63.68	59.33	61.86
16-20	64.01	55.16	44.72	66.81	66.82	66.50	45.43	50.77	103.28	62.61	72.20	83.42
21-25	75.02	50.64	68.61	77.93	55.94	56.28	69.94	40.58	74.28	70.25	96.81	114.32
26-END	54.72	79.73	47.32	103.86	42.23	48.44	78.36	35.84	65.94	98.05	122.08	108.77
AVERAGE	93.70	56.83	50.95	61.18	73.16	61.26	59.98	55.37	76.82	71.84	85.74	82.41

YEAR: 1962												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	118.01	37.41	40.23	59.43	87.15	40.96	45.14	21.30	40.89	40.42	104.92	92.05
6-10	77.73	31.97	31.92	60.65	99.58	52.75	35.15	19.78	50.75	47.95	131.11	70.00
11-15	54.20	32.01	44.37	93.85	139.15	45.96	25.72	29.28	33.58	125.78	142.31	66.18
16-20	92.97	26.59	50.19	100.09	113.74	39.17	24.61	37.96	57.07	149.14	157.20	53.03
21-25	68.78	31.02	102.41	52.29	60.61	40.27	21.16	42.50	62.52	140.11	157.43	47.51
26-END	45.22	41.85	52.53	56.25	43.07	42.43	20.89	58.53	36.63	83.53	104.51	53.47
AVERAGE	75.15	32.88	61.64	73.76	89.02	43.59	28.20	35.65	46.91	97.36	132.91	63.38

YEAR: 1963												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	69.56	27.46	18.77	18.56	21.05	63.94	28.45	21.53	39.31	36.07	132.69	166.64
6-10	54.14	23.83	25.14	14.69	42.61	47.78	28.81	90.15	29.08	83.94	176.57	130.62
11-15	41.80	26.23	30.99	15.84	29.14	42.12	34.76	58.85	29.91	116.75	155.80	96.72
16-20	38.04	24.88	23.94	19.91	53.87	26.70	28.44	36.22	55.99	126.23	159.12	75.53
21-25	44.09	20.13	24.85	16.62	74.46	28.07	18.41	43.01	81.10	132.49	186.73	65.18
26-END	32.16	18.27	30.27	17.53	46.94	48.04	31.66	52.03	49.80	89.73	163.79	56.18
AVERAGE	46.16	23.84	25.81	17.19	44.75	42.78	28.53	50.35	47.53	97.28	162.45	97.11

YEAR: 1964												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	55.99	31.26	54.68	25.72	51.65	27.42	39.77	73.06	66.59	36.78	127.35	103.79
6-10	46.33	33.84	54.08	26.06	62.58	25.47	51.78	41.41	106.93	42.33	94.70	80.30
11-15	51.87	42.04	29.18	46.44	44.57	32.12	82.61	43.42	117.21	51.78	98.22	115.47
16-20	93.59	36.91	30.12	41.48	55.10	43.87	57.32	32.42	88.97	43.67	75.14	76.58
21-25	66.14	27.71	42.62	33.07	35.44	34.42	57.27	32.42	56.47	90.43	81.25	59.89
26-END	39.12	27.05	28.90	63.52	28.26	47.84	68.68	31.64	40.04	111.76	119.51	54.82
AVERAGE	58.20	33.34	39.57	39.72	45.69	35.19	63.74	42.05	79.37	64.37	99.36	80.94

YEAR: 1965												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	53.78	26.32	27.52	64.79	77.66	46.16	29.92	43.03	56.14	61.94	110.31	59.34
6-10	44.35	22.22	21.12	64.95	84.41	51.53	32.03	45.14	58.26	41.15	94.87	66.29
11-15	35.68	39.65	20.72	47.63	115.77	37.78	34.15	47.26	60.37	50.85	69.56	96.84
16-20	31.46	36.35	19.64	74.52	119.99	45.89	36.26	49.37	62.49	82.01	101.70	128.52
21-25	29.90	28.37	33.34	76.06	135.08	38.92	38.38	51.49	64.60	78.82	103.12	139.16
26-END	29.49	25.36	63.76	71.62	59.73	31.73	40.70	53.82	66.72	97.59	86.28	111.07
AVERAGE	37.19	30.02	32.07	66.65	97.51	42.01	35.42	48.53	61.43	69.66	94.31	100.55

YEAR: 1966												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	69.54	44.65	34.93	64.17	67.27	39.40	58.39	26.24	37.88	122.22	96.23	102.40
6-10	63.77	38.58	40.29	61.79	54.71	67.44	46.44	40.94	28.27	114.91	100.32	98.65
11-15	73.51	30.74	42.78	69.91	39.47	57.05	82.53	47.36	44.34	90.28	102.60	105.45
16-20	64.10	55.00	82.46	48.87	39.44	37.37	52.56	35.25	51.38	79.42	120.24	106.82
21-25	57.20	77.80	72.47	86.95	36.61	51.29	34.06	44.37	66.14	67.61	135.30	91.58
26-END	49.41	40.89	74.72	93.11	31.19	46.58	27.18	65.46	83.74	73.71	114.01	136.76
AVERAGE	62.49	48.45	52.48	77.47	44.34	48.86	46.23	43.99	51.96	90.79	111.45	107.91

Table A-16 (2/4) SUPPLEMENTED FIVE-DAY MEAN DISCHARGE AT SKC BRIDGE STATION

YEAR: 1967												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	126.87	91.57	66.41	45.03	67.80	37.39	26.37	16.67	19.75	44.59	112.06	113.95
6-10	114.92	63.98	46.02	72.29	95.20	31.07	22.01	14.80	17.95	36.43	115.46	72.78
11-15	161.21	55.39	59.35	63.51	70.66	29.96	20.05	16.44	26.74	49.71	135.35	56.30
16-20	59.03	59.51	39.80	39.32	95.87	48.94	22.90	25.08	48.45	31.39	137.29	58.26
21-25	81.16	57.81	41.05	58.83	98.99	31.20	24.28	24.30	37.12	51.94	112.61	59.38
26-END	92.45	65.12	36.71	96.70	52.32	24.61	16.98	19.33	40.58	117.40	143.77	39.82
AVERAGE	100.67	65.60	47.85	62.61	79.34	33.76	21.93	19.43	31.76	57.25	126.09	65.88

YEAR: 1968												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	33.10	23.59	13.35	16.69	95.14	76.50	43.92	26.79	50.73	56.22	103.95	49.47
6-10	31.10	29.57	12.82	15.83	53.21	71.25	34.49	32.13	51.51	64.56	77.37	74.75
11-15	29.25	22.00	12.18	20.45	73.13	100.91	30.87	34.34	43.79	76.92	52.03	87.48
16-20	26.78	23.92	12.92	17.16	123.06	75.05	44.41	27.49	67.85	61.90	68.39	91.49
21-25	28.33	17.15	14.73	25.03	99.21	43.08	75.08	29.05	42.22	54.90	59.34	52.18
26-END	27.05	13.59	19.25	58.77	90.15	41.50	34.10	55.30	49.74	83.41	58.36	96.04
AVERAGE	29.20	21.91	14.37	25.65	89.02	68.05	43.50	34.86	50.97	66.87	69.91	75.91

YEAR: 1969												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	110.83	49.68	59.35	59.77	106.20	56.30	33.45	23.67	67.79	66.49	75.46	106.18
6-10	77.60	34.76	26.98	30.80	75.21	43.79	34.71	17.43	54.97	62.21	86.55	78.28
11-15	58.15	32.55	30.55	29.30	69.72	59.14	27.74	24.77	27.26	145.91	90.76	84.54
16-20	60.25	31.60	26.46	42.08	92.38	49.75	25.68	36.36	31.87	163.81	87.19	80.84
21-25	41.34	63.05	27.92	35.36	111.99	42.04	21.05	59.44	29.44	123.31	69.75	51.51
26-END	44.83	69.23	44.51	72.26	90.99	33.73	18.19	69.60	36.60	115.13	88.54	73.48
AVERAGE	64.83	45.21	33.01	44.92	91.08	42.46	26.53	39.55	40.99	113.21	83.04	78.96

YEAR: 1970												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	59.58	40.64	25.43	29.33	104.48	55.34	42.27	21.98	33.53	87.67	54.59	96.07
6-10	94.90	33.77	22.06	57.75	81.80	35.09	22.68	21.84	50.47	178.56	96.34	88.43
11-15	96.05	28.42	26.08	38.59	75.66	34.30	20.34	60.59	60.32	138.33	98.86	80.50
16-20	61.97	23.72	35.36	42.83	56.99	31.93	21.28	25.97	49.73	90.64	79.75	92.64
21-25	45.41	32.71	22.47	75.03	90.33	32.87	28.45	21.26	95.87	57.81	98.80	103.50
26-END	63.71	29.42	45.34	66.26	67.68	39.47	38.57	36.72	46.94	41.07	99.64	86.63
AVERAGE	73.28	31.59	29.97	61.63	79.11	38.17	29.24	31.95	56.14	97.18	88.00	91.14

YEAR: 1971												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	214.52	45.68	59.29	44.27	22.71	22.65	25.39	28.97	50.32	25.55	52.31	99.20
6-10	350.38	32.44	31.50	34.06	21.41	18.71	18.41	18.79	75.57	22.10	188.92	107.96
11-15	143.91	27.72	34.40	26.63	27.84	19.24	18.64	43.78	82.39	26.33	145.12	159.91
16-20	105.33	26.63	49.72	20.75	28.28	21.25	17.70	27.09	42.41	36.34	75.54	125.38
21-25	65.56	43.91	60.87	19.14	33.63	22.52	17.02	124.00	92.10	44.15	89.71	142.84
26-END	56.84	45.37	30.81	31.66	48.13	29.97	26.32	56.57	39.24	51.11	68.85	133.44
AVERAGE	152.58	36.36	43.99	29.42	36.91	22.39	20.77	50.08	63.67	34.81	103.41	128.29

YEAR: 1972												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	103.89	46.19	22.60	44.88	75.86	56.42	30.27	18.44	48.60	132.47	128.76	151.48
6-10	87.82	49.99	24.27	28.88	61.68	38.05	26.49	18.18	40.29	71.28	131.63	74.37
11-15	63.94	38.95	44.16	58.52	95.66	53.21	23.04	20.08	73.39	202.23	122.83	63.70
16-20	44.74	26.84	35.83	44.98	75.98	94.90	28.90	21.22	44.68	114.34	257.93	75.09
21-25	37.09	37.32	24.78	53.05	107.48	95.74	21.15	28.32	40.73	86.93	223.05	110.90
26-END	34.43	31.45	22.39	70.76	89.60	44.48	20.40	29.94	46.51	141.71	121.95	57.59
AVERAGE	61.10	38.70	29.79	55.18	84.55	62.80	24.90	22.93	49.03	125.37	164.36	87.85

Table A-16 (3/4) SUPPLEMENTED FIVE-DAY MEAN DISCHARGE AT SKC BRIDGE STATION

YEAR: 1973												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	45.57	21.60	27.10	86.75	107.13	206.65	62.04	92.21	74.31	70.51	171.13	187.47
6-10	38.87	21.63	23.46	76.73	80.51	113.46	36.20	73.31	85.35	44.19	143.24	273.32
11-15	29.69	18.85	48.29	69.79	132.15	63.79	35.74	87.52	68.01	91.26	142.19	155.80
16-20	35.37	20.07	31.43	85.19	92.04	45.08	26.36	41.99	80.52	76.83	124.43	119.76
21-25	30.94	19.33	26.99	131.63	76.86	88.45	29.70	38.77	69.93	222.66	158.89	91.78
26-END	25.61	54.50	34.40	212.50	179.72	96.74	55.60	39.13	52.67	266.18	202.75	64.92
AVERAGE	34.06	23.96	32.02	110.43	113.61	101.36	41.41	61.41	71.80	133.04	157.11	146.13

YEAR: 1974												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	52.62	27.53	55.00	25.69	90.53	37.87	37.78	36.73	47.00	52.48	40.50	72.55
6-10	43.18	32.57	52.46	81.32	102.23	33.26	26.10	35.24	47.55	40.12	35.12	66.90
11-15	34.78	23.24	42.52	49.91	104.90	27.60	32.56	32.57	52.57	37.44	47.18	68.64
16-20	30.46	41.11	30.56	75.85	115.45	42.43	34.44	23.30	57.20	38.02	89.28	73.47
21-25	28.42	82.73	22.68	77.68	79.63	46.01	42.52	23.90	72.79	35.07	70.34	66.01
26-END	32.85	89.81	20.68	110.41	55.09	67.48	41.38	22.74	63.29	36.35	77.92	75.07
AVERAGE	36.92	46.62	37.61	70.14	90.14	42.44	35.98	28.88	56.73	39.80	60.06	70.59

YEAR: 1975												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	85.68	40.28	59.99	74.52	45.42	32.68	28.65	34.82	57.85	33.92	27.53	47.15
6-10	98.25	29.98	80.85	63.55	52.63	29.63	29.09	29.14	52.94	32.50	34.43	83.94
11-15	68.37	57.78	39.43	36.90	48.02	25.97	25.79	25.39	33.76	28.21	57.72	85.59
16-20	62.17	67.26	30.50	58.23	50.24	38.09	90.55	24.61	41.68	25.36	85.46	63.35
21-25	47.65	33.62	36.92	67.90	38.77	24.49	140.15	23.60	65.22	22.32	77.71	85.13
26-END	43.39	39.01	55.34	94.37	36.98	37.60	83.50	20.54	46.44	20.88	70.63	67.51
AVERAGE	66.80	45.06	50.66	72.58	45.07	31.39	66.84	26.16	49.65	26.99	58.91	71.96

YEAR: 1976												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	78.55	29.22	19.82	37.44	39.95	62.51	59.49	29.29	44.82	77.21	62.08	33.77
6-10	58.97	25.74	20.33	45.21	34.01	69.59	48.05	25.84	36.97	90.87	68.63	83.38
11-15	44.44	24.16	56.95	58.53	33.30	64.25	49.17	24.65	31.88	81.10	54.87	53.91
16-20	38.39	21.64	44.24	55.71	29.16	41.81	35.63	25.39	31.00	62.41	50.08	39.14
21-25	32.34	20.99	61.72	45.92	25.41	54.36	38.17	51.19	29.59	46.18	39.35	38.38
26-END	22.97	33.58	32.96	42.36	18.95	55.32	22.03	59.53	31.35	38.63	38.30	29.82
AVERAGE	45.20	25.62	38.97	47.53	29.76	57.97	42.60	36.74	34.27	65.22	52.22	45.87

YEAR: 1977												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	34.57	23.64	32.69	16.05	20.43	23.65	19.59	15.00	23.12	79.08	104.83	52.46
6-10	33.02	22.25	20.17	11.26	26.99	44.01	24.33	16.24	18.08	130.52	78.61	70.83
11-15	32.50	29.23	17.46	20.15	48.42	31.17	28.29	15.79	16.65	208.92	97.40	92.53
16-20	28.35	23.20	17.03	25.34	20.04	33.75	19.97	17.00	16.61	164.86	91.17	58.38
21-25	26.45	20.96	22.29	25.21	20.49	22.24	17.95	14.14	16.85	140.55	94.29	45.83
26-END	21.03	43.65	18.32	24.57	22.33	20.24	13.27	17.30	46.02	174.16	64.60	32.04
AVERAGE	29.05	25.97	21.25	21.93	29.87	29.18	20.33	15.96	22.89	150.47	88.48	57.82

YEAR: 1978												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	16.07	10.71	9.51	17.97	41.41	19.43	9.77	8.57	9.34	11.05	57.06	29.17
6-10	16.89	12.42	10.36	17.65	52.21	17.87	14.58	7.81	10.63	8.90	49.05	43.68
11-15	17.06	12.53	12.57	19.75	62.55	15.40	12.07	12.84	10.38	11.86	61.74	30.41
16-20	22.55	15.05	12.37	21.02	41.34	12.09	11.14	9.76	7.67	14.34	75.13	21.10
21-25	16.41	9.93	14.57	63.59	33.93	11.55	14.21	8.35	21.09	26.34	70.39	19.80
26-END	12.93	10.16	14.42	37.73	20.13	10.74	10.95	7.93	12.04	53.36	39.51	15.79
AVERAGE	16.85	11.93	12.42	30.84	41.23	14.51	12.18	9.17	11.86	22.02	58.81	26.31

Table A-16 (4/4) SUPPLEMENTED FIVE-DAY MEAN DISCHARGE AT SKC BRIDGE STATION

YEAR: 1979												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	16.52	10.09	21.43	46.66	51.18	26.90	16.13	21.65	39.99	23.10	66.69	73.16
6-10	16.18	11.11	22.52	38.51	34.11	60.67	14.19	19.69	50.32	25.23	71.95	54.39
11-15	13.80	10.76	20.68	30.26	46.00	61.14	20.61	15.86	69.70	34.45	73.22	36.85
16-20	10.86	13.55	46.08	25.74	21.32	27.78	21.84	18.95	72.82	36.85	153.53	31.56
21-25	10.90	32.52	59.64	32.21	17.31	21.02	67.21	24.50	38.71	42.07	101.36	28.81
26-END	10.23	31.74	36.25	41.17	24.34	18.44	45.08	25.64	33.80	72.04	103.99	24.19
AVERAGE	12.99	17.33	35.36	35.76	32.12	35.99	31.30	21.20	50.89	40.02	95.12	40.94

YEAR: 1980												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	23.14	13.35	32.84	19.84	42.25	29.79	15.64	34.84	27.34	42.92	32.19	80.35
6-10	20.72	10.94	57.89	22.54	65.32	33.28	13.26	23.75	36.69	67.16	30.33	144.14
11-15	16.40	9.26	19.60	24.18	62.27	22.91	12.22	23.05	24.22	70.04	32.92	134.62
16-20	14.19	6.30	25.16	17.52	52.19	34.61	26.84	19.19	37.81	231.58	44.81	64.70
21-25	13.24	11.70	20.66	16.12	30.02	22.30	20.86	76.37	68.71	58.92	64.43	48.30
26-END	17.42	25.55	17.67	40.27	24.19	21.73	32.95	39.63	46.32	36.61	73.61	41.10
AVERAGE	17.52	12.76	27.90	23.41	47.27	27.44	20.90	36.25	40.18	82.99	46.38	84.10

YEAR: 1981												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	49.26	36.09	51.33	39.04	56.19	60.29	21.73	15.10	22.05	20.48	28.15	47.30
6-10	47.56	29.32	21.31	63.90	72.12	37.24	17.69	11.92	21.07	26.12	29.76	75.92
11-15	34.52	29.07	21.96	54.81	82.14	31.10	21.99	10.62	62.78	42.25	58.20	50.46
16-20	31.58	47.05	16.35	71.09	91.08	24.58	18.07	9.76	49.84	70.11	59.37	33.75
21-25	29.55	27.74	15.51	68.05	90.56	22.68	17.96	14.18	36.38	35.19	98.23	26.96
26-END	24.73	46.54	17.72	38.07	76.76	33.87	20.43	23.72	25.07	37.31	65.70	24.36
AVERAGE	35.83	35.21	21.33	55.83	78.26	34.96	19.67	14.52	46.20	38.54	56.57	42.52

YEAR: 1982												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	23.10	13.56	14.33	16.42	72.46	55.23	23.19	13.71	23.30	48.91	78.69	114.29
6-10	19.80	26.92	30.42	17.49	61.06	42.72	17.36	18.67	15.22	46.71	74.38	66.14
11-15	26.16	34.32	23.50	28.62	45.69	32.16	14.35	20.71	27.32	54.39	86.35	66.67
16-20	18.10	18.36	14.52	97.45	43.91	33.39	14.36	25.35	43.21	69.41	104.28	64.20
21-25	17.75	16.36	25.13	91.20	88.12	20.61	22.89	38.77	40.72	49.59	77.92	51.69
26-END	14.29	13.99	25.95	60.76	90.49	16.66	13.76	22.75	40.41	53.36	99.64	29.89
AVERAGE	19.69	21.06	22.44	55.32	67.72	33.47	17.53	23.31	31.70	53.72	86.88	64.33

YEAR: 1983												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	35.66	17.18	19.07	14.33	30.23	21.82	13.85	56.86	41.59	32.20	36.74	28.95
6-10	32.22	14.99	12.56	12.26	22.64	13.05	15.84	43.26	58.55	29.70	50.93	25.82
11-15	25.09	15.17	17.56	11.01	27.63	24.04	17.38	28.78	75.10	27.63	44.48	36.73
16-20	22.58	20.27	17.33	9.69	24.30	30.96	15.38	28.52	115.01	30.83	41.52	28.61
21-25	20.10	15.88	16.86	11.66	26.56	17.95	48.59	19.75	66.94	34.85	32.40	25.04
26-END	17.54	14.28	23.02	17.49	19.49	13.70	26.22	24.55	41.03	38.32	31.43	23.55
AVERAGE	25.27	16.44	15.15	12.74	24.96	20.25	22.99	33.33	66.37	32.45	39.58	27.97

YEAR: 1984												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	21.97	62.96	49.94	63.29	78.37	6.18	30.35	28.56	24.42	46.74	61.24	85.52
6-10	16.92	89.52	40.41	59.70	53.03	59.81	31.97	27.35	21.24	50.29	64.33	97.20
11-15	20.16	70.84	49.46	64.95	47.53	58.60	33.68	20.61	18.77	28.07	87.54	79.95
16-20	26.07	63.39	57.49	57.59	45.76	61.78	80.41	17.83	38.89	37.27	98.66	79.73
21-25	62.30	54.34	74.58	53.85	52.58	39.66	49.24	19.77	41.53	47.30	90.77	135.97
26-END	55.14	49.03	77.40	51.89	52.84	32.90	31.28	22.70	27.69	34.77	67.17	99.64
AVERAGE	54.45	65.56	58.67	65.21	54.95	56.52	42.45	22.80	28.76	40.55	78.29	96.44

Table A-17 SUPPLEMENTED MONTHLY MEAN DISCHARGE AT SKC BRIDGE STATION

Unit: cu.m/s

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1961	93.70	56.83	50.95	81.18	73.16	61.26	59.98	55.37	76.82	71.84	85.74	82.41
1962	75.15	32.88	61.64	73.76	89.02	43.59	28.20	35.65	46.91	97.36	132.91	63.38
1963	46.16	23.84	25.81	17.19	44.75	42.78	28.53	50.35	47.53	97.28	162.45	97.11
1964	58.20	33.34	39.57	39.72	45.69	35.19	63.74	42.05	79.37	64.37	99.36	80.94
1965	37.19	30.02	32.07	66.65	97.51	42.01	35.42	48.53	61.43	69.66	94.31	100.55
1966	62.49	48.45	58.48	77.47	44.34	48.86	46.23	43.99	51.96	90.79	111.45	107.91
1967	100.67	65.60	47.85	62.61	79.34	33.76	21.93	19.43	31.76	57.25	126.09	65.88
1968	29.20	21.91	14.37	25.65	89.02	68.05	43.50	34.86	50.97	66.87	69.91	75.91
1969	64.83	45.21	33.01	44.92	91.08	48.46	26.53	39.55	40.99	113.21	83.04	78.96
1970	73.28	31.59	29.97	61.63	79.11	38.17	29.24	31.95	56.14	97.18	88.00	91.14
1971	152.58	36.36	43.99	29.42	30.91	22.39	20.77	50.08	63.67	34.81	103.41	128.29
1972	61.10	38.70	28.79	55.18	84.55	63.80	24.90	22.93	49.03	125.37	164.36	87.85
1973	34.06	23.96	32.02	110.43	113.61	101.36	41.41	61.41	71.80	133.04	157.11	146.13
1974	36.92	46.62	33.61	70.14	90.14	42.44	35.98	28.88	56.73	39.80	60.06	70.59
1975	66.80	45.06	50.66	72.58	45.07	31.39	66.84	26.16	49.65	26.99	58.91	71.96
1976	45.20	25.62	38.97	47.53	29.76	57.97	42.60	36.74	34.27	65.22	52.22	45.87
1977	29.05	25.97	21.23	21.93	29.87	29.18	20.33	15.96	22.89	150.47	88.48	57.82
1978	16.85	11.93	12.42	30.84	41.23	14.51	12.18	9.17	11.86	22.02	58.81	26.31
1979	12.99	17.33	35.30	35.76	32.12	35.99	31.30	21.20	50.89	40.02	95.12	40.94
1980	17.52	12.76	27.96	23.41	47.27	27.44	20.90	36.25	40.18	82.99	46.38	84.10
1981	35.83	35.21	21.33	55.83	78.26	34.96	19.67	14.52	46.20	38.54	56.57	42.52
1982	19.69	21.06	22.44	55.32	67.72	33.47	17.53	23.31	31.70	53.72	86.88	64.33
1983	25.27	16.44	18.15	12.74	24.96	20.25	22.99	33.33	66.37	32.45	39.58	27.97
1984	34.45	65.56	58.67	65.21	54.95	56.52	42.45	22.80	28.76	40.55	78.29	96.44
MEAN	51.22	33.84	34.97	51.55	62.64	43.08	33.46	33.52	48.66	71.33	91.64	76.47

Table A-18 (1/4) FIVE-DAY MEAN DISCHARGE AT BRH

YEAR: 1961												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	138.29	65.90	54.74	70.08	113.51	53.40	48.34	88.21	70.18	75.47	79.35	76.46
6-10	145.88	58.89	54.54	98.41	96.17	63.50	71.77	81.39	96.80	68.84	101.08	56.42
11-15	107.68	56.29	51.06	93.82	98.51	99.10	58.62	60.25	72.16	70.05	65.26	68.05
16-20	92.41	60.68	49.19	73.49	73.50	73.15	49.97	55.85	113.61	68.87	79.42	91.76
21-25	82.52	55.70	75.47	85.72	61.53	61.91	76.93	44.64	81.71	77.27	106.49	125.75
26-END	60.19	87.70	52.05	114.25	46.45	53.28	86.20	39.42	72.53	107.85	134.29	119.65
AVERAGE	103.07	62.51	56.04	89.29	80.48	67.39	65.98	60.91	84.50	79.02	94.32	90.65

YEAR: 1962												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	129.81	41.15	44.25	65.37	95.86	45.06	49.65	23.43	44.98	44.46	115.41	101.26
6-10	85.50	35.17	90.11	88.71	109.54	58.02	36.46	21.76	55.82	52.74	144.22	77.00
11-15	59.62	35.21	48.81	103.23	153.06	50.56	28.29	32.21	36.94	138.36	156.54	72.80
16-20	102.27	29.25	55.21	110.10	125.11	43.09	27.07	41.76	62.78	164.05	172.92	58.33
21-25	75.66	34.12	112.65	57.52	66.67	44.30	23.28	46.75	68.77	154.12	173.17	52.26
26-END	49.74	46.03	57.78	61.87	47.38	46.67	22.98	64.38	40.29	91.88	114.96	58.82
AVERAGE	82.67	36.16	67.80	81.14	97.92	47.95	31.02	39.22	51.60	107.10	146.20	69.71

YEAR: 1963												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	76.52	30.21	20.65	20.42	23.15	70.33	31.29	23.68	43.24	39.68	145.96	183.30
6-10	59.55	26.21	27.65	16.16	46.87	52.56	31.69	99.16	31.99	92.33	194.23	143.68
11-15	45.98	28.85	34.09	17.42	32.05	46.33	38.24	64.73	32.90	128.42	171.38	106.39
16-20	41.84	27.37	26.33	21.90	59.26	29.37	31.28	39.84	61.59	138.85	175.03	83.08
21-25	48.50	22.14	27.33	18.28	81.91	30.88	20.25	47.31	89.21	145.74	205.40	71.70
26-END	35.38	20.10	33.30	19.28	51.63	52.84	34.83	57.23	54.78	98.70	180.17	61.80
AVERAGE	50.78	26.22	28.39	18.91	49.23	47.05	31.38	55.39	52.28	107.01	178.70	106.83

YEAR: 1964												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	81.59	34.39	60.15	28.29	56.81	30.16	43.75	80.37	73.25	40.46	140.08	114.17
6-10	50.96	37.22	59.49	30.87	66.84	28.02	56.96	45.55	117.62	46.56	104.17	88.33
11-15	57.06	46.24	32.10	51.08	49.03	35.33	90.87	47.76	128.93	56.96	108.04	127.02
16-20	102.95	40.60	33.13	45.63	60.61	48.26	63.05	35.66	97.87	48.04	82.65	84.24
21-25	72.75	30.48	46.88	36.38	38.98	37.86	63.00	35.66	62.12	99.47	89.37	65.88
26-END	43.03	29.75	31.79	69.94	31.11	52.62	97.55	34.80	44.04	122.94	131.46	60.30
AVERAGE	64.02	36.68	43.53	43.70	50.26	38.71	70.11	46.25	87.31	70.81	109.30	89.03

YEAR: 1965												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	59.16	28.95	30.27	71.27	85.43	50.78	32.91	47.33	61.75	68.13	121.34	65.27
6-10	48.78	24.44	23.23	71.42	92.85	56.68	35.23	49.65	64.09	45.26	104.36	72.92
11-15	39.25	43.61	22.79	52.41	127.35	41.56	37.57	51.99	66.41	55.93	76.52	106.52
16-20	34.61	39.98	21.60	82.30	131.99	50.48	35.85	54.31	68.74	90.21	111.87	141.37
21-25	32.89	31.21	36.67	83.69	148.59	42.88	42.22	56.64	71.06	86.70	113.43	153.08
26-END	32.44	27.90	70.14	78.78	65.70	34.90	44.77	59.20	73.39	107.35	94.91	122.18
AVERAGE	40.91	33.02	35.28	73.31	107.27	46.21	38.96	53.38	67.57	76.62	103.74	110.61

YEAR: 1966												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	76.42	49.11	38.42	92.59	74.00	43.34	42.23	28.86	41.67	134.44	105.85	112.64
6-10	70.15	42.44	44.32	89.97	60.18	74.18	51.08	45.03	31.10	126.40	110.35	108.51
11-15	80.86	33.81	47.06	76.90	43.42	62.75	90.78	52.10	48.77	99.31	112.86	115.99
16-20	70.51	60.50	90.71	53.76	43.38	41.11	57.82	38.77	56.52	87.36	132.26	117.50
21-25	62.92	85.58	79.72	95.64	40.27	56.42	37.47	48.81	72.75	74.37	148.83	100.74
26-END	34.35	44.98	82.19	102.42	34.31	44.64	29.90	72.01	92.11	81.08	125.41	150.44
AVERAGE	68.73	53.29	64.33	85.21	48.78	53.74	50.85	48.38	57.15	99.87	122.59	118.70

Table A-18 (2/4) FIVE-DAY MEAN DISCHARGE AT BRH

YEAR: 1967												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	139.56	100.73	73.05	49.53	74.58	41.13	29.01	18.34	21.72	49.05	123.27	125.34
6-10	126.41	70.38	50.62	79.52	105.38	34.18	24.21	16.28	19.74	40.07	127.01	80.06
11-15	111.33	60.93	65.28	69.86	77.73	32.96	22.05	18.08	29.41	54.68	148.89	61.93
16-20	97.93	65.46	43.78	43.25	105.46	53.83	25.19	27.59	53.29	34.53	151.02	64.09
21-25	89.28	63.59	45.15	64.71	108.89	34.32	26.71	26.73	40.83	57.13	123.87	65.32
26-END	101.69	71.63	40.38	106.37	57.55	26.41	18.68	21.26	44.64	129.14	158.15	43.80
AVERAGE	110.73	72.15	52.64	68.87	87.27	37.14	24.13	21.38	34.94	62.97	138.70	72.47

YEAR: 1968												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	36.41	25.95	14.68	18.36	104.65	84.15	48.31	29.47	55.80	61.84	114.34	54.42
6-10	34.21	32.53	14.10	17.41	58.53	78.38	37.94	35.34	56.66	71.02	85.11	82.22
11-15	32.17	24.20	13.40	22.49	80.44	111.00	33.96	37.77	48.17	84.61	57.23	96.23
16-20	29.46	26.31	14.21	18.88	135.37	82.55	48.85	30.24	74.64	68.09	75.23	100.64
21-25	31.16	18.87	16.20	27.53	109.13	57.39	82.59	31.95	46.44	60.39	65.27	57.40
26-END	29.75	14.95	21.17	64.65	99.16	45.65	37.51	60.83	54.71	91.75	64.20	105.64
AVERAGE	32.12	24.11	15.81	28.22	97.92	74.85	47.85	38.35	56.07	73.56	76.90	83.50

YEAR: 1969												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	121.91	54.65	43.28	65.75	116.82	61.93	36.79	26.04	74.57	73.14	83.01	116.80
6-10	65.36	38.26	29.68	33.88	82.73	48.17	38.18	19.17	60.47	68.43	95.20	86.11
11-15	63.96	35.80	33.60	32.23	76.69	65.05	30.51	27.25	29.99	160.50	99.84	92.99
16-20	66.27	34.76	25.11	46.29	101.62	54.72	28.25	40.00	35.06	182.39	95.91	88.92
21-25	45.47	69.35	30.71	38.90	123.19	52.84	23.15	65.38	32.38	135.64	76.72	58.66
26-END	49.31	76.15	58.96	78.52	100.09	37.10	20.01	76.56	38.06	126.64	97.39	80.83
AVERAGE	71.32	49.74	36.31	49.41	100.19	53.30	29.16	43.50	45.09	124.53	91.35	86.85

YEAR: 1970												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	65.54	44.70	27.97	98.26	114.93	60.87	46.50	24.18	36.88	96.66	60.05	105.68
6-10	104.39	37.15	24.27	63.52	89.98	38.60	24.95	24.02	55.52	196.42	105.97	97.27
11-15	105.65	31.26	28.69	42.45	83.25	37.73	22.37	66.65	66.35	152.16	108.75	88.55
16-20	50.17	28.09	38.92	47.11	62.69	35.12	23.41	28.57	54.70	99.70	87.72	101.90
21-25	49.95	35.98	24.72	82.53	99.36	36.16	31.29	23.39	105.46	63.59	108.68	113.85
26-END	70.08	32.36	45.87	72.89	74.45	43.42	42.43	42.59	51.63	45.18	109.60	95.29
AVERAGE	80.61	34.75	32.97	67.79	87.02	41.98	32.17	35.15	61.76	106.89	96.80	100.26

YEAR: 1971												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	235.97	50.25	65.22	48.70	24.98	24.89	27.93	31.87	55.35	28.10	57.54	109.12
6-10	385.97	35.68	34.65	37.49	23.55	20.58	20.25	20.67	83.13	24.31	207.81	118.76
11-15	158.30	30.49	37.84	29.29	30.62	21.16	20.50	48.16	90.63	28.96	159.63	175.90
16-20	115.86	29.29	54.69	22.80	31.11	23.37	19.47	29.80	46.65	39.97	83.09	137.92
21-25	72.12	48.30	66.96	21.05	36.95	24.77	18.72	136.40	101.31	48.57	98.68	157.12
26-END	60.32	49.91	33.89	34.83	52.94	32.97	28.95	62.23	43.16	56.22	75.73	146.78
AVERAGE	167.84	39.99	48.39	32.36	34.00	24.63	22.84	55.09	70.04	38.29	113.75	141.12

YEAR: 1972												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	114.28	50.81	24.86	45.37	83.45	62.06	33.30	20.28	53.46	145.72	141.64	166.63
6-10	96.60	54.99	26.70	42.77	67.85	41.86	29.14	20.00	44.32	78.41	144.79	81.81
11-15	70.33	42.84	48.60	64.37	105.25	58.53	25.37	22.09	80.73	222.45	135.11	70.07
16-20	49.21	29.52	35.41	71.48	83.58	104.39	31.79	23.34	49.15	125.77	283.72	82.60
21-25	40.80	41.65	27.26	58.36	118.23	105.31	23.26	31.15	44.80	95.62	245.35	121.99
26-END	37.87	34.59	24.63	77.84	96.56	48.93	22.44	32.93	51.16	155.88	134.14	63.35
AVERAGE	67.21	42.57	31.67	60.70	93.00	70.18	27.38	25.22	53.94	137.91	180.79	96.63

Table A-18 (3/4) FIVE-DAY MEAN DISCHARGE AT BRH

YEAR: 1973												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	50.13	23.76	29.81	95.42	117.84	220.71	68.24	101.43	81.74	77.56	188.24	206.22
6-10	42.76	23.79	25.81	84.40	88.56	124.81	39.82	80.64	93.89	48.61	157.56	300.65
11-15	32.66	20.73	53.12	76.77	145.36	70.17	39.31	96.27	74.81	100.39	156.41	171.38
16-20	38.91	22.08	34.57	93.71	101.24	49.59	29.00	46.19	88.57	84.51	136.87	131.74
21-25	34.03	21.26	29.69	144.79	84.55	97.29	32.67	42.65	76.92	244.93	174.78	100.96
26-END	28.17	59.95	37.84	233.75	197.69	106.41	61.16	43.04	57.94	292.80	223.02	71.41
AVERAGE	37.47	26.36	35.23	121.47	124.97	111.50	45.55	67.55	78.98	146.35	172.82	160.75

YEAR: 1974												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	57.88	30.28	38.50	28.26	99.58	41.66	41.56	40.40	51.70	57.73	44.55	79.80
6-10	47.50	35.83	57.71	89.45	112.45	36.59	28.71	38.76	52.30	44.13	38.63	73.59
11-15	38.26	25.56	47.10	54.90	115.39	30.36	35.82	35.83	57.83	41.18	51.90	75.50
16-20	33.51	45.22	33.64	83.44	126.99	46.67	37.88	25.63	62.92	41.82	98.21	80.82
21-25	31.26	91.00	24.95	85.45	87.59	50.61	46.77	26.29	80.07	38.58	77.37	72.61
26-END	36.13	98.79	22.75	121.45	60.60	74.23	45.52	25.01	69.62	39.98	85.71	82.58
AVERAGE	40.61	51.28	36.97	77.16	99.15	46.69	39.57	31.76	62.41	43.78	66.06	77.65

YEAR: 1975												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	94.25	44.31	65.99	81.97	49.96	36.17	31.51	38.30	63.63	37.31	30.28	51.86
6-10	108.07	32.98	88.93	91.90	57.89	32.59	32.00	32.05	58.23	35.75	37.87	92.33
11-15	75.21	63.56	43.37	40.59	52.82	28.57	28.37	27.93	37.14	31.03	63.49	94.15
16-20	68.39	73.99	33.55	64.05	55.26	41.90	99.60	27.07	45.85	27.90	94.01	69.68
21-25	52.41	36.98	46.61	96.69	42.65	26.61	154.16	25.96	71.74	24.55	85.48	93.64
26-END	47.73	62.91	60.87	103.81	40.68	41.36	91.85	22.59	51.08	22.97	77.69	74.26
AVERAGE	73.48	49.56	55.73	79.84	49.58	34.53	73.53	28.78	54.61	29.69	64.80	79.16

YEAR: 1976												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	86.40	32.14	20.70	41.18	43.94	68.76	65.44	32.22	49.30	84.93	68.29	37.15
6-10	64.87	28.31	22.36	49.73	37.41	76.55	52.86	28.42	40.67	99.96	75.49	91.72
11-15	48.88	26.58	62.64	64.38	36.63	70.67	54.09	27.12	35.07	89.21	60.36	59.30
16-20	42.23	23.80	48.66	61.28	32.01	45.99	39.19	27.93	34.10	68.65	55.09	43.05
21-25	35.52	23.09	67.39	56.51	27.95	59.80	41.99	56.31	32.55	50.80	43.28	42.22
26-END	25.27	36.94	36.26	46.60	20.85	60.85	30.83	65.48	34.48	42.71	42.13	32.80
AVERAGE	49.72	28.19	42.87	52.28	32.74	63.77	46.86	40.42	37.70	71.74	57.44	50.45

YEAR: 1977												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	38.63	26.00	35.96	15.85	22.47	26.01	21.55	16.50	25.43	86.99	115.31	57.71
6-10	36.32	24.47	22.19	20.09	29.65	48.41	26.76	17.86	19.89	143.57	86.47	77.91
11-15	35.75	32.15	19.21	22.16	53.27	34.29	31.12	17.37	18.32	229.81	107.14	101.78
16-20	31.18	25.52	18.73	27.87	33.04	37.16	21.97	18.70	18.27	181.35	100.29	64.22
21-25	29.09	23.06	24.52	27.74	22.54	24.46	19.74	15.55	18.53	154.60	103.72	50.41
26-END	23.13	57.99	20.15	27.03	35.56	22.26	15.60	19.03	50.62	191.58	71.06	35.24
AVERAGE	31.96	28.57	23.35	24.12	32.85	32.10	22.36	17.55	25.18	165.52	97.33	63.60

YEAR: 1978												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	17.68	11.82	10.46	19.77	45.55	21.37	10.75	9.43	10.27	12.15	62.77	32.09
6-10	18.58	13.66	11.40	19.41	57.43	19.66	16.04	8.59	11.69	9.79	53.95	48.05
11-15	18.77	13.84	13.83	21.72	68.81	16.94	13.28	14.12	11.42	13.05	67.91	33.45
16-20	24.80	16.55	13.61	30.82	45.47	13.30	12.25	10.74	8.44	15.77	82.64	23.21
21-25	18.65	10.92	16.36	70.28	37.32	12.70	16.29	9.18	23.20	28.97	77.43	21.78
26-END	14.22	11.18	15.86	41.50	22.14	11.81	12.04	8.72	13.24	58.70	43.46	17.37
AVERAGE	18.54	13.13	13.66	33.92	45.35	15.96	13.40	10.09	13.04	24.22	64.69	28.94

Table A-18 (4/4) FIVE-DAY MEAN DISCHARGE AT BRH

YEAR: 1979												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	18.17	11.10	27.97	51.33	56.30	29.59	17.74	23.82	43.99	25.41	73.36	80.48
6-10	17.80	12.22	25.87	42.36	37.52	66.74	15.61	21.66	55.35	27.75	79.14	59.83
11-15	15.18	11.84	22.75	33.29	50.60	67.25	22.67	17.45	76.67	37.89	80.54	40.53
16-20	11.95	14.90	30.69	28.31	23.45	30.56	24.02	20.85	80.10	40.53	168.88	34.72
21-25	11.99	35.77	65.60	35.43	19.04	23.12	73.93	26.95	42.58	46.28	111.50	31.69
26-END	11.25	34.91	39.88	45.29	26.77	20.28	49.59	28.20	37.18	79.24	114.39	26.61
AVERAGE	14.29	19.07	35.83	39.33	35.33	39.59	34.43	23.32	55.98	44.03	104.64	45.03

YEAR: 1980												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	25.45	14.68	24.12	21.82	46.47	32.77	17.20	38.32	30.07	47.21	35.41	88.39
6-10	22.79	12.03	59.26	25.89	71.85	36.61	14.59	26.12	40.36	73.88	33.36	158.55
11-15	18.04	10.19	21.56	25.50	68.50	25.20	13.44	25.35	26.64	77.04	36.21	148.08
16-20	15.61	9.13	27.66	19.27	57.41	38.07	29.52	21.11	41.59	254.74	49.29	71.17
21-25	14.56	12.87	22.73	17.73	33.02	24.53	22.95	84.01	75.58	64.81	70.87	53.13
26-END	19.16	28.10	15.44	44.30	37.61	23.90	37.34	43.59	50.95	40.27	80.97	45.21
AVERAGE	19.27	14.03	30.76	25.75	52.00	30.18	22.99	39.88	44.20	91.29	51.02	92.51

YEAR: 1981												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	54.19	39.70	35.01	42.94	61.81	66.32	23.90	16.61	24.25	22.53	30.96	52.03
6-10	52.32	32.25	21.44	70.29	80.43	46.96	19.46	13.11	89.18	28.73	32.74	83.51
11-15	37.97	31.98	24.16	60.29	90.35	34.21	24.19	11.68	69.06	46.47	64.02	55.51
16-20	34.74	51.76	17.96	78.20	100.19	27.04	19.88	10.74	54.82	77.12	65.31	37.13
21-25	32.50	30.51	21.46	74.85	99.62	24.95	19.76	15.60	40.02	38.71	108.05	29.66
26-END	27.20	51.19	19.49	41.88	84.44	37.26	22.47	26.09	27.58	41.04	72.27	26.80
AVERAGE	39.41	38.73	23.46	61.41	86.08	38.46	21.64	15.98	50.82	42.39	62.23	46.77

YEAR: 1982												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	25.41	14.92	15.83	18.00	79.71	60.77	25.51	15.08	25.63	53.80	86.56	125.72
6-10	21.78	29.61	33.53	41.24	67.17	46.99	19.10	20.54	16.74	51.38	81.82	72.75
11-15	28.28	37.75	25.96	31.48	50.26	35.38	15.78	22.78	30.05	59.83	94.98	73.34
16-20	19.91	20.20	15.97	107.17	48.30	36.73	15.80	27.88	47.53	76.35	114.71	70.62
21-25	19.52	18.00	27.64	100.32	57.00	22.67	25.18	42.65	44.75	54.55	85.71	56.86
26-END	15.72	15.39	28.43	66.84	99.54	18.33	15.14	29.02	44.45	56.70	109.60	32.88
AVERAGE	21.66	23.16	24.69	60.25	74.50	36.81	19.28	25.64	34.87	59.09	95.56	70.77

YEAR: 1983												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	39.23	18.90	20.98	15.76	33.25	24.00	15.28	62.57	45.75	35.42	40.41	31.84
6-10	35.44	16.49	14.94	13.49	24.90	14.35	17.42	47.59	64.40	32.67	56.02	28.40
11-15	27.60	16.69	19.25	12.11	30.39	26.44	19.12	31.66	82.61	30.39	48.93	40.40
16-20	24.84	22.30	19.61	10.66	26.73	34.06	16.92	31.37	126.51	33.91	45.67	31.47
21-25	22.11	17.47	18.55	12.83	29.22	19.74	53.45	21.72	73.63	38.33	35.64	27.54
26-END	19.29	15.71	25.39	19.24	21.44	15.07	28.84	27.00	65.13	42.15	34.57	25.90
AVERAGE	27.80	18.08	19.97	14.01	27.46	22.28	25.29	36.66	73.01	35.70	43.54	30.77

YEAR: 1984												UNIT: CMS
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1-5	24.17	69.26	54.93	91.62	86.21	94.80	33.38	31.42	26.86	51.41	67.36	94.07
6-10	18.61	98.47	44.45	65.67	58.33	65.79	35.17	30.08	23.36	55.32	70.76	106.92
11-15	22.18	77.92	53.31	93.44	52.28	64.46	37.05	22.67	20.65	30.88	94.29	87.94
16-20	23.68	69.73	63.24	63.35	50.34	67.96	88.45	19.61	42.78	41.00	108.53	87.70
21-25	68.53	59.77	82.04	59.23	52.84	43.85	54.16	21.25	45.68	52.03	99.85	169.57
26-END	60.65	53.93	85.14	57.08	58.12	36.19	34.41	24.97	30.46	38.25	73.89	109.60
AVERAGE	37.89	72.12	64.54	71.73	60.44	62.17	46.69	25.08	31.63	44.60	86.11	106.09

Table A-19 MONTHLY MEAN DISCHARGE AT BRH

Unit: cu.m/s

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1961	103.07	62.51	56.04	89.29	80.48	67.39	65.98	60.91	84.50	79.02	94.32	90.65
1962	82.67	36.16	67.80	81.14	97.92	47.95	31.02	39.22	51.60	107.10	146.20	69.71
1963	50.78	26.22	28.39	18.91	49.23	47.05	31.38	55.39	52.28	107.01	178.70	106.83
1964	64.02	36.68	43.53	43.70	50.26	38.71	70.11	46.25	87.31	70.81	109.30	89.03
1965	40.91	33.02	35.28	73.31	107.27	46.21	38.96	53.38	67.57	76.62	103.74	110.61
1966	68.73	53.29	64.33	85.21	48.78	53.74	50.85	48.38	57.15	99.87	122.59	118.70
1967	110.73	72.15	52.64	68.87	87.27	37.14	24.13	21.38	34.94	62.97	138.70	72.47
1968	32.12	24.11	15.81	28.22	97.92	74.85	47.85	38.35	56.07	73.56	76.90	83.50
1969	71.32	49.74	36.31	49.41	100.19	53.30	29.18	43.50	45.09	124.53	91.35	86.85
1970	80.61	34.75	32.97	67.79	87.02	41.98	32.17	35.15	61.76	106.89	96.80	100.26
1971	167.84	39.99	48.39	32.36	34.00	24.63	22.84	55.09	70.04	38.29	113.75	141.12
1972	67.21	42.57	31.67	60.70	93.00	70.18	27.38	25.22	53.94	137.91	180.79	96.63
1973	37.47	26.36	35.23	121.47	124.97	111.50	45.55	67.55	78.98	146.35	172.82	160.75
1974	40.61	51.28	36.97	77.16	99.15	46.69	39.57	31.76	62.41	43.78	66.06	77.65
1975	73.48	49.56	55.73	79.84	49.58	34.53	73.53	28.78	54.61	29.69	64.80	79.16
1976	49.72	28.19	42.87	52.28	32.74	63.77	46.86	40.42	37.70	71.74	57.44	50.45
1977	31.96	28.57	23.35	24.12	32.85	32.10	22.36	17.55	25.18	165.52	97.33	63.60
1978	18.54	13.13	13.66	33.92	45.35	15.96	13.40	10.09	13.04	24.22	64.69	28.94
1979	14.29	19.07	38.83	39.33	35.33	39.59	34.43	23.32	55.98	44.03	104.64	45.03
1980	19.27	14.03	30.76	25.75	52.00	30.18	22.99	39.88	44.20	91.29	51.02	92.51
1981	39.41	38.73	23.46	61.41	86.08	38.46	21.64	15.98	50.82	42.39	62.23	46.77
1982	21.66	23.16	24.69	60.85	74.50	36.81	19.28	25.64	34.87	59.09	95.56	70.77
1983	27.80	18.08	19.97	14.01	27.46	22.28	25.29	36.66	73.01	35.70	43.54	30.77
1984	37.89	72.12	64.54	71.73	60.44	62.17	46.69	25.08	31.63	44.60	86.11	106.09
MEAN	56.34	37.23	38.47	56.70	68.91	47.38	36.81	36.87	53.53	78.46	100.81	84.12

Table A-20 ANNUAL MAXIMUM PEAK DISCHARGE AT SKC BRIDGE STATION

Year	Flood Runoff (cu.m/s)	Year	Flood Runoff (cu.m/s)
1962	194.90	1973*	359.14
1963	237.96	1974*	158.47
1964	188.10	1977*	261.95
1965	209.39	1978*	93.22
1966	186.41	1979*	181.43
1967	179.43	1980*	536.60
1968	138.71	1981	138.94
1969	251.73	1982*	184.57
1970	230.51	1983*	152.39
1971*	605.93	1984	236.01
1972	338.55		

Remarks: *: There are some interruptions of discharge record.

Table A-21 GROUNDWATER LEVEL IN SWAMP

A) SWL-Line		Unit: m					
Observed Point	SWL-1	SWL-2	SWL-3	SWL-4	SWL-5	SWL-6	
Distance from the Drain	0	30	100	250	500	750	
Elevation of Ground Surface	-	-	6.25	6.25	6.41	6.32	
Groundwater level							
Date							
July	26	4.52	5.18	5.39	5.52	5.72	5.74
	30	4.49	5.38	5.58	5.58	5.88	5.94
Aug.	6	4.43	5.26	5.44	5.44	5.74	5.83
	13	4.36	5.11	-	5.33	5.63	5.73
	20	4.34	5.10	-	5.26	5.54	5.62
	27	4.32	4.88	5.28	5.25	5.48	5.58
Sept.	3	4.37	5.16	5.43	5.42	5.67	5.79
	10	4.38	5.22	5.49	5.53	5.83	5.95
	17	4.36	5.16	5.41	5.40	5.74	5.88

B) MSL-Line		Unit: m				
Observed Point	MSL-1	MSL-2	MSL-3	MSL-4	MSL-5	
Distance from the Drain	0	100	250	500	1,000	
Elevation of Ground Surface	-	4.66	4.67	5.02	5.64	
Date						
July	26	4.13	4.33	4.37	4.55	5.04
	30	4.25	4.34	4.38	4.64	5.04
Aug.	6	3.60	4.24	4.28	4.57	4.95
	13	3.55	4.14	4.20	4.49	4.88
	20	3.50	4.04	4.11	4.42	4.81
	27	3.53	3.95	4.03	4.42	4.84
Sept.	6	3.57	4.17	4.22	4.51	4.78
	10	3.59	4.39	4.43	4.76	5.00
	17	3.81	4.31	4.37	4.67	4.91

Table A-22 GRADIENT OF GROUNDWATER LEVEL

Section of Observed Points	SWL-Line				
	SWL-1 SWL-2	SWL-2 SWL-3	SWL-3 SWL-4	SWL-4 SWL-5	SWL-5 SWL-6
Sectional Distance (m)	30	70	150	250	250
Gradient of Groundwater Table					
Date					
July 26	2.2×10^{-2}	3.0×10^{-3}	8.7×10^{-4}	8.0×10^{-4}	8.0×10^{-5}
30	3.0×10^{-2}	2.9×10^{-3}	0	1.2×10^{-3}	2.4×10^{-4}
Aug. 6	2.8×10^{-2}	2.6×10^{-3}	0	1.2×10^{-3}	3.6×10^{-4}
13	2.5×10^{-2}	-	-	1.2×10^{-3}	4.0×10^{-4}
20	2.5×10^{-2}	-	-	1.1×10^{-3}	3.2×10^{-4}
27	1.9×10^{-2}	5.7×10^{-3}	-2.0×10^{-4}	9.2×10^{-4}	4.0×10^{-4}
Sept. 3	2.6×10^{-2}	3.9×10^{-3}	-6.7×10^{-5}	1.0×10^{-3}	4.8×10^{-4}
10	2.8×10^{-2}	3.9×10^{-3}	2.7×10^{-4}	1.2×10^{-3}	4.8×10^{-4}
17	2.7×10^{-2}	3.6×10^{-3}	4.7×10^{-4}	1.0×10^{-3}	5.6×10^{-4}

Section of Observed Points	MSL-Line			
	MSL-1 MSL-2	MSL-2 MSL-3	MSL-3 MSL-4	MSL-4 MSL-5
Sectional Distance (m)	100	150	250	500

Gradient of Groundwater Table

Date

July 26	2.0×10^{-3}	2.7×10^{-4}	7.2×10^{-4}	9.8×10^{-4}
30	9.0×10^{-4}	2.7×10^{-4}	1.0×10^{-3}	8.0×10^{-4}
Aug. 6	6.4×10^{-3}	2.7×10^{-4}	1.2×10^{-3}	7.6×10^{-4}
13	5.9×10^{-3}	4.0×10^{-4}	1.2×10^{-3}	7.8×10^{-4}
20	5.4×10^{-3}	4.7×10^{-4}	1.2×10^{-3}	7.8×10^{-4}
27	4.2×10^{-3}	5.3×10^{-4}	1.6×10^{-3}	8.4×10^{-4}
Sept. 3	6.0×10^{-3}	3.3×10^{-4}	1.2×10^{-3}	5.4×10^{-4}
10	8.0×10^{-3}	2.7×10^{-4}	1.3×10^{-3}	4.8×10^{-4}
17	5.0×10^{-3}	4.0×10^{-4}	1.2×10^{-3}	4.8×10^{-4}

Table A-23 RESULT OF PERMEABILITY TEST IN SWAMP

Location	d (cm)	t (s)	So (cm)	St (cm)	K (cm/s)
- 7.5 km inside from Main Canal along Timber road	1.30	180	32.2	8.5	9.4×10^{-3}
	1.30	180	27.2	8.0	8.6×10^{-3}
	1.90	180	50.2	28.6	4.0×10^{-3}
	1.90	180	43.2	22.3	4.6×10^{-3}
- 110 m from Main canal (MSL line)	1.00	300	35.7	16.3	3.3×10^{-3}
	1.00	300	40.7	11.9	5.2×10^{-3}
- 500 m from Main canal (MSL line)	0.80	600	37.3	12.4	2.3×10^{-3}
	0.80	600	37.3	20.4	1.3×10^{-3}
	1.30	600	90.3	57.0	9.7×10^{-4}
	1.30	600	90.2	54.7	1.1×10^{-3}
- 1,000 m from Main canal (MSL line)	1.00	300	57.7	36.2	2.0×10^{-3}
	1.00	300	59.7	33.1	2.5×10^{-3}
	1.40	300	55.7	20.4	4.2×10^{-3}
	1.40	300	49.7	17.3	4.5×10^{-3}
- 30 m from Drain (SWL line)	1.30	600	37.6	14.6	2.0×10^{-3}
	1.30	600	39.6	13.6	2.3×10^{-3}
	1.80	600	68.6	40.3	1.1×10^{-3}
	1.80	600	71.6	43.1	1.1×10^{-3}
- 250 m from Drain (SWL line)	0.90	600	47.1	27.1	1.2×10^{-3}
	0.90	600	43.1	23.4	1.3×10^{-3}
- 750 m from Drain (SWL line)	0.80	60	25.6	1.6	5.9×10^{-2}
	1.10	300	50.3	33.1	1.8×10^{-3}
- Beside Main Canal at Parit 7 of Sungai Leman	0.90	300	38.4	8.1	6.6×10^{-3}
	0.90	300	40.4	5.9	8.1×10^{-3}

Table A-24 DISCHARGE OF SEEPAGE FLOW INTO DRAIN IN SWAMP

A) SWL-Line

Date	Water Depth (m)			Discharge of Unit Length (lit/s/km)
	SWL-1	SWL-3	SWL-4	
July 26	3.20	4.07	4.20	2.98
30	3.17	4.26	4.26	4.04
Aug. 6	3.11	4.12	4.12	3.66
13	3.04	4.01	4.01	3.42
20	3.02	3.94	3.94	3.20
27	3.00	3.96	3.93	3.38
Sept. 3	3.05	4.11	4.10	3.80
10	3.06	4.17	4.21	3.96
17	3.04	4.09	4.16	3.64
Average				3.56

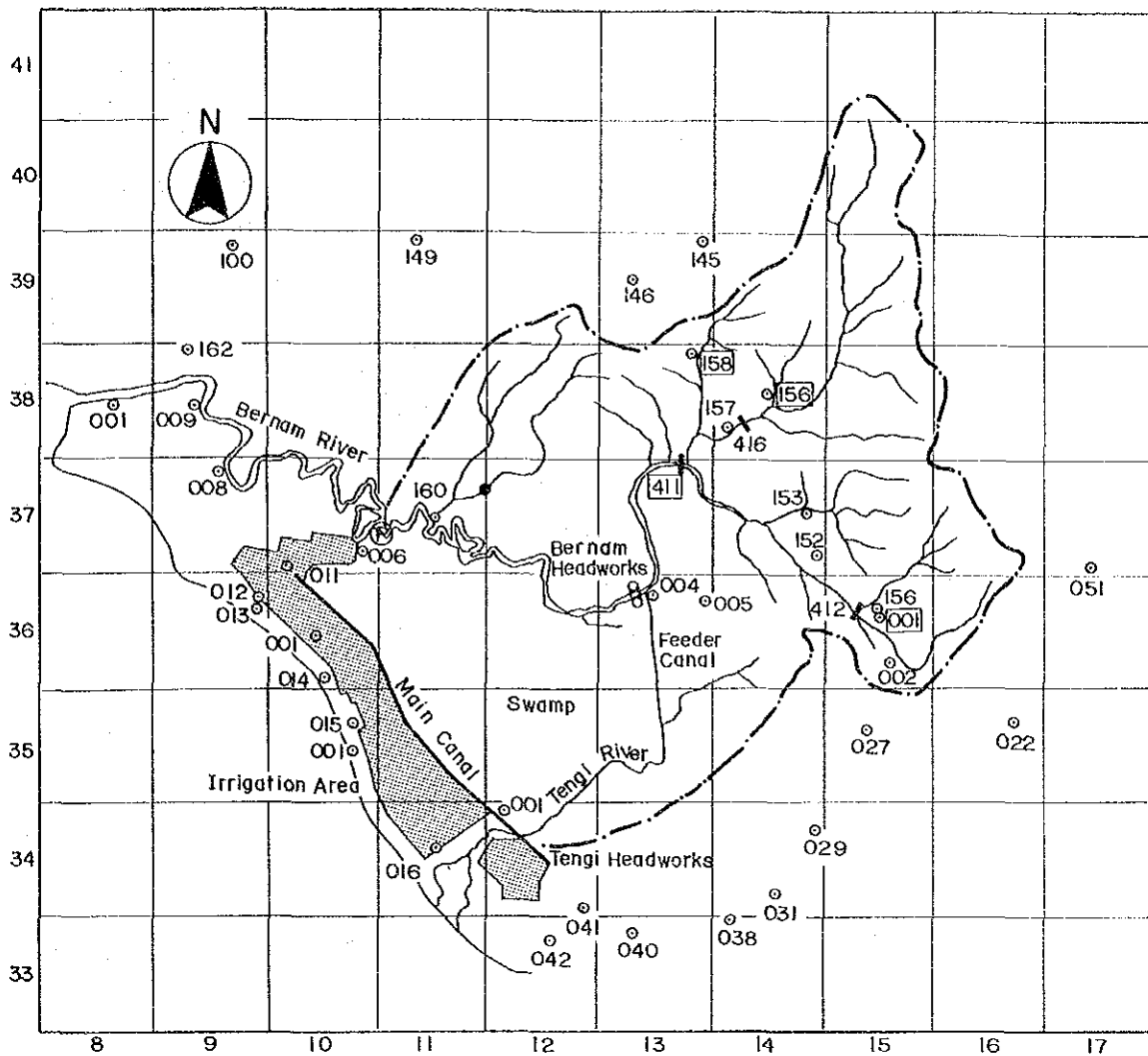
Remarks: In this estimate, impermeable layer is assumed to exist in horizontal and at 5.00m below the ground surface at observed point SWL-6.

B) MSL- Line

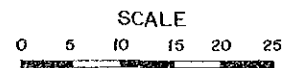
Date	Water Depth (m)			Discharge of Unit Length (lit/s/km)
	MSL-1	MSL-2	MSL-3	
July 26	3.49	3.69	3.73	0.33
30	3.61	3.70	3.74	0.14
Aug. 6	2.96	3.60	3.64	1.03
13	2.91	3.50	3.56	0.91
20	2.86	3.40	3.47	0.81
27	2.89	3.31	3.39	0.61
Sept. 3	2.93	3.53	3.58	0.94
10	2.95	3.75	3.79	1.32
17	3.17	3.67	3.73	0.82
Average				0.77

Remarks: In this estimate, impermeable layer is assumed to exist in horizontal and at 5.00m below the ground surface at observed point MSL-5.

FIGURES



- Rainfall station
 - |— Water level gauging station No.3813411 (SKC Bridge Station)
 - ⊞ Bernam River Headworks (BRH)
 - ⊙ Bagan Terap Pump house
 - Measuring point at tributary of Bernam River
- Note : The numbers shown in the margin indicate the hydrological grid in Peninsular Malaysia.



Catchment area at SKC Bridge Station	1090 km ²
at BRH	1260 km ²
at Bagan Terap Pump house	1960 km ²
at tributary	106 km ²

Fig.A-1 Location of Meteorological and River Gauging Station

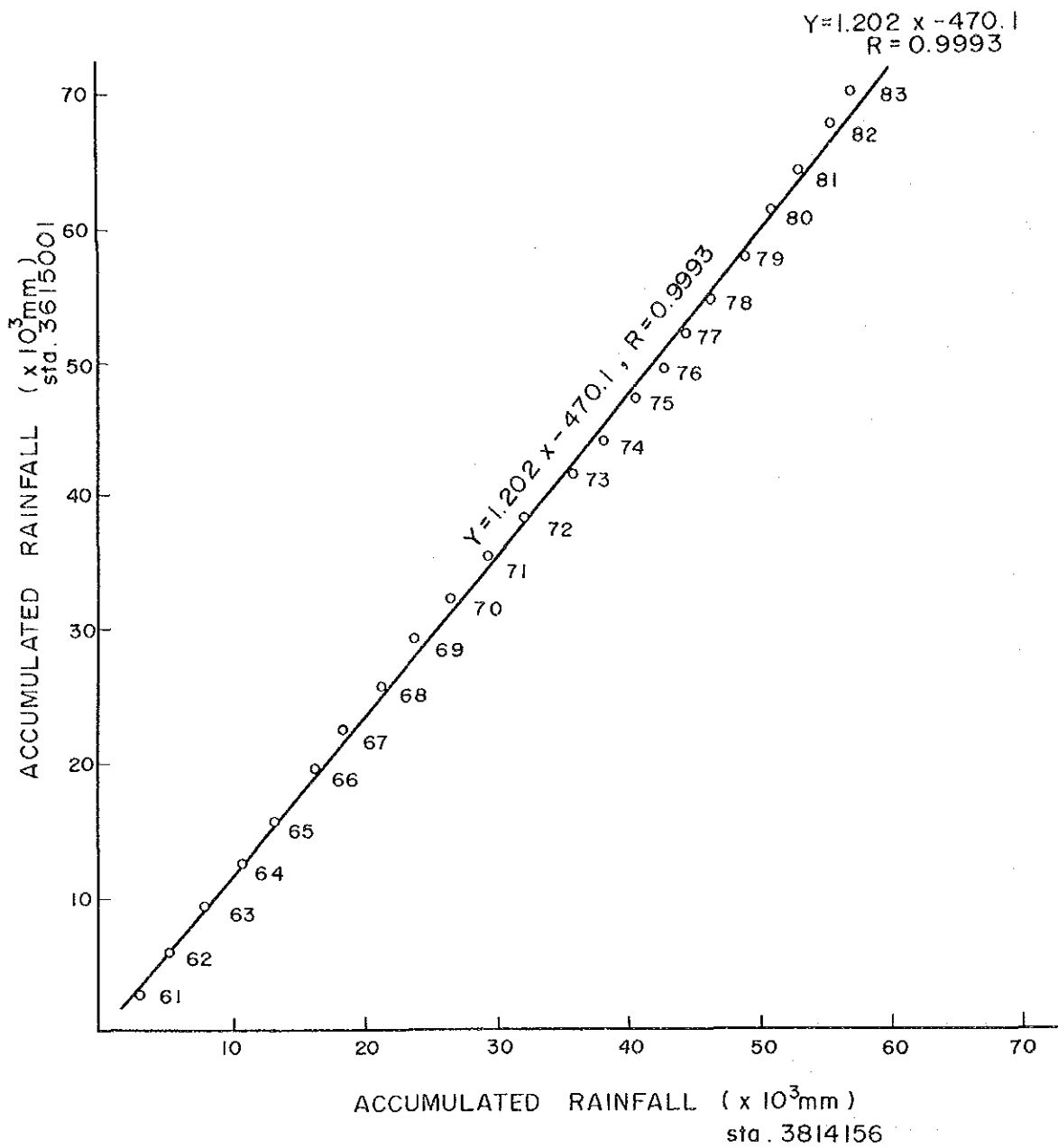


Fig.A-2 Double Mass Curve of Rainfall
(1/3)

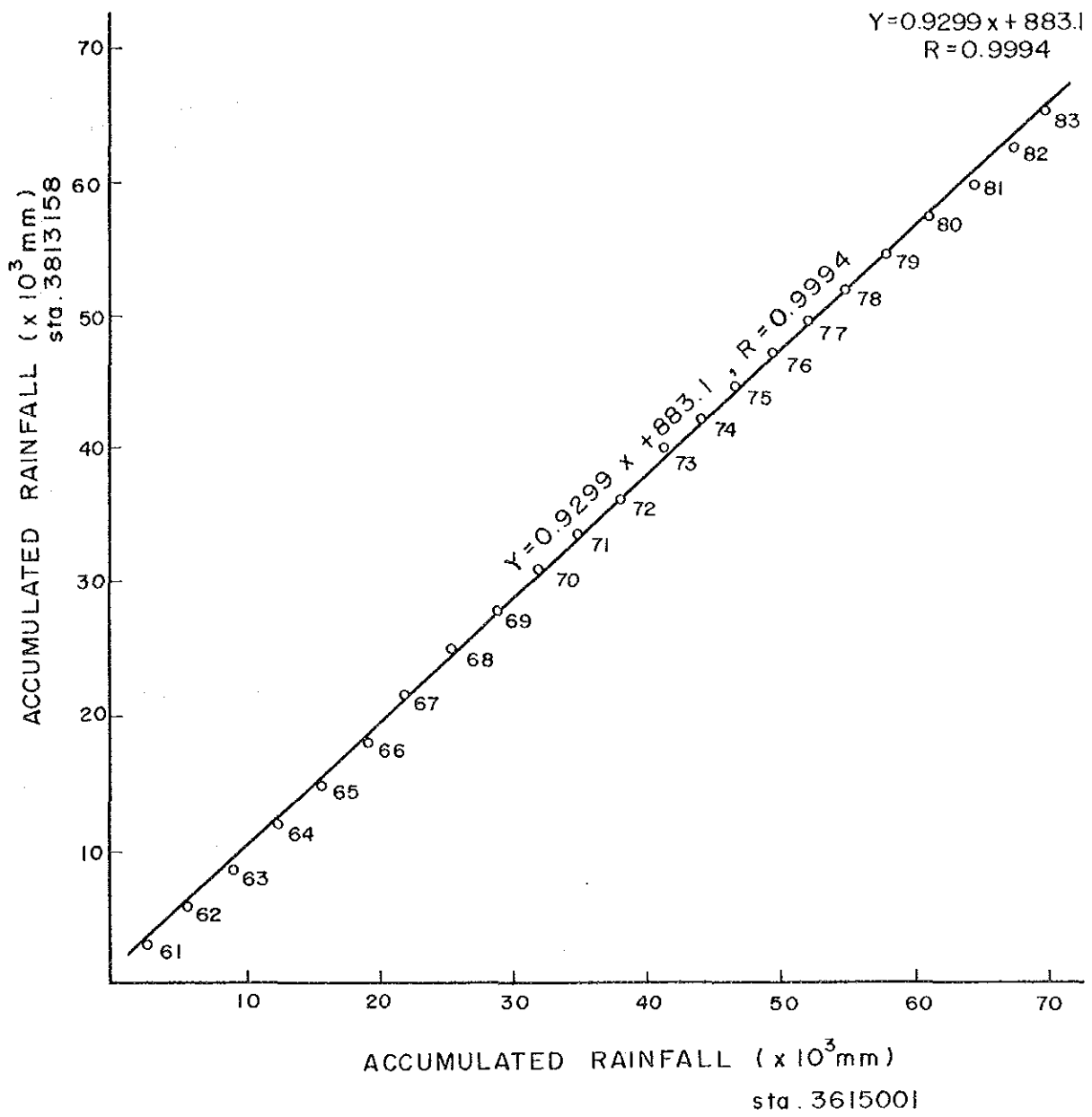


Fig. A-2 Double Mass Curve of Rainfall
(2/3)

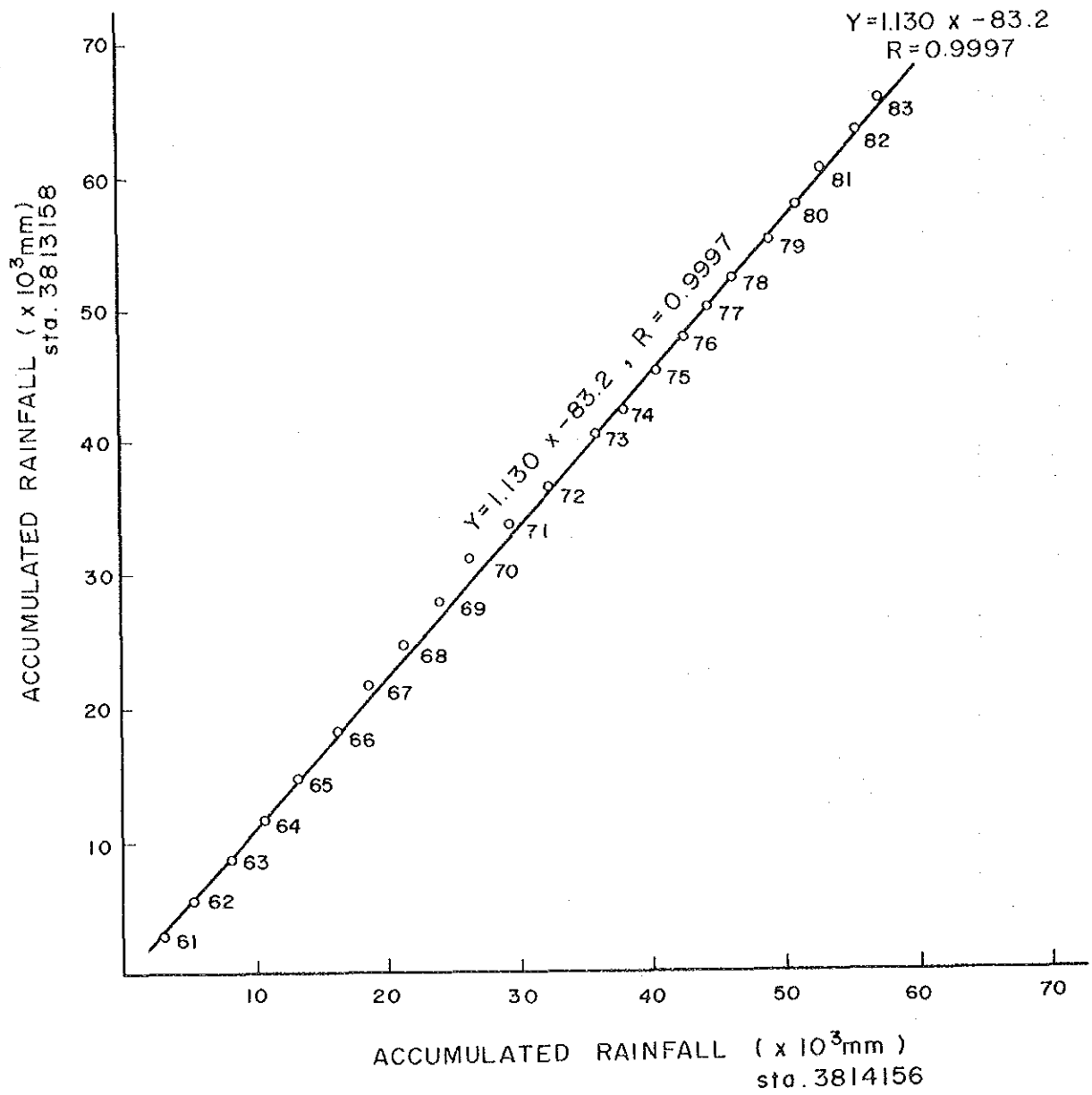


Fig. A-2 Double Mass Curve of Rainfall
(3/3)

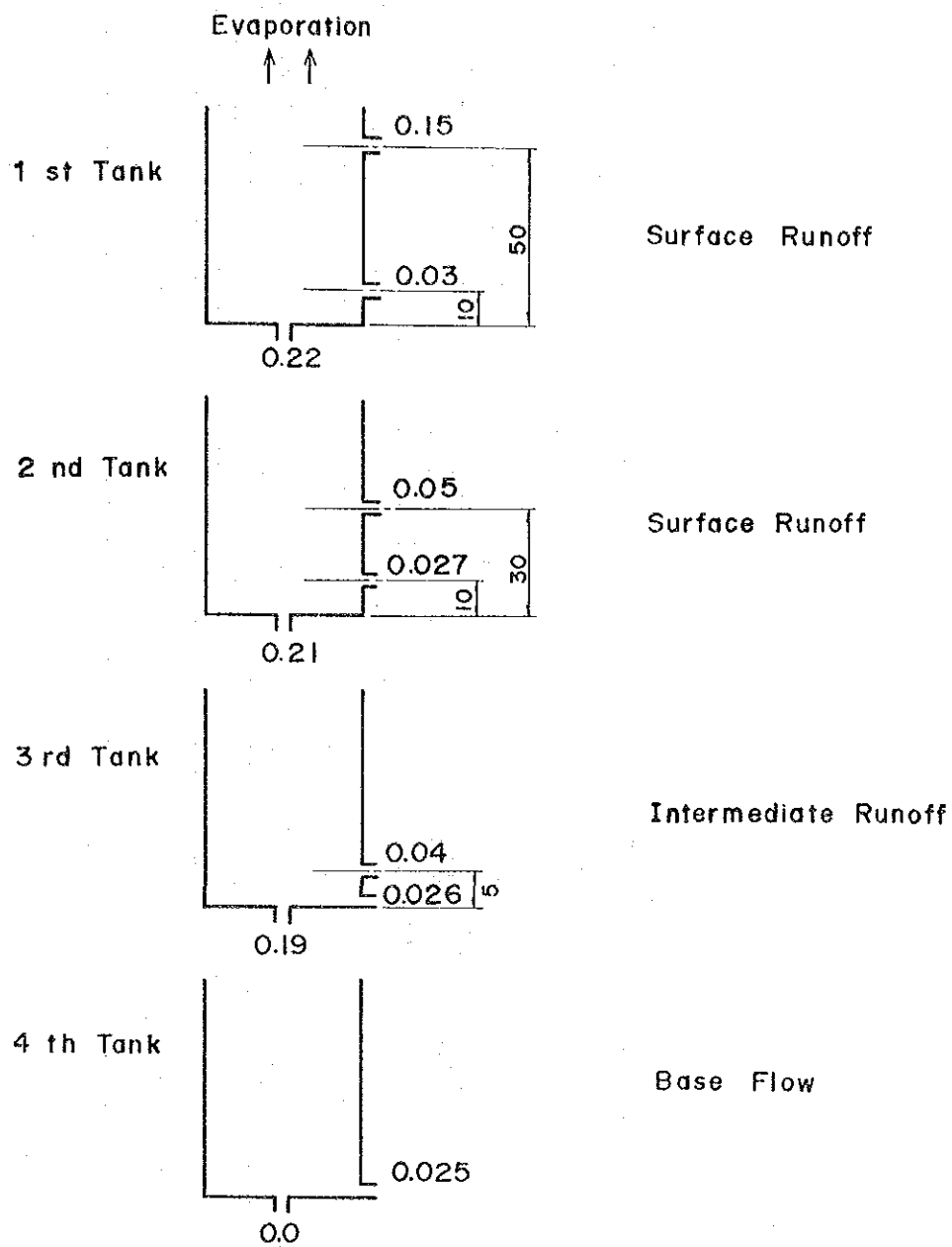


Fig. A-3 Simulation Model of Tank Model Method

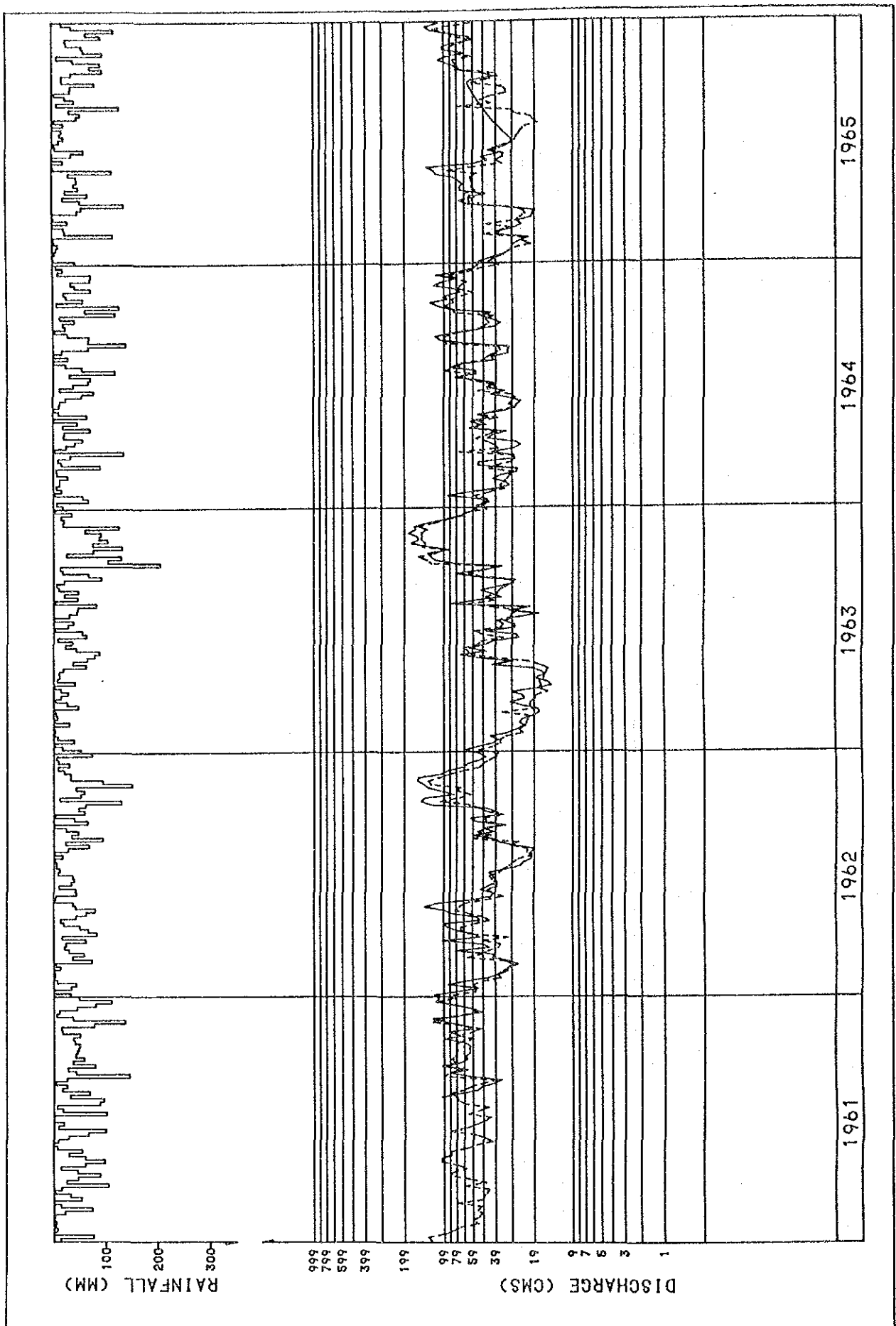


Fig. A-4 Result of Runoff Simulation at SKC Bridge Station (1/5)

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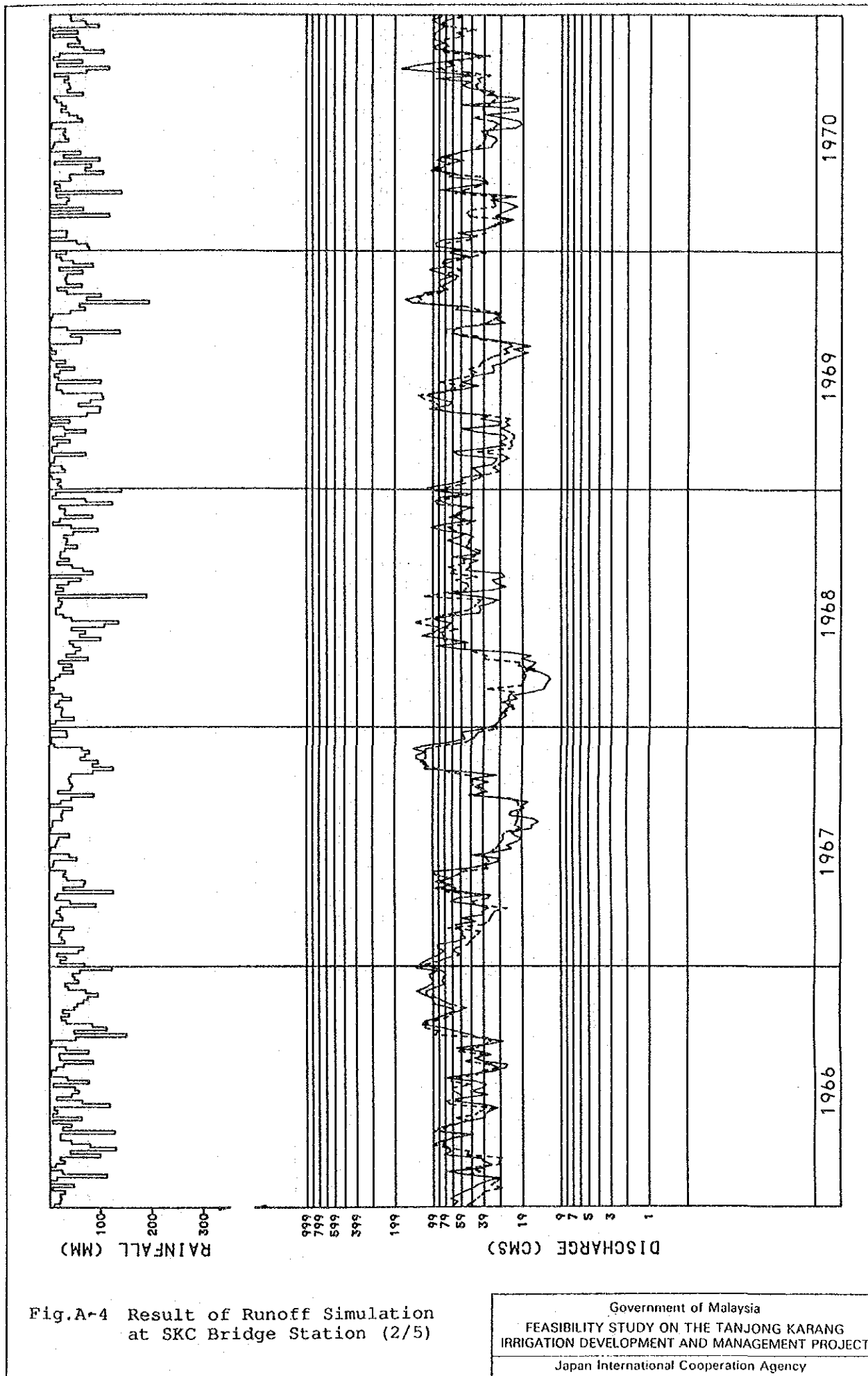


Fig.A-4 Result of Runoff Simulation at SKC Bridge Station (2/5)

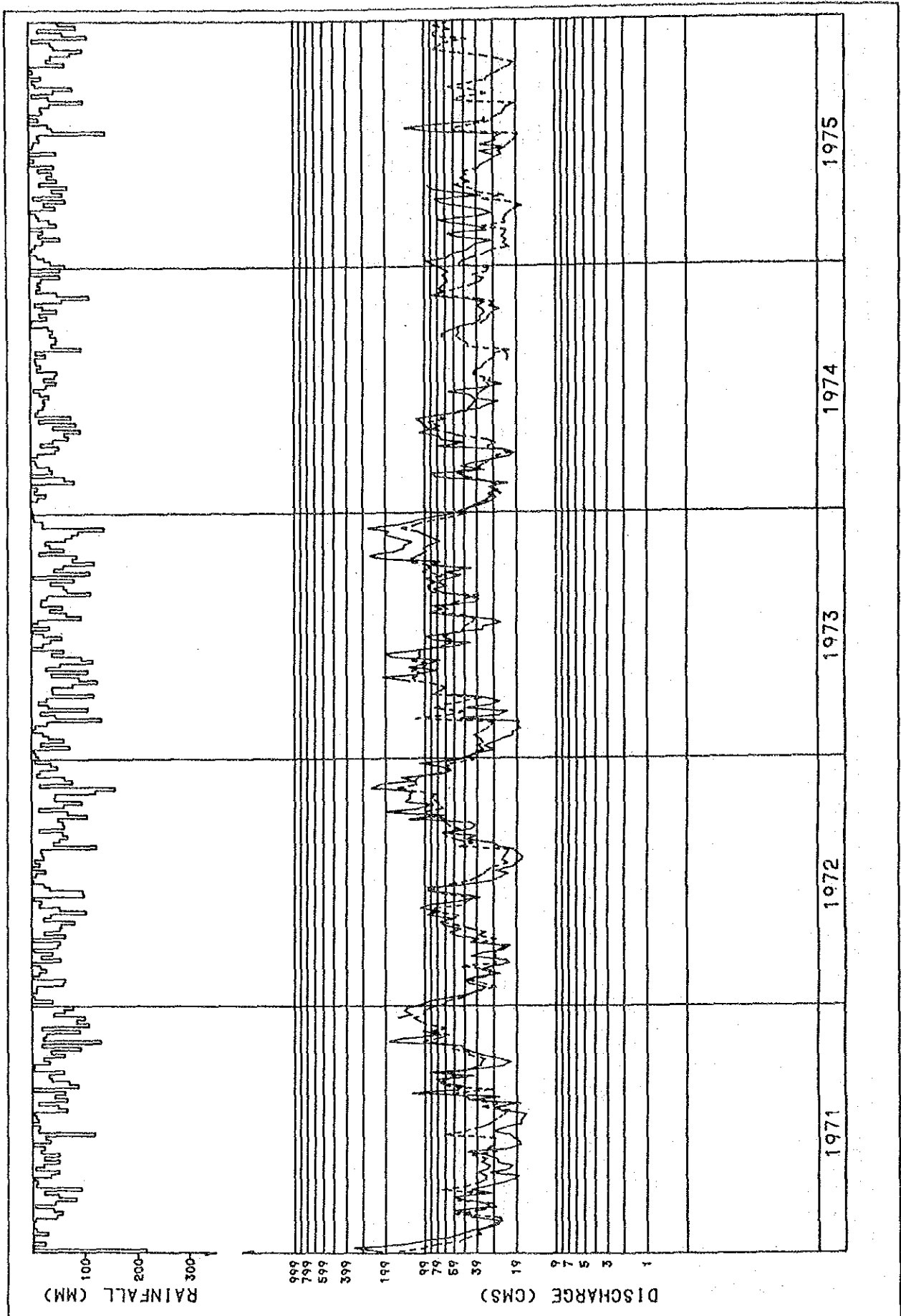


Fig. A-4 Result of Runoff Simulation at SKC Bridge Station (3/5)

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 Japan International Cooperation Agency

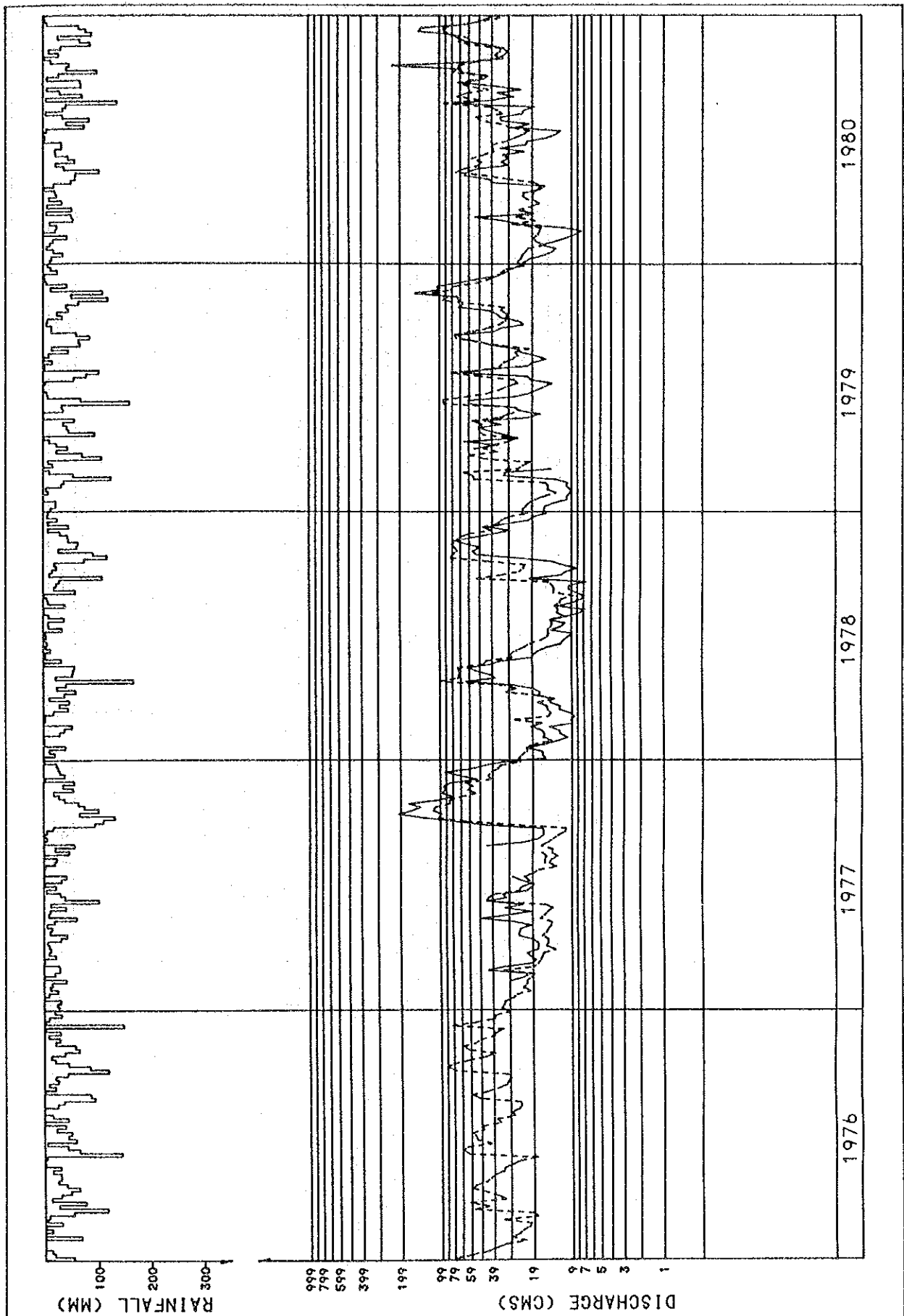


Fig. A-4 Result of Runoff Simulation at SKC Bridge Station (4/5)

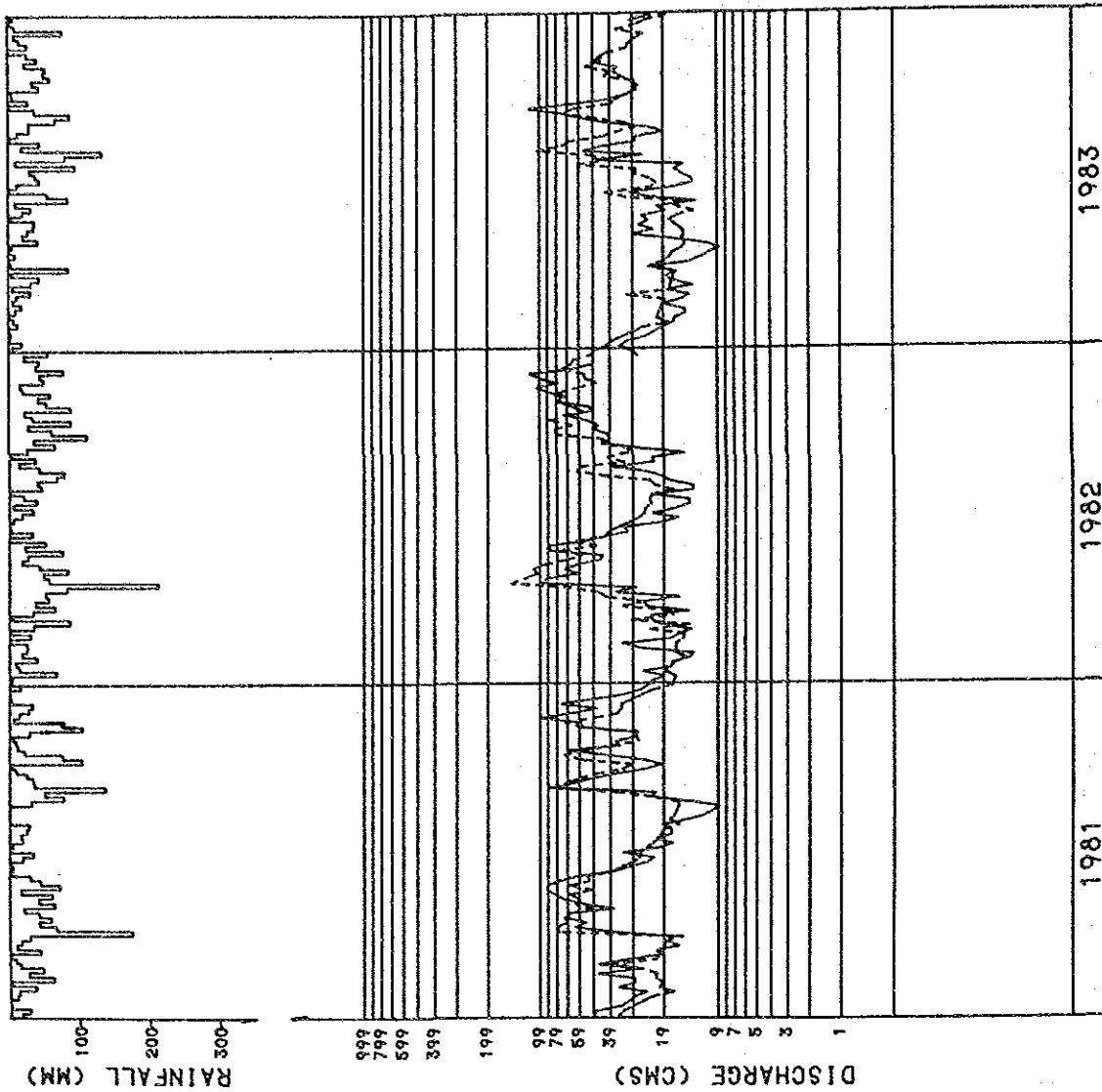
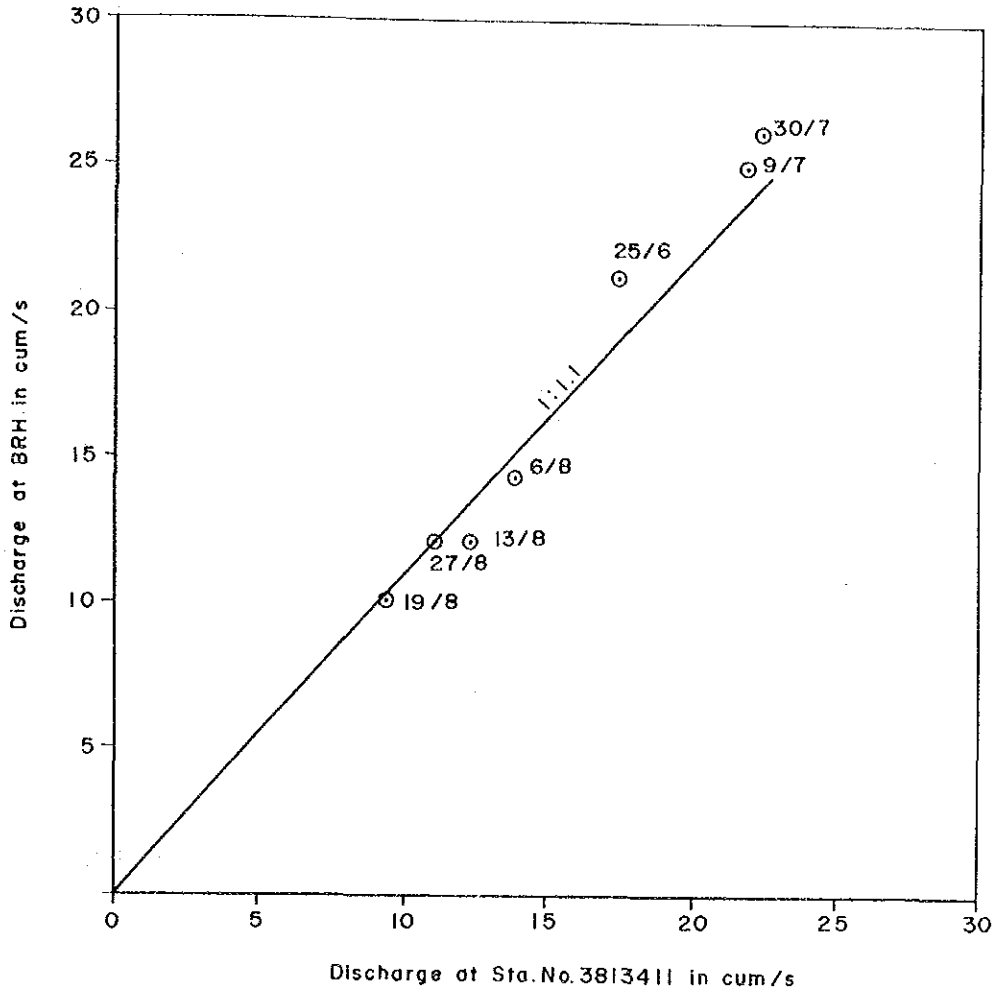


Fig. A-4 Result of Runoff Simulation at SKC Bridge Station (5/5)



Note: Discharge measurement at Sta. No. 3813411 was made one day before that at BRH

Fig. A-5 Relationship of Runoff at SKC Bridge Station and BRH

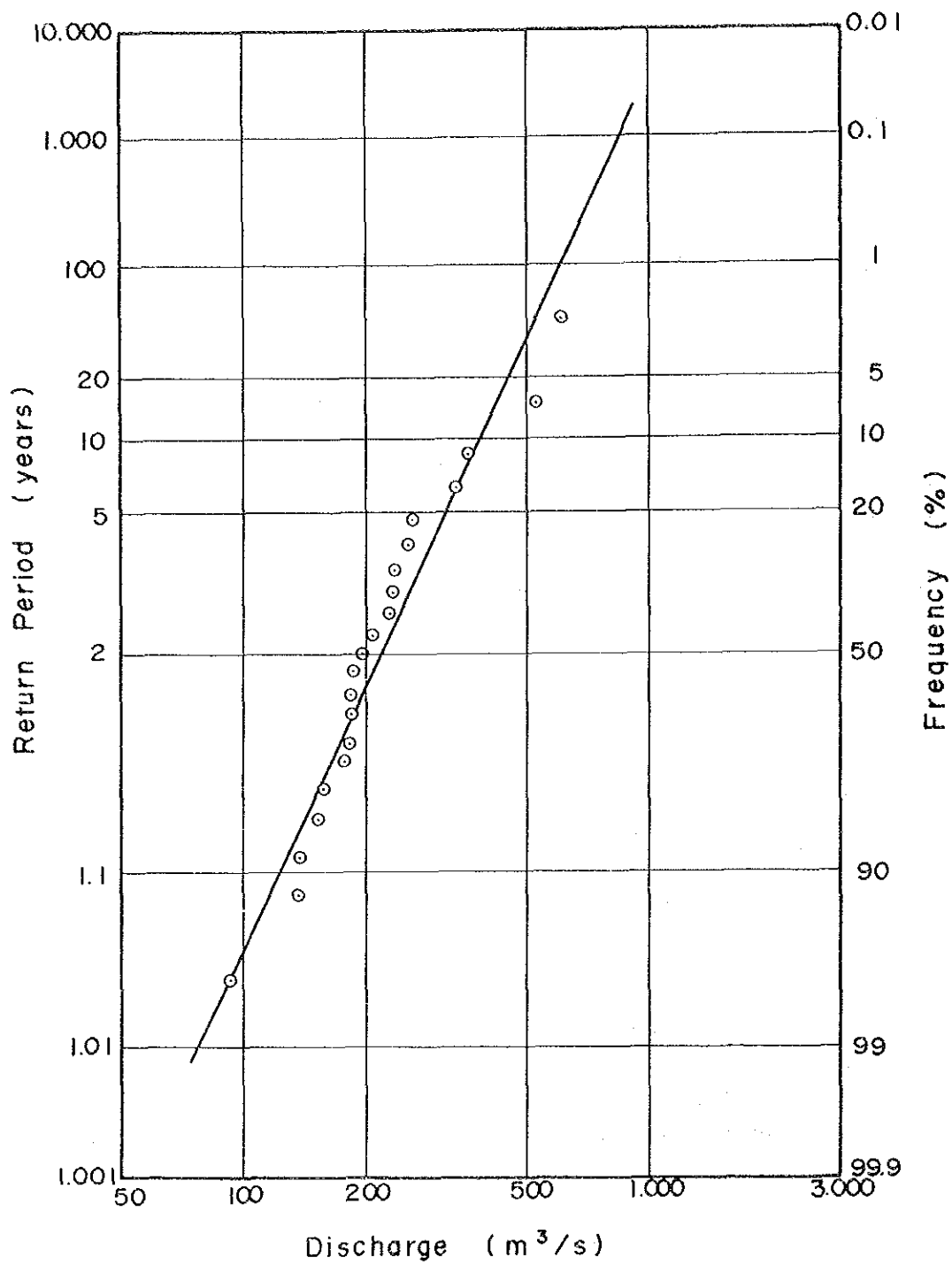


Fig. A-6 Frequency Analysis of Peak Discharge at SKC Bridge

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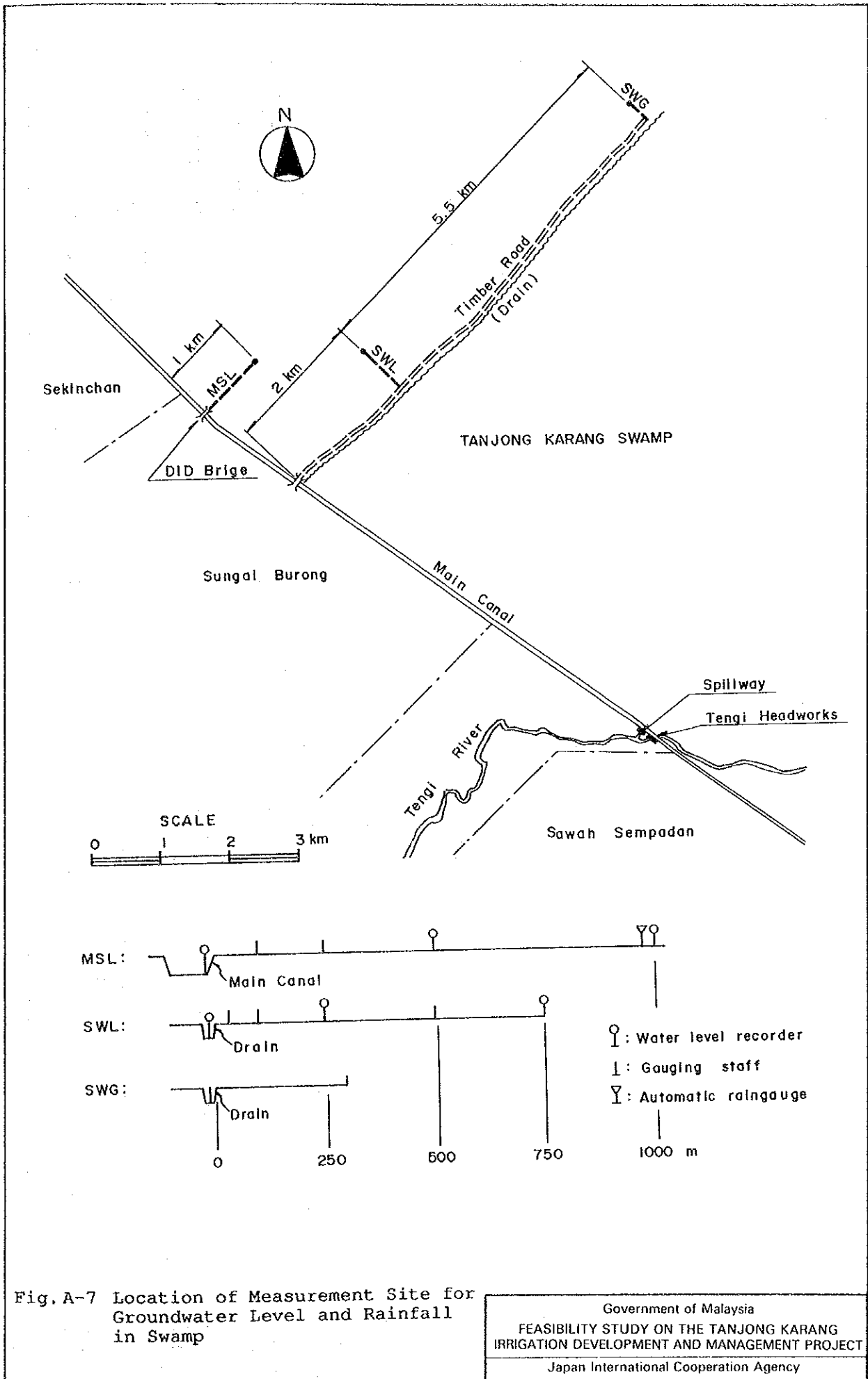


Fig. A-7 Location of Measurement Site for Groundwater Level and Rainfall in Swamp

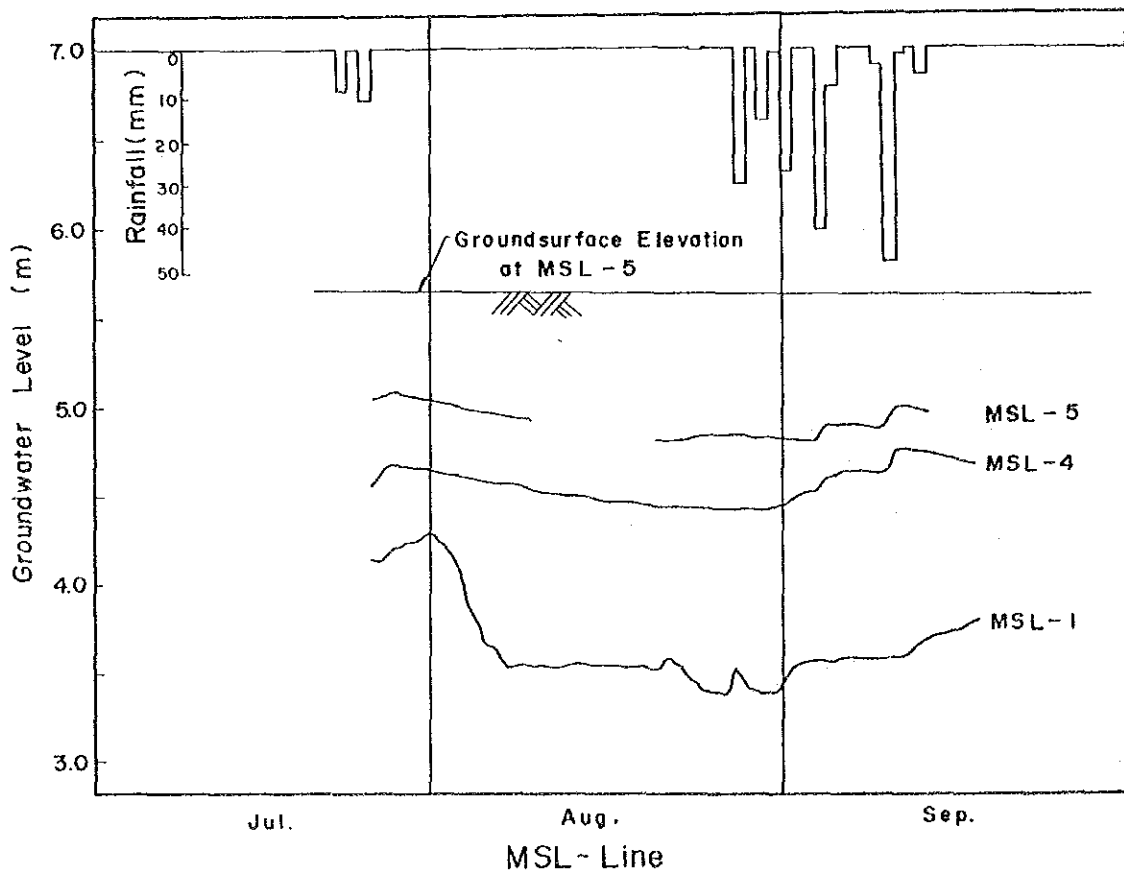
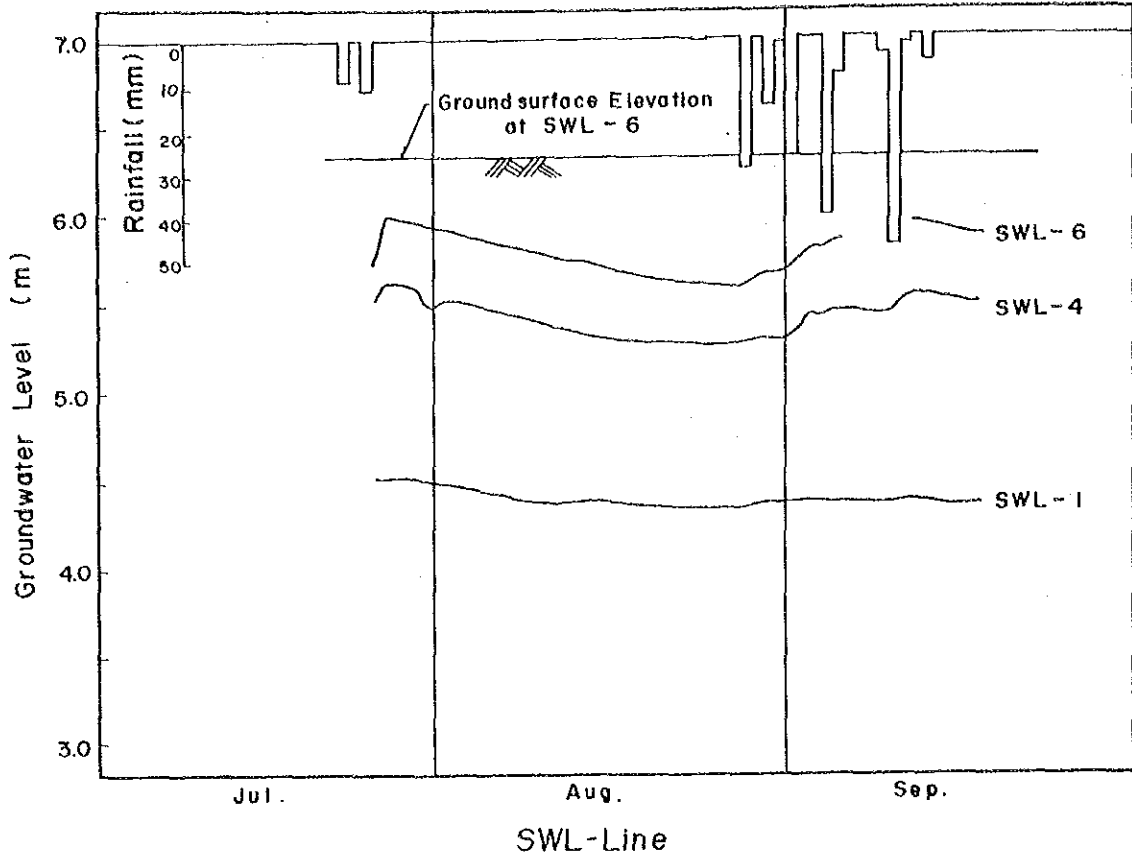
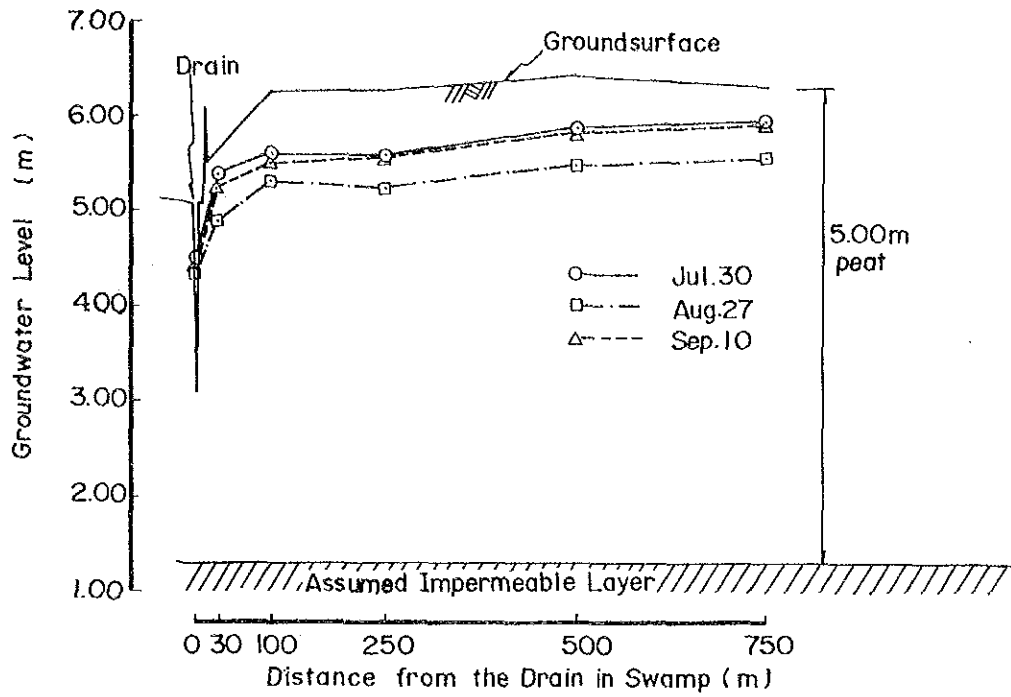
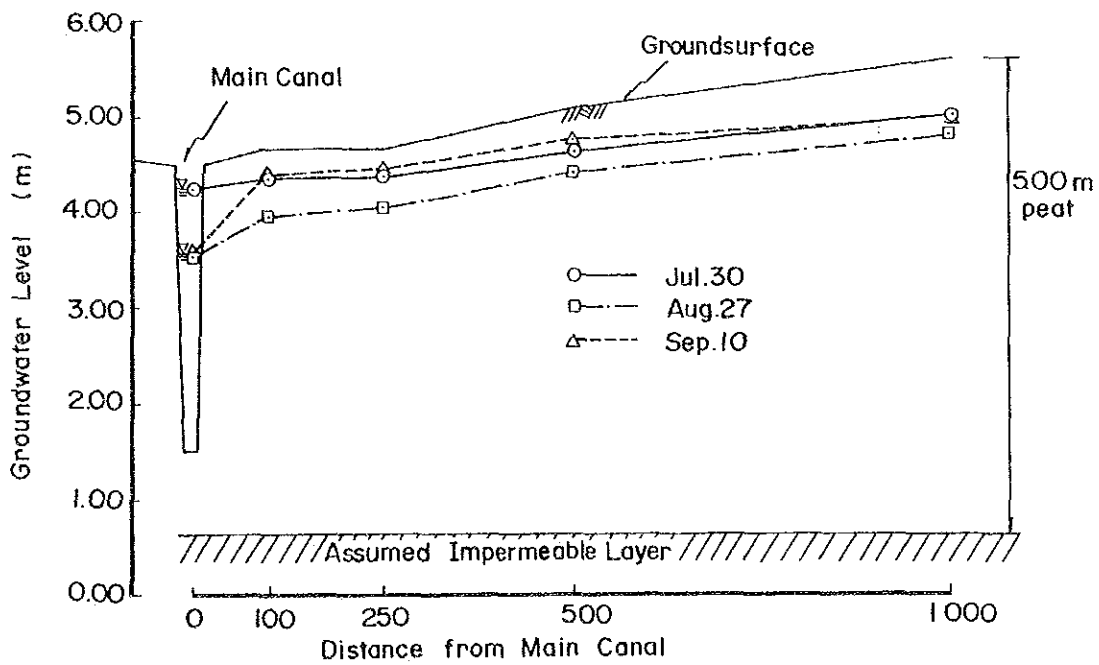


Fig. A-8 Groundwater Level and Rainfall in Swamp



a) SWL-Line



b) MSL-Line

Fig. A-9 Profile of Groundwater Level

ANNEX B

Agriculture and Agro-economy

**ANNEX B
AGRICULTURE AND AGRO-ECONOMY**

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1. INTRODUCTION

This ANNEX B presents relevant data and information on the agricultural and agro-economic situation in and around the project area. Such data and information were collected from DID, Economic Planning Unit (EPU), Department of Statistics (DOS), Department of Agriculture (DOA) in Kuala Lumpur and various agencies concerned in the project area.

2. SOCIO-ECONOMIC BACKGROUND

2.1 Population

The Northwest Selangor Integrated Agricultural Development Project (PBLIS) straddles the Districts of Kuala Selangor and Sabak Bernam. The total population of the two Districts was 213,627 according to the 1980 Population and Housing Census of Malaysia. Population by sex, age-group and ethnic group is tabulated in Tables B-1 to B-3.

Of the total population as of 1980, 64.4% were Malays followed by Chinese 22.2%, Indians 13.3% and others 0.1%. The Chinese population is largely concentrated in town areas such as Kuala Selangor, Tanjong Karang, Sekinchan, Sungai Besar and Sabak Bernam. The Indian population mostly lives in tree crop estates in the District of Kuala Selangor.

Population of productive age between 15 and 64 years old was 113,384 as of 1980 sharing 53.1% of the total population in the PBLIS area. Among the productive age group, younger generation of 15 to 29 years old had a share of 25.8%, while middle generation of 30 to 49 years old shared 19.3% followed by older generation of 50 to 59 years sharing 5.8%. Population of non-productive age was 100,243 including 93,142 people below 15 years old and 7,101 people of 65 years old and above.

The social profile of the PBLIS area has been annually surveyed by the PBLIS Office. According to this PBLIS Monitoring Survey for 1985, the population of the age-group below 15 years old reduced to 38.3% while the older generation of 50 years and above increased from 11.3% to 16.0% during the period from 1980 to 1985. Among 407 sample paddy farm households of the 1985 PBLIS Monitoring Survey, 34.9% of heads were 60 years old and above, and 26.5% were between 50 and 59 years old in the whole project area as shown in table of the next page.

The ratio of female heads of households to the total sample paddy farm households was 15.2%. Female heads of households aged 60 years old and above were 16.1% of the total female population.

<u>Irrigation Compartments</u>	<u>Distribution by Age-group (%)</u>				
	<u><29</u>	<u>39-39</u>	<u>40-49</u>	<u>50-59</u>	<u>>60</u>
Sawah Sempadan	-	18.2	21.2	21.2	39.4
Sungai Burong	7.3	10.9	21.8	31.8	28.2
Sekinchan	1.4	20.5	31.9	17.8	27.4
Sungai Leman	1.7	9.8	9.8	29.5	49.2
Pasir Panjang	6.7	13.3	6.7	60.0	13.3
Sungai Nipah	-	19.4	25.8	16.1	38.7
Panchang Bedena	2.6	7.9	15.8	26.3	47.4
Bagan Terap	-	23.1	23.1	30.7	23.1
<u>Total</u>	<u>3.0</u>	<u>14.5</u>	<u>21.1</u>	<u>26.5</u>	<u>34.9</u>

2.2 Household

There were 38,293 households in the Districts of Kuala Selangor and Sabak Bernam as of 1980. Of these, 38,274 were private households comprising Malay households 67.5%, Chinese 19% and Indians 13% as shown in Table B-4. The average size of a household by ethnic group was 5.6 as a whole, 5.3 for a Malay household, 6.5 for Chinese and 5.7 for Indians.

The average size of 905 households selected as samples under the PBLs Monitoring Survey for 1985 was 5.9. That of 407 paddy farm household was 6.0 as a whole ranging from 4.9 in Sungai Nipah to 7.1 in Sekinchan among the eight irrigation compartments.

2.3 Occupation

The population aged 10 years and over by occupation in the PBLs area and each District as of 1980 is shown in Tables B-5 to B-7. Out of the total population, 69,263 or 32.4% were identified as the total labour force. The population with occupations was 60,686 in total, comprising 62.9% for Malays, 22.0% for Chinese, 15.0% for Indians and 0.1% for others. The overall ratio of population with occupations to the total labour force was 87.6%. The ratio by ethnicity was 85.5% for Malays, 91.3% for Chinese and 79.7% for Indians.

The breakdown by occupation was office workers 5,490 or 9.0%, sales and service workers 7,432 or 12.3%, agricultural workers and fishermen 39,070 or 64.4%, and factory workers and operators 8,694 or 14.3%. Distribution by occupation for each ethnic group is as follows:

<u>Occupation</u>	<u>(Unit: %)</u>		
	<u>Malays</u>	<u>Chinese</u>	<u>Indians</u>
Office works	10.4	6.7	7.0
Sales & service workers	7.3	27.4	10.3
Agricultural workers & fishermen	70.9	44.6	66.3
Factory workers & operators	11.4	21.3	16.4

The PBLs Monitoring Survey for 1985 shows that the average rate of school attendance is 52.9% as a whole, 48.5% for paddy farm households and 56.2% for tree crop smallholders. This rate by irrigation compartment is as 53.0% in Sawah Sempadan, 33.6% in Sungai Burong, 54.7% in Sekinchan, 59.7% in Sungai Leman, 55.7% in Pasir Panjang, 56.9% in Sungai Nipah, 50.6% in Panchang Bedena and 55.4% in Bagan Terap.

3. AGRO-CLIMATE

3.1 Available Observation Data

Data on air temperature, relative humidity, sunshine hours and wind velocity in the PBLIS area are available at a secondary climatological station in Tanjong Karang. Observation were started in September, 1980. Data collected cover until March, 1985, and are summarized in Tables B-8 to B-11. In the PBLIS area, pan evaporation was observed in Sungai Besar until April, 1978, and Bagan Terap till end of 1983. Observation of evapotranspiration is made by the Penman method at the Tanjong Karang Climatological Station. These are summarized in Table B-12.

Daily rainfall records in the project area for 10 years between 1975 and 1984 were collected at three rainfall stations namely Station No. 3411016 at Parit 1 in Sungai Burong, Station No. 3510001 at Taliair 8 in Sungai Leman and Station No. 3710011 at Parit 6 in Sungai Besar. Based on observation records collected, 5-day rainfalls are calculated and the results are shown in Tables B-13 to B-15. Mean 5-day rainfall at each station for the period of 10 years between 1975 and 1984 is given in Table B-16. Mean monthly rainfall is as follows:

<u>Month</u>	<u>Sungai Burong</u>	<u>Sungai Leman</u>	(Unit: mm) <u>Sungai Besar</u>
Jan.	93.6	96.9	124.3
Feb.	135.7	116.6	104.3
Mar.	107.4	105.0	114.3
Apr.	168.1	144.0	134.9
May	147.3	129.3	123.6
June	87.1	77.3	78.1
July	138.1	116.7	113.1
Aug.	118.4	121.6	103.1
Sept.	181.5	122.9	133.0
Oct.	205.1	170.6	137.7
Nov.	212.9	181.0	164.6
Dec.	178.5	165.4	172.0
<u>Total</u>	<u>1,773.7</u>	<u>1,547.3</u>	<u>1,503.0</u>

3.2 Climatic Conditions for Mechanized Farming

Since mechanical harvesting has been introduced to the project area, operation of heavy harvesters has caused disturbance of surface soils. This becomes very serious when timing of harvesting works falls when farm lots are submerged after heavy or continuous rainfall and surface soils are soft.

To identify suitable periods for uninterrupted operation of heavy harvesters, data assessment is made regarding the number of days having daily precipitation of more than 5 mm and leaving stagnant water on farm lots. The latter was estimated on the assumption that percolation loss is 2 mm/day based on the average field measurements of the Study Team and the field is left fallow without drainage works. The results are shown in Tables B-17 to B-19 and summarized in Table B-20.

From these, it is found that more than seven days for every 10 days have no rainfall or submerged water on farm lots during the periods from January 11th to April 10th in the whole project area. The same condition is seen from June 1st to August 20th in the upstream part of the project area; from June 1st to August 10th and from September 11th to October 10th in the middle; and from June 21st to October 20th in the downstream.

4. SOILS

4.1 Soil Survey

Available information regarding soils in the project area comprises the Reconnaissance Soil Survey of Peninsular Malaysia and the Semi-detailed Soil Survey of Northwest Selangor, both of which were prepared by the Ministry of Agriculture. The former was completed in 1967, while the latter was issued in 1984. The Semi-detailed Soil Survey covers 71,330 ha which are bounded by the Bernam river in the north and by the Straits of Malacca in the west and south. The eastern boundary is somewhat irregular being bounded by the Bernam river, a short timber track running south of Tanjong Merbau Berdarah, the Main Canal and the Terusan Besar. The semi-detailed soil map is produced on a scale of 1/50,000.

4.2 Physiography and Geology

The surveyed area forms part of a very large and flat coastal alluvial plain which rises very gently from the Straits of Malacca and includes the Tanjong Karang peat swamp. The swamp has a maximum elevation of about 4 m, an average width of about 10 km and a length of about 67 km. It is drained mainly by two large rivers namely the Bernam river in the north and the Selangor river in the south, while smaller streams such as the Besar river and the Tenggi river also play a part by draining into the Straits of Malacca.

The parent materials of the soils in the survey area are mainly of alluvial origin. They are dominated by recent marine-derived clays, recent riverine clays, and brackish water and organic deposits. The alluvium is of the Quaternary Age. It is made up of unconsolidated marine and riverine clays. The thickness of the alluvium is variable but there is a general thickening towards coast.

4.3 Soil Classification

In the surveyed area, a total of 12 soil series was identified through the Semi-detailed Soil Survey. Soils derived from marine alluvium are

classified into eight series namely Kranji, Banjar, Sedu, Jawa, Selangor, Bernam, Bakau and Serong. Soils derived from brackish water deposits are classified as Brown Clays, while soils derived from organic soil materials are identified as Organic Clays and Mucks. Soils originated from riverine alluvium are classified as Bria Series. Other than such 12 soil series, quite variable soils occur on an old river bed and, basically, these are derived from fairly well drained marine alluvium overlying poorly drained marine alluvium. These soils are collectively grouped as Unclassified Clays. Distribution of each soil series in the surveyed area is illustrated in Fig. B-1.

As hecтарage of each soil series and group is as tabulated in Table 21, the soils of Bernam Series cover 22,258 ha in the survey area followed by the soils of Jawa and Bria Series which extend over 11,450 ha and 8,446 ha, respectively. The area covered with the Organic Clays and Mucks is 2,013 ha.

The soils identified as soil series can be classified into the U.S. Soil Taxonomy and FAO/UNESCO legend as shown in Table 22. Data on laboratory analysis of major soil series are compiled in Table 23.

4.4 Soil Suitability Classification

By referring to "Soil-crop Suitability Classification for Peninsular Malaysia", Soils and Analytical Services Bulletin No. 1, issued by MOA in 1974, all the soil series identified in the survey area are classified into the following four soil suitability classes.

<u>Class</u>	<u>Symbol</u>	<u>Limitation</u>
1		Few or no minor limitations
2		One or more moderate limitations
3		One serious limitation
4		Two or more serious limitations
	a	Acid sulphate layer
	d	drainage
	s	Salinity
	t	Texture and structure

The soil suitability class of each soil series is as shown below.

<u>Soil Series</u>	<u>Soil Suitability Class</u>	<u>Soil Series</u>	<u>Soil Suitability Class</u>
Selangor	1d	Brown Clays	3d(t)
Bernam	2nd	Unclassified Clays	3d(t)
Briah	2nd	Mucks	4dt
Organic Clays	2dt	Serong	4dt
Jawa	2dt(a)	Banjar	4dt
Sedu	2adt	Kranji	4dst
Bakau	3d(t)		

4.5 Crop Suitability

The soils of Kranji Series extend over mangrove swamps along the coast and tidal river mouth areas. These can be utilised for coconut plantations with construction of coastal bunds to prevent sea-water flooding and provision of adequate drains to drain off surplus water.

The soils of Banjar Series are located inland only after coastal bunds or river mouths. These can be utilised for coconut cultivation with improved drainage and some leaching of the dissolved salts. Cocoa planting can be also attempted with further soil amelioration.

The soils of Sedu Series have quite wide distribution in coastal areas. These can be recommended for growing oil palm, cocoa, coconut and orchards if liming and bunch-ash of oil palm are provided together with good drainage.

The soils of Jawa Series are found mainly in tree crop and paddy cultivation areas. These are considered suitable for oil palm, cocoa, coconut and orchards provided liming and bunch-ash of oil palm are given with adequate drainage and good management.

The soils of Selangor Series extend over flat terrain with fairly well-drained status. These are suitable for a wide variety of crops including oil palm, coconut, cocoa and orchards with adequate drainage and management.

The soils of Bernam Series on very flat terrain are of average fertility. With good drainage and management, coconut and oil palm can be cultivated successfully. Paddy cultivation is also suitable with irrigation.

The soils of Bakau Series extending over very flat lowlying topography are better used for paddy cultivation on account of the heavy texture, flat terrain and tendency to get water-logged during the wet season. Double cropping of paddy under adequate irrigation should be encouraged and yields are reported to be fairly high by local standards.

The soils of Serong Series mainly found on very flat terrain are of average fertility. The water-logged nature together with their heavy texture and flat terrain are well suited for paddy cultivation. Double cropping of paddy under sufficient irrigation has great potential as yields of paddy are reported to be fairly high by local standards.

The soils of Brown Clays are found between areas covered with mineral soils on coastal bund and areas having organic rich soils along the swamp. These have quite low pH value varying from 3.5 to 4.0 and the necessity of soil improvement by liming. With irrigation, paddy should perform well on these soils. With good drainage, vegetables, coconut, oil palm and maize can be cultivated successfully.

The soils of Organic Clays and Mucks occur around the western edges of the peat swamp. These have low pH values. The nitrogen content is low and the C/N ratio is high. Such characteristics make these soils marginal for paddy cultivation. But these soils can be recommended as suitable for vegetables, bananas and oil palm providing liming is given.

The soils of Bria Series found along meandering streams can be successfully recommended for a wide range of crops including rubber, oil palm, coconut and orchard. Alternatively these soils can be used for paddy cultivation with irrigation.

The soils of Unclassified Clays are located on old river bed of the Bernam river. With improved drainage and soil management, these can be utilised successfully for oil palm and coconut cultivation despite their clayey nature and sited on lowlying poorly-drained situations.

The correlation between soil and crop suitabilities is as shown in

Table 24.

4.6 Soils in the Project Area

Among 12 soil series, nine soil series are found in the project area. The followings show their hectarage and distribution.

<u>Soil Series</u>	<u>Hectarage</u> (ha)	<u>Distribution</u> (%)
Sedu	3,594	17.6
Jawa	7,346	36.0
Bernam	1,244	6.1
Bakau	1,520	7.4
Serong	674	3.3
Brown Clays	3,081	15.1
Organic Clays and Mucks	2,013	9.9
Briah	750	3.7
Unclassified Clays	178	0.9
<u>Total</u>	<u>20,400</u>	<u>100.0</u>

5. LAND USE

5.1 Present Land Use

Two series of land use maps covering the project area are available. The one was produced in 1969 by interpretation of aerial photographs taken in 1966, while the other was the second series land use report issued in 1977 after interpretation of aerial photographs newly taken in 1974. At present, the Ministry of Agriculture is preparing a third series of land use map based on the latest aerial photographs which were taken in 1985.

Changes in land use conditions in the Districts of Kuala Selangor and Sabak Bernam between 1966 and 1985 were assessed by referring to the above three series of land use data. The results as shown in Tables B-25 to B-28. The changes in the main land use categories for agricultural use in the two Districts are summarized below.

(Unit: ha)

<u>Land Use Category</u>	<u>1966</u>	<u>1974</u>	<u>1985</u>
Rubber	24,787	14,096	5,934
Oil palm	6,453	18,976	32,348
Coconut	35,442	39,589	40,368
Cocoa	13	1,372	901
Paddy	20,918	21,310	20,240
Vegetables	2,063	3,136	3,286
Others	927	1,474	723
<u>Total</u>	<u>89,793</u>	<u>99,953</u>	<u>103,800</u>

The two Districts of Kuala Selangor and Sabak Bernam except for the Tanjong Karang peat swamp are included in the PBLs area which covers 100,199 ha in total. As of 1985, cropped areas amounted to 96,424 ha in gross, comprising 64,189 ha under smallholders and 32,235 ha under estates. Coconut, paddy and cocoa intercropped in coconut area are mainly grown by smallholders, while oil palm is widely planted by estates. The distribution of main crops grown in the PBLs area are illustrated in Fig. B-2.

The Tanjong Karang Irrigation Scheme of PBLs has a gross area of 19,857 ha. The Scheme is divided into eight irrigation compartments, namely Sawa Sempadan, Sungai Burong, Sekinchan, Sungai Leman, Pasir Panjang, Sungai Nipah, Panchang Bedena and Bagan Terap. These compartments are located along the Main Canal of the Scheme from upstream in order of mention. The Scheme consists of 16,265 farm lots of which standard size is 1.2 ha (3 acres). In the upstream six irrigation compartments from Sawa Sempadan to Sungai Nipah where each tertiary canal directly connects to the Main Canal, about 50 farm lots are grouped in one sub-block as shown below.

<u>Irrigation Compartment</u>	<u>Gross Area (ha)</u>	<u>No. of Sub-block</u>	<u>No. of Farm Lots</u>
Sawah Sempadan	2,395	24	1,983
Sungai Burong	3,616	34	1,903
Sekinchan	1,857	16	1,522
Sungai Leman	2,133	20	1,771
Pasir Panjang	1,616	18	1,346
Sungai Nipah	2,019	26	1,662
Panchang Bedena	3,351	-	2,746
Bagan Terap	2,870	-	2,328
<u>Total</u>	<u>19,857</u>	<u>138</u>	<u>16,265</u>

The land title of farm lots in the Scheme area was firstly registered as paddy fields in the State Land Office. Due to the existence of the Organic Clay and Muck Soils with very low productivity of paddy, however, a total of 298 ha in Sungai Burong was legally converted to the permanent crop land in 1980. Further conversion was applied by the PBLs office in 1986 for the same reason. The area to be newly converted to the permanent crop land covers 341 ha in Sungai Leman and 108 ha in Pasir Panjang.

In addition to permanent tree cropping, some farm lots are cultivated for vegetables. 5,909 farm households living in the Scheme area are using a part of their farm lots. Many farm lots also have small patches with coconut and mango trees and huts. Public quarters such as schools, mosques and community buildings occupy farm lots to some extent. Taking the above situation into account, a lot-to-lot survey to grasp the actual land use was conducted with the assistance of DID's Irrigation Inspectors

during the Phase I Study period. Based on the results of lot-to-lot survey and by referring to field measurement records on the net area of farm lots made by the Ministry of Agriculture, the Scheme area is classified into cultivable and non-cultivable areas as follows:

<u>Irrigation Compartment</u>	<u>Gross Area (ha)</u>	<u>Non-cultivable Area (ha)</u>	<u>Cultivable Area (ha)</u>
Sawah Sempadan	2,395	85	2,310
Sungai Burong	3,616	37	3,579
Sekinchan	1,857	33	1,824
Sungai Leman	2,133	27	2,106
Pasir Panjang	1,616	38	1,578
Sungai Nipah	2,019	79	1,940
Panchang Bedena	3,351	91	3,260
Bagan Terap	2,870	220	2,650
<u>Total</u>	<u>19,857</u>	<u>610</u>	<u>19,247</u>

Present land use conditions in the Scheme area are presented in Table B-29. Of the total cultivable area of 19,247 ha, paddy fields cover 17,510 ha. The remaining area of 1,737 ha comprises vegetable growing area of 760 ha, tree cropping area of 460 ha and idle land of 517 ha. The idle land is kept fallow mainly due to the existence of the Organic Clay and Muck Soils.

5.2 Future Land Use Plan

The PBLs Office has a plan to extend the irrigation area to land presently located outside the Scheme. This extension area covers 543 ha gross including a net cultivable area of 480 ha. Meanwhile, most of the existing vegetable cultivation areas in the Scheme will continue as it is, under the title of paddy land. Taking into account the present land use pattern, distribution of the Organic Clay and Muck Soils and the existing land use plan of the PBLs Office, the future land use plan in each irrigation compartment is formulated as shown in Table B-30 and as summarized below.

In Sawah Sempadan, the existing vegetable cultivation area of 2 ha will be used for growing paddy. The net paddy cultivation in the future will be 2,310 ha.

In Sungai Burong, the converted area of 298 ha for planting permanent tree crops is excluded from the irrigation service area. The existing idle land will be cultivated for paddy and vegetables covering 49 ha and 110 ha, respectively. The total net paddy cultivation area in the future will be 2,890 ha. Out of 391 ha under irrigated vegetables in the future, 121 ha will be grown with vegetables permanently. The remainder will be used for mixed cropping of paddy and vegetables. After 3-years' continuous vegetable cropping, paddy cultivation will be carried out for one year. Out of the net paddy cultivation area, therefore, 90 ha will correspond to the mixed cropping area.

In Sekinchan, the present tree cropping area of 46 ha will be used for growing vegetables in the future, while 157 ha among the present vegetable cropping area of 295 ha will be planted with paddy. The future paddy and vegetable cropping areas will be 1,640 ha and 184 ha, respectively. As the mixed cropping is performed, 60 ha of paddy field are convertible between paddy and vegetable croppings every year.

In Sungai Leman, the existing tree crop area of 85 ha and idle land of 256 ha are going to be legally converted to the permanent crop area, resulting in a non-irrigated coverage of 341 ha. The future paddy and vegetable cropping areas will be 1,680 ha and 85 ha, respectively. For undertaking of mixed cropping, 30 ha of paddy field will be annually convertible between paddy and vegetable croppings.

In Pasir Panjang, the present paddy cultivation area of 1 ha, vegetable growing area of 13 ha, tree cropping area of 31 ha and idle land of 63 ha will be legally converted to the permanent crop area of 108 ha to which no irrigation water will be supplied. The future paddy cultivation area will be 1,470 ha.

In Sungai Nipah, the future paddy cultivation area will increase to 1,940 ha by utilizing the present idle land of 2 ha.

In Panchang Bedena, the present paddy cultivation area of 3,260 ha will be maintained in the future.

In Bagan Terap, the existing idle land of 37 ha will be fully utilized for paddy cultivation in the future. Thus, the total area under paddy will

be 2,650 ha in net.

In Extension Area, a total of 480 ha will be irrigated under the Scheme in the future. The Extension Area is separated into two portions, namely 320 ha located in Sungai Panjang and 160 ha situated adjacent to Pasir Panjang.

6. PRESENT SITUATION OF PADDY CULTIVATION

6.1 Cropping Schedule

The double cropping of paddy a year is the target of PBLs. In the present cropping schedule as proposed by the PBLs Office, each farm operation period is fixed to be 201 days with a 40-day crop staggering period. Off-season cropping starts from February 1 and main season cropping from August 1. The plan was set up on the basis of traditional farming practices in which the main farming practices like transplanting, harvesting and threshing are all carried out manually. To cope with the shortage of farm labour due to recent changes in socio-economic conditions, however, direct seeding and mechanized farming practices are already being widely practiced by farmers in the project area. The actual cropping schedule is thus different from the proposed one.

The irrigation water supply schedule is fixed in accordance with the proposed cropping schedule. Even after the irrigation system of PBLs was upgraded, the proposed cropping schedule has not been realized. The irrigation water supply schedule was adjusted for every crop season in each compartment by the Paddy Planting Schedule Committee chaired by the PBLs Office, taking into accounts performances in the preceding season and available irrigation water resources. Farmers' requests are also reflected in determining the water supply schedule. The cropping schedule is determined individually for each compartment. The adjusted water supply schedule is gazetted by means of a notice board system. The gazetted schedules for the last five crop seasons are shown in Table B-31. Past performances are summarized in Fig. B-3. In compartments other than Sawah Sempadan and Sekinchan, one to two crop seasons have been missed in four years from 1983 to 1986. According to the PBLs cropping schedule, paddy transplanted between February 21 and March 31 is defined as the off-season crop, while that transplanted between August 21 and September 30 as the main season crop. The present definition on crop season is made based on timing of planting. The first crop season is a period between January 1 and June 30, during which planting work in an irrigation compartment, even though partly, is commenced, while the second season is between July 1 and December 31.

6.2 Farming Practices

(1) Land preparation

Land preparation works are usually carried out by 4-wheeled tractors of 20 to 80 HP on a rental basis. Most of farm lots are rotavated twice, though the number of times of rotavation depends on the conditions of the paddy fields and the cash solvency of the farmer. The available number of tractors in the project area totals 113, of which 14 are kept by the Farm Mechanization Center in Tanjung Karang and the remainders are owned by private sectors. Private-owned tractors include 29 in Sawah Sempadan, 13 in Sungai Burong, 15 in Sekinchan, five in Sungai Leman, six in Pasir Panjang, 28 in Sungai Nipah and four in Panchang Bedena and Bagan Terap.

(2) Planting method

Two different kinds of paddy planting are practiced in the area. One is traditional transplanting and another is the newly introduced direct seeding. In case of traditional transplanting, paddy is transplanted twice. The first transplanting to a nursery bed made in a farm lot starts from the 7th to 10th day after the seeding on a dry seedbed made of wet mud from a drainage ditch and covered with banana leaves.

Direct seeding method was firstly introduced in Sekinchan in 1979. The method has broadly extended in other compartments. In the first crop season in 1986, the direct seeding was practiced in the area of about 35 % of the whole project area with a wide range between 96 % in Sekinchan and 1 % in Sungai Nipah. As shown in Table B-32, 60 to 100 % of paddy farmers in Sawah Sempadan, Sungai Burong, Sekinchan, Sungai Leman, Pasir Panjang and Sungai Nipah have practiced direct seeding method, while none of them has no experience in Panchang Bedena and Bagang Terap.

Presently, three different kinds of direct seeding methods are practiced in the project area. These are as follows:

- a. Mechanized dry seeding using a seed driller attached to a tractor is applied when the field is dry. In order to germinate seeds evenly in a farm lot, harrowing is carried out after rotavating. Seeding is done five to ten days before the commencement of

water supply.

- b. If the surface of farm lot is uneven, manual dry seeding method is applied. Seeding is conducted with the same timing of mechanized dry seeding method.
- c. Manual wet seeding method is applied if a farm lot is wet. As pre-germinated seeds are used, more precise control of water is necessary as compared with other direct seeding methods. At first, a farm lot is supplied with water for about two weeks and presaturation work is carried out. Then, surface water is completely drained out one day before seeding. After the seeding, the farm lot is immediately flooded within 10 days at the longest.

(3) Rice variety

Prevailing rice varieties in the project area are Setanjung (MR1), Sekembang (MR10), Manik (MR52), Muda (MR71), Makmur (MR73) and Seberang (MR77). Characteristics of these released varieties are summarized in Table B-33. The distribution of these varieties in 1985 are summarized in Table B-34.

(4) Seeding

Seeding rates are 20 kg/ha for transplanting and 80 kg/ha for direct seeding, respectively. Required seeds in the project area amount to about 800 tons of paddy for every crop season. Out of these, about 500 tons are retention from the preceding harvests. The remaining 300 tons are certified seeds which are produced by the farmers contracted with the District DOA. The certified seeds are released directly to farmers or through a supply channel of Area Farmers' Organization.

(5) Fertilizing

Fertilizers are distributed to farmers through Area Farmer's Organizations. To increase crop yield and net farm income of paddy farmers, the Government gives such fertilizers free of charge as urea of 100 kg/ha and compound fertilizer of 200 kg/ha for every crop season. The total content of nitrogen is 80 kg/ha. Farmers supplement fertilizers by their own expenses, if necessary.

(6) Controlling of rats and weeds

If a rat control program is made by farmers in line with DOA's recommendation, rodenticides are given to farmers free of charge.

With the extension of direct seeding methods, the need of weed control has been increased. There are two kinds of weeds, *Echinochloa crusgalli* and *Echinochloa colona* which grow faster than rice plant under dry field condition. These weeds absorb nutrient elements instead of rice plant. The field should therefore be covered with water immediately after seeding. As the chemical weed control is costly, the transplanting method is re practiced by farmers as a cheaper measure for weed control.

(7) Controlling of Insects

Since late 1970s, the outbreak of brown plant hopper (BPH) has become a serious threat to rice production in the project area. Damage from BPH was first recorded in Sungai Leman in 1977 and in Sungai Burong in 1978. These are the earliest records in the country. Buildup of BPH takes place in three months from June to August. Past occurrence of BPH and its damage are shown in Table B-35.

Overuse of chemicals by farmers have destroyed the delicate ecological balance, because chemicals also kill beneficial insects. At present, DOA is directly involving in control of BPH by the following means.

- a. About 10% of the whole area is monitored weekly under a crop surveillance system.
- b. Action Committee chaired by the State DOA is held regularly every week. Based on the result of monitoring, a pest control plan is established.
- c. If the outbreak of BPH is recognized, the State DOA releases stocked pesticides directly to farmers.

Pesticides are procured with special fund and kept by DOA. In 1986, a total of M\$175,100 of pesticides was allocated for controlling outbreaks of BPH. A breakdown of pesticide used for PBLs in 1986 is shown below.

<u>Compartment</u>	<u>Stock</u>	<u>Amount</u>	<u>Market Value(M\$)</u>
Sawa Sempadan	Hopcin	1,896 lit	21,240
	Sogatox Dust	19,436 kg	40,670
Sungai Burong	Sogatox Dust	11,455 kg	19,800
Sekinchan	Sogatox Dust	18,410 kg	31,850
Sungai Leman	Hopcin	3,238 lit	36,270
	Sogatox Dust	14,606 kg	25,270
<u>Total</u>			<u>175,100</u>

DOA's long-term strategies and programme for controlling BPH are as summarized below.

- a. Adjustment of cropping schedule in three compartments of Sekinchan, Sungai Burong and Sungai Leman in order that the heading stage would not fall in a period from the end of June to the beginning of July. For this purpose, cropping in the three compartments is started together.
- b. Both extension officers and farmers are to be trained concerning the suitable use of chemical.

(8) Harvesting

Harvesting has already been mechanized in the whole project area. Harvesters with 32 to 220 HP are used on a contract basis. Of 65 harvesters, eight are owned by the Farmer's Organizaion Authority, while the remainder are operated by privated owners. The distribution of private harvesters is four in Sawah Sempadan, 11 each in Sungai Burong and Sekinchan, one in Sungai Leman, nine in Pasir Panjang, seven in Sungai Nipah and 14 in Panchang Bedena and Bagan Terap. Recently, a field drain has been provided along 'batas' of farm lot under the Field Improvement Scheme managed by DOA. This improves the drainage conditions in the farm lot and makes the mobility of heavy machinery easier. Paddy stalks remained after harvesting are slashed and burnt in the farm lot.

(9) Processing

Paddy after harvested is directly sacked without drying and cleaning

on the farm lot. After weighing, paddy sacked is transported to mills by lorries or to licensed dealers' depots by motor-cycles.

6.3 Yield and Production of Paddy

Data on cropped area, unit yield and production of paddy in the project area were collected from PBLIS office for the past five years from 1981 to 1985. These data as summarized in Tables B-36 to B-38 are based on the PBLIS Monitoring Survey. The average cropped area for the above period is calculated at 15,460 ha for the first crop season and 16,400 ha for the second crop season. As the total cultivable paddy fields are 18,027 ha consisting of paddy of 17,510 ha and idle land of 517 ha, the cropping intensity becomes 1.77. The average unit yield of paddy is 2.89 ton/ha in the first crop season and 3.35 ton/ha in the second crop season. The range of paddy yield by irrigation compartment and block in the main season of 1985/1986 is as shown in Fig. B-4. The annual production of paddy in the project area is estimated at 99,630 tons on average during the above five years.

6.4 Processing and Marketing

In the project area, there are four rice mills which are managed by the National Paddy and Rice Board (LPN) as shown below.

Location	Drying Capacity ^{L1} (ton/hr)	Milling Capacity ^{L2} (ton/hr)	Storage Capacity (ton)
Sungai Besar	9.8	3.5	11,100
Sekinchan	31.7	5.5	10,000
Ulu Tiram Burok (Sawah Sempadan)	31.7	5.5	10,000
Batu Dua (Kuala Selangor)	23.8	6.8	8,000
<u>Total</u>	<u>97.0</u>	<u>20.5</u>	<u>39,100</u>

Remarks: L1= Wet paddy L2= Dry paddy

All paddy harvested in the project area are dried and milled in these

four rice mills. The maximum working hour of these mills is 20 hours per day. The present drying and milling capacities are estimated at 1,940 and 410 tons per day, respectively. The above rice mills have storage facilities with a total capacity of 39,100 tons. They are used for storing dry paddy before it is milled.

With regard to marketing, LPN is responsible for controlling the marketing of paddy and rice, maintaining a national stockpile and importing rice. All paddy produced are handled by LPN. Farmers usually sell paddy immediately after harvesting without drying it. Paddy is sold to LPN milling complexes through the licensed dealers which are Farmers' Cooperatives or private agents. Some small amount of paddy is also directly sold to LPN complexes. The purchasing price of paddy is controlled by the Government. In 1986, the purchasing price of clean dry paddy delivered at the mill gate is M\$66.15/100 kg for long grain and M\$62.84/100 kg for medium grain, both including Government subsidy of M\$16.54/100 kg.

Rice milled in LPN complexes is immediately delivered to the Government rice stockpile in Kuala Lumpur or sold to wholesalers, and then marketed at open rice markets. The price of rice at each open market depends on the supply and demand of the markets, though the price at the open market is controlled indirectly by the Government's management on national stockpile and import of rice.

6.5 Crop Budget and Farmers' Economy

6.5.1 Crop budget for paddy cultivation

Based on the PBLIS Monitoring Survey, the analysis is made to clarify production cost, gross income and net return for paddy cultivation in the area. The results are shown in Tables B-39 and B-40.

As shown in the following table, net return has not substantially increased. Its averages were M\$329/ha in the first crop season and M\$624/ha in the second crop season, accounting for 21 % and 33 % of the gross income, respectively. The average production cost of rice was M\$762/ton in the past five years and M\$871/ton for the crop year of 1984/85, both of which are expensive if compared to the imported price of

rice of M\$608/ton in 1985.

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>Average</u>
<u>First crop season (M\$/ha)</u>							
Production cost ¹	-	1,283	1,286	1,117	1,249	1,192	1,225
Gross income	-	1,539	2,094	1,261	1,570	1,306	1,554
Net return	-	256	808	144	321	114	329
<u>Second crop season (M\$/ha)</u>							
Production cost ¹	1,361	1,366	1,246	1,230	1,210	-	1,283
Gross income	2,170	2,463	1,720	1,598	1,579	-	1,907
Net return	809	1,103	474	368	366	-	624
<u>Production cost of rice (M\$/ton)</u>							
1st crop season	-	850	624	901	811	931	823
2nd crop season	639	562	737	783	781	-	700
Average							762

Remarks: ¹Including costs for seed, agro-chemicals, fertilizer, hired and family labour, farm machinery, etc.

As shown in the following table, net return has not substantially increased. Its averages were M\$329/ha in the first crop season and M\$624/ha in the second crop season, accounting for 21 % and 33 % of the gross income, respectively. The average production cost of rice was M\$762/ton in the past five years and M\$871/ton for the crop year of 1984/85, both of which are expensive if compared to the imported price of rice of M\$608/ton in 1985.

6.5.2 Farmers' economy

In order to examine paddy farmers' economy, farm budget was analyzed selecting typical farmers holding farm land of 1.2 ha for the years 1984 and 1985. The farm budget, two crop seasons' average, is summarized below. Its details by compartment are given in Table B-41.

	7 Compartments	
	<u>Excluding Sekinchan</u>	<u>Sekinchan</u>
<u>A. Gross Income</u>	4,600	8,637
1) Farm income	3,755	5,940
- Paddy	2,963	4,111
- Other crops and activities	792	1,829
2) Off-farm income	845	2,697
<u>B. Gross Outgo</u>		
1) Production cost	1,589	2,192
2) Land rent	1,007	1,975
3) Land and water charges	17	17
<u>C. Living Expenses and Net Reserve</u>		
1) Owner operator ^{/1}	2,994	6,428
2) Tenant operator ^{/2}	2,004	4,470

Remarks: /1 = (A)-(B.1)-(B.3) /2 = (A)-(B.1)-(B.2)

The gross income of farmers in the seven compartments other than Sekinchan is lower than the median gross household income of M\$7,150 for rural areas of Peninsula Malaysia in 1984. Earnings from paddy cultivation account for 48% of the gross income in Sekinchan and 64 % in the other compartments. Off-farm income mainly consists of the remittances from family members working in the areas outside and wages earned from non-farm activities. Farmers in Sekinchan have a higher living expenses and net reserve than those in other compartments, about twice.

6.6 Existing Water-related Problems

6.6.1 Low level of paddy production

The paddy production in the project area is still low against the target of PBLs. From agricultural viewpoints, two factors have adversely affected the paddy production in the project area: low unit yield and low cropping intensity.

The unit yield of paddy in the past five years was 2.89 ton/ha in the first crop season and 3.35 ton/ha in the second crop season. It is low if compared to the original target yield of PBLs which is 4.4 ton/ha in the main season and 4.7 ton/ha in the off-season. Recently, the PBLs Office

has revised the original target yield and its projected yield for 1990 is 3.7 ton/ha in the first crop season and 3.8 ton/ha in the second crop season. One of the reasons of such low unit yield is derived from the prevailing traditional method of transplanting. The method has been applied on 65% of the total cropped area for the first season in 1986. In this method, the transplanting is done twice; the first transplanting is done 10 days and the second one 40 days after seeding. The second transplanting is carried out when seedlings are in the initial tillering stage with around 50 cm in height. Since the supply of irrigation water is unreliable, farmers try to keep water depth as high as possible against the water shortage. The traditional method is suitable under deep water condition. However, the number of tillers is considerably less than that of an ordinary transplanting method in which seedlings are transplanted only once. As a result, the yield of paddy decreases. This tendency is characterized in the downstream compartments of which soil productivity is highest in the project area.

In the upstream compartments, Sawa Sempadan to Pasir Panjang other than Sekinchan, soil improvement has not been made where the Organic Clays and Mucks or Brown Clays Soils extend. Therefore, the average yield in areas affected by these problem soils is still low.

Annual paddy cropped area is dependent on the intensity of cropping. Under PBLs, double cropping has been promoted. However, the cropping intensity has never attained 2.0. Delay in cropping in one season greatly affects the cropping schedule for the succeeding season. In six compartments except for Sawah Sempadan and Sekinchan, one to two crop seasons were missed for four years from 1983 to 1986. The present cropping intensity is about 1.8 for the whole project area. As a result, the cropped area has not covered what is required for the target of paddy production under PBLs.

6.6.2 Change in farming practices

Recently, direct seeding methods have been spreading over the project area. In the first crop season of 1986, 35 % of the planted area was under direct seeding methods. The introduction of direct seeding methods requires a lot of improvement in the present irrigation facilities. The capacity of tertiary canals is designed to meet the requirements for the

transplanting method. Once the direct seeding methods are introduced, the irrigation water has to be supplied for presaturation within a shortest period in order to realize an even germination of seeds and an effective control of weeds. The peak water requirement is increased during presaturation with the introduction of direct seeding methods. If all farmers along one tertiary canal start farm operation at the same date following the present cropping schedule, the flow capacity of tertiary canal is insufficient to meet the increased peak water requirement. The fixed cropping schedule proposed by PBLs would not be able to be adhered to.

More precise land leveling is necessary for the dry direct seeding method than that required in the transplanting method. If the land leveling is not properly done, it will lead to unreliable and uneven germination of seeds. The necessity of land leveling has been increased with the introduction of direct seeding methods. Although the State DOA has emphasized the land leveling work through "Field Improvement Scheme", the number of farm lots on which its fund has been allocated is still limited. In order to promote the dry direct seeding, land leveling work should be promoted in the project area.

6.6.3 Farm mechanization

An average paddy farm household has 6.0 family members of which 4.7 members are 16 years old and above. Since the end of the 1970's, some of the young female generation have found job opportunities in public and private service sectors around the project area. Young male family members have migrated to urban areas such as Kuala Lumpur, Klang and Petaling Jaya for finding employment or entering school. They are still registered as family members. Farm operations depend mainly on a family leader. Even at the peak time of farm operations, available family members are limited to only 3.1. Recently, family leaders of paddy farm households have become older. According to the PBLs Monitoring Survey in 1985, about 60 % of family leaders are 50 years old and above, while 5 % are under 30 years old.

Mechanized farming has been spreading over the project area in the course of the above change in quantity and quality of manpower. It is accelerating owing to difficulties in hiring the required labourers for

farming as well as high labour cost in the project area. Land preparation and harvesting have already been fully mechanized. The existing machinery in the project area includes 113 tractors, 65 harvesters, 113 rotavators and 52 slashers. Most machines are operated by private owners on a contract basis. If paddy cropping is practised following the schedule set by PBLs, the required machines would be 190 tractors, 67 harvesters, 143 rotavators and 53 slashers as shown in Table B-42. The number of existing tractors and rotavators is definitely insufficient. As a result, private owners determine the operation schedules of farm machinery to suit themselves. This has become one of the main reasons why a fixed cropping schedule cannot be achieved.

7. AGRICULTURAL DEVELOPMENT PLAN

7.1 Development Concept

To increase rice production with lower unit costs is the pressing need from the viewpoint of the national economy. To meet this requirement, paddy cultivation in the project area categorized as the country's granary should be improved by increasing the cropping intensity and paddy yield and by reducing production costs. The project area has the potential to support good plant growth with a high paddy yield of around 5 ton/ha. Therefore, the target is to realize the production potential to its full extent by means of irrigated double cropping with the improvement of project facilities.

In order to attain a cropping intensity of 2.0 in the project area, farm operation period in each crop season must be shortened. It is essential to revise the present cropping pattern of PBLs which fixes an operation period for 175 days based on use of the traditional transplanting method.

For increasing paddy yield, farm operations should be done in proper manner with timely supply of fertilizer and irrigation water. It is imperative to keep a fixed cropping schedule with provision of measures for betterment of paddy fields.

To reduce production costs, labour consuming farming practices should be improved from the man-power saving viewpoint. Since aged farmers are increasing in numbers and experienced farmers together with young people are decreasing, it is essential to replace manual transplanting by labour-saving countermeasures.

From the above, it is clear that improvement of that planting method will be one of the key factors to attain the target. By converting the traditional transplanting to direct seeding methods, about 14 man-days of labour force per hectare can be saved and the irrigation water supply period can be also shortened by 15 to 20 days. These facts have been broadly proved through practices of farmers themselves in the project area. In the upstream six compartments, about 80 % to 100 % of farmers have practiced direct seeding methods in their farm lots. In due consideration to the above advantages, therefore, the direct seeding is recommended to improve planting in the project area.

7.2 Proposed Development Plan

7.2.1 Proposed cropping schedule

The proposed cropping schedule is shown in Fig. B-5, taking the following aspects into consideration.

a. Best use of available water

In order to make the best use of the available water source, it is proposed to divide the project area into three irrigation schedule areas. Each area will have a staggering period of 30 days for presaturation. The presaturation in the whole area will be completed within 90 days.

b. Timing of harvest

Mechanized harvesting should be undertaken in dry months. Taking into account the seasonal rainfall pattern, the harvesting in wet seasons from April to May and from October to December should be avoided.

c. Damages by brown plant hopper (BPH)

Occurrence of BPH is normally from June to July. If the heading stage of paddy overlaps to this period, the outbreak of BPH becomes serious. It becomes out of control and leads to widespread damage. The damages by BPH are significant in three compartments of Sungai Burong, Sekinchan and Sungai Leman. The cropping schedule in these three compartments should be so determined that the heading stage will not coincide with the period from the end of June to the beginning of July.

In the proposed cropping schedule, the first season crop is defined as off-season crop which lasts from the middle of February until the end of September. The second season crop is called as main season crop with a cultivation period between early August and early April.

7.2.2 Planting method

There are two direct seeding methods: dry direct seeding; and wet direct seeding. With wet direct seeding method, the farm lot is presaturated for puddling work. The water in farm lot is then drained completely for seeding. After seeding, water is supplied again. As the farm lot must be filled with water twice during the presaturation period, the wet direct seeding method requires a lot of water and timely supply. But this method has such advantages that weeds can be controlled easily by the puddling work and costs for chemical control of weeds can be saved. With dry direct seeding method, seeds are broadcasted on a dry farm lot. Irrigation water is then supplied gradually to match the growth of paddy. If the water is supplied on a fixed schedule, seeding can be started five to seven days before commencement of presaturation water supply. The supply period of normal irrigation water can thus be shortened by 20 days compared with that for the transplanting method. Taking into account the rainfall pattern in addition to the above, dry direct seeding is proposed for the off-season cropping and the wet direct seeding for the main season cropping.

Transplanting method will be still continued until the direct seeding methods are extended to whole the area. Mechanized transplanting method requires farmers to make unreasonable investments or to rely excessively on contract works. Therefore, manual transplanting method is proposed during the transition period.

7.3 Proposed Farm Operations

7.3.1 Farming practices

The proposed farming practices for the two direct seeding methods are summarized below. The details are presented in Tables B-43 and B-44 respectively, and illustrated in Figs. B-6 and B-7. The farm input requirements are shown in Table B-45.

(1) Land preparation

In order to promote the tillering activity of the rice plant at the initial growth stage and to increase the number of effective tillers, it is

necessary to carry out land preparation, rotavating or puddling, three times before seeding. The first land preparation should be done immediately after slashing and burning of paddy stalks. For wet direct seeding, the second and the third land preparation should be done immediately before seeding. With dry direct seeding, the second land preparation should be performed before seeding and the third one at the same time of seeding.

(2) Seeding

Medium-term varieties such as MR52, MR71, MR77 and MR84 are recommended for each planting method. The growth period of these varieties is 135 days. The recommended seeding rate is 80 kg/ha. If a short-term variety is required in adjusting the fixed cropping schedule when delayed, MR7 can be used for replacement of the above medium-term varieties.

(3) Fertilizing

Recommended fertilizer application method consists of four top dressings. The first top dressing is made 20 days after seeding applying mixed fertilizer of 100 kg/ha. The second is applied 35 days after seeding with the same rate of mixed fertilizer. The third and fourth are done after 55 and 75 days, respectively, applying urea of 50 kg/ha each.

(4) Pest and rat control

In order to prevent the outbreak and spread of pests, especially BPH, the cropping schedule should be so determined that the heading period of paddy never overlaps with the end of June. For rat control, an area-wise operation should be made in line with the recommendations of DOA.

(5) Weed control

Proper control of weeds is recommended by the use of weedicides together with better land preparation works. For dry direct seeding, weedicides are sprayed twice, 22 days and seven days before seeding. Application of weedicides for wet direct seeding is only once, 22 days before seeding. After seeding, spraying of weedicides is also required for both cases of dry and wet direct seeding about 20 days after seeding.