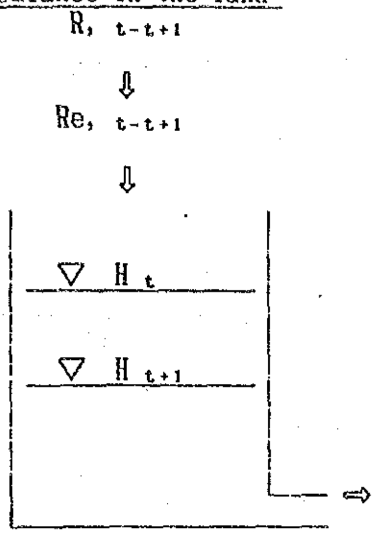
2.2 Runoff Analysis by Tank Model (X-57)

(1) Tank Model

(a) General

<u>Water Balance in the Tank</u>



Basic Equation

$$Q = Qo \times e^{-Kt}$$

The water balance in the tank is given by the following differential equation :

$$H_{t+1} = H_t + (Re,_{t-t+1} - (Q_t + Q_{t+1})/2)\ dt$$

where: H_{t+1} = water stage in the tank at t = t+1

H_t = -do- at t = t

$Re,_{t-t+1}$ = effective rain poured into tank during time t and t+1

Q_t = outflow from tank at t = t

Q_{t+1} = -do- at t = t+1

dt = time interval for calculation

Giving that dt = 1.0 day, $Q_t = KH_t$ and $Q_{t+1} = KH_{t+1}$, then ;

$$H_{t+1} = H_t + Re,_{t-t+1} - KH_{t+1}/2$$

$$H_{t+1} = (1-K/2)/(1+K/2)H_t + 1/(1+K/2)Re,_{t-t+1}$$

$$= aH_t + bRe,_{t-t+1}$$

RUNOFF ANALYSIS BY TANK MODEL (DAILY BASE)

- LOCATION : PHANG
- ANALYSED POINT : X-57 PHANOM+KAPONG+TAKUA PA
- CA : 312.000 (km²)

DIMENSION OF TANK

		UPPER HOLE	MIDDLE HOLE	LOWER HOLE	PENETRATION	EVAPORATION
TANK 1	COEFFI	0.300000	0.100000	0.050000	0.450000	1.000
	HEIGHT	40.0	20.0	0.0		
TANK 2	COEFFI	0.200000	0.150000	0.100000	0.300000	0.0
	HEIGHT	40.0	20.0	0.0		
TANK 3	COEFFI	0.020000	0.010000	0.005000	0.000100	0.0
	HEIGHT	10.0	5.0	0.0		
TANK 4	COEFFI	0.0	0.0	0.0	0.0	0.0
	HEIGHT	0.0	0.0	0.0		

【MONTHLY EVAPORATION】

(mm/D)

	1	2	3	4	5	6	7	8	9	10	11	12
RATE	3.70	3.90	4.50	3.70	3.10	2.90	3.10	3.80	3.30	3.10	3.10	3.20

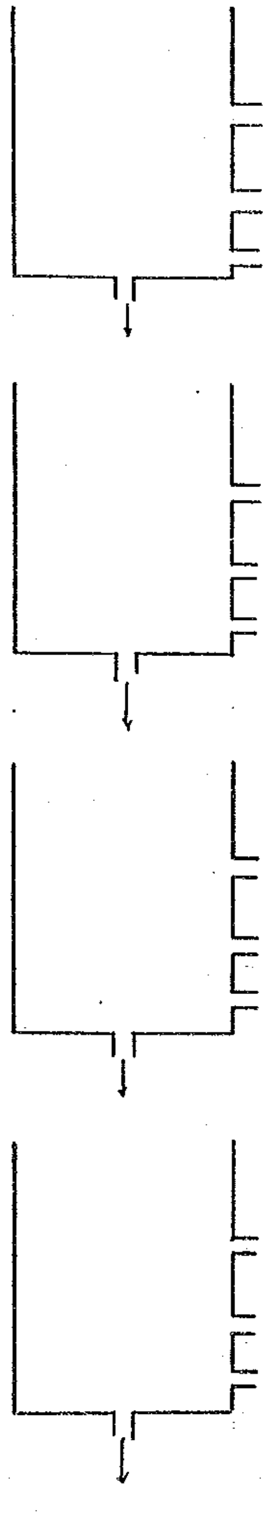
DIMENSION OF TANK

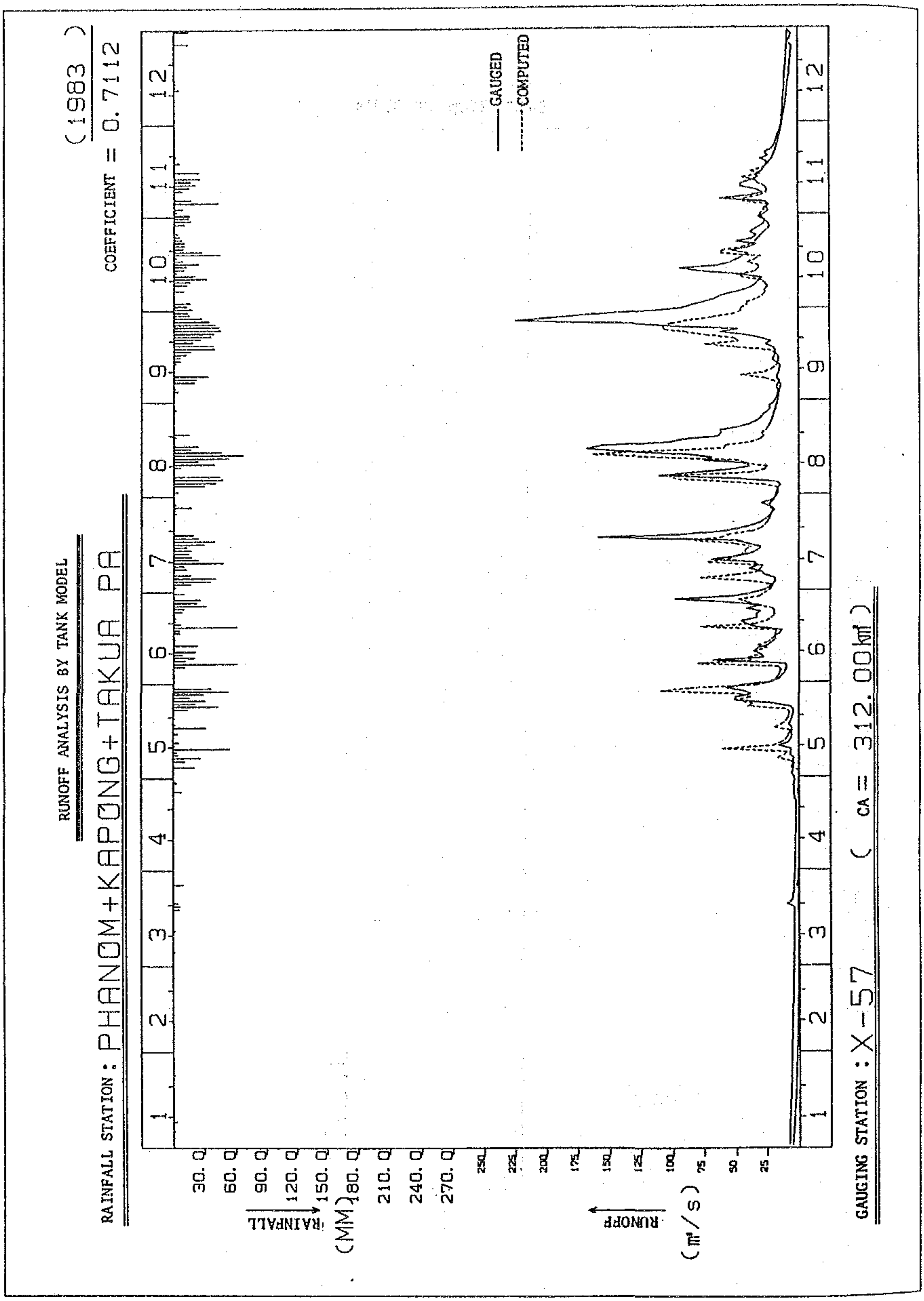
TANK 1

TANK 2

TANK 3

TANK 4




RUNOFF ANALYSIS BY TANK MODEL
RAINFALL STATION : PHANOM+KAPONG+TAKUA PA
(1983)
COEFFICIENT = 0.7112
GAUGED
COMPUTED
RAINFALL (MM)
30.0 60.0 90.0 120.0 150.0 180.0 210.0 240.0 270.0
RUNOFF (m³/s)
250 225 200 175 150 125 100 75 50 25
1 2 3 4 5 6 7 8 9 10 11 12
GAUGING STATION : X-57
(CA = 312.00km²)

< DAILY RAINFALL > PHANG PHANOM+KAPONG+TAKUA PA
(1983)

UNIT = (mm/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.0	0.0	17.4	14.1	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.2	0.0	12.2	2.4	0.0	
3	0.0	0.0	0.0	0.0	0.0	0.0	15.9	0.0	0.0	15.1	8.3	0.0	
4	0.0	0.0	0.0	0.0	19.9	0.0	34.8	28.8	4.1	0.1	0.0	0.0	
5	0.0	0.0	1.2	0.0	0.6	0.0	39.4	39.4	1.1	0.5	42.0	0.0	
	(0.0)	(0.0)	(1.2)	(0.0)	(20.8)	(0.4)	(92.0)	(72.4)	(5.2)	(45.2)	(66.7)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.2>	< 0.0>	< 4.2>	< 0.1>	< 18.4>	< 14.5>	< 1.0>	< 9.0>	< 13.3>	< 0.0>	
6	0.8	0.0	0.0	0.0	11.3	10.8	16.1	46.4	0.0	0.0	15.8	0.0	
7	0.0	0.0	0.0	0.0	25.6	60.6	0.7	43.7	19.3	9.2	0.0	0.0	
8	0.0	0.0	0.0	0.0	4.6	11.0	12.1	0.0	21.4	0.4	0.0	0.0	
9	3.1	0.0	0.0	0.0	3.5	19.5	9.7	0.0	32.3	12.1	7.4	0.0	
10	0.0	0.0	0.0	0.0	53.6	7.9	46.9	6.7	0.0	15.0	13.9	0.0	
	(3.9)	(0.0)	(0.0)	(0.0)	(98.7)	(109.8)	(85.5)	(96.8)	(73.0)	(36.6)	(37.1)	(0.0)	
AVERAGE	< 0.8>	< 0.0>	< 0.0>	< 0.0>	< 19.7>	< 22.0>	< 17.1>	< 19.4>	< 14.6>	< 7.3>	< 7.4>	< 0.0>	
11	0.0	0.0	0.0	0.0	1.3	20.3	23.1	38.1	0.0	31.0	20.2	0.0	
12	0.0	0.0	1.7	0.0	5.3	0.8	16.8	22.9	0.0	19.9	15.1	4.4	
13	0.0	0.0	0.0	0.0	0.0	22.5	14.1	52.1	1.8	2.3	24.4	1.4	
14	0.0	0.0	0.0	0.0	0.0	0.7	16.5	65.9	5.8	9.8	0.0	1.4	
15	0.0	0.0	0.0	0.0	3.9	0.9	12.2	44.8	6.4	11.4	23.0	0.5	
	(0.0)	(0.0)	(1.7)	(0.0)	(10.4)	(45.2)	(82.6)	(223.8)	(14.1)	(74.4)	(82.8)	(7.7)	
AVERAGE	< 0.0>	< 0.0>	< 0.3>	< 0.0>	< 2.1>	< 9.0>	< 16.5>	< 44.8>	< 2.8>	< 14.9>	< 16.6>	< 1.5>	
16	0.0	0.0	0.0	0.0	0.2	0.1	29.1	16.1	11.6	23.3	0.0	0.0	
17	0.0	0.0	0.0	0.0	30.7	5.8	38.6	22.6	16.6	8.3	0.0	0.0	
18	0.0	0.0	0.0	0.0	2.1	5.1	23.0	0.0	38.4	2.0	4.9	0.0	
19	0.0	0.0	5.6	0.0	0.0	60.5	18.8	0.0	37.3	44.2	0.0	0.0	
20	0.0	0.0	6.1	0.0	1.3	6.1	0.0	2.1	17.6	26.0	1.4	0.0	
	(0.0)	(0.0)	(11.6)	(0.0)	(34.3)	(77.7)	(109.5)	(40.8)	(121.5)	(103.8)	(6.3)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 2.3>	< 0.0>	< 6.9>	< 15.5>	< 21.9>	< 8.2>	< 24.3>	< 20.8>	< 1.3>	< 0.0>	
21	0.0	0.0	4.2	0.0	0.0	1.1	0.0	14.4	24.9	8.8	0.0	0.0	
22	0.0	0.0	0.0	0.0	1.4	1.6	0.0	0.0	35.1	9.9	0.0	0.0	
23	0.0	0.0	0.0	0.0	13.9	0.7	0.0	0.0	37.9	9.6	0.0	0.0	
24	1.3	0.0	0.0	0.0	42.7	7.5	0.0	0.0	43.9	7.2	0.0	0.0	
25	0.0	0.0	0.0	0.4	20.9	9.8	0.0	0.0	42.6	5.1	0.0	0.0	
	(1.3)	(0.0)	(4.2)	(0.4)	(78.9)	(20.7)	(0.0)	(14.4)	(184.4)	(40.6)	(0.0)	(0.0)	
AVERAGE	< 0.3>	< 0.0>	< 0.8>	< 0.1>	< 15.8>	< 4.1>	< 0.0>	< 2.9>	< 36.9>	< 8.1>	< 0.0>	< 0.0>	
26	0.0	0.0	0.0	7.5	30.3	30.8	2.8	0.0	39.0	3.4	0.0	0.0	
27	0.0	0.0	9.4	0.0	15.3	21.7	1.0	0.0	33.0	0.0	0.0	13.5	
28	0.0	0.0	0.0	0.0	28.3	25.0	16.3	0.0	26.1	0.0	0.0	0.5	
29	0.0*********		0.0	3.1	52.2	0.4	1.9	2.0	14.5	9.3	0.0	0.0	
30	0.0*********		0.0	0.0	35.6	9.9	0.0	0.0	13.5	15.5	0.0	0.0	
31	0.0*********		0.0*********		0.0*********		0.0	0.0*********		13.9*********		13.8	
	(0.0)	(0.0)	(9.4)	(10.6)	(161.7)	(87.8)	(22.0)	(2.0)	(126.1)	(42.0)	(0.0)	(27.8)	
AVERAGE	< 0.0>	< 0.0>	< 1.6>	< 2.1>	< 27.0>	< 17.6>	< 3.7>	< 0.3>	< 25.2>	< 7.0>	< 0.0>	< 4.6>	
GRAND TOTAL	5.2	0.0	28.2	11.1	404.8	341.7	391.6	450.0	524.2	342.6	193.0	35.4	2727.8
AVERAGE	0.2	0.0	0.9	0.4	13.1	11.4	12.6	14.5	17.5	11.1	6.4	1.1	7.5
MAX	3.1	0.0	9.4	7.5	53.6	60.6	46.9	65.9	43.9	44.2	42.0	13.8	
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

< GAUGED DAILY RUNOFF > (1983) PHANG X-57

UNIT = (CUM/D)

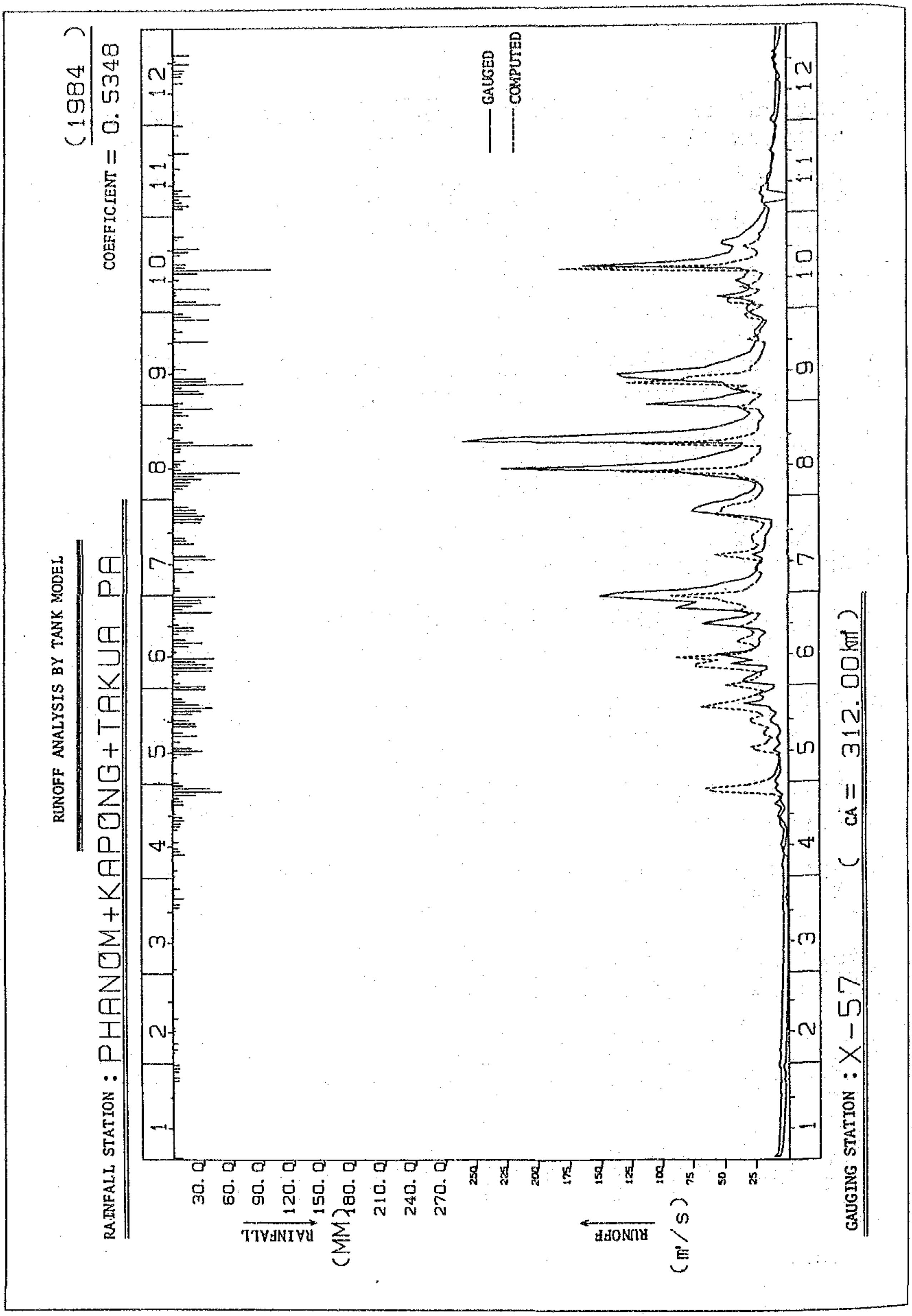
	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	7.800	6.000	4.550	3.500	4.250	22.480	27.520	17.000	18.540	93.850	26.680	13.500	
2	7.800	5.800	4.550	3.500	5.800	16.250	22.760	16.250	17.250	84.850	23.600	13.000	
3	7.800	5.800	4.400	3.500	4.850	14.250	20.240	16.750	16.500	76.600	24.720	13.000	
4	7.800	5.800	4.400	3.350	4.400	11.600	18.560	14.500	16.000	66.600	23.320	12.600	
5	7.800	5.600	4.400	3.200	4.100	10.600	18.840	17.000	17.500	61.950	25.840	12.200	
	(39.000)	(29.000)	(22.300)	(17.050)	(23.400)	(75.180)	(107.920)	(81.500)	(85.790)	(383.850)	(124.160)	(64.300)	
AVERAGE	<7.800>	<5.800>	<4.460>	<3.410>	<4.680>	<15.036>	<21.584>	<16.300>	<17.158>	<76.770>	<24.832>	<12.860>	
6	7.600	5.600	4.250	3.200	4.400	10.000	27.520	49.000	16.750	52.850	62.300	12.000	
7	7.600	5.600	4.250	3.050	4.100	11.200	28.920	111.280	15.000	43.750	38.700	12.000	
8	7.600	5.400	4.250	3.050	7.000	68.600	39.690	87.100	17.250	37.050	28.080	11.800	
9	7.600	5.400	4.250	2.900	6.200	28.080	32.300	56.000	16.500	33.230	33.230	11.600	
10	7.400	5.400	4.250	2.900	6.200	29.820	35.400	39.690	15.500	31.370	46.200	11.400	
	(37.800)	(27.400)	(21.250)	(15.100)	(27.900)	(147.700)	(163.830)	(343.070)	(81.000)	(198.250)	(208.510)	(58.800)	
AVERAGE	<7.560>	<5.480>	<4.250>	<3.020>	<5.580>	<29.540>	<32.766>	<68.614>	<16.200>	<39.650>	<41.702>	<11.760>	
11	7.400	5.400	4.100	2.900	15.750	35.400	69.800	41.670	15.250	28.920	45.500	11.200	
12	7.400	5.200	4.100	2.900	8.400	32.610	49.350	75.000	14.500	45.850	38.370	10.800	
13	7.200	5.200	4.100	2.750	6.600	25.280	37.380	69.400	16.500	76.600	32.300	10.800	
14	7.200	5.200	4.100	2.750	5.600	21.360	31.990	89.350	20.800	94.300	33.230	10.800	
15	7.000	5.200	3.950	2.750	5.800	18.560	29.820	144.960	18.840	64.200	28.360	10.800	
	(36.200)	(26.200)	(20.350)	(14.050)	(42.150)	(133.210)	(218.340)	(420.380)	(85.890)	(309.870)	(177.760)	(54.400)	
AVERAGE	<7.240>	<5.240>	<4.070>	<2.810>	<8.430>	<26.642>	<43.668>	<84.076>	<17.178>	<61.974>	<35.552>	<10.880>	
16	7.000	5.200	3.950	2.750	5.600	19.400	40.680	168.550	18.560	54.600	26.960	10.600	
17	6.800	5.000	3.950	2.750	5.400	15.250	49.700	155.900	18.560	49.000	25.000	10.600	
18	6.800	5.000	3.800	2.600	7.800	13.500	159.750	104.200	19.680	44.450	24.440	10.400	
19	6.800	5.000	3.800	2.600	6.200	35.400	97.000	91.600	25.840	40.020	29.820	10.000	
20	6.800	5.000	3.950	2.600	5.400	43.050	59.850	64.600	21.640	53.200	23.880	9.600	
	(34.200)	(25.200)	(19.450)	(13.300)	(30.400)	(126.600)	(406.980)	(584.850)	(104.280)	(241.270)	(130.100)	(51.200)	
AVERAGE	<6.840>	<5.040>	<3.890>	<2.660>	<6.080>	<25.320>	<81.396>	<116.970>	<20.856>	<48.254>	<26.020>	<10.240>	
21	6.600	4.850	9.200	2.450	4.700	45.850	46.200	61.950	28.920	40.020	26.120	9.600	
22	6.400	4.850	5.800	2.450	4.100	33.230	36.390	62.300	40.350	33.850	21.920	9.400	
23	6.400	4.850	5.000	2.450	4.400	34.160	30.130	47.600	62.300	49.700	19.400	9.200	
24	6.400	4.700	4.700	3.650	6.800	30.440	25.840	39.690	49.000	36.720	18.280	9.200	
25	6.400	4.700	4.250	4.250	20.520	42.000	23.040	33.850	99.250	33.230	17.250	9.000	
	(32.200)	(23.950)	(28.950)	(15.250)	(40.520)	(185.680)	(161.600)	(245.390)	(279.820)	(193.520)	(102.970)	(46.400)	
AVERAGE	<6.440>	<4.790>	<5.790>	<3.050>	<8.104>	<37.136>	<32.320>	<49.078>	<55.964>	<38.704>	<20.594>	<9.280>	
26	6.200	4.700	4.100	4.100	50.750	30.130	21.080	29.820	134.100	38.040	16.750	8.800	
27	6.200	4.550	3.950	4.250	50.400	57.400	19.400	28.360	225.600	35.090	16.000	8.600	
28	6.200	4.550	3.950	4.400	38.370	98.350	22.200	25.000	194.400	30.130	15.000	8.600	
29	6.000	*********	3.800	3.950	43.750	52.500	29.510	22.480	167.450	26.960	14.250	8.400	
30	6.000	*********	3.650	3.800	58.100	37.710	21.640	23.040	124.600	26.400	13.500	8.400	
31	6.000	*********	3.500	*********	44.800	*********	18.560	19.960	*********	31.990	*********	8.200	
	(36.600)	(13.800)	(22.950)	(20.500)	(286.170)	(276.090)	(132.390)	(148.660)	(846.150)	(188.610)	(75.500)	(51.000)	
AVERAGE	<6.100>	<4.600>	<3.825>	<4.100>	<47.695>	<55.218>	<22.065>	<24.777>	<169.230>	<31.435>	<15.100>	<8.500>	
GRAND TOTAL	216.000	145.550	135.250	95.250	450.540	944.459	1191.059	1823.849	1482.929	1515.369	819.000	326.100	9145.340
	60.	40.	37.	26.	125.	262.	330.	505.	411.	420.	227.	90.	2533.
AVERAGE	6.968	5.198	4.363	3.175	14.534	31.482	38.421	58.834	49.431	48.883	27.300	10.519	25.056
MAX	7.800	6.000	9.200	4.400	58.100	98.350	159.750	168.550	225.600	94.300	62.300	13.500	
MIN	6.000	4.550	3.500	2.450	4.100	10.000	18.560	14.500	14.500	26.400	13.500	8.200	

< COMPUTED DAILY RUNOFF > (1983)

P H A N G
X - 5 7

UNIT = (CUM/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	1 0 OCT	1 1 NOV	1 2 DEC	
1	5.417	1.788	0.656	0.569	0.376	22.467	23.166	17.991	16.524	45.879	30.315	12.564	
2	5.226	1.725	0.633	0.529	0.353	18.632	20.448	17.353	15.939	41.153	27.129	12.121	
3	5.043	1.664	0.610	0.499	0.338	16.732	23.408	16.568	15.377	41.171	26.471	11.695	
4	4.866	1.606	0.589	0.475	6.298	15.397	41.616	26.759	15.106	32.549	23.027	11.284	
5	4.695	1.549	0.568	0.454	4.453	14.408	78.007	58.253	14.407	28.588	44.158	10.888	
	(25.247)(	8.331)(	3.055)(	2.526)(	11.818)(	87.635)(	186.644)(	136.924)(	77.353)(	189.340)(	151.100)(	58.552)	
AVERAGE	< 5.049><	1.666><	0.611><	0.505><	2.364><	17.527><	37.329><	27.385><	15.471><	37.868><	30.220><	11.710>	
6	4.530	1.495	0.548	0.435	6.508	16.485	49.480	97.634	13.879	26.118	43.186	10.505	
7	4.371	1.442	0.529	0.418	16.383	80.526	32.348	105.751	19.150	26.662	29.599	10.136	
8	4.217	1.391	0.510	0.403	11.392	38.544	29.850	39.140	26.482	24.032	25.133	9.780	
9	4.069	1.342	0.492	0.388	9.290	40.254	28.531	27.043	45.910	25.959	24.388	9.437	
10	3.926	1.295	0.475	0.374	60.699	30.686	72.013	25.114	26.789	28.658	26.295	9.106	
	(21.114)(	6.966)(	2.553)(	2.018)(	104.273)(	206.495)(	212.223)(	294.682)(	132.209)(	131.430)(	148.600)(	48.965)	
AVERAGE	< 4.223><	1.393><	0.511><	0.404><	20.855><	41.299><	42.445><	58.936><	26.442><	26.286><	29.720><	9.793>	
11	3.788	1.250	0.458	0.361	20.375	36.294	56.119	43.736	20.888	44.002	31.673	8.786	
12	3.655	1.206	0.442	0.355	14.406	25.239	49.994	48.638	17.807	47.495	33.654	8.913	
13	3.527	1.163	0.426	0.350	10.721	32.713	43.736	109.928	16.204	33.968	44.341	8.330	
14	3.403	1.122	0.411	0.345	8.537	24.786	42.543	163.322	15.963	31.532	30.034	8.002	
15	3.284	1.083	0.397	0.339	7.682	21.323	38.012	124.795	16.046	31.402	37.834	7.700	
	(17.658)(	5.824)(	2.133)(	1.751)(	61.722)(	140.356)(	230.403)(	490.418)(	86.907)(	188.399)(	177.536)(	41.731)	
AVERAGE	< 3.532><	1.165><	0.427><	0.350><	12.344><	28.071><	46.081><	98.084><	17.381><	37.680><	35.507><	8.346>	
16	3.168	1.045	0.383	0.334	6.737	18.770	51.718	59.583	17.998	40.465	28.315	7.416	
17	3.057	1.008	0.369	0.329	18.882	18.375	82.929	57.702	21.412	34.376	24.299	7.148	
18	2.950	0.973	0.359	0.324	13.544	17.939	61.772	38.416	49.625	29.407	22.863	6.893	
19	2.846	0.938	0.729	0.319	10.501	78.197	56.169	30.522	73.991	61.522	20.730	6.648	
20	2.746	0.905	1.215	0.314	8.563	35.242	37.719	27.463	48.168	60.615	19.475	6.413	
	(14.767)(	4.869)(	3.054)(	1.621)(	58.227)(	168.523)(	290.307)(	213.686)(	211.194)(	226.385)(	115.682)(	34.518)	
AVERAGE	< 2.953><	0.974><	0.611><	0.324><	11.645><	33.705><	58.061><	42.737><	42.239><	45.277><	23.136><	6.904>	
21	2.649	0.873	0.953	0.310	7.628	25.368	30.100	29.322	50.893	44.823	18.476	6.187	
22	2.556	0.843	0.667	0.305	6.980	21.972	26.844	25.883	72.810	38.008	17.637	5.969	
23	2.467	0.813	0.573	0.300	10.388	19.151	24.897	23.983	88.979	34.364	16.904	5.759	
24	2.380	0.784	0.510	0.296	40.311	19.279	23.420	22.700	107.094	31.793	16.243	5.556	
25	2.296	0.757	0.466	0.291	36.599	20.359	22.237	21.639	108.358	29.527	15.632	5.361	
	(12.349)(	4.070)(	3.169)(	1.502)(	101.907)(	106.130)(	127.498)(	123.528)(	428.133)(	178.515)(	84.892)(	28.832)	
AVERAGE	< 2.470><	0.814><	0.634><	0.300><	20.381><	21.226><	25.500><	24.706><	85.627><	35.703><	16.978><	5.766>	
26	2.216	0.730	0.435	1.615	51.290	33.322	21.239	20.721	101.127	27.078	15.058	5.173	
27	2.138	0.704	2.185	0.696	38.249	40.943	20.363	19.898	86.469	24.237	14.515	8.693	
28	2.063	0.680	1.002	0.553	46.309	48.273	24.324	19.143	68.191	22.699	13.996	6.978	
29	1.990	*********	0.819	0.465	110.461	30.786	22.421	18.437	53.384	23.708	13.500	5.882	
30	1.920	*********	0.701	0.411	86.680	27.504	20.011	17.769	45.980	26.821	13.023	5.421	
31	1.853	*********	0.623	*********	33.641	*********	18.900	17.133	*********	28.756	*********	8.888	
	(12.179)(	2.114)(	5.765)(	3.740)(	366.630)(	180.828)(	127.258)(	113.100)(	355.149)(	153.299)(	70.092)(	41.035)	
AVERAGE	< 2.030><	0.705><	0.961><	0.748><	61.105><	36.166><	21.210><	18.850><	71.030><	25.550><	14.018><	6.839>	
GRAND TOTAL	103.312	32.175	19.730	13.158	704.576	889.966	1174.333	1372.338	1290.945	1067.367	747.902	253.633	7669.422
AVERAGE	29.	9.	5.	4.	195.	246.	325.	380.	357.	296.	207.	70.	2124.
MAX	3.333	1.149	0.636	0.439	22.728	29.666	37.882	44.269	43.031	34.431	24.930	8.182	21.012
MIN	5.417	1.788	2.185	1.615	110.461	80.526	82.929	163.322	108.358	61.522	44.341	12.564	
	1.853	0.680	0.359	0.291	0.338	14.408	18.900	16.568	13.879	22.699	13.023	5.173	


RUNOFF ANALYSIS BY TANK MODEL
RAINFALL STATION : PHANOM+KAPONG+TAKUA PA
(1984)
COEFFICIENT = 0.5348
GAUGED
COMPUTED
RAINFALL
(MM)
30.0
60.0
90.0
120.0
150.0
180.0
210.0
240.0
270.0
RUNOFF
(m³/s)
250
225
200
175
150
125
100
75
50
25
1
2
3
4
5
6
7
8
9
10
11
12
GAUGING STATION : X-57 (CA = 312.00km²)

< DAILY RAINFALL > (1984)

PHANG PHANOM+KAPONG+TAKUA PA

UNIT = (mm/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	8.7	0.0	0.0	1.7	5.5	31.3	0.3	0.0	9.3	0.0	0.0	0.0	
2	0.0	0.0	3.0	0.0	0.0	6.6	6.0	0.0	0.0	0.0	0.4	0.0	
3	0.0	0.0	0.0	4.1	0.0	1.9	5.3	2.8	0.7	45.8	9.5	0.0	
4	0.0	1.3	0.0	0.4	4.0	0.0	0.0	8.7	29.3	22.3	14.8	0.0	
5	0.0	3.9	0.0	0.4	0.0	5.5	0.0	14.2	24.8	1.0	8.2	0.0	
	(8.7)	(5.2)	(3.0)	(6.5)	(9.5)	(45.2)	(11.6)	(25.7)	(64.1)	(69.1)	(32.8)	(0.0)	
AVERAGE	<1.7>	<1.0>	<0.6>	<1.3>	<1.9>	<9.0>	<2.3>	<5.1>	<12.8>	<13.8>	<6.6>	<0.0>	
6	0.0	0.0	0.0	0.0	0.0	37.3	0.0	16.4	7.9	2.6	4.9	0.0	
7	0.0	4.2	0.0	0.0	0.0	38.3	0.0	26.8	68.9	2.7	16.1	0.0	
8	0.0	0.0	0.0	11.6	1.1	31.5	19.1	20.2	31.3	34.8	4.4	0.0	
9	0.0	0.0	0.0	6.5	3.7	21.3	7.6	65.6	31.3	0.6	8.9	0.0	
10	0.0	1.2	0.0	4.7	17.8	39.4	0.0	7.2	0.6	0.0	0.0	0.0	
	(0.0)	(5.5)	(0.0)	(22.8)	(22.6)	(167.8)	(26.7)	(136.2)	(140.0)	(40.7)	(34.4)	(0.0)	
AVERAGE	<0.0>	<1.1>	<0.0>	<4.6>	<4.5>	<33.6>	<5.3>	<27.2>	<28.0>	<8.1>	<6.9>	<0.0>	
11	0.0	2.7	0.0	0.0	28.5	0.0	0.0	3.9	0.0	5.4	1.3	0.0	
12	0.0	1.4	0.0	5.0	17.7	3.0	40.2	6.6	12.4	0.4	1.4	0.0	
13	0.0	0.0	0.5	0.0	0.0	0.5	30.1	11.4	1.7	22.9	0.5	0.0	
14	0.0	0.0	1.0	0.0	6.1	15.3	0.0	0.8	0.0	96.5	1.0	9.4	
15	0.0	5.0	0.0	0.0	0.0	28.0	0.0	0.0	0.0	11.2	0.4	0.0	
	(0.0)	(9.1)	(1.5)	(5.0)	(52.4)	(46.7)	(70.3)	(22.6)	(14.2)	(136.4)	(4.6)	(9.4)	
AVERAGE	<0.0>	<1.8>	<0.3>	<1.0>	<10.5>	<9.3>	<14.1>	<4.5>	<2.8>	<27.3>	<0.9>	<1.9>	
16	0.0	0.0	0.0	4.2	23.3	11.8	0.0	6.7	0.0	12.2	6.4	7.4	
17	0.0	0.0	0.0	6.9	9.5	0.0	20.2	7.3	0.9	0.0	0.0	8.8	
18	0.0	0.0	0.0	7.6	0.0	5.4	12.4	78.0	0.0	0.0	0.0	10.8	
19	0.0	0.0	0.0	10.5	22.1	19.5	11.1	19.1	0.0	6.3	0.0	0.0	
20	0.0	0.0	0.0	8.7	21.2	19.6	0.0	6.1	0.0	14.3	0.9	15.4	
	(0.0)	(0.0)	(0.0)	(37.9)	(76.0)	(56.2)	(43.8)	(117.1)	(0.9)	(32.7)	(7.3)	(42.4)	
AVERAGE	<0.0>	<0.0>	<0.0>	<7.6>	<15.2>	<11.2>	<8.8>	<23.4>	<0.2>	<6.5>	<1.4>	<8.5>	
21	0.0	0.0	0.0	2.8	15.5	5.4	0.0	0.1	33.4	25.3	14.8	2.8	
22	1.0	0.0	5.7	1.4	0.0	0.0	0.0	0.0	2.4	0.0	0.0	1.2	
23	0.0	0.0	6.2	1.0	18.3	2.4	0.0	5.0	0.4	0.0	0.0	15.4	
24	0.0	0.0	0.0	10.1	27.3	1.7	26.0	9.2	8.9	3.6	0.0	0.0	
25	1.2	1.0	10.3	9.3	38.1	37.3	28.1	7.3	2.6	9.6	0.0	0.0	
	(2.2)	(1.0)	(22.2)	(24.6)	(99.3)	(46.7)	(54.2)	(21.6)	(47.6)	(38.5)	(14.8)	(19.5)	
AVERAGE	<0.4>	<0.2>	<4.4>	<4.9>	<19.9>	<9.3>	<10.8>	<4.3>	<9.5>	<7.7>	<2.9>	<3.9>	
26	5.3	0.0	1.3	5.2	25.1	9.4	30.3	0.0	0.0	0.0	0.0	0.0	
27	5.7	0.0	0.0	21.9	11.6	18.0	22.1	1.0	0.0	0.0	4.9	0.0	
28	0.0	0.0	6.2	47.2	8.7	27.1	22.0	14.7	34.7	0.0	0.0	0.0	
29	5.5	0.0	0.6	35.7	0.0	26.8	14.1	8.4	17.2	0.0	0.0	0.0	
30	6.2	*********	0.0	9.8	0.0	40.6	0.0	37.6	9.4	0.0	8.9	0.0	
31	5.9	*********	0.9	*********	31.1	*********	0.0	4.3	*********	0.0	*********	0.0	
	(28.6)	(0.0)	(9.1)	(119.8)	(76.5)	(121.8)	(88.4)	(66.0)	(61.3)	(0.0)	(13.9)	(0.0)	
AVERAGE	<4.8>	<0.0>	<1.5>	<24.0>	<12.7>	<24.4>	<14.7>	<11.0>	<12.3>	<0.0>	<2.8>	<0.0>	
GRAND TOTAL	39.4	20.8	35.7	216.5	336.3	484.4	295.0	389.3	328.1	317.5	107.7	71.2	2642.0
AVERAGE	1.3	0.7	1.2	7.2	10.8	16.1	9.5	12.6	10.9	10.2	3.6	2.3	7.2
MAX	8.7	5.0	10.3	47.2	38.1	40.6	40.2	78.0	68.9	96.5	16.1	15.4	
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

< DAILY RUNOFF > PHANG X-57 (1984) UNIT = (CUM/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	9.828	2.981	0.889	0.729	20.730	49.342	40.876	22.196	27.231	22.654	14.220	7.753	
2	7.340	2.669	0.858	0.683	13.918	34.082	32.569	20.540	23.067	19.062	13.696	7.293	
3	6.237	2.450	0.828	0.777	10.991	25.359	29.158	19.292	20.050	46.697	15.494	6.924	
4	5.662	2.289	0.798	0.662	9.886	21.386	25.304	20.078	29.957	46.897	18.862	6.613	
5	5.249	2.164	0.770	0.624	8.729	20.233	23.177	22.723	40.550	30.147	19.206	6.340	
	(34.315)	(12.554)	(4.144)	(3.475)	(64.255)	(150.403)	(151.083)	(104.829)	(140.855)	(165.457)	(81.478)	(34.924)	
AVERAGE	<6.863>	<2.511>	<0.829>	<0.695>	<12.851>	<30.081>	<30.217>	<20.966>	<28.171>	<33.091>	<16.296>	<6.985>	
6	4.937	2.061	0.743	0.593	8.027	37.744	21.706	25.657	31.812	24.256	18.097	6.093	
7	4.686	2.091	0.717	0.566	7.507	72.812	20.549	37.689	128.913	21.468	21.108	5.865	
8	4.476	1.935	0.692	3.385	7.101	71.979	25.346	41.645	83.812	36.659	19.452	5.650	
9	4.291	1.851	0.667	3.938	6.990	55.379	25.240	133.643	77.520	26.162	19.533	5.446	
10	4.123	1.777	0.644	3.623	11.974	88.114	22.143	46.747	39.582	22.175	16.437	5.252	
	(22.512)	(9.715)	(3.463)	(12.105)	(41.600)	(326.028)	(114.984)	(285.381)	(361.640)	(130.720)	(94.627)	(28.307)	
AVERAGE	<4.502>	<1.943>	<0.693>	<2.421>	<8.320>	<65.206>	<22.997>	<57.076>	<72.328>	<26.144>	<18.925>	<5.661>	
11	3.969	1.709	0.621	2.185	24.690	39.184	19.964	33.191	28.666	20.880	14.539	5.066	
12	3.823	1.645	0.599	2.256	28.429	29.243	38.285	28.102	28.993	18.428	13.473	4.887	
13	3.685	1.585	0.578	1.681	17.132	25.213	57.226	27.954	25.725	24.297	12.667	4.714	
14	3.554	1.528	0.558	1.463	15.608	27.424	32.785	24.200	22.841	182.788	12.023	6.774	
15	3.428	1.863	0.538	1.316	12.330	39.629	25.636	21.639	21.286	53.377	11.481	5.156	
	(18.458)	(8.330)	(2.895)	(8.901)	(98.189)	(160.693)	(173.896)	(135.085)	(127.512)	(299.770)	(64.182)	(26.596)	
AVERAGE	<3.692>	<1.666>	<0.579>	<1.780>	<19.638>	<32.139>	<34.779>	<27.017>	<25.502>	<59.954>	<12.836>	<5.319>	
16	3.306	1.556	0.519	1.393	18.364	36.541	22.215	21.195	20.087	42.465	12.187	6.298	
17	3.190	1.469	0.501	2.430	18.212	28.241	26.560	21.139	19.111	28.901	10.983	7.786	
18	3.077	1.398	0.483	3.577	14.748	26.281	27.632	116.380	18.277	23.974	10.475	9.741	
19	2.969	1.337	0.466	5.545	20.345	29.889	27.900	54.867	17.538	22.865	10.034	7.414	
20	2.865	1.283	0.450	6.495	28.680	36.708	24.017	38.131	16.864	25.072	9.638	10.909	
	(15.408)	(7.044)	(2.419)	(19.439)	(100.350)	(157.659)	(128.324)	(251.711)	(91.877)	(143.277)	(53.317)	(42.148)	
AVERAGE	<3.082>	<1.409>	<0.484>	<3.888>	<20.070>	<31.532>	<25.665>	<50.342>	<18.375>	<28.655>	<10.663>	<8.430>	
21	2.764	1.234	0.434	5.105	29.442	30.175	20.840	27.837	30.687	34.130	13.468	9.401	
22	2.667	1.188	0.847	3.475	19.474	26.000	19.271	23.846	24.085	26.482	11.360	7.447	
23	2.573	1.145	1.374	2.906	22.317	23.418	18.092	22.258	20.740	22.691	10.000	10.973	
24	2.483	1.104	0.781	4.826	37.285	21.269	26.463	22.647	20.955	20.911	9.357	8.505	
25	2.396	1.064	2.761	6.242	68.596	37.493	40.004	22.380	18.984	21.757	8.854	6.884	
	(12.882)	(5.736)	(6.197)	(22.554)	(177.115)	(138.356)	(124.670)	(118.968)	(115.450)	(125.972)	(53.039)	(43.210)	
AVERAGE	<2.576>	<1.147>	<1.239>	<4.511>	<35.423>	<27.671>	<24.934>	<23.794>	<23.090>	<25.194>	<10.608>	<8.642>	
26	2.873	1.027	1.312	5.906	54.377	32.604	57.557	19.690	17.026	19.086	8.438	6.185	
27	3.429	0.990	1.062	11.972	40.451	37.622	52.140	18.534	15.970	17.789	8.738	5.694	
28	2.639	0.955	1.504	59.592	31.049	49.300	51.988	21.534	30.544	16.848	7.984	5.330	
29	3.089	0.922	1.006	64.699	22.789	56.638	44.385	21.806	32.797	16.067	7.627	5.044	
30	3.729	*********	0.877	31.392	19.058	93.075	30.059	40.555	28.026	15.388	9.413	4.808	
31	4.151	*********	0.790	*********	30.267	*********	24.845	29.021	*********	14.780	*********	4.603	
	(19.910)	(3.894)	(6.551)	(173.561)	(197.991)	(269.240)	(260.975)	(151.139)	(124.363)	(99.958)	(42.200)	(31.664)	
AVERAGE	<3.318>	<0.974>	<1.092>	<34.712>	<32.999>	<53.848>	<43.496>	<25.190>	<24.872>	<16.660>	<8.440>	<5.277>	
GRAND TOTAL	123.486	47.272	25.669	240.036	679.499	1202.378	953.931	1047.112	961.695	965.154	388.843	206.849	6841.918
	34.	13.	7.	66.	188.	333.	264.	290.	266.	267.	108.	57.	1895.
AVERAGE	3.983	1.630	0.828	8.001	21.919	40.079	30.772	33.778	32.057	31.134	12.961	6.673	18.694
MAX	9.828	2.981	2.761	64.699	68.596	93.075	57.557	133.643	128.913	182.788	21.108	10.973	
MIN	2.396	0.922	0.434	0.566	6.990	20.233	18.092	18.534	15.970	14.780	7.627	4.603	

< DAILY RUNOFF > P H A N G X − 5 7 (1984) UNIT = (CUM/D)

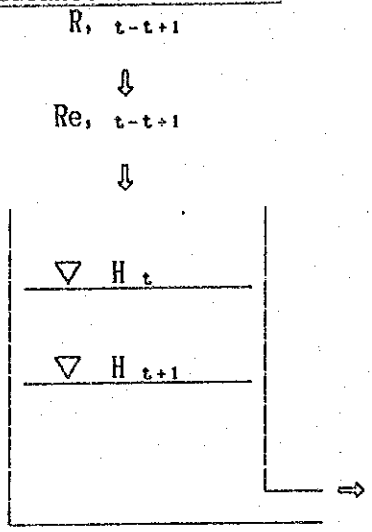
	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	1 0 OCT	1 1 NOV	1 2 DEC	
1	8.200	7.400	4.850	4.250	10.200	10.800	137.160	37.380	76.200	31.680	18.000	12.400	
2	11.000	6.800	4.700	4.250	9.200	35.730	82.600	29.510	54.250	29.820	17.000	11.600	
3	8.600	6.400	4.700	4.100	7.400	33.540	60.900	26.400	45.150	25.280	16.500	9.200	
4	8.000	6.400	4.550	5.000	6.200	28.360	52.150	25.280	32.300	34.470	17.750	8.800	
5	8.000	7.400	4.550	4.700	6.000	23.040	37.380	24.720	44.100	55.300	0.010	8.800	
	(43.800)	(34.400)	(23.350)	(22.300)	(39.000)	(131.470)	(370.190)	(143.290)	(252.000)	(176.550)	(69.260)	(50.800)	
AVERAGE	< 8.760>	< 6.880>	< 4.670>	< 4.460>	< 7.800>	< 26.294>	< 74.038>	< 28.658>	< 50.400>	< 35.310>	< 13.852>	< 10.160>	
6	7.800	6.400	4.550	4.100	6.600	16.250	30.130	32.610	49.000	37.050	0.010	8.800	
7	7.600	6.400	4.400	3.650	6.600	16.750	26.680	50.050	51.450	30.440	0.010	8.800	
8	7.600	6.400	4.400	3.500	6.200	44.800	23.600	73.000	101.500	29.200	14.750	8.600	
9	7.400	6.000	4.400	4.550	7.600	27.800	23.600	89.800	132.100	34.160	14.500	8.400	
10	7.400	5.800	4.250	5.000	6.400	42.350	24.160	229.800	136.640	40.350	14.000	8.400	
	(37.800)	(31.000)	(22.000)	(20.800)	(33.400)	(147.950)	(128.170)	(475.260)	(470.690)	(171.200)	(43.270)	(43.000)	
AVERAGE	< 7.560>	< 6.200>	< 4.400>	< 4.160>	< 6.680>	< 29.590>	< 25.634>	< 95.052>	< 94.138>	< 34.240>	< 8.654>	< 8.600>	
11	7.200	5.800	4.250	6.000	11.000	56.000	20.800	142.360	94.300	33.850	15.000	8.200	
12	7.200	6.000	4.250	4.850	8.600	31.990	20.520	88.000	65.800	32.300	15.000	8.000	
13	7.000	6.000	4.250	4.250	6.400	25.000	27.240	71.800	58.450	29.200	14.750	8.000	
14	7.000	5.800	4.100	3.950	7.600	22.200	19.960	60.900	49.000	38.700	12.200	7.800	
15	6.800	5.600	4.400	3.800	8.800	21.920	18.280	53.200	41.010	164.150	12.000	7.800	
	(35.200)	(29.200)	(21.250)	(22.850)	(42.400)	(157.110)	(106.800)	(416.260)	(308.560)	(298.200)	(68.950)	(39.800)	
AVERAGE	< 7.040>	< 5.840>	< 4.250>	< 4.570>	< 8.480>	< 31.422>	< 21.360>	< 83.252>	< 61.712>	< 59.640>	< 13.790>	< 7.960>	
16	6.800	5.600	4.250	3.800	6.800	22.760	17.750	41.670	35.090	99.250	12.000	7.800	
17	6.800	5.600	4.100	6.000	6.000	19.960	17.250	36.720	28.640	65.400	11.600	7.800	
18	6.800	5.400	3.950	6.600	7.200	17.000	17.500	35.090	27.520	56.350	11.600	8.600	
19	6.600	5.400	3.950	6.600	8.000	23.040	17.250	261.600	25.560	45.850	11.200	9.600	
20	6.600	5.400	3.800	8.000	13.250	41.670	15.250	241.200	25.280	43.750	11.000	9.400	
	(33.600)	(27.400)	(20.050)	(31.000)	(41.250)	(124.430)	(85.000)	(616.280)	(142.090)	(310.600)	(57.400)	(43.200)	
AVERAGE	< 6.720>	< 5.480>	< 4.010>	< 6.200>	< 8.250>	< 24.886>	< 17.000>	<123.256>	< 28.418>	< 62.120>	< 11.480>	< 8.640>	
21	6.400	5.400	4.550	7.800	13.250	67.400	14.000	163.050	21.920	42.350	12.200	11.200	
22	6.400	5.200	4.700	6.200	10.800	54.600	12.200	84.850	23.320	51.800	11.000	9.400	
23	7.000	5.200	4.400	5.400	8.800	34.780	12.800	61.600	25.280	50.400	10.600	8.800	
24	6.800	5.200	4.100	10.200	13.500	28.920	12.200	50.050	25.280	38.370	10.400	8.600	
25	6.600	5.000	4.400	7.600	15.000	39.030	26.960	42.000	21.920	34.780	10.000	8.800	
	(33.200)	(26.000)	(22.150)	(37.200)	(61.350)	(224.730)	(78.160)	(401.550)	(117.720)	(217.700)	(54.200)	(46.800)	
AVERAGE	< 6.640>	< 5.200>	< 4.430>	< 7.440>	< 12.270>	< 44.946>	< 15.632>	< 80.310>	< 23.544>	< 43.540>	< 10.840>	< 9.360>	
26	6.400	5.000	3.950	6.000	34.470	88.900	52.500	34.160	19.960	32.610	9.600	8.800	
27	6.400	5.000	4.250	5.000	20.800	79.000	75.400	31.060	18.560	28.640	9.000	8.600	
28	6.400	4.850	4.100	8.600	18.560	72.200	72.600	29.200	19.120	25.560	9.000	8.400	
29	6.200	4.850	3.950	10.400	23.600	117.600	65.800	33.540	26.120	23.320	8.800	8.200	
30	6.400	*********	4.100	8.000	15.250	150.950	57.050	40.350	30.440	21.640	8.800	8.000	
31	7.600	*********	4.250	*********	11.200	*********	41.670	112.720	*********	20.240	*********	8.000	
	(39.400)	(19.700)	(24.600)	(38.000)	(123.880)	(508.650)	(365.020)	(281.030)	(114.200)	(152.010)	(45.200)	(50.000)	
AVERAGE	< 6.567>	< 4.925>	< 4.100>	< 7.600>	< 20.647>	<101.730>	< 60.837>	< 46.838>	< 22.840>	< 25.335>	< 9.040>	< 8.333>	
GRAND TOTAL	223.000	167.700	133.400	172.150	341.280	1294.340	1133.339	2333.669	1405.259	1326.260	338.280	273.600	9142.266
AVERAGE	62.	46.	37.	48.	95.	358.	314.	646.	389.	367.	94.	76.	2532.
MAX	7.194	5.783	4.303	5.738	11.009	43.145	36.559	75.280	46.842	42.783	11.276	8.826	24.979
MIN	11.000	7.400	4.850	10.400	34.470	150.950	137.160	261.600	136.640	164.150	18.000	12.400	
	6.200	4.850	3.800	3.500	6.000	10.800	12.200	24.720	18.560	20.240	0.010	7.800	

2.3 Runoff Analysis by Tank Model (X-58)

(1) Tank Model

(a) General

Water Balance in the Tank



Basic Equation

$$Q = Qo \times e^{-Kt}$$

The water balance in the tank is given by the following differential equation :

$$H_{t+1} = H_t + (Re,_{t-t+1} - (Q_t + Q_{t+1})/2)\ dt$$

where: H_{t+1} = water stage in the tank at $t = t+1$

H_t = -do- at $t = t$

$Re,_{t-t+1}$ = effective rain poured into tank during time t and t+1

Q_t = outflow from tank at $t = t$

Q_{t+1} = -do- at $t = t+1$

dt = time interval for calculation

Giving that dt = 1.0 day, $Q_t = KH_t$ and $Q_{t+1} = KH_{t+1}$, then ;

$$H_{t+1} = H_t + Re,_{t-t+1} - KH_{t+1}/2$$

$$H_{t+1} = (1-K/2)/(1+K/2)H_t + 1/(1+K/2)Re,_{t-t+1}$$

$$= aH_t + bRe,_{t-t+1}$$

RUNOFF ANALYSIS BY TANK MODEL (DAILY BASE)

- LOCATION ; PHANG
- ANALYSED POINT ; X-58 PHANOM
- CA ; 8.000 (km²)

DIMENSION OF TANK

		UPPER HOLE	MIDDLE HOLE	LOWER HOLE	PENETRATION	EVAPORATION
TANK 1	COEFFI	0.400000	0.300000	0.200000	0.100000	1.000
	HEIGHT	15.0	5.0	0.0		
TANK 2	COEFFI	0.300000	0.250000	0.150000	0.050000	0.0
	HEIGHT	30.0	10.0	0.0		
TANK 3	COEFFI	0.020000	0.010000	0.005000	0.000100	0.0
	HEIGHT	10.0	5.0	0.0		
TANK 4	COEFFI	0.0	0.0	0.0	0.0	0.0
	HEIGHT	0.0	0.0	0.0		

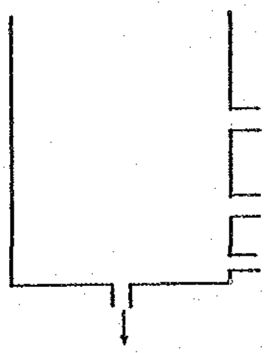
【MONTHLY EVAPORATION】

(mm/D)

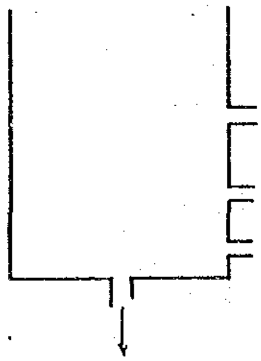
	1	2	3	4	5	6	7	8	9	10	11	12
RATE	3.70	3.90	4.50	3.70	3.10	2.90	3.10	3.80	3.30	3.10	3.10	3.20

DIMENSION OF TANK

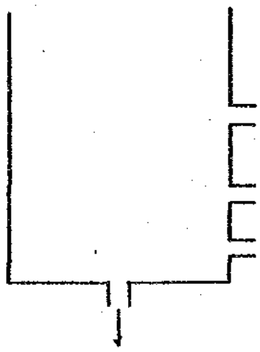
TANK 1



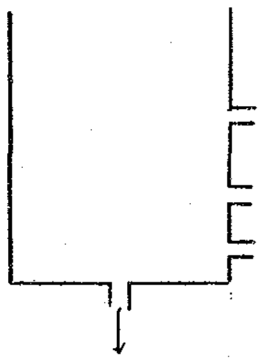
TANK 2



TANK 3



TANK 4

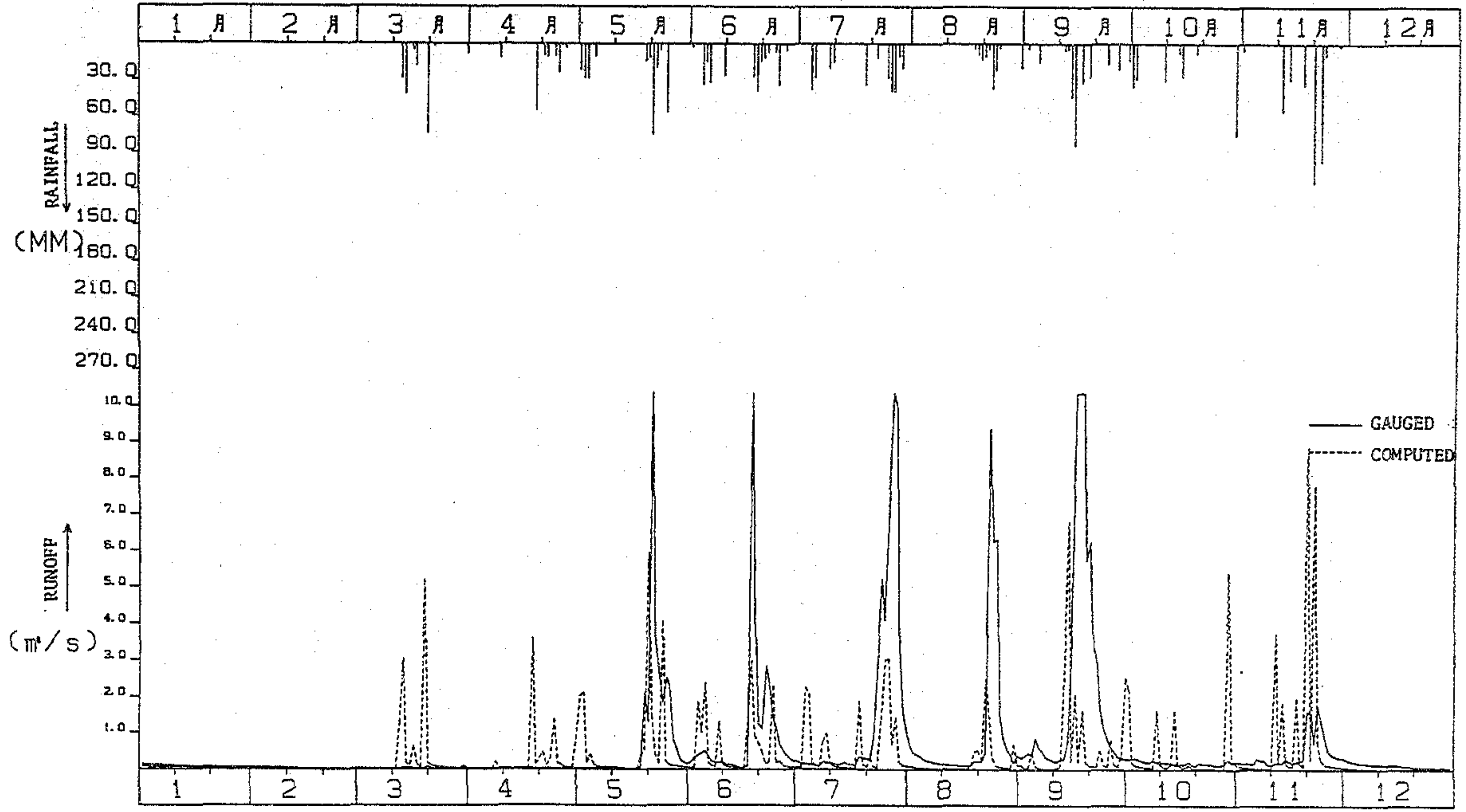


RUNOFF ANALYSIS BY TANK MODEL

RAINFALL STATION : PHANØM

(1976)

COEFFICIENT = 0. 1998



GAUGING STATION : X-58 (CA = 8. 00㎢)

< DAILY RAINFALL > (1976) PHANG PHANOM

UNIT = (mm/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	0.0	0.0	0.0	0.0	20.9	2.8	0.0	0.0	0.0	35.2	5.2	0.0	
2	0.0	0.0	0.0	0.0	27.4	0.0	0.0	0.0	4.1	29.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	32.8	37.6	0.0	0.0	0.0	0.0	0.0	
5	0.0	0.0	0.0	0.0	9.8	14.9	27.7	0.0	15.1	0.0	0.0	0.0	
	(0.0)	(0.0)	(0.0)	(0.0)	(86.3)	(50.4)	(65.3)	(0.0)	(19.2)	(64.2)	(5.2)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 0.0>	< 17.3>	< 10.1>	< 13.1>	< 0.0>	< 3.8>	< 12.8>	< 1.0>	< 0.0>	
6	0.0	0.0	0.0	0.0	0.0	31.0	0.0	0.0	0.0	0.0	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9	0.0	0.0	0.0	11.0	0.0	0.0	19.8	0.0	0.0	0.0	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	25.8	14.8	0.0	0.0	30.2	0.0	0.0	
	(0.0)	(0.0)	(0.0)	(11.0)	(0.0)	(56.8)	(34.6)	(0.0)	(0.0)	(30.2)	(0.0)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 2.2>	< 0.0>	< 11.4>	< 6.9>	< 0.0>	< 0.0>	< 6.0>	< 0.0>	< 0.0>	
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	55.4	0.0	
13	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	
14	0.0	0.0	40.9	0.0	0.0	0.0	0.0	0.0	43.6	7.7	29.2	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.2	26.8	0.0	0.0	
	(0.0)	(0.0)	(68.8)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(136.3)	(34.4)	(84.6)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 13.8>	< 0.0>	< 0.0>	< 0.0>	< 0.0>	< 0.0>	< 27.3>	< 6.9>	< 16.9>	< 0.0>	
16	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17	0.0	0.0	17.3	0.0	0.0	0.0	0.0	0.0	31.4	0.0	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	26.8	0.0	3.8	0.0	0.0	34.0	0.0	
19	0.0	0.0	0.0	54.7	13.6	38.5	33.4	8.9	26.6	7.4	0.0	0.0	
20	0.0	0.0	73.4	0.0	11.2	13.6	0.0	13.0	0.0	0.0	0.0	0.0	
	(0.0)	(0.0)	(96.2)	(54.7)	(24.7)	(78.8)	(33.4)	(25.7)	(58.1)	(7.4)	(34.0)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 19.2>	< 10.9>	< 4.9>	< 15.8>	< 6.7>	< 5.1>	< 11.6>	< 1.5>	< 6.8>	< 0.0>	
21	0.0	0.0	0.0	9.4	74.0	11.2	0.0	10.3	0.0	0.0	114.2	0.0	
22	0.0	0.0	2.2	10.6	19.7	6.5	11.4	4.4	0.0	0.0	0.0	0.0	
23	0.0	0.0	0.0	0.0	5.3	0.0	0.0	36.6	0.0	0.0	96.6	0.0	
24	0.0	0.0	0.0	9.8	0.0	6.2	0.0	21.2	15.8	0.0	8.8	0.0	
25	0.0	0.0	0.0	23.0	56.2	33.8	27.4	3.2	0.0	0.0	0.0	0.0	
	(0.0)	(0.0)	(2.2)	(52.8)	(155.2)	(57.7)	(38.8)	(75.8)	(15.8)	(0.0)	(219.6)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.4>	< 10.6>	< 31.0>	< 11.5>	< 7.8>	< 15.2>	< 3.2>	< 0.0>	< 43.9>	< 0.0>	
26	0.0	0.0	0.0	0.7	0.0	0.0	38.9	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	3.4	0.0	5.4	38.6	0.0	20.5	0.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	0.0	1.8	0.0	
29	0.0	0.0	0.0	0.0	0.0	0.0	19.4	0.0	0.0	0.0	0.0	0.0	
30	0.0	*********	0.0	0.0	0.0	0.0	0.0	0.0	13.6	75.1	0.0	0.0	
31	0.0	*********	8.2	*********	0.0	*********	0.0	19.7	*********	0.0	*********	0.0	
	(0.0)	(0.0)	(8.2)	(4.1)	(0.0)	(5.4)	(107.2)	(19.7)	(34.1)	(75.1)	(1.8)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 1.4>	< 0.8>	< 0.0>	< 1.1>	< 17.9>	< 3.3>	< 6.8>	< 12.5>	< 0.4>	< 0.0>	
GRAND TOTAL	0.0	0.0	175.3	122.6	266.2	249.1	279.1	121.2	263.5	211.4	345.1	0.0	2033.6
AVERAGE	0.0	0.0	5.7	4.1	8.6	8.3	9.0	3.9	8.8	6.8	11.5	0.0	5.6
MAX	0.0	0.0	73.4	54.7	74.0	38.5	38.9	36.6	83.2	75.1	114.2	0.0	
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

< GAUGED DAILY RUNOFF > (1976) PHANG X－58

UNIT = (CUM/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC		
1	0.070	0.055	0.026	0.036	0.028	0.150	0.230	1.060	0.390	0.300	0.220	0.320		
2	0.070	0.055	0.026	0.032	0.032	0.190	0.210	0.640	0.330	0.280	0.210	0.280		
3	0.070	0.055	0.024	0.028	0.028	0.340	0.170	0.470	0.390	0.290	0.170	0.230		
4	0.065	0.055	0.024	0.028	0.030	0.380	0.150	0.420	0.460	0.310	0.180	0.220		
5	0.060	0.055	0.024	0.028	0.030	0.450	0.140	0.360	0.400	0.270	0.160	0.190		
	(0.335)(	0.275)(	0.124)(	0.152)(	0.148)(	1.510)(	0.900)(	2.950)(	1.970)(	1.450)(	0.940)(	1.240)		
AVERAGE	< 0.067><	0.055><	0.025><	0.030><	0.030><	0.302><	0.180><	0.590><	0.394><	0.290><	0.188><	0.248>		
6	0.060	0.055	0.024	0.028	0.032	0.520	0.130	0.280	0.870	0.230	0.150	0.180		
7	0.060	0.055	0.024	0.028	0.030	0.350	0.130	0.230	0.590	0.210	0.290	0.180		
8	0.060	0.055	0.024	0.028	0.034	0.220	0.080	0.220	0.510	0.190	0.250	0.160		
9	0.065	0.055	0.024	0.028	0.080	0.190	0.220	0.200	0.330	0.260	0.250	0.150		
10	0.060	0.055	0.024	0.028	0.065	0.200	0.180	0.180	0.290	0.210	0.130	0.150		
	(0.305)(	0.275)(	0.120)(	0.140)(	0.241)(	1.480)(	0.740)(	1.110)(	2.590)(	1.100)(	1.070)(	0.820)		
AVERAGE	< 0.061><	0.055><	0.024><	0.028><	0.048><	0.296><	0.148><	0.222><	0.518><	0.220><	0.214><	0.164>		
11	0.060	0.050	0.024	0.028	0.065	0.210	0.180	0.160	0.240	0.200	0.140	0.150		
12	0.060	0.050	0.024	0.028	0.065	0.130	0.150	0.140	0.220	0.200	0.180	0.150		
13	0.060	0.050	0.024	0.028	0.050	0.130	0.120	0.130	0.280	0.190	0.180	0.140		
14	0.060	0.050	0.040	0.028	0.040	0.120	0.150	0.120	0.290	0.180	0.180	0.130		
15	0.060	0.036	0.040	0.028	0.036	0.085	0.190	0.120	0.790	0.150	0.300	0.130		
	(0.300)(	0.236)(	0.152)(	0.140)(	0.256)(	0.675)(	0.790)(	0.670)(	1.820)(	0.920)(	0.980)(	0.700)		
AVERAGE	< 0.060><	0.047><	0.030><	0.028><	0.051><	0.135><	0.158><	0.134><	0.364><	0.184><	0.196><	0.140>		
16	0.060	0.036	0.055	0.028	0.032	0.045	0.140	0.110	3.650	0.150	0.220	0.130		
17	0.060	0.036	0.032	0.028	0.032	0.080	0.130	0.100	18.000	0.150	0.180	0.120		
18	0.060	0.036	0.030	0.028	0.034	0.090	0.100	0.100	20.000	0.150	0.210	0.100		
19	0.060	0.036	0.028	0.028	0.075	11.000	0.360	0.100	18.000	0.220	0.240	0.100		
20	0.060	0.036	0.028	0.028	2.140	4.240	0.320	0.220	5.760	0.140	0.250	0.090		
	(0.300)(	0.180)(	0.173)(	0.140)(	2.313)(	15.455)(	1.050)(	0.630)(	65.410)(	0.810)(	1.100)(	0.540)		
AVERAGE	< 0.060><	0.036><	0.035><	0.028><	0.463><	3.091><	0.210><	0.126><	13.082><	0.162><	0.220><	0.108>		
21	0.060	0.036	0.080	0.028	1.300	1.260	0.300	0.220	6.260	0.100	1.620	0.080		
22	0.060	0.034	0.036	0.028	16.000	1.140	0.260	0.220	3.410	0.200	1.570	0.080		
23	0.060	0.034	0.034	0.028	3.500	2.870	0.870	0.460	2.930	0.160	0.740	0.070		
24	0.060	0.034	0.032	0.028	2.630	2.400	2.980	9.400	1.670	0.160	1.760	0.070		
25	0.060	0.034	0.030	0.028	1.860	1.480	5.250	6.280	1.140	0.150	1.300	0.070		
	(0.300)(	0.172)(	0.212)(	0.140)(	25.290)(	9.150)(	9.660)(	16.580)(	15.410)(	0.770)(	6.990)(	0.370)		
AVERAGE	< 0.060><	0.034><	0.042><	0.028><	5.058><	1.830><	1.932><	3.316><	3.082><	0.154><	1.398><	0.074>		
26	0.060	0.034	0.028	0.028	2.530	1.140	4.140	6.340	0.840	0.130	0.840	0.070		
27	0.060	0.030	0.028	0.028	2.290	0.660	7.140	1.550	0.610	0.120	0.520	0.065		
28	0.060	0.030	0.030	0.028	0.850	0.520	12.000	0.880	0.500	0.120	0.420	0.065		
29	0.060	0.030	0.028	0.030	0.560	0.380	10.000	0.570	0.350	0.170	0.360	0.070		
30	0.060	*********	0.028	0.030	0.270	0.280	3.350	0.410	0.310	0.260	0.330	0.060		
31	0.055	*********	0.028	*********	0.190	*********	1.620	0.190	*********	0.210	*********	0.060		
	(0.355)(	0.124)(	0.170)(	0.144)(	6.690)(	2.980)(	38.250)(	9.940)(	2.610)(	1.010)(	2.470)(	0.390)		
AVERAGE	< 0.059><	0.031><	0.028><	0.029><	1.115><	0.596><	6.375><	1.657><	0.522><	0.168><	0.494><	0.065>		
GRAND TOTAL	1.895	1.262	0.951	0.856	34.938	31.250	51.390	31.880	89.810	6.060	13.550	4.060	267.901	(m³/s)
AVERAGE	20.	14.	10.	9.	377.	337.	555.	344.	970.	65.	146.	44.	2893.	(mm)
MAX	0.061	0.044	0.031	0.029	1.127	1.042	1.658	1.028	2.994	0.195	0.452	0.131	0.732	(m³/s)
MIN	0.070	0.055	0.080	0.036	16.000	11.000	12.000	9.400	20.000	0.310	1.760	0.320		(m³/s)
	0.055	0.030	0.024	0.028	0.028	0.045	0.080	0.100	0.220	0.100	0.130	0.060		(m³/s)

< COMPUTED DAILY RUNOFF > PHANG X-58

(1976)

UNIT = (CUM/D)

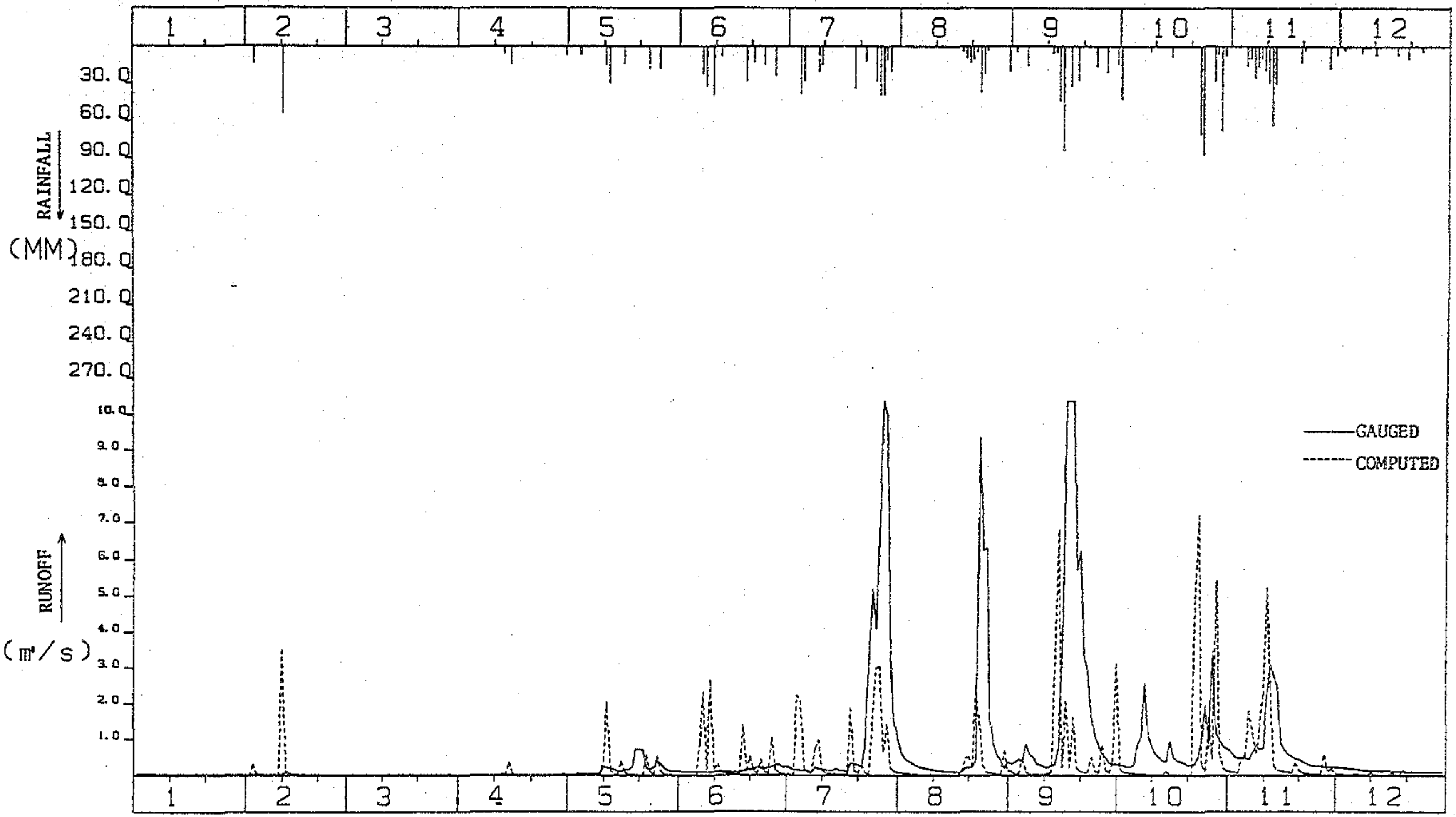
	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC		
1	0.139	0.046	0.016	0.028	0.848	0.052	0.055	0.098	0.136	2.555	0.193	0.061		
2	0.134	0.044	0.016	0.025	2.048	0.045	0.048	0.083	0.124	2.232	0.087	0.053		
3	0.129	0.043	0.015	0.022	2.148	0.039	0.042	0.070	0.047	0.204	0.066	0.047		
4	0.125	0.041	0.015	0.020	0.191	1.871	2.263	0.060	0.040	0.102	0.056	0.041		
5	0.120	0.040	0.014	0.018	0.421	1.021	2.100	0.052	0.460	0.086	0.048	0.037		
	(0.647)	(0.214)	(0.076)	(0.112)	(5.656)	(3.029)	(4.507)	(0.363)	(0.806)	(5.180)	(0.451)	(0.240)		
AVERAGE	<0.129>	<0.043>	<0.015>	<0.022>	<1.131>	<0.606>	<0.901>	<0.073>	<0.161>	<1.036>	<0.090>	<0.048>		
6	0.116	0.038	0.014	0.017	0.134	2.396	0.186	0.046	0.102	0.073	0.041	0.033		
7	0.112	0.037	0.013	0.015	0.076	0.198	0.088	0.040	0.041	0.062	0.036	0.030		
8	0.108	0.036	0.013	0.014	0.064	0.100	0.074	0.036	0.036	0.054	0.031	0.028		
9	0.104	0.034	0.012	0.224	0.054	0.080	0.784	0.032	0.031	0.047	0.028	0.025		
10	0.101	0.033	0.012	0.035	0.046	1.313	1.003	0.029	0.027	1.646	0.025	0.024		
	(0.541)	(0.179)	(0.063)	(0.306)	(0.372)	(4.087)	(2.135)	(0.182)	(0.237)	(1.882)	(0.161)	(0.140)		
AVERAGE	<0.108>	<0.036>	<0.013>	<0.061>	<0.074>	<0.817>	<0.427>	<0.036>	<0.047>	<0.376>	<0.032>	<0.028>		
11	0.097	0.032	0.011	0.019	0.039	0.175	0.172	0.026	0.024	0.155	0.022	0.022		
12	0.094	0.031	0.011	0.017	0.034	0.082	0.077	0.024	0.059	0.062	3.761	0.021		
13	0.090	0.030	1.294	0.016	0.030	0.065	0.065	0.022	0.070	0.054	0.166	0.019		
14	0.087	0.029	3.064	0.014	0.026	0.056	0.056	0.021	2.884	0.138	1.845	0.018		
15	0.084	0.028	0.141	0.013	0.024	0.048	0.049	0.019	6.838	1.628	0.180	0.017		
	(0.453)	(0.149)	(4.521)	(0.079)	(0.154)	(0.426)	(0.419)	(0.112)	(9.875)	(2.036)	(5.973)	(0.097)		
AVERAGE	<0.091>	<0.030>	<0.904>	<0.016>	<0.031>	<0.085>	<0.084>	<0.022>	<1.975>	<0.407>	<1.195>	<0.019>		
16	0.081	0.027	0.133	0.012	0.021	0.042	0.042	0.018	0.231	0.158	0.082	0.016		
17	0.078	0.026	0.638	0.011	0.019	0.037	0.037	0.017	2.089	0.065	0.069	0.016		
18	0.076	0.025	0.130	0.011	0.017	1.360	0.033	0.017	0.220	0.056	1.979	0.015		
19	0.073	0.024	0.062	3.639	0.376	3.016	1.900	0.120	1.651	0.134	0.172	0.014		
20	0.070	0.023	5.200	0.143	0.543	0.942	0.149	0.487	0.212	0.047	0.076	0.014		
	(0.379)	(0.125)	(6.163)	(3.816)	(0.977)	(5.396)	(2.162)	(0.659)	(4.403)	(0.460)	(2.378)	(0.075)		
AVERAGE	<0.076>	<0.025>	<1.233>	<0.763>	<0.195>	<1.079>	<0.432>	<0.132>	<0.881>	<0.092>	<0.476>	<0.015>		
21	0.068	0.022	0.183	0.318	5.949	0.744	0.058	0.519	0.112	0.041	8.893	0.013		
22	0.066	0.022	0.105	0.478	1.473	0.494	0.306	0.257	0.093	0.036	0.275	0.013		
23	0.063	0.021	0.088	0.112	0.451	0.160	0.087	2.508	0.079	0.032	7.817	0.012		
24	0.061	0.020	0.073	0.292	0.162	0.209	0.047	1.501	0.526	0.028	0.774	0.012		
25	0.059	0.019	0.062	1.394	4.070	2.320	1.402	0.289	0.136	0.025	0.248	0.011		
	(0.317)	(0.104)	(0.511)	(2.595)	(12.105)	(3.926)	(1.900)	(5.074)	(0.945)	(0.161)	(18.006)	(0.060)		
AVERAGE	<0.063>	<0.021>	<0.102>	<0.519>	<2.421>	<0.785>	<0.380>	<1.015>	<0.189>	<0.032>	<3.601>	<0.012>		
26	0.057	0.019	0.053	0.164	0.228	0.199	3.036	0.098	0.065	0.023	0.139	0.011		
27	0.055	0.018	0.045	0.123	0.121	0.230	3.065	0.075	0.820	0.021	0.117	0.010		
28	0.053	0.017	0.039	0.059	0.101	0.105	0.692	0.063	0.151	0.019	0.098	0.010		
29	0.051	0.017	0.034	0.050	0.085	0.075	1.443	0.053	0.062	0.018	0.083	0.010		
30	0.049	*********	0.030	0.042	0.072	0.064	0.221	0.046	0.404	5.425	0.071	0.009		
31	0.048	*********	0.099	*********	0.061	*********	0.117	0.691	*********	0.185	*********	0.009		
	(0.312)	(0.071)	(0.299)	(0.438)	(0.668)	(0.673)	(8.575)	(1.025)	(1.502)	(5.692)	(0.508)	(0.059)		
AVERAGE	<0.052>	<0.018>	<0.050>	<0.088>	<0.111>	<0.135>	<1.429>	<0.171>	<0.300>	<0.949>	<0.102>	<0.010>		
GRAND TOTAL	2.649	0.842	11.633	7.346	19.933	17.538	19.697	7.415	17.769	15.411	27.478	0.672	148.382	(m³/s)
AVERAGE	29.	9.	126.	79.	215.	189.	213.	80.	192.	166.	297.	7.	1603.	(mm)
MAX	0.085	0.029	0.375	0.245	0.643	0.585	0.635	0.239	0.592	0.497	0.916	0.022	0.405	(m³/s)
MIN	0.139	0.046	5.200	3.639	5.949	3.016	3.065	2.508	6.838	5.425	8.893	0.061		(m³/s)
	0.048	0.017	0.011	0.011	0.017	0.037	0.033	0.017	0.024	0.018	0.022	0.009		(m³/s)

RUNOFF ANALYSIS BY TANK MODEL

(1977)

RAINFALL STATION : PHANØM

COEFFICIENT = 0. 2129



GAUGING STATION : X-58 (CA = 8. 00km²)

< DAILY RAINFALL > PHANG PHANOM
(1977)

UNIT = (mm/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.2	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	2.8	
3	0.0	13.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	6.4	0.0	37.6	0.0	0.0	0.0	0.0	0.0	
5	0.0	0.0	0.0	0.0	0.0	0.0	27.7	0.0	15.1	0.0	15.1	0.0	
	(0.0)	(13.4)	(0.0)	(0.0)	(6.4)	(0.0)	(65.3)	(0.0)	(19.2)	(42.2)	(15.1)	(2.8)	
AVERAGE	< 0.0>	< 2.7>	< 0.0>	< 0.0>	< 1.3>	< 0.0>	< 13.1>	< 0.0>	< 3.8>	< 8.4>	< 3.0>	< 0.6>	
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8	0.0	
7	0.0	0.0	0.0	0.0	0.0	21.8	0.0	0.0	0.0	0.0	25.0	5.0	
8	0.0	0.0	0.0	0.0	0.0	31.0	0.0	0.0	0.0	0.0	16.1	0.0	
9	0.0	0.0	0.0	0.0	0.0	0.0	19.8	0.0	0.0	3.8	9.4	0.0	
10	0.0	0.0	0.0	0.0	0.0	38.9	14.8	0.0	0.0	0.0	19.1	0.0	
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(91.7)	(34.6)	(0.0)	(0.0)	(3.8)	(79.3)	(5.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 0.0>	< 0.0>	< 18.3>	< 6.9>	< 0.0>	< 0.0>	< 0.8>	< 15.9>	< 1.0>	
11	0.0	53.4	0.0	0.0	14.8	0.0	0.0	0.0	0.0	0.0	29.3	6.6	
12	0.0	0.0	0.0	0.0	29.3	7.4	0.0	0.0	5.2	0.0	63.1	0.0	
13	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	4.4	0.0	30.4	0.0	
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.6	0.0	0.0	0.0	
15	0.0	0.0	0.0	14.2	0.0	0.0	0.0	0.0	83.2	8.2	0.0	0.0	
	(0.0)	(53.4)	(0.0)	(19.9)	(44.0)	(7.4)	(0.0)	(0.0)	(136.3)	(8.2)	(122.8)	(6.6)	
AVERAGE	< 0.0>	< 10.7>	< 0.0>	< 4.0>	< 8.8>	< 1.5>	< 0.0>	< 0.0>	< 27.3>	< 1.6>	< 24.6>	< 1.3>	
16	0.0	0.0	0.0	0.0	13.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.4	0.0	0.0	6.5	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	
19	0.0	0.0	0.0	0.0	0.0	27.4	33.4	8.9	26.6	0.0	0.0	0.0	
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	12.2	9.2	
	(0.0)	(0.0)	(0.0)	(0.0)	(13.7)	(27.4)	(33.4)	(25.7)	(58.1)	(0.0)	(12.2)	(15.7)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 0.0>	< 2.7>	< 5.5>	< 6.7>	< 5.1>	< 11.6>	< 0.0>	< 2.4>	< 3.1>	
21	0.0	0.0	0.0	0.0	0.0	12.5	0.0	10.3	0.0	0.0	2.8	0.0	
22	0.0	0.0	0.0	0.0	0.0	0.0	11.4	4.4	0.0	0.0	0.0	0.0	
23	0.0	0.0	0.0	0.0	17.8	0.0	0.0	36.6	0.0	69.8	0.0	0.0	
24	0.0	0.0	0.0	0.0	0.0	14.2	0.0	21.2	15.8	86.8	0.0	4.1	
25	0.0	0.0	0.0	0.0	0.0	0.0	27.4	3.2	0.0	0.0	0.0	0.0	
	(0.0)	(0.0)	(0.0)	(0.0)	(17.8)	(26.6)	(38.8)	(75.8)	(15.8)	(156.6)	(2.8)	(4.1)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 0.0>	< 3.6>	< 5.3>	< 7.8>	< 15.2>	< 3.2>	< 31.3>	< 0.6>	< 0.8>	
26	0.0	0.0	0.0	0.0	17.2	0.0	38.9	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	23.0	38.6	0.0	20.5	27.8	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	5.9	17.5	0.0	
29	0.0	*********	0.0	0.0	0.0	0.0	19.4	0.0	0.0	67.7	0.0	0.0	
30	0.0	*********	0.0	6.5	0.0	0.0	0.0	0.0	13.6	7.0	6.2	0.0	
31	0.0	*********	0.0	*********	0.0	*********	0.0	19.7	*********	0.0	*********	0.0	
	(0.0)	(0.0)	(0.0)	(6.5)	(17.2)	(23.0)	(107.2)	(19.7)	(34.1)	(108.4)	(23.8)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 1.3>	< 2.9>	< 4.6>	< 17.9>	< 3.3>	< 6.8>	< 18.1>	< 4.8>	< 0.0>	
GRAND TOTAL	0.0	66.8	0.0	26.4	99.0	176.2	279.1	121.2	263.5	319.2	256.0	34.2	1641.6
AVERAGE	0.0	2.4	0.0	0.9	3.2	5.9	9.0	3.9	8.8	10.3	8.5	1.1	4.5
MAX	0.0	53.4	0.0	14.2	29.3	38.9	38.9	36.6	83.2	86.8	63.1	9.2	
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

< DAILY RUNOFF > PHANG X－58 UNIT = (CUM/D)

(1977)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC		
1	0.060	0.036	0.034	0.020	0.020	0.120	0.230	1.060	0.390	0.330	0.760	0.230		
2	0.060	0.036	0.034	0.020	0.030	0.110	0.210	0.640	0.330	0.300	0.670	0.220		
3	0.060	0.036	0.034	0.020	0.030	0.110	0.170	0.470	0.390	0.280	0.540	0.220		
4	0.060	0.040	0.034	0.020	0.030	0.100	0.150	0.420	0.460	0.230	0.490	0.210		
5	0.060	0.038	0.034	0.020	0.050	0.100	0.140	0.360	0.400	0.240	0.490	0.200		
	(0.300)(	0.186)(	0.170)(	0.100)(	0.160)(	0.540)(	0.900)(	2.950)(	1.970)(	1.380)(	2.950)(	1.080)		
AVERAGE	< 0.060><	0.037><	0.034><	0.020><	0.032><	0.108><	0.180><	0.590><	0.394><	0.276><	0.590><	0.216>		
6	0.055	0.036	0.034	0.020	0.040	0.100	0.130	0.280	0.870	0.320	0.490	0.190		
7	0.055	0.036	0.034	0.020	0.040	0.100	0.130	0.230	0.590	0.870	0.440	0.180		
8	0.050	0.036	0.034	0.020	0.040	0.090	0.080	0.220	0.510	1.100	0.630	0.170		
9	0.045	0.034	0.034	0.020	0.050	0.090	0.220	0.200	0.330	2.580	0.820	0.150		
10	0.045	0.036	0.034	0.020	0.070	0.090	0.180	0.180	0.290	1.100	0.730	0.150		
	(0.250)(	0.178)(	0.170)(	0.100)(	0.240)(	0.470)(	0.740)(	1.110)(	2.590)(	5.970)(	3.110)(	0.840)		
AVERAGE	< 0.050><	0.036><	0.034><	0.020><	0.048><	0.094><	0.148><	0.222><	0.518><	1.194><	0.622><	0.168>		
11	0.045	0.038	0.034	0.010	0.250	0.100	0.180	0.160	0.240	0.840	0.770	0.140		
12	0.040	0.090	0.034	0.010	0.220	0.100	0.150	0.140	0.220	0.610	2.080	0.140		
13	0.040	0.038	0.034	0.020	0.200	0.100	0.120	0.130	0.280	0.520	3.120	0.140		
14	0.040	0.038	0.034	0.020	0.170	0.100	0.150	0.120	0.290	0.420	2.820	0.130		
15	0.040	0.036	0.032	0.020	0.130	0.100	0.190	0.120	0.790	0.390	2.500	0.130		
	(0.205)(	0.240)(	0.168)(	0.080)(	0.970)(	0.500)(	0.790)(	0.670)(	1.820)(	2.780)(	11.290)(	0.680)		
AVERAGE	< 0.041><	0.048><	0.034><	0.016><	0.194><	0.100><	0.158><	0.134><	0.364><	0.556><	2.258><	0.136>		
16	0.040	0.036	0.032	0.020	0.120	0.090	0.140	0.110	3.650	0.960	0.900	0.130		
17	0.040	0.036	0.032	0.020	0.160	0.090	0.130	0.100	18.000	0.520	0.710	0.120		
18	0.038	0.036	0.032	0.020	0.170	0.090	0.100	0.100	20.000	0.420	0.590	0.120		
19	0.038	0.036	0.032	0.020	0.230	0.120	0.360	0.100	18.000	0.380	0.540	0.120		
20	0.038	0.034	0.030	0.020	0.740	0.150	0.320	0.220	5.760	0.350	0.470	0.120		
	(0.194)(	0.178)(	0.158)(	0.100)(	1.420)(	0.540)(	1.050)(	0.630)(	65.410)(	2.630)(	3.210)(	0.610)		
AVERAGE	< 0.039><	0.036><	0.032><	0.020><	0.284><	0.108><	0.210><	0.126><	13.082><	0.526><	0.642><	0.122>		
21	0.038	0.034	0.030	0.020	0.730	0.170	0.300	0.220	6.260	0.280	0.450	0.110		
22	0.038	0.034	0.030	0.020	0.720	0.180	0.260	0.220	3.410	0.290	0.400	0.110		
23	0.038	0.034	0.028	0.020	0.210	0.220	0.870	0.460	2.930	0.310	0.320	0.110		
24	0.038	0.034	0.028	0.020	0.180	0.200	2.980	9.400	1.670	0.540	0.290	0.110		
25	0.036	0.034	0.028	0.020	0.230	0.180	5.250	6.280	1.140	1.080	0.270	0.100		
	(0.188)(	0.170)(	0.144)(	0.100)(	2.070)(	0.950)(	9.660)(	16.580)(	15.410)(	2.500)(	1.730)(	0.540)		
AVERAGE	< 0.038><	0.034><	0.029><	0.020><	0.414><	0.190><	1.932><	3.316><	3.082><	0.500><	0.346><	0.108>		
26	0.036	0.034	0.028	0.020	0.410	0.210	4.140	6.340	0.840	1.960	0.260	0.100		
27	0.036	0.036	0.028	0.020	0.320	0.230	7.140	1.550	0.610	0.770	0.250	0.100		
28	0.036	0.034	0.028	0.020	0.210	0.310	12.000	0.880	0.500	3.500	0.240	0.100		
29	0.036	*********	0.026	0.020	0.150	0.290	10.000	0.570	0.350	1.180	0.240	0.100		
30	0.036	*********	0.026	0.020	0.120	0.220	3.350	0.410	0.310	0.960	0.230	0.100		
31	0.036	*********	0.026	*********	0.120	*********	1.620	0.190	*********	0.800	*********	0.100		
	(0.216)(	0.104)(	0.162)(	0.100)(	1.330)(	1.260)(	38.250)(	9.940)(	2.610)(	9.170)(	1.220)(	0.600)		
AVERAGE	< 0.036><	0.035><	0.027><	0.020><	0.222><	0.252><	6.375><	1.657><	0.522><	1.528><	0.244><	0.100>		
GRAND TOTAL	1.353	1.056	0.972	0.580	6.190	4.260	51.390	31.880	89.810	24.430	23.510	4.350	239.781	(m³/s)
AVERAGE	15.	11.	10.	6.	67.	46.	555.	344.	970.	264.	254.	47.	2590.	(mm)
MAX	0.044	0.038	0.031	0.019	0.200	0.142	1.658	1.028	2.994	0.788	0.784	0.140	0.657	(m³/s)
MIN	0.060	0.090	0.034	0.020	0.740	0.310	12.000	9.400	20.000	3.500	3.120	0.230		(m³/s)
	0.036	0.034	0.026	0.010	0.020	0.090	0.080	0.100	0.220	0.230	0.230	0.100		(m³/s)

< DAILY RUNOFF > (1977) PHANG X－58

UNIT = (CUM/D)

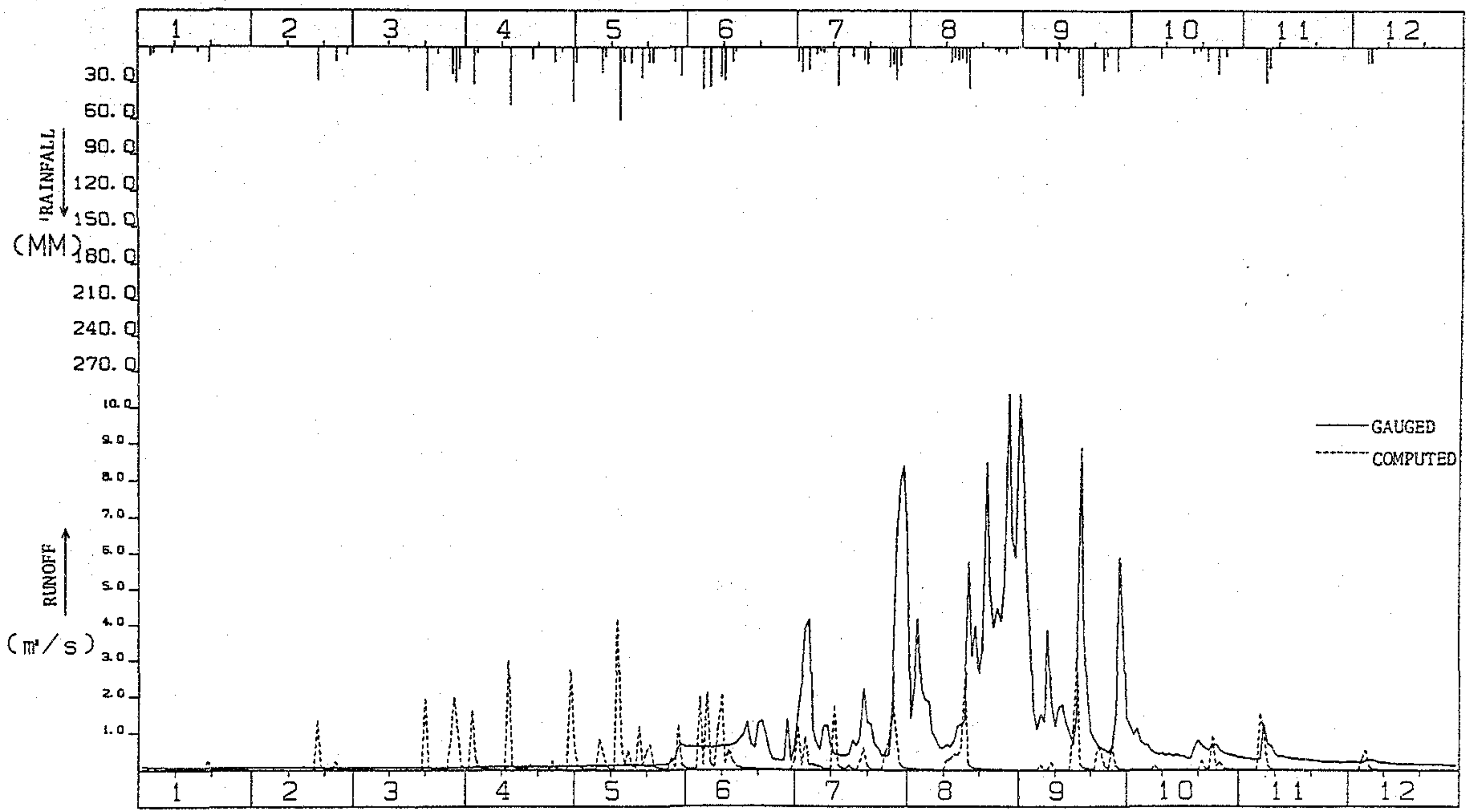
	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC		
1	0.009	0.006	0.007	0.003	0.006	0.016	0.034	0.093	0.134	3.155	0.122	0.062		
2	0.009	0.005	0.006	0.003	0.005	0.014	0.029	0.078	0.122	0.188	0.102	0.044		
3	0.009	0.321	0.006	0.003	0.005	0.012	0.025	0.066	0.045	0.089	0.086	0.038		
4	0.009	0.044	0.006	0.003	0.069	0.010	2.247	0.056	0.039	0.075	0.073	0.034		
5	0.008	0.015	0.006	0.003	0.008	0.009	2.084	0.048	0.458	0.064	0.497	0.030		
	(0.044)	(0.392)	(0.031)	(0.016)	(0.093)	(0.062)	(4.419)	(0.340)	(0.799)	(3.571)	(0.881)	(0.206)		
AVERAGE	<0.009>	<0.078>	<0.006>	<0.003>	<0.019>	<0.012>	<0.884>	<0.068>	<0.160>	<0.714>	<0.176>	<0.041>		
6	0.008	0.013	0.005	0.003	0.007	0.008	0.171	0.041	0.101	0.055	0.551	0.027		
7	0.008	0.012	0.005	0.003	0.006	0.918	0.074	0.036	0.040	0.047	1.801	0.062		
8	0.008	0.010	0.005	0.003	0.005	2.346	0.061	0.032	0.034	0.041	1.136	0.025		
9	0.008	0.009	0.005	0.003	0.004	0.155	0.771	0.028	0.030	0.051	0.621	0.023		
10	0.008	0.008	0.005	0.003	0.004	2.684	0.991	0.025	0.026	0.033	1.357	0.021		
	(0.040)	(0.053)	(0.026)	(0.015)	(0.026)	(6.111)	(2.068)	(0.162)	(0.231)	(0.228)	(5.466)	(0.159)		
AVERAGE	<0.008>	<0.011>	<0.005>	<0.003>	<0.005>	<1.222>	<0.414>	<0.032>	<0.046>	<0.046>	<1.093>	<0.032>		
11	0.008	3.507	0.005	0.003	0.421	0.182	0.161	0.023	0.023	0.029	2.273	0.088		
12	0.008	0.134	0.005	0.003	2.063	0.310	0.066	0.021	0.058	0.027	5.268	0.022		
13	0.007	0.056	0.005	0.044	0.138	0.107	0.055	0.019	0.069	0.024	2.517	0.021		
14	0.007	0.046	0.004	0.005	0.046	0.062	0.046	0.017	2.883	0.022	0.272	0.019		
15	0.007	0.038	0.004	0.365	0.037	0.051	0.039	0.016	6.837	0.123	0.144	0.018		
	(0.037)	(3.781)	(0.023)	(0.419)	(2.704)	(0.713)	(0.367)	(0.096)	(9.870)	(0.225)	(10.474)	(0.167)		
AVERAGE	<0.007>	<0.756>	<0.005>	<0.084>	<0.541>	<0.143>	<0.073>	<0.019>	<1.974>	<0.045>	<2.095>	<0.033>		
16	0.007	0.031	0.004	0.055	0.396	0.042	0.033	0.015	0.230	0.033	0.121	0.016		
17	0.007	0.026	0.004	0.016	0.089	0.035	0.029	0.014	2.088	0.023	0.103	0.081		
18	0.007	0.022	0.004	0.013	0.033	0.029	0.025	0.014	0.219	0.021	0.087	0.018		
19	0.007	0.019	0.004	0.011	0.027	1.403	1.891	0.117	1.650	0.019	0.075	0.017		
20	0.007	0.016	0.004	0.009	0.023	0.140	0.141	0.485	0.211	0.017	0.362	0.165		
	(0.035)	(0.116)	(0.021)	(0.104)	(0.569)	(1.650)	(2.119)	(0.646)	(4.398)	(0.112)	(0.749)	(0.297)		
AVERAGE	<0.007>	<0.023>	<0.004>	<0.021>	<0.114>	<0.330>	<0.424>	<0.129>	<0.880>	<0.022>	<0.150>	<0.059>		
21	0.007	0.014	0.004	0.008	0.019	0.517	0.050	0.517	0.111	0.016	0.163	0.036		
22	0.006	0.013	0.004	0.007	0.016	0.126	0.299	0.255	0.093	0.015	0.070	0.020		
23	0.006	0.011	0.004	0.006	0.574	0.048	0.080	2.506	0.078	4.975	0.056	0.018		
24	0.006	0.010	0.004	0.005	0.113	0.438	0.040	1.498	0.525	7.226	0.050	0.034		
25	0.006	0.009	0.004	0.005	0.028	0.108	1.396	0.287	0.135	0.272	0.044	0.016		
	(0.032)	(0.057)	(0.019)	(0.031)	(0.749)	(1.236)	(1.865)	(5.062)	(0.942)	(12.504)	(0.383)	(0.123)		
AVERAGE	<0.006>	<0.011>	<0.004>	<0.006>	<0.150>	<0.247>	<0.373>	<1.012>	<0.188>	<2.501>	<0.077>	<0.025>		
26	0.006	0.008	0.004	0.004	0.555	0.042	3.030	0.096	0.064	0.135	0.039	0.014		
27	0.006	0.008	0.004	0.004	0.115	1.047	3.059	0.073	0.819	1.514	0.036	0.013		
28	0.006	0.007	0.004	0.004	0.034	0.144	0.686	0.061	0.150	0.473	0.581	0.012		
29	0.006	*********	0.004	0.003	0.028	0.055	1.438	0.052	0.062	5.454	0.129	0.011		
30	0.006	*********	0.003	0.059	0.023	0.041	0.216	0.044	0.403	0.592	0.196	0.011		
31	0.006	*********	0.003	*********	0.019	*********	0.111	0.689	*********	0.201	*********	0.010		
	(0.035)	(0.023)	(0.021)	(0.074)	(0.774)	(1.328)	(8.541)	(1.014)	(1.499)	(8.370)	(0.981)	(0.073)		
AVERAGE	<0.006>	<0.008>	<0.004>	<0.015>	<0.129>	<0.266>	<1.423>	<0.169>	<0.300>	<1.395>	<0.196>	<0.012>		
GRAND TOTAL	0.223	4.422	0.141	0.660	4.916	11.100	19.379	7.320	17.738	25.010	18.934	1.025	110.869	(m³/s)
AVERAGE	2.	48.	2.	7.	53.	120.	209.	79.	192.	270.	204.	11.	1197.	(mm)
MAX	0.007	0.158	0.005	0.022	0.159	0.370	0.625	0.236	0.591	0.807	0.631	0.033	0.304	(m³/s)
MIN	0.009	3.507	0.007	0.365	2.063	2.684	3.059	2.506	6.837	7.226	5.268	0.165		(m³/s)
	0.006	0.005	0.003	0.003	0.004	0.008	0.025	0.014	0.023	0.015	0.036	0.010		(m³/s)

RUNOFF ANALYSIS BY TANK MODEL

(1978)

RAINFALL STATION: PHANØM

COEFFICIENT = -0.0162



GAUGING STATION : X-58 (CA = 8.00km²)

< DAILY RAINFALL > PHANG PHANOM
(1978)

UNIT = (mm/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	0.0	0.0	0.0	0.0	12.0	0.0	11.5	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	19.8	0.0	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	30.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	7.3	0.0	0.0	3.8	0.0	0.0	18.1	0.0	0.0	0.0	0.0	0.0	
5	4.9	0.0	0.0	0.0	0.0	34.6	0.0	0.0	0.0	0.0	0.0	12.7	
	(12.2)	(0.0)	(0.0)	(34.2)	(12.0)	(34.6)	(49.4)	(0.0)	(0.0)	(0.0)	(0.0)	(12.7)	
AVERAGE	<2.4>	<0.0>	<0.0>	<6.8>	<2.4>	<6.9>	<9.9>	<0.0>	<0.0>	<0.0>	<0.0>	<2.5>	
6	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	12.0	
7	0.0	0.0	0.0	0.0	0.0	32.3	2.8	0.0	9.1	0.0	29.2	0.0	
8	0.0	0.0	0.0	0.0	20.9	0.0	4.0	0.0	0.0	0.0	16.3	0.0	
9	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	8.6	0.0	0.0	
10	4.3	0.0	0.0	0.0	0.0	24.0	0.0	0.0	10.6	0.0	0.0	0.0	
	(4.3)	(0.0)	(0.0)	(0.0)	(28.6)	(56.3)	(12.0)	(0.0)	(19.7)	(8.6)	(45.5)	(12.0)	
AVERAGE	<0.9>	<0.0>	<0.0>	<0.0>	<5.7>	<11.3>	<2.4>	<0.0>	<3.9>	<1.7>	<9.1>	<2.4>	
11	0.0	0.0	0.0	0.0	0.0	27.0	0.0	0.0	0.0	0.0	0.0	0.0	
12	0.0	0.0	0.0	0.0	0.0	0.0	31.6	12.2	1.3	0.0	0.0	0.0	
13	0.0	0.0	0.0	47.3	60.0	12.0	0.0	7.8	3.5	0.0	0.0	0.0	
14	0.0	0.0	0.0	0.0	11.4	3.1	0.0	10.4	0.0	0.0	0.0	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.0	
	(0.0)	(0.0)	(0.0)	(47.3)	(71.4)	(42.1)	(31.6)	(39.0)	(4.8)	(0.0)	(0.0)	(0.0)	
AVERAGE	<0.0>	<0.0>	<0.0>	<9.5>	<14.3>	<8.4>	<6.3>	<7.8>	<1.0>	<0.0>	<0.0>	<0.0>	
16	0.0	0.0	3.6	0.0	12.4	0.0	7.7	12.2	24.8	0.0	0.0	0.0	
17	3.6	0.0	0.0	0.0	0.0	0.0	0.0	33.6	39.1	0.0	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	
19	0.0	28.0	0.0	9.4	24.8	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
20	12.0	0.0	0.0	0.0	0.0	0.0	13.7	0.0	0.0	2.9	0.0	0.0	
	(15.6)	(28.0)	(3.6)	(9.4)	(37.2)	(0.0)	(31.3)	(45.8)	(64.0)	(7.2)	(0.0)	(0.0)	
AVERAGE	<3.1>	<5.6>	<0.7>	<1.9>	<7.4>	<0.0>	<6.3>	<9.2>	<12.8>	<1.4>	<0.0>	<0.0>	
21	0.0	0.0	35.5	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
22	0.0	0.0	0.0	0.0	12.4	0.0	0.0	0.0	0.0	11.4	0.0	0.0	
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7	0.0	0.0	0.0	
24	0.0	11.4	5.0	0.0	0.0	0.0	0.0	1.6	7.0	0.0	0.0	0.0	
25	0.0	0.0	0.0	11.5	0.0	0.0	0.0	3.0	0.0	21.8	0.0	0.0	
	(0.0)	(11.4)	(40.6)	(11.5)	(24.4)	(0.0)	(0.0)	(4.6)	(25.7)	(33.2)	(0.0)	(0.0)	
AVERAGE	<0.0>	<2.3>	<8.1>	<2.3>	<4.9>	<0.0>	<0.0>	<0.9>	<5.1>	<6.6>	<0.0>	<0.0>	
26	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	
27	0.0	6.2	0.0	3.6	0.0	0.0	13.6	4.9	19.3	7.0	0.0	0.0	
28	0.0	0.0	21.6	0.0	12.1	0.0	26.4	0.0	0.0	0.0	0.0	0.0	
29	0.0	*********	28.3	0.0	0.0	0.0	14.6	0.0	0.0	0.0	0.0	0.0	
30	0.0	*********	17.8	44.4	23.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
31	0.0	*********	0.0	*********	0.0	*********	0.0	0.0	*********	0.0	*********	0.0	
	(0.0)	(6.2)	(67.7)	(48.0)	(35.6)	(0.0)	(70.6)	(4.9)	(19.3)	(7.0)	(0.0)	(0.0)	
AVERAGE	<0.0>	<2.1>	<11.3>	<9.6>	<5.9>	<0.0>	<11.8>	<0.8>	<3.9>	<1.2>	<0.0>	<0.0>	
GRAND TOTAL	32.2	45.6	111.8	150.4	209.2	133.0	194.9	94.3	133.4	56.0	45.5	24.7	1231.0
AVERAGE	1.0	1.6	3.6	5.0	6.7	4.4	6.3	3.0	4.4	1.8	1.5	0.8	3.4
MAX	12.0	28.0	35.5	47.3	60.0	34.6	31.6	33.6	39.1	21.8	29.2	12.7	
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

< DAILY RUNOFF > (1978)

P H A N G
X − 5 8

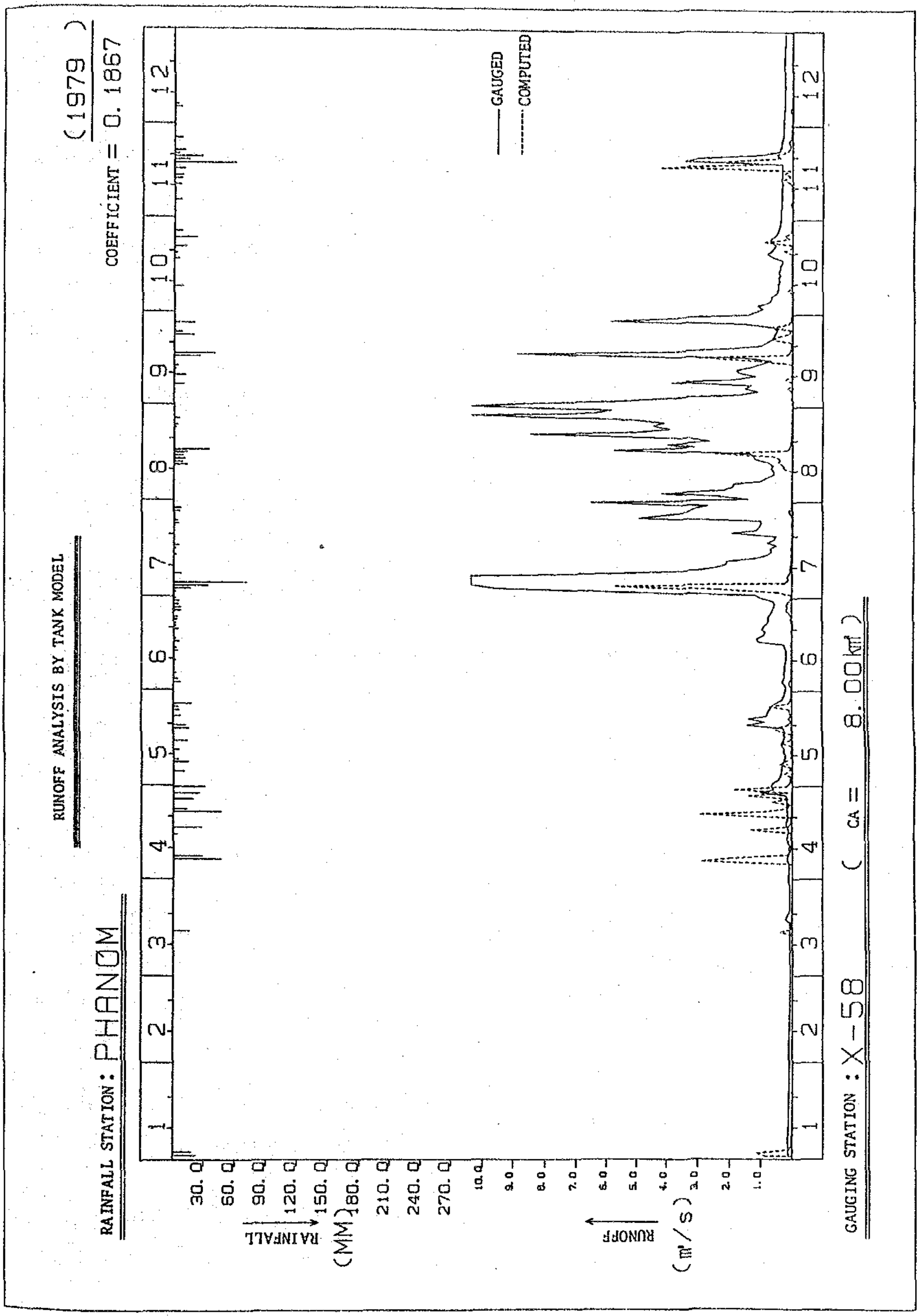
UNIT = (CUM/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	1 0 OCT	1 1 NOV	1 2 DEC		
1	0.100	0.080	0.070	0.080	0.120	0.640	0.660	6.540	13.630	1.440	0.360	0.230		
2	0.100	0.080	0.070	0.080	0.120	0.640	1.690	1.420	8.640	1.200	0.350	0.240		
3	0.100	0.080	0.070	0.080	0.120	0.640	2.450	2.420	5.570	0.980	0.330	0.240		
4	0.090	0.080	0.070	0.100	0.120	0.640	3.920	4.180	3.890	1.140	0.320	0.220		
5	0.090	0.080	0.070	0.100	0.130	0.630	4.180	2.240	1.720	0.790	0.300	0.220		
	(0.480)	(0.400)	(0.350)	(0.440)	(0.610)	(3.190)	(12.900)	(16.800)	(33.450)	(5.550)	(1.660)	(1.150)		
AVERAGE	<0.096>	<0.080>	<0.070>	<0.088>	<0.122>	<0.638>	<2.580>	<3.360>	<6.690>	<1.110>	<0.332>	<0.230>		
6	0.090	0.080	0.070	0.100	0.130	0.630	1.100	1.930	1.120	0.700	0.300	0.270		
7	0.090	0.080	0.070	0.100	0.130	0.630	0.740	1.860	1.520	0.700	0.320	0.290		
8	0.090	0.080	0.080	0.100	0.130	0.610	0.570	1.020	1.340	0.530	1.260	0.280		
9	0.080	0.080	0.080	0.100	0.130	0.640	1.200	0.840	3.860	0.470	0.730	0.250		
10	0.080	0.080	0.080	0.100	0.130	0.640	1.220	0.610	1.860	0.450	0.660	0.220		
	(0.430)	(0.400)	(0.380)	(0.500)	(0.650)	(3.150)	(4.830)	(6.260)	(9.700)	(2.850)	(3.270)	(1.310)		
AVERAGE	<0.086>	<0.080>	<0.076>	<0.100>	<0.130>	<0.630>	<0.966>	<1.252>	<1.940>	<0.570>	<0.654>	<0.262>		
11	0.080	0.080	0.080	0.100	0.150	0.660	0.680	0.600	1.220	0.460	0.460	0.220		
12	0.080	0.080	0.080	0.100	0.150	0.670	0.450	0.700	1.720	0.410	0.390	0.210		
13	0.080	0.080	0.080	0.110	0.150	0.670	0.410	0.640	1.810	0.440	0.380	0.200		
14	0.080	0.080	0.080	0.110	0.150	0.700	0.400	0.800	1.320	0.390	0.360	0.190		
15	0.080	0.090	0.080	0.110	0.150	0.740	0.400	1.220	1.020	0.440	0.340	0.180		
	(0.400)	(0.410)	(0.400)	(0.530)	(0.750)	(3.440)	(2.340)	(3.960)	(7.090)	(2.140)	(1.930)	(1.000)		
AVERAGE	<0.080>	<0.082>	<0.080>	<0.106>	<0.150>	<0.688>	<0.468>	<0.792>	<1.418>	<0.428>	<0.386>	<0.200>		
16	0.080	0.080	0.080	0.110	0.160	0.870	0.440	1.260	0.710	0.390	0.330	0.180		
17	0.080	0.080	0.080	0.100	0.160	0.960	0.800	1.360	1.500	0.380	0.320	0.180		
18	0.080	0.080	0.080	0.100	0.160	1.300	0.670	5.790	8.920	0.330	0.300	0.180		
19	0.080	0.080	0.070	0.100	0.150	0.710	0.870	3.150	3.800	0.330	0.300	0.180		
20	0.080	0.070	0.070	0.100	0.150	0.610	2.240	3.980	1.960	0.630	0.290	0.170		
	(0.400)	(0.390)	(0.380)	(0.510)	(0.780)	(4.450)	(5.020)	(15.540)	(16.890)	(2.060)	(1.540)	(0.890)		
AVERAGE	<0.080>	<0.078>	<0.076>	<0.102>	<0.156>	<0.890>	<1.004>	<3.108>	<3.378>	<0.412>	<0.308>	<0.178>		
21	0.080	0.070	0.070	0.100	0.140	1.280	1.300	2.680	1.040	0.820	0.280	0.170		
22	0.080	0.070	0.070	0.110	0.140	1.360	1.260	3.350	0.840	0.680	0.270	0.160		
23	0.080	0.070	0.070	0.110	0.140	1.020	0.710	8.500	0.680	0.600	0.260	0.160		
24	0.080	0.070	0.070	0.100	0.160	0.520	0.600	5.100	0.590	0.540	0.240	0.160		
25	0.080	0.070	0.070	0.100	0.160	0.300	0.400	3.950	0.560	0.710	0.240	0.160		
	(0.400)	(0.350)	(0.350)	(0.520)	(0.740)	(4.480)	(4.270)	(23.580)	(3.710)	(3.350)	(1.290)	(0.810)		
AVERAGE	<0.080>	<0.070>	<0.070>	<0.104>	<0.148>	<0.896>	<0.854>	<4.716>	<0.742>	<0.670>	<0.258>	<0.162>		
26	0.080	0.070	0.070	0.110	0.170	0.280	0.390	4.490	0.490	0.700	0.230	0.160		
27	0.080	0.070	0.070	0.120	0.180	0.270	0.410	4.140	0.640	0.560	0.230	0.160		
28	0.080	0.070	0.070	0.120	0.240	0.270	1.640	5.180	1.550	0.470	0.230	0.150		
29	0.080	*********	0.070	0.120	0.330	1.400	6.420	11.810	5.910	0.450	0.220	0.150		
30	0.080	*********	0.070	0.120	0.630	0.260	8.010	6.500	3.860	0.410	0.220	0.140		
31	0.080	*********	0.070	*********	0.700	*********	8.410	5.910	*********	0.400	*********	0.140		
	(0.480)	(0.210)	(0.420)	(0.590)	(2.250)	(2.480)	(25.280)	(38.030)	(12.450)	(2.990)	(1.130)	(0.900)		
AVERAGE	<0.080>	<0.070>	<0.070>	<0.118>	<0.375>	<0.496>	<4.213>	<6.338>	<2.490>	<0.498>	<0.226>	<0.150>		
GRAND TOTAL	2.590	2.160	2.280	3.090	5.780	21.190	54.640	104.170	83.290	18.940	10.820	6.060	315.009	(m³/s)
AVERAGE	28.	23.	25.	33.	62.	229.	590.	1125.	900.	205.	117.	65.	3402.	(mm)
MAX	0.084	0.077	0.074	0.103	0.186	0.706	1.763	3.360	2.776	0.611	0.361	0.195	0.863	(m³/s)
MIN	0.100	0.090	0.080	0.120	0.700	1.400	8.410	11.810	13.630	1.440	1.260	0.290		(m³/s)
	0.080	0.070	0.070	0.080	0.120	0.260	0.390	0.600	0.490	0.330	0.220	0.140		(m³/s)

< DAILY RUNOFF > (1978) PHANG X-58

UNIT = (CUM/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	0.010	0.007	0.015	0.064	0.753	0.057	0.276	0.064	0.014	0.034	0.020	0.007	
2	0.010	0.007	0.013	0.052	0.154	0.046	1.156	0.054	0.013	0.029	0.018	0.007	
3	0.009	0.006	0.011	1.607	0.060	0.039	0.132	0.046	0.012	0.025	0.016	0.006	
4	0.081	0.006	0.010	0.291	0.049	0.034	0.882	0.039	0.011	0.022	0.014	0.006	
5	0.088	0.006	0.009	0.079	0.041	2.018	0.145	0.034	0.011	0.019	0.013	0.321	
	(0.198)	(0.032)	(0.058)	(2.094)	(1.058)	(2.193)	(2.592)	(0.238)	(0.062)	(0.131)	(0.080)	(0.347)	
AVERAGE	<0.040>	<0.006>	<0.012>	<0.419>	<0.212>	<0.439>	<0.518>	<0.048>	<0.012>	<0.026>	<0.016>	<0.069>	
6	0.016	0.006	0.008	0.052	0.035	0.153	0.165	0.029	0.010	0.017	0.011	0.551	
7	0.014	0.006	0.007	0.043	0.029	2.125	0.116	0.026	0.149	0.015	1.524	0.109	
8	0.013	0.006	0.007	0.036	0.837	0.177	0.110	0.023	0.027	0.014	1.100	0.030	
9	0.012	0.005	0.006	0.030	0.479	0.083	0.044	0.020	0.015	0.138	0.144	0.025	
10	0.023	0.005	0.006	0.025	0.113	1.177	0.037	0.018	0.221	0.031	0.051	0.021	
	(0.079)	(0.028)	(0.034)	(0.187)	(1.492)	(3.716)	(0.472)	(0.117)	(0.422)	(0.216)	(2.830)	(0.736)	
AVERAGE	<0.016>	<0.006>	<0.007>	<0.037>	<0.298>	<0.743>	<0.094>	<0.023>	<0.084>	<0.043>	<0.566>	<0.147>	
11	0.011	0.005	0.005	0.022	0.044	2.062	0.032	0.017	0.043	0.017	0.043	0.018	
12	0.010	0.005	0.005	0.019	0.037	0.194	1.745	0.279	0.020	0.015	0.036	0.016	
13	0.010	0.005	0.005	3.014	4.158	0.539	0.144	0.308	0.021	0.014	0.030	0.014	
14	0.009	0.005	0.005	0.139	0.735	0.268	0.053	0.450	0.016	0.013	0.026	0.012	
15	0.009	0.005	0.005	0.056	0.180	0.108	0.045	0.421	0.014	0.012	0.022	0.011	
	(0.049)	(0.025)	(0.025)	(3.250)	(5.154)	(3.172)	(2.019)	(1.474)	(0.113)	(0.071)	(0.156)	(0.071)	
AVERAGE	<0.010>	<0.005>	<0.005>	<0.650>	<1.031>	<0.634>	<0.404>	<0.295>	<0.023>	<0.014>	<0.031>	<0.014>	
16	0.008	0.005	0.004	0.047	0.531	0.071	0.129	0.590	1.143	0.011	0.019	0.010	
17	0.008	0.005	0.004	0.039	0.148	0.060	0.040	2.498	3.012	0.010	0.017	0.009	
18	0.008	0.005	0.004	0.033	0.071	0.052	0.033	0.163	0.163	0.034	0.015	0.008	
19	0.008	1.349	0.004	0.159	1.207	0.044	0.217	0.078	0.070	0.011	0.013	0.008	
20	0.264	0.103	0.004	0.031	0.162	0.039	0.601	0.065	0.058	0.010	0.012	0.007	
	(0.296)	(1.466)	(0.021)	(0.308)	(2.120)	(0.266)	(1.020)	(3.394)	(4.446)	(0.076)	(0.076)	(0.042)	
AVERAGE	<0.059>	<0.293>	<0.004>	<0.062>	<0.424>	<0.053>	<0.204>	<0.679>	<0.889>	<0.015>	<0.015>	<0.008>	
21	0.039	0.030	1.938	0.025	0.500	0.034	0.131	0.055	0.048	0.009	0.011	0.007	
22	0.016	0.025	0.098	0.022	0.693	0.030	0.043	0.046	0.040	0.266	0.010	0.006	
23	0.014	0.021	0.035	0.019	0.164	0.027	0.037	0.040	0.646	0.052	0.010	0.006	
24	0.012	0.237	0.040	0.016	0.069	0.024	0.032	0.034	0.440	0.018	0.009	0.006	
25	0.011	0.036	0.025	0.249	0.058	0.022	0.028	0.030	0.105	0.909	0.008	0.006	
	(0.092)	(0.349)	(2.136)	(0.331)	(1.484)	(0.135)	(0.271)	(0.205)	(1.280)	(1.254)	(0.048)	(0.031)	
AVERAGE	<0.018>	<0.070>	<0.427>	<0.066>	<0.297>	<0.027>	<0.054>	<0.041>	<0.256>	<0.251>	<0.010>	<0.006>	
26	0.010	0.021	0.021	0.040	0.049	0.020	0.499	0.026	0.047	0.123	0.008	0.005	
27	0.009	0.064	0.017	0.031	0.042	0.018	0.791	0.045	0.702	0.227	0.008	0.005	
28	0.009	0.018	0.769	0.018	0.327	0.017	1.966	0.022	0.135	0.060	0.007	0.005	
29	0.008	*********	1.991	0.016	0.081	0.016	0.997	0.019	0.048	0.032	0.007	0.005	
30	0.008	*********	1.126	2.768	1.193	0.015	0.174	0.017	0.041	0.027	0.007	0.005	
31	0.007	*********	0.134	*********	0.145	*********	0.077	0.016	*********	0.023	*********	0.005	
	(0.051)	(0.102)	(4.058)	(2.872)	(1.837)	(0.085)	(4.503)	(0.145)	(0.973)	(0.493)	(0.037)	(0.031)	
AVERAGE	<0.009>	<0.034>	<0.676>	<0.574>	<0.306>	<0.017>	<0.750>	<0.024>	<0.195>	<0.082>	<0.007>	<0.005>	
GRAND TOTAL	0.765	2.003	6.333	9.042	13.145	9.568	10.877	5.573	7.295	2.240	3.228	1.258	71.325 (m³/s)
AVERAGE	8.	22.	68.	98.	142.	103.	117.	60.	79.	24.	35.	14.	770. (mm)
MAX	0.025	0.072	0.204	0.301	0.424	0.319	0.351	0.180	0.243	0.072	0.108	0.041	0.195 (m³/s)
MIN	0.264	1.349	1.991	3.014	4.158	2.125	1.966	2.498	3.012	0.909	1.524	0.551	(m³/s)
	0.007	0.005	0.004	0.016	0.029	0.015	0.028	0.016	0.010	0.009	0.007	0.005	(m³/s)


RUNOFF ANALYSIS BY TANK MODEL
RAINFALL STATION : PHANOM
(1979)
COEFFICIENT = 0.1867
GAUGED
COMPUTED
RAINFALL
(MM)
30.0
60.0
90.0
120.0
150.0
180.0
210.0
240.0
270.0
RUNOFF
(m³/s)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
1
2
3
4
5
6
7
8
9
10
11
12
GAUGING STATION : X-58
(CA = 8.00km²)

< DAILY RAINFALL > (1979) PHANG PHANOM

UNIT = (mm/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	22.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	
3	17.4	0.0	0.0	0.0	0.0	6.1	15.8	0.0	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	3.8	32.8	0.0	0.0	0.0	0.0	0.0	
5	0.0	0.0	0.0	0.0	10.2	0.0	70.2	0.0	0.0	0.0	0.0	0.0	
	(39.4)	(0.0)	(0.0)	(0.0)	(10.2)	(10.0)	(120.6)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	
AVERAGE	< 7.9>	< 0.0>	< 0.0>	< 0.0>	< 2.0>	< 2.0>	< 24.1>	< 0.0>	< 0.0>	< 0.0>	< 0.0>	< 0.0>	
6	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	6.4	6.2	
7	0.0	0.0	0.0	46.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	3.2	
8	0.0	0.0	0.0	27.6	13.7	0.0	6.5	0.0	0.0	0.0	0.0	0.0	
9	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	8.6	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	10.6	0.0	0.0	0.0	
	(0.0)	(0.0)	(0.0)	(73.6)	(18.1)	(3.8)	(6.5)	(0.0)	(19.7)	(8.6)	(6.4)	(9.5)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 14.7>	< 3.6>	< 0.8>	< 1.3>	< 0.0>	< 3.9>	< 1.7>	< 1.3>	< 1.9>	
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	
12	0.0	0.0	0.0	0.0	5.3	0.0	0.0	12.2	1.3	0.0	0.0	0.0	
13	0.0	0.0	0.0	0.0	0.0	3.6	0.0	7.8	3.5	0.0	7.4	0.0	
14	0.0	0.0	0.0	0.0	0.0	2.5	2.2	10.4	0.0	0.0	8.6	0.0	
15	0.0	0.0	15.0	3.7	12.7	0.0	0.0	8.5	0.0	0.0	0.0	0.0	
	(0.0)	(0.0)	(15.0)	(3.7)	(18.0)	(6.1)	(2.2)	(39.0)	(4.8)	(0.0)	(22.0)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 3.0>	< 0.7>	< 3.6>	< 1.2>	< 0.4>	< 7.8>	< 1.0>	< 0.0>	< 4.4>	< 0.0>	
16	0.0	0.0	0.0	0.0	0.0	5.0	1.6	12.2	24.8	0.0	9.7	0.0	
17	0.0	0.0	0.0	27.0	0.0	1.6	4.4	33.6	39.1	0.0	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	59.4	0.0	
19	0.0	0.0	0.0	0.0	14.5	0.0	0.0	0.0	0.0	0.0	14.3	0.0	
20	0.0	0.0	0.0	0.0	11.8	4.2	0.0	0.0	0.0	2.9	27.1	0.0	
	(0.0)	(0.0)	(0.0)	(27.0)	(26.3)	(10.8)	(6.0)	(45.8)	(64.0)	(7.2)	(110.5)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 5.4>	< 5.3>	< 2.2>	< 1.2>	< 9.2>	< 12.8>	< 1.4>	< 22.1>	< 0.0>	
21	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	4.4	0.0	
22	0.0	0.0	0.0	46.3	0.0	1.9	0.0	0.0	0.0	11.4	9.8	0.0	
23	0.0	0.0	0.0	12.6	6.5	3.6	0.0	0.0	18.7	0.0	0.0	0.0	
24	0.0	0.0	0.0	0.0	0.0	3.4	4.2	1.6	7.0	0.0	0.0	0.0	
25	0.0	0.0	0.0	0.0	5.3	0.0	3.2	3.0	0.0	21.8	0.0	0.0	
	(0.0)	(0.0)	(0.0)	(58.9)	(11.8)	(10.6)	(7.4)	(4.6)	(25.7)	(33.2)	(14.3)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 11.8>	< 2.4>	< 2.1>	< 1.5>	< 0.9>	< 5.1>	< 6.6>	< 2.9>	< 0.0>	
26	0.0	0.0	0.0	18.8	4.3	6.5	0.0	0.0	0.0	0.0	7.1	0.0	
27	0.0	0.0	0.0	0.0	17.5	6.7	0.0	4.9	19.3	7.0	0.0	0.0	
28	0.0	0.0	0.0	25.0	0.0	4.6	5.8	0.0	0.0	0.0	0.0	0.0	
29	0.0	**********	0.0	0.0	0.0	5.2	6.6	0.0	0.0	0.0	0.0	0.0	
30	0.0	**********	0.0	30.1	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	
31	0.0	**********	0.0	**********	0.0	**********	0.0	0.0	**********	0.0	**********	0.0	
	(0.0)	(0.0)	(0.0)	(73.9)	(21.8)	(25.3)	(12.4)	(4.9)	(19.3)	(7.0)	(7.1)	(0.0)	
AVERAGE	< 0.0>	< 0.0>	< 0.0>	< 14.8>	< 3.6>	< 5.1>	< 2.1>	< 0.8>	< 3.9>	< 1.2>	< 1.4>	< 0.0>	
GRAND TOTAL	39.4	0.0	15.0	237.1	106.2	66.6	155.0	94.3	133.4	56.0	160.2	9.5	1072.8
AVERAGE	1.3	0.0	0.5	7.9	3.4	2.2	5.0	3.0	4.4	1.8	5.3	0.3	2.9
MAX	22.0	0.0	15.0	46.3	17.5	6.7	70.2	33.6	39.1	21.8	59.4	6.2	
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

< DAILY RUNOFF > PHANG UNIT = (CUM/D)

(1979) X－58

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	1 0 OCT	1 1 NOV	1 2 DEC		
1	0.140	0.100	0.080	0.120	0.680	0.220	0.980	6.540	13.630	1.440	0.380	0.300		
2	0.140	0.100	0.080	0.120	0.630	0.200	1.200	1.420	8.640	1.200	0.380	0.290		
3	0.140	0.100	0.080	0.110	0.460	0.230	4.710	2.420	5.570	0.980	0.380	0.290		
4	0.140	0.100	0.080	0.110	0.400	0.320	9.650	4.180	3.890	1.140	0.380	0.280		
5	0.140	0.100	0.090	0.110	0.360	0.260	13.630	2.240	1.720	0.790	0.360	0.280		
	(0.700)	(0.500)	(0.410)	(0.570)	(2.530)	(1.230)	(30.170)	(16.800)	(33.450)	(5.550)	(1.880)	(1.440)		
AVERAGE	<0.140>	<0.100>	<0.082>	<0.114>	<0.506>	<0.246>	<6.034>	<3.360>	<6.690>	<1.110>	<0.376>	<0.288>		
6	0.150	0.100	0.090	0.110	0.350	0.250	17.580	1.930	1.120	0.700	0.360	0.280		
7	0.150	0.100	0.090	0.160	0.340	0.250	19.740	1.860	1.520	0.700	0.360	0.270		
8	0.150	0.100	0.090	0.160	0.320	0.240	15.580	1.020	1.340	0.530	0.360	0.270		
9	0.140	0.090	0.080	0.120	0.280	0.240	6.100	0.840	3.860	0.470	0.350	0.270		
10	0.140	0.090	0.080	0.110	0.240	0.220	3.120	0.610	1.860	0.450	0.350	0.260		
	(0.730)	(0.480)	(0.430)	(0.660)	(1.530)	(1.200)	(62.120)	(6.260)	(9.700)	(2.850)	(1.780)	(1.350)		
AVERAGE	<0.146>	<0.096>	<0.086>	<0.132>	<0.306>	<0.240>	<12.424>	<1.252>	<1.940>	<0.570>	<0.356>	<0.270>		
11	0.140	0.090	0.080	0.120	0.240	0.200	2.500	0.600	1.220	0.460	0.350	0.260		
12	0.120	0.090	0.080	0.110	0.290	0.200	2.140	0.700	1.720	0.410	0.340	0.260		
13	0.120	0.090	0.080	0.150	0.280	0.200	2.110	0.640	1.810	0.440	0.340	0.260		
14	0.120	0.090	0.080	0.170	0.330	0.200	1.180	0.800	1.320	0.390	0.340	0.250		
15	0.120	0.090	0.080	0.130	0.340	0.230	0.840	1.220	1.020	0.440	0.330	0.260		
	(0.620)	(0.450)	(0.400)	(0.680)	(1.480)	(1.030)	(8.770)	(3.960)	(7.090)	(2.140)	(1.700)	(1.290)		
AVERAGE	<0.124>	<0.090>	<0.080>	<0.136>	<0.296>	<0.206>	<1.754>	<0.792>	<1.418>	<0.428>	<0.340>	<0.258>		
16	0.120	0.090	0.080	0.120	0.280	0.270	0.680	1.260	0.710	0.390	0.330	0.260		
17	0.120	0.080	0.080	0.120	0.250	1.100	0.710	1.360	1.500	0.380	0.320	0.270		
18	0.120	0.080	0.080	0.160	0.260	1.140	0.540	5.790	8.920	0.330	0.320	0.270		
19	0.120	0.080	0.210	0.190	0.250	0.940	0.820	3.150	3.800	0.330	0.320	0.260		
20	0.120	0.080	0.180	0.150	0.270	0.880	0.590	3.980	1.960	0.630	3.440	0.260		
	(0.600)	(0.410)	(0.630)	(0.740)	(1.310)	(4.330)	(3.340)	(15.540)	(16.890)	(2.060)	(4.730)	(1.320)		
AVERAGE	<0.120>	<0.082>	<0.126>	<0.148>	<0.262>	<0.866>	<0.668>	<3.108>	<3.378>	<0.412>	<0.946>	<0.264>		
21	0.120	0.080	0.120	0.150	1.420	0.980	0.530	2.680	1.040	0.820	3.010	0.260		
22	0.120	0.080	0.080	0.150	0.890	0.920	1.960	3.350	0.840	0.680	1.040	0.260		
23	0.110	0.080	0.080	0.150	1.380	0.820	1.180	8.500	0.680	0.600	0.420	0.260		
24	0.110	0.080	0.080	0.180	0.820	0.760	1.080	5.100	0.590	0.540	0.390	0.250		
25	0.110	0.080	0.080	0.160	0.790	0.770	1.020	3.950	0.560	0.710	0.360	0.250		
	(0.570)	(0.400)	(0.440)	(0.790)	(5.300)	(4.250)	(5.770)	(23.580)	(3.710)	(3.350)	(5.220)	(1.280)		
AVERAGE	<0.114>	<0.080>	<0.088>	<0.158>	<1.060>	<0.850>	<1.154>	<4.716>	<0.742>	<0.670>	<1.044>	<0.256>		
26	0.110	0.080	0.080	0.160	0.730	0.680	1.040	4.490	0.490	0.700	0.350	0.250		
27	0.100	0.080	0.080	0.160	0.660	0.630	4.960	4.140	0.640	0.560	0.320	0.250		
28	0.100	0.080	0.080	0.210	0.560	0.590	4.080	5.180	1.550	0.470	0.300	0.240		
29	0.100	*********	0.080	1.020	0.340	0.560	3.320	11.810	5.910	0.450	0.300	0.240		
30	0.100	*********	0.080	0.610	0.280	0.600	3.120	6.500	3.860	0.410	0.300	0.230		
31	0.100	*********	0.120	*********	0.240	*********	2.710	5.910	*********	0.400	*********	0.230		
	(0.610)	(0.240)	(0.520)	(2.160)	(2.810)	(3.060)	(19.230)	(38.030)	(12.450)	(2.990)	(1.570)	(1.440)		
AVERAGE	<0.102>	<0.080>	<0.087>	<0.432>	<0.468>	<0.612>	<3.205>	<6.338>	<2.490>	<0.498>	<0.314>	<0.240>		
GRAND TOTAL	3.830	2.480	2.830	5.600	14.960	15.100	129.400	104.170	83.290	18.940	16.880	8.120	405.599	(m³/s)
AVERAGE	41.	27.	31.	60.	162.	163.	1398.	1125.	900.	205.	182.	88.	4380.	(mm)
MAX	0.124	0.089	0.091	0.187	0.483	0.503	4.174	3.360	2.776	0.611	0.563	0.262	1.111	(m³/s)
MIN	0.150	0.100	0.210	1.020	1.420	1.140	19.740	11.810	13.630	1.440	3.440	0.300		(m³/s)
	0.100	0.080	0.080	0.110	0.240	0.200	0.530	0.600	0.490	0.330	0.300	0.230		(m³/s)

< DAILY RUNOFF > (1979)   PHANG X-58   UNIT = (CUM/D)

	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC		
1	0.005	0.004	0.003	0.003	0.172	0.024	0.025	0.014	0.011	0.032	0.019	0.026		
2	0.857	0.004	0.002	0.002	0.074	0.021	0.022	0.013	0.011	0.028	0.017	0.023		
3	1.127	0.004	0.002	0.002	0.061	0.082	0.487	0.012	0.010	0.024	0.015	0.020		
4	0.121	0.004	0.002	0.002	0.050	0.083	2.408	0.011	0.009	0.021	0.013	0.018		
5	0.041	0.004	0.002	0.002	0.241	0.021	5.733	0.010	0.009	0.018	0.012	0.016		
	(2.151)	(0.019)	(0.012)	(0.012)	(0.597)	(0.231)	(8.675)	(0.059)	(0.050)	(0.122)	(0.076)	(0.102)		
AVERAGE	<0.430>	<0.004>	<0.002>	<0.002>	<0.119>	<0.046>	<1.735>	<0.012>	<0.010>	<0.024>	<0.015>	<0.020>		
6	0.034	0.004	0.002	0.002	0.067	0.018	0.220	0.009	0.008	0.016	0.076	0.075		
7	0.028	0.004	0.002	2.888	0.037	0.016	0.113	0.009	0.147	0.014	0.013	0.060		
8	0.024	0.004	0.002	2.015	0.397	0.014	0.159	0.008	0.025	0.013	0.012	0.017		
9	0.020	0.003	0.002	0.151	0.237	0.013	0.079	0.008	0.013	0.137	0.011	0.015		
10	0.017	0.003	0.002	0.065	0.065	0.012	0.065	0.008	0.219	0.029	0.010	0.014		
	(0.123)	(0.018)	(0.012)	(5.122)	(0.803)	(0.073)	(0.636)	(0.042)	(0.412)	(0.210)	(0.121)	(0.181)		
AVERAGE	<0.025>	<0.004>	<0.002>	<1.024>	<0.161>	<0.015>	<0.127>	<0.008>	<0.082>	<0.042>	<0.024>	<0.036>		
11	0.015	0.003	0.002	0.053	0.035	0.011	0.054	0.007	0.041	0.016	0.064	0.013		
12	0.013	0.003	0.002	0.043	0.073	0.010	0.045	0.271	0.018	0.014	0.011	0.012		
13	0.011	0.003	0.002	0.035	0.028	0.023	0.038	0.301	0.019	0.013	0.097	0.011		
14	0.010	0.003	0.002	0.029	0.024	0.012	0.032	0.443	0.014	0.012	0.284	0.010		
15	0.009	0.003	0.364	0.024	0.340	0.009	0.027	0.415	0.012	0.011	0.059	0.010		
	(0.057)	(0.016)	(0.373)	(0.185)	(0.500)	(0.065)	(0.197)	(1.436)	(0.103)	(0.065)	(0.516)	(0.055)		
AVERAGE	<0.011>	<0.003>	<0.075>	<0.037>	<0.100>	<0.013>	<0.039>	<0.287>	<0.021>	<0.013>	<0.103>	<0.011>		
16	0.008	0.003	0.038	0.020	0.074	0.051	0.024	0.584	1.142	0.010	0.259	0.009		
17	0.007	0.003	0.013	1.296	0.027	0.014	0.047	2.492	3.010	0.009	0.058	0.009		
18	0.007	0.003	0.011	0.116	0.023	0.010	0.020	0.157	0.161	0.033	4.193	0.008		
19	0.006	0.003	0.009	0.037	0.426	0.009	0.017	0.072	0.068	0.010	0.974	0.008		
20	0.006	0.003	0.008	0.031	0.594	0.035	0.016	0.059	0.056	0.009	2.067	0.008		
	(0.034)	(0.015)	(0.078)	(1.500)	(1.144)	(0.119)	(0.124)	(3.364)	(4.437)	(0.071)	(7.550)	(0.042)		
AVERAGE	<0.007>	<0.003>	<0.016>	<0.300>	<0.229>	<0.024>	<0.025>	<0.673>	<0.887>	<0.014>	<1.510>	<0.008>		
21	0.006	0.003	0.007	0.025	0.128	0.010	0.014	0.049	0.046	0.008	0.392	0.008		
22	0.005	0.003	0.006	2.938	0.040	0.009	0.013	0.041	0.039	0.265	0.522	0.007		
23	0.005	0.003	0.005	0.761	0.101	0.022	0.012	0.034	0.645	0.051	0.157	0.007		
24	0.005	0.003	0.004	0.148	0.033	0.028	0.033	0.029	0.438	0.017	0.081	0.007		
25	0.005	0.003	0.004	0.063	0.071	0.009	0.030	0.025	0.103	0.908	0.067	0.007		
	(0.026)	(0.014)	(0.026)	(3.935)	(0.373)	(0.078)	(0.101)	(0.179)	(1.271)	(1.250)	(1.220)	(0.036)		
AVERAGE	<0.005>	<0.003>	<0.005>	<0.787>	<0.075>	<0.016>	<0.020>	<0.036>	<0.254>	<0.250>	<0.244>	<0.007>		
26	0.005	0.003	0.004	0.640	0.081	0.080	0.012	0.021	0.045	0.122	0.135	0.007		
27	0.004	0.003	0.003	0.135	0.716	0.175	0.011	0.041	0.700	0.226	0.051	0.007		
28	0.004	0.003	0.003	1.386	0.128	0.150	0.063	0.018	0.133	0.059	0.042	0.007		
29	0.004	*********	0.003	0.146	0.039	0.171	0.129	0.016	0.046	0.031	0.036	0.006		
30	0.004	*********	0.003	1.832	0.033	0.093	0.028	0.014	0.038	0.027	0.030	0.006		
31	0.004	*********	0.003	*********	0.028	*********	0.016	0.013	*********	0.023	*********	0.006		
	(0.026)	(0.008)	(0.018)	(4.139)	(1.024)	(0.669)	(0.260)	(0.122)	(0.962)	(0.487)	(0.294)	(0.039)		
AVERAGE	<0.004>	<0.003>	<0.003>	<0.828>	<0.171>	<0.134>	<0.043>	<0.020>	<0.192>	<0.081>	<0.059>	<0.007>		
GRAND TOTAL	2.417	0.090	0.520	14.893	4.441	1.235	9.993	5.202	7.236	2.205	9.777	0.456	58.463	(m³/s)
AVERAGE	26.	1.	6.	161.	48.	13.	108.	56.	78.	24.	106.	5.	631.	(mm)
MAX	0.078	0.003	0.017	0.496	0.143	0.041	0.322	0.168	0.241	0.071	0.326	0.015	0.160	(m³/s)
MIN	1.127	0.004	0.364	2.938	0.716	0.175	5.733	2.492	3.010	0.908	4.193	0.075		(m³/s)
	0.004	0.003	0.002	0.002	0.023	0.009	0.011	0.007	0.008	0.008	0.010	0.006		(m³/s)

APPENDIX A-3-1

Study on Flow and Pressure Measurement in Distribution System

APPENDIX STUDY ON FLOW AND PRESSURE MEASUREMENTS IN DISTRIBUTION SYSTEM

(1) Introduction

To evaluate the characteristics of the distribution system, pressure and flow measurements were made from August 29 and 31, 1988.

(2) Method and results

The flow measurements of 24-hours were conducted at the main distribution pipe in the treatment plant using the ultrasonic flow meter with pen recorder.

The pressure measurements were made by installing pressure gage at 6 house connections in the distribution system.

The results of flow measurement at the Phang Nga waterworks, Location of pressure measurement points and the results of pressure measurement are shown in Figure A3-1, A3-2 and A3-3 to A3-9, respectively.

The results of pressure measurements in the distribution system show simular conditions with distribution network analysis (refer to section 3.1.3).

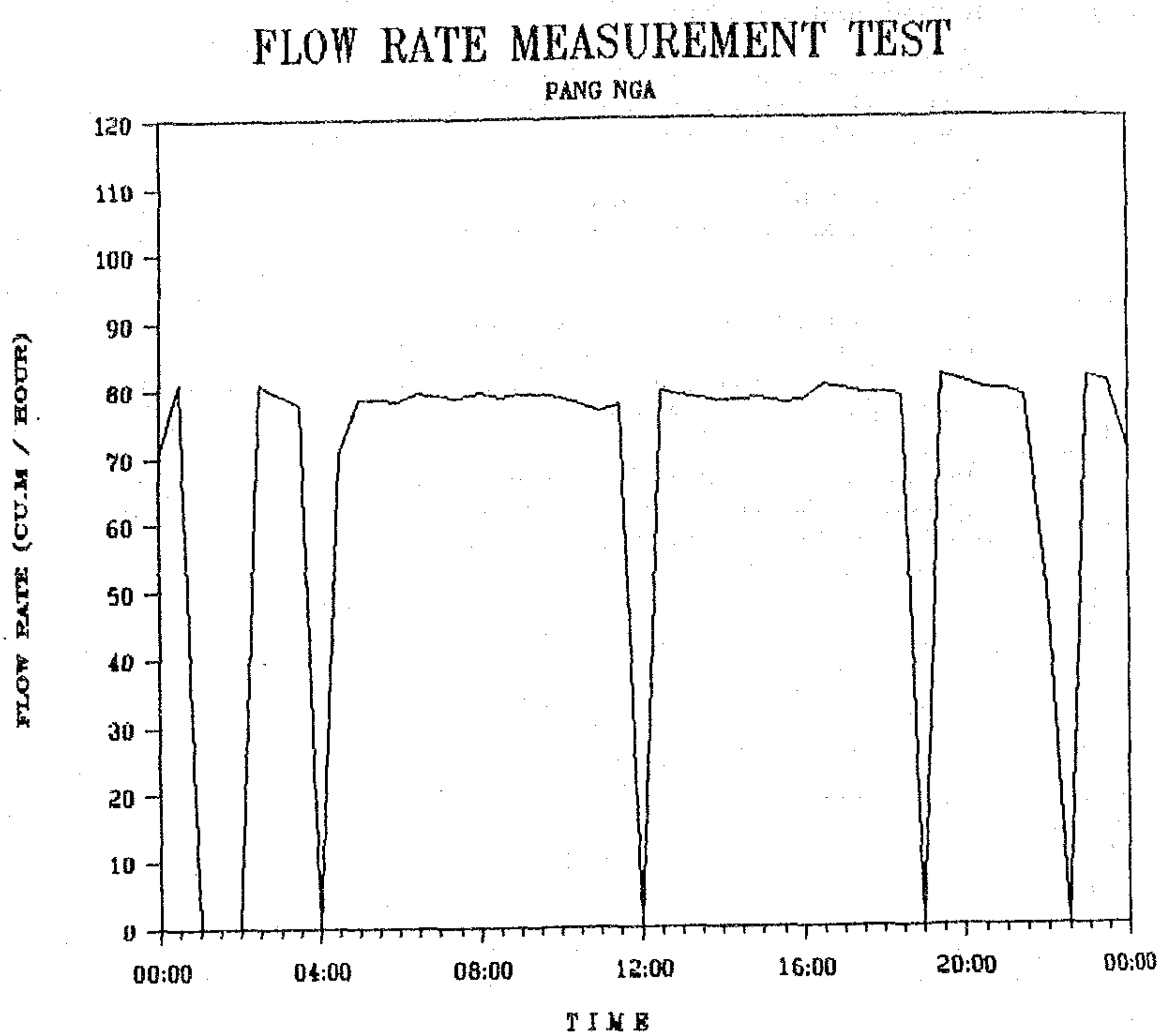


FIGURE A3-1

FLOW RATE MEASUREMENT TEST

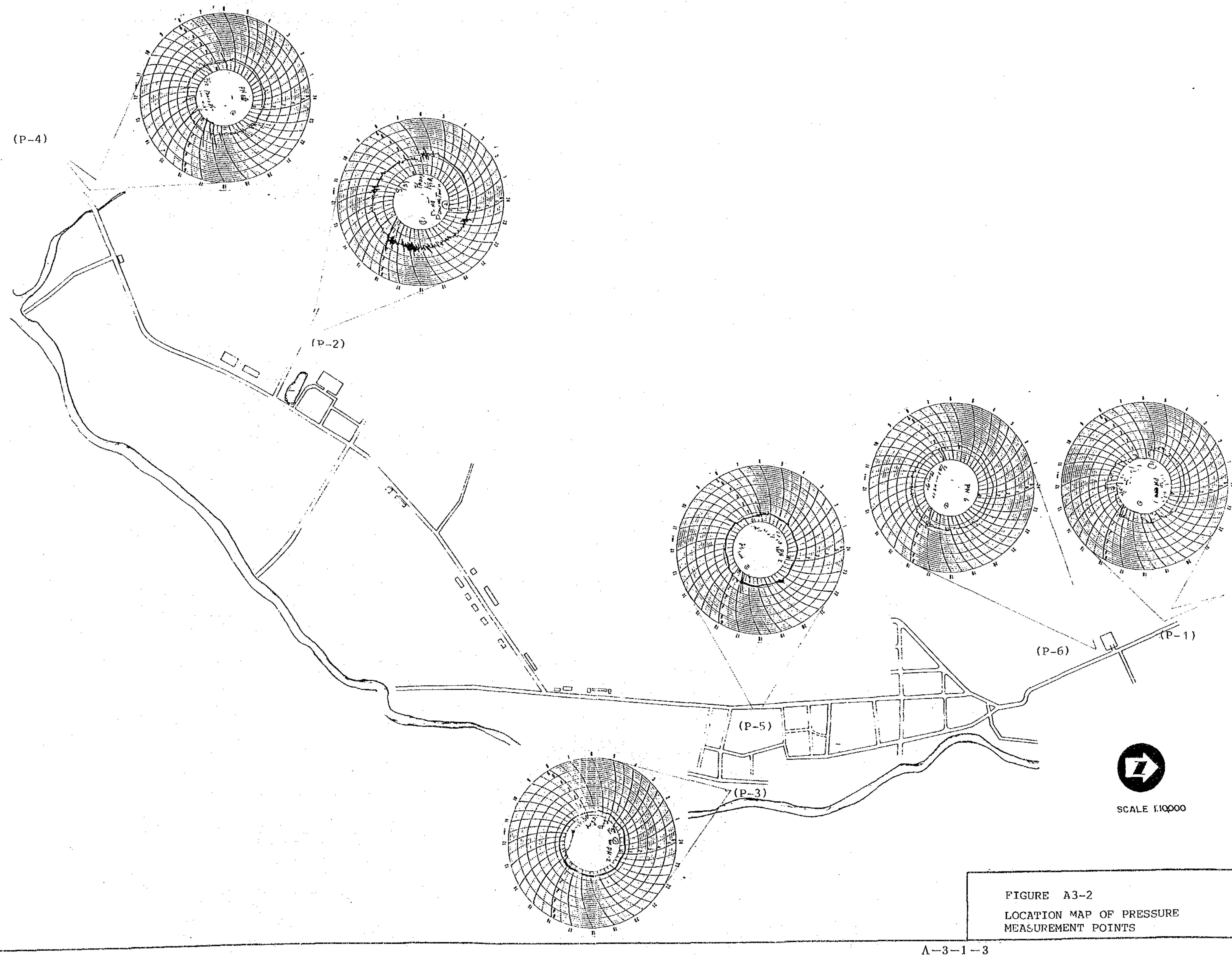


FIGURE A3-2

LOCATION MAP OF PRESSURE MEASUREMENT POINTS

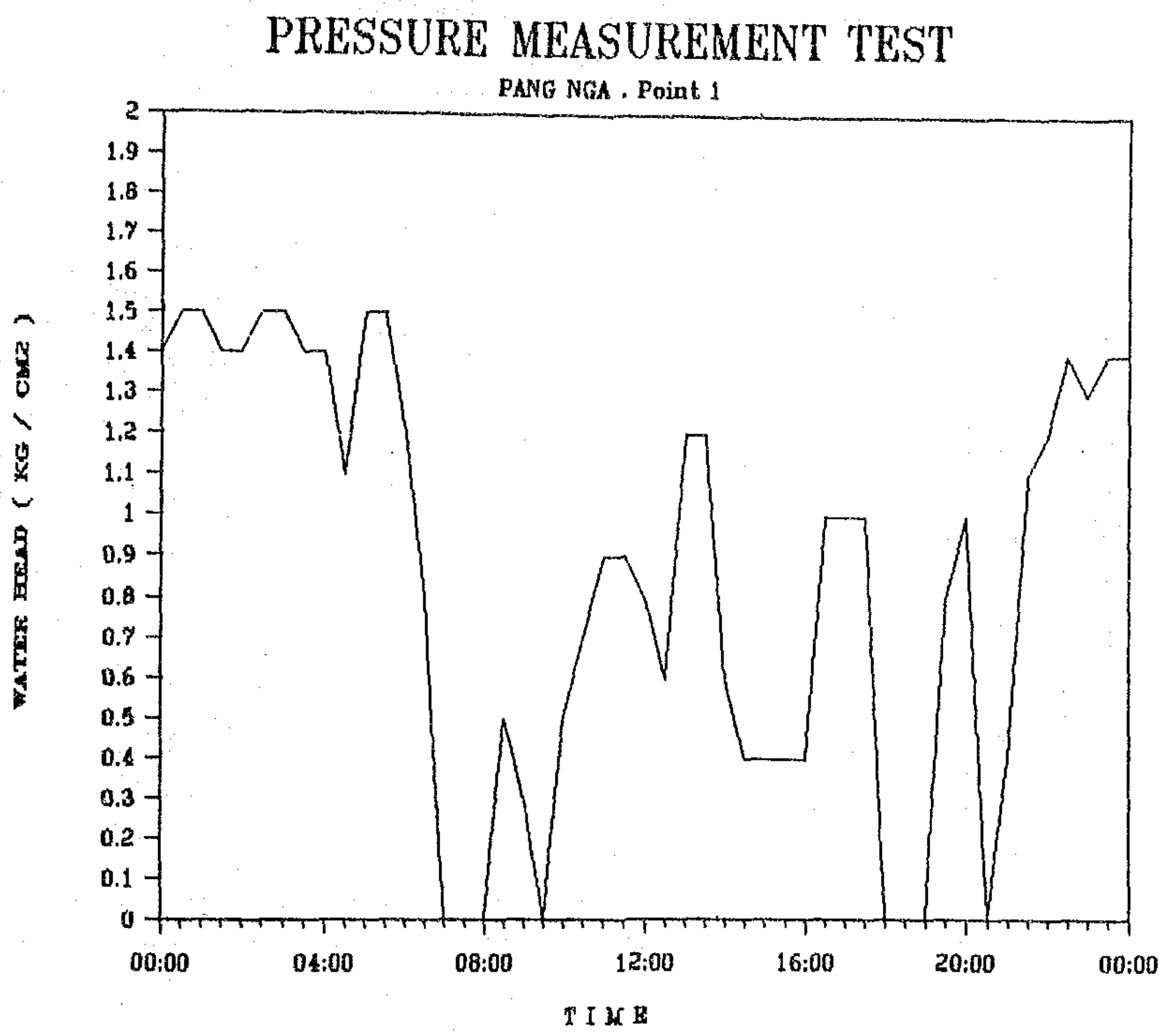


FIGURE A3-3

PRESSURE MEASUREMENT TEST
(Point 1)

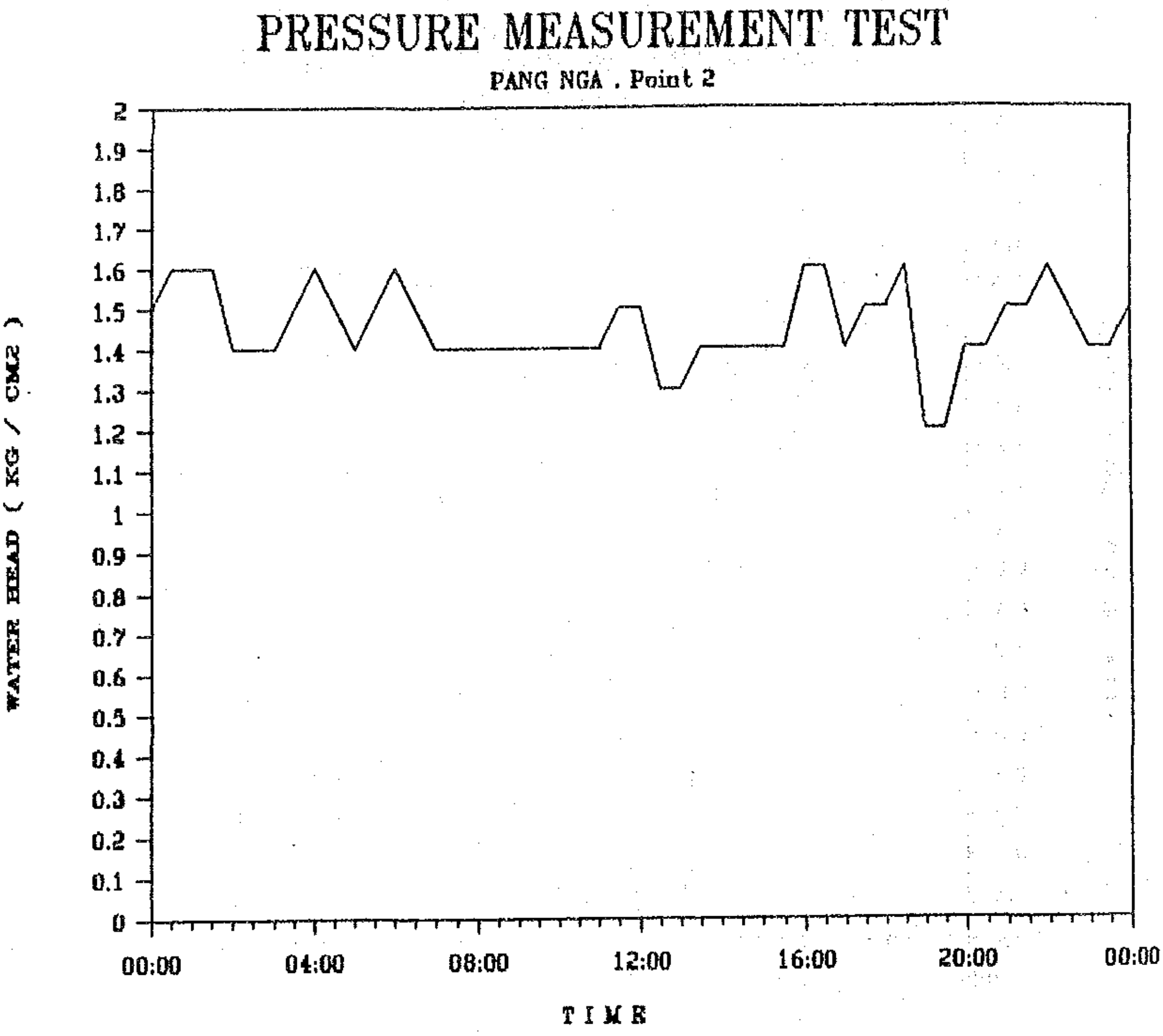


FIGURE A3-4

PRESSURE MEASUREMENT TEST
(Point 2)

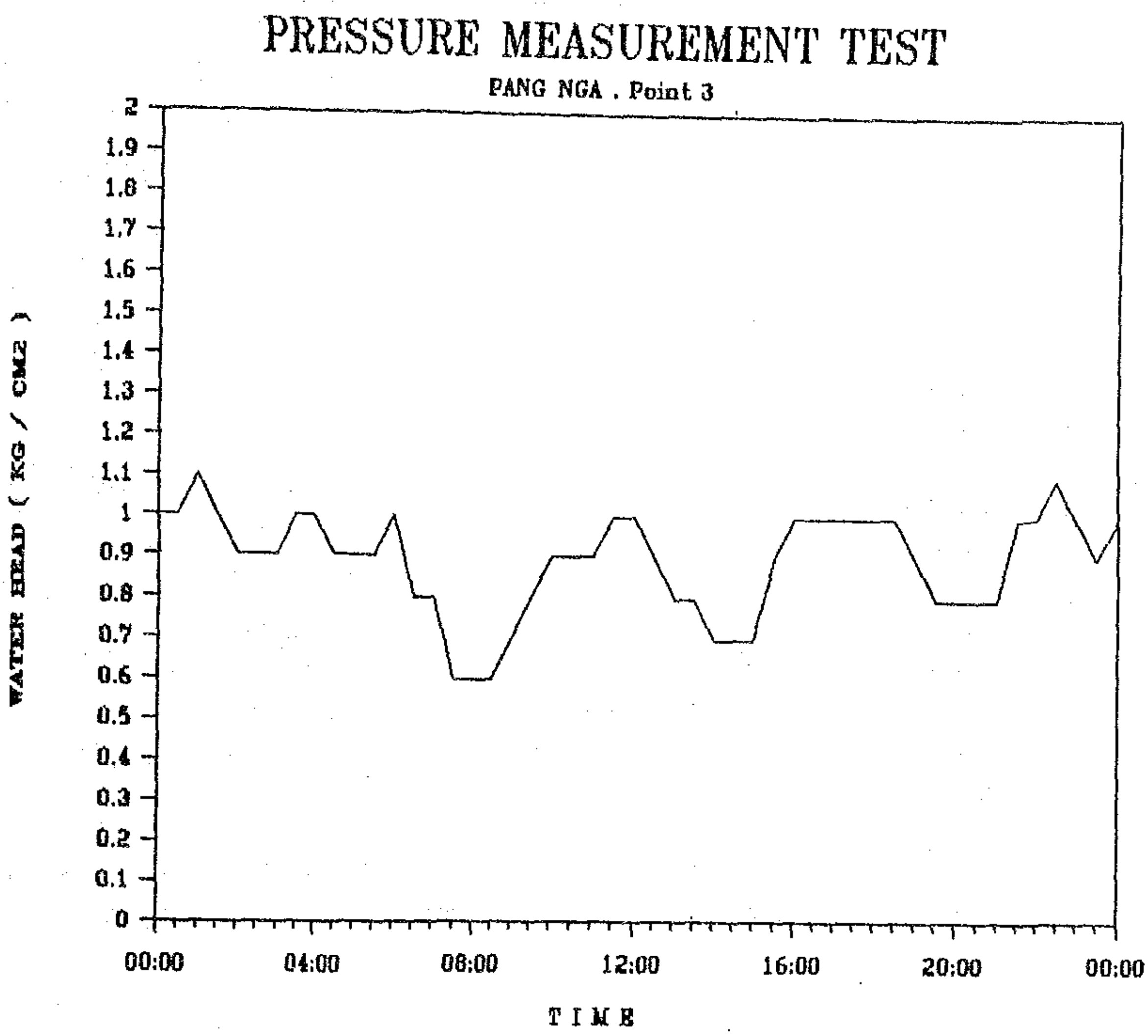


FIGURE A3-5

PRESSURE MEASUREMENT TEST
(Point 3)

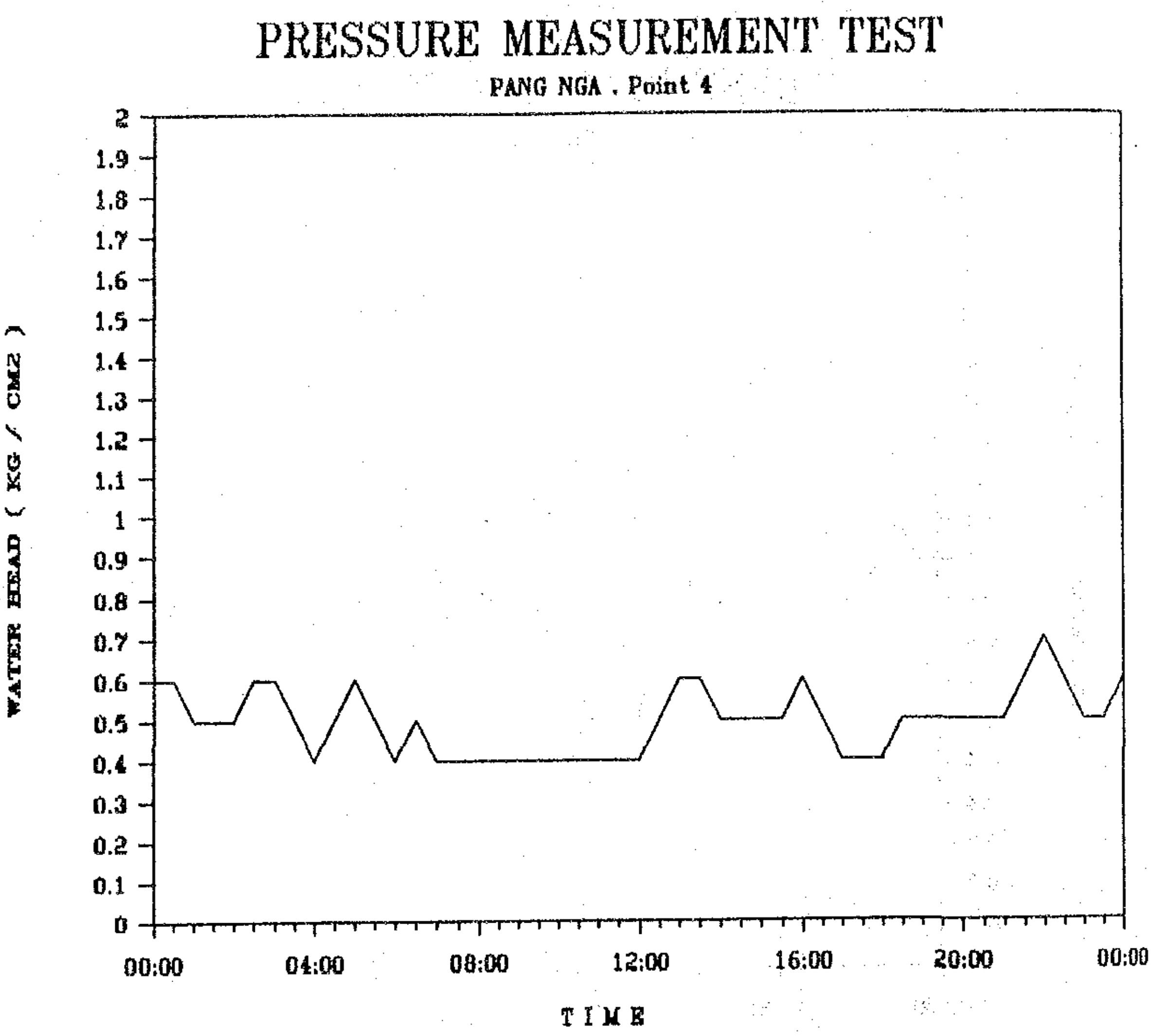


FIGURE A3-6

PRESSURE MEASUREMENT TEST
(Point 4)

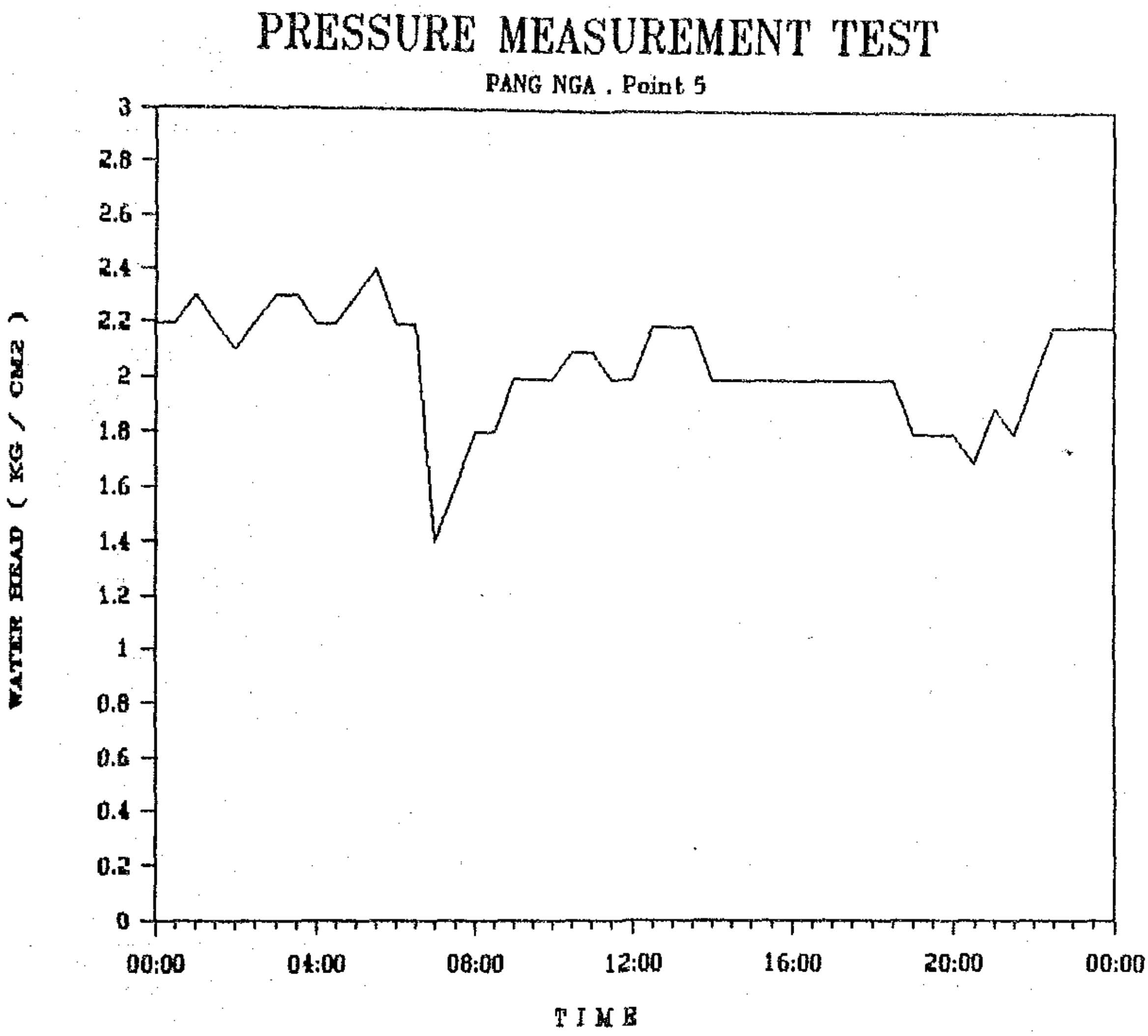


FIGURE A3-7

PRESSURE MEASUREMENT TEST
(Point 5)

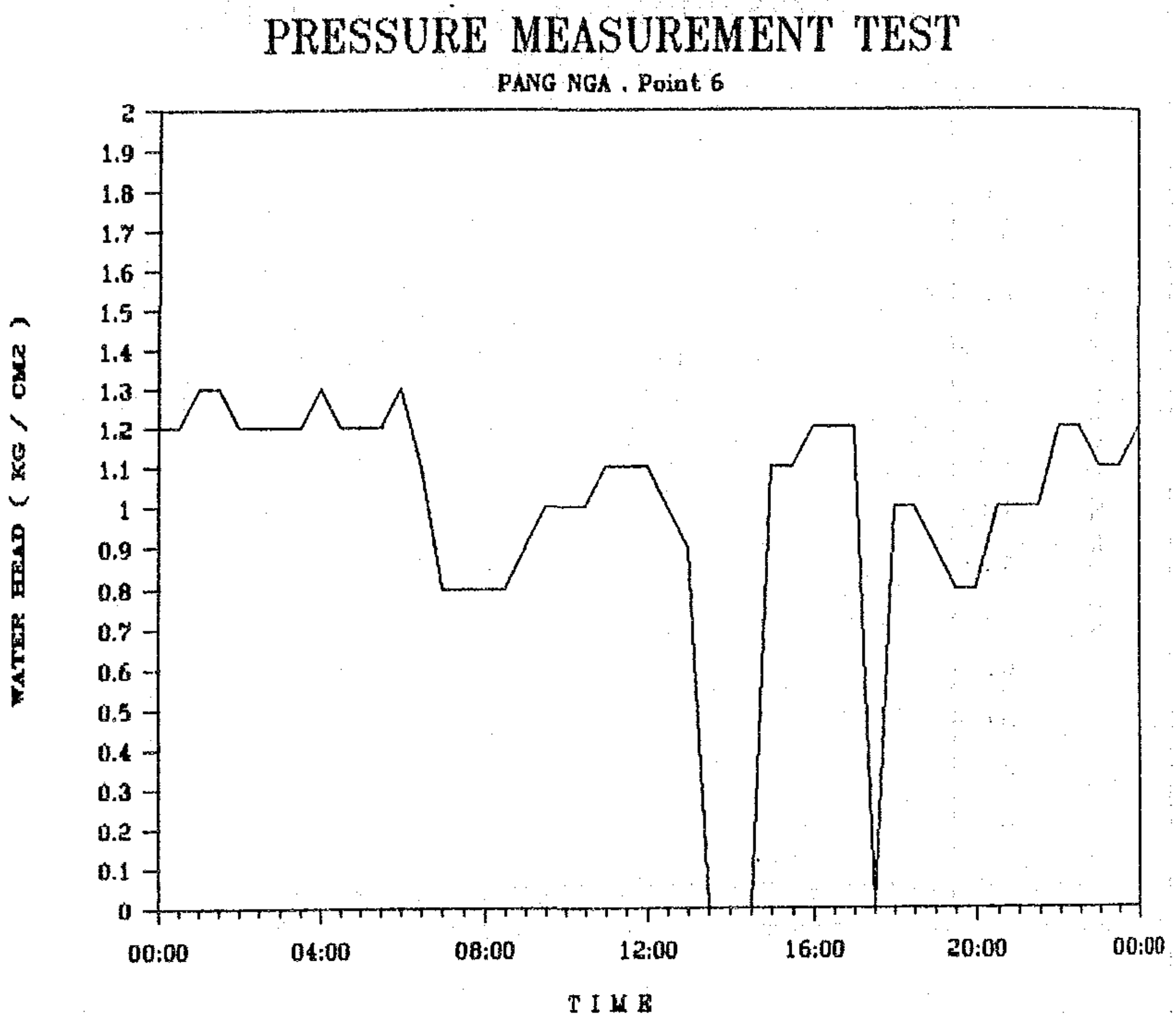


FIGURE A3-8

PRESSURE MEASUREMENT TEST
(Point 6)

APPENDIX A-3-2

Study on Water Quality on Distribution Network

APPENDIX WATER SUPPLY ON DISTRIBUTION NETWORK

1. General

Water quality analysis was conducted along the existing distribution mains with a portable water quality analyzer. Parameters of the analysis are pH, conductivity and temperature.

The results of the analysis are shown in Table A4-1, and sampling points are presented in Figure A4-1.

2. Causes of high pH

Results show that pH values are 9.0 at No.1, 8.7 at No.4 and 8.6 at No.7, respectively.

Others are relatively low within the water quality standard.

Based on the field investigation, the following causes may result in calcium dissolution from the inner wall of asbestos cement pipe.

1) Pipes are newly installed about two year age;
2) Water is retained for long time inside the pipe due to low water flow.

3. Counter measure

Drain-off from hydrants or blow-off pipes should be periodically carried out in these area.

Table A4-1 Results of Water Quality Analysis

Sampling Point	1	2	3	4	5	6	7	8
pH	9.00	6.91	6.91	7.15	8.70	8.20	7.50	6.92
Temp. (C)	27.4	27.8	27.4	27.0	28.8	28.3	28.3	27.8
Conductivity (x5x10)	6.4	4.6	4.8	4.8	5.9	5.8	5.0	4.5

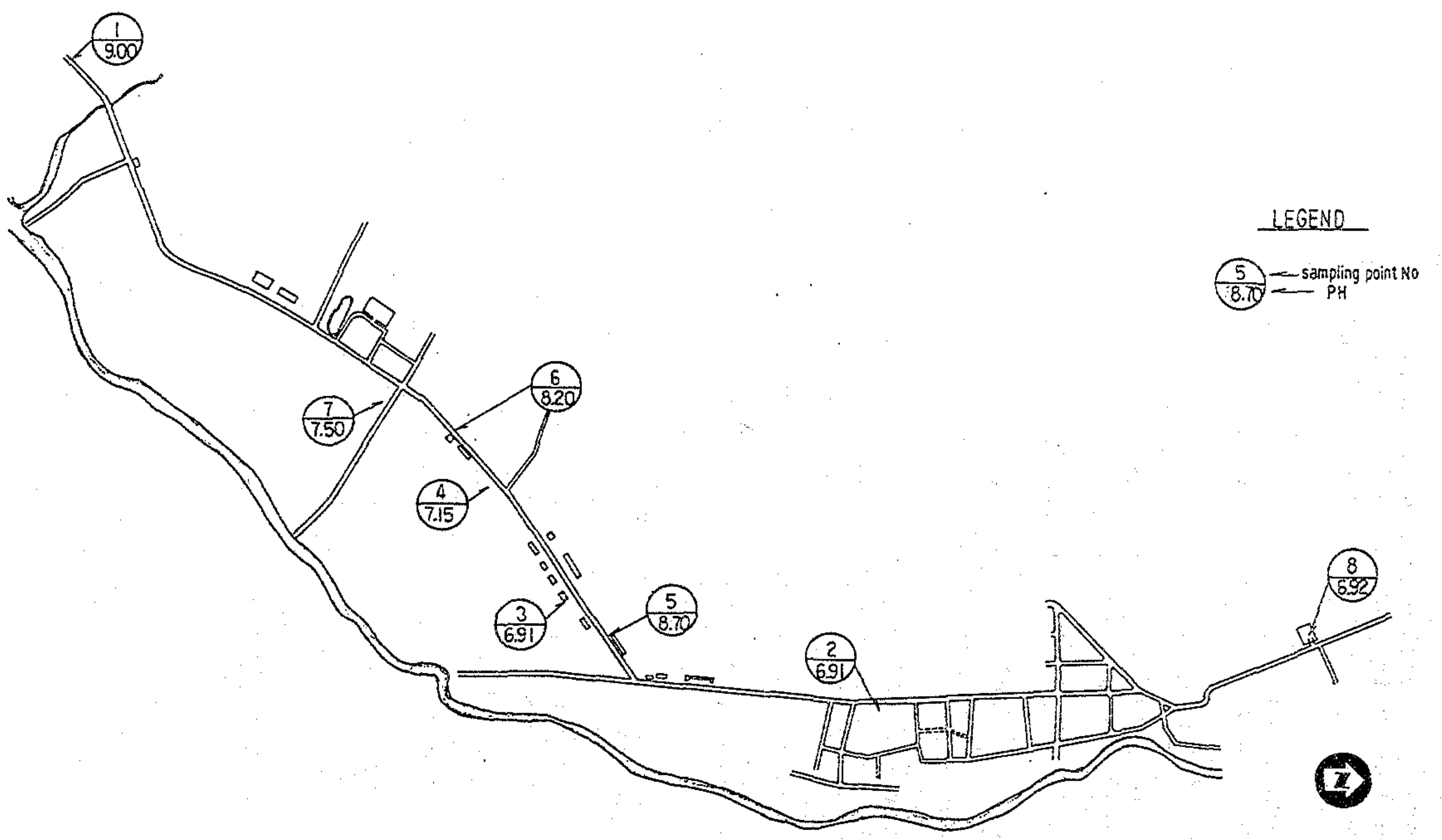


FIGURE A-4-1
SAMPLING POINTS

APPENDIX A-3-3

Jar Test on Raw Water of the Water Treatment Plant

APPENDIX JAR TEST

1 General

Jar Test was conducted to evaluate the present dosage rate of coagulant and to verify the appropriate dosage rate. The test was conducted on September 1988 for the raw water presently used by the waterworks.

2 Coagulant Used

Aluminum sulfate is being used as coagulant at Phang Nga Waterworks as well as the other waterworks. The chemical is a solid type in a package of 25 kg bag, which is dissolved in the coagulant solution tank with an effective volume of about 0.6 cu.m.

According to the operator, they are consuming 12.5 kg of aluminum sulfate a day. From this amount of consumption, dosage rate is calculated as below:

Dosage rate (R) for daily average flow rate:

R = 12,000 g/1,560 cu.m/day =8.0 mg/l

Concentration of the coagulant in the solution tank is calculated from the amount of chemical dissolved and the volume of the tank as follows:

Concentration of coagulant solution (C)

C = 12,500 g/0.6 cu m = 20,800 mg/l

This solution was diluted 10 times for use of Jar Test; therefore, solution had the concentration of:

20,800 x (1/10) = 2,080 mg/l

3 Test Procedure

Test procedure followed the PWA's regulation for Jar Test. Sequence and time are shown as follows:

a) Coagulant dosed

b) Rapid Mixing, 60 rpm - 7.5 min

c) Flocculation, 40 rpm - 7.5 min

d) Flocculation, 25 rpm - 5.0 min

e) Sedimentation, about 5 min

4 Condition and Results

Jar Test was conducted with a series of six different dosage rates. The condition and results are as shown in Table A5-1.

Table A5-1 Jar Test Condition and Result

	1	2	3	4	5	6
1. Coagulant Solution (ml)	1.25	2.5	5.0	7.5	10.0	12.5
2. Dosage Rate (mg/l)	2.5	5.0	10	15	20	25
3. Turbidity after settling	1.0	1.0	1.0	1.5	1.5	2.0
4. pH	7.05	7.01	6.59	6.50	6.65	6.55
5. Conductivity (micro ohm/cm)	4.2	4.5	4.6	4.6	4.5	4.4
6. Characteristics of floc	Fine floc	large floc	largest floc	large floc	fine floc	fine floc

Dosage rate of 5 and 10 mg/l showed the better result than others in terms of floc formation, and turbidity removal. Actual dosage rate (8.0 mg/l) falls in this range.

APPENDIX A-4-1

Study on Water Consumption

APPENDIX STUDY ON WATER CONSUMPTION

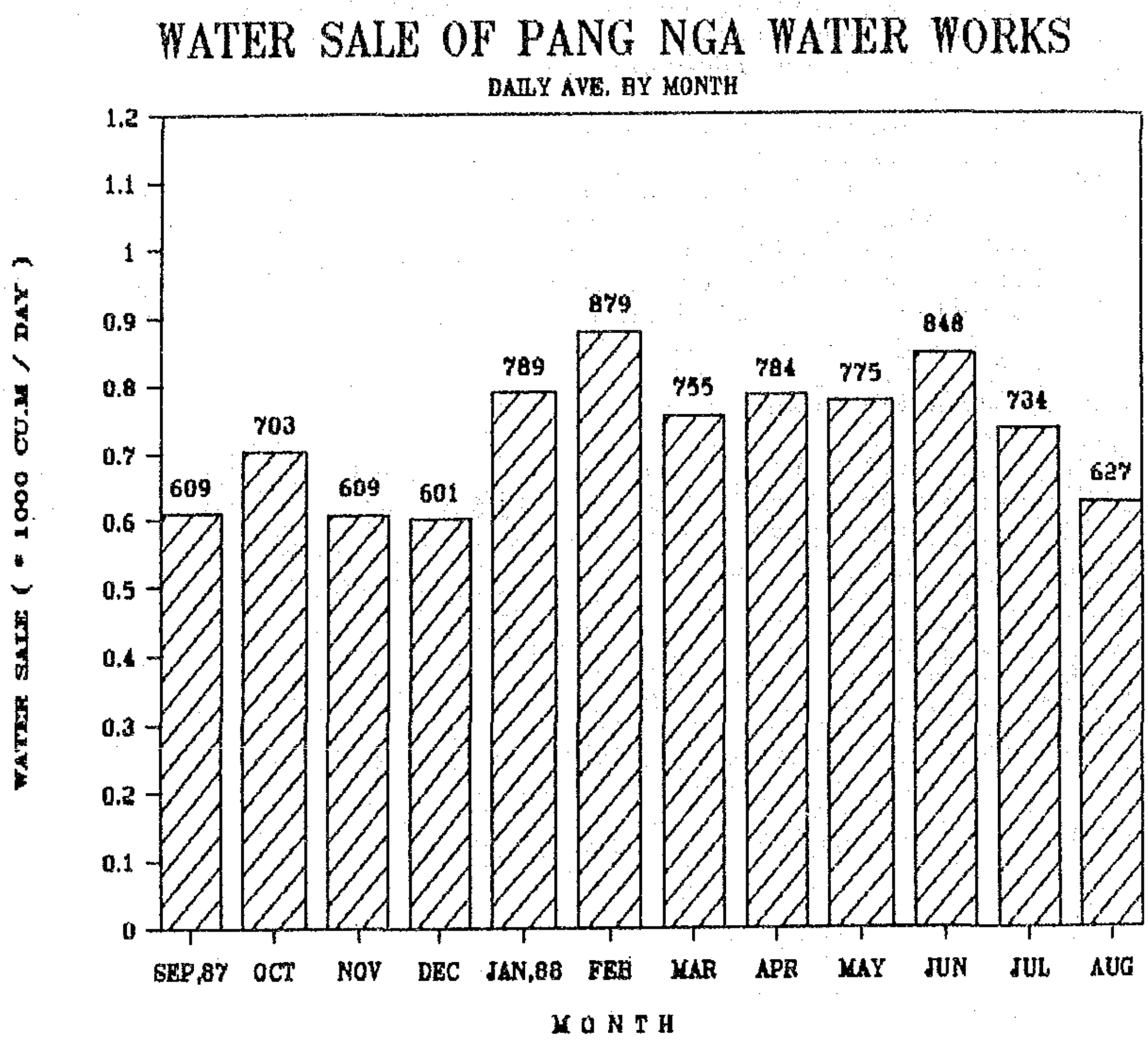
1 Data Collection

Present water consumption data was collected from the waterworks' meter reading records for the study of water demand and distribution network analysis. Meter reading records at the waterworks office consist of volumes of cards in PWA's format for each connection. Monthly consumptions from September 1987 to August 1988 of each connection are recorded on this card.

Data collection was made in a manner of copying figures water consumption of each consumer for every month. For distribution network analysis, each consumer was located on the map by interviewing meter readers of the waterworks. When the exact locations were not identified, they were located in some extent of the pipeline. Big consumers were also identified for further analysis.

2 Collected Data

Raw data copied from meter reading books was then summed up by month and by area. The attached sheets hereafter show the summary of water consumption.



WATER SALE OF PANG NGA WATER WORKS
DAILY AVE. BY MONTH
WATER SALE (* 1000 CU.M / DAY)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
609
703
609
601
789
879
755
784
775
848
734
627
SEP,87
OCT
NOV
DEC
JAN,88
FEB
MAR
APR
MAY
JUN
JUL
AUG
MONTH

FIGURE A2 - 2 - 1

Table A2 - 2 - 1

Water Sale of Pang Nga Waterworks

Book No.	SEP,87	OCT	NOV	DEC	JAN,88	FEB	MAR	APR	MAY	JUN	JUL	AUG	Total	Day Ave.
1	8,664	8,221	7,371	7,309	11,954	10,559	9,360	10,257	8,021	11,162	7,384	7,034	107,296	293.96
2	3,127	4,526	3,403	3,456	3,975	4,664	5,176	4,998	4,465	3,935	4,771	3,645	50,141	137.37
3-1	1,039	1,475	1,281	1,124	1,444	1,592	1,688	2,010	1,593	1,333	1,657	1,499	17,735	48.59
3-2	1,691	2,336	1,971	1,928	2,497	2,781	2,130	1,856	3,666	3,092	3,268	2,509	29,725	81.44
4	2,566	3,607	3,104	3,357	3,001	3,938	3,506	2,519	4,656	4,619	3,907	3,135	41,915	114.84
5	1,190	1,616	1,129	1,462	1,584	1,957	1,536	1,880	1,639	1,307	1,770	1,609	18,679	51.18
Total by Month (cu.m/mo)	18,277	21,781	18,259	18,636	24,455	25,491	23,396	23,520	24,040	25,448	22,757	19,431	265,491	727.37
Total by Day (cu.m/ day)	609	703	609	601	789	879	755	784	775	848	734	627		

APPENDIX A-4-2

Questionnaire Survey for Residents

APPENDIX QUESTIONNAIRE SURVEY IN PHANG NGA (RESIDENTIAL)

A1.1 Objective

The door-to-door questionnaire survey was conducted to obtain the basic information on the resident's living conditions, water use patterns, responses to the municipal system and/or their own water sources and willingness for house-connection supply, and covered the area served or unserved by the municipal water supply system.

A1.2 Survey Area

The survey area was divided into 5 blocks traversing the national road Route 4 as shown in Figure A1-2-1. All blocks were at present, partially served by the municipal system.

A1.3 Survey Item

The form used for the questionnaire survey was originally written by Thai and included the following items.

1. General

   1.1 Address
   1.2 Type of House
   1.3 No. of Persons in Family
   1.4 No. of Employees
   1.5 Average Monthly Income
   1.6 Average Monthly Medical Expense

2. Type of Water Supply

3. Conditions in case of Municipal System

   3.1 Pressure
   3.2 Quantity

4. Other Sources than Municipal System

   4.1 Type of Source
   4.2 Conditions in case of Groundwater

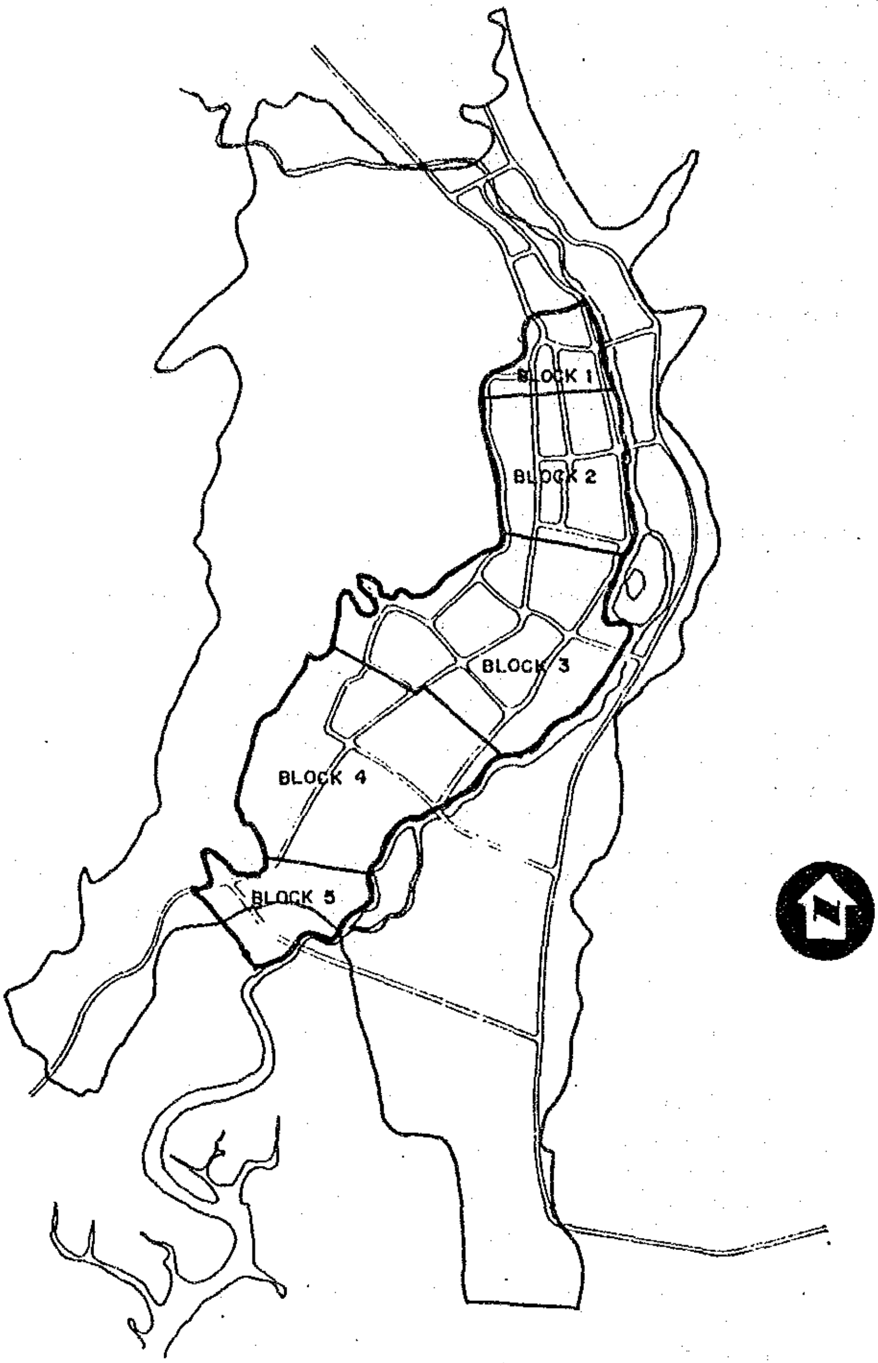
5. Potability

6. Water Quality in case of Municipal System

   6.1 Color
   6.2 Smell
   6.3 Turbidity

7. Average Monthly Water Consumption

8. Average Monthly Water Charge



NOTE :
BLOCK 5 INCLUDES THE PHANG NGA BAY RESORT AREA

FIGURE AI - 2 - I

QUESTIONNAIRE SURVEY IN PHANG NGA

9. Willingness to Pay for Water Charge

10. Water Quality in case of Other Source

    10.1 Color
    10.2 Smell
    10.3 Turbidity

11. Willingness to Connect to the Municipal System

12. Willingness to Pay for Connection Fee

13. Willingness to Pay for Water Charge

4 Survey Method

College students were employed as interviewers and were engaged in the questionnaire survey with the guidance of the PWA Head Office staff. The survey was conducted to 122 residents on August 30, 1988.

5 Survey Results

The results of the questionnaire survey are summarized in Table A1-5-1.

1) General

64.8% of the respondents lived in residential houses while 33.6% in commercial buildings and the remaining 1.6% was unknown due to the omission of confirmation by the interviewers.

The total numbers of persons in families and employees were 556 and 274, respectively. Accordingly, one household is composed of 4.56 family members and 2.25 employees on an average or a total of 6.81 persons.

Regarding the average monthly income, 70.5% respondents were in the up-to-4,500 Baht bracket, or 19.7% in the up-to-2,000 Baht, 32.0% in the 2,001-3,000 Baht and 18.8% in the 3,001-4,500 Baht brackets, respectively. The average in respondents weighted by the number of persons and the median in each income bracket was approximately 3,840 Baht, but the number of persons was biggest in the 2,001-3,000 Baht bracket.

As to the average monthly medical expense, 27.9% was in the up-to-50 Baht bracket and 19.7%, 15.6% and 27.9% were in the 51-100, 101-200 and 201-500 Baht brackets, respectively. The average in respondents calculated by the same method as the above is 300 Baht, but the number of persons was biggest in the up-to-50 and 201-500 Baht brackets.

2) Type of Water Supply

26.2% of the respondents used the municipal system only, 50.0% the other source than the municipal system and 23.8% the combined system of the municipal system and other source(s).

91.1% or 82 out of 90 other sources was groundwater as shown below.

Block No.	1	2	3	4	5	Total
Municipal System Only	7	8	6	8	3	32
plus Rain/River	-	1	1	1	-	3
plus Water Vender	-	-	1	-	1	2
plus Well	8	3	4	6	2	23
plus Others	1*	-	-	-	-	1
Well Only	7	18	13	11	2	51
plus Rain/River	3	-	-	-	2	5
plus Pond/Reservoir	2	-	-	-	-	2
Paid Source Only	-	-	-	-	3	3
Total	28	30	25	26	13	122

* Rain/River and Well

3) Response to Municipal System

The reputation of the PWA waterworks among 61 respondents using the municipal system was not so good, that is to say, 45.9% complained of low pressure, 24.6% of insufficient water, 59.0% of color, 55.7% of smell and 68.9% turbidity. However, there were big gaps in response by the block. Though the low pressure took place in all blocks, the respondents in Block 2 have sufficient water. The complaint of color was conspicuous in Blocks 1, 3 and 5, while no complaint in Block 2. Smell was mostly detected in Blocks 1 and 3. Turbidity was found in other area than Block 2.

4) Potability

This question was originally intended to know the potability of tap water, but the answer seemed to be made not only for the tap water but also for other source water, since the question followed that on other sources.

Accordingly, the evaluation was made extracting the data from respondents using tap water or well water only.

	Tap Water	Well Water
Drinking	12 (37.5%)	32 (62.7%)
Not Drinking	14 (43.8%)	6 (11.8%)
Both	6 (18.7%)	12 (23.5%)
Unknown	- (-)	1 (2.0%)
Total	32 (100%)	51 (100%)

37.5% used tap water for drinking and 18.7% for drinking and not-drinking in spite of their complaints of its water quality, while 62.7% used well water for drinking and 23.5% for drinking and not-drinking.

The doubt as to the kind of water the respondents (who answered that they didn't use only one source for drinking) used for drinking is remained. They may use the water vendor, although this is not expressed clearly in the survey.

5) Water Quality of Other Sources

As mentioned above, the main water source was the groundwater. 34.4% complained of color, 31.1% of smell and 40.0% of turbidity. Scrutinizing the data block by block, such complaints mostly took place in Blocks 3 and 5, while Block 4 was blessed with water quality. Compared with those in tap water, the complaint of water quaily was less in well water.

6) Conditions of Wells

The well depth distribution is shown below. Between 2 and 40 m and 82.9% wells had depths of not more than 10 m. The deep wells with depths of more than 30 m were located along the Petchkaseam Road and Soi Dokya in Blocks 2 and 3.

Block No.	5m	>5m <10m	>10m <15m	>15m <20m	>20m <30m	>30m	Un-known	Total
1	3	15	-	2	1	-	-	21
2	7	6	2	1	1	3	1	21
3	9	6	-	-	1	1	-	17
4	13	4	-	-	-	-	-	17
6	1	4	1	-	-	-	-	6
Total	33	35	3	3	3	4	1	82
Well Dep. (m)	4.0 (33)	7.8 (35)	14.3 (3)	20.0 (3)	28.3 (3)	38.8 (4)		
Water Dep. (m)	1.9 (33)	3.8 (35)	2.7 (3)	11.7 (3)	18.3 (3)	15.0 (3)		
Operation Time (h/d)	1.7 (23)	2.8 (22)	0.5 (1)	10.3 (3)	1.0 (2)	18.1 (4)		
No.of Fetching Times (1/d)	5.4 (12)	8.7 (18)	6.0 (2)	-	7.0 (1)	4.0 (1)		

The figures in parentheses show the number of wells used for the average calculation.

7) Average Monthly Water Consumption, Water Charge and Willingness-to-Pay

Regarding the average monthly water consumption, 54.1% belonged to the up-to-15 cu m bracket and 24.6% to the 16-30 cu m bracket.

42.6% paid for the water charge in the up-to-50 Baht bracket and 27.9% in the 51-100 Baht bracket, while, according to the result on the willingness-to-pay for water charge, 57.4% wanted that the water charge would be in the up-to-50 Baht bracket and 32.8 % in the 51-100 Baht bracket. The expectant amount was less than the actual payment.

8) Willingness-to-Connect

Out of 122 respondents, 61 didn't use the municipal system at present. However, 42.6% was willing to connect to the municipal system. Such people mainly lived in Blocks 1, 2 and 5. They wanted that the connection fee would be less than 2,500 Baht (100%) and the water charge less than 100 Baht (84.6%). The response to the water charge of the possible consumers was almost equal to that of the existing consumers.

Table A1-5-1 SUMMARY OF QUESTIONNAIRE SURVEY IN PHANG NGA

Block No.	1	2	3	4	5	Total	Rate (%)
No. of Samples	28	30	25	26	13	122	
1. General							
1.1 Address							
1.2 Type of House							
Residential	23	20	11	21	4	79	64.8
Commercial	5	9	14	5	8	41	33.6
Residential/Commercial	-	-	-	-	-	-	-
Unknown	-	1	-	-	1	2	1.6
1.3 No.of Persons in Family	123	141	100	122	70	556	
Unknown (No.of Samples)	-	-	-	-	-	-	
1.4 No.of Employees	61	57	58	53	45	274	
Unknown (No.of Samples)	-	-	-	-	-	-	
1.5 Ave. Monthly Income Baht							
up to 2,000	6	8	7	1	2	24	19.7
2,001-3,000	13	7	12	4	3	39	32.0
3,001-4,500	3	5	4	6	5	23	18.8
4,501-6,000	5	3	1	9	-	18	14.8
6,001-7,500	1	2	1	1	1	6	4.9
7,501-10,000	-	3	-	3	-	6	4.9
10,001-15,000	-	2	-	2	1	5	4.1
15,001-50,000	-	-	-	-	-	-	-
Over 50,000	-	-	-	-	1	1	0.8
Unknown	-	-	-	-	-	-	-
1.6 Ave. Monthly Medical Expense Baht							
up to 50	4	12	12	5	1	34	27.9
51-100	4	8	2	6	4	24	19.7
101-200	3	5	4	5	2	19	15.6
201-500	17	1	4	7	5	34	27.9
501-1,000	-	3	1	1	1	6	4.9
1,001-2,000	-	1	1	1	-	3	2.4
2,001-5,000	-	-	-	-	-	-	-
Over 5,000	-	-	1	1	-	2	1.6
Unknown	-	-	-	-	-	-	-
2. Type of Water Supply							
Municipal System	7	8	6	8	3	32	26.2
Combined	9	4	6	7	3	29	23.8
Other Sources	12	18	13	11	7	61	50.0
Unknown	-	-	-	-	-	-	-
3. Municipal System							
3.1 Pressure							
Low	6	6	8	4	4	28	45.9
High	2	6	4	11	2	25	41.0
Unknown	8	-	-	-	-	8	13.1
3.2 Quantity							
Sufficient	12	12	7	11	4	46	75.4
Not Sufficient	4	-	5	4	2	15	24.6
Unknown	-	-	-	-	-	-	-

Reasons for unwillingness-to-connect were summarized below.

Block No.	1	2	3	4	5	Total
There is a well	-	4	5	1	-	10
Well water is enough	1	1	3	3	-	8
Well water is clean	1	5	-	2	-	8
Well water is convenient	-	-	-	1	1	2
Lack of money	-	-	1	1	-	2
Less stay in the house	-	-	1	-	-	1
Not my own house	1	-	-	2	-	3
Unknown	-	-	-	-	1	1
Total	3	10	10	10	2	35

Most people who were unwilling to connect to the municipal system thought that they already had wells and those were enough or clean. The wells were very close and indispensable to their living.

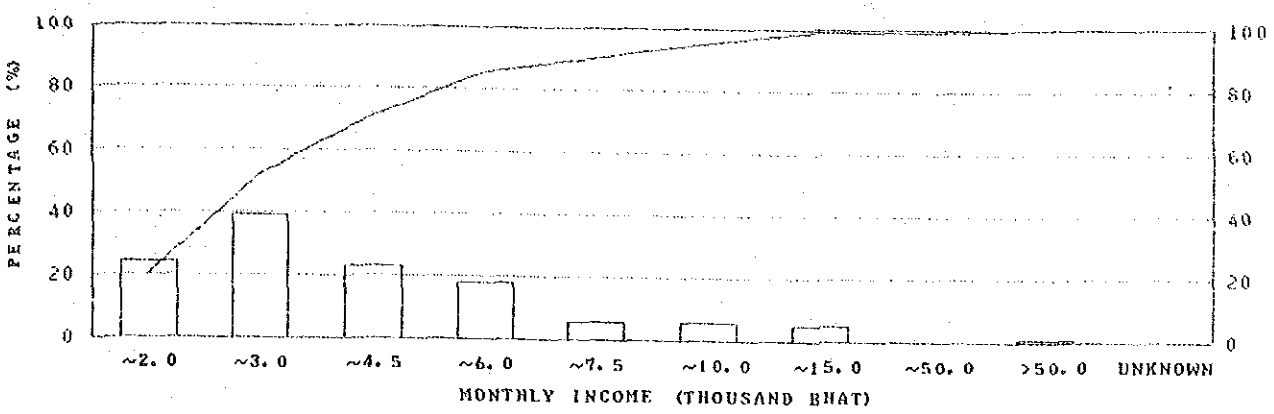
Table A1-5-1 SUMMARY OF QUESTIONNAIRE SURVEY IN PHANG NGA (CONT'D)

Block No.	1	2	3	4	5	Total	Rate (%)
4. Other Sources							
Rain/River	4	1	1	1	2	9	
Pond/Reservoir	2	-	-	-	-	2	
Water Vendor	-	-	1	-	4	5	
Groundwater-Shallow Well	21	17	16	17	6	77	
-Deep Well	-	4	1	-	-	5	
Unknown	-	-	-	-	-	-	
5. Potability							
Drinking	24	16	5	17	-	62	50.8
Not Drinking	3	13	2	9	3	30	24.6
Both	-	-	18	-	10	28	23.0
Unknown	1	1	-	-	-	2	1.6
6. Water Quality (Municipal System)							
6.1 Colored							
Yes	12	1	10	7	6	36	59.0
No	4	11	-	6	-	21	34.4
Unknown	-	-	2	2	-	4	6.6
6.2 Smell							
Yes	12	3	12	4	3	34	55.7
No	4	9	-	9	3	25	41.0
Unknown	-	-	-	2	-	2	3.3
6.3 Turbidity							
Yes	14	2	11	10	5	42	68.9
No	2	10	-	3	1	16	26.2
Unknown	-	-	1	2	-	3	4.9
7. Ave. Monthly Water Consumption							
Up to 15 cu m	8	8	6	7	4	33	54.1
16-30 cu m	5	2	3	4	1	15	24.6
31-50 cu m	2	1	-	-	1	4	6.6
51-75 cu m	-	1	3	1	-	5	8.2
76-100 cu m	1	-	-	1	-	2	3.3
101-150 cu m	-	-	-	-	-	-	-
151-200 cu m	-	-	-	-	-	-	-
201-300 cu m	-	-	-	-	-	-	-
Over 300 cu m	-	-	-	1	-	1	1.6
Unknown	-	-	-	1	-	1	1.6
8. Ave. Monthly Water Charge							
Baht							
Up to 50	6	7	6	6	1	26	42.6
51-100	6	3	2	3	3	17	27.9
101-150	1	-	1	2	-	4	6.6
151-200	2	2	3	1	1	9	14.7
201-300	-	-	-	1	1	2	3.3
301-500	1	-	-	1	-	2	3.3
501-1,000	-	-	-	-	-	-	-
Over 1,000	-	-	-	-	-	-	-
Unknown	-	-	-	1	-	1	1.6

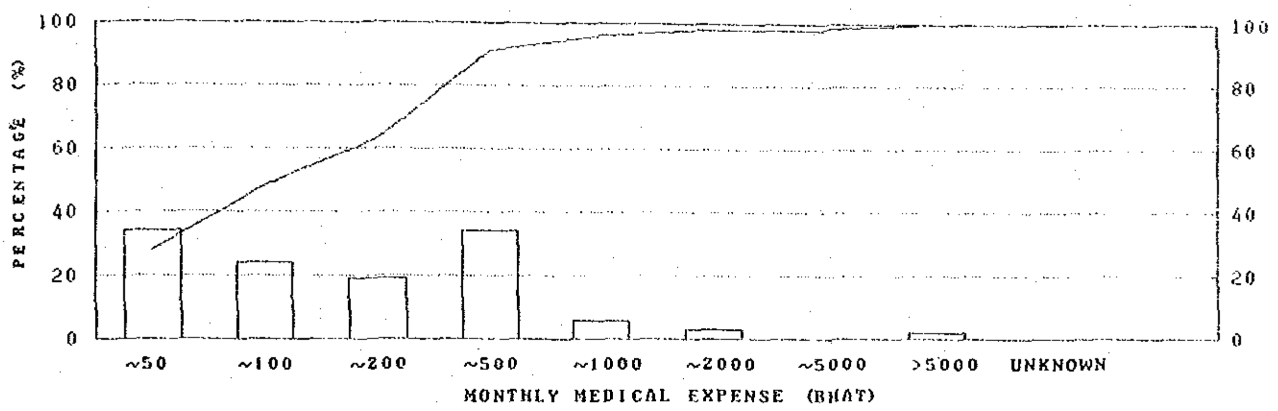
Table A1-5-1 SUMMARY OF QUESTIONNAIRE SURVEY IN PHANG NGA (CONT'D)

Block No.	1	2	3	4	5	Total	Rate (%)
9. Willingness to Pay							
Baht							
Up to 50	9	6	9	9	2	35	57.4
51-100	6	5	3	3	3	20	32.8
101-200	-	1	-	3	-	4	6.6
201-500	1	-	-	-	-	1	1.6
501-1,000	-	-	-	-	-	-	-
Over 1,000	-	-	-	-	-	-	-
Unknown	-	-	-	-	1	1	1.6
10. Water Quality (Other Source)							
10.1 Color							
Yes	5	5	15	1	5	31	34.4
No	16	16	3	15	4	54	60.0
Unknown	-	1	1	2	1	5	5.6
10.2 Smell							
Yes	5	1	15	1	6	28	31.1
No	16	20	3	16	3	58	64.5
Unknown	-	1	1	1	1	4	4.4
10.3 Turbidity							
Yes	6	7	15	3	5	36	40.0
No	15	14	3	15	4	51	56.7
Unknown	-	1	1	-	1	3	3.3
11. Willingness to Connect							
Yes	9	8	3	1	5	26	42.6
No	3	10	10	10	2	35	57.4
Unknown	-	-	-	-	-	-	-
12. Willingness to Pay for Connection Fee							
Baht							
Up to 1,000	5	1	1	-	1	8	30.8
1,001-2,000	3	3	1	-	1	8	30.8
2,001-2,500	1	4	1	1	3	10	38.4
2,501-3,000	-	-	-	-	-	-	-
3,001-4,000	-	-	-	-	-	-	-
4,001-5,000	-	-	-	-	-	-	-
5,001-6,000	-	-	-	-	-	-	-
Over 6,000	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	-	-
13. Willingness to Pay for Water Charge							
Baht							
Up to 50	2	5	2	-	-	9	34.6
51-100	7	2	1	1	2	13	50.0
101-200	-	1	-	-	2	3	11.5
201-500	-	-	-	-	-	-	-
501-1,000	-	-	-	-	1	1	3.9
Over 1,000	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	-	-

MONTHLY INCOME DISTRIBUTION



MONTHLY MEDICAL EXPENSE DISTRIBUTION



TYPE OF WATER SOURCE & WILLINGNESS-TO-CONNECT

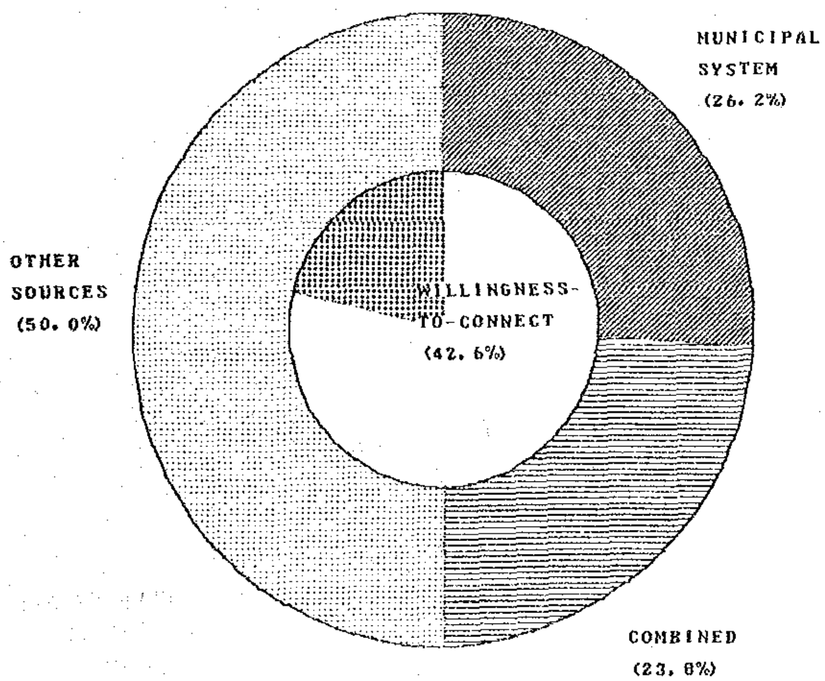
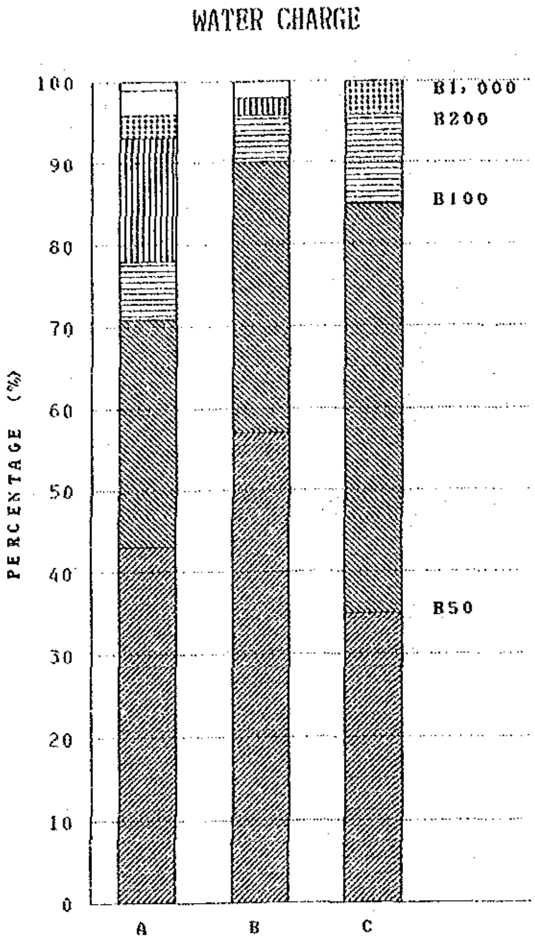
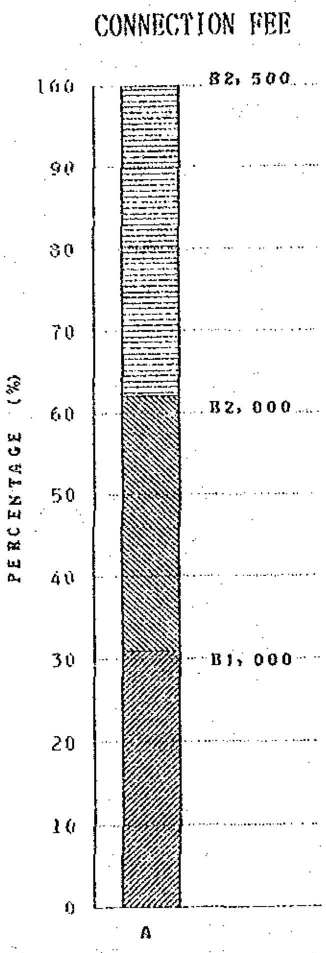


FIGURE A1-5-2
RESULTS OF QUESTIONNAIRE SURVEY (1)
(PHANG NGA)

WILLINGNESS-TO-PAY





A : ACTUAL PAYMENT BY EXISTING USERS
B : EXPECTANT PAYMENT BY EXISTING USERS
C : EXPECTANT PAYMENT BY POSSIBLE USERS

COMPLAINTS OF RESPONDENTS

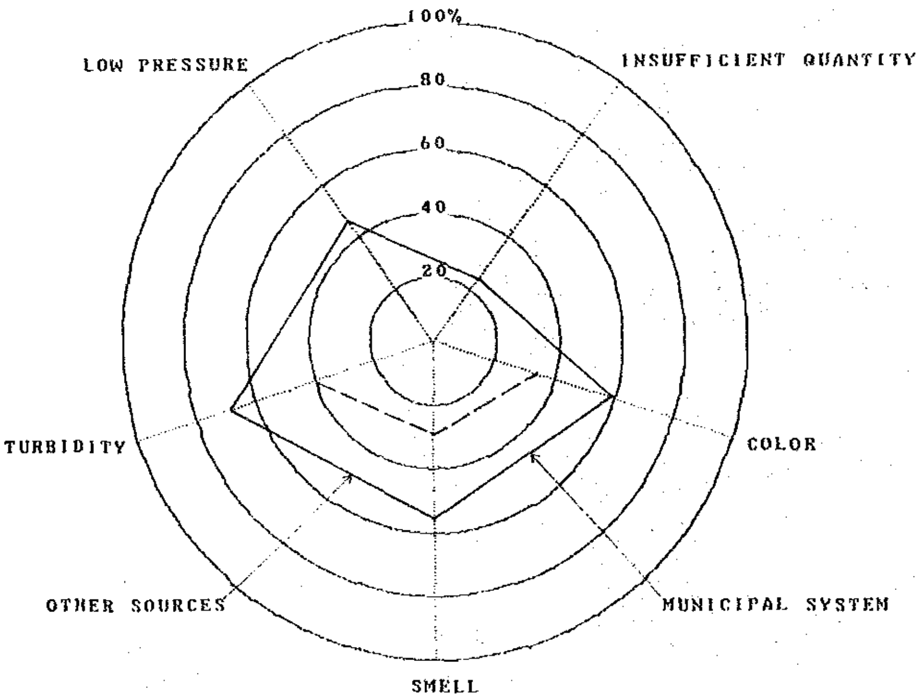


FIGURE A1-5-2
RESULTS OF
QUESTIONNAIRE SURVEY (2)
(PHANG NGA)

APPENDIX A-6-1

Construction Unit Cost

Unit Cost

Item	Material	Fitting	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1 (w/10%coat)	Pavement	Total 2
Pipeline									
	(################			P W A 's	Unit Rate (1987)	###########################			)
a. A/C Pipe(Normal Tytpe)		(25%)							
100 mm	85	21	56	162	6	35	224	140	364
150 mm	142	36	77	255	11	56	353	154	507
200 mm	255	64	90	409	19	90	569	166	735
250 mm	352	88	126	566	29	125	792	179	971
300 mm	507	127	167	801	40	177	1119	223	1342
400 mm	970	243	248	1461	80	324	2050	248	2298
500 mm	1362	341	278	1981	132	444	2812	283	3095
600 mm	1761	440	354	2555	161	570	3615	319	3934
b. Steel Pipe		(35%)							
150 mm	545	191	99	835	12	178	1127	140	1267
200 mm	720	252	111	1083	22	232	1471	154	1625
250 mm	1080	378	153	1611	38	346	2195	166	2361
300 mm	1330	465	202	1998	58	432	2736	179	2915
400 mm	1420	497	250	2167	80	472	2991	223	3214
500 mm	1785	625	361	2771	160	615	3901	248	4149
600 mm	2140	749	468	3357	264	760	4820	283	5103
700 mm	2495	873	582	3950	322	897	5686	319	6005

Unit Cost

For Transmission Pipeline (Transportation < 800 km)

Item	Material	Fitting (10%)	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2	PWA Price (1987)	Ratio	Adopted (1988)
	(****** Unit Rate Based on Pipe Material Cost as of December,1988								*******)			
a. A/C Pipe (Class 20 Normal type)		(10 %)										
100 mm	115	12	63	190	7	41	261	153	414	364	1.14	410
150 mm	189	19	87	295	12	64	408	168	577	507	1.14	580
200 mm	328	33	101	462	21	101	643	181	824	735	1.12	820
250 mm	454	45	142	641	32	141	895	196	1091	971	1.12	1,090
300 mm	643	64	188	895	44	197	1249	244	1493	1342	1.11	1,490
400 mm	1217	122	279	1618	87	358	2270	271	2541	2298	1.11	2,540
500 mm	1699	170	313	2182	144	488	3096	309	3405	3095	1.10	3,410
600 mm	2187	219	398	2804	176	626	3967	349	4315	3934	1.10	4,320
b. Steel Pipe		(15 %)										
150 mm	550	83	111	744	13	159	1008	168	1176	1267	0.93	1,270
200 mm	908	136	125	1168	24	250	1587	181	1769	1625	1.09	1,770
250 mm	1210	182	172	1564	42	337	2136	196	2332	2361	0.99	2,360
300 mm	1507	226	227	1960	63	425	2693	244	2937	2915	1.01	2,940
400 mm	1887	283	281	2451	87	533	3378	271	3649	3214	1.14	3,650
500 mm	2261	339	406	3006	175	668	4233	309	4542	4149	1.09	4,540
600 mm	2723	408	526	3657	288	829	5252	349	5600	5103	1.10	5,600
700 mm	3179	477	655	4311	352	979	6206	407	6612	6005	1.10	6,610
800 mm	4527	679	932	6138	460	1385	8781	465	9246			9,250
900 mm	5104	766	1051	6921	582	1575	9986	523	10508			10,510
1000 mm	6804	1021	1401	9225	718	2088	13234	581	13815			13,820
1100 mm	7926	1189	1632	10746	869	2439	15460	639	16099			16,100
1200 mm	9048	1357	1863	12268	1034	2793	17705	697	18402			18,400
1350 mm	11000	1650	2265	14915	1309	3407	21594	784	22378			22,380
1500 mm	12953	1943	2667	17563	1616	4027	25526	871	26398			26,400

*** Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Distribution Pipeline (Transportation < 800 km)

Item	Material	Fitting	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2	PWA Price (1987)	Ratio	Adopted (1988)
(###### Unit Rate Based on Pipe Material Cost as of December,1988 #######)												
a. A/C Pipe (Class 20 Normal type)		(25 %)										
100 mm	115	29	63	207	7	45	284	153	437	364	1.20	440
150 mm	189	47	87	323	12	70	446	168	614	507	1.21	610
200 mm	328	82	101	511	21	112	708	181	890	735	1.21	890
250 mm	454	113	142	709	32	155	986	196	1181	971	1.22	1,180
300 mm	643	161	188	991	44	217	1378	244	1621	1342	1.21	1,620
400 mm	1217	304	279	1801	87	397	2513	271	2784	2298	1.21	2,780
500 mm	1699	425	313	2437	144	542	3435	309	3744	3095	1.21	3,740
600 mm	2187	547	398	3132	176	695	4403	349	4752	3934	1.21	4,750
b. Steel Pipe		(35 %)										
150 mm	550	193	111	854	13	182	1154	168	1322	1267	1.04	1,320
200 mm	908	318	125	1350	24	289	1829	181	2010	1625	1.24	2,010
250 mm	1210	424	172	1806	42	388	2459	196	2654	2361	1.12	2,650
300 mm	1507	527	227	2262	63	488	3095	244	3338	2915	1.15	3,340
400 mm	1887	660	281	2828	87	612	3880	271	4151	3214	1.29	4,150
500 mm	2261	791	406	3458	175	763	4835	309	5144	4149	1.24	5,140
600 mm	2723	953	526	4202	288	943	5977	349	6325	5103	1.24	6,330
700 mm	3179	1113	655	4946	352	1113	7052	407	7459	6005	1.24	7,460
800 mm	4527	1584	932	7043	460	1576	9986	465	10451			10,450
900 mm	5104	1786	1051	7941	582	1790	11344	523	11867			11,870
1000 mm	6804	2381	1401	10586	718	2374	15045	581	15626			15,630
1100 mm	7926	2774	1632	12332	869	2772	17570	639	18209			18,210
1200 mm	9048	3167	1863	14077	1034	3173	20113	697	20810			20,810
1350 mm	11000	3850	2265	17115	1309	3869	24522	784	25307			25,310
1500 mm	12953	4533	2667	20153	1616	4571	28974	871	29846			29,850

Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Transmission Pipeline (Transportation >= 800 km)

Item	Material	Fitting (10%)	Labor	SubTotal	Transprt (>=800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2			Adopted (1988)
<****** Unit Rate Based on Pipe Material Cost as of December,1988 *******>												
a. A/C Pipe (Class 20 Normal type)		(10 %)										
100 mm	115	12	63	190	13	43	270	153	423	364	1.16	420
150 mm	189	19	87	295	24	67	424	168	593	507	1.17	590
200 mm	328	33	101	462	42	106	670	181	852	735	1.16	850
250 mm	454	45	142	641	63	148	937	196	1133	971	1.17	1,130
300 mm	643	64	188	895	87	206	1308	244	1551	1342	1.16	1,550
400 mm	1217	122	279	1618	175	377	2387	271	2658	2298	1.16	2,660
500 mm	1699	170	313	2182	288	519	3288	309	3597	3095	1.16	3,600
600 mm	2187	219	398	2804	352	663	4201	349	4549	3934	1.16	4,550
b. Steel Pipe		(15 %)										
150 mm	550	83	111	744	26	162	1025	168	1193	1267	0.94	1,270
200 mm	908	136	125	1168	48	255	1619	181	1801	1625	1.11	1,800
250 mm	1210	182	172	1564	83	346	2192	196	2387	2361	1.01	2,390
300 mm	1507	226	227	1960	127	438	2778	244	3022	2915	1.04	3,020
400 mm	1887	283	281	2451	175	551	3495	271	3766	3214	1.17	3,770
500 mm	2261	339	406	3006	350	705	4466	309	4775	4149	1.15	4,780
600 mm	2723	408	526	3657	577	889	5636	349	5984	5103	1.17	5,980
700 mm	3179	477	655	4311	704	1053	6674	407	7081	6005	1.18	7,080
800 mm	4527	679	932	6138	919	1482	9393	465	9857			9,860
900 mm	5104	766	1051	6921	1163	1698	10760	523	11283			11,280
1000 mm	6804	1021	1401	9225	1436	2239	14190	581	14771			14,770
1100 mm	7926	1189	1632	10746	1738	2622	16616	639	17256			17,260
1200 mm	9048	1357	1863	12268	2068	3011	19081	697	19778			19,780
1350 mm	11000	1650	2265	14915	2617	3682	23336	784	24120			24,120
1500 mm	12953	1943	2667	17563	3231	4367	27677	871	28548			28,550

*** Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Distribution Pipeline (Transportation >= 800 km)

Item	Material	Fitting	Labor	SubTotal	Transprt (>=800km)etc.	Profit (21%)	Total 1 (w/10%cont)	Pavement	Total 2			Adopted (1988)
(****** Unit Rate Based on Pipe Material Cost as of December,1988 *******)												
a. A/C Pipe (Class 20 Normal type)												
		(25 %)										
100 mm	115	29	63	207	13	46	293	153	446	364	1.23	450
150 mm	189	47	87	323	24	73	462	168	630	507	1.24	630
200 mm	328	82	101	511	42	116	736	181	917	735	1.25	920
250 mm	454	113	142	709	63	162	1028	196	1223	971	1.26	1,220
300 mm	643	161	188	991	87	227	1436	244	1680	1342	1.25	1,680
400 mm	1217	304	279	1801	175	415	2630	271	2901	2298	1.26	2,900
500 mm	1699	425	313	2437	288	572	3627	309	3936	3095	1.27	3,940
600 mm	2187	547	398	3132	352	732	4637	349	4986	3934	1.27	4,990
b. Steel Pipe		(35 %)										
150 mm	550	193	111	854	26	185	1171	168	1340	1267	1.06	1,340
200 mm	908	318	125	1350	48	294	1861	181	2042	1625	1.26	2,040
250 mm	1210	424	172	1806	83	397	2514	196	2709	2361	1.15	2,710
300 mm	1507	527	227	2262	127	502	3179	244	3423	2915	1.17	3,420
400 mm	1887	660	281	2828	175	631	3997	271	4268	3214	1.33	4,270
500 mm	2261	791	406	3458	350	800	5068	309	5377	4149	1.30	5,380
600 mm	2723	953	526	4202	577	1004	6361	349	6709	5103	1.31	6,710
700 mm	3179	1113	655	4946	704	1187	7520	407	7927	6005	1.32	7,930
800 mm	4527	1584	932	7043	919	1672	10598	465	11062			11,060
900 mm	5104	1786	1051	7941	1163	1912	12118	523	12641			12,640
1000 mm	6804	2381	1401	10586	1436	2525	16001	581	16582			16,580
1100 mm	7926	2774	1632	12332	1738	2955	18726	639	19365			19,370
1200 mm	9048	3167	1863	14077	2068	3391	21490	697	22187			22,190
1350 mm	11000	3850	2265	17115	2617	4144	26264	784	27049			27,050
1500 mm	12953	4533	2667	20153	3231	4911	31125	871	31996			32,000

*** Note: Pipe material prices are estimated from the contractor's purchasing price
as of Dec.1988

Unit Cost

Construction Works		Price in 3 Lowest Tenders (1988) (A)		Estimated Cost (A)*1.35	PWA's Unit Cost (for 1987)	Adopted Cost (1988)
Concrete Work (incl.Form Work,Scafolding)	Baht	2,200 /cu m	Baht	2,970 /cu m	-	
Re-Bar	Baht	18 /kg	Baht	24 /kg	-	
Unit Concrete Cost (incl.Form Work,Scafolding, Re-Bar(100kg/cu m concrete))			Baht	5,370 /cu m	-	5,400
Earth Work						
Excavation (with Backfill)		55 /cu m		79 /cu m	-	80
Soil Fill		53 /cu m		76		120 (From PWA Cost)
Architectural Works						
Administration Bldg.		4,516 /sq m		6,451 /sq m		
Head Quarter Bldg.		3,612		5,160		5,000
Chlorination House	Baht	2,830 /sq m	Baht	4,043 /sq m	3610 - 4300	3,800
Pump House (excl.pump pit)	Baht	1,860 /sq m	Baht	2,657 /sq m	3540 - 4200	3,600

Unit Cost

Construction Works	PWA's Cost (for 1987) (Baht 1000)	Unit Cost (Baht/cu m/h) (A)	Estimated Cost (for 1989) (A)*1.30	Adopted Cost (1988)
Treatment Facilities			Unit Cost (Baht/cu m/h)	Unit Cost (Baht/cu m/h)
Sedimentation Basin				
50 cu m/hr	1,310	26,200	34,100	34,000
100 cu m/hr	1,633	16,330	21,200	21,000
200 cu m/hr	3,136	15,680	20,400	20,000
250 cu m/hr	5,133	20,532	26,700	27,000
500 cu m/hr	7,708	15,416	20,000	20,000
1000 cu m/hr	17,723	17,723	23,000	23,000
Filters				
50 cu m/hr	588	11,760	15,300	15,000
100 cu m/hr	1,044	10,440	13,600	14,000
200 cu m/hr	2,227	11,135	14,500	15,000
250 cu m/hr	2,337	9,348	12,200	12,000
500 cu m/hr	4,674	9,348	12,200	12,000
1000 cu m/hr	11,356	11,356	14,800	15,000
Clear Water Reservoir			Unit Cost (Baht/cu m)	Unit Cost (Baht/cu m)
500 cu m	887	1,774	2,300	2,300
1000 cu m	1,628	1,628	2,100	2,100
1500 cu m	2,699	1,799	2,300	2,300
2000 cu m	2,803	1,402	1,800	1,800
2250 cu m	3,282	1,459	1,900	1,900
3000 cu m	6,633	2,211	2,900	2,900
3300 cu m	6,603	2,001	2,600	2,600
4000 cu m	7,730	1,933	2,500	2,500
5800 cu m	10,809	1,864	2,400	2,400
Elevated Tank			Cost (Baht 1000)	Cost (Baht 1000)
50 cu m	722		940	900
120 cu m	1,146		1,490	1,500
250 cu m	1,394		1,810	1,800

APPENDIX A-8-1

Distribution Network Analysis

TITLE : Pang Nga (Proposed)
NO. OF PIPES : 109
NO. OF NODES : 80
PEAK FACTOR : 1.3
MAX HEADLOSS/Km : 100
MAX UNBAL(LPS) : .008

PIPE NO.	FROM Node	TO Node	LENGTH (M)	DIA (MM)	HWC	FLOW (LPS)	VELOCITY (MPS)	HEADLOSS (M/KM)	HEADLOSS (M)
1	1	2	800.00	200	100	6.33	0.20LO	0.46	0.37
2	2	3	3200.00	200	100	0.69	0.02LO	0.01	0.02
3	1	4	550.00	200	100	22.47	0.72	4.80	2.64
4	4	5	240.00	200	100	13.76	0.44	1.94	0.47
5	5	6	90.00	100	100	2.46	0.31	2.35	0.21
6	5	7	160.00	200	100	11.18	0.36	1.32	0.21
7	7	8	515.00	200	100	8.48	0.27LO	0.79	0.41
8	8	9	990.00	200	100	8.64	0.28LO	0.82	0.81
9	9	10	390.00	150	110	4.00	0.23LO	0.67	0.26
10	10	11	220.00	150	110	2.87	0.16LO	0.36	0.08
11	11	12	200.00	150	110	2.03	0.11LO	0.19	0.04
12	12	13	230.00	100	100	0.16	0.02LO	0.02	0.00
13	13	15	600.00	100	110	0.60	0.08LO	0.14	0.09
14	15	14	200.00	100	110	0.26	0.03LO	0.03	0.01
15	14	16	130.00	100	100	1.18	0.15LO	0.61	0.08
16	16	17	240.00	100	100	0.70	0.09LO	0.23	0.06
17	17	18	135.00	100	110	0.47	0.06LO	0.09	0.01
18	19	18	405.00	100	100	0.18	0.02LO	0.02	0.01
19	19	20	170.00	100	100	0.04	0.01LO	0.00	0.00
20	9	66	410.00	150	100	3.25	0.18LO	0.55	0.22
21	21	22	710.00	150	100	1.83	0.10LO	0.19	0.13
22	22	23	650.00	100	100	0.16	0.02LO	0.02	0.01
23	16	24	290.00	100	100	0.29	0.04LO	0.04	0.01
24	24	25	240.00	150	100	1.88	0.11LO	0.20	0.05
25	25	26	640.00	150	110	1.50	0.08LO	0.11	0.07
26	27	26	400.00	100	100	1.07	0.14LO	0.51	0.20
27	26	28	550.00	150	110	2.05	0.12LO	0.20	0.11
28	29	30	260.00	100	100	0.01	0.00LO	0.00	0.00
29	4	29	60.00	150	100	8.39	0.47	3.15	0.19
30	29	31	250.00	100	100	1.62	0.21LO	1.09	0.27
31	32	31	130.00	100	100	0.34	0.04LO	0.06	0.01
32	31	33	180.00	100	100	1.71	0.22LO	1.20	0.22
33	34	33	165.00	100	100	0.15	0.02LO	0.01	0.00
34	33	35	115.00	150	100	4.08	0.23LO	0.83	0.10
35	36	35	185.00	100	100	0.16	0.02LO	0.01	0.00
36	35	37	180.00	150	100	4.20	0.24LO	0.88	0.16
37	37	38	215.00	100	100	0.34	0.04LO	0.06	0.01
38	37	39	90.00	150	100	3.84	0.22LO	0.74	0.07
39	40	39	205.00	100	100	0.10	0.01LO	0.01	0.00
40	42	41	145.00	150	100	0.95	0.05LO	0.06	0.01
41	40	42	155.00	150	100	3.12	0.18LO	0.51	0.08

PIPE NO.	FROM Node	TO Node	LENGTH (M)	DIA (MM)	HWC	FLOW (LPS)	VELOCITY (MPS)	HEADLOSS (M/KM)	(M)
42	41	43	230.00	150	100	4.32	0.24LO	0.92	0.21
43	43	44	80.00	100	150	4.32	0.55	3.15	0.25
44	44	61	125.00	150	100	3.62	0.20LO	0.67	0.08
45	45	46	160.00	150	100	0.15	0.01LO	0.00	0.00
46	100	1	30.00	200	100	28.85	0.92	7.63	0.23
47	29	32	190.00	150	100	5.39	0.30	1.39	0.26
48	32	34	200.00	150	100	4.76	0.27LO	1.10	0.22
49	34	36	100.00	150	100	4.38	0.25LO	0.95	0.09
50	36	38	215.00	150	100	4.01	0.23LO	0.80	0.17
51	38	40	60.00	150	100	4.21	0.24LO	0.88	0.05
52	39	41	110.00	150	100	3.93	0.22LO	0.78	0.09
53	7	33	15.00	200	100	2.51	0.08LO	0.08	0.00
54	41	8	20.00	150	100	0.56	0.03LO	0.02	0.00
55	45	9	20.00	100	100	1.38	0.18LO	0.80	0.02
56	12	14	520.00	150	100	1.82	0.10LO	0.19	0.10
57	14	22	20.00	100	100	0.55	0.07LO	0.15	0.00
59	11	21	20.00	100	100	0.78	0.10LO	0.28	0.01
60	25	19	20.00	100	100	0.27	0.03LO	0.04	0.00
61	17	19	270.00	100	100	0.18	0.02LO	0.02	0.01
62	22	24	380.00	150	100	2.06	0.12LO	0.24	0.09
63	10	13	950.00	100	100	0.51	0.06LO	0.13	0.12
64	61	45	550.00	150	100	2.94	0.17LO	0.45	0.25
65	2	51	200.00	150	110	5.50	0.31	1.21	0.24
66	51	52	250.00	100	110	2.54	0.32	2.09	0.52
67	51	53	650.00	100	110	2.77	0.35	2.44	1.59
68	52	56	670.00	100	110	2.17	0.28LO	1.55	1.04
69	56	55	850.00	100	110	1.71	0.22LO	1.01	0.86
70	53	54	750.00	100	110	1.76	0.22LO	1.06	0.80
71	29	54	300.00	100	110	1.23	0.16LO	0.55	0.16
72	40	57	310.00	100	110	0.80	0.10LO	0.25	0.08
73	60	59	400.00	100	110	0.41	0.05LO	0.07	0.03
74	42	60	420.00	100	110	2.00	0.25LO	1.34	0.56
75	61	60	400.00	100	110	0.17	0.02LO	0.01	0.01
76	57	58	250.00	100	110	0.20	0.03LO	0.02	0.00
77	58	62	700.00	100	110	1.60	0.20LO	0.89	0.62
78	62	64	850.00	100	110	1.13	0.14LO	0.47	0.40
79	63	64	630.00	100	110	0.23	0.03LO	0.02	0.02
80	66	21	200.00	100	100	1.21	0.15LO	0.63	0.13
81	64	67	720.00	100	110	1.06	0.13LO	0.41	0.30
82	66	65	450.00	100	110	1.03	0.13LO	0.40	0.18
83	67	68	740.00	100	110	0.65	0.08LO	0.17	0.12
84	23	68	890.00	100	110	0.57	0.07LO	0.13	0.12
85	69	70	950.00	100	110	0.01	0.00LO	0.00	0.00
86	27	70	1070.00	100	110	0.73	0.09LO	0.21	0.23
87	18	71	320.00	100	110	0.18	0.02LO	0.02	0.00
88	9	27	400.00	100	110	1.95	0.25LO	1.28	0.51
89	45	63	320.00	100	110	1.33	0.17LO	0.63	0.20
90	54	55	420.00	100	110	0.47	0.06LO	0.09	0.04

PIPE NO.	FROM Node	TO Node	LENGTH (M)	DIA (MM)	HWC	FLOW (LPS)	VELOCITY (MPS)	HEADLOSS (M/KM)	(M)
91	10	73	330.00	100	110	0.47	0.06LO	0.09	0.03
92	72	73	430.00	100	110	0.17	0.02LO	0.01	0.01
93	74	72	400.00	100	110	1.05	0.13LO	0.41	0.16
94	75	74	600.00	100	110	1.48	0.19LO	0.76	0.46
95	76	75	400.00	100	110	2.00	0.25LO	1.34	0.53
96	6	76	200.00	100	110	2.30	0.29LO	1.74	0.35
97	77	23	400.00	100	110	0.48	0.06LO	0.09	0.04
98	65	77	350.00	100	110	0.65	0.08LO	0.17	0.06
99	78	65	370.00	100	110	0.78	0.10LO	0.23	0.09
100	63	78	350.00	100	110	0.99	0.13LO	0.37	0.13
101	79	63	350.00	100	110	1.32	0.17LO	0.63	0.22
102	59	79	270.00	100	110	1.45	0.18LO	0.74	0.20
103	80	59	320.00	100	110	1.56	0.20LO	0.84	0.27
104	57	80	340.00	100	110	1.65	0.21LO	0.94	0.32
105	81	57	350.00	100	110	1.69	0.22LO	0.98	0.34
106	54	81	350.00	100	110	1.77	0.22LO	1.07	0.37
107	55	82	350.00	100	110	1.76	0.22LO	1.06	0.37
108	82	58	350.00	100	110	1.61	0.21LO	0.90	0.31
109	68	83	490.00	100	110	0.70	0.09LO	0.19	0.09
110	83	69	580.00	100	110	0.26	0.03LO	0.03	0.02

NODE NO.	FLOW (LPS)	ELEVATION (M)	H G L (M)	PRESSURE (M)
100 R	28.853	100.00	128.00	28.00
1	-0.052	100.00	127.77	27.77
2	-0.138	102.00	127.40	25.40
3	-0.690	106.50	127.38	20.88
4	-0.324	104.00	125.13	21.13
5	-0.113	105.00	124.66	19.66
6	-0.159	107.00	124.45	17.45
7	-0.191	106.00	124.45	18.45
8	-0.400	108.00	124.05	16.05
9	-0.820	100.00	123.23	23.23
10	-0.153	100.00	122.97	22.97
11	-0.056	99.50	122.89	23.39
12	-0.049	99.50	122.85	23.35
13	-0.074	102.20	122.85	20.65
14	-0.339	99.50	122.76	23.26
15	-0.342	104.40	122.76	18.36
16	-0.190	99.50	122.68	23.18
17	-0.053	99.50	122.59	23.09
18	-0.464	100.00	122.58	22.58
19	-0.239	99.50	122.59	23.09
20	-0.040	99.00	122.59	23.59
21	-0.161	99.50	122.88	23.38
22	-0.156	99.50	122.75	23.25

NODE NO.	FLOW (LPS)	ELEVATION (M)	H G L (M)	PRESSURE (M)
23	-0.070	96.50	122.74	26.24
24	-0.476	99.50	122.66	23.16
25	-0.109	99.50	122.59	23.09
26	-0.516	99.00	122.52	23.52
27	-0.142	94.00	122.72	28.72
28	-2.054	104.00	122.41	18.41
29	-0.129	104.00	124.94	20.94
30	-0.013	103.80	124.94	21.14
31	-0.256	105.00	124.67	19.67
32	-0.291	104.00	124.68	20.68
33	-0.298	106.00	124.45	18.45
34	-0.222	104.00	124.46	20.46
35	-0.029	106.00	124.36	18.36
36	-0.217	104.00	124.36	20.36
37	-0.022	107.00	124.20	17.20
38	-0.140	105.00	124.19	19.19
39	-0.013	107.00	124.13	17.13
40	-0.177	105.00	124.14	19.14
41	0.000	108.00	124.05	16.05
42	-0.176	106.00	124.05	18.05
43	0.000	109.40	123.83	14.43
44	-0.705	109.00	123.58	14.58
45	-0.074	100.00	123.25	23.25
46	-0.155	100.00	123.25	23.25
51	-0.195	100.00	127.16	27.16
52	-0.377	102.00	126.64	24.64
53	-1.002	100.00	125.57	25.57
54	-0.764	100.00	124.78	24.78
55	-0.422	100.00	124.74	24.74
56	-0.452	102.00	125.60	23.60
57	-0.641	104.00	124.06	20.06
58	-0.209	104.00	124.05	20.05
59	-0.519	103.00	123.47	20.47
60	-1.758	107.00	123.49	16.49
61	-0.511	108.00	123.50	15.50
62	-0.467	103.00	123.43	20.43
63	-1.430	100.00	123.05	23.05
64	-0.307	100.00	123.03	23.03
65	-1.161	99.00	122.83	23.83
66	-1.006	99.30	123.01	23.71
67	-0.406	100.00	122.73	22.73
68	-0.519	99.50	122.62	23.12
69	-0.254	99.00	122.50	23.50
70	-0.740	99.00	122.50	23.50
71	-0.180	100.00	122.58	22.58
72	-0.880	100.00	122.95	22.95
73	-0.642	100.00	122.94	22.94
74	-0.422	106.00	123.11	17.11

NODE NO.	FLOW (LPS)	ELEVATION (M)	H G L (M)	PRESSURE (M)
75	-0.521	107.00	123.57	16.57
76	-0.307	107.00	124.10	17.10
77	-0.178	99.50	122.77	23.27
78	-0.214	99.50	122.92	23.42
79	-0.121	101.50	123.27	21.77
80	-0.098	103.50	123.74	20.24
81	-0.074	102.00	124.40	22.40
82	-0.146	102.00	124.37	22.37
83	-0.439	99.00	122.51	23.51

APPENDIX A-11-1

Details of Operation Cost

WATER TRANSMISSION AND DISTRIBUTION COST STUDY (Phang Nga)

Item					Y			E			A			R							
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1. Planned Daily Average Water Demand (cu m/d)																						
	1,639	1,683	1,728	1,775	1,824	1,875	1,928	2,048	2,170	2,292	2,415	2,540	2,612	2,687	2,764	2,844	2,927	3,004	3,083	3,165	3,249	3,335
2. Planned Daily Maximum Water Demand: QDM (cu m/d)																						
Peak Factor =	1.30																					
Planned Total	2,131	2,188	2,246	2,308	2,371	2,438	2,506	2,662	2,821	2,980	3,140	3,302	3,396	3,493	3,593	3,697	3,805	3,905	4,008	4,115	4,221	4,336

3. Treatment Plant
Existing Plant
After Modified |##>> Max. Capacity 1,440 cu m/d Net Capacity 1,333 cu m/day 1,330 cu m/d ##############################);

New Treatment Unit |####################################>> Max. Capacity 3,300 cu m/d Net Capacity 3,056 cu m/day ##############################;

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Treatment Capacity	1,440	1,440	1,440	1,440	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740	4,740
Net Treatment Capa	1,333	1,333	1,333	1,333	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386	4,386
4. Water Amount for Intake Design : (cu m/d)																						
Raw water for Treatment Plant (Daily Max)*1.08*1.1	2,531	2,599	2,669	2,741	2,817	2,896	2,978	3,163	3,351	3,540	3,730	3,923	4,034	4,150	4,269	4,392	4,520	4,639	4,761	4,888	5,015	5,151
5 Daily Average Transmission Amount																						
Raw water for Treatment Plant	1,639	1,683	1,728	1,775	1,824	1,875	1,928	2,048	2,170	2,292	2,415	2,540	2,612	2,687	2,764	2,844	2,927	3,004	3,083	3,165	3,249	3,335

6. Pump Characteristics
Raw Water Pump Dia= 100 mm, P = 10 KW, H = 10.0 m, Q = 1.8 cu m/min, No.of Pumps = 2 units (excluding 1 unit stand-by)

Clear Water Pump
at New WTP Dia= 200 mm, P = 20 KW, H = 40.0 m, Q = 1.6 cu m/min, No.of Pumps = 2 units (excluding 1 unit stand-by)
at Exis.WTP Exis.Pump Dia= 100 mm, P = 10 KW, H = 40.0 m, Q = 0.7 cu m/min, No.of Pumps = 2 units (excluding 1 unit stand-by)

WATER TRANSMISSION AND DISTRIBUTION COST STUDY (Phang Nga)

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011
8. No.of Operating Pumps																						
Raw Water Pump		1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
Max.Capa.of Pump		2,575	2,575	2,575	2,575	2,575	2,575	2,575	2,575	2,575	2,575	5,151	5,151	5,151	5,151	5,151	5,151	5,151	5,151	5,151	5,151	5,151
Clear Water Pump																						
at New WTP					1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Max.Capa.of Pump					2,310	2,310	2,310	2,310	2,310	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620
at Exis.WTP	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Max.Capa.of Pump	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016
Total Capacity (cu m)	2,016	2,016	2,016	2,016	4,326	4,326	4,326	4,326	4,326	6,636	6,636	6,636	6,636	6,636	6,636	6,636	6,636	6,636	6,636	6,636	6,636	6,636
9. Motor Output (Kw)																						
Raw Water Pump	0	10	10	10	10	10	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20
Clear Water Pump	20	20	20	20	40	40	40	40	40	60	60	60	60	60	60	60	60	60	60	60	60	60
10. Energy Consumption (Kwh/day)																						
Raw Water Pump		242	249	255	263	270	277	295	312	330	348	366	376	387	398	409	421	432	444	456	468	480
Clear Water Pump	317	317	317	317	455	468	481	511	542	497	524	551	567	583	600	617	635	652	669	687	705	724
11. Pump Operation Cost (Baht x1,000/year)																						
Demand Charge	55	82	82	82	137	137	137	137	137	192	192	220	220	220	220	220	220	220	220	220	220	220
Energy Charge	143	251	254	257	322	331	341	362	383	371	391	412	423	435	448	461	474	487	500	513	526	540
Total Cost	197	334	337	340	460	469	478	499	521	564	584	631	643	655	668	681	694	707	719	733	746	760
																			Total (1990-2011) =			12,412
Chemical Cost																						
Alum (ave 10.0 mg/l)																						
Chemical (kg/y)	5,982	6,143	6,307	6,479	6,658	6,844	7,037	7,475	7,921	8,366	8,815	9,271	9,534	9,808	10,089	10,381	10,684	10,965	11,253	11,552	11,859	12,173
Cost (Baht 1000)	24.2	24.9	25.5	26.2	27.0	27.7	28.5	30.3	32.1	33.9	35.7	37.5	38.6	39.7	40.9	42.0	43.3	44.4	45.6	46.8	48.0	49.3
Lime (ave 3.0 mg/l)																						
Chemical (kg/y)	1,795	1,843	1,892	1,944	1,997	2,053	2,111	2,243	2,376	2,510	2,644	2,781	2,860	2,942	3,027	3,114	3,205	3,289	3,376	3,466	3,558	3,652
Cost (Baht 1000)	2.2	2.3	2.4	2.4	2.5	2.6	2.6	2.8	3.0	3.1	3.3	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.6
Chlorine (ave 2.0 mg/l)																						
Chemical (kg/y)	1,196	1,229	1,261	1,296	1,332	1,369	1,407	1,495	1,584	1,673	1,763	1,854	1,907	1,962	2,018	2,076	2,137	2,193	2,251	2,310	2,372	2,435
Cost (Baht 1000)	18.7	19.2	19.7	20.2	20.8	21.4	22.0	23.3	24.7	26.1	27.5	28.9	29.7	30.6	31.5	32.4	33.3	34.2	35.1	36.0	37.0	38.0
Total cost(Baht 1000	45.1	46.3	47.6	48.9	50.2	51.6	53.1	56.4	59.8	63.1	66.5	69.9	71.9	74.0	76.1	78.3	80.6	82.7	84.3	87.2	89.5	91.8
																					Total	1,477

WATER TRANSMISSION AND DISTRIBUTION COST STUDY (Phang Nga)

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011

Note: Pumps is designed for Qda (Daily Average Demand)

8. Energy Consumption (KWh) = No.of Pumps x Motor Output(KW) x 24 h/day x (actual daily demand(qla)/max.capacity of pump(8))

9 . Demand Charge = Baht 229 /KW/mon x 12 mon/year x Motor Demand(7) KW

Energy Charge = Baht 1.23 /KWh x Energy Consumption (8) KWh/day x 365 days/year

Design Pump Head=(Head Loss of Pipeline)+(Actual Head for H.W.L)+(Pump Head 1.5 m)

DA : Daily Average

DM : Daily Maximum

Electricity Fee = Rate of Provincial Electricity Authority(PEA) for Narathiwad as of January, 1989.

Chemical Cost

Alum :Baht 4.05 /kg

Lime :Baht 1.25 /kg

Cl gas :Baht 15.60 /kg

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