FIGURE 4B-12. DRAINAGE SYSTEM IN THE PADDY FIELD

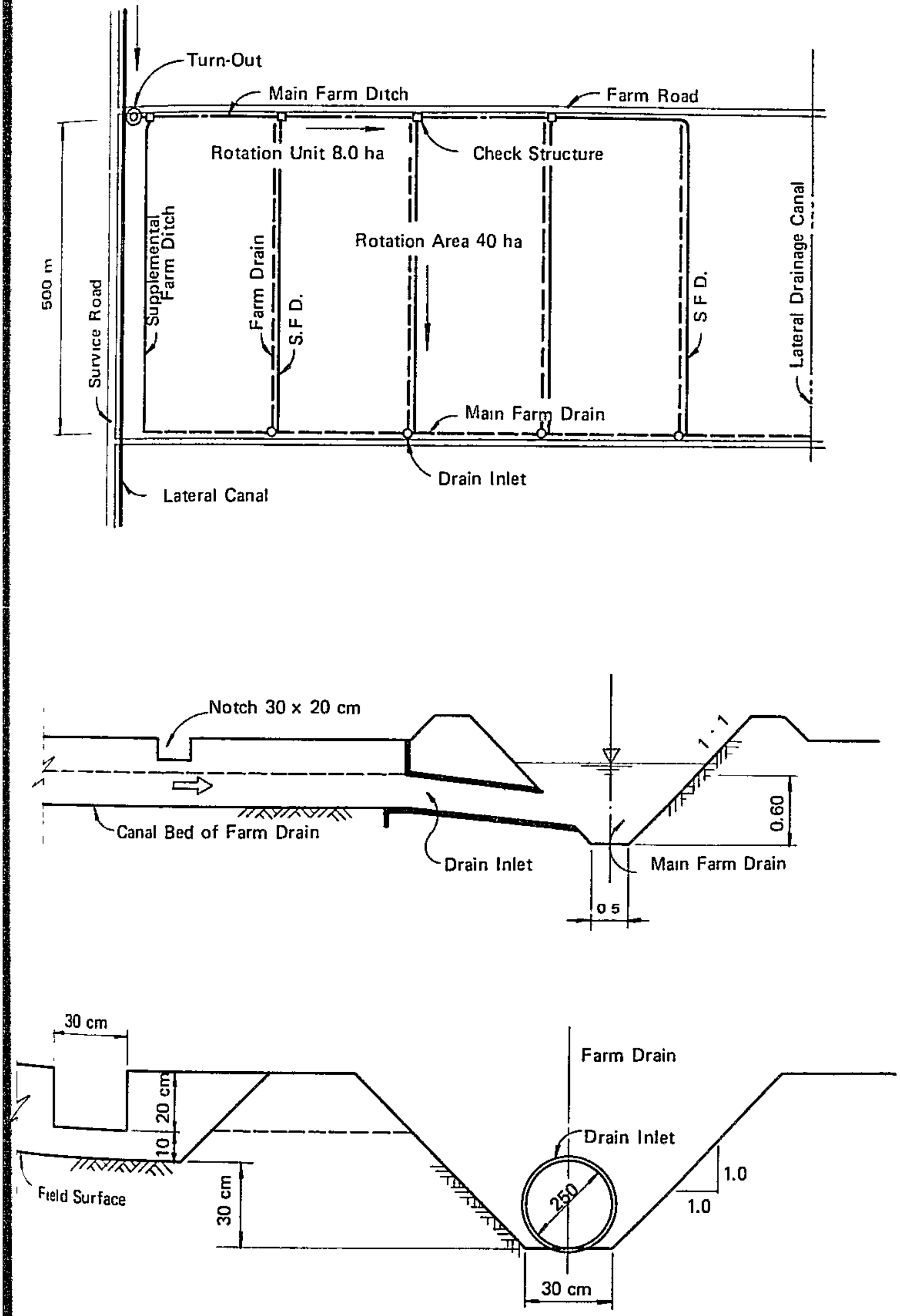


FIGURE 4B - 13. DIAGRAM OF RUN-OFF CAPACITY IN PADDY FIELD

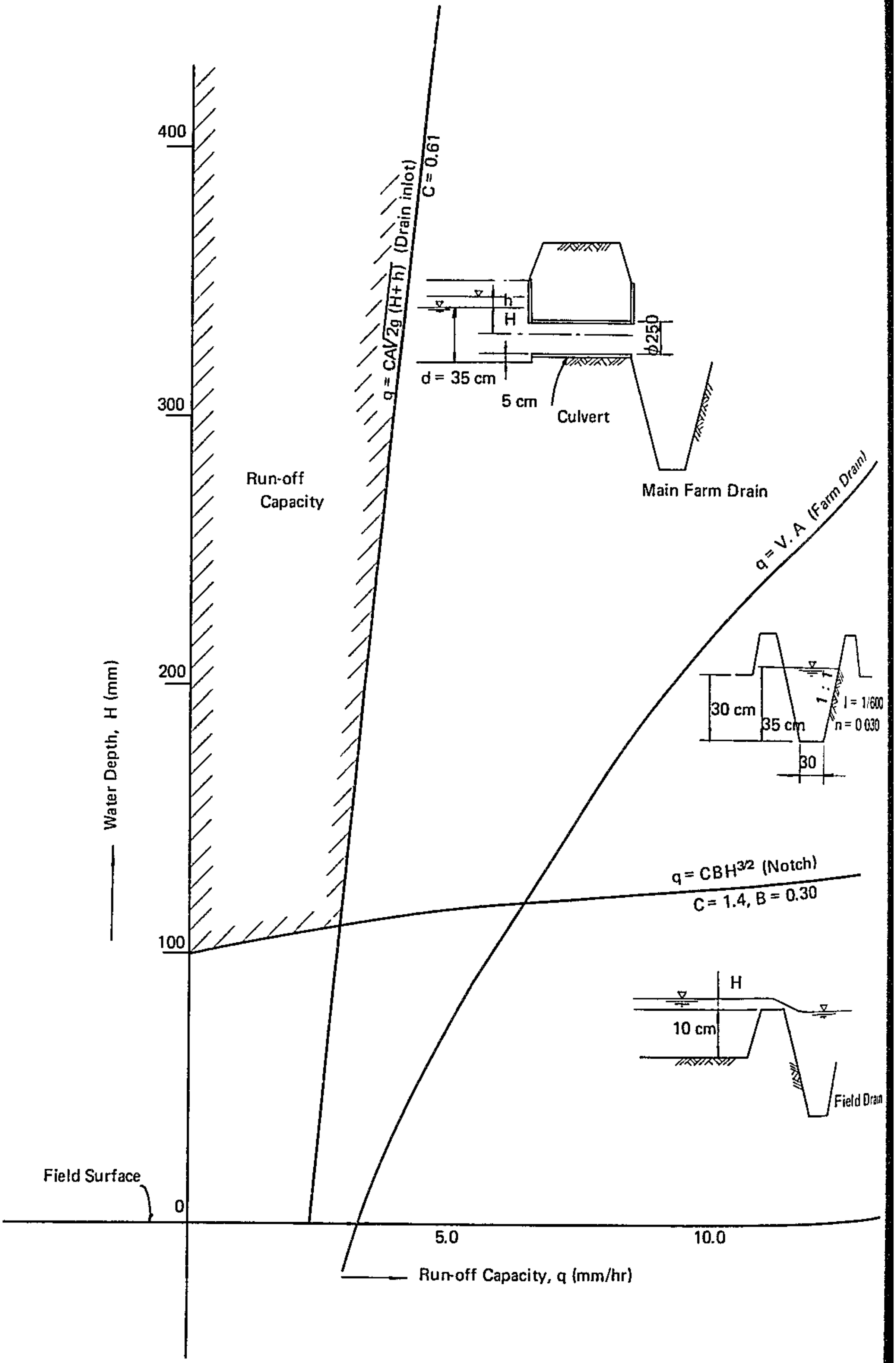


FIGURE 4B-14 DIAGRAM OF RUN-OFF ROUTING IN PADDY FIELD (3-DAY CONSECUTIVE RAINFALL)

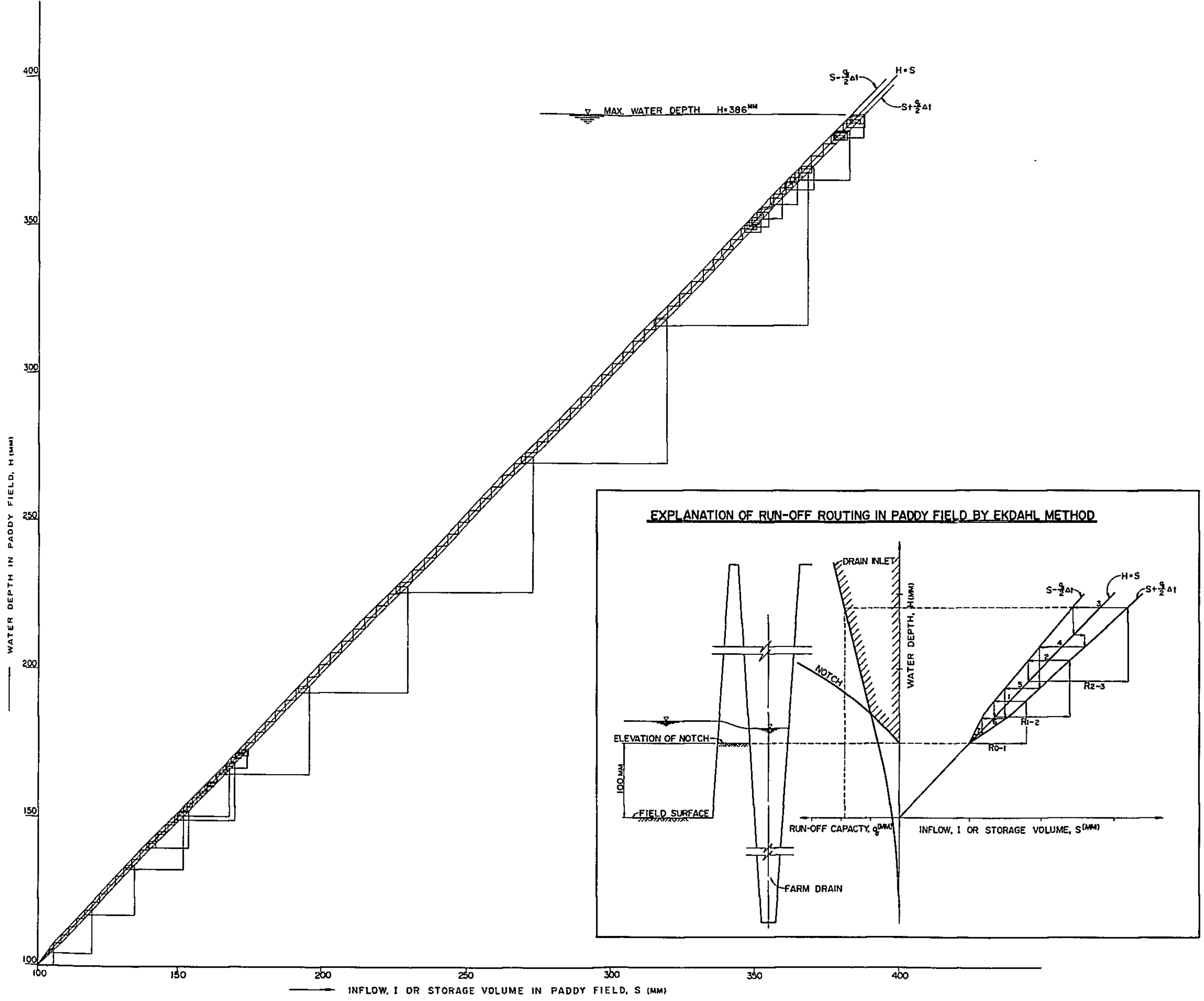


Table 4B-11 Result of Run-off Routing in Paddy Field (1)

Time	Hourly Rainfall (mm)	Effective Rainfall (mm)	Water Depth in Paddy Field2/ (mm)	Run-off Discharge	
				mm3/	cu.m/sec/sq.km
1	1.2	0 1/	81.2	0	0
2	5.5	0	86.7	0	0
3	6.7	0	93.4	0	0
4	12.3	5.7	105.0	1.70	0.472
5	14.7	14.7	118.6	2.90	0.805
6	18.4	18.4	134.0	3.00	0.833
7	19.6	19.6	150.5	3.09	0.858
8	20.8	20.8	168.2	3.19	0.886
9	7.4	7.4	172.8	3.20	0.889
10	3.7	3.7	173.1	3.20	0.889
11	1.9	1.9	171.6	3.19	0.886
12	1.9	1.9	170.0	3.18	0.883
13	1.2	1.2	168.2	3.18	0.833
14	2.5	2.5	167.4	3.18	0.833
15	0.6	0.6	164.8	3.17	0.881
16	0.6	0.6	162.2	3.15	0.875
17	1.8	1.8	160.8	3.14	0.872
18	1.2	1.2	159.0	3.15	0.875
19	0.6	0.6	156.7	3.14	0.872
20	0	0	153.6	3.11	0.864
21	0	0	150.5	3.10	0.861
22	0	0	147.5	3.08	0.855
23	0	0	144.5	3.05	0.847
24	0	0	141.2	3.04	0.844
1	3.1	3.1	141.5	3.04	0.844
2	14.1	14.1	152.2	3.10	0.861
3	17.2	17.2	166.0	3.16	0.878
4	31.4	31.4	194.2	3.35	0.931
5	37.6	37.6	227.5	3.52	0.978
6	47.0	47.0	271.0	3.80	1.056
7	50.2	50.2	317.2	4.00	1.111
8	53.3	53.3	366.5	4.33	1.203
9	18.8	18.8	380.8	4.40	1.222
10	9.4	9.4	385.5	4.43	1.231
11	4.7	4.7	385.5	4.43	1.231
12	4.7	4.7	385.5	4.43	1.231
13	3.1	3.1	384.3	4.42	1.228
14	6.3	6.3	386.0	4.44	1.233 (max.)
15	1.6	1.6	383.0	4.91	1.225
16	1.6	1.6	380.0	4.40	1.222
17	4.7	4.7	380.1	4.40	1.222
18	3.1	3.1	379.0	4.39	1.219
19	1.6	1.6	376.3	4.38	1.217
20	0	0	372.0	4.35	1.208
21	0	0	367.7	4.32	1.200
22	0	0	363.5	4.30	1.194
23	0	0	359.2	4.29	1.192
24	0	0	354.8	4.25	1.181
1	0.6	0.6	351.5	4.22	1.172
2	2.6	2.6	349.7	4.21	1.169
3	3.2	3.2	348.8	4.21	1.169
4	5,7	5.7	350.4	4.22	1.172
5	6.9	6.9	353.2	4.24	1.178
6	8.6	8.6	357.9	4.28	1.189
7	9.2	9.2	363.0	4.30	1.194
8	9.7	9.7	368.5	4.32	1.200
9	3.4	3.4	367.9	4.32	1.200
10	1.7	1.7	364.8	4.30	1.194
11	0.9	0.9	361.5	4.29	1.192
12	0.9	0.9	358.0	4.29	1.192
13	0.6	0.6	354.4	4.25	1.181
14	1.1	1.1	351.5	4.24	1.178
15	0.3	0.3	347.6	4.21	1.169
16	0.3	0.3	344.0	4.19	1.164
17	0.9	0.9	340.6	4.17	1.158
18	0.6	0.6	337.2	4.15	1.153
19	0.3	0.3	333.7	4.12	1.144
20	0	0	329.7	4.10	1.139
21	0	0	325.8	4.09	1.136
22	0	0	321.6	4.07	1.131

Note: 1/: Rainfall of 20 mm is neglected as initial losses in paddy fields
height of notch : 100 m above field surface
Water level : 80 mm

2/: Obtained from Figure

3/: Obtained from Figure

Table 4B-11. Result of Run-off Routing in Paddy Field (2)

Time	Hourly Rainfall (mm)	Effective Rainfall (mm)	Water Depth in Paddy Field (mm)	Run-off Discharge mm	Run-off Discharge cu.m/sec/sq.km
23	0	0	317.6	4.05	1.125
24	0	0	313.8	4.01	1.113
1	-	-	310.0	3.99	1.108
2	-	-	306.4	3.96	1.100
3	-	-	302.4	3.95	1.097
4	-	-	298.5	3.92	1.089
5	-	-	294.8	3.90	1.083
6	-	-	291.1	3.89	1.081
7	-	-	287.4	3.88	1.077
8	-	-	283.5	3.84	1.066
9	-	-	279.8	3.82	1.061
10	-	-	276.0	3.80	1.055
11	-	-	272.3	3.79	1.053
12	-	-	268.5	3.75	1.042
13	-	-	264.7	3.74	1.039
14	-	-	260.9	3.70	1.028
15	-	-	257.0	3.69	1.025
16	-	-	253.0	3.67	1.019
17	-	-	249.9	3.65	1.014
18	-	-	245.0	3.62	1.005
19	-	-	241.0	3.60	1.000
20	-	-	237.0	3.60	1.000
21	-	-	233.0	3.56	0.989
22	-	-	229.0	3.54	0.983
23	-	-	225.0	3.51	0.975
24	-	-	221.0	3.50	0.972
1	-	-	217.1	3.50	0.972
2	-	-	213.3	3.48	0.966
3	-	-	209.1	3.40	0.944
4	-	-	205.2	3.39	0.942
5	-	-	201.2	3.37	0.946
6	-	-	197.2	3.36	0.933
7	-	-	193.4	[illegible]	[illegible]
8	-	-	[illegible]	[illegible]	[illegible]

Time	Rainfall (mm)	Rainfall (mm)	in Paddy Field (mm)	Run-off Discharge mm	Run-off Discharge cu.m/sec/sq.km
9	-	-	185.6	3.29	0.914
10	-	-	182.0	3.26	0.906
11	-	-	178.5	3.24	0.900
12	-	-	175.0	3.23	0.897
13	-	-	171.8	3.20	0.889
14	-	-	168.5	3.19	0.886
15	-	-	165.0	3.16	0.878
16	-	-	161.5	3.15	0.875
17	-	-	158.2	3.12	0.867
18	-	-	154.8	3.10	0.861
19	-	-	151.7	3.10	0.858
20	-	-	148.4	3.09	0.858
21	-	-	145.0	3.07	0.853
22	-	-	143.8	3.05	0.847
23	-	-	139.0	3.03	0.842
24	-	-	135.8	3.00	0.833
1	-	-	133.0	2.99	0.831
2	-	-	130.3	2.98	0.828
3	-	-	127.2	2.96	0.822
4	-	-	124.3	2.94	0.817
5	-	-	121.3	2.92	0.811
6	-	-	118.6	2.90	0.806
7	-	-	115.7	2.90	0.806
8	-	-	113.0	2.88	0.800
9	-	-	110.2	2.86	0.794
10	-	-	107.3	2.30	0.639
11	-	-	105.4	1.60	0.444
12	-	-	103.7	1.00	0.278
13	-	-	102.7	0.90	0.250
14	-	-	102.0	0.50	0.139
15	-	-	101.3	0.30	0.083
16	-	-	[illegible]	0.20	0.056
17	-	-	[illegible]	[illegible]	[illegible]
[illegible]		-	[illegible]	[illegible]	[illegible]

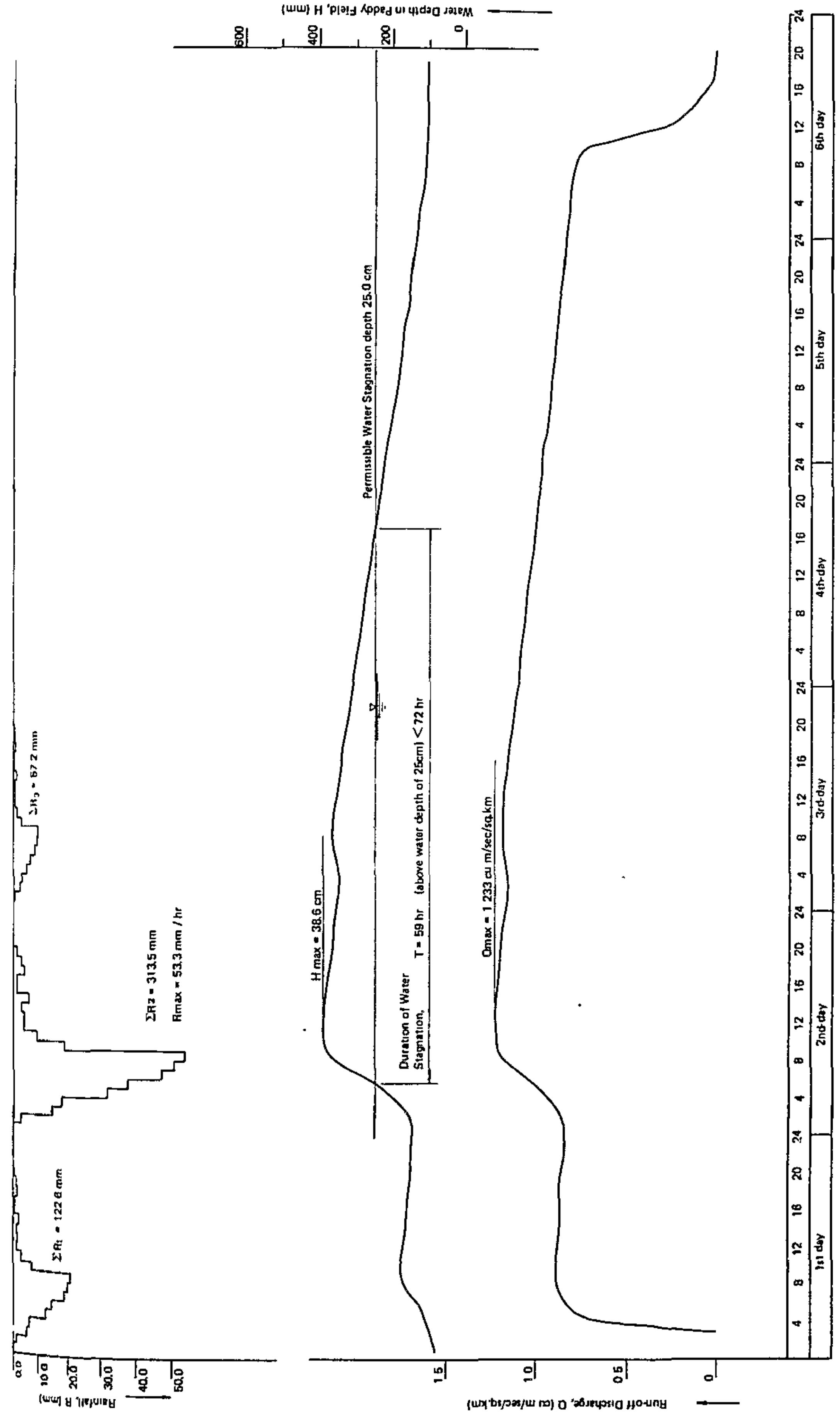
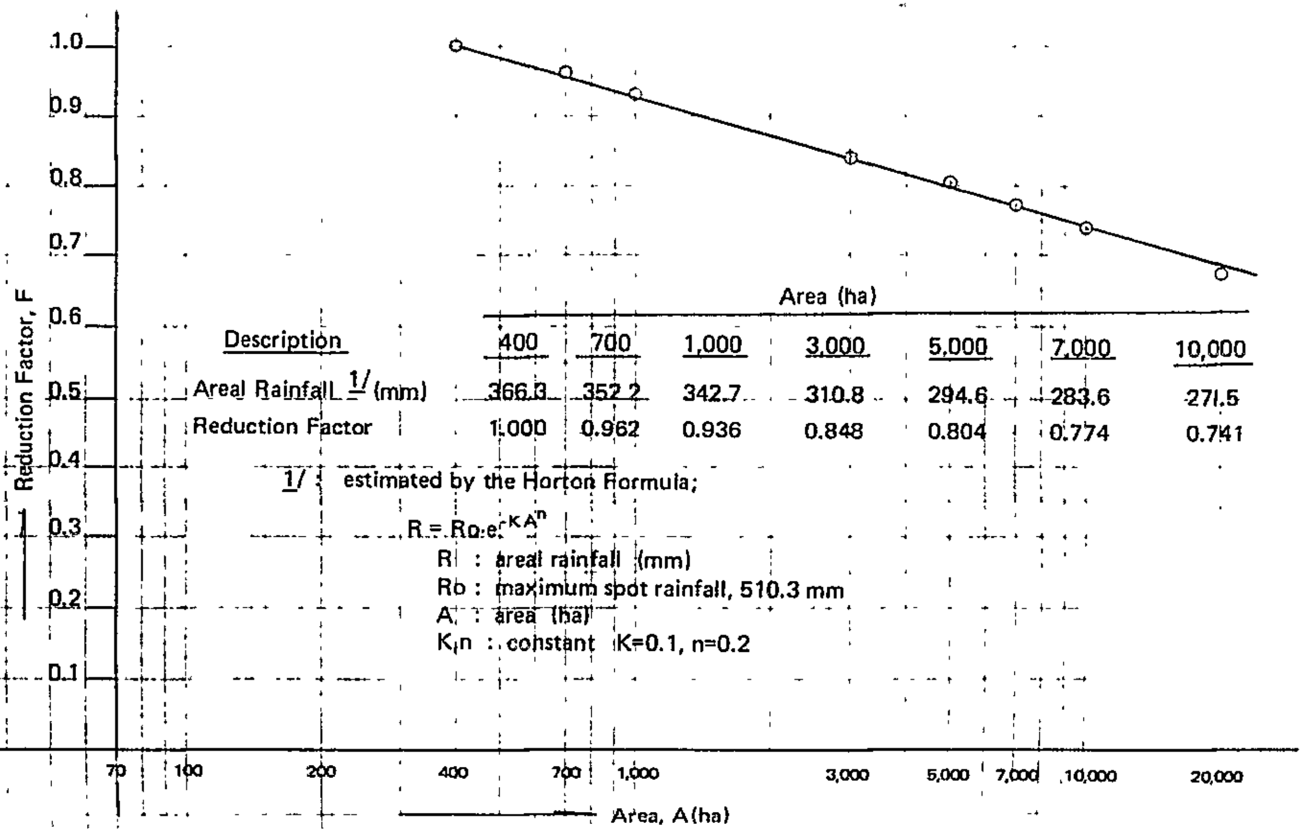

Rainfall, R (mm)
0.0
10.0
20.0
30.0
40.0
50.0
ΣR1 = 122.8 mm
ΣR2 = 313.5 mm
Rmax = 53.3 mm / hr
ΣR3 = 67.2 mm
Water Depth in Paddy Field, H (mm)
600
400
200
0
Permissible Water Stagnation depth 25.0 cm
H max = 38.6 cm
Duration of Water Stagnation,
T = 59 hr (above water depth of 25cm) < 72 hr
Run-off Discharge, Q (cu m/sec/sq.km)
1.5
1.0
0.5
0
Qmax = 1.233 cu m/sec/sq.km
4
8
12
16
20
24
1st day
2nd day
3rd day
4th day
5th day
6th day

FIGURE 4B-16 AREA-REDUCTION FACTOR FOR DRAINAGE MODULUS



Description	Area (ha)						
	400	700	1,000	3,000	5,000	7,000	10,000
Areal Rainfall 1/ (mm)	366.3	352.2	342.7	310.8	294.6	283.6	271.5
Reduction Factor	1.000	0.962	0.936	0.848	0.804	0.774	0.741

1/ : estimated by the Horton Formula;

$$R = Ro \cdot e^{-KA^n}$$

R : areal rainfall (mm)
Ro : maximum spot rainfall, 510.3 mm
A : area (ha)
K,n : constant K=0.1, n=0.2

3. Drainage Discharge from Hilly Land [1/]

Drainage areas located in the hilly land are mostly less than 100 sq.km. The flood time of concentration for such a small drainage area will be less than one hour. Only hourly peak rainfall, therefore, was considered for drainage discharge analysis. Relationships between observed peak discharges from drainage areas less than 100 sq.km and hourly peak rainfall intensity was plotted as shown in Figure 4B-17. This shows the peak discharge and hourly rainfall increase in a rather constant rate. So, the run-off coefficient was estimated as f = 0.269 from the figure. This run-off coefficient was adopted to estimate the peak discharge from hourly rainfall.

The obtained run-off coefficient might be on a high side, because the available peak discharges are mostly in the mountainous area. Normally run-off coefficient for small areas in hilly land ranges from 0.1 to 0.3. So, the obtained value of 0.269 is considered to be acceptable.

The estimation of peak discharge was made based upon the Rational formula;

$$Q = 0.2778.f.r_t.A$$

where f : run-off coefficient of 0.269

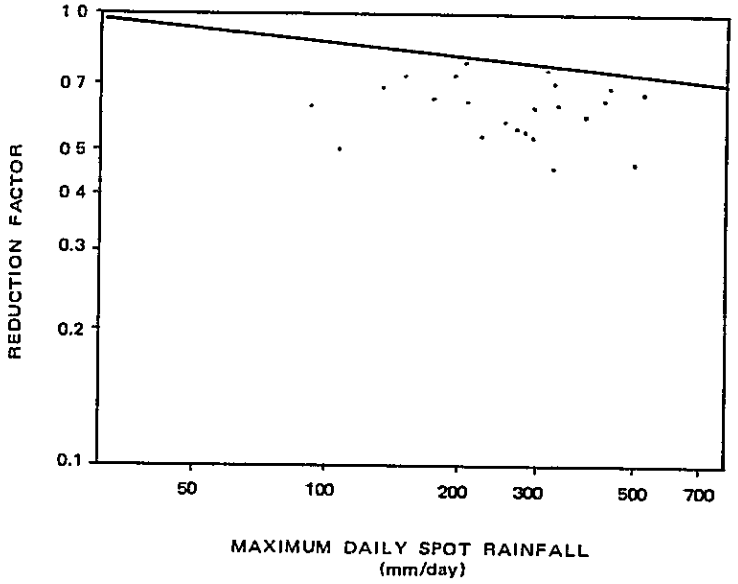
r_t: areal hourly peak rainfall intensity (mm/hr)

A : catchment area (sq.km)

In order to estimate the peak discharge, the peak rainfall as obtained from the reduction factor of daily rainfall (see figure 4B-18), was considered as average rainfall in the Project Area, and used in the Rational formula for areas smaller than 100 hectares. The areal hourly rainfall obtained from the relationship of spot hourly rainfall to areal hourly rainfall (see Figure 4B-19) was adopted to estimate the peak discharge for large areas up to 20,000 hectares using as basis for estimation of areal hourly rainfall obtained from Laoag and Vigan. The results are shown as follows;

[1/] : reference was made to the study of NISIS-I, prepared by NIA, 1976.

Figure 4B-18. Reduction Factor of Areal Rainfall to Maximum Daily Spot Rainfall



Note: Arithmetic mean method was adopted to estimate a reduction factor of spot rainfall to the areal rainfall. The maximum rainfall and the reduction rate to the areal rainfall was plotted on the logarithmic paper.

Areal Hourly Rainfall of Each Return Period

Return Period	Spot Peak Hourly Rainfall (mm)	Areal Hourly Rainfall (1) (mm)	Areal Hourly Rainfall (2) (mm)
5-year	53.3	41.0	35.5
10-year	66.2	49.7	40.0

(1) : Obtained from the reduction factor of areal daily rainfall.(Fig.4B-18)
(2) : Obtained from the relation ship of spot hourly rainfall and(Fig. 4B-1
areal hourly rainfall.

Peak Discharge of Hilly Land Area

Period	Drainage Area (sq.km)	Hourly Rainfall (mm/hr)	Peak Discharge (cu.m/sec)	Specific Discharge (cu.m/sec/ha)
1/5	1.0	41.0	3.1	3.064
	200.0	35.5	530.5	2.653
1/10	1.0	49.7	3.7	3.714
	200.0	40.0	597.8	2.989

FIGURE 4B-17. RELATION OF PEAK HOURLY RAINFALL AND PEAK RUN-OFF (LESS THAN 100 sq.KM)

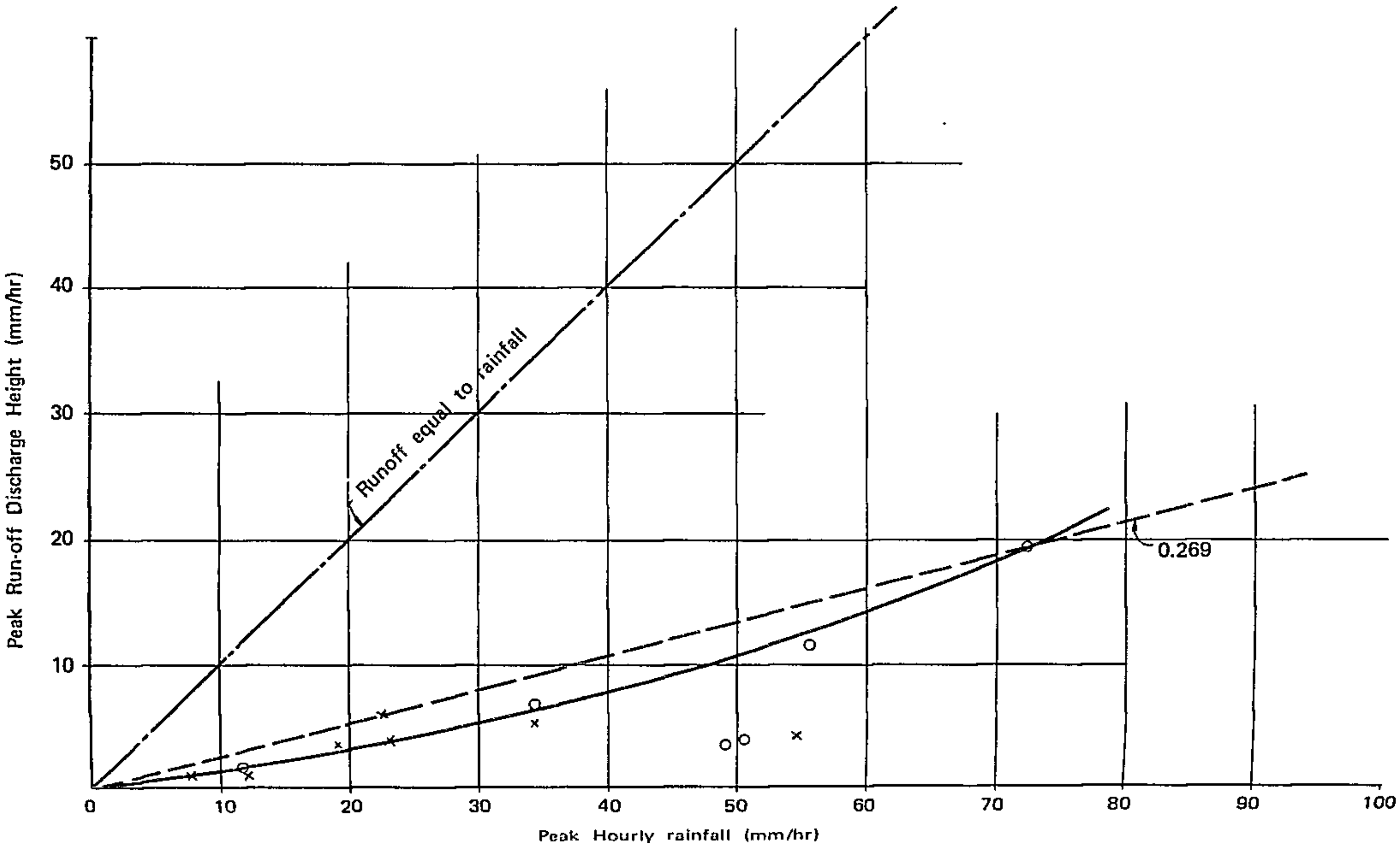
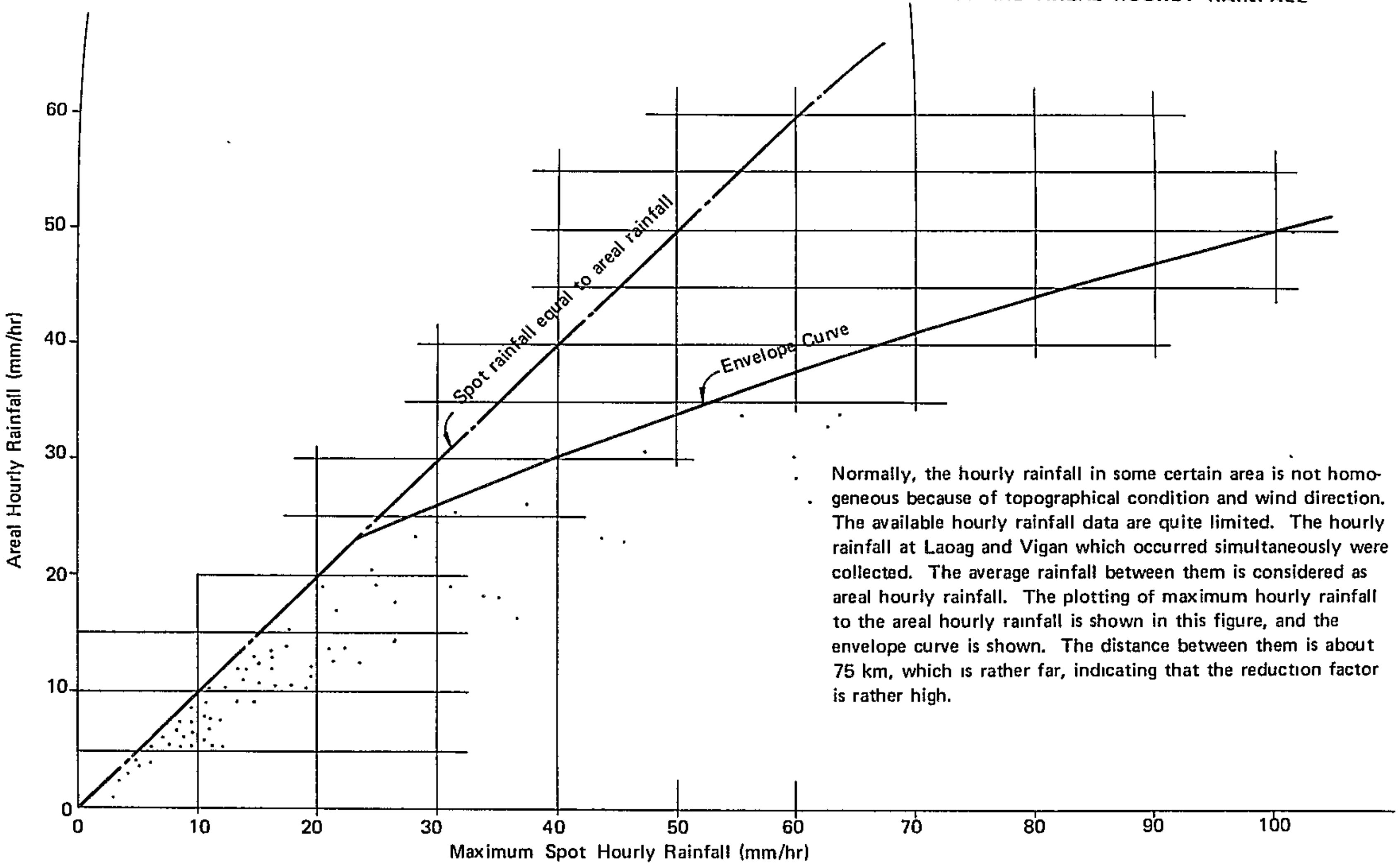


FIGURE 4B-1D. RELATION OF MAXIMUM SPOT HOURLY RAINFALL AND AREAL HOURLY RAINFALL



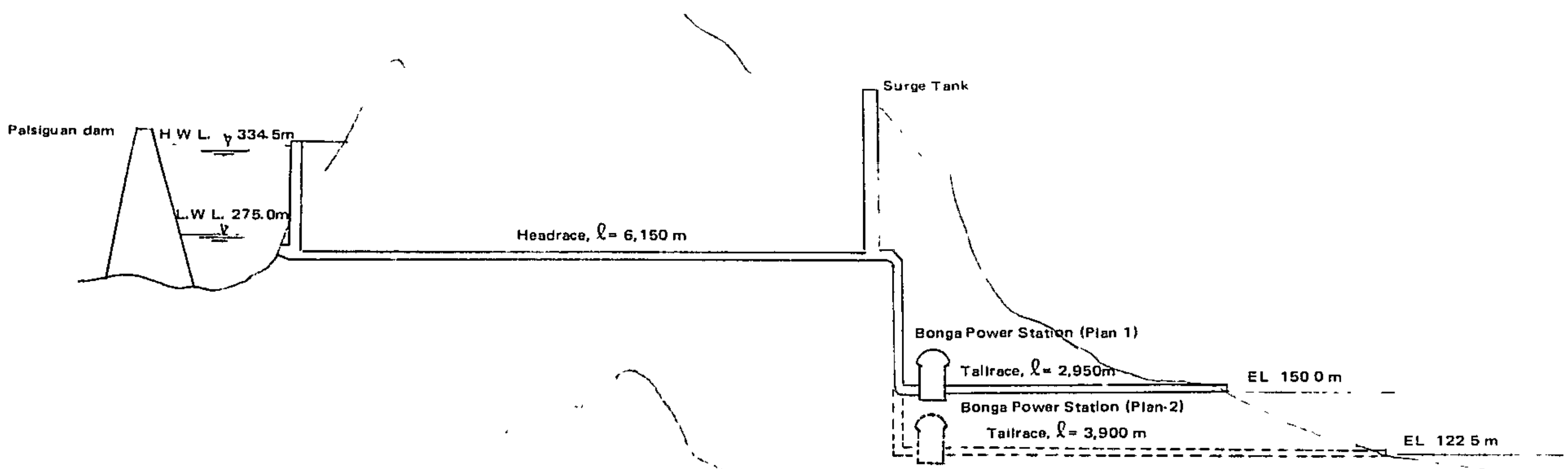
Normally, the hourly rainfall in some certain area is not homogeneous because of topographical condition and wind direction. The available hourly rainfall data are quite limited. The hourly rainfall at Laoag and Vigan which occurred simultaneously were collected. The average rainfall between them is considered as areal hourly rainfall. The plotting of maximum hourly rainfall to the areal hourly rainfall is shown in this figure, and the envelope curve is shown. The distance between them is about 75 km, which is rather far, indicating that the reduction factor is rather high.

Table 4B-12. Comparison of Low Water Level

Description	Unit	Low Water Level			
		EL 265.00 m	EL 275.00 m	EL 285.00 m	EL 295.00 m
Max. Discharge at Bonga P/S	cu.m/sec	28,225	28,225	28,225	28,225
Design Effective Head	m	146.26	150.82	155.40	161.22
Installed Capacity	KW	35,200	36,000	37,400	38,800
Annual Generation	GWh	154.83	159.66	164.51	170.67
Effective Output	KW	32,586	33,776	35,198	36,718
Construction Cost					
Bonga P/S 1/	₱10^3	527,241	538,325	566,564	584,127
Palsiguan Dam 2/	₱10^3	798,963	844,483	889,080	954,738
Tunnel	₱10^3	160,140	140,330	138,330	138,330
Power Plant	₱10^3	143,600	144,400	145,600	146,900
Annual Cost Ratio	%	15.43	15.43	15.43	15.43
Annual Cost Value of Bonga P/S (C)	₱10^3/Year	81,353	83,064	87,421	90,131
Annual Unit Capacity Value	₱/KW	700.0	700.0	700.0	700.0
Annual Unit Energy Value	₱/KWh	0.429	0.429	0.429	0.429
Annual Capacity Value (B)	₱10^3/Year	82,599	85,288	88,156	91,599
Annual KW Value 3/	₱10^3/Year	22,810	23,643	24,639	25,703
Annual KWh Value 4/	₱10^3/Year	59,780	61,645	63,517	65,896
(C) - (B)		- 1,246	- 2,224	- 735	- 1,468

Note: 1/: (Palsiguan dam cost + Tunnel cost) x 0.4 + Power plant cost
0.4: allocation ratio of hydropower
2/: Total Palsiguan dam cost
3/: Effective output x 700 ₱/KW
4/. Annual generation (KWh) x 0.90 x [illegible] ₱/KWh

Alternative - I (Without Nueva Era Dam)



Alternative - II (Upstream Nueva Era Dam)

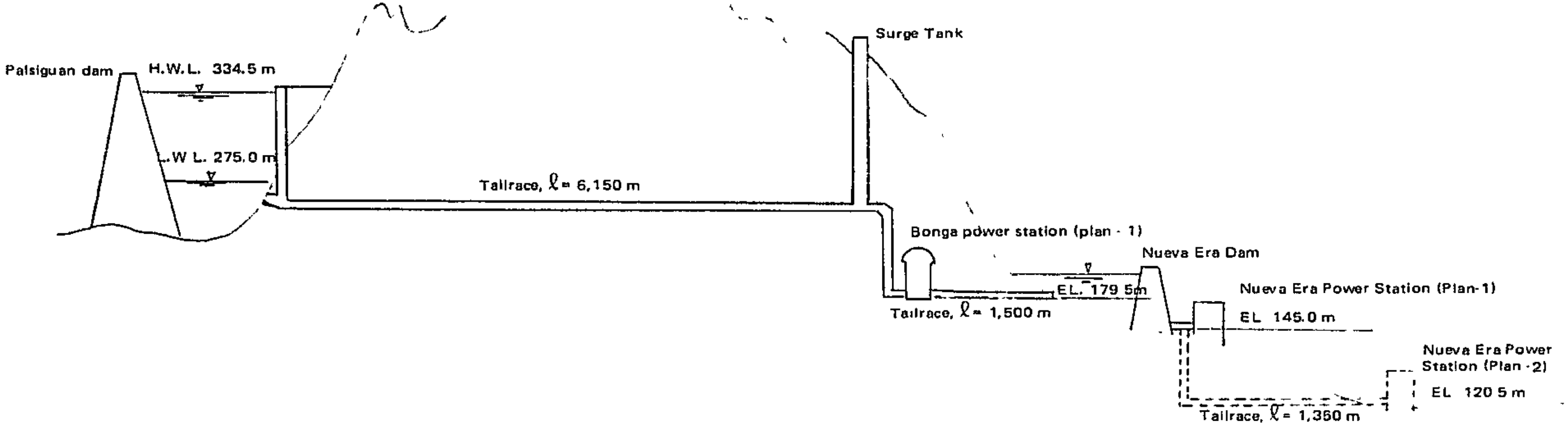


Table 4B-13 Comparison of Alternative Plans

1. Major Dimension

Item	Unit	Proposed Plan	Alternative-I		Alternative-II	
			Plan-1	Plan-2	Plan-1	Plan-2
a. Bonga Power Station						
Full Water Level	m	334.50	334.50	334.50	334.50	334.50
Tail Water Level	m	150.00	150.00	122.50	179.50	179.50
Tailrace Length	km	2.95	2.95	3.90	1.50	1.50
Effective Head	m	150.82	150.82	177.32	119.82	119.82
Installed Capacity	KW	36,000	36,000	42,000	29,000	29,000
Firm Peak Capacity	KW	30,510	-	-	24,600	24,600
Annual Generation	MWh	159.660	159.660	185.300	123.400	123.400
Turbine	type	Deriaz	Francis	Francis	Deriaz	Deriaz
	set	1	1	1	1	1
b. Nueva Era Power Station						
High Water Level	m	150.00	-	-	179.50	179.50
Lower Water Level	m	148.50	-	-	177.50	177.50
Tail Water Level	m	120.50	-	-	145.00	120.50
Tailrace Length	km	-	-	-	-	1.55
Effective Head	m	27.92	-	-	32.32	55.60
Installed Capacity	KW	6,800	-	-	7,900	13,600
Annual Generation	MWh	39,540	-	-	54,700	73,200
Turbine	type	Kaplan	-	-	Kaplan	Kaplan
	set	1			1	1
c. Nueva Era Dam						
Catchment Area	sq.km	52.40	-	-	45.10	45.10
Dam Height	m	45.50	-	-	47.10	47.10
Crest Length	m	220.00	-	-	187.00	187.00
Dam Volume	cu.m	141,000	-	-	130,000	105,000
Diversion Channel		Open Channel 10mx7m	-	-	Tunnel ø8m	Tunnel ø8m
d. Diversion Dam		No Provision	Provided	Provided	Provided	No Provisi

2 Evaluation of Alternative Plans

Item	Unit	Proposed Plan	Alternative-I Plan-1	Alternative-I Plan-2	Alternative-II Plan-1	Alternative-II Plan-2
a Installed Capacity						
Bonga Power Station	KW	36,000	36,000	42,000	29,000	29,000
Nueva Era Power Station	KW	6,800	-	-	7,900	13,600
Total		42,000	36,000	42,000	36,900	42,600
b Annual Generation						
Bonga Power Station	MWh	159.660	159.660	185.300	123.400	123.400
Nueva Era Power Station	MWh	39.540	-	-	45.700	73.200
Total		199.200	159.660	185.300	169.100	196.600
c Effective Output						
Bonga Power Station	KW	33,780	14,720	17,490	26,690	26,690
Nueva Era Power Station	KW	4,510	-	-	5,210	8,410
Total		38,290	14,720	17,490	31,900	35,100
5 Construction Cost						
Bonga Power Station	10^3₱	144,400	171,700	198,000	113,600	113,600
Nueva Era Power Station	10^3₱	40,900	-	-	46,000	75,200
Nueva Era Dam	10^3₱	121,600	-	-	119,500	119,500
Diversion Dam	10^3₱	-	10,000	10,000	10,000	-
Total		306,900	181,700	208,000	289,100	298,300
6. Unit Value						
Annual Cost Ratio	%	15.43	15.43	15.43	15.43	15.43
Annual Unit Capacity Value	₱/KW	700	700	700	700	700
Annual Unit Energy Value	₱/KWh	0.429	0.429	0.429	0.429	0.429
7. Annual Value						
KW Value1/	10^3₱	26,803	10,304	12,243	22,330	24,570
KWh Value2/	10^3₱	76,911	61,645	71,544	65,290	75,907
Total (B)	10^3₱	103,714	71,949	83,787	87,620	100,477
8 Annual Cost Value (C)	10^3P	47,355	28,036	32,094	44,608	46,027
9. (B) - (C)	10^3₱	56,359	43,913	51,693	43,012	54,450
10. Use Ratio of Effective Output3/	%	0.281	0.134	0.138	0.275	0.261

Note: 1/: Effective output x 700₱/KW
2/: Annual generation (KWh) x 0.90 x 0.429 ₱/KWh
3/: Effective output x 4hr x 365days/Annual Generation (KWh)

Table 4B-14	Hydro Power Operation Study for 10 Year (1960 – 1969) ·	Bonga Power Station
Table 4B 15	Hydro-Power Operation Study for 10 Year (1960 – 1969) -	Nueva Era Power Station

Note **Bonga Power Station**

Max Loss 13 85 m (28 225 m^3/s)
Mini Loss . 4 23 (9 5 m^3/s)

Turbin Efficiency d = H W L. – W.L.

Efficiency (1) = 0 000454 x d + 0 865 (28 225 m^3/s)
Efficiency (2) = 0.00134 + d + 0 700 (9 50 m^3/s)

Generator Efficiency 0 975

Nueva Era Power Station

Loss = 0 0015 x Q^2 + 0 30

Turbine Efficiency·

Discharge	Efficiency
m^3/s m^3/s	
27.273 – 25 00	0.890
24 99 – 20 00	0 895
19 99 – 17 50	0 892
17.49 – 15 00	0.889
14.99 – 12 50	0 882
12.49 – 10 00	0 872
9.99 – 9 00	0.850
8 99 –	0.800

Generator Efficiency. 0 965

H W.L. : High Water Level (m)
Gross H Gross Head (m)
Losses . Losses (m)
E. Head · Effective Head (m)
P. Head . Effective Head for Peak
Req Dis Requirement Discharge (cu.m/sec)
T Dis Turbine Discharge (cu m/sec)
Over F Over Flow (cu m/sec)
Effice Turbine Efficiency
P Effico Turbine Efficiency for Peak
Peak Kw Peak Output (Kw)
KWH : Annual Generation (KWH)

Table 4B-14 Hydro Power Operation Study for 10 Year (1960 ~ 1969) Bonga Power Station

BONGA P/S 1960 T.W.L=150.0

	H.W.L. (M)	GROSS H . (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DIS (CM/S)	. T.DIS. (CM/S)	OVER F (CM/S)	. EFFICE	P.EFFI.	KW	PEAK KW	KWH
NOV 1	334.500	184.500	8.245	176.255	170.650	6.019	6.055	0.0	0.827	0.892	8433.	36000.	2023920.
NOV 2	334.500	184.500	13.850	170.650	170.650	4.700	28.225	0.0	0.892	0.892	36000.	36000.	8640000.
NOV 3	331.063	181.063	12.476	168.587	167.213	4.700	22.016	0.0	0.874	0.890	30996.	36000.	7439040.
S.TOTAL													18102960.
DEC 1	331.600	181.600	13.280	168.320	167.750	10.893	25.260	0.0	0.884	0.891	35913.	36000.	8619120.
DEC 2	331.375	181.375	13.489	167.886	167.525	13.808	26.265	0.0	0.887	0.891	36000.	36000.	8640000.
DEC 3	330.894	180.894	13.406	167.488	167.044	12.453	25.856	0.0	0.885	0.890	36000.	36000.	9504000.
S.TOTAL													26763120.
JAN 1	331.128	181.128	13.430	167.698	167.278	9.546	25.971	0.0	0.885	0.890	36000.	36000.	8640000.
JAN 2	330.589	180.589	13.756	166.833	166.739	9.546	27.672	0.0	0.889	0.890	36000.	36000.	8640000.
JAN 3	330.315	180.315	13.629	166.686	166.465	8.531	26.983	0.0	0.887	0.890	36000.	36000.	9504000.
S.TOTAL													26784000.
FEB 1	330.393	180.393	13.724	166.669	166.543	8.186	27.493	0.0	0.888	0.890	36000.	36000.	8640000.
FEB 2	330.628	180.628	13.593	167.034	166.778	7.188	26.797	0.0	0.887	0.890	36000.	36000.	8640000.
FEB 3	330.928	180.928	13.421	167.507	167.078	5.869	25.928	0.0	0.885	0.890	36000.	36000.	25056000.
S.TOTAL													42336000.
MAR 1	330.002	180.002	13.786	166.216	166.152	4.700	27.637	0.0	0.889	0.890	36000.	36000.	8640000.
MAR 2	329.931	179.931	13.850	166.081	166.081	4.700	28.225	0.0	0.890	0.890	36000.	36000.	8640000.
MAR 3	329.502	179.502	13.850	165.652	165.652	4.700	28.225	0.0	0.890	0.890	36000.	36000.	9504000.
S.TOTAL													26784000.
APR 1	329.931	179.931	13.850	166.081	166.081	4.700	28.225	0.0	0.890	0.890	36000.	36000.	8640000.
APR 2	329.904	179.904	13.850	166.054	166.054	4.700	28.225	0.0	0.890	0.890	36000.	36000.	8640000.
APR 3	329.786	179.786	13.850	165.936	165.936	4.700	28.225	0.0	0.890	0.890	36000.	36000.	8640000.
S.TOTAL													25920000.
MAY 1	329.696	179.696	13.850	165.846	165.846	4.700	28.225	0.0	0.890	0.890	36000.	36000.	8640000.
MAY 2	329.699	179.699	13.850	165.849	165.849	4.700	28.225	0.0	0.890	0.890	36000.	36000.	8640000.
MAY 3	329.458	179.458	13.751	165.707	165.608	4.700	27.644	0.0	0.889	0.890	36000.	36000.	9504000.
S.TOTAL													26784000.
JUN 1	330.426	180.426	13.509	166.917	166.576	7.949	26.366	0.0	0.886	0.890	36000.	36000.	8640000.
JUN 2	331.032	181.032	12.778	168.254	167.182	9.894	23.129	0.0	0.877	0.890	32610.	36000.	7826400.
JUN 3	330.187	180.187	13.170	167.017	166.337	19.125	24.758	0.0	0.882	0.890	34848.	36000.	8363520.
S.TOTAL													24829920.
JUL 1	327.439	177.439	13.439	164.000	163.589	11.210	26.014	0.0	0.884	0.889	36000.	36000.	8640000.
JUL 2	326.203	176.203	13.552	162.651	162.353	10.980	26.581	0.0	0.884	0.888	36000.	36000.	8640000.
JUL 3	326.413	176.413	11.797	164.616	162.563	4.700	19.862	0.0	0.863	0.868	26961.	36000.	7117704.
S.TOTAL													24397696.
AUG 1	328.101	178.101	10.978	167.123	164.251	4.700	17.766	0.0	0.854	0.889	24228.	36000.	5814720.
AUG 2	331.797	181.797	11.074	170.723	167.947	4.700	17.989	0.0	0.858	0.891	25178.	36000.	6042720.
AUG 3	334.500	184.500	13.850	170.650	170.650	4.700	28.225	0.0	0.892	0.892	36000.	36000.	9504000.
S.TOTAL													21361440.
SEP 1	330.741	180.741	13.189	167.552	166.891	5.764	24.844	0.0	0.882	0.890	35081.	36000.	8419440.
SEP 2	332.531	182.531	12.102	170.429	168.681	7.514	20.774	0.0	0.870	0.891	29432.	36000.	7063680.
SEP 3	333.165	183.165	12.703	170.462	169.315	4.700	22.842	0.0	0.878	0.891	32665.	36000.	7839600.
S.TOTAL													23322720.
OCT 1	333.586	183.586	9.553	174.033	169.736	4.700	15.010	0.0	0.841	0.892	20991.	36000.	5037840.
OCT 2	334.500	184.500	13.850	170.650	170.650	4.700	28.225	0.0	0.892	0.892	36000.	36000.	8640000.
OCT 3	334.500	184.500	12.045	172.455	170.650	4.700	11.532	0.0	0.871	0.892	16551.	36000.	4369464.
S.TOTAL													18047296.
TOTAL													305437832.

BUNGA P/S 1961 T.W.L=150.0

	H.W.L. (M)	GROSS H . (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DIS . (CM/S)	T.DIS. (CM/S)	OVER F . (CM/S)	EFFICE	P.EFFI.	KW	PEAK KW	KWH
NOV 1	333.157	183.157	12.978	170.179	169.307	12.149	12.149	0.0	0.881	0.891	17404.	36000.	4176960.
NOV 2	330.445	180.445	12.232	168.213	166.595	21.190	21.190	0.0	0.871	0.890	29665.	36000.	7119600.
NOV 3	327.023	177.023	12.830	164.193	163.173	23.335	23.335	0.0	0.876	0.889	32070.	36000.	7696800.
S.TOTAL													18993360.
DEC 1	323.292	173.292	12.997	160.295	159.442	24.014	24.014	0.0	0.876	0.887	32219.	36000.	7732560.
DEC 2	319.170	169.170	13.091	156.079	155.320	24.413	24.413	0.0	0.875	0.885	31857.	36000.	7645680.
DEC 3	314.495	164.495	13.392	151.104	150.645	25.785	25.785	0.0	0.877	0.883	32649.	35880.	8619336.
S.TOTAL													23997576.
JAN 1	309.371	159.371	13.789	145.582	145.521	27.855	27.855	0.0	0.880	0.881	34098.	34581.	8183520.
JAN 2	304.525	154.525	12.906	141.618	140.675	23.640	23.640	0.0	0.864	0.878	27638.	33316.	6633120.
JAN 3	296.543	146.543	13.850	132.693	132.693	28.225	28.225	0.0	0.875	0.875	31313.	31318.	8266632.
S.TOTAL													23083264.
FEB 1	292.159	142.159	10.161	131.998	128.309	16.073	16.073	0.0	0.816	0.873	16542.	30214.	3970080.
FEB 2	288.526	138.526	8.403	130.122	124.676	13.340	13.340	0.0	0.784	0.871	13003.	29292.	3120720.
FEB 3	285.734	135.734	7.962	127.772	121.884	12.794	12.794	0.0	0.775	0.870	12105.	28603.	8425080.
S.TOTAL													15515890.
MAR 1	285.464	135.464	7.914	127.650	121.614	4.700	4.700	0.0	0.772	0.870	4426.	28539.	1062240.
MAR 2	285.115	135.115	7.814	127.301	121.265	4.700	4.700	0.0	0.772	0.870	4413.	28457.	1059120.
MAR 3	284.344	134.344	7.814	126.530	120.494	4.700	4.700	0.0	0.771	0.869	4361.	27244.	1156544.
S.TOTAL													3277544.
APR 1	283.363	133.363	7.814	125.549	119.513	4.700	4.700	0.0	0.770	0.869	4341.	28014.	1041840.
APR 2	282.419	132.419	7.814	124.605	118.569	4.700	4.700	0.0	0.769	0.868	4303.	27761.	1032720.
APR 3	281.511	131.511	7.814	123.697	117.661	4.700	4.700	0.0	0.768	0.868	4266.	27544.	1023840.
S.TOTAL													3098400.
MAY 1	280.807	130.807	7.814	122.993	116.957	4.700	4.700	0.0	0.767	0.868	4236.	27383.	1016640.
MAY 2	280.826	130.826	7.814	123.012	116.976	4.700	4.700	0.0	0.767	0.868	4237.	27388.	1016880.
MAY 3	282.490	132.490	7.814	124.676	118.640	4.700	4.700	0.0	0.769	0.868	4306.	27777.	1136784.
S.TOTAL													3170304.
JUN 1	282.793	132.793	8.187	124.606	118.943	5.891	5.891	0.0	0.776	0.869	5443.	27889.	1306320.
JUN 2	277.739	127.739	10.430	117.309	113.889	16.593	16.593	0.0	0.808	0.866	15028.	26004.	3606720.
JUN 3	281.072	131.072	7.814	123.258	117.222	4.700	4.700	0.0	0.783	0.878	4251.	27445.	1020240.
S.TOTAL													5933280.
JUL 1	291.007	141.007	7.814	133.193	127.157	4.700	4.700	0.0	0.778	0.872	4654.	29903.	1116960.
JUL 2	311.204	161.204	7.814	153.390	147.354	4.700	4.700	0.0	0.790	0.881	5497.	35017.	1319280.
JUL 3	316.730	166.730	7.814	158.916	152.880	4.700	4.700	0.0	0.804	0.884	5738.	36000.	1514832.
S.TOTAL													3951072.
AUG 1	319.901	169.901	7.814	162.097	156.051	4.700	4.700	0.0	0.807	0.885	5874.	36000.	1409760.
AUG 2	323.281	173.281	7.814	165.467	159.431	4.700	4.700	0.0	0.810	0.887	6019.	36000.	1444560.
AUG 3	329.261	179.261	7.814	171.447	165.411	4.700	4.700	0.0	0.817	0.890	6290.	36000.	1660560.
S.TOTAL													4514880.
SEP 1	332.110	182.110	10.237	171.873	168.260	4.700	16.217	0.0	0.848	0.891	22584.	36000.	5420160.
SEP 2	331.465	181.465	11.780	169.685	167.615	4.700	19.812	0.0	0.866	0.891	27814.	36000.	6675360.
SEP 3	331.122	181.122	12.383	168.739	167.272	4.700	21.693	0.0	0.873	0.890	30534.	36000.	7328160.
S.TOTAL													19423680.
OCT 1	333.586	183.586	10.419	173.167	169.736	4.700	16.571	0.0	0.852	0.892	23361.	36000.	5606640.
OCT 2	334.008	184.008	12.125	171.883	170.158	4.700	20.846	0.0	0.872	0.892	29854.	36000.	7164960.
OCT 3	334.500	184.500	11.946	172.554	170.653	4.700	11.458	0.0	0.873	0.892	16435.	36000.	4338840.
S.TOTAL													17110440.
TOTAL													[illegible]

BUNGA P/S 1962 T.W.L.=150.0

	H.W.L. (M)	GROSS H . (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DIS . (CM/S)	T.DIS. (CM/S)	OVER F . (CM/S)	EFFICE	P.EFFI.	KW	PEAK KW	KWH
NOV 1	333.870	183.870	9.804	174.066	170.020	9.206	9.206	0.0	0.845	0.892	12938.	36000.	3105123.
NOV 2	331.371	181.371	11.822	169.549	167.521	19.933	19.933	0.0	0.867	0.891	27997.	36000.	6719280.
NOV 3	330.946	180.946	9.505	171.442	167.096	8.745	8.745	0.0	0.838	0.890	12005.	36000.	2881200.
S.TOTAL													12705603.
DEC 1	327.813	177.813	12.603	165.210	163.963	22.470	22.470	0.0	0.874	0.889	31001.	36000.	7440240.
DEC 2	325.604	175.604	11.646	163.958	161.754	19.440	19.440	0.0	0.861	0.888	26222.	36000.	6293280.
DEC 3	321.059	171.059	12.914	158.145	157.209	23.672	23.672	0.0	0.874	0.886	31263.	36000.	8253432.
S.TOTAL													21986944.
JAN 1	317.297	167.297	12.497	154.800	153.447	22.088	22.088	0.0	0.866	0.884	28293.	36000.	6790320.
JAN 2	312.333	162.333	13.430	148.903	148.483	25.972	25.972	0.0	0.876	0.882	32370.	35325.	7768800.
JAN 3	306.823	156.823	12.899	143.934	142.973	23.571	23.571	0.0	0.865	0.879	28041.	33893.	7402824.
S.TOTAL													21961936.
FEB 1	303.555	153.555	9.927	143.628	139.705	15.646	15.646	0.0	0.821	0.878	17629.	33096.	4230960.
FEB 2	301.226	151.226	13.179	138.047	137.376	12.265	12.265	0.0	0.867	0.877	14026.	32493.	3366240.
FEB 3	298.786	148.786	8.353	140.433	134.936	13.275	13.275	0.0	0.794	0.876	14143.	31884.	9843528.
S.TOTAL													17440720.
MAR 1	297.380	147.380	8.768	138.612	133.530	4.700	7.354	0.0	0.798	0.875	7772.	31516.	1865280.
MAR 2	296.553	146.553	8.893	137.660	132.703	4.700	7.620	0.0	0.800	0.875	8018.	31321.	1924320.
MAR 3	295.385	145.385	8.931	136.454	131.535	4.700	7.699	0.0	0.794	0.574	9020.	31007.	2117220.
S.TOTAL													5906883.
APR 1	294.616	144.616	8.828	135.788	130.766	4.700	7.483	0.0	0.797	0.874	7738.	30828.	1857120.
APR 2	293.781	143.781	8.924	134.857	129.931	4.700	7.624	0.0	0.790	0.874	7401.	30631.	1596240.
APR 3	293.066	143.066	8.736	134.330	129.216	4.700	7.282	0.0	0.794	0.873	7421.	30429.	1781040.
S.TOTAL													5534400.
MAY 1	292.152	142.152	8.742	133.410	129.302	4.700	7.297	0.0	0.793	0.873	7376.	30213.	1770240.
MAY 2	291.398	141.398	8.688	132.710	127.548	4.700	7.175	0.0	0.792	0.872	7206.	30001.	1729440.
MAY 3	290.304	140.304	9.926	130.378	126.454	9.379	9.379	0.0	0.810	0.872	9464.	29743.	2498496.
S.TOTAL													5998176.
JUN 1	289.624	139.624	9.318	130.306	125.774	8.431	9.431	0.0	0.800	0.872	8398.	29583.	2015520.
JUN 2	291.857	141.857	8.247	133.610	128.007	6.062	6.062	0.0	0.785	0.873	6075.	30143.	1458000.
JUN 3	294.285	144.285	7.914	136.471	130.435	4.700	4.700	0.0	0.781	0.874	4787.	30750.	1148880.
S.TOTAL													4622400.
JUL 1	296.631	146.631	7.854	138.777	132.781	4.840	4.840	0.0	0.784	0.875	5032.	31339.	1207680.
JUL 2	302.260	152.260	7.814	144.446	138.410	4.700	4.700	0.0	0.789	0.877	5118.	32742.	1228320.
JUL 3	315.520	165.520	7.814	157.706	151.670	4.700	4.700	0.0	0.902	0.883	5680.	36000.	1499520.
S.TOTAL													3935520.
AUG 1	322.646	172.646	7.814	164.832	158.796	4.700	4.700	0.0	0.810	0.887	5996.	36000.	1439040.
AUG 2	326.331	176.331	7.814	168.517	162.481	4.700	4.700	0.0	0.813	0.888	6153.	36000.	1476720.
AUG 3	330.570	180.570	7.814	172.756	166.720	4.700	4.700	0.0	0.818	0.890	6346.	36000.	1675344.
S.TOTAL													4591104.
SEP 1	334.040	184.040	8.117	175.923	170.190	4.700	5.686	0.0	0.825	0.892	7885.	36000.	1892400.
SEP 2	330.854	180.954	12.787	168.067	167.004	4.700	23.164	0.0	0.877	0.890	32623.	36000.	7829520.
SEP 3	331.084	181.084	12.443	168.641	167.234	4.700	21.901	0.0	0.873	0.890	30809.	36000.	7394160.
S.TOTAL													17116080.
OCT 1	331.187	181.187	12.276	168.911	167.337	4.700	21.334	0.0	0.871	0.890	29990.	36000.	7197600.
OCT 2	334.008	184.008	11.788	172.220	170.158	4.700	19.837	0.0	0.868	0.892	28334.	36000.	6800160.
OCT 3	334.500	184.500	10.168	174.332	170.650	4.700	16.086	0.0	0.849	0.892	22749.	36000.	6005736.
S.TOTAL													20003488.
TOTAL													141803248.

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                                           RONGA P/S        1963                         T.W.L=150.0

           H.W.L.   GROSS H . LOSSES    E.HEAD    P.HEAD  REQ.DIS . T.DIS.   OVER F . LEFFICE  P.EFFI.   KW       PEAK KW       KWH
            (M)      (M)      (M)        (M)       (M)    (CM/S)   (CM/S)   (CM/S)
  NOV 1  334.500  184.500   11.409   173.091   170.650    4.700   11.019    0.0      0.864    0.892   15746.   36000.     3779040.
  NOV 2  332.742  182.742   12.326   170.416   168.892   13.082   21.499    0.0      0.873    0.891   30561.   36000.     7334640.
  NOV 3  331.542  181.542    9.326   172.216   167.692   14.648   14.648    0.0      0.837    0.891   20175.   36000.     4842000.
 S.TOTAL                                                                                                                15955680.
  DEC 1  330.633  180.633   12.044   168.589   166.783   17.376   20.593    0.0      0.868    0.890   28794.   36000.     6910560.
  DEC 2  327.537  177.537   13.334   164.203   163.687   25.509   25.509    0.0      0.883    0.889   35340.   36000.     8481600.
  DEC 3  322.286  172.286   13.847   158.439   158.436   28.188   28.188    0.0      0.887    0.886   36000.   36000.     9504000.
 S.TOTAL                                                                                                                24896160.
  JAN 1  317.513  167.513   13.281   154.231   153.063   25.265   25.265    0.0      0.877    0.884   32653.   36000.     7836720.
  JAN 2  312.875  162.875   13.154   149.721   149.025   24.690   24.690    0.0      0.873    0.882   30835.   35454.     7400400.
  JAN 3  309.152  159.152   11.298   147.854   145.302   18.529   18.529    0.0      0.844    0.880   22093.   34490.     5832552.
 S.TOTAL                                                                                                                21069664.
  FEB 1  307.066  157.066   12.112   144.954   143.216   11.581   11.581    0.0      0.856    0.880   13714.   33995.     3291360.
  FEB 2  304.952  154.952   12.212   142.740   141.102   11.653   11.653    0.0      0.855    0.879   13589.   33455.     3261360.
  FEB 3  303.757  153.757   10.044   143.713   139.907    9.541    9.541    0.0      0.823    0.878   10753.   33134.     7504968.
 S.TOTAL                                                                                                                14057688.
  MAR 1  302.778  152.778    8.781   143.997   138.928    4.773    7.383    0.0      0.804    0.878    8167.   32902.     1960080.
  MAR 2  302.224  152.224    8.910   143.315   138.374    4.700    7.655    0.0      0.805    0.877    8438.   32734.     2025120.
  MAR 3  301.460  151.460    8.896   142.564   137.610    4.700    7.627    0.0      0.804    0.877    8353.   32551.     2205192.
 S.TOTAL                                                                                                                 6190392.
  APR 1  300.881  150.881    8.917   141.964   137.031    4.700    7.670    0.0      0.804    0.877    8365.   32416.     2007600.
  APR 2  300.307  150.307    8.794   141.513   136.457    4.700    7.411    0.0      0.801    0.876    8027.   32243.     1926480.
  APR 3  299.386  149.386    8.896   140.490   135.536    4.700    7.627    0.0      0.802    0.876    8211.   32026.     1970640.
 S.TOTAL                                                                                                                 5904720.
  MAY 1  298.420  148.420    8.934   139.486   134.570    4.700    7.706    0.0      0.802    0.876    8237.   31794.     1976880.
  MAY 2  297.527  147.527    8.879   138.648   133.677    4.700    7.591    0.0      0.800    0.875    8045.   31551.     1930800.
  MAY 3  291.989  141.989   11.433   130.556   128.139   18.872   18.872    0.0      0.835    0.873   19658.   30174.     5189712.
 S.TOTAL                                                                                                                 9097392.
  JUN 1  296.183  146.193    7.814   138.369   132.333    4.700    4.700    0.0      0.783    0.875    4866.   31233.     1167840.
  JUN 2  299.072  149.072    7.814   141.258   135.222    4.700    4.700    0.0      0.786    0.876    4986.   31952.     1196640.
  JUN 3  302.643  152.643    7.814   144.829   138.793    4.700    4.700    0.0      0.790    0.878    5138.   32870.     1233120.
 S.TOTAL                                                                                                                 3597600.
  JUL 1  306.709  156.709    7.814   148.895   142.859    4.700    4.700    0.0      0.793    0.879    5303.   33972.     1272720.
  JUL 2  310.914  160.914    7.814   153.100   147.064    4.700    4.700    0.0      0.798    0.881    5487.   34944.     1316880.
  JUL 3  315.737  165.737    7.814   157.923   151.887    4.700    4.700    0.0      0.803    0.883    5695.   36000.     1503480.
 S.TOTAL                                                                                                                 4093080.
  AUG 1  318.830  168.830    7.814   161.016   154.980    4.700    4.700    0.0      0.806    0.885    5828.   36000.     1398720.
  AUG 2  320.576  170.576    8.997   161.579   156.726    7.832    7.832    0.0      0.823    0.886    9951.   36000.     2388240.
  AUG 3  322.337  172.337    7.814   164.523   158.487    4.700    4.700    0.0      0.804    0.886    5977.   36000.     1577928.
 S.TOTAL                                                                                                                 5364888.
  SEP 1  326.930  176.930    7.814   169.116   163.080    4.700    4.700    0.0      0.814    0.889    6182.   36000.     1483680.
  SEP 2  332.061  182.061    7.814   174.247   168.211    4.700    4.700    0.0      0.819    0.891    6409.   36000.     1538160.
  SEP 3  333.165  183.165    9.505   173.660   169.315    4.700   14.932    0.0      0.840    0.891   20813.   36000.     4995120.
 S.TOTAL                                                                                                                 8016960.
  OCT 1  333.586  183.586    8.123   175.463   169.736    4.700   12.988    0.0      0.825    0.892   17964.   36000.     4311360.
  OCT 2  334.008  184.008   10.944   173.064   170.158    4.700   13.583    0.0      0.858    0.882   15915.   36000.     [illegible]
  OCT 3  334.500  184.500   10.298   174.202   170.650    4.700    9.774    0.0      [illegible] 0.877 13807.  36000.     3645048.
 S.TOTAL                                                                                                                [illegible]
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BONGA P/S 1964 T.W.L=150.0

	H.W.L. (M)	GROSS H (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DIS (CM/S)	T.DIS. (CM/S)	OVER F (CM/S)	EFFICI	P.EFFI.	KW	PEAK KW	KWH
NOV 1	333.390	183.390	12.838	170.552	169.540	12.065	12.065	0.0	0.877	0.891	17282.	36000.	4147680.
NOV 2	330.181	180.181	12.891	167.290	166.331	23.576	23.576	0.0	0.878	0.890	33088.	36000.	7941120.
NOV 3	327.591	177.591	11.847	165.744	163.741	20.006	20.006	0.0	0.864	0.889	27374.	36000.	6569760.
S.TOTAL													18658560.
DEC 1	325.180	175.180	11.767	163.413	161.330	19.776	19.776	0.0	0.862	0.888	26617.	36000.	6388080.
DEC 2	326.247	176.247	7.986	168.261	162.397	4.770	5.280	0.0	0.815	0.888	6918.	36000.	1660320.
DEC 3	324.115	174.115	11.239	162.876	160.265	18.383	18.383	0.0	0.854	0.887	24432.	36000.	6450048.
S.TOTAL													14498448.
JAN 1	320.383	170.383	13.214	157.169	156.533	24.958	24.958	0.0	0.876	0.886	32908.	36000.	7897920.
JAN 2	316.228	166.228	13.520	152.708	152.378	26.421	26.421	0.0	0.880	0.884	33925.	36000.	8142000.
JAN 3	311.614	161.614	13.246	148.368	147.764	25.102	25.102	0.0	0.874	0.882	31102.	35154.	8210928.
S.TOTAL													24250848.
FEB 1	309.273	159.273	11.080	148.185	145.423	18.021	18.021	0.0	0.842	0.881	21465.	34558.	5150400.
FEB 2	309.429	159.429	9.438	149.991	145.579	8.636	8.636	0.0	0.819	0.881	10137.	34595.	2432880.
FEB 3	308.826	158.826	11.970	146.856	144.976	11.476	11.476	0.0	0.854	0.880	13752.	34413.	9571392.
S.TOTAL													17160672.
MAR 1	309.535	159.535	8.562	150.973	145.685	4.700	6.880	0.0	0.807	0.881	8009.	34623.	1922160.
MAR 2	310.310	160.310	8.785	151.525	146.460	4.700	7.390	0.0	0.811	0.881	8677.	34805.	2082480.
MAR 3	310.803	160.803	8.801	152.002	146.953	4.700	7.426	0.0	0.811	0.881	8747.	34922.	2309208.
S.TOTAL													6313848.
APR 1	311.004	161.004	8.845	152.159	147.154	4.700	7.519	0.0	0.812	0.881	8877.	34969.	2130480.
APR 2	310.994	160.994	8.835	152.159	147.144	4.700	7.498	0.0	0.812	0.881	8852.	34967.	2124480.
APR 3	310.875	160.875	8.729	152.152	147.025	4.700	7.253	0.0	0.810	0.881	8541.	34632.	2049840.
S.TOTAL													6304800.
MAY 1	311.287	161.287	8.242	153.045	147.437	4.700	6.048	0.0	0.804	0.881	7111.	35037.	1706640.
MAY 2	310.662	160.662	8.470	152.193	146.812	4.700	13.426	0.0	0.807	0.881	15756.	34883.	3781440.
MAY 3	311.733	161.733	7.814	153.919	147.883	4.700	4.700	0.0	0.799	0.882	5523.	35183.	1458072.
S.TOTAL													6946152.
JUN 1	313.422	163.422	7.814	155.608	149.572	4.700	4.700	0.0	0.800	0.882	5591.	35584.	1341840.
JUN 2	313.103	163.103	10.216	152.887	149.253	9.764	9.764	0.0	0.833	0.882	11882.	35509.	2851680.
JUN 3	310.895	160.895	10.707	150.188	147.045	17.166	17.166	0.0	0.838	0.881	20643.	34944.	4954320.
S.TOTAL													9147840.
JUL 1	308.919	158.919	9.521	149.398	145.069	14.958	14.958	0.0	0.820	0.880	17509.	34435.	4202160.
JUL 2	308.692	158.692	8.299	150.393	144.842	6.204	6.204	0.0	0.802	0.889	7150.	34381.	1716000.
JUL 3	309.364	159.364	7.814	151.550	145.514	4.700	4.700	0.0	0.796	0.881	5417.	34580.	1430088.
S.TOTAL													7348248.
AUG 1	312.814	162.814	7.814	155.000	148.964	4.700	4.700	0.0	0.871	0.882	5569.	35440.	1336560.
AUG 2	317.857	167.857	7.814	160.043	154.007	4.700	4.700	0.0	0.805	0.884	5786.	36000.	1388640.
AUG 3	325.618	175.618	7.814	167.804	161.768	4.700	4.700	0.0	0.813	0.888	6127.	36000.	1617528.
S.TOTAL													4342728.
SEP 1	330.813	180.813	7.814	172.999	166.963	4.700	4.700	0.0	0.816	0.890	6355.	36000.	1525200.
SEP 2	331.894	181.894	10.841	171.053	168.044	4.700	17.458	0.0	0.855	0.891	24396.	36000.	5855040.
SEP 3	331.272	181.272	12.131	169.141	167.422	4.700	20.867	0.0	0.870	0.891	29340.	36000.	7041600.
S.TOTAL													14421840.
OCT 1	331.251	181.251	12.168	169.083	167.401	4.700	20.982	0.0	0.871	0.891	29525.	36000.	7086000.
OCT 2	334.008	184.008	10.695	173.313	170.158	4.700	17.141	0.0	0.855	0.892	24270.	36000.	5824800.
OCT 3	334.500	184.500	8.774	175.726	170.650	4.700	7.366	0.0	0.833	0.892	10303.	36000.	2719992.
S.TOTAL													15630792.
TOTAL													145024736.

BUNGA P/S 1965 T.W.L=150.0

	H.W.L. (M)	GROSS H. (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DIS. (CM/S)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICI.	P.EFFI.	KW	PEAK KW	KWH
NOV 1	334.500	184.500	8.595	175.905	170.650	4.700	6.958	0.0	0.831	0.892	9718.	36000.	2332320.
NOV 2	334.500	184.500	13.850	170.650	170.650	4.700	28.225	0.0	0.892	0.892	36000.	36000.	8640000.
NOV 3	331.832	181.832	10.991	170.841	167.982	4.700	17.795	0.0	0.857	0.891	24894.	36000.	5974560.
S.TOTAL													16946880.
DEC 1	331.249	181.249	13.211	168.038	167.399	8.651	24.945	0.0	0.883	0.891	35366.	36000.	8487840.
DEC 2	332.426	182.426	9.254	173.172	168.576	4.700	14.536	0.0	0.837	0.891	20132.	36000.	4831680.
DEC 3	330.729	180.729	12.971	167.758	166.879	6.499	23.904	0.0	0.879	0.890	33680.	36000.	8891520.
S.TOTAL													22211040.
JAN 1	331.393	181.393	13.620	167.765	167.543	16.426	26.976	0.0	0.886	0.891	36000.	36000.	8640000.
JAN 2	330.111	180.111	13.403	166.708	166.261	11.761	25.842	0.0	0.885	0.890	36000.	36000.	8640000.
JAN 3	328.959	178.959	13.505	165.454	165.109	11.589	26.344	0.0	0.885	0.889	36000.	36000.	9504000.
S.TOTAL													26784000.
FEB 1	328.296	178.296	13.665	164.631	164.446	8.813	27.177	0.0	0.887	0.889	36000.	36000.	8640000.
FEB 2	327.618	177.618	13.830	163.788	163.768	8.412	28.089	0.0	0.883	0.889	36000.	36000.	8640000.
FEB 3	327.864	177.864	13.850	164.014	164.014	9.569	28.225	0.0	0.889	0.889	36000.	36000.	25056000.
S.TOTAL													42336000.
MAR 1	326.202	176.202	13.850	162.352	162.352	4.700	28.225	0.0	0.888	0.888	36000.	36000.	8640000.
MAR 2	325.854	175.854	13.850	162.004	162.004	4.700	28.225	0.0	0.888	0.886	36000.	36000.	8640000.
MAR 3	324.912	174.912	13.850	161.062	161.062	4.700	28.225	0.0	0.888	0.888	36000.	36000.	9504000.
S.TOTAL													26784000.
APR 1	324.857	174.857	13.850	161.007	161.007	4.700	28.225	0.0	0.888	0.888	36000.	36000.	8640000.
APR 2	324.276	174.276	13.850	160.426	160.426	4.700	28.225	0.0	0.887	0.887	36000.	36000.	8640000.
APR 3	324.021	174.021	13.603	160.418	160.171	4.700	26.847	0.0	0.884	0.887	36000.	36000.	8640000.
S.TOTAL													25920000.
MAY 1	323.760	173.760	13.360	160.400	159.910	4.700	25.634	0.0	0.881	0.887	34612.	36000.	8306880.
MAY 2	323.065	173.065	13.505	159.560	159.215	4.700	26.344	0.0	0.873	0.887	35465.	36000.	8511600.
MAY 3	322.553	172.553	13.456	159.097	158.703	4.700	26.100	0.0	0.882	0.887	34995.	36000.	9238680.
S.TOTAL													26057152.
JUN 1	326.034	176.034	11.180	164.854	162.184	4.700	14.240	0.0	0.855	0.868	24565.	36000.	5895600.
JUN 2	328.820	178.820	9.953	168.867	164.970	4.700	15.692	0.0	0.842	0.869	21319.	36000.	5116560.
JUN 3	332.335	182.335	9.571	172.764	168.485	4.700	15.039	0.0	0.840	0.891	20854.	36000.	5004960.
S.TOTAL													16017120.
JUL 1	330.702	180.702	12.993	167.709	166.852	4.700	23.997	0.0	0.880	0.890	33840.	36000.	8121600.
JUL 2	331.635	181.635	11.436	170.199	167.785	4.700	18.879	0.0	0.862	0.891	26465.	36000.	6351600.
JUL 3	331.192	181.192	11.775	169.417	167.342	4.700	19.798	0.0	0.864	0.890	27722.	36000.	7318608.
S.TOTAL													21791808.
AUG 1	330.906	180.906	12.712	168.194	167.056	4.700	22.877	0.0	0.876	0.890	32207.	36000.	7729680.
AUG 2	330.755	180.755	12.922	167.833	166.905	4.700	23.703	0.0	0.879	0.890	33412.	36000.	8018880.
AUG 3	330.350	180.350	12.993	167.357	166.500	4.700	23.997	0.0	0.880	0.990	33769.	36000.	8915016.
S.TOTAL													24663569.
SEP 1	331.563	181.563	11.535	169.978	167.713	4.700	19.274	0.0	0.864	0.891	27046.	36000.	6491040.
SEP 2	332.531	182.531	11.109	171.422	168.681	6.939	18.071	0.0	0.859	0.891	25426.	36000.	6102240.
SEP 3	333.165	183.165	10.083	173.082	169.315	4.700	15.329	0.0	0.847	0.891	22313.	36000.	5355120.
S.TOTAL													17948400.
OCT 1	333.586	183.586	11.981	171.605	169.736	4.700	11.484	0.0	0.879	0.892	16382.	36000.	[illegible]
OCT 2	334.008	184.008	9.038	174.970	170.158	4.700	7.314	0.0	0.830	0.892	11001.	36000.	[illegible]
OCT 3	334.500	184.500	8.118	176.382	170.450	4.700	5.683	0.0	0.825	0.897	7710.	36000.	[illegible]
S.TOTAL													[illegible]

TOTAL

HUNGA 025 [illegible] T.W.L=150.0

	H.W.L. (M)	GROSS H. (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DI. (CM/S)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFIC.	P.EFFI.	KW	PEAK KW	KWH
NOV 1	334.500	184.500	8.207	176.293	170.150	4.700	5.947	0.0	0.826	0.892	8275.	36000.	1986000.
NOV 2	332.742	182.742	8.502	174.240	168.897	10.771	13.469	0.0	0.828	0.891	18567.	36000.	4456080.
NOV 3	330.409	180.409	11.847	168.562	166.559	20.006	20.006	0.0	0.866	0.890	27904.	36000.	6696960.
S.TOTAL													13139040.
DEC 1	326.809	176.809	12.972	163.838	162.959	23.907	23.907	0.0	0.876	0.889	32860.	36000.	7886400.
DEC 2	323.608	173.608	12.013	161.595	159.758	20.498	20.498	0.0	0.864	0.887	27345.	36000.	6562800.
DEC 3	317.664	167.664	13.760	153.904	153.814	27.694	27.694	0.0	0.883	0.884	35961.	36000.	9493704.
S.TOTAL													23942896.
JAN 1	313.355	163.355	12.743	150.612	149.505	22.997	22.997	0.0	0.867	0.882	23693.	35569.	6386320.
JAN 2	307.034	157.034	13.850	143.184	143.184	28.611	28.225	0.0	0.880	0.880	33981.	33987.	8155440.
JAN 3	298.935	148.935	13.850	135.095	135.085	28.295	28.225	0.0	0.876	0.876	31914.	31913.	8425296.
S.TOTAL													23467056.
FEB 1	292.766	142.766	11.741	131.025	128.916	19.702	19.702	0.0	0.840	0.873	20719.	30357.	4972560.
FEB 2	288.281	138.281	9.547	128.734	124.431	14.999	14.399	0.0	0.802	0.871	14777.	29234.	3551280.
FEB 3	285.329	135.329	7.943	127.386	121.479	12.771	12.771	0.0	0.774	0.870	12031.	29508.	8373570.
S.TOTAL													16897430.
MAR 1	284.385	134.385	7.814	126.571	120.535	4.700	4.700	0.0	0.771	0.869	4362.	28254.	1051680.
MAR 2	283.238	133.238	7.814	125.424	119.388	4.700	4.700	0.0	0.770	0.869	4337.	27985.	1040880.
MAR 3	281.908	131.908	7.814	124.094	118.058	4.700	4.700	0.0	0.768	0.868	4280.	27641.	1129920.
S.TOTAL													3222480.
APR 1	280.667	130.667	7.814	122.853	116.817	4.700	4.700	0.0	0.767	0.868	4232.	27351.	1015680.
APR 2	279.363	129.363	7.814	121.549	115.513	4.700	4.700	0.0	0.766	0.867	4181.	27014.	1003440.
APR 3	278.152	128.152	7.814	120.338	114.307	4.700	4.700	0.0	0.764	0.866	4129.	26703.	990960.
S.TOTAL													3010080.
MAY 1	277.057	127.057	7.814	119.243	113.207	4.700	4.700	0.0	0.764	0.866	4091.	26444.	981840.
MAY 2	276.990	126.990	7.814	119.176	113.140	4.700	4.700	0.0	0.764	0.866	4089.	26429.	981360.
MAY 3	280.477	130.477	8.022	122.455	116.627	5.392	5.392	0.0	0.770	0.867	4858.	27275.	1282512.
S.TOTAL													3245712.
JUN 1	276.552	126.552	9.749	116.803	112.702	15.337	15.337	0.0	0.796	0.866	13625.	26324.	3270000.
JUN 2	275.000	125.000	8.534	116.466	111.150	17.330	6.812	0.0	0.774	0.865	5867.	25934.	1408080.
JUN 3	275.000	125.000	7.840	117.160	111.159	18.889	4.791	0.0	0.762	0.965	4037.	25934.	[illegible]
S.TOTAL													5653960.
JUL 1	275.000	125.000	7.747	117.253	111.150	12.256	4.460	0.0	0.760	0.965	3798.	25934.	911520.
JUL 2	275.644	125.644	7.814	117.830	111.794	4.700	4.700	0.0	0.762	0.865	4032.	26084.	967680.
JUL 3	276.687	126.687	7.814	118.873	112.837	4.700	4.700	0.0	0.763	0.866	4073.	26358.	1075272.
S.TOTAL													2954472.
AUG 1	280.218	130.218	7.814	122.404	116.368	4.700	4.700	0.0	0.767	0.867	4216.	27214.	1011840.
AUG 2	290.995	140.995	7.814	133.181	127.145	4.700	4.700	0.0	0.778	0.872	4653.	29906.	1116720.
AUG 3	296.194	146.194	7.814	138.380	132.344	4.700	4.700	0.0	0.783	0.875	4866.	31236.	1284624.
S.TOTAL													3413184.
SEP 1	300.714	150.714	7.814	142.500	136.864	4.700	4.700	0.0	0.788	0.877	5057.	32377.	1213680.
SEP 2	304.087	154.087	7.814	146.273	140.237	4.700	4.700	0.0	0.791	0.878	5196.	33212.	1247040.
SEP 3	305.481	155.481	7.814	147.667	141.631	4.700	4.700	0.0	0.792	0.879	5252.	33581.	1260480.
S.TOTAL													3721200.
OCT 1	305.476	155.476	8.179	147.297	141.626	5.868	5.868	0.0	0.796	0.879	6590.	33573.	1581600.
OCT 2	305.334	155.334	7.814	147.520	141.484	4.700	4.700	0.0	0.792	0.879	5247.	33545.	1259280.
OCT 3	305.195	155.195	7.814	147.381	141.345	4.700	4.700	0.0	0.792	0.879	5242.	33513.	1383888.
S.TOTAL													4224768.
TOTAL													106847258.

BONGA P/S 1967 T.W.L=150.0

	H.W.L. (M)	GROSS H. (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DIS. (CM/S)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICE	P.EFFI.	KW	PEAK KW	KWH
NOV 1	305.988	155.988	7.814	148.174	142.138	4.700	4.700	0.0	0.793	0.879	5277.	33701.	1266480.
NOV 2	304.461	154.461	10.860	143.601	140.611	10.498	10.498	0.0	0.835	0.878	12028.	33301.	2986720.
NOV 3	309.702	159.702	7.914	151.888	145.852	4.700	4.700	0.0	0.797	0.881	5436.	34660.	1304640.
S.TOTAL													5457840.
DEC 1	310.912	160.912	8.073	152.840	147.362	5.550	5.550	0.0	0.801	0.881	6492.	34545.	1558080.
DEC 2	308.086	158.086	10.979	147.107	144.236	17.767	17.767	0.0	0.840	0.880	20976.	34237.	5034720.
DEC 3	306.602	156.602	13.089	143.513	142.752	12.214	12.214	0.0	0.868	0.879	14538.	33846.	3838032.
S.TOTAL													10430832.
JAN 1	305.504	155.504	13.200	142.304	141.654	12.277	12.277	0.0	0.870	0.879	14523.	33386.	3485520.
JAN 2	304.443	154.443	8.123	146.320	140.593	12.988	12.988	0.0	0.796	0.878	14454.	33297.	3468960.
JAN 3	302.918	152.918	8.230	144.688	139.068	13.120	13.120	0.0	0.796	0.976	14438.	32935.	3811632.
S.TOTAL													10766112.
FEB 1	302.078	152.078	9.780	142.298	138.228	9.170	9.170	0.0	0.819	0.877	10199.	32699.	2447760.
FEB 2	301.230	151.230	8.895	142.335	137.380	7.625	7.625	0.0	0.804	0.877	8336.	32494.	2001120.
FEB 3	300.621	150.621	8.369	142.252	136.771	6.394	6.394	0.0	0.796	0.877	6918.	32355.	4814928.
S.TOTAL													9263808.
MAR 1	300.060	150.060	8.116	141.944	136.210	4.850	5.691	0.0	0.791	0.876	6095.	32185.	1462800.
MAR 2	299.316	149.316	8.291	141.025	135.466	4.700	6.184	0.0	0.793	0.876	6608.	32003.	1585920.
MAR 3	298.090	148.090	8.571	139.519	134.240	4.700	6.902	0.0	0.796	0.975	7324.	31683.	1933536.
S.TOTAL													4982256.
APR 1	300.318	150.318	8.016	142.303	136.468	4.700	5.373	0.0	0.790	0.876	5771.	32246.	1385040.
APR 2	300.378	150.378	8.268	142.110	136.528	4.700	6.119	0.0	0.794	0.877	6597.	32297.	1583280.
APR 3	300.080	150.080	8.377	141.703	136.230	4.700	6.414	0.0	0.795	0.876	6904.	32190.	1656960.
S.TOTAL													4625280.
MAY 1	299.196	149.196	8.616	140.580	135.346	4.700	7.039	0.0	0.796	0.976	7513.	31781.	1803120.
MAY 2	298.482	148.482	8.489	139.993	134.632	4.700	6.701	0.0	0.796	0.876	7135.	31612.	1712400.
MAY 3	297.640	147.640	8.202	139.438	133.790	4.700	5.933	0.0	0.790	0.875	6245.	31577.	1648680.
S.TOTAL													5164200.
JUN 1	302.602	152.602	7.814	144.788	138.752	4.700	4.700	0.0	0.790	0.878	5137.	32861.	1232880.
JUN 2	302.638	152.638	9.984	142.654	138.788	9.459	9.459	0.0	0.821	0.878	10585.	32860.	2540400.
JUN 3	307.030	157.030	7.814	149.216	143.180	4.700	4.700	0.0	0.794	0.880	5321.	33987.	1277040.
S.TOTAL													5050320.
JUL 1	310.456	160.456	7.814	152.642	146.606	4.700	4.700	0.0	0.797	0.881	5463.	34039.	1311120.
JUL 2	311.891	161.891	7.814	154.077	149.041	4.700	4.700	0.0	0.799	0.882	5529.	35220.	1326960.
JUL 3	314.019	164.019	7.814	156.205	150.169	4.700	4.700	0.0	0.801	0.883	5619.	35767.	1483416.
S.TOTAL													4121496.
AUG 1	317.079	167.079	7.814	159.265	153.229	4.700	4.700	0.0	0.804	0.884	5751.	36000.	1380240.
AUG 2	318.691	168.691	7.814	160.677	154.841	4.700	4.700	0.0	0.806	0.885	5823.	36000.	1397520.
AUG 3	321.208	171.208	7.814	163.394	157.358	4.700	4.700	0.0	0.808	0.886	5924.	36000.	1565256.
S.TOTAL													4343016.
SEP 1	325.966	175.966	7.814	168.152	162.116	4.700	4.700	0.0	0.813	0.888	6139.	36000.	1473360.
SEP 2	330.411	180.411	7.814	172.597	166.561	4.700	4.700	0.0	0.818	0.890	6340.	36000.	1521600.
SEP 3	333.165	183.165	12.674	170.491	163.315	4.700	11.963	0.0	0.777	0.891	17091.	36000.	4101840.
S.TOTAL													7096800.
OCT 1	333.586	183.586	12.521	171.065	169.736	5.974	22.173	0.0	0.876	0.842	31748.	36000.	[illegible]
OCT 2	331.190	181.179	12.250	166.943	167.349	4.700	21.263	0.0	0.872	0.891	29733.	36000.	[illegible]
OCT 3	334.500	184.500	8.156	176.344	170.650	4.700	13.028	0.0	0.826	0.892	14132.	36000.	[illegible]
S.TOTAL													[illegible]
TOTAL													

BONGA P/S L.C.R T.W.L=150.0

	H.W.L. (M)	GROSS H. (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DIS. (CM/S)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFIC.	P.EFFI.	KW	PEAK KW	KWH
NOV 1	334.500	184.500	8.190	176.310	170.650	4.700	5.899	0.0	0.826	0.892	8209.	36000.	1970160.
NOV 2	332.742	182.742	8.437	174.305	168.892	4.700	13.383	0.0	0.827	0.891	18433.	36000.	4423920.
NOV 3	331.688	181.628	11.169	170.519	167.830	8.065	18.214	0.0	0.859	0.891	25492.	36000.	6118080.
S.TOTAL													12512160.
DEC 1	330.633	180.633	11.288	169.345	166.783	13.221	18.505	0.0	0.853	0.890	25721.	36000.	6173040.
DEC 2	329.578	179.578	8.967	170.610	165.728	13.459	14.110	0.0	0.831	0.890	19115.	36000.	4587600.
DEC 3	327.439	177.439	8.540	168.899	163.589	13.519	13.519	0.0	0.824	0.889	17977.	36000.	4745928.
S.TOTAL													15506568.
JAN 1	325.782	175.782	13.225	162.557	161.932	12.291	12.291	0.0	0.880	0.888	16800.	36000.	4032000.
JAN 2	322.409	172.409	11.273	161.136	158.559	18.468	18.468	0.0	0.854	0.887	24283.	36000.	5827920.
JAN 3	316.412	166.412	13.430	152.982	152.562	25.973	25.973	0.0	0.876	0.884	33334.	36000.	8800176.
S.TOTAL													18660096.
FEB 1	311.691	161.691	12.561	149.130	147.841	22.317	22.317	0.0	0.864	0.882	27476.	35173.	6594240.
FEB 2	308.839	158.839	8.011	150.828	144.999	12.852	12.852	0.0	0.798	0.880	14780.	34415.	3547200.
FEB 3	307.230	157.230	8.833	148.397	143.380	7.494	7.494	0.0	0.809	0.880	9596.	34034.	5982816.
S.TOTAL													16124256.
MAR 1	305.497	155.497	8.788	146.709	141.647	4.841	7.397	0.0	0.806	0.879	6356.	33584.	2035920.
MAR 2	304.413	154.413	8.811	145.602	140.563	4.700	7.447	0.0	0.805	0.878	8340.	33289.	2001600.
MAR 3	303.166	153.166	8.814	144.352	139.316	4.700	7.494	0.0	0.805	0.878	8276.	32994.	2154864.
S.TOTAL													6192384.
APR 1	302.130	152.130	8.828	143.302	138.280	4.700	7.483	0.0	0.804	0.877	8238.	32711.	1977120.
APR 2	301.080	151.080	8.707	142.373	137.230	4.700	7.218	0.0	0.801	0.877	7865.	32463.	1887600.
APR 3	300.182	150.182	8.410	141.772	136.332	4.700	6.500	0.0	0.796	0.876	7009.	32214.	1682160.
S.TOTAL													5546880.
MAY 1	298.934	148.934	8.331	140.603	135.084	4.700	6.232	0.0	0.793	0.876	6703.	31919.	1608720.
MAY 2	297.879	147.879	8.052	139.827	134.029	4.700	5.488	0.0	0.788	0.875	5778.	31634.	1386720.
MAY 3	296.128	146.128	8.230	137.898	132.278	6.012	6.012	0.0	0.789	0.875	6250.	31220.	1650000.
S.TOTAL													4645440.
JUN 1	294.020	144.020	8.955	135.065	130.170	7.748	7.748	0.0	0.798	0.874	7979.	30683.	1914960.
JUN 2	290.879	140.879	11.799	129.080	127.029	11.344	11.344	0.0	0.840	0.872	11753.	24870.	2820720.
JUN 3	288.004	138.004	10.566	127.438	124.154	10.191	10.181	0.0	0.813	0.871	10153.	29160.	2436720.
S.TOTAL													7172400.
JUL 1	287.110	137.110	7.960	129.150	123.260	5.184	5.194	0.0	0.776	0.870	4974.	23926.	1193760.
JUL 2	287.500	137.500	9.290	128.210	123.650	8.381	8.381	0.0	0.798	0.871	8193.	29050.	1966320.
JUL 3	305.341	155.341	7.814	147.527	141.491	4.700	4.700	0.0	0.792	0.879	5247.	33547.	1385208.
S.TOTAL													4545288.
AUG 1	306.971	156.971	7.814	149.157	143.121	4.700	4.700	0.0	0.794	0.880	5319.	33472.	1276560.
AUG 2	313.270	163.270	7.814	155.456	149.420	4.700	4.700	0.0	0.800	0.882	5585.	35548.	1340400.
AUG 3	319.807	169.807	7.814	161.993	155.957	4.700	4.700	0.0	0.807	0.885	5871.	36000.	1549944.
S.TOTAL													4166904.
SEP 1	327.705	177.705	7.814	169.891	163.855	4.700	4.700	0.0	0.815	0.889	6218.	36000.	1492320.
SEP 2	330.489	180.489	7.814	172.675	166.639	4.700	4.700	0.0	0.815	0.890	6343.	36000.	1522320.
SEP 3	331.173	181.173	12.300	168.873	167.323	4.700	21.413	0.0	0.872	0.890	30129.	36000.	7230960.
S.TOTAL													10245600.
OCT 1	334.500	184.500	13.850	170.650	170.650	4.700	29.225	0.0	0.892	0.892	36000.	36000.	8640000.
OCT 2	334.000	184.000	11.597	172.411	170.158	4.700	19.305	0.0	0.866	0.892	27541.	36000.	6609840.
OCT 3	334.500	184.500	11.104	173.396	170.650	4.700	10.740	0.0	0.860	0.897	15303.	36000.	4039992.
S.TOTAL													19289824.
TOTAL													124607776.

BENGA P/S 1969 T.W.L=150.0

	H.W.L. (M)	GROSS H . (M)	LOSSES (M)	E.HEAD (M)	P.HEAD (M)	REQ.DIS . (CM/S)	T.DIS. (CM/S)	OVER F . (CM/S)	EFFICI.	P.EFFI.	KW	PEAK KW	KWH
NOV 1	332.195	182.195	11.313	170.882	168.345	18.567	18.567	0.0	0.861	0.891	26102.	36000.	6264480.
NOV 2	328.364	178.364	13.650	164.714	164.514	27.094	27.094	0.0	0.887	0.889	36000.	36000.	8640000.
NOV 3	325.583	175.583	12.973	162.610	161.733	23.912	23.912	0.0	0.877	0.888	32583.	36000.	7819920.
S.TOTAL													22724400.
DEC 1	322.638	172.638	13.203	159.435	158.788	24.907	24.907	0.0	0.879	0.887	33352.	36000.	8004480.
DEC 2	318.114	168.114	13.484	154.630	154.264	26.239	26.239	0.0	0.880	0.885	34116.	36000.	8187840.
DEC 3	314.203	164.203	11.962	152.241	150.353	20.345	20.345	0.0	0.857	0.883	25363.	35811.	6695832.
S.TOTAL													22886144.
JAN 1	309.374	159.374	13.335	146.039	145.524	25.516	25.516	0.0	0.874	0.881	31119.	34582.	7468560.
JAN 2	304.553	154.553	12.415	142.138	140.703	21.803	21.803	0.0	0.857	0.878	25377.	33323.	6090480.
JAN 3	296.730	146.730	13.578	133.152	132.880	26.719	26.719	0.0	0.871	0.875	29608.	31362.	7816512.
S.TOTAL													21375552.
FEB 1	292.083	142.083	10.289	131.794	128.233	16.317	16.317	0.0	0.817	0.873	16788.	30196.	4029120.
FEB 2	288.403	138.403	8.204	130.199	124.553	13.088	13.088	0.0	0.781	0.871	12716.	29263.	3051840.
FEB 3	285.417	135.417	8.030	127.387	121.567	12.875	12.875	0.0	0.776	0.870	12161.	28524.	8464056.
S.TOTAL													15545016.
MAR 1	284.217	134.217	7.928	126.289	120.367	5.089	5.089	0.0	0.773	0.869	4747.	28214.	1139280.
MAR 2	283.033	133.033	7.814	125.219	119.183	4.700	4.700	0.0	0.770	0.869	4330.	27937.	1039200.
MAR 3	281.685	131.685	7.814	123.871	117.835	4.700	4.700	0.0	0.768	0.868	4272.	27582.	1127808.
S.TOTAL													3306288.
APR 1	280.378	130.378	7.814	122.564	116.528	4.700	4.700	0.0	0.767	0.867	4222.	27252.	1013280.
APR 2	279.145	129.145	7.814	121.331	115.295	4.700	4.700	0.0	0.766	0.867	4174.	26563.	1001760.
APR 3	277.828	127.828	7.814	120.014	113.978	4.700	4.700	0.0	0.764	0.866	4118.	26024.	988320.
S.TOTAL													3003360.
MAY 1	276.613	126.613	7.814	118.799	112.763	4.700	4.700	0.0	0.763	0.866	4071.	26341.	977040.
MAY 2	275.428	125.428	7.814	117.614	111.578	4.700	4.700	0.0	0.762	0.865	4025.	26034.	966000.
MAY 3	275.130	125.130	7.814	117.316	111.280	4.700	4.700	0.0	0.762	0.865	4015.	25964.	1059960.
S.TOTAL													3003000.
JUN 1	278.034	128.034	8.969	119.065	114.184	7.777	7.777	0.0	0.784	0.866	6937.	26673.	1664880.
JUN 2	285.258	135.258	7.814	127.444	121.408	4.700	4.700	0.0	0.772	0.870	4418.	28491.	1060320.
JUN 3	286.479	136.479	9.497	126.982	122.629	14.918	14.918	0.0	0.800	0.870	14480.	28778.	3475200.
S.TOTAL													6200400.
JUL 1	290.387	140.387	7.814	132.573	126.537	4.700	4.700	0.0	0.777	0.872	4626.	29763.	1110240.
JUL 2	293.279	143.279	7.814	135.465	129.429	4.700	4.700	0.0	0.780	0.873	4745.	30478.	1138800.
JUL 3	315.470	165.470	7.814	157.656	151.620	4.700	4.700	0.0	0.802	0.883	5678.	36000.	1498992.
S.TOTAL													3748032.
AUG 1	321.271	171.271	7.814	163.457	157.421	4.700	4.700	0.0	0.808	0.886	5931.	36000.	1423440.
AUG 2	325.278	175.278	8.071	167.207	161.428	5.159	5.545	0.0	0.816	0.888	7229.	36000.	1734960.
AUG 3	321.194	171.194	13.850	157.344	157.344	29.032	28.225	0.0	0.886	0.886	36000.	36000.	9504000.
S.TOTAL													12662400.
SEP 1	321.842	171.842	9.872	161.970	157.992	9.304	9.304	0.0	0.835	0.886	12023.	36000.	2885520.
SEP 2	328.342	178.342	7.814	170.528	164.492	4.700	4.700	0.0	0.815	0.869	6241.	36000.	1497840.
SEP 3	329.401	179.401	9.767	169.634	165.551	9.151	9.151	0.0	0.840	0.890	12459.	36000.	2990160.
S.TOTAL													7373520.
OCT 1	333.586	183.586	8.936	174.650	169.736	4.700	14.065	0.0	0.834	0.892	19575.	36000.	4698000.
OCT 2	334.008	184.008	8.612	175.396	170.158	4.700	13.615	0.0	0.831	0.892	18961.	36000.	4550640.
OCT 3	334.500	184.500	8.905	175.595	170.657	4.700	7.645	0.0	0.834	0.892	11098.	36000.	2929872.
S.TOTAL													12178512.
TOTAL													

NUEVA ERA P/S 1960

	H.W.L. (M)	T.W.L. (M)	GROSS.H (M)	LOSSES (M)	E.HEAD (M)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICE.	KW	KWH
NOV 1	149.253	118.593	30.660	0.398	30.262	8.079	0.0	0.800	1850.	444000.
NOV 2	150.000	120.500	29.500	1.585	27.915	29.273	12.734	0.883	6800.	1632000.
NOV 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
S.TOTAL										3708000.
DEC 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
DEC 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
DEC 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										5059200.
JAN 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JAN 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JAN 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										5059200.
FEB 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
FEB 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
FEB 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	4732800.
S.TOTAL										7996800.
MAR 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
MAR 2	149.986	120.465	29.521	1.552	27.969	28.885	0.0	0.883	6746.	1619040.
MAR 3	149.983	120.457	29.526	1.543	27.983	28.792	0.0	0.883	6728.	1776192.
S.TOTAL										5027232.
APR 1	149.992	120.479	29.513	1.565	27.948	29.036	0.0	0.883	6776.	1626240.
APR 2	149.985	120.463	29.522	1.549	27.973	28.857	0.0	0.883	6741.	1617840.
APR 3	149.979	120.447	29.532	1.534	27.998	28.684	0.0	0.883	6706.	1609440.
S.TOTAL										4853520.
MAY 1	149.983	120.457	29.526	1.543	27.983	28.792	0.0	0.883	6720.	1614720.
MAY 2	149.993	120.494	29.504	1.580	27.924	29.208	0.0	0.883	6800.	1632000.
MAY 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										5041920.
JUN 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JUN 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JUN 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
S.TOTAL										4896000.
JUL 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JUL 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JUL 3	149.835	120.079	29.756	1.207	28.549	24.592	0.0	0.895	5942.	1568688.
S.TOTAL										4832688.
AUG 1	149.844	120.102	29.742	1.226	28.516	24.851	0.0	0.895	5998.	1439520.
AUG 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
AUG 3	150.000	120.500	29.500	1.585	27.915	29.273	27.123	0.883	6800.	1795200.
S.TOTAL										4866720.
SEP 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
SEP 2	149.819	120.037	29.782	1.174	28.608	24.133	0.0	0.895	5843.	1402320.
SEP 3	149.917	120.287	29.630	1.386	28.244	26.905	0.0	0.890	6396.	1535040.
S.TOTAL										4569360.
OCT 1	149.610	119.505	30.105	0.798	29.307	18.219	0.0	0.892	4504.	1080960.
OCT 2	150.000	120.500	29.500	1.585	27.915	29.273	6.977	0.883	6800.	1632000.
OCT 3	149.491	119.201	30.290	0.630	29.660	14.841	0.0	0.882	3672.	969408.
S.TOTAL										3682368.
TOTAL										59593008.

NUEVA FRA P/S 1961

	H.W.L. (M)	T.W.L. (M)	GROSS.H (M)	LOSSES (M)	E.HEAD (M)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICE.	KW	KWH
NOV 1	149.466	119.136	30.330	0.599	29.731	14.123	0.0	0.882	3502.	840480.
NOV 2	149.771	119.916	29.855	1.079	28.776	22.784	0.0	0.895	5549.	1331760.
NOV 3	149.842	120.095	29.747	1.221	28.526	24.778	0.0	0.895	5982.	1435680.
S.TOTAL										3607920.
DEC 1	149.876	120.184	29.692	1.296	28.396	25.765	0.0	0.890	6158.	1477920.
DEC 2	149.889	120.216	29.673	1.323	28.350	26.114	0.0	0.890	6231.	1495440.
DEC 3	149.930	120.322	29.608	1.417	28.191	27.292	0.0	0.890	6476.	1709664.
S.TOTAL										4683024.
JAN 1	149.993	120.482	29.511	1.568	27.943	29.075	0.0	0.883	6784.	1628160.
JAN 2	149.864	120.154	29.710	1.270	28.440	25.427	0.0	0.890	6087.	1460880.
JAN 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										4884240.
FEB 1	149.566	119.393	30.173	0.732	29.441	16.977	0.0	0.889	4202.	1008480.
FEB 2	149.458	119.117	30.341	0.590	29.751	13.907	0.0	0.882	3451.	828240.
FEB 3	149.437	119.062	30.375	0.565	29.810	13.296	0.0	0.862	3336.	2300976.
S.TOTAL										4137696.
MAR 1	149.250	118.339	30.911	0.342	30.569	5.260	0.0	0.800	1216.	291840.
MAR 2	149.250	118.356	30.894	0.345	30.549	5.454	0.0	0.800	1261.	302640.
MAR 3	149.250	118.333	30.917	0.340	30.577	5.195	0.0	0.800	1202.	317328.
S.TOTAL										911808.
APR 1	149.250	118.325	30.925	0.339	30.586	5.139	0.0	0.800	1182.	283680.
APR 2	149.250	118.327	30.923	0.339	30.584	5.124	0.0	0.800	1186.	284640.
APR 3	149.250	118.323	30.927	0.339	30.588	5.080	0.0	0.800	1176.	282240.
S.TOTAL										850560.
MAY 1	149.250	118.345	30.905	0.343	30.562	5.332	0.0	0.800	1233.	295920.
MAY 2	149.250	118.373	30.877	0.348	30.529	5.640	0.0	0.800	1303.	312720.
MAY 3	149.277	118.655	30.622	0.415	30.207	8.770	0.0	0.800	2004.	529056.
S.TOTAL										1137696.
JUN 1	149.283	118.670	30.613	0.420	30.193	8.935	0.0	0.800	2041.	489840.
JUN 2	149.626	119.544	30.082	0.822	29.260	18.653	0.0	0.892	4604.	1104960.
JUN 3	149.340	118.815	30.525	0.467	30.058	10.550	0.0	0.872	2615.	627600.
S.TOTAL										2222400.
JUL 1	149.470	119.148	30.322	0.605	29.717	14.254	0.0	0.882	3533.	847920.
JUL 2	149.997	120.491	29.506	1.577	27.929	29.177	0.0	0.883	6800.	1632000.
JUL 3	149.585	119.442	30.143	0.760	29.383	17.513	0.0	0.892	4341.	1146024.
S.TOTAL										3625944.
AUG 1	149.399	118.966	30.433	0.524	29.909	12.230	0.0	0.872	3016.	723840.
AUG 2	149.457	119.115	30.342	0.589	29.753	13.881	0.0	0.882	3445.	826800.
AUG 3	149.728	119.805	29.923	0.996	28.927	21.547	0.0	0.895	5275.	1392600.
S.TOTAL										2943240.
SEP 1	149.935	120.333	29.602	1.428	28.174	27.422	0.0	0.890	6503.	1560720.
SEP 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.863	6800.	1632000.
SEP 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
S.TOTAL										4824720.
OCT 1	149.856	120.133	29.723	1.252	28.471	25.190	0.0	0.890	6039.	1449360.
OCT 2	149.993	120.463	29.510	1.568	27.942	29.079	0.0	0.883	6785.	1628400.
OCT 3	149.491	119.202	30.289	0.631	29.658	14.846	0.0	0.882	4673.	[illegible]
S.TOTAL										[illegible]

NUEVA ELA P/S 1982

	H.W.L. (M)	T.W.L. (M)	GROSS.H (M)	LOSSES (M)	F.HEAD (M)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICE.	KW	KWH
NOV 1	149.377	118.910	30.467	0.502	29.965	11.603	0.0	0.872	2867.	688080.
NOV 2	149.735	119.823	29.912	1.010	28.902	21.749	0.0	0.895	5320.	1276800.
NOV 3	149.402	118.974	30.428	0.527	29.901	12.313	0.0	0.872	3036.	728640.
S.TOTAL										2693520.
DEC 1	149.828	120.061	29.767	1.193	28.574	24.394	0.0	0.895	5900.	1416000.
DEC 2	149.736	119.826	29.910	1.012	28.898	21.787	0.0	0.895	5329.	1278960.
DEC 3	149.857	120.135	29.722	1.254	28.468	25.222	0.0	0.890	6043.	1595352.
S.TOTAL										4290312.
JAN 1	149.798	119.984	29.814	1.132	28.682	23.545	0.0	0.895	5716.	1371840.
JAN 2	149.924	120.305	29.619	1.402	28.217	27.106	0.0	0.890	6437.	1544880.
JAN 3	149.846	120.106	29.740	1.229	28.511	24.892	0.0	0.895	6007.	1585848.
S.TOTAL										4502568.
FEB 1	149.560	119.376	30.184	0.722	29.462	16.780	0.0	0.889	4156.	997440.
FEB 2	149.430	119.046	30.384	0.558	29.826	13.112	0.0	0.882	3262.	782880.
FEB 3	149.456	119.112	30.344	0.588	29.756	13.849	0.0	0.882	3437.	2392152.
S.TOTAL										4172472.
MAR 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAR 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAR 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	483648.
S.TOTAL										1363008.
APR 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
APR 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
APR 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
S.TOTAL										1319040.
MAY 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAY 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAY 3	149.355	118.854	30.501	0.481	30.020	10.987	0.0	0.872	2720.	718080.
S.TOTAL										1597440.
JUN 1	149.388	118.938	30.450	0.513	29.937	11.912	0.0	0.872	2941.	705840.
JUN 2	149.411	118.998	30.413	0.537	29.876	12.580	0.0	0.882	3135.	752400.
JUN 3	149.377	118.909	30.468	0.502	29.966	11.598	0.0	0.872	2866.	687840.
S.TOTAL										2146080.
JUL 1	149.295	118.702	30.593	0.429	30.164	9.290	0.0	0.850	2253.	540720.
JUL 2	149.476	119.161	30.315	0.611	29.704	14.398	0.0	0.882	3567.	856080.
JUL 3	149.908	120.266	29.642	1.367	28.275	26.672	0.0	0.890	6348.	1675872.
S.TOTAL										3072672.
AUG 1	149.609	119.501	30.108	0.795	29.313	18.173	0.0	0.892	4494.	1078560.
AUG 2	149.410	118.994	30.416	0.536	29.880	12.538	0.0	0.882	3125.	750000.
AUG 3	149.635	119.568	30.067	0.637	29.230	18.920	0.0	0.892	4665.	1231560.
S.TOTAL										3060120.
SEP 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
SEP 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
SEP 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
S.TOTAL										4896000.
OCT 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
OCT 2	149.891	120.223	29.668	1.329	28.339	26.190	0.0	0.890	6247.	1499280.
OCT 3	149.686	119.699	29.987	0.922	29.065	20.371	0.0	0.895	5011.	1322904.
S.TOTAL										4454184.
TOTAL										37567392.

NUEVA FHA P/S 1963

	H.W.L. (M)	T.W.L. (M)	GROSS.H (M)	LOSSES (M)	F.HEAD (M)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICE.	KW	KWH
NOV 1	149.515	119.263	30.252	0.662	29.590	15.527	0.0	0.889	3863.	927120.
NOV 2	149.812	120.021	29.791	1.161	28.630	23.954	0.0	0.895	5805.	1393200.
NOV 3	149.572	119.408	30.164	0.741	29.423	17.139	0.0	0.889	4240.	1017600.
S.TOTAL										3337920.
DEC 1	149.830	120.066	29.764	1.197	28.567	24.455	0.0	0.895	5913.	1419120.
DEC 2	149.917	120.287	29.630	1.386	28.244	26.909	0.0	0.890	6397.	1535280.
DEC 3	149.999	120.497	29.502	1.563	27.919	29.243	0.0	0.863	6800.	1795200.
S.TOTAL										4749600.
JAN 1	149.895	120.232	29.663	1.337	28.326	26.299	0.0	0.890	6270.	1504800.
JAN 2	149.877	120.187	29.690	1.298	28.392	25.795	0.0	0.890	6164.	1479360.
JAN 3	149.684	119.693	29.991	0.918	29.073	20.302	0.0	0.895	4996.	1318944.
S.TOTAL										4303104.
FEB 1	149.436	119.060	30.376	0.564	29.812	13.268	0.0	0.882	3299.	791760.
FEB 2	149.412	119.000	30.412	0.538	29.874	12.601	0.0	0.882	3140.	753600.
FEB 3	149.342	118.820	30.522	0.469	30.053	10.603	0.0	0.872	2629.	[illegible]
S.TOTAL										3374448.
MAR 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAR 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAR 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	483648.
S.TOTAL										1363008.
APR 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
APR 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
APR 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
S.TOTAL										1319040.
MAY 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAY 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAY 3	149.649	119.604	30.045	0.860	29.185	19.317	0.0	0.892	4756.	1255584.
S.TOTAL										2134944.
JUN 1	149.433	119.053	30.380	0.561	29.819	13.199	0.0	0.882	3283.	787920.
JUN 2	149.490	119.198	30.292	0.629	29.663	14.807	0.0	0.882	3664.	879360.
JUN 3	149.472	119.152	30.320	0.606	29.714	14.290	0.0	0.882	3542.	850080.
S.TOTAL										2517360.
JUL 1	149.435	119.058	30.377	0.563	29.814	13.249	0.0	0.882	3295.	790800.
JUL 2	149.484	119.183	30.301	0.622	29.679	14.642	0.0	0.882	3625.	870000.
JUL 3	149.477	119.166	30.311	0.613	29.698	14.448	0.0	0.882	3579.	944856.
S.TOTAL										2605656.
AUG 1	149.380	118.918	30.462	0.505	29.957	11.691	0.0	0.872	2888.	693120.
AUG 2	149.563	119.386	30.177	0.728	29.449	16.891	0.0	0.889	4182.	1003680.
AUG 3	149.337	118.808	30.529	0.464	30.065	10.471	0.0	0.872	2596.	685344.
S.TOTAL										2382144.
SEP 1	149.671	119.659	30.012	0.896	29.116	19.932	0.0	0.892	4895.	1174800.
SEP 2	149.446	119.086	30.360	0.576	29.784	13.565	0.0	0.882	3370.	808800.
SEP 3	149.721	119.789	29.932	0.985	28.947	21.371	0.0	0.895	5236.	1256640.
S.TOTAL										3240240.
OCT 1	149.572	119.407	30.165	0.740	[illegible]	17.130	0.0	0.889	4238.	1017120.
OCT 2	149.430	119.044	30.386	0.557	29.829	13.095	0.0	0.882	3258.	[illegible]
OCT 3	149.414	119.004	30.410	0.540	[illegible]	[illegible]	0.0	0.882	[illegible]	[illegible]
S.TOTAL										[illegible]

NUEVA ITA P/S 1964

	H.W.L. (M)	T.W.L. (M)	GROSS.H (M)	LOSSES (M)	F.HEAD (M)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICE.	KW	KWH
NOV 1	149.460	119.121	30.339	0.592	29.747	13.946	0.0	0.882	3460.	830400.
NOV 2	149.842	120.097	29.745	1.222	28.523	24.796	0.0	0.895	5986.	1436640.
NOV 3	149.735	119.823	29.912	1.010	28.902	21.750	0.0	0.895	5321.	1277040.
S.TOTAL										3544080.
DEC 1	149.732	119.815	29.917	1.004	28.913	21.664	0.0	0.895	5302.	1272480.
DEC 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
DEC 3	149.686	119.699	29.987	0.922	29.065	20.371	0.0	0.895	5011.	1322904.
S.TOTAL										3035064.
JAN 1	149.901	120.247	29.654	1.351	28.303	26.465	0.0	0.890	6304.	1512960.
JAN 2	149.946	120.362	29.584	1.454	28.130	27.735	0.0	0.883	6515.	1563600.
JAN 3	149.881	120.195	29.686	1.305	28.381	25.884	0.0	0.890	6183.	1632312.
S.TOTAL										4708872.
FEB 1	149.640	119.582	30.059	0.846	29.212	19.076	0.0	0.892	4701.	1128240.
FEB 2	149.324	118.775	30.549	0.453	30.096	10.108	0.0	0.872	2509.	602160.
FEB 3	149.405	118.982	30.423	0.531	29.892	12.402	0.0	0.872	3057.	2127672.
S.TOTAL										3858072.
MAR 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAR 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAR 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	483648.
S.TOTAL										1363008.
APR 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
APR 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
APR 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.900	1832.	439680.
S.TOTAL										1319040.
MAY 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAY 2	149.492	119.204	30.288	0.632	29.656	14.869	0.0	0.882	3678.	882720.
MAY 3	149.344	118.827	30.517	0.471	30.046	10.679	0.0	0.872	2646.	698544.
S.TOTAL										2020944.
JUN 1	149.558	119.370	30.188	0.719	29.469	16.723	0.0	0.889	4143.	994320.
JUN 2	149.650	119.607	30.043	0.862	29.181	19.354	0.0	0.892	4764.	1143360.
JUN 3	149.844	120.101	29.743	1.225	28.518	24.839	0.0	0.895	5995.	1438800.
S.TOTAL										3576480.
JUL 1	149.671	119.660	30.011	0.896	29.115	19.940	0.0	0.892	4897.	1175280.
JUL 2	149.401	118.970	30.431	0.526	29.905	12.277	0.0	0.872	3028.	726720.
JUL 3	149.319	118.761	30.558	0.449	30.109	9.954	0.0	0.850	2409.	635976.
S.TOTAL										2537976.
AUG 1	149.485	119.185	30.300	0.623	29.677	14.663	0.0	0.882	3630.	871200.
AUG 2	149.475	119.160	30.315	0.610	29.705	14.303	0.0	0.882	3564.	855360.
AUG 3	150.000	120.500	29.500	1.585	27.915	29.273	0.306	0.883	6800.	1795200.
S.TOTAL										3521760.
SEP 1	150.000	120.500	29.500	1.585	27.915	29.273	7.944	0.883	6800.	1632000.
SEP 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
SEP 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
S.TOTAL										4896000.
OCT 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
OCT 2	149.839	120.090	29.749	1.216	28.533	24.714	0.0	0.895	5969.	1432560.
OCT 3	149.368	118.886	30.482	0.493	29.989	11.343	0.0	0.872	2805.	740520.
S.TOTAL										3805080.
TOTAL										38186352.

NUEVA ERA P/S 1965

	H.W.L. (M)	T.W.L. (M)	GROSS.H (M)	LOSSES (M)	F.HEAD (M)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICT.	KW	KWH
NOV 1	149.420	119.019	30.401	0.546	29.855	12.315	0.0	0.882	3191.	765840.
NOV 2	150.000	120.500	29.500	1.585	27.915	29.273	10.616	0.883	6800.	1632000.
NOV 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
S.TOTAL										4029840.
DEC 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
DEC 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
DEC 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										5059200.
JAN 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JAN 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JAN 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										5059200.
FEB 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
FEB 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
FEB 3	149.995	120.486	29.509	1.572	27.937	29.122	0.0	0.883	6794.	4728624.
S.TOTAL										7992624.
MAR 1	149.988	120.468	29.520	1.555	27.965	28.921	0.0	0.883	6754.	1620960.
MAR 2	149.986	120.464	29.522	1.550	27.972	28.871	0.0	0.883	6744.	1618560.
MAR 3	149.984	120.458	29.526	1.545	27.981	28.806	0.0	0.883	6731.	1776984.
S.TOTAL										5016504.
APR 1	149.980	120.450	29.530	1.537	27.993	28.713	0.0	0.883	6712.	1610880.
APR 2	149.979	120.447	29.532	1.534	27.998	28.684	0.0	0.883	6706.	1609440.
APR 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
S.TOTAL										4852320.
MAY 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
MAY 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
MAY 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										5059200.
JUN 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JUN 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JUN 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
S.TOTAL										4896000.
JUL 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JUL 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
JUL 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										5059200.
AUG 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
AUG 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
AUG 3	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1795200.
S.TOTAL										5059200.
SEP 1	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
SEP 2	149.845	120.105	29.740	1.229	28.511	24.883	0.0	0.895	6005.	1441200.
SEP 3	149.758	119.883	29.875	1.054	28.821	22.418	0.0	0.895	5469.	1312560.
S.TOTAL										4385760.
OCT 1	149.549	119.349	30.200	0.708	29.492	16.487	0.0	0.889	4066.	[illegible]
OCT 2	149.371	118.894	30.477	0.496	29.981	11.441	0.0	0.872	2826.	678240.
OCT 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	[illegible]	[illegible]
S.TOTAL										[illegible]

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                                      NUEVA ERA P/S        1966

          H.W.L.   T.W.L.   GROSS.H  LOSSES   E.HEAD    T.DIS.   OVER F.  EFFICE.   KW        KWH
           (M)      (M)      (M)      (M)      (M)     (CM/S)    (CM/S)
 NOV 1   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     439680.
 NOV 2   149.514  119.260   30.254   0.660   29.594   15.493    0.0      0.889    3855.     925200.
 NOV 3   149.734  119.820   29.914   1.008   28.906   21.722    0.0      0.895    5314.    1275360.
S.TOTAL                                                                                    2640240.
 DEC 1   149.873  120.175   29.698   1.287   28.411   25.658    0.0      0.890    6135.    1472400.
 DEC 2   149.765  119.900   29.865   1.067   28.798   22.608    0.0      0.895    5511.    1322640.
 DEC 3   149.988  120.470   29.518   1.556   27.962   28.936    0.0      0.883    6757.    1783848.
S.TOTAL                                                                                    4578888.
 JAN 1   149.825  120.053   29.772   1.186   28.586   24.303    0.0      0.895    5880.    1411200.
 JAN 2   149.983  120.456   29.527   1.543   27.984   28.785    0.0      0.883    6726.    1614240.
 JAN 3   149.980  120.449   29.531   1.536   27.995   28.706    0.0      0.883    6711.    1771704.
S.TOTAL                                                                                    4797144.
 FEB 1   149.681  119.686   29.995   0.914   29.081   20.226    0.0      0.895    4978.    1194720.
 FEB 2   149.512  119.255   30.257   0.657   29.600   15.437    0.0      0.889    3842.     922080.
 FEB 3   149.439  119.068   30.371   0.568   29.803   13.360    0.0      0.882    3321.    2311416.
S.TOTAL                                                                                    4428216.
 MAR 1   149.250  118.323   30.927   0.339   30.588    5.080    0.0      0.800    1176.     282240.
 MAR 2   149.250  118.305   30.945   0.336   30.609    4.879    0.0      0.800    1130.     271200.
 MAR 3   149.250  118.305   30.945   0.336   30.609    4.887    0.0      0.800    1132.     298848.
S.TOTAL                                                                                     852288.
 APR 1   149.250  118.307   30.943   0.336   30.607    4.908    0.0      0.800    1136.     272640.
 APR 2   149.250  118.299   30.951   0.335   30.616    4.815    0.0      0.800    1115.     267600.
 APR 3   149.250  118.308   30.942   0.336   30.606    4.915    0.0      0.800    1138.     273120.
S.TOTAL                                                                                     813360.
 MAY 1   149.250  118.492   30.758   0.373   30.385    6.961    0.0      0.800    1600.     384000.
 MAY 2   149.250  118.535   30.715   0.383   30.332    7.442    0.0      0.800    1708.     409920.
 MAY 3   149.330  118.790   30.540   0.458   30.082   10.273    0.0      0.872    2548.     672672.
S.TOTAL                                                                                    1466592.
 JUN 1   149.654  119.618   30.036   0.869   29.167   19.472    0.0      0.892    4791.    1149840.
 JUN 2   149.437  119.063   30.374   0.565   29.809   13.301    0.0      0.892    3307.     793680.
 JUN 3   149.255  118.599   30.656   0.400   30.256    8.150    0.0      0.800    1866.     447840.
S.TOTAL                                                                                    2391360.
 JUL 1   149.302  118.718   30.584   0.435   30.149    9.477    0.0      0.850    2297.     551280.
 JUL 2   149.250  118.560   30.690   0.389   30.301    7.715    0.0      0.800    1769.     424560.
 JUL 3   149.250  118.585   30.665   0.396   30.269    7.995    0.0      0.800    1831.     483384.
S.TOTAL                                                                                    1459224.
 AUG 1   149.423  119.027   30.396   0.550   29.846   12.905    0.0      0.882    3213.     771120.
 AUG 2   149.751  119.864   29.887   1.040   28.847   22.207    0.0      0.895    5422.    1301280.
 AUG 3   149.557  119.369   30.188   0.718   29.470   16.702    0.0      0.889    4138.    1092432.
S.TOTAL                                                                                    3164832.
 SEP 1   149.505  119.236   30.269   0.648   29.621   15.230    0.0      0.889    3793.     910320.
 SEP 2   149.499  119.222   30.277   0.641   29.636   15.072    0.0      0.889    3755.     901200.
 SEP 3   149.312  118.744   30.568   0.443   30.125    9.761    0.0      0.850    2364.     567360.
S.TOTAL                                                                                    2378880.
 OCT 1   149.278  118.657   30.621   0.416   30.205    8.797    0.0      0.800    2010.     482400.
 OCT 2   149.250  118.472   30.778   0.368   30.410    6.739    0.0      0.800    1550.     372000.
 OCT 3   149.250  118.447   30.803   0.363   30.440    6.459    0.0      0.800    1487.     392568.
S.TOTAL                                                                                    1246968.

  TOTAL                                                                                   30217968.
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NUEVA ERA P/S 1967

	H.W.L. (M)	T.W.L. (M)	GROSS.H (M)	LOSSES (M)	F.HEAD (M)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICE.	KW	KWH
NOV 1	149.514	119.259	30.255	0.660	29.595	15.489	0.0	0.889	3854.	924960.
NOV 2	149.417	119.010	30.407	0.543	29.864	12.723	0.0	0.882	3169.	760560.
NOV 3	149.576	119.418	30.158	0.746	29.412	17.247	0.0	0.889	4265.	1023600.
S.TOTAL										2709120.
DEC 1	149.348	118.836	30.512	0.474	30.038	10.783	0.0	0.872	2671.	641040.
DEC 2	149.669	119.654	30.015	0.893	29.122	19.877	0.0	0.892	4833.	1171920.
DEC 3	149.507	119.241	30.266	0.650	29.616	15.286	0.0	0.889	3806.	1004784.
S.TOTAL										2817744.
JAN 1	149.591	119.456	30.135	0.768	29.367	17.668	0.0	0.892	4377.	1050480.
JAN 2	149.590	119.454	30.136	0.767	29.369	17.654	0.0	0.892	4374.	1049760.
JAN 3	149.559	119.375	30.184	0.722	29.462	16.774	0.0	0.889	4155.	1096920.
S.TOTAL										3197160.
FEB 1	149.399	118.965	30.434	0.524	29.910	12.221	0.0	0.872	3014.	723360.
FEB 2	149.352	118.845	30.507	0.478	30.029	10.884	0.0	0.872	2695.	646800.
FEB 3	149.287	118.679	30.608	0.422	30.186	9.036	0.0	0.850	2193.	1526329.
S.TOTAL										2896488.
MAR 1	149.250	118.585	30.665	0.396	30.269	8.010	0.0	0.800	1832.	439680.
MAR 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.900	1832.	439690.
MAR 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	483648.
S.TOTAL										1363008.
APR 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	437690.
APR 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
APR 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
S.TOTAL										1319040.
MAY 1	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAY 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
MAY 3	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	483648.
S.TOTAL										1363008.
JUN 1	149.664	119.643	30.021	0.885	29.136	19.752	0.0	0.892	4855.	1165200.
JUN 2	149.625	119.543	30.082	0.821	29.261	18.640	0.0	0.892	4601.	1104240.
JUN 3	149.935	120.335	29.600	1.429	28.171	27.440	0.0	0.890	6506.	1561440.
S.TOTAL										3830880.
JUL 1	150.000	120.500	29.500	1.585	27.915	29.273	2.158	0.883	6800.	1632000.
JUL 2	149.906	120.259	29.647	1.361	28.286	26.593	0.0	0.890	6331.	1519440.
JUL 3	149.928	120.317	29.611	1.413	28.198	27.239	0.0	0.890	6465.	1706760.
S.TOTAL										4858200.
AUG 1	149.289	118.685	30.604	0.424	30.180	9.107	0.0	0.850	2209.	530160.
AUG 2	149.292	118.693	30.599	0.427	30.172	9.193	0.0	0.850	2230.	535200.
AUG 3	149.318	118.760	30.558	0.448	30.110	9.940	0.0	0.850	2406.	635184.
S.TOTAL										1700544.
SEP 1	149.368	118.888	30.480	0.494	29.986	11.361	0.0	0.872	2809.	674160.
SEP 2	149.278	118.656	30.622	0.416	30.206	8.784	0.0	0.800	2007.	481680.
SEP 3	149.523	119.283	30.240	0.672	29.568	15.753	0.0	0.889	3916.	939840.
S.TOTAL										2095680.
OCT 1	149.817	120.032	29.785	1.169	28.616	24.075	0.0	0.895	5831.	1399440.
OCT 2	150.000	120.500	29.500	1.585	27.915	29.273	0.0	0.883	6800.	1632000.
OCT 3	149.627	119.549	30.078	0.825	29.253	18.706	0.0	0.892	4616.	1218624.
S.TOTAL										4250064.
TOTAL										[illegible]

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                                  NUEVA ERA P/S          1968

            H.W.L.   T.W.L.   GROSS.H  LOSSES   F.HEAD    T.DIS.   OVER F.  EFFICE.    KW       KWH
             (M)      (M)      (M)      (M)      (M)     (CM/S)   (CM/S)
   NOV 1   149.366  118.881   30.485   0.491   29.994   11.283    0.0      0.872    2791.     669840.
   NOV 2   149.606  119.494   30.112   0.791   29.321   18.092    0.0      0.892    4475.    1074000.
   NOV 3   149.759  119.886   29.873   1.056   28.817   22.449    0.0      0.895    5476.    1314240.
  S.TOTAL                                                                                   3058080.
   DEC 1   149.777  119.929   29.848   1.089   28.759   22.934    0.0      0.895    5582.    1339680.
   DEC 2   149.619  119.528   30.091   0.812   29.279   18.474    0.0      0.892    4563.    1095120.
   DEC 3   149.594  119.463   30.131   0.772   29.359   17.747    0.0      0.892    4395.    1160280.
  S.TOTAL                                                                                   3595080.
   JAN 1   149.528  119.296   30.232   0.679   29.553   15.894    0.0      0.889    3949.     947760.
   JAN 2   149.703  119.741   29.962   0.952   29.010   20.844    0.0      0.895    5118.    1228320.
   JAN 3   149.927  120.314   29.613   1.410   28.203   27.208    0.0      0.890    6459.    1705176.
  S.TOTAL                                                                                   3881256.
   FEB 1   149.780  119.939   29.841   1.096   28.745   23.042    0.0      0.895    5606.    1345440.
   FEB 2   149.461  119.123   30.338   0.593   29.745   13.972    0.0      0.882    3466.     831840.
   FEB 3   149.294  118.697   30.597   0.428   30.169    9.245    0.0      0.850    2242.    1560432.
  S.TOTAL                                                                                   3737712.
   MAR 1   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     439680.
   MAR 2   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     439680.
   MAR 3   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     483648.
  S.TOTAL                                                                                   1363008.
   APR 1   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     439680.
   APR 2   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     439680.
   APR 3   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     439680.
  S.TOTAL                                                                                   1319040.
   MAY 1   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     439680.
   MAY 2   149.250  118.585   30.665   0.396   30.269    8.000    0.0      0.800    1832.     439680.
   MAY 3   149.298  118.708   30.590   0.432   30.158    9.304    0.0      0.850    2270.     599280.
  S.TOTAL                                                                                   1478640.
   JUN 1   149.485  119.186   30.299   0.623   29.676   14.668    0.0      0.882    3631.     871440.
   JUN 2   149.691  119.711   29.980   0.931   29.049   20.503    0.0      0.895    5041.    1209840.
   JUN 3   149.604  119.490   30.114   0.789   29.325   18.048    0.0      0.892    4465.    1071600.
  S.TOTAL                                                                                   3152880.
   JUL 1   149.387  118.936   30.451   0.512   29.939   11.898    0.0      0.872    2938.     705120.
   JUL 2   149.470  119.148   30.322   0.605   29.717   14.253    0.0      0.882    3533.     847920.
   JUL 3   149.687  119.701   29.986   0.924   29.062   20.391    0.0      0.895    5016.    1324224.
  S.TOTAL                                                                                   2877264.
   AUG 1   149.440  119.070   30.370   0.569   29.801   13.305    0.0      0.882    3327.     798480.
   AUG 2   149.435  119.058   30.377   0.564   29.813   13.256    0.0      0.882    3296.     791040.
   AUG 3   149.462  119.126   30.336   0.594   29.742   14.010    0.0      0.882    3476.     917664.
  S.TOTAL                                                                                   2507184.
   SEP 1   149.504  119.234   30.270   0.647   29.623   15.209    0.0      0.889    3788.     909120.
   SEP 2   149.305  118.727   30.578   0.437   30.141    9.574    0.0      0.850    2320.     556800.
   SEP 3   150.000  120.500   29.500   1.585   27.915   29.273    0.0      0.883    6800.    1632000.
  S.TOTAL                                                                                   3097920.
   OCT 1   150.000  120.500   29.500   1.585   27.915   29.273    3.359    0.883    6800.    1632000.
   OCT 2   149.737  119.829   29.908   1.014   28.894   21.817    0.0      0.895    5336.    1280640.
   OCT 3   149.419  119.016   30.403   0.545   29.858   12.786    0.0      0.882    3184.     840576.
  S.TOTAL                                                                                   3753216.

    TOTAL                                                                                  33921280.
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NUEVA ERA P/S 1969

	H.W.L. (M)	T.W.L. (M)	GROSS.H (M)	LOSSES (M)	E.HEAD (M)	T.DIS. (CM/S)	OVER F. (CM/S)	EFFICE.	KW	KWH
NOV 1	149.674	119.667	30.007	0.901	29.106	20.017	0.0	0.895	4931.	1183440.
NOV 2	149.975	120.435	29.540	1.523	28.017	28.551	0.0	0.883	6680.	1603200.
NOV 3	149.876	120.184	29.692	1.296	28.396	25.764	0.0	0.890	6158.	1477920.
S.TOTAL										4264560.
DEC 1	149.905	120.257	29.648	1.359	28.289	26.572	0.0	0.890	6327.	1518480.
DEC 2	149.944	120.357	29.587	1.450	28.137	27.689	0.0	0.883	6506.	1561440.
DEC 3	149.732	119.816	29.916	1.005	28.911	21.673	0.0	0.895	5303.	1399992.
S.TOTAL										4479912.
JAN 1	149.907	120.263	29.644	1.364	28.280	26.636	0.0	0.890	6340.	1521600.
JAN 2	149.775	119.927	29.848	1.087	28.761	22.901	0.0	0.895	5575.	1338000.
JAN 3	149.939	120.345	29.594	1.439	28.155	27.552	0.0	0.883	6478.	1710192.
S.TOTAL										4569792.
FEB 1	149.570	119.402	30.168	0.737	29.431	17.078	0.0	0.889	4226.	1014240.
FEB 2	149.451	119.099	30.352	0.582	29.770	13.705	0.0	0.862	3403.	816720.
FEB 3	149.440	119.070	30.370	0.569	29.801	13.385	0.0	0.882	3327.	2315592.
S.TOTAL										4146552.
MAR 1	149.250	118.355	30.895	0.344	30.551	5.441	0.0	0.800	1258.	301920.
MAR 2	149.250	118.316	30.934	0.338	30.596	5.001	0.0	0.800	1158.	277920.
MAR 3	149.250	118.319	30.931	0.338	30.593	5.045	0.0	0.800	1168.	308352.
S.TOTAL										888192.
APR 1	149.250	118.321	30.929	0.338	30.591	5.066	0.0	0.800	1172.	281280.
APR 2	149.250	118.319	30.931	0.338	30.593	5.045	0.0	0.800	1168.	280320.
APR 3	149.250	118.325	30.925	0.339	30.586	5.102	0.0	0.800	1181.	283440.
S.TOTAL										845040.
MAY 1	149.250	118.380	30.870	0.349	30.521	5.712	0.0	0.800	1319.	316560.
MAY 2	149.250	118.375	30.875	0.348	30.527	5.662	0.0	0.800	1308.	313920.
MAY 3	149.250	118.463	30.787	0.366	30.421	6.638	0.0	0.800	1528.	403392.
S.TOTAL										1033872.
JUN 1	149.343	118.824	30.519	0.470	30.049	10.648	0.0	0.872	2639.	633360.
JUN 2	149.307	118.730	30.577	0.438	30.139	9.603	0.0	0.850	2326.	558240.
JUN 3	149.636	119.570	30.066	0.838	29.228	18.945	0.0	0.892	4671.	1121040.
S.TOTAL										2312640.
JUL 1	149.280	118.663	30.617	0.418	30.199	8.863	0.0	0.800	2025.	486000.
JUL 2	149.250	118.502	30.748	0.375	30.373	7.069	0.0	0.800	1624.	389760.
JUL 3	149.675	119.670	30.005	0.903	29.102	20.047	0.0	0.895	4938.	1303632.
S.TOTAL										2179392.
AUG 1	149.296	118.704	30.592	0.430	30.162	9.316	0.0	0.850	2259.	542160.
AUG 2	149.250	118.585	30.665	0.396	30.269	8.000	0.0	0.800	1832.	439680.
AUG 3	150.000	120.500	29.500	1.585	27.915	29.273	1.357	0.893	6800.	1795200.
S.TOTAL										2777040.
SEP 1	149.389	118.941	30.443	0.514	29.934	11.953	0.0	0.872	2951.	708240.
SEP 2	149.615	119.517	30.098	0.805	29.293	18.346	0.0	0.892	4533.	1087920.
SEP 3	149.425	119.031	30.394	0.552	29.842	12.955	0.0	0.882	3225.	774000.
S.TOTAL										2570160.
OCT 1	149.788	119.958	29.830	1.111	28.719	23.253	0.0	0.895	5652.	1356480.
OCT 2	149.592	119.458	30.134	0.770	29.364	17.632	0.0	0.892	4382.	1051680.
OCT 3	149.345	118.827	30.518	0.471	30.047	[illegible]	0.0	0.882	2647.	[illegible]
S.TOTAL										[illegible]
TOTAL										[illegible]

Marketability Forecast of the Selected Major Crops

1. Method of Forecasing

Paddy rice, garlic and mungbean together with virginia tobacco and cotton have been selected as the major crops in the Project. In order to analyze their demand-supply balance at the three levels of the whole country, Ilocos region and Ilocos Norte province during the period of 1975 to 1979, the demand of these crops has been estimated base on the NEDA data on the projected population and food consumption per capita whereas the supply capacity estimation has been made based on the production data of BAEcon and the other government agencies.

The data of the projected population applied in forecasting are shown below;

Projected Population

(Unit: '000)

Year	Whole Country	Ilocos Region	Ilocos Norte Province
1975	42,517	3,310	371
1976	43,841	3,374	380
1977	45,165	3,438	389
1978	45,500	3,499	397
1979	46,700	3,565	405
1980	49,137	3,631	414
1990	65,041	4,445	497

Source: Population Dimension of Planning, NEDA, 1975
(Medium Assumption)

To compute the demand of the selected major crops in from 1975 to 1979 and 1990, the food consumption per capita shown in the following table has been applied in the computation.

Consumption per Capita

Crop	Philippines 1975-1979 1/	Philippines I.Q.E. 2/	Philippines 1990 3/	Ilocos Region 1975-1979 1/	Ilocos Region I.Q.E. 2/	Ilocos Region 1990 3/
Rice & rice product	106.1kg	0.13%	112.9kg	133.8kg	0.02%	135.1kg
Garlic	0.4	0.48	6.5	0.3	0.23	0.4
Mungbean	1.3	0.48	1.6	1.8	0.34	2.1

Note: 1/ The data on the consumption per capita for the year from 1974 to 1976 in "the Regional Consumption Pattern for Major Foods" prepared by DA in 1976.

2/ Income-quantity elasticity in the report mentioned in 1/

3/ Forecast from the assumed income increase rate at 50% from 1974-1976 to 1990, applysing the above-mentioned I.Q.E.

B. Forecast of Marketability

1. Rice

The Philippines was an importer of rice for a long time although some surplus of rice was recorded in 1979 (See Table 4C-1) It is presumed that the average rice consumption per capita will continuously increase in future, too, juding from the small average consumption per capita at present as well as from the fact that reportedly about 20 percent of the total popultaion lives on corn.

The Five-year Development Plan of the Government indicates that the total demand for rice in the year 1990 will increase to 140 percent of that as of 1978. This estimate has been made based on such a small consumption per capita as about 95 kg. Therefore, it is well anticipated that the actual demand for paddy rice will be more than the above-estimated in 1990.

In 1979 rice equivalent to 20 percent of the total demand in Ilocos region was short. The demand for rice in the region as of 1990 is forecast at 604 thousand tons. To meet the above-mentioned demand, the yield per unit area of paddy should increase to 3.1 ton/ha if the paddy cropping area is not expanded. In fact, the paddy cropping area in the region has not been expanded these 10 years:

Table 4C-1. Projected Balance on Demand and Supply, Rice

(Unit:thousand ton)

Item		Actual					Forecasted
		1975	1976	1977	1978	1979	1990
Philippines	Supply (Paddy)	5,660.0	6,159.5	6,456.1	6,894.9	7,199.0	-
	(Rice)	3,396.0	3,695.7	3,873.7	4,136.9	4,319.4	*7,329
	Demand (Rice)	4,506.0	4,647.0	4,787.0	4,140.0	4,260.0	*5,766
	Balance (Rice)	(-)1,110.0	(-)951.0	(-)913.0	(-)3.0	59.0	*1,563
Region I	Supply (Paddy)	422.0	577.5	511.0	575.8	638:7	-
	(Rice)	253.2	346.5	306.6	345.5	383.2	-
	Demand (Rice)	443.5	452.1	460.7	468.9	477.7	596
	Balance (Rice)	(-)190.3	(-)105.6	(-)154.1	(-)123.4	(-)94.5	-
Ilocos Norte	Supply (Paddy)	50.9	72.4	83.6	83.3	92.4	-
	(Rice)	30.5	43.4	50.2	50.0	55.4	-
	Demand (Rice)	49.7	50.9	52.1	53.2	54.3	67
	Balance (Rice)	(-) 19.2	(-) 7.5	(-) 1.9	(-) 3.2	(-) 1.1	-

Source; Supply ---- BAEcon
* --------- Five-year Philippine Development Plan (1978-1982)
Note: Conversion rate from paddy to rice : 60%

On the countrary, it is the tendency that the paddy cropping area is decreasing in the region recently. It might be difficult to increase in a short time the present yield per unit area to the above-mentioned 3.1 ton/ha. Under the situations, Ilocos region will remain as one of the rice digicit area in the year of 1990.

Ilocos Norte province recorded some surplus production of rice in 1979, however, the production trend indicates that the production in the ptovince has a great yearly variation.

The demand for rice in the province as of 1990 has been forecast at 67 thousand tons. To meet the forecast demand plus the buffer stock equivalent to 15 percent of this forecast demand, the target production of rice in 1990 should be set up at 77 thousand tons, which is converted to the unhulled rice of 130 thousand tons. This volume of unhulled rice is equivalent to 150% of the averaged production in the province during the three year-period from 1977 to 1979. (The difference between the forecasted demand for the year of 1990 and the said present production is some 44 thousand tons.)

At least an area of about 10 thousand hectares of paddy harvesting area would be newly developed under on-going irrigation projects inclusive this Project. Under the situations, the above-mentioned target could be easily achieved if the yield per unit area slightly increases.

2. Virginia Tobacco

PVTA data shows that the average production of virginia tobacco at the whole country level was about 42 thousand tons during 1975 to 1978. Out of this production, about 10 thousand tons were exported as one of the major export goods obtaining foreign currencies. In the Five-year Development Plan of the Government the annual increase rate of virginia tobacco production is projected at 2.4 percent during 1978 to 1987.

Ilocos region and Ilocos Norte province produced virginia tobacco equivalent to 94% and 10% of the national production in 1977, respectively. The Presidential Degree on the zonificaion of virginia tobacco production area suggests that the cropping area of virginia tobacco will be continueously concentrated to Ilocos region.

The virginia tobacco production in the Project Area could increase at least up to 130 percent of the total production as of 1978 if 2.4 percent of annual increase rate is applied.

3. Garlic

The BAEcon data indicate that the garlic production in Ilocos Region maintained its share of more than 75 percent of the total production in the whole country for the past ten years from 1970 to 1979. Garlic production area in the region concentrates in the Project Area and its neighborhood.

At the national level, the domestic demand of garlic in each of the last five years appears larger than the supply capacity as shown in the following table.

Table 4C-2 Demand and Supply Balance, Garlic

(Unit:thousand ton)

Item		Actual					Forecasted
		1975	1976	1977	1978	1979	1990
Philippines	Supply	16.0	15.2	16.0	16.8	14.0	
	Demand	17.0	17.5	18.1	18.2	18.7	32.0
	Balance	(-)1.0	(-)2.3	(-)2.1	(-)1.4	(-)4.7	
Region I	Supply	11.8	11.9	12.4	13.6	9.6	
	Demand	1.0	1.0	1.0	1.0	1.1	1.8
	Balance	10.8	10.9	11.4	12.6	8.5	
Ilocos Norte	Supply	9.9	10.0	10.5	11.5	7.4	
	Demand	0.1	0.1	0.1	0.1	0.1	0.2
	Balance	9.8	9.9	10.4	11.4	7.3	

Source: Supply----BAEcon

However, the "Garlic Projection and Marketing, Ilocos Region" prepared by DA in 1978 suggests that the Philippines has been an exporter of garlic these years, specially in 1978. A considerably large amount of demand than the supply capacity as previously described may be derived from the underestimate of the garlic production in the production data.

The demand of garlic at national level for the year of 1990 is forecast as much as 32 thousand tons, which corresponds to about 176 percent of the total demand in 1978. The production target in the Project Area for the year 1990 could be set up at 176 percent of the total production in 1978 since the marketing share of garlic in the Project Area will be easily maintained, at least, at present level.

4. Mungbean

A marked increase of mungbean production in the whole country has been registered since 1973 according to the BAEcon production data. The production share of mungbean in Ilocos region was expanded to a great extent from seven percent in 1973 to 45 percent in 1977 due to the increase of harvested area by five times. This sharp increase in mungbean production of the region made almost 100 percent contribution to the nation-wide increase of this crop during the said period.

The mungbean production data in the Ilocos Norte province also show a moderately large increase in production and harvested area as well since 1973. The harvested area was expanded in 1979 to 1.9 times of that in 1973 whereas the production in 1979 increased only to 1.4 times of that in 1973. That is, the increse of production per unit area is not observed during the period.

As seen in the following table 4C-3 , a tremendous amount of deficit is found in the demant-supply balance of mungbean at the national level.

Table 4C-3 Demand and Supply Balance, Mungbean

(Unit:thousand ton)

Item		Actual					Forecasted
		1975	1976	1977	1978	1979	1990
Philippines	Supply	21.7	24.4	25.3	26.2	29.0	
	Demand	55.3	57.0	58.7	59.2	60.7	104.1
	Balance	(-)33.6	(-)32.6	(-)33.4	(-)33.0	(-)31.7	
Region I	Supply	6.0	10.8	11.3	N.A.	N.A.	
	Demand	6.0	6.1	6.2	6.3	6.4	9.3
	Balance	0.0	4.7	5.1	N.A.	N.A.	
Ilocos Norte	Supply	0.8	0.9	0.9	1.0	1.0	
	Demand	0.7	0.7	0.7	0.7	0.7	1.0
	Balance	0.1	0.2	0.2	0.3	0.3	

Source; Supply --- BAEcon

The "Commodity Situation Report, Mungbean" prepared by BAEcon in 1979 indicates that the Philippines'imported mungbean of about 9 thousand tons during the 10 years from 1967 to 1976 whereas the country exported the product of less than one thousand tons during the same period. The report recommends to export mungbean since it is free from tariff duties.

The production target to meet the forecast demand in the year 1990 at the national level should be set up so much as 3.9 times of the total production in 1978. In this connection, the production in the Project Area could be at least as much as to 3.9 times of the production in 1978.

5. Cotton

Philippine Cotton Cooperation (PCC) is responsible for the development of cotton production in this country. The "National Cotton Production Development Program, 1979 to 1987" prepared by this organization aims to attain the self-sufficiency of cotton by 1987. The target production for this purpose is 138 thousand tons. The said program also suggests that some 146 thousand hectares are identified as potential cotton production area, of which 32 thousand hectares (22 per cent of the total) and 4 thousand hectares (two %) belong to Ilocos region and Ilocos Norte province, respectively. For the identified area in Ilocos Norte, three thousand hectares are assumed to be located in paddy fields. Then, the potential cotton area in the Ptoject Area is estimated at 1.3 thousand hectares based on the proportion of paddy field area in the Project Area to the total paddy field area in Ilocos Norte province.

Table 4C-4. Cropping Area by Cropping Pattern, Sub-project Area
(With Project, In Future)

(Unit:ha)

Cropping Pattern (Wet Season + Dry Season)	Cura	Nueve Era	Sub-total	Madupayas	Batac-Paoay	Pinili	Badoc-Sinait	Sub-total	Total
1 Paddy + Paddy	1,270	600	1,870	60	2,130	80	830	3,100	4,970
2 Paddy + Upland Crops									
(1) Paddy + Tobacco	40	30	70	80	1,150	280	550	2,060	2,130
(2) Paddy + Garlic	100	40	140	-	700	450	915	2,065	2,205
(3) Paddy + Garlic + Mungbeans	-	-	-	-	700	450	915	2,605	2,065
(4) Paddy + Cotton	-	-	-	20	510	140	360	1,030	1,030
(Sub-total)	(140)	(70)	(210)	(100)	(3,060)	(1,320)	(2,740)	(7,220)	(7,430)
Total (Physical Area)	1,410	670	2,080	160	5,190	1,400	3,570	10,320	12,400
(Cropping Area)	2,820	1,340	4,160	320	11,080	3,250	8,055	23,245	26,865
Cropping Intensity (%)	200	200	200	200	213	232	226	225	217

Result of Field Survey on Farmers' Intension for Improvement of Farm Management

A. Purpose and Method of the Survey

The prupose of the survey is to know the needs of irrigation project for farm management in the Project Area and the field survey by interviewing some 70 sample farmers was made with prepared questionary in the Project Area, exclusive of Cura and Nueva Era Sub-project Areas from 18th to 28th, January, 1980.

The selected sample Barangays and sample farmers were, as a general rule, the same as those of the Farm Management Survey conducted by NIA in 1978. But some interviewees were unavoidably different from there of the NIA survey. The sample Barangays and number of farmers by Barangays are listed as follows;

Sample Barangays and Nos. of Sample Farmers

No.	Municipality	Barangay	Nos. of Sample Farmers
1	Batac	San Pedro	9
2	Paoay	Cabaguan	7
3	Paoay	San Roque	5
4	Paoay	Sideg	3
5	Paoay	Bacsil	3
6	Pinili	Dart	5
7	Pinili	Puritac	6
8	Pinili	Tartarabang	9
9	Badoc	Ar-arusip (A)	6
10	Sinait	Battog	4
11	Sinait	Duy-yayat	7
12	Sinait	Barikir	6
Total			70

3. Result of Survey

Farmers' responses to each question in the questionary are tabulated in Table 4C-5. Based on the Table 4C-5, farmers' intention for the improvement of their farm management and also the necessity of irrigation project are summarized as follows;

1. Outline of Farm Management of Sample Farmers

Average farm size per farm household is 1.2 hectares, including 1.1 hectares of paddy field and 0.1 hectare of upland field. Out of 1.1 hectares os paddy field, 0.2 hectares are irrigated by Communal Irrigation Systems and the remaining 0.9 hectares are rainfed. As for land tenure of the cultivated land, each half of 1.2 hectares is owned and tenanted.

The average cropping area by crops per farm household in this survey are as follows;

Cropping Area by Crop per Farm Household

Crop	Area (ha)	Percentage (%)
Paddy (Wet season)	1.1	52.4
Tobacco	0.3	14.3
Garlic	0.4	19.0
Mungo	0.1	4.8
Corn	0.1	4.8
Others	0.1	4.7
Total	2.1	100.0

The main cropping pattern by each sample farmer is shown as follows;

Main Cropping Pattern of Sample Farmers

	Cropping Pattern	Nos. of Farmers	Percentage (%)
1.	Paddy (P) only	3	4.3
2.	P + Tobacco (T)	3	4.3
3.	P + Garlic (G)	13	18.6
4.	P + Corn (C)	1	1.4
5.	P + T / G	17	24.4
6.	P + T / G	1	1.4
7.	P + T / Mung Bean (M)	1	1.4
8.	P + G / M	4	5.7
9.	P + G / O	1	1.4
10.	P + G / C	3	4.3
11.	P + M / C	1	1.4
12.	P + T / G / M	1	1.4
13.	P + T / G / C	9	12.9
14.	P + T / G / O	3	4.3
15.	P + T / M / C	1	1.4
16.	P + G / M / C	1	1.4
17.	P + T / G / C / O	6	8.6
18.	P + T / G / M / C / O	1	1.4
	Total	70	100.0

2. Major Source of Family Income in Future

All of sample farmers responded that they would continue their present farm management in future as well and the major source of their family income would come from their farm mamangement.

3. Present Irrigation Condition

Seventy-seven percent of interviewees can not have enough irrigation water, especially during the dry season.

[illegible]. Flooding Damages in Past Five Years

Sixty percent of sample farmers have been suffered from flood damages two or three times on an average within past five years. Among the flood damages, the biggest damage experienced was such damage as scale of 0.3 hectares in the area with 1.7 meters flood depth and 3.3 days in duration.

[illegible]. Main Cropping Pattern in Future

Seventy-eight percent of sample farmers chose the cropping pattern of three croppings a year, for example, "Paddy + Garlic + Mung Bean", as the main cropping if they can have enough irrigation water throughout the year.

On the other hand, thirty two percent of sample farmers responded that they would choose such cropping pattern as "Paddy + Paddy" or "Paddy + Tobacco or Garlic + Paddy", both of which have two croppings of paddy. It may be one of the reason why so many farmers as thirty two percent of interviewees desire to plant paddy twice a year that these farmers want to increase rice production because their rice production is limitted under small farm size at present.

Table 4C-5. Farmers' Response to Questionary

Main Item	Sub-Item			Unit	Total	Per Farm Household
I. General Information on Their Farm Management	I-1. Cultivated area:	- Paddy land,	Owned	ha	36.6	0.5
			Tenanted	ha	43.5	0.6
		- Upland,	Owned	ha	6.6	0.1
			Tenanted	ha	3.4	0.0
	I-2. Irrigated area by: Communal irri.systems	- Wet season		ha	12.6	0.2
		- Dry season		ha	-	-
	I-3. Irrigated area by: Pumps	- Wet season		ha	-	-
		- Dry season		ha	51.8	0.7
	I-4. Planted area by: crop	- Paddy, Wet		ha	80.1	1.1
		- Paddy, Dry		ha	-	-
		- Tobacco		ha	19.4	0.3
		- Garlic		ha	29.0	0.4
		- Mungo		ha	4.8	0.1
		- Corn		ha	11.1	0.1
		- Others		ha	2.5	0.1
		Total		ha	146.9	2.1
	I-5. Nos. of family members				420	6.0
	I-6. Nos. of farm lavor within family				200	2.9

(Cont'd)

Table [illegible] Farmers' Response to the [illegible] (Cont'd)

Main Item	Sub-Item			Unit	Total	Percent
II. Source of Farmily Income in Future	II-1.	To continue farm management in future ;	- Farm income only		68	97
			- Farm income + Others		2	3
			- Others/No r-sonse		0	0
	II-2.	To stop farm management in future			0	0
	II-3.	No response/other reply			0	0
III. Present Irrigation Condition (Availability of Irrigation Water)	III-1.	Sufficient			16	23
	III-2.	Deficient ;	- In both wet & dry season		6	9
			- In wet season only		0	0
			- In dry season only		48	68
	III-3.	No response/other reply			0	0
IV. Flooding Damages in Past Five Years	IV-1.	Not suffered ;			28	40
	IV-2.	Suffered ;			42	60
			- Nos. of times	time	2 - 3	
			- Damaged area (biggest flood)	ha	0.3	
			- Flood depth (biggest flood)	m	1.7	
			- Flood duration (biggest flood)	day	3.3	

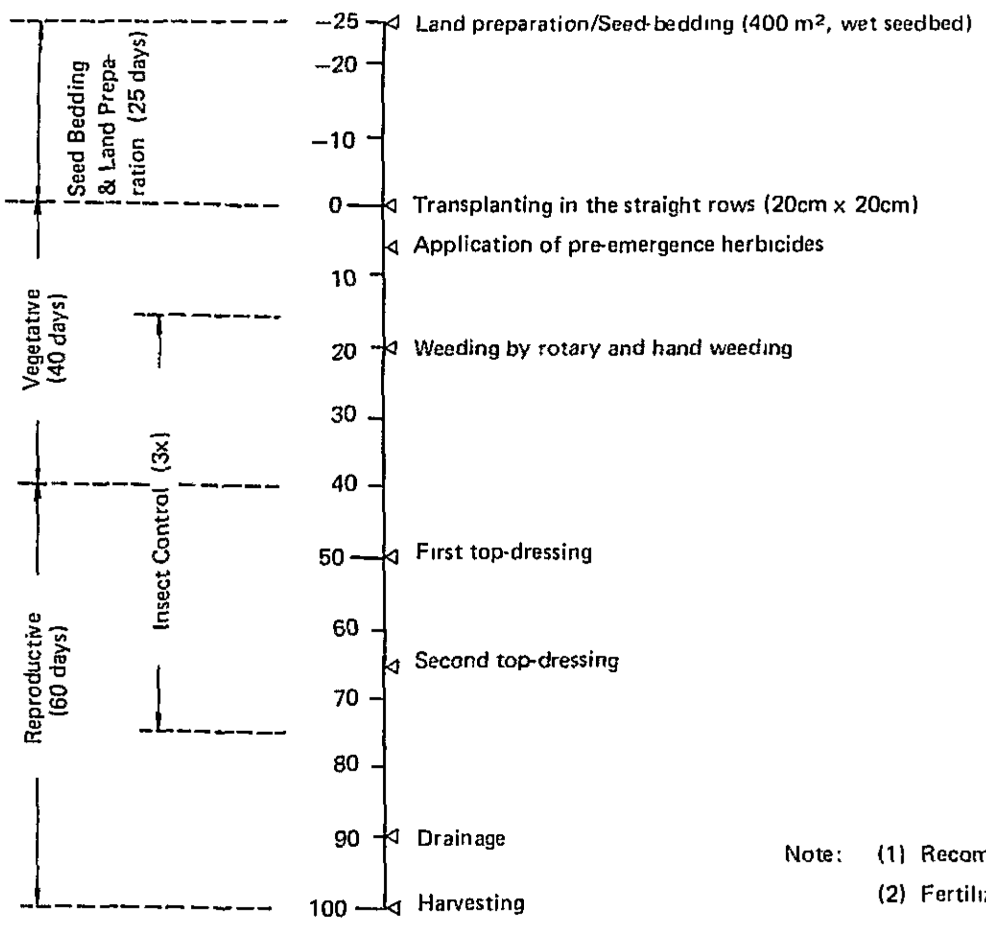
(Cont'd)

Table 4C-5. Farmers' Response to Questionary (Cont'd)

Main Item	Sub-Item	Unit	Total	Percent
V. Main Cropping Pattern in Futre (In case of Full Irrigation	V-1. One cropping a year;		0	0
	V-2. Two cropping a year; - Paddy + Paddy (P)		8	11
	- Paddy + Garlic (G)		5	8
	- Paddy + Tobacco(T)		0	0
	- Paddy + Other diversified crops		2	3
	V-3. Three cropping a year; - P + T/G + P		15	21
	- P + T/G + Corn/Others		18	26
	- P + T/G + Mungo (M)		15	21
	- Others (Ex. P+P+M)		7	10
VI. Needs of Agricultural Development Project	VI-1. Construction/improvement of irrigation facilities	%	70	100
	VI-2. Construction of drainage facilities	%	70	100
	VI-3. Construction/improvement of farm roads	%	70	100
	VI-4. Strengthening of extension activities	%	70	100
	VI-5. Expansion of farm credits such as M-99	%	70	100
	VI-6. Land exchange for grouping dispersed parcels	%	70	100

FIGURE 4C - 1 FARM PRACTICES AND FARM INPUTS, PADDY RICE

Growth Stage | Farm Practices | Farm Inputs per Hectare



Seeds, 50 kg

Fertilizer for seedbeds;
14 - 14 - 14, 10 kg

Insecticide for seedbeds; e.g.
Azodrin 20.2% EC, 0.12 qts

Basal fertilizer;
16 - 20 - 0, 150 kg

Insecticide for treatment of
Seedings; e.g. Furadan 22%
Flowable, 0.75 qts

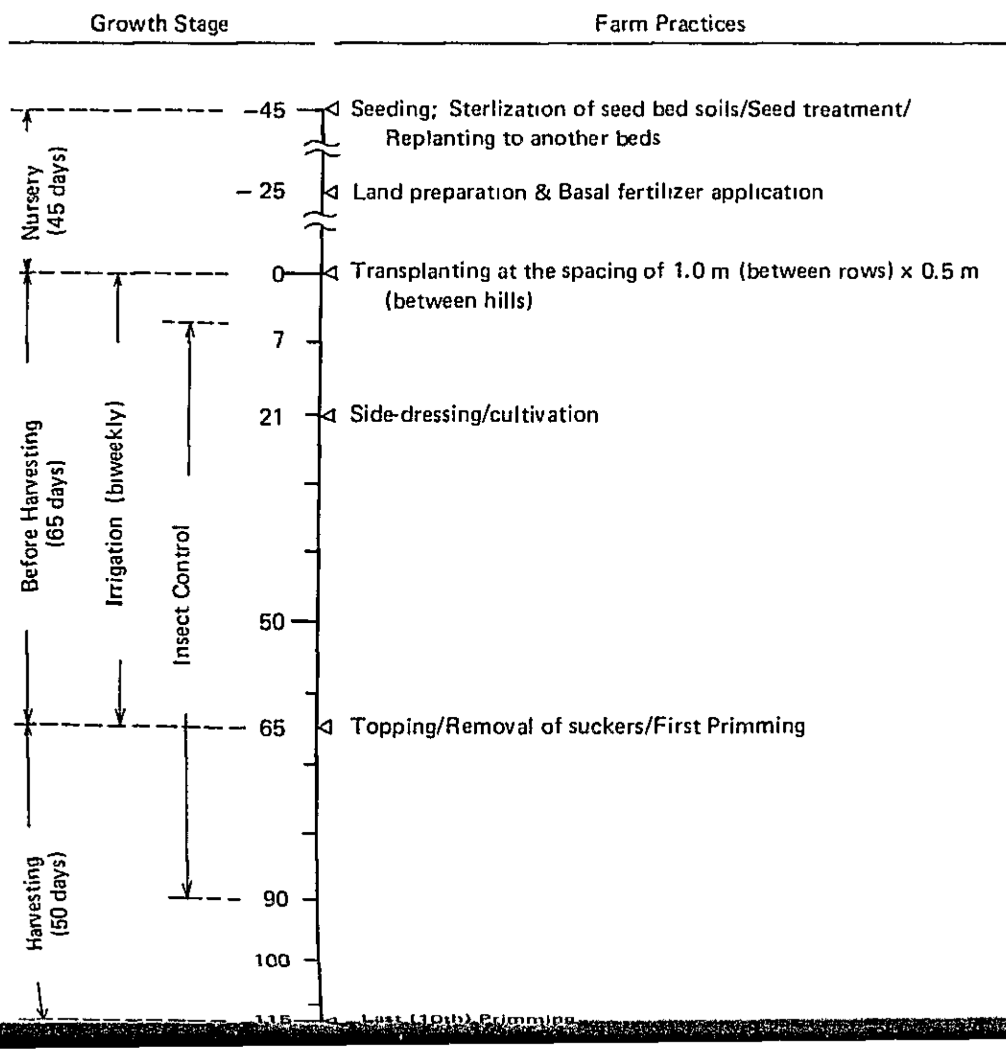
Herbicides (Ex.); e.g. Hednal 40%
EC 2.0 qts.

Insecticides; e.g.
- Hopcin 50% EC, 1.25 qts (2x)
- Hytox 50% WP, 1.5 kg (1x)

Fertilizer for top-dressing;
- First; Urea, 35 kg (Wet)
45 kg (Dry)
- Second; Ammosul, 75 kg (Wet)
45 kg (Dry)

Note: (1) Recommended varieties; IR - 36, 38, 40 & 42
(2) Fertilizer requirement; 50 - 30 - 0 (Wet)
65 - 30 - 0 (Dry)

FIGURE 4C - 2. FARM PRACTICES AND FARM INPUTS, VIRGINIA TOBACCO



-45 Seeding; Sterlization of seed bed soils/Seed treatment/ Replanting to another beds

− 25 Land preparation & Basal fertilizer application

0 Transplanting at the spacing of 1.0 m (between rows) x 0.5 m (between hills)

21 Side-dressing/cultivation

65 Topping/Removal of suckers/First Primming

115 Last (10th) Primming

Farm Inputs per Hectare

Seeds; 30 g

Basal fertilizer;
- 6 - 9 - 15, 200 kg
- 16 - 20 - 0, 50 kg

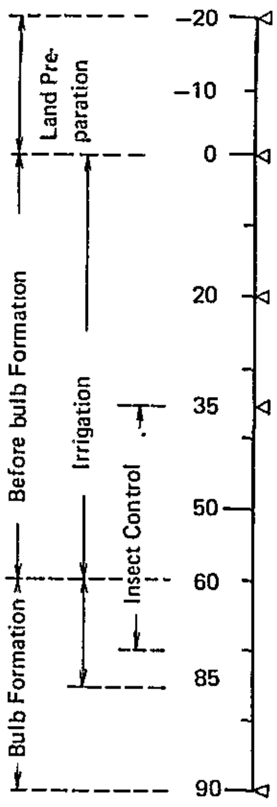
Insecticides; e.g.
- Orthen-Dibron WP, 3kg (4x)
- Lannate WP, 3 kg (4x)

Fertilizer for side-dressing;
- 6 - 9 - 15, 200 kg
- 16 - 20 - 0, 50 kg

Note:
(1) Recommended varieties,
MRC, Cocker 319, Cocker 258 & Cocker 254
(2) Soil requirement;
Loam to clay loam (PH 5.5 – 7.0)
(3) Fertilizer requirement;
40 - 50 - 35 (N - P - K)

FIGURE 4C - 3 FARM PRACTICES AND FARM INPUTS, GARLIC

Growth Period



Farm Practices

- Land preparation/Basal fertilizer application, Mulching
- Seeding at the space of 25cm x 25cm
- Start of irrigation
- Weeding
- Harvesting

Farm Inputs per Hectare

Fertilizer:
- 46 - 0 - 0, 50 kg
- 0 - 0 - 60, 55 kg
- 16 - 20 - 0, 325 kg

Seeds; 420 kg (25,000 bulbs)

Insecticides; e.g.
- Lannate EC, 1 qts (1x)
- Malathion EC, 2 qts (2x)

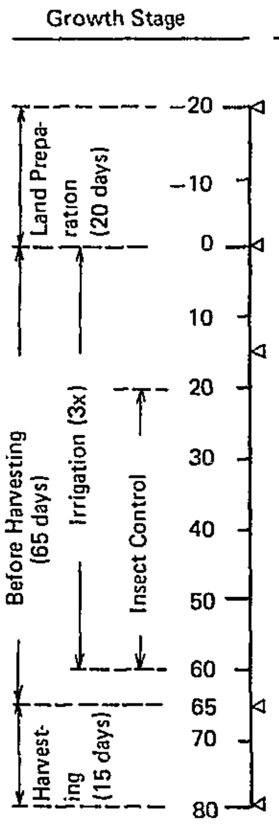
Note:

(1) Recommended varieties,
Ilocos White

(2) Soil requirement;
Clay loam to silty loam
(PH: 5.5 – 7.0)

(3) Fertilizer requirement
75 - 65 - 35 (N - P - K)

FIGURE 4C - 4. FARM PRACTICES AND FARM INPUTS, MUNGBEAN



Farm Practices	Farm Input per Hectare
Land preparation/Basal fertilizer application	Basal fertilizer; - 14 - 14 - 14, 150 kg
Drilling inoculated seeds at the spacing of 50 cm between rows	Seeds; 25 kg
Thinning/Off-baring, Hilling-up/Weeding	Insecticides; e.g. - Thiodam 35%, EC, 3 qts. (3x) - Furadam 3G, 16 kg
First Harvest	
Last Harvest	

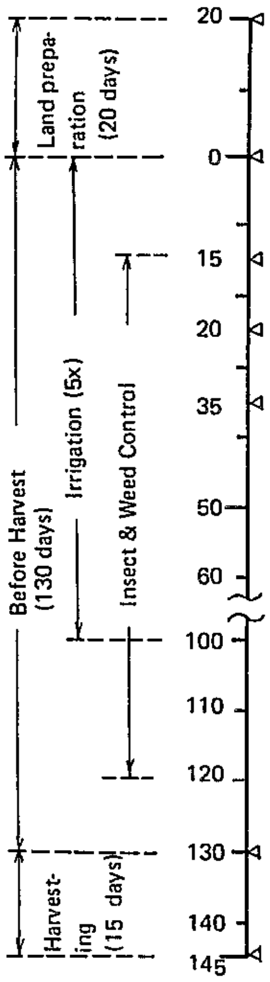
Note;

(1) Recommended varieties;
CES 55, Pagasa, MG55
(Blabrous)

(2) Soil requirement;
Clay loam to silty loam
(PH 5 8 – 6.5)

(3) Fertilizer requirement;
20 - 20 - 20 (N - P - K)

FIGURE 4C 5. FARM PRACTICES AND FARM INPUTS, COTTON



Growth Stage	Farm Practices
20	Land preparation/Basal fertilizer application
0	Sowing three to four seeds at the spacing of 1.00 m (major rows) x 0.75m (minor rows)
15	Start of insect control/cultivating & spot weeding
20	Off-baring
35	Side-dressing/Hilling-up
50	
60	
100	
110	
120	
130	First Harvesting (Three to four days - interval, four times)
140	
145	Last Harvesting

Farm Input per Hectare

Basal fertilizer,
- 14 - 14 - 14, 200 kg
- 46 - 0 - 0, 50 kg

Seeds; 25 kg

Pesticides for seed treatment;
e.g.; orthocide 50% WP, 0.75kg

Insecticides; e.g
- Thiodan 35%, EC, 6 qts (4x)
- Metasystoc 25% EC, 4 qys (3x)
- Kafil, WP, 5kg (3x)

Note;

(1) Recommended varieties; Deltapine 16

(2) Soil requirement; clay loam to sandy loam

(3) Fertilizer requirement;
50 - 25 - 25 (N - P - K)

Table 4C-6. Total Amount of Input Materials, with Project, In Future

Input Materials	Unit	Paddy, Wet (12,400 ha)		Paddy, Dry (4,970 ha)		Tobacco (2,130 ha)		Garlic (4,270 ha)		Mung Bean (2,065 ha)		Cotton (1,030 ha)		Ground Total
		Per ha	Total	Per ha	Total	Per ha	Total	Per ha	Total	Per ha	Total	Per ha	Total	
1. Seeds	ton	50 kg	620	50 kg	249	0.03 kg	0	420 kg	1,793	25 kg	52	25 kg	26	Paddy 869 Tobacco 0 Garlic 1,793 Mung Bean 52 Cotton 26
2. Fertilizer														
- Urea (45-0-0)	ton	35 kg	434	45 kg	224	-	-	50 kg	214	-	-	50 kg	52	924
- Ammosul (21-0-0)		75 kg	930	100 kg	497	100 kg	213	-	-	-	-	-	-	1,640
- Potassium (0-0-60) Chloride		-	-	-	-	-	-	55 kg	235	-	-	-	-	235
- Compound (16-20-0)		150 kg	1,860	150 kg	746	-	-	325 kg	1,388	-	-	-	-	3,994
- Compound (14-14-14)		10 kg	124	-	-	-	-	-	-	150 kg	310	200 kg	206	640
- Compound (6-9-15)		-	-	-	-	400 kg	852	-	-		-	-	-	852
Total														8,285
3. Insecticides														
- Liquid	x100 qt.	2.1 qt.	260	2.1 qt.	104	6.0	128	3.0 qt.	128	30 qt.	62	10.0 qt.	103	785
- Water Soluble Powder	ton	1.5 kg	19	1.5 kg	7	3.0	6	-	-	-	-	5.8 kg	6	38
- Granular	kg	-	-	-	-	-	-	-	-	17 kg	35	-	-	35
4. Herbicides														
- Liquid	x100 qt.	2.0 qt.	248	2.0 qt.	99	-	-	-	-	-	-	-	-	347
- Water Soluble Powder	kg	-	-		-	-	-		-	-	-		-	-

Note (1) The figures in the parenthesis show the total cropping area in the Project Area [illegible]

Target Yield of Major Crops, "With Project"

Paddy

Experimental Yield

Following experimental data on paddy yield at each amount of nitrogen were used to have the quadratic equation for the regression between yield (Y) and amount of applied nitrogen (X).

Paddy Yield at Each Level of Applied Nitrogen

(unit:ton/ha)

Season	Nitrogen Application (kg/ha)				
	0	30	90	120	150
Wet	3.3	3.9	4.5	4.2	-
Dry	3.5	-	4.7	5.3	5.4

Source: BPI, Average yield of the latest 6 HYVs at three national experiment stations (Maligaya Rice Research and Training Center, Bicol Rice and Corn Experiment Station and Visaya Rice Experiment Station)

The quadratic equations for above data are shown as follows;

Wet season crop: $y = 3.28 + 0.025x - 0.00014x^2$

Dry season crop: $y = 3.50 + 0.029x - 0.00011x^2$

(The curves for both equations are shown in Figure 4C-6 .)

Attained Yield in the Project and Its Vicinity

The attained yield under Masagana 99 (1976-1979) in the Project municipalities is 3.6 ton/ha for wet season crop and 3.5 ton/ha for dry season as shown in Table 3D-16, Appendix 3D-1.

Almost all the same level of average yields are attained in the existing national irrigation system areas which are located near to the Project Area as shown below:

Attained Yield in Existing National Irrigation System Areas (1977)

Area	Yield (cavan/ha)	Area Coverage of HYVs
Laoag-Vintar	70	more than 70%
Dingras	70	more than 75%
Cura	40	less than 50%
Bonga Bump #2	73	more than 70%
Mean	71 (3.6 ton/ha)	

Note: (1) The yields refer to the average yields for wet and dry season crops

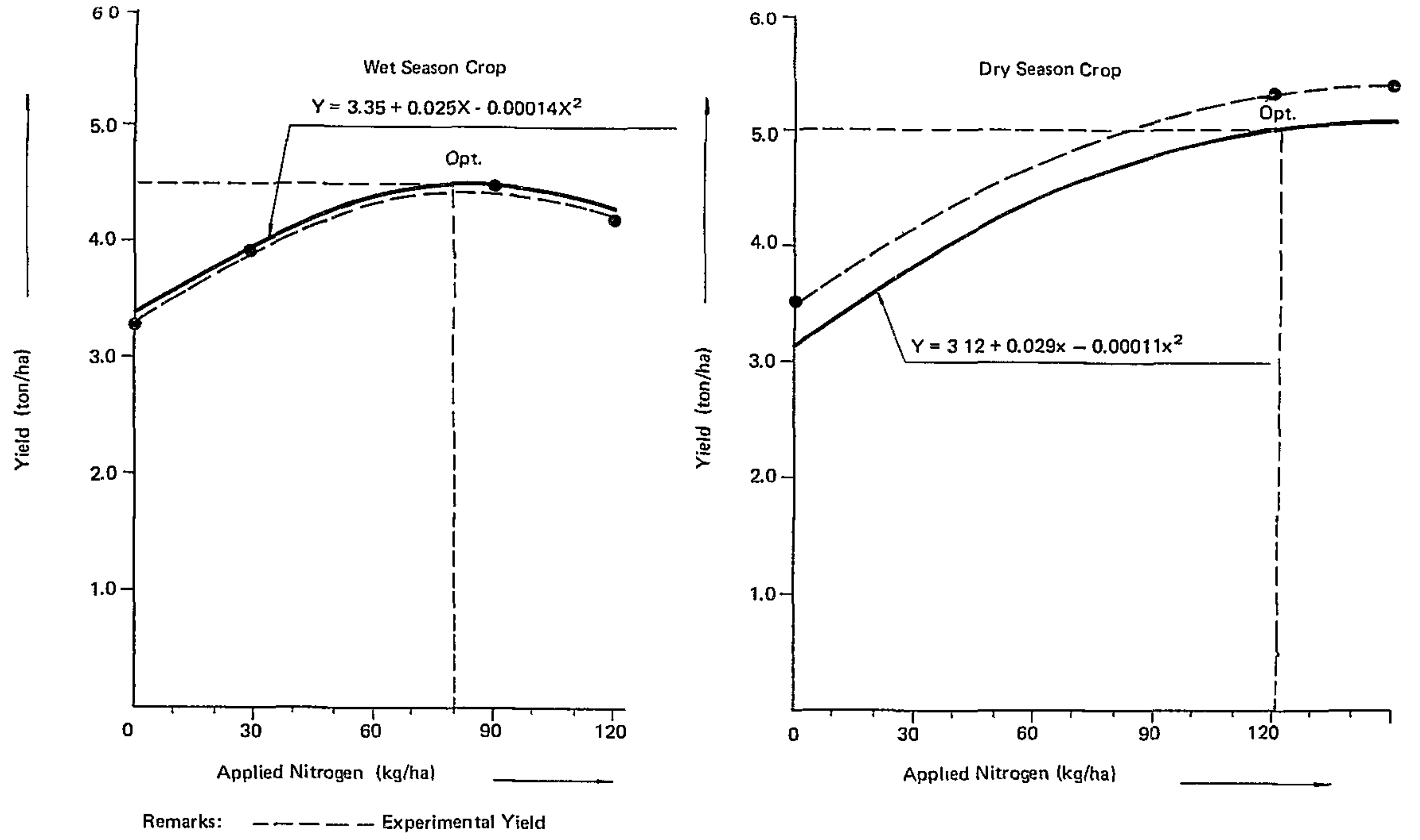
(2) The mean yield is exclusive of the yield in Cura area because of small area coverage of HYVs.

The attained yield in the foundation seed farm at BPI Dingras Experimental Station (1977) was 3.8 ton/ha for wet season crop and 3.5 ton/ha for dry season crop. But the station has attained more high yield of 4.4 ton/ha for wet season crop a few years ago.

The irrigation conditions in the existing national irrigation system areas need rehabilitation under NISIP because of the inadequate irrigation water amount and on-farm facilities. Also, at BPI Dingras experiment station, the irrigation water supply during dry season is limitted very much because the irrigation water supply to the station is made by one of the existing national irrigation systems. These unfavorable irrigation conditions are considered to be the main reason why the comparatively low yield in the existing national irritation system areas and also at BPI Dingras Experimental Station.

On the other hand, the yield of 4.41 ton/ha was attained at 70 kg of applied nitrogen according to the yield record of FAO/NFAC/JICA Fertilizer Trial (1978-1979) in three Project municipalities (See Table 3D-18, Appendix 3D-1).

FIGURE 4C-6. EXPERIMENTAL AND PREDICTED YIELD OF PADDY



It is considered that the proposed irrigation development of the Project will improve the irrigation conditions to attain high yield, at least such level of attained yield of 4.41 ton/ha at 70 kg of applied nitrogen for wet season paddy rice by FAO/HFAC/JICA Fertilizer Trial in the Project municipalities, as shown previously. The following equation is assumed to represent the quadratic equation for the regression between potential yield (y) and amount of applied nitrogen (x) in the Project, which is produced by substituting the above yield data into the said equation for the experimental yield data of wet season crop:

$$y = 3.35 + 0.025x - 0.00014x^2$$

For dry season crop, such kind of yield data for the substitution is not available. Therefore, the assumed potential yield of 4.78 ton/ha at 70 kg of applied nitrogen is used to have the equation as follows:

The assumed potential yield for dry season crop:

4.41 ton/ha (potential yield of the wet season crop) x
4.7 ton/4.5 ton = 4.61 ton/ha

where; 4.7 tons and 4.5 tons are the above-mentioned experimental yields at 90 kg of applied nitrogen for wet season crop.

Thus the new equation with regard to potential yield for dry season crop in the Project Area is as follows:

$$y = 3.12 + 0.029x - 0.00011x^2$$

3. Yield at Optimum Amount of Nitrogen Application

Optimum amount of nitrogen application and their yields are computed as follows:

Wet season crop:

$$\text{Opt. nitrogen (kg/ha)} = \frac{0.025Py - Pn}{2(0.00014 \times Py)} = 82 \text{ kg}$$

Yield at 82 kg of the nitrogen application = 4.5 ton/ha

Dry season crop:

$$\text{Opt. nitrogen (kg/ha)} = \frac{0.029Py - Pn}{2(0.00011 \times Py)} = 122 \text{ kg}$$

Yield at 122 kg of the nitrogen application = 5.0 ton/ha

Where Py = ₱ 2,090 (Paddy price per ton)
Pn = ₱ 4.5 (Nitrogen price per kg)
(Projected prices for the year of 1990 at the values in 1980)

4. Estimated Yield at Different Land Class

The yields at optimum amount of nitrogen application are regarded as the potential yield after Project. Hence, the yield at different land classes are estimated as follows:

Target Yield of Paddy

Land Class	Range of Productivity (%)	Average Productivity Rating (%)	Target Yield (ton/ha)	
			Wet Season	Dry Season
Potential	100	100	4.5	5.0
1R	90 - 100	95	4.3	4.7
2R	80 - 90	85	3.8	4.2
3R	70 - 80	75	3.4	3.8

B. Upland Crops

1. Tobacco

The potential yiels of virginia tobacco varieties to be introduced in the Project are estimated at 2.0 ton/ha, based on the following Table.

Potential Yields of Selected Varieties

Variety	Growth[1/] Period (day)	No. of Harvested Leaves	Potential[2/] Yield (ton/ha)
NC Blight Yellow	80 - 90	29	2.08
Coker 254	90 - 100	26	2.27
Coker P-11-1	N.A.	N.A.	2.05
MRS-3	90 - 100	25	1.89
Golden Harvest	80 - 90	26	1.91
Average			2.04

Note: 1/ : From transplanting to flowering
2/ : Data source : "Three Years of Cooperative Research on Philippine Virginia Tobacco, UPLB. PVTA Research & Training Program, 1973"

The PVTA compact farm that was organized in San Pedro, Batac by the farmer paticipants to the "UPLB-PVTA applied package technology commercial trials for virginia tobacco" attained about 1.6 tons of average yield in 1977-78, according to "the Philippine Virginia Tobacco Industry : In Search for Effective Technology for Development and Transfer in the Farmland prepared by Adolf C. Necesito in 1979"

The yield was attained by applying the PVTA-UPLB and Taiwan technology having the fertilizer recommendations of 30-60-90 and 64-64-128 (N-P-K in kg per hectare) respectivery. Reffering to the relationship between the attained yield and the soil conditions in the compact farm, the target yield for second class land is set up at 1.7 tons per hectare.

The target yields by land class are decided in the basis of above said potential yield and the target yield for second class land as follows;

Target Yield of Virginia Tobacco

Land Class	Range of Productivity (%)	Average Productivity Rating (%)	Target Yield (ton/ha)
Potential	100	100	2.0
First	90 - 100	95	1.9
Second	80 - 90	85	1.7
Third	70 - 80	75	1.5

2. Garlic

The potential yield of garlic is estimated at 3.0 ton/ha from the experimental data on the garlic planted in October and November at BPI Dingras Experimental Station.

The high-yield farmers, one third of sample farmers in "the Garlic Production and Marketing, Ilocos Region prepared by DA" had about 2.3 tons of average yield per hectare.

Following target yields by land class are decided in the basis of the above-mentioned potential yield and the yield of high-yield farmers.

Target Yield of Garlic

Land Class	Range of Productivity (%)	Average Productivity Rating (%)	Target Yield (ton/ha)
Potential	100	100	3.0
First	90 - 100	95	2.9
Second	80 - 90	85	2.6
Third	70 - 80	75	2.3

3. Mungbeans

The potential yield of mungbeans is estimated at 1.3 tob/ha from the following studied yield of improved varieties.

Studied Yield of Mungbeans

Variety	Studied Yield (ton/ha)	Maturity to days to 1st Priming (day)
MG 50-10A(G)	1.0 - 1.3	60 - 65
MD 15-2	1.0 - 1.3	60 - 65
E.G. Glabrous	1.0 - 1.3	60 - 65
CES 55	1.0 - 1.5	65 - 68
CES 87	1.0 - 1.5	65 - 68
CES 1D-21	1.0 - 1.2	65 - 68

Source: Philippine Recommendation on Mungbeans, PCARR

According to the yield data taken from "the Angat-Magat Integrated Agricultural Development Project Applied Research Phase one Report", the yield of about 1.2 ton/ha was attained for the wet season crop in 1974 on farmers' field of Magat Project Area. (used variety; CES-55)

The target yields by land class are decided as shown in the following Table, assuming the potential yield and the yield for the first class land as 1.3 ton and 1.2 ton per hectare respectively.

Target Yield of Mungbean

Land Class	Range of Productivity (%)	Average Productivity Rating (%)	Target Yield (ton/ha)
Potential	100	100	1.3
First	90 - 100	95	1.2
Second	80 - 90	85	1.1
Third	70 - 80	75	1.0

4. Cotton

The estimated potntial yield is 2.9 tons/ha (seed cotton) from the following experimental data.

Experimental Yield of Cotton

(Unit:ton/ha, seed cotton)

Fertiliaer Level (kg/ha)	Plant Density (plant/ha) & Planting Time 83,882 (Oct. 1st)	93,393 (Nov. 1st)	Mean
120 - 25 - 25	2.4	2.4	2.4
90 - 25 - 25	2.9	2.9	2.9
90 - 0 - 0	1.8	1.0	1.4
50 - 25 - 25	1.2	2.0	1.6
Control	1.1	1.5	1.3

Source: PCC Annual Report (1977 - 1978)
Philippine Cotton Cooperation through Cotton
Development and Research Institute

Nots: (1) Experimental location : Pangasinan (Irrigated)
(2) Variety : Deltapine

The target yields by land class are decided as shown in the following Table, based on the above mentioned potential.

Target Yield of Cotton

Land Class	Range of Productivity (%)	Average Productivity Rating (%)	Target Yield (ton/ha)
Potential	100	100	2.9
First	90 - 100	95	2.8
Second	80 - 90	85	2.5
Third	70 - 80	75	2.2

C. Projected Total Production with Project

1. Paddy

The aggregate projected production after full implementation of the Project is 74,492 ton, 51,916 tons of which are wet season harvest and the balance of 22,576 tons are dry season harvest. The weighted average yield at each area of different land class is 4.2 tons/ha and 4.5 tons/ha for wet and dry season crop respectively. (See Table 4C-7)

2. Upland Crops

The total projected production and the weighted average yield at each area of different land class for each selected upland crops are as follows;

Total Projected Upland Crops Production

Crop	Weighted Average Yield (ton/ha)
Tobacco	1.7
Garlic	2.6
Mungbean	1.1
Cotton	2.5

Table 4C-7. Paddy Rice and Upland Crops Production by Land Class, With Project, Future

1. Paddy

	1R or 1R(2)			2R or 2R(2)			3R or 3R(3)			Total		
Season	Area (ha)	Yield (ton/ha)	Production (ton)	Area (ha)	Yield (ton/ha)	Production (ton)	Area (ha)	Yield (ton/ha)	Production (ton)	Area (ha)	Yield (ton/ha)	Production (ton)
Wet	9,920	4.3	42,656	2,070	3.8	7,866	410	3.4	1,394	12,400	(4.2)	51,916
Dry	3,660	4.7	17,202	980	4.2	4,116	330	3.8	1,254	4,970	(4.5)	22,576

2. Upland Crops

	1R(2) or 2R(2)			3R(3)			Total		
Crop	Area (ha)	Yield (ton/ha)	Production (ton)	Area (ha)	Yield (ton/ha)	Production (ton)	Area (ha)	Yield (ton/ha)	Production (ton)
(1) Tobacco	2,130	1.7	3,621	-	-	-	2,130	(1.7)	3,621
(2) Garlic	4,190	2.6	10,894	80	2.3	184	4,170	(2.6)	11,078
(3) Mungbean	2,065	1.1	2,272	-	-	-	2,065	(1.1)	2,272
(4) Cotton	1,030	2.5	2,575	-	-	-	1,030	(2.5)	2,575
Total	9,415			80			9,495		

Farm Mechanization and Land Requirement

A. Proposed Farm Mechanization Plan

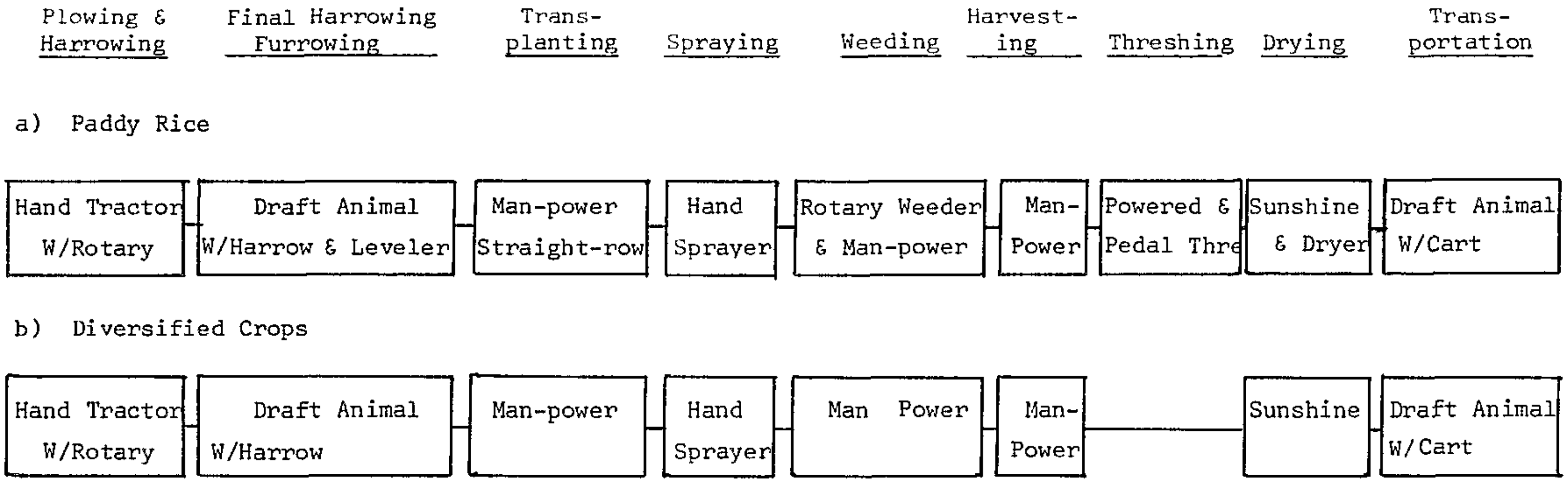
The farm operation systems as shown in Figure 4C-7 will be applied for the scheduled farming after completion of the Project. These systems require mechanization in such major operations as land preparation, threshing and drying. The selected machines and the assumed area coverages of mechanization area by selected machine are as follows;

Selected Farm Machinery and Assumed Area Coverage of Farm Mechanization

Operation	Selected Machine	Area Coverage (%)
Land preparation	- Hand tractor (7-8 HP diesel)	40
Threshing	- Powered thresher (7-8 HP diesel, throw-in type)	50
	- Pedal thresher	50
Drying	- Dryer (flat-bed type, 2.0 ton bin)	50

As for all selected machines, the Philippines-made or the imported ones are available in the Philippines. The traditional way of operation for land preparation by draft animal and drying by sunshine will be employed in the areas where the above-mentioned mechanization will not cover. The farm operation efficiency are calculated for the operation of land preparation, threshing, drying and transportation in both cases of using machineries and draft animals as shown in Table 4C-8.

FIGURE 4C-7. PROPOSED FARM OPERATION SYSTEM



	Plowing & Harrowing	Final Harrowing Furrowing	Trans-planting	Spraying	Weeding	Harvest-ing	Threshing	Drying	Trans-portation
a) Paddy Rice	Hand Tractor W/Rotary	Draft Animal W/Harrow & Leveler	Man-power Straight-row	Hand Sprayer	Rotary Weeder & Man-power	Man-Power	Powered & Pedal Thre	Sunshine & Dryer	Draft Animal W/Cart
b) Diversified Crops	Hand Tractor W/Rotary	Draft Animal W/Harrow	Man-power	Hand Sprayer	Man Power	Man-Power		Sunshine	Draft Animal W/Cart

Note: (1) Area coverage of mechanization for the operations of plowing and harrowing by hand tractor is estimated at 40 percent of cultivated area in both cases of paddy rice and diversified crops.

(2) Area coverage of mechanization for threshing by the powered thresher and pedal thresher is estimated at 50 percent of cultivated area respectively.

Table 4C-8. Efficiency of Farm Operation

Operation	Machinery/ Animal	(1) Ope. Width (m)	(2) Ope. Speed (km/hr.)	(3)= Theoretic Ope. Capacity (ha/hr.)	(4) Efficiency in Field (%)	(5)=(3)x(4) Ope. Capacity in Field (ha/hr.)	(6) Ope. Efficiency (%)	(7)=(5)x(6) Actual Ope. Capacity (ha/hr.)	(8) Hours per ha (ha/hr.)	(9) Ope. Times (time)	(10)=(8)x(9) Hours per ha (hr./ha)	(11) Ope. Hours per day (hr./day)	(12)= (10)+(11) Days per day (day/ha)
a) Plowing	-Carabao w/plow	0.12	2.2	0.026	84	0.022	80	0.018	55.6	1	55.6	8	7.0
	-Hand tractor w/rotary	0.55	1.5	0.083	80	0.066	80	0.053	18.9	1	18.9	8	2.4
b) Harrowing	-Carabao w/harrow	1.0	2.0	0.200	80	0.160	65	0.104	9.6	2	19.2	8	2.4
	-Hand tractor w/rotary	0.55	2.0	0.110	80	0.088	80	0.070	14.3	1	14.3	8	1.8
c) Final Harrowing	-Carabao w/harrow & leveler	0.7	2.0	0.140	80	0.112	65	0.073	13.7	2	27.4	8	3.4
	-Hand tractor w/ harrow & leveler	1.4	3.0	0.420	80	0.336	80	0.269	3.7	2	7.4	8	0.9
d) Threshing	-Powered thresher	-	-	0.298 (1.25ton/hr.)	80	0.238	75	0.179	5.6	1	5.6	6	0.9
	-Pedal thresher	-	-	0.070 (0.32ton/hr.)	80	0.056 (0.25ton)	75	0.042 (0.19ton)	24.0	1	24.0	6	4.0
e) Drying	-Dryer (Flat-bed type, 2.0 tons bin)	-	-	0.119 (0.5ton/hr.)		-	80	0.095 (0.4ton/hr.)	10.5	1	10.5	16	0.7
f) Transportation	-Carabao w/ cart	-	2.5	0.2 ton	80	0.16 ton	80	0.1 ton	-	-	-	-	-

3. Number of Required Machinery per Compact Farm

It is considered that the required units of machinery will be introduced in each compact farm or in each two compact farms for the collective use of machinery in order to minimize the machinery costs. The required units of the machinery per compact farm (average size is 40 ha) are computed as follows;

1. Hand tractor

The type of hand tractor having P.T.O. for the attachment of rotary will be chosen in most of the Project Area because of big area coverage of upland crops. One unit of the hand tractor is required for land preparation work in 16 ha (40 percent of compact farm area) in each compact farm in this chase as follows;

Efficiency: 4.2 (2.4 + 1.8) days/ha/unit (see Table 4C-8)

Possible operation days per crop season: 67 days (Lag period + land praparation period + Overtime work)

Number of required units: 4.2 days/ha x 16 ha ÷ 67 days ≑ one unit

2. Thresher

One unit of powered thresher and five units of pedal threshers will cover each half area of compact farm as follows;

Powered Thresher

Efficiency: 0.9 days/ha/unit (See Table 4C-8)

Assumed possible operation days per crop season: 35 days x 0.8[1/]
= 28 days

Number of required units: 0.9 days/ha x 20 ha ÷ 28 days ≑ one unit

Pedal Thresher

Efficiency: 4.0 days/ha/unit (See Table 4C-8)

Possible operation days per crop season: 28 days

Number of required units: 4.0 days/ha x 20 ÷ 28 days ÷ 0.6[2/] = five un

Remarks 1/: assumed rate of possible operation days to full operation days

2/: assumed reduction rate of operation efficiency

3. Dryer

One unit of the selected drier has the capacity of drying up 2.0 tons of threshed paddy in moisture content from 26% to 14% and will take eight hours. But it is considered that the traditional way of sunshine-drying will be employed at least in the half stage of drying in moisture content from 26% to 14%. In this case, the dryer has the capacity to dry up 2.0 ton with four hours of the drying time. Then, one unit of the drier is able to cover two compact farms as follows;

Efficiency: 4.2 ton/ha (unit yield of wet season crop) ÷ 2.0 tons/unit x three rotations = 0.7 days/ha/unit (See Table 4C-8

Possible operation days per crop season: 28 days[1/]

Number of required units: 0.7 day/ha/unit x 40 ha ÷ 28 days ≑ one unit

Remarks 1/: 35 x 0.8 (assumed rate of possible operation days)

4. Working Carabao

The operation of land preparation in non-mechanization area (24 per compact farm ha) will be performed by animal power (carabao or cattle). The required heads of draft animal per compact farm is computed as follows:

Efficiency:	Plowing:	7.0 animal-days/ha
	1st harrowing:	2.4 animal-days/ha
	2nd harrowing:	2.4 animal-days/ha
	3rd harrowing:	3.4 animal-days/ha
	Total	15.2 animal-days/ha

Estimated possible operation days per crop season = 55 days

Required heads of working carabao: 15.3 animal-days/ha x 24 ha
÷ 67 days ≑ 6 heads

3. Labor Requirement and Machinery Cost

The labor requirements for paddy rice and concerned diversified crops are estimated as follows:

	Labor Requirement per ha.	
Crop	Man-day	Machinery or animal day
Paddy Rice	103.1	20.2
Tobacco	273.5	28.8
Garlic	165.0	22.5
Mung Beans	86.3	22.3
Cotton	139.3	37.3

Remarks: The detailed labor requirements by crop and operation are indicated in Table 4C-9 to 4C-13.

The machinery cost of paddy rice cultivation is calculated at 569 per ha. The cost for the diversified crops is computed at 395 per ha because of no machinery cost for threshing and drying. (See Table 4C-14).

Table 4C-9. Labor Requirement of Paddy Cultivation with Project in Future

(Unit: day/ha

Operation	Man-day	Machinery or Animal-day	Remarks
1. Seed-bedding			
a) Land preparation/Sowing	1.5	0.5	Same as the item 2
b) Care of seedlings	1.5		
Sub-total	(3.0)	(0.5)	
2. Land Preparation			
a) Plowing	5.2	5.2	Animal(60%), Machine(
b) Harrowing	3.6	3.6	-do-
c) Final harrowing/Leveling	2.6	2.6	Animal(100%)
d) Repair of dikes	2.7		
Sub-total	(14.1)	(11.4)	
3. Transplanting			
a) Pulling/Delivery of seedlings	7.5	0.5	
b) Transplanting	20.0		
Sub-total	(27.5)	(0.5)	
4. Fertilizer Application			
a) Basal fertilizer	1.0	0.2	
b) Top dressing (2x)	1.0	0.2	
Sub-total	(2.0)	(0.4)	
5. Spraying			
a) Insecticides (3x)	3.0		
b) Herbicides (1x)	1.0		
Sub-total	(4.0)		
6. Weeding			
a) 1st weeding (2x)	7.0		
b) 2nd weeding	6.0		
Sub-total	(13.0)		
7. Irrigation/Drainage	5.0		
8. Harvesting			
a) Cutting/Bundling	16.0		
b) Hauling/Piling	3.0	2.0	
c) Threshing	8.5	2.6	Powered Thresher(50%) & Pedal Thresher (50%)
Sub-total	(27.5)	(4.6)	
9. Post Harvesting			
a) Drying	3.5	2.5	Drier(50%) & sunshine (50%)
b) Sacking	2.0		
c) Piling/Delivery	1.5	0.3	
Sub-total	(7.0)	(2.8)	
Total	103.1	20.2	

Table 4C-10. Labor Requirement of Tobacco Cultivation with Project in Future

Operation	Man-day	Machinery or Animal-day	Remarks
1. Seed-bedding			
a) Land preparation/Sowing	4.0	0.5	
b) Care of seedling	22.2		
Sub-total	(26.2)	(0.5)	
2. Land Preparation			
a) Plowing	9.4	9.4	Animal(60%), Machine(40%)
b) Harrowing	4.2	4.2	-do-
c) Leveling/Furrowing	2.7	2.7	Animal(100%)
Sub-total	(16.3)	(16.3)	
3. Transplanting			
a) Preparing of seedijgs	5.0		
b) Transplanting/Replanting	30.0		
Sub-total	35.0		
4. Fertilizer Application			
a) Basal fertilizer	4.0		
b) Side-dressing	4.0		
Sub-total	8.0		
5. Weeding/Hilling-up	8.8	8.0	Animal(100%)
6. Spraying (8x)	8.0		
7. Irrigation (5x)	10.0		
8. Topping/Sucker control	10.0		
9. Harvesting (8x)			
a) Printing/Hauling	60.0	4.0	Animal(100%)
b) Sorting/Sticking	40.0		
Sub-total	(100.0)	(4.0)	
10. Post Harvesting			
a) Curing	30.0		
b) Grading/Bundling	20.0		
c) Packing/Storing	2.0		
Sub-total	(52.0)		
Total	273.5	28.8	

Table 4C-11. Labor Requirement of Garlic Cultivation with Project in Future

Operation	Man-day	Machinery or Animal-day	Remarks
1. Land Preparation			
a) Plowing	9,4	9.4	Animal(60%), Machine(4
b) Harrowing	4.2	4.2	-do-
c) Leveling/Furrowing	2.7	2.7	Animal(100%)
d) Mulching	8.7	4.0	Animal(100%)
Sub-total	(25.0)	(20.3)	
2. Planting			
a) Preparing of seeds	10.0		
b) Planting	35.0		
Sub-total	45.0		
3. Fertilizer Application	2.0	0.2	Animal(100%)
4. Thinning	2.0		
5. Spraying (3x)	8.0		
6. Irrigation (4x)	8.0		
7. Harvesting			
a) Pulling/Gathering	23.0		
b) Hauling	2.0	2.0	Animal(100%)
Sub-total	(25.0)	(2.0)	
8. Post Harvesting			
a) Drying	5.0		
b) Cleaning/Cutting of roots	15.0		
c) Classifying/Grading	10.0		
d) Bundling/Trimming	10.0		
Sub-total	(40.0)		
9. Removal of hay (rice straw)	10.0		
Total	165.0	22.5	

Table 4C-12. Labor Requirement of Mungbeans Cultivation with Project in Future

Operation	Man-day	Machinery or Animal-day	Remarks
1. Land Preparation			
a) Plowing	9.4	9.4	Animal(60%), Machine(40%)
b) Harrowing	4.2	4.2	-do-
c) Leveling/Furrowing	2.7	2.7	Animal(100%)
Sub-total	(16.3)	(16.3)	
2. Planting			
a) Seeding/Covering	4.0		
b) Thinning	1.0		
Sub-total	(5.0)		
3. Fertilizing	2.0		
4. Cultivation/Weeding			
a) Off-baring	2.0	2.0	Animal(100%)
b) Hilling-up	2.0	2.0	Animal(100%)
c) Weeding	10.0		
Sub-total	(14.0)	(4.0)	
5. Spraying (3x)	4.0		
6. Irrigation (3x)	6.0		
7. Harvesting			
a) Picking (4x)	25.0		
b) Hauling	2.0	2.0	Animal(100%)
8. Threshing/Drying/Others	12.0		
Total	86.3	22.3	

Table 4C-13. Labor Requirement of Cotton Cultivation with Project in Future

Operation	Man-day	Machinery or Animal-day	Remarks
1. Land Preparation			
a) Plowing	9.4	9.4	Animal(60%), Machine(4
b) Harrowing	4.2	4.2	-do-
c) Leveling/Furrowing	2.7	2.7	Animal(100%)
Sub-total	(16.3)	(16.3)	
2. Planting/Thinning			
a) Seeding/Covering	20.0		
b) Re-planting	2.0		
c) Thinning	1.0		
Sub-total	(23.0)		
3. Fertilizing			
a) Basal fertilizer	4.0		
b) Side dressing	4.0		
Sub-total	(8.0)		
4. Cultivation			
a) Off-baring/Hilling-up	18.0	18.0	Animal(100%)
5. Spraying (10x)	20.0		
6. Irrigation (5x)	10.0		
7. Harvesting/Drying			
a) Picking (4x)	30.0		
b) Hauling	3.0	3.0	Animal(100%)
c) Cleaning	3.0		
d) Drying	4.0		
Sub-total	(40.0)		
8. Packaging/Deliverying	4.0		
Total	139.3	37.3	

Table 4C-14. Farm Machinery Cost

1. Fixed Cost

Machinery	Purchasing Price (₱)	Durable Period (Year)	Depreciation Cost[1] (₱/year)	Repair Cost (₱/year)	Other Fixed Cost[2] (₱/year)	Total Cost (₱/year)	Coverage per unit (ha)	Total cost per hectare (₱)
Hand tractor	23,000	5	4,140	1,840 (8%)	230	6,210	Wet 16 Dry 19	177
Thresher	19,425[3]	8	2,185	583 (3%)	194	2,962	Wet 20 Dry 12	93
Pedal thresher	650	6	98	-	7	105	Wet 4 Dry 0	26
Dryer	8,250	8	928	412 (5%)	83	1,423	Wet 40 Dry 12	27
Total								323

Note: 1/ Computed as (1) x 0.9 ÷ (2)

2/ Computed as (1) x 0.01

3/ Price without engine because the engine of hand tractor can be used for thresher.

2. Variable Cost

Operation	Machinery	(1) Ope. hours per ha (hr/ha)	(2) Fuel Consumption (ℓ/hr)	(3) Fuel (ℓ)	(4) Unit Cost (₱/ℓ)	(5) Cost of Fuel (₱)	(6)=(5)x1.3 Cost inclusive pf lubricant (₱)
Land preparation for seedbed	Hand tractor with rotary	1.7	D 2.0	3.4	2.4	8.2	10.7
Land preparation	Hand tractor with rotary	33.2	D 2.0	66.4	2.4	159.4	207.2
Threshing	Powered thresher	5.6	D 2.0	11.2	2.4	26.9	35.0
Drying	Drier	10.5	G+L 0.75 K 1.5	G+W 7.9 K 15.8	4.3 2.4	34.0 37.9	44.2 49.3
	Total						346.4

Note: G: Gasoline, L: Lubricant Oil, K: Kerosin

3. Machinery Cost per Hectare

Paddy : ₱323 (fixed cost) + ₱346 (variable cost) = 669

Diversified Crops: ₱177 (fixed cost) + ₱218 (variable cost) = ₱395

FIGURE 4C-8. FARM LABOR BALANCE (WITH PROJECT, IN FUTURE)

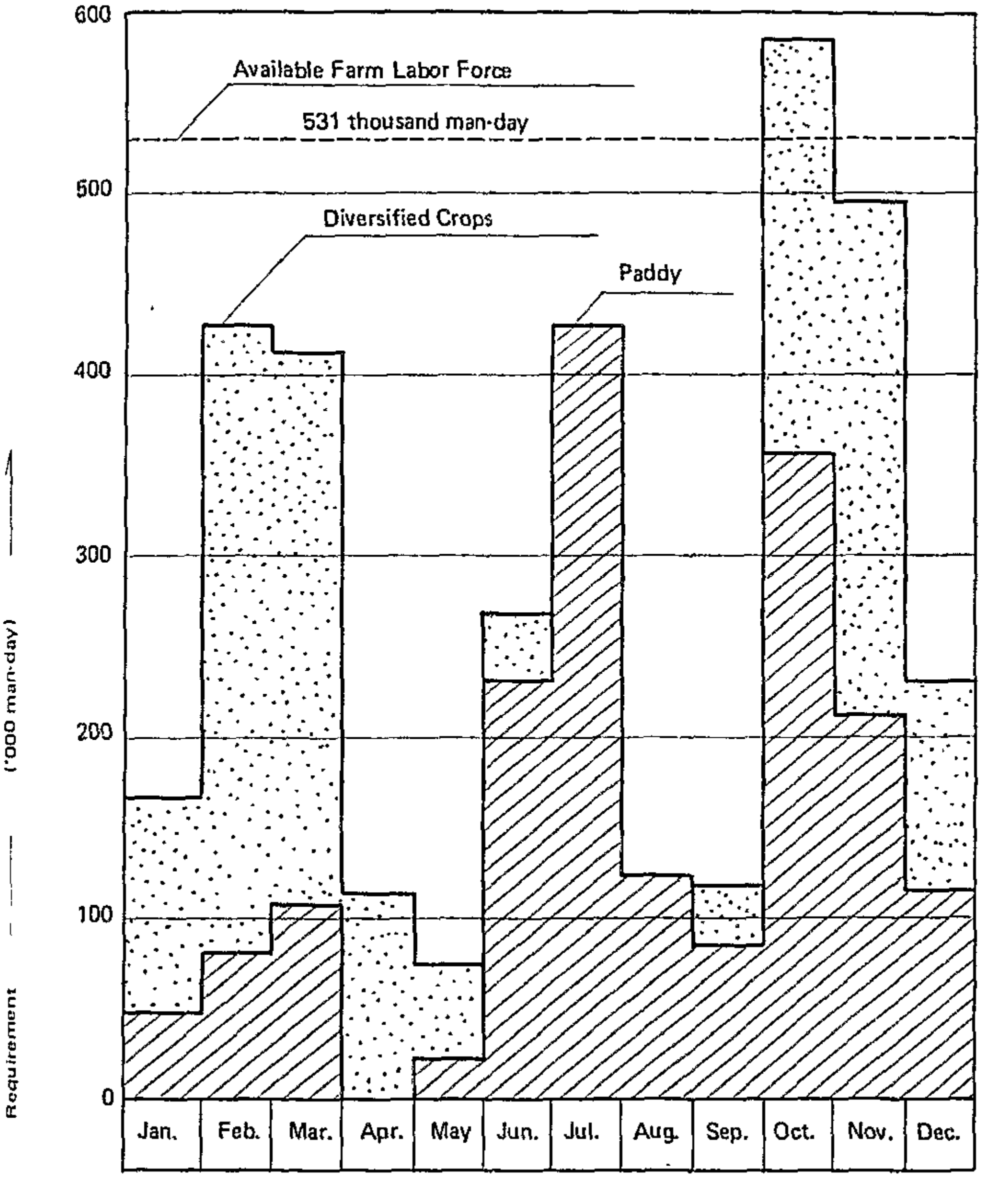
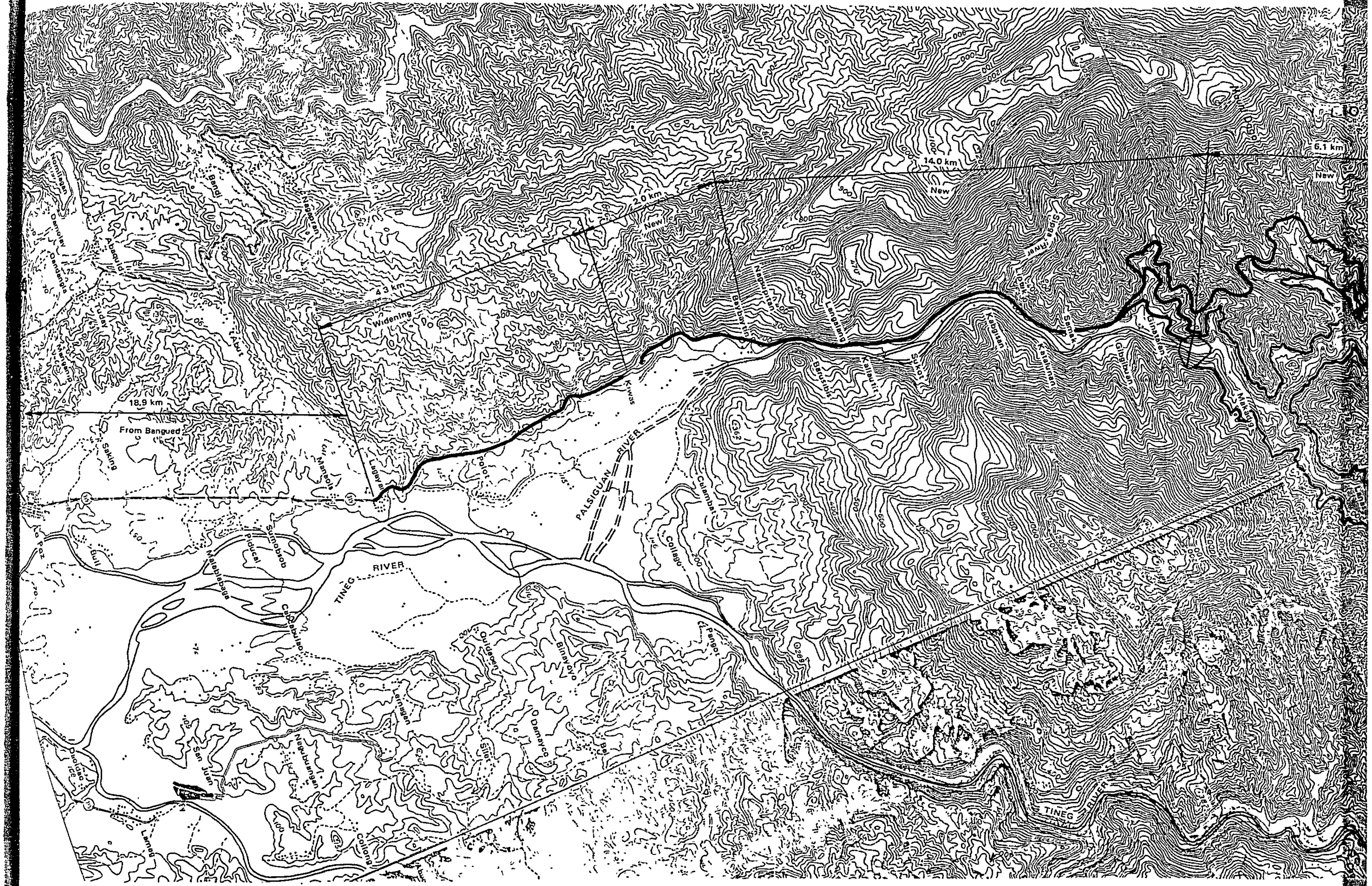


Table 4C-15. Agricultural Development Cost

Items	Amount	Unit Price (₱)	Cost (₱ '000)	Remarks
1. Preparation of cadastral maps				
(a) Production of cadastral maps	2,440 ha	32	78	Siniot(1,770ha), Nueva Era(670ha) only
(b) Preparation of cadastres	12,400.ha	22	272	Whole service area
(sub-total)			(350)	
2. Arrangement for establishment of FIAs	106	1,400	150	
3. Construction of FAI Offices	106	7,200	770	
4. Extension of FIA Federation offices	1	20,000	20	
5. Others			150	
Total			1,440	
6. Operation Cost				
(a) FIA Offices	106	14,500/year	2,690	₱ 1,540,000/year x 1.75(1st to 3rd year)
(b) FIA Federation Offices	lump sum		210	₱ 70,000/year x 3 years
Total			2,900	
Ground Total			4,340	


6.1 km
New
14.0 km
New
2.0 km
New
4.3 km
Widening
18.9 km
From Bangued
Saking
Lagayan
Kiwas
PALSIGUAN RIVER
TINEG RIVER
TINEG RIVER
San Juan
Binbayoyo
Collago
Calambat
Kalauitan
Suyo
Sibang
New
900
800
700
600
500
400
300
200
100

Appendix 4D-1

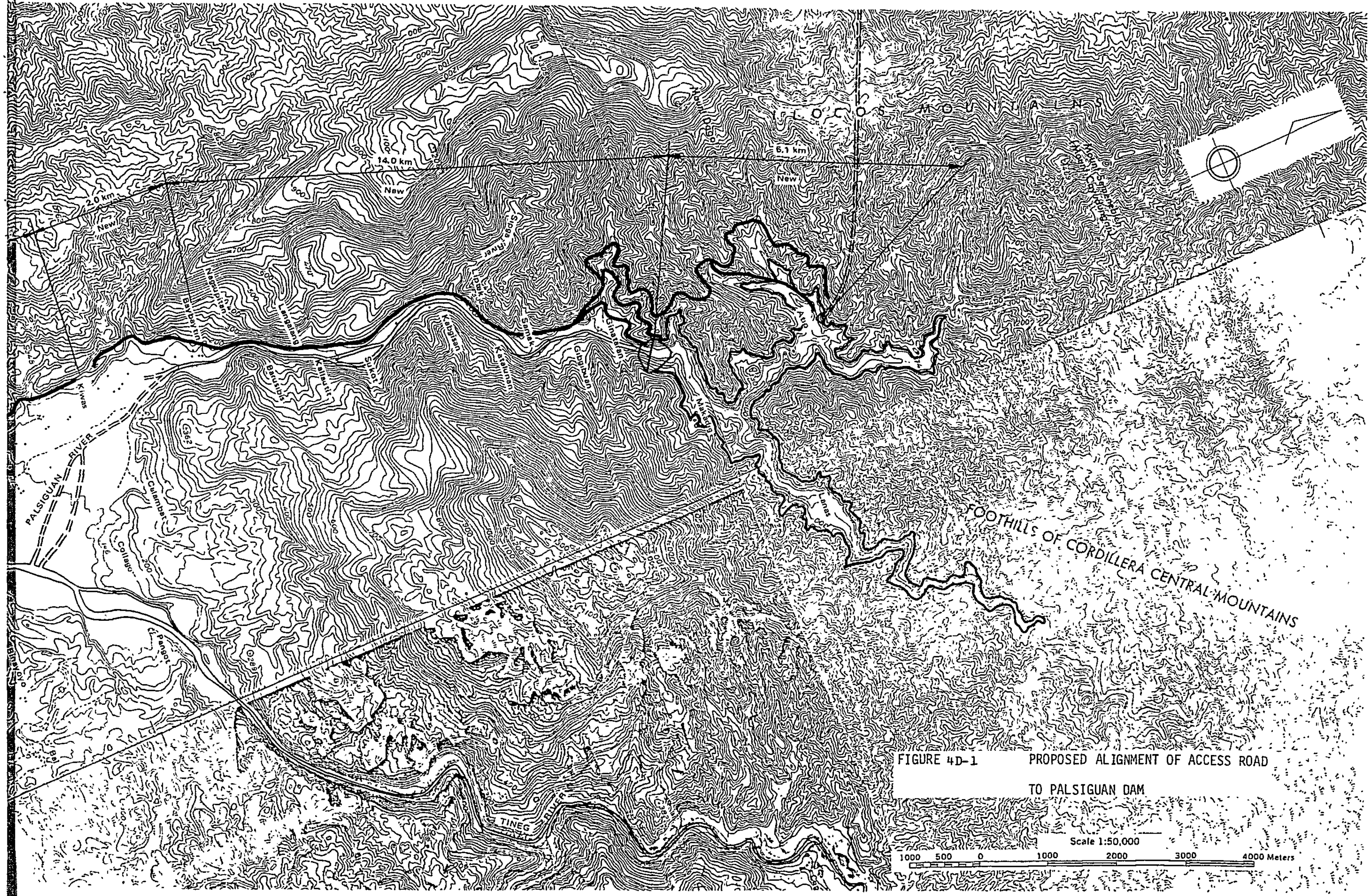


FIGURE 4D-1 PROPOSED ALIGNMENT OF ACCESS ROAD TO PALSIGUAN DAM

Appendix 4D-2

Table 4D-1 Dam Type Comparison Chart for Palsiguan Dam

Dam Type	Earth and Rock Fill	Concrete Gravity	Concrete Arch
1) Dam height (m)		140 ~ 145	
2) Dam volume (cu.m)	8,900,000	2,100,000$^{1/}$	500,000$^{2/}$~600,000$^{3/}$
3) -ditto- (ratio)	100	24	6 ~ 7
4) Unit cost ratio for Dam construction	100	600	1,500
5) Cost index 3) x 4)	10,000	14,400	9,000 - 10,500
6) Required compressive strength of bed rock (kg/sq.cm)	250 ~	350 ~	600 ~
7) Present compressive strength of bed rock (kg/sq.cm)		300 ~ 600 (average 418)	
8) Judgement 6) < 7)	good	need more excavation	impossible
9) Required elastic wave velocity of bed rock (km/sec)	1 ~	3 ~	4 ~
10) Present elastic wave velocity of bed rock (km/sec)		2.0 ~ 2.5 ~ 3.4	
11) Judgement 9) < 10)	good	need more excavation	impossible
12) Construction material	earth and rock; exist	gravel;exist	gravel;exist
13) Concrete mixing plant	small	huge	big
Final judgement	suitable	not economical	impossible

Note 1/ estimated at nomal condition,
2/ -ditto- ,Dome type
3/ -ditto- ,Constant angle type

Table 4D-2 Probable Earthquake Accelerations at Palsiguan Damsite

Ranking	Date	Epicenter		Intensity (m)	Distance from Palsiguan Dam (km)	Acceleratio	
		Latitude	Longitude			(Gal)[1/]	Averag
4	3-19-31	18.3	120.2	6.9	72.9	121.8	112.9
		18.0	121.5	6.9	83.7	104.0	
7	10-28-31	17.5	121.5	6.25	98.1	84.1	84.1
12	1-14-32	18.3	120.2	6.5	72.9	85.9	66.0
		18.0	120.0	6.0	77.5	44.1	
		18.5	120.25	6.5	86.0	68.1	
14	2-14-34	17.5	119.0	7.6	186.4	51.7	51.7
3	3-16-37	18.0	121.0	6.5	33.0	174.9	127.0
		18.0	120.0	6.5	77.5	79.2	
6	3-23-38	18.2	119.7	7.0	113.9	73.8	85.3
		18.0	119.5	7.0	129.8	59.1	
		18.0	120.0	7.0	77.5	123.1	
1	12-29-49	17.5	121.5	7.2	92.2	116.8	183.5
		18.0	121.0	7.2	33.0	250.3	
10	1-3-50	18.0	121.5	6.5	83.7	70.9	70.
5	6-11-57	18.0	121.5	6.7	83.7	86.9	86.
16	9-30-62	18.0	121.0	5.0	32.9	45.7	45.
17	3-14-63	18.3	120.5	5.5	53.3	43.4	43.4
8	8-26-70	18.02	120.5	5.5	30.4	83.9	83.9
15	4-29-71	18.21	120.85	5.3	40.3	50.4	46.2
		18.25	120.72	5.2	42.2	42.0	
9	5-22-72	17.7	120.7	5.0	19.1	75.5	75.5
2	2-29-72	17.8	120.6	5.5	14.9	131.3	131.3
13	3-6-73	18.1	120.71	5.1	27.0	62.9	62.9
11	9-21-76	17.98	120.82	5.1	16.2	91.4	66.5
		17.95	120.83	4.2	14.2	41.6	

[1/] Okamoto's Formula: $\log_{10}\frac{Galmax}{640} = \frac{D + 40}{100}(-7.604 + 1.7244M - 0.103$

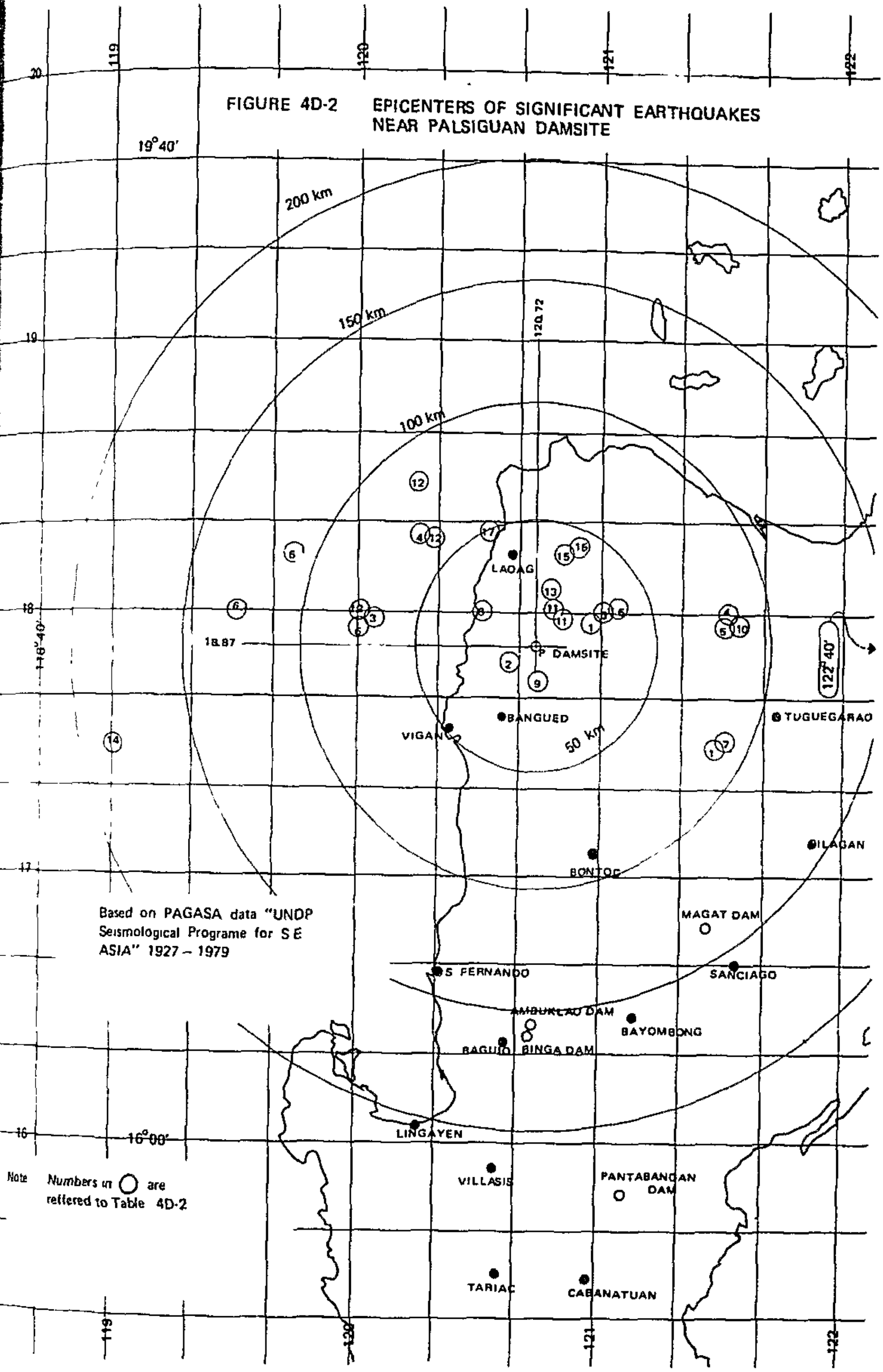
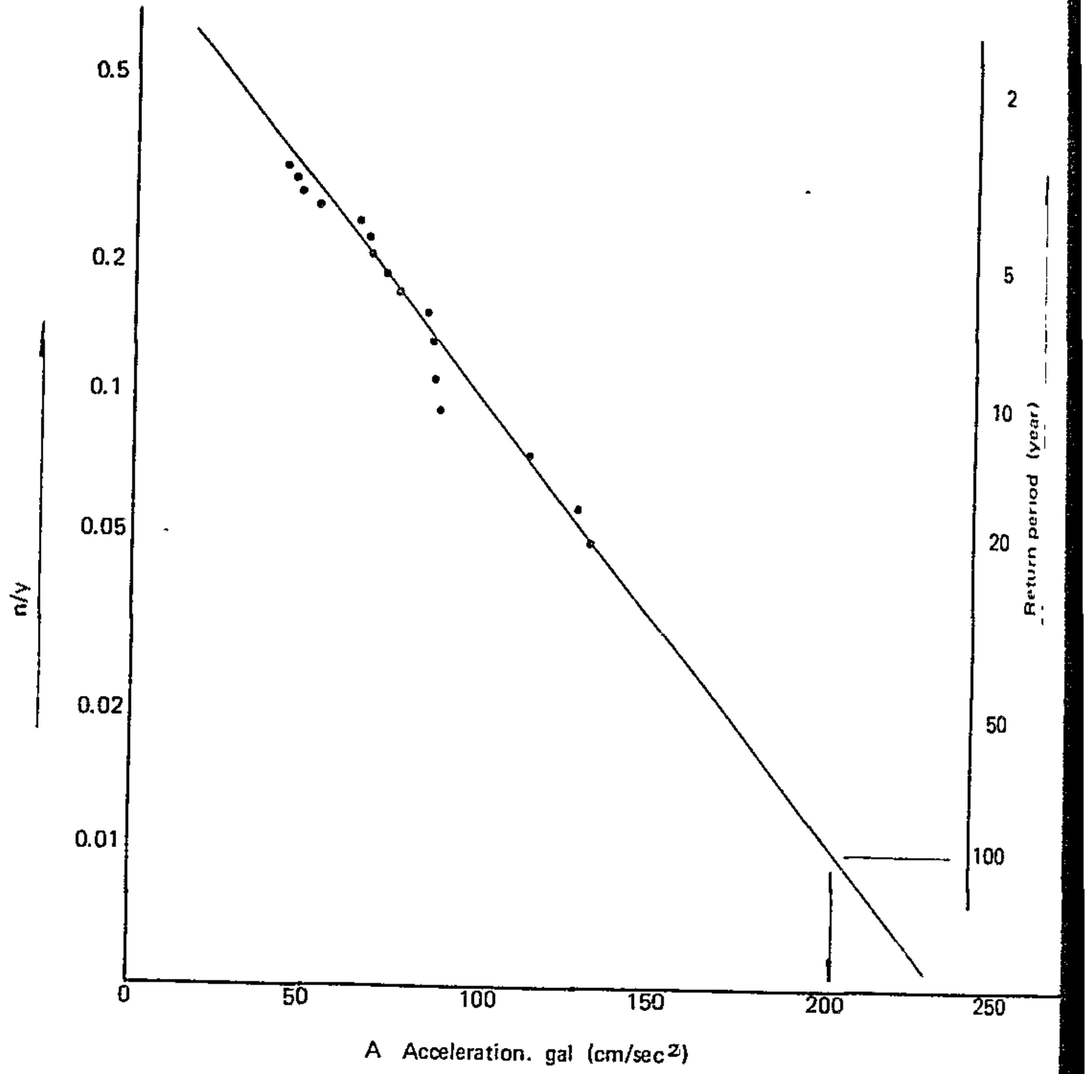


FIGURE 4D-2 EPICENTERS OF SIGNIFICANT EARTHQUAKES NEAR PALSIGUAN DAMSITE

Based on PAGASA data "UNDP Seismological Programe for S E ASIA" 1927 – 1979

Note Numbers in ○ are reffered to Table 4D-2

FIGURE 4D-3 PROBABLE EARTHQUAKE ACCELERATION CURVE AT PALSIGUAN DAMSITE



Based on PAGASA data "UNDP Seismological Programe for Southeast ASIA" 1927 – 1979, and
Okamoto's Formula;

$$\log_{10} \frac{\text{gal max}}{640} = \frac{D + 40}{100} \quad (-7.604 + 1.7224M - 0.1036\ M^2)$$

gal: Acceleration at the damsite
D: Distance between damsite and epicenter
M: Magnitude at epicenter
n: Chronological order according to acceleration
y: Number of years of records = 53

Seismic forth, K = gal/980

Design of Dam and Appurtenant Structures

1. Freeboard and Crest Elevation of Dam

Freeboard is the difference between the crest elevation and the full water surface level in a reservoir and is shown in the following equation in consideration of various factors according to the Design Criteria for Dams which was published (and revised on July 1978) by Japanese National Committee on Large Dams.

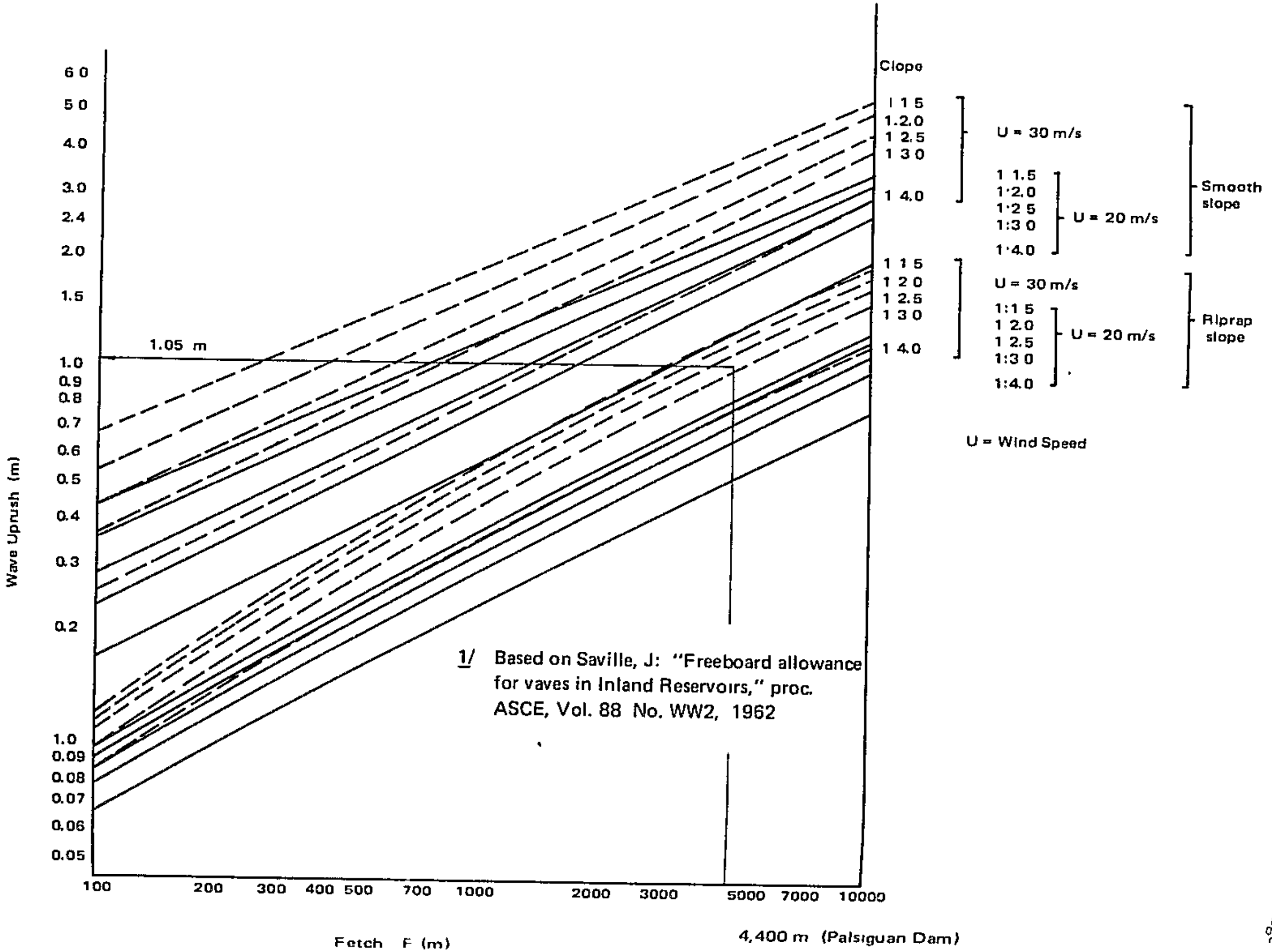
$$Hf \geqq hw + he + ha + hi$$

where,
Hf: freeboard of dam (m)
hw: height of wave due to wind (m)
he: height of wave due to earthquake (m)
ha: rise of water level due to unexpected accident in operating spillway gates, standard value ha=0.5 m is adopted
hi: addition of allowance according to type and importance of dam, standard value hi=1.0 m is adopted for fill type and zero for concrete type.

(1) Height of Wave dur to Wind

Height of wave due to the wind is considered to be caused by deep water wave, and then, the height of significant wave is adopted based on S.M.B. (Sherdrup-Munk-Breschneider) method which is derived from factors such as fetch and wind speed. On the other hand, since uprushing height varies considerably with embankment slope and roughness of slope, height of significant wave should be adjusted adequately with Saville method to obtain height of wave due to the wind with consideration of uprushing height as well.

The calculation results with various slope, fetch and wind speed are shown in the Figures 4D-4.



1/ Based on Saville, J: "Freeboard allowance for vaves in Inland Reservoirs," proc. ASCE, Vol. 88 No. WW2, 1962

FIGURE 4D 4 WAVE UPRUSH ONTO THE SLOPE 1/

In order to obtain the height of wave due to wind in the Palsiguan damsite, the wind speed of 30 meters per second in 10 minutes on an average is to be adopted taking into account the observed data of maximum instantaneous wind speed in Laoag (observed maximum value is 40 m/sec in July 1965) and the following conditions.

- The maximum instantaneous wind speed does not last for the blow time (usually 10 minutes) which is required for bringing about the wave due to wind.
- In many case, the wind direction does not accord with the maximum fetch direction.
- The wind speed in the Palsiguan damsite decrease by the topographical and vegetative conditions.

b) Height of Wave due to Earthquake

The height of wave due to earthquake can be obtained by Sato's formula, as follows;

$$he = \frac{K\tau}{2\pi} \cdot \sqrt{g.Ho}$$

where,
he: height of wave at upstream face of the dam due to the earthquake.
K : horizontal seismic coefficient. (K=0.2)
τ : period of seismic wave in second. (usually, τ is 1.0 second adopted)
g : gravitational acceleration (g=9.8 m/sec^2)
Ho: depth of reservoir water (m)

c) Freeboad

Estimated freeboard of the Palsiguan dam is shown in the following table. The upstream surface of Palsiguan dam is formed with rock zone by the materials obtained from quarry site, therefore, the "riprap slope" was adopted as the height of wave due to wind.

F	hw	Ho	he	ha	hi	Hf
(m)	(m)	(m)	(m)	(m)	(m)	(m)
4,400	1.05	130	1.15	0.50	1.00	$3.70 \leqq 4.00$

d) Dam Crest Elevation

The Palsiguan dam will be constructed not only for irrigation b also for hydro-electric power, and its corresponding water surface elevation are tabulated as follows;

Water level	Storage capacity	Water surface elevation	Area of water surface
	(x 10^3 cu.m)	(EL m)	(x 10^3 sq.m
Full water	232,000	334.5	5,040
Dead water	43,000	275.0	1,560

From the above table, the Palsiguan dam crest elevation without extra bank can be obtained by adding the freeboard to full water surface;

Dam crest elevation EL. 334.50 + 4.00 = EL. 338.50 m

2. Surface slope stability

In case that the dam body will be constructed by the material with less cohesion, the critical slip circle approaches to the surface of dam body. In this case, the factor of safety[1/] can be obtained from the following formula;

For upstream slope
$$F.S = \frac{(1-K.\frac{\gamma sat}{\gamma sub}.\tan\alpha)}{K.\frac{\gamma sat}{\gamma sub} + \tan\alpha} \cdot \tan\phi$$

For downstream slope
$$F.S = \frac{1 - K.\tan\alpha}{K + \tan\alpha} \cdot \tan\phi$$

where,

F.S : factor of safety

K : seismic coefficient (K=0.2 see Figure 4D-3, Appendix 4D-3)

γsat: saturated density of outer shell material (γsat=2.21 ton/cu.m [2])

γsub: submerged density of outer shell material (γsub=γsat - 1= 1.21 ton/cu.m)

α : tangential value of slope

ϕ : angle of internal friction of outer shell material (ϕ=45, see Appendix 3B-4)

[1] The factor of safety is in conformity with the Design for Dams established by Japanese National Committee on Large Dams is to say, it must not be less than 1.2 in any case.

[2] $$\gamma sat = \frac{Gs + e}{1 + e} = 2.21$$

where, Gs(Specific gravity of the rock material) = 2.7 reduced as 10% allowance from the Test result; 2.95, See Appendix 3B-4.

e(Void ratio of the rock embankment) = 0.4

3. Spillway

a) Design Flood Discharge

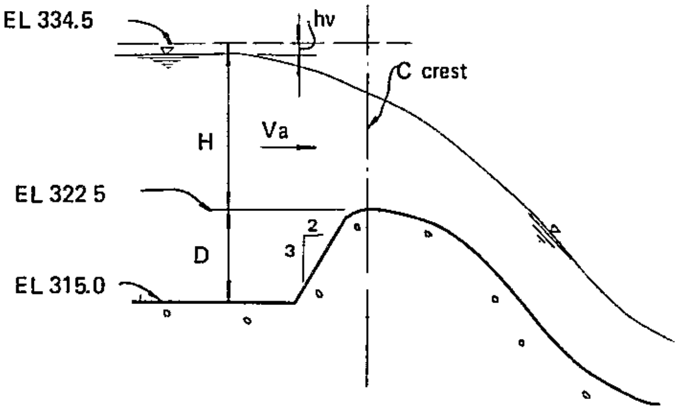
The peak discharge (inflow) and design flood discharge of the Kalsiguan dam are shown in the following table.

Dam type	Catchment area (sq.km)	Max. Peak Discharge (cu.m/sec)	Design Flood Discharge (cu.m/sec)
Earth and rockfill	153	3,070	3,070

Note; (See Chapter III.B.2)

b) Overflow Head and Width

In general, open type spillway should be adopted to the fill type dam from view points of nonresistance against overtopping from unexpected flood and hydraulic characteristic of itself. It is considered that the gate type spillway is more suitable to be adopted than the ungated spillway from the view points of design discharge and topographical feature. In the gated spillway, at least two gates or more should be provided for the purpose of diversification of risk by gate control.



The discharge coefficient of complete overflow on the weir has a close relation with a shape of weir. On assumption that D/H is 0.5[illegible], the most effective upstream slope of weir is 3 vertical to 2 horizontal and coefficient of discharge is 2.14. Length of weir, e.g. width of spillway can be obtained from the following equation, considering the contraction by piers.

$$L = \frac{Qd}{CH^{3/2}} + N.b + 2N.Kp.H = \frac{Qd}{2.14.H^{3/2}} + (b+2Kp.H)N$$

where, L : length of weir (width of spillway) (m)

H : overflow head (m)

b : width of peir (b=2.50m, place for lifting unit)

Kp : coefficient of contraction on pier.
(Kp=0 at the design discharge)

N : number of pier

The length of weir for various overflow heads in case of the Palsiguan dam spillway is estimated in the following table.

Overflow head (m)	Number of pier	$\frac{Qd}{CH^{3/2}} + 2N.Kp.H$ (m)	Gate size (m)	Length of weir (m)
H = 11.0	N = 2	39.3	3 - 11.5(a) x 13.1(b)	44.3
H = 12.0	N = 2'	34.5	3'- 12.5 x 11.5	39.5
H = 13.0	N =2	30.6	3 - 13.5 x 10.2	35.6

Note: (a) height of gate leaf
(b) width of gate leaf

c) Hydraulic Dimensions

The water depth on chute section for the Palsiguan dam is shown in the following table.

Elevation (EL m)	Water Depth1/ d (m)	Velocity V(m/sec)	Froude Number Fr
322.50	8.0	11.1	1.3
300.00	3.2	24.5	4.4
275.00	2.5	31.4	6.4
250.00	2.2	35.1	7.5
230.00	2.2	35.9	7.8

1/ calculated by Manning's roughness : n=0.014

From the flip-bucket which is installed at EL 230 m ∿ 235 m. The water jet shall fly through following points.

Distance from the Flip (m)	Elevation1/ (EL-m)
0	235.0
20	244.3
40	249.0
60	249.1
80	244.7
100	235.7
140	204.0 = river bed

1/ calculated by energy loss of 10%

4. Diversion Works

The tunnel type diversion facilities are planned for the Palsiguan dam due to the topographical condition and the diversion facilities will be used for the outlet facilities from the reservoir after completion of the dam.

a) Design Flood Discharge

The design flood discharge for diversion facilities is as follows.

Dam type	Catchment Area (sq.km)	Design Flood Discharge for Diversion Facilities (cu.m/sec)
Earth and rockfill	153	950

The open flow type tunnel has been proposed so that the dam construction will not hinder the transportation of pulpwood by the Palsiguan river flow.

Necessary tunnel sizes according to the ration of water dept to tunnel diameter is as follow;

Depth/Diameter	Tunnel Diameter[1/] (m)	Clearance (m)	Velocity[1/] (m/sec)
0.70	10.16	3.05	14.6
0.75	9.86	2.47	14.5
0.80	9.62	1.92	14.3
0.85	9.45	1.42	14.1
0.90	9.34	0.93	13.8

[1/] conditions : $Q = 950$ cu.m/sec
Slope = 7/740
Manning's $n = 0.014$

Siges of pulpwood, which is measured at Baybaytin on February 4th, 1980 are varied as follows;

	Normal (cm)	Longest (cm)	Thickest (cm)
Diameter	40	25	85
Length	150	180	145

In order to keep the pulpwood transportation, the tunnel clearance should be nearly two meters, so the tunnel diameter of 9.6 meters is adopted with the following hydraulic dimensions:

Tunnel Diameter (m)	Slope	Manning's Roughness	Depth (m)	Velocity (m/sec)
9.60	7/740	0.014	7.74	14.3

b) Crest Elevation of Coffer Dam

The necessary elevation of coffer dam can be obtained from the necessary head for tunnel flow as shown belows;

Tunnel flow		Necessary Head at Tunnel Front 1/
Velocity (m/sec)	Velocity Head (m)	(m)
14.3	10.4	15.6

Necessary Elevation at Tunnel Front 2/ (m)	Free board (m)	Top of Coffer dam (EL-m)
222.6	2.4	225.0

1/ 150% of tunnel velocity head

2/ Invert of tunnel entrance = EL 207.0 m

Table 4D-3 Stability Analysis of Gravity Dam

Downstream Slope .... M=0.88
Upstream Slope .... N1=0.0
Distance from Crest to Beginning Point of Fillet .... HF=27.00
Slope of Fillet .... N2=0.20

Condition

Full water
Earthquake, K=0.15

KA=1 KB=1 KC=1 K= 0.150

X	T	SN	SH	SM	SU	SD	N
10.500	9.240	130.094	-79.727	-106.067	6.626	21.533	22.493
15.500	13.640	246.454	-185.164	-369.060	6.167	29.970	14.591
20.500	18.040	410.114	-338.827	-984.760	4.578	40.889	10.794
25.500	22.440	621.074	-540.272	-2089.042	2.785	52.569	8.626
30.500	27.540	904.081	-789.643	-3801.125	2.758	62.898	7.423
35.500	32.940	1258.380	-1087.983	-6194.941	3.946	72.459	6.606
40.500	38.340	1675.730	-1435.213	-9377.719	5.430	81.985	5.976
45.500	43.740	2156.131	-1831.206	-13459.426	7.084	91.505	5.477

Full water
Earthquake, K=0.0

KA=1 KB=1 KC=2 K= 0.0

X	T	SN	SH	SM	SU	SD	N
10.500	9.240	130.094	-42.821	48.649	17.498	10.661	41.879
15.500	13.640	246.454	-113.771	51.809	19.739	16.398	23.746
20.500	18.040	410.114	-222.221	-98.253	20.922	24.545	16.458
25.500	22.440	621.074	-368.170	-484.979	21.898	33.456	12.658
30.500	27.540	904.081	-551.620	-1176.438	23.521	42.135	10.626
35.500	32.940	1258.380	-772.570	-2191.448	26.084	50.320	9.303
40.500	38.340	1675.730	-1031.020	-3579.922	29.095	58.319	8.319
45.500	43.740	2156.131	-1326.970	-5395.230	32.374	66.214	7.558

KA=1 KB=2 KC=1 K= 0.075

X	T	SN	SH	SM	SU	SD	N
10.500	9.240	143.911	-20.100	144.904	25.758	5.392	89.904
15.500	13.640	262.779	-77.231	324.624	29.734	8.796	35.193
20.500	18.040	428.947	-177.599	409.282	31.323	16.232	20.699
25.500	22.440	642.415	-320.767	287.998	32.060	25.197	14.595
30.500	27.540	926.333	-506.730	-161.443	32.359	34.913	11.611
35.500	32.940	1280.861	-735.972	-979.735	33.467	44.302	9.797
40.500	38.340	1698.439	-1008.431	-2235.391	35.175	53.424	8.528
45.500	43.740	2179.067	-1324.031	-4010.159	37.242	62.395	7.592

KA=1 KB=2 KC=2 K= 0.0

X	T	SN	SH	SM	SU	SD	N
10.500	9.240	143.911	-7.538	199.361	29.585	1.565	239.740
15.500	13.640	262.779	-49.988	476.052	34.618	3.913	54.373
20.500	18.040	428.947	-129.938	745.697	37.526	10.030	28.292
25.500	22.440	642.415	-247.387	924.859	39.648	17.608	18.924
30.500	27.540	926.333	-402.337	917.478	40.894	26.378	14.623
35.500	32.940	1280.861	-594.787	710.729	42.815	34.955	12.122
40.500	38.340	1698.439	-824.737	264.906	45.381	43.218	10.427
45.500	43.740	2179.067	-1092.187	-473.352	48.334	51.303	9.204

Empty
Earthquake, K=0.075

KA=1 KB=3 KC=1 K= 0.075

X	T	SN	SH	SM	SU	SD	N
10.500	9.240	150.698	11.302	277.047	35.779	-3.160	160.488
15.500	13.640	285.118	21.384	827.067	47.576	-5.769	128.149
20.500	18.040	471.238	35.343	1789.781	59.119	-6.875	105.210
25.500	22.440	709.058	53.179	3298.316	70.898	-7.703	89.288
30.500	27.540	1001.457	75.109	5174.844	77.301	-4.574	79.333
35.500	32.940	1356.777	101.758	7610.523	83.274	-0.895	71.601
40.500	38.340	1775.547	133.166	10849.355	90.595	2.026	65.157
45.500	43.740	2257.767	169.332	15022.941	98.732	4.504	59.829

Empty
Earthquake, K=0.0

KA=1 KB=3 KC=2 K= 0.0

X	T	SN	SH	SM	SU	SD	N
10.500	9.240	150.698	0.0	224.002	32.051	0.567	0.0
15.500	13.640	285.118	0.0	693.921	43.282	-1.475	0.0
20.500	18.040	471.238	0.0	1516.435	54.080	-1.836	0.0
25.500	22.440	709.058	0.0	2805.280	65.024	-1.828	0.0
30.500	27.540	1001.457	0.0	4362.996	70.879	1.849	0.0
35.500	32.940	1356.777	0.0	6358.492	76.350	6.029	0.0
40.500	38.340	1775.547	0.0	9011.992	83.095	9.526	0.0
45.500	43.740	2257.767	0.0	12431.316	90.604	12.632	0.0

IN PUT DATA NO.1

HIGH-WATER-LEVEL	2.000
LOW-WATER-LEVEL	7.700
ELEVATION OF SEDIMENT	7.700
UNIT-WEIGHT OF CONCRETE	2.350
UNIT-WEIGHT OF SEDIMENT	1.000
COEFFICIENT OF SEDIMENT-PRESSURE	0.500
COEFFICIENT OF UP-LIFT	0.200
COEFFICIENT OF SLIDE	1.000
ALLOWABLE SHEARING-STRESS	180.000

Note:

X: Dam height (m)
T: Bottom width of dam (m)
SN: Vertical force (ton)
SH: Horizontal force (ton)
SM: Moment (ton.m)
SU: Vertical stress at upstream toe (ton/sq.m)
SP: Vertical stress at downstream toe (ton/sq.m)
N: Safety factor for sliding shearing friction

3. Diversion Dams

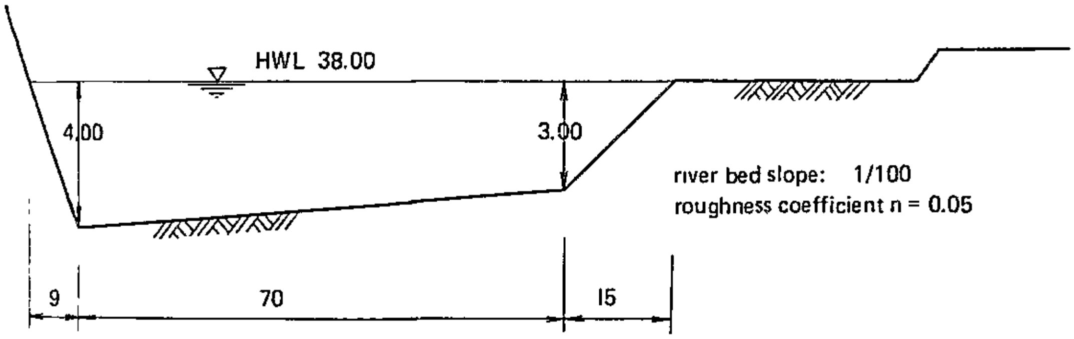
Two diversion dams, Madupayas and Tibangran diversion dams, are proposed in the project. The subsequent paragraph gives the hydraulic calculation for determining major dimensions of the facilities in case of Tibangran diversion dam.

Design Conditions

Intake discharge:	Q = 7.71 cu.m/sec
High-water discharge:	Qf = 950 cu.m/sec
Intake water surface:	NWS. 36.50 m
Dam bed elevation:	EL. 34.15 m
Dam crest elevation:	NWS. 36.50 + 0.15 = 36.65 m
Weir type:	Floating type

Present High-Water Level

Present high-water level can be estimated depending on the present typical cross section of river at the proposed site as shown below:



Now, when high-water level is assumed at WL 38.0 m, total discharge of the section is estimated at 1,188 cu.m/sec, by applying the Manning's formula.

A_1 = 4 x 9 x 1/2 = 18 sq.m

A_2 = (4 + 3) x 1/2 x 70 = 245

A_3 = 3 x 15 x 1/2 = 22.5

ΣA = 285.5 sq.m

$$P = 9.8 + 70 + 15.3 = 95.1 \text{ m}$$

$$R = 285.5/95.1 = 3.00, \; R^{2/3} = 2.08$$

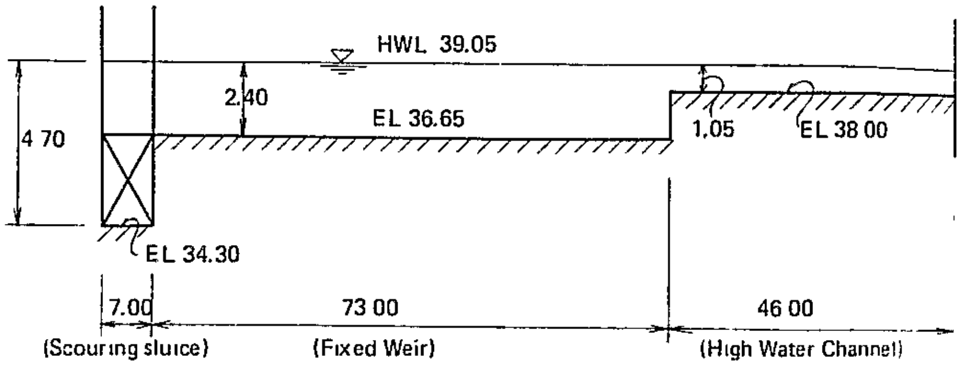
$$V = \frac{1}{0.05} \times 2.08 \times \left(\frac{1}{100}\right)^{1/2} = 4.16 \text{ m/sec}$$

$$Q = 285.5 \times 4.16 = 1{,}188 > 950 \text{ cu.m/sec}$$

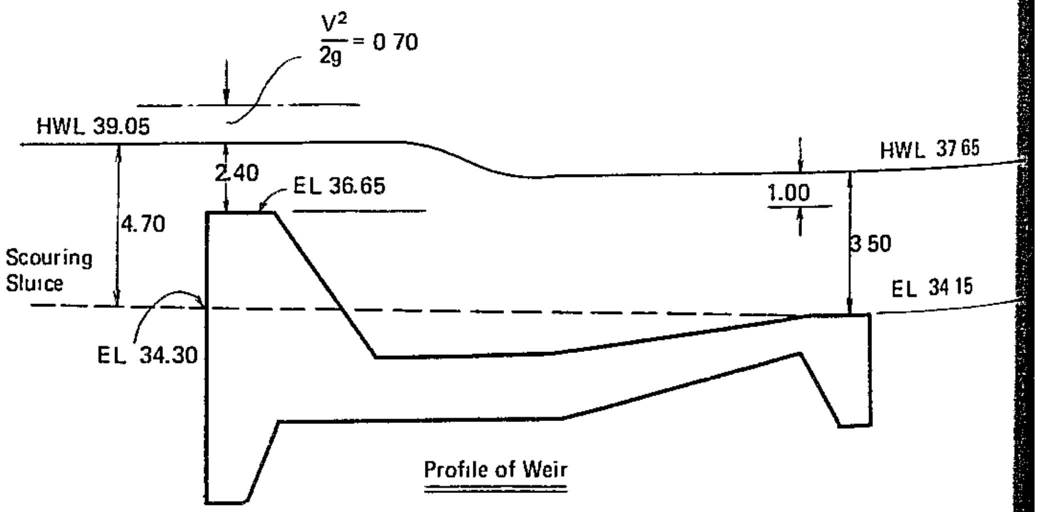
So, high-water level is decided at WL. 38.0 m.

3. Future High Water Level

Future high water level after completion of the diversion dam can be estimated by using the proposed section of weir.



Cross Section of Weir



Profile of Weir

Approaching velocity:

$A_1 = 7.00 \times 4.70 = 32.9$ sq.m

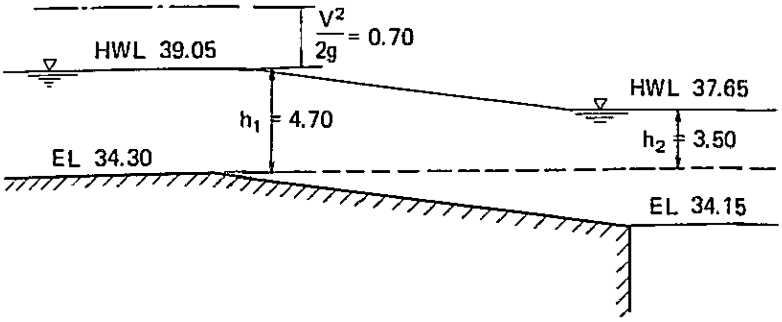
$A_2 = 73.00 \times 2.40 = 175.2$

$A_3 = 46.00 \times 1.05 = 48.3$

$\Sigma A = 256.4$ sq.m

$$V = \frac{0.50}{256.4} = 3.71 \text{ m/sec} \qquad \frac{V^2}{2g} = \frac{3.71^2}{19.6} = 0.70 \text{ m}$$

uring Sluice



$$h_2 = 3.50 < \frac{2}{3} h_1 = \frac{2}{3} \times 5.40 = 3.60 \text{ (Complete overflow)}$$

$$Qm = 1.70 \text{ Lm } (h_1 + \frac{V^2}{2g})^{3/2}$$

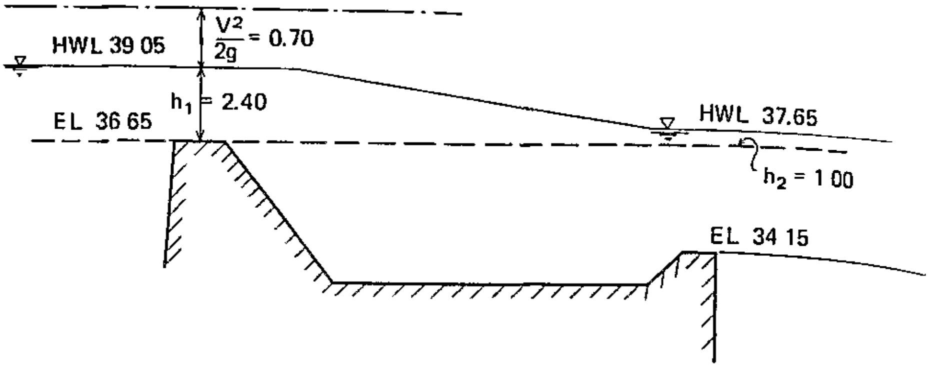
$$= 1.70 \times 6.62 \times (4.70 + 0.70)^{3/2}$$

$$\fallingdotseq 141 \text{ cu.m/sec}$$

where; $bo = 6 - 0.04\ nh_1$

$= 7.00 - 0.04 \times 2 \times 4.70 = 6.62$

Fixed Weir

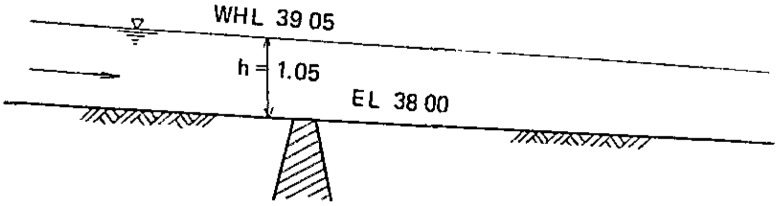


$h_2 = 1.00 < \frac{2}{3} h_1 = \frac{2}{3} \times 3.10 = 2.07$ (Complete overflow)

$Qf = 1.7\ \ell\ \ (h_1 + \frac{V^2}{2g})^{3\ \ 2}$

$= 1.7 \times 73.00 \times (2.40 + 0.70)^{3/2} \fallingdotseq 677$ cu.m/sec

High-Water Channel



$Qf' = A.V$

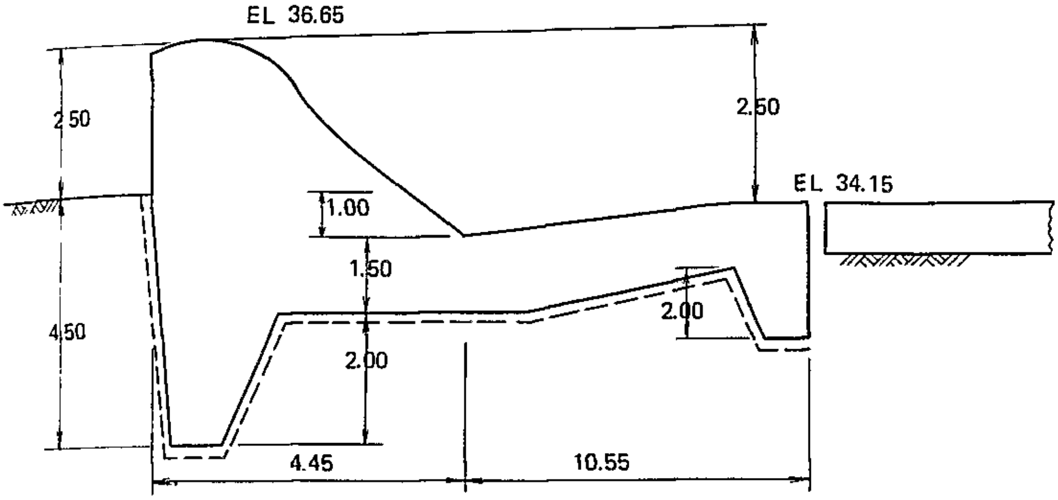
$= 46.00 \times 1.05 \times 3.71 = 179$ cu.m

Total discharge;

$\Sigma Q = Qm + Qf + Ff' = 141 + 677 + 179 = 997 > 950$ cu.m/se

Therefore, back water shall be determined at HWL 39.05 m as assumed.

4. Design of Fixed Weir



a) Length of Fore-apron

By Bligh Method;

$\ell f_1 = 0.6 \cdot C \sqrt{D_1}$

$= 0.6 \times 9 \times \sqrt{2.50} = 8.53 < 10.55$ m

Length = 10.55 m

b) Piping (Creep Length)

By Bligh Method;

$S = C \cdot \Delta h$

$= 9.0 \times 2.50 = 22.50$ m

$S' = 4.50 + 2.00 + 15.00 + 2.00 = 23.50$ m

$S < S'$ O·K

By Lane Method;

$L = C \cdot \Delta h$

$= 3.5 \times 2.50 = 8.75$

$L' = (4.50 + 2.00 + 2.00) + 1/3 \times 15.00 = 13.50$ m

$L < L'$ O·K

c) Thickness of Fore-apron

$$T_a = \frac{4}{3} \times \frac{\Delta h - hf}{r - 1}$$

$$= \frac{4}{3} \times \frac{2.50 - 1.16}{2.3 - 1} = 1.37 < 1.50 \text{ m}$$

$$hf = \frac{\Delta h}{S} \times S' = \frac{2.50}{23.50} \times (4.50 + 2.00 + 4.45) = 1.16 \text{ m}$$

Thickness = 1.50 m

d) Apron Protection Works

By Bligh Method ;

$$\ell = 0.67\ C \sqrt{D_1 q}$$

$$\ell fr = \ell - \ell f_1$$

$$\ell = 0.67 \times 9 \times \sqrt{2.50 \times 9.3} = 46.22 \text{ m}$$

where; $q = \frac{677}{73} \doteqdot 9.3$

$$\ell fr = 29.08 - 10.55 = 18.53 \text{ m}$$

Length = 20.00 m

5. Design of Scouring Sluice

a) Elevation

Elevation of scouring sluice shall be determined based on the averaged river bed slope of the stream center line after constructing the diversion dam. Accordingly, the elevation was calculated at El 34.[illegible] based on the averaged river bed slope derived from the elevation at the 100 m upstream point and the 150 m lowerstream point of the dam site.

b) Design Discharge for Flushing Sediment

In order to flush away sediment even during irrigation period, the normal water discharge in irrigation periods (Qo = 13.0 cu.m/sec) is adopted.

3) Required Water Velocity for Flushing Sediment

$$Vc = 1.5\ C\sqrt{d}$$

where; Vc: required velocity (m/sec)

C: coefficient by sand/gravel condition 4.5

d: max. particle size of sediment (m)

$$Vc = 1.5 \times 4.5 \times \sqrt{0.15} = 2.61\ \text{m/sec}$$

[illegible]) Width

The width should be determined to secure the required velocity mentioned above to lead the water course and to flow driftwood, etc.

$$Lmc = \frac{Q_0}{q}$$

$$q = \frac{Vc^3}{g}$$

where; Lmc: width (m)

q: traction discharge per unit width (cu.m/sec/m)

g: acceleration of gravity (m/sq.sec)

Q_0: design discharge for flushing away sediment (cu.m/sec)

Vc: required water velocity for flushing away sediment (m/sec)

$$q = \frac{2.61^3}{9.8} = 1.81\ \text{cu.m/sec/m}$$

$$Lmc = \frac{13}{1.81} = 7.18\ \text{m}$$

width = 7.00 m x 1 set

[illegible]) Slope

The slope is determined to secure the critical velocity in the scouring sluice canal, setting the control point on the upstream end of this canal as follows:

$$Ic \geqq \frac{n^2 g}{hc^{1/3}}$$