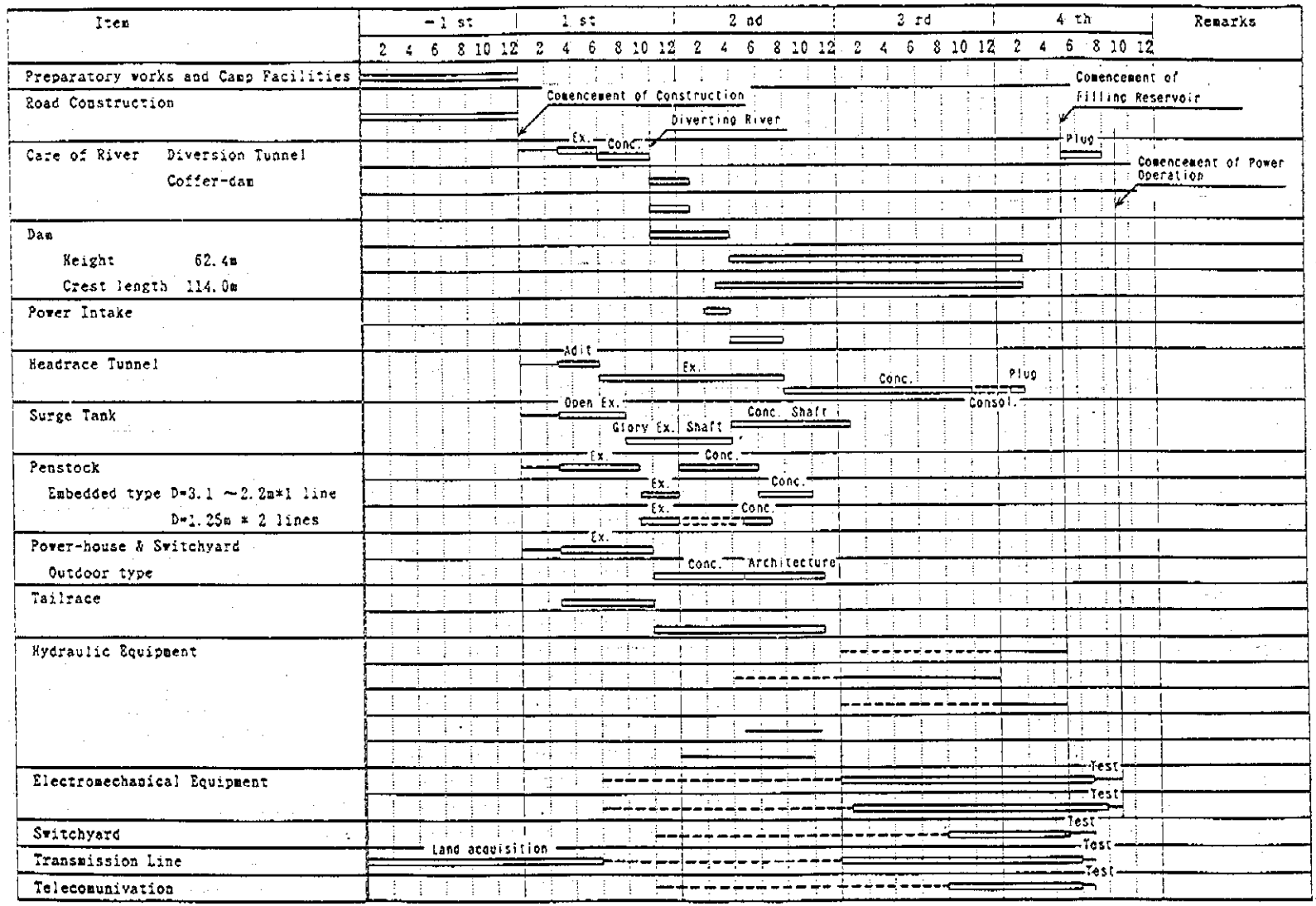

Table 13-40 Construction Schedule

Table 13-41 Project Items

High Water Level		EL. 477.4 m
Low Water Level		EL. 470.0 m
Effective Storage Capacity		653 x 10^3 m^3
Tail Water Level		EL. 84.0 m
Gross Head		389.7 m
Effective Head		359.4 m
Maximum Discharge		27 m^3/s
Installed Capacity		85 MW
Firm Power Output		82.7 MW
Annual Available Energy		389 GWh
Firm Energy		107 GWh
Secondary Energy		282 GWh
Main Facilities		
Dam	Concrete Gravity Type	62.4 m x 114 m
Headrace		3.1 m x 5,540 m
Surge Tank		8.0 m x 58 m
Penstock	Tunnel Type	3.10 m - 1.25 x 1,570 m
Powerhouse	Open Type	
	Francis Turbine	

Table 13-42 Change on Water Flow Rate by project Implementation

Items	Annual Mean		Max. Monthly Mean		Min. Monthly Mean	
Location	Without	With	Without	With	Without	With
Los Llanos	15.0	15.0	27.4	27.4	4.3	4.3
Londres	27.8	13.2	56.0	30.8	5.7	1.4
Naranjo						
Intake	28.4	14.1	57.5	33.4	5.8	1.5
Mouth	36.8	22.6	74.6	50.5	7.6	3.3
Paquita						
P.H.	3.7	17	7.5	32	0.8	5.0
Cerritos	9.8	24.1	20.0	44.1	2.0	6.3
Mouth	22.1	36.5	44.9	69.0	4.6	8.8

* m^3/sec

Table 13-43 Monthly Inflow at Cerritos Site without Project Implementation

Catchment Area 68 km^2 Annual Precipitation 7,241 mm

Unit : m^3/s

Year	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average
1971	18.53	29.09	19.28	27.83	33.36	24.29	16.12	7.01	6.42	3.22	2.22	4.55	15.99
1972	10.53	8.65	8.37	10.53	12.49	17.97	14.60	7.47	3.33	2.27	2.03	3.32	8.46
1973	6.72	17.40	15.68	23.59	25.76	29.94	13.12	9.84	9.04	3.66	2.40	3.14	13.36
1974	10.49	18.69	11.85	13.64	18.83	26.59	13.89	5.24	3.13	2.23	2.20	2.62	10.78
1975	11.11	12.32	13.12	17.49	22.96	22.51	19.78	7.80	4.05	2.14	1.63	1.92	11.40
1976	5.30	9.20	7.12	7.76	13.62	16.80	10.23	4.83	2.67	2.05	1.84	2.25	6.97
1977	5.41	9.23	6.46	14.47	16.57	19.88	15.26	6.68	3.05	2.14	2.01	5.46	8.88
1978	7.53	13.04	13.19	15.80	19.17	22.58	14.40	6.92	3.63	2.47	2.17	4.14	10.42
1979	11.80	13.04	11.92	14.45	20.81	22.66	14.22	7.12	4.79	2.86	1.98	3.29	10.74
1980	8.14	12.38	12.65	12.59	14.53	17.20	18.92	7.69	4.26	2.82	2.48	4.94	9.88
1981	17.61	20.28	12.61	16.66	12.32	16.56	14.12	5.77	4.72	2.79	2.84	3.79	10.84
1982	13.19	9.11	9.22	9.21	11.95	14.55	7.64	3.37	2.15	2.02	2.43	2.74	7.30
1983	3.98	8.65	6.63	8.83	15.54	19.46	19.33	9.19	4.53	3.68	3.01	3.13	8.83
1984	11.61	14.96	17.31	13.88	17.29	20.04	15.84	5.29	2.46	1.78	1.39	1.67	10.29
1985	6.72	11.08	11.57	16.73	18.87	24.15	15.86	11.08	4.28	2.29	1.71	2.36	10.56
1986	8.65	11.63	11.07	9.45	11.92	18.52	11.28	4.83	2.63	1.86	1.47	2.55	7.99
1987	8.43	9.97	13.09	16.10	11.85	12.98	9.77	5.34	2.88	1.86	1.57	1.89	7.98
1988	6.63	12.77	13.28	20.24	27.50	23.97	10.22	4.94	2.90	1.60	1.20	1.69	10.58
1989	7.24	8.86	9.00	13.83	19.92	15.34	10.92	10.04	4.52	2.62	2.25	3.36	8.99
1990	10.44	13.14	13.63	13.78	15.04	21.49	14.45	8.46	6.31	2.83	2.05	3.28	10.41
1991	8.03	12.60	11.81	11.90	13.15	15.26	10.96	6.81	3.28	2.75	1.74	2.05	8.36
1992	3.71	11.82	13.52	10.02	19.18	18.40	12.96	7.02	2.96	2.18	2.08	3.05	8.91
1993	9.68	8.39	8.98	14.55	21.31	17.82	10.19	5.11	2.92	1.90	1.76	2.50	8.76
Total	211.49	296.29	271.35	333.35	413.93	458.97	314.07	157.82	90.91	56.00	46.46	69.67	226.69
Average	9.20	12.88	11.80	14.49	18.00	19.96	13.66	6.86	3.95	2.43	2.02	3.03	9.86
Min.	3.71	8.39	6.46	7.76	11.85	12.98	7.64	3.37	2.15	1.60	1.20	1.67	6.97
Max.	18.53	29.09	19.28	27.83	33.36	29.94	19.78	11.08	9.04	3.68	3.01	5.46	15.99

Table 13-44 Monthly Inflow at Cerritos Site with Project Implementation

Catchment Area : 230 km^2

Unit : m^3/s

Year	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average
1971	43.53	54.09	44.28	52.83	58.36	49.29	39.29	18.73	17.33	9.46	6.83	12.74	33.89
1972	26.80	22.62	21.96	26.88	31.32	42.97	35.97	19.82	9.75	6.97	6.33	9.48	21.74
1973	17.92	42.07	38.21	48.59	50.76	54.94	32.64	25.35	23.44	10.56	7.33	9.24	30.09
1974	26.73	43.69	29.82	33.69	43.83	51.59	34.36	14.48	9.24	6.86	6.78	7.87	25.74
1975	27.90	30.87	32.73	42.18	47.96	47.51	44.78	20.65	11.55	6.63	5.22	6.00	27.00
1976	14.37	23.91	19.04	20.54	33.71	40.62	26.22	13.49	8.05	6.37	5.78	6.89	18.25
1977	14.75	23.79	17.48	35.53	40.11	44.88	37.43	17.95	9.03	6.61	6.24	14.45	22.35
1978	19.95	32.51	32.92	38.61	44.17	47.58	35.48	18.54	10.52	7.52	6.69	11.60	25.51
1979	29.72	32.48	30.05	35.51	45.81	47.66	35.01	19.03	13.32	8.53	6.18	9.52	26.07
1980	21.34	30.90	31.41	31.51	35.79	41.66	43.92	20.37	12.09	8.44	7.53	13.59	24.88
1981	42.50	45.28	31.60	40.40	30.91	40.28	34.72	15.82	13.24	8.36	8.47	10.90	26.87
1982	32.64	23.70	23.89	23.92	29.98	35.85	20.26	9.86	6.65	6.29	7.38	8.21	19.05
1983	11.31	22.58	17.89	23.00	38.07	44.46	44.33	23.77	12.77	10.63	8.93	9.18	22.24
1984	29.09	36.75	41.91	34.45	41.86	45.04	38.63	14.61	7.48	5.64	4.55	5.29	25.44
1985	17.97	28.18	29.21	40.47	43.87	49.15	38.57	28.06	12.14	7.03	5.44	7.19	25.61
1986	21.96	29.40	28.17	24.47	30.08	43.52	28.65	13.49	7.93	5.85	4.77	7.67	20.50
1987	22.10	25.63	32.68	39.32	29.93	32.41	25.14	14.75	8.59	5.86	5.05	5.91	20.61
1988	17.78	31.71	33.08	45.24	52.50	48.97	26.11	13.78	8.63	5.13	4.00	5.33	24.36
1989	19.33	23.09	23.45	34.31	44.92	37.64	27.83	25.72	12.74	7.90	6.93	9.75	22.80
1990	26.69	32.81	33.80	34.16	37.00	46.49	35.59	22.16	17.12	8.45	6.38	9.57	25.85
1991	21.15	31.56	29.83	29.89	32.80	37.41	27.84	18.21	9.63	8.24	5.53	6.37	21.54
1992	10.65	29.74	33.63	25.79	44.18	43.40	32.39	18.72	8.80	6.77	6.20	8.40	22.39
1993	26.57	27.52	26.14	33.73	46.31	40.10	24.33	14.76	9.01	6.66	5.79	6.43	22.28
Total	542.76	724.87	683.17	795.04	934.22	1013.43	769.48	422.09	259.05	170.74	144.33	201.56	555.06
Average	23.60	31.52	29.70	34.57	40.62	44.06	33.46	18.35	11.26	7.42	6.28	8.76	24.13
Min.	10.65	22.58	17.48	20.54	29.93	32.41	20.26	9.86	6.65	5.13	4.00	5.29	18.25
Max.	43.53	54.09	44.28	52.83	58.36	54.94	44.78	28.06	23.44	10.63	8.93	14.45	33.89

Table 13-45 Monthly Inflow at the Mouth of Paquita River without Project Implementation

Catchment Area : 178.5 km^2 Annual Precipitation 6,207 mm

Unit : m^3/s

Year	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average
1971	41.70	65.45	43.37	62.62	75.06	54.65	36.27	15.76	14.45	7.24	4.98	10.23	35.98
1972	23.70	19.47	18.83	23.69	28.10	40.43	32.84	16.80	7.49	5.11	4.58	7.46	19.04
1973	15.11	39.15	35.28	53.09	57.97	67.37	29.52	22.14	20.35	8.23	5.41	7.06	30.06
1974	23.59	42.07	26.66	30.69	42.36	59.84	31.26	11.78	7.04	5.02	4.95	5.90	24.26
1975	24.99	27.71	29.53	39.37	51.67	50.65	44.50	17.54	9.12	4.82	3.68	4.33	25.66
1976	11.93	20.71	16.02	17.47	30.65	37.81	23.02	10.86	6.02	4.61	4.14	5.06	15.69
1977	12.17	20.77	14.55	32.55	37.28	44.74	34.34	15.03	6.87	4.81	4.51	12.28	19.99
1978	16.95	29.34	29.67	35.55	43.14	50.80	32.41	15.56	8.17	5.56	4.87	9.30	23.44
1979	26.55	29.33	26.82	32.51	46.83	50.99	31.99	16.03	10.77	6.43	4.45	7.40	24.17
1980	18.31	27.85	28.47	28.32	32.71	38.69	42.56	17.29	9.58	6.36	5.58	11.11	22.24
1981	39.63	45.62	28.38	37.49	27.73	37.27	31.77	12.99	10.63	6.28	6.38	8.53	24.39
1982	29.67	20.51	20.75	20.73	26.89	32.74	17.18	7.58	4.84	4.55	5.47	6.16	16.42
1983	8.95	19.46	14.92	19.88	34.97	43.80	43.49	20.68	10.19	8.28	6.77	7.05	19.87
1984	26.13	33.66	38.95	31.23	38.91	45.09	35.64	11.91	5.53	4.01	3.13	3.77	23.16
1985	15.11	24.92	26.03	37.64	42.45	54.35	35.69	24.93	9.63	5.16	3.84	5.31	23.76
1986	19.47	26.17	24.91	21.25	26.83	41.67	25.38	10.86	5.92	4.18	3.31	5.74	17.97
1987	18.98	22.44	29.44	36.23	26.66	29.21	21.97	12.01	6.48	4.18	3.54	4.25	17.95
1988	14.92	28.74	29.88	45.54	61.88	53.94	23.00	11.12	6.52	3.59	2.71	3.80	23.80
1989	16.28	19.95	20.26	31.12	44.82	34.53	24.57	22.58	10.16	5.89	5.07	7.56	20.23
1990	23.50	29.56	30.67	31.01	33.84	48.37	32.51	19.03	14.21	6.37	4.61	7.37	23.42
1991	18.07	28.35	26.58	26.78	29.59	34.33	24.67	15.32	7.37	6.18	3.91	4.61	18.81
1992	8.36	26.59	30.42	22.55	43.16	41.40	29.16	15.79	6.66	4.90	4.67	6.87	20.04
1993	21.78	18.88	20.20	32.75	47.95	40.09	22.94	11.49	6.57	4.27	3.97	5.63	19.71
Total	475.87	666.71	610.57	750.08	931.42	1032.76	706.70	355.11	204.57	126.01	104.55	156.77	510.09
Average	20.69	28.99	26.55	32.61	40.50	44.90	30.73	15.44	8.89	5.48	4.55	6.82	22.18
Min.	8.36	18.88	14.55	17.47	26.66	29.21	17.18	7.58	4.84	3.59	2.71	3.77	15.69
Max.	41.70	65.45	43.37	62.62	75.06	67.37	44.50	24.93	20.35	8.28	6.77	12.28	35.98

Table 13-46 Monthly Inflow at the Mouth of Paquita River with Project Implementation

Catchment Area : 178.5 km^2

Unit : m^3/s

Year	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average
1971	66.70	90.45	68.37	87.62	100.06	79.65	59.44	27.48	25.36	13.48	9.59	18.42	53.89
1972	39.97	33.44	32.42	40.04	46.93	65.43	54.21	29.15	13.91	9.81	8.88	13.62	32.32
1973	26.31	63.82	57.81	78.09	82.97	92.37	49.04	37.65	34.75	15.13	10.34	13.16	46.79
1974	39.83	67.07	44.63	50.74	67.36	84.84	51.73	21.02	13.15	9.65	9.53	11.15	39.23
1975	41.78	46.26	49.14	64.06	76.67	75.65	69.50	30.39	16.62	9.31	7.27	8.41	41.26
1976	21.00	35.42	27.94	30.25	50.74	61.63	39.01	19.52	11.40	8.93	8.08	9.70	26.97
1977	21.51	35.33	25.57	53.61	60.82	69.74	56.51	26.30	12.85	9.28	8.74	21.27	33.46
1978	29.37	48.81	49.40	58.36	68.14	75.80	53.49	27.18	15.06	10.61	9.39	16.76	38.53
1979	44.47	48.77	44.95	53.57	71.83	75.99	52.78	27.94	19.30	12.10	8.65	13.63	39.50
1980	31.51	46.37	47.23	47.24	53.97	63.15	67.56	29.97	17.41	11.98	10.63	19.76	37.23
1981	64.52	70.62	47.37	61.23	46.32	60.99	52.37	23.04	19.15	11.85	12.01	15.64	40.43
1982	49.12	35.10	35.42	35.44	44.92	54.04	29.80	14.07	9.34	8.82	10.42	11.63	28.18
1983	16.28	33.39	26.18	34.05	57.50	68.80	68.49	35.26	18.43	15.23	12.69	13.10	33.28
1984	43.61	55.45	63.55	51.80	63.48	70.09	58.43	21.23	10.55	7.87	6.29	7.39	38.31
1985	26.36	42.02	43.67	61.38	67.45	79.35	58.40	41.91	17.49	9.90	7.57	10.14	38.81
1986	32.78	43.94	42.01	36.27	44.99	66.67	42.75	19.52	11.22	8.17	6.61	10.86	30.48
1987	32.65	38.10	49.03	59.45	44.74	48.64	37.34	21.42	12.19	8.18	7.02	8.27	30.59
1988	26.07	47.68	49.68	70.54	86.88	78.94	38.89	19.96	12.25	7.12	5.51	7.44	37.58
1989	28.37	34.18	34.71	51.60	69.82	56.83	41.48	38.26	18.38	11.17	9.75	13.95	34.04
1990	39.75	49.23	50.84	51.39	55.80	73.37	53.65	32.73	25.02	11.99	8.94	13.66	38.86
1991	31.19	47.31	44.60	44.77	49.24	56.48	41.55	26.72	13.72	11.67	7.70	8.93	31.99
1992	15.30	44.51	50.53	38.32	68.16	66.40	48.59	27.49	12.50	9.49	8.79	12.22	33.52
1993	38.67	38.01	37.36	51.93	72.95	62.37	37.08	21.14	12.66	9.03	8.00	9.56	33.23
Total	807.14	1095.29	1022.39	1211.77	1451.71	1587.22	1162.11	619.38	372.71	240.75	202.42	288.66	838.46
Average	35.09	47.62	44.45	52.69	63.12	69.01	50.53	26.93	16.20	10.47	8.80	12.55	36.45
Min.	15.30	33.39	25.57	30.25	44.74	48.64	29.80	14.07	9.34	7.12	5.51	7.39	26.97
Max.	66.70	90.45	68.37	87.62	100.06	92.37	69.50	41.91	34.75	15.23	12.69	21.27	53.89

Table 13-47 Monthly Average Inflow at the River Mouth of Naranjo without Project Implementation

Catchment Area : 332 km^2 Annual Precipitation 5.543 mm

Unit : m^3/s

Year	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average
1971	69.26	108.71	72.04	104.01	124.67	90.77	60.25	26.18	24.00	12.02	8.28	17.00	59.77
1972	39.36	32.33	31.28	39.35	46.67	67.16	54.55	27.90	12.45	8.48	7.60	12.39	31.63
1973	25.11	65.03	58.60	88.17	96.28	111.90	49.04	36.78	33.80	13.67	8.99	11.73	49.92
1974	39.19	69.87	44.27	50.97	70.36	99.40	51.93	19.57	11.70	8.33	8.23	9.80	40.30
1975	41.50	46.03	49.05	65.39	85.82	84.13	73.92	29.14	15.15	8.01	6.11	7.19	42.62
1976	19.82	34.40	26.61	29.02	50.90	62.80	38.24	18.04	10.00	7.65	6.88	8.40	26.06
1977	20.21	34.50	24.16	54.07	61.92	74.30	57.04	24.96	11.41	7.99	7.49	20.39	33.20
1978	28.15	48.73	49.28	59.05	71.66	84.38	53.83	25.85	13.56	9.24	8.09	15.45	38.94
1979	44.10	48.72	44.54	54.00	77.78	84.70	53.14	26.62	17.89	10.68	7.39	12.29	40.15
1980	30.42	46.26	47.28	47.04	54.32	64.27	70.70	28.73	15.91	10.56	9.26	18.45	36.93
1981	65.82	75.78	47.14	62.27	46.06	61.90	52.77	21.58	17.65	10.44	10.60	14.16	40.51
1982	49.28	34.06	34.46	34.44	44.66	54.38	28.54	12.59	8.04	7.56	9.09	10.24	27.28
1983	14.87	32.32	24.79	33.01	58.08	72.75	72.24	34.36	16.92	13.75	11.25	11.71	33.00
1984	43.41	55.91	64.69	51.87	64.63	74.89	59.20	19.78	9.18	6.66	5.20	6.26	38.47
1985	25.11	41.40	43.24	62.52	70.51	90.28	59.28	41.41	16.00	8.57	6.38	8.83	39.46
1986	32.35	43.46	41.37	35.30	44.57	69.21	42.16	18.04	9.84	6.94	5.50	9.53	29.85
1987	31.52	37.27	48.91	60.18	44.27	48.52	36.50	19.94	10.76	6.94	5.88	7.06	29.81
1988	24.79	47.73	49.62	75.65	102.78	89.60	38.20	18.48	10.84	5.96	4.50	6.31	39.54
1989	27.05	33.13	33.65	51.69	74.44	57.35	40.81	37.51	16.88	9.78	8.43	12.55	33.61
1990	39.03	49.11	50.94	51.51	56.21	80.33	53.99	31.61	23.60	10.58	7.65	12.25	38.90
1991	30.02	47.10	44.14	44.49	49.15	57.03	40.97	25.45	12.25	10.26	6.50	7.65	31.25
1992	13.88	44.17	50.53	37.46	71.68	68.77	48.43	26.22	11.06	8.13	7.76	11.41	33.29
1993	36.18	31.36	33.54	54.39	79.64	66.60	38.10	19.09	10.92	7.09	6.59	9.36	32.74
Total	790.42	1107.39	1014.14	1245.86	1547.06	1715.38	1173.81	589.83	339.79	209.29	173.65	260.40	847.25
Average	34.37	48.15	44.09	54.17	67.26	74.58	51.04	25.64	14.77	9.10	7.55	11.32	36.84
Min.	13.88	31.36	24.16	29.02	44.27	48.52	28.54	12.59	8.04	5.96	4.50	6.26	26.06
Max.	69.26	108.71	72.04	104.01	124.67	111.90	73.92	41.41	33.80	13.75	11.25	20.39	59.77

Table 13-48 Monthly Average Inflow at the River Mouth of Naranjo with Project Implementation

Catchment Area : 332 km^2

Unit : m^3/s

Year	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average
1971	44.26	83.71	47.04	79.01	99.67	65.77	37.08	14.46	13.09	5.78	3.67	8.81	41.86
1972	23.09	18.36	17.69	23.00	27.84	42.16	33.18	15.55	6.03	3.78	3.30	6.23	18.35
1973	13.91	40.36	36.07	63.17	71.28	86.90	29.52	21.27	19.40	6.77	4.06	5.63	33.19
1974	22.95	44.87	26.30	30.92	45.36	74.40	31.46	10.33	5.59	3.70	3.65	4.55	25.34
1975	24.71	27.48	29.44	40.70	60.82	59.13	48.92	16.29	7.65	3.52	2.52	3.11	27.02
1976	10.75	19.69	14.69	16.24	30.81	38.98	22.25	9.38	4.62	3.33	2.94	3.76	14.79
1977	10.87	19.94	13.14	33.01	38.38	49.30	34.87	13.69	5.43	3.52	3.26	11.40	19.73
1978	15.73	29.26	29.55	36.24	46.66	59.38	32.75	14.23	6.67	4.19	3.57	7.99	23.85
1979	26.18	29.28	26.41	32.94	52.78	59.70	32.35	14.71	9.36	5.01	3.19	6.06	24.83
1980	17.22	27.74	28.52	28.12	33.06	39.81	45.70	16.05	8.08	4.94	4.21	9.80	21.94
1981	40.93	50.78	28.15	38.53	27.47	38.18	32.17	11.53	9.13	4.87	4.97	7.05	24.48
1982	29.83	19.47	19.79	19.73	26.63	33.08	15.92	6.10	3.54	3.29	4.14	4.77	15.52
1983	7.54	18.39	13.53	18.84	35.55	47.75	47.24	19.78	8.68	6.80	5.33	5.66	19.59
1984	25.93	34.12	40.09	31.30	40.06	49.89	36.41	10.46	4.16	2.80	2.04	2.64	23.32
1985	13.86	24.30	25.60	38.78	45.51	65.28	36.57	24.43	8.14	3.83	2.65	4.00	24.41
1986	19.04	25.69	24.27	20.28	26.41	44.21	24.79	9.38	4.54	2.95	2.20	4.41	17.35
1987	17.85	21.61	29.32	36.96	26.19	29.09	21.13	10.53	5.05	2.94	2.40	3.04	17.18
1988	13.64	28.79	29.82	50.65	77.78	64.60	22.31	9.64	5.11	2.43	1.70	2.67	25.76
1989	14.96	18.90	19.20	31.21	49.44	35.05	23.90	21.83	8.66	4.50	3.75	6.16	19.80
1990	22.78	29.44	30.77	31.13	34.25	55.33	32.85	17.91	12.79	4.96	3.32	5.96	23.46
1991	16.90	28.14	26.12	26.50	29.50	34.88	24.09	14.05	5.90	4.77	2.71	3.33	18.07
1992	6.94	26.25	30.42	21.69	46.68	43.77	29.00	14.52	5.22	3.54	3.64	6.06	19.81
1993	19.29	12.23	16.38	35.21	54.64	44.32	23.96	9.44	4.83	2.33	2.56	5.43	19.22
Total	459.15	678.81	602.32	784.17	1026.77	1160.92	718.40	325.56	171.65	94.55	75.78	128.51	518.88
Average	19.96	29.51	26.19	34.09	44.64	50.47	31.23	14.15	7.46	4.11	3.29	5.59	22.56
Min.	6.94	12.23	13.14	16.24	26.19	29.09	15.92	6.10	3.54	2.33	1.70	2.64	14.79
Max.	44.26	83.71	47.04	79.01	99.67	86.90	48.92	24.43	19.40	6.80	5.33	11.40	41.86

Table 13-49 Monthly Inflow at the Intake without Project Implementation

Catchment Area : 230 km^2 Annual Precipitation 6.167 mm

Unit : m^3/s

Year	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average
1971	53.38	83.79	55.53	80.17	96.09	69.96	46.44	20.18	18.50	9.26	6.38	13.10	46.07
1972	30.34	24.92	24.11	30.33	35.97	51.76	42.04	21.50	9.59	6.54	5.86	9.55	24.38
1973	19.35	50.12	45.16	67.96	74.21	86.24	37.80	28.35	26.05	10.54	6.93	9.04	38.48
1974	30.21	53.85	34.12	39.28	54.23	76.61	40.02	15.08	9.02	6.42	6.34	7.55	31.06
1975	31.99	35.48	37.81	50.40	66.15	64.84	56.97	22.46	11.68	6.18	4.71	5.54	32.85
1976	15.28	26.51	20.51	22.37	39.23	48.41	29.48	13.90	7.71	5.90	5.30	6.47	20.09
1977	15.57	26.59	18.62	41.68	47.73	57.27	43.96	19.24	8.79	6.16	5.78	15.72	25.59
1978	21.70	37.56	37.98	45.51	55.23	65.04	41.49	19.92	10.45	7.12	6.24	11.91	30.01
1979	33.99	37.55	34.33	41.62	59.95	65.28	40.96	20.52	13.79	8.23	5.69	9.47	30.95
1980	23.44	35.65	36.44	36.26	41.87	49.53	54.49	22.14	12.26	8.14	7.14	14.22	28.47
1981	50.73	58.41	36.33	48.00	35.50	47.71	40.67	16.63	13.60	8.04	8.17	10.92	31.23
1982	37.98	26.25	26.56	26.54	34.42	41.91	22.00	9.71	6.20	5.83	7.01	7.89	21.03
1983	11.46	24.91	19.10	25.44	44.76	56.07	55.68	26.48	13.04	10.60	8.67	9.03	25.44
1984	33.46	43.09	49.86	39.98	49.81	57.72	45.63	15.25	7.08	5.13	4.01	4.82	29.65
1985	19.35	31.91	33.32	48.19	54.35	69.58	45.69	31.92	12.33	6.61	4.91	6.80	30.41
1986	24.93	33.50	31.89	27.21	34.35	53.34	32.49	13.90	7.58	5.35	4.24	7.35	23.01
1987	24.30	28.73	37.69	46.38	34.12	37.40	28.13	15.37	8.29	5.35	4.53	5.44	22.98
1988	19.10	36.79	38.25	58.31	79.22	69.06	29.45	14.24	8.35	4.60	3.47	4.86	30.47
1989	20.85	25.54	25.94	39.84	57.37	44.20	31.46	28.91	13.01	7.54	6.49	9.68	25.90
1990	30.08	37.85	39.26	39.71	43.33	61.92	41.61	24.37	18.19	8.16	5.90	9.44	29.98
1991	23.14	36.30	34.02	34.29	37.88	43.95	31.58	19.62	9.44	7.91	5.01	5.90	24.09
1992	10.70	34.04	38.95	28.87	55.25	53.00	37.33	20.21	8.53	6.27	5.98	8.79	25.66
1993	27.89	24.17	25.85	41.92	61.38	51.33	29.36	14.71	8.41	5.47	5.08	7.21	25.23
Total	609.22	853.53	781.66	960.26	1192.41	1322.15	904.72	454.61	261.89	161.32	133.84	200.70	653.03
Average	26.49	37.11	33.99	41.75	51.84	57.48	39.34	19.77	11.39	7.01	5.82	8.73	28.39
Min.	10.70	24.17	18.62	22.37	34.12	37.40	22.00	9.71	6.20	4.60	3.47	4.82	20.09
Max.	53.38	83.79	55.53	80.17	96.09	86.24	56.97	31.92	26.05	10.60	8.67	15.72	46.07

Table 13-50 Monthly Inflow at the Intake with Project Implementation

Catchment Area : 230 km^2

Unit : m^3/s

Year	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Average
1971	28.38	58.79	30.53	55.17	71.09	44.96	23.27	8.46	7.59	3.02	1.77	4.91	28.16
1972	14.07	10.95	10.52	13.98	17.14	26.76	20.67	9.15	3.17	1.84	1.56	3.39	11.10
1973	8.15	25.45	22.63	42.96	49.21	61.24	18.28	12.84	11.65	3.64	2.00	2.94	21.75
1974	13.97	28.85	16.15	19.23	29.23	51.61	19.55	5.84	2.91	1.79	1.76	2.30	16.10
1975	15.20	16.93	18.20	25.71	41.15	39.84	31.97	9.61	4.18	1.69	1.12	1.46	17.25
1976	6.21	11.80	8.59	9.59	19.14	24.59	13.49	5.24	2.33	1.58	1.36	1.83	8.81
1977	6.23	12.03	7.60	20.62	24.19	32.27	21.79	7.97	2.81	1.69	1.55	6.73	12.12
1978	9.28	18.09	18.25	22.70	30.23	40.04	20.41	8.30	3.56	2.07	1.72	4.45	14.93
1979	16.07	18.11	16.20	20.56	34.95	40.28	20.17	8.61	5.26	2.56	1.49	3.24	15.63
1980	10.24	17.13	17.68	17.34	20.61	25.07	29.49	9.46	4.43	2.52	2.09	5.57	13.47
1981	25.84	33.41	17.34	24.26	16.91	23.99	20.07	6.58	5.08	2.47	2.54	3.81	15.19
1982	18.53	11.66	11.89	11.83	16.39	20.61	9.38	3.22	1.70	1.56	2.06	2.42	9.27
1983	4.13	10.98	7.84	11.27	22.23	31.07	30.68	11.90	4.80	3.65	2.75	2.98	12.02
1984	15.98	21.30	25.26	19.41	25.24	32.72	22.84	5.93	3.66	1.27	0.85	1.20	14.51
1985	8.10	14.81	15.68	24.45	29.35	44.58	22.98	14.94	5.67	1.87	1.18	1.97	15.37
1986	11.62	15.73	14.79	12.19	16.19	28.34	15.12	5.24	2.28	1.36	0.94	2.23	10.50
1987	10.63	13.07	18.10	23.16	16.04	17.97	12.76	5.96	2.58	1.35	1.05	1.42	10.34
1988	7.95	17.85	18.45	33.31	54.22	44.06	13.56	5.40	2.62	1.07	0.67	1.22	16.70
1989	8.76	11.31	11.49	19.36	32.37	21.90	14.55	13.23	4.79	2.26	1.81	3.29	12.09
1990	13.83	18.18	19.09	19.33	21.37	36.92	20.47	10.67	7.38	2.54	1.57	3.15	14.54
1991	10.02	17.34	16.00	16.30	18.23	21.80	14.70	8.92	3.09	2.42	1.22	1.58	10.91
1992	3.76	16.12	18.84	13.10	30.25	28.00	17.90	8.51	2.69	1.68	1.86	3.44	12.18
1993	11.00	5.04	8.69	22.74	36.38	29.05	15.22	5.06	2.32	0.71	1.05	3.28	11.71
Total	277.95	424.95	369.84	498.57	672.12	767.69	449.31	190.34	93.75	46.58	35.97	68.81	324.65
Average	12.08	18.48	16.08	21.68	29.22	33.38	19.54	8.28	4.08	2.03	1.56	2.99	14.12
Min.	3.76	5.04	7.60	9.59	16.04	17.97	9.38	3.22	1.70	0.71	0.67	1.20	8.81
Max.	28.38	58.79	30.53	55.17	71.09	61.24	31.97	14.94	11.65	3.65	2.75	6.73	28.16

Table 13-51 Salinity Tolerance of Mangrove Species

Group	Species	Groups characteristics	Max. S	Optimal S
1.	Aegiceras corniculatum	Torerant of wide range of salinity.		
	Avicenia marina		63	8-15
	Bruguiera gymnorhiza		37	8-34
	Rhizophora stylosa		74	8
2.	Acrostichum speciosum	Associated with fresh-water influence and characteristics of the middle and upper reaches of rivers.		
	Acanthus Ilicifolius			
	Heritiera littoralis			
3.	Rhizophora apiculata	Species often growing together behined frontal stands of R. stylosa.	65	8
	R. Tamarckii			
4.	Lumnitzera racemosa	Species associated with mid to inner mangrove zones.	78	
	Aegialitis annulata		85	
	Bruguiera exaristata		72	8
5.	Bruguiera parviflora	A degree of freshwater influence seems to be important and limits the distribution of this group.	66	8-17
	Ceriops decandra		67	17
6.	Cynometra iripa	Rarely or never found near river months of close to seawater influence.		
	Lumnitzera littorea			
	Rhizophora mucronata		35	
7.	Baringtonia racemosa	Species associated with freshwater influence and mid and up reaches of in restricted area.		
	Bruguiera sexangula		33	
8.	Bruguiera cylindrica	No unifying ecological features.		
	Bruguiera sexangula		33	
	Nypa fruticans			

Table 13-52 Water Nutrient Load from Intake to Mangrove Area

Date	Water Volume(m_3/s)			PO_4-P(kg/day)			TIN(kg/day)		
	TOMA	St.4	St.6-10	TOMA	St.4	St.6-10	TOMA	St.4	St.6-10
20/09/95	0.2	0.5	3.9	0.9	2.1	13	1.5	0.4	92
15/12	dry	0.2	0.7						
06/01/95	dry	0.6	0.4						
18-19/01	1.44	2	0.9						
25/01					0.9	12		3.7	
					(43)	(92)		(925)	(15)
					[4]	[7]		[26]	[18]
01-02/02	1.24	0.4	0.4		5.9	6.2		2	1.6
					(280)	(48)		(500)	(2)
					[28]	[3]		[15]	[2]
15/02	?				1.8	9.8		1.5	3.7
					(86)	(75)		(375)	(4)
					[9]	[5]		[11]	[5]
22/02	?	?	0.7						
	(1.7)	(0.7)	(1.9)						
08/03	1.44	0.5	0.7						
23/03	1.46	0.8	2						
22/03	?				21	180		14	79
06/04/95	1.52	0.7	4.4						
19/04	?	?	?						
10/05	?	0.91	1.89						

* : ( )shows (%) by the bese of value on 20/09/94.
[ ] shows (%) by the base of value on 22/03/95.

Table 13-53 Salinity changes at Estero Negro (1995)

Date	Tide Cond.	0m	0.5m	1m	2m	Inflow Sum
22/02						0.7
27/02	Low	2.3-27.5	2.3-29.5	27.9-31.2		
	High	30.2-33	32.2-33	32.3-33	32.6-33	
28/02	High	29.8-32.7	31-32.7	31-32.7	31.2-32.7	
01/03	Low	3.3-17.6	4-8.2	4.1		
03/03						0.7
23/03						2.0
29/03	Low	32.3-33.8	32.8-34.2	32.9-34.2		
	High	28.9-32.8	6-32.8	31.5-32.8	32.1-32.8	
06/04						4.4

* : Inflow sum shows total water flow rate (m^3/sec) from channels St.6,7,8,9,10,to mangrove area.

Table 13-54 Salinity changes at Naranjo River Mouth (1995)

Date	Tide Cond.	0m	0.5m	1m	2m	Naranjo
02/02						6.73
27/02	Low	2.2-13.7	0.9-2	26.7-32.4	29.7	
	High	2.7-20.5	32.2-32.5	32.8	33.0	
28/02	High	2.1-15.3	28.4-31.7	31.7-32.4		
01/03	Low	0.9-2	0.9	0.9		
09/03						4.15
22/03						5.84
29/03	High	31.9-33.4	31.9-34.2	31.9		
	Low	2.2-4.5	30.4-32.7	32.1-32.8	32.7-32.8	
05/04						12.2
19/04						9.42
29/04	High	0.7-1	1.2-3.7	1.2-0.0	20.0-28.5	
26/04	Low	0.0	0.0	0.7	4.8	8.8

* Naranjo means Water flow Rate(m^3/sec) at Londres point in Naranjo river.

Table 13-55 (1) Land Acquisition Cost

Category	Quantity Land		Type	Unit Price	Expense
1. Land	(ha)				
1. 1 Permanent Use					
· Reservoir		11.5	Forest(Wasteland)	200	2,300×1,000
· Dam and Intake		2.0	Wasteland	80	160
· Surge Tank		1.7	Meadow	300	510
· Powerhouse and Switchyard		3.1	Meadow	300	930
	Sub.Total	19.2			3,900×1,000
· Dam, Disposal Area		2.0	Meadow	300	
· Headrace-Work Adit-A Dispersal Area		1.1	Meadow	300	
· Power Plant-Disposal Area		1.4			
	Sub.Total	4.5			1,350×1,000
		(km)			
· Dam Access Road		4.3	Meadow	300	
· Headrace, Adit-A Access R.		2.4	Meadow	300	
· Powerhouse Access Road		0.8	Meadow		
· Surge Tank Access Road		5.6	Meadow	300	
· Penstock, Work Adits		1.1	Meadow	300	
· Access Road	Total (km)	14.2	Meadow	300	
	Width (m)	10			
	Area (ha)	14.2			4,260×1,000
	Total(ha)	37.9			9,510×1,000

Expense Unit ; Colones

Table 13-55 (2) Land Acquisition Cost

Category	Quantity Land	Type	Unit Price	Expense
1.2 Temporary Use	(ha)			
· Dam, Quarry and Crashing Plant	4.2	Meadow	300	
· Concrete Plant and Facility	2.1	Meadow	300	
· Concrete Placing Facility	1.0	Meadow	300	
· Headrace, Work Adit-A	0.9	Meadow	300	
· Penstock, Work Adit	0.8	Meadow	300	
· Powerhouse, Borrow Area	4.2	Meadow	300	
· Powerhouse, Crashing and Concrete Plant	3.0	Meadow	300	
· Penstock Yard	1.5	Meadow	300	
· Power Plant Temporary Facility	1.0	Meadow	300	
	Total(ha) 18.7			5,610 x 1,000

Expense Unit ; Colones

Table 13-56 Amount of Water to be used (m^3/sec.)

	Jan.			Feb.			Mar.			Apr.		
Year	(A)	(B)	(C)	(A)	(B)	(C)	(A)	(B)	(C)	(A)	(B)	(C)
1971	7.39	6.72	4.92	3.02	2.51	0.71	1.77	1.10	-0.70	4.91	4.24	4.24
1972	3.17	2.50	0.70	1.84	1.18	-0.62	1.56	0.89	-0.91	3.39	2.72	1.02
1973	11.65	10.98	9.18	3.64	2.97	1.17	2.00	1.33	-0.47	2.94	2.27	0.47
1974	2.91	2.24	0.44	1.79	1.12	-0.68	1.76	1.09	-0.71	2.30	1.63	-0.17
1975	4.18	3.51	1.71	1.69	1.02	-0.78	1.12	0.45	-0.35	1.46	0.79	-1.01
1976	2.33	1.66	-0.14	1.58	0.91	-0.89	1.36	0.69	-1.11	1.83	1.16	-0.64
1977	2.81	2.14	0.34	1.69	1.02	-0.78	1.55	0.88	-0.92	6.73	6.06	4.26
1978	3.56	2.89	1.09	2.07	1.40	-0.40	1.72	1.05	-0.75	4.45	3.78	1.98
1979	5.26	4.59	2.79	2.56	1.89	0.09	1.49	0.82	-0.98	3.24	2.57	0.77
1980	4.43	3.76	1.96	2.52	1.85	0.05	2.09	1.42	-0.38	5.57	4.90	3.10
1981	5.08	4.41	2.61	2.47	1.80	0.00	2.54	1.89	0.09	3.81	3.14	1.34
1982	1.70	1.03	-0.77	1.56	0.89	-0.91	2.06	1.39	-0.41	2.24	1.75	-0.05
1983	4.80	4.13	2.33	3.65	2.89	1.09	2.75	2.08	0.28	2.98	2.31	0.51
1984	2.06	1.39	-0.41	1.27	0.60	-1.20	0.85	0.18	-1.62	1.20	0.53	-1.27
1985	4.47	3.80	2.00	1.87	1.20	-0.60	1.18	0.51	-1.29	1.97	1.30	-0.50
1986	2.28	1.61	-0.19	1.36	0.69	-1.11	0.94	0.27	-1.53	2.23	1.63	-0.17
1987	3.58	2.91	1.11	1.45	0.68	-1.12	1.05	0.38	-1.42	1.42	0.75	-1.05
1988	2.62	1.94	0.14	1.07	0.39	-1.41	0.67	0.00	-1.80	1.22	0.55	-1.25
1989	4.79	4.12	2.32	2.26	1.59	-0.21	1.81	1.14	-0.66	3.29	2.62	0.82
1990	7.38	6.71	4.91	2.54	1.89	0.09	1.57	0.90	-0.90	3.15	2.48	0.68
1991	3.09	2.42	0.62	2.42	1.75	-0.05	1.22	0.55	-1.25	1.58	0.91	-0.89
1992	2.69	2.02	0.22	1.68	1.01	-0.79	1.86	1.19	-0.61	3.44	2.77	0.97
1993	2.32	1.65	-0.15	0.71	0.04	-1.76	1.05	0.38	-1.42	3.28	2.61	0.81
Mean	4.08			2.03			1.56			2.99		
Max.	1.70			0.71			0.67			1.20		
Max	11.65			3.65			2.75			6.73		
Number of Months			5			16			21			10
Percentage						57%(52/92)						

Table 13-57 Summary of Impacts

Item	Impact and solution
Naranjo River	
1. Topography of river mouth	• No serious influences (Supplement the earth and sand to river mouth on the time of flood)
2. Mangrove protection	• No serious change by maintaining existing fresh water supply system (Water volume to be supplied, nutrient load)
3. Aquatic organisms	• No serious influences by preservation of mangrove and future fresh water runoff
4. Fauna and flora	• No serious influences (Vegetation study shall be planned to confirm the distribution of precious species)
5. Intake of water to palm plantation	• Lack in water to be used (Either compensation or alternative water supply facility is necessary)
6. Shrimp breeding facility	• No serious influence
7. Underground water utilization	• Monitoring and sampling a deep underground water
8. River rafting	• No serious influences (Operation season only changes)
Paqiota River	
1. Flood problems at Cerritos	• No serious influence (Measures by operation plan)
2. Underground water utilization	• Monitoring and sampling of deep underground water
3. Erosion at Paquita river mouth	• Sending an urgent measures to governmental conference
4. Fishery	• No serious influences on operation of boat and fishing activities

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14.1 Economic Evaluation

14.1.1 Methodology

(1) Basic Approach

In general, economic evaluation of a development project is designed to measure its socio-economic impacts on the country as a whole by comparing two cases; the project is implemented and the project is not implemented.

The economic evaluation employs indices such as net present value of the project, benefit/cost ratio and economic internal rate of return, which are calculated from benefit and cost of the project by using the Discounted Cash Flow method.

To obtain economic benefit and cost of a project, market prices should be converted to real benefit and cost, since market prices are generally distorted due to taxes, government subsidies, import control, import duties, public charges, minimum wages, and other government intervention and monopolistic pricing. By excluding such distortions in price, approximation is sought to obtain prices of goods and services prevailing in the international market (international market price).

A method to calculate benefit and costs using international market prices (border prices has been widely adopted by international financing organizations such as the World Bank, based on an understanding that these prices are formed within free competitions, though which might not be perfect.

Phase 1: To exclude items to be transferred to national income from market prices

Phase 2: To convert market prices into border prices, item by item such as tradable goods, non-tradable goods, skilled labor, non-skilled labor, etc.

Phase 3: To calculate internal rate of return based on border prices, and to compare the rate with the opportunity cost of capital of the country.

Phase 4: To make socio-economic evaluation in consideration of national savings and income distribution.

Economic evaluation of Los Llanos Hydroelectric Power Project (hereinafter called "the Project") will be carried out up to the Phase 3.

(2) Method of Evaluation

In an economic evaluation of a power development project, it is ideal to measure the benefit which belongs to the project itself, using long term marginal cost method and a tariff system whenever possible. However, when it is difficult to calculate the benefit this way, another method is commonly adopted: to calculate the cost saving of an alternative project which has the equivalent effect as the said project, assuming the saving to be the benefit of the relevant project. This "alternative facility approach method" is also adopted in the Project. As the Project is designed to be a peak load power generation plant, a peak load thermal power generating facility is assumed as alternative facility. The alternative facility should have a capacity to render the equivalent service to the Project (in effective dependable capacity and annual available energy).

Construction cost, operation and maintenance cost, etc. are to be calculated as the cost, while these costs for the alternative project are taken as the benefit of the Project, and economic evaluation is to be made, as described above in the section (1), by calculating Net Present Value (B-C), Benefit/Cost Ratio (B/C) and Economic Internal Rate of Return (EIRR).

In calculating each index, a cash flow sheet is to be prepared to develop project benefit and cost by year over the period of the project life. Construction cost of the Project, operation and maintenance cost after the commissioning, and fuel cost are to be reckoned in this cash flow projection, while such costs incurred from the investment as interest and depreciation are excluded.

(3) Conversion Factors for Economic Pricing

When evaluating the benefit and the cost of a project, it is necessary to convert market prices of goods and services into border prices. Simply speaking, border prices of imported goods are to be CIF price at the port of unloading, while those of exported goods are to be FOB prices at the port of shipment.

Conversion factors are used in order to obtain border prices of non-tradable goods. While these factors are obtained from the proportion of weighted average of the amount of major export/import goods and import tariff, export subsidy, and import restriction, the standard conversion factor obtained from the total amount of major export/import goods is used as a general index to show the distortion between border prices and market prices. Aside from the standard conversion factor, in some cases, different coefficients are used for consumer goods, intermediate goods, and capital goods respectively, and a shadow wage rate is used for labor cost. However, only the standard conversion factor is used in the economic evaluation of the Project when calculating border prices. The standard conversion factor now in use in Costa Rica is 1.0 for foreign currency portion and 0.83 for domestic currency portion.

(4) Discount Rate

The discount rate used for economic evaluation is to be 12%. This figure is the one also used for other projects and has been adopted based on a discussion with ICE.

14.1.2 Economic Cost of the Project

Financial cost of the Project, calculated at market price, is described in Chapter 12.2 "Construction Cost". Table 14-1 shows the cost of the initial investment. The economic cost is calculated by excluding the transfer items from the financial cost, and the standard conversion factor, as stated in 14.1.1 (3), was applied.

Annual operation and maintenance cost is obtained by applying the following ratios to the economic construction cost. The same ratios used for Pirris Project are employed here.

(Unit: 1000 US dollar)

Item	Ratio	Construction Cost	O&M Cost
Civil Facilities	0.5%	78,370.5	391.9
Hydraulic Equipment	1.5%	10,692.3	160.4
Electro-Mecha. Equipment	1.5%	32,787.6	491.8
Transmission Line	1.5%	4,961.8	74.4
Total	-	-	1,118.5

Economic compensation cost for palm plantation (Palma Tica), as described in 13.4 "Compensation Cost", is calculated by applying the standard conversion factor.

14.1.3 Economic Benefit of the Project

As discussed earlier, alternative facility approach method is adopted for economic evaluation of the Project. Here thermal generating facility which can render the equivalent service (both in effective dependable capacity and annual available energy) to the Project is assumed. And the required cost for the thermal power generation is regarded as the benefit for the Project. The basic criteria used in this evaluation are presented in Table 14-2.

(1) Selection of Alternative Thermal Plant

Thermal power plant such as oil-fired, coal-fired or nuclear are generally considered to be alternative facility to a hydroelectric power project. Energy resources in Costa Rica are not so abundant except for lignite (reserves not known), geothermal (potential is approx. 1,200MW) and hydropower (potential is approx 9,000MW). Therefore, it is considered that future power supply will rely on coal and oil-fired thermal after development of hydropower and lignite.

Under such circumstance, a combination of gas turbine and diesel engine is selected as an alternative thermal because of the following reasons:

- Gas turbine and diesel engine are principal thermal power plants in the Power Development Program of Costa Rica.
- It is possible to estimate the cost of alternative thermal more realistically by combination of two types of power generating plant, because the alternative power plant will have the similar unit capacity now in use in Costa Rica.

Most of the output of the Project will be transmitted to the large load centers around San Jose. Therefore, the alternative thermal power plant which is taken as the basis of the economic evaluation is assumed to be located at Caldera on the coast of the Pacific Ocean, approximately 78 km west of San Jose. The output of the alternative thermal power plant is also assumed to be transmitted to San Jose. As to the transmission line for the alternative project, construction of a new line up to a nearest substation (Barranca, 10km) was considered, because the Project contemplates to construct a new transmission line to the nearest San Rafael Substation.

In addition, it is assumed that the reference point at which the Project and the alternative thermal power plant are compared is San Jose to which the output of the Project is to be supplied.

(2) Specifications of the Alternative Thermal Power Facilities

The major specifications of the alternative thermal power plant which is assumed to be the benefit of the Project are stated hereunder.

Item	Gas Turbine	Slow Speed Diesel
Installed capacity	91.9 MW	23.8 MW
Construction cost	US$56,298,000	US$44,111,000
Service life	15 years	25 years
Plant factor	30%	80%

Details of the specification is shown in Table 14-3.

(3) Cost of Alternative Thermal Power Facilities

(a) Construction cost of the Alternative Thermal Power Plant

The initial investment for the construction of the alternative thermal power plant will be as follows:

(Unit: 1,000 US$)

Item	Gas Turbine	Slow Speed Diesel	Transmission Line
1st year	-	-	48.6
2nd year	-	-	290.4
3rd year	112.6	-	159.3
4th year	49,823.7	14,821.3	1,079.4
5th year	6,361.7	29,289.7	541.2
Total	56,297.9	44,110.9	2,119.0

(b) Operation and Maintenance Cost

Annual operation and maintenance cost is obtained by multiplying a cost ratio by the construction cost (economic price) of the alternative thermal power plant.

(Unit: 1,000 US$)

Item	Rate	Construction Cost	O&M Cost
Gas Turbine	1.0%	56,297.9	563.0
Slow Speed Diesel	0.51%	44,110.9	225.0
Transmission Line	1.5%	2,119.0	31.8

(c) Fuel Cost (Coal)

Diesel Oil (for Gas Turbine) and Banker Oil (for Slow Speed Diesel) will be used for the alternative thermal power plants.

	Diesel Oil	Banker Oil
Unit fuel cost	US$0.123/ℓ	US$0.073/ℓ
Annual fuel cost	US$10,977,500	US$3,037,100

14.1.4 Economic Evaluation of the Project

As has been described above, economic evaluation of the Project is to be made using such indices as Net Present Value (B-C), Benefit/Cost Ratio (B/C) and Economic Internal Rate of Return (EIRR), applying the "cash discount flow method".

It should be pointed out that transmission line scheme contemplated in the Project is formulated on the condition that Pirris Hydropower Project will have been completed before commissioning of Los Llanos Project. Therefore the result of this evaluation is also subject to this precondition.

As a result of evaluation, it has been revealed that the Project is feasible with any index. (See Table 14-4)

(1) Net Present Value (B-C) and Benefit/Cost Ratio (B/C)

The total present value of the Project's economic cost (C) in the initial year of the Project is calculated to be US$99,117 x 10^3. Likewise, the total present value of the Project's economic benefit (B) is calculated to be US$141,506 x 10^3. Therefore, Net Present Value (B-C) is US$42,389 x 10^3, and Benefit/Cost ratio (B/C) is 1.43. As both these indices show, to construct and operate the Project is regarded to be superior, because of

its smaller cost, to installing an alternative thermal power plant which can provide an equivalent service.

(2) **Economic Internal Rate of Return (EIRR)**

A discount rate which equalizes the present value of the invested cost in the initial year of the Project with that of the alternative thermal power plant is 20.2%. Therefore, it is concluded to be advantageous to carry out the Project until the discount rate is arrived at 20.2%. This figure is larger than the opportunity cost of capital of 12% in Costa Rica. Thus the Project is deemed to be worthwhile enough for investment from an economic point of view.

14.2 Financial Evaluation

14.2.1 Method of Financial Evaluation

In a financial evaluation of an electric power project, it is usual to obtain Financial Internal Rate of Return (FIRR) by "discount cash flow method" reckoning construction cost, operation and maintenance cost, renovation cost, etc., as cost factors, while sale of electric energy produced by the project is to be reckoned as benefit. Evaluation point will be the entrance of San Rafael (Parrita) Substation.

Fund repayment plan is also prepared based on the electric sale revenue. At the same time, the financial situations of ICE have been analyzed using balance sheet and income statement.

14.2.2 Financial Cost and Benefit of the Project

(1) **Financial Cost**

Financial costs of the Project are the initial investment at market prices, renovation cost, and operation and maintenance cost. Among them, the initial investment and renovation cost have been obtained in Chapter 12.

As to operation and maintenance cost, annual amount is obtained by applying following ratios for each type of equipment. The same ratios has been used for Pirris Project.

(Unit: 1,000 US$)

Item	Rate	Construction Cost	O&M Cost
Civil structures	0.5%	85,978.3	429.9
Hydraulic equipment	1.5%	11,244.1	168.7
Electro-mechanical equipment	1.5%	34,172.0	512.6
Transmission line	1.5%	5,274.5	79.1
Total	-	-	1,190.3

(2) Financial Benefit

The financial benefit of the Project is the electricity sale revenue. The revenue is calculated based on ICE's average bulk sale tariff of 0.059 US$/kWh as of January 1995.

It is assumed that the average annual available energy of the Project (387.5 x 10^6 kWh) throughout its life corresponds to the amount of electricity that can be sold.

Thus the revenue was calculated at the average rate of 0.059 US$/kWh which amounts to 22,862.5 x 10^3 US$/year.

14.2.3 Financial Evaluation of the Project

Financial Internal Rate of Return (FIRR) has been calculated based on the financial benefit (=income from the sale of electric power) shown in Table 14-5.

The discount rate at which the financial cost equals the income (that is, the financial internal rate of return) is 12.4%. When this rate is compared to the expected average interest rates of 8.5% for borrowings for foreign currency, it can be concluded that the Project is sound from the financial point of view.

14.2.4 Loan Repayment Schedule

In general, when constructing electric power facilities, a huge amount of preinvestment is needed during the initial investment period, and an income becomes available only after the construction has been completed. The period of capital recovery is considerably long in comparison with general consumers' durables. Therefore, investment fund in many cases has loan conditions of low interest rate with a long term of deferment as well as a long term of repayment.

Considerable portion of the fund necessary to realize the Project is to be procured from international financing institutions with the rest of it from ICE's own fund. Since it is difficult to forecast the allotment at this time, as a result of a discussion with ICE, a loan repayment schedule is prepared based on the following financing conditions.

- Interest:
  8.5% for foreign currency (share: 70%)
  5.75% for domestic currency as an opportunity cost (share: 30%)
  0.75% for Commitment charge
  1.0% for Supervision and inspection charge

- Terms of repayment:
  Repayment is deferred during the construction period (5 years including preparation period)
  Repayment of principal and interest in equal installment for 15 years.

Other conditions are as follows:

- Depreciation:
  Straight line method with no residual value.
  The service life for each equipment is to be as follows:

Civil structures	50 years
Hydraulic equipment	35 years
Electro-mechanical equipment	35 years
Transmission facilities	30 years

- Operation and Maintenance Cost:
  To be obtained by multiplying a certain ratio by the construction cost of the Project.

Civil structures	0.5%
Hydraulic equipment	1.5%
Electro-mechanical equipment	1.5%
Transmission facilities	1.5%

- Price escalation:

  All costs are estimated on the basis of January 1995 with no escalation taken into account.

Loan Repayment Schedule is shown in Table 14-6, Profit and Loss Statement in Table 14-7, and Cash Flow Sheet in Table 14-8.

14.2.5 Financial Situation of ICE

ICE has two divisions: Electricity and Telecommunication. Therefore, financial situation is analyzed for ICE as a whole and for electricity division. Table 14-9 (1) shows financial indicators (1990-1994) for ICE and Table 14-9 (2) for ICE's electricity division, based on balance sheet and income statement.

The financial indicators show that ICE is not in a very good financial situation. However, some of the indicators are improving gradually over the period, which implies ICE effort to improve efficiency in their business operations. Especially it should be pointed out that their financial performance of electricity sector for this period was quite good as compared to previous years due mainly to adjustment of tariff, moderate devaluation of Colon/US dollar, and lower interest rate in the international market. This is clearly seen in their profitability and debt ratio as shown below:

	1991	1992	1993	1994
Profitability	8.67%	8.57%	10.15%	8.45%
Debt ratio	80.68%	63.85%	58.53%	55.02%

Source: Indicadores de Gestion, ICE

The following briefly explains the meaning of these indicators.

(1) Liquidity Ratio

This ratio indicates the capability of repaying current liabilities.

(2) Fixed Asset Ratio

This is the ratio of fixed assets and owned capital and indicates how much of assets is covered by own capital.

(3) Owned Capital Ratio

This ratio indicates how much of total capital is covered by owned capital.

(4) **Turnover Ratio of Fixed Assets**

This ratio indicates how efficiently fixed assets are utilized in business activities.

(5) **Turnover Ratio of Capital**

This ratio indicates how efficiently capital is utilized in business activities.

(6) **Turnover Ratio of Total Capital**

This ratio indicates how efficiently total capital, which is the sum of owned capital and liabilities, is utilized in business activities.

(7) **Owned Capital Profit Ratio**

This ratio indicates capability of earning profits.

(8) **Total Capital Profit Ratio**

This ratio indicates capability of earning profits.

14.3 Sensitivity Analysis

The sensitivity analysis was implemented for the following cases considering varying financial conditions that will raise construction costs of the Los Llanos Project by 10%, 20% and 25%, as well as the case of service life of dam being 40 years.

The evaluation of B-C, B/C were calculated on the basis of a discount rate of 12%. The results of each evaluation of B-C, B/C, EIRR and FIRR are presented below.

	B-C (10^3US$)	B/C	EIRR	FIRR
Dam Life 40 yrs	41,860	1.42	20.2%	12.3%
Original Case	42,389	1.43	20.2%	12.4%
10% UP	32,744	1.30	17.6%	11.4%
20% UP	23,100	1.20	15.5%	10.5%
25% UP	18,278	1.15	14.7%	10.1%

Table 14-1 Economic Cost in Initial Stage

(unit:Thousand US$)

Item		-1st year	1st year	2nd year	3rd year	4th year	Total
1. Civil Works							
a) Subtotal	F.C.	5,615.8	9,776.0	11,263.7	6,949.8	1,015.0	34,620.3
	L.C.	4,230.1	6,911.8	9,697.3	7,120.7	942.8	28,902.7
	T	9,845.8	16,687.8	20,961.0	14,070.5	1,957.8	63,522.9
b) Project control	F.C.	200.4	339.6	426.6	286.3	39.8	1,292.7
(a x 18.5%)	L.C.	1,621.1	2,747.6	3,451.2	2,316.7	322.3	10,459.1
	T	1,821.5	3,087.2	3,877.8	2,603.0	362.2	11,751.7
c) Contingency	F.C.	862.4	1,500.4	1,732.2	1,071.1	156.2	5,322.3
(a x 15% + b x 10%)	L.C.	796.6	1,311.5	1,799.7	1,299.8	173.6	5,381.3
	T	1,659.0	2,811.9	3,531.9	2,370.9	329.9	10,703.6
d) Total	F.C.	6,678.5	11,616.0	13,422.5	8,307.2	1,211.1	41,235.3
	L.C.	6,647.8	10,971.0	14,948.3	10,737.2	1,438.7	44,743.0
	T	13,326.4	22,587.0	28,370.8	19,044.4	2,649.8	85,978.3
2. Hydraulic Equipment	F.C.	0.0	0.0	5,123.9	654.0	1,648.2	7,426.1
a) Subtotal	L.C.	0.0	0.0	1,099.4	111.3	333.2	1,543.9
	T	0.0	0.0	6,223.4	765.3	1,981.4	8,970.1
b) Project control	F.C.	0.0	0.0	126.6	15.6	40.3	182.5
(a x 18.5%)	L.C.	0.0	0.0	1,024.7	126.0	326.2	1,476.9
	T	0.0	0.0	1,151.3	141.6	366.6	1,659.5
c) Contingency	F.C.	0.0	0.0	268.9	34.3	86.4	389.6
(a x 5% + b x 10%)	L.C.	0.0	0.0	157.4	18.2	49.3	224.9
	T	0.0	0.0	426.3	52.4	135.7	614.5
d) Total	F.C.	0.0	0.0	5,519.4	703.9	1,775.0	7,998.2
	L.C.	0.0	0.0	2,281.6	255.5	708.7	3,245.8
	T	0.0	0.0	7,801.0	959.3	2,483.7	11,244.0
3. Electromechanical	F.C.	0.0	4,149.0	692.7	16,346.3	3,020.0	24,208.0
Equipment	L.C.	0.0	0.0	0.0	1,647.7	1,405.6	3,053.3
a) Subtotal	T	0.0	4,149.0	692.7	17,994.0	4,425.6	27,261.3
b) Project control	F.C.	0.0	84.4	14.1	366.2	90.1	554.8
(a x 18.5%)	L.C.	0.0	683.1	114.1	2,962.7	728.7	4,488.6
	T	0.0	767.6	128.1	3,328.9	818.7	5,043.3
c) Contingency	F.C.	0.0	215.9	36.0	853.9	160.0	1,265.9
(a x 5% + b x 10%)	L.C.	0.0	68.3	11.4	378.7	143.1	601.5
	T	0.0	284.2	47.4	1,232.6	303.2	1,867.4
d) Total	F.C.	0.0	4,449.3	742.8	17,566.4	3,270.1	26,028.6
	L.C.	0.0	751.4	125.5	4,989.1	2,277.4	8,143.4
	T	0.0	5,200.8	868.3	22,555.5	5,547.5	34,172.0
4. Transmission Line	F.C.	0.0	637.0	1,953.0	391.0	195.0	3,182.0
a) Subtotal	L.C.	0.0	205.0	0.0	547.0	274.0	1,026.0
	T	0.0	842.0	1,953.0	938.0	469.0	4,208.0
b) Project control	F.C.	0.0	17.1	39.9	19.1	9.5	85.6
(a x 18.5%)	L.C.	0.0	138.6	322.5	154.4	77.2	692.8
	T	0.0	155.8	362.4	173.5	86.8	778.5
c) Contingency	F.C.	0.0	33.6	101.9	21.5	10.7	167.7
(a x 5% + b x 10%)	L.C.	0.0	24.1	32.3	42.8	21.4	120.6
	T	0.0	57.7	134.2	64.3	32.1	288.2
d) Total	F.C.	0.0	687.7	2,100.8	431.5	215.2	3,435.3
	L.C.	0.0	367.7	354.8	744.2	372.6	1,839.4
	T	0.0	1,055.4	2,455.6	1,175.8	587.9	5,274.7
5. TOTAL	F.C.	6,678.5	16,753.0	21,785.6	27,009.0	6,471.4	78,697.5
	L.C.	6,647.8	12,090.2	17,710.1	16,726.0	4,797.5	57,971.6
	T.	13,326.4	28,843.2	39,495.7	43,735.0	11,268.9	136,669.1

Table 14-2 Basic Criteria for Economic Study

Item	Description
Method of Analysis	Discounted Cash Flow Method
Study Period	50 Years plus Construction Period
Discount Rate	12%
Escalation	Not Considered
Shadow Price Factor (Conversion Factor)	Considered (0.83)
Service Life of Facilities	
Dam and Reservoir	50 Years
Hydro-power Plant	35 Years
Thermal Power Plant	25 Years for Diesel (slow speed), 15 Years for Gas Turbine
Transmission Line	30 Years
Exchange Rate of Currency (As of January, 1995)	US$1.00 = 168 Colones

Table 14-3 Alternative Thermal Power Plant for Studying Economic Justification

Item	Unit	Gas Turbine Thermal Power Plant		Diesel Thermal Power Plant		Pirris Hydroelectric Project	
Installed Capacity	MW	91.9		23.8		85.0	
Dependable Capacity	MW	91.9		23.8		82.7	
Losses	%	31.2		25.9		2.9	
Effective Dependable Capacity	MW	63.3		17.6		80.9	
Annual Energy Production	GWh	241.0		166.5		389.4	
Station Service Use	%	kW 5	kWh 5	kW 5	kWh 5	kW 0.3	kWh 0.3
Failure Loss	%	21	--	15	--	0.3	--
Repair Loss	%	8	--	8	--	2.0	--
Transmission Loss	%	0.3	0.1	0.2	0.1	0.3	0.2
Annual Available Energy	GWh	229.2		158.3		387.5	
Annual Plant Factor	%	30.0		80.0		34.7	
Service Life	year	15		25		50 (Civil) 35 (Hydro/Elec. Equip.)	
Thermal Efficiency	%	27.23		34.32		--	
Diesel Calorific Value	kcal/kg	10,248		--		--	
Bunker Calorific Value	kcal/kg	--		10,207		--	
Fuel Consumption Rate	kg/kWh	0.308		0.246		--	
Unit Fuel Price 1/	$/kg ($/lt.)	0.1478 (0.123)		0.0743 (0.073)		--	
Specific Weight	kg/lt.	0.832		0.982		--	
Construction Cost 2/ 3/	10^3 US$	56.298		44,111		--	
Unit Construction Cost 3/	US$/kW	612.6		1,853.4		--	
O & M Cost Ratio	%	3.58		2.02		--	
O & M Cost per year 3/	10^3 US$	1,983.9		872.3		--	
Fuel Cost per year	10^3 US$	10,975.5		3,037.1		--	

1/ : CIF Price, not including taxes
2/ : not included (interest during construction, transmission line cost)
included (project controlling cost)
3/ : Economic price

Table 14-3 (2) Alternative Thermal Power Plant for Study Economic Justification

1. Los Llanos Hydro Power Plant

1.1 Effective Dependable Capacity

Effective Dependable Capacity
= Dependable Capacity x (1 - station service) x (1 - failure loss) x (1 - repair loss) x (1 - transmission loss)
= 82.7 MW x (1-0.003) x (1-0.003) x (1-0.02) x (1-0.003)
= 80.3188 MW
= 80.3 MW

1.2 Annual Available Energy

Annual Available Energy
= Annual Energy x (1-station service) x (1 - transmission loss)
= 389.4 MWh x (1-0.003) x (1-0.002)
= 387.455 MWh
= 387.5 MWh

2. Alternative Thermal Power Plants

Dependable Capacity (= Installed Capacity)
Gas Turbine: X kW
Slow Speed Engine: Y kW

X x (1 - station service) x (1 - failure loss) x (1 - repair loss) x (1 - transmission loss)
+ Y x (1 - station service) x (1 - failure loss) x (1 - repair loss) x (1 - transmission loss)
= X x (1-0.05) x (1-0.21) x (1-0.08) x (1-0.003) + Y x (1-0.05) x (1-0.15) x (1-0.08) x (1-0.002)
= 80,300kW

X x 24h x 365 days x 0.3 x (1 - station service) x (1 - transmission loss)
+ Y x 24h x 365 days x 0.7987679 x (1 - station service) x (1 - transmission loss)
= X x 24 x 365 x 0.3 x (1-0.05) x (1-0.001) + Y x 24 x 365 x 0.7987679 x (1-0.05) x (1-0.001)
= 387,500,000 kWh

Installed Capacity		**Effective Dependable Capacity**		
X = 90,349.17 =	**90.4 MW**	62,230.3	=	**62.2 MW**
Y = 24,419.09 =	**24.4 MW**	18,090.5	=	**18.1 MW**

Annual Available Energy

Gas Turbine:	225,466,947 =	**225.5 GWh**
Slow Speed Engine:	162,033,058 =	**162.0 GWh**

Table 14-4 Economic Evaluation

(Unit: Thousand US dollars)

No.		YEAR	LOS LLANOS HYDROPOWER PROJECT					ALTERNATIVE THERMAL POWER PROJECT												(B) - (C)
								GAS TURBINE				SLOW SPEED DIESEL				TRANSMISSION		LINE	(B)	
			Construct. Cost	Transmssn Line Cost	O & M Cost	Compen-sation	(C) TOTAL COST	Constr. Cost	O & M Cost	Fuel Cost	Subtotal	Constr. Cost	O & M Cost	Fuel Cost	Subtotal	Constr. Cost	O & M Cost	Subtotal	TOTAL COST	
-1		2000	12,755	0			12,755				0				0	49		49	49	-12,706
1		2001	25,795	993			26,788				0				0	290		290	290	-26,497
2		2002	34,090	2,395			36,485	111			111				0	159		159	270	-36,215
3		2003	39,842	1,049			40,892	49,010			49,010	15,195			15,195	1,079		1,079	65,285	24,393
4		2004	9,929	524			10,453	6,258			6,258	30,028			30,028	541		541	36,827	26,374
5	1	2005			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
6	2	2006			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
7	3	2007			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
8	4	2008			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
9	5	2009			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
10	6	2010			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
11	7	2011			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
12	8	2012			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
13	9	2013			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
14	10	2014			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
15	11	2015			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
16	12	2016			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
17	13	2017			1,118	554	1,672	111	554	10,800	11,464		231	3,108	3,339		32	32	14,835	13,162
18	14	2018			1,118	554	1,672	49,010	554	10,800	60,364		231	3,108	3,339		32	32	63,735	62,062
19	15	2019			1,118	554	1,672	6,258	554	10,800	17,611		231	3,108	3,339		32	32	20,982	19,310
20	16	2020			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
21	17	2021			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
22	18	2022			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
23	19	2023			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
24	20	2024			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
25	21	2025			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
26	22	2026			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
27	23	2027			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
28	24	2028			1,118	554	1,672		554	10,800	11,354	15,195	231	3,108	18,534		32	32	29,919	28,247
29	25	2029			1,118	554	1,672		554	10,800	11,354	30,028	231	3,108	33,367		32	32	44,752	43,080
30	26	2030			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339	49	32	80	14,773	13,100
31	27	2031		993	1,118	554	2,665		554	10,800	11,354		231	3,108	3,339	290	32	322	15,015	12,349
32	28	2032		2,395	1,118	554	4,068	111	554	10,800	11,464		231	3,108	3,339	159	32	191	14,994	10,927
33	29	2033		1,049	1,118	554	2,722	49,010	554	10,800	60,364		231	3,108	3,339	1,079	32	1,111	64,814	62,092
34	30	2034		524	1,118	554	2,197	6,258	554	10,800	17,611		231	3,108	3,339	541	32	573	21,523	19,326
35	31	2035			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
36	32	2036	5,073		1,118	554	6,745		554	10,800	11,354		231	3,108	3,339		32	32	14,724	7,979
37	33	2037	8,260		1,118	554	9,933		554	10,800	11,354		231	3,108	3,339		32	32	14,724	4,792
38	34	2038	22,623		1,118	554	24,296		554	10,800	11,354		231	3,108	3,339		32	32	14,724	-9,572
39	35	2039	7,524		1,118	554	9,196		554	10,800	11,354		231	3,108	3,339		32	32	14,724	5,528
40	36	2040			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
41	37	2041			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
42	38	2042			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
43	39	2043			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
44	40	2044			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
45	41	2045			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
46	42	2046			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
47	43	2047			1,118	554	1,672	111	554	10,800	11,464		231	3,108	3,339		32	32	14,835	13,162
48	44	2048			1,118	554	1,672	49,010	554	10,800	60,364		231	3,108	3,339		32	32	63,735	62,062
49	45	2049			1,118	554	1,672	6,258	554	10,800	17,611		231	3,108	3,339		32	32	20,982	19,310
50	46	2050			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
51	47	2051			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
52	48	2052			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
53	49	2053			1,118	554	1,672		554	10,800	11,354		231	3,108	3,339		32	32	14,724	13,052
54	50	2054	-24,846	-1,654	1,118	554	-24,827	-36,919	554	10,800	-25,566		231	3,108	3,339	-706	32	-675	-22,902	1,926
TOTAL			141,045	8,270	55,924	27,700	232,939	184,597	27,690	539,990	752,277	90,446	11,530	155,410	257,386	3,532	1,589	5,121	1,014,784	781,845
Present Value I = 12%							99,117												141,506	42,389
																			N.P.V.	42,389
																			E.I.R.R.	20.2%
																			B / C	1.43

Table 14-5 Financial Evaluation

(Unit: Thousand US dollars)

No.		YEAR	LOS LLANOS HYDRO PROJECT				(B)	(B) - (C)
			Construct. Cost	Transmssn Line Cost	O & M Cost	(C) TOTAL COST	POWER SALES REVENUE	
-1		2000	14,000	0	0	14,000		-14,000
1		2001	27,788	1,055	0	28,843		-28,843
2		2002	37,040	2,456	0	39,496		-39,496
3		2003	42,559	1,176	0	43,735		-43,735
4		2004	10,681	588	0	11,269		-11,269
5	1	2005			1,190	1,190	22,863	21,672
6	2	2006			1,190	1,190	22,863	21,672
7	3	2007			1,190	1,190	22,863	21,672
8	4	2008			1,190	1,190	22,863	21,672
9	5	2009			1,190	1,190	22,863	21,672
10	6	2010			1,190	1,190	22,863	21,672
11	7	2011			1,190	1,190	22,863	21,672
12	8	2012			1,190	1,190	22,863	21,672
13	9	2013			1,190	1,190	22,863	21,672
14	10	2014			1,190	1,190	22,863	21,672
15	11	2015			1,190	1,190	22,863	21,672
16	12	2016			1,190	1,190	22,863	21,672
17	13	2017			1,190	1,190	22,863	21,672
18	14	2018			1,190	1,190	22,863	21,672
19	15	2019			1,190	1,190	22,863	21,672
20	16	2020			1,190	1,190	22,863	21,672
21	17	2021			1,190	1,190	22,863	21,672
22	18	2022			1,190	1,190	22,863	21,672
23	19	2023			1,190	1,190	22,863	21,672
24	20	2024			1,190	1,190	22,863	21,672
25	21	2025			1,190	1,190	22,863	21,672
26	22	2026			1,190	1,190	22,863	21,672
27	23	2027			1,190	1,190	22,863	21,672
28	24	2028			1,190	1,190	22,863	21,672
29	25	2029			1,190	1,190	22,863	21,672
30	26	2030			1,190	1,190	22,863	21,672
31	27	2031		1,055	1,190	2,246	22,863	20,617
32	28	2032		2,456	1,190	3,646	22,863	19,217
33	29	2033		1,176	1,190	2,366	22,863	20,497
34	30	2034		588	1,190	1,778	22,863	21,084
35	31	2035			1,190	1,190	22,863	21,672
36	32	2036	5,201		1,190	6,391	22,863	16,472
37	33	2037	8,669		1,190	9,860	22,863	13,003
38	34	2038	23,515		1,190	24,705	22,863	-1,843
39	35	2039	8,031		1,190	9,221	22,863	13,641
40	36	2040			1,190	1,190	22,863	21,672
41	37	2041			1,190	1,190	22,863	21,672
42	38	2042			1,190	1,190	22,863	21,672
43	39	2043			1,190	1,190	22,863	21,672
44	40	2044			1,190	1,190	22,863	21,672
45	41	2045			1,190	1,190	22,863	21,672
46	42	2046			1,190	1,190	22,863	21,672
47	43	2047			1,190	1,190	22,863	21,672
48	44	2048			1,190	1,190	22,863	21,672
49	45	2049			1,190	1,190	22,863	21,672
50	46	2050			1,190	1,190	22,863	21,672
51	47	2051			1,190	1,190	22,863	21,672
52	48	2052			1,190	1,190	22,863	21,672
53	49	2053			1,190	1,190	22,863	21,672
54	50	2054	-25,952	-1,053	1,190	-25,815	22,863	48,677
TOTAL			151,532	9,496	59,513	220,540	1,143,125	922,585
							F.I.R.R.	12.4%

Table 14-6 Fund Requirement and Repayment Schedule

(unit: Thousand US$)

No.	FUND REQUIREMENT			REPAYMENT SCHEDULE							
				FOREIGN CURRENCY				LOCAL CURRENCY			
	Foreign	Local	Total	Interest	Principal	Total	Balance	Interest	Principal	Total	Balance
1	9,800	4,200	14,000	(416)				(121)			
2	20,190	8,653	28,843	(1,691)				(490)			
3	27,647	11,849	39,496	(3,724)				(1,080)			
4	30,615	13,121	43,735	(6,200)				(1,798)			
5	7,888	3,381	11,269	(7,837)			96,139	(2,272)			41,203
6				8,172	1,987	10,159	94,152	2,369	1,151	3,520	40,052
7				8,003	2,156	10,159	91,996	2,303	1,217	3,520	38,835
8				7,820	2,339	10,159	89,656	2,233	1,287	3,520	37,549
9				7,621	2,538	10,159	87,118	2,159	1,361	3,520	36,188
10				7,405	2,754	10,159	84,364	2,081	1,439	3,520	34,749
11				7,171	2,988	10,159	81,376	1,998	1,522	3,520	33,228
12				6,917	3,242	10,159	78,134	1,911	1,609	3,520	31,619
13				6,641	3,518	10,159	74,616	1,818	1,702	3,520	29,917
14				6,342	3,817	10,159	70,799	1,720	1,799	3,520	28,118
15				6,018	4,141	10,159	66,658	1,617	1,903	3,520	26,215
16				5,666	4,493	10,159	62,164	1,507	2,012	3,520	24,202
17				5,284	4,875	10,159	57,289	1,392	2,128	3,520	22,074
18				4,870	5,290	10,159	52,000	1,269	2,250	3,520	19,824
19				4,420	5,739	10,159	46,261	1,140	2,380	3,520	17,444
20				3,932	6,227	10,159	40,034	1,003	2,517	3,520	14,928
21				3,403	6,756	10,159	33,277	858	2,661	3,520	12,266
22				2,829	7,331	10,159	25,947	705	2,814	3,520	9,452
23				2,205	7,954	10,159	17,993	543	2,976	3,520	6,476
24				1,529	8,630	10,159	9,363	372	3,147	3,520	3,328
25				796	9,363	10,159	0	191	3,328	3,520	0
Total	96,139	41,203	137,342	126,912	96,139	203,183		34,951	41,203	70,393	

Note: Figures in parentheses are I.D.C.

Remarks: Repayment condition

Foreign currency: 8.50%

Local currency : 5.75% (as an opportunity cost)

Grace Period : 5 years (construction period including preparation)

Table 14-7 Profit and Loss Statement

(unit:Thousand US$)

No.	Operating Revenue (A)	Operating Expenses O & M	Operating Expenses Depreci-ation	Total (B)	Operating Income (C)=A-B	Financial Expenses* F.C.	Financial Expenses* L.C.	Commitment, Inspection, Supervision	Total* (D)	Net Income (E)=C-D
1						(416)	(121)	721	(1,258)	
2						(1,691)	(490)	746	(2,927)	
3						(3,724)	(1,080)	796	(5,600)	
4						(6,200)	(1,798)	865	(8,863)	
5						(7,837)	(2,272)	942	(11,050)	
6	22,863	1,190	3,193	4,383	18,479	8,172	2,369		10,541	7,938
7	22,863	1,190	3,193	4,383	18,479	8,003	2,303		10,306	8,173
8	22,863	1,190	3,193	4,383	18,479	7,820	2,233		10,053	8,427
9	22,863	1,190	3,193	4,383	18,479	7,621	2,159		9,780	8,699
10	22,863	1,190	3,193	4,383	18,479	7,405	2,081		9,486	8,993
11	22,863	1,190	3,193	4,383	18,479	7,171	1,998		9,169	9,310
12	22,863	1,190	3,193	4,383	18,479	6,917	1,911		8,828	9,652
13	22,863	1,190	3,193	4,383	18,479	6,641	1,818		8,459	10,020
14	22,863	1,190	3,193	4,383	18,479	6,342	1,720		8,063	10,417
15	22,863	1,190	3,193	4,383	18,479	6,018	1,617		7,635	10,845
16	22,863	1,190	3,193	4,383	18,479	5,666	1,507		7,173	11,306
17	22,863	1,190	3,193	4,383	18,479	5,284	1,392		6,676	11,804
18	22,863	1,190	3,193	4,383	18,479	4,870	1,269		6,139	12,340
19	22,863	1,190	3,193	4,383	18,479	4,420	1,140		5,560	12,919
20	22,863	1,190	3,193	4,383	18,479	3,932	1,003		4,935	13,544
21	22,863	1,190	3,193	4,383	18,479	3,403	858		4,261	14,218
22	22,863	1,190	3,193	4,383	18,479	2,829	705		3,534	14,945
23	22,863	1,190	3,193	4,383	18,479	2,205	543		2,749	15,730
24	22,863	1,190	3,193	4,383	18,479	1,529	372		1,902	16,577
25	22,863	1,190	3,193	4,383	18,479	796	191		987	17,492
Total	457,250	23,806	63,860	87,666	369,584	126,912	34,951	4,069	165,933	253,350

*Note: Figures in parentheses are I.D.C.

Remarks: Operating revenue : 387.5 GWh x 0.059 US$/kWh= 22862.5 Thousand US$/year

Depreciation:

- Civil (50 years):	85,978	/ 50 =	1,719.6
- Hydro/Elec. (35 years):	45,416	/ 35 =	1,297.6
- Transm. Line (30 years):	5,275	/ 30 =	175.8
Total			3,193.0

Commitment charge: 0.75%

Inspection and supervision 1.00%

Table 14-8 Cash Flow Sheet

(unit: Thousand US$)

No.	CASH INFLOW				CASH OUTFLOW						BALANCE	
	Fund Requirement	Net Income	Depreciation	Total (A)	Construction Cost	Principal Repayment F.C.	Principal Repayment L.C.	Principal Repayment Subtotal	I.D.C.	Total (B)	Yearly (A)-(B)	Accummulation
1	14,000	0	0	14,000	14,000	0	0	0	537	14,537	-537	-537
2	28,843	0	0	28,843	28,843	0	0	0	2,181	31,024	-2,181	-2,719
3	39,496	0	0	39,496	39,496	0	0	0	4,804	44,300	-4,804	-7,522
4	43,735	0	0	43,735	43,735	0	0	0	7,998	51,733	-7,998	-15,520
5	11,269	0	0	11,269	11,269	0	0	0	10,109	21,377	-10,109	-25,629
6	0	7,938	3,193	11,131	0	1,987	1,151	3,138	0	3,138	7,993	-17,635
7	0	8,173	3,193	11,366	0	2,156	1,217	3,373	0	3,373	7,993	-9,642
8	0	8,427	3,193	11,620	0	2,339	1,287	3,626	0	3,626	7,993	-1,649
9	0	8,699	3,193	11,892	0	2,538	1,361	3,899	0	3,899	7,993	6,345
10	0	8,993	3,193	12,186	0	2,754	1,439	4,193	0	4,193	7,993	14,338
11	0	9,310	3,193	12,503	0	2,988	1,522	4,510	0	4,510	7,993	22,332
12	0	9,652	3,193	12,845	0	3,242	1,609	4,851	0	4,851	7,993	30,325
13	0	10,020	3,193	13,213	0	3,518	1,702	5,219	0	5,219	7,993	38,318
14	0	10,417	3,193	13,610	0	3,817	1,799	5,616	0	5,616	7,993	46,312
15	0	10,845	3,193	14,038	0	4,141	1,903	6,044	0	6,044	7,993	54,305
16	0	11,306	3,193	14,499	0	4,493	2,012	6,506	0	6,506	7,993	62,298
17	0	11,804	3,193	14,997	0	4,875	2,128	7,003	0	7,003	7,993	70,292
18	0	12,340	3,193	15,533	0	5,290	2,250	7,540	0	7,540	7,993	78,285
19	0	12,919	3,193	16,112	0	5,739	2,380	8,119	0	8,119	7,993	86,279
20	0	13,544	3,193	16,737	0	6,227	2,517	8,744	0	8,744	7,993	94,272
21	0	14,218	3,193	17,411	0	6,756	2,661	9,418	0	9,418	7,993	102,265
22	0	14,945	3,193	18,138	0	7,331	2,814	10,145	0	10,145	7,993	110,259
23	0	15,730	3,193	18,923	0	7,954	2,976	10,930	0	10,930	7,993	118,252
24	0	16,577	3,193	19,770	0	8,630	3,147	11,777	0	11,777	7,993	126,245
25	0	17,492	3,193	20,685	0	9,363	3,328	12,692	0	12,692	7,993	134,239
Total	137,342	233,350	63,860	434,552	137,342	96,139	41,203	137,342	25,629	300,313	134,239	

Table 14-9 (1) Financial Situation of ICE

1. ICE Total (Electricity + Telecommunication)

A: Extract from Balance Sheet and Profit & Loss Statement (1994-1990) (Unit: Thousand Colones)

Fiscal Year	1994	1993	1992	1991	1990
A. Current Asset	41,982,766	25,111,576	21,428,460	21,005,927	14,441,796
B. Current Liabilities	25,825,377	23,855,622	19,552,744	18,547,330	17,845,080
C. Fixed Asset	370,308,990	301,622,606	248,924,701	222,384,360	160,763,939
D. Total Capital	283,257,147	225,991,678	183,431,639	150,781,153	110,297,084
E. TOTAL	457,501,334	365,708,718	302,503,806	271,085,476	196,454,333
F. Total Liabilities	174,244,196	139,717,040	119,072,167	120,304,324	86,157,249
G. Net Income	13,471,509	14,813,118	17,117,055	1,736,892	1,736,892
H. Operating Revenue	67,877,997	56,021,865	46,574,169	26,694,271	26,694,271

Source: "Balance de Situacion por Sector Electrico y Telefonico" and "Estado de Ingresos y Gastos", ICE (Estados Contables)

B: Financial Situation

Fiscal Year	1994	1993	1992	1991	1990
1. Liquidity Ratio	162.6%	105.3%	109.6%	113.3%	80.9%
2. Fixed Asset Ratio	130.7%	133.5%	135.7%	147.5%	145.8%
3. Owned Capital Ratio	61.9%	61.8%	60.6%	55.6%	56.1%
4. Turnover Ratio of Fixed Asset	18.3%	18.6%	18.7%	12.0%	16.6%
5. Turnover Ratio of Capital	24.0%	24.8%	25.4%	17.7%	24.2%
6. Turnover Ratio of Total Capital	14.8%	15.3%	15.4%	9.8%	13.6%
7. Owned Capital Profit Ratio	4.8%	6.6%	9.3%	1.2%	1.6%
8. Total Capital Profit Ratio	2.9%	4.1%	5.7%	0.6%	0.9%

Table 14-9 (2) Financial Situation of ICE

2. ICE Electricity Sector

A: Extract from Balance Sheet and Profit & Loss Statement (1994-1990) (Unit: Thousand Colones)

Fiscal Year	1994	1993	1992	1991	1990
A. Current Asset	26,591,810	12,191,964	11,485,937	12,748,590	8,878,921
B. Current Liabilities	16,367,373	13,274,934	9,572,276	11,932,211	12,010,923
C. Fixed Asset	278,830,895	230,317,122	188,816,510	172,092,947	121,963,737
D. Total Capital	176,275,438	139,021,812	111,644,004	92,377,629	66,630,261
E. TOTAL	319,035,239	255,454,433	211,578,578	195,254,229	138,591,388
F. Total Liabilities	142,759,801	116,432,621	99,934,573	102,876,600	71,961,127
G. Net Income	5,841,764	7,595,886	10,428,195	-5,614,205	-1,120,624
H. Operating Revenue	37,689,694	30,554,527	25,283,377	19,370,459	13,999,126

Source: "Balance de Situacion por Sector Electrico y Telefonico" and "Estado de Ingresos y Gastos", ICE (Estados Contables)

B: Financial Situation

Fiscal Year	1994	1993	1992	1991	1990
1. Liquidity Ratio	162.5%	91.8%	120.0%	106.8%	73.9%
2. Fixed Asset Ratio	158.2%	165.7%	169.1%	186.3%	183.0%
3. Owned Capital Ratio	55.3%	54.4%	52.8%	47.3%	48.1%
4. Turnover Ratio of Fixed Asset	13.5%	13.3%	13.4%	11.3%	11.5%
5. Turnover Ratio of Capital	21.4%	22.0%	22.6%	21.0%	21.0%
6. Turnover Ratio of Total Capital	11.8%	12.0%	11.9%	9.9%	10.1%
7. Owned Capital Profit Ratio	3.3%	5.5%	9.3%	-6.1%	-1.7%
8. Total Capital Profit Ratio	1.8%	3.0%	4.9%	-2.9%	-0.8%

Chapter 15 Further Investigations

Chapter 15 Further Investigations

CHAPTER 15 FURTHER INVESTIGATIONS

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CHAPTER 15 FURTHER INVESTIGATIONS

To proceed from the detailed design stage to the implementation stage in this Project, it is necessary to further examine the topography and geology of the sites where the major civil engineering structures are installed as described in the Feasibility Study.

This chapter describes the studies to be added or continued including the topographic study, geological study, material survey, hydrologic study for downstream, environmental impact, and compensation.

15.1 Topographic Study

(1) Construction Road Route Survey:

Supplement to existing 1:5,000 scale topography map

(2) Aggregate Acquisition Site & Temporary Facility Sites:

1:1,000 Scale Topographic Survey

(3) Headrace Longitudinal Survey (Concavo Pass Point):

Approx. 250m downstream from Work Adit B

15.2 Geological/Material Study

To proceed this Project to the detailed design stage, the additional geological survey/construction shown in Table 15-1 is required for each planned site, and the route and construction material acquisition sites. (cf. Fig. 15-1 - 15.5)

Further accurate geotechnical data is required regarding the waterproofing treatment for the foundation rockbed at the dam site (downstream site).

It is necessary to confirm the dynamic characteristics of the rockbed from its surface to the structure foundation depth at the intake site.

Regarding the headrace tunnel route, it is necessary to examine the dynamic characteristics of the rockbed and the hydrographic conditions in the tunnel where the tunnel rock cover is max. 50m.

Regarding the surge tank site and penstock route, it is vital to ensure that the dynamic characteristics of the rockbed and hydrographic conditions around the civil engineering structures where the tunnel rock cover is max. 100m.
It is also necessary to ensure the concrete aggregate mine near the dam site.

15.3 Hydrologic and Meteorologic Study

15.3.1 Meteorologic Study

It is necessary to continue meteorological observations since the entire observation network required for the implementation design and construction plan is now completed. The network includes the Napoles Observation Station, newly installed for this Project study.

15.3.2 Flow Observation

It is necessary to continue flow observations since the entire observation network required for the future construction plan and operation plan is now completed. The network includes the run-off gauging station at Paquita River powerhouse site, newly installed for this Project study.

15.3.3 Site Observation

It is necessary to continue site observations at the Naranjo River downstream basin for environmental assessment in the future. The sites are described in Fig. 13-16, Channel Water Distribution. It is recommended that observations be made twice monthly from December through March in the dry season, and once monthly for the remainder of the year.