GOVERNMENT OF THE REPUBLIC OF HONDURAS
MINISTRY OF NATURAL RESOURCES

CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

UPDATING FEASIBILITY STUDY

VOLUME III

ANNEXES

FEBRUARY 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

REPORT

Volume - I		MAIN REPORT (English & Spanish)
Volume - II		ANNEXES (English)
	Annex A	General Background
	Annex B	Sectoral Background
	Annex C	Meteorology and Hydrology
	Annex D	Geology and Soils
	Annex E	Present Situation of Agriculture
	Annex F	Proposed Agriculture
Volume - III		ANNEXES (English)
	Annex G	Alternative Plans
	Annex H	Irrigation and Drainage Plan
	Annex I	Dam and Power Plan
	Annex J	Project Evaluation

ANNEX G

ALTERNATIVE PLANS

ANNEX - G

ALTERNATIVE PLANS

Table of Contents

Chapter | Page

List of Tables

List of Figures

List of Drawings

RESERVOIR OPERATION

G. ALTERNATIVE PLANS

G.1 ALTERNATIVE DAMSITES

G.1.1 Selection of Damsite

To store and secure water primarily for irrigation in the Choluteca plain, some alternative dam and reservoir sites were identified by the previous study in 1977-78, on the basis of available topographic maps on the scale of 1/50,000. These damsites are: (Refer to Figure G-01)

Damsite	Drainage Area (km^2)	Approx. Annual Runoff (MCM)
Zorillo	1,590	380
San Fernando	1,665	400
Oropoli	4,154	930
Morolica I	6,140	1,200
Morolica II	6,187	1,215

Out of these alternative damsites, the Oropoli site was found to be unfavorable for dam construction because of topographic conditions which were inferior to any other alternative damsites. The Morolica I and Morolica II sites are located some 5 km and 12 km downstream from Morolica town. At the Morolica I damsite, the Choluteca valley becomes narrowest, and is topographically superior to the Morolica II site. However, the drilling survey in 1977-78 revealed that the debris on the right abutment of the Morolica I damsite was extremely deep and outcrop of tuff near the damsite was judged as a moved rock mass. Since the bed rock was not identified at 30 m and 60 m in depth in two drill holes, the Morolica I damsite was concluded to be geotechnically unsuitable for dam construction.

Construction of a rock-fill type dam is technically possible at the Moralica II damsite, though the valley is relatively wide at the site. A solid bed rock composed of andesite is discernible at 10 - 12 m in depth from the ground surface. Rock materials are available nearby, but impervious core materials are scarce and insufficient for a large rock-fill dam construction. More serious problem for dam construction at the Morolica II site is the resettlement from the submergible area. The dam will inundate Morolica town and some other villages in the Morolica valley. It was estimated that about 700 households, including some 250 households in Morolica town, had to be resettled for dam construction. Due to such a social problem, the Morolica II damsite will not be preferred as a site for dam construction.

The San Fernando damsite and Zorillo damsite are located in the upstream reach of the Choluteca river. At the San Fernando damsite, the Choluteca valley forms a very narrow gorge, with both abutments rising 70 - 80° to the terraces at around EL. 835 m. The site offers favorable topographic condition for construction of an arch type or gravity type dam. As reviewed in Annex D.2.1, geological and geo-technocal conditions will permit construction of a concrete dam, though careful design is required due to low shearing strength in the foundation. Construction of a fill-type dam at San Fernando will result in higher cost due to availability of rock and impervious core materials and the need for treatment of steep slopes on both abutments. The study indicated that the construction cost of the rock-fill type dam would be higher than the gravity-type dam by about 12%.

The Zorillo damsite is conceived as an alternative to the San Fernando damsite if and when a concrete dam construction is not technically feasible at San Fernando. The Zorillo damsite is located at about 2 km upstream of San Fernando, or 0.5 km downstream from Hernando Lopez bridge. At Zorillo, rock outcrops are rhyolitic welded tuff which are hard to moderately hard, with bedding plane dipping 10 - 15°S. Although vertical joints are strongly developed and open cracks are observed, they may be treated by excavation to a reasonable depth and by foundation grouting. The rock excavation will be required for 10 - 12 m in depth. In view of the strength of rocks and change in their hardness by stratum, it is considered questionable to construct a concrete dam at Zorillo.

Through a review of possible alternative damsites in the Choluteca valley, the San Fernando damsite was selected as the most promising site for construction of a dam for storage of water primarily for irrigation purpose. The water stored by the San Fernando dam will also be beneficial to other purposes, which will be further studied subsequently.

G.1.2 Storage by San Fernando Dam

Available discharge at the San Fernando damsite is calculated in Annex C.3.2 (Table C-24) on the basis of hydrological record at the Hernando Lopez gauging station located at approximately 2 km upstream of the damsite. The mean monthly discharge at San Fernando ranges from 4.6 MCM (1.7 m^3/s) in March - April to 88.0 MCM (34.0 m^3/s) in September. The average annual runoff for the past 29 years is 400.5 MCM (12.7 m^3/s).

In the Choluteca river basin upstream of the proposed San Fernando dam, SANAA envisages to construct the Guacerique dam and reservoir for water supply to the metropolitan area, as noted in Annex B.3. Detailed design of the Guacerique dam and water supply project has already been prepared, and it is scheduled to be constructed by 1991. In case that the Guacerique dam (catchment area of 189 km^2) is constructed and 1.18 m^3/s of water is taken on an average, the discharge available at the San Fernando damsite is estimated to decrease to approximately 385 MCM per annum on an average, on the assumption that a return flow from water supply is available at the rate of 50%. Such a decrease is to be counted in studying reservoir operation at the San Fernando damsite. Possibility of further utilization of the Choluteca water for municipal water supply is reviewed in Chapter G.5.

A storage capacity curve of the San Fernando damsite was drawn out on the basis of 1/5,000 scaled topographic maps prepared in 1967, as shown on Figure G-02. A gross storage capacity was estimated at around 280 MCM at the high water level at EL. 818 m (about 91 m in dam height), and 450 MCM at EL. 826.5 m (100 m in dam height). Since the sediment volume was estimated at 800 $m^3/km^2/year$ or 1.33 million $m^3/year$, as noted in Annex C, the effective storage was estimated at around 210 MCM at the high water level at EL. 818 m and 380 MCM at EL. 826.5 m.

G.2 PRIORITY USE IN IRRIGATION

G.2.1 Irrigable Area

Water stored in the San Fernando dam and reservoir would be utilized for irrigation as the primary objective. As reviewed in Annex D.4, Annex E and Annex F, the land irrigable by water stored by the San Fernando dam covers the Choluteca plain in a sizable scale, as well as in the middle reach valleys of the Choluteca river. The net irrigable area identified through the study is summarized as follows:

Western plain		16,000 ha
Eastern plain - A		4,600 ha
Eastern plain - B		5,200 ha
Middle reach valley	(existing)	680 ha
	(potential)	1,640 ha
San Juan de Flores	(existing & extension)	2,680 ha
Total		30,500 ha

Water requirement for irrigation in respective area was estimated in Annex H.1 in accordance with the cropping pattern proposed in Annex F. The monthly irrigation water requirement is reproduced and attached in Table G-01 for easier reference. The estimated irrigation water requirement would be first met by discharge available from the remaining river basin downstream from the San Fernando dam to the intake site, and supplementarily fed by water stored in the San Fernando reservoir, particularly during the dry season. The monthly irrigation water requirement in each area will form a basis for reservoir operation at San Fernando.

G.2.2 Priority Area

Alternative study on reservoir operation at the San Fernando dam will be made on various scales of irrigation area, in view of a possibility of limitation in the storage capacity at San Fernando. After reviewing the socio-economic condition in respective areas, as well as the net incremental return estimated for each area in Annex F, it is proposed that priority of water use for irrigation will be accorded in the following order:

Priority	Area	
1 a	Western plain area	16,000 ha
1 b	San Juan de Flores area	2,680 ha
1 c	Middle reach valley (existing)	680 ha
2 a	Eastern plain - A	4,600 ha
2 b	Eastern plain - B	5,200 ha
3	Middle reach valley (potential)	1,640 ha

G.3 HYDROPOWER PLAN

G.3.1 Power Generation at San Fernando

Present situation of electric power, as well as power demand forecast by ENEE, has been reviewed in Annex B.2. With the completion of El Cajon hydroelectric project in 1985, the hydropower capacity will be increased to 423 MW. After completion of El Cajon project, some thermal plants are scheduled to be retired, and their capacity will be decreased to 87 MW in 1991 and 30 MW in 1994. Since the peak demand was estimated at 344 MW and required power capacity (inclusive of reserve capacity) at around 430 MW in 1991, the demand would be covered by the existing and committed plants. By the year 2000, however, the required power capacity would reach around 840 MW, and additional plants of about 380 MW should be installed.

The average energy produced by the existing and committed hydropower plants would reach around 2,090 GWh, but the firm hydropower energy would be around 1,620 GWh (average plant factor of 44%) or about 810 GWh in the dry season and wet season. Since the energy demand was estimated to reach 1,980 GWh in 1991, the demand in the dry season (990 GWh) will have to be partly covered by thermal plants. The energy demand in the year 2000 is estimated to reach 3,630 GWh (1,815 GWh in the dry season and wet season), and the plants to be additionally installed will have to cover about 850 GWh in the dry season and 460 GWh in the wet season. (Refer to Table G-02 and G-03)

It is presumed that the existing and committed hydropower will share, in the wet season, in upper portion of the base load and middle load of the demand estimated for 2000. In the dry season, the hydropower will share in the middle load and peak load portion. The remaining part of the load will be covered by plants to be additionally installed.
On the other hand, water stored by the San Fernando dam will be primarily used for irrigation purpose, and the stored water should basically be released in accordance with the irrigation water requirement.

In view of the above situation, as well as the water requirement for irrigation (Refer to Table G-01), power generation in the dry season at the San Fernando dam was planned to be made by water released for irrigation (8 to 30 m^3/s), and it will cover a part of base load of the power demand. In the wet season, inflow into the San Fernando reservoir is to be stored to recover water released for irrigation in the dry season. However, discharge in the range of 0.1 m^3/s - 0.9 m^3/s is to be released from the reservoir to cover the water requirement in the San Juan de Flores irrigation area which is located immediately downstream from the dam and little discharge is made available from the remaining basin. This water release can be utilized for mini-hydropower generation for auxiliary power supply for the power station and dam operation, as well as for rural electrification. In a wet year, some surplus water would be released in the rainy season through water turbine, and generated power will cover a part of peak load of the demand in central grid.

G.3.2 Generating Capacity

The capacity of generating plants to be installed at the San Fernando dam will be determined in the light of water release for irrigation. Release for irrigation water requirement is normally largest in April. The average requirement for release in April would reach 21.9 m^3/s for 19,360 ha (priority 1a - 1c area) and 32.2 m^3/s for 23,960 ha (priority 1 and 2a area). The capacity of water turbine was determined to release such a quantity of water at any water level. The averaged water level of the reservoir will be adopted as a rated water level to determine the rated output of generator.

The maximum plant discharge and rated reservoir water level will be calculated in accordance with the following formula:

$$Qm = Qe \sqrt{hr/he}$$

$$hm/hr = \sqrt{hr/he}$$

where, Qm: Maximum plant discharge at rated head (m^3/s)

Qe: Average discharge in April (27.6 m^3/s)

hr: Rated effective head (m)

he: Minimum effective head (Design LWL - Tailwater level - Loss head, m)

hm: Maximum effective head (Design HWL - Tailwater level - Loss head, m)

A mini-hydropower plant would be additionally installed to release water required for the San Juan de Flores area in the wet season and to supply auxiliary power source for power station and dam operation. The capacity of the plant is determined at 500 kW.

A water release valve would be installed to release irrigation water during the period of scheduled and/or forced outage of the power plant. The capacity of water release would be equal to the power plant discharge, or averaged required water at the low water level.

On the basis of the power generation plan as outlined above, the reservoir operation of the San Fernando dam is studied as described in Chapter G.5.

G.4 PRELIMINARY STUDY OF WATER SUPPLY

G.4.1 General

As reviewed in Annex B.3.1, demand of water supply has been rapidly increasing in the metropolitan area, and SANAA is obliged to seek for water supply sources to meet the growing demand. The Guacerique dam and water supply project, selected in SANAA's master plan as a priority scheme, has already been designed and it is scheduled for completion by 1991. Consequently, the reservoir operation of the San Fernando dam and reservoir will be made by taking into account the water to be taken out at the Guacerique dam for supply to the metropolitan area (1.18 m^3/s).

The cost of water to be produced by the Guacerique dam project, as well as the Concepcion dam and other storage schemes envisaged in the master plan, is considerably high, and MRN requested to preliminarily study the possibility of water supply from the San Fernando reservoir to be planned for construction primarily for irrigation purpose. The study made herein on the water supply system is preliminary in nature, and it must be followed by further study in future. However, the preliminary study will serve to evaluate a possible case of water supply and operation of the San Fernando reservoir.

G.4.2 Preliminary Plan

Water of the Choluteca river is planned to be taken at a pumping station to be located at the low water level of the San Fernando reservoir. A site of the intake pump station is preliminarily selected nearby the Hombre river which is the largest tributary of the Choluteca river. Although data are unavailable on quality of water, it is considered that water quality is much better than the quality of mainstream flow that involves untreated sewage from Tegucigalpa metropolitan area. The intake elevation is provisionally set at EL. 797 m.

The average monthly minimum discharge of the Hombre river at the existing gauging station (catchment area of 334 km^2) located at several kilometers upstream of the intake pump station is estimated at around 0.99 m^3/s. On the other hand, the Concepcion dam and water supply project, which was selected as the second priority storage scheme by the master plan, envisages to produce 1.37 m^3/s of regulated water to cover the demand up to around the year 2002. In view of the above situation, as well as in the light of possible effects on the reservoir operation at the San Fernando dam, it is provisionally planned to take 1.0 m3/s of water at the intake pump station for supply to the metropolitan area.

Water is planned to be first pumped up by No. 1 pump station to a pondage to be constructed at EL. 1,030 m (L.W.L at EL. 1,026 m), and further boosted up by No. 2 pump station to a delivery pond to be constructed nearby Tegucigalpa at EL. 1,105 m. The static head is 233 m for No. 1 pump station and 79 m for No. 2 station, or 312 m in total. (Refer to DWG-G-01) No. 1 and No. 2 pumping stations are planned to be equipped with 5 units of pumps (including 1 spare unit) with a capacity of 15.0 m^3/min. (Refer to Table G-04)

Water would be conducted mainly through a pipeline and partly by tunnel. The pipeline would run along the existing highway in view of the access for construction and maintenance. A ductile iron pipe is proposed for such an alignment. The diameter of the pipeline is determined at 1,100 mm, through the economic comparative study to minimize the investment and operational costs. The length of pipeline is estimated at around 19.5 km from the intake pump station to the delivery pondage. Water would be further led through a 3.8 km long tunnel to the receiving pondage at a filtration plant. A treatment plant will have a capacity of 87,000 m^3/day.

A profile of the pipeline alignment, as well as preliminary layout of the pumping stations used for the preliminary cost estimate are illustrated on DWG-G-02 to DWG-G-05.

G.4.3 Preliminary Cost Estimate

An investment cost of the facilities required for water supply from the San Fernando reservoir has been preliminarily estimated. The construction cost of the intake pump station is estimated to be Lp. 12.9 million, including the cost of pumps and motors, valves, surge tank, water filling and drain pumps, excavation and concrete works of pump station, overhead crane, starter and control equipment and other auxiliary equipment and works. The cost of the booster pump station is also estimated to be Lp. 5.4 million in total.

The cost of pipeline and tunnel works is also estimated at around Lp. 35.2 million, including pipes, excavation backfill and lining. The cost of treatment plant is preliminary estimated at Lp. 13.0 million. In addition, cost of power transmission line, substation at pumping stations and expansion of substation in Tegucigalpa is preliminarily estimated at Lp. 13.6 million. The cost of replacement, engineering and contingencies is estimated to be around Lp. 35 million. Consequently, the total investment cost required for the water supply system was preliminarily estimated at around Lp. 120 million. (Refer to Table G-05).

The annual operation and maintenance cost is estimated at around 2% of the electric works and 14.3% of treatment plant, as well as at the rate of Lp. 0.174/kWh of electric power. It would amount to around Lp. 10.7 million per annum. On the other hand, the annual cost of investment is assumed at 10% of the total investment cost as applied in SANAA's evaluation. Consequently, the annual cost would amount to Lp. 20.2 million in total. Since the volume of water supply would be 31.5 million m^3/year, the cost of treated water at Tegucigalpa is calculated at around Lp. 0.72/m^3.

G.4.4 Further Study

The cost of water preliminarily estimated hereinabove is much lower than the cost estimated for the Concepcion and other storage schemes contemplated in SANAA's master plan. It appears that the water supply from the San Fernando reservoir is worthwhile to be considered in the case study of reservoir operation at San Fernando, as an alternative to the expansion of irrigation area in the Choluteca plain and middle reach valleys.

It is noted, further, that the study made so-far was preliminary in nature and additional studies should be carried out on the technical and economic feasibility of the water supply system. It is suggested that such additional studies will cover, among others:

a) Review of demand forecast of water supply which was made previously under unlimited condition of sprawl of urbanization in the metropolitan district,

b) Analysis of water quality and hydrological condition of the Hombre river, as well as water quality of the mainstream of Choluteca river at the confluence with the Hombre river,

c) Measures to restrict water contamination in the Zambrano valley in the upstream of the Hombre river,

d) Comparative study on water intake at the low water level of the San Fernando reservoir and alternative intake by constructing a dam at a possible damsite at around EL. 870 m on the Hombre river,

e) Study of alternative site for treatment plant and alternative alignment of pipeline, and

f) Comparative study of other water supply systems contemplated by SANAA.

It is suggested that the additional studies be made in the shortest possible period or, at the latest, by the time of the initial stage of the detailed design for construction of the San Fernando dam.

G.5 RESERVOIR OPERATION

G.5.1 Alternatives

In the light of priority area for irrigation as discussed in Chapter G.2.2, the alternative study on reservoir operation at the San Fernando has been made in the following cases:

Case 1-1: Irrigation of 1st priority areas of 19,360 ha (16,000 ha in Western plain, 2,680 ha in San Juan de Flores and 680 ha in existing irrigation area in the middle reach valley), Without intake of water for the metropolitan area.

Case 1-2: Irrigation of 19,360 ha, With intake for water supply at 1.0 m^3/s.

Case 2-1: Irrigation of 23,960 ha (1st priority area and 4,600 ha in Eastern plain - B), Without intake for water supply.

Case 2-2: Irrigation of 23,960 ha, With intake of water supply at 1.0 m^3/s.

Case 3 : Irrigation of 29,160 ha (1st and 2nd priority area, including Eastern plain - B), Without intake for water supply.

G.5.2 Reservoir Operation Program

The reservoir operation would be made in accordance with the following procedures: (Refer to Figure G-03)

1) Water Release from Reservoir:

Release of water from the San Fernando reservoir is basically made in accordance with irrigation water requirement. Quantity of release is calculated in accordance with the following formula:

$$Qout_o = \sum_i (Qdiv_i - Qres_i, 0)$$

where, $Qout_o$: Release from reservoir

$Qdiv_i$: Diversion water requirement

$Qres_i$: Discharge from residual catchment area

The diversion water requirement is shown on Table G-01. The discharge from residual catchment area is calculated by deducting discharge at the San Fernando damsite from discharge at El Papalon (Ref. Table C-22), as shown on Table G-06. (Refer also to Figure G-04)

2) Water Supply:

Water is presumed to be taken at the Guacerique dam and San Fernando reservoir. At Guacerique, 1.18 m^3/s would be taken out, and a return flow of 50% is presumed. Water spilled out from the Guacerique dam is also added by referring to the discharge record as shown on Table G-07. Pump-up from the San Fernando reservoir at 1.0 m^3/s and its return flow at 50% are also presumed.

3) Inflow into Reservoir:

On the basis of discharge estimated at San Fernando and presumed water supply, the inflow into the San Fernando reservoir is calculated as shown on Table G-08.

4) Evaporation:

Evaporation from the reservoir is estimated on the basis of evaporation record at La Venta meteorological station located close to the damsite. (Refer to Table C-16).

5) Reservoir Scale:

Reservoir scale is determined to guarantee release for irrigation and water supply. Failure in irrigation water supply may be allowed in dry years with a recurrence period of not less than 5 years.

6) Power Capacity and Output:

Power capacity and output are calculated in accordance with the procedures explained in Chapter G.3.2.

The water release from the San Fernando reservoir for irrigation of 19,360 ha and 23,960 ha is calculated as summarized on Table G-09 and G-10.

G.5.3 Result of Reservoir Operation Study

The result of reservoir operation is compiled in the attached sheets and summarized in Table G-11. For irrigation of 19,360 ha in the Western plain, San Juan de Flores area and existing irrigation area in the middle reach valley, an effective storage capacity of 200 MCM with the high water level at EL. 817.6 m would be required (Case 1-1). The annual energy output is calculated at approximately 45 GWh, with the average power capacity of 7.1 MW in the dry season. In case that intake of water supply is planned to be 1.0 m^3/s (Case 1-2), the storage capacity would slightly increase to 210 MCM, and annual energy output would be reduced to 43 GWh.

For irrigation of 23,960 ha in the first priority areas and the Eastern plain - A (4,600 ha), the storage requirement is to be increased to 354 MCM (Case 2-1). Such a sharp increase in storage capacity is necessitated to secure adequate restoration of water storage for irrigation. In case that intake of water supply is planned to be 1.0 m^3/s (Case 2-1), the storage requirement is further increased to 380 MCM, and annual energy output is calculated at 54 GWh with the maximum power capacity of 18.2 MW and average capacity of 11.1 MW in the dry season.

Further, in case that the irrigation area is expanded to 29,160 ha to additionally cover the Eastern plain - B, the storage requirement would be increased to 737 MCM (Case-3). As noted in Chapter G.1.2, the averaged annual inflow into the San Fernando reservoir for the last

29 years is 400.5 MCM, and the storage capacity will not be recoverable if water would be released to cover 29,160 ha. Therefore, this alternative to additionally irrigate the Eastern plain-B is found to be technically unjustifiable.

G.6 SELECTION OF RECOMMENDABLE PLAN

G.6.1 Economic Comparison

Four alternative plans (Case 1-1, 1-2, 2-1 and 2-2) have been preliminarily evaluated in terms of economic benefit/cost (B/C) ratio and benefit-cost (B-C) value. The economic benefit is estimated on the basis of incremental net revenue of agricultural production between "with" and "without" project condition and power revenue from fuel saving. Benefit of water supply is provisionally assumed at Lp. 0.9/m^3 which is equivalent to the water production cost of the Guacerique project (production cost of the Concepcion project is much higher).

The B/C ratio of Case 1-1 turns out to be 1.20 as shown on Table G-07. The ratio would be slightly decrease to 1.11, if water supply scheme is incorporated (Case 1-2). For irrigation of 23,960 ha and water supply at 1.0 m^3/s with a storage capacity of 380 MCM (Case 2-2), the B/C ratio is calculated at 1.14. In case that intake for water supply is unnecessary (Case 2-1), the ratio would be 1.24. (Refer to Table G-12)

Additionally, a case study is made on the economic feasibility of irrigation on the Western plain by diverting natural flow of the Choluteca river at El Papalon without seasonal regulation by the San Fernando dam. The incremental benefit by such a supplemental irrigation in the rainy season would rather be limited, as reviewed in Annex F.6, and the B/C ratio is calculated at 0.46. Consequently, the execution of irrigation only in the rainy season is considered as economically unjustifiable.

G.6.2 Recommendable Plan

The plan recommendable for implementation is to be selected in the light of economic comparison as noted in the foregoing chapter. Some other factors are additionally taken into account in the selection of the recommendable plan. They are, among others:

a) Even in case that intake for water supply is not decided to be made directly from the San Fernando reservoir through detailed study as recommended in Annex G.4.4, water of the Choluteca river in the upstream reaches may possibly be utilized for water supply in a long run, as contemplated in SANAA's master plan. Intake of water from the San Fernando reservoir and in the upstream reaches would have similar effect on storage requirement for irrigation at the San Fernando reservoir, and it is recommendable that the storage capacity be planned for the present to cover the water supply to the metropolitan area (Case 1-2 and Case 2-2).

b) The site suitable for water storage in the Choluteca river basin is relatively limited and much more costly if compared with the San Fernando dam and reservoir. In view of such a cost of alternative storage scheme at the Morolica II site as previously reviewed in 1977-78 study, it is desirable to store as much water as possible at the San Fernando and to expand irrigation area on the Choluteca plain.

c) A stage-wise development would be desirable. However, the dam heightening in stages would be practically difficult, because it involves dewatering of the reservoir for heightening and causes much inconvenience in irrigation water supply and power generation. Reduction of irrigation and power benefit for two years of dewatering and re-filling would amount to Lp. 62 million in financial terms, which is higher than the incremental cost of dam heightening. Consequently, it is recommendable that the San Fernando dam be constructed at the initial stage at the height designed for ultimate stage of development.

With the above in view, it is recommended that the San Fernando dam be designed to have a storage capacity of 380 MCM for irrigation of 23,960 ha and for power generation of 54 GWh. The result of reservoir operation is summarized as illustrated in Figure G-05. Characteristics of power output are also illustrated in Figure G-06 and G-07.

G.6.3 Possible Implementation Program

In view of the urgency of agricultural development on the Choluteca river basin and fund requirement for implementation, it would be possible to contemplate phased-out implementation of the recommended plan. A possible program for implementation will be as follows:

Stage-1: Phase 1-1
- a) construction of the San Fernando dam with the storage capacity of 380 MCM.
- b) irrigation of 12,400 ha of land on the right bank of the Choluteca river in the Western plain.

Phase 1-2
- a) irrigation of 3,600 ha of land on the left bank of the Choluteca river in the Western plain.

Stage-2: Phase 2-1
- a) irrigation of 4,600 ha of land on Eastern plain - A.

Regardless of the phased-out implementation as provisionally contemplated above, rehabilitation of the irrigation systems in the San Juan de Flores area and the middle reach valleys should be executed separately.

Power supply in the dry season in 1991 would be partly covered by thermal plants, as reviewed in Chapter G.3.1, and power generation at San Fernando may contribute to fuel saving. The economic evaluation will therefore be made on the condition that power plant will be installed at the time of dam construction. Since the additional cost required for the power scheme would be limited to the power house, generating equipment, substation and transmission line, the fund required for the power plant installation may possibly be arranged separately.

TABLES

Table G-01 DIVERSION WATER REQUIREMENT

(Unit: $10^3 m^3$)

Area	(Ha)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1) Western Plain	(16,000)	39,952	32,352	47,936	54,192	8,832	1,456	18,320	6,032	208	336	26,336	51,328	287,280
2) Middle Reach	(680)	2,450	3,071	4,226	3,329	992	158	544	65	0	1,874	2,349	3,330	22,388
3) S.J. Flores	(2,680)	3,457	3,508	5,333	3,578	1,914	86	2,200	2,021	874	994	2,278	2,224	28,467
Total (1 - 3)	(19,360)	45,859	38,931	57,495	61,099	11,738	1,700	21,064	8,118	1,082	3,204	30,963	56,882	338,135
4) Eastern Plain - A	(4,600)	11,196	7,457	15,691	20,985	5,028	805	4,002	0	0	483	6,081	15,658	87,386
Total (1 - 4)	(23,960)	57,055	46,388	73,186	82,084	16,766	2,505	25,066	8,118	1,082	3,687	37,044	72,540	425,521
5) Eastern Plain - B	(5,200)	15,371	11,263	15,241	18,252	2,345	338	5,169	1,425	0	208	9,121	18,689	97,422
Total (1 - 5)	(29,160)	72,426	57,651	88,427	100,336	19,111	2,843	30,235	9,543	1,082	3,895	46,165	91,229	522,943

Table G-02 EXISTING AND COMMITTED HYDRO PLANTS

Plant	Installed Capacity (MW)	Annual Energy Output Average (GWh)	(Plant Factor) (%)	Firm (GWh)	(Plant Factor) (%)
Canaveral	28.5	197	(60)	149	(46)
Rio Lindo	80.0	576	(82)	449	(64)
El Nispero	22.5	71	(36)	40	(20)
El Cajon	292.0	1,243	(49)	986	(39)
Total	423.0	2,087	(56)	1,624	(44)

Table G-03 SYSTEM POWER AND ENERGY BALANCE

	1991		2000	
	Wet Season	Dry Season	Wet Season	Dry Season
Power (MW)				
Power Demand/1	344	344	669	669
Required Capacity/2	430	430	836	836
Existing Plant:/3	510	510	453	453
Hydro	(423)	(423)	(423)	(423)
Thermal	(87)	(87)	(30)	(30)
Plants to be installed	-	-	383	383
Energy (GWh)				
Energy Demand/1	989	989	1,817	1,817
Existing Plant:	1,204	989	1,362	970
Hydro	(1,204)/4	(812)/5	(1,204)	(812)
Thermal	-	(177)	(158)	(158)
Plants to be installed	-	-	455	847

Note: /1: Refer to Table B-26

/2: Including reserve capacity of 25%

/3: Refer to Table B-18. Thermal plants at Santa Fe, San Lorenzo, S.P. Sula and Miraflores are to be retired by 1990, and P. Cortes I and La Ceiba are retired by 1994.

/4: Estimated at a plant factor of 65%

/5: 1/2 of firm annual energy output

Table G-04 PRELIMINARY PLAN FOR WATER SUPPLY

Facilities	Outline
1. Intake Pump Station (No. 1)	
L.W.L in Reservoir	EL. 797.0 m
H.W.L of No. 1 Pondage	EL. 1,030.0 m
Static Head	233.0 m
Pumps:	
Discharge	15.0 m^3/min.
Head	240.0 m
Unit	4 + 1 (spare)
Motor	1,000 kW
Type	Horizontal shaft multi-stage volute pump
2. Booster Pump Station (No. 2)	
L.W.L of No. 1 Pondage	EL. 1,026.0 m
W.L of Delivery Pondage	EL. 1,105.0 m
Static Head	79.0 m
Pumps:	
Discharge	15.0 m^3/min.
Head	100.0 m
Unit	4 + 1 (spare)
Motor	400 kW
Type	Horizontal shaft double suction volute pump
3. Pipeline and Tunnel	
Pipeline:	
Length	19.5 km
Diameter	1,100 mm
Pipe	Ductile iron pipe
Tunnel length:	3.8 km
4. Treatment Plant	
Capacity:	87,000 m^3/day
5. Transmission Line & Substation	
Transmission line	approx. 30 km
No. 1 pump station	6,000 kVA
No. 2 pump station	3,000 kVA
Tegucigalpa s/s (expansion)	9,000 kVA

Table G-05 PRELIMINARY ESTIMATE OF COST FOR WATER SUPPLY SYSTEM

	Amount (Lp. 10^6)
Investment Cost:	
1. Intake pump station	12.9
2. Booster pump station	5.4
3. Pipeline and tunnel	35.2
4. Treatment plant	13.0
5. Transmission line and substation	13.6
6. Miscellaneous	4.9
Sub-total	85.0
Replacement Cost:	
7. Equipment related to No. 1 station	5.9
8. Equipment related to No. 2 station	4.1
Sub-total	10.0
Total (1 - 8)	95.0
9. Engineering and administration	10.0
10. Contingency	15.0
Total (1 - 10)	120.0

Table G-06 INFLOW AT EL PAPALON WEIR

INFLOW DATA AT THE WEIR — UNIT : MCM

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1957	30.80	21.60	16.50	15.70	116.90	147.80	26.40	41.90	184.40	158.00	29.60	18.30
1958	13.40	7.30	6.50	6.10	104.90	239.50	186.70	92.10	58.40	163.60	33.50	15.50
1959	14.00	8.80	5.30	3.60	24.50	44.80	9.00	24.80	26.40	182.60	25.90	7.00
1960	10.40	4.40	2.60	2.80	94.20	154.70	119.00	173.80	166.40	215.90	89.30	28.20
1961	23.60	18.90	14.10	11.30	9.10	139.00	142.80	73.40	101.80	130.50	75.20	22.00
1962	17.90	12.10	7.20	5.80	54.60	109.70	82.10	61.20	83.80	78.20	21.60	13.50
1963	13.20	7.40	7.00	6.70	5.60	71.10	73.40	43.00	102.20	183.70	129.60	23.70
1964	16.20	9.70	9.60	8.90	7.60	284.00	164.40	67.10	128.00	251.80	38.50	24.20
1965	10.70	2.90	3.80	3.30	71.20	103.60	43.40	44.70	148.20	231.00	58.80	24.00
1966	18.10	11.20	9.30	14.40	144.80	398.50	240.70	106.30	160.00	360.40	55.80	30.70
1967	22.10	15.60	13.50	26.70	11.80	96.00	45.30	39.50	144.20	89.70	31.40	18.00
1968	16.40	10.70	7.20	7.10	104.90	451.90	80.50	51.40	273.40	294.60	84.30	34.60
1969	30.70	12.80	11.70	10.90	43.40	445.50	139.10	422.50	463.60	686.90	158.50	31.20
1970	16.30	6.30	5.30	1.50	21.90	16.00	88.10	185.90	360.80	321.30	94.60	35.70
1971	26.10	16.80	13.90	10.70	55.00	41.20	19.60	81.00	247.10	293.00	56.80	27.30
1972	18.20	12.30	8.60	7.10	41.00	110.10	17.50	22.80	21.90	27.60	17.80	9.90
1973	6.80	3.10	1.50	3.30	19.10	51.50	62.70	50.00	173.80	475.20	147.20	29.50
1974	14.40	4.70	3.10	3.70	174.30	184.80	94.90	108.80	455.80	331.30	70.00	13.80
1975	4.30	0.80	2.30	3.70	16.00	1.30	20.30	51.60	427.00	443.70	232.50	69.00
1976	18.70	9.00	4.20	3.00	64.50	840.90	168.50	36.10	27.10	534.00	48.30	43.60
1977	23.40	18.60	16.10	17.20	44.90	114.20	24.90	25.00	61.70	35.00	25.20	18.20
1978	17.50	14.20	12.60	18.60	71.50	138.70	138.70	44.50	227.60	65.90	25.00	30.30
1979	17.80	11.90	11.90	25.80	60.60	275.30	107.50	70.30	406.40	466.20	129.40	50.40
1980	25.40	9.20	4.10	17.10	233.70	378.80	109.50	123.90	273.10	910.50	107.60	64.60
1981	38.00	23.50	18.20	13.20	73.60	903.80	132.90	115.90	309.70	120.30	48.40	32.50
1982	16.00	26.50	28.30	21.90	112.40	218.40	75.40	42.40	73.10	145.70	32.90	175.70
1983	15.90	13.20	8.50	16.40	20.50	63.00	34.30	41.40	109.20	241.20	91.80	51.10

Table G-07 MONTHLY DISCHARGE AT GUACERIQUE DAMSITE

(Unit: m^3/s)

year	jan.	feb.	mar.	apr.	may	june	jul.	aug.	sep.	oct.	nov.	dec.	mean
1957	0.20	0.23	0.15	0.32	1.12	4.88	1.96	1.73	2.27	1.68	0.51	0.28	1.28
1958	0.21	0.26	0.74	1.01	1.32	8.97	5.28	2.91	0.79	3.37	0.94	0.39	2.18
1959	0.31	0.32	0.23	0.29	0.60	8.59	1.05	2.23	0.33	3.62	0.98	0.49	1.59
1960	0.39	0.36	0.23	0.35	0.76	1.44	2.81	4.27	2.62	6.91	1.42	0.62	1.85
1961	0.52	0.42	0.15	0.14	0.06	0.57	3.17	1.46	1.18	2.07	0.63	0.91	0.94
1962	0.70	0.49	0.26	0.28	0.14	4.97	2.54	3.54	2.74	6.41	1.37	0.45	1.99
1963	0.36	0.33	0.37	0.29	1.02	3.87	3.77	2.05	1.21	3.35	0.93	0.57	1.51
1964	0.44	0.41	0.59	0.58	0.70	4.32	5.47	1.14	3.44	2.70	0.44	0.34	1.71
1965	0.27	0.20	0.15	0.12	0.91	2.15	1.43	1.90	35.85	3.25	1.33	0.29	3.99
1966	0.17	0.15	0.14	0.14	1.42	5.24	4.50	1.82	2.83	3.25	0.71	0.48	1.74
1967	0.40	0.31	0.23	0.60	0.22	0.68	1.18	0.86	1.56	1.65	0.45	0.13	0.69
1968	0.07	0.04	0.09	0.08	5.06	7.48	2.58	1.10	3.05	2.39	1.69	0.49	2.01
1969	0.41	0.26	0.17	0.15	1.57	12.33	5.82	9.70	13.69	10.56	1.69	0.95	4.78
1970	0.70	0.62	0.44	0.64	1.19	1.36	5.77	8.93	15.33	5.80	1.67	0.84	3.61
1971	0.53	0.42	0.34	0.35	3.30	1.96	2.08	4.66	8.19	5.87	0.55	0.28	2.38
1972	0.21	0.13	0.07	0.09	1.65	4.16	1.09	0.11	0.03	0.32	0.03	0.20	0.67
1973	0.13	0.19	0.14	0.14	0.28	2.02	3.20	2.86	5.82	9.12	1.77	0.58	2.19
1974	0.42	0.34	0.12	0.10	0.92	3.76	3.09	0.91	4.84	2.91	0.86	0.40	1.56
1975	0.30	0.38	0.18	0.16	1.40	0.89	0.87	0.12	11.44	4.06	1.39	0.60	1.82
1976	0.46	0.40	0.16	0.23	1.24	2.76	2.78	1.01	0.20	5.13	0.93	0.46	1.31
1977	0.34	0.29	0.33	0.38	1.19	7.85	1.11	0.09	0.91	0.35	0.06	0.17	1.09
1978	0.08	0.21	0.75	0.86	1.67	3.64	3.91	1.89	2.47	1.39	0.37	0.25	1.46
1979	0.14	0.19	0.40	0.88	1.02	3.75	2.61	1.38	5.68	5.45	1.13	0.64	1.94
1980	0.33	0.22	0.15	0.17	1.12	5.80	2.36	1.98	3.53	4.06	0.77	0.55	1.75
1981	0.28	0.33	0.39	0.18	0.97	5.94	2.59	3.14	4.21	1.58	0.66	0.43	1.73
1982	0.21	0.38	0.37	0.30	1.29	3.18	0.87	0.80	1.33	2.70	0.76	0.54	1.06
1983	0.45	0.32	0.31	0.30	0.25	1.78	1.79	0.96	2.84	3.05	1.68	0.67	1.20
mean	0.33	0.30	0.28	0.34	1.20	4.23	2.80	2.35	5.13	3.81	0.95	0.48	1.85

Table G-08 INFLOW AT SAN FERNANDO DAMSITE

MONTHLY INFLOW TO RESERVOIR (MCM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1957	14.3	9.0	7.1	6.1	28.5	78.8	18.0	19.0	52.2	41.8	11.4	10.9
1958	7.1	4.8	3.5	2.1	64.4	142.5	63.8	32.4	26.5	65.2	9.7	8.5
1959	9.0	6.6	5.8	4.9	25.4	36.9	12.0	23.2	20.8	56.6	16.7	11.5
1960	5.8	4.5	4.5	3.9	14.1	108.8	14.4	40.6	92.2	129.4	17.1	10.9
1961	10.6	8.8	8.5	6.9	7.3	25.1	25.2	14.3	40.3	29.0	30.6	11.3
1962	11.3	7.8	6.9	6.4	23.6	56.8	13.4	32.6	72.2	135.4	11.5	11.9
1963	9.2	6.6	5.8	5.6	3.6	18.2	30.4	11.5	31.2	47.2	44.2	6.7
1964	5.8	4.3	3.7	3.3	2.8	80.9	109.4	14.6	56.7	73.0	8.0	6.9
1965	3.7	3.9	3.1	2.8	21.9	41.7	15.4	8.7	261.5	81.6	36.1	14.1
1966	9.0	5.9	6.1	5.9	49.2	73.5	77.2	26.4	40.1	65.4	13.2	8.7
1967	7.7	6.2	5.8	11.1	4.7	13.9	13.5	9.3	32.4	32.3	11.0	7.3
1968	6.2	4.3	3.3	3.2	43.1	152.1	27.8	21.9	90.6	66.7	38.5	13.0
1969	10.7	4.9	4.3	3.1	15.3	215.5	75.4	136.4	191.5	214.4	39.5	21.7
1970	10.0	6.5	4.5	8.5	14.8	19.2	52.2	95.4	185.5	78.8	28.8	14.7
1971	7.4	5.3	4.1	3.6	17.7	14.2	15.5	41.8	107.5	100.4	19.8	9.1
1972	6.9	4.5	3.7	3.9	12.0	30.8	6.9	10.2	11.7	9.7	6.4	4.5
1973	4.6	4.0	4.4	4.2	19.2	44.7	38.9	25.0	81.0	184.4	41.5	10.4
1974	6.9	6.0	6.1	4.7	91.6	36.2	20.7	8.0	109.9	40.8	12.1	11.0
1975	10.5	7.4	6.3	4.9	13.0	7.7	16.9	6.8	232.8	162.4	185.5	13.4
1976	9.4	6.9	6.6	6.1	7.1	169.7	36.7	10.0	9.0	67.8	12.1	12.4
1977	7.0	4.8	4.0	4.3	16.6	87.2	8.6	9.9	17.9	11.7	10.9	6.6
1978	5.9	4.7	2.5	3.2	16.3	30.6	29.2	12.4	58.9	20.3	9.1	11.0
1979	6.6	4.6	4.1	7.1	22.7	76.2	55.2	29.9	126.1	124.9	23.9	14.7
1980	8.4	5.6	4.6	4.8	24.6	128.9	53.1	44.3	77.8	92.7	16.8	12.8
1981	7.4	7.6	9.5	5.1	21.6	119.6	58.5	71.4	93.1	35.1	14.6	10.3
1982	5.9	8.6	9.2	7.4	28.0	64.8	19.5	18.0	28.0	57.2	16.6	12.7
1983	10.8	7.5	8.0	7.4	6.6	36.9	38.3	21.4	57.9	64.3	35.0	15.4
MEAN	8.1	6.0	5.4	5.2	22.9	70.8	35.0	29.5	81.7	77.4	26.7	11.2

Table G-09 REQUIRED RELEASE FOR IRRIGATION (19,360 HA)

REQUIRED RELEASE FOR IRRIGATION

UNIT : MCM

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1957	15.1	17.3	41.0	45.4	1.9	0.1	2.2	2.0	0.9	1.0	2.3	38.6
1958	32.5	31.6	51.0	55.0	1.9	0.1	2.2	2.0	0.9	1.0	2.3	41.4
1959	31.9	30.1	52.2	57.5	1.9	0.1	12.1	2.0	0.9	1.0	5.1	49.9
1960	35.5	34.5	54.9	58.3	1.9	0.1	2.2	2.0	0.9	1.0	2.3	28.7
1961	22.3	20.0	43.4	49.8	2.6	0.1	2.2	2.0	0.9	1.0	2.3	34.9
1962	28.0	26.8	50.3	55.3	1.9	0.1	2.2	2.0	0.9	1.0	9.4	43.4
1963	32.7	31.5	50.5	54.4	6.1	0.1	2.2	2.0	0.9	1.0	2.3	33.2
1964	29.7	29.2	47.9	52.2	4.1	0.1	2.2	2.0	0.9	1.0	2.3	32.7
1965	35.2	36.0	53.7	57.8	1.9	0.1	2.2	2.0	0.9	1.0	2.3	32.9
1966	27.8	27.7	43.2	46.7	1.9	0.1	2.2	2.0	0.9	1.0	2.3	26.2
1967	23.8	23.3	44.0	34.4	1.9	0.1	2.2	2.0	0.9	1.0	2.3	38.9
1968	29.5	28.2	50.3	54.0	1.9	0.1	2.2	2.0	0.9	1.0	2.3	22.3
1969	15.2	26.1	45.8	50.2	1.9	0.1	2.2	2.0	0.9	1.0	2.3	25.7
1970	29.6	32.6	52.2	59.6	1.9	0.1	2.2	2.0	0.9	1.0	2.3	21.2
1971	19.8	22.1	43.6	50.4	1.9	0.1	2.2	2.0	0.9	1.0	2.3	29.6
1972	27.7	26.6	48.9	54.0	1.9	0.1	3.6	2.0	0.9	1.0	13.2	47.0
1973	39.1	35.8	56.0	57.8	1.9	0.1	2.2	2.0	0.9	1.0	2.3	27.4
1974	31.5	34.2	54.4	57.4	1.9	0.1	2.2	2.0	0.9	1.0	2.3	43.1
1975	41.6	38.1	55.2	57.4	1.9	0.4	2.2	2.0	0.9	1.0	2.3	2.2
1976	27.2	29.9	53.3	58.1	1.9	0.1	2.2	2.0	0.9	1.0	2.3	13.3
1977	22.5	20.3	41.4	43.9	1.9	0.1	2.2	2.0	0.9	1.0	5.8	38.7
1978	28.4	24.7	44.9	42.5	1.9	0.1	2.2	2.0	0.9	1.0	6.0	26.6
1979	28.1	27.0	45.6	35.3	1.9	0.1	2.2	2.0	0.9	1.0	2.3	6.5
1980	20.5	29.7	53.4	44.0	1.9	0.1	2.2	2.0	0.9	1.0	2.3	2.2
1981	7.9	15.4	39.3	47.9	1.9	0.1	2.2	2.0	0.9	1.0	2.3	24.4
1982	29.9	12.4	29.2	39.2	1.9	0.1	2.2	2.0	0.9	1.0	2.3	2.2
1983	30.0	25.7	49.0	44.7	1.9	0.1	2.2	2.0	0.9	1.0	2.3	5.8

MAXIMUM IRRIGATION DISCHARGE (MCM) : 59.6

Table G-10 REQUIRED RELEASE FOR IRRIGATION (23,960 HA)

REQUIRED RELEASE FOR IRRIGATION

UNIT : MCM

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1957	26.3	24.8	56.7	66.4	1.9	0.1	2.2	2.0	0.9	1.0	7.5	54.2
1958	43.7	39.1	66.7	76.0	1.9	0.1	2.2	2.0	0.9	1.0	3.5	57.0
1959	43.1	37.6	67.9	78.5	1.9	0.1	16.1	2.0	0.9	1.0	11.1	65.5
1960	46.7	42.0	70.6	79.3	1.9	0.1	2.2	2.0	0.9	1.0	2.3	44.3
1961	33.5	27.5	59.1	70.8	7.7	0.1	2.2	2.0	0.9	1.0	2.3	50.5
1962	39.2	34.3	66.0	76.3	1.9	0.1	2.2	2.0	0.9	1.0	15.5	59.0
1963	43.9	39.0	66.2	75.4	11.2	0.1	2.2	2.0	0.9	1.0	2.3	48.8
1964	40.9	36.7	63.6	73.2	9.2	0.1	2.2	2.0	0.9	1.0	2.3	48.3
1965	46.4	43.5	69.4	78.8	1.9	0.1	2.2	2.0	0.9	1.0	2.3	48.5
1966	39.0	35.2	63.9	67.7	1.9	0.1	2.2	2.0	0.9	1.0	2.3	41.8
1967	35.0	30.8	59.7	55.4	5.0	0.1	2.2	2.0	0.9	1.0	5.6	54.5
1968	40.7	35.7	66.0	75.0	1.9	0.1	2.2	2.0	0.9	1.0	2.3	37.9
1969	26.4	33.6	61.5	71.2	1.9	0.1	2.2	2.0	0.9	1.0	2.3	41.3
1970	40.8	40.1	67.9	80.6	1.9	0.1	2.2	2.0	0.9	1.0	2.3	36.8
1971	31.0	29.6	59.3	71.4	1.9	0.1	5.5	2.0	0.9	1.0	2.3	45.2
1972	38.9	34.1	64.6	75.0	1.9	0.1	7.6	2.0	0.9	1.0	19.3	62.6
1973	50.3	43.3	71.7	78.8	1.9	0.1	2.2	2.0	0.9	1.0	2.3	43.0
1974	42.7	41.7	70.1	78.4	1.9	0.1	2.2	2.0	0.9	1.0	2.3	58.7
1975	52.8	45.6	70.9	78.4	1.9	1.2	4.8	2.0	0.9	1.0	2.3	3.5
1976	38.4	37.4	69.0	79.1	1.9	0.1	2.2	2.0	0.9	1.0	2.3	28.9
1977	33.7	27.8	57.1	64.9	1.9	0.1	2.2	2.0	0.9	1.0	11.8	54.3
1978	39.6	32.2	60.6	63.5	1.9	0.1	2.2	2.0	0.9	1.0	12.0	42.2
1979	39.3	34.5	61.3	56.3	1.9	0.1	2.2	2.0	0.9	1.0	2.3	22.1
1980	31.7	37.2	69.1	65.0	1.9	0.1	2.2	2.0	0.9	1.0	2.3	7.9
1981	19.1	22.9	55.0	68.9	1.9	0.1	2.2	2.0	0.9	1.0	2.3	40.0
1982	41.1	19.9	44.9	60.2	1.9	0.1	2.2	2.0	0.9	1.0	4.1	2.2
1983	41.2	33.2	64.7	65.7	1.9	0.1	2.2	2.0	0.9	1.0	2.3	21.4

MAXIMUM IRRIGATION DISCHARGE (MCM) : 80.6

Table G-11 RESULT OF RESERVOIR OPERATION STUDY

		Case 1-1	Case 1-2	Case 2-1	Case 2-2	Case 3
Irrigation Area	(ha)	19,360	19,360	23,960	23,960	29,160
Water Supply	(m^3/s)	-	1.0	-	1.0	-
Storage Capacity	(MCM)	200.5	207.2	354.0	387.6	737.5
Full Supply Level	(EL)	817.6	818.0	825.1	826.6	843.2
Min. Operating Level	(EL)	797.0	797.0	797.0	797.0	797.0
Max. Discharge	(m^3/s)	21.8	21.9	32.1	32.2	43.4
Power Capacity	(MW)	7.1	7.0	10.9	11.1	15.8
Annual Energy	(GWh)	45.2	43.4	55.4	53.6	63.4

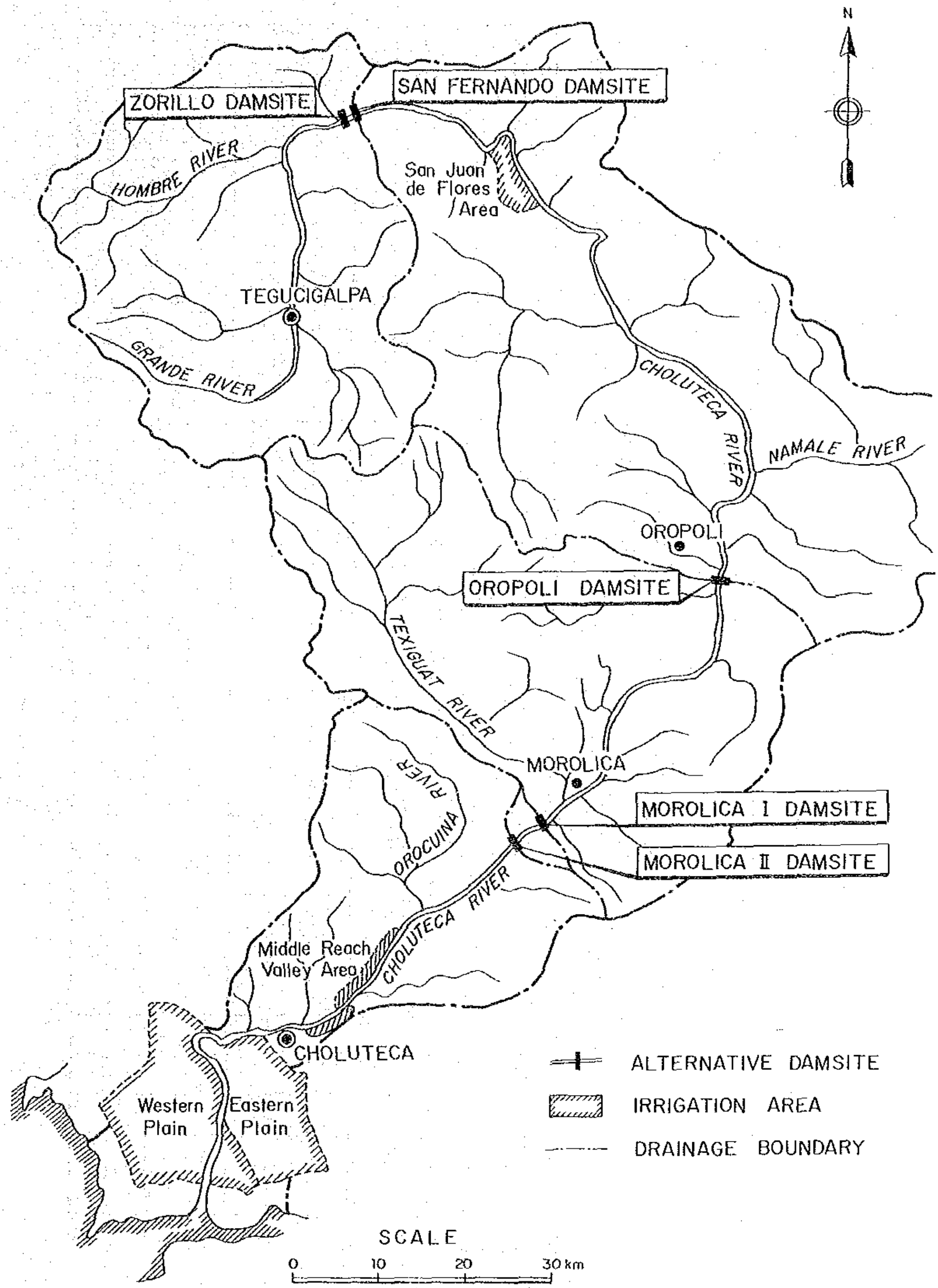
Table G-12 COMPARISON OF ALTERNATIVES

		Case 1-1	Case 1-2	Case 2-1	Case 2-2	Rainy Season Irrigation
Irrigation Area	(ha)	19,360	19,360	23,960	23,960	16,000
Water Supply	(m^3/s)	-	1.0	-	1.0	-
Storage	(MCM)	200	210	354	380	-
Power Capacity	(MW)	7.1	7.0	10.9	11.1	-
Annual Energy	(GWh)	45	43	55	54	-
Benefit (Present Value, Lp.10^6)						
Irrigation		159	159	192	192	38
Power		36	37	51	50	-
Water Supply /1		-	90	-	90	-
Total		195	286	243	332	38
Cost (Present Value, Lp.10^6)						
Dam, Irrigation & Power Plant		162	162	196	198	83
Water Supply		-	94	-	94	-
Total		162	256	196	292	83
B/C Ratio /2		1.20	1.11	1.24	1.14	0.46
B-C (Lp.10^6)		33	30	47	40	-45

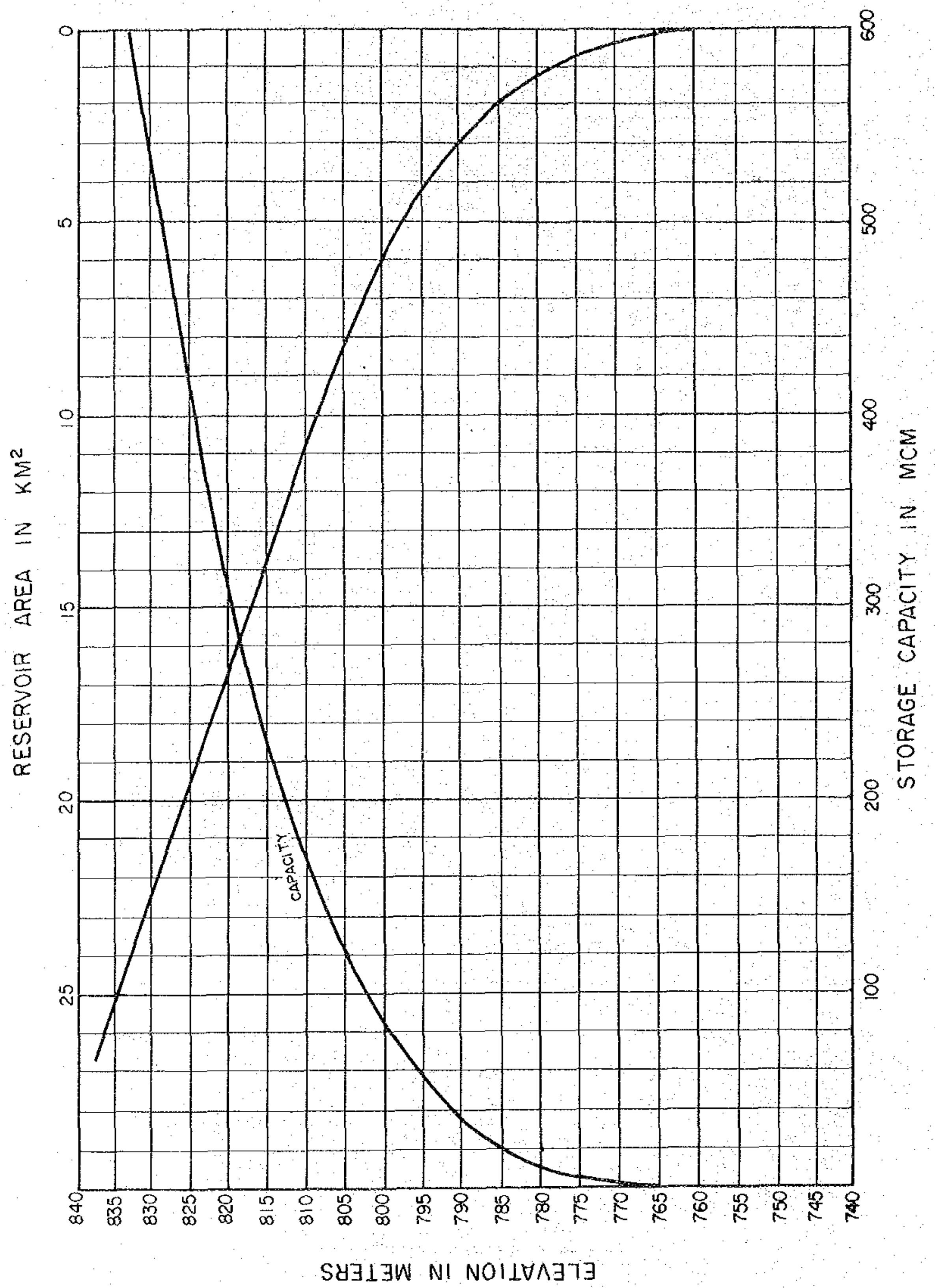
Note: /1: Presumed at Lp. 0.9/m^3 which is estimated for Guacerique water supply project

/2: Calculated at the discount rate of 12%

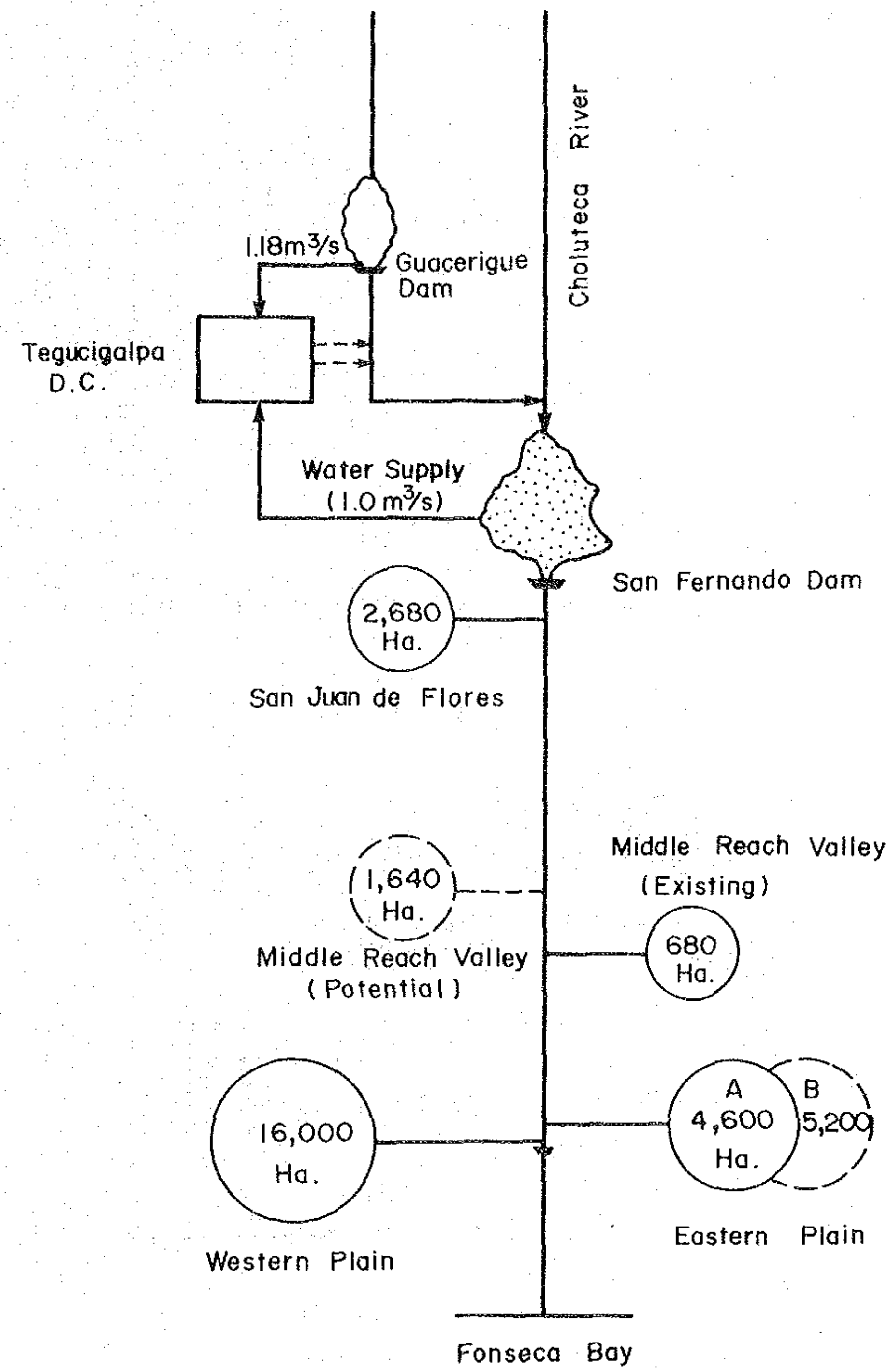
FIGURES



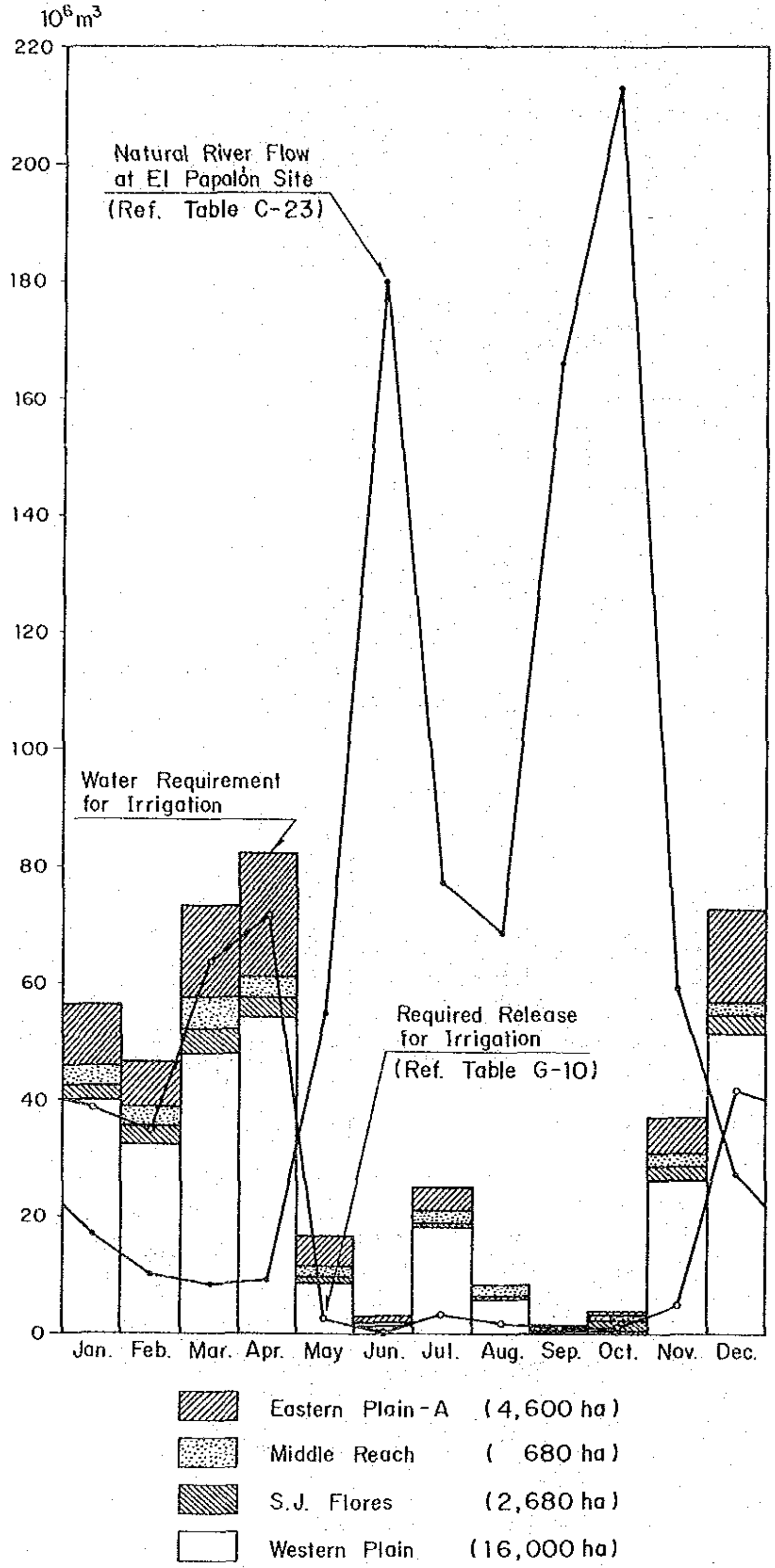
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES	Fig.	
CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT	G-01	LOCATION OF ALTERNATIVE DAMSITES
JAPAN INTERNATIONAL COOPERATION AGENCY		



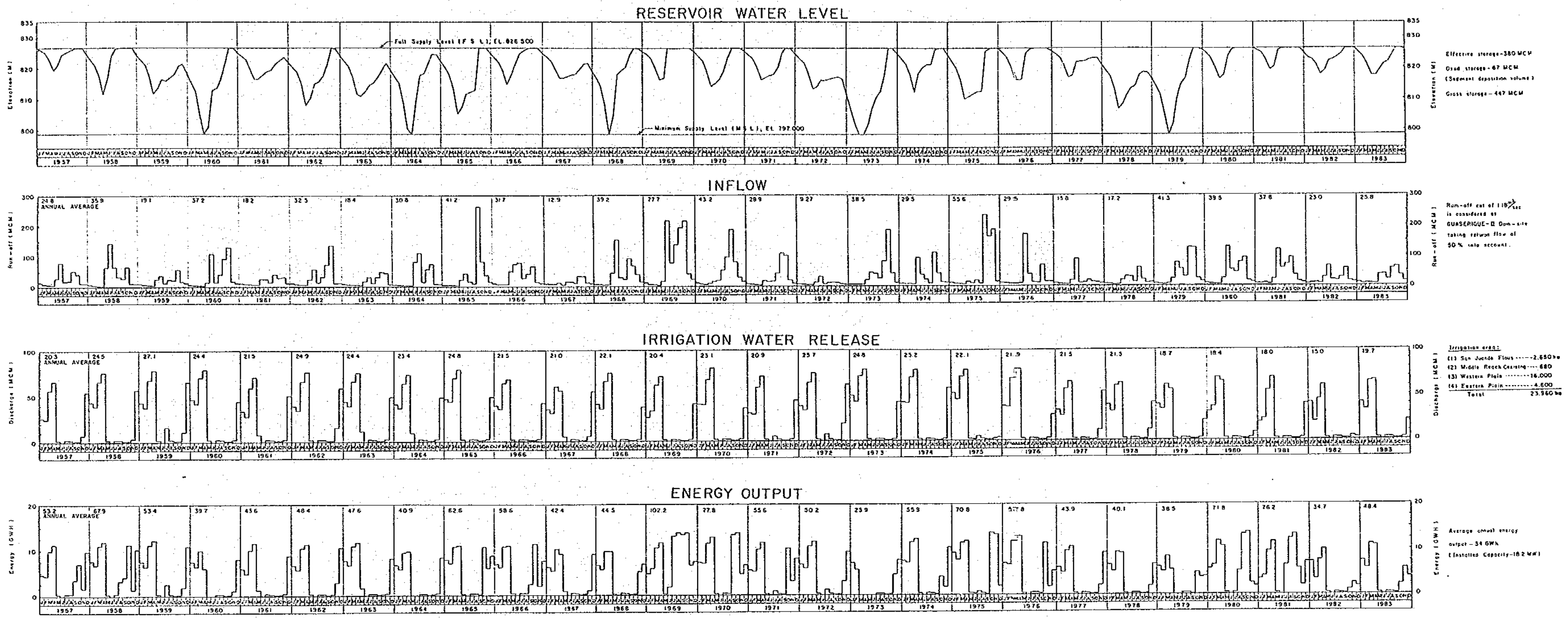
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES	Fig.	STORAGE CURVE AT SAN FERNANDO DAMSITE
CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT	G-02	
JAPAN INTERNATIONAL COOPERATION AGENCY		



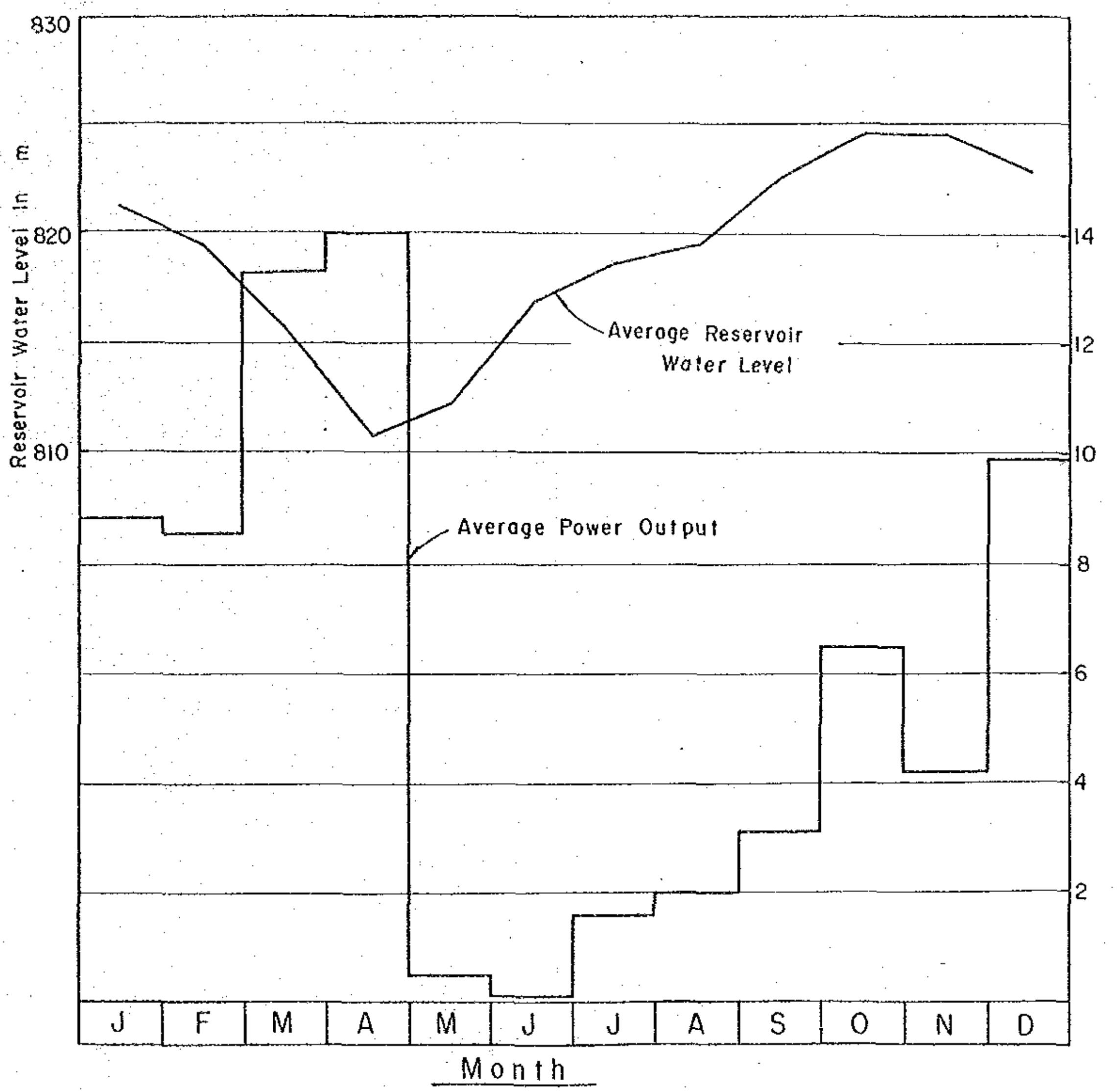
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES	Fig.	
CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT	G-03	MODEL OF CHOLUTECA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY		



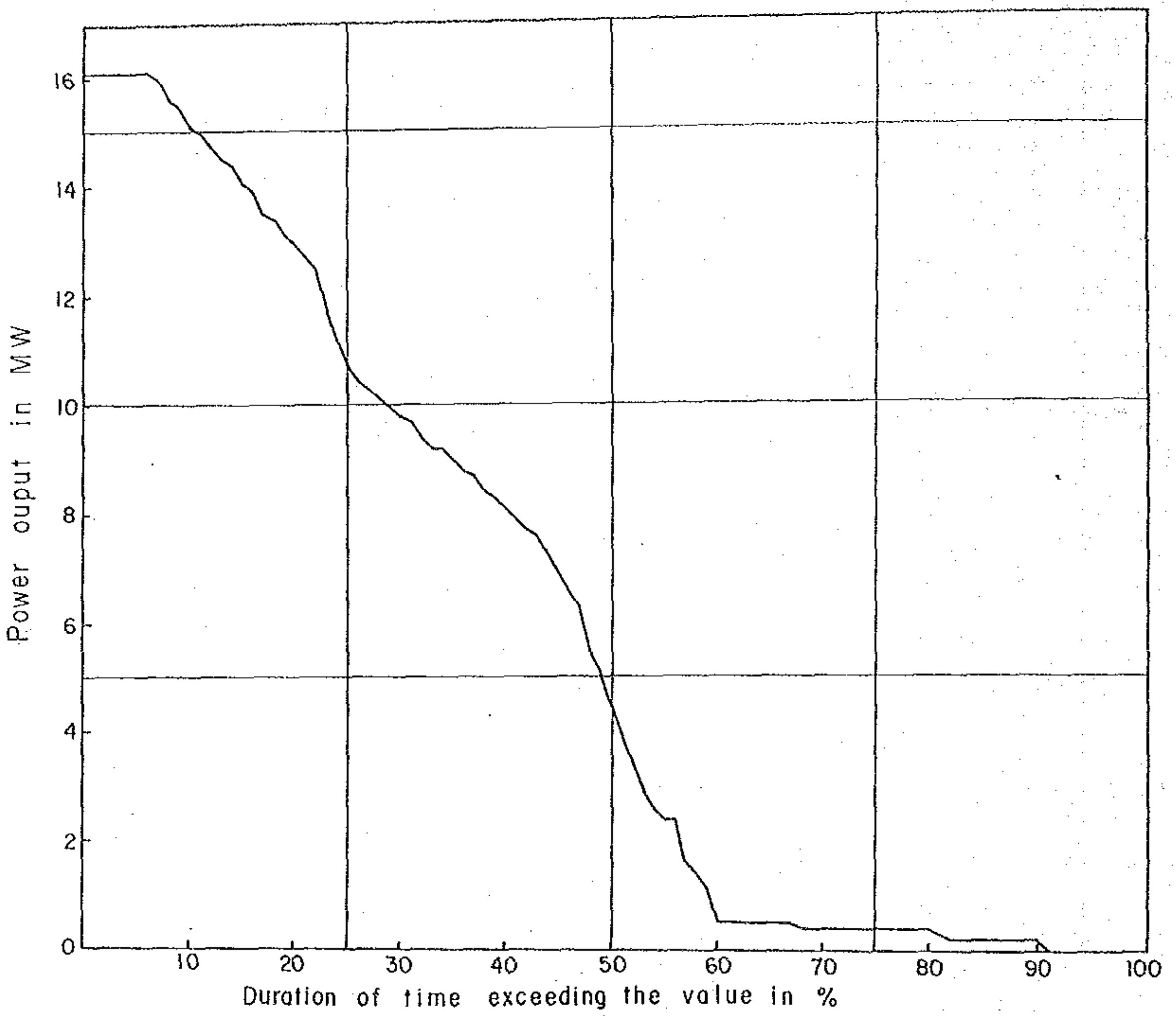
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. G-04	WATER REQUIREMENT FOR IRRIGATION



GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. G-05	RESULT OF RESERVOIR OPERATION (Case 2-2)

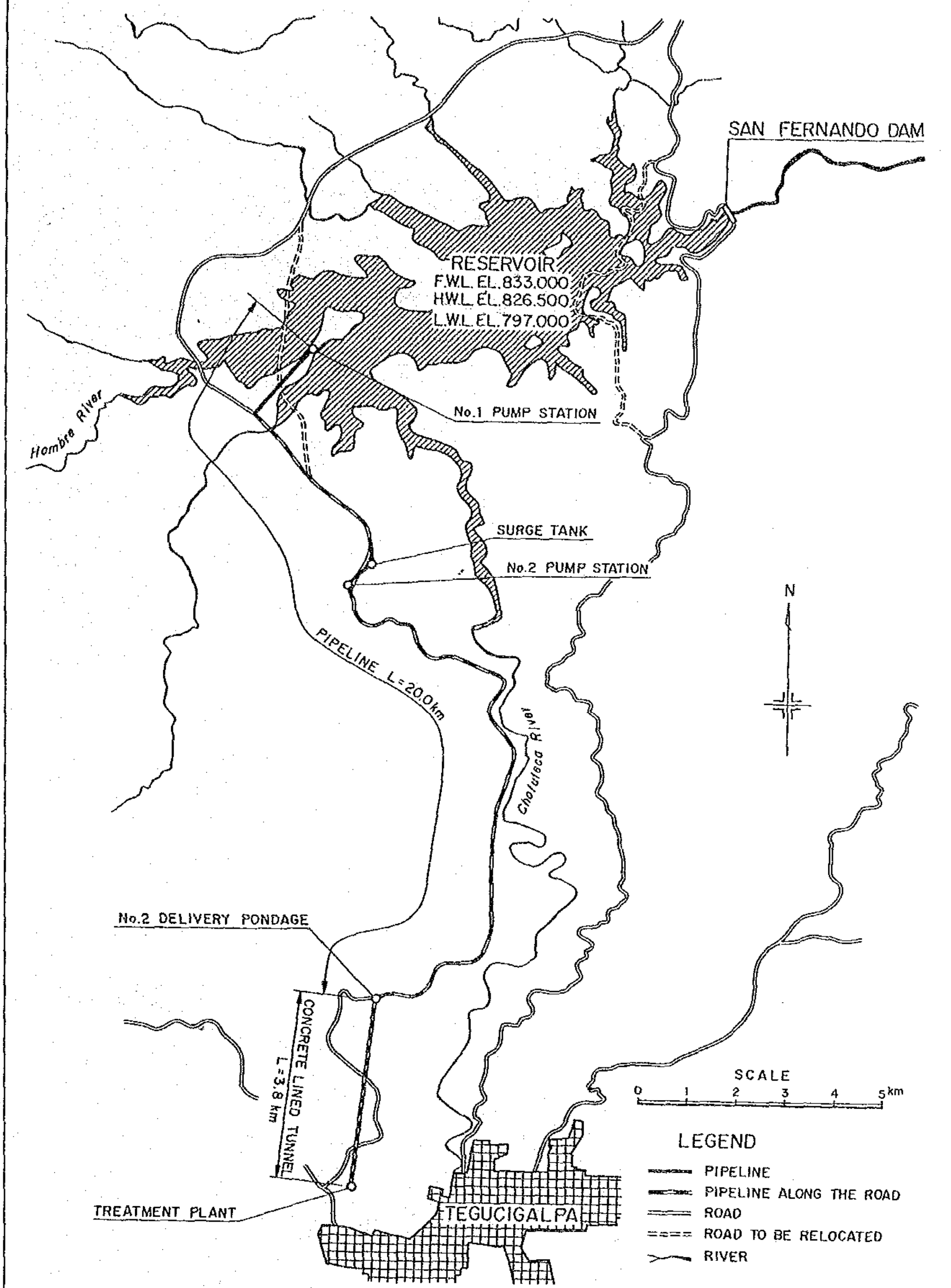


GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. G-06	Mean Monthly Power Output and Reservoir Water Level



GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. G-07	Duration of Power Output

DRAWINGS



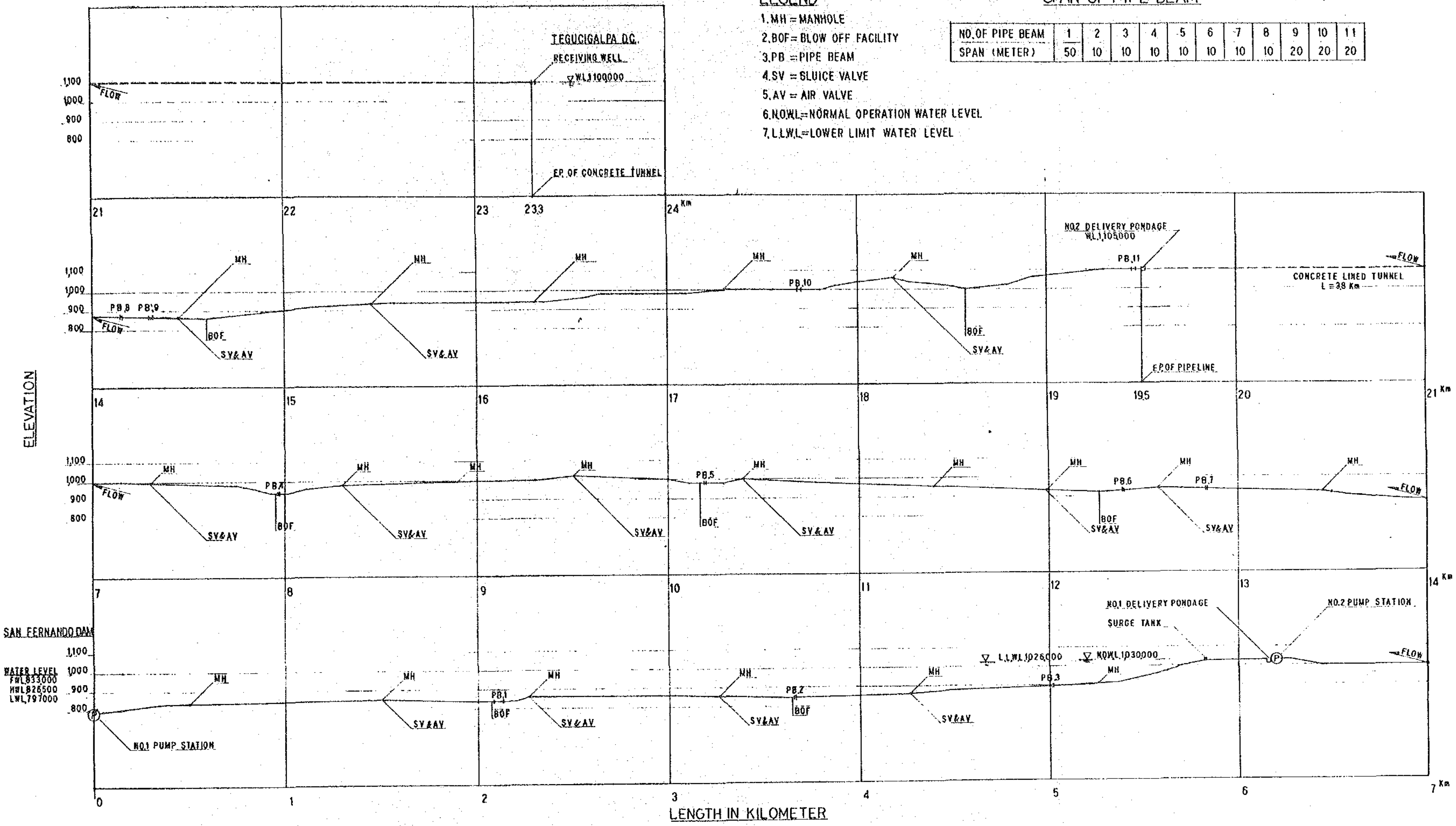
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES	DWG. G-01	WATER SUPPLY SYSTEM LOCATION MAP
CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT		
JAPAN INTERNATIONAL COOPERATION AGENCY		

LEGEND

1. MH = MANHOLE
2. BOF = BLOW OFF FACILITY
3. PB = PIPE BEAM
4. SV = SLUICE VALVE
5. AV = AIR VALVE
6. N.O.W.L. = NORMAL OPERATION WATER LEVEL
7. L.L.W.L. = LOWER LIMIT WATER LEVEL

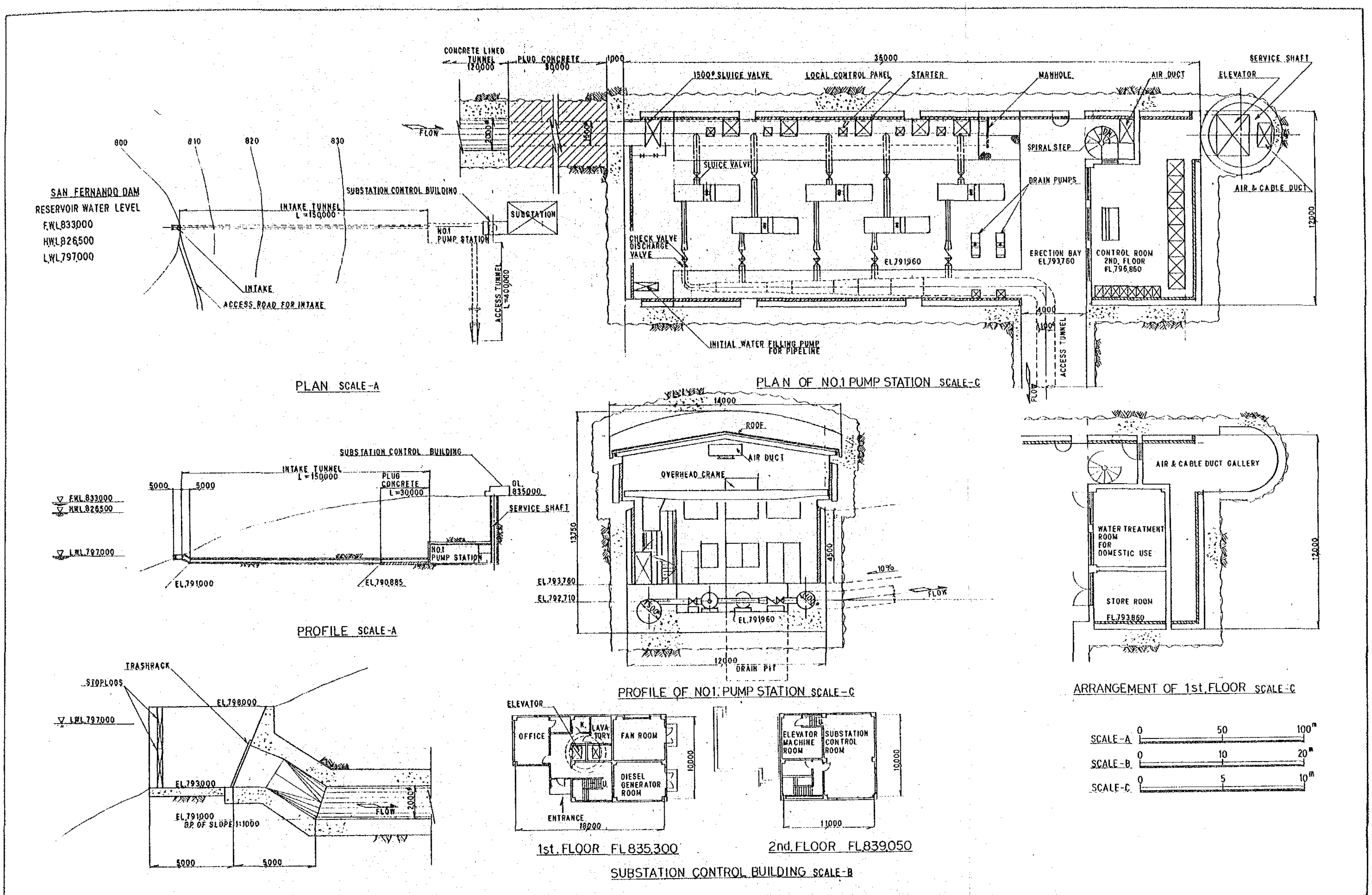
SPAN OF PIPE BEAM

NO. OF PIPE BEAM	1	2	3	4	5	6	7	8	9	10	11
SPAN (METER)	50	10	10	10	10	10	10	10	20	20	20

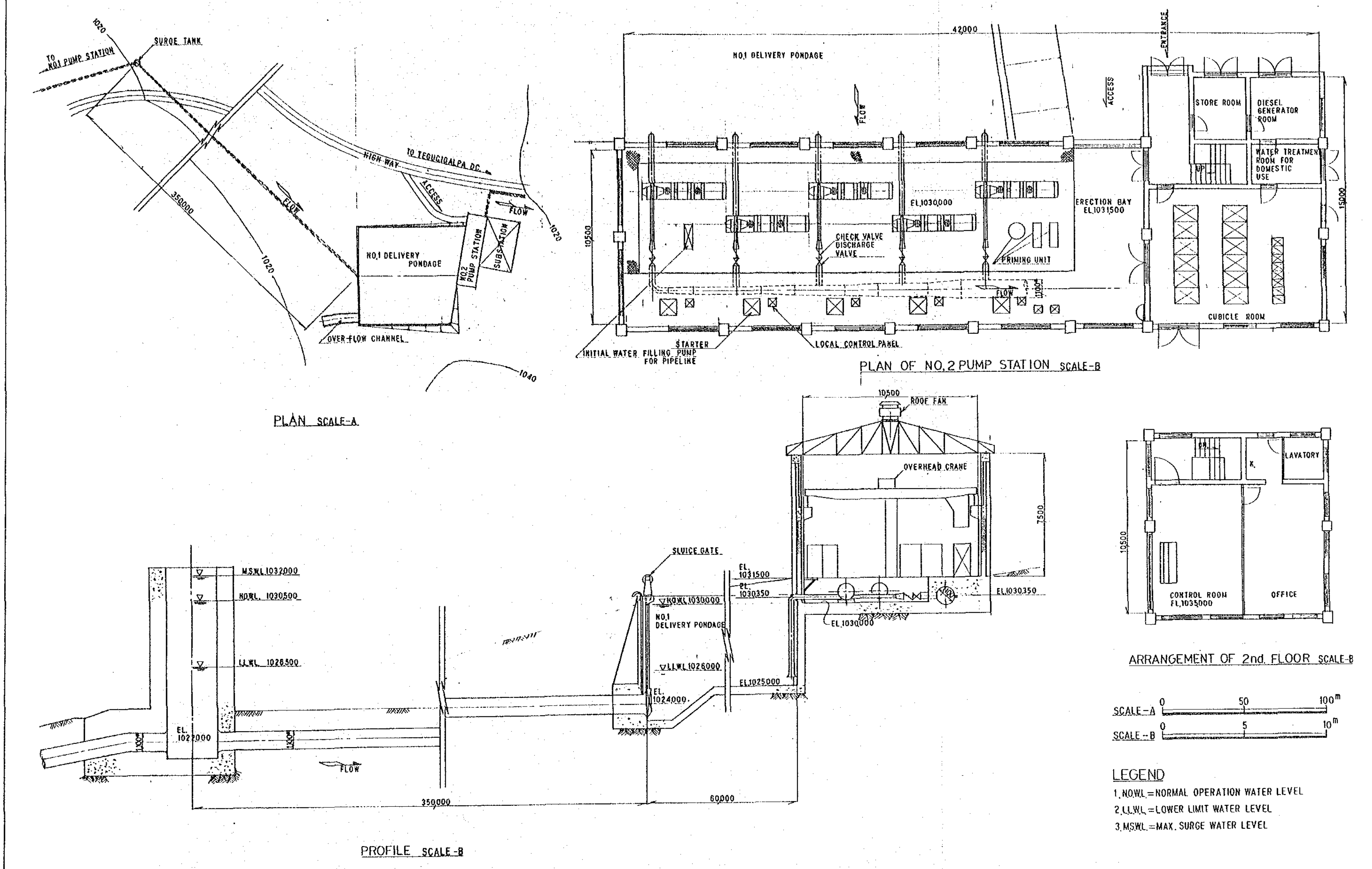


PROFILE OF PIPELINE

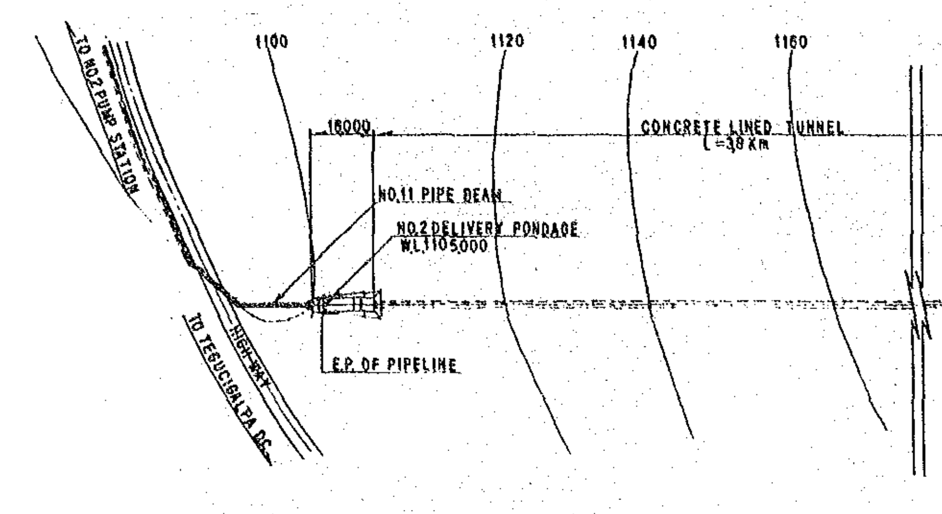
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES	DWG.	WATER SUPPLY SYSTEM
CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT	G-02	PROFILE OF PIPELINE
JAPAN INTERNATIONAL COOPERATION AGENCY		



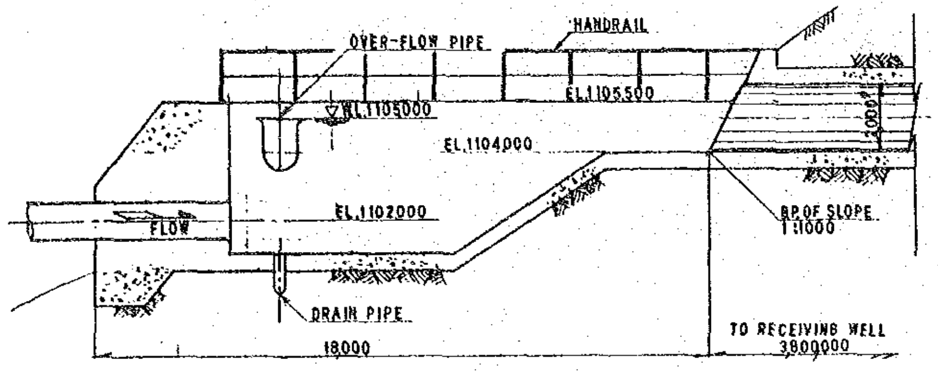
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. G-03	WATER SUPPLY SYSTEM NO.1 PUMPING STATION



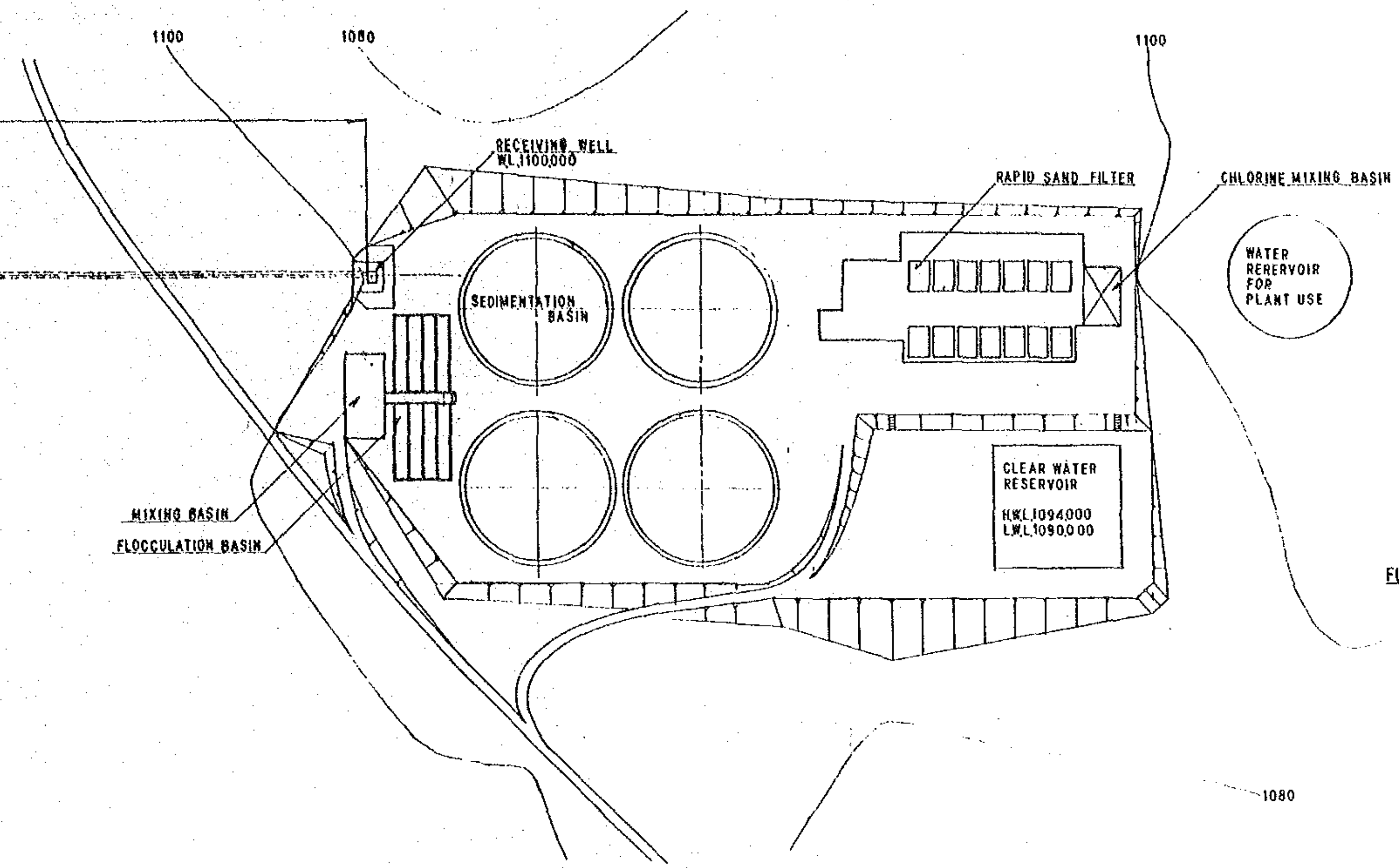
GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. G-04	WATER SUPPLY SYSTEM NO.2 PUMPING STATION



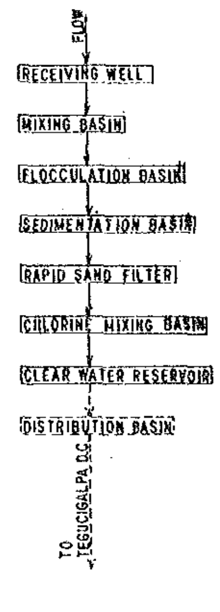
PLAN OF NO.2 DELIVERY PONDAGE SCALE-A



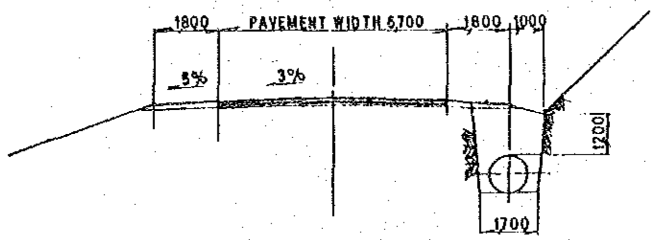
PROFILE OF NO.2 DELIVERY PONDAGE SCALE-C



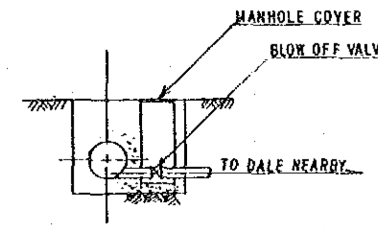
PLAN OF FILTRATION PLANT SCALE-A



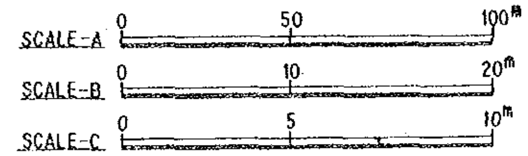
FLOW CHART IN PLANT

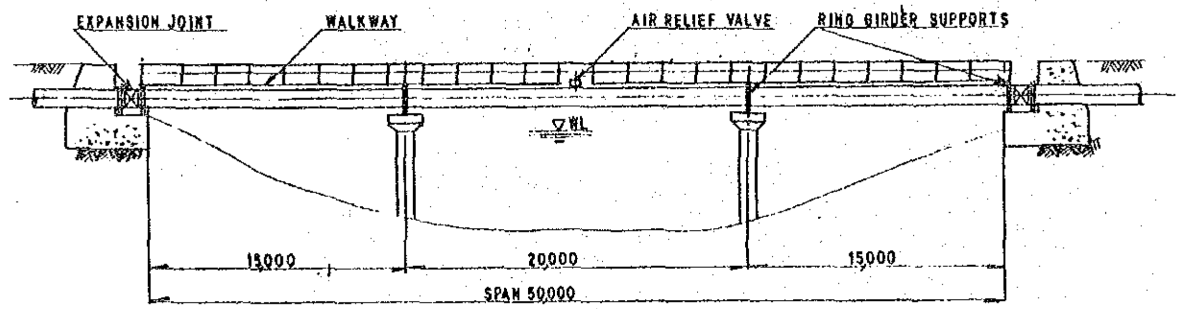


TYPICAL SECTION OF PIPELINE ROUTE SCALE-C

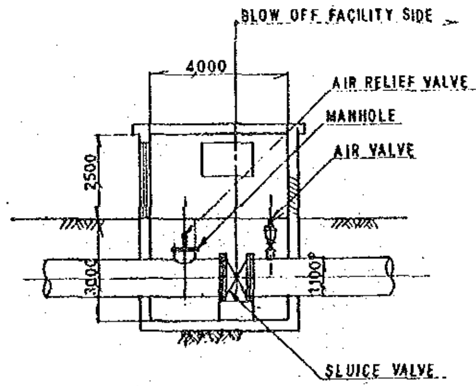


BLOW OFF FACILITY SCALE-C





TYPICAL PROFILE OF NO.1 PIPE BEAM SCALE-B



MANHOLE CHAMBER SCALE-C

GOVERNMENT OF THE REPUBLIC OF HONDURAS MINISTRY OF NATURAL RESOURCES CHOLUTECA RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. G-05	WATER SUPPLY SYSTEM WATERWAY & TREATMENT PLANT

RESERVOIR OPERATION

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW
OPERATION LEVEL : 797.0 EL.M (MOL)
- DO - : 826.6 EL.M (FSL)

CHOLUTECA CHOLUTECA

FIRM DISCHARGE : 0. M3/S
P.MAX DISCHARGE : 32.2 M3/S
ACTIVE STORAGE : 387.6 MIL.M3

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV.-STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
(INITIAL)								457.2	815.2			
1957	JAN	14.3	26.3	0.	1.3	0.	1.8	442.2	826.0	6.4	0.	4.8
	FEB	9.0	24.8	0.	1.2	0.	2.1	423.0	825.1	6.6	0.	4.4
	MAR	7.1	56.7	0.	1.3	0.	3.0	369.1	822.6	13.4	0.	9.9
	APR	6.1	66.4	0.	1.3	0.	3.0	304.5	819.5	15.6	0.	11.2
	MAY	28.5	1.9	0.	1.3	0.	2.9	326.8	820.6	0.4	0.	0.3
	JUN	78.8	0.1	0.	1.3	0.	2.4	401.8	824.1	0.0	0.	0.0
	JUL	18.0	2.2	0.	1.3	0.	2.3	414.0	824.7	0.5	0.	0.4
	AUG	19.0	2.0	0.	1.3	0.	2.5	427.2	825.3	0.5	0.	0.4
	SEP	52.2	0.9	17.5	1.3	0.	2.5	457.2	826.6	4.6	0.	3.3
	OCT	41.8	1.0	37.4	1.3	0.	2.1	457.2	826.6	9.4	0.	7.0
	NOV	11.4	7.5	1.1	1.3	0.	1.5	457.2	826.6	2.2	0.	1.6
	DEC	10.9	54.2	0.	1.3	0.	1.5	411.1	824.5	13.1	0.	9.7
(ANNUAL TOTAL)		297.1	243.9	56.0	15.8	0.	27.6	-	-	-	0.	53.1
1958	JAN	7.1	43.7	0.	1.3	0.	1.6	371.6	822.7	10.3	0.	7.6
	FEB	4.8	39.1	0.	1.2	0.	1.8	334.3	821.0	10.0	0.	6.7
	MAR	3.5	66.7	0.	1.3	0.	2.3	267.5	817.4	14.5	0.	11.0
	APR	2.1	76.0	0.	1.3	0.	2.3	190.0	812.0	16.5	0.	11.9
	MAY	64.4	1.9	0.	1.3	0.	2.7	248.5	816.3	0.4	0.	0.3
	JUN	142.5	0.1	0.	1.3	0.	2.4	387.2	823.4	0.0	0.	0.0
	JUL	63.8	2.2	0.	1.3	0.	2.3	445.2	826.1	0.5	0.	0.4
	AUG	32.4	2.0	14.6	1.3	0.	2.5	457.2	826.6	4.0	0.	3.0
	SEP	26.5	0.9	21.8	1.3	0.	2.5	457.2	826.6	5.7	0.	4.1
	OCT	65.2	1.0	60.8	1.3	0.	2.1	457.2	826.6	15.1	0.	11.2
	NOV	9.7	3.5	3.3	1.3	0.	1.5	457.2	826.6	1.7	0.	1.2
	DEC	8.5	57.0	0.	1.3	0.	1.5	405.9	824.3	13.7	0.	10.2
(ANNUAL TOTAL)		430.6	294.1	100.5	15.8	0.	25.5	-	-	-	0.	67.8
1959	JAN	9.0	43.1	0.	1.3	0.	1.6	368.9	822.6	10.1	0.	7.5
	FEB	6.6	37.6	0.	1.2	0.	1.8	334.8	821.0	9.6	0.	6.4
	MAR	5.8	67.9	0.	1.3	0.	2.3	269.1	817.5	15.1	0.	11.2
	APR	4.9	78.5	0.	1.3	0.	2.2	192.0	812.2	17.0	0.	12.3
	MAY	25.4	1.9	0.	1.3	0.	2.2	211.9	813.9	0.4	0.	0.3
	JUN	36.9	0.1	0.	1.3	0.	1.8	245.6	816.2	0.0	0.	0.0
	JUL	12.0	16.1	0.	1.3	0.	1.7	238.5	815.8	3.4	0.	2.5
	AUG	23.2	2.0	0.	1.3	0.	1.9	256.5	816.8	0.4	0.	0.3
	SEP	20.8	0.9	0.	1.3	0.	2.1	273.0	817.7	0.2	0.	0.1
	OCT	56.6	1.0	0.	1.3	0.	1.8	325.5	820.6	0.2	0.	0.2
	NOV	16.7	11.1	0.	1.3	0.	1.3	328.4	820.7	2.6	0.	1.9
	DEC	11.5	65.5	0.	1.3	0.	1.2	271.8	817.7	14.6	0.	10.8
(ANNUAL TOTAL)		229.1	325.7	0.	15.8	0.	21.8	-	-	-	0.	53.6

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW
OPERATION LEVEL : 797.0 EL.M (MOL)
- DO - : 826.6 EL.M (FSL)

CHOLUTECA CHOLUTECA
FIRM DISCHARGE : 0. M3/S
P.MAX DISCHARGE : 32.2 M3/S
ACTIVE STORAGE : 387.6 MIL.M3

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV.-STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
1960	JAN	5.8	46.7	0.	1.3	0.	1.2	228.4	815.2	10.0	0.	7.4
	FEB	4.5	42.0	0.	1.3	0.	1.3	188.4	811.8	9.2	0.	6.4
	MAR	4.5	70.6	0.	1.3	0.	1.2	119.7	804.6	13.4	0.	9.9
	APR	3.9	51.6*	0.	1.3	0.	1.1	69.6	797.0	9.0	0.	6.5
	MAY	14.1	1.9	0.	1.3	0.	1.5	78.9	799.3	0.	0.	0.
	JUN	108.8	0.1	0.	1.3	0.	1.6	184.7	811.5	0.0	0.	0.0
	JUL	14.4	2.2	0.	1.3	0.	1.6	193.9	812.3	0.4	0.	0.3
	AUG	40.6	2.0	0.	1.3	0.	2.0	229.2	815.2	0.4	0.	0.3
	SEP	92.2	0.9	0.	1.3	0.	2.4	316.8	820.2	0.2	0.	0.1
	OCT	129.4	1.0	0.	1.3	0.	2.1	441.8	825.9	0.2	0.	0.2
	NOV	17.1	2.3	0.	1.3	0.	1.5	453.7	826.5	0.6	0.	0.4
	DEC	10.9	44.3	0.	1.3	0.	1.5	417.4	824.8	10.7	0.	8.0
(ANNUAL TOTAL)		446.2	265.6	0.	15.8	0.	19.1	-	-	-	0.	39.6
1961	JAN	10.6	33.5	0.	1.3	0.	1.6	391.6	823.6	7.9	0.	5.9
	FEB	8.8	27.5	0.	1.2	0.	2.0	369.7	822.6	7.1	0.	4.8
	MAR	8.5	59.1	0.	1.3	0.	2.7	315.1	820.1	13.5	0.	10.0
	APR	6.9	70.8	0.	1.3	0.	2.6	247.3	816.3	16.0	0.	11.5
	MAY	7.3	7.7	0.	1.3	0.	2.4	243.2	816.0	1.6	0.	1.2
	JUN	25.1	0.1	0.	1.3	0.	2.0	265.0	817.3	0.0	0.	0.0
	JUL	25.2	2.2	0.	1.3	0.	1.8	284.8	818.4	0.5	0.	0.4
	AUG	14.3	2.0	0.	1.3	0.	2.1	293.6	818.9	0.4	0.	0.3
	SEP	40.3	0.9	0.	1.3	0.	2.2	329.5	820.8	0.2	0.	0.1
	OCT	29.0	1.0	0.	1.3	0.	2.0	354.2	821.9	0.2	0.	0.2
	NOV	30.6	2.3	0.	1.3	0.	1.5	379.8	823.1	0.5	0.	0.4
	DEC	11.3	50.5	0.	1.3	0.	1.4	337.8	821.1	11.7	0.	8.7
(ANNUAL TOTAL)		217.9	257.5	0.	15.8	0.	24.3	-	-	-	0.	43.5
1962	JAN	11.3	39.2	0.	1.3	0.	1.5	307.1	819.7	8.8	0.	6.6
	FEB	7.8	34.3	0.	1.2	0.	1.8	277.7	818.0	8.4	0.	5.6
	MAR	6.9	66.0	0.	1.3	0.	2.2	215.0	814.1	14.0	0.	10.4
	APR	6.4	76.3	0.	1.3	0.	2.1	141.8	807.1	15.5	0.	11.2
	MAY	23.6	1.9	0.	1.3	0.	2.2	159.9	809.2	0.4	0.	0.3
	JUN	56.8	0.1	0.	1.3	0.	1.9	213.5	814.0	0.0	0.	0.0
	JUL	13.4	2.2	0.	1.3	0.	1.8	221.6	814.7	0.5	0.	0.3
	AUG	32.6	2.0	0.	1.3	0.	2.1	248.7	816.3	0.4	0.	0.3
	SEP	72.2	0.9	0.	1.3	0.	2.4	316.3	820.2	0.2	0.	0.1
	OCT	135.4	1.0	0.	1.3	0.	2.1	447.3	826.2	0.2	0.	0.2
	NOV	11.5	15.5	0.	1.3	0.	1.5	440.5	825.9	3.9	0.	2.8
	DEC	11.9	59.0	0.	1.3	0.	1.5	390.5	823.6	14.1	0.	10.5
(ANNUAL TOTAL)		389.8	298.3	0.	15.8	0.	23.0	-	-	-	0.	48.4

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW
OPERATION LEVEL : 797.0 EL.M (MOL)
- DO - : 826.6 EL.M (FSL)

CHOLUTECA CHOLUTECA

FIRM DISCHARGE : 0. M3/S
P.MAX DISCHARGE : 32.2 M3/S
ACTIVE STORAGE : 387.6 MIL.M3

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV. STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
1963	JAN	9.2	43.9	0.	1.3	0.	1.6	353.0	821.8	10.2	0.	7.6
	FEB	6.6	39.0	0.	1.2	0.	1.8	317.6	820.2	9.8	0.	6.6
	MAR	5.8	66.2	0.	1.3	0.	2.3	253.6	816.6	14.5	0.	10.8
	APR	5.6	75.4	0.	1.3	0.	2.0	180.5	811.2	16.1	0.	11.6
	MAY	3.6	11.2	0.	1.3	0.	1.9	169.7	810.2	2.2	0.	1.6
	JUN	18.2	0.1	0.	1.3	0.	1.6	184.9	811.5	0.0	0.	0.0
	JUL	30.4	2.2	0.	1.3	0.	1.6	210.3	813.7	0.4	0.	0.3
	AUG	11.5	2.0	0.	1.3	0.	1.8	216.6	814.3	0.4	0.	0.3
	SEP	31.2	0.9	0.	1.3	0.	2.0	243.7	816.1	0.2	0.	0.1
	OCT	47.2	1.0	0.	1.3	0.	1.8	286.7	818.5	0.2	0.	0.2
	NOV	44.2	2.3	0.	1.3	0.	1.4	326.0	820.6	0.5	0.	0.4
	DEC	6.7	48.8	0.	1.3	0.	1.3	281.2	818.2	10.9	0.	8.1
(ANNUAL TOTAL)		220.2	292.9	0.	15.8	0.	20.9	-	-	-	0.	47.7
1964	JAN	5.8	40.9	0.	1.3	0.	1.3	243.5	816.0	8.8	0.	6.6
	FEB	4.3	36.7	0.	1.3	0.	1.5	208.4	813.6	8.2	0.	5.7
	MAR	3.7	63.6	0.	1.3	0.	1.6	145.6	807.6	12.5	0.	9.3
	APR	3.3	73.2	0.	1.3	0.	1.2	73.2	797.9	13.1	0.	9.5
	MAY	2.6	3.6*	0.	1.3	0.	1.5	69.6	797.0	0.	0.	0.
	JUN	80.9	0.1	0.	1.3	0.	1.7	147.4	807.8	0.0	0.	0.0
	JUL	109.4	2.2	0.	1.3	0.	1.9	251.5	816.5	0.4	0.	0.3
	AUG	14.6	2.0	0.	1.3	0.	2.1	260.6	817.0	0.4	0.	0.3
	SEP	56.7	0.9	0.	1.3	0.	2.4	312.7	820.0	0.2	0.	0.1
	OCT	73.0	1.0	0.	1.3	0.	2.1	381.3	823.1	0.2	0.	0.2
	NOV	8.0	2.3	0.	1.3	0.	1.5	384.2	823.3	0.6	0.	0.4
	DEC	6.9	48.3	0.	1.3	0.	1.5	339.9	821.2	11.2	0.	8.3
(ANNUAL TOTAL)		369.5	274.8	0.	15.8	0.	20.3	-	-	-	0.	40.7
1965	JAN	3.7	46.4	0.	1.3	0.	1.5	294.3	818.9	10.4	0.	7.8
	FEB	3.9	43.5	0.	1.2	0.	1.8	251.8	816.5	10.5	0.	7.0
	MAR	3.1	69.4	0.	1.3	0.	2.1	182.0	811.3	14.4	0.	10.7
	APR	2.8	78.8	0.	1.3	0.	2.0	102.8	802.5	15.1	0.	10.9
	MAY	21.9	1.9	0.	1.3	0.	2.0	119.4	804.6	0.3	0.	0.2
	JUN	41.7	0.1	0.	1.3	0.	1.7	157.9	809.0	0.0	0.	0.0
	JUL	15.4	2.2	0.	1.3	0.	1.6	168.1	810.1	0.4	0.	0.3
	AUG	8.7	2.0	0.	1.3	0.	2.1	171.3	810.4	0.4	0.	0.3
	SEP	261.5	0.9	0.	1.3	0.	2.5	428.1	825.3	0.2	0.	0.1
	OCT	81.6	1.0	48.1	1.3	0.	2.1	457.2	826.6	11.9	0.	8.9
	NOV	36.1	2.3	31.0	1.3	0.	1.5	457.2	826.6	6.4	0.	6.0
	DEC	14.1	48.5	0.	1.3	0.	1.5	419.9	824.9	11.7	0.	8.7
(ANNUAL TOTAL)		494.4	296.9	79.0	15.8	0.	22.7	-	-	-	0.	61.0

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW
OPERATION LEVEL : 797.0 EL.M (MOL)
- DO - : 826.6 EL.M (FSL)

CHOLUTECA

CHOLUTECA

FIRM DISCHARGE : 0. M3/S
P.MAX DISCHARGE : 32.2 M3/S
ACTIVE STORAGE : 387.6 MIL.M3

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV.-STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
1966	JAN	9.0	39.0	0.	1.3	0.	1.6	387.0	823.4	9.2	0.	6.9
	FEB	5.9	35.2	0.	1.2	0.	1.9	354.6	821.9	9.1	0.	6.1
	MAR	6.1	63.9	0.	1.3	0.	2.5	293.0	818.9	14.4	0.	10.7
	APR	5.9	67.7	0.	1.3	0.	2.6	227.3	815.1	15.1	0.	10.8
	MAY	49.2	1.9	0.	1.3	0.	2.7	270.6	817.6	0.4	0.	0.3
	JUN	73.5	0.1	0.	1.3	0.	2.3	340.4	821.3	0.0	0.	0.0
	JUL	77.2	2.2	0.	1.3	0.	2.3	411.8	824.6	0.5	0.	0.4
	AUG	26.4	2.0	0.	1.3	0.	2.5	432.4	825.5	0.5	0.	0.4
	SEP	40.1	0.9	10.6	1.3	0.	2.5	457.2	826.6	2.9	0.	2.1
	OCT	65.4	1.0	61.0	1.3	0.	2.1	457.2	826.6	15.2	0.	11.3
	NOV	13.2	2.3	8.1	1.3	0.	1.5	457.2	826.6	2.6	0.	1.9
	DEC	8.7	41.8	0.	1.3	0.	1.5	421.2	825.0	10.1	0.	7.5
(ANNUAL TOTAL)		380.6	257.9	79.7	15.8	0.	26.0	-	-	-	0.	58.3
1967	JAN	7.7	35.0	0.	1.3	0.	1.6	391.0	823.6	8.3	0.	6.2
	FEB	6.2	30.8	0.	1.2	0.	1.9	363.2	822.3	8.0	0.	5.3
	MAR	5.8	59.7	0.	1.3	0.	2.7	305.3	819.6	13.6	0.	10.1
	APR	11.1	55.4	0.	1.3	0.	2.6	257.0	816.8	12.5	0.	9.0
	MAY	4.7	5.0	0.	1.3	0.	2.4	253.0	816.6	1.1	0.	0.8
	JUN	13.9	0.1	0.	1.3	0.	1.9	263.6	817.2	0.0	0.	0.0
	JUL	13.5	2.2	0.	1.3	0.	1.8	271.8	817.7	0.5	0.	0.4
	AUG	9.3	2.0	0.	1.3	0.	2.0	275.7	817.9	0.4	0.	0.3
	SEP	32.4	0.9	0.	1.3	0.	2.1	303.8	819.5	0.2	0.	0.1
	OCT	32.3	1.0	0.	1.3	0.	1.9	331.9	820.9	0.2	0.	0.2
	NOV	11.0	5.6	0.	1.3	0.	1.3	334.5	821.0	1.3	0.	1.0
	DEC	7.3	54.5	0.	1.3	0.	1.3	284.7	818.4	12.2	0.	9.1
(ANNUAL TOTAL)		155.0	252.1	0.	15.8	0.	23.6	-	-	-	0.	42.5
1968	JAN	6.2	40.7	0.	1.3	0.	1.3	247.6	816.3	8.8	0.	6.5
	FEB	4.3	35.7	0.	1.3	0.	1.5	213.5	814.0	8.0	0.	5.6
	MAR	3.3	66.0	0.	1.3	0.	1.5	148.0	807.8	13.0	0.	9.7
	APR	3.2	75.0	0.	1.3	0.	1.3	73.6	798.0	13.5	0.	9.7
	MAY	43.1	1.9	0.	1.3	0.	2.0	111.5	803.6	0.3	0.	0.2
	JUN	152.1	0.1	0.	1.3	0.	2.1	260.1	817.0	0.0	0.	0.0
	JUL	27.8	2.2	0.	1.3	0.	2.0	282.5	818.3	0.5	0.	0.4
	AUG	21.9	2.0	0.	1.3	0.	2.3	298.7	819.2	0.4	0.	0.3
	SEP	90.6	0.9	0.	1.3	0.	2.5	384.6	823.3	0.2	0.	0.1
	OCT	66.7	1.0	0.	1.3	0.	2.1	446.9	826.2	0.2	0.	0.2
	NOV	38.5	2.3	23.1	1.3	0.	1.5	457.2	826.6	6.4	0.	4.6
	DEC	13.0	37.9	0.	1.3	0.	1.6	429.3	825.4	9.2	0.	6.8
(ANNUAL TOTAL)		470.8	265.6	23.1	15.8	0.	21.7	-	-	-	0.	44.2

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW
OPERATION LEVEL : 797.0 EL.M (MOL)
- DO - : 826.6 EL.M (FSL)

CHOLUTECA CHOLUTECA

FIRM DISCHARGE : 0. M3/S
P.MAX DISCHARGE : 32.2 M3/S
ACTIVE STORAGE : 387.6 MIL.M3

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV.-STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
1969	JAN	10.7	26.4	0.	1.3	0.	1.7	410.6	824.5	6.3	0.	4.7
	FEB	4.9	33.6	0.	1.2	0.	2.0	378.8	823.0	8.8	0.	5.9
	MAR	4.3	61.5	0.	1.3	0.	2.7	317.6	820.2	14.1	0.	10.5
	APR	3.1	71.2	0.	1.3	0.	2.6	245.6	816.2	16.1	0.	11.6
	MAY	15.3	1.9	0.	1.3	0.	2.8	254.9	816.7	0.4	0.	0.3
	JUN	215.5	0.1	9.2	1.3	0.	2.5	457.2	826.6	2.2	0.	1.6
	JUL	75.4	2.2	69.6	1.3	0.	2.3	457.2	826.6	17.6	0.	13.1
	AUG	136.4	2.0	84.2	1.3	46.4	2.5	457.2	826.6	18.2	0.	13.5
	SEP	191.5	0.9	82.6	1.3	104.2	2.5	457.2	826.6	18.2	0.	13.1
	OCT	214.4	1.0	85.3	1.3	124.7	2.1	457.2	826.6	18.2	0.	13.5
	NOV	39.5	2.3	34.3	1.3	0.	1.6	457.2	826.6	9.3	0.	6.7
	DEC	21.7	41.3	0.	1.3	0.	1.5	434.7	825.6	10.0	0.	7.5
(ANNUAL	TOTAL)	932.7	244.3	365.2	15.8	275.3	26.7	-	-	-	0.	101.9
1970	JAN	10.0	40.8	0.	1.3	0.	1.6	401.0	824.1	9.7	0.	7.2
	FEB	6.5	40.1	0.	1.2	0.	1.9	364.3	822.4	10.4	0.	7.0
	MAR	4.5	67.9	0.	1.3	0.	2.5	297.1	819.1	15.4	0.	11.5
	APR	8.5	80.6	0.	1.3	0.	2.4	221.3	814.7	17.9	0.	12.9
	MAY	14.8	1.9	0.	1.3	0.	2.3	230.5	815.3	0.4	0.	0.3
	JUN	19.2	0.1	0.	1.3	0.	1.9	246.4	816.2	0.0	0.	0.0
	JUL	52.2	2.2	0.	1.3	0.	2.0	293.1	818.9	0.5	0.	0.4
	AUG	95.4	2.0	0.	1.3	0.	2.4	382.6	823.2	0.5	0.	0.3
	SEP	185.5	0.9	82.6	1.3	23.8	2.5	457.2	826.6	18.2	0.	13.1
	OCT	78.8	1.0	74.4	1.3	0.	2.1	457.2	826.6	18.2	0.	13.5
	NOV	28.8	2.3	23.6	1.3	0.	1.6	457.2	826.6	6.5	0.	4.7
	DEC	14.7	36.3	0.	1.3	0.	1.6	432.2	825.5	8.9	0.	6.7
(ANNUAL	TOTAL)	518.9	276.5	180.6	15.8	23.8	24.7	-	-	-	0.	77.5
1971	JAN	7.4	31.0	0.	1.3	0.	1.7	405.6	824.3	7.4	0.	5.5
	FEB	5.3	29.6	0.	1.2	0.	2.0	378.1	823.0	7.7	0.	5.2
	MAR	4.1	59.3	0.	1.3	0.	2.7	318.9	820.3	13.6	0.	10.1
	APR	3.6	71.4	0.	1.3	0.	2.6	247.2	816.3	16.2	0.	11.6
	MAY	17.7	1.9	0.	1.3	0.	2.4	259.3	816.9	0.4	0.	0.3
	JUN	14.2	0.1	0.	1.3	0.	1.9	270.2	817.6	0.0	0.	0.0
	JUL	15.5	5.5	0.	1.3	0.	1.9	277.0	818.0	1.2	0.	0.9
	AUG	41.8	2.0	0.	1.3	0.	2.3	313.2	820.0	0.4	0.	0.3
	SEP	107.5	0.9	0.	1.3	0.	2.5	416.0	824.7	0.2	0.	0.1
	OCT	100.4	1.0	54.8	1.3	0.	2.1	457.2	826.6	13.5	0.	10.0
	NOV	19.8	2.3	14.7	1.3	0.	1.5	457.2	826.6	4.3	0.	3.1
	DEC	9.1	45.2	0.	1.3	0.	1.5	418.2	824.8	10.9	0.	8.1
(ANNUAL	TOTAL)	346.5	250.1	69.5	15.8	0.	25.1	-	-	-	0.	55.4

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT — CHOLUTECA — CHOLUTECA
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW
OPERATION LEVEL : 797.0 EL.M (MOL)
- DO - : 826.6 EL.M (FSL)

FIRM DISCHARGE : 0. M3/S
P.MAX DISCHARGE : 32.2 M3/S
ACTIVE STORAGE : 387.6 MIL.M3

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV.-STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
1972	JAN	6.9	38.9	0.	1.3	0.	1.6	383.3	823.2	9.2	0.	6.8
	FEB	4.5	34.1	0.	1.3	0.	1.9	350.6	821.7	8.4	0.	5.9
	MAR	3.7	64.6	0.	1.3	0.	2.4	286.0	818.5	14.5	0.	10.8
	APR	3.9	75.0	0.	1.3	0.	2.3	211.3	813.8	16.5	0.	11.9
	MAY	12.0	1.9	0.	1.3	0.	2.2	217.8	814.4	0.4	0.	0.3
	JUN	30.8	0.1	0.	1.3	0.	1.8	245.5	816.2	0.0	0.	0.0
	JUL	6.9	7.6	0.	1.3	0.	1.7	241.8	816.0	1.6	0.	1.2
	AUG	10.2	2.0	0.	1.3	0.	1.8	246.8	816.2	0.4	0.	0.3
	SEP	11.7	0.9	0.	1.3	0.	1.9	254.5	816.7	0.2	0.	0.1
	OCT	9.7	1.0	0.	1.3	0.	1.6	260.3	817.0	0.2	0.	0.2
	NOV	6.4	19.3	0.	1.3	0.	1.1	245.1	816.1	4.3	0.	3.1
	DEC	4.5	62.6	0.	1.3	0.	0.9	184.8	811.5	12.9	0.	9.6
(ANNUAL TOTAL)		111.4	307.9	0.	15.8	0.	21.1	-	-	-	0.	50.2
1973	JAN	4.6	50.3	0.	1.3	0.	0.7	137.1	806.6	9.6	0.	7.2
	FEB	4.0	43.3	0.	1.2	0.	0.7	95.9	801.7	8.5	0.	5.7
	MAR	4.4	28.4*	0.	1.3	0.	0.9	69.6	797.0	0.	0.	0.
	APR	4.2	1.8*	0.	1.3	0.	1.1	69.6	797.0	0.	0.	0.
	MAY	19.2	1.9	0.	1.3	0.	1.3	84.3	800.3	0.	0.	0.
	JUN	44.7	0.1	0.	1.3	0.	1.3	126.3	805.4	0.0	0.	0.0
	JUL	38.9	2.2	0.	1.3	0.	1.4	160.3	809.2	0.4	0.	0.3
	AUG	25.0	2.0	0.	1.3	0.	1.8	180.2	811.1	0.4	0.	0.3
	SEP	81.0	0.9	0.	1.3	0.	2.3	256.8	816.8	0.2	0.	0.1
	OCT	184.4	1.0	0.	1.3	0.	2.1	436.8	825.7	0.2	0.	0.2
	NOV	41.5	2.3	15.9	1.3	0.	1.5	457.2	826.6	4.6	0.	3.3
	DEC	10.4	43.0	0.	1.3	0.	1.5	421.7	825.0	10.4	0.	7.7
(ANNUAL TOTAL)		462.4	177.1	15.9	15.8	0.	16.6	-	-	-	0.	24.8
1974	JAN	6.9	42.7	0.	1.3	0.	1.6	383.0	823.2	10.1	0.	7.5
	FEB	6.0	41.7	0.	1.2	0.	1.8	344.3	821.4	10.7	0.	7.2
	MAR	6.1	70.1	0.	1.3	0.	2.3	276.6	817.9	15.7	0.	11.7
	APR	4.7	78.4	0.	1.3	0.	2.5	199.1	812.8	17.1	0.	12.3
	MAY	91.6	1.9	0.	1.3	0.	2.6	284.8	818.4	0.4	0.	0.3
	JUN	36.2	0.1	0.	1.3	0.	2.1	317.5	820.2	0.0	0.	0.0
	JUL	20.7	2.2	0.	1.3	0.	2.0	332.6	820.9	0.5	0.	0.4
	AUG	8.0	2.0	0.	1.3	0.	2.3	335.0	821.0	0.5	0.	0.3
	SEP	109.9	0.9	0.	1.3	0.	2.5	440.2	825.9	0.2	0.	0.2
	OCT	40.8	1.0	19.4	1.3	0.	2.1	457.2	826.6	5.0	0.	3.7
	NOV	12.1	2.3	7.0	1.3	0.	1.5	457.2	826.6	2.3	0.	1.7
	DEC	11.0	58.7	0.	1.3	0.	1.5	406.6	824.3	14.2	0.	10.5
(ANNUAL TOTAL)		353.9	301.9	26.4	15.8	0.	25.0	-	-	-	0.	55.8

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT — CHOLUTECA — CHOLUTECA
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW — FIRM DISCHARGE : 0. M3/S
OPERATION LEVEL : 797.0 EL.M (MOL) — P.MAX DISCHARGE : 32.2 M3/S
- DO - : 826.6 EL.M (FSL) — ACTIVE STORAGE : 387.6 MIL.M3

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV.-STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
1975	JAN	10.5	52.8	0.	1.3	0.	1.5	361.5	822.2	12.4	0.	9.2
	FEB	7.4	45.6	0.	1.2	0.	1.7	320.4	820.3	11.5	0.	7.7
	MAR	6.3	70.9	0.	1.3	0.	2.1	252.3	816.6	15.6	0.	11.6
	APR	4.9	78.4	0.	1.3	0.	1.9	175.6	810.7	16.7	0.	12.0
	MAY	13.0	1.9	0.	1.3	0.	1.8	183.6	811.4	0.4	0.	0.3
	JUN	7.7	1.2	0.	1.3	0.	1.5	187.3	811.8	0.2	0.	0.2
	JUL	16.9	4.8	0.	1.3	0.	1.4	196.7	812.6	1.0	0.	0.7
	AUG	6.8	2.0	0.	1.3	0.	2.0	198.1	812.7	0.4	0.	0.3
	SEP	232.8	0.9	0.	1.3	0.	2.5	426.2	825.2	0.2	0.	0.1
	OCT	162.4	1.0	85.3	1.3	41.7	2.1	457.2	826.6	18.2	0.	13.5
	NOV	185.5	2.3	81.2	1.3	99.1	1.6	457.2	826.6	18.2	0.	13.1
	DEC	13.4	3.5	6.9	1.3	0.	1.6	457.2	826.6	2.6	0.	1.9
(ANNUAL TOTAL)		667.5	265.2	173.3	15.8	140.9	21.8	-	-	-	0.	70.7
1976	JAN	9.4	38.4	0.	1.3	0.	1.7	425.1	825.2	9.3	0.	6.9
	FEB	6.9	37.4	0.	1.3	0.	2.1	391.3	823.6	9.5	0.	6.6
	MAR	6.6	69.0	0.	1.3	0.	2.7	324.9	820.5	15.9	0.	11.8
	APR	6.1	79.1	0.	1.3	0.	2.6	248.1	816.3	18.0	0.	12.9
	MAY	7.1	1.9	0.	1.3	0.	2.7	249.1	816.4	0.4	0.	0.3
	JUN	169.7	0.1	0.	1.3	0.	2.5	414.9	824.7	0.0	0.	0.0
	JUL	36.7	2.2	0.	1.3	0.	2.3	445.8	826.1	0.5	0.	0.4
	AUG	10.0	2.0	0.	1.3	0.	2.5	450.0	826.3	0.5	0.	0.4
	SEP	9.0	0.9	0.	1.3	0.	2.5	454.3	826.5	0.2	0.	0.2
	OCT	67.8	1.0	60.5	1.3	0.	2.1	457.2	826.6	15.0	0.	11.2
	NOV	12.1	2.3	7.0	1.3	0.	1.6	457.2	826.6	2.3	0.	1.7
	DEC	12.4	28.9	0.	1.3	0.	1.6	437.7	825.7	7.0	0.	5.2
(ANNUAL TOTAL)		353.6	263.1	67.5	15.8	0.	26.7	-	-	-	0.	57.6
1977	JAN	7.0	33.7	0.	1.3	0.	1.7	408.0	824.4	8.1	0.	6.0
	FEB	4.6	27.8	0.	1.2	0.	2.0	381.8	823.2	7.3	0.	4.9
	MAR	4.0	57.1	0.	1.3	0.	2.7	324.7	820.5	13.1	0.	9.8
	APR	4.3	64.9	0.	1.3	0.	2.7	260.1	817.0	14.8	0.	10.7
	MAY	16.6	1.9	0.	1.3	0.	2.7	270.8	817.6	0.4	0.	0.3
	JUN	87.2	0.1	0.	1.3	0.	2.3	354.3	821.9	0.0	0.	0.0
	JUL	8.6	2.2	0.	1.3	0.	2.1	357.3	822.0	0.5	0.	0.4
	AUG	9.9	2.0	0.	1.3	0.	2.3	361.6	822.2	0.5	0.	0.3
	SEP	17.9	0.9	0.	1.3	0.	2.4	374.9	822.9	0.2	0.	0.2
	OCT	11.7	1.0	0.	1.3	0.	2.0	382.4	823.2	0.2	0.	0.2
	NOV	10.9	11.8	0.	1.3	0.	1.4	378.6	823.0	2.9	0.	2.1
	DEC	6.6	54.3	0.	1.3	0.	1.4	328.2	820.7	12.5	0.	9.3
(ANNUAL TOTAL)		189.6	257.7	0.	15.8	0.	25.6	-	-	-	0.	44.0

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW
OPERATION LEVEL : 797.0 EL.M (MOL)
- DO - : 826.6 EL.M (FSL)

CHOLUTECA

FIRM DISCHARGE : 0. M3/S
P.MAX DISCHARGE : 32.2 M3/S
ACTIVE STORAGE : 387.6 MIL.M3

CHOLUTECA

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV.-STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
1978	JAN	5.9	39.6	0.	1.3	0.	1.5	291.7	818.8	6.9	0.	6.6
	FEB	4.7	32.2	0.	1.2	0.	1.7	261.3	817.1	7.8	0.	5.2
	MAR	2.5	60.6	0.	1.3	0.	2.1	199.8	812.8	12.7	0.	9.5
	APR	3.2	63.5	0.	1.3	0.	2.0	136.2	806.5	12.7	0.	9.2
	MAY	18.3	1.9	0.	1.3	0.	2.0	149.3	808.0	0.4	0.	0.3
	JUN	30.6	0.1	0.	1.3	0.	1.7	176.8	810.8	0.0	0.	0.0
	JUL	29.2	2.2	0.	1.3	0.	1.7	200.8	812.9	0.4	0.	0.3
	AUG	12.4	2.0	0.	1.3	0.	1.9	207.9	813.5	0.4	0.	0.3
	SEP	58.9	0.9	0.	1.3	0.	2.1	262.5	817.1	0.2	0.	0.1
	OCT	20.3	1.0	0.	1.3	0.	1.8	278.7	818.1	0.2	0.	0.2
	NOV	9.1	12.0	0.	1.3	0.	1.3	273.1	817.7	2.7	0.	2.0
	DEC	11.0	42.2	0.	1.3	0.	1.3	239.3	815.8	9.1	0.	6.7
(ANNUAL TOTAL)		206.1	258.2	0.	15.8	0.	21.0	-	-	-	0.	40.4
1979	JAN	6.6	39.3	0.	1.3	0.	1.3	204.0	813.2	8.2	0.	6.1
	FEB	4.6	34.5	0.	1.2	0.	1.4	171.4	810.4	7.6	0.	5.1
	MAR	4.1	61.3	0.	1.3	0.	1.6	111.3	803.6	11.3	0.	8.4
	APR	7.1	46.0*	0.	1.3	0.	1.5	69.6	797.0	7.9	0.	5.7
	MAY	22.7	1.9	0.	1.3	0.	1.8	87.2	800.6	0.	0.	0.
	JUN	76.2	0.1	0.	1.3	0.	1.8	160.2	809.2	0.0	0.	0.0
	JUL	55.2	2.2	0.	1.3	0.	1.8	210.0	813.7	0.4	0.	0.3
	AUG	29.9	2.0	0.	1.3	0.	2.2	234.3	815.5	0.4	0.	0.3
	SEP	126.1	0.9	0.	1.3	0.	2.5	355.7	822.0	0.2	0.	0.1
	OCT	124.9	1.0	19.0	1.3	0.	2.1	457.2	826.6	4.7	0.	3.5
	NOV	23.9	2.3	18.8	1.3	0.	1.6	457.2	826.6	5.3	0.	3.8
	DEC	14.7	22.1	0.	1.3	0.	1.6	446.8	826.2	5.4	0.	4.0
(ANNUAL TOTAL)		495.9	213.6	37.7	15.8	0.	21.3	-	-	-	0.	37.5
1980	JAN	8.4	31.7	0.	1.3	0.	1.7	420.5	825.0	7.6	0.	5.7
	FEB	5.6	37.2	0.	1.3	0.	2.1	385.6	823.3	9.4	0.	6.6
	MAR	4.6	69.1	0.	1.3	0.	2.7	317.1	820.2	15.9	0.	11.8
	APR	4.8	65.0	0.	1.3	0.	2.7	252.9	816.6	14.7	0.	10.6
	MAY	24.6	1.9	0.	1.3	0.	2.8	271.5	817.6	0.4	0.	0.3
	JUN	128.9	0.1	0.	1.3	0.	2.4	396.5	823.8	0.0	0.	0.0
	JUL	53.1	2.2	0.	1.3	0.	2.3	443.8	826.0	0.5	0.	0.4
	AUG	44.3	2.0	25.1	1.3	0.	2.5	457.2	826.6	6.6	0.	4.9
	SEP	77.8	0.9	73.1	1.3	0.	2.5	457.2	826.6	18.2	0.	13.1
	OCT	92.7	1.0	85.3	1.3	3.0	2.1	457.2	826.6	18.2	0.	13.5
	NOV	16.8	2.3	11.7	1.3	0.	1.6	457.2	826.6	3.5	0.	2.5
	DEC	12.8	7.9	1.9	1.3	0.	1.6	457.2	826.6	2.4	0.	1.8
(ANNUAL TOTAL)		474.4	221.2	197.1	15.8	3.0	26.9	-	-	-	0.	71.2

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

RESULTS OF RESERVOIR OPERATION STUDY

PROJECT NAME : CHOLUTECA PROJECT
PROJECT ID : 0- 0- 0
POWER CAPACITY : 18.2 MW
OPERATION LEVEL : 797.0 EL.M (MOL)
- DO - : 826.6 EL.M (FSL)

CHOLUTECA CHOLUTECA

FIRM DISCHARGE : 0. M3/S
P.MAX DISCHARGE : 32.2 M3/S
ACTIVE STORAGE : 387.6 MIL.M3

YEAR	MONTH	INFLOW MIL.M3	RELEASE IRRI. MIL.M3	RELEASE POWER MIL.M3	WATER-SUPPLY 1/ MIL.M3	SPILL OUT MIL.M3	EVAPO-RATION MIL.M3	RESV.-STORG. 2/ MIL.M3	R.W.L. 2/ EL.M	POWER OUTPUT MW	ENERGY OUTPUT FIRM GWH	ENERGY OUTPUT 2NDARY GWH
1981	JAN	7.4	19.1	0.	1.3	0.	1.8	442.5	826.0	4.6	0.	3.5
	FEB	7.6	22.9	0.	1.2	0.	2.1	423.9	825.1	6.1	0.	4.1
	MAR	9.5	55.0	0.	1.3	0.	3.0	374.1	822.8	13.0	0.	9.7
	APR	5.1	68.9	0.	1.3	0.	3.0	306.0	819.6	16.2	0.	11.7
	MAY	21.6	1.9	0.	1.3	0.	3.0	321.3	820.4	0.4	0.	0.3
	JUN	119.6	0.1	0.	1.3	0.	2.5	437.1	825.7	0.0	0.	0.0
	JUL	58.5	2.2	32.6	1.3	0.	2.3	457.2	826.6	8.5	0.	6.3
	AUG	71.4	2.0	65.6	1.3	0.	2.5	457.2	826.6	16.5	0.	12.3
	SEP	93.1	0.9	82.6	1.3	5.8	2.5	457.2	826.6	18.2	0.	13.1
	OCT	35.1	1.0	30.7	1.3	0.	2.1	457.2	826.6	7.7	0.	5.8
	NOV	14.6	2.3	9.5	1.3	0.	1.5	457.2	826.6	3.0	0.	2.1
	DEC	10.3	40.0	0.	1.3	0.	1.5	424.6	825.1	9.7	0.	7.2
(ANNUAL TOTAL)		453.9	216.2	220.9	15.8	5.8	27.8	-	-	-	0.	76.0
1982	JAN	5.9	41.1	0.	1.3	0.	1.6	386.5	823.4	9.7	0.	7.2
	FEB	8.6	19.9	0.	1.2	0.	2.0	372.0	822.7	5.1	0.	3.5
	MAR	9.2	44.9	0.	1.3	0.	2.8	332.2	820.9	10.3	0.	7.7
	APR	7.4	60.2	0.	1.3	0.	2.8	275.3	817.9	13.9	0.	10.0
	MAY	28.0	1.9	0.	1.3	0.	2.8	297.3	819.1	0.4	0.	0.3
	JUN	64.8	0.1	0.	1.3	0.	2.3	358.4	822.1	0.0	0.	0.0
	JUL	19.5	2.2	0.	1.3	0.	2.1	372.2	822.7	0.5	0.	0.4
	AUG	18.0	2.0	0.	1.3	0.	2.4	384.5	823.3	0.5	0.	0.4
	SEP	28.0	0.9	0.	1.3	0.	2.5	407.8	824.4	0.2	0.	0.2
	OCT	57.2	1.0	3.4	1.3	0.	2.1	457.2	826.6	1.1	0.	0.8
	NOV	16.6	4.1	9.5	1.3	0.	1.6	457.2	826.6	3.5	0.	2.5
	DEC	12.7	2.2	7.6	1.3	0.	1.6	457.2	826.6	2.4	0.	1.8
(ANNUAL TOTAL)		275.9	180.5	20.5	15.8	0.	26.6	-	-	-	0.	34.6
1983	JAN	10.6	41.2	0.	1.3	0.	1.7	423.8	825.1	10.0	0.	7.4
	FEB	7.5	33.2	0.	1.2	0.	2.0	394.8	823.8	8.7	0.	5.9
	MAR	8.0	64.7	0.	1.3	0.	2.8	333.9	821.0	15.0	0.	11.1
	APR	7.4	65.7	0.	1.3	0.	2.7	271.7	817.7	15.1	0.	10.9
	MAY	6.6	1.9	0.	1.3	0.	2.6	272.5	817.7	0.4	0.	0.3
	JUN	36.9	0.1	0.	1.3	0.	2.1	305.9	819.6	0.0	0.	0.0
	JUL	38.3	2.2	0.	1.3	0.	2.0	338.6	821.2	0.5	0.	0.4
	AUG	21.4	2.0	0.	1.3	0.	2.3	354.4	821.9	0.5	0.	0.3
	SEP	57.9	0.9	0.	1.3	0.	2.5	407.6	824.4	0.2	0.	0.2
	OCT	64.3	1.0	10.3	1.3	0.	2.1	457.2	826.6	2.7	0.	2.0
	NOV	35.0	2.3	29.8	1.3	0.	1.6	457.2	826.6	8.1	0.	5.8
	DEC	15.4	21.4	0.	1.3	0.	1.6	448.2	826.2	5.2	0.	3.9
(ANNUAL TOTAL)		309.4	236.5	40.1	15.8	0.	26.0	-	-	-	0.	48.2
(GRAND TOTAL)		10253.5	6995.3	1753.1	426.0	448.8	639.3	-	-	-	0.	1446.2

REMARK : * INDICATES DIFFICIT IN SUPPLY

NOTE : 1/ RETURN FLOW COUNTED
2/ AS OF END/MONTH

FREQUENCY OF RESERVOIR OPERATION LEVEL

PROJECT NAME	: CHOLUTECA PROJECT			CHOLUTECA		CHOLUTECA
PROJECT ID	: 0- 0- 0		POWER CAPACITY	:	18.2	MW
OPERATING LEVLE	: 826.6	EL.M (FSL)	PLANT DISCHARGE	:	32.2	M3/S
- DO -	: 797.0	EL.M (MOL)	RATED W.L.	:	815.2	EL.M
- DO -	: 745.0	EL.M (TWL)	ACTIVE STORAGE	:	387.6	MIL.M3

797.0	797.9	800.6	803.6	804.6	806.6	807.8	809.2	810.1	810.4
811.2	811.5	311.8	812.2	812.8	813.2	813.7	813.9	814.3	814.7
815.2	815.5	816.0	816.1	816.2	816.3	816.3	816.5	816.6	816.7
816.8	817.0	817.1	817.3	817.6	817.7	817.7	817.9	818.0	818.3
818.4	818.8	818.9	819.2	819.6	819.7	820.1	820.2	820.3	820.5
820.6	820.7	820.9	821.0	821.1	821.3	821.9	821.9	822.1	822.3
822.6	822.7	823.0	823.1	823.2	823.3	823.3	823.4	823.6	824.1
824.3	824.4	824.6	824.7	824.9	825.0	825.1	825.3	825.5	825.7
825.9	826.0	826.1	826.2	826.5	826.6	826.6	826.6	826.6	826.6
826.6	826.6	826.6	826.6	826.6	826.6	826.6	826.6	826.6	826.6

FREQUENCY OF POWER OUTPUT (MW)

0.	0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1.0	1.2	1.6	2.2	2.4	2.6	2.7	3.4	3.9	4.3
4.6	5.1	5.7	6.4	6.6	7.1	7.6	7.8	8.0	8.1
8.4	8.5	8.8	8.8	9.1	9.2	9.3	9.4	9.7	9.8
10.0	10.1	10.3	10.4	10.7	11.2	11.7	12.4	12.5	12.9
13.1	13.4	13.5	13.7	14.1	14.4	14.6	14.8	15.1	15.1
15.5	15.7	16.0	16.2	16.5	17.1	18.0	18.2	18.2	18.2

FREQUENCY OF ENERGY OUTPUT (GWH)

0.	0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4
0.7	0.9	1.2	1.6	1.8	1.9	2.0	2.5	2.8	3.1
3.5	3.7	4.1	4.6	4.8	4.9	5.2	5.6	5.7	5.8
5.9	6.0	6.2	6.4	6.6	6.6	6.7	6.8	7.0	7.2
7.2	7.4	7.5	7.7	7.8	8.1	8.7	9.1	9.3	9.5
9.7	9.9	10.0	10.1	10.5	10.7	10.8	10.8	11.0	11.2
11.3	11.6	11.6	11.8	12.0	12.3	13.1	13.1	13.5	13.5

SUMMARY OF RESERVOIR OPERATION STUDY


```
PROJECT NAME      : CHOLUTECA PROJECT                     CHOLUTECA          CHOLUTECA
PROJECT ID        :  0- 0- 0                  POWER CAPACITY   :    18.2     MW
OPERATING LEVLE   :   826.6   EL.M (FSL)      PLANT DISCHARGE  :    32.2     M3/S
     - DO -       :   797.0   EL.M (MOL)      RATED W.L.       :   815.2     EL.M
     - DO -       :   745.0   EL.M (TWL)      ACTIVE STORAGE   :   387.6 MIL.M3
```

SIMULATED RESERVOIR WATER LEVELS (EL.M)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1957	826.0	825.1	822.6	819.5	820.6	824.1	824.7	825.3	826.6	826.6	826.6	824.5
1958	822.7	821.0	817.4	812.0	816.3	823.4	826.1	826.6	826.6	826.6	826.6	824.3
1959	822.6	821.0	817.5	812.2	813.9	816.2	815.8	816.8	817.7	820.6	820.7	817.7
1960	815.2	811.8	804.6	797.0	799.3	811.5	812.3	815.2	820.2	825.9	826.5	824.8
1961	823.6	822.6	820.1	816.3	816.0	817.3	818.4	818.9	820.8	821.9	823.1	821.1
1962	819.7	818.0	814.1	807.1	809.2	814.0	814.7	816.3	820.2	826.2	825.9	823.6
1963	821.8	820.2	816.6	811.2	810.2	811.5	813.7	814.3	816.1	818.5	820.6	818.2
1964	816.0	813.6	807.6	797.9	797.0	807.8	816.5	817.0	820.0	823.1	823.3	821.2
1965	818.9	816.5	811.3	802.5	804.6	809.0	810.1	810.4	825.3	826.6	826.6	824.9
1966	823.4	821.9	818.9	815.1	817.6	821.3	824.6	825.5	826.6	826.6	826.6	825.0
1967	823.6	822.3	819.6	816.3	816.6	817.2	817.7	817.9	819.5	820.9	821.0	818.4
1968	816.3	814.0	807.8	798.0	803.6	817.0	818.3	819.2	823.3	826.2	826.6	825.4
1969	824.5	823.0	820.2	816.2	816.7	826.6	826.6	826.6	826.6	826.6	826.6	825.6
1970	824.1	822.4	819.1	814.7	815.3	816.2	818.9	823.2	826.6	826.6	826.6	825.5
1971	824.3	823.0	820.3	816.3	816.9	817.6	818.0	820.0	824.7	826.6	826.6	824.8
1972	823.2	821.7	818.5	813.8	814.4	816.2	816.0	816.2	816.7	817.0	816.1	811.5
1973	806.6	801.7	797.0	797.0	800.3	805.4	809.2	811.1	816.8	825.7	826.6	825.0
1974	823.2	821.4	817.9	812.8	818.4	820.2	820.9	821.0	825.9	826.6	826.6	824.3
1975	822.2	820.3	816.6	810.7	811.4	811.8	812.6	812.7	825.2	826.6	826.6	826.6
1976	825.2	823.6	820.5	816.3	816.4	824.7	826.1	826.3	826.5	826.6	826.6	825.7
1977	824.4	823.2	820.5	817.0	817.6	821.9	822.0	822.2	822.9	823.2	823.0	820.7
1978	818.8	817.1	812.8	806.5	808.0	810.8	812.9	813.5	817.1	818.1	817.7	815.8
1979	813.2	810.4	803.6	797.0	800.6	809.2	813.7	815.5	822.0	826.6	826.6	826.2
1980	825.0	823.3	820.2	816.6	817.6	823.8	826.0	826.6	826.6	826.6	826.6	826.6
1981	826.0	825.1	822.8	819.6	820.4	825.7	826.6	826.6	826.6	826.6	826.6	825.1
1982	823.4	822.7	820.9	817.9	819.1	822.1	822.7	823.3	824.4	826.6	826.6	826.6
1983	825.1	823.8	821.0	817.7	817.7	819.6	821.2	821.9	824.4	826.6	826.6	826.2
MEAN	821.4	819.7	815.9	810.9	812.4	817.1	818.7	819.6	822.8	824.7	824.8	823.2

ANNEX H

IRRIGATION AND DRAINAGE PLAN

ANNEX - H

IRRIGATION AND DRAINAGE PLAN

Table of Contents

List of Tables

Page

List of Figures

List of Drawings

H. IRRIGATION AND DRAINAGE PLAN

H.1 IRRIGATION WATER REQUIREMENT

H.1.1 General

Irrigation water requirement is basically dependent on the cropping patterns, climatic conditions and soil conditions. The cropping patterns proposed for each irrigable area are as discussed in Annex F. Since the irrigable areas will extend largely in the Choluteca river basin, their climatic conditions are different from each other. Under such situations, the proposed irrigation areas were categorized into the following groups, for estimation of the irrigation water requirement and for the evaluation of the project:

	Net Irrigable Area
1. Western plain area in Choluteca plain	16,000 ha
2. Eastern plain area in Choluteca plain	(9,800 ha)
a) Eastern plain - A	4,600 ha
b) Eastern plain - B	5,200 ha
3. Middle Reach area in Orocuina - Choluteca (existing)	680 ha
4. San Juan de Flores area (existing)	2,680 ha

In addition to the above schemes, the water requirement for the alternative scheme of supplemental irrigation during the rainy season on the Western plain was also estimated in a case study.

The estimate of irrigation water in this updating study, in principle, followed the procedures adopted in the study made in 1977-78. However, the updated climatological and other data were applied and the irrigation water requirement was re-estimated. The design irrigation water requirement was estimated through the following procedures:

a) Estimate of potential evapotranspiration
b) Estimate of consumptive use
c) Estimate of effective rainfall
d) Estimate of percolation (for paddy field)
e) Estimate of net irrigation water requirement
f) Estimate of diversion water requirement.

H.1.2 Potential Evapotranspiration and Consumptive Use

In the previous study in 1977-78, several methods of estimating the potential evapotranspiration have been compared, including the Modified Blaney-Cliddle, Modified Penman, Hargreaves, Christiansen-Hargreaves, and it was found that the Christiansen-Hargreaves method explained below was found to be most suitable:

$$E_p = 17.4 \times d \times Tc \times Fh \times Fw \times Fs \times Fe$$
$$Fh = 0.59 - 0.55\ Hn^2$$
$$Fw = 0.75 + 0.0255 \times \sqrt{Wkd}$$
$$Fs = 0.478 + 0.58\ S$$
$$Fe = 0.950 + 0.0001\ E$$

where,

Hn : Mean noon humidity in decimal (%)
$0.40\ Hm + 0.60\ Hm^2$
Wkd: Mean wind velocity (km/day) at 2 m above ground surface
S : Mean monthly sunshine hour (%)
Hm : Mean daily relative humidity (%)
E : Elevation above the sea level

For the Western plain area and Eastern plain area, as well as for the Middle Reach area of Orocuina - Choluteca which is located relatively close to Choluteca city, the A-pan evaporation record at Choluteca meteorological station and the potential evapotranspiration calculated by the Christiansen - Hargreaves method were reviewed. As shown in Annex C, Table C-14, the annual mean A-pan evaporation was around 2,898 mm. On the other hand, the potential evapotranspiration at Choluteca station was calculated at around 2,405 mm/year, as shown on Table H-01.

On the other hand, in the "Monthly Precipitation Probabilities for Moisture Availability for Honduras" by G. Hargreaves it was estimated at around 2,020 mm/year. In view of the accuracy of observation and conditions in the Choluteca plain, the updating study followed the calculation by the Christiansen-Hargreaves method. The design monthly potential evapotranspiration ranges from 112.9 mm in September to 274.6 mm in March. During the driest months from December to April, the potential evapotranspiration would always exceed 240 mm/month.

The design potential evapotranspiration in the San Juan de Flores area is different from that on the Choluteca plain. The potential evapotranspiration calculated by the Christiansen-Hargreaves method seemed to be substantially high. On the other hand, A-pan evaporation recorded at El Porvenir in the San Juan de Flores valley was around 1,670 mm/year, as shown in Annex C, Table C-15. As applied in the previous study in 1977-78, the A-pan evaporation was selected for the design potential evapotranspiration in the San Juan de Flores area.

Consumptive use was estimated by multiplying potential evapotranspiration by crop consumptive use coefficient (Kc) in different growth stages of crops. The crop coefficient curve and Kc values were set in accordance with the study and recommendation by G. Hargreaves.

H.1.3 Effective Rainfall

Probable rainfall on the Choluteca plain (Western and Eastern) and Middle Reach valley of Orocuina - Choluteca was estimated on the basis of monthly rainfall records at Choluteca station, at Azucarela Central (ACENSA) and at Los Encuentros station, which are reproduced in Table H-02 to H-04. For the calculation of probable rainfall on the Western plain and Eastern plain, and average of rainfall record at Choluteca station (1974-83) and at ACENSA station (1978-83) was applied. While, the probable rainfall in the Middle Reach valley of Orocuina - Choluteca was estimated using an average of the record at Choluteca station and Los Eucuentros station (1974-83). On the other hand, the probable rainfall in the San Juan de Flores area was estimated on the basis of rainfall record at El Porvenir station.

In this updating study, 80% probable rainfall has been applied instead of the probable drought rainfall of 90% recurrence adopted in the previous study in 1977-78. The 80% probable rainfall was calculated as shown on Table H-05 to H-07.

Effective rainfall was estimated separately for upland crop cultivation and paddy field as noted hereunder:

a) Effective Rainfall for Upland Crops:

A relationship among average monthly effective rainfall, mean monthly rainfall and averate monthly consumptive use has been developed by US Department of Agriculture, Soil Conservation Services (USDA-SCS) and it is applicable to the estimate of effective rainfall in the project area. The effective rainfall values are shown on Table H-08. The values were calculated for a 75 mm net irrigation application, and adjustment factors were worked out for application to other net depth soil and crop characteristics, as shown on Table H-09. The monthly effective rainfall should not exceed the rate of consumptive use.

b) Effective Rainfall for Paddy Field:

Effective rainfall for paddy field was estimated by means of daily water balance method. The effective rainfall at Choluteca station, ACENSA station and Los Encuentros station was calculated as shown on Table H-10 to H-12. Further, the average effective rainfall at Choluteca and ACENSA stations, as well as at Choluteca and Los Encuentros stations, was calculated as shown on Table H-13 and H-14. The effective rainfall for paddy field was applied in the following manner:

Daily Rainfall (R= mm)	Effective Rainfall (mm)
$80 < R$	$80 \times 0.8 = 64$
$5 < R < 80$	$R \times 0.8$
$R < 5$	0