No. 2

THE REPUBLIC OF GUATEMALA
MINISTRY OF AGRICULTURE,
CATTLE AND FOOD RESOURCES

FEASIBILITY STUDY ON THE MONJAS IRRIGATION PROJECT

FINAL REPORT

VOLUME II:
APPENDIX 2

JULY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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4.1.1 Water Resources Development

(1) Study of the Proposed Dam Sites

The following five proposed dam sites are selected and studied in due consideration of topographic, geological and social conditions (Fig. 4.2.1-1).

- Guirila Dam Site
- Ostua Dam Site
- Blanco Dam Site
- San Pedro Dam Site
- Achiotes Dam Site

a. Guirila Dam Site

i. Topography and geology

Topography:
As a result of wide erosion, gentle topography is formed to a large extent. In both banks, terraces show conspicuous flat plains.

Geology:
This dam site consist of welded tuff with very low grade welding however, massive and relatively impermeable condition is suggested. The bed of river deposits including terraces is estimated several meters.

ii. Study of dam site

The Guirila dam site is located at about 4 km south ward from Casa de Tablas. The characteristics of this dam site are as follow:

- The left bank forms a gentle topography and occupies a half of the crest length. The river course is on the right bank, and the shape of valley is an inverted tropezoid.

- The crest length is long in about 1km, but the dam volume becomes small due to use of a gentle topography of the left bank.

- The saddle dam is required on the depression of right bank over the right abutment.

- Both abutments have enough creep ratio for seepage water.

- The dam site possess a favorable topography for the spillway. And also, the scale of spillway becomes small due to small catchment area in 26 km^2.

- The reservoir capacity at this dam site is bigger than the other dam site, because the pocket of reservoir is wide and the river bed slope is gentle in 1/120.

The features of main dam site and saddle dam site are as follows.

	Main dam site	Saddle dam site
Right abutment	slope 1 to 2.5	slope 1 to 11.0
Left abutment	slope 1 to 2.7	slope 1 to 1.5
Width of river bed	30 m	30 m
Span height ratio	23	29

The geology of the dam site consist of low welded tuff, and sand gravel covers in several meter thickness on the welded tuff. The core trench for impervious zone should be placed on the welded tuff after removal of sand gravel layer.

The dam of about 50m height will be suitable for this dam site judging from the bearing capacity of low welded tuff.

The live capacity of reservoir is obtained 39.6 MCM from height-volume and height-area curve.

On the other hand, the height of saddle dam becomes about 31m from topography and geology condition.

b. Ostua Dam Site

i. Topography and geology

- Topography
  The valley of this site shows U-shape and 200m width in bottom. In the right side of the river a flat plain like terrace composed of basalt lava is found at about 10m higher than river level.

- Geology
  This site consists of welded tuff and basalt. As to characteristic, welded tuff is a low welding and a weak rock however,massive and less permeable. On the other hand, basalt is a solid, while permeable due to many open joints.

ii. Study of dam site

The Ostua dam site is located at approximately 1.5km upstream from the confluence of the Ostua river and the Blanco river. This dam site is selected by the following reasons:

- The place where the foundation of the dam site is covered by thin terrace deposit and both abutments are narrowed.

- The river bed slope is steep 1/50. Therefore, a downstream is favorable position for the dam site in order to obtain more reservoir capacity.

- Both abutments have enough creep ratio for seepage water.

- The dam site has favorable topography for the placement of spillway.

The topographic features of this dam site are as follows:

Right abutment	slope 1 to 1.5
Left abutment	slope 1 to 2.0
Width of river bed	60 m
Span height ratio	4.7

Considering the topography, the dam site has favorable shape for a fill dam.

The dam height corresponding to the capacity of the Guirila dam is estimated approximately 76m from the height-volume and height-area curve.

As a conclusion, it is too difficult to construct a large dam of 70m dam height from viewpoint of the geological condition. Because, the bed rock of the dam site is low welded tuff and basalt layer overlies on the bed rock. It is presumed that pervious layer exist below the basalt layer. A considerable leakage water from the foundation will be anticipated, and the foundation treatment becomes difficult and entails great construction cost in this geological condition.

The dam scale at this site will be limited to maximum dam height of 50m (gross capacity of reservoir 14 MCM) due to the geological condition and the property of impervious material.

c. Blanco Dam Site

i. Topography and geology

- Topography
  Topographical features of this site is shown by gentle mountain slopes and a wide river deposit layer. Slope is about twenty degree at both slopes, especially a left slope shows a more gentle. In addition terraces, 200 to 30m wide are distributed.

- Geology
  Both mountain slopes are composed welded tuff top of which are overlaid by a thin basalt lava.
  This welded tuff is a weak rock with low welding grade. The river deposit may be shown very thick.

ii. Study of dam site

The Blanco dam site is located at approximately 1.5km upstream from the confluence of the Ostua river and the Blanco river. The dam site has the topography of converse trapezoid, and the right abutment uses in common the left abutment of the Ostua dam. There exist wide river bed and developed terrace deposit at the dam site.

The right and left abutments form gentle slope of 1 to 3.0 and 1 to 2.5, respectively and the span height ratio is 10 on the longitudinal section along the dam axis. A fill dam is suitable for this dam site judging from the topography.

The geology of this dam site and the Ostua dam site is the same, the maximum dam height will be limited in 50m like the Ostua dam. And also, it is presumed that pervious layer exists below the welded tuff. Therefore, the foundation treatment becomes difficult and costly.

d. San Pedro Dam

i. Topography and geology

- Topography
  This dam site shows V shape. Steep slope (forty to fifty degree) is formed in both banks. River width is narrow about 15m on an average.

- Geology

  This site is composed of porous basalt, basalt lava and andesite. Porous basalt is a stratified layer of basalt bombs and shows loose in solidification and high in permeability. Basalt lava is a fine, compact and hard rock however,may have high permeable due to dominant open joints. Andesite lava shows fine to medium grain and a hard rock however, fragile matrix is shown. High permeability is foreseen from many open joints.

ii. Study of dam site

The San Pedro dam site is located at about 700m southeast from El Ovejero. The left abutment is fromed by a small mountain having summit elevation of 1,258m which part of the Tahual volcano jutted out. The right abutment is caldera rim of the Retana lake.

This position is the narrowest valley and its topographic feature is as follows:

Right abutment	slope 1 to 2.0
Left abutment	slope 1 to 1.5
Width of river bed	30 m
Span height ratio	4.6

This vallley has a suitable shape for a dam site like the Ostua dam site.

According to the geological reconnaissance around the dam site, the geology of left slope consists of fine scoriaceous material between river bed and elevation 1,200m. It is presumed that the coefficient of permeability of scoria layer is the range of 10^{-2} to 10^{-3} cm/s. Basalt lava covers on the scoria layer.

There exist fracture zone with void at the river bed, and cracky andesite laid on the fracture zone forms the right abutment.

The existance of fault is observed on the direction of N-S at the dam site. It is not easy to construct a dam on this geological condition.

e. Achiotes Dam

i. Topography

- Topography and geology
  This site shows a locally small V shape valley. Hill top of both banks is located at some meter higher than the river bed. River deposit is thinly distributed.

- Geology
  This site consists of welded tuff showing very loose in welding and volcanic ash. Therefore, permeability of these lithologies is relatively low.

ii. Study of dam site

The Achiotes dam site is located at approximately 3.0km north-northeastern from Casa de Tablas. The reservoir scale of this dam site is small, but it is possible to utilize as a regulating reservoir.

The features of the dam site are as follows:

- The layer of terrace deposit is thin and the width of valley is narrow.

- The river bed slope is steep 1/60. Therefore, it is difficult to expect sufficient storage capacity for a small scale dam.

- It is guessed that leakage from the foundation is not so much, because the geology of the dam site and the reservoir foundation is composed of massive welded tuff.

- The property of welded tuff is soft due to low welding degree, but has sufficient bearing capacity for the fondation of fill dam.

- The spillway becomes small scale because of small catchment area (13.6 km^2). Therefore, it is possible to construct a spillway on the foundation of welded tuff. The topographic feature along the dam axi as follows:

Right abutment	slope 1 to 7.0
Left abutment	slope 1 to 3.0
Width of river bed	20 m
Span height ratio	7.3

Considering the topography and geology of the dam site a fill dam is suitable as the dam type. A favorable storage capacity is about 5 MCM for this dam site.

(3) Groundwater Development Plan

In establishing the groundwater development plan, this paragraph describes the basic concept, intake plan, development work cost, and irrigation plan.

1) Basic development policy

- Groundwater resources in the Study area are considered subsidiary resources of surface water.

- Groundwater development is restricted to Mojarritas Sector (512 ha) and San Pedro Sector (288 ha), both of which are remote from the dam site, have many existing wells, and are proven that pumping is hydrogeologically feasible.

- The area of a irrigated field by one well is 15 ha, and no well of common use is planned because local inhabitants have no custom of a common control system.

- Existing wells and facilities are further improved in productivity by means of cleaning and re-digging.

- New wells are of such type that farmers involved in development have been familiar with operation and maintenance.

- Emphasis is placed on least expensive construction cost, wherever practicable.

2) Water intake plan

a. Plan pumping volume and pumping time

Assuming that the pumping irrigation area covers about 800 ha out of benefited area of 4,800 ha, pumping volume is estimated at about 6.31×10^6 m^3 per year (Table A.4.2.1-5), that is, an annual water requirement per unit area is about 7,900 m^3/ha. In designing wells to pump this water requirement, reference should be made to peak water demand.

For the purpose of groundwater irrigation in the area of about 800 ha, the maximum volume of total water requirements is obtained for final 10 days in January.

$$568 \text{ ha} \times 0.74 \text{ l/sec/ha} \times 1/1000 \times 10 \text{ days} \times 24 \text{ hours} \times 3600$$
$$= 363.2 \times 10^3 \text{ m}^3$$

In this case, total pumping volume is found as follows.

$$363.2 \times 10^6/10 \text{ days} \times 24 \text{ hours} \times 3600 = 420 \text{ l/sec}$$

This pumping volume is less than the average of the actual pumping volume per well (about 15 l/s), and regarded as being within the limit of safety pumping volume.

Assuming that an irrigation area per well is 15 ha approximate to the present average volume, Mojarritas Sector (512 ha) and San Pedro Sector (288 ha) require 35 wells and 20 wells, respectively, 55 wells in total. Thus, pumping volume per well is approximately 7.6 l/sec.

Annual pumping time per well is calculated as shown below.

$$T = \frac{6.31 \times 10^9}{7.6\ l/s \times 3600\ sec \times 55\ wells} = 4193\ hours$$

Pumping time is 18 hours max. per day, and a recovery time of 6 hours is provided.

b. Intake well

The intake well should have a diameter of 100 mm (4 inches) considering maximum daily water supply. The well is designed to a depth of 80 m at Mojarritas Sector, and 100 m at San Pedro Sector. Layout of wells depends on the influence radius of the well, which is estimated at 350 m from data of existing wells. Therefore, wells are spaced at an interval of 400 m, with a safety factor taken into account. In summary, 55 wells are planned in total. More exactly, Mojarritas Sector has 17 new wells of 100 mm in diameter and 80 m in depth, and 18 existing wells to be repaired. San Pedro Sector has 16 new wells of 100 mm in diameter and 100 m in depth, and 4 existing wells to be repaired or re-digging.

The casing is used carbon steel pipes, and joints are subjected to socket full-circled welding. The screen is selected that meets the thickness of the aquifer. The SP layer inspection and specific gravity layer inspection are carried out immediately after digging, and screen length is determined. The screen is of slot type and gravel packed at the outside bore wall section. The packed gravel is sealed with clay on the top so as to prevent objectionable water from penetrating from the upper layer.

c. Water pump

In order to select pump type, the submergible pump is employed which is superior to the vertical turbine pump considering the following advantages.

- Given the design discharge, the submergible pump generally requires a smaller digging diameter than the vertical turbine pump. This results in less initial investment.

- The submergible pump requires no special tools and devices during installation. Therefore, this pump causes less trouble for maintenance.

- Excellent operation efficiency entails less expensive pump operation expenses.

- Farmers in this Area are familiar with operation and maintenance of this pump.

The water intake facilities are composed of the submergible pump, water lift pipe, air valve, combination meter, check valve, sluice valve, power cable, control electrodes and cables, and field panel.

d. Prime mover output

The shaft power of the pump is found from the obtained discharge Q and total lift using the following equation.

$$Ps = 0.163 \times rQH/\eta$$

In the next, the prime power output P is obtained in the following equation, including the allowance.

$$P = Ps\ (1 + \alpha)$$

Where, Ps = shaft horse power, kW.

r : Unit Weight of Wafer (kg/ℓ)
Q : Discharge Volume (m^3/min)
H : Total Head (m)
η : Efficiency of Pump (= 75%)
P : Horse Power of Motor (kW)
α : Allowance (= 0.2)

$$Ps = 0.163 \times 1 \times 0.46 \times 60/0.75 \doteqdot 6.0$$

$$P = 6.0\ (1 + 0.2) = 7.2\ (kW)$$

Both Sectors are provided with 10 HP pumps manufactured to the pump specification. The 10 HP pump commonly used in the Study has a pumping capacity of about 8.4 l/sec according to the capacity curve of the pump, assuming that the total head is 60 m (as obtained from private well diggers by hearing). This value sufficiently covers water requirements per well.

3) Construction cost and maintenance expense

a. Construction cost

Groundwater development is put into practice for following Sectors as shown below.

Sector	New well	Existing well to be repaired
Mojarritas	17	18
San Pedro	16	4 1/

1/ Three wells require re-digging to a depth of 100 m.

Construction cost, repair expenses, etc. are shown as below.

New well construction cost (*1)

17 wells x Q82,700 = Q1,405,900 .... Mojarritas Sector
16 wells x Q90,500 = Q1,448,000 .... San Pedro Sector
Subtotal Q2,853,900

Maintenance expense (*2) and re-digging cost of existing well (*3)

18 wells x Q5,900 = Q106,200 ... Mojarritas Sector
1 well x Q6,500 x 1.7 (*4) = Q11,100 ... San Pedro Sector
3 wells x Q23,200 = Q69,600 ... San Pedro Sector
Subtotal Q186,900
Grand Total Q3,040,800

*1 Refer to Table A.4.1.1-5.
*2 Refer to Table A.4.1.1-6.
*3 Refer to Table A.4.1.1-7.
*4 Well depth: Approximately 170 m

b. Operation and Maintenance expenses

Operation and Maintenance expenses consist of maintenance expense imposed once a 5 years and electric charges. Annual operation and maintenance expenses are shown as below.

Annual Operation and Maintenance Cost by Sector

(Unit: Q/ha/yr)

Sector	Repair cost	Electric charges	Total
Mojarritas	79	353.15	432.15
San Pedro	87	353.15	440.15

c. Groundwater cost

The following calculation shows groundwater cost necessary for obtaining a pumping discharge per unit from the well to be newly developed in San Pedro Sector.

Item	Price (Q)	Note
Development Cost for New Well	90,500	see Table A.4.1.1-5
Annual Maintenance Cost	1,300	see Table A.4.1.1-6 Q 6,500 - 5 years
Electric Charge	5,297	Q 353.15 x 15 ha

Annual Instalment Rate	0.0805 (i = 5%), 0.1175 (i = 10%), durable period : 20 yrs, i : annual interest
Annual Pumping Discharge	114,720 m^3 (= 7.6 liter/s x 4193 hrs)

<u>Case of 5% (= i)</u>

$$\text{Unit Cost of Groundwater} = \frac{90{,}500 \times 0.0805 + 1{,}300 + 5{,}297}{114{,}720} = 0.12\ Q/m^3$$

<u>Case of 10% (= i)</u>

$$\text{Unit Cost of Groundwater} = \frac{90{,}500 \times 0.1175 + 1{,}300 + 5.297}{114{,}720} = 0.15\ Q/m^3$$

4) Groundwater irrigation plan

In the Study area irrigation groundwater is generally supplied directly to farm land with the submergible pump of the well.

The irrigation plan is summarized as below.

Proposed irrigation area : 15 ha
Crop : Vegetables
Irrigation system : Sprinkler irrigation system, which enables furrow irrigation.
Irrigation interval : 7 days
Normal sprinkler pressure: pressure 1.5 kgf/cm^2
Soil : Vertisol

a. Design

- Total water requirement 4.5 mm/day
  Evaporation loss : 5%
  Field loss : 5 mm/day
  Irrigation intensity: 2.1 mm/hr (standard value of plant soil)

- Irrigation water depth, d mm

$$d\ mm/day = 4.5\ mm/day \times 7 \times (1 + 5\%) + 5\ mm/day = 38.1\ mm/day$$

Irrigation system for 2.1 ha per day (15 ha for 7 days)

i. Total water requirement, q
$q' = 2.1 \times 100 \times 100 \times 38.1/1000 = 800.1\ m^3/day$

If a transmission loss is 10%, then
$q = 800.1\ m^3/day \times 1.1 = 880.1\ m^3/day.$

- Irrigation time

$$t = \frac{Q}{\text{Irrigation Intensity}} = \frac{880.1 \times 1000 \times 1000 \times 1000}{2.1 \times 100000 \times 100000 \times 10} = 4.19 \doteqdot 4.2\ hr$$

- Design of irrigation facilities

i. Distribution and discharge

$$Q = \frac{880.1\ m^3}{4.2\ hr \times 60 \times 60} = 0.0582\ m^3/sec$$

Pipe diameter
If maximum Vmax is 1.0 mm, then

pipe area $A = 0.0582/1.0 = 0.0582\ m^2$

Therefore

pipe diameters $D = 0.27$ m

The mean pipe diameter is to be 100 mm (4 inches).

The YU pipe is used that sufficiently withstands an inner pressure of 1.5 kg/cm^2.

ii. Sprinkler interval, L

If a sprinkler system uses a nozzle 5.2 x 3.2 in diameter under a pressure of 1.5 kg/cm, then

spray irrigation diameter Dc = 25.0 m
spray irrigation diameter q = 30.0 /min and,
spray irrigation intensity r = 8.0 mm/hr

Therefore, the sprinkler is as follows, with influence of wind taken into account.

$L = Dc \times 0.5 = 12.5$ m

b. Work quantity

Water source – Deep well (depth: 80 m or 100 m)

– Submergible pump and incidental facilities

Water Supply pipe VU 100, 250 m per 2 ha

i. Underground pipeline

- excavation, normal soil
  $V_1 = 1.2 \times 0.5 \times 250 = 150\ m^3$

- residual soil
  $V_2 = \frac{0.1^2}{4} \times 250 = 2\ m^3$

- refilling
  $V_3 = 150 - 2 = 148\ m^3$

ii. Coupling

- excavation
  $V_1 = \frac{1.0^2}{4} \times 0.5 = 0.50 \times \frac{200m}{15m} = 7$

- Refilling
  $V_2 = 7.0 - 0.7^2 \times 0.5 \times \frac{200}{15} = 4\ m^3$

- Form
  $S = 0.7 \times 0.5 \times 8 \times \frac{200}{15} = 38\ m^2$

- Plain concrete
  $V_1 = (0.7^2 \times 0.5 - 0.4^2 \times 0.35) \times \frac{200}{15} = 2.52\ m^2$

- Valve 50, (13.3)

iii. Sprinkler set

1. Component: Nozzle : 5 sets
   Riser pipe : 5 sets
   Relocatable pipe: 45 m

2. Quantity per 2 ha
   $\frac{200}{15} \times 2 = 26.6 = 26.6$ sets

Table A.4.1.1-9 summarizes the necessary work quantity.

Table A.4.1.1-1 Summary of Geological Feature of Dam Sites

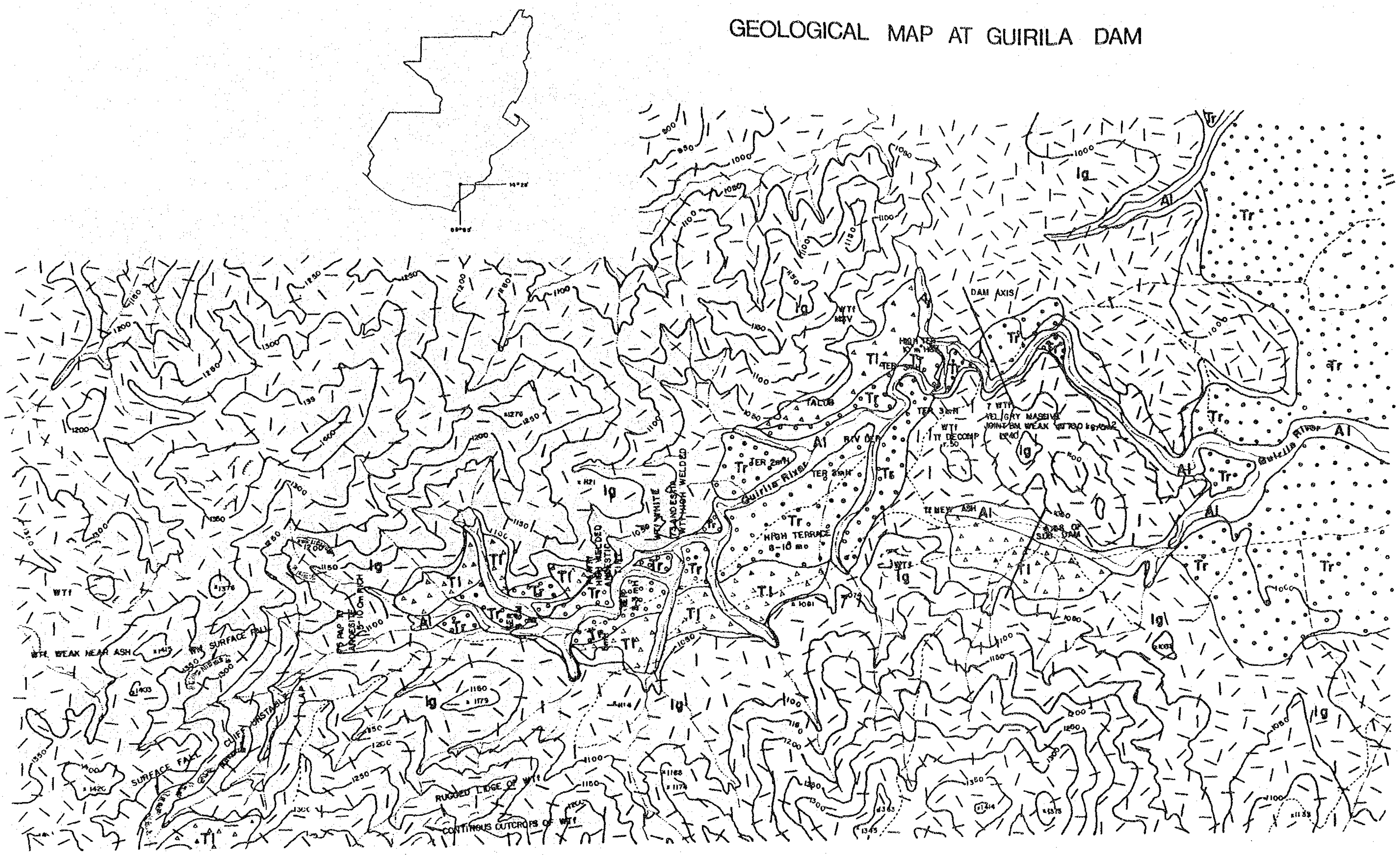
Item \ Dam Site		Guirila River	Ostua River	Blanco River	San Pedro River	Los Achiotes (Regulating)
Geomorphological Features		Widely eroded valley gentle slope	U-shape valley Wide plain of basalt lava in the right bank	Very thin ridge Extensively wide alluvial plain	V-shape valley	Small scale of V-shape valley
GEOLOGY	Rock Type	Welded Tuff	Welded Tuff and Basalt	Welded Tuff	Porous Basalt, Basalt Lava Andesite	Welded Tuff
	Hardness Toughness	Weak rock	Welded tuff: Weak rock Basalt: Hard rock	Weak rock	Porous Basalt: Loose, weak Basalt Lava: Hard rock Andesite: Hard rock	Weak
	Permeability	Low	High in the contact zone of basalt layer and welded tuff	Low	Very high	Low
	River deposit and Talus deposit	Thin, 5 m ± in thickness	Common about 10 m in thickness	Very wide and thick Assumed more than 20 m	Thinly scatter	Thinly scatter
Remarks		Low permeability of foundation rock	Welded tuff is weak for large spillway High permeability	Thin ridge for abutment Extensively wide and thick river deposit	Very high permeability in the porous basalt and basalt lava	Massive and less permeable layer for foundation
Evaluation for Dam Site		Better	Relatively Bad	Unsuitable	Relatively Bad	Ordinary (Dam scale is small)

Table A.4.1.1-2 Comparative Table on the Optimum Dam Sites

Dam Site	Topography	Order	Catchment Area Flood Discharge for Spillway	Order	Reservoir Capacity	Dam Height	Order	Dam Volume	Order	Coefficient of Reservoir Capacity	Order	Synthetic Estimation
Guirila	Left Abutment slope 1:2.7 Right Abutment slope 1:2.5 Span-height Ratio 22	3	Catchment Area 26 km^2 Flood Discharge 461 m^3/s	1	Live Capacity 39.6 MCM Gross Capacity 40.9 MCM	49.0 m	1 ①	2.63 MCM	2 ①	13.50	1 ①	1
Ostua	Left Abutment slope 1:2.0 Right Abutment slope 1:1.5 Span-height Ratio 4.7	1	Catchment Area 177 km^2 Flood Discharge 1900 m^3/s	3	Live Capacity 5.1 MCM (39.6) Gross Capacity 14.0 MCM (48.5)	50.0 m (76.5) m	2 ③	1.53 MCM (3.60) MCM	1 ②	9.20 (13.40)	2 ②	2
Blanco	Left Abutment slope 1:2.5 Right Abutment slope 1:3.0 Span-height Ratio 10	2	Catchment Area 36 km^2 Flood Discharge 510 m^3/s	2	Live Capacity 11.2 MCM (39.0) Gross Capacity 13.0 MCM (41.4)	50.0 m (74.0) m	2 ②	2.80 MCM (5.10) MCM	3 ③	4.60 (8.10)	3 ③	3

(Notes) Figure of ( ) and order of ○, in case of live capacity of reservoir 39.6 MCM at the Ostua and Blanco dam sites.

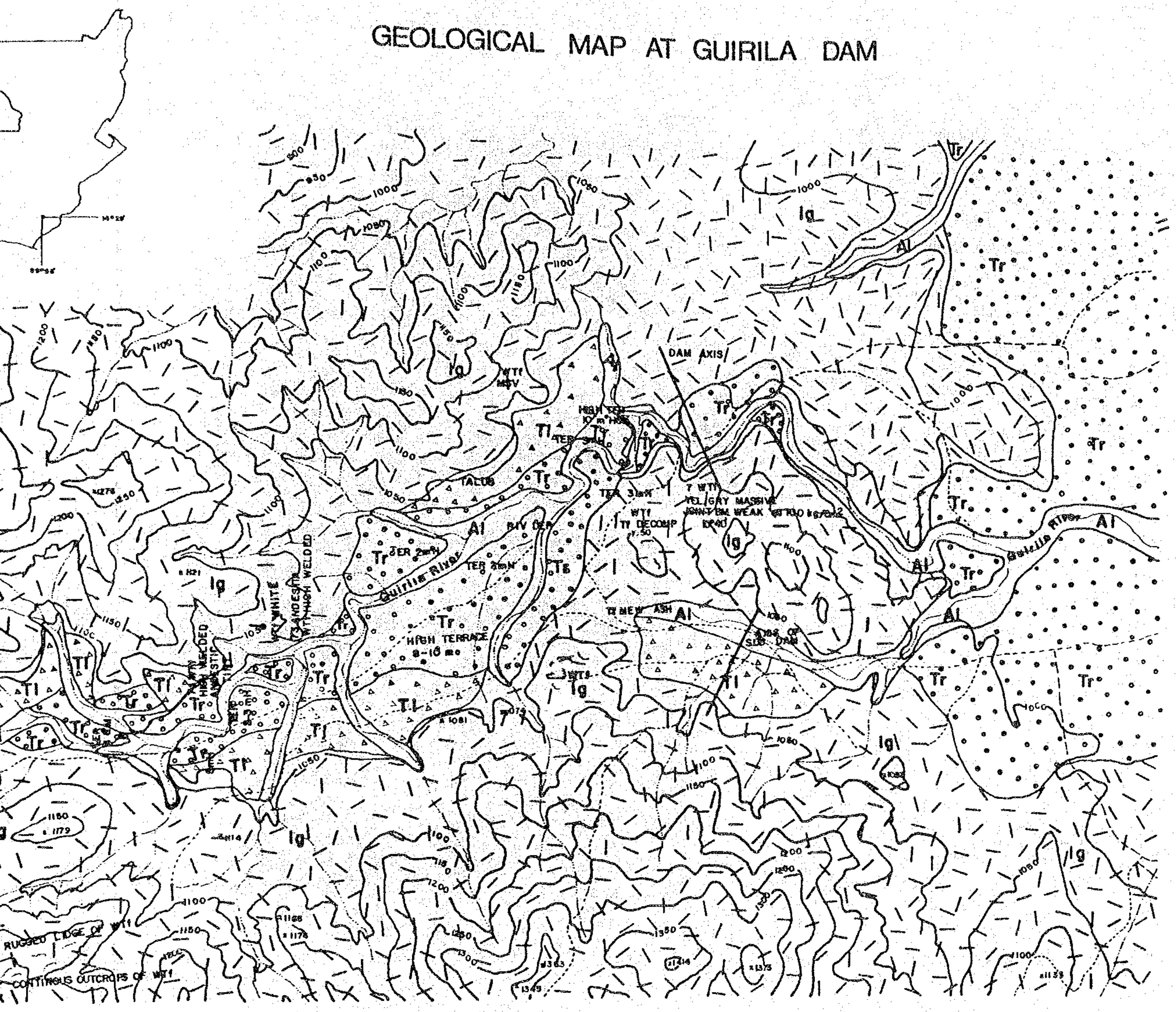
GEOLOGICAL MAP AT GUIRILA DAM

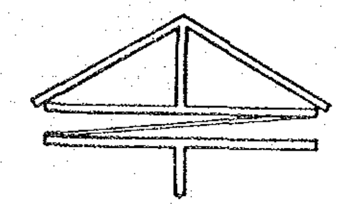


Symbol	TIME		
Al	CENOZOIC	Quaternary	Holo
Tr			Pleis
Tl			
Ig		Neogene Tertiary	Plioc Mioc

Fig. A.4.1.1-

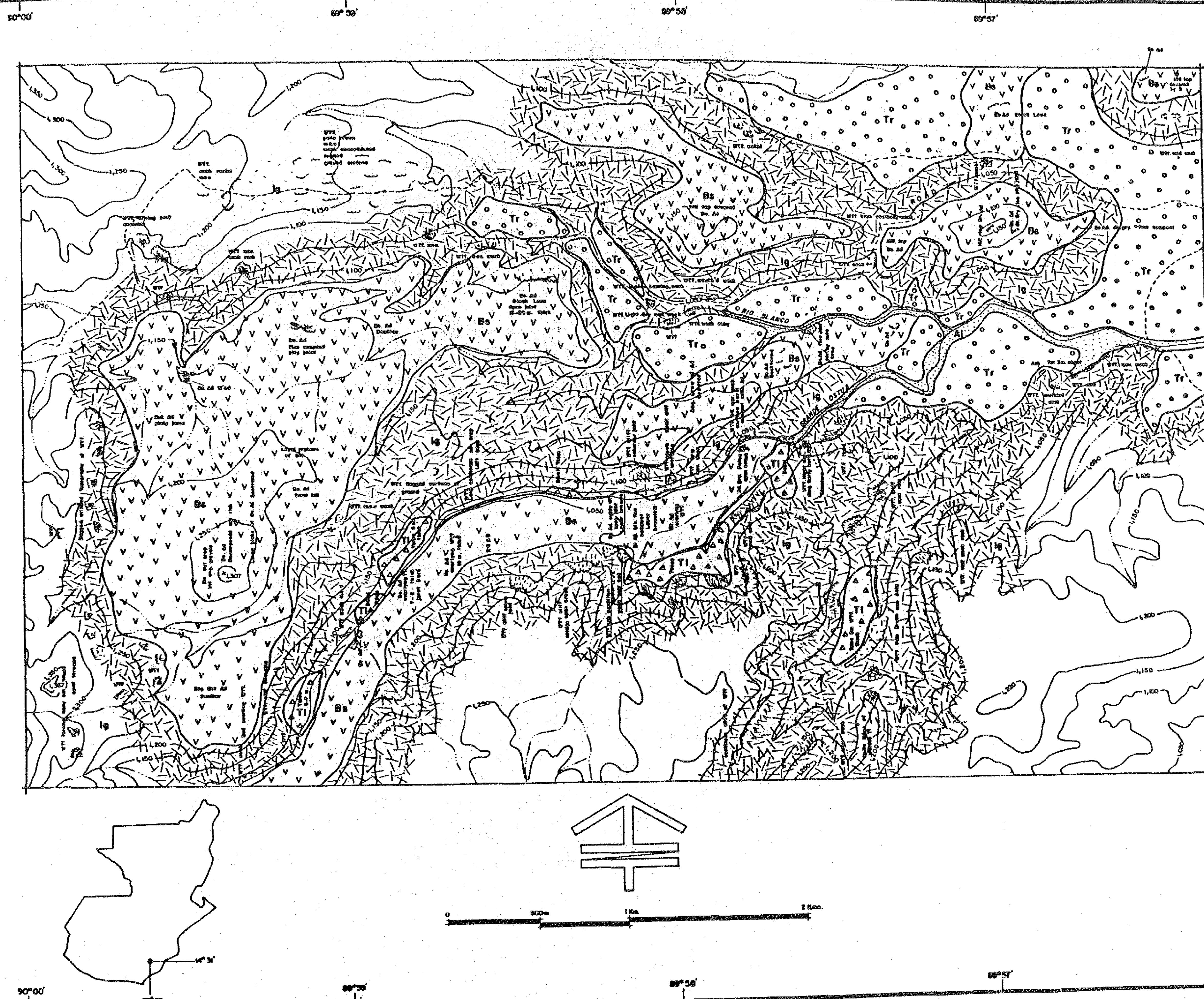
GEOLOGICAL MAP AT GUIRILA DAM





G E O L O G Y					
Symbol	TIME			NAME	Rock Type and Characteristic
Al	CENOZOIC	Quaternary	Holocene	Alluvial Deposit	Recent river deposit, sand and gravel and boulder rich.
Tr			Pleistocene	Terrace Deposit	Sand and gravel layer, boulder rich.
Tl				Talus Deposit	Tuff origin silty soil associated with large boulders.
Ig		Neogene Tertiary	Pliocene Miocene	Welded Tuff	Low Welding Weak rock. Massive and low permeability.

Fig. A.4.1.1-1 Geological Map at Guirila Dam Site

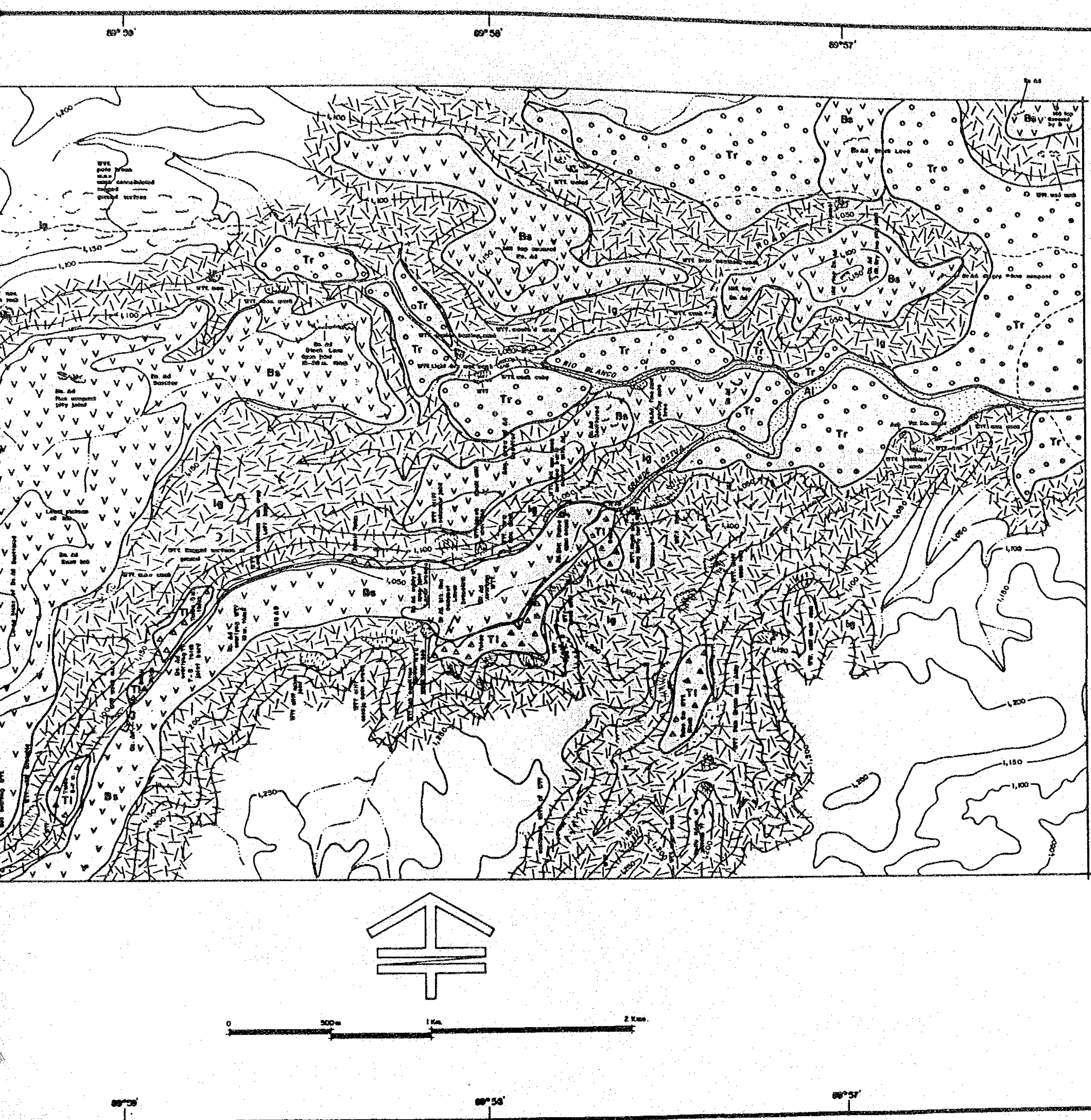


SYMBOL	GEOLOGY				
	TIME			NAME	Rock Type and Character
Al	CENOZOIC	Quaternary	Holocene	Alluvial deposit	Recent river deposit. Boulder rich sand (gravel layer.
Tr			Pleistocene	Terrace deposit	Sand and gravel, partly fine soil. Large b(abundant.
Tl				Talus deposit	Ash origin fine soil and large blocks of fallen from the background.
Bs				Basalt	Lava flow. Very fine and compact hard rock Brecciated under part. Open joints develop Relatively permeable.
Ig		Neogene Tertiary	Pliocene Miocene	Ignimbrite	Welded Tuff. Low grade welding. Cle weak rock. Massive and less permeable.

REFERENCIAS:

GEOLOGICAL MAP AT OSTUA DAM

Fig. A.4.1.1-2 Geological Map at Ostua Dam Site



SYMBOL	TIME			NAME	Rock Type and Characteristic
Al	CENOZOIC	Quaternary	Holocene	Alluvial deposit	Recent river deposit. Boulder rich sand and gravel layer.
Tr			Pleistocene	Terrace deposit	Sand and gravel, partly fine soil. Large boulder abundant.
Tl				Talus deposit	Ash origin fine soil and large blocks of ignimbrite fallen from the background.
Bs				Basalt	Lava flow. Very fine and compact hard rock. Brecciated under part. Open joints develope. Relatively permeable.
Ig		Neogene Tertiary	Pliocene Miocene	Ignimbrite	Welded Tuff. Low grade welding. Classified into weak rock.. Massive and less permeable.

REFERENCIAS:

RIO

GEOLOGICAL MAP AT OSTUA DAM

Fig. A.4.1.1-2 Geological Map at Ostua Dam Site

GEOLOGICAL MAP AT SAN PEDRO DAM

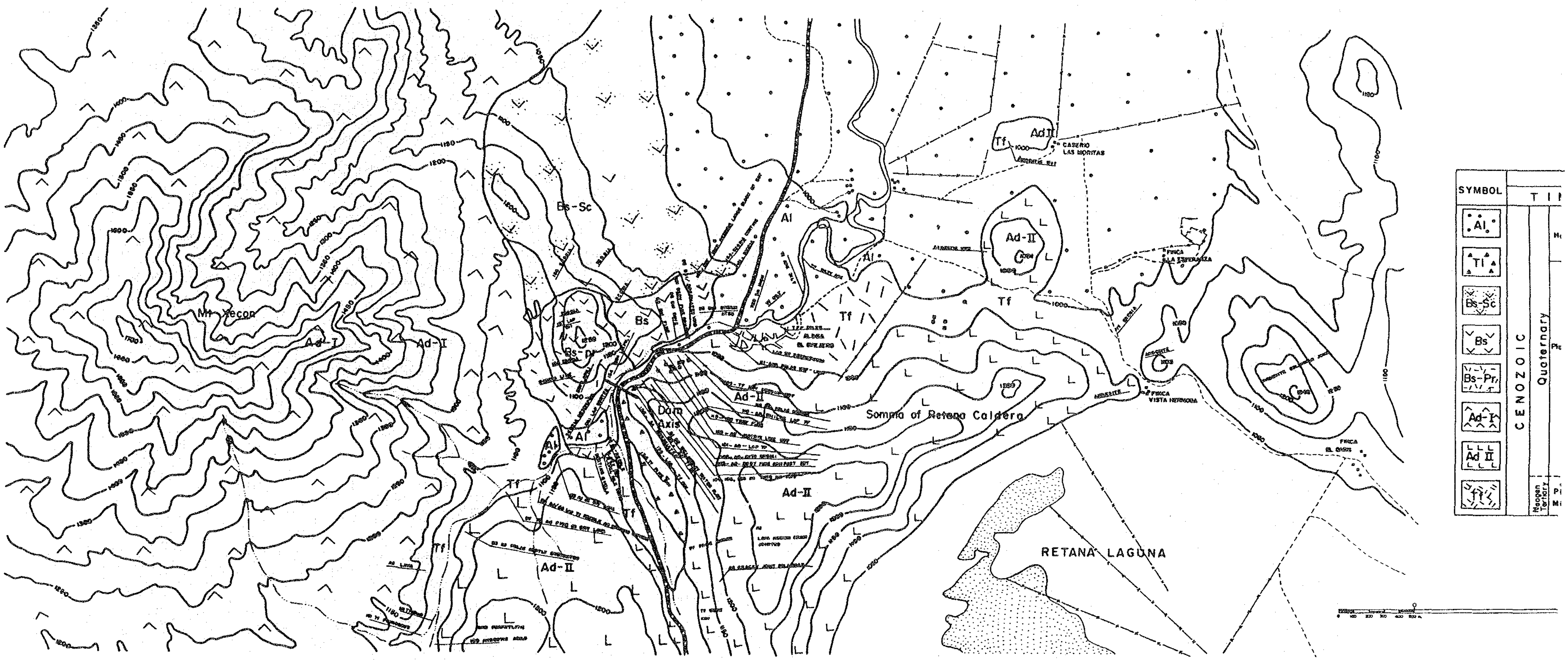
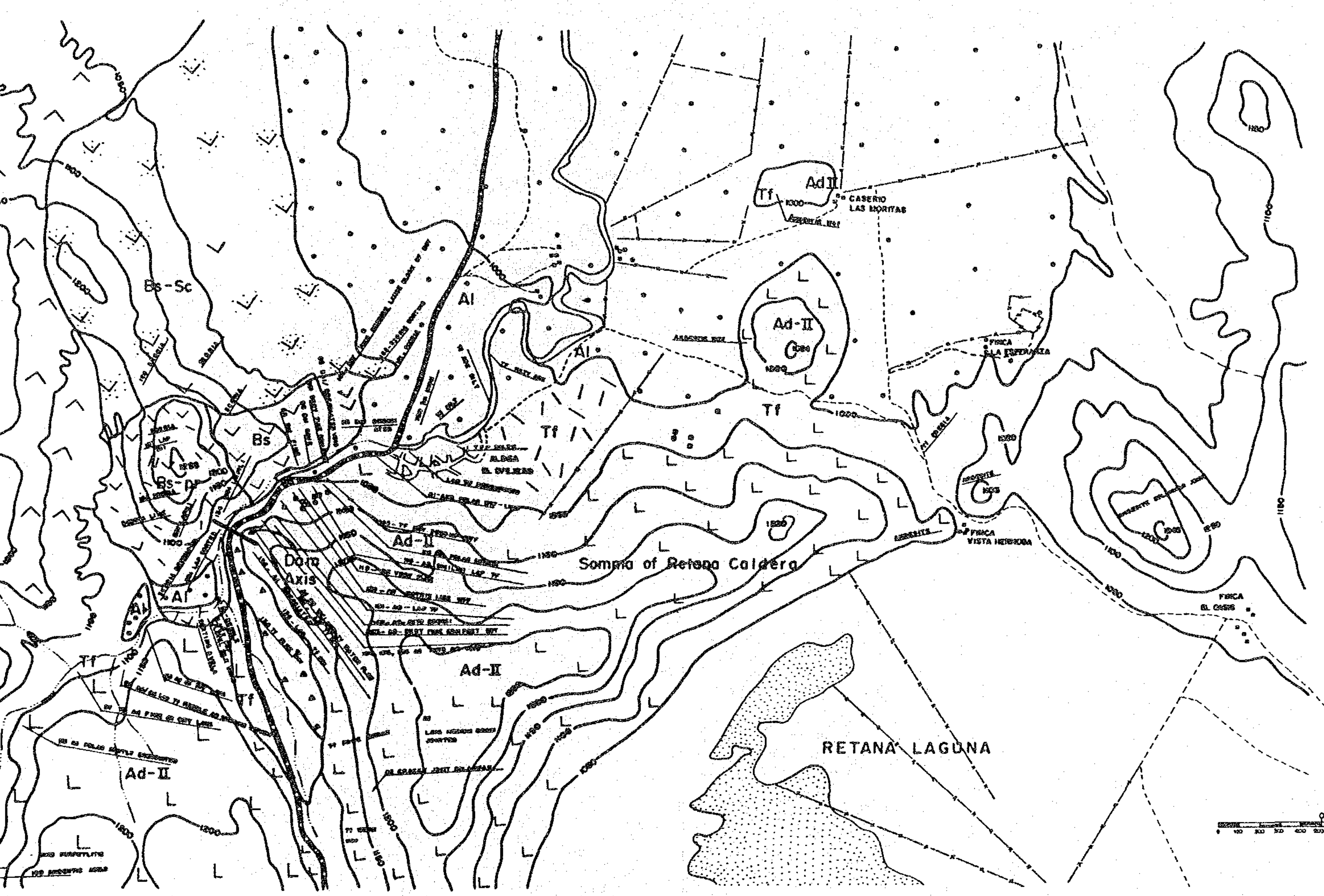
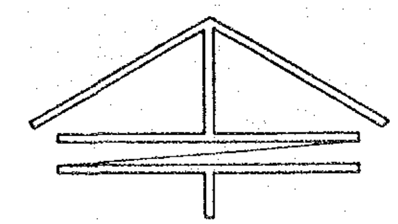


Fig. A.4.1.1-3 Geological Map at San Pedro Dam Site

GEOLOGICAL MAP AT SAN PEDRO DAM





SYMBOL	GEOLOGY				
	TIME			NAME	CHARACTERISTIC
Al	CENOZOIC	Quaternary	Holocene	Alluvial Layer	Recent river deposit and terrace deposit; Sand and gravel layer
Tl				Talus deposit	Soil layer with angular gravels associated with large andesite blocks
Bs-Sc			Pleistocene	Scoria	Mainly consist of pebble size possibly graded into porous basalt very loose and permeable
Bs				Basalt Lava	Very fine, compact and hard rock Brecciated zone underlaid. Many open joints Relatively permeable
Bs-Pr				Porous Basalt	Aggregate of basalt beds. Well-grading in grain size distribution and sorted Loose, weak and permeable
Ad-I				Andesite Lava	Originated from the Mt Xecoa fine compact and hard rock many open joint, hight permeability
Ad II				Andesite Lava	Originated from the somma of Caldera RETANA. Generally compact and hard, Fragile locally high permeability
Tf		Neogen Tertiary	Pliocene Miocene	Tuff	Basic layer around this area Loose and weak tuff massive and low permeability

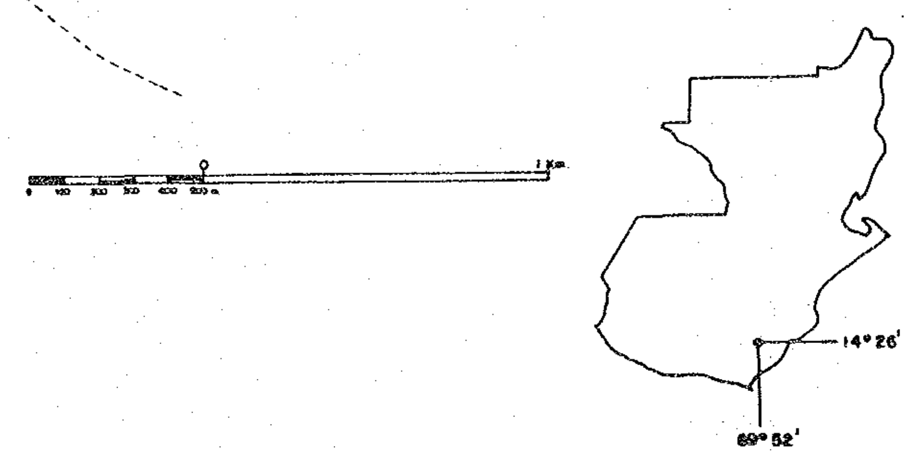


Fig. A.4.1.1-3 Geological Map at San Pedro Dam Site

(2) H-Q Curves of Studies Dams

Table A.4.1.1-3 Height-Volume and Height-Area (1)

Guirila Dam:

EL	ΔH	Area	Ave. Area	Unit Volume	Accumulated Volume
EL 1,000	-	-	-	-	-
1,010	10	359,300	179,650	1,796,500	1,796,500
1,020	10	963,875	661,587	6,615,870	8,412,370
1,030	10	1,773,400	1,368,637	13,686,370	22,098,740
1,040	10	2,342,137	2,057,768	20,577,680	42,676,420
1,050	10	2,829,662	2,585,899	25,858,990	68,535,410

Ostua Dam:

EL	ΔH	Area	Ave. Area	Unit Volume	Accumulated Volume
EL 1,030	-	-	-		
1,040	10	59,375	29,687	296,870	296,870
1,050	10	304,687	182,031	1,820,310	2,117,180
1,060	10	667,187	485,937	4,859,370	6,976,550
1,070	10	928,125	797,656	7,976,560	14,953,110
1,080	10	1,262,500	1,095,312	10,953,120	25,906,240
1,090	10	1,593,750	1,428,125	14,281,250	40,187,490
1,100	10	1,884,375	1,739,062	17,390,625	57,578,115

Blanco Dam:

EL	ΔH	Area	Ave. Area	Unit Volume	Accumulated Volume
EL 1,030	-	-	-	-	-
1,040	10	101,562	50,781	507,810	507,810
1,050	10	412,500	257,031	2,570,310	3,078,120
1,060	10	728,125	570,312	5,703,120	8,781,240
1,070	10	965,625	846,875	8,468,750	17,249,990
1,080	10	1,256,250	1,110,937	11,109,370	28,359,360
1,090	10	1,584,375	1,420,312	14,203,120	42,562,480
1,100	10	1,962,500	1,773,437	17,734,370	60,296,850

Table A.4.1.1-3 Height-Volume and Height-Area (2)

San Pedro Dam:

EL	ΔH	Area	Ave. Area	Unit Volume	Accumulated Volume
EL 1,055	-	-	-	-	-
1,060	5	143,750	67,188	355,940	335,940
1,070	10	343,750	239,062	2,390,620	2,726,560
1,080	10	596,875	470,312	4,703,120	7,429,680
1,090	10	848,438	722,656	7,226,560	14,656,240
1,100	10	1,182,812	1,015,625	10,156,250	24,812,490

Achiotes Dam:

EL	ΔH	Area	Ave. Area	Unit Volume	Accumulated Volume
EL 1,000	-	-	-	-	-
1,010	10	40,625	20,312	203,120	203,120
1,020	10	190,625	115,625	1,156,250	1,359,370
1,030	10	392,187	291,406	2,914,060	4,273,430
1,040	10	623,437	507,812	5,078,120	9,351,550
1,050	10	881,250	752,343	7,523,430	16,874,980
1,060	10	1,165,625	1,023,437	10,234,370	27,109,350

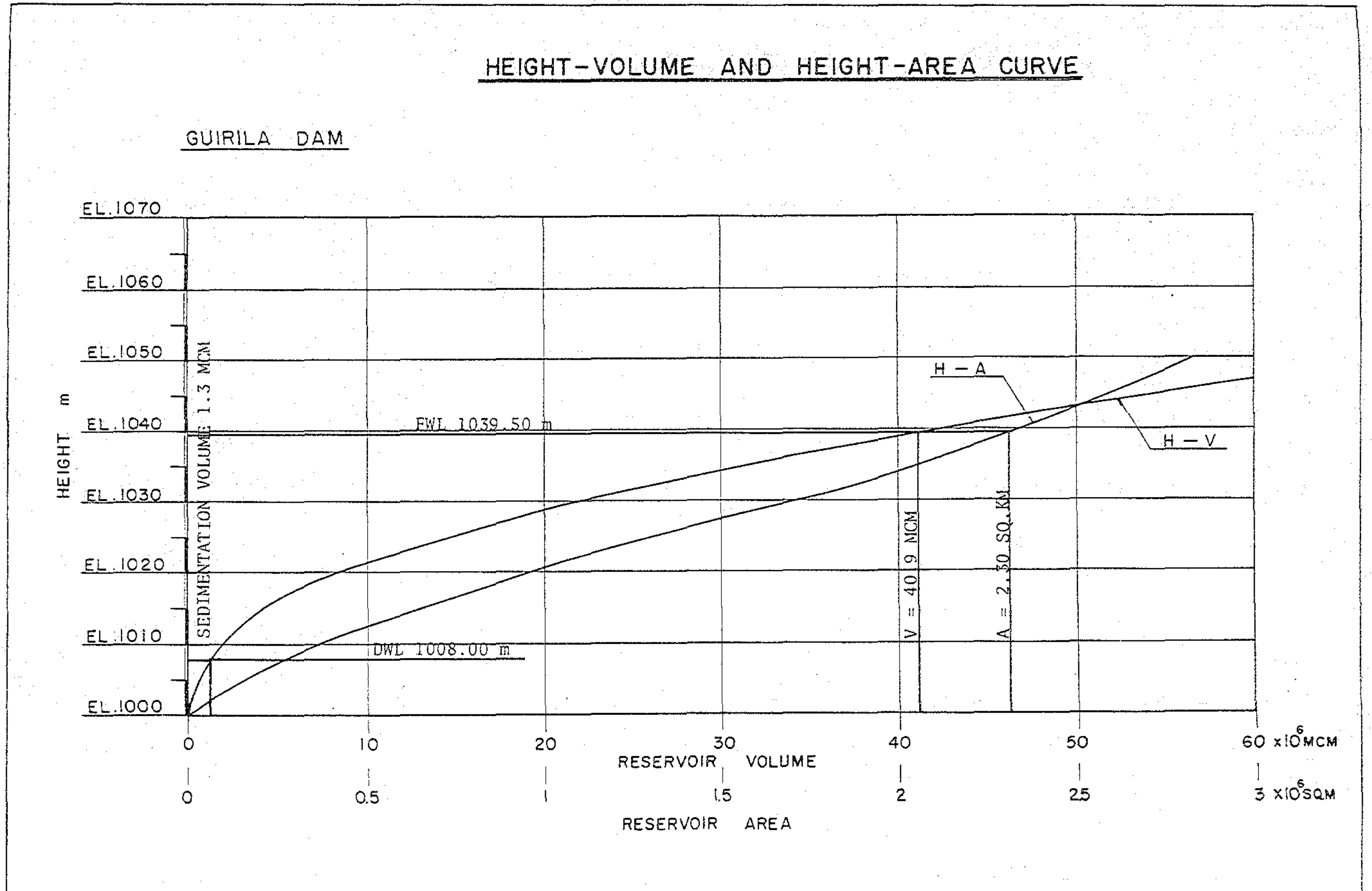


Fig. A.4.1.1-4 Height-Volume and Heihgt-Area Curves (Guirila Dam Site)

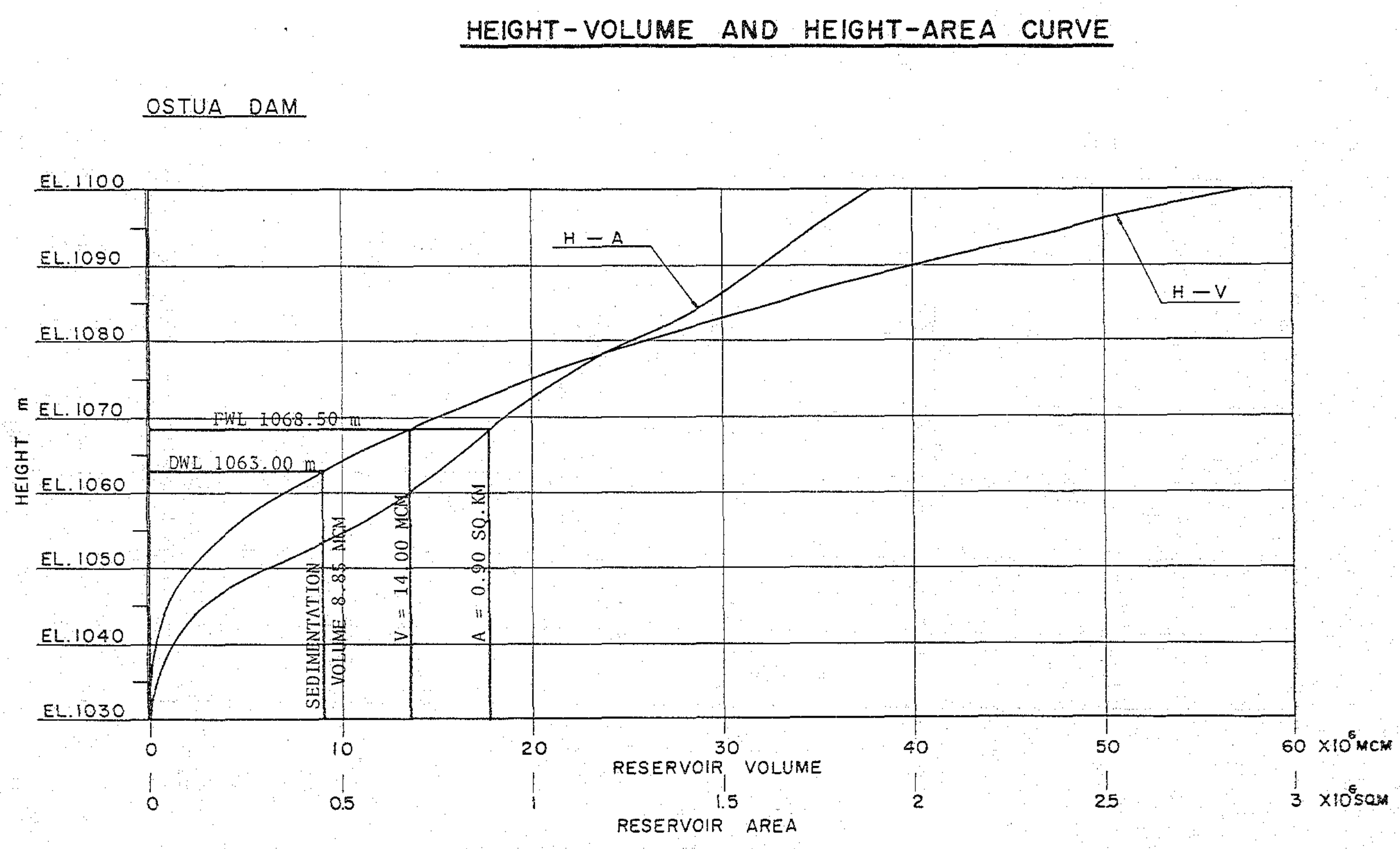


Fig. A.4.1.1-4 Height-Volume and Heihgt-Area Curves (Ostua Dam Site)

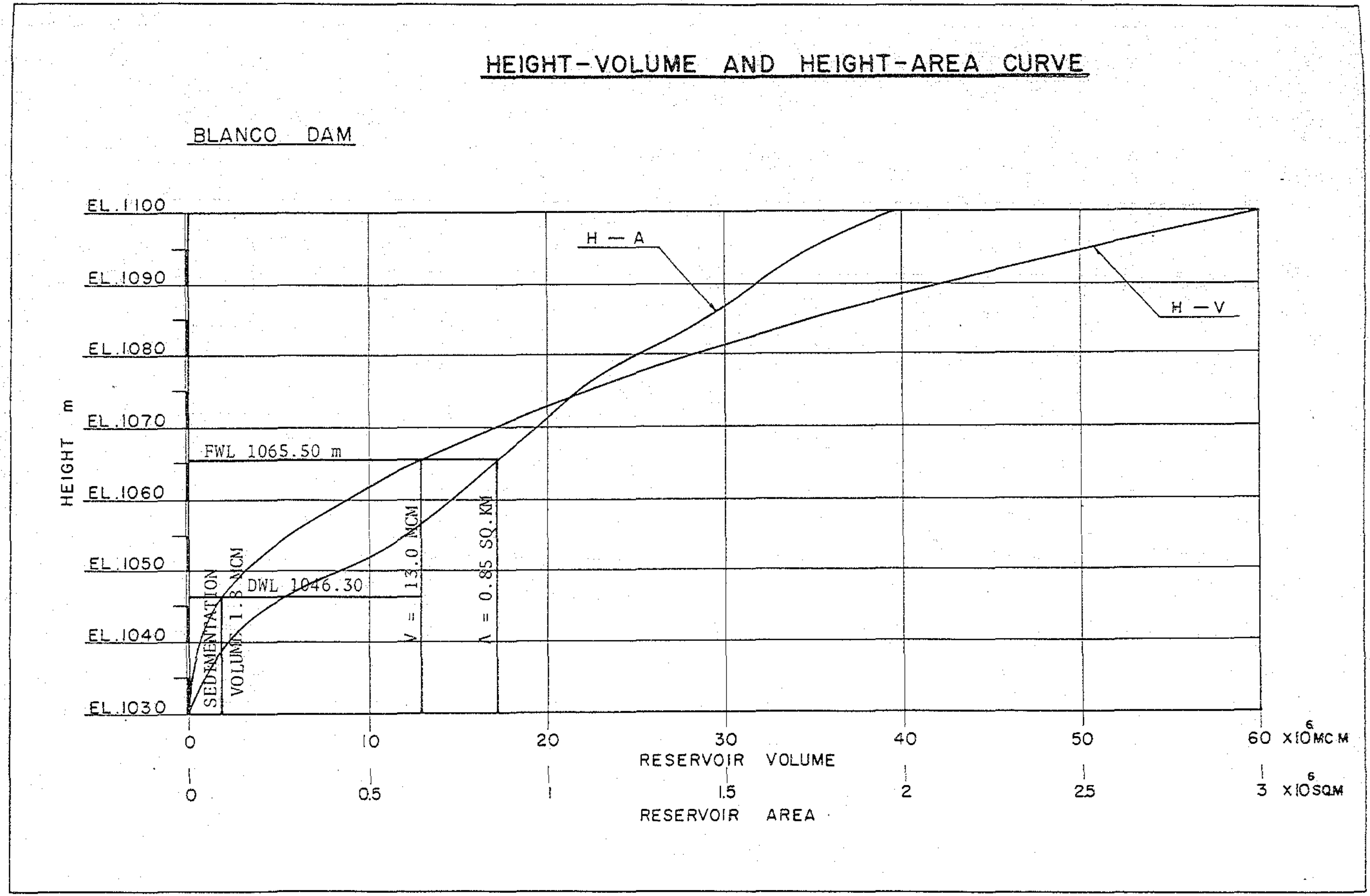


Fig. A.4.1.1-4 Height-Volume and Heihgt-Area Curves (Blanco Dam)

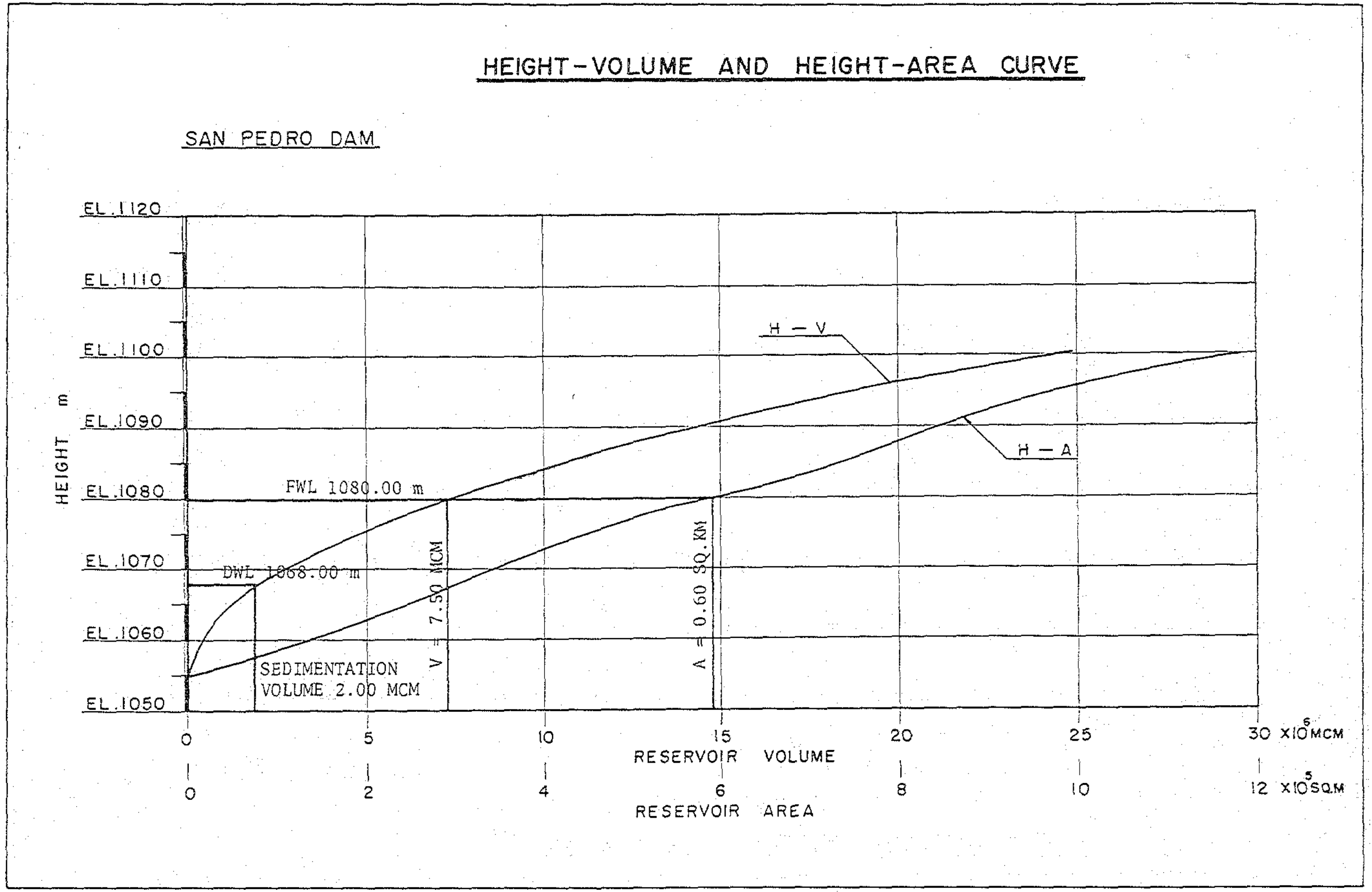


Fig. A.4.1.1-4 Height-Volume and Heihgt-Area Curves (San Pedro Dam Site)

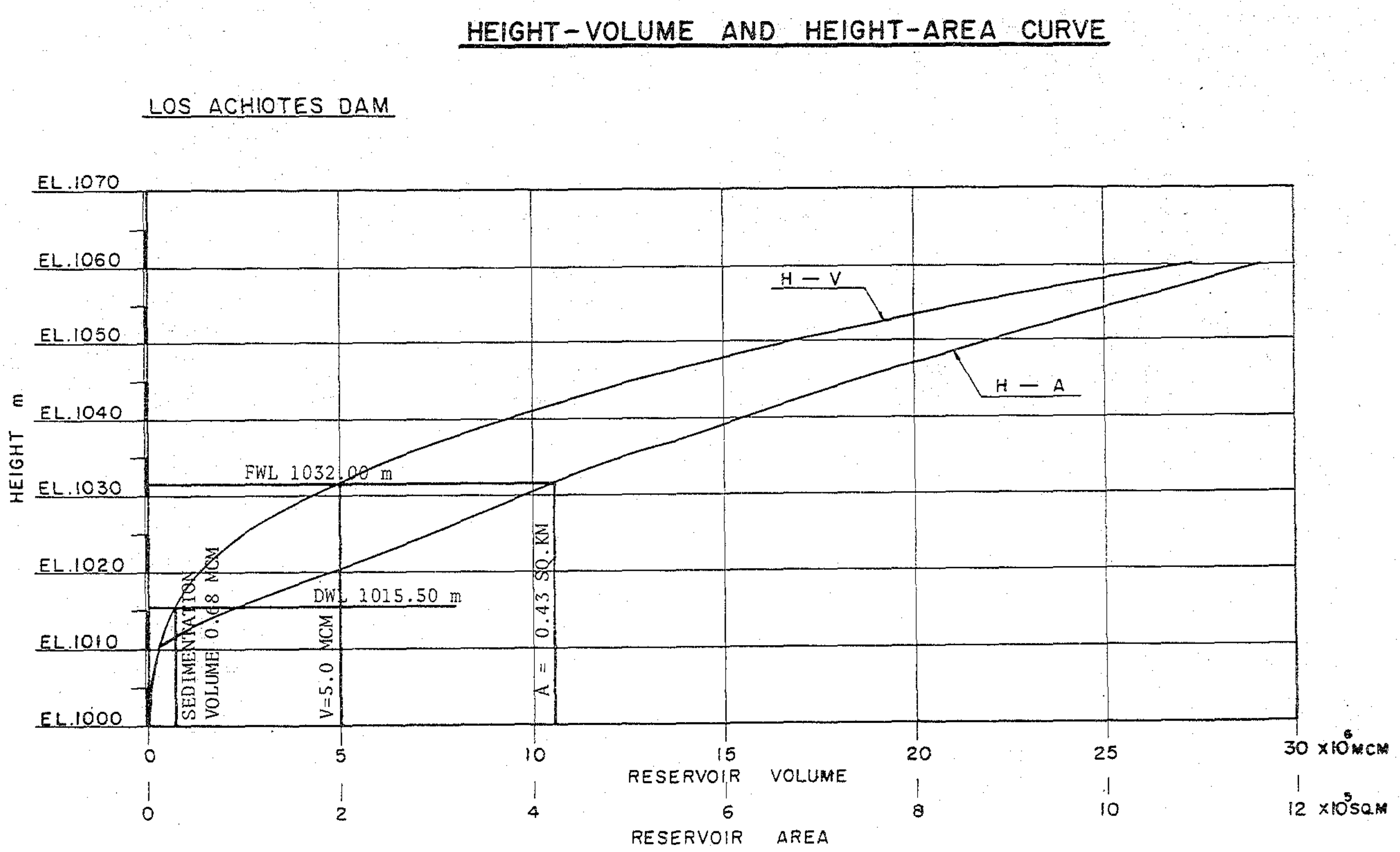


Fig. A.4.1.1-4 Height-Volume and Heihgt-Area Curves (Achiotes Dam)

Table A.4.1.1-4 Groundwater Requirement

Month	Day 10day	Irrigation (ha)	Unit Water Requirement (liter/sec/ha)	Water Requirement x10^3 m^3
	B	331	0.32	91.5
May	M	345	0.23	68.6
	L	359	0.20	62.0
	B	418	0.06	21.7
Jan.	M	476	0.05	20.6
	L	535	0.03	13.9
	B	602	0.04	20.8
Jul.	M	668	0.05	28.9
	L	735	0.06	38.1
	B	735	0.08	50.8
Aug.	M	735	0.14	88.9
	L	735	0.12	76.2
	B	713	0.15	90.4
Sep.	M	691	0.15	89.6
	L	668	0.12	69.3
	B	624	0.25	134.8
Oct.	M	579	0.24	120.1
	L	535	0.31	143.3
	B	579	0.59	295.2
Nov.	M	579	0.51	255.1
	L	602	0.49	254.9
	B	602	0.49	254.9
Dec.	M	602	0.51	265.3
	L	602	0.58	301.7
	B	610	0.61	321.5
Jan.	M	618	0.63	336.4
	L	627	0.67	363.0
	B	568	0.74	363.2
Feb.	M	510	0.77	339.3
	L	451	0.81	315.6
	B	415	0.81	290.4
Mar.	M	379	0.81	265.2
	L	343	0.86	254.9
	B	312	0.84	226.4
Apr.	M	281	0.84	203.9
	L	251	0.81	175.7
				6,312.1

1) Area obtained from proposed cropping pattern
2) Unit water requirement of surface water x 0.476 (Irrigation Efficiency) - 0.62 (Field Application Efficiency)
3) Unit water requirement x ha x 10days x 24hrs x 3,600

Table A.4.1.1-5 Construction Cost of New Well

(unit: Q)

Item	U. Price	Volume	Price Mojarritas Sec.	Price S. Pedro Sec.	Note
Transportation		1 unit	1,500	1,500	machine, equipment
Installation & Remove		1 unit	1,000	1,000	
Boring	205	80m, 100m	16,400	20,500	∅ 10 "
Casing		1 unit	10,400	13,000	including installation
Screen	420	50 m	21,000	21,000	including installation
Gravel Packing	5	80m, 100m	400	500	
Cementing		1 unit	100	100	
Well Cleaning		1 unit	800	1,000	
Pumping Test		1 unit	1,500	1,500	
Electric Prospecting		1 unit	400	500	
Submergible Pump		1 unit	11,500	11,500	10 HP including installation
Installation of Electric Cable	24	300m	7,200	7,200	
Transformer		1 unit	3,000	3,000	
Contingency		10%	7,500	8,200	
Total			82,700	90,500	

(source : INSIVUMEH)

Table A.4.1.1-6 Maintenance Cost of Existing Well

Item	Unit Price (Q)	Volume	Price (Q)	Note
Transportation		1 unit	1,000	machine, equipment, etc
Installment &		1 unit	500	
Cleaning	60	65 hrs	3,900	Mojarritas Sec.
		75 hrs	4,500	San Pedro Sec.
Pump Maintenance		1 unit	500	
Total			5,900	Mojarritas Sec.
			6,500	San Pedro Sec.

(source : Private Company)

Table A.4.1.1-7 Rehabilitation Cost of Existing Well

Item	Unit Price (Q)	Volume	Price (Q)	Note
Transportation		1 unit	1,500	machine, equipment
Installment & Remove		1 unit	1,000	
Boring	205	21 m	4,300	ø 10 " including pipe
Screen	420	21 m	8,800	including installment
Gravel Packing	50	21 m	1,000	
Cementing		1 unit	100	
Well Cleaning		1 unit	4,500	
Pumping Test		1 unit	1,500	
Pump Maintenance		1 unit	500	
Total			23,200	

Table A.4.1.1-8 Proposed Electric Charge

Item	
Pumping Hour	4,193 hrs
Pump Power	7.5 kW
Consumed Electricity	31,448 kWh
Electric Charge	
Basic Charge	Q 2,96 x 7.5 kW = Q 22.2
Consumption Charge	Q 0.134 x 100 kWh x 7.5 kW + Q 0.128 x 100 kWh x 7.5 kW + Q 0.108 x 31.248 kWh = Q 3571.28
Utilization Charge of Electric Installation	Q 1.35 x 7.5 kW = Q 10.13
Sub-total	Q 3,603.61
Combustible Adjustment (40%) + IVA (70%)	Q 1,693.70
Grand-total	Q 5,297.31
Electric Charge per ha	Q 353.15

Table A.4.1.1-9 Groundwater irrigation Facilities

Item	2.0 ha Unit quantity	15 ha Calculation	Total quantity
VU 100	250 m	$15\ ha \times \frac{250}{2\ ha} = 1875\ m$	1875 m
Coupling, valve	13.3	$15 \times \frac{13.3}{2} = 99.75 = 100$	100
Excavation	$150 + 7 = 157\ m^3$	$15 \times \frac{157}{2} = 1177.5$	1178 m
Refilling	$148 + 4 = 152\ m^3$	$15 \times \frac{152}{2} = 1140$	1140 m
Form	$37\ m^2$	$15 \times \frac{37}{2} = 277.5$	277.5
Plain concrete	$2.75\ m^3$	$15 \times \frac{2.75}{2} = 20.625$	20.625 m
Sprinkler set			
Nozzle	5	$\frac{15\ ha}{7\ days} \times \frac{5}{2\ ha} = 5.36$	5.4
Riser pipe	5	$\frac{15\ ha}{7\ days} \times \frac{5}{2\ ha} = 5.36$	5.4
Pipe	5	$\frac{15\ ha}{7\ days} \times \frac{5}{2\ ha} = 5.36$	48.2 m

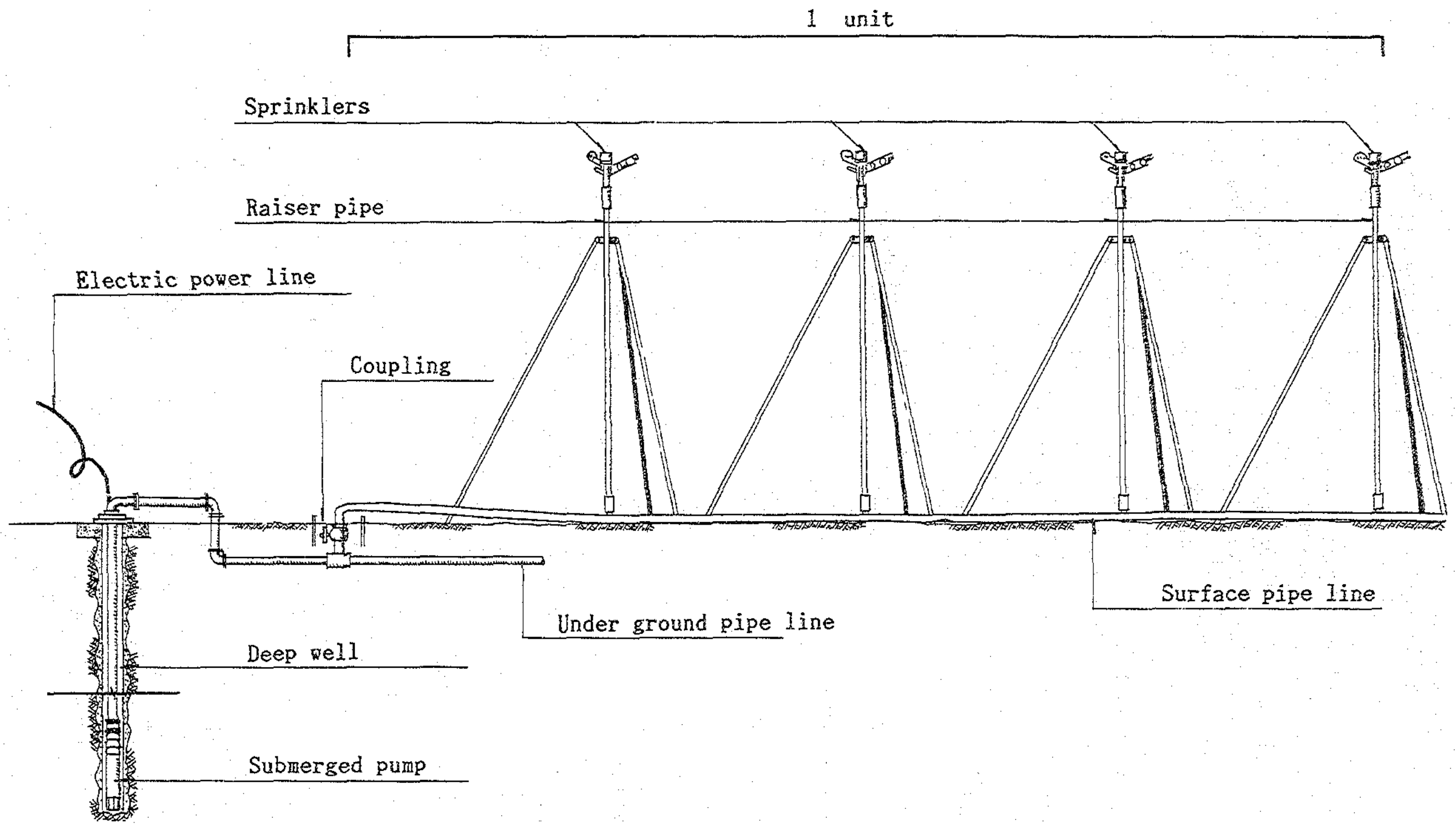


Fig. A.4.1.1-5 Field Irrigation System (1)

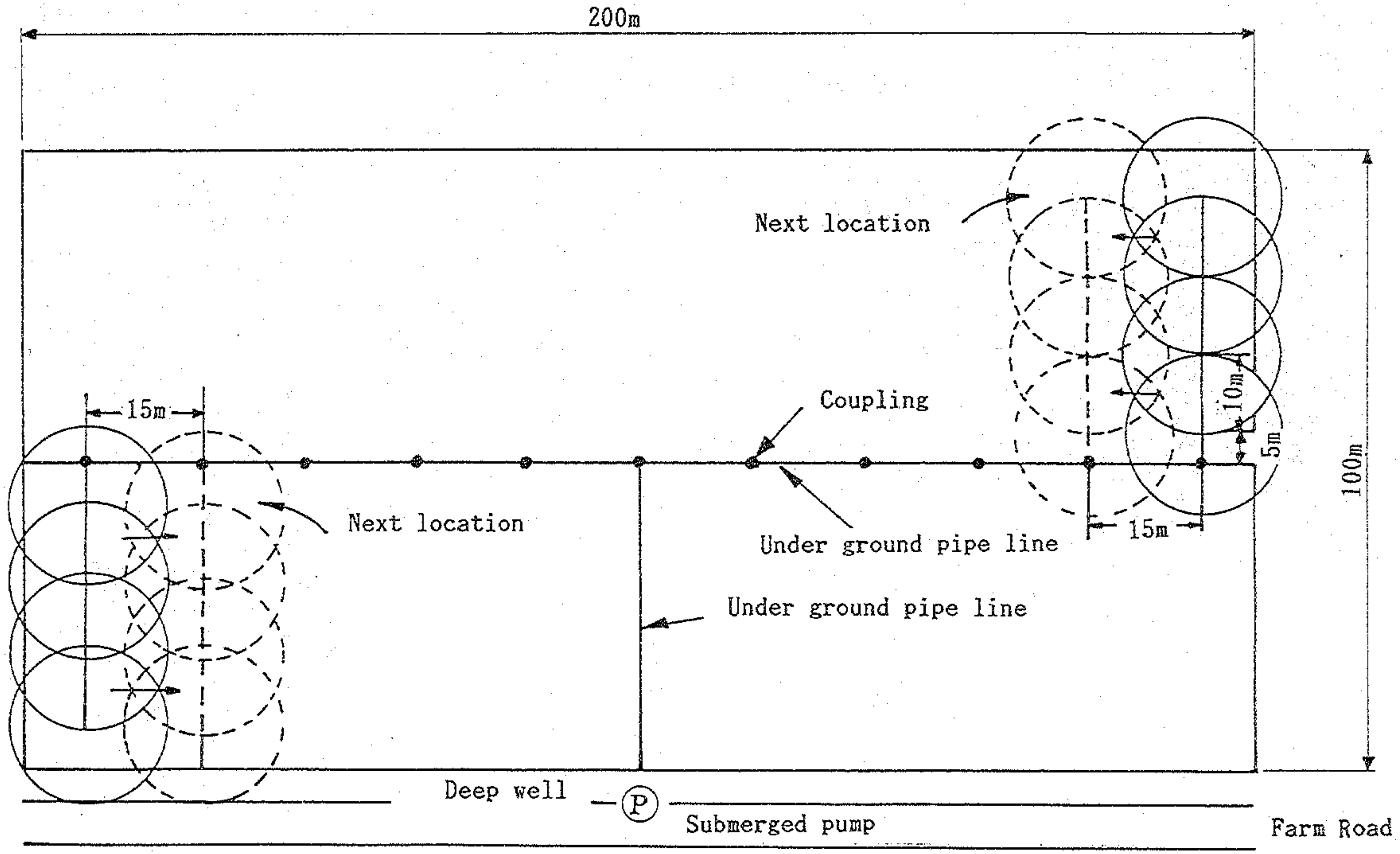


Fig. A.4.1.1-5 Field Irrigation System (2)

(1) Inflow of Guirila Dam

Table A.4.1.2-1 Inflow of Guirila Dam

(Units; MCM)

Year	Driving Canal Capacity (m^3/s)				
	3.0	4.0	5.0	6.0	7.0
1967	49.3	56.6	61.2	65.2	68.4
68	64.0	74.1	83.0	90.6	99.0
69	74.3	86.9	98.6	109.1	118.4
70	55.6	64.4	72.3	79.6	86.4
71	55.0	62.4	68.5	73.9	78.9
72	19.4	20.5	21.4	22.2	22.8
73	65.3	77.1	88.1	98.2	106.5
74	45.6	52.4	58.3	63.4	67.8
75	39.2	45.5	50.8	55.3	59.4
76	40.8	45.8	50.0	53.8	57.4
77	21.9	23.7	25.1	26.2	27.2
78	55.1	60.8	65.9	70.0	73.4
79	50.4	57.7	63.8	69.4	74.6
80	54.5	62.1	68.7	74.7	79.8
81	57.8	64.2	68.2	71.1	73.3
Mean	49.9	56.3	62.9	68.2	72.9
Max	74.3	86.9	98.6	109.1	118.4
Min	19.4	20.5	21.4	22.2	22.8

V = Qqui + Qost

V; Inflow of Guirila Dam

Qqui; Discharge of Guirila river (direct)

Qost; Diverted water from Ostua river (Indirect)

Table A.4.1.2-2 Total Inflow of Guirila Dam (1)

Year : 1967 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
	1	721	721	721	721	721	90	811	811	811	811	811
MAY	2	1152	1152	1152	1152	1152	144	1296	1296	1296	1296	1296
	3	554	554	554	554	554	69	623	623	623	623	623
	4	905	905	905	905	905	113	1018	1018	1018	1018	1018
JUN	5	893	893	893	893	893	111	1004	1004	1004	1004	1004
	6	1830	2036	2122	2179	2179	272	2102	2308	2394	2451	2451
	7	1852	1986	2073	2076	2076	259	2111	2245	2332	2335	2335
JUL	8	1521	1718	1891	2064	2182	273	1794	1991	2164	2337	2455
	9	1820	1874	1874	1874	1874	234	2054	2108	2108	2108	2108
	10	1779	1895	1892	2035	2035	254	2033	2149	2146	2289	2289
AUG	11	2592	3456	4320	5184	6008	1783	4375	5239	6103	6967	7791
	12	2851	3802	4752	5643	6392	1294	4145	5096	6046	6937	7686
	13	2395	2832	2955	3041	3128	472	2867	3304	3427	3513	3600
SEP	14	1593	3368	3678	3788	3849	480	2073	3848	4158	4268	4329
	15	2542	3100	3392	3565	3737	514	3056	3614	3906	4079	4251
	16	2592	3456	4320	5161	5938	941	3533	4397	5261	6102	6879
OCT	17	2592	3410	4096	4631	5075	945	3537	4355	5041	5576	6020
	18	2034	2042	2042	2042	2042	255	2289	2297	2297	2297	2297
	19	2294	2596	2818	2901	2901	362	2656	2958	3180	3263	3263
NOV	20	1279	1279	1279	1279	1279	160	1439	1439	1439	1439	1439
	21	786	786	786	786	786	98	884	884	884	884	884
	22	542	542	542	542	542	68	610	610	610	610	610
DEC	23	360	360	360	360	360	45	405	405	405	405	405
	24	355	355	355	355	355	48	403	403	403	403	403
	25	236	236	236	236	236	30	266	266	266	266	266
JAN	26	170	170	170	170	170	21	191	191	191	191	191
	27	109	109	109	109	109	13	122	122	122	122	122
	28	129	129	129	129	129	16	145	145	145	145	145
FEB	29	99	99	99	99	99	12	111	111	111	111	111
	30	73	73	73	73	73	9	82	82	82	82	82
	31	72	72	72	72	72	9	81	81	81	81	81
MAR	32	79	79	79	79	79	10	89	89	89	89	89
	33	86	86	86	86	86	11	97	97	97	97	97
	34	429	429	429	429	429	53	482	482	482	482	482
APR	35	353	353	353	353	353	44	397	397	397	397	397
	36	100	100	100	100	100	12	112	112	112	112	112
TOTAL		39769	47053	51707	55666	58898	9524	49293	56577	61231	65190	68422

Table A.4.1.2-2 Total Inflow of Guirila Dam (2)

Year : 1968 [x1000 m3]

Period		Intake Canal Capacity (m3/sec)					Runoff of GUIRILA	Inflow by Canal Capacity				
		3	4	5	6	7		3	4	5	6	7
	1	289	289	289	289	289	36	325	325	325	325	325
MAY	2	725	725	725	725	725	91	816	816	816	816	816
	3	1222	1222	1222	1222	1222	153	1375	1375	1375	1375	1375
	4	2352	2826	3162	3237	3237	404	2756	3230	3566	3641	3641
JUN	5	2592	3456	4245	5023	5735	1257	3849	4713	5502	6280	6992
	6	2592	3456	4320	5184	6048	1808	4400	5264	6128	6992	7856
	7	2592	3456	4320	5184	5979	1047	3639	4503	5367	6231	7026
JUL	8	2547	3131	3571	3833	4072	558	3105	3689	4129	4391	4630
	9	1832	1832	1832	1832	1832	229	2061	2061	2061	2061	2061
	10	1794	1989	2142	2200	2200	275	2069	2264	2417	2475	2475
AUG	11	1748	1771	1771	1771	1771	221	1969	1992	1992	1992	1992
	12	2025	2051	2051	2051	2051	256	2281	2307	2307	2307	2307
	13	2451	3085	3655	4172	4573	851	3302	3936	4506	5023	5424
SEP	14	2592	3456	4320	5184	6048	1690	4282	5146	6010	6874	7738
	15	2592	3456	4320	5184	6048	1757	4349	5213	6077	6941	7805
	16	2592	3456	4143	4388	4423	552	3144	4008	4695	4940	4975
OCT	17	2592	3341	3948	4553	5081	1144	3736	4485	5092	5697	6225
	18	2851	3802	4752	5693	6520	2471	5322	6273	7223	8164	8991
	19	2592	3456	4320	4930	5185	656	3248	4112	4976	5586	5841
NOV	20	2456	2842	2960	2960	2960	370	2826	3212	3330	3330	3330
	21	1311	1311	1311	1311	1311	164	1475	1475	1475	1475	1475
	22	829	829	829	829	829	103	932	932	932	932	932
DEC	23	540	540	540	540	540	67	607	607	607	607	607
	24	465	465	465	465	465	58	523	523	523	523	523
	25	318	318	318	318	318	40	358	358	358	358	358
JAN	26	237	237	237	237	237	30	267	267	267	267	267
	27	182	182	182	182	182	23	205	205	205	205	205
	28	115	115	115	115	115	14	129	129	129	129	129
FEB	29	99	99	99	99	99	12	111	111	111	111	111
	30	45	45	45	45	45	6	51	51	51	51	51
	31	60	60	60	60	60	7	67	67	67	67	67
MAR	32	50	50	50	50	50	6	56	56	56	56	56
	33	65	65	65	65	65	8	73	73	73	73	73
	34	90	90	90	90	90	11	101	101	101	101	101
APR	35	66	66	66	66	66	8	74	74	74	74	74
	36	96	96	96	96	96	12	108	108	108	108	108
TOTAL		47596	57666	66636	74183	80567	16395	63991	74061	83031	90578	96962

Table A.4.1.2-2 Total Inflow of Guirila Dam (3)

Year : 1969 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
	1	90	90	90	90	90	11	101	101	101	101	101
MAY	2	338	338	338	338	338	42	380	380	380	380	380
	3	1959	2219	2461	2548	2634	401	2360	2620	2862	2949	3035
	4	2592	3456	4225	4772	5003	702	3294	4158	4927	5474	5705
JUN	5	2592	3416	4091	4509	4781	645	3237	4061	4736	5154	5426
	6	2592	3456	4320	5184	6048	1964	4556	5420	6284	7148	8012
	7	2592	3456	4320	5184	6048	3264	5856	6720	7584	8448	9312
JUL	8	2592	3456	4320	5067	5674	1617	4209	5073	5937	6684	7291
	9	2791	3408	3803	4040	4169	522	3313	3930	4325	4562	4691
	10	2592	3456	4287	4978	5670	1592	4184	5048	5879	6570	7262
AUG	11	2592	3456	4320	5184	6048	1599	4191	5055	5919	6783	7647
	12	2852	3802	4752	5660	6490	1165	4017	4967	5917	6825	7655
	13	2592	3456	4320	5184	6048	3201	5793	6657	7521	8385	9249
SEP	14	2592	3456	4320	5184	6048	1656	4248	5112	5976	6840	7704
	15	2592	3456	4320	5184	6048	2142	4734	5598	6462	7326	8190
	16	2592	3456	4320	5184	6048	1348	3940	4804	5668	6532	7396
OCT	17	2592	3456	4170	4714	5041	656	3248	4112	4826	5370	5697
	18	2727	3161	3410	3583	3676	469	3196	3630	3879	4052	4145
	19	1543	1543	1543	1543	1543	193	1736	1736	1736	1736	1736
NOV	20	1069	1069	1069	1069	1069	133	1202	1202	1202	1202	1202
	21	705	705	705	705	705	88	793	793	793	793	793
	22	596	596	596	596	596	74	670	670	670	670	670
DEC	23	518	518	518	518	518	65	583	583	583	583	583
	24	493	493	493	493	493	62	555	555	555	555	555
	25	385	385	385	385	385	48	433	433	433	433	433
JAN	26	309	309	309	309	309	39	348	348	348	348	348
	27	303	303	303	303	303	38	341	341	341	341	341
	28	293	293	293	293	293	36	329	329	329	329	329
FEB	29	277	277	277	277	277	35	312	312	312	312	312
	30	218	218	218	218	218	27	245	245	245	245	245
	31	242	242	242	242	242	30	272	272	272	272	272
MAR	32	189	189	189	189	189	23	212	212	212	212	212
	33	197	197	197	197	197	25	222	222	222	222	222
	34	187	187	187	187	187	23	210	210	210	210	210
APR	35	652	652	652	652	652	81	733	733	733	733	733
	36	239	239	239	230	239	30	269	269	269	260	269
TOTAL		50276	62865	74602	84993	94317	24046	74322	86911	98648	109039	118363

Table A.4.1.2-2 Total Inflow of Guirila Dam (4)

Year : 1970 [x1000 m3]

Period		Intake Canal Capacity (m3/sec)					Runoff of GUIRILA	Inflow by Canal Capacity				
		3	4	5	6	7		3	4	5	6	7
MAY	1	116	116	116	116	116	14	130	130	130	130	130
	2	634	634	634	634	634	79	713	713	713	713	713
	3	499	499	499	499	499	62	561	561	561	561	561
JUN	4	359	359	359	359	359	45	404	404	404	404	404
	5	736	736	736	736	736	92	828	828	828	828	828
	6	1292	1292	1292	1292	1292	161	1453	1453	1453	1453	1453
JUL	7	1592	1852	2049	2161	2247	298	1890	2150	2347	2459	2545
	8	2401	3091	3783	4474	5119	1186	3587	4277	4969	5660	6305
	9	2852	3802	4752	5703	6653	1932	4784	5734	6684	7635	8585
AUG	10	2592	3456	4320	5184	6048	1410	4002	4866	5730	6594	7458
	11	2592	3456	4320	5184	6004	1615	4207	5071	5935	6799	7619
	12	2851	3605	4213	4732	5206	1721	4572	5326	5934	6453	6927
SEP	13	2592	3456	4320	5184	6048	1974	4566	5430	6294	7158	8022
	14	2592	3456	4320	5129	5719	873	3465	4329	5193	6002	6592
	15	2592	3456	4320	5184	6048	1135	3727	4591	5455	6319	7183
OCT	16	2592	3456	4320	5095	5708	1065	3657	4521	5385	6160	6773
	17	2510	2984	3186	3186	3186	398	2908	3382	3584	3584	3584
	18	2437	2691	2753	2753	2753	344	2781	3035	3097	3097	3097
NOV	19	1493	1493	1493	1493	1493	186	1679	1679	1679	1679	1679
	20	968	968	968	968	968	121	1089	1089	1089	1089	1089
	21	741	741	741	741	741	92	833	833	833	833	833
DEC	22	469	469	469	469	469	58	527	527	527	527	527
	23	357	357	357	357	357	45	402	402	402	402	402
	24	357	357	357	357	357	45	402	402	402	402	402
JAN	25	264	264	264	264	264	33	297	297	297	297	297
	26	237	237	237	237	237	30	267	267	267	267	267
	27	252	252	252	252	252	31	283	283	283	283	283
FEB	28	157	157	157	157	157	20	177	177	177	177	177
	29	135	135	135	135	135	17	152	152	152	152	152
	30	70	70	70	70	70	9	79	79	79	79	79
MAR	31	423	596	596	615	615	77	500	673	673	692	692
	32	134	134	134	134	134	17	151	151	151	151	151
	33	88	88	88	88	88	11	99	99	99	99	99
APR	34	236	236	236	236	236	29	265	265	265	265	265
	35	120	120	120	120	120	15	135	135	135	135	135
	36	62	62	62	62	62	8	70	70	70	70	70
TOTAL		40394	49133	57028	64360	71130	15248	55642	64381	72276	79608	86378

Table A.4.1.2-2 Total Inflow of Guirila Dam (5)

Year : 1971 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
	1	68	68	68	68	68	9	77	77	77	77	77
MAY	2	378	378	378	378	378	47	425	425	425	425	425
	3	392	392	392	392	392	49	441	441	441	441	441
	4	807	807	807	807	807	101	908	908	908	908	908
JUN	5	2097	2335	2412	2412	2412	301	2398	2636	2713	2713	2713
	6	1060	1060	1060	1060	1060	132	1192	1192	1192	1192	1192
	7	499	499	499	499	499	62	561	561	561	561	561
JUL	8	2234	2556	2816	3000	3172	443	2677	2999	3259	3443	3615
	9	2041	2288	2308	2308	2308	288	2329	2576	2596	2596	2596
	10	2530	3221	3912	4560	5158	774	3304	3995	4686	5334	5932
AUG	11	2451	2805	2987	3100	3187	546	2997	3351	3533	3646	3733
	12	2851	3801	4640	5391	6083	2836	5687	6637	7476	8227	8919
	13	2592	3456	4320	5184	6048	1589	4181	5045	5909	6773	7637
SEP	14	2453	2936	3271	3504	3669	477	2930	3413	3748	3981	4146
	15	2535	3283	3939	4474	4906	1149	3684	4432	5088	5623	6055
	16	2592	3456	4320	5184	6048	4048	6640	7504	8368	9232	10096
OCT	17	2592	3456	4320	5184	6048	1554	4146	5010	5874	6738	7602
	18	2852	3566	4021	4378	4645	694	3546	4260	4715	5072	5339
	19	1753	1753	1753	1753	1753	219	1972	1972	1972	1972	1972
NOV	20	1088	1088	1088	1088	1088	136	1224	1224	1224	1224	1224
	21	882	882	882	882	882	110	992	992	992	992	992
	22	600	600	600	600	600	75	675	675	675	675	675
DEC	23	468	468	468	468	468	58	526	526	526	526	526
	24	336	336	336	336	336	42	378	378	378	378	378
	25	243	243	243	243	243	30	273	273	273	273	273
JAN	26	144	144	144	144	144	18	162	162	162	162	162
	27	129	129	129	129	129	16	145	145	145	145	145
	28	100	100	100	100	100	13	113	113	113	113	113
FEB	29	76	76	76	76	76	9	85	85	85	85	85
	30	55	55	55	55	55	7	62	62	62	62	62
	31	52	52	52	52	52	7	59	59	59	59	59
MAR	32	68	68	68	68	68	9	77	77	77	77	77
	33	28	28	28	28	28	3	31	31	31	31	31
	34	27	27	27	27	27	3	30	30	30	30	30
APR	35	28	28	28	28	28	3	31	31	31	31	31
	36	89	89	89	89	89	11	100	100	100	100	100
TOTAL		39190	46529	52636	58049	63054	15868	55058	62397	68504	73917	78922

Table A.4.1.2-2 Total Inflow of Guirila Dam (6)

Year : 1972 [x1000 m3]

Period		Intake Canal Capacity (m3/sec)					Runoff of GUIRILA	Inflow by Canal Capacity				
		3	4	5	6	7		3	4	5	6	7
	1	56	56	56	56	56	7	63	63	63	63	63
MAY	2	488	488	488	488	488	61	549	549	549	549	549
	3	265	265	265	265	265	33	298	298	298	298	298
	4	1763	2041	2301	2560	2819	738	2501	2779	3039	3298	3557
JUN	5	970	970	970	970	970	121	1091	1091	1091	1091	1091
	6	715	715	715	715	715	89	804	804	804	804	804
	7	341	341	341	341	341	43	384	384	384	384	384
JUL	8	317	317	317	317	317	40	357	357	357	357	357
	9	2484	3090	3586	3987	4246	746	3230	3836	4332	4733	4992
	10	1176	1176	1176	1176	1176	147	1323	1323	1323	1323	1323
AUG	11	508	508	508	508	508	63	571	571	571	571	571
	12	1080	1253	1421	1507	1594	201	1281	1454	1622	1708	1795
	13	1252	1252	1252	1252	1252	156	1408	1408	1408	1408	1408
SEP	14	882	882	882	882	882	110	992	992	992	992	992
	15	620	620	620	620	620	77	697	697	697	697	697
	16	508	508	508	508	508	63	571	571	571	571	571
OCT	17	405	405	405	405	405	51	456	456	456	456	456
	18	278	278	278	278	278	35	313	313	313	313	313
	19	164	164	164	164	164	21	185	185	185	185	185
NOV	20	433	433	433	433	433	54	487	487	487	487	487
	21	193	193	193	193	193	24	217	217	217	217	217
	22	152	152	152	152	152	19	171	171	171	171	171
DEC	23	152	152	152	152	152	19	171	171	171	171	171
	24	155	155	155	155	155	19	174	174	174	174	174
	25	128	128	128	128	128	16	144	144	144	144	144
JAN	26	106	107	107	107	107	13	119	120	120	120	120
	27	113	113	113	113	113	14	127	127	127	127	127
	28	113	113	113	113	113	14	127	127	127	127	127
FEB	29	82	82	82	82	82	10	92	92	92	92	92
	30	65	65	65	65	65	8	73	73	73	73	73
	31	68	68	67	67	67	8	76	76	75	75	75
MAR	32	58	58	58	58	58	7	65	65	65	65	65
	33	57	57	57	57	57	7	64	64	64	64	64
	34	68	68	68	68	68	9	77	77	77	77	77
APR	35	83	83	83	83	83	10	93	93	93	93	93
	36	82	82	82	82	82	10	92	92	92	92	92
TOTAL		16380	17438	18361	19107	19712	3063	19443	20501	21424	22170	22775

Table A.4.1.2-2 Total Inflow of Guirila Dam (7)

Year : 1973 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
	1	99	99	99	99	99	12	111	111	111	111	111
MAY	2	116	116	116	116	116	15	131	131	131	131	131
	3	830	830	830	830	830	104	934	934	934	934	934
	4	627	627	627	627	627	78	705	705	705	705	705
JUN	5	2351	3042	3733	4424	5115	866	3217	3908	4599	5290	5981
	6	2592	3456	4320	5131	5743	1170	3762	4626	5490	6301	6913
	7	2519	3167	3632	4021	4243	538	3057	3705	4170	4559	4781
JUL	8	1767	1853	1940	2026	2113	275	2042	2128	2215	2301	2388
	9	2852	3802	4733	5485	6082	865	3717	4667	5598	6350	6947
	10	2592	3456	4320	5012	5498	745	3337	4201	5065	5757	6243
AUG	11	2592	3456	4320	5184	5900	1583	4175	5039	5903	6767	7483
	12	2851	3802	4718	5522	6300	2319	5170	6121	7037	7841	8619
	13	2592	3456	4011	4929	5465	1133	3725	4589	5144	6062	6598
SEP	14	2592	3456	4316	4980	5270	687	3279	4143	5003	5667	5957
	15	2592	3456	4272	5049	5827	1313	3905	4769	5585	6362	7140
	16	2592	3456	4320	5184	6048	1751	4343	5207	6071	6935	7799
OCT	17	2592	3456	4320	5184	6048	2701	5293	6157	7021	7885	8749
	18	2851	3802	4752	5643	6474	1358	4209	5160	6110	7001	7832
	19	2592	3290	3589	3600	3600	450	3042	3740	4039	4050	4050
NOV	20	1469	1469	1469	1469	1469	184	1653	1653	1653	1653	1653
	21	1241	1241	1241	1241	1241	155	1396	1396	1396	1396	1396
	22	700	700	700	700	700	88	788	788	788	788	788
DEC	23	492	492	492	492	492	62	554	554	554	554	554
	24	383	383	383	383	383	48	431	431	431	431	431
	25	348	348	348	348	348	43	391	391	391	391	391
JAN	26	283	283	283	283	283	35	318	318	318	318	318
	27	269	269	269	269	269	34	303	303	303	303	303
	28	168	168	168	168	168	21	189	189	189	189	189
FEB	29	149	149	149	149	149	19	168	168	168	168	168
	30	85	85	85	85	85	11	96	96	96	96	96
	31	258	258	258	258	258	32	290	290	290	290	290
MAR	32	257	257	257	257	257	32	289	289	289	289	289
	33	95	95	95	95	95	12	107	107	107	107	107
	34	52	52	52	52	52	6	58	58	58	58	58
APR	35	58	58	58	58	58	7	65	65	65	65	65
	36	45	45	45	45	45	6	51	51	51	51	51
TOTAL		46543	58430	69320	79398	87750	18758	65301	77188	88078	98156	106508

Table A.4.1.2-2 Total Inflow of Guirila Dam (8)

Year : 1974 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
MAY	1	106	106	106	106	106	13	119	119	119	119	119
	2	293	293	292	292	292	36	329	329	328	328	328
	3	2373	2938	3456	3975	4493	920	3293	3858	4376	4895	5413
JUN	4	2588	3279	3758	4045	4218	576	3164	3855	4334	4621	4794
	5	2592	3438	4216	4994	5771	1434	4026	4872	5650	6428	7205
	6	2592	3456	4320	5184	6048	1581	4173	5037	5901	6765	7629
JUL	7	2592	3452	4190	4736	5192	775	3367	4227	4965	5511	5967
	8	2592	3279	3883	4310	4576	661	3253	3940	4544	4971	5237
	9	2260	2322	2322	2322	2322	290	2550	2612	2612	2612	2612
AUG	10	952	952	952	952	952	119	1071	1071	1071	1071	1071
	11	797	797	797	797	797	99	896	896	896	896	896
	12	1189	1189	1189	1189	1189	149	1338	1338	1338	1338	1338
SEP	13	1500	1759	2018	2208	2294	314	1814	2073	2332	2522	2608
	14	2519	3101	3585	3942	4129	899	3418	4000	4484	4841	5028
	15	2592	3456	4320	5184	6048	1602	4194	5058	5922	6786	7650
OCT	16	2494	3031	3406	3655	3802	486	2980	3517	3892	4141	4288
	17	1477	1477	1477	1477	1477	184	1661	1661	1661	1661	1661
	18	967	967	967	967	967	121	1088	1088	1088	1088	1088
NOV	19	601	601	601	601	601	75	676	676	676	676	676
	20	369	369	369	369	369	46	415	415	415	415	415
	21	300	300	300	300	300	38	338	338	338	338	338
DEC	22	283	283	283	283	283	35	318	318	318	318	318
	23	215	215	215	215	215	27	242	242	242	242	242
	24	197	197	197	197	197	24	221	221	221	221	221
JAN	25	119	119	119	119	119	15	134	134	134	134	134
	26	76	76	76	76	76	10	86	86	86	86	86
	27	59	59	59	59	59	7	66	66	66	66	66
FEB	28	54	54	54	54	54	7	61	61	61	61	61
	29	32	32	32	32	32	4	36	36	36	36	36
	30	27	27	27	27	27	3	30	30	30	30	30
MAR	31	36	36	36	36	36	5	41	41	41	41	41
	32	36	36	36	36	36	4	40	40	40	40	40
	33	31	31	31	31	31	4	35	35	35	35	35
APR	34	28	28	28	28	28	3	31	31	31	31	31
	35	24	24	24	24	24	3	27	27	27	27	27
	36	31	31	31	31	31	4	35	35	35	35	35
TOTAL		34993	41810	47772	52853	57191	10573	45566	52383	58345	63426	67764

Table A.4.1.2-2 Total Inflow of Guirila Dam (9)

Year : 1975 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
	1	54	54	54	54	54	7	61	61	61	61	61
MAY	2	97	97	97	97	97	12	109	109	109	109	109
	3	413	413	413	413	413	52	465	465	465	465	465
	4	278	278	278	278	278	35	313	313	313	313	313
JUN	5	260	260	260	260	260	33	293	293	293	293	293
	6	212	212	212	212	212	26	238	238	238	238	238
	7	45	45	45	45	45	362	407	407	407	407	407
JUL	8	180	180	180	180	180	22	202	202	202	202	202
	9	454	454	454	454	454	57	511	511	511	511	511
	10	628	628	628	628	628	79	707	707	707	707	707
AUG	11	764	764	764	764	764	95	859	859	859	859	859
	12	2085	2276	2405	2491	2577	331	2416	2607	2736	2822	2908
	13	2592	3456	4266	4908	5426	1101	3693	4557	5367	6009	6527
SEP	14	2592	3456	4239	5017	5791	1805	4397	5261	6044	6822	7596
	15	2592	3373	4045	4606	5125	958	3550	4331	5003	5564	6083
	16	2592	3371	4148	4927	5673	1393	3985	4764	5541	6320	7066
OCT	17	2592	3456	4320	5184	6013	1231	3823	4687	5551	6415	7244
	18	2785	3576	4079	4451	4781	878	3663	4454	4957	5329	5659
	19	2593	3404	3932	4332	4634	700	3293	4104	4632	5032	5334
NOV	20	1964	2254	2455	2455	2455	307	2271	2561	2762	2762	2762
	21	796	796	796	796	796	99	895	895	895	895	895
	22	622	629	629	629	629	79	701	708	708	708	708
DEC	23	233	233	233	233	233	29	262	262	262	262	262
	24	269	269	269	269	269	34	303	303	303	303	303
	25	145	145	145	145	145	18	163	163	163	163	163
JAN	26	108	108	108	108	108	13	121	121	121	121	121
	27	68	68	68	68	68	8	76	76	76	76	76
	28	78	78	78	78	78	10	88	88	88	88	88
FEB	29	97	97	97	97	97	12	109	109	109	109	109
	30	89	89	89	89	89	11	100	100	100	100	100
	31	68	68	68	68	68	9	77	77	77	77	77
MAR	32	62	62	62	62	62	8	70	70	70	70	70
	33	54	54	54	54	54	7	61	61	61	61	61
	34	364	424	424	424	424	53	417	477	477	477	477
APR	35	184	184	184	184	184	23	207	207	207	207	207
	36	284	284	284	284	284	35	319	319	319	319	319
TOTAL		29293	35595	40862	45344	49448	9932	39225	45527	50794	55276	59380

Table A.4.1.2-2 Total Inflow of Guirila Dam (10)

Year : 1976 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
MAY	1	312	312	312	312	312	39	351	351	351	351	351
	2	541	541	541	541	541	67	608	608	608	608	608
	3	655	655	655	655	655	82	737	737	737	737	737
JUN	4	1512	1858	2185	2445	2704	562	2074	2420	2747	3007	3266
	5	2592	3456	4221	4908	5443	1116	3708	4572	5337	6024	6559
	6	2592	3456	4320	5184	6048	1772	4364	5228	6092	6956	7820
JUL	7	2592	3456	4320	5184	6048	1679	4271	5135	5999	6863	7727
	8	2413	2850	3091	3210	3296	417	2830	3267	3508	3627	3713
	9	1149	1149	1149	1149	1149	143	1292	1292	1292	1292	1292
AUG	10	542	542	542	542	542	68	610	610	610	610	610
	11	823	823	823	823	823	103	926	926	926	926	926
	12	977	1002	1002	1002	1002	125	1102	1127	1127	1127	1127
SEP	13	1906	2213	2386	2559	2731	386	2292	2599	2772	2945	3117
	14	1252	1252	1252	1252	1252	156	1408	1408	1408	1408	1408
	15	1394	1480	1480	1480	1480	185	1579	1665	1665	1665	1665
OCT	16	2592	3422	4199	4942	5602	996	3588	4418	5195	5938	6598
	17	2144	2403	2579	2676	2721	340	2484	2743	2919	3016	3061
	18	1041	1041	1041	1041	1041	130	1171	1171	1171	1171	1171
NOV	19	593	593	593	593	593	74	667	667	667	667	667
	20	543	543	543	543	543	68	611	611	611	611	611
	21	464	464	464	464	464	58	522	522	522	522	522
DEC	22	334	334	334	334	334	42	376	376	376	376	376
	23	281	281	281	281	281	35	316	316	316	316	316
	24	284	284	284	284	284	35	319	319	319	319	319
JAN	25	190	190	190	190	190	24	214	214	214	214	214
	26	183	183	183	183	183	23	206	206	206	206	206
	27	220	220	220	220	220	27	247	247	247	247	247
FEB	28	179	179	179	179	179	22	201	201	201	201	201
	29	166	166	166	166	166	21	187	187	187	187	187
	30	122	122	122	122	122	15	137	137	137	137	137
MAR	31	150	150	150	150	150	19	169	169	169	169	169
	32	144	144	144	144	144	18	162	162	162	162	162
	33	194	194	194	194	194	24	218	218	218	218	218
APR	34	111	111	111	111	111	14	125	125	125	125	125
	35	455	542	614	614	614	77	532	619	691	691	691
	36	183	183	183	183	183	23	206	206	206	206	206
TOTAL		31825	36794	41053	44860	48345	8985	40810	45779	50038	53845	57330

Table A.4.1.2-2 Total Inflow of Guirila Dam (11)

Year : 1977 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
MAY	1	162	162	162	162	162	20	182	182	182	182	182
	2	133	133	133	133	133	17	150	150	150	150	150
	3	180	180	180	180	180	23	203	203	203	203	203
JUN	4	1145	1172	1172	1172	1172	146	1291	1318	1318	1318	1318
	5	1261	1261	1261	1261	1261	157	1418	1418	1418	1418	1418
	6	1818	2077	2330	2503	2675	437	2255	2514	2767	2940	3112
JUL	7	608	608	608	608	608	76	684	684	684	684	684
	8	462	538	538	538	538	67	529	605	605	605	605
	9	252	252	252	252	252	32	284	284	284	284	284
AUG	10	413	413	413	413	413	52	465	465	465	465	465
	11	284	284	284	284	284	35	319	319	319	319	319
	12	492	492	492	492	492	61	553	553	553	553	553
SEP	13	330	330	330	330	330	41	371	371	371	371	371
	14	1072	1167	1254	1297	1297	162	1234	1329	1416	1459	1459
	15	2425	3105	3704	4196	4628	842	3267	3947	4546	5038	5470
OCT	16	2523	3213	3649	4055	4401	772	3295	3985	4421	4827	5173
	17	927	927	927	927	927	116	1043	1043	1043	1043	1043
	18	469	469	469	469	469	58	527	527	527	527	527
NOV	19	364	364	364	364	364	45	409	409	409	409	409
	20	226	226	226	226	226	28	254	254	254	254	254
	21	237	237	237	237	237	30	267	267	267	267	267
DEC	22	172	172	172	172	172	21	193	193	193	193	193
	23	152	152	152	152	152	19	171	171	171	171	171
	24	158	158	158	158	158	20	178	178	178	178	178
JAN	25	180	180	180	180	180	23	203	203	203	203	203
	26	180	180	180	180	180	23	203	203	203	203	203
	27	187	187	187	187	187	23	210	210	210	210	210
FEB	28	157	157	157	157	157	20	177	177	177	177	177
	29	157	157	157	157	157	20	177	177	177	177	177
	30	125	125	125	125	125	16	141	141	141	141	141
MAR	31	173	173	173	173	173	22	195	195	195	195	195
	32	179	179	179	179	179	22	201	201	201	201	201
	33	199	199	199	199	199	25	224	224	224	224	224
APR	34	147	147	147	147	147	18	165	165	165	165	165
	35	342	342	342	342	342	43	385	385	385	385	385
	36	57	57	57	57	57	7	64	64	64	64	64
TOTAL		18348	20175	21550	22664	23614	3539	21887	23714	25089	26203	27153

Table A.4.1.2-2 Total Inflow of Guirila Dam (12)

Year : 1978 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
MAY	1	38	38	38	38	38	5	43	43	43	43	43
	2	39	39	39	39	39	5	44	44	44	44	44
	3	499	499	499	499	499	62	561	561	561	561	561
JUN	4	570	570	570	570	570	71	641	641	641	641	641
	5	557	557	557	557	557	70	627	627	627	627	627
	6	862	937	937	937	937	117	979	1054	1054	1054	1054
JUL	7	1530	1576	1576	1576	1576	197	1727	1773	1773	1773	1773
	8	2188	2539	2885	3175	3426	544	2732	3083	3429	3719	3970
	9	2648	3064	3336	3509	3653	472	3120	3536	3808	3981	4125
AUG	10	1051	1051	1051	1051	1051	131	1182	1182	1182	1182	1182
	11	843	843	843	843	843	105	948	948	948	948	948
	12	1041	1217	1390	1507	1594	612	1653	1829	2002	2119	2206
SEP	13	2592	3456	4320	5184	5961	1272	3864	4728	5592	6456	7233
	14	2592	3415	4095	4471	4699	688	3280	4103	4783	5159	5387
	15	2592	3456	4320	5038	5680	1360	3952	4816	5680	6398	7040
OCT	16	2592	3456	4320	5073	5756	1135	3727	4591	5455	6208	6891
	17	2592	3456	4320	5110	5791	1048	3640	4504	5368	6158	6839
	18	2669	3007	3162	3175	3175	396	3065	3403	3558	3571	3571
NOV	19	2094	2094	2094	2094	2094	262	2356	2356	2356	2356	2356
	20	1963	1963	1963	1963	1963	245	2208	2208	2208	2208	2208
	21	1718	1718	1718	1718	1718	214	1932	1932	1932	1932	1932
DEC	22	1747	1747	1747	1747	1747	218	1965	1965	1965	1965	1965
	23	1522	1522	1522	1522	1522	190	1712	1712	1712	1712	1712
	24	1298	1298	1298	1298	1298	162	1460	1460	1460	1460	1460
JAN	25	989	989	989	989	989	123	1112	1112	1112	1112	1112
	26	731	731	731	731	731	91	822	822	822	822	822
	27	676	676	676	676	676	85	761	761	761	761	761
FEB	28	557	557	557	557	557	70	627	627	627	627	627
	29	557	557	557	557	557	70	627	627	627	627	627
	30	427	427	427	427	427	53	480	480	480	480	480
MAR	31	509	509	509	509	509	64	573	573	573	573	573
	32	509	509	509	509	509	64	573	573	573	573	573
	33	551	551	551	551	551	69	620	620	620	620	620
APR	34	461	461	461	461	461	58	519	519	519	519	519
	35	461	461	461	461	461	58	519	519	519	519	519
	36	428	428	428	428	428	53	481	481	481	481	481
TOTAL		44693	50374	55456	59550	63043	10439	55132	60813	65895	69989	73482

Table A.4.1.2-2 Total Inflow of Guirila Dam (13)

Year : 1979 [x1000 m3]

Period		Intake Canal Capacity (m3/sec) 3	4	5	6	7	Runoff of GUIRILA	Inflow by Canal Capacity 3	4	5	6	7
	1	530	530	530	530	530	66	596	596	596	596	596
MAY	2	1370	1434	1434	1434	1434	180	1550	1614	1614	1614	1614
	3	421	421	421	421	421	52	473	473	473	473	473
	4	528	528	528	528	528	66	594	594	594	594	594
JUN	5	1519	1634	1634	1634	1634	204	1723	1838	1838	1838	1838
	6	360	360	360	360	360	449	809	809	809	809	809
	7	2592	3456	4320	5184	6048	1209	3801	4665	5529	6393	7257
JUL	8	2483	2884	3106	3279	3423	434	2917	3318	3540	3713	3857
	9	2624	3071	3341	3476	3562	449	3073	3520	3790	3925	4011
	10	1902	2207	2413	2548	2634	394	2296	2601	2807	2942	3028
AUG	11	1098	1271	1443	1616	1789	629	1727	1900	2072	2245	2418
	12	2851	3802	4752	5702	6653	2134	4985	5936	6886	7836	8787
	13	2592	3456	4320	5184	6048	1466	4058	4922	5786	6650	7514
SEP	14	2592	3456	4320	5184	6048	1833	4425	5289	6153	7017	7881
	15	2592	3389	4027	4557	4981	700	3292	4089	4727	5257	5681
	16	2199	2324	2410	2496	2554	319	2518	2643	2729	2815	2873
OCT	17	2592	3375	3962	4461	4893	757	3349	4132	4719	5218	5650
	18	2600	3071	3380	3638	3811	671	3271	3742	4051	4309	4482
	19	1296	1382	1468	1555	1573	196	1492	1578	1664	1751	1769
NOV	20	634	634	634	634	634	79	713	713	713	713	713
	21	473	473	473	473	473	59	532	532	532	532	532
	22	373	373	373	373	373	47	420	420	420	420	420
DEC	23	293	293	293	293	293	36	329	329	329	329	329
	24	245	245	245	245	245	31	276	276	276	276	276
	25	179	179	179	179	179	22	201	201	201	201	201
JAN	26	149	149	149	149	149	19	168	168	168	168	168
	27	154	154	154	154	154	19	173	173	173	173	173
	28	105	105	105	105	105	13	118	118	118	118	118
FEB	29	95	95	95	95	95	12	107	107	107	107	107
	30	66	66	66	66	66	8	74	74	74	74	74
	31	58	58	58	58	58	7	65	65	65	65	65
MAR	32	64	64	64	64	64	8	72	72	72	72	72
	33	83	83	83	83	83	10	93	93	93	93	93
	34	141	141	141	141	141	18	159	159	159	159	159
APR	35	164	164	164	164	164	21	185	185	185	185	185
	36	140	140	140	140	140	18	158	158	158	158	158
TOTAL		38157	45467	51585	57203	62340	12635	50792	58102	64220	69838	74975

Table A.4.1.2-2 Total Inflow of Guirila Dam (14)

Year : 1980 [x1000 m3]

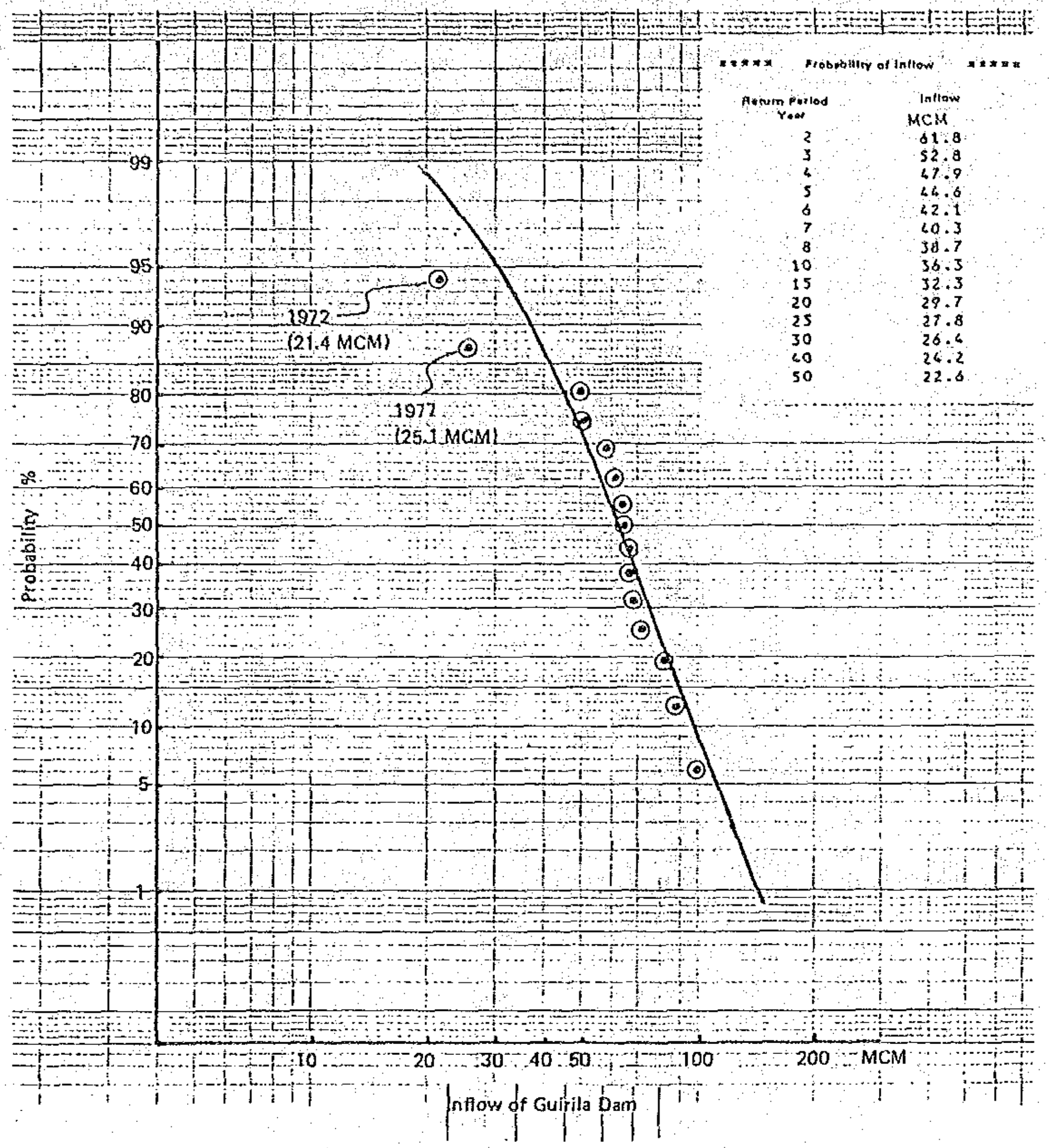
Period		Intake Canal Capacity (m3/sec)					Runoff of GUIRILA	Inflow by Canal Capacity				
		3	4	5	6	7		3	4	5	6	7
MAY	1	115	115	115	115	115	14	129	129	129	129	129
	2	130	130	130	130	130	16	146	146	146	146	146
	3	690	690	690	690	690	86	776	776	776	776	776
JUN	4	578	578	578	578	578	72	650	650	650	650	650
	5	3539	4316	5094	5872	6620	114	3653	4430	5208	5986	6734
	6	2585	3337	4007	4611	5188	1223	3808	4560	5230	5834	6411
JUL	7	1287	1287	1287	1287	1287	161	1448	1448	1448	1448	1448
	8	1117	1117	1117	1117	1117	139	1256	1256	1256	1256	1256
	9	2790	3568	4345	5122	5813	1356	4146	4924	5701	6478	7169
AUG	10	2592	3456	4320	5128	5906	1299	3891	4755	5619	6427	7205
	11	2592	3092	3332	3466	3466	433	3025	3525	3765	3899	3899
	12	2803	3447	3878	4186	4376	598	3401	4045	4476	4784	4974
SEP	13	2592	3429	4085	4634	5104	841	3433	4270	4926	5475	5945
	14	2592	3456	4283	5061	5839	1378	3970	4834	5661	6439	7217
	15	2592	3456	4320	5184	5951	885	3477	4341	5205	6069	6836
OCT	16	2592	3295	3810	4186	4328	547	3139	3842	4357	4733	4875
	17	2002	2002	2002	2002	2002	250	2252	2252	2252	2252	2252
	18	1492	1492	1492	1492	1492	186	1678	1678	1678	1678	1678
NOV	19	1032	1032	1032	1032	1032	129	1161	1161	1161	1161	1161
	20	992	992	992	992	992	124	1116	1116	1116	1116	1116
	21	1004	1004	1004	1004	1004	125	1129	1129	1129	1129	1129
DEC	22	713	713	713	713	713	89	802	802	802	802	802
	23	615	615	615	615	615	77	692	692	692	692	692
	24	660	660	660	660	660	82	742	742	742	742	742
JAN	25	500	500	500	500	500	62	562	562	562	562	562
	26	423	423	423	423	423	53	476	476	476	476	476
	27	404	404	404	404	404	50	454	454	454	454	454
FEB	28	357	357	357	357	357	45	402	402	402	402	402
	29	331	331	331	331	331	41	372	372	372	372	372
	30	246	246	246	246	246	31	277	277	277	277	277
MAR	31	292	292	292	292	292	36	328	328	328	328	328
	32	371	371	371	371	371	46	417	417	417	417	417
	33	321	321	321	321	321	40	361	361	361	361	361
APR	34	236	236	236	236	236	30	266	266	266	266	266
	35	264	264	264	264	264	33	297	297	297	297	297
	36	339	338	339	339	339	42	381	380	381	381	381
TOTAL		43780	51362	57985	63961	69102	10733	54513	62095	68718	74694	79835

Table A.4.1.2-2 Total Inflow of Guirila Dam (15)

Year : 1981 [x1000 m3]

Period		Intake Canal Capacity (m3/sec)					Runoff of GUIRILA	Inflow by Canal Capacity				
		3	4	5	6	7		3	4	5	6	7
MAY	1	311	311	311	311	311	39	350	350	350	350	350
	2	275	275	275	275	275	34	309	309	309	309	309
	3	537	537	537	537	537	67	604	604	604	604	604
JUN	4	444	444	444	444	444	56	500	500	500	500	500
	5	865	865	865	865	865	108	973	973	973	973	973
	6	2503	2727	2855	2895	2895	361	2864	3088	3216	3256	3256
JUL	7	2378	2995	3540	3994	4367	700	3078	3695	4240	4694	5067
	8	2592	3659	4052	4589	4897	756	3348	4415	4808	5345	5653
	9	2852	3755	4383	4672	4768	600	3452	4355	4983	5272	5368
AUG	10	2151	2454	2492	2492	2492	311	2462	2765	2803	2803	2803
	11	2486	3154	3752	4270	4681	689	3175	3843	4441	4959	5370
	12	2593	3038	3288	3399	3455	431	3024	3469	3719	3830	3886
SEP	13	2515	3000	3228	3401	3563	488	3003	3488	3716	3889	4051
	14	2586	3258	3769	4072	4331	713	3299	3971	4482	4785	5044
	15	2592	3456	4118	4636	5154	1256	3848	4712	5374	5892	6410
OCT	16	1263	1263	1263	1263	1263	158	1421	1421	1421	1421	1421
	17	711	711	711	711	711	89	800	800	800	800	800
	18	1534	1653	1653	1653	1653	206	1740	1859	1859	1859	1859
NOV	19	2430	2531	2531	2531	2531	316	2746	2847	2847	2847	2847
	20	1920	1920	1920	1920	1920	240	2160	2160	2160	2160	2160
	21	1525	1525	1525	1525	1525	191	1716	1716	1716	1716	1716
DEC	22	1316	1316	1316	1316	1316	164	1480	1480	1480	1480	1480
	23	1123	1123	1123	1123	1123	140	1263	1263	1263	1263	1263
	24	1335	1335	1335	1335	1335	167	1502	1502	1502	1502	1502
JAN	25	1033	1033	1033	1033	1033	129	1162	1162	1162	1162	1162
	26	809	809	809	809	809	101	910	910	910	910	910
	27	790	790	790	790	790	99	889	889	889	889	889
FEB	28	641	641	641	641	641	80	721	721	721	721	721
	29	629	629	629	629	629	78	707	707	707	707	707
	30	503	503	503	503	503	63	566	566	566	566	566
MAR	31	629	629	629	629	629	78	707	707	707	707	707
	32	560	560	560	560	560	70	630	630	630	630	630
	33	565	565	565	565	565	71	636	636	636	636	636
APR	34	493	493	493	493	493	62	555	555	555	555	555
	35	514	514	514	514	514	64	578	578	578	578	578
	36	514	514	514	514	514	64	578	578	578	578	578
TOTAL		48517	54985	58966	61909	64092	9239	57756	64224	68205	71148	73331

(2) Probability of Guirila Dam Inflow



***** Probability of Inflow *****

Return Period Year	Inflow MCM
2	61.8
3	52.8
4	47.9
5	44.6
6	42.1
7	40.3
8	38.7
10	36.3
15	32.3
20	29.7
25	27.8
30	26.4
40	24.2
50	22.6

Fig. A.4.1.2-1 Probability of Inflow

Table A.4.1.2-3 Probability of Guirila Dam Inflow by Iwai's Method

Order	Year	X	LOG-X	X+B	LOG-(X+B)	(LOG-(X+B))**2	Thomas Plot (%)	Hazen Plot (%)	X**2	Return Period
1	1972	21.4	1.33041	144.0	2.15835	4.65846	93.75	96.67	457.96	59.9
2	1977	25.1	1.39967	147.7	2.16937	4.70615	87.50	90.00	630.01	35.6
3	1976	50.0	1.69897	172.6	2.23703	5.00430	81.25	83.33	2500.00	3.5
4	1975	50.8	1.70586	173.4	2.23904	4.01329	75.00	76.67	2580.64	3.4
5	1974	58.3	1.76567	180.9	2.25743	5.09598	68.75	70.00	3398.89	2.3
6	1967	61.2	1.78675	183.8	2.26433	5.12721	62.50	63.33	3745.44	2.0
7	1979	63.8	1.80482	186.4	2.27043	5.15487	56.25	56.67	4070.44	1.9
8	1978	65.9	1.81889	188.5	2.27530	5.17699	50.00	50.00	4342.81	1.7
9	1981	68.2	1.83378	190.8	2.28057	5.20099	43.75	43.33	4651.24	1.6
10	1971	68.5	1.83569	191.1	2.28125	5.20410	37.50	36.67	4692.25	1.6
11	1980	68.7	1.83696	191.3	2.28170	5.20617	31.25	30.00	4719.69	1.6
12	1970	72.3	1.85914	194.9	2.28980	5.24319	25.00	23.33	5227.29	1.5
13	1968	83.0	1.91908	205.6	2.31301	5.35003	18.75	16.67	6889.00	1.2
14	1973	88.1	1.94498	210.7	2.32365	5.39937	12.50	10.00	7761.61	1.1
15	1969	98.6	1.99388	221.2	2.34478	5.49797	6.25	3.33	9721.96	1.1
Total		943.9	26.53455		33.98604	77.03905			65389.23	
1/N		62.9	1.76897		2.26574	5.13594			4359.28	

(3) Water Balance Calculation

Table A.4.1.2-4 Summary Water Balance Calculation by Developed Area

[x1000 m3]

	Driving Canal Capacity					
	Year	3 m3/sec	4 m3/sec	5 m3/sec	6 m3/sec	7 m3/sec
IRRIGATION AREA: 4800 (ha)	1967	31468	31468	31468	31468	31468
	1968	30623	30623	30623	30623	30623
	1969	30995	30995	30995	31004	30995
	1970	32865	32692	32692	32673	32673
	1971	33551	33551	33551	33551	33551
	1972	39836	39835	39836	39836	39836
	1973	31255	31255	31255	31255	31255
	1974	37690	37690	37691	37691	37691
	1975	32515	32448	32448	32448	32448
	1976	34636	34549	34477	34477	34477
	1977	38478	38478	38478	38478	38478
	1978	21754	21754	21754	21754	21754
	1979	34486	34400	34314	34227	34209
	1980	30431	30432	30431	30431	30431
	1981	21479	21479	21479	21479	21479
	Year	3 m3/sec	4 m3/sec	5 m3/sec	6 m3/sec	7 m3/sec
IRRIGATION AREA: 4350 (ha)	1967	27963	27963	27963	27963	27963
	1968	27240	27240	27240	27240	27240
	1969	27157	27157	27157	27166	27157
	1970	29077	28904	28904	28885	28885
	1971	23667	29667	29667	29667	29667
	1972	35649	35648	35649	35649	35649
	1973	27632	27632	27632	27632	27632
	1974	33823	33823	33824	33824	33824
	1975	23052	28985	28985	28985	28985
	1976	30848	30761	30689	30689	30689
	1977	34295	34295	34295	34295	34295
	1978	18606	18606	18606	18606	18606
	1979	30683	30597	30511	30424	30406
	1980	26593	26594	26593	26593	26593
	1981	17960	17960	17960	17960	17960
	Year	3 m3/sec	4 m3/sec	5 m3/sec	6 m3/sec	7 m3/sec
IRRIGATION AREA: 4000 (ha)	1967	25237	25237	25237	25237	25237
	1968	24609	24609	24609	24609	24609
	1969	24172	24172	24172	24181	24172
	1970	26131	25958	25958	25939	25939
	1971	26738	26738	26738	26738	26738
	1972	32396	32395	32396	32396	32396
	1973	24814	24814	24814	24814	24814
	1974	30838	30838	30839	30839	30839
	1975	26381	26314	26314	26314	26314
	1976	27902	27815	27743	27743	27743
	1977	31077	31077	31077	31077	31077
	1978	16226	16226	16226	16226	16226
	1979	27737	27651	27565	27478	27460
	1980	23608	23609	23608	23608	23608
	1981	15325	15325	15325	15325	15325

Note:

$$V = \sum_{i=1}^{n} (Qin - Qout)$$

where; V; Reservoir Storage

Qin; Inflow of Dam

Qout; Release from Dam and Loss.