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NOMENCLATURA (SUBESTACIONES)

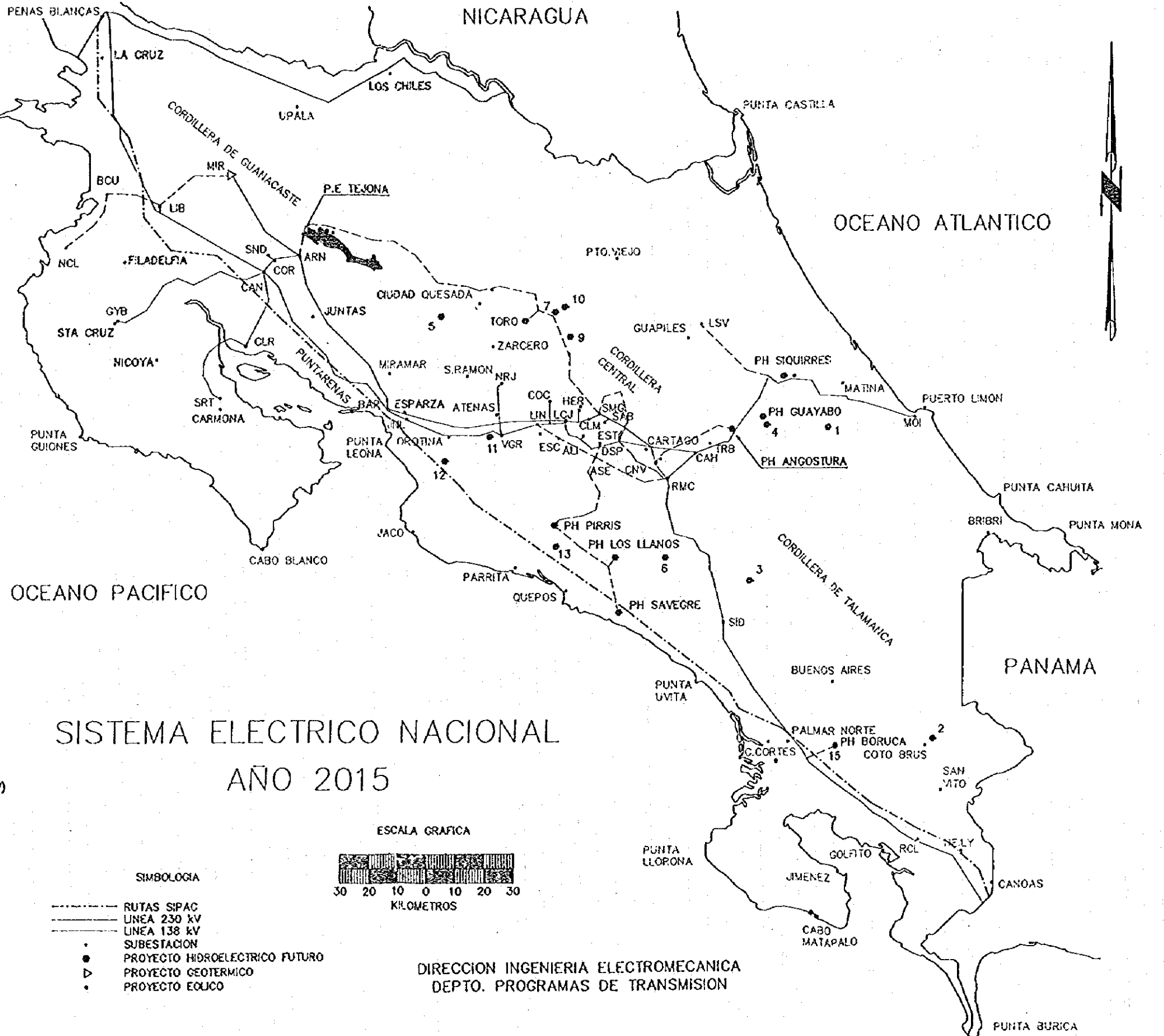
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ARN	ARENAL
BAR	BARRANCA
CAH	CACHI
CAN	CANAS
CLM	COLIMA
CQS	CIUDAD QUESADA
CLR	COLORADO
CNV	CONCAVAS
COR	COROBICI
DSP	DESAMPARADOS
COC	EL COCO
ESC	ESCAZU
EST	EL ESTE
GYB	GUAYABAL
HER	HEREDIA
JNL	JUANILAMA
LCJ	LA CAJA
LIB	LIBERIA
LSV	LEESVILLE
MIR	MIRAVALLS
MOI	MOIN
NRJ	NARANJO
RCL	RIO CLARO
RMC	RIO MACHO
SAB	SABANILLA
SIO	SAN ISIDRO
SMG	SAN MIGUEL
SND	SANDILLAL
SRT	SANTA RITA
SQR	SQUIRRES
TOR	TORO
TRB	TURRIALBA
VGR	VENTANAS GARITA

PROYECTOS FUTUROS

	CAPACIDAD (MW)
1	AYL 195
2	CEIBO 98
3	CHIMIROL 58
4	PACUARE 225
5	SAN LORENZO 57
6	BRUJO 1 100
7	LAGUNA HULE 90
8	LOS LLANOS 98
9	SAN FERNANDO 66
10	VOLCAN 44
11	PURIRES 165
12	TURRUBARES 100
13	PARRITA 80
14	SAVEGRE 57
15	BORUCA 1520

PROYECTOS AL AÑO 2010

	CAPACIDAD (MW) 1992	CAPACIDAD (MW) 2010
ARENAL	157	157
COROBICI	174	174
BARRANCA	42	42
VENTANAS-GARITA	120	120
COLIMA	20	20
RIO MACHO	120	120
CACHI	100	100
MOIN	32	108
MIRAVALLS	165	165
SANDILLAL	32	32
TORO		90
GUAYABO		245
SQUIRRES		412
ANGOSTURA		177
PIRRIS		120
TEJONA		20



SISTEMA ELECTRICO NACIONAL  
AÑO 2015

ESCALA GRAFICA



SIMBOLOGIA

- RUTAS SIPAC
- ==== LINEA 230 kV
- ==== LINEA 138 kV
- SUBESTACION
- PROYECTO HIDROELECTRICO FUTURO
- ▷ PROYECTO GEOTERMICO
- PROYECTO EOLICO

DIRECCION INGENIERIA ELECTROMECHANICA  
DEPTO. PROGRAMAS DE TRANSMISION

Fig. 4-2 Electric Power System in Costa Rica (2005)

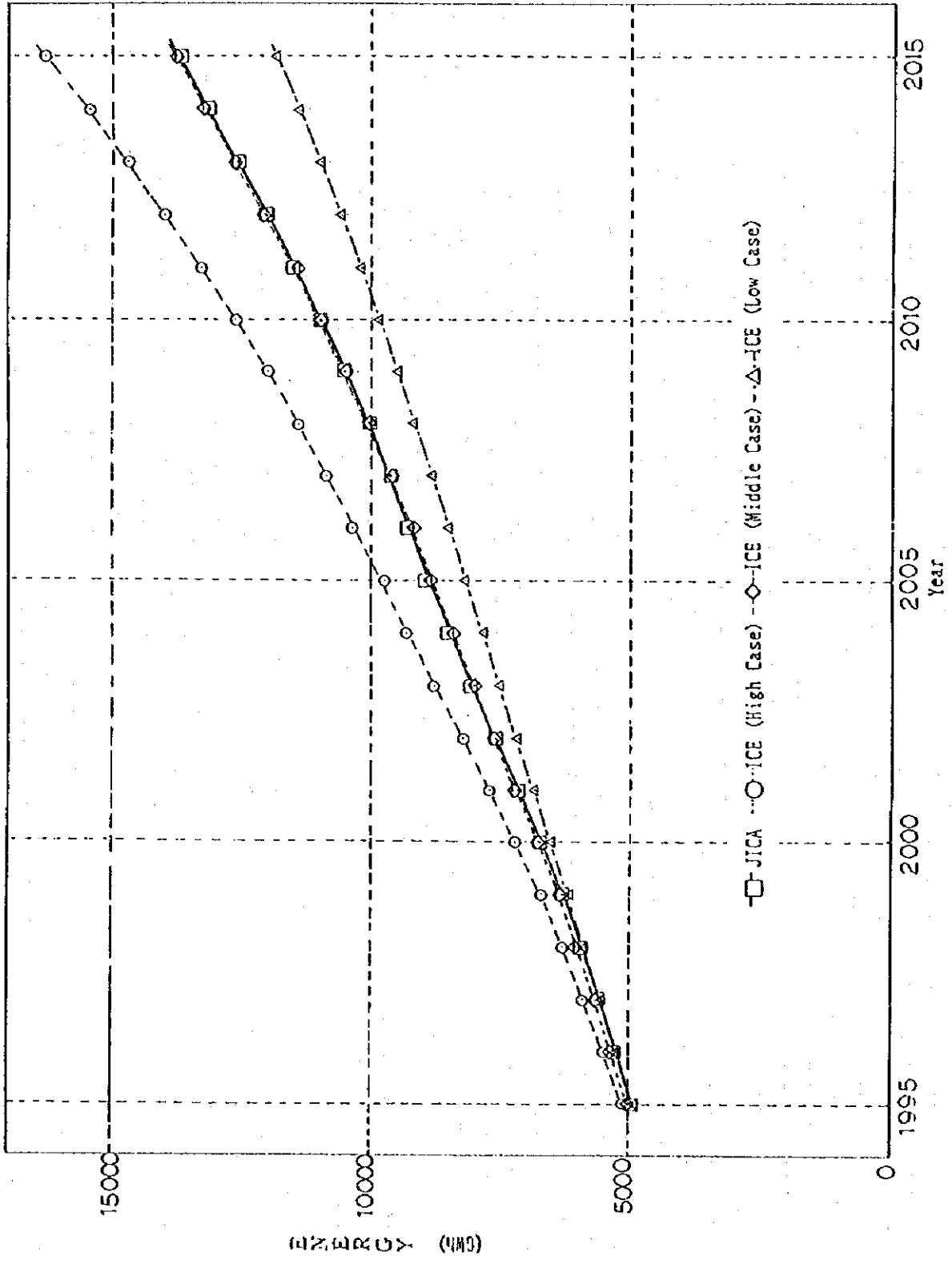
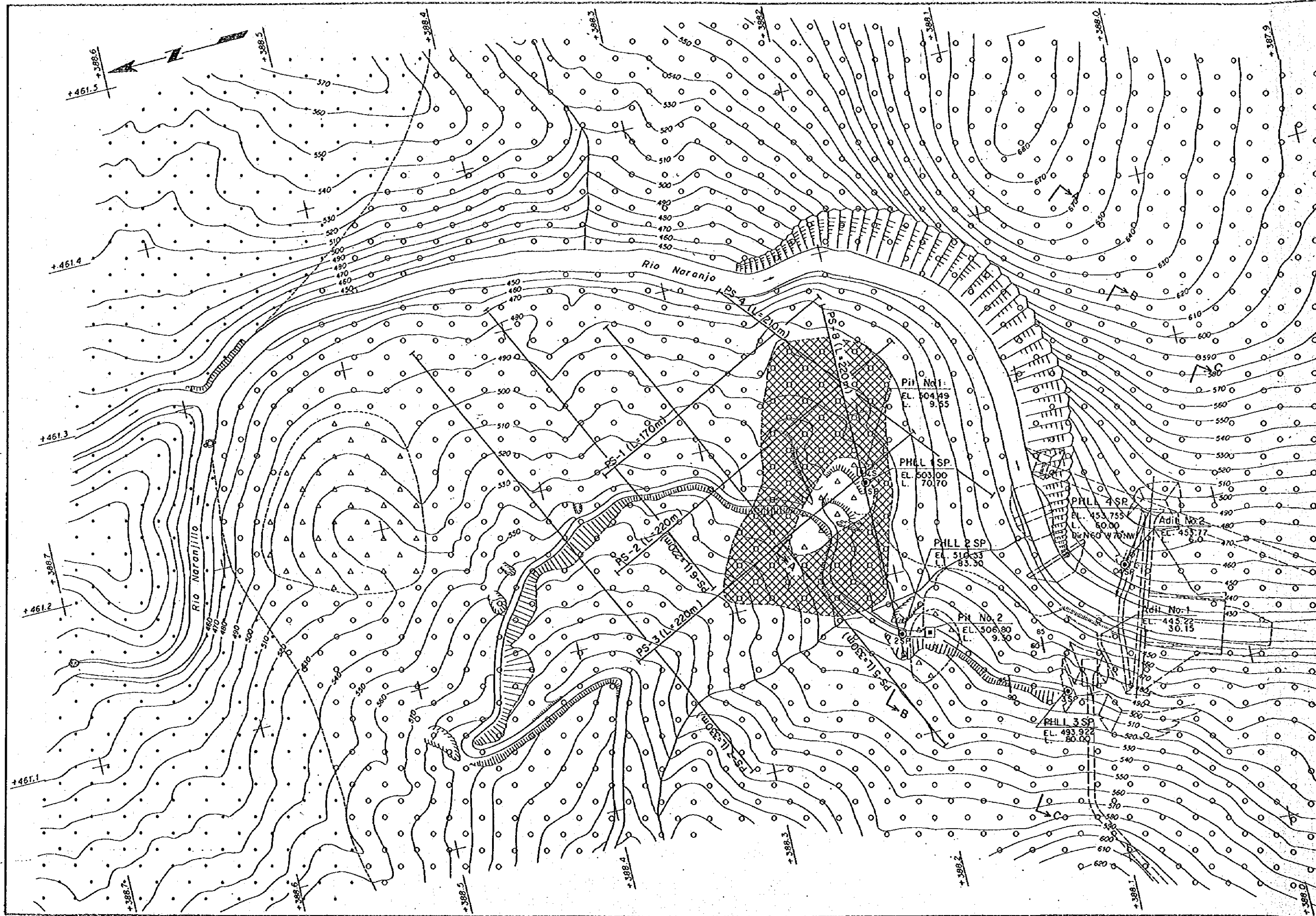
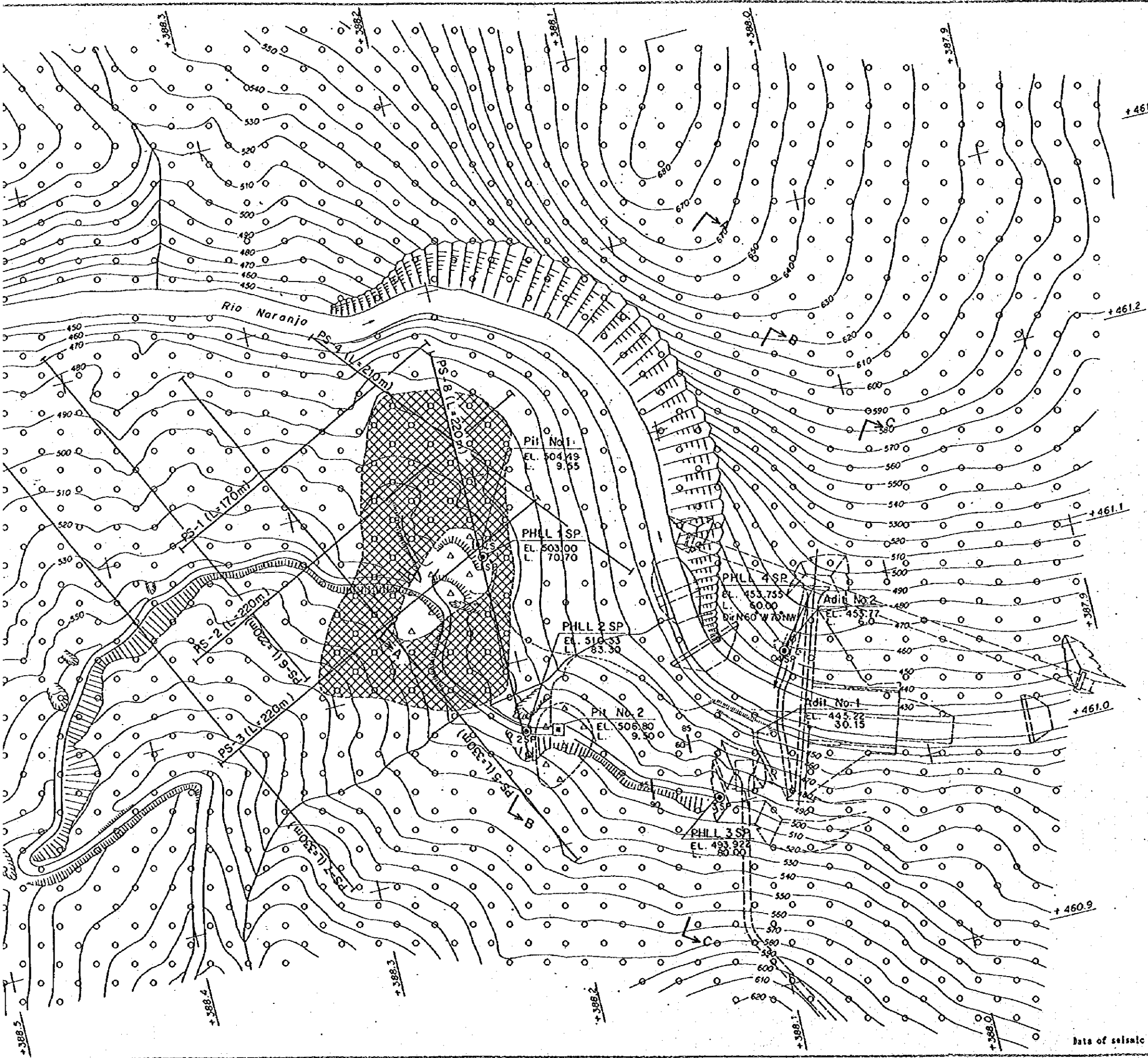













Fig. 5-4 Demand Forecast of Costa Rica 1995-2015





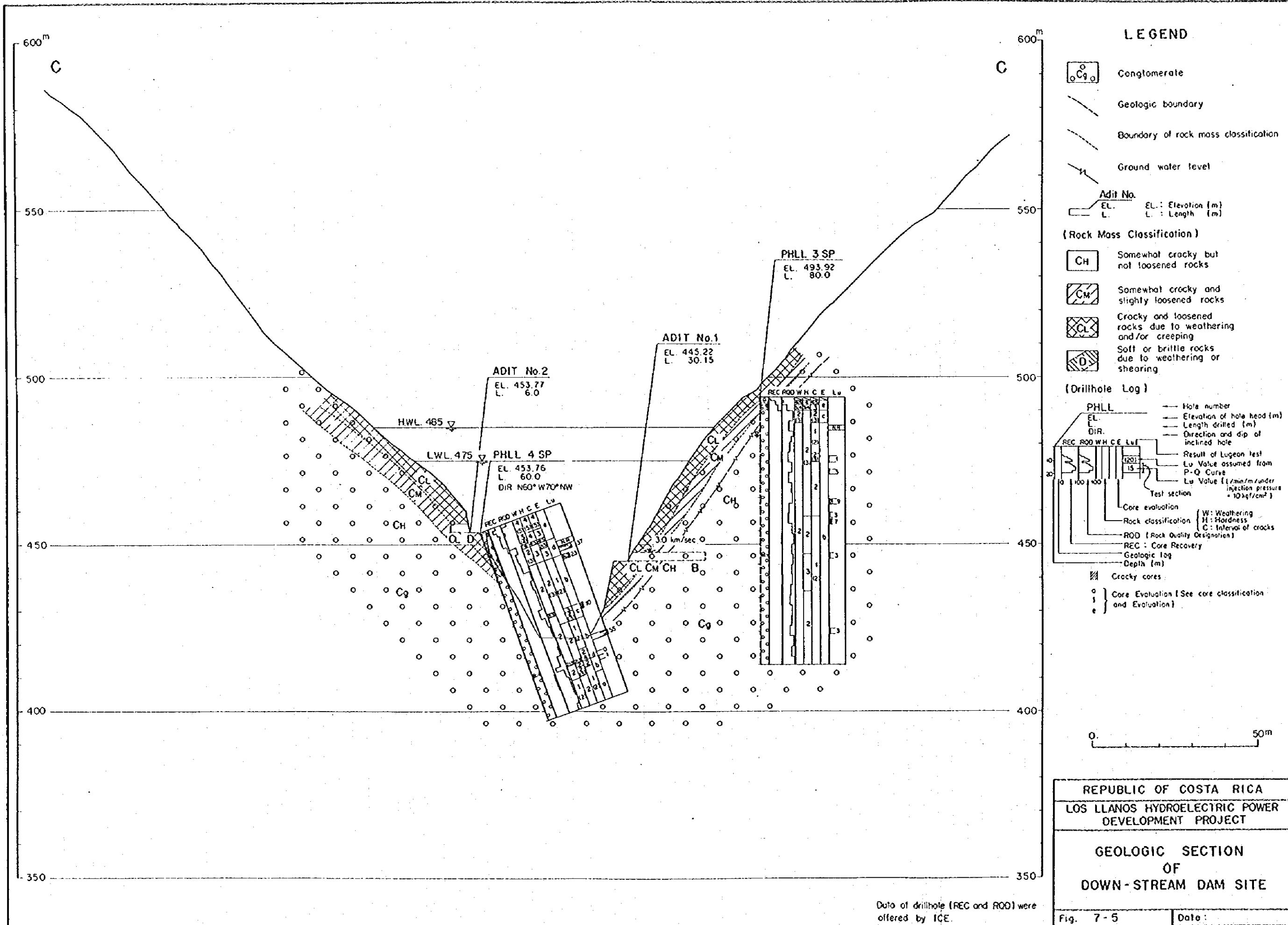


LEGEND

-  Talus Deposits
-  Conglomerate (Strongly Weathered)
-  Conglomerate
-  Sandstone
-  Geologic Boundary
-  Strike and dip of Bedding
-  Adit
-  Test Pit
-  Drillhole
-  Seismic Prospecting Traverse
-  Geologic Section

REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
GEOLOGIC PLAN OF DAMSITE	
Fig. 7-2	Date:

Data of seismic prospecting were offered by ICE.



**LEGEND**

- Conglomerate
- Geologic boundary
- Boundary of rock mass classification
- Ground water level
- Adit No.**  
 EL. : Elevation (m)  
 L. : Length (m)
- (Rock Mass Classification)**
- Somewhat cracky but not loosened rocks
- Somewhat cracky and slightly loosened rocks
- Cracky and loosened rocks due to weathering and/or creeping
- Soft or brittle rocks due to weathering or shearing
- (Drillhole Log)**
- PHLL**  
 EL. : Hole number  
 L. : Elevation of hole head (m)  
 DIR. : Length drilled (m)  
 DIR. : Direction and dip of inclined hole
- Result of Lugeon test  
 Lu Value assumed from P-Q Curve  
 Lu Value (l/min/m under injection pressure = 10kg/cm<sup>2</sup>)
- Test section
- Core evaluation
- Rock classification (W: Weathering, H: Hardness, C: Interval of cracks)
- ROD (Rock Quality Designation)
- REC: Core Recovery
- Geologic log
- Depth (m)
- Cracky cores
- Core Evaluation (See core classification and Evaluation)

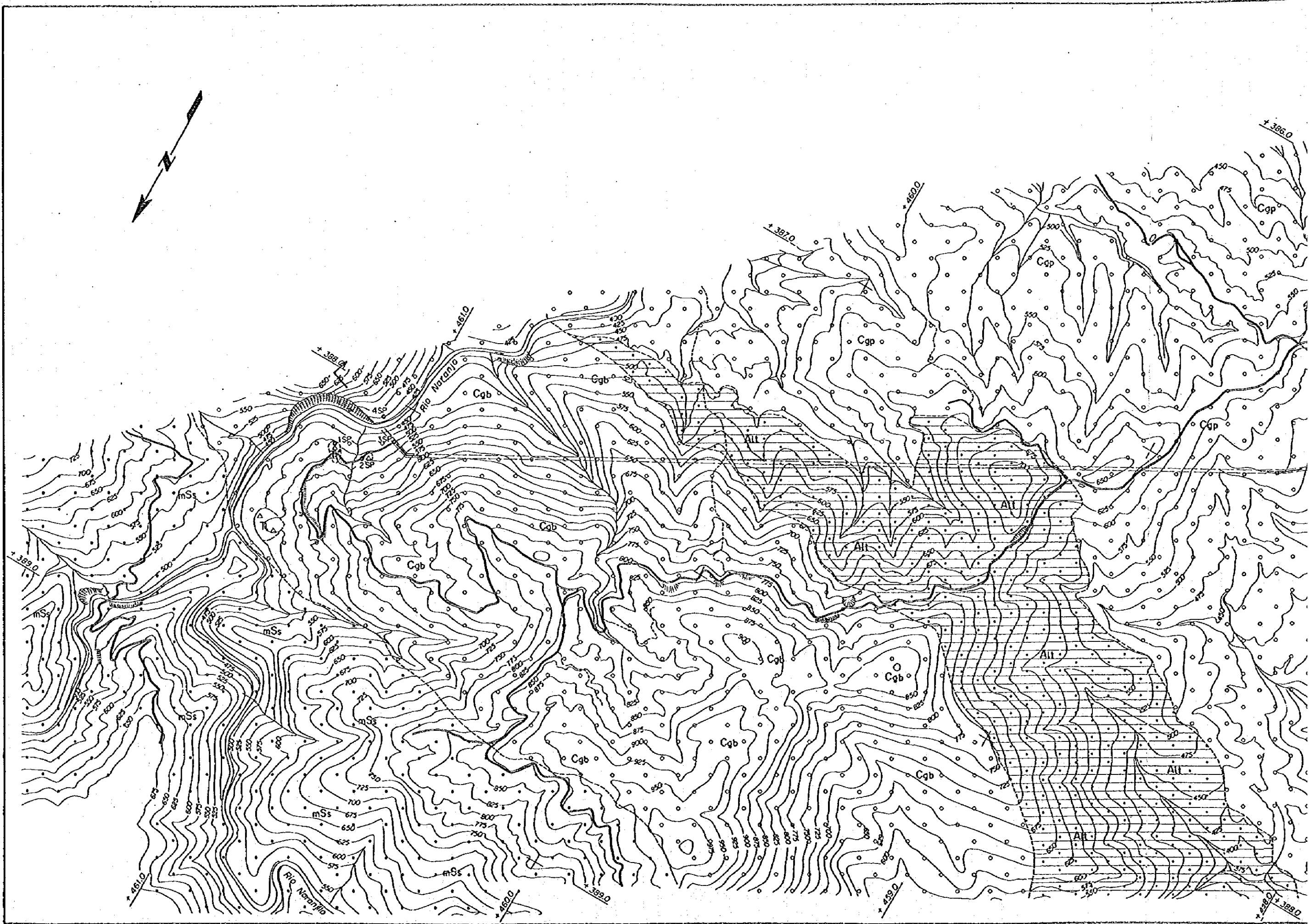


REPUBLIC OF COSTA RICA  
 LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT

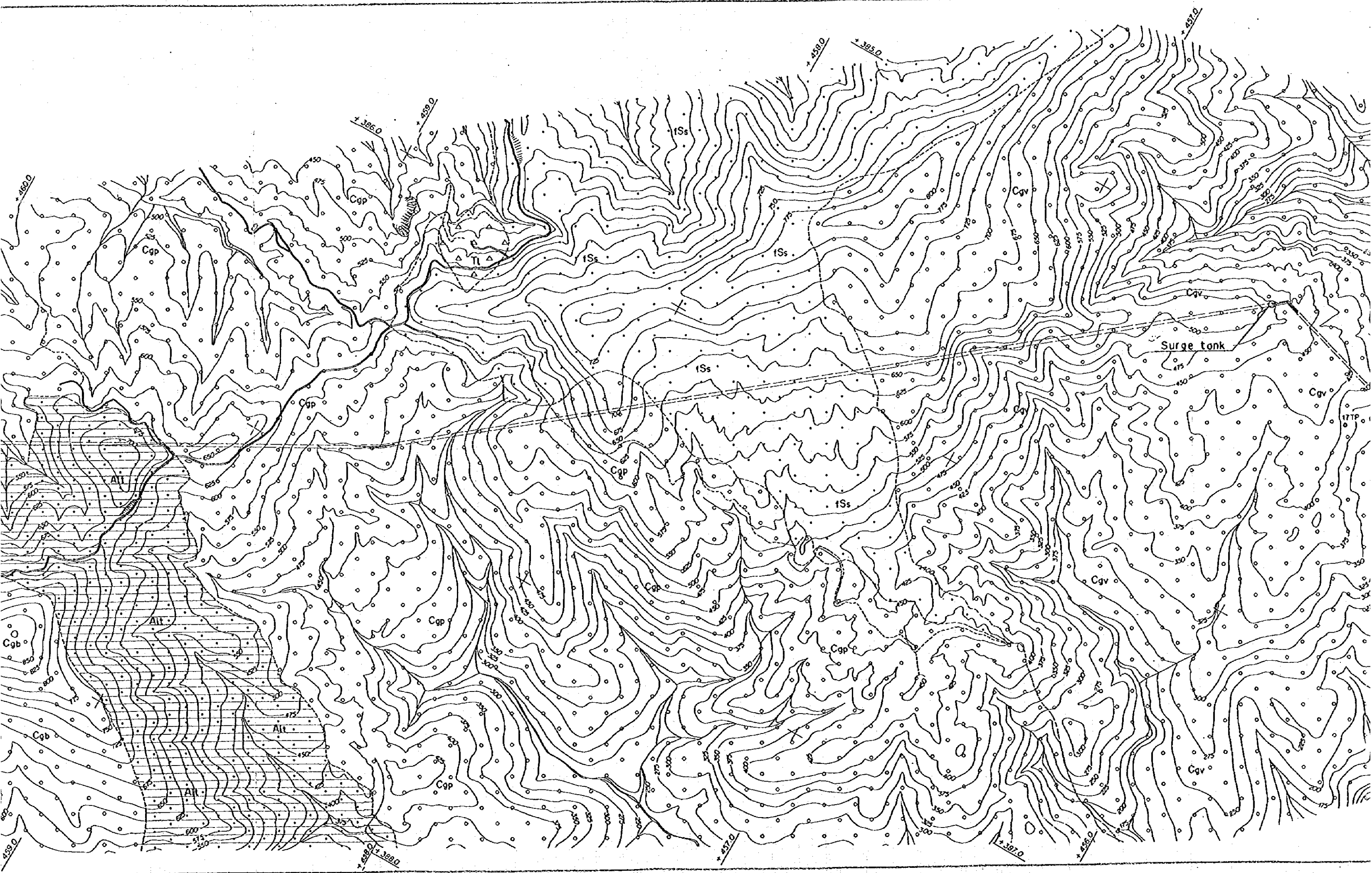
**GEOLOGIC SECTION OF DOWN-STREAM DAM SITE**

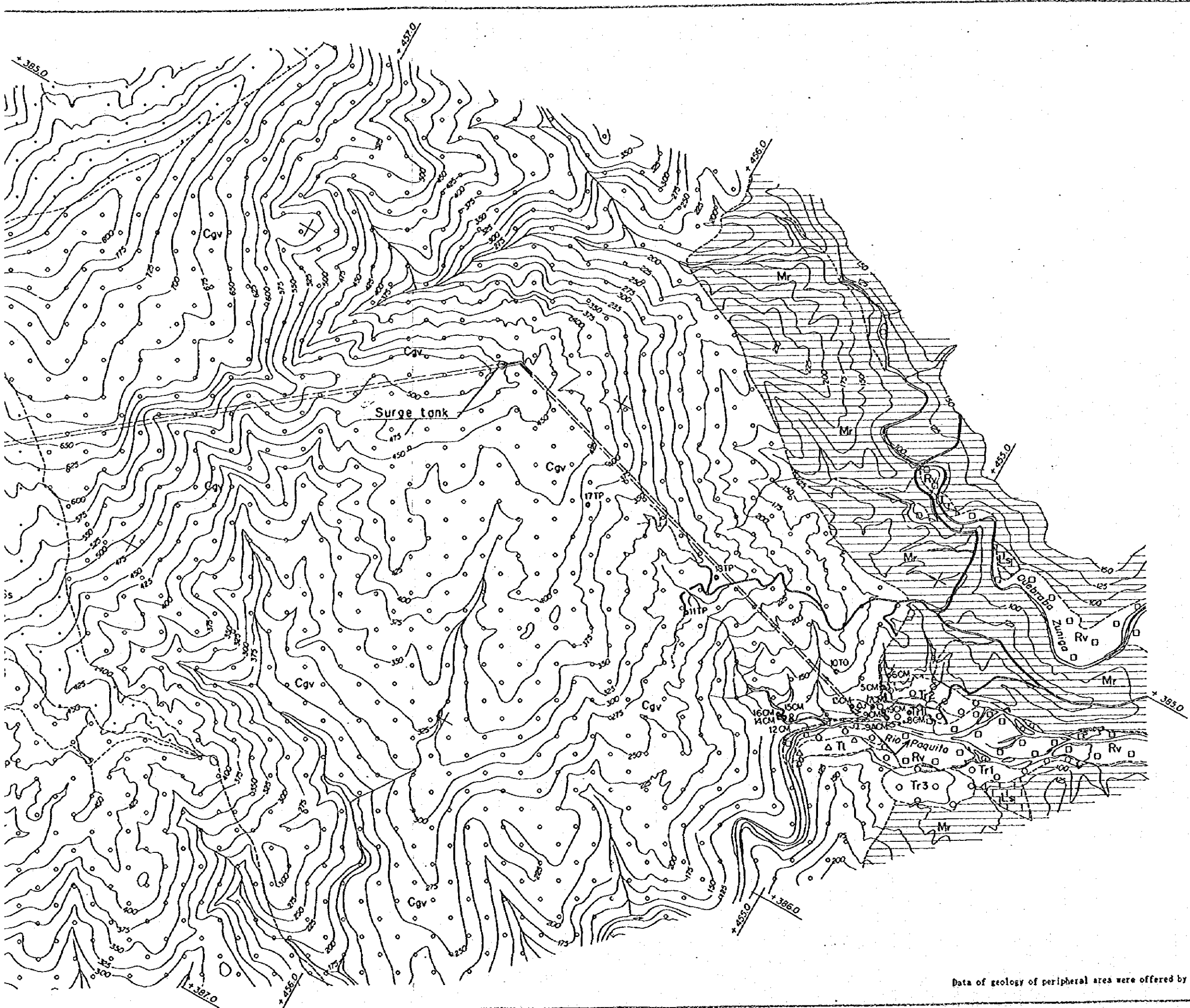
Date of drillhole (REC and ROD) were offered by ICE.

Fig. 7-5 Date:



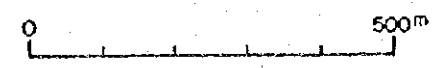






**LEGEND**

- Rv Riverbed Deposits
- △  
Tl Talus Deposits
- Tr1 Terrace Deposits (Lower)
- Tr2 Terrace Deposits (Middle)
- Tr3 Terrace Deposits (Upper)
- mSs Sandstone (Medium)
- Cgb Conglomerate (Boulder)
- Alt- Alternation of Sandstone and Siltstone
- Cgp Conglomerate (Pebble)
- fSs Sandstone (Fine)
- Cgv Conglomerate (Volcanic)
- Mr Mudstone (Marl)
- Ls Limestone
- Geologic boundary
- Strike and dip of bedding
- Fault
- Geologic Section



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LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
GEOLOGIC PLAN OF WATERWAY ALIGNMENT ROUTE	
Fig. 7-8	Date:

Data of geology of peripheral area were offered by ICE.

800m  
500  
0

Rio Naranjo

Quebrada Jiguero

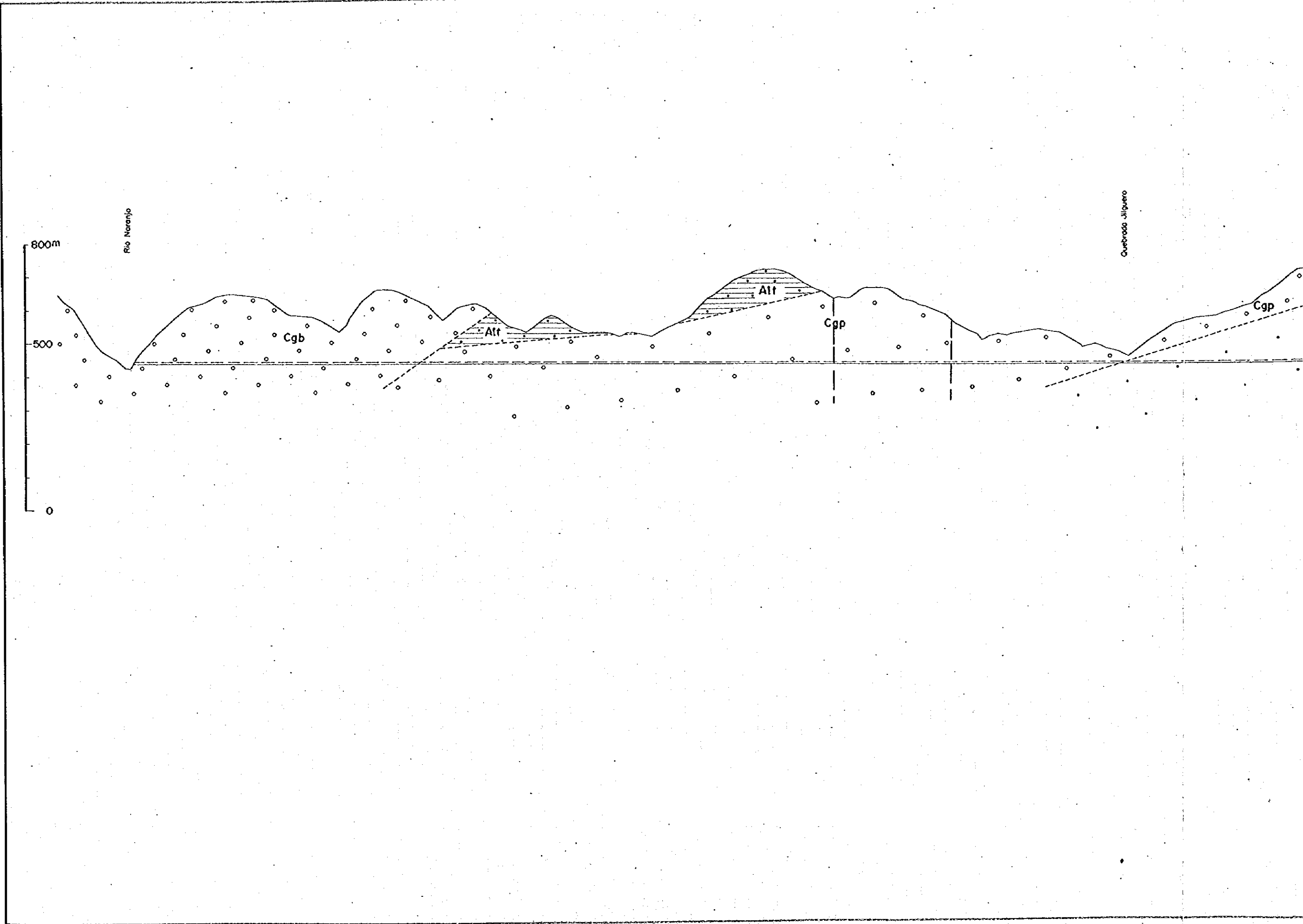
Cgb

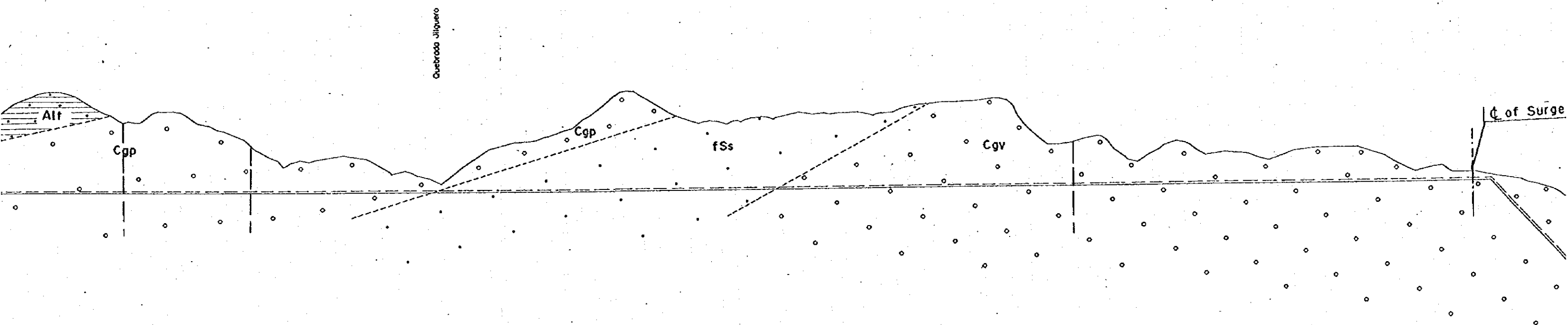
Alt

Alt

Cgp

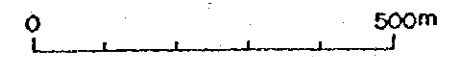
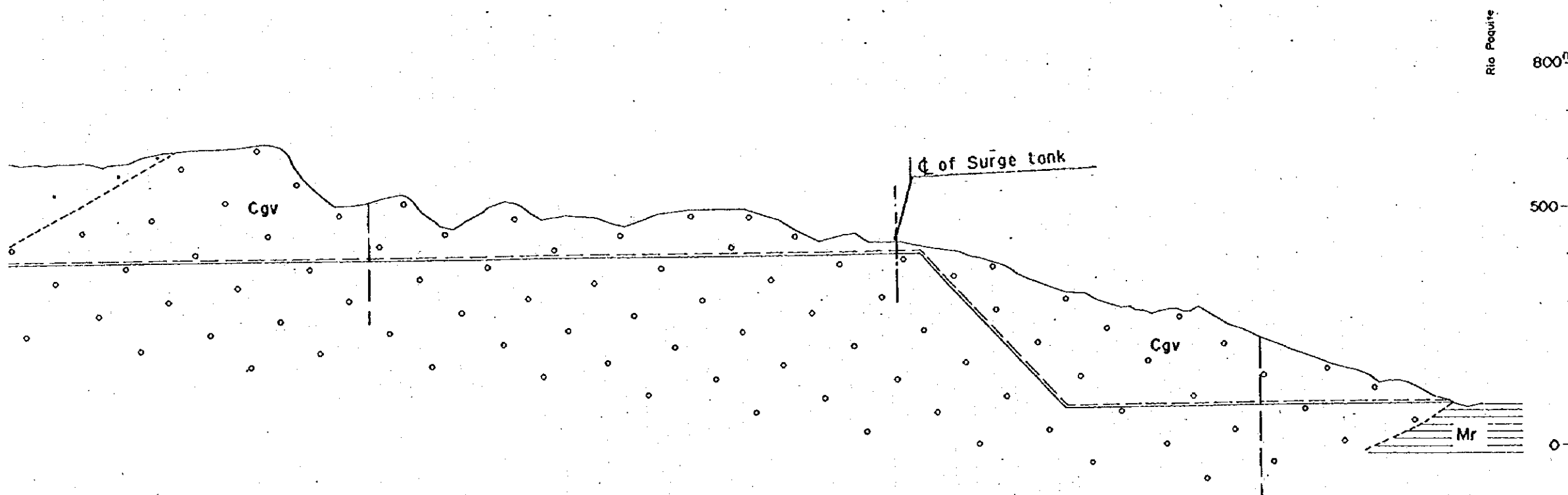
Cgp



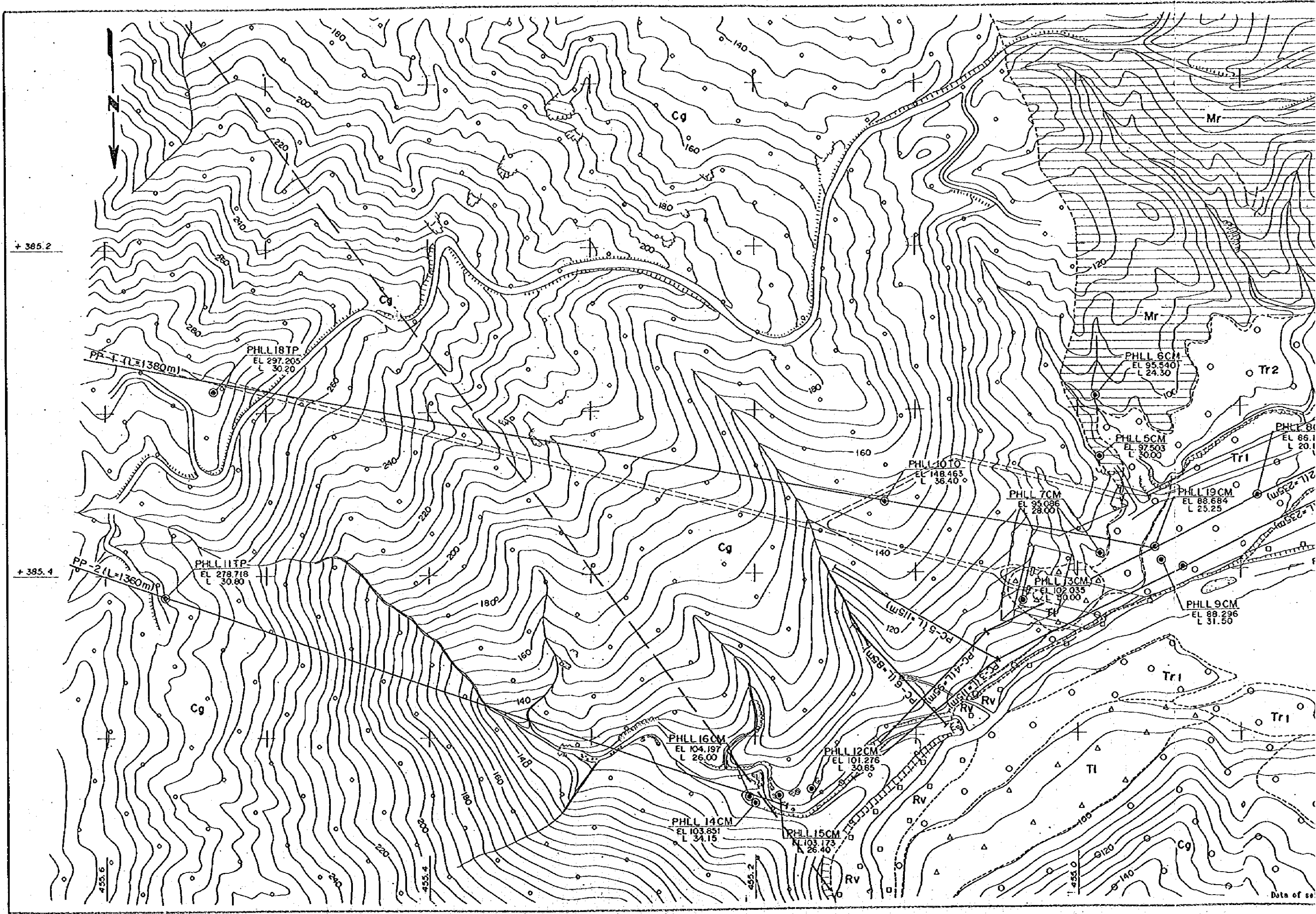


LEGEND

- Rv □ Riverbed Deposits
- △ Tl △ Talus Deposits
- Tri ○ Terrace Deposits (Lower)
- Cgb ○ Conglomerate (Boulder)
- - - All - - - Alternation of Sandstone and Siltstone
- Cgp ○ Conglomerate (Pebble)
- - - Ss - - - Sandstone (Fine)
- Cgv ○ Conglomerate (Volcanic)
- - - Mr - - - Mudstone (Mori)
- - - Geologic boundary
- | Lineament by aero-photo interpretation



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LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
GEOLOGIC SECTION ALONG HEADRACE TUNNEL ROUTE	
Fig. 7-9	Date:

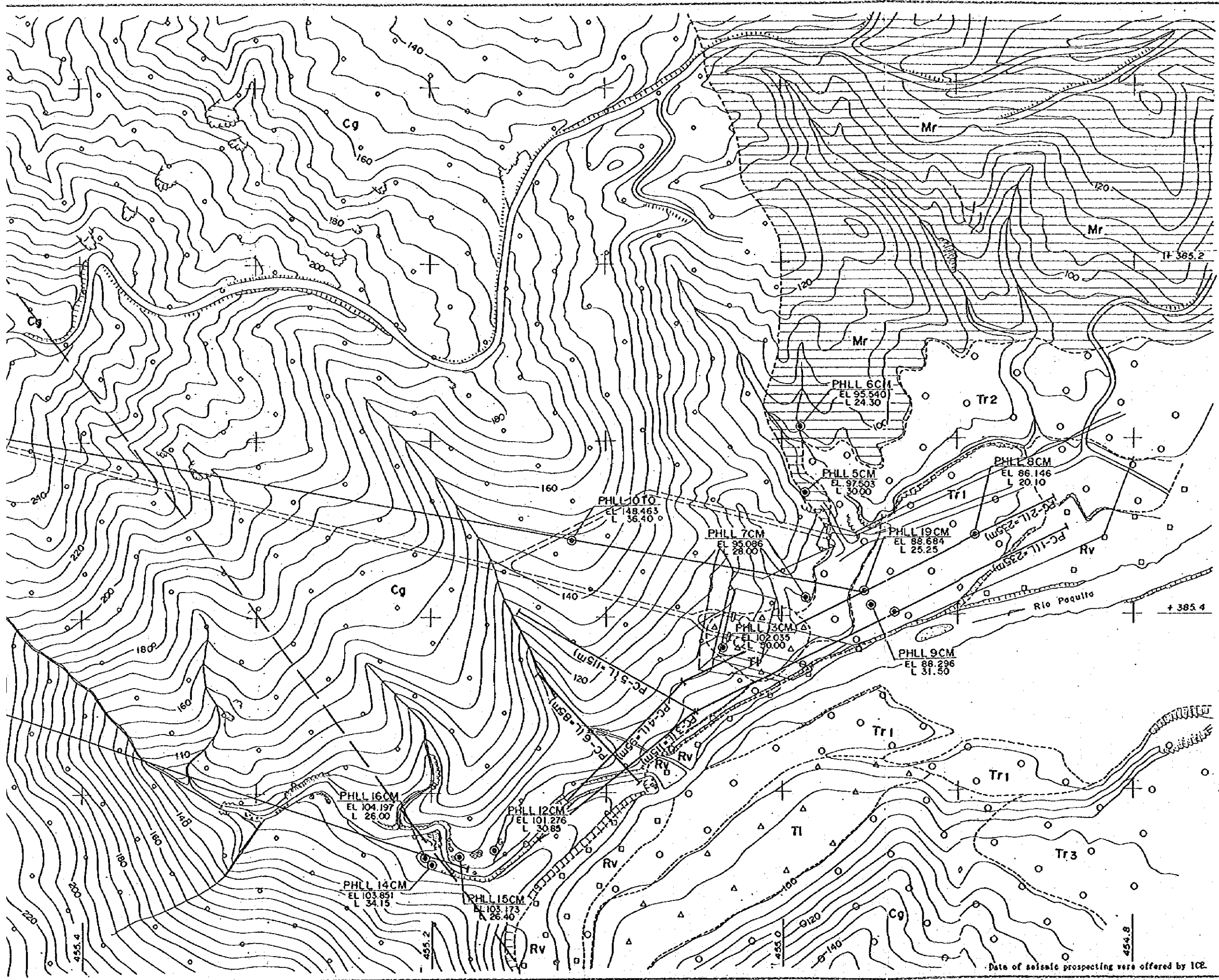


+ 385.2

+ 385.4

L-7

Data of so



**LEGEND**

- Rv○ Riverbed Deposits
- △Ti△ Talus Deposits
- Tr1○ Terrace Deposits (Lower)
- Tr2○ Terrace Deposits (Middle)
- Tr3○ Terrace Deposits (Upper)
- Cg○ Conglomerate
- Mr Mudstone (Marl)
- Geologic boundary
- | Lineament by  
aero-photo interpretation
- ↘ Strike and dip of bedding
- ⊙ Drillhole
- Seismic Prospecting Traverse
- ┌└ Geologic Section

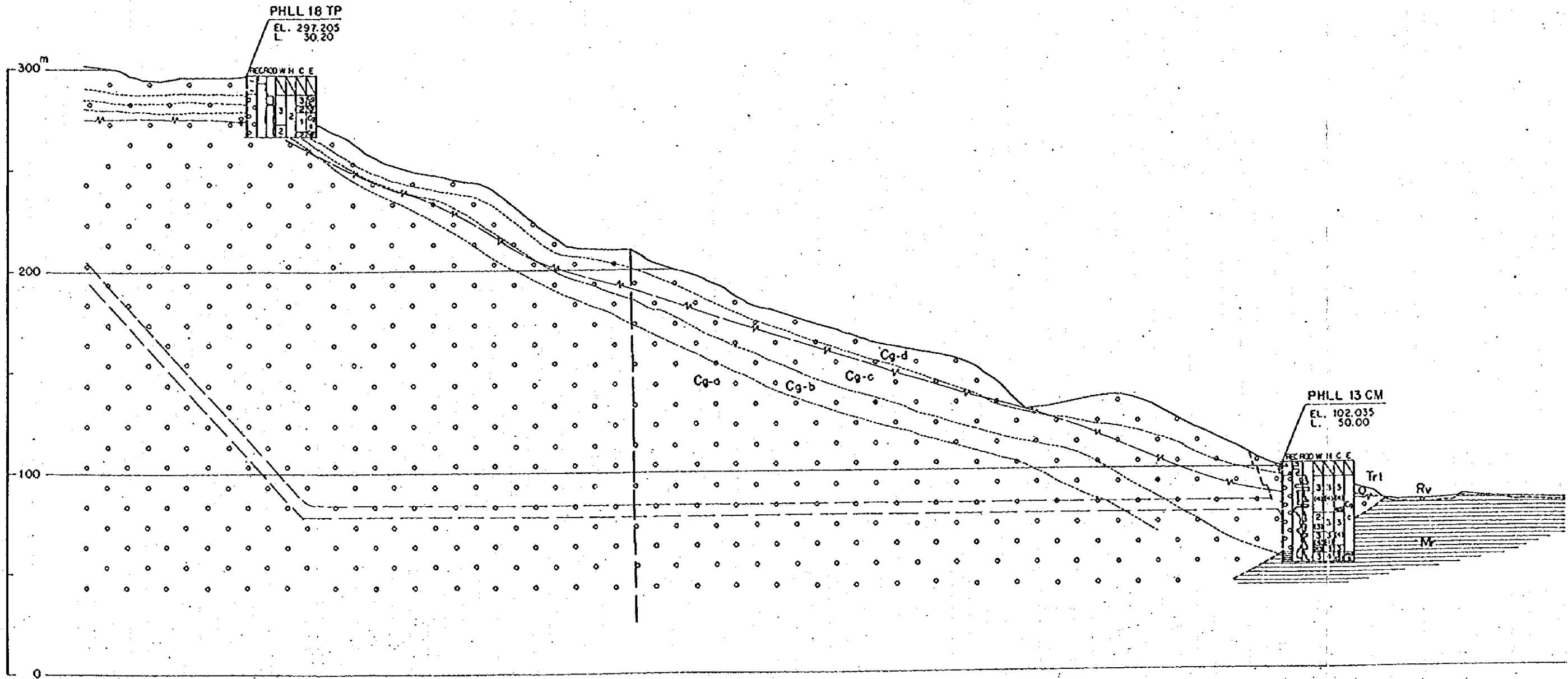


REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
GEOLOGIC PLAN OF PENSTOCK ROUTE AND POWER STATION SITE	
Fig. 7-10.	Date:

Date of seismic prospecting were offered by ICE.

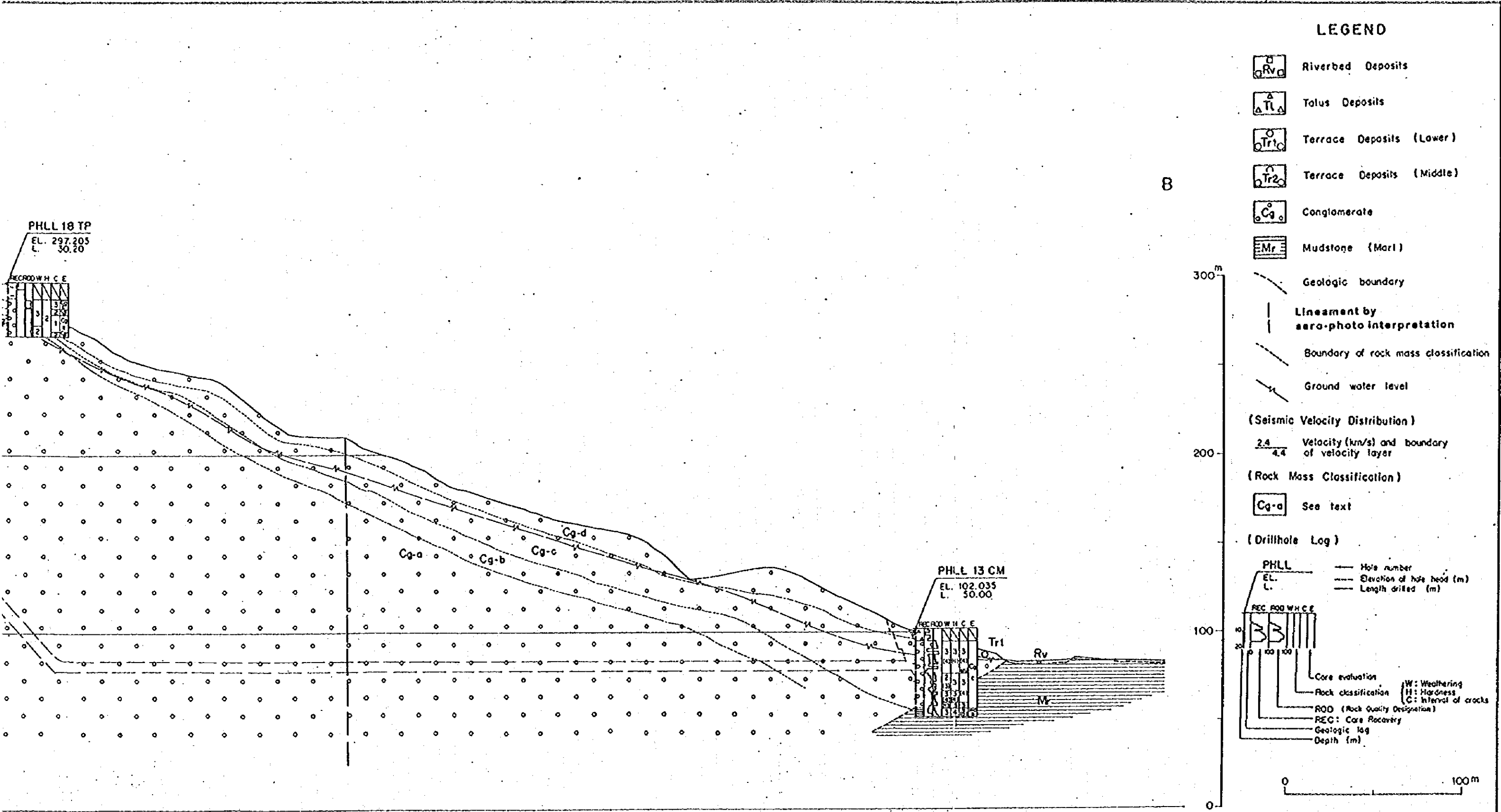
B

E



: Data of drillhole(REC and RQO) were offered by





**LEGEND**

- Riverbed Deposits
- Talus Deposits
- Terrace Deposits (Lower)
- Terrace Deposits (Middle)
- Conglomerate
- Mudstone (Marl)
- Geologic boundary
- Lineament by aero-photo interpretation
- Boundary of rock mass classification
- Ground water level

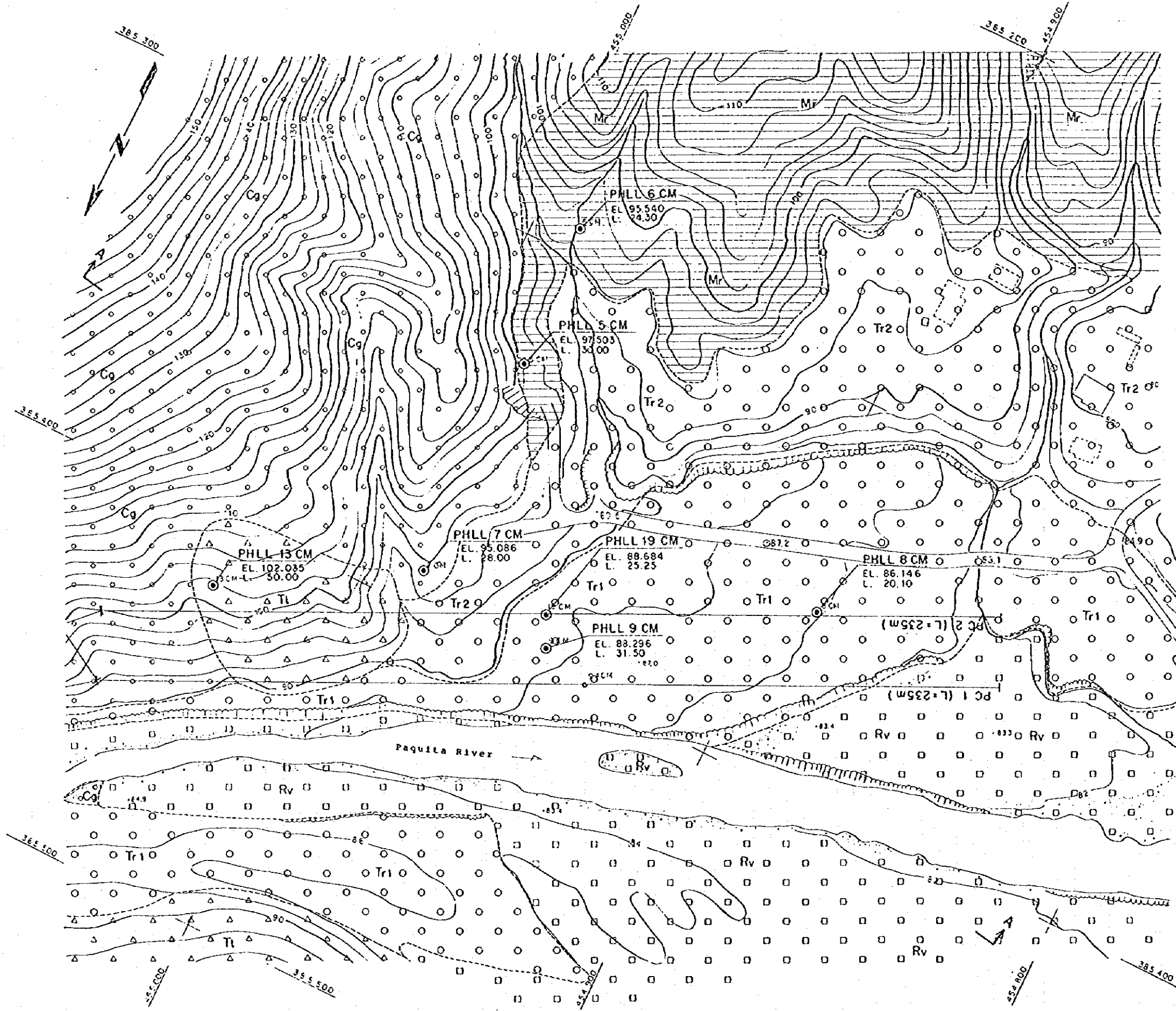
(Seismic Velocity Distribution)  
 $\frac{2.4}{4.4}$  Velocity (km/s) and boundary of velocity layer

(Rock Mass Classification)  
 See text

(Drillhole Log)  
  
 — Hole number  
 — Elevation of hole head (m)  
 — Length drilled (m)  
 Core evaluation  
 Rock classification  
 ROD (Rock Quality Designation)  
 REC: Core Recovery  
 Geologic log  
 Depth (m)  
 (W: Weathering, H: Hardness, C: Interval of cracks)

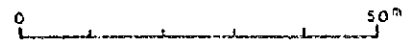
REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
GEOLOGIC SECTION OF PENSTOCK ROUTE (SECTION B - B)	
Fig. 7-12	Date:

Data of drillhole (REC and ROD) were offered by ICE.



**LEGEND**

- Rv Riverbed Deposits
- Tl Talus Deposits
- Tr1 Terrace Deposits (Lower)
- Tr2 Terrace Deposits (Middle)
- Cg Conglomerate
- Mr Mudstone (Marl)
- Geologic boundary
- Strike and dip of bedding
- Drillhole
- Seismic Prospecting Traverse
- Geologic Section



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 LOS LLANOS HYDROELECTRIC  
 POWER DEVELOPMENT PROJECT

**GEOLOGIC PLAN  
 OF  
 POWER STATION SITE**

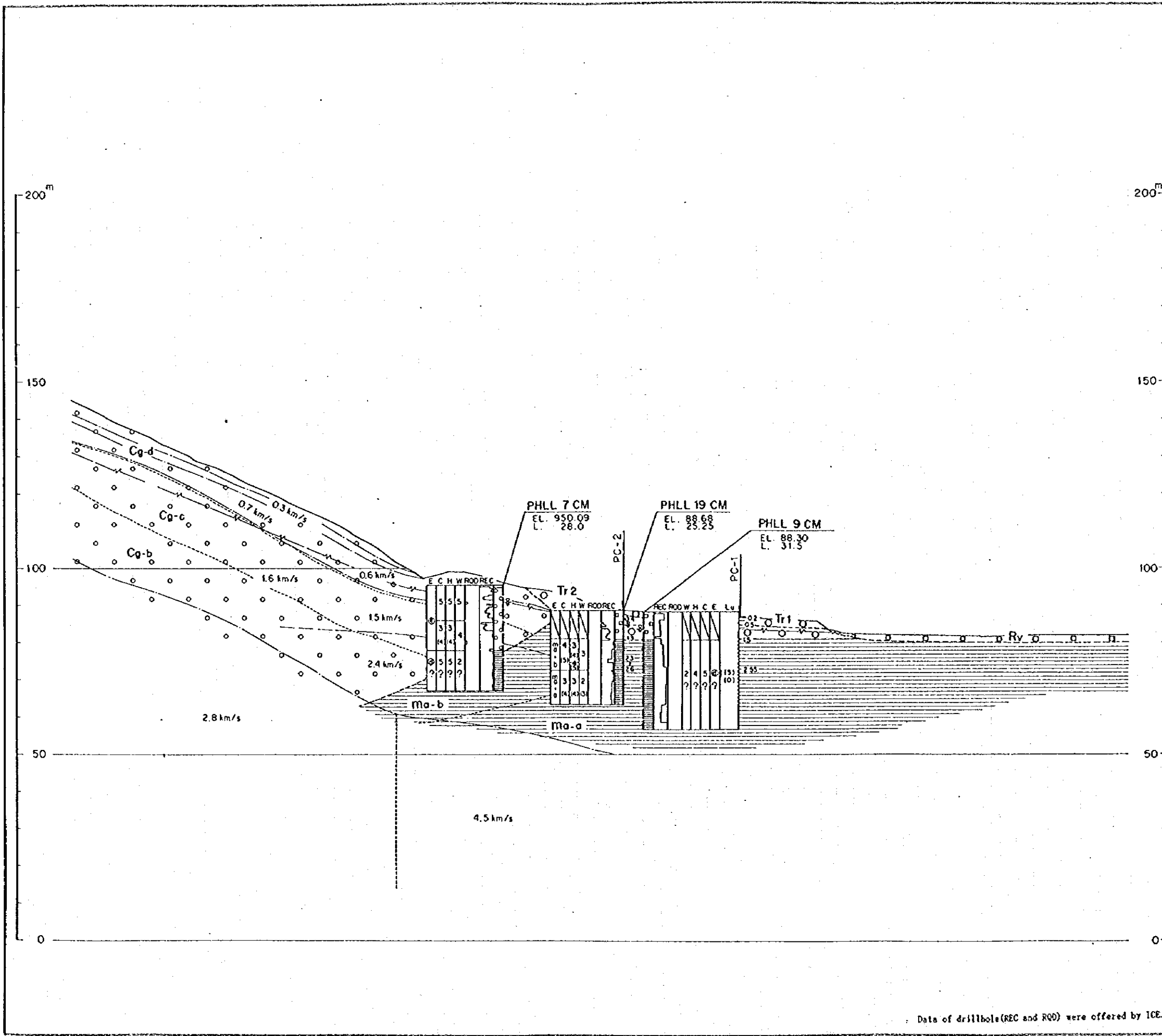
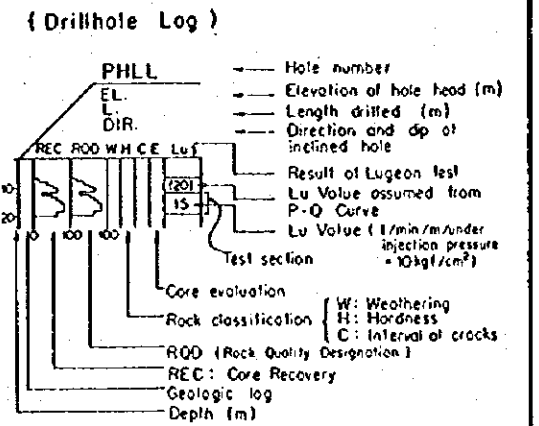
**Fig. 7-13**

Data of seismic prospecting were offered by ICE.

Los Llanos Power Plant Site

**LEGEND**

- Riverbed Deposits
- Terrace Deposits (Lower)
- Terrace Deposits (Middle)
- Conglomerate
- Mudstone (Mart)
- 
- 
- 
- (Seismic Velocity Distribution)
- $\frac{2.4}{4.4}$  Velocity (km/s) and boundary of velocity layer
- (Rock Mass Classification)
- See text

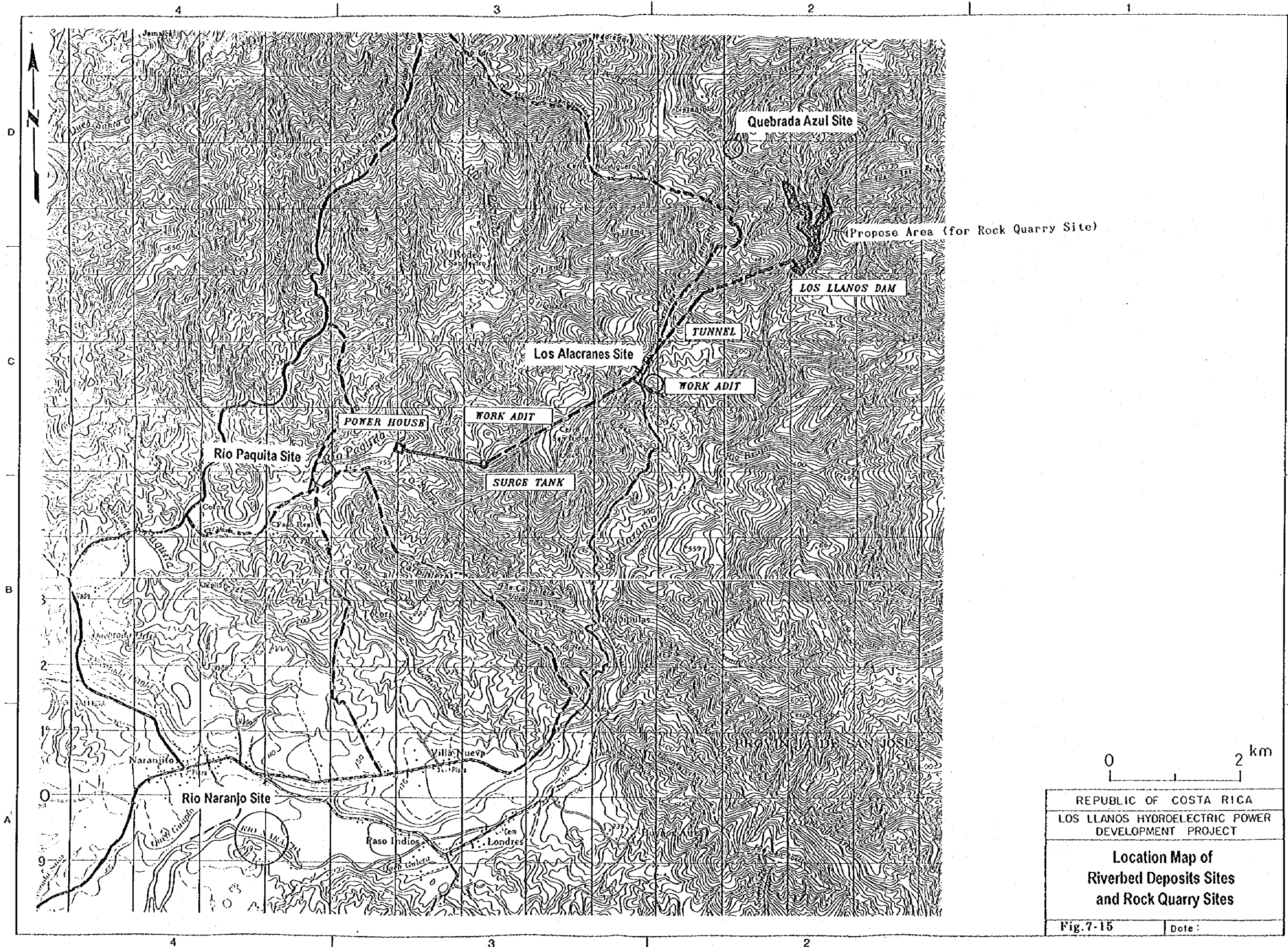


0 50m

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 LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT  
 GEOLOGIC SECTION OF POWER STATION SITE (section A-A)

Data of drillhole (REC and RQD) were offered by ICE.

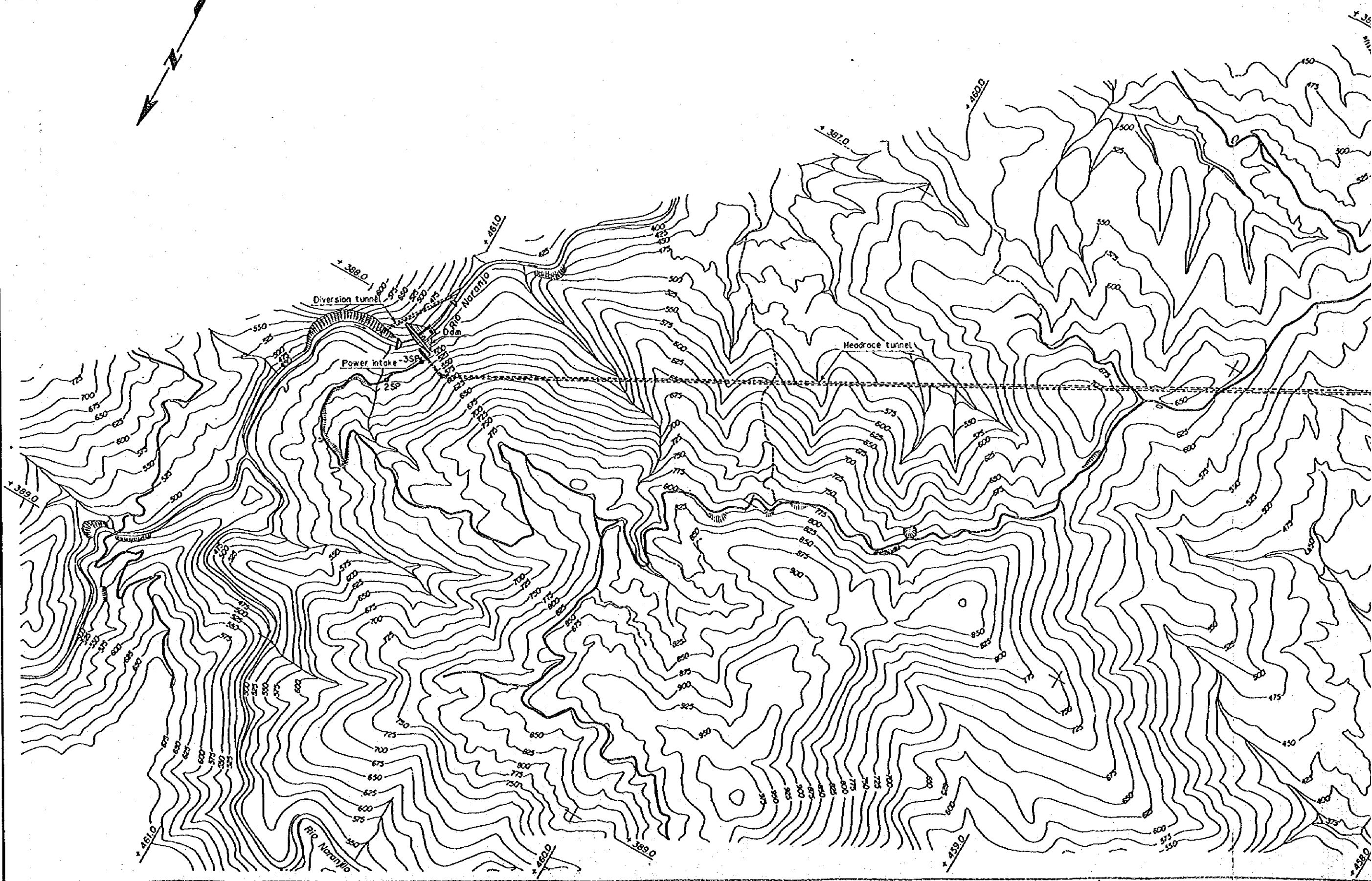
Fig. 7-14 Date:



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 LOS LLANOS HYDROELECTRIC POWER  
 DEVELOPMENT PROJECT

**Location Map of  
 Riverbed Deposits Sites  
 and Rock Quarry Sites**

Fig. 7-15      Date:



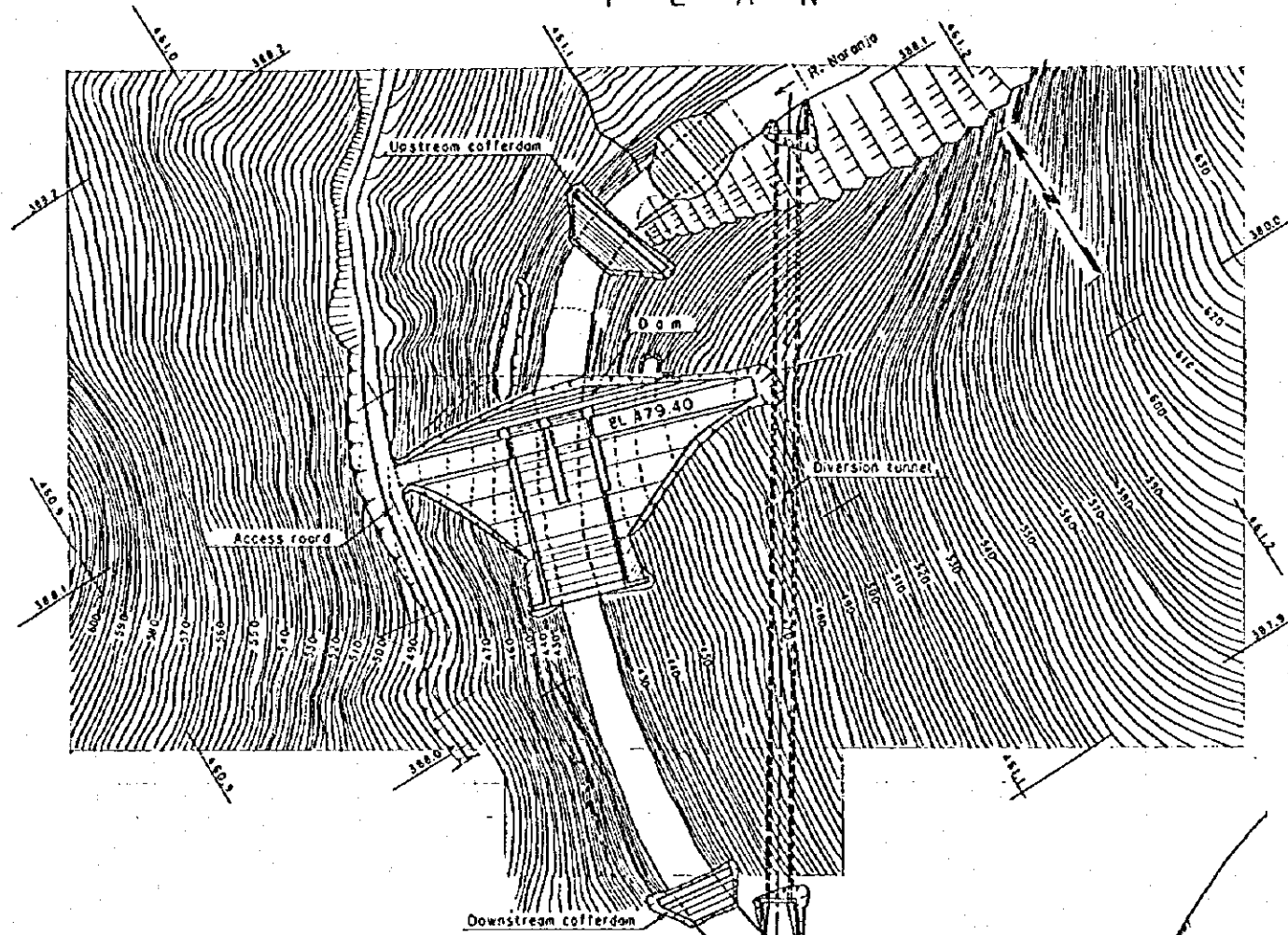
27/2



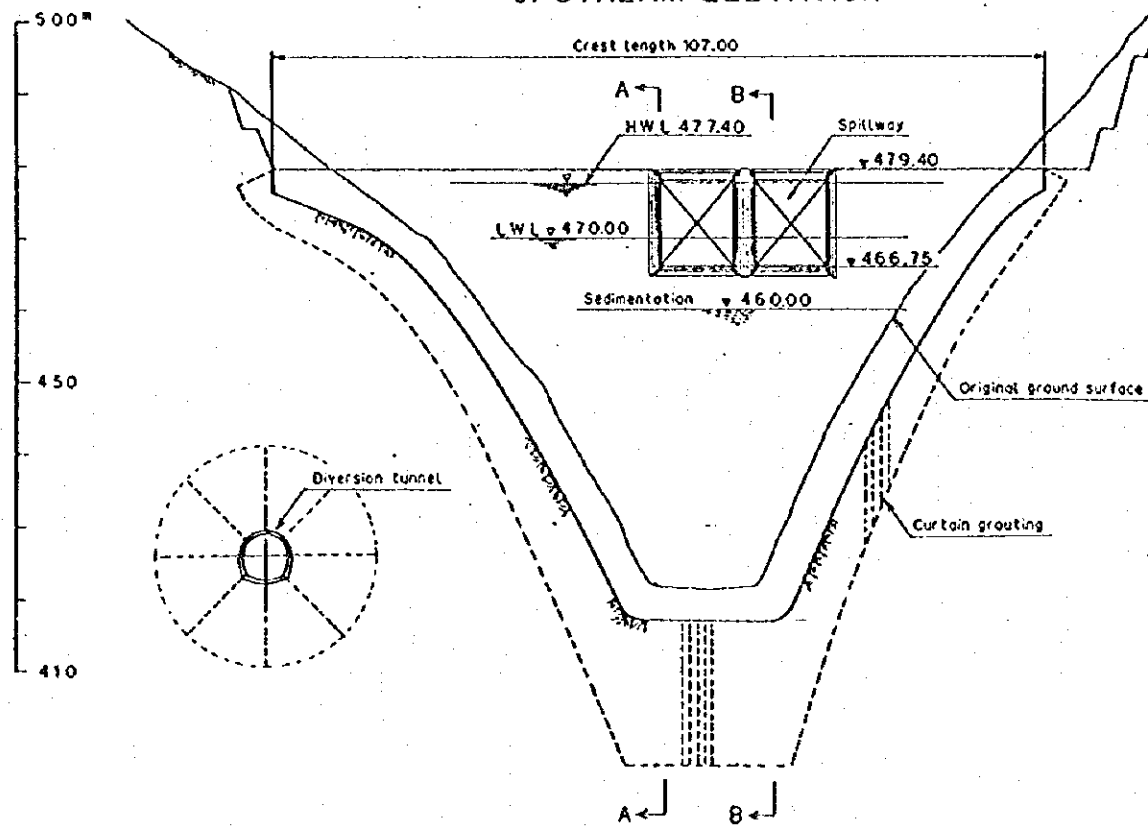


REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
GENERAL PLAN	
Fig. 9-13	Date:

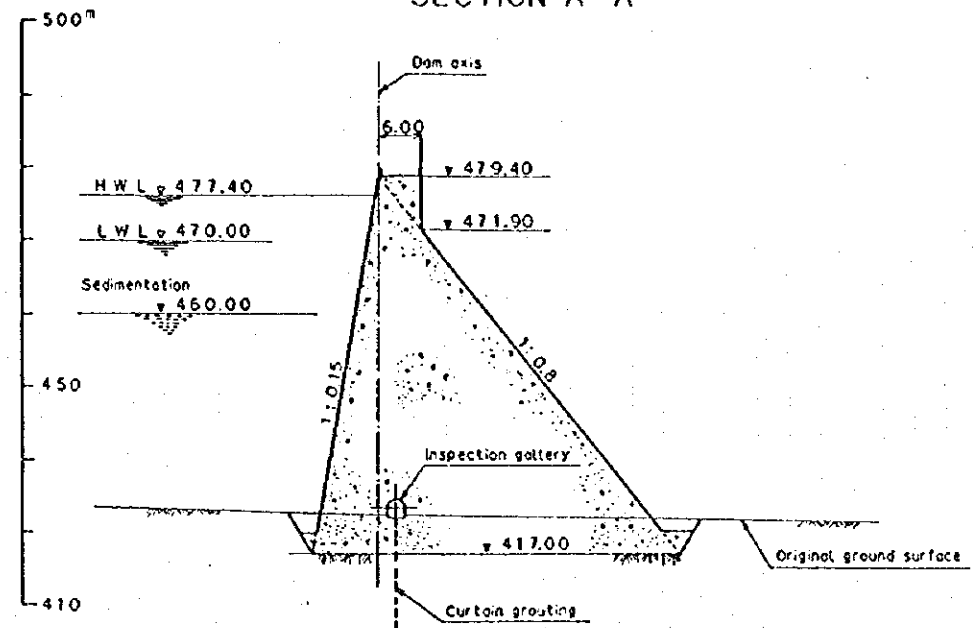
PLAN



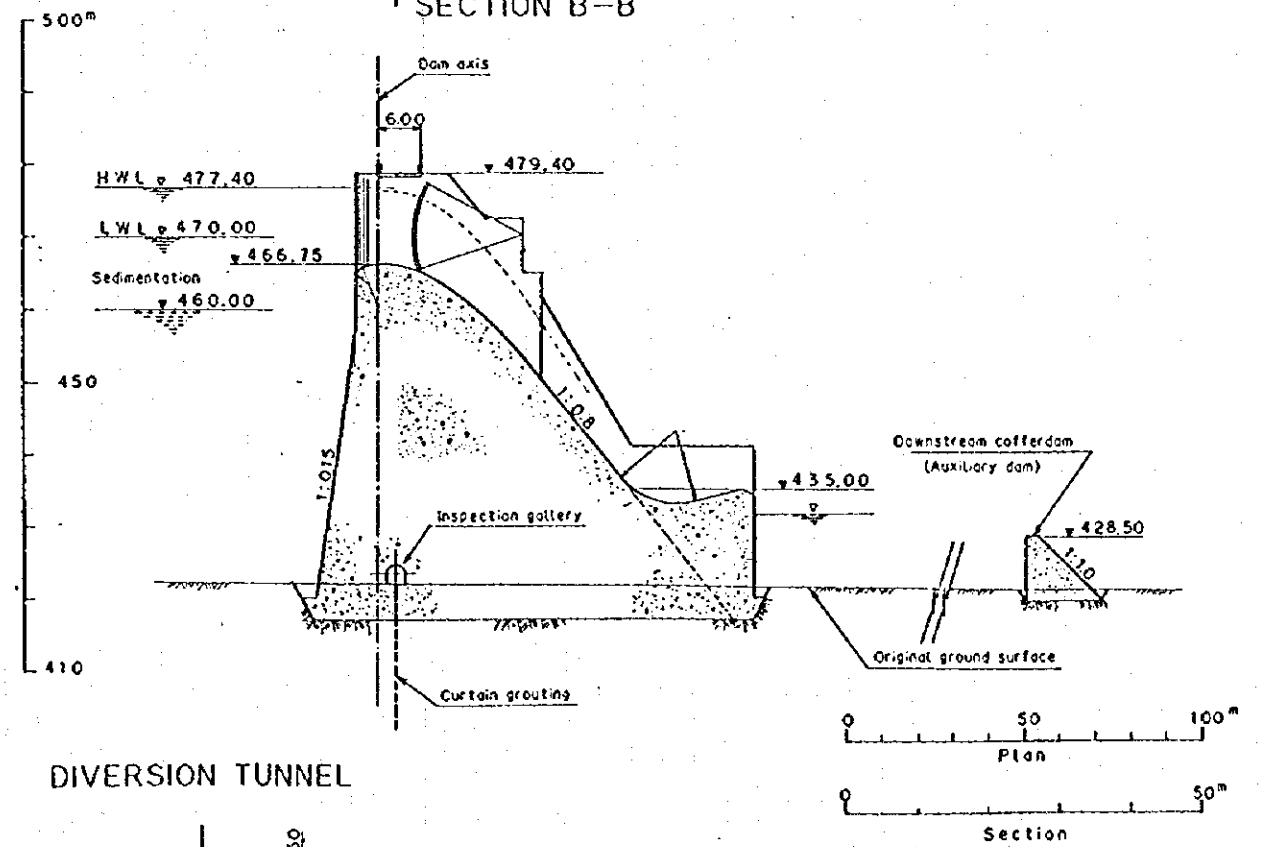
UPSTREAM ELEVATION



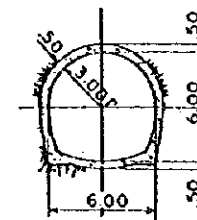
SECTION A-A



SECTION B-B



DIVERSION TUNNEL



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LOS LLANOS HYDROELECTRIC  
POWER DEVELOPMENT PROJECT

Los Llanos Dam  
Plan and Sections

Fig.9-14



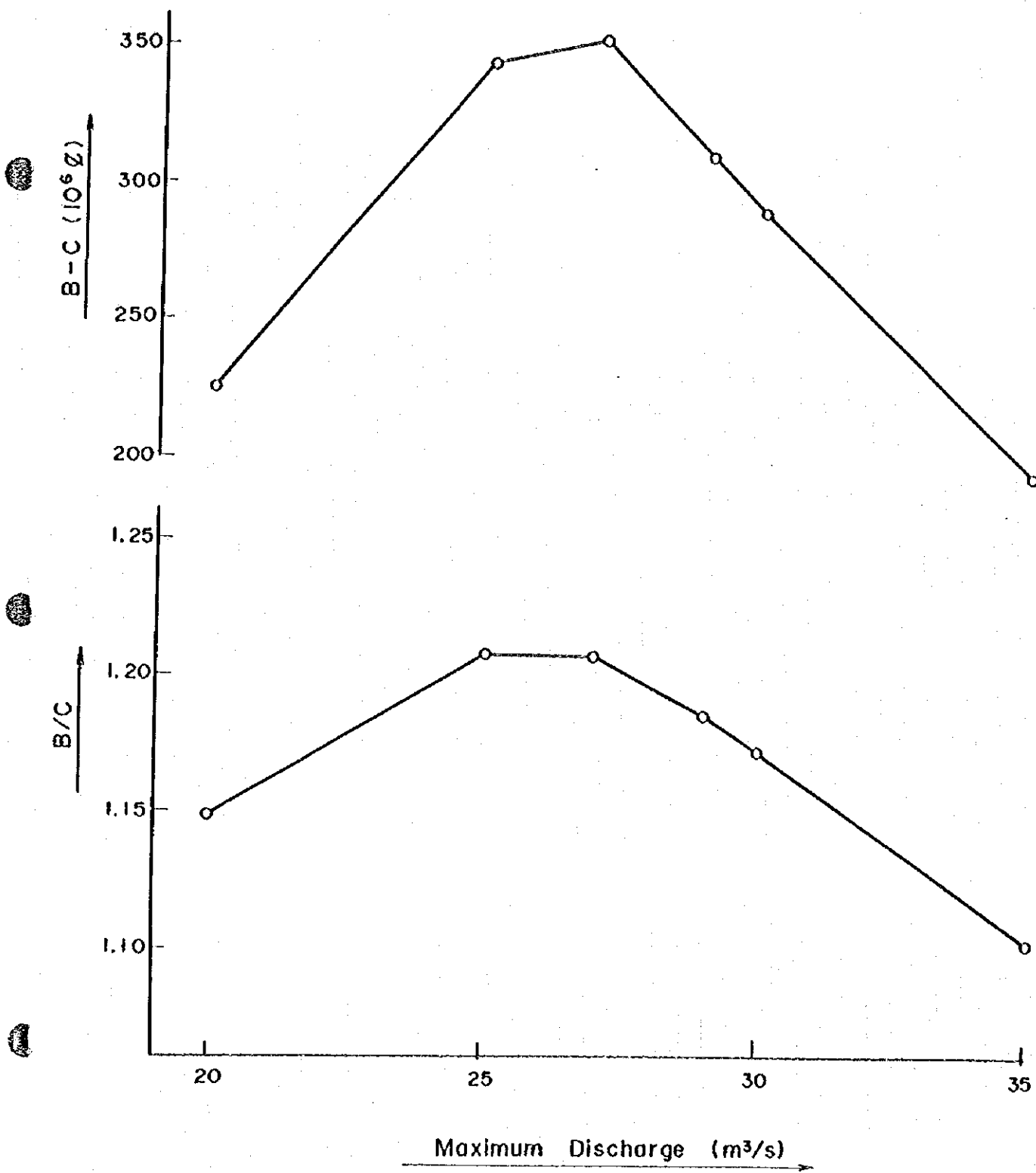


Fig. 9-15 Study on Maximum Discharge

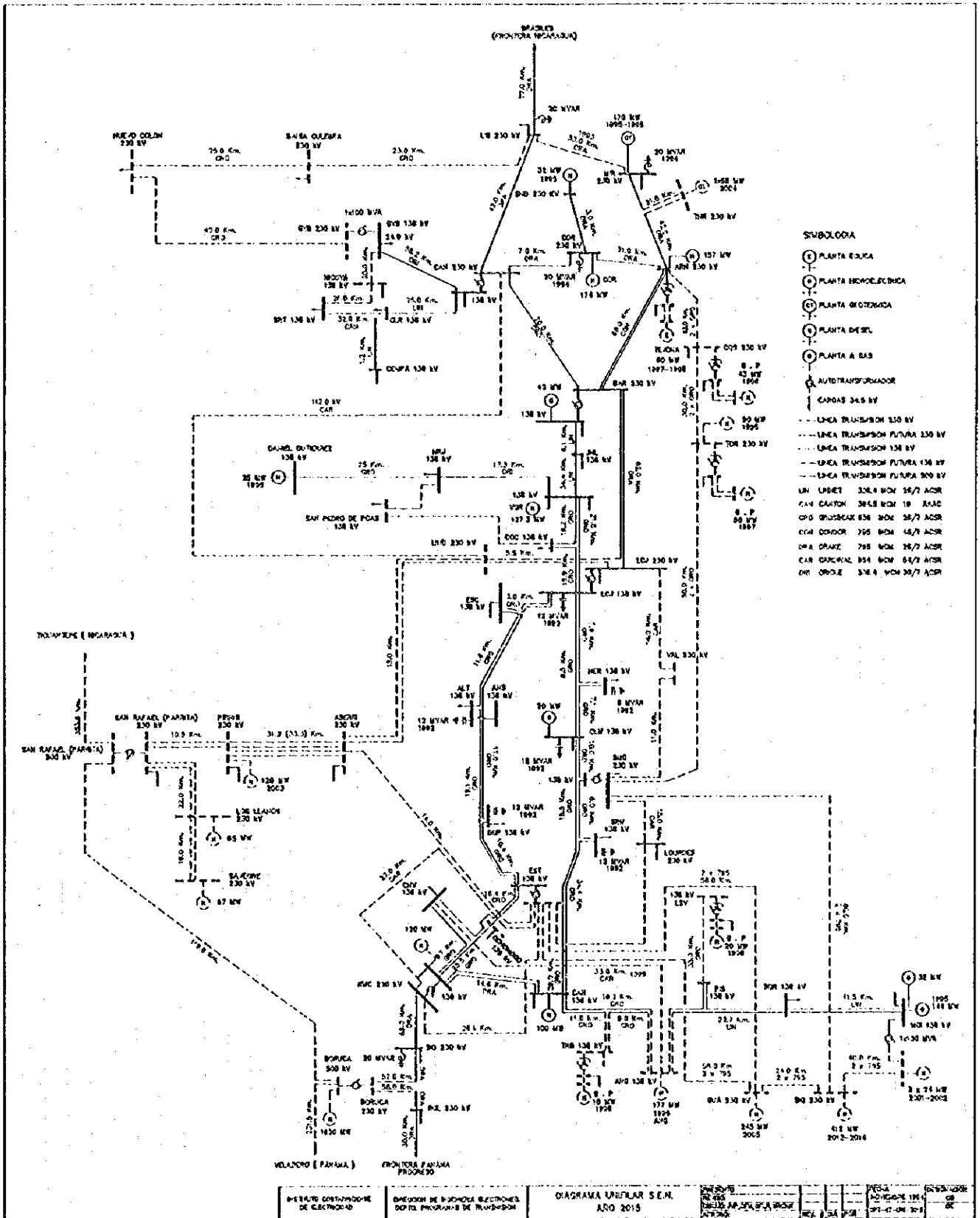
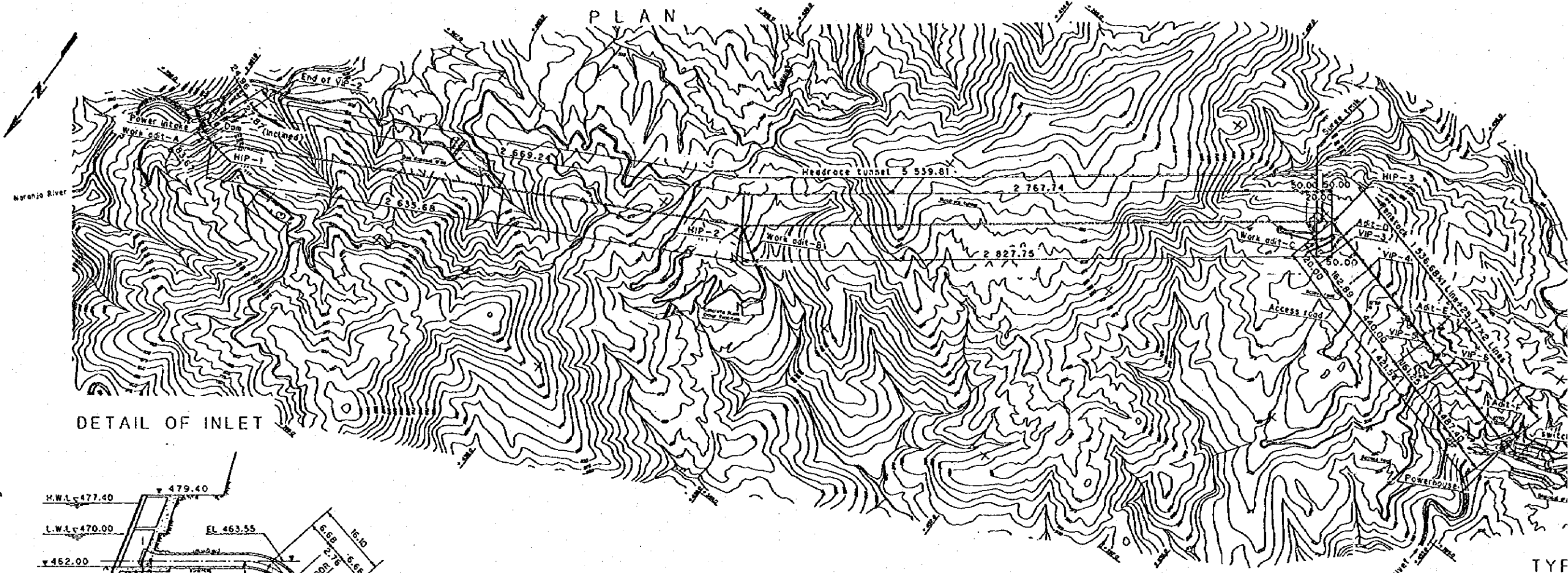
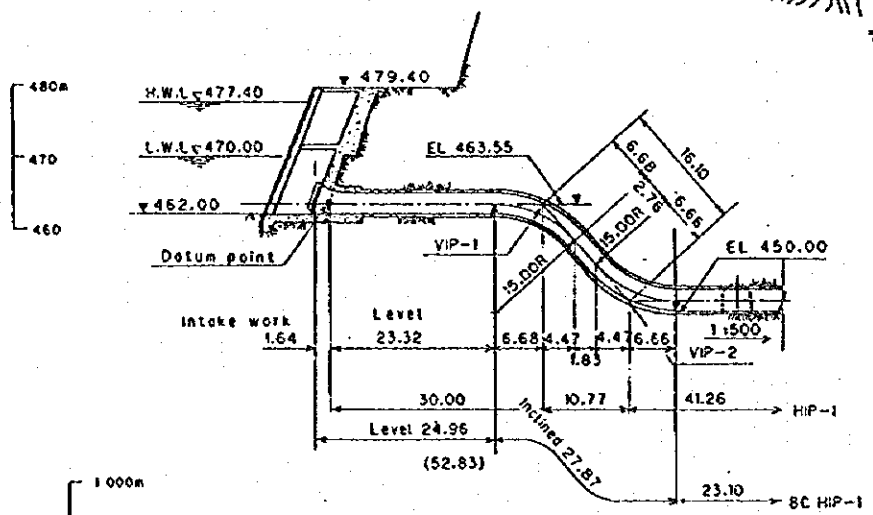


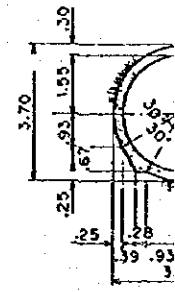
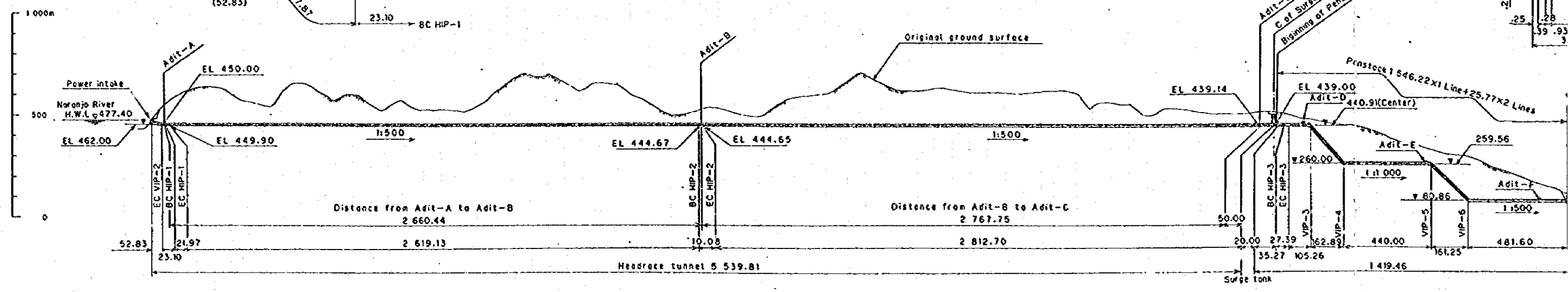
Fig. 10-1 Power Transmission System in Costa Rica

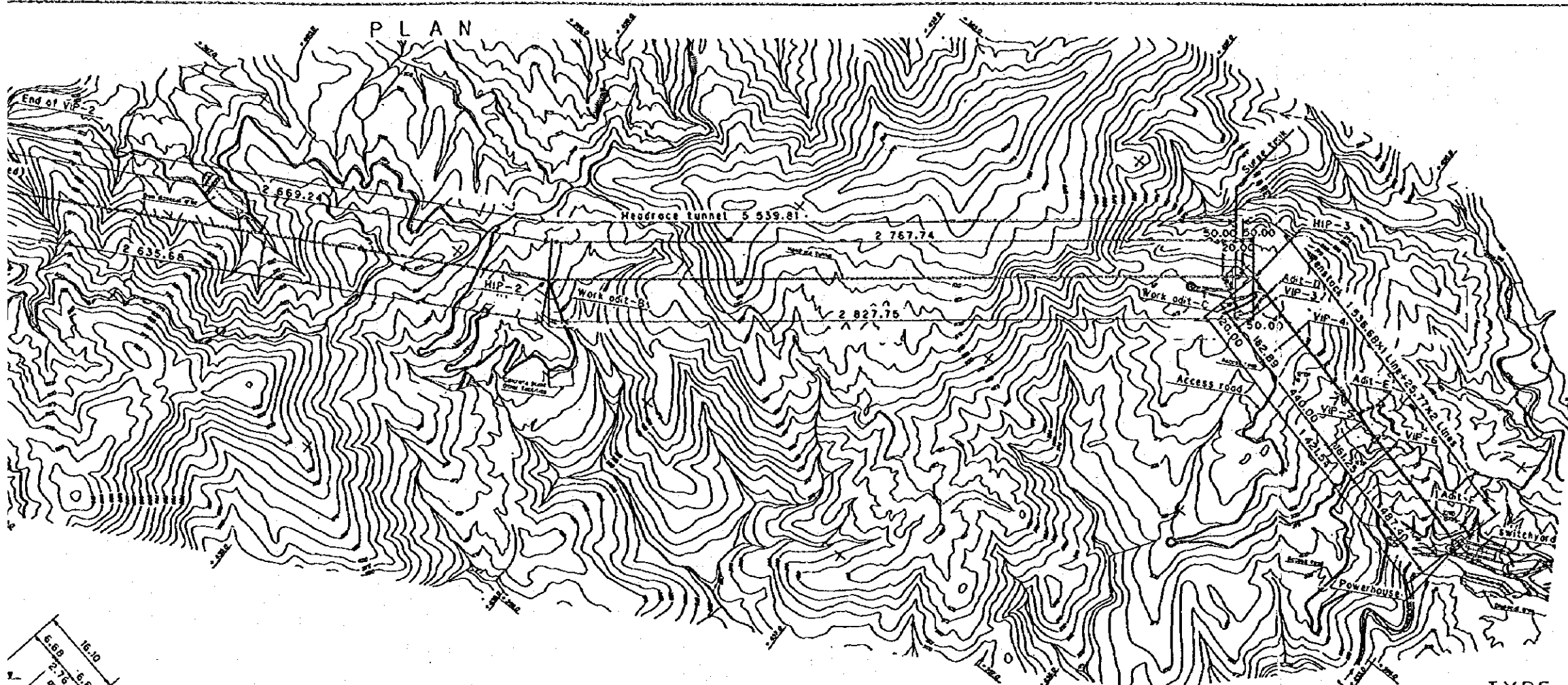


DETAIL OF INLET



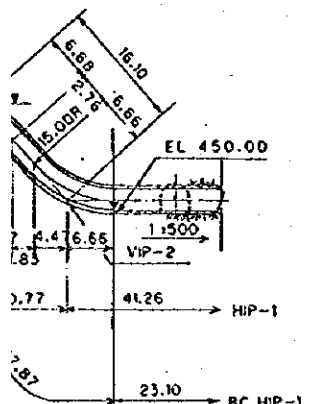
PROFILE



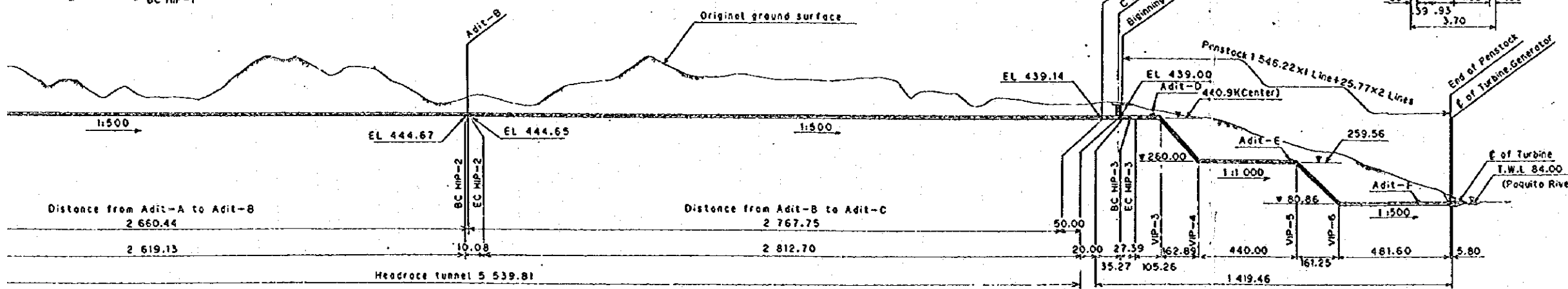


IP	Coordinate		Distance	Note
	X	Y		
Intake	388 101.00	461 014.80		Datum point
HIP-1	388 120.00	460 935.00	82.03	
HIP-2	386 860.00	458 620.00	2 635.68	
Surge tank	385 112.09	456 397.17	2 827.75	C of S.T
HIP-3	385 075.00	456 350.00	60.00	

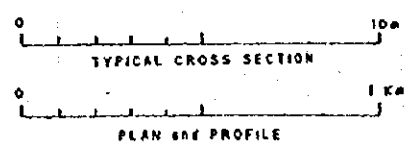
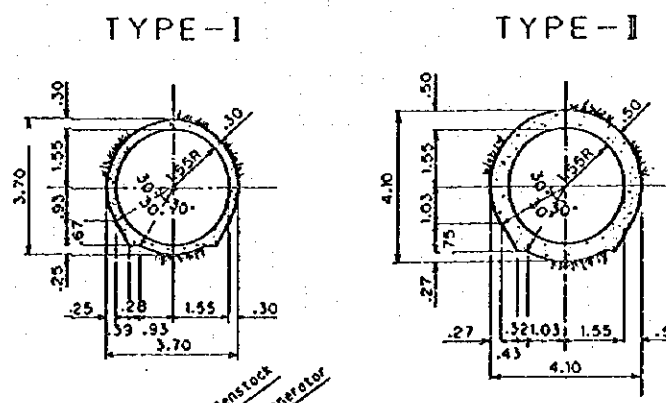
IP	IA	R	TL	CL
VIP-1	48°00'00"	15.00	6.68	12.57
VIP-2	47°53'07"	15.00	6.66	12.54
HIP-1	41°57'03"	30.00	11.50	21.97
HIP-2	9°37'16"	60.00	5.05	10.08
HIP-3	52°19'01"	30.00	14.74	27.39



PROFILE



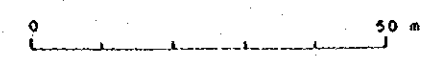
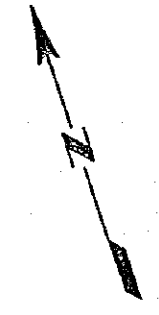
TYPICAL CROSS SECTION OF HEADRACE TUNNEL



REPUBLIC OF COSTA RICA  
 LOS LLANOS HYDROELECTRIC  
 POWER DEVELOPMENT PROJECT

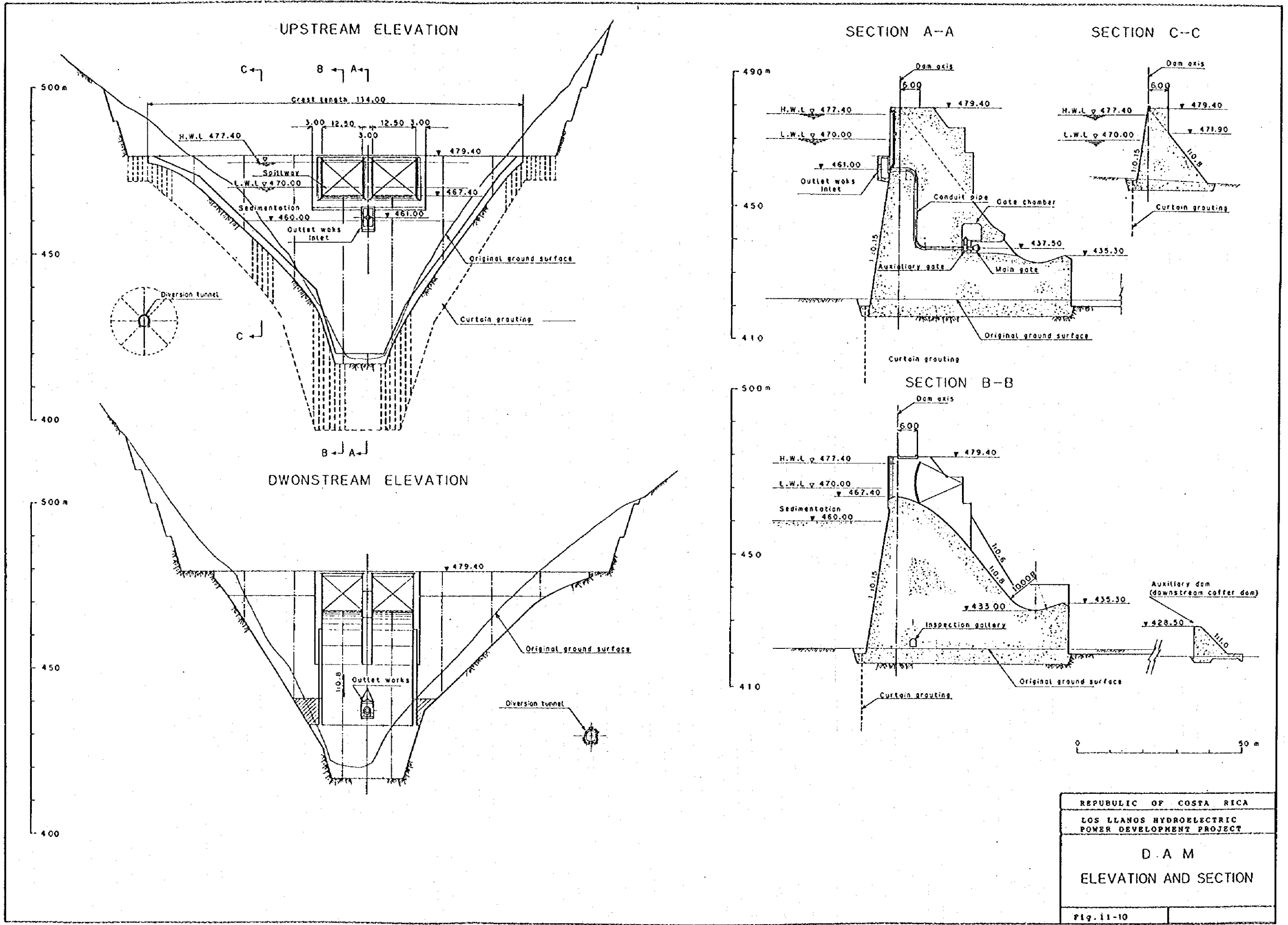
**GENERAL PLAN  
 PROFILE AND SECTION**

Fig. 11-7



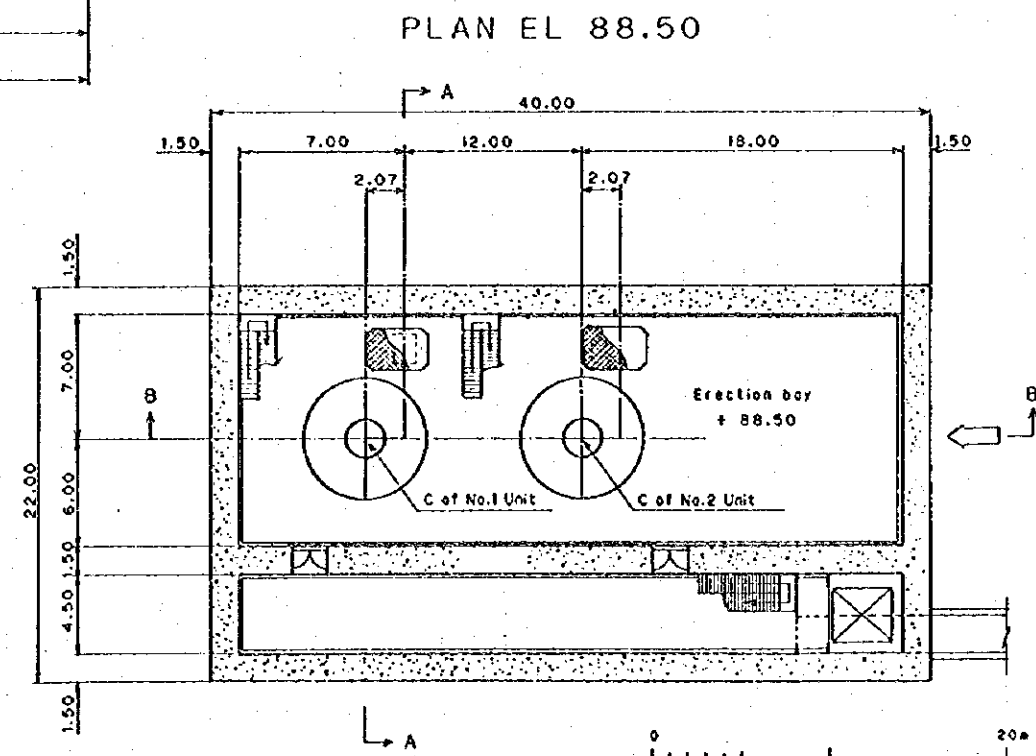
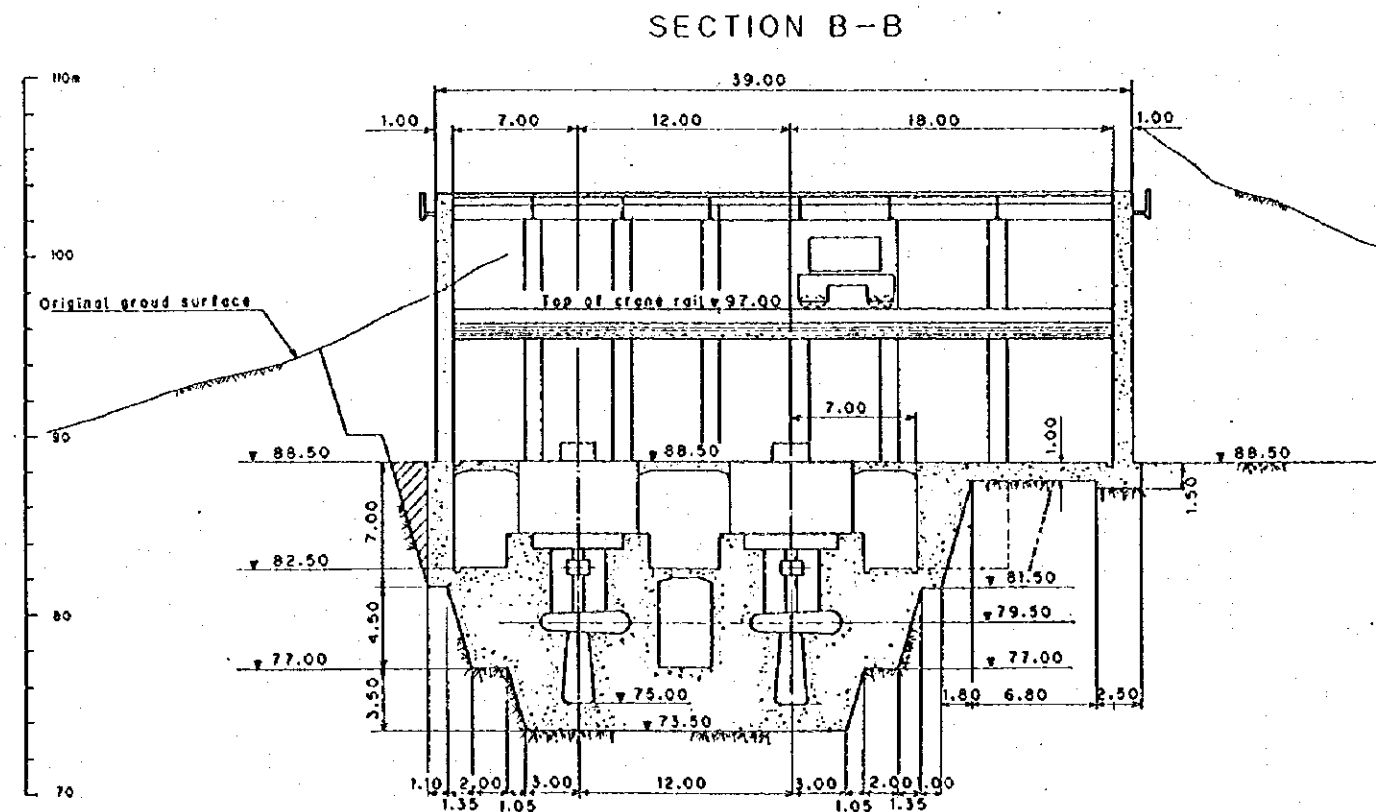
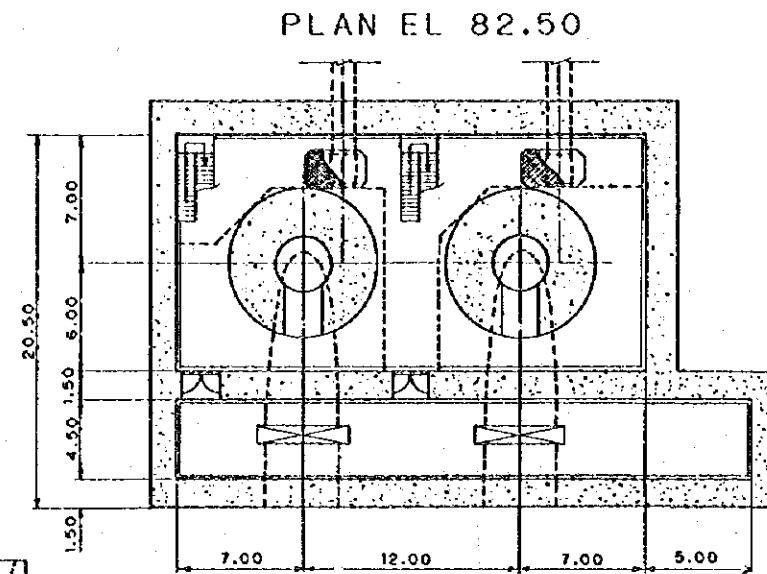
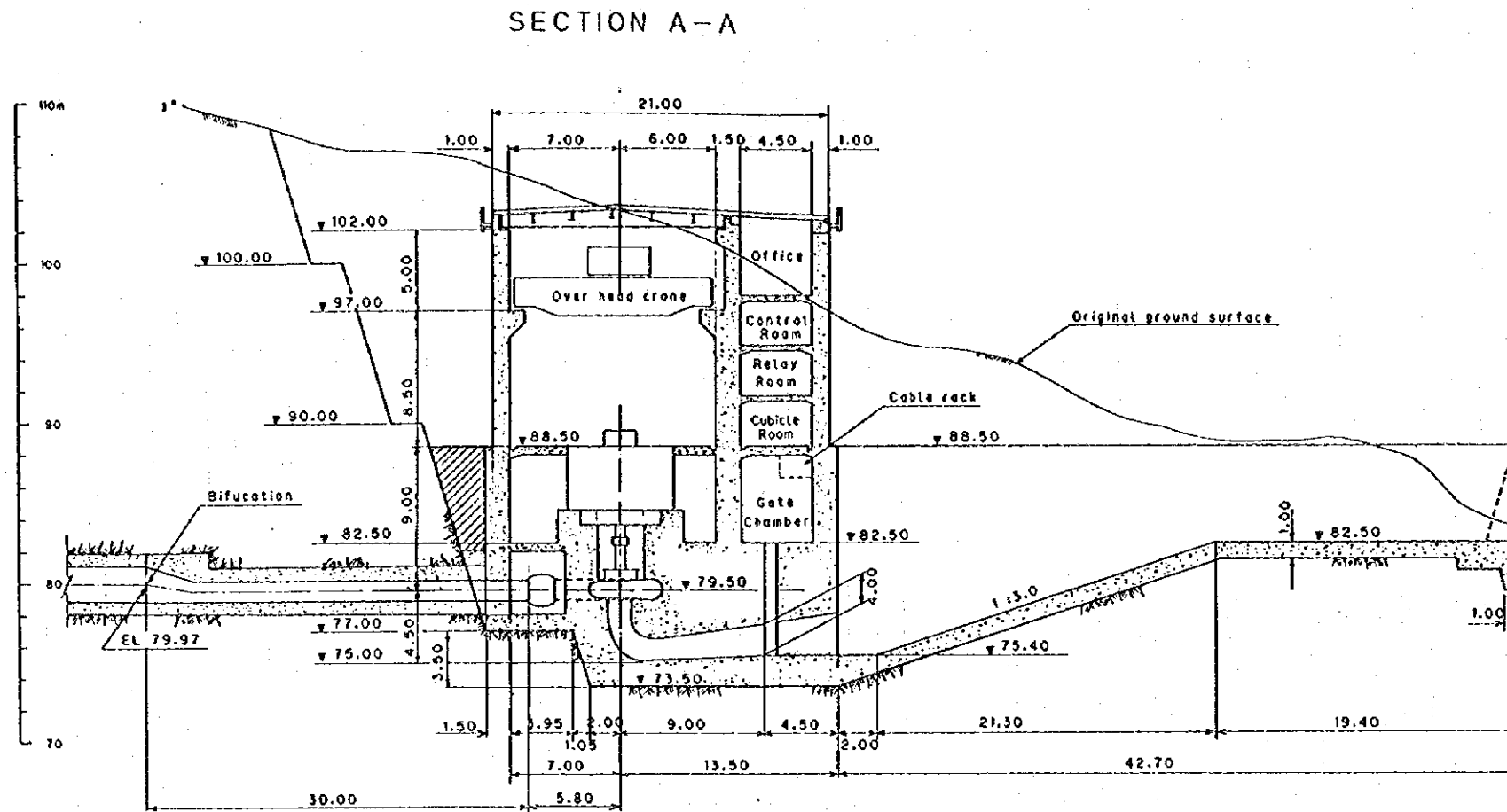
REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
D. A. M.	
GENERAL PLAN	
Fig. 11-9	

21-2



REPUBLIC OF COSTA RICA	
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT	
D.A.M	
ELEVATION AND SECTION	
Fig. 11-10	

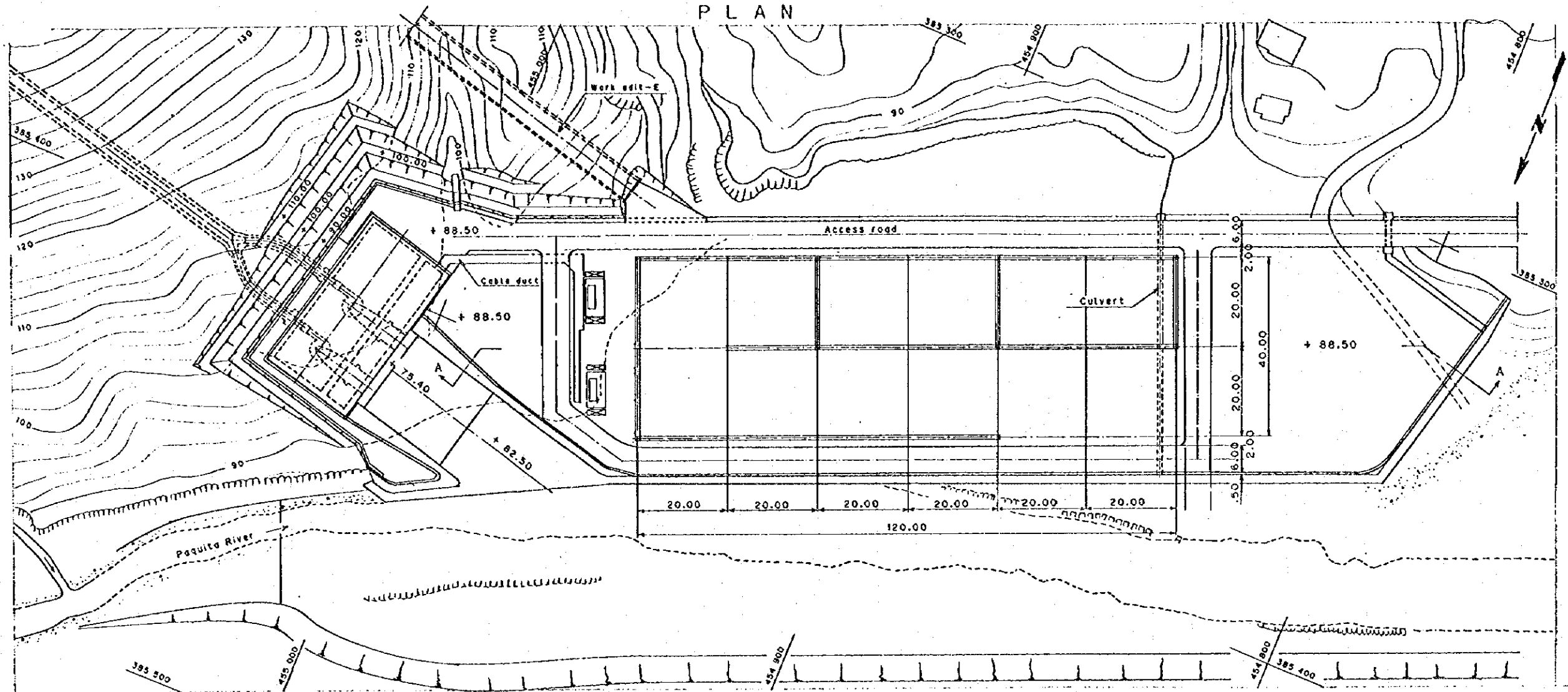
5-10



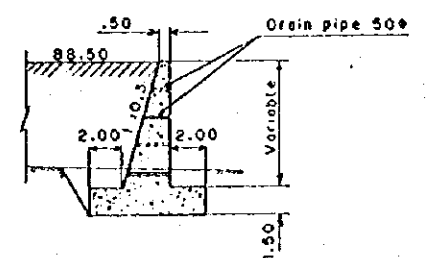
REPUBLIC OF COSTA RICA
LOS LLANOS HYDROELECTRIC POWER DEVELOPMENT PROJECT
<b>POWER HOUSE PLAN AND SECTION</b>
Fig. 11-16

11-19

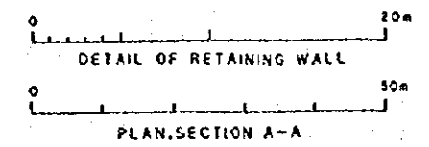
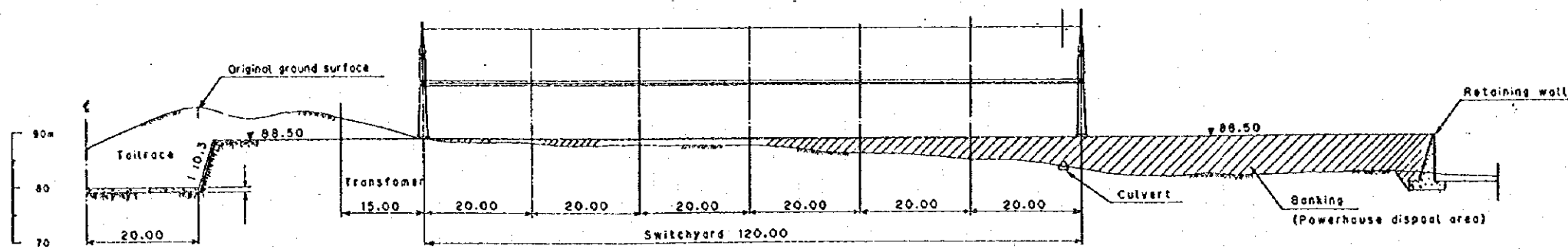
PLAN



DETAIL OF RETAINING WALL



SECTION A-A



REPUBLIC OF COSTA RICA  
 LOS LLANOS HYDROELECTRIC  
 POWER DEVELOPMENT PROJECT

**SWITCHYARD  
 PLAN AND PROFILE**

Fig. 11-17

N-20



Los Llanos Hydroelectric Power Development Project

Fig. 12-3 Construction Schedule

Item	Quantity	- 1 st					1 st					2 nd					3 rd					4 th					Remarks		
		2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2		4	6
Preparatory works and Camp Facilities																													
Road Construction	Dam 6.0 Km, Power plant 0.9 Km Headrace tunnel 7.2 Km																					Comencement of Construction							
Care of River	Diversion Tunnel																					Diverting River							
	Coffer-dam																					Plug							
Dam	D = 6.0 m, L = 225 m																					Comencement of Filling Reservoir							
	Upstream h = 20.5 m, Conc. 3,430 m <sup>3</sup>																												
	Downstream h = 11.5 m, Conc. 1,200 m <sup>3</sup>																												
Power Intake	Excavation 53,030 m <sup>3</sup>																												
	Concrete 89,200 m <sup>3</sup>																												
	Drilling & Grouting 3,100 m																												
Headrace Tunnel	Excavation 9,250 m <sup>3</sup>																												
	Concrete 1,000 m <sup>3</sup>																												
Surge Tank	D = 3.1 m L = 5,540 m (Maximum length 2,770 m)																					Adit							
	Shaft D = 8.0 m, h = 57.3 m Shaft Ex. 3,640 m <sup>3</sup> , Conc. 1,100 m <sup>3</sup>																					Open Ex.							
Penstock	Horizontal tunnel ΣL=1,090 m																					Glory Ex. Shaft							
	Inclined tunnel ΣL= 508 m																					Ex.							
	After branch ΣL=26 m * 2																					Ex.							
Power-house & Switchyard	Excavation 69,500 m <sup>3</sup>																					Conc. Shaft							
	Concrete 13,000 m <sup>3</sup>																					Conc.							
Tailrace	Excavation 1,410 m <sup>3</sup>																					Conc.							
	Concrete 2,210 m <sup>3</sup>																					Conc.							
Hydraulic Equipment	Spillway Gate 10m * 12.5m * 2																					Conc. Architecture							
	Outlet Gate & Conduit																												
	Intake Gate 4m * 4m * 1																												
	Draft Gate 2m * 4m * 2																												
	Penstock D=3.1 ~ 1.25 m, L=1,560 m																												
Electromechanical Equipment	No. 1 Unit																					Test							
	No. 2 Unit																					Test							
Switchyard																						Test							
Transmission Line																						Test							
Telecommunication																						Test							
																						land acquisition							