THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

THE MASTER PLAN SURVEY REPORT
ON
THE IRRAWADDY BASIN
INTEGRATED AGRICULTURAL DEVELOPMENT

ANNEX E

HYDRAULIC ANALYSIS AND RECLAMATION

MARCH 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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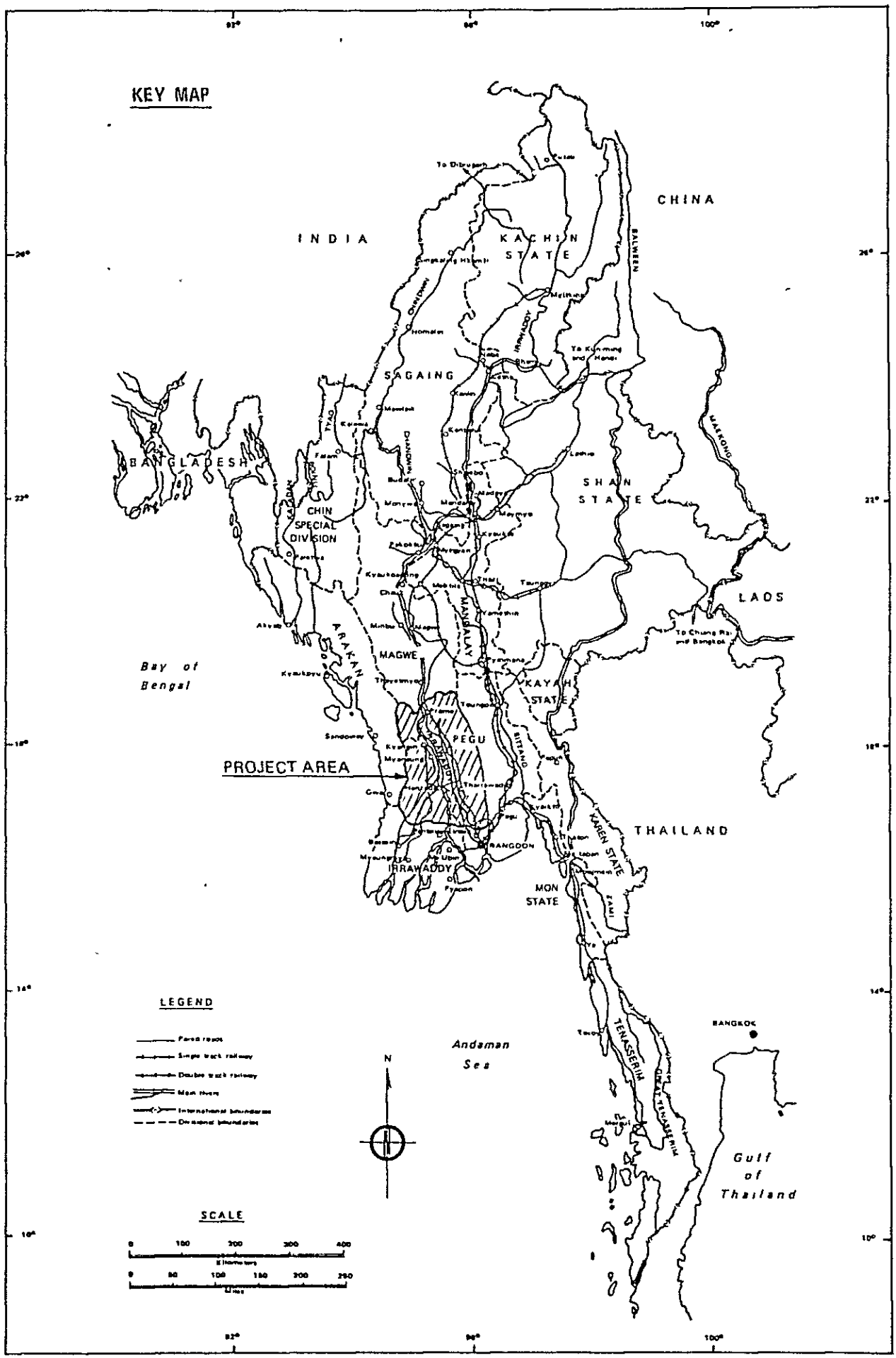
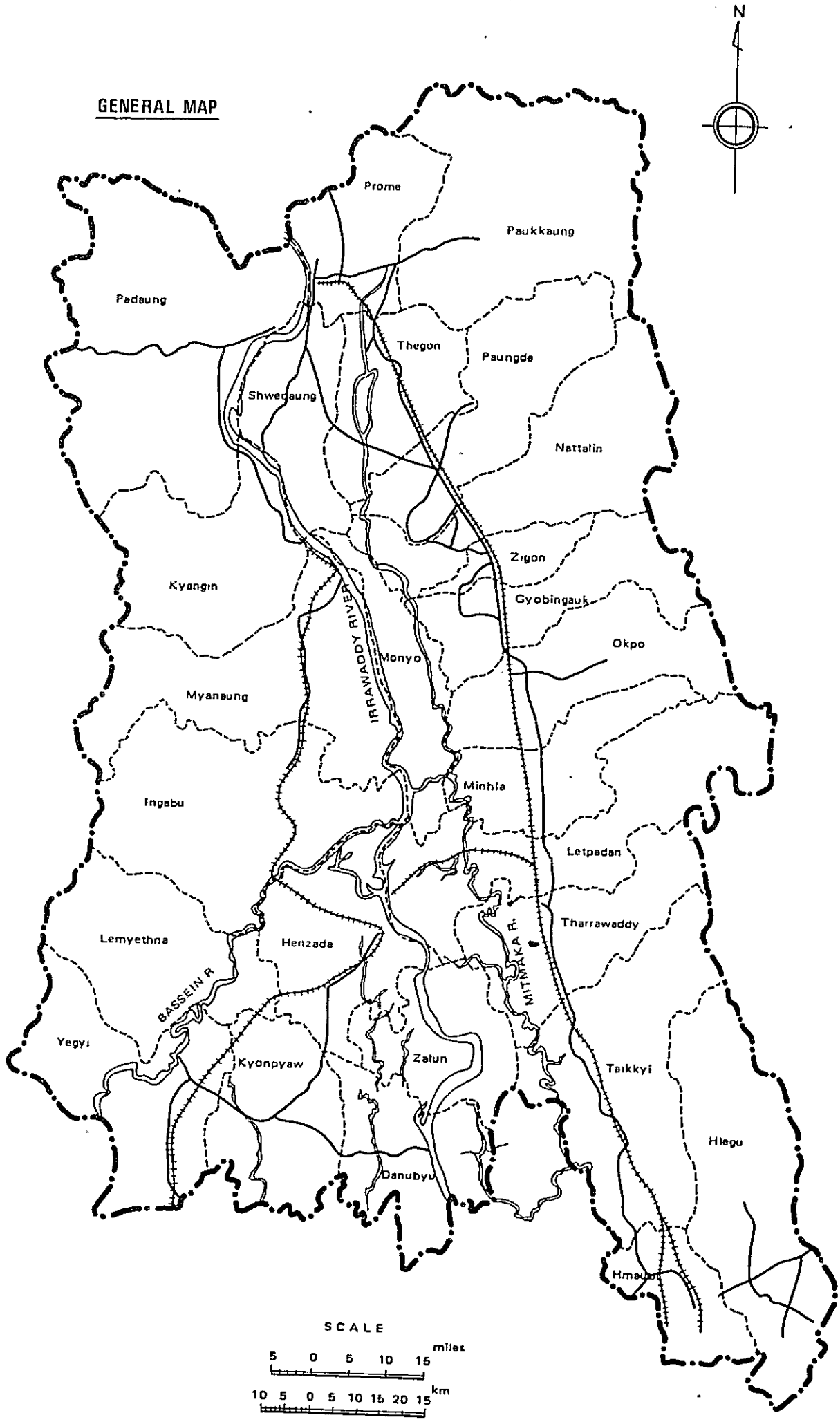

KEY MAP
INDIA
CHINA
KACHIN STATE
SAGAING
BANGLADESH
CHIN SPECIAL DIVISION
SHAN STATE
LAOS
MAGWE
MANDALAY
ARAKAN
Bay of Bengal
KAYAH STATE
PEGU
PROJECT AREA
THAILAND
KAREN STATE
RANGOON
IRRAWADDY
MON STATE
TENASSERIM
BANGKOK
Andaman Sea
Gulf of Thailand
LEGEND
SCALE
N


GENERAL MAP
N
Prome
Paukkaung
Padaung
Thegon
Paungde
Shwegaung
Nattalin
Kyangin
Zigon
Gyobingauk
IRRAWADDY RIVER
Okpo
Monyo
Myanaung
Minhla
Ingabu
Letpadan
Tharrawaddy
Lemyethna
Henzada
BASSEIN R.
MITNGKA R.
Yegyi
Kyonpyaw
Zalun
Taikkyi
Hlegu
Danubyu
Hmawbi
SCALE
miles
5 0 5 10 15
km
10 5 0 5 10 15 20 15

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ABBREVIATION, MEASURES AND GLOSSARIES

AC	Agriculture Corporation
ADB	Asian Development Bank
AE	Assistant Engineer
AGM	Assistant General Manager
AFPTC	Agricultural and Farm Produce Trade Corporation
AMD	Agricultural Mechanization Department
APS	Advance Purchase System
Ave	Average
BAG	Bachelor of Agricultural University
BKT	Basket(s)
CIF	Cost Insurance and Freight
°C	Degree Centigrade
DAGM	Deputy Assistant General Manager
DG	Director General
DGM	Deputy General Manager
Dy	Deputy
EE	Executive Engineer
EL	Elevation
EPC	Electric Power Corporation
FC	Foreign Currency
FiD	Fishery Department
FERD	Foreign Economic Relations Department
FIC	Foodstuff Industries Corporation
FOB	Free on Board
FoD	Forest Department
F/S	Feasibility Study
FY	Fiscal Year from April to March
GM	General Manager
GNP	Gross National Product
GWH	Giga Watt Hour
HP	Horsepower

HWL	High Water Level
HYV	High Yielding Variety (of paddy)
Hz	Hertz per second
IBRD	International Bank for Reconstruction and Development
ID	Irrigation Department
IDA	International Development Association
KV	Kilo Volt
KW	Kilo Watt
KWH	Kilo Watt Hour
LC	Local Currency
LDMC	Livestock Development and Marketing Corporation
LIV	Local Improved Variety
LWL	Lower Water Level
LV	Local Variety
MAF	Ministry of Agriculture and Forests
MD	Managing Director
MHD	Meteorological and Hydrological Department
MI 1	Ministry of Industry No. 1
M/P	Master Plan
MPF	Ministry of Planning and Finance
MT	Ministry of Trade
MW	Mega Watt
MWL	Mean Water Level
PD	Project Director
pH	Potential of Hydrogen
PPFC	People's Pearl and Fishery Corporation, MAF
PPM	Part(s) per Million
%	Percent
PSD	Planning and Statistics Department
SD	Survey Department, MAF
SLRD	Settlements and Land Records Department, MAF
TC	Timber Corporation, MAF
TEM	Township Extension Manager
TSP	Triple Super Phosphate

UCC	University Computer Center
UGCF	Union Government Consolidated Fund
VAHD	Veterinary and Animal Husbandry Department
VTB	Village Tract Banks
WPSD	Working People's Settlement Department

MEASURES

Length

mm	millimeter (s)
cm	centimeter (s)
m	meter (s)
km	kilometer (s)
inch	25.4 mm
ft	foot (feet) = 12 inch = 30.48 cm
mile	5,280 feet = 1.609 km

Area

sq.cm	square centimeter (s)
sq.m	square meter (s)
sq.km	square kilometer (s) = 100 ha
ac	acre (s) = 4,047 sq.m
sq.mile	square mile = 2.59 sq.km = 640 ac
ha	hectare

Capacity

ℓ	litter
cu.m	cubic meter
MCM	Million Cubic Meter
cu.ft	cubic foot (feet) = 28.32 ℓ
cu.yd	cubic yard = 0.765 cu.m
AF	Acre Foot (feet) = 1,233.48 cu.m
Qt	Quart = 1/4 gl = 1.136 ℓ (UK) = 0.946 ℓ (US)
gl	gallon = 4.543 ℓ (UK) = 3.785 ℓ (US)

Note: UK: British Measure
US: US Measure

Weight

g	gram (s)
kg	kilogram (s)
ton	metric ton
oz	ounce = 28.4 g
lb	Pound = 16 oz = 0.454 kg

Others

cm/sec	centimeter per second
m/sec	meter per second
km/sec	kilometer per second
mile /hr	mile per hour= 1.609 km/hr = 0.447 m/sec
ft/second	feet per second
cu.m/sec	cubic meter per second
cfs/cu.sec	cubic foot (feet) per second = 0.0283 cu.m/sec
gl/sec	gallon per second = 4.543 ℓ/sec = 0.0757 ℓ/min

Glossaries

lakh	100,000
crore	10,000,000
viss	1.633 kg
Pyi	2,127 kg
basket	20.9 kg (paddy)
basket	34.0 kg (rice)
bag	75.6 kg (rice)
Chaung	River or Stream
Kyat	Unit of Local Currency (about 30 Japanese Yen)
In	Lake or Swamp area
Yoma	Mountain range
1 US$	6.44 kyats

SUMMARY

Drainage, polder, and flood control works are considered as the methods of improvement of the inundated area during the rainy season, of which extent is about 200,000 ha. Judging from three areas determined preferentially as the polder works about 60 percent of the inundated area, namaly 120,000 ha, (about 0.3 million ac) will be technically and financially feasible to be utilized as the cultivable land. (Ref. to Table E-1)

Since these areas have an inevitable role as retarding basins for Irrawaddy river, the polder work project should be implemented only after the hydraulic conditions are elucidated by the hydraulic analysis at the time of floodings mainly caused by Irrawaddy River.

On the other hand, the development by means of the drainage improvement of polder works is requested by the local government. The village drainage works are carried on partially on a small size.

Taking these points into consideration, polder works for three areas and flood control works is determined as the project plan.

Concerning to the polder works, based on the relationship between water level frequency and ground elevation, the development plan of the lowest parts of the polder area is reserved as retarding basins of Irrawaddy river from financial point of view.

With the implementation of the project, the area of about 17,200 ha (about 42,500 ac) will be possible to be cultivated and the water of the retarding basins can be used as the irrigation water during the dry season.

Concerning to the flood control works, about 52,000 ha of the inundated area in the middle reaches of Myitmaka river will be improved by controling the inflow from Irrawaddy river.

TABLE E-1 POTENTIAL ACREAGE TO BE DEVELOPED

Basin	Inundated Area (ha)	Developed Cultivable Land (ha)	Percentage (%)	Remarks
Upper Reaches of Myitmaka River	66,600	40,000	60	Polder
Middle Reaches of Myitmaka River	52,300	42,000	80	Flood Control Structure
West Side of Irrawaddy River	50,400	20,000	40	Polder
Delta	36,800	18,000	50	Polder
Total	206,100	120,000	60	

By the time of the implementation of the project, it is necessary to estimate the influence of the flood control properly beforehand.

In the section of hydraulic analysis, mathematical model of the middle reaches of Myitmaka rever has been built and hydraulic simulation has been made by the electronic computer. However, the detail simulation analysis could not be carried out because of the deta deficiency. It will be possible to grasp the hydraulic status of the Project Area by the preparation of the complete data and the extension of the mathematical model.

I. INTRODUCTION

I.1. Outline of the Projects

1) Name of Project

a) Monyo Area Polder Works Project
b) Ingabu Area Polder Works Project
c) Danubyu Area Polder Works Project
d) Thenet C. Flood Control Structure Project

2) Location (Ref. to Fig. E.1)

a) Monyo Township
b) Ingabu Township
c) Danubyu Township
d) Monyo Township

3) Agency Concerned

Irrigation Deaprtment

4) Objectives

In line with the Government policy, the improvement of ill-drained low-lying lands around the three major rivers, Irrawaddy Myitmaka and Bassein, contributes doubtlessly toward the expansion of farm land.

5) Background

a) A number of vast inundated area developed around the three major rivers in the Project Area. These uncultivable land or ill-drained areas are currently subject to abandon implying enormous development potentiality.

b) A drastic solution may be accompanied with a big investment together with time and man power. Thus, step by step approach but not disorder development is proposed under this Project. This Project may be significantly

characterized by such nature as pilot project for future inundated area improvement over the entire areas.

c) Similar practices are also employed under the Pilot Land Consolidation Project which may refer to the Reservoir Irrigation Project for the existing paddy areas.

6) Components (Refer to table E-2)

a) Embankment
b) Sluice gate
c) Drainage canal
d) Reclamation of swamp
e) Land consolidation
f) Pumping plant for drainage and irrigation
g) Roller gate

I.2. Review of Existing Data

The reliable hydrological data for long term observation in the Project Area are indispensably required to formulate the project plan for polder and flood control works.

Concerning to the hydrological data, it is mentioned in Annex D.

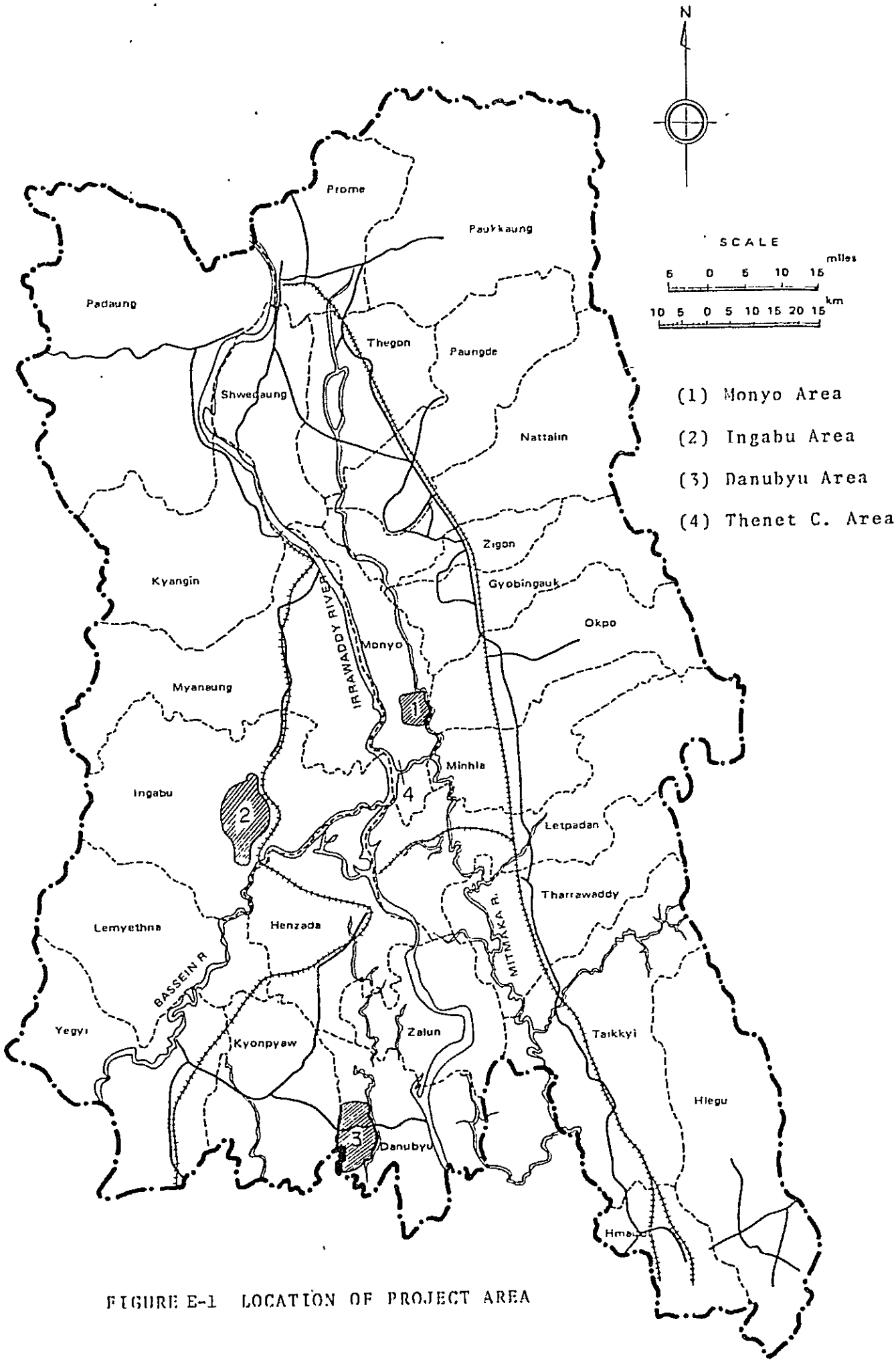


FIGURE E-1 LOCATION OF PROJECT AREA

TABLE E-2 PROJECT COMPONENTS

	Project Name	Project Area (ha)	Cultivable Land (ha)	Embankment (km)	Drainage Canal (km)	Gate	Remarks
(1)	Monyo Polder Works	5,800	3,200	17.5	18.0	Sluice Gate	2.0 to 5.0 m Height Embankment
(2)	Ingabu Polder Works	15,000	9,000	31.5	19.0	Sluice Gate	2.0 to 5.0 m Height Fmbankment
(3)	Danubyu Polder Works	7,700	5,000	37.0	11.3	Sluice Gate	1.0 to 2.0 m Height Embankment
(4)	Thenet Chaung Flood Control Works	52,300	42.000	-	-	Roller Gate	-

II. PRESENT CONDITION

II.1. Physical Conditons

The plains of the Project Area are consisted with wide spread deltas formed by Irrawaddy river. The delta area reaches Prome, the most northern place of the project. Topography of this area is flat; the most part is covered with lowlands, of which heights are around 50 ft. above mean sea level; the average slope of the river bed between Prome and Henzada is about 1/10,000.

The geographic condition of the Pegu range, the east boundaries of the region, has erosive characteristics, and the mean annual rainfall is about 2,000 mm (about 80 inches). Consequently, about ten tributary rivers of this area transport a large quantity of sediment run-off to the downstream. These rivers, or chaung form alluvium plains on the east side of the Irrawaddy.

As for the Arakan range, the west boundaries, the geographic condition is comparatively solid, and the topographic feature is quite steep. Therefore, a large alluvium plain has not formed.

Flood control of Irrawaddy River has begun formerly and embankments of the both sides are almost constructed. (Ref. to Fig. E-2) The height of the west embankment is one-feet higher than the east embankment for the purpose of protecting the wide and fertile delta area, of where Henzada is situated to the vertex. Owing to the natural flow doctrine for flood control of the Irrawaddy, the great portion of the region below the elevation of about 15 m (50 ft) would be the returding basin.

The lowlands make swamp and mostly it can be found along Myitmaka River and the west side of Bassein river. The condition of the drainage of the swamp is not so good, because it contains clay a great deal. On the other hand, the drainage condition of the

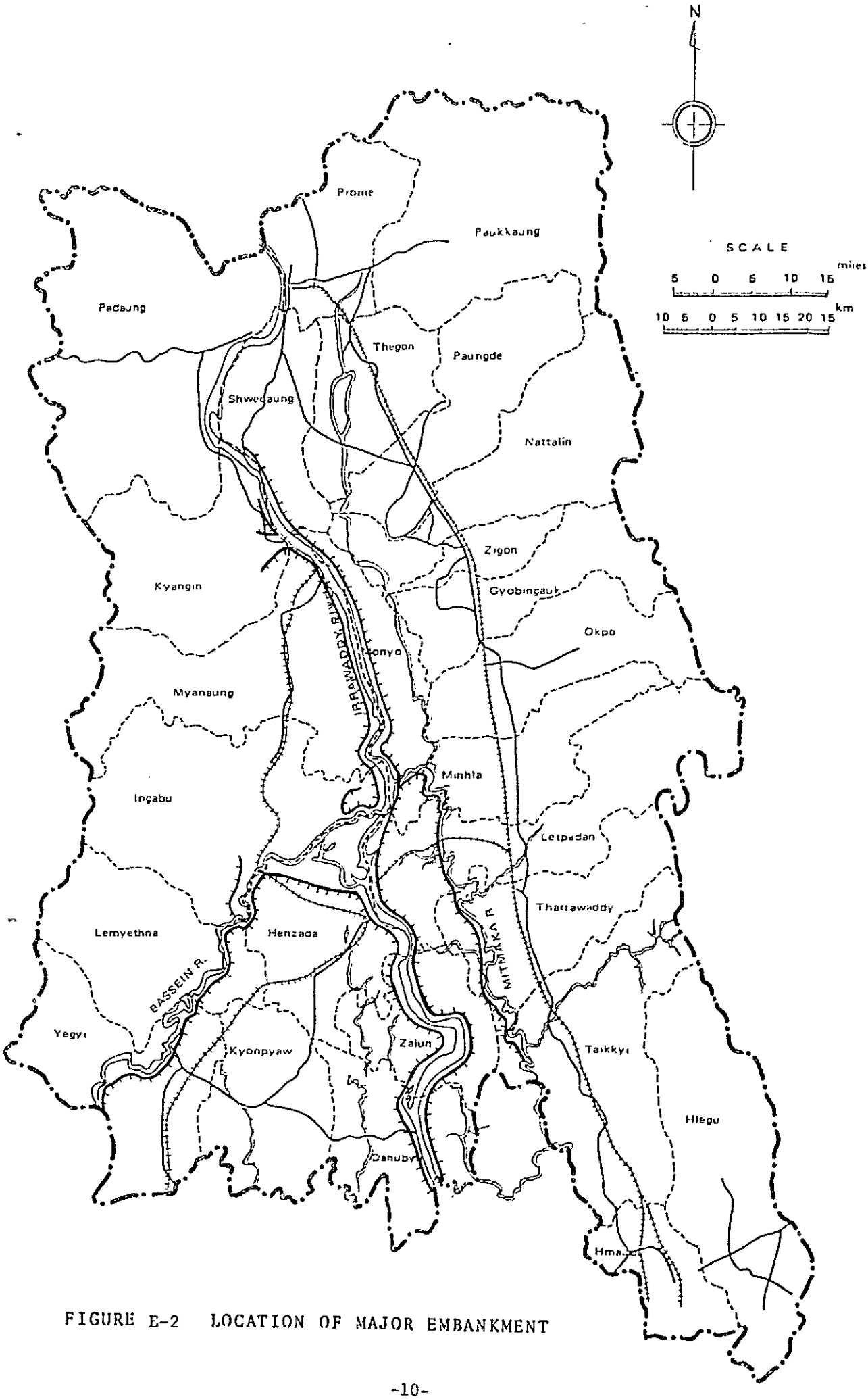


FIGURE E-2 LOCATION OF MAJOR EMBANKMENT

place over about 15 m (50 ft) above mean sea level, where is not inundated, is good because of its component of silt and sand.

In order to promote the plan of the drainage improvement or the polder works of the lowlands in this region, it is necessary to prove the problem quite contrary to the flood control of Irrawaddy river. Since the great part of this region is non-tidal compartment, hydraulic condition is comparatively simple in the flood season.

II.2. Major Rivers

The major rivers of the Project Area are Irrawaddy river, Myitmaka river, and Bassein river. (Other tributary rivers or small streams are called "chaung" in the region and the word will be used in the followings). Concerning to those three river, brief explanations will be made as follows. (Ref. to Fig. E-3)

1) IRRAWADDY river

The catchment area of Irrawaddy river is about 400,000 sq.km at Prome site. Its peak flood discharge was recorded in 1974 at 60,000 cu.m/s. In the downstream of Prome, it is impossible to make an accurate discharge measurement, because the river course often changes its stream axis in the delta area. (Ref. to Fig. E-4)

The embankment of both sides of the Irrawaddy river are nearly completed. However, there are no irrigation or drainage facilities directly constructed in Irrawaddy river. The difference of water level between high water and low water is about 10m (about 30 ft). According to the local people, the river water flows to Myitmaka river basin at three confluences of its west side during the rainy season. (The tributary streams are Sinagaung, Miyttha and Thenet Chaung.) Consequently, water is gathered and stagnant to make swamps in this area.

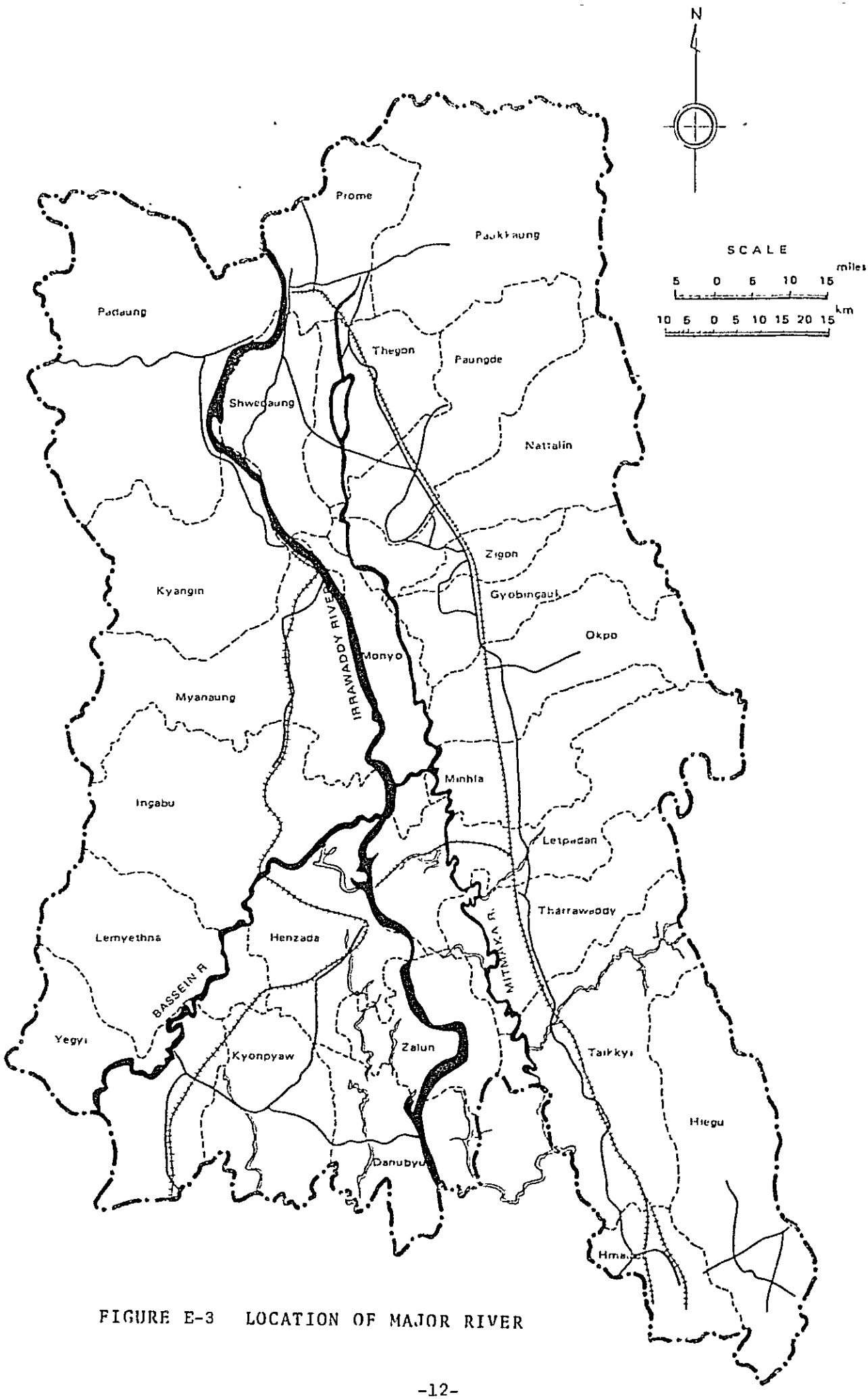


FIGURE E-3 LOCATION OF MAJOR RIVER

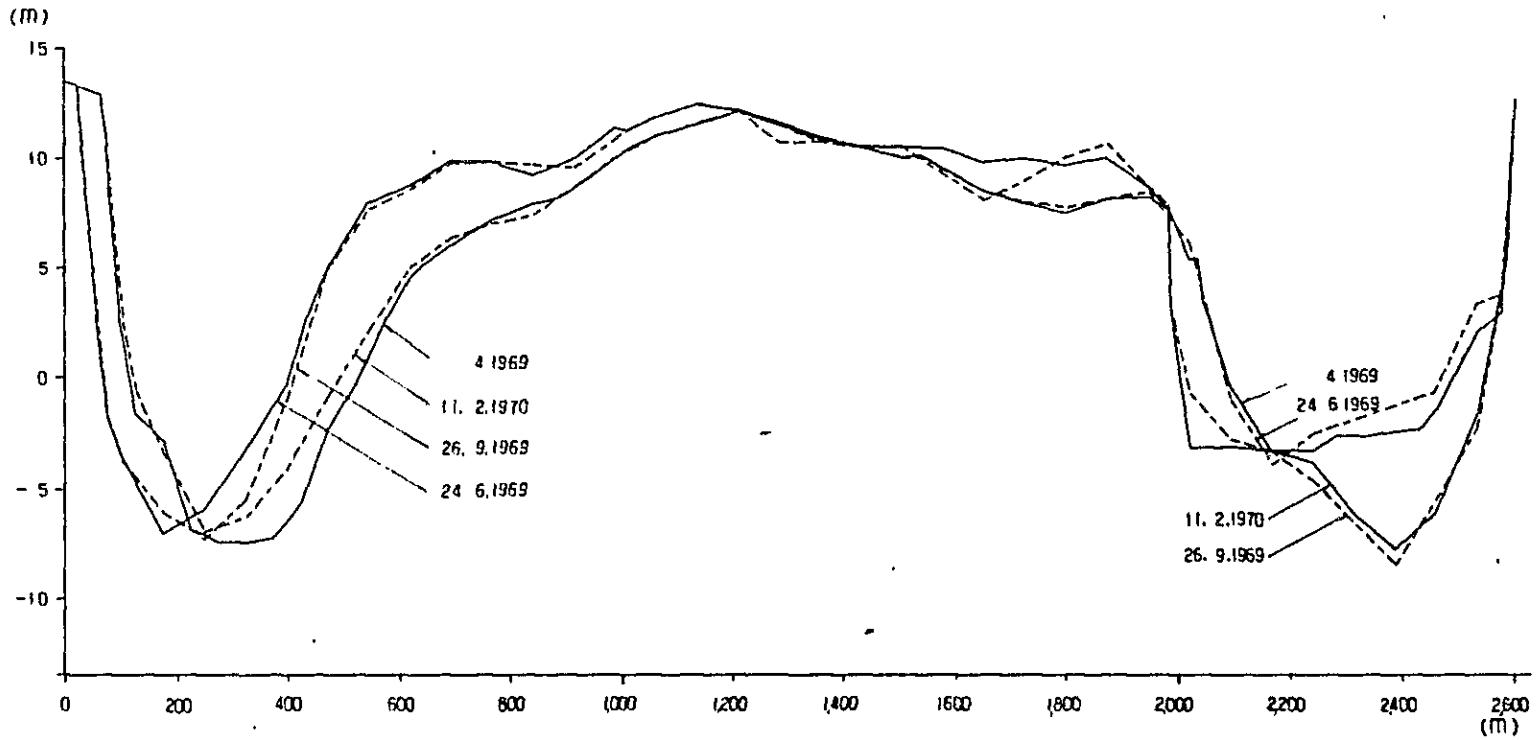


FIGURE E-4 CROSS SECTION OF IRRAWADDY RIVER AT HENZADA

As the result of the field survey, the flow regime at the conflux of Myitmaka river with Thenet Chaung was investigated. However, two places branching in the upper stream could not be surveyed. Taking into consideration of confluence-conditions with Myitmaka river, the amount of diverted discharge from the upper two tributaries to Irrawaddy river should be investigated.

Bassein river joins Irrawaddy river to be the west boundaries of the large delta, of which vertex is Henzada.

2) MYITMAKA river

Myitmaka river is located to the west of the Irrawaddy, and covers the basin of the Pegu range. It runs through the lowest part of the Project Area, and diverts into Hlaing river and Rangoon river to flow in the Andaman Sea. The length of Myitmaka river is about 350 km (about 200 miles) and its catchment area is about 12,000 sq.km.

The river regime changes at the confluence with the diversion canals of Irrawaddy river: the river width of the upperstream is under 80m to 30m (about 70 - 100 ft).

The only completed embankment is about 50m (about 32 miles) at length in the right side of the middle reaches. As explained above, inundation of the lowlands are affected by the run-off from Myitmaka river basin and the inflow from Irrawaddy river.

Irrigation Department is constructing embankments, drainage canals, and a sluice gate, as Village Drainage Works (VDW) for this region. However, the construction works hardly progress due to the reason of financial difficulties.

3) BASSEIN river

Bassein river branches from Irrawaddy river in the north of

Henzada, and flows in the west of the Project Area. As already mentioned, the flood of Bassein river, mainly in its right side depends upon the flood of Irrawaddy river.

In addition, there are a few tributary streams, which cover the basin of the Arakan Yoma and flows in the right side of Bassein river. The catchment area of those streams is quite large; the Arakan Yoma, with comparatively high mountains around 1,200 m (about 4,000 ft) above mean sea level, has more rainfalls than that of the Pegu Yoma. Considerable amount of run-off water flows in the streams during the rainy season. It causes water stagnance of the east lowland together with the backwater followed by the rise of flood water level in Bassein river.

II.3. Inundation and Drainage Status

1) Myitmaka River Basin

Myitmaka river basin can be divided into three parts as follows.

a) Lower Reaches of Myitmaka River

Myitmaka river changes its name to "Hlaing river" in the down-stream. The embankment was constructed only in the left side of Myitmaka river in order to protect the lowland area form the flood.

At present, the Irrigation Department is executing the flood. tion works under the project as follow.

Name	:	Duntabe Embankment Project
Area	:	4,200 ha (7,000 ac)
Facilities:		Embankment 6.4 km (4 miles)
		Drainage Canal 8.0 km (5 miles)
		Sluice Gate

In order of flood protection of Myitmaka river, required methods would be; construction of embankment along Myitmaka river; river

improvement of tributary streams in the district and construction of flap gates to avoid tidal influences, since this region is located in the tidal compartment.

b) Middle Reaches of Myitmaka River

As for the right side of Myitmaka river, the embankment is nearly completed up to Lebu site, in the south of the Project Area. It forms polder with the left Irrawaddy embankment and the right Thenet embankment. This area has been protected from flood except the unusual flood in 1974.

In spite of the flood control works, the lowland still remains as inundating area; it is caused by inner drainage, since drainage canals are poorly provided. Cope with the problem, the Irrigation Department is promoting a few plans of drainage project; out of which two places of sluice gates [1.2m (4 ft) x 1.2m (4 ft) x 2 nos.] have already been constructed.

Faced to financial problems, however, the construction of main drainage canal is not started yet. Accordingly, the flood water of Myitmaka river flows into the area from the no embankment parts and makes inundation damages to the area.

As for the left side of Myitmaka river, project plans have not been considered yet. Therefore, the area is inundated by the flooding of Myitmaka river during the flood season. The water level in the inundated area reaches about 15m (about 50 ft) in the upper part near the railway line (between Tharrawa and Letpadan), (between Rangoon and Prome) and Myitmaka river.

Taking account of each crossing point at the national road (Prome Road), the tributary stream of Myitmaka River is estimated to have a sufficient Discharge capacity. However, according to the local people, the region has been inundated about once three years.

The inundation might have been caused by the back water from the flooding of Myitmaka River.

c) Upper Reaches of Myitmaka River

Myitmaka River in the upper reaches flows down through the very narrow levees near Monyo, where the elevation is over 15m (50 ft). In the upstream of the narrow place lies the lowland, tangled with netlike streams to form swamps. In this area, there are two places, at Singaung and Myittha, from where flood water from Irrawaddy river flows into Myitmaka river. The flow regime of the above two parts, however, could not be confirmed.

The inundation area of Myitmaka river has been accumulated by a volume of sediment from the flooding of Irrawaddy river, and the sediment brought by the flows of the Pegu range. The land is cultivated with upland crops as "Kaing Land" during the dry season.

2) West Side of Irrawaddy River

The west side of Irrawaddy river is divided into the following two parts.

a) The right-side reaches of Irrawaddy river

This area forms polder with the Irrawaddy embankment and the railway line. The northern part is over 15m (about 50 ft) above mean sea level at height and has no tributary streams, so that there has been no inundating area caused by flood. The slight inundation near Tu In Swamp is caused by the rise of water level of Mamya Chaung during the flood season. At present, the drainage plan for this district is under construction, and the Project Area is 400 ha (100 ac) at its size.

The southern part of this area has depressed area, where river water flows in from Mamya Chaung and Kankin Chaung. The inundation

of the places mentioned baove is caused by these chaungs, and the back water from Bassein River during the flood season.

In addition, a polder at size of 1,900 ha (4,800 ac) has been completed near Kyang in 1960. (Sluice gate: 12ft x 12ft x 2 nos.)

b) Bassein River has no embankments for its right side reaches; river water flows in to the Bassein from comparatively large sized tributary streams, such as Kankin Chaung, and Nangathu Myaunt Bhaung, that cover the basin of the Arakan range. Accordingly, the flood from Bassein River and the discharge of the Arakan Yoma cause inundation in the lowland area.

3) Delta Area

This area is covered with the delta, of which two sides are Irrawaddy river and Bassein river, and of which vertex is Henzada in the north. Even during the flood season, The delta Area is protected perfectly by the embankments along the both rivers. However, near Danubyu, the most southern part of the area, the lower places are inundated due to the poor drainage condition, and floating rice is cultivated at present time.

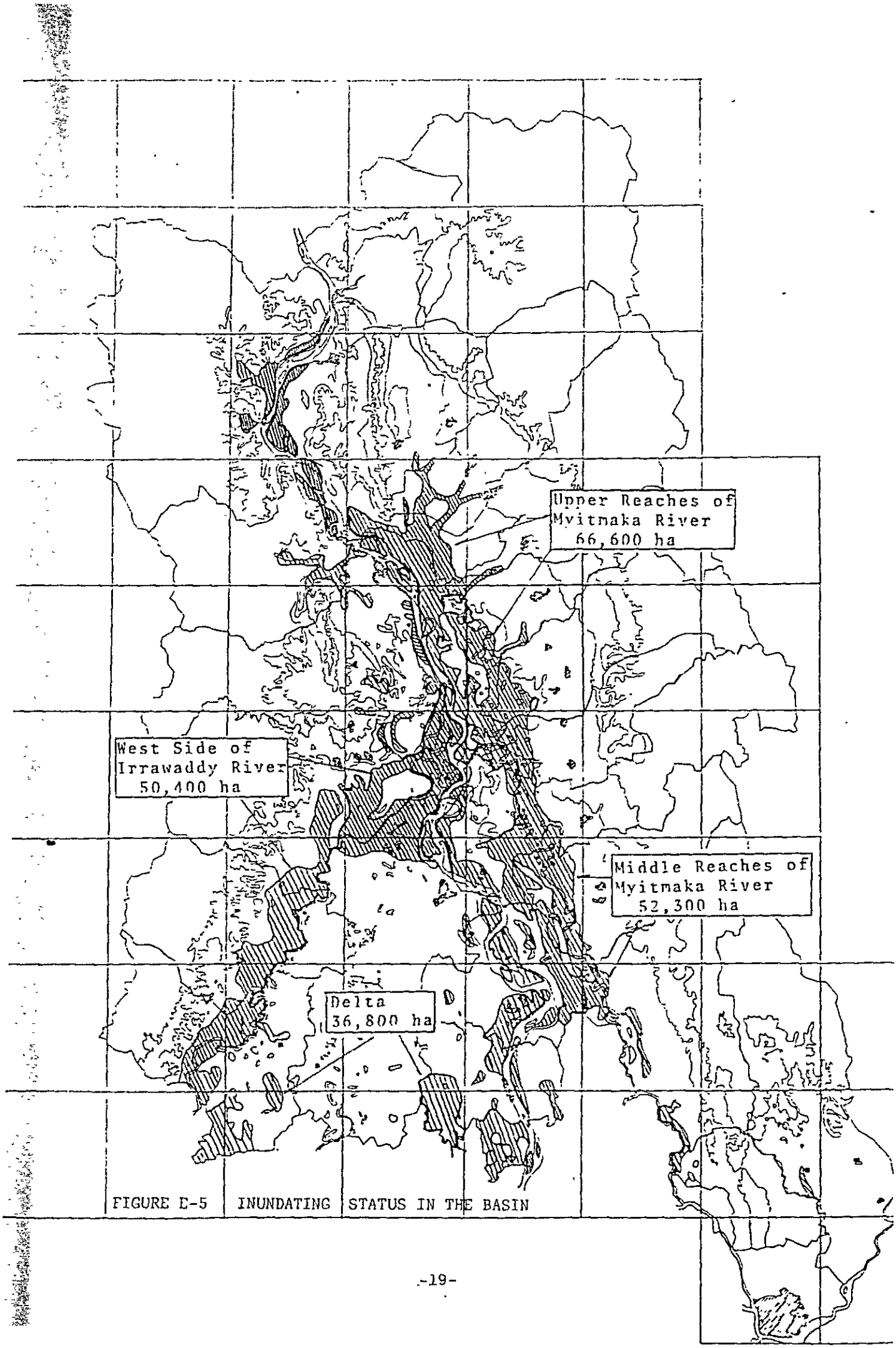


FIGURE E-5 INUNDATING STATUS IN THE BASIN

TABLE E-3 INUNDATING STATUS IN THE BASIN

Basin	Area (H)	Period	Av. Depth (M)	Av. Grand Height (M)	High Water Level	Remark
Upper Reaches of Myitmaka River	66,600	Jul. to Oct.	4.3	12.0	14.8	Gamon ST.
Middle Reaches of Myitmaka River	52,300	"	3.5	9.0	13.1	Dawwi ST.
West Side of Irrawaddy River	50,400	"	2.7	12.0	14.5	Henzada ST.
Delta	36,800	"	2.1	4.0	No Data	
Total	206,100					

TABLE E-4 INUNDATING STATUS AT EACH TOWNSHIP

(Unit: ha)

No.	Township	Inundating Area	Remark
1.	Paukkaung	2,825	
2.	Prome	2,613	
3.	Padaung	10,163	
4.	Paungde	1,139	
5.	Thegon	1,317	
6.	Shwedaung	11,785	
7.	Nattalin	1,386	
8.	Jigon	498	
9.	Gyobingauk	2,446	
10.	Monyo	35,045	
11.	Okpo	3,861	
12.	Minhla	7,435	
13.	Letpadan	11,620	
14.	Tharrawaddy	5,045	
	Sub-total	97,178	
15.	Taikkyi	4,284	
16.	Hlegu	3,686	
17.	Hmawbi	2,554	
	Sub-total	10,524	
18.	Kyangin	4,766	
19.	Myanaung	11,524	
20.	Ingabu	11,628	
21.	Lemyethna	7,077	
22.	Yegyi	10,423	
23.	Henzada	20,182	
24.	Zalun	21,413	
25.	Kyonpyaw	2,748	
26.	Kanubyr	8,676	
	Sub-total	98,437	
	Total	206,139	

III. POLDER WORKS

III.1. Premises for Polder Works

In order to examine the project, the premises are set up as follows.

a) The investigation of flood and inundation have been performed by the informations of local people at the time of field survey; the use of topographic map (one-inch map); and the interpretation of satellite pictures.

b) Concerning to water level of Myitmaka river, the records of mean daily water level at Gamon, Dawwi, and Kunakyaik site have been used, these observations were carried out by the Irrigation Department. As for Bassein river, the records of mean daily water level at Henzada site of Irrawaddy river have been used instead for convenience. The ground elevations of the polder area have been assumed by spot elevations marked in the topographic map (one inch map).

c) The daily rainfall records at Henzada and Tharrawaddy rain gauge stations have been used.

d) Strictly speaking, design water level for each river should be determined by the hydraulic analysis connected with the flood status of Irrawaddy river. But at present stage, design water level has been estimated by the observed data at nearby gauging station.

III.2. Selection of the Project Areas

1) Pre-conditions for the Selection

Taking account of technical, financial, social conditions and the operation and maintenance in the future, the following areas

have been considered as the objects of the drainage and polder projects. The relevant areas are:

a) the area, inundated by the flow of inner or outer rivers during the rainy season, left un-cultivated at present, but cultivable and possible to be improved by the construction of relatively small-scaled facilities.

b) the area, surrounded by the cultivated places, used to be inundated by rainfall into own area due to insufficient drainage facilities.

c) the area already included in the governmental proejct, or requested by the Government to be included in the proejct.

d) Concerning to the area that turns to be a retarding basin for Irrawaddy river during the flood season, the development plan for the area should be laid aside, for the purpose of its specific role as a retarding basin. However, the part of the area, where its role might not be so important, has been considered as the Project Area.

2) Determination of the Proejct Area

The cultivated land in the surveyed area extends over about 1.2 million ha (about 3 million ac), of where one million (about 2.5 million ac) is covered by the paddy field. Mainly the paddy field is located in the lowlands. All of the paddy field is rainfed and there is no systematic drainage networks. The drainage improvement for this area is closely related to the irrigation water supply, so that the drainage problem will be examined in Annex D, together with the land consolidation works relevant to the irrigation plan of this survey. The Project Area along Irrawaddy river, Myitmaka river, and Bassein river will be studied as follows.

As mentioned in Chapter II, the inundated area of the

investigated area is estimated about 200,000 ha (about 694 thousand ac). This area has a special role as a retarding basin for Irrawaddy river during the flood season. Therefore, a large-scaled drainage and polder project should be avoided. On the basis of the pre-conditions mentioned above and the results of the field survey, following Project Area along each river have been determined. (Ref. to Fig. E-6)

a) Monyo Area for Myitmaka River Basin

The place is situated near Monyo, and is quite easy to be inundated by insufficient discharge capacity of Myitmaka river during the rainy season. The polder works can be considered for this part; the embankments of left-side of the Irrawaddy river and the road between Minhla and Monyo would be available as a part of enclosure embankment.

b) Ingabu Area for the West Side of Irrawaddy River

Ingabu area is located in the lowland part between Bassein river and the Arakan range and its east side abuts on the railway between Kayngin and Henzada. This area belongs to the Ingabu township. The highest ground elevation in the area is 15m (about 50 ft) and the lowest is 10m (about 30 ft). The central part forms swamps.

c) Danubyu Area for the Delta Area

The delta area that includes Henzada in the north is protected from the floodings of Irrawaddy river by its embankment. However, the southern part of the surveyed area is partially inundated during the rainy season, because of its gently-slopig feature in topography. The area along the road between Danubyu and Kyonpyaw is selected; that belongs to Danubyu township.

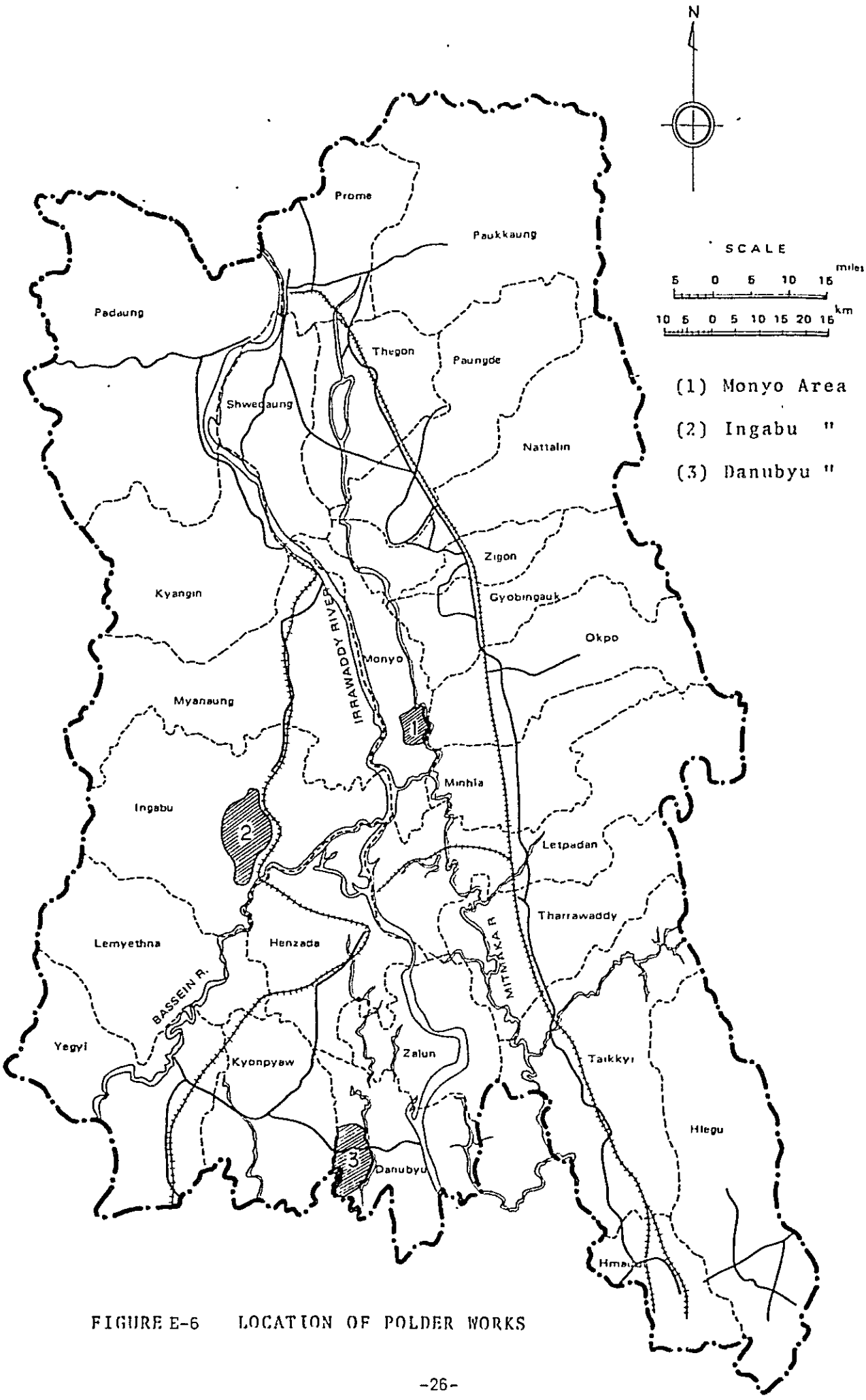


FIGURE E-6 LOCATION OF POLDER WORKS

III.3. Possibility of the Project

Most of the objective areas have been damaged by inundation caused by the rise of water level during the flood season. In this section, possibility of the project plan will be examined, from the view-point of the relationship between flood frequency and ground elevation of the Project Area. (Ref. to Fig. E-7, Table E-5, E-6)

Judging from the collected data, the flood frequency of the lowest part of the relevant area is about 45 precent in Myitmaka river basin, and about 60 percent in the west-side Irrawaddy Basin. In order to improve the lowest parts, pump plants should be required, of which construction and operation and maintenance cost is estimated considerable high. Therefore it may be said that a complete land utilization plan extending to the lowest parts is still reserved from financial point of view.

Also possibility of the project plan of the polder works will be estimated by the relation between run-off by rainfall in relevant areas and water balance connected with outer water level.

Accordingly the polder works of three areas have been selected: and the relationship between flood frequency and grand elevation of each area has been studied, together with the utilization of inner drainage by pump plant.

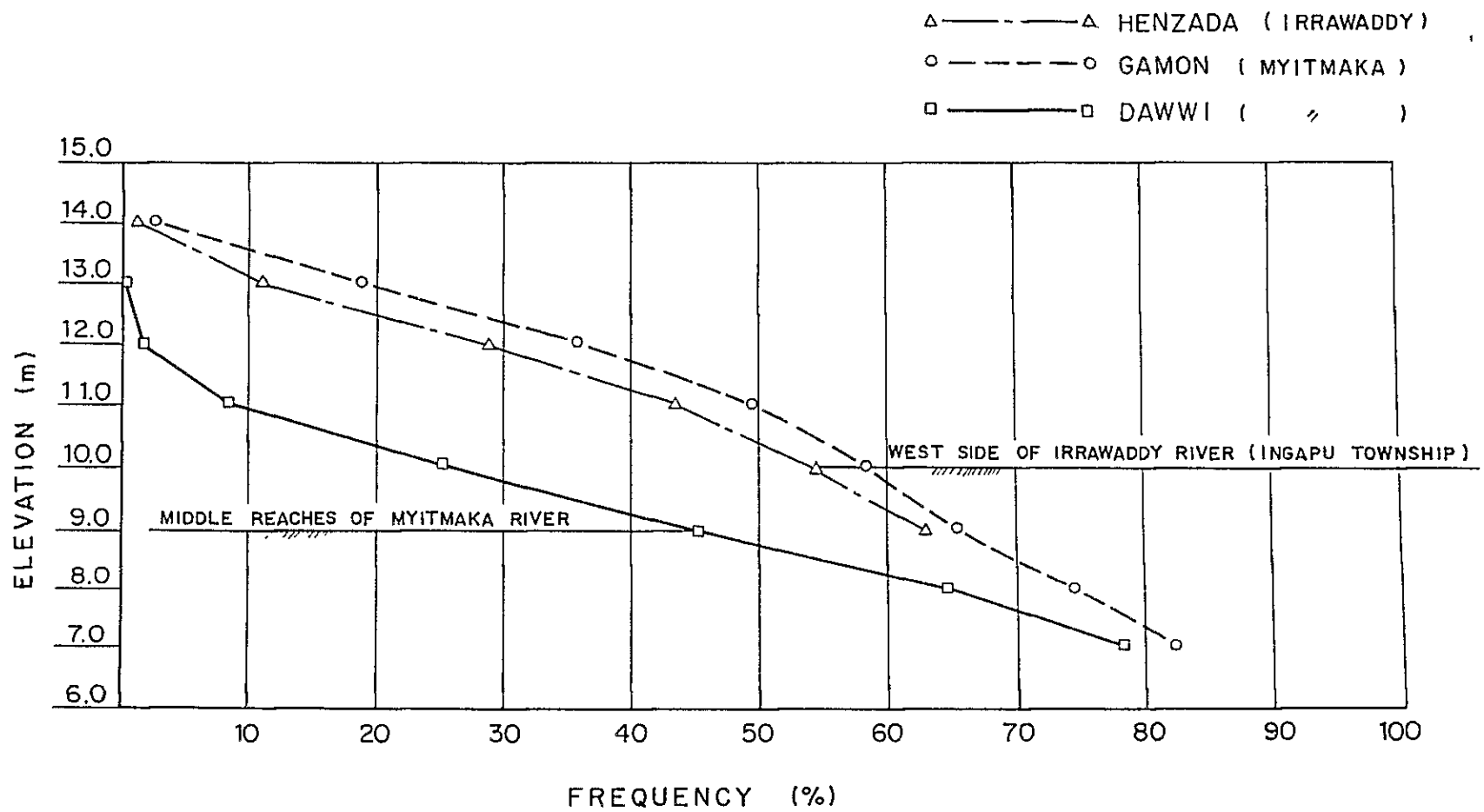


FIGURE E-7 WATER LEVEL FREQUENCY

TABLE E-5 WATER LEVEL FREQUENCY OF IRRAWADDY RIVER AT HENZADA

(Unit: day)

Year	All Data	Range (m) 9.0	10.0	11.0	12.0	13.0	14.0	Remark
1960	183	92	77	58	42	-	-	
61	"	104	78	52	30	11	-	
62	"	93	85	66	49	9	-	
63	"	125	110	86	68	11	-	
64	"	107	98	90	52	1	-	
65	"	137	125	92	35	13	-	
66	"	132	128	121	102	55	7	
67	"	116	81	68	17	-	-	
68	"	118	106	97	64	40	-	
69	"	104	96	87	60	20	-	
1970	"	133	106	67	40	28	4	
71	"	135	126	96	59	29	3	
72	"	81	47	26	17	4	-	
73	"	120	106	79	58	18	5	
74	"	116	112	108	88	50	10	
75	"	117	102	73	38	5	-	
76	"	128	107	80	64	26	10	
77	"	115	102	82	62	13	3	
Total	3,294	2,073	1,792	1,428	945	333	42	
%	100	62.9	54.4	43.4	28.7	10.1	1.3	

Note: All Data---Number of available data in July to November

TABLE E-6 WATER LEVEL FREQUENCY OF MYITMAKA RIVER

(Unit: day)

Year	All Data	Range (m) 7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	Remark
1970	169	96	85	72	60	48	21	-	-	Gamon ST.
71	183	162	149	138	128	109	66	50	5	
72	160	116	100	78	54	30	20	-	-	
73	-	-	-	-	-	-	-	-	-	
74	153	143	141	124	117	111	100	61	13	
75	-	-	-	-	-	-	-	-	-	
76	183	163	139	118	112	94	76	41	7	
77	-	-	-	-	-	-	-	-	-	
78	153	143	132	124	113	103	76	36	-	
Total	1,001	823	746	654	584	495	359	188	25	
%	100	82.2	74.5	65.3	58.3	49.5	35.9	18.8	2.5	
1972	111	63	28	22	8	-	-	-	-	Dawwi ST.
73	153	121	104	66	31	6	-	-	-	
74	153	125	118	108	85	48	15	2	-	
75	153	126	105	53	12	-	-	-	-	
76	139	118	90	64	30	18	-	-	-	
77	-	-	-	-	-	-	-	-	-	
78	138	111	102	70	37	-	-	-	-	
Total	847	664	547	383	213	72	15	2	-	
%	100	78.4	64.6	45.2	25.1	8.5	1.8	0.2	-	

Note: All Data---Number of available data in July to November

III.4. Project Formulation

1) Assumptive Conditons

Three areas selected for the project will be examined on the following assumptions; ring levee will be constructed to protect the areas from the floodings during the rainy season; inundated volume brought by rainfall in the relevant areas will be computed; and as the consequences of the project, the extension of cultivable land will be estimated.

Taking the cost of construction, operation, and maintenance into consideration, the case of complete drainage of inner water in the lowland areas will be excluded.

a) Outer water level

Generally speaking, the calcualtion of water balance should be made in relation to the outer water level and run-off caused by rainfall in the relevant areas on the basis of design year. In this chapter, however, observed data in 1974 has been used for water level in order to know the tendency. (The maximum water level at Prome in 1974 corresponds to 40 year return period).

b) Rainfall

Concerning to the calculation of inner discharge, the return period of total rainfall in inundated period should be considered. Here, 2 - 5 year return period of annual rainfall is adopted. The rainfall data at Tharrawaddy has been used for Myitmaka river basin, and that at Henzada has been used for the west side of Irrawaddy river.

c) Unit area drainage discharge

The Irrigation Department is adopting the way that 10% probability 6 day maximum rainfall drains out within 6 days. In the

delta area in lower Burma, 4.5 ℓ/sec/ha has been adopted. 10% probability 6 day maximum rainfall at Henzada station is 335 mm. (13.2 inches) Based on the rainfall above, the unit area dainage discharge is 3.2 ℓ/sec/ha. In the same way, at Tharrawaddy station, 10% probability 6 day maximum rainfall is 318 mm. (about 12.5 inches) and the unit area drainage discharge is 3.1 ℓ/sec/ha.

2) Outline of the Project

a) Monyo area

The left Irrawaddy embankment and the road between Minhla and Monyo can be used as the part of the enclosure levee; in addition new embankment, 17.5 m (57 ft) at length, is planned to be constructed along the right side of Myitmaka river. (Ref. to Fig. E-8, E-9, E-10, Table E-7)

Component and Major Dimensions

Project Area	5,800 ha (14,500 ac)
Cultivable Land	3,200 ha (7,900 ac)
Embankment	17.5 km (11 miles) [H=2~5m (7~15 ft)]
Drainage Canal	18.0 km (11.3 miles)
Sluice Gate	6 nos. (3.6m x 3.6m) (12 ft x 12 ft)
Land Consolidation and Swamp Reclamation	3,200 ha (7,900 ac)

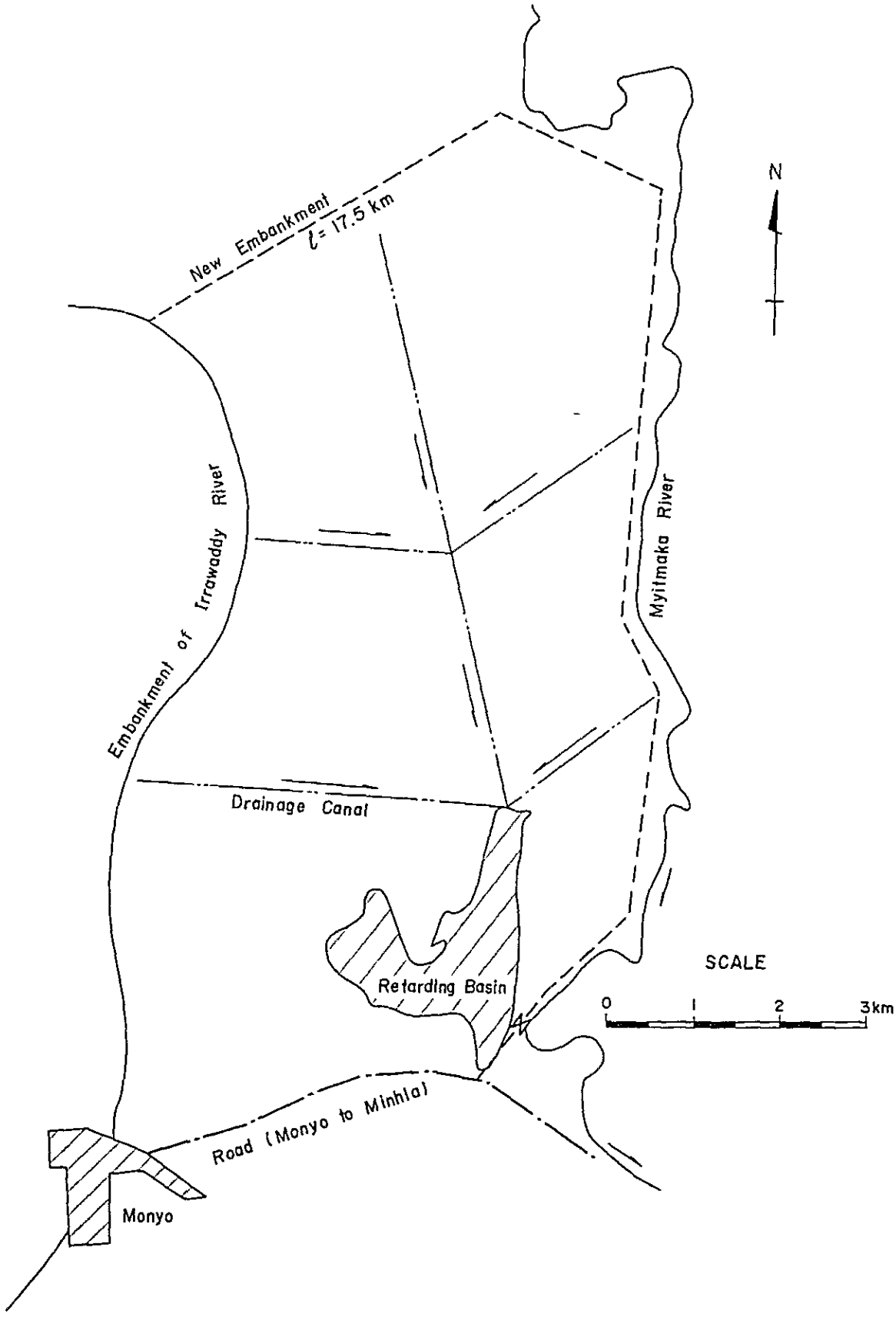


FIGURE E-3 POLDER WORKS IN MONYO AREA

Elevation	Area	Water Volume	Remark
m	ha	$10^3 m^3$	
12.00	270	———	
13.00	2,651	14,605	
15.00	4,994	91,055	
16.00	5,844	145,245	

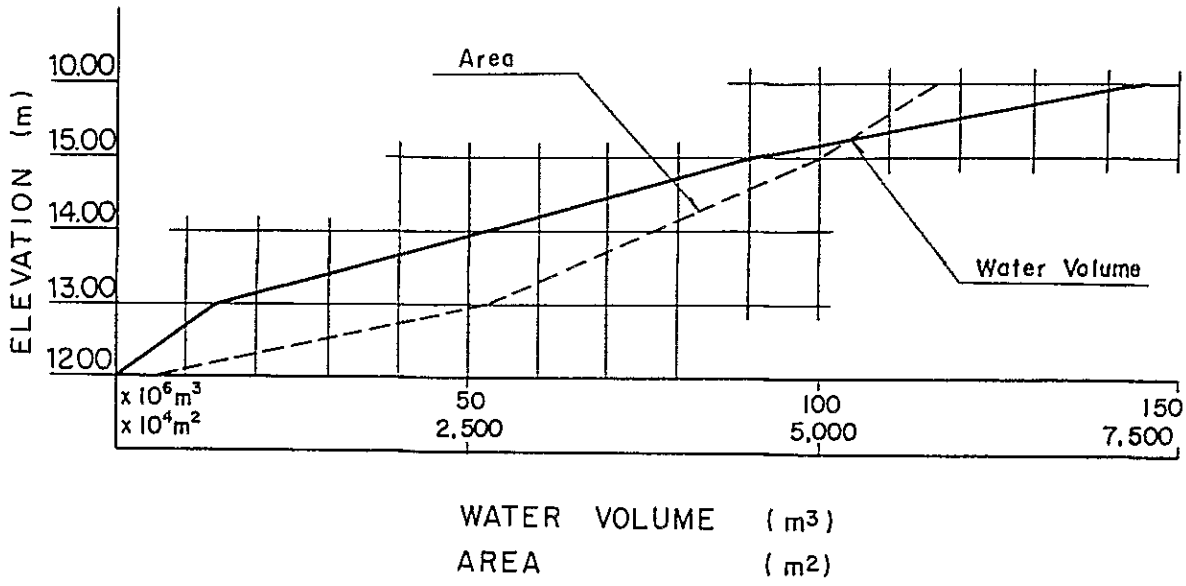
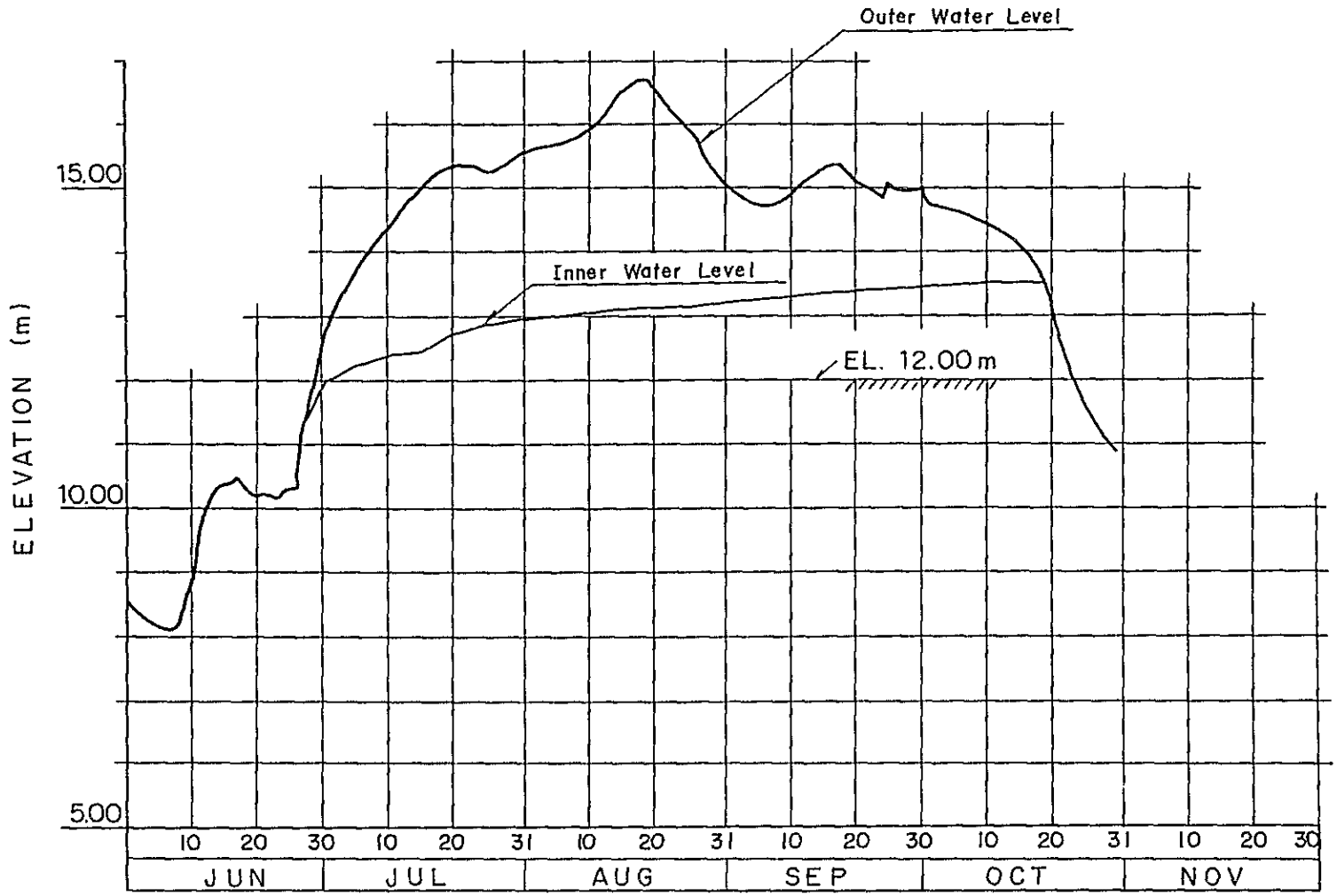


FIGURE E-9 H-A AND H-V CURVE AT MONYO AREA



FIGUREE-10 RELATION BETWEEN INNER WATER LEVEL AND OUTER WATER LEVEL AT MONYO AREA

TABLE E-7 COST ESTIMATION OF MONYO AREA

(Unit: Thousand Kyat)

Description	Quantity	F.C	L.C	Total
Embankment	542,500 m^3	-	2,713	2,713
Drainage Canal	(C) 68,000 m^3	-	286	286
	(B) 37,800 m^3	-	189	189
Sluice Gate (3.6 m x 3.6 m)	6 No.s	150	-	150
Land Consolidation and Swamp Reclamation	3,200 ha	-	8,960	8,960
Sub-total (1)		150	12,148	12,298
Engineering Fee, etc.	(15 % of 1)	23	1,823	1,846
Preparation	(10 % of 1)	15	1,215	1,230
Tax and Transportation	(50 % of 1)	75	-	75
Total (2)		263	15,186	15,449
Contingency (3)	(15 % of 2)	40	2,278	2,318
Price Escalation	(15 % of 2+3)	46	2,620	2,666
Grand total		349	20,084	20,433

b) Ingabu area

The embankment is planned to be constructed along the left side of Thebyu Chaung, along the right side of Bassein River, and along the railroad (Kyangin-Henzada).

In order to protect the area from the run-off from outer areas, intercepting drainage canal should be constructed in the northwest boundaries. (See Fig. E-11, E-12, E-13, E-14, Table E-8)

Component and Major Dimensions

Project Area	15,000 ha (37,000 ac)
Cultivable Land	9,000 ha (22,000 ac)
Embankment	31.5 km (20 miles)(H=2.0m-5.0m)
Drainage Canal	19.0 km (12 miles)
Sluice Gate	15 nos. (3.6m x 3.6m)
Land Consolidation and Swamp Reclamation	9,000 ha (22,000 ac)

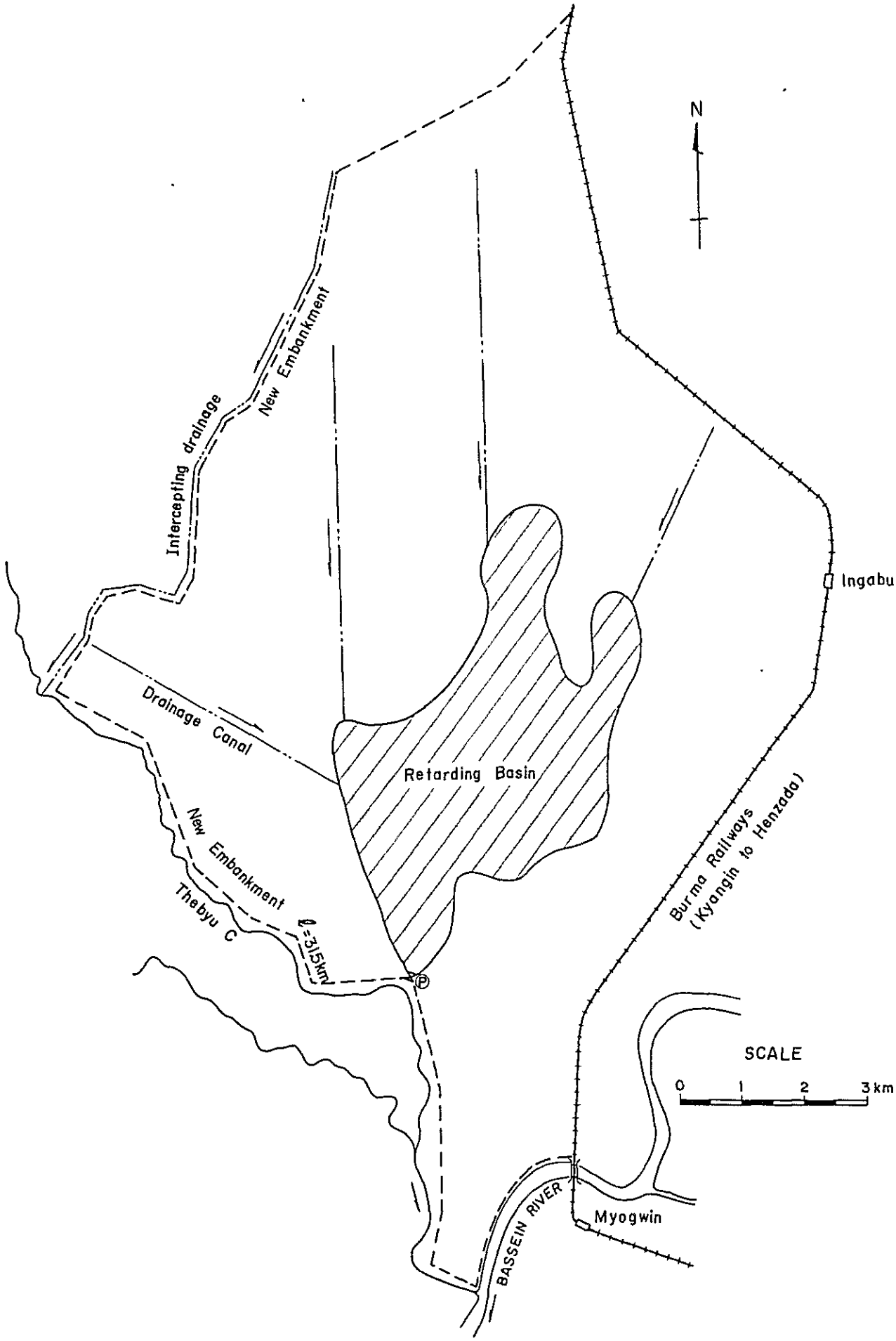


FIGURE E-11 POLDER WORKS IN INGABU AREA

Elevation	Area	Water Volume	Remark
m	ha	$10^3 m^3$	
10.00	2,000	———	
11.00	6,000	40,000	
12.00	12,000	130,000	
13.00	15,000	265,000	

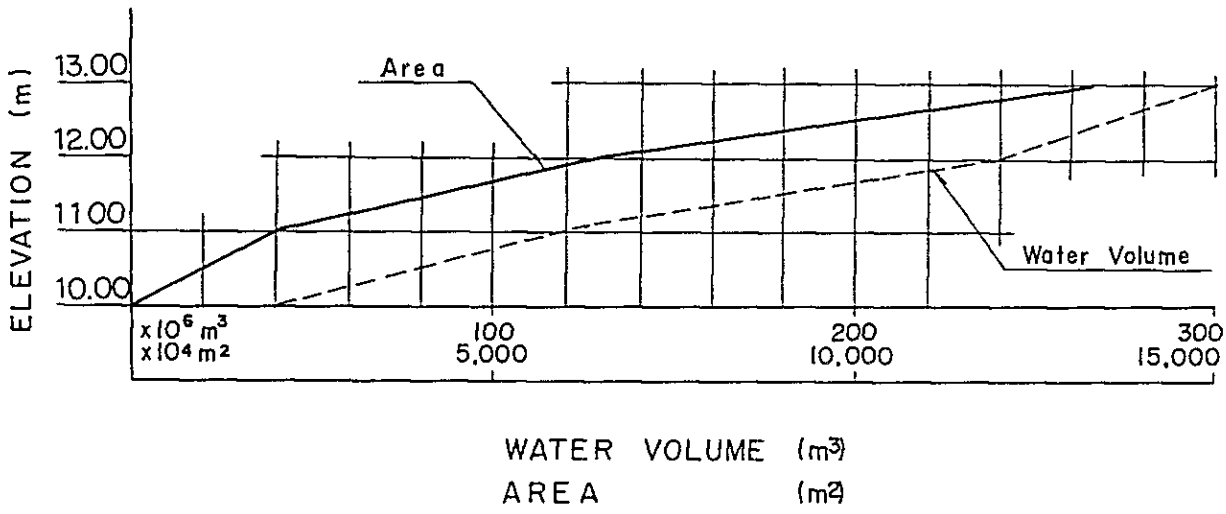


FIGURE E-12 H-A AND H-V CURVE AT INGABU AREA

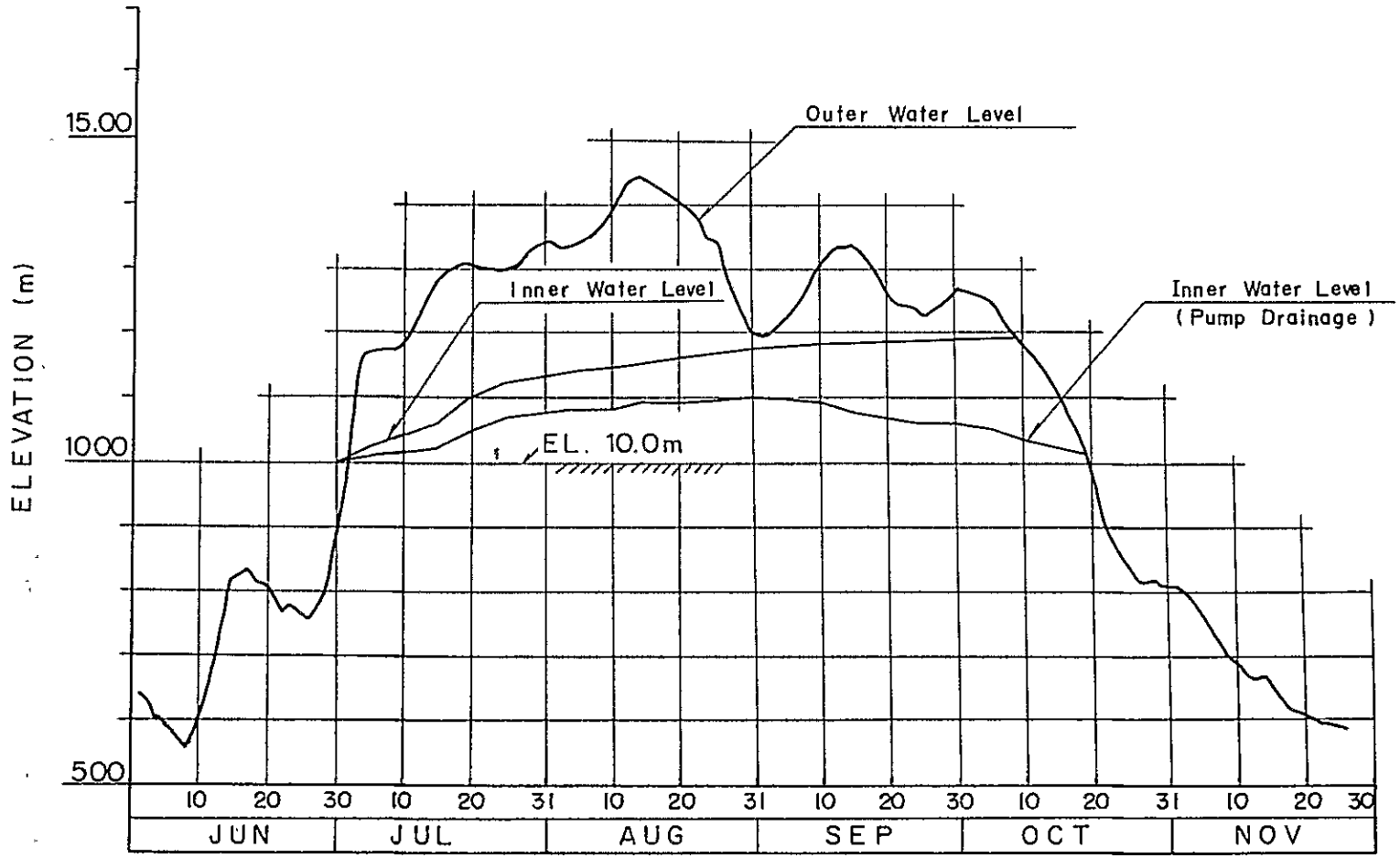


FIGURE E-13 RELATION BETWEEN INNER WATER LEVEL AND OUTER WATER LEVEL AT INGABU AREA

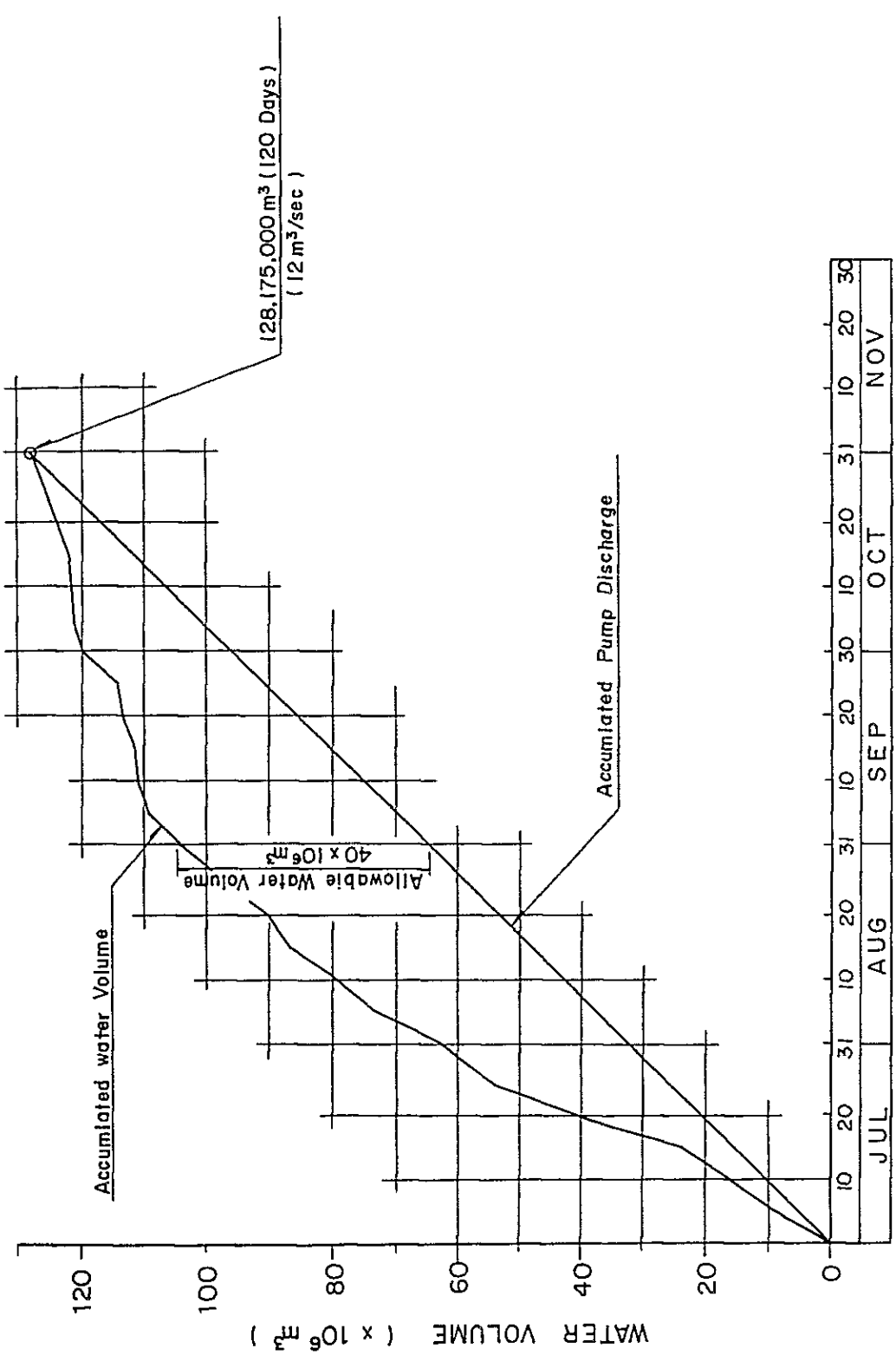


FIGURE E-14 RELATION BETWEEN PUMP DRAINAGE AND ALLOWABLE WATER VOLUME

TABLE E-8 COST ESTIMATION OF INGABU AREA

(Unit: Thousand Kyat)

Description	Quantity	F.C	L.C	Total
Embankment	976,500 m^3	-	4,883	4,883
Drainage Canal	(C) 65,800 m^3	-	277	277
	(B) 39,900 m^3	-	200	200
Sluice Gate (3.6 m x 3.6 m)	15 Nos.	375	-	375
Pumping Plant (1,700 mm)	3 Nos.	42,000	-	42,000
Land Consolidation and Swamp Reclamation	9,000 ha	-	25,200	25,200
Sub-total (1)		42,375	30,560	72,935
Engineering Fee, etc.	(15 % of 1)	6,357	4,584	10,941
Preparation	(10 % of 1)	4,238	3,056	7,294
Tax and Transportation	(50 % of 1)	21,188	-	21,188
Total (2)		74,158	38,200	112,358
Contingency (3)	(15 % of 2)	11,124	5,730	16,854
Price Escalation	(15 % of 2+3)	12,793	6,590	19,383
Grand total		98,075	50,520	148,595

c) Danubyu area

The embankment is planned to be constructed along Kyonpyat Chaung and Towtalu Chaung; and the water can be drained to Taungai Chaung. (Ref to Fig. E-15, E-16, Table E-9)

Component and Major Dimensions

Project Area	7,700 ha (19,000 ac)
Cultivable Land	5,000 ha (12,300 ac)
Embankment	37.0 km (23 miles) (H=1.0m~2.0m)
Drainage Canal	11.3 km (7 miles)
Sluice Gate	8 nos. (3.6m x 3.6m)
Land Consolidation and Swamp Reclamation	5,000 ha (12,300 ac)

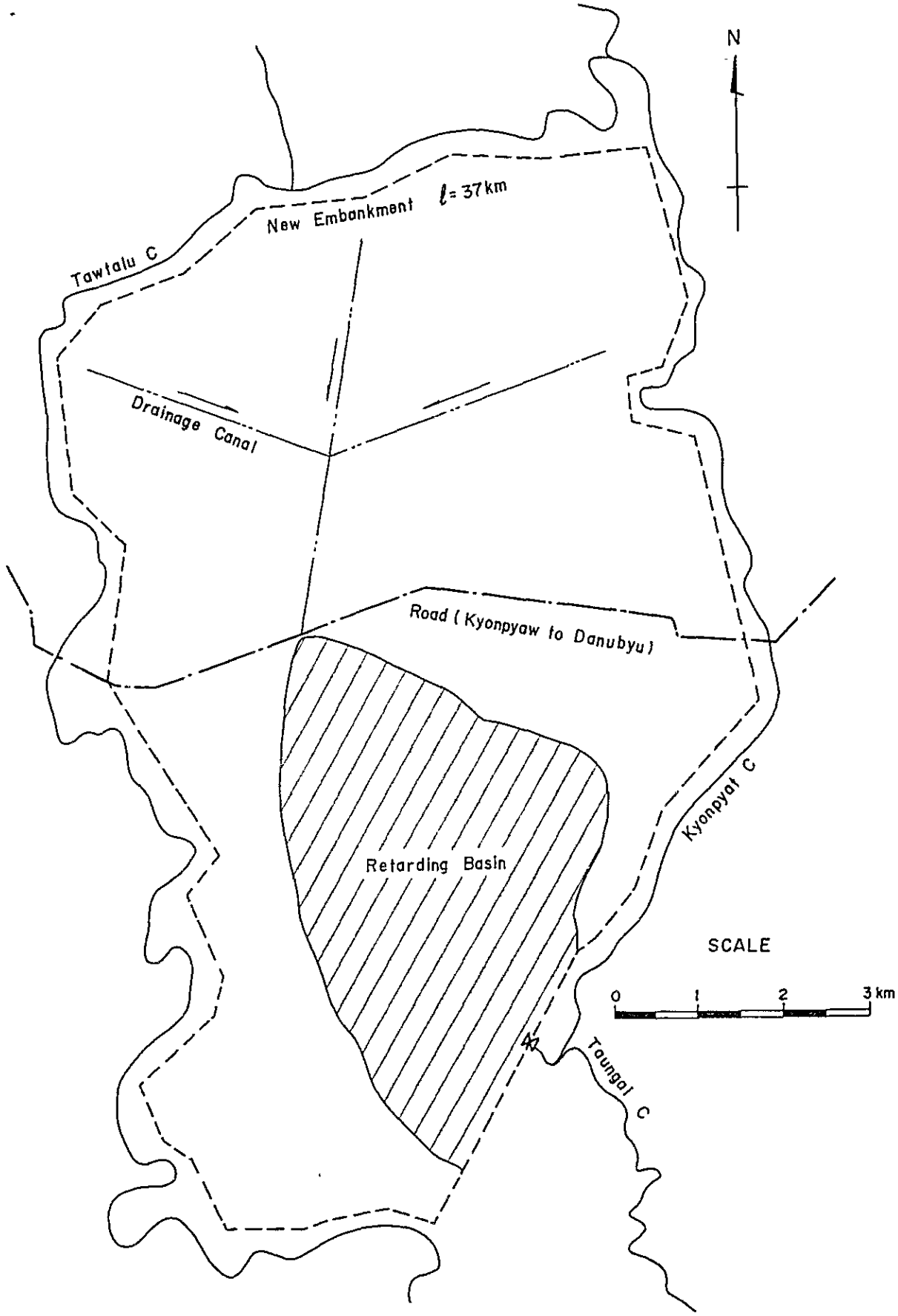


FIGURE E-15 POLDER WORKS IN DANUBYU AREA

Elevation	Area	Water Volume	Remark
m	ha	$10^3 m^3$	
2.00	2,264	———	
2.50	5,352	19,040	
3.00	7,732	51,750	

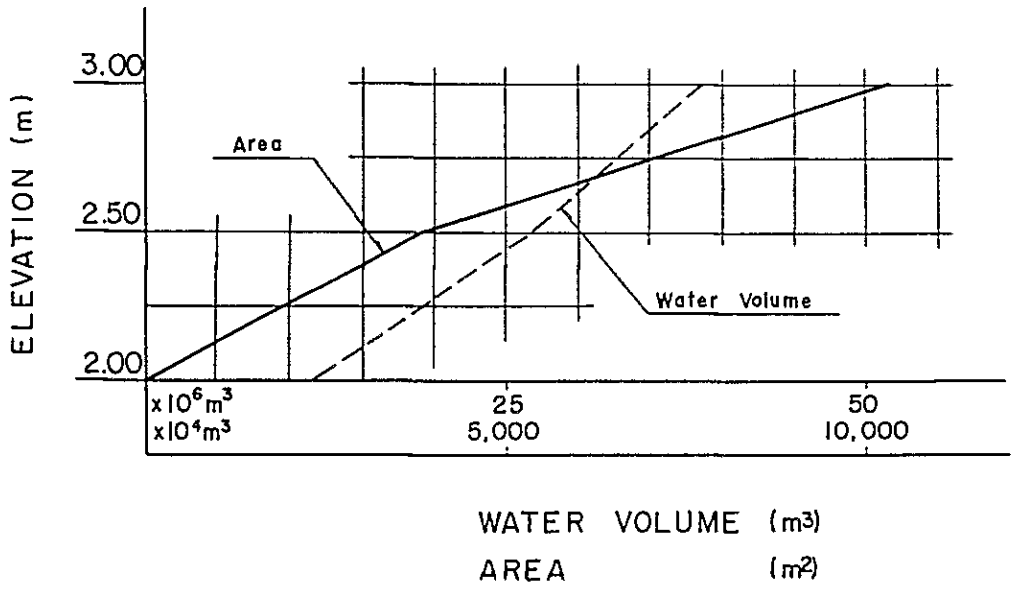


FIGURE E-16 H-A AND H-V CURVE AT DANUBYU AREA

TABLE E-9 COST ESTIMATION OF DANUBYU AREA

(Unit: Thousand Kyat)

Description	Quantity	F.C	L.C	Total
Embankment	325,600 m^3	-	1,628	1,628
Drainage Canal	(C) 44,400 m^3	-	187	187
	(B) 23,730 m^3	-	119	119
Sluice Gate (3.6 m x 3.6 m)	8 Nos.	200	-	200
Land Consolidation and Swamp Reclamation	5,000 ha	-	14,000	14,000
Sub-total (1)		200	15,934	16,134
Engineering Fee, etc.	(15% of 1)	30	2,391	2,421
Preparation	(10% of 1)	20	1,594	1,641
Tax and Transportation	(50% of 1)	100	-	100
Total (2)		350	19,919	20,269
Contingency (3)	(15% of 2)	53	2,988	3,041
Price Escalation	(15% of 2+3)	61	3,436	3,497
Grand total		464	26,343	26,807

III.5. Relationship to Other Stage

1) Relationship to Irrigation Project

Concernign to the areas under the project of drainage improvement and polder works, it would be better that the double cropping is induced with the construction of irrigation facilities. In relation with the irrigation plan, the irrigation water supply will be considered as follows.

a) As irrigation water for Myitmaka river basin, the repeating use of return flow by West Pegu Yoma Irrigation Plan, and pumping up from Irrawaddy river would be available.

b) As for west side of Irrawaddy River, irrigation water for dry season would be obtained by the reservoirs in the Arakan range.

c) The lowland area of each district should remain as a retarding basin during the flood season. The water in retarding basins can be used as irrigation water during the dry season by means of controling the sluice gates.

2) Relation to Inland Fishery

In land fishery is carried on in the rivers, drainage canals, and swamps in the Project Area. However, the drainage improvement and polder works would change river environment to give considerable influence area fishery.

On the other hand, if the drainage network is fully constructed, it is possible to increase the water area, while the swamp area remain as regulating reservoirs even after the project plan is implemented.

In order to utilize the inland-fisherv-ground, it is necessary to make the river channel plan and the conditions of retarding basins suitable for ecology of fish.

3) Others

Full-equipment of drainage canal would be acompanied with improvement of road net work. Especially, it will be possible to increase the productivity in the Project Area by means of the construction of the trunk road, which has a sufficient width for vehicle traffic, along with main drainage canal.

IV. FLOOD CONTROL WORKS

IV.1. Objectives

For development of about 52,000 ha of the inundated area spread vastly middle reaches of the Myitmaka river, prevention of flood inflow into the Myitmaka river from the Irrawaddy river through the Thenet Chaung is proposed. The inundated area along the Myitmaka river will be remarkably reduced after the provision of a flood control structure at the mouth of the Thenet Chaung. (Refer to Fig. E-17, Table E-10)

VI.2. Background

1) The flooding along the Myitmaka river is caused by insufficient discharge capacity of the river.

2) The discharge capacity of the Myitmaka river is roughly estimated around 1,600 cu.m/sec at the middle reaches of the river.

3) Meanwhile, an inflow amount from the Irrawaddy River into the Myitmaka river through the Thenet Chaung comes up to around 4,000 cu.m/sec during flood period.

4) Hence, for the development of the inundated area along the Myitmaka river, control of the inflow is proposed.

5) Anticipated adverse effects due to this project sould be carefully assessed.

6) The probably adverse effects may be as follows:

   a) a rise of water stage in the Irrawaddy and the Bassein rivers and subsequent strengthning of the existing embankment if required. (This item is connected with the result of hydraulic analysis conducted under Paddy I Project).

   b) sedimentation of the Rangoon harbour and the Hlaing river.

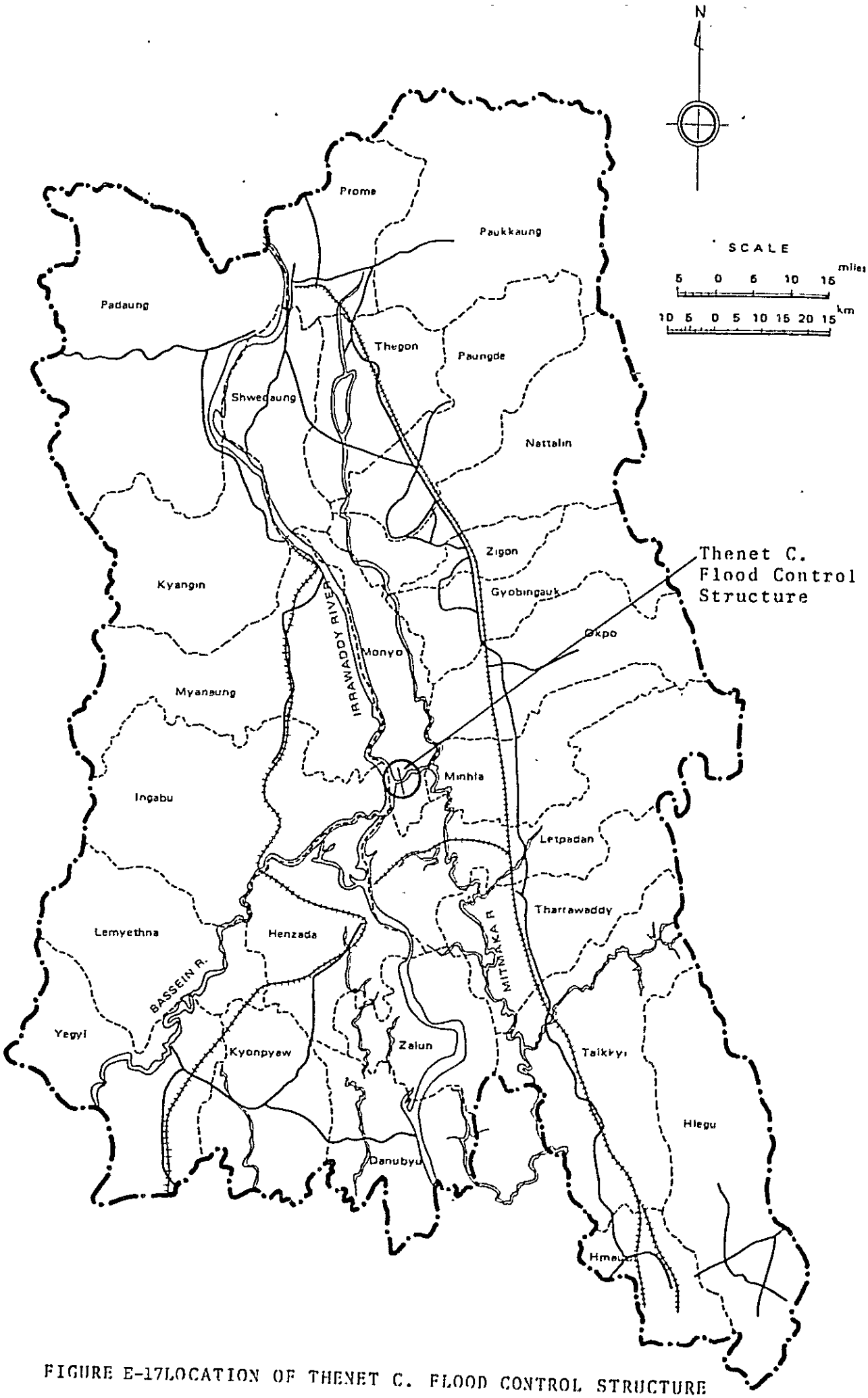


FIGURE E-17LOCATION OF THENET C. FLOOD CONTROL STRUCTURE

TABLE E-10 COST ESTIMATION OF THENET CHAUNG AREA

(Unit: Thousand Kyat)

Description	Quantity	F.C	L.C	Total
Roller Gate	1,900 t	95,000	-	95,000
Bridge	2,500 m^2	16,600	-	16,600
Concrete	30,000 m^3	20,000	20,000	40,000
Casson	6 Nos.	60,000	-	60,000
Pile	1 Ls.	30,000	-	30,000
River Protection Work	4,300 m^2	-	21,500	21,500
Sub-total (1)		221,600	41,500	263,100
Engineering Fee, etc.	(15% of 1)	33,240	6,225	39,465
Preparation	(10% of 1)	22,160	4,150	26,310
Tax and Transportation	(50% of 1)	110,800	-	110,800
Total (2)		387,800	51,875	439,675
Contingency	(15% of 2)	58,170	7,782	65,952
Price Escalation	(25% of 2+3)	111,493	14,915	126,408
Grand total		557,463	74,572	632,035

V. HYDRAULIC ANALYSIS

V.I. Summary

In case of normal and flood flow, hydraulic condition of the whole basin of Irrawaddy river, is grasped by hydraulic simulation with mathematical model. However, due to data deficiency, hydraulic analysis is limited to the middle reaches of Myitmaka river as first step. Namely, the upper stream boundary is the mouth of Thenet Chaung diversion canal and the down stream boundary is Kunhakyaik station.

Water level records of Prome, Henzada, Gammon, Dawwi and Kunhakyaik station in 1974 are adopted as initial conditions and verification data.

The result of hydraulic analysis with mathematical model is explained as follows.

1) Manning's roughness coefficient is 0.03
2) The width of inundated area is assumed about 10 km (about 6 miles), and that of velocity zone varies to between 0.5 and 1.0 km (1,640-3,280 ft).
3) The inundated area of the middle reaches of Myitmaka River will be improved by controling flood inflow from the Irrawaddy river below 1,000 cu.m/sec.

V.2. Outline of Mathematical Model

In the flow status of river, there are two physical phenomena. One is a steady flow that is constant with time, other is an unsteady flow that is changebale with time,

In analysis of an unsteady flow, it is necessary to solve the differential equation. But this equation is a non-linear type, so it is very difficult to solve it directly. Then, it will be solved

by means of numerical analysis, which is a kind of mathematical simulation. Here, the Dr. Shiraishi's method is adopted that is famous and popular in Japan.

Hydraulic characteristics of an unsteady flow as a mathematical model are given by simultaneous solution of both the equation of motion and that of continuity. With the down stream boundary as origin the foundamental equation of a one-dimensional flow are expressed as follows;

$$\frac{1}{g}\left(\frac{\partial v}{\partial t}\right)+\frac{1}{g}\frac{\partial}{\partial x}\left(\frac{V^2}{2}\right)+S+\frac{\partial h}{\partial x}+\frac{n^2|v|}{R^{4/3}}V=0 \quad \cdots\cdots (1)$$

$$\frac{\partial A}{\partial t}+\frac{\partial Q}{\partial x}-q=0 \quad \cdots\cdots (2)$$

where;

g: acceleration of gravity (9.80 m/sec^2)
v: velocity (positive for the upper stream direction) (m/sec)
t: elapsed time (sec)
x: distance in longitudinal directions on a horizontal datum plane (m)
s: river bed slope
h: water depth (m)
n: manning's roughness coefficient
R: hydraulic radius (m)
A: Cross-sectional area including swampy zone
Q: discharge through a section (cu.m/sec)
q: lateral inflow per unit length (positve for inflow, negative for outflow) (cu.m/sec/m)

In case of hydraulic analysis of mathematical model, these equation, (1) and (2), are converted into difference expressions. Then, for the given initial condition, boundary condition and

geometric conditions, the numerical integration is performed. It is desirable to constitute the efficient and economic grid system from the point of the electronic computer performance. The calculation proceeds from the down stream to the upper stream with the distance interval to be used is not arbitrary. It is well-known that solving by finite differences method will not produce a stable solution unless the distance interval and the time interval are related to the velocity of the long wave, such as

$$\Delta t < \left| \frac{\Delta x}{V_{max} \pm \sqrt{g\, h_{max}}} \right| \quad \ldots\ldots\ldots\ldots\ldots (3)$$

In the value of Δt exceeds that given above, the transmission of the hydraulic phenomena goes beyond the tracing speed in the mathematical model and the solution is led to uncoveragence. The value of Δt and Δx must be determined to satisfy the expression (3), by speculating in advance the maximum possible velocity and water depth.

Detailed explanation about the central differences is mentioned in Appendix E.

V.3. Hydraulic Analysis by Mathematical Model

1) River model

Due to data deficiency, the river model is limited to the middle reaches of Myitmaka River and the purpose of the preliminary model is to explain the present hydraulic status (reappearance model).

2) Boundary condition

In the hydraulic analysis for the mathematical model, the boundary conditions are water level in upper and down stream, and tributary inflow along the Myitmaka River (Ref. to Fig. E-18). Here, the water level records in 1974 (unusual flood year) is adopted.

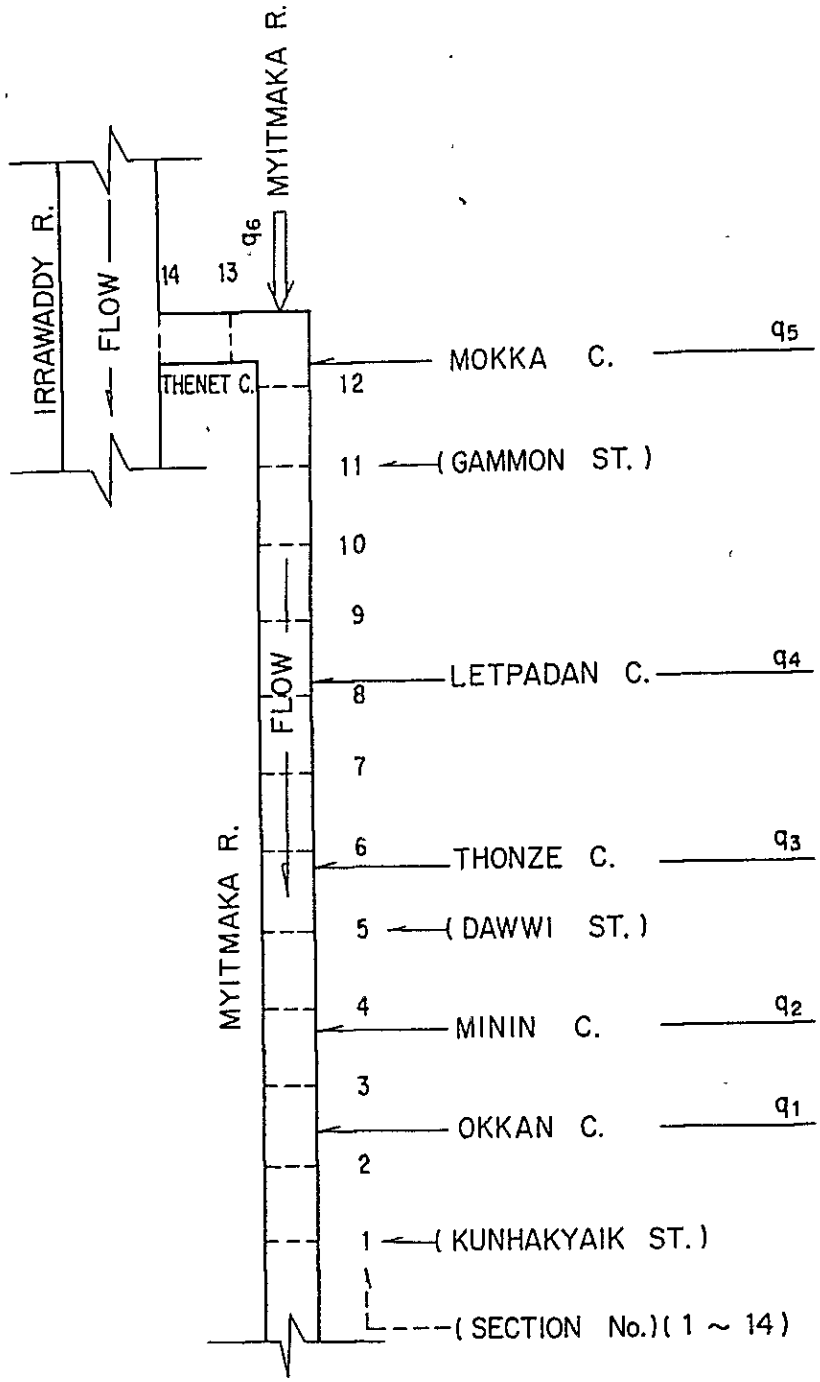


FIGURE E-18 MODEL FOR HYDRAULIC ANALYSIS

V.4. Review of the Result

Judging from the results of the hydraulic simulation, the followings are cleared. (Ref. to Fig. E-19, E-20, E-21, E-22)

1) Manning's roughness coefficient is 0.03.

2) The width of inundated area is assumed about 10 km (about 6 miles), and that of velocity zone varies to between 0.5 and 1.0 km (1,640 ft~3,280 ft).

3) The inundated area of the middle reaches of Myitmaka river will be improved by controbing folld inflow from the Irrawaddy river below 1,000 cu.m/sec at the mouth of the Tenet Chaung in 1974.

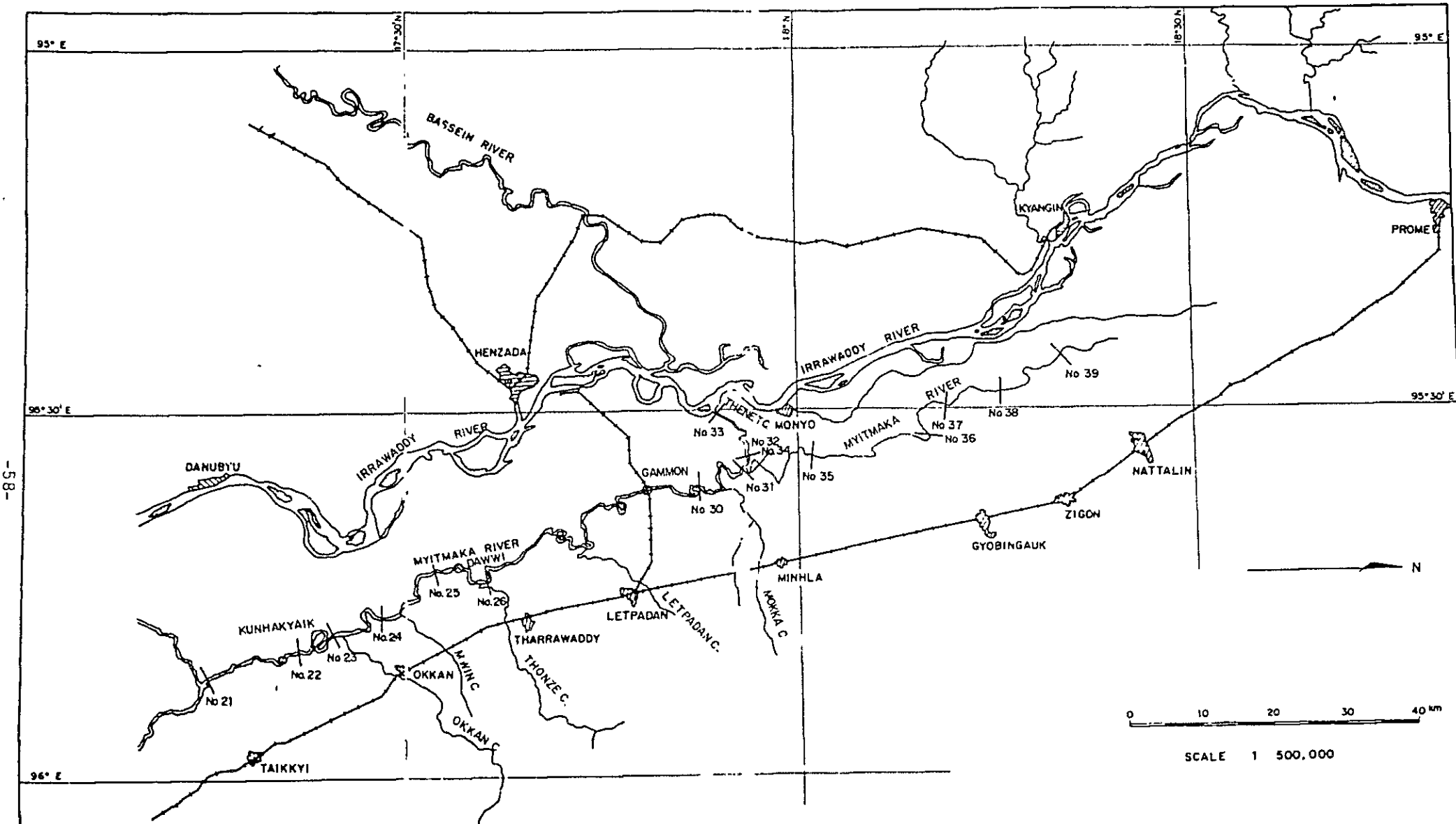


FIGURE E-19 LOCATION OF CROSS SECTION

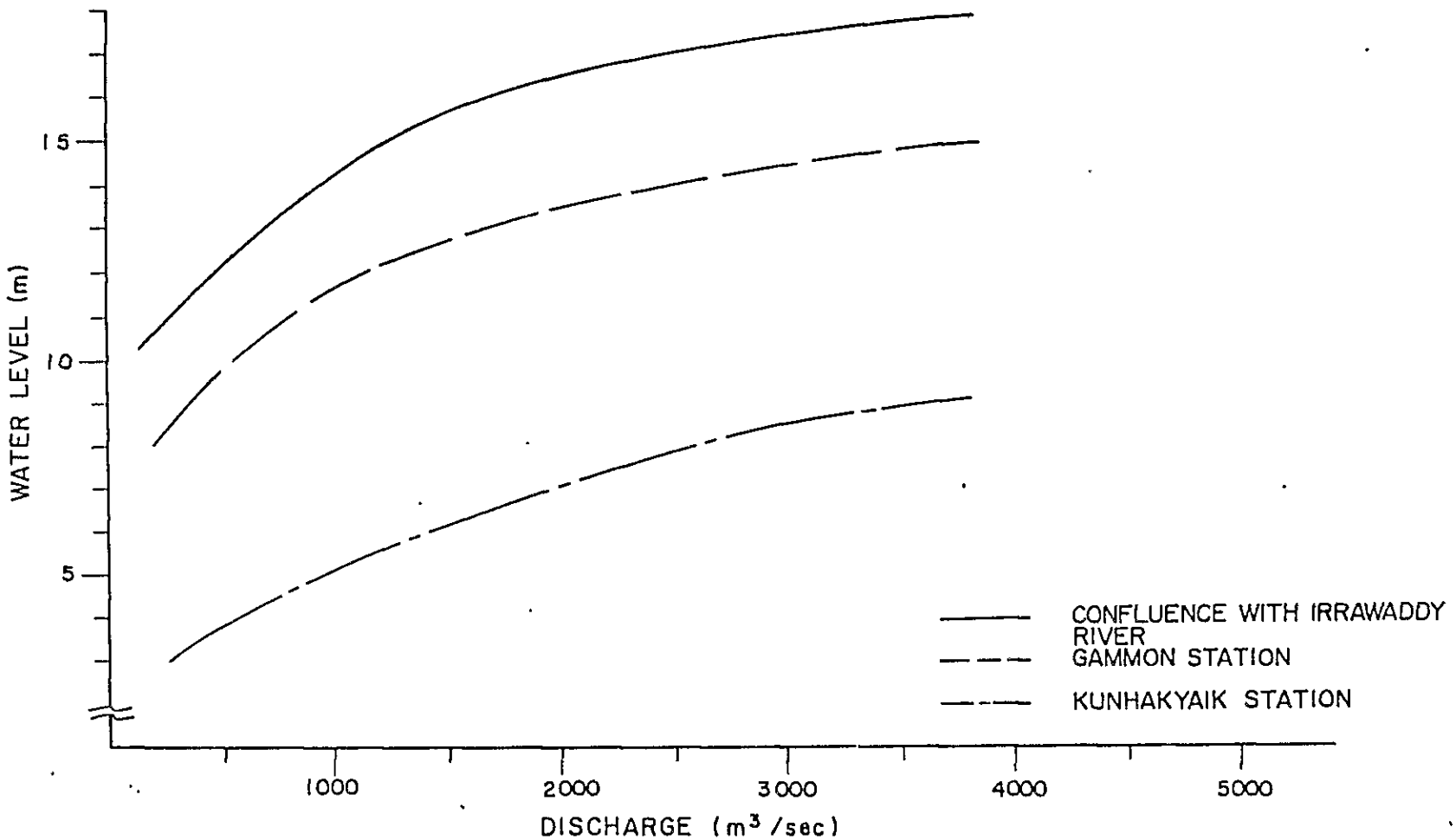


FIGURE E-20 RELATION BETWEEN WATER LEVEL AND DISCHARGE

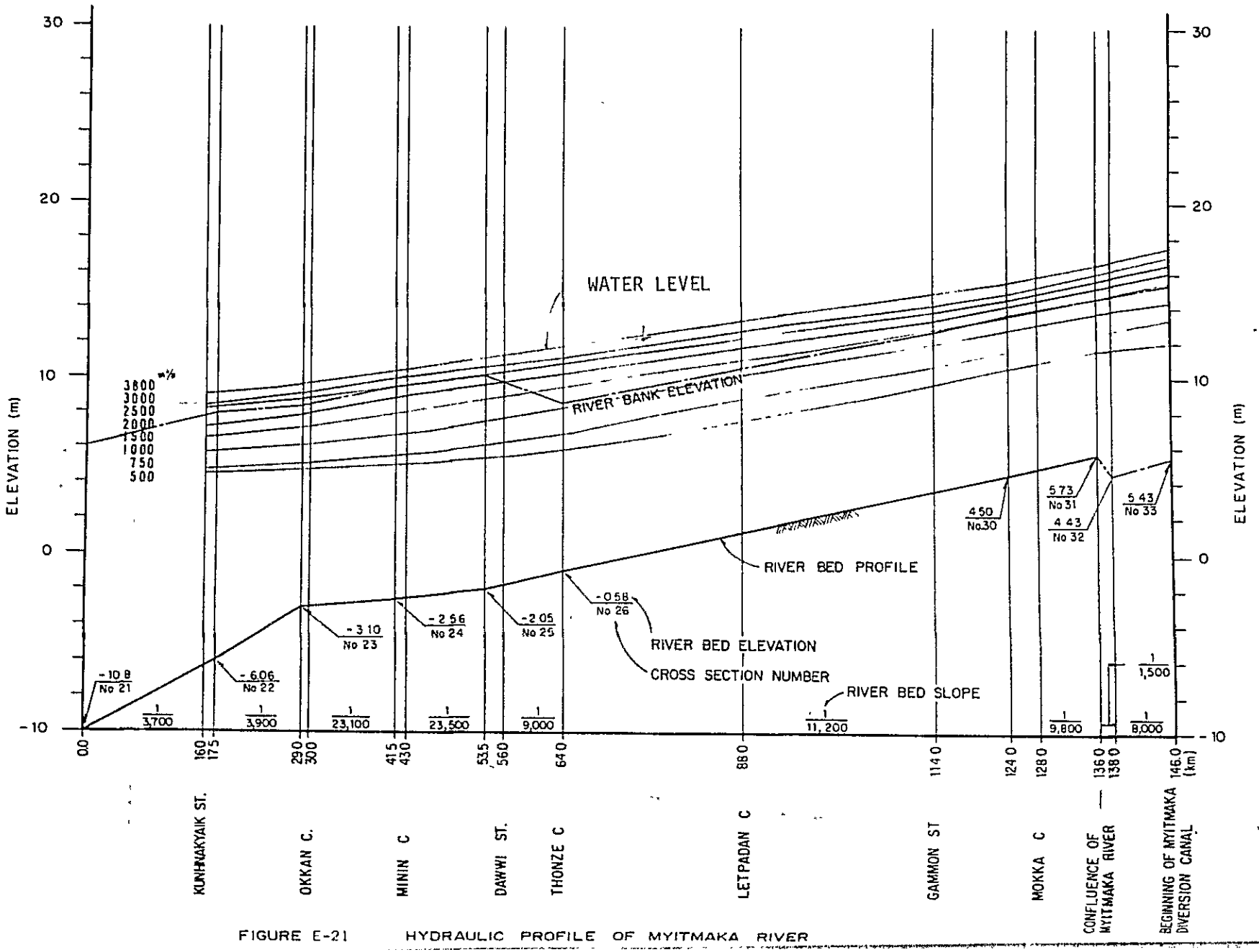


FIGURE E-21 HYDRAULIC PROFILE OF MYITMAKA RIVER

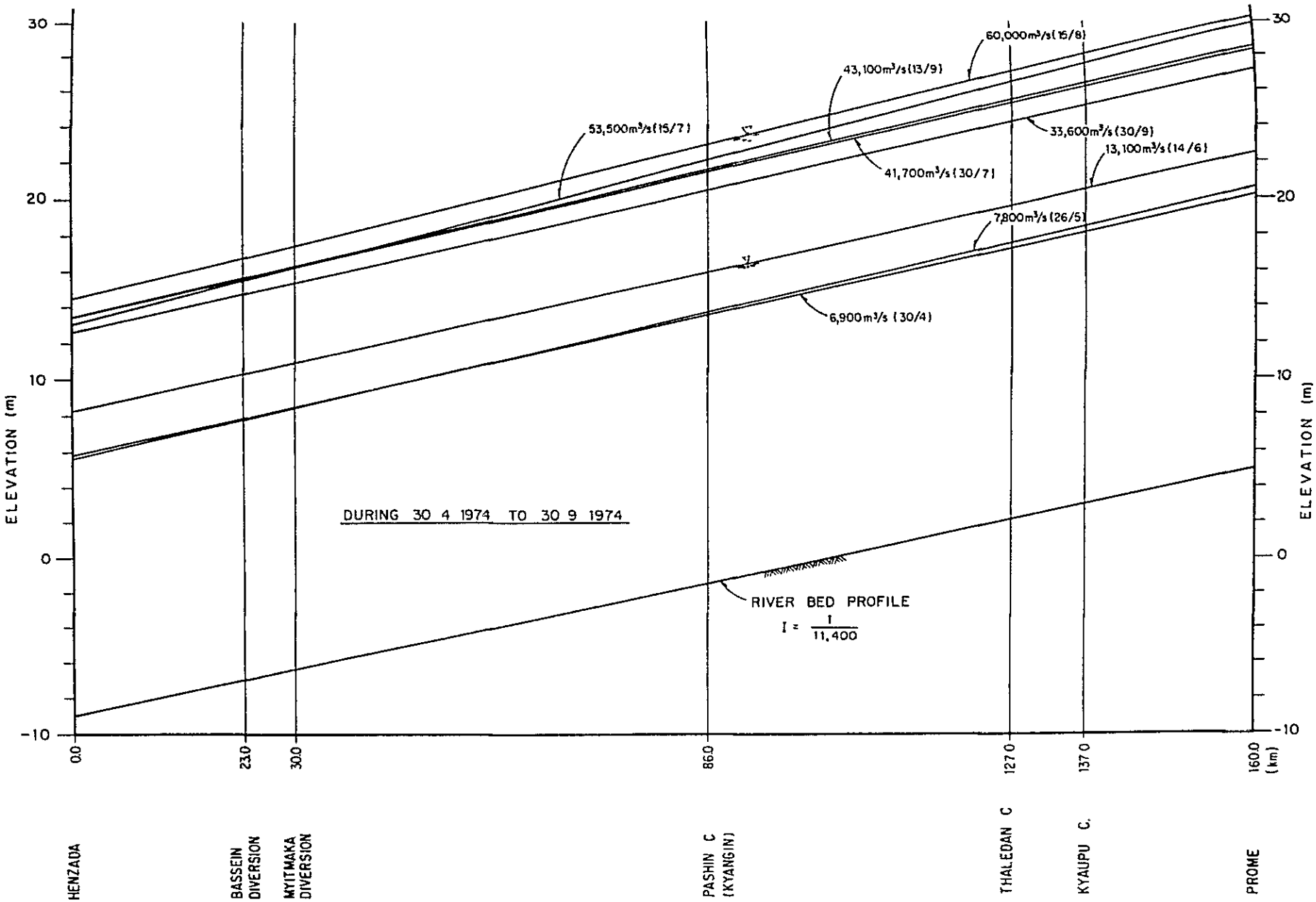


FIGURE E-22 HYDRAULIC PROFILE OF IRRAWADDY RIVER

VI. FURTHER INVESTIGATION

By the time of implementation of polder and flood control works, the influence cased by changing of natural flow doctrine for flood control should be made clear beforehand.

Accordingly, the required investigations in the future are;

(1) Topo map with scale 1 : 5,000 and contour interval 0.25m

(2) Data collection of water level and rainfall at the Project Area.

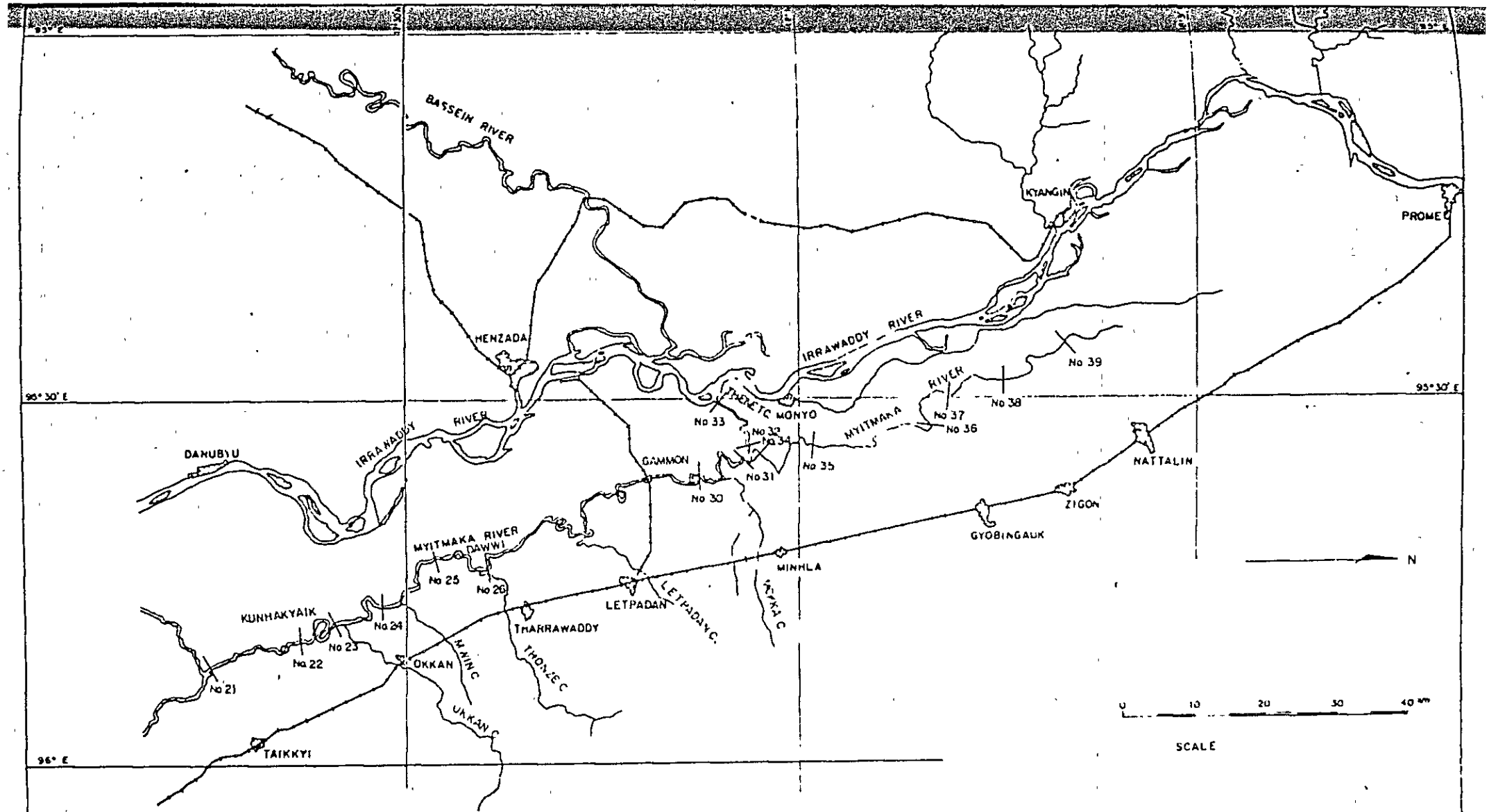
(3) Investigation of the present drainage networks and drainage facility.

(4) Relation between water level and discharge at Thenet confluence.

(5) Periodic cross-section of the Rangoon harbour.

(6) Hydraulic model test and/or simulation.

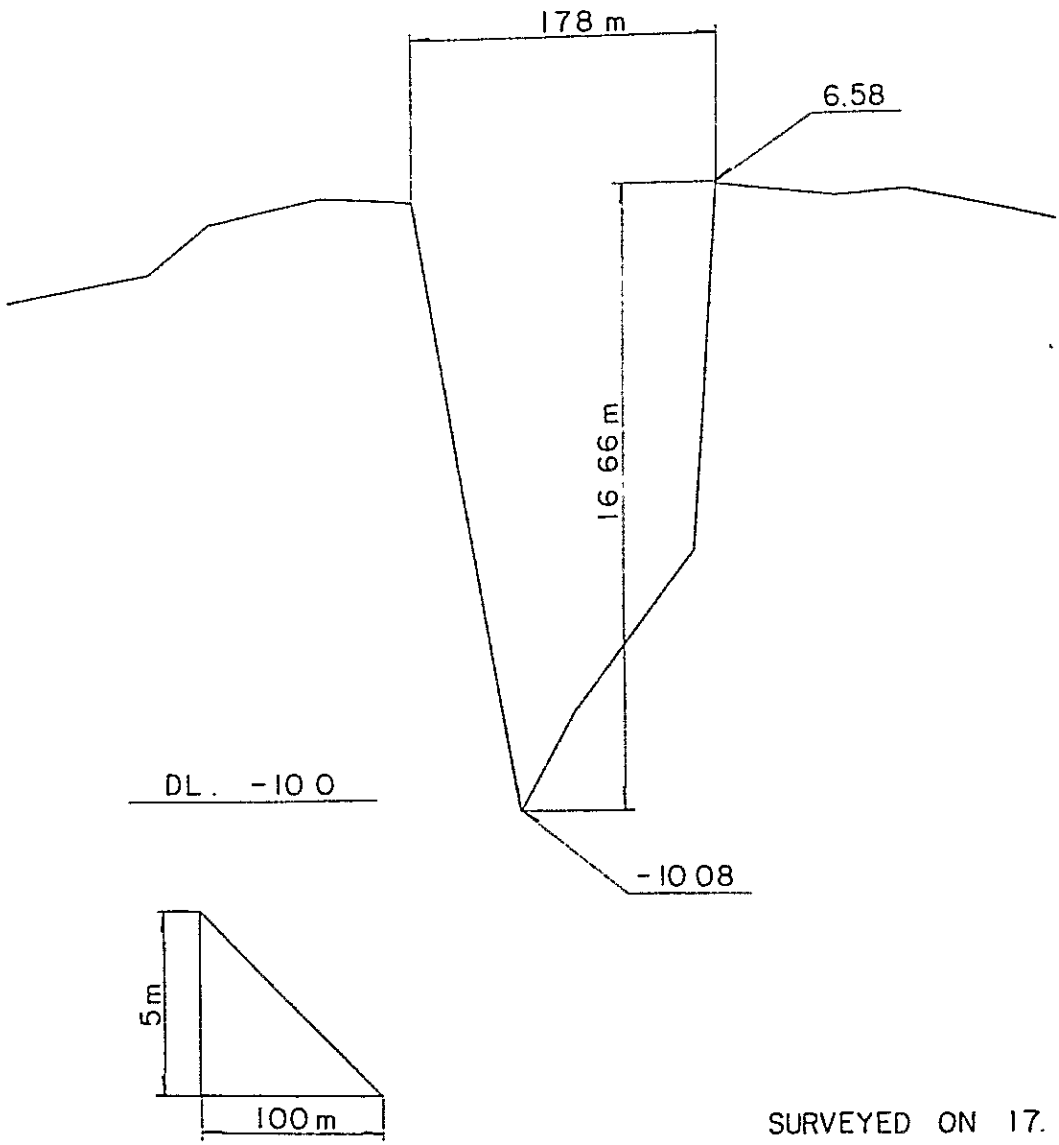
APPENDICES



APPENDIX E-1 CROSS SECTION OF MYITMAKA RIVER

LINE NO. 21

NEAR MINHLAWA VILLAGE

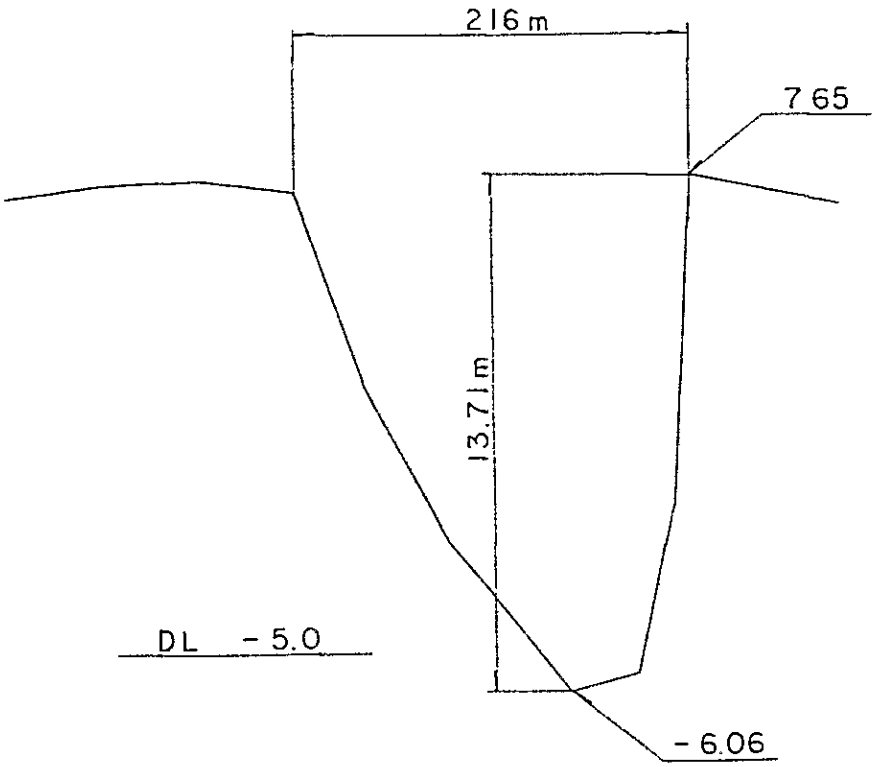


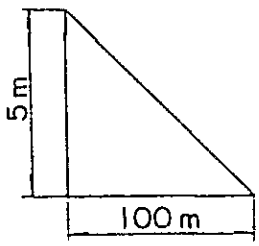
SURVEYED ON 17.1.79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.22

NEAR KUNHNAKYAIK VILLAGE



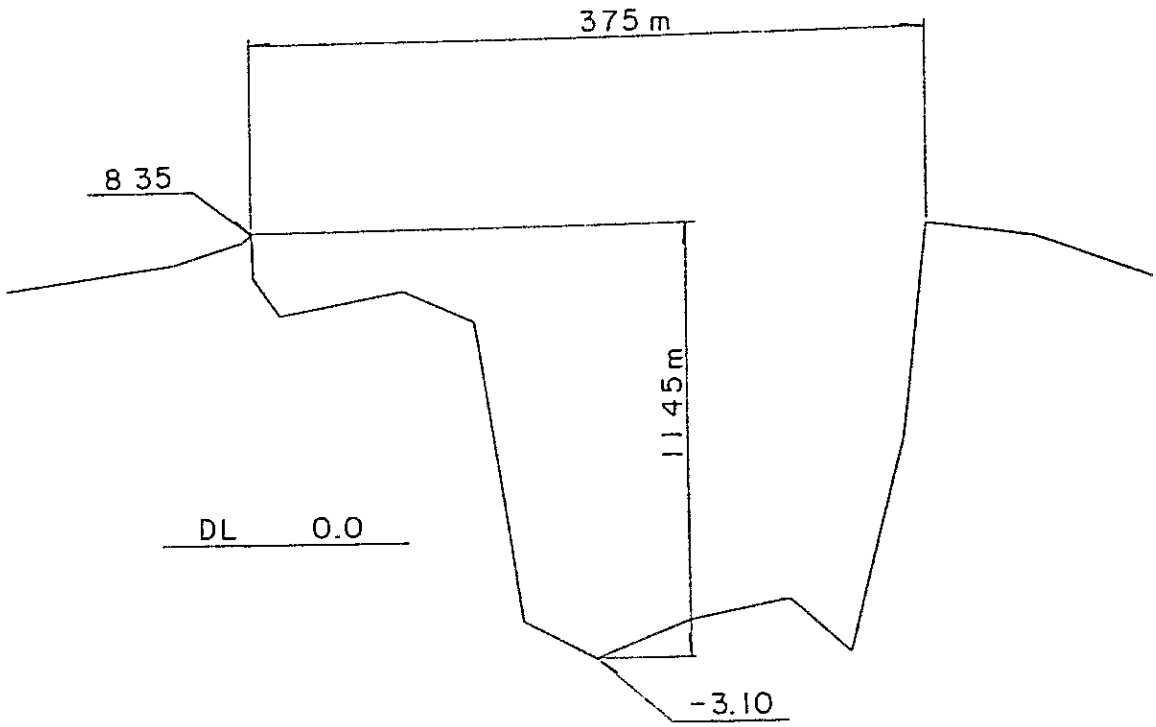


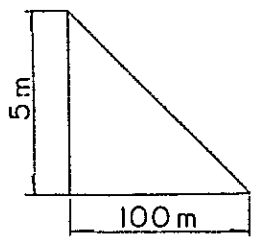
SURVEYED ON 19.1 79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.23

NEAR PYINMAGON VILLAGE



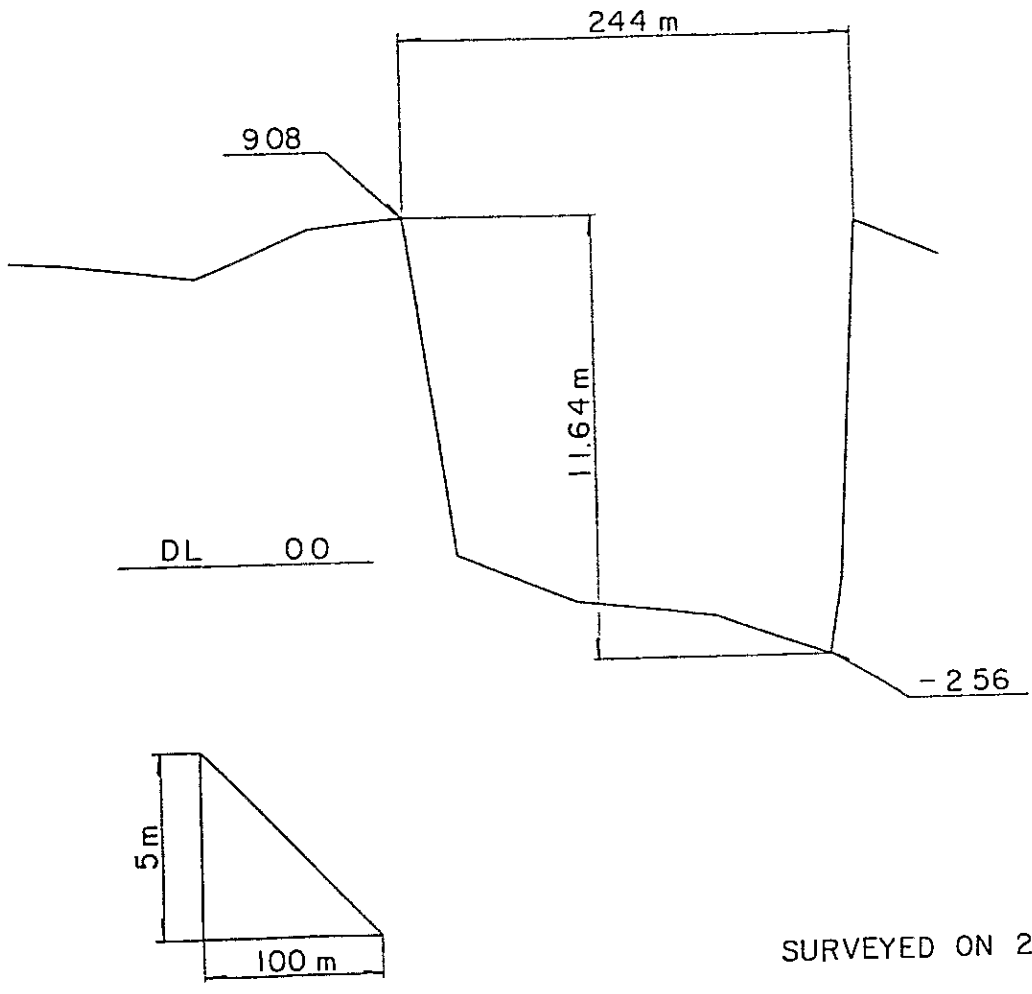


SURVEYED ON 21.1.79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO. 24

NEAR KYAUNG GON VILLAGE

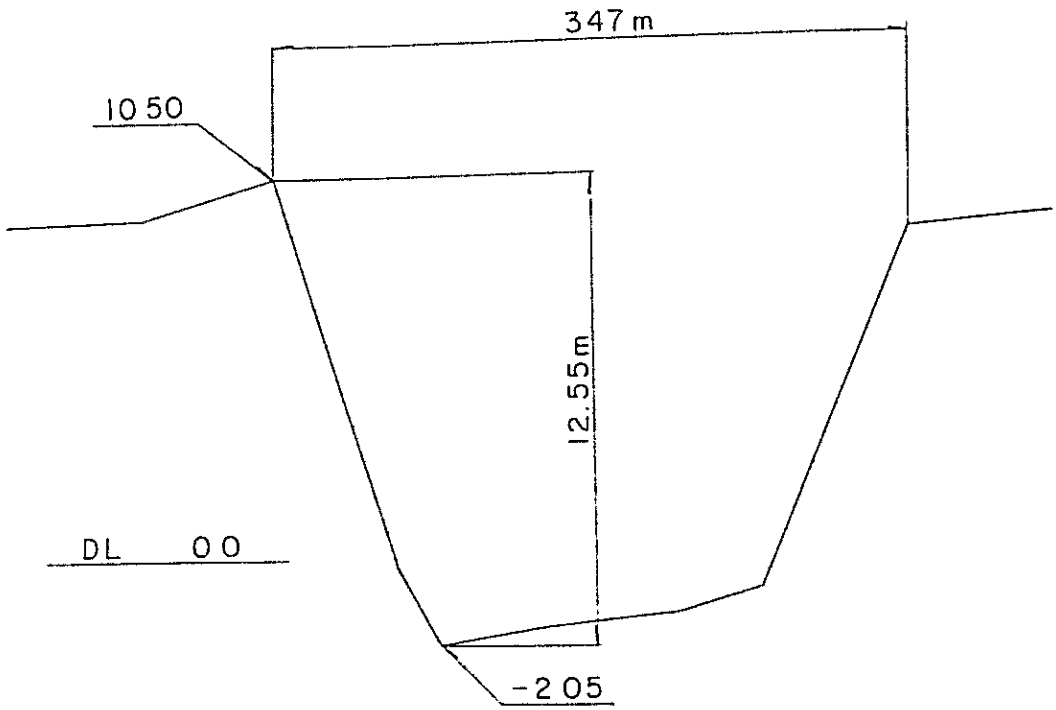


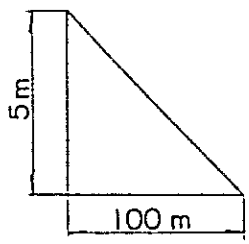
SURVEYED ON 23 1.79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO. 25

NEAR DAWWI VILLAGE



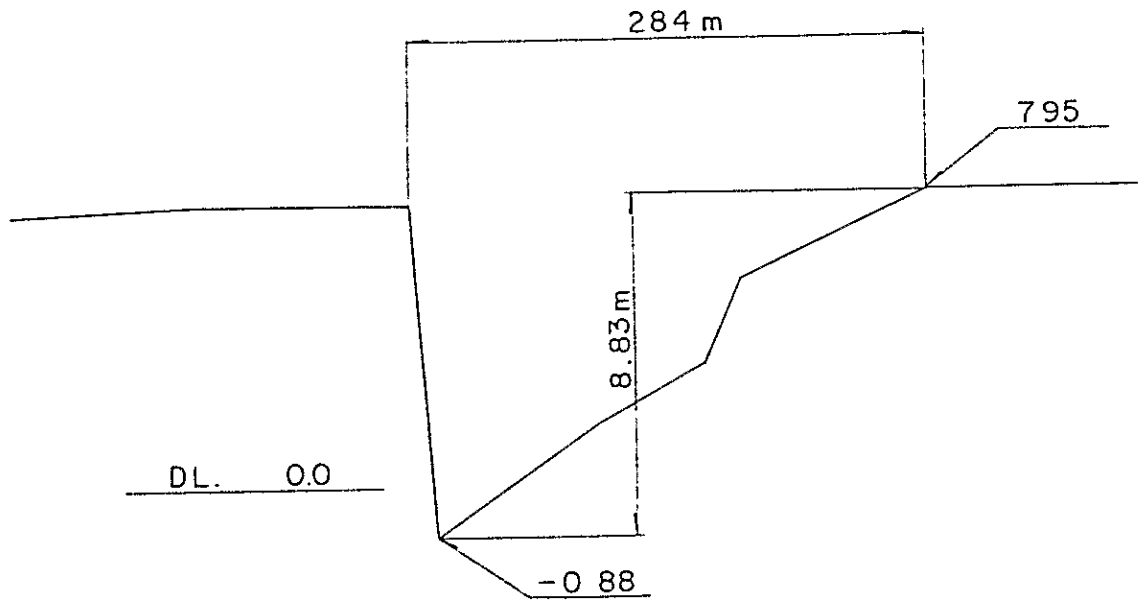


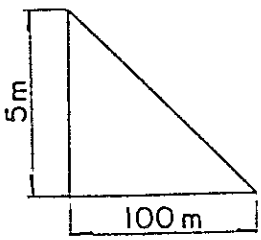
SURVEYED ON 25.1.79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.26

NEAR PHOGAUNG VILLAGE



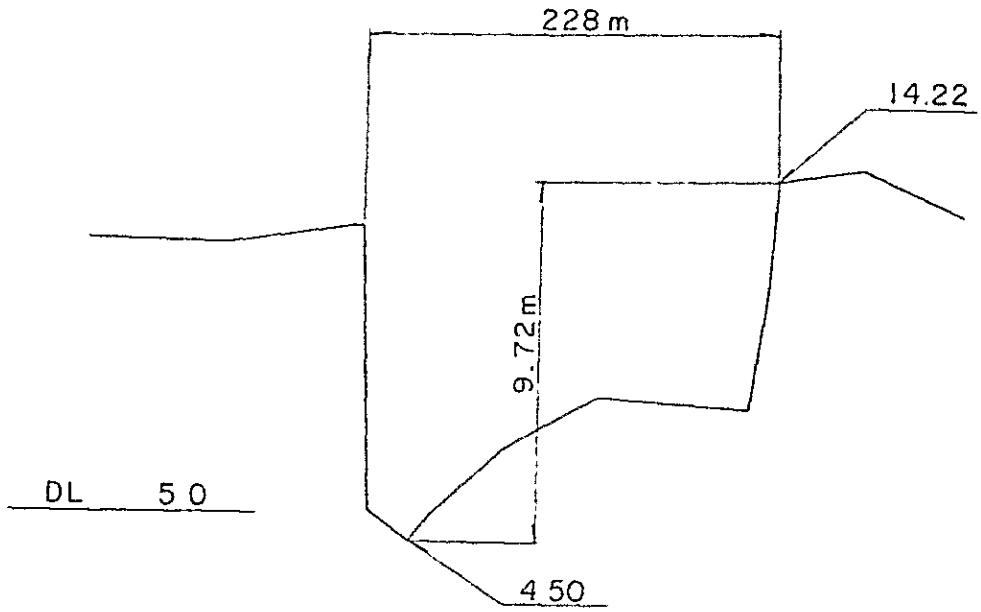


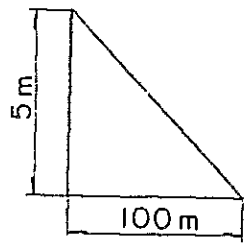
SURVEYED ON 30 I 79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.30

BETWEEN NYAUNGBINTHA VILLAGE AND ALANGON VILLAGE



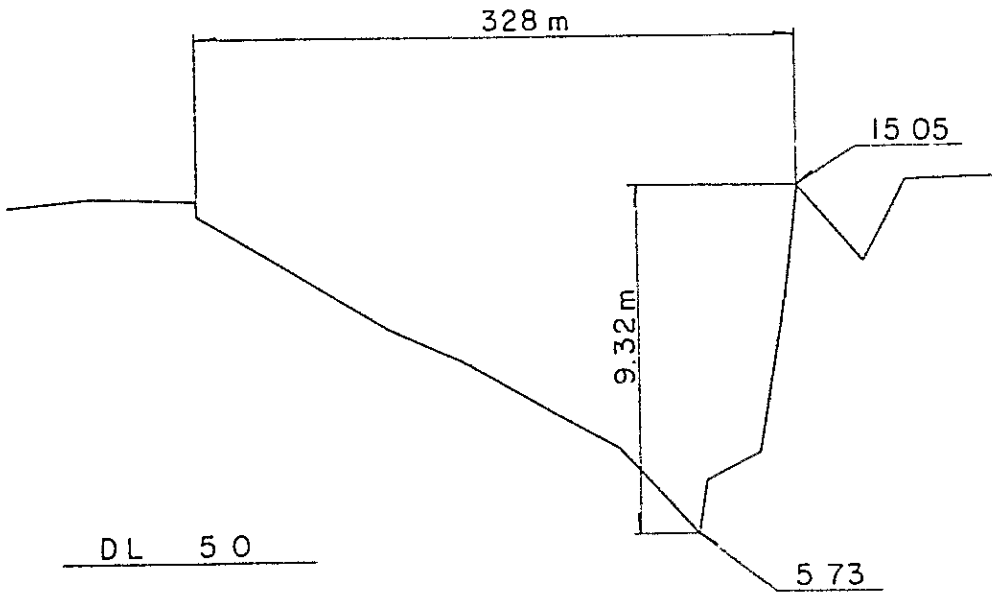


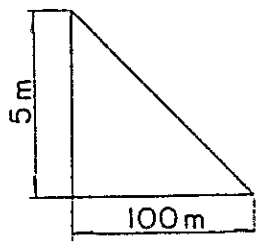
SURVEYED ON 28 1.79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.31

NEAR DIHLAING VILLAGE



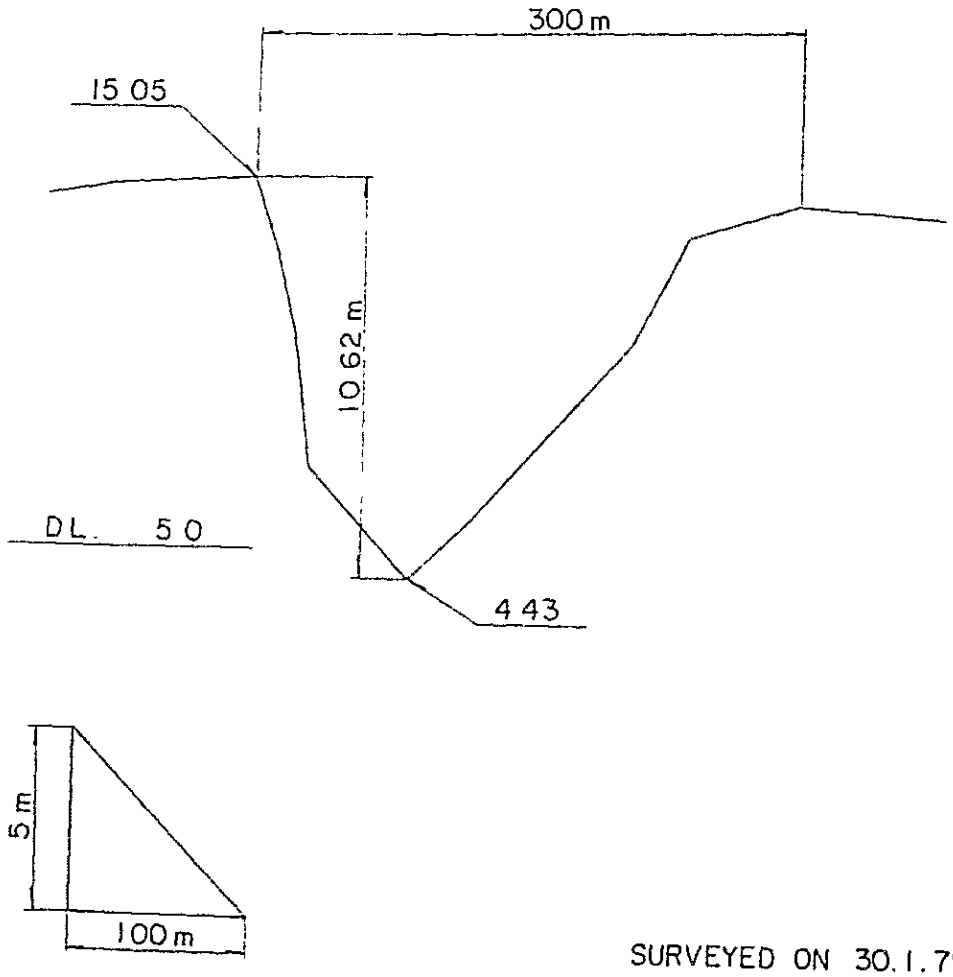


SURVEYED ON 29 I 79

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.32

BETWEEN MA-U-GON VILLAGE AND SHWEGE VILLAGE

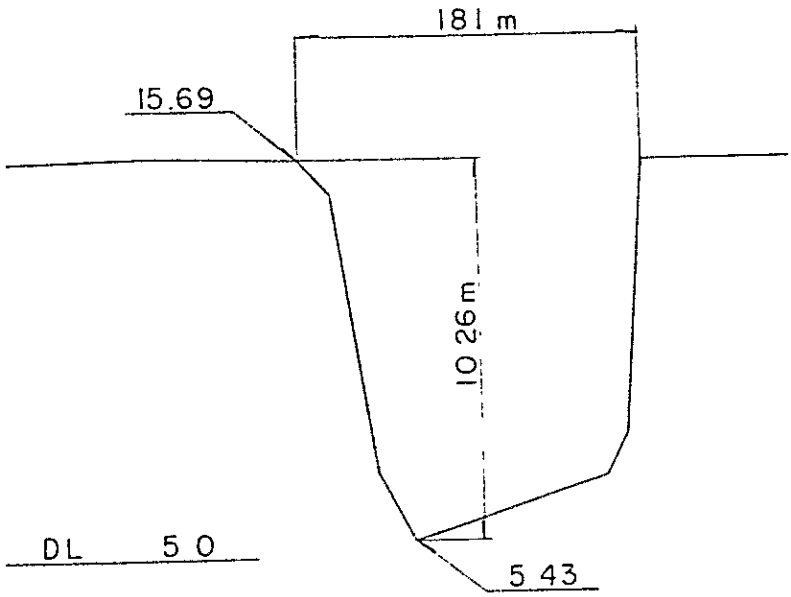


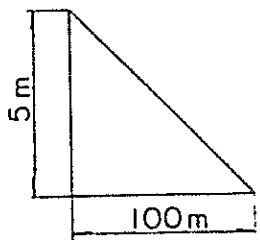
SURVEYED ON 30.1.79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.33

NEAR DUT VILLAGE



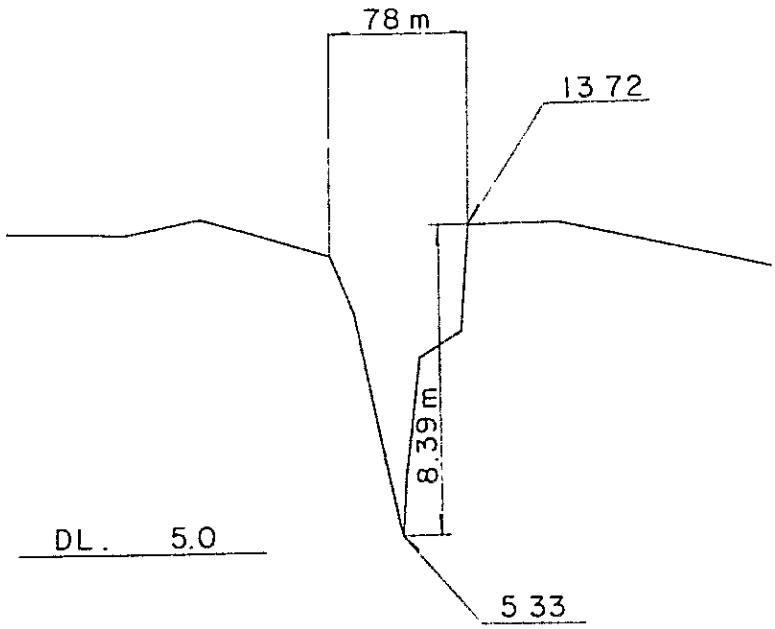


SURVEYED ON 6.1.79

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.34

BETWEEN SHWEGE VILLAGE AND TANBINGON VILLAGE



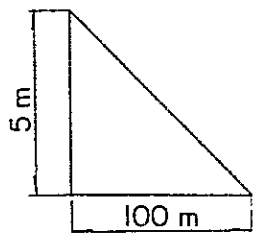


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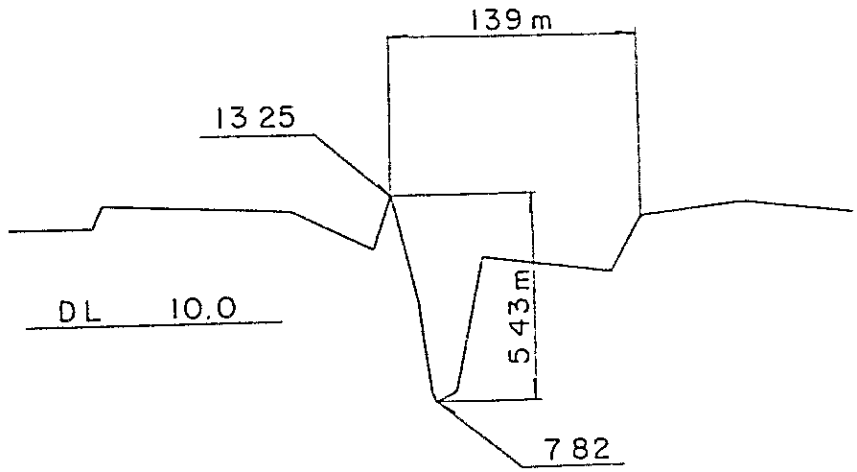
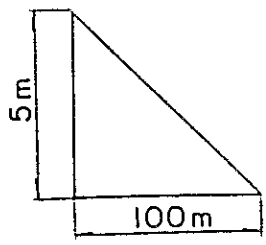
FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.35

BETWEEN CHAUNGNET VILLAGE AND HMETGADAN VILLAGE



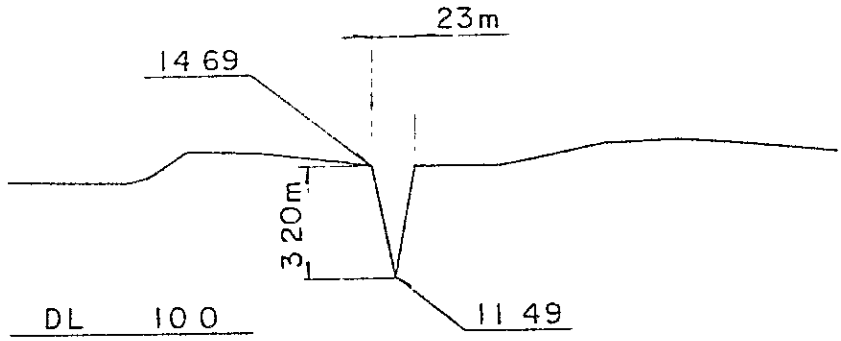


SURVEYED ON 10.1 79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO. 36

BETWEEN BITHALUN VILLAGE AND AUK-YWAGALE VILLAGE



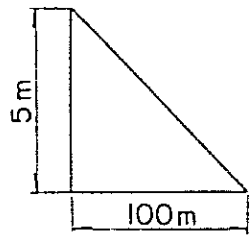


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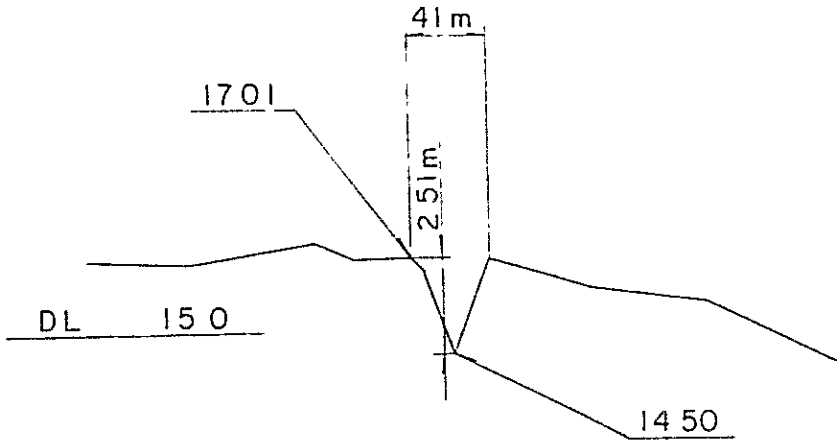
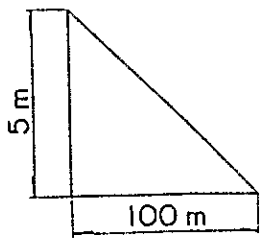
FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.37

NEAR MYAUKLOKKON VILLAGE



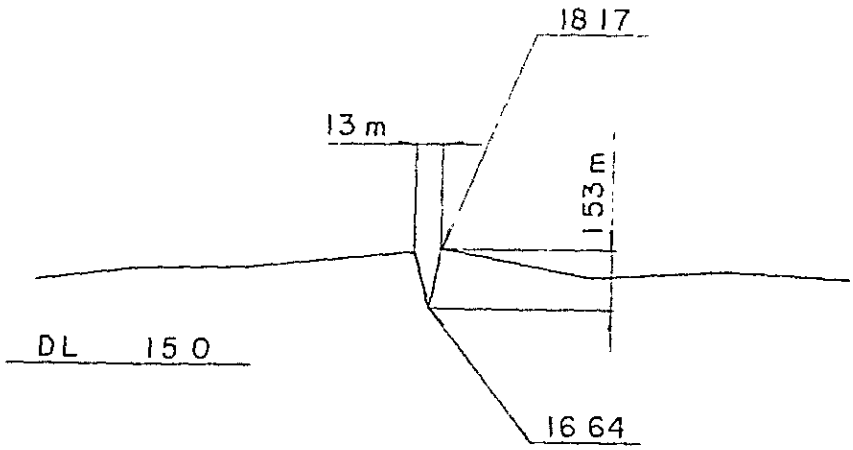


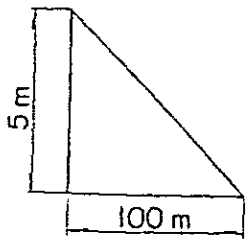
SURVEYED ON 16 2.79'

FIGURE -- CROSS SECTION OF MYITMAKA RIVER

LINE NO.38

BETWEEN TAUNGYADAW VILLAGE AND GYOBININN VILLAGE



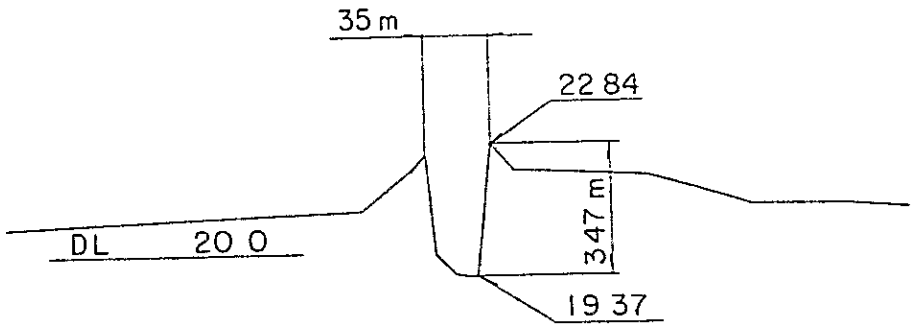


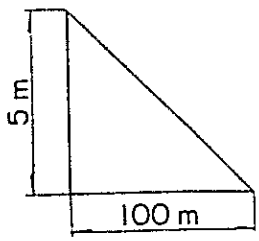
SURVEYED ON 18 2 79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

LINE NO.39

NEAR YEGYI-CHAUNGWA VILLAGE





SURVEYED ON 21 2.79'

FIGURE CROSS SECTION OF MYITMAKA RIVER

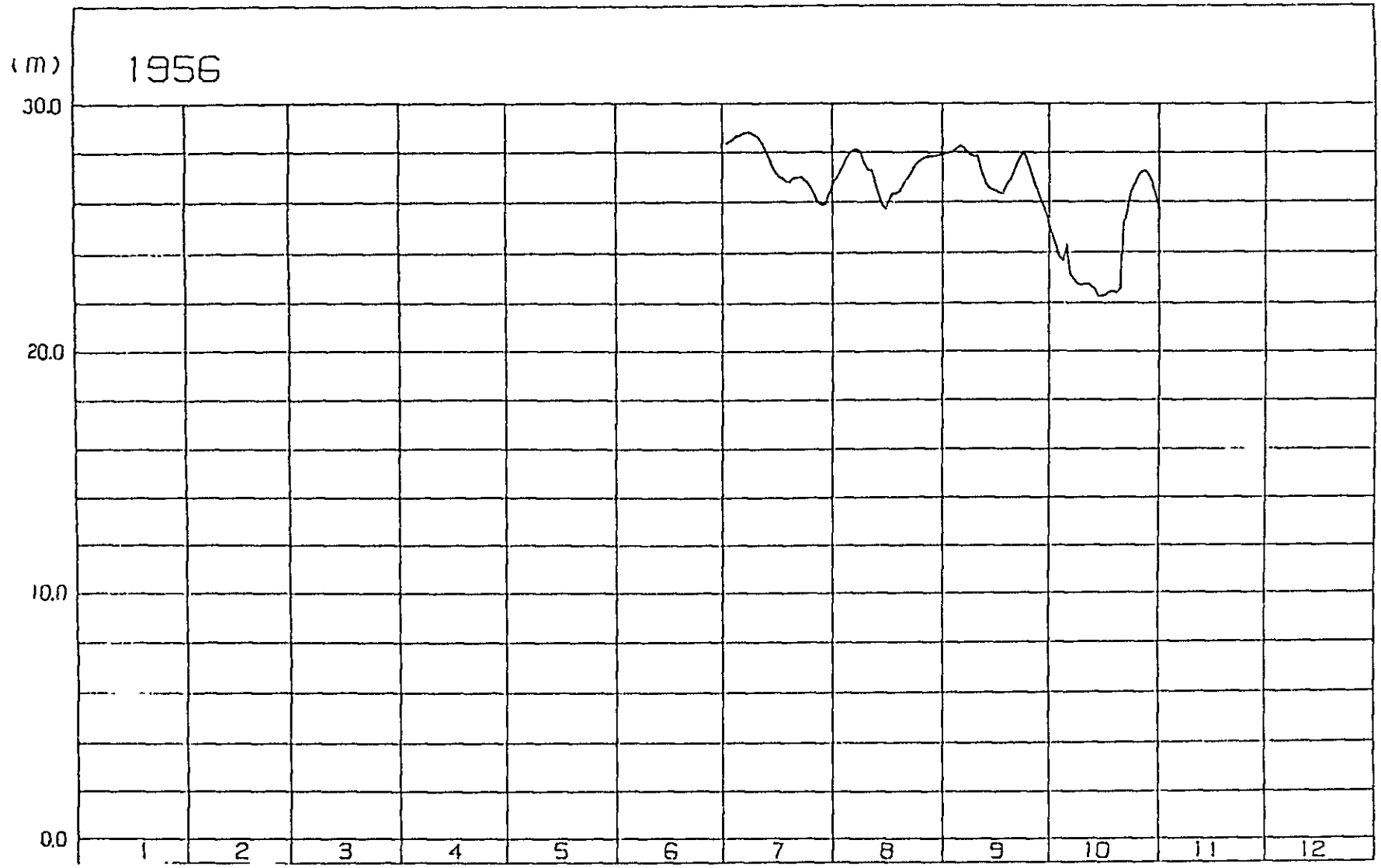


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

APPENDIX E-2 WATER LEVEL OF IRRAWADDY REVER AT PROME

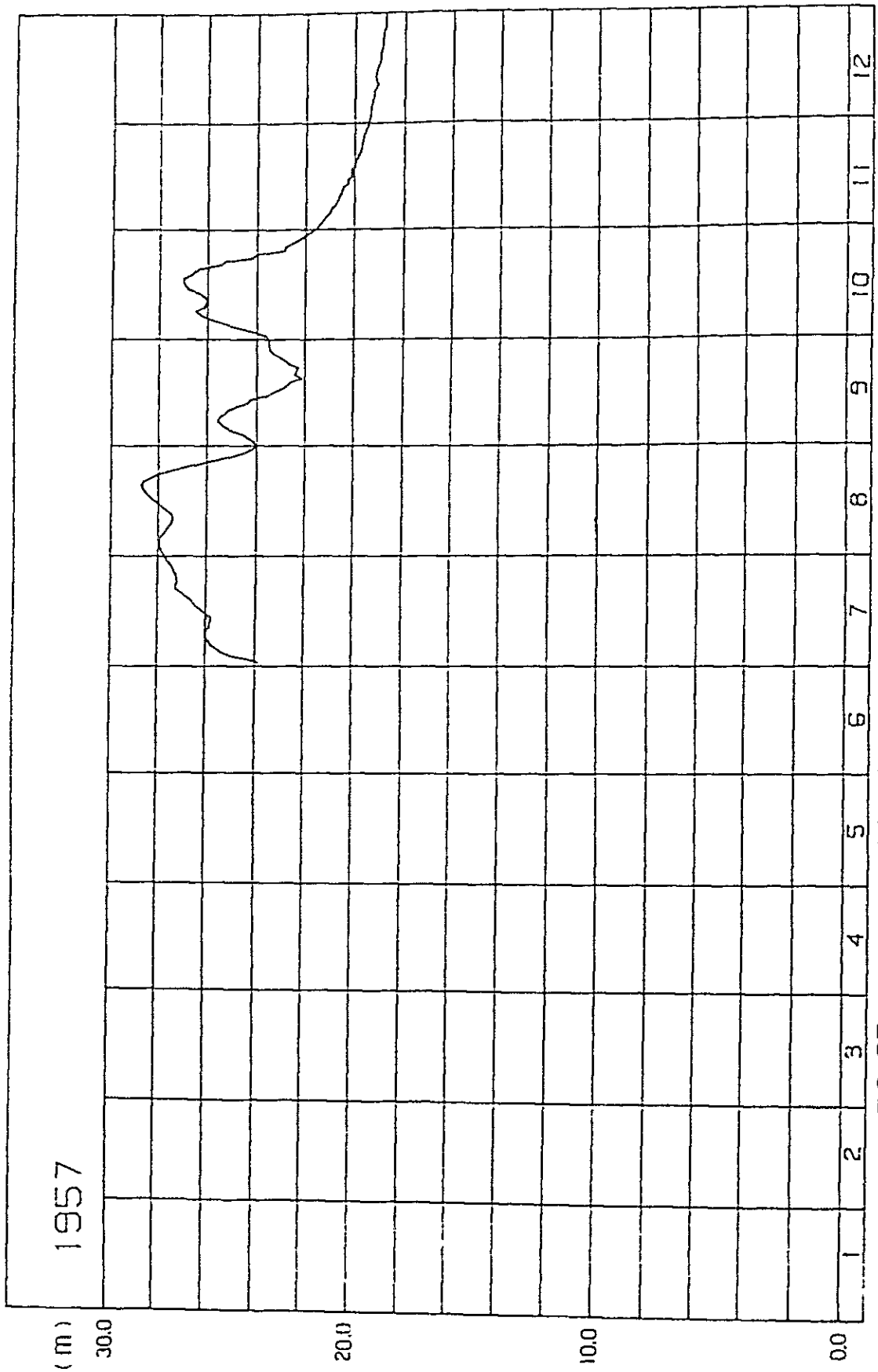


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

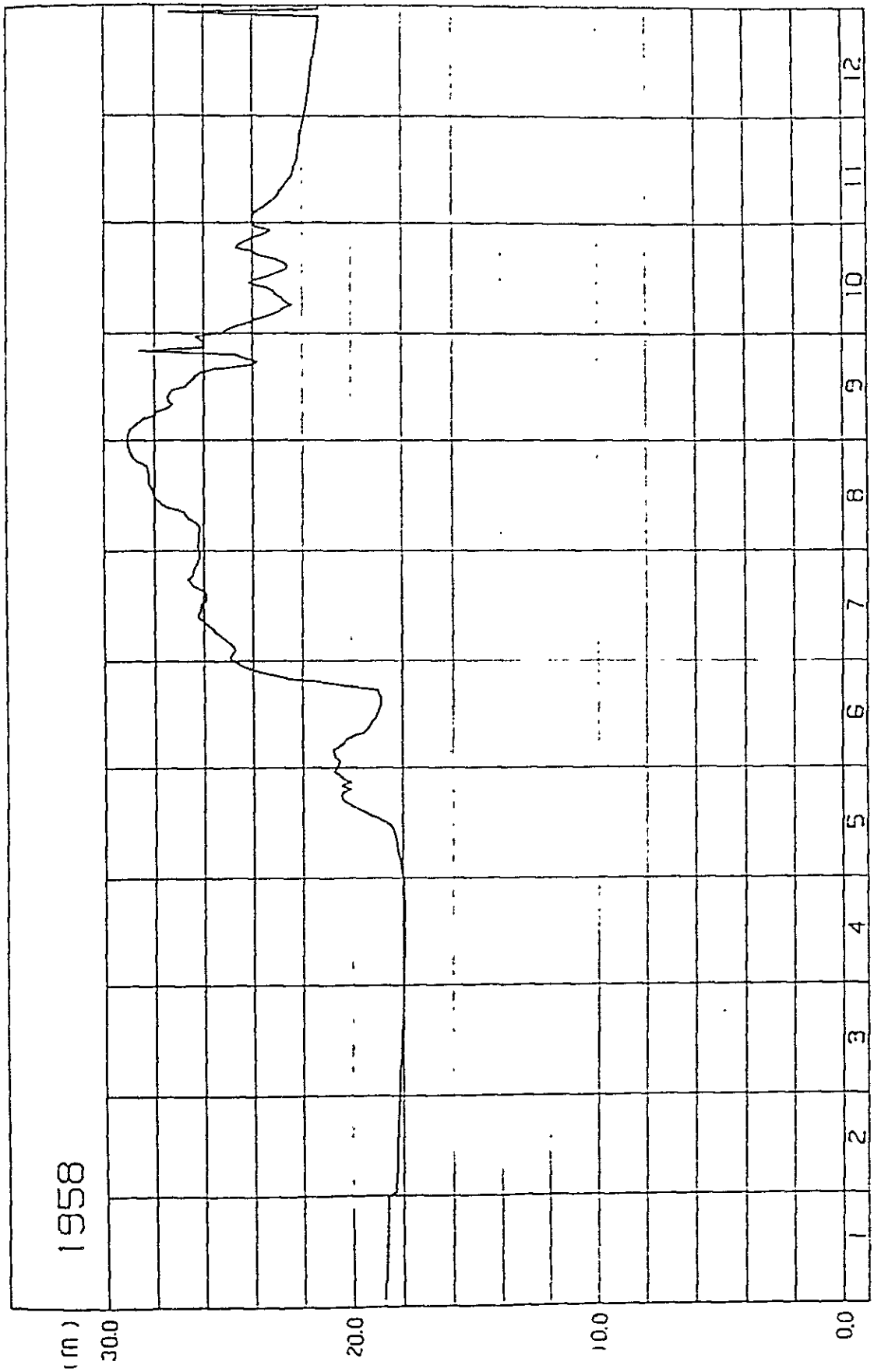


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

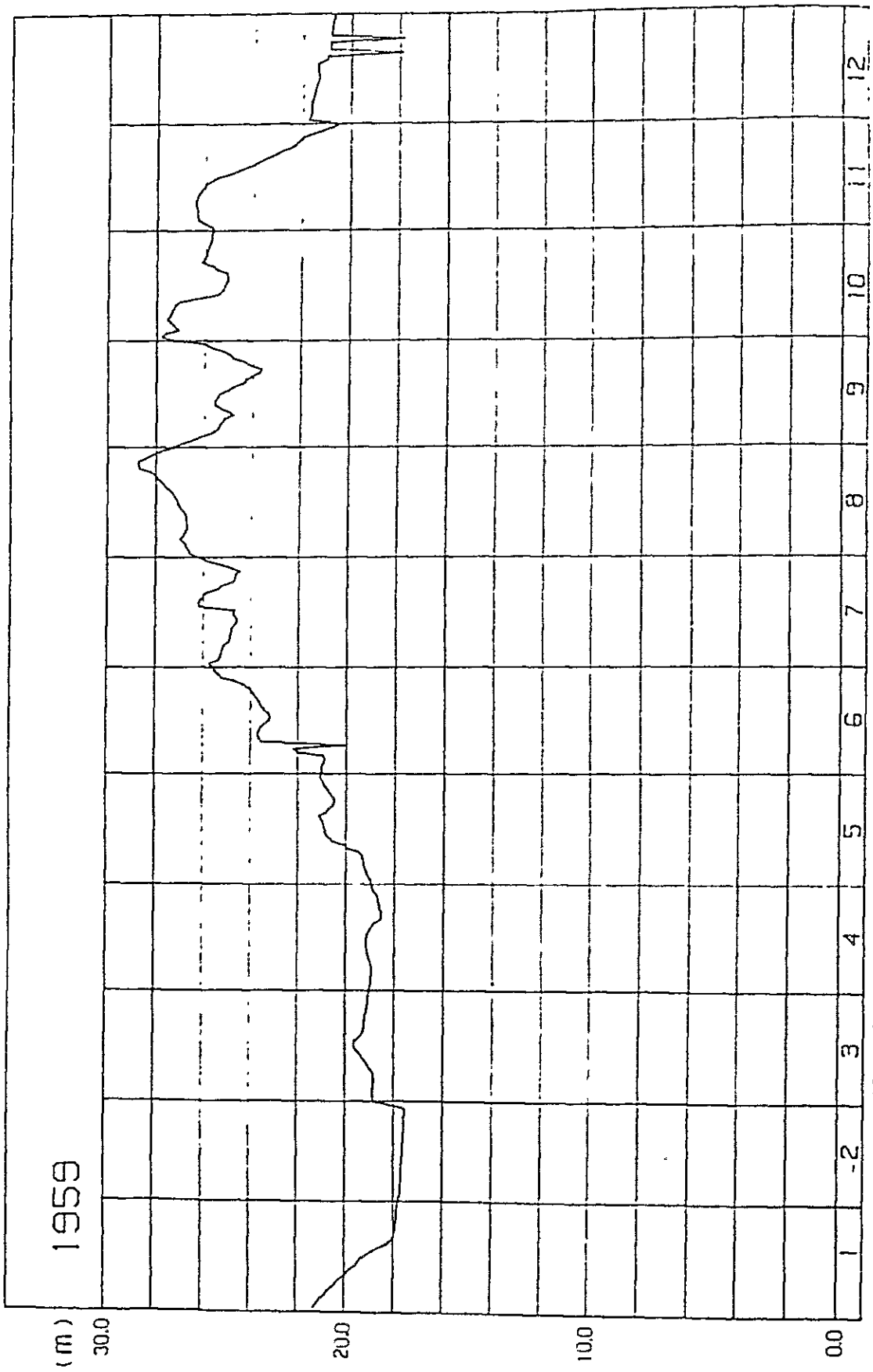


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

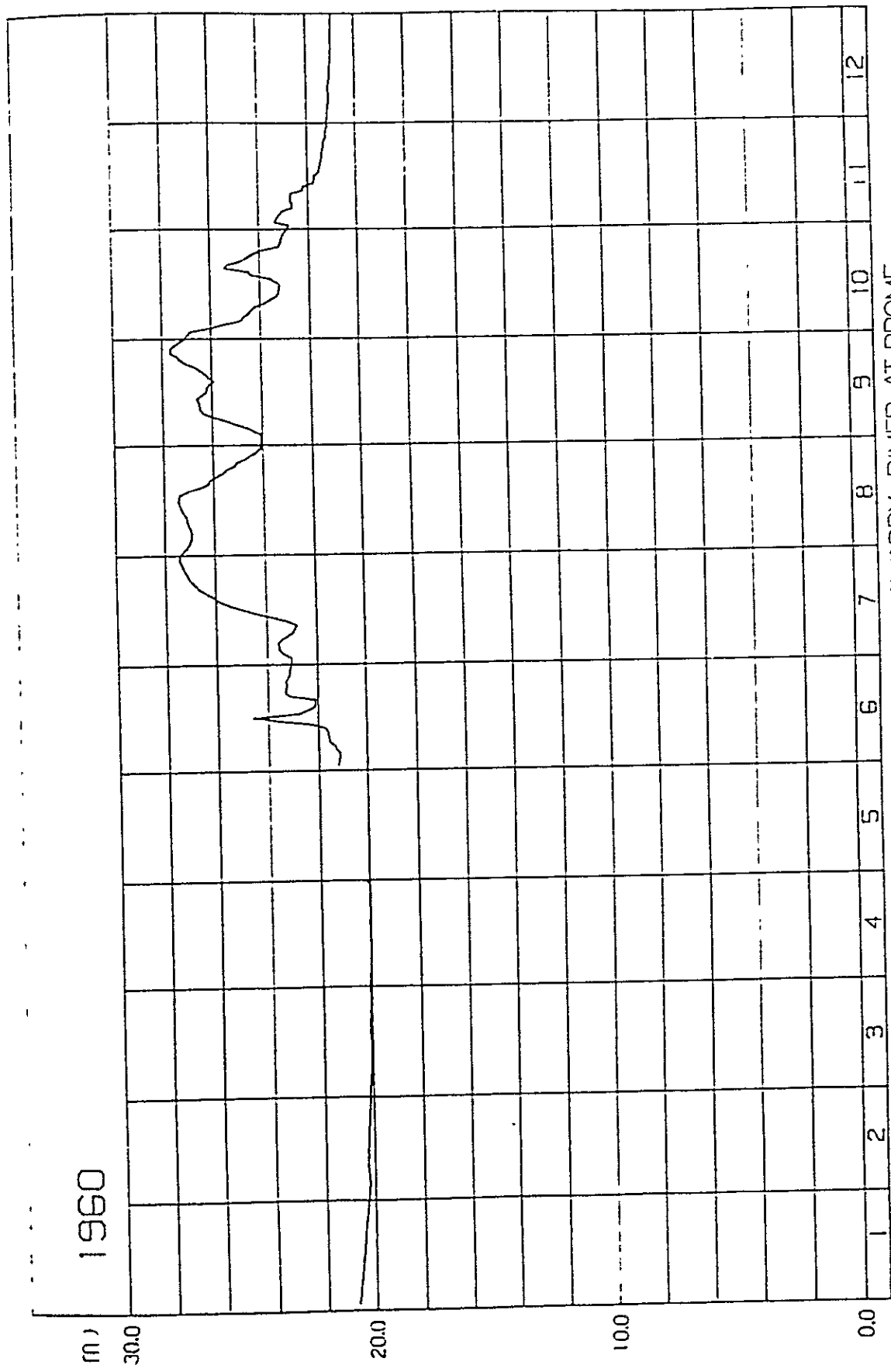


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

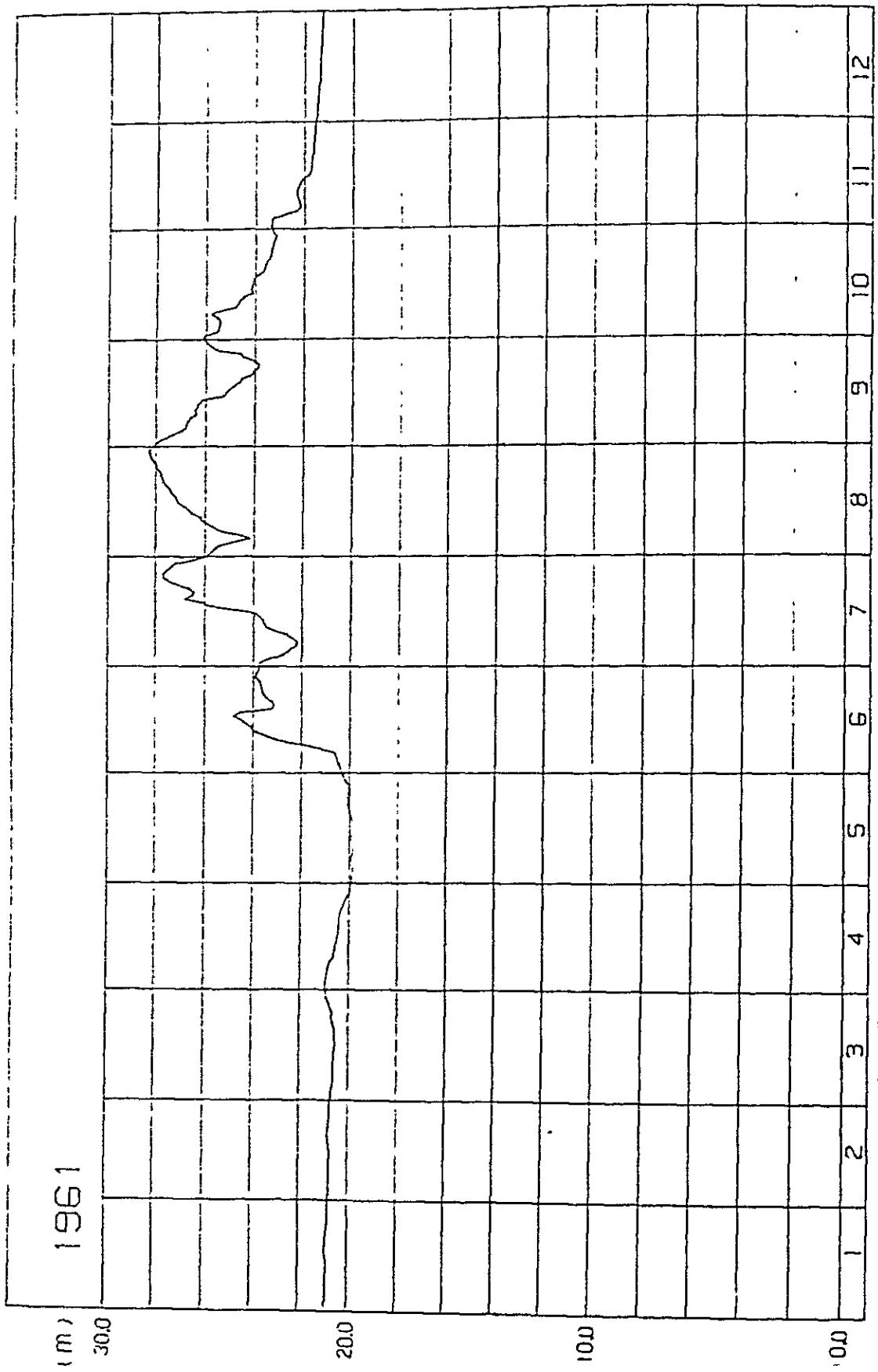


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

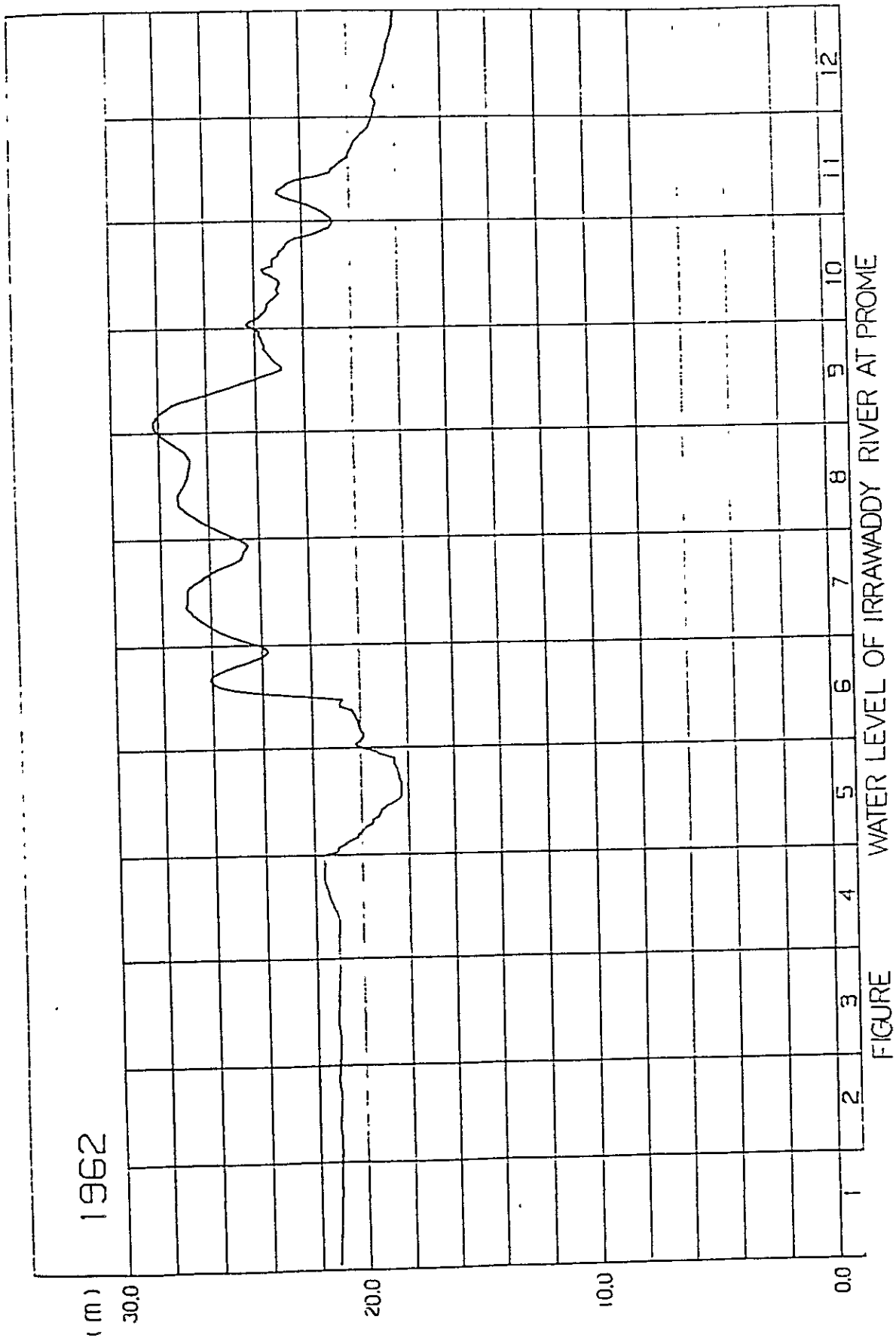


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

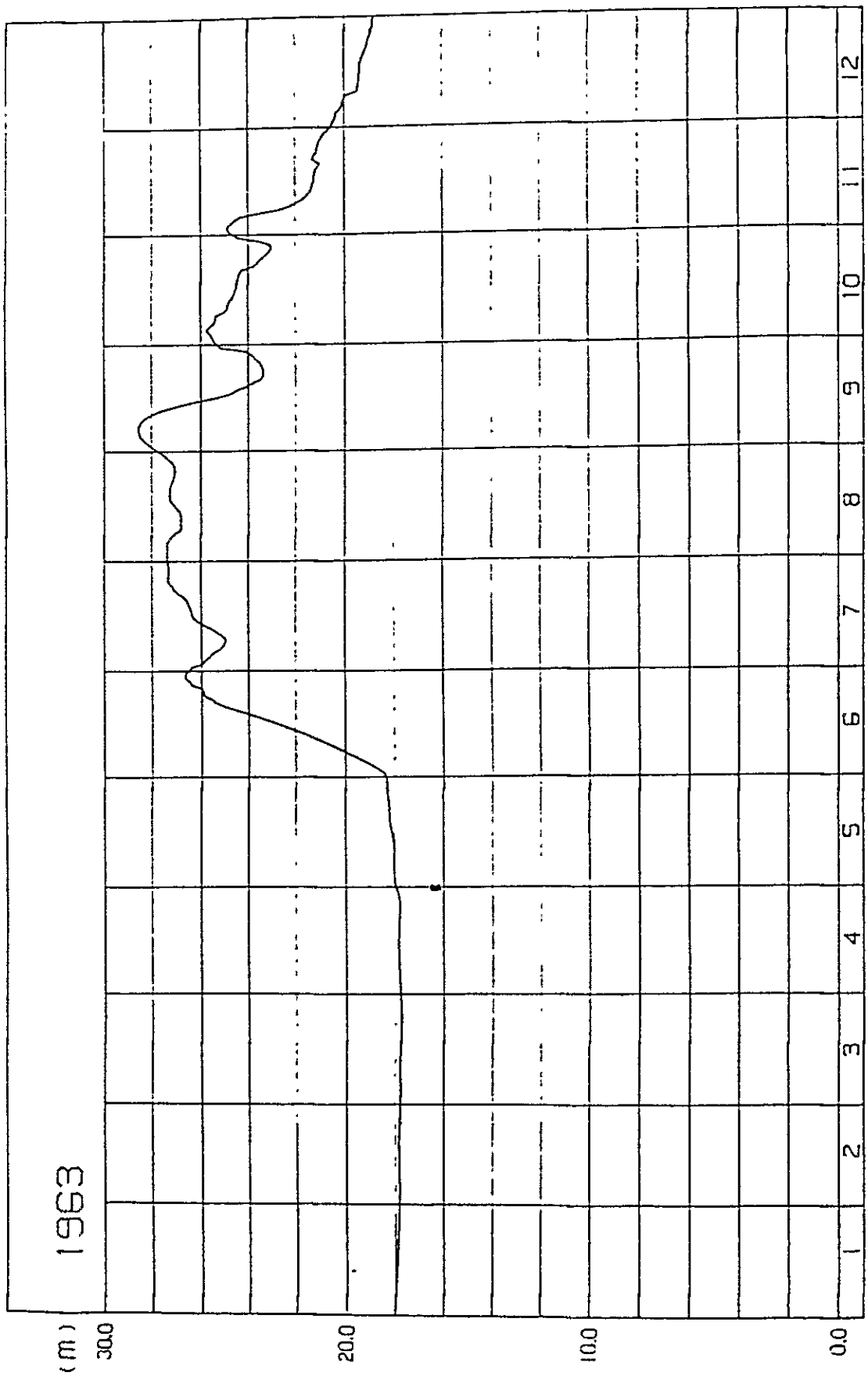


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

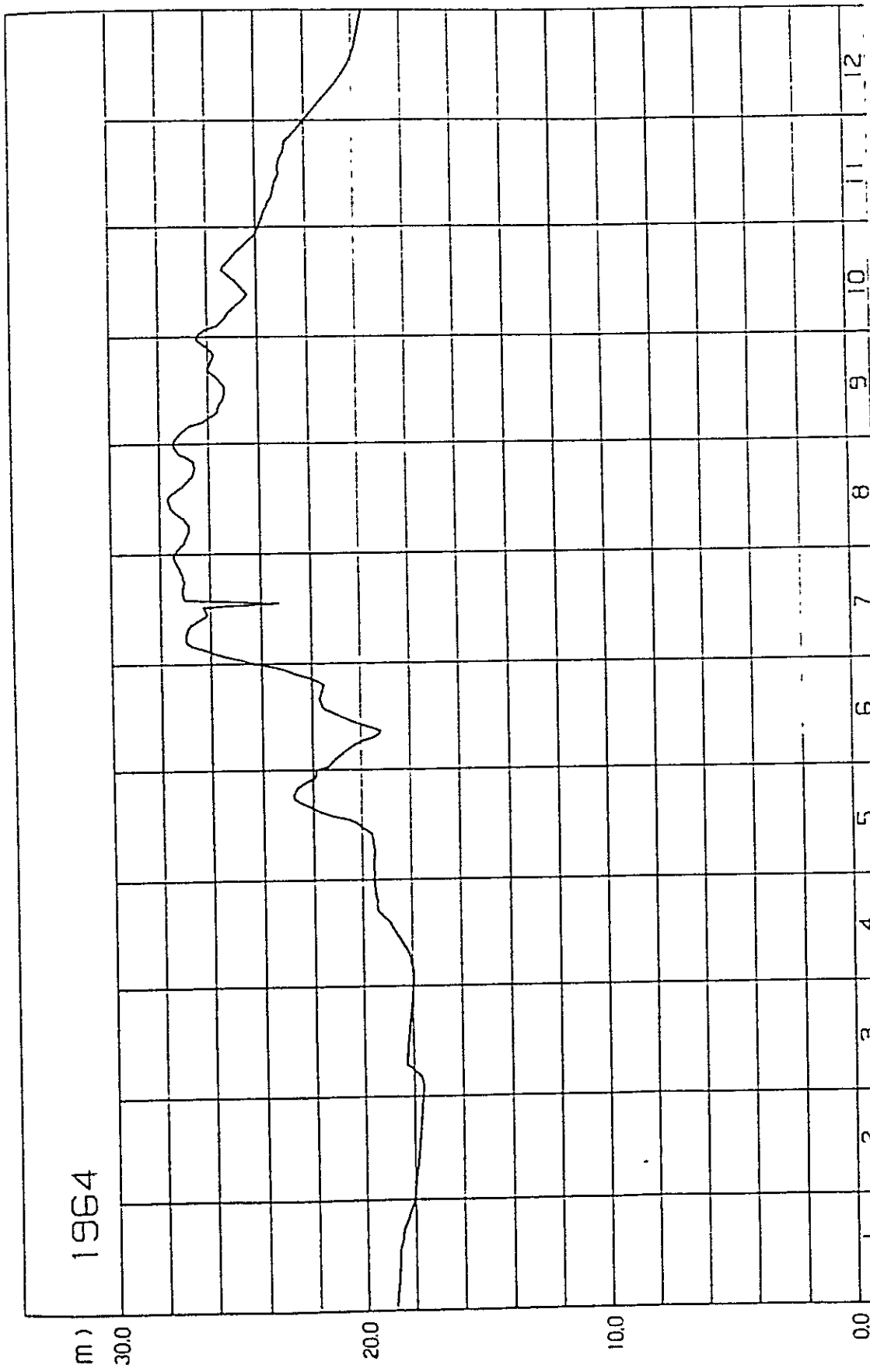


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

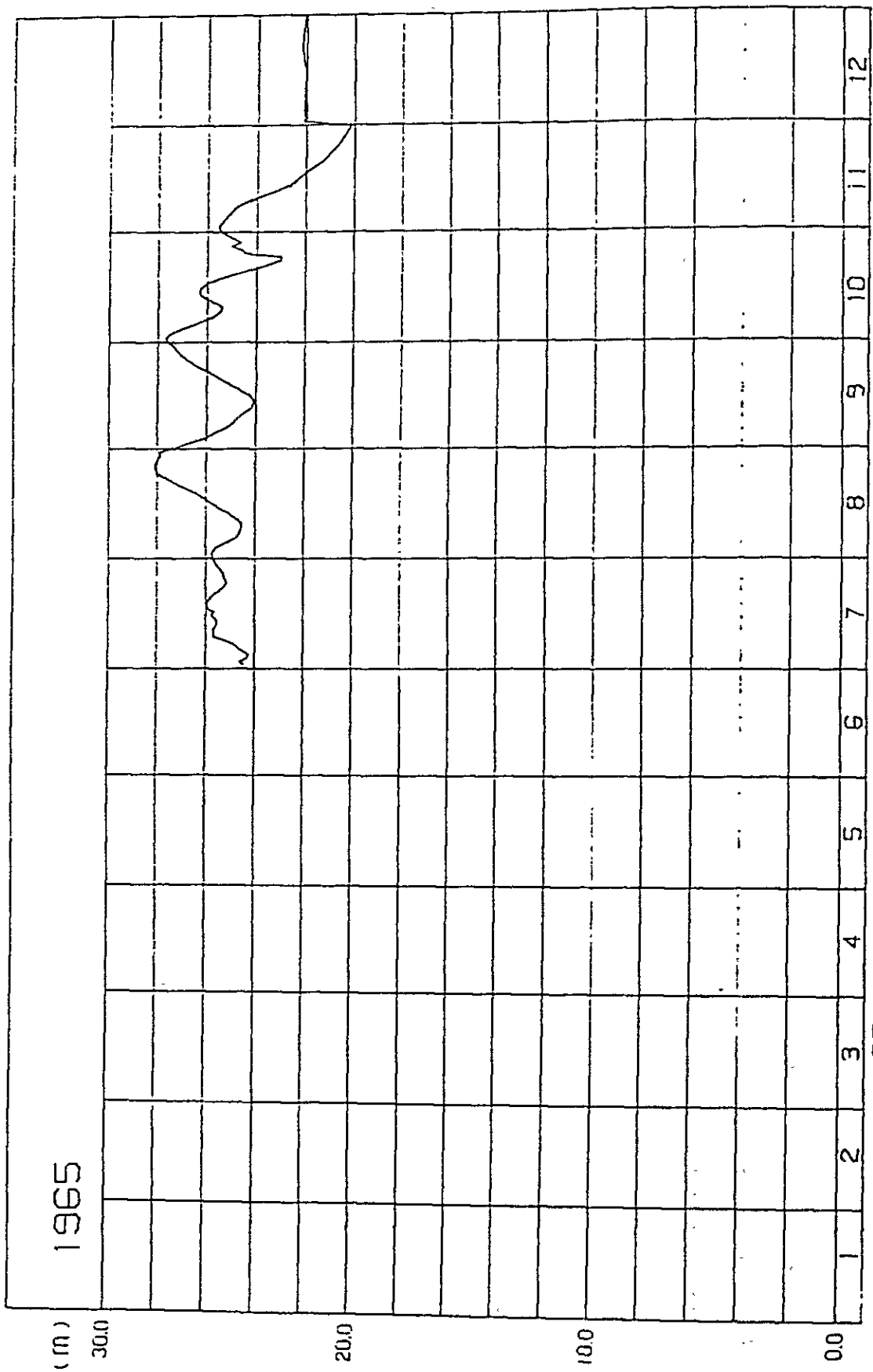


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

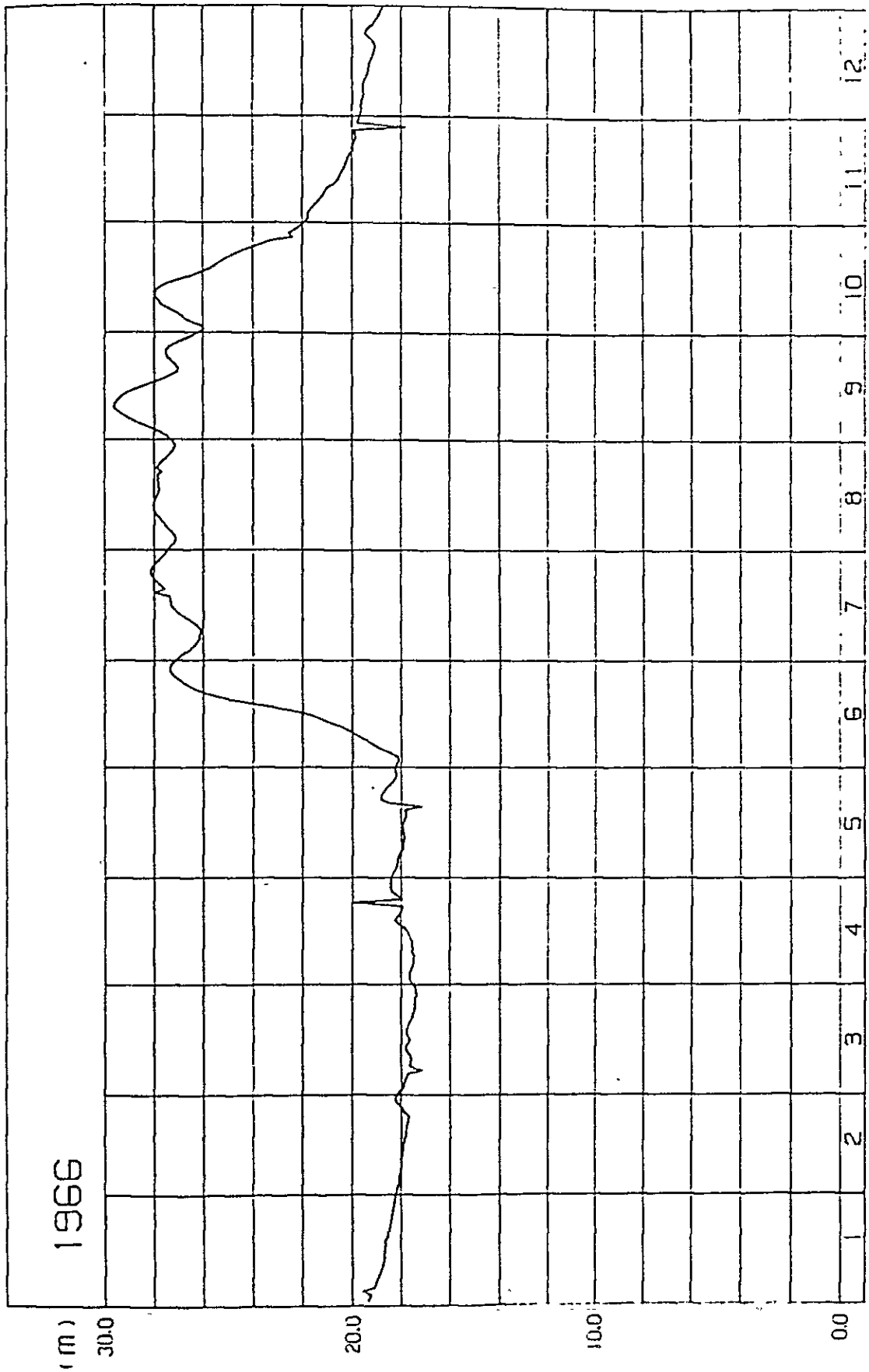


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

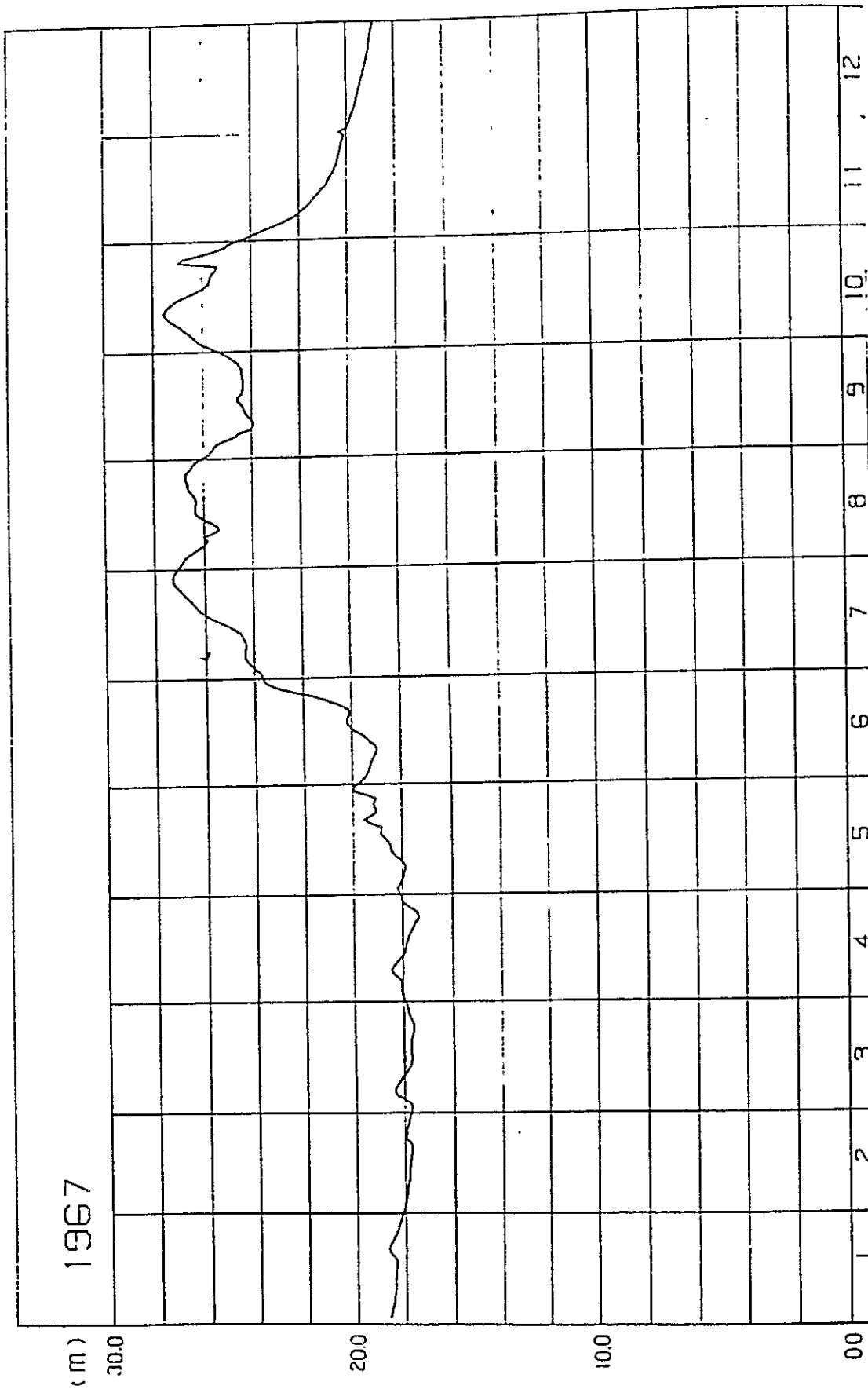


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

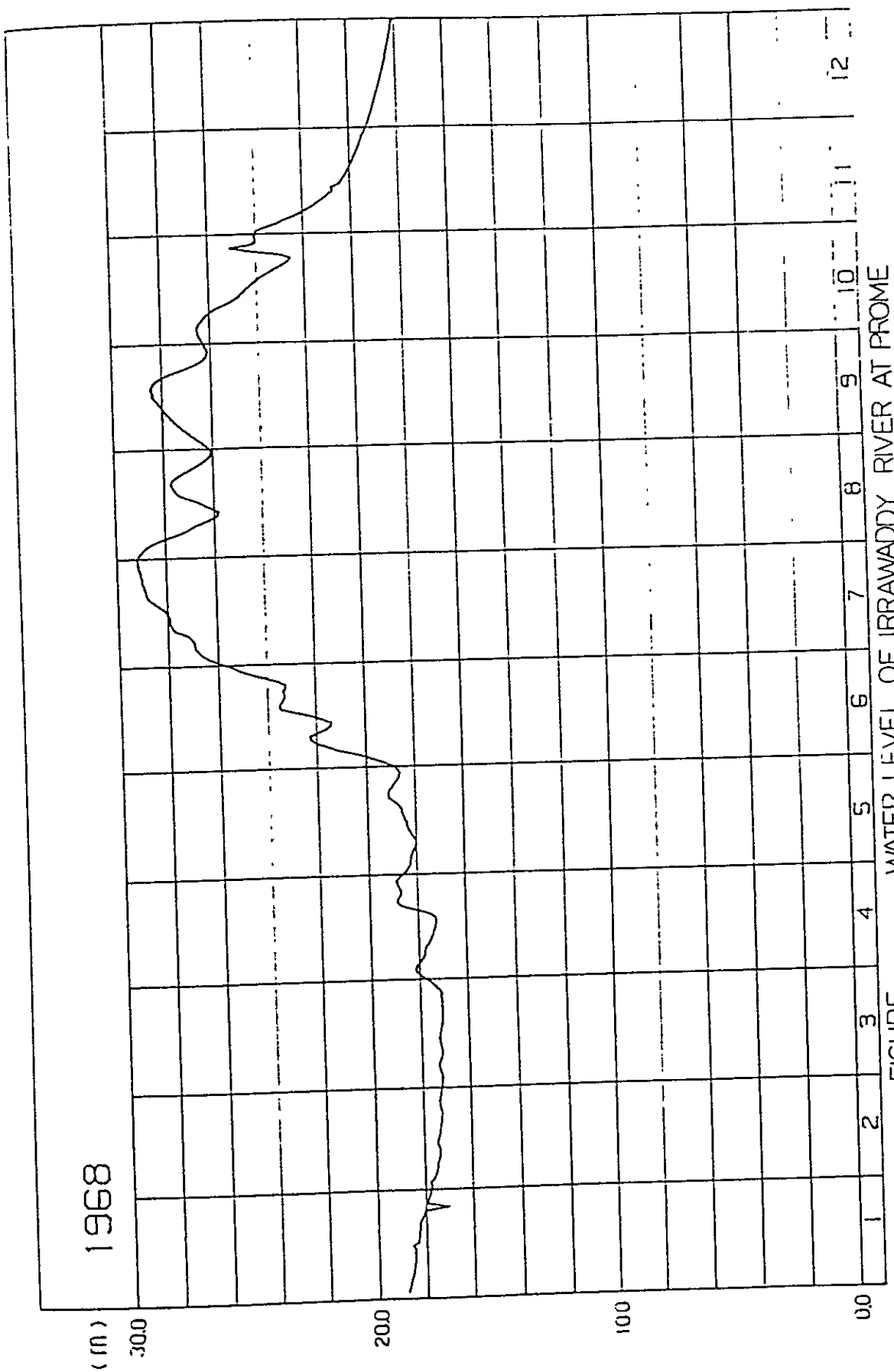


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

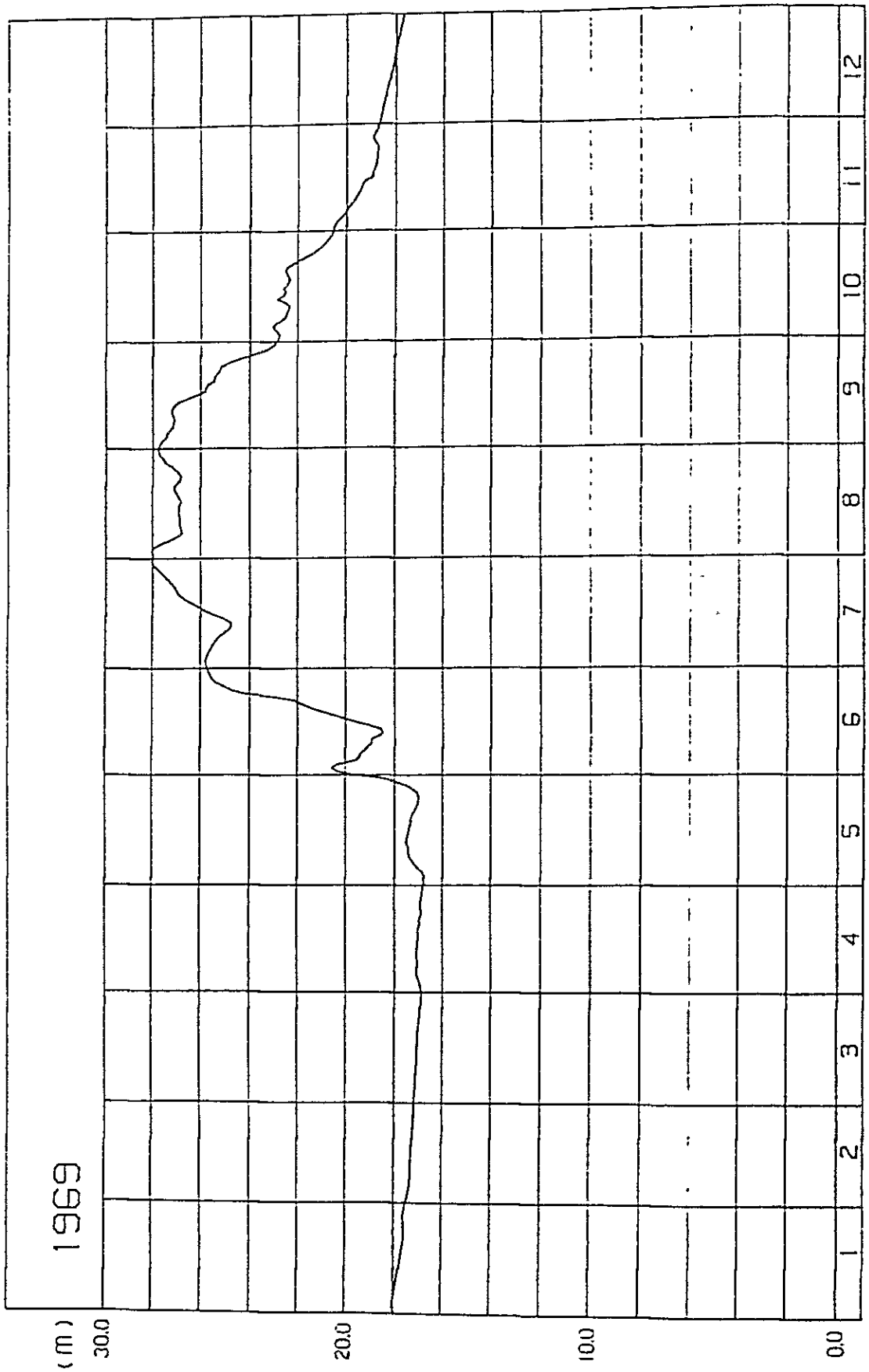


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

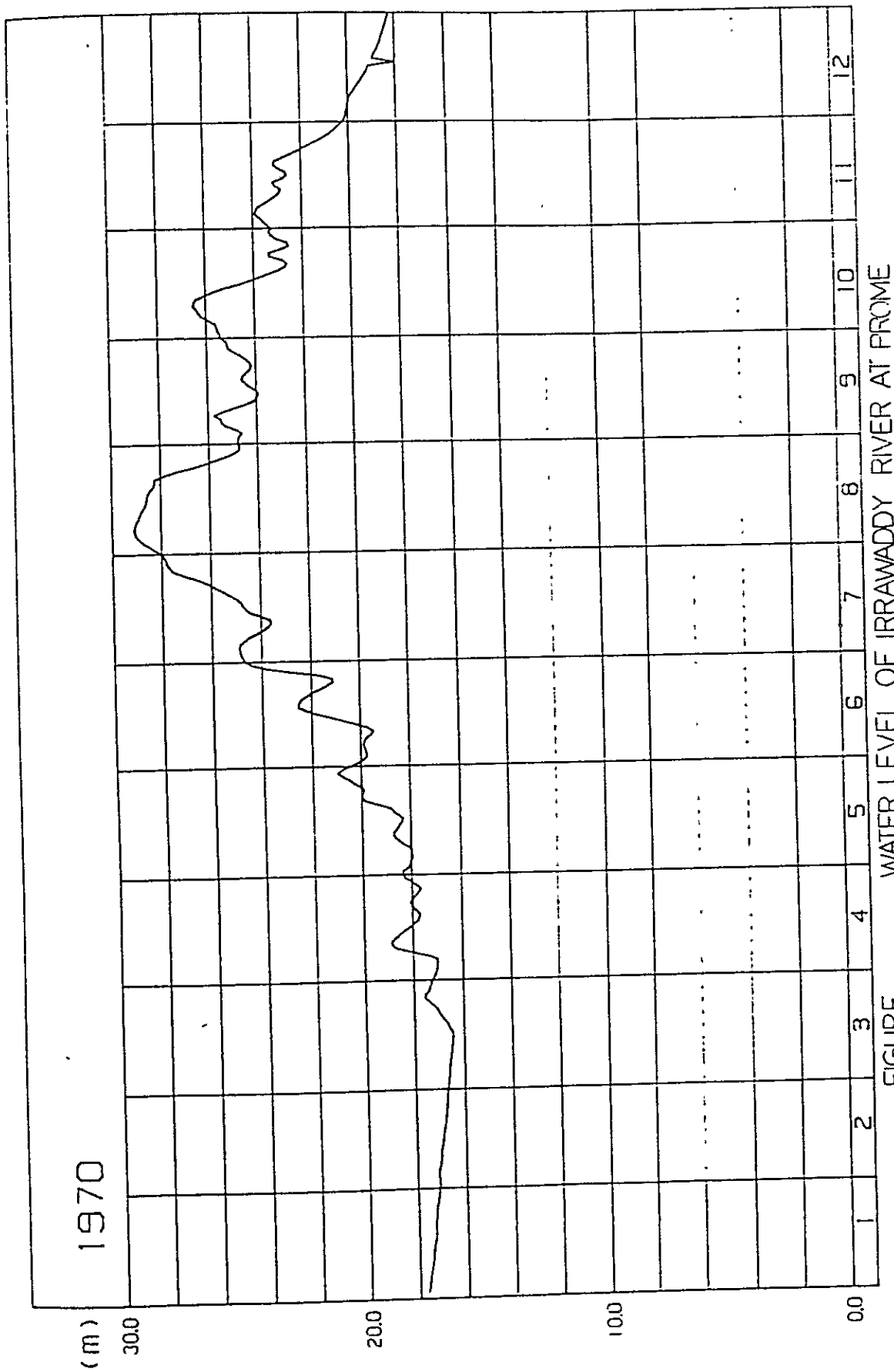


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

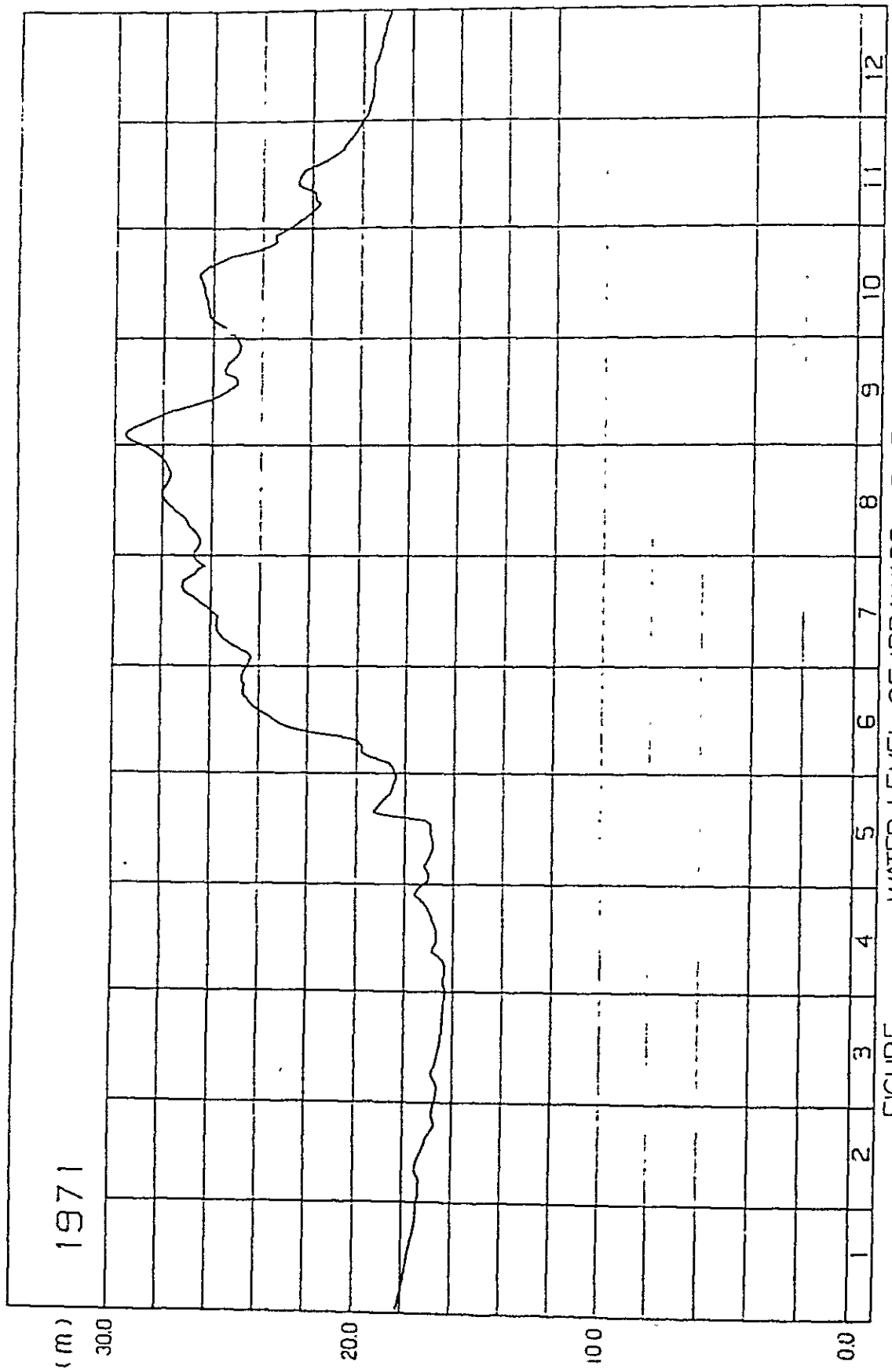
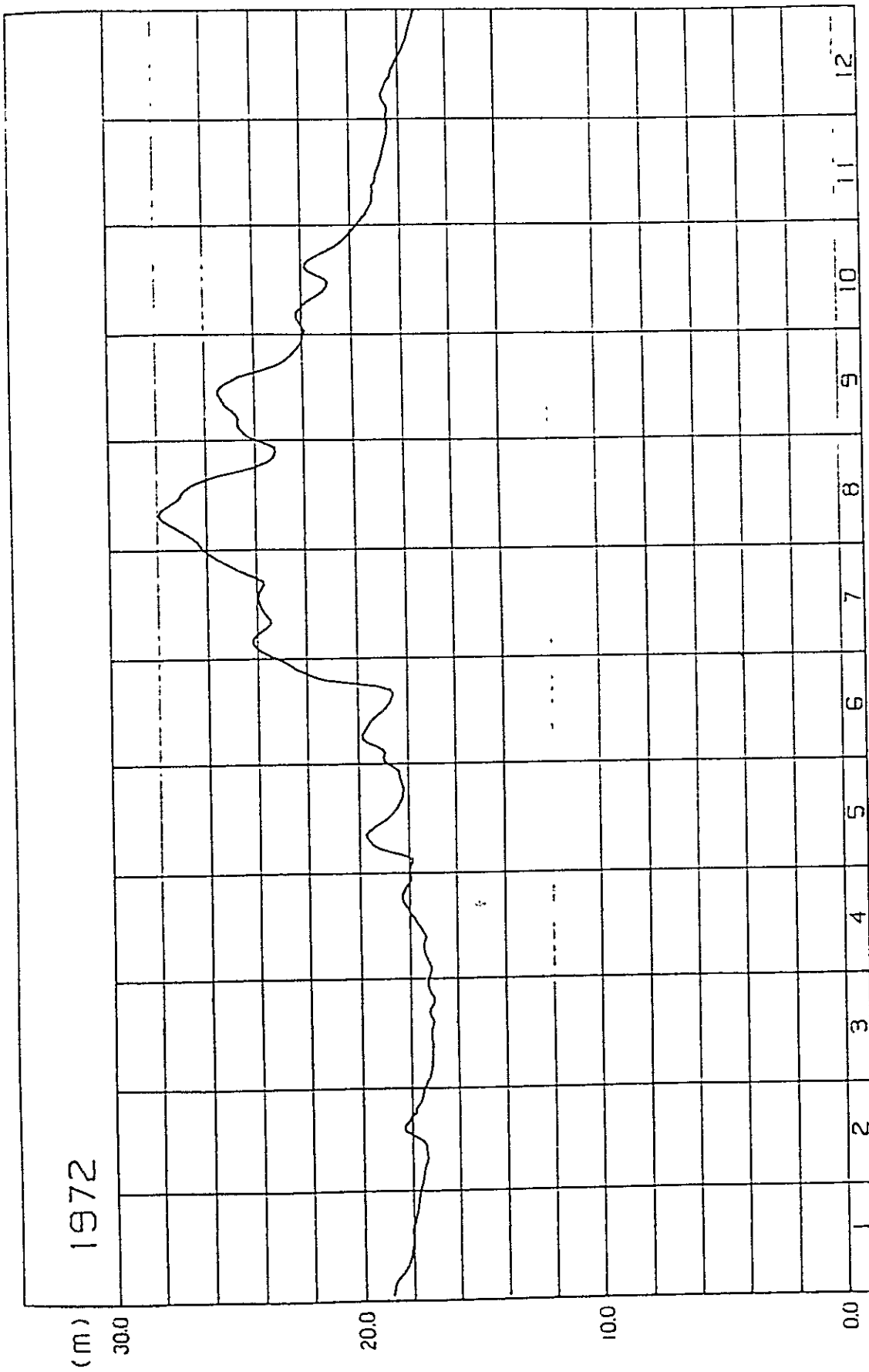


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME



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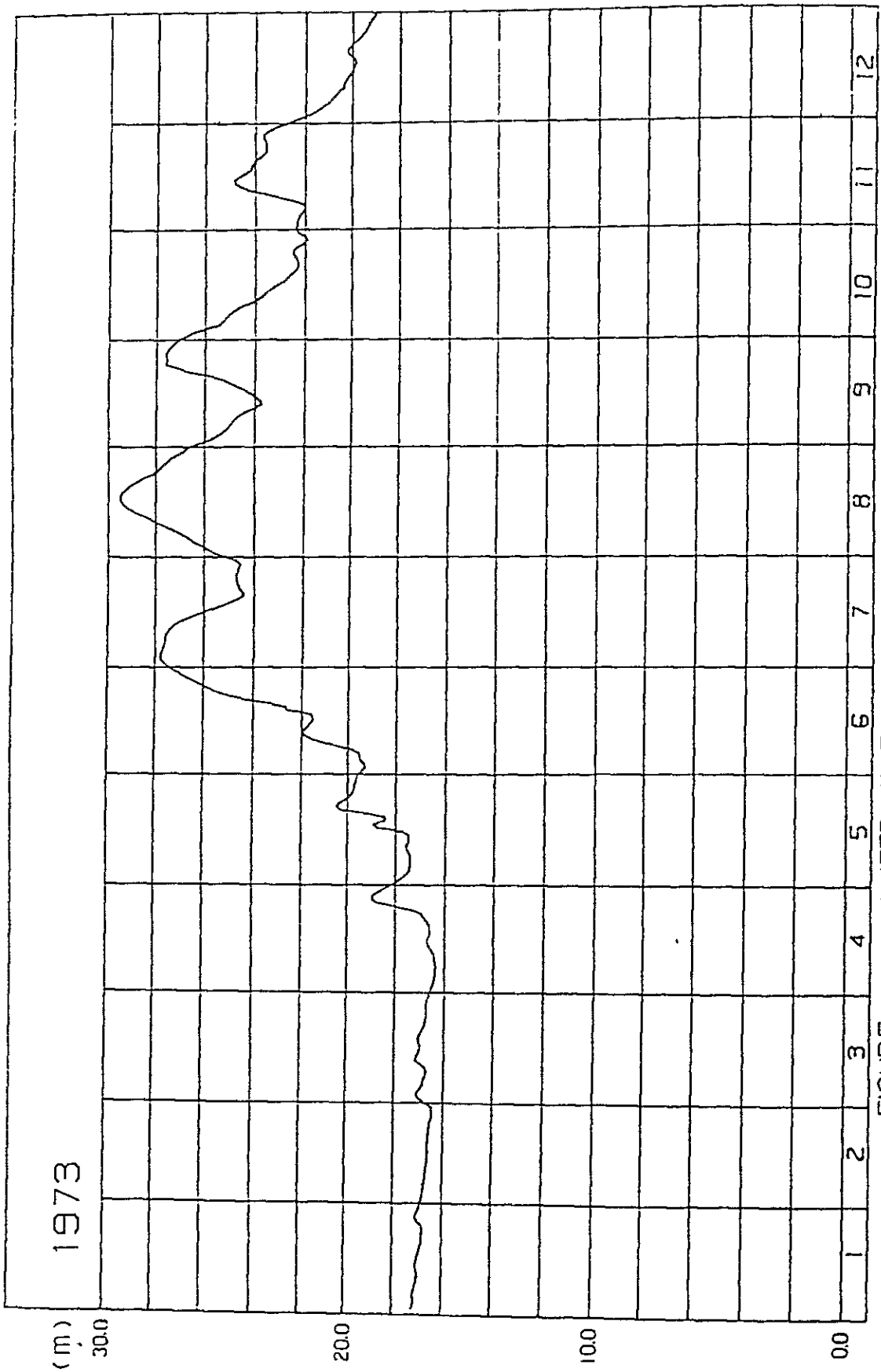

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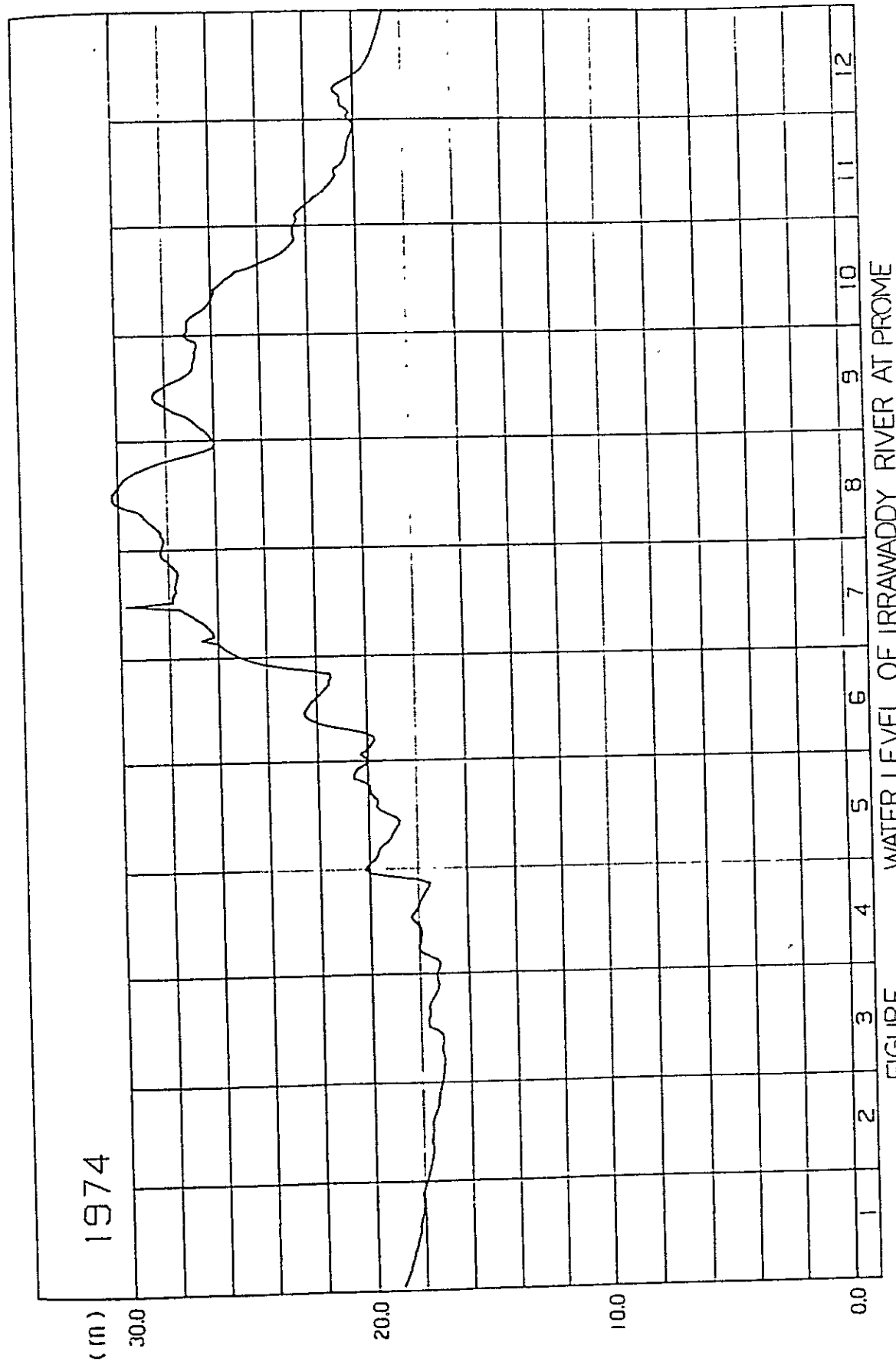

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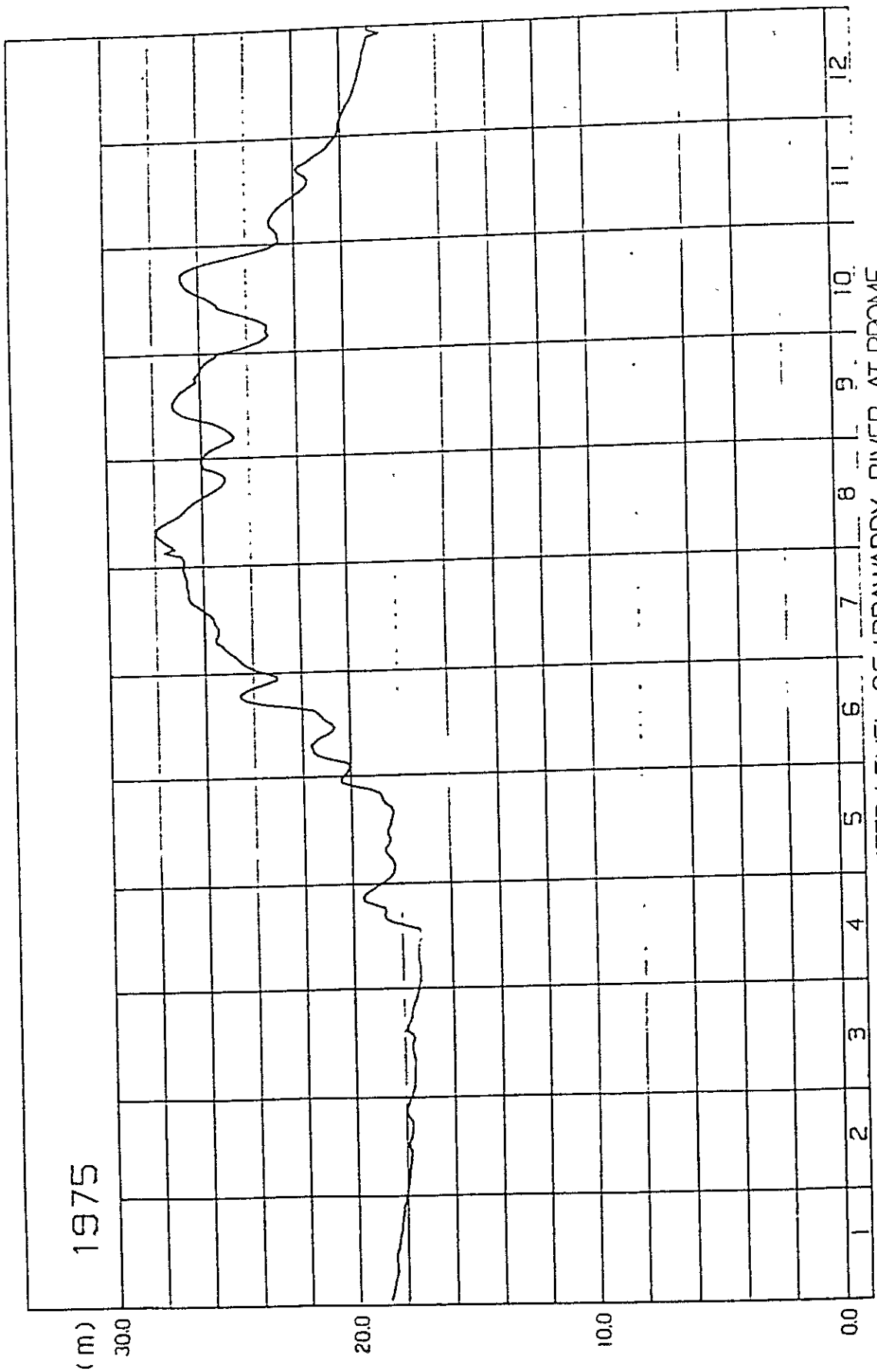

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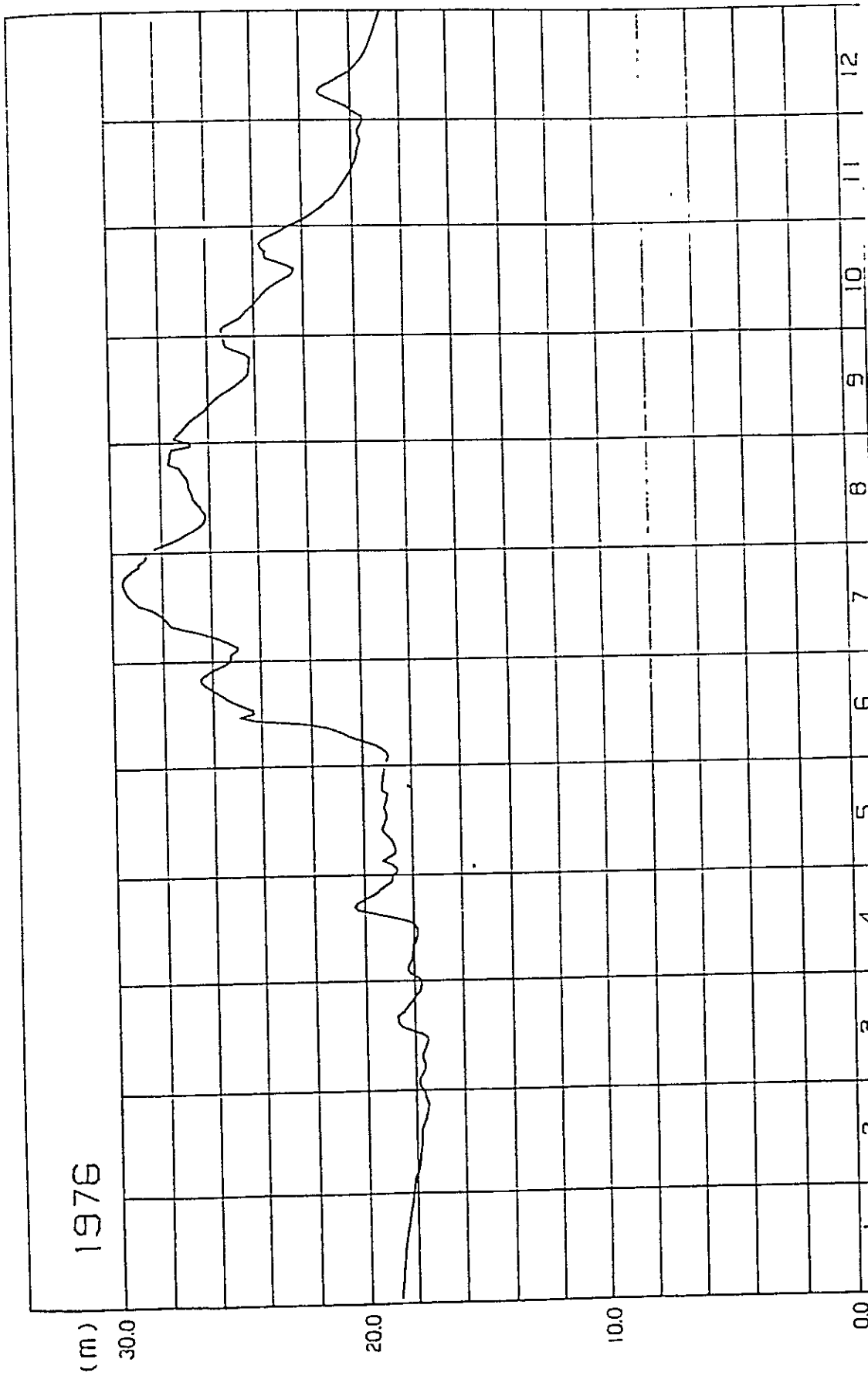

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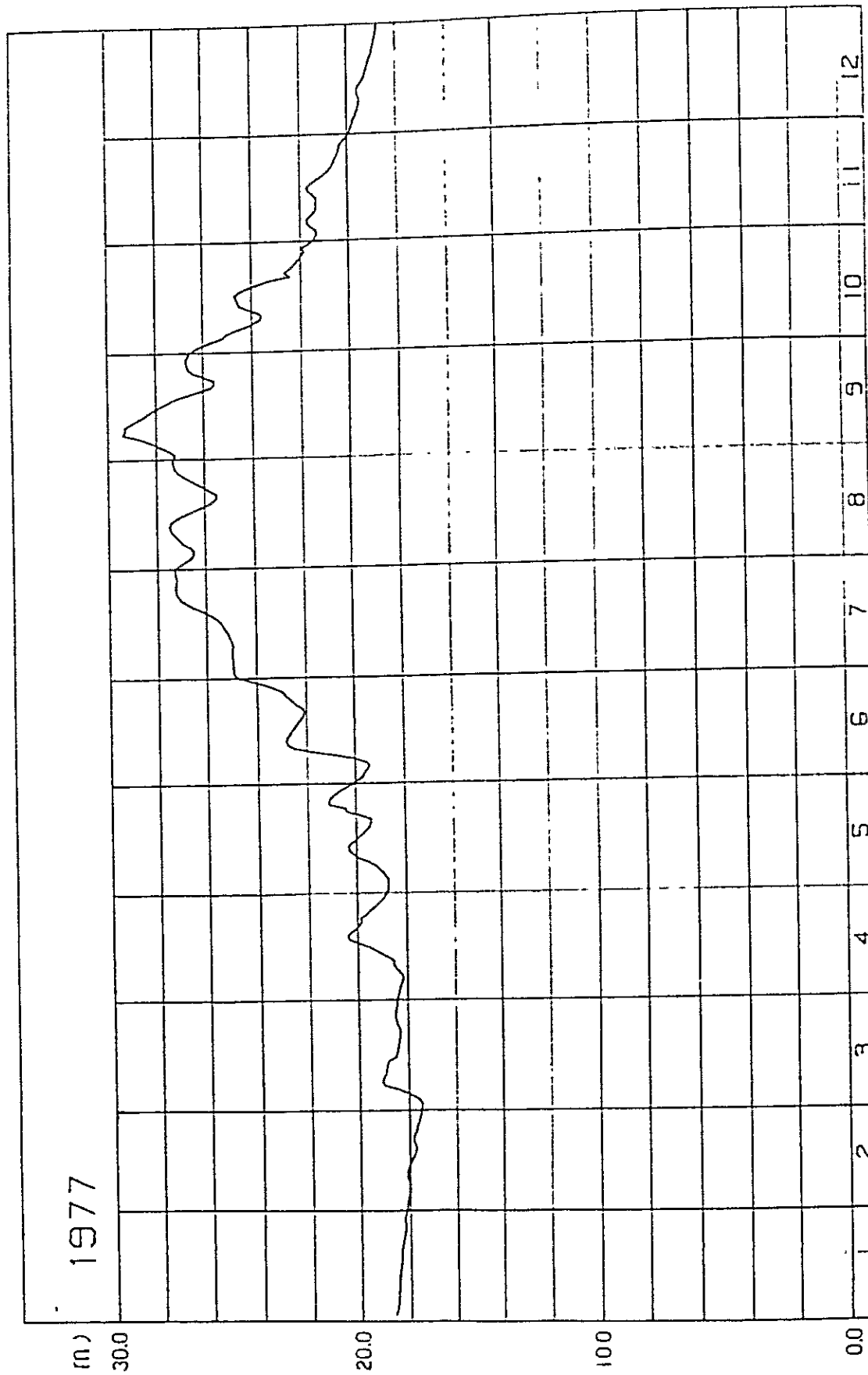


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT PROME

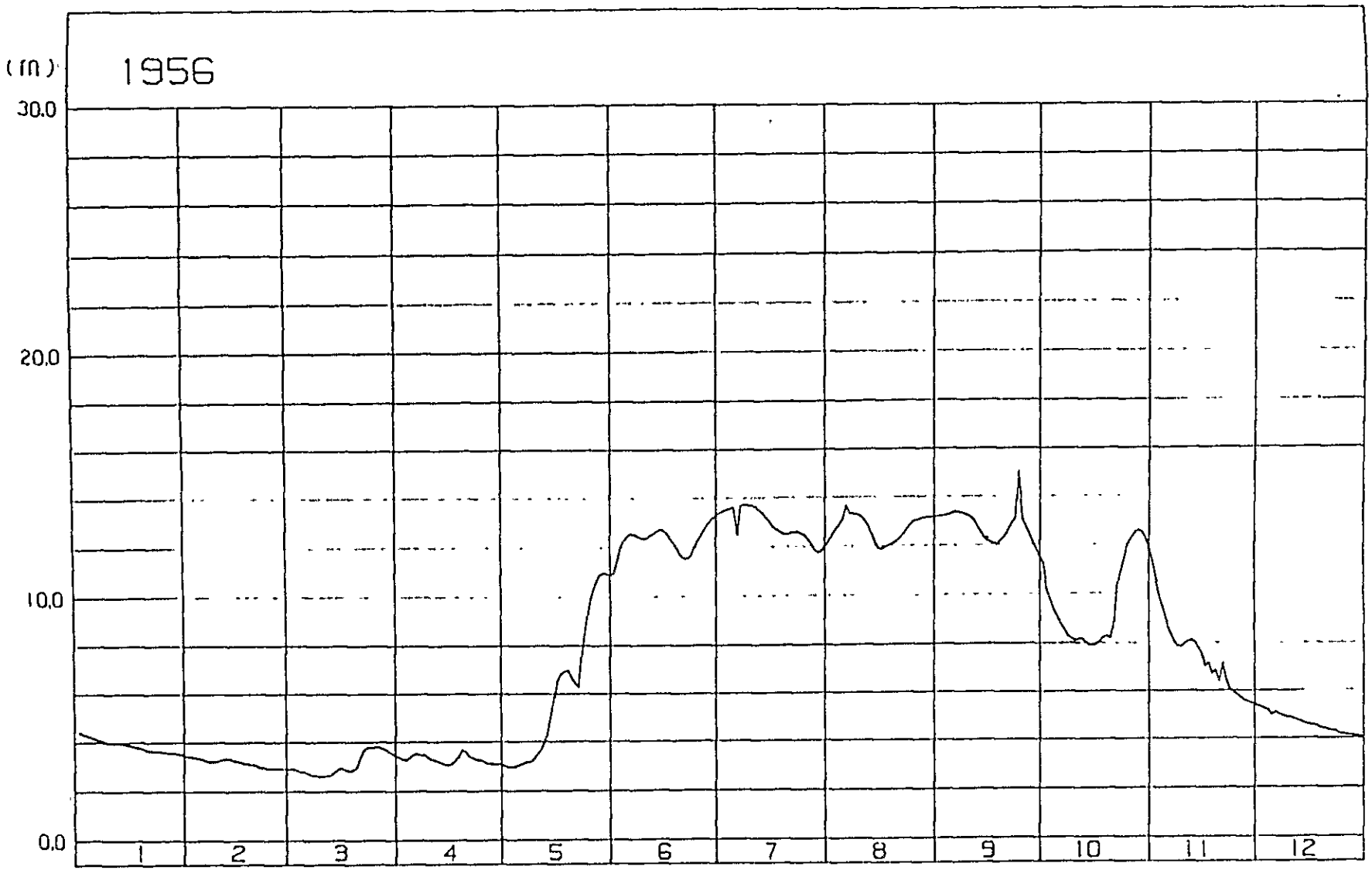


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HENZADA

APPENDIX E-3 WATER LEVEL OF IRRAWADDY RIVER AT HENZADA

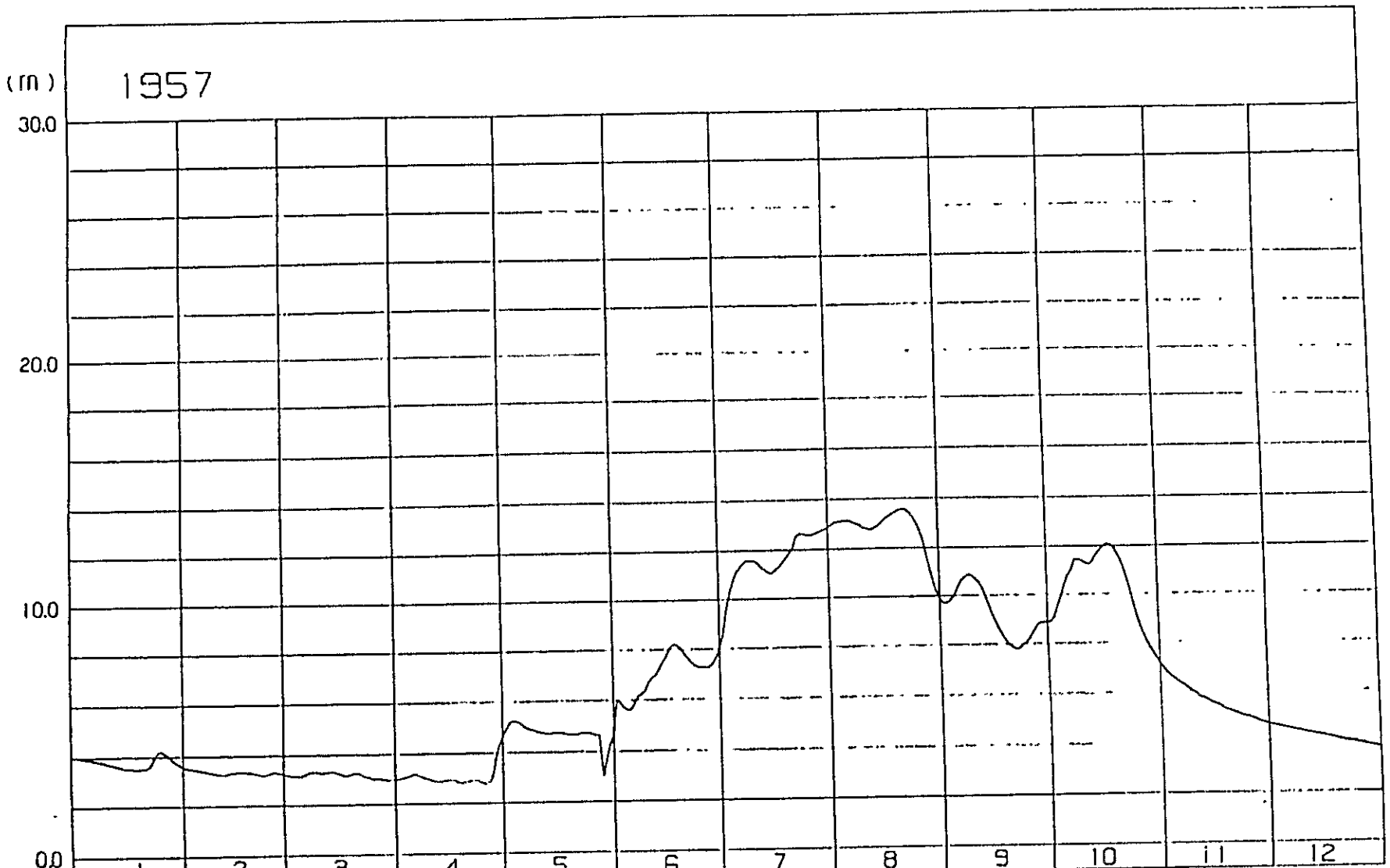


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HLENZADA

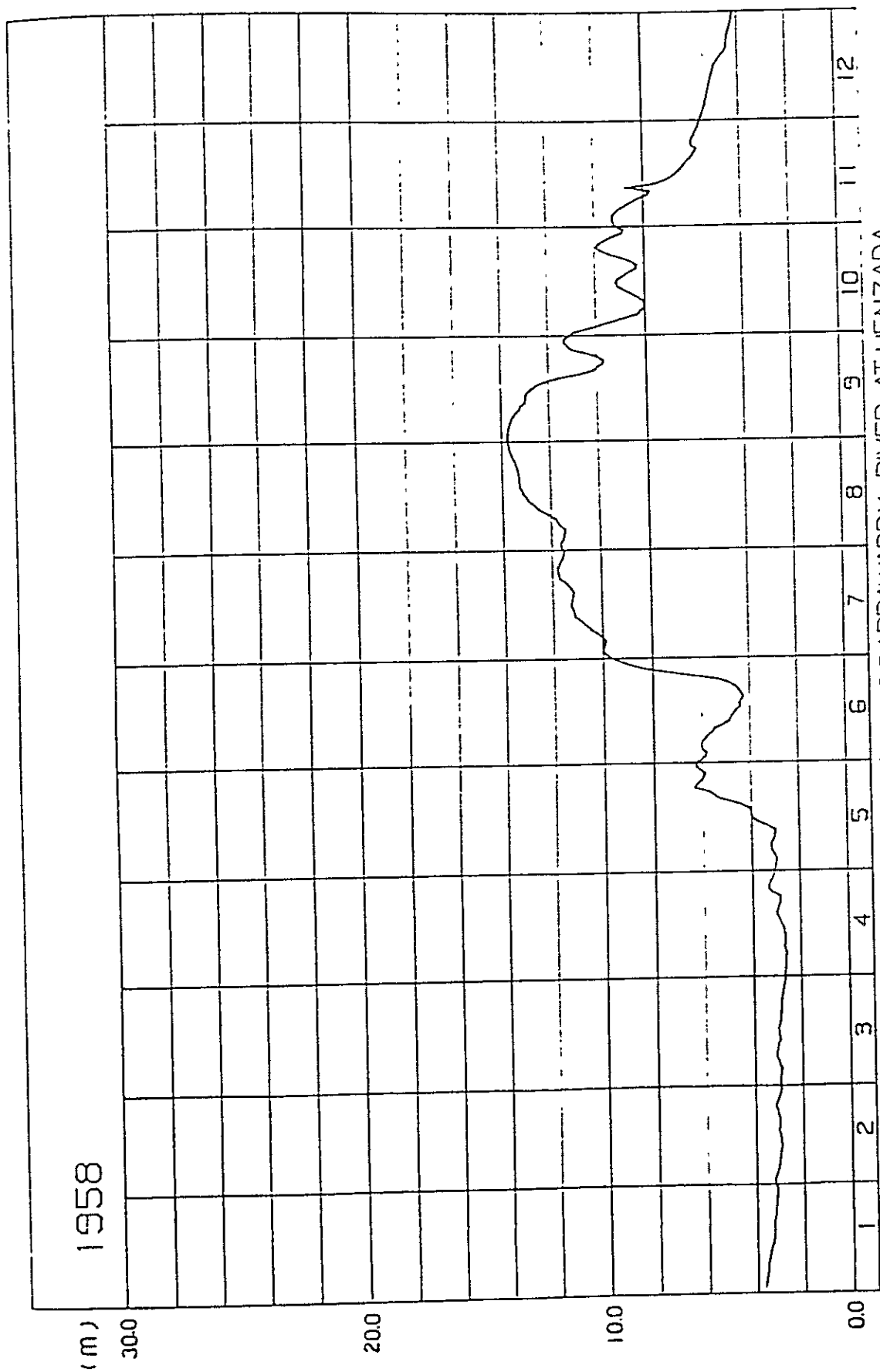


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HENZADA

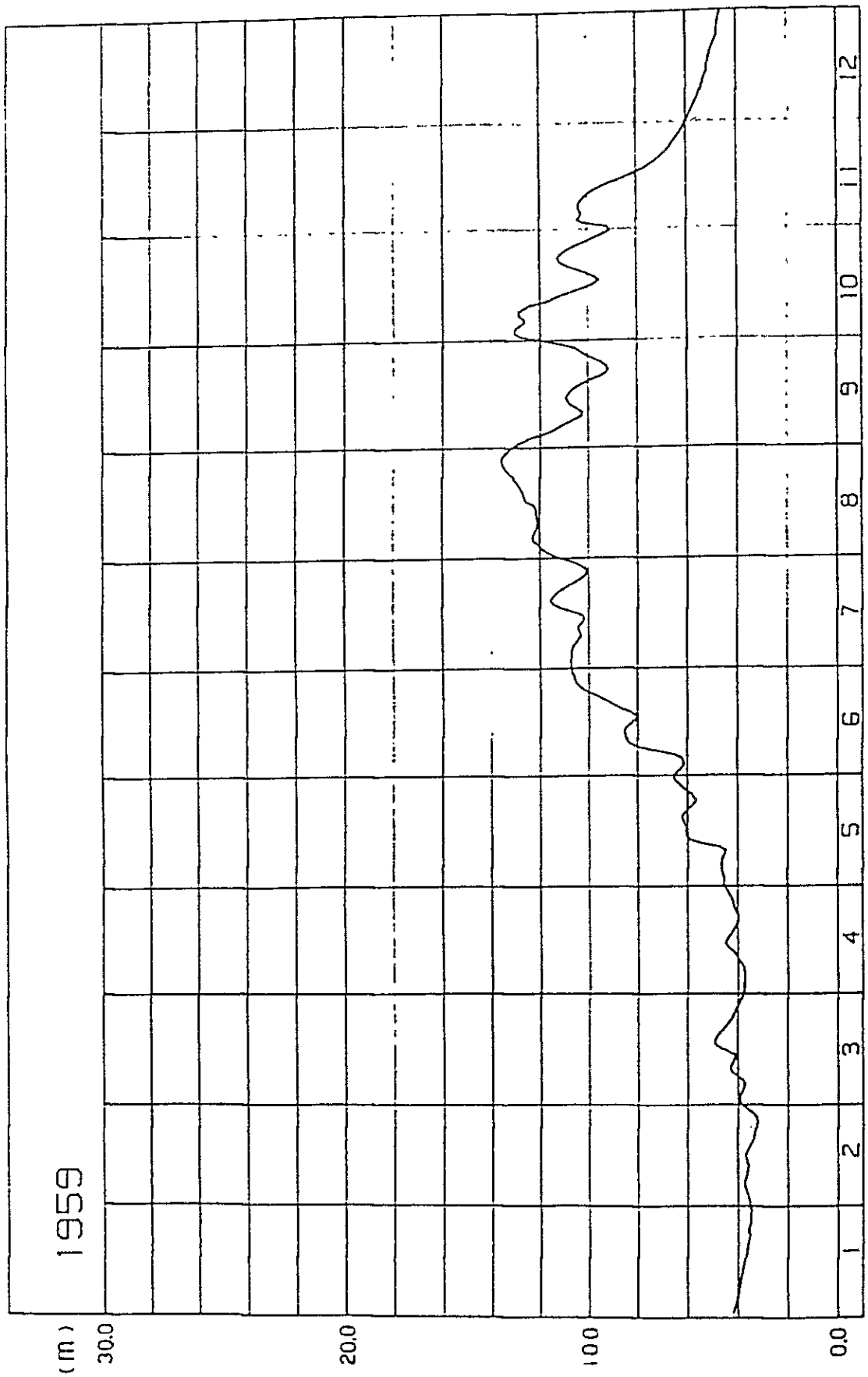


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HENZADA

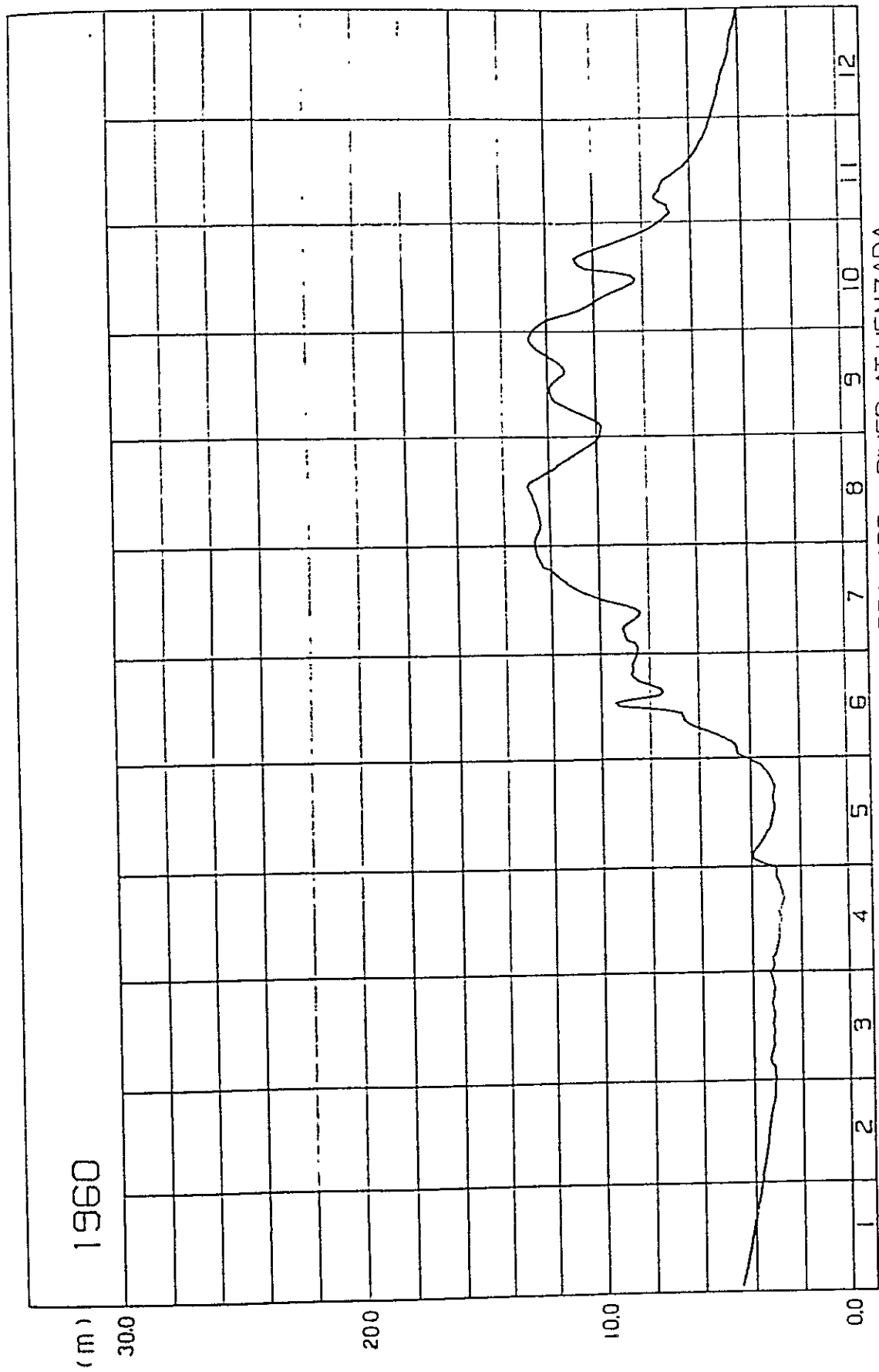


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HENZADA

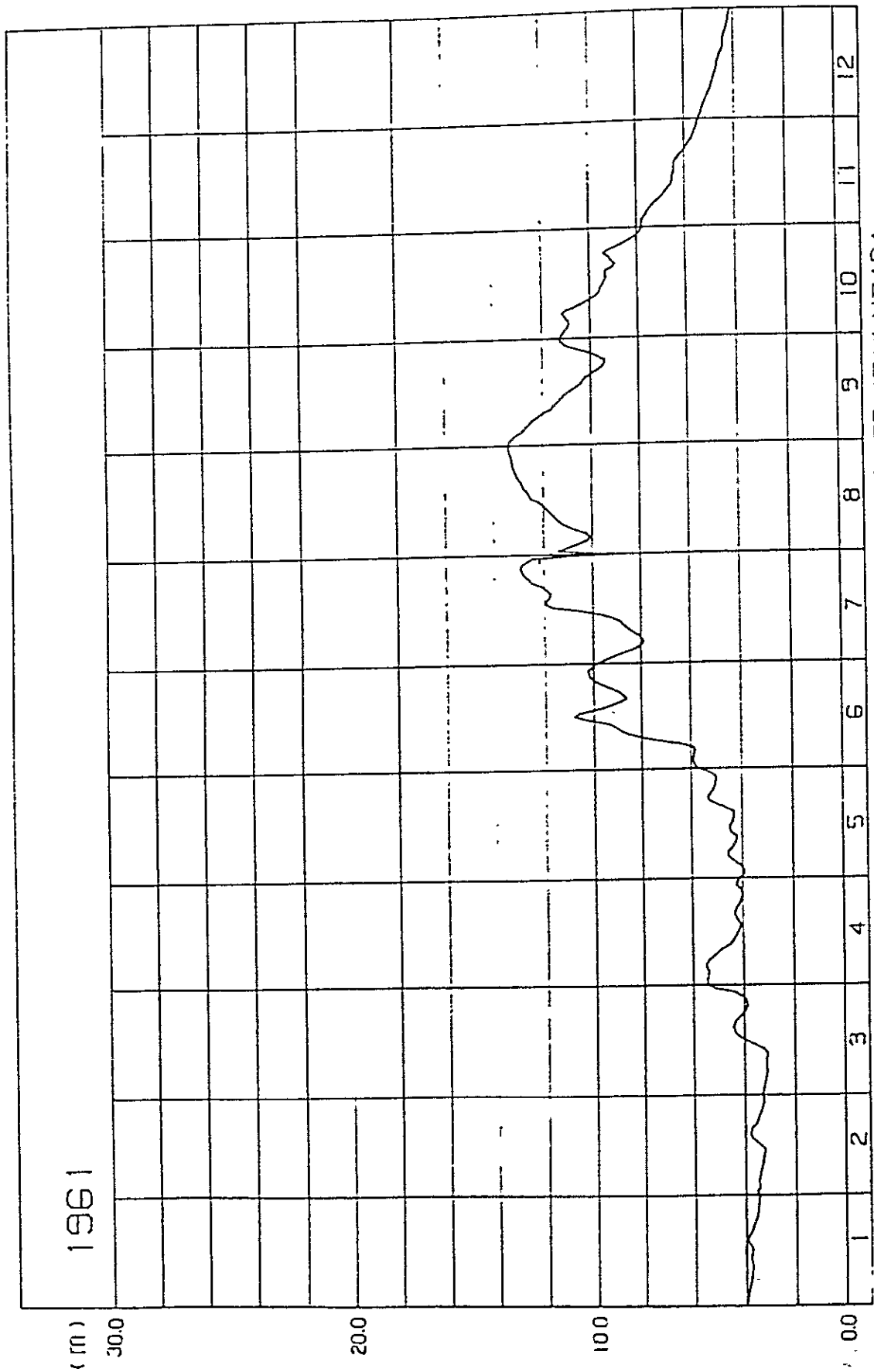
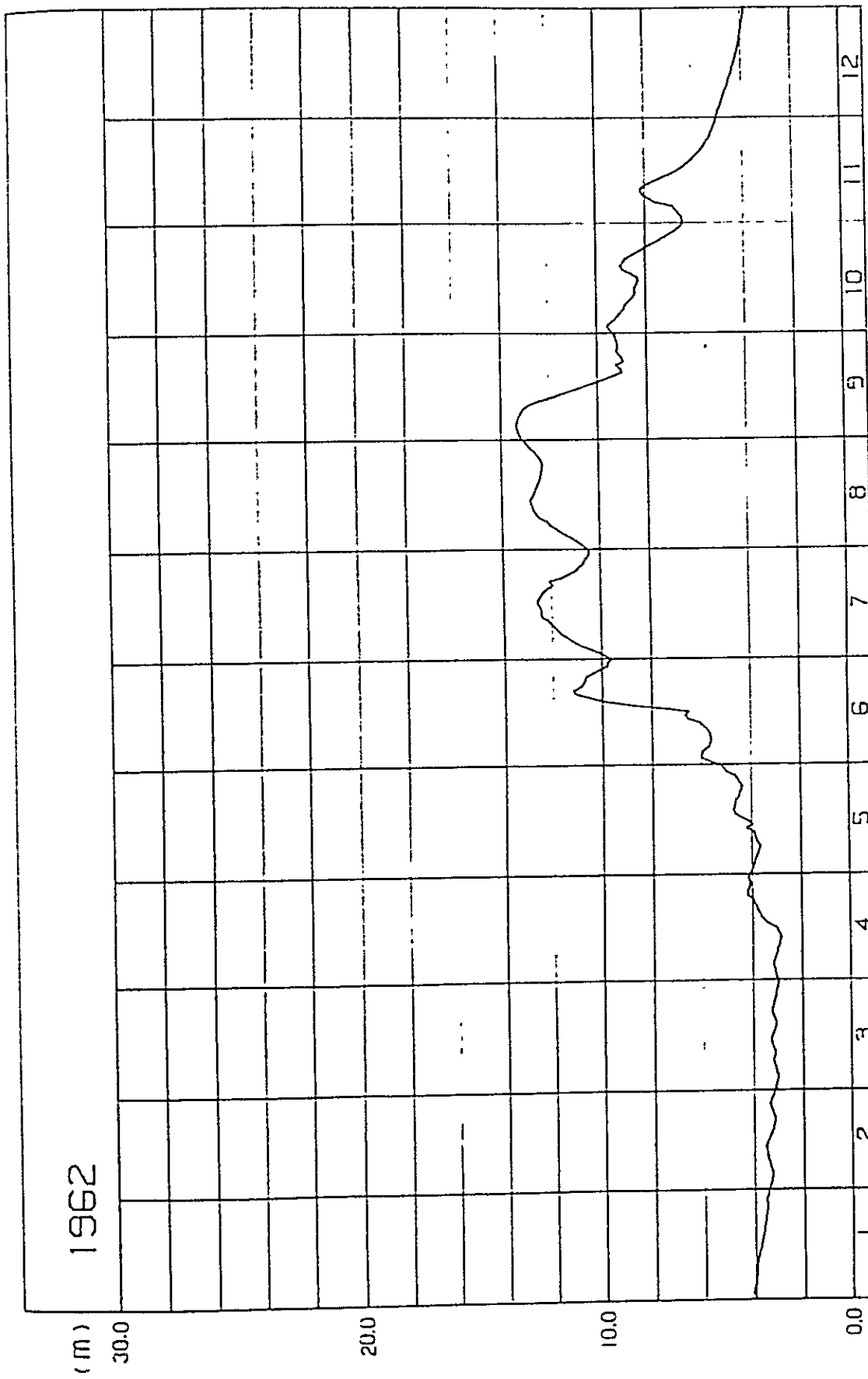


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HLNZADA



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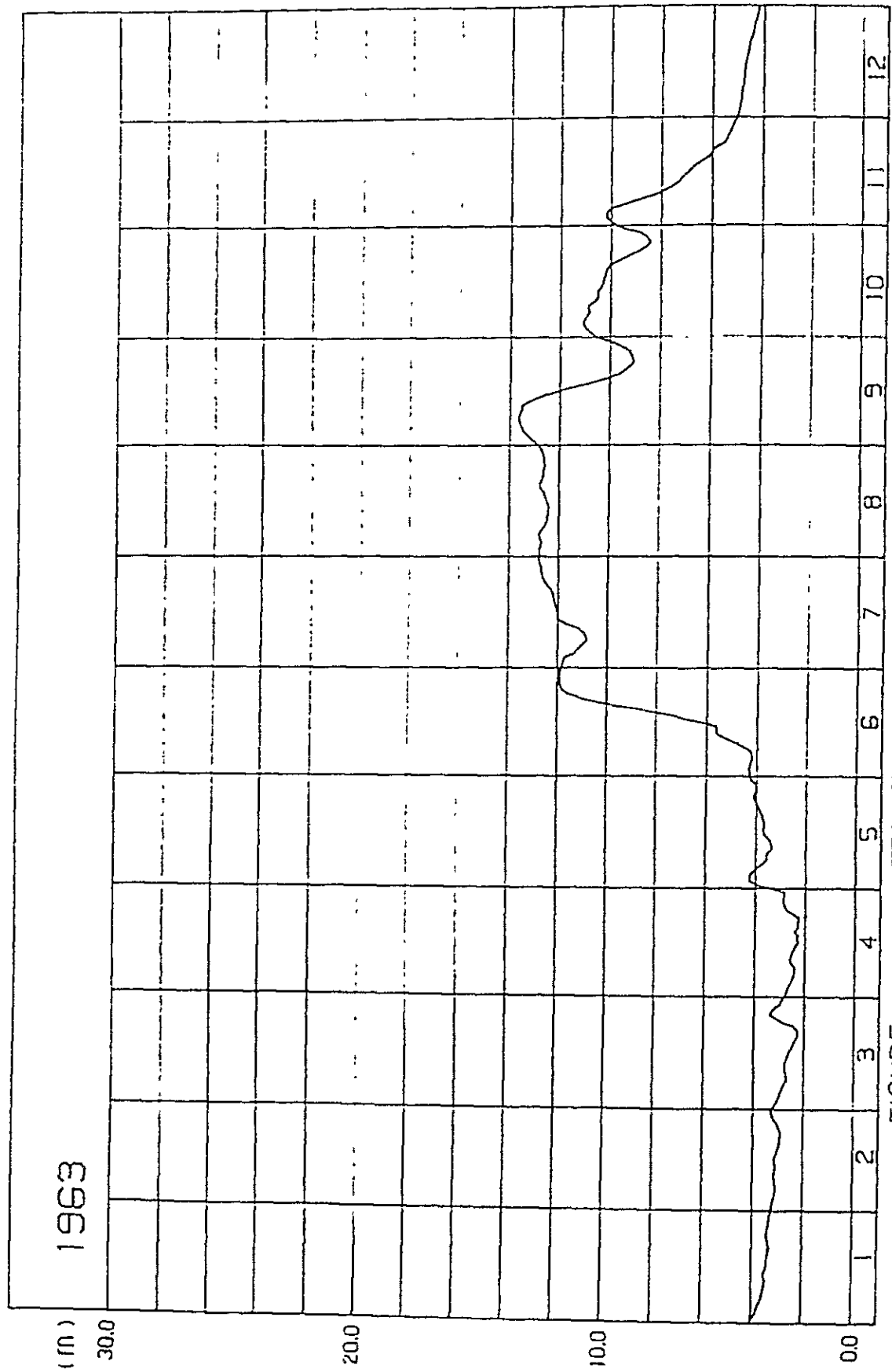

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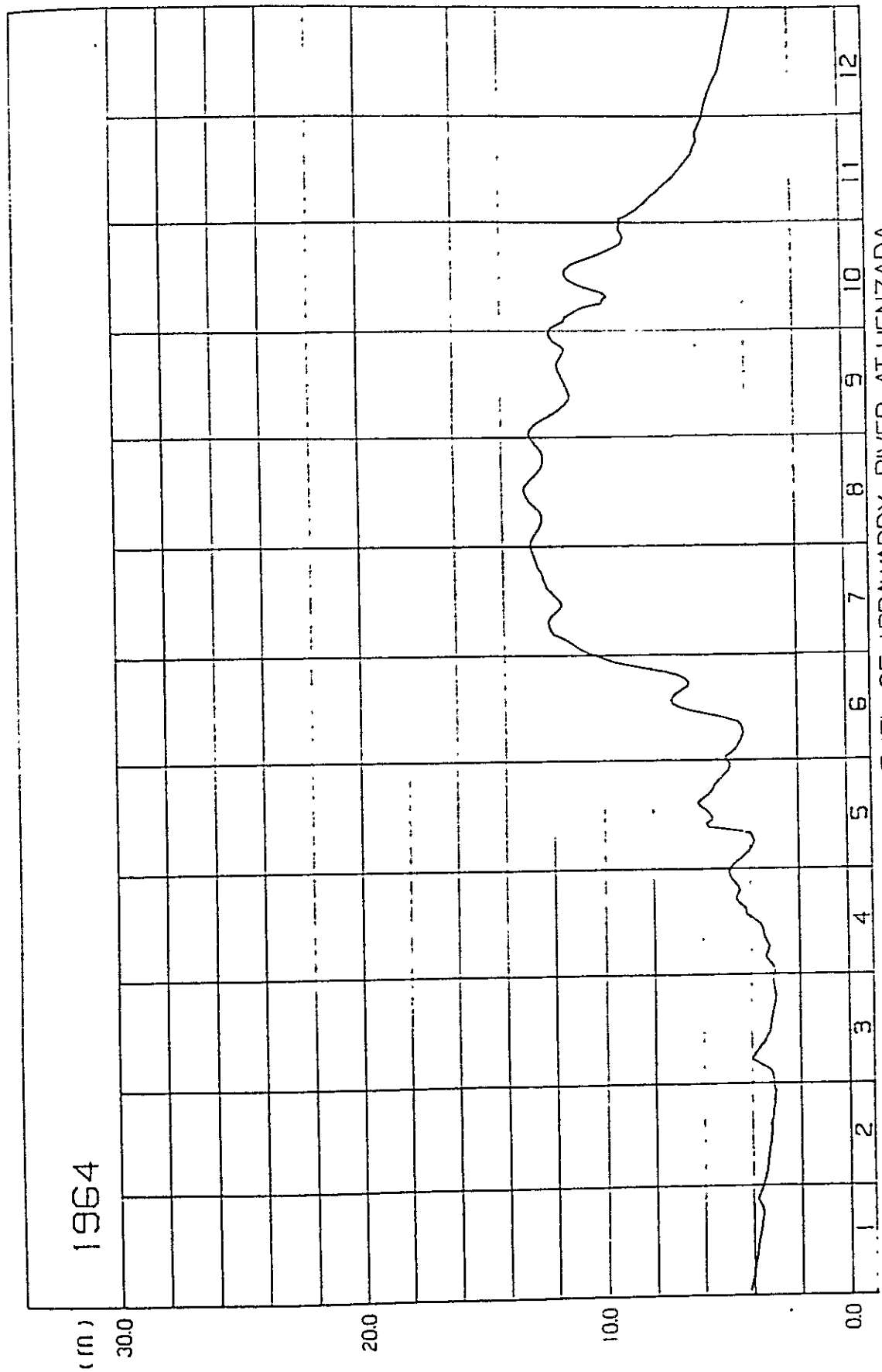
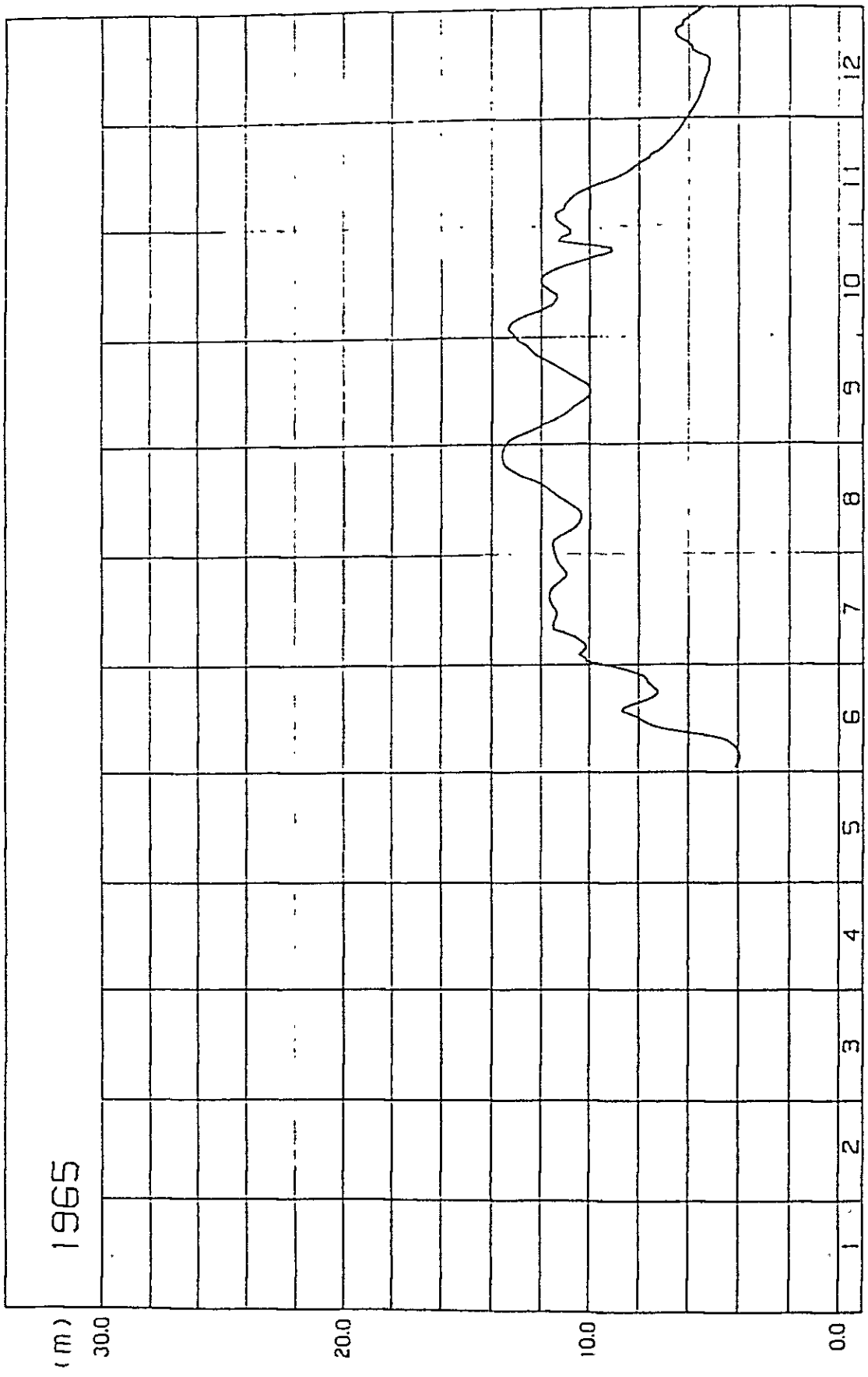


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HENZADA



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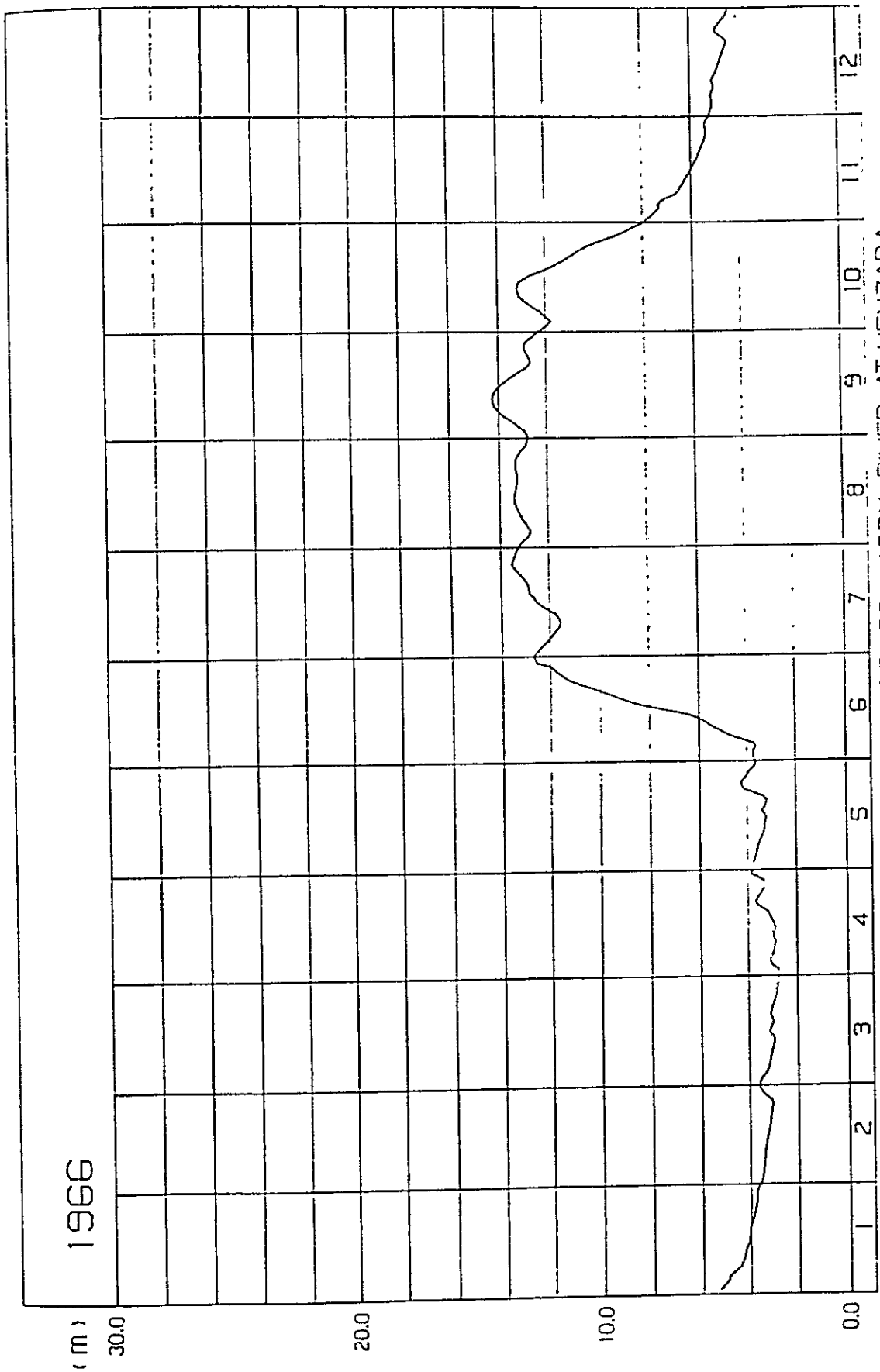

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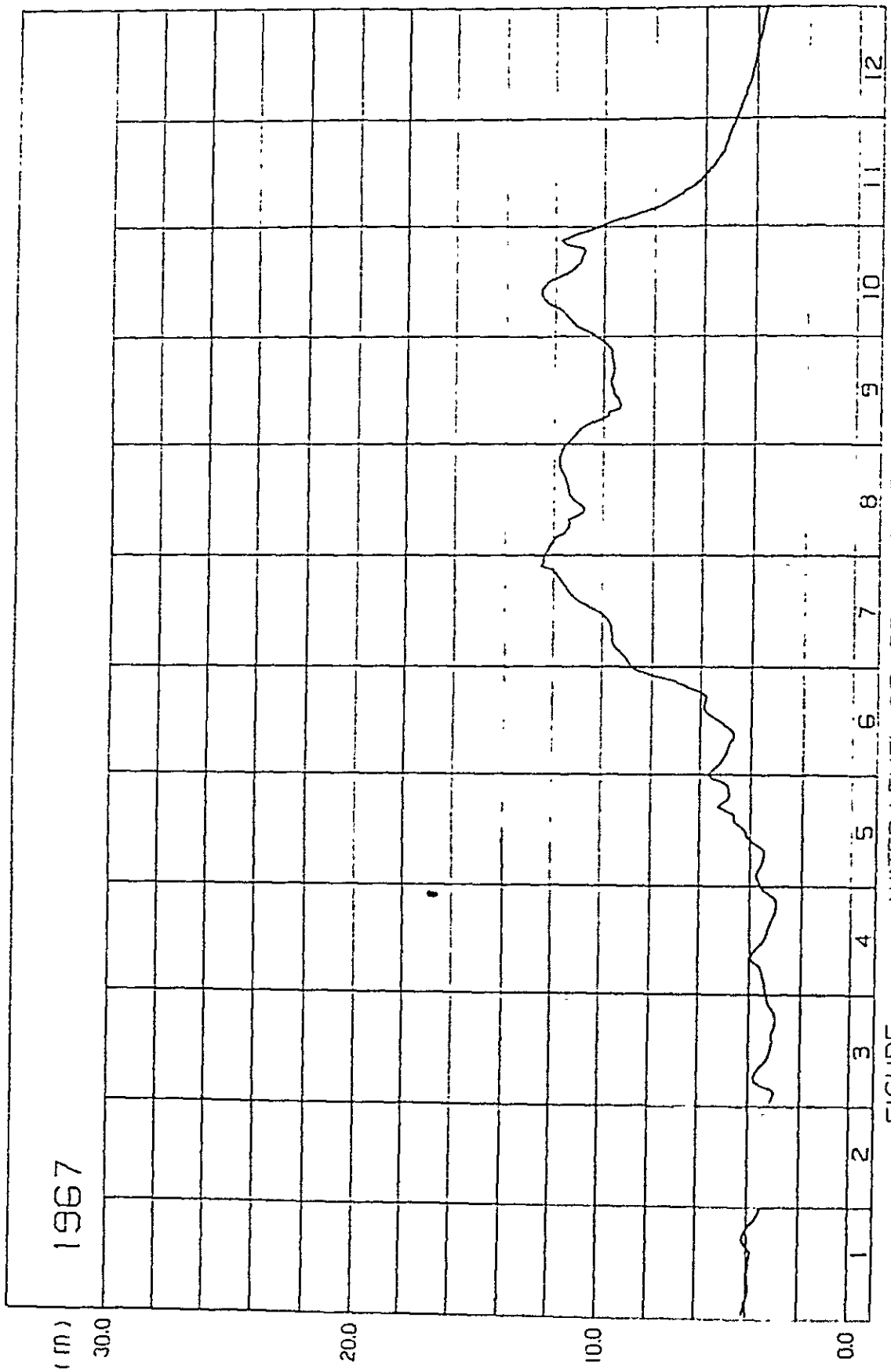

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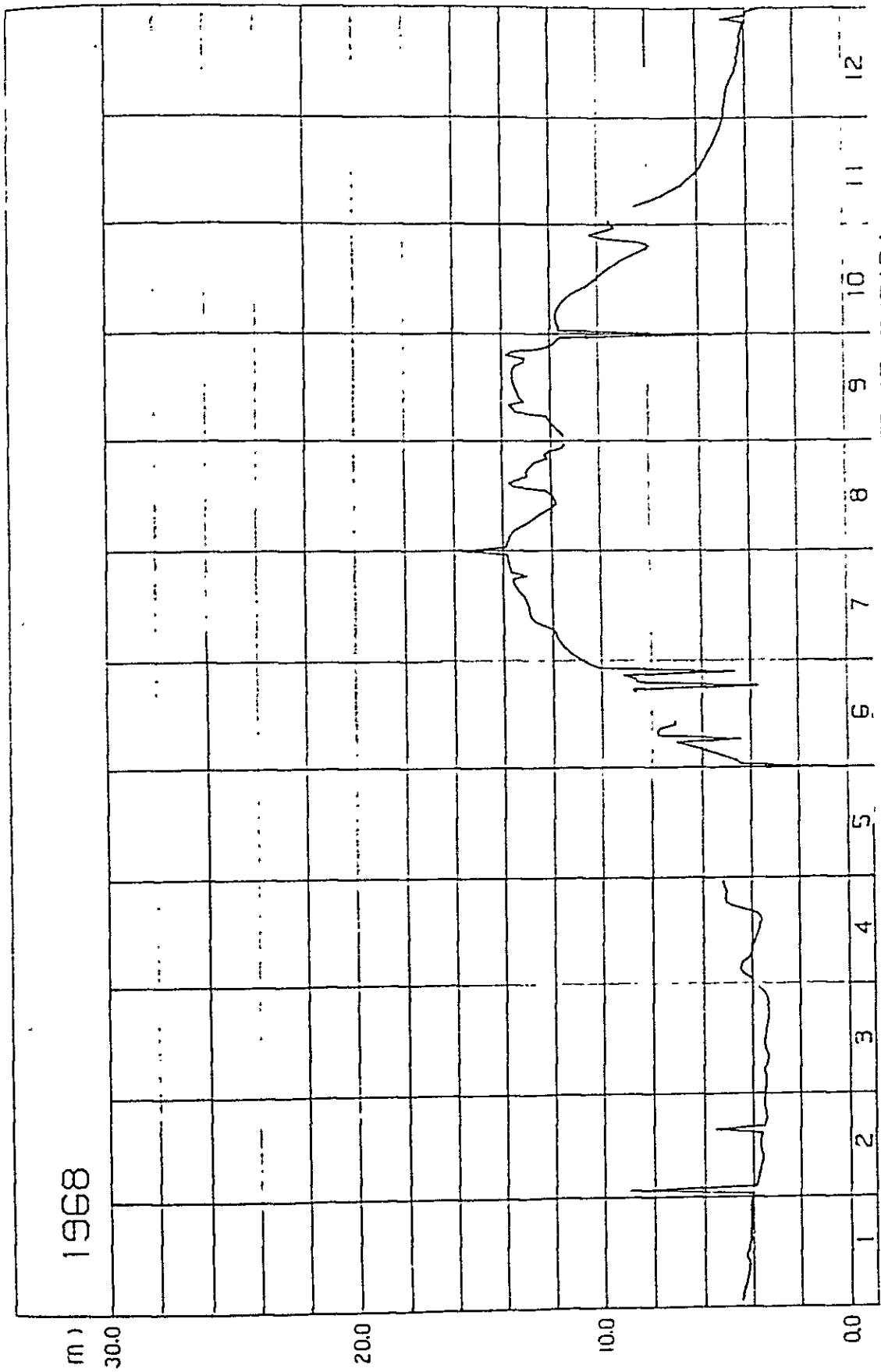

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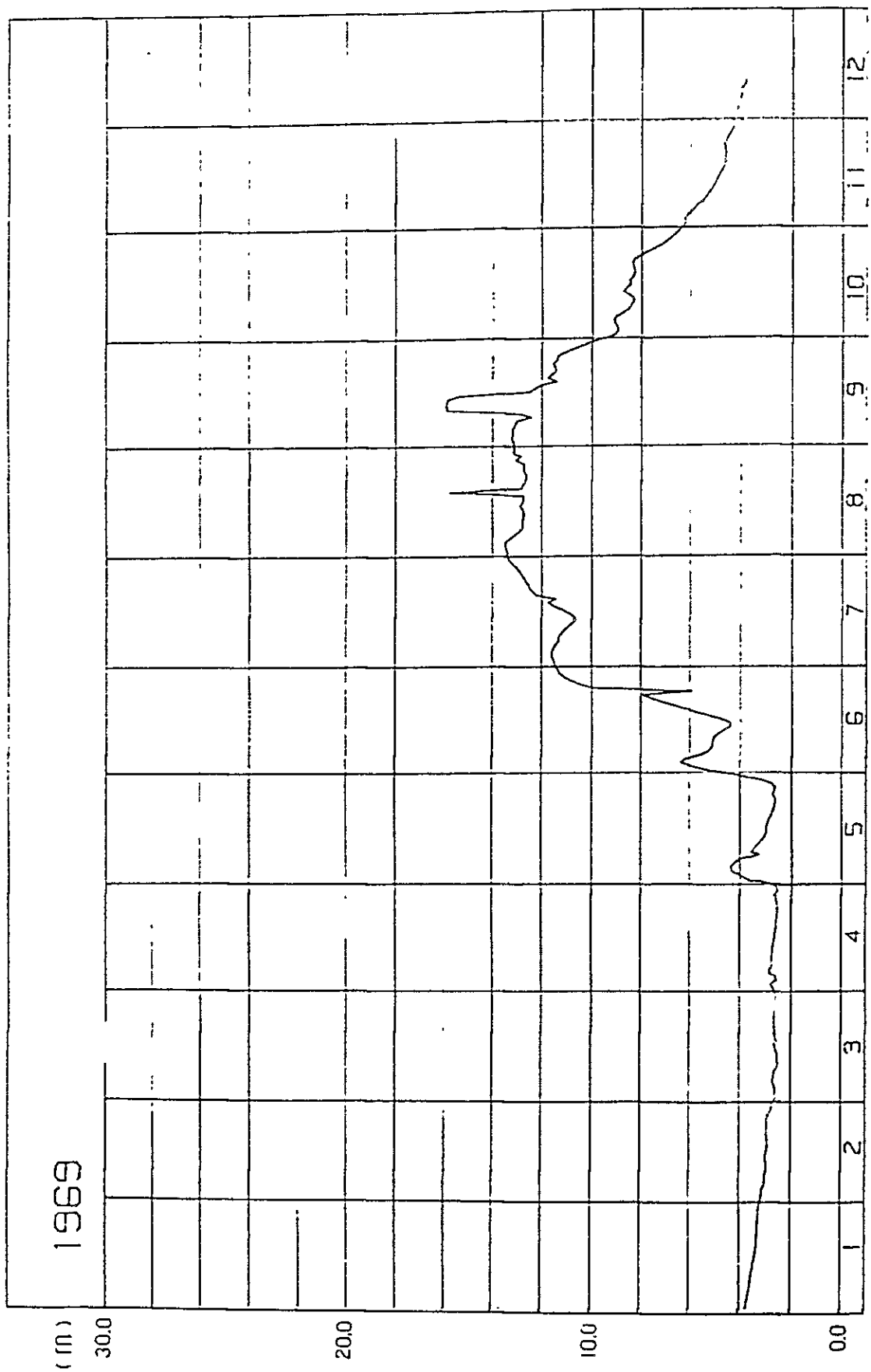


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HENZADA

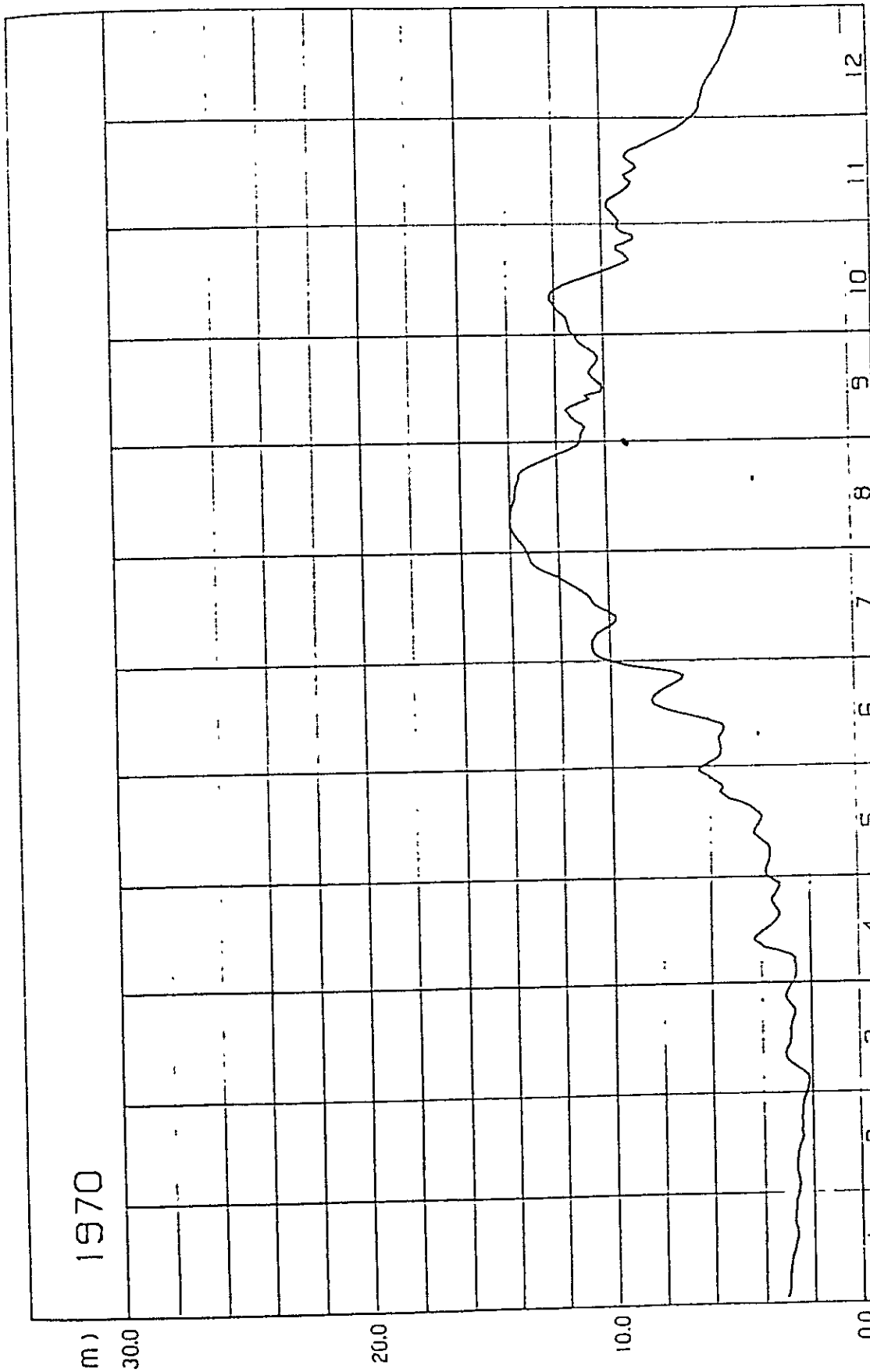
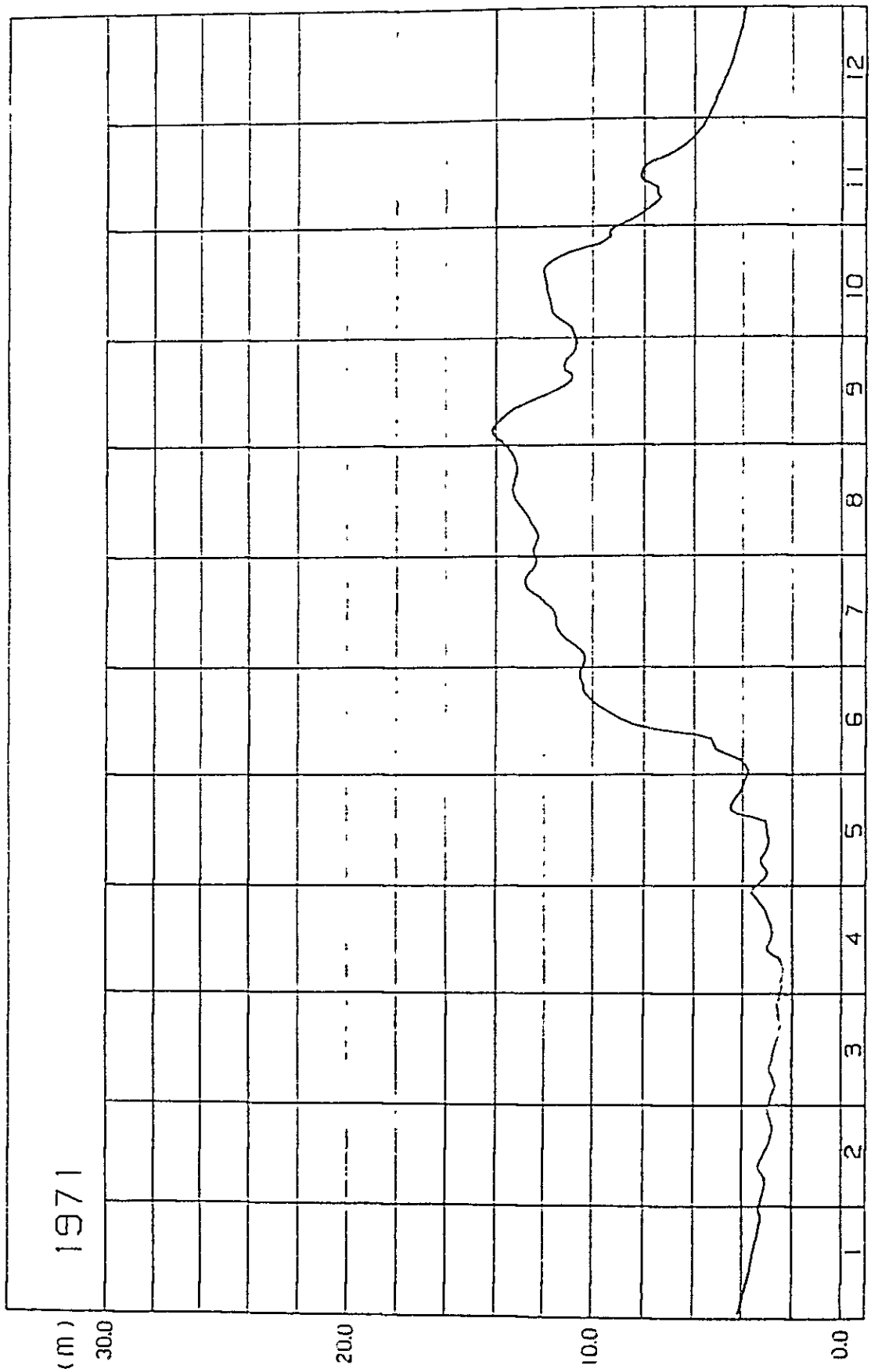


FIGURE WATER LEVEL OF IRRAWADDY RIVER AT HENZADA



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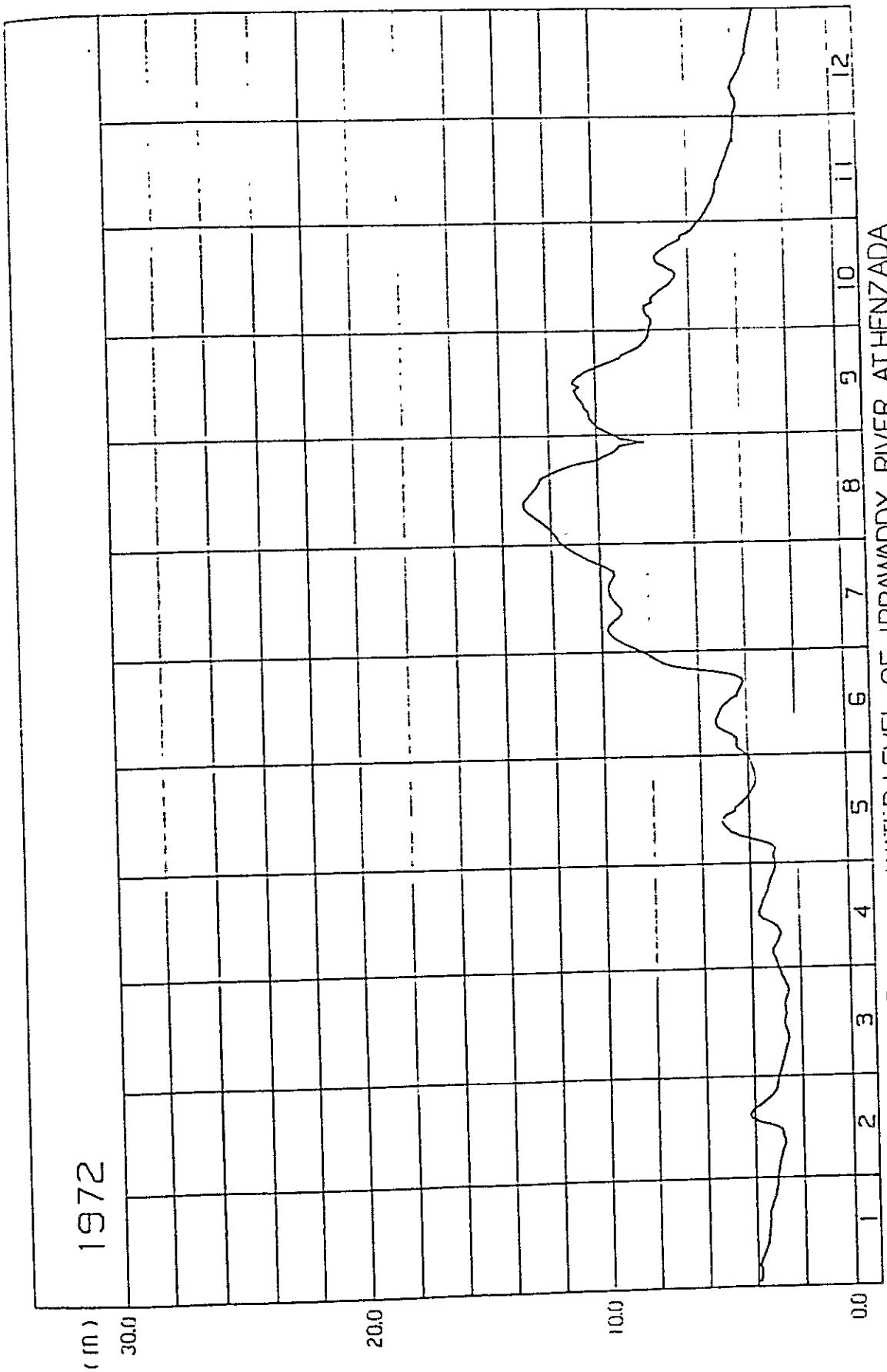

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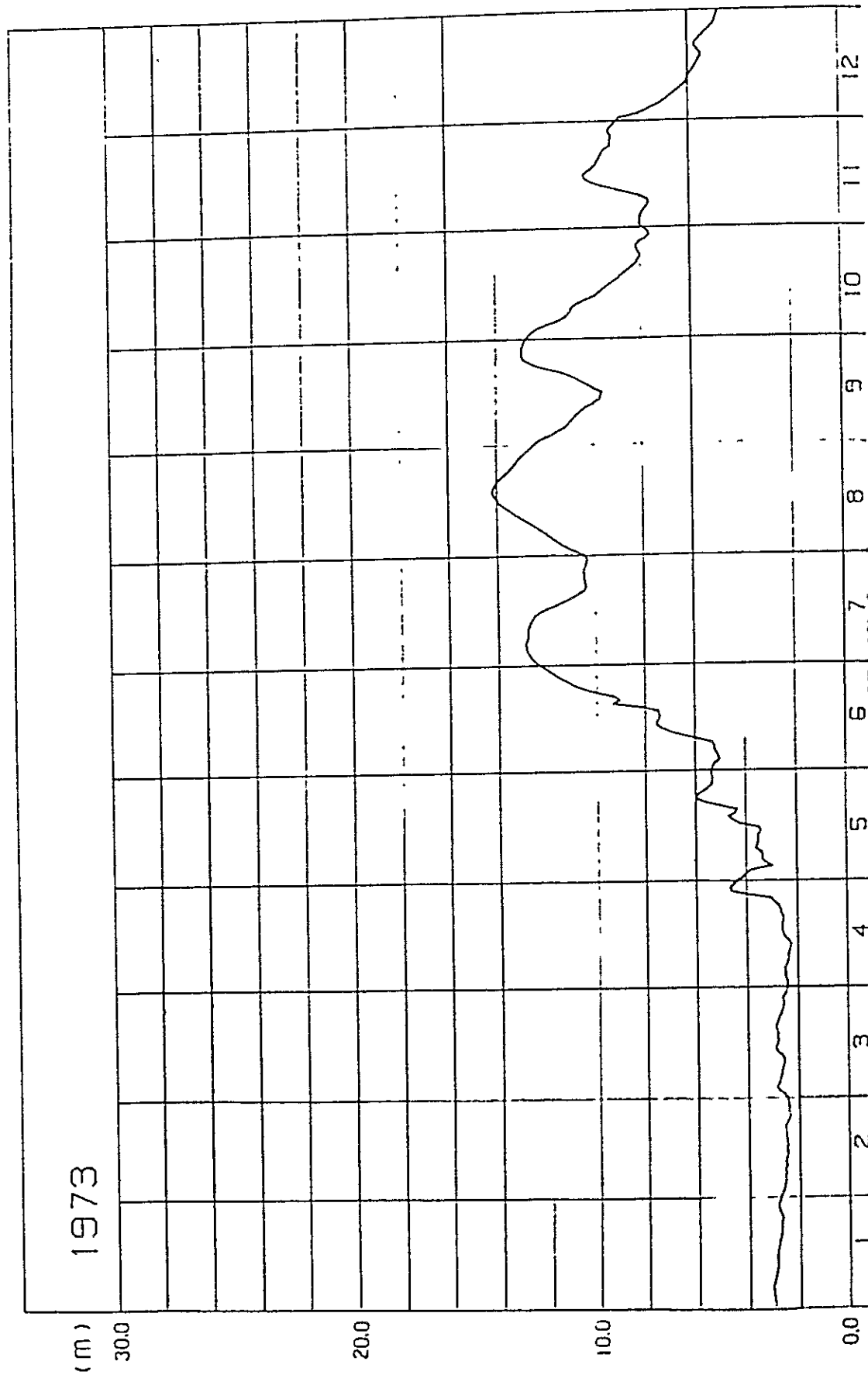

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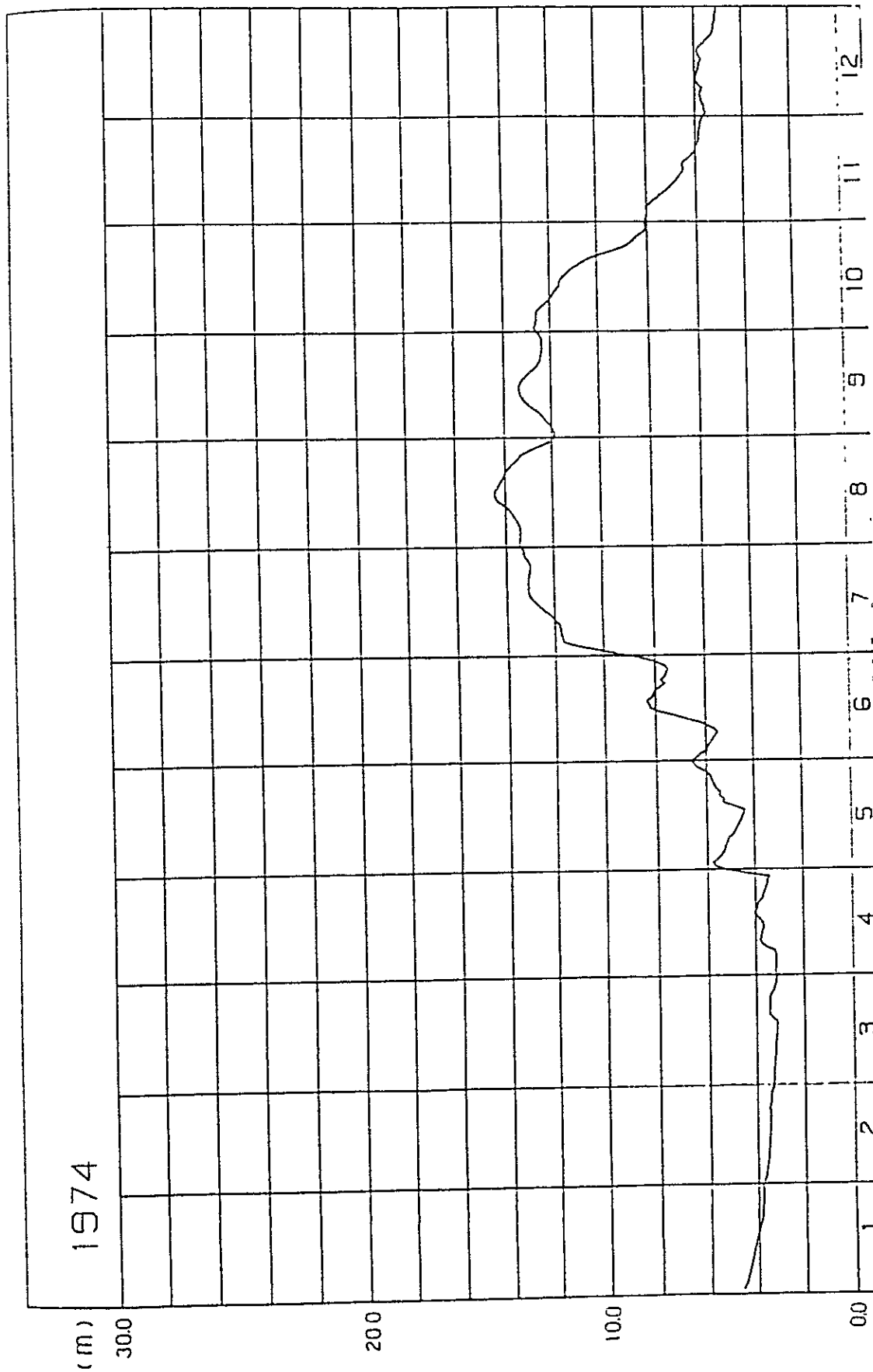

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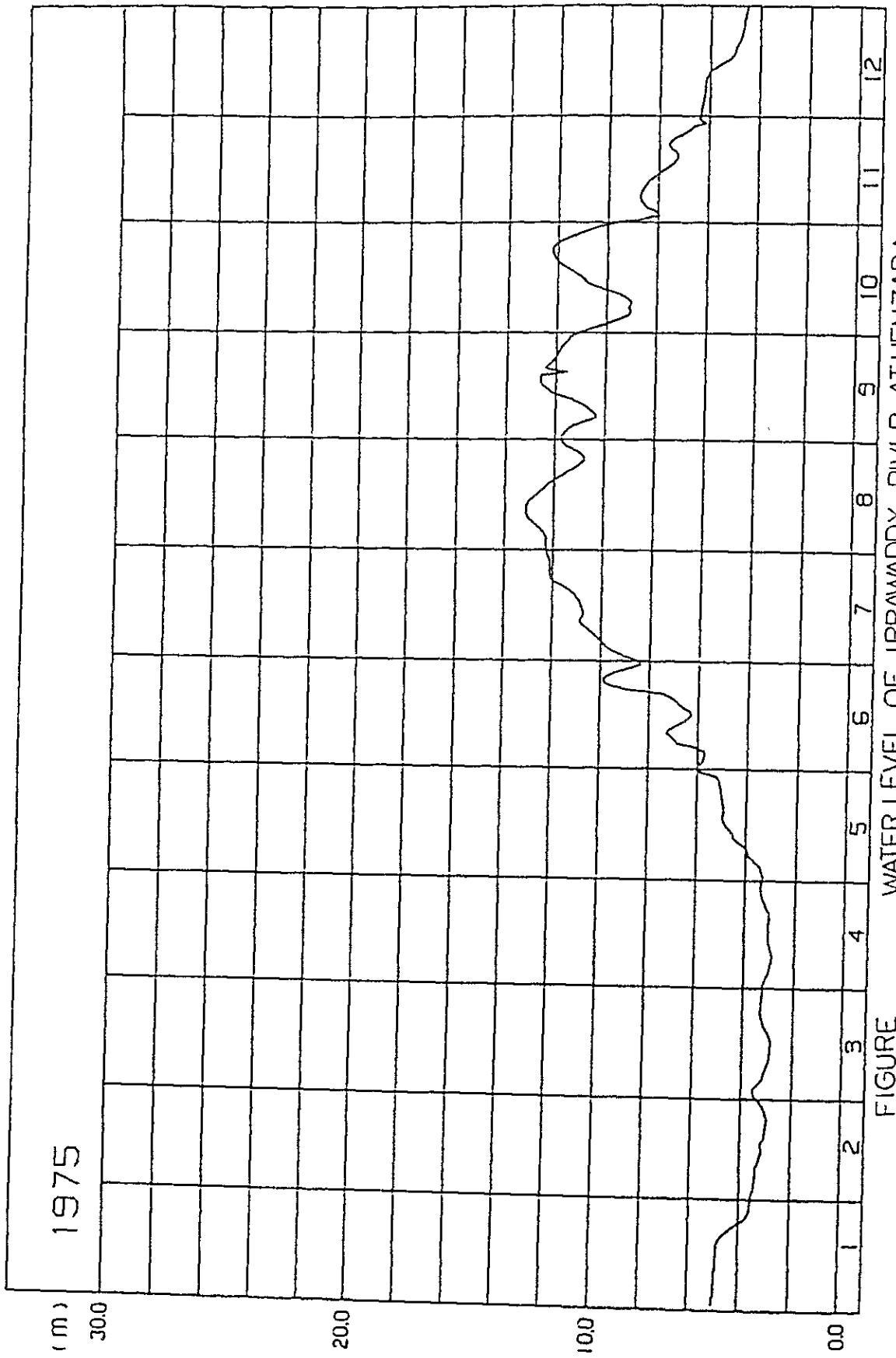

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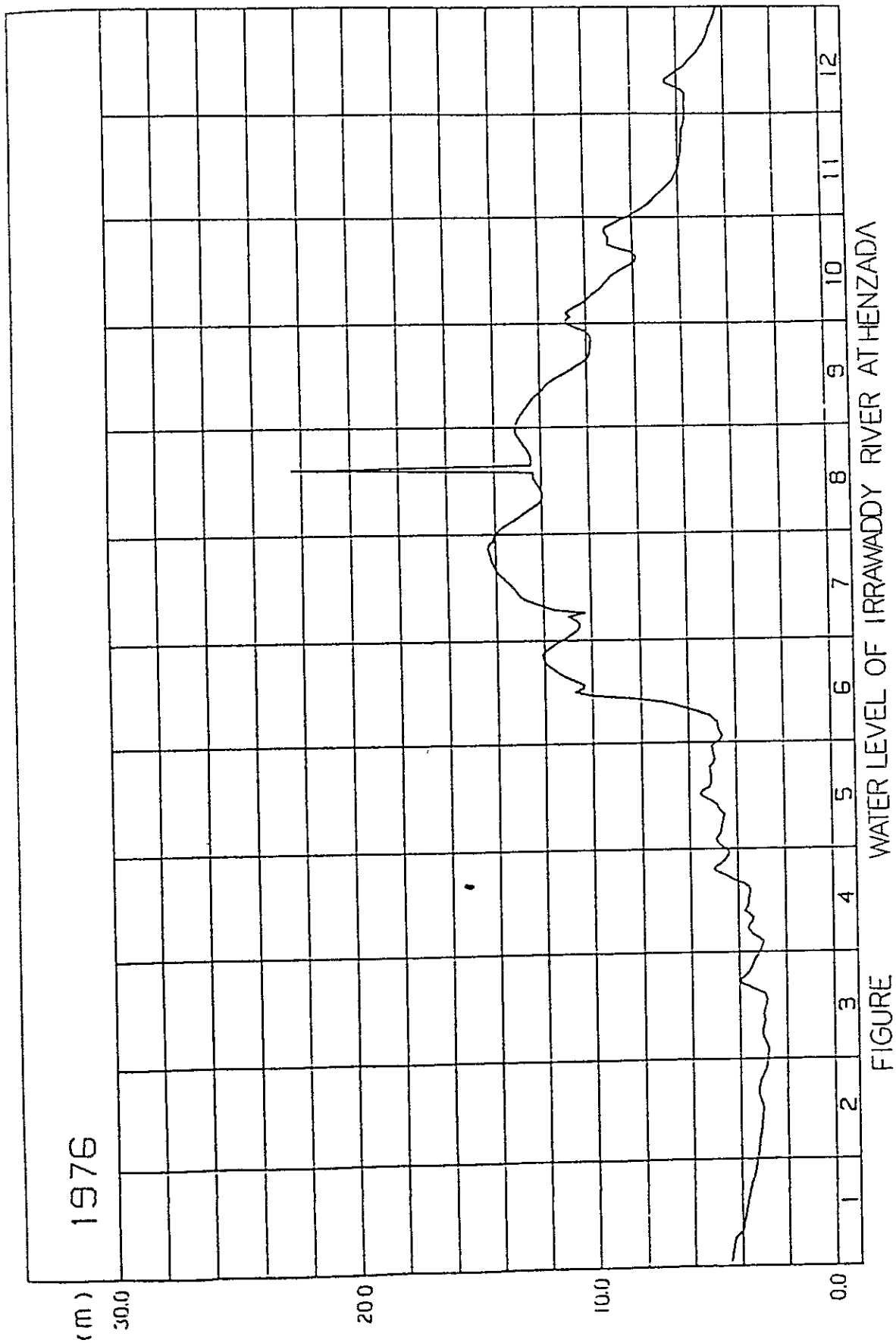

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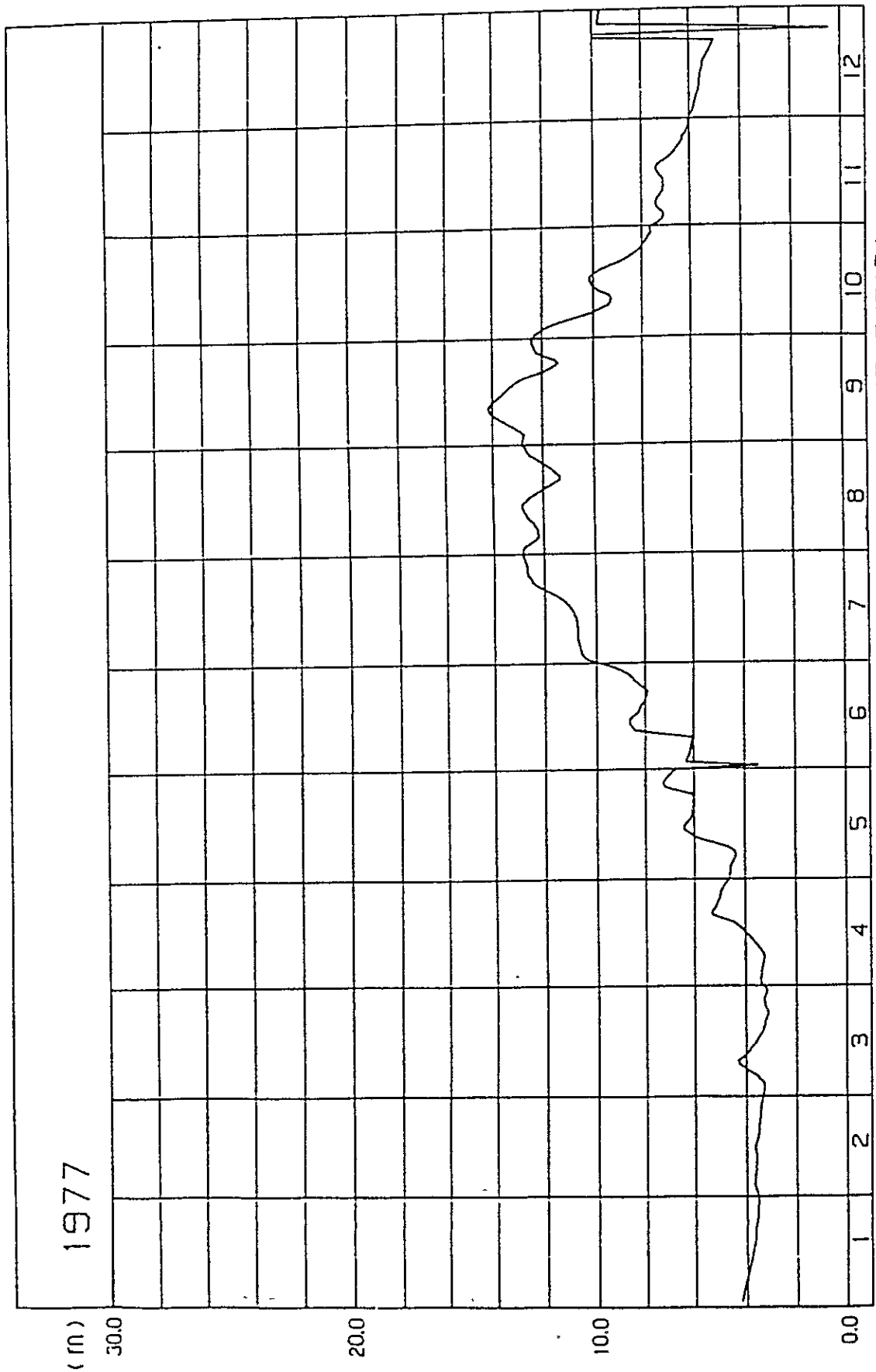

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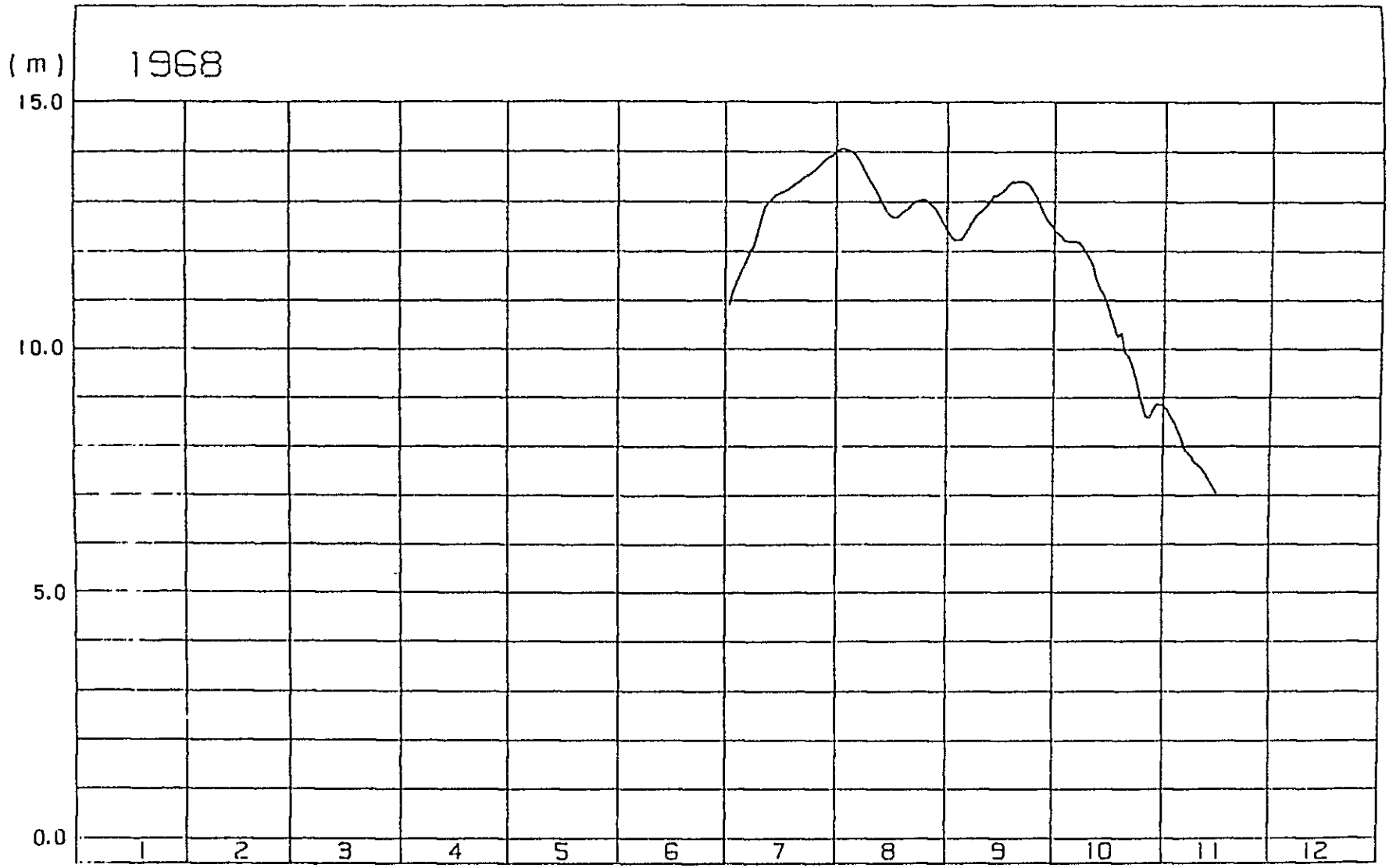


FIGURE WATER LEVEL OF MYITMAKA RIVER AT GAMON

APPENDIX E-4 WATER LEVEL OF MYITMAKA RIVER

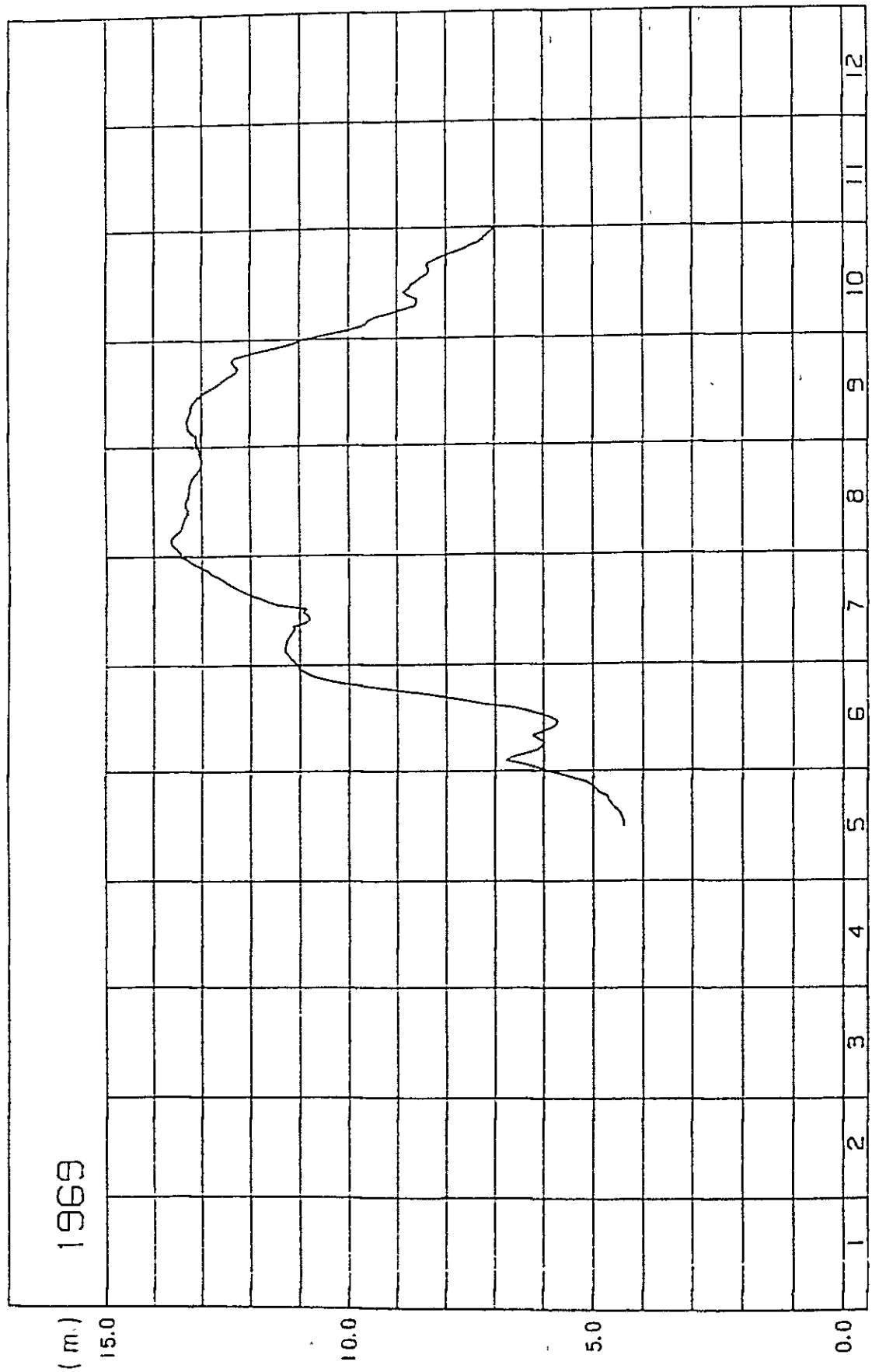


FIGURE WATER LEVEL OF MYITMAKA RIVER AT GAMON

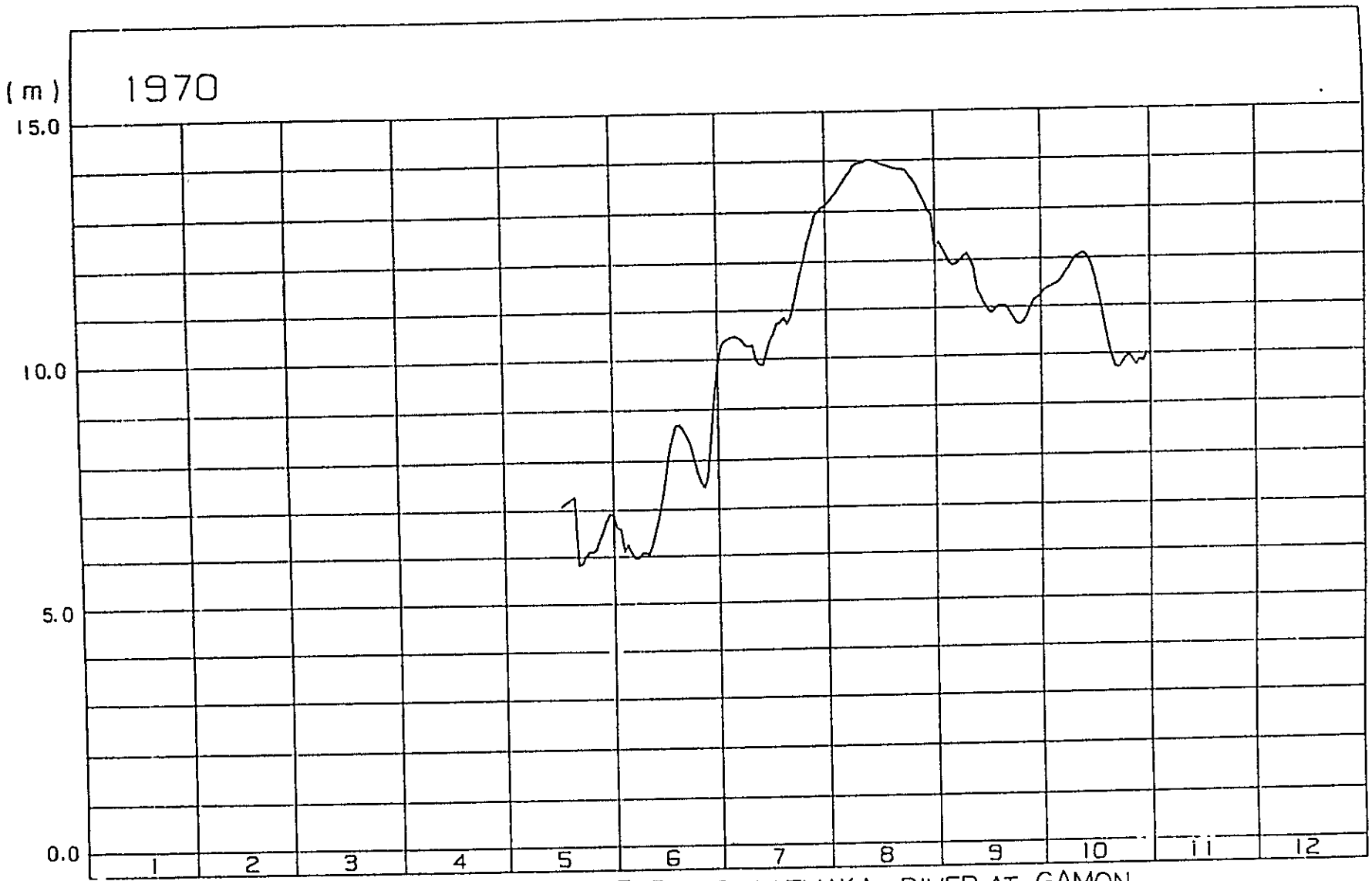


FIGURE WATER LEVEL OF MYITMAKA RIVER AT GAMON

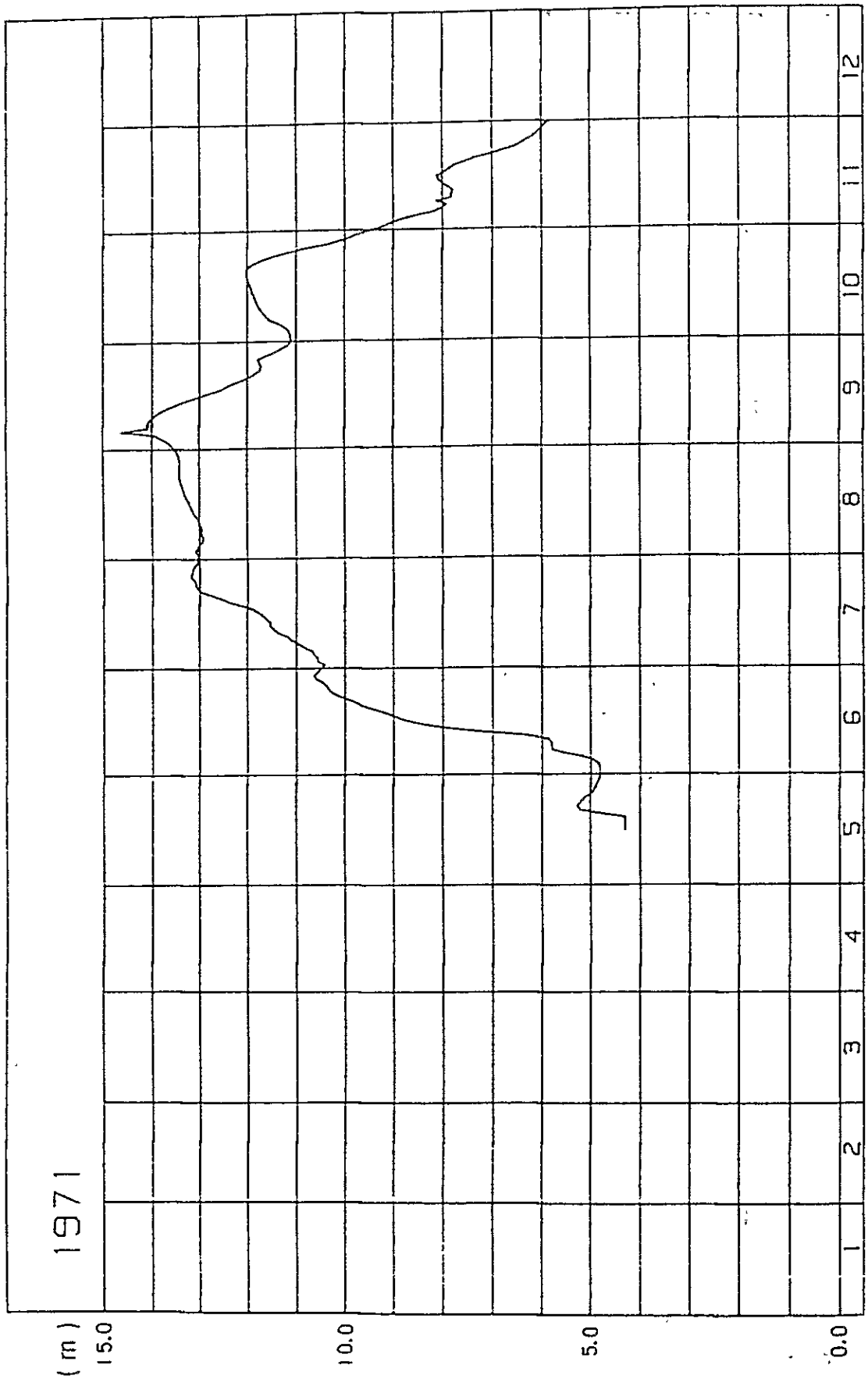
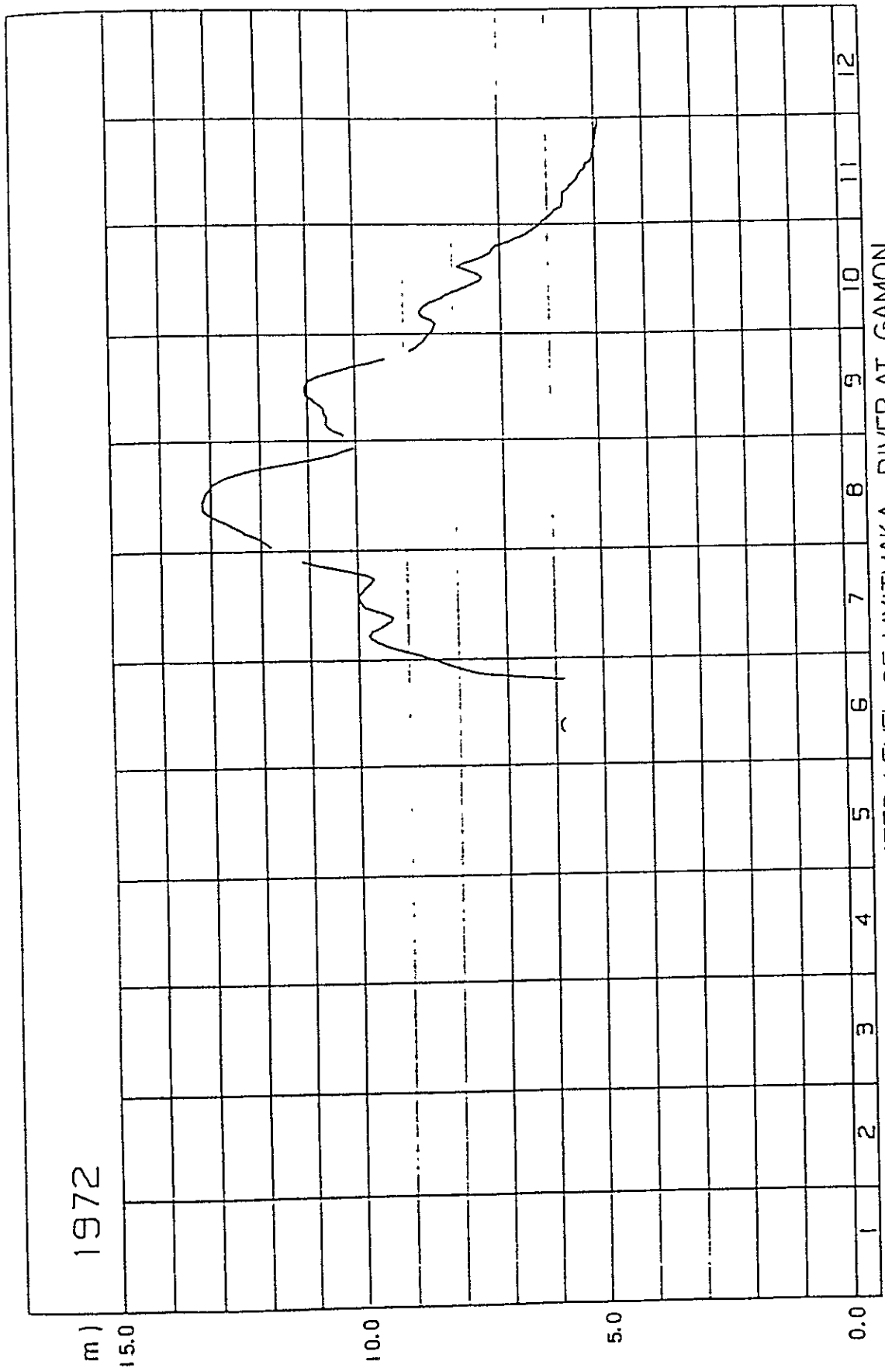


FIGURE WATER LEVEL OF MYITMAKA RIVER AT GAMON



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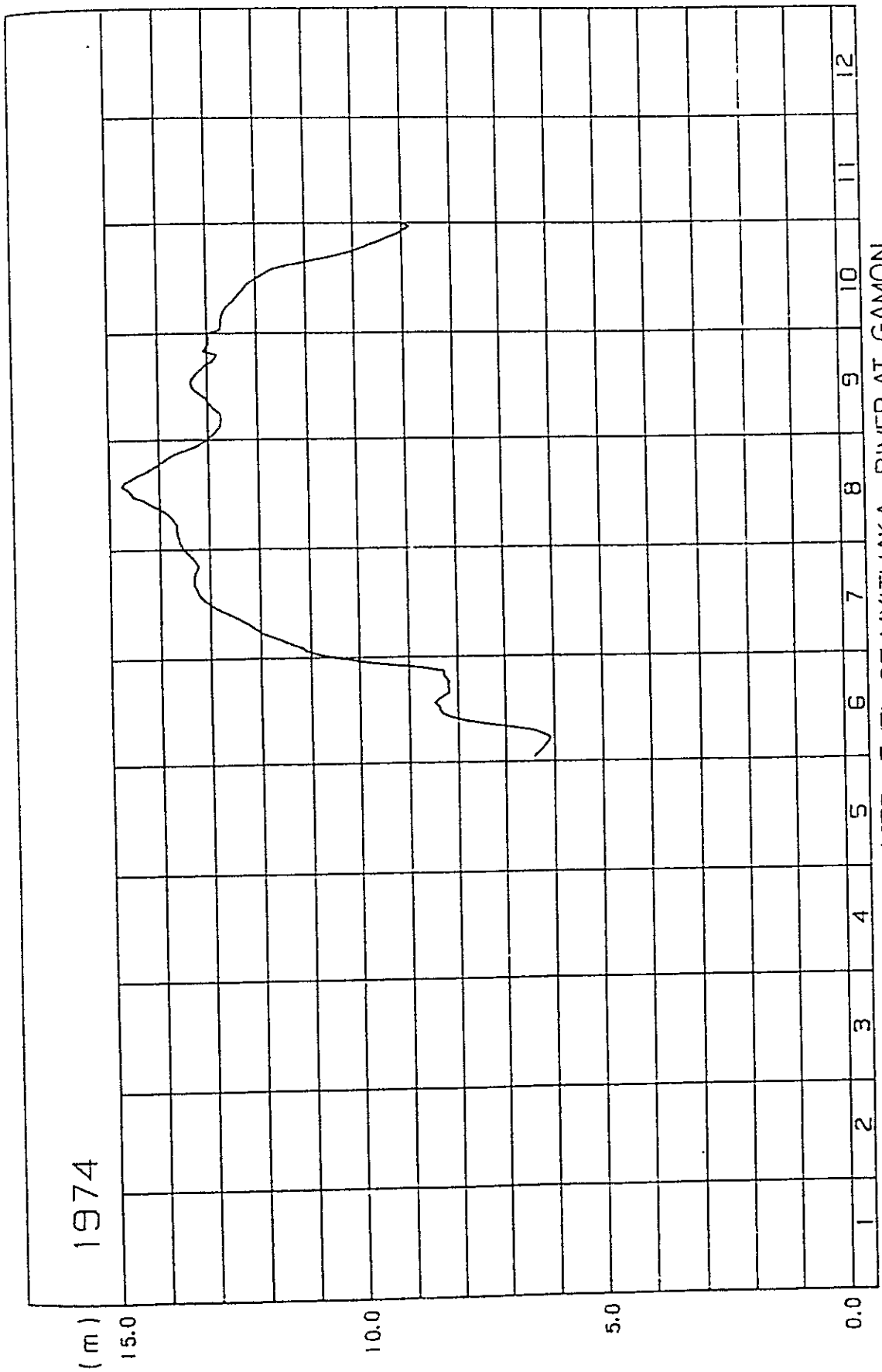

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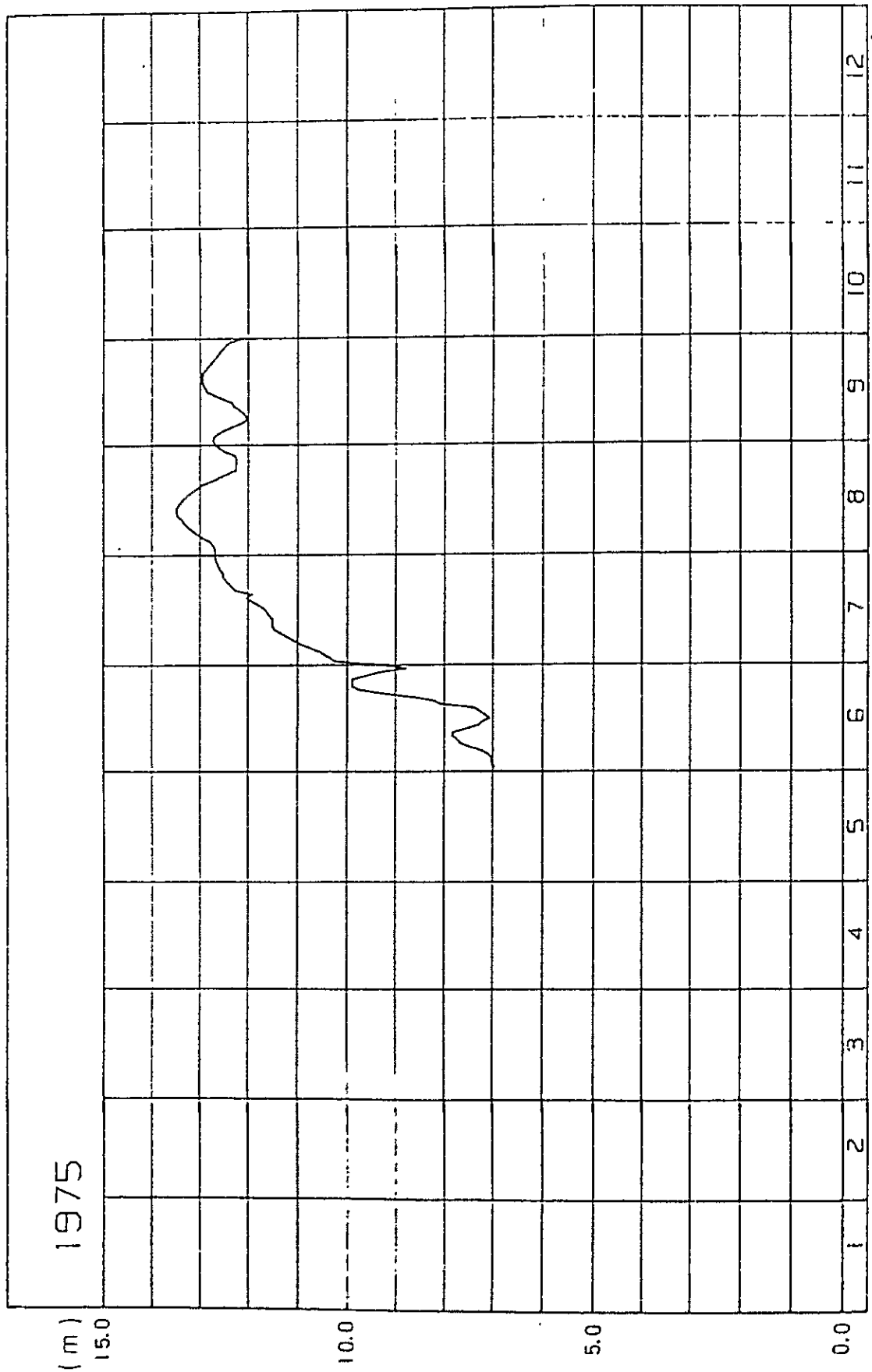
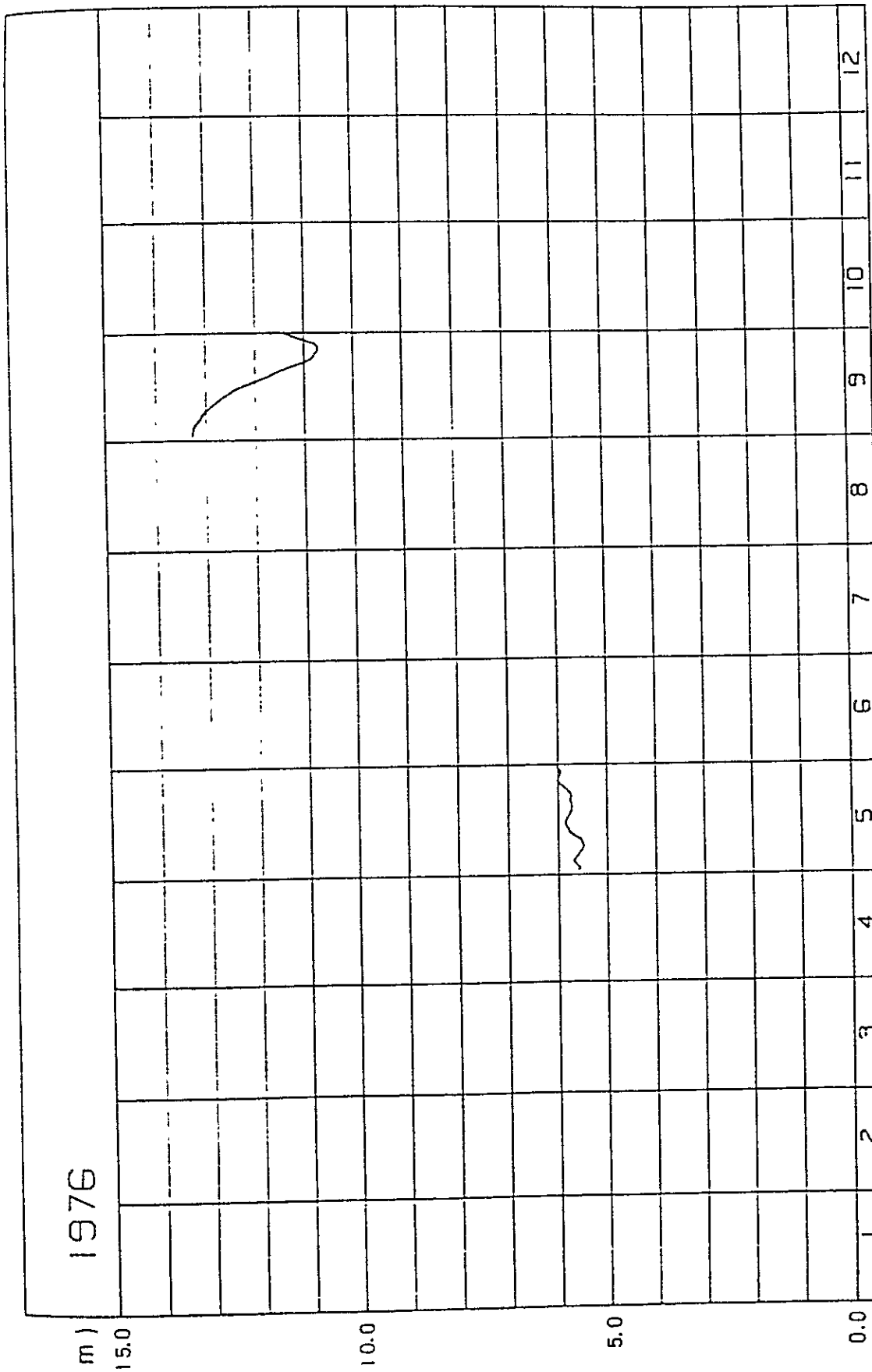


FIGURE WATER LEVEL OF MYITMAKA RIVER AT GAMON



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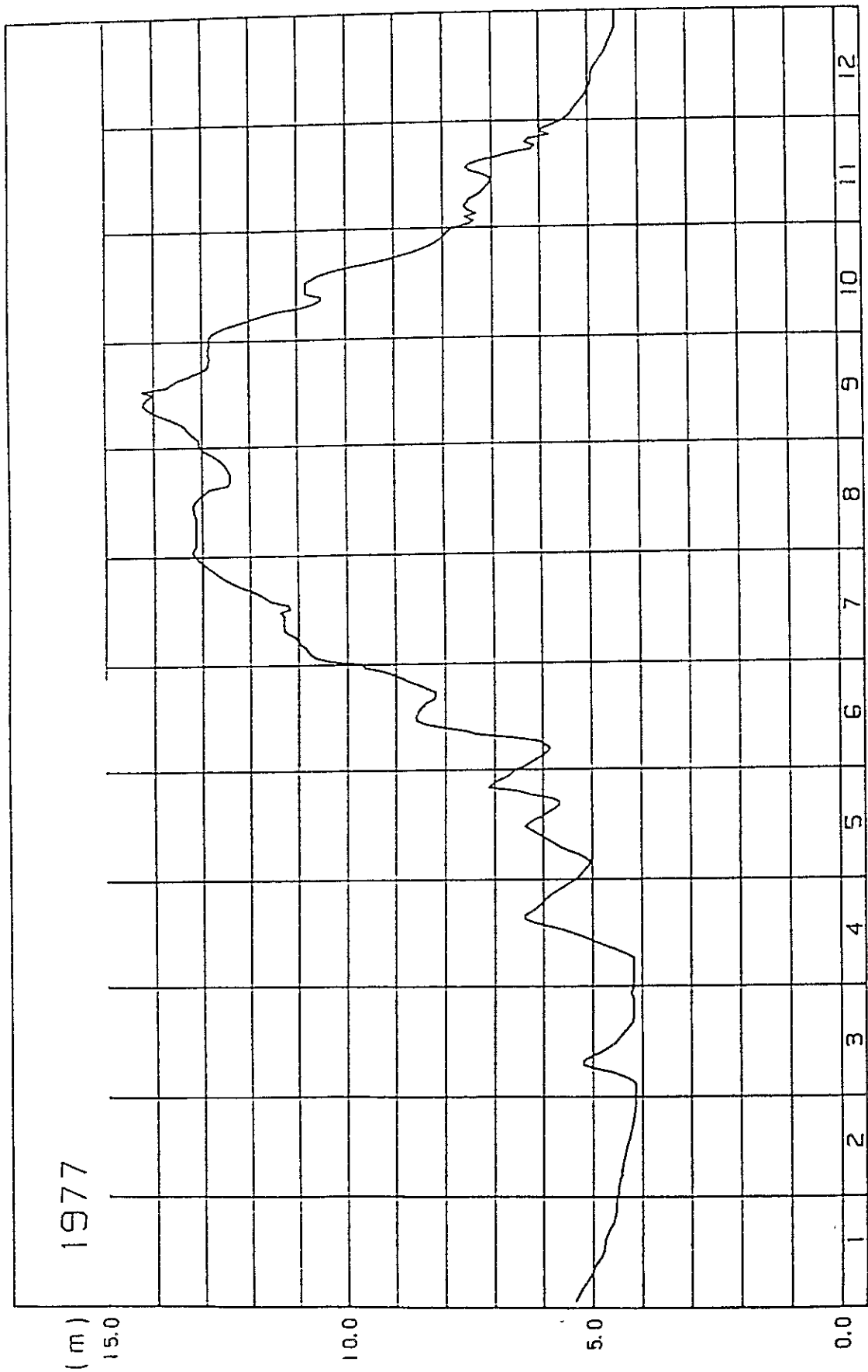

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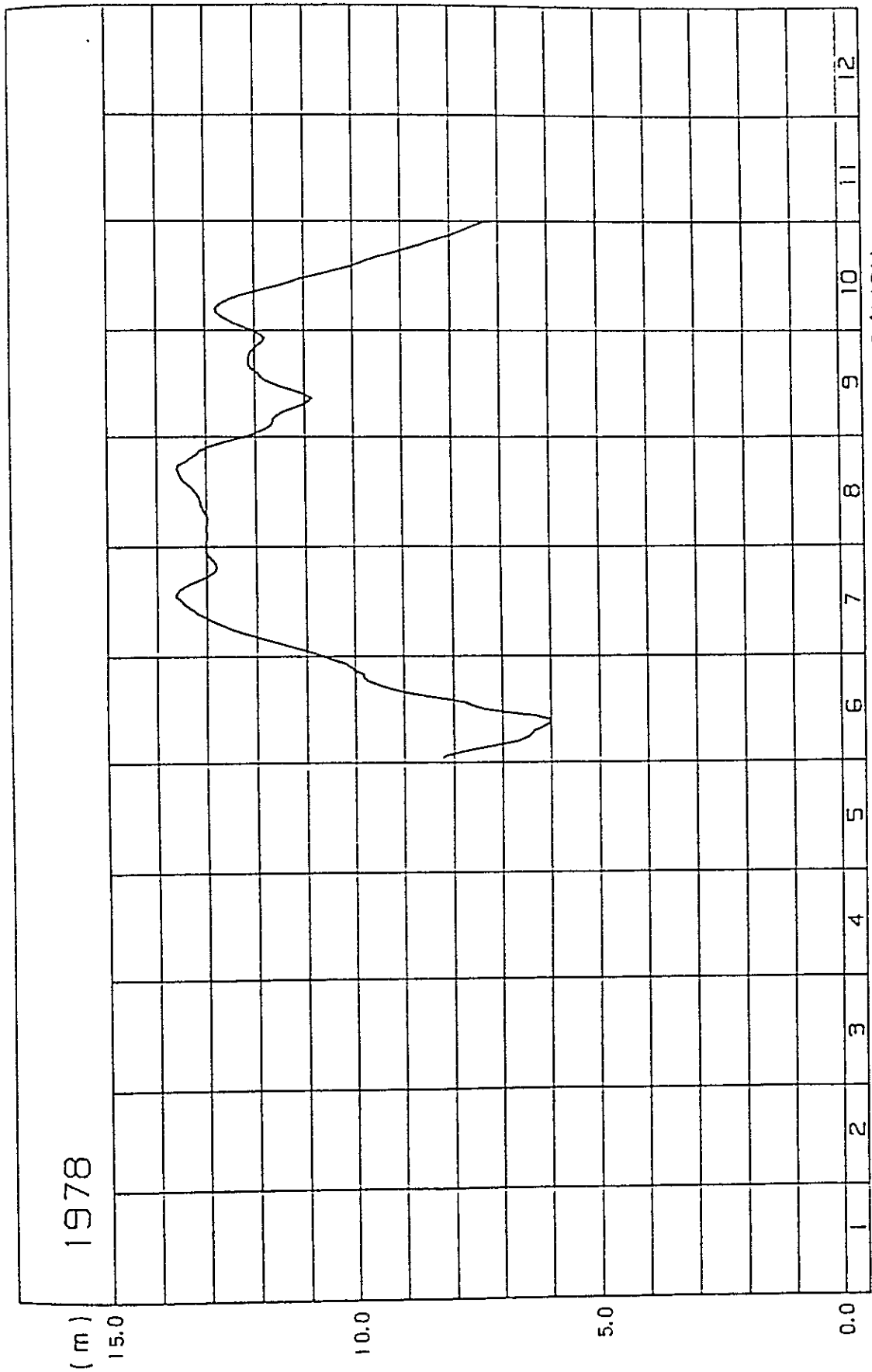

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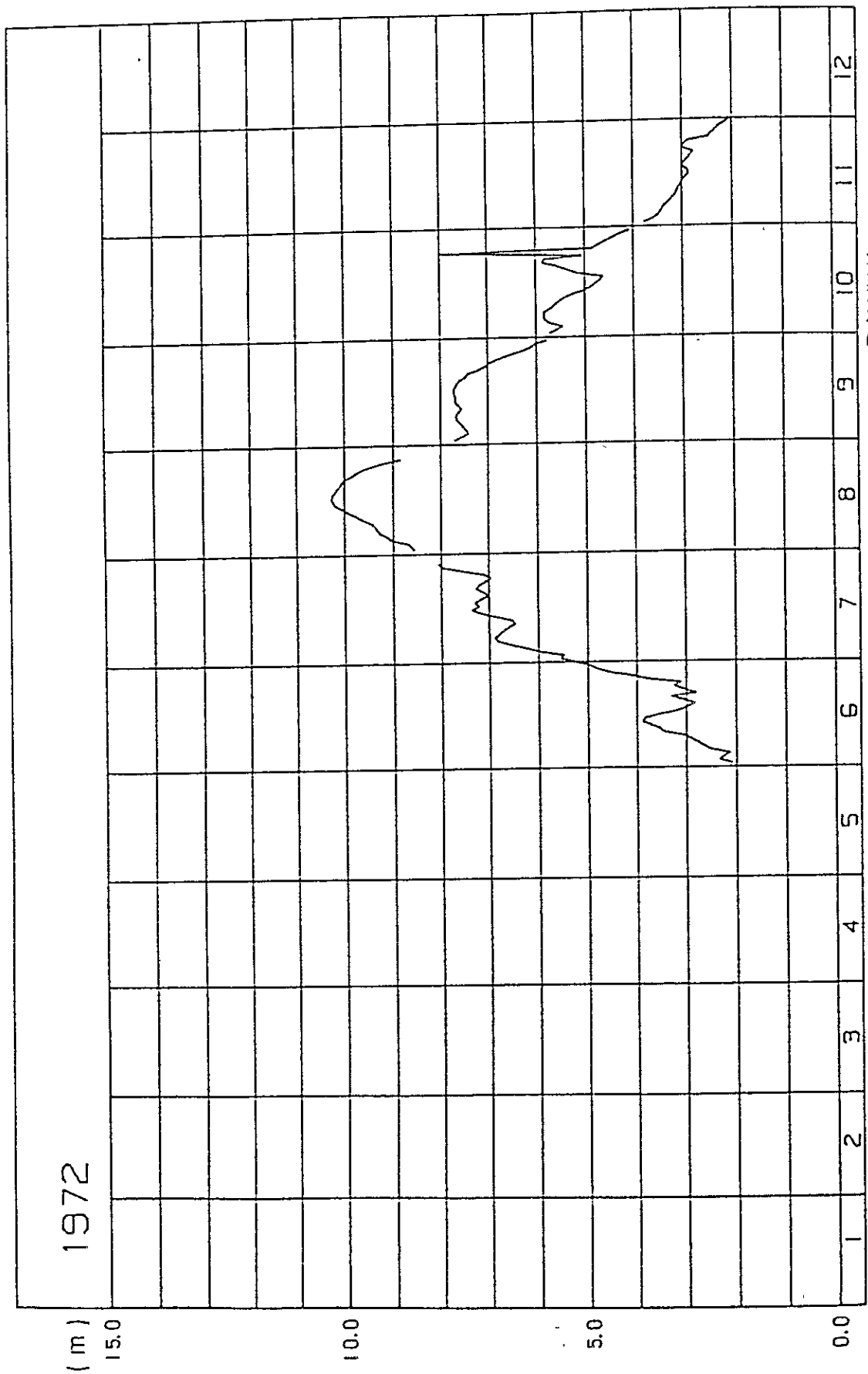
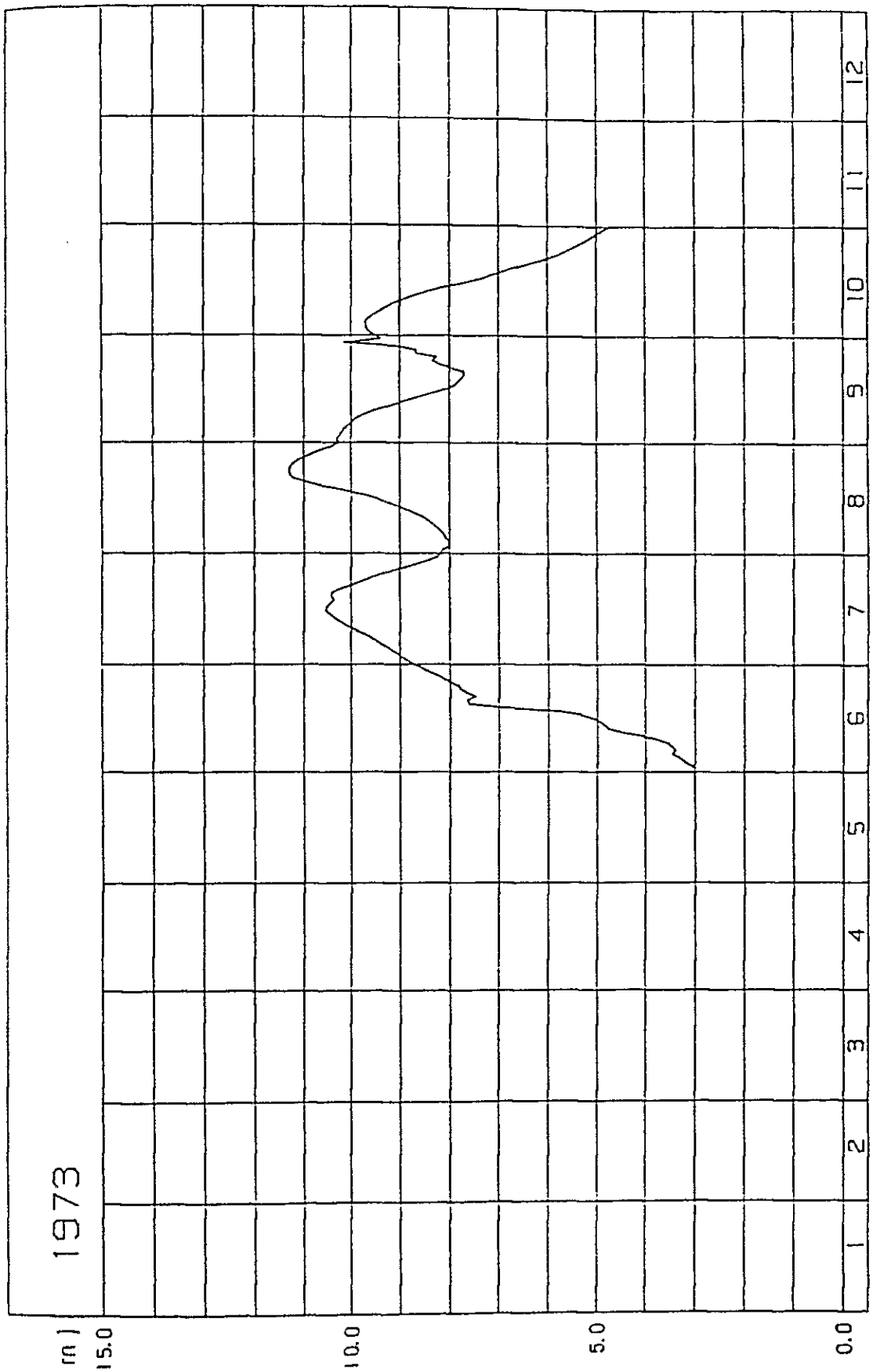


FIGURE WATER LEVFL OF MYITMAKA RIVER AT DAWWI



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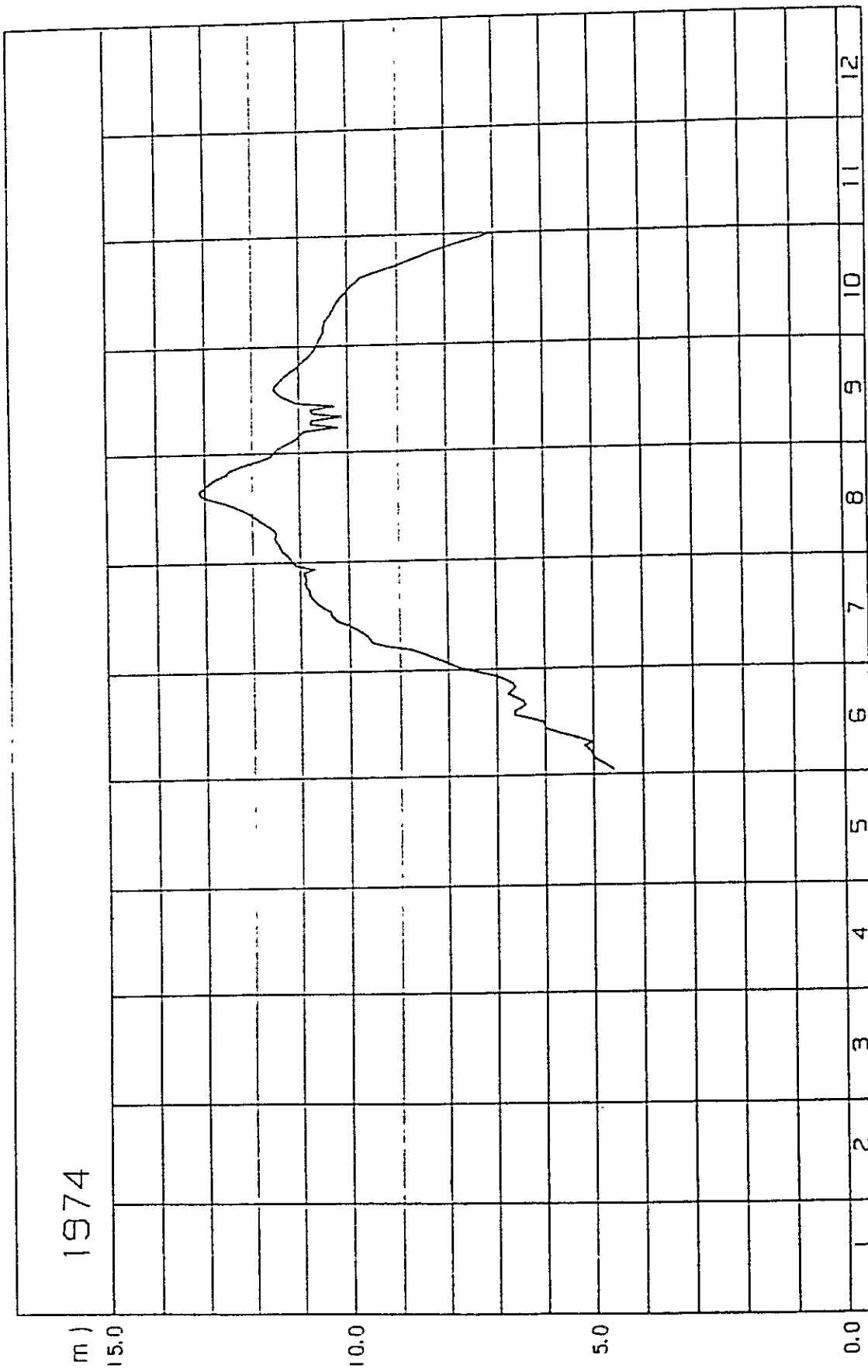

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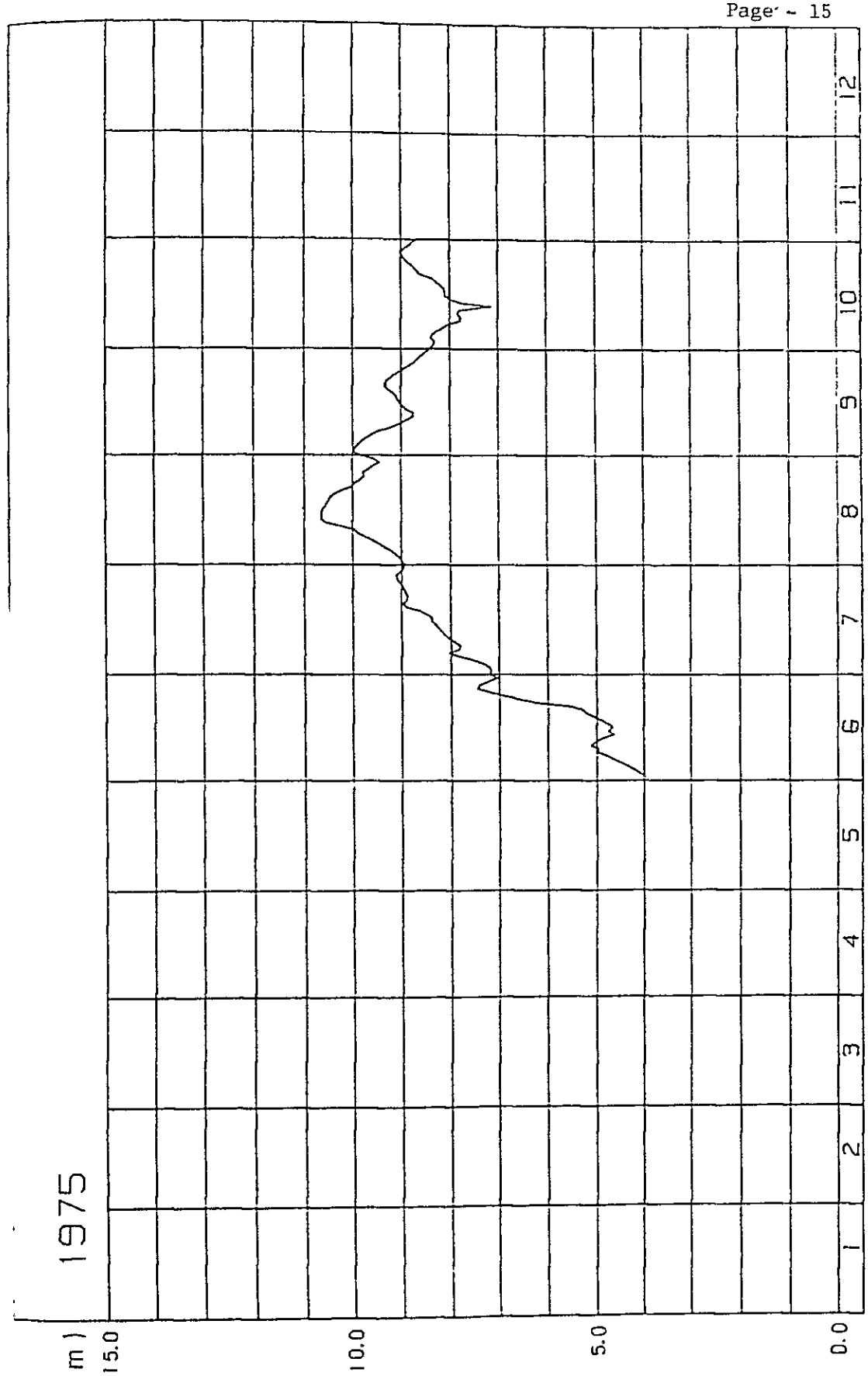

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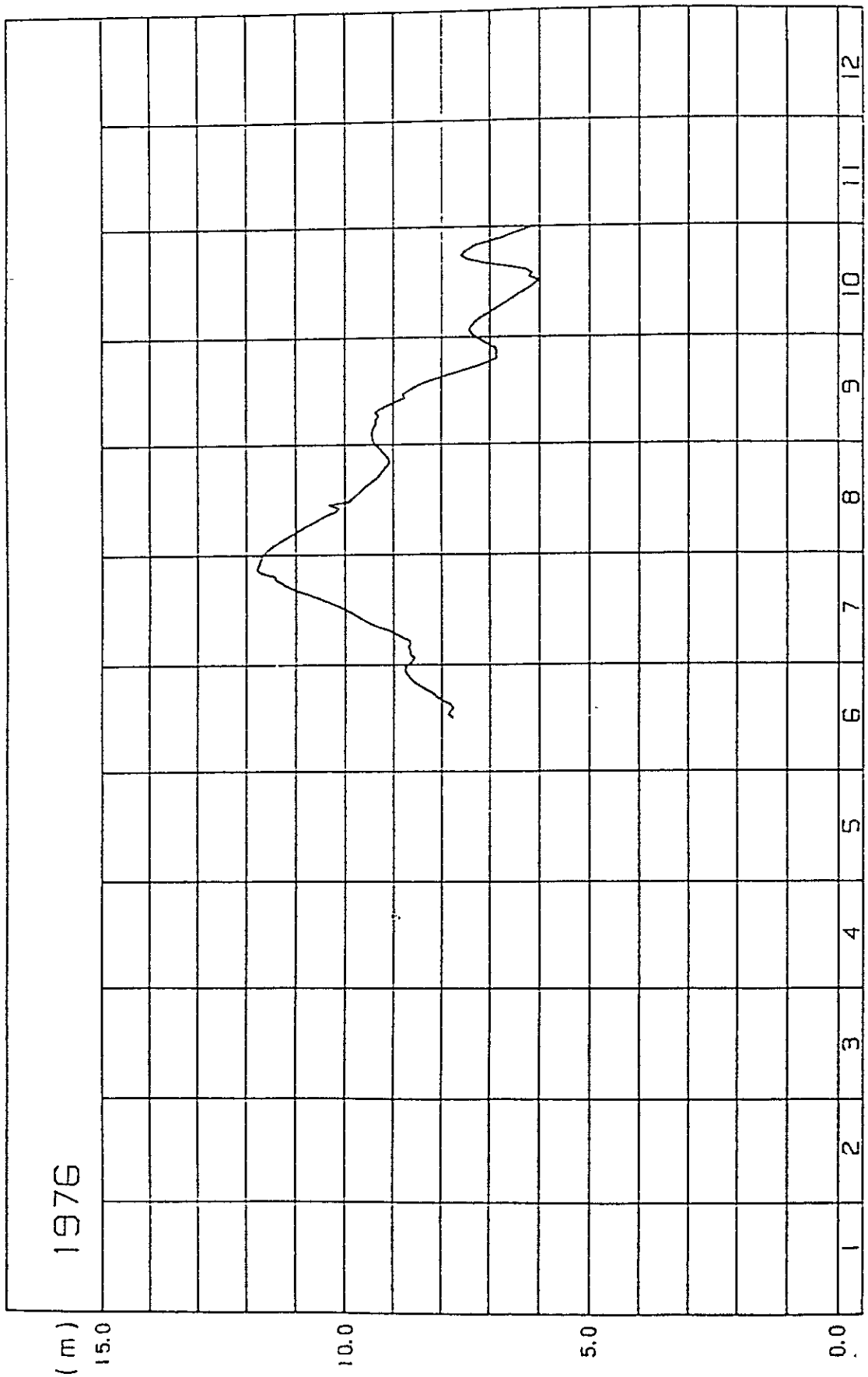


FIGURE WATER LEVEL OF MYITMAKA RIVER AT DAWWI

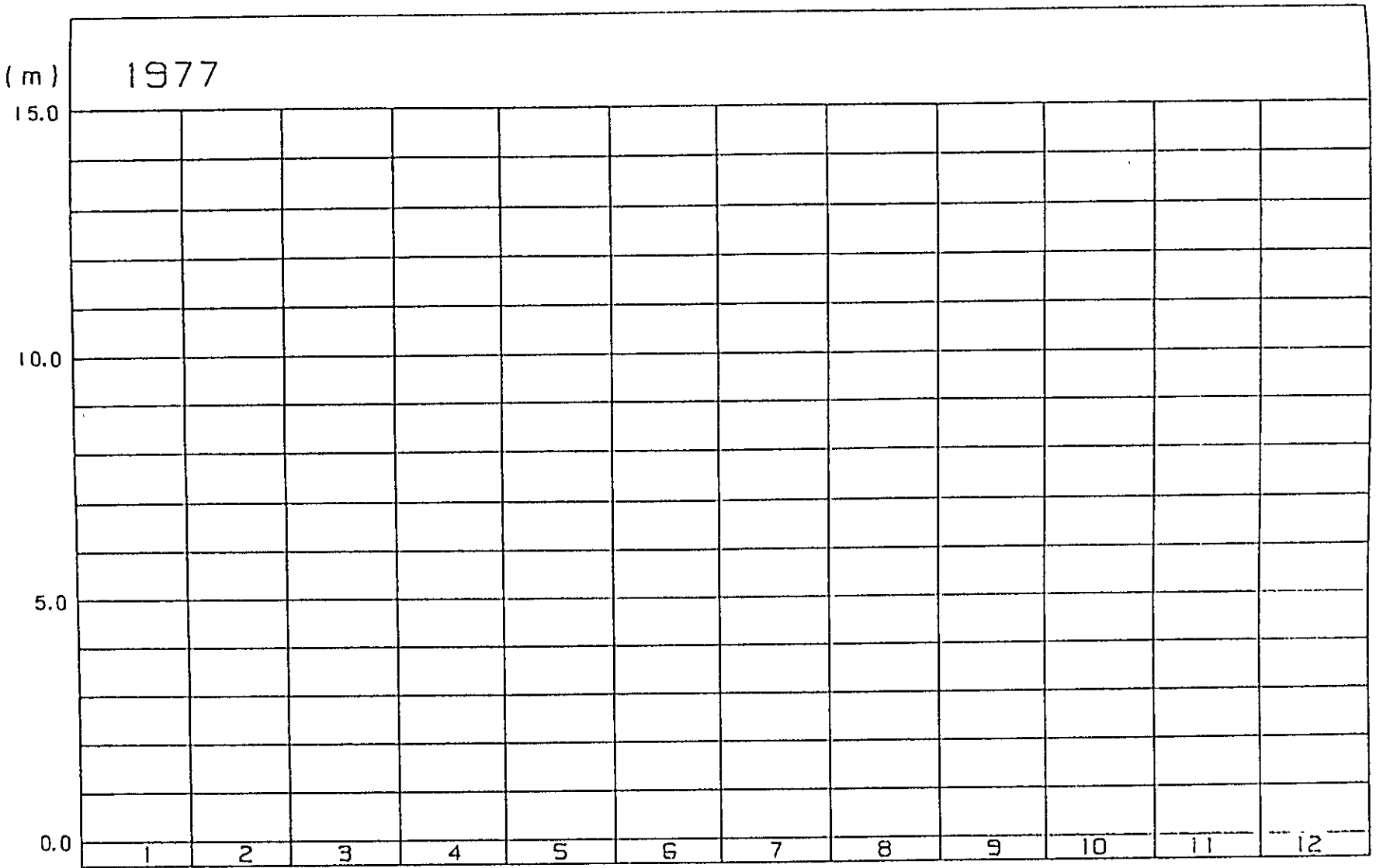
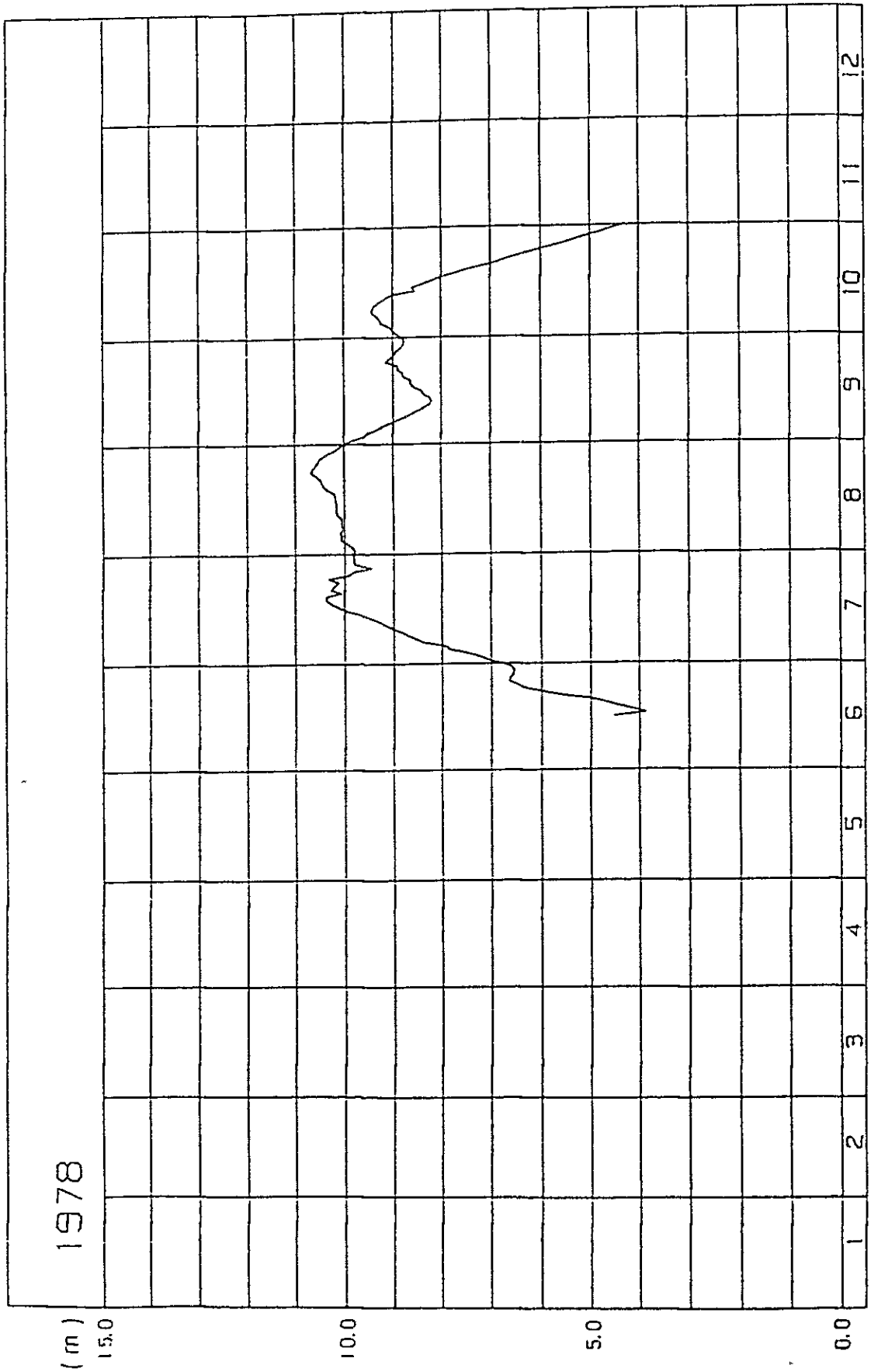


FIGURE WATER LEVEL OF MYITMAKA RIVER AT DAWWI



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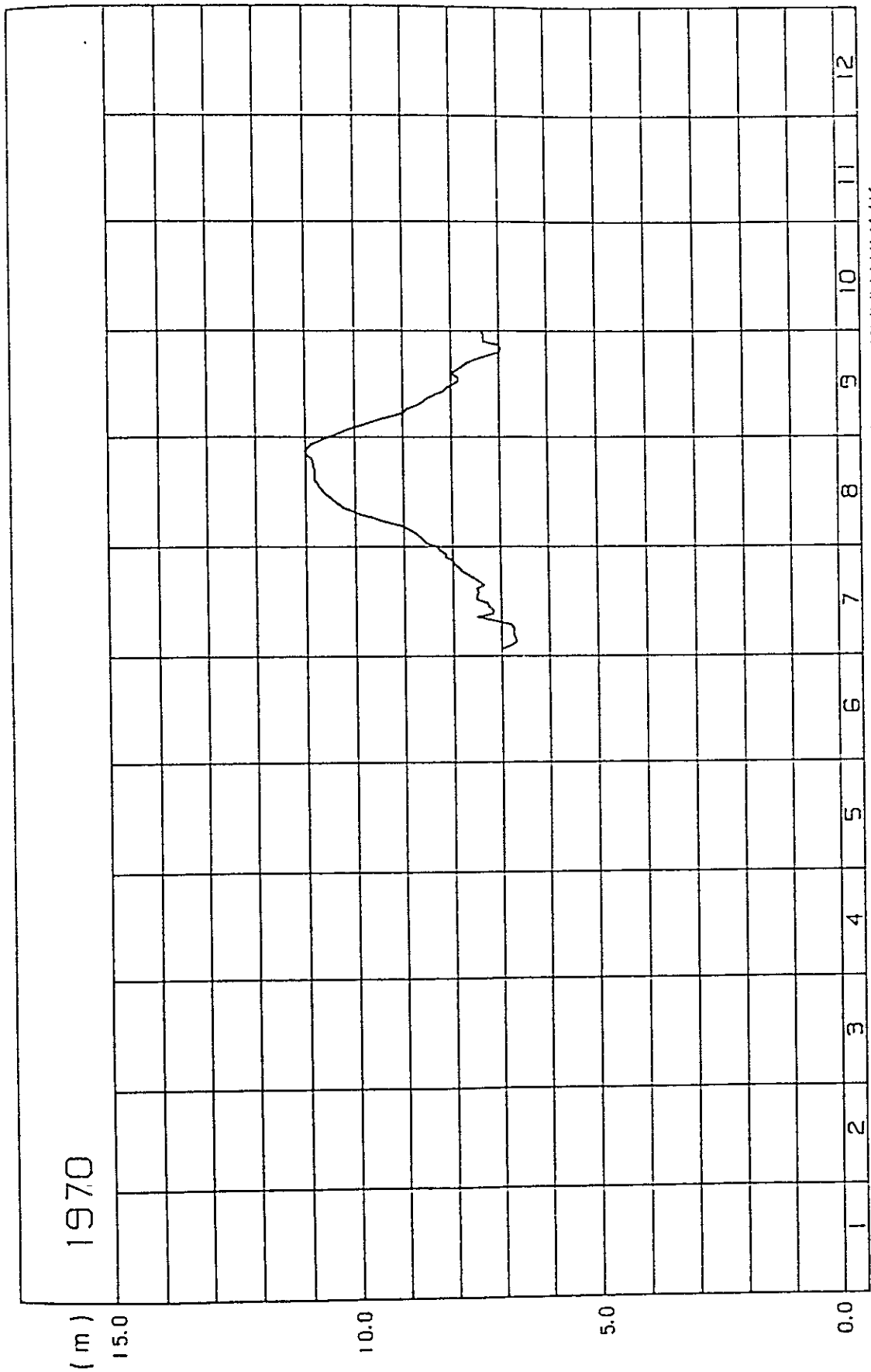


FIGURE WATER LEVEL OF MYITMAKA RIVER AT KUNNAKYAIK

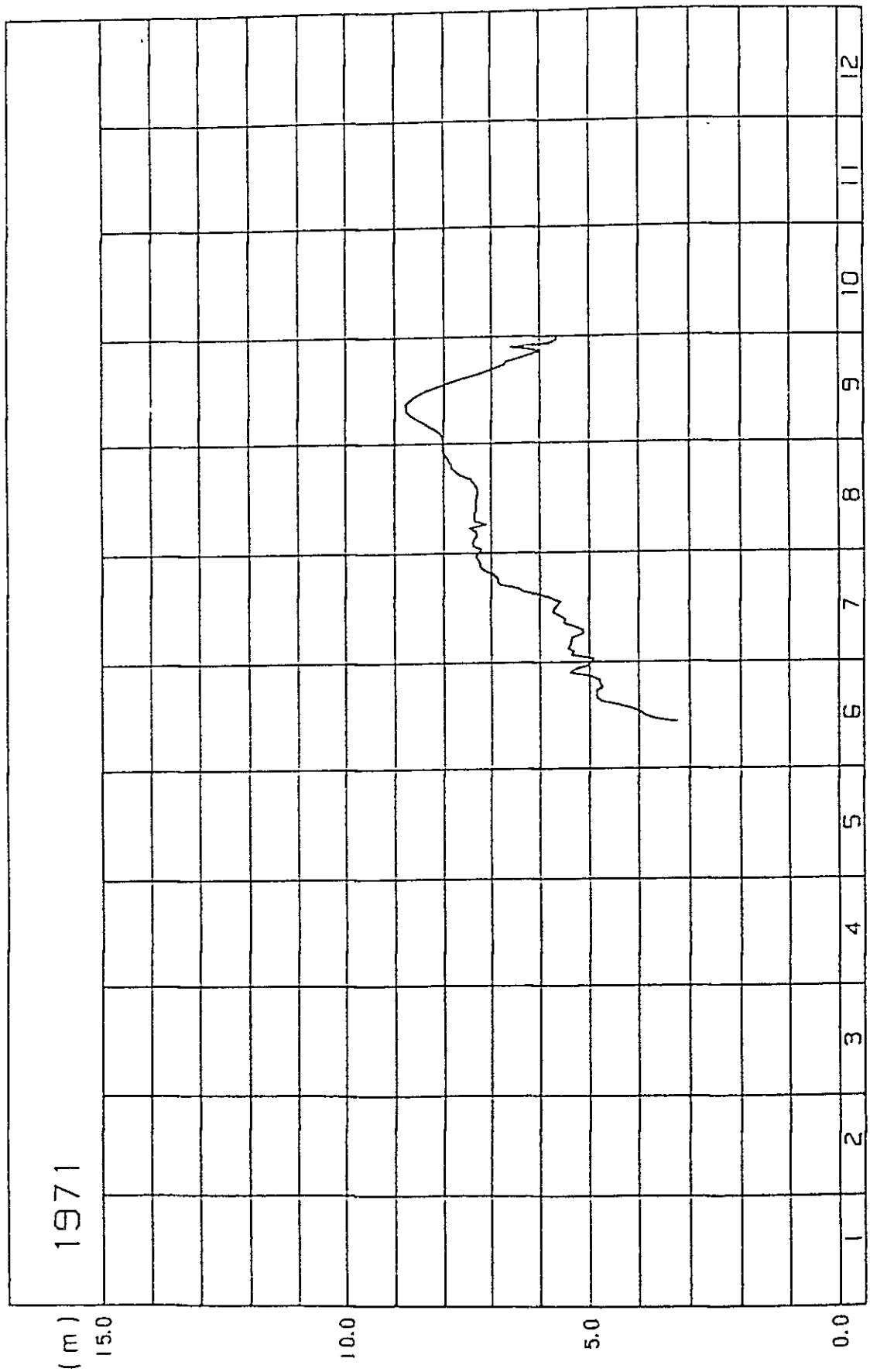
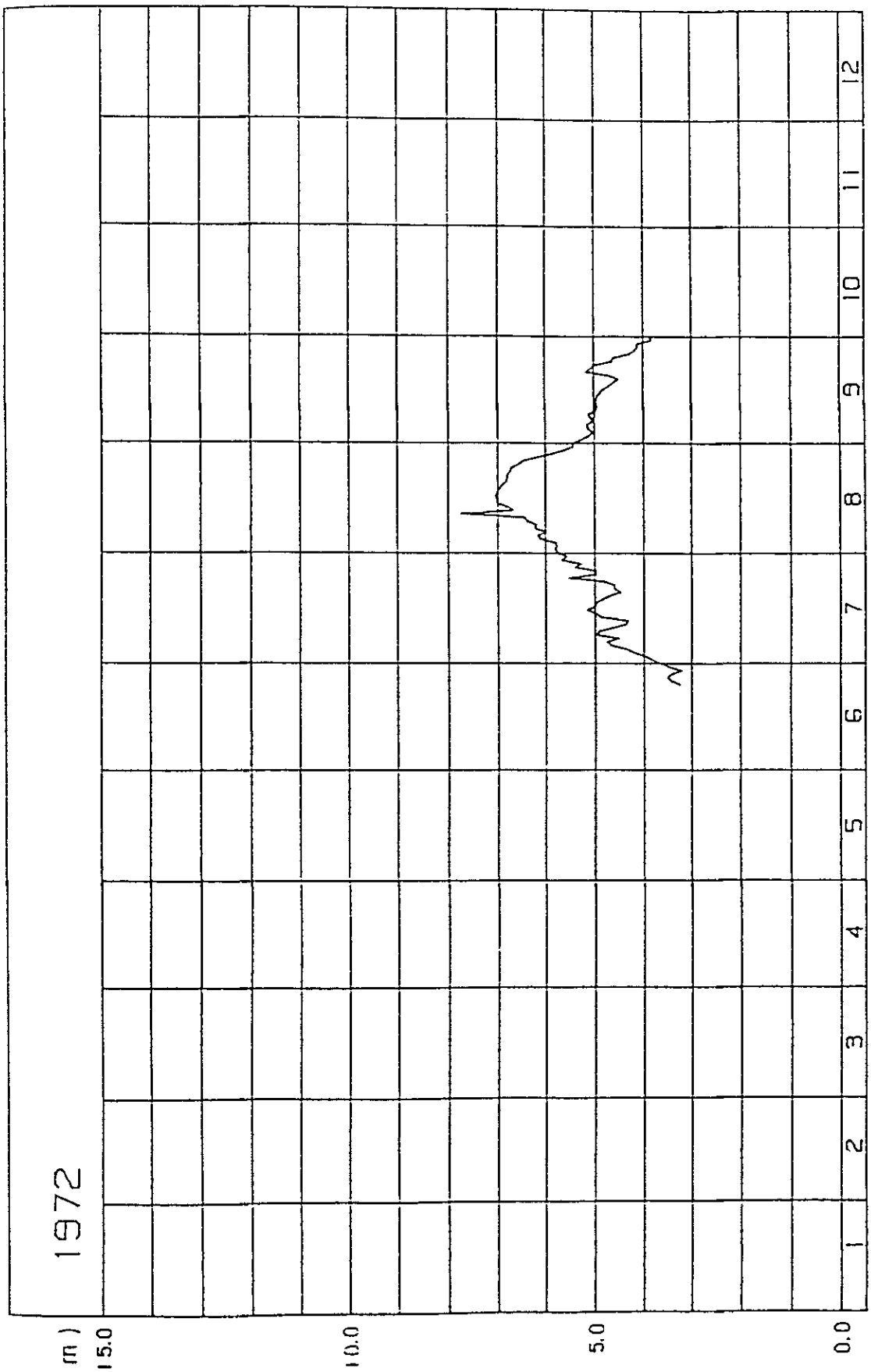


FIGURE WATER LEVEL OF MYITMAKA RIVER AT KUNNAKYAIK



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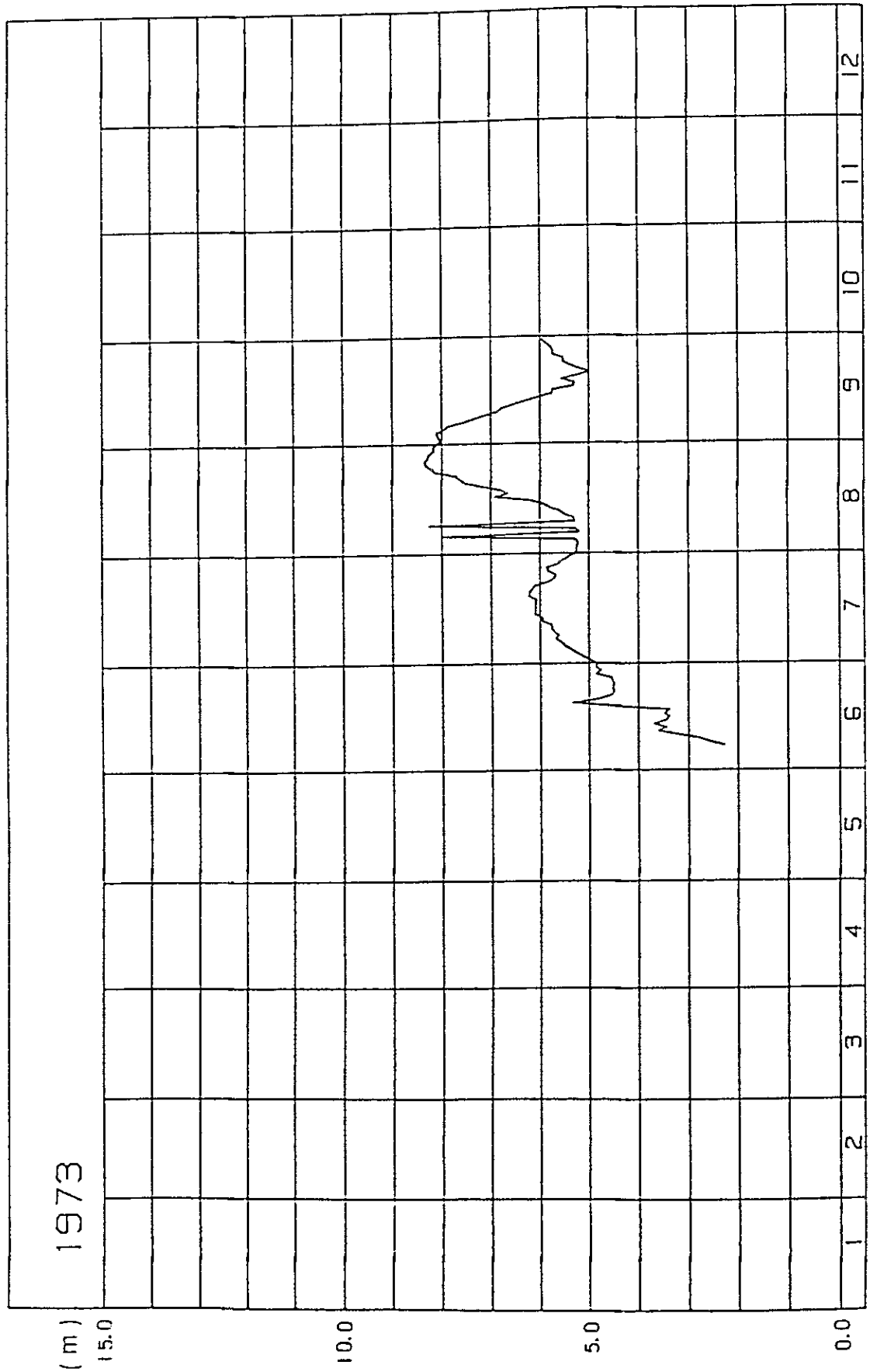

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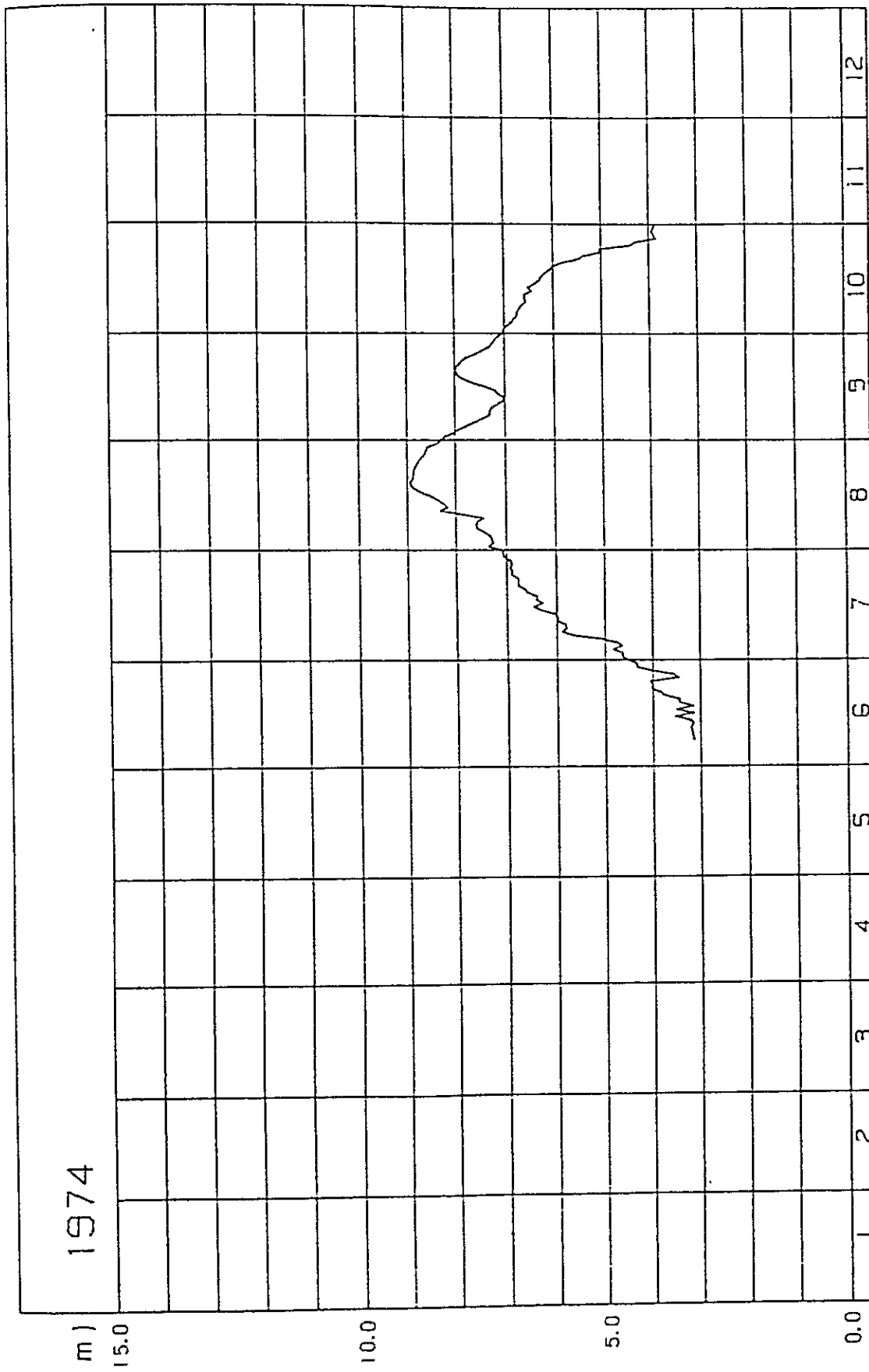

FIGURE WATER LEVEL OF MYITMAKA RIVER AT KUNNAKYAIK

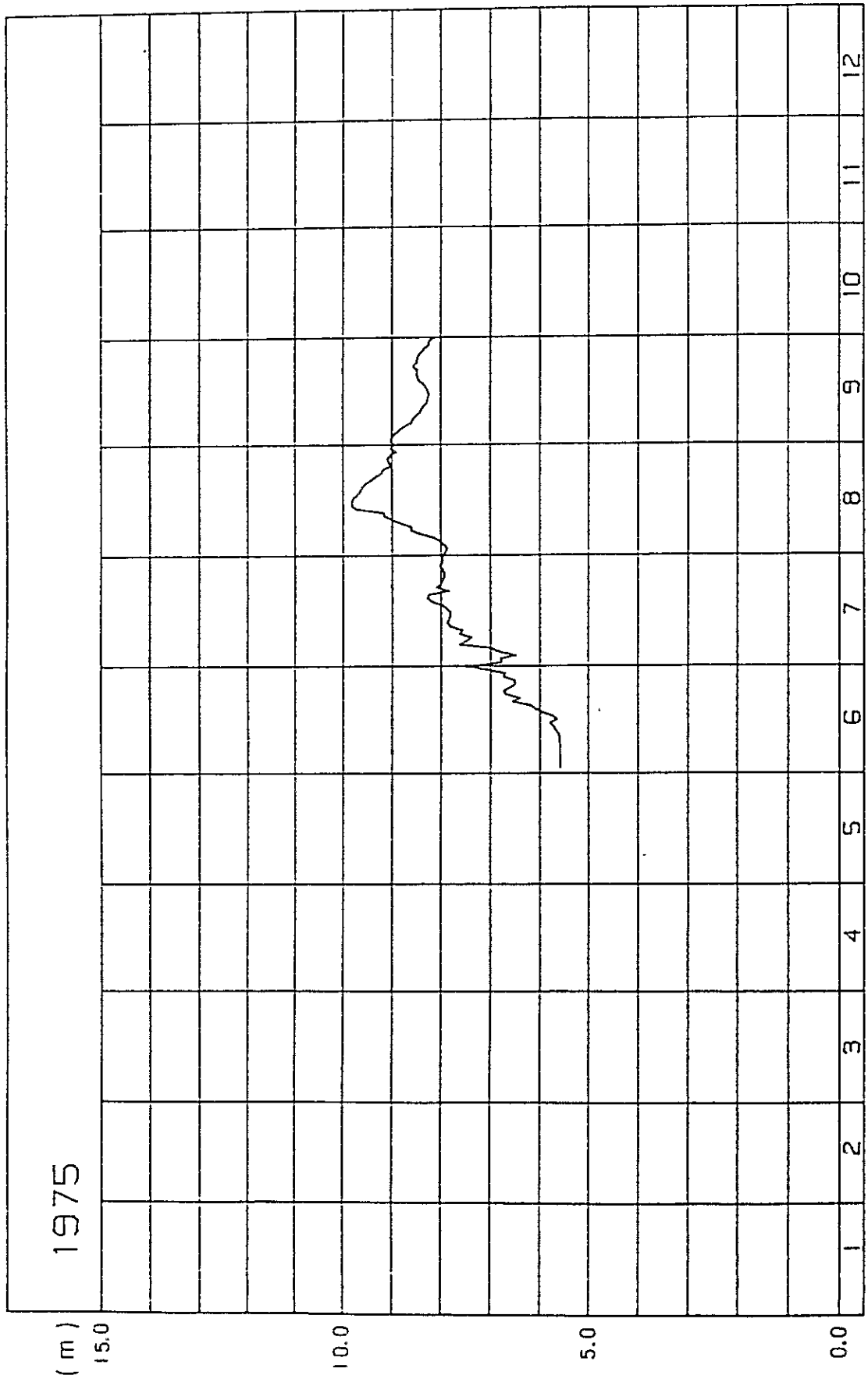

FIGURE WATER LEVEL OF MYITMAKA RIVER AT KUNNAKYAIK

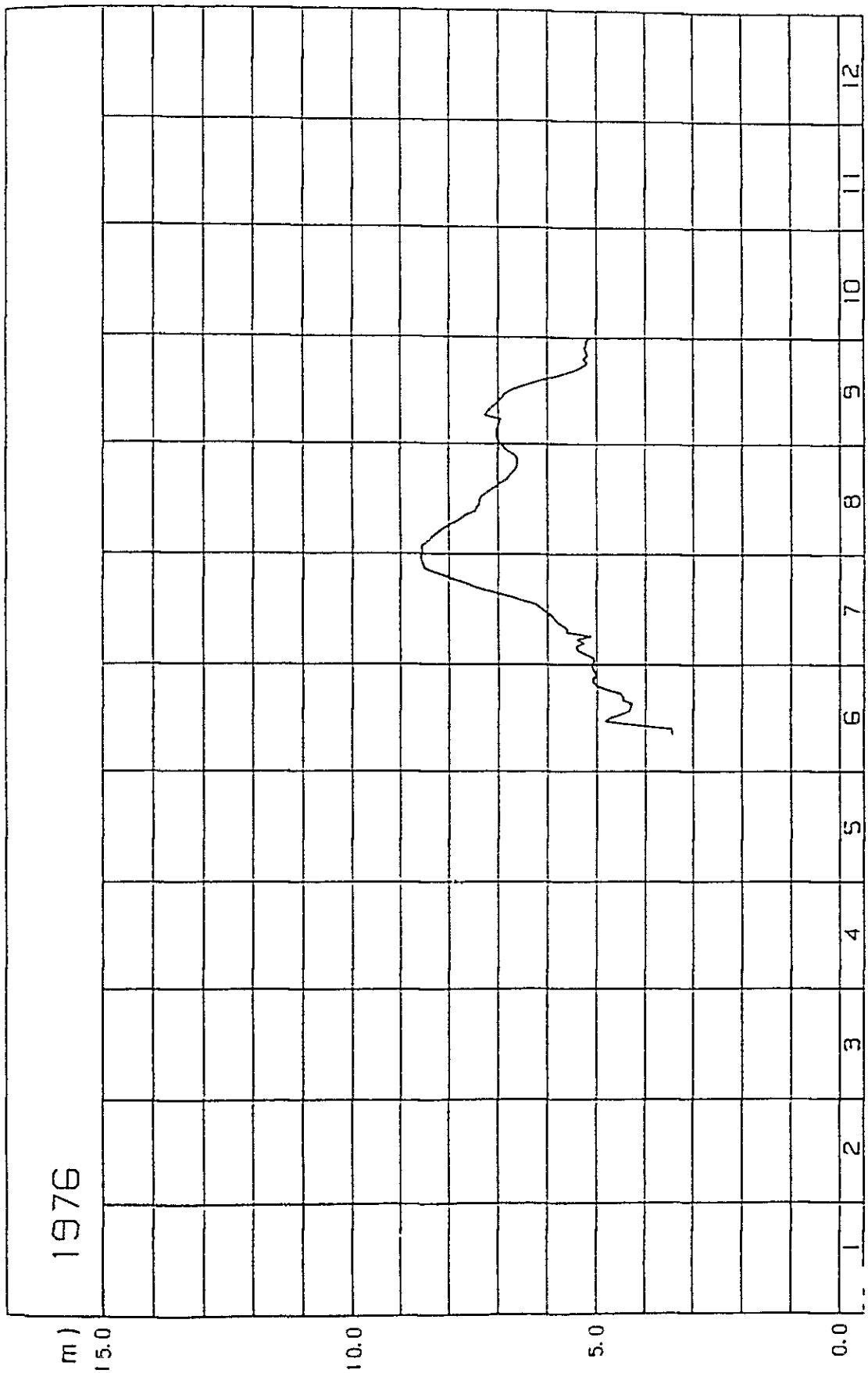

FIGURE WATER LEVEL OF MYITMAKA RIVER AT KUNNAKYAIK

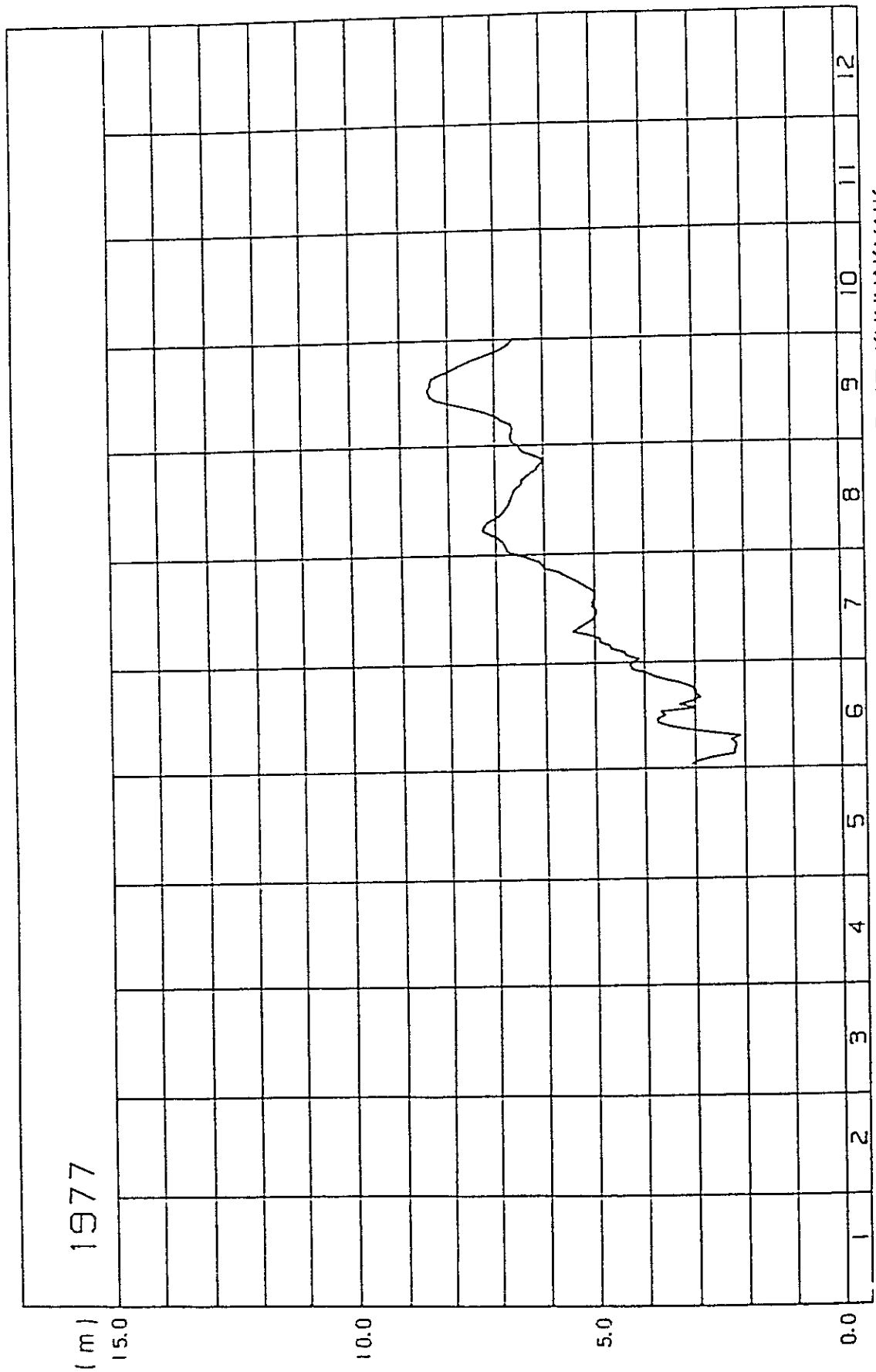

FIGURE WATER LEVEL OF MYITMAKA RIVER AT KUNNAKYAIK

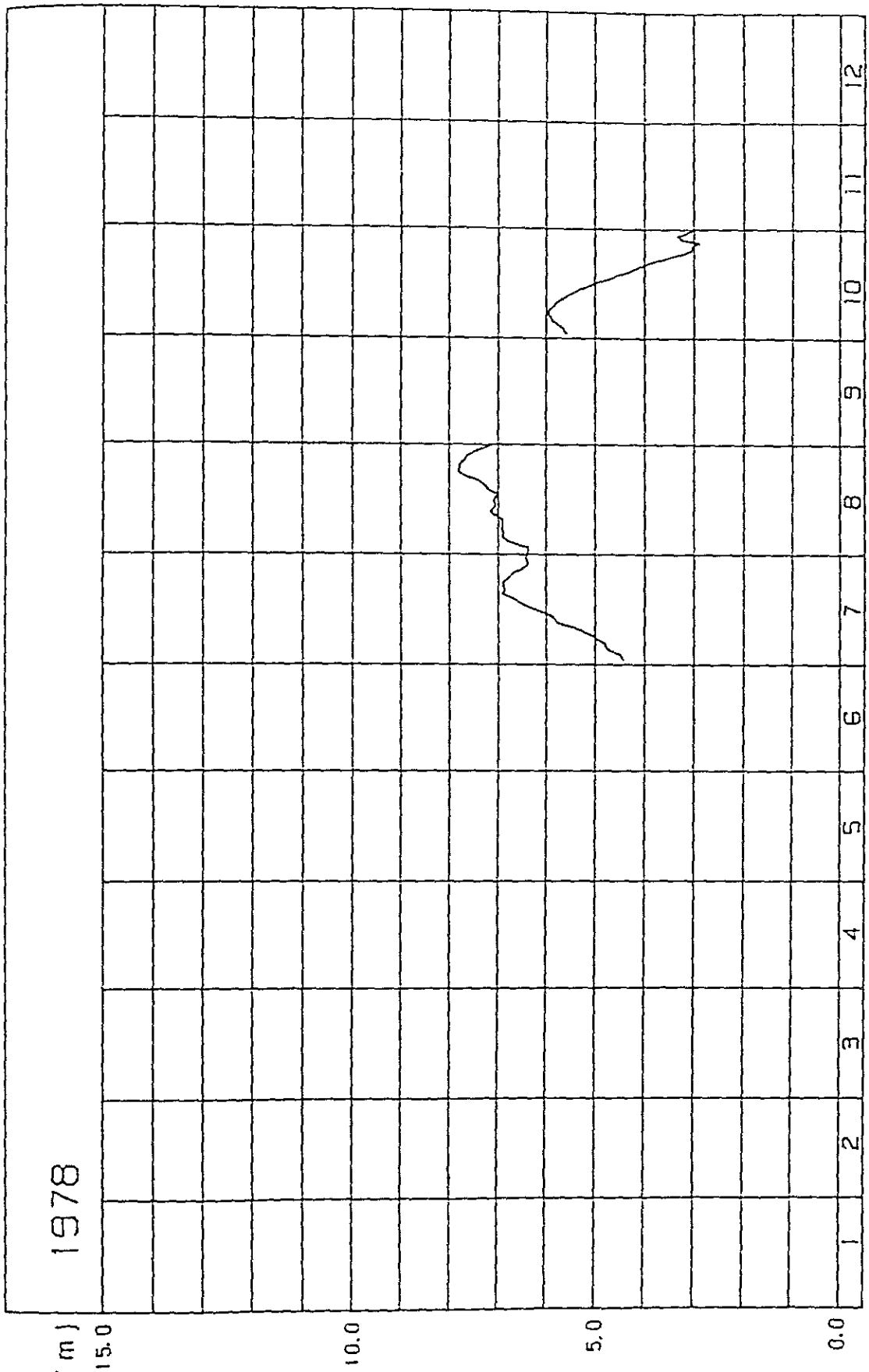

FIGURE WATER LEVEL OF MYITMAKA RIVER AT KUNNAKYAIK

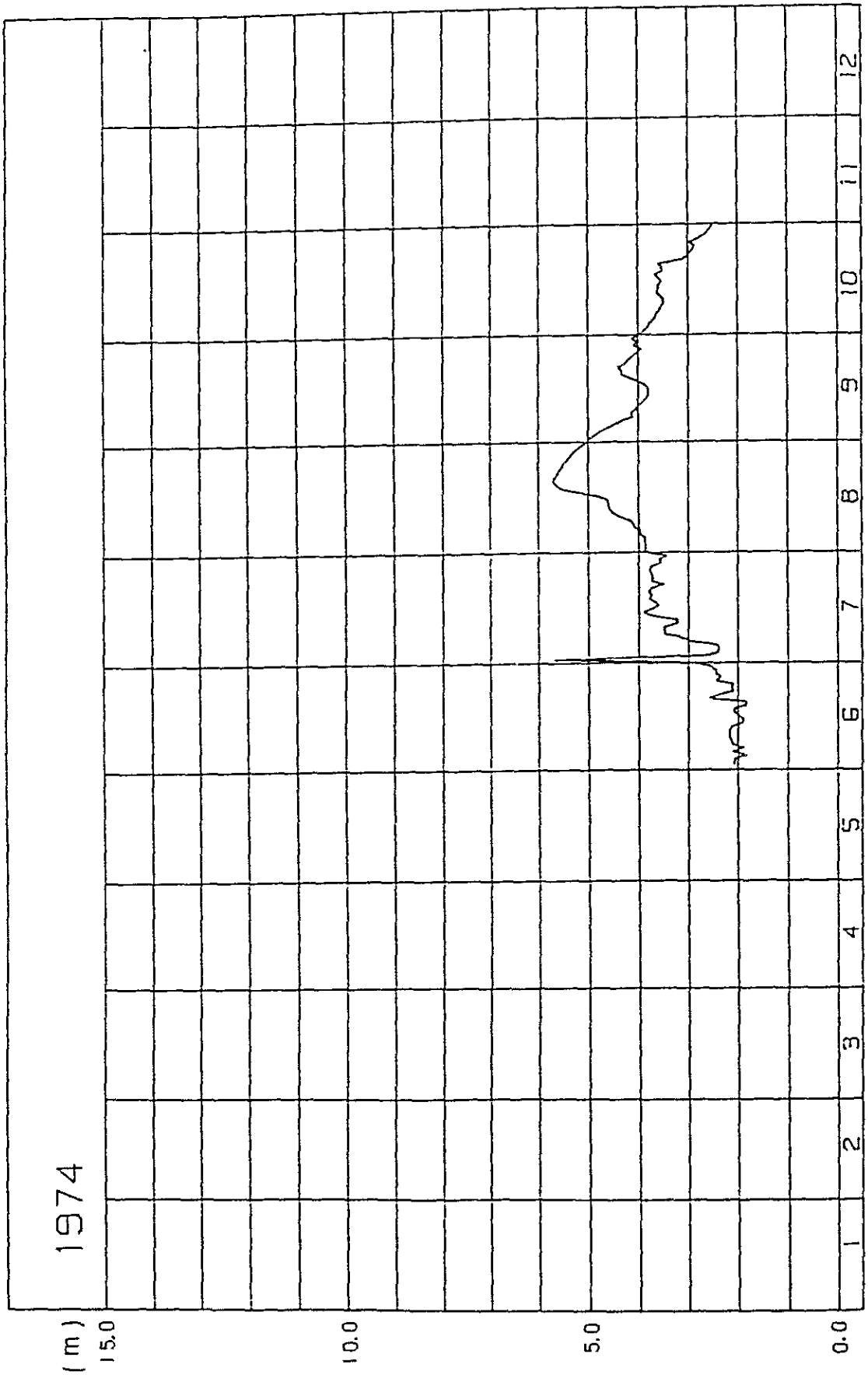

FIGURE WATER LEVEL OF MYITMAKA RIVER AT YOWA

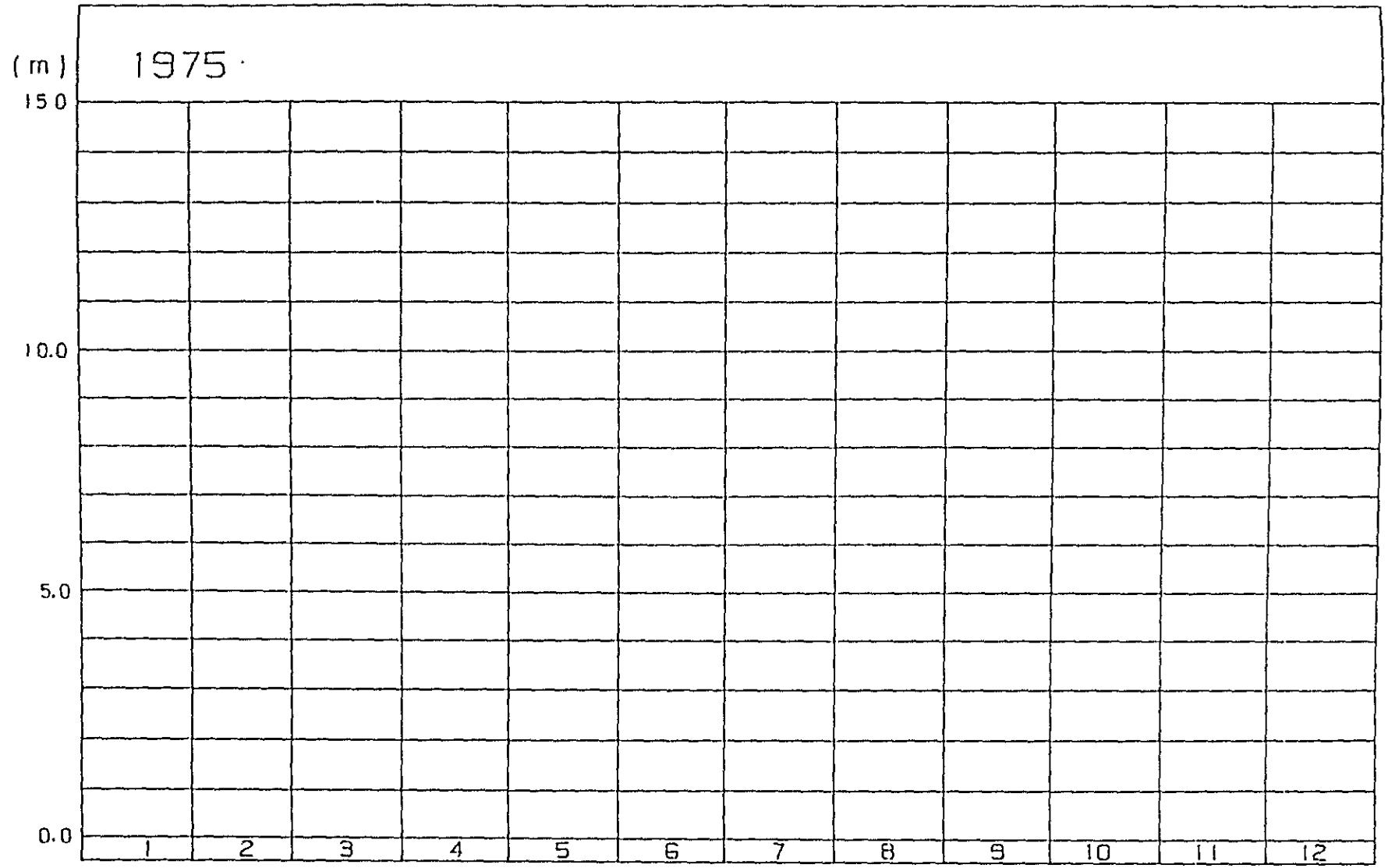

FIGURE WATER LEVEL OF MYITMAKA RIVER AT YOWA

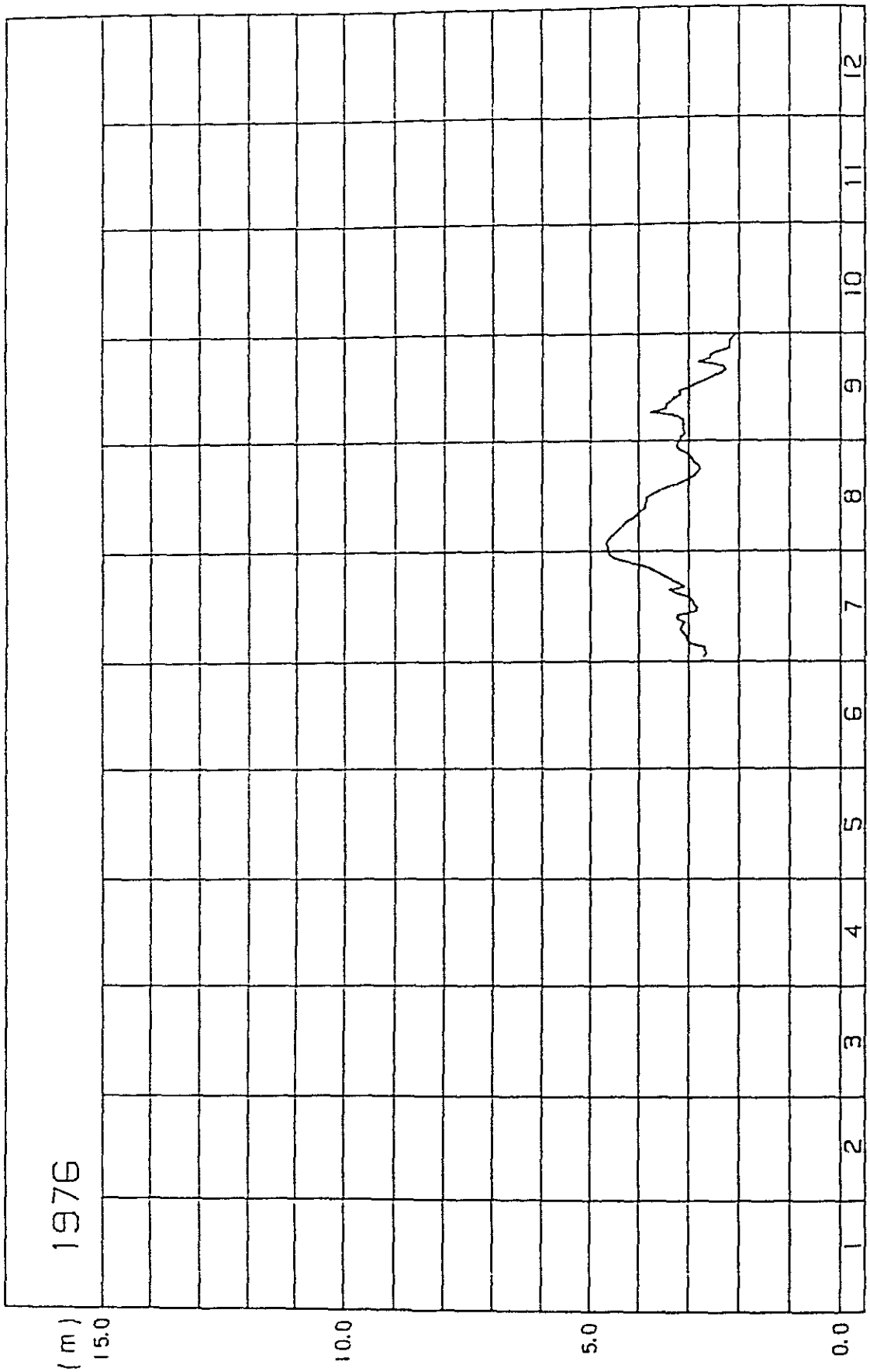

FIGURE WATER LEVEL OF MYITMAKA RIVER AT YOWA

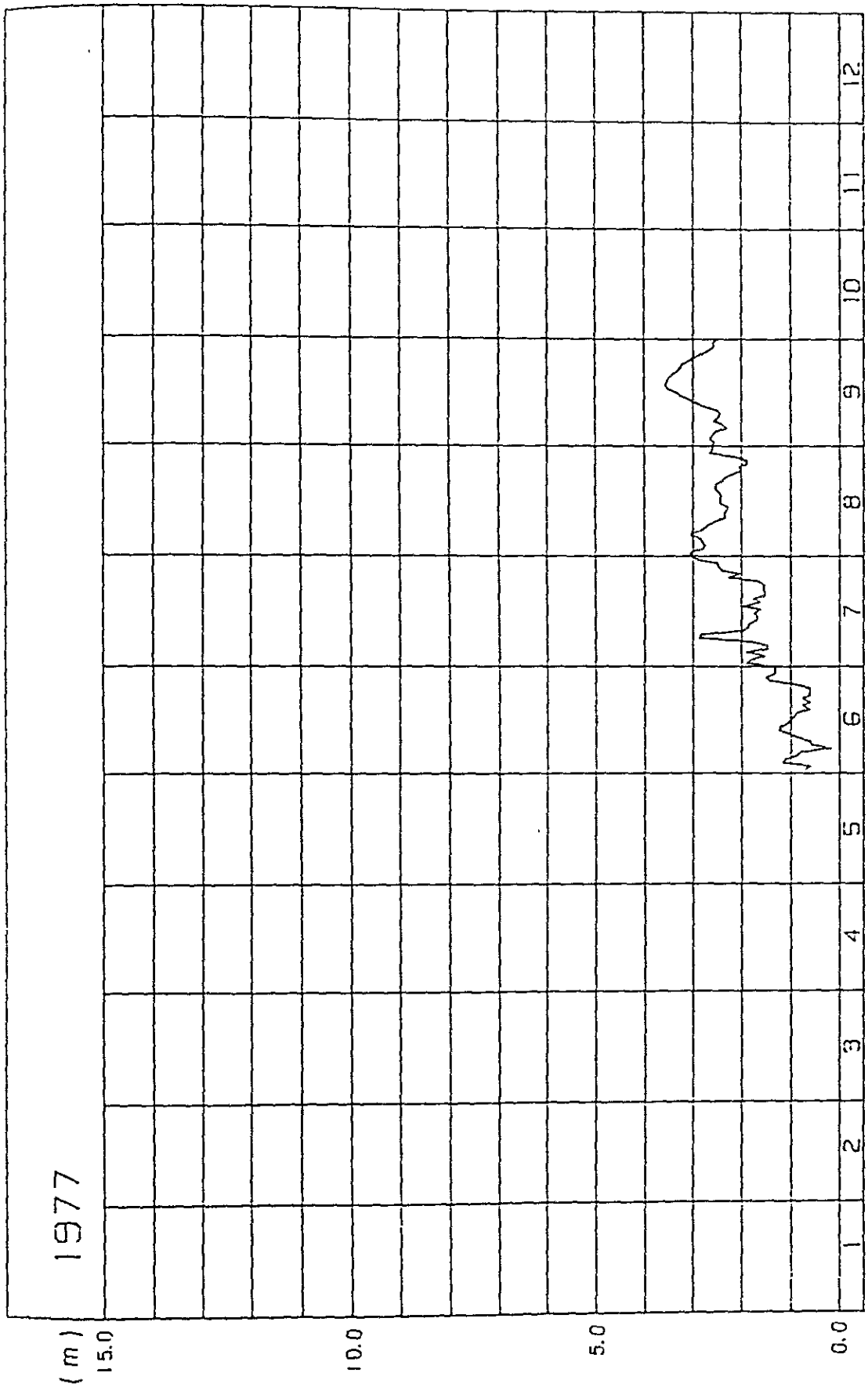

FIGURE WAIFR LEVEL OF MYITMAKA RIVER AT YOWA

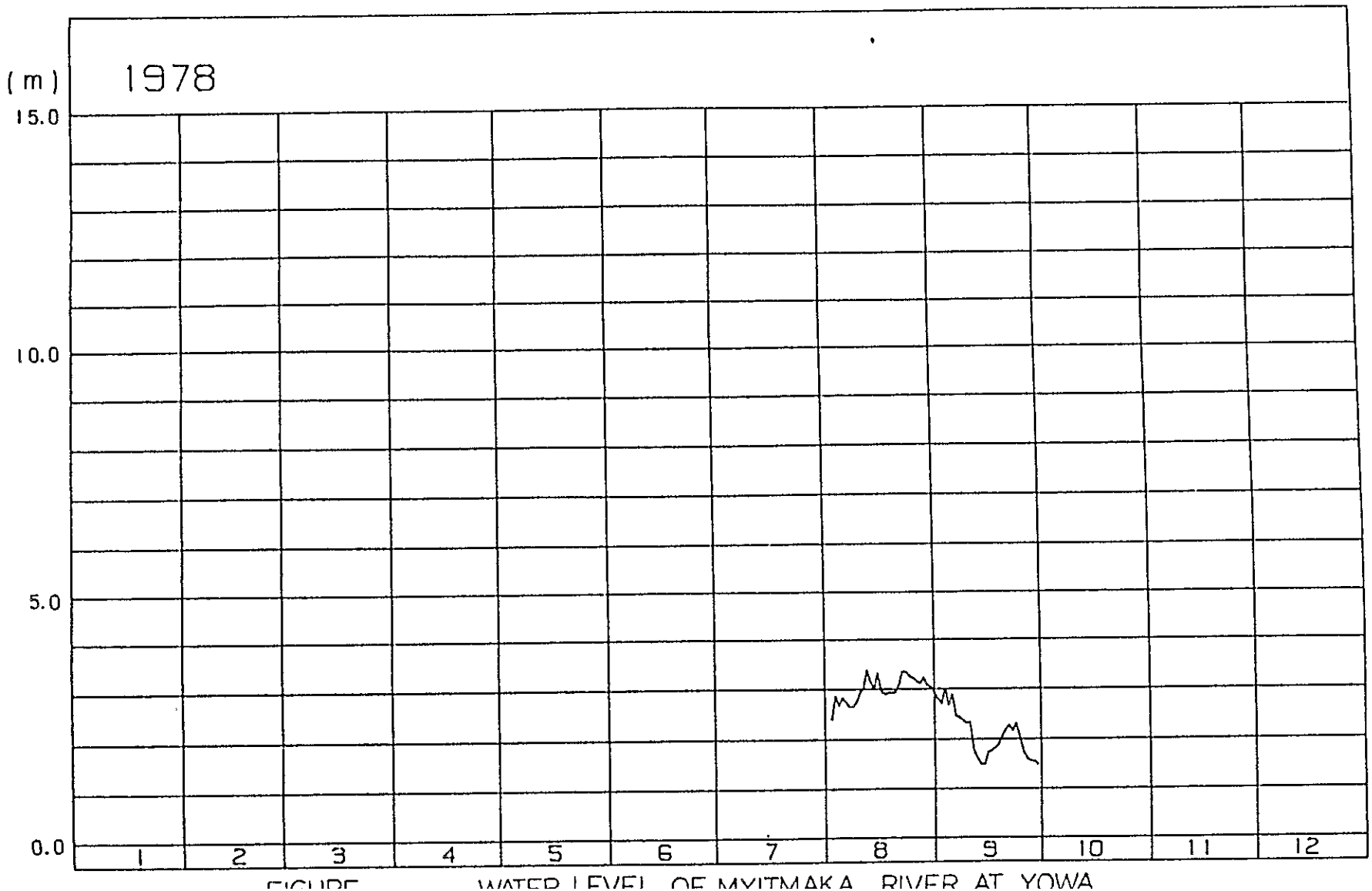

FIGURE WATER LEVEL OF MYITMAKA RIVER AT YOWA