CHAPTER 7

CONCLUSION

1. Highway No. 1A plays an important role in the national economic development for the Cuu Long River Delta Region in which the Hau river crossing point at Can Tho is very important. The socio-economic development of the region demands for urgent investment in the construction of Can Tho.

The proposed investment in the construction of Can Tho bridge shall result in high economic returns.

2. For the bridge location, Option I which is recommended and located 2.7 km downstream from the existing ferry crossings is appropriate for traffic on the basis of natural and social conditions.

3. Technical specifications of the proposed bridge.

- Permanent structure.

- Vehicle loading standard : H - 30, XB - 80 and pedestrians

- Structure of bridge deck :

Stage I : 16.5m wide two vehicle lanes, two motor cycle lanes and two sidewalks.

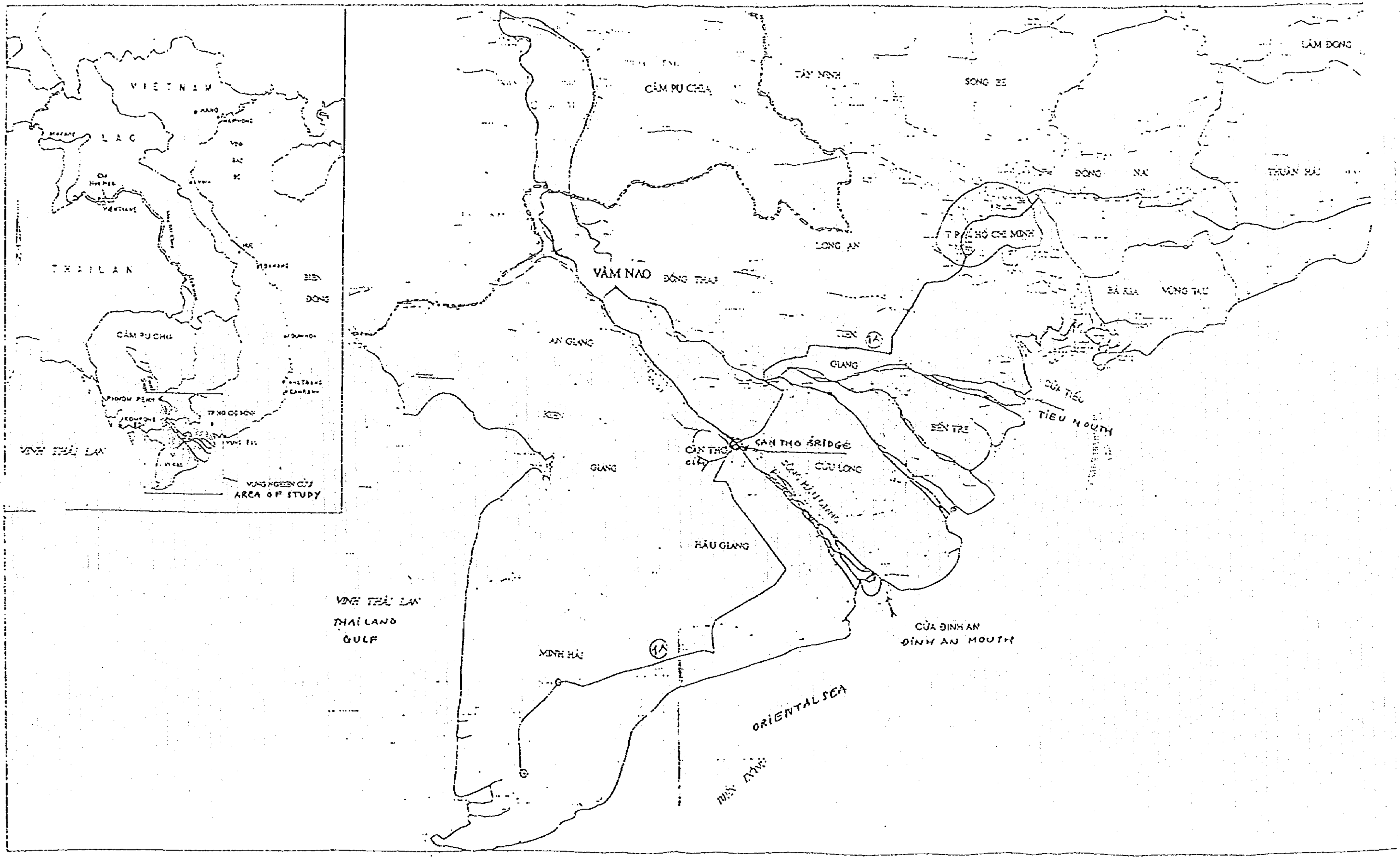
State II : Widened into 4 vehicle lanes and two sidewalks.

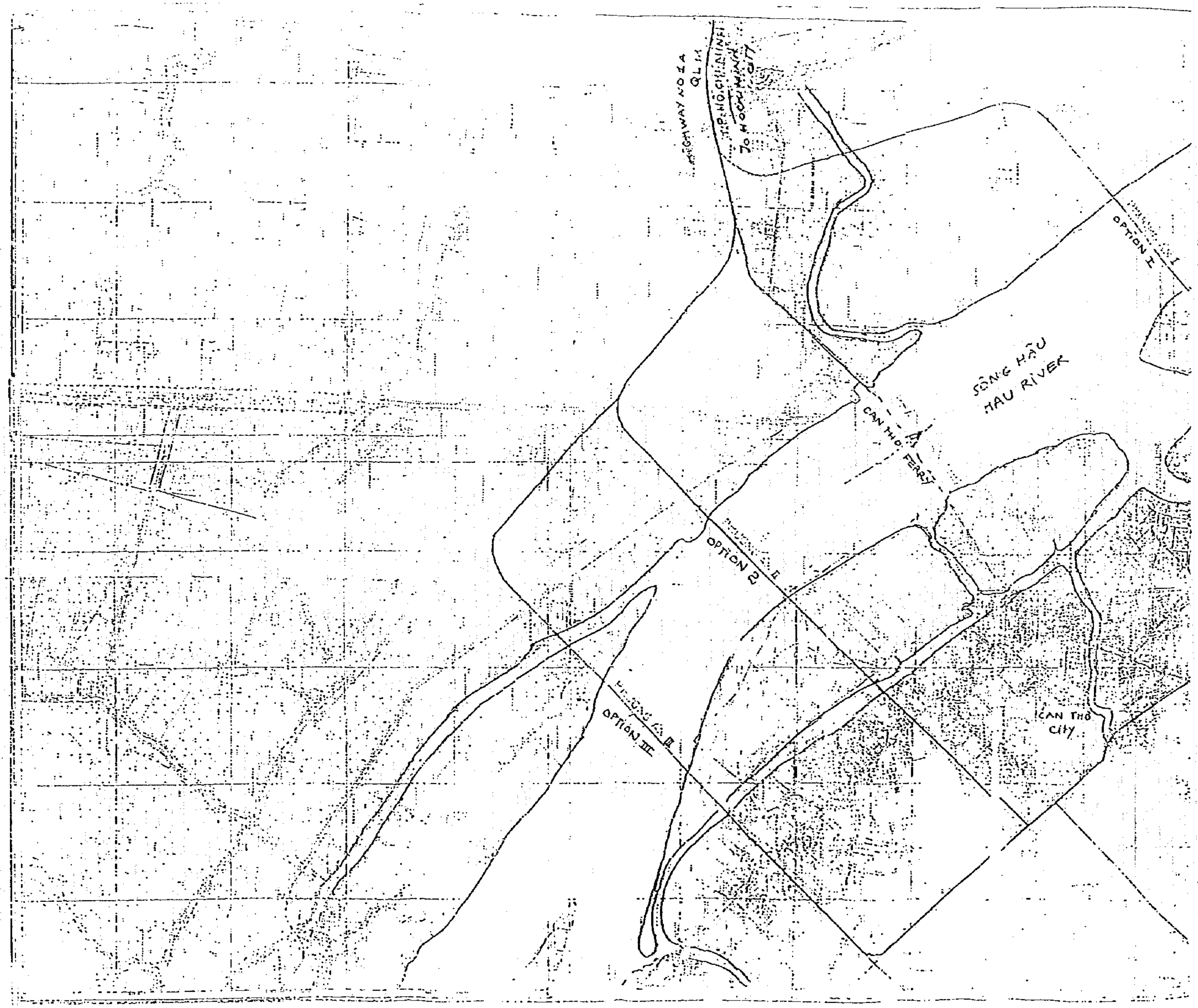
- Longitudinal gradient or the bridge : 4.5%.

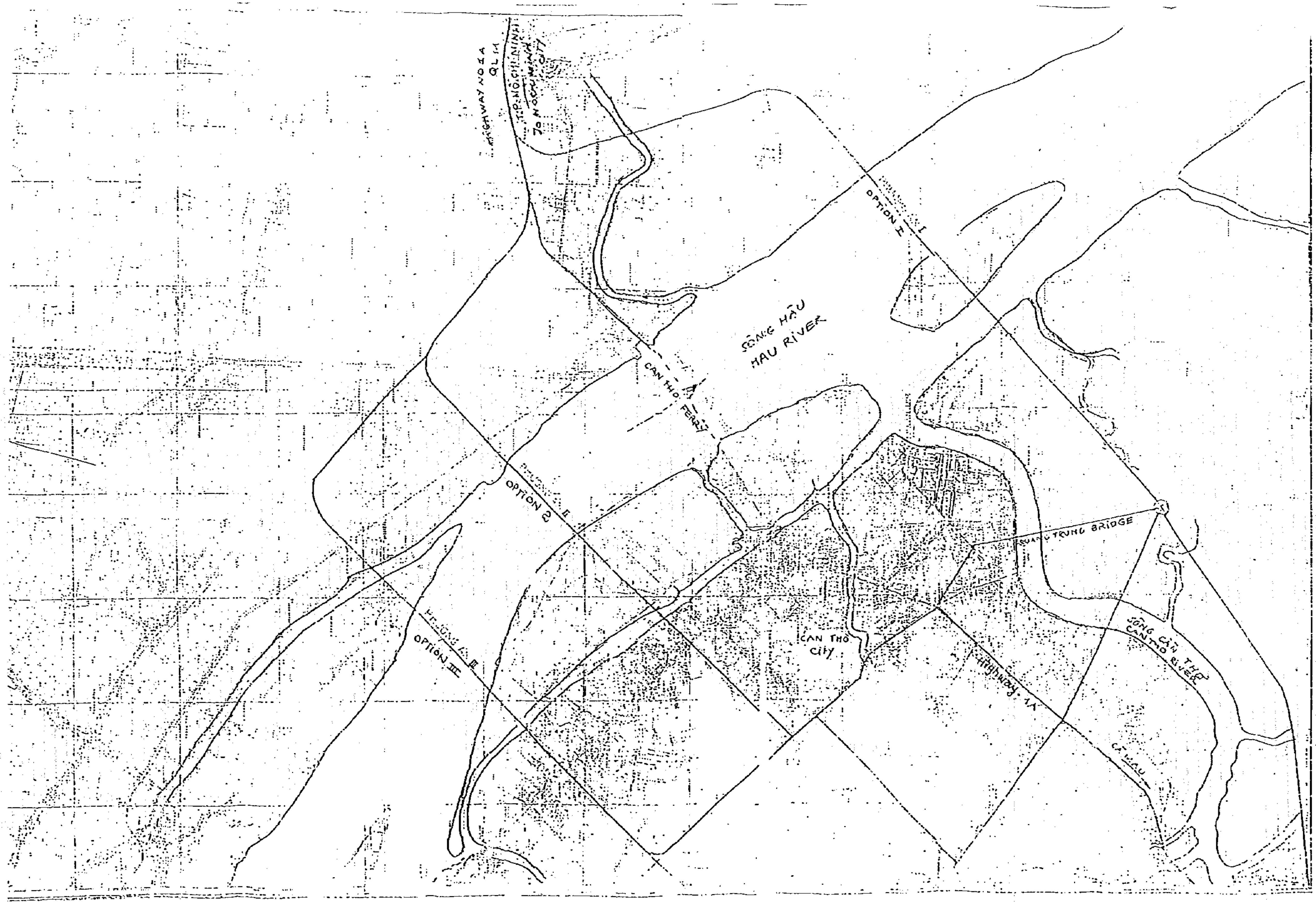
- Navigation clearance : It should ensure the international navigation of shops. Vertical clearance designed is 37.5m.

4. A plant should be formu lated to mobilize local and foreign finance. As the project requires for high technology, cooperation with foreign countries for the required technical assistance is essentially needed.

5. Construction period : It is estimated to take 4 to 5 years, commencing from the year 2000.


VIETNAM
LÀO
THÁI LAN
CĂM PU CHIA
PHNOM PENH
BIỂN ĐÔNG
VỊNH THÁI LAN
VÙNG NGHIÊN CỨU
AREA OF STUDY
LÂM ĐỒNG
TÂY NINH
SÔNG BÉ
ĐỒNG NAI
THUẬN HẢI
TP HỒ CHÍ MINH
LONG AN
BÀ RỊA VŨNG TÀU
VÀM NAO
ĐỒNG THÁP
AN GIANG
TIỀN GIANG
CỬA TIỂU
TIEU MOUTH
BẾN TRE
KIÊN GIANG
CẦN THƠ CITY
CAN THO BRIDGE
CỬU LONG
HẬU GIANG
VỊNH THÁI LAN
THAILAND GULF
MINH HẢI
CỬA ĐỊNH AN
ĐỊNH AN MOUTH
ORIENTAL SEA
1A

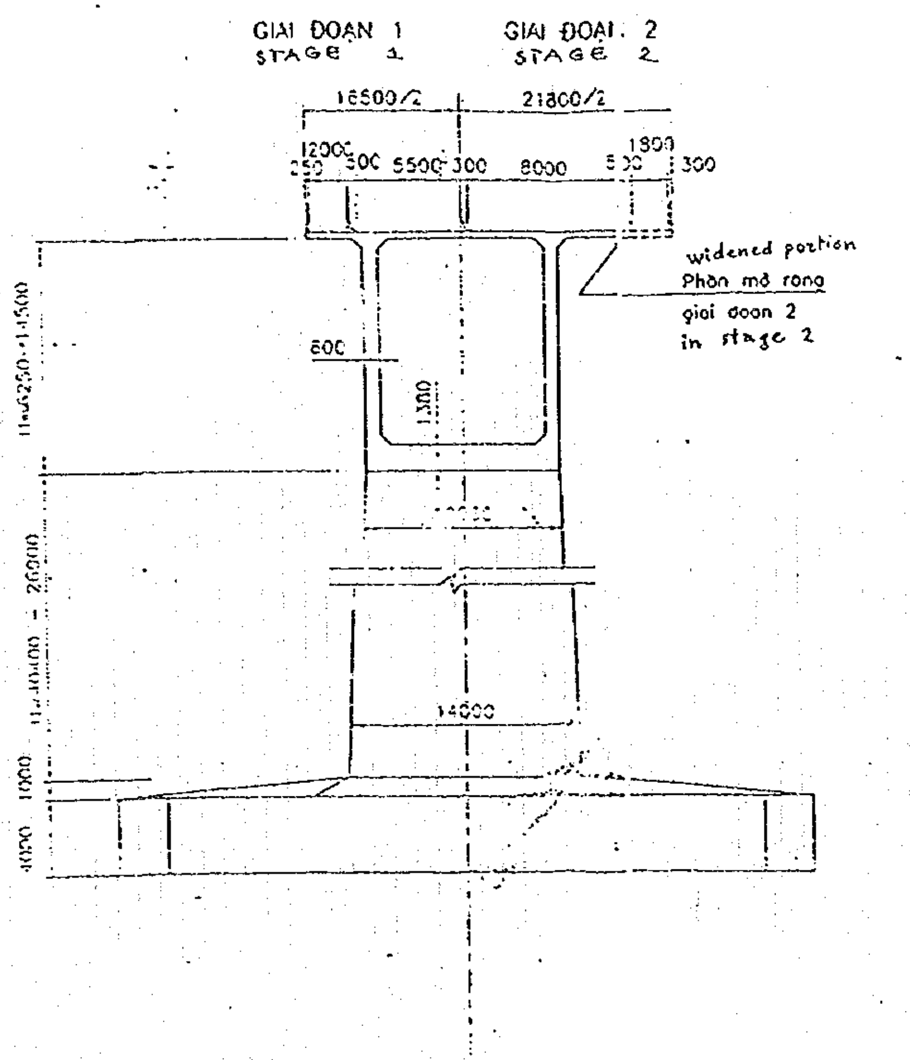

HIGHWAY NO 1A
QL 1A
TO HO CHI MINH CITY
OPTION I
SÔNG HẬU
HAU RIVER
CAN THO FERRY
OPTION 2
OPTION III
CAN THO CITY


SÔNG HẬU
HAU RIVER
OPTION I
OPTION 2 II
OPTION III
CAN THO FERRY
CAN THO CITY
HIGHWAY 1A
SÔNG CẦN THƠ
CAN THO RIVER
CA MAU

INH

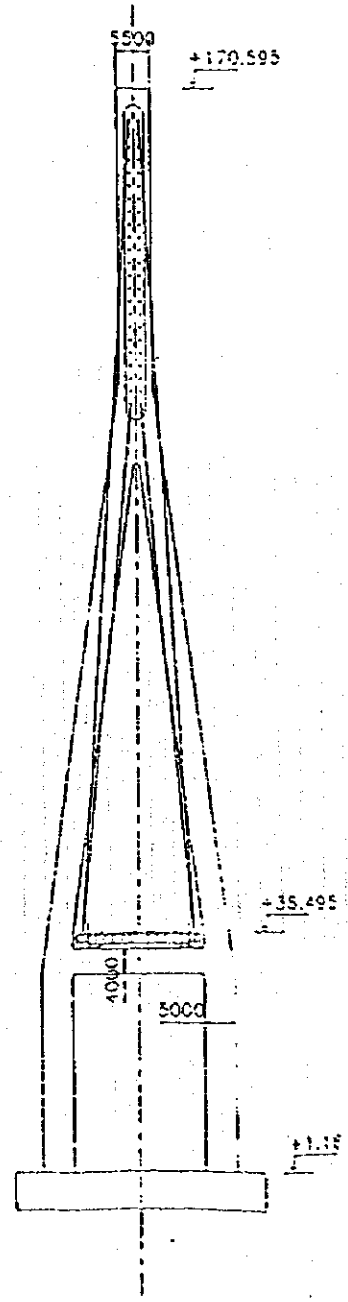
A – A

(1:500)



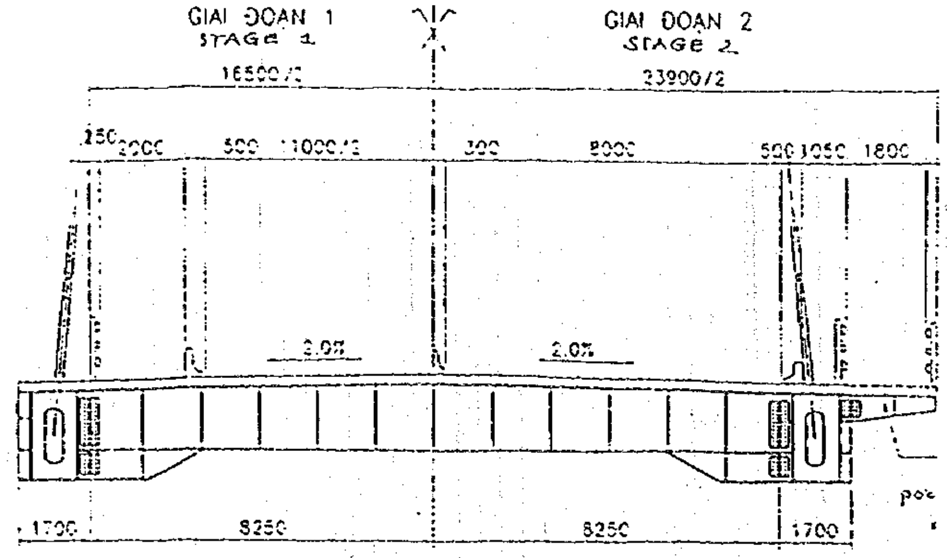
B – B

(1:1000)



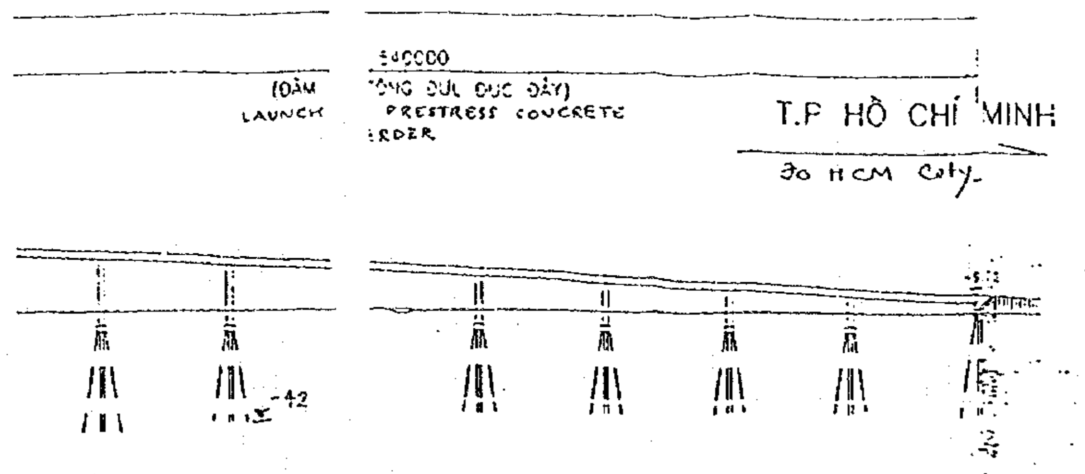
C – C

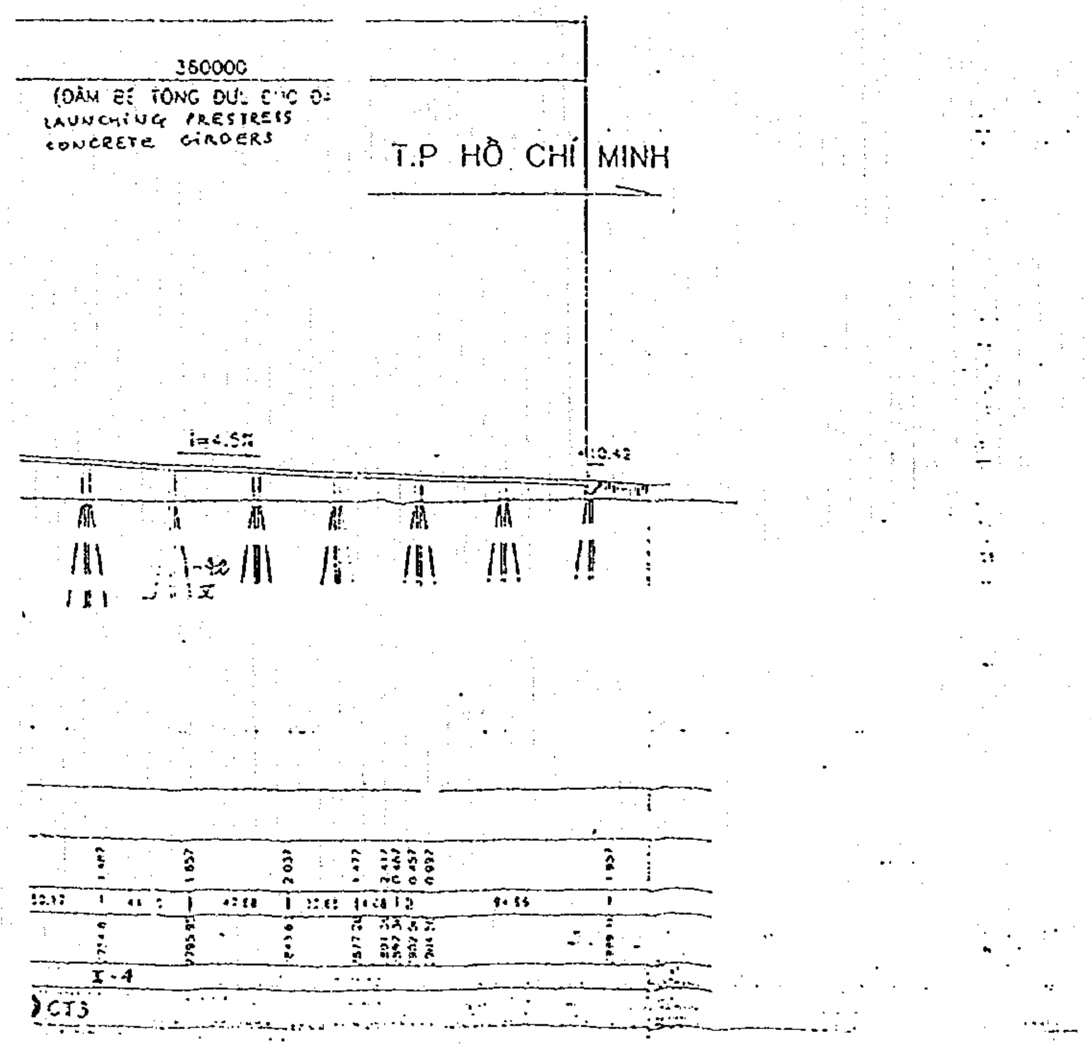
1:150



THUYẾT MINH

1. BRIDGE LOCATION
   To select Option I at downstream location
2. DESIGN STANDARD
   - loading standard : H30 and XB-80
   - Bridge Deck : Stage I : 2 motor vehicle lanes + 2 motorcycle lanes + 2 s.
     Stage II : 4 motor vehicle lanes + 2 motorcycle lanes + 2 s.
3. PROPOSED OPTIONS OF BRIDGE STRUCTURE
   - option 1 : Main bridge span is made up prestressed concrete girders constructed by balanced cantilever method. outer spar made of P.S.C girders constructed by launching method
   - option 2 : Main Bridge span is made of by cable stayed structur alloy steel girders constructed by cantilever method.
   - bridge spans are made of P.S.C girders constructe launching method.
   - structure of foundation for both options :
   - Main bridge foundation is made of cast in situ bored with diameter of 1,8m and approach bridge is m spun driven piles with diameter of 1.0 m.
4. REMARK :
   - All dimensions are in millimeter except the height sta is in meter.





A - A

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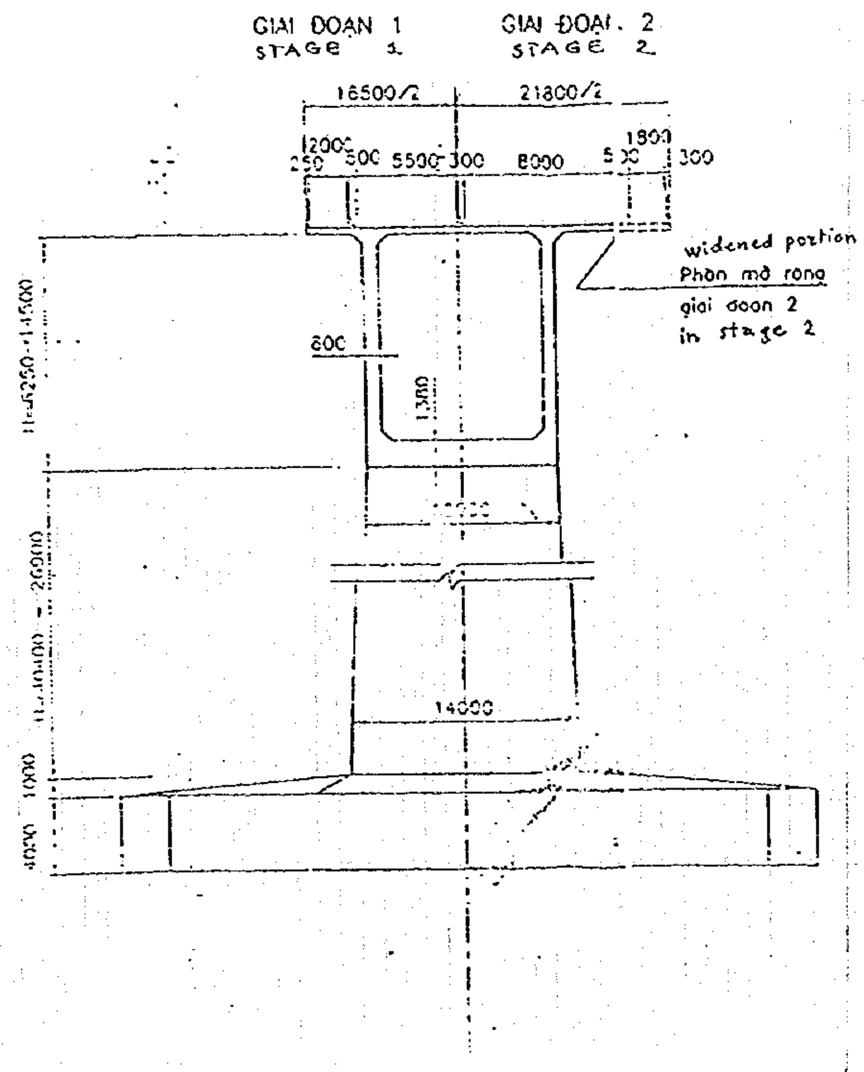

B - B

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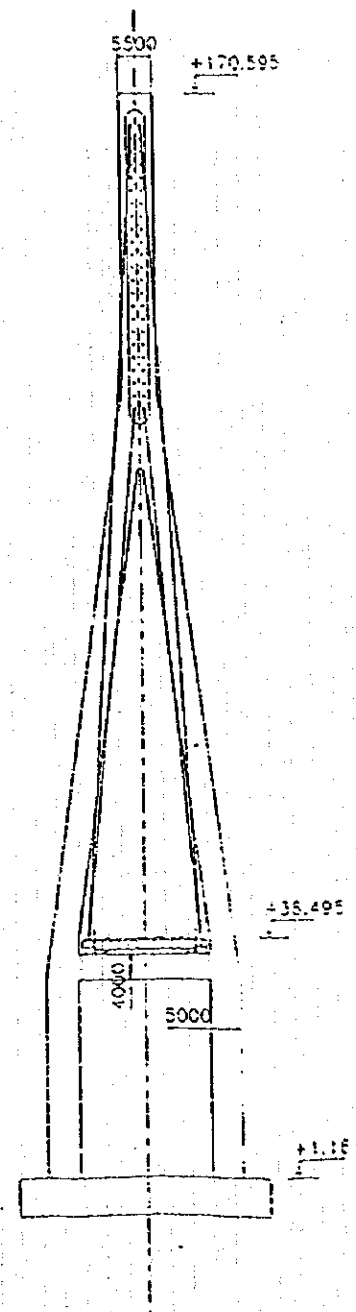
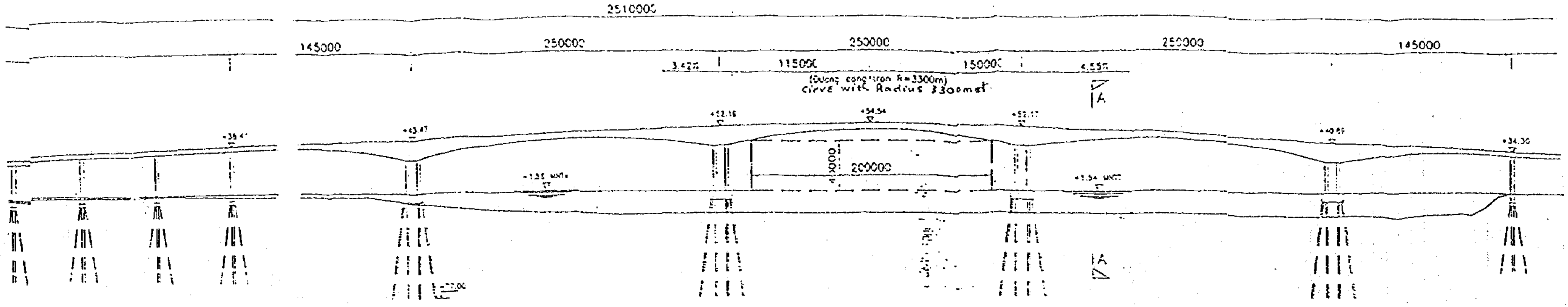
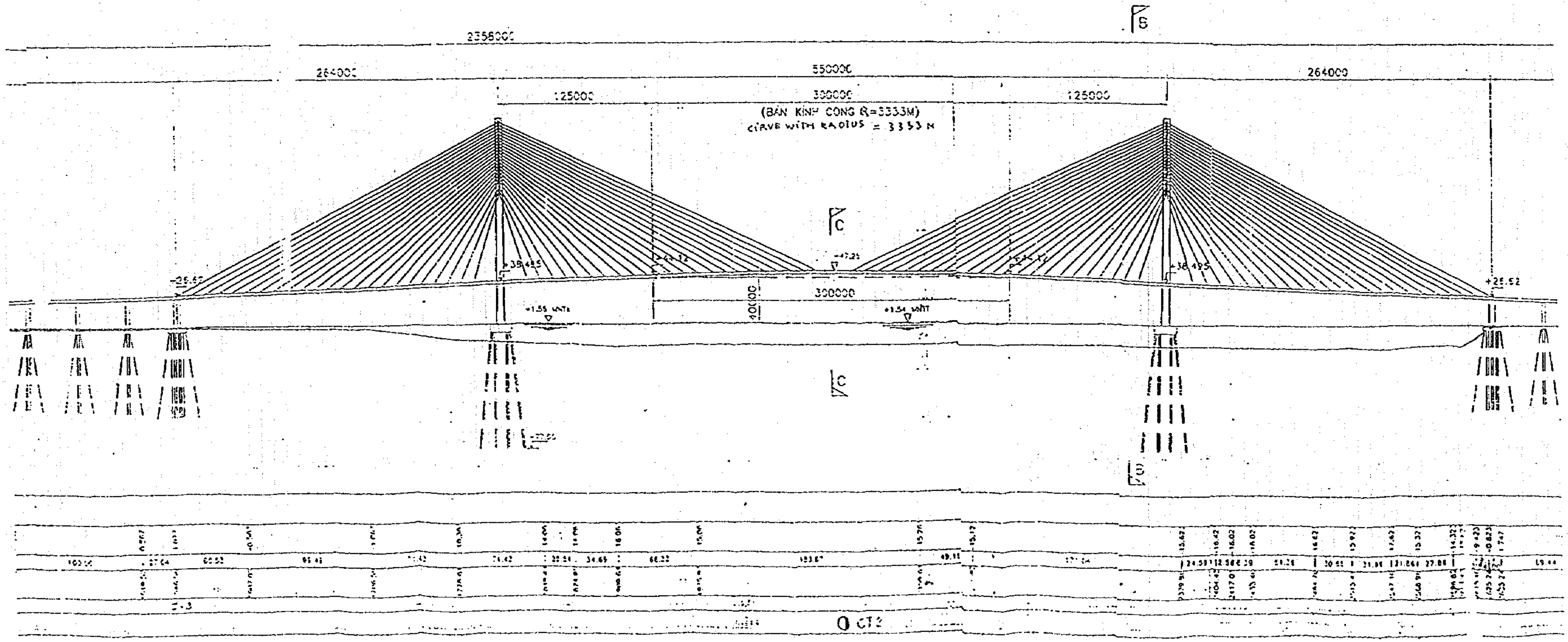


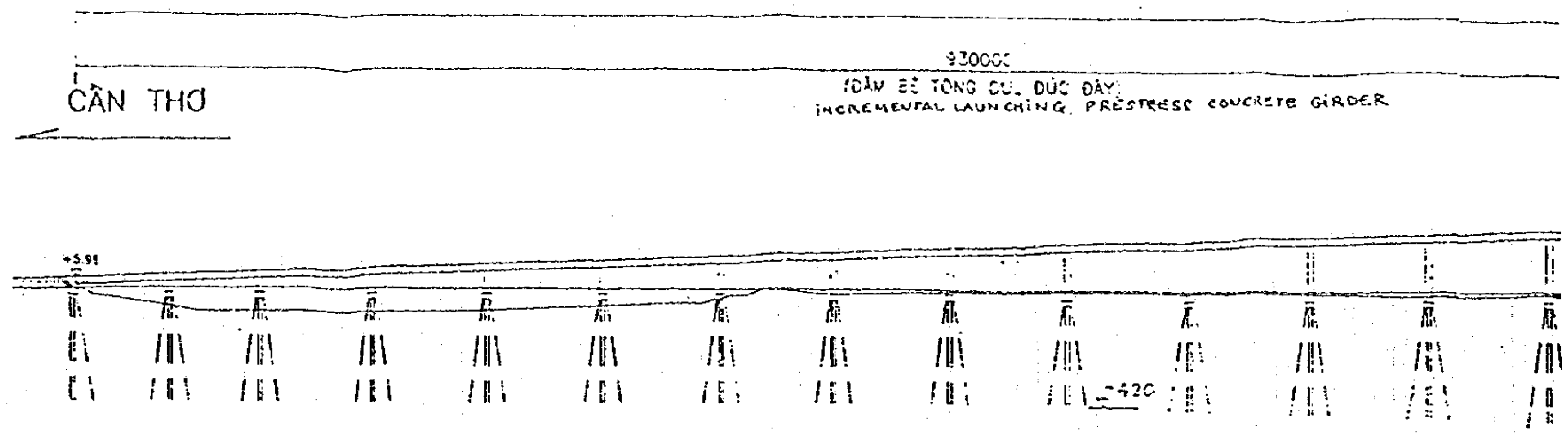


2510000
165000
250000
250000
250000
145000
115000
150000
(Đường cong tròn R=3300m)
curve with Radius 3300met
200000
A



B
2358000
264000
550000
264000
125000
300000
125000
(BÁN KÍNH CONG R=3333M)
curve with radius = 3333 M
C
300000
+25.52

PHƯƠNG ÁN I
(1:3000)
OPTION 1



PHƯƠNG ÁN II
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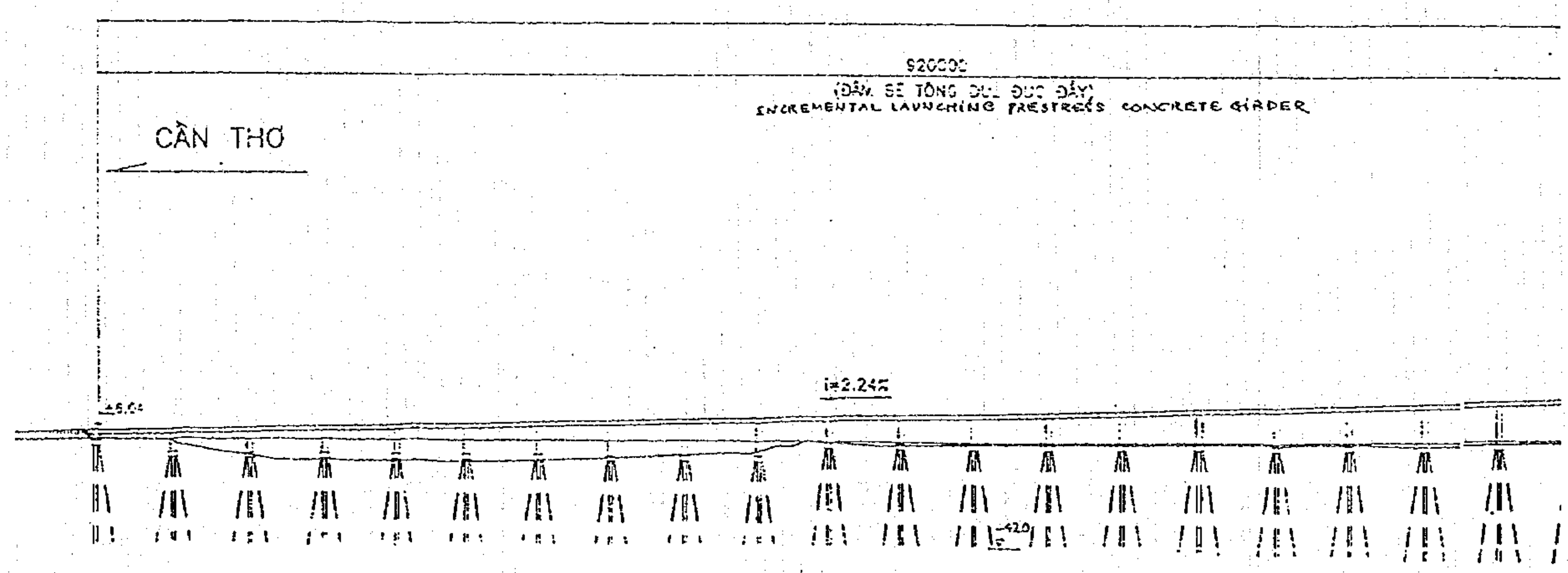
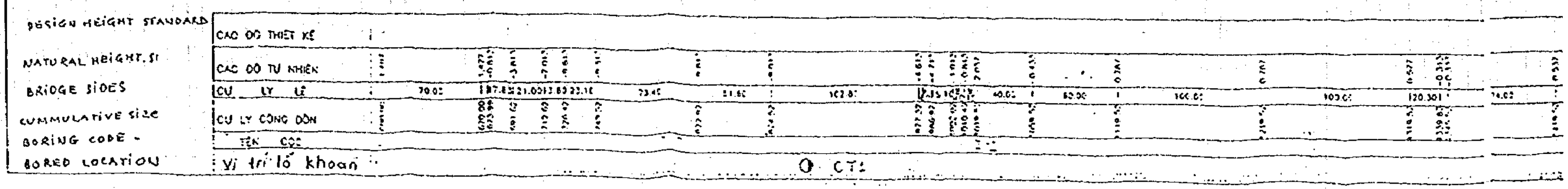
OPTION II





SOCIALIST REPUBLIC OF VIETNAM
MINISTRY OF TRANSPORT
TRANSPORT DESIGN AND CONSULTANT INCORPORATION

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HIGHWAY NO 1A - CAN THO PROVINCE

REPORT ON METEOROLOGICAL, HYDROLOGICAL AND HYDRAULIC CONDITIONS OF CANTHO BRIDGE PRE - FEASIBILITY STUDY

Overall presenting manager : Do Quang Chinh
Vice head Technical section : Khuat Dinh Phan
Director of the company : Phan Khac Le
Principal Engineer of the corporation : Doan Duc Cuong

Hanoi, 14 March 1996
TRANSPORT DESIGN AND CONSULTANT INCORPORATION

SIGNED ON BEHALF OF
GENERAL DIRECTOR
CHIEF ENGINEER

Vu Khac Le

STUDY ON METEOROLOGICAL HYDROLOGICAL AND HYDRAULIC CONTIONS OF CAN THO BRIDGE

The proposed Can Tho Bridge across Hau River (The Hau) is situated on highway N^{0} 1 at kilometer post 1889.

The Hau is one of the two main branches of the low Mekong River basin.

The Mekong River is one of the world largest rivers, ranks seventh in term of length. The river, from upstream to the sea is 4,200 km long which is 3.7 times longer than the length of the Red River and flows through six countries, namely China, Myama, Laos, Thailand, Campuchia and Vietnam. it estuary looks fence like, having catchment area of 795,000 km2 that is about 5.5 times bigger than that of the Red river.

At Phnom Penh, the Mekong River is deviled into two channels flowing into Vietnam, namely Tien River (The Tien) and Hau River (The Hau). The Tien and The Hau are interconnected by Van Nam redistributor channel and a plentiful and densed channels and man - made canals.

On The Tine, at My Thuan, a feasibility study for a bridge construction here has been completed.

On The Hau pre - feasibility study for the construction of Can Tho bridge is being conducted.

The content of the meteorological, hydro - logical and hydraulic study shall cover.

3.III Determination of frequency for high water level at Can Tho hydrau-metric station.
4.III Determination of frequency for yearly maximum stream flow, at Can Tho hydrau-metric station.
5.III Determination of frequency for yearly high water level at My Thuan station.
6.III Determination of frequency for yearly maximum stream flow at My Thuan station.
7.III Determination of percentage of steam flow
8.III Determination of bridge span, vertical clearance and water draft.

IV. Short comings and recommendations

I. Climate

1.1 Climate in South Vietnam

Southern Vietnam is situated at low latitude in the affected South East Monsoon Area. having some specific characteristics.

In most parts of South Vietnam, high temperature remains constant around the year with temperature variance from 3^0 - 5^0 C between the hottest month and the coldest month.

Every year, rainy season takes place from either April or May till October or November and which is concurrent with South West Monsoon season that accounts for 90% of the yearly rainfall with average rain fall from 200mm to 400mm in a month of which number of rainy days accounts for 2/3 of total days in a month and is current - like rains. On contrary in the dry season, average rainfall in a month is about 10m to 15mm. Total amount of rain fall in dry season accounts for 10% of the whole year's.

Rainy season is also the season of rather high humidity (above 85%) with cloudy sky and rarely sunny days. In dry season, humidity degree reduces considerably (at about 75%) with plentiful sun - shine days which is equivalent to 150 to 200 sunny hours.

Following lable gives a comparison between Sai Gon and Hanoi in and seasons.

Table 1

	Sai Gon		Hanoi	
	Dry Season (March)	Rainy season (September)	Dry season (December)	Rainy season (August)
Rain water (mm)	3	338	20	323
Number of rainy days	1	22	9	16
Relative humidity (%)	74	87	81	87
Sun shinning hours	204	117	121	184
Cloudiness (one tenth of sky)	4,6	8,2	6,5	7,8

Compared with the Red River Della, the Cuu Long River Delta is of higher daily temperature amplitude. In the former, daily temperature is less varying in a year because there are no contracts in the conditions of rains, humidity and clouds between the two seasons, while in the latter, daily varian there off is greater in the dry season rather than in the rainy one.

The following table indicates daily temperature amplitudes between Sai Gon and Hanoi

(^{0} C).

Month / Locality	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Sai Gon	10.5	11.1	10.6	10.0	18.8	8.0	7.4	7.5	7.4	7.5	8.2	9.0	8.8
Hanoi	6.8	5.8	5.6	6.7	7.9	7.4	7.1	6.6	6.6	7.4	7.6	7.2	6.9

2.1 Climate condition in the Cuu Long River Delta. Being located at low latitude and near the equator, Cuu Long River Region has a very typically East west Monsoon climate.

This region has a high temperature base and no differentiation of weather on the basis of temperature Regime. Yearly average temperature is ranging from 24^{0} C to 27^{0} C in every part of the region and no month of the year has temperature less than 25^{0} C. The temperature variation between the highest and lowest temperature months is 3^{0} C to 4^{0} C.

Another feature of region is the differentiation in rain and humidity regimes which take place concurrently with East - West monsoon. Every year, there is rain and humidity in half time of the year which is taking place concurrently with summer winds, and dry season in half time of the year which is associated concurrently with winter winds. In rainy season, rain falls account for 90% of the total of the year, while dry season accounts for the remainder. The number of rainy days in a month of dry season is 2 to 3 days equivalent days in rainy season. Rain water level in dry season is constantly in the range ± 110m variance compared to the Mean rainfall.

Rainfall is distributed equally through out the months of rainy season. There are very few strong rains.

There are almost no great typhoons in this region, except one or two weak typhoons takes place in 10 year/time. According to statistics recorded in continuously observed 55 years, there have been 7 typhoons which attacked directly the coastal area of southern part of Vietnam. It is noted that should there is any typhoon, it takes place lately in the year, mainly in November and December. Typhoon could take place in April and May just beginning of summer season (2 typhoons out of 7 cases as recorded).

Typhoons in this region is normally associated with weak winds and light rains. For Cuu Long River Delta Region, what most astrous to is the water rising caused by typhoons. Seawater arise, flooding over the entire plane field of which some have scours up to 2 - 3m deep.

Meteorological characteristics of Southern part of Vietnam in general and the Cuu Long River Delta in special is typicalized by plenty storms which are larest in member compared to central coastal, highland (Tay Nguyen) and pro - storm area in the North of Vietnam.

At average, about 100 to 150 stormy days are observed in a year at various places Winter season beginner from April and ends at November. From May to October, there are about 15 to 20 stormy days in each month ; there are 10 to 12 stormy stays each month, and 10 to 20 stormy days in the initial month (April) and the last month (November) in this season.

3.1 Climate environment of Can Tho side

Can Tho station is located at 10° 02 North latitude and 105°47 East longitude. Its height is 3m Means Sea Level (MSL)

A series of data were recorded in 20 years and deviled into 2 stages due to circumstances.

- The 1st stage : from 1963 to 1971 data was collected in the pre - liberation time of South Vietnam.

- The 2nd stage : from 1977 to 1987 was the recorded data by the station.

In series of data, some factors covered full 20 year time, such as temperature, humidity level, total monthly and yearly level of rainfalls. There is the lack of some data due to unrecorded practices applied in the past, therefore there remain interrupted periods only data related to air pressure, level of rain falls was obtained in period 1977 - 1987 (11 years)

1. Maximum Ambient temperature (^{0} C)

Tmax = 36^{0} 5 Cv = 0.04 Cs = 0.06

Table 3

Return period (Year)	10000	100	20	10	5	2					
Frequency p%)	0.1	1	5	10	20	50	70	75	80	90	95
Maximum t^{0}	42.2	40.5	39.1	38.5	37.7	36.3	35.6	35.4	35.3	34.8	34.4

2. Minimum ambient temperature (^{0} C)

Tmin = 1707 Cv = - 0.08 Cs = 0.06

Return period (Year)	10000	100	20	10	5	2					
Frequency (p%)	0.1	1	5	10	20	50	70	75	80	90	95
Maximum t^{0}	12.1	13.8	15.2	15.9	16.6	17.8	18.5	18.7	18.9	19.4	19.8

3. Humidity

Table 5

Month / Humidity (%)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Relative average %	82	79	77	78	83	86	85	86	87	86	85	83
Relative minimum %	32	37	30	31	27	39	49	42	46	40	31	43
Absolute average (mb)	25.9	25.9	27.4	29.3	30.3	30.4	29.9	29.9	30.2	30.1	29.4	26.8
Absolute maximum (mb)	30.2	32.2	32.1	34.5	36.4	35.8	36.6	34.8	35.0	34.7	35.0	32.9
Absolute minimum (mb)	17.7	19.1	19.0	20.9	27.1	22.7	25.3	25.4	24.7	21.6	19.0	17.7

4. Rainfall :

- Average monthly and yearly rainfall level Rmm
- Maximum daily and yearly rainfall level R_x mm
- Average number of monthly and yearly rainy days N

Table 6

Month / Factor	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Rmm	10	1	8	39	204	231	213	254	265	325	146	30	1727
R_x mm	34	11	60	69	76	125	103	137	118	129	116	96	137
N	1.5	0.3	1.2	4.8	15.3	19.0	20.3	21.8	21.9	20.4	13.1	5.4	144

5. Wind

Maximum wind velocity in a month V_x m/s and its directions

Month / Factor	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
V_x m/s	14	14	14	24	21	30	31	31	28	20	18	13	31
Direction	E, NINE	S,E	NE, SE	S	SE	SW, W	S,W	S,W	S,W	W	E	ENE ,E	SW
Year Wise	1979 1981	1981	1979 1981	1980	1980	1970 1981	1979 1982	1979	1983	1983	1982	1977 1978	1979

II. Hydro-graphy

Can Tho Bridge is across the Hau River. The Hau is one of the main channels of the MeKong river.

The Mekong River is one of largest rivers in the world, flows through 6 countries. Focus has long been given in the hydro-graphic studies by the concerned countries but mainly addresses to the observation of water level and rainfall level. Until 1968, such studies were integratealy performed by an international body, namely "Mekong cooperation committee" which consisted of 4 member countries i.e Laos, Thailand, Campuchia and Vietnam, hydro-graphic measure, meteorological and hydro - logical studies on various simultaneously.

The hydraugraphic studies which swerve the design purpose for the Hau crossing bridge were performed by analysis of hydraugraphical data at Kratie station and at other downstream stations - Kratie station is the last hydraumetric one located at the upstream river section which catches the whole rainy water from river upstream.

At Kratie Station (located at 545 km from the sea) flowing downstream to Kompong Cham the gradient of river becomes reduced with wider river width, and flood run over the river banks in parellel with the main stream to a limited extent. From Kompong cham to downstream area, flood water over flows the river banks down to the vast low-lying field where a part of flood water still remain when water flows back to the river (flood recedes).

At Phnompenh, Ton Le Sap river is joined by Mekong river to form up 4 distributaries. In the flood season, Ton Le Sap charges part of its water from Mekong River to the Great Lake in North west flow direction. When water flood recedes, Ton Le Sap discharges water of the Great lake back into Mekong River in South East flow direction.

Beyond Phrompenh, Mekong river has a turning branch, called Bassac River. In Vietnam's territory, Mekong River has two main channels, namely Tien River and Hau River or Bassac river (called by Campuchean). Inter connecting the two main channels, the Hau and the Tien, are Vam Nao River and a densed system of small distributaries and man - made canals.

The Tien flows through big towns, such as Tan Chua, Cho Moi, Cao Lanh, Sa Dec, Vinh Long and My Tho. Flowing through My Thuan, the Tien is further deviled into 3 distributaries, namely Song My Tho, Co Chien and Cung Hau.

The Hau flows through major towns, such as Chau Doc, Long Xuyen, Can Tho, Dai Ngai and discharges to the sea through the two river months, namely Dinh An and Tran De.

I.II. HYDRAUGRAPHIC DOCUMENTS.

For the purpose of doing design and calculation of the Hau crossing bridge, the following documents relater to the water level and water discharge on this river have been collected :

A. The Hau.

1. Chau Doc Station.
- Water level document from 1939 to 1985
- Stream flow document from 1978 to 1985.

2. Long Xuyen Station

- Water level document from 1090 to 1977

3. Can Tho Station
- Water level document from 1939 to 1959 and from 1977 to 1985.
- Stream flow document from 1977 to 1985.

B. Vam Nao River.

Vam Nao Station.
- Water level document from 1978 to 1985.

C. The Tien

1. Tan Chau Station.
- Water level document from 1933 to 1985.
- Stream flow document from 1978 to 1985.

2. Cho Moi Station
- Water level document from 1963 to 1977

3. Cao Lang Station
- Water level document from 1963 to 1977.

4. Sa Dec Station
- Water level document from 1978 to 1985.

5. My Thuan Station.
- Water level document from 1960 to 1966 and from 1978 to 1985.
- Stream flow documents in the various years : 1978, 1982, 1983 and 1984.
- Observation document carved out by the major bridge and tunnel research and Design Company from 1985 to 1988 at the site of My Thuan proposed bridge. Such document covers.
- Water level per hour
- Topography of river sections at the proposed bridge side measured twice a year : in flood and dry seasons.
- Cross section of the proposed bridge side measured once in every month.

Documents recording flow velocity in flood and dry seasons.

2. II. Hydrographic features at Kratie.

Kratie Station's catchmen-area is 645,000 km2 accounting for 81 2% of the total area of the river Basin.

There maintains recorded data on stream flow from 1924 to 1968.
- Annually average stream flow : Q = 13,970m3/s
- Modulla rate of average stream flow recorded in various years Mo=21,61/s/km2.

This is the river, having rich water volume per area unit (for Red river : Mo=23.51/s/km2 Dong Nai River Mo = 23.11/s/km2).
- Total average stream flow annually : 440 billion m3.
- Maximum stream flow Qmax = 66,700m3/s
(recorded on 3 - September 1939) equivalent to Modulla factor Mo=1031/s/km2 (at Son tay for the Red river, this value is Mo=2441/s/km2).

- Minimum stream flow : Qmin = 1250 m3/s (recorded on 17-April 1960) equivalent to Modulla factor Mo = 1.91/s/km2 (at Son Tay for the Red river, this value is Mo = 51/s km2).

The tidal season in this area lasts 4 months from July till October. Tidal season rarely occurs in June or ends on November.

3.II. Characteristic of stream flow between Kratie and Phonopenh.

In flood season when water level at Kralice rises up to 11m (the highest water level rising at Kratie is 23.20m in 1939), it starts flowing over river banks. On the right bank of the river the area is but has plenty of low-lying fields when water recedes, water therefrom flows back quickly to the river. While on the left bank of the river, an water current which flows in parallel with the river main stream is created. Part of the newly created stream flows back to the main river at upstream point in Kom Pong Cham and the rest flows to river down stream. The river water level doesn't lost its water (on change much in terms of its water level) from Kratie to Kom - Pong - Cham.

From Kom - Pong - Cham to Phnom Penh, low lands at the both bank of the river have fence-like shape where the low land of the right side approaches to the Great lake and that of the best rise extends to Dong Thap Muoi. This shows that the tidy current flow exceeding the Mekong Basin in to the Vam co river basin. Flood water which changes into Vam Co at upstream Phnom Penh. The flood water at Pnom Penh is therefore lower than that at Kratie.

Table 8.

Year / Station	1962	1963	1964	1965	1966	1967	1968	1969	Average
Kratie	50,100	50,800	56,000	39.800	58,600	45,000	54,700	45,600	50,100
Phnom Penh	44,200	43,300	45,200	36,500	48,600	40,200	46,800	40,600	43,200
Reduction %	11.8	14.8	19.3	8.3	17	10.4	14.4	11	13.8

Table 8 indicates that average water level in high flooding level at Phnom Penh is 13.8% lower compared to that at Kratie, taking into account the traditional lost at upstream due to of nature shows that the higher the flood level is, the greater the water reduction occurs (at Phnom penh) as clearly indicated in 1964 and 1996.

4.II. Regulating function of the Great lake.

The Great lake is a water regulating lake by nature which connects with Mekong river at Phnom Penh by ton lesap river. It has a catechumen area of 84.400km2 of which the area of the lake surface at low water level and at tidal water is 3,000 km2 and 10.000km2 respectively.

According to the actual measuring data available at Prek-Dan station (on Ton Le Sap river) from 1960 to 1973, every year from June to September, the Great lake reserves river water from Mekong river through Ton Se sap, the connecting river, and from October to May of the subsequent year, the Greak lake discharges its water including rain water of the Great Lake's Basin back to Mekong River via Tong Le Sap river.

The Greak lake has water reserve of about 49,1 billion m3 from Mekong river at yearly average which accounts for 11% of rain water output passing through Kratie. It is to say that at the almost peak tides in a year, the Great lake reduces the flood water level considerably for the downstream area.

Anyhow, being a water regulating lake by nature, the Great lake has limits in reducing maximum flood flow level in downstream area. For example, in 1966 flood season the peak flood took place at Phnom Penh on 11 November. At this time, the Great lake no more functioned absorbing started discharging its water back into Mekong river. While water level at Phnom Penh became reduced, the water level in the main river, due to the currently water discharge from the Great lake made the peak flood unchanged. Until the end of November, flood water level reached the maximum at Tan Chau while the water flow passing through Phnom Penh reduced to 10,00m3/s and water discharged from the Great lake was of 7,000m3/s. So, if the flood water hasn't discharged into Mekong river, the flood level couldn't reach so high as happened

According to the is statistical data, the peak floods in the year at Tan Chau and Chau Doc accounts for 56% of the total number of the cases taking place in October when the Great lake started flowing back into Cuu Long river. So in the case of 1966 flood, the Greak lake has had no impacts to flood at downstream and increased water logging after the post flood time.

5.II. Flood phenomenon in the Cuu Long river Delta region.

The deltaic triangle with Phnom Penh as its head, the sea as the bottom line and Thailand gulf as the west line, and Vam Co river as the East line, covers an area of 49,520km2 (of which 26% belongs to Campuchea in the size of 12,875km2 and 74% belongs to Vietnam in the size of 36,645km2). It is 2 times greater than the size of the Red river Delta.

The Cuu long river Delta has more interlacing big and small rivers and canals than those in the Red river Delta with the former's total length of more than 5000km, distributed in a flat and low terrain which is from +0.5m to +1.0 along the coastal land and abo +1.5m to +2.0m above the Mean sea level on land near the Northern border, and is at average 1cm per 1km gradoent.

Cuu Long river network consists of upstream river sections having 100 to 300m wide and downstream river sections having up to 2km wide, and 18km wide, the biggest section of the Hau Giang river. Besides the main river channels, there are planty of river channels, canals with 30m to 100m wide, 2-4m deep and small channels with less 30m wide and 1.5 to 2m deep.

River flood of Cuu Long river is createa by rain water. Therefore, the flood chart alike the rainfall chart. From Kratie to upstream, flood graphic line is very steep whole from Kratie downward, due to the flowing over of water on both river banks, the regulating effect of the Greak lake, the tidal effects and the natural flow of the river itself, the graphic lone of flood impact becomes flat. It is therefore said that floods in the South loest Vietnam of the low. River Basin is regarded as "friendly flood" which is different with floods of other river in remaining parts of the country.

The Cuu long stream flow which pours into Cuu Long Delta region and discharges to the Sea is very complicated because the river has various flood paths which are difficult to determine the volume at each flow direction.

In order to make clear the flood condition in Cuu Long river Delta, the following issues are addressed to :

1. Water volume discharged to Cuu long river Delta.

River water which yours into Cuu Long river Delta is made mainly through two rivers : the Tien and the Hau. At the same time, a considerable amount of water flows over the Long Xuyen rectangular through Chau Doc and Tinh Bien, over the midde area between over Dong Thap Muoi through Dong Tien river canals which then flow into Cai Bè, Vam Co rivers, Vam Co Dong river and the low land between Tan Hoi and Binh Phu. According to the mathematical modelling made in 1961, the maximum rainfall level which occured in Campuchea flowed into Dong Thap Muoi area was about 2,850m3/s.

2. *Water discharge reversal direction.*

Part of the Hau stream flow pours into Long Xuyen rectangles area and kangs up the area and one part of it flow to Thailand Gulfs directly through river channels and canals. The rest of river water in the Hau river flows to the Oriental sea.

When water level at Tan Chau rises up to about 4.2m, the water in the Tien starts flowing over its bank and flowing into Dong Thap Muoi area through small channel and canals. With additonal water charged into the from Kampuchea, such water, even under 3 to 4m deep. Water accumulated in this area portly flows into Vam Co river, then Sai Gon river and fonnally to the Oriental sea, and partly flows back to the Tien river. According to the recorded documents in 1983, the maximum stream flow runed into Vam Co river and backed to the Tien river was recorded at 650m3/s and 740m3/s respectively.

6.II. Tidal system in the Cuu long river Delta.

Unlike tidal regine affecting the Red river Delta in "*" direction, tidal regime in the Cuu long river is influenced in three directions namely East, South and North -West through varies channels and canals of which the tidal regimes and strength of tidal effects are different from each other. Between big river channels and canals, there are plenty of small channels and canals interconnected. Therefore the image of tidal regimies in this region is very vivid and complicated.

Tan Chau station which is about 200km from the sea has tidal amplitude to be 4m (about one third of the tidal amplitute in the red river) and has the flood rising level from 2.4cm to 4.4cm/day with maximum rising level of 15 to 42cm taily while dourly tidal amplitute here if not effected by flooding can rise up to 100cm per 12 hours or 250 to 400cm per 12 hours. In the maximum tidal cycle in a year, the tidal water level can change from 50 to 100cm/hour. According to actual records, the limit of tidal wave transmission can reach 400km distance. That is to be beyond Phnom Penh.

In the flood season, the tidal effect becomes less important but it is still observed at those stations which are about 200km distance from the sea, such as Tan Chau and Chau Doc.

In interfere phenomenon in the Cuu Long river Delta is very popular and rarely found in other pents of the would.

The tidal waves from the sea affects Cuu Long river Delta from three directions : from the East (the oriental sea) is irregularly semi-day tide with ampliture changing from 2.5m to 4.0m at high tide, from the South is irregularly semi-day with lower apphitute and from the West and the South of Thailand Gulf is mainly irregularly daily side with amplitrite ranging from 0.7m to 1.2m at high tide.

When sealing the Cuu Long river Delta, the tidal waves, due to the varying strengths characters and different directions have interfere where the local people name as the water border line or tidal boundary line of the two or three or more different tidal systems having the same or different characters and strengths.

The tidal amplitute in the channels and carals located in the area between the Hau and the Tien is influenced by the tidal waves coming from these two rivers.

The Long- Chau -Ha rectangular is influenced by irregulary semi-day of the Hau river coming from the sea and the direct transmission of the tidal waves from Thailand Gulf through Rach Gia and Ha Tien.

At the tidal boundary lines is the area of the lowest compund tidal flows which resultea visually in siltation of earth and sand which made channels and canals shallower and narrower with accumulated disposals on water surface.

In the flood season, when side rising concurrently takes place, with flood it causes the problems of low speed of flood drainage, and on the contrary when tide recedes concurrently, the flood drains faster having positive effects daily.

7. II. Orientation to the anti - flood measures applied at the Cuu long river Delta.

The Cuu long river Delta is the biggest "rice basket" of Vietnam, accounting for 50% of rice output of the whole country. It has a population of 15 million inhabitants. Every year, there still remains an area of 1.4 to 1.5 million hectares under water in the flood season in about two to six months. Judicially, there happened vigorous floods in the year 1978, 1984, 1991 and 1994.

On 10th October 1994, the Prime Minister promulgated a Decision No.549/TTg requesting the Ministry of Irrigation to co-ordinate with concerned anti-flood scheme for the Cuu long river Delta.

In the past, as the flood totally unantrolled, only one rice crop can be produced in the year. Anyhow, since 1980s till nowadays, the "August" flood dyke system has been constincted (August is the beginning of flood season) to enable farming two rice crops per year (Winter-Spring and Summer-Autumn crops). Thank to this, the rice output of the Cuu Long river Delta was increasing from 4.6 million tonnes in 1976 to 12 mil tonnes in 1993. The rice crop in Winter-Spring period of 1994 did not last much during to early harvesting and the protective dyke-system. This success may confirm that the availability of summer-spring crop at present is vable thanks to the first result of the anti-flood measures.

The five experiences in anti flood measures which derived from those applied in the Red river Delta have been studied for application on the Cuu long river Delta ... i.e. flood cutting by water reservoirs, system of flood dykes, forest planting, facilitation of flood drainage and lowering flooding movement.

Measures to stop flood by water reservoirs and forest creation at upstream are not yet physiarlly applied in the immediate future on the Cuu long river Delta. The construction of system of flood dykes, the facilitation of flood drainage and lowering flood movements are the "spot" measures, complicated and is not yet intensively studied.

For the inmcate future, preventive and anti flood measures applicable on the Cuu Long river system are to stop incoming floods to the maximum exiling and facilitate the speedy drainage of outgoing flood water.

In slop incoming flood : the low-lying lands which insist of Dong Thap Muoi area, Long Xuyen rectangular area and North Cai Lan Thuong, are prevented from flood attacks by the "August" flood dykes.

Those areas less flooded of which summer Autumn crop is prevented by dykes of Nam Kenh, Nguyen Van Tiep, South Cai Tin Thuong and South Cai San canal. Since flood water is not so high, volume of dyke conduction be small and easily strengthened to fight against the high tide for the main crop (dyke to be higher than the top tide. The fact shows at the marginal safety height, the "August" flood dykes can prevent the main crops floodings in many locations.

There are two categories of road networks : the main traffic road system and the provincial roads with distribute traffic roads for rescure and insurance of the through traffic during the flood season. The question here is that how to avoid the blockage of flood drainage due to the existence of ruch dykes. It is therefore necessary to widen spons of bridges and adequat acces for flood watr flowing through roads.

For provinral road system, it is normally provided with dyhes control low rice flood.

What most concerns to the out going flood is to facilitate speedy drainage. The best solucailon is to widen canals and bridge spans at the side of flood flow. It is necessary to have coordinated efferts between the Ministry of Transport the Ministry of Irrigation woks.

III. CAN THO BRIDGE.

1. III. General situation.

The proposed Can tho bridge crosses Hau Giang river and located on the main rute, which is the most important one in the country. This route runs across most of the provinces in the whole country, begining from the North Border of Lang Son province and ending at Ca Mau provincial town in a total lengh of 2,247km.

Hau Giang river is one of the two main river channels of the Me Kong river of which the depth is sufficient to privide ship navigation along the river.

Hau Giang river is the most important inland waterway at international and local level. Upstream navigation on the Hau (Hau Giang river) is the waterway to provide access to Laos and Campuchea, and downstream foreign countries. With regards to waterway transport the Hau contribertes reasonably to the prosperity of the people living in Cuu Long river Delta in general and in Can Tho province in special. Given navigation through the Hau, the Cuu long Delta region is accessible to perform goods exchang with any points in the country as well as in the world!

2. III. Can Tho bridge location.

There are 3 options for Can Tho bridge locations.

Option III : The location is about 3100m upstream from the existing ferry crossing and about 83km from the sea.

Option II : The location is about 1,650m upstream from the existing ferry crossing and about 82km from the sea.

Option II : The location is about 2,650m downstream and about 82km from the sea.

To study plane map surveryed on October and November 1963 with 1/25,000 scale showed that there is Cu Lao Linh (river islet) upstream. The main river flow concentrates on the side of Cu Lao Linh, having the common of depth of≥ (higher or equal to) 10m on this side with the maximum depth of 16m. On the left side of Cu Lao Linh, the channel is shallow at depth less than 10m.

The proposed bridge location in option III shall cross the tail of Cu Lao Linh islet and the head of Cu Lao Binh islet. The river crossing profile will deflelect to right side with maximum depth of 22m.

The proposed bridge location in the Option II also deflectos to the right side, having the maximum depth of 23m.

The bridge location in the Option I has the deepest point 14m.

By making map of the river in 1975 having the same scale of 1/25,000 with the map made in 1963 and having compared the two maps, the result whowed that.

In the last 8 years (1963-1975) there was a morpholygical change in the river bed : the riva channel on the right side of Cu Lao high becomer more shallower while the one on the left side become more widened and deeper which affect to the bridge locations in Option III and Option II. The river crossing profole of which the deysest thos occurence shall result in gradual erosion on the left bank and in reducing one sided deflection of river profile.

The stretch of the Hau across Can Tho province has fairly stable riverbed. There is a snow change in horizontal mouphology. As the river is permitted for international shopping, it is essential to provide higher vertical navigation clearance and a bridge with longer length than that of the river in order to allow sufficient drainage.

The determine the bridge location depends much on the general planning for reconstructio of the highway No.1 network and the Manster plan for the Can Tho City's development.

TIDAL CHARACTERISTICS AT CANTHO STATION
(BETWEEN 1939-1959 AND 1977-1984)

Table 9

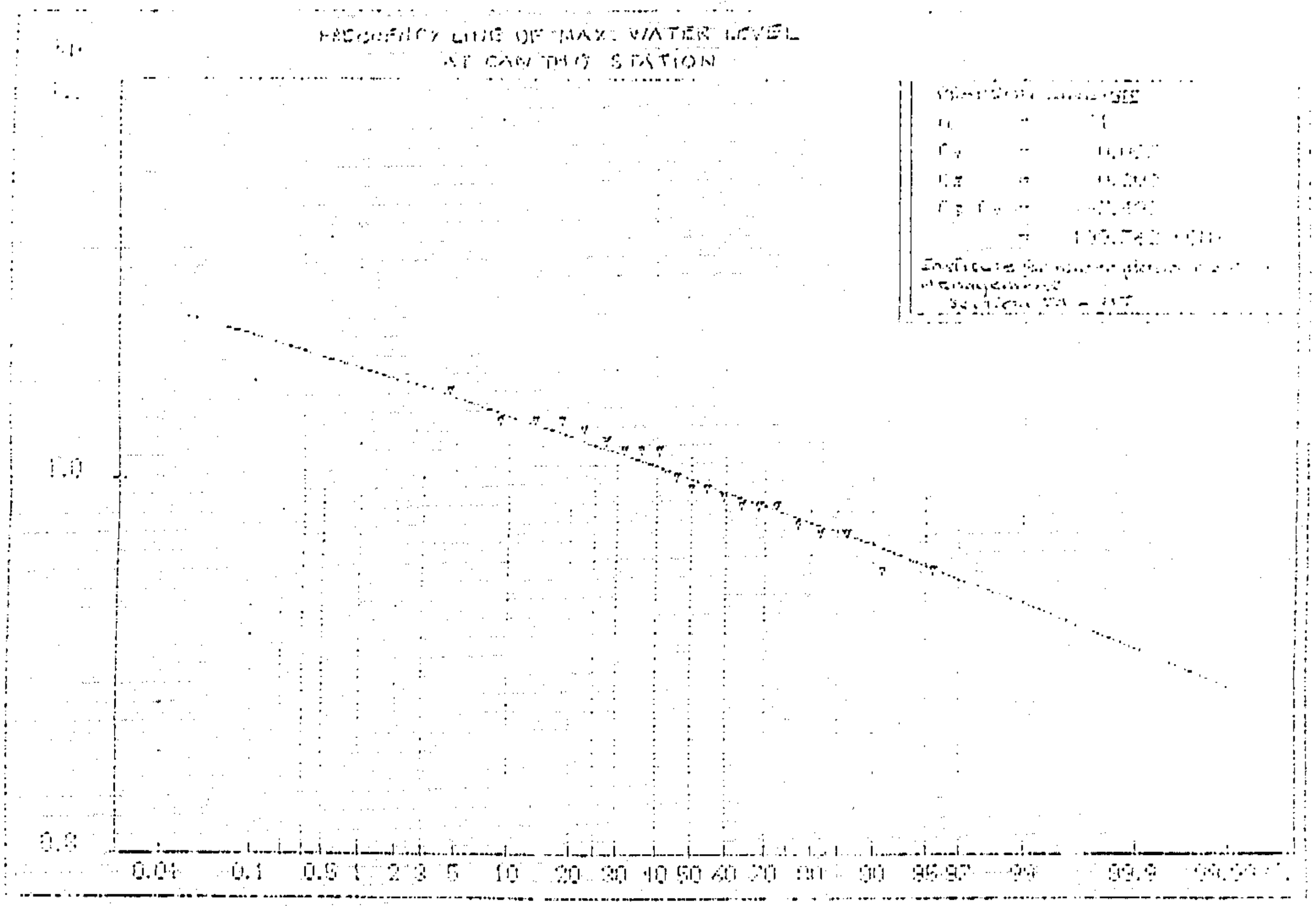
Factor \ Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Maximum Water level $H_{max\ max}$ (cm)	184	177	169	163	163	188	173	187	203	209	209	154
Minimum Water level $H_{min\ min}$	-102	-117	-117	-125	-135	-133	-124	-81	52	-20	-18	-72
Amplitude ΔH_{max} (cm)	286	294	286	288	298	321	297	268	255	229	227	226

Mui Nai Height Standard
Minimum water level at Cantho Hydro-metric station (Mui Nai standard) = -135cm = -1.35m
This is converted into National standard Height H_{minmin} = -1.35 - 0.40 = -1.75 (May 1977).

Remark : in the previous design of My Thuan bridge, water level at minimum was given to be -1.71m at Cantho (Mui Nai Standard) and to be -2.11 m in National converted Height Standard.

WATER LEVEL H MAX AND H MIN IN 1984 AT CAN THO STATION

Day	I		II		III		IV		V		VI		VII		VIII		IX		X		XI		XII	
	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin	Hmax	Hmin
1	[illegible]	-21	150	-38	137	-42	119	-79	114	-75	130	-100	148	-81	148	-43	163	40	142	10	151	[illegible]	[illegible]	[illegible]
2	154	-22	151	-33	146	-28	120	-72	121	-97	127	-97	146	-73	150	-42	160	30	138	11	147	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	153	-42	139	-36	119	-67	121	-118	129	-96	140	-68	144	-42	141	20	134	14	[illegible]	[illegible]	158	[illegible]
4	160	-21	146	-29	153	-24	114	-84	119	-104	125	-93	136	-66	143	-24	116	17	142	14	157	[illegible]	[illegible]	[illegible]
5	162	-21	144	-45	150	-22	113	-96	113	-109	104	-99	134	-60	130	-28	124	15	144	10	176	[illegible]	[illegible]	[illegible]
6	[illegible]	-28	143	-25	140	-38	112	-95	122	-112	105	-103	139	-56	119	-35	141	9	156	38	175	30	[illegible]	[illegible]
7	153	-25	139	-11	129	-50	108	-99	127	-89	103	-97	142	-39	115	-41	151	1	156	35	172	[illegible]	170	[illegible]
8	151	-20	136	-2	129	-47	106	-103	121	-72	106	-102	136	-34	112	-53	159	36	170	41	167	[illegible]	[illegible]	-6
9	151	-16	127	-11	119	-52	100	-96	118	-78	111	-78	137	-48	118	-51	162	37	170	44	173	44	155	[illegible]
10	130	34	120	-11	110	-68	100	-87	121	-94	120	-64	137	-56	146	-35	168	41	164	46	174	[illegible]	168	-14
11	[illegible]	-22	119	-26	103	-75	114	-103	123	-89	130	-76	130	-56	141	-41	172	48	171	50	172	43	166	-16
12	[illegible]	-12	124	-41	101	-84	116	-105	130	-77	140	-72	137	-62	145	-50	170	50	170	45	162	36	156	-15
13	132	-1	120	-55	93	-99	116	-109	135	-67	136	-82	132	-56	150	-25	176	69	162	43	162	35	157	-17
14	131	-17	121	-71	103	-114	130	-65	138	-76	136	-85	136	-67	152	-19	169	74	161	39	156	36	142	-25
15	[illegible]	-21	129	-69	110	-112	133	-78	140	-81	134	-76	138	-61	152	-13	166	71	154	36	149	34	142	-26
16	[illegible]	-33	135	-68	118	-106	144	-71	137	-84	119	-89	138	-56	153	-12	159	67	148	38	147	32	148	-24
17	[illegible]	-37	150	-75	129	-101	144	-72	130	-97	112	-94	133	-53	146	-4	151	66	134	34	151	31	144	-11
18	[illegible]	-59	155	-51	136	-80	138	-96	122	-102	104	-102	135	-46	141	5	145	64	129	37	157	32	154	[illegible]
19	151	-66	154	-76	142	-82	131	-99	119	-108	88	-106	126	-40	137	22	134	60	136	36	172	42	158	[illegible]
20	160	-60	160	-62	138	-72	116	-107	102	-103	75	-114	131	-38	122	16	129	54	145	34	162	[illegible]	167	-16
21	163	-46	146	-51	136	-78	104	-113	93	-108	87	-106	126	-28	115	7	134	45	174	35	168	54	159	[illegible]
22	152	-47	140	-38	134	-76	92	-110	89	-114	94	-87	121	-25	113	2	134	41	177	34	182	[illegible]	164	[illegible]
23	155	-25	128	-23	131	-67	94	-110	94	-110	103	76	114	-36	111	-2	169	44	197	70	192	37	169	[illegible]
24	[illegible]	-21	114	-53	121	-66	96	-109	101	-118	90	-79	108	-52	127	-3	180	48	204	81	195	[illegible]	171	[illegible]
25	147	-12	111	-57	106	-64	110	-107	109	-89	94	-82	98	-66	152	2	195	52	204	75	197	[illegible]	[illegible]	[illegible]
26	140	-12	115	-57	111	-73	106	-105	106	-76	104	-78	110	-78	166	8	200	57	206	67	192	[illegible]	[illegible]	[illegible]
27	128	-18	122	-61	113	-94	110	-86	111	-69	117	-86	118	-73	174	8	200	64	194	60	170	[illegible]	157	[illegible]
28	[illegible]	-42	127	-60	114	-100	110	-36	116	-83	116	-80	136	-81	183	20	195	68	187	57	[illegible]	[illegible]	[illegible]	[illegible]
29	[illegible]	-53	132	-59	116	-87	112	-75	114	-88	131	-97	136	-82	187	30	195	64	173	55	163	30	135	[illegible]
30	134	-42			115	-89	114	-63	122	-79	136	-86	145	-71	180	39	176	60	164	55	161	44	126	[illegible]
31	[illegible]	-42			116	-88			124	-96			153	-63	180	40			154	57			[illegible]	[illegible]


FREQUENCY LINE OF MAX. WATER LEVEL
AT CAN THO STATION
1.0
0.8
0.01 0.1 0.5 1 2 3 5 10 20 30 40 50 60 70 80 90 95 97 99 99.9 99.99

CALCULATED RESULT OF FREQUENCY CURVE
BY APPROPRIATE LINE METHOD.

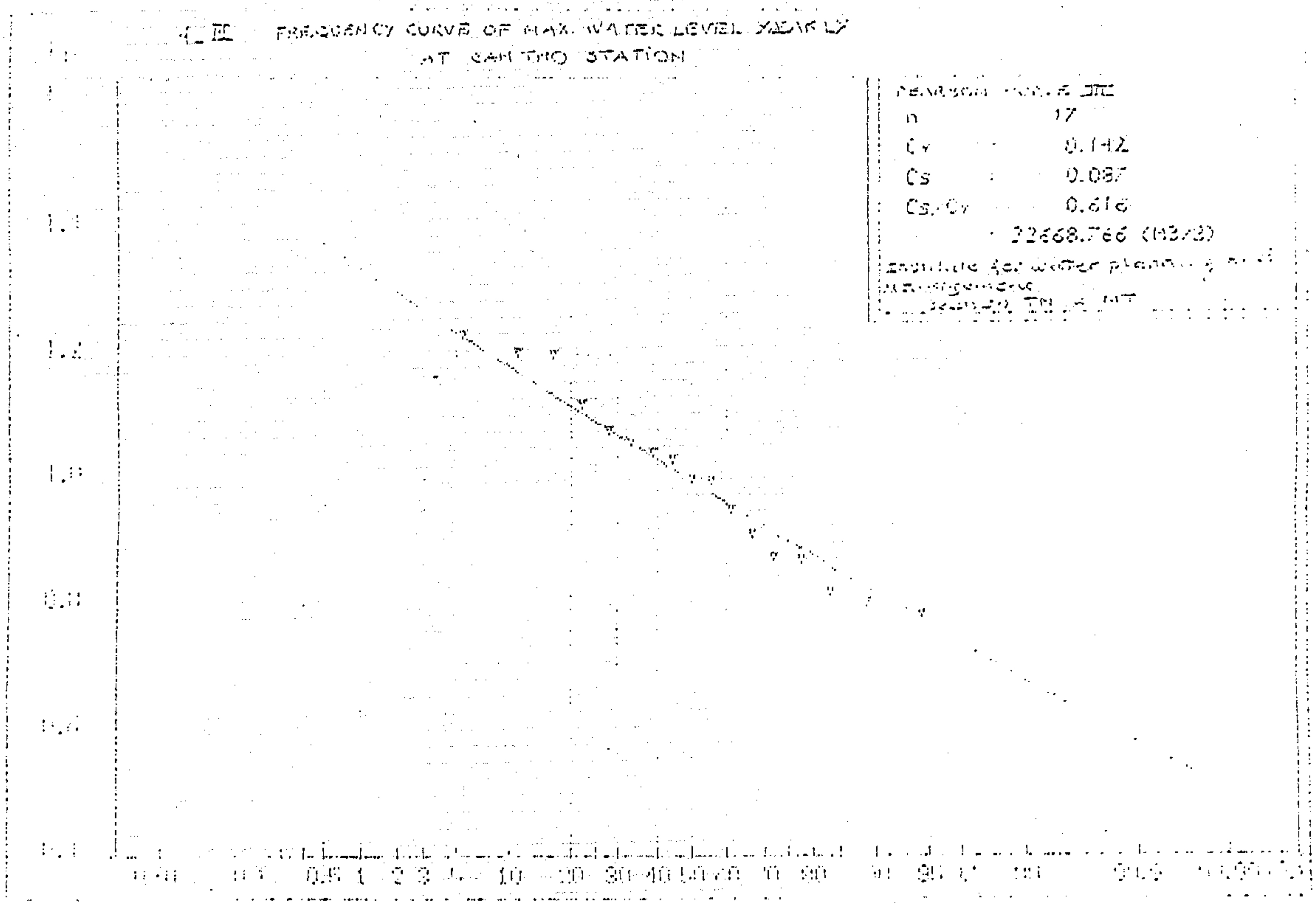
☆☆☆☆☆☆☆☆☆☆☆☆☆☆

DATA : HIGH WATER LEVEL AT CAN THO STATION
CALCULATING LOCATION :
NO. OF CALCULATING POINTS : 21
AVERAGE VALUE : 199.7619 (CM)
CY RATIO : 0.0271
Cs RATIO : - 0.2030
n RATIO : - 7.4925

P%	Xp (CM)
0.01	217.603
0.10	214.947
0.20	214.022
0.33	213.293
0.50	212.677
1.00	211.545
2.00	210.283
3.00	209.469
5.00	208.343
10.00	206.570
20.00	204.360
25.00	203.503
30.00	202.724
40.00	201.299
50.00	199.945
60.00	198.567
70.00	197.065
75.00	196.221
80.00	195.270
85.00	194.150
90.00	192.719
95.00	190.557
97.00	189.126
99.00	186.365
99.90	181.449
99.99	177.227

SERIES OF ACTUAL MEASURED DATA

SERIES	YEAR	X	YEAR	X REDUCTION
1	1973	199.00	1989	209.00
2	1974	203.00	1992	206.00
3	1975	195.00	1984	206.00
4	1976	197.00	1978	206.00
5	1977	194.00	1979	205.00
6	1978	206.00	1993	204.00
7	1979	205.00	1983	203.00
8	1980	203.00	1980	203.00
9	1981	197.00	1974	203.00
10	1982	200.00	1982	200.00
11	1983	203.00	1986	199.00
12	1984	206.00	1973	199.00
13	1985	194.00	1991	198.00
14	1986	199.00	1987	197.00
15	1987	197.00	1981	197.00
16	1988	190.00	1976	197.00
17	1989	209.00	1975	195.00
18	1990	190.00	1985	194.00
19	1991	198.00	1977	194.00
20	1992	206.00	1990	190.00
21	1993	204.00	1988	190.00


FREQUENCY CURVE OF MAX. WATER LEVEL YEARLY
AT SAN THO STATION
n 17
Cv 0.142
Cs 0.087
Cs/Cv 0.616
22668.766 (M3/S)
0.5 1 2 3 10 20 30 40

CALCULATED RESULT OF FREQUENCY
BY APPROPRIATE CURVE METHOD.

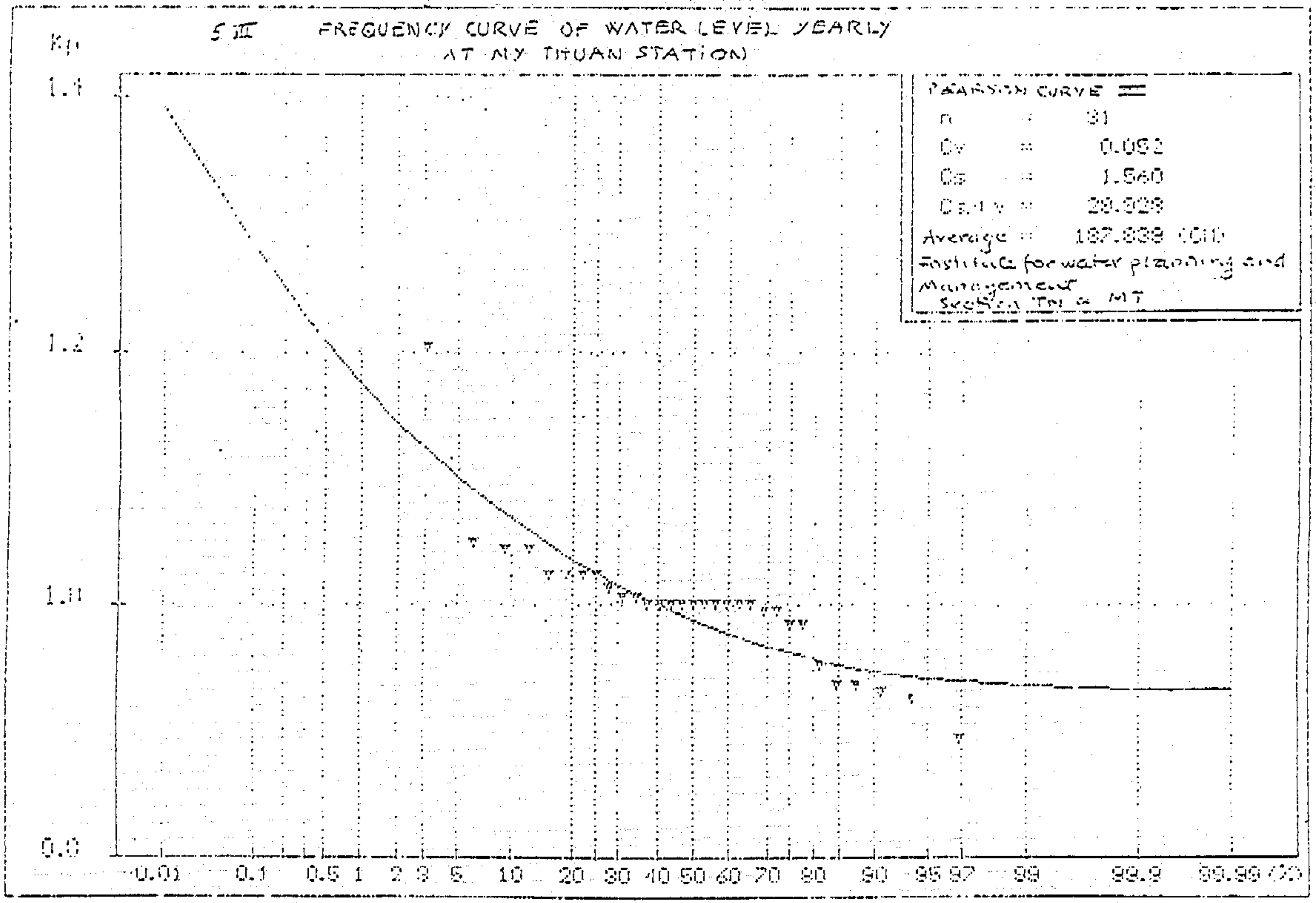
☆☆☆☆☆☆☆☆☆☆☆☆☆☆

DATA : MAX YEARLY WATER LEVEL
CALCULATING LOCATION : AT CANTHO STATION
NO. OF CALCULATING POINTS : 17
AVERAGE VALUE : 22668.7656 (M3/S)
CY RATIO : 0.1416
Cs RATIO : 0.0872
n RATIO : 0.6158

P%	Xp (M3/S)
0.01	35215.750
0.10	32993.540
0.20	32252.735
0.33	31680.130
0.50	31204.129
1.00	30345.424
2.00	29413.905
3.00	28826.519
5.00	28029.735
10.00	26812.958
20.00	25355.938
25.00	24807.196
30.00	24316.734
40.00	23436.881
50.00	22622.100
60.00	21813.291
70.00	20953.093
75.00	20479.426
80.00	19954.345
85.00	19345.541
90.00	18584.569
95.00	17467.084
97.00	16747.972
99.00	15404.054
99.90	13142.068
99.99	11319.488

SERIES OF ACTUAL MEASURED DATA

SERIES	YEAR	X	YEAR	X REDUCTION
1	1977	19800.00	1991	27000.00
2	1978	27200.00	1981	27300.00
3	1979	20700.00	1978	27200.00
4	1980	23400.00	1985	25400.00
5	1981	27300.00	1990	24500.00
6	1982	21600.00	1984	24100.00
7	1983	22669.00	1986	23700.00
8	1984	24100.00	1980	23400.00
9	1985	25400.00	1983	22669.00
10	1986	23700.00	1992	22600.00
11	1987	19900.00	1982	21600.00
12	1988	18600.00	1979	20700.00
13	1989	18200.00	1987	19900.00
14	1990	24500.00	1977	19800.00
15	1991	27900.00	1988	18600.00
16	1992	22600.00	1989	18200.00
17	1993	17800.00	1993	17800.00


5 III FREQUENCY CURVE OF WATER LEVEL YEARLY
AT MY THUAN STATION
Kp
1.4
1.2
1.0
0.0
0.01 0.1 0.5 1 2 3 5 10 20 30 40 50 60 70 80 90 95 97 99 99.9 99.99 (%)
PEARSON CURVE III
n = 31
Cv = 0.092
Cs = 1.560
Cs/Cv = 20.929
Average = 187.838 (cm)
Institute for water planning and Management
Section TN & MT

CALCULATED RESULT OF FREQUENCY CURVE BY APPROPRIATE LINE METHOD.

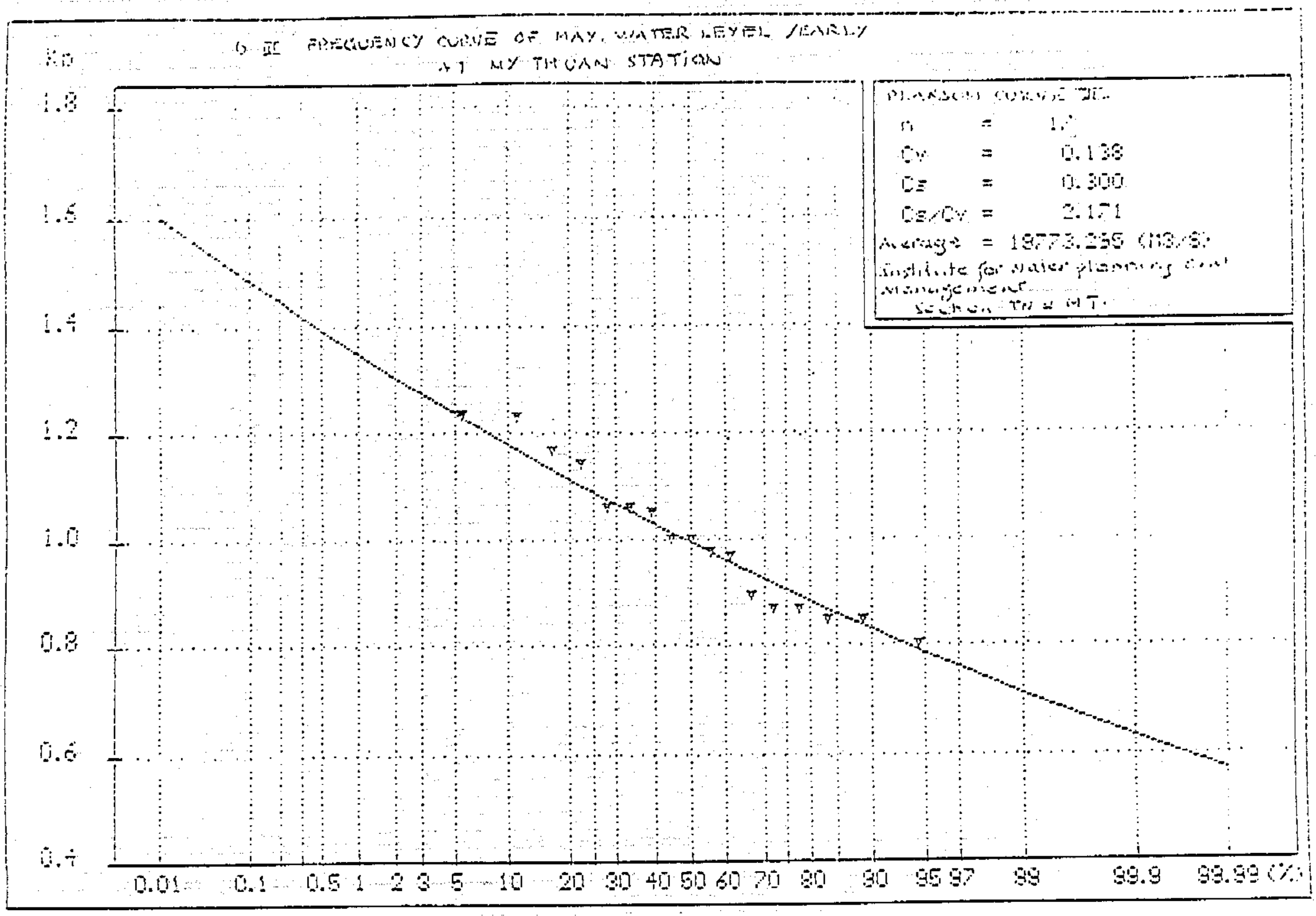
☆☆☆☆☆☆☆☆☆☆☆☆☆☆

DATA :	MAX YEARLY WATER LEVEL
CALCULATING LOCATION :	AT MY THUAN STATION
NO. OF CALCULATING POINTS :	31
AVERAGE VALUE :	187.838756 (CM)
CY RATIO :	0.0521
Cs RATIO :	1.5601
n RATIO :	29.9284

P%	Xp (CM)
0.01	261.312
0.10	240.963
0.20	234.903
0.33	230.461
0.50	226.926
1.00	220.906
2.00	214.884
3.00	211.352
5.00	206.881
10.00	200.744
20.00	194.444
25.00	192.354
30.00	190.613
40.00	187.777
50.00	185.469
60.00	183.464
70.00	181.628
75.00	180.741
80.00	179.855
85.00	178.951
90.00	177.993
95.00	176.907
97.00	176.387
99.00	175.734
99.90	175.321
99.99	175.293

SERIES OF ACTUAL MEASURED DATA

SERIES	YEAR	X	YEAR	X REDUCTION
1	1963	174.00	1965	226.00
2	1964	176.00	1991	197.00
3	1965	226.00	1982	196.00
4	1966	175.00	1978	196.00
5	1967	188.00	1992	192.00
6	1968	188.00	1989	192.00
7	1969	188.00	1986	192.00
8	1970	188.00	1984	192.00
9	1971	188.00	1993	190.00
10	1972	188.00	1985	189.00
11	1973	188.00	1983	189.00
12	1974	188.00	1976	188.00
13	1975	188.00	1975	188.00
14	1976	188.00	1974	188.00
15	1977	168.00	1973	188.00
16	1978	196.00	1972	188.00
17	1979	179.00	1971	188.00
18	1980	187.00	1970	188.00
19	1981	187.00	1969	188.00
20	1982	196.00	1968	188.00
21	1983	189.00	1967	188.00
22	1984	192.00	1981	187.00
23	1985	189.00	1980	187.00
24	1986	192.00	1990	185.00
25	1987	185.00	1987	185.00
26	1988	176.00	1979	179.00
27	1989	192.00	1988	176.00
28	1990	185.00	1964	176.00
29	1991	197.00	1966	175.00
30	1992	192 .00	1963	174.00
31	1993	190.00	1977	168.00


FREQUENCY CURVE OF MAX. WATER LEVEL YEARLY
AT MY THUAN STATION
Kp
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
Cv = 0.138
Cs = 0.300
Cs/Cv = 2.171
Average = 18773.255 (M3/S)
0.01 0.1 0.5 1 2 3 5 10 20 30 40 50 60 70 80 90 95 97 99 99.9 99.99 (%)

CALCULATED RESULT OF FREQUENCY
BY APPROPRIATE LINE METHOD.

☆☆☆☆☆☆☆☆☆☆☆☆☆☆

DATA : MAX WATER LEVEL
CALCULATING LOCATION : AT MY THUAN STATION
NO. OF CALCULATING POINTS : 17
AVERAGE VALUE : 19773.2949 (M3/S)
CY RATIO : 0.1381
Cs RATIO : 0.2999
n RATIO : 2.1711

P%	Xp (M3/S)
0.01	31746.725
0.10	29405.256
0.20	28643.726
0.33	28061.679
0.50	27582.214
1.00	26727.373
2.00	25814.850
3.00	25247.406
5.00	24487.583
10.00	23349.385
20.00	22021.632
25.00	21562.142
30.00	21099.052
40.00	20333.311
50.00	19637.088
60.00	18958.291
70.00	18249.922
75.00	17865.854
80.00	17445.093
85.00	16963.845
90.00	16372.323
95.00	15523.645
97.00	14990.834
99.00	14021.638
99.90	12470.838
99.99	11295.541

SERIES OF ACTUAL MEASURED DATA

SERIES	YEAR	X	YEAR	X REDUCTION
1	1977	21000.00	1984	24400.00
2	1978	22600.00	1991	24300.00
3	1979	17100.00	1986	23100.00
4	1980	19773.00	1978	22600.00
5	1981	17600.00	1987	21000.00
6	1982	19100.00	1977	21000.00
7	1983	19773.00	1985	20800.00
8	1984	24400.00	1983	19773.00
9	1985	20800.00	1980	19773.00
10	1986	23100.00	1990	19300.00
11	1987	21000.00	1982	19100.00
12	1988	15800.00	1981	17600.00
13	1989	16700.00	1992	17100.00
14	1990	19300.00	1979	17100.00
15	1991	24300.00	1993	17100.00
16	1992	17100.00	1989	16700.00
17	1993	16700.00	1988	15800.00

7.III Determination of stream flow and water level Hp.

1. Based on recorded documents available at Can Tho station on :

- Maximum water level from 1973 to 1993 and
- Maximum stream flow in the periods 1977 - 1982 and 1984 - 1993

The calculated frequency has resulted as follows :

Table 11

Factor / P%	1	5	10
Water level (Mui Nai standard height) H in Cm Flow Capacity Q in m^3/s	211 30,345	208 28,029	206 26,812

2. Based on recorded documents available at My Thuan Station

- Maximum water level from 1963 - 1966 and 1977 - 1993 and
- Maximum stream flow from 1977 - 1979 and from 1981 - 1993.

The calculated frequency has resulted as follows :

Table 12

Factor / P%	1	5	10
Water level (Mui Nai standard height) H in Cm Flow Capacity Q in m^3/s	220 26,727	206 24,487	200 23,349

Water flow velocity V_{cp} = 1.85 m/s

3. In the My Thuan Bridge Project carried out 1995, the hydraulic mathematical model was applied for the entire Cuu Long Delta Region with regards to stream flow, flood and dredging options of which VRSAP Model was applied by the Branch Institute for Irrigation Management and Planning with results as follows:

- 10 year return period flood discharge : Q = 20150m3/s H = + 2.04m
- 25 year return period flood discharge : Q = 21,200m3/s H = + 2.09m
- 100year return period flood discharge: Q = 22,800m3/s H = + 2.15m

(Using the standard height MSL (Maximum Stream Level)
* Q = discharge H = water level

4. Calculate water level H_p and water discharge Q at Can Tho

So far, the value of Hp and Qp at Can Tho applying VRSAP model by the Branch Institute for Irrigation Management and Planning hasn't yet obtained.

In the process of Can Tho bridge project's formulation should the data available in the My Thuan Bridge Project made in 1995 and recorded data at two stations Can Tho and My Thuan are applied to calculate frequency, correlation for determination of water level (Hp) and stream flow (Qp) at Can Tho, the results will be as follows

Table 13

Station	Factor \ P% (Frequency)	1	3	5	10
My Thuan	Water level (Mui Nai standard height) Hin Cn	215 22,800	209 21,200	207* 20,800*	204 20150
Can Tho	Water level (Mui Nai standard height) Hin Cm	210 26,100	209	208	207
	National converted standard	170	169	168	167
Location III	National standard H (cm)	187	186	185	184
Location I	National standard H (cm)	156	155	154	153

Note :National Standard (Height) is equal to Mui Nai standard height minus 0.399m

- Location III is located upstream and about 3100m distant from Can Tho hydrometric station.

Height at location III will be equal to Hp at station plue ΔH_1.

While ΔH_1 equals to 0.000055 x 3100 = 0.17 m

- Location I is located downstream and about 2650m distant from Can Tho hydrometric station.

Height at location I is equal to Hp recorde at station minus Δh_2

Δh_2 equals to 0.000055 x 2650 = 0.14m

* Low water level H_{MT} = 207 and stream flow Q_{MT} = 20,800 are the internal assumption.

8.III Determination of bridge span, navigation clearance and water draft.

1. Determination of bridge span

Minimum bridge span to be designed for sufficient drainage shall be based on this formular :

$$L = B_p + \Delta B \frac{\sum Q_n}{V_n h_n}$$

In which : Bp is the width of the main river bed

Δ B depends on the value of $f \frac{\sum Q_n}{Q_n T_1}$

length of span should be ≥ 1550m

2. Navigation clearance and water draft

- According to the Transport planning in Can Tho province to the year 2010, the Hau is assessable to 5000 DWT vessels to transport cargoes along the river ;

- Based on the available fleet of vessels owned by Vietnam shipping companies with regards to vessels manufactured by Scandinavian countries, Japan and Germany before 1970,

The maximum, vessel draft is measured from the top of flag tower to the water draft level of the vessel in empty (unloaded) condition. So the calculated water draft is 35m and the shop length is 120 to 125m (1 max).

In accordance with stipulated regulations by the Inland water way Bureau of Vietnam, the maximum navigation clearance will be Hmax 5%.

At the location III, water draft at maximum level is Hmax 5% = 1.85m,
At the location I, water draft at maximum level is Hmax 5% = 1.54m

IV. Short comings and recommendation

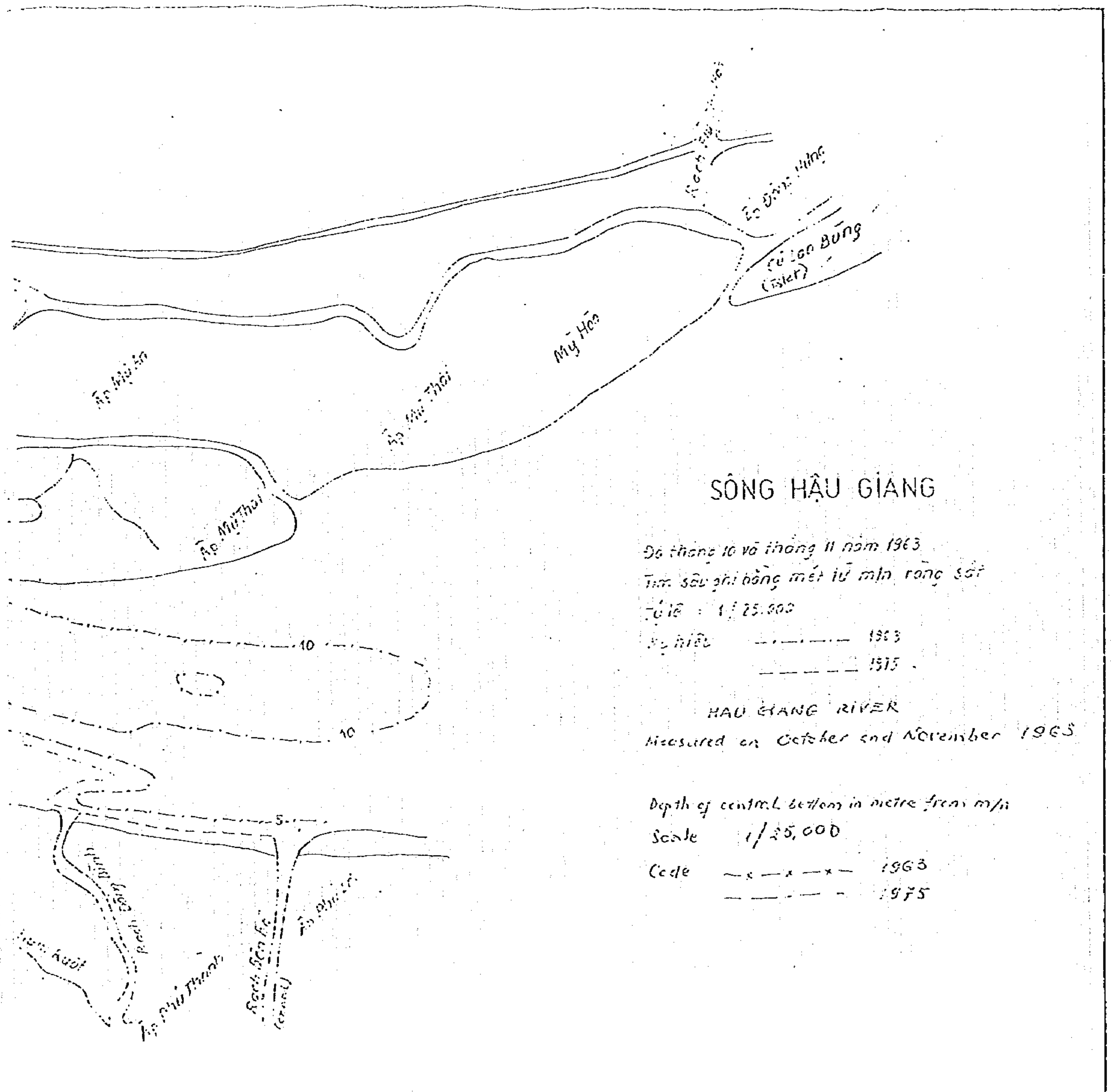
1. The water level (Hp) and stream flow (Qp) which are determined by the Branch Institute of Irrigation Management and Planning using URSAP method has not accomplished. It is there fore recommended that methods and solutions to obtain the above said value of Hp and Qp should be soon carried out for each bridge location on cooperation with the Branch Institute.

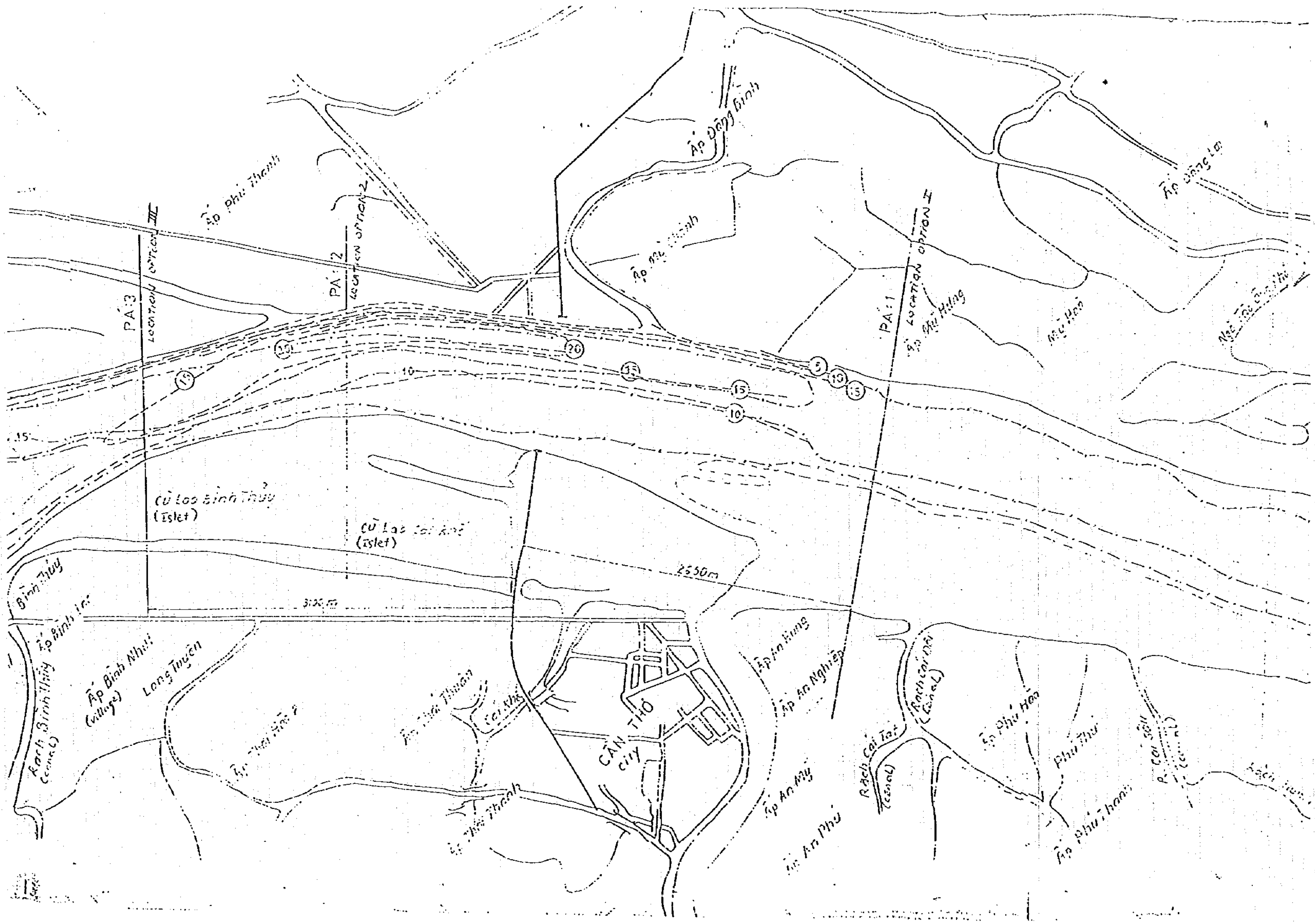
2. It is needed to collect the plan form and hydrometric data from all stations located at down and upstream of the Hau in order to intensively study the morphological change of the river bed and regulation of stream flows, water velocity. These will help to calculate the degree of pier erosion and water rise in the vicinity of the bridge.

3. It is essential to carry out surveys and investigations of river bed morphology, the appearance of emerging is lets, erosion problems to the river branks from Vam Nao downstream to the river month.

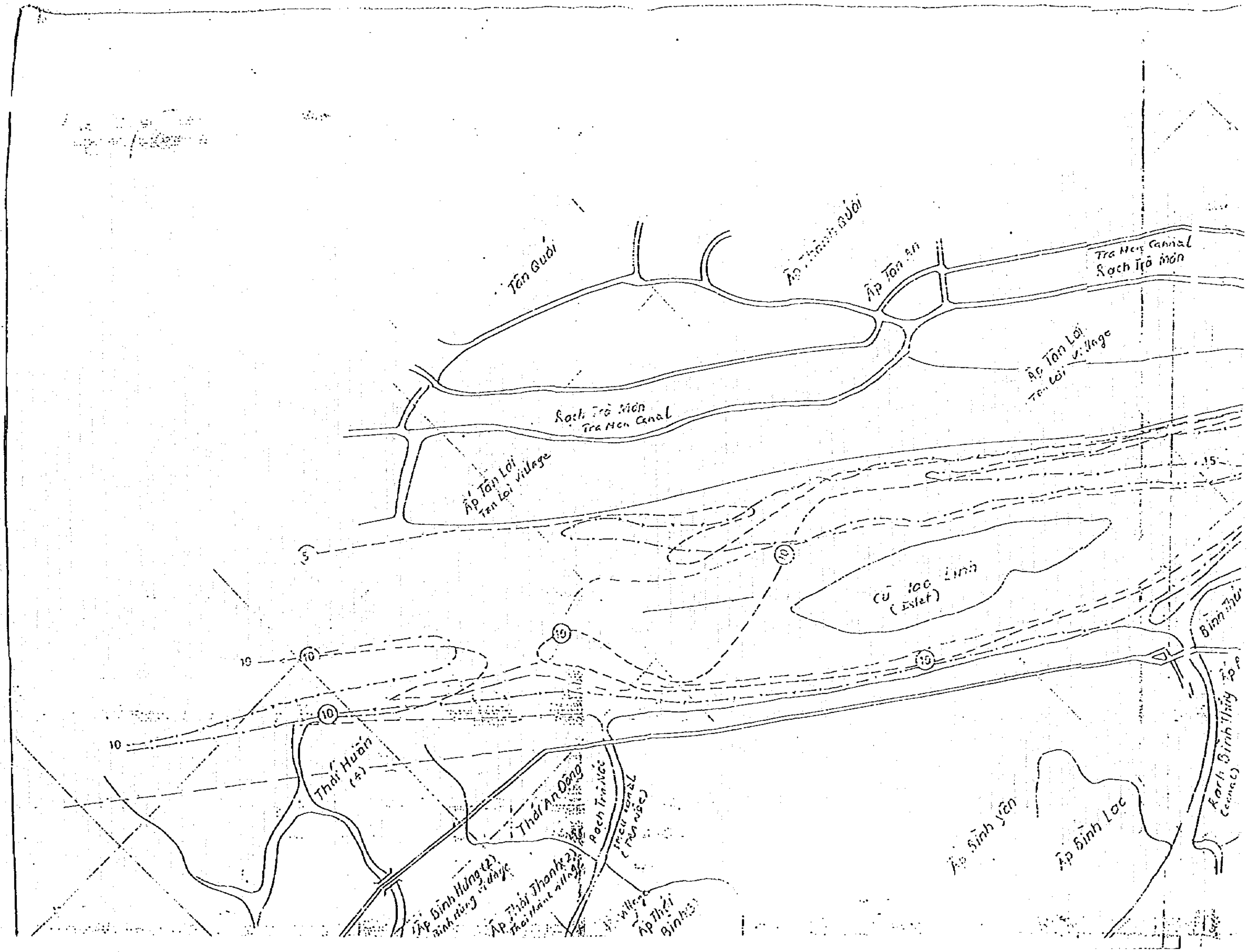
4. As Can Tho bridge is one of the specially large bridge, the observation of water level, stream flow, flow direction and erosion problem at the proposed bridge construction should be carried out from 1 to 3 years.

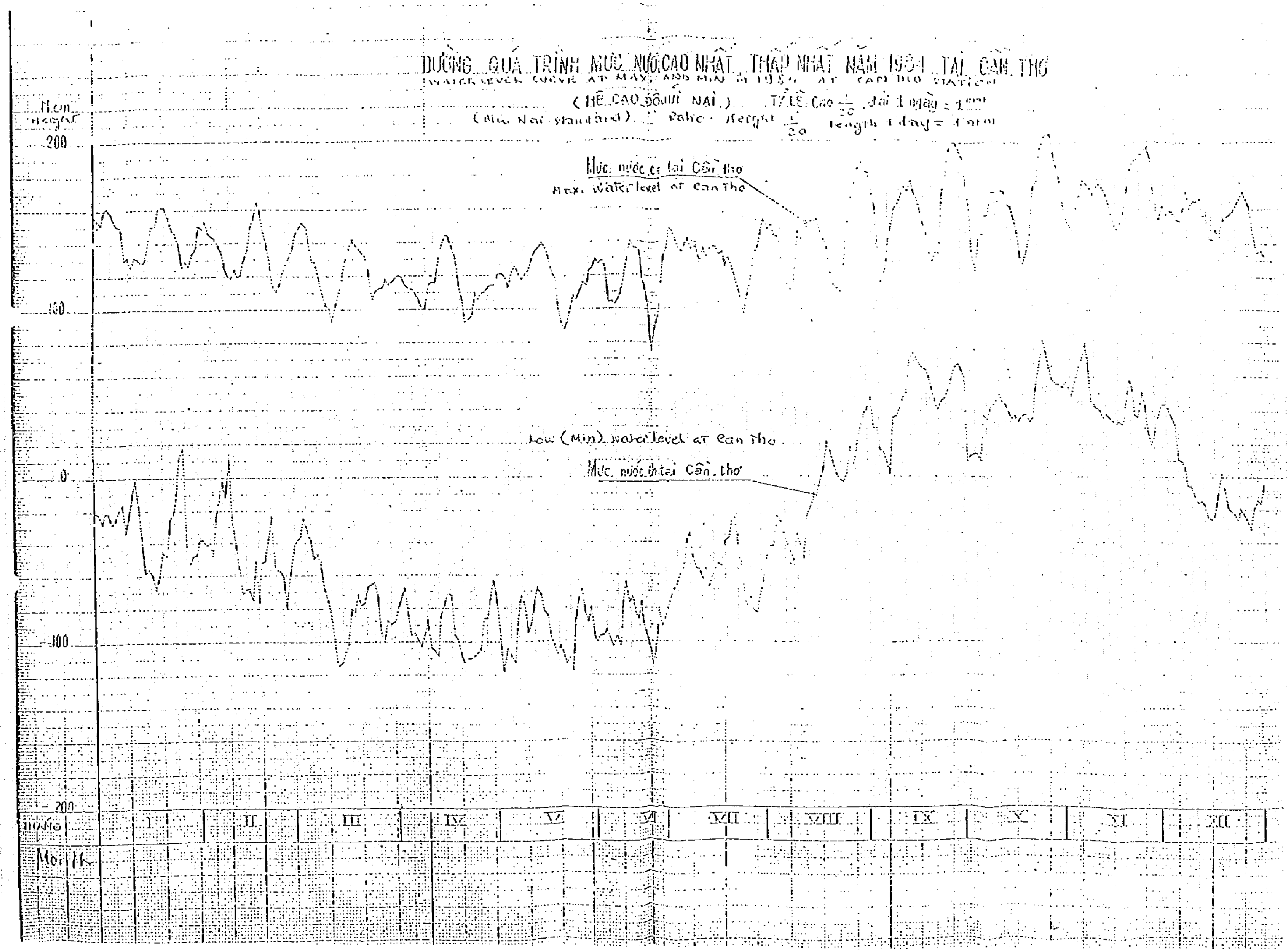
RESPONSIBLE FOR ADJUSTMENT AND PRESENTATION	SIGNED ON BEHALF OF THE GENERAL DIRECTOR OF TRANSPORT DESIGN CONSULTANT ALREADY
(Signed)	*(Signed)*
Do Quang Trung	Mr. Vu Khac Thanh Chief Engineer

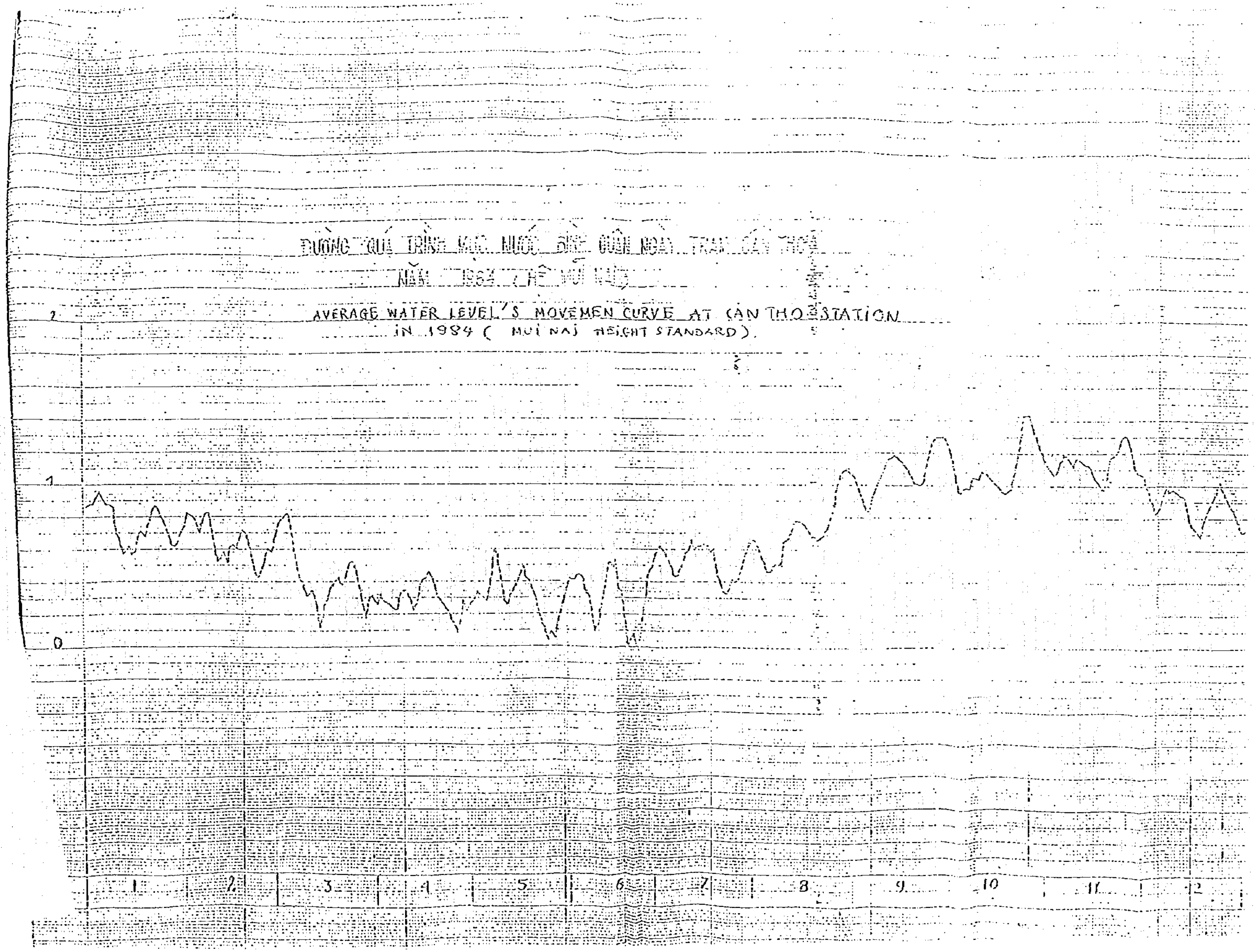

SÔNG HẬU GIANG
Đo tháng 10 và tháng 11 năm 1963
Tim sâu ghi bằng mét từ mln rừng sắt
Tỷ lệ : 1/25.000
Ký hiệu —.—.—.— 1963
— — — — — 1915 .
HAU GIANG RIVER
Measured on October and November 1963
Depth of central bottom in metre from m/n
Scale 1/25,000
Code —x—x—x— 1963
— —.— — 1975
10
10
5

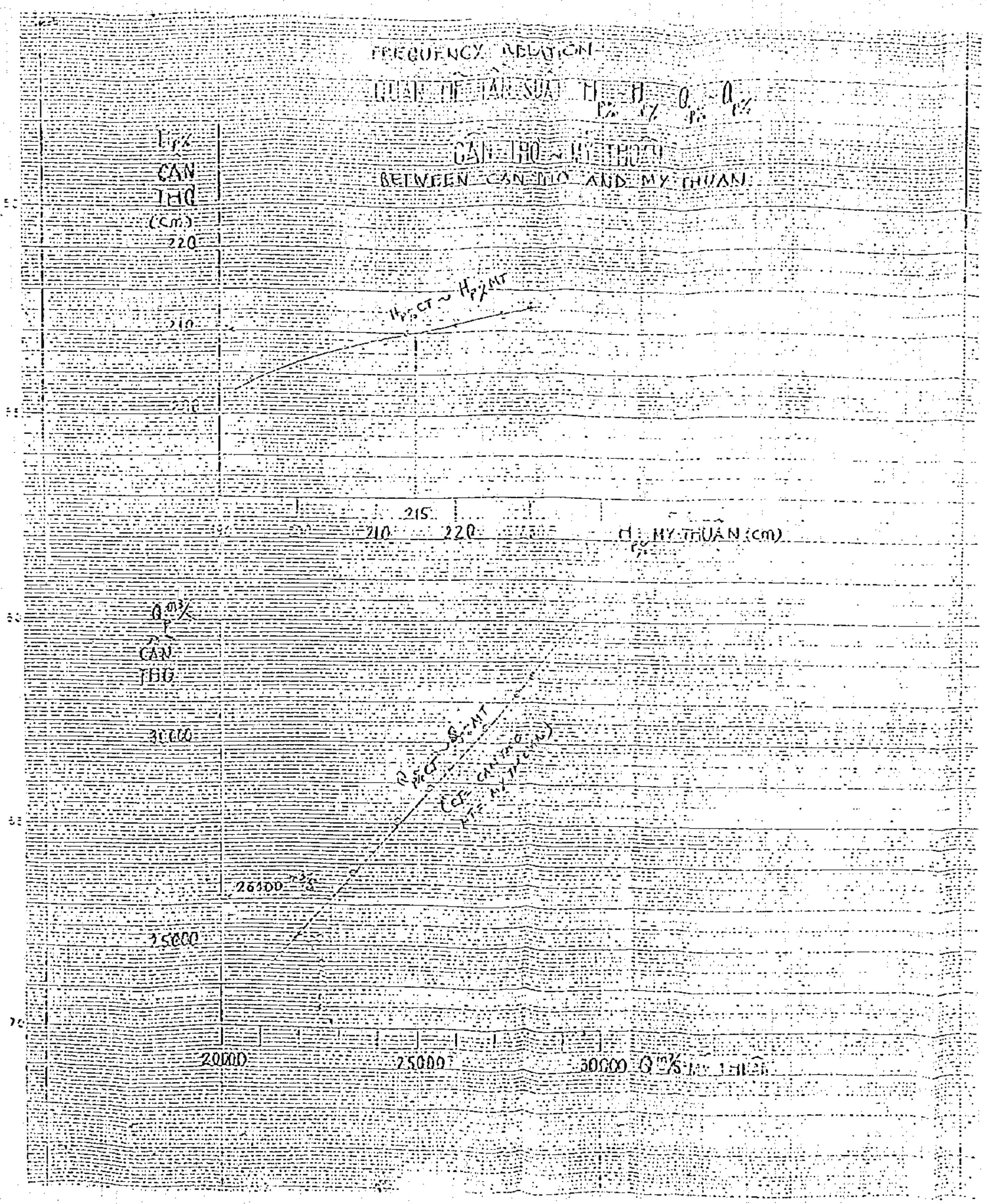


PA:3
LOCATION OPTION III
PA:2
LOCATION OPTION 2
PA:1
LOCATION OPTION I
Cù Lao Bình Thủy
(Islet)
(Islet)
3100 m
2550 m
Bình Thủy
Ấp Bình Nhựt
(village)
Long Tuyền
CẦN THƠ
city
(canal)


Tân Quới
Ấp Thành Quới
Ấp Tân An
Tra Mon Canal
Rạch Trà Môn
Ấp Tân Lợi
Tan Loi Village
Rạch Trà Môn
Tra Mon Canal
Ấp Tân Lợi
Tan Loi Village
Cù lao Linh
(Islet)
Thới Hưng
Thới An Đông
Rạch Trà Nóc
Ấp Bình Yên
Ấp Bình Lạc
Rạch Bình Thủy
(Canal)
Ấp Bình Hưng
Ấp Thới Thạnh
Ấp Thới Bình


ĐƯỜNG QUÁ TRÌNH MỰC NƯỚC CAO NHẤT, THẤP NHẤT NĂM 1954 TẠI CẦN THƠ
(HỆ CAO ĐỒNG NAI). TỶ LỆ Cao 1/20, dài 1 ngày = 1mm
(Đông Nai standard). Ratio: Height 1/20 length 1 day = 1 mm
Mức nước cao tại Cần thơ
Max. water level at Can Tho
Low (Min) water level at Can Tho.
Mức nước thấp tại Cần thơ
200
150
0
-100
-200
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII
Month


ĐƯỜNG QUÁ TRÌNH MỰC NƯỚC BÌNH QUÂN NGÀY TRẠM CẦN THƠ
NĂM 1984 (HỆ MŨI NAI)
AVERAGE WATER LEVEL'S MOVEMEN CURVE AT CAN THO STATION
IN 1984 (MUI NAI HEIGHT STANDARD).
2
1
0
1
2
3
4
5
6
7
8
9
10
11
12


FREQUENCY RELATION
BETWEEN CAN THO AND MY THUAN
CÂN
THO
(cm)
220
210
215
210
220
MY THUAN (cm)
CÂN
THO
30000
26100
25000
20000
25000
30000

JICA