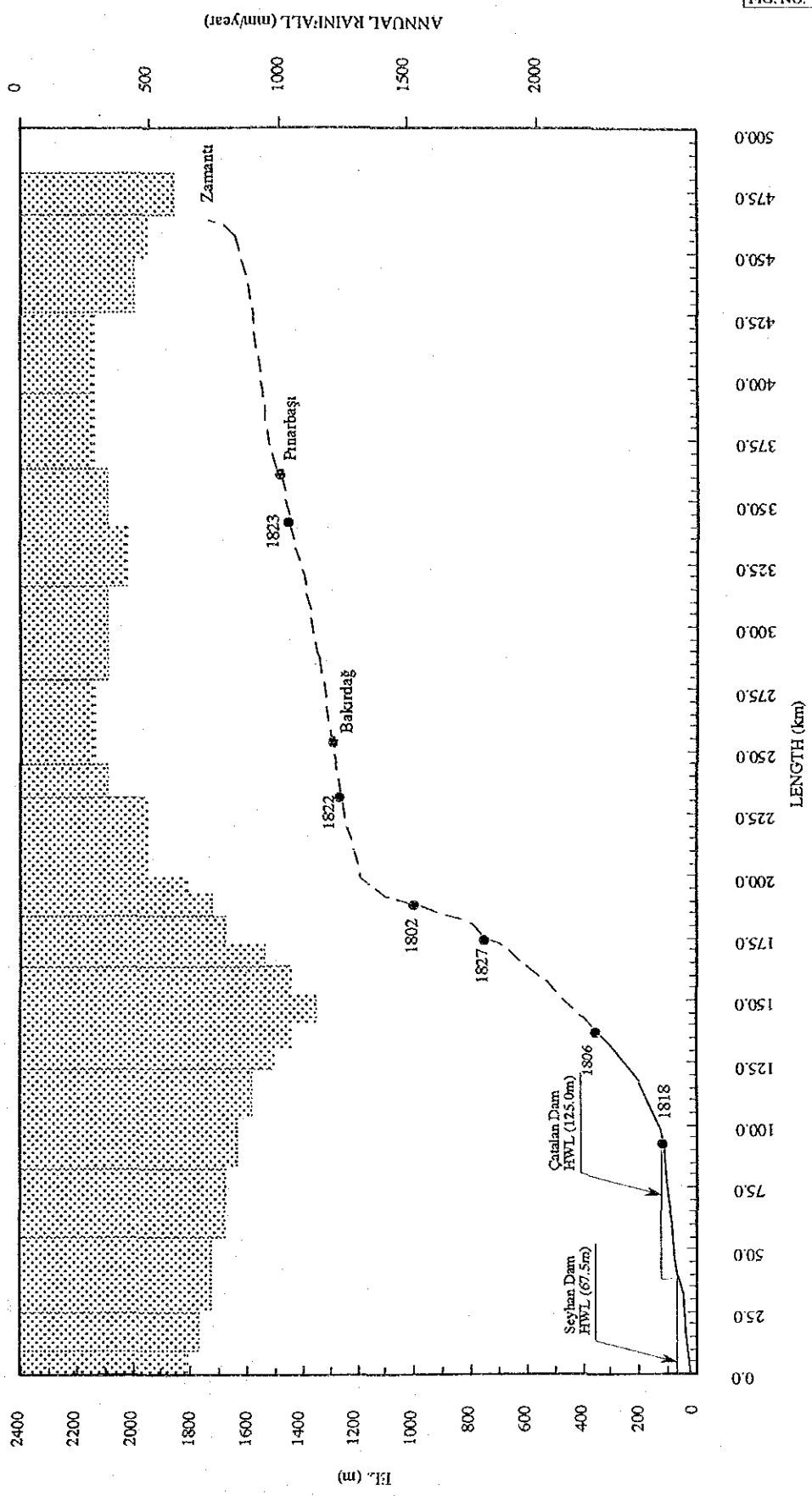
FIG. NO.



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.4.2 RELATIONSHIP BETWEEN ANNUAL RAINFALL AND RIVER CHANNEL PROFILE IN THE ZAMANTI RIVER

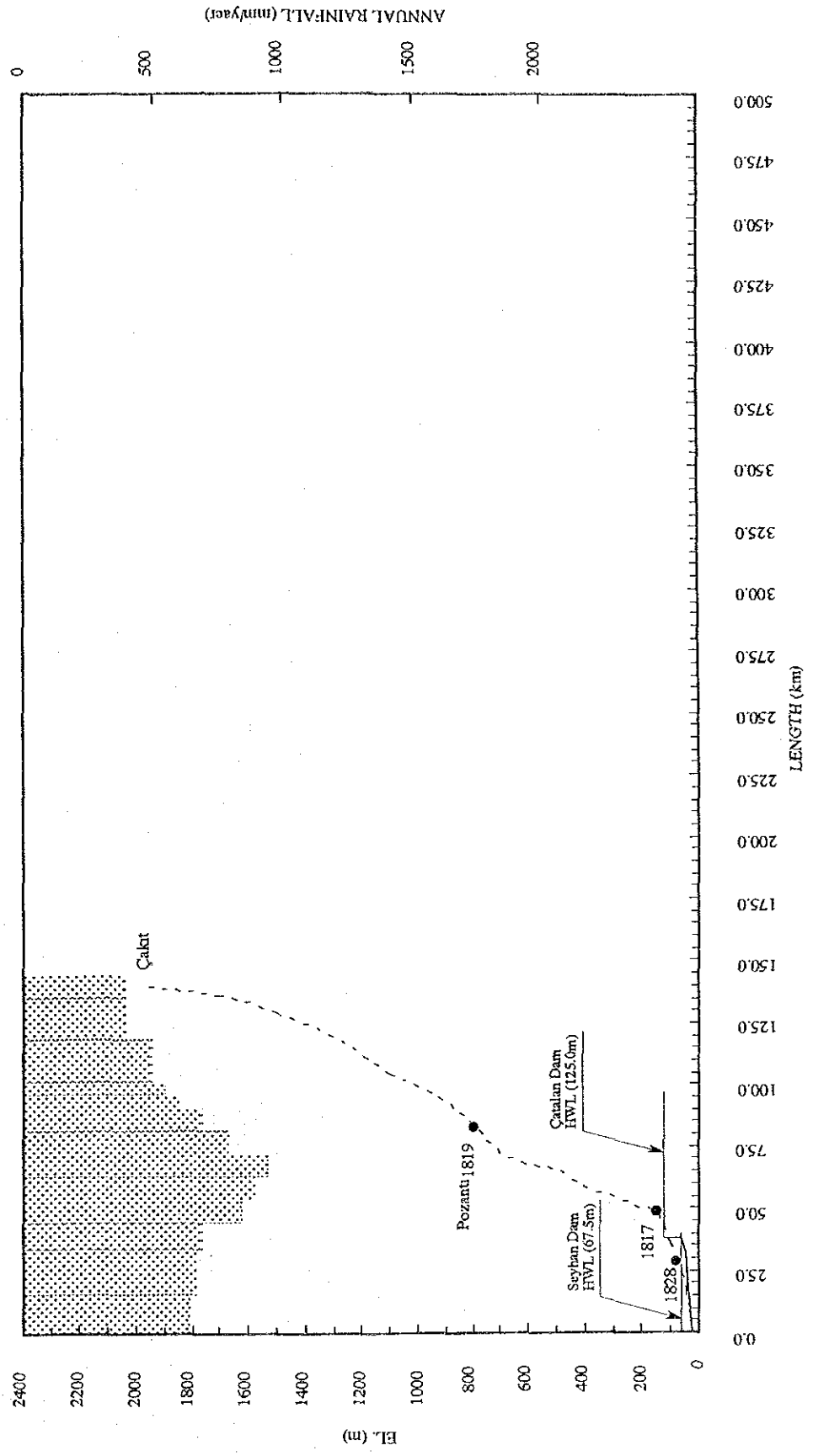
FIG. NO.

THE REPUBLIC OF TURKEY *DEVLET SU İŞLERİ* GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.4.3 RELATIONSHIP BETWEEN ANNUAL RAINFALL AND RIVER CHANNEL PROFILE IN THE GÖKSU RIVER

FIG. NO.

THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.4.4 RELATIONSHIP BETWEEN ANNUAL RAINFALL AND RIVER CHANNEL PROFILE IN THE EĞLENCE RIVER

FIG. NO.



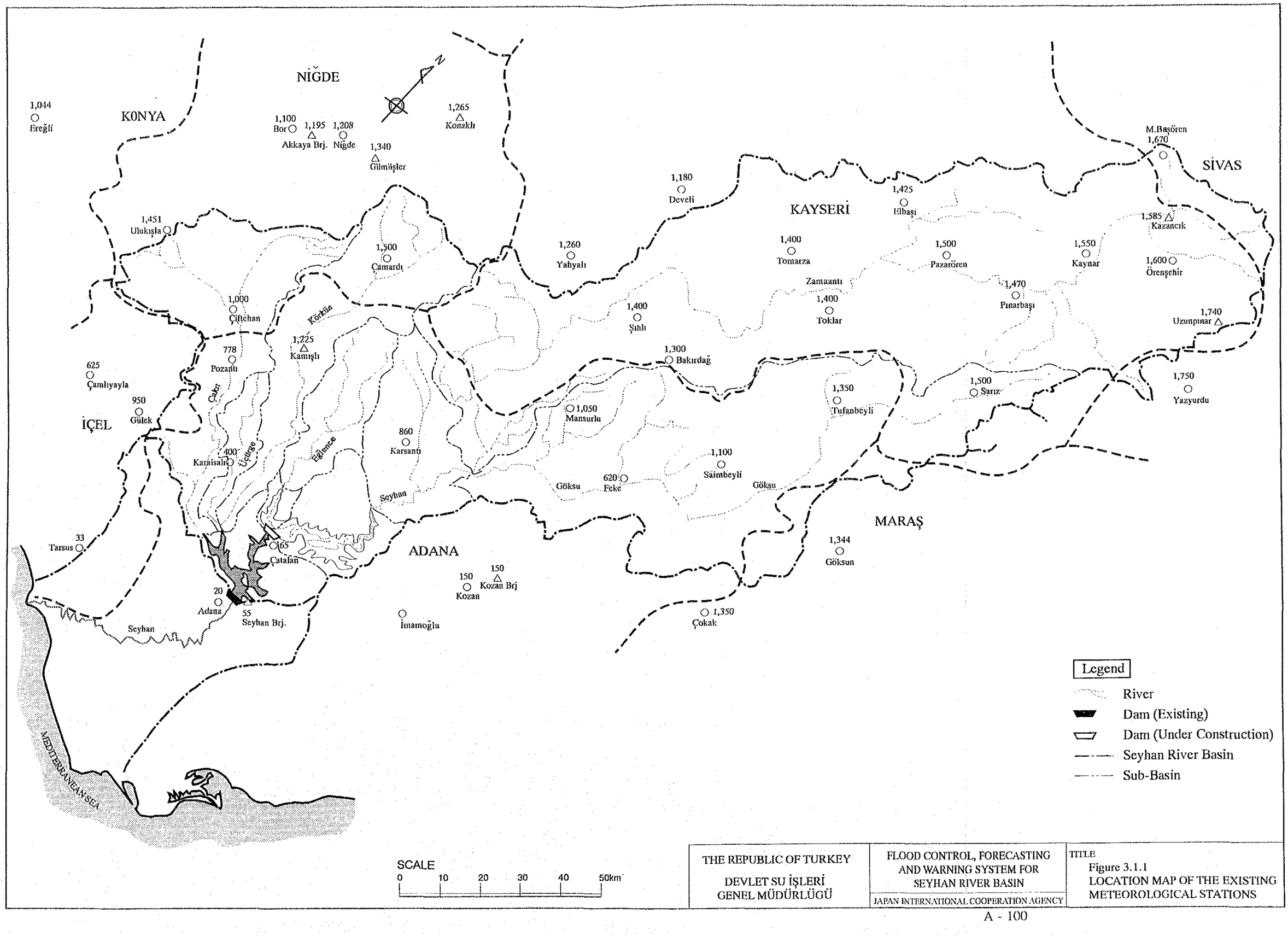
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.4.5 RELATIONSHIP BETWEEN ANNUAL RAINFALL AND RIVER CHANNEL PROFILE IN THE ÇAKIT RIVER

FIG. NO.

THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.4.6 RELATIONSHIP BETWEEN ANNUAL RAINFALL AND RIVER CHANNEL PROFILE IN THE ÜÇÜRGE RIVER

FIG. NO.

THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.4.7 RELATIONSHIP BETWEEN ANNUAL RAINFALL AND RIVER CHANNEL PROFILE IN THE KÖRKÜN RIVER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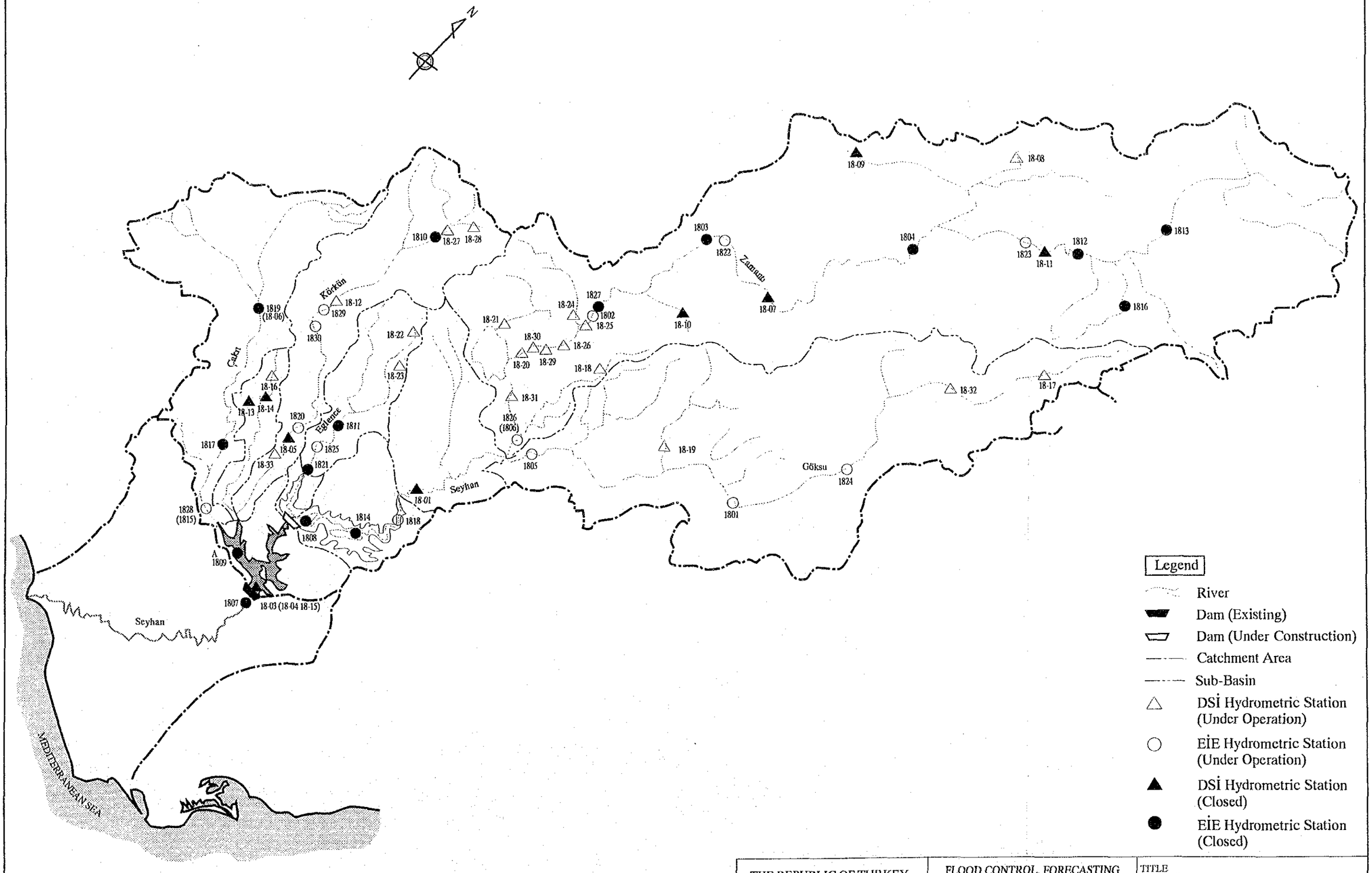
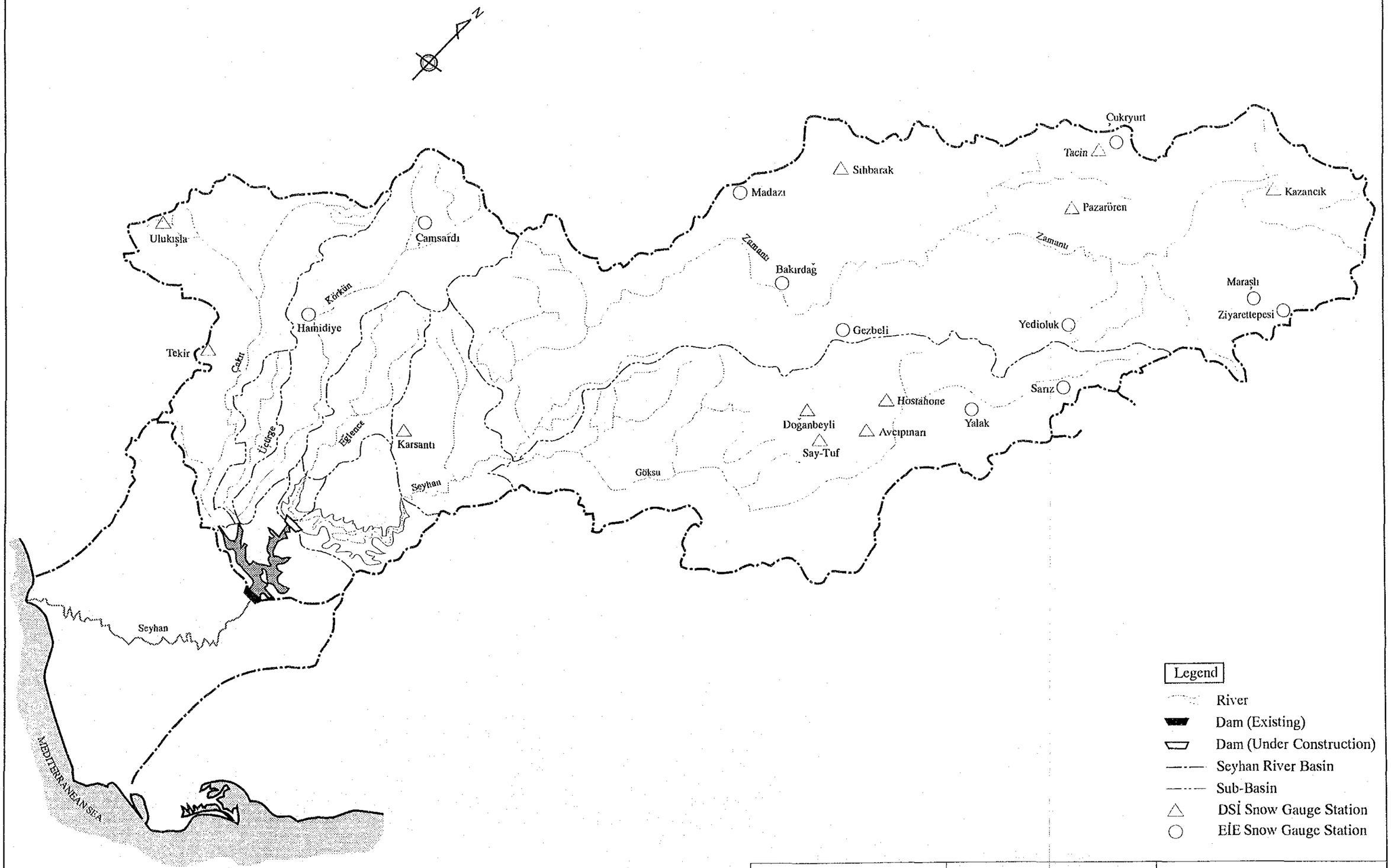
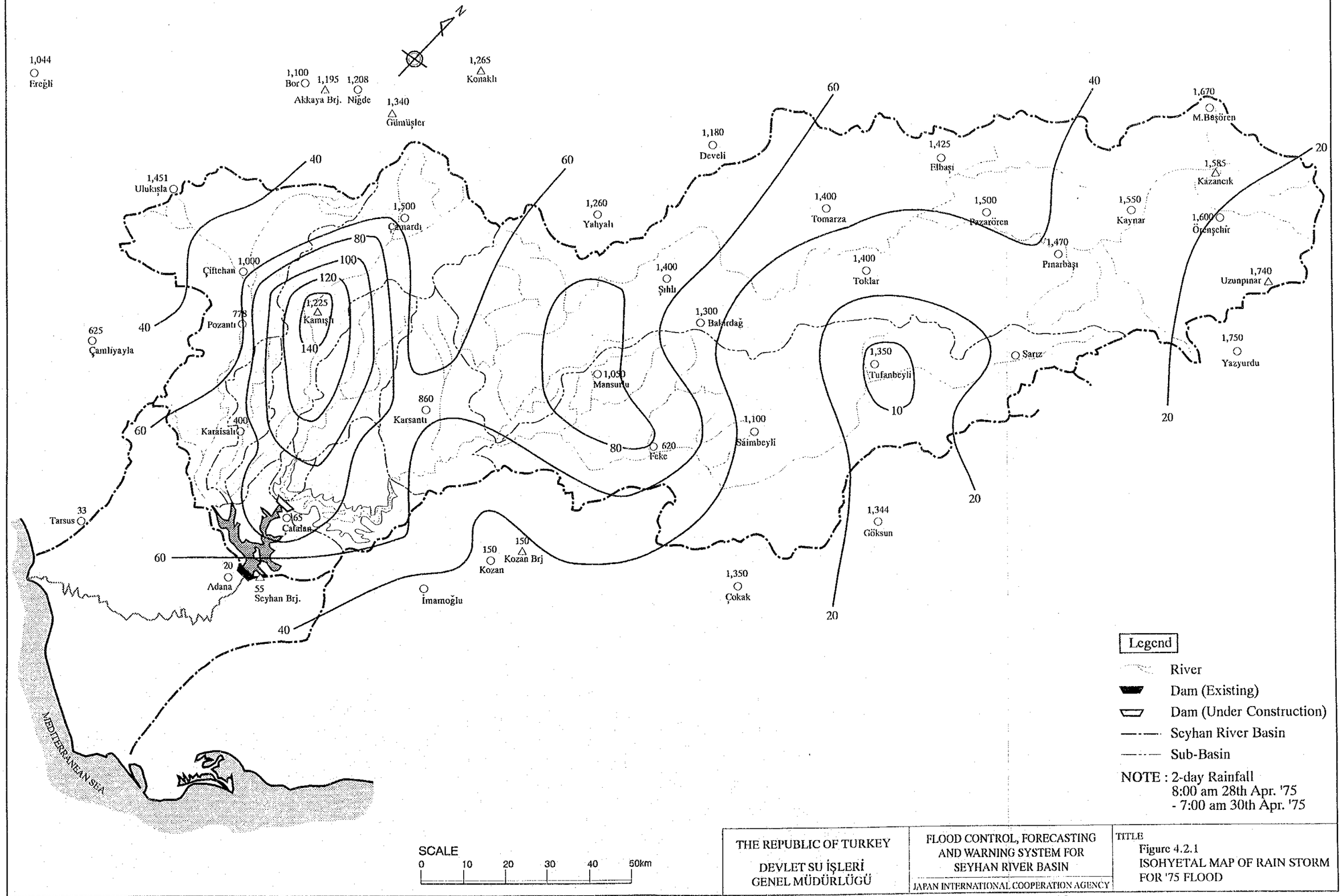
KONYA
İÇEL
KAYSERİ
SİVAS
ADANA
MARAŞ
1,044 Ereğli
1,100 Bor
1,195
1,208 Niğde
Akkaya Brj.
1,265 Konakh
1,340 Gümüşler
1,180 Develi
1,425 Elbaşi
M.Başören 1,670
1,585 Kazancık
1,451 Ulukışla
1,500 Çamardı
1,260 Yahyalı
1,400 Tomarza
1,500 Pazarören
1,550 Kaynar
1,600 Örenşehir
1,000 Çiftehan
Kürkün
1,400 Şıhlı
Zamaantı
1,400 Toklar
1,470 Pınarbaşı
1,740 Uzunpınar
1,225 Kamışlı
778 Pozantı
625 Çamlıyayla
1,300 Bakırdağ
1,500 Sarız
1,750 Yazyurdu
1,350 Tufanbeyli
950 Gülek
Çakıt
1,050 Mansurlu
860 Karsantı
400 Karaisalı
Uçurtma
Eğlence
1,100 Saimbeyli
620 Feke
Göksu
Göksu
Seyhan
33 Tarsus
65 Catalan
150 Kozan Brj
150 Kozan
20 Adana
55 Seyhan Brj.
Seyhan
İmamoğlu
1,344 Göksun
1,350 Çokak
MEDITERRANEAN SEA
SCALE
0 10 20 30 40 50km
Legend
River
Dam (Existing)
Dam (Under Construction)
Seyhan River Basin
Sub-Basin
THE REPUBLIC OF TURKEY
DEVLET SU İŞLERİ
GENEL MÜDÜRLÜGÜ
FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE
Figure 3.1.1
LOCATION MAP OF THE EXISTING METEOROLOGICAL STATIONS



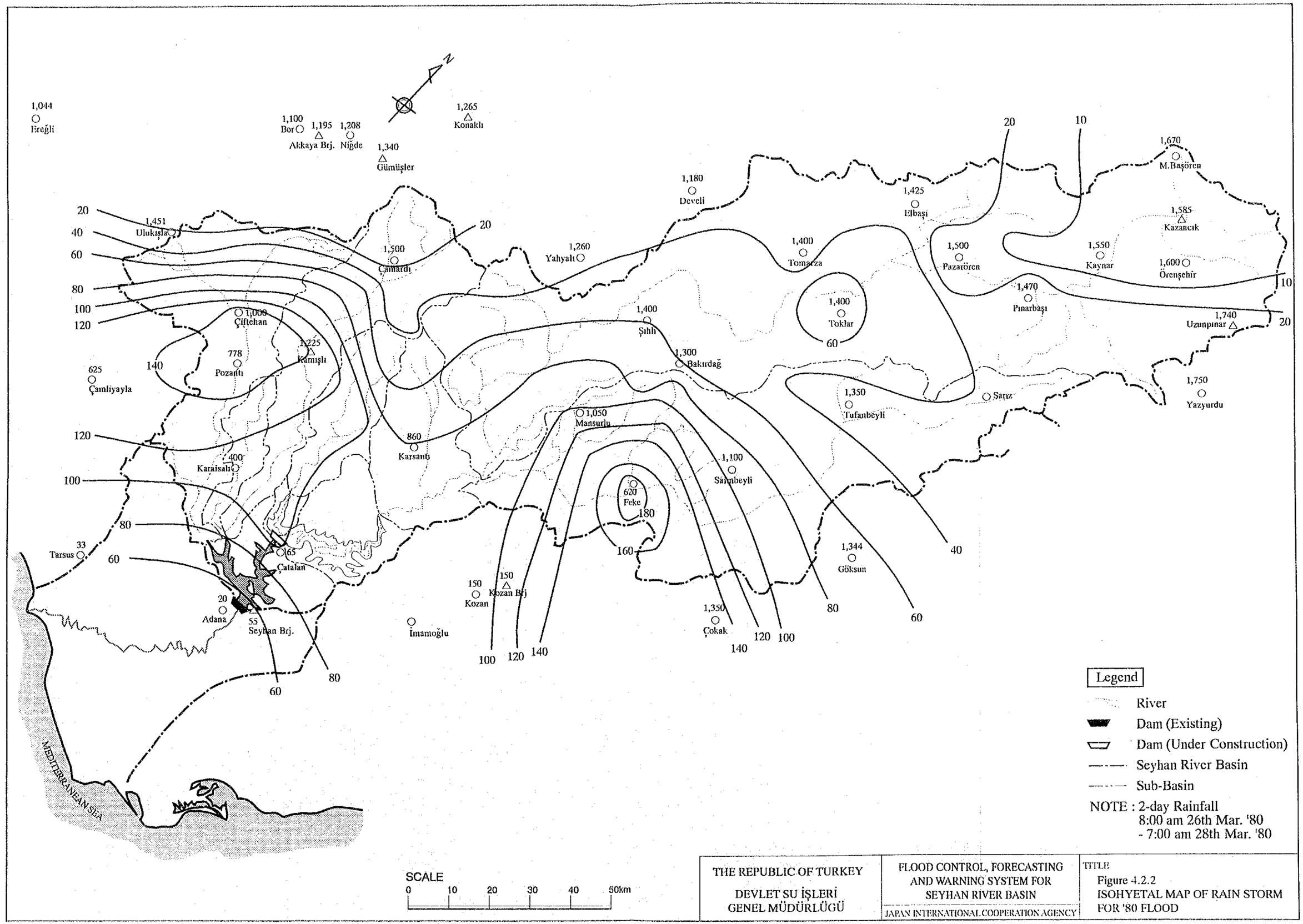
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	*FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN* JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.1.2 LOCATION MAP OF THE HYDROMETRIC STATIONS



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.1.3 LOCATION MAP OF THE SNOW GAUGE STATIONS



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 4.2.1 ISOHYETAL MAP OF RAIN STORM FOR '75 FLOOD


N
1,044
Ereğli
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Akkaya Brj.
Niğde
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Gümüşler
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Develi
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Elbaşı
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M.Başören
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Tomarza
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Pazarören
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Kaynar
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Örenşehir
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Pınarbaşı
1,400
Toklar
1,400
Şıhlı
1,300
Bakırdağ
1,740
Uzunpınar
1,750
Yazyurdu
1,350
Tufanbeyli
Sarız
1,050
Mansurlu
1,100
Saimbeyli
620
Feke
1,344
Göksun
1,350
Çokak
1,008
Çiftehan
1,225
Kamışlı
778
Pozantı
625
Çamliyayla
860
Karsantı
400
Karaisalı
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Tarsus
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Çatalan
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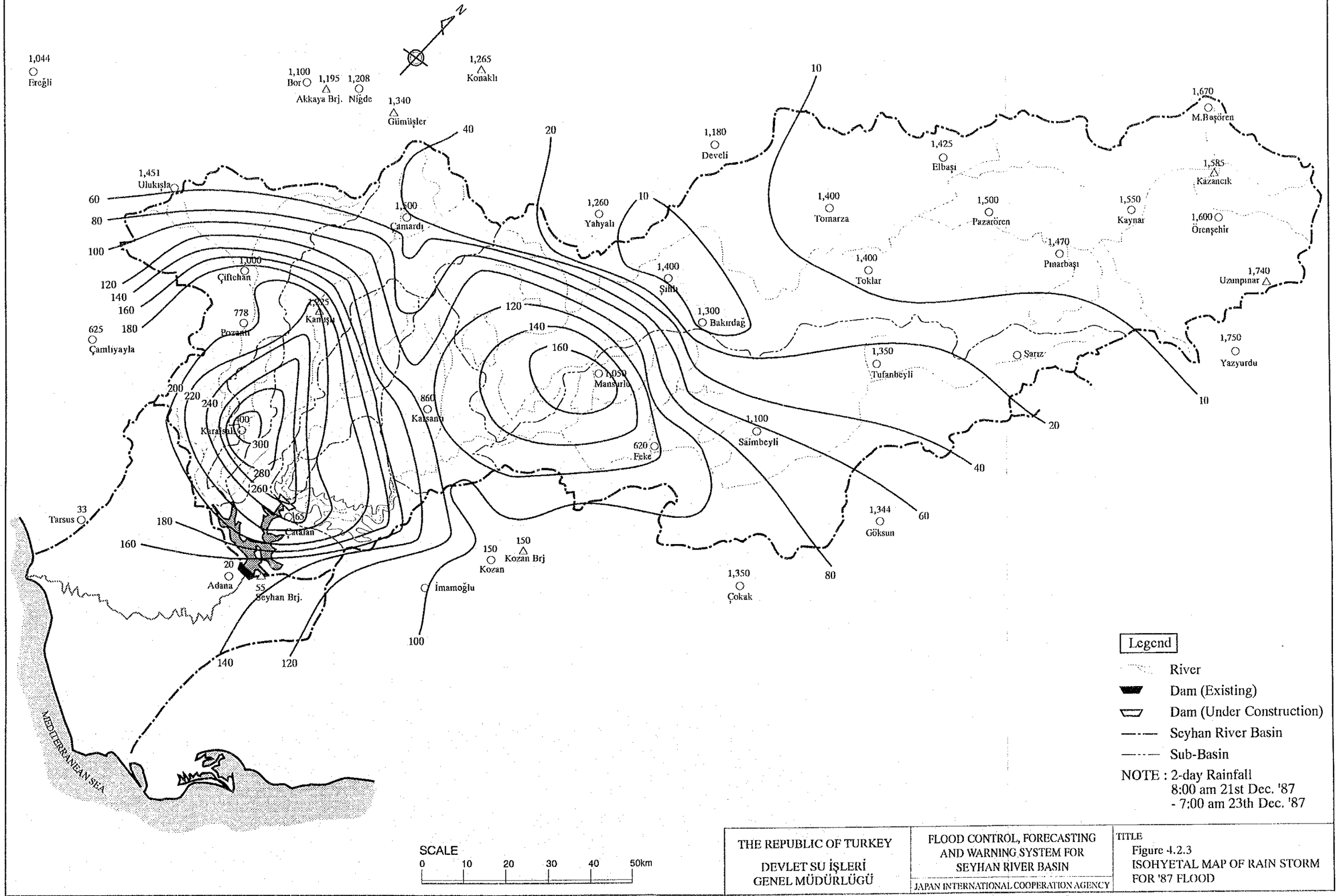
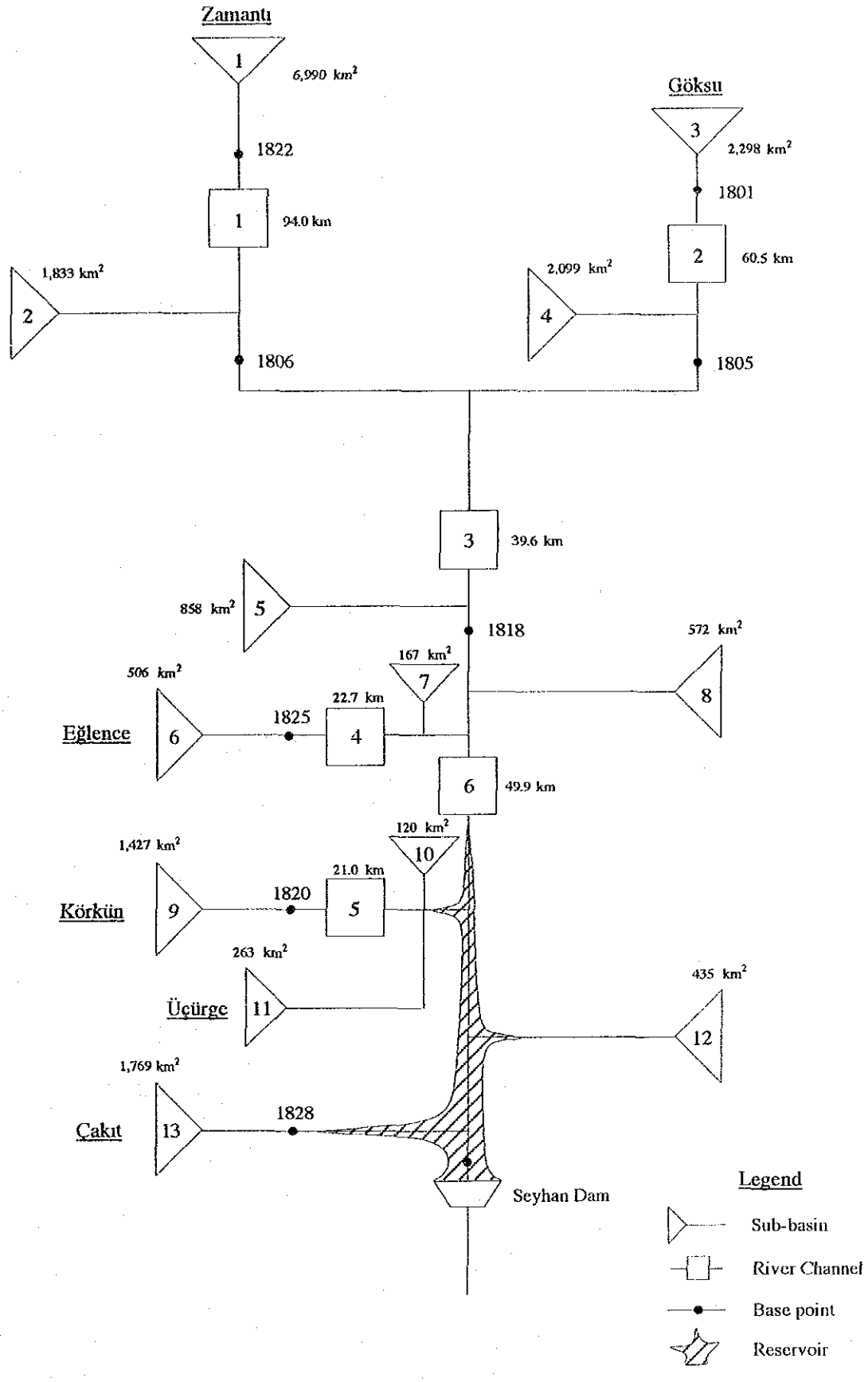
Adana
55
Seyhan Brj.
150
Kozan
150
Kozan Brj
İmamoğlu
20
40
60
80
100
120
140
160
180
10
MEDITERRANEAN SEA
Legend
River
Dam (Existing)
Dam (Under Construction)
Seyhan River Basin
Sub-Basin
NOTE : 2-day Rainfall
8:00 am 26th Mar. '80
- 7:00 am 28th Mar. '80
SCALE
0 10 20 30 40 50km
THE REPUBLIC OF TURKEY
DEVLET SU İŞLERİ
GENEL MÜDÜRLÜGÜ
FLOOD CONTROL, FORECASTING
AND WARNING SYSTEM FOR
SEYHAN RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE
Figure 4.2.2
ISOHYETAL MAP OF RAIN STORM
FOR '80 FLOOD



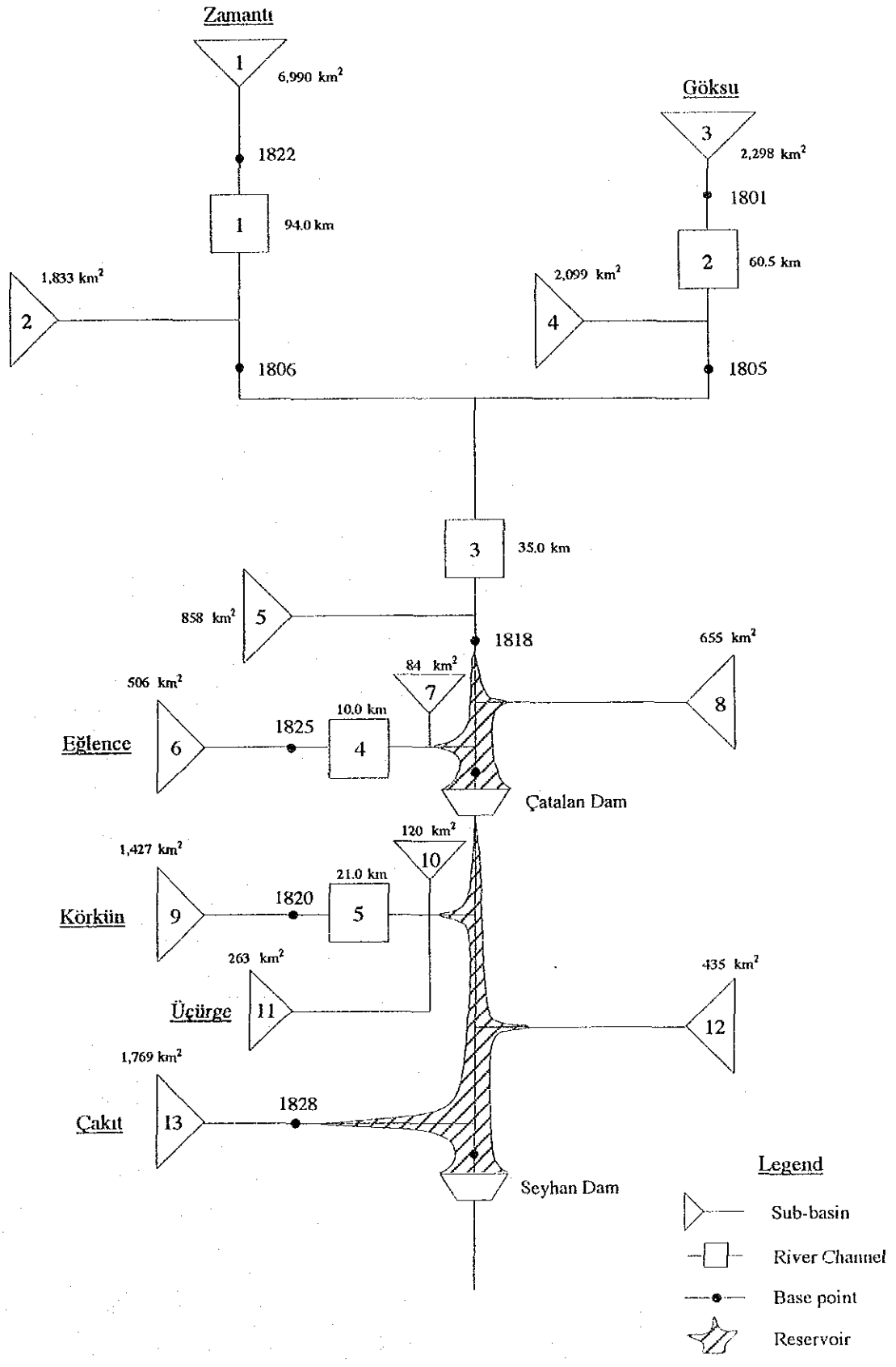
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 4.2.3 ISOHYETAL MAP OF RAIN STORM FOR '87 FLOOD

FIG. NO.

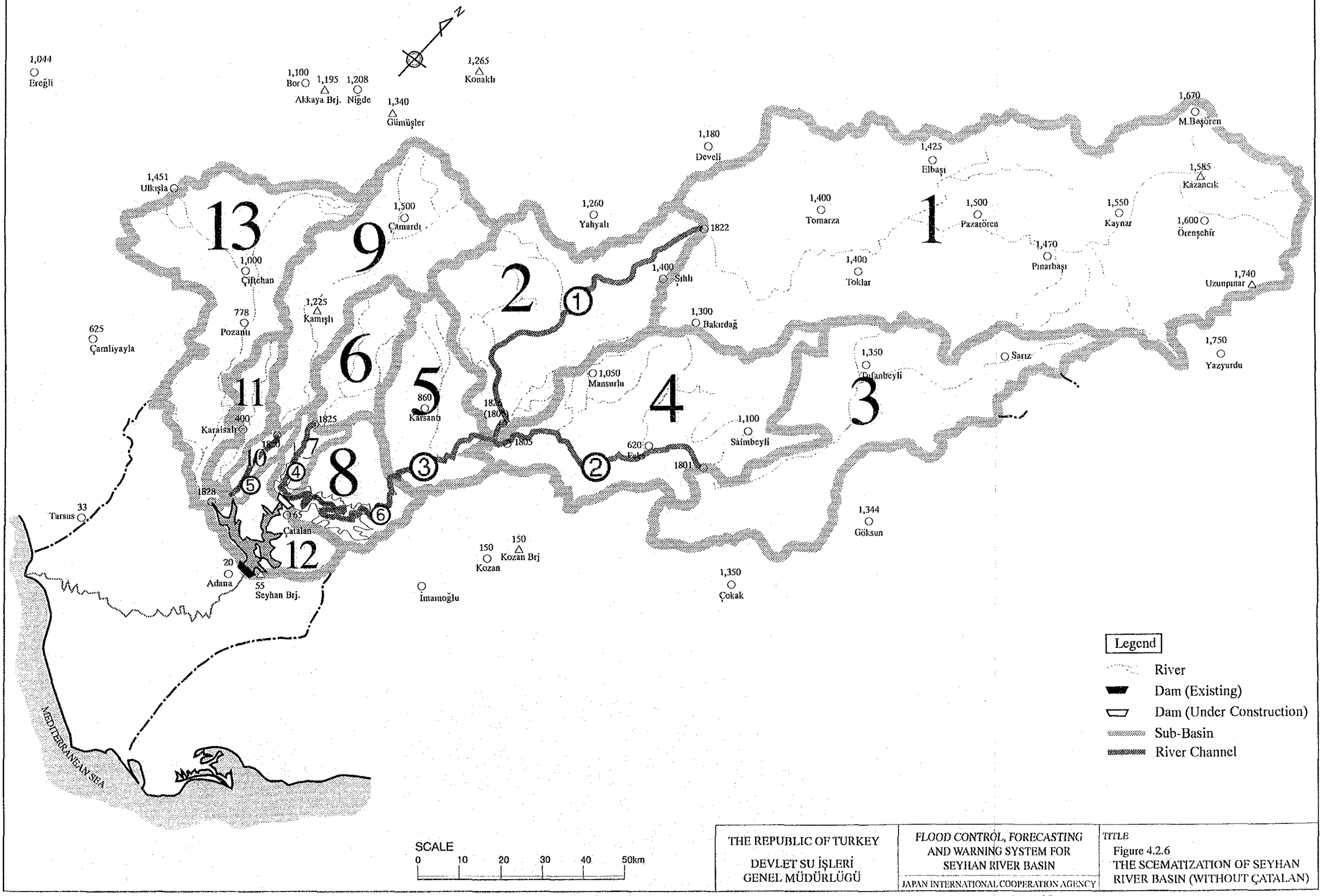


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 4.2.4 SCHEMATIC DIAGRAM FOR SEYHAN RIVER BASIN (WITHOUT ÇATALAN)

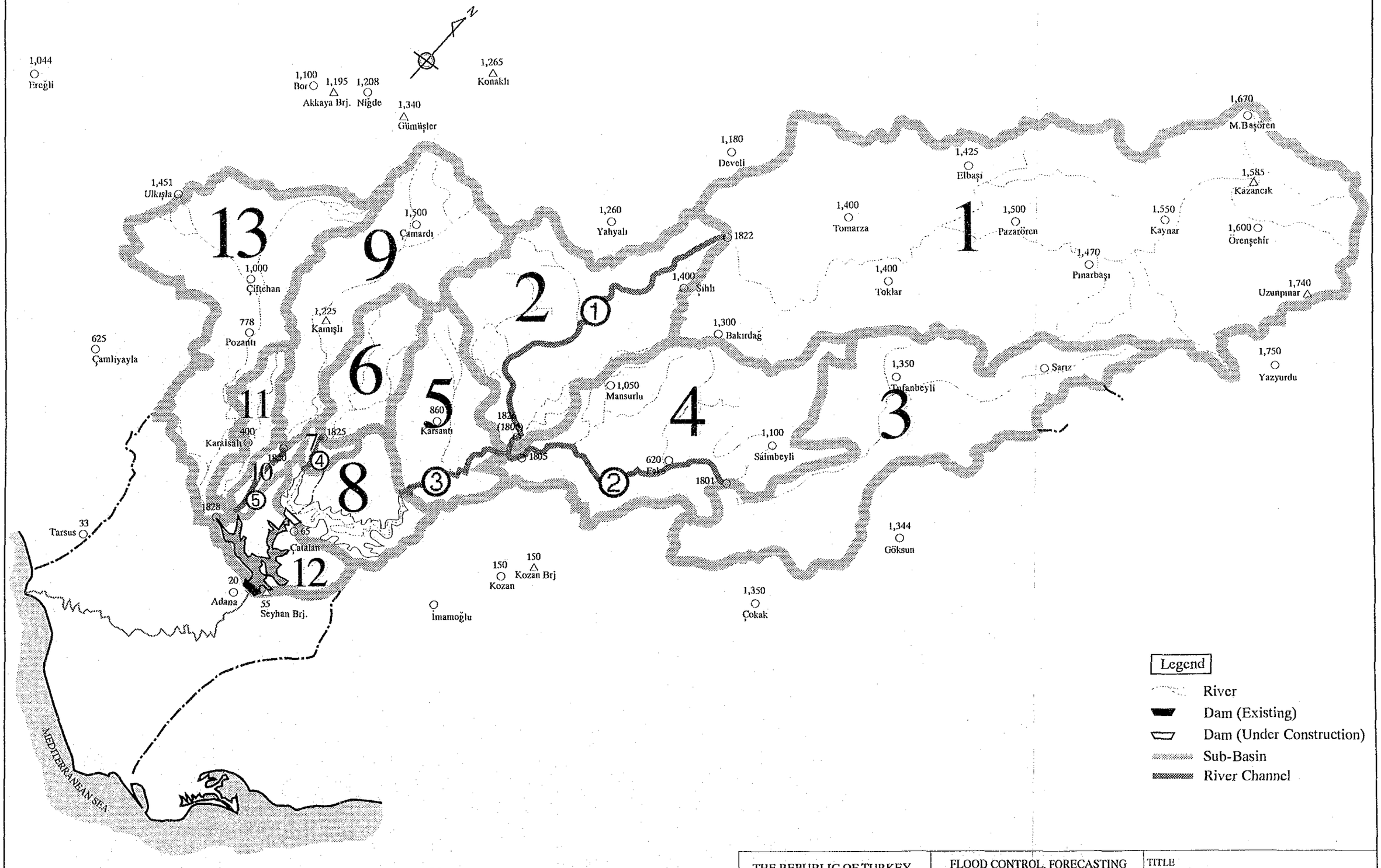
FIG. NO.



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 4.2.5 SCHEMATIC DIAGRAM FOR SEYHAN RIVER BASIN (WITH ÇATALAN)



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	*FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN* JAPAN INTERNATIONAL COOPERATION AGENCY	*TITLE* Figure 4.2.6 THE SCEMATIZATION OF SEYHAN RIVER BASIN (WITHOUT ÇATALAN)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Ereğli
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Develi
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Elbaşı
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M.Başören
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Ulukışla
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Çamardı
1,260
Yahyalı
1822
1,400
Tomarza
1,500
Pazarören
1,550
Kaynar
1,585
Kazancık
1,600
Örenşehir
1,000
Çiftehan
1,400
Sıhlı
1,400
Toklar
1,470
Pınarbaşı
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Uzunpınar
1,225
Kamışlı
778
Pozantı
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Çamliyayla
1,300
Bakırdağ
1,350
Tufanbeyli
Sarız
1,750
Yazyurdu
1,050
Mansurlu
860
Karsantı
1825
Karaisalı
400
1805
620
Fek
1,100
Saimbeyli
1801
1828
33
Tarsus
65
Çatalan
1,344
Göksun
150
Kozan
150
Kozan Brj
20
Adana
55
Seyhan Brj.
İmamoğlu
1,350
Çokak
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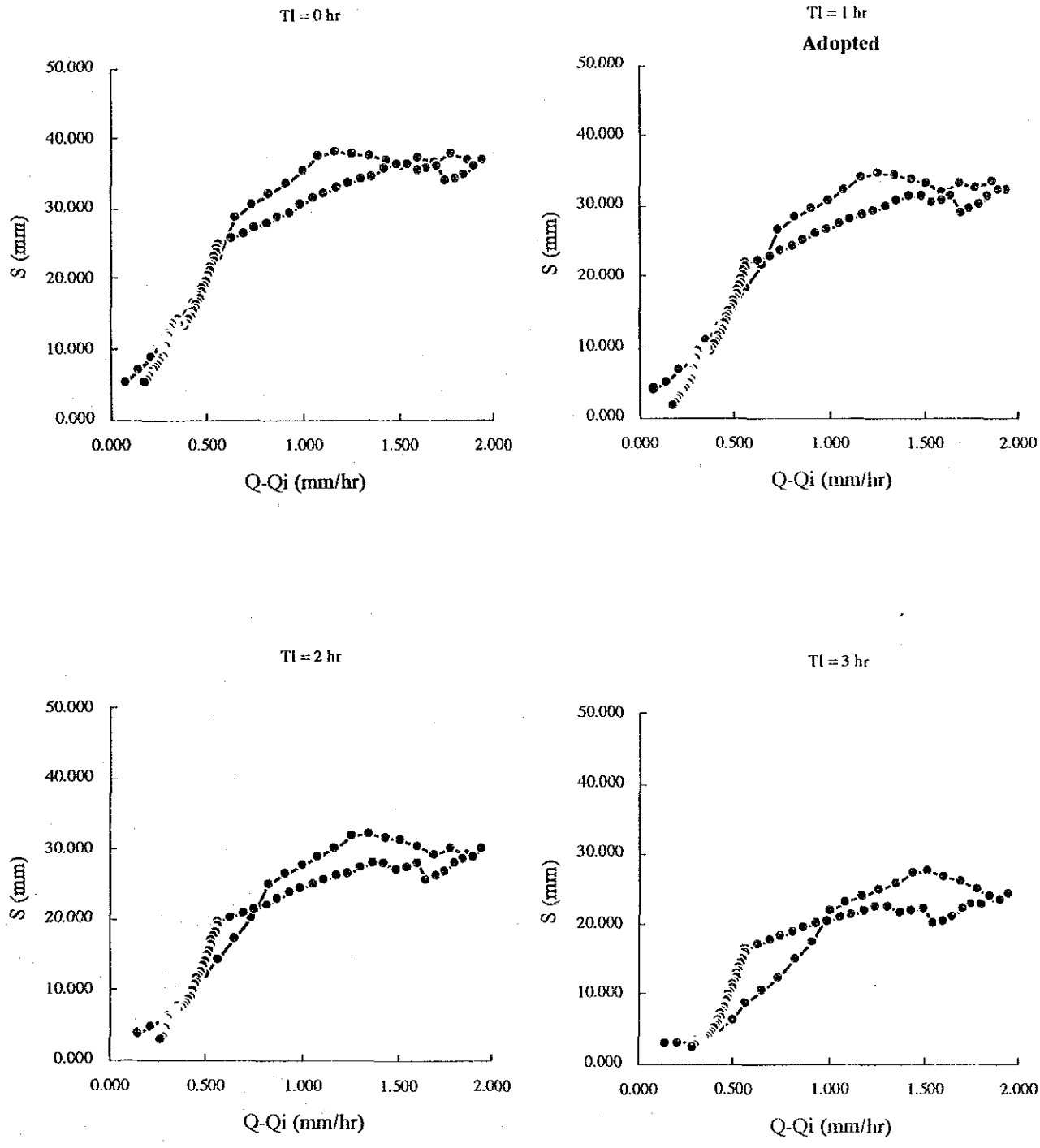
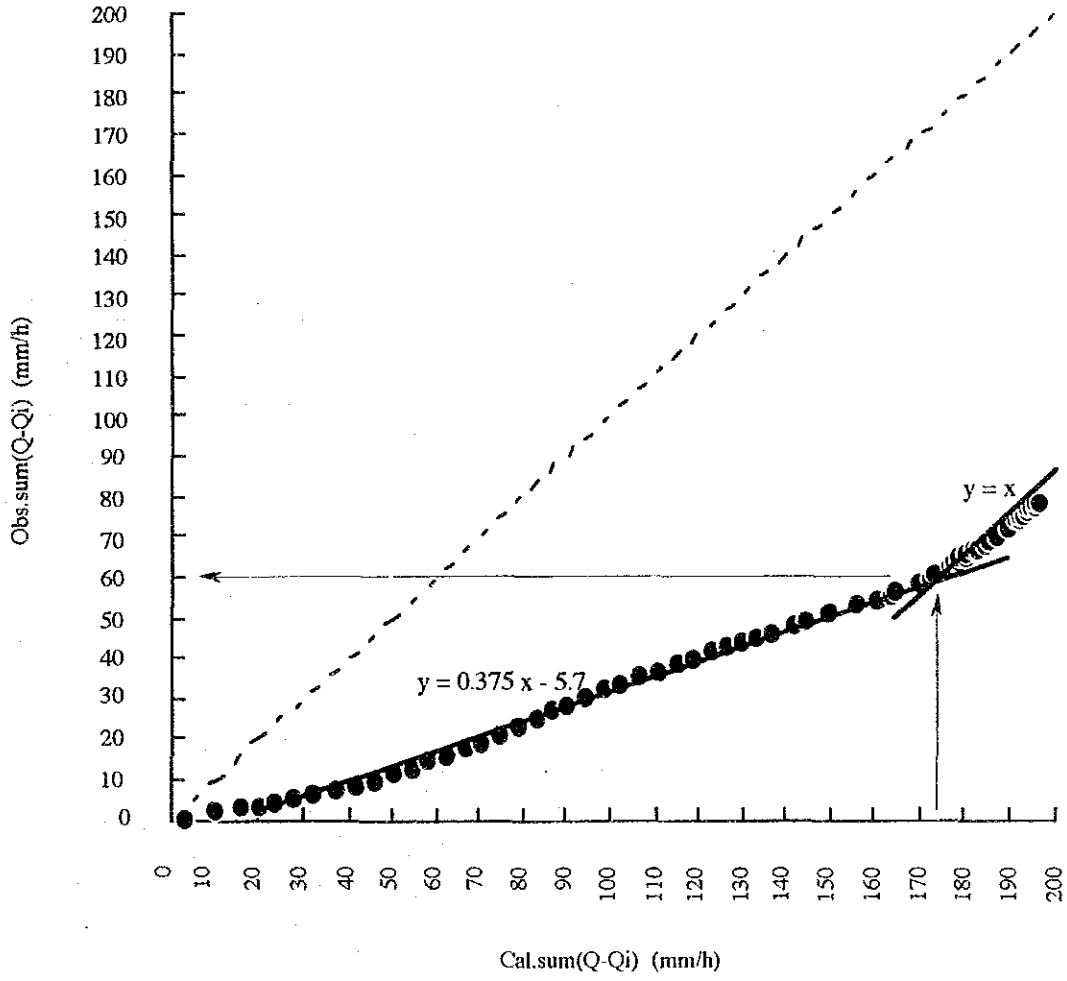
8
12
MEDITERRANEAN SEA
Legend
River
Dam (Existing)
Dam (Under Construction)
Sub-Basin
River Channel
SCALE
0 10 20 30 40 50km
THE REPUBLIC OF TURKEY
DEVLET SU İŞLERİ
GENEL MÜDÜRLÜGÜ
FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE
Figure 4.2.7
THE SCEMATIZATION OF SEYHAN RIVER BASIN (WITH ÇATALAN)

FIG. NO.



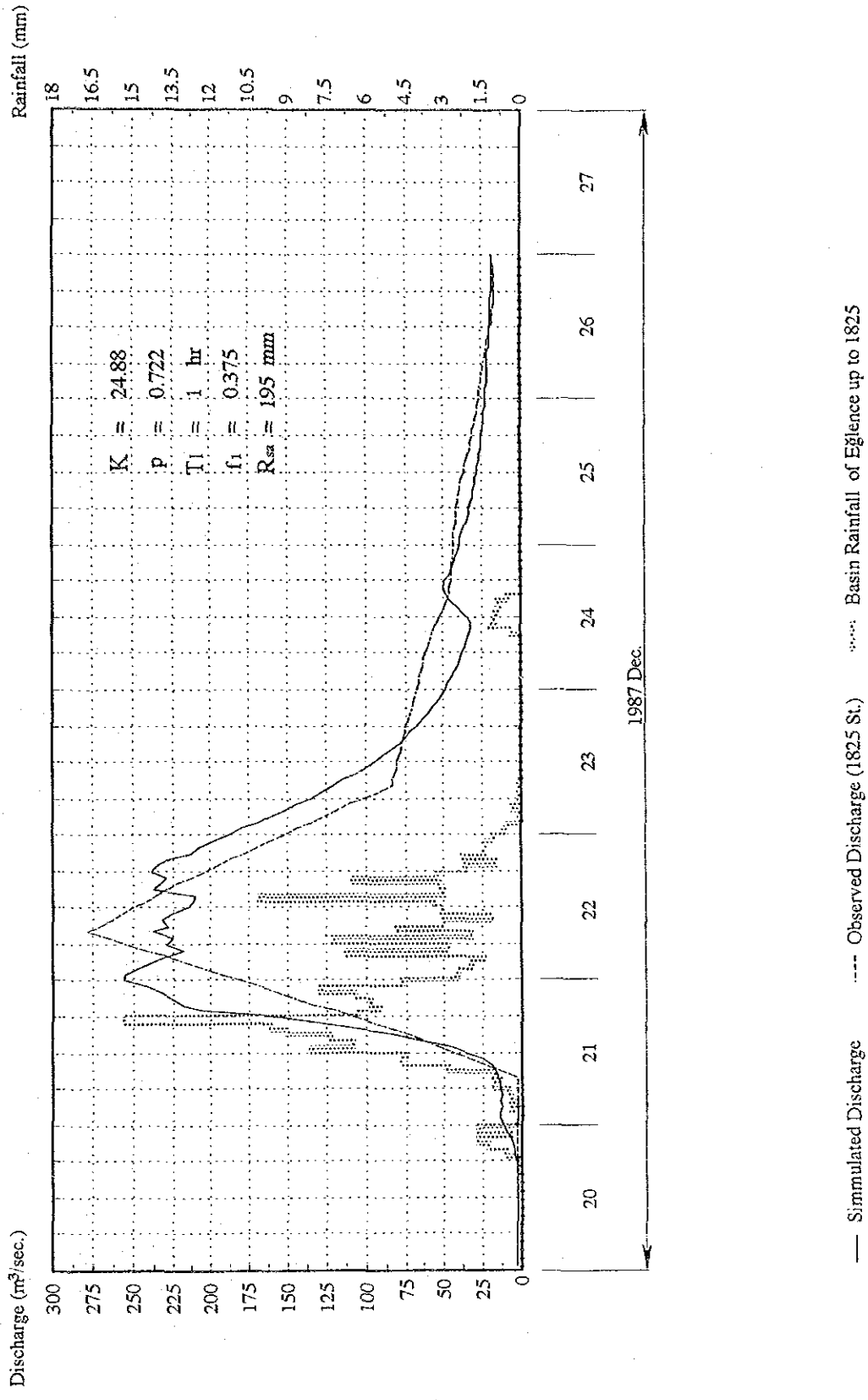
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 5.3.1 RELATIONSHIP BETWEEN STORAGE AND RUNOFF

FIG. NO.



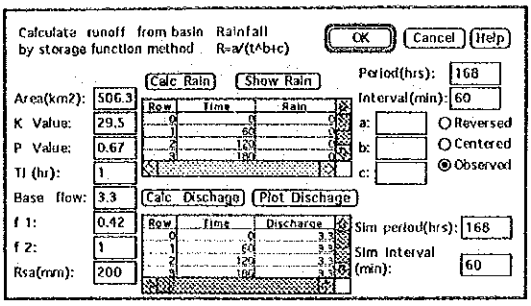
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 5.3.2 DETERMINATION OF FIRST DEGREE RUNOFF RATIO AND SATURATED RAINFALL

FIG. NO.

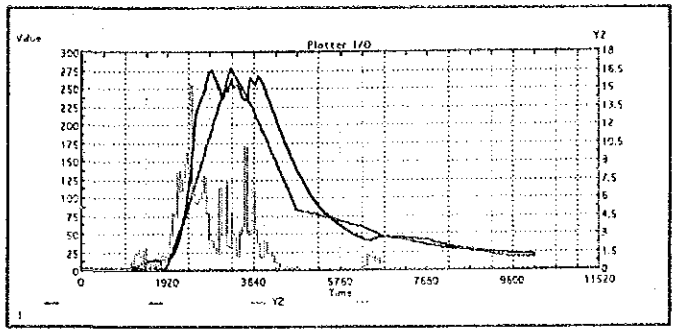


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING *AND WARNING SYSTEM FOR* SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 5.3.3 COMPARISON OF SIMULATED AND OBSERVED DISCHARGE AT 1825 (FIRST TRIAL)

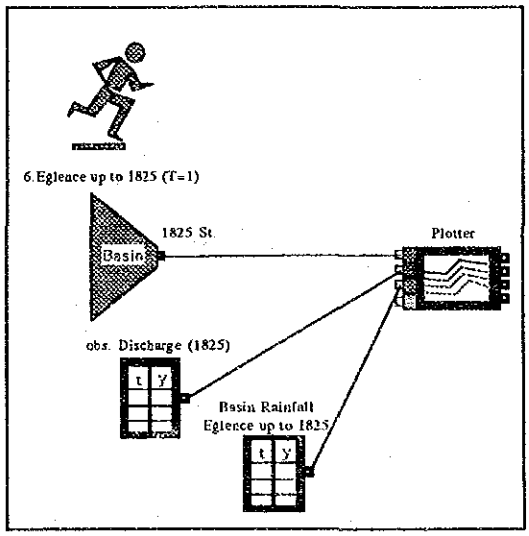
FIG. NO.



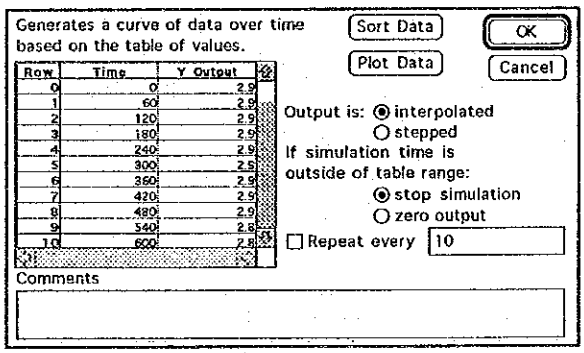
"Sub-Basin" Dialog



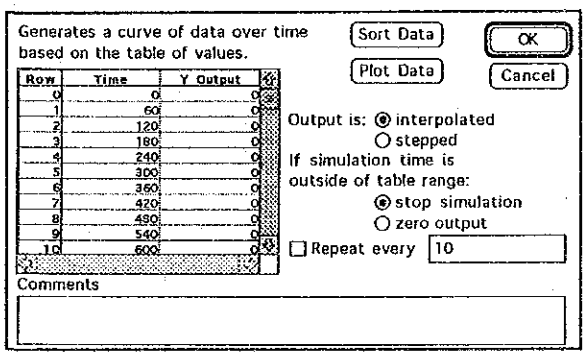
Plotter



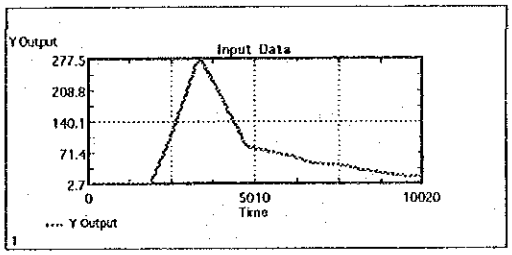
Sub-Basin Model

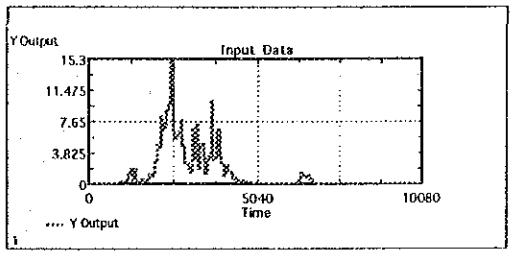


Input Data Dialog (Discharge)



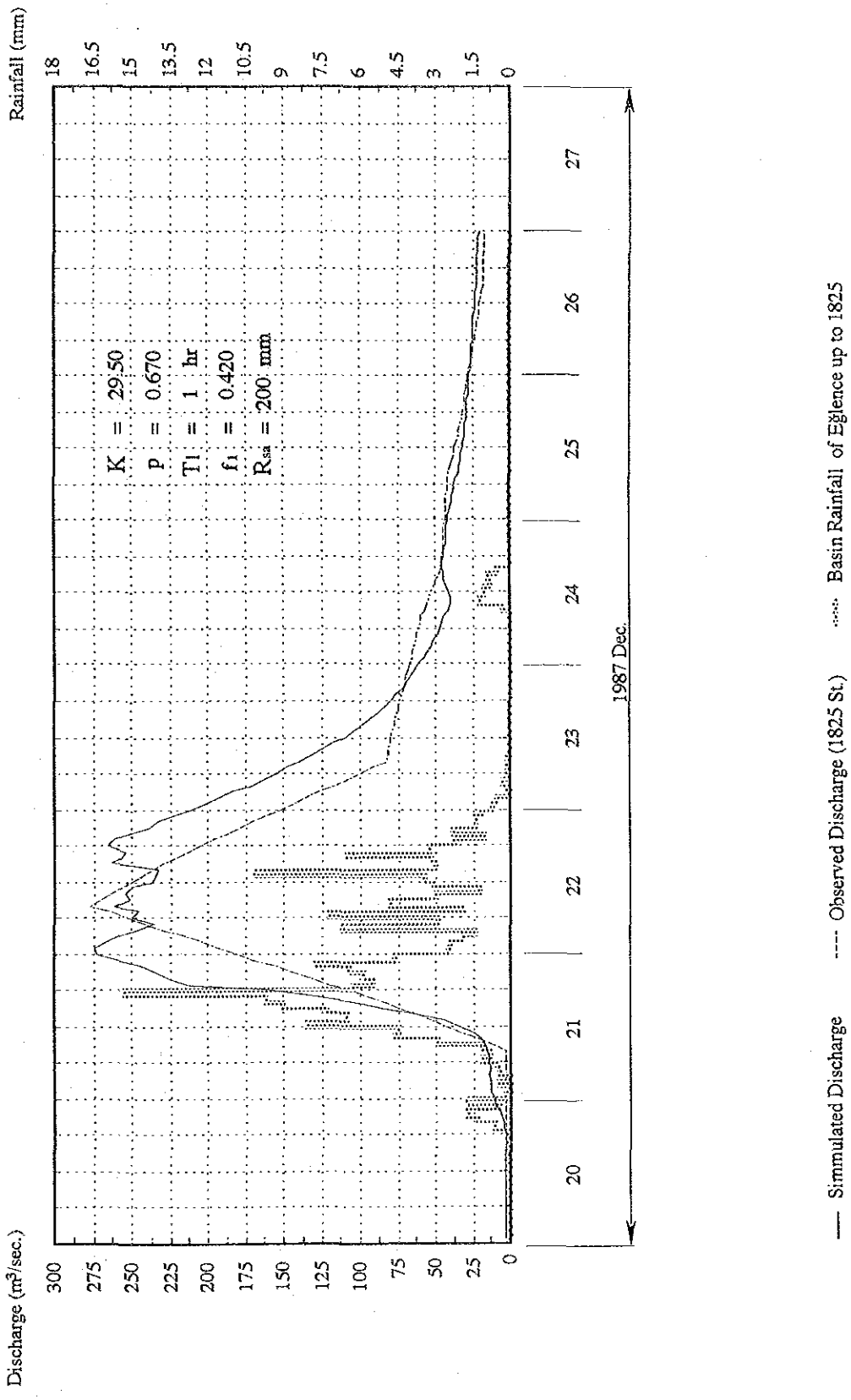
Input Data Dialog (Rainfall)





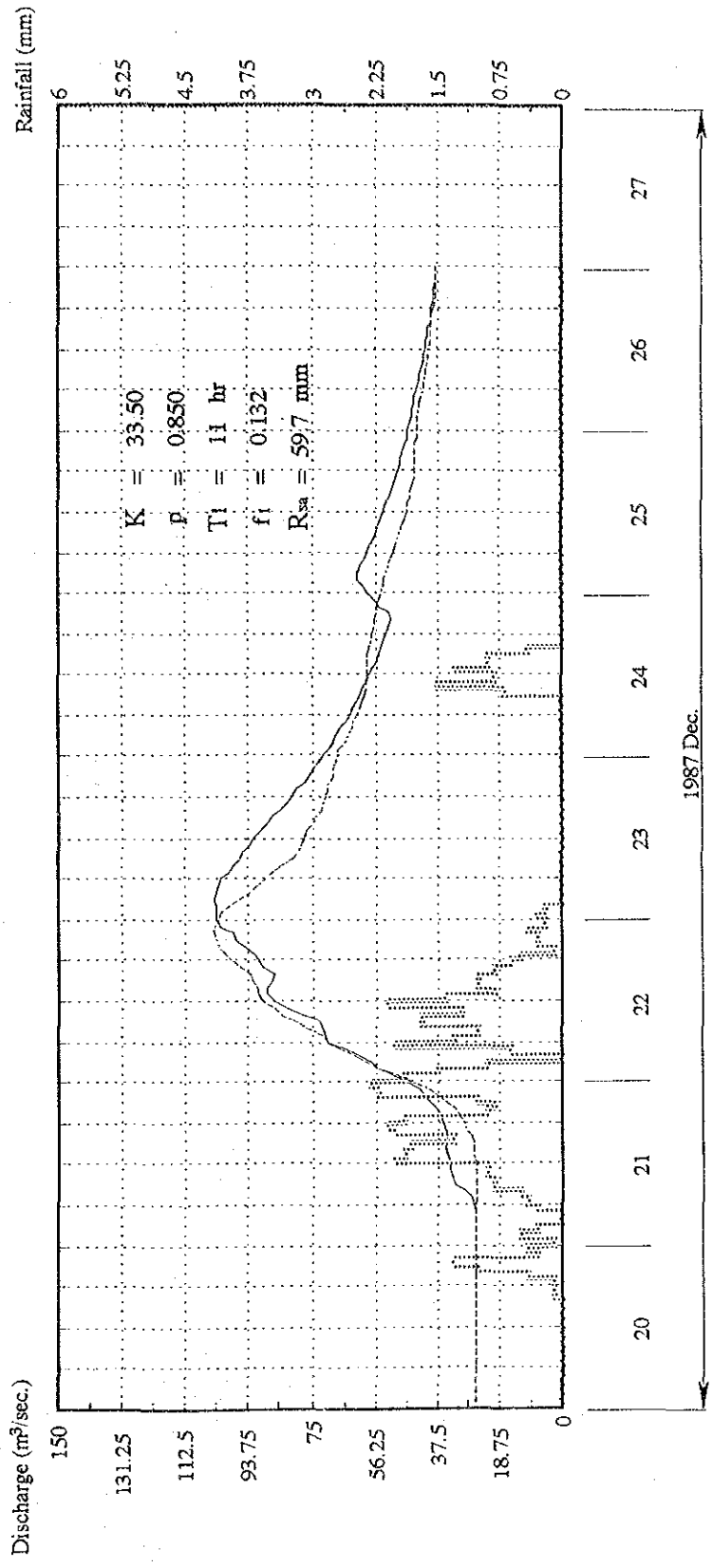
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 5.3.4 ILLUSTRATION OF THE INTERACTIVE PROCEDURE OF EVENT SIMULATION

FIG. NO.



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 5.3.5 COMPARISON OF SIMULATED AND OBSERVED DISCHARGE AT 1825 (FINAL TRIAL)

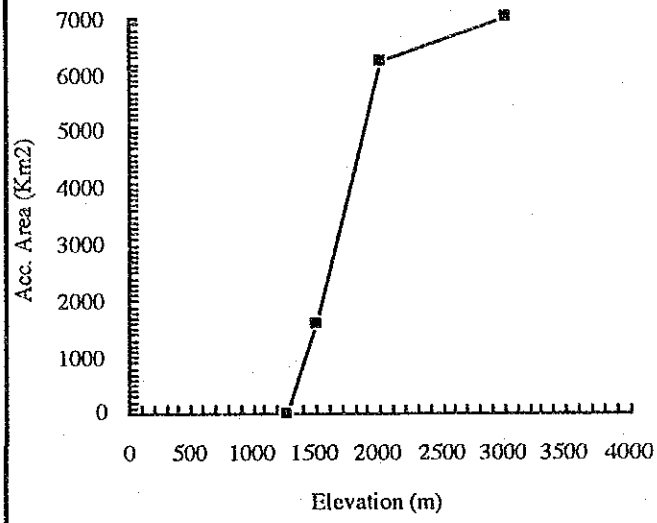
FIG. NO.



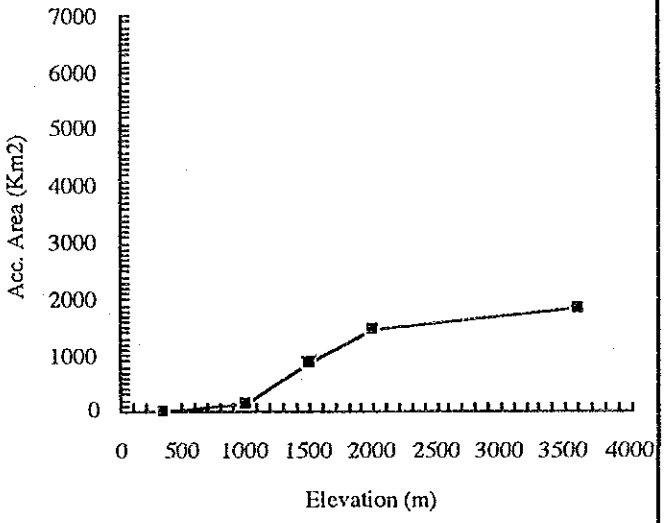
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 5.3.6 COMPARISON OF SIMULATED AND OBSERVED DISCHARGE AT 1801 (FINAL TRIAL)

FIG. NO.

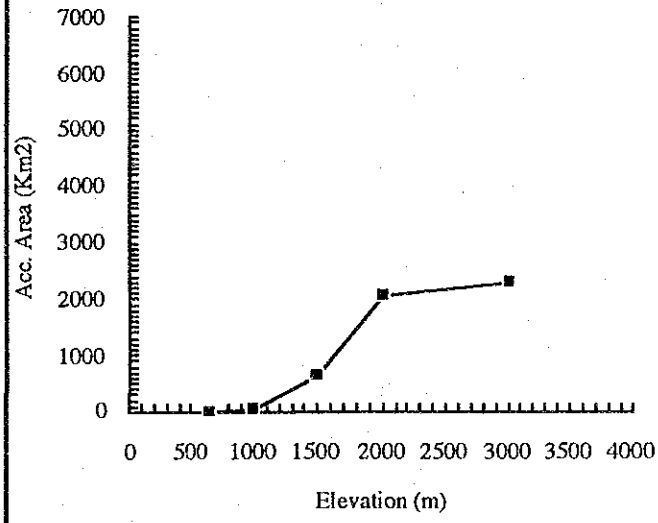
1.Zamantı up to 1822



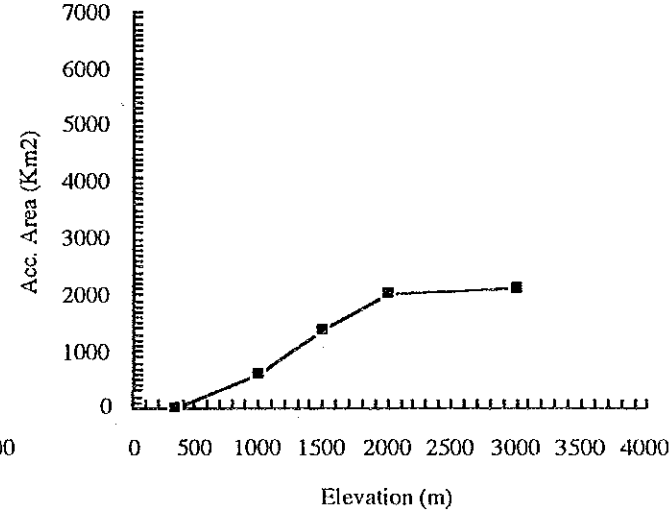
2.Zamantı up to 1806



3.Göksu up to 1801



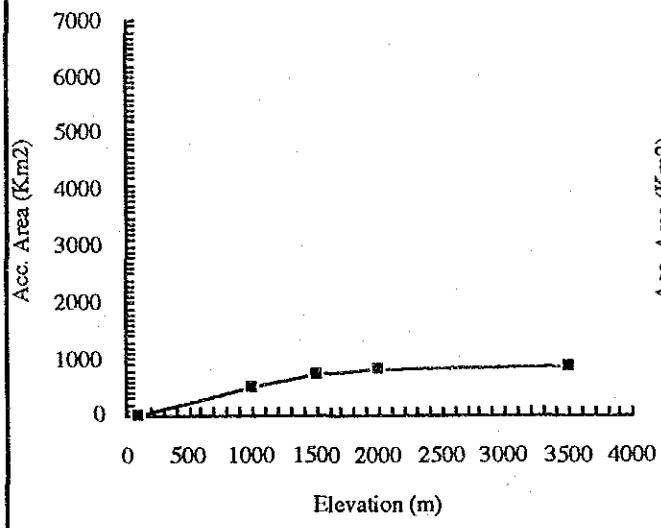
4.Göksu up to 1805



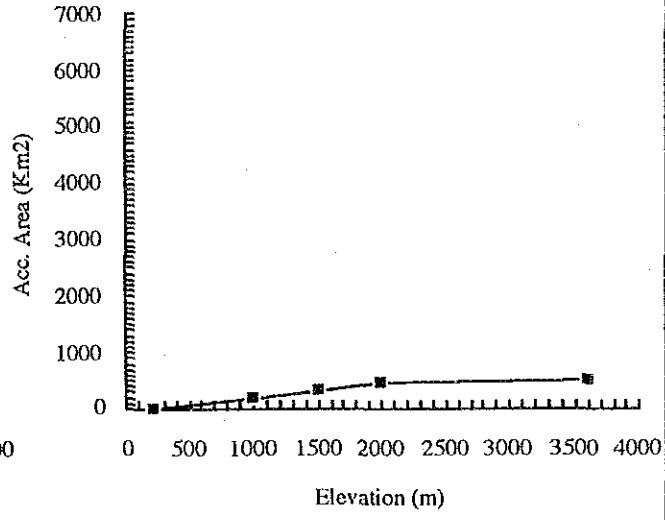
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.2.1 AREA - ELEVATION CURVE (1/3)

FIG. NO.

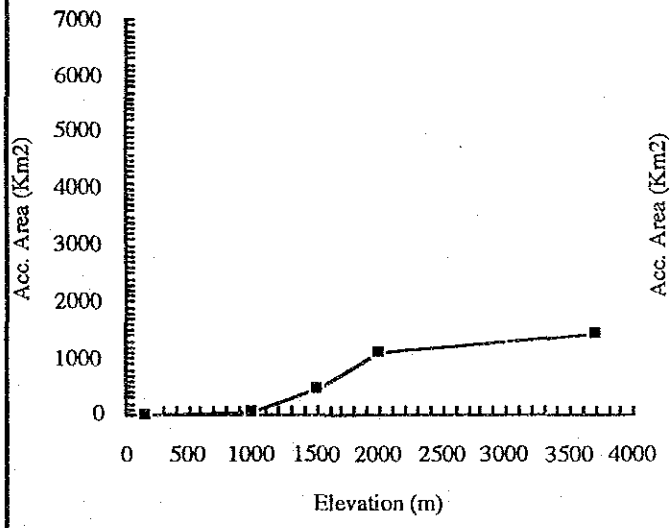
5.Zamantı-Göksu joint to Çatalan HWL



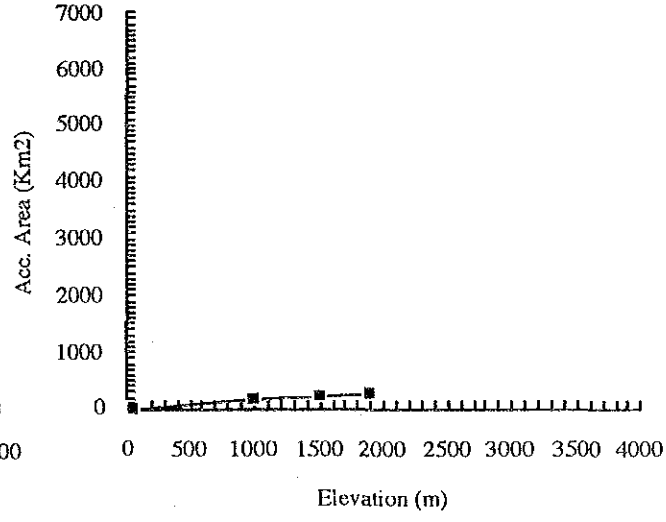
6.Eğlence up to 1825



9.Körkün up to 1820



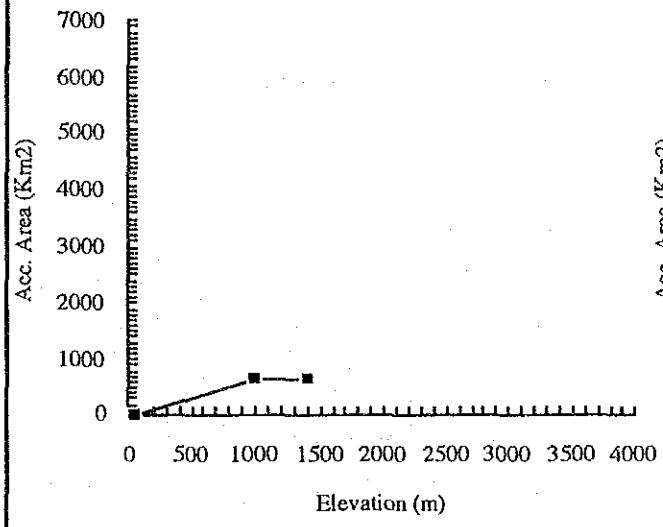
11.Üçürge



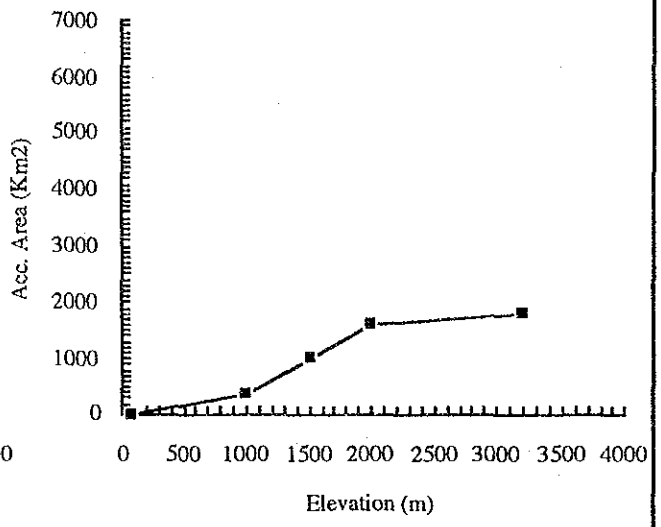
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.2.2 AREA - ELEVATION CURVE (2/3)

FIG. NO.

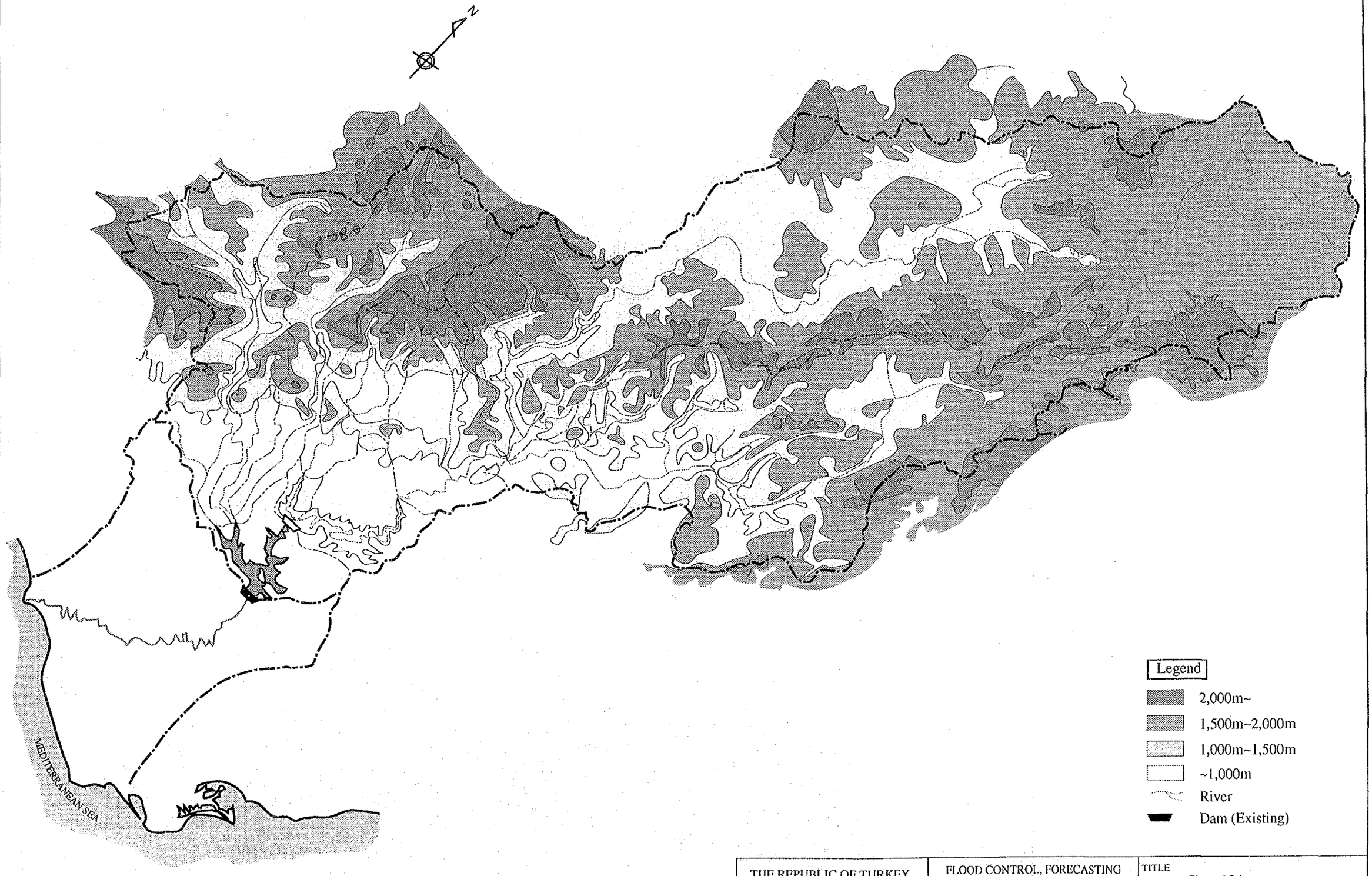
12.Çatalan Brj.-Seyhan Brj.



13.Çakıt up to 1828

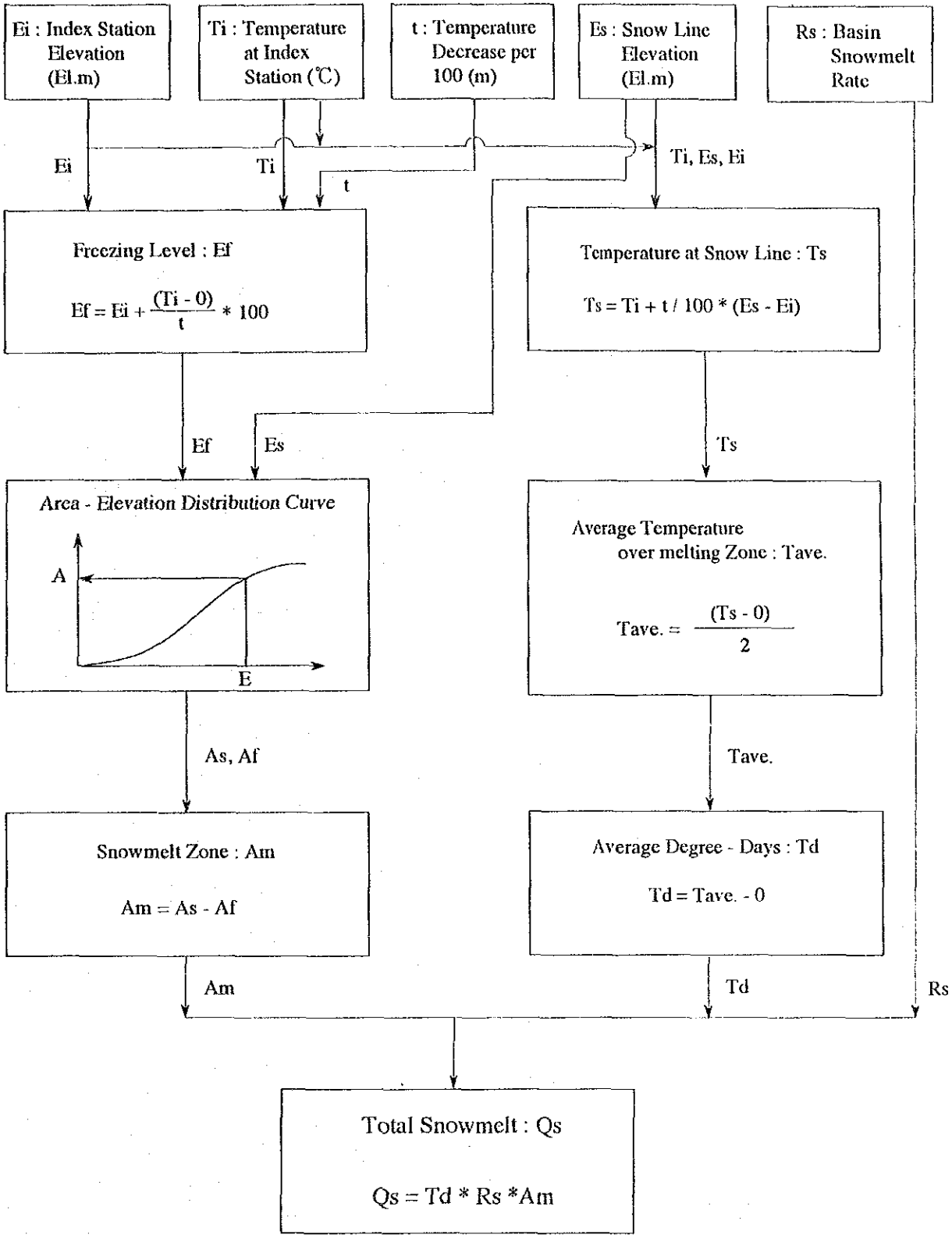


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.2.3 AREA - ELEVATION CURVE (3/3)



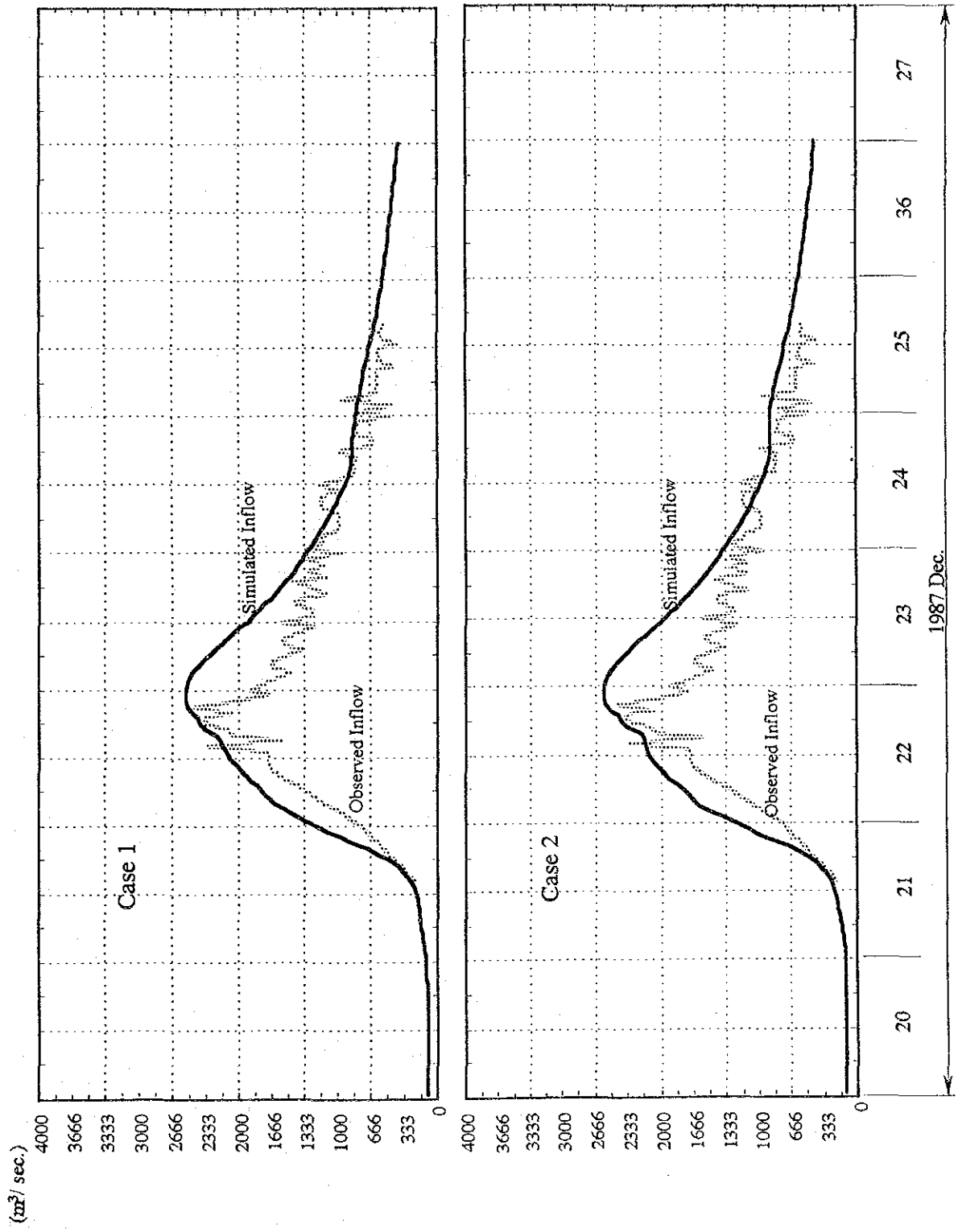
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.2.4 TOPOGRAPHICAL MAP OF THE SEYHAN RIVER BASIN

FIG. NO.



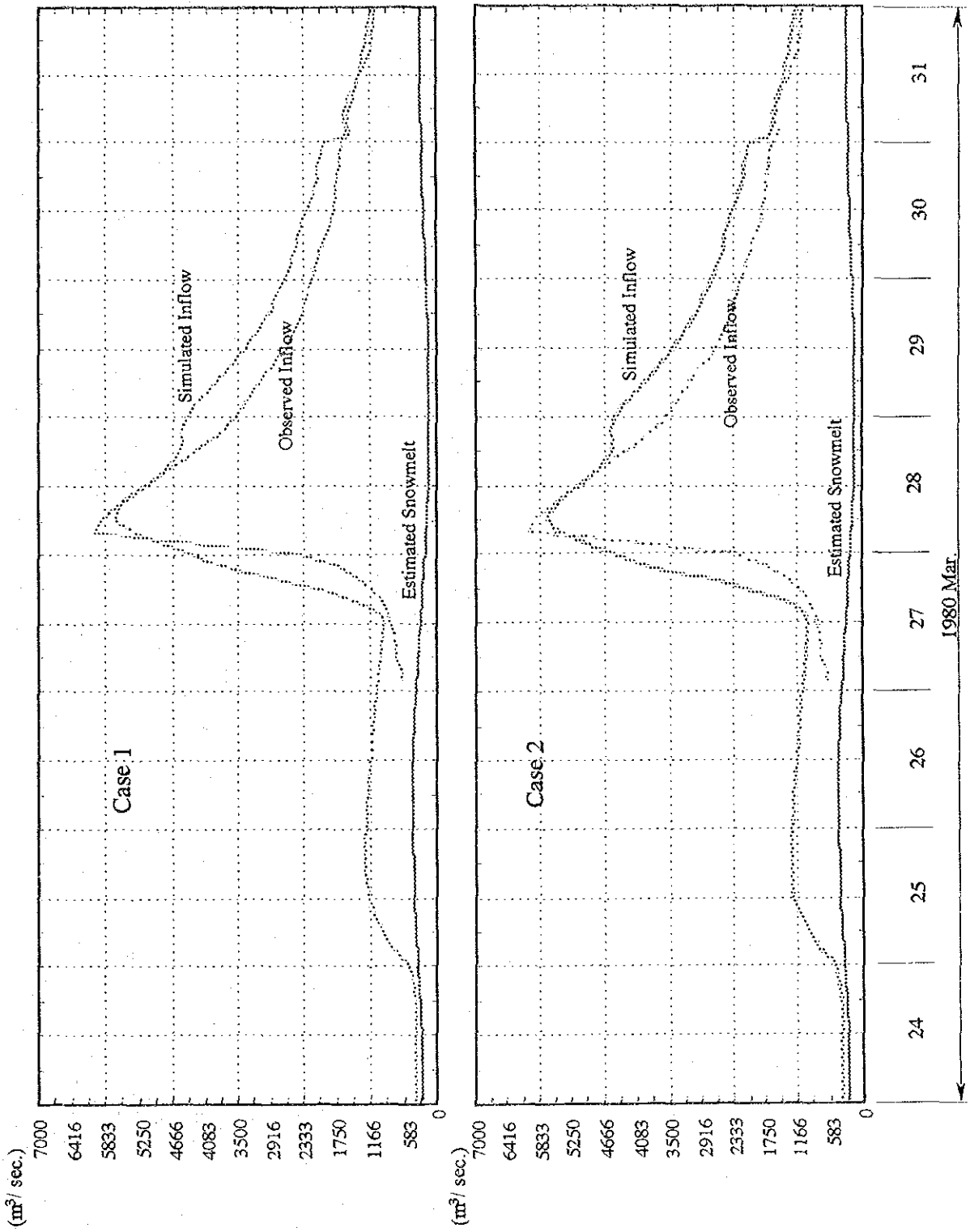
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	***FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN*** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.7.1 FLOW CHART OF SNOWMELT RUNOFF DETERMINATION

FIG. NO.



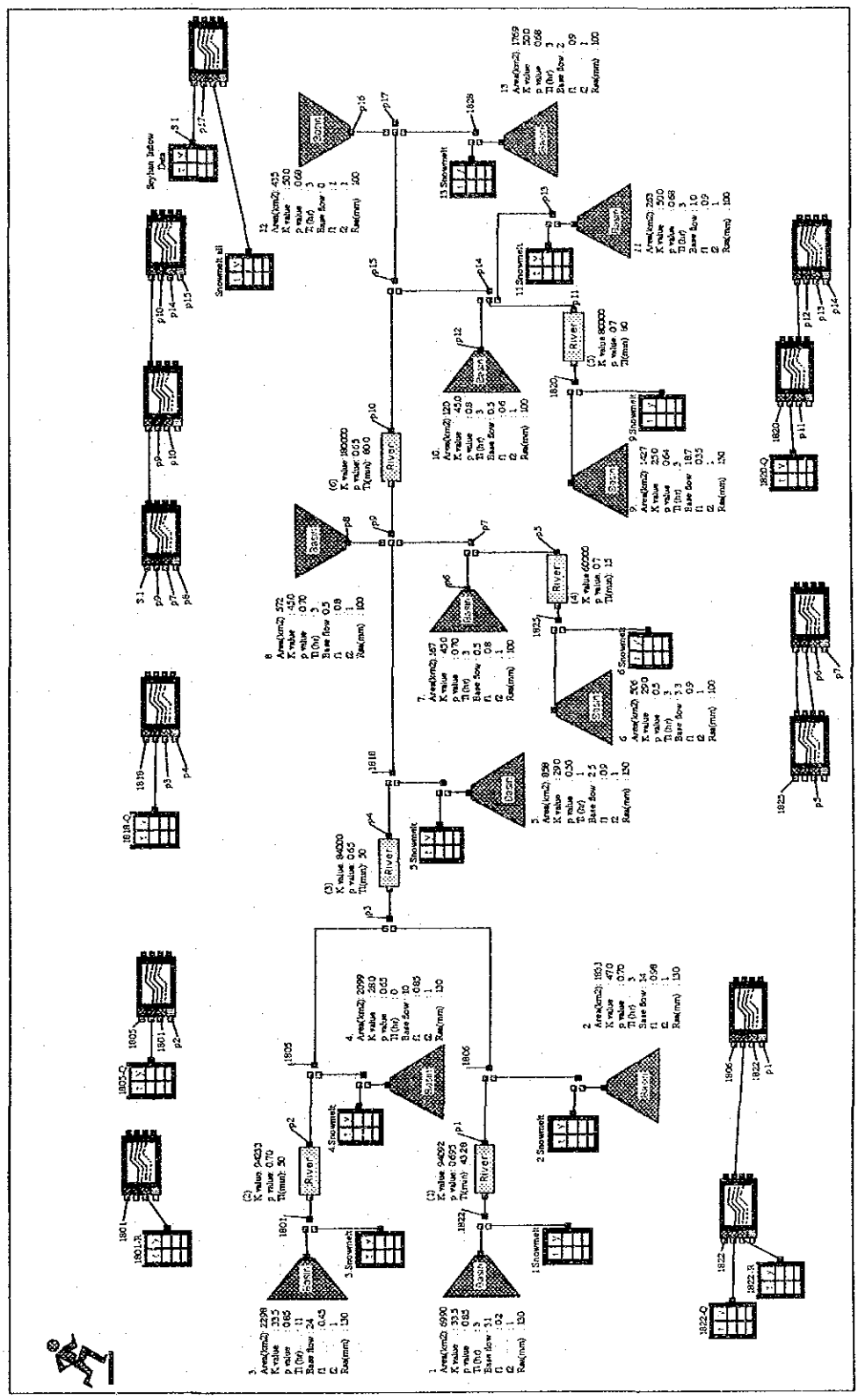
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING *AND WARNING SYSTEM FOR* SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 7.1.1 *RESULTS OF THE CALIBRATION OF* RUNOFF CALCULATION MODELS ('87 FLOOD)

FIG. NO.



THE REPUBLIC OF TURKEY *DEVLET SU İŞLERİ* GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 7.1.2 RESULTS OF THE CALIBRATION OF RUNOFF CALCULATION MODELS ('80 FLOOD)

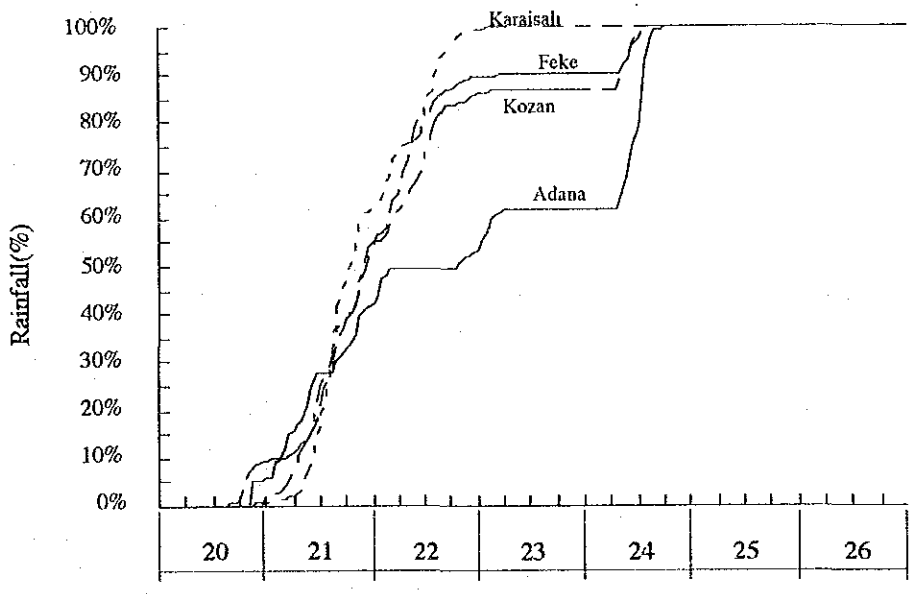
FIG. NO.



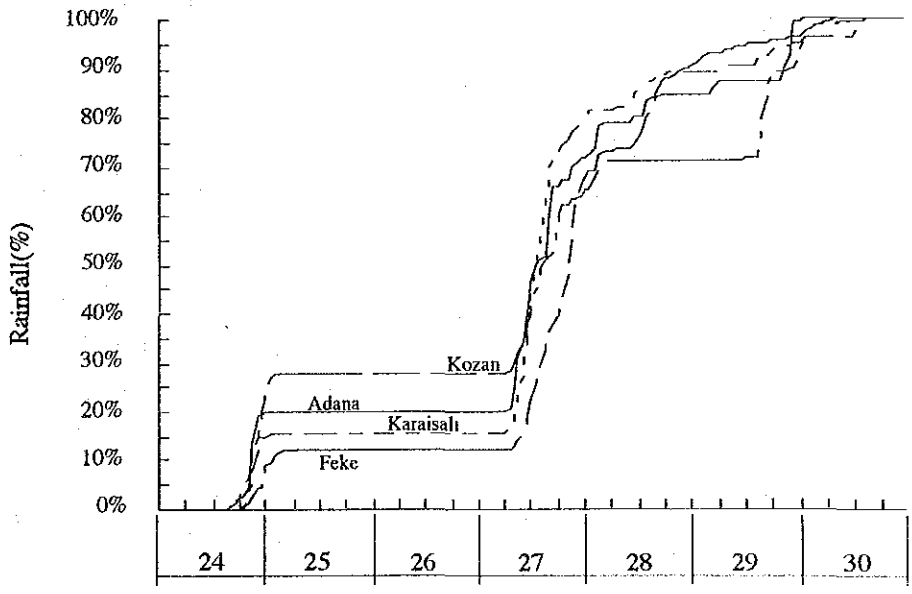
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING** ***AND WARNING SYSTEM FOR*** **SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE *Figure* 7.2.1 RESULTS OF COMPUTATION MODEL FOR FLOOD IN 1980

FIG. NO.

Dec. 20 - 26 '87

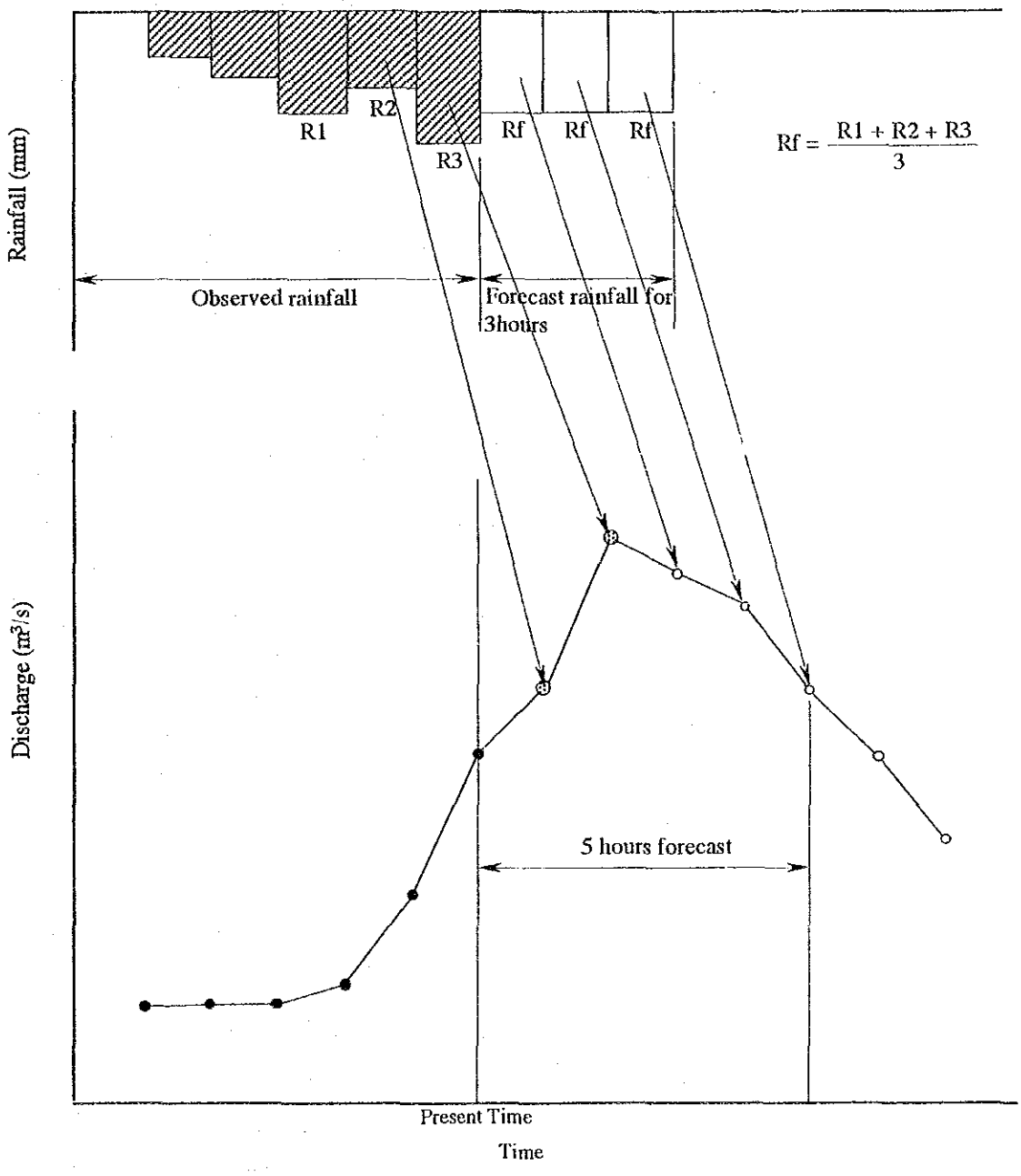


Mar. 24 - 30 '80



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 8.1.1 HOURLY RAINFALL MASS CURVES ('80 AND '87 FLOODS)

FIG. NO.



—○— Forecast Discharge with Rainfall Forecast

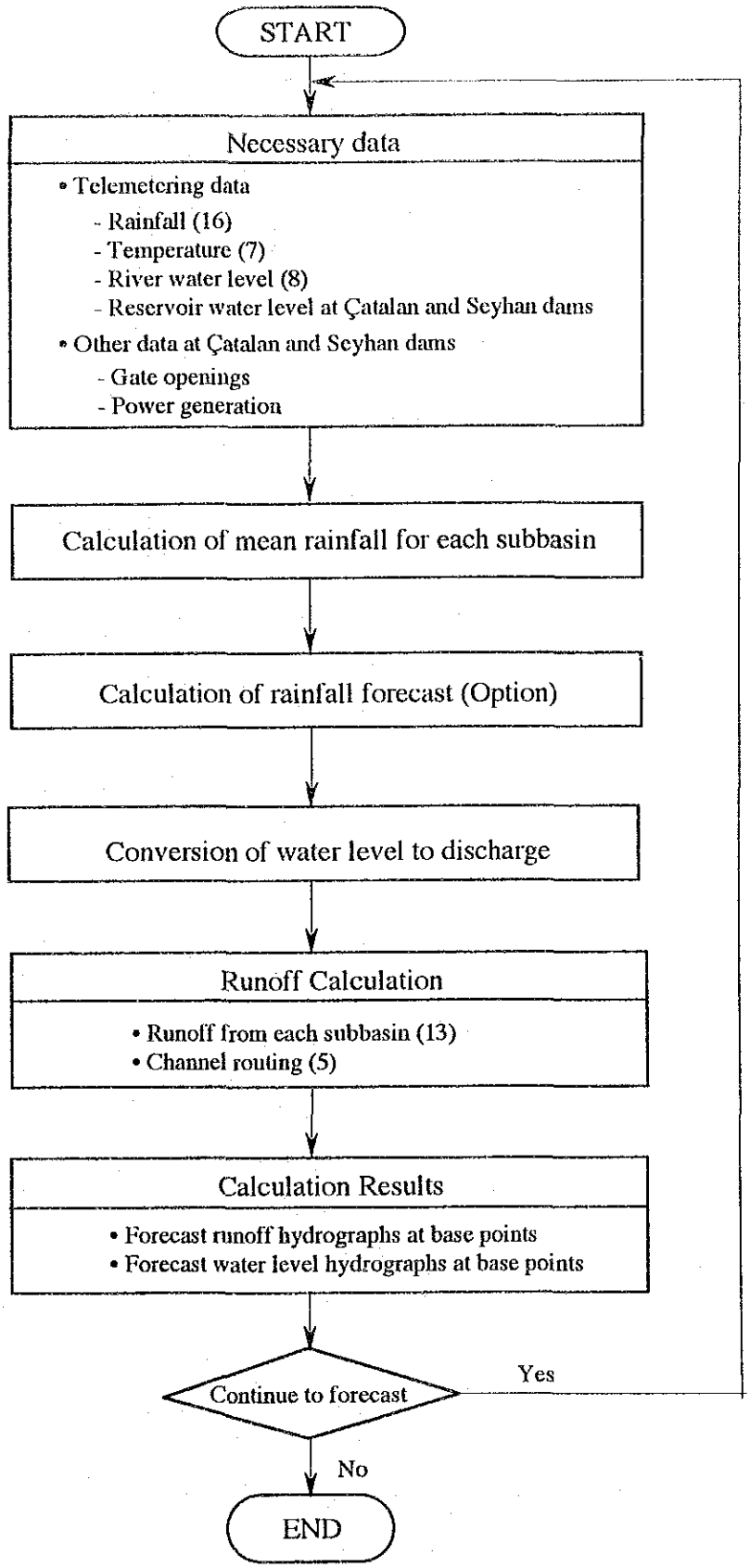
—⊙— Forecast Discharge without Rainfall Forecast

—●— *Observed Discharge*

Note : Time lag is 2 hours

THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE *Figure 8.2.1* SCHEMATIC DIAGRAM FOR METHOD OF RAINFALL FORCAST

FIG. NO.



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 9.1.1 GENERAL FLOOD FORECASTING PROCEDURE FOR RUNOFF SIMULATION

SUPPORTING REPORT B

RADIO WAVE PROPAGATION TEST

THE FEASIBILITY STUDY
ON
FLOOD CONTROL, FORECASTING AND WARNING SYSTEM
FOR
SEYHAN RIVER BASIN

Supporting Report B Radio Wave Propagation Test

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1. INTRODUCTION

A radio wave propagation test is one of the foremost study to obtain actual propagation losses in a path, environment noise , and etc. The values of theoretical circuit design are corrected by the values all of that are measured by the test. The radio wave propagation is highly dependent on the geographical condition and radio frequency used. If the site land selected proves to be unsuitable as a result of the test, alternative one should be selected to make a reliable radio link.

The objective of radio wave propagation test and site investigation was to gather necessary information about radio path conditions and site conditions and to design tentative radio circuits so that several alternative plans of telecommunication network can be proposed for the flood control, forecasting and warning system for Seyhan River basin.

The radio wave propagation test, which includes simplex and multiplex radio link was made based on the three alternative plans of hydrometeorological observation network and a brief design of the system. As a result of study, the transmission line of data collection system for three alternative plans of hydrometeorological observation network can be possible by means of the combination of simplex and multiplex radio system. However some gauging stations locating in mountainous area were unable to be possible because of obstructions by mountains. To solve the problem, placing a repeater station in the path or shifting their gauging points were studied.

The test was placed as a part of OJT program for staff of DSİ. In the program, the significance of test and method of test were discussed through the radio wave propagation test.

2. STUDY AREA, ROUTES AND SPANS

2.1 Study Area, Routes and Spans

The study area was the whole catchment area of Seyhan River basin. The test was conducted in accordance with a tentative plan of telecommunication network which was drafted by based on the three alternative plans of hydrometeorological network. The three alternative plan of hydrometeorological network is listed below.

Three Alternative Plans of Hydrometeorological Observation Network

Name of Gauging Station	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3
Çatalan Dam RG	√	√	√
Karsantı RG	√	√	√
Çiftehan RG	√	√	√
Pozantı RG	√	√	√
Karaisalı RG	√	√	√
Kamişlı RG	√	√	√
Çamardı RG	√	√	√
Feke RG	√	√	√
Mansurlu RG	√	√	√
Saimbeyli RG	√	√	√
Tufanbeyli RG	√	√	√
Kazancık RG	√	√	√
Sarız RG		√	
Pınarbaşı RG	√	√	
Şıhlı (Şeyhli) RG	√		
Toklar RG	√		
Tomarza RG	√	√	
1805 WL	√	√	√
1806 WL	√	√	√
1820 WL	√	√	√
1825 WL	√	√	√
1817 WL	√	√	√
1822 WL	√		√
1818(Eğner)WL	√	√	√
1801 WL	√	√	√
Seyhan Dam WL	√	√	√
Çatalan Dam WL	√	√	√

Note: RG: Rainfall gauging station

WL: Water-level gauging station

The tentative plan of telecommunication network for radio wave propagation test is shown in Figure 2.1.1. The tentative plan of telecommunication network indicates that the test performed is shown with a solid line and the theoretical study performed is shown with a dotted line.

2.2 Multiplex Radio Link

Several locations of repeater station were selected by considering proper repeater spacing. Then a study route was drafted. The theoretical circuit design and field survey were conducted at several conceivable locations. The foremost consideration in setting up a multiplex radio link is that line-of -sight transmission is required. In this field survey, the line-of-sight in a path was examined by means of flashing a path by reflecting sunlight off a mirror to the opposite end of the path, or mirror test. The radio paths were studied and evaluated by checking obstructions. The height of obstruction (ridge) in a path was checked with terrain contour maps.

The circuit design was made on assuming that the 2GHz band to be used for the multiplex radio link .
The study route of multiplex radio link is shown in Figure 2.2.1.

(1) The theoretical circuit design and field survey were conducted at several conceivable locations.

- Field survey and theoretical circuit design were conducted at the following station.

No.	Station	SPAN	Station
1.	DSİ Adana	-	Ziyaret T.
2.	Ziyaret T.	-	Seyhan Dam
3.	Ziyaret T.	-	Çatalan Dam
4.	Çatalan Dam	-	Karlik T.
5.	Karlik T.	-	Nernec T.
6.	Nernec T.	-	Feke Dağı

- Theoretical circuit design was conducted on the following station.

No.	Station	SPAN	Station
1.	Feke Dağı	-	Meydancık
2.	Meydancık	-	Süt T.

(2) The main study items of multiplex radio link are listed below.

- Survey of site aspects at the conceivable location
- Examination of site location
- Terrain profile
- Examination of line-of-sight condition with a mirror
- Examination of topography condition
- Examination of topography around the reflecting point

2.3 Simplex Radio Link

Several locations of repeater station were selected to connect each gauging station planned. Then a transmission route was drafted. The theoretical circuit design and radio wave propagation test for telemetry system was conducted based on the three alternative plan of hydrometeorological network, and the test for UHF radio link system was conducted based on the brief design of the system. The test of simplex radio was made by means of measuring the strength of a signal by transmitting radio waves. Radio frequencies used were: (1) 70.26MHz for the test of telemetry system, and (2) 411.7MHz for the test of data transmission system.

The each study route of simplex radio link is shown in Figure 2.3.1 to Figure 2.3.6.

(1) The theoretical circuit design and field survey were conducted at several conceivable locations.

- Radio wave propagation test for telemetry system was conducted at the following station.

No.	Repeater Station	No.	Water level gauging station	No.	Rainfall gauging station
1.	Karlık T.	1.	1818 (Eğner)	1.	Karaısalı
2.	Sallangac T.	2.	1806	2.	Hasanddede (Alternative point)
3.	Feke Dağı	3.	1805	3.	Mansurlu
4.	Bileğe T.	4.	1801	4.	Saimbeylı
		5.	1820	5.	Çiftehan
		6.	1825	6.	Kamişlı
		7.	1817	7.	Çamardı

- The site survey or theoretical calculation for telemetry system was conducted at the following station.

No.	Repeater Station	No.	Water level gauging station	No.	Rainfall gauging station
1.	Karataş T.	1.	Çatalan Dam	1.	Kazancık
2.	Kuzören	2.	Seyhan Dam	2.	Pinaraşı
3.	Alaylı (Ziyaret T.)	3.	1822	3.	Tomarza
4.	Süt T.			4.	Toklar
				5.	Seyhlı (Şıhlı)
5.	Kılkoyak T.			6.	Sarız
6.	Sırvan Dağı			7.	Karsantı
				8.	Feke
				9.	Pozantı
				10.	Çatalan Dam
				11.	Tufanbeyli

- Radio wave propagation test for UHF radio link system was conducted at the following station.

No.	Repeater Station	No.	Station
1.	Kuranşa	1.	Adana DSİ
		2.	Taşcı
		3.	Kuranşa

- Theoretical calculation was conducted at the following station.

No.	Station
1.	Yenice
2.	Doğankent
3.	Karayusuflu
4.	Baharlı
5.	Tabaklar

(2) The main study items of simplex radio link are listed below.

- Survey of site aspects (radio wave propagation conditions)
- Measuring of receiving power (receiving input voltage)
- Measuring of polarization plane pattern of antenna (horizontal pattern)
- Measuring of height pattern of antenna (height pattern)
- Measuring of signal to noise ratio
- Recording of external noise
- Survey of radio interference from existing radio station

(3) Test method

The test was made by selecting necessary items to be measured from the measuring items as listed above. A radio station was temporally established at both sides in accordance with the Schematic Diagram of Radio Wave Propagation Test Equipment is shown in Figure 2.3.7.

i) Communication test
This test is performed by setting a radio link between the master or repeater station and the gauging station. The transmitting side monitors the its output power with a through line power meter. In this test, the possibility of radio link is roughly evaluated by the communication over the radio.

ii) Measuring of receiving power (receiving input voltage)
Both of the stations aim their antenna each other with a map and compass.

The master station or repeater station transmits the test wave, while the gauging station measures the receiving signal with a field strength meter. Then, find the antenna direction where the maximum receiving signal is obtained as rotating the receiving antenna gradually to right and left. In this test, fluctuation of radio wave signal is examined by shifting the receiving antenna position to backward and forward(right and left). If the fluctuation is observed, polarization plane pattern of antenna and height pattern are measured as following method iii) and iv).

iii) Measuring of polarization plane pattern of antenna (horizontal pattern)
The gauging station measures the receiving signal as rotating the receiving antenna at intervals of 30 degree until the revolution of the antenna.

iv) Measuring of height pattern of antenna (height pattern)
The gauging station measures the receiving signal with keeping the antenna direction and lowering the receiving antenna height one meter at a time.

v) Measuring of signal to noise ratio (S/N)

- The transmitting side transmits a 800Hz test signal about 30 seconds, while the receiving side measures the output signal with a level meter. The signal measured is referred as Signal level (S).

- Then transmitting side transmits a non-modulated carrier about 30 seconds, while the receiving side measures the output signal (noise) with a level meter. The signal (noise) measured is referred as Noise level (N).

- The S/N can be calculated following equation.

  $S/N = S - N$ (dB)

  where

  S = Signal level (dB)
  N = Noise level (dB)

vi) Recording of external noise

vii) Survey of radio interference from existing radio station

viii) Measured data are filled in the Radio Propagation Data Sheet.

2.4 Equipment and Instruments

Equipment and instruments used for the radio wave propagation test are listed in Table 2.4.1.

3. TEST RESULTS AND EVALUATION

3.1 Multiplex radio link

Conditions of line-of-sight were confirmed by mirror test at each test location. The results of field survey for multiplex radio link are summarized in Table 3.1.1. The results of test data are shown in Table 3.1.2. In some spans the mirror test was unable to carry out due to limited survey period; theoretical path calculation was made based on terrain profiles. A mirror test including a field survey for the rest of station is required in the future.

Required field survey items in the future are listed below.

- Detailed field survey at each planed repeater station
- Path survey at each station at which the mirror test was not able to carry out during the field survey

(1) Criteria of multiplex radio link

The criteria of multiplex radio link are followed in accordance with CCIR (Consultative Committee International Radio) Recommendation 594 and Report 930.

Hypothetical reference circuit for radio relay system: length of reference circuit: 2,500km

Bit error rate(BER) should not exceed the following values.

- Short term: BER 1 x 10^{-3} during more than 0.054% x D (km) / 2,500 of any month (integration time 1 second)
- Long term: BER 1 x 10^{-6} during more than 0.4% x D (km) / 2,500 of any month (integration time 1 minute)

3.2 Simplex radio link

The test result shows that some stations require countermeasures such as a placement of repeater station or a selection of alternative location. These problems are mainly caused by obstructions existed in the radio path. The problems and their countermeasures are summarized in Table 3.2.1 and Table 3.2.2.

External noise was measured at several stations. The result suggests that the external noise will not significantly affect the radio circuits because the gauging stations and repeater

stations are located in remote area where there are less noise sources such as high voltage transmission lines, factories, and vehicles with ignition system.

As for radio interference from existing radio stations, no interference was observed at each station tested on the frequency and the frequency nearby.

The evaluation was made by considering the receiving voltage(calculated and measured value), fading, terrain profile, antenna patterns(horizontal and height pattern), and external noise power in all their aspects. The results of radio wave propagation test for simplex radio link are shown in Table 3.2.3 to Table 3.2.5. The location of gauging and repeater station is shown in Table 3.2.6 to Table 3.2.8. The result of site investigation is shown in Table 3.2.9 to Table 3.2.16.

(1) Criteria of simplex radio link

The criteria of simplex radio link are followed in accordance with a standard which is usually applied for telemetry radio link in VHF/UHF band as described below.

(a) Required signal to noise ratio (S/N)

The required signal to noise ratio for telemetry radio link is 30dB which is equivalent to the bit error rate 1 x 10^{-5} for obtaining the required C/N by applying following factors.

- Characteristics of modulation at VHF/UHF radio equipment
- Equivalent of peak noise power
- Distortion margin

(b) The standard signal to noise ratio of simplex radio link (S/Nsd)

The standard signal to noise is set by applying following factors.

- Fading margin
  - 70MHz band: 0.1dB/km + 3dB
  - 400MHz band: 0.2dB/km + 3dB
- Compensative value for 2 span connection
  - Simplex radio link: 3dB (per span)
  - Multiplex radio link: 0.3dB (Telemetry system)
- Other margin (deterioration margin)
  - 2.5dB

The standard S/N of simplex radio link is shown below.

(i) Telemetry Radio Link 70MHz Band

Number of radio span:	S/Nsd (dB)	Standard distance (km)
Single span	40.5	50
Two span	43.5	50
Connection with multiplex radio link	40.8	50

(ii) Telemetry Radio Link 400MHz Band

Number of radio span:	S/Nsd (dB)	Standard distance (km)
Single span	41.5	30
Two span	44.5	30
Connection with multiplex radio link	41.8	30

(c) Required receiving power

The required receiving power at standard S/Nsd (40.5dB) is set by applying noise figure and deterioration by external noise.

Required receiving power is shown below.

Item	Standard S/N(S/Nsd)	Remarks
EN(Ambient conditions in mountain area)	14.7 (NC: equivalent to 5dB)	The measured value can be applied as EN when the data is available.
Standard S/N	40.5dB	
Single span	-88.8dBm	required receiving power

(d) External noise

The noise deterioration (NC) by external noise to the radio circuit design is adopted from the following values listed below.

Frequency Band	Noise Deterioration (NC)	Condition of Location
70MHz Band	5dB	remote area, mountain area, river side(no residential area or road)
	10dB	suburb, near the high voltage transmission line
	15dB	vicinity of national road, cites
	Measured value	urban area(big city), heavy traffic road, industrial area
400MHz Band	2dB	all area except the area described bellow
	Measured value	urban area(big city), heavy traffic road, industrial area

5dB was adopted as a noise deterioration in design of 70MHz band radio circuit.

2dB was adopted as a noise deterioration in design of 400MHz band radio circuit.

3.3 Outline of Telecommunication Network

A telecommunication network is drafted based on the test results and technical considerations. The telecommunication network is made up of the combination of simplex radio, multiplex radio and PTT line. The outline of telecommunication network is shown in Figure 3.3.1.

Tables

Table 2.4.1 List of Equipment and Instruments for Radio Wave Propagation Test

No.	Description	Model/Rating	Quantity
1.	Radio Equipment 70MHz band	JHV-125	3 sets
2.	Radio Equipment 400MHz band	JHM-401S10ST	3 sets
3.	Sleeve Antenna 70MHz band	C-SH-060 2.15dB	1 set
4.	3 Element Yagi Antenna 70MHz band	C-3BD-0602 7.15dB	1 set
5.	Sleeve Antenna 400MHz band	C-SL-4502 2.15dB	1 set
6.	5 Element Yagi Antenna 400MHz band	C-5DV-450 11.15dB	1 set
7.	Field Strength Meter	ML518A	1 set
8.	Level Meter	LM-310	2 sets
9.	Through Line Power Meter	TLP-52A	2 sets
10.	Signal Generator 70MHz band	MG54E	1 set
11.	Signal Generator 400MHz band	MG54D	1 set
12.	Pen Recorder	EPR-121A	1 set
13.	Antenna Assemble Pole	10m	2 sets
14.	Coaxial Cable	10D-2V 20m	2 sets
15.	DC Power Supply Equipment	DC12V, 5A	2 sets
16.	Portable Engine Generator	AC100V, DC12V 300W	2 sets
17.	Tool Set		2 sets
18.	Circuit Tester		2 sets
19.	Binoculars		2 sets
20.	Camera		2 sets
21.	Altimeter		2 sets
22.	GPS Navigator	JLR-4400	1 set
23.	Personal Computer	PowerBook 160	2 set
24.	Printer	BJ-220JC	1 set
25.	Theodolite	TL-20F	2 sets
26.	Mirror		2 sets
27.	Intercom		2 sets
28.	Portable Computer		2 sets
29.	Camping Gear		2 sets

Table 3.1.1 The Results of Field Survey for Multiplex Radio Link

	Span	Summary of Test Result	Remarks
1.	DSİ Adana - Ziyaret T.	1) Line-of-sight was confirmed at each station by mirror test. 2) Antenna height at DSİ Adana should be high enough to clear trees in the site of DSİ Adana.	
2.	Çatalan Dam - Ziyaret T.	1) Line-of-sight was confirmed at each station by mirror test. 2) No obstruction was existed within the path.	
3.	Çatalan Dam - Karlık T.	1) Line-of-sight was confirmed at each station by mirror test. 2) The height of antenna tower should be determined by considering a hill which is existed in the front of Çatalan Dam.	
4.	Karlık T. - Nernek T.	1) Line-of-sight was confirmed at each station by mirror test. 2) No obstruction was existed within the path.	
5.	Nernek T. - Feke Dağı	1) Line-of-sight was confirmed at each station by mirror test. 2) No obstruction was existed within the path.	
6.	Seyhan Dam - Ziyaret T.	1) Line-of-sight was confirmed at each station by mirror test. 2) No obstruction was existed between the path. 3) Since the path is over the water with unblocked reflective paths, the design should take ground-reflected multipath fading into consideration.	

Table 3.1.2 Test Results of Multiplex Radio Link

No.	Radio Link	Latitude (N)			Longitude (E)			Distance	Azuimuth	Ground Level	Antenna Height	Elevation
		D	M	S	D	M	S	km	degree	m	m	degree
1	DSİ Adana	37	0	18	35	19	54		10.62	20.0	40.0	1° 05.7'
	Ziyaret T.	37	4	30	35	20	53	7.90	190.63	196.0	20.0	- 1° 10.0'
2	Ziyaret T.	37	4	30	35	20	53		202.51	196.0	20.0	- 1° 46.7'
	Seyhan Dam	37	2	32	35	19	52	3.94	22.50	75.0	20.0	1° 44.6'
3	Ziyaret T.	37	4	30	35	20	53		338.74	196.0	20.0	- 0° 13.6'
	Çatalan Dam	37	11	50	35	17	19	14.55	158.71	150.0	25.0	0° 05.7'
4	Çatalan Dam	37	11	50	35	17	19		31.51	150.0	25.0	1° 26.7'
	Karlık T.	37	33	8	35	33	44	46.25	211.68	1490.0	20.0	- 1° 51.7'
5	Karlık T.	37	33	8	35	33	44		70.31	1490.0	20.0	- 0° 32.5'
	Nemec T.	37	37	22	35	48	40	23.33	250.47	1312.0	20.0	0° 19.9'
6	Nemec T.	37	37	22	35	48	40		19.80	1312.0	20.0	0° 50.9'
	Feke Dağı	37	52	55	35	55	44	30.57	199.88	1838.0	20.0	- 1° 07.4'
7	Feke Dağı	37	52	55	35	55	44		68.59	1838.0	20.0	- 0° 55.6'
	Meydancık	37	55	13	36	3	9	11.67	248.67	1660.0	20.0	0° 49.3'
8	Meydancık	37	55	13	36	3	9		39.57	1660.0	20.0	1° 08.4'
	Süt Tepe	38	2	9	36	10	24	16.65	219.65	2013.0	20.0	- 1° 17.4'

Table 3.2.1 Problems and Countermeasures for Simplex Radio Link (1/2)

(1) Telemetry Radio Link

Span	Problems	Countermeasures
Karsantı - Karlık T.	The radio link quality is not sufficient because a steep slope of mountain blocks the radio path in the front of Karsantı. The terrain profile and result of calculated data suggest that it is less possibility to establish a radio link between the sites even if Karsantı's antenna is located at a height of 20m or more.	Karsantı should be moved to an alternative location where the radio link is possible to establish. Hasandede, as an alternative point, is selected and tested. The result of test, the radio link can be connected to Karlık T..
Çamardı - Bileğe T.	The radio link quality is not sufficient because the path is obstructed by a mountain.	Since the ridge of mountain in the path is high (about EL 2.170m), Çamardı (EL 1,490m) should be moved to a higher place within an allowable area in view of hydrometeorological technique. Çamardı (EL 1,670m), as an alternative point is selected and studied. The result of theoretical calculation suggests that the radio link can be connected to Bileğe T. It is advisable to do a further study including a radio wave propagation test in the future.
Mansurlu - Feke Dağı	The radio link quality is not sufficient because the path is obstructed by some mountains.	It is necessary to place a repeater station between the sites, or move to an alternative location where the radio link is possible to establish. Since the gauging station which is situated at the bottom of a mountain in mountain chains, it is difficult to find an alternative location in the vicinity of site. A location of repeater station, Karataş T., is selected for the study.
Saimbeyli - Feke Dağı	The radio link quality is not sufficient because the path is obstructed by some mountains.	It is necessary to place a repeater station between the sites, or move to an alternative location where the radio link is possible to establish. Since the gauging station which is situated at the bottom of a mountain in mountain chains, it is difficult to find an alternative location in the vicinity of site. A location of repeater station, Süt T., is selected for the study.

Table 3.2.2 Problems and Countermeasures for Simplex Radio Link (2/2)

(2) UHF Radio Link

Span	Problems	Countermeasures
DSİ Adana - Taşcı	Radio paths extending toward the down stream of Seyhan river from the DSİ 6th regional directorate is completely blocked by tall buildings(10 to 12 story). This results in the radio link quality insufficient.	The antenna of UHF radio system in the DSİ 6th regional directorate should be high enough so that the obstructions of these buildings are cleared.

Table 3.2.3 The Results of Radio Wave Propagation Test for Simplex Radio Link (1/3)

(1) Telemetry Radio Link

No.	Span	Receiving Voltage Calculated Value (dBμv)	Receiving Voltage Measured Value (dBμv)	Result of Evaluation
1.	Karlık T. - 1806 WL	38.6	35.0	Possible
2.	Karlık T. - 1805 WL	38.7	37.0	Possible
3.	Karlık T. - 1818 (Eğner)	46.7	63.0	Possible
4.	Karlık T. - Karsantı	14.7	-	The radio link cannot be established because of obstruction. Karsantı should be moved to an alternative location (Hasandede).
5.	Karlık T. - Hasandede (Alternative point)	32.4	25.5	The radio link can be connected to Karlık T. repeater station.
6.	Feke Dağı - 1801 WL	31.7	47.0	Possible
7.	Feke Dağı - Saimbeyli	25.2	22.0	The radio link cannot be connected directly to Feke Dağı repeater station. Therefore, it is necessary to place a repeater station to extend communication range. Süt Tepe was selected as a repeater station.
8.	Feke Dağı - Mansurlu	-14.0	13.0	The radio link cannot be connected directly to Feke Dağı repeater station. Therefore, it is necessary to place a repeater station to extend communication range. Karataş T. was selected as a repeater station.
9.	Feke Dağı - Karataş T.	45.9	-	The result of theoretical calculation suggests that the radio link is possible.
10.	Feke Dağı - Feke	25.4	-	-
11.	Karataş - Mansurlu	51.3	-	-
12.	Süt Tepe - Saimbeyli	29.6	-	-
13.	Süt Tepe - Tufanbeyli	31.2	-	-
14.	Sallangaç T. - Çatalan dam	56.5	70.0	Possible
15.	Sallangaç T. - 1820 WL	45.9	50.0	Possible
16.	Sallangaç T. - 1825 WL	26.3	39.0	Possible
17.	Sallangaç T. - 1817 WL	36.4	48.0	Possible
18.	Sallangaç T. - 1828 WL	37.0	-	-

Table 3.2.4 The Results of Radio Wave Propagation Test for Simplex Radio Link (2/3)

(1) Telemetry Radio Link

No.	Span	Receiving Voltage Calculated Value (dBμv)	Receiving Voltage Measured Value (dBμv)	Result of Evaluation
19.	Sallangaç T. - Karaisalı	56.2	57.0	Possible
20.	Bileğe T. - Çiftehan	36.5	52.0	Possible
21.	Bileğe T. - Kamışlı	16.9	38.0	Possible
22.	Bileğe T. - Çamardı	12.9	18.0	The radio link cannot be established because of obstruction. Çamardı should be moved to an alternative location.
23.	Bileğe T. - Çamardı (Alternative point)	29.7	-	The result of theoretical calculation suggests that the radio link is possible.
24.	Bileğe T. - Çatalan dam	31.7	-	-
25.	Bileğe T. - Pozantı	41.5	-	-
26.	Kılkoyak T. - Sarız	44.7	-	-
27.	Kılkoyak T. - Sırvan Dağı	51.0	-	-
28.	Kılkoyak - Süt T	48.9	-	-
29.	Sırvan Dağı - Pınarbaşı	62.0	-	-
30.	Sırvan Dağı - Toklar	48.3	-	-
31.	Sırvan Dağı - Kazancık	48.3	-	-
32.	Feke Dağı - Alayli (Ziyaret T.)	52.1	-	-
33.	Alayli (Ziyaret T.) - Tomarza	49.9	-	-
34.	Alayli (Ziyaret T.) - 1822 WL	43	-	-
35.	Alayli (Ziyaret T.) - Kuzören T.	32.5	-	-
36.	Kuzören T. - Seyhlı (Sıhlı)	50.6	-	-

Note: The evaluation was made by considering the receiving voltage (calculated and measured value), fading, terrain profile, and antenna patterns (horizontal and height pattern), and external noise in all their aspects.

Table 3.2.5 The Results of Radio Wave Propagation Test for Simplex Radio Link (3/3)

(2) UHF Radio Link

No.	Span	Receiving Voltage Calculated Value (dBμv)	Receiving Voltage Measured Value (dBμv)	Result of Evaluation
1.	DSİ Adana - Taşcı	32.5	16.0	Receiving voltage of measured valuewas a quite low level compared with calculated one because the path was blocked by tall buildings which have surrounded the test antenna at DSİ Adana. If the antenna at Adana is located at 40m above the ground, the radio link will be possible.
2.	DSİ Adana - Kuranşa	38.5	9.0	ditto
3.	DSİ Adana - Yenice	22.6	-	ditto
4.	DSİ Adana - Doğankent	33.3	-	ditto
5.	DSİ Adana - Karayusufulu	29.5	-	ditto
6.	Kuranşa - Baharlı	41.5	-	-
7.	Kuranşa - Tabaklar	43.3	-	-

Note: The evaluation was made by considering the receiving voltage (calculated and measured value), fading, terrain profile, and antenna patterns (horizontal and height pattern), and external noise in all their aspects.

Table 3.2.6 Location of Station (1/3)

No.	Radio Link	Latitude (N)			Longitude (E)			Distance	Azuimuth	Ground Level
		D	M	S	D	M	S	km	degree	m
1	Karlık T.	37	33	8	35	33	44		7.69	1490.0
	1806(WL)	37	40	0	35	34	54	12.82	187.70	350.0
2	Karlık T.	37	33	8	35	33	44		32.00	1490.0
	1805(WL)	37	37	4	35	36	49	8.57	212.00	310.0
3	Karlık T.	37	33	8	35	33	44		213.80	1490.0
	1818(Eğner)	37	25	22	35	27	13	17.28	33.73	150.0
4	Karlık T.	37	33	8	35	33	44		268.80	1490.0
	Karsantı	37	32	58	35	23	29	15.10	88.80	850.0
5	Karlık T.	37	33	8	35	33	44		252.90	1490.0
	Hasandede(Alternative point)	37	30	45	35	24	0	15.00	72.90	1050.0
6	Feke Dağı	37	52	55	35	55	44		97.90	1838.0
	1801(WL)	37	52	2	36	3	47	11.91	277.90	680.0
7	Feke Dağı	37	52	55	35	55	44		50.23	1838.0
	Saimbeyli	37	59	12	36	5	17	18.19	230.33	980.0
8	Feke Dağı	37	52	55	35	55	44		263.00	1838.0
	Mansurlu	37	51	21	35	39	20	24.22	83.00	970.0
9	Feke Dağı	37	52	55	35	55	44		264.06	1838.0
	Karataş T.	37	51	38	35	40	22	22.66	83.91	1520.0
10	Karataş T.	37	51	38	35	40	22		250.90	1520.0
	Mansurlu	37	51	21	35	39	20	1.60	70.90	970.0
11	Feke Dağı	37	52	55	35	55	44		189.30	1838.0
	Feke	37	49	7	35	54	57	7.12	9.30	560.0
12	Süt Tepe	38	2	9	36	10	24		233.90	1660.0
	Saimbeyli	37	59	12	36	5	17	9.26	53.90	930.0
13	Çatalan Dam	37	11	50	35	17	19		325.30	150.0
	Sallangaç T.	37	19	41	35	10	31	17.66	145.30	559.0
14	Sallangaç T.	37	19	41	35	10	31		208.88	559.0
	1820(WL)	37	17	48	35	9	13	3.98	28.86	180.0
15	Sallangaç T.	37	19	41	35	10	31		22.83	559.0
	1825(WL)	37	21	48	35	11	38	4.25	202.85	230.0
16	Sallangaç T.	37	19	41	35	10	31		233.85	559.0
	1817(WL)	37	14	3	35	0	53	17.64	53.75	160.0
17	Sallangaç T.	37	19	41	35	10	31		193.61	559.0
	1828(WL)	37	6	14	35	6	27	25.59	13.57	78.0
18	Sallangaç T.	37	19	41	35	10	31		234.10	559.0
	Karaisalı	37	15	34	35	3	24	12.98	54.10	241.0

Table 3.2.7 Location of Station (2/3)

No.	Radio Link	Latitude (N)			Longitude (E)			Distance	Azuimuth	Ground Level
		D	M	S	D	M	S	km	degree	m
18	Bileğe T.	37	27	9	34	48	4		340.30	2350.0
	Çiftehan	37	30	47	34	46	26	7.14	160.30	960.0
19	Bileğe T.	37	27	9	34	48	4		49.00	2350.0
	Kamişlı	37	33	21	34	57	0	17.46	229.00	1130.0
20	Bileğe T.	37	27	9	34	48	4		21.09	2350.0
	Çamardı	37	50	0	34	59	11	45.32	201.21	1490.0
21	Bileğe T.	37	27	9	34	48	4		159.52	2350.0
	Çamardı(Alternative point)	37	50	30	34	59	0	46.08	200.48	1670.0
22	Bileğe T.	37	27	9	34	48	4		123.10	2350.0
	Çatalan Dam	37	11	50	35	17	19	51.66	303.40	150.0
23	Kılkoyak T.	38	23	21	36	21	26		51.50	2485.0
	Sarız	38	29	35	36	28	7	15.08	231.50	1615.0
24	Kılkoyak T.	38	23	21	36	21	26		7.82	2485.0
	Sırvan Dağı	38	41	8	36	24	33	33.20	187.85	2300.0
25	Sırvan Dağı	38	41	8	36	24	33		340.50	2300.0
	Pınarbaşı	38	43	30	36	23	45	4.53	160.50	1525.0
26	Sırvan Dağı	38	41	8	36	24	33		229.61	2300.0
	Toklar	38	25	9	36	0	44	45.51	49.36	1550.0
27	Sırvan Dağı	38	41	8	36	24	33		17.30	2300.0
	Kazancık	39	4	29	36	33	45	45.19	197.30	1687.0
28	Feke Dağı	37	52	55	35	55	44		9.20	1838.0
	Alaylı (Ziyaret T.)	38	8	39	35	58	57	29.48	189.20	2250.0
29	Alaylı (Ziyaret T.)	38	8	39	35	58	57		333.89	2250.0
	Tomarza	38	26	59	35	47	31	37.78	153.77	1390.0
30	Alaylı (Ziyaret T.)	38	8	39	35	58	57		289.70	2250.0
	1822(WL)	38	14	45	35	37	29	33.30	109.70	1270.0
31	Alaylı (Ziyaret T.)	38	8	39	35	58	57		263.84	2250.0
	Kuzören T.	38	6	52	35	38	24	30.20	83.62	1800.0
32	Kuzören T.	38	6	52	35	38	24		193.45	1800.0
	Seyhlı (Sıhlı)	38	5	36	35	38	1	2.41	13.45	1380.0
33	Bileğe T.	37	27	9	34	48	4		117.60	2350.0
	Pozantı	37	25	24	34	52	21	7.10	297.90	780.0
35	Kılkoyak T.	38	23	21	36	21	26		202.38	2485.0
	Süt T.	38	2	9	36	10	24	42.39	22.27	2013.0
36	DSİ Adana	37	0	18	35	19	54		182.50	20.0
	Taşcı	36	52	37	35	19	29	14.22	2.50	16.0

Table 3.2.8 Location of Station (3/3)

No.	Radio Link	Latitude (N)			Longitude (E)			Distance	Azuimuth	Ground Level	
		D	M	S	D	M	S	km	degree	m	
37	DSİ Adana	37	0	18	35	19	54		211.52	20.0	
	Kuranşa	36	47	37	35	10	14	27.50	31.42	5.0	
38	Kuranşa	36	47	37	35	10	14		72.30	5.0	
	Tabaklar	36	45	0	35	0	4	15.88	252.30	3.0	
39	DSİ Adana	37	0	18	35	19	54		264.36	20.0	
	Yenice	36	59	0	35	3	0	25.19	84.26	30.0	
40	DSİ Adana	37	0	18	35	19	54		185.39	20.0	
	Doğankent	36	53	0	35	19	0	13.57	5.38	16.0	
41	Süt Tepe	38	2	9	36	10	24		6.10	24850.0	
	Tufanbeyli	38	16	0	36	12	17	25.76	186.10	1450.0	
42	DSİ Adana	37	0	18	35	19	54		208.08	20.0	
	Karayusufulu	36	52	13	35	14	32	16.94	28.03	10.0	
43	Kuranşa	36	47	37	35	10	14		260.03	5.0	
	Baharlı	36	45	47	34	57	21	19.46	79.90	10.0	

Table 3.2.9 Result of Site Investigation (1/8)

Name of Station	Type	Result of Investigation
1818 WL (EĞNER)	Water level	Eğner was selected as an alternative location to avoid the possible influence of Çatalan Dam back water on the water level gauging station planned. The elevation is about 150m. The radio link can be connected to Karlık T. repeater station and no problem will be arisen for radio propagation. The gauging station will be separated into telemetry station (station housing) and water level gauge (well). The distance of separation is about 50m. Electricity is available in the vicinity of site. The site is no problem of sunshine condition for possible use of solar cell.
1806	Water level	The radio link can be connected to Karlık T. repeater station and no problem will be arisen for radio propagation. The gauging station will be separated into telemetry station (station housing) and water level gauge (well). The distance of separation is about 30m. Electricity is available in the vicinity of site. The site is no problem of sunshine condition for possible use of solar cell.
1805	Water level	The radio link can be connected to Karlık T. repeater station and no problem will be arisen for radio propagation. The gauging station will be separated into telemetry station (station housing) and water level gauge (well). The distance of separation is about 20m. There was no power line in the vicinity of site. Since the site is close to on the south slope of mountain, the location of solar cell should be selected by taking the sunshine condition into consideration.
Karsantı	Rainfall	The propagation test was not performed at the site because the terrain profile and calculated data suggested that the radio link cannot be established at this point. A steep slope of mountain in the front of Karsantı blocks the radio path. It is necessary to move to an alternative location where the radio link is possible to establish. Then Hasandede was selected as an alternative point for the test.

Table 3.2.10 Result of Site Investigation (2/8)

Name of Station	Type	Result of Investigation
Hasandede (Alternative point)	Rainfall	Hasandede is located to the south of Karsantı. The distance is about 4km from Karsantı. The elevation difference between the sites is 200m. The elevation of each location is: (1) Karsantı: 850m (2) Hasandede: 1.050m The site is located next to the existing TRT's TV satellite station. The radio wave propagation test was conducted. The test result shows that the radio link can be connected to Karlık repeater station. Electricity is available in the vicinity of site. The site is no problem of sunshine condition for possible use of solar cell.
Karlık T.	Repeater (μ-v)	The site is on the top of mountain and situated near the fire observation tower which belongs to the State of Forestry Agency. Access road (unstabilized) is available to the fire tower, but no access road is available to the repeater site from the unstabilized road. It takes about 7 minutes on foot, or about 200m. Since the site is covered with rock, the land development is required for constructing a station and antenna tower. There was no power line in the vicinity of site. Since the location is on the top of mountain, there is a great possibility that the station planned will be suffered by lightning. Therefore, the design of grounding system should carefully be considered.
1825	Water level	The radio link can be connected to Sallangac T. repeater station. The site was surrounded by pain trees which height about 10m, therefore the height of antenna tower should be 15m. The gauging station will be separated into telemetry station(station housing) and water level gauge(well). The distance of separation is about 15m. There was no power line in the vicinity of site. The site is no problem of sunshine condition for possible use of solar cell.

Table 3.2.11 Result of Site Investigation (3/8)

Name of Station	Type	Result of Investigation
1820	Water level	The radio link can be connected to Sallangac T. repeater station. The gauging station will be separated into telemetry station(station housing) and water level gauge(well). The distance of separation is about 10m. The floor level of station house and well should be high enough not to suffer from flood water. In addition, a retaining wall may be required around the well to protect the embankment against erosion. Electricity is available in the vicinity of site. The site is no problem of sunshine condition for possible use of solar cell.
Karaısalı	Rainfall	The test was conducted at the DMİ's weather station. The radio link can be connected to Sallangac T. repeater station. Electricity is available at the site. The site is no problem of sunshine condition for possible use of solar cell.
1817	Water level	The condition of radio wave propagation was no problem, however the site was not suitable for setting a water level gauge. There were two considerable problems: (1) Occurrence of water turbulence (2) Accumulation of cobble stone in the riverbed In this reason, an alternative station, 1828, was selected for the study.

Table 3.2.12 Result of Site Investigation (4/8)

Name of Station	Type	Result of Investigation
1828	Water level	The elevation of 1828 was surveyed, by DSİ in December 1993, whether or not the site is influenced by the back water of Seyhan Dam. The survey result shows that the gauging station will not be influenced by the back water of Seyhan Dam, HWL is 67.5m. There is a staff gauge(0m to 4m) on the well at 1828, and the staff gauge 0m is equal to the elevation 77.554m. The radio wave propagation test was not performed at 1828, however the result of theoretical calculation suggests that the radio link between Sallangac and 1828 is possible. It is advisable to do a further study including a radio wave propagation test in the future. There was no power line in the vicinity of the site. There is no problem of sunshine condition for possible use of solar cell. The water level gauging station will be separated into telemetry station and water level gauge. the distance of separation is about 200m.
Sallangaç T.	Repeater (v-v)	The radio wave propagation test was performed at the fire observation tower of Forestry Agency. Electricity is available at the site. The site is no problem of sunshine condition for possible use of solar cell. Since the location is on the top of mountain, there is a great possibility that the station planned will be suffered by lightning. Therefore, the design of grounding system should carefully be considered.
Çiftehan	Rainfall	The radio link can be connected to Bileğe T. repeater station. Electricity is available in the vicinity of the site. There is no problem of sunshine condition for possible use of solar cell.
Kamışlı	Rainfall	The radio link can be connected to Bileğe T. repeater station. Electricity is available in the vicinity of the site. There is no problem of sunshine condition for possible use of solar cell.

Table 3.2.13 Result of Site Investigation (5/8)

Name of Station	Type	Result of Investigation
Çamardı	Rainfall	The propagation test was conducted near the existing meteorological observation station. The radio link cannot be connected to Bileğe T. from this point because the path has been obstructed by a mountain which is existed about 1 km far from the site. It is necessary to move to an alternative location where the radio link is possible to establish. An alternative location was selected for the study. And the result of study is described as follows.
Çamardı (Alternative point)	Rainfall	An alternative location is close to the existing TRT' TV satellite station in Çamardı. The distance is about 0.77km far from the existing meteorological observation station. The elevation difference between the sites is 180m. The elevation of each location is: (1) Existing meteorological station: 1,490m (2) Alternative location: 1,670m The radio wave propagation test was not conducted at the site, however the result of theoretical calculation suggests that the radio link between Bileğe T. and the site is possible. It is advisable to do a further study including a radio wave propagation test in the future. Electricity is available in the vicinity of site. The site is no problem of sunshine condition for possible use of solar cell.
Pozantı	Rainfall	The site survey was conducted at an area in the local government (T.C. Pozantı Belediyesi). Electricity is available at the site. The site is no problem of sunshine condition for possible use of solar cell.

Table 3.2.14 Result of Site Investigation (6/8)

Name of Station	Type	Result of Investigation
Bileğe T.	Repeater (v-v)	The radio wave propagation test was conducted on the side of Bileğe Tepe, EL 2,350m. The summit of Bileğe Tepe. is 2,508m. The site is suitable for repeater station in view of radio propagation, however the site is not easily accessible. It takes about two hours and 10 minutes by foot from Horz village. Footpath is available for a half way to the site which belongs to the State of Forestry Agency. It is necessary to study the availability of access road to the site from Pozantı in future. There was no power line in the vicinity of the site. The site is no problem of sunshine condition for possible use of solar cell.
1801	Water level	The radio link can be connected to Feke Dağı repeater station. The antenna should be placed so that the height of antenna is higher than 10m from the surface of national road. The gauging station will be separated into telemetry station(station housing) and water level gauge(well). The distance of separation is about 10m. The floor level of station house and well should be high enough not to suffer from flood water. Electricity is available in the vicinity of site. The site is no problem of sunshine condition for possible use of solar cell.
Mansurlu	Rainfall	The radio link cannot be connected to Feke Dağı repeater station from this point because the radio path is heavily obstructed by mountains. For the access road condition to the site, unstabilized road is available and a car can be accessible in dry condition. There was no power line in the vicinity of site. The site was no problem of sunshine condition for possible use of solar cell. It is necessary to place a repeater station, or move to an alternative location where the radio link is possible to establish. Since the site that is situated at the bottom of a mountain in mountain chains, it is difficult to find an alternative location in the vicinity of area. Therefore, Karataş was selected as a repeater station for the study.

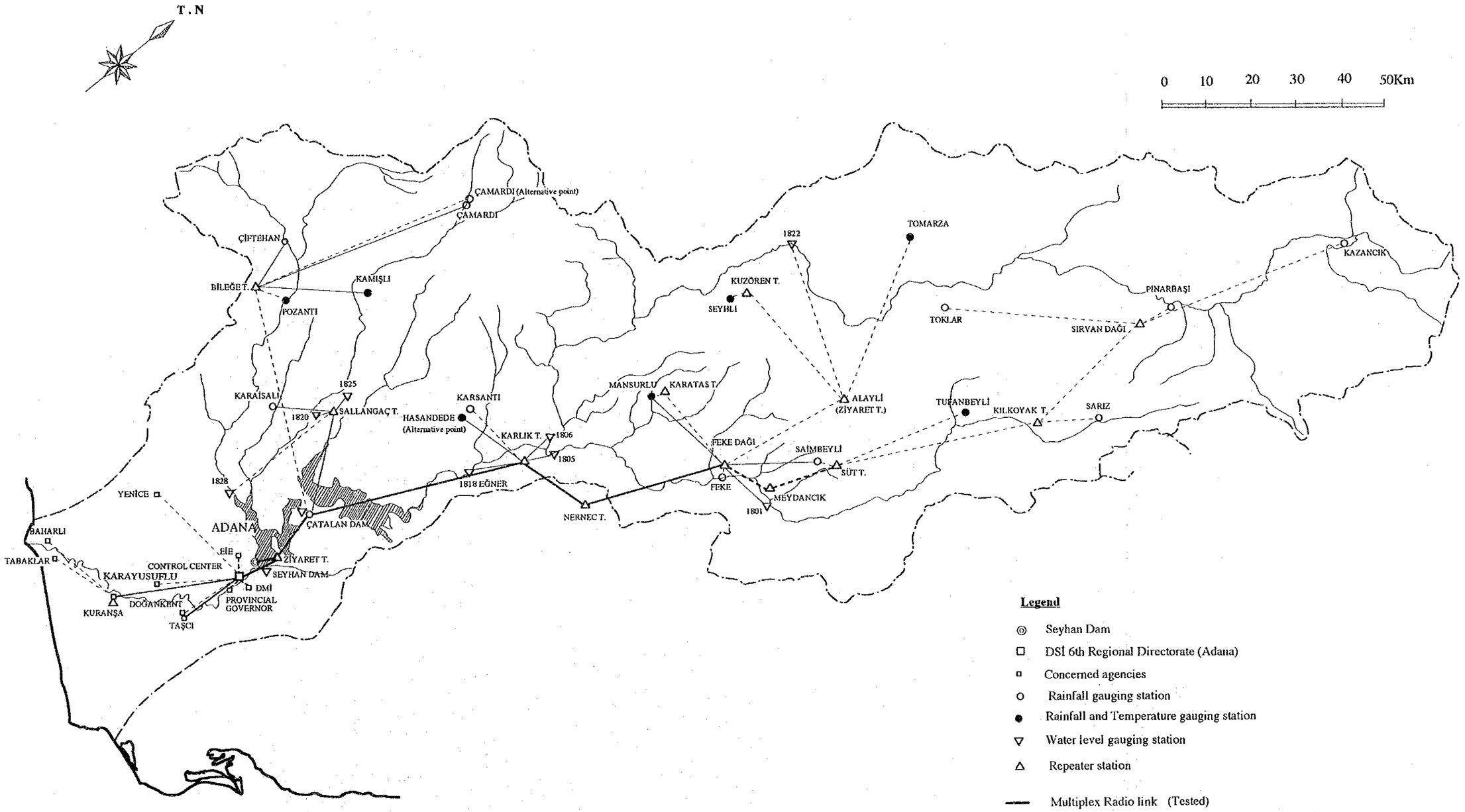
Table 3.2.15 Result of Site Investigation (7/8)

Name of Station	Type	Result of Investigation
Karataş T.	Repeater (v-v)	The result of theoretical path calculation suggests the radio links will be possible to establish. It is advisable to do a further study including a radio wave propagation test in the future.
Saimbeyli	Rainfall	The radio link cannot be connected to Feke Dağı repeater station from this point because the radio path is obstructed by mountains. It is necessary to place a repeater station or move to an alternative location where the radio link is possible to establish. Since the site that is situated at the bottom of a mountain in mountain chains, it is difficult to find an alternative location in the vicinity of that area. Therefore, Süt Tepe was selected as a repeater station for the study. Electricity is available in the vicinity of site. The site was no problem of sunshine condition for possible use of solar cell.
Süt Tepe	Repeater (μ-v or v-v)	The result of theoretical path calculation suggests that the radio links will be possible to establish. It is advisable to do a further study including a radio wave propagation test in the future.
Feke	Rainfall	The site survey was conducted at an area in the local government (Hükümet Konağı). Electricity is available at the site. The site was no problem of sunshine condition for possible use of solar cell.
Feke Dağı	Repeater (μ-v)	The test was conducted at the fire observation tower which belongs to the State of Forestry Agency. Access road(unstabilized) is available from Feke to the fire tower. It takes about 75 minutes by car. The land development is required for constructing a station and antenna tower. Electrictiy is available at the site. There was no problem of sunshine condition for possible use of solar cell. Since the location is on the top of mountain, there is a great possibility that the station planned will be suffered by lightning. Therefore, the design of grounding system should carefully be considered.

Table 3.2.16 Result of Site Investigation (8/8)

Name of Station	Type	Result of Investigation
Sarız	Rainfall	The site survey was made at the existing weather station of DMİ. Electricity is available at the site. There was no problem of sunshine condition for possible use of solar cell. The result of theoretical path calculation suggests that the radio link between Sarız and Kilkoyak T. repeater station will be possible to establish. It is advisable to do a further study including a radio wave propagation test in the future.
Kazancık	Rainfall	The site survey was made at the existing weather station of DMİ. There was no power line in the vicinity of site. There was no problem of sunshine condition for possible use of solar cell. The result of theoretical path calculation suggests that the radio link between Kazancık and Sirvan dağı repeater station will be possible to establish. It is advisable to do a further study including a radio wave propagation test in the future.
Pinarbaşi	Rainfall	The site survey was made at the existing weather station of DMİ. Electricity is available at the site. There was no problem of sunshine condition for possible use of solar cell. The result of theoretical path calculation suggests that the radio link between Pinarbaşi and Sirvan dağı repeater station will be possible to establish. It is advisable to do a further study including a radio wave propagation test in the future.
1822	Water level	The site survey was made at the existing water level gauging station of EİE. Electricity is available in the vicinity of site. There was no problem of sunshine condition for possible use of solar cell. The result of theoretical path calculation suggests that the radio link between 1822 and Alaylí repeater station will be possible. It is advisable to do a further study including a radio wave propagation test in the future.

Figures



Legend

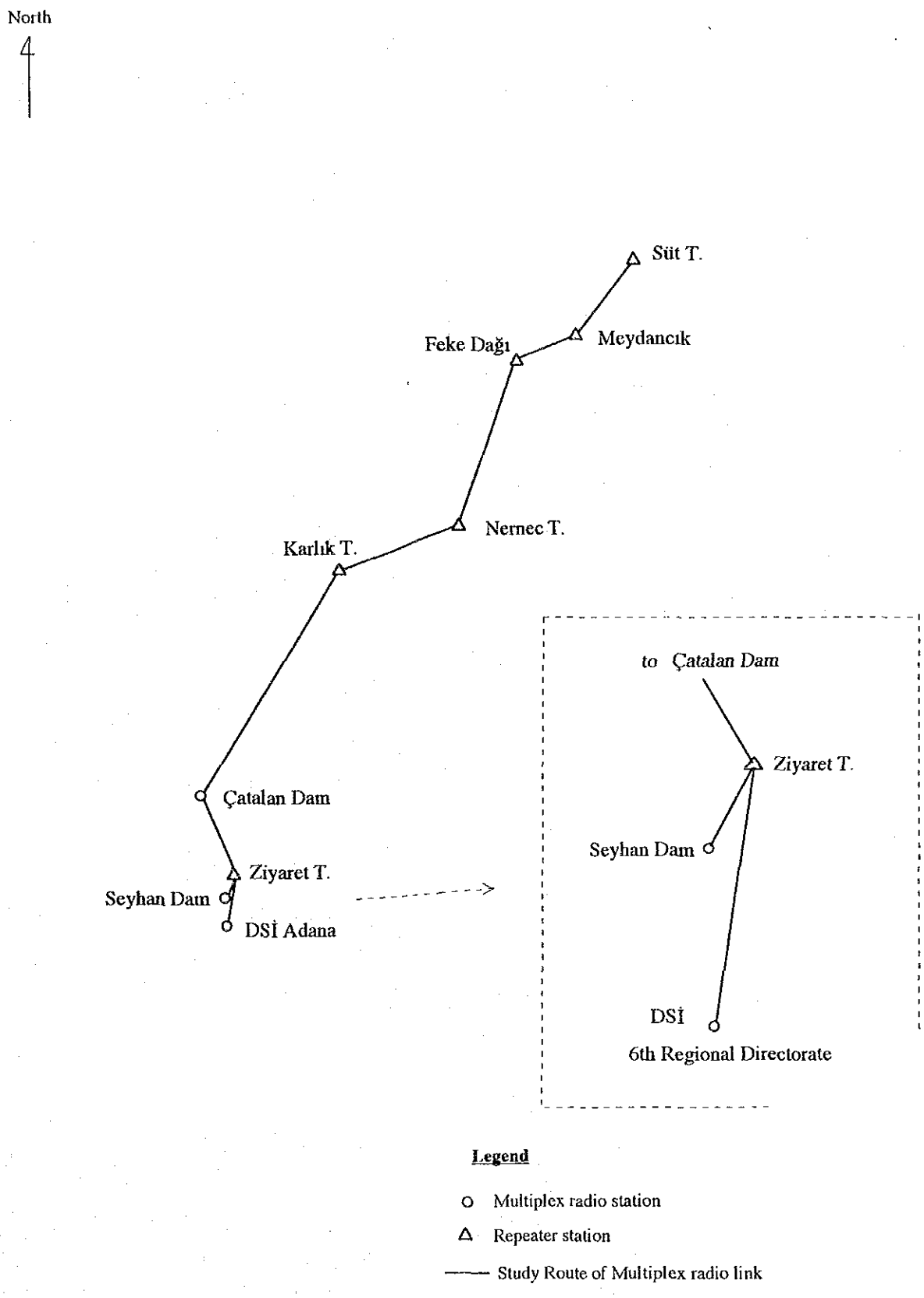
- ◎ Seyhan Dam
- □ DSİ 6th Regional Directorate (Adana)
- ▫ Concerned agencies
- ○ Rainfall gauging station
- ● Rainfall and Temperature gauging station
- ▽ Water level gauging station
- △ Repeater station
- ——— Multiplex Radio link (Tested)
- —— Simplex or Duplex radio link for voice communication 400MHz band (Tested)
- — Simplex radio link for telemetry 70MHz band (Tested)
- - - - Multiplex Radio link (Theoretical circut design)
- - - Simplex Radio link 70MHz and 400MHz band (Theoretical circuit design)
- ----- PTT line

Notes:

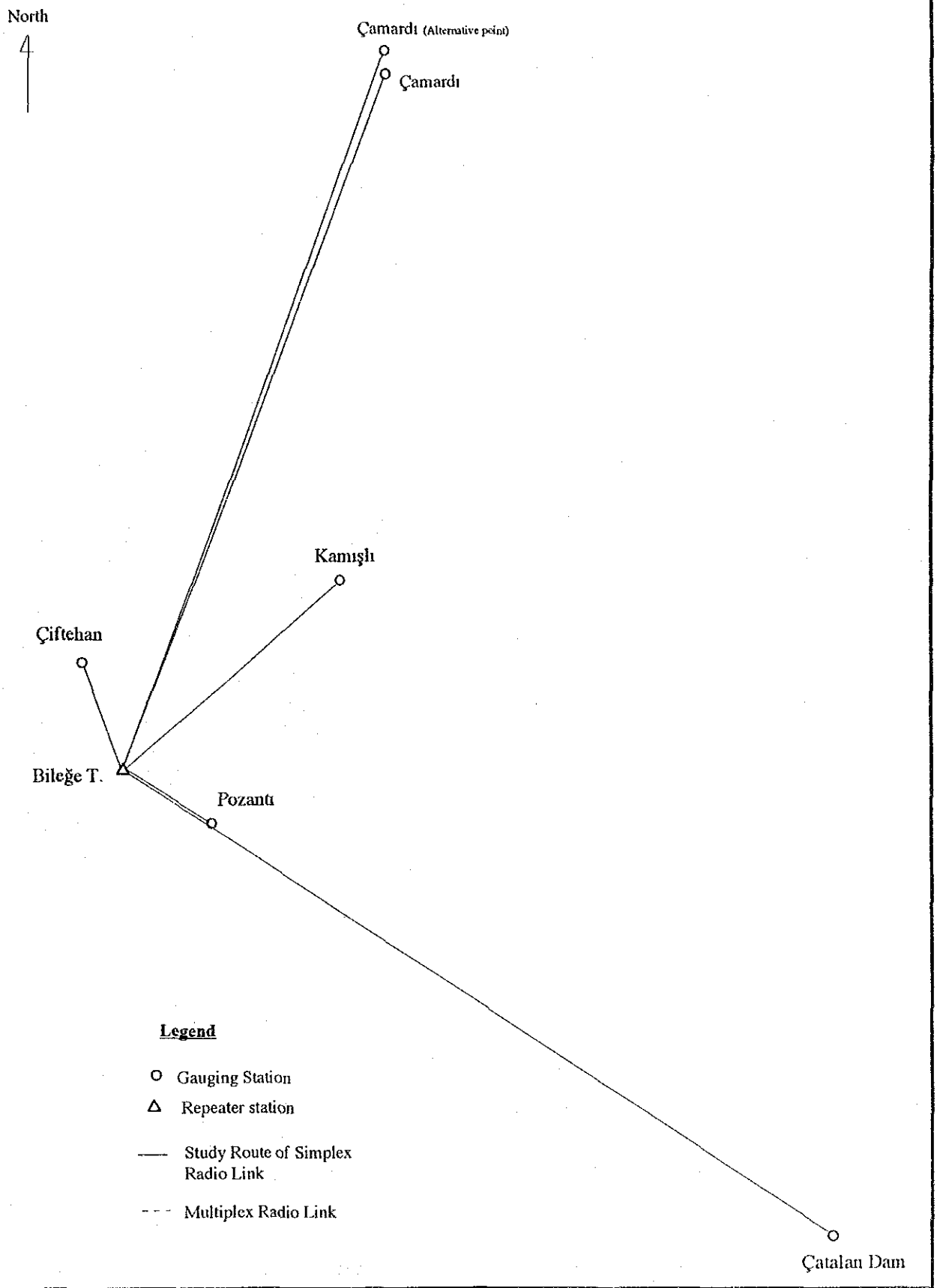
This figure shows all the representative gauging station in three alternative plans of hydrometeorological observation network.
The number of representative gauging station in each alternative plan of hydrometeorological observation network is listed below.

Alternative Plan	Number of Gauging Station		
	Rainfall gauging station	Water level gauging station	Dam water level gauging station
1	16	8	2
2	14	7	2
3	11	8	2

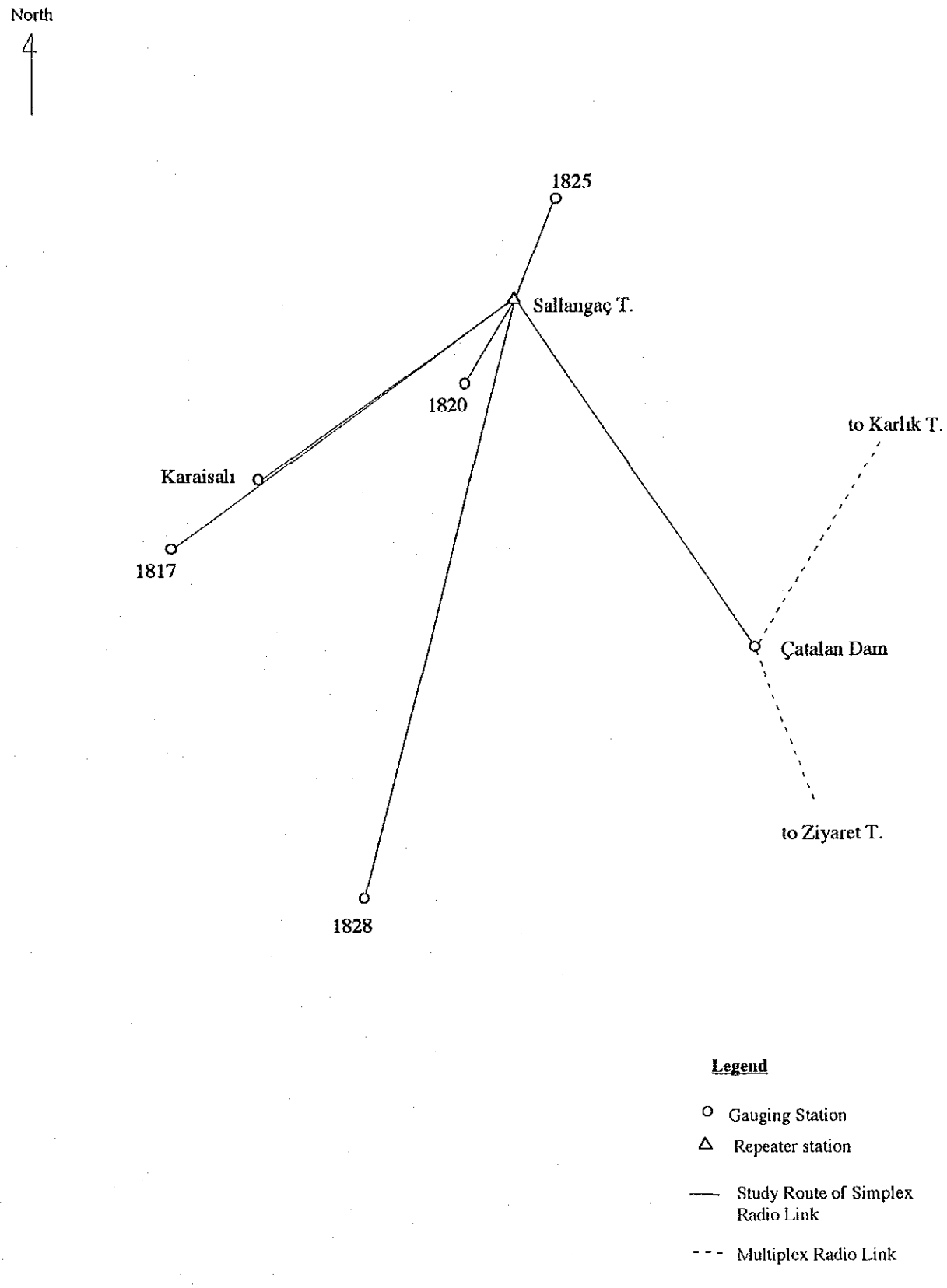
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.1.1 TENTATIVE PLAN OF TELECOMMUNICATION NETWORK FOR RADIO WAVE PROPAGATION TEST



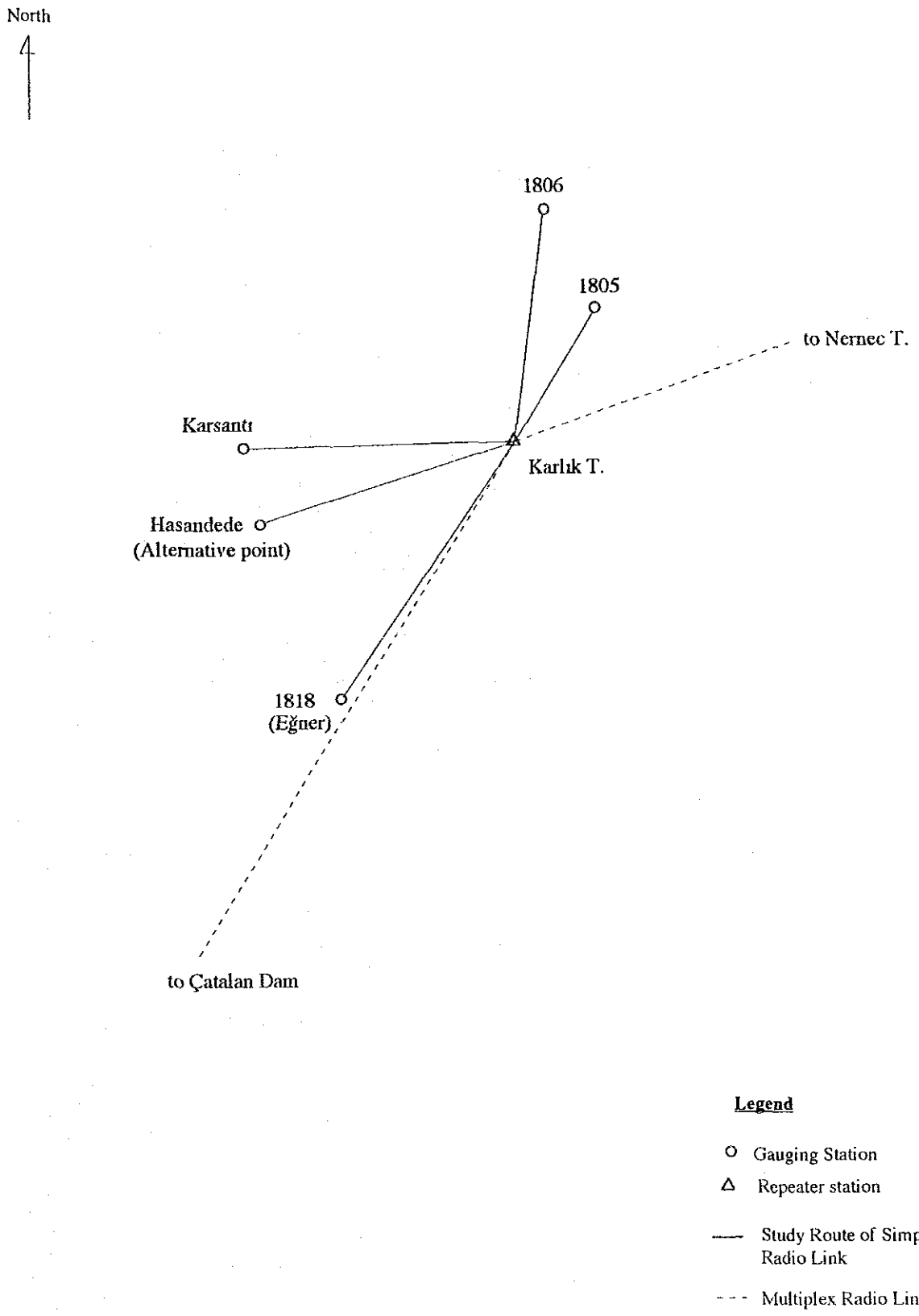
THE REPUBULIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.2.1 SUTDY ROUTE OF MULTIPLEX RADIO LINK



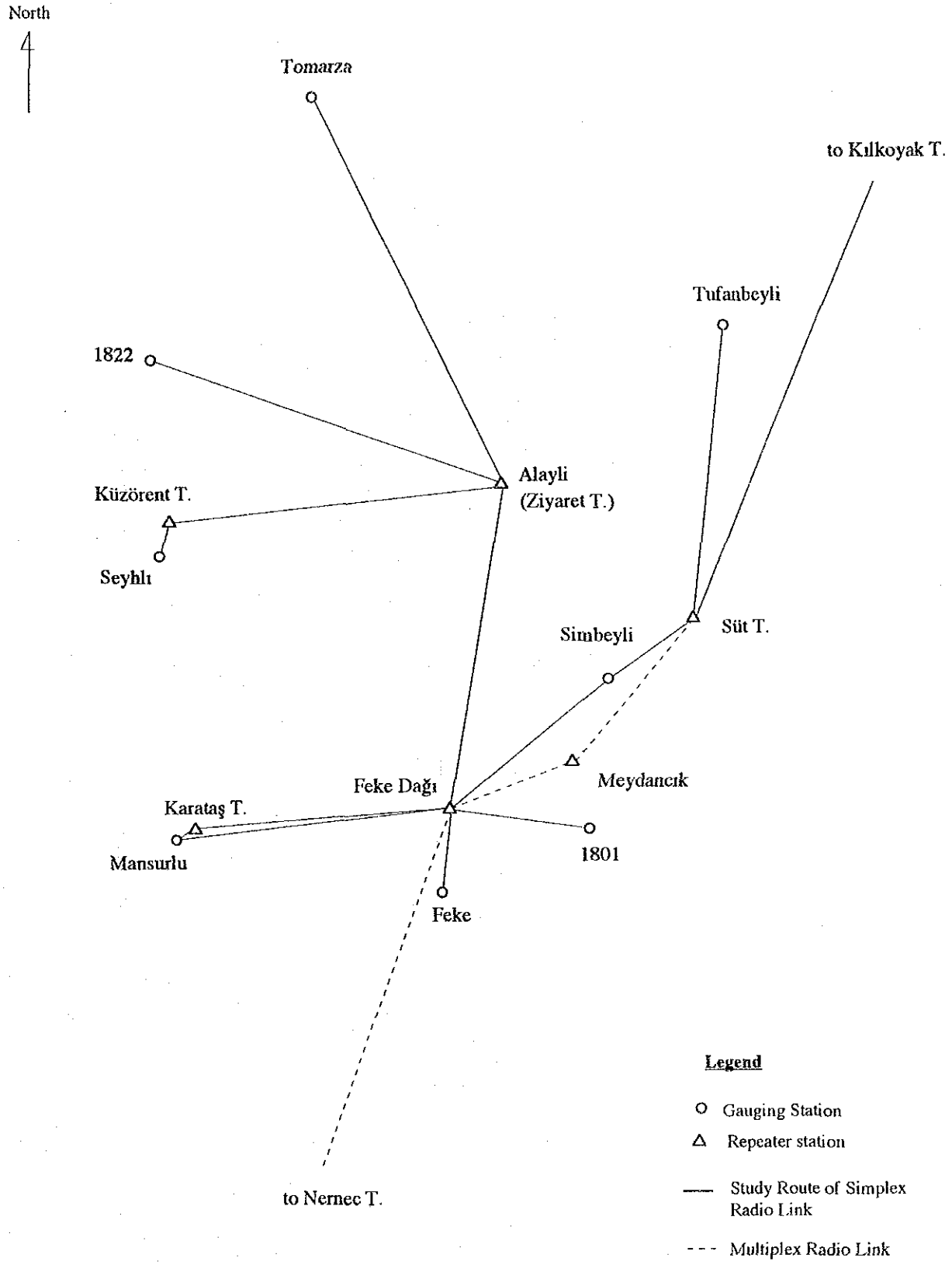
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.3.1 STUDY ROUTE OF SIMPLEX RADIO LINK (1/6)



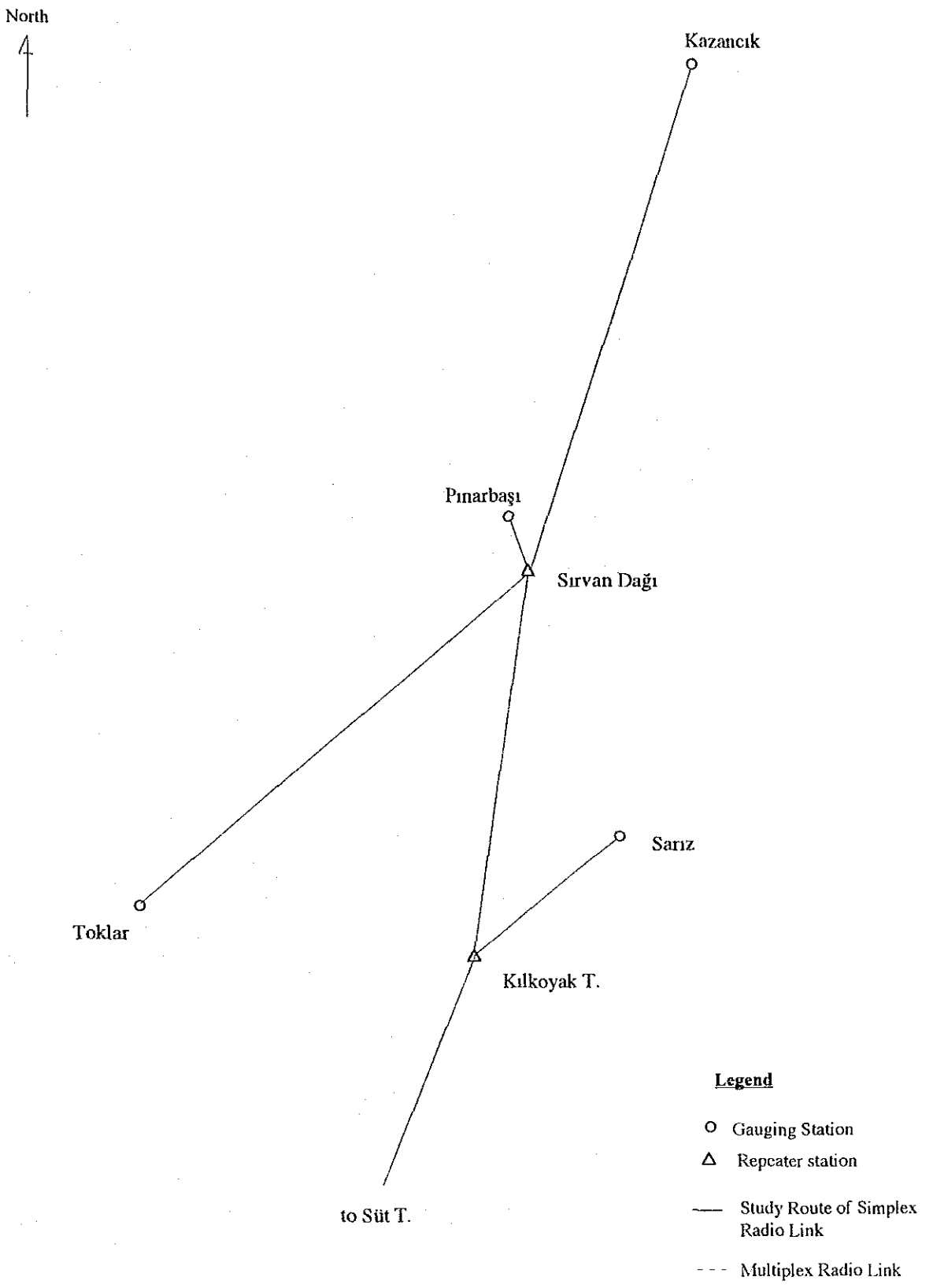
THE REPUBULIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.3.2 STUDY ROUTE OF SIMPLEX RADIO LINK (2/6)



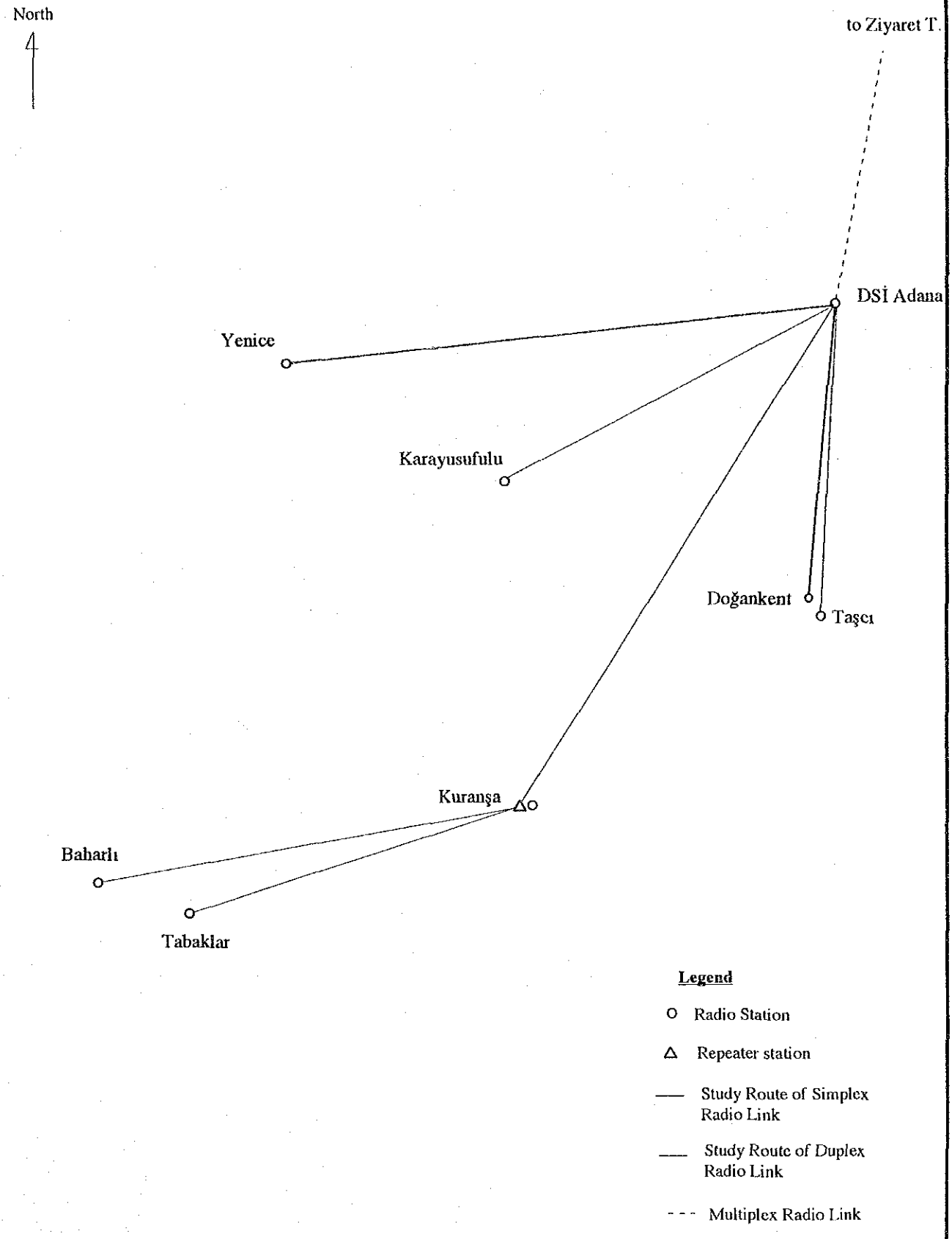
THE REPUBULIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.3.3 STUDY ROUTE OF SIMPLEX RADIO LINK (3/6)



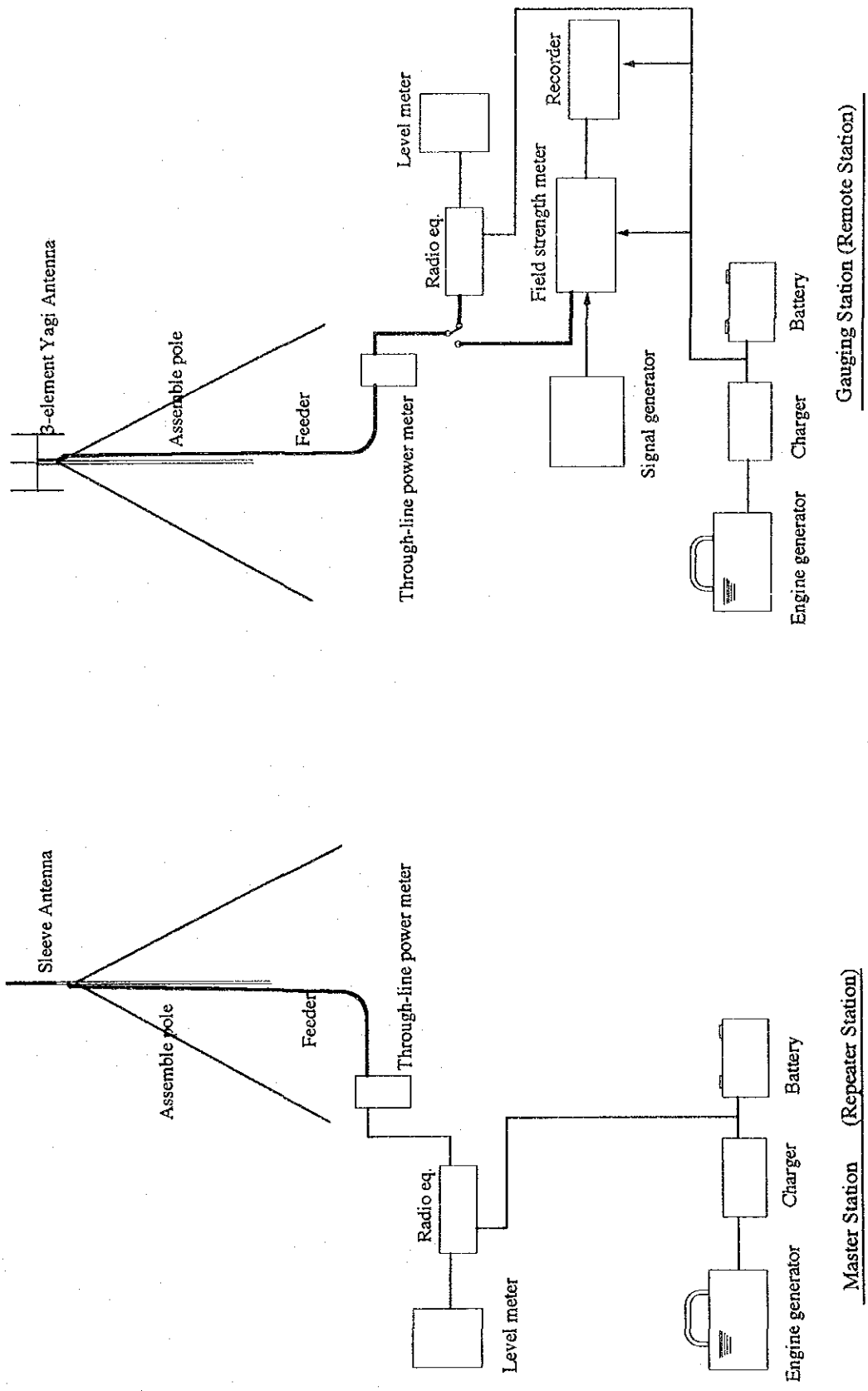
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.3.4 STUDY ROUTE OF SIMPLEX RADIO LINK (4/6)



THE REPUBULIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.3.5 STUDY ROUTE OF SIMPLEX RADIO LINK (5/6)



THE REPUBULIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.3.6 STUDY ROUTE OF SIMPLEX RADIO LINK (6/6)



THE REPUBULIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.3.7 SCHEMATIC DIAGRAM OF RADIO WAVE PROPAGATION TEST EQUIPMENT