8. MAINTENANCE AND MANAGEMENT SYSTEM

8.1 Outline

Establishment of an effective maintenance management system becomes one of the most important subjects for the flood forecasting and warning system. It is not an exaggeration to say that whether the flood forecasting and warning system installed will effectively function depends on the quality of the maintenance management system.
The following lists general items that should be incorporated into the maintenance management of a flood forecasting and warning system:

- Organizing a maintenance section and studying its improvement
- Training maintenance personnel
- Establishing maintenance procedures
- Establishing storage and control procedures for drawings and other documents
- Establishing storage, control, and replenishment procedures for spare and consumable parts
- Budgeting maintenance and operation expenses

8.2 Maintenance and Management System Structuring

Based on the study items listed in Section 8.1 above, studies are performed below as to the structuring of a maintenance management system for the flood forecasting and warning system.

(1) Organizing a maintenance section and studying its improvement

It is preferable that a maintenance management system for the Seyhan River basin flood forecasting and warning system should be organized as shown in Figure 8.2.1. Actual organization of a maintenance management system, however, is likely to significantly depend on the particular environment and factors associated with the structuring of the organization. An actual maintenance system should therefore be established only after separate studies which will be made on environment and factors.

Personnel placement planning under this maintenance management organization plan covers only the personnel requirement for the maintenance of the flood forecasting and warning system; it does not consider the personnel who will be involved in system operational jobs, such as hydrological gauging, flood forecasting and warning jobs, etc.

(2) Training maintenance personnel

In general, prior to introduction of a flood forecasting and warning system, several types of training such as factory training, site training, operational and maintenance training, etc., are usually carried out and maintenance personnel is correspondingly educated and trained. However, after separate examination of the actual subsequent situations for each existing flood forecasting and warning system, it is usually found that the promotions, replacements, etc. of the initially educated and trained personnel have resulted in the lack of sufficiently educated and trained maintenance personnel and thus that satisfactory situations have not been obtained. This is due to the fact that the education of new personnel or the transfer of technology has not been sufficiently executed. The measures listed below, therefore, should be undertaken.

- Establishing and executing periodic education/training programs
- Executing periodic education by special engineers such as those of the manufacturer of the system
- Establishing and executing the programs for periodic education in the factories of the manufacturer of the system
- Introducing simulation systems for education and training
- Other necessary measures

Since the implementation of the measures listed above incurs expenses, the appropriate budges should be set on an annual schedule and on a perennial schedule.

(3) Establishing maintenance management procedures

Standards for failure recovery and periodic maintenance procedures, for emergency and normal contact routes, for report documentation, and for all other necessary items, should be clearly provided for and executed. The following lists standards that should be established as maintenance management procedures:

- Routine check and periodic check items, and standards for these checks
- Execution standards for failure or abnormal recovery actions
- Standards that specify control procedures concerning various reports and log lists, and their submission routes
- Standards that specify full details of repair request forms and routes
- Standards that specify storage, control, and replenishment procedures concerning spare and consumable parts
- Standards for the control of various maintenance documents and drawings
- Other necessary standards

(4) Establishing storage and control procedures for drawings and other documents

It is not the rare case that several years after installation, the corresponding documents, such as drawings, are gone somewhere on the user site and cannot be found when necessary. Since the drawings and other documents that accompany the system are important ones for maintenance, these documents should be controlled very carefully and using the appropriate methods to allow immediate reference to be made whenever necessary. It is also important that any modifications should be recorded both correctly and accurately and, at the same time, the corresponding documents should also be modified both correctly and accurately.

(5) Establishing storage, control, and replenishment procedures for spare and consumable parts

Even if, during the installation of the system, the user keeps a sufficient stock of spare and consumable parts, the stock may run out after several years and if this is the case, it may not become possible for the necessary maintenance actions to be undertaken and thus for the system itself to be operated smoothly. Such is mainly due to the fact that after the user stock of spare and consumable parts has run short, necessary refills are not procured at the appropriate time. A system should therefore be established that allows timely replenishment, including budgeting.

(6) Budgeting maintenance and operation expenses

It is particularly important that prior to the startup of the flood forecasting and warning system, budgeting and other necessary measures should be set up by estimating maintenance and operation expenses. The appropriate budgets should be set before continued smooth operation of the flood forecasting and warning system can be achieved.

Tables

Table 2.2.1 Correlation Matrix for Simple Linear Regression Analysis

	Adana	Çatalan	Feke	Kamışlı	Karaisalı	Karsantı	Kozan	Mansurlu	Pozantı	Saimbeyli	Seyhan Brj.	Tufanbeyli	Bakırdağ	Develi	Elbaşı	Kaynar	Kazancık	Örenşehir	Pazarören	Pınarbaşı	Sarız	Şıhlı	Toklar	Tomarza	Uzunpınar	M. Boşören	Göksun	Çamardı	Çiftehan	Ereğli	Niğde	Ulukışla
Adana	1.000	0.742	0.656	0.810	0.832	0.475	0.787	0.346	0.592	0.607	0.935	0.405	0.416	0.411	0.230	0.141	0.089	0.063	0.118	0.105	0.219	0.674	0.440	0.302	0.114	0.000	0.672	0.513	0.566	0.503	0.743	0.482
Çatalan		1.000	0.747	0.780	0.876	0.587	0.802	0.550	0.647	0.587	0.875	0.118	0.533	0.590	0.404	0.155	0.063	0.045	0.224	0.307	0.349	0.601	0.429	0.567	0.195	0.000	0.338	0.678	0.534	0.748	0.743	0.619
Feke			1.000	0.863	0.701	0.740	0.780	0.660	0.727	0.844	0.737	0.352	0.706	0.579	0.451	0.173	0.118	0.077	0.268	0.319	0.475	0.737	0.737	0.602	0.349	0.063	0.829	0.519	0.680	0.534	0.804	0.472
Kamışlı				1.000	0.910	0.712	0.696	0.639	0.922	0.685	0.857	0.161	0.780	0.623	0.445	0.152	0.089	0.045	0.257	0.351	0.483	0.846	0.688	0.541	0.274	0.063	0.772	0.720	0.760	0.573	0.889	0.786
Karaisalı					1.000	0.640	0.734	0.616	0.884	0.653	0.928	0.355	0.495	0.400	0.182	0.000	0.000	-0.032	0.095	0.095	0.207	0.727	0.609	0.292	0.114	-0.045	0.779	0.524	0.622	0.436	0.815	0.629
Karsantı						1.000	0.591	0.683	0.724	0.653	0.669	0.363	0.527	0.686	0.609	0.507	0.464	0.414	0.552	0.604	0.606	0.783	0.418	0.612	0.490	0.251	0.599	0.686	0.617	0.378	0.490	0.507
Kozan							1.000	0.507	0.694	0.677	0.743	0.212	0.446	0.482	0.313	0.148	0.100	0.084	0.176	0.295	0.434	0.609	0.429	0.445	0.205	0.000	0.679	0.728	0.595	0.520	0.632	0.675
Mansurlu								1.000	0.643	0.625	0.387	0.359	0.594	0.566	0.417	0.243	0.212	0.114	0.409	0.397	0.521	0.663	0.375	0.521	0.339	0.089	0.814	0.404	0.571	0.396	0.435	0.348
Pozantı									1.000	0.680	0.788	0.224	0.675	0.510	0.363	0.134	0.100	0.095	0.202	0.295	0.463	0.779	0.729	0.484	0.332	0.045	0.820	0.586	0.914	0.358	0.775	0.651
Saimbeyli										1.000	0.578	0.446	0.583	0.688	0.440	0.265	0.202	0.164	0.344	0.407	0.567	0.681	0.606	0.564	0.860	0.145	0.688	0.476	0.553	0.327	0.541	0.471
Seyhan Brj.											1.000	0.221	0.543	0.401	0.200	0.000	-0.032	-0.055	0.105	0.158	0.245	0.563	0.499	0.307	0.105	-0.055	0.688	0.734	0.608	0.414	0.829	0.819
Tufanbeyli												1.000	0.126	0.071	0.032	0.237	0.241	0.187	0.224	0.155	0.265	0.000	0.000	0.032	0.161	0.130	0.968	0.224	0.063	0.857	0.725	0.247
Bakırdağ													1.000	0.716	0.680	0.348	0.354	0.228	0.517	0.520	0.567	0.782	0.853	0.809	0.474	0.292	0.361	0.596	0.722	0.575	0.574	0.535
Develi														1.000	0.851	0.529	0.508	0.429	0.771	0.704	0.632	0.803	0.581	0.838	0.550	0.385	0.375	0.769	0.583	0.614	0.524	0.516
Elbaşı															1.000	0.694	0.661	0.556	0.749	0.806	0.666	0.756	0.724	0.872	0.683	0.578	0.202	0.572	0.545	0.559	0.333	0.303
Kaynar																1.000	0.921	0.861	0.752	0.856	0.671	0.539	0.473	0.583	0.744	0.749	0.176	0.448	0.322	0.311	0.134	0.224
Kazancık																	1.000	0.903	0.751	0.797	0.628	0.424	0.491	0.564	0.762	0.792	0.152	0.415	0.302	0.315	0.130	0.195
Örenşehir																		1.000	0.665	0.742	0.601	0.295	0.383	0.462	0.807	0.729	0.167	0.342	0.391	0.302	0.138	0.195
Pazarören																			1.000	0.834	0.691	0.563	0.553	0.737	0.723	0.638	0.298	0.497	0.348	0.453	0.316	0.235
Pınarbaşı																				1.000	0.759	0.669	0.665	0.743	0.846	0.669	0.381	0.555	0.418	0.395	0.265	0.394
Sarız																					1.000	0.694	0.689	0.700	0.784	0.523	0.603	0.572	0.517	0.456	0.374	0.462
Şıhlı																						1.000	0.701	0.820	0.527	0.302	0.647	0.727	0.696	0.505	0.537	0.599
Toklar																							1.000	0.828	0.657	0.476	0.440	0.513	0.696	0.373	0.498	0.373
Tomarza																								1.000	0.674	0.532	0.308	0.628	0.640	0.643	0.414	0.329
Uzunpınar																									1.000	0.683	0.411	0.438	0.611	0.373	0.251	0.268
M. Boşören																										1.000	0.210	0.303	0.221	0.308	0.167	0.155
Göksun																											1.000	0.599	0.755	0.394	0.647	0.657
Çamardı																												1.000	0.540	0.669	0.850	0.821
Çiftehan																													1.000	0.224	0.298	0.539
Ereğli																														1.000	0.671	0.590
Niğde																															1.000	0.880
Ulukışla																																1.000

Table 2.2.2 Effective Rainfall Gauging Station and Its Area Ratio for Subbasins

Station	Catchment Area of Station			Location	Göksu up to 1801	Göksu up to 1805	Göksu up to 1805	Zamantı up to 1822	Zamantı up to 1806	Zamantı up to 1806	Zamantı-Göksu Joint to	Zamantı-Göksu after	Zamantı-Göksu after		Çatalan Brj.		Eğlence up to	Eğlence up to	Eğlence up to		Körkün up to	Körkün up to	Üçtirge	Çakıt up to
	Total	(Seyhan)	(Çatalan)	River Basin	(Alternative 1)	(Alternative 1)	(Alternative 2)	(Alternative 1)	(Alternative 1)	(Alternative 2)	Çatalan HWL	Çatalan HWL (without Çatalan)	Çatalan HWL (with Çatalan)		-Seyhan Brj.		1825	Seyhan R. (without Çatalan)	Çatalan HWL (with Çatalan)		1820	Seyhan HWL		1828
Çatalan	738.2	(10.0)	(124.4)	Seyhan								0.664	0.693	(0.952)	0.528	(0.138)		0.565	0.244			0.172	0.017	0.005
Karsantı	1,512.7		(6.3)	Seyhan		0.034	0.016		0.139	0.029	0.952	0.319	0.279	(0.048)			0.336	0.105	0.208					
Seyhan Brj.	200.1	(62.5)		Seyhan											0.460	(0.862)								
Çiftehan	988.4			Çakıt																	0.001			0.558
Pozantı*	404.3			Çakıt																	0.017		0.276	0.174
Karaisalı*	815.8			Üçtirge								0.017	0.029		0.013		0.051	0.330	0.548		0.070	0.828	0.708	0.189
Kamışlı	792.1			Körkün							0.002						0.561				0.338			0.014
Çamardı*	1,266.3			Körkün					0.150	0.031	0.045						0.053				0.574			0.061
Feke	852.9			Göksu	0.074	0.326	0.194																	
Mansurlu*	1,187.8			Göksu		0.227	0.108		0.388	0.081														
Saimbeyli	1,257.7			Göksu	0.310	0.260	0.286																	
Tufanbeyli	1,050.4			Göksu	0.395	0.040	0.226	0.008		0.007														
Sarız*	829.5			Göksu	0.220		0.115	0.046		0.037														
Bakırdağ	733.3			Zamantı		0.113	0.054	0.070	0.004	0.056														
Elbaşı	511.7			Zamantı				0.073		0.058														
Kaynar	734.3			Zamantı				0.105		0.083														
Kazancık	305.5			Zamantı				0.044		0.035														
Örenşehir	491.4			Zamantı				0.070		0.056														
Pazarören	627.6			Zamantı				0.090		0.071														
Pınarbaşı*	839.9			Zamantı	0.002		0.001	0.119		0.095														
Sıhlı	812.3			Zamantı				0.033	0.319	0.092														
Toklar	794.5			Zamantı				0.114		0.090														
Tomarza	969.4			Zamantı				0.139		0.110														
Uzunpınar	433.2			Zamantı				0.062		0.049														
M. Boşören	187.8			Zamantı				0.027		0.021														
Total	19,337.0	(72.5)	(130.6)		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	(1.000)	1.000	(1.000)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* : Station with Pluviograph
( ) : Reservoir Area

Table 2.2.3 The Results of Selection of Representative Rainfall Station (Alternative 1)

Station	Catchment Area of Station			Location	Göksu up to 1801 (Alternative 1)	Göksu up to 1805 (Alternative 1)	Göksu up to 1805 (Alternative 2)	Zamantı up to 1822 (Alternative 1)	Zamantı up to 1806 (Alternative 1)	Zamantı up to 1806 (Alternative 2)	Zamantı-Göksu Joint to Çatalan HWL	Zamantı-Göksu after Çatalan HWL (without Çatalan)	Zamantı-Göksu after Çatalan HWL (with Çatalan)		Çatalan Brj. -Seyhan Brj.		Eğlence up to 1825	Eğlence up to Seyhan R. (without Çatalan)	Eğlence up to Çatalan HWL (with Çatalan)	Körkün up to 1820	Körkün up to Seyhan HWL	Üçürge	Çakıt up to 1828
	Total	(Seyhan)	(Çatalan)	River Basin	(Alternative 1)	(Alternative 1)	(Alternative 2)	(Alternative 1)	(Alternative 1)	(Alternative 2)	Çatalan HWL	(without Çatalan)	(with Çatalan)		-Seyhan Brj.		1825	Seyhan R. (without Çatalan)	Çatalan HWL (with Çatalan)	1820	Seyhan HWL		1828
Çatalan	738.2	(10.0)	(124.4)	Seyhan								0.664	0.693	(0.952)	0.528	(0.138)		0.565	0.244		0.172	0.017	0.005
Ketsanlı	1,512.7		(6.3)	Seyhan		0.034	0.016		0.139	0.029	0.952	0.319	0.279	(0.048)			0.336	0.105	0.298				
Seyhan Brj.	200.1	(62.5)		Seyhan											0.460	(0.862)							
Ulukhan	988.4			Çakıt																0.001			0.858
Pozantı*	404.3			Çakıt																0.017		0.276	0.174
Karaisalı*	815.8			Üçürge								0.017	0.029		0.013		0.051	0.930	0.548	0.070	0.828	0.708	0.289
Karaisalı	792.1			Körkün							0.002						0.561			0.338			0.014
Camardı*	1,266.3			Körkün					0.150	0.031	0.045						0.053			0.574			0.061
Feke	852.9			Göksu	0.074	0.326	0.194																
Mansurlu*	1,187.8			Göksu		0.227	0.108		0.388	0.081													
Saimbeyli	1,257.7			Göksu	0.316	0.260	0.286																
Tufanbeyli	1,050.4			Göksu	0.395	0.040	0.226	0.008		0.007													
Sarız*	829.5			Göksu	0.220		0.115	0.046		0.037													
Bakırdağ	733.3			Zamantı		0.113	0.054	0.070	0.004	0.056													
Elbaşı	511.7			Zamantı				0.073		0.058													
Kaynar	734.3			Zamantı				0.105		0.083													
Kazancık	305.5			Zamantı				0.044		0.035													
Örenşehir	491.4			Zamantı				0.070		0.056													
Pazarören	627.6			Zamantı				0.090		0.071													
Pınarbaşı*	839.9			Zamantı	0.002		0.001	0.119		0.095													
Şıhlı	812.3			Zamantı				0.033	0.319	0.092													
Toklar	794.5			Zamantı				0.114		0.090													
Tomarza	969.4			Zamantı				0.139		0.110													
Uzunpınar	433.2			Zamantı				0.062		0.049													
M. Bosören	187.8			Zamantı				0.027		0.021													
Total	19,337.0	(72.5)	(130.6)		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	(1.000)	1.000	(1.000)	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* : Station with Pluviograph
( ) : Reservoir Area
▨ : Selected Rainfall Gauging Station

Table 2.2.4 The Results of Selection of Representative Rainfall Station (Alternative 2)

Station	Catchment Area of Station			Location	Göksu up to 1801 (Alternative 1)	Göksu up to 1805 (Alternative 1)	Göksu up to 1805 (Alternative 2)	Zamantı up to 1822 (Alternative 1)	Zamantı up to 1806 (Alternative 1)	Zamantı up to 1806 (Alternative 2)	Zamantı-Göksu Joint to Çatalan HWL	Zamantı-Göksu after Çatalan HWL (without Çatalan)	Zamantı-Göksu after Çatalan HWL (with Çatalan)		Çatalan Brj. -Seyhan Brj.		Eğlence up to 1825	Eğlence up to Seyhan R. (without Çatalan)	Eğlence up to Çatalan HWL (with Çatalan)	Körkün up to 1820	Körkün up to Seyhan HWL	Üçürge	Çakıt up to 1828
	Total	(Seyhan)	(Çatalan)	River Basin																			
Çatalan	738.2	(10.0)	(124.4)	Seyhan								0.664	0.693	0.952	0.528	(0.138)		0.565	0.244		0.172	0.017	0.005
Kocasarı	1,512.7		(6.3)	Seyhan		0.034	0.016		0.139	0.029	0.952	0.319	0.279	0.348			0.536	0.105	0.208				
Seyhan Brj.	200.1	(62.5)		Seyhan											0.460	(0.862)							
Çukurhan	988.4			Çakıt																0.001			0.558
Pozantı*	404.3			Çakıt																0.017		0.276	0.174
Karaisalı*	815.8			Üçürge								0.017	0.029		0.013		0.051	0.330	0.548	0.070	0.828	0.708	0.589
Kamışlı*	792.1			Körkün							0.002						0.561			0.338			0.014
Esmarda*	1,266.3			Körkün					0.150	0.031	0.045						0.053			0.574			0.061
Feke	852.9			Göksu	0.074	0.326	0.194																
Mansurlu*	1,187.8			Göksu		0.227	0.108		0.388	0.081													
Saimbeyli	1,257.7			Göksu	0.310	0.260	0.286																
Tufanbeyli	1,050.4			Göksu	0.395	0.040	0.226	0.008		0.007													
Sarız*	829.5			Göksu	0.220		0.115	0.046		0.097													
Bakırdağ	733.3			Zamantı		0.113	0.054	0.070	0.004	0.056													
Elbası	511.7			Zamantı				0.073		0.058													
Kaynar	734.3			Zamantı				0.105		0.083													
Kazancık	305.5			Zamantı				0.044		0.035													
Örenşehir	491.4			Zamantı				0.070		0.056													
Pazarören	627.6			Zamantı				0.090		0.071													
Pınarbaşı*	839.9			Zamantı	0.002		0.001	0.119		0.095													
Şıhlı	812.3			Zamantı				0.033	0.319	0.092													
Toklar	794.5			Zamantı				0.114		0.090													
Tomarza	969.4			Zamantı				0.139		0.110													
Uzunpınar	433.2			Zamantı				0.062		0.049													
M. Boşören	187.8			Zamantı				0.027		0.021													
Total	19,337.0	(72.5)	(130.6)		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	(1.000)	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* : Station with Pluviograph
( ) : Reservoir Area
▨ : Selected Rainfall Gauging Station

Table 2.2.5 Multiple Regression Coefficient of the Representative Rainfall Gauging Stations

Sub - basin	Multiple Regression Coefficient (ai)																Constant
	Çatalan	Karsantı	Çiftlıhan	Pozantı*	Karaisalı*	Kamışlı	Çamardı*	Feke	Mansurlu*	Saimbeyli	Tufanbeyli	Kazancık	Pınarbaşı*	Şıhlı	Toklar	Tomarza	b
1 Zamantı up to 1822												0.263	0.318		0.129	0.307	0.140
2 Zamantı up to 1806		0.192							0.385					0.346			0.114
3 Göksu up to 1801										0.496	0.411						0.215
4 Göksu up to 1805								0.386	0.250	0.244							0.183
5 Zamantı - Göksu joint to Çatalan HWL		0.973															0.063
6 Eğlence up to 1825		0.367				0.608											0.017
7 Eğlence up to Seyhan R.	0.569				0.374												0.337
(7) (Eğlence up to Çatalan HWL)		(0.213)			(0.739)												(0.147)
8 Zamantı-Göksu after Çatalan HWL	0.681	0.325															-0.032
(8) (")	(0.722)	(0.289)															(-0.029)
9 Körkün up to 1820						0.425	0.571										0.008
10 Kürkön up to Seyhan HWL					0.965												0.117
11 Üçtirge				0.273	0.724												0.016
12 Çatalan Brj.- Seyhan Brj.	0.534				0.462												0.024
13 Çakıt up to 1828			0.684		0.254												0.229

( ) : with Çatalan Dam

* : Station with Pluviograph

Table 3.1.1 List of Intended Gauging Items

No.	Name of Station	Kind of Station	Hydrometeorological Gauging Items			
			Rainfall	Temperature	Water Level	Reservoir
	Seyhan River Basin					
1	Çamardı	RG Station	√			
2	Çiftehan	RG Station	√			
3	Pozantı	RG/TP Station	√	√		
4	Kamışlı	RG/TP Station	√	√		
5	Karaisalı	RG Station	√			
6	Karsantı	RG/TP Station	√	√		
7	1825	WL Station			√	
8	1820	WL Station			√	
9	1818	WL Station			√	
10	1828	WL Station			√	
11	Seyhan dam	WL Station				√
12	Çatalan dam	RG/WL Station	√			√
	Zamantı River Basin					
13	Kazancık	RG Station	√			
14	Pinarbaşı	RG Station	√			
15	Toklar	RG Station	√			
16	Tomarza	RG/TP Station	√	√		
17	Şeyhli	RG/TP Station	√	√		
18	1822	WL Station			√	
19	1806	WL Station			√	
	Göksu River Basin					
20	Tufanbeyli	RG/TP Station	√	√		
21	Saimbeyli	RG Station	√			
22	Feke	RG Station	√			
23	Sarız	RG Station				
24	Mansurlu	RG/TP Station	√	√		
25	1801	WL Station			√	
26	1805	WL Station			√	

Abbreviation

RG: Rainfall

TP: Temperature

WL: Water level

Table 3.1.2 Comparative Studies of Terrestrial Communications Link Scheme and Satellite Communications Link Scheme

Item	Terrestrial Communications Links Scheme	Satellite Communications Links Scheme
Outline of Scheme	Data is to be collected through VHF radio communications links or micro wave multiplex radio communications links via repeater stations.	A VSAT (Very Small Aperture Terminal) is to be installed at gauging stations and data is to be collected through a communications satellite.
System Design	System design id flexible since circuit are to be designed considering system requirement.	System design will be restricted since it should be complied with the specifications of the satellite used.
Circuit design and radio wave propagation test	Both required.	Although circuit design is required, it is easy. However, the transmitting output power, antenna type, transmission method, etc. of VSAT will be determined from the design of the satellite.
Initial investment cost	The approximate estimate of the initial investment costs for the VHF radio communications facility and micro wave multiplex radio communications facility based on hydrometeorological observation network plan 1, are as follows: VHF radio communications facility: $892,400 Micro wave multiplex radio communications facility: $2,119,800 Total $3,012,200 (Power supply facility cost included)	For the VSAT system, VSAT facility should be installed by the user. The approximate estimate of the initial investment costs for the VSAT facility based on hydrometeorological observation network plan 1, are as follows: VSAT facility: $3,491,700 Total $3,491,700 (Power supply facility cost included)
Operation cost	Maintenance expenses only.	In addition to maintenance expenses, circuit usage charges are required. The annual usage charge per one channel of the VSAT system of the Republic of Turkey is as follows: Annual usage charge: Approx. $9,600/channel (based on the monthly charge of $800, surveyed in May 1994)
Reliability	The necessary reliability level can be set during design.	Depends on the reliability of the satellite. For a system that does not have a standby satellite, dangerous situations may be encountered since the life of a satellite is usually between about 7 and 10 years. If satellite is launching fails, sudden notice on discontinuation of the services may be given.
Influence of attenuation by rainfall	Because of 2 GHz band, operation is not adversely affected by rainfall.	Because of a Ku band (12/14 GHz), operation is adversely affected by rainfall. In areas, where snow falls, installation of heaters are undertaken against the influence of icing of snow on antenna.
Maintenance expenses	Compared with those of the satellite communications link scheme, the maintenance expenses for the terrestrial communications link scheme increased by repeating links	Compared with terrestrial communications link, satellite communications link usually take slight maintenance expenses since only terminal stations are required.
Overall evaluation	O	Δ

Table 3.1.3 Comparison of Data Collection Method

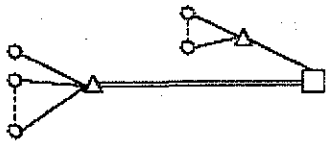
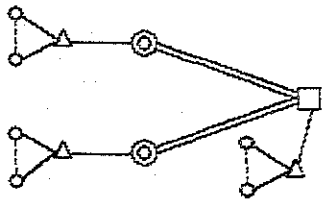
	Centralized Collection Method	Distributed Collection Method
System configuration □ : Monitor station ◎ : Sub-monitor station ═ : Multiplex radio telecommunication line — : Simplex radio telecommunication line	(Example) 	(Example) 
System description	Without installing sub-monitor stations, data is acquired by the monitor station (system control center) directly from the gauging stations.	Data is acquired first by each sub-monitor station, and then transferred automatically to the monitor station (system control center),or only when a transfer request is received from the monitor station. Data from some observatory stations may be acquired directly by the monitor station.
System capacity (capacity of gauging station)	Depends on the capacity of the telemetry monitoring equipment which is installed in the monitor station. If a number of gauging stations are installed, it is necessary to provide the telemetry monitoring equipment with larger capacity.	This scheme is applicable to larger system because gauging stations can be distributed to each sub-monitor station.
Data collection time	Time required for acquiring data is longer than in the distributed acquisition method because all gauging stations are to be collected in sequence.	Time required for acquiring data can be shortened because data from each sub-monitor station can be acquired independently.
Radio frequencies required	A system can be built up with the least number of radio frequencies because centralized control over the emission of radio waves can be done by the monitor station.	Independent radio frequency is required for each sub-monitor station. If a radio frequency is commonly used by two or more sub-monitor stations, it is necessary to assure of no interference by means of D/U calculation.
Problems in radio circuit design	For the centralized collection scheme, it is necessary to make radio circuit design in consideration of increased noises because the number of spans between the monitor station and the observatory stations increases. In addition, this scheme is disadvantageous for radio circuit design because the number of spans in the simplex telecommunication line inevitably increases in case of data collected in wide area.	This scheme is advantageous in designing the radio circuit because digital regenerative repeater can be used in each sub-monitor station.
Maintenance	Cost is of no problem if the cover area is small enough for the monitor station to directly control the gauging stations. However, it is hard to provide sufficient maintenance over a wide area because maintenance data can nowhere be acquired except in the monitor station.	This scheme best fits to a large-scale system with wide cover area because it is possible to allow each sub-monitor station to acquire its own maintenance data, thereby enabling distributed control over the system.
Economy	Initial investment cost (initial equipment cost) is lower than that for the distributed scheme, however, total cost evaluation including the maintenance cost leads to a question.	Initial investment cost (initial equipment cost) is relatively higher than that for the centralized collection scheme. For a large-scale system with wide cover area, however, this method is advantageous in many cases.

Table 3.1.4 Comparison of Each Telemetry Method (1/3)

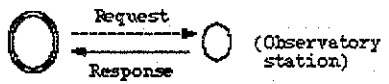
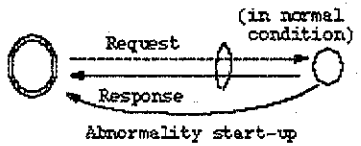
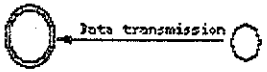
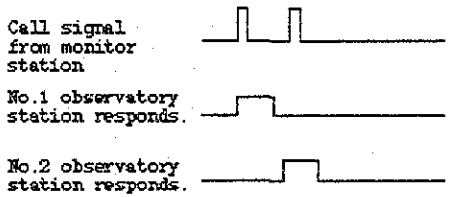
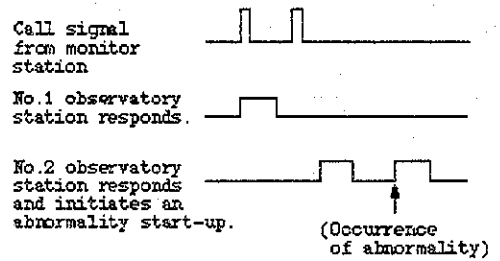
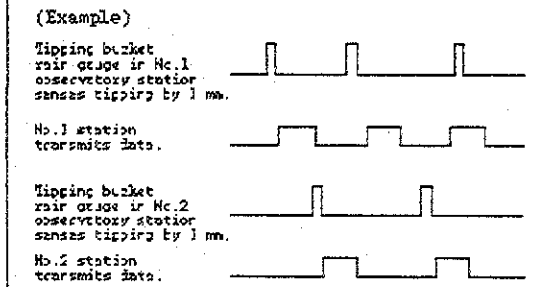
	Polling Method	Polling Scheme + Event Reporting Method	Event Reporting Method
1. Description of function	Scheme by which an observatory station transmits data upon request from the monitor station.	Polling scheme plus an additional function of transmitting data when an event is sensed (e.g. warning level of the water is sensed, or start of rainfall is sensed).	Scheme by which an observatory station automatically transmits data when an event is sensed (e.g. rainfall of 1 mm is sensed).
2. System diagram			
3. Operation sequence			
4. Transmission method	Half-duplex communication method	Half-duplex communication method	Unidirectional communication method
5. Applicable radio communication circuit	Simplex radio communication circuit is applicable.	Same as in the left.	Same as in the left.
6. System capacity (Number of observatory stations that can be included in the system)	Large	Large (However, it is necessary to take into consideration the frequency of event report.)	In order to lower the probability of data missing due to simultaneous data transmission by multiple observatory stations, it is necessary to build up a system with smaller number of observatory stations.
7. Reliability in data acquisition	100% reliability is maintained because there is no data missing resulting from the data acquisition method.	100% reliability can be maintained for acquiring data in the normal mode provide that the event report locking method is employed together. However, it is necessary to take into consideration the frequency of event report because the transmitted event reporting data may collide with each other.	When multiple stations transmit data simultaneously, the transmitted data collides with each other resulting in a data missing. Accordingly, reliability in data acquisition depends upon frequency of data transmission, transmission time, and number of observatory stations.

Table 3.1.5 Comparison of Each Telemetering Method (2/3)

	Polling Method	Polling Scheme + Event Reporting Method	Event Reporting Method
8. Transmission capacity	Capacity can be freely determined; up to 10 items/station in general. Transmission of more items is also possible.	Same as in the left.	Because the data transmission time increases as the number of data items to be transmitted increases, probability of data missing due to collision of the transmitted data increases. Normally, a system is designed to transmit two data items at a time.
9. Common use of data transmission link	Because the same link used for data acquisition can then be used for transmission (distribution) of the data without any additional operation, it is possible to better the efficiency of the radio frequencies in use and the economy of the equipment. Therefore, this method is the most suitable for a system that requires both data acquisition and data transfer (distribution) like in case of the flood forecasting and warning system.	Same as in the left. (However, it is necessary to employ the event report lock method together.)	Not possible.
10. Joint use of maintenance servicecommunication link	Possible	Possible	Not possible.
11. Applicable frequency	It is possible to design the system using the smallest possible number of frequencies. Even for a system with multi-channel data acquisition link, it is also possible to design the system using the smallest possible number of radio frequencies because data can be acquired from each channel by way of conducting link control (relay station control).	Same as in the left. (However, a consideration must be given if the frequency of event report is high.)	A number of radio frequencies are generally required because it is necessary to allocate separate radio frequency for each channel.
12. Maintenance	Advantageous in maintenance because intercommunication is possible and also because data can be acquired at any time from a specified observatory station.	Same as in the left.	Not recommendable from the view point of maintenance because this employs the unidirectional communication method and hence intercommunication is not available.
13. Features of transmission via radio communication link	A procedure for re-calling the station (re-acquiring the data) is available when a data error is caused by noise or radio interference. This can complement the weak point in data transmission via radio communication link.	Same as in the left. (However, a consideration must be given to the event report.)	Disadvantageous because re-transmission function is generally not available to cope with noise or interference which is peculiar to the radio communication link. If the resend code method is employed throughout the operation, transmission time of the codes becomes longer, resulting in higher probability of data missing due to collision of transmitted data.

Table 3.1.6 Comparison of Each Telemetry Method (3/3)

	Polling Method	Polling Scheme + Event Reporting Method	Event Reporting SMethod
14. Power supply system in observatory station	Intercommunication is required and hence it is necessary to keep the power on to the receivers all the time. Therefore, the power supply system needs to have higher capacity for the above than in the event reporting scheme.	Same as in the left.	Power supply system of small capacity will generally suffice because no receiver is necessary. Required capacity for a rainfall observatory station can be estimated according to the past data. For a water-level observatory station, however, special design consideration shall be given to the capacity of the power supply system if it is set to report by the change of the level by 1 cm.
15. Operation of relay station	By implementing the start/stop method, it is possible to actuate the relaying operation only when it is necessary.	Same as in the left. However, a consideration must be given to the event report.	In general, it is necessary to keep the relay station always in an operable condition. Consequently, if interference is frequent, power is unnecessarily consumed in relaying the interfered signals, resulting in a problem in many cases.
16. Considerations in construction	Each station generally requires a building. Installation inside the building is more advantageous from the view point of maintenance.	Same as in the left.	Outdoor cylinder installation type is possible for a rainfall observatory station. Construction of a water-level observatory station is about the same as in the polling method, employing the indoor installation normally.
17. Economy	In case of a large-scale system, there is no remarkable difference in economy compared to the event reporting scheme.	Same as in the left.	A small-scale system of this method can be built up at lower cost than in the polling method, but there is no remarkable difference in case of a large-scale system.

Table 3.1.7 Each Type Water Levle Gauge (1/2)

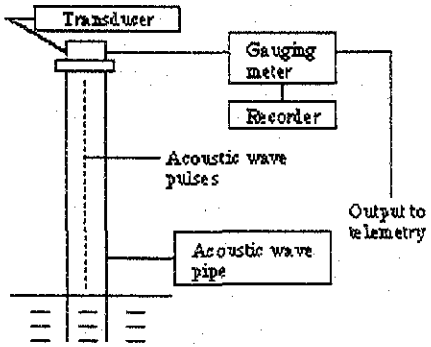
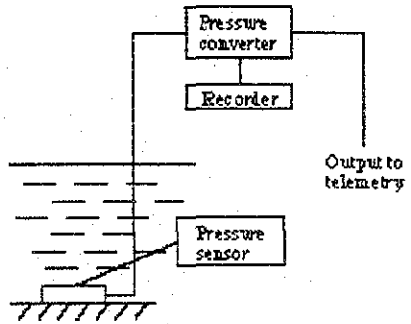
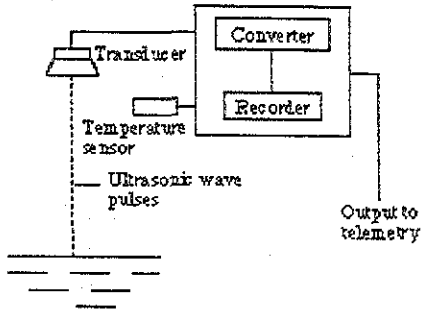
WATER LEVEL GAUGE		FLOATLESS TYPE		UNTOUCH TYPE
ITEM		ACOUSTIC TYPE	PRESSURE TYPE	ULTRASONIC TYPE
MEASURING PRINCIPLE		Water level is measured by detecting time from transmission of acoustic pulses to reception of the wave reflected by water surface	Water level is measured by detecting water pressure corresponded to water level with sensor such as crystal type.	Water level is measured by detecting time from transmission of ultrasonic wave to reception of the wave reflected by water surface.
EQUIPMENT COMPOSITION				
INSTALLA-	NECESSITY OF GAUGING WELL	Disuse (Acoustic wave pipe is needed)	Disuse	Disuse
TION CONDITION	INSTALLATION DISTANCE FROM SENSOR TO CONVERTER	Possible Maximum 200 m	Possible Approx. 2,000 m	Possible Approx., 500 m
	INCLINE INSTALLATION ALLOWABLE DECREES	Possible Maximum allowable angle: 30°	Possible	Impossible
	OTHERS	Possible for average water level output	No obstruction under a transducer	
CONNECTABLE CONVERTER AND MEASURING ACCURACY		±1 cm	± 1cm	±1 cm
MEASURING RANGE		0 - 10 m/30 m	0 - 5 m/10 m/30 m/50 m/100 m	0 - 10 m
RECORDER		Separate type (Analogue recorder: 1/3 months)	Separate type (Analogue recorder: 1/3 months)	Separate type (Analogue recorder: 1/3 months)
POWER SOURCE AND CONSUMPTION		AC 100 V, 50/60 Hz, Approx. 20 VA DC 12 V/DC 24 V, Approx. 15 W	DC 12V, Approx. 6 W	AC 100 V, 50 - 60 Hz, Approx. 20 VA DC 12 V, Approx. 8 W
APPLICATION OF SOLAR CELLS POWER SUPPLY SYSTEM		Suitable	Suitable	Suitable

Table 3.1.8 Each Type Water Levle Gauge (2/2)

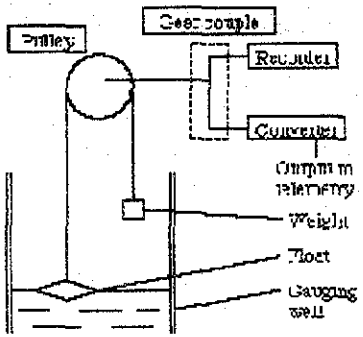
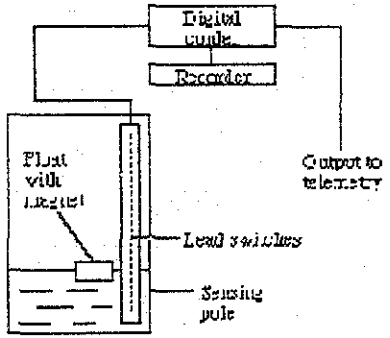
WATER LEVEL GAUGE		FLOAT TYPE		
ITEM		FLOAT AND WEIGHT TYPE	SENSING POLE TYPE	
MEASURING PRINCIPLE		Water level is measured by a rotary degree of pulley which is directly connected to a float balanced with a counter weight in response to up and down motion of water level.	Water level is measured by lead switches which correspond to position of a float with magnet.	
EQUIPMENT COMPOSITION				
INSTALLA-	NECESSITY OF GAUGING WELL	Necessity, 650 mm,o or more	Disuse	
TION CONDITION	INSTALLATION DISTANCE FROM SENSOR TO CONVERTER	Impossible	Possible, Maximum 500 m	
	INCLINE INSTALLATION ALLOWABLE ANGLE	Impossible	Possible with sensing pole for incline Maximum allowable angle: 27°	
	OTHERS	Narrow well type is available (Diameter of well is 200 mmø or less)	Firm installation is needed to avoid sensing pole washed away by a flood	
CONNECTABLE CONVERTER AND MEASURING ACCURACY		Shaft encoder ±1 cm	Digital coder ±1 cm	
MEASURING RANGE 0 - 10 m/20 m/50 m/100 m		0 - 10 m/20 m		
RECORDER		Equipped type (Analogue record: 1/3 months)	Separate type (Analogue record: 1/3 months)	
POWER SOURCE AND CONSUMPTION		Power supply is not necessary	DC 12 V, Approx. 6 W	
APPLICATION OF SOLAR CELLS POWER SUPPLY SYSTEM		Most suitable	Suitable	

Table 3.1.9 Comparative Studies of the Promising Installation Sites of Radar Rain Gauges

Study Item	Ziyaret T. Relay Station	Feke Dağı Relay Station
Site	• Ziyaret T., the scheduled installation location of a multiplex radio line relay station	• Feke Dağı, the scheduled installation location of a multiplex radio line relay station and a telemetering radio line relay station.
Supervisory control center	• DSİ 6th regional directorate	• DSİ 6th regional directorate
Possible ranges of rainfall gauging	• Although a quantitative gauging range of 120km is not perfect, it covers the midstream area of the Seyhan River basin. • A qualitative gauging range of 200km almost covers the intended Seyhan River basin.	• A quantitative gauging range of 120km almost covers the intended Seyhan River basin. • A qualitative gauging range of 200km almost fully covers the Seyhan River basin.
Topographical conditions of the radar site	• The relationship between the positions of neighboring mountains and the allowable emitting radar beam angle should be studied in detail.	• The relationship between the positions of neighboring mountains and the allowable emitting radar beam angle should be studied in detail.
Power receiving situation	• Power distribution lines are present nearby.	• Power distribution lines are present nearby.
Access to the radar site	• Possible by car	• Possible by car

Table 3.3.1 List of Evaluation of Related Agencies To Be Transmitted of Information

Information / Related Agencies	Rainfall Data	Water Level Data	Discharge Data	Flood Protection Information	Evacuation Information	Seyhan Dam Operation Information	Çatalan Dam Operation Information						Evaluation of Related Agencies	Remarks
DSİ 6 th Flood Control Committee	O	O	O	O	O	O	O						A	
DSİ General Directorate	O	O	O	O	O	O	O						A	
Seyhan Dam Office	O	O	O	-	-	-	O						A	
Çatalan Dam Office	O	O	O	-	-	O	-						A	
DMİ Adana Regional Directorate	O	-	-	-	-	-	-						A	
EİE Adana Regional Directorate	-	O	O	-	-	-	-						A	
Doğankent Office of ASO	-	-	-	O	-	-	-						A	
Yenice Office of ASO	-	-	-	O	-	-	-						A	
Adana Provincial Governor	-	-	-	-	O	-	-						A	
Seyhan District	-	-	-	-	O	-	-						B	
Yüreğir District	-	-	-	-	O	-	-						B	
Seyhan Municipality	-	-	-	-	O	-	-						C	
Yüreğir Municipality	-	-	-	-	O	-	-						C	
Feke District Office	-	-	-	-	O	-	-						C	
Pozantı District Office	-	-	-	-	O	-	-						C	
Saimbeyli District Office	-	-	-	-	O	-	-							
Tufanbeyli District Office	-	-	-	-	O	-	-							
Sarız District Office	-	-	-	-	O	-	-							
Pinarbası District Office	-	-	-	-	O	-	-							
Karaısalı District Office	-	-	-	-	O	-	-							
Heads of Towns and Villages downstream	-	-	-	-	O	-	-						B	

Note: Siren warning is effective for evacuation, but it is excluded because of military use.

Legend: A; Transmission media is to be installed preferentially.

B; Transmission media is good to be installed.

Table 3.3.2 List of Kind of Data and Information Transmitted in Present Conditions

Kind of Information		Intervals of Transmission	Transmission Media	Content of Information
	Rainfall	Every 1 H	Numerical (Telephone)	Hourly rainfall by gauge read
Hydrometeorological information	Water level	Every 2/1 H	Numerical (Telephone)	Present water level by gauge read
	Discharge	Every 2H/1H	Numerical (Telephone)	Present discharge by conversion table
Flood protection information		At any time	Voice (VHF)	Necessary information of flood protection action
Flood protective facility information		At any time	Numerical/voice (Telephone/VHF)	Information of flood discharge
		At any time	Letter/voice (FAX/Teleohone)	Villages to be evacuated
Evacuation information			Voice (Çukurova radio broadcasting station)	People downstream to be evacuated

Table 3.3.3 List of Data Transmission Media Used in Flood Forecasting and Warning System (1/2)

Transmission Media	Description and Features of Media	Examples of Types of Information Provided	Typical Hardware Units
Image information	* Graphic information and digital information are combined and served in the form of an image. * Suitable for the information that can be better understood in a chart of a diagram. * Suitable to display the time-series data.	* River basin status chart * Water level/flow change chart * Rainfall status chart * Table of rainfalls * Table of water level/discharge * Dam status chart * Water level/discharge forecast chart * Others	* CRT display unit * Overhead projector * Hard copy
Data display	* Display by digital numbers or indicator lamps. * Suitable for the information that is displayed and monitored all the time. * Applicable also for displaying or instructing a warning or a status of disaster condition. * It is possible for many persons to monitor the data at a time.	* Rainfall display * Water level and discharge display * Dam gate discharge * Rainfall warning * Water level warning * Danger warning * Status display * (Command)	* Data display panel * Graphic display panel * Warning display panel * Status display panel (e.g. flood fighting action system)
FAX	* It is possible to output a text or a diagram in the form of paper. * Automatic transmission is possible, but operation for the transmission and delivery after the receipt are manual. * It is possible to exchange detail information in the form of written documents. * Effective for recording the command (order).	* Command/order for operation * Guidance for operation * Detailed status reportof flood fighting action	* Facsimile eqyuipment
Record		* Record of hourly/daily report * Record of monthly report * Record of yearly report * Record of warning report	* Typewriter * Printer * Hard copy
TELEX	* Character transmission via the general-purpose public TELEX line which uses the network service of the post offices.	* Character information	Facilities of post offices are used.

Table 3.3.4 List of Data Transmission Media Used in Flood Forecasting and Warning System (2/2)

Transfer Media		Description and Features of Media	Examples of Types of Information Provided	Typical Hardware Units
Voice telephone	Private announcement	* Only picking up the handset of the telephone causes the telephone set at the other end to ring. Because a private line is used, this is a transfer medium which assures communication and instruction without fail whenever necessary.	* Dam operation command * Flood fighting command * Emergency announcement	* Multiplex communication facility * Radio communication facility
	Simultaneous announcement	* A system for simultaneous announcement from a point such as the control center to all relevant places and parties. In general, an alert signal for caution is sent first and then the announcement is sent simultaneously.	* Command regarding the in-alert condition * Command to issue warning/alert * Announcement of information common to all stations such as information about the status of upstream dams	* Multiplex communication facility * Radio communication facility * Mobile communication facility * Simultaneous announcement facility * Simultaneous broadcasting facility
	Individual announcement	* A system for sending the announcement after calling up each station with voice or signal such as bell.	* Individual command regarding the in-alert condition * Command to issue warning/alert individually	* Multiplex communication facility * Radio communication facility * Mobile communication facility * Individual announcement facility
	General announcement	* A system for communication by calling up the other end with bell or voice like in general telephony.	* General operation-related announcement * Maintenance-related announcement	* Multiplex communication facility * Radio communication facility * Mobile communication facility
Warning equipment such as siren		* A system for announcing a warning to the general residents by remote or manual operation.	* Alert for caution * Evacuation warning * Gate operation warning	* Siren broadcasting facility * Dam discharge warning facility
Loud-speaker broadcasting		* To transfer information to the general residents via voice broadcasting by way of remote loud-speaker broadcasting or field manual operation.	* Alert for caution * Flood information * Evacuation warning/command * General announcement	* Simultaneous broadcasting facility * Loud-speaker broadcasting facility
Electric sign board		* To transfer information by way of displaying in characters by remote control or field manual control.	* Alert for caution * Flood information * Evacuation warning/command * General announcement	* Electric sign board
Rotational warning light		* To alert for caution by way of revolving red or yellow lights by remote control or field manual control.	* Alert for caution	* Rotational warning light

Table 3.3.5 List of Kinds of Information Transmission and Media Recommended

Kinds of Information / Transmission Media		Image Information Display	Data Display	FAX	TELEX	Recording	Private Telephone	Simultaneous Messaging	Independent Messaging	General Contact Telephone	Siren Warning	Loud Speaker Broadcasting	Electric Sign Board	Rotation Alarm lamp	Remarks
Hydrometeorological Information	Rainfall	A	A	C	-	B	-	-	-	-	-	-	-	-	
	Water level	A	A	C	-	B	-	-	-	-	-	-	-	-	
	Discharge	A	A	C	-	B	-	-	-	-	-	-	-	-	
Flood Protection Information		A	A	B	-	-	B	B	B	C	-	-	-	-	
Evacuation Information		A	A	B	-	-	-	B	B	B	-	C	C	C	
Seyhan Dam Operation Information		A	A	B	-	-	A	B	B	B	-	-	-	-	
Çatalan Dam Operation Information		A	A	B	-	-	A	B	B	B	-	-	-	-	
Maintenance Management Information		A	A	B	-	-	-	-	-	A	-	-	-	-	

Note: Siren warning is effective for evacuation, but it is excluded because of military use.

Legend: A; Transmission media is to be installed preferentially.

B; Transmission media is good to be installed.

C; Transmission media is to be installed, if possible.

Table 3.3.6 List of Transmission Media Between DSİ Flood Control Committee and Related Agencies

Transmission Media / Related Agencies	Image Information Display	Data Display	FAX	TELEX	Recording	Private Telephone	Simultaneous Messaging	Independent Messaging	General Contact Telephone	Siren Warning	Loud Speaker Broadcasting	Electric Sign Board	Rotation Alarm lamp	Remarks
DSİ 6 th Flood Control Committee	A	B	B	-	A	A	-	-	-	-	-	-	-	
DSİ General Directorate	A	-	B	-	A	A	-	-	-	-	-	-	-	
Seyhan Dam Office	A	-	B	-	A	A	-	-	-	-	-	-	-	
Çatalan Dam Office	A	-	B	-	A	A	-	-	-	-	-	-	-	
DMİ Adana Regional Directorate	A	-	-	-	A	-	-	-		-	-	-	-	
EİE Adana Regional Directorate	A	-	-	-	A	-	-	-		-	-	-	-	
Doğankent Office of ASO	-	-	B	-	-	-	-	B		-	-	-	-	
Yenice Office of ASO	-	-	B	-	-	-	-	B		-	-	-	-	
Adana Provincial Governor	-	-	A	-	-	A	-	-	-	-	-	-	-	
Seyhan District	-	-	B	-	-	-	-	-	B	-	-	-	-	
Yüreğir District	-	-	B	-	-	-	-	-	B	-	-	-	-	
Seyhan Municipality	-	-	-	-	-	-	-	-	-	-	-	-	-	
Yüreğir Municipality	-	-	-	-	-	-	-	-	-	-	-	-	-	
Feke District Office	-	-	B	-	-	-	-	-	B	-	-	-	-	
Pozantı District Office	-	-	B	-	-	-	-	-	B	-	-	-	-	
Saimbeyli District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tufanbeyli District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sarız District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pınarbası District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Karaısalı District Office	-	-	-	-	-	-	-	-	-	-	-	-	-	
Heads of Towns and Villages downstream	-	-	B	-	-	-	-	-	-	-	-	-	-	People downstream

Legend: A; Transmission media is to be installed preferentially.

B; Transmission media is good to be installed.

Table 3.3.7 Comparison of Voice-based Information Transmission Method (1/2)

		Method 1 Voice Call Radio Communication Method	Method 2 Sele-call Radio Communication Method	Method 3 Single Channel Radio Dial Communication Method	Method 4 Frequency Division Multi-channel Method (Rural Telephone System)	Method 5 Time Division Multi-channel Method
General matters	Method	The system comprises of the base station, relay stations and terminal stations, where only the radio equipment is installed in the terminal stations. Each station is called up by voice.	The system comprises of the base station, relay stations and terminal stations. Cell-call control device is added to the radio equipment installed at the base station (center station) and terminal stations. During communication, it is possible to call up a required station by audible sound such as a sound tone and then talk with it.	The system comprises of the base station, relay stations and terminal stations. The base station connects through a controller to the radio equipment which is installed in the switching unit of the relay stations for communication with the terminal stations. Stations to talk to are called up by dialing like in general telephony.	The radio communication line with each terminal station uses multiple frequencies, and any unoccupied frequency at the time is used for communication. This allows the system to be used in the same manner as in general telephony.	While the method 4 employs multiple frequencies, this method communicates via the time division multiplex digital radio communication link.
	Transmission method	Half-duplex communication method	Half-duplex communication method	Full duplex communication method	Full duplex communication method	Full duplex communication method
	How to call the other station	Voice call	Audible signal	Dialing	Dialing	Dialing
	Communication method	Press-to-talk conversation	Press-to-talk conversation	Bi-directional simulta-neous conversation (the same as in general telephony)	Bi-directional simulta-neous conversation (the same as in general telephony)	Bi-directional simulta-neous conversation (the same as in general telephony)
	System size	No particular limita-tion, but several tens of stations are included in one radio communication link.	Same as in the left.	Only several stations are included in one radio communication link because each terminal requires independent radio frequency.	Possible to include up to tens or hundreds of stations depending upon the type of each system.	Possible to include up to tens or hundreds of stations depending upon the type of each system.
	Required number of radio frequencies (in case of one radio communication link having no relay station)	One wave	One wave	Two waves x number of terminal stations	In general, the system is built up using two waves x several channels depending upon the type and size of the system.	One wave
	Applicable frequency band in considera-tion of the market	60 MHz/70 MHz band, 150 MHz band, and 400 MHz band are commonly used.	60 MHz/70 MHz band, 150 MHz band, and 400 MHz band are commonly used.	250 MHz band to 450 MHz band is commonly used.	400 MHz band is used in some cases.	1.5 GHz band to 2.5 GHz band

Table 3.3.8 Comparison of Voice-based Information Transmission Method (2/2)

		Method 1 Voice Call Radio Communication Method	Method 2 Sele-call Radio Communication Method	Method 3 Single Channel Radio Dial Communication Method	Method 4 Frequency Division Multi-channel Method (Rural Telephone System)	Method 5 Time Division Multi-channel Method
Appli-cability to announce-ment function	Simultaneous announcement	Difficult	Possible	Impossible	Generally impossible	Generally impossible
	Individual announcement	Possible despite of voice call-up method.	Possible	Possible	Possible	Possible

Table 4.2.1 Alternative Plans of Telemetering Gauging Stations

No.	Name of Station	Kind of Station	Alternative 1 Hydrometeorological Gauging Items				Alternative 2 Hydrometeorological Gauging Items				Alternative 3 Hydrometeorological Gauging Items			
			Rainfall	Temperature	Water Level	Reservoir	Rainfall	Temperature	Water Level	Reservoir	Rainfall	Temperature	Water Level	Reservoir
	Seyhan River Basin													
1	Çamardı	RG Station	√				√				√			
2	Çiftehan	RG Station	√				√				√			
3	Pozantı	RG/TP Station	√	√			√	√			√	√		
4	Kamışlı	RG/TP Station	√	√			√	√			√	√		
5	Karaisalı	RG Station	√				√				√			
6	Karsantı	RG/TP Station	√	√			√	√			√	√		
7	1825	WL Station			√				√				√	
8	1820	WL Station			√				√				√	
9	1818	WL Station			√				√				√	
10	1828	WL Station			√				√				√	
11	Seyhan dam	WL Station				√				√				√
12	Çatalan dam	RG/WL Station	√			√	√			√	√			√
	Zamantı River Basin													
13	Kazancık	RG Station	√											
14	Pinarbaşı	RG Station	√				√							
15	Toklar	RG Station	√											
16	Tomarza	RG/TP Station	√	√			√	√						
17	Şeyhli	RG/TP Station	√	√										
18	1822	WL Station			√								√	
19	1806	WL Station			√				√				√	
	Göksu River Basin													
20	Tufanbeyli	RG/TP Station	√	√			√	√			√	√		
21	Saimbeyli	RG Station	√				√				√			
22	Feke	RG Station	√				√				√			
23	Sarız	RG Station					√							
24	Mansurulu	RG/TP Station	√	√			√	√			√	√		
25	1801	WL Station			√				√				√	
26	1805	WL Station			√				√				√	

Abbreviation: RG; Rainfall, TP; Temperature, WL; Water level

Table 4.2.2 Comparison of Alternative Plans for The Data Collection System

Item	Plan 1	Plan 2	Plan 3	Plan 4
1. Data to be collected				
(1) Rainfall	15	13	10	10
(2) Dam rainfall	1	1	1	1
(3) River water level	8	7	8	8
(4) Dam water level	2	2	2	2
(5) Air temperature	7	6	5	5
2. Facilities				
(1) Gauging stations	25	22	20	20
(2) Radio repeater stations (Multiplex repeater stations included)	14	13	10	11
(3) Radar rain gauges	0	0	0	1
3. Basin rainfall gauging accuracy	• High accuracy is ensured even for the rainfall only in some specific areas.	• A certain degree of accuracy is ensured even for the rainfall only in some specific areas.	• High accuracy is not ensured for the rainfall only in some specific areas.	• Although Plan 3 can be complemented, further study based on stored data is required after installation of radar rain gauges.
4. Water level prediction accuracy	• Changes in regional runoff can be incorporated. • Accuracy becomes stable.	• Accuracy significantly fluctuates according to the particular scale of flooding.	Same as at left.	Same as at left.
5. VHF radio frequency required	Implementable with a minimum of 4 frequencies	Same as at left.	Same as at left.	Same as at left.
6. Behavioral monitoring of rainy zones (Prediction included)	Impossible	Impossible	Impossible	Possible

Table 4.2.3 Comparative Studies of Ground Rain Gauges and Radar Rain Gauges

Item	Ground Rain Gauge	Radar Rain Gauge
Gauging characteristics	Gauging of the amount of rainfall at a site using a previously ground-installed rain gauge allows that gauged value to be evaluated as a typical amount of rainfall in the corresponding split areas.	Processing of the receiving intensity data of radar beam reflections allows the intensities of rainfall to be calculated and evaluated for each fixed mesh.
Outline of the facilities	A telemetering system for collecting data using the telemeter gauging units installed previously for each rain gauge of each site must be structured.	A system for supervisory control and processing of a previously installed radar site is to be structured.
Areal rainfall calculation accuracy	In general, rainfall data of the past is stored at each site. High accuracy can therefore be obtained by analyzing such past data and then selecting the appropriate measurement positions.	Analytical study based on after-installation stored data is required. Calibration with a ground rain gauge usually becomes necessary, and its technique is currently under analytical research. At present, therefore, a prescribed technique is not yet established since actual data is affected by the topographical environment.
Static monitoring of rain fall	In general, one rain gauge is installed in each split area ranging from several tens of square kilometers to several hundreds of square kilometers. The amounts of rainfall between these areas, therefore, are to be estimated from the amount of rainfall in one specific position.	Static monitoring of rain fall is possible. Accuracy can be improved by using this type of rain gauge together with the ground type.
Dynamic monitoring rain fall	Dynamic monitoring may become possible with image processing that uses data of the past. In general, however, such monitoring is difficult to execute, because of rough meshes.	Possible. Since the situation in fine meshes can be checked, it also becomes possible for the centers of rainy zones, the processes of appearance and disappearance of these zones, and the directions of movement of the zones to be examined.
Actual results of outflow analysis with existing flood prediction/warning systems	Data from ground rain gauges is mainly used.	Systems based on radar rain gauges are not yet almost structured by foreign companies. A radar rain gauge combined with a ground rain gauge becomes a powerful instrument in that flood prediction becomes complemented and strengthened in function.

Table 4.3.1 Comparison of the Methods of Data Processing System Structuring

	Item	Plan 1 (Centralized Processing Method)	Plan 2 (Distributed Processing Method)	Remarks
1	System configuration	• Minicomputer	• Distributed processing that mainly uses engineering workstations(EWS's)	
2	Processing speed	• Under a single CPU arrangement, the speed is limited because of serial processing.	• The seed can be improved because of load distribution.	
3	Operation	• Education is required since the appropriate computer operation skill is needed.	• Education on EWS operation is required.	
4	Extendibility	• The operating system and application programs are recreated with each addition or modification of a program. • Actual addition/modification of programs is usually consigned to the manufacturer.	• Addition/modification is possible with each EWS(thus, total adverse effects are minimized). • Addition/modification of the EWS section itself by the user may become possible.	
5	Maintainability	• Various types of fault diagnostic programs are available. • After recovery, the restart of the system may require expertise. • The total maintainability of the system is not too high.	• The EWS section is almost the same as for the minicomputer method. • The total maintainability of the system is high since faults can be isolated for each EWS.	
6	Reliability	• The hardware is highly reliable. • Errors in the CPUs result in immediate system failures. • Various types of fault detection are provided. Memory protection is also provided. • Duplexing of the system becomes expensive.	• The hardware is highly reliable. • System failures can be minimized by localizing faults.	
7	Installation conditions	• Installation conditions are slightly strict, and a special room is usually required. • Noise arises from the operation of heat release fans. • It is preferable that the system should be powered from a CVCF unit.	• There are not too many limitation on installation conditions, and the system can be installed even in the living room of an office(in terms of power requirements, dimensions, and noise). • Power consumption is not significant, a heat release fan is not required, nor does noise almost occur.	
8	Economy	• High initial investment cost(compared with that of the distributed processing method) • Significant power consumption(compared with that of the distributed processing method) • Large quantity of related facility	• Low initial investment cost because of standardization of each functional module • Insignificant power consumption • Very high cost performance	
9	Other factors	• Terminal equipment extendible for operation in other rooms. • (Limited functions) With appropriate memory, operating system, and processing capability margins, programs separate from those of the intended system can be operated	• Operation possible even in the living room of the section in charge • The EWS can be disconnected from the system at any appropriate time to be operated as a personal computer.	
10	Overall evaluation	Δ	O	

Table 4.4.1 Alternative Plans of Related Agencies To Be Transmitted of Information

Information / Related Agencies	Rainfall Data	Water Level Data	Discharge Data	Flood Protection Information	Evacuation Information	Seyhan Dam Operation Information	Çatalan Dam Operation Information						Evaluation of Related Agencies	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Remarks
DSİ 6 th Flood Control Committee	O	O	O	O	O	O	O						A	O	O	O	
DSİ General Directorate	O	O	O	O	O	O	O						A	O	O	O	
Seyhan Dam Office	O	O	O	-	-	-	O						A	O	O	O	
Çatalan Dam Office	O	O	O	-	-	O	-						A	O	O	O	
DMİ Adana Regional Directorate	O	-	-	-	-	-	-						A	O	O	O	
EİE Adana Regional Directorate	-	O	O	-	-	-	-						A	O	O	O	
Doğankent Office of ASO	-	-	-	O	-	-	-						A	O	O	O	
Yenice Office of ASO	-	-	-	O	-	-	-						A	O	O	O	
Adana Provincial Governor	-	-	-	-	O	-	-						A	O	O	O	
Seyhan District	-	-	-	-	O	-	-						B		O		
Yüreğir District	-	-	-	-	O	-	-						B		O		
Seyhan Municipality	-	-	-	-	O	-	-						C			O	
Yüreğir Municipality	-	-	-	-	O	-	-						C			O	
Feke District Office	-	-	-	-	O	-	-						C		O		
Pozantı District Office	-	-	-	-	O	-	-						C		O		
Saimbeylı District Office	-	-	-	-	O	-	-										
Tufanbeylı District Office	-	-	-	-	O	-	-										
Sarız District Office	-	-	-	-	O	-	-										
Pınarbası District Office	-	-	-	-	O	-	-										
Karaısalı District Office	-	-	-	-	O	-	-										
Heads of Towns and Villages downstream	-	-	-	-	O	-	-						B	O			

Note: Siren warning is effective for evacuation, but it is excluded because of military use.

Legend: A; Transmission media is to be installed preferentially.

B; Transmission media is good to be installed.

Table 4.4.2 Comparison of Alternative Plans for Data Transmission System

Item	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3
Destinations of data and information transmission	Governmental agencies: 7 places • DSİ general directorate • Seyhan dam office • Çatalan dam office • EİE Adana regional directorate • DMİ Adan regional directorate • Doğankent office of ASO • Yenice office of ASO Provincial governor: 1 place Heads of towns and villages in downstream area of Seyhan dam: 5 places	Governmental agencies: 7 places • DSİ general directorate • Seyhan dam office • Çatalan dam office • EİE Adana regional directorate • DMİ Adan regional directorate • Doğankent office of ASO • Yenice office of ASO Provincial governor: 1 place Heads of towns and villages in downstream area of Seyhan dam: 5 places Heads of official districts: 4 places	Governmental agencies: 7 places • DSİ general directorate • Seyhan dam office • Çatalan dam office • EİE Adana regional directorate • DMİ Adan regional directorate • Doğankent office of ASO • Yenice office of ASO Provincial governor: 1 place Heads of towns and villages in downstream area of Seyhan dam: 5 places Heads of official districts: 4 places Municipalities: 2 places
Flood information monitoring at the DSİ general directorate	√	√	√
Telephone private line between the DSİ 6 th flood control committee and Seyhan dam office	√	√	√
Telephone private line between the DSİ 6 th flood control committee and Çatalan dam office	√	√	√
Telephone private line between the DSİ 6 th flood control committee and Adana provincial governor	√	√	√
Liaison radio telephone link between DSİ 6 th flood control committee and ASO branch offices	√	√	√
Liaison radio telephone link between DSİ 6 th flood control committee and offices of towns and villages' head in downstream area of Seyhan dam	√	√	√
Liaison radio telephone link between DSİ 6 th flood control committee and heads of official districts		√	√
Liaison radio telephone link between DSİ 6 th flood control committee and municipalities			√

Table 6.2.1 Hydrometeorological Gauging Items To Be Collected

No.	Name of Station	Kind of Station	Hydrometeorological Gauging Items			
			Rainfall	Temperature	Water Level	Reservoir
	Seyhan River Basin					
1	Çamardı	RG Station	√			
2	Çiftehan	RG Station	√			
3	Pozantı	RG/TP Station	√	√		
4	Kamışlı	RG/TP Station	√	√		
5	Karaisalı	RG Station	√			
6	Karsantı	RG/TP Station	√	√		
7	1825	WL Station			√	
8	1820	WL Station			√	
9	1818	WL Station			√	
10	1828	WL Station			√	
11	Seyhan dam	WL Station				√
12	Çatalan dam	RG/WL Station	√			√
	Zamantı River Basin					
13	Kazancık	RG Station	√			
14	Pinarbaşı	RG Station	√			
15	Toklar	RG Station	√			
16	Tomarza	RG/TP Station	√	√		
17	Şeyhli	RG/TP Station	√	√		
18	1822	WL Station			√	
19	1806	WL Station			√	
	Göksu River Basin					
20	Tufanbeyli	RG/TP Station	√	√		
21	Saimbeyli	RG Station	√			
22	Feke	RG Station	√			
23	Mansurlu	RG/TP Station	√	√		
24	1801	WL Station			√	
25	1805	WL Station			√	

Abbreviation

RG: Rainfall

TP: Temperature

WL: Water level

Table 6.2.2 Data Processing Items for Flood Forecasting and Warning System for Seyhan River Basin (1/6)

Name of Stations	Items of Data	Telemetering	Control Center (DSİ 6 th Flood Control Committee)																			CRT Display/Hard Copy					Remarks
			Display										Processing				Recording										
			Data Display Panel				Mimic Display Panel				CRT																
			Digital	Analogue	Lamp	Warning Status	Digital	Analogue	Lamp	Warning	Digital	Chart	Discharge Conversion	Calculation	Accumulation	Forecast	Daily Report	Monthly Report	Annual Report	Malfunction Status	Warning Status	DSİ Ankara	Seyhan Dam Office	Çatalan Dam Office	Adana EİE	Adana DMİ	
(Seyhan River Basin)																											
Çamardı	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Çiftehan	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Pozantı	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Kamışlı	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Karaisalı	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Karsantı	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Çatalan dam	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
(Zamantı River Basin)																											
Kazancık	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Pınarbaşı	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Toklar	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Tomarza	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Şeyhli	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
(Göksu River Basin)																											
Tufanbeyli	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Saimbeyli	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Feke	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	
Mansurlu	Rainfall Data	√	√			√			√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	

Table 6.2.3 Data Processing Items for Flood Forecasting and Warning System for Seyhan River Basin (2/6)

Name of Stations	Items of Data	Telemetering	Control Center (DSİ 6 th Flood Control Committee)																			CRT Display/Hard Copy					Remarks
			Display										Processing				Recording										
			Data Display Panel				Mimic Display Panel				CRT																
			Digital	Analogue	Lamp	Warning Status	Digital	Analogue	Lamp	Warning	Digital	Chart	Discharge Conversion	Calculation	Accumulation	Forecast	Daily Report	Monthly Report	Annual Report	Malfunction Status	Warning Status	DSİ Ankara	Seyhan Dam Office	Çatalan Dam Office	Adana EİE	Adana DMİ	
(Seyhan River Basin)																											
1825	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
1820	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
1818	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
1828	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
Seyhan dam	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
Çatalan dam	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
(Zamantı River Basin)																											
1822	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
1806	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
(Göksu River Basin)																											
1801	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
1805	Water level Data	√	√			√			√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		
(Seyhan River Basin)																											
Pozantı	Temperature Data	√	√			√			√	√	√	√		√			√	√	√	√		√	√	√	√	√	
Kamışlı	Temperature Data	√	√			√			√	√	√	√		√			√	√	√	√		√	√	√	√	√	
Karsantı	Temperature Data	√	√			√			√	√	√	√		√			√	√	√	√		√	√	√	√	√	
(Zamantı River Basin)		√	√			√			√	√	√	√		√			√	√	√	√		√	√	√	√	√	
Tomarza	Temperature Data	√	√			√			√	√	√	√		√			√	√	√	√		√	√	√	√	√	

Table 6.2.4 Data Processing Items for Flood Forecasting and Warning System for Seyhan River Basin (3/6)

Name of Stations	Items of Data	Telemetering	Control Center (DSİ 6 th Flood Control Committee)																			CRT Display/Hard Copy					Remarks
			Display										Processing				Recording										
			Data Display Panel				Mimic Display Panel				CRT																
			Digital	Analogue	Lamp	Warning Status	Digital	Analogue	Lamp	Warning	Digital	Chart	Discharge Conversion	Calculation	Accumulation	Forecast	Daily Report	Monthly Report	Annual Report	Malfunction Status	Warning Status	DSİ Ankara	Seyhan Dam Office	Çatalan Dam Office	Adana EİE	Adana DMİ	
Şeyhli	Temperature Data	√	√			√			√	√	√	√		√			√	√	√	√		√	√	√	√	√	
(Göksu River Basin)																											
Tufanbeyli	Temperature Data	√	√			√			√	√	√	√		√			√	√	√	√		√	√	√	√	√	
Mansurlu	Temperature Data	√	√			√			√	√	√	√		√			√	√	√	√		√	√	√	√	√	
(Forecast Processing)																											
1825	Water Level Forecast										√	√				√						√	√	√	√		
1820	Water Level Forecast										√	√				√						√	√	√	√		
1818	Water Level Forecast										√	√				√						√	√	√	√		
1828	Water Level Forecast										√	√				√						√	√	√	√		
Seyhan dam	Water Level Forecast										√	√				√						√	√	√	√		
Çatalan dam	Water Level Forecast										√	√				√						√	√	√	√		
1822	Water Level Forecast										√	√				√						√	√	√	√		
1806	Water Level Forecast										√	√				√						√	√	√	√		
1801	Water Level Forecast										√	√				√						√	√	√	√		
1805	Water Level Forecast										√	√				√						√	√	√	√		
1825	Discharge Forecast										√	√	√			√						√	√	√	√		
1820	Discharge Forecast										√	√	√			√						√	√	√	√		
1818	Discharge Forecast										√	√	√			√						√	√	√	√		
1828	Discharge Forecast										√	√	√			√						√	√	√	√		

Table 6.2.5 Data Processing Items for Flood Forecasting and Warning System for Seyhan River Basin (4/6)

Name of Stations	Items of Data	Telemetering	Control Center (DSİ 6 th Flood Control Committee)																			CRT Display/Hard Copy					Remarks
			Display										Processing				Recording										
			Data Display Panel				Mimic Display Panel				CRT																
			Digital	Analogue	Lamp	Warning Status	Digital	Analogue	Lamp	Warning	Digital	Chart	Discharge Conversion	Calculation	Accumulation	Forecast	Daily Report	Monthly Report	Annual Report	Malfunction Status	Warning Status	DSİ Ankara	Seyhan Dam Office	Çatalan Dam Office	Adana EİE	Adana DMİ	
Seyhan dam	Discharge Forecast										√	√	√			√						√	√	√	√		
Çatalan dam	Discharge Forecast										√	√	√			√						√	√	√	√		
1822	Discharge Forecast										√	√	√			√						√	√	√	√		
1806	Discharge Forecast										√	√	√			√						√	√	√	√		
1801	Discharge Forecast										√	√	√			√						√	√	√	√		
1805	Discharge Forecast										√	√	√			√						√	√	√	√		
(Rainfall Data Processing)																											
Rainfall data gauged		√																		√							
Hourly rainfall data			√								√			√			√					√	√	√	√	√	
Daily rainfall data											√			√			√					√	√	√	√	√	
Cumulative rainfall data			√								√			√			√					√	√	√	√	√	
Mean basin rainfall											√			√			√					√	√	√	√	√	
Warning rainfall judgment					√					√	√			√							√	√	√	√	√	√	
Monthly rainfall data report																		√									
Annual rainfall data report																			√								
Rainfall data lists											√											√	√	√	√	√	
Rainfall data chronological graphs											√	√										√	√	√	√	√	

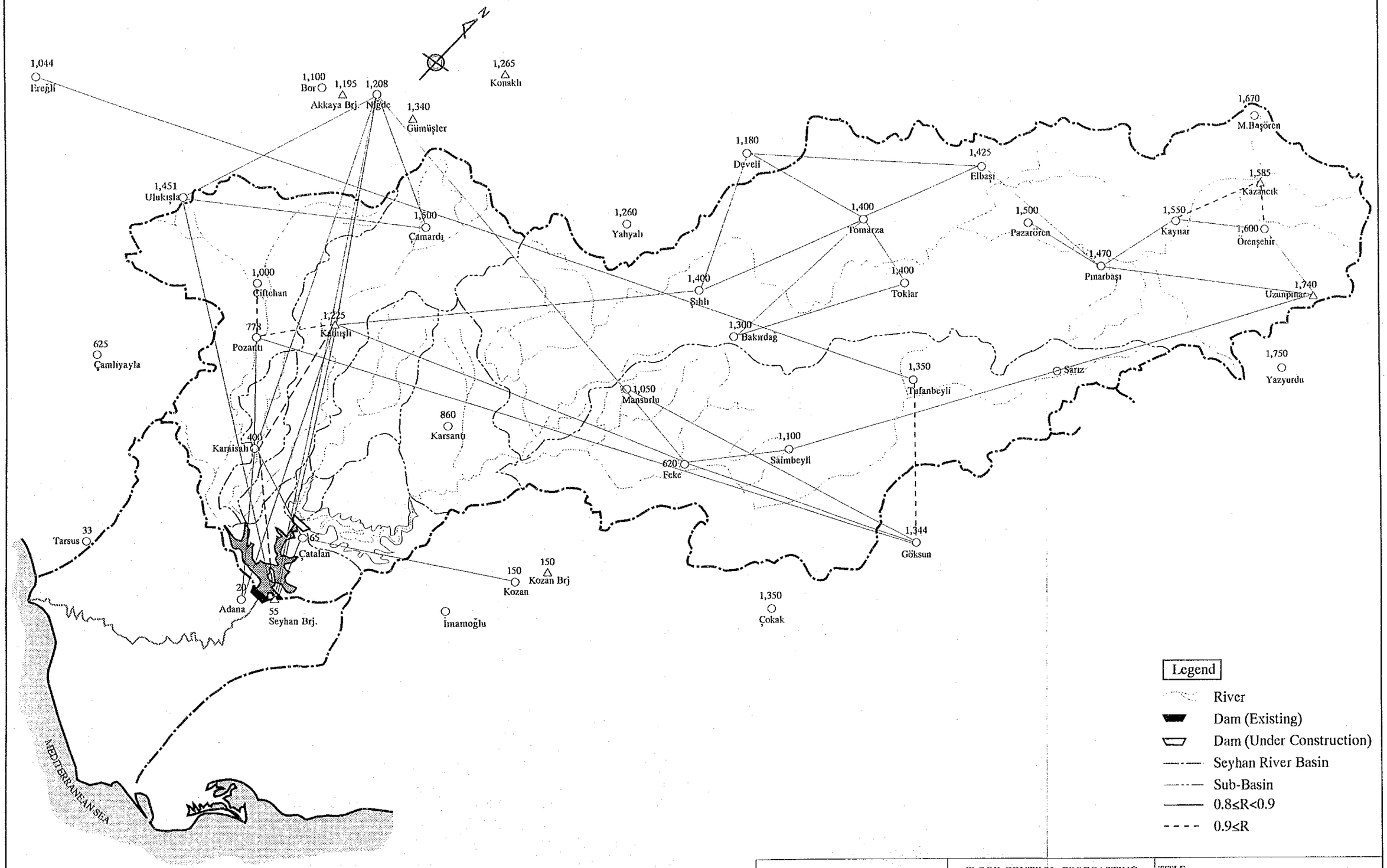
Table 6.2.6 Data Processing Items for Flood Forecasting and Warning System for Seyhan River Basin (5/6)

Name of Stations	Items of Data	Telemetering	Control Center (DSİ 6 th Flood Control Committee)																			CRT Display/Hard Copy					Remarks
			Display										Processing				Recording										
			Data Display Panel				Mimic Display Panel				CRT																
			Digital	Analogue	Lamp	Warning Status	Digital	Analogue	Lamp	Warning	Digital	Chart	Discharge Conversion	Calculation	Accumulation	Forecast	Daily Report	Monthly Report	Annual Report	Malfunction Status	Warning Status	DSİ Ankara	Seyhan Dam Office	Çatalan Dam Office	Adana EİE	Adana DMİ	
(Water Level Data Processing)																											
Water level data gauged		√	√								√									√		√	√	√	√		
Mean daily water level data											√			√			√					√	√	√	√		
Maximum daily water level data											√			√			√					√	√	√	√		
Minimum daily water level data											√			√			√					√	√	√	√		
Warning water level judgment						√					√			√							√	√	√	√	√		
Water level data lists											√											√	√	√	√		
Water level data chronological graphs											√	√										√	√	√	√		
Monthly water level report																		√									
Annual water level report																			√								
(Temperature Data Processing)																											
Temperature data gauged		√	√																	√							
Mean daily temperature data											√			√			√					√	√	√	√	√	
Maximum daily temperature data											√			√			√					√	√	√	√	√	
Minimum daily temperature data											√			√			√					√	√	√	√	√	
Temperature data lists											√											√	√	√	√	√	
Temperature data chronological graphs											√	√										√	√	√	√	√	
Monthly temperature data report																		√									
Annual temperature data report																			√								

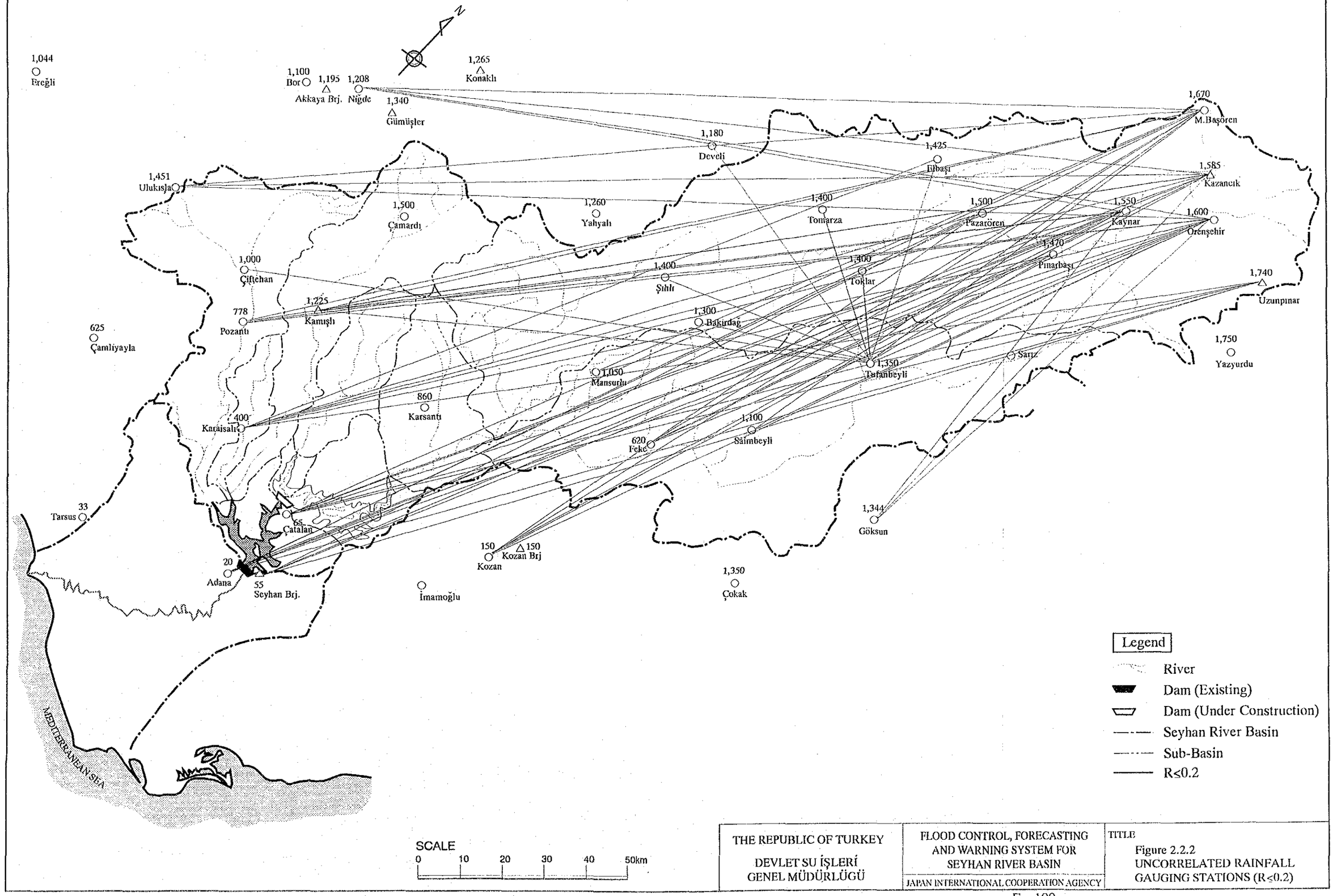
Table 6.2.7 Data Processing Items for Flood Forecasting and Warning System for Seyhan River Basin (6/6)

Name of Stations	Items of Data	Telemetering	Control Center (DSİ 6 th Flood Control Committee)																			CRT Display/Hard Copy					Remarks
			Display										Processing				Recording										
			Data Display Panel				Mimic Display Panel				CRT																
			Digital	Analogue	Lamp	Warning Status	Digital	Analogue	Lamp	Warning	Digital	Chart	Discharge Conversion	Calculation	Accumulation	Forecast	Daily Report	Monthly Report	Annual Report	Malfunction Status	Warning Status	DSİ Ankara	Seyhan Dam Office	Çatalan Dam Office	Adana EİE	Adana DMİ	
(Discharge Data Processing)																											
Current discharge data			√								√		√									√	√	√	√		
Mean daily discharge data											√			√			√					√	√	√	√		
Maximum daily discharge data											√			√			√					√	√	√	√		
Minimum daily discharge data											√			√			√					√	√	√	√		
Discharge data lists											√											√	√	√	√		
Discharge data chronological graphs											√	√										√	√	√	√		
Monthly discharge report																		√									
Annual discharge report																			√								
River Basin Status Chart											√	√										√	√	√			

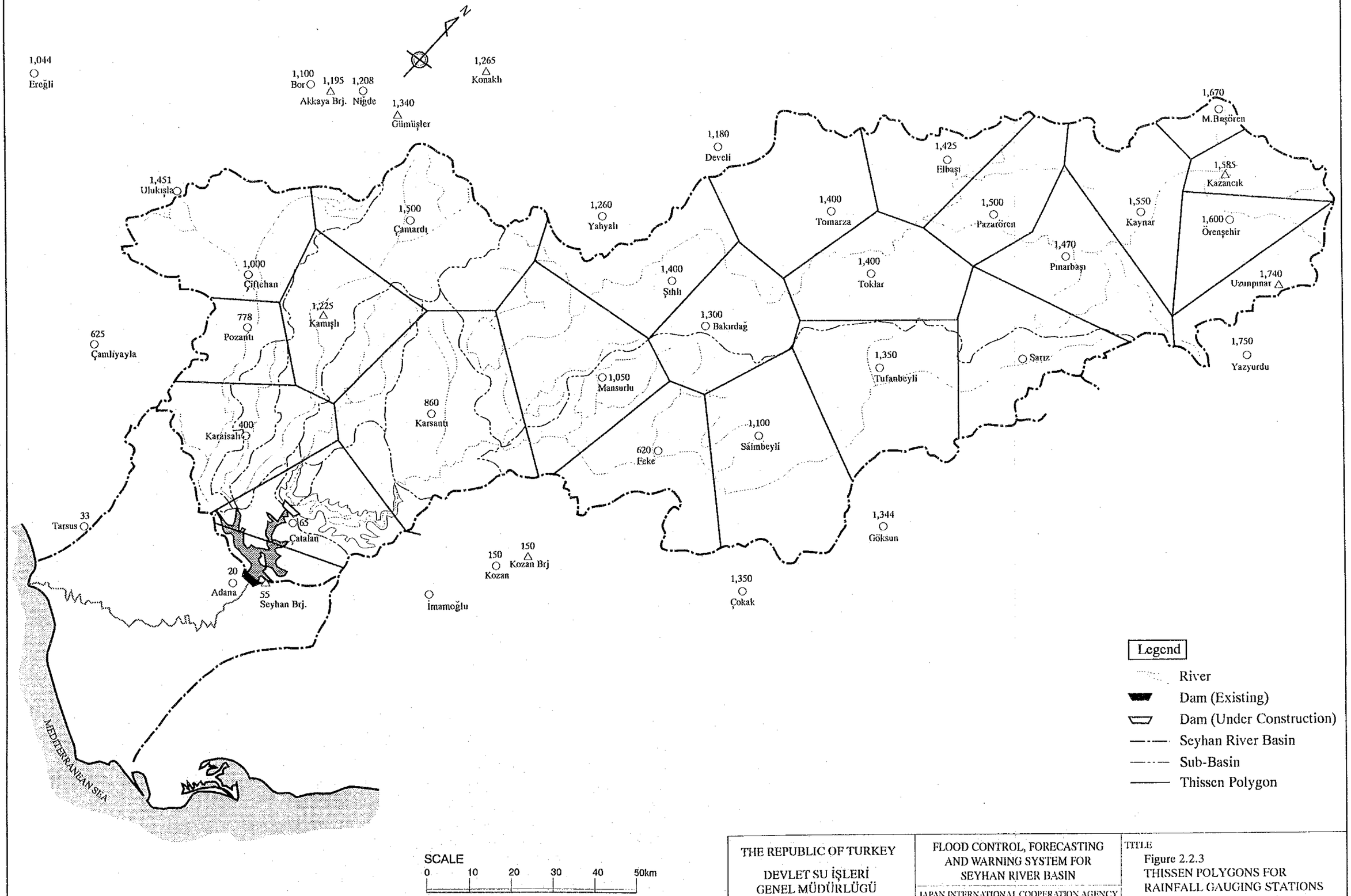
Figures



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 2.2.1 CORRELA TED RAINFALL GAUGING STATIONS (R>0.8)



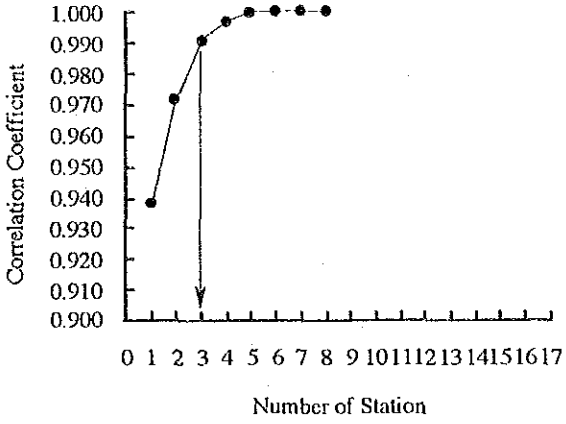
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.2.2 UNCORRELATED RAINFALL GAUGING STATIONS (R≤0.2)



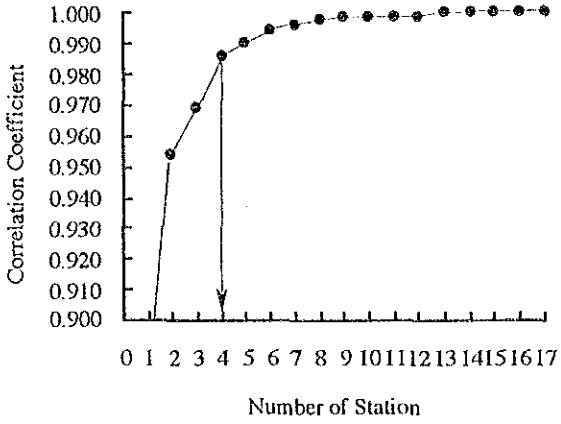
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.2.3 THISSEN POLYGONS FOR RAINFALL GAUGING STATIONS

FIG. NO.

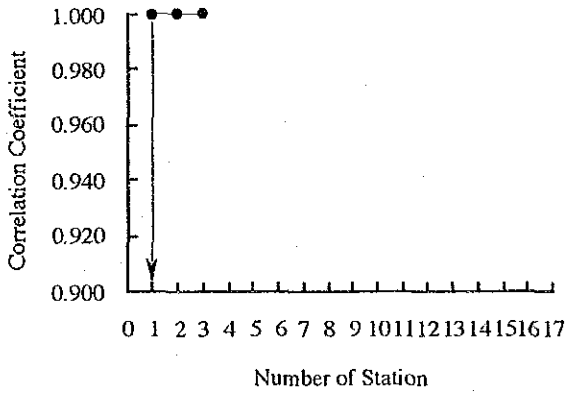
Göksu up to 1805



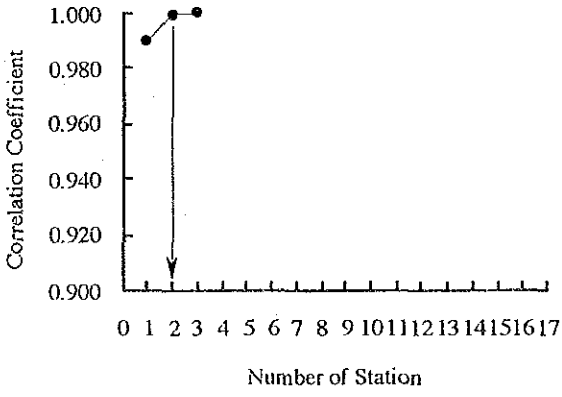
Zamantı up to 1806



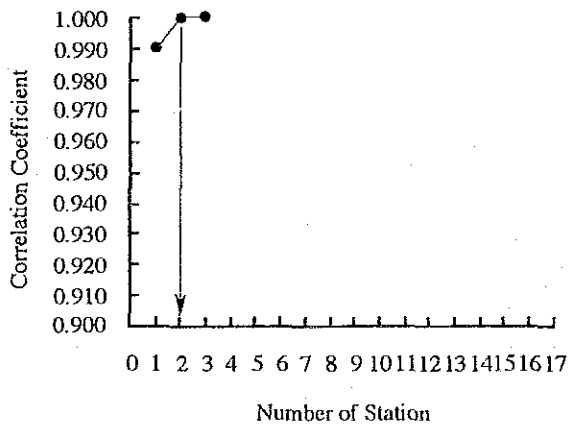
Zamantı-Göksu Joint to Çatalan
(up to Çatalan HWL)



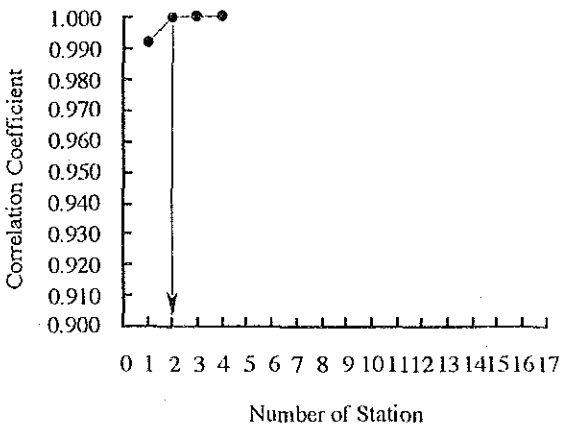
Zamantı-Göksu after Çatalan HWL



Çatalan Brj.-Seyhan Brj.



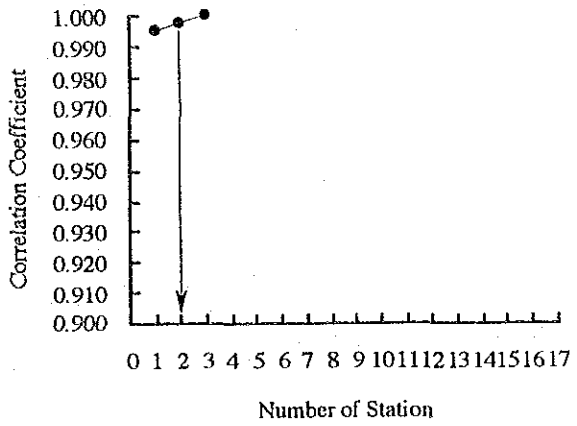
Eğlence up to 1825



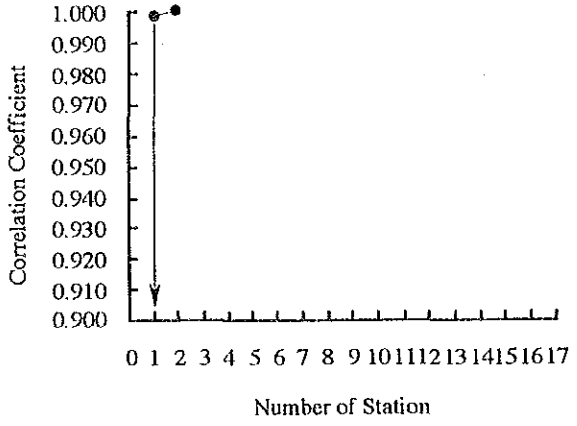
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.2.4 RELATIONSHIP BETWEEN THE NUMBER OF REPRESENTATIVE STATION AND CORRELATION COEFFICIENT (1/2)

FIG. NO.

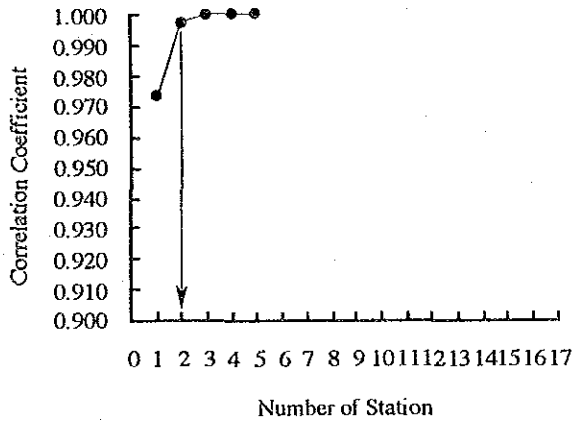
Eğlence up to Çatalan HWL



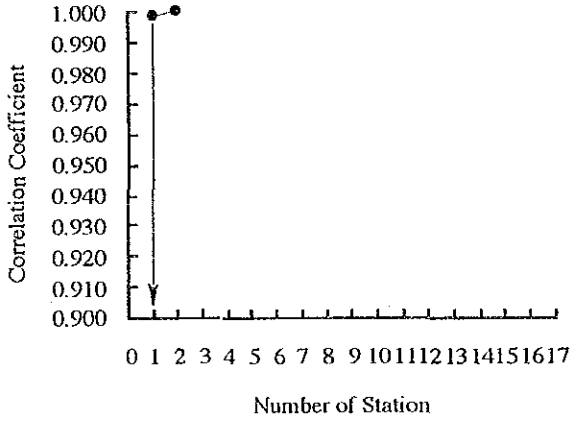
Eğlence after Çatalan HWL



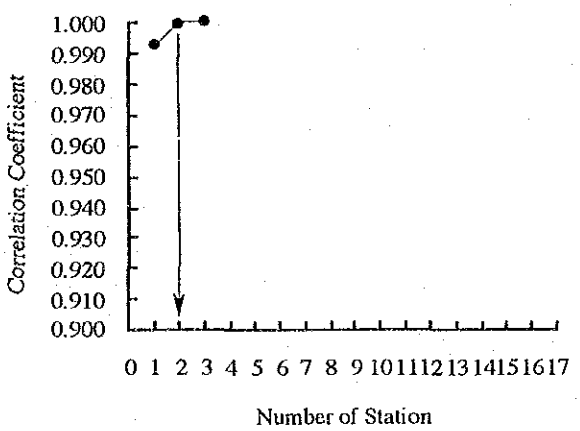
Körkün up to 1820



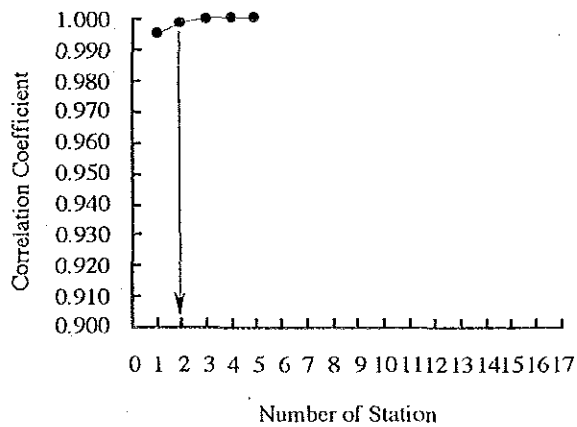
Körkün up to Seyhan HWL



Üçürge

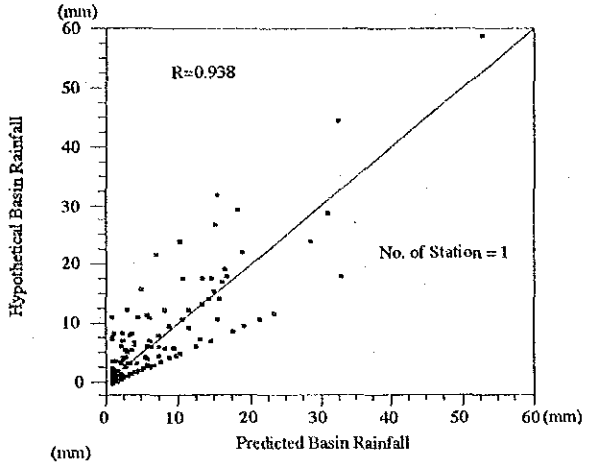


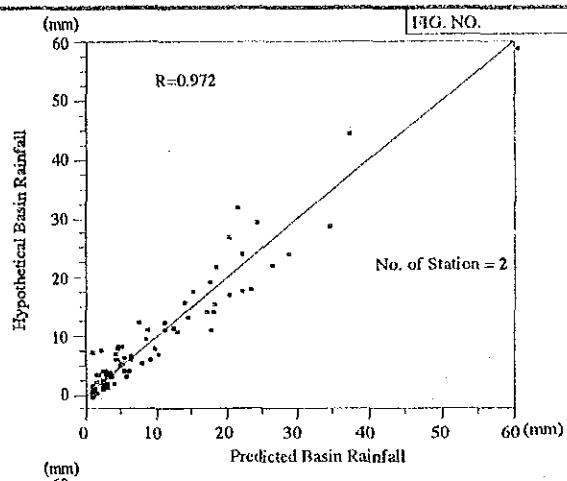
Çakıt up to 1828

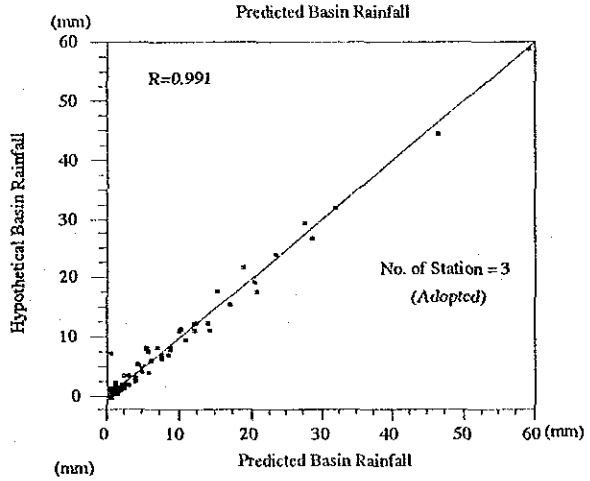


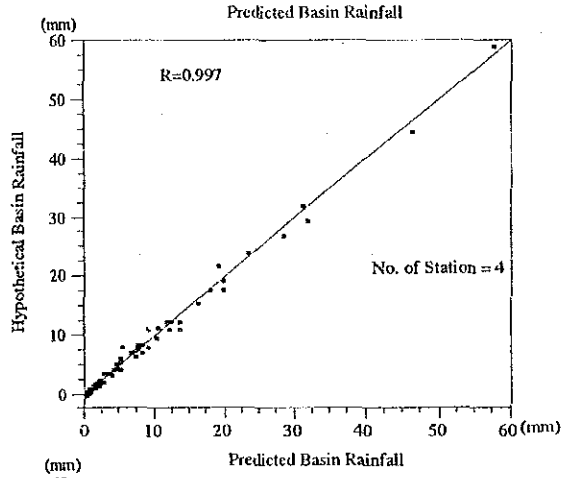
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.2.4 RELATIONSHIP BETWEEN THE NUMBER OF REPRESENTATIVE STATION AND CORRELATION COEFFICIENT (2/2)

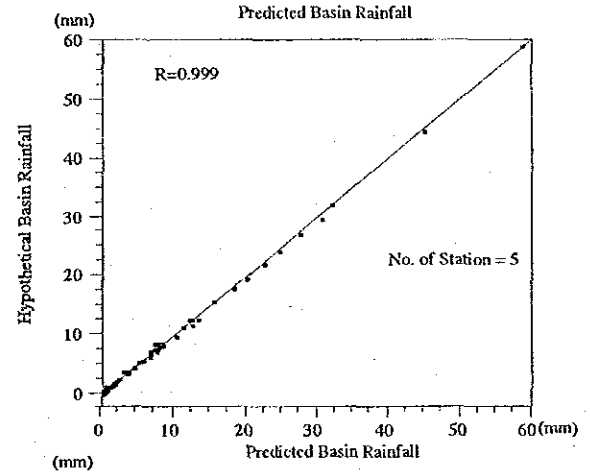
FIG. NO.

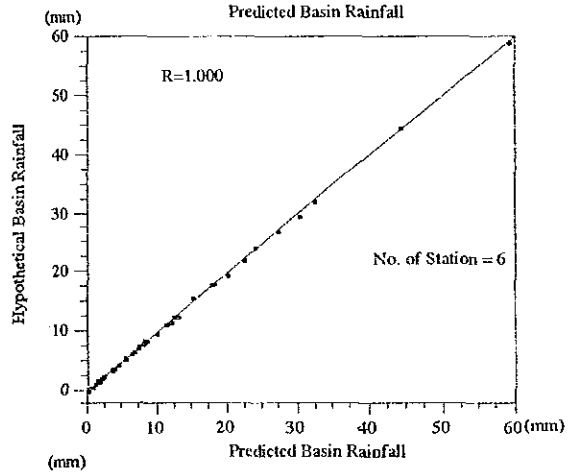


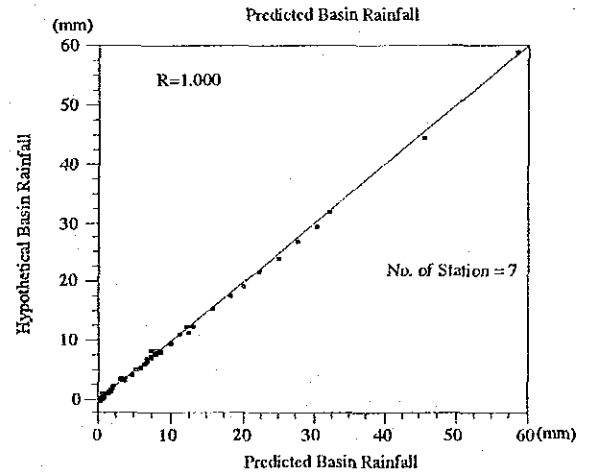


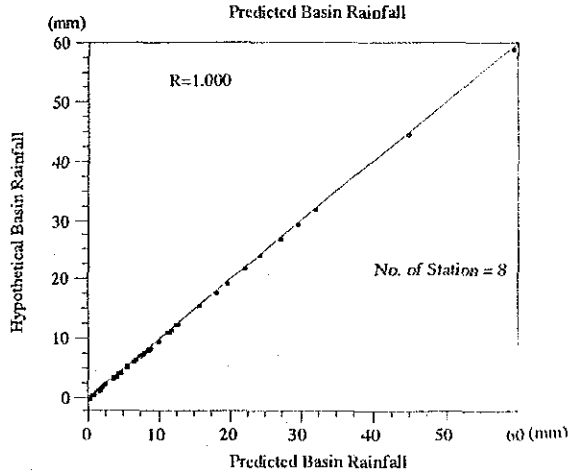




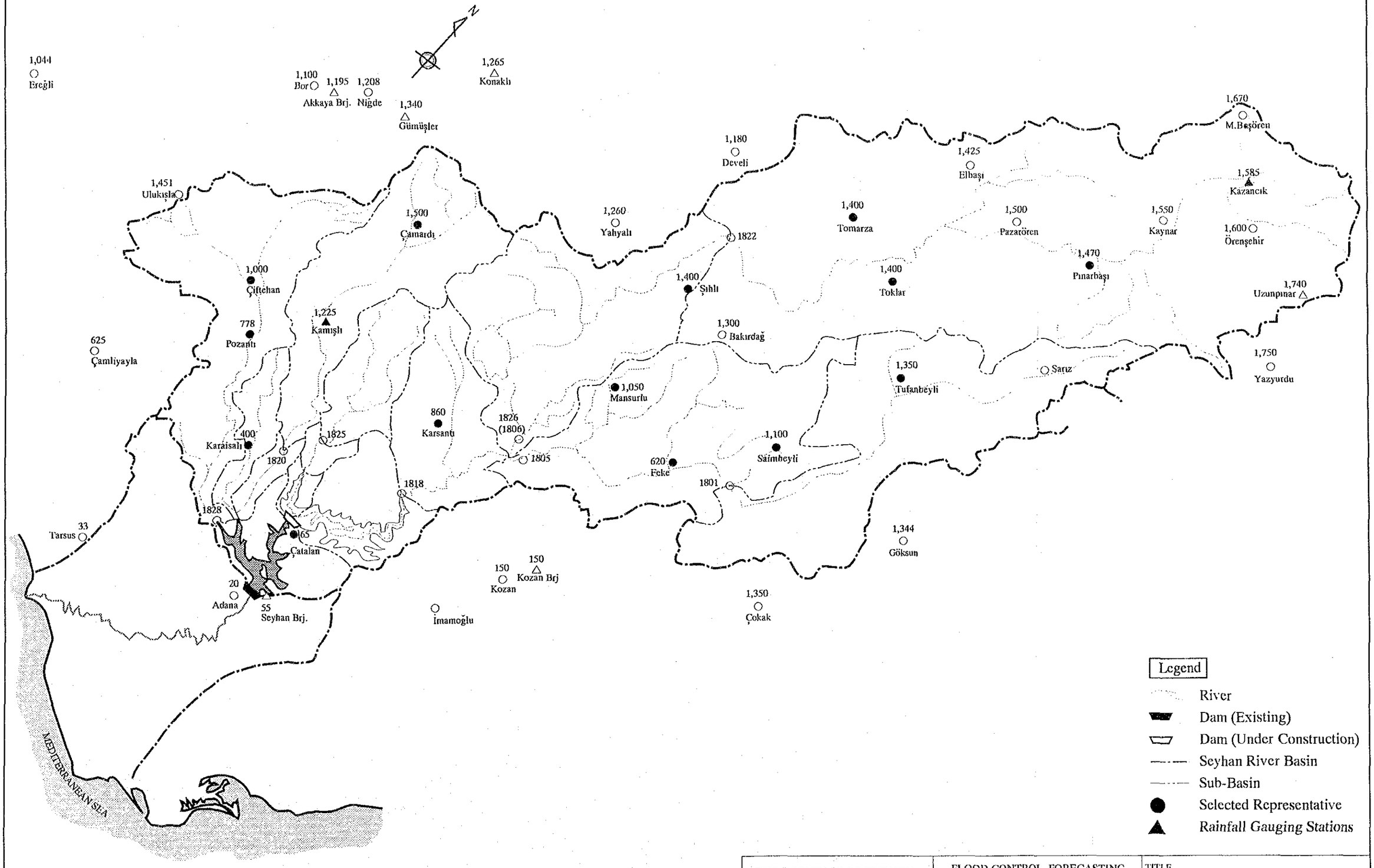




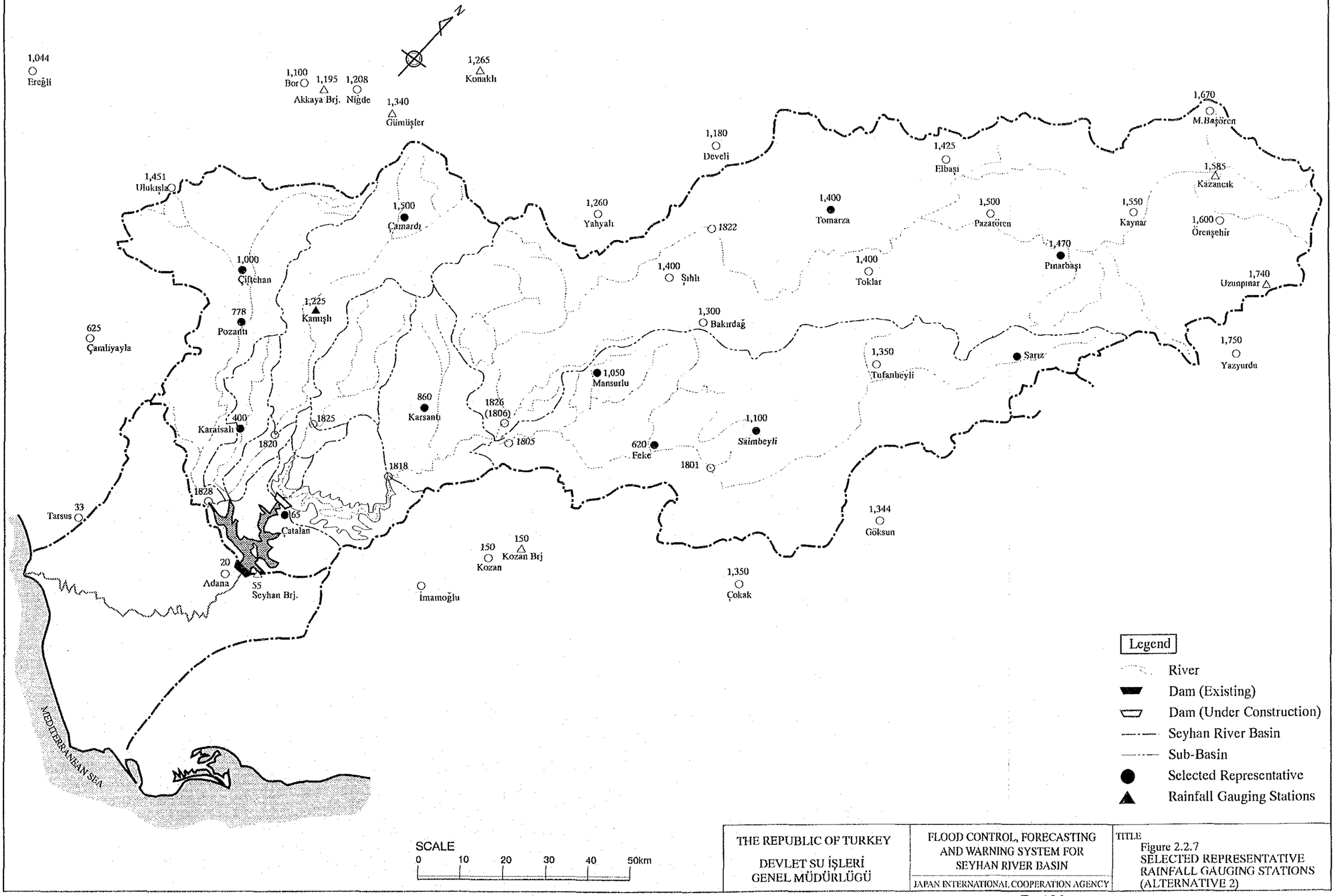




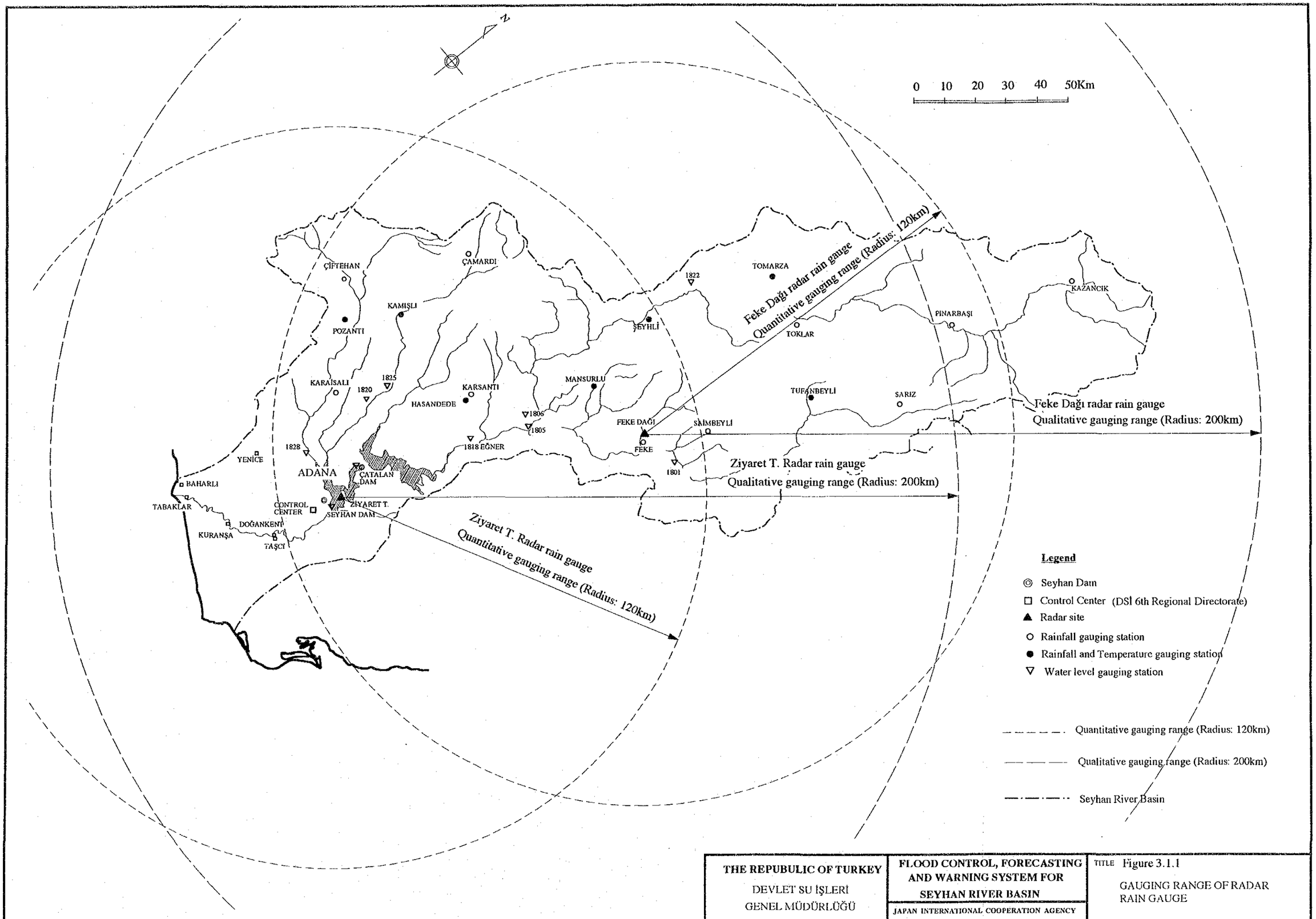
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.2.5 SCATTERGRAM OF HYPOTHETICAL AND PREDICTED BASIN RAINFALL (GÖKSU SUBBASIN UP TO 1805)



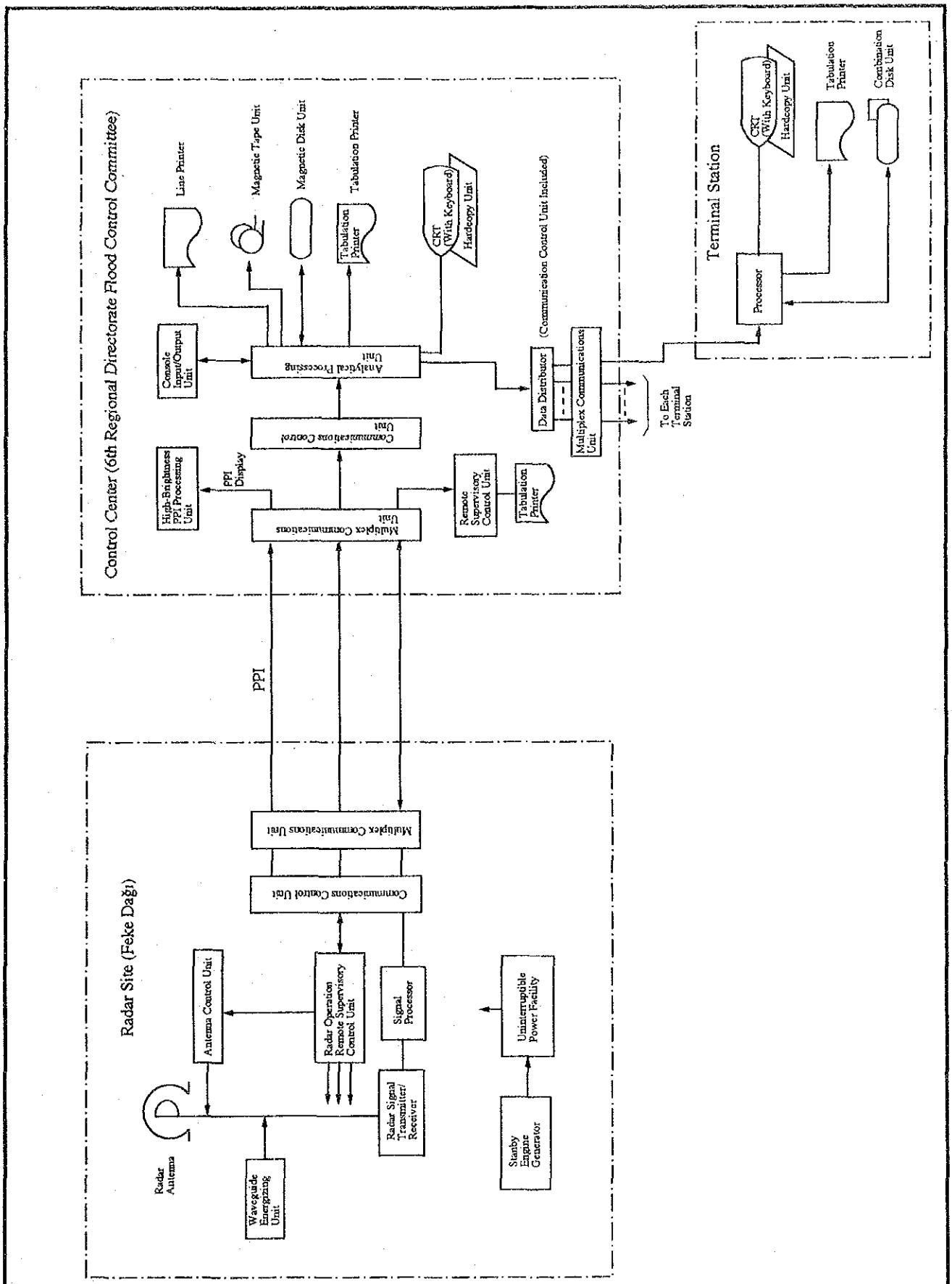
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜGÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 2.2.6 SELECTED REPRESENTATIVE RAINFALL GAUGING STATIONS (ALTERNATIVE 1)



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 2.2.7 SELECTED REPRESENTATIVE RAINFALL GAUGING STATIONS (ALTERNATIVE 2)

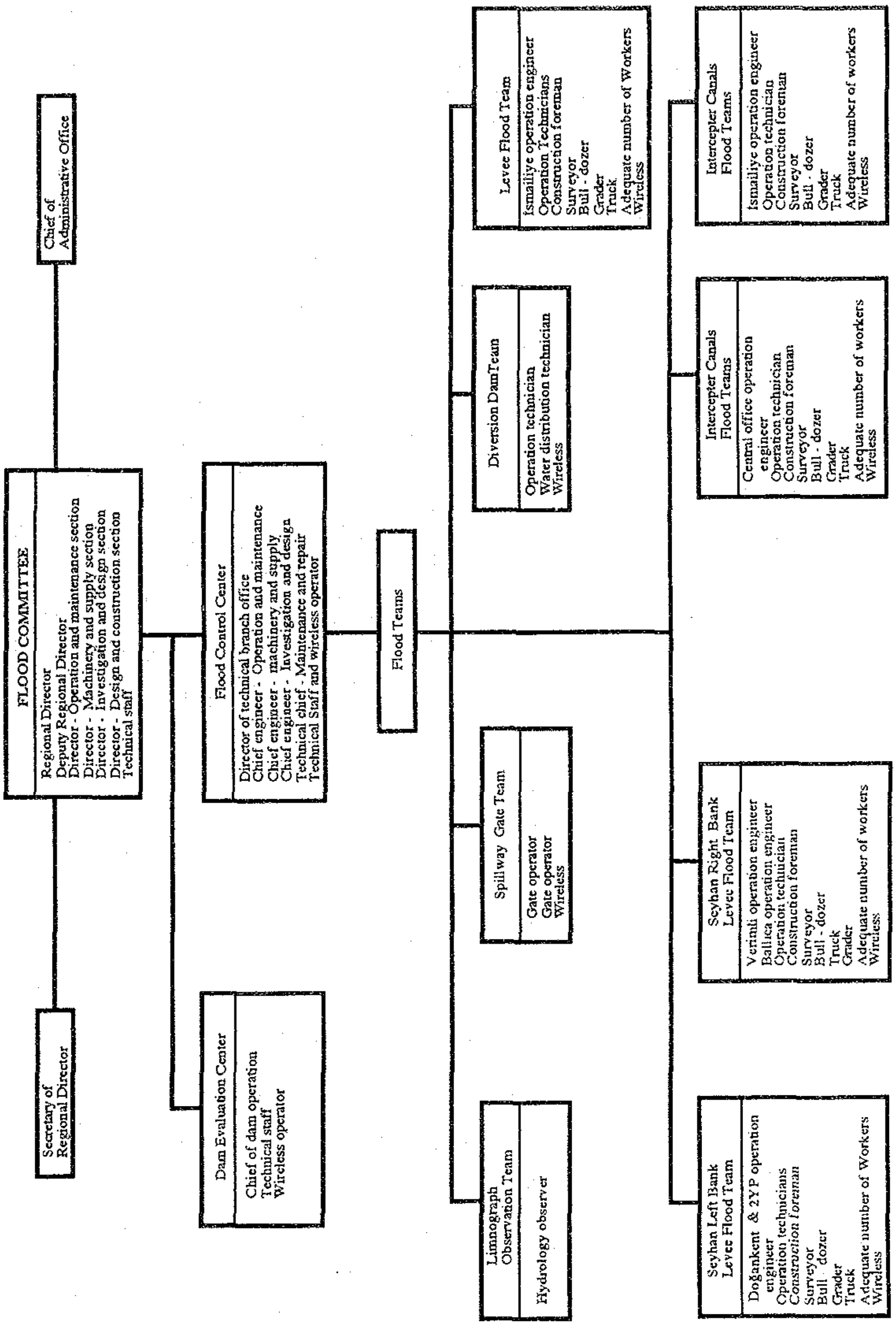


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.1.1 GAUGING RANGE OF RADAR RAIN GAUGE



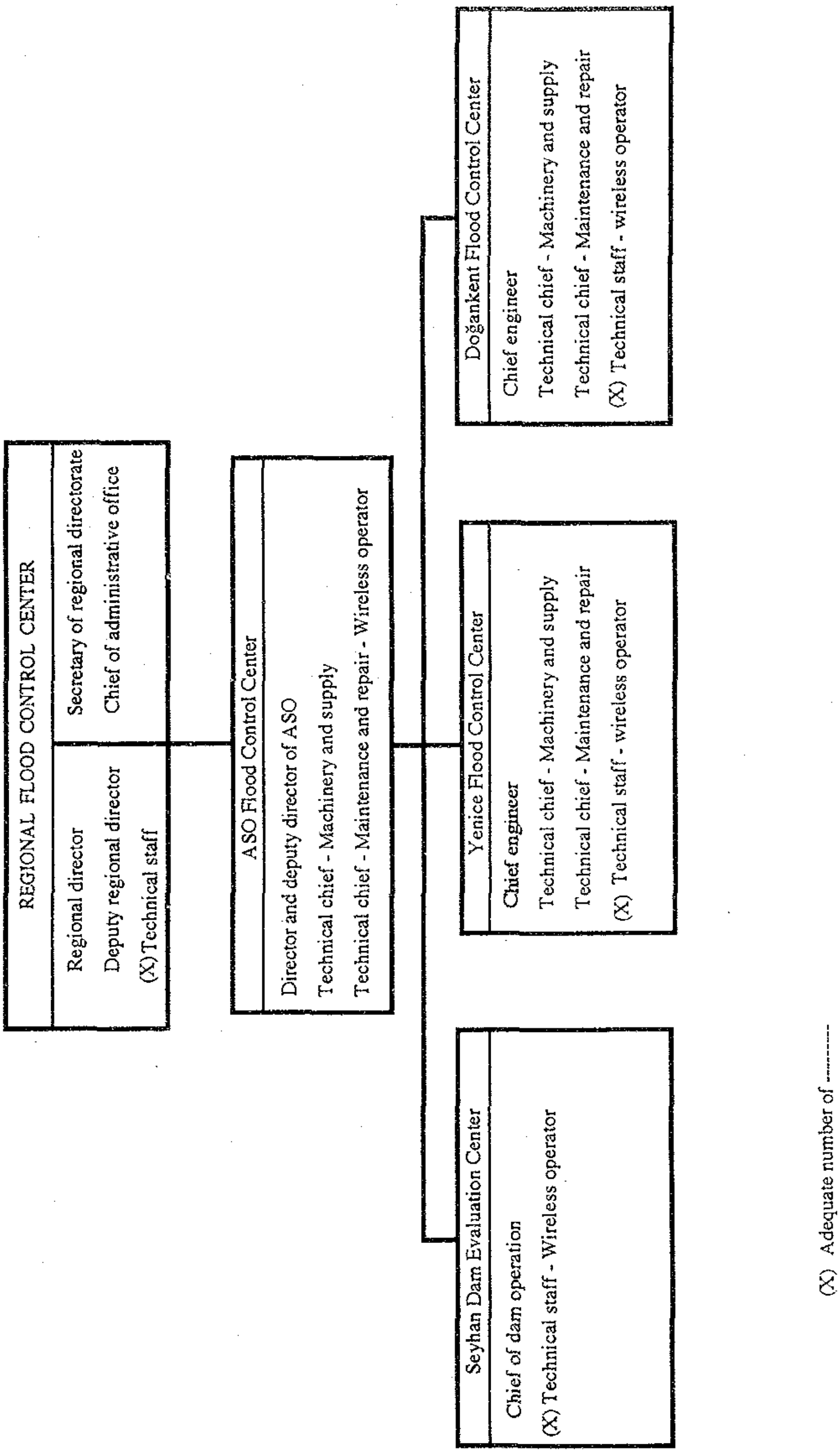
THE REPUBULIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.1.2 TYPICAL SYSTEM CONFIGURATION OF RADAR RAIN GAUGES

FIG. NO.



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 3.3.1 CHART OF FLOOD CONTROL COMMITTEE OF DSİ 6 TH REGIONAL DIRECTORATE

FIG.NO.



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 3.3.2 ASO SPECIFIC CHART OF DSİ 6 TH REGIONAL DIRECTORATE

FIG.NO.

----TH REGIONAL DIRECTORATE OF DSİ
SECRETARIAT

VERY URGENT
Time : ----------

No. : 564/----------
Subject : Evacuation of villages
Subject to flood

TO THE GOVERNOR'S OFFICE

Water level in----------riverbed is rapidly rising due to the rain.

In order to prevent life and property losses, villages mentioned below must be evacuated starting with the closer ones to the levees.

DSİ-----th Regional Director

Villages to be evacuated
Right bank
URGENT

LESS URGENT

Left bank
URGENT

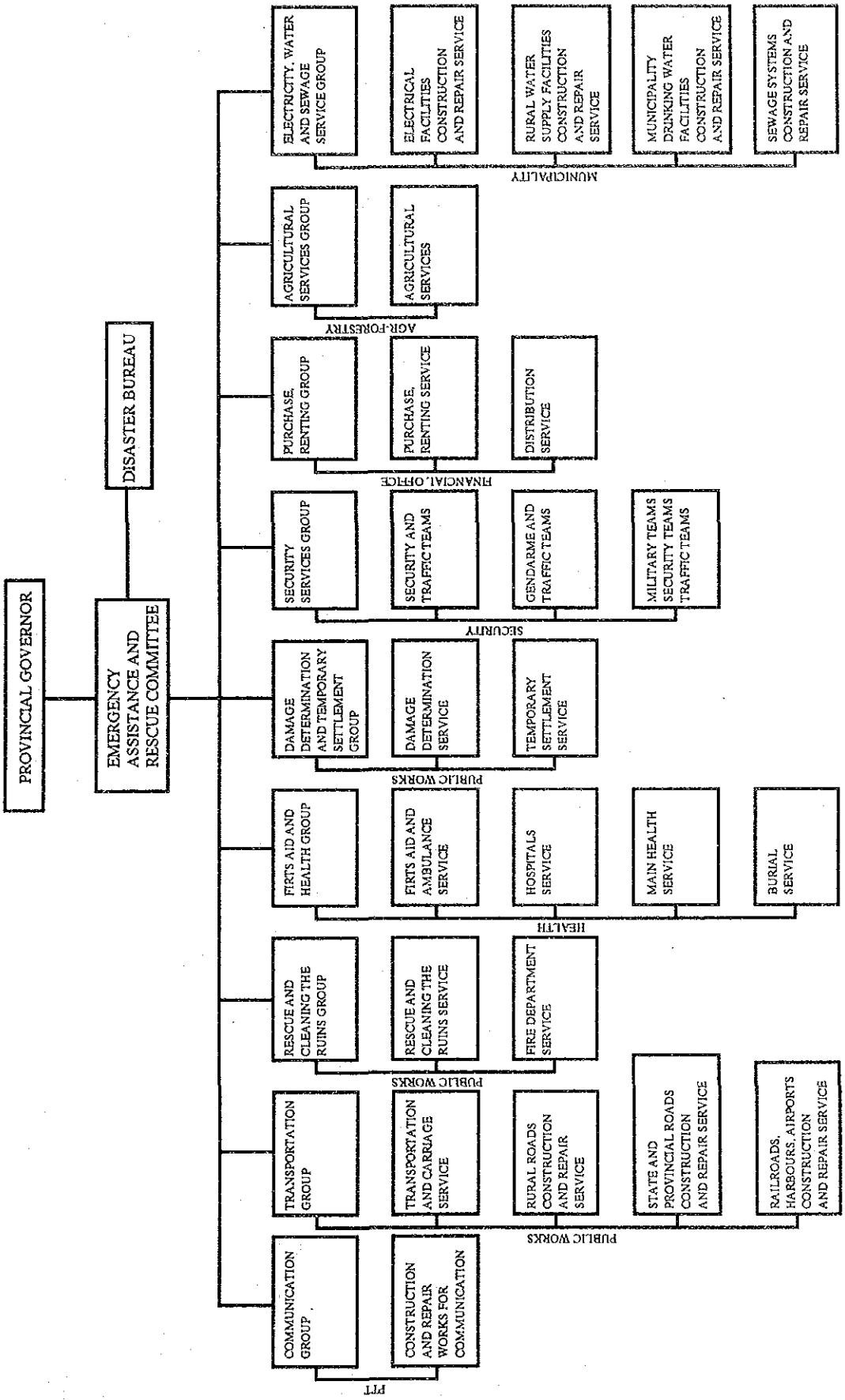
LESS URGENT

Distribution
Governor's office of ----------city

Information
General Directorate of DSİ

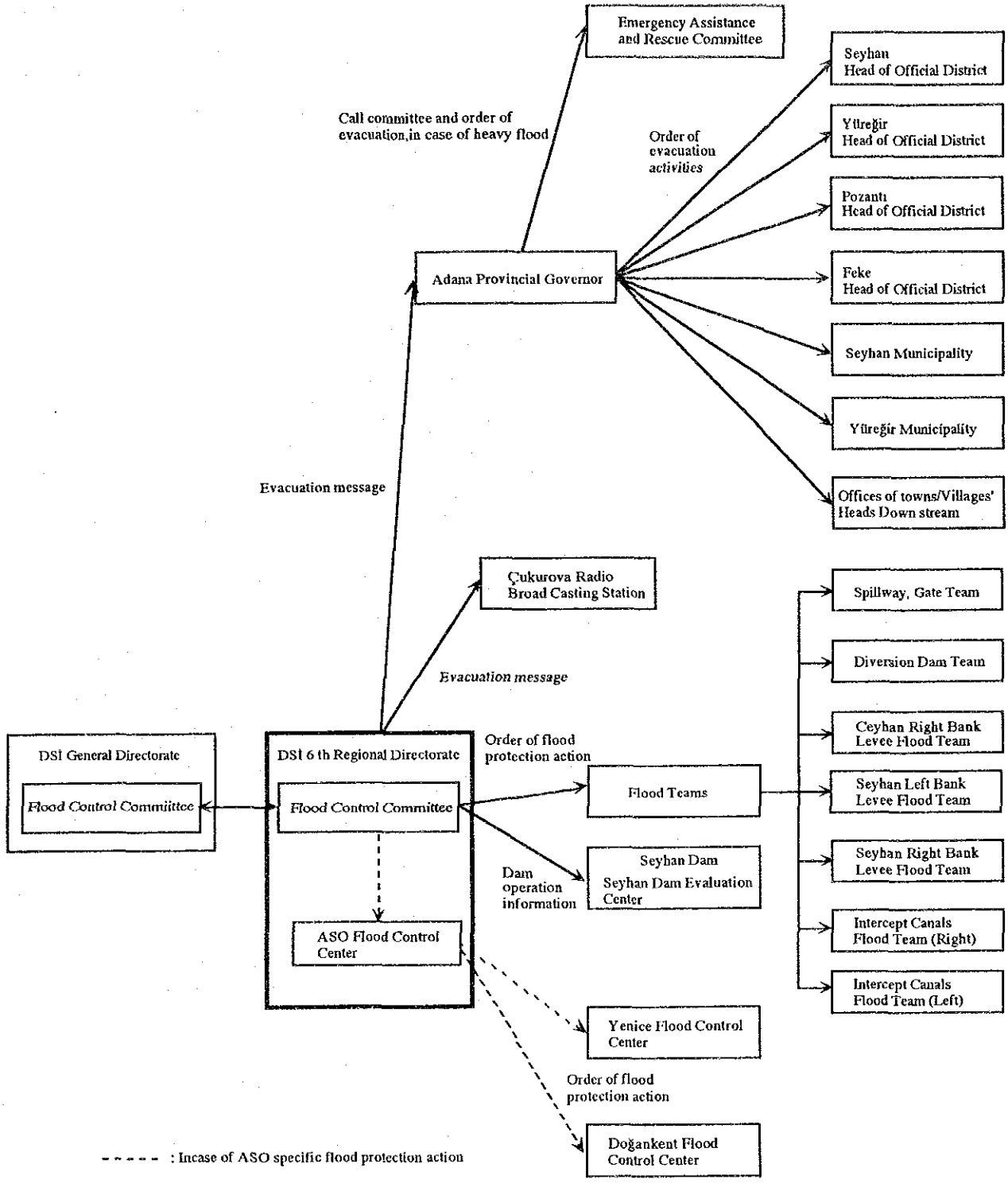
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.3.3 FORM OF EVACUATION MESSAGE TO GOVERNOR

FIG. NO.



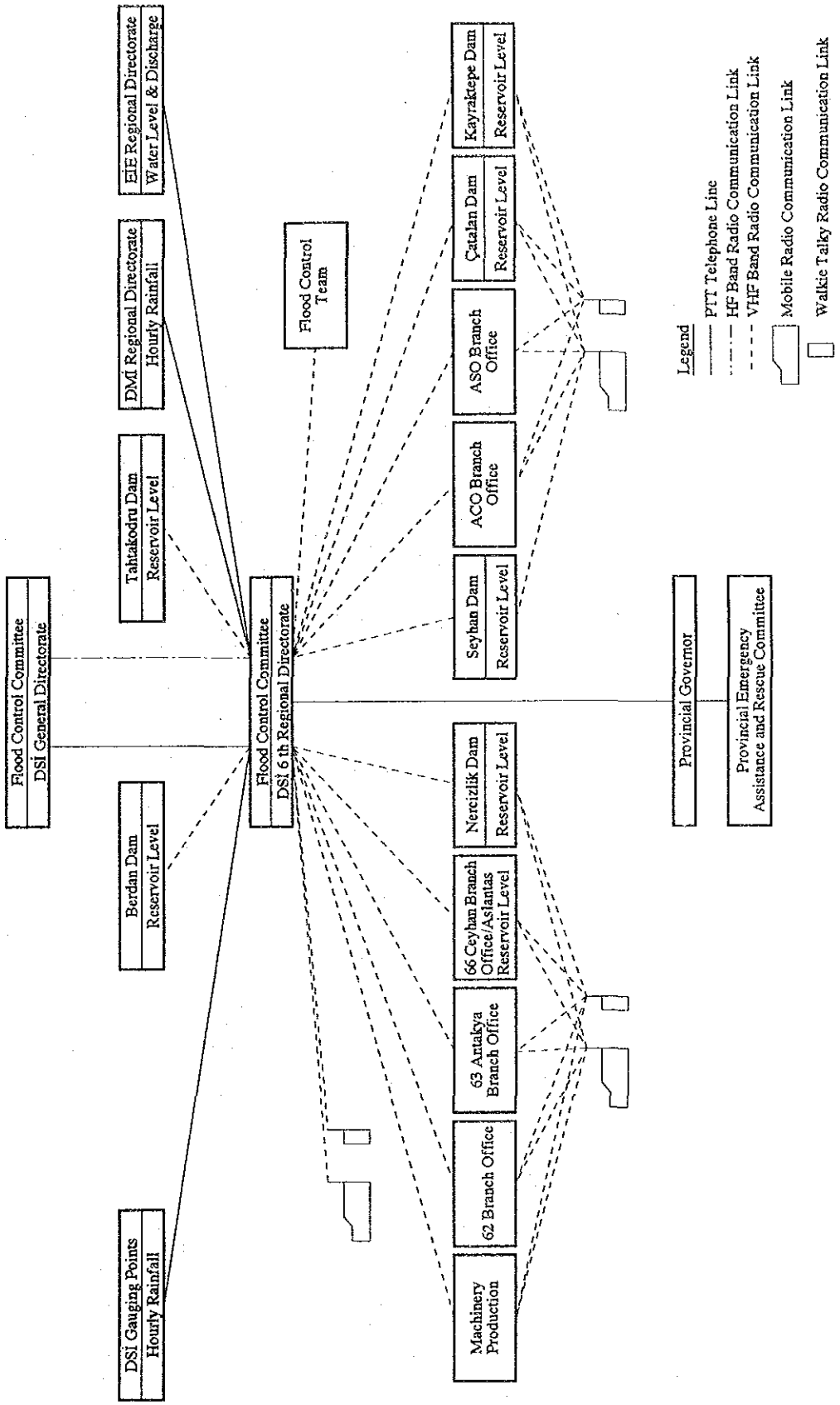
THE REPUBLIC OF TURKEY DEVLET SU İŞLERI GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BAISIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.3.4 ORGANIZATION CHART OF EMERGENCY ASSISTANCE AND RESCUE COMMITTEE

FIG.NO.

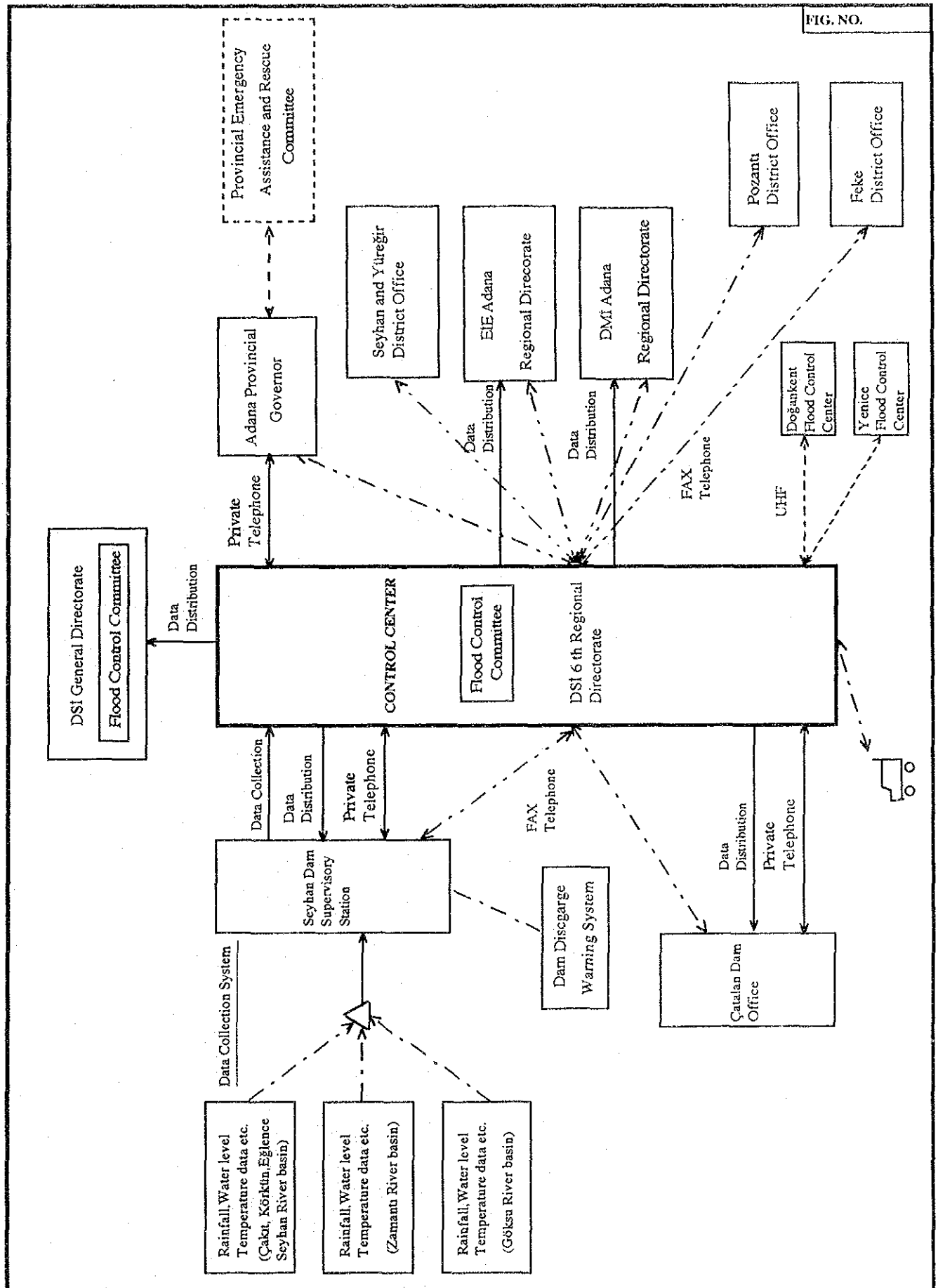


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.3.5 INFORMATION TRANSMISSION IN PRESENT CONDITION

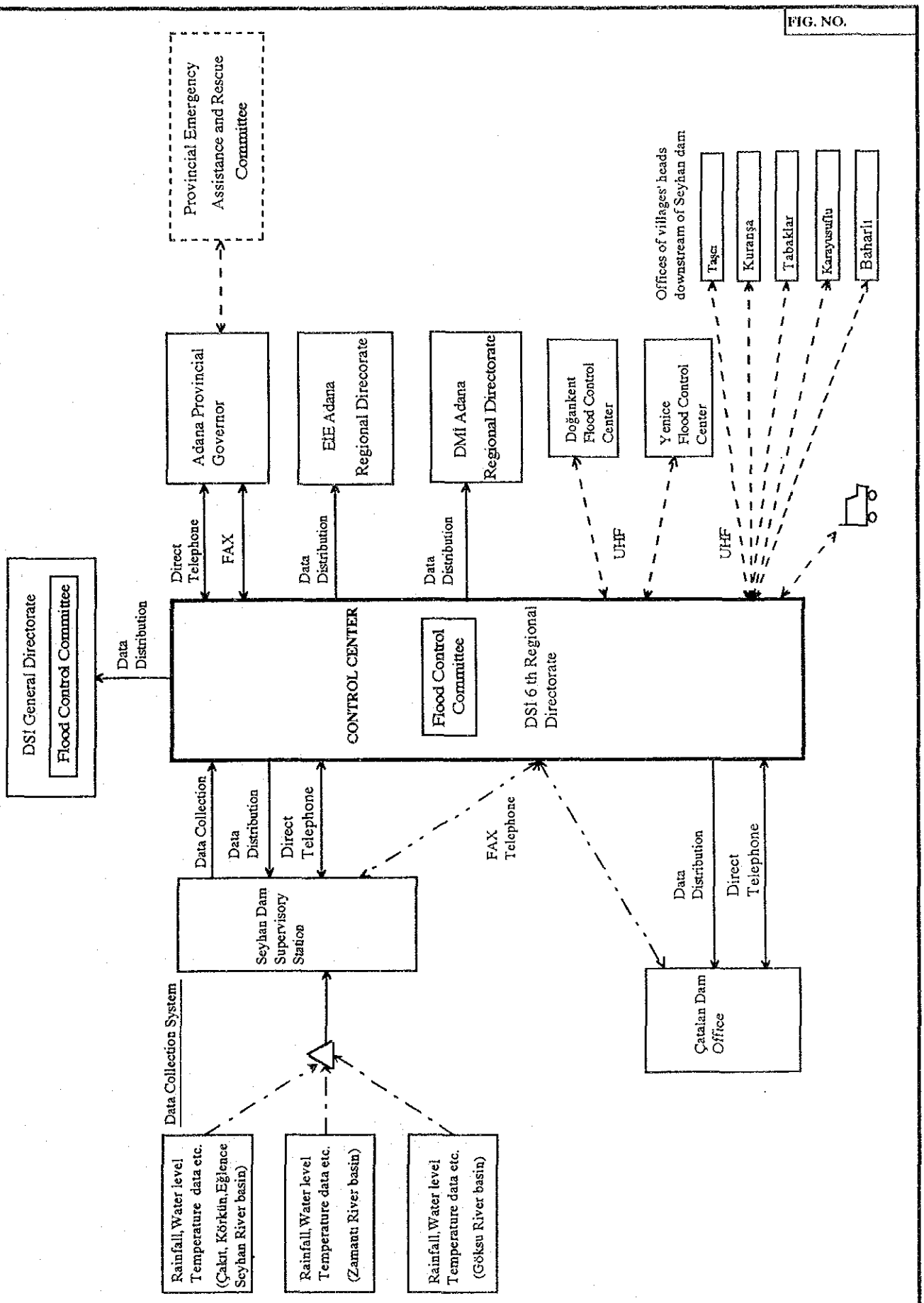
FIG. NO.



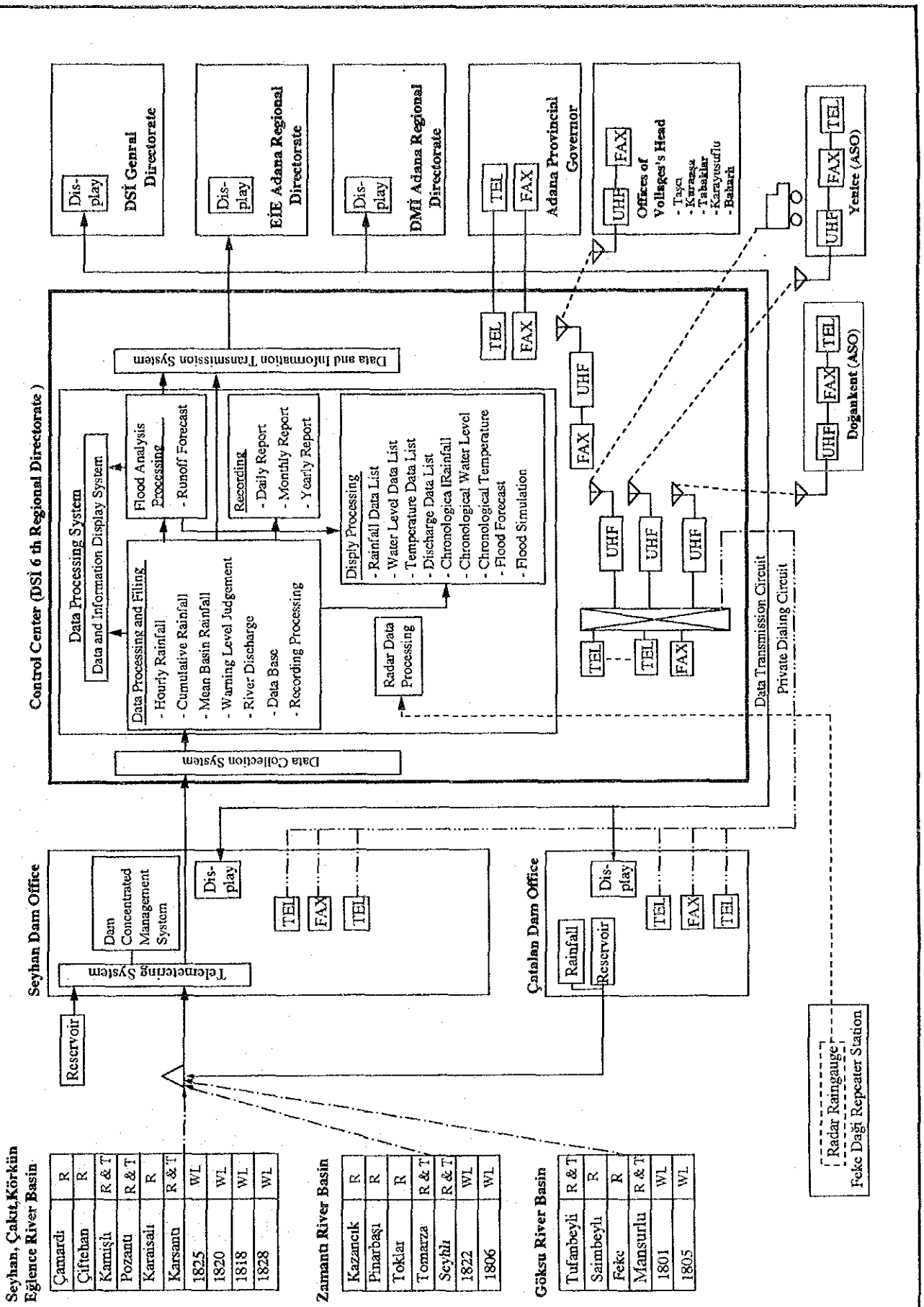
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BAISIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.3.6 OVERALL DATA AND INFORMATION COMMUNICATION NETWORK IN PRESENT CONDITION



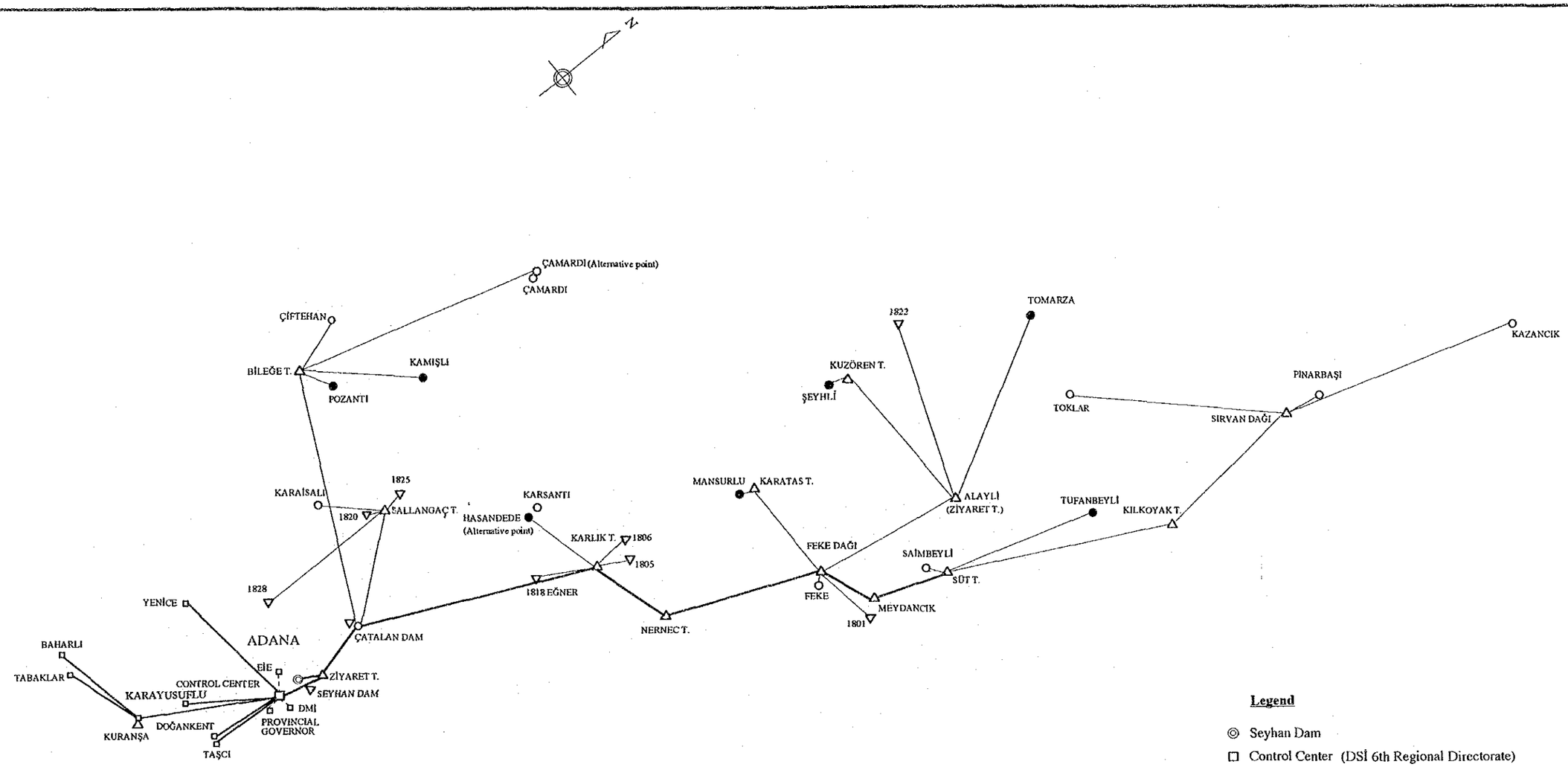
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 3.3.7 BASIC PLAN OF DATA COLLECTION AND TRANSMISSION



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 6.1.1 CONFIGURATION AND FUNCTION OF DATA COLLECTION & TRANSMISSION SYSTEM



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 6.1.2 DATA COLLECTION, PROCESSING & TRANSMISSION FLOW CHART



Legend

- ◎ Seyhan Dam
- □ Control Center (DSİ 6th Regional Directorate)
- ▫ Concerned agencies
- ○ Rainfall gauging station
- ● Rainfall and Temperature gauging station
- ▽ Water level gauging station
- △ Repeater station

—— Multiplex radio link 2GHz band

—— *Simplex or Duplex raio link for voice communication* 400MHz band

—— Simplex radio link for telemetry 70MHz band

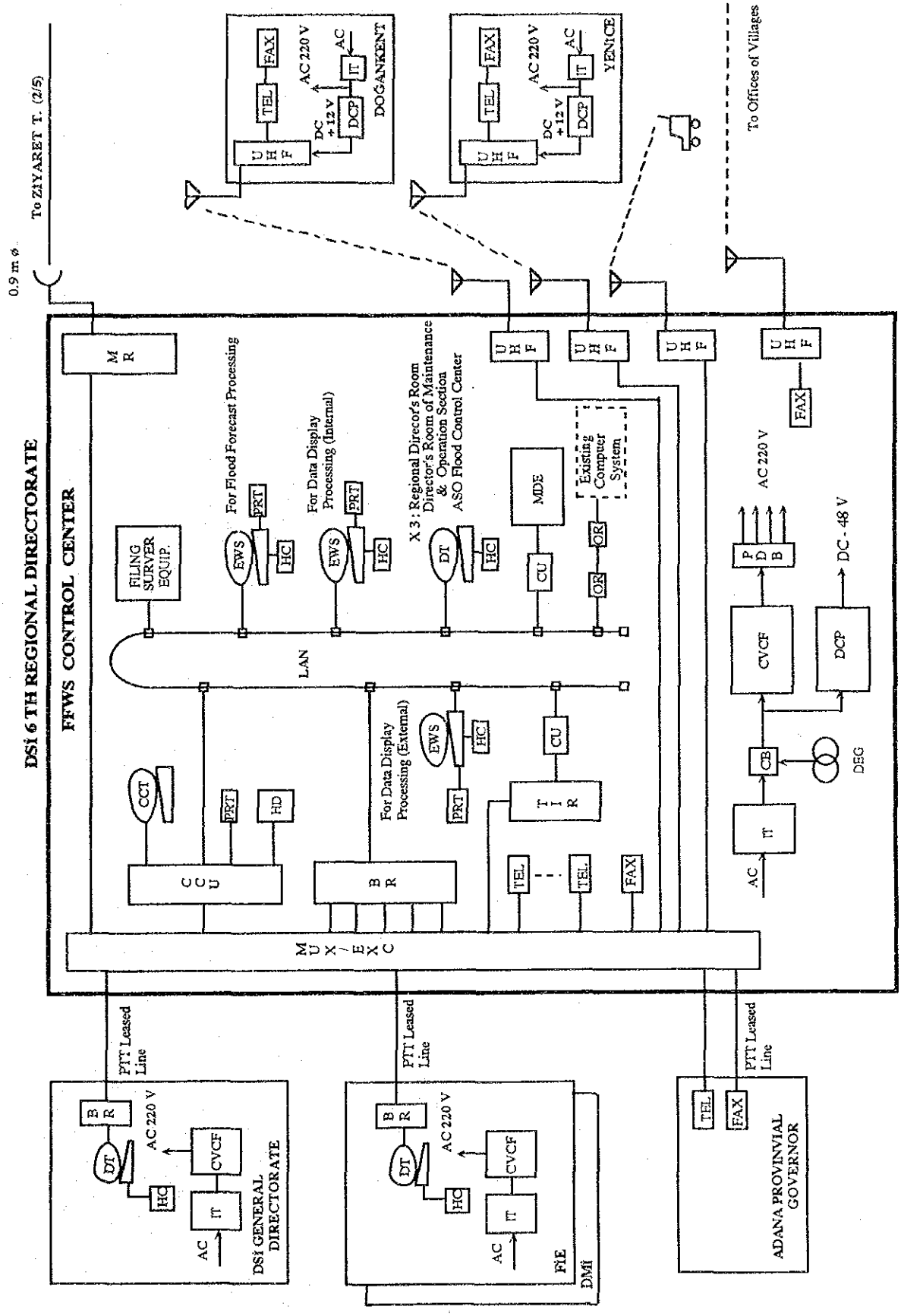
--- PTT line

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 6.1.3 OVERALL CIRCUIT CONFIGURATION OF THE FLOOD FORECASTING AND WARNING SYSTEM

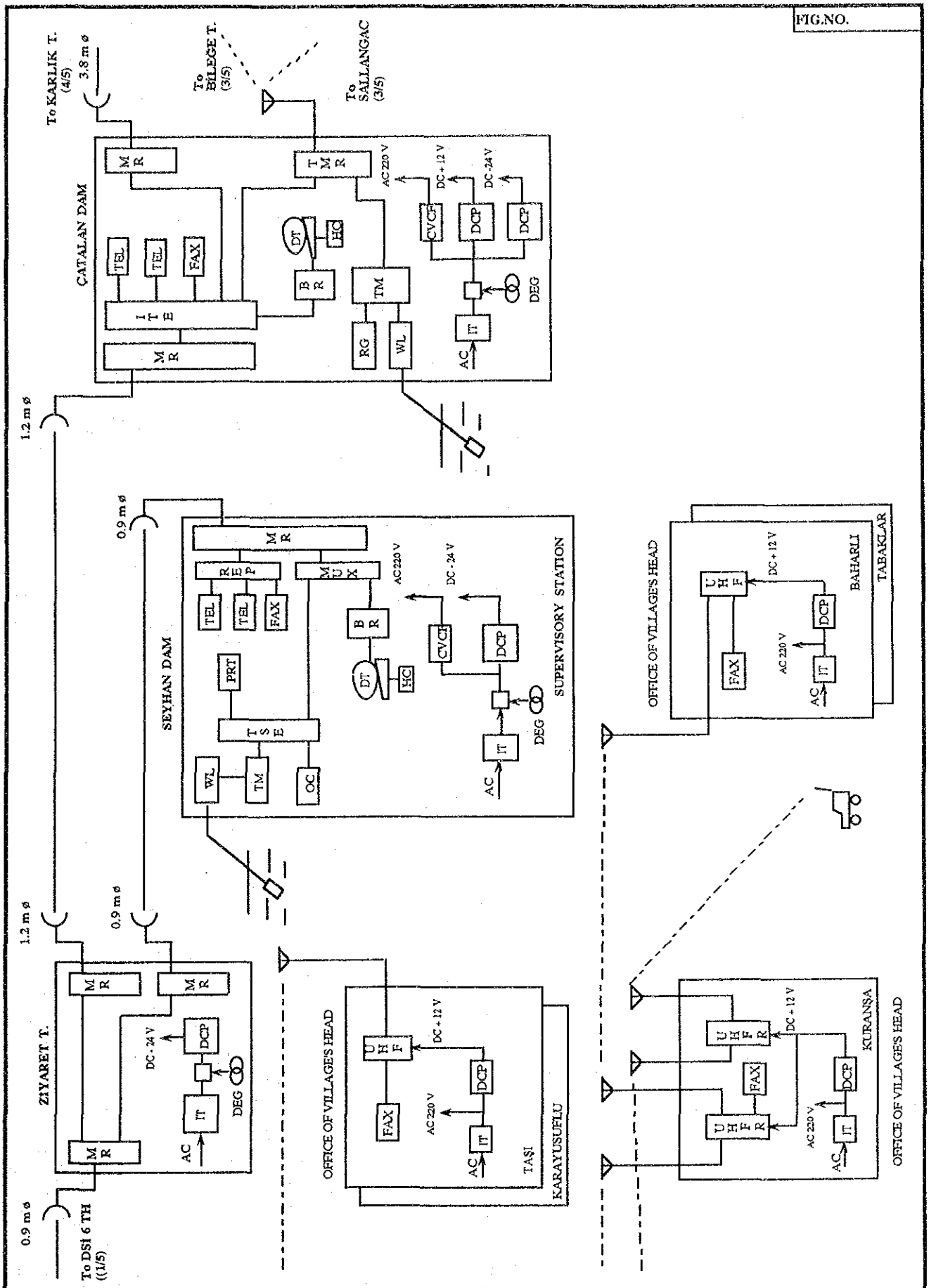
ABBREVIATION

BAT : STORAGE BATTERY
BR : BRIDGE
CB : CONTROL BOX
CCU : COMMUNICATION CONTROL UNIT
CU : CONTROL UNIT
CVCF : CONSTANT VOLTAGE AND CONSTANT FREQUENCY
DCP : DC POWER SUPPLY EQUIPMENT
DEG : DIESEL ENGINE GENERATOR
DT : DISPLAY TERMINAL
EWS : ENGINEERING WORK STATION
EXC : EXCHANGE EQUIPMENT
FAX : FACSIMILE EQUIPMENT
HC : HARD COPY UNIT
IT : ISOLATION TRANSFORMER
ITE : INTEGRATED TERMINAL EQUIPMENT
MDE : MIMIC DISPLAY EQUIPMENT
MR : MICRO WAVE RADIO RELAY EQUIPMENT
MUX : PCM MULTIPLEX TERMINAL EQUIPMENT
OC : OPERATION CONSOLE
PDB : POWER DISTRIBUTION BOARD
PRT : PRINTER
REP : TELEPHONE REPEATER
RG : RAINFALL GAUGING EQUIPMENT
SBP : SOLAR BATTERY PANEL
TEL : TELEPHONE SET
TIR : TELEPHONE INFORMING AND RESPONDING EQUIPMENT
TM : TELEMETERING EQUIPMENT
TMP : TEMPERATURE SENSOR
TMR : TELEMETERING REPEATER EQUIPMENT
TSE : TELEMETERING SUPERVISORY EQUIPMENT
UHF : UHF RADIO EQUIPMENT
UHFR : UHF REPEATER EQUIPMENT
WL : WATER LEVEL GAUGING EQUIPMENT

FIG.NO.

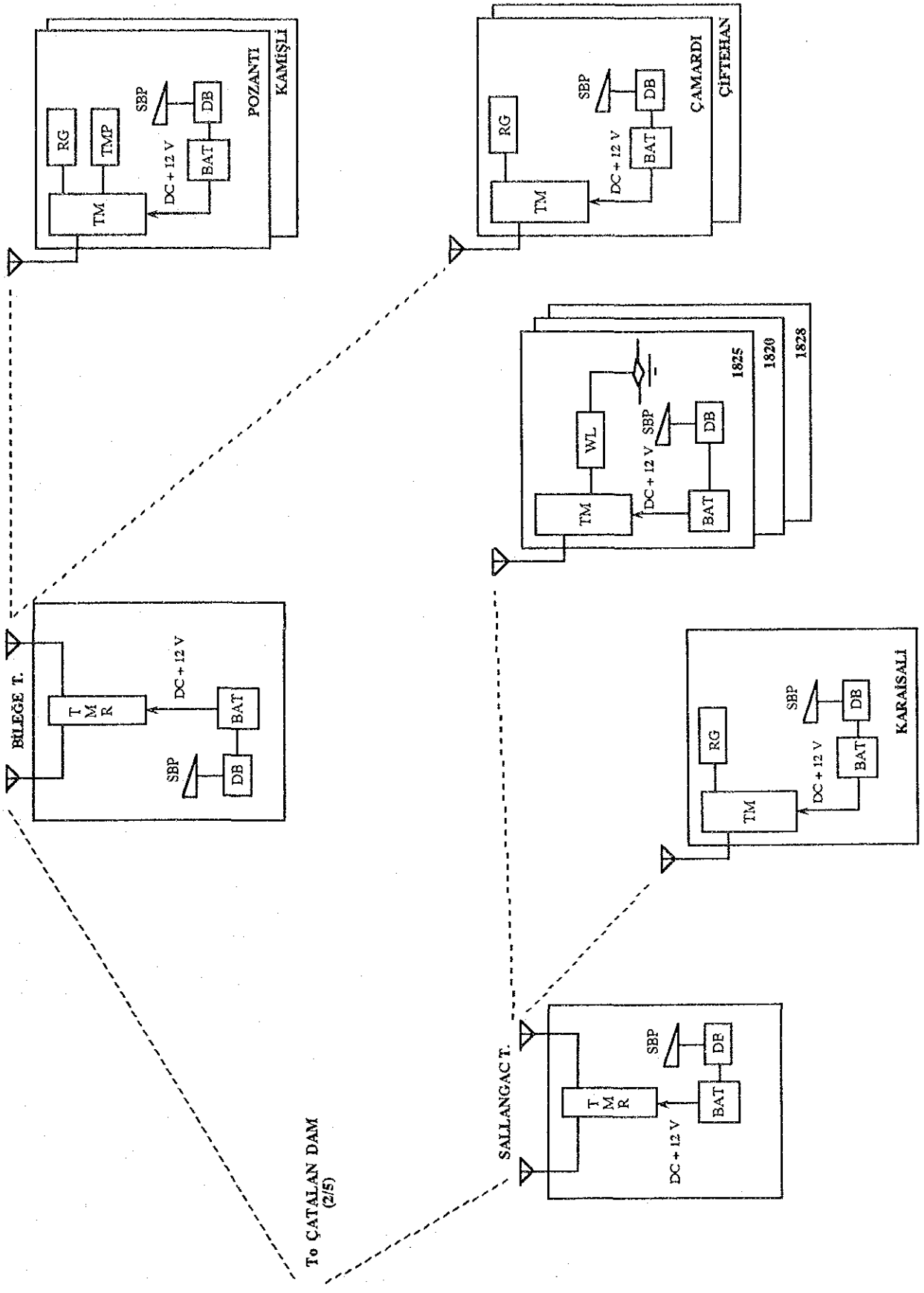


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.1.5 SCHEMATIC EQUIPMENT COMPOSITION OF FLOOD FORECASTING AND WARNING SYSTEM (1/5)

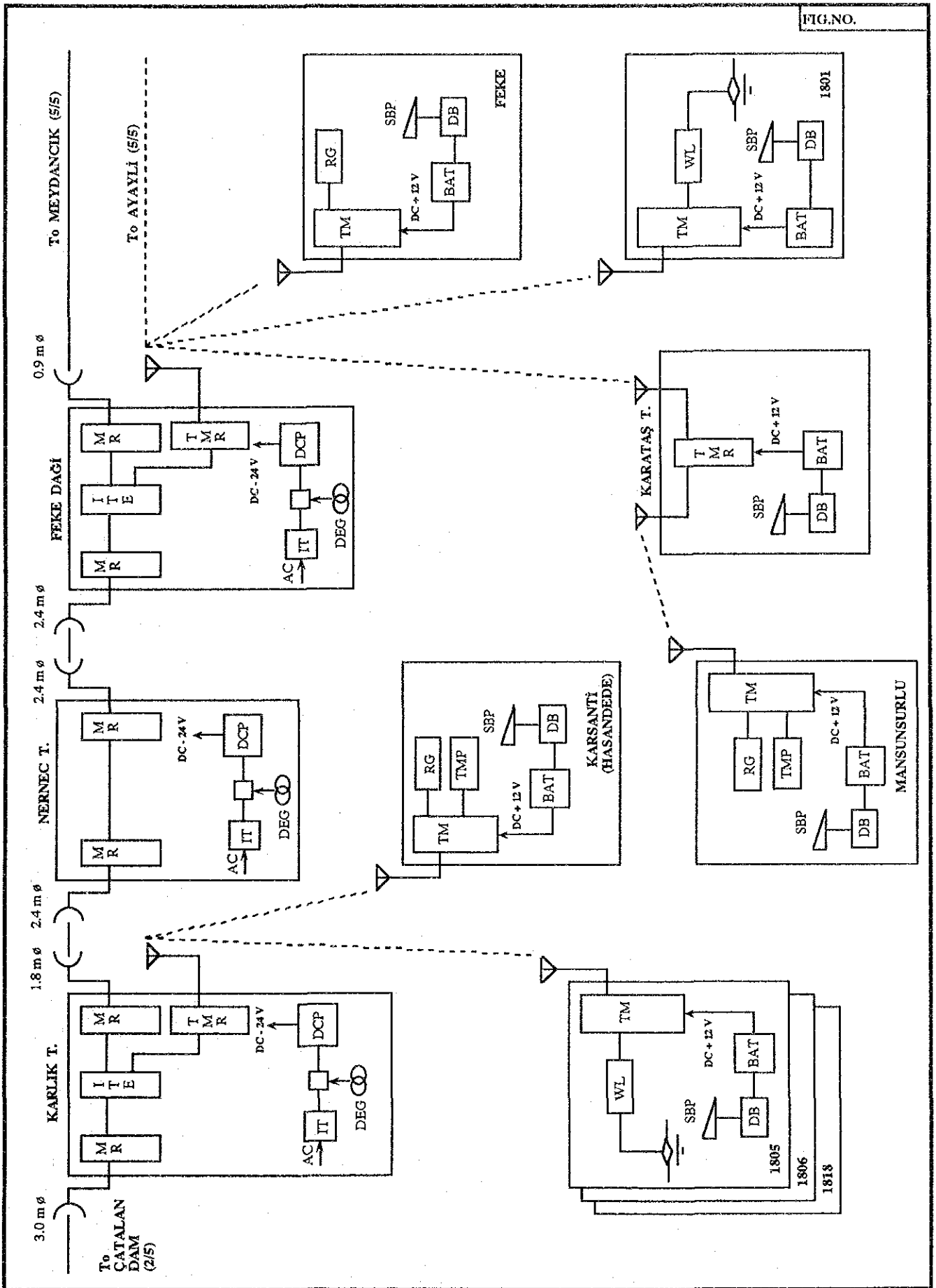


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	**FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN** JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.1.6 SCHEMATIC EQUIPMENT COMPOSITION OF FLOOD FORECASTING AND WARNING SYSTEM (2/5)

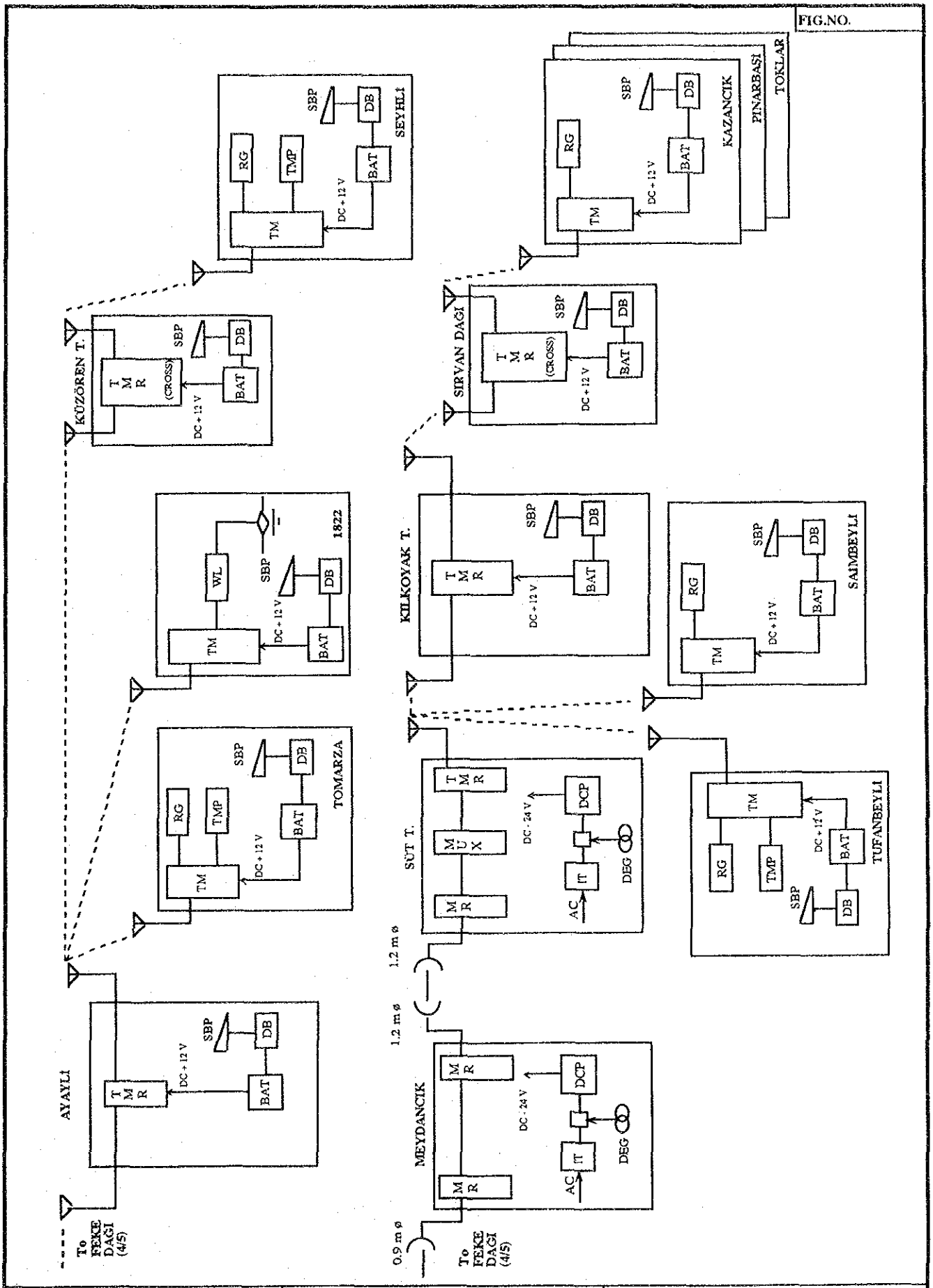
FIG.NO.



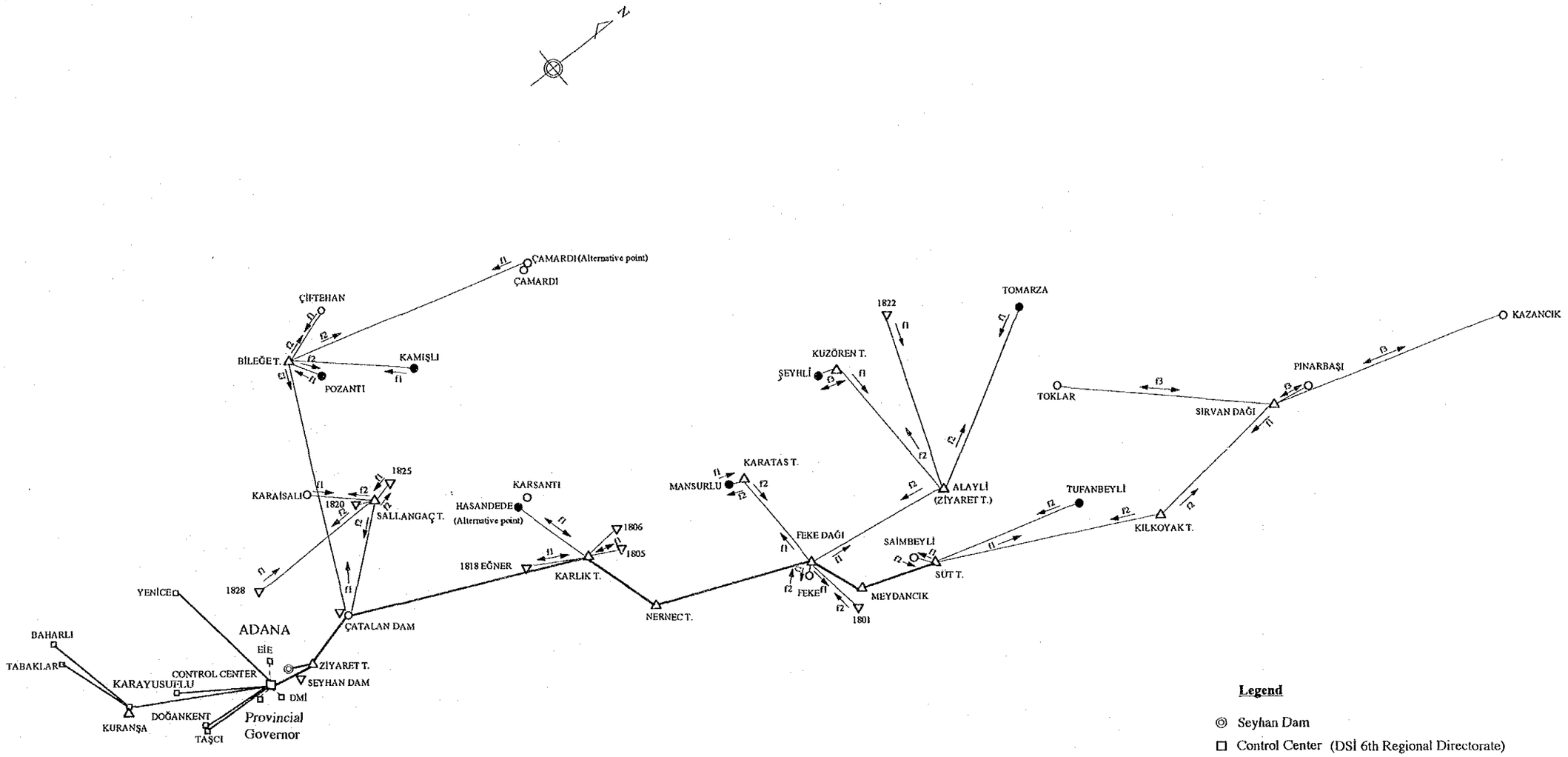
THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.1.7 SCHEMATIC EQUIPMENT COMPOSITION OF FLOOD FORECASTING AND WARNING SYSTEM (3/5)



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 6.1.8 SCHEMATIC EQUIPMENT COMPOSITION OF FLOOD FORECASTING AND WARNING SYSTEM (4/5)



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 6.1.9 SCHEMATIC EQUIPMENT COMPOSITION OF FLOOD FORECASTING AND WARNING SYSTEM (5/5)



Legend

- ◎ Seyhan Dam
- □ Control Center (DSİ 6th Regional Directorate)
- ▫ Concerned agencies
- o Rainfall gauging station
- ● Rainfall and Temperature gauging station
- ▽ Water level gauging station
- △ Repeater station

—— Multiplex radio link 2GHz band

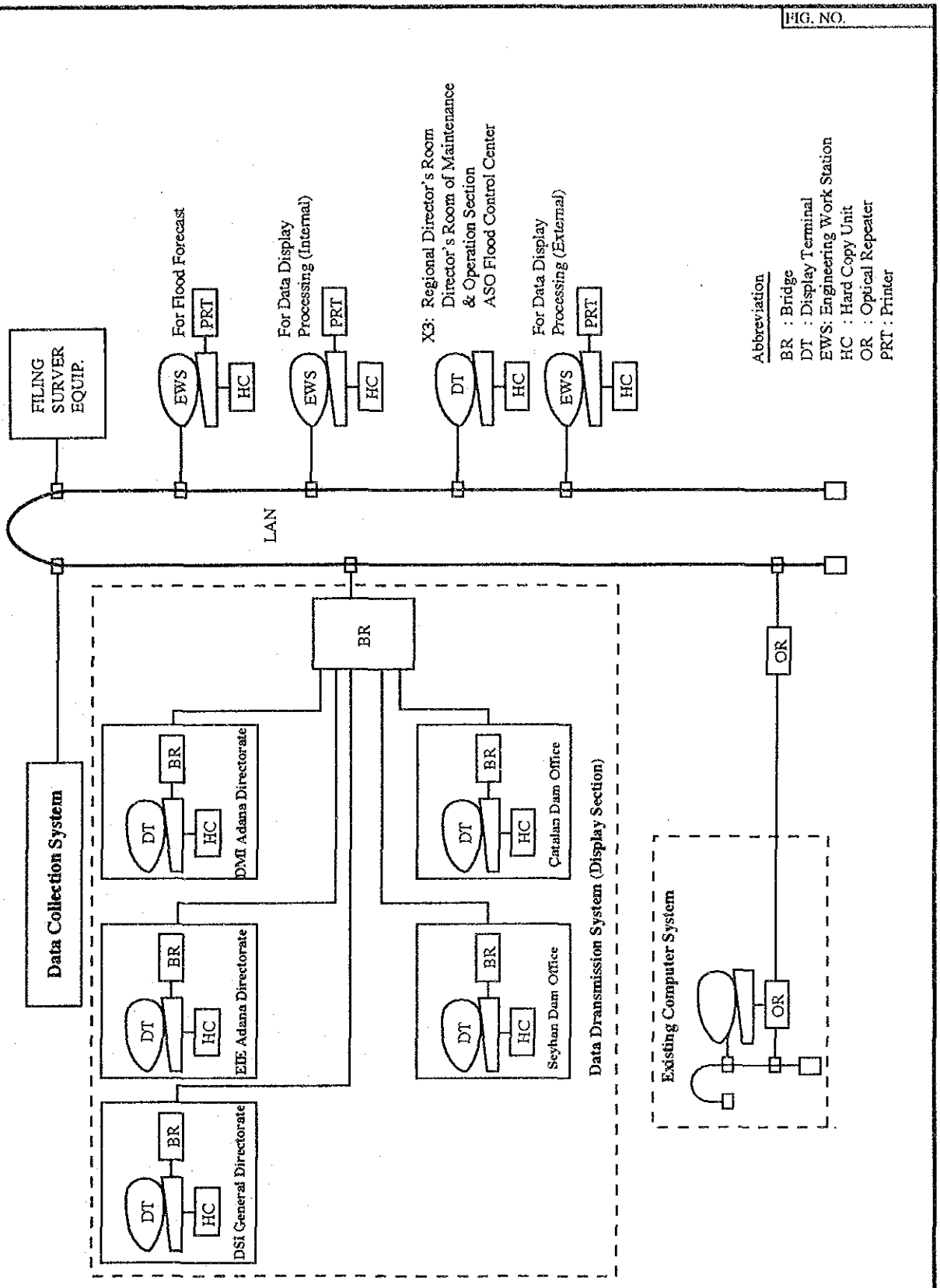
—— Simplex or Duplex raio link for voice communication 400MHz band

—— Simplex radio link for telemetry 70MHz band

--- PTT line

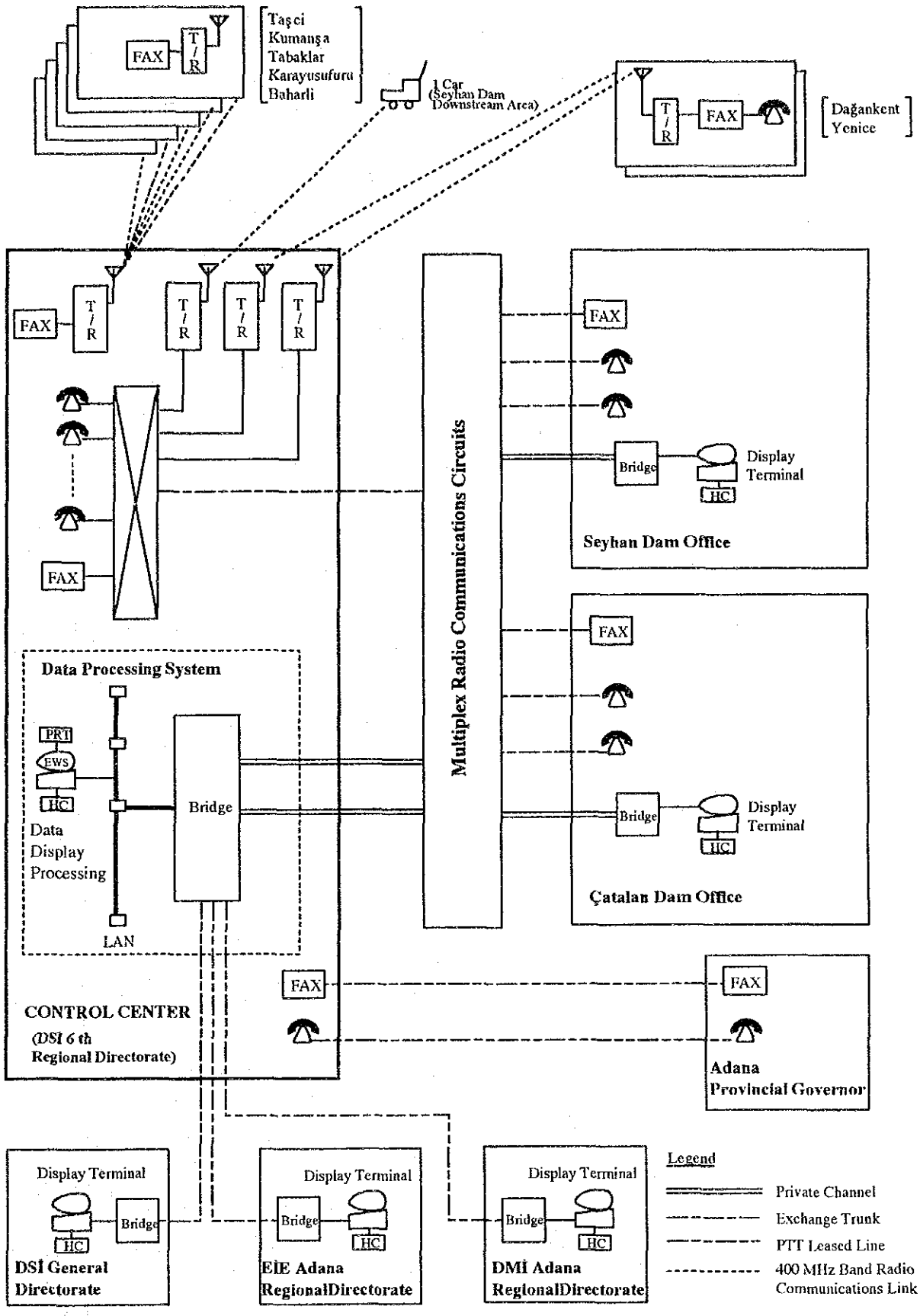
THE REPUBULIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.2.1 RADIO FREQUENCY ASSIGMENT PLAN OF TELEMETRY RADIO LINK

FIG. NO.

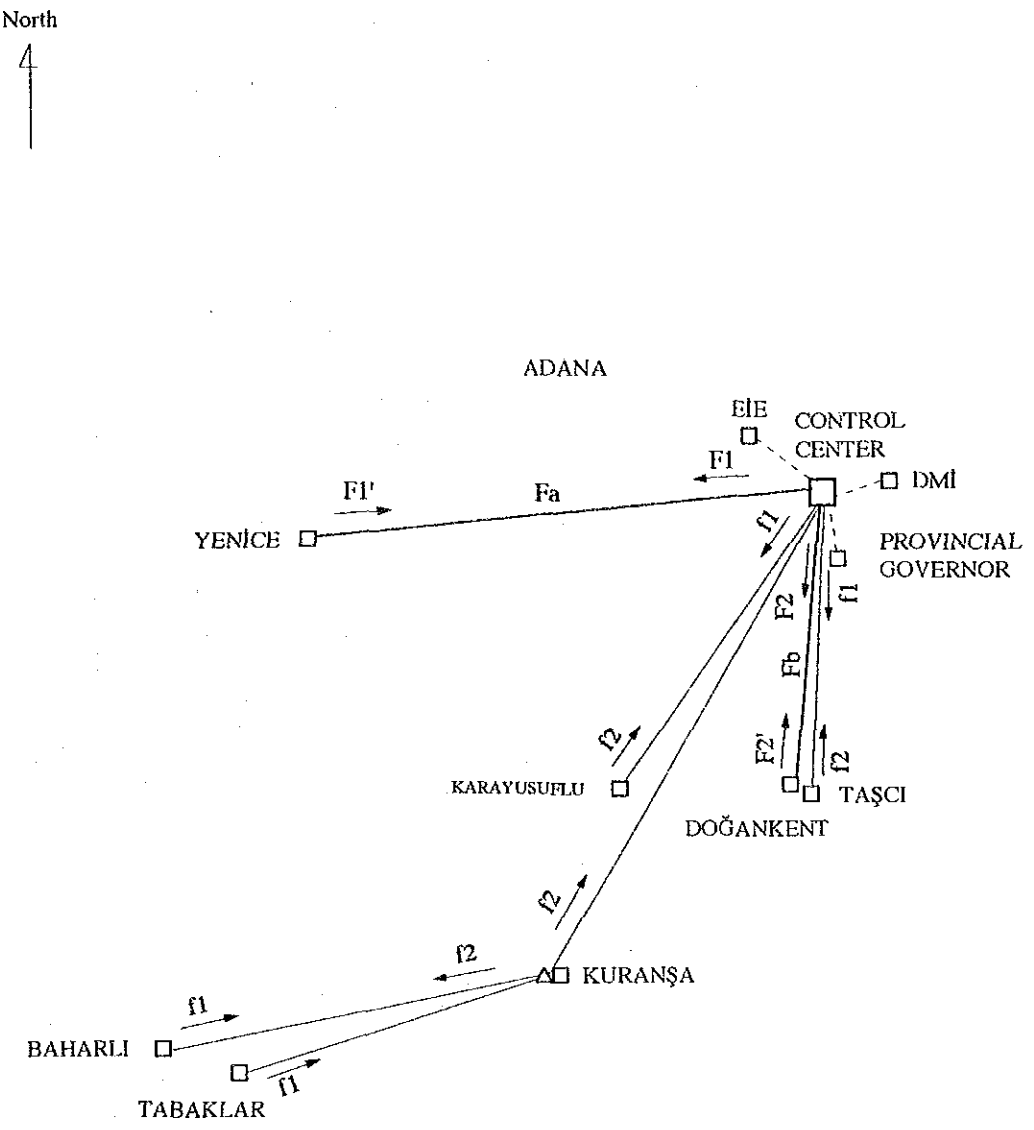


THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDÜRLÜĞÜ	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BAISIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.2.2 DATA PROCESSING SYSTEM CONFIGURATION

FIG. NO.



THE REPUBLIC OF TURKEY DEVLET SU İŞLERİ GENEL MÜDURLÜĞ Ü	FLOOD CONTROL, FORECASTING AND WARNING SYSTEM FOR SEYHAN RIVER BAISIN JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE Figure 6.2.3 DATA TRANSMISSION SYSTEM CONFIGURATION



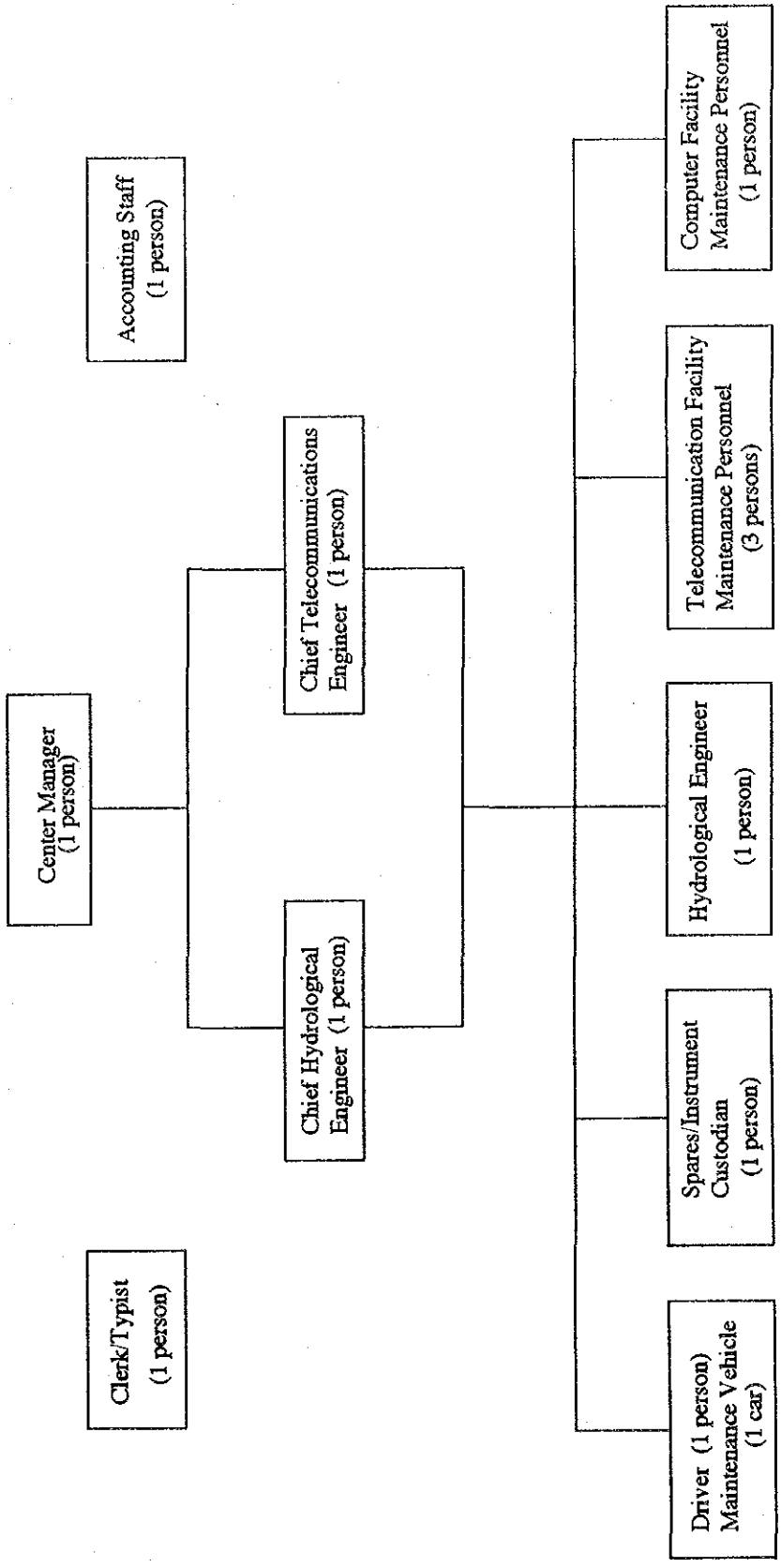
Legend

Note: Frequency assigment plan for Duplex radio link

Fa: F1 and F1'
Fb: F2 and F2'

- Control Center (DSİ 6th Regional Directorate)
- Concerned agencies
- Repeater station
- Duplex radio link 400MHz band
- Simplex radio link 400MHz band
- PTT line

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 6.2.4 RADIO FREQUENCY ASSIGNMENT PLAN OF INFORMATION TRANSMISSION SYSTEM



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 8.2.1 RECOMMENDED MAINTENANCE AND MANAGEMENT SYSTEM

SUPPORTING REPORT F

FEASIBILITY GRADE DESIGN AND ESTIMATE OF PROJECT COST