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DATA ON
EUPHRATES AND TIGRIS RIVERS BASIN
DEVELOPMENT PLAN

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PLATES

DATA ON EUPHRATES AND TIGRIS RIVERS BASIN DEVELOPMENT PLAN

SECTION I

INTRODUCTION

I. 1. Purpose of the report

Depending on the studies carried out to date, the purpose of this report is to present available data related with the parts of the Euphrates and Tigris Rivers basin in Turkey for the preparation of a plan to ensure benefiting in the most favouable way from the water resources of both rivers. This report includes some illustrations of the tentative projects for taking advantage from the existing hydro-power potentialities, brief data on the irrigation problem in these basins and some documents on floods. Thus, it will be possible to lead further geological and hydrological works to be carried out in future.

I. 2. Summary

The Euphrates and Tigris Rivers both originate in Turkey and Euphrates River flows through Syria and Iraq, Tigris River after leaving Turkey takes its tributaries from Iran and flows completely in Iraq. Those rivers have bestowed various possible benefits to the countries mentioned above.

In this report meteorological and hydrological data and some analyses are given in order to give the possibility to integrate such works with similar ones which might be done in the other concerned countries. Further, the present known potential possibilities on both rivers have been examined and hydrologic data and a general layout of the following projects have been given.

Projects on Euphrates River, from upstream to downstream and on the main river are : Keban, Bilaluşağı, Sarsap, and Halfeti. Projects on Tigris River are from upstream to downstream and on the main river : Selman, Diyarbakır and Dermah; Hüseyinkân, on the Batman tributary and Beşiri on the Garzan tributary. The purpose of the said projects may be summarized as to make almost full regulation of the river flow. By this way the average regulated discharge available throughout the year on Euphrates River, at Keban will be 630 m^3/sec which is about four times of the minimum. Respectively average regulated discharge of Tigris River at Dermah location will be 360 m^3/sec compared with the minimum 69 m^3/sec. Through the proposed power plants on Euphrates River an annual energy as much as 18 billion kWh may be generated, this will be 3.5 billion kWh from the plants located in Tigris River basin.

By means of through regulation on both rivers a large portion of the total area of 3 million hectares, subject of soil analyses, may be irrigated in the whole basin of both rivers in Turkey.

Except minor local floods, there is no serious flood problem for the part of the basins located in Turkey. Navigation also may not be considered as an economic and pressing problem.

The mentioned projects in this report are those which have been judged useful in the development plan and no consideration is given for the small projects located either on the main river or on the tributaries. This explains why the work is concentrated on Euprates River downstream of Keban which is the point where the river gains its full potentiality.

It has to be pointed that, out of the above mentioned projects, all investigations including detail geological studies are almost completed for Keban and Dermah dam sites located respectively on Euphrates and Tigris Rivers and dependable data are available in order to design the final projects. However there is a lack of geological studies on some of the other projects, which may have a consequence as a material change in the presented layouts.

In the following step of our work, consideration will be given in order to obtain full information including specially geological studies which may be judged necessary for the preparation of the definite layouts.

SECTION II

GENERAL DESCRIPTION, METEOROLOGY AND HYDROLOGY.

II. 1. General Description of the Euphrates and Tigris River basins

These two basins will be briefly described in order to give more complete information on the basin. Then, the proposed projects will be illustrated next. The drainage areas of the Euphrates and Tigris Rivers in Turkey are 118,000 and 44,000 km² respectively. The plan and the profile of the Euphrates and Tigris Rivers are given on the Plates No. 1 and 2.

The Euphrates River Basin

The sources of the Euphrates River are in the Dumlu mountain el. 3000 m, north of Erzurum and in the western slopes of the mountains surrounding the Van lake. The Euphrates River basin, which has great difference in elevation from its sources down to the end of its downstream reaches in Turkey, includes the highest mountains and the two mountain ranges of Turkey which are parallel to each other and known as the East Tauruses and the East External Tauruses. The East Tauruses form the Munzur, Kop and Bingöl mountain ranges by extending towards southwest-northeast directions. The south slopes of these mountains form the basin of the Euphrates River which takes its first tributaries near Erzurum. Then the Euphrates River, flowing from the north-east of the Munzur mountain, enters the narrow valley in the East Tauruses and joins the Murat tributary at north of Keban. The Murat stream which is the biggest tributary of the Euphrates River, flows towards west by collecting various streams in the valley between the Eastern and the East External Tauruses. The drainage area of the Euphrates River at the Keban dam site is 66,160 km². The Euphrates river collects its most important tributaries up to Keban. The Euphrates river valley gets narrower near Keban and the gorge runs up to Geyikkısığı in the southwest direction and the valley opens up near Bilaluşağı and the Euphrates River turns to east with large windings in the Malatya plain and collects the tributaries of Kuruhan and Tohma. The Euphrates River is intersected by the Malatya-Elazığ railway which is about 23 km. downstream of Bilaluşağı and by the higway at Kömürhan which is 20 - 25 km. downstream of the railway.

Following the above mentioned part, Euphrates River flows through the Sarsap gorge, a narrow and deep one, and flows into its valley near Siverek by taking the Kâhta tributary a little downstream of the Sarsap location and finally flows again through the gorge about 80 km north of Halfeti and then flows into Syria. The area which is worthed to be studied for irrigation in the Euphrates river basin is about 2,500,000 hectars. The Nusaybin-Mardin-Viranşehir plain of 1,000,000 hectars, the Haran plain of 200,000 hectars, the Birecik plain of 150,000 and the Malatya plain of 120,000 hectars are of importance.

The Tigris River Basin

In the south of Elazığ, the Tigris River takes its first tributary from the south slopes of the mountain ranges surrounding the Hazar lake; flows towards south through its valley in the south slopes of the East External Tauruses then turns to the east direction after Diyarbakır and takes the Batman, Garzan and Botan tributaries. The Tigris River flows through the gorges offering favourable sites for the dam construction near Selman north of Diyarbakır and in the gorge located near Diyarbakır. The valley becomes wider near Diyarbakır and forms the Diyarbakır plain which has an area of 250,000 hectars suitable for irrigation. The Batman tributary of the Tigris River, after taking its own tributaries such as Sason and Talori, flows towards south in a narrow gorge near Hüseyinkân and finally joins the Tigris River. The upstream part of this gorge has suitable sites for dam construction. The average discharge of Batman river is approximately two or three times of the discharge of the main river upstream of the confluence.

But, the Garzan River is comparatively much smaller than the Batman river. Its valley near Beşiri has, from the topographic point of view, sites suitable for dam construction.

The Botan stream, which is one of the most important tributary of the Tigris River collects the streams on the south slopes of the mountain range surrounding the Van lake at south and flows through the narrow valleys.

The Tigris river after receiving the last tributary in Turkey, the Botan river, passes the Idil plain by flowing to the south direction through the gorge where the Dermah dam site has been chosen, and flows by Cizre and enters Iraq.

II. 2. Meteorology

There are totally 87 meteorological stations for the part of the basin included in Turkey. Out of those stations 56 are located in Euphrates River basin (Plate 1).

The meteorological stations, according their operation characteristics are divided as first order and second order stations.

Rainfall, temperature, pressure, moisture, cloudliness, evaporation, wind, soil surface temperature, snow depths are measured in the first order stations.

In the second order stations, measurements of rainfall and snow depth and wind gaging are made and cloudliness is determined by observation.

The operation periods of the first order stations are given below.

Ağrı	16 years
Mardin	18 »
Erzurum, Erzincan, Elazığ, Malatya, Urfa, Diyarbakır, Siirt	29 »

Out these stations, only in Ağrı, Erzurum and Elazığ snow cover depth and density is measured. Further hourly rainfall is measured in Diyarbakır and Malatya, however in Erzurum, Elazığ, Urfa stations hourly rainfall is measured during the day time and at the three hours intervals during night time. All those are non automatic except Diyarbakır, Erzincan, Elazığ, Malatya which are equipped with automatic rainfall recorder since 1957.

Mountain pluviographs are not installed in the basin and the snow courses in high altitude have not yet started.

The periods of record of meteorological measurements may be classified as follows :

20 years and more	12 stations.
15-20 years	7 »
10-15 »	4 »
5-10 »	31 »
2- 5 »	15 »
Stations in operation since 1957	18 »

In order to give an overall idea on the precipitation on the whole basin an isohyetal map for the average annual rainfall has been drawn by giving consideration to the all records obtained from the above mentioned stations. For the use of hydrological study two isohyetal maps related with two respective recorded intensive rainfall storms have been drawn. The said isohyetal maps are given in Plate 3.

II. 3. Hydrology

As it was stated previously, the Euphrates and Tigris Rivers drain an area of 162 000 square kilometers in Turkey. The Euphrates river is one of the largest river in Turkey and its catchment area of 118,000 square kilometers constitutes one seventh of Anatolia. During the month of October, November and December, due to autumn rains, the waters of the Tigris and Euphrates Rivers rise temporarily but come down due to snow and frost in January. Sometimes the water level rises gradually starting from the middle of February and more often the beginning of March. Due to the melting snow in the higher reaches of mountains in the warmer weathers, the river waters increase. This increase is observed to continue until the middle of May and then starts to decrease as usual each year. This decrease continues until the end of August and sometimes September.

When the hydrographs of the Tigris and Euphrates Rivers are examined, it is observed that, the ratio between the maxima and minima discharges is very low compared to other rivers in Turkey. For example, this Q max/Q min ratio for the Euphrates at Keban is between 12 - 19. This characteristic of the Euphrates and Tigris Rivers system is due to their catchment areas situation on high mountains and the fact that their water comes from melting snow. The stream gaging stations operated on the Euphrates and Tigris Rivers within Turkey are shown on Plate 1.

The most important gaging station on the Euphrates river is located at Keban. The Euphrates River acquires its potential power after it joins the Murat river. Keban is situated downstream of this point of junction. The following information is obtained at the Keban station dated since August 1936 : average flow 650 m^3/sec; maximum recorded flow 6,600 m^3/sec; minimum recorded flow 167 m^3/sec.

The gaging stations of prime importance on the Tigris river are Diyarbakır, Dermah and Cizre on the main river and Sinan-Batman, Beşiri-Garzan, Billoris-Botan on its tributaries.

The detailed data, flow duration curves, mass curves obtained at these stream gaging stations are given in the related projects.

Recorded Floods, Spillway Design Floods :

The recorded peak flow rates and the flood seasons may be seen from the flow duration curves.

Some studies are carried out on the maximum possible flood conditions for the Keban project, and some preliminary estimates are made in order to determine spillway capacities for other projects.

According to the 21 years record of stream gaging at Keban and available meteorological data, estimates have been made on the max. possible rainfall storm and max. snowmelt runoff. The floods of the Euphrates River at the Keban damsite are found to be created specially by snowmelt and rainfall during snowmelt season. The recorded flood peak flows occuring every year, vary between 4,000 - 5,000m^3/sec. Peak flow at a rate of max 6,600 m^3/sec., has been recorded once during the gaging period. The flood period takes about two months. The recorded max. flood runoff volume is computed as 14×10^9 m^3.

Max. melt rate method ise applied to drive max. snowmelt flood volume and peak flow. Max. possible design flood is obtained by superposing recorded max. rainfall storm during snowmelt season. It is prefered to be on the safety side for the preliminary design purposes. By the mentioned method the spillway design inflow for the Keban project is computed as 26,000 m^3/sec. peak flow and 32×10^9 m^3 volume of flood during two months flood season.

(The isohyetal maps for reccorded max. storm rainfall are given in Plate 3).

The estimates on the spillway design floods for the other projects are given within the pertinent data on each project described in the report.

SECTION III

PROPOSED TENTATIVE PROJECTS

III. 1. General

The Euphrates and Tigris Rivers basin has huge potential possibilities.

As they flow through different countries, in order to get the most efficient utilization, their development should be done by giving due consideration by the interested countries from their upper reaches down to their downstream parts.

In this section tentative projects are studied seperately and their layouts are given in order to summarize all the work done up to date, however they may not be the final ones since the necessary explorations are not completed yet, further the said projects are not planned as an integrated system covering the need of the whole basin.

The Euphrates River has two possible dam sites at which almost the full regulation of the river can be done. Those are Keban located at the confluence of Euphraes and its main tributary Murat and the other one Halfeti which is far downstream close to the Syrian border.

The difference of the river elevations between Keban and the point where Euphrates leaves Turkey is approximately 360 m. Out of the amount 310 m. may be utilized economically by three following steps Bilaluşağı, Sarsap and Halfeti located downstream of Keban.

By these proposed projects and including Keban project an annual energy as much as 18 million kWh may be generated. It has to be pointed out that the Bilaluşağı and Sarsap projects do not have adequate storage. This gives priority to the construction of Keban project for their utilization.

In this report consideration is given only for the part of the Euphrates river downstream of Keban since the upstream parts of the river do not have essential projects in big scale which may affect the development. However, for local purposes, consideration should be given for projects located upstream of Keban and those located on the downstream tributaries.

As far as Tigris River is concerned situation is quite different from the Euphrates River, since the river gets its full potentiality at the confluence of Botan river which is very close to the Iraqien border. This led our work especially on the main tributaries as well as the river itself. The main projects located on Tigris river are : Selman and Diyarbakır located on the most upstream part of the river; Hüseyinkân, Beşiri projects respectively on Batman and Garzan tributaries and finally Dermah project on the main river just downstream of the confluence of Botan tributary. It has to be pointed out that Botan is the biggest tributary of the Tigris river and special consideration should be given on, in the future studies. Through the projects in Tigris River basin an aggregate yearly energy of 3.5 billion kWh may be generated. Through the projects on both rivers a huge amount of land in Turkey may be irrigated by gravity and pumping. The area which is subject to irrigation studies is estimated as much as 3 million hectares.

Through the regulation of the rivers besides of power and irrigation, flood control and navigation will also be possible, however the said benefits are not important for the part of the basin, in Turkey.

III. 2. Projects on Euphrates River

III. 2. 1. Keban Project

Keban project located in the gorge few kilometers downstream of the confluence of the Euphrates and Murat Rivers, is the key project on the Euphrates River basin.

Knowing the great power potentiality at Keban, a stream gaging station at the damsite has been put in operation since 1937 and necessary surveys are made and geological investigations are carried out and almost completed in detail. Flow duration curves are given on Plate 4.

According to the results of borings on the dam axis there is schist formation beneath the depths of the limestone formation of the gorge. The boundaries of the schist formation (quartzite, sericite, calcarous schist) has been investigated and the permeability of this zone of contact has been determined by water pressure tests made at each drillhole. It has been determined that the limestone formations generally consist of very sound and massive limestones together with broken limestone and also contain traces of solution. Up to the present, total borings amount to 8,200 meters at 120 drill holes. Completion of the explorations is expected at the amount over 9,000 meters which will take about four or six months more. As, a minimum 10 m depth of water in the river is found in the dryest season and speed of the flow is great it was preferred to carry out the riverbed explorations by means of inclined borings on the banks. Accordingly deep shafts has been excavated on each bank and borings are made on the bottom of the shafts across the riverbed. As a result the depth of the alluvial deposit in the riverbed has been found out as 36 meters.

The borings on the cross section along the axis of spillway weir and on the axis of the chute spillway are also carried out.

In order to evaluate the water pressure tests and have a sound opinion concerning groutings for the future foundation treatment, a grouting program is arranged to be performed in the coming months.

The geological map and the general view of the borings are given on Plates 5 and 6.

According to cores obtained from borings, water pressure tests, and geological field surveys, it has been decided that any type of dam to be constructed at the Keban damsite will be geologically suitable from both the stress and impermeability points of view.

As the left abutment is a favourable site for chute spillway in any layout either the dam is a concrete or rockfill type, the spillway will be located on the left abutment. The investigations on the materials for dam construction, aggregate deposits, impervious core material and suitable borrow areas for rockfill dam are made. The results indicate adequate deposits of aggregate necessary for a concrete gravity dam, nearby the damsite, but impervious core material has scarcely found in the surrounding area of the damsite as far as 20 kilometers. Taking all items of cost into consideration a study has been make to determine the type of the dam. For this

purpose, preliminary layouts and designs for both concrete gravity and rockfill dam and appurtenant structures have been made and overall cost of the project is estimated for each case. Thus, the layout for the concrete gravity dam has been found more economical than the layout for the rockfill dam in which case power tunnels and penstocks and the hauling distance of the impervious core material have substantial effect on the cost. Further, a rockfill dam as high as 200 m from the foundation may not be preferred with the point of view of safety. As a result, concrete gravity type of dam has been accepted in the layout of Keban project.

Another study has been made to determine the economic height of the dam in order to make the exploitation of the potentiality in the most economical way. In this study, all cost items such as expropriation of the land, railway and highway relocations, cost of the dam and power structures, equipment, transmission lines for various height of the dam are included on one hand, and benefits on the other, and it has been concluded that most suitable solution would be obtained with the spillway crest at such an elevation that full regulation of the river would be possible. The elevation of the uncontrolled spillway crest has been determined at 831.00 m. as a result. Top of the dam is at 840.00 m elevation. However, it is preferred that the dam would be built in two stages in order to undertake the expropriation cost successively at appropriate time when it would be imperative. Accordingly, a preliminary project has been prepared with spillway crest at 811.00 m. and top of the dam at 823.00 m. elevation, which will be raised in the second stage. In this report, the layout of the project with the dam at full height is included on Plate 7. The diversion canal on the right bank which is found out most suitable solution for diversion has also been drawn on the same Plate.

To get detailed data on hydrologic studies, mass curves, reservoir area-capacity curves, spillway design flood inflow, flood routing computations, diversion work, «The Preliminary Project for Keban Dam and Power Plant» is to be referred.

By means of 20×10^9 m^3 active storage, full regulation of the river will be possible and 630 m^3/sec of average dependable prime flow — adjusted for evaporation and other losses — will be provided.

Since considerable degree of river regulation is not possible at Bilaluşağı and Sarsap projects downstream of Keban, Keban project is in the position of key project in the basin.

As it was summarized in the paragraph II. 3. of this report, spillway design inflow is accepted to hit the reservoir with 26,000 m^3/sec peak flow and 32×10^9 m^3 volume of runoff during two months of flood season. The outflow discharge is computed to be approximately 20,000 m^3/sec. The floods will be conducted downstream side of the dam through a lined chute spillway.

The capacity, which should be computed in accordance with the characteristics of the power market to be fed by the plant, is determined to be 980 MW ultimately. Keban project will be cabaple of producing 5.5 billion kWh annually.

Savings on costs of powerplant structure and equipment are contemplated by installing big units, so 7 units each 140 MW capacity have been chosen.

Some additional data on the characteristics of the Keban project is given below :

Hydrology:

Drainage area	66,160 km²
Average flow during the 21 years period of record	650 m³/sec
Maximum recorded peak flow	6,600 m³/sec
The volume of the max. recorded flood	14×10^9 m³

Storage:

The volume of reservoir at the spillway crest elevation (831.00 m).	22×10^9 m³
Active storage	20×10^9 m³
Prime flow (average regulated flow adjusted for evaporation and other losses)	630 m³/sec
Regulation capability of the reservoir	full regulation of the river.
The mean powerpool elevation	821.00 m approximately.

Dam:

Type	Concrete gravity
Foundation	Schist under the alluvial layer in the riverbed, limestone formation at abutments.
Crest lenght	1120 m (including spillway section)
Crest elevation	840 m
Riverbed elevation	681 m approximately
Height from the foundation	200 m approximately
Height from the riverbed	159 m
The volume of concrete in the dam	2,950,000 m³
Spillway	uncontrolled, concrete weir with 400 m crest lenght, concrete lined chute spillway.
Excavation volume for spillway	1,700,000 m³
Volume of concrete in spillway structures	750,000 m³

Diversion during construction:

A concrete lined canal on right bank with 6,600 m³/sec capacity found most economical. Necessary excavation and concrete volume for this canal is 800,000 m³ and 35,000 m³ respectively. Outlet penstocks will be embedded in the dam for second stage of the diversion.

III. 2. 2. Bilaluşağı Project

Bilaluşağı project is located about 48 km. downstream of Keban. The drainage area of the Euphrates River at Bilauşağıis 70,180 km². The valley is wide at the

damsite, but provides some advantages in point of view of general layout of the project. By means of this project the potential of the river will be fully exploited till the upstream end of Malatya plain. For the time being, geological information on the damsite is not available, this may materially affect the layout.

Considering the capacity of the project, an earthfill dam of 14,000,000 m³ of volume is thought to be feasible to build. So, the spillway crest elevation is fixed at the normal tailwater elevation at Keban with the aim of full utilization of the potentiality. The spillway excavation of 5,600,000 m³ is the determing factor on the type of the dam. The height of the earthfill dam above riverbed ise 54 meters, and assumed height from its foundation is 85 meters. The construction of the dam may be accomplished by sheet-piling cofferdams and two stage diversion.

Two 11 meter diameter tunnels will be used both for diversion and for conveying water to the powerplant.

There is no tributary joining the main river between Keban and Bilaluşağı. Since full regulation of the river will be done at Keban reservoir there is no need for large scale storage at Bilaluşağı project. However, 1.95×10^9 m³ reservoir that Bilaluşağı project provides, would not be capable of any remarkable degree of regulation without Keban dam. Having Keban dam built, it will be possible to generate 1.8×10^9 kWh of firm energy annually at Bilaluşağı.

Although it is impossible to make an estimate on the powerplant capacity, at present, 0.50 capacity factor is accepted to have a basis for the preliminary design. Thus, the capacity of the plant is estimated to be 4×100 MW = 400 MW.

The general layout and some details of the project is given in Plates 8 and 9.

III. 2. 3. Sarsap Project

The project is located on the Euphrates River where it flows in a narrow gorge named Sarsap, about 130 km. downstream of Bilaluşağı. The drainage area of the river being 85,160 km². Tohma river joins the main river between Bilaluşağı and Sarsap locations. The annual average discharge of the Tohma river is computed as 30 m³/sec.

The Sarsap damsite is selected with the topographical point of view only. Geological information concerning the damsite is not available at present. It is found necessary to built a chute spillway on the right abutment to take the adventage of the site for rockfill dam layout. It is contemplated that the excavation of 7,500,000 m³ volume for spillway wil be used as rockfill material.

In case of concrete gravity or concrete arch design it would also be necessary to locate the spillway on the right abutment in order to provide necessary clearance to conduct the floods downstream. This makes rockfill design more economical.

To determine the height of the dam, consideration was given to be in economical limits. So, 32 m difference in elevation between Bilaluşağı tailwater and Sarsap dam spilway crest is justified to avoid flooding of existing railway and highway in Malatya plain and at Kömürhan respectively.

However, a considerably high rockfill dam, 120 m. high from the riverbed, is proposed. The volume of the embankment in the dam is 5,300,000 m³. Active storage will be about 400×10^6 m³ which is insignificant in point of view of regulation. But having Keban dam built, an annual output as much as 4.5 billion kWh may be possible at Sarsap powerplant. This figure is computed on the basis of 640 m³/sec average

annual flow and 103 m net head. A stream gaging station at Mezra, located close to the damsite is put in operation two years ago.

The regulation of the Tohma river may be provided by Ozan dam, which is a multi-purpose project for irrigation and power for local demand.

The capacity of the Sarsap plant is determined by 0.50 capacity factor, just to base the layout on. Thus the layout is made for 8×130 MW units or 1040 MW powerplant.

Spillway is designed for 26,000 m^3/sec outflow discharge.

The layout of the project and some details are given on Plates 10 and 11.

II. 2. 4. Halfeti project.

Halfeti project on Euphrates River, is located in the gorge north of town Halfeti close to the Syrian border. The necessary geological information on the damsite is not available and the damsite is determined with the topographical point of view. The drainage area of the river at Halfeti damsite is 99,633 km^2. Tohma and Kâhta tributaries join the main river between Keban and Halfeti damsite.

A large reservoir of 26×10^9 m^3 volume will be created behind the proposed 136 m. high dam, and complete regulation of the river and full use of the potential will be obtained. An earthfill dam is accepted to be the most suitable.

Although, having the geological conditions disclosed, the type of the dam and layout of the project should be checked.

The volume of the earthfill for dam is computed as 18,000,000 m^3. In this computation the depth of the alluvial deposit in the riverbed is assumed to be 30 m and the height of the dam above foundation 166 m. The spillway excavation is determined as 4,782,000 m^3. Even in the case Keban dam is constructed first, four tunnels 10 m. diameter found necessary for diversion during construction. Two of these tunnels will be used as power tunnel.

The mean discharge available at the powerplant is accepted to be 655 m^3/sec. and annual output of 5.5 billion kWh. Capacity factor of 0.50 is accepted just to give an idea on the powerplant capacity which is computed as 1120 MW with 8×140 MW units.

General layout and some details are shown on Plates 12 and 13.

III. 2. 5. Projects on the tributaries of Euphrates River

A reconnaissance made at Malpınar damsite on the Göksu tributary, disclosed a potentiality of approximately 300 million kWh annual energy production. Mean flow of Göksu River is determined as 45 - 50 m^3/sec. Approximately 100 m high dam is proposed to be built.

Another one, Ozan project on Tohma river was briefly investigated to meet the local power demand and provide irrigation water to Malatya plain.

III. 3. Projects on Tigris River and its tributaries

III. 3. 1. Selman project

The proposed location for Selman project is at the downstream of Amini and Tigris River confluence, 35 kilometers north of Diyarbakır city. Drainage area of the river at Selman damsite is 4052 km^2. The average flow, during the 11 years period

operation of Diyarbakır gaging station, is computed as 66.50 m^3/sec. Dependable average regulated flow for a long period is estimated as 50 m^3/sec. The active storage of 2.1×10^9 m^3 is capable to make full regulation of the river. Total reservoir capacity at the spillway crest elevation is 3.5×10^9 m^3. Selman reservoir will serve for both irrigation and power purposes. In the summer months, the flow of the Tigris River is quite inadequate for irrigation of 250,000 hectar Diyarbakır Plain.

Although geological data on the damsite is not available at present, a rockfill type dam with inclined impervious core is adopted. The height of the dam is taken to be 137 m from the riverbed, embankment volume in the dam being 8,600,000 m^3, spilway excavation 6,810,000 m^3. An uncontrolled chute spillway is designed to carry 7,000 m^3/sec design flood outflow. The recorded peak flow is 2,156 m^3/sec and spillway design flood inflow is estimated to be roughly 9,500 m^3/sec.

Annual energy output at Selman powerplant will be 385 million kWh. Powerplant capacity is determined as $2 \times 44{,}000$ kW or 88,000 kW.

Hydrologic data, general layout and some details are given on Plates 14, 15 and 16.

III. 3. 2. Diyarbakır Project

Diyarbakır damsite on Tigris River is located just upstream of Silvan highway bridge, 2 kilometers south of Diyarbakır city. Drainage area of the river is 6,160 km^2.

This project is in the position of secondary importance in the basin, because of its small capacity and comparativey higher specific construction cost per kW and per kWh of annual production.

An earthfill dam 57 meters high from the riverbed is proposed. Embankment volume in the dam is 1,930,000 m^3. Spillway excavation on the left ebutment is computed as 4,500,000 m^3 which is one of the factor affecting on cost. Preliminary studies and surveys do not point out the damsite as a favourable site from the geological point of view.

As the river will be regulated by Selman project, upstream of Diyarbakır damsite, large scale regulation will not be needed at Diyarbakır reservoir. However, consirerable degree of regulation would not be possible by 500×10^6 m^3 active storage at Diyarbakır reservoir.

The annual output of the Diyarbakır project will be 142×10^6 kWh. Capacity of the plant is assumed as $2 \times 16{,}250$ kW or 33,500 kW.

General layout and some details are given on Plates 17 and 18.

III. 3. 3. Hüseyinkân Project on Batman River

The proposed location for Hüseyinkân dam is at the confluence of Kulp and Talori streams, 10 kilometers north of Malabadi bridge on Diyarbakır-Siirt highway. Drainage area of the river is 5328 km^2 at the damsite.

Batman River is one of the main tributary of Tigris River. Average flow during 12 years operation of Sinan gaging station is computed as 154.60 m^3/sec. However, one year ago another stream gaging station is put into operation at Malabadi, to determine the river flow at the damsite. Between Malabadi and Sinan gaging stations Sason stream and some small streams join Batman River.

Preliminary geological surveys have been made at the damsite and detailed geological investigations and drilling program is going to be carried out in near future. Although the gorge offers more suitable sites at the downstream parts, from topographical point of view, the axis of the dam is located at a wide cross section at the upstream end of the gorge where geologic formation found much better. Spillway is located on the saddle at the left bank, 6 kilometers far from the dam axis. Depending on the data at hand, rockfill type dam with inclined impervious core is considered to be the most suitable. The height of the dam, above riverbed is 115 m, Embankment volume in the dam 10,200,000 m^3, spillway excavation 1,350,000 m^3. A dike will be constructed to plug a saddle as it is shown in the general layout.

The total and active storage is 3.9×10^9 m^3 and 2.2×10^9 m^3 respectively. Yearly regulation of the river will be possible and average dependable flow will be 130 m^3/sec approximately.

Spillway design inflow discharge is estimated as 9,000 m^3/sec and outflow is found 8,000 m^3/sec approximately. Maximum recorded peak flow at Sinan gaging station is 1,834 m^3/sec.

Two 10 m diameter, each 555 m long, conerete lined tunnels in the right abutment will be used for diversion purposes. Diversion works are planned according to the recorded peak flow. One of the tunnels will be used as power tunnel ultimately.

Hüseyinkân project will be both for power and irrigation purposes. It may be possible to produce 775×10^6 kWh energy annually and to provide irrigation water for the eastern part of the Diyarbakır plain. For the preliminary design purposes, capacity of the plant is determined to be $3 \times 60{,}000$ kW or 180,000 kW.

Hydrologic data, general layout and some details are given on Plates 19, 20 and 21.

III. 3. 4. Beşiri project on Garzan River

Beşiri project on Garzan River is located in the gorge near Beşiri town. Drainage area of the river being 2,476 km^2 at the damsite.

This project may be considered to be secondary in priority and importance in the development plan, because of its comparatively high specific construction cost per kW and per kWh of annual production and small capacity on the contrary. The construction of the dam necessitates 30 kilometers railway relocation and expropriation of some amount of land in the reservoir area.

A 111 m. high (above riverbed) concrete gravity dam with 1,300 000 m^3 volume is planned. Necessary excavation for the chute spillway, located on the right bank, is 3,100,000 m^3, Embankment volume for the dike on the right abutment is 1,300,000 m^3.

However an embankment type dam may also be planned as well.

Provided active storage of 3.7×10^9 m^3 will be capable of full regulation of the river. Regulated average flow is estimated to be 45 m^3/sec. The average flow, determined by means of 11 years record at Beşiri gaging station, is 51.58 m^3/sec. Recorded max peak flow is 1,063 m^3/sec.

Beşiri project will be both for irrigation and power pruposes. 20,000 hectar land in the Garzan valley may be irrigated and 285×10^6 kWh energy produced annually. The capacity of the plant is taken as $2 \times 33{,}500$ kW or 67,000 kW.

Hydrologic data, general layout and some details are given on Plates 22, 23 and 24.

III. 3. 5. Dermah Project

A 90 m high dam is proposed to be constructed at Dermah, downstream of Tigris and Botan river confluence, about 30 km. south of Siirt. Tigris River has all its tributaries collected upstream of Dermah damsite. The drainage area of the river at Dermah is 38,194 km^2.

A stream gaging station is put into operation at Rezuk since 1955 in order to get precise data on river flow at the damsite. Although estimates for preliminary design purposes can be made by means of the data from the upstream gaging stations on the main river and its tributaries.

According to the topographical and geological surveys three damsites were determined on Tigris river after it is joined by its tributary Botan. These are, beginning from the upstream side Rezuke I, Rezuk II and Dermah damsites. Geological surveys started at the Dermah damsite which has been considered to be the most favourable alternative. Pilot borings at the riverbed Rezuk II and Rezuk I damsites disclosed the unfavorable foundation formations and the Rezuk alternatives have been eliminated. Geological surveys started in August 1955 at the Dermah damsite and 44 borings, totally 3,050 m. have been made. A small depth of alluvium layer, 3.00 m, was encountered in the riverbed. Gorge has middyat limestone of the eocene formation. Middyat limestones consist of thick dolomitic and sometimes various kinds of layers. The limestone layers dip in the upstream direction. The limestones are generally massive, with localised joints. There are cavities in some layers, filled with crystal dated from the sedimentation period. However these cavities are not found to be connected with each other. These layers are to be found 25 - 30 m deep at the dam axis. In order to make a more reliable decision, water pressure tests are carried out every two meters. Moreover a grouting test program is being carried out.

The maximum reservoir elevation is limited at 500 m by Diyarbakır-Kurtalan railway. Thus, the spillway crest elevation and the powerpool elevation at the top of the radial gates are fixed at 484.00 m and 494.00 m respectively. Out of 2.6×10^9 m^3 total reservoir volume, 2 billion m^3 will be active storage by which full yearly regulation is not possible without upstream projects. Major upstream projects, Selman and Hüseyinkân will have indirect benefit by providing regulation.

The regulated average flow is computed to be 360 m^3/sec at Dermah, whereas last two years stream gaging records at Rezuk show 491 m^3/sec average flow. By means of some degree of regulation on Botan river, energy production capability of the Dermah project may be increased. For preliminary purposes, spillway is designed for 16,000 m^3/sec outflow discharge, computed inflow design discharge and recorded peak flow (in the last two years at Rezuk) being 21,000 m^3/sec and 4,371 m^3/sec respectively.

By means of some precautions taken, a concrete gravity dam may be built economically at the damsite. For example, special kind of cement should be used in in dam to protect the concrete from the effets of sulphurous water which is expected to exist in the reservoir. On the other hand soluble formations, although at the depths of the foundation, bring forward another problem which is not yet decided on.

Although it is apparently more expensive alternate, the layout for rockfill dam is given in this report just to give an idea. For this layout, spillway has to be excavated on the right abutment. The embankment material in the dam will be taken from the spillway excavation. The height of the dam from the riverbed and from the foundation is 90 m and approximateiy 110 m respectively.

The volume of the dam embankment above riverbed is 4,000,000 m^3, which may amount to 4,400,000 m^3 totally.

Gated spillway is found economical to cut the excavation cost. Gated spillway is also necessary to fit the limitation on the maximum reservoir elevation. Spillway excavation is computed to be 4,300,000 m^3.

Diversion during construction is planed to be attained by two 10 m. diameter concrete lined tunnels and a canal to be excavated on the left abutment. The length of these tunnels are 680 m and 725 m. The canal will be capable of carrying 4,200 m^3/sec flow and the two tunnels 2,000 m^3/sec.

The excavation for the concrete lined canal is 900,000 m^3 and the toal volume of the cofferdams is 450,000 m^3.

Annual output of the project will be 2 billion kWh dependable and 2.6 billion kWh total. For the preliminary purposes, plant capacity has been taken as 4×115 MW or 460 MW.

Hydrologic data, general layout and details are included on Plates 25, 26 and 27.

SECTION IV

FUTURE STUDIES IN THE BASIN

In order to obtain additional data on some of the proposed projects and to evaluate the potentialities, further geological and topographical surveys should be extensively done in future. These works will be comprised of successive steps as visual inspection and preliminary geological studies, topographical surveys, preliminary and detailed geological explorations, additional stream gaging stations, necessary meteorological observations, surveys for irrigation projects.

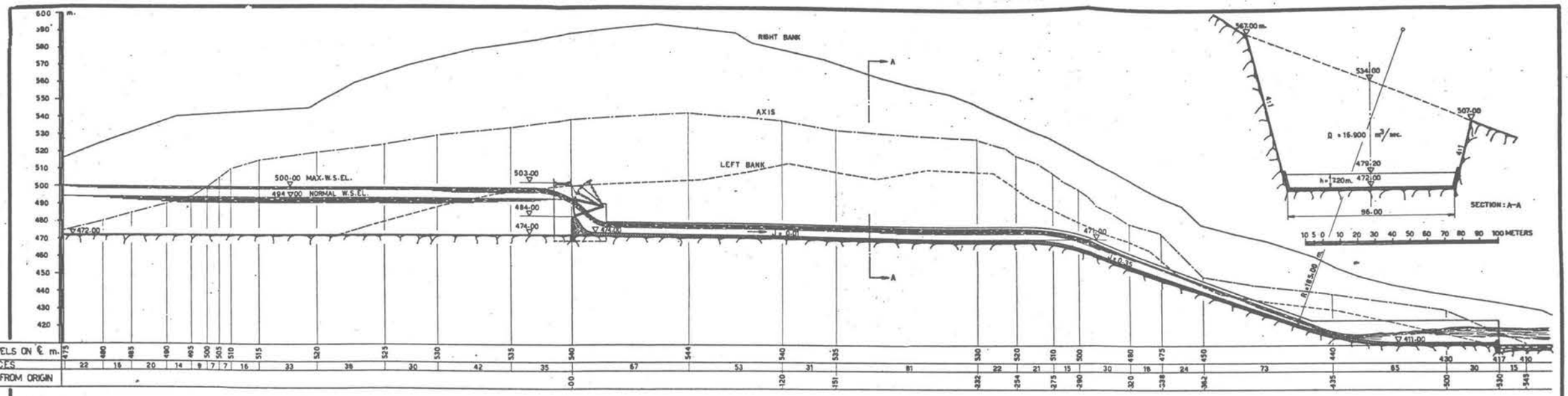
On the Euphrates River, Bilauşağı, Sarsap and Halfeti damsites will be subject to further studies beginning from visual inspection. On the Tigris River and its tributaries, Selman, Diyarbakır and Garzan damsites will be investigated. As the data available at present is not enough to disclose the potentiality of the Botan River, the river is to be investigated throughout its length.

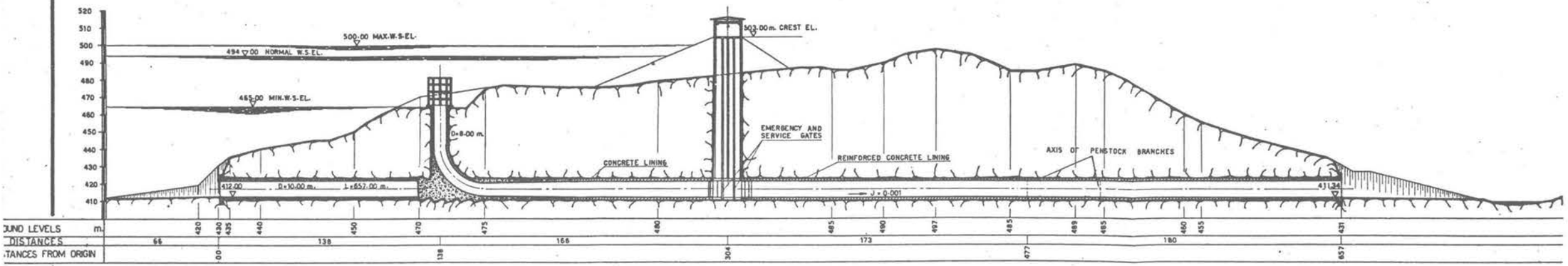
After the reconnaissance surveys, additional gaging stations may be put into operation at Halfeti and Selman damsite. (Şerbetin gaging station was in operation at Selman damsite, formerly.)

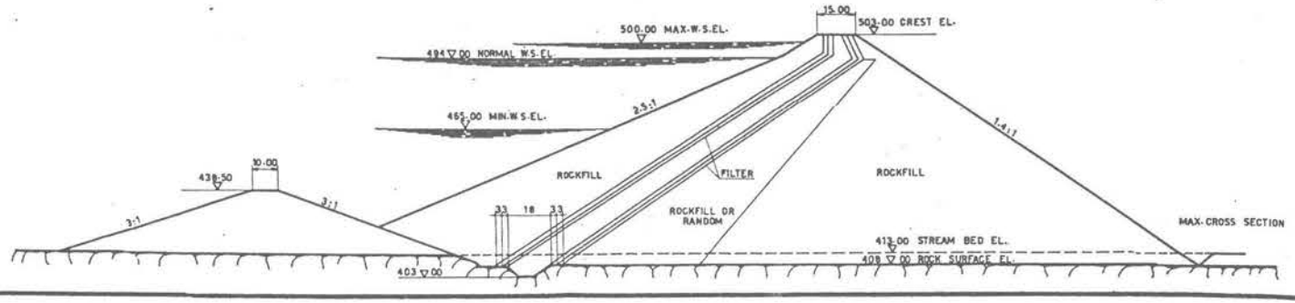
By means of these studies, definite layouts for the projects included in this report can be decided on. Substantial change on the proposed layouts may be expected in the definite projects. However studies on Keban project on the Euphrates River is in the last stage and definite decisions are made on the characteristics of the project. The detailed surveys at Dermah damsite on Tigris River is also almost completed by which the characteristics of the project can be determined.

Another part of the studies will be on irrigation probem, determination of irrigable land, surveys for irrigation projects.

All of these will be a part of the studies for an integrated development plan for the whole basin.







ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

TIGRIS RIVER-DERMAH PROJECT SECTIONS

DRAWN : | SUBMITTED :
TRACED : N. K. | RECOMMENDED :
CHECKED : | APPROVED :

FEB. 1958 | SCALE | 4146 (VII-15) | PLATE. 27

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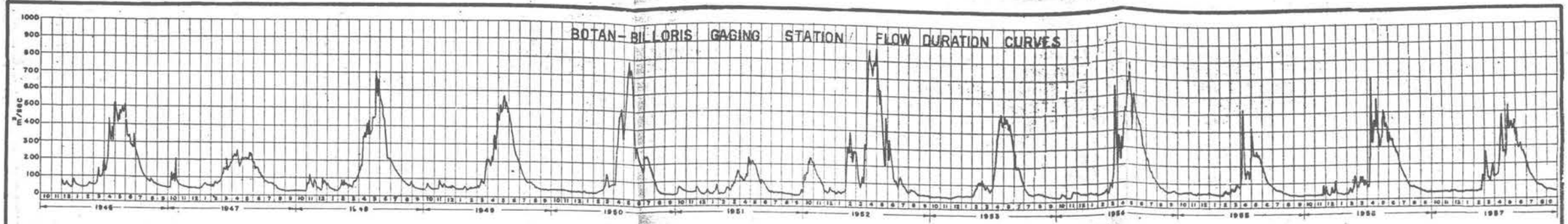
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

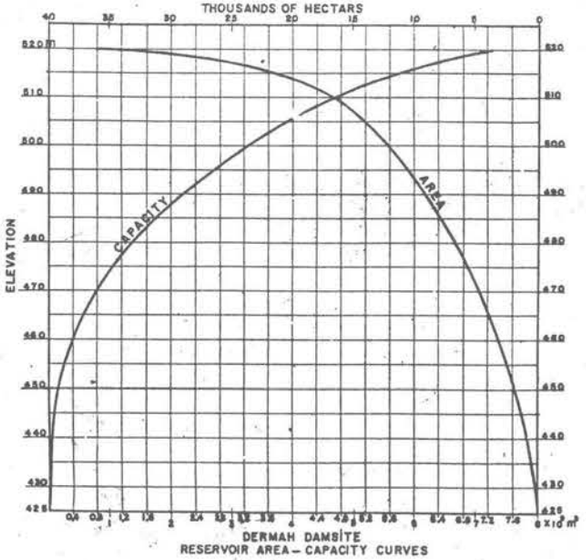
TIGRIS RIVER-DERMAH PROJECT

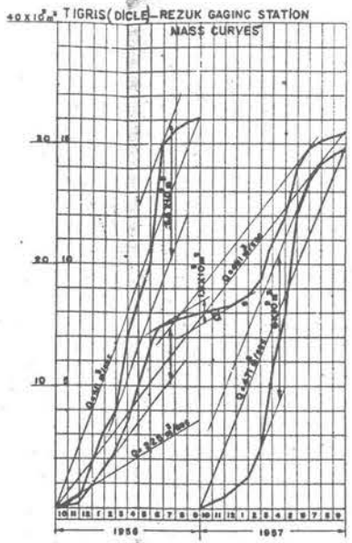
GENERAL LAYOUT

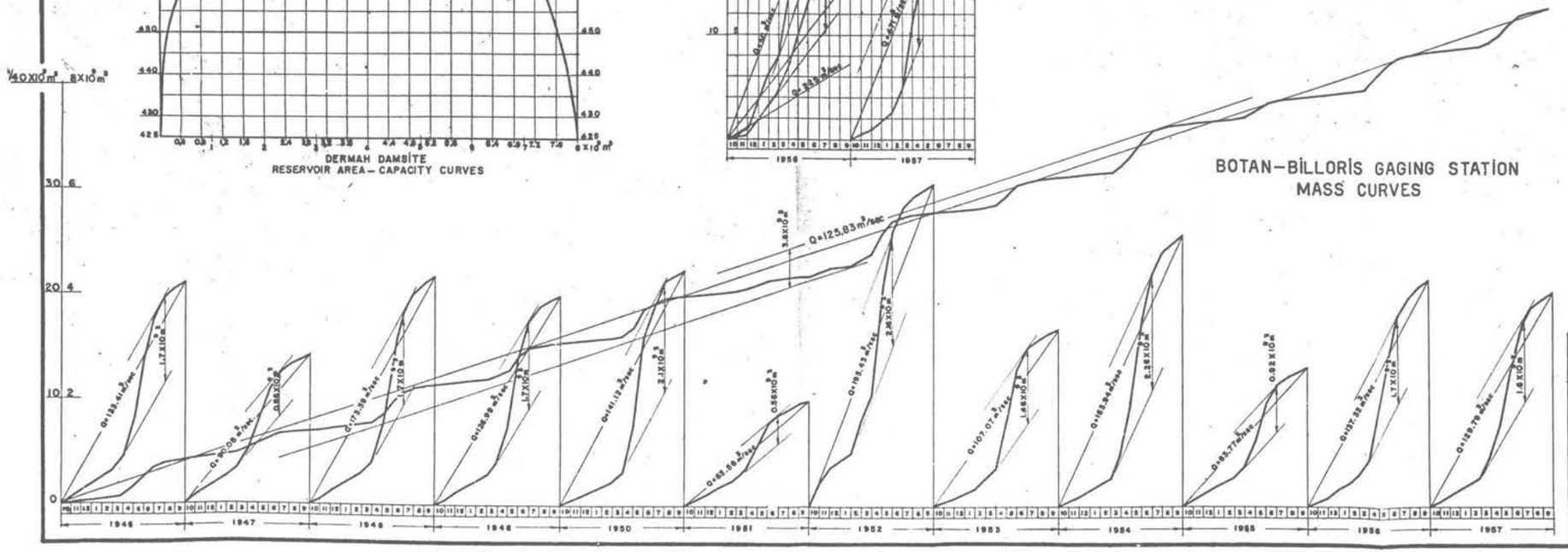
DRAWN: TRACED: N.K. CHECKED: SUBMITTED: RECOMMENDED: APPROVED:

FEB.-1958 | SCALE | 4145/VII-15/PLATE: 28







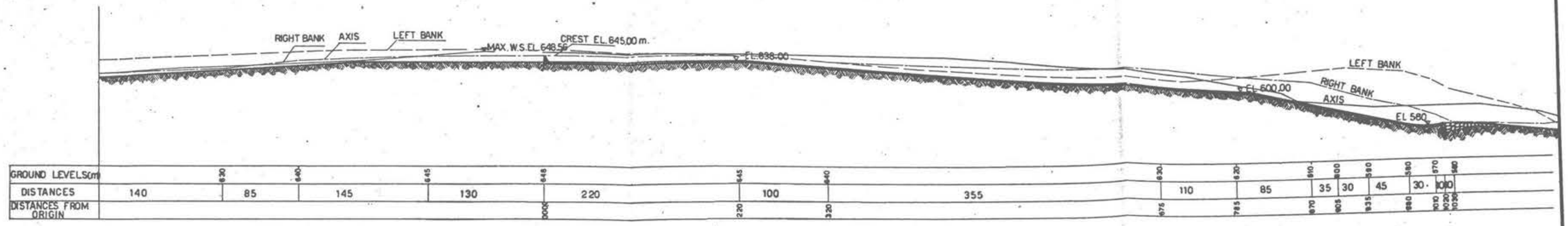


ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

TIGRIS RIVER-DERMAH PROJECT HYDROLOGIC DATA

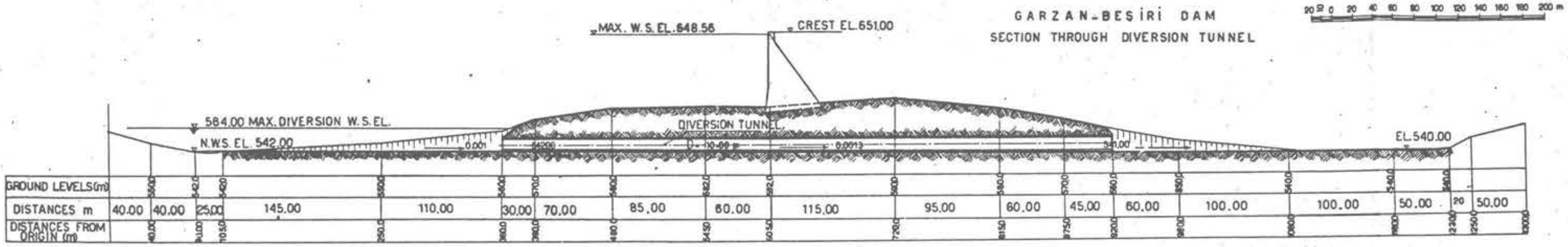
DRAWN: E. Kamiloğlu
TRACED: C.A.
CHECKED:
SUBMITTED:
RECOMMENDED:
APPROVED:

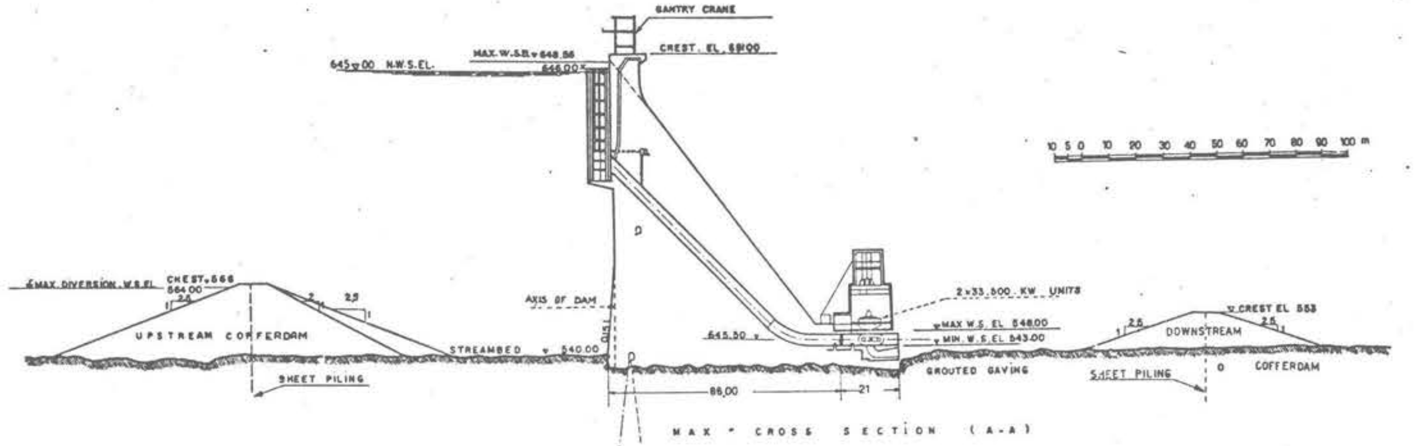
FEB.-1958	SCALE	4144	VII-15	PLATE: 25



GARZAN-BEŞİRİ DAM

SECTION THROUGH DIVERSION TUNNEL





ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

GARZAN RIVER-BESIRI PROJECT SECTIONS

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TRACED: H. BÜRGAN	RECOMMENDED: [signature]
CHECKED: [signature]	APPROVED: [signature]

FEB 1958	SCALE	4143	YR 15	PLATE 24

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THE EUPHRATES AND TIGRIS RIVER BASINS DEVE OPMENT .PLAN

GARZAN RIVER-BEŞİRİ PROJECT GENERAL LAYOUT

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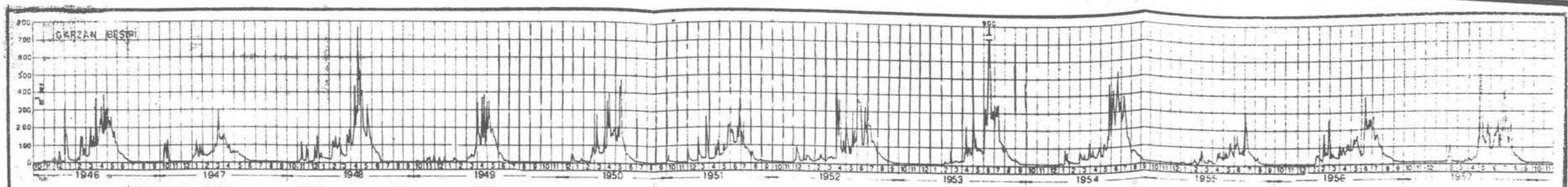
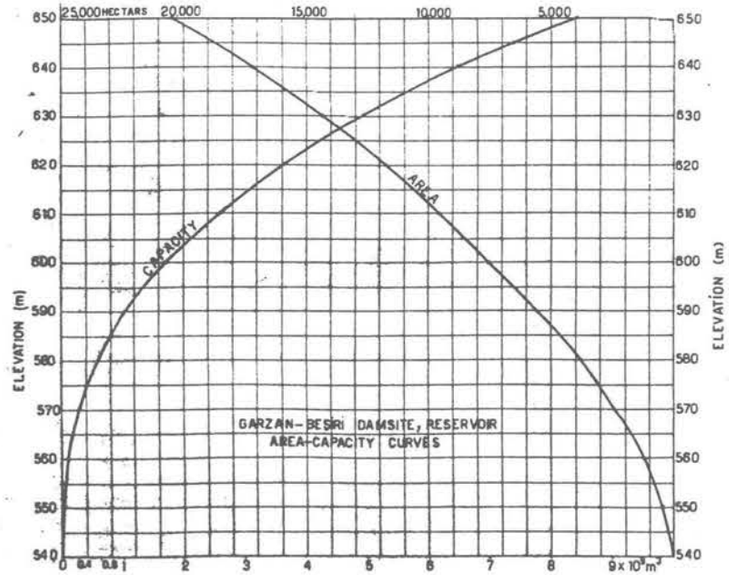
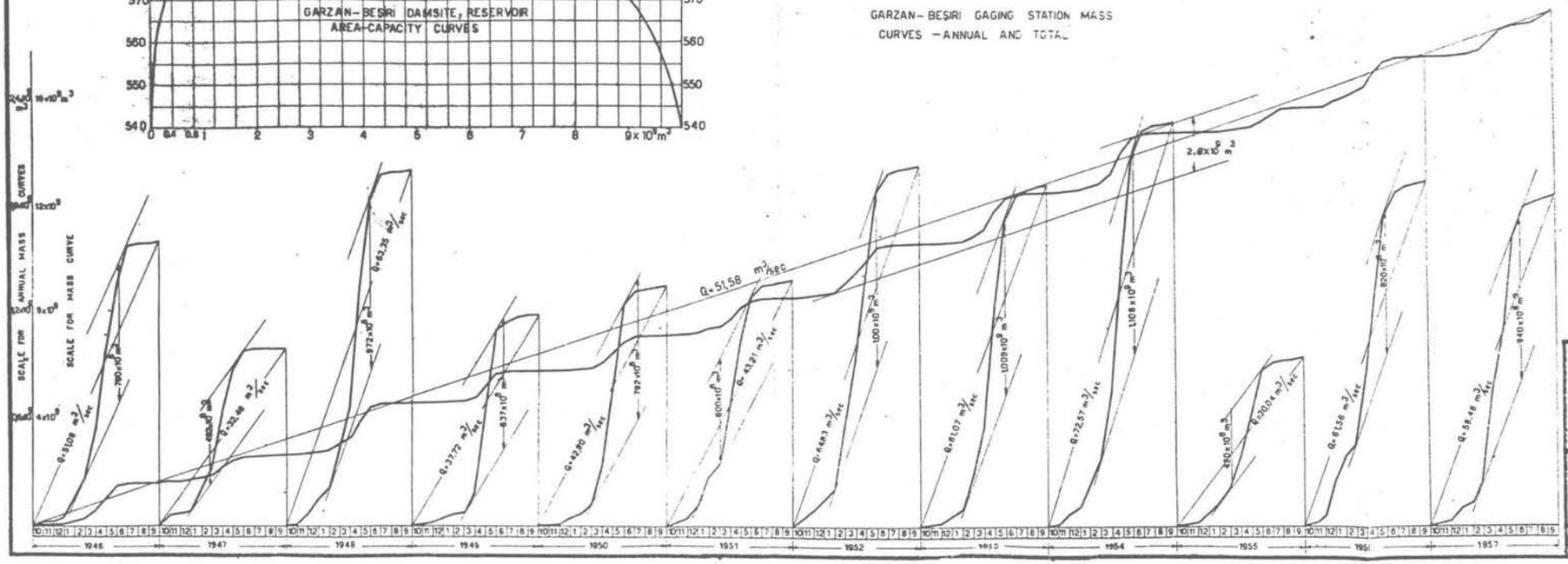
FEB_1958	SCALE	4142	PLATE. 23





GARZAN-BEŞİRİ DAMSITE, RESERVOIR
AREA-CAPACITY CURVES

GARZAN-BEŞİRİ GAGING STATION MASS
CURVES - ANNUAL AND TOTAL



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THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN
GARZAN RIVER-BEŞİRİ PROJECT
HYDROLOGIC DATA

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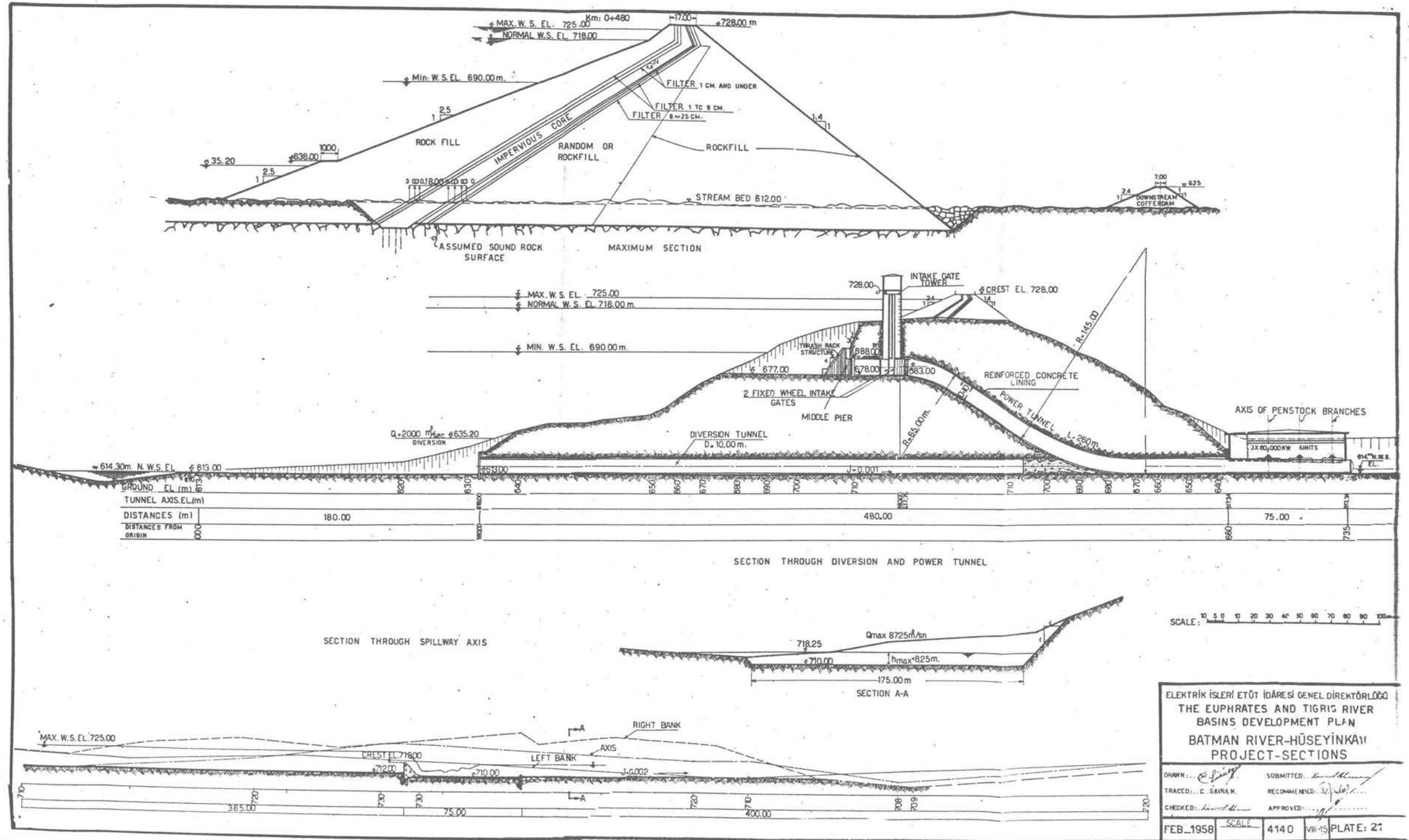
TRACED: H. BÜRGAN RECOMMENDED: [illegible]
CHECKED: [illegible] APPROVED: [illegible]

FEB. 1958 | SCALE | 4141 | VB-15 | PLATE: 22



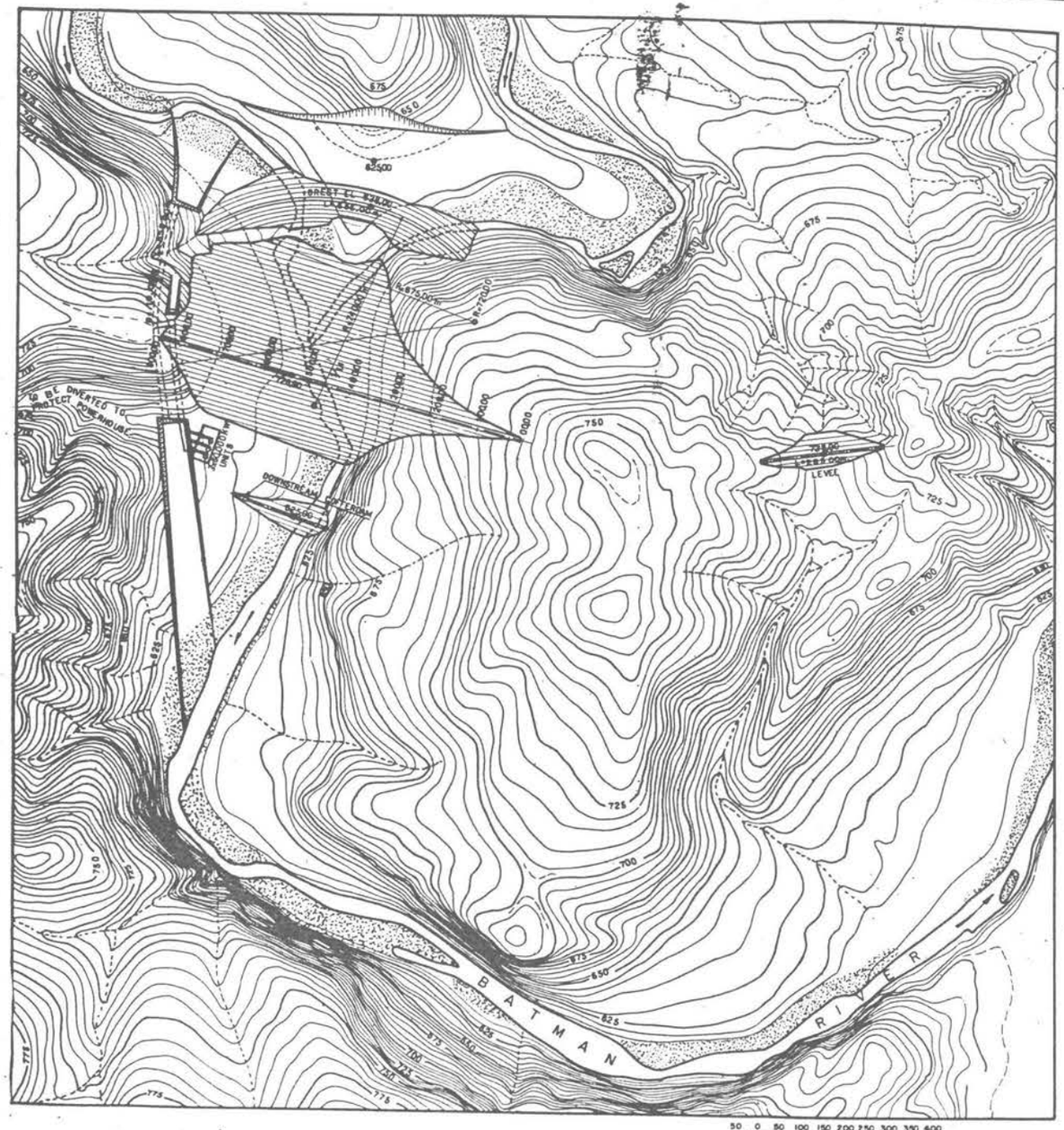
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

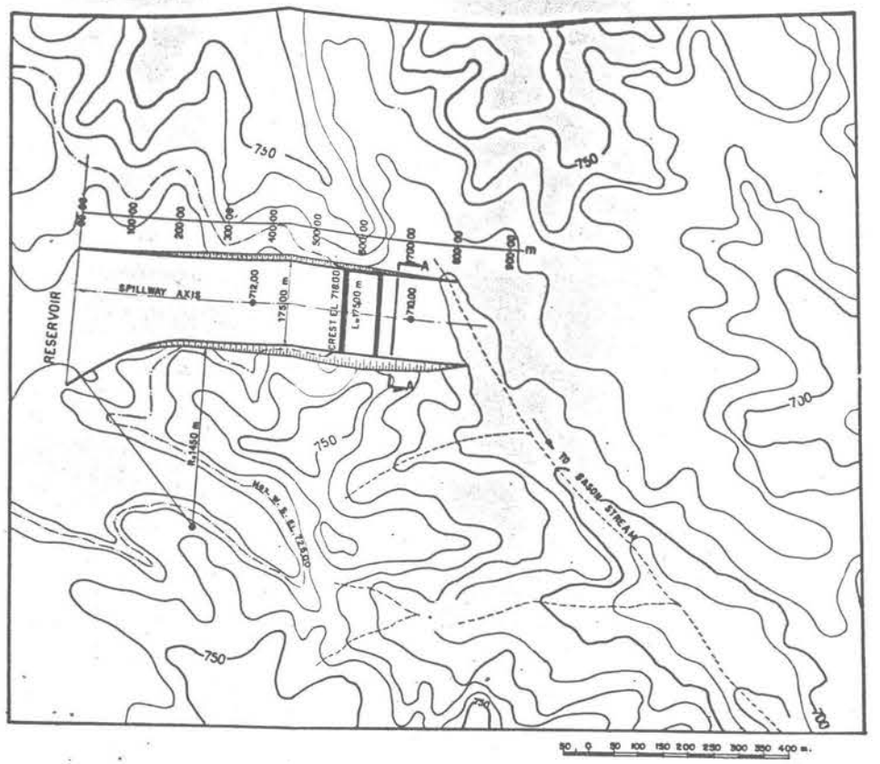
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

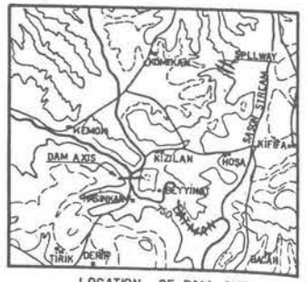
BATMAN RIVER-HÜSEYİNKAYI PROJECT-SECTIONS

DRAWN:		SUBMITTED:	
TRACED: C. SAVRAN		RECOMMENDED:	
CHECKED:		APPROVED:	

FEB_1958	SCALE	4140	VIII-15	PLATE: 27







LOCATION OF DAM AXIS AND SPILLWAY

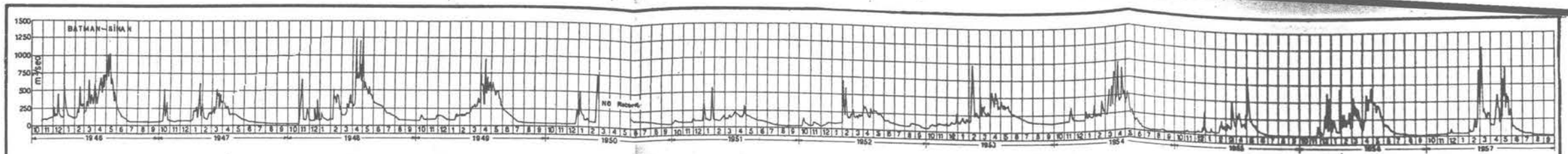
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

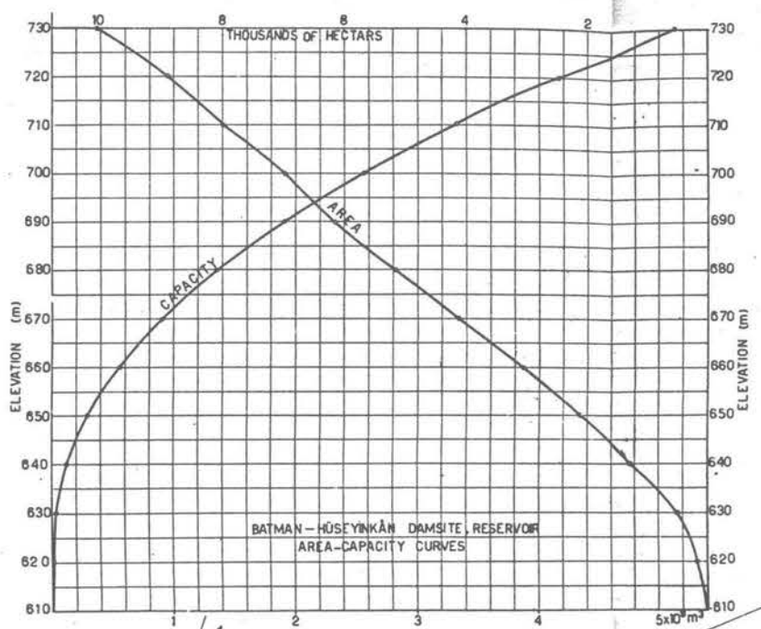
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

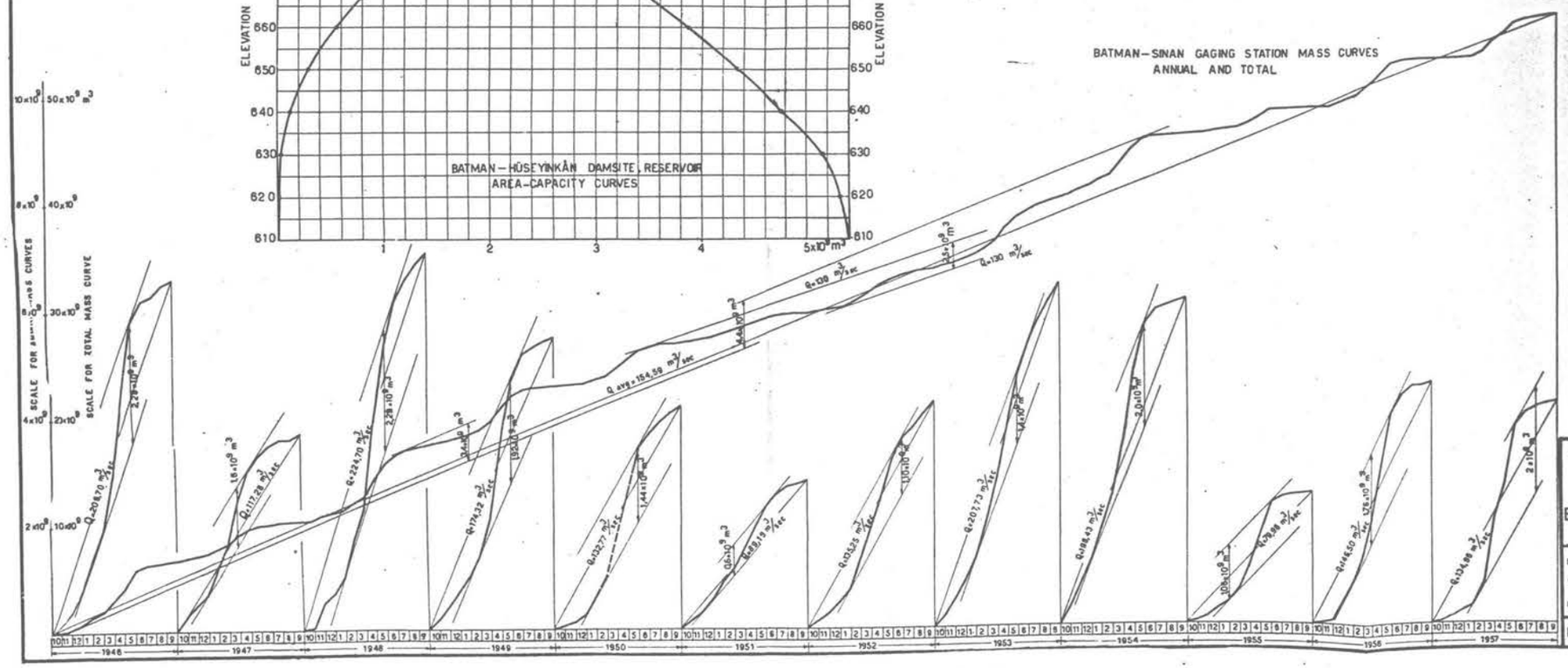
BATMAN RIVER-HÜSEYİNKÂN PROJECT GENERAL LAYOUT

DRAWN : ...
TRACED : H. BÜRGAN ...
CHECKED : ...
SUBMITTED : ...
RECOMMENDED : ...
APPROVED : ...

FEB. 1958	SCALE	4139	VIII-YS	PLATE: 20







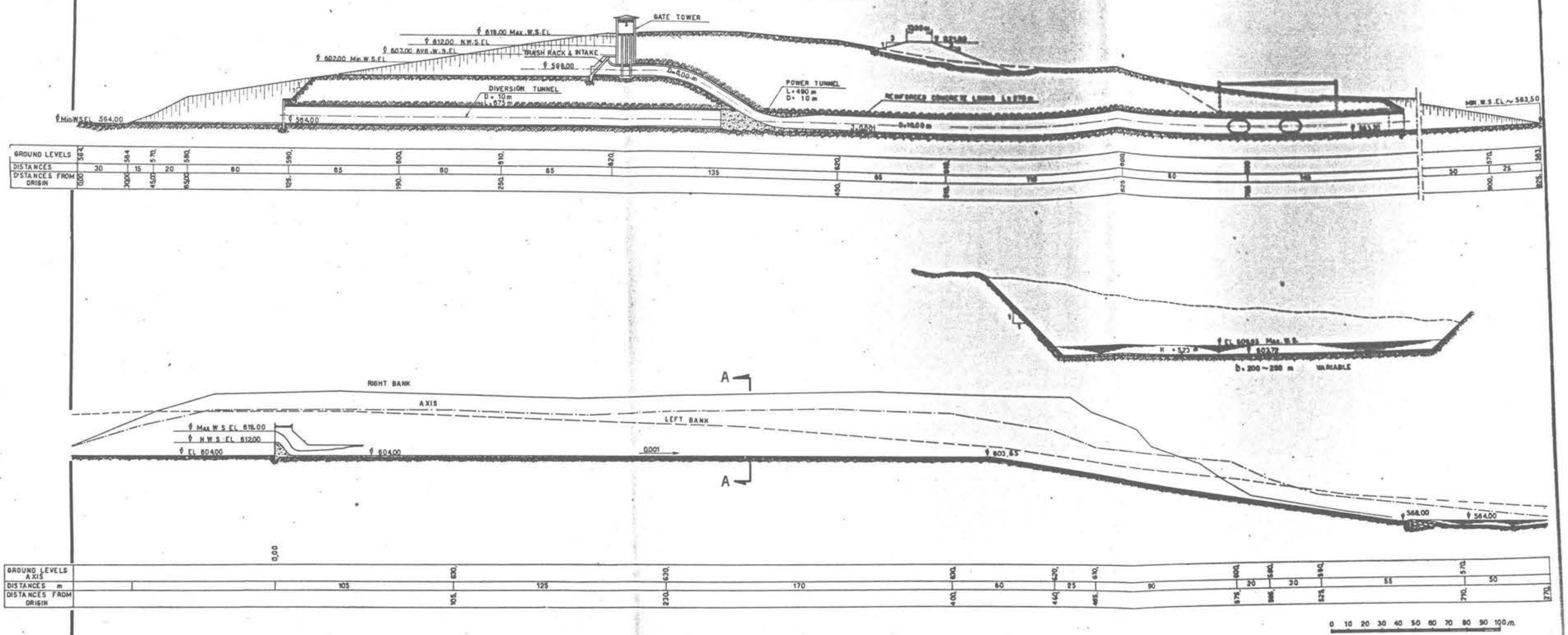
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

BATMAN RIVER-HÜSEYINKÂN PROJECT HYDROLOGIC DATA

DRAWN		SUBMITTED	
TRACED H. BÜRBAN		RECOMMENDED	
CHECKED		APPROVED	
FEB. 1958	SCALE	4136	VII-15 PLATE: 19

PROFILE ON ℄ DIVERSION, ℄ POWER TUNNEL



ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

TIGRIS RIVER-DİYARBAKIR PROJECT

SECTIONS

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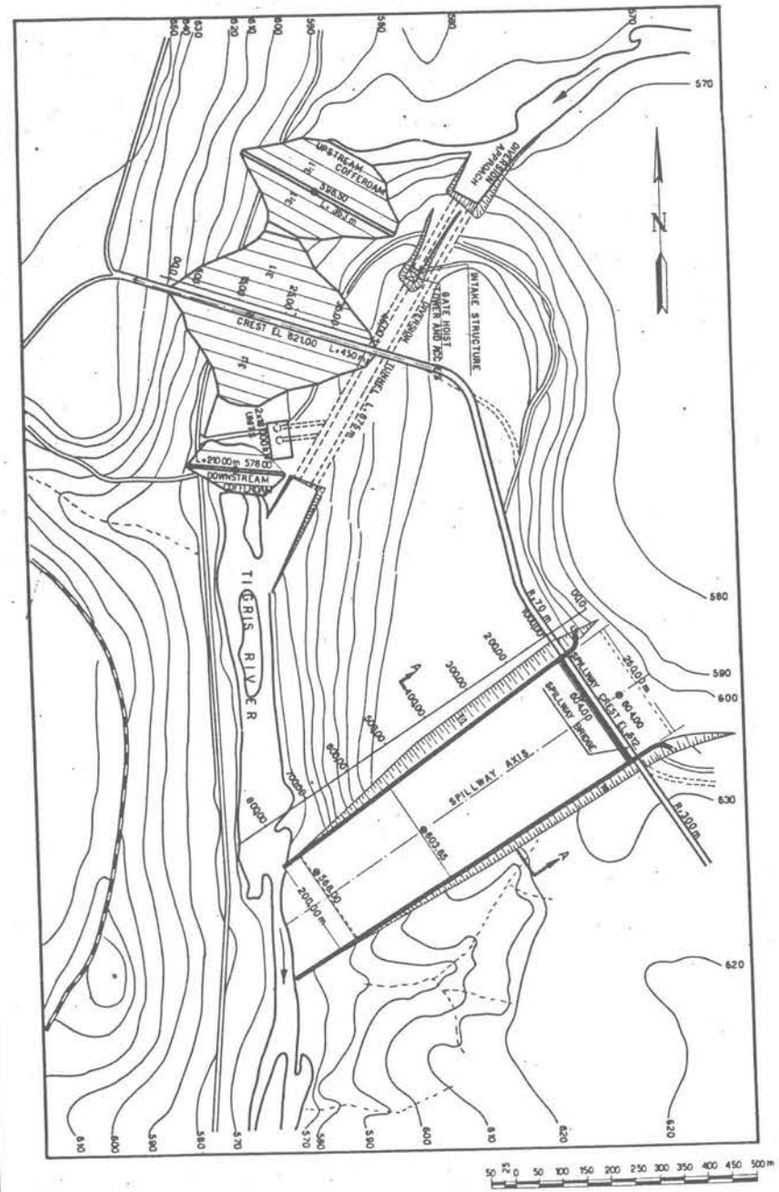
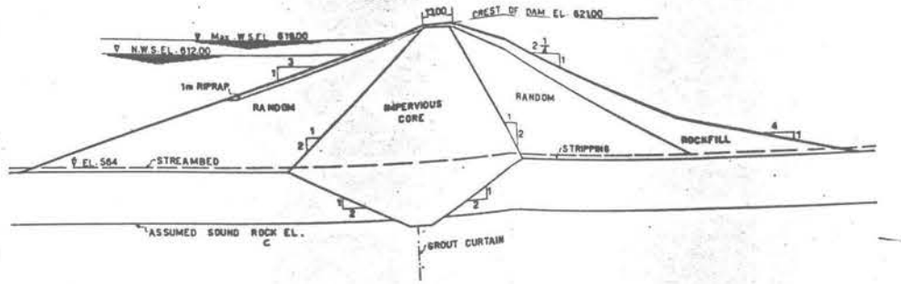
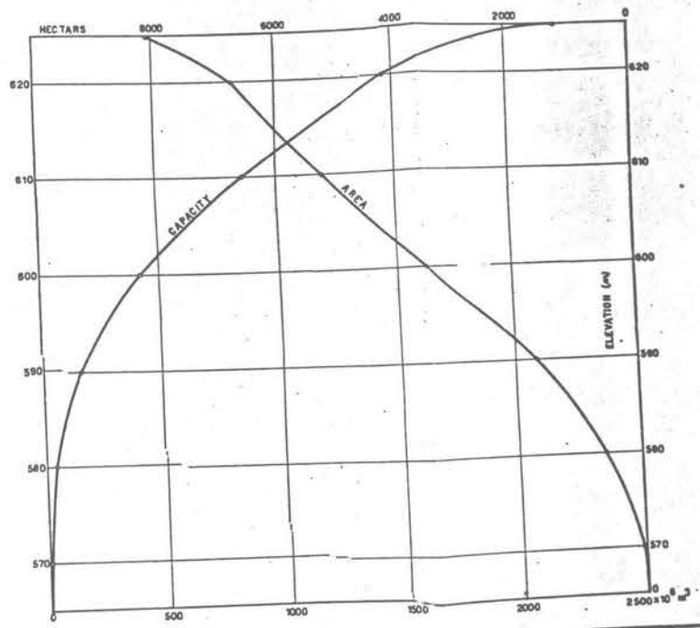
TRACED: H. BÜRBAN	RECOMMENDED: [signature]
CHECKED: [signature]	APPROVED: [signature]

FEB_1958	SCALE	4137	VIII-15	PLATE: 18



MAX. CROSS SECTION THROUGH DAM

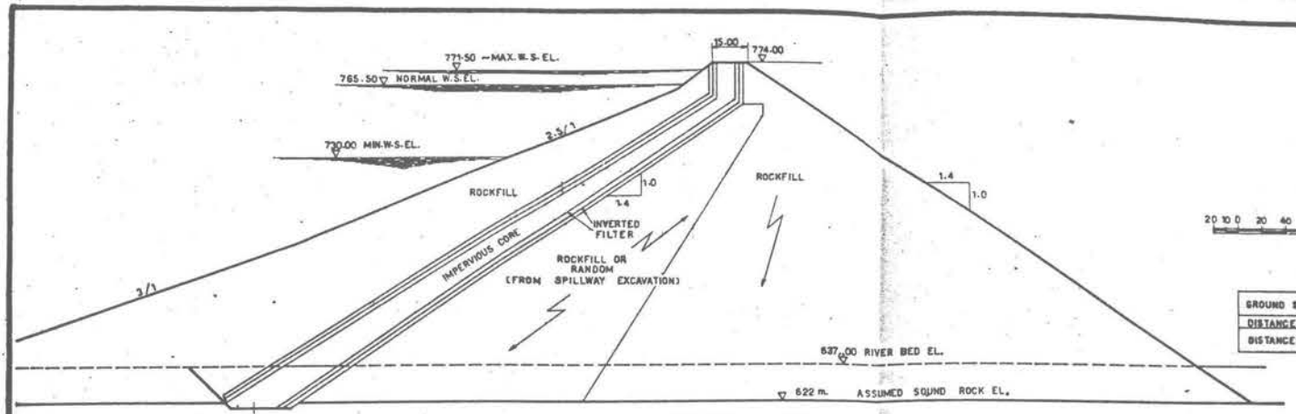




RESERVOIR AREA CAPACITY CURVES

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN
TIGRIS RIVER-DIYARBAKIR PROJECT
GENERAL LAYOUT

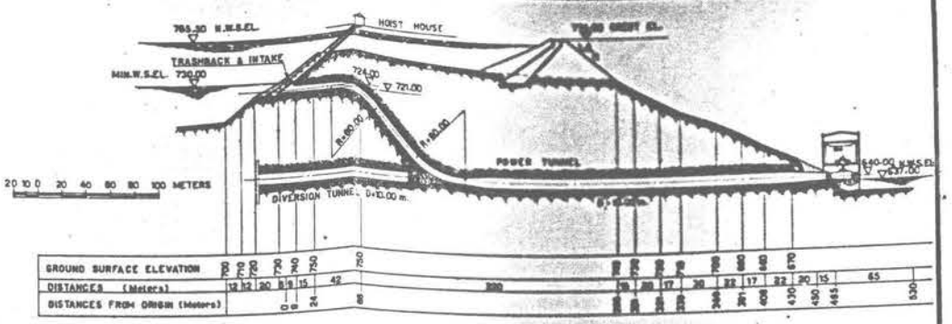
DRAWN : e.ş.		SUBMITTED :	
TRACED : H.A.U. AN...		RECOMMENDED :	
CHECKED :		APPROVED :	
FEB_1958	SCALE	4136/VIII-1	PLATE: 17

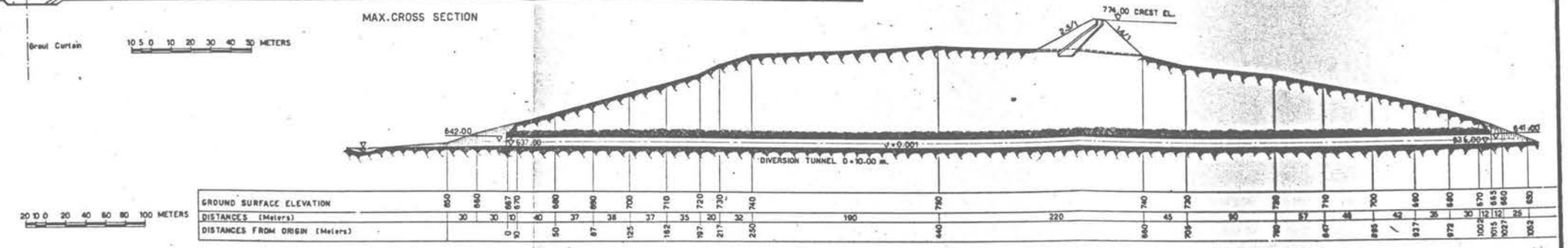


MAX. CROSS SECTION

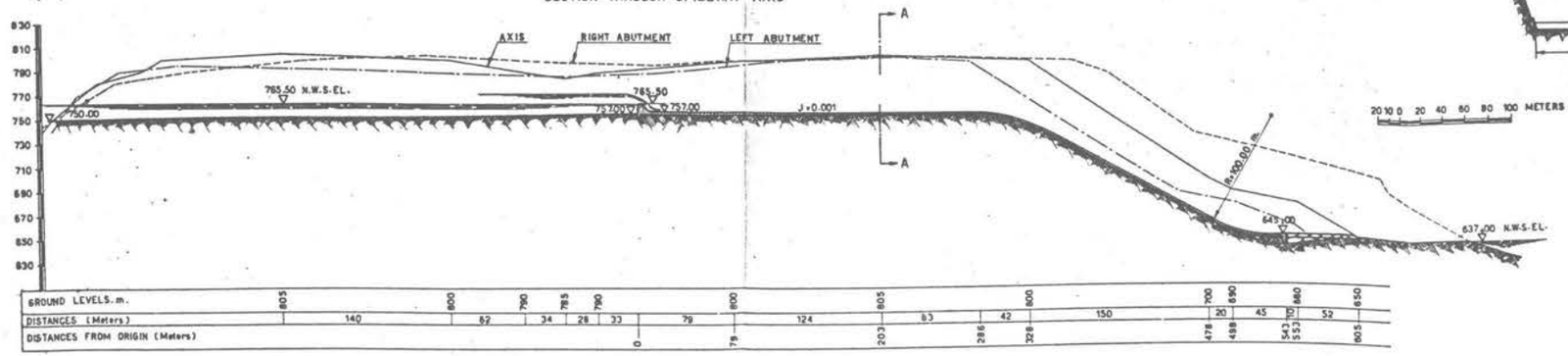
Grout Curtain

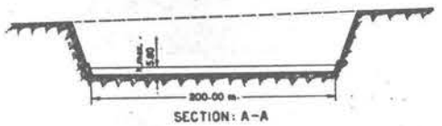
10 5 0 10 20 30 40 50 METERS





SECTION THROUGH SPILLWAY AXIS





SECTION: A-A

20 10 0 20 40 60 80 100 METERS

ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

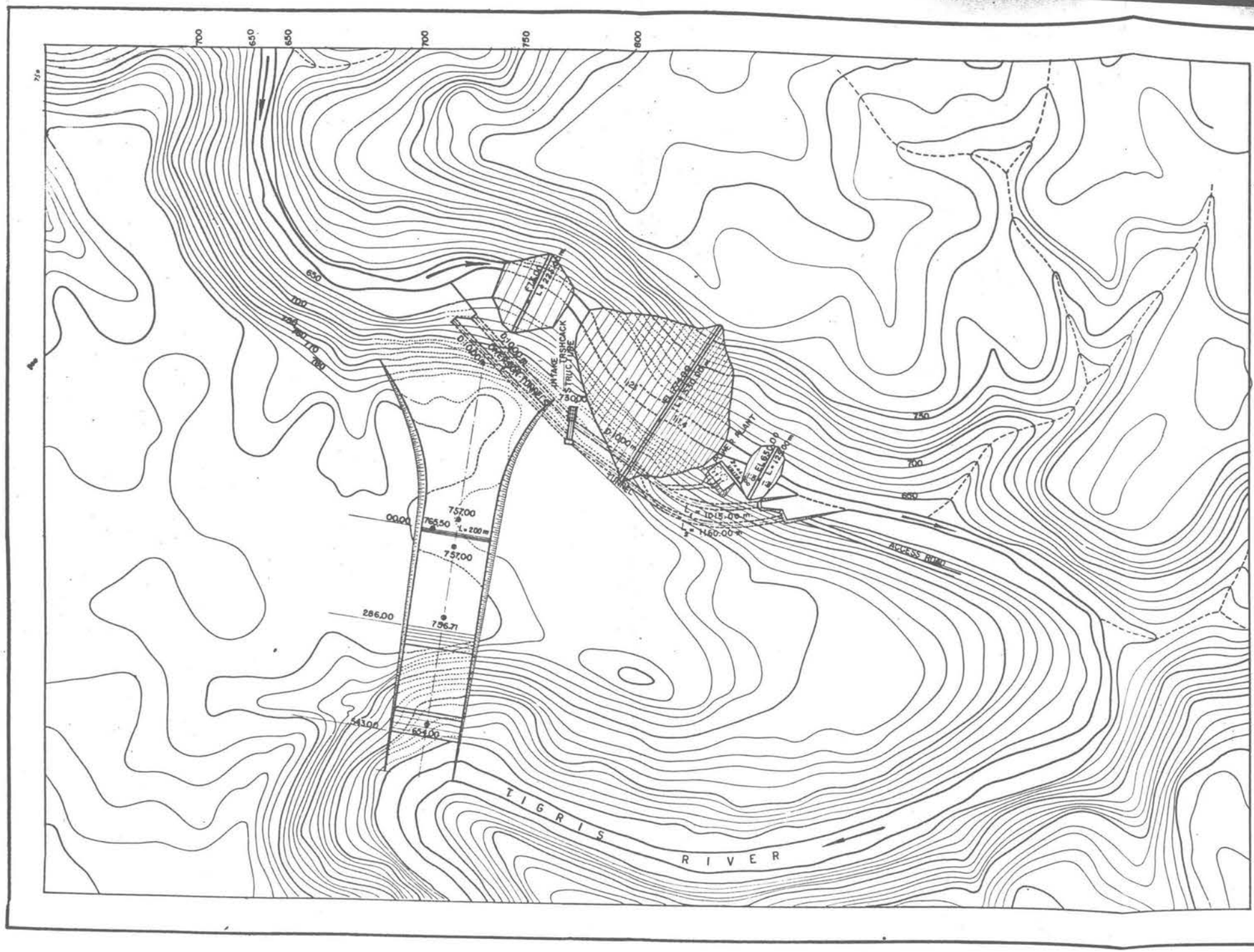
TIGRIS RIVER-SELMAN PROJECT SECTIONS

DRAWN: ..... SUBMITTED: .....

TRACED: N.K. ..... RECOMMENDED: .....

CHECKED: ..... APPROVED: .....

FEB.-1958	SCALE	4135	VIII-15	PLATE 16

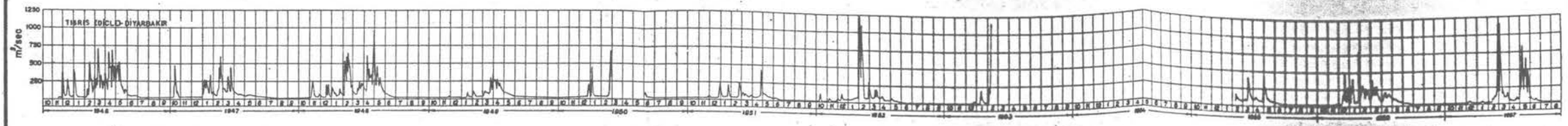


ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

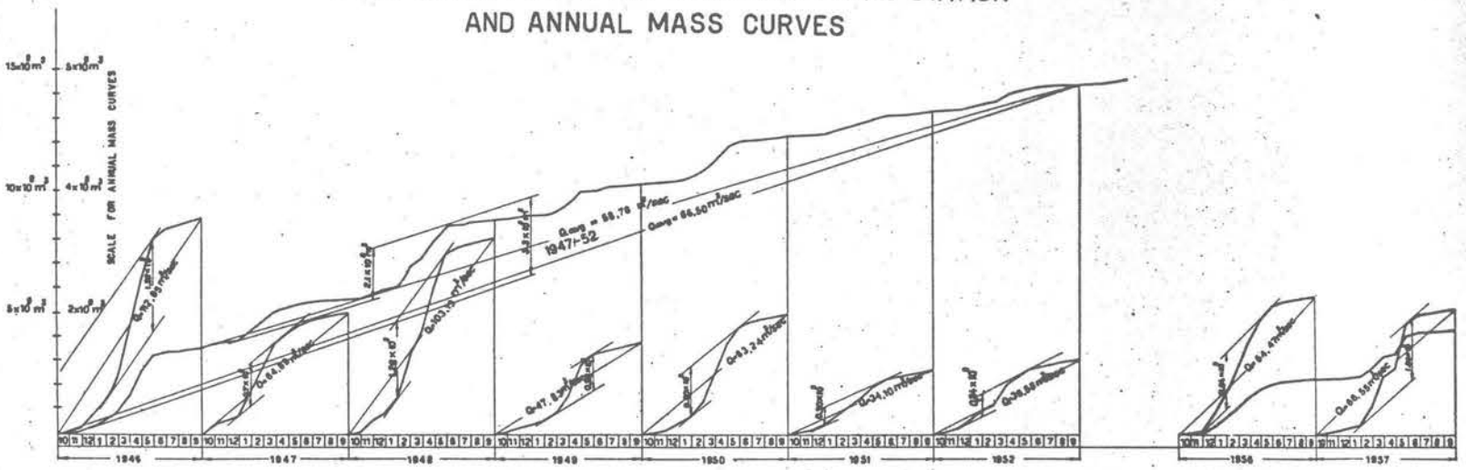
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

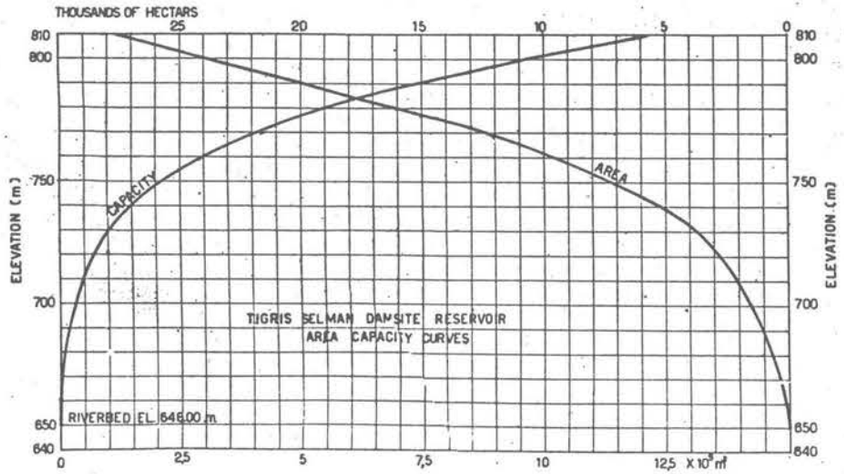
TIGRIS RIVER-SELMAN PROJECT GENERAL LAYOUT

DRAWN:	SUBMITTED:		
TRACED: T. BÜROCAK	RECOMMENDED:		
CHECKED:	APPROVED:		
FEB. 1958	SCALE	4134	VIII-15 PLATE: 15



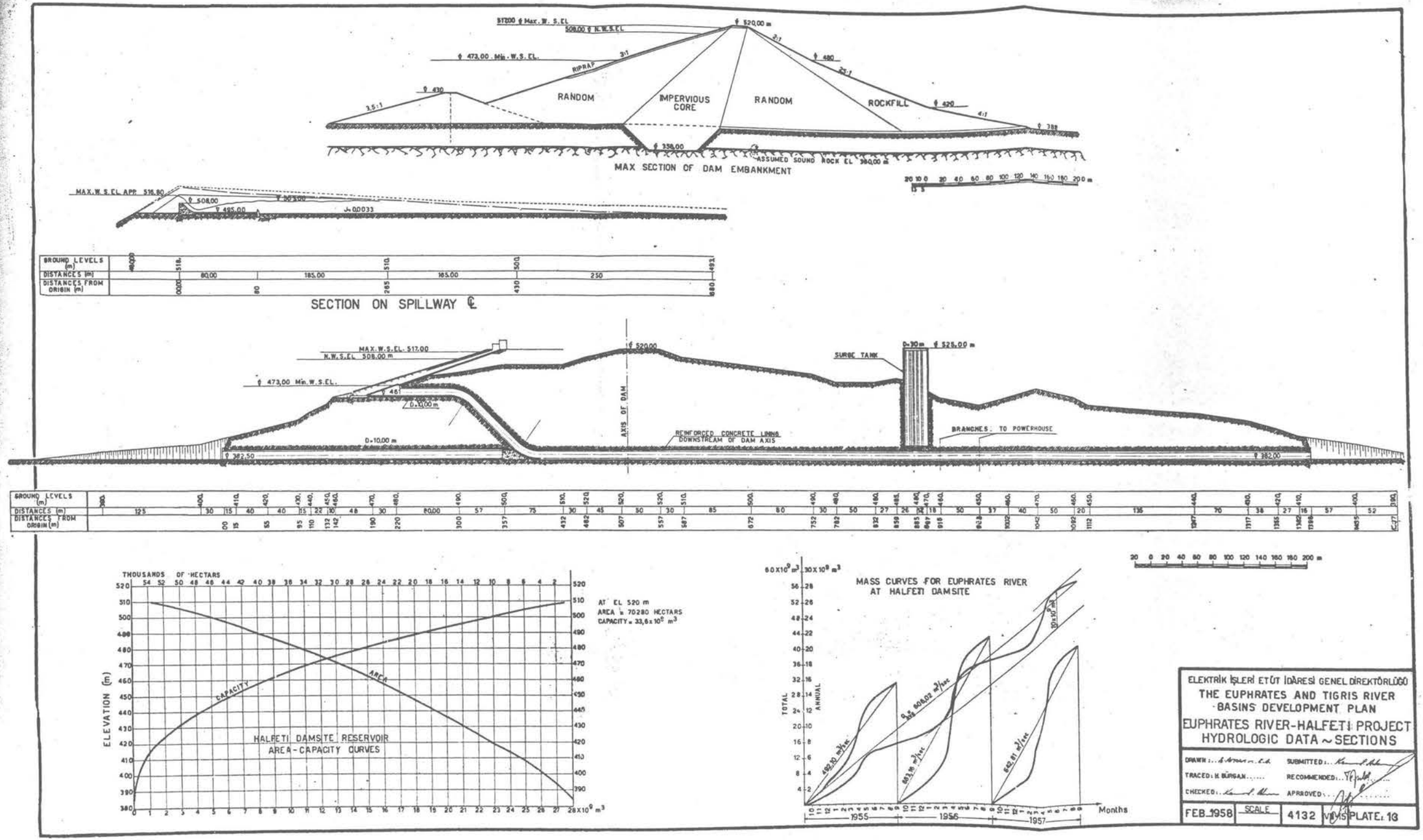
MASS CURVE FOR TIGRIS - DIYARBAKIR GAGİNG STATİON AND ANNUAL MASS CURVES





ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN
TIGRIS RIVER-SELMAN PROJECT
HYDROLOGIC DATA

DRAWN :		SUBMITTED :	
TRACED : M.Y.OLSEVER		RECOMMENDED :	
CHECKED :		APPROVED :	
FEB.-1958	SCALE	4133	PLATE: 14



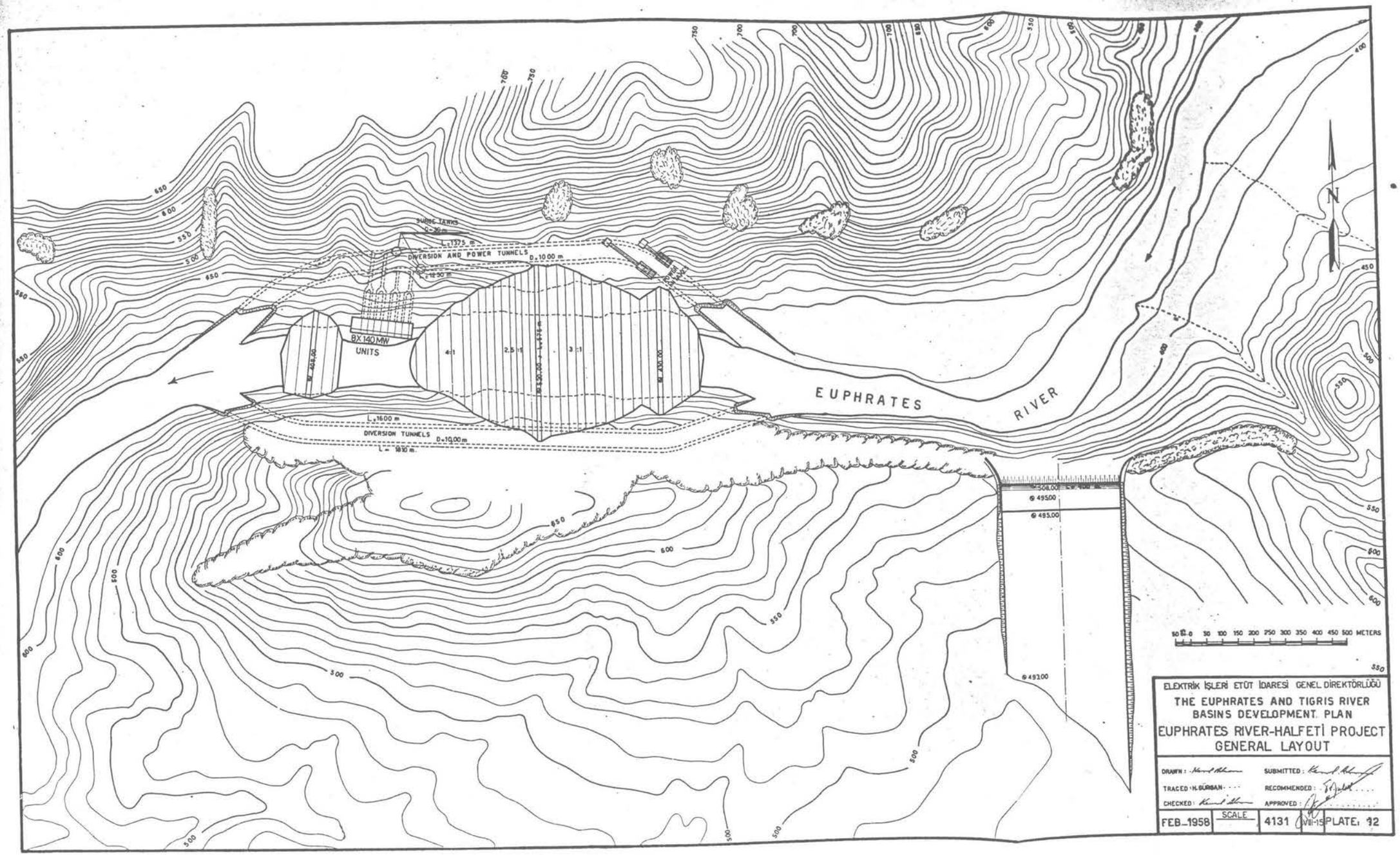
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

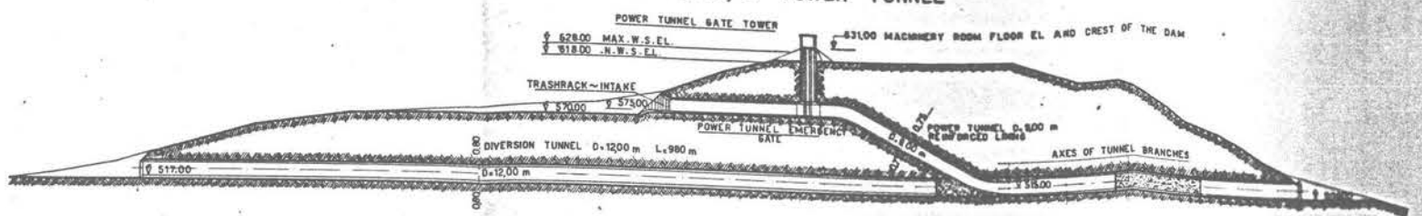
EUPHRATES RIVER-HALFETİ PROJECT HYDROLOGIC DATA ~ SECTIONS

DRAWN : S. Arman ... E.A.
TRACED : H. BÜRGAN .....
CHECKED : ... A. Alkan
SUBMITTED : ...
RECOMMENDED : ...
APPROVED : ...

FEB. 1958 | SCALE | 4132 | VMS | PLATE: 13

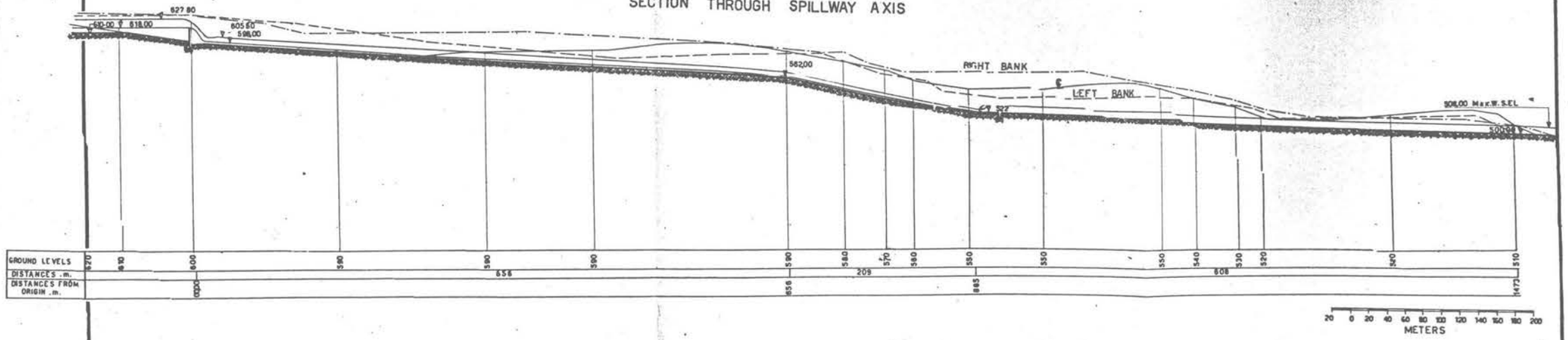

SURGE TANKS
D=30 m
L=1375 m
DIVERSION AND POWER TUNNELS D=10.00 m
H=30 m
POWER HOUSE
8X140 MW
UNITS
4:1
2.5:1
3:1
EUPHRATES
RIVER
L=1600 m
DIVERSION TUNNELS D=10.00 m
L=880 m.
@ 504.00
@ 495.00
@ 485.00
@ 492.00
N
0 30 100 150 200 250 300 350 400 450 500 METERS
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ
THE EUPHRATES AND TIGRIS RIVER
BASINS DEVELOPMENT PLAN
EUPHRATES RIVER-HALFETİ PROJECT
GENERAL LAYOUT
DRAWN:
TRACED: H.BURSAN
CHECKED:
SUBMITTED:
RECOMMENDED:
APPROVED:
FEB-1958
SCALE
4131
VII-15
PLATE: 12

PROFILE ON ℄ DIVERSION, ℄ POWER TUNNEL

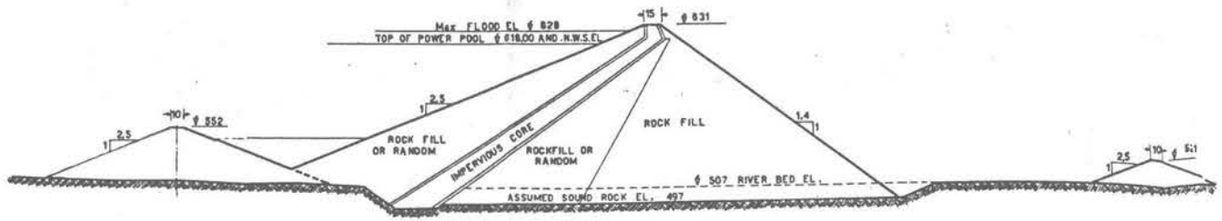


GROUND LEVELS	520	530	540	550	560	570	580	590	600	610	620	630	610	600	600	590	580	570	560	550	540	530	520	510
DISTANCES m	35	57	38	40	30	82	204	52	32	34	34	200	28	30	34	26	22	74	30	21	14	20	34	38
DISTANCES FROM ORIGIN m	00	35	92	128	168	198	280	484	536	568	602	636	636	664	694	728	754	828	858	879	893	913	947	985

SECTION THROUGH SPILLWAY AXIS



GROUND LEVELS	620	610	600	590	580	590	590	580	570	560	550	550	550	540	530	520	560	510
DISTANCES .m.				856				209						608				
DISTANCES FROM ORIGIN .m.			000				856				885							1473



MAXIMUM SECTION

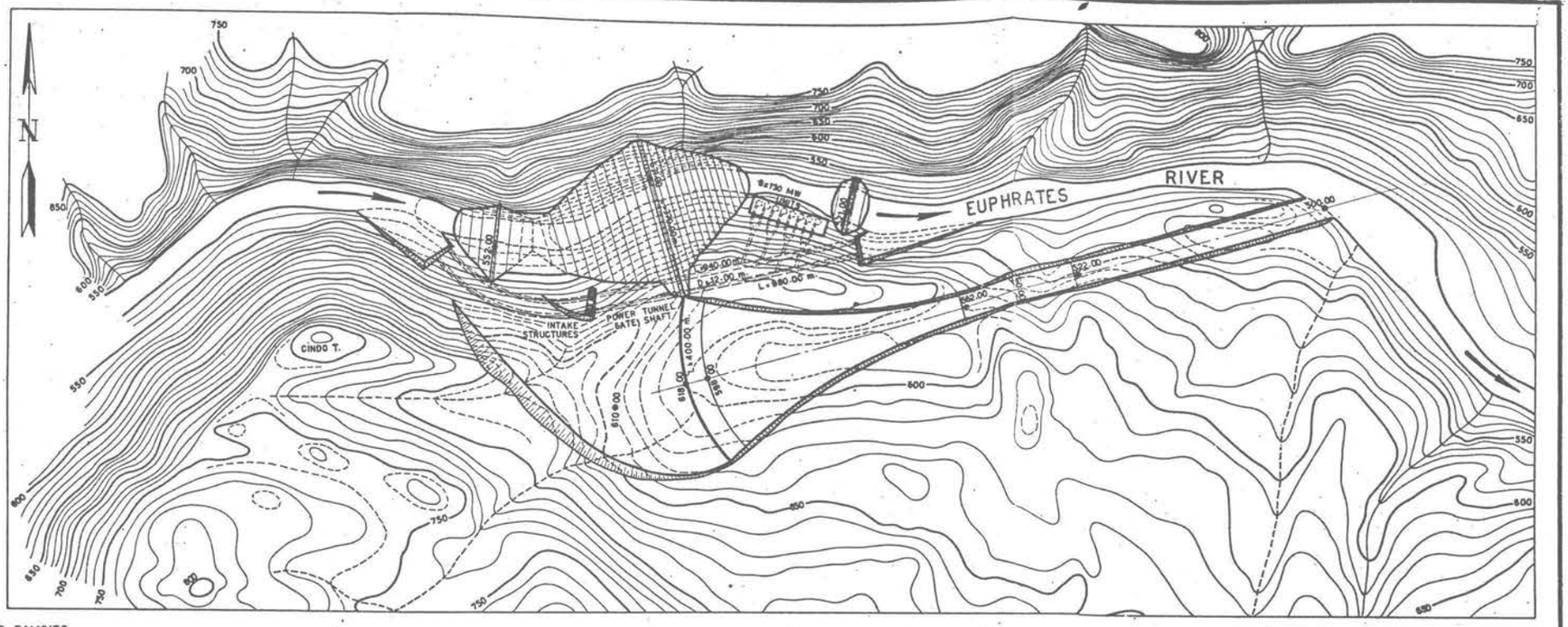
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

EUPHRATES RIVER-SARSAP PROJECT

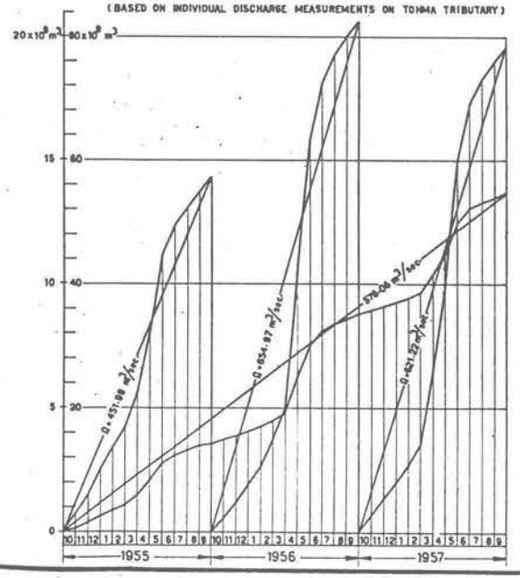
SECTIONS

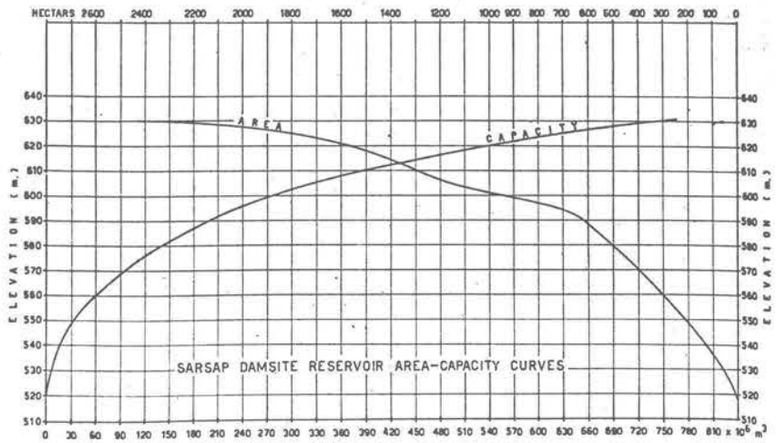
DRAWN: Y. Tanrıkut	SUBMITTED:		
TRACED: H. BÜRBAN.	RECOMMENDED:		
CHECKED:	APPROVED:		
FEB_1958	SCALE	4130	VIII-15 PLATE. 11



ASSUMED MASS CURVES AT SARSAP DAMSITE

(BASED ON INDIVIDUAL DISCHARGE MEASUREMENTS ON TOHMA TRIBUTARY)





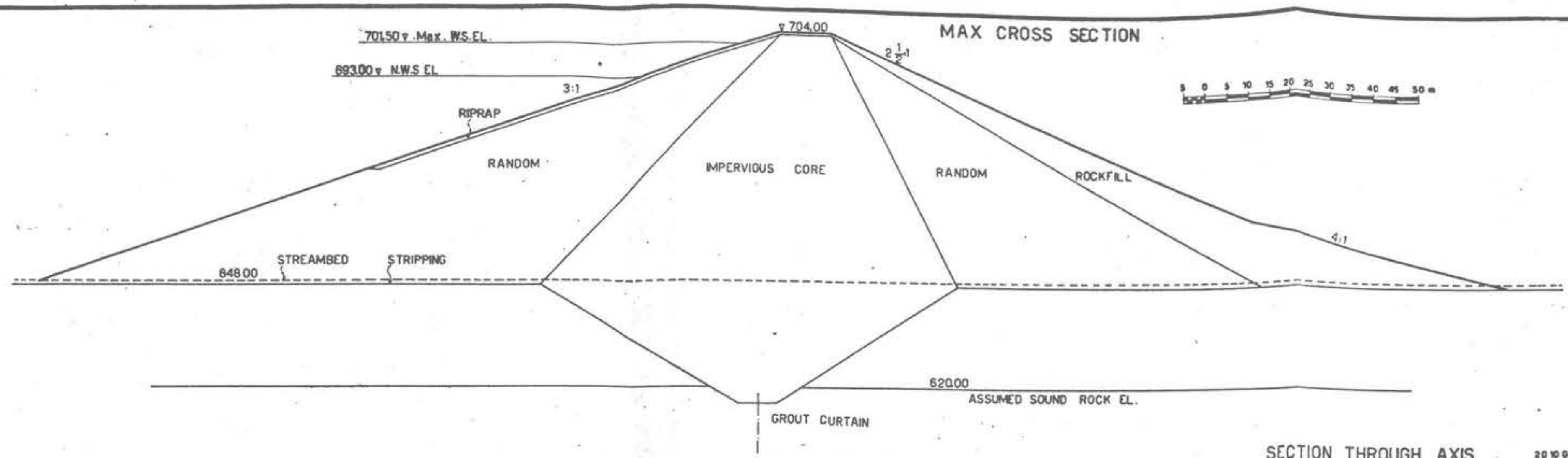
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

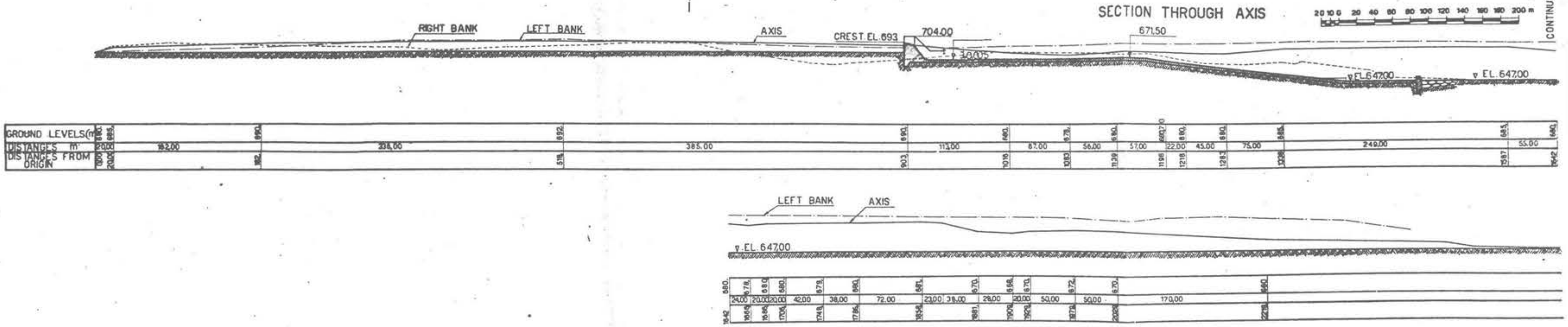
EUPHRATES RIVER-SARSAP PROJECT GENERAL LAYOUT

DRAWN: A. Bamdat	SUBMITTED:		
TRACED: N.K.	RECOMMENDED		
CHECKED:	APPROVED		
FEB. 1958	SCALE	4129	VII-15 PLATE 10

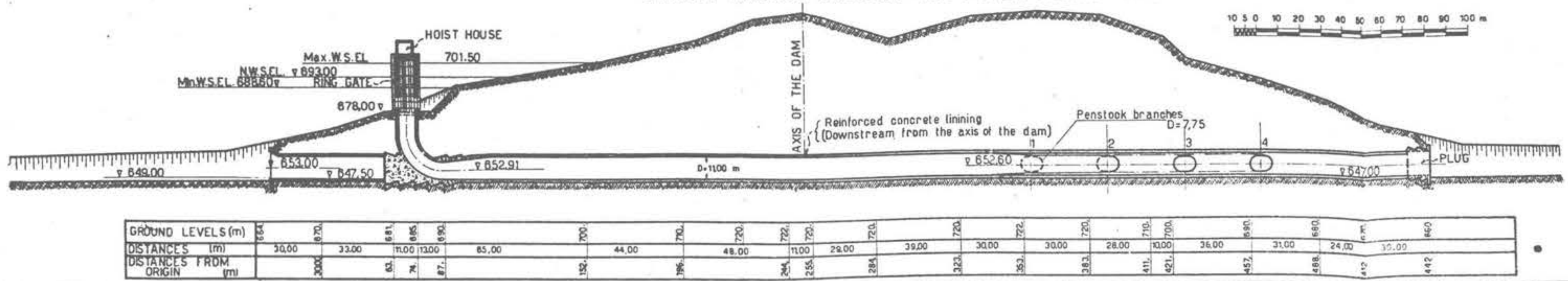
MAX CROSS SECTION



SECTION THROUGH AXIS



SECTION THROUGH DIVERSION AND POWER TUNNEL No: 1



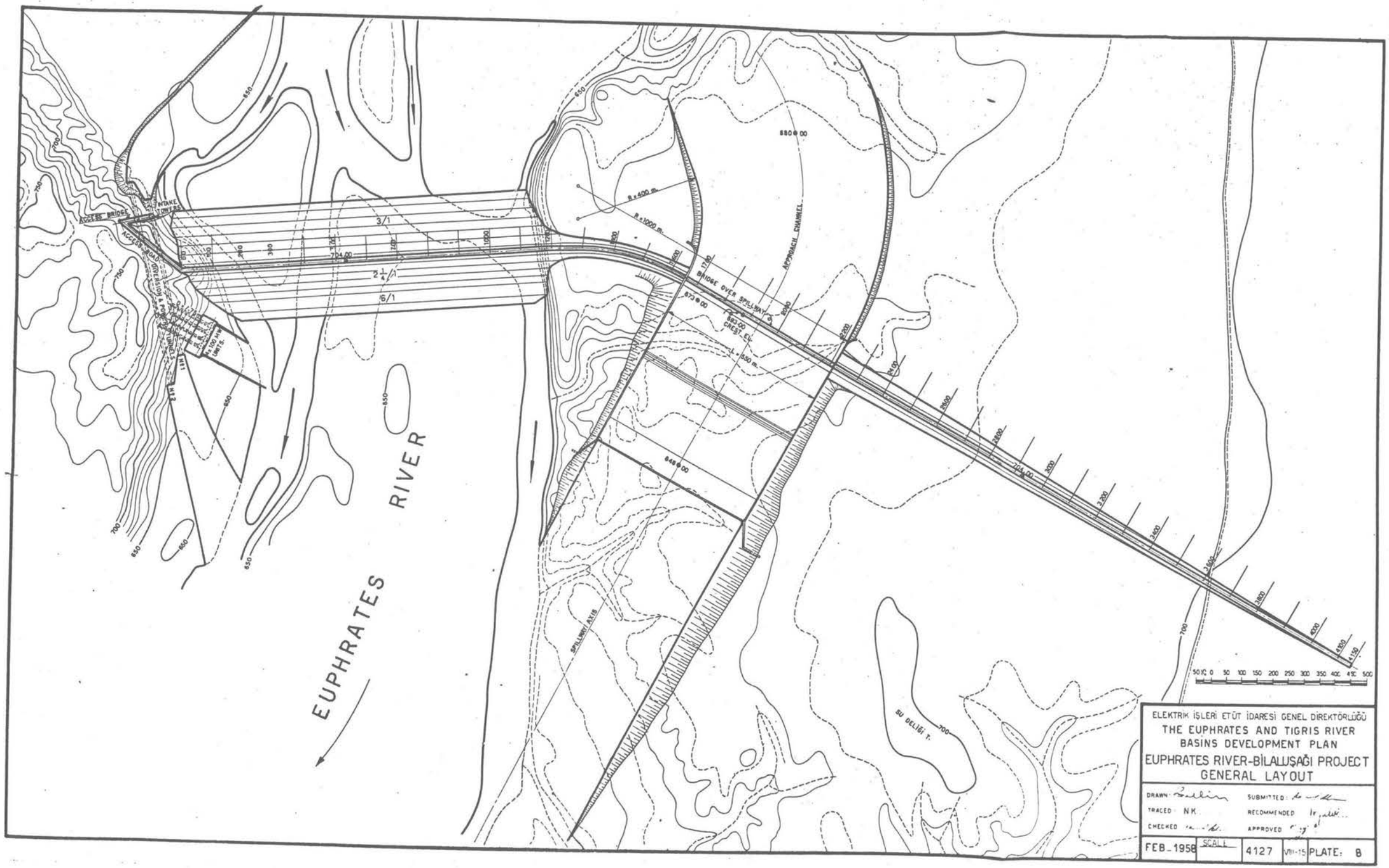
ELEKTRIK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

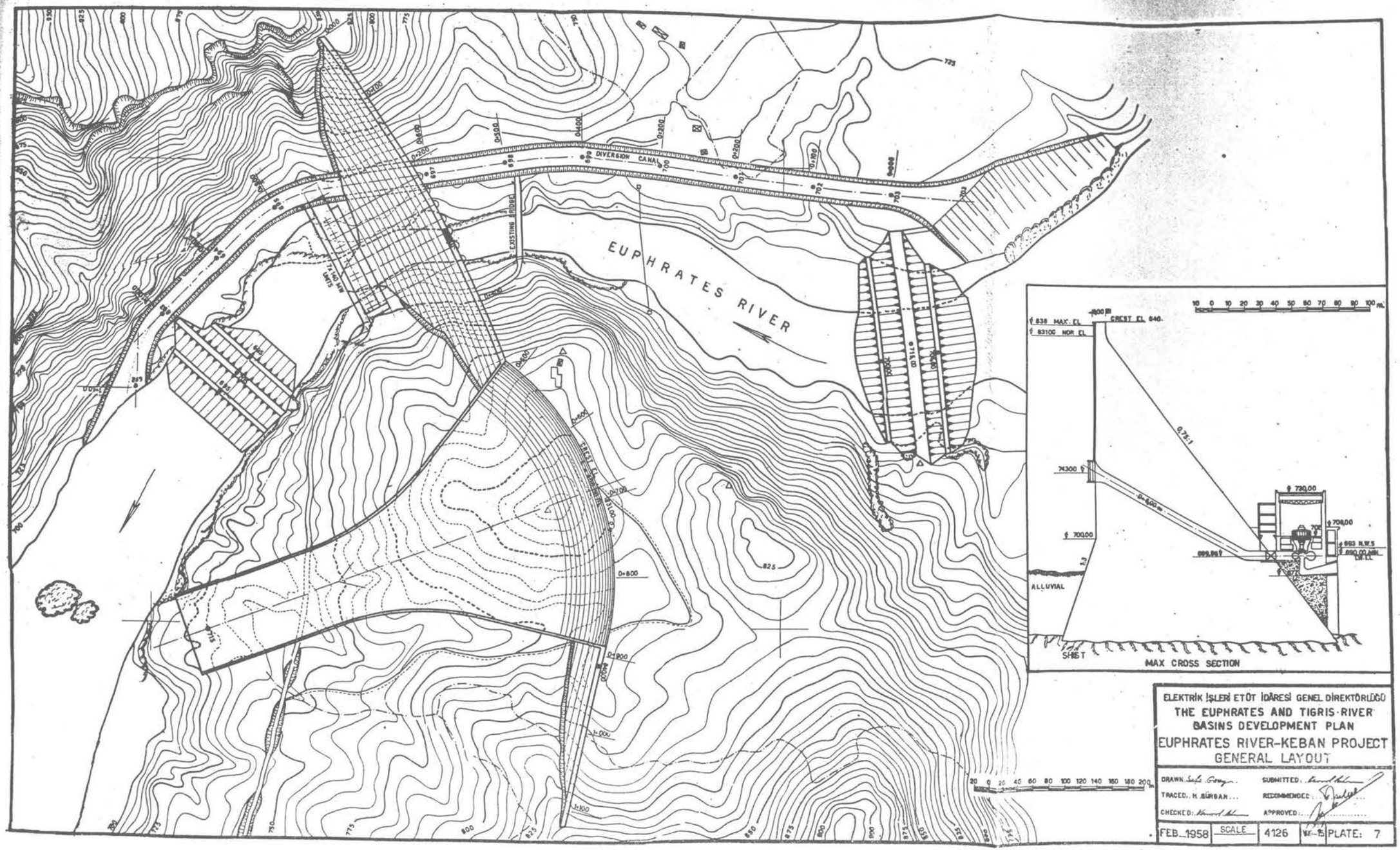
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

EUPHRATES RIVER-BİLALUŞAĞI PROJECT SECTIONS

DRAWN:	SUBMITTED:
TRACED: H. GÜRBAK	RECOMMENDED:
CHECKED:	APPROVED:

FEB_1958	SCALE	4128	PLATE: 9


EUPHRATES RIVER
EUPHRATES
ACCESS BRIDGE
INTAKE TOWERS
ACCESS ROAD TO INTAKE & POWERHOUSE
3/1
2 1/4/1
6/1
BRIDGE OVER SPILLWAY
APPROACH CHANNEL
SPILLWAY AXIS
SU DELİĞİ T.
R=400 m.
R=1000 m.
880.00
873.00
848.00
CREST EL.
704.00
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN
EUPHRATES RIVER-BİLALUŞAĞI PROJECT
GENERAL LAYOUT
DRAWN
TRACED N.K.
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
FEB-1958
SCALE
4127
VIII-15
PLATE: 8



ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

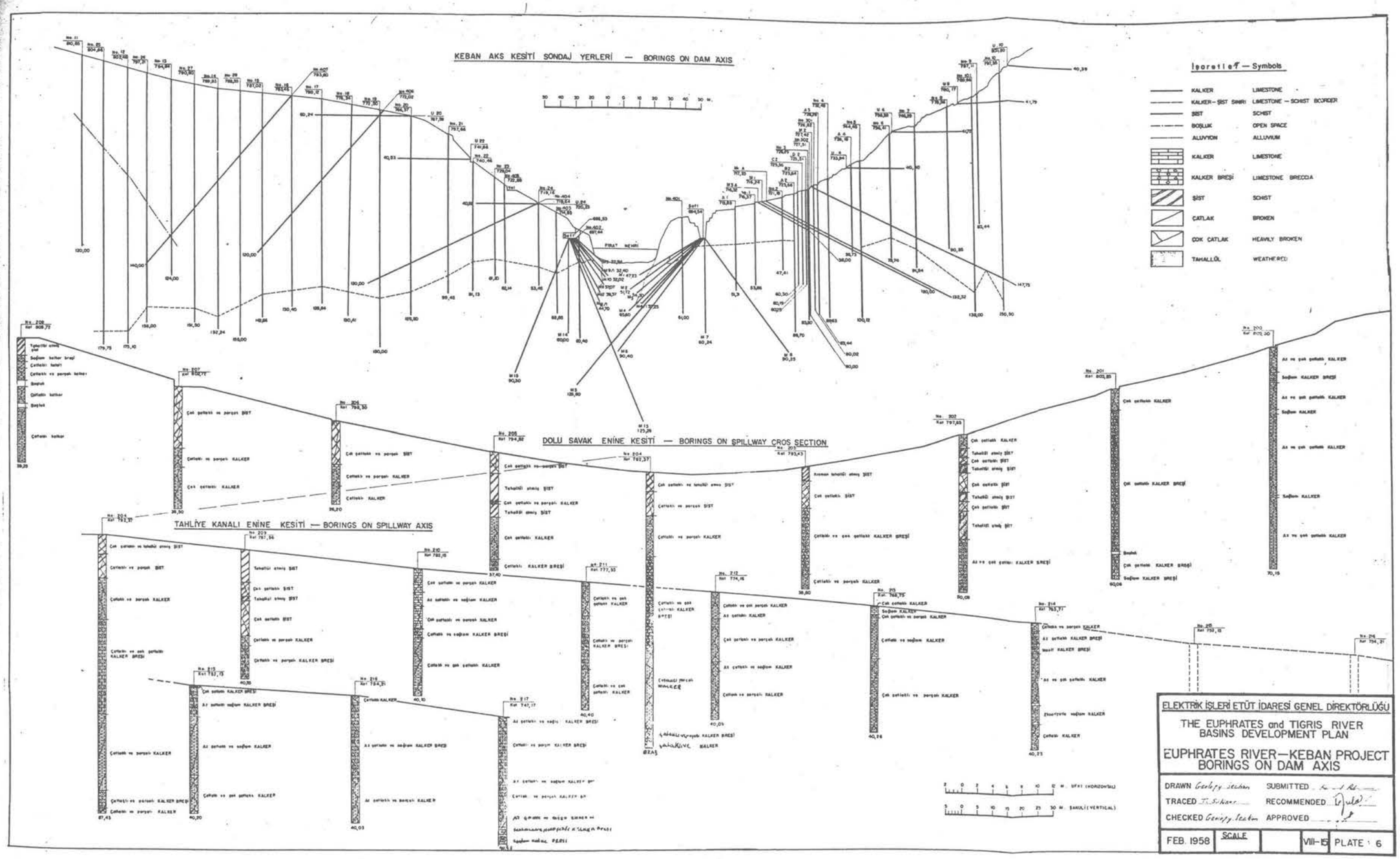
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

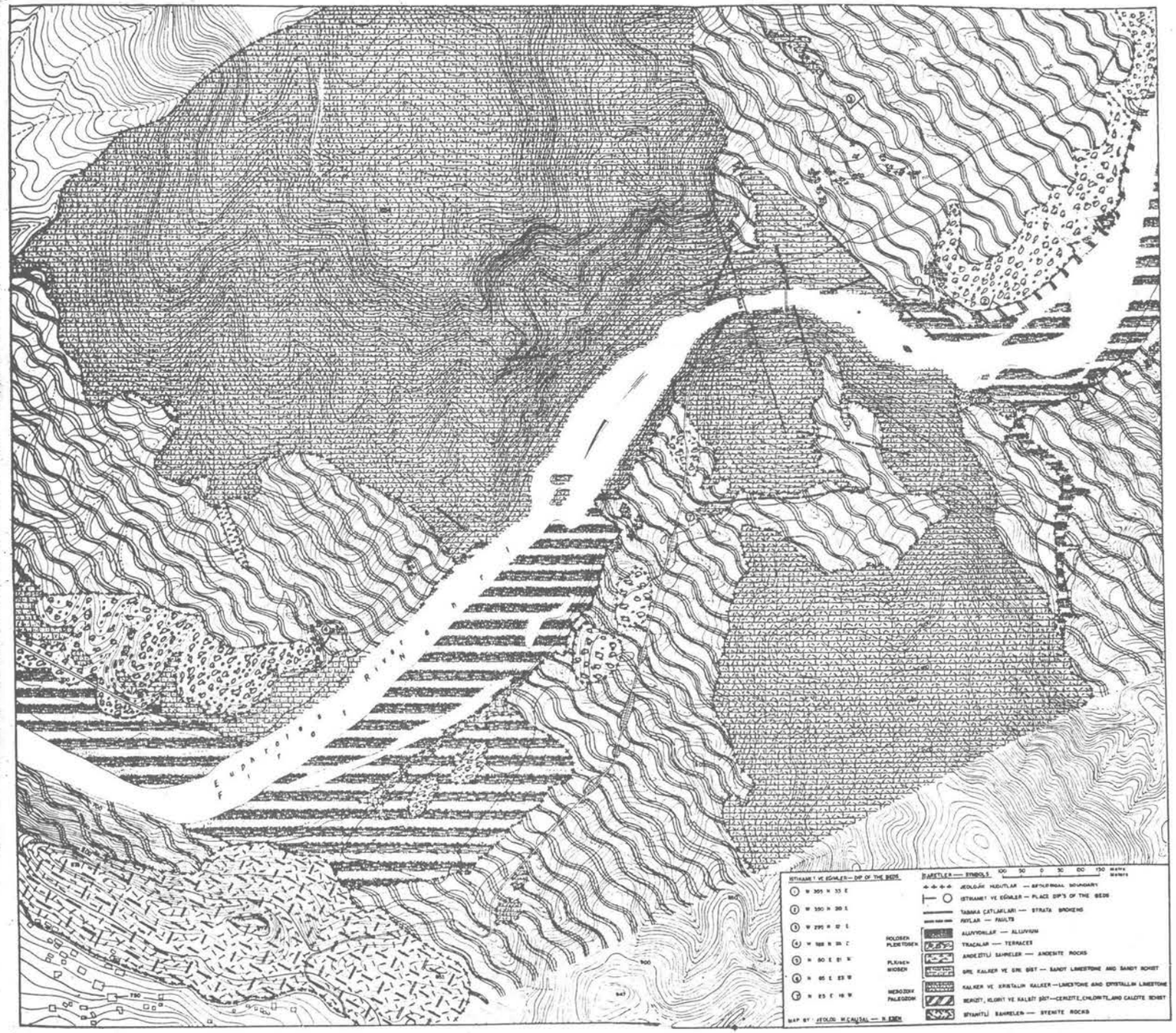
EUPHRATES RIVER-KEBAN PROJECT

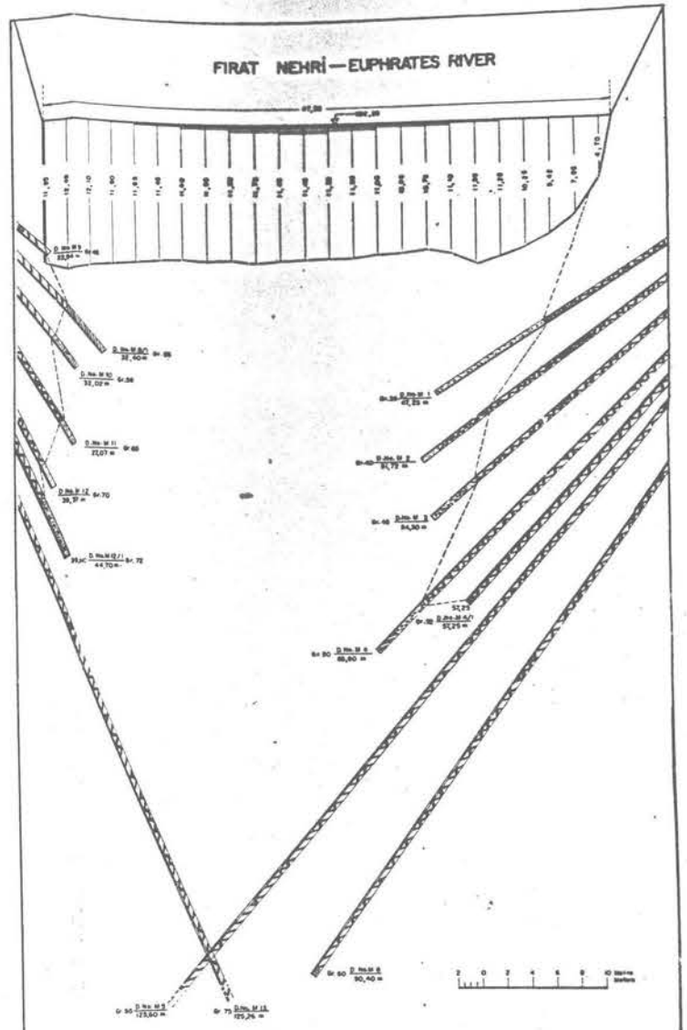
GENERAL LAYOUT

DRAWN: Sayfa Groups	SUBMITTED:
TRACED: H. SÜRSAN	RECOMMENDED:
CHECKED:	APPROVED:

FEB. 1958	SCALE	4126	PLATE: 7







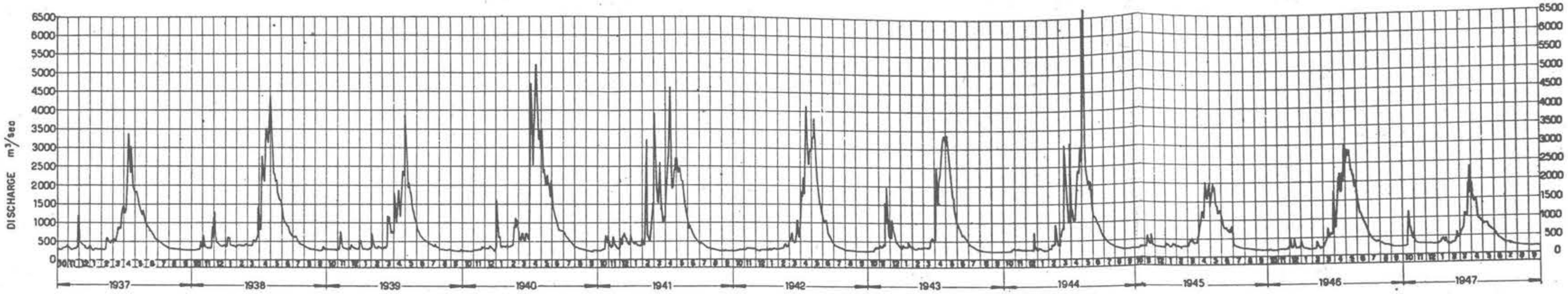
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

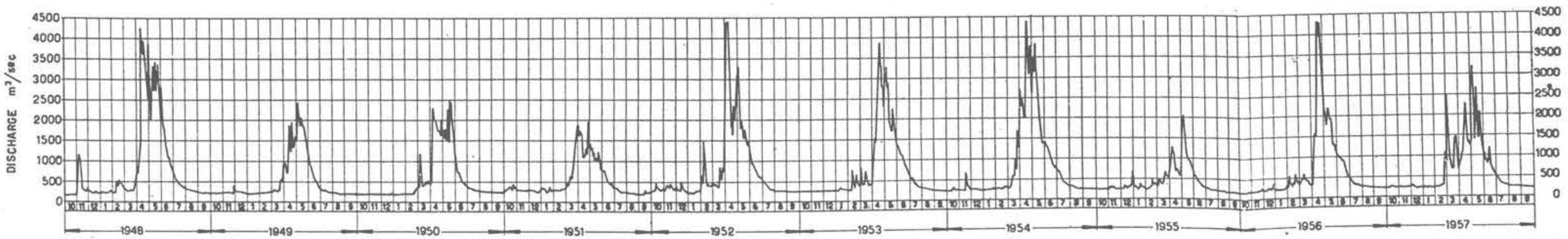
THE EUPHRATES and TIGRIS RIVER BASINS DEVELOPMENT PLAN

EUPHRATES RIVER-KEBAN PROJECT GEOLOGICAL MAP

DRAWN Geolog. Technician	SUBMITTED
TRACED T. Draftsman	RECOMMENDED
CHECKED Geolog. Engineer	APPROVED
FEB. 1958	SCALE

PLATE : 5





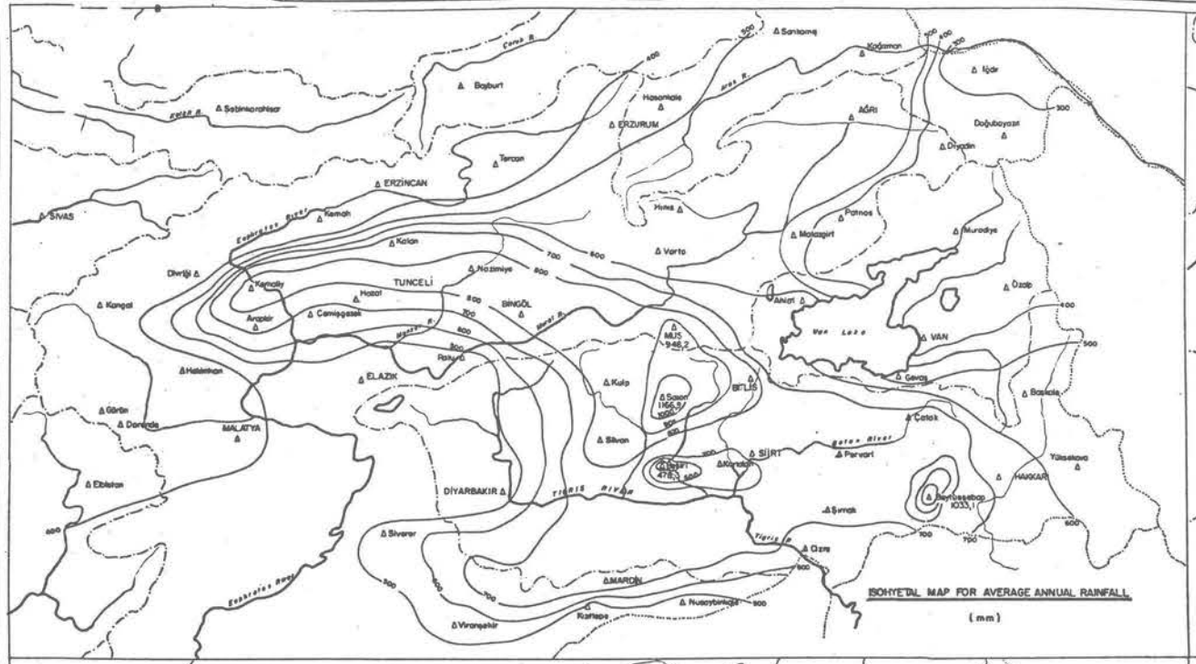
ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

EUPHRATES RIVER-KEBAN PROJECT HYDROGRAHS

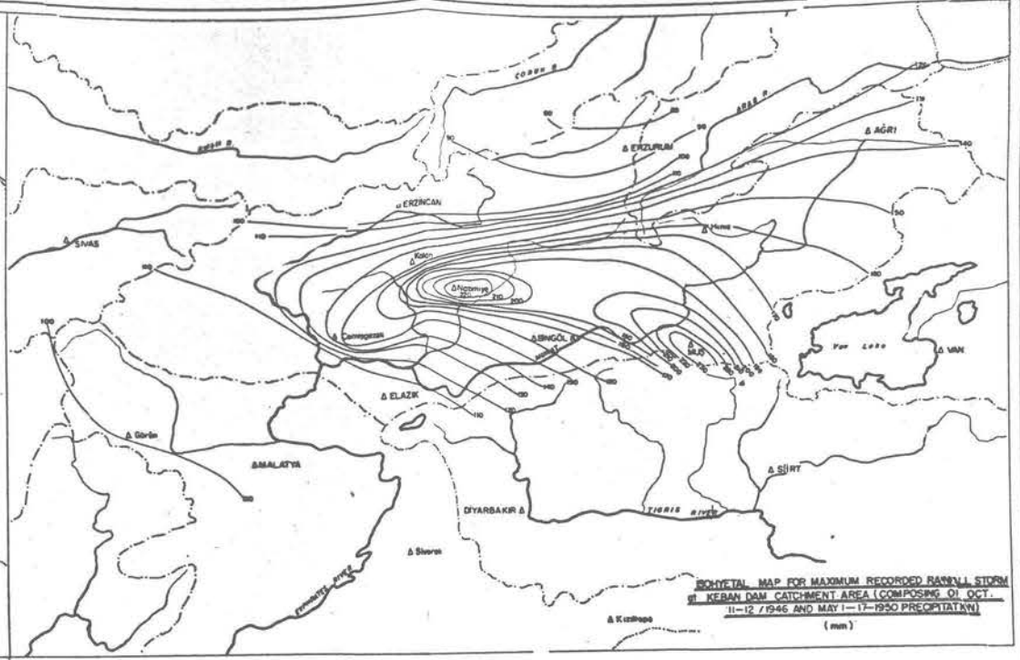
DRAWN.	SUBMITTED
TRACED H. GURGAN	RECOMMENDED
CHECKED	APPROVED

FEB_1958	SCALE		VIII-15	PLATE 4



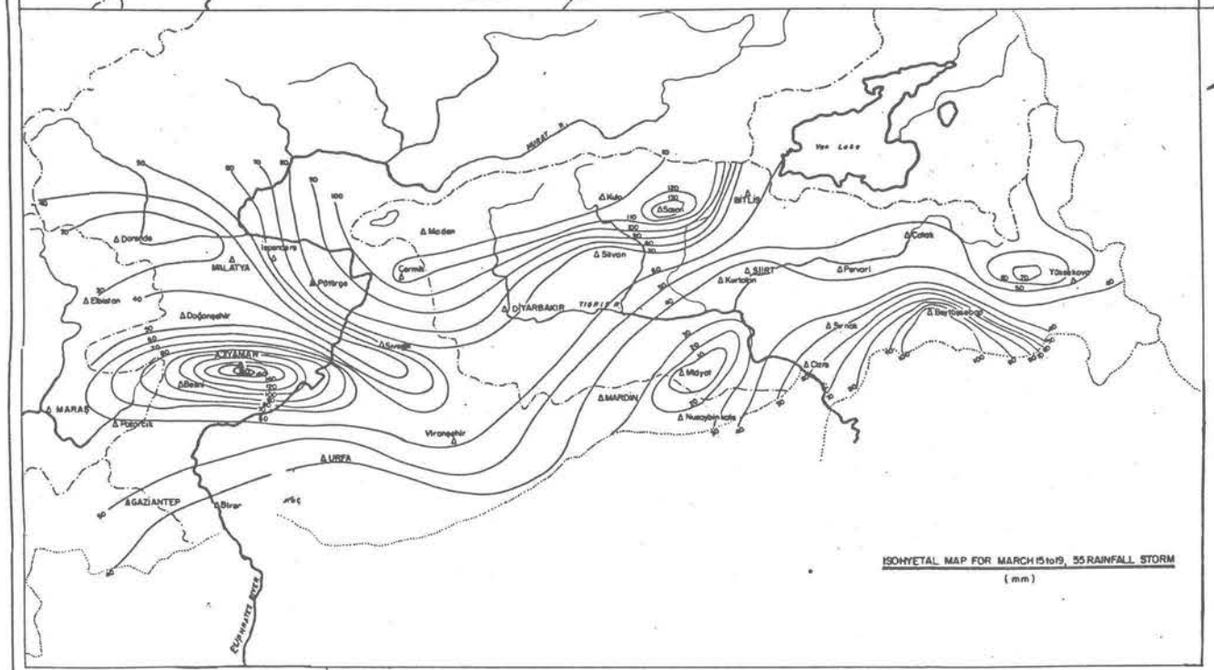
ISOHYETAL MAP FOR AVERAGE ANNUAL RAINFALL

(mm)



ISOHYETAL MAP FOR MAXIMUM RECORDED RAINFALL STORM
at KEBAN DAM CATCHMENT AREA (COMPOSING OF OCT.
11–12 / 1946 AND MAY 1–17–1950 PRECIPITATION)

(mm)



ISOHYETAL MAP FOR MARCH 15 to 19, 55 RAINFALL STORM

(mm)

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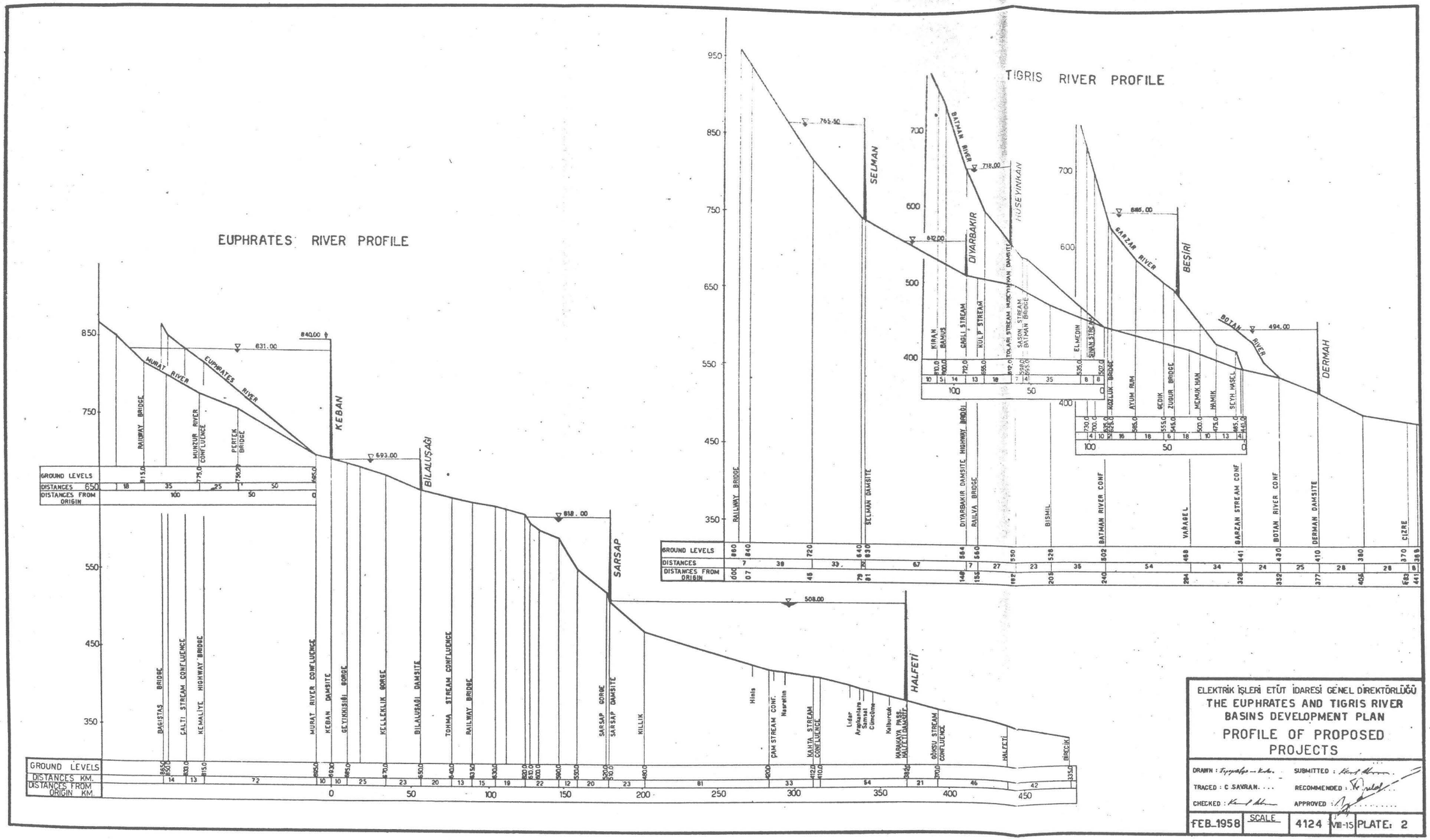
THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

ISOHYETALS

DRAWN : K.	SUBMITTED :
TRACED : T. SÜLÜNER	RECOMMENDED :
CHECKED :	APPROVED :

FEB–1958	SCALE	4125	PLATE : 3

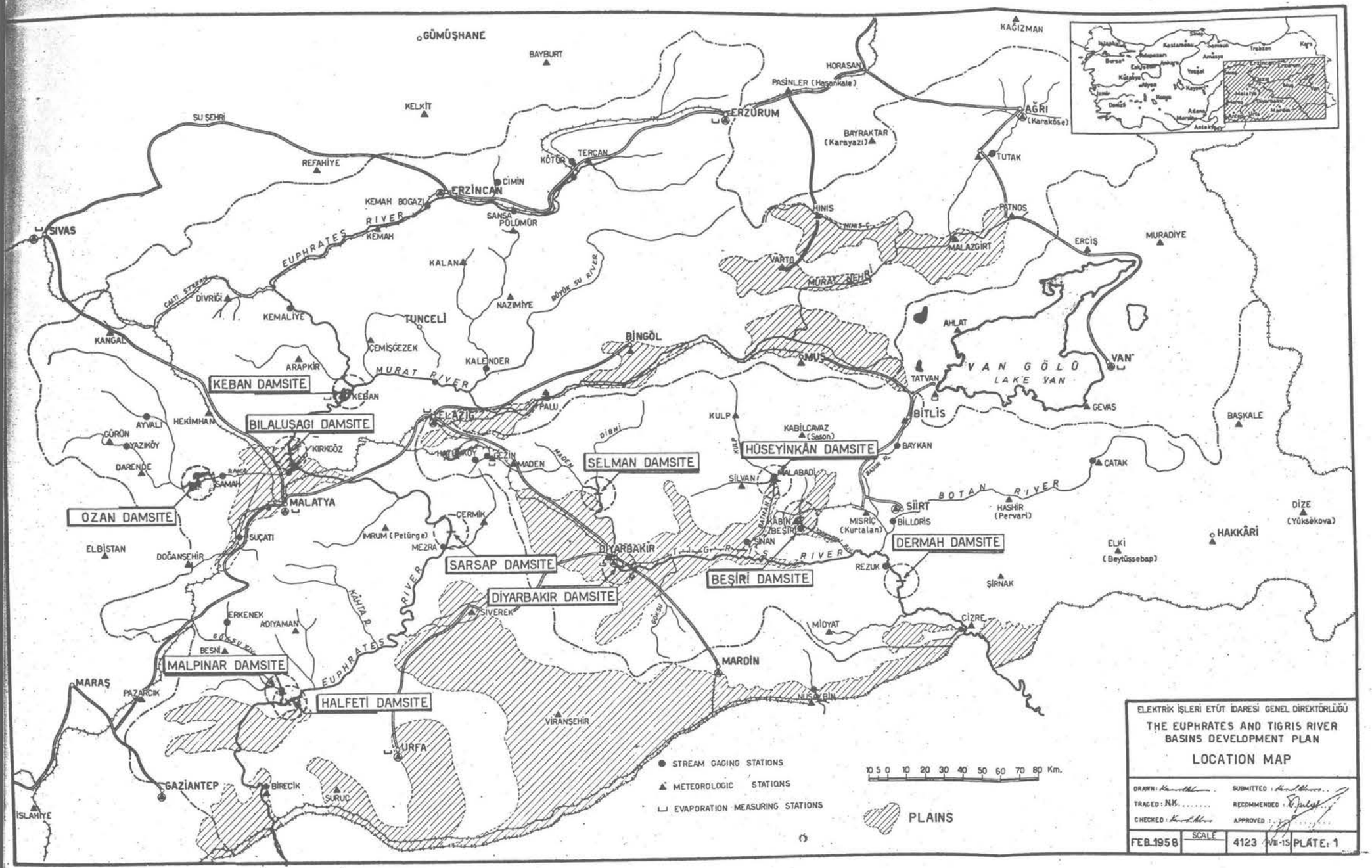


ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

PROFILE OF PROPOSED PROJECTS

DRAWN : Typografo — Kalk.	SUBMITTED :		
TRACED : C SAVRAN.	RECOMMENDED :		
CHECKED :	APPROVED :		
FEB_1958	SCALE	4124	VIII-15 PLATE: 2



ELEKTRİK İŞLERİ ETÜT İDARESİ GENEL DİREKTÖRLÜĞÜ

THE EUPHRATES AND TIGRIS RIVER BASINS DEVELOPMENT PLAN

LOCATION MAP

DRAWN:		SUBMITTED:	
TRACED: NK		RECOMMENDED:	
CHECKED:		APPROVED:	
FEB. 1958	SCALE	4123 / VII-15	PLATE: 1