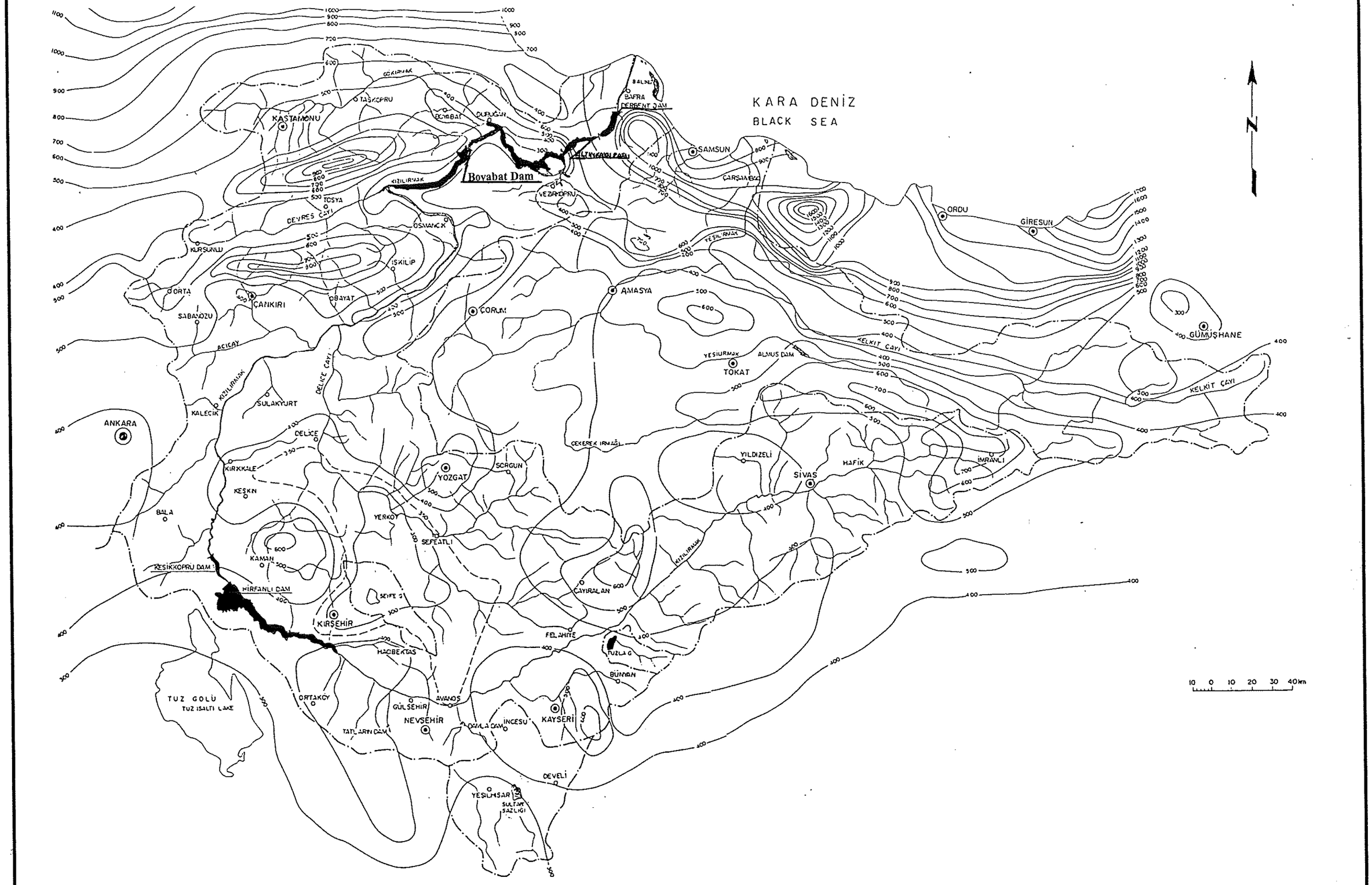


Figure V.14. Isohyetal Map of Mean Annual Precipitation of Kizilirmak Basin

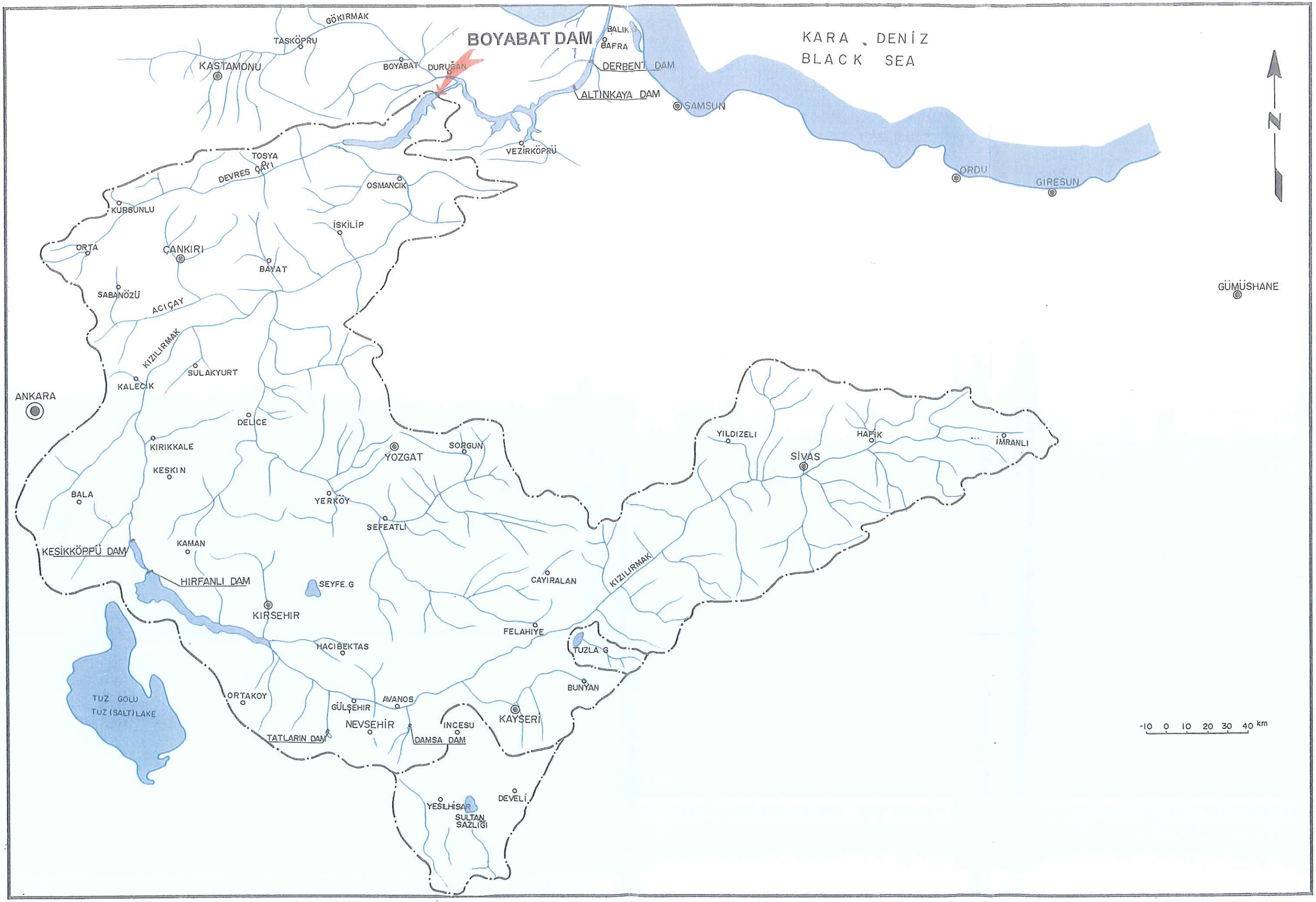


Figure V.15. Location of Proposed Boyabat Dam in the Kizilirmak Basin

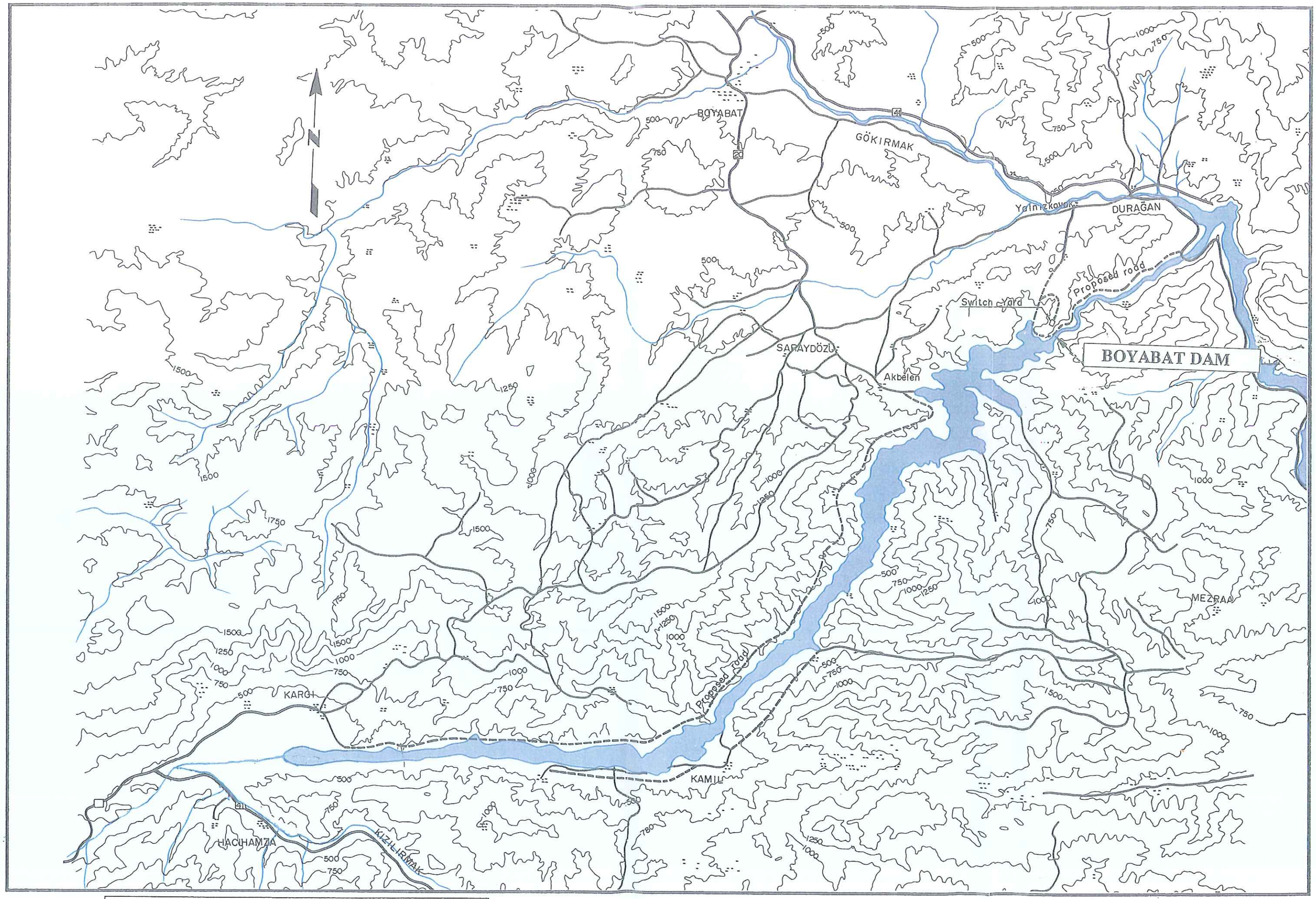


Figure V.16. Layout of the Boyabat Reservoir

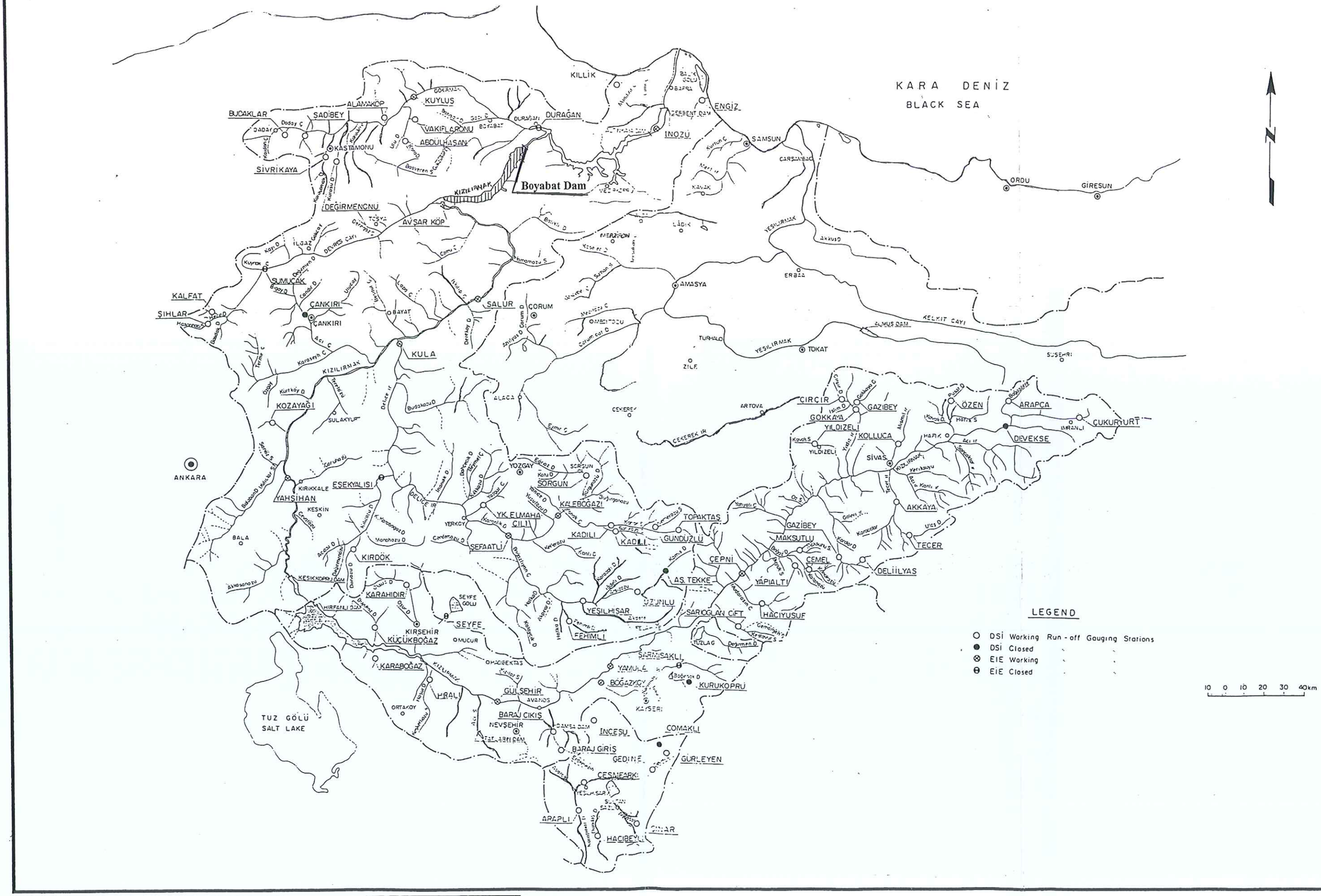


Figure V.17. Run-off Gauging Stations in the Kizilirmak River Basin

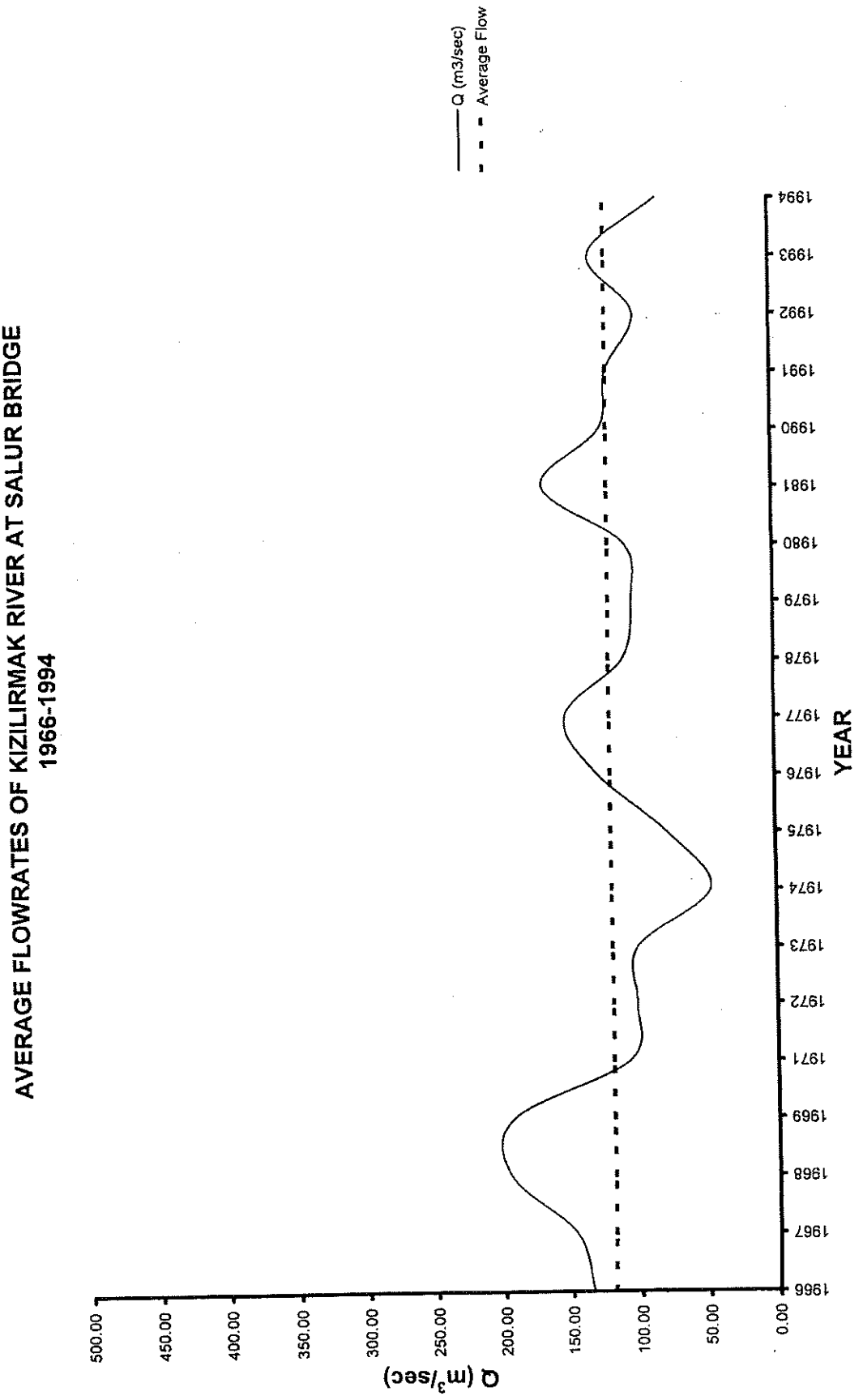


Figure V.18. Average Flowrates of Kizilirmak River at Salur Bridge

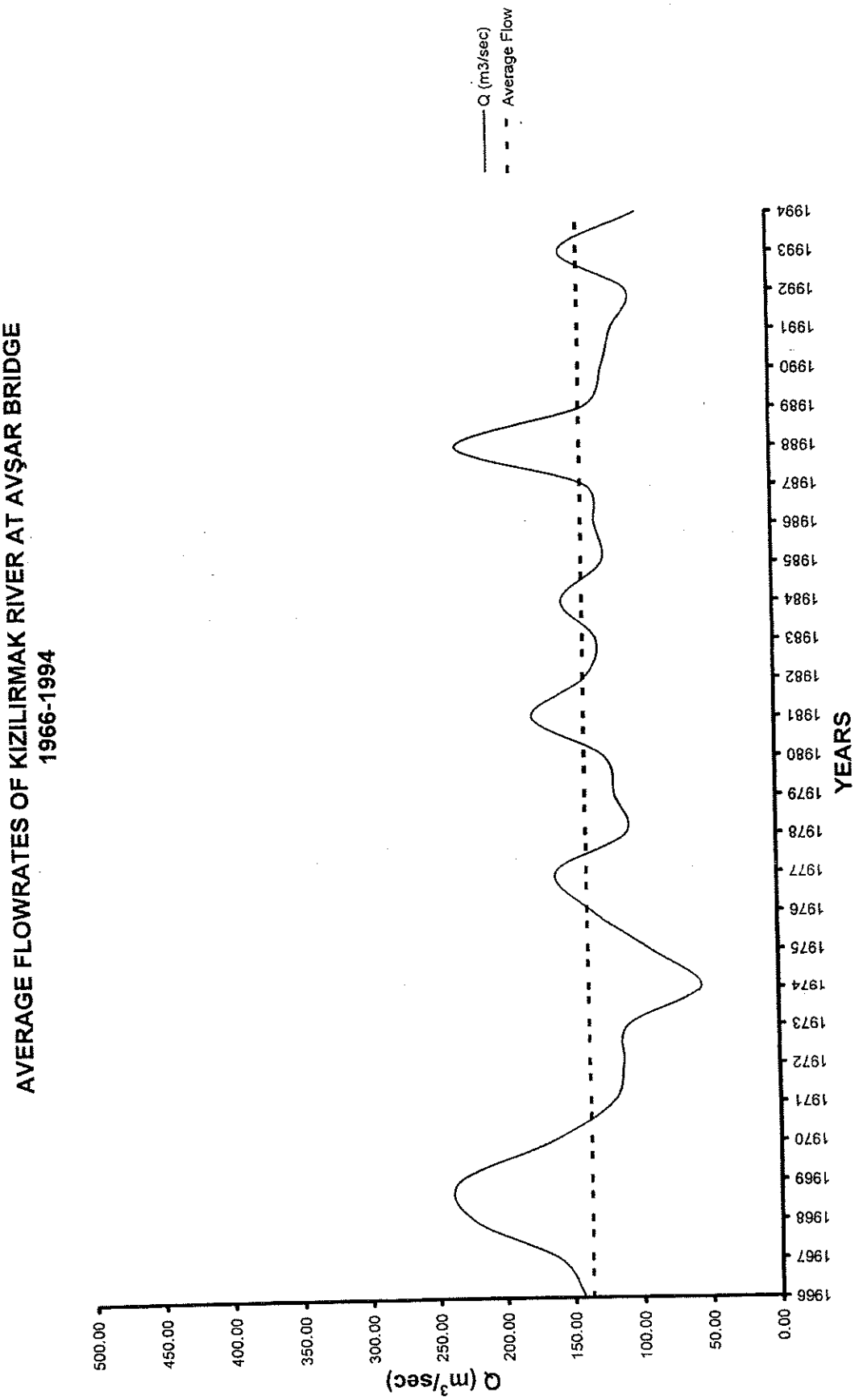


Figure V.19. Average Flowrates of Kizilirmak River at Avsar Bridge

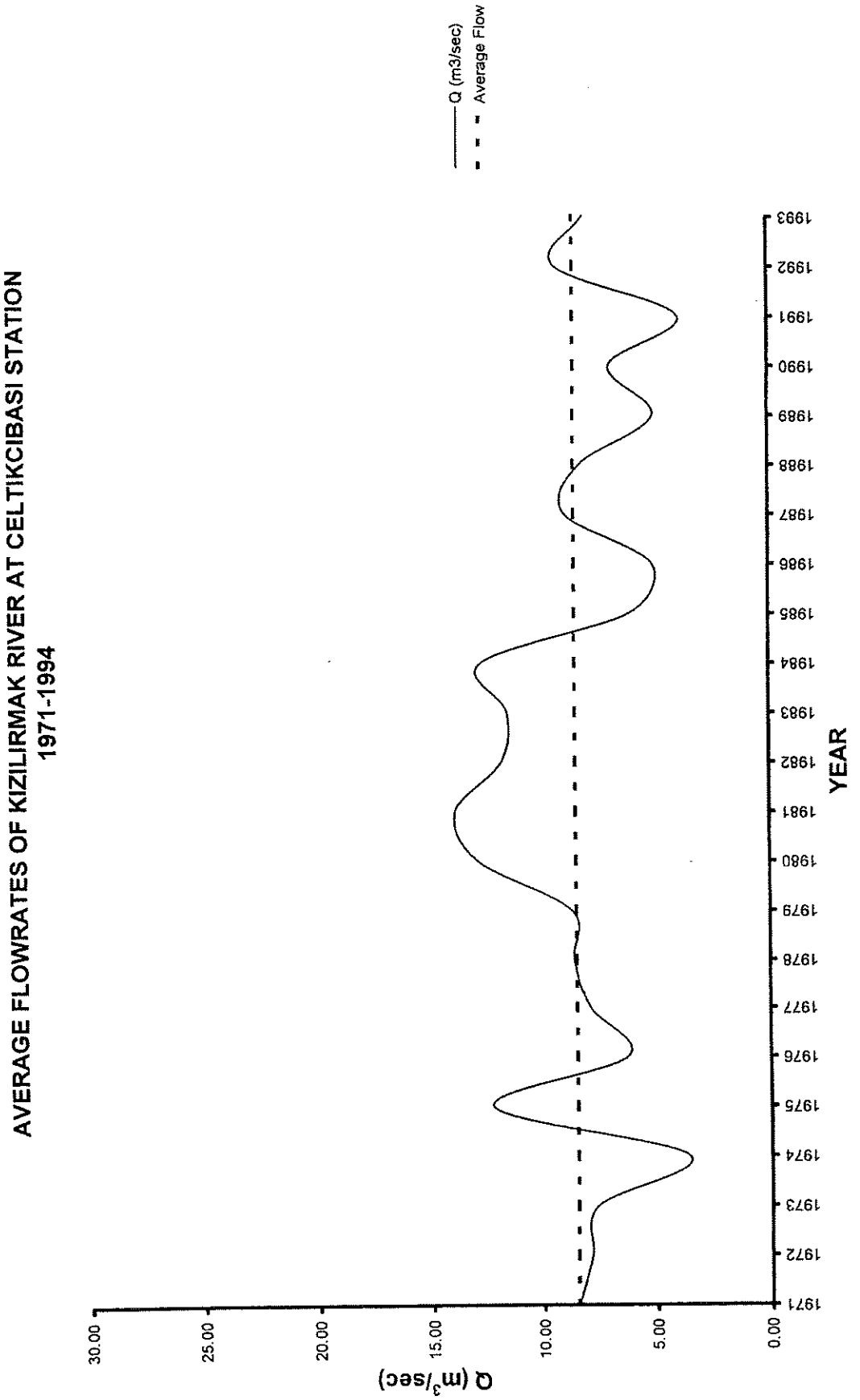


Figure V.20. Average Flowrates of Kizilirmak River at Celtikcibasi Bridge

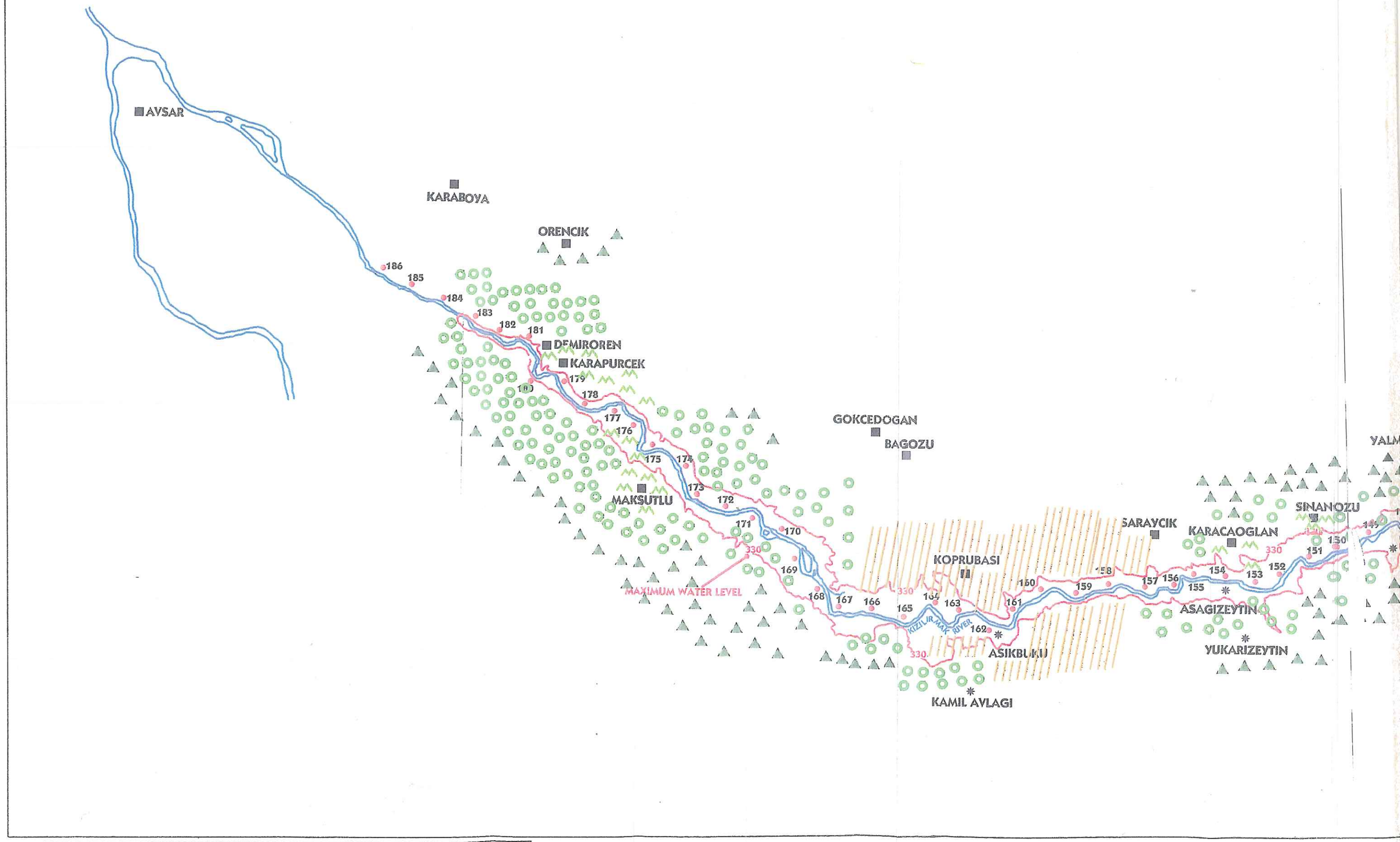
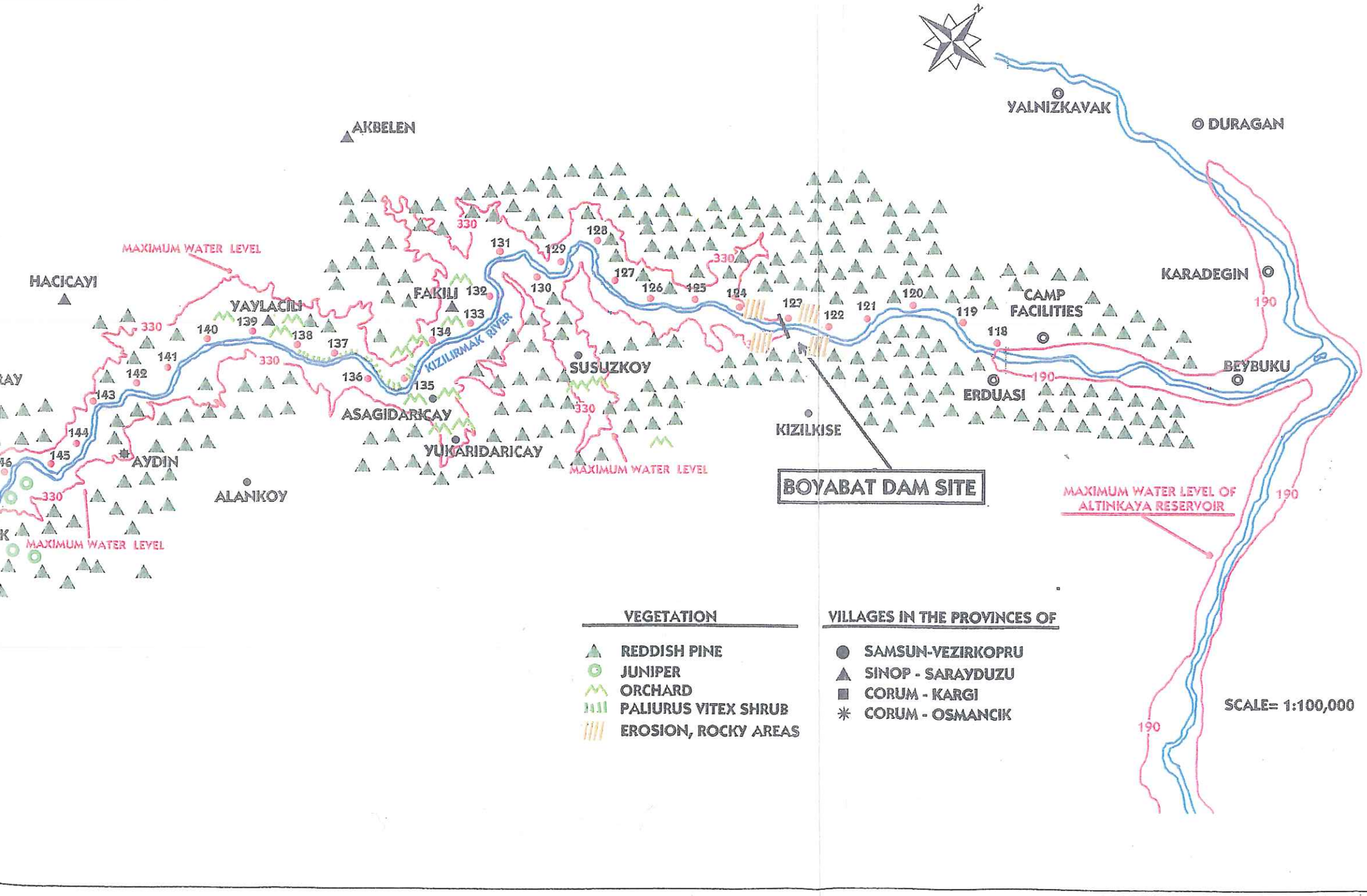


Figure V.21. Vegetation Map of the Boyabat Project Area


AKBELEN
YALNIZKAVAK
DURAGAN
KARADEGIN
CAMP FACILITIES
BEYBUKU
ERDUASI
SUSUZKOY
KIZILKISE
BOYABAT DAM SITE
HACICAYI
YAYLACIL
FAKILI
KIZILIRMAK RIVER
ASAGIDARICAY
YUKARIDARICAY
AYDIN
ALANKOY
MAXIMUM WATER LEVEL
MAXIMUM WATER LEVEL OF ALTINKAYA RESERVOIR
330
190
VEGETATION
REDDISH PINE
JUNIPER
ORCHARD
PALIURUS VITEX SHRUB
EROSION, ROCKY AREAS
VILLAGES IN THE PROVINCES OF
SAMSUN-VEZIRKOPRU
SINOP - SARAYDUZU
CORUM - KARGI
CORUM - OSMANCIK
SCALE= 1:100,000

VI. ENVIRONMENTAL IMPACTS

VI. ENVIRONMENTAL IMPACTS

Environmental impact analysis is concerned with three different environments, as in the baseline data: the physical, biological, and socioeconomic environments. The impact analysis is carried out from two perspectives: the impact of the project on these environmental components and the impact of the environment on the project. Impacts incurred during construction and operation are discussed separately.

VI.1. Physical Environment

The impacts of the project on the physical environment and the impacts of the physical environment on the project are examined in this section. The impacts during construction and operation are discussed together with the beneficial and adverse impacts in the following subsections. The environmental impact analysis and assessment generally follow the outline of the previous section in order to address the impacts based on the baseline data provided. This section is divided into subsections on physiograhy, geology, climatology and hydrology.

VI.1.1. Physiography

The geology of the dam site and the reservoir area has a complex structure. The geological characteristics of the site are such that subsidence due to the weight of the reservoir water will not be a problem. The dam site will be located on, principally, a limestone foundation, which has been found to possess adequate strength for construction of a concrete gravity dam.

VI.1.2. Geology

Geological surveys undertaken at the dam site indicated that the geology at the dam location generally consists of microcrystallized limestone. This formation will provide adequate support as bedrock for the dam and no significant problem with respect to the watertightness of the reservoir is expected.

VI.1.2.1. Watertightness

When the reservoir area of the project is considered, there is no problem with regard to either watertightness or slope stability. Faults in the area and the foundation soils will not pose a problem, since the necessary grouting will be done in areas with cavities and faults during the construction phase.

VI.1.2.2. Seismic Risk

The project area is located immediately north of the North Anatolian Fault Zone. The earthquakes that have occurred within a radius of 50 km from the projected dam site were indicated in Figure V.9, according to the data obtained from The Ministry of Reconstruction and Settlement, and the "Earthquake Catalogue of Turkey and Surroundings," prepared by Istanbul Technical University.

The dam and the other structures will be designed to withstand the loading created by the maximum credible earthquake (MCE). This is the largest reasonably conceivable earthquake that appears possible along a recognized fault, or within a geographically defined tectonic province, under the presently known or presumed framework. The MCE is generally defined as an upper bound of expected earthquake intensity.

The seismic risk to be considered can be evaluated in accordance with the recommendations of the International Committee On Large Dams (ICOLD, 1989). Evaluation of the MCE is possible by using a deterministic approach. In this procedure, critical seismogenic sources representing a threat to the site are identified and a maximum magnitude assigned to each of them. The effects of these faults are ascertained through historical data and checked by geological criteria, such as the rupture length-magnitude, the fault movement-magnitude relationship, or the rupture area and slip vector-magnitude relationship. The design MCE will be obtained by considering the most severe combination of maximum magnitude and minimum distance to the site independently of the return period.

In summary, the Boyabat Dam site is close to the North Anatolian Fault Zone and has a seismic risk of the second degree. Design of the structures would be done according to the maximum credible earthquake. Based on recent studies, the project area may be subjected to earthquakes producing a maximum ground acceleration of 0.45 g with a 10,000 - year return period. This value is taken as the MCE for confirming the stability of the dam, though seismic risk of the project area is second degree, and the past records show no such a severe earthquake. Earthquakes that would cause severe damage on the periphery of the reservoir are highly unlikely.

VI.1.2.3. Reservoir Induced Seismicity

Many seismic events induced by filling large reservoirs (e.g. Krematsa, Kariba) have been documented with maximum magnitudes of 6 to 6.5. The impoundment seems to act as a triggering mechanism, whereby elastic strain release is accelerated. The scientific community accepts that reservoir impoundment can induce seismicity only in systems that are already near failure.

The physical mechanism causing induced seismicity is not fully understood, but is accepted to be related to higher fluid pressures resulting from increased head. Stress changes because of surface loading may increase the likelihood of crustal failure in areas of normal and transcurrent faulting. However, this may inhibit failure in areas of thrust faulting. Induced seismicity mainly occurs in areas that combine steeply dipping faults, relatively high strain rates and either extensional or horizontal shear strain.

The Boyabat Dam site and project area is close to the North Anatolian Fault Zone. From the seismic activity recorded, this fault is considered active. The seismicity of the area and the earthquakes observed in the last century (having a magnitude greater than 4 on Richter Scale) are discussed in Section V.1.2.1 in detail. No fault

exists at the project site, which would create a problem for stability of the dam. The brittle portion, including weathered parts of the F-5 fault at the left bank side, is of large scale. However, it lies outside the stress field of the dam, and the existence of the proposed reservoir is not considered likely to significantly effect the seismic behavior of the fault.

As a result, triggering strong earthquakes by the impoundment of the Boyabat Reservoir seems to be unlikely. The dam will be designed to withstand the maximum credible earthquake and reservoir induced seismicity would not cause a significant problem. In any case, induced seismicity will be monitored by the strong motion accelerographs installed in the dam and its foundation.

VI.1.2.4. Dam Safety

The microcrystallized limestone is found to provide more than adequate support as bedrock of the dam (DOGUS, 1995). The design of the dam described in Chapter IV will produce a structure that meets all engineering standards. As noted in the Chapters on Mitigation (VIII) and Monitoring (IX) further actions will be taken to protect the public and the integrity of downstream structures.

VI.1.2.5. Impacts of a Catastrophic Failure

In evaluating the potential impacts of a catastrophic failure of the Boyabat Dam, there are two major concerns: The settlements downstream of the dam that are relatively close to the site; and Altinkaya Dam, downstream of Boyabat Project.

A catastrophic failure of the dam, in the absence of protective measures, would cause serious injury and drowning of downstream residents, in addition to destroying buildings in the path of the flood. The villages of Erduasi and Beybuku would be the hardest hit. Erduasi is situated above 330 m elevation but the height of the downstream wave can only be determined by a flood routing analysis, which would be prepared for the Emergency Action Plan (EAP). The Boyabat Camp also would receive part of the wave of water, with attendant damage and possible loss of life. The protection of downstream residents will be accomplished through the preparation and implementation of an Emergency Action Plan

The upstream part of Altinkaya Reservoir is about 3-4 km downstream of Boyabat Dam. Altinkaya Dam is a rockfill dam with a clay core. The height of the dam is 195 m from the foundation and 137 from the riverbed.

The reservoir has a total volume of $5{,}763 \times 10^6$ m^3 and an area of 118 km^2. The spillway capacity of the dam is 11,800 m^3/sec. When the average annual flow rate of Kizilirmak is considered (approximately $5{,}780 \times 10^6$ m^3), Altinkaya Reservoir has a total capacity that is nearly able to store all the annual flow of Kizilirmak.

The water released by a collapse of Boyabat Dam would traverse a gorge about 4-5 kilometers before reaching the Altinkaya Reservoir. In a catastrophic failure, the

characteristic parameters related to Altinkaya Dam and Reservoir become very important. These parameters are;

- the total reservoir capacity of the Altinkaya Dam,
- the height of the Altinkaya Dam,
- the capacity of the spillway of the Altinkaya Dam,
- the water level of the Altinkaya Reservoir at the time of failure and,
- the speed at which the spillway gates of the Altinkaya Dam can be opened.

The risk of temporary overtopping of Altinkaya depends on the above parameters. Here it should be pointed out that, for the last two years, water elevation in Altinkaya Reservoir has been about 165 m (about 25 meters below the maximum water level; minimum water level is accepted as 163 m). Water storage in the reservoir was initiated in 1987. Since 1987, the water surface level in the reservoir has reached an elevation of 188 m once and stayed at that elevation for about 6-8 months (personal communications, DSI VII. Regional Office). As a general trend, the water surface level has stayed at about elevation 165 m from 1987 and 1996. The annual precipitation during this period was about 450 mm, slightly higher than the mean annual precipitation, 400 mm.

Considering the water level of the Altinkaya Reservoir, it is unlikely that there will be any instant overtopping of the Altinkaya Dam in a failure occurrence. In addition, it should be noted that for overtopping to occur, the water level in Altinkaya Reservoir would have to be higher than elevation 195 m. During years with annual precipitation much greater than the mean annual precipitation, water level in the reservoir may reach the maximum water level (190 m). If the initial water level in Altinkaya Reservoir is at 190 m elevation (which has never occurred) there would be a risk of instant overtopping, depending on the opening time of the spillway's gates.

The tailwater of Altinkaya Reservoir reaches Beybuku village at the maximum water level. Also, when full, Altinkaya Reservoir reaches 4-5 km upstream of the confluence of the Gokirmak with the Kizilirmak. This area was previously expropriated with the construction of Altinkaya Dam, so there are no settlements in this area. For this reason, in case of a failure of Boyabat Dam, no settlements in this region would be affected, but people working in fields would be at risk.

In conclusion, the readings of the instruments (pendulums, extensiometers, join measurement devices, etc.) monitoring the Boyabat Dam should be regularly interpreted and evaluated. Total failure of the dam is highly unlikely. In addition, if the dam is carefully monitored any failure would become foreseeable. As a major dam operator states, "a regularly monitored dam always warns before undergoing a failure or any major disorders." In addition, however, a warning system linking Boyabat to Altinkaya and Altinkaya to Derbent would be beneficial.

When a problem is foreseen as a result of monitoring, the responsible operating engineer at the Altinkaya Project can be placed on alert and notified of any failure immediately by a redundant communication system. Furthermore, if the problem or

danger seems to be significant, the water level at Altinkaya Reservoir can be lowered or limited to the minimum operating level (low water surface) to prevent an overtopping. The EAP will include a plan to notify settlements within and adjacent to the drawdown zone of Altinkaya Reservoir, immediately downstream of Boyabat Dam, as well as the camp facilities.

VI.1.2.6. Landslides and Erosion

The impact of the project on landslides and erosion should be considered both during the construction and operation phases. Slope wash is distributed on the left bank side, at the gully and at the portion of change in topography on the right bank side, upstream of dam axis. These slope wash deposits are around five meters thick.

Construction activities may increase the potential for landslides and erosion in various ways, which include destabilization of rock masses by cuts in slopes, improper stockpiling of materials, destruction of vegetative cover during site clearing and uncontrolled surface run-off (slope wash) during storms.

There are many landslides in the Kuzkoy Formation, distributed about five kilometers southwest of Kamil. They are about one square kilometer in area and five to eight meters thick. The nearest is about two kilometers from the reservoir surface and will not directly affect the reservoir. These landslides are indicated on the geological map of the reservoir area (Figure V.7).

Exploration in the project area has shown that there are no formations that have a potential for landslides and slope collapses. Therefore, no problem is expected with regard to slope stability and unstable soil-rock masses in the reservoir area or at the dam site. Thus, it is not expected that construction activities would create any important slope stability problems and landslides. The diversion tunnels, access roads and site camp facilities caused no landslides, erosion, or slope instability during their construction (personal communication, DSI).

VI.1.2.7. Sedimentation of the Reservoir

Measurements of the concentration of suspended sediments in the Kizilirmak River, were made by the State Hydraulic Works at Cetinkaya Bridge at Bafra up to 1989, until Altinkaya Dam and HPP was placed in operation. Similar measurements were made by EIE at the Inozu Gauging Station downstream of Altinkaya Dam. These analyses show the suspended load of Kizilirmak River to be 26% sand and 74% silt and clay, with an average concentration of 6,000 ppm (a range of 300 to 9,000 ppm). Prior to the construction of the downstream dams, the measured sediment loads at those two gages were considered to exist also at the Boyabat Dam site. The relation between suspended load concentration and run-off at the Altinkaya Dam site by months is expressed logarithmically in Figure VI.1. The 37-year monthly average run-off duration curves at Altinkaya and Boyabat Dam sites are shown in Figure VI.2.

Sediment that will enter Boyabat Reservoir has been evaluated using "Sediment Key Curves" and monthly average discharge values. Sediment density has been computed as W = 1.193 ton/m^3 for 50 years by USBR method. It is considered that additional material in a quantity of approximately 20% of the suspended matter of the river will reach the reservoir via tributaries. Thus, on the average, 25.2 × 10^6 m^3 suspended solids and 5.0 × 10^6 m^3 transported material, totaling 30.2 × 10^6 m^3 of sediment will enter Boyabat Reservoir every year.

When it is considered that the minimum reservoir volume of Boyabat Project is 2,147 × 10^6 m^3, every year 1.4 % of the minimum reservoir volume would be filled with sediment. As sediment is deposited in a reservoir, an alluvial fan is formed, which is cut and resuspended as the reservoir is drawn down. This complex process continues through the active live of the reservoir, with the percent of incoming sediment retained gradually decreasing until eventually none is retained. By the end of the 50-year economic life of the Boyabat Project, 70 % of the minimum reservoir volume would be filled by sediment, reducing the storage capacity but not hindering generation. The control of deforestation and clearing of land in the vicinity of the reservoir area (and watershed) would contribute to the efforts for preventing erosion and for prevention of sedimentation in the Boyabat Reservoir.

The trapping of sediments in reservoirs is known to exert serious effects on river deltas, especially when the dam is the first on that river. The Kizilirmak Delta is one of the most important wetlands of Turkey. When the cumulative impacts of the downstream Altinkaya and Derbent Projects are considered, the effect of Boyabat on Kizilirmak Delta will be negligible. Boyabat Project will hinder the transport of sediment, thus nutrients and alluvium, reducing the primary productivity in Altinkaya Reservoir. However, Altinkaya Reservoir will receive water with less turbidity.

VI.1.2.8. Downstream Effects

No downstream effects regarding geological formations and issues (such as seismicity) are expected on Altinkaya Reservoir .

There is a disposal area located about 1,000 m downstream of the Boyabat Dam axis, with a capacity of 55,000 m^3. This area will be used for the materials excavated during construction. Necessary precautions regarding this disposal area will be taken to prevent any adverse impacts on the downstream river quality. Also, this area will not impose any impacts on slope stability, erosion, seismicity and sedimentation.

VI.1.3. Climatology

VI.1.3.1. Impacts During Construction

During construction, the main impact on the air quality would be dust generation, particularly under windy conditions. There are two different sources of dust :

1. Dust from civil engineering works equipment, such as trucks, loaders, bulldozers, etc. used in the processes such as earth moving and construction of access roads.

2. Dust from blasting operations.

Dust may also arise from the use of access roads by the trucks. Blasting will cause significant amount of dust, but highly localized. Dust is more disturbing to people when there is little or no wind.

Since the nearest settlement (Kepez) to the dam site is about 4 km away, the impacts of construction on this settlement, particularly dust, will not be appreciable. Nor will dust adversely affect the camp facilities.

Necessary precautions will be taken to protect the health of the workers in any operation and from any adverse affects as well as dust. This will be achieved as required by the regulation, numbered 14453 and dated February 1973, of The Ministry of Labor and Social Security. The air in underground works will be kept in a condition suitable for the health of the workers, as required by the technical specification, civil engineering works, May 1991. Workers directly exposed to particulates in the workplace will be protected by respirators. The equipment used in construction will be periodically examined for protecting the health of the workers.

VI.1.3.2. Impacts After Impounding

The project will not lead to a significant change in the microclimate of the zone around the future reservoir. There will be only a small change in relative humidity near the reservoir. This affect would be naturally limited to a narrow zone around the future reservoir, although about 640 mm yearly evaporation is expected in the Boyabat Reservoir. Weather systems are so broad and contain so much moisture that the evaporation from even a large reservoir has no regional effect.

VI.1.4. Hydrology

Large dam projects have various and extended impacts on river hydrology, affecting water quality and seasonal flow pattern. These impacts are both upstream and downstream of the dam, and occur during construction and operation of a project. The impacts are important from a watershed perspective, as well as the immediate project area. Watershed level impacts are examined in relation to management and

development plans for the river basin. Project area impacts are examined from the perspective of affected local resources.

VI.1.4.1. Compatibility with the Master Plan of State Hydraulic Works

The Boyabat Project was developed as part of the Master Plan of the Turkish State Hydraulic Works (DSI) in the 1970's. The project feasibility report was prepared in 1979, and the project was justified on an economic and technical basis. In January 1987, the initial design of the project was completed and construction was started by DSI. However, during this development period, no serious environmental studies were carried out. This report is the first extended evaluation of the environmental issues and impacts related to the Boyabat Project.

In the mean time, DSI has built the access roads to the dam site, the bridge to pass to the right bank of the river, the diversion tunnels and the camp facilities. Future developments in Kizilirmak Basin will not be affected by the construction of Boyabat Project as they are already planned taking this project into account. The future development of hydro-projects in the Kizilirmak basin, as proposed by DSI, are shown in Figure VI.3, Hydro-Development Plan of Kizilirmak River. In addition, a longitudinal profile of the existing and proposed general development of the Kizilirmak River is presented in Figure VI.4.

This project will be developed under the Build-Operate-Transfer Model. Boyabat Electricity Production and Trade Company, the concession company (CC), in which DOGUS is a major partner, will construct the dam and the power plant, and operate the project for 15 years. Then, DSI will be in charge of the project and will continue operation for the rest of the economic life of the dam.

VI.1.4.2. Water Quality

VI.1.4.2.1. Impacts of Project Construction

During construction of a dam, turbidity and sedimentation in the waters downstream of the site will unavoidably increase due to in-river construction activities. Additionally, excavation of the foundation, construction of access roads, processing aggregate, and batching concrete all result in turbid or sediment laden wastewater. If the water is discharged without treatment into a watercourse, it can adversely affect the quality of water for irrigation, and physically harm aquatic biological resources and their uses. It can also adversely affect water-related recreational activities, such as fishing.

Concrete dams require more wastewater treatment than earthfill dams. Water is required to wash aggregate, and batch and cure concrete. Typically, wastewater from these operations is polluted and extremely basic with a pH greater than 10.5. Concentrated sulfuric and hydrochloric acid can be used as a buffer to reduce the pH close to neutrality. In the construction phase of Boyabat Dam, clarification and neutralization will be applied to prevent pollution.

VI.1.4.2.2. Impacts of Impoundment

When a free flowing stream is impounded, a number of physical, chemical and biological phenomena occur as a result of the change from a flowing water environment to an essentially standing or lake water environment. One of the most significant changes is in water temperature or heat distribution within the impoundment. This factor largely determines what takes place biologically, chemically and physically in the reservoir (Smalley, 1978).

Additionally, the general effect of reservoir releases on downstream water temperature results in changes in the species composition of the downstream biotic communities. These effects could be similar up to a point for a reservoir that remains isothermal and for a reservoir that stratifies into temperature caused density layers. In general, the overall effect of releases from an isothermal reservoir would not be highly significant since the temperature of these releases would tend to approximate that of the riverine environment, provided that retention time of water within the reservoir did not allow for additional heating. On the other hand, hypolimnial releases of cold water from thermally stratified reservoirs have had pronounced effects on the downstream biotic community to the extent that some changes have occurred in response to the changed thermal regime.

Altinkaya Dam and Hydroelectric Power Plant is located downstream of the Boyabat Project Site and it is anticipated that the future Boyabat Reservoir would have similar characteristics to those of the Altinkaya Reservoir. Thus, the possible changes in water quality due to the formation of the Boyabat Reservoir can be inferred from the characteristics of the Altinkaya Project. Therefore, the characteristics of that reservoir are described below.

VI.1.4.2.3. Altinkaya Reservoir

Relevant characteristics Altinkaya Dam and Reservoir, and those anticipated for Boyabat Project are compared below:

	Boyabat	**Altinkaya**
Maximum water elevation (MWL) in the reservoir:	330 m	190 m
Minimum water elevation in the reservoir:	305 m	160 m
Surface area of the reservoir at MWL:	65.4 km^2	118 km^2
Total reservoir volume:	$3,557 \times 10^6$ m^3	$5,763 \times 10^6$ m^3
Active volume:	$1,410 \times 10^6$ m^3	$2,892 \times 10^6$ m^3
Dead storage:	$2,147 \times 10^6$ m^3	$2,871 \times 10^6$ m^3
Annual flow:	$4,109 \times 10^6$ m^3	$5,785 \times 10^6$ m^3
Height of the dam from the river bed:	150 m	137 m
Elevation of top of water intake	305 m	160 m
Elevation of bottom of water intake	295 m	139 m

a) Water Quality Studies in Altinkaya Reservoir in 1988 and 1989

In March and October 1988, and in June 1989 a series of vertical profile water quality measurements were carried out in the Altinkaya Reservoir by the State Hydraulic Works. Four sampling stations were identified within the reservoir (Figure VI.5).

Sampling station I was about 7 km upstream of the dam axis. Stations II, III and IV were located, approximately 23 km, 34 km and 45 km from the dam axis, respectively. At all of the stations, sampling was conducted at 5-m intervals from the surface to a depth of 20 m. Thereafter, sampling intervals were increased to 10 m. The maximum sampling depths of Stations I, II, III and IV were 90 m, 50 m, 50 m, and 40 m, respectively. Sampling and analysis of water samples were carried out in accordance with the methods and procedures given in "Standard Methods for the Examination of Water and Wastewater, 13th Edition (American Water Works Association et al., 1971).

The analytical results of the chemical parameters measured in the vertical profiles at each station on each sampling date are provided in Tables VI.1 through VI.8. The results of these analyses show that the parameters do not fluctuate appreciably with depth. The values for physical water quality characteristics and most of these chemical parameters are summarized in Table VI.9. The findings of the water quality studies performed in Altinkaya Reservoir in 1997 are presented in Table VI.10. The results of the vertical profiles of temperature and dissolved oxygen are tabulated in Tables VI.11 and VI.12, and are discussed in the thermal stratification and dissolved oxygen sections.

According to the Turkish Inland Water Standards, given in Table V.4, the Altinkaya Reservoir would be considered as Class III waters because some of the parameters fall in that category. This class of water is designated to be used only for industrial purposes, although after proper treatment it can also be used for some other purposes, such as irrigation. Here it should be pointed out that the waters of Altinkaya are second class waters for most of the parameters, except sulfate and sodium. However, the measured levels of sodium and sulfate do not have appreciable adverse effects on aquatic life. Further, Altinkaya waters can be utilized for the irrigation of most crops.

The maximum **pH** is 8.5 and the minimum is 7.6 in Altinkaya Reservoir according to the results of the measurements provided above. This parameter did not vary appreciably with depth and is acceptable for any water use.

Dissolved oxygen concentration varied between 6.0 (48 % saturation) and 12.7 mg/L (supersaturation), having an average value of 9.0 mg/L (89 % saturation). These values are sufficient for aquatic life. More detailed discussion on DO is provided in the following sections.

Table VI.1. Vertical Profiles of Water Quality Parameters in Altinkaya Reservoir, March 1988 (Station I)

Parameter	Depth (m)									
	0	5	10	15	20	30	40	50	70	90
pH	8.1	8.3	8.4	8.1	8.2	8.2	8.3	8.3	8.1	8.2
EC (µmhos/cm)	1440	1470	1464	1440	1440	1476	1420	1428	1452	1440
Alkalinity (mg/L as $CaCO_3$)	180.0	172.5	177.5	172.5	177.5	170.0	172.5	175.0	177.5	172.5
Cl^- (mg/L)	193.5	184.6	186.0	184.6	200.5	184.6	186.3	186.3	186.3	186.3
NH4-N (mg/L)	0.20	0.30	0.40	0.40	0.10	0.10	0.10	0.15	0.10	0.15
NO2-N (mg/L)	0	0	0	0	0	0	0	0	0	0
$KMnO_4$ (mg/L)	2.1	1.6	2.5	2.1	2.1	2.0	1.9	1.6	2.0	2.0
Orto-P (mg/L)	0.01	0.01	0.67	0.02	0.00	0.00	0.00	0.00	0.00	0.01
SO_4 (mg/L)	285.0	306.7	288.5	301.4	267.5	304.8	299.0	288.9	291.3	290.0
Na^+ (mg/L)	150	140	147	144	144	147	144	144	144	140
K^+ (mg/L)	4.6	4.5	4.6	4.6	4.4	4.5	4.6	4.5	4.5	4.5
Mg^{++} (mg/L)	40.0	42.0	35.9	41.9	39.5	37.1	38.3	36.5	41.9	39.5
Ca^{++} (mg/L)	101	108	107	102	103	108	108	108	101	106
Total Hardness (mg/L as $CaCO_3$)	417.5	442.5	415.0	427.5	420.0	422.5	427.5	420.0	425.0	427.5
Dissolved silis (mg/L)	8.4	8.6	8.0	8.0	7.8	8.0	8.0	8.2	8.6	8.6

Table VI.2. Vertical Profiles of Water Quality Parameters in Altinkaya Reservoir, March 1988 (Station II)

Parameter	Depth (m)					
	0	5	10	15	20	30
pH	8.0	8.5	8.4	8.4	8.3	8.0
EC (µmhos/cm)	1380	1392	1308	1404	1416	1428
Alkalinity (mg/L as $CaCO_3$)	185.0	172.5	170.0	175.0	175.0	177.5
Cl^- (mg/L)	188.0	186.3	181.0	177.5	177.5	179.2
NH4-N (mg/L)	0.10	0.20	0.20	0.25	0.10	1.20
NO2-N (mg/L)	0	0	0	0	0	0
$KMnO_4$ (mg/L)	1.8	1.7	2.6	2.2	2.1	10.0
Orto-P (mg/L)	0.00	0.00	0.00	0.00	0.00	0.26
SO_4 (mg/L)	279.8	308.6	307.6	296.6	307.6	297.6
Na^+ (mg/L)	144	144	147	144	147	147
K^+ (mg/L)	4.6	4.6	4.7	4.6	4.6	4.5
Mg^{++} (mg/L)	38.9	42.6	38.3	34.6	36.4	37.7
Ca^{++} (mg/L)	105	105	105	109	108	104
Total Hardness (mg/L as $CaCO_3$)	422.5	437.5	420.0	415.0	420.0	415.0
Dissolved silis (mg/L)	8.8	8.8	8.6	8.2	8.8	9.8

Table VI.3. Vertical Profiles of Water Quality Parameters in Altinkaya Reservoir, March 1988 (Station III)

Parameter	Depth (m)								
	0	5	10	15	20	30	40	50	70
pH	8.4	8.3	8.2	8.2	7.9	8.3	8.3	8.2	8.2
EC (µmhos/cm)	1488	1390	1380	1416	1392	1368	1416	1380	1452
Alkalinity (mg/L as $CaCO_3$)	177.5	177.5	177.5	172.5	177.5	170.0	175.0	175.0	167.5
Cl^- (mg/L)	193.2	175.7	175.7	179.2	177.5	181.0	177.5	188.0	188.0
NH4-N (mg/L)	0.10	0.05	0.25	0.10	0.10	0.15	0.10	0.20	0.30
NO2-N (mg/L)	0	0	0	0	0	0	0	0	0
$KMnO_4$ (mg/L)	1.5	2.1	1.8	1.4	1.8	1.2	1.4	1.4	1.6
Orto-P (mg/L)	0	0	0	0	0	0	0	0	0
SO_4 (mg/L)	302.8	272.0	283.2	310.0	291.8	244.8	296.6	254.4	323.5
Na^+ (mg/L)	154	138	140	147	144	140	144	150	150
K^+ (mg/L)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.5	4.6
Mg^{++} (mg/L)	39.5	35.3	35.2	40.7	34.6	37.0	37.0	37.0	37.0
Ca^{++} (mg/L)	106	103	106	102	108	105	105	113	114
Total Hardness (mg/L as $CaCO_3$)	427.5	402.5	410.0	422.5	412.5	415.0	415.0	435.0	437.5
Dissolved silis (mg/L)	11.0	9.6	9.4	9.6	9.8	9.6	9.8	9.8	10.2

Table VI.4. Vertical Profiles of Water Quality Parameters in Altinkaya Reservoir, March 1988 (Station IV)

Parameter	Depth (m)						
	0	5	10	15	20	30	40
pH	8.3	8.3	8.4	8.3	8.3	8.4	8.2
EC (µmhos/cm)	1404	1476	1412	1404	1404	1450	1548
Alkalinity (mg/L as $CaCO_3$)	177.5	175.0	175.0	175.0	175.0	177.5	180.0
Cl^- (mg/L)	181.0	179.2	179.2	179.2	177.5	179.2	188.0
NH4-N (mg/L)	0.20	0.20	0.10	0.05	0.05	0.05	0.05
NO2-N (mg/L)	0	0	0	0	0	0	0
$KMnO_4$ (mg/L)	2.0	2.0	1.4	1.4	1.4	1.8	1.6
Orto-P (mg/L)	0.00	0.00	0.01	0.00	0.00	0.00	0.00
SO_4 (mg/L)	289.4	298.0	194.2	299.0	312.4	318.7	362.4
Na^+ (mg/L)	144	140	144	144	147	150	178
K^+ (mg/L)	4.6	4.6	4.6	4.6	4.6	4.6	4.4
Mg^{++} (mg/L)	39.5	34.6	32.8	31.6	35.2	41.9	41.9
Ca^{++} (mg/L)	101	114	112	116	112	103	103
Total Hardness (mg/L as $CaCO_3$)	415.0	427.5	415.0	420.0	425.0	430.0	430.0
Dissolved silis (mg/L)	9.4	9.4	9.0	9.8	9.0	9.8	9.6

Table VI.5. Vertical Profiles of Water Quality Parameters in Altinkaya Reservoir, October 1988 (Station I)

Parameter	Depth (m)									
	0	5	10	15	20	30	40	50	70	90
pH	7.7	7.8	8	8.1	8.1	7.9	8.1	7.9	8	8
EC (µmhos/cm)	1321	1309	1285	1273	1285	1214	1214	1226	1309	1416
Alkalinity (mg/L as $CaCO_3$)	125.0	137.5	125.0	135.0	97.5	145.0	137.5	160.0	162.5	152.5
Cl^- (mg/L)	166.8	159.8	159.8	159.8	159.8	159.8	159.8	158.0	161.5	195.3
NH4-N (mg/L)	0.15	0.05	0.10	0.01	0.05	0.10	0.05	0.10	0.10	0.10
NO2-N (mg/L)	0	0	0	0	0	0	0	0	0	0
$KMnO_4$ (mg/L)	1.8	1.5	1.7	1.6	1.4	1.7	1.7	1.2	1.7	1.3
Orto-P (mg/L)	0.04	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SO_4 (mg/L)	355.7	289.9	319.7	306.7	348.5	307.9	302.9	208.8	307.2	312.0
Na^+ (mg/L)	130	126	130	126	130	130	130	130	138	162
K^+ (mg/L)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	3.9	3.9	4.3
Mg^{++} (mg/L)	46.8	34.7	34.7	36.5	34.7	35.9	37.1	33.4	37.1	38.3
Ca^{++} (mg/L)	100	97	101	100	102	102	95	100	101	95
Total Hardness (mg/L as $CaCO_3$)	442.5	385.0	395.0	400.0	397.5	402.5	390.0	387.5	405.0	395.0
Dissolved silis (mg/L)	8.6	9.2	8.8	8.6	9.2	9.0	8.8	10.4	10.0	10.2

Table VI.6. Vertical Profiles of Water Quality Parameters in Altinkaya Reservoir, October 1988 (Station II)

Parameter	Depth (m)					
	0	5	10	15	20	30
pH	8.0	8.0	8.1	8.1	8.0	8.0
EC (µmhos/cm)	1309	1285	1309	1309	1309	1309
Alkalinity (mg/L as $CaCO_3$)	132.5	137.5	137.5	135	137.5	137.5
Cl^- (mg/L)	172.18	170.40	172.17	172.17	170.40	173.95
NH4-N (mg/L)	0.15	0.20	0.25	0.10	0.10	0.15
NO2-N (mg/L)	0	0	0	0	0	0
$KMnO_4$ (mg/L)	1.20	1.92	1.48	1.44	1.60	1.36
Orto-P (mg/L)	0.00	0.02	0.00	0.00	0.22	0.01
SO_4 (mg/L)	317.3	310.6	327.4	310.6	322.6	334.6
Na^+ (mg/L)	138.0	135.9	135.9	135.9	135.9	135.9
K^+ (mg/L)	4.3	4.3	4.3	4.3	4.3	4.3
Mg^{++} (mg/L)	33.4	35.3	37.1	32.8	32.8	38.9
Ca^{++} (mg/L)	105	102	106	106	111	108
Total Hardness (mg/L as $CaCO_3$)	400.0	400.0	420.0	400.0	412.5	430.0
Dissolved silis (mg/L)	8.4	8.8	8.6	8.8	9.4	9.0

Table VI.7. Vertical Profiles of Water Quality Parameters in Altinkaya Reservoir, October 1988 (Station III)

Parameter	Depth (m)						
	0	5	10	15	20	30	40
pH	8.0	8.0	8.0	7.9	8.0	8.1	8.1
EC (µmhos/cm)	1333	1309	1333	1202	1321	1321	1309
Alkalinity (mg/L as $CaCO_3$)	142.5	142.5	140.0	130.0	137.5	140.0	140.0
Cl^- (mg/L)	179.3	177.5	177.5	159.8	175.7	179.3	179.3
NH4-N (mg/L)	0.20	0.15	0.10	0.25	0.05	0.05	0.10
NO2-N (mg/L)	0	0	0	0	0	0	0
$KMnO_4$ (mg/L)	1.16	1.32	1.28	1.60	1.40	1.52	1.40
Orto-P (mg/L)	0.03	0.05	0.03	0.12	0.00	0.05	0.06
SO_4 (mg/L)	353.8	313.0	307.7	299.5	329.8	313.0	317.8
Na^+ (mg/L)	135.93	135.93	138.00	126.04	135.93	135.93	135.93
K^+ (mg/L)	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Mg^{++} (mg/L)	47.42	31.00	35.26	35.26	40.74	32.83	35.87
Ca^{++} (mg/L)	107	116	104	97	104	113	110
Total Hardness (mg/L as $CaCO_3$)	462.5	417.5	405.0	387.5	427.5	417.5	422.5
Dissolved silis (mg/L)	9.2	9.4	7.6	7.2	7.2	8.2	9.2

Table VI.8. Vertical Profiles of Water Quality Parameters in Altinkaya Reservoir, October 1988 (Station IV)

Parameter	Depth (m)					
	0	5	10	15	20	30
pH	-	8.0	8.1	8.0	7.9	8.0
EC (µmhos/cm)	-	1333	1333	1333	1333	1333
Alkalinity (mg/L as $CaCO_3$)	-	137.5	142.5	142.5	137.5	140.0
Cl^- (mg/L)	-	188.15	179.39	179.39	181.05	181.05
NH4-N (mg/L)	-	0.15	0.05	0.10	0.10	0.05
NO2-N (mg/L)	0	0	0	0	0	0
$KMnO_4$ (mg/L)	2.36	1.64	1.20	2.16	1.60	2.04
Orto-P (mg/L)	0.03	0.00	0.06	0.00	0.03	0.03
SO_4 (mg/L)	-	305.3	317.3	325.0	329.8	329.8
Na^+ (mg/L)	-	138.0	138.0	144.0	144.0	144.0
K^+ (mg/L)	-	4.3	4.3	4.3	4.3	4.3
Mg^{++} (mg/L)	-	36.48	36.48	37.08	34.05	37.70
Ca^{++} (mg/L)	-	106	108	105	111	106
Total Hardness (mg/L as $CaCO_3$)	-	415.0	420.0	415.0	417.5	420.0
Dissolved silis (mg/L)	-	8.8	9.0	3.4	3.8	9.0

Table VI.9. Physical and Chemical Characteristics of Altinkaya Reservoir

Parameters	March 1988				October 1988				June 1989				Overall Average			
	n	Min	Max	Avg.	n	Min	Max	Avg.	n	Min	Max	Avg.	n	Min	Max	Avg.
Secchi Disk (cm)	4	330	460	408	4	365	730	551	4	185	730	459	12	185	730	473
T (°C)	33	7.6	12.0	9.5	29	7.0	25.0	16.1	29	10.0	21.0	19.5	91	7.0	25.0	15.0
pH	32	7.9	8.5	8.2	29	7.6	8.1	7.9	28	7.7	8.1	8.0	89	7.6	8.5	8.0
DO (mg/L)	31	9.2	12.7	11.4	29	6.0	12.0	8.9	29	6.0	7.5	6.6	89	6.0	12.7	9.0
DO (% saturation)	31	76	117	98	29	47	143	89	29	53	83	72	89	48	152	89
EC (µmhos/cm)	32	1308	1548	1424	29	1073	1521	1278	28	1202	1416	1303	89	1073	1548	1335
TH (mg $CaCO_3$ /L)	32	402	442	418	29	334	534	449	28	385	462	410	89	334	534	426
Total Alkalinity (mg $CaCO_3$ /L)	32	168	185	175	29	160	180	171	28	98	62	138	89	98	185	161
Ca (mg/L)	32	101	116	106	29	80	116	95	28	95	113	104	89	80	116	102
Cl^- (mg/L)	32	176	200	183	29	128	220	167	28	158	195	172	89	128	220	174
Mg (mg/L)	32	31.6	42.6	37.9	29	26.1	76.3	51.3	28	31.0	47.4	36.4	89	26.1	76.3	41.9
NO_3-N (mg/L)	33	0.87	2.50	1.36	29	1.85	2.60	2.19	29	1.15	1.85	1.54	91	0.87	2.60	1.70
CO_2 (mg/L)	32	1.1	4.5	2.0	29	2.2	9.0	4.3	28	1.6	5.0	2.7	89	1.1	9.0	3.0
NH_4-N (mg/L)	33	0.05	0.86	0.36	29	0.12	0.95	0.26	29	0.10	0.40	0.17	91	0.05	0.95	0.26
Phosphate (mg/L)	32	0.00	0.67	0.01	29	0.00	0.07	0.03	29	0.00	0.22	0.03	90	0.00	0.67	0.02

n: Number of Samples collected

Electrical conductivity (EC) in the reservoir was between 1,073 and 1,548 µmhos/cm, with an average of 1,335 µmhos/cm. The electrical conductivity values varied slightly with depth on all sampling dates. The average EC value of Altinkaya Reservoir is close to the EC value of the Kizilirmak (1,411 µmhos/cm) and indicates the conservative characteristic of this parameter. Given these EC values, the water of the Boyabat Reservoir will be as suitable for irrigation of crops as the existing condition of the Kizilirmak.

The average **alkalinity** in the reservoir was 161 mg/L (as calcium carbonate). The maximum level was 185 mg/L and the minimum was 98 mg/L. Thus, the reservoir water is slightly alkaline. The alkalinity did not vary significantly with depth.

The measurements show that the average **secchi depth** reading was 408 cm, and was between 330 cm and 460 cm. This indicates that the water is very clear in the reservoir. This occurs as the reservoir acts as a settling basin with its high detention time.

The maximum **hardness** observed was 534 mg/L (as calcium carbonate), with an average hardness of 426 mg/L. These levels are high, indicating that the water of Altinkaya Reservoir is very hard. However, these hardness values are in agreement with the hardness values measured in the Kizilirmak, and it is anticipated that the water of the Boyabat Reservoir will also be very hard. Hardness is an important parameter for some industrial water supplies, but neither the Altinkaya nor the Boyabat Reservoirs will be used as an industrial water supply. Hardness is also important for metal toxicity to fish. Soft waters increase the sensitivity of fish to toxic metals. For instance, in hard water, insoluble copper compounds precipitate and amount of toxicity reduces. Thus, this water will be suitable for fish and aquatic life.

b) Water Quality Studies in Altinkaya Reservoir in 1997

During 1988 and 1989 numerous water quality parameters were measured in Altinkaya Reservoir by the State Hydraulic Works. However, there were no data for the summer season, which is a critical period with respect to thermal stratification. Therefore, water quality parameters having significance for aquatic life were measured in Altinkaya Reservoir in August 1997. The vertical profile measurements of pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), and salinity, were carried out at Sampling Station I of the State Hydraulic Works (Figure VI.5). Sampling started from the surface and proceeded to a depth of 45 m. The results of these measurements are presented in Table VI.10 and the change of these parameters with respect to depth is plotted in Figure VI.6.

The results are evaluated by parameter in the following paragraphs. They are compared with the results obtained in different seasons and their variation with respect to depth is described.

Table VI.10. Vertical Profile of Water Quality Parameters in Altinkaya Dam Lake, August 1997 (Station I)

Depth	Parameter				
	pH	Temperature	DO	EC, 25 °C	Salinity
(m)		(°C)	(mg/L)	(µmhos/cm)	(‰)
1	8.14	24.5	8.6	1160	0.70
3	8.05	24.0	8.3	1140	0.70
5	8.12	24.0	8.9	1150	0.80
7	8.09	24.0	8.6	1140	0.75
9	7.94	24.0	8.7	1150	0.80
11	8.08	24.0	8.5	1140	0.80
13	7.87	24.0	8.0	1145	0.80
15	7.99	23.5	7.9	1155	0.80
20	7.96	19.0	5.0	1180	0.85
25	7.97	17.0	5.0	1180	0.85
30	7.99	23.0	6.1	1185	0.80
35	8.10	23.0	6.5	1185	0.85
40	7.99	16.5	9.1	1290	0.85
45	8.40	19.0	7.0	1210	0.80

The maximum **pH** measured in August was 8.4; and the minimum, 7.87. These values are very close to those obtained in the other seasons. This range of pH is favorable for all uses of water and the variation of pH with respect to depth is not significant.

In Altinkaya Reservoir, **salinity** changed between 0.70 ‰ (parts per thousand) and 0.85 ‰ in August. The change of salinity with depth is negligible and based on these salinity values, the water would be suitable for irrigation. However, for domestic uses, proper treatment would be necessary.

The values measured for **EC** changed slightly with depth, and were between 1,140 and 1,290 µmhos/cm. These values are in the range of maximum and minimum values measured in other seasons. The EC values measured in the reservoir are lower than the EC values measured in the Kizilirmak. Based on this parameter, the water would be suitable for irrigation of some crops, but it would require proper treatment if used for domestic water supply.

The vertical profile of water **temperature** in August was between 24.5°C and 16.5°C. The temperature at the surface was 24.5 and did not appreciably change with depth to 15 m. Below 15 m, temperature decreased to 17 °C at 25 m, then became 23°C between 30 m and 40 m, and decreased to 16.5°C at 40 m. Thus, a thermocline was apparent below 15 m.

Dissolved oxygen levels in Altinkaya Reservoir were 100 % to 105 % air saturation in the upper 10 meters and above 8.0 mg/L to a depth of 13 m. Within the

thermocline, the DO values in the reservoir did not deplete below 5.0 mg/L (53 % air saturation) and similar characteristics are expected in the future Boyabat reservoir. The water is suitable to support aquatic life in the reservoir with this amount of DO. The minimum DO values were observed at 20 and 25 m depths and DO values began to increase again below 30 m depth, reaching 7.0 mg/L at 45 m depth.

VI.1.4.2.4. Sedimentation

The sedimentation of the Boyabat Reservoir has been discussed previously. Suspended and bedload sediment carried by the Kizilirmak River will settle in the Boyabat Reservoir. These river-borne particles will cover the bottom of the reservoir, forming a silt/sand substrate in the upper portion of the Boyabat Reservoir.

VI.1.4.2.5. Eutrophication

When an excessive amount of carbon (C), phosphorus (P) and nitrogen (N) are introduced into a lake, the nutrients promote the growth of algae, which, when it dies, sinks to the bottom and becomes a source of carbon for bacteria. Aerobic bacteria will use the available dissolved oxygen and create anaerobic conditions in the bottom waters (hypolimnion). As more algae is produced in the surface waters (epilimnion), the bacteria in the lower portions will use more oxygen. If the process continues for an extended period of time, the mid-waters (metalimnion) might also become anaerobic. The aerobic biological activity would then be concentrated in the upper part of the lake. All these processes cause turbidity, thus decreasing light penetration and limiting algal activity. The amount of DO contributed by the algae is then further decreased. Because of limited light penetration, the algae concentrate on the surface of the lake forming algae blooms.

Incoming phosphorus, nitrogen, and carbon are the primary water quality parameters affecting eutrophication. The nitrogen and phosphorous values measured in Altinkaya Reservoir are very low. Phosphorus is generally the parameter controlling the level of eutrophication. The phosphorus values measured in Altinkaya Reservoir, which exhibits oligotrophic conditions, are very low, being 0.02 mg PO_4/L on the average. These phosphorus levels, and the existing nitrogen levels, indicate that eutrophication is not a problem in Altinkaya, and will not likely be a problem in the Boyabat Reservoir. It is also likely that turbidity and BOD in the Boyabat Reservoir (usually) will not be high. This conclusion is supported by the secchi disk and dissolved oxygen measurements in Altinkaya Reservoir. However, the primary productivity of the Boyabat Reservoir is expected to be higher than the river, and this would enhance fish production.

VI.1.4.2.6. Reservoir Thermal Stratification

If heat is not distributed evenly throughout a reservoir, but rather, heating occurs to limited depths, density differences occur leading to thermal stratification (the dividing of the reservoir into horizontal layers of differing temperature and density). Inflowing water may travel through a thermally stratified reservoir in one of several ways

depending upon the temperature of the inflow. During summer, when the reservoir is strongly stratified, no remarkable density overflow or underflow is expected. Because the temperatures of the inflowing water and the surface of the reservoir are about the same, the inflow will find its own density layer, the top layer in this case, and flow through the reservoir as a density interflow. However, during spring and fall, when the temperatures of the reservoir and the inflow may be different, density overflow or underflow can occur. Density overflow would occur in spring, when the inflow is warmer than the reservoir. Density underflow is expected in fall, when the lake is warmer than the inflow.

Reservoirs result in many improvements in the water quality for most water uses. Nevertheless, the chemistry and the aquatic biota of impounded water, whether isothermal or stratified, inevitably will differ from that of the original free flowing stream. In isothermal reservoirs, temperature has much less effect on reservoir water quality than in stratified impoundments.

Thermal characteristics of the Boyabat Reservoir are anticipated to be similar to those of the downstream Altinkaya Reservoir. Vertical profiles of temperature in Altinkaya Reservoir during the 1997 field studies are plotted in Figure VI.6, and by sampling season, for each of the DSI sampling stations during 1988-1989, in Figure VI.7, Figure VI.8 and Figure VI.9. From the plots, it can be observed that, during spring and fall, measurements at each station produced similar results. In March 1988, the surface water temperature was found to be between 10 to 12 °C, and the temperature, at depths where final samples were taken, decreased to 8 °C. Likewise, in fall, there was not an appreciable difference between the temperatures at the reservoir surface and deeper portions. In October 1988, temperature was unchanged throughout the sampling depths to about 40 m, and the average temperature was 20.1 °C at each station. At station 1, the lake depth reaches about 90 meters. In October 1988, the temperature began to decline below 40 m depth at this station, and decreased to 10 °C at the bottom of the lake.

As expected, the reservoir undergoes seasonal variations in water temperature and as the warmer weather approaches, the top layers begin to warm. Because water is poor conductor of heat and warmer water is lighter, a distinct temperature gradient is formed. As heat is not distributed evenly, but rather, heating occurs to limited depths, density differences occur leading thermal stratification. The vertical temperature profiles in Altinkaya Reservoir (Table VI.11.) show the seasonal change in temperature with respect to depth. Profiles in the summer season indicate that there is strong stratification in the reservoir.

The thermal stratification phenomenon can be seen in Altinkaya Reservoir from the data obtained for June 1989 and August 1997. In June 1989, the thermocline began at a depth of approximately 10 m and the hypolimnion began at about 30 m. During August 1997, the thermocline formed below about 15 m. Because the water intake at the Altinkaya Hydroelectric Project is about 30 m below the maximum water surface elevation, water is drawn into the turbines from the hypolimnion during the

summer. This coldwater release from Altinkaya supports a commercial trout venture in the Derbent Reservoir downstream of Altinkaya.

A similar situation will occur at the water intake structure of the Boyabat Project. The top of this structure will be at an elevation of 305 m (at a depth of 25 m from the maximum water level) and the bottom of the structure will be at 295 m (at a depth of 35 m from the maximum water level) elevation. Thus, the water discharged from the Boyabat Project will also be from the cooler hypolimnion level.

Cold bottom water releases from stratified impoundments will affect the aquatic flora and fauna downstream from the dam. Fish have optimum temperatures for growth and reproduction. They also show a preference for water of a definite temperature range. If the temperature of the water below a dam is decreased, it is probable that some fish species will avoid that portion and migrate to other reaches. These species may be replaced by coldwater species of fish. Warmwater species presently living downstream of the Boyabat Project can be expected to continue to survive in the Gokirmak during periods of cold water releases. Thus, without any direct mortality, the composition of the fish community downstream of the Boyabat Dam will change in response to these temperature changes.

At maximum water level, Altinkaya Reservoir may reach to nearly within 3 km of the Boyabat Dam, leaving 3 km of river environment. However, because of the drawdown of Altinkaya Reservoir (Photograph VI.1), the reservoir presently ends approximately 15 km downstream of the Boyabat Dam axis. The distinction between the end of the river and the beginning of Altinkaya Reservoir can be seen in Photograph VI.2. Thus, during the drawdown, the riverine portion below Boyabat will have more potential to warm during the summer months. This may mitigate the impact on warmwater species, but may also limit the suitability of the area for coldwater species.

Table VI.11. Depth versus Temperature Values in Altinkaya Reservoir

	Temperature (°C)											
	March 1988				October 88				June 1989			
Depth (m)	Station I	Station II	Station III	Station IV	Station I	Station II	Station III	Station IV	Station I	Station II	Station III	Station IV
0	10.0	12.0	11.0	11.0	21.0	21.0	19.5	19.5	20.0	25.0	24.0	24.0
5	10.0	10.4	10.0	10.0	20.5	21.0	19.5	19.5	18.5	21.0	21.0	22.0
10	10.0	10.0	9.8	9.5	20.5	21.0	19.5	19.5	17.0	20.0	20.0	21.0
15	10.0	10.0	9.6	9.4	20.5	21.0	19.5	19.5	16.5	18.0	18.0	20.0
20	10.0	9.8	9.5	9.2	20.5	21.0	19.5	19.5	15.0	13.0	15.0	15.0
30	9.6	9.5	8.5	8.0	20.5	21.0	19.5	19.5	12.0	10.0	9.0	12.0
40	9.2	9.0	8.0	7.6	20.0		19.5		9.0	8.0		
50	8.6	8.6	8.0		18.0				8.5			
70	8.5				13.5				8.0			
90	8.0				10.0				7.5			

VI.1.4.2.7. Reservoir Dissolved Oxygen Vertical Profiles

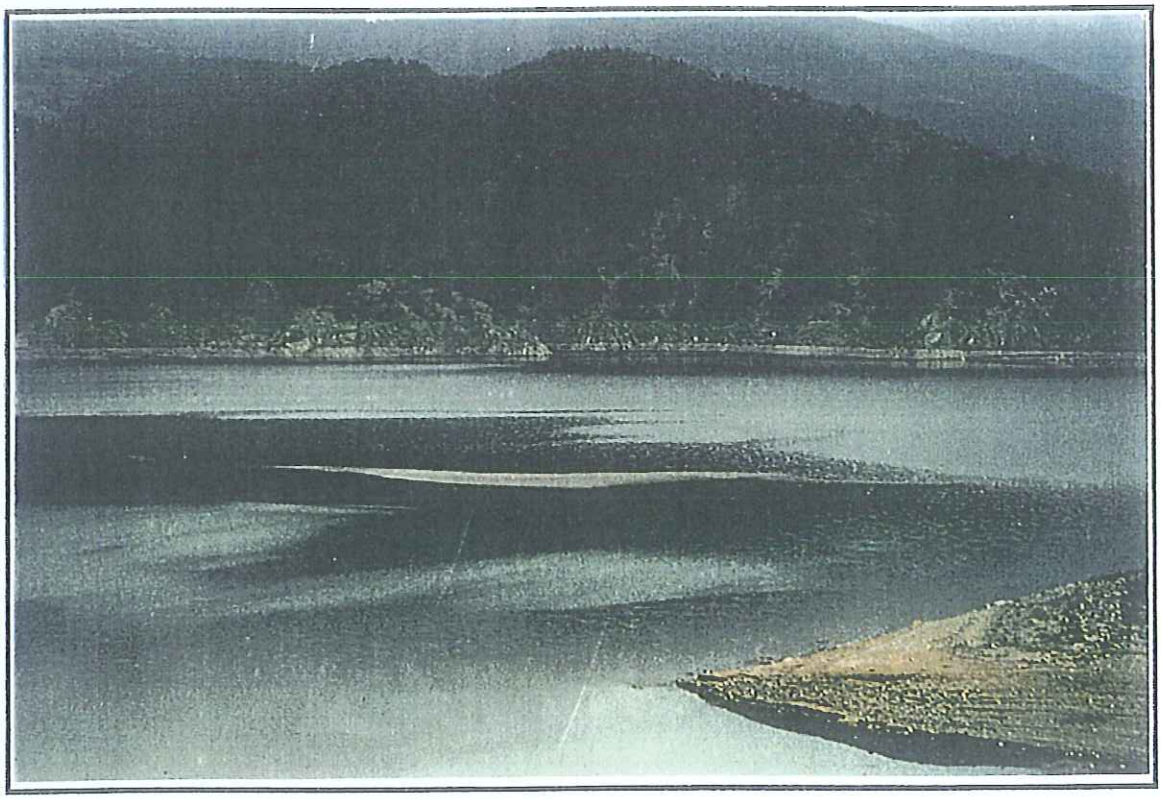
Stratification of a reservoir will indirectly lead to changes in other water quality parameters. Thermal stratification creates a density barrier, thus the hypolimnion can become depleted in DO. The epilimnion maintains high DO levels through surface reaeration and photosynthetic activity; DO often becomes supersaturated during the day due to photosynthesis. In productive reservoirs, epilimnetic production of biomass leads to a rain of organic material in the form of dead plankton which settle down through the water column and into the hypolimnion. Decay of this organic matter depletes DO and eventually the hypolimnion may become anaerobic.

The vertical profiles of DO in Altinkaya Reservoir at different stations are given in Table VI.12 and show just slight differences with depth. DO concentration, with respect to depth, is almost constant in October and March 1988. The maximum DO concentrations are observed at the water surface (as expected) and were found to be 12 mg/L in March and 7 mg/L in October. In October, DO concentration remained fairly constant through the depth of the reservoir. At a depth of 30 meters, DO concentration was recorded as 6.5 mg/L, indicating 70 percent saturation. Percent saturation of DO declined to about 50 below 40 m depth, but DO concentrations did not go below 6.0 mg/L in October. The DO concentrations in March fluctuated between 9 and 13 mg/L, but DO did not drop below 9 mg/L at any depth. The change of DO with respect to depth is plotted, for each sampling season, for each station in Figure VI.10, Figure VI.11 and Figure VI.12.

In June, the concentration of dissolved oxygen remained around 9 to 10 mg/L, and it did not drop below 7 mg/L at any depth. At the surface the maximum recorded concentration in June 1989 was 12 mg/L at Station I. From these data it can be seen that biologically adverse low levels of dissolved oxygen did not develop with depth in the reservoir. There was sufficient oxygen for the existing productive organic activity, and no significant depletion of oxygen occurred at any depth.

Dissolved oxygen concentrations are closely related to water temperature and the level of percent saturation of a gas is temperature dependent (Corbitt, 1989, AWWA, 1990). This phenomenon can easily be seen from the data for Altinkaya Reservoir. A seasonal comparison of dissolved oxygen and temperature for Altinkaya Reservoir and the Kizilirmak River are given in Table VI.13. Because water is released at 30 m depth (when the reservoir is full) during Altinkaya Project operation, the average of the dissolved oxygen and temperature values at this depth are listed to obtain some idea of the possible effect of release such waters from the Boyabat Project on the river environment.

Photograph VI.1. Drawdown at Altinkaya Reservoir



Photograph VI.2. Distinction Between the End of Altinkaya Dam Lake and The River

Table VI.12. Depth versus Dissolved Oxygen Values in Altinkaya Reservoir

	Dissolved Oxygen																							
	March 1988								October 1988								June 1989							
Depth	Station I		Station II		Station III		Station IV		Station I		Station II		Station III		Station IV		Station I		Station II		Station III		Station IV	
m	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%	mg/L	%
0	12.6	111	12.5	115	11.6	104	12.7	115	7.0	78	7.5	83	6.5	65	6.5	65	12.0	131	8.0	95	9.0	105	10.0	117
5	12.2	107	12.5	110	11.5	102	12.7	112	7.0	78	7.0	78	6.5	65	6.5	65	11.0	118	9.0	100	8.0	89	9.0	102
15	11.8	104	11.6	102	11.3	100	12.1	104	7.0	78	7.0	78	6.5	65	6.5	65	10.0	103	9.0	94	6.0	63	8.0	87
20	11.6	102	11.4	100	11.2	97	11.4	98	6.5	72	6.5	72	6.5	65	6.5	65	9.0	89	9.0	85	7.0	69	8.0	79
30	10.0	88	9.5	84	10.6	91	11.2	94	6.5	72	6.5	72	6.5	65	6.5	65	9.0	83	9.0	79	9.0	78	8.0	74
40	9.2	79	10.0	86	11.0	93	11.1	93	6.0	65			6.5	65			9.0	78	9.0	76				
50	9.6	83	10.6	92	10.8	91			6.0	63							9.0	77						
70									6.0	58							9.0	76						
90									6.0	53							9.0	75						

Table VI.13. Comparison of Dissolved Oxygen and Temperature Values in Altinkaya Reservoir and Kizilirmak River Waters

	Temperature (°C)		Dissolved Oxygen (mg/L)	
	Altinkaya Reservoir (at 30 m depth)	Kizilirmak River	Altinkaya Reservoir (at 30 m depth)	Kizilirmak River
March, 1988	9.6	11.0	10.3	12.2
June, 1989	12.0	21.0	8.8	9.0
August, 1997	23.0	23.8	6.1	8.4
October, 1988	20.5	13.5	6.5	9.0

VI.1.4.3. Evaporative Loss and Effects of Downstream Releases on Water Quantity and Quality

As shown above, thermally stratified reservoirs can have a large effect on the quality of the water discharged downstream. When these reservoirs have low-level intakes, low temperature and reduced DO waters are released. This is well demonstrated in the case of Altinkaya.

The evaporative loss, because of releasing cold hypolimnial water, would not significantly increase. In addition, the annual evaporation estimated for Boyabat Reservoir is 640 mm, which is not a significant amount compared with the reservoir volume.

When Altinkaya Reservoir is full, the Boyabat Project will be located about 3 km upstream. As a result, the downstream effects on aquatic life and water quality by the project would be limited. However, when Altinkaya Reservoir is drawn down to its present level, the riverine portion of the Kizilirmak between the Boyabat Dam axis and the upstream end of the reservoir is about 15 km. Under these conditions, the effect of the Boyabat Project on the riverine biota will be much greater. However, for the most part, it is anticipated that the Boyabat Project will supply better quality water to Altinkaya than the existing conditions. Nonetheless, the present seasonal flow patterns in the section of the river between the Altinkaya Reservoir and the Boyabat Dam will change to reflect the generation pattern at the Boyabat Project.

VI.1.4.4. Sanitary Risk

The main parasitic diseases that could develop or spread due to the development of a reservoir are summarized in Table VI.14. According to the studies and statistics of The Ministry of Health, among the parasitic diseases, only Malaria is found in Turkey. However, this disease has not been seen in the Black Sea Region, where the Project area is located, because of the weather conditions. The viral disease, Dengue Fever, has been recorded occasionally in Turkey, but only a few scattered cases have been reported. No adverse health impacts have been reported to have occurred as a result of developing the Altinkaya or Derbent Reservoirs.

The Boyabat Reservoir will not be used as a source of drinking water for any of the people in its vicinity. For this reason, bacterial diseases (such as diarrhea) are not expected to deveop or spread as a result of the impoundment. Therefore, the Boyabat Project will not impose any increased risk to human health.

Table VI.14. Main Waterborne Diseases

Diseases	Means of Transmittal	Presence in Turkey
Parasitic		
Malaria	Mosquitoes (Anopheles) with part of their life cycle in aquatic surroundings	Yes
Onchocercosis	Transmittal by sandflies (dipterous) with part of their life cycle in aquatic surroundings	No
Schistosomiases	Molluscs (whelks and planorbid snails) serving as intermediary host	No
Filariasis	aquatic crustacea (Cyclops) intermediary host of the Guinea worm	No
Viral		
Yellow Fever	Mosquitoes (Aedes) with part of life cycle in water	No
Dengue Fever	Mosquitoes (Aedes) with part of life cycle in water	Sporadic cases
Bacterial		
Various infectious cases of diarrhea	Transmitted by means of fecally-contaminated water (and containing for example Collibacillus, Vibrio, Salmonella, Shigella, etc.	Yes

VI.1.4.5. Groundwater and Springs

The impoundment of water in the reservoir will most probably result in some subsequent rise in the water table level in the close vicinity of the reservoir. However, no significant leakage from the reservoir is expected because of the characteristics of the geological formation (limestone) in the area. This formation will provide a watertight barrier (except at the locations indicated above under geology,which will sealed by grout). Grouting will be done using the grouting galleries, and grout curtains will be installed at the dam site.

The baseline water quality data show no appreciable differences for the parameters measured in the groundwater and the river. The water quality in Altinkaya Reservoir is similar to the quality in the Kizilirmak. Thus, the Boyabat Reservoir should not have any particular impact on the water quality of the groundwater aquifer.

VI.1.5. Impacts of Impoundment on the Water Use

Irrigation (primarily for rice production) is the main existing domestic use of river water. The rice fields in the Boyabat Reservoir area will be inundated by the project. After impoundment, a rise in the groundwater table is expected. Thus, both the reservoir and groundwater would be available to irrigate the remaining fields and orchards surrounding the project.

The terrestrial faunal species would be able to use the reservoir as a source of water. The impact of the impoundment on the aquatic biota and the faunal species living in the area are discussed in more detail in Sections VI.2.1 and VI.2.2.

VI.1.6. Impacts of Noise and Blasting

The effects of project construction and operation on villages surrounding the project were evaluated. Because the nearest settlement to the dam site (Kepez) is 4 km away, the impacts of construction (due to blasting during excavation and noise from the site) on this settlement is not expected to be objectionable to the inhabitants. In addition, construction of the access roads, and then use of these roads by the trucks and construction machines will not adversely affect Kepez.

VI.2. Biological Environment

Dam and hydroelectric power projects have many direct and indirect effects on the environment, though they do not cause significant pollution problems. There are positive and negative effects of these projects, including the changes in the biological environment.

By the construction of the dam, riverine and terrestrial habitats are transformed into a lentic environment. The area covered by the reservoir is no longer a river habitat and terrestrial ecosystem, but becomes more like a lake ecosystem. Reservoirs, however, do not behave quite like natural lakes, which retain water and nutrients for long periods. Reservoir water frequently has a short residence time, depending largely on how the dam is operated. The topography also is influential. The water body of the proposed reservoir has a significant impact on the limnetic ecosystem. This artificial water body will have a maximum capacity of about $3{,}557 \times 10^6$ m^3, a length of 60 km and cover an area of 6,540 ha.

Depending on the topographical conditions of the Boyabat Reservoir shoreline and the annual drawdown in the reservoir, different types of habitats will be formed. The annual fluctuation in the reservoir surface elevation is expected to be less than 3 m, but this is sufficient to exert a considerable effect on the littoral ecosystem, depending on how long the surface remains at the maximum and minimum levels. As Altinkaya demonstrates, vegetation that grows when the water is high is desiccated when the surface drops, and plants established when the water is low are denied light when it is high. This tends to result in a lack of aquatic vegetation in the drawdown zone. The development of water dependent vegetation along the shoreline, which may occur in hollows and depressions, is beneficial for waterbirds and some mammals. For wildlife, this water dependent vegetation will serve as a nesting place and feeding ground .

Terrestrial plants vary in their tolerance to flooding. Although many plants will be unable to survive near the reservoir edge, others, such as willows, are able to tolerate alternate periods of flooding and drying. The altitudinal distribution of common plant species identified in the project area are given in Table A5.1. As can

be seen from this table, no plant species currently exist solely below the maximum water elevation of the future reservoir, so no plant species in the area would be completely lost. A number of species will be substantially affected by the impoundment, but all of these are widespread.

Access roads and the diversion tunnels of the Boyabat Project are already constructed, imposing minor effects on the forests in the area. During dam construction, there can also be negative impacts on the wildlife, as existing habitat in and around the dam site would be degraded to some extent. Most medium to large mammals and birds will leave the area, due to the noise, dust, and human activity of construction.

Although the proposed reservoir will be very narrow in most places, it will be an obstruction for terrestrial animals to cross to the other side of the valley. However, since these are casual movements, the negative impact of the future reservoir on some members of fauna in this respect, would not be significant. At present, there are few bridges permitting people, and wild and domestic animals to cross the river. The reservoir will have a slight negative impact on some members of the fauna in this respect.

VI.2.1. Effects on Aquatic Fauna

The development of the Boyabat Project will affect the existing aquatic fauna by the formation of a reservoir and by downstream releases from the dam. The formation of the reservoir will inundate riverine habitats and change existing water quality. The water quality of downstream releases will be different from that presently existing in the river due to the water quality changes in the reservoir, and project operation will alter present flow patterns. All these changes will affect the aquatic biota in the project area.

VI.2.1.1. Effects of Reservoir on the Aquatic Biota

The aquatic fauna in the project area will change with the development of the project due to the formation of the reservoir. The faunal elements that live in flowing waters will be replaced by lake dwelling species. Most of the fish species in this basin can readily adapt to this new environment. Nonetheless, with the development of the Boyabat Reservoir, the composition of the fish community will likely shift from that found in the 1997 aquatic studies of the Kizilirmak River (Table A5.10, Annex 5) to that found in Altinkaya Reservoir (Table VI.15) .

Although the species comprising the Boyabat Reservoir community will not likely change appreciably (because species such as carp, chup, zander, siraz, and barb will adapt to the reservoir environment), the percent composition of these species can be expected to change. Whereas barb was the dominant species in the river in 1997, based on the percent composition of the Altinkaya fish community, the dominant species in the Boyabat Reservoir will likely be siraz. Increases in the populations of chup, carp, chub mackerel, and zander can also be expected. Most

of these species have some economic value. Commercial fishing in the reservoir may develop for species such as carp and chup. Furthermore, a trout fishery may be established in the Boyabat Reservoir, as was the case in the Derbent Reservoir downstream of Altinkaya.

Table VI.15. Fish Species in Altinkaya Reservoir

Fish Species		Percent Composition (%)
Siraz	*Capoeta tinca* *Capoeta capoeta sieboldi*	51.2
Chup	*Leuciscus cephalus sp.*	21.2
Carp	*Cyprinus carpio*	14.5
Carp	*Cyprinus carpio var. royal*	1.0
Wels	*Silurus glanis*	4.8
Chub mackerel	*Chalcarburnus chalcoides*	0.3
Rudd	*Scardinius erythrophthalmus*	0.3

The composition of the zooplankton and phytoplankton communities will also change from that of the river to that of a lacustrine environment. Based on studies in Altinkaya Reservoir in March and October 1988, and June 1989, the seasonal composition of these communities in the Boyabat Reservoir will likely be similar to those shown in Table VI.16.

Table VI.16. Zooplankton and Phytoplankton Composition in Altinkaya

	March 1988	**October 1988**	**June 1989**
Phytoplankton Species	Composition (%)	Composition (%)	Composition (%)
Bagillariophycae	94.7	2.2	7.8
Chlorophyceae	4.8	1.2	3.5
Dinophyceae	0.4	87.2	76.4
Euglenophyceae	0.1		
Cyaneophyceae		9.2	12.3
Rhodophyceae		0.2	
Zooplankton Species	**March 1988**	**October 1988**	**June 1989**
Cladocera	1.1	39.2	49.1
Copepoda	2.8	28.2	33.3
Rotifera	93.8	22.4	17.6
Ciliata	2.3	10.2	

VI.2.1.2. Effects of Reservoir Releases on Downstream Biota

The relation of the depth of the thermocline to the depth of the water intake will have an effect on the downstream biota. Depending on season, the existing fauna will change due to the quality of water released by the project. If water is drawn from the epilimnion, the downstream release may be equivalent to, or warmer than,

normal river temperatures, and will have DO levels near air-saturation. If drawn from the hypolimnion, the downstream release will be colder than normal river temperatures, and may have reduced levels of DO. In any event, as seen in Table VI.13, the temperature of the downstream releases from Boyabat can be expected to lag behind the normal temperature cycle in the river. These physical changes will affect the seasonal distribution and abundance of downstream aquatic species.

When the Boyabat Reservoir is at its maximum elevation, water will be released from a depth of 25 to 35 m. As indicated in the Water Quality Section, the temperature and dissolved oxygen conditions in Altinkaya Reservoir provide a good indication of the likely conditions in the Boyabat Reservoir. In summer, if water is drawn from an average depth of 30 m, the downstream release water temperature at Boyabat (assuming it is similar to Altinkaya Reservoir) can be expected to be between approximately 12°C and 23°C. However, if the reservoir is drawn down, the release water temperature will increase. For instance, if the water depth above the intake becomes 10 m, the release water temperature at Boyabat would be between 17°C and 24°C. In summer, the river water temperature is normally between 20 °C and 23°C. The difference between the temperature of the released water and the normal temperature of the river will thus depend on the water level during operation.

The effect of reservoir releases on downstream water quality will likely result in some changes in the species composition of the downstream biotic communities. These changes may not be appreciable when the reservoir is isothermal and for releases from the epilimnion when it is stratified. However, releases of cold water from the hypolimnion when the reservoir is thermally stratified will have pronounced effects on the downstream biotic community, shifting it from predominantly warmwater species to coolwater/coldwater species. Under such conditions, it is likely that most of the present fish species would be displaced from the project tailwaters.

VI.2.2. Effects on Terrestrial Fauna

In realization of water development projects, loss and destruction of habitat are main threats for mammals, as like as other animals. Self rehabilitation for mammals is expected due to the existence of reserve places, over the elevation of 335 m Above Sea Level (ASL), for the terrestrial animals.

By the impoundment of water in the reservoir, terrestrial faunal elements are expected to escape to the nearby areas. This in turn, will push carrying capacity of the receiving sites to its limits overloading the ecosystems. In addition to this, in the region there are sites surrounding the project area that are preserved as reserves for the endangered species, such as Kargi-Kosdag, Taskopru-Elekdagi, Tosya, Vezirkopru-Karanar reserve areas. The future reservoir will not inundate any land of the surrounding reserve areas. Hunting is already prohibited in the reserve areas, with heavy punishment. In the parts that are inundated by the reservoir, terrestrial flora and fauna will be lost.

Some of the bird species affected will be visitors that live in the hills or in towns outside the reservoir area, but depend on the valley bottom for foraging. Foremost among these is the white stork, about 40 pairs of which nest between Kargi and the dam site. Eleven of these are in Yayalcili (to be inundated) and another 20 or so in Kargi. Although the neighboring towns will provide more than enough rooftops to support those pairs whose nest sites have been lost, the loss of rice fields will force most of these birds out of the valley.

Some short-term effects may be expected, both adverse and beneficial. Townspeople in towns not inundated may experience a "plague of rodents" (including meadow vole, house mouse, and black rat), nonvenomous reptiles, and amphibians (frogs and toads) as these animals are flooded from agricultural lands and villages. These small animals can attain surprising densities (up to 1,000 per hectare in voles) and may prove annoying pests for a short time.

To the extent that a littoral ecosystem develops in the reservoir, with small fish, amphibians, and insects, certain waterbirds, such as cormorants, herons, ducks, and rails may be expected to colonize the reservoir margins. As at Altinkaya, wintering waterfowl (mostly coot, in that case) probably will use the reservoir for resting and feeding.

VI.2.3. Effects on Species of International Concern

Amphibians, reptiles, birds and mammals observed during the field studies in the Boyabat Project area are listed in the relevant tables in Annex 5. In these tables, the status of fauna in the Boyabat Project area is specified according to the Convention of Bern and the European Red List categories. The Project will not adversely affect any ERL/IUCN species, but many Bern-listed species will lose habitat. None of these species is limited in its distribution. A few Bern-listed species, such as the herons and waders, may benefit from the presence of the reservoir.

There are three fish species of international concern that will be impacted by the Boyabat Project. The barb, chub mackerel and wels are listed as "protected" by the Appendix 3 of the Convention of Bern (Table A5.9, Annex 5). As such, the survival of the populations of these species in the project area is required. Because all these species will adapt to the Boyabat Reservoir, the change from riverine to lacustrine habitat will not be detrimental. Further, it is anticipated that the formation of the reservoir will be generally beneficial to the populations of chub mackerel and wels.

Although the development of a reservoir will be beneficial for most life stages of the chub mackerel, the presently available spawning habitat will be reduced by the loss of riverine conditions. This species migrates from lacustrine areas to rivers to spawn. Populations of chub mackerel in the Boyabat Reservoir can migrate to suitable spawning sites upstream of the reservoir in Devres Creek and to the first upstream irrigation diversion barrier in the Kizilirmak. Populations in Altinkaya Reservoir will continue to have access to the Gokirmak and the portion of the Kizilirmak downstream of the Boyabat Dam.

VI.3. Impact on Socio-Economic Environment

VI.3.1. Impact on Population

Approximately 12,000 people will be affected and/or displaced by the project. Young males who spend most of the year away from their villages as seasonal workers would be the least affected people, because their chances of finding employment in the nearby towns are higher than those living permanently in the village. The young female population living in the villages can also be considered as a group who would be least affected by the Project, owing to the tradition of "going outside the village after getting married".

Married young men living regularly in the village and sharing the same houses with their fathers would be adversely affected by the Project to a degree, especially if their fathers use their choice of expropriation. Because, it is very likely that their fathers would take control of the compensation for expropriation. However, in such a case if they require, they would be resettled by the Government.

Children and young people in school age could have a significant chance to benefit from the education opportunities when they settle in the towns and province centers. In case of rural settlement however, education opportunities can increase or decrease according to the characteristics of the place of settlement.

The construction of the Project would have adverse effects on the elderly population. Because:

- Abandonment of the village settlement, known as "home-land" will have a negative impact, especially on elderly people. Problems such as familiarizing themselves with a new physical and social environment and the problems of adaptation will occur more frequently.

- It will be harder for elderly people who sustain their livelihood in the village by giving their land for sharecropping. They may not establish the same relations in their new place of settlement. Due to their decreasing physical capacities, it will be difficult for them to set up a new agricultural enterprise. Finding employment opportunities is equally difficult in urban areas.

- Female heads of household may have difficulty in earning their living if they now live with the support of their neighbors and relatives in their villages. Urban settlement may also be difficult for this group due to the scarcity of jobs for women in urban areas. In the case of receiving compensation for expropriation, the effective use of this money may be problematical and risky for women who are not used to dealing with money and capital.

VI.3.2. Impact on Employment

The level of education is very low among the villagers. Few villagers have occupational qualifications other than having a driving license. In the case of urban settlement, the villagers thus would be adversely affected and might remain unemployed due to their low level of education and skills.

A possible positive effect of the Project might be the provision of employment for the people in the region. People whose houses and/or land will not be submerged under the water can continue to live in the region and may find employment in the construction site and thus even could increase their incomes. It is most likely that towns in the region will not be considerably affected by the resettlement out of the area of people living in nearby villages.

VI.3.3. Impact on Social Interactions

Dispersion and disassociation of the villages and separation of the villagers from friends and relatives, due to the different choices (expropriation, urban and rural resettlement), would weaken the solidarity and dependency ties, which have been functional in case of poverty, sickness, indebtedness, and marriage.

Families that decide to live in urban places plan to move to their sons' and daughters' houses in cities. This is a reasonable behavior as far as the young people are able to support their parents. However, in case of limited wage income and overcrowding, the receiving families would also be affected by this move.

Emigration following the construction of the Project would not only cause changes in social relations, but would also affect the psychological state of the villagers. Already one can observe uneasiness among the villagers.

VI.3.4. Impact on Standard of Living and Poverty

At present, most villagers do not indicate extreme dissatisfaction with their income levels. Care must be taken during resettlement to avoid any decrease in living standards of the villagers.

The present standard of living in the villages is maintained through the participation of all members of the families in the agricultural activities. In this context, the contribution of women, children and elderly people is important. In the case of urban resettlement, the likelihood of finding employment for these groups would be quite weak.

In the villages that will be affected by the Project, the subsistence economy protects people from extreme poverty. They thus are able to consume commercial goods less frequently and to live without much cash income. In selecting urban resettlement, villagers opt to sacrifice this cushion on the expectation of achieving better living conditions in the city. This depends on the head-of-household finding a job that pays enough to make up for the lost labor of children and elderly family members.

VI.3.5. Impacts of the Project in Terms of Submersion and Living Standards

The villagers whose land will be completely or partially submerged will be affected by the Project in various ways. The realization of the Project will have different impacts on the villagers which are relatively rich and poor. Rich villagers do not prefer to leave their villages, since they are the ones whose land losses would be the highest. However, it is equally plausible that they will also have the highest opportunities of setting up a new business with their compensation. On the other hand, poor villagers may take advantage of the Project, provided that their needs are met. If resettled in productive areas and given sufficient land, the poor villagers will benefit from the Project.

VI.3.6. Impact on People Living in the Project Area

Information gathered through interviews and focus group discussions in the villages reveal that there are four main preferences among the villagers in terms of their future plans for action. The first group of villagers prefer to receive compensation for expropriation. The second group is in favor of rural resettlement. The third group wants to live in urban areas and therefore opt for urban resettlement.

Finally, the last group wants to stay in their villages despite losing part of their land, if suitable conditions are provided. Although losing part of their irrigated will cause economic difficulties for these villagers, they will have job opportunities in the construction phase of the Project.

VI.3.6.1. Impact on Those Who Opt for Expropriation

The villagers have various reasons for preferring expropriation for their immovables that will remain under the reservoir:

- Young people, both the ones living in the villages and those who work as seasonal workers, have a strong tendency to live in cities. The realization of the Boyabat Project will provide them this opportunity. Young villagers thus want their fathers to receive the compensation and emigrate together to cities.

- Elderly heads of households prefer to receive the compensation and settle in the nearest district or the town center where their children are living. They think that it would be very difficult in their old age to continue agricultural production. Therefore, living close to their children will be advantageous for them.

- As for the relatively well-off villagers, owners of large areas of land, some think that expropriation would be advantageous for them. Since most of such villagers already have houses outside of the village, they plan to set up businesses with their compensation money.

Some of the villagers in this group have ideas about how they would use this compensation, such as buying a house and setting up a business in the city or deal with trade if they already possess a house. The villagers who opt for compensation for expropriation may face problems regarding the determination of the real value of their property. However, if they think that the compensation is not the real value for their expropriated property, they may bring suits for value increase. In the case of payment of the compensation in installments, their attempt to set up a business or to buy a house would be delayed.

VI.3.6.2. Impact on Those Who Opt for Resettlement

There are two possible types of resettlement, rural and urban. The group preferring rural resettlement consists of adults and some of the elderly in the middle or lower middle income categories. Young villagers are mostly not inclined to prefer rural resettlement. Below are the reasons why rural resettlement is preferred:

- Wariness of urban resettlement and living in cities.
- The uncertainty about the advance payment of the compensation and how to use the compensation fee efficiently.
- Being accustomed to agricultural production and animal husbandry as an accepted form of activity, they are inclined to continue with such work.
- Continuation and the survival of the village traditions and social interactions, which would be better pursued in the case of rural resettlement. In addition, the solidarity would continue and less adaptation problems would be encountered.

Urban resettlement is preferred more by those villagers who have already formed links with the urban centers. Households that have sent their children either for education, or seasonal work can be considered as "semi-urban residents". Those with a skill that they think they can use, also prefer urban resettlement.

Relevant and essential capital items are provided, such as land, houses, and business premises for resettlers. Immovable property provided to the settlers by the Turkish Government can not be sold, or pledged in any manner for a period of ten years. The only exception to this rule is the use of such property as guarantee to receive credits from the Turkish Agricultural Bank. Settlers under Government sponsorship are exempt from building and land taxes for one year after the new properties are registered in their names.

VI.3.7. Impacts Created by the Project up to the Present

Boyabat Project was incorporated into the plans of State Hydraulic Works (DSI) in the late 1970's and JICA prepared a feasibility report in 1979. Later, in January 1987 design documents were completed by EPDC and three previously mentioned Turkish engineering and consulting companies. Construction of the Boyabat Project

was started in 1987 by DSI and to date, access roads to the dam site, including a bridge to the right bank, camp facilities, diversion tunnels, and access tunnels to the crest were completed.

When the studies on Boyabat Project were initiated in late 1970's, the locals in the project area were informed about the Project. With the start of the construction of project components in 1987, the villagers became aware that the Project would be realized in the near future. There have been several effects on the local people during the planning of the Project and construction of the Project components since 1987:

- The houses have not been renewed or repaired by the villagers and no maintenance services have been provided for infra-structure by the State. The State has not invested in the villages either, owing to the fact that these villages are located in the project area.

- The villagers have refrained from investing in real estate and in forest.

- The demography in the villages has changed. The younger people have emigrated out. Emigration has gained momentum and the ratio of elderly population has increased.

The environmental specialists of the United States Bureau of Reclamation had reviewed five water resource development projects in Turkey in 1993, which include the Boyabat Project as well, pursuant to an agreement between the United Nations Food and Agriculture Organization (FAO) and the U.S. Bureau of Reclamation (USBR). In the context of this study, they had carried out interviews in Yaylacili Village on January 1993. The issues mentioned above and especially the decrease in population were also mentioned during their interviews and discussed by the authors in their reports dated April 1993 (Ellis, April 1993).

As a result of these circumstances, the villagers have looked for alternatives both individually and collectively. People with savings have invested in houses in nearby towns. Some groups have attempted to purchase land to build apartments.

VI.3.8. Impacts on the Transportation Network

The Boyabat Reservoir will inundate three bridges across the Kizilirmak River, near Asikbuku, Asagidaricay, and Maksutlu. The loss of these bridges will eliminate direct contact between the villages on the right bank and the left bank, where the road parallels the river. These crossings are utilized for the movement of livestock, and for access to markets, health services, and social activities.

The road along the left bank of the river (much of which was constructed by DSI as an access road) will also be inundated by the Boyabat Reservoir. The portion of this road constructed by DSI as an access road is mostly unimproved, and is vulnerable to weather conditions. During rain storms, portions of the road are impassable. Although this portion of the road is currently being used by the local populace as a

matter of convenience, there are several alternative roads at higher elevations between the various villages and settlements. A segment of the road along the left bank (near the upper portion of the reservoir area) is paved. The main highway connecting the cities closest to the project (Havza, to the east, and Kastamonu, to the west) crosses the Kizilirmak River downstream of the Boyabat Project. Therefore, the project will not greatly affect the traffic pattern on this highway during construction or alter the route between these cities.

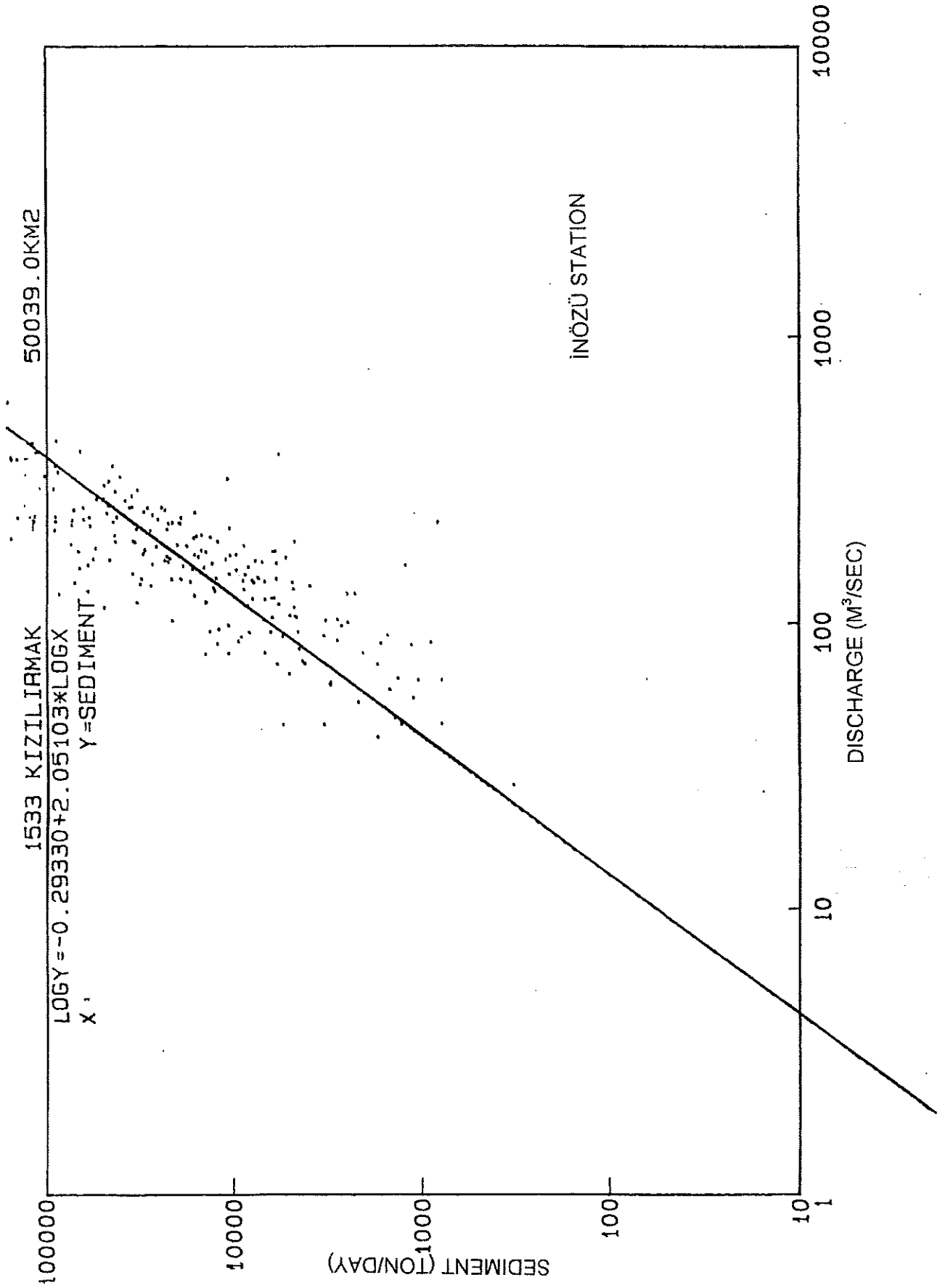


Figure VI.1. Relation between Suspended Load Concentration and Run-off at Altınkaya Dam Site

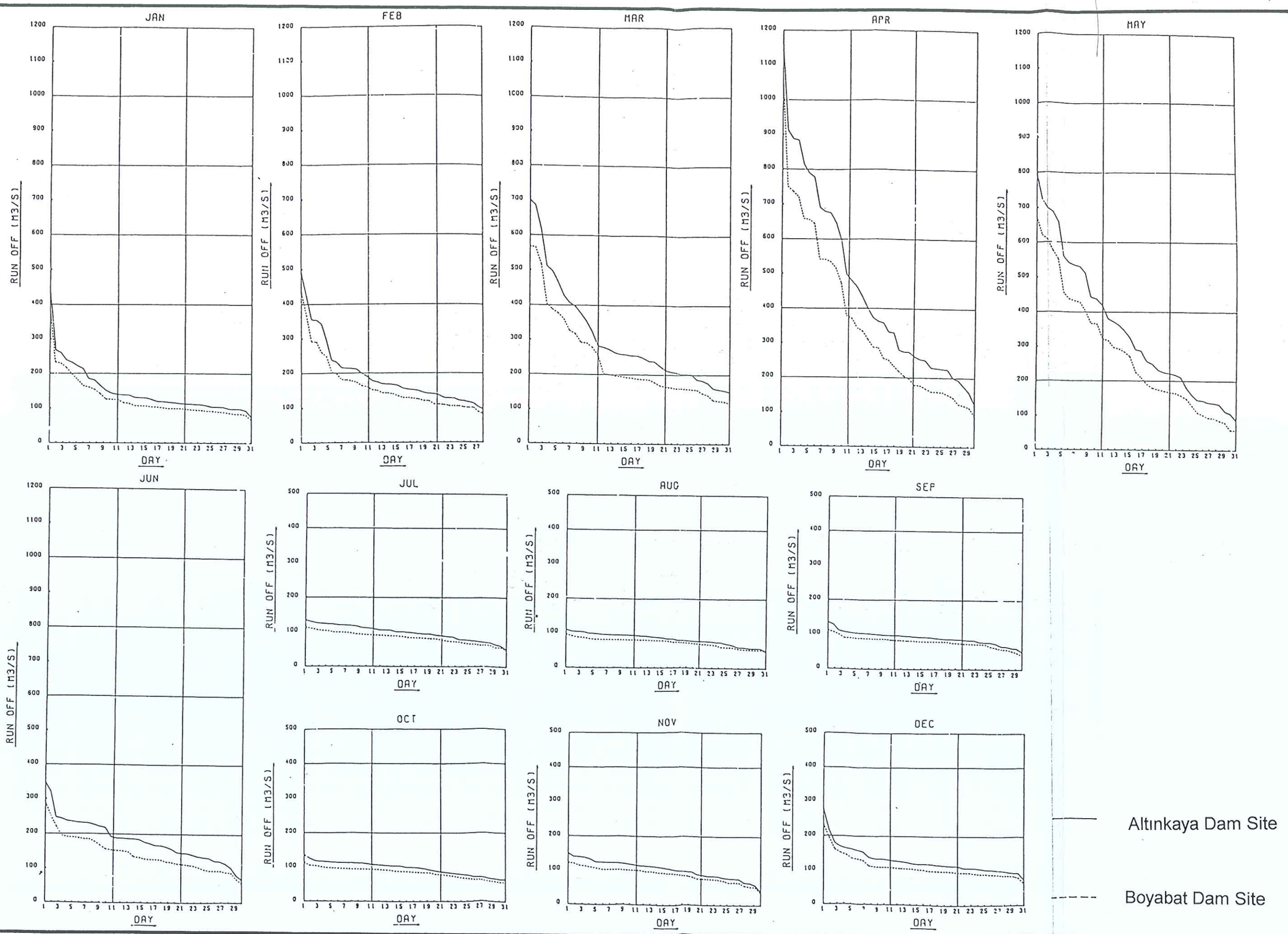


Figure VI.2. Run-off Duration Curves of Altinkaya and Boyabat Dam Sites

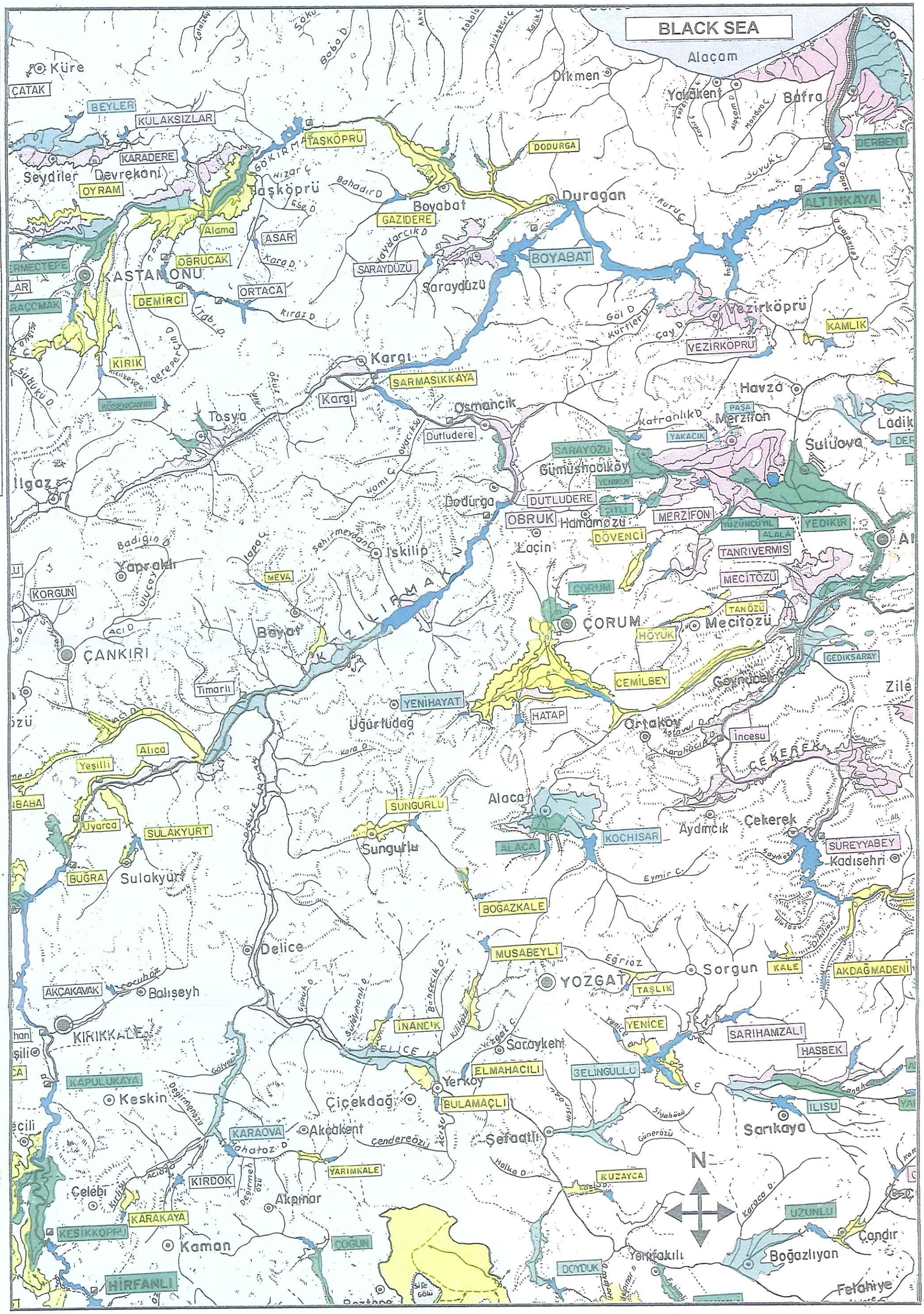
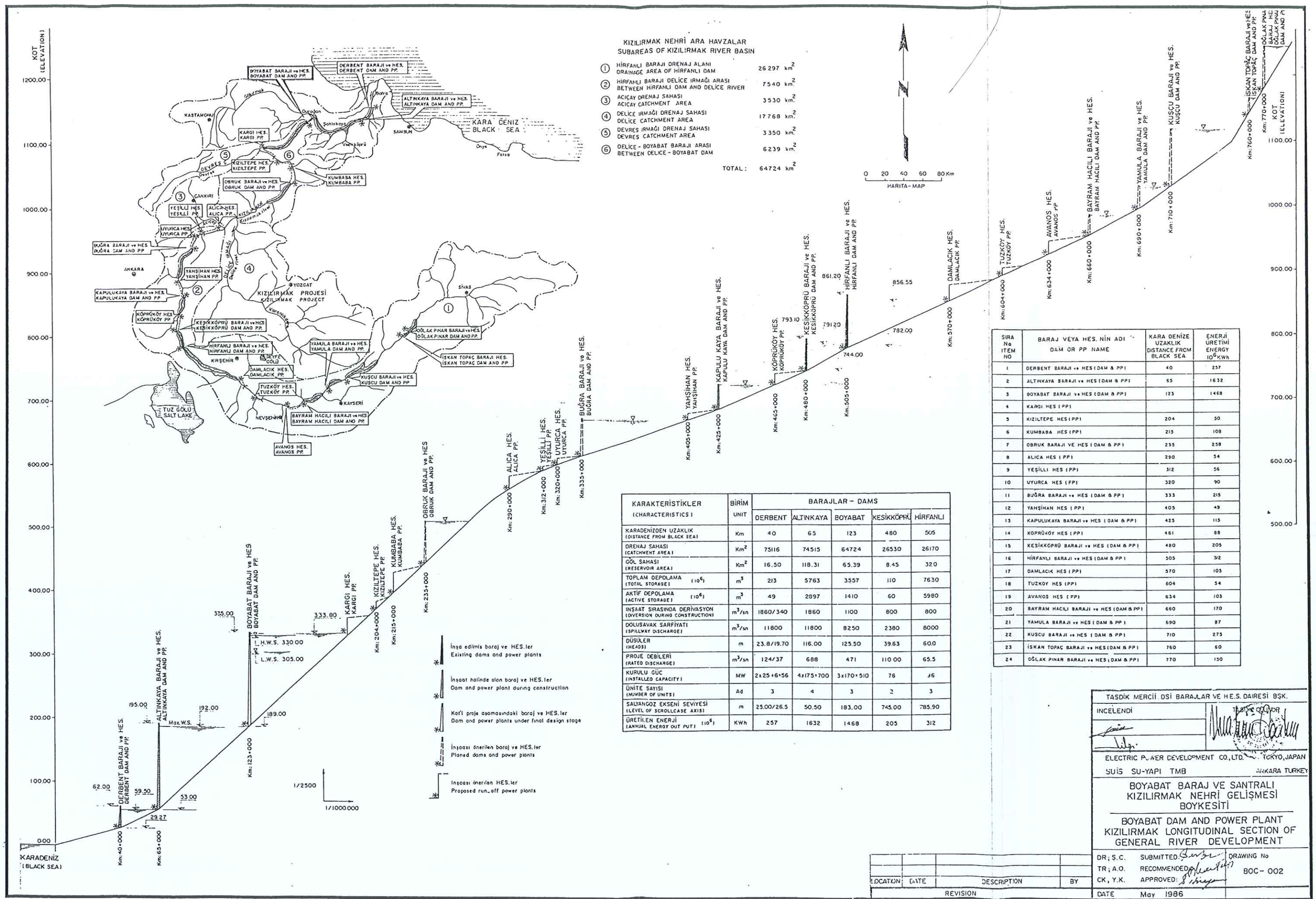


Figure VI.3. Hydro-Development Plan of Kizilirmak River



KIZILIRMAK NEHRİ ARA HAVZALAR
SUBAREAS OF KIZILIRMAK RIVER BASIN

①	HİRFANLI BARAJI DRENAJ ALANI DRAINAGE AREA OF HİRFANLI DAM	26 297 km^2
②	HİRFANLI BARAJI DELİCE IRMAĞI ARASI BETWEEN HİRFANLI DAM AND DELİCE RIVER	7540 km^2
③	ACIÇAY DRENAJ SAHASI ACIÇAY CATCHMENT AREA	3530 km^2
④	DELİCE IRMAĞI DRENAJ SAHASI DELİCE CATCHMENT AREA	17768 km^2
⑤	DEVRES IRMAĞI DRENAJ SAHASI DEVRES CATCHMENT AREA	3350 km^2
⑥	DELİCE - BOYABAT BARAJI ARASI BETWEEN DELICE - BOYABAT DAM	6239 km^2
	TOTAL :	64724 km^2

0 20 40 60 80 Km
HARITA - MAP

KARAKTERİSTİKLER (CHARACTERISTICS)	BİRİM UNIT	BARAJLAR – DAMS				
		DERBENT	ALTINKAYA	BOYABAT	KESİKKÖPRÜ	HİRFANLI
KARADENİZDEN UZAKLIK (DISTANCE FROM BLACK SEA)	Km	40	65	123	480	505
DRENAJ SAHASI (CATCHMENT AREA)	Km^2	75116	74515	64724	26530	26170
GÖL SAHASI (RESERVOIR AREA)	Km^2	16.50	118.31	65.39	8.45	320
TOPLAM DEPOLAMA (10^6) (TOTAL STORAGE)	m^3	213	5763	3557	110	7630
AKTİF DEPOLAMA (10^6) (ACTIVE STORAGE)	m^3	49	2897	1410	60	5980
İNŞAAT SIRASINDA DERİVASYON (DIVERSION DURING CONSTRUCTION)	m^3/sn	1860/340	1860	1100	800	800
DOLUSAVAK SARFİYATI (SPILLWAY DISCHARGE)	m^3/sn	11800	11800	8250	2380	8000
DÜŞÜLER (HEADS)	m	23.8/19.70	116.00	125.50	39.63	60.0
PROJE DEBİLERİ (RATED DISCHARGE)	m^3/sn	124/37	688	471	110.00	65.5
KURULU GÜÇ (INSTALLED CAPACITY)	MW	2x25+6+56	4x175+700	3x170+510	76	76
ÜNİTE SAYISI (NUMBER OF UNITS)	Ad	3	4	3	2	3
SALYANGOZ EKSENİ SEVİYESİ (LEVEL OF SCROLLCASE AXIS)	m	25.00/26.5	50.50	183.00	745.00	785.90
ÜRETİLEN ENERJİ (10^6) (ANNUAL ENERGY OUT PUT)	KWh	257	1632	1468	205	312

SIRA No ITEM NO	BARAJ VEYA HES. NİN ADI DAM OR PP NAME	KARA DENİZE UZAKLIK DISTANCE FROM BLACK SEA	ENERJİ ÜRETİMİ ENERGY 10^6 KWh
1	DERBENT BARAJI ve HES (DAM & PP)	40	257
2	ALTINKAYA BARAJI ve HES (DAM & PP)	65	1632
3	BOYABAT BARAJI ve HES (DAM & PP)	123	1468
4	KARGI HES (PP)		
5	KIZILTEPE HES (PP)	204	50
6	KUMBABA HES (PP)	215	108
7	OBRUK BARAJI VE HES (DAM & PP)	235	258
8	ALICA HES (PP)	290	54
9	YEŞİLLI HES (PP)	312	56
10	UYURCA HES (PP)	320	90
11	BUĞRA BARAJI ve HES (DAM & PP)	333	215
12	YAHŞİHAN HES (PP)	405	49
13	KAPULUKAYA BARAJI ve HES (DAM & PP)	425	115
14	KÖPRÜKÖY HES (PP)	461	88
15	KESİKKÖPRÜ BARAJI ve HES (DAM & PP)	480	205
16	HİRFANLI BARAJI ve HES (DAM & PP)	505	312
17	DAMLACIK HES (PP)	570	103
18	TUZKÖY HES (PP)	604	54
19	AVANOS HES (PP)	634	103
20	BAYRAM HACILI BARAJI ve HES (DAM & PP)	660	170
21	YAMULA BARAJI ve HES (DAM & PP)	690	87
22	KUSCU BARAJI ve HES (DAM & PP)	710	275
23	İSKAN TOPAÇ BARAJI ve HES (DAM & PP)	760	60
24	OĞLAK PINAR BARAJI ve HES (DAM & PP)	770	150

TASDİK MERCİİ DSİ BARAJLAR VE H.E.S. DAİRESİ BŞK.
İNCELENDİ
TASDİK EDİLDİ

ELECTRIC POWER DEVELOPMENT CO.,LTD. TOKYO,JAPAN
SUİS SU-YAPI TMB ANKARA TURKEY

BOYABAT BARAJ VE SANTRALI
KIZILIRMAK NEHRİ GELİŞMESİ
BOYKESİTİ

BOYABAT DAM AND POWER PLANT
KIZILIRMAK LONGITUDINAL SECTION OF
GENERAL RIVER DEVELOPMENT

DR ; S.C. SUBMITTED:
TR ; A.O. RECOMMENDED:
CK , Y.K. APPROVED:
DRAWING No BOC - 002
DATE May 1986

LOCATION	DATE	DESCRIPTION	BY
REVISION			

Figure VI.4. Longitudinal Section of General Kizilirmak River Development

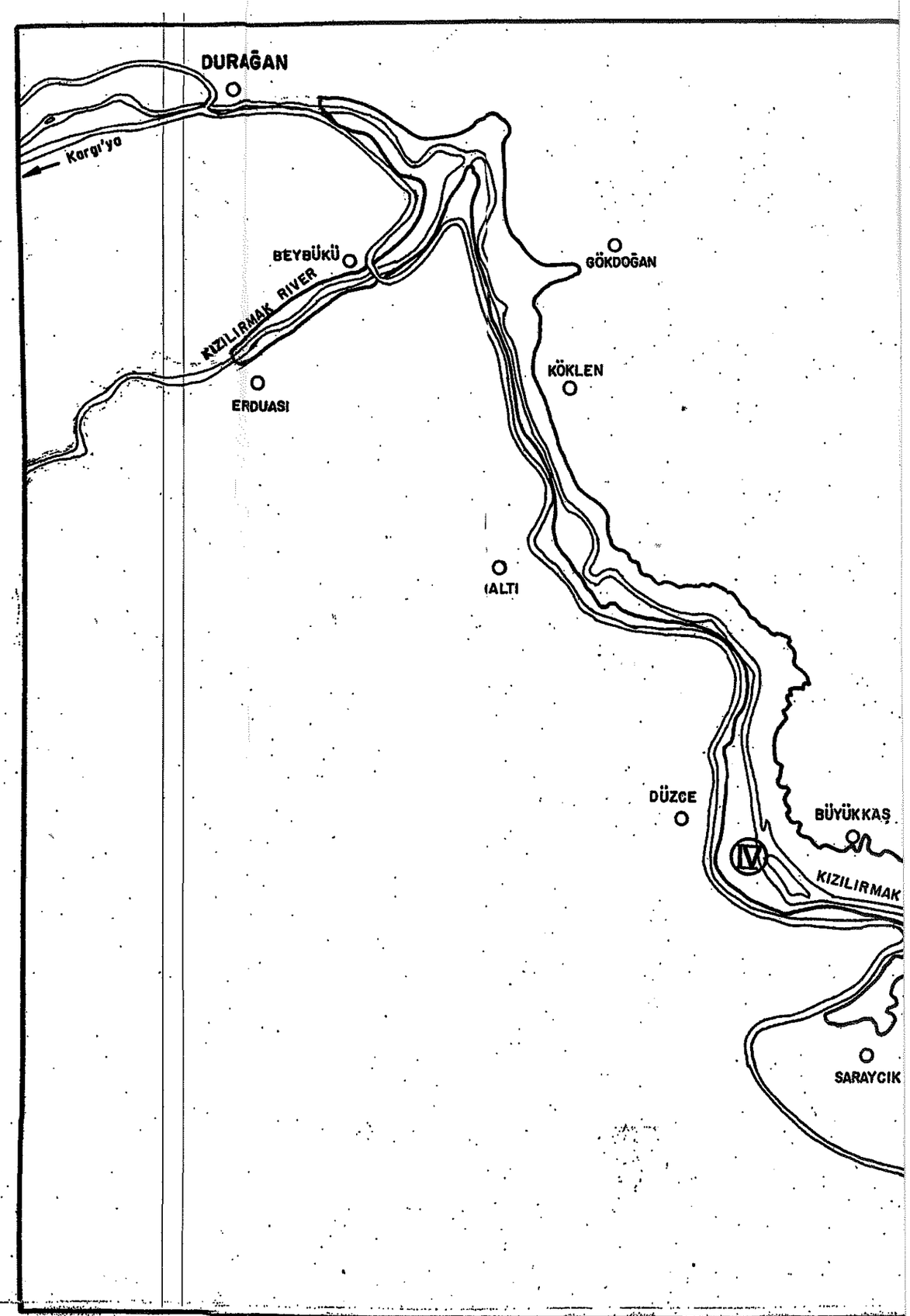


Figure VI.5. Sampling Stations in Altinkaya Reservoir

ALTINKAYA DAM

KIZILIRMAK RIVER

Koçaçay Stream

Çaltak Stream

IĞDİR

I

AĞLANÇAYI

AKALAN

GÖKALAN

BENGÜ

ALAÇAM

YOLPINAR

KURUÇAY

II

KAPLANGO

ALANCIK

YESİLADA

TÜRKMENKÖYÜ

BOYABÜKÜ

ÇALTICAK

SALARKOLU

YAĞBASAP

KARANAR

III

KIRATBÜKÜ

ÇELTEK

ÖRENÇİK

KAPLANCIK

KABALI

AKÇAY

ASAĞINARLI

SARAYLI

Girlan Stream

I II III IV Sampling Locations

İNKAYA

SCALE: 1/100 000

1 0 1 2 3 4 5 km

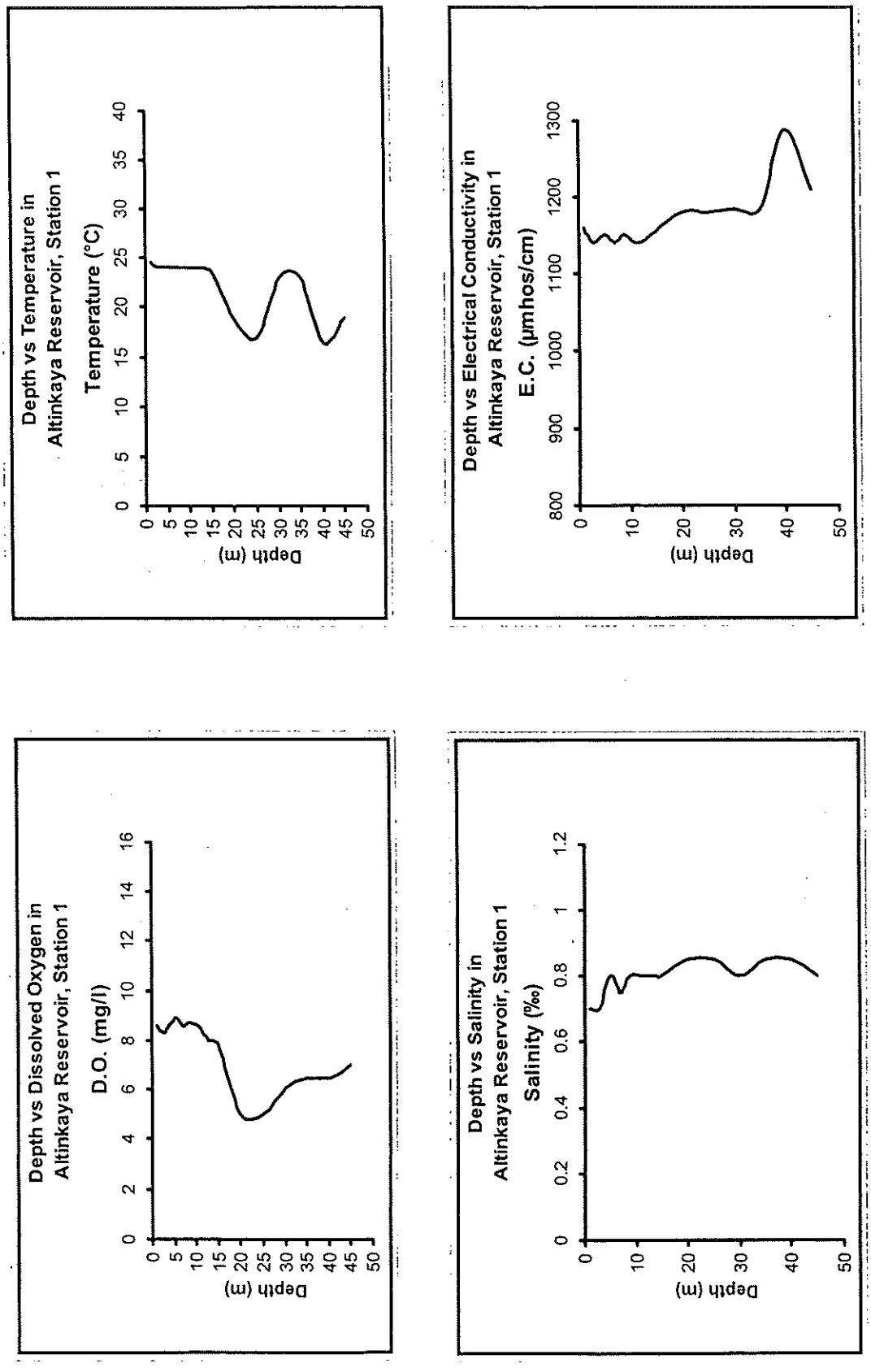


Figure VI.6. Change of D.O. Temperature, Salinity and E.C. with Depth, August 1997

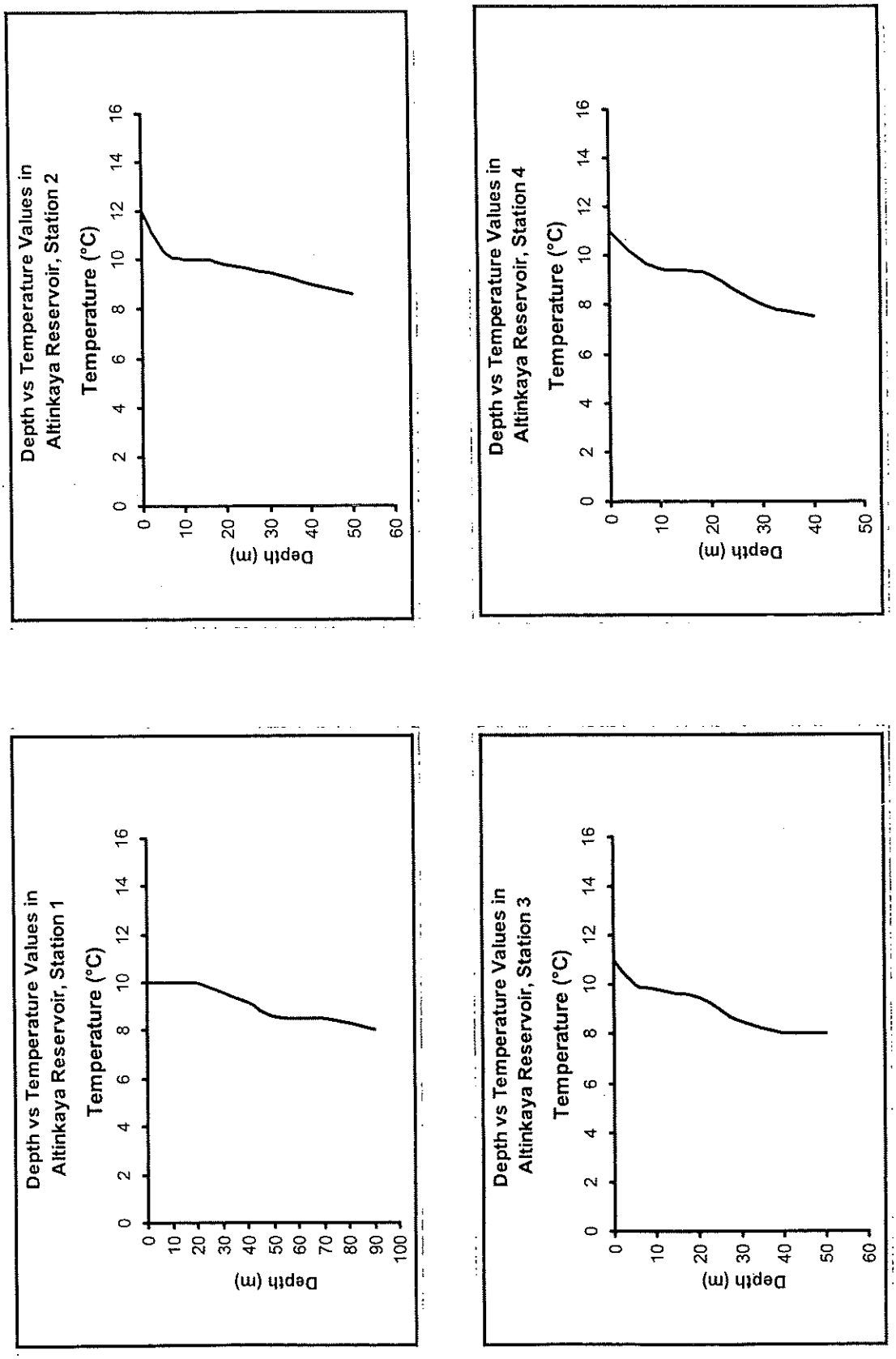


Figure VI.7. Change of Temperature with Depth in Altinkaya Reservoir, March 1988

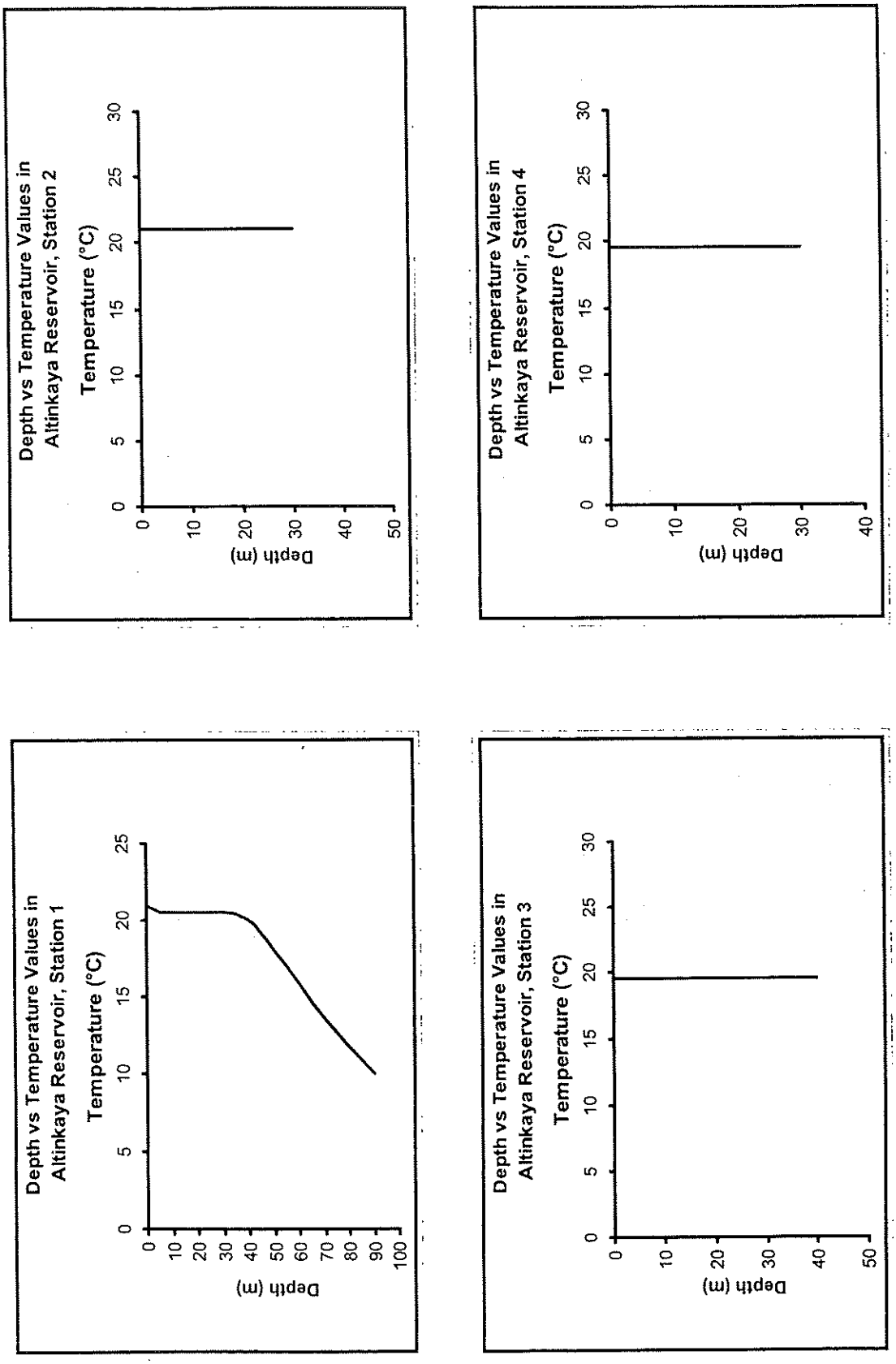


Figure VI.8. Change of Temperature with Depth in Altinkaya Reservoir, October 1988

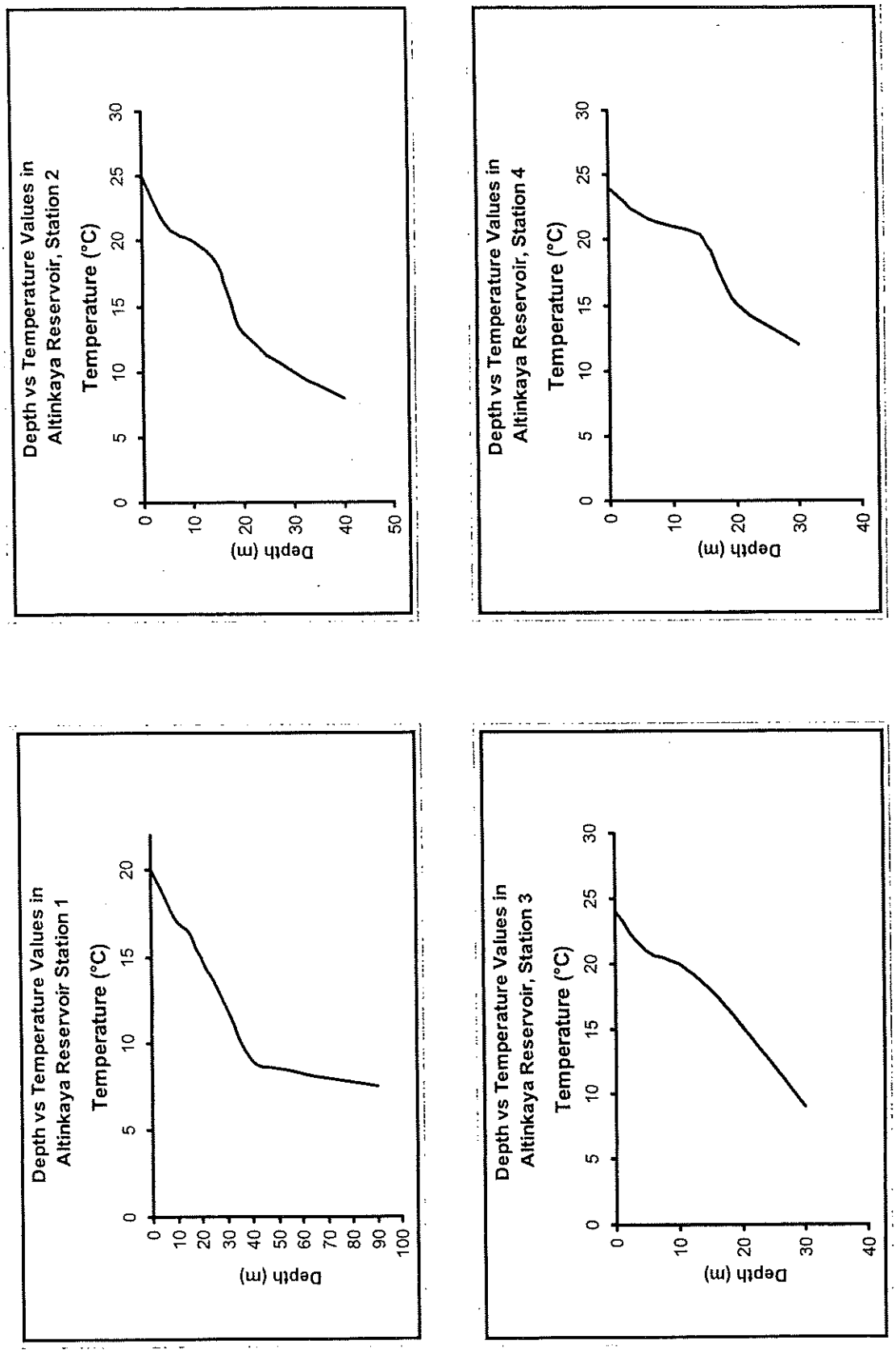


Figure VI.9. Change of Temperature with Depth in Altinkaya Reservoir, June 1989

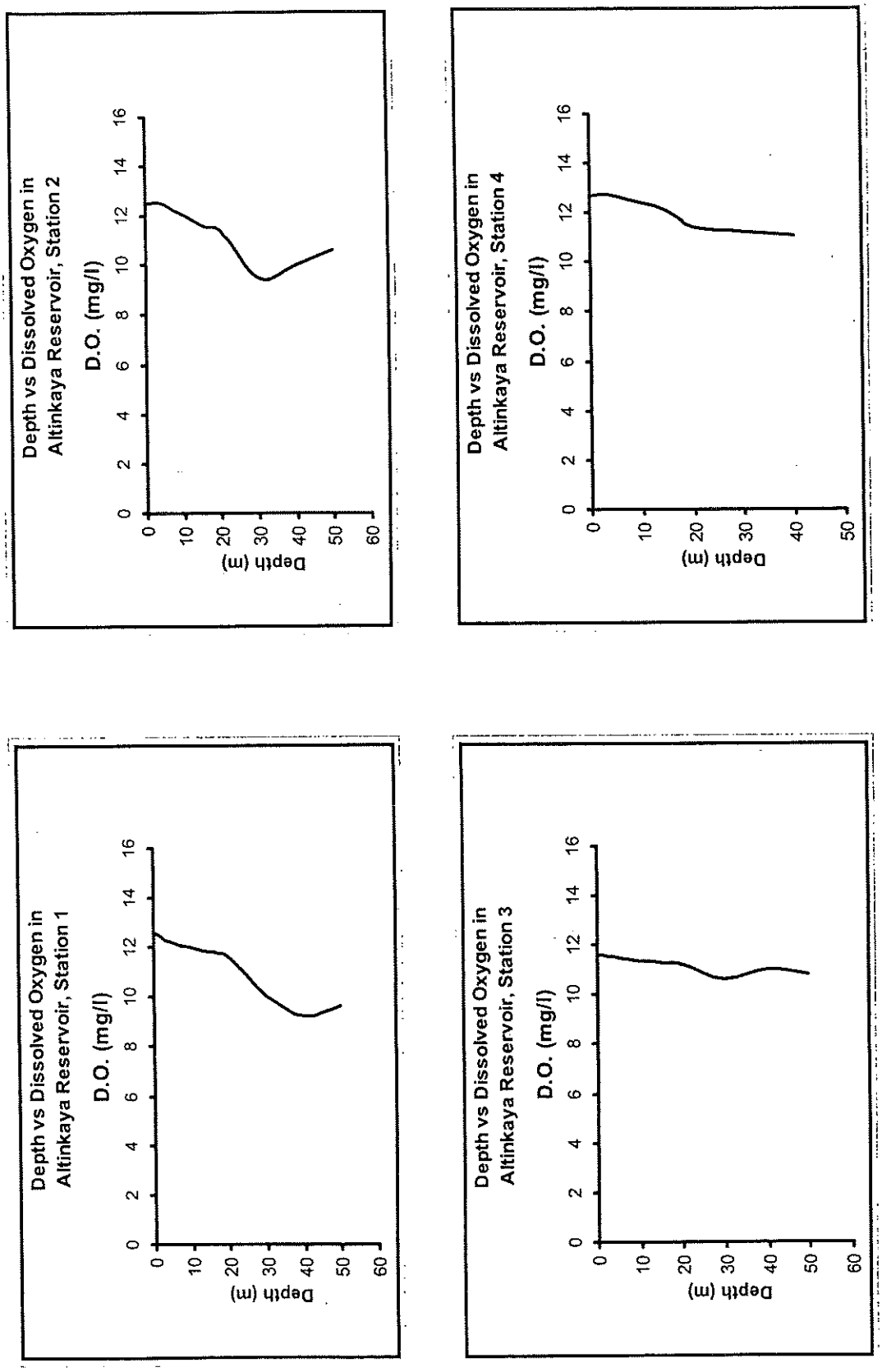


Figure VI.10. Change of Dissolved Oxygen with Depth in Altinkaya Reservoir, March 1988

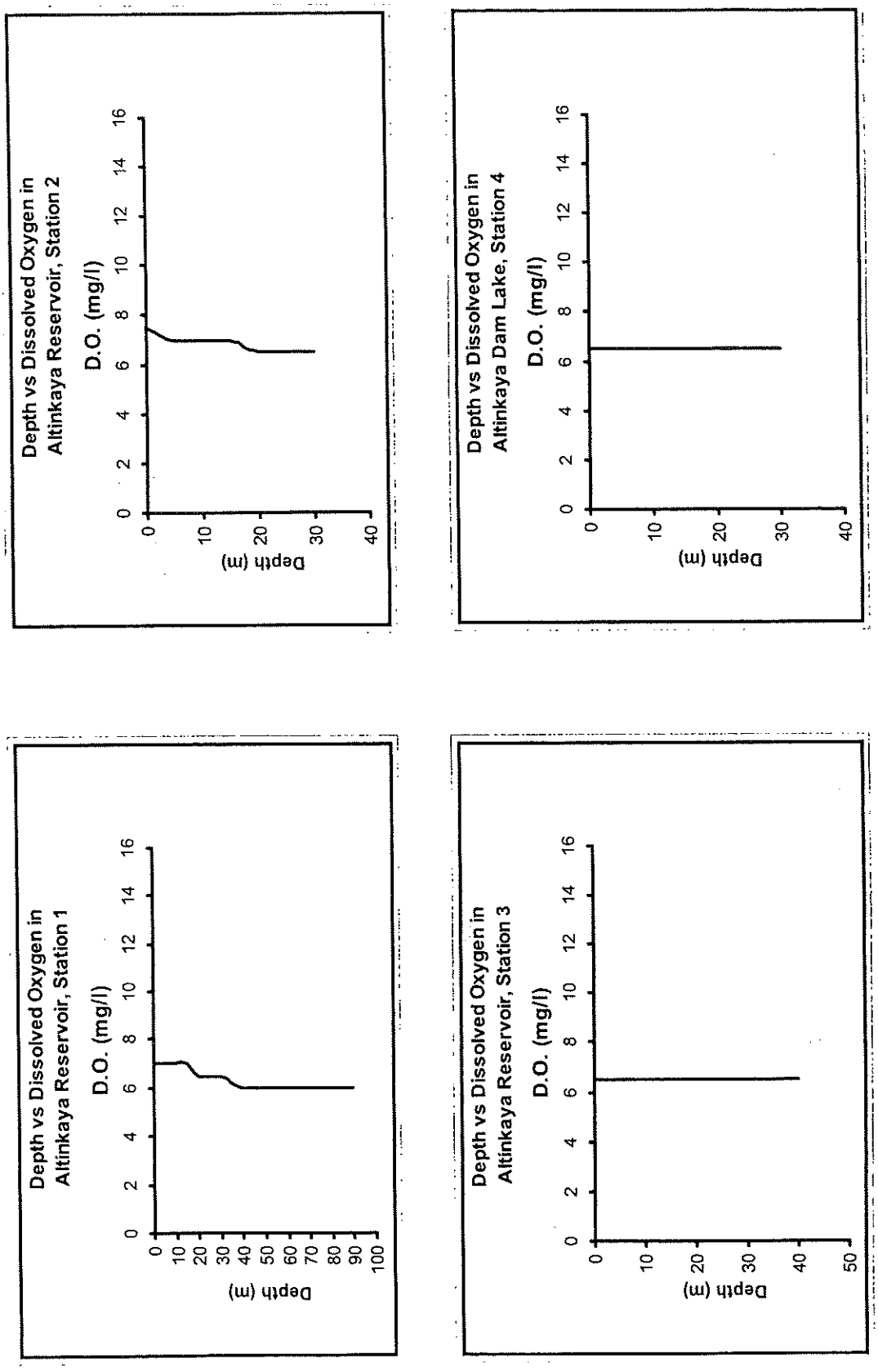


Figure VI.11. Change of Dissolved Oxygen with Depth in Altinkaya Reservoir, October 1988

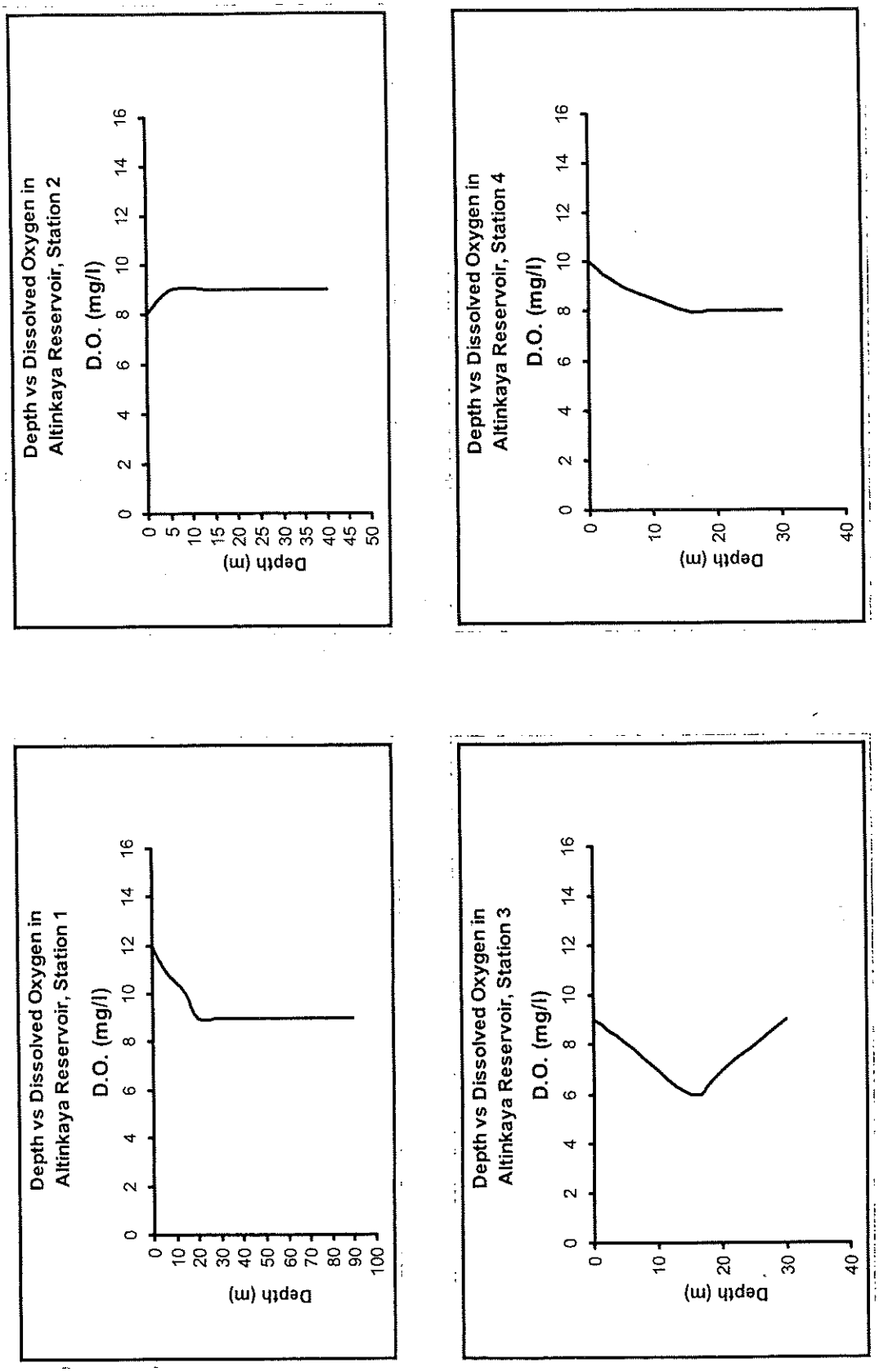


Figure VI.12. Change of Dissolved Oxygen with Depth in Altinkaya Reservoir, June 1989

VII. ANALYSIS OF ALTERNATIVES

VII. ANALYSIS OF ALTERNATIVES

VII.1. Background

The Boyabat Dam and Hydroelectric Power Plant (HPP) Project, located in the downstream part of the Kizilirmak River, will be one of the important projects for electricity production in Turkey. The Electricity Works Survey Administration (EIE) initially performed a survey on the proposed dam site in 1958 and a further study was undertaken in 1968. The project site was later revisited by the State Hydraulic Works (DSI), which commissioned a feasibility report with funding and assistance provided by the Japan International Co-operation Agency (JICA).

DSI included the project in its 1986 Construction Program and commenced construction of access roads, camp facilities and diversion tunnels during the year. The access road to the dam site, including a bridge to the right bank, camp facilities, and construction of diversion tunnels have been completed. In this chapter five different classes of alternatives are analyzed: project type, project location (site), project size, operating mode, and the no action alternative.

VII.2. Project Type

The economic and environmental impacts of the Boyabat Project are evaluated by considering a standard-type fuel-oil fired thermal power plant as an alternative facility. It is assumed that the fuel-oil fired thermal power plant (TPP) would be constructed at the load center in the West Anatolia Region. The general features of the TPP are indicated in Table VII.1.

The economic life of TPP is assumed as 25 years. For this reason, another TPP having the same capacity would be constructed in order to meet the 50-year demand. This economic evaluation and comparison was done in the JICA Feasibility Report (1979).

The benefit-cost ratio (B/C) for the Boyabat Project, taking into account the additional benefit at Altinkaya Power Station, which is located downstream of the proposed Project, was calculated as 1.197 in the JICA Feasibility Report.

Table VII.1. Properties of Alternative Thermal Power Plant

Item	Unit	Description
Installed Capacity	MW	600 (300 × 2)
Annual Utilization Factor	%	73
Thermal Efficiency	%	35
Annual Energy Production	GWh	3,840
Economic Life	Year	25
Station Service Use	%	kW 2.5, kWh 2.8

The cash flow, for economic comparison between HPP and TPP were given in the JICA Report. These values provided in the JICA Report (1979), which were in Turkish Liras, are escalated to 1998 values and converted to U.S. Dollars, and presented in Table VII.2.

Table VII.2. Cash Flow for Economic Comparison, (x 10^6 $) (JICA, 1979)

	Hydraulic-Power				Thermal Power			
	Costs				Costs			
Year	Construction (Civil)	Construction (Electrical)	Operation	Total	Construction	Operation	Fuel & oil	Total
1st	9.723			9.723				
2nd	13.664			13.664				
3rd	10.371	10.252		20.623				
4th	23.691	5.437		29.127	8.288			8.288
5th	25.048	14.287		39.335	33.148			33.148
6th	21.553	11.247		32.799	33.148			33.148
7th	14.044	12.158		26.202	8.288			8.288
8th-								
28th			3.996	3.996		5.586	11.794	17.380
29th			3.996	3.996	8.288	5.586	11.794	25.667
30th			3.996	3.996	33.148	5.586	11.794	50.528
31st			3.996	3.996	33.148	5.586	11.794	50.528
32nd		10.252	3.996	14.249	8.288	5.586	11.794	25.667
33rd		5.437	3.996	9.433		5.586	11.794	17.380
34th		14.287	3.996	18.283		5.586	11.794	17.380
35th		11.247	3.996	15.243		5.586	11.794	17.380
36th		12.158	3.996	16.154		5.586	11.794	17.380
36th-57th			3.996	3.996		5.586	11.794	17.380
TOTAL (at the end of 57 years)				264.818				339.539

The comparison of potential environmental impacts of this alternative type of project and Boyabat Project are discussed in Table VII.3. As indicated previously, it is assumed that the thermal power plant would be located in the West Anatolia Region, since most of the industries are located at that region.

One major difference between these projects is that the thermal power plant uses a non-renewable resource to produce energy where Boyabat Project uses a renewable resource. Various estimates of fossil fuel resources indicate that they would be exhausted in about a century. However, it is a fact that energy is one of the primary inputs for an economy and a primary concern for human welfare. Therefore, the reconciliation of the present economic growth and the continuing productivity of resources should be maintained, which is generally referred as sustainable development. The estimates of fossil fuel resources increase the importance of renewable energy resources, which hydropower is one of the most important, for sustainable development.

Table VII.3. Comparison of The Potential Impacts of an Alternative Thermal Power Plant and Boyabat Hydroelectric Power Plant Projects

Potential Negative Impact	Thermal Power Plant	Boyabat Hydroelectric Power Plant
Air emission effects to the environment	Yes	No
Increased noise and vibration	Yes	Yes[1]
Change in surface and groundwater quality	Yes	Yes[2]
Toxic effects of chemical discharges and spills	Yes	No
Thermal shock to aquatic organisms	Yes	No
Change in surface water flow and discharge	No	Yes
Human population displacement	Yes[3]	Yes
Disruption of traffic	Yes[3]	Yes
Worker exposure to dust from ash and coal	Yes	No
Worker exposure to toxic gases leaking from boilers	Yes	No
Worker exposure to excessive noise during operation	Yes	No
Effects of power transmission lines	Yes	Yes
Loss of land	No	Yes
Loss of wildlands and wildlife habitat	No[4]	Yes
Sedimentation of reservoir and loss of storage capacity	No	Yes[5]
Salt water intrusion in estuary	No	No[6]
Vegetation removal and habitat loss	Yes[7]	Yes
Effects on aquatic life	Yes	Yes
Increase of water related diseases	No	No

1 Only in construction phase.
2 Adverse downstream effects on river water quality, positive impacts on impounded water, and no effect on groundwater
3 Depending on the project location.
4 Except indirect effects because of air and water emissions.
5 Sedimentation will not cause a problem in the economic life time of Boyabat Project.
6 Because of the location of Boyabat Project.
7 Relatively minor loss when compared with hydroelectric projects.

In summary, it can be said that the environmental impacts of a hydroelectric power plant are mostly initial and those of a thermal power plant are mostly during operation. Overall, the Boyabat HPP Project is more viable from the environmental impact and economic point of views when compared to an alternative thermal power project.

VII.3. Project Location

In the feasibility report, issued in 1979, a concrete gravity dam at the present axis and a fill dam five kilometers upstream of the present axis were evaluated. The location of the alternative site is given in Figure V.2. Since the concrete dam was believed to be more economically viable, DSI commenced soil investigations at the appropriate site and design works for the project were carried out by Electric Power Development Company of Japan and local companies SU-YAPI Musavirlik Muhendislik and TMB Terzibasoglu Musavir Muhendislik. Final project drawings were subsequently completed in 1986.

The comparison study between the proposed project (Boyabat) and the alternative, at five kilometers upstream, is summarized in Table VII.4.

Table VII.4. Comparison of Boyabat and Alternative Project

Item	Unit	Boyabat Project	Alternative Project
Catchment (drainage) Area	km^2	64,724	64,675
Annual Flow (of Kizilirmak)	10^6 m^3	4,109	4,109
Reservoir			
Normal Water Level	m	330.00	330.00
Minimum Water Level	m	305.00	305.00
Gross (total) Storage Capacity	10^6 m^3	3,557	3,040
Effective Storage Capacity	10^6 m^3	1,410	1,410
Available Depth	m	25.00	28.80
Reservoir Area	km^2	65.40	58.71
Dam			
Type		Concrete Gravity	Rockfill
Crest Elevation	m	335.00	335.00
Crest Length	m	265.00	670.00
Foundation Elevation	m	140.00	140.00
Dam Height (from foundation)	m	195.00	195.00
Dam (embankment) Volume	10^3 m^3	2,300	20,060
Spillway Capacity	m^3/sec	9,300	9,300
Generating Plan			
Maximum Discharge	m^3/sec	471	471
Effective Head	m	125.5	112.9
Number of Unit	Unit	3	3
Installed Capacity	MW	510	459
Annual Energy Production			
Firm Energy	GWh	925.4	823.6
Secondary Energy	GWh	543.0	517.9
Total Energy	GWh	1,468.4	1,341.5
Construction Cost	10^6 US $	650	915
Economic Evaluation			
Annual Cost (C)	10^6 US $	74.738	105.248
Annual Benefit (B)	10^6 US $	89.465	80.846
Surplus Benefit (B-C)	10^6 US $	14.727	-24.402
Benefit Cost Ratio (B/C)		1.197	0.768

Environmental impacts of the alternative site are similar to those at the Boyabat Project site. The normal water levels of both of the projects are the same, so the upstream end of both reservoirs will be at the same location. The number of people to be resettled is the same for the two alternatives. The area to be flooded is about six and a half square kilometers less for the second alternative. As the two alternative sites are very close, the wildland and habitat loss will be only about 670 ha greater in the downstream alternative.

The Boyabat Project site is located approximately 5 kilometers upstream of Altinkaya Reservoir (at full pool). As a result, downstream effects of the project, both on the aquatic life and water quality, would be limited. However, the alternative would inundate less riverine habitat, when compared to the Boyabat Project site. From the terrestrial perspective, the embankment volume of the alternative rockfill dam is about ten times that of the Boyabat Dam. More construction material would be needed if this alternative were selected. This may increase the impacts of the construction phase on the habitat and aquatic life, unless borrow areas are within the reservoir area.

As can be observed from the above discussion, the proposed site for the project is economically much more feasible when compared to the alternative site. When the potential environmental impacts of the two alternatives are considered, the two sites would result in roughly equal, though different, environmental impacts.

VII.4. Project Development Scale

In order to adjust the seasonal and yearly fluctuations in inflow and develop the water resources in the most effective manner, it is necessary to secure a storage capacity making it possible to effectively utilize the inflow to the reservoir, supplementing water not only in dry seasons, but also dry years, aiming for long term stabilization of generating output. Reservoir normal water level and effective storage capacity must further be such that there will be the greatest merit in the economics of power generation.

In contemplating the normal water level, comparison studies were made for four cases: 310 m, 320 m, 330 m, 340 m, taking such factors as submergence compensation costs, sedimentation, dam height and effective storage capacity into consideration.

Regarding the effective capacity of the reservoir, the cases below were selected in a range of 300×10^6 m^3 to $2,200 \times 10^6$ m^3 for the various normal water levels stated above. Comparisons were made for energy costs per one kilowatt-hour and benefit-cost ratios. The reservoir capacity and area curves that were obtained according to the four different effective storage capacities given in Table VII.5, are shown in Figure VII.1.

Table VII.5. Effective Storage Capacities According to Normal Water Levels

	Normal Water Level (m)	Selected Effective Storage Capacities (10^6 m^3)			
Case 1	340	2,200	1,800	1,410	1,150
Case 2	330	1,640	1,410	1,150	1,000
Case 3	320	1,000	800	600	400
Case 4	310	500	400	300	-

The study on optimum normal water level and effective storage capacity of the reservoir is shown in Figure VII.2.

The area to be flooded was estimated according to the normal water level changes. This area is 78.6 km^2 at a normal level of 340 m. It decreases to 65.4 km^2 at 330 m, 58.2 km^2 at 320 m, and 51.2 km^2 at 310 m. Cases 3 and 4 (normal water levels of 320 m and 310 m) are not economically and technically viable as the effective storage capacities decrease sharply, when compared to case 2. In case 3, the effective storage capacity decreases to 57% of the volume calculated in case 2.

In cases 3 and 4 the habitat loss is less than the proposed normal water level for the project (case 2). The difference between the areas to be flooded in cases 2 and 3 is seven square kilometers, and in cases 2 and 4 is 14 km^2. The loss of land in case 3 and 4 is 10 and 20% less than the loss in the proposed case, respectively. On the other hand, in case 1, the area to be flooded is 13 km^2 larger than the area in case 2. In this case the loss of land is about 20 % more than the one in case 2.

As discussed in the previous chapters, the land to be inundated mainly consists of agricultural land, forests and shrubby vegetation. In cases 3 and 4, mainly the loss of orchards, forest and shrubby areas will be less when compared to case 2. The loss of rice fields, which are the main constituents of the agricultural land to be inundated, will not change significantly.

When the normal water level is accepted as 320 m (case 3) and 310 m (case 4), instead of 330 m, the number of people that will be affected by the project would decrease to approximately 11,600 and 11,350, respectively. In case 3, there is about a 3.3 % decrease in the number of people that will be affected by the project. In case 4 the decrease is about 5.4 %. On the other hand, Case 1 would produce increase in the number of affected people of approximately a four percent, bringing the number of affected people to 12,500.

As can be seen from the results, the selection of 330 m for normal water level of the reservoir and effective storage capacity of 1,410 $\times$ 10^6 m^3 was the most economic, and, thus, considered to be the optimal level. Accordingly, it was decided that the normal water level would be at an elevation of 330 m, with available depth of 25.0 m and effective storage capacity of 1,410 $\times$ 10^6 m^3. It can be concluded that although cases 3 and 4 have less adverse effects on the environment, when operational and economic aspects are taken into consideration together with the environmental issues, case 2 is more beneficial.

VII.5. Modes of Operation

Several operating modes have been analyzed in selecting the proposed mode for the Project; base load only; peaking or load following only; and a combination of these. Each alternative would exert its own environmental impacts and benefits, some of which could be mitigated.

In a strictly baseload operation, all generators would operate continuously, (unless one were out of service for maintenance or repair). If the reservoir could not be maintained at a high enough level to provide the required minimum head, one unit would be shut down. By maintaining a constant downstream flow (except during periods of spilling, which would be rare), this mode would avoid ecological damage in the river reach between Boyabat Dam and the headwaters of Altinkaya Reservoir.

In a strictly peaking (or load following) operation, the Project would cease to operate during an overnight period when energy demand is low, from about 8:00 p.m. to about 5:00 a.m. In the absence of a downstream minimum release, the river would be dried out between the Boyabat Dam and the upper end of the Altinkaya Reservoir (at full pool), although some water would remain in depressions. Even with a minimum release, the aquatic ecosystem downstream of the project would be substantially affected by varying tailwater levels. Daily fluctuations would be induced in the reservoir, but they would be small. The annual drawdown would remain essentially as in the baseload mode.

The selected mode of operation (see Section IV.3.4.) will be a combination of baseload and load following, with one turbine in continuous operation and the others operating in response to system demand. The operation will be such that at least the estimated minimum flow of 24 m^3/sec (seven day 10-year low flow) will be provided to the downstream section continuously. Although the selection of this mode was made largely on technical and economic grounds, it compares favorably with the others in adverse environmental impacts and the problem of fluctuating water level in the river downstream of the dam is less extreme. The daily high flows during full operation may increase the scour of the channel, but will not pose a risk to local residents.

VII.6. No Action Alternative

If this project is not realized, the following alternatives and consequences may take place:

- There would not be any adverse ecological impacts, such as effects on existing river hydrology and sedimentology and aquatic life, that would be caused by the realization of the Boyabat Project. Wildlife habitat and agricultural land would not be lost since the flooding of 65 km^2 of land would be avoided. In addition, about 12,000 people, who currently live within the limits of the future reservoir area, would not be displaced.

- However, not developing this project will inevitably result in the utilization of other sources to meet the increasing energy demand of the country due to the rapidly growing population and industry in Turkey. Since, hydropower is one of the most feasible energy sources for Turkey, not developing the Boyabat Project may result in the establishment of alternative plants, such as coal-fired thermal power plants, or the utilization of gasoline, diesel and fuel-oil fueled individual gensets in

the case of insufficient grid-based energy supply. These alternative sources would be less economic, have more adverse impacts on the environment, and are not environmentally sound for sustainable development.

- From a broader perspective, failure to make full use of the available low cost and peaking energy resources may ultimately limit social and economic development.

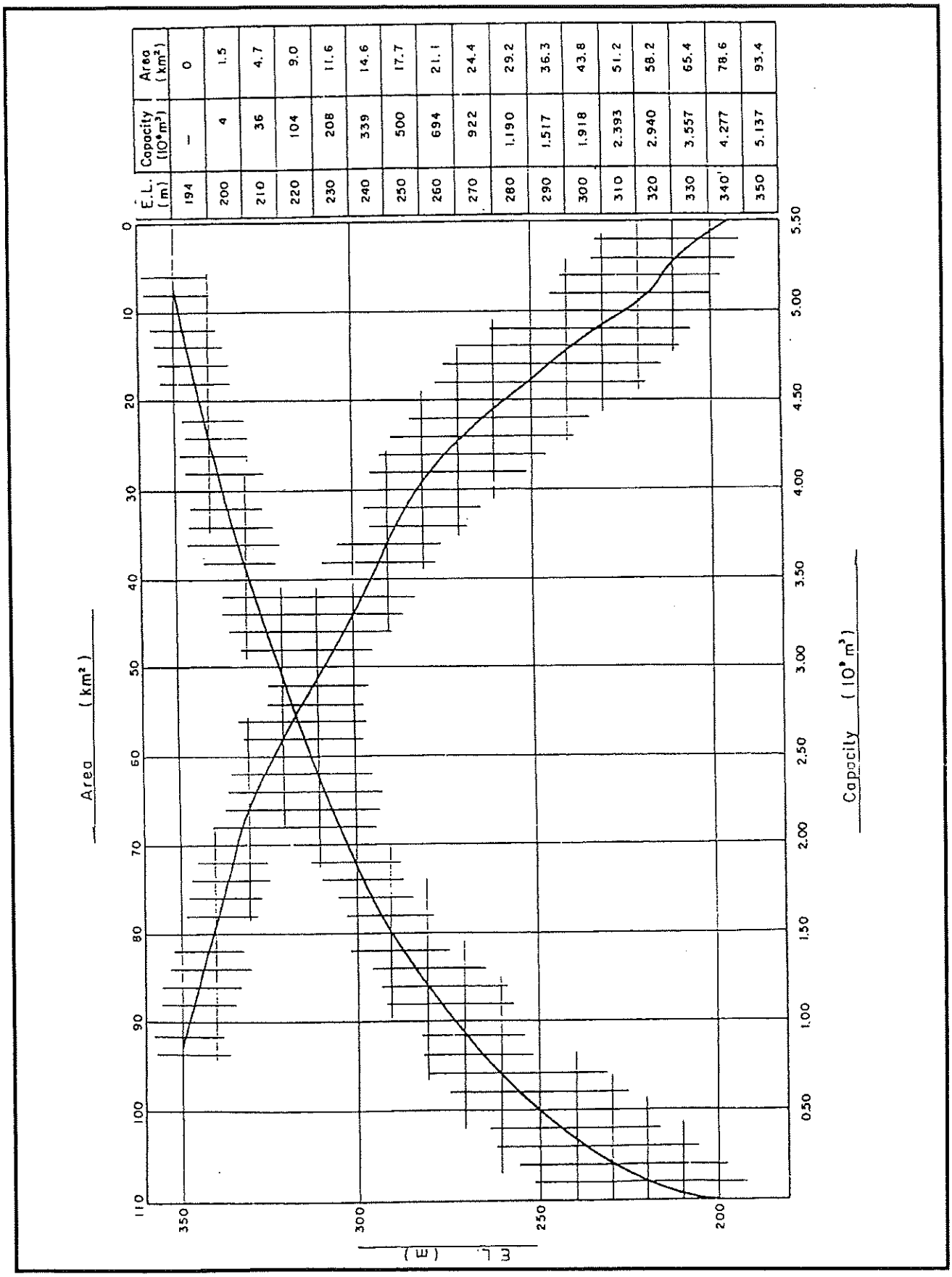


Figure VII.1. Reservoir Capacity and Area Curves

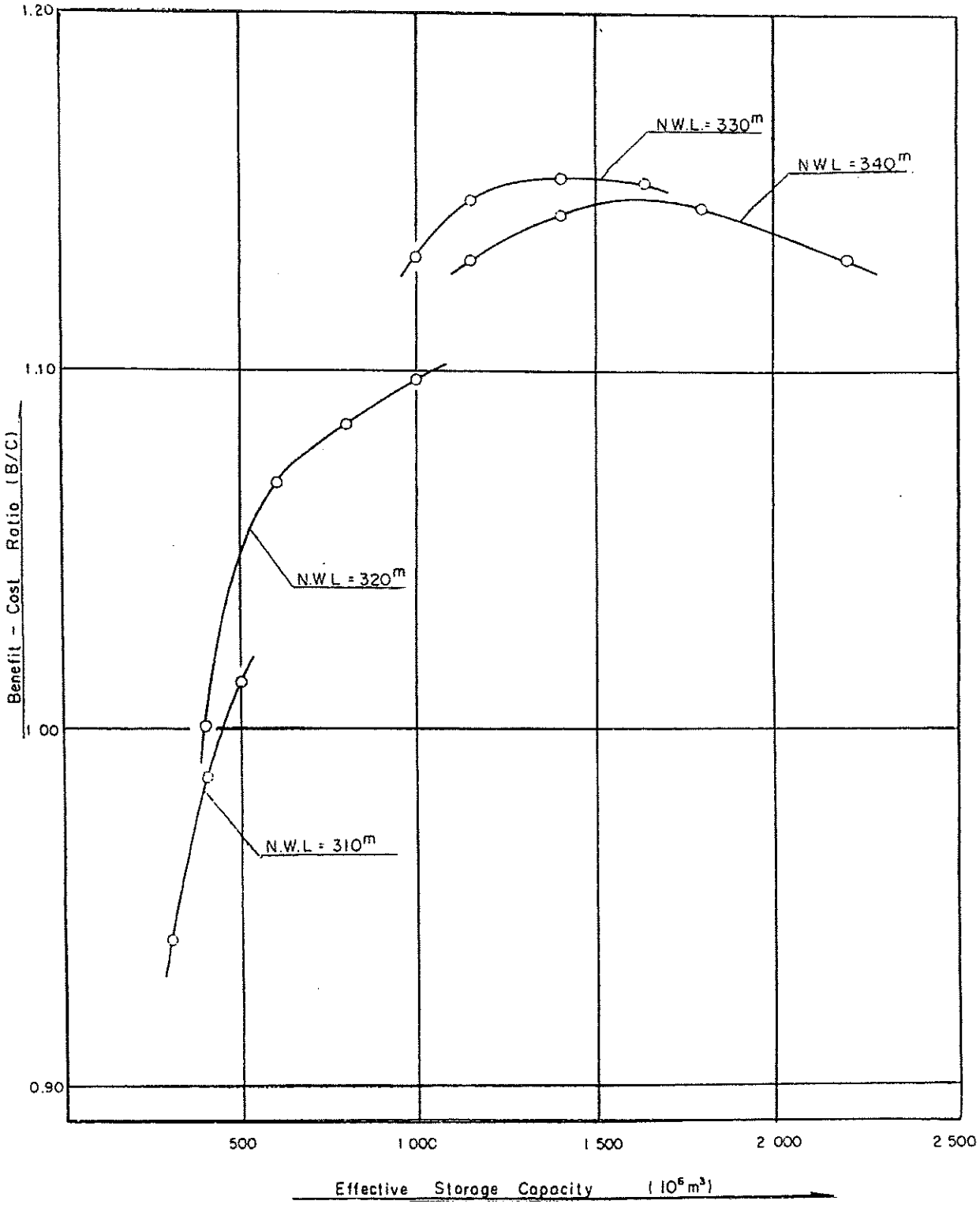


Figure VII.2. Study on Optimum Normal Water Level and Effective Storage Capacity of the Reservoir

VIII. MITIGATION PLAN

VIII. MITIGATION PLAN

Although some impacts are unavoidable, the losses may be replaced (in-kind or out-of-kind); others can be avoided. Thus, mitigation measures may take different forms. The mitigation activities required to avoid or reduce the adverse environmental impacts discussed in Section VI are summarized in this section.

The Concession Company, Boyabat Electricity Production and Trade Company (CC), will develop the Boyabat Project and will be responsible for arranging the mitigation actions. However, there are several other organizations that are responsible for mitigation activities. The CC will arrange for those actions. For some of the mitigation activities, CC is the only responsible party. These activities will be accomplished by CC. The proposed mitigation activities, and the designated organization responsible for carrying out the respective activity, schedule, cost and funding are listed in Table VIII.1.

VIII.1. Catastrophic Failure

The dam will be monitored continuously with regard to dam safety and seismicity by the help of the devices installed. A redundant communication system will be established between the Boyabat and Altinkaya Dams. When the monitoring system indicates a possible problem, the responsible engineer at Altinkaya Reservoir will be placed on alert and any local residents considered at risk will be warned.

Additionally, an Emergency Action Plan will be established for public coordination, to notify settlements within and adjacent to the drawdown zone of Altinkaya Reservoir, immediately downstream of Boyabat Dam, as well as the camp facilities. In addition, establishing a communication system with some of the settlements immediately downstream of Boyabat will be a means of emergency preparedness.

VIII.2. Erosion and Sedimentation

On the average, 25.2×10^6 m^3 suspended solids and 5.0×10^6 m^3 transported material, summing up to 30.2×10^6 m^3, will be deposited in Boyabat Reservoir every year. When the minimum reservoir volume of Boyabat Project is considered ($2,147 \times 10^6$ m^3) there will be no problems due to sedimentation in the economic life of the dam, which is considered as 50 years. Nevertheless, some mitigation measures will be taken to reduce the sediment load coming into the Boyabat Reservoir.

Mitigation will consist of developing a basin management plan for proper management of land around the reservoir area and the watershed of the dam. It will prescribe forest protection, soil management, and land use goals in the basin. The lead agency is to be the Ministry of Forestry, with the active support of the Ministry of Agriculture. These organizations would provide funds and/or manpower for this purpose. The Concession Company would also provide funds for this purpose if required by the Ministry of Energy and the Ministry of Forestry. This will help in both

preventing any increase of erosion rate, being a benefit to the community, and minimizing the sedimentation in the Boyabat Reservoir.

VIII.3. Water Quality and Water Use

The reservoir water quality should be protected from release of pollutants from any source that might adversely impact the water quality. This should be achieved by a buffer zone around the reservoir where settlement would be prohibited by the Ministry of Energy and Natural Resources. The management of the watershed in collaboration with the related agencies, as discussed above, would be beneficial for many issues, including water quality. Necessary precautions will be taken during construction to prevent landslides and erosion, although they are unlikely to occur.

The turbid wastewater resulting from dam construction facilities, and other construction waste originating from equipment and vehicles, will be treated before discharge. However, the normal level of turbidity in the river water is so high that addition of small amounts of turbid waters from construction facilities may not cause appreciable changes in the water quality of the Kizilirmak River.

Although no adverse water quality conditions are expected to develop in the project reservoir, project operation will affect the quantity and quality of water downstream of the project. Because spillage will rarely (if ever) occur at the dam, the number of turbine units in operation and their operational characteristics will regulate the volume of water discharged downstream. The level of the reservoir determines the temperature and dissolved oxygen concentration of the water drawn into the turbines and discharged when the reservoir is stratified. The discharge thus determines the flow and water quality in the river downstream of the dam.

To maintain sufficient flow and adequate water quality to support all existing uses in the Kizilirmak from the dam to the Gokirmak, one turbine unit will be in continuous operation at the Boyabat Project. Based on the firm energy production of the project, the minimum volume of water discharged is estimated to be 101 m^3/sec. This is over four times the historical minimum flow (24 m^3 /sec) of the Kizilirmak at the Boyabat Dam site. Additionally a facility will be constructed at the dam to provide a minimum release of 24 m^3/sec to maintain water quality and existing uses during reservoir filling and during periods when all turbine units may be out of operation. Because low river flows, reservoir drawdown and stratification of the reservoir generally all occur during the same period of time, the facility will be designed to maintain the desired flows and water quality under this combination of conditions.

VIII.4. Air Quality

Adverse air quality impacts, such as dust, that could affect the health of construction workers will be mitigated. The roadways will be watered to minimize dust. This will be achieved as required by the regulation, numbered 14453 and dated February 1973, of the Turkish Republic, Ministry of Labor and Social Security. The air in underground works will be kept in a condition suitable for the health of the workers,

as required by the Turkish Technical Specifications, Civil Engineering Works, May 1991. The exhaust systems of equipment used in construction will also be periodically examined and maintained so as to protect the health of the workers.

VIII.5. Biota

The present and future impacts of Boyabat Project on the biological environment will be minimized by implementing a series of mitigation actions. In the future, a more detailed Environmental Management Plan (EMP) will be developed by a team of consultants consisting of the representatives of allied organizations and the CC.

Mitigation actions related to construction will be the responsibility of the CC. Necessary precautions (proper disposal of solid wastes, wastewater treatment, etc.) will be taken to minimize the adverse effects on aquatic and terrestrial habitats during construction. It is recognized that construction activities will adversely affect the environment in a limited area. Damage due to these activities will be restored after the completion of the dam. Restoration of damage to the nature due to the construction activities will improve the appearance of the area and prevent localized erosion. Additionally, a minimum downstream release of 24 m^3/sec (7-day 10-year low flow) will be maintained during reservoir filling to sustain aquatic biota between the dam and the Gokirmak (the first major tributary downstream of the dam).

The activities proposed to mitigate adverse impacts on terrestrial and aquatic biological resources are listed in Table VIII.1. Most of these are understood to be the responsibility of organizations other than the developer (CC). For example, afforestation of the watershed of the Boyabat Reservoir will be performed and funded by relevant Regional Forest Directorates. The CC will also contribute to the funding of afforestation activities for an area equivalent to the forest area to be inundated by the reservoir. Preparation and implementation of landscape and wildlife habitat developments would be similarly carried out. Preparation and implementation of a fishery management plan for the project reservoir would be carried out and funded by the State Hydraulic Works.

The loss of feeding habitat for white storks will be mitigated by improving stork nest sites in other areas. This will be accomplished by seeking potential feeding habitat (rice fields and pasture) that lacks nearby nest sites for storks. A preliminary survey by the environmental team suggested that such areas exist along the main highway (Rt. 190) between Corum and Merzifon.

Fifteen to twenty nest platforms will be placed in areas that appear suitable for stork nesting. If the land is privately owned, the permission of the owner will be obtained. Each platform will be a wooden structure approximately one meter square, set atop a ten-meter wooden pole. The use of such platforms for storks and some large raptors has proved highly successful in many other countries.

VIII.6. Resettlement

Land and properties to be submerged will be expropriated, and their owners will receive a compensation or, if they request it, the government would resettle them. The compensation would be paid by CC, and the expropriation would be done by the Ministry of Energy and Natural Resources. It should be noted that if the owners of the land or property that is expropriated disagree on the price offered, they would be able to go to court to increase compensation.

For the group that requests resettlement from the government, urban resettlement (for merchants, artisans and professional people) or rural resettlement (for farmers) choices are provided under the Turkish Resettlement Law. According to the selection, General Directorate of Rural Affairs takes the responsibility and provides resettlement assistance to these people.

Relevant and essential capital items are provided, such as land, houses, business premises, and operating capital on credit for resettlers. For those who select urban settlement, for each family:

- a house (either as a long term credit with the repayments starting five years later, or as a donation),

- training in a field in which there are job opportunities, as a means to earn their living, is provided by the government (General Directorate of Rural Affairs).

Farmers receive sufficient land, animals for farming, equipment and tools, seeds, barns, storage areas and other facilities. In addition, the Turkish Government transports the people being resettled along with their goods and animals. For the group that prefers to be located in rural areas and earn their living in agriculture, each family receives:

- A house (either as a long term credit with the repayments starting five years later, or as a donation).

- An adequate amount of irrigated land of at least the same quality as the land lost (depending on the compensation judged for the land or property expropriated or, if the family or person does not have some land or property, depending on the person's occupation).

- Required equipment and tools, such as a tractor (generally as a long term loan).

- An appropriate amount and type of seed is provided by the government (General Directorate of Rural Affairs).

- Barns, storage areas and other opportunities such as courses given to the women to make them more productive.

Immovable property provided to the settlers by the Turkish Government cannot be sold, pledged or otherwise liened in any manner for a period of ten years. The only exception to this rule is the use of such property as collateral to receive credits from the Turkish Agricultural Bank. Settlers under Government sponsorship are exempt from building and land taxes for one year after the new properties are registered in their names.

It should be noted that because of the sequence of steps in the resettlement process it is not possible to prepare a detailed plan based on people's final resettlement decisions until after the cadastral surveys of land and inventories of property are complete, and values put on such property. To reach this stage may take years in some cases, extending into the dam construction period.

VIII.7. Employment

It is estimated that about 750 workers will be required in the construction phase. In construction and operation activities that do not require high skills or special training, local residents will be hired and trained. The local residents will be preferred for employment during both construction and operation phases, for positions relevant to their skills. This will provide job opportunities for the local residents and economic benefits for the area.

VIII.8. Infrastructure

Interruption of the transportation network could be prevented by raising or relocating roads that are to be inundated. Several stretches of the road on the left bank fall in this category, along with the approach road to the Maksutlu bridge. These roads are mainly used for access to the dam site and they carry limited traffic. Therefore, the inundation of these roads will not impose severe social and economic hardship. If required, a traffic study may be conducted in the course of preparing the EMP and necessary mitigation actions can be proposed accordingly.

The inundation of the three bridges at Maksutlu, Asagizeytin and Asagidaricay will not pose severe impacts on the transportation network, since two bridges, one at Kargi and one downstream of the site facilities, will be still serving the area after water impoundment.

VIII.9. Socio - Economy

A sound fishery management program would be carried out by DSI as the reservoir would be managed by this agency. Fishing rights will be granted to cooperatives of villagers, as it is the custom in Turkey, and they will pay the Government, the owner of the lake, in return. Besides, public access to the reservoir for recreational and aesthetic purposes would be allowed.

There are no archeological or cultural protection sites in the project area. If any archeological or cultural resources are found during construction, the Ministry of Culture will be informed, in accordance with Turkish Laws. Necessary actions to protect these resources will be undertaken by the Ministry of Culture.

VIII.10. Institutional Development and Environmental Coordination

An environmental coordination unit in CC will be established to monitor the environmental issues discussed in mitigation and monitoring. Consultants will also be employed.

Coordination with the relevant agencies will be ensured either by the consultant(s) or the coordinator. Compliance with environmental regulations will also be seriously considered and professional assistance can be required for this purpose.

Table VIII.1. List of Mitigation Activities

Subject	Activity	Timing	Responsible Organization	Source Of Funding	Estimated Cost (US $)
Structural integrity and watertightness of the reservoir	Review of already prepared design reports	Completed	Concession Company (CC)	Project Budget (PB)	No additional cost
	Grouting	During construction	CC	Project Budget	~25,000,000
	Install necessary instruments to monitor the dam safety	During construction	CC	Project Budget	400,000
Catastrophic failure	Develop a redundant communication system with Altinkaya	During construction	CC	Project Budget	40,000
	Establish an Emergency Action Plan	Before impounding	CC in coordination with State Hydraulic Works (DSI)	Project Budget	40,000
Erosion and sedimentation	Coordinate land management activities, such as reforestation and slope protection measures, with the related agency, such as Ministry of Forestry	During and after construction	Relevant Regional Forest Directorates	Budgets of Related Agencies (BRA)	125,000 (BRA)
	Restore the damaged land during and after construction	During and immediately after construction	CC	Project Budget	30,000
	Control fires from spills and accidents	During and after construction	Relevant Regional Forest Directorates & Fire Deparments	Budgets of Fire Departments	20,000
Downstream water quantity	Minimum flow	During and after construction	CC	Project Budget	No additional cost
Water quality	Clarification of wastewater resulting from construction activities, equipment and vehicles, and domestic sources	During construction	CC	Project Budget	300,000
Air Quality	Take necessary precautions, such as watersprays, to prevent the adverse affects of dust on construction workers	During construction	CC	Project Budget	50,000

Table VIII.1. (continued)

Subject	Activity	Timing	Responsible Organization	Source Of Funding	Estimated Cost (US $)
Wildlife	Afforestation of the watershed area of Boyabat Reservoir to control erosion and to reduce siltation in the reservoir	As early as possible in the uplands	Relevant Regional Forest Directorates	Budgets of Related Agencies (BRA)	30,000
	Afforestation in compensation of the inundated forests	After completion of the dam	CC	Project Budget	120,000
	Preparation of landscaping project for recreational activities by nearby population	At the earliest convenience	DSI	Project Budget	30,000
	Implementation of landscaping project	After completion of the dam	DSI	Project Budget	250,000
	Habitat development plans	At the earliest convenience	Relevant Regional Forest Directorates & CC	Project Budget	25,000
	Implementation of habitat development plans	During and after construction	Relevant Regional Forest Directorates	Budget of Organization	30,000/year
	Precautions to minimize the probable adverse affects on the aquatic and terrestrial habitats.	During construction	CC	Project Budget	30,000
	Preparation of a fish management program for the reservoir	At the earliest convenience, prior to the foundation of the dam	DSI	Budget of Organization	20,000
	Implementation of the fish management program	Three years after the completion of the dam	DSI	Budget of Organization	60,000

Table VIII.1. (continued)

Subject	Activity	Timing	Responsible Organization	Source Of Funding	Estimated Cost (US $)
Resettlement	Expropriate land	Before impounding	Ministry of Energy and Natural Resources (MENR)	Project Budget	34,000,000
	Give assistance to affected people for resettlement	Before impounding	General Directorate of Rural Affairs	Budget of Organization & Government Loans	250,000
Employment	Employ and train local residents and provide necessary services	During and after construction	CC	Project Budget	No additional cost
Infrastructure	Access roads and bridge connecting two banks of the river	Completed	DSI	Budget of Organization	8,000,000
	Camp facilities	Completed	DSI	Budget of Organization	11,000,000
	Diversion tunnels	Completed	DSI	Budget of Organization	17,000,000
Socio-Economy	Provide opportunities for recreational and aesthetic uses of the reservoir	After impounding	Relevant Forest Directorates	Budgets of Related Agencies	15,000
	Protection of cultural and archeological resources that might be found	During construction	Ministry of Culture	Budget of Organization	Dependent on the resource
Institutional Development and Environmental Coordination	Improve environmental management measures	During and after construction	CC	Project Budget	110,000/year

IX. MONITORING PLAN

IX. MONITORING PLAN

In this section, the monitoring activities during the construction or operation phases are described. The schematic representation of the monitoring plan is given in Table IX.1. All of the monitoring activities will be carried out in coordination with the monitoring team of the Boyabat Electricity Production and Trade Company, the Concession Company (CC). The activities discussed briefly below will be described in greater detail in the Environmental Management Plan (EMP).

IX.1. Seismicity

Seismicity around the dam site will be monitored by the use of several strong motion accelerographs, some of which would be installed in a foundation gallery, and the rest in the dam at various elevations.

IX.2. Dam Safety

Throughout the construction phase:

- Routine quality control measurements will be implemented by inspectors from the government organizations,
- The same sort of measurements will be done by the experts of CC, as the constructor, and the results of those will be sent to the controllers for review.

Throughout the operation phase:

- Studies of dam safety (especially for stability) will be made and compared with the results obtained at the planning stage,
- Routine monitoring of all instruments used in the construction phase will be carried out by the workers and reports prepared to compare with the assumed values.

IX.3. Catastrophic Failure

The public will be informed of the risk of failure by coordination and participation meetings. Additionally, an Emergency Action Plan will be prepared and the public informed about all aspects of it. Periodic tests of the communication system for the Emergency Action Plan will be carried out as well.

IX.4. Erosion and Sedimentation

As discussed previously in this report, sedimentation would not create any significant adverse impact within the economic life of the dam. However, the depth of the sediment will be measured annually to confirm this assessment.

To ensure erosion control, a land management plan, covering the dam site and its vicinity, will be prepared in the coordination with the Ministry of Forestry, starting at

the construction phase. Application of this plan will be monitored at the operation stage. The vegetation and forests, needed to reduce erosion, will be an important component of this plan.

IX.5. Water Quantity and Quality

The volume of water released downstream will be monitored daily by the CC. The quality of water upstream and downstream of the dam site will be monitored monthly by the CC. The water quality parameters that will be monitored will include temperature, dissolved oxygen, BOD, pH, conductivity, nitrates, phosphates, ammonia, and suspended matter. In addition, development of aquatic resources, such as fisheries, will be monitored.

IX.6. Health

Health problems arising from water-borne diseases, although not expected, will be monitored by the Ministry of Health. The Environmental Officer of the CC will maintain contact with local health agencies to monitor any conditions that may be associated with the project.

IX.7. Wildlife

After the implementation of the project, detailed field observations and records will be required, to determine conditions of wildlife and fish habitat and populations in the project area. The effectiveness of the fishery management program set forth in the EMP will be evaluated and program adjustments made, if necessary. Such studies will provide an important means for efficient management of the reservoir and its biological resources, as well as effective implementation of the EMP.

Studies of characteristics of the wildlife populations will be conducted in the project area. During these studies attention will be focused on the species of international concern. Utilizing these studies, CC will work with the Wildlife Directorate to develop effective management plans.

Plantation forests, restoration activities, implementation of the landscaping program, and habitat development activities will be monitored by means of field observations and participation meetings.

The success of the mitigation plan can be assessed by the quality of implementation. According to the proposed mitigation plan, the negative impacts defined for Boyabat Project will have been remediated or mitigated, and environmental advantages should be enhanced.

To be successful, monitoring should be done by a specialized team that reports regularly to the environmental officer. This specialized team may be established by CC or independent consultants, knowledgeable of the area, may be employed for this purpose.

After implementation of the mitigation plan, the monitoring evaluation should continue throughout the operation period. Initially, it will be performed quarterly, until the success of the mitigation program has been established. Thereafter, some aspects of the monitoring effort may be reduced to the schedule in Table IX.1. Results of the monitoring program will be assembled annually in a report by the monitoring team of the CC.

IX.8. Economy

The productivity of the fishery management program will be monitored to evaluate the impacts on the resource. In addition, the impacts of the project on the energy production of the other dams, upstream and downstream of Boyabat, will be monitored in the operation stage, to determine the overall project benefit.

IX.9. Cultural Resources

Within the framework of Turkish legislation, if any cultural or archeological site is found during the construction, the closest office or directorate of the Ministry of Culture must be informed, either in writing or orally. Specialists from the responsible office examine the site and evaluate the means of preserving this cultural or palaeontological resource. Therefore, monitoring is not advised for this resource category.

IX.10. Resettlement

MENR will carry out the expropriation and the General Directorate of Rural Affairs will resettle the people requesting urban or rural resettlement. The progress of this resettlement process will be monitored by the MENR and General Directorate of Rural Affairs which are responsible agencies for the expropriation and resettlement.

IX.11. Environmental Coordination

According to the Environmental Impact Assessment Regulation of Turkish Republic, all items in the mitigation scenario mentioned in the report are accepted as commitments by the investor, and the monitoring and follow-up of those are handled by the Ministry of Environment. Reports will be prepared annually by the monitoring team to describe the monitoring activities.

Table IX.1. Monitoring Plan

Subject	Monitoring Activities To Be Undertaken For:	Monitoring Technique	Time Frame	Responsible Organization	Source Of Funding	Estimated Cost (US $)
Seismicity	Measurement and reporting	Strong-motion accelerographs	Continuous	CC [1] & MENR [2]	Project Budget	100,000
Dam safety	Read dam monitoring instruments	Variable	Variable	CC	Project Budget	Included in operation cost
Dam safety	Reporting	-	Annually	CC	Project Budget	15,000/year
Catastrophic failure	Coordination plan	Participation meetings	Semiannually	CC	Project Budget	4,500/meeting
Catastrophic failure	Emergency Action Plan and the Communication System	Participation meetings and periodic tests	Biannually	CC & DSI (DSI is the coordinator)	Project Budget	15,000/2 years
Erosion and sedimentation	Measurement in the reservoir	Physical and chemical analyses	Annually	MENR & MAFRA [3]	Budgets of Related Agencies	12,500/year
Erosion and sedimentation	Land management	Land management plan and reporting	Annually	MAFRA	Budget of Organization	10,000/year
Water quality	Measurement	Physical, chemical, biological sampling and analyses	Monthly	CC [1] & DSI [2]	Project Budget & Budget of Organization	40,000/year
Minimum flow	Maintaining downstream water uses and quality	Discharge / flow estimation	Daily	CC	Project Budget	No additional cost
Health	Control of water-born diseases	Research and survey	When necessary	MOH [4]	Budget of Organization	7,500/occasion
Wildlife	Control of plantation works in the watershed area of Boyabat Reservoir for erosion and reducing siltation in the reservoir	Surveys	Biannually	MAFRA	Budget of Organization	8,000/survey

Table IX.1. (continued)

Subject	Monitoring Activities To Be Undertaken For:	Monitoring Technique	Time Frame	Responsible Organization	Source Of Funding	Estimated Cost (US $)
Wildlife	Preparation and implementation of landscaping project for the reservoir area	Participation meetings	Annually	MAFRA	Budget of Organization	4,500/year
	Planning and implementation of habitat development	Field research on fauna and habitat	Seasonally	Relevant Regional Forest Directorates & CC	Project Budget & Budget of Organization (BO)	5,000/year (PB) & 3,000/year (BO)
	Precautions to minimize the probable adverse affects on the aquatic and terrestrial habitats	Field research and reporting	During construction	CC	Project Budget	40,000/year
	Fishery management	Fish management program	Annually	DSI	Budget of Organization	4,000/year
Economy	Productivity of fisheries	Measurement and reporting	Annually	DSI	Budget of Organization	6,000/year
Resettlement	Determination of the condition of the resettled people	Research and reporting	Annually	MENR & General Directorate of Rural Affairs	Budgets of Related Agencies	8,000/year
Environmental coordination	Reporting	Report on compliance of monitoring plan	Annually	CC	Project Budget	10,000/year

[1] Throughout the first 15 years after construction
[2] Throughout the economic life after transfer
[3] Ministry of Agriculture, Forestry and Rural Affairs
[4] Ministry of Health

ANNEXES

ANNEX 1

LIST OF PREPARERS

LIST OF PREPARERS

ENCON Cevre Danismanlik Ltd. Sti.

Selale ATABERK	Environmental Engineer, M.Sc.
Tolga H. BALTA	Environmental Engineer, M.Sc., Project Coordinator
Ozlem BOZOGLU	Economist
Okan BILKAY	Mechanical Engineer, M.Sc.
I. Haluk CERIBASI	Environmental Engineer, M.Sc., Project Coordinator
Cagatay NUHOGLU	Civil Engineer, M.Sc.
Huseyin TEKIN	Environmental Engineer, M.Sc., Project Coordinator
Sebnem SAHIN	Environmental Engineer, M.Sc.

DOGUS Construction and Trade

Tugba BOZKURT	Environmental Engineer

HARZA Engineering Company, International, L. P.

Dr. John W. MELDRIM	Chief Environmental Scientist
Dr. Peter L. AMES	Senior Environmental Scientist, International Projects Coordinator

Hacettepe University, Department of Biology

Assoc. Prof. Dr. Sedat Yerli	Biologist (Aquatic Ecology)
Assoc. Prof. Dr. Levent Turan	Biologist (Terrestrial Ecology)
Asst. Prof. Dr. Galip Akaydin	Biologist (Botany)
Dr. Ali Fuat Canbolat	Biologist (Aquatic - Terrestrial Ecology)
Burak Ali Cicek	Biologist (Aquatic Ecology)

Middle East Technical University, Department of Sociology

Assoc. Prof. Mehmet ECEVIT	Sociologist
Assoc. Prof. Yildiz ECEVIT	Sociologist
Reyhan CEYLAN	Sociologist
Nurten CANBEYOGLU	Sociologist
Fatime GUNES	Sociologist
Nadide KARGINER	Sociologist
Nogman KILICALP	Sociologist
Aysin KOCAK	Sociologist
Hatice YESILDAL	Sociologist
Cayan YILMAZ	Sociologist
Hakan YORULMAZ	Sociologist
Kamil KALELI	Sociologist
Kivanc AYDIN	Sociologist

ANNEX 2

BIBLIOGRAPHY

BIBLIOGRAPHY

Akalin, S., 1956. *Buyuk Bitkiler Kilavuzu - The Guide for Plants*, Guzel Sanatlar Matbaasi - Fine Arts Publication, Ankara.

Altinayar, S., 1988. *Sucul Fauna - Aquatic Fauna*. State Hydraulic Works (DSI), Ankara.

American Water Works Association, 1990. *Water Quality and Treatment: A Handbook of Community Water Supplies*. McGraw-Hill, New York.

Ankara University, 1992. *Determination of Pollution of Kizilirmak Basin*. 2 Volumes, Ankara.

Anonymous., 1988. *Tabiati Koruma Alanlari Etudleri (TKAE) I - Studies on Natural Preservation Areas I*. The General Directorate of Forestry, Ankara.

Anonymous, 1990. *Turkiye'nin Cevre Sorunlari - Environmental Problems of Turkey*. Turkiye Cevre Sorunlari Vakfi (TCSV) - Environmental Problems Foundation of Turkey, Ankara.

AWWA, APHA and WPCF, 1971. *Standard Methods for the Examination of Water and Wastewater*. 13th Ed., New York.

Balkas, T., et.al., 1995. *Wastewater Pollution Assessment and Waste Management*. Middle East Technical University (METU), Ankara.

Baran, I., 1976. *Turkiye Yilanlarinin Taksonomik Revizyonu ve Cografik Dagilislari - Taxonomic Revisions and Geographical Distribution of the Snakes of Turkey*. TUBITAK Yayinlari - TUBITAK Publications, Ankara.

Basoglu, M. and I. Baran, 1977a. *Turkiye Surungenleri Kisim I, Kaplumbagalar ve Kertenkeleler - Reptiles of Turkey Part I, Turtles and Lizards*. Ege Universitesi, Fen Fakultesi Kitaplari Serisi, No:76 - Ege University Faculty of Science Book No:76, Izmir.

Basoglu, M. and I. Baran, 1977b. *Turkiye Surungenleri Kisim II, Yilanlar - Reptiles of Turkey Part II, Snakes*. Ege Universitesi, Fen Fakultesi Kitaplari Serisi, No:80 - Ege University Faculty of Science Book No:80, Izmir.

Basoglu, M. and N. Ozeti, 1973. *Turkiye Amphibileri - Amphibians of Turkey*. Ege Universitesi, Fen Fakultesi Kitaplari Serisi, No:50 - Ege University Faculty of Science Book No:50, Izmir.

Baytop, T., 1994. *Turkce Bitki Adlari Sozlugu - Dictionary of Turkish Plant Names,* Turk Dil Kurumu Yayinlari No: 578 - Turkish Language Foundation, Publication No: 578, Ankara.

California State Water Resources Control Board, 1978. *Water Quality Criteria.* State Water Resources, Pasedana, California.

Committee on Environmental Effects of the United States Committee on Large Dams, 1978. *Environmental Effects of Large Dams.* ASCE, New York.

Corbitt, R.A., 1990. *Standard Handbook of Environmental Engineering.* McGraw-Hill, New York.

Council of Europe, 1997. *Convention on the Conservation of European Wildlife and Natural Habitats, Appendices to the Convention.* Secretariat Memorandum, Directorate of Environment and Local Authorities. Strasbourg, 6 March 1997. T-PVS(97) 4.

Council of Europe, 1996. *Convention on the Conservation of European Wildlife and Natural Habitats.* Standing Commitee Report, 16th Meeting, Strasbourg, 6 December 1996. Secretariat Memorandum, Directorate of Environment and Local Authorities. T-PVS(96) 102.

Council of Europe, 1994a. *Convention on the Conservation of European Wildlife and Natural Habitats, Appendices to the Convention.* T-PVS(94) 2.

Council of Europe, 1994b. *Symposium on the United Nations Conference on Environment and Development (UNCED), the Convention on Biodiversity and the Bern Convention: the next steps.* Strasbourg, 150 pp.

Council of Europe, 1979. *Convention on the Conservation of European Wildlife and Natural Habitats.* Bern/Bern, 19.IX.1979. European Treaty Series/104.

Davis, P.H., 1965-1988. *Flora of Turkey and East Aegean Islands.* Vol. 1-10, Univ Press. Edinburgh.

Demirsoy, A., 1996. *Genel ve Turkiye Zoocografyasi - General Zoogeography and the Zoogeography of Turkey.* Meteksan, Ankara.

Demirsoy. A, 1992. *Yasamin Temel Kurallari, Omurgalilar/Amniota (Surungenler, Kuslar ve Memeliler) - The Basic Rules of Life, Vertabrates/Amniota (Reptiles, Birds and Mammals).* Cilt 2/3 (Vol. 2 of 3). Meteksan, Ankara.

Demirsoy. A, 1988. *Yasamin Temel Kurallari, Omurgalilar/Amniota - The Basic Rules of Life, Vertabrates/Amniota.* Cilt 1/3 (Vol. 1 of 3). Meteksan, Ankara.

Demirsoy. I, 1982. *Yasamin Temel Kurallari, Omurgasiz Hayvanlar - The Basic Rules of Life, Invertabrates.* Cilt II (Vol II). Meteksan, Ankara.

Dixon, J., L. Talbot and G. Moigne, 1990. *Dams and The Environment: Considerations in WorldBank Projects.* The World Bank, Washington, D.C..

Dogus Construction and Trade Company (DOGUS) and Chemical Bank, December 1995. *Boyabat Power Project: Project Outline.* DOGUS, Istanbul.

Dogus Construction and Trade Company (DOGUS), July 1995. *Boyabat Dam and Hydroelectric Power Plant: Revised Feasibility Report.* DOGUS, Istanbul.

Economic Commission for Europe, 1991. *European Red List of Globally Threatened Animals and Plants and Recommendations on Its Application as Adopted by the Economic Commission for Europe and Its 46th Session by Decision D(46) United Nations.* E/EC/1249,ECE/ENVWA/20, New York.

Ekim, T., M. Koyuncu S. Erik, and R. Ilarslan, 1989. *Turkiye'nin Nadir ve Endemik Bitkileri - List of Rare and Endemic Plants in Turkey.* Turkiye Tabiatini Koruma Dernegi, Yayin No: 18 - Environmental Problems Foundation of Turkey, Publication No: 18, Ankara.

Ekim, T., S. Erik, M. Koyuncu and R. Ilarslan, 1988. *Turkiye'nin Endemik ve Nesli Tehlike Altinda Olan Turleri - Endemic and Threatened Species of Turkey.* Environmental Problems Foundation of Turkey, Ankara.

Erk'akan, F. and M. Akgol, 1985. *Investigation of Kizilirmak Basin Economic Fish Stocks.* TUBITAK Project No: VHA6 - 584, Ankara.

Electric Power Development Co., SU-IS, SU-YAPI and TMB, 1987. *Boyabat Dam and Hydroelectric Power Plant.* Ankara.

Electrical Works Institute (EIE), March 1989. *Turkiye Akarsularinda Su Kalitesi Gozlemleri - Water Quality Data for Surface Waters in Turkey.* EIE, Ankara.

Electrical Works Institute (EIE), March 1993. *Turkiye Akarsularinda Sediment Gozlemleri ve Sediment Tasinim Miktarlari - Sediment Data and Sediment Transport Amount for Surface Waters in Turkey.* EIE, Ankara.

Ellis B. and P. Mangan, April 1993. *Environmental Review of Five Water Resource Development Projects in Turkey.* U.S. Bureau of Reclamation, Washington, D.C.

Environmental Foundation of Turkey (TCV), 1992. *Turk Cevre Mevzuati - Turkish Environmental Regulations.* 2 Volumes, Turkiye Cevre Vakfi (TCV), Ankara.

Geldiay, R., 1988. *Turkiye Tatlisu Baliklari - Freshwater Fish of Turkey*. Ege Universitesi Fen Fakultesi Kitaplari Serisi, No: 97 - Ege University Faculty of Science Book No: 97, Izmir.

Giles, R. H., 1978. *Wildlife Management*. W. H. Freeman and Company, San Fransisco.

Hankst T. and H. Kanomori, 1979. "A Moment Magnitute Scale." *Journal of Geog.Phys. Res*, V.82, pp.2981-2987.

Hasbenli, A. and K. Yildiz, 1993. "Kizilirmak Nehri'nin Baciloriophyto Disindaki Algleri. - Algae of Kizilirmak River except Baciloriophyto." Istanbul University. *Water Products Periodical*, No: 1-2.

Haslam, S., 1992. *River Pollution: An Ecological Perspective*. John Wiley and Sons, West Sussex.

Heinzel, H., R. F. Fitter, and J. Parslow, 1992. *Birds of Britain and Europe with North Africa and the Middle East*. Collins Pocket Guide.

ICOLD (International Committee On Large Dams), 1989. *Selecting Seismic Parameters for Large Dams - Guidelines*. ICOLD Publications, Paris.

International Finance Corporation, *Guidance for Preparation of an Environmental Assessment*. The Washington D.C..

Istanbul Technical University, 1990. *Turkiye ve Cevresinin Depremler Katalogu - Earthquake Catalogue of Turkey and Surroundings*. Istanbul.

Japan International Cooperation Agency, 1979. *Feasibility Report on Boyabat Dam and Hydroelectric Power Plant Development Project*. 2 Volumes, Ankara.

Jeffries, M. and D. Mills, 1994. *Freshwater Ecology: Principles and Applictions*. John Wiley and Sons, West Sussex.

Ketenoglu, O., Y. Akman and M. Aydogdu, 1983. *A Phytosociological Research on the Maquis Formation in the West Black Sea Region*. Coomm. de la Fac. Sc. De L'Univ., Serie C, Tome 1, pp. 11-19.

Kiziroglu, I., 1989. *Turkiye Kuslari - Birds of Turkey*. The General Directorate of Forestry, Ankara.

Kuru. H, 1987. *Omurgali Hayvanlar - Vertabrates*. Ataturk University Press, Ankara.

Loar, J. M. and M. J. Sale, 1981. *Analysis of Environmental Issues Related to Small-scale Hydroelectric Development, V. Instream Flow Needs for Fishery Resources*. Environmental Sciences Division Publication No: 1829, Oak Ridge National Laboratory, Oak Ridge, TN.

Mahon, R., 1980. "Accuracy of Catch-Effort Methods for Estimating Fish Density and Biomass in Streams." Biol. Fish., Vol. 5, No. 4, s. 342-360.

Maitland, P. S., 1977. *The Hamlyn Guide to Freshwater Fishes of Britain and Europe*. The Hamlyn Publishing Group, Ltd., Astronaut House, Feltham, Middlesex, England.

Organization for Economic Cooperation and Development (OECD), 1992. *Environmental Policies in Turkey*. OECD, Paris.

Overseas Private Investment Corporation (OPIC). *Program Handbook*. OPIC, USA.

Pili, A., D. O. Carle, E. Kline, Q. Pickering ve J. Lazorchak, 1988. "Effects of Pollution on Freshwater Organisms." *Journal WPCF*, Vol. 60, No. 6, s. 994-1088.

Slammons D., 1982. "Determination of the Design Earthquake Magnitute for Microzonation." *Proceedings of Third International Earthquake Microzonation Conference*, Vol. 1, pp. 119-130.

State Planning Organization (DPT), 1995. *Yedinci Bes Yillik Kalkinma Plani - Seventh Five Year Development Plan*. DPT, Ankara.

Stumm, W. and J. Morgan, 1970. *Aquatic Chemistry*. John Wiley and Sons, New York.

Tchobanoglous, G., 1979. *Wastewater Engineering: Treatment, Disposal, Reuse*. McGraw-Hill, Boston.

Tennant, D. L., 1975. *Instream Flow Regimens for Fish, Wildlife, Recreation and Related Environmental Resources*. U.S. Fish and Wildlife Service, Billings, MT.

The General Directorate of Mineral Exploration and Research (MTA), 1997. *Sinop, Corum ve Samsun Illeri Maden ve Enerji Kaynaklari - Mineral Resources of the Provinces of Sinop, Corum and Samsun*. MTA, Ankara.

The General Directorate of Rural Affairs (KHGM), 1994. *Sinop, Corum ve Samsun Illeri Arazi Kullanim Haritalari - Land Use Maps of the Provinces of Sinop, Corum and Samsun*. KHGM, Ankara.

The General Directorate of State Hydraulic Works (DSI), 1988. *Altinkaya Dam and Hydroelectric Power Plant.* DSI VII. Regional Office, Samsun.

The General Directorate of State Hydraulic Works (DSI), 1987. *Boyabat Project: Environmental Report on Boyabat Dam.* DSI VII. Regional Office, Samsun.

The General Directorate of State Meteorological Institute (DMI), 1995. *Sinop, Corum ve Samsun Illeri Meteorolojik Verileri - Meteorological Data for the Provinces of Sinop, Corum and Samsun.* DMI, Ankara.

The Ministry of Labor and Social Security, 1993. *Isci Sagligi ve Guvenligi Uzerine Genel Bilgiler - General Information on Labor Health and Security.* Ankara.

The Ministry of Reconstruction and Settlement, 1995. *1900 - Agustos 1995 Tarihleri Arasinda Kaydedilen Depremler - Earthquakes Recorded between 1990 and August 1995.* Deprem Arastirma Dairesi Baskanligi, Sismoloji Sube Mudurlugu, Ankara.

The World Bank, 1991a. *Environmental Assessment Sourcebook.* The World Bank, Washington, D.C..

The World Bank, 1991b. *Operational Manual.* The World Bank, Washington, D.C..

Train, R., 1979. *Quality Criteria for Water.* Castle House Publications, Great Britain.

Vesilind, A., 1975. *Environmental Pollution and Control.* Ann Arbor Science, Durham, North Carolina.

Water Research Center, 1980. *River Pollution Control.* Ellis Horwood, West Sussex.

World Conservation Monitoring Centre, 1998. *Result of Red List Country Enquiry for Turkey.* Microsoft Internet Explorer, 26 pp.

WYSS, M., 1979. "Estimating Maximum Expectable Magnitude of Earthquakes from Fault Dimensions." *Geology*, Vol. 7, No. 7, pp. 336-340.

Yilmaz, I., 1989. "Kuzey Anadolu Amfibilerinin Yayilisi Uzerine Bir Calisma (Amphibia: Urodala, Anadolu). - A Study on the Distribution of Amphibians of North Anatolia (Amphibia: Urodala, Anatolia)." *Dogu TU Zooloji*, Vol. 13, No. 2, pp. 130-140.

Yilmaz, M., and A. Gul, 1995. "Kapulukaya Reservoir (Kizilirmak) Fish Fauna." *Gazi University Natural Sciences Periodical*, Vol. 8, No: 2, pp. 33-40.

ANNEX 3

KIZILIRMAK RIVER DAILY FLOW DATA
USED FOR
BOYABAT PROJECT CRITICAL MINIMUM FLOW ANALYSIS

GENERAL DIRECTORATE OF STATE HYDRAULIC WORKS
FLOW GAUGES 1536 AND 1538

KEY TABLE FOR THE DAILY FLOW DATA SHEETS FOR FLOW GAUGES 1538 AND 1536

15 - KIZILIRMAK BASIN

1538 - DEVRES CREEK-CELTIKCIBASI

LOCATION (33° 46' 29" E - 40° 54' 14" N) 16th km of the road between Ilgaz Town and Tosya Town (Kastamonu Province)

RAINFALL AREA :1962 Km^2 ELEVATION :775 m

OBSERVATION PERIOD : 01/10/1970 - 30/09/1994

AVERAGE FLOWS : During observation period : 8.184 m3/sec (24 Years) in 1994 water year : 2.712 m3/sec

INSTANT MAXIMUM AND MINIMUM FLOWS:

In 1994 water year maximum flow	15.6	m^3/sec	13/05/1994
In 1994 water year minimum flow	0.678	m^3/sn	27/07/1994
During observation period maximum flow	558.	m^3/sec	28/03/1980
During observation period maximum flow	0.322	m^3/sec	12/08/1985

Level Measurement : Equivalent - Limnigraph

NOTES :

16 . Key Curve (Levels, cm - Flows, m^3/sn.)

Level	Flow	Level	Flow	Level	Flow	Level	Flow
110	0.430	235	76.0	360	258.	485	570.
135	6.10	260	103.	385	315.	510	645.
160	17.2	285	135.	410	377.		
185	32.9	310	169.	435	440.		
210	52.5	335	210.	460	502.		

FLOWS, from 1 October 1993 to 30 September 1994 (as m^3/sec)

Day / Month	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May	June	July	Aug.	Sept.
1	1.93	2.60	2.83	3.33	3.33	4.44	6.80	3.11	1.58	1.23	0.926	0.926
2	1.93	2.60	2.83	3.33	3.05	4.44	6.10	2.87	1.58	1.23	0.926	0:926
3	1.93	2.60	2.83	4.16	3.05	5.10	5.45	2.63	1.58	1.23	0.926	0.926
4	2.15	2.60	2.83	4.77	3.05	5.44	5.45	2.39	1.40	1.23	0.926	0:926
5	2.38	2.60	2.83	4.44	3.05	6.10	5.45	2.15	1.23	1.23	0.926	0.802
6	2.38	2.60	2.83	4.16	3.05	6.10	6.10	1.73	1.05	1.05	0.926	0.802
7	2.38	2.83	2.83	3.88	3.05	5.10	6.10	1.73	1.05	1.05	0.926	0.802
8	2.38	2.60	2.83	3.61	3.33	4.77	5.13	1.73	1.05	1.23	0.926	0.802
9	2.38	2.60	2.83	3.61	3.61	4.77	4.80	2.39	1.23	1.23	0.926	0.802
10	2.38	2.83	2.83	3.61	3.61	5.10	5.13	2.63	1.23	1.05	0.926	0.802
11	2.15	2.83	2.83	3.61	3.61	5.10	4.80	3.35	1.05	1.05	1.05	0.802
12	2.15	2.83	2.83	3.33	3.61	4.77	4.80	5.78	1.05	1.05	0.926	0.802
13	1.93	2.83	3.05	3.05	3.61	4.77	4.51	10.4	1.05	1.05	0.926	0.802
14	1.75	2.83	2.83,	3.05	3.61	4.77	4.22	7.23	0.926	1.05	0.926	0.802
15	1.58	2.83	2.38	3.33	3.33	4.77	3.93	6.10	0.926	1.05	0.926	0.802
16	1.58	2.83	2.60	3.33	3.05	5.10	3.93	5.44	0.926	1.23	0.926	0.802
17	1.58	3.05	2.60	3.05	2.60	7.23	3.35	4.44	0.926	1.23	0.926	1.05
18	1.58	2.83	2.60	3.05	2.83	10.0	2.63	4.16	0.926	1.23	0.926	1.05
19	1.40	2.83	2.60	3.05	3.05	9.60	2.39	3.88	0.926	1.23	0.926	0.926
20	1.58	2.83	2.60	2.83	3.05	10.0	2.15	3.61	0.926	1.05	0.926	0.926
21	1.93	2.83	2.60	2.83	3.05	9.60	2.87	3.33	0.926	1.05	0.926	0.926
22	2.15	2.83	2.60	2.83	3.33	9.60	2.63	2.83	0.926	0.926	0.926	0.802
23	2.15	2.83	2.60	2.60	3.33	9.19	3.35	2.60	1.05	0.926	0.926	0.802
24	2.15	2.83	2.60	2.60	3.61	6.80	4.80	2.15	0.926	0.926	0.926	0.678
25	2.15	2.83	2.60	2.60	3.61	5.78	4.51	1.93	0.926	0.802	0.926	0.678
26	2.15	2.83	3.05	2.60	4.16	5.78	4.51	1.93	1.05	0.926	0.926	0.678
27	2.15	2.83	3.33	2.60	4.44	6.80	3.93	1.75	1.05	0.802	0.926	0.678
28	2.15	2.83	4.16	2.60	4.44	8.30	3.93	1.75	1.40	0.802	1.23	0.678
29	2.15	2.83	3.88	2.83	-----	9.14	3.93	1.75	1.40	0.802	1.23	0.678
30	2.38	2.83	3.88	3.05	-----	8.30	3.64	1.58	1.23	0.802	1.23	0.678
31	2.60	-----	3.61	3.61	-----	7.55	-----	1.58	-----	0.802	1.23	-----
Total	63.6	83.3	90.1	101.	94.5	204.	131.	101.	33.5	32.5	30.0	24 6.
Avg.	2.05	2.78	2.91	3.27	3.38	6.59	4.38	3.26	1.12	1.05	0.969	0.819
Lt/s/km^2	1.05	1.41	1.48	1.67	1.72	3.36	2.23	1.66	0.569	0.535	0.494	0.417
Level, mm	2.80	3.67	3.97	4.46	4.16	9.00	5.78	4.44	1.48	1.43	1.32	1.08
10^6 m^3	5.50	7.20	7.79	8.76	8.16	17.7	11.3	8.72	2.89	2.81	2.60	2:12

Water Year (1994) Yearly Total Flow 990.0 m^3/sec 85.5 10^6 m^3 43.6 mm 1.38 Lt/sec/km^2

1538 - DEVRES ÇAYI-ÇELTİKÇİBAŞI

YERİ :(33° 46' 29" D - 40° 54' 14" K) Kastamonu ili Ilgaz ilçesinden Tosya ya giden yolun 16.ka. sindeki Çeltikbaşı köyüne 1 km. mesafededir.

YAĞIŞ ALANI : 1962 Km' YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ :01/10/1970 - 30/09/1993

ORTALAMA AKIMLAR :Gözlem süresinde 8.422 m3/sn. (23 Yıllık) 1993 Su yılında 8.110 m3/sn.

ANLIK EN ÇOK VE EN AZ AKIMLAR:

1993 Su yılında anlık ençok akım	:	115.	m3/sn	28/03/1993
1993 Su yılında anlık enaz akım	:	1.23	m3/sn	23/07/1993
Gözlem süresinde anlık ençok akım	:	558.	m3/sn	28/03/1980
Gözlem süresinde anlık enaz akım	:	0.322	m3/sn	12/08/1985

SEVİYE ÖLÇEĞİ :Eşel-Limnigraf

DÜŞÜNCELER :Su yılı içinde 14 akım ölçüşü yapılmıştır. Su yılı akım değerlendirmesinde 16 :nolu akım anahtar eğrisi kullanılmıştır.

16 . Anahtar eğrisi (Seviyeler cm. - Akımlar m3/sn.)

Seviye	Akım	Seviye	Akım	Seviye	Akım	Seviye	Akım
110	0.430	235	76.0	360	258.	485	570.
135	6.10	260	103.	385	315.	510	645.
160	17.2	285	135.	410	377.		
185	32.9	310	169.	435	440.		
210	52.5	335	210.	460	502.		

AKIMLAR 1 EKİM 1992 'DEN 30 EYLÜL 1993 'A KADAR SANİYEDE METRE KÜP OLARAK

GÜN/AY	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AĞUSTOS	EYLÜL
1	2.38	3.05	3.05	2.38	3.05	5.44	33.6	10.4	11.3	3.88	1.58	1.75
2	2.60	2.83	3.05	2.38	3.33	6.10	38.7	12.2	10.9	3.88	1.58	1.75
3	3.88	2.83	3.05	2.60	3.33	7.98	25.6	18.9	10.4	3.88	1.58	1.93
4	4.77	2.83	3.05	2.60	3.33	7.98	20.6	28.3	9.19	3.88	1.58	1.93
5	4.16	3.05	2.60	2.38	3.33	8.38	23.0	19.4	9.19	3.88	1.58	1.93
6	3.88	2.83	2.83	2.38	3.61	7.23	21.2	15.6	10.9	3.88	1.58	1.93
7	3.61	2.60	2.83	2.60	3.61	6.85	21.8	13.1	10.9	3.61	1.58	1.93
8	3.61	2.60	3.33	2.60	3.33	7.98	20.0	12.7	10.0	3.61	1.40	1.75
9	3.61	2.60	3.33	2.60	3.05	7.60	19.4	13.6	8.79	3.61	1.40	1.75
10	3.88	2.60	3.33	2.60	3.05	6.48	16.1	14.5	7.98	3.61	1.40	1.75
11	3.61	2.38	3.33	2.38	3.33	6.10	14.0	22.4	7.60	3.61	1.75	1.75
12	3.61	2.38	3.33	2.38	3.33	5.77	12.2	25.6	6.48	3.33	2.38	1.58
13	3.61	2.38	3.33	2.60	3.05	5.77	12.7	53.4	5.77	3.33	2.83	1.58
14	3.61	2.60	3.61	2.60	3.05	5.77	14.5	33.6	5.10	3.33	2.83	1.58
15	3.88	3.05	3.33	2.60	3.33	5.44	18.9	71.0	6.10	2.83	2.60	1.75
16	3.88	2.83	3.05	3.05	3.33	5.77	20.0	46.9	8.38	2.60	2.38	1.58
17	3.88	2.83	3.33	2.83	3.33	6.10	25.6	37.2	7.23	2.38	2.15	1.58
18	3.61	2.83	3.33	3.33	3.33	6.85	26.3	30.9	6.85	1.93	2.15	1.58
19	3.61	2.83	3.33	3.33	3.33	8.38	21.8	43.6	7.23	1.75	2.15	1.58
20	3.61	3.05	3.33	3.33	3.33	10.9	16.1	41.1	6.48	1.58	2.38	1.58
21	3.88	4.16	3.05	3.61	3.33	10.4	13.6	40.2	6.10	1.58	2.15	1.75
22	3.88	3.88	2.60	3.61	3.61	11.8	12.7	28.9	5.77	1.40	2.15	1.75
23	3.61	4.16	3.05	3.61	3.61	21.8	11.3	34.3	5.44	1.23	2.15	1.75
24	3.33	3.88	3.05	3.61	3.88	36.5	11.3	28.3	4.44	1.40	1.93	1.93
25	3.61	3.88	2.38	3.61	3.88	52.5	11.3	35.1	4.16	1.58	1.93	1.93
26	3.88	3.33	2.60	3.61	4.77	67.3	10.9	46.1	3.88	1.58	1.75	1.93
27	3.33	3.33	2.38	3.88	6.85	79.0	10.4	27.0	4.44	1.58	1.58	1.75
28	3.61	3.61	2.38	4.16	5.44	87.6	9.60	21.2	4.44	1.58	1.75	1.75
29	3.33	3.05	2.60	3.61	-----	82.1	8.79	17.2	4.16	1.58	1.75	1.75
30	3.33	3.05	2.60	3.61	-----	40.2	8.79	14.0	4.16	1.58	1.75	1.75
31	3.05	-----	2.38	3.33	-----	34.3	-----	12.7	-----	1.58	1.58	-----
TOPLAM	112.	91.3	92.8	93.8	101.	662.	531.	869.	214.	81.1	59.3	52.6
ORTALAMA	3.62	3.04	2.99	3.03	3.61	21.4	17.7	28.0	7.13	2.61	1.91	1.75
LT/SN/KM'	1.84	1.55	1.53	1.54	1.84	10.9	9.02	14.3	3.63	1.33	0.975	0.893
AKIM MM.	4.94	4.02	4.09	4.13	4.45	29.2	23.4	38.3	9.41	3.57	2.61	2.32
MİL. M3	9.69	7.89	8.02	8.10	8.74	57.2	45.9	75.1	18.5	7.00	5.13	4.54

SU YILI (1993) YILLIK TOPLAM AKIM 2960. M3/SN. 256. MİLYON M3 130. MM. 4.13 LT/SN/KM'

1538 - DEVRES ÇAYI-ÇELTİKÇİBAŞI

1538 - DEVRES ÇAYI-ÇELTİKÇİBAŞI

YERİ :(33' 46' 29" D - 40' 54' 14" K) Kastamonu ili Ilgaz ilçesinden Tosya ya giden yolun 16.km. :sindeki Çeltikbaşı köyüne 1 km. mesafededir.

YAĞIŞ ALANI : 1962 Km² YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ :01/10/1970 - 30/09/1992

ORTALAMA AKIMLAR :Gözlem süresinde 8.436 m3/sn. (22 Yıllık) 1992 Su yılında 9.272 m3/sn.

ANLIK EN ÇOK VE EN AZ AKIMLAR:

1992 Su yılında anlık ençok akım	:	187.	m3/sn	29/03/1992
1992 Su yılında anlık enaz akım	:	0.430	m3/sn	15/08/1992
Gözlem süresinde anlık ençok akım	:	558.	m3/sn	28/03/1980
Gözlem süresinde anlık enaz akım	:	0.322	m3/sn	12/08/1985

SEVİYE ÖLÇEĞİ :Eşel-Limnigraf

DÜŞÜNCELER :Su yılı içinde 17 akım ölçüsü yapılmıştır. Su yılı akım değerlendirmesinde 10 :nolu (01.10.1991-09.04.1992) ve 15 nolu (10.04.1992-30.09.1992) akım anahtar :eğrileri kullanılmıştır.

15 . Anahtar eğrisi (Seviyeler cm. - Akımlar m3/sn.)

Seviye	Akım	Seviye	Akım	Seviye	Akım	Seviye	Akım
10	0.430	135	76.0	260	258.	385	570.
35	6.10	160	103.	285	315.	410	645.
60	17.2	185	135.	310	377.		
85	32.9	210	169.	335	440.		
110	52.5	235	210.	360	502.		

AKIMLAR 1 EKİM 1991 'DEN 30 EYLÜL 1992 'A KADAR SANİYEDE METRE KÜP OLARAK

GUN/AY	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AĞUSTOS	EYLÜL
1	1.21	2.50	3.06	3.34	2.50	3.62	47.0	18.9	2.15	13.6	0.802	1.05
2	1.21	2.50	3.06	3.34	2.50	3.90	51.7	16.7	2.15	28.3	0.802	1.05
3	1.21	2.50	3.06	3.34	2.50	4.23	71.0	15.0	2.38	16.7	0.802	1.05
4	1.21	2.50	3.06	3.34	2.50	4.23	77.0	14.0,	2.38	13.6	0.802	1.05
5	1.21	2.50	3.06	3.34	2.27	4.56	75.0	13.1	2.60	15.6	0.802	1.05
6	1.21	2.50	2.78	3.62	2.27	4.23	84.1	12.2	2.60	13.6	0.802	1.05
7	1.37	2.50	3.06	3.34	2.27	4.23	101.	11.8	2.38	10.0	0.802	1.05
8	2.05	2.50	4.23	3.06	2.05	4.23	118.	11.3	2.60	7.98	0.802	1.23
9	2.05	2.50	5.55	3.34	2.05	4.23	127.	10.9	2.38	6.48	0.802	1.23
10	2.05	2.50	3.90	3.34	1.82	4.23	80.0	10.0	2.60	5.77	0.802	1.40
11	2.27	2.50	3.34	3.34	1.60	4.23	80.0	9.19	2.38	5.44	0.802	1.75
12	2.27	2.50	3.06	3.62	2.78	4.23	107.	8.79	2.15	4.44	0.802	1.93
13	2.05	3.62	2.50	3.06	2.50	4.56	97.5	8.79	1.93	3.33	0.678	1.93
14	2.05	2.78	2.50	3.06	2.78	4.89	51.7	8.79	2.60	2.83	0.802	2.15
15	2.05	3.06	2.78	3.34	2.78	4.89	37.2	8.79	5.44	4.77	0.678	2.15
16	2.05	3.06	2.50	3.06	2.78	5.55	32.2	8.79	5.77	3.88	0.678	2.38
17	2.05	3.06	2.27	3.34	3.06	8.24	30.3	5.44	5.77	3.33	0.678	2.38
18	2.05	3.06	2.27	2.78	3.62	34.1	30.9	5.10	6.48	3.05	0.678	2.60
19	2.05	3.06	2.27	2.50	4.23	36.3	30.9	4.16	8.79	2.83	0.802	2.60
20	2.27	3.06	2.27	2.27	3.90	20.1	50.9	3.88	10.4	2.15	0.926	2.83
21	2.05	3.06	2.50	2.27	3.62	18.4	46.9	3.61	10.0	2.38	0.926	2.83
22	1.82	3.06	2.50	2.27	3.62	15.7	35.8	3.05	8.38	2.15	0.926	2.83
23	2.05	3.06	2.50	2.50	3.62	13.7	30.3	2.83	7.60	2.15	1.05	3.05
24	2.05	2.78	2.50	2.50	3.62	11.7	25.6	3.05	6.85	2.15	1.23	3.05
25	2.05	2.78	3.62	2.50	3.62	14.2	24.3	2.83	6.10	1.93	1.23	3.05
26	2.27	2.78	3.62	2.50	3.62	24.1	22.4	2.83	5.10	1.58	1.23	3.05
27	2.27	2.78	3.62	2.50	3.62	46.2	21.8	2.60	6.10	1.40	1.23	3.05
28	2.27	3.06	3.34	2.78	3.62	82.0	21.8	2.60	7.60	1.23	1.23	2.83
29	2.27	3.06	3.34	2.78	3.62	125.	20.0	2.38	13.1	1.05	1.05	2.83
30	2.50	3.06	3.62	2.50	-----	74.0	20.0	2.38	14.5	0.926	1.05	2.60
31	2.50	-----	3.62	2.50	-----	60.3	-----	2.15	-----	0.802	1.05	-----
TOPLAM	60.0	84.2	95.4	91.4	85.3	654.	1649.	236.	161.	185.	27.7	63.1
ORTALAMA	1.94	2.81	3.08	2.95	2.94	21.1	55.0	7.61	5.38	5.98	0.895	2.10
LT/SN/KM²	0.987	1.43	1.57	1.50	1.50	10.8	28.0	3.88	2.74	3.05	0.456	1.07
AKIM MM.	2.64	3.71	4.20	4.02	3.76	28.8	72.6	10.4	7.10	8.17	1.22	2.78
MİL. M3	5.19	7.28	8.24	7.89	7.37	56.5	143.	20.4	13.9	16.0	2.40	5.45

SU YILI (1992) YILLIK TOPLAM AKIM 3393. M3/SN. 293. MİLYON M3 149. MM. 4.73 LT/SN/KM²

15 - KIZILIRMAK HAVZASI

1530 - DEVRES ÇAYI-ÇELTİKÇİBAŞI

YERİ :(33° 46' 29" D - 40° 54' 14" K) Kastamonu ili Ilgaz ilçesinden Tosya ya giden yolun 16.ka.
:sindeki Çeltikbaşı köyüne 1 km. mesafededir.

YAĞIŞ ALANI : 1962 Km² YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ :01/10/1970 - 30/09/1991

ORTALAMA AKIMLAR :Gözlem süresinde 0.397 m3/sn. (21 Yıllık) 1991 Su yılında 3.054 m3/sn.

ANLIK EN ÇOK VE EN AZ AKIMLAR:

1991 Su yılında anlık encok akım	:	26.4	m3/sn	19/03/1991
1991 Su yılında anlık enaz akım	:	0.550	m3/sn	16/08/1991
Gözlem süresinde anlık encok akım	:	550.	m3/sn	20/03/1980
Gözlem süresinde anlık enaz akım	:	0.322	m3/sn	12/08/1985

SEVİYE ÖLÇEĞİ :Eşel-Limnigraf

DÜŞÜNCELER :Akım durumu iyi.Yıl içinde 12 akım ölçüsü yapılmıştır.Değerlendirmede 3 ayrı
:akım anahtar eğrisi kullanılmıştır. (10: 06.07.1991-30.09.1991)
:(11: 01.10.1990-31.10.1990 / 20.02.1991-05.07.1991)
:(15: 01.11.1990-19.02.1991)

15 . Anahtar eğrisi (Seviyeler cm. - Akımlar m3/sn.)

Seviye	Akım	Seviye	Akım	Seviye	Akım	Seviye	Akım	Seviye	Akım
10	0.430	40	7.09	90	36.5	190	141.	290	327.
15	1.05	50	12.2	110	52.5	210	169.	320	402.
20	1.93	60	17.2	130	71.0	230	201.	350	477.
25	3.05	70	23.0	150	92.0	250	237.	380	555.
30	4.44	80	29.6	170	115.	270	280.	410	645.

AKIMLAR 1 EKİM 1990 'DEN 30 EYLÜL 1991 'A KADAR SANİYEDE METRE KÜP OLARAK

GÜN/AY	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AĞUSTOS	EYLÜL
1	1.93	4.77	3.33	3.33	3.05	5.84	6.45	6.14	4.01	1.25	0.714	1.60
2	1.93	4.16	3.33	3.33	3.05	5.53	6.45	7.15	3.46	1.10	0.714	1.82
3	1.74	4.16	3.33	3.61	3.33	5.23	8.33	6.14	2.98	1.10	0.714	1.60
4	1.74	3.88	5.44	3.05	3.33	4.92	9.52	5.84	3.46	1.10	0.714	1.60
5	1.55	3.61	4.44	3.05	3.33	4.31	8.33	5.53	3.70	1.10	0.878	1.60
6	1.55	3.33	4.77	3.33	3.05	4.01	7.15	5.23	6.75	3.34	0.714	1.60
7	1.40	3.33	4.44	3.33	3.33	4.01	6.45	4.62	5.84	3.62	0.714	1.60
8	1.40	3.33	4.44	3.33	3.33	3.70	7.54	4.31	4.92	3.90	0.550	1.60
9	1.40	3.33	4.44	3.33	3.05	3.70	19.2	4.01	4.31	3.34	0.714	1.60
10	1.55	3.61	4.44	3.33	3.05	3.46	13.5	3.70	9.12	2.78	0.714	1.60
11	1.55	3.33	4.16	3.33	2.83	3.46	10.7	3.46	10.7	2.50	0.714	1.60
12	1.55	3.33	3.88	3.33	3.05	3.22	9.12	3.70	8.73	2.50	0.550	1.60
13	1.55	3.05	3.88	3.33	3.05	3.70	7.94	3.46	8.33	2.27	0.550	1.37
14	1.55	3.05	4.44	3.33	2.83	8.73	7.15	3.46	6.75	2.05	0.550	1.37
15	1.55	3.05	4.77	3.33	2.83	10.3	7.15	3.22	5.53	2.05	0.550	1.37
16	1.55	3.05	5.44	3.33	3.61	9.52	8.73	4.62	4.31	1.82	0.550	1.37
17	1.55	3.33	6.05	3.33	3.33	7.54	9.12	4.62	3.22	1.60	0.714	1.37
18	1.55	3.33	6.05	2.83	3.61	15.9	9.52	4.01	2.50	1.21	0.550	1.37
19	1.55	3.33	6.10	2.60	3.88	21.4	8.73	3.46	1.93	1.04	0.714	1.37
20	1.55	3.05	6.10	2.30	3.70	10.1	8.73	3.22	1.55	1.21	0.714	1.60
21	1.55	3.05	5.77	2.60	4.31	15.3	8.73	4.01	1.55	1.21	0.714	1.60
22	1.55	3.05	5.44	2.83	4.01	14.4	7.94	4.62	2.12	1.04	0.714	1.60
23	1.74	3.05	5.10	2.83	4.01	12.5	7.94	4.92	3.46	1.04	1.37	1.60
24	2.12	3.05	4.44	2.83	4.62	12.1	7.54	4.31	2.50	1.04	1.60	1.60
25	2.50	3.05	4.16	2.83	5.84	11.6	8.33	3.70	1.93	1.04	1.60	1.37
26	2.74	3.05	3.61	3.05	6.75	10.7	8.33	3.70	1.55	1.04	1.60	1.37
27	2.74	3.05	3.33	2.83	7.54	10.3	7.94	4.31	1.55	0.878	1.37	1.37
28	2.90	3.05	3.33	2.83	6.45	9.12	6.75	4.31	1.55	0.878	1.21	1.37
29	2.74	3.05	3.61	3.33	-----	7.94	6.45	4.31	1.40	0.878	1.21	1.21
30	2.74	3.05	3.61	3.33	-----	7.94	6.14	4.01	1.25	0.878	1.21	1.37
31	4.01	-----	3.05	3.33	-----	6.75	-----	4.01	-----	0.714	1.21	-----
TOPLAM	59.1	99.9	140.	96.8	108.	265.	256.	136.	121.	51.5	27.1	45.1
ORTALAMA	1.91	3.33	4.53	3.12	3.86	8.56	8.53	4.39	4.03	1.66	0.874	1.50
LT/SN/KM²	0.972	1.70	2.31	1.59	1.97	4.36	4.35	2.24	2.06	0.847	0.446	0.766
AKIM MM.	2.60	4.40	6.10	4.26	4.76	11.7	11.3	5.99	5.33	2.27	1.19	1.98
MİL. M3	5.11	8.63	12.1	8.36	9.34	22.9	22.1	11.8	10.5	4.45	2.34	3.89

SU YILI (1991) YILLIK TOPLAM AKIM 1406. M3/SN. 121. MİLYON M3 61.9 MM. 1.96 LT/SN/KM²

15 - KIZILIRMAK HAVZASI

1538 - DEVRES ÇAYI-ÇELTİKÇİBAŞI

YERİ :(33° 46' 29" D - 40° 54' 14" K) Kastamonu İli Ilgaz İlçesinden Tosya ya giden yolun 16.km. :sindeki Çeltikbaşı köyüne 1 km. mesafededir.

YAĞIŞ ALANI : 1962 Km² YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ :01/10/1970 - 30/09/1990

ORTALAMA AKIMLAR :Gözlem süresindo 8.624 m3/sn. (20 Yıllık) 1990 Su yılında 6.921 m3/sn.

ANLIK EN ÇOK VE EN AZ AKIMLAR:

1990 Su yılında anlık encok akım	:	107.	m3/sn	01/03/1990
1990 Su yılında anlık enaz akım	:	0.520	m3/sn	01/10/1989
Gözlem süresinde anlık encok akım	:	550.	m3/sn	28/03/1980
Gözlem süresinde anlık enaz akım	:	0.322	m3/sn	12/08/1985

SEVİYE ÖLÇEĞİ :Eşel-Limnigraf

DÜŞÜNCELER :Akım durumu iyi.Yıl içinde 16 akım ölçüsü yapılmıştır.Değerlendirmede 2 ayrı :akım anahtar eğrisi kullanılmıştır.

12 . Anahtar eğrisi (Seviyeler cm. - Akımlar m3/sn.)

Seviye	Akım	Seviye	Akım	Seviye	Akım	Seviye	Akım	Seviye	Akım
15	0.420	50	9.60	100	41.0	190	141.	290	327.
20	0.920	60	14.5	110	50.0	210	169.	320	402.
25	1.65	70	20.3	130	68.5	230	201.	350	477.
30	2.65	80	27.0	150	90.0	250	237.	380	555.
40	5.55	90	34.0	170	115.	270	280.	410	645.

AKIMLAR 1 EKİM 1989 'DEN 30 EYLÜL 1990 'A KADAR SANİYEDE METRE KÜP OLARAK

GÜN/AY	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AĞUSTOS	EYLÜL
1	0.720	1.85	7.17	13.5	2.94	65.7	19.7	10.7	9.91	1.40	1.55	0.950
2	0.720	1.85	5.96	10.6	2.94	34.0	15.9	10.7	9.91	1.40	1.55	0.950
3	0.820	1.65	4.97	10.1	2.94	23.9	13.5	11.2	7.94	1.40	1.10	0.950
4	0.020	1.65	4.97	8.39	2.94	29.8	11.6	12.1	6.75	1.25	1.10	0.950
5	0.920	1.65	4.39	6.77	2.94	10.1	13.0	14.4	6.14	1.25	0.950	1.10
6	0.920	1.65	3.81	4.39	2.94	14.4	13.0	18.6	5.23	1.25	1.25	1.10
7	1.07	1.50	3.81	2.94	2.94	13.0	13.0	19.7	4.01	1.10	1.25	1.10
8	1.21	1.65	3.52	3.23	2.94	12.1	12.5	19.2	3.46	0.950	1.25	1.10
9	1.36	1.85	3.52	3.52	2.94	11.2	14.4	18.1	3.22	0.950	1.40	1.10
10	1.36	1.65	3.81	3.52	2.94	14.8	14.8	17.0	2.98	1.40	1.40	1.10
11	1.50	1.85	3.81	3.23	2.94	22.0	27.0	16.4	2.31	1.93	1.25	1.10
12	1.65	2.05	4.60	3.23	3.23	14.8	42.6	15.3	2.12	1.74	1.25	1.10
13	1.65	2.05	7.58	3.23	3.23	12.5	30.5	13.0	1.93	1.40	1.40	1.40
14	1.50	2.05	6.36	3.52	9.20	14.8	32.6	11.2	1.74	1.40	1.40	1.74
15	1.50	2.25	5.55	3.52	10.1	16.4	52.7	9.91	1.74	1.40	1.40	1.74
16	1.65	2.45	5.26	3.52	7.90	13.0	41.0	8.73	1.74	1.55	1.10	1.74
17	1.85	2.45	5.26	3.52	7.17	10.7	29.1	11.2	1.55	1.40	1.10	1.55
18	4.10	2.45	6.77	3.23	6.36	10.7	27.0	13.0	2.74	1.25	0.950	1.55
19	2.94	2.45	11.6	3.23	5.26	13.0	23.9	15.3	3.22	1.25	0.800	1.74
20	2.94	2.65	14.0	3.23	4.60	19.7	19.7	12.5	2.50	1.10	1.10	1.93
21	2.94	2.65	11.6	3.52	4.10	22.0	10.1	12.5	1.93	1.10	1.10	1.93
22	2.65	2.45	10.1	3.23	4.10	25.1	17.5	11.2	2.12	1.10	1.10	1.93
23	2.65	2.45	9.20	2.94	4.39	27.7	15.3	9.52	2.12	1.10	1.10	1.93
24	2.45	4.39	8.39	2.94	4.39	26.4	13.9	7.94	2.12	1.10	0.950	1.93
25	2.45	4.68	7.58	2.94	4.39	26.4	13.0	6.45	1.93	0.800	0.950	1.93
26	2.45	8.79	6.36	2.65	4.39	27.7	12.1	5.53	2.12	0.800	1.10	1.74
27	2.45	15.7	6.77	2.65	7.58	27.7	13.0	4.31	1.93	0.950	1.10	1.74
28	2.05	11.1	7.90	2.94	16.8	28.4	12.1	5.23	1.74	1.25	0.950	1.74
29	2.05	13.5	9.60	2.94	-----	29.8	10.7	4.31	1.55	3.70	0.950	1.74
30	2.05	11.1	13.0	3.23	-----	25.1	10.7	3.46	1.55	2.31	0.950	1.93
31	2.05	-----	10.6	3.23	-----	21.4	-----	4.31	-----	1.93	0.950	-----
TOPLAM	57.4	116.	226.	134.	140.	672.	604.	353.	100.	42.9	35.8	44.5
ORTALAMA	1.85	3.80	7.29	4.31	4.99	21.7	20.1	11.4	3.34	1.38	1.15	1.48
LT/SN/KM²	0.944	1.98	3.72	2.20	2.54	11.1	10.3	5.80	1.70	0.706	0.588	0.757
AKIM MM.	2.53	5.13	9.95	5.88	6.15	29.6	26.6	15.5	4.41	1.89	1.57	1.96
MİL. M3	4.96	10.1	19.5	11.5	12.1	58.1	52.2	30.5	8.66	3.71	3.09	3.85

SU YILI (1990) YILLIK TOPLAM AKIM 2526. M3/SN. 218. MİLYON M3 111. MM. 3.53 LT/SN/KM²

1538 - DEVRES ÇAYI-ÇELTİKÇİBAŞI

15- KIZILIRMAK HAVZASI

1538- DEVRES ÇAYI- ÇELTİKÇİBAŞI

YERİ :(33 47'08''D- 40 54'23''K) Kastamonu'nunIlgaz ilçesinden Tosya'ya giden karayolunun 22.km.sindeki Çeltikçibaşı köyüne 1 km. uzaklıktadır.

YAKIF ALANI :1962.0 Km^2. YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ :1 Ekim 1970- 30 Eylül 1989

ORTALAMA AKIMLAR :Gözlem süresinde 8.713 m^3/sn. (19 yıllık) 1989 Su yılında 4.900 m^3/sn.

EN ÇOK VE EN AZ AKIMLAR :

1989 Su yılında en çok akım	:	80.9 m^3/sn.	(01.03.1989)
1989 Su yılında en az akım	:	0.620 ''	(29.09.1989)
Gözlem süresinde en çok akım	:	550. ''	(28.03.1980)
Gözlem süresinde en az akım	:	0.322 ''	(12.08.1985)

SEVİYE ÖLÇEĞİ :Esel.

DÜŞÜNCELER :Akım durumu iyi.Yıl içinde 2 ayrı anahtar eğrisi kullanılmış;13 akım ölçüsü yapılmıştır.

12.Anahtar eğrisi (Seviyeler Cm. -Akımlar m^3/sn. dir.)

Seviye	Akım	Seviye	Akım
15	0.420	60	14.5
20	0.920	80	27.0
30	2.65	100	41.0
40	5.55	150	90.0
50	9.60	200	155.

AKIMLAR 1 EKİM 1988'DEN 30 EYLÜL 1989'A KADAR SANİYEDE METRE KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	SUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AGUSTOS	EYLÜL
1	1.20	4.80	5.47	5.84	3.90	53.6	7.58	2.25	4.97	1.21	1.36	0.920
2	1.05	4.50	5.47	5.84	3.90	27.0	7.17	2.05	4.68	1.21	1.36	1.21
3	1.05	4.20	5.84	5.10	3.60	21.6	7.58	2.05	4.68	1.21	1.36	1.07
4	1.20	3.90	8.06	4.80	3.60	27.0	7.17	2.65	5.55	1.07	1.21	0.920
5	1.20	3.90	9.70	5.10	3.60	25.7	7.17	2.94	5.26	1.07	1.21	0.920
6	1.98	3.90	9.70	4.80	3.90	23.0	7.17	3.52	4.39	1.36	0.820	0.920
7	1.98	4.50	9.70	4.50	3.90	23.0	7.17	3.81	3.23	1.65	0.720	0.920
8	1.77	5.10	8.80	5.10	3.90	24.3	6.36	3.52	2.45	1.65	0.720	0.820
9	1.56	5.10	8.43	5.10	3.90	21.6	5.96	5.55	2.45	1.65	0.720	0.820
10	1.56	4.80	8.43	5.10	3.90	24.3	5.96	5.26	2.45	1.65	0.820	0.820
11	1.98	4.50	9.70	4.50	3.90	14.5	6.36	4.68	2.25	1.50	0.820	0.820
12	1.05	4.50	10.2	4.50	3.36	13.5	6.77	4.10	2.65	1.50	1.21	0.820
13	1.05	4.20	9.25	4.80	3.36	13.0	7.17	3.52	2.65	1.65	1.21	0.920
14	3.36	3.90	8.80	4.80	3.60	12.5	7.17	2.94	2.65	1.65	1.21	0.920
15	2.88	4.50	9.25	3.60	3.60	12.5	7.17	2.65	3.23	1.50	1.21	0.920
16	2.64	4.80	10.2	4.20	3.60	11.6	6.77	2.45	3.23	1.36	1.21	1.07
17	2.64	4.80	10.6	3.90	3.60	11.6	6.36	2.45	2.94	2.05	1.21	1.07
18	2.64	4.50	11.1	4.20	3.60	11.6	5.55	2.25	2.65	1.85	1.21	1.07
19	3.12	4.20	10.6	4.50	3.60	12.1	5.26	2.25	2.45	1.85	1.21	1.07
20	3.36	4.20	10.2	4.20	3.36	12.5	4.97	2.05	1.85	1.85	1.21	1.07
21	3.36	3.90	9.70	3.36	3.60	12.5	4.39	1.85	1.50	1.50	1.21	0.920
22	3.36	4.20	9.70	3.36	3.90	12.1	4.39	2.05	1.50	1.50	1.21	0.920
23	2.88	4.50	9.70	3.90	4.20	12.1	4.10	4.39	1.65	1.36	1.21	0.820
24	2.88	5.84	7.69	3.90	4.50	12.1	3.52	5.96	1.65	1.36	1.21	0.820
25	3.12	5.84	6.58	3.60	5.47	12.1	3.81	4.97	1.50	1.36	1.21	0.820
26	3.60	6.21	6.58	3.60	10.2	12.5	4.10	4.68	1.50	1.36	1.21	0.720
27	5.84	6.21	5.47	3.36	27.6	12.1	3.81	4.39	1.21	1.36	1.07	0.720
28	5.10	6.58	5.10	3.36	75.4	12.1	3.23	4.10	1.21	1.21	0.920	0.720
29	5.10	6.21	5.47	3.90	——	9.60	2.65	3.81	1.85	1.21	0.920	0.620
30	4.80	5.84	5.47	3.60	——	8.39	2.65	7.17	1.50	1.36	0.920	0.620
31	4.50	——	5.84	3.60	——	7.98	——	5.96	——	2.05	0.920	——
TOPLAM	83.81	144.13	256.80	134.02	208.55	520.07	169.49	112.27	81.73	46.12	34.020	26.790
ORTALAMA	2.704	4.804	8.284	4.323	7.448	16.78	5.650	3.622	2.724	1.488	1.097	0.893
LT/SN/KM^2	1.38	2.45	4.22	2.20	3.80	8.55	2.88	1.85	1.39	0.758	0.559	0.455
AKIM.MM.	3.69	6.35	11.3	5.90	9.18	22.9	7.46	4.94	3.60	2.03	1.50	1.18
10^6 M^3 AKIM	7.24	12.5	22.2	11.6	18.0	44.9	14.6	9.70	7.06	3.98	2.94	2.31

SU YILI (1989) YILLIK TOPLAM AKIM. 157.1 MİLYON M^3. 80.0 MM . 2.54 LT/SN/KM^2 .

15- KIZILIRMAK HAVZASI

1538- DEVRES ÇAYI- CELTİKÇİFTLİĞİ

YERİ :(33 47'00''D- 40 54'23''K) Kastamonu'nunIlgaz ilçesinden Tosya'ya giden karayolunun 22.km.sindeki Çeltikçibaşı köyüne 1 km. uzaklıktadır.

YAĞIŞ ALANI :1962.0 Km^2 YANLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ :1 Ekim 1970- 30 Eylül 1988

ORTALAMA AKIMLAR :Gözlem süresinde 8.920 m^3/sn. (10 yıllık) 1988 Su yılında 8.039 m^3/sn.

EN ÇOK VE EN AZ AKIMLAR :1988 Su yılında en çok akım : 116. m^3/sn. (22.04.1988)

1988 Su yılında en az akım : 0.750 " (09.08.1988)

Gözlem süresinde en çok akım : 550. " (28. 3.1980)

Gözlem süresinde en az akım : 0.322 " (12. 8.1985)

SEVİYE ÖLÇEĞİ :Eşel.

DÜŞÜNCELER :Akım durumu iyi.Yıl içinde 12 akım ölçüsü yapılmıştır.

14.Anahtar eğrisi (Seviyeler Cm. -Akımlar m^3/sn. dir.)

Seviye	Akım	Seviye	Akım
20	0.600	80	25.0
30	2.40	100	39.7
40	5.10	150	90.0
50	8.80	200	155.
60	13.3	250	237.

AKIMLAR 1 EKİM 1987 DEN 30 EYLÜL 1988'E KADAR VE SANİYEDE METRE-KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AGUSTOS	EYLÜL
1	1.77	3.90	3.60	4.50	6.95	5.47	30.1	10.4	12.9	7.69	1.35	1.20
2	1.98	3.90	3.60	3.90	7.32	5.04	32.2	16.7	11.5	6.58	1.35	1.20
3	1.98	3.90	3.60	3.90	5.84	5.04	39.7	15.6	13.3	5.04	1.35	1.20
4	1.98	3.90	3.90	3.90	5.47	5.47	33.9	14.4	12.4	4.80	1.20	1.20
5	1.98	3.90	3.90	4.50	5.10	4.80	33.1	12.9	13.9	4.20	1.05	1.20
6	1.98	3.90	3.60	5.10	5.10	4.80	34.7	12.0	12.4	3.90	1.05	1.05
7	1.98	3.90	3.36	5.10	5.10	4.80	43.3	13.3	12.0	3.12	0.900	1.05
8	1.98	3.90	3.36	5.10	4.80	4.50	34.7	12.9	8.06	2.88	0.750	1.05
9	1.98	3.90	3.60	4.80	5.10	4.80	39.7	12.0	8.06	2.40	0.750	1.20
10	2.40	3.90	8.06	4.50	5.10	7.32	46.0	11.1	9.70	2.19	0.750	1.35
11	2.40	3.90	6.95	4.50	5.47	12.4	43.3	10.2	8.80	1.98	0.750	1.20
12	2.40	3.90	6.58	4.50	6.21	10.6	39.7	9.25	8.80	1.98	1.56	1.05
13	2.40	3.60	5.47	4.50	6.95	9.25	38.9	9.70	8.43	2.88	1.35	1.20
14	2.40	3.60	4.80	4.20	7.32	8.80	38.0	9.70	8.43	2.40	1.35	1.20
15	2.64	3.60	4.50	3.90	7.69	9.25	38.0	9.25	7.69	1.98	1.35	1.20
16	2.88	3.60	4.80	3.36	7.32	13.9	37.2	8.80	8.06	1.56	1.35	1.05
17	3.12	3.60	7.32	3.36	6.21	17.0	38.0	8.43	9.25	1.77	1.20	1.20
18	2.88	3.60	7.69	3.12	5.10	29.5	40.6	8.06	11.5	1.56	1.20	1.20
19	2.88	3.90	6.95	3.36	5.10	33.9	38.9	7.69	14.4	1.35	1.20	1.05
20	3.12	3.90	5.84	3.90	5.10	22.0	40.6	8.43	15.0	1.77	1.20	1.05
21	3.60	3.90	5.10	3.60	5.10	13.9	67.0	7.69	30.8	1.56	1.20	1.05
22	3.60	3.90	5.10	3.90	5.10	12.3	93.6	8.06	17.9	1.77	1.35	1.05
23	3.60	3.90	5.47	3.90	4.80	13.9	65.0	9.70	12.4	1.56	1.20	1.20
24	3.60	3.90	5.10	3.90	3.90	22.0	39.7	10.2	11.1	1.56	1.20	1.20
25	3.36	3.90	4.50	3.90	3.90	44.2	30.8	8.80	10.6	1.56	1.20	1.20
26	3.36	3.90	3.60	3.90	4.50	59.0	26.9	8.06	9.70	1.56	1.20	1.20
27	3.60	3.60	3.12	3.90	4.80	39.7	23.8	15.0	8.80	1.35	1.20	1.20
28	3.60	3.60	2.88	3.90	5.10	33.1	22.6	20.2	8.80	1.20	1.20	1.20
29	3.90	3.60	3.36	3.90	5.10	46.9	20.8	14.4	8.80	1.35	1.20	1.35
30	3.90	3.60	3.60	3.90	---	36.4	18.4	16.7	8.06	1.35	1.20	1.20
31	3.90	---	4.20	4.20	---	30.1	---	15.6	---	1.35	1.20	---
TOPLAM	87.15	114.00	147.51	126.90	160.65	574.74	1169.2	363.22	341.54	79.00	36.360	34.95
ORTALAMA	2.811	3.800	4.758	4.094	5.540	18.54	38.97	11.72	11.38	2.548	1.173	1.165
LT/SN/KM^2	1.43	1.94	2.43	2.09	2.82	9.45	19.9	5.97	5.80	1.30	0.598	0.594
AKIM.MM.	3.84	5.02	6.50	5.59	7.07	25.3	51.5	16.0	15.0	3.48	1.60	1.54
10 M^3 AKIM	7.53	9.85	12.7	11.0	13.9	49.7	101.	31.4	29.5	6.83	3.14	3.02

SU YILI (1988) YILLIK TOPLAM AKIM. 279.5 MİLYON M^3. 142. MM . 4.51 LT/SN/KM^2.

15- KIZILIRMAK HAVZASI

1530- DEVREZ CAYI- ÇELTİKÇİBAŞI

YERİ : (33 47'08''D- 40 54'23''K) Kastamonu'nunIlgaz ilçesinden Tosya'ya giden karayolunun 22.km.sindeki Çeltikçibaşı köyüne 1 km. uzaklıktadır.

YAĞIŞ ALANI : 1962.0 Km^2 YARLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ : 1 Ekim 1970- 30 Eylül 1987

ORTALAMA AKIMLAR : Gözlem süresinde 8.925 $m^3/sn.$ (17 yıllık) 1987 Su yılında 9.650 $m^3/sn.$

EN ÇOK VE EN AZ AKIMLAR :

1987 Su yılında en çok akım	:	191.	$m^3/sn.$	(31.1.1987)
1987 Su yılında en az akım	:	1.03	''	(10.10.1986)
Gözlem süresinde en çok akım	:	550.	''	(28. 3.1900)
Gözlem süresinde en az akım	:	0.322	''	(12. 8.1985)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi.Yıl içinde 2 ayrı anahtar eğrisi kullanılmış 13 akım ölçüsü yapılmıştır.

14.Anahtar eğrisi (Seviyeler Cm. -Akımlar $m^3/sn.$ dir.)

Sevive	Akım	Seviye	Akım
20	0.600	80	25.0
30	2.40	100	39.7
40	5.10	150	90.0
50	8.00	200	155.
60	13.3	250	237.

AKIMLAR 1 EKİM 1986'DAN 30 EYLÜL 1987'YE KADAR SANİYEDE METRE KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AGUSTOS	EYLÜL
1	1.49	2.00	2.44	2.88	30.7	7.52	73.5	31.4	16.2	4.50	3.36	1.35
2	1.15	2.22	2.44	3.10	24.5	7.14	91.2	37.2	16.7	3.90	2.88	1.35
3	1.15	2.22	2.44	3.10	10.6	6.76	75.5	32.2	17.9	3.12	3.12	1.20
4	1.15	2.22	2.44	3.10	14.0	6.76	44.3	25.6	16.7	2.88	2.64	1.20
5	1.15	2.22	2.44	4.55	11.7	8.20	32.6	24.4	13.9	2.64	2.19	1.20
6	1.15	2.66	2.44	4.55	9.42	6.76	33.3	23.0	12.9	2.64	2.19	1.05
7	1.15	2.66	2.22	4.26	9.04	6.76	39.7	24.4	14.4	5.47	1.77	1.20
8	1.15	2.66	2.22	3.97	8.66	6.76	60.0	26.9	12.4	6.95	1.56	1.20
9	1.15	2.88	2.22	4.26	8.26	6.38	56.1	23.2	11.5	5.47	1.56	1.20
10	1.15	2.88	2.00	4.26	7.14	6.38	44.2	22.6	10.6	4.80	1.35	1.35
11	1.15	2.80	2.00	4.26	6.76	6.00	49.6	17.9	9.70	4.20	1.20	1.35
12	1.15	2.44	2.22	3.68	6.76	6.00	83.1	15.0	8.43	3.36	1.35	1.35
13	1.15	2.44	2.44	3.97	6.76	6.00	56.1	14.4	8.06	3.36	1.20	1.35
14	1.15	2.44	2.44	3.97	7.52	5.42	39.7	16.2	7.32	3.12	1.20	1.35
15	1.32	2.44	2.44	4.55	9.04	4.55	30.8	22.0	6.58	2.88	1.20	1.35
16	1.55	2.44	2.22	4.84	10.7	5.13	29.5	20.8	6.50	2.64	1.20	1.56
17	1.55	2.44	2.44	4.55	15.7	5.42	29.5	20.2	6.95	2.64	1.35	1.35
18	1.55	2.44	2.22	4.26	15.1	5.71	26.9	19.6	7.32	2.40	1.35	1.35
19	1.49	2.44	2.44	3.97	14.0	5.71	23.8	19.0	7.32	2.40	1.35	1.56
20	1.49	2.44	2.44	3.97	12.2	5.42	19.0	20.8	13.9	2.19	1.35	1.56
21	1.49	2.44	2.44	3.97	10.7	5.13	17.3	19.6	10.6	2.19	1.20	1.56
22	1.49	2.44	2.44	4.26	11.2	6.76	20.2	17.3	9.25	1.98	1.35	1.56
23	2.00	2.44	2.44	3.97	13.1	9.04	22.6	17.9	8.00	1.90	1.77	1.56
24	2.00	2.44	2.88	3.68	17.4	9.00	25.0	16.2	8.43	1.90	3.12	1.56
25	2.00	2.44	3.68	3.68	23.0	15.0	20.2	15.6	7.69	1.77	2.40	1.56
26	1.83	2.44	3.39	3.39	14.0	18.6	17.9	15.6	6.95	1.77	2.19	1.56
27	1.83	2.44	3.10	2.88	11.2	16.2	17.3	15.6	6.50	1.77	1.98	1.56
28	1.83	2.44	2.88	3.39	8.66	24.3	20.2	15.6	6.21	1.77	1.77	1.56
29	1.83	2.44	2.66	4.55	----	38.7	28.2	15.0	5.84	1.77	1.77	1.56
30	1.83	2.44	2.66	31.9	----	58.1	26.9	15.0	5.10	4.50	1.56	1.77
31	1.83	----	2.80	119.	----	65.7	----	17.3	----	3.60	1.56	----
TOPLAM	45.35	73.86	78.05	264.72	363.84	392.19	1162.2	646.3	300.01	96.64	56.04	42.24
ORTALAMA	1.463	2.462	2.518	8.539	12.99	12.65	38.74	20.85	10.03	3.117	1.808	1.408
$LT/SN/KM^2$	0.746	1.25	1.28	4.35	6.62	6.45	19.7	10.6	5.11	1.59	0.922	0.718
AKIM.MM.	2.00	3.25	3.44	11.7	16.0	17.3	51.2	28.5	13.2	4.26	2.47	1.86
10 M^3 AKIM	3.92	6.38	6.74	22.9	31.4	33.9	100.	55.0	26.0	8.35	4.84	3.65

SU YILI (1987) YILLIK TOPLAM AKIM. 304.3 MİLYON M^3. 155. MM . 4.92 $LT/SN/KM^2$.

15- KIZILIRMAK HAVZASI

1538- DEVRES ÇAYI- ÇELTİKÇİBAŞI

YERİ : (33 47'08''D- 40 54'23''K) Kastamonu'nunIlgaz ilçesinden Tosya'ya giden karayolunun 22.km.sindeki Çeltikçibaşı köyüne 1 km. uzaklıktadır.

YAĞIŞ ALANI : 1962.0 Km^2. YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ : 1 Ekim 1970- 30 Eylül 1986

ORTALAMA AKIMLAR : Gözlem süresinde 8.880 $m^3/sn.$ (16 yıllık) 1986 Su yılında 4.998 $m^3/sn.$

EN ÇOK VE EN AZ AKIMLAR :

1986 Su yılında en çok akım	: 34.0	$m^3/sn.$	(24. 2.1986)
1986 Su yılında en az akım	: 0.654	''	(18. 8.1986)
Gözlem süresinde en çok akım	: 558.	''	(28. 3.1980)
Gözlem süresinde en az akım	: 0.322	''	(12. 8.1985)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi.Yılıçinde 12 akım ölçüsüyapılmıştır.

13.Anahtar eğrisi (Seviyeler Cm. -Akımlar $m^3/sn.$ dir.)

Seviye	Akım	Seviye	Akım
15	0.530	60	14.5
20	1.15	80	27.0
30	3.10	100	41.8
40	6.00	150	90.0
50	9.80	200	155.

AKIMLAR 1 EKİM 1985'DEN 30 EYLÜL 1986'YA KADAR SANİYEDE METRE KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AĞUSTOS	EYLÜL
1	1.66	2.66	4.84	4.26	5.42	13.1	11.7	1.83	4.55	2.00	0.778	1.03
2	1.66	2.66	4.55	4.84	5.42	11.2	12.7	1.83	3.97	1.66	0.778	1.03
3	1.49	2.66	4.55	7.14	5.42	10.7	12.7	1.83	3.68	1.49	0.778	1.49
4	1.49	2.88	4.26	8.66	6.00	10.7	11.2	1.83	5.13	1.32	0.778	1.49
5	1.49	3.10	4.55	7.90	6.00	16.2	9.80	1.83	6.76	1.03	0.778	1.32
6	1.66	3.39	4.55	7.90	6.00	22.3	9.42	1.83	6.38	1.03	0.778	1.32
7	1.66	3.68	4.55	10.3	5.71	24.3	8.66	1.83	5.42	1.03	0.778	1.15
8	1.66	4.26	4.55	21.0	5.71	22.3	8.28	2.00	4.84	1.03	0.778	1.15
9	1.66	5.42	4.55	14.5	5.42	20.3	8.28	2.00	6.76	1.03	0.778	1.32
10	1.66	5.42	4.55	10.7	5.42	19.7	7.52	2.44	7.14	1.03	0.778	2.44
11	1.66	5.13	4.55	9.42	5.13	19.7	7.14	2.88	13.1	1.03	0.778	1.83
12	1.66	5.13	3.97	8.28	5.42	18.6	6.76	2.66	10.7	1.03	0.778	1.66
13	1.83	5.13	3.97	7.52	5.71	17.4	6.76	2.66	11.7	0.902	0.778	1.66
14	1.83	4.84	3.97	6.76	5.71	15.7	6.36	2.88	14.0	0.902	0.778	1.49
15	1.83	4.26	3.97	5.71	5.42	13.6	5.71	2.88	12.6	1.03	0.654	1.49
16	2.00	3.97	3.97	4.84	5.42	12.2	5.42	3.10	10.3	0.902	0.778	1.49
17	2.00	3.68	3.97	5.42	5.13	10.7	5.42	3.10	8.66	0.902	0.778	1.32
18	2.22	3.68	3.68	13.1	5.42	10.7	4.84	3.39	7.14	1.03	0.654	1.32
19	2.22	3.68	3.39	12.2	6.76	9.80	4.84	3.39	6.38	0.778	0.654	1.49
20	2.44	3.68	3.39	7.52	9.42	9.42	4.84	4.26	5.13	0.778	0.778	1.49
21	2.44	3.68	3.39	6.76	12.6	9.04	4.84	4.55	4.84	0.778	0.778	1.49
22	2.44	3.68	3.39	6.38	23.7	9.04	4.84	5.13	3.97	0.778	0.778	1.49
23	2.44	3.68	3.39	6.00	20.3	8.28	4.55	5.13	3.68	0.778	0.778	1.49
24	2.44	3.68	3.10	5.71	26.3	8.28	4.26	4.55	3.68	0.778	0.902	1.49
25	2.22	3.68	3.10	5.42	26.3	8.28	3.97	4.26	3.39	0.778	0.902	1.49
26	2.66	3.68	3.39	5.13	21.6	8.28	3.68	4.26	2.88	0.778	0.902	1.32
27	2.66	3.68	3.68	5.13	25.7	8.66	3.10	4.26	3.10	0.778	1.03	1.32
28	2.66	3.68	3.97	5.13	18.0	9.80	2.66	3.97	2.88	0.778	1.03	1.49
29	2.66	3.39	3.10	4.84	----	10.7	2.22	3.68	2.66	0.778	1.03	1.32
30	2.66	4.55	3.68	4.84	----	11.2	2.00	4.84	2.22	0.778	1.03	1.49
31	2.66	----	3.97	4.84	----	10.7	----	5.42	----	0.654	1.03	----
TOPLAM	63.72	116.69	122.49	238.15	290.56	410.88	194.47	100.50	137.64	30.368	25.378	43.37
ORTALAMA	2.055	3.890	3.951	7.682	10.38	13.25	6.482	3.242	6.255	0.980	0.819	1.446
LT/SN/KM^2	1.05	1.98	2.01	3.92	5.29	6.75	3.30	1.65	3.19	0.499	0.417	0.737
AKIM,MM.	2.81	5.14	5.39	10.5	12.8	18.1	8.56	4.43	8.26	1.34	1.12	1.91
10 M^3 AKIM	5.51	10.1	10.6	20.6	25.1	35.5	16.8	8.68	16.2	2.62	2.19	3.75

SU YILI (1986) YILLIK TOPLAM AKIM. 157.6 MİLYON M^3, 80.3 MM , 2.55 LT/SN/KM^2.

15- KIZILIRMAK HAVZASI

1538- DEVRES ÇAYI- ÇELTİKÇİBAŞI

YERİ :(33 47'08''D- 40 54'23''K) Kastamonu'nun Ilgaz ilçesinden Tosya'ya giden karayolunun 22.km.sindeki Çeltikçibaşı köyüne 1 km. uzaklıktadır.

YAĞIŞ ALANI :1962.0 km^2 YANLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ :1 Ekim 1970- 30 Eylül 1985

ORTALAMA AKIMLAR :Gözlem süresinde 9.138 $m^3/sn.$ (15 yıllık) 1985 Su yılında 6.021 $m^3/sn.$

EN ÇOK VE EN AZ AKIMLAR :1985 Su yılında en çok akım : 138. $m^3/sn.$ (1. 4.1985)

1985 Su yılında en az akım : 0.322 " (12. 8.1985)

Gözlem süresinde en çok akım : 558. " (28. 3.1980)

Gözlem süresinde en az akım : 0.322 " (12. 8.1985)

SEVİYE ÖLÇEĞİ :Eşel.

DÜŞÜNCELER :Akım durumu iyi.Yıliçinde 2 ayrı anahtareğrisi kullanılmış,12 akım ölçüsü yapılmıştır.

13.Anahtar eğrisi (Seviyeler Cm. -Akımlar $m^3/sn.$ dir.)

Seviye	Akım	Seviye	Akım
15	0.530	80	14.5
20	1.15	80	27.0
30	3.10	100	41.8
40.	6.00	150	90.0
50	9.80	200	155.

AKIMLAR 1 EKİM 1984'DEN 30 EYLÜL 1985'E KADAR SANİYEDE METRE KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AGUSTOS	EYLÜL
1	2.05	2.45	3.23	2.94	4.10	2.94	83.1	12.1	7.14	1.83	1.32	1.03
2	2.05	2.45	2.94	2.94	4.10	3.23	57.2	10.1	6.76	1.83	1.15	0.902
3	2.05	2.45	2.65	2.94	4.10	3.52	45.9	9.20	6.76	1.83	1.15	1.03
4	2.05	2.45	2.65	3.23	3.81	3.52	39.9	8.39	6.76	2.00	1.15	1.15
5	2.05	2.45	2.45	3.52	3.81	4.10	28.4	7.98	6.38	2.00	1.15	1.32
6	2.05	2.65	2.45	3.52	2.94	4.39	28.4	8.39	6.00	1.83	1.15	1.32
7	2.05	2.94	2.25	3.52	2.94	4.68	29.8	7.98	5.71	1.83	1.15	1.49
8	2.05	3.52	2.25	3.52	2.94	5.55	34.0	7.17	4.94	1.83	1.03	1.49
9	1.85	3.23	2.94	3.81	2.65	4.97	30.5	6.77	3.97	1.83	0.902	1.49
10	1.85	3.52	2.94	7.58	2.94	4.97	28.4	6.36	3.39	1.83	0.902	1.49
11	1.85	3.52	2.94	8.79	4.97	4.97	34.0	5.55	3.97	1.83	0.778	1.66
12	1.85	3.52	2.65	5.26	5.96	4.97	36.3	5.26	5.13	1.83	0.530	1.66
13	2.05	3.52	2.94	3.81	10.6	5.96	26.3	4.97	4.26	1.66	0.654	1.66
14	2.25	3.23	2.94	2.94	18.6	7.17	25.7	4.97	3.63	1.49	0.902	1.66
15	2.25	3.23	2.94	3.23	11.6	8.79	23.7	6.77	3.39	1.49	2.00	1.66
16	2.25	3.23	2.94	2.94	6.36	20.3	16.8	9.04	3.10	1.49	1.49	1.66
17	2.45	3.23	2.94	2.65	5.96	34.0	15.7	9.42	3.10	1.49	1.03	1.66
18	2.45	3.23	2.94	2.94	4.68	34.8	17.4	8.28	2.88	1.66	0.902	1.49
19	2.25	3.23	2.94	2.94	5.26	34.0	18.0	7.90	2.88	1.66	0.902	1.66
20	2.25	3.23	2.94	3.23	4.39	38.7	16.8	7.90	3.10	1.66	0.902	1.66
21	2.25	3.23	2.94	3.23	5.26	28.4	15.7	7.14	3.10	1.66	0.902	1.66
22	2.25	3.52	2.94	3.23	5.26	20.3	13.5	6.38	3.10	1.49	1.03	1.66
23	2.25	4.10	2.94	3.23	4.97	17.4	13.0	5.71	2.88	1.49	1.03	1.49
24	2.25	3.81	2.94	3.23	4.97	18.6	12.1	5.13	2.44	1.66	1.15	1.49
25	2.25	3.81	2.94	3.23	3.81	17.4	11.1	6.00	2.22	1.49	1.03	1.49
26	2.25	3.81	2.94	3.52	3.52	15.7	10.6	5.13	2.22	1.49	1.15	1.66
27	2.25	3.52	2.94	3.81	3.23	15.7	10.6	4.55	2.22	1.49	1.15	1.66
28	2.25	3.52	2.94	3.81	3.23	14.5	11.6	4.94	2.22	1.32	1.03	1.66
29	2.25	3.23	2.94	3.81	----	19.7	11.6	6.76	2.00	1.32	1.15	1.66
30	2.25	2.94	2.94	4.10	----	25.7	12.1	9.42	2.00	1.32	1.03	1.66
31	2.45	----	2.94	4.10	----	33.3	----	8.28	----	1.32	1.15	----
TOPLAM	66.95	96.77	88.20	115.55	146.96	482.23	750.2	228.94	117.65	56.95	32.946	45.232
ORTALAMA	2.160	3.226	2.845	3.727	5.247	14.91	25.01	7.224	3.922	1.644	1.063	1.508
LT/SN/KM²	1.10	1.64	1.45	1.90	2.68	7.60	12.7	3.68	2.00	0.838	0.542	0.769
AKIM.MM.	2.95	4.26	3.88	5.09	6.47	20.4	33.0	9.86	5.18	2.24	1.45	1.99
10 M AKIM	5.79	8.36	7.62	9.98	12.7	39.9	64.8	19.3	10.2	4.40	2.85	3.91

SU YILI (1985) YILLIK TOPLAM AKIM. 189.9 MİLYON m^3 . 96.8 MM . 3.07 LT/SN/KM² .

Yıl içinde 2. Pik Akım Değeri 45.9 $m^3/sn.$ tarihi 12. 4.1985

Yıl içinde 3. Pik Akım Değeri 41.8 " tarihi 29. 3.1985

15- KIZILIRMAK HAVZASI

1538- DEVRES ÇAYI- ÇELTİKÇİBAŞI

YERİ : (33 47'08''D- 40 54'23''K) Kastamonu'nunIlgaz ilçesinden Tosya'ya giden karayolunun 22.km.sindeki Çeltikçibaşı köyüne 1 km. uzaklıktadır.

YAĞIŞ ALANI : 1962.0 Km^2 YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ : 1 Ekim 1970- 30 Eylül 1984

ORTALAMA AKIMLAR : Gözlem süresinde 9.361 $m^3/sn.$ (14 yıllık) 1984 Su yılında 12.641 $m^3/sn.$

EN ÇOK VE EN AZ AKIMLAR :

1984 Su yılında en çok akım.	191.	$m^3/sn.$	(16. 4.1984)
1984 Su yılında en az akım	1.36	''	(20. 7.1984)
Gözlem süresinde en çok akım	558.	''	(28. 3.1980)
Gözlem süresinde en az akım	0.429	''	(3.8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi.Yıliçinde 3 ayrı anahtareğrisi kullanılmış,12 akım ölçüsü yapılmıştır.

12.Anahtar eğrisi (Seviyeler Cm. -Akımlar $m^3/sn.$ dir.)

Seviye	Akım	Seviye	Akım
20	0.920	70	20.3
30	2.65	80	27.0
40	5.55	100	41.8
50	9.60	150	90.0
60	14.5	200	155.

AKIMLAR 1 EKİM 1983'DEN 30 EYLÜL 1984'E KADAR VE SANİYEDE METRE-KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AGUSTOS	EYLÜL
1	2.50	3.46	63.8	6.38	11.7	15.7	29.1	21.6	10.1	3.52	2.94	2.25
2	2.50	3.46	44.3	6.38	10.7	37.9	34.0	27.0	8.79	2.94	2.65	2.05
3	2.98	3.22	30.5	6.00	9.80	33.3	27.0	45.1	11.1	2.65	2.45	2.05
4	3.22	2.98	19.7	6.00	9.80	50.0	24.3	31.9	18.6	2.65	2.25	1.85
5	3.22	2.98	16.8	6.00	9.80	45.1	32.6	25.7	11.1	2.45	2.25	2.05
6	3.22	2.98	14.5	6.00	9.42	41.0	29.1	22.3	8.79	2.25	2.25	2.05
7	2.98	3.70	13.1	6.38	9.80	79.7	27.7	25.0	7.58	2.45	2.25	2.05
8	2.98	5.53	12.2	6.38	9.80	45.9	27.7	40.2	6.36	2.45	2.25	2.05
9	2.74	5.84	12.2	6.38	9.80	30.5	24.3	27.0	5.96	2.65	2.25	1.85
10	2.74	7.94	14.0	6.00	12.2	64.7	25.7	22.3	7.58	2.65	2.25	1.85
11	2.74	7.15	14.0	6.38	65.7	73.5	30.5	19.7	7.58	2.65	2.25	1.85
12	2.74	6.14	13.6	7.90	91.9	37.1	25.7	21.0	6.36	2.45	2.25	1.85
13	2.98	5.53	12.2	8.66	20.3	29.8	21.6	21.6	5.55	2.45	2.05	1.85
14	3.22	4.92	10.3	8.28	16.2	25.7	23.0	34.8	5.96	2.45	1.85	1.85
15	3.46	4.62	8.66	7.52	12.7	22.3	45.1	24.3	5.96	2.45	1.85	2.05
16	3.22	4.92	7.90	7.14	12.2	20.3	128.	19.7	5.55	2.25	2.05	2.05
17	2.98	4.92	7.52	7.14	11.7	19.1	116.	16.8	5.26	2.05	2.05	2.05
18	2.98	5.23	7.14	6.76	10.7	18.0	71.5	15.1	3.81	1.85	2.05	2.05
19	2.98	7.94	7.14	6.76	10.7	17.4	57.2	14.0	3.81	1.85	2.05	2.05
20	2.98	22.0	7.14	6.76	13.1	16.2	54.5	14.0	3.81	1.50	1.85	2.05
21	2.74	16.4	7.14	6.38	12.7	15.1	47.5	12.5	3.81	1.36	1.85	2.05
22	2.74	13.9	6.76	6.00	11.7	14.0	46.7	11.1	3.81	1.36	2.05	2.05
23	2.74	13.0	6.76	6.00	10.3	14.5	39.5	10.1	3.81	1.50	2.05	2.05
24	2.74	10.7	7.90	7.52	9.80	31.2	32.6	10.1	4.97	1.65	2.25	2.05
25	3.22	8.33	7.52	10.7	9.80	25.7	29.8	13.0	4.39	1.65	2.25	2.05
26	3.22	5.84	7.52	50.0	11.7	21.0	27.0	11.6	3.81	1.65	2.25	1.65
27	3.22	7.15	7.14	29.8	10.7	18.0	27.0	10.1	4.39	1.85	2.25	2.05
28	2.98	12.5	6.76	19.7	10.3	16.2	27.0	10.1	4.10	2.05	2.65	2.05
29	3.22	13.9	6.76	14.5	9.42	14.0	25.7	9.20	3.81	1.85	2.65	2.05
30	3.46	27.7	6.38	13.1	----	13.6	24.3	8.79	3.81	2.45	2.45	2.05
31	3.46	----	6.38	12.7	----	15.7	----	10.6	----	3.23	2.45	----
TOPLAM	93.10	244.88	413.72	311.60	464.44	922.2	1181.7	606.29	190.32	69.21	69.24	59.90
ORTALAMA	3.003	8.163	13.35	10.05	16.02	29.75	39.39	19.56	6.344	2.233	2.234	1.997
LT/SN/KM^2	1.53	4.16	6.80	5.12	8.17	15.2	20.1	9.97	3.23	1.14	1.14	1.02
AKIM.MM.	4.10	10.8	18.2	13.7	20.5	40.6	52.0	26.7	8.38	3.05	3.05	2.64
10^6 M^3 AKIM	8.04	21.2	35.7	26.9	40.1	79.7	102.	52.4	16.4	5.98	5.98	5.18

SU YILI (1984) YILLIK TOPLAM AKIM. 399.7 MİLYON M^3. 204. MM , 6.44 LT/SN/KM^2.

Yıl içinde 2. Pik.Akım Değeri 136. $m^3/sn.$ Tarihi 7. 3.1984
Yıl içinde 3. Pik Akım Değeri 118. '' Tarihi 11. 2.1984

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - CELTİKCİBAŞI

YERİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz İlçesinden Tosya'ya giden karayolunun 22. Km. sindeki Celtikcibaşı Köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2 YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ : 1.Ekim.1970 - 30.Eylül.1983

ORTALAMA AKIMLAR : Gözlem süresinde 9.108 m^3/sn. (13 yıllık) 1983 Su yılında 8.863 m^3/sn.

EN ÇOK VE EN AZ AKIMLAR

1983	Su yılında	en çok akım	:	265. m^3/sn.	(6.6.1983)
1983	Su yılında	en az akım	:	1.55 "	(28.8.1983)
Gözlem süresinde		en çok akım	:	558. "	(28.3.1980)
Gözlem süresinde		en az akım	:	0.429 "	(3.8.1974)

ŞEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 2 ayrı anahtar eğrisi kullanılmış, 12 akım ölçüsü yapılmıştır.

11. Anahtar eğrisi (Seviyeler Cm. — Akımlar m^3/Sn. dir.)

Seviye	Akım	Seviye	Akım
15	0.800	100	41.8
20	1.55	150	90.0
30	3.70	200	155.
40	6.75	250	237.
50	10.7	300	352.

AKIMLAR 1 EKİM 1982'DEN 30 EYLÜL 1983'E KADAR VE SANİYEDE METRE-KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	SUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AĞUSTOS	EYLÜL
1	3.52	3.52	2.94	2.94	3.81	4.10	34.0	9.12	28.4	4.62	2.98	1.93
2	3.52	3.52	2.94	2.94	3.52	4.10	36.3	8.33	17.5	3.70	2.98	1.93
3	3.23	3.52	2.94	3.23	3.52	4.10	34.0	7.54	17.5	4.92	2.50	1.93
4	3.23	3.52	2.94	3.23	4.10	3.81	25.7	6.14	13.5	4.31	2.12	1.93
5	3.23	3.52	3.23	3.23	4.10	4.10	23.0	5.53	15.9	24.5	1.93	1.93
6	3.23	3.52	3.23	2.94	3.81	4.10	*25.7	6.75	118.	*13.9	2.12	1.93
7	3.23	3.52	3.23	2.94	3.81	4.10	42.6	7.15	60.9	11.2	3.22	1.93
8	3.23	3.52	2.94	2.94	3.81	4.39	96.0	7.94	35.6	8.73	4.31	1.93
9	3.23	3.52	2.94	2.65	4.10	4.39	92.4	7.15	23.9	20.3	4.92	1.93
10	3.23	3.23	2.65	2.65	4.10	4.68	72.5	6.45	17.5	13.9	5.53	1.93
11	2.94	3.23	2.65	*2.94	4.39	6.36	44.3	6.75	15.3	10.3	4.92	1.74
12	2.94	3.23	2.65	*2.94	4.68	13.5	31.2	7.94	13.5	7.94	4.31	1.74
13	3.23	3.52	2.94	2.94	4.68	16.2	23.9	7.54	12.5	8.73	4.01	1.74
14	3.52	3.52	2.94	2.65	4.39	10.6	20.3	6.45	26.4	7.15	3.70	1.74
15	3.52	3.81	3.23	2.94	4.68	*9.60	18.6	6.14	27.7	5.84	6.14	1.74
16	3.52	3.81	3.52	3.52	4.97	9.20	21.4	5.84	18.6	4.92	4.62	1.93
17	3.52	3.52	3.52	3.81	*5.55	10.6	28.4	6.14	14.4	4.01	4.01	1.93
18	3.81	3.52	3.23	3.52	5.26	12.5	22.0	7.94	12.5	3.22	3.46	1.93
19	3.81	3.81	3.23	3.52	3.52	16.8	18.1	8.73	10.7	2.74	2.98	1.93
20	3.81	4.10	3.23	3.52	3.23	21.0	17.5	7.94	9.12	2.50	2.50	1.93
21	3.52	4.68	3.23	4.10	3.23	17.4	22.0	10.3	9.12	2.74	2.31	1.93
22	3.52	3.81	*3.23	3.81	3.52	18.0	17.5	14.8	9.12	3.22	2.12	2.12
23	*3.52	3.81	3.23	3.52	3.81	18.0	14.8	11.6	9.91	3.22	*2.12	2.12
24	3.52	*3.52	3.23	3.23	3.81	23.0	13.9	*10.7	13.0	2.74	2.12	1.93
25	3.52	3.52	3.23	2.94	3.81	34.8	13.0	17.5	12.1	2.31	2.12	1.93
26	3.52	3.23	5.26	2.94	3.52	46.7	12.1	12.1	11.2	2.31	2.12	2.12
27	3.52	3.23	4.39	2.94	3.52	65.7	10.7	10.7	9.12	3.22	1.93	2.31
28	3.52	3.23	3.81	3.23	3.81	59.0	10.3	12.1	7.54	4.62	1.93	*2.31
29	3.52	2.94	3.52	3.23	----	46.7	9.91	13.9	6.14	4.62	1.93	2.31
30	3.52	2.94	3.23	3.23	----	37.9	9.52	23.3	5.53	3.22	1.93	2.31
31	3.52	----	3.23	3.81	----	33.3	----	37.1	----	2.98	1.93	----
TOPLAM	106.22	105.89	100.71	98.97	113.06	568.73	861.63	317.61	604.20	203.13	95.82	59.04
ORTALAMA	3.426	3.530	3.249	3.193	4.038	18.35	28.72	10.25	20.14	6.553	3.091	1.968
LT/SN/KM^2	1.75	1.80	1.66	1.63	2.06	9.35	14.6	5.22	10.3	3.34	1.58	1.00
AKIM, MM.	4.68	4.66	4.43	4.36	4.98	25.0	37.9	14.0	26.6	8.95	4.22	2.60
10^6 M^3 AKIM	9.18	9.15	8.70	8.55	9.77	49.1	74.4	27.4	52.2	17.6	8.28	5.10

SU YILI (1983) YILLIK TOPLAM AKIM. 279.5 MİLYON M^3, 142. MM , 4.52 LT/SN/KM^2.

(*) AKIM ÖLÇÜSÜNÜN YAPILDIĞI GÜNLERİ GÖSTERİR. Yıl içinde 2.Pik Akım Değeri 112. m^3/sec. Tarihi 9.4.1983
Yıl içinde 3.Pik Akım Değeri 82.0 " Tarihi 27.3.1983

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKÇİBAŞI

YERİ. : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz İlçesinden Tosya'ya giden karayolunun 22. Km. sindeki Çeltikçibaşı Köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2 YAKLAŞIK KOT : 775 m.

GÖZLEM SÜRESİ : 1.Ekim.1970 - 30.Eylül.1982

ORTALAMA AKIMLAR : Gözlem süresinde 9.129 m^3/sn. (12 yıllık) 1982 Su yılında 11.801 m^3/sn.

EN ÇOK VE EN AZ AKIMLAR

1982 Su yılında en çok akım	: 223.	m^3/sn.	(16.12.1981)
1982 Su yılında en az akım	: 1.40	"	(24. 8.1982)
Gözlem süresinde en çok akım	: 558.	"	(28. 3.1980)
Gözlem süresinde en az akım	: 0.429	"	(3. 8.1974)

SEVİYE ÖLÇEĞİ : Egel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 3 ayrı anahtar eğrisi kullanılmış, 13 akım ölçüsü yapılmıştır.

12 Anahtar eğrisi (Seviyeler Cm.__ Akımlar m^3/Sn. dir.)

Seviye	Akım	Seviye	Akım
15	0.420	100	41.8
20	0,920	150	90.0
30	2.65	200	155.
40	5.55	250	237.
50	9.60	300	352.

AKIMLAR 1 EKİM 1981'DEN 30 EYLÜL 1982'E KADAR VE SANİYEDE METRE-KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	SUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AĞUSTOS	EYLÜL
1	1.82	3.90	5.55	15.9	6.45	22.0	82.0	44.1	18.6	5.84	3.46	4.10
2	1.82	3.62	7.82	14.4	6.14	14.8	72.5	29.8	13.5	6.45	3.22	3.23
3	1.82	3.62	7.40	13.0	6.14	13.9	51.8	24.5	12.5	6.45	3.22	3.23
4	1.82	3.34	7.40	13.0	5.84	14.4	60.9	21.4	17.5	5.84	* 2.98	3.81
5	1.82	3.62	6.29	11.6	5.84	14.4	66.6	18.6	29.1	4.92	2.74	4.10
6	1.60	3.62	10.8	9.91	5.53	17.0	41.8	17.0	23.3	4.62	2.50	3.23
7	1.82	3.62	11.3	11.8	5.53	19.2	30.5	16.4	21.4	* 4.31	2.98	2.65
8	1.82	3.62	9.08	20.3	5.23	20.3	27.7	15.3	17.0	4.01	2.98	2.65
9	1.82	3.90	7.40	16.4	5.84	15.3	24.5	14.8	17.5	5.23	2.98	2.96
10	1.82	3.90	6.29	11.2	5.84	11.2	27.0	13.9	19.7	7.15	2.74	4.10
11	2.05	3.62	6.29	9.91	5.84	9.52	33.3	13.0	18.6	6.45	2.74	3.81
12	2.05	3.62	5.92	10.7	5.53	7.94	40.2	11.2	14.4	5.53	2.50	3.52
13	2.05	3.62	7.03	18.6	5.53	9.12	32.6	11.6	12.5	4.62	2.50	3.23
14	2.27	3.62	10.8	18.1	5.53	10.3	* 27.7	12.5	11.2	4.31	2.31	2.94
15	3.34	3.62	73.0	10.7	5.23	17.5	24.5	15.3	9.91	4.01	2.31	2.65
16	2.78	7.03	*135.	9.52	4.92	72.5	23.9	15.3	* 9.12	5.23	2.12	* 2.45
17	2.78	6.29	43.4	8.73	* 4.92	41.8	29.1	18.6	8.73	5.53	1.93	2.65
18	2.78	5.22	29.1	8.33	5.23	22.0	33.3	25.8	7.94	4.62	1.93	2.65
19	2.50	4.89	22.0	7.94	5.53	15.9	23.9	19.7	7.54	4.01	1.74	2.45
20	2.50	4.56	15.9	* 7.15	5.23	16.4	20.3	18.6	6.45	3.70	1.93	2.45
21	* 2.50	4.23	15.9	7.15	5.53	18.1	* 19.2	15.3	5.84	3.46	1.93	2.45
22	2.50	3.90	14.8	6.75	5.84	16.4	22.0	14.4	5.23	3.46	1.74	2.45
23	2.50	3.90	12.5	6.45	5.84	14.8	27.7	13.9	4.92	3.46	1.74	2.45
24	2.50	3.90	11.6	6.45	6.45	* 11.6	29.1	13.5	4.62	3.46	1.55	2.45
25	2.50	* 3.90	12.5	6.45	7.15	9.91	34.0	13.0	4.31	3.22	1.74	2.65
26	2.27	3.90	17.5	6.45	15.9	9.12	25.8	12.1	4.31	2.98	6.14	2.94
27	2.27	3.90	41.0	6.45	15.6	9.12	23.9	* 11.2	4.01	2.74	12.5	5.26
28	2.27	3.90	31.9	6.14	29.1	9.91	23.9	10.3	4.01	4.62	8.79	3.81
29	2.78	3.90	25.1	6.14	----	14.4	44.3	13.9	4.01	5.53	5.96	2.94
30	3.90	4.56	21.4	6.14	----	29.8	86.6	21.4	7.54	4.92	5.26	2.65
31	7.03	----	18.6	6.45	----	47.5	----	23.3	----	4.01	4.68	----
TOPLAM	76.10	122.84	650.57	318.21	223.28	576.14	1110.6	539.9	345.29	144.69	103.84	95.91
ORTALAMA	2.455	4.095	20.99	10.26	7.974	18.59	37.02	17.42	11.51	4.667	3.350	3.197
LT/SN/KM^2	1.25	2.09	10.7	5.23	4.06	9.48	18.9	8.88	5.87	2.38	1.71	1.63
AKIM, MM.	3.35	5.41	28.6	14.0	9.83	25.4	48.9	23.8	15.2	6.37	4.57	4.22
10^6 M^3 AKIM	6.58	10.6	56.2	27.5	19.3	49.8	96.0	46.6	29.8	12.5	8.97	8.29

SU YILI (1982) YILLIK TOPLAM AKIM. 372.2 MİLYON M^3, 190. MM , 6.01 LT/SN/KM^2.

(*) AKIM ÖLÇÜSÜNÜN YAPILDIĞI GÜNLERİ GÖSTERİR. Yıl içinde 2.Pik Akım Değeri 114. m^3/sec. Tarihi 30.4.1982
Yıl içinde 3.Pik Akım Değeri 112. " Tarihi 16.3.1982

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKÇİBAŞI

YERİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz İlçesinden Tosya'ya giden karayolunun 22. Km. sindeki Çeltikçibaşı Köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2. YAKLAŞIK KOT :775 m.

GÖZLEM SÜRESİ : 1.Ekim.1970 - 30.Eylül.1981

ORTALAMA AKIMLAR : Gözlem süresinde 8.886 m^3/sn. (11 yıllık) 1981 Su yılında 13.917 m^3/sn.

EN ÇOK VE EN AZ AKIMLAR

1981	Su yılında	en çok akım	: 385.	m^3/sn.	(20.3.1981)
1981	Su yılında	en az akım	: 1.37	"	(28.7.1981)
Gözlem süresinde		en çok akım	: 558.	"	(28.3.1980)
Gözlem süresinde		en az akım	: 0.429	"	(3.8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 13 akım ölçüsü yapılmıştır.

10. Anahtar eğrisi (Seviyeler Cm. — Akımlar m^3/Sn. dir.)

Seviye	Akım	Seviye	Akım
15	1.37	100	46.2
20	2.50	150	93.8
30	5.55	200	153.
40	9.50	250	237.
50	14.2	320	402.

AKIMLAR 1 EKİM 1980'DEN 30 EYLÜL 1981'E KADAR VE SANİYEDE METRE-KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	SUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AĞUSTOS	EYLÜL
1	2.65	3.06	4.56	8.26	10.4	15.2	30.0	16.2	5.55	3.06	1.60	1.82
2	2.50	3.06	4.56	7.40	9.94	15.7	21.7	15.7	6.29	3.90	1.60	1.60
3	2.65	3.34	4.56	6.66	9.50	15.2	23.7	15.2	5.55	3.90	1.60	1.60
4	2.73	3.34	4.56	5.92	9.08	14.7	22.4	15.2	5.55	3.90	1.60	1.60
5	2.73	*3.34	5.92	5.92	9.08	20.7	20.1	15.7	4.89	3.62	1.60	1.60
6	2.78	3.34	7.40	14.7	9.50	56.7	19.5	18.4	4.56	7.03	1.37	1.82
7	2.78	3.34	7.03	18.9	9.50	59.4	18.9	20.7	4.23	6.29	1.37	1.82
8	2.56	3.34	6.29	12.2	9.94	41.6	*18.9	18.4	3.90	5.55	1.37	1.82
9	2.73	3.34	6.66	9.50	9.50	40.8	18.9	16.2	3.62	6.29	1.37	1.82
10	2.73	3.34	7.82	9.94	9.08	40.8	19.5	14.7	3.34	5.55	1.37	2.05
11	2.78	4.23	7.03	9.08	*9.50	46.2	18.9	15.7	3.06	5.55	1.37	3.06
12	2.78	4.89	7.40	8.26	9.50	72.0	21.2	14.7	4.23	4.56	1.37	2.50
13	2.78	4.89	6.29	7.40	11.7	153.	23.6	15.7	4.23	3.90	1.37	2.50
14	2.78	4.56	6.29	7.40	34.9	193.	24.7	*22.4	9.50	*3.90	1.37	2.50
15	2.75	4.56	6.66	9.50	55.8	135.	26.5	20.7	9.08	3.34	1.60	2.50
16	2.78	4.23	6.66	9.94	40.0	87.3	28.3	17.8	9.08	3.06	3.06	2.50
17	2.78	3.90	6.29	9.94	30.6	*94.9	27.1	15.7	7.82	2.78	4.23	2.50
18	2.78	3.90	5.92	9.94	23.0	130.	28.3	14.2	6.29	2.50	4.23	2.50
19	2.75	3.90	5.92	9.50	20.1	199.	33.4	12.7	5.22	2.30	9.08	2.27
20	2.78	4.23	5.92	*10.4	21.8	278.	48.5	11.7	4.56	2.27	4.56	2.27
21	2.78	4.56	6.29	11.7	20.7	92.7	42.4	10.8	3.62	2.05	3.34	2.05
22	2.75	4.23	6.66	10.8	17.8	56.7	31.9	10.4	3.34	1.82	2.05	1.82
23	2.75	4.23	9.50	10.4	16.2	56.7	28.8	9.50	3.34	1.60	1.82	*1.82
24	2.78	4.23	*17.8	9.94	15.7	51.7	27.7	9.08	*3.34	1.60	1.82	1.82
25	2.78	4.23	16.9	9.94	15.2	*52.4	25.9	8.66	4.23	1.60	*1.82	1.82
26	2.78	*4.23	14.7	9.50	14.2	52.4	24.7	8.24	3.34	1.60	1.82	1.82
27	2.78	4.23	12.2	9.50	14.2	47.0	23.6	7.82	4.89	1.60	1.82	1.82
28	2.78	4.23	10.4	10.4	14.2	44.7	25.3	7.03	3.90	1.37	2.05	1.82
29	2.78	4.56	9.50	11.3	----	39.3	22.4	6.66	3.62	1.60	2.05	2.05
30	2.78	4.56	8.66	10.8	----	37.0	18.4	6.29	3.34	1.60	2.05	2.05
31	2.78	----	8.66	10.4	----	34.9	----	5.92	----	1.60	2.05	----
TOPLAM	85.06	119.42	247.01	305.40	480.62	2274.7	766.8	418.10	148.25	103.14	69.78	61.54
ORTALAMA	2.744	3.981	7.968	9.852	17.17	73.38	25.56	13.49	4.942	3.327	2.251	2.051
LT/SN/KM^2	1.40	2.03	4.06	5.02	8.75	37.4	13.0	6.88	2.52	1.70	1.15	1.05
AKIM, MM.	3.75	5.26	10.9	13.4	21.2	100.	33.8	18.4	6.53	4.54	3.07	2.71
10^6 M^3 AKIM	7.35	10.3	21.3	26.4	41.5	197.	66.3	36.1	12.8	8.91	6.03	5.32

SU YILI (1981) YILLIK TOPLAM AKIM. 438.9 MİLYON M^3. 224. MM . 7.09 LT/SN/KM^2.

(*) AKIM ÖLÇÜSÜNÜN YAPILDIĞI GÜNLERİ GÖSTERİR. Yıl içinde 2.Pik Akım Değeri 224. m^3/sec. Tarihi 14.3.1981
Yıl içinde 3.Pik Akım Değeri 75.0 " Tarihi 15.2.1981

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKCİBAŞI

MEVKİİ : (35° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz İlçesinden Tosya'ya giden karayolunun 22.Km. sindeki Çeltikcibaşı Köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2.

TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1980

ORTALAMA AKIMLAR : Rasat süresinde 8.383 $m^3/sn.$ (10 yıllık) 1980 Su yılında 12.918 $m^3/sn.$

AZAMİ VE ASGARİ AKIMLAR

1980 Su yılında	azami	akım :	558.	$m^3/sn.$	(28.3.1980)
1980 Su yılında	asgari	akım :	1.21	"	(25.7.1980)
Rasat süresinde	azami	akım :	558.	"	(28.3.1980)
Rasat süresinde	asgari	akım :	0.429	"	(3.8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 2 ayrı anahtar eğrisi kullanılmıştır. 4.2.1980 ile 21.3.1980 günleri arasında şift tatbik edilmiştir.

10. Anahtar egrisi (Seviyeler Cm. — Akımlar $m^3/Sn.$ dır.)

Seviye	Akım	Seviye	Akım
15	1.37	100	46.2
20	2.50	150	93.8
30	5.55	200	153.
40	9.40	300	359.
50	14.2	400	615.

AKIMLAR 1 EKİM 1979DAN 30 EYLÜL 1980E KADAR VE SANİYEDE METRE-KÜP OLARAK

GÜN	EKİM	KASIM	ARALIK	OCAK	SUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AGUSTOS	EYLÜL
1	1.55	2.70	3.05	3.45	4.70	6.05	51.7	20.1	8.24	2.50	2.05	1.37
2	1.85	3.05	3.05	4.25	4.70	6.05	53.2	19.5	9.94	2.27	2.78	1.37
3	1.85	3.05	3.05	4.25	4.70	5.60	75.0	19.5	9.08	2.27	2.78	1.37
4	1.55	3.45	3.05	10.1	4.70	5.60	74.0	18.9	8.66	2.05	2.50	1.60
5	1.55	3.05	3.05	10.6	4.70	5.60	65.0	17.8	8.66	2.27	2.50	2.05
6	1.55	3.05	3.05	7.50	4.25	5.60	48.5	17.3	8.24	2.27	2.50	2.05
7	1.55	3.45	3.05	5.60	4.25	6.05	44.7	17.8	8.24	2.27	2.27	2.05
8	1.55	6.50	3.05	5.15	4.25	6.05	49.3	22.4	10.8	2.27	2.05	2.05
9	1.55	5.15	3.05	5.15	4.70	6.50	47.0	21.2	10.4	2.27	2.05	2.05
10	1.55	4.25	3.05	5.15	4.25	8.00	53.2	18.4	* 9.08	2.27	1.82	1.82
11	1.85	3.45	3.05	4.70	4.25	* 18.1	44.7	21.2	7.82	2.27	1.82	1.82
12	1.85	3.45	3.05	4.70	4.70	35.0	31.9	24.7	7.03	2.05	1.82	1.82
13	2.05	* 3.45	6.50	4.25	* 4.70	31.3	27.7	71.0	6.66	2.05	1.82	1.60
14	2.05	4.70	15.7	3.05	5.15	26.8	29.4	* 105.	6.29	2.05	2.05	1.60
15	2.05	4.25	12.5	2.40	5.15	24.0	33.4	73.0	5.92	1.82	2.05	1.82
16	2.05	3.85	7.50	2.40	5.15	20.5	31.2	42.4	5.55	1.60	2.05	1.82
17	2.05	3.45	7.00	2.70	6.05	19.3	32.7	31.9	4.56	1.60	2.05	1.82
18	1.85	3.05	7.00	2.70	6.50	20.5	34.1	25.9	4.23	1.60	1.82	2.05
19	2.05	3.85	* 8.00	3.05	6.05	16.8	31.2	23.0	3.90	1.60	1.60	2.05
20	2.70	3.85	8.00	3.45	6.05	17.5	30.6	20.1	3.90	1.37	1.82	2.05
	3.05	3.45	7.00	3.45	6.05	21.9	33.4	18.4	4.56	1.37	1.82	2.05
	2.70	3.45	5.60	3.05	6.05	44.2	* 33.4	17.3	4.23	* 1.37	1.82	2.05
	* 2.40	3.05	5.60	* 3.05	6.05	83.8	30.6	16.2	3.90	1.37	1.82	* 2.27
24	2.40	3.45	5.15	3.05	6.05	114.	31.9	15.7	3.62	1.37	1.60	2.27
25	2.40	3.45	5.15	3.05	6.05	102.	30.6	14.7	3.62	1.37	1.60	2.27
26	2.40	3.05	3.85	3.05	6.05	130.	28.8	14.7	3.34	1.21	* 1.37	2.05
27	2.05	3.05	2.70	3.45	6.05	128.	24.7	13.7	3.34	3.34	1.37	2.50
28	2.05	3.45	3.05	6.50	6.05	410.	21.8	11.3	3.06	4.23	1.37	2.50
29	2.40	3.45	3.05	6.05	6.05	252.	20.7	10.4	3.06	2.78	1.37	2.50
30	2.40	3.45	3.05	5.60	----	121.	20.7	9.08	2.78	2.78	1.37	2.50
31	2.40	----	3.05	5.15	----	93.8	----	8.66	----	2.50	1.37	----
TOPLAM	63.30	108.75	159.05	140.05	159.40	1791.60	1165.1	781.24	182.71	64.41	59.08	59.19
ORTALAMA	2.042	3.625	5.131	4.518	5.290	57.79	38.84	25.20	6.090	2.078	1.906	1.973
LT/SN/KM²	1.04	1.85	2.62	2.30	2.70	29.5	19.8	12.8	3.10	1.06	0.971	1.01
AKIM MM.	2.79	4.79	7.00	6.17	6.76	78.9	51.3	34.4	8.05	2.84	2.60	2.61
10^6 m^3 AKIM	5.47	9.40	13.7	12.1	13.3	155.	101.	67.5	15.8	5.57	5.10	5.11

SU YILI (1980) YILLIK TOPLAM AKIM. 403.5 MİLYON m^3, 208. MM , 6.58 LT/SN/KM^2.

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR. Yıl içinde 2.Pik Akım Değeri 121. $m^3/sec.$ Tarihi 13.5.1980
Yıl içinde 3.Pik Akım Değeri 86.2 " Tarihi 3.4.1980

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKÇİBAŞI

MEVKİİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz İlçesinden Tosya'ya giden karayolunun 22. Km. sindeki Çeltikcibaşı Köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2. TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1979

ORTALAMA AKIMLAR : Rasat süresinde 7.878 m^3/sn. (9 yıllık) 1979 Su yılında 8.534 m^3/sn.

AZAMİ VE ASGARİ AKIMLAR
1979 Su yılında azami akım : 205. m^3/sn. (31.1.1979)
1979 Su yılında asgari akım : 1.150 " (4. 8.1979)
Rasat süresinde azami akım : 205. " (31.1.1979)
Rasat süresinde asgari akım : 0.429 " (3.8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. 16.12.1978 ile 23.1.1979, 24.3.1979 ile 29.3.1979, 7.5.1979 ile 10.7.1979, 19.9.1979 ile 25.9.1979 günleri arasında şift tatbik edilmiştir.

9. Anahtar eğrisi (Seviyeler Cm. — Akımlar m^3/Sn. dır.)

Seviye	Akım	Seviye	Akım
40	1.15	100	35.0
50	4.25	120	52.5
60	9.00	150	85.0
70	14.4	200	153.
80	20.5	250	237.

AKIMLAR 1 EKİM 1978'DEN 30 EYLUL 1979'A KADAR VE SANİYEDE METRE-KUP OLARAK

GUN	EKİM	KASIM	ARALIK	OCAK	SUBAT	MART	NİSAN	MAYIS	HAZİRAN	TEMMUZ	AGUSTOS	EYLUL
1	2.40	4.25	3.85	7.50	88.6	8.50	17.5	4.70	18.1	2.70	1.55	1.34
2	2.40	4.25	4.25	15.6	42.5	8.00	17.5	4.70	15.0	2.70	1.34	1.34
3	2.40	4.25	3.85	42.5	29.0	9.00	18.1	4.70	19.9	2.70	1.34	1.34
4	2.05	4.25	3.45	23.3	26.8	9.00	18.1	4.25	15.0	2.40	1.34	1.34
5	2.05	3.85	3.05	12.8	29.8	8.50	16.2	3.85	12.2	2.05	1.15	1.15
6	2.05	3.45	3.45	8.50	40.0	8.00	13.9	3.45	10.6	2.40	1.15	1.34
7	2.05	3.45	3.85	7.50	43.3	8.00	12.8	3.05	9.00	2.40	1.15	1.34
8	1.85	3.45	3.85	8.00	40.8	8.00	12.2	2.70	8.00	2.40	1.15	1.55
9	1.85	3.45	3.55	7.50	33.5	8.00	11.7	2.70	7.50	2.40	1.15	1.89
10	1.85	3.45	3.45	6.50	30.5	8.00	11.2	2.70	6.50	2.40	1.15	1.55
11	1.85	3.05	3.85	6.05	39.2	7.50	9.54	3.05	5.60	3.05	1.15	1.34
12	1.85	2.70	3.85	6.50	45.1	8.00	9.00	3.85	5.15	2.70	1.15	1.34
13	1.85	3.05	3.45	6.50	52.5	9.00	9.00	4.25	4.70	2.40	1.15	1.34
14	1.85	2.70	3.45	7.00	59.3	8.50	8.50	4.70	4.25	2.05	1.15	1.55
15	1.85	2.70	8.00	12.2	46.1	8.50	8.00	5.15	3.85	1.85	1.55	1.34
16	1.85	2.70	39.2	24.0	35.0	10.1	7.50	* 5.15	3.45	1.85	1.65	1.34
17	1.85	2.70	15.6	16.8	26.8	13.3	7.00	5.60	3.05	1.85	3.05	1.34
18	2.05	2.70	10.6	13.9	24.0	15.0	7.00	5.60	2.70	1.85	2.70	1.34
19	2.05	2.70	11.7	14.4	21.9	15.6	7.50	5.60	2.40	1.85	2.05	1.34
20	2.05	2.70	13.9	13.3	19.3	15.0	8.00	6.05	2.05	2.05	1.85	* 1.34
21	2.05	2.70	11.2	11.2	16.2	17.5	7.50	9.00	1.85	1.85	1.55	1.55
22	2.40	* 2.70	9.54	9.54	15.0	21.2	7.50	10.1	2.40	1.85	1.34	1.34
23	3.85	2.70	8.50	* 8.50	13.3	17.5	7.00	10.1	2.40	1.55	1.34	1.34
24	* 3.05	2.70	7.00	8.00	* 12.2	21.9	7.00	10.6	2.40	* 1.55	1.15	1.34
25	3.85	2.70	7.00	7.50	12.2	19.9	6.50	9.00	2.40	1.55	1.15	1.34
26	4.70	2.70	* 6.50	9.00	11.2	17.5	* 6.05	11.7	3.45	1.55	1.34	1.34
27	4.25	2.70	6.05	15.6	10.6	15.0	6.05	13.9	* 3.85	1.55	1.34	1.34
28	3.85	2.70	6.05	29.0	9.54	14.4	6.05	15.6	3.85	1.85	1.34	1.34
29	3.45	2.70	5.60	26.8	----	* 16.8	5.60	15.6	3.45	1.85	* 1.34	1.55
30	3.85	2.70	5.15	67.6	----	18.1	5.60	11.2	3.05	1.55	1.34	1.55
31	4.70	----	5.15	143.	----	18.1	----	15.6	----	1.55	1.34	----
TOPLAM	80.05	92.80	228.24	596.09	874.24	391.40	295.09	218.20	188.10	64.30	44.69	41.78
ORTALAMA	2.582	3.093	7.363	19.23	31.22	12.63	9.836	7.039	6.270	2.074	1.442	1.393
LT/SN/KM^2	1.32	1.58	3.75	9.80	15.9	6.44	5.01	3.59	3.20	1.06	0.735	0.710
AKIM MM.	3.53	4.09	10.1	26.2	38.5	17.2	13.0	9.61	8.28	2.83	1.97	1.84
10^6 M^3 AKIM	6.92	8.02	19.7	51.5	75.5	33.8	25.5	18.9	16.3	5.56	3.86	3.61

SU YILI (1979) YILLIK TOPLAM AKIM. 269.1 MİLYON M^3. 137. MM . 4.35 LT/SN/KM^2.

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR. Yıl içinde 2.Pik Akım Değeri 74.2 m^3/sec. Tarihi 16.12.1978
Yıl içinde 3.Pik Akım Değeri 44.2 " Tarihi 3.1.1979

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKÇİBAŞI

MEVKİİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz İlçesinden Tosya'ya giden karayolunun 22.Km. sindeki Çeltikçibaşı Köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2 TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1978

ORTALAMA AKIMLAR : Rasat süresinde 7.796 m^3/sn. (8 yıllık) 1978 Su yılında 8.473 m^3/sn.

AZAMİ VE ASGARİ AKIMLAR
1978 Su yılında azami akım : 159. m^3/sn. (16. 2.1978)
1978 Su yılında asgari akım : 0.960 " (9. 8.1978
Rasat süresinde azami akım : 196. " (13.12.1976)
Rasat süresinde asgari akım : 0.429 " (3. 8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 2 ayrı anahtar eğrisi kullanılmıştır. 3.10.1977 ile 19.10.1977, 14.12.1977 ile 31.12.1977, 10.7.1978 ile 21.7.1978 günleri arasında şift tatbik edilmiştir.

9. Anahtar egrisi (Seviyeler Cm. — Akımlar m^3/Sn. dır.)

Seviye	Akım	Seviye	Akım
35	0.430	80	20.5
40	1.15	90	27.5
50	4.25	100	35.0
60	9.00	150	85.0
70	14.4	210	168.

AKIMLAR 1 EKIM 1977'DEN 30 EYLUL 1978'E KADAR VE SANIYEDE METRE-KUP OLARAK

GUN	EKIM	KASIM	ARALIK	OCAK	SUBAT	MART	NISAN	MAYIS	HAZIRAN	TEMMUZ	AGUSTOS	EYLUL
1	2.15	1.85	2.70	6.05	3.45	43.3	16.2	25.4	7.00	1.85	1.55	0.960
2	2.15	1.85	2.70	6.50	3.85	41.6	15.6	21.9	6.50	1.55	1.55	0.960
3	1.85	1.85	2.70	3.85	8.00	35.0	14.4	23.3	6.50	2.05	1.55	1.15
4	1.85	1.85	2.70	3.85	6.50	40.8	20.5	24.0	5.60	1.85	1.55	1.15
5	1.85	1.85	2.70	2.70	8.50	35.0	51.6	19.9	4.70	1.85	1.55	1.15
6	1.55	1.85	2.70	3.70	21.9	35.8	35.0	18.1	4.25	1.85	1.55	1.15
7	1.55	1.85	2.40	3.05	24.0	32.8	28.3	16.2	3.45	1.85	1.55	1.15
8	1.55	1.85	2.05	2.70	26.8	29.8	28.3	13.9	3.05	1.55	1.55	1.15
9	1.32	1.85	2.05	2.70	29.0	29.0	39.2	12.2	3.05	1.55	*1.15	1.34
10	1.32	1.85	2.40	2.40	19.9	27.5	47.9	11.7	2.70	1.85	0.960	1.85
11	*1.32	*2.05	2.05	2.40	14.7	20.5	*31.3	12.2	2.70	1.85	0.960	2.05
12	1.32	2.05	1.85	2.70	9.54	17.5	27.5	17.5	*2.40	1.15	0.960	2.05
13	1.32	2.05	1.85	2.40	11.7	14.4	25.4	22.6	2.05	1.85	0.960	2.05
14	1.32	2.05	1.55	2.40	11.7	*11.2	23.3	15.0	2.05	*1.55	0.960	2.05
15	1.55	2.05	1.85	2.40	18.1	11.7	23.3	12.8	2.05	1.55	0.960	2.05
16	1.85	2.05	1.85	2.40	93.8	10.6	28.3	14.4	2.05	1.55	0.960	1.85
17	1.85	2.05	1.85	2.05	40.0	9.54	30.5	15.0	1.85	1.34	0.960	1.85
18	1.85	2.05	1.55	1.85	24.0	10.1	27.5	12.2	1.85	1.34	1.15	1.85
19	1.85	2.40	1.85	2.05	28.3	10.6	22.6	11.2	1.85	1.34	1.15	1.85
20	1.85	4.70	1.55	2.40	27.5	11.7	24.7	10.1	1.85	1.34	0.960	1.85
21	1.55	4.25	1.55	2.40	*47.0	15.0	23.3	9.54	1.85	1.34	0.960	1.85
22	1.55	3.85	1.34	2.70	36.7	*13.3	*20.5	*8.50	1.85	1.55	0.960	2.70
23	1.55	3.05	*1.34	2.70	21.9	14.4	23.3	7.50	1.85	1.55	0.960	9.00
24	1.55	2.70	1.34	2.70	21.2	19.9	21.9	7.00	1.85	1.34	1.15	4.25
25	1.55	2.70	1.34	3.05	20.5	19.3	21.9	6.50	1.85	1.34	1.15	3.45
26	1.55	2.70	1.55	3.05	18.7	19.3	21.2	6.50	1.85	1.34	1.15	3.05
	1.55	2.70	1.85	3.45	18.7	34.3	22.6	8.00	1.55	1.15	1.15	2.70
	1.55	2.40	1.85	3.05	41.6	24.0	29.8	8.00	1.55	1.15	1.15	2.40
	1.85	2.70	2.05	*3.45	----	21.2	37.5	7.00	1.55	1.15	1.15	2.40
	1.85	2.70	2.05	3.45	----	17.5	32.8	8.00	1.55	1.15	0.960	2.40
31	1.85	----	2.40	3.85	----	15.6	----	7.50	----	1.15	0.960	----
TOPLAM	51.17	71.75	61.56	94.40	657.54	692.24	816.2	413.64	84.80	47.37	36.190	65.710
ORTALAMA	1.651	2.392	1.986	3.045	23.48	22.33	27.21	13.34	2.827	1.528	1.167	2.190
LT/SN/KM^2	0.841	1.22	1.01	1.55	12.0	11.4	13.9	6.80	1.44	0.779	0.595	1.12
AKIM MM.	2.25	3.16	2.71	4.16	29.0	30.5	35.9	18.2	3.73	2.09	1.59	2.89
10^6 M^3 AKIM	4.42	6.20	5.32	8.16	56.8	59.8	70.5	35.7	7.33	4.09	3.13	5.68

SU YILI (1978) YILLIK TOPLAM AKIM. 267.2 MILYON M^3, 136. MM , 4.32 LT/SN/KM^2.

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR. Yıl içinde 2.Pik Akım Değeri 66.5 m^3/sec. Tarihi 5.4.1978
Yıl içinde 3.Pik Akım Değeri 54.4 " Tarihi 1.3.1978

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKÇİBAŞI

MEVKİİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz ilçesinden Tosya'ya giden karayolunun 22.Km.sindaki Çeltikçibaşı Köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2. TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1977

ORTALAMA AKIMLAR : Rasat süresinde 7.699 $m^3/sn.$ (7 yıllık) 1977 Su yılında 7.787 $m^3/sn.$

AZAMİ VE ASGARİ AKIMLAR
1977 Su yılında azami akım : 196. $m^3/sn.$ (13.12.1976)
1977 Su yılında asgari akım : 0.920 " (24. 7.1977)
Rasat süresinde azami akım : 196. " (13.12.1976)
Rasat süresinde asgari akım : 0.429 " (3. 8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 2 ayrı anahtar eğrisi kullanılmıştır. 9.6.1977 ile 16.6.1977 günleri arasında şift tatbik edilmiştir.

8. Anahtar eğrisi (Seviyeler Cm. — Akımlar $m^3/Sn.$ dir.)

Seviye	Akım	Seviye	Akım
35	0.630	80	22.8
40	1.55	100	38.0
50	5.10	150	87.0
60	10.3	200	153.
70	16.3	250	237.

AKIMLAR 1 EKİM 1976'DAN 30 EYLUL 1977'E KADAR VE SANİYEDE METRE-KUP OLARAK

GUN	EKİM	KASIM	ARALIK	OCAK	SUBAT	MART	NISAN	MAYIS	HAZIRAN	TEMMUZ	AGUSTOS	EYLUL
1	1.85	3.96	3.33	4.28	4.69	17.0	16.3	15.1	5.60	2.15	0.920	4.28
2	1.85	3.96	3.33	3.87	5.10	15.1	16.3	15.7	5.10	2.15	0.920	4.28
3	1.85	3.96	4.68	3.46	6.60	12.1	15.7	15.1	4.69	2.75	0.920	4.28
4	1.85	3.33	8.84	3.05	7.60	10.3	17.6	17.0	6.10	2.15	0.920	4.28
5	1.85	3.33	10.3	3.05	8.14	10.3	18.3	14.5	5.60	2.15	0.920	4.28
6	1.85	3.06	9.27	3.05	7.60	10.3	17.0	13.9	7.60	1.85	0.920	4.69
7	1.85	3.06	8.41	3.05	6.60	9.22	14.5	13.3	10.9	1.85	0.920	5.10
8	1.85	3.06	6.26	2.75	5.60	8.14	12.7	14.5	7.60	1.55	0.920	4.69
9	1.85	2.79	6.26	2.75	* 4.69	7.10	10.9	16.3	5.60	1.55	0.920	4.28
10	1.85	2.79	5.40	3.05	4.28	* 7.10	8.68	13.3	4.69	1.55	0.920	3.87
11	1.85	3.06	5.40	3.46	6.10	7.10	* 8.14	* 12.7	4.28	* 1.32	0.920	3.46
12	1.85	3.06	11.4	3.46	36.4	7.10	8.68	12.7	3.87	1.32	0.920	3.05
13	1.85	2.79	119.	3.05	102.	7.60	8.68	10.9	* 4.28	1.32	0.920	2.75
14	1.85	2.79	51.9	3.05	109.	8.14	7.60	9.22	6.10	1.12	0.920	2.15
15	1.85	2.79	20.9	3.05	89.4	14.5	7.10	9.76	4.69	1.12	* 0.920	1.85
16	1.85	2.79	13.9	3.05	52.8	20.9	7.10	8.68	4.28	1.12	0.920	1.85
17	1.85	3.06	12.1	3.46	38.9	22.2	10.3	10.3	4.69	1.12	0.920	2.15
18	1.85	* 3.33	9.76	3.46	32.4	16.3	12.1	9.22	5.60	1.12	0.920	2.15
19	1.85	3.33	8.14	3.46	27.1	13.3	10.9	9.76	6.60	1.12	0.920	2.15
20	2.05	3.06	6.60	3.05	21.5	13.9	10.3	8.14	5.10	1.12	0.920	1.85
21	2.25	3.06	* 5.60	3.05	15.7	19.6	9.22	7.10	3.87	1.12	1.12	1.55
22	2.05	3.33	4.69	3.05	12.1	* 29.3	9.76	6.10	3.46	1.12	1.32	1.55
23	2.05	3.60	4.28	3.46	11.5	32.4	9.76	5.10	3.05	1.12	1.55	1.55
24	3.06	3.96	4.69	3.05	10.9	29.3	9.22	9.22	2.75	0.920	1.85	1.55
25	* 9.27	4.32	4.69	* 3.05	10.9	26.4	* 9.76	8.14	2.45	0.920	2.15	1.55
	7.55	3.96	4.69	3.46	12.1	22.8	18.9	6.10	2.45	0.920	2.45	* 1.55
	5.40	3.96	4.69	3.46	13.3	20.8	20.9	5.10	2.45	0.920	2.75	1.85
	4.32	3.96	4.69	3.87	15.1	18.9	16.3	4.28	3.05	0.920	3.46	1.85
29	6.26	3.60	4.28	4.28	----	17.6	14.5	5.60	3.05	0.920	3.87	2.15
30	4.68	3.33	3.87	4.28	----	16.3	13.9	9.22	2.45	0.920	3.87	2.15
31	4.32	----	3.87	4.28	----	15.1	----	6.60	----	0.920	4.28	----
TOPLAM	88.41	100.44	375.22	104.20	678.10	486.20	371.10	322.64	142.00	42.220	47.070	84.74
ORTALAMA	2.852	3.348	12.10	3.361	24.22	15.68	12.37	10.41	4.733	1.362	1.518	2.825
LT/SN/KM^2	1.45	1.71	6.17	1.71	12.3	7.99	6.30	5.31	2.41	0.694	0.774	1.44
AKIM MM.	3.89	4.42	16.5	4.59	29.9	21.4	16.3	14.2	6.25	1.86	2.07	3.73
10^6 M^3 AKIM	7.64	8.68	32.4	9.00	58.6	42.0	32.1	27.9	12.3	3.65	4.07	7.32

SU YILI (1977) YILLIK TOPLAM AKIM: 245.6 MİLYON M^3, 125. MM , 3.97 LT/SN/KM^2.

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR. Yıl içinde 2.Pik Akım Değeri 159. $m^3/sec.$ Tarihi 14.3.1977
Yıl içinde 3.Pik Akım Değeri 57,5 " Tarihi 22.3.1977

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKÇİBAŞI

MEVKİİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz İlçesinden Tosya'ya giden karayolunun 22. Km. sindeki Çeltikçibaşı köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km². TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1976

ORTALAMA AKIMLAR : Rasat süresinde 7.685 m³/sn. (6 yıllık) 1976 Su yılında 6.250 m³/sn.

AZAMİ VE ASGARİ AKIMLAR

1976	Su yılında	azami akım	: 93.2	m³/sn.	(25.3.1976)
1976	Su yılında	asgari akım	: 1.00	"	(15.7.1976)
Rasat süresinde		azami akım	: 175.	"	(1.5.1975)
Rasat süresinde		asgari akım	: 0.429	"	(3.8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. 1.10.1975 ile 5.10.1975, 14.12.1975 ile 19.12.1975, 18.2.1976 ile 22.2.1976, 15.6.1976 ile 17.6.1976, 29.7.1976 ile 9.8.1976 günleri arasında günleri arasında şift tatbik edilmiştir.

7. Anahtar eğrisi (Seviyeler Cm. — Akımlar m³/Sn. dir.)

Seviye	Akım	Seviye	Akım
40	0.630	90	22.0
50	2.25	100	29.3
60	5.40	120	45.5
70	9.70	150	76.0
80	15.4	200	140.

AKIMLAR 1 EKİM 1975'DEN 30 EYLUL 1976'YA KADAR VE SANİYEDE METRE-KUP OLARAK

GUN	EKIM	KASIM	ARALIK	OCAK	ŞUBAT	MART	NISAN	MAYIS	HAZIRAN	TEMMUZ	AGUSTOS	EYLUL
1	2.05	2.05	2.79	1.85	3.33	2.52	26.4	9.27	5.40	3.33	1.45	1.85
2	2.05	2.05	2.79	2.05	2.79	2.79	29.3	9.27	7.12	2.25	1.25	1.85
3	2.05	2.25	2.79	2.25	2.79	2.79	27.1	8.41	5.83	2.05	1.13	1.65
4	2.05	2.25	2.79	2.52	2.79	2.79	20.7	7.12	5.04	1.85	1.13	1.45
5	2.05	2.52	2.52	2.79	2.79	2.79	24.2	6.26	4.32	1.85	1.13	1.45
6	2.05	2.52	2.79	2.52	2.79	2.79	27.1	5.40	3.60	1.45	1.13	1.45
7	2.05	2.52	2.79	2.52	2.52	2.79	24.9	6.26	3.33	1.25	1.13	1.45
8	2.05	2.52	2.79	2.52	2.25	2.79	25.7	6.69	4.68	1.13	1.13	1.45
9	2.05	2.52	2.79	2.25	1.85	3.33	26.4	6.26	7.12	* 1.13	1.13	1.45
10	2.05	2.52	2.79	2.25	1.85	5.40	24.2	5.40	7.12	1.25	1.13	1.45
11	2.05	2.52	2.79	2.25	2.05	6.26	24.2	5.04	5.40	1.25	1.13	1.45
12	2.05	2.52	2.52	2.25	2.05	6.26	39.6	5.83	4.68	1.25	1.13	1.45
13	2.05	2.52	2.25	2.25	2.52	5.83	43.8	7.12	3.60	1.65	1.13	1.25
14	2.05	2.79	2.52	2.25	2.52	5.40	28.6	7.12	3.60	1.45	1.13	1.25
15	2.05	3.06	2.52	2.25	2.79	5.40	24.9	* 6.26	4.32	1.13	1.13	1.45
16	2.05	3.06	2.79	* 2.79	3.06	7.12	* 39.6	5.40	3.60	1.13	1.13	1.45
17	* 2.05	3.06	3.06	3.06	3.06	18.7	52.1	5.04	* 3.06	1.45	1.00	1.45
18	2.05	3.06	3.33	3.06	3.06	33.2	35.5	6.26	2.79	1.45	1.00	1.45
19	2.05	3.06	* 3.33	2.79	3.06	42.1	30.1	5.83	3.33	1.45	1.00	1.45
20	2.05	3.06	4.32	2.25	* 3.06	51.8	20.0	6.26	3.06	1.25	1.13	1.45
21	1.85	* 3.33	4.68	2.25	3.06	33.9	16.7	5.83	2.79	1.25	1.13	1.45
22	1.85	3.33	4.32	2.25	2.79	40.4	15.4	5.04	2.52	1.13	1.13	1.65
23	1.85	3.33	3.33	2.52	2.79	50.0	16.7	4.32	2.52	1.13	1.13	1.85
24	2.05	3.60	3.06	2.52	2.79	* 62.9	15.4	3.96	2.25	1.13	1.13	2.05
25	2.25	4.68	3.06	2.52	2.79	66.1	14.8	3.96	2.25	1.13	1.25	1.85
26	2.52	5.04	3.33	3.06	2.52	58.7	14.8	4.68	2.05	1.13	1.25	1.85
27	2.25	4.68	3.33	3.60	2.52	53.6	14.8	6.69	2.79	1.13	1.65	1.85
28	2.25	3.96	2.79	3.33	2.79	39.6	16.7	5.40	2.79	1.13	3.33	1.85
29	2.05	3.33	2.05	3.96	2.52	33.2	13.1	5.83	5.40	1.13	2.25	1.85
30	2.05	3.06	1.85	3.60	----	25.7	10.3	7.12	4.32	1.13	2.05	1.85
31	2.05	----	2.05	3.33	----	19.4	----	5.83	----	1.85	1.85	----
TOPLAM	64.02	90.77	90.91	81.66	77.55	696.35	743.7	189.16	120.68	44.27	40.80	47.70
ORTALAMA	2.065	3.026	2.933	2.634	2.674	22.46	24.79	6.102	4.023	1.428	1.316	1.590
LT/SN/KM²	1.05	1.54	1.49	1.34	1.36	11.4	12.6	3.11	2.05	0.728	0.671	0.810
AKIM:MM.	2.82	4.00	4.00	3.60	3.42	30.7	32.8	8.33	5.31	1.95	1.80	2.10
10⁶ M³ AKIM	5.53	7.84	7.85	7.06	6.70	60.2	64.3	16.3	10.4	3.82	3.53	4.12

SU YILI (1976) YILLIK TOPLAM AKIM. 197.6 MİLYON M³, 101. MM , 3.19 LT/SN/KM².

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR.

YILLIK TOPLAM = 2287.57, ORTALAMA = 6.250. 1538 DEVRES C.CELTIKCIBASI

MINIMUM	1.850	2.050	1.850	1.850	1.850	2.520	10.300	3.960	2.050	1.130	1.000	1.250
MAKSIMUM	2.520	5.040	4.680	3.960	3.330	66.100	52.700	9.270	7.120	3.330	3.330	2.050

15 - KIZILIRMAK HAVZASI
1538 - DEVRES CAYI - ÇELTİKÇİBAŞI

MEVKİİ : (33^{o} 47' 08" D - 40^{o} 54' 23" K) Kastamonu'nun Ilgaz ilçesinden,Tosya'ya giden karayolunun 22.Km. sindeki Çeltikcibaşı köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2. TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1975

ORTALAMA AKIMLAR : Rasat süresinde 7.972 m^3/sn. (5 yıllık) 1975 Su yılında 12.329 m^3/sn.

AZAMİ VE ASGARİ AKIMLAR

1975	Su yılında	azami akım :	175. m^3/sn.	(1.5.1975)
1975	Su yılında	asgari akım :	0.764 "	(2.9.1975)
Rasat süresinde		azami akım :	175. "	(1.5.1975)
Rasat süresinde		asgari akım :	0.429 "	(3.8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 2 ayrı anahtar eğrisi kullanılmıştır. 1.2.1975 ile 28.2.1975, 1.3.1975 ile 25.3.1975, 30.3.1975 ile 15.4.1975 günleri arasında şift tatbik edilmiştir.

6. Anahtar eğrisi (Seviyeler Cm. - Akımlar m^3/Sn. dir.)

Seviye	Akım	Seviye	Akım
40	0.550	100	31.7
50	3.30	130	57.0
60	7.65	160	90.0
70	12.5	190	127.
80	18.0	230	185.

AKIMLAR 1 EKIM 1974'DEN 30 EYLUL 1975'E KADAR VE SANIYEDE METRE-KUP OLARAK

GUN	EKIM	KASIM	ARALIK	OCAK	SUBAT	MART	NISAN	MAYIS	HAZIRAN	TEMMUZ	AGUSTOS	EYLUL
1	1.05	1.55	5.18	2.32	4.79	2.61	66.5	146.	18.0	4.59	1.96	0.978
2	1.22	1.55	4.01	2.32	4.40	3.61	57.0	121.	13.1	3.73	1.96	0.978
3	1.22	1.55	3.61	2.83	4.01	3.61	63.7	85.2	11.0	2.96	1.62	1.41
4	1.22	1.55	2.57	2.83	3.61	4.01	70.0	62.7	9.59	2.96	1.41	1.62
5	1.22	1.55	2.32	2.57	3.61	4.40	47.1	44.5	9.59	2.96	1.41	1.62
6	1.22	1.55	2.32	2.57	3.22	5.57	36.3	35.5	18.0	2.96	1.41	5.89
7	1.22	1.55	2.06	2.32	2.83	7.84	33.2	28.0	13.1	2.96	1.41	4.16
8	1.22	1.55	2.06	2.32	2.83	9.48	28.7	23.7	10.6	2.63	1.41	2.29
9	1.22	1.55	2.06	2.83	2.83	11.1	24.3	21.2	10.1	2.63	1.96	1.62
10	1.22	1.55	2.06	2.83	2.57	12.9	20.5	* 21.8	12.5	2.63	8.14	2.29
11	1.22	* 1.81	2.06	2.57	2.32	19.9	* 18.6	47.1	11.0	2.63	7.21	2.29
12	1.22	1.81	2.06	2.06	2.57	29.2	16.9	53.4	15.3	2.29	4.16	2.29
13	1.22	1.81	2.06	2.06	2.57	38.0	16.4	55.2	11.0	1.96	2.63	1.96
14	1.22	1.81	2.06	1.81	2.83	48.0	15.8	33.2	9.59	1.96	3.30	1.96
15	1.22	1.81	2.06	1.81	2.83	51.0	14.2	87.6	9.11	1.62	4.16	1.62
16	1.22	2.06	2.06	2.06	2.83	57.0	13.1	75.7	8.14	* 1.62	2.96	1.62
17	1.22	2.06	* 2.32	2.06	2.83	56.0	19.3	51.6	7.21	1.41	2.96	1.96
18	1.22	2.06	2.57	2.06	2.83	47.0	23.0	36.3	6.33	1.41	2.63	* 1.96
19	1.38	1.81	2.57	* 2.06	2.57	48.0	26.5	37.8	5.45	1.41	1.96	1.96
20	1.38	1.81	2.57	2.06	2.83	49.0	28.0	51.6	5.02	1.41	1.96	1.96
21	1.38	1.81	2.32	1.81	2.83	60.0	35.5	48.0	4.59	1.41	1.62	1.96
22	1.22	1.81	2.32	1.81	* 3.22	56.0	34.0	46.3	4.16	1.41	1.41	1.96
23	* 1.22	1.81	2.32	1.81	4.40	* 48.0	27.3	35.5	* 4.16	1.41	1.62	2.29
24	1.22	1.81	2.06	1.81	4.40	57.0	23.7	50.7	7.65	1.62	1.62	2.29
25	1.22	1.81	2.32	2.06	4.01	69.6	24.3	37.8	5.89	1.96	1.41	2.29
26	1.38	1.81	2.32	2.06	4.01	93.6	41.9	58.0	5.02	1.62	1.41	2.29
27	1.38	1.81	2.32	2.32	4.01	42.8	42.8	49.8	4.16	3.73	1.19	2.29
28	1.55	1.81	2.06	2.32	3.61	31.0	48.9	32.5	4.16	2.63	1.19	2.29
	1.55	1.81	2.06	2.32	-----	30.2	62.7	25.8	5.02	1.62	0.978	2.29
	1.55	2.32	2.32	3.61	-----	35.5	87.6	26.5	5.45	1.62	0.978	1.96
31	1.55	----	2.32	4.79	-----	46.3	----	21.2	----	1.41	0.978	----
TOPLAM	39.77	52.96	75.38	73.07	92.20	1079.23	1067.8	1551.2	263.99	69.17	71.024	64.346
ORTALAMA	1.283	1.765	2.432	2.357	3.293	34.81	35.59	50.04	8.800	2.231	2.291	2.145
LT/SN/KM^2	0.654	0.900	1.24	1.20	1.68	17.7	18.1	25.5	4.49	1.14	1.17	1.09
AKIM,MM.	1.75	2.33	3.32	3.22	4.06	47.5	47.0	68.3	11.6	3.05	3.13	2.83
10^6 M^3 AKIM	3.44	4.58	6.51	6.31	7.97	93.2	92.3	134.	22.8	5.98	6.14	5.56

SU YILI (1975) YILLIK TOPLAM AKIM. 388.8 MILYON M^3, 198. MM , 6.28 LT/SN/KM^2.

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR.

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKCİBAŞI

MEVKİİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz ilçesinden, Tosya'ya giden karayolunun 22. Km.sindeki Çeltikcibaşı köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2 TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1974

ORTALAMA AKIMLAR : Rasat süresinde 6.884 $m^3/sn.$ (4 yıllık) 1974 Su yılında 3.611 $m^3/sn.$

AZAMİ VE ASGARİ AKIMLAR

1974 Su yılında	azami	akım :	148.	$m^3/sn.$	(15.3.1974)
1974 Su yılında	asgari	akım :	0.429	"	(3.8.1974)
Rasat süresinde	azami	akım :	148.	"	(15.3.1974)
Rasat süresinde	asgari	akım :	0.429	"	(3.8.1974)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 2 ayrı anahtar eğrisi kullanılmıştır. 15.3.1974 ile 21.3.1974, 12.5.1974 ile 20.5.1974 günleri arasında şift tatbik edilmiştir.

5. Anahtar eğrisi (Seviyeler Cm. — Akımlar $m^3/Sn.$ dır.)

Seviye	Akım	Seviye	Akım
50	0.720	100	27.5
60	2.83	120	46.0
70	6.75	140	66.0
80	12.2	160	90.0
90	19.0	200	140.

AKIMLAR 1 EKIM 1973'DEN 30 EYLUL 1974'E KADAR VE SANIYEDE METRE-KUP OLARAK

GUN	EKIM	KASIM	ARALIK	OCAK	SUBAT	MART	NISAN	MAYIS	HAZIRAN	TEMMUZ	AGUSTOS	EYLUL
1	1.62	1.96	2.63	2.63	1.96	3.30	5.18	5.67	3.61	1.22	0.526	1.05
2	1.62	1.96	2.63	2.63	1.96	3.30	5.18	19.0	2.83	1.05	0.526	1.05
3	1.62	2.29	2.63	2.63	1.96	2.96	6.75	14.2	2.57	0.886	0.429	1.05
4	1.62	2.29	2.63	2.29	2.29	4.16	6.36	10.0	2.57	0.886	0.429	1.05
5	1.62	2.29	2.29	2.29	2.29	4.16	5.97	8.93	3.22	0.886	0.429	1.05
6	1.41	1.96	2.29	2.29	2.29	3.73	5.97	8.39	4.40	0.886	0.429	1.05
7	1.62	1.96	2.29	2.29	1.96	3.73	5.97	6.75	3.61	0.886	0.429	1.22
8	1.62	1.96	2.29	2.29	1.96	3.73	5.97	5.18	2.83	0.886	0.429	1.22
9	1.62	1.96	2.29	2.29	2.29	5.02	5.57	4.79	2.57	0.886	0.429	1.22
10	1.62	2.29	2.29	1.96	2.63	5.02	5.57	5.97	2.06	1.05	0.429	1.22
11	1.62	2.29	2.29	1.62	2.96	4.59	5.18	9.48	2.06	1.05	0.526	1.05
12	2.29	2.29	2.29	1.62	2.96	6.02	5.18	17.0	1.81	*0.886	0.623	1.05
13	2.96	2.29	2.29	1.62	2.96	9.64	5.57	15.6	1.81	0.886	0.623	1.05
14	2.29	2.29	2.29	1.62	2.63	20.4	6.36	11.1	1.38	0.886	0.623	1.05
15	1.96	*2.29	2.63	1.62	2.63	90.0	*6.75	7.30	*1.22	0.886	0.623	1.05
16	1.96	2.29	2.96	1.62	2.63	*47.0	6.75	5.97	1.22	0.886	0.623	1.05
17	2.29	2.29	2.63	1.62	2.96	25.8	8.93	8.39	1.22	0.886	0.623	*0.886
18	2.29	2.29	*2.63	1.96	2.96	19.9	9.48	* 8.39	1.38	0.886	0.623	0.886
19	1.96	*2.29	2.63	1.96	2.96	11.7	7.30	6.36	2.06	0.886	0.623	0.886
20	1.96	2.29	2.63	1.96	2.96	10.6	7.30	7.84	1.81	0.886	0.720	0.886
21	1.96	2.29	2.63	1.96	2.96	*10.0	6.75	17.0	2.57	0.886	0.720	0.886
22	1.96	2.29	2.63	*1.96	2.96	10.0	6.75	12.9	2.06	0.886	0.886	0.886
23	*1.96	2.29	2.63	1.96	2.96	10.0	6.75	9.48	2.06	0.886	0.886	0.886
24	1.96	2.29	2.29	1.62	2.96	12.2	6.75	* 6.36	1.81	0.886	0.886	1.05
25	2.29	2.29	2.63	1.62	*3.30	11.1	5.97	6.36	1.81	0.886	*0.720	1.05
26	2.63	2.29	2.63	1.62	3.73	8.93	5.57	5.18	1.55	0.886	0.720	1.05
27	2.63	2.29	2.63	1.96	3.73	8.39	6.36	4.40	1.22	0.886	0.720	1.05
28	2.29	2.29	2.63	1.96	3.73	7.84	6.36	4.01	1.22	0.886	0.720	1.05
29	1.96	2.96	2.63	1.96	-----	5.97	5.18	3.61	1.22	0.720	0.720	1.05
30	1.96	2.63	2.63	1.96	-----	5.97	4.40	3.22	1.22	0.720	0.720	1.05
31	1.96	-----	2.63	1.96	-----	5.57	-----	4.40	-----	0.623	0.886	-----
TOPLAM	61.13	67.73	78.12	61.35	76.53	380.73	188.13	263.13	62.98	27.697	19.298	31.032
ORTALAMA	1.972	2.258	2.520	1.979	2.733	12.28	6.271	8.488	2.099	0.893	0.623	1.034
LT/SN/KM^2	1.01	1.15	1.28	1.01	1.39	6.26	3.20	4.33	1.07	0.455	0.318	0.527
AKIM,MM.	2.69	2.98	3.44	2.70	3.37	16.8	8.28	11.6	2.77	1.22	0.850	1.37
10^6 M^3 AKIM	5.28	5.85	6.75	5.30	6.61	32.9	16.3	22.7	5.44	2.39	1.67	2.66

SU YILI (1974) YILLIK TOPLAM AKIM. 113.9 MILYON M^3, 58.0 MM , 1.84 LT/SN/KM^2.

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR.

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKCİBAŞI

MEVKİİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz ilçesinden, Tosya'ya giden karayolunun 22. Km. sindeki Çeltikcibaşı köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2 TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1973

ORTALAMA AKIMLAR : Rasat süresinde 7.974 m^3/sn. (3 yıllık) 1973 Su yılında 7.560 m^3/sn.

AZAMİ VE ASGARİ AKIMLAR
1973 Su yılında azami akım : 135. m^3/sn. (16.3.1973)
1973 Su yılında asgari akım : 0.550 " (1.8.1973)
Rasat süresinde azami akım : 135. " (16.3.1973)
Rasat süresinde asgari akım : 0.550 " (1.8.1973)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 2 ayrı anahtar eğrisi kullanılmıştır. 13.2.1973 ile 26.2.1973, 17.3.1973 ile 28.3.1973, 15.5.1973 ile 20.5.1973, 2.8.1973 ile 13.9.1973 günleri arasında şift tatbik edilmiştir.

4. Anahtar eğrisi (Seviyeler Cm. - Akımlar m^3/Sn. dir.)

Seviye	Akım	Seviye	Akım
40	0.550	100	36.0
45	1.62	120	52.0
50	3.30	140	70.0
55	5.45	160	91.0
60	8.30	200	140.

AKIMLAR 1 EKIM 1972'DEN 30 EYLUL 1973'E KADAR VE SANIYEDE METRE-KUP OLARAK

GUN	EKIM	KASIM	ARALIK	OCAK	SUBAT	MART	NISAN	MAYIS	HAZIRAN	TEMMUZ	AGUSTOS	EYLUL
1	4.10	8.04	4.52	2.47	3.77	23.3	32.5	11.8	3.45	0.550	1.19	1.19
2	3.77	7.58	4.52	2.47	3.77	14.7	31.1	11.2	3.45	0.550	4.10	1.19
3	3.45	7.12	4.52	2.47	3.45	11.8	31.1	10.1	3.45	0.550	1.62	1.19
4	3.45	7.12	4.52	2.24	3.45	9.04	32.5	9.58	3.12	0.550	1.19	1.19
5	3.45	6.66	4.10	2.47	3.12	8.50	29.7	9.58	2.47	0.764	0.978	1.19
6	3.17	6.66	3.77	2.80	3.45	9.58	32.5	9.04	2.24	2.29	0.978	1.19
7	3.12	6.20	3.77	2.80	3.45	10.1	39.8	8.50	2.24	2.29	0.978	0.978
8	3.12	5.78	3.77	2.80	3.45	8.04	25.9	7.58	2.24	2.63	0.978	1.19
9	3.12	5.78	3.45	3.12	3.45	6.20	24.0	6.66	2.24	2.29	0.764	1.19
10	3.12	5.78	3.12	3.12	3.45	6.20	22.1	6.20	2.24	1.62	0.550	1.19
11	3.12	5.36	3.12	3.12	3.77	8.50	22.7	5.78	25.9	1.41	0.550	1.19
12	2.80	5.36	3.12	3.12	7.58	14.1	22.1	5.78	13.0	1.41	0.550	1.19
13	2.80	5.36	2.80	3.12	*18.1	24.0	21.6	4.94	8.97	1.41	0.550	2.29
14	2.80	5.36	2.80	2.80	17.0	22.7	21.6	4.52	6.59	1.41	0.550	1.96
15	2.80	5.36	*2.80	2.80	13.5	* 78.0	18.1	4.10	5.02	2.96	0.550	1.62
16	4.10	5.36	2.80	2.80	12.4	106.	*15.8	4.10	*4.59	2.63	0.550	*1.62
17	18.1	5.36	3.12	*2.80	16.4	42.8	14.7	4.10	5.02	1.62	0.550	1.62
18	* 6.20	4.94	3.12	2.80	22.1	25.9	12.4	4.52	4.59	1.62	0.550	1.62
19	7.12	4.94	3.45	2.47	23.3	19.7	11.2	*4.52	4.16	1.41	0.550	1.62
20	9.04	4.94	3.45	2.80	19.9	18.7	10.7	4.10	3.73	1.19	0.550	1.62
21	8.04	*4.52	3.45	3.12	11.8	15.8	10.7	3.77	2.96	0.978	0.550	2.29
22	7.58	4.52	3.45	3.12	11.8	14.7	10.7	3.45	2.63	*1.19	0.550	11.7
23	14.1	4.52	3.45	3.12	12.4	11.8	10.7	3.12	2.29	1.19	0.550	5.02
24	15.8	4.52	3.12	3.12	10.7	*11.8	9.58	2.80	1.62	1.19	0.550	2.29
25	23.3	4.10	3.12	2.80	9.58	14.7	15.7	2.47	1.41	1.19	0.550	1.96
	26.5	4.10	3.12	2.80	21.0	22.7	26.5	*4.10	1.19	0.978	0.764	1.96
	28.4	4.10	3.12	3.12	64.3	28.4	27.0	4.94	1.19	0.978	0.764	1.62
	18.1	4.52	2.80	3.12	45.2	27.1	20.4	4.52	0.978	0.978	0.978	1.62
29	14.1	4.52	2.80	3.45	-----	25.2	17.0	3.45	0.978	0.978	0.978	1.62
30	11.2	4.52	2.47	3.77	-----	22.1	12.9	3.12	0.764	0.978	*0.978	1.62
31	9.58	-----	2.47	3.77	-----	27.1	-----	3.12	-----	0.978	1.19	-----
TOPLAM	269.40	163.00	104.01	90.70	375.64	688.26	638.28	175.56	124.719	42.760	27.288	59.738
ORTALAMA	8.690	5.433	3.355	2.926	13.42	22.20	21.28	5.663	4.157	1.379	0.880	1.991
LT/SN/KM^2	4.43	2.77	1.71	1.49	6.84	11.3	10.8	2.89	2.12	0.703	0.449	1.01
AKIM,MM.	11.9	7.18	4.58	3.99	16.5	30.3	28.1	7.73	5.49	1.88	1.20	2.63
10^6 M^3 AKIM	23.3	14.1	8.99	7.84	32.5	59.5	55.1	15.2	10.8	3.69	2.36	5.16

SU YILI (1973) YILLIK TOPLAM AKIM. 238,4 MILYON M^3. 122. MM . 3.85 LT/SN/KM^2.

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR.

15 - KIZILIRMAK HAVZASI
1538 - DEVRES ÇAYI - ÇELTİKCİBAŞI

MEVKİİ : (33° 47' 08" D - 40° 54' 23" K) Kastamonu'nun Ilgaz ilçesinden, Tosya'ya giden karayolunun 22. Km. sindeki Çeltikcibaşı köyüne 1 Km. mesafededir.

YAĞIŞ ALANI : 1962.0 Km^2 TAKRİBİ RAKIMI : 775 m.

RASAT SÜRESİ : 1.Ekim.1970 - 30.Eylül.1972

ORTALAMA AKIMLAR : Rasat süresinde 8.181 $m^3/sn.$ (2 yıllık) 1972 Su yılında 7.890 $m^3/sn.$

AZAMİ VE ASGARİ AKIMLAR

1972 Su yılında	azami	akım	: 88.8	$m^3/sn.$	(10.6.1972)
1972 Su yılında	asgari	akım	: 1.04	"	(21.8.1972)
Rasat süresinde	azami	akım	: 94.3	"	(26.3.1971)
Rasat süresinde	asgari	akım	: 1.04	"	(21.8.1972)

SEVİYE ÖLÇEĞİ : Eşel.

DÜŞÜNCELER : Akım durumu iyi. Yıl içinde 2 ayrı anahtar eğrisi kullanılmıştır. 12.11.1971 ile 31.11.1971, 15.2.1972 ile 11.3.1972, 30.3.1972 ile 4.5.1972, 13.5.1972 ile 9.6.1972, 24.8.1972 ile 23.9.1972 günleri arasında şift tatbik edilmiştir.

3. Anahtar eğrisi (Seviyeler Cm. - Akımlar $m^3/Sn.$ dir.)

Seviye	Akım	Seviye	Akım
30	0.610	100	36.0
40	2.47	120	52.0
50	6.20	140	70.0
60	11.2	160	91.0
70	17.0	180	114.

AKIMLAR 1 EKIM 1971'DEN 30 EYLUL 1972'YE KADAR VE SANIYEDE METRE-KUP OLARAK

GUN	EKIM	KASIM	ARALIK	OCAK	SUBAT	MART	NISAN	MAYIS	HAZIRAN	TEMMUZ	AGUSTOS	EYLUL
1	2.05	2.55	5.48	3.16	2.30	8.42	23.3	18.7	8.50	9.04	2.47	4.52
2	2.05	2.80	5.48	3.16	2.55	10.1	24.6	17.0	9.58	9.58	2.01	6.20
3	2.05	2.80	5.04	3.16	2.55	13.7	31.1	19.9	10.7	14.7	1.78	4.52
4	2.05	2.80	4.60	3.16	2.55	11.3	22.1	20.4	8.50	15.3	1.55	3.45
5	2.05	2.80	4.60	3.16	2.55	15.5	19.9	25.9	8.04	38.3	1.55	2.80
6	2.30	2.80	4.24	3.16	2.55	21.7	25.2	45.2	9.04	21.0	1.55	2.24
7	2.30	2.80	3.88	3.16	2.55	19.8	21.6	29.7	10.7	12.4	1.55	2.24
8	2.30	2.80	4.24	3.16	2.55	18.0	24.0	25.9	*12.4	10.1	*1.55	3.45
9	2.30	2.80	4.24	3.16	2.55	21.1	24.6	19.9	16.4	8.04	1.55	4.10
10	2.30	2.80	4.24	3.16	2.80	35.3	21.0	15.3	42.0	6.66	1.55	3.12
11	*2.30	*2.80	7.88	3.52	2.80	36.0	27.7	*14.1	31.1	8.04	1.32	3.12
12	2.30	2.80	25.8	3.88	2.80	50.3	28.4	*14.1	21.0	9.04	1.32	2.80
13	2.30	2.80	20.5	3.88	2.80	32.5	23.3	16.4	12.9	*8.04	1.55	2.47
14	2.30	2.80	13.1	3.16	2.80	21.6	*15.8	14.7	10.1	7.58	1.55	2.24
15	2.30	2.80	6.36	2.55	3.52	13.5	11.2	13.5	7.58	4.94	1.55	*2.47
16	2.30	2.80	6.36	2.55	4.24	14.7	12.4	10.1	6.66	3.12	1.55	2.47
17	2.30	2.80	5.92	2.55	3.88	22.7	15.3	8.50	5.78	2.80	1.32	2.24
18	2.30	2.80	5.92	2.55	3.88	24.0	12.4	8.04	5.36	4.52	1.32	2.01
19	2.30	2.80	5.04	2.55	4.24	*22.1	11.2	7.12	4.52	5.36	1.32	2.01
20	2.55	2.80	4.60	2.55	4.24	19.3	18.1	6.20	4.52	4.10	1.18	2.01
21	2.55	*2.80	*4.60	2.55	4.24	17.0	18.1	5.78	8.50	3.45	1.18	2.01
22	2.55	3.52	4.60	2.80	4.24	17.6	16.4	5.78	8.50	2.80	1.32	2.01
23	2.55	4.24	4.60	2.80	4.24	16.4	14.1	9.58	7.58	2.01	0.66	4.10
24	2.80	3.88	5.04	2.80	4.24	14.1	15.3	*7.58	6.20	1.78	17.0	3.45
25	2.80	4.24	5.04	2.80	4.60	10.1	*15.8	7.12	4.94	1.55	7.58	3.77
26	2.80	4.24	5.04	2.80	*4.60	8.50	17.0	6.66	4.10	1.32	8.04	3.12
27	*2.80	*5.04	4.24	2.80	5.04	7.12	17.0	5.78	3.77	2.01	7.58	3.77
28	2.80	4.60	3.52	2.80	5.04	5.78	18.1	4.52	3.77	5.78	8.50	4.10
29	2.80	4.24	*2.80	2.80	5.92	7.58	15.8	4.10	4.52	9.04	4.10	8.50
30	2.80	4.24	2.80	2.55	====	28.4	17.0	3.77	4.94	5.78	3.45	5.78
31	2.80	----	3.16	2.55	----	24.6	----	6.66	----	3.45	2.80	----
TOPLAM	75.05	96.79	192.96	91.39	102.86	588.80	577.8	417.99	302.20	241.63	99.30	101.09
ORTALAMA	2.421	3.226	6.225	2.948	3.547	18.99	19.26	13.48	10.07	7.795	3.203	3.370
LT/SN/KM^2	1.23	1.64	3.17	1.50	1.81	9.68	9.82	6.87	5.13	3.97	1.63	1.72
AKIM,MM.	3.30	4.26	8.50	4.02	4.53	25.9	25.4	18.4	13.3	10.6	4.37	4.45
10^6 M^3 AKIM	6.48	8.36	16.7	7.90	8.89	50.9	49.9	36.1	26.1	20.9	8.58	8.73

SU YILI (1972) YILLIK TOPLAM AKIM, 249.5 MILYON M^3, 127. M.M , 4.02 LT/SN/KM^2.

(*) AKIM OLCUSUNUN YAPILDIGI GUNLERI GOSTERIR.