

## **CHAPTER 13 ENVIRONMENT IMPACT AND COMPENSATION**

## CONTENTS

### CHAPTER 13 ENVIRONMENT IMPACT AND COMPENSATION

	Page
13.1 Purpose of the Project.....	13-1
13.2 Location of the Project Site .....	13-1
13.3 Economic and Social Dimensions of the Project .....	13-1
13.3.1 Investment Program and Financial Resources.....	13-1
13.3.2 Work Schedule.....	13-1
13.3.3 Economic Analysis .....	13-2
13.3.4 Economical Social and Infrastructure Activities.....	13-2
13.3.5 Other Required Activities .....	13-2
13.3.6 Land Acquisition and Resettlement.....	13-3
13.4 Environmental Characteristics of the Project Site.....	13-3
13.4.1 Physical and Biological Environments and Utilization of Natural Resources .....	13-3
13.4.2 Characteristics of Socio-Economic Environment.....	13-17
13.5 Impacts of the Project on Environment and Countermeasure .....	13-23
13.5.1 Activities during Land Preparation, Construction and Installation Stages, Impacts on Physical and Biological Environment and Countermeasure.....	13-23
13.5.2 Activities in the Operation Phase, Impacts on the Physical and Biological Environment and Countermeasure .....	13-28
13.5.3 Effects of the Project on the Socio-Economic Environment.....	13-37
13.6 Effects which May Occur or Continue After the Enterprise.....	13-42
13.7 Alternative of the Project.....	13-42
13.8 Conclusion .....	13-44

## List of Figures

- Figure 13-1 Location of Temporary Facilities
- Figure 13-2 Location of Project Site
- Figure 13-3 Geological Plan of Bayram Dam Site
- Figure 13-4 Geological Plan of Bađlık Dam Site
- Figure 13-5 Soil Distribution
- Figure 13-6 River Water Utilization Plan of Berta River System and Pollution Sources
- Figure 13-7 Location of Trout Existing Area and Protection Area
- Figure 13-8 Land Utilization and Vegetational Condition
- Figure 13-9 Scenery of Bayram Dam Site
- Figure 13-10 Scenery of Bađlık Dam Site
- Figure 13-11 Administrative Boundary
- Figure 13-12 Labor Distribution and Production in Artvin Province(1985)
- Figure 13-13 Transportation Route
- Figure 13-14 Transmission Route
- Figure 13-15 Probability Distribution of Nutrition Level
- Figure 13-16 Vertical Distribution of Water Temperature at Tortum Lake in Summer
- Figure 13-17 Water Temperature of Berta River ( Observation Term: 1990-1994)
- Figure 13-18 Water Temperature Change obtained by Model Simulation
- Figure 13-19 Future Scenery of Bayram Dam Site
- Figure 13-20 Future Scenery of Bađlık Dam Site

## List of Tables

Table 13-1	Project Items
Table 13-2	Construction Schedule
Table 13-3	Land Expropriation and Relocation Cost
Table 13-4	Monthly Mean Air Temperature
Table 13-5	Monthly Precipitation
Table 13-6	Monthly Snow Depth
Table 13-7	Wind Velocity and Direction
Table 13-8	Monthly Humidity
Table 13-9	Agricultural Area in Artvin Province
Table 13-10	Water Flow Rate at Bayram Dam Site
Table 13-11	Water Flow Rate at Bağlık Dam Site
Table 13-12	Water Quality of Berta River (November)
Table 13-13	Local Irrigation Activity
Table 13-14	Fish living in Berta River System
Table 13-15	Animals Living in Artvin Region
Table 13-16	Trend on Population and Agricultural Area at Upstream Area
Table 13-17	Movement of Residents at Several Villages
Table 13-18	Land Utilization in Artvin Province
Table 13-19	Some Agricultural Income of Artvin Province
Table 13-20	Income and Employment
Table 13-21	Main Civil Works of Bayram Project
Table 13-22	Main Civil Works of Bağlık Project
Table 13-23	Excavation Works and Waste Soil Disposal Area
Table 13-24	Machinery and Equipment
Table 13-25	Air Temperature and Humidity at Artvin and Şavşat
Table 13-26	Equation and Parameters to be used in Prediction of Water Temperature
Table 13-27	Some Limitations on Water Temperature for Carp (Cyprinus Carpio)
Table 13-28	Value of Parameter to be used in Estimation of Water Temperature
Table 13-29	Estimated Monthly Mean Discharge between Bayram and Kaledüzu Dam Site
Table 13-30	Estimated Monthly Mean Discharge between Bağlık Dam Site and G.S. No.2334

Table 13-31	Reservoir Operation of Bayram Project
Table 13-32	Reservoir Operation of Bađlık Project
Table 13-33	Content of Expropriation for Dam-Reservoir Area on Bayram Project
Table 13-34	Land Expropriation Value for Dam-Reservoir Area on Bayram Project
Table 13-35	Land Expropriation Value for Dam-Reservoir Area on Bađlık Project
Table 13-36	Content of Expropriation of Borrow and Waste Soil Dumping Site
Table 13-37	Land Expropriation Value and Net Income Losses
Table 13-38	Relocation and Improvement Cost for Public Facilities
Table 13-39	Environmental Preservation Measures

## **CHAPTER 13 ENVIRONMENT IMPACT AND COMPENSATION**

### **13.1 Purpose of the Project**

The purpose of the present project is to construct the two stage hydraulic power plants of 68 MW and 59 MW maximum respectively at Bayram and Bağlık sites in Berta River which is one branch of Çoruh River water system.

Table 13-1 shows various project items of this project and Figure 13-1 shows the layout of planned facilities.

### **13.2 Location of the Project Site**

The project sites exist in Artvin Province in the Eastern Black Sea region of Turkey, and the Bayram hydraulic power project site is located at the valley area of V-letter shape which is about 32 km upstream from the conflux point of Çoruh River and Berta River. Bağlık electric power project site is located at the point of about 10 km down stream of Bayram electric power generation site (Figure 13-2).

### **13.3 Economic and Social Dimensions of the Project**

#### **13.3.1 Investment Program and Financial Resources**

The fund requirement for construction of the Project is estimated to be a total of approximately  $251.5 \times 10^6$  US\$ in the price of 1996.

#### **13.3.2 Work Schedule**

Work schedule is shown in Table 13-2.

### **13.3.3 Economic Analysis**

According to the economic evaluation on total value of Bayram Project and Bađlık Project is 12.0% for FIRR and 1.21 for Benefit-Cost Ratio (Financial).

### **13.3.4 Economical Social and Infrastructure Activities**

There are no other economic, social and infrastructure activities which are not within the Project but related with the Project.

### **13.3.5 Other Required Activities**

Necessary activities, which shall be implemented by the other public institutions are listed as below.

- Resettlement of villagers is cooperated with the Ministry of Village Affairs and Project Owner.
- D965 Highway, which will be submerged by the project, is to be relocated or improved by the General Directorate of State Highways.
- The transmission cable of 26km which is to be immersed in the water will be relocated to the alternative route by the Turkish Electricity Distribution Co.
- The telephone line 26km which is to be immersed in the water will be relocated to the alternative route by the Turkish Telecommunication Co.(Türk Telecom).
- One primary school, mosque, police station, road maintenance building which are located in Bayram village and Okçular village which will be immersed in the water will be relocated to the other locations by the Ministry of Village Affair, the Ministry of Education, TCK and the owner of the Project, relating to the construction of this Project. In addition, a small army station locating at Okçular village will be relocated by the army.
- The service of buses being utilized by the inhabitant will be changed to an alternative route.

### **13.3.6 Land Acquisition and Resettlement**

Agricultural and dwelling area 349.2 da will be expropriated and 133 buildings, including private houses and public structures will be relocated.

Total cost to be needed is  $21.3 \times 10^6$  US\$ in 1996 price (Table 13-3).

## **13.4 Environmental Characteristics of the Project Site**

### **13.4.1 Physical and Biological Environments and Utilization of Natural Resources**

#### **(1) Climate and Meteorology**

##### **(a) Climate**

The downstream zone of Çoruh River belongs to the East Black Sea climate, and the annual rainfall volume exceeds the level of 2,000 mm. The upper stream zone belongs to inland climate, and it is cold in the winter and severely hot in the summer.

Berta River basin area is included in the inland climate usually seen in areas away from the sea effect but is also equipped with the special features of East Black Sea climate. The average altitude of Berta Basin is 1,800 m.

##### **(b) Meteorology**

According to Şavşat Meteorological Observation Station at the altitude of 1,100 m, the annual average atmospheric temperature of 9.9°C, with its minimum record being -19.9°C and maximum record being 38.8°C. Table 13-4 shows the secular change of monthly average atmospheric temperatures.

The monthly rainfall volume is much from March to May in Şavşat, and much from December to February in Artvin (Table 13-5). Further, the snowfall record of 125 cm was recorded in December in Şavşat (Table 13-6). Table 13-7 shows the most numerous appearance wind direction by every month and also shows the value of average wind velocity, and Table 13-8 shows the relative humidity.



(2) Geological Characteristics.

(a) Topology

The area surrounding the project site consists of mountainous districts with the altitude being from 2,000 to 3,000 m, and the north side of Berta River basin area is in touch with the country boundary of the Republic of Georgia.

A great number of steep mountain slopes with their altitude being from 1,000 to 2,000 m exists inside the basin area. Out of the project spots, Bayram site is located approximately 2.5 km downstream at the conflux of the Şavşat River and Meydancık River, but the valleys by erosion in the downstream side hold the typical-sharp patterns. The width of valleys becomes narrower toward the Bayram site and moreover toward its downstream side from the conflux point, and from the area passing the Bağlık project site, the river stream becomes slower and the width of river becomes wider and flows together with the Köprüler River.

The project site is inside the valleys covered with rough rocks and a slight degree of shrubs, and is not the topology which is precious and needs to be projected in scientific aspect.

Moreover, the slope area facing the Berta River in Savail Village on the left bank in the Bayram district in the downstream side at the spot where Şavşat River flows together with Meydancık River has the topology formed by the landslide, but there are no outstanding landslide topology at other spots.

(b) Geology

Berta River basin area is the area subjected to the Carboniferous Hercynian Orogeny in Paleozoic time and to the Alpine Orogeny from Mesozoic time to Cenozoic time. The distributed geology is the Quaternary period deposited substances, the Berta of Cretaceous age, the Yusufeli Formation of Jurassic age, and the İkidere granite rocks penetrating into both the layers. Out of them, the geological structure other than the Quaternary period deposited substances is in the unconformity.

(i) Bayram Site

The river bed area of dam site is covered by the river deposited substance of about 33 m maximum, but the river width is about 100 m, and both the banks are sharp slopes from 30°

to 50°. There hardly exists any surface soil on both the slope banks, and the bedrock is exposed. This bedrock consists of the Berta Formation of igneous rocks, basalt and tuff. These are comparatively hard rocks but the surface is slightly weathered though the providence has developed. No special dislocation nor landslide are recognized at this dam site. The ground-water level at this site is low as a whole.

The Berta Formation is mainly distributed on the basis around the reservoir, but the deposited substances are distributed in the form of covering the said formation. The basis of reservoir is in the Berta Formation, and there is no distribution of lime stones (Figure 13-3).

#### (ii) Bağlık Site

The geology of dam site mainly consists of sandy hornfels of the Yusufeli Formation.

The river bed area of this site is covered by the river deposited substances, but the bedrock is exposed to both the banks. The bedrock is hard but the development of providence can be seen. No dislocation nor land slide are found in this site. The ground-water level is at a slightly lower place.

The bedrock of the reservoir consists of the Yusufeli Formation and the Berta Formation, and the distribution of river bed deposited substances covering this is less. There is no unstable place to the slopes of this site, there is no possibility for the appearance of land slide, and there is no geology which is precious and should be protected in scientific aspect (Fig. 13-4).

#### (3) Hydrologic Geology Characteristics

There is no underground water utilization at the project site. The water from springs is used for the inhabitants' potable water and the supply of living water. The underground water utilization to the industry doesn't exist in this area.

#### (4) Soil Characteristics and Utilization

##### (a) Peripheral Area

The soils being distributed in the Şavşat country are mainly the non-calcarious brown forest soil and the brown forest soil. The pH of soil is higher than 7.5 in almost all of this area, but

the soils whose pH is lower than 6.5 also exist spatteringly. The degree of erosion is in the area from middle to high.

(b) Project Area

(i) Bayram Site

The soil being distributed in this spot is the non calcareous brown forest soil, and its thick area is from 50 to 90 cm, but there is a small scale irrigation farm land in the soil area along Berta River (Figure 13-5).

There is the soil being utilized to the dry farming in Çayağzı Village, Üzümlü Village and Savail Village on the left bank of Berta River, but they are not the soil in the class important to the agriculture.

Agricultural lands are distributed in Eskikale Village in high altitudes. On the other hand, soils having low PH are distributed in the form crossing the Berta River in this spot. The degree of erosion belongs to the middle class.

(ii) Bağlık Site

The calcareous soil is distributed in this spot. The thickness of soil is from 20 to 50 cm, is covered by the poor and low tall scarce shrubs, and no distribution of soil important to the agriculture can be seen. In addition, soils having low PH does not exist in this area. Most of the lands have high degree of erosion (Figure 13-5).

(5) Agricultural Area

(a) Peripheral Area

According to the statistics in 1990, the agricultural land area where the seeds are sown in Artvin Province is 168,350 da, where the wheat occupies the area of 36 %, the corn 26 %, the barley 15 % and then the potatoes 10 %. The product highest in the productivity is the potatoes and accounts for 1,001 kg/da (Table 13-9). These agricultural product kinds don't greatly differ from the other provinces in Turkey.

The main field crops are the rice, beans, sugar beet, Egypt beans, lens beans, broad beans, alfalfa, etc.

(b) Project Area

(i) Bayram Site

The land of dam and water reservoir of project is the land where the dry farming is being done, which is classified into 4 of irrigated lands (ST 1, 2), non-irrigated lands (KTT 2, 3), orchard cultivation yard (MbK) and non-utilized land (KT). Crops to be produced in these lands are shown below. Among these lands, there are no agriculturally important fields and products are common.

	Kind	Area (da)	Crops	
ST	class 1	15.5	Wheat,	Corn, Tomato, Beam
	2	90.65	Wheat,	Corn, Tomato, Beans
	3	72.85	Wheat,	Corn, Tomato, Beans
KTT	2	9.1	Wheat,	Barley
KTT	3	2.3	Wheat,	Barley
KT	3	43.1	Wheat,	Barley
MbK		10.3	Apricot, Cherry, Fig	
	Total	243.9		

(Source: Çoruh Berta, Bağlık and Bayram Dam Nationalization Value Report, EIE, 1996)

(ii) Bağlık Site

No agricultural area exists in this project area.

(6) Hydrological Characteristics

(a) Flow Rate

Berta River basin area is 2,315 km<sup>2</sup>, is positioned at the north east portion of Çoruh water system and occupies 12% of the Çoruh River basin area.

Berta River consists of three typical branches of Şavşat, Meydancık and Ardanuç with their basin areas being 580.1, 577.3 and 572.0 km<sup>2</sup> respectively.

Meydancık River is located at the north east portion of Berta basin, flows to the south east direction, changes its flow to the south west after its conflux with Şavşat River flowing from the east, and becomes a rapid current having the slope of 1/100.

According to the flow rate data (Table 13-10) obtained at the Bayram dam site from 1942 to 1994, the minimum value on monthly mean discharge is from 3.3 to 23.5 m<sup>3</sup>/sec, and the least value appears in September. On the other hand, in the Bağlık dam site, the least value is from 4.5 to 30.1 m<sup>3</sup>/sec (Table 3-11), and the minimum value appears in September in the same manner. Moreover, the similar situations can be seen also in August.

(b) Probable Flood

According to G.S. No. 2327 observation data, the probable floods at Bayram and Bağlık sites can be obtained as follow (Source; Main feasibility report of Çoruh-Berta Hydroelectric power Development Project, 1997).

	Cycle (year)						(Unit: m <sup>3</sup> /sec)
	2	5	10	25	50	100	
Bayram site	138.2	195.7	233.6	281.6	317.0	352.0	
Bağlık site	179.9	254.7	304.0	366.5	413.0	459.0	

(c) Sedimentation

According to the suspended load and the outflow water rate data at G.S. No. 2327 observation station, the annual average suspended sediment volume up to the year of 1994 is estimated to be 219 ton/km<sup>2</sup>. The bed load is estimated to be 20 % of the suspended load.

(d) Water Quality

According to the survey at the project site, the water of Şavşat River which is one branch of Berta River is relatively clean though containing silt. However, it has the tendency for its turbidity to get increased suddenly by the rain fall.

Meydancık river flowing together with Berta River at Okçular Village indicates the similar situation.

Berta River downstream side from Okçular Village is located at the middle point to Bağlık site.

This river consists of a shallow stream up to the area near Çiftehanlar Village. The river width downstream side from this site becomes narrow and changes to a rapid current. After flowing together with Ardanuç River, the water color changes to brown.

According to the visual observation of Berta River, no outstanding organic pollution can be recognized, and the depth of water varies everywhere with the structure of river bottoms.

According to the result (Figure. 13-6, Table 13-12) of water quality investigation, the water quality falls under water class (I) of inland water source, but the total phosphor (T-P) belongs to class (III). The influence of Şavşat Town appears to the water quality upstream side of project spot, and is worse relatively than the downstream side water quality, but the clean water quality is generally maintained in the river of project by the decomposition and dilution involved in the flowing-down.

#### (7) Surface Water and its Utilization

##### (a) Berta River

According to the master plan of hydraulic power development in Berta River basin area, there are Şavşat and Meydancık power projects (Figure 13-6) beside the present projects. However, there is no plan of utilizing the river water to the agriculture. The trout cultivation is being done in the upstream basin area of Meydancık River which is a branch of Berta River and also in Karçal River, but there is no fishery in the Berta main river.

(b) Project Area

(i) Bayram Site

There are several water turbine cots for powder making and several small scale irrigation facilities in the water reservoir planned spots downstream side from Okçular Village. This irrigation is for the cultivation of corn and pasture and the water of 30 m<sup>3</sup>/da (6 m<sup>3</sup>/day) is consumed in the season carrying out the agriculture in the land of 120 da, but there is no utilization of water other than this (Table 13-13).

The spring water is used as the inhabitants' potable water, and the river water is generally utilized for agricultural purposes, but it is not utilized for the supply of drinking water demands.

(ii) Bağlık Site

Some extremely small scale agricultural lands exist partially in the area along the river between Bayram site and Bağlık site, but there is no agricultural land in Bağlık site and its downstream basin area because they are of sharp topology, and the river water is not utilized.

(8) Aquatic Organisms

The fish whose living are reported in Berta River water system are 17 kinds of 4 families as shown in Table 13-14, and out of them there are two kinds of trout family, namely Salmo trutta labrax and Salmo trutta macrostigma. 12 kinds are included in the carp family and 2 kinds are included in the loach family.

According to the hearing survey to the inhabitants, the living of carp can be found in the main Berta River, but no living of trout can be found, and the living of trout is reported only in the area higher than 800 m in altitude. (Figure 13-7)

(9) Thermal and Geo-thermal Water Resources

There are no thermal and geo-thermal water resources at the project sites.

(10) Protected Area

There are one natural park and the protected block of wild cock near this area (Figure 13-7), but both the project sites are not included in these areas.

(11) Forest Area

According to the vegetation map (Figure 13-8) along Berta River with the Bayram and Bağlık sites as its center, the vegetation is extremely poor, and some species such as Quercus cocelfera, Picea sp., Abies sp., etc. are distributed but there is no vegetation that can be called as a forest.

(12) Fauna and Flora

(a) Fauna

(i) Periphery Area

The animals reported in Artvin Province are those as listed in Table 13-15.

(ii) Project Sites

According to the hearing survey at the project area, Wild goad, Wild pig, Jackal, Bear, Fox, Lynx, Wolf, Badger, European rabbit, Otter, Tree pine mertin, Rock pine martin, Weasel, Squirrel and Rock pigeon live in these locations.

(b) Flora

(i) Periphery Area

This area including the project sites is in the plant distribution area called Euxine cholchis and Irano-Tutaian. The climate in the Eastern Black Sea is featured with the much rain volume and high humidity, and the plant phase is relatively rich and high in density.



The typical plant phase in this area covers Picea orientalis, Abies nordmanniana, Acer trautvetteri, Acer capodocium, Fagus orientalis, Alnus glutinosa, Castanea sativa, Laurocerasus officinalis, Buxus sempervirens, Corylus avellana, Rhododendron sp., Lonicera caucasica, Sambucus nigra, Vaccinium arctostaphylos, etc.

The plant phase in Çoruh Valley can be classified into three of forest block, high-mountain step block and shrub block, but the major plants cover Acer divergens, Acer divergens var. trilobum, Arbutus andrachne, Caragana grandiflora, Cerasus prostrata, Capparis spinosa var. spinosa, Colutea cilicica, Cotinus coggygria, Ephedra major, Euphorbia macroclada, Inula helenium, Juniperus oxycedrus, Juniperus excelsa, Laurus nobilis, Lonicera caucasica, Melica ciliata, Ostrya carpinifolia, Paliurus spina-christi, Pistacia terebinthes sub sp. plaestina, Punica granatum, Quercus macranthera sub sp., Quercus petraea sub sp. iberica, Phagnalon pallasii, Rhus coriaria, Rosa elymaitica, Rosa pisiformis, Sedum spurium and the like.

The inherent species in this area are in the following areas :

<u>Quercus macranthera sub sp. sypriensis</u> :	Ispir.
<u>Rosa elymaitica</u> :	Artvin-Yusufeli.
<u>Lonicera caucasica</u> :	Ispir Çamlıkaya-Yavuzlar
<u>Alyssum artvinense</u> :	Çoruh Valley
<u>Rhododendron ungerii</u> :	Borçka

The rare species are listed below :

<u>Acer divergens var. trilobum</u> :	Çamlıkaya.
<u>Sempervivum minus var. minus</u> :	Bayburt, Çoruh-Darica.
<u>Iris teochia</u> :	Ispir, Çamlıkaya -Yavuzlar Mah.
<u>Ballota rotundifolia</u> :	Ispir, Maden-Köprübaşı.
<u>Allium flavum sub sp. tauricum var. tauricum</u> :	Ispir, Ardıçlı-Küçüköl.
<u>Linaria genistifolia sub sp. artvinense</u> :	Artvin, Yusufeli-Yaylalar.

(ii) Project Areas

1) Bayram site

According to the topology map, the Bayram site is included in a part of forest area. However, there is no forest in the project site.

On the other hand, the forest consisting of fir and pine trees is distributed at the area close to ayaęzı and Savail Villages which are high in altitude. The forest limit line is in this area and at the altitude of about 1,500 m.

There is no forest at the dam site and the water reservoir planned site, and the scarce distribution of low tall shrubs can only be seen.

According to the plant investigation, the distribution of the colony which is one of cyclamens can be seen at the area higher than 750 m in altitude on the right bank slope of Okular Village. Project site is not being covered by natural vegetation. The plant phase at the planned water reservoir is similar to the dam spot.

2) Baęlık site

No forest exists in the dam and water reservoir similar to the Bayram site. According to the result of plant survey, the distribution of cyclamen can be seen at the area closer to the spot of 440 m in altitude in the upstream side of Baęlık dam site. The plant phase at the water reservoir planned spot is analogous to that of dam site. This site is also not covered by natural vegetation.

(13) Stock Raising

(a) Peripheral Area

The kinds and quantity of livestock being fed in Artvin Province are as follows : 109,098 cows, 172,990 sheep, 2,680 horses, 2,240 donkeys, 770 mules, 642 buffaloes (1990).

(b) Project Area

The inhabitants are feeding the livestock around the project area, and the kinds and quantity are as follows.

These livestock animals are utilized for the inhabitants' milk and meat :

Kind	Çayağzı Village	Üzümlü Village	Eskikale Village
Cow	142	199	697
Donkey, horse	5	4	38
Sheep	60	650	186
(Livestock)	(94)	(173)	(678)

(Source of information; Artvin Province Village Affairs Bureau, Animal Information Office, 1996)

(14) Mines and Fossil Fuel Resources

There exist no ore under management nor the underground buried resources at the project area.

(15) Area with High Leadscape Value and Recreational Area

(a) Landscape

The rules relating to the environment in Turkey has no items concerning the landscape, but the spots which are said to have the excellent landscape and the recreation spots in Artvin province are as follows :

- Protected area : Kafkasar, Mervesan, Hatila Dere, Karagöl, Tavzet and Boğa, Altıparmak creek and mountain.
- National park : Söğüllüeflar (Şavşat district), Karagöl (Şavşat district).
- Hunting protection area : Balıklı (Şavşat district).
- Camping, Pknic area : Kafkasar, Mervesan, Hatila Dere, Karagöl, Şavşat yöresinde bulunan karagöl, Tavezet and Böga Göllerin, İlica Köyünde.

The landscape element at the project sites are the sharp cliffs and poor vegetation on both the banks of Şavşat River, the exposed rocks (Figure 13-9, Figure 13-10), and these landscape have no special features and are generally found widely in this province.

(b) Relics and Sight seeing Objects

According to the Ministry of Culture (1994), the following relics are listed up in Şavşat District where the project site exist.

Şavşat district :	Dullu village :	Civarhisar castle.
	Cevizli village :	Tibeti church, Sastel castle
	Meydancık village :	Parih castle
	Köprülü village :	Köprülü mosque
	Sögütlü village :	Mosque

The following outline is grasped in the vicinity of the project spots.

(i) Bayram Site

The relics nearest to this spot is the castle on the cliff climbing the slope from Okçular Village and is not included in the water reservoir. Further, there is no sight seeing object in this spot.

(ii) Bağlık Site

There is no sight seeing object in this spot, and there is no relics to be protected in the water immersion spot.

(16) Land Under Control and Responsibility of Athorized Governmental Agencies

The project area is not included in the land which is to be limited by the laws.

(17) Pollution Load

(a) Water Quality Contamination

The municipal waste water is drained off and the solid wastes are casted in the suburbs of Şavşat Town (Figure 13-6). The use of chemical fertilizer is not common in this area. Agricultural and the compost type fertilizer occupy the general trend. In addition, there is no plan for industrialization and city developments. Moreover, in the upstream side area of project site, the reduction of population and the reduction of agricultural land (Table 13-17) are happening, and there is no agricultural promotion plan. Waster quality of Berta River is shown in Table 13-12. Following load was obtained by field survey carried out in November of 1997.  $\text{NO}_2$ ,  $\text{NO}_3$  and  $\text{NH}_4$  were measured as inorganic nitrogen compounds.

	T-P (kg/day)	TIN (kg/day)
Bayram dam site	21.3	266
Bağlık dam site	58.8	337

As clearly known from this result, the T-P and TIN at Bağlık dam site is high as 2.8 times and 1.3 times respectively as that of Bayram dam spot. The increase of water volume in this block is 1.6 times, and there is no artificial corruption source in this block, and the fresh valley water alone flows into the river.

(b) Air Pollution

There is no atmospheric pollution source at the project sites.

(c) Noise and Vibration

There are no noise and vibration sources at the project sites.

(d) Soil Contamination

The general soil contamination problems can be imagined at the waste discarding spots in Şavşat Town, but no contamination can be recognized at the project sites.

### 13.4.2 Characteristics of Soclo-Economic Environment

#### (1) Population

##### (a) Periphery area

Figure 13-11 shows the administration block in the area comprehending the project spots. The district where the project sites are located is the Şavşat District and Ardanuç District of Artvin Province, but the colony near the water reservoir in the project is included in the Şavşat District.

The population in the entire Artvin Province and in the counties building up the province is as shown below. The population in Artvin Province is in the decreasing trend since 1980.

The population increase percentage according to the population comparison in 1990 with that of 1985 is minus 12.3 %, and this province enters the area where the population decrease is greater in Turkey. In the statistics in 1980, the outflow to the foreign countries is 26 % and the inflow into Turkey is 16.7 % against the population decrease volume in entire Artvin Province and the reason of population decrease is mainly economic. Further, the population increase percentage in the rural zones proves to be minus 22% on the average, while the percentage at the urban areas of each county proves to be 11%. This indicates the concentration in the urban area is another reason. This indicates the concentration in the urban area is another reason. The number of family members per household in Artvin Province is between 4 - 6 persons, which occupies about 50 % of the entire households.

	District Total	City Pop.	Village Pop.	Area (km <sup>2</sup> )	Density
Artvin P.	212,833	66,079	146,736	7,346	29
A. center	33,183	20,306	12,877		
Ardanuç	17,782	5,052	12,730		
Arhavi	18,351	10,048	8,303		
Borçka	30,329	6,102	24,227		
Hopa	30,862	11,507	19,355		
Murgul	11,951	4,728	7,673		
Şavşat	33,315	4,850	28,465		
Yusufeli	37,060	3,954	33,106		

(Source of information; Census of Population: 1990)

(b) Project Area

(i) Bayram Site

Many of village communities in the project area are the colonies called Mahalle. According to the survey result concerning the population (Table 13-18)

Bayram Village alone is the village where the population increases in the winter season.

(ii) Bađlık Site

There are villages around the Bađlık site, but their populations are quite small. There is no population change between the winter season and the summer season as the inhabitants of Bađlık Village.

(2) Economical Characteristics.

(a) Peripheral Area

The major industries in Artvin Province are the ore, forestry, industry, agriculture and commerce. The copper ore industry builds up the trunk of province industry. The forestry industry is one of important industries, the production for industry or fuel is limited but the production of logs as the timber such as plate is being done. The industry depends on the mining of copper, and the others cover the lumbering, wooden industry, tea manufacture, foodstuff industry, metal industry, repair industry of automobiles and machines.

The agriculture is important to Artvin Province, and many inhabitants are engaged in this industry, but the income amount is smaller than the other industries. The main agricultural products cover the tea, potato, wheat, apple, corn, grape, western country pear, cherry, hazel nut, olive, peach, orange, etc. These fruits can be harvested. According to the statistics in 1988, the tea that can be harvested in Artvin Province accounts for about 9 % the total tea production volume in Turkey.

The modern livestock industry has not yet been developed, and the cows and sheep are mainly fed but the sales channel of livestock product is small.

The commerce doesn't occupy the important position to the province economy, and the products can not be exported but takes the self consumption type posture. Hopa Port which

is located on the west coast of Artvin Province is used for exporting the copper, timbers, wooden products and sulfuric acid. The structure of major industries in Şavşat County of Artvin Province is as listed below, which consists of 3 kinds of the agriculture or cultivation, livestock industry and service industry (Census of Population: 1990).

Type of Industry	Number of villages (Total 63)	
	First indust.	Second Indust.
Agriculture (farming)	2	16
Fruit production	0	0
Vegetable production	0	0
Animal breeding	25	37
Water products	0	0
Mining	0	0
Handcrafts	0	0
Forestry	0	0
Worker	36	10

According to the census in 1990, the labor population in Artvin Province is 112,974 persons, out of which 74 % is the agriculture, being followed by 15 % for service industry, 6 % for industry, 3 % for commerce and 2 % for construction.

The production amount proves to be 105 billion TL in total according to the statistics in 1986, out of which the service industry accounts for 38 %, being followed by 29 % for agriculture and 22 % for industry (Figure 13-12).

The Şavşat District occupies 22 % of the entire cultivation area (3,730,115 da) in Artvin Province, and its area is in the order of forest, bush land, pasture, dry agriculture area and meadow, and the irrigated field occupies only 2 % of the cultivated area in Şavşat District.

(b) Project Area

(i) Bayram Site

Each village of Eskikake, Üzümlü and Çayağzı located close to the project site has the agriculture as its main industry, but its scale is small. The agriculture percentage against all the activities in the village is as listed below.



Village	Area(da)	Agricultural activities	Percentage
Eskikale	2,211	Maize, fruits, orchard, animal	70 - 75%
Üzümlü	1,150	Maize, animal food, vineyard	70
Çayağzı	329	Vineyard, etc.	80

(Source of Information; Artvin Directorate of Agriculture, 1996)

There is no activity called an industry in this area, and the major economical activities are the small scale agriculture and livestock, and the main products are wheat, corn, tomato and beans which become the inhabitants' foodstuff but the extra products become the source for cash income.

The gravel is collected inside the Bayram water reservoir planned site, and there is the lumber yard facing National Road No. 965 in Çiftehanlar Village, where the lumber is temporarily stored and is transported.

(ii) Bağlık Site

The industries in this spot are the agriculture and livestock, and the wheat, tomato and apricot are cultivated. Yogurt can be obtained as the livestock product.

The agriculture depends on the human force and livestock force. There is no activity called as industry.

(3) Local Social Infrastructure Services

(a) Bayram Site

According to the distribution of traffic routes in the periphery of project area, National Road No. 965 is an important road and passes to Trabzon City which is a port town at National Road No. 10 after passing through Ardahan close to the national boundary and Artvin City which is the metropolitan in this province and moreover through Hopa which is a port town along the Black Sea via National Road No. 950.

There are many passages of material transportation trucks and passenger boarding long distance busses together with the local inhabitants' traffic via National Road No. 10 and No. 950 to Artvin City. National Road No. 965 is a pavement road with one lane on one side, and is used as the road for local inhabitants' traffic to Şavşat town, etc., the movement of

trucks or the truck transportation. This road is new, and the old road runs through the mountain's breast of cliff on the right bank of dam spot and passes to Şavşat Town after running over a mountain. This road partially becomes the traffic road of small size busses being utilized by the local inhabitants but is not paved and has only one lane.

There is Okçular Village of Mahalle in the Bayram dam and water reservoir planned area out of the project spots, which is to be completely immersed into the water. A part of Bayram Village is also included in the area which is immersed into the water.

The following public facilities are reported to be within the water immersed planned area of Bayram project, but no clinical facility is included; One primary school, one lodge of primary school, one mosque, four stores, one police station, one road maintenance building, one store, 21.8 km of road, 6 km of transmission cable, 6 km of telephone line.

(b) Bağlık Site

There exist no colonies in this site. The roads, transmission cables and telephone line which are to be immersed into the water are as follows :

Road	:	13.7 km
Transmission cable	:	20 km
Telephone line	:	20 km

(4) Land Utilization

(a) Peripheral Area

Table 3-19 shows the land utilization situations in Artvin Province. The agricultural area occupies 71 % of the entire area. In Şavşat District occupies 75% as agricultural area. On the other hand, the land utilization areas as the forest are in the structure of 31% and 27% respectively.

(b) Project Area

According to the map (Figure 13-8) showing the land utilization of project area, its main body is the land where a slight degree of shrubs destructed by the strength are distributed, and this land is also structured of the river, its periphery naked land and unused wasteland.

(5) Income

The income (1994) that can be obtained by the cultivation of agricultural products in the agricultural villages in Artvin Province is reported as given in Table 13-20.

According to the hearing survey result, the income by agriculture of a certain inhabitant is 6 million TL/month, and it is said that there is no cash income in the farming house which is performing a domestic supply.

According to the result of investigation the income situation at 9 villages in the project spots, the income ranges from 5 million to 10 million TL/month (Table 13-20), and the major source resides in the agriculture including the live-stock farming.

(6) Unemployment

According to the hearing survey at the project area, the percentage of unemployed persons ranges from 20 to 75 % of the population in each village (Table 13-20).

(7) Sanitation and Hygiene

There is no endemic diseases in which the water is involved in the project area. Further, the clinical facility is located at the central city of county, and the inhabitants in the project area utilize the said facility.

### **13.5 Impacts of the Project on Environment and Countermeasure**

#### **13.5.1 Activities during Land Preparation, Construction and Installation Stages, Impacts on Physical and Biological Environment and Countermeasure**

##### **(1) Facilities to be planned, Location and Amount of Excavation Works**

###### **(a) Facilities**

Table 13-21 shows Main Civil Works of Bayram Project and Table 13-22 shows Bağlık Project.

###### **(b) Construction Period**

Table 13-2 shows the construction work schedules.

###### **(c) Excavation Works**

Figure 13-1 shows the topological change spot by the excavation, etc. together with the facility projects.

The excavation of ground is planned for the construction of Bayram and Bağlık dams and ancillary facilities. The aggregate collection spot is mainly to be excavated, but the excavation is being conducted in the form of crossing the river at both the dam spots for ground levelling of dam basis.

The water to be used for electricity generation is to be transported to the Bağlık water reservoir through the underground tunnel of about 8.0 km via the underground power generation plant from the Bayram dam, and moreover be transported and returned to Berta River via the underground power generation planned from Bağlık dam and via the underground tunnel of about 4.5 km, so the tunnel of about 12.5 km in total is to be excavated.

Table 13-23 shows the area of excavation area and the excavation volume.

###### **(d) Equipment and Materials to be used**

Table 13-24 shows the major equipment and materials to be used. The amount of explosion powder to be used for the excavation is about 500kg per every day, but needs to be shrunk

as much as possible. Moreover, the blasting during the night and the continuous blasting are not planned. The noise and vibrations being caused from the blasting/excavation works and the equipment/materials to be used are controlled by the concerned rules, and the work during the night is extremely limited.

(2) Utilization and Discard of Aggregates

The kinds of aggregate to be used are the rocks, gravel and clay. The materials collected from the places shown in Figure 13-1 and Table 13-23 are utilized for construction, but the extra materials are discarded at the spots shown in Figure 13-1 and Table 13-23. The stability of basis is secured by the slope control and water drain countermeasure at the discarded area.

(3) Excavation in Water Environment

The direct excavation plan in water environment is not included in the present work project. The construction work needs to have the material stock yard to be used for temporary stock yard which is required at the work and also the flat land for the facility construction. Because this area is the spot extremely least in the flat land, the excavation debris at the collection of aggregates is utilized as the materials for reclamation at river bank. The reclamation of minimum area required flat land is conducted at the places shown in Figure 13-1 and Table 13-23. Its area is 360,000 m<sup>2</sup>, which is presently the river bank site and the river bank wasteland. The collapse of slope is to be prevented by the blasting method for the river bank site which has been reclaimed according to the enforcement of project.

Disposal Area Name	Area to be filled	
	Area (m <sup>2</sup> )	Volume (m <sup>3</sup> )
D1	160,000	2,800,000
D2	60,000	1,100,000
D4	50,000	900,000
D5	30,000	500,000
D7	40,000	400,000
D9	20,000	200,000
Total	360,000	5,900,000

(4) Sand, Rocks, Clay and Cement being used in the Works

410,000m<sup>3</sup> sand, 817,000m<sup>3</sup> gravel, 868,000m<sup>3</sup> clay, 4,476,000m<sup>3</sup> rock and 122,000 ton cement will be used in construction works of project facility.

		<u>Bayram Project</u>	<u>Bağlık Project</u>	<u>Total</u>
<b>Concrete Material</b>				
Cement	(t)	59,500	62,000	121,500
Sand	(m <sup>3</sup> )	56,600	81,400	138,000
Gravel	(m <sup>3</sup> )	97,000	187,700	284,700
<b>Rockfill Dam Material (Excepting Coffe Dam)</b>				
Core	Clay (m <sup>3</sup> )	868,000		868,000
Sand for Filter	(m <sup>3</sup> )	270,000		270,000
Gravel for Filter	(m <sup>3</sup> )	532,000		532,000
Rock	(m <sup>3</sup> )	4,367,000		4,367,000

The cement is to be transported from Kars, while the concrete is to be mixed and manufactured within the site reclaimed in Figure 13-1. The reinforcing materials, etc. of concrete are to be procured from the steel plant.

The waste water being caused during the manufacture of concrete is introduced to the settling basin and suspended concrete will be removed as much as possible for preventing its influence on the aquatic organisms.

(5) Leakage Suppression

The drain water and discarded soil from the construction area are controlled at the site sufficiently spacious for preventing them from leaking into the peripheral districts and river (Figure 13-1).

(6) Protection of Basis

The preventive measure of slope protection is to be done for preventing the collapse of excavated areas.

(7) Flood and Drain Water

The flood water volumes at Bayram site and Bađlık site of Berta River are 352.0 m<sup>3</sup>/sec and 459.0 m<sup>3</sup>/sec in the appearance probability for 100 years, respectively. Both the dams have the release function bearable even to the physically possible maximum flood water volume. Its size is 1,660 m<sup>3</sup>/sec in case of Bayram dam and 1,830 m<sup>3</sup>/sec in case of Bađlık dam. The disaster occurrence of dam itself due to the flood during the heavy rain can be prevented by the release function of these dams.

(8) Dust Emission

For decreasing the influence of dust being caused by the excavation, crushing and blasting of land and the traffic of vehicles, the water spray counter measure, etc. is planned during the seasons when the land especially dries up.

(9) Transportation

The transportation road sufficient for transporting a large size hydraulic equipment and materials is to be formed by partially repairing or expanding the road. In addition, a new road which is temporarily used for work connecting the work spot and the existing roads is to be constructed (Figure 13-1).

(10) Electrification Plan

Electricity for construction work will be supplied by providing a 9,000 kVA of substation at camp facility site of Bayram project connected to 33 kV existing TEDAŞ transmission line and 6 kV transmission to each work site of Bayram project and Bađlık project.

(11) Noise and Vibrations

Bayram dam site is located very much close to Bayram village. For this reason, the reduction of noise and vibration influence during the work to the inhabitants can be attempted by the associated rules, but the work during the night time and the traffic of vehicles are limited to the lowest level.

#### (12) Deforestation and Effect on Terrestrial Animals

The vegetation in both the Bayram and Bağlık dam work sites is very much poor and there is no forest. There are small scale colonies of one species of cyclamen at the place of 750 m altitude in the small mountain (886 m altitude) on the right bank of conflux with Meydancık River in the vicinity of Okçular Village where the Bayram water reservoir is planned, and at the place of 540 m altitude on the left bank in the vicinity of Bağlık dam site, but care must be paid during the enforcement of latter Bağlık dam facility work.

16 species of animals are reported to be living in the valleys where the project spots exist, but care needs to be paid to the collision by the traffic of vehicles being used by the laborers, especially during the night. Further, the temporary escape of partial animals can be considered by the work noise, etc., but its influence doesn't last long.

#### (13) Agricultural Land

243.9 da of agriculture land will be inundated after construction. The compensation will be needed for this influence. These lands are not designated to be the important agricultural lands. 105.25 da at Savail borrow area will be also expropriated before construction works.

#### (14) Supply of Water, and Waste Water

Springs will be utilized for portable water supply. Waste water is to be drained out according to the associated rules.

Spring water is to be used for about 3,000 persons working in construction area and offices and concrete preparation work. Moreover, such water is used as spray water in order to prevent dust emission generated from construction and transportation works.

#### (15) Solid Waste Substances

There appears no more than 600 kg/day solid waste substances which are supposed to be produced by the laborers' activities. The waste substances will be transported to the neighbor self-governing community's waste stock yard existing in the project spot, but will be discussed previously with the local self-governing community on the basis of the associated rules relating to the disposal of waste.



**(16) Facilities and Services for the Laborers**

The laborers' living facilities and offices, etc. are constructed at the project spots during the work period. All the wastes are disposed in accordance with the related rules.

**(17) Works Involving Risks and Dangers**

The present project doesn't include the works having problematic risk in view of the safety and public health hygiene. An adequate control for preventing the accidents during the traffic and work will be conducted.

**(18) Protected Areas**

There exists no object to which the legal protection is sought in the project spots. In addition, the project spots are not included in the area subjected to the limitation due to the military reasons.

**(19) Landscape of Project Sites**

Both the Bayram and Bağılık project sites are not the areas having the landscape value.

**13.5.2 Activities in the Operation Phase, Impacts on the Physical and Biological Environment and Countermeasure**

**(1) Characteristics of Facilities and Operation Plan**

**(a) Characteristics of Facilities**

The major facilities in the project are listed below. Following characteristics of facility are obtained from the main report on Çoruh Berla Hydroelectric Power Development Project.

		Bayram	Bağlık
<b>Dam</b>			
Type		Rockfill	Concrete Gravity
Height	(m)	145	74
Volume	(10 <sup>3</sup> m <sup>3</sup> )	about 6,200	195
(Including Cofferdam)			
<b>Reservoir</b>			
Area	(km <sup>2</sup> )	3.38	0.37
Total storage capacity	(10 <sup>6</sup> m <sup>3</sup> )	133.0	7.3
Effective storage capacity	(10 <sup>6</sup> m <sup>3</sup> )	113.0	1.0
<b>Power Station</b>			
Type		Underground	Underground
Width x Length x Height	(m)	19.0x44.5x41.0	21.0x50.0x41.5
Number of unit		1	1
Installed Capacity (MW)		68	59
<b>Tailrace Tunnel</b>			
Diameter	(m)	4.6	4.9
Length	(m)	7,930	4,454
<b>Switchyard</b>			
Type		Surface	Underground
Width x Length	(m)	40.0x40.0	8.0x10.0 (GIS)
<b>Transmission Line</b>			
Number of Circuit		1	1
Voltage	kv	154	154
Length	(km)	12	25

(b) Operation Plan of Reservoir

The characteristics and water exchange rate of the both water reservoirs are 4.5 cycles/year for Bayram dam and 107.5 cycles/year for Bağlık dam.

## (2) Sedimentation and the Life of Dam

Bayram dam has the dead volume of  $11.8 \times 10^6 \text{ m}^3$  corresponding to the sedimentation volume for 50 years. Moreover, the total water storage volume at  $133 \times 10^6 \text{ m}^3$  corresponds to the sedimentation volume for 565 years.

Bağlık dam has the dead volume of  $3.6 \times 10^6 \text{ m}^3$  corresponding to the sedimentation volume for 50 years in the similar manner. The total water storage capacity of  $7.3 \times 10^6 \text{ m}^3$  corresponds to the sedimentation capacity for 103 years.

## (3) Influence on the Animals and Plants

The vegetation in the areas where Bayram and Bağlık water reservoirs are to be planned are quite poor. One species of cyclamen exists in the Bayram water reservoir area, but is positioned at the upper area than the maximum water level. The distribution of cyclamen is also found in the water reservoir planned area in the vicinity of Bağlık dam site in the same manner, but is located at the area higher than the maximum water level. The animals are distributed in wide area of valleys, but their movement and exchange are not disturbed although their living space is slightly narrowed than ever before by the appearance of water reservoir.

## (4) Public Health Hygiene

There isn't any contagious disease where the water itself or the aquatic organisms intervene in this area. In addition, the inhabitants don't use the river water as the potable water.

## (5) Influence on the Aquatic Organisms

The reservoir provides a better environment to the aquatic organisms. Because the water temperature is comparatively low and the nutrition degree of water reservoir is also low, it can be estimated that there is no conspicuous proliferation of algae, but if they should get proliferated in a large volume, the algae should be removed.

T-P in the future Bayram reservoir is to be expected to become 0.023 mg/l. Fish catch reported in the lake showing this T-P range is approximately 1 ton per  $\text{km}^2$  according to foreign fishery data and carp type as a dominant fish family is to be expected to live.

## (6) Change of Water Quality

### (a) Contamination Source

There are the release of municipal waste water and the waste disposal yard in the downstream spot in the vicinity of Şavşat Town in the upstream side of project spots. Further, because the sewage is not treated in Şavşat Town, there is the actual situation for the raw sewage to flow into Şavşat River. However, according to the result of water quality survey, the water quality of river flowing into the projected Bayram water reservoir becomes clean by the mixture effect with the water of Maydancık River which is another branch and by the purification action of river.

The livehood wastes are discarded to the waste disposal yard in Şavşat Town, but are quite small in scale and don't give any big influence on the water quality of reservoir.

Because the population of Şavşat Town and the agriculture in the upstream side are decreasing or shrinking as a whole, it is estimated that there is no increase of nutrients and contaminants attributable to the inhabitants' living and fertilizers higher than the present level. Besides them, there is no contamination source at the project sites.

### (b) Eutrophication

The water quality of Berta River approximately falls under the water class (I) of inland water source and is clean as shown in Table 13-12. The limit value as the suppression of eutrophication of water reservoir becomes lower than 0.1 mg/l against the utilization purpose other than the recreation utilization, whose water quality of Berta River satisfies this level.

The water exchange rate of water reservoir is 4.5 cycles/year in case of Bayram water reservoir and 108 cycles/year in case of Bağlık water reservoir which is quite nice in exchange rate, and it is anticipated that the Bayram water reservoir becomes the stratification type while the Bağlık water reservoir becomes the mixed type (the state close to the water flow state).

As a result of predicting the future water quality investigated in November (T-P : 40 mg/m<sup>3</sup> under the current situation), the T-P concentration becomes 23 mg/m<sup>3</sup>, and as regards the nutrition stage, the possibility for becoming Oligotrophic stage is 18 %, the possibility for becoming the Mesotrophic state is 65 % and the possibility for becoming the Eutrophic stage is 17 % (Figure 13-15), while even if the eutrophication of 80 mg/m<sup>3</sup> which is twice

during the rainy season, the internal production can be also suppressed because the water temperature during the summer season in this area is low, and it is evaluated that it can not lead to the eutrophication.

The formation of water temperature discontinuity layer is difficult by its physical shape, doesn't become the stagnant state and doesn't become eutrophic.

#### (7) Influence on the Downstream

Berta River is one of branches of Çoruh River. The Çoruh River has the area of 19,750 km<sup>2</sup> and Bayram dam has the area of 1,159 km<sup>2</sup> while Bağlık dam has the area of 1,509 km<sup>2</sup>. Since the water of both dams is brought to Şavşat River by the underground tunnel via the respective underground electric power generation plants, about 9 km up to the underground tunnel outlet point in the downstream side just below both the dam facilities and about 5 km up to the underground tunnel outlet point in the downstream side just below the Bağlık dam are planned to be the water reduction blocks (Figure 13-1).

The water depth at the service water in-take port of Bayram water reservoir is planned to be 64 m maximum.

This is 13 m maximum in case of the Bağlık water reservoir. The water temperature at the deep water where the water intake port exists is estimated to be about 5°C during the summer season according to the case study (Figure 13-16) of Tortum Lake existing in Erzurum Province, so the release of a large volume of low temperature water gives an unfavorable influence on the aquatic organisms living in the river as its result.

In determining the river maintaining water volume to the water reduction block from the dams, there is the need for first maintaining the range of water temperature favorable to the organisms. Figure 13-17 shows the water temperature under the current situation. The present project roughly estimated the level of water level to be released using as the indexes the air temperature, humidity (Table 13-25), the transmission and reflection to the water of radiant heat from the sun and atmosphere, the latent heat, sensible heat, water volume, river width, etc. (Table 13-26) and also the water temperature which is one of ecological information (Table 13-27) of *Cyprinus carpio* which is a species of carps living in Berta River. Table 13-28 shows the values of used parameters.

According to this information, it is estimated adequate (Figure 13-18) that the water volume capable of maintaining the water temperature of Berta River during the current summer season where the organism are active is between 0.3 m<sup>3</sup>/sec ~ 0.7 m<sup>3</sup>/sec.

Water temperature to be discharged from Bađlık dam to the downstream is predicted to be 5~10°C, since intake depth is located at 13 m from water surface as a maximum depth and cold water from Bayram reservoir inflows to Bađlık reservoir through tunnel.

Therefore, discharge of same order is to be needed for the water reduction section of Bađlık dam downstream.

For this, small valve is planned to attach to dam body and detailed work will be practiced to decide a suitable amount of water to be discharged in the field after the construction of dams.

Natural inflow volume between Bayram dam site and Kaledüzu point (3 km downstream of Bayram dam site), and Bađlık dam site and No.2334 gauging station (5 km downstream of Bađlık dam site) can be estimated by hydrological data from above 4 point of Berta river. These data are shown in Table 13-29 and 13-30. Table 13-31 and 13-32 show the scheme of reservoir operation for Bayram and Bađlık projects, respectively.

The river beds in both the water reduction blocks are not flat with the river slope being 1/100 and are structured of the irregularity by a great amount of rocks, so the width of deep pool and shallow water which are found many in the current situation and the river width will be narrowed by the enforcement of project, but the stream becomes comparatively slower and the aquatic insects and such fish as carp and loach can survive. In other words, the organism environment can be protected by the increase of biomass due to the appearance of newly installed water reservoir, the expansion of living space and the maintenance of river water quality. Discharge point locating 5 km downstream of dam is connected to the reservoir of the Deriner project.

The annual outflow sand volume of Berta River is (8.5%) of Çoruh River, and the soil being accumulated in the water reservoirs is estimated to be  $235 \times 10^3 \text{m}^3/\text{year}$  and  $71 \times 10^3 \text{m}^3/\text{year}$  respectively. According to these data, Bađlık dam will be stopped the outflow sand volume of 4.4% for Çoruh River. So it doesn't give a great influence on the soil transportation volume to the river mouth of Çoruh River itself.

Moreover, on saltification of Çoruh river mouth delta area, this project doesn't give serious influence, since water supply is small compare to the total water supply to the mouth of the Çoruh river.

(8) Influence on Microclimate

Bayram and Bađlık water reservoirs have the areas of 3.38 km<sup>2</sup> and 0.37 km<sup>2</sup> respectively. Because the area of water reservoir formed among the valleys is relatively small, there is no great negative influence on the microclimate in the area.

(9) Influence on the Underground Water and Surface Water

(a) Underground Water

The underground water is not utilized in the project spot.

(b) Surface Water

The waters of 140 x 10<sup>6</sup> ton and 7.3 x 10<sup>6</sup> ton are stored in the Bayram and Bađlık water reservoirs, and returned back to Berta River after their utilization to the electric power generation. The water decreases in the block down to the Bađlık water reservoir in the downstream side just below each dam. However, there is no utilization of river and river water including the fishery in this block. The inhabitants' potable water is the valley water originating from the spring water located at a high place in the valleys, so no problem is especially caused by the enforcement of project.

(10) Thermal and Geothermal Water Resources and Mineral Resources

There are no thermal and geothermal water resources and mineral resources.

(11) Influence on the Agriculture and Livestock Farming

The agricultural land of 243.9 da producing the agricultural products which are consumed as self-sufficient one by resident is lost by the project. The compensation will be done to the inhabitants for this loss, but the production scale is small, and the value of agricultural land is low, so there is no great influence on the agricultural production in this area where the project spots exist. A part of livestock farming uses as feed the poor grass growing on the river bank, but there is no big influence because the livestock farming is also managed at the neighboring places relatively high in altitude.

**(12) Influence on the Protected Areas**

The project spots are not included in the protected areas.

**(13) Influence on the Recreation and the Spots having Excellent Landscapes**

There are no recreation facilities and excellent landscapes in the project spots.

There is a possibility for the recreation yard utilizing the lakeshore such as camp yards to be created. Further, both the spots are located at the place having wild landscapes, but become one of the landscape yard by the formation of water reservoirs, which can be utilized in the future as one of other sightseeing spots being distributed in Şavşat District.

**(14) Loss of Agricultural Land**

The agricultural land of 243.9 da in total will be immersed into the water by the appearance of Bayram and Bağlık water reservoirs and agricultural area of 105 da at Savail village, is also altered by borrowing work. There is no special product in the harvested products, which are mainly consumed by the inhabitants themselves. The compensation will be done for the loss of agricultural land. It can be imagined that the loss of agricultural land does not cause a great influence on the agriculture industry in this area.

**(15) Influence of Agricultural Chemicals, Fertilizers and Insecticides**

The population in the upstream area of Şavşat Town is decreasing, and the declining trend can be seen in recent years in the agricultural activities. Further, there is no agricultural promotion project in the future.

The nitrogen and phosphorus are low according to the water quality survey conducted in this examination, and the environment influence by the fertilizers from the upstream area cannot be predicted. A small scale agricultural land in the vicinity of water reservoir area uses the livestock excrements as the fertilizers but in a small scale, and the danger for the eutrophication of water reservoir by the fertilizers is quite small. The current situation of agricultural chemicals and insecticide is estimated to be at the low level, but is anticipated to be decreasing proportional to the declining trend of agricultural activities. The water



reservoirs in the present project are for the electric power generation, and are not for the irrigation or the potable water supply plan.

(16) Repair Maintenance of Transmission Cable

Tower of transmission line located in the area where there are possibilities of people enter in will be protected by appropriate facilities such as fence or wall.

Trees under the transmission line will be cut when it grow up to the line. However, no special problem will be arised since transmission route will be run on the area where is poor on natural vegetation. Periodical patrol by maintenance engineer will be carried out to check the conditions of transmission lines.

(17) Fuels to be used

No social facilities are included in the dam spots of the present project. The subject of energy being used to the facility activity is the electricity, and there are only a small amount of lumbers and fossil fuels as the fuel for employees' living.

(18) Waste Water and Solid Waste Substances

The waste water and solid waste substances are not caused by the operation of facilities. The waste water and other waste substances being caused by the employees' living are disposed according to the rules of waste substances. Waste water treatment facilities will be attached to the lodgings and offices. These facilities consist of sedimentation-activated sludge treatment system with chlorination. Dimension of treatment capacity will be 50 persons.

(19) Noise and Vibrations

The noise and vibrations will be caused by the operation of power generators, but the influence of noise and vibrations to the environment are quite small because the electric power generation plants of both the projects are constructed underground.

(20) Accommodation and Social Infrastructure

The employees of only about 50 persons are staying for the operation of facilities. The facilities for these people are small and have no big influence on the environment, where is located of the permanent office of operational employees.

(21) Risky and Hazardous Activities

The activities involving dangers and risks are not done around the dam, switching station and transmission cable. However, in consideration of the operator, maintenance service men and local inhabitants acting around the water reservoirs, such a counter measure will be taken as providing the vehicle of rescue boats in preparation for accidents.

(22) Landscape

The ground levelling and cleaning will be done for the periphery of dam, aggregate collection site, access roads, employees' lodging work block.

The landscapes of newly created dam facilities and water reservoirs are shown in Figure 13-17 and Figure 13-18.

### 13.5.3 Effects of the Project on the Socio-Economic Environment

(1) Effects on the Social and Economic Environments

(a) Socio-economic Characteristics

The economic basis at the project spots resides in the ultra-small agriculture and livestock farming, and the wheat, corn, tomato, beans and fruits mainly for self sufficiency are being produced. About 349.2 da of agricultural land in conflict with both the projects will be changed or immersed into the water.

There is the need for the compensation of the inhabitants dealing with agriculture against this influence. However, the land area and the production amount being influenced by the projects are small and there is no special product. So no serious influence will be given on the economic basis of Şavşat District and Artvin Province.

In addition, there is no industry utilizing the river itself and the river water in the project spots.

There are several enterprises for collecting the lumber being fallen down from the forest located at the high places of surrounding mountains and for transporting them to the demand area in Çiftehanlar Village which is in the block between Bayram dam and Bağlık water reservoir.

Because the present project considers the alternative roads in the block being immersed into the water out of National Street No. 965 which is being used for the traffic of local inhabitants and for the transportation of these lumbers and life necessary goods, the transportation roads connecting Çiftehanlar Village and its periphery areas can be secured (Figure 13-1).

Moreover, because the gravel are collected inside the Bayram water reservoir, the present project attempts the benefit to the concerned inhabitants by purchasing the necessary gravel from the enterpriser.

This project requires the general laborers of about 3,000 persons per year for 5 years, so the local inhabitants will be employed with preference.

#### (b) Population

The population in object of the resettlement is about 380 persons in this project. The minute correspondence will be taken meeting the inhabitants' desire of transfer location against the transfer of inhabitants.

On the other hand, the laborers will be gathered from the city and the peripheral agricultural village areas by the start of construction work, but the increase of population in this area where the population is decreasing is expected to give a great contribution to the economic activities in the area thought it is of short term.

#### (c) Infrastructure Facilities and Services

The following infrastructure facilities and services will be influenced by the present projects.

- (i) Because a part of National Road No. 965 is immersed into the water, an alternative road of 28 km is constructed (Figure 13-1) by the General Directorate of State Highways, and the traffic in the area will be guaranteed. Village road will be relocated by Village Affairs.

- (ii) The transmission cable of 26 km being immersed into the water will be constructed as an alternative route by the Turkish Electricity Distribution Co. and be transferred.
- (iii) The telephone line of 26 km being immersed into the water will be constructed as an alternative route by the Turkish Telecommunication Co. (Türk Telecom) and be transferred.
- (iv) A small number of primary schools, mosques, police stations, roads maintenance buildings which are located in Bayram Village and Okçular Village being immersed into the water will be constructed and transferred to the other locations by the Ministry of Village Affair, The Ministry of Education, TCK and the owner of the project, relating to the construction. In addition, a small army station located at Okçular Village will be transferred by the army.
- (v) The service of buses being utilized by the inhabitants will be changed to an alternative route.

(d) Land Utilization

3.75 km<sup>2</sup> of land area will be lost or reclaimed according to the project. This area includes 349.2 da of agricultural land.

(e) Income and Employment

According to the hearing survey to the inhabitants, the monthly income per household at the project spots ranges from 5 million to 10 million TL (1995) (1\$=45,705 TL). According to the survey relating to the employment in 9 villages, the percentage of inhabitants who desire to get engaged for obtaining the wage but can not obtain the employment seems to range from 44% to 75% in 9 villages when it should be estimated from the population structure.

The inhabitants' income level at the project spots falls under the low level to the middle level in the amount per household of typical farm house in Artvin Province, and is poor. The present project can be expected to employ about 3,000 persons per year and brings an employment chance to the region.

(f) Public health hygiene

The water exchange rate of Bayram reservoir dam is estimated to be 4.5 cycle/year while that of Bağlık dam is estimated to be 108 cycle/year. On the other hand, the future nutrition degree of Bayram water reservoir is estimated to be Mesotrophic state.

Furthermore, because the Bağlık water reservoir is quite small, the water can be replaced easily, and it is predicted that there appears no eutrophication phenomenon due to the stagnancy of water.

There is no problem on the relation between the natural potable water and the diseases because the inhabitants in this area drink the spring water in the mountains and moreover they don't depend on the river water in the future too. There is no occurrence of diseases attributable to the water or relating to the aquatic organisms, and there is no public health hygiene problems being caused by the enforcement of project.

(2) The Expenses for Expropriation and the Compensation Counter Measure

(a) Land expropriation and relocation cost

Expropriation of land including dwelling area, Bayram, Bağlık project site and borrow area and relocation cost are shown in Table 13-33, 13-34, 13-35 13-36 and 13-37. Total cost is  $2,063 \times 10^3$  US\$.

(b) Net income losses

Net income losses is shown in Table 13-34 and Table 13-37.

(3) Cost Benefit Analysis

(a) Negative and Positive Influences

The negative and positive influences in this project can be summarized as follows :

<Negative influence>

- Social influence by the transfer of inhabitants
- A slight degree of loss especially of agricultural production by the acquisition of land.

- A slight degree of loss especially fish living in Berta river between Bayram dam and Bağlık reservoir, and between Bağlık dam and the out let point of Bağlık Project. However, compensation on loss of biomass can be expected by new 2 reservoirs.

<Positive influence>

- Acquisition of electric power
- Employment of local inhabitants, increase of the chance for earning the income.
- Vitalization of regional economic activities though they are of temporal nature.
- Suppression of population decrease
- Creation of landscape and creation of the recreation activity yard such as camp site.

(b) External Benefit

There is the employment of general laborers and technicians for the local inhabitants as the secondary benefit of this project, and the employment can be considered not only to the repair work after the construction in addition to the work during the construction of facilities. Moreover, the purchase of goods necessary for the work such as the general materials that can be supplied in the local area, the foodstuffs, the daily living miscellaneous goods, clothing, etc. can be considered. This benefit contributes to the vitalization of economy in the present project spots and peripheral towns where the ultra-small farming are managed. Moreover, it is also possible in the future to create the camp industry like Karagöl Lake in Şavşat District and the cultivation of trout just below the dam utilizing the cold water being released for maintaining the river environment from the dams.

(c) Environment Counter Measure Expense

The following contamination preventive counter measure and environment preservation counter measure (Table 13-39) are necessitated.

What is important as the environment contamination preventive counter measure during the work is the water counter measure during the manufacture of concrete. What is important next is the erosion and collapse problems of land that was excavated or reclaimed. Especially the basis stability counter measure shall be conducted on the land after collecting the core materials, which is planned at Savail Village on the left bank of Berta River opposite to Bayram Village. This district is the place which collapsed in the past by the natural phenomenon. The slope protection and drainage channel need to be done as a

concrete counter measure, and the amount of  $450 \times 10^3$  US\$ will be appropriated as the expense. Waste water treatment facilities will be attached to camps.

Cost for water treatment is  $90 \times 10^3$  US\$. Wastewater treatment plant will be also attached to concrete yard as settling basin. These cost will be  $60 \times 10^3$  US\$.

(d) External Expenditure

The amount of  $21.3 \times 10^6$  US\$ will be appropriated as the resettlement expenditure of and public facilities.

### 13.6 Effects which May Occur or Continue After the Enterprise

The planned life span of facilities in the present project is for 50 years, and the hydraulic equipment and electric power generation equipment has 35 years as the life of machines. Moreover, it is considered that the soil may get deposited within 50 years on the dead storage area of water reservoir.

At the end of planned operation period, the facilities or portions being damaged until then will be repaired or renewed, and the facilities will be continuously operated until any decisive problem should not occur to the water storage and electric power generation functions even after the period of 50 years.

Therefore, after the end of this project, no serious environmental problem will be caused. What's more, the provision of lakeshore is possible for the recreation activities, but will not be permitted in view of human's safety because the storage water up/down fluctuations can be prospected by the operation of dam and also by the seasonal aspect.

### 13.7 Alternative of the Project

On the Berta river mainstream, as an alternative to the 2-step development scheme with the Bayram project and the Bağlık project, there is the Kaledüzü project contemplated for development in a single step of the head obtained by a dam of 120 m height at a site of river-bed elevation 585 m, 3 km downstream from the Bayram dam site, down to the end of the Deriner reservoir backwater. However, since the economics is poorer than the 2-step development with the Bayram and Bağlık projects, while due to Kaledüzü reservoir, there will be a risk of the large-scale landsliding zone in the vicinity of Savail village located at the

left bank of the Berta river 2 km upstream from Kaledüzü dam and 1 km downstream from the Bayram dam site being activated to induce landsliding, it is not proposed as an object of this survey. According to the plan, there is only one suitable place from a topographical point of view where a work adit or vertical shaft can be provided for the headrace tunnel which will exceed 14 km in length, and this will be problem in construction of the tunnel.

Outline of Kaledüzü project scheme is as follows.

	Description
<b>Reservoir</b>	
Catchment Area	1,214 km <sup>2</sup>
Annual Inflow	20.10 m <sup>3</sup> /s
High Water Level	720.00 m
Normal Water Level	703.33 m
Low Water Level	670.00 m
Available Drawdown	50.00 m
Gross Capacity	186.80 x 10 <sup>6</sup> m
Effective Capacity	140.00 x 10 <sup>6</sup> m
<b>Dam</b>	
Type	Rockfill
Height from Foundation	120 m
Crest Length	450 m
Volume	8,990 x 10 <sup>3</sup> m <sup>3</sup>
<b>Headrace Tunnel</b>	
Type	Circle Pressure
Diameter	4.5 m
Length	14,150 m
<b>Penstock</b>	
Type	Tunnel
Diameter	3.5 m
Length	540 m
<b>Powerhouse</b>	
Type	Underground
<b>Tailrace Tunnel</b>	
Type	Horseshoe Non pressure
Diameter	4.5 m
Length (Tunnel)	150 m
Firm Discharge	12.00 m <sup>3</sup> /s
Maximum Discharge	48.00 m <sup>3</sup> /s
Tail Water Level	392.00 m



Effective Head	306.94 m
Installed Capacity	127 MW

### 13.8 Conclusion

Following conclusion was obtained by the environmental study carried out on the feasibility stage of the Berta Project, which consists of the Bayram and Bađlık Projects.

1. Both project sites lie in the barren area and low population density which has a trend on decreasing. Population to be affected by the dam-reservoirs planned is approximately 380 persons and 124 private houses.
2. Land to be inundated is 3.38 km<sup>2</sup> for the Bayram project and 0.37 km<sup>2</sup> for the Bađlık project. There is no agriculture and dwelling area in Bađlık project site, although Bayram project site involves 243.9 da of local agriculture area on domestic consumption. In addition to the land to be inundated, 105.25 da of agricultural and dwelling area at Savail village is utilized for borrow area. These area produce no special products. Economical activity of both sites are not high by low population density and industrial activity.
3. No forest exists in the both sites and no protected flora and animals especially found exist in the project sites. No special fish is living in the Berta River.
4. Water reduction sections, approximately 8 km for the Bayram project and 4.5 km for the Bađlık project will be formed by the implementation of both projects. 0.3 ~ 0.7 m<sup>3</sup>/sec of artificial discharge from both dams is planned for 3 months of dry season considering of natural inflow volume for 2 sections in order to maintain a natural river water stream, although precious organisms can not be found in these sections. Appropriate amount of water on discharge to water reduction sections is to be decided by the following detailed design study.
5. Serious water pollution and eutrophication phenomena are not predicted, since nutrition level of Berta River is low and by rapid exchange of reservoir water.

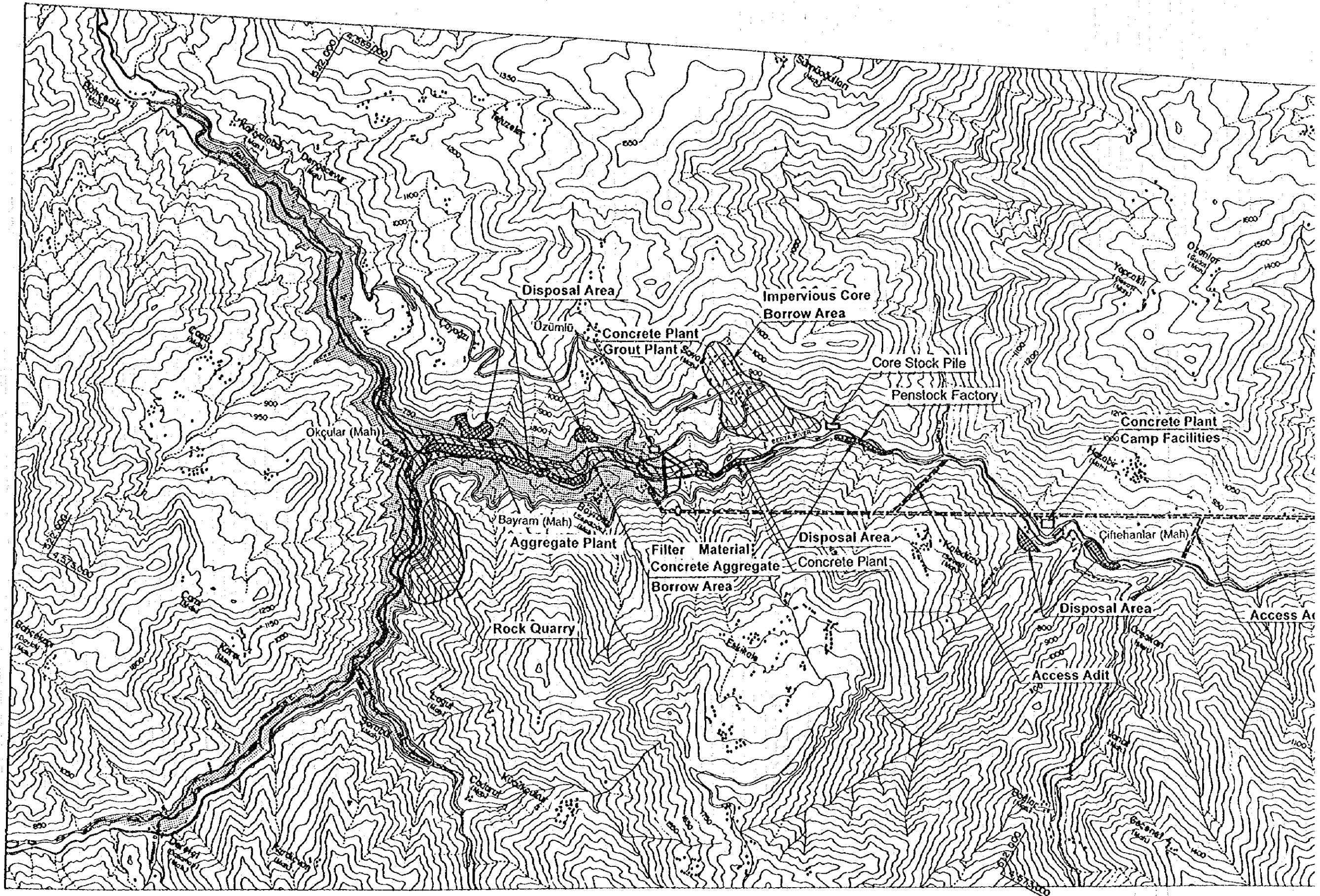
6. Serious losses of sediment matters to be carried to the Çoruh river mouth and expansion of saltification at river mouth region are not expected.
7. On the construction works, pollution prevention measures will be introduced in accordance with the related Turkish regulation. Land slope protection measures will be adapted for disposal and borrow area after construction. Actual locations of treatment facilities of waste water to be generated from workers and concrete preparation work are to be decided by the detailed design study.
8. Serious issues on environmental side is not found. Relocation of private and public properties will be planned. Total cost on land acquisition and relocation of properties is accounted as  $21.3 \times 10^6$  US\$.

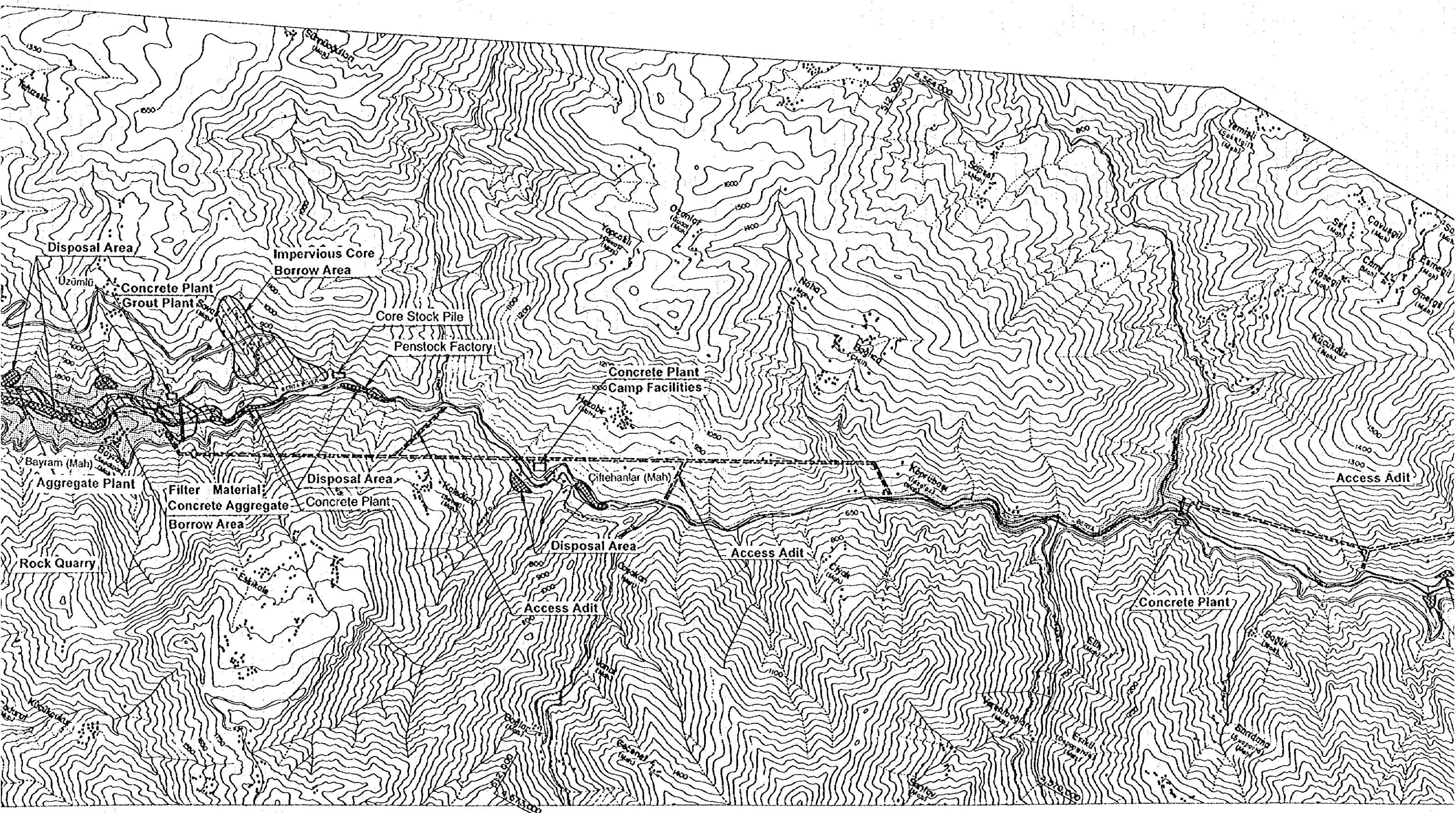
1

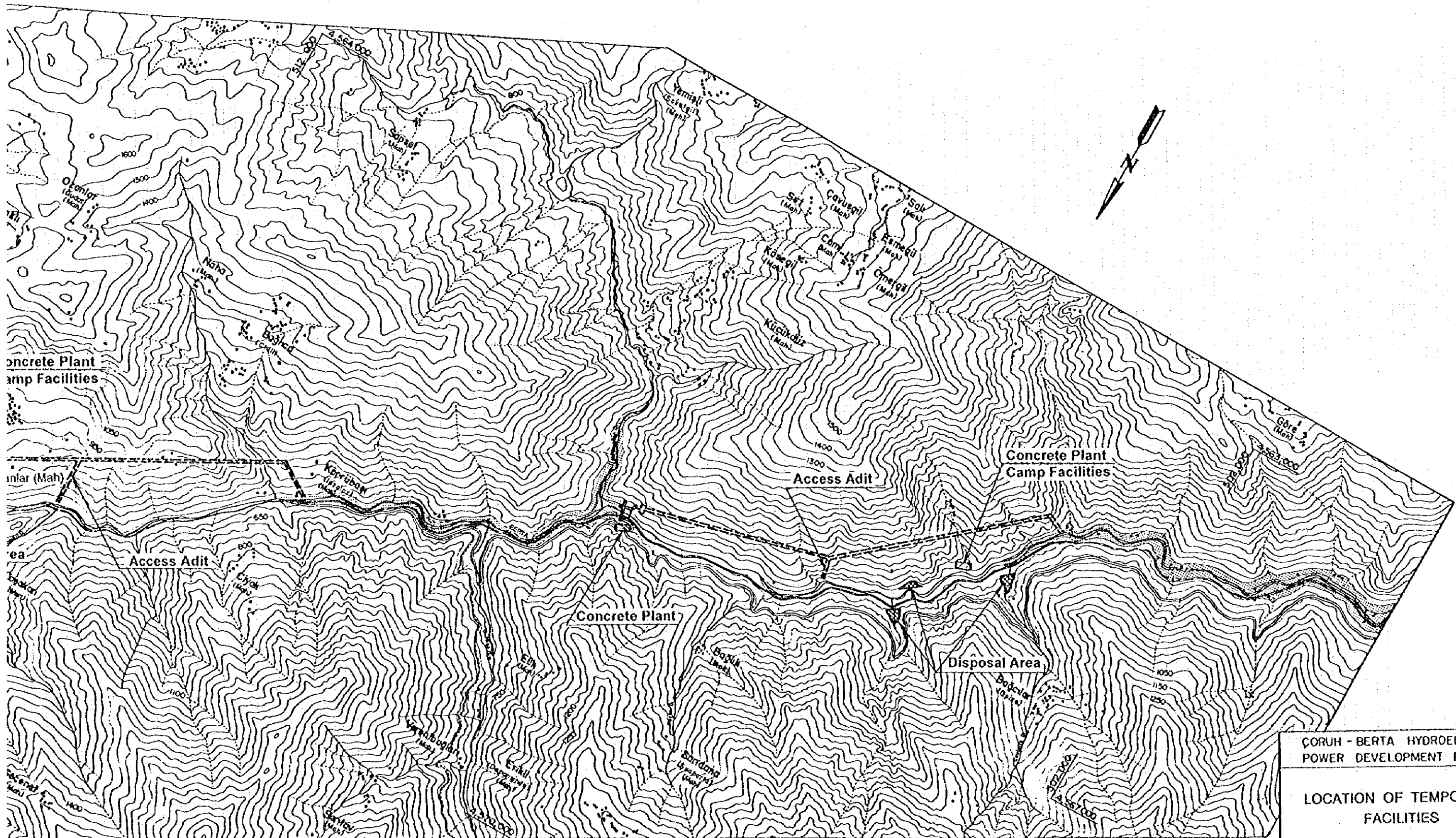
1

1









ÇORUH - BERTA HYDROELECTRIC  
POWER DEVELOPMENT PROJECT

LOCATION OF TEMPORARY  
FACILITIES

Figure 13-1







1

2

3



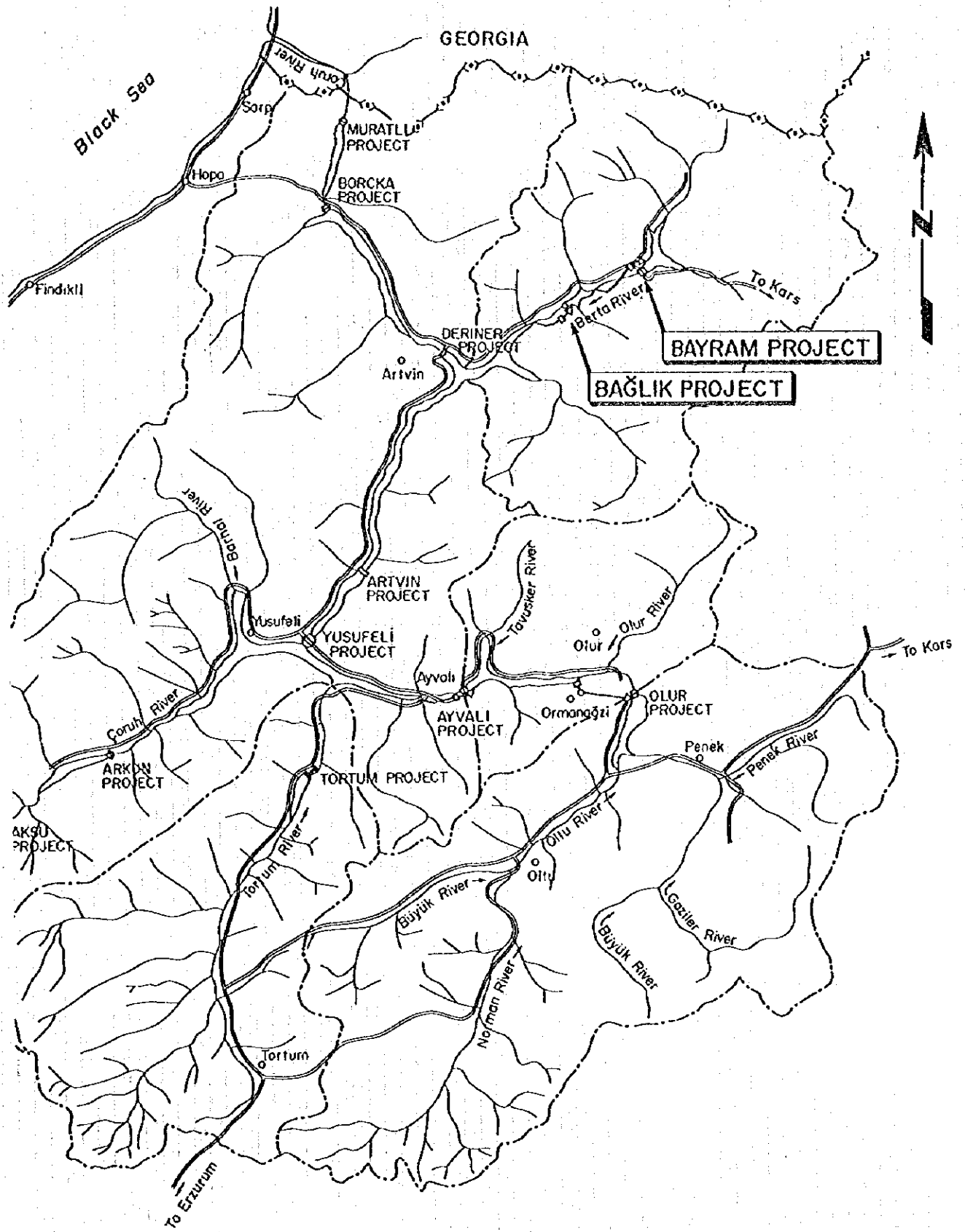


Figure 13-2 Location of Project Site














1

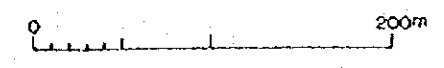
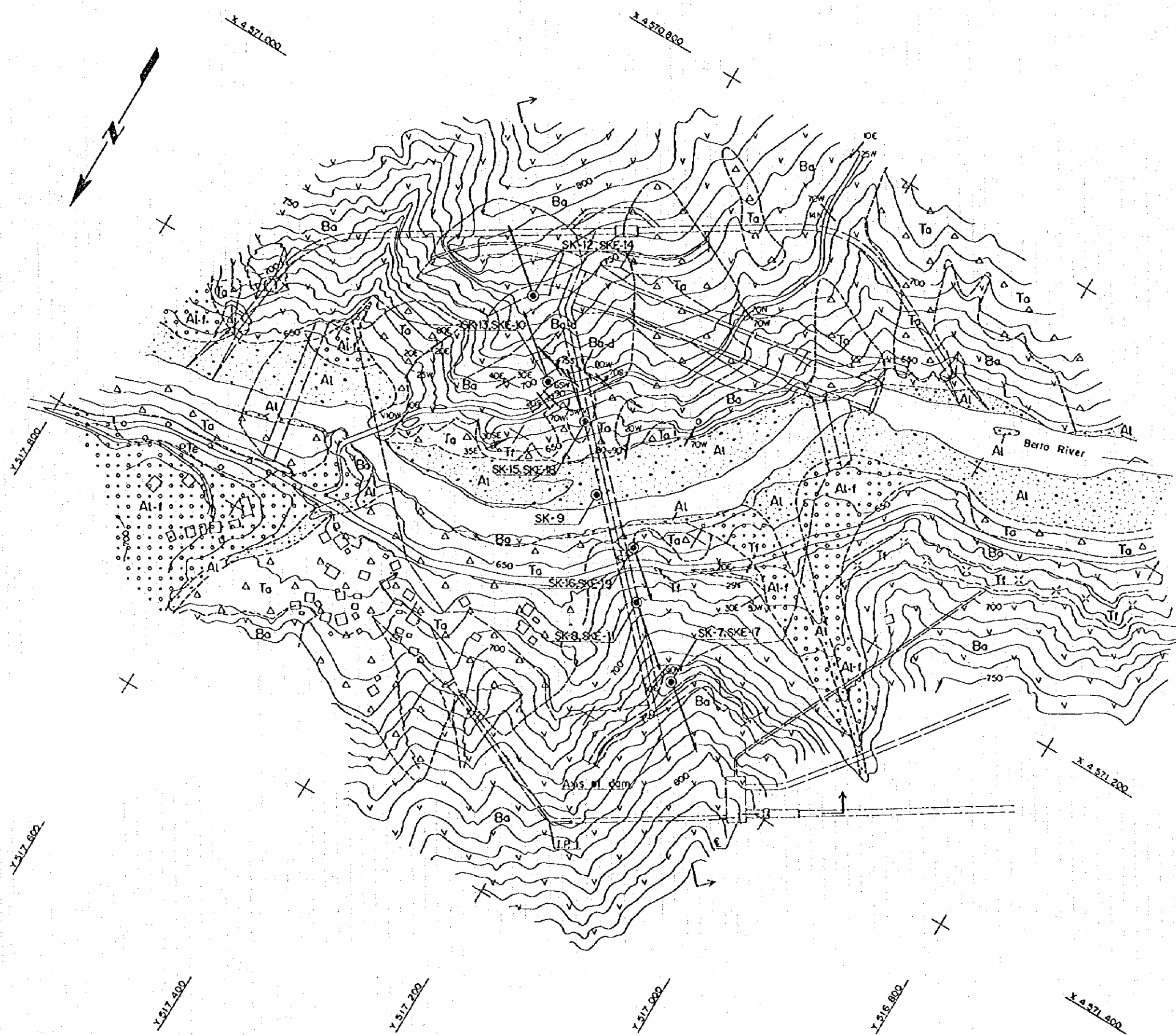
2

3



LEGEND

- |            |                 |   |  |
|------------|-----------------|---|--|
| Quaternary | Surface deposit |    | Alluvial deposit   |
|            |                 |    | Alluvial fan deposit   |
|            |                 |    | Talus deposit  |
|            |                 |    | Terrace deposit  |
| Cretaceous | Berta formation |    | Basalt (thin dike)   |
|            |                 |    | Tuff, Lapilli tuff   |
|            |                 |    | Basalt and Altered basalt (lava and dike),<br>Volcanic breccia, Tuff breccia |
|            |                 |    | Geologic boundary  |
|            |                 |    | Strike and dip of strata   |
|            |                 |    | Strike and dip of dike   |
|            |                 |    | Strike and dip of joint  |
|            |                 |  | Drill hole<br>(SK - vertical hole)<br>(SKE - inclined hole of 45 degree)     |
|            |                 |  | Location of profile  |

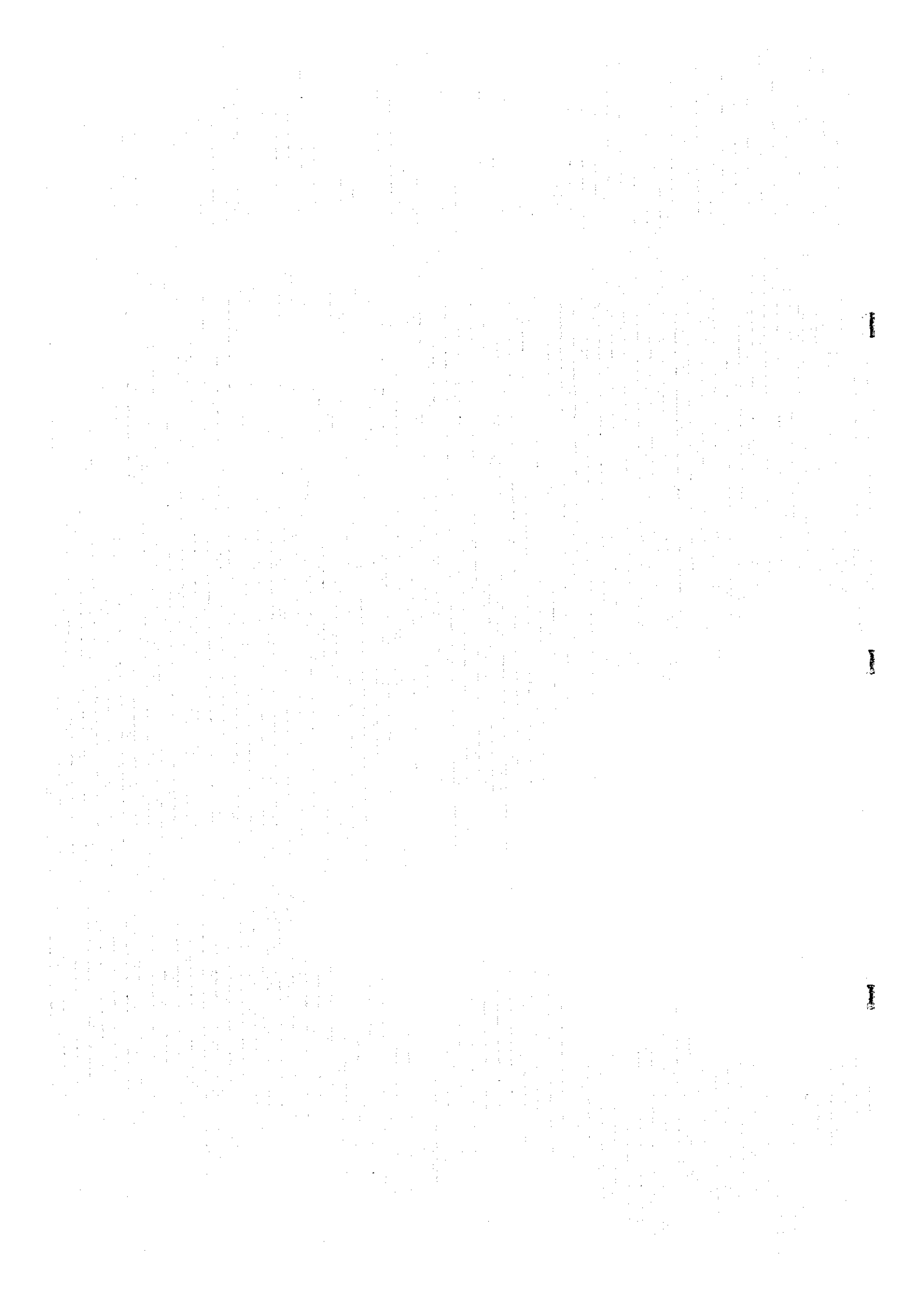


ÇORUH - BERTA HYDROELECTRIC  
POWER DEVELOPMENT PROJECT

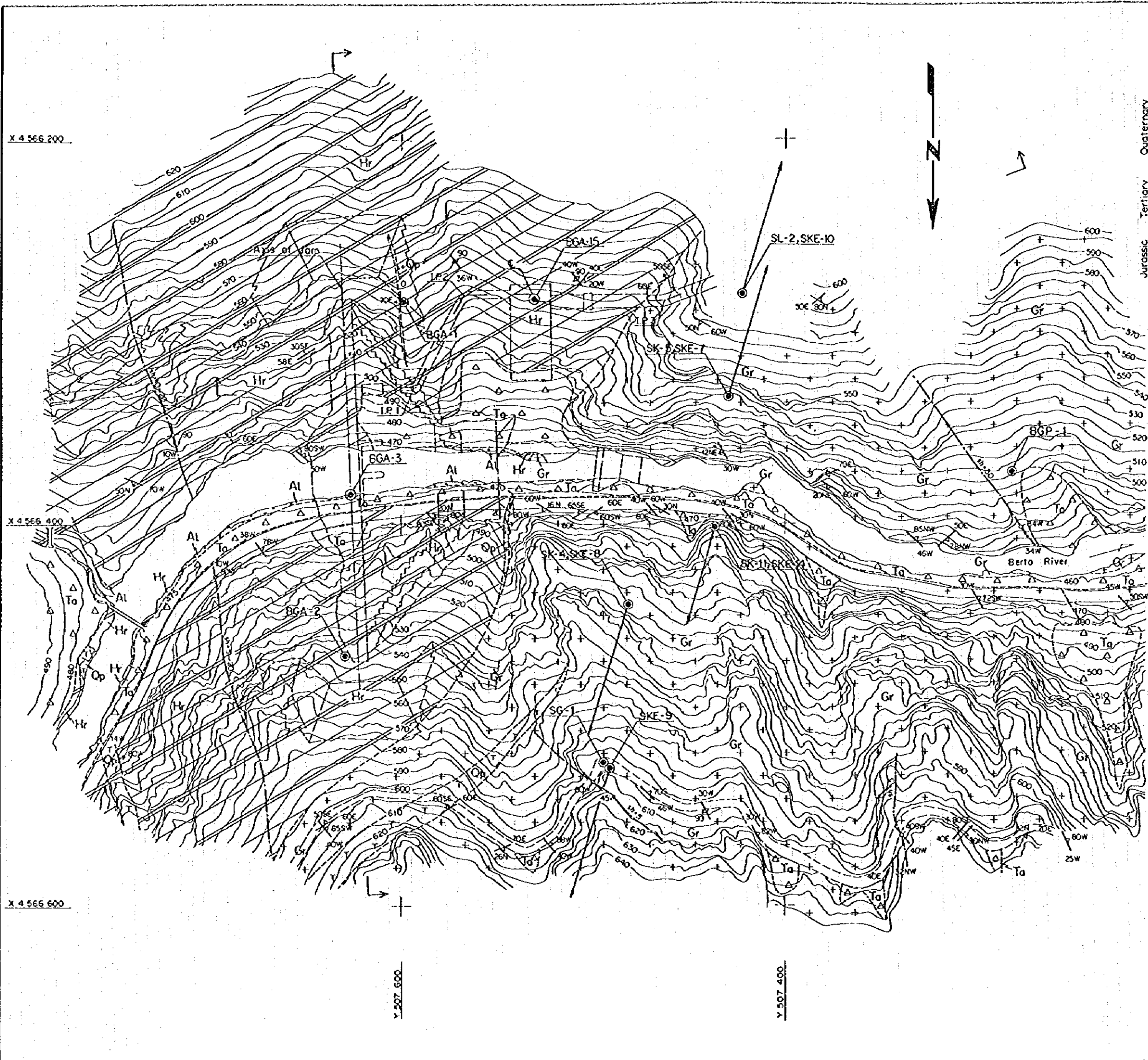
BAYRAM PROJECT  
GEOLOGIC PLAN OF DAM SITE

Figure 13-3









LEGEND

- |            |                        |                 |  |
|------------|------------------------|-----------------|--|
| Quaternary | Surface deposit        | [Al]            | Alluvial deposit   |
|            |                        | [Ta]            | Talus deposit  |
| Tertiary   | Izidere granitic rocks | [Op]            | Quartz porphyry  |
|            |                        | [Gr]            | Granite  |
| Jurassic   | Yusufeli formation     | [Hr]            | Hornfels<br>(with Meta-diorite and Meta-basalt)                          |
|            |                        | ---             | Geologic boundary  |
|            |                        | 30W 60E<br>sh=5 | Strike and dip of fault<br>(sh: width of shear zone, cm)                 |
|            |                        | 30N 60E         | Strike and dip of strato   |
|            |                        | 30N 60E         | Strike and dip of dike   |
|            |                        | 30N 60E         | Strike and dip of joint  |
|            |                        | ○               | Drill hole<br>(SK - vertical hole)<br>(SKE - inclined hole of 45 degree) |
|            |                        | ↑               | Location of profile  |



ÇORUH - BERTA HYDROELECTRIC  
POWER DEVELOPMENT PROJECT

BAĞLIK PROJECT  
GEOLOGIC PLAN OF DAM SITE

Figure 13-4



