

IV.1.16 Present Pollution Loads of Area

(1) Air Pollution

The project area is located at the area between mountains, which is apart some 40 km from Bolu City, some 15 km from Mengen Town and some 25 km from Devrek Town.

The facilities releasing the pollutants such as gases from factories and the like don't exist at the project area including Gökçesu Village and Köprübaşı Village which have both the highest population in the vicinity. In addition, there is no source of offensive odor in the project area.

(2) Noises and Vibrations

There are no noisy facilities making vibrations, other than the chain saw sound of cutting down the forest existing in the project area.

(3) Land Stubidence

(The existence of land stubidence in the past of each construction area is being described.)

(4) Water Pollution

The pollution loads of river is generally estimated from the generated loads in the basin, but can be calculated on the basis of the concentration of inflow water to future reservoir here as a more realistic method.

Bolu City as the center of Bolu Province exists at the middle reaches of Büyüksu River (Bolu River) which is one branch of Devrek River on the upper stream of project area. Bolu City has a population of about 60,000.

In addition, Mengen Town, which is the center of Mengen District, is located near Mengen River which is a branch stream of Devrek River, where about 4,000 persons are living. Some 2,100 persons are living at Gökçesu Village at the junction between both the rivers, and the sewage and drainage disposal facilities relating to the other industrial productions can not be seen under the present situation in both villages.

In order to grasp the magnitude of pollution loads into the reservoir and to see the relationship between the concentration of pollution elements and the flow rate, they are applied to the regression on logarithmic functions. The SS and NH₄-N have a positive correlation ($r = 0.8$) with the flow rate and no clear relationship can be seen in the other constituents.

Below mentioned is the result of having approximately calculated the loads with a simple method while considering the constituents, taking into consideration the element to be increased when flow rate becomes increased.

Because the long term measured data are in lack, the value of 14.4 m³/sec which is calculated from the data for the past 35 years was multiplied here for convenience by the mean concentration of elements obtained from March through July. Pollution loads calculated by above method are shown in Table IV-29. COD was also calculated as a reference, although it was measured only once.

The values of BOD and COD shown in the table were comparatively larger as the amount of loads for one day load. In addition, the phosphorus and nitrogen showed high value. Especially, nitrogen showed remarkable amount of loads, which is contributed much by NH₄-N.

Table IV-29 Pollution Loads

Item	Mean Conc. (mg/l)	Loads (ton/day)
SS	285	255
BOD	2.5	3.11
COD	3.0	3.73
T-P		
PO ₄ -P	0.08	0.10
T-N		
TIN	1.24	1.54

(Calculate the mean value from the water quality survey on each month, multiply it by the mean flow rate to obtain the annual load and to fill the above table. The detailed load shall be studied by the survey at least for two years before preparing the effect evaluation report before the construction.)

(5) Soil Contamination

(Make the representative points at each of construction work areas including the reservoir area, survey the harmful substances contained in the soil and describe the results.)

(6) Waste Matters

(Make a survey to see if or not the waste matters were discarded in the past inside each of the construction work areas including the reservoir area and describe the results.)

IV.2 Social and Economic Environmental Characteristics

IV.2.1 Economic Characteristics

More than half the Filyos River basin is covered by mountains and high lands and the lands suitable for cultivation are limited. In the Northern district, Çaycuma Plain best suits for agriculture, and the economy of farm villages is constituted by the production of crops, livestock and forestry.

The vicinity of Devrek is adjacent to the south of Çaycuma Plain and the lands suitable for cultivation are comparatively fewer, but the crops and vegetables are prosperously produced. The total cultivation area covers some 21,000 ha including the field farming and the irrigation farming lands. In addition, livestock breeding is also being conducted to a certain extent. The main crops are wheat and barley while the livestock are mainly sheep and goats. In Karabük and Safranbolu adjacent to the east side of Devrek district on the other hand, it is reported that agriculture is the main production activity, covering such major farm products as wheat, corn, vegetables and fruits. It is also known that rice is being produced along Araç River. In these northern districts, which are covered by forest, the quality of wood exceeds the national average and the industries related with the forest are inevitably developed.

The farming industry plays important economic role in this area together with the forestry in the entire area of Bolu. In Gereede Plain, which is located at the eastern part of Bolu area, irrigation has not yet been done up to the present time, but the crops are mainly being produced, and the sheep and goats utilizing the wide pasture land become the important livestock though their quality has yet to be improved.

The entire area covering Bolu city and its south-west district is the plain of about 725 meter altitude. In this area, irrigation farming is being done comparatively widely. The total farming cultivation area covers some 137,000 ha, and is by far

wider than the farming cultivation area in the Devrek area. For example, the cultivation areas of vegetables and crops in Bolu are about 35 times and 12 times those of Devrek respectively. The main agricultural products are wheat, barley, corn, potatoes, apples, grapes and hazelnuts. It is noted that the hazelnut which is a famous product of Turkey is being abundantly produced in this area.

The area of Mengen is occupied mainly by the mountains as the area of Devrek, and the farming zone exists in the area of the junction of Mengen and Büyüksu rivers and in the area adjacent to Gereke Plain. The total farming cultivation area is about 11,000 ha, which is only about one tenth of the area of Bolu. The orchard area is about 600 ha, which is only some 1/100 as compared with the case in Bolu. The main agricultural products are wheat, potatoes, barley, apples and pears, which are similar to those in the area of Devrek. More than half of the northern part of Filyos River basin is covered by forest, and both the quantity and quality of the timbers are favorable. This rich forest resource leads to the development of wood-made product industry in this region and generates many employment opportunities. The forest area of Devrek district is the largest there, and the timber processing industry becomes main income source. In view of the species of trees, such needle leaf trees as Australia pine and Scotland pine grow much in the high altitude mountainous area, while such broad leaf trees as beech, oak, Torineko, Shide, etc. are distributed in the low altitude area.

The livestock breeding is also prosperously being conducted in this vicinity area. Especially, the area of Bolu covers wide land suitable for the livestock breeding, and the livestock quantity is large than that of the other areas. The main livestock animals are cows, sheep and goats, and poultry is also being produced in much quantity. Therefore, this area becomes the supply source of raw meats, milk, butter, eggs, etc. to the adjacent cities and towns.

The area of Zonguldak, which is located at the northern part of Filyos river basin has rich coal resources, and some 14.5% of the population is working in the coal mining industry. On the other hand, the area of Bolu has lignite resource, which is also being produced. In addition to the mining industry, there are the factories of cement, cast iron products, agricultural machines and tools, and construction materials in Bolu area. Moreover, Bolu is also a commercial city.

On the other hand, the similar life style is being carried out in the three villages called Kayabükü, Kesebükü and Ispaca, which constitute the Kayabükü Village as a whole at the project site area. Main income sources of the village are vegetable farming, orchards and timbers, and that from livestock breeding remains only at the level less than 10%. The food stuffs are self-sustained and any extra portions are delivered. At the time of the field survey, there are 55 families living in the project site, and their average monthly income per family house proves to be about 900,000 TL, which is said to be insufficient for the living. There are 50 families living at Köprübaşı Village which is located near the project point. The livelihood of the villagers in this village is similar to that at Kayabükü Village, but the average monthly income per family is said to be about one million TL. The incomes of the villagers are insufficient, and therefore it is the current situation that many young people go out of the villages to İstanbul and Ankara to get more income.

The detailed contents of economic characteristics are described hereafter by using related data. All of the data and information used here are based on those provided by the survey report, which is prepared by the Environmental Group of DSi for the project study.

(1) Peripheral Area

a) Agriculture and Forest Industries

More than half of the Filyos River Basin is covered by mountains and high lands, and the lands suitable for farm cultivation are limited. In the northern area, Çaycuma Plain is most suitable for agriculture, and the economy of the villages is constituted by production of crops, livestock and plantation.

The Devrek area is adjacent to the south of Çaycuma Plain and the lands suitable for agriculture are comparatively small. However, crops and vegetables are prosperously being produced. The total agriculture area is about 21,000 ha including the dry farming and irrigated lands. The following Table IV-30 shows the agriculture areas and the production volumes of Devrek area.

Table IV-30 Main Agricultural Products of Devrek District (1992)

(1992)

Products	Cultivation Area (ha)	Annual Production Volume (tons)
Wheat	10,135	23,817
Maize	9,300	23,994
Barley	500	1,100
Potatoes	100	1,350
Tomatoes	30	1,050
Black Cabbages	50	700

The total area of orchard in Devrek district is about 350 ha, and fruits and nuts are widely being produced. The following Table IV-31 shows the number of cultivated plants and production volumes of main fruits.

Table IV-31 Production Situation of Main Fruits, etc. in Devrek District (1992)

Kind	Number of Trees	Annual Production Volume (tons)
Apples	14,850	2,032
Pears	6,500	1,960
Cherries	1,800	1,281
Hazelnuts	59,220	158

The tables listed below, which are attached hereafter, shows the details of the current production situation of the vegetables, crops and fruits of Devrek area.

Table IV-32 Vegetables: Area Sown, Production and Yield in Devrek

Table IV-33 Cereals, Pulses, Feeders: Area Sown, Production and Yield in Devrek

Table IV-34 Number of Fruit Trees and Fruit production in Devrek

The area of Bolu city and its west-southern district is the plain with its average altitude of 725 meters. In this region, the irrigated farming is carried out comparatively widely. The total agriculture area is about 137,000 ha, which is by far greater than the area of Devrek. For example, the cultivation areas for vegetables and crops in Bolu are about 35 times and 12 times of those of Devrek area, respectively. Consequently, the production volumes of Bolu are correspondingly much more. The Table IV-36 below shows the cultivation areas and production volumes of the agriculture in Bolu.

Table IV-35 Main Agricultural Products of Bolu District (1992)

Main Products	Cultivation Area (ha)	Annual production Volume (tons)
Wheat	72,380	203,270
Maize	16,870	99,230
Barley	27,428	68,769
Sugar beets	1,710	62,180
Potatoes	11,195	301,690
Onions	749	8,720
Black cabbage	317	6,900
Leek	308	6,515
Tomatoes	258	5,800

The total area of orchard in Bolu area is wide and reaches about 59,560 ha, where the fruits and nuts are vigorously being produced. The Table IV-36 lists the cultivated number and production volume of the main fruit plants.

Table IV-36 Present Production Situation of Main Fruits, and Others in Bolu Area (1992)

Species	Number of trees	Annual Production Volume (tons)
Hazelnuts	20,970,000	57,074
Apples	613,200	41,199
Grapes	---	11,475
Pears	177,600	8,875
Plums	213,500	7,053

The tables listed below, which are attached hereafter, show the detailed current production of vegetables, crops and fruits in Bolu area.

Table IV-37 Vegetables: Area Sown, Production and Yield In Bolu

Table IV-38 Cereals, Pulses, Industrial Crops, Fooders: Area Sown, Production and Yield in Bolu

Table IV-39 Number of Fruit Trees and Fruit production in Bolu

The majority of Mengen area is mountainous zone similarly to that of Devrek, and the farming zone is located in the area of junction of Mengen River and Büyüksu River and also in the area adjacent to Gerede Plain. The total agriculture area is about 11,000 ha, which is about one tenth of that of Bolu region. The area of orchard is about 600 ha, which is also about one tenth of that Bolu. The Table IV-40 and Table IV-41 below show current productions of main agriculture products and fruits in Mengen area.

Table IV-40 Current Productions of Main Agriculture Products in Mengen Area (1992)

Products	Cultivated Area (ha)	Annual Production Volume (tons)
Wheat	3,850	8,470
Potatoes	295	3,540
Barley	905	2,172
Maize	214	706
Onions	55	245
Cabbage	10	150

Table IV-41 Current productions of Main Fruits in Mengen Area (1992)

Products	Number of trees	Annual Production Volume (tons)
Apples	35,000	660
Pears	15,000	375
Cherries	9,000	94
Plums	9,300	55

The tables listed below, which are attached hereafter, show detailed current situation of agriculture products, such as vegetables, crops and fruits in Mengen area.

Table IV-42 Vegetables: Area Sown, Production and Yield in Mengen

Table IV-43 Cereals, Pulses, Feeders: Area Sown, Production and Yield in Mengen

Table IV-44 Number of Fruit Trees and Fruit Production in Mengen

More than half the Filyos River basin is covered by forest. The quality of the forest is good as timber. This rich forest resource leads to the development of wood products industry in this area. Much of them are such needle leaf trees as Australia pine and Scotland pine in the high altitude mountainous zone, while such broad leaf trees as beech, oak, Torineko and shide, etc. are distributed in the low altitude zone. In case of considering the division between the forest and coppice, the latest timber quantity data of various concerned area are provided by the following Table IV-45.

Table IV-45 Forest Data of the Areas of Bolu, Devrek and Mengen

Items	Bolu	Devrek	Mengen
Small wood area	72,320 ha	86,326 ha	45,636 ha
Wood richness	11,916,530 m ³	16,775,000 m ³	---
Yearly increase in wood richness	293,450 m ³	297,170 m ³	---
Copse area	1,987 ha	10,657 ha	833 ha
Copse richness	102,540 m ³	109,060 m ³	---
Yearly increase in wood richness	6,526 m ³	2,780 m ³	---
Other copse areas (unqualified copse)	1,877 ha	2,824 ha	---

b) Livestock Breeding

The livestock breeding is prosperously being carried out in Devrek area which is on downstream side of project site, and the areas along Mengen and Büyüksu Rivers. Main livestock animals are cows, sheep and goats. In addition, poultry are also being produced in much quantity. Because the area of bolu is wide in the land suitable for livestock breeding, number of livestock animals is larger than other areas. The following Table IV-46 and Table IV-47 show the current number of livestocks and productions in these areas.

**Table IV-46 Livestock Breeding in the Areas of Bolu,
Devrek and Mengen (Number of Animals)**

Kinds of Animal	Bolu	Devrek	Mengen
Cow	94,340	25,524	11,713
Calves	115,000	---	---
Bull	19,670	---	---
Sheep	218,080	3,520	14,960
Goat	75,110	10,350	805
Water buffaloes	11,240	1,210	---
Poultry	514,000	48,160	54,700
Bee hives	---	4,775	5,000

**Table IV-47 Amount of Production form Livestock in
the Areas of Devrek and Mengen**

Main Products	Devrek	Mengen
Red meat	194 tons	---
Milk	4,500 tons	11,250 tons
Butter	80 tons	---
Yoghurt	750 tons	---
Cheese	225 tons	---
Egg	3,600,000 pcs	3,495,000 pcs
Wool, mohair, hair	19.5 tons	---
Honey	46.7 tons	40.3 tons
Skin	25 tons	---

c) Mining and Other Industries

Zonguldak area, which is located a northern part of Filyos River basin has rich coal resource, and about 14.5% of the population is working for the mining industry. On the other hand, the brown coal is the most important underground resource in the area of Bolu, and a high quality of brown

coal is being produced. Besides these resources, manganese resource has been discovered in the vicinity of Devrek and Karabük-Yenice, and their surveys are being proceeded at present.

Cement industry has been developed in Bolu area, and its production has reached the amount of about 1.2 million tons per year. Besides, this area has rich forest resource as mentioned earlier, and timber processing industry has been developed. The foodstuff processing industry, especially the diary product processing has also become the important industry in this area. Gravel and stone material production is prosperous as the other industries, and permissible collection site and years have been made clear (refer to the DSi survey report). Table IV-48 summarized main industrial institutions of Bolu Province. The following table shows current situations of main industrial products of Bolu area.

**Table IV-49 Current Situations of Main Industrial products and
Their Production Amount in the Area of Bolu**

Products	Annual production Quantity
Cement	1,200,000 tons
Iron casting products	510,240 items
Pig iron	2,920 tons
Agriculture trailer/machines	200 items
Window glasses and systems	199,200 m ²
Construction materials	3,750,000 items
Canvas	126,000 m ²
Cologne	70,800 lt
Flour	52,000 tons
Mixed fodder	103,200 tons
Milk products	20,000 tons

On the other hand, timber processing industry becomes an important industry in Devrek area. Gravel and stone materials for construction use are also being properly produced. The production factories of ceramics, rubber, tire, etc. are also being operated. The following Table IV-50 shows the main industrial products and their production quantities in the Devrek area.

The amount of coal resource exists at the location of several kilometer downstream side from the junction of Mengen River and Büyüksu River is estimated to be about 50 million tons, and the coal has been mined since 1955. About 100,000 tons of coal is being yearly produced at present.

**Table IV-50 Current Situations of Main Industrial Products and
Their Production Amount in the Area of Devrek**

Products	Annual Production Amount
Forestry products	
Raw materials (timber)	30,000 m ³
Parquet (wood panel)	95,000 m ³
Grease	25,650 tons
Tin products	3,210,000 items
Ceramic products	4,550 tons
Nails and wires	2,530 tons
Rubber/tires	110 tons/190 tons
Cast iron parts	700 tons
Curb stones	207,360 m ³
Sand/gravel	201,320 m ³

d) Gross Production Amount

In the above explanation, the current situations of agriculture, forestry as well as mining and other industries in the areas of both Bolu and Zonguldak Provinces and also Devrek and Mengen relating closely to the project have been described using the data of various products. As a summary, a comparison between total product amounts of Bolu and Zonguldak Provinces is made here as shown by Table IV-51 below.

The said agriculture item shows the total sum of agriculture, forestry and livestock breeding. Regretfully, the data of mining industry, etc. in Bolu Province have not yet been obtained. However, except for the agriculture and livestock breeding, the hardware industrial production amount in Bolu Province is said to be very much lower than the value in Zonguldak province. The

production amount of agriculture, forest and livestock industries in Bolu Province proved to be about 4,951 billion TL, which is more than 10 times of 448.8 billion TL in Zonguldak Province. On the other hand, the gross production amount of mining and manufacturing industry in Zonguldak proves to be 2,743.1 billion TL, but some 3,192 billion TL which is the gross production amount including the agriculture industry and the forestry is still lower than the gross production amount of the agriculture, forestry and livestock industry in Bolu province. Therefore, it can be seen that the gross production amount of agriculture, forest and livestock breeding in Bolu province is a huge amount.

Table IV-51 Gross production Amounts of Bolu and Zonguldak Provinces (1989)

Classification	Bolu Province (Million TL)	Zonguldak Province (Million TL)
Agriculture	4,950,810	448,820
Mining	N.A.	384,500
Electric, gas and water supply	N.A.	23,606
Manufacturing	N.A.	2,334,910
Total		3,191,926

(2) Project Area

The project site is located between downstream side of the junction of Büyüksu and Mengen Rivers and upstream of Devrek River. In the area of the project reservoir, there is a village called Kayabükü, which is composed of three small villages named Kayabükü, Kesebükü and Ispaca. All of the three small villages will be submerged. Based on the

field survey performed during November 1992, there are 15 houses in Kayabükü, 23 houses in Kesebükü and 17 houses in Ispaca. Total population is 392 persons living in the 55 houses, and there are about 7 people per family.

The livelihood of most of the families there is similar. Cultivation of vegetables, orchard and wood production from forestry are their main income sources. The income from livestock raising is less than 10%. The foodstuff is self-sufficient, and any extra portion is delivered to Gökçesu and Mengen for sale. The main agricultural products are beans, tomatoes, cabbages, potatoes and peppers, following by the wheat and maize. Chickens and turkeys are being feeded as poultry, and those are for their own used. They utilizes groundwater for living and irrigation, which is delivered from the place several kilometers apart from the village. The average income is about 900,000 TL per month, which is said to be insufficient for the living of each family. There are no such facilities as a production factory and the like available for employment opportunity in this area.

**Table IV-52 Main Agriculture and Livestock Breeding
Products at Kayabükü Village**

Classification	Products
Main agriculture products:	Beans, tomatoes, cabbages, potatoes, peppers
Secondary agriculture products:	Wheat, maize, spinach
Poultry and livestock products:	Chickens, turkeys, sheep, milk cows, milk products

Köprübaşı Village exists at the vicinity of the submerged area. About 400 villagers with 50 houses in total are living at this village. Production of vegetables, fruits and timbers is their main income source, which is similar to those of Kayabükü village. The self sufficiency and the

delivery of residual products are their livelihood. Income per family ranges from about 10 million to 15 million TL per year, which is slightly higher than that of Kasebükü villages. Despite of this, the income is said to be insufficient for their living, and the young people are go out of the village to İstanbul or Ankara for working there.

Coal resource is available at the place near Gökçesu, of which the resource amount is estimated to be about 50 million tons. The coal is being mined, and produced at the volume from 80,000 to 100,000 tons every year using about 350 employees. The Table IV-53 below shows the general situations of production activities in the area of the project site.

Table IV-53 Present Situation of Production Activities in the Project Area

Component	Gökçesu	Kayabükü	Köprübaşı	Akçabey
Agriculture	Second	70%	10%	90%
Forestry	third	20%	90%	10%
Livestock	forth	10%		
Mining	70%			

The villagers of the project site area utilize the nearby towns for saling their residual products after their self sufficiency and for purchasing living necessities. The following Table IV-54 shows the trade places by villages.

Table IV-54 Places for Trading Living Necessaries by Villagers around the Project Area

Villages	Gökçesu	Kayabükü	Köprübaşı	Akçabey
Trading	Gökçesu	Gökçesu	Mengen	Dirgine
Locations	Bolu	Bolu	Dirgine	Devrek
	Mengen	Mengen		

As the result of interview survey, the information regarding annual average income amount per family of these 4 villages were obtained and summarized as shown below.

**Table IV-55 Annual Average Income per Family of
the Villages around the Project Area (1992)**

Villages	Gökçesu	Kayabükü	Köprübaşı	Akçabey
Annual income amount (million TL)	50	9 - 10	10 - 15	10 - 15

Table IV-32

Vegetables; Area Sown, Production and Yield in Devrek

	AREA SOWN (Hectares)	PRODUCTION (Tons)	YIELD (kg / hectares)
Okra	3	9	3,000
Broad beans	10	38	3,800
Peas	10	45	4,500
Sweet pepper	10	60	6,000
Green pepper	13	117	9,000
Tomatoes	30	1,050	35,000
Potatoes	100	1,350	13,500
Green beans	50	410	8,200
Carrots	1	8	8,000
Cucumbers	8	56	7,000
Pumpkins	5	100	20,000
Squash	10	140	14,000
Spinash	40	160	4,000
Cabbage	3	42	14,000
Black cabbage	50	700	14,000
Eggplant	15	300	20,000
Leek	20	400	20,000
Leaf lettuce	8	27	3,375
Head lettuce	7	24	3,429
Parsley	1	5	5,000
Garlic	5	40	8,000
Onions	20	170	8,500

Table IV-33

Cereals, Pulses, Fodders; Area Sown, Production and Yield in Devrek

	AREA SOWN (Hectares)	PRODUCTION (Tons)	YIELD (kg / trees)
Wheat	10,135	23,817	2,350
Barley	500	1,100	2,200
Oats	150	258	1,720
Maize	9,300	23,994	2,580
Broad beans	5	10	2,000
Dry peas	3	6.6	2,200
Chick peas	5	10	2,000
Dry beans	40	80	2,000
Sunflower	6	7.3	1,217
Cow vetch	10	350	35,000
Clover	75	900	12,000

Table IV-34

Number of Fruit Trees and Fruit Production in Devrek

	NUMBER OF TREES (1)	PRODUCTION (Ton)
Apples	14,850	2,032
Pears	6,500	1,960
Cherries	1,800	1,281
Plums	4,445	601
Peaches	480	284
Sour cherries	2,700	234
Walnuts	400	716
Hazelnuts	59,220	158

(1) : It is include the number of young trees too.

Table IV-37

Vegetables; Area Sown, Production and Yield in Bolu

	AREA SOWN (Hectares)	PRODUCTION (Tons)	YIELD (kg / hectares)
Okra	23	77	3,348
Calavence	122	965	7,910
Peas	48	271	5,646
Sweet pepper	78	1,050	13,462
Green pepper	144	1,900	13,194
Green beans	626	4,980	7,955
Broad beans	57	430	7,544
Potatoes	11,195	301,690	26,949
Tomatoes	258	5,800	22,481
Cucumbers	143	1,975	13,811
Pumpkins	131	1,960	14,962
Squash	122	1,910	15,656
Spinash	212	2,190	10,330
Cabbage	130	2,900	22,308
Black cabbage	317	6,900	21,767
Head lettuce	12	170	14,167
Leaf lettuce	131	1,380	10,534
Eggplant	35	735	21,000
Warden orach	7	130	18,571
Leek	308	6,515	21,153
Green garlic	22	138	6,273
Dry garlic	23	75	3,261
Green onions	209	2,410	11,531
Dry onions	540	6,310	11,685
Horse radishes	24	540	22,500
Red radishes	6	105	17,500
Watermelons	52	1,100	21,154
Melons	19	380	20,000

Table IV-38

Cereals, Pulses, Industrial Crops, Fodders;

Area Sown, Production and Yield in Bolu

	AREA SOWN (Hectares)	PRODUCTION (Tons)	YIELD (kg / hectares)
Wheat	72,380	203,270	2,808
Barley	27,428	68,769	2,507
Rye	820	1,923	2,345
Oats	4,290	9,698	2,261
Spelts	690	950	1,377
Maize	16,870	99,230	5,882
Chick peas	260	370	1,423
Dry beans	1,365	3,258	2,387
Rice	534	3,430	6,423
Tobacco	142	270	1,901
Sugar beets (seed)	559	522	934
Sugar beets	1,710	62,180	36,363
Sunflower	300	420	1,400
Cow vetch	2,440	14,480	5,934
Clover	2,180	14,000	6,422
Wheat straw	72,380	243,848	3,369
Barley straw	27,428	89,400	3,259
Oats straw	4,290	12,607	2,939

Table IV-39

Number of Fruit Trees and Fruit Production in Bolu

	NUMBER OF PRODUCTIVE TREES	PRODUCTION (Tons)	YIELD (kg / trees)
Pears	177,600	8,875	50
Quinces	37,130	1,930	52
Apples	613,200	41,199	67
Plums	213,500	7,053	33
Cornels	205,950	1,576	8
Cherries	55,500	2,160	39
Peaches	44,330	1,408	32
Sour cherries	11,725	521	44
Apricots	2,200	116	53
Mulberries	39,725	1,688	43
Figs	4,970	111	22
Almonds	13,000	257	20
Walnuts	60,902	2,868	47
Hazelnuts	20,970,000	57,074	3
Chestnuts	21,950	1,014	46
Grapes	---	11,475	---

Table IV-42

Vegetables; Area Sown, Production and Yield in Mengen

	AREA SOWN (Hectares)	PRODUCTION (Tons)	YIELD (kg / hectares)
Broad beans	15	80	5,333
Calavence	2	12	6,000
Peas	1	7	7,000
Tomatoes	10	20	2,000
Potatoes	295	3,540	12,000
Green beans	23	71	3,087
Pepper	11	16	1,455
Cucumbers	1	3.5	3,500
Squash	13	46	3,539
Spinash	19	38	2,000
Cabbage	10	150	15,000
Lettuce	4	45	11,250
Leek	1	20	20,000
Radishes	5	25	5,000
Dry onions	40	200	5,000
Green onions	15	45	3,000
Dry Garlic	2	1.6	800

Table IV-43

Cereals, Pulses, Fodders; Area Sown, Production and Yield in Mengen

	AREA SOWN (Hectares)	PRODUCTION (Tons)	YIELD (kg / hectares)
Wheat	3,850	8,470	2,200
Barley	905	2,172	2,400
Oats	150	150	1,000
Rye	15	21	1,400
Maize	214	706	3,299
Broad beans	5	5	1,000
Clover	740	2,220	3,000
Cow vetch	1	3	3,000

Table IV-44 Number of Fruit Trees and Fruit Production in Mengen

	NUMBER OF TREES (1)	PRODUCTION (Ton)
Apples	35,000	660
Pears	15,100	375
Quinces	1,000	20
Plums	9,300	55
Cornels	20,000	75
Cherries	9,000	94
Sour cherries	1,800	8
Mulberries	3,000	12
Walnuts	3,000	15
Hazelnuts	8,000	11

(1) : It is include the number of young trees too.

Table IV-48

Industrial Institutions of Bolu Province (1/2)

INDUSTRY BRANCHES	TYPE OF PRODUCTION	YEARLY PRODUCTION	YEARLY CAPACITY	NUMBER OF WORKERS	FUTURE TARGET
Goncagül Abant Colognes	Cologne	6,000 lt.	Full Capacity	2	
Gentaş	Verzalit	615,195	Full Capacity	230	
All Kind Mixed Fodder Production	Mixed fodder	43,200 ton	Full Capacity	46	
All Kind Mixed Fodder Production	Mixed fodder	43,200 ton	Full Capacity	49	
Construction Industry Materials	Wood,metal, steel	3,750,000 pieces	Full Capacity	26	
Bolu Glass Operation Facility	Window glasses and systems	199,234 m2	Full Capacity	63	
Doğuş Forest Product Industry and Trade	Shovel, pickaxe, handle, timber	7,560 m3		4	
Hastarmak Agriculture Machines	Agriculture trailer and machines	120 pieces		6	
Karadeniz Casting Industry and Supply ltd.	Various pig iron Products	2,918 ton	Full Capacity	23	
Kınacı Flour and Fodder Industry	- Flour - Bran	13,908 ton 3,477 ton	Full Capacity	14	
Kınacı Flour and Fodder Industry	All kind mixed fodder	16,800 ton	Full Capacity	14	
Cologne Production	Cologne	45,000 lt.	Full Capacity	3	
Yeniçağ Colognes	Cologne	19,800 lt.	Full Capacity	3	
Balkır Construction Materials	Timber	22,680 m3	Full Capacity	22	
Cement Industry	Cement	600,000 ton	Full Capacity	272	
Abant Parquet Industry	Parquet	3,680 m3	Full Capacity	110	
Şen Industry	- Trailer -Agriculturel trailer	8 pieces 80 pieces		7	
Tahsin Çiftçi	- Flour - Bran	8,816 ton 2,204 ton		13	
Güreller Industry	Puller of trailer, tanker, truck	302,5 ton		14	
Milk Product Industry	- Yokhurt - Buttermilk - Cheese	6,000 ton 2,800 ton 140 ton	Full Capacity	39	
Akdağ Metallic Goods and Press Industry	Electrical Goods parts	516 ton		13	
Flour Industry	- Flour - Bran	29,120 ton 7,280 ton		54	
Turkish Iron Casting Factories	Iron casting products	510,240 pieces			
Trophy X-ray Industry	X- ray devices	780 pieces	Full Capacity	50	

Table IV-48

Industrial Institutions of Bolu Province (2/2)

INDUSTRY BRANCHES	TYPE OF PRODUCTION	YEARLY PRODUCTION	YEARLY CAPACITY	NUMBER OF WORKERS	FUTURE TARGET
SEKA	- Wall Decoration Paper - Sheet	1,065 ton 6,641,000 m2	Full Capacity	369	
Heating Devices	Electrical kitchen devices	900,041 pieces		871	
Filiz Nourishment Industry	- Macaroni - Semolina - Bran	34,560 ton 33,739 ton 17,381 ton		266	
Koza Canvas	Canvas	126,000 m2		5	
Cement Industry	Cement	600,000 ton		378	
KÖY-TÜR	Broiler chicken and eggs	7,679,920 pieces		47	
KÖY-TÜR	- cleaned chicken - side products	6,415,200 kg 748,440 kg		77	
Ermak Electric Machines	- Machine - Press and side products	1,500 pieces 244 ton		24	
SEK	Milk and milk products	11,043 ton		84	

IV.2.2 Population

(1) Peripheral Areas

The dam, water reservoir and most part of waterway route of the project are located at Mengen District area of Bolu Province, while the powerhouse site (in case of ground surface system) is located at the boundary area of Devrek District of Zonguldak Province. Büyüksu River and Mengen River exist in the upstream side of the dam, the former has its valleys in Bolu District while the latter has its valleys in Mengen District. On the other hand, Devrek River flowing downstream side of the dam passes through Devrek District, joins with Yenice River, then flows into the Black Sea as Filyos River. Therefore, this project relates mostly to Bolu and Zonguldak Provinces in the province level and to the three Districts of Bolu, Mengen and Devrek in the district level. Figure IV-29 shows the administrative map of the area of both Bolu and Zonguldak Provinces.

Based on the past population census, the population in Mengen District has been kept almost unchanged since 1955 (18,425 persons) until 1990 (18,982 persons), while that of Devrek District has been almost doubled in 1985 (104,186 persons) compared with the year of 1955 (55,585 persons). On the province level, the population of Bolu Province is 536,869 persons, which is about 1.7 times of that in 1955 (318,219 persons). And the population of Zonguldak Province is 1,073,560 in 1990, which is about 2.2 times of that in 1955 (491,147 persons). Table IV-56 attached hereafter shows the population data of the concerned provinces, districts, towns and villages based on the past population censuses since 1955.

When looking at population density, the density of Bolu Province was 29 (persons per sq. km) in 1955 and 45 in

1990, while that of Zonguldak Province was 57 in 1955 and 124 in 1990. On the district level, the density of Mengen was 21 in 1955 and also 21 in 1985. And the density of Devrek was 45.5 in 1955 and 85 in 1985. Table IV-57 shows the population density data of the both concerned provinces and three districts, together with the national average values for past three census years of 1955, 1985 and 1990. It is noted that, because of the administrative boundaries are being modified since 1986, the trend of the density change of Devrek District is not consistent with that of the years before 1985. As shown by the table, the densities of Zonguldak Province and Devrek District are always higher than national average, while those of Bolu Province and Mengen District are always lower than the national average. The national density was 65 in 1985 which was more than twice of 31 in 1955. Population density of Bolu District has been kept about the same with the national densities to date, while the density of Mengen has been kept quite low. Figure IV-30 shows national population density changes since 1935.

As known from the result of the above various data and the field surveys, the population is concentrated in the plain areas and the gentle slope regions among mountains. In addition, the population becomes higher toward the north direction and the Black Sea coast in this area. The tendency is indicated by the fact that the population density in Zonguldak Province becomes double of the national average. The development of rich coal resource, the unfolding of iron/steel industry and the development of paper mill industry utilizing the rich forest resource has greatly contributed to the population increase in this area. It can be said that these industrial activities required a great deal of labor forces and led to the population increase. On the other hand, the timber industry has become the motive force of development of Devrek District.

The social and economic backgrounds of Mengen District differ from those of Devrek District. Agriculture and the foodstuff processing industry are the main industries in Mengen area, but the river and lake areas in this region are spacious, and therefore the production amount in the agriculture and forestry is lower than that in Devrek District. On the other hand, Mengen area has a more or less coal resource, but its production amount has not been enough to become hauling force of economical development of this area. These various elements become the cause of the low population density in this area. The population density in Mengen District remains almost unchanged for the past 35 years, which has been about 21 persons per square kilometer and less than one third of national average value.

Gökçesu Village is located at the junction point of Büyüksu River and Mengen River, and is an important town from which transportation into deep valleys along Devrek River basin begins. Personnel and material transportation between the valleys and Bolu district must go through this town. Therefore, the population of Gökçesu has been increased along with the growth of Bolu area and reached 1,299 persons in 1985, while it was 480 persons in 1970. Moreover, the population recorded 2,110 in 1990 was a dramatic change in the five years after 1986. The annual population increase rate during the five years was 12.5%, while that of Bolu city (center) was 4.2%, all of them were much higher than the national annual increase rate of 2.2% during the same period.

Bolu city plays important roles for personnel and material land transportation for İstanbul, Ankara and eastern part of Turkey. It also connects various agriculture and industrial products flow between Zonguldak and Ankara areas. All of such roles have contributed to the population increase of Bolu district and city. As shown by Table IV-58, population density of Bolu District has been kept

almost the same with the national average since 1955, which became more than twice in 1990 compared with that in 1955. This reflects the feature of Bolu district and city as mentioned.

The following Table IV-58 shows the population movement data between 1975 and 1980, and also those between 1980 and 1985 in Bolu City and Zonguldak City.

Table IV-58 Population Movement Data of Bolu and Zonguldak Cities

City	Period	Division	Population Movement (persons)
Bolu	1975 - 1980	Inflow	26,899
	" "	Outflow	27,859
	1980 - 1985	Inflow	24,943
	" "	Outflow	29,949
Zonguldak	1975 - 1980	Inflow	43,497
	" "	Outflow	37,811
	1980 - 1985	Inflow	29,284
	" "	Outflow	47,904

Table IV-59 shows the result of employment statistics by different occupation (subdivided into 7 groups) indicated by the population census in 1985 of Bolu Province and Zonguldak Province. The population of the group including agriculture, forestry and others showed the first rank and shared more than 50 % in both the provinces. The second large group was that of manufacturing and production workers, which shared about 25%. The group of administration, scientist and engineers shared less than 5%. Unemployed persons was 6.6% in Zonguldak. Table IV-60 shows the population data in terms of age and sex groups.

Figure IV-31 shows the population structure (pyramid) by age groups in Bolu Province and Zonguldak Province, which was prepared based on the population census of 1985. It is noted that the age group of 12 to 14 appeared less than its higher age groups. This would imply that sound pyramid shape might be lost in future, and could cause labour resource shortage.

The above various data not only shows the population characteristics of the project area and its vicinity, but also reflects the topographical features of the same areas.

(2) Project Area

The populations of Kayabükü and Köprübaşı villages are quite few, which is caused by the severity of its natural environment. Population of Kayabükü, which is the village falling under the reservoir area of the project, was 331 persons in 1970 and 284 in 1990. It was 302 persons in late 1992. On the other hand, the population of Köprübaşı village was 455 persons in 1980 and 356 in 1990.

The following Table IV-61 shows the population data of the villages around the project site area from 1970 through 1990.

Table IV-61 Transition of Populations at the Villages around the Project Area

Villages	1970	1975	1980	1985	1990
Kayabükü	331	310	295	302	284
Köprübaşı	303	373	455	448	356
Akcabey	264	219	236	235	630
Gökçesu	480	653	1,111	1,299	2,110

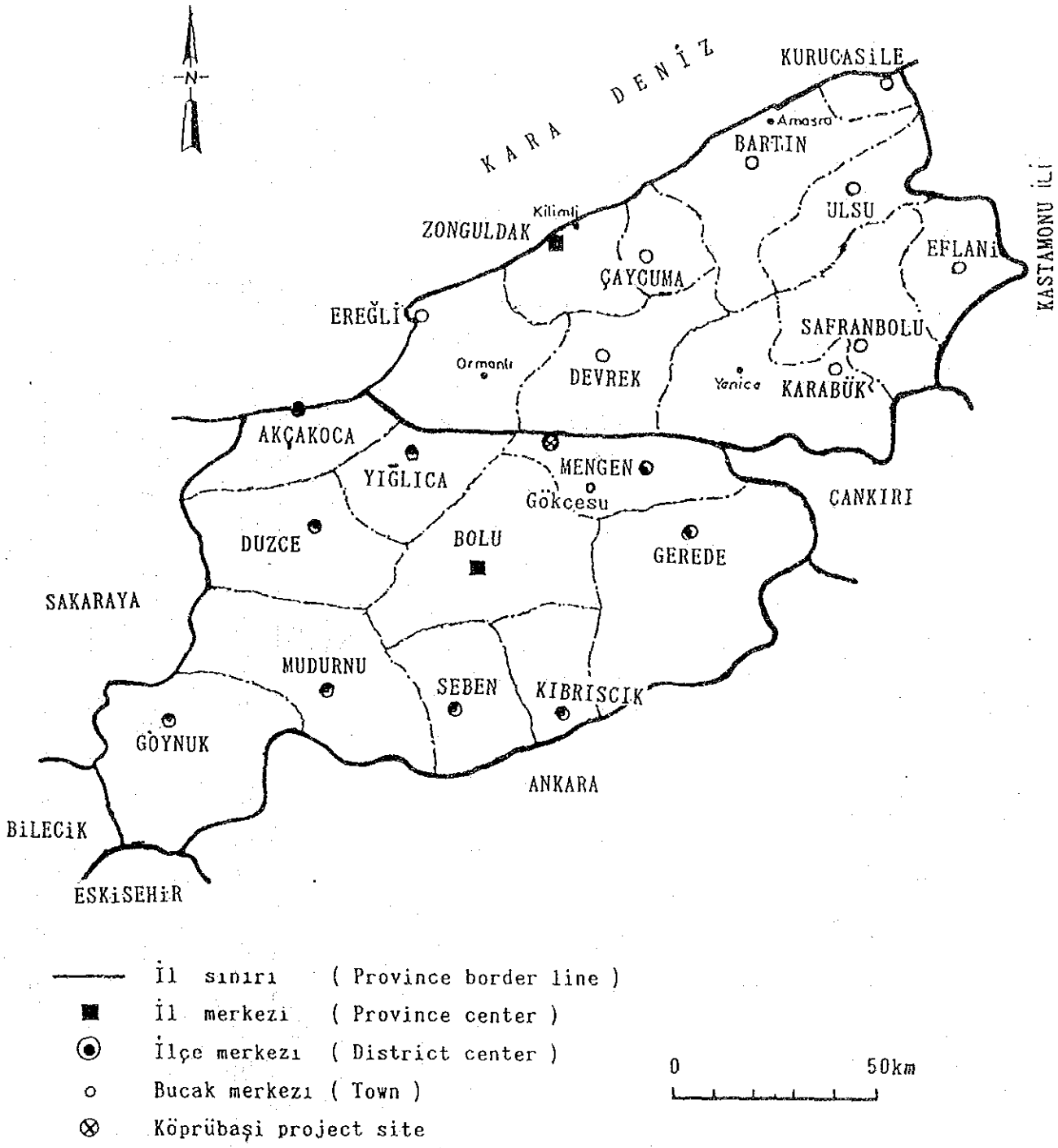


Figure IV-29 Administrative Map of the Area of Bolu and Zonguldak Provinces

SAYIM YILLARINA GÖRE NÜFUS YOĞUNLUĞU

Population density by year of census

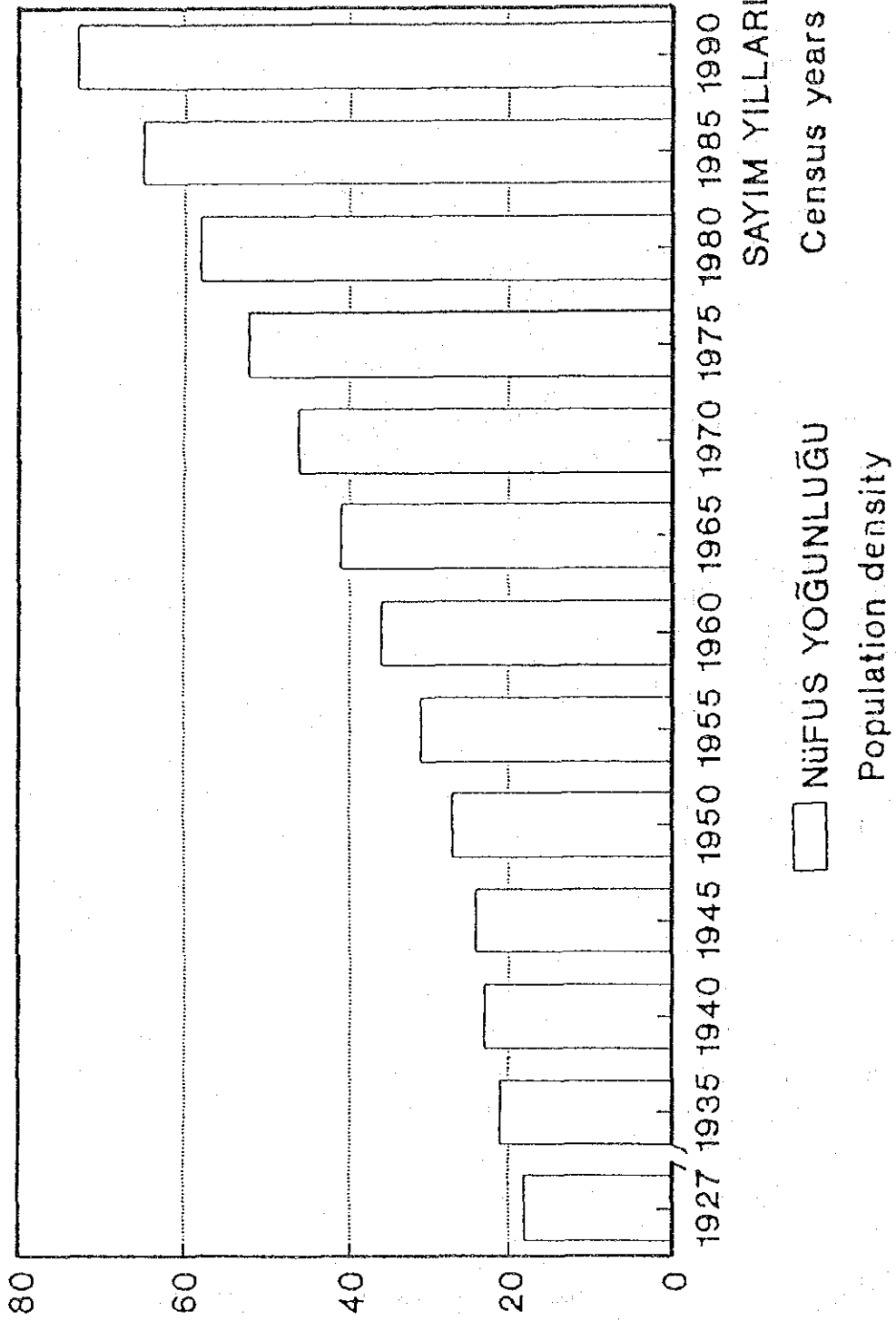


Figure IV-30 National Population Density by Year of Census

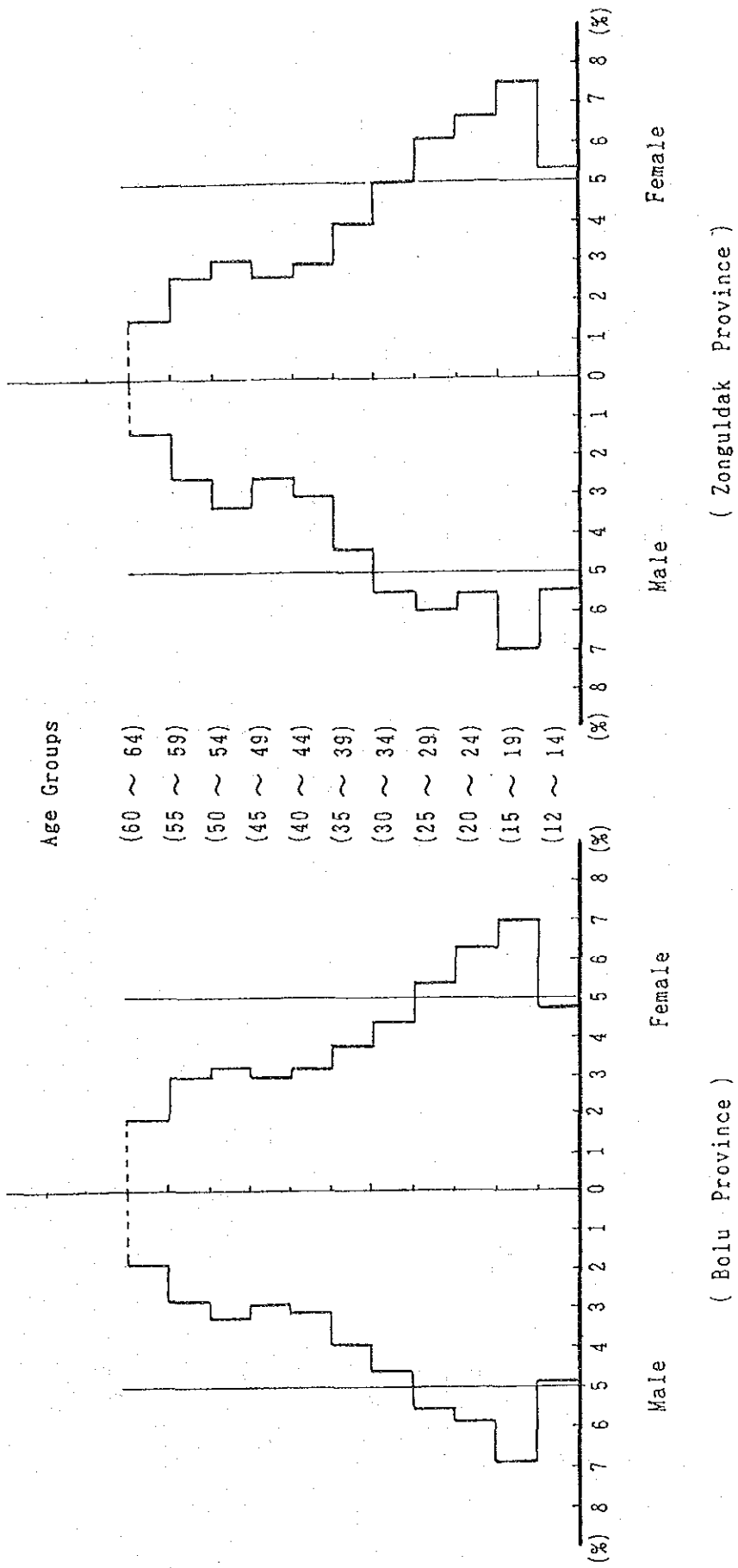


Figure IV-31 Population Pyramid of Bolu and Zonguldak Provinces (1985)

Note: The part of age group of 0 ~ 11 and 65 + are not shown because of lacking necessary data.

Table IV-56 Population Data of Bolu and Zonguldak Provinces and Concerned Cities, Towns and Villages

Names of Provinces, Districts, Towns and Villages	Years of Population Census										
	1955	1960	1965	1970	1975	1980	1985	1990			
Bolu	province	318,219	353,004	383,939	403,766	428,704	471,751	504,778	536,869		
	district	48,002	54,882	63,182	69,200	77,078	87,257	100,910	113,596		
	center (city)	12,271	13,745	21,700	26,944	32,812	38,283	50,288	60,783		
Zonguldak	province	491,147	569,059	650,191	753,654	836,156	954,512	1,044,945	1,073,560		
	district	110,486	NA	148,041	173,207	194,700	231,581	250,164	249,610		
	center (city)	47,589	54,010	55,404	77,135	90,221	109,044	117,879	116,725		
Mengen	18,425	NA	20,791	18,849	18,302	18,886	18,813	18,982			
Devrek	55,585	61,970	68,532	79,343	84,104	94,298	104,186	(74,133)			
Gökçesu	242	NA	784	480	653	1,111	1,299	(2,110)			
Kayabükü	292	NA	319	331	310	295	302	284			
Köprübaşı	221	NA	281	303	373	455	448	356			
Akçabey	263	NA	287	263	219	236	235	(630)			
National total	24,064,763	27,754,820	31,391,421	35,605,176	40,347,719	44,736,957	50,664,558	56,473,035			

Remarks : 1) NA stands for " Not Available "

2) It is noted that the number with parenthesis shows sudden increase or decrease from its past data. After reviewing the census document of 1990 and discussions made with pertinent personnel, it is understood that such sudden change was caused by rearrangement of administrative boundaries, which was started from 1986.

Table IV-57

Population Density Data of Bolu and Zonguldak Provinces,
and Concerned Districts

Administrative Unit	Area (sq. km)	Population density per sq.km		
		1955	1985	1990
Bolu (province)	11,051	29	46	49
Zonguldak (province)	8,629	57	121	124
Bolu (district)	1,527	32	66	75
Devrek (district)	1,222	45.5	85	61 (*)
Mengen (district)	883	21	21	21.5
National average	774,814	31	65	73

(*) Note : Since the administrative boundaries are being modified after 1986, the trend of the density change of Devrek is not consistent with that of the years before 1985.

Table IV-59

Employed Population of Bolu and Zonguldak Provinces

(Population Census of 1985)

Classified Group	Province	
	Bolu	Zonguldak
Scientific, technical, professional and related persons	9,505 (3.7%)	18,067 (4.6%)
Administrative and managerial persons	1,198	1,740
Clerical and related workers	5,718	12,138
Sales workers	7,809	12,258
Service workers	11,707	20,856
Agriculture, livestock breeding, forestry, fishery and hunting	146,771 (57.4%)	207,035 (52.3%)
Manufacturing and production workers, transportation vehicle operators, and related labourers	67,243 (26.3%)	97,747 (24.7%)
Unemployed persons seeking a job	5,923 (2.3%)	26,040 (6.6%)

Remarks : 1) Unit : number of persons

2) The percentage number in each parenthesis shows the part it shares within the total sum of the all groups listed.

Table IV-60 Population Data of Bolu and Zonguldak by Age Group and Sex (1985)

(Based on Population Census of 1985)

Age Group	Bolu Province				Zonguldak Province			
	Total		Male	Female	Total		Male	Female
	persons	%			persons	%		
Total	369,355	100	182,152	187,203	717,508	100	354,887	362,821
12 ~ 14	35,665	9.7	18,047	17,618	77,441	10.8	39,149	38,292
15 ~ 19	51,077	13.8	25,180	25,897	103,978	14.5	50,574	53,404
20 ~ 24	44,729	12.1	21,426	23,303	87,241	12.2	39,543	47,598
25 ~ 29	40,343	10.9	20,439	19,904	86,557	12.1	42,738	43,819
30 ~ 34	33,413	9.0	17,004	16,409	75,314	10.5	39,364	35,950
35 ~ 39	28,282	7.7	14,323	13,959	59,306	8.3	31,397	27,909
40 ~ 44	23,104	6.3	11,349	11,755	43,172	6.0	22,159	21,013
45 ~ 49	21,878	5.9	10,649	11,229	37,585	5.2	18,699	18,886
50 ~ 54	23,860	6.5	11,985	11,875	45,375	6.3	23,699	21,676
55 ~ 59	21,457	5.8	10,519	10,938	37,293	5.2	18,656	18,637
60 ~ 64	14,085	3.8	6,925	7,160	20,452	2.9	9,919	10,533
65 +	30,477	8.3	13,763	16,714	42,832	6.0	18,119	24,713
Unknown	985	-	543	442	962	-	571	391

IV.2.3 Social Infrastructure Service

(1) Transportation

Figure IV-32 shows the traffic to the project site from the peripheral cities and towns. Further, Figure IV-33 shows the distribution of roads around the project site and the distances among the respective towns and villages. The National Route No. 100, which has been adjusted to two traffic lanes on one side in the east/west direction passing through the remote location by some 20 km in its straight line distance, runs in the south direction of project site, wherein the large scale trucks loading the materials and commodities, the buses and the passenger cars are incessantly running. This National Route No.100 leads to Istanbul in its west and to Samsun of the Black Sea Coast in its east, and further leads to the national boundary with Iran via Erzincan. In addition, the National Route No. 100 is connected with National Route No. 750 at Gerede, and is connected with many cities and towns on the Mediterranean Sea Coast and the Aegean Sea Coast in its west/south via capital city Ankara in its south. In order to correspond to the increase in the comings and goings (traffic) of persons and materials between Istanbul and Ankara, the construction of high speed ways has been advanced between both the cities in the recent years. These high ways have almost been completed at this point of time.

Besides the foregoing main routes, the asphalt pavement roads connecting the cities, towns and villages in the area around the project site with each other, as well as the gravel pavement roads whose ground is stabilized and the car roads and mountain paths all together, forms the transportation network. The following Table IV-62 shows the total extension distances of various kinds of roads in each district of Bolu, Devrek and Mengen.

Table IV-62 Total Extension Distances of Various Kinds of Roads in Each District of Bolu, Devrek and Mengen

District	Kinds of Road	Total Distance	Remark
Bolu	Asphalt pavement	Some 300 km	buses can be used at all villages in Bolu area.
	Stable ground gravel pavement	Some 4,000 km	
	Simple pavement	Some 780 km	
Devrek	Asphalt pavement	Some 80 km	Buses can be used at 52 villages in Devrek area.
	Stable ground gravel pavement	Some 400 km	
	Simple pavement	Some 70 km	
Mengen	Asphalt pavement	Some 8 km	Buses can be used at all villages in Mengen area.
	Stable ground gravel pavement	Some 420 km	
	Simple pavement	Some 70 km	

As shown in Figure IV-32 illustrating the peripheral transportation network, the project site can be approached from Bolu or Mengen. In any of the cases, the project site can be reached by advancing the simple car road and the mountain lane along Devrek River toward the downstream direction via Gökçesu. After passing through Köprübaşı Village, Kayabükü Village and Dirgene Village which are located at the project area, the road leads to Ayrım Village on National Route No.750. The road is destined to be directed to Mengen in the south from there and to Devrek in the north. The National Route No.750 can also be utilized up to Zonguldak on the Black Sea Coast from Devrek.

The roads around the dam and reservoirs of the project site

are narrow, which are difficult for the traffic of large sized vehicles transporting equipment and materials which are heavy substances. In addition, the large sized vehicles can not pass through the bridge connecting both the banks of river. Therefore, the adjustment of road connecting the project site will be required for construction work in future.

(2) Public Facilities

a) Peripheral areas

The educational facilities in both Bolu and Zonguldak Provinces and in the entire area of Mengen and Devrek which are the peripheral area are considerably replenished. The survey this time could clarify their actual situation. The following Table IV-63 and IV-64 show the outline of the kinds of educational facilities and their number in these districts.

**Table IV-63 Outline of Kinds of Educational Facilities and
Number of Facilities in Bolu and Zonguldak**

District	Kinds of Educational Facilities	No. of Facilities
Bolu Province	Pre-school education (kindergarten)	94
	Primary school	997
	Secondary school	69
	High school	51
	Industrial high school	5
	Girl Science school	7
	Various training school	18
Zonguldak Province	Pre-school education (kindergarten)	12
	Primary school	1,435
	Secondary school	43
	High school	31
	University	3
	Various training school	2,217
	Public education course	1,839

**Table IV-64 Outline of Kinds of Educational Facilities and
Number of Facilities in Devrek and Mengen**

District	Kinds of Educational Facilities	No. of Facilities
Devrek District	Kindergarten	1
	Primary school	157
	Secondary school	6
	High school	2
	Industrial high school	1
	Various training school	12
Mengen District	Primary school	52
	Secondary school	1
	Anatolian Cookery High School	1
	Practical Handcrafts School for Girls	1
	Other various training school/course	5

There exists in Bolu the educational facilities established with the fund called "Izzet Baysal Fund" in addition to the above mentioned facilities, which covers kindergarten, primary school, junior high school, senior high school, university and job training school. For information, "Anatolian Cookery High School" in Mengen is said to be sole high school specialized in cookery education in Turkey. Moreover, "Practical Handcrafts School for Girls" in both the districts are playing an important role for girls' handcraft education. On the other hand, it can be noticed that there are three universities and as many as some 2,000 various kinds of education training schools and courses are set up in Zonguldak. This variety of education training schools and courses aims at providing the general education, commerce, sight seeing and skill training.

b) Project Site

On the other hand, the layout situation of public facilities at the villages in the vicinity including the project site area is shown in the following Table IV-65, and Gökçesu Village becomes the trading and transportation center of this area. Besides this, the electric cables and the telephone lines run through this entire area, and the electricity service has been given to this area.

Table IV-65 Public Facilities at the Project Site and its Vicinity

Villages, Colonies	Gökçesu	Kayabüktü	Köprübaşı	Akçabey
School				
Pre-primary school		1	1	
Primary school				1
Primary + Secondary	1			
High school	1			
Mosque	2	1	2	1
Post office	1			
Police office	1			(1)
Town hall	1			
Store	about 50			
Petrol office	1			
Medical facility	1			
Recreation facility				
Grave site	1	4	1	1

Note: In Akçabey, petrol office at Dergine village is being used by the villagers.

Regarding the subject of health and hygiene, see Item IV.2.7.

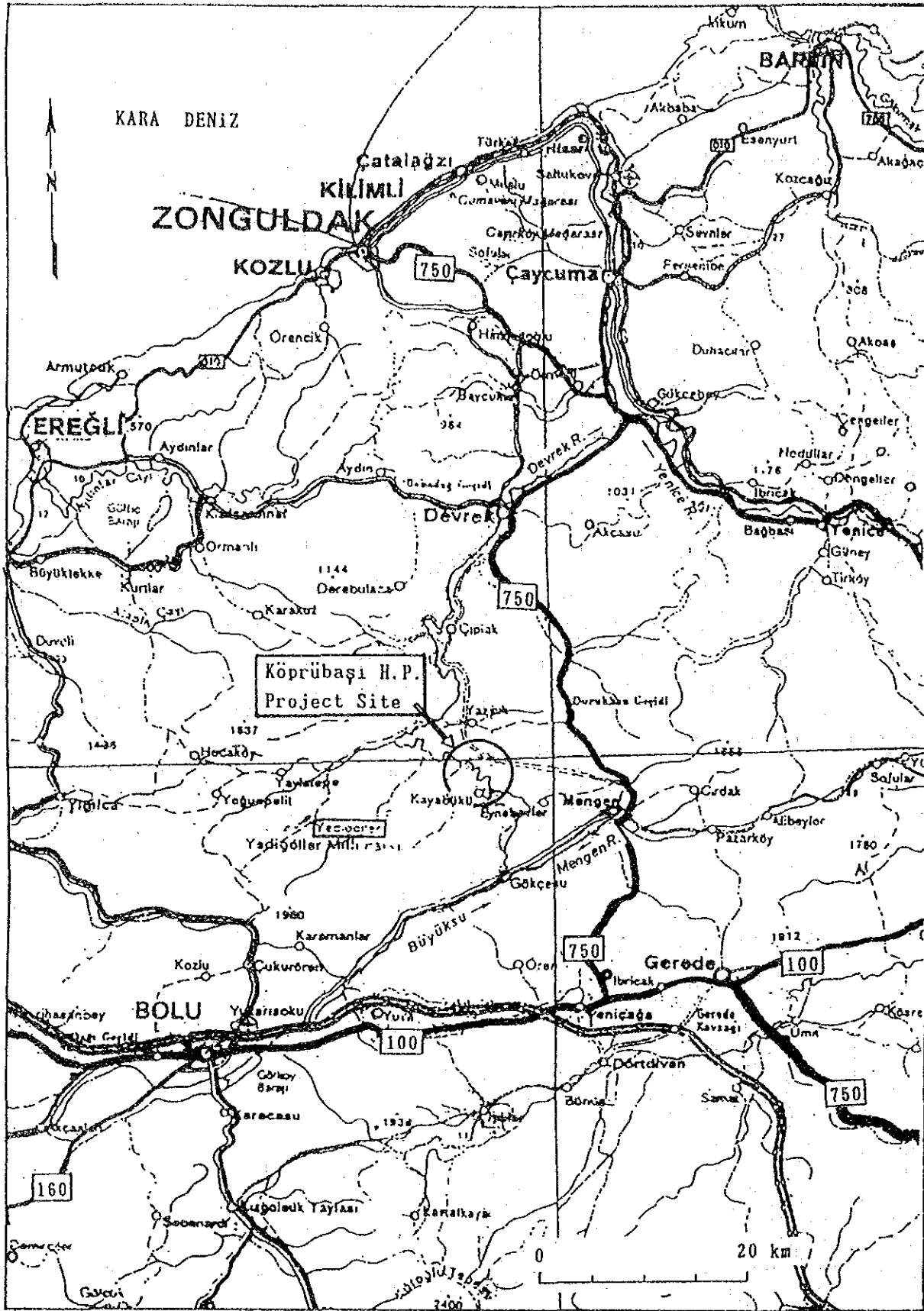


Figure IV-32 Transportation Network of the Area of Bolu and Zonguldak Provinces

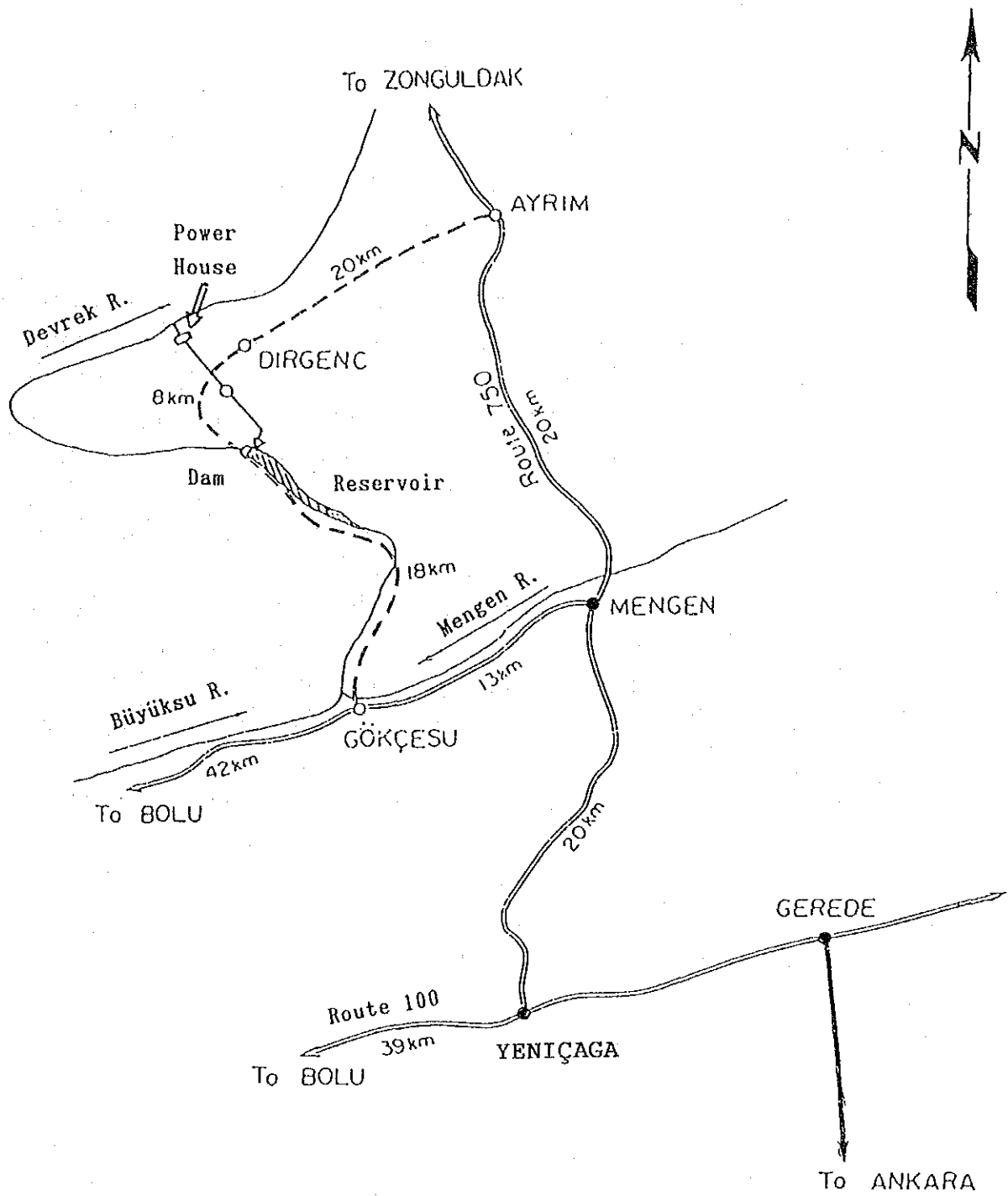


Figure IV-33

Transportation Network around the Project Area and Distances between Cities and Towns

IV.2.4 Land Utilization

(1) Peripheral Areas

The attached Table IV-66 shows the land utilization situations in terms of different utilization patterns in each of Bolu, Devrek and Mengen districts. The following Table IV-67 shows the outline of the land utilization situation. As can be seen from these tables, the total area of Bolu district covers the space of some 9 times as compared with that in Mengen district and of some 6.8 times in comparison with that in Devrek district. The area of forest and low tree land occupy about 60 % in any of the districts. In Bolu district, the water area including rivers, lakes, marshes, etc. occupies about 10 %, the dry field farming land 16.5 % and the orchard 7.5 %, while the irrigation farming land occupies only 0.5 %. In Mengen district, the water area including rivers, lakes and marshes occupies 21 %, the dry field farming land 13 % and the orchard 0.7 %, while the irrigation farming land is small like 0.5 %. In Devrek district on the other hand, the water area of rivers, lakes and marshes occupies 8 %, the dry field farming land 15.7 %, irrigation farming land 2.2 %, whereas the orchard is the narrowest at 0.3%.

Table IV-66

Land Use Situation of Bolu, Devrek and Mengen Districts

LAND USE

Unit : Hectare

Type	Districts		
	BOLU	MENGEN	DEVREK
Pasture			
Meadow	50,488	2,111	6,450
Forest			
Brush wood	459,848	51,988	73,482
Dry agriculture with fallow	18,724	729	---
Dry agriculture without fallow	114,503	10,609	18,523
Irrigated field	3,708	469	2,557
Orchard	59,561	595	350
Vineyard	586	---	7
Housing land		2,405	7,250
Water surface area			
River Bed	99,301	16,659	9,409
Swampy (Marsh)			
Rocky and other uncultivated land		1,500	
TOTAL			

Table IV-67 Outline of Land Utilization in the Peripheral Areas

Pattern	Bolu district (%)	Mengen district (%)	Devrek district (%)
Pasture & meadow	6.2	2.4	5.5
Forest & bush wood	57	59.7	62.2
Dry agriculture	16.5	13	15.7
Irrigated field	0.5	0.5	2.2
Orchard & vineyard	7.5	0.7	0.2
Housing land	(note)	2.7	6.1
Water surface area	12.3	21	8

(Note) The percentage of housing site area in Bolu district is included in the figure of 12.3 %, which is for the water area portion.

(2) Project site

The main industries at the project site are agriculture and forestry, and livestock breeding is also being more or less carried out. These farming and the livestock breeding lands are dispersed in the periphery of the villagers' houses, whereas the forestry land is spread over the entire area of sharp slope surface and ridge which are not suitable for the living quarters. In the periphery of Köprübaşı village, the farming land is spread with the gentle slope surface along the river and the area more western side than the Bellen colony as its center. In Kayabükü village, the slope surface of valley and the small slope surface along the canyon on the downstream side are utilized as farming land. This is approximately applicable to the colonies in Kesebükü and Ispaca. Item IV.2.1 described the main agricultural and livestock breeding products in these villages. They are living on the self-sufficiency and selling any extra products to the market.

IV.2.5 Income

(1) Peripheral Area

The economical activities, products, production amounts, etc. in Bolu and Zonguldak Provinces as well as Mengen and Devrek districts falling under the peripheral areas of project site are described in detail in Item IV.2.1. However, the income, its maximum, minimum and mean values per family or person in terms of agriculture, livestock breeding, forestry and mining industries are not required in the final draft of the EIA Rule prepared by the Environment Ministry in Turkey.

(2) Project Site

Table IV-68 clarified the main income sources and approximate income amounts per year per family of the four villages at the project site, which are the result of hearing survey performed during the study.

Table IV-68 Main Income Source and Annual Mean Income per Family of the Four Villages

Source of Income	Gökçesu	Kayabükü	Köprübaşı	Akçabey
Forestry		Second	Second	First
Agriculture	Second	First	First	Second
Livestock breeding		Third	Third	Third
Mining	Third			
Commerce	First			
Working outside of the village	Yes		Yes	Yes
Total income per Family (Million TL)	50	9-10	10-15	10-15

The cash income source at Gökçesu village comes mainly from the labor reward at the coal mining in the vicinity and from the commerce, and 65% of the current population at

this village is the immigrants from Zonguldak Province. They have the mean income more than twice of the other villages, but about 20 % of villagers are working away from home at the neighbor cities and towns or at foreign countries from the shortage of employment opportunities against the population. Working away from home is similarly applicable to the other villages. The above mentioned income amount doesn't include the remitted amount from the workers working outside.

The agriculture (mainly vegetables) is the major income source at Kayabükü Village (including Kayabükü, Kesubükü and Ispaca), being followed by the timber production. The income from the livestock breeding accounts for only 10 %. Twenty percent of vegetable production volume is for the self sufficiency, and the residual 80 % is being sold out. 80 % of the livestock products is for the self-sufficiency and the residual 20 % is being sold out. It is added that at this village many persons have thus moved to Gökçesu.

Agricultural land is comparatively small at Köprübaşı Village and the villagers are obtaining the cash income mainly as the workers of forestry. Because the employment at the forestry has been decreasing in recent year, about 150 persons are working away from home in İstanbul at the point of present time.

Working at Forestry Control Office is one of the methods for earning the cash income at Akçabey, but about 25 young people are working outside.

IV.2.6 Unemployment

(1) Peripheral Areas

Item IV.2.2 showed the investigation result concerning the employment population by occupations in both Bolu and Zonguldak Provinces. Table IV-59 showed those data in detail based on the population census of 1985. The unemployment population and its percentage are included in the same table. A part of the said data is extracted below:

Table IV-69 Unemployment Population in Bolu and Zonguldak Provinces

Unemployment Population	Bolu	Zonguldak
Unemployed persons seeking a job	5,923 (2.3%)	26,040 (6.6%)

Note: This data is derived from the population census of 1985.

The number of unemployed persons being quoted here stands for those who are seeking a job in the periphery of living quarters, and excludes those persons working away from home at other cities and towns and at foreign countries.

(2) Project Site

As shown in the part of Item IV.2.1 (Economical characteristics), agriculture is the main industry at the project site, and the villagers are earning the cash income from the sale of any extra agricultural products after their self-sufficiency and from the labor at the forestry. The income amount per family is shown in the preceding item, but is insufficient for the living. Therefore, it is the current situation that most young people are working outside of the villages. Namely, it could mean that the unemployment population is almost close to zero.

IV.2.7 Health and Hygiene

(1) Peripheral Areas

Zonguldak is an industrial area. According to the statistics in 1990, the patient percentage in Zonguldak Province proved to be one per 3,896 persons, which is considerably lower than the national average of one per 1,300 persons. The major medical facilities are State Hospitals in Karabük, Devrek and Safranbolu.

The medical service in Bolu Province was not adequate in the past, but has gradually been improved. Therefore, the mean life span of this area in recent years becomes longer than the national average, and contagious disease has also become less. The patient percentage at the same province is one per 2,432 persons, which is also lower than that of national average.

There are six State Hospitals in Bolu city and Gerede city as the major medical facilities, and there are also the spring physical medical hospitals, social insurance hospitals and health care centers.

There exist no other generic diseases that become problem than rheumatism in Mengen area. The adults' major death cause is the cardiac disease, and the children's major death cause is the disease relating to the lungs. The mean life ranges from 65 to 70 years old, and the death percentage is 10/1,000 (or 1 percent). On the other hand, in Devrek, the adults' major death causes are cardiac disease and lung disease, while children's major death causes are the unbalanced nutrition and the lung disease. The mean life ranges from 62 to 63 years old and the death percentage is 25/1,000 (or 2.5 percents).

The following Table IV-70 shows the number of various kinds

of medical facilities in Bolu city, Mengen and Devrek districts, and Table IV-71 shows the current number of doctors and medical concerned persons of the same areas.

Table IV-70 Number of Various Medical Facilities in Bolu city, Mengen and Devrek Districts

Kind of Medical Facilities	Bolu city	Mengen	Devrek
State hospital	6	-	1
Tuberculosis hospital	1	-	-
Health center	4	1	7
Dispensary	4	-	-
Private hospital	1	-	-
Health unit	55	3	-
Health house	199	-	-

Table IV-71 Number of Medical Concerned Persons in Bolu city, Mengen and Devrek districts

Category	Bolu	Mengen	Devrek
General practitioner or doctor	186	9	- 20
Specialist	78	-	-
Dentist	16	1	-
Pharmacist	7	-	-
Nurse	329	5	-
Midwife	371	8	-
Health technician	173	6	-
Other health staff	90	-	-

(2) Project Site

As a result of a wuestion survey at the site area, it was found that no medical facility exists at any of Köprübaşı

Village and Kayabükü Village (including three colonies of Kayabükü, Kasebükü and Ispaca). Therefore, in case of a disease, patients have to be treated in Gökçesu, in Mengen or Devrek, or even in Bolu city depending on the kinds and degrees of the diseases, if the medical treatment is required. This can be said to be the common anxiety among the mountain villages. In recent years, there seem to be no epidemic nor contagious diseases in this entire area. There exist lung disease as children's contagious disease.

Chapter V Effects of Project on Environment and Countermeasure

V.1 Preparation of the Field, Activities at Construction and Establishment Stage, it's Effects on Physical and Biological Environment and Countermeasure

V.1.1 Outline of Facilities and Constructions

(1) Construction Area

Figure V-1 and V-2 show the locations of collection and disposal area of aggregate, the route of transportation of materials, area of dam main body and attached facilities, raceway, electric power station and switchyard, the route of power transmission line.

(2) Construction Scales and Used Materials and Equipment

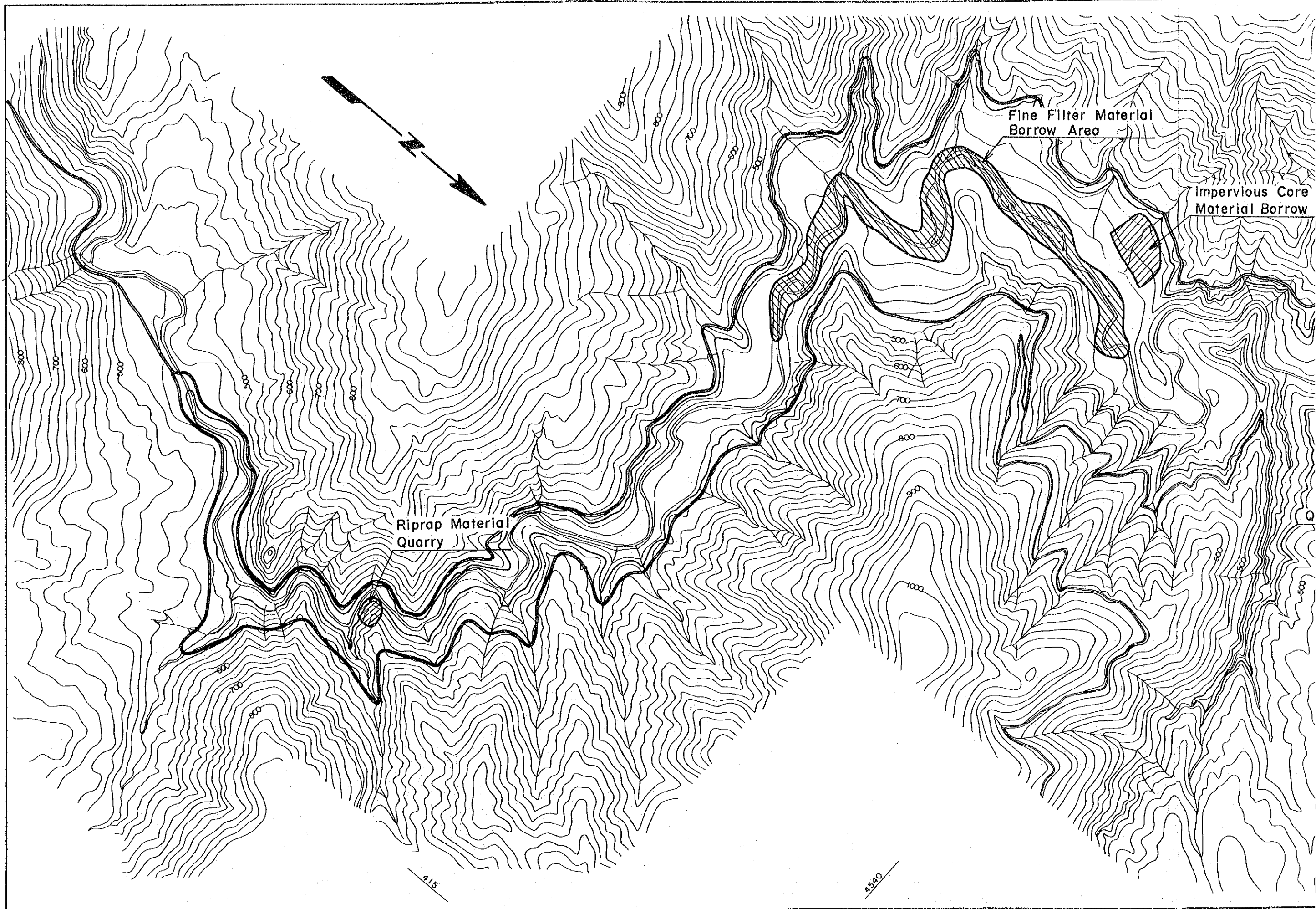
Construction Scales are shown in Table V-1. Used materials and equipment are shown in Table V-2.

(3) Transportation of Materials and Equipment

Main transportation routes of materials and equipment are shown in Figure V-3.

(4) Construction Process and Labor Forces

Construction processes are shown in Table V-3. Construction process of Köprübasi project are planned under 6 stages. Appromate maximum number of labors is about 2,000.



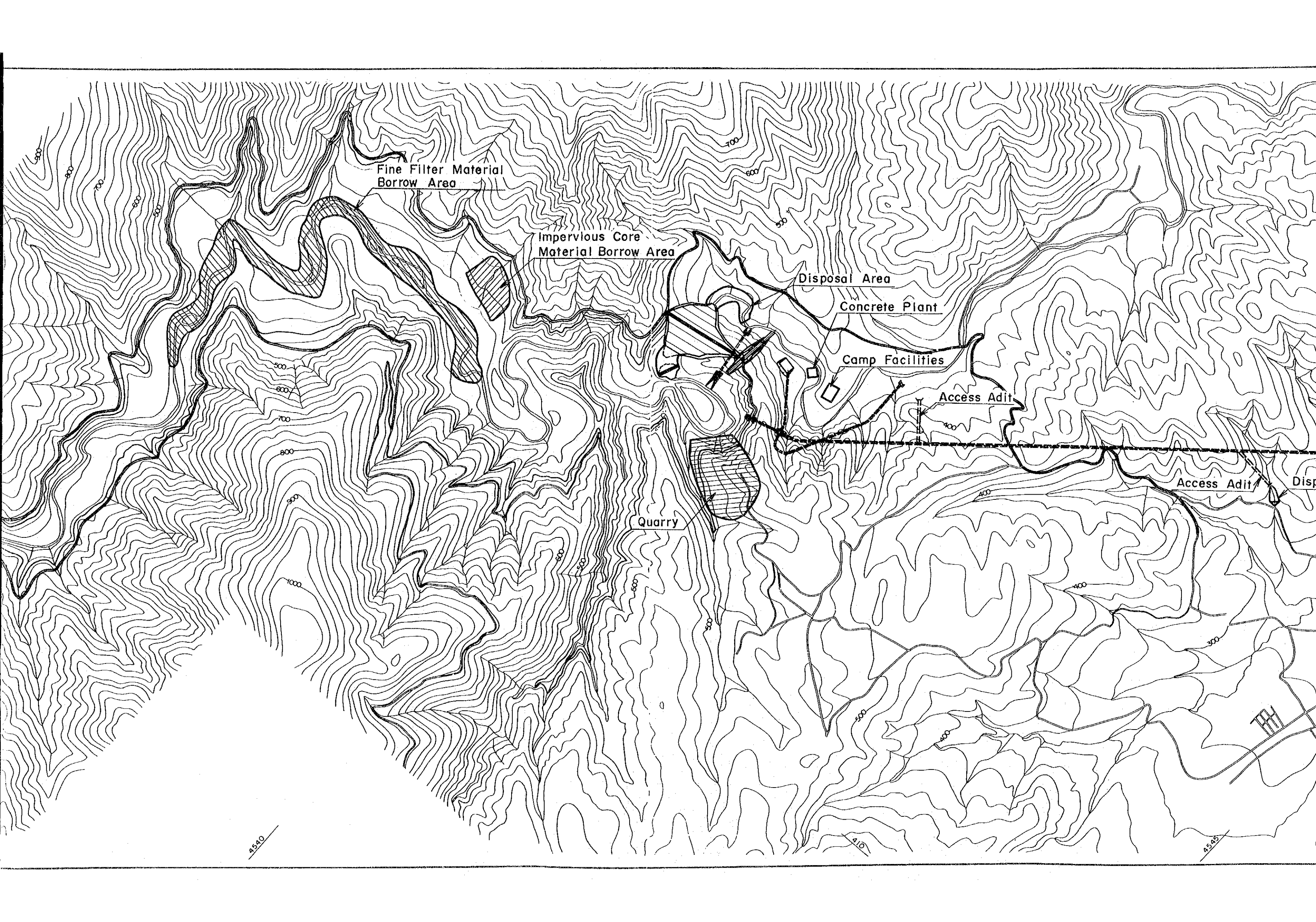
Riprap Material
Quarry

Fine Filter Material
Borrow Area

Impervious Core
Material Borrow

415

4540



Fine Filter Material
Borrow Area

Impervious Core
Material Borrow Area

Quarry

Disposal Area

Concrete Plant

Camp Facilities

Access Adit

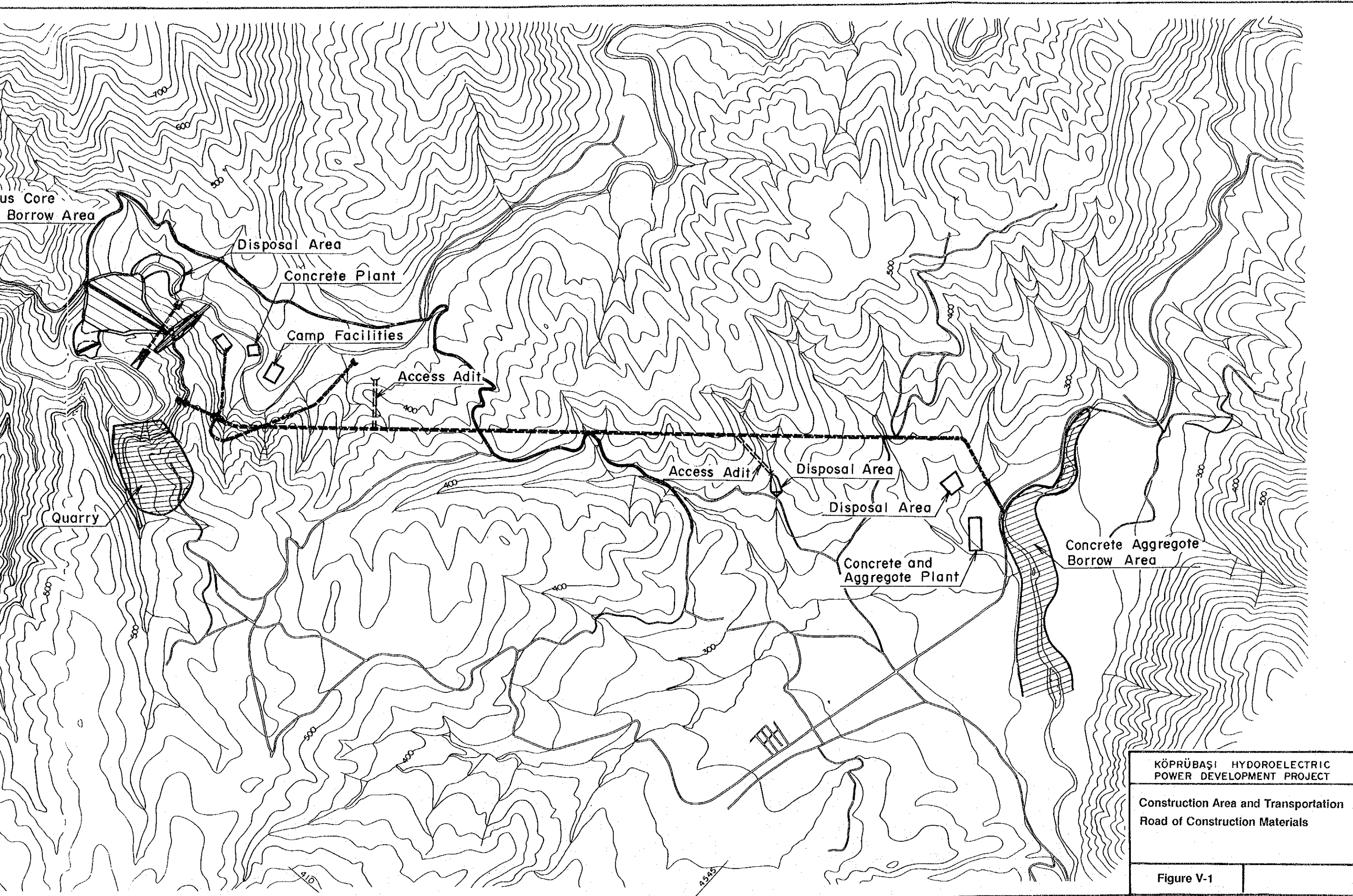
Access Adit

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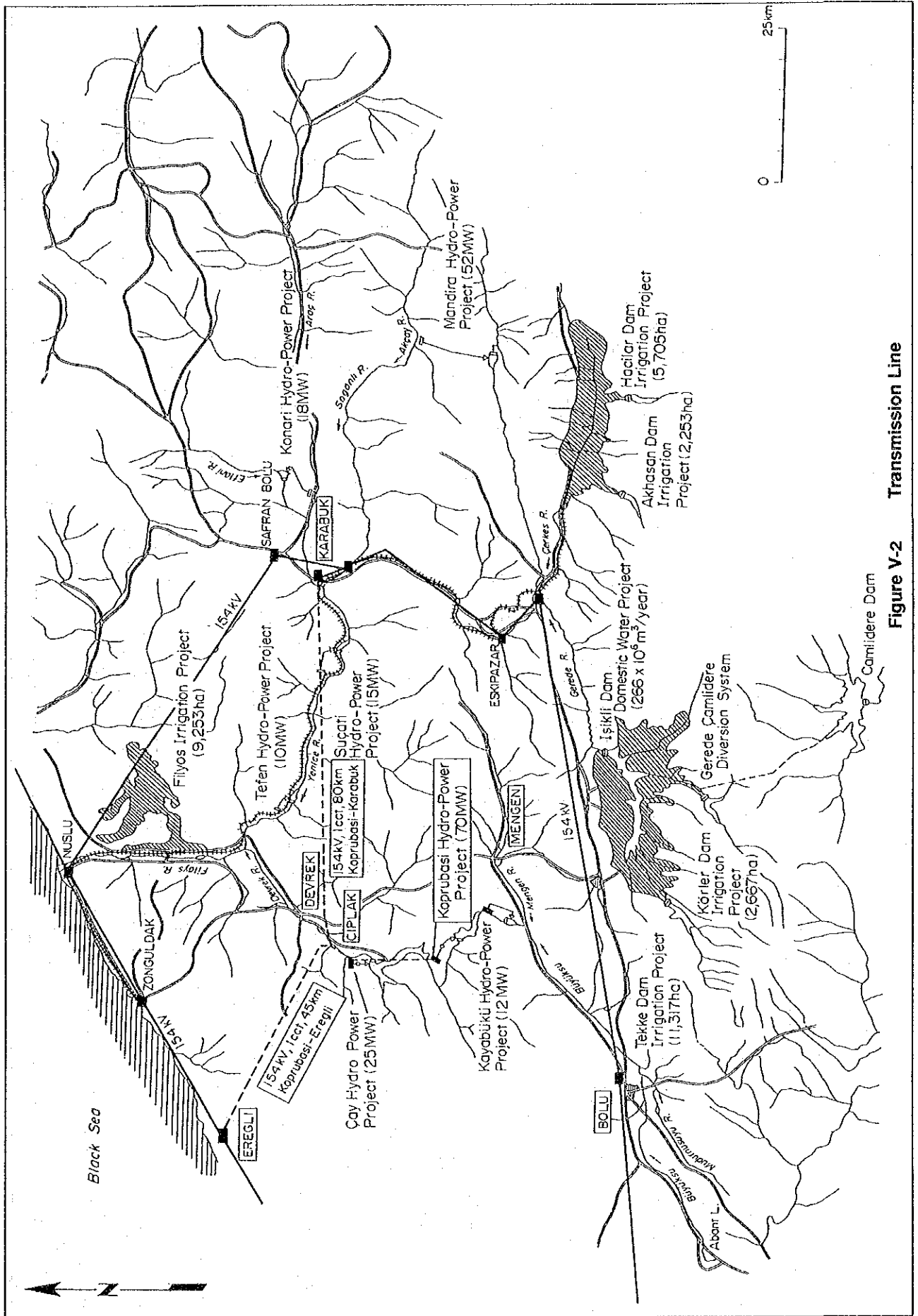


Figure V-2 Transmission Line

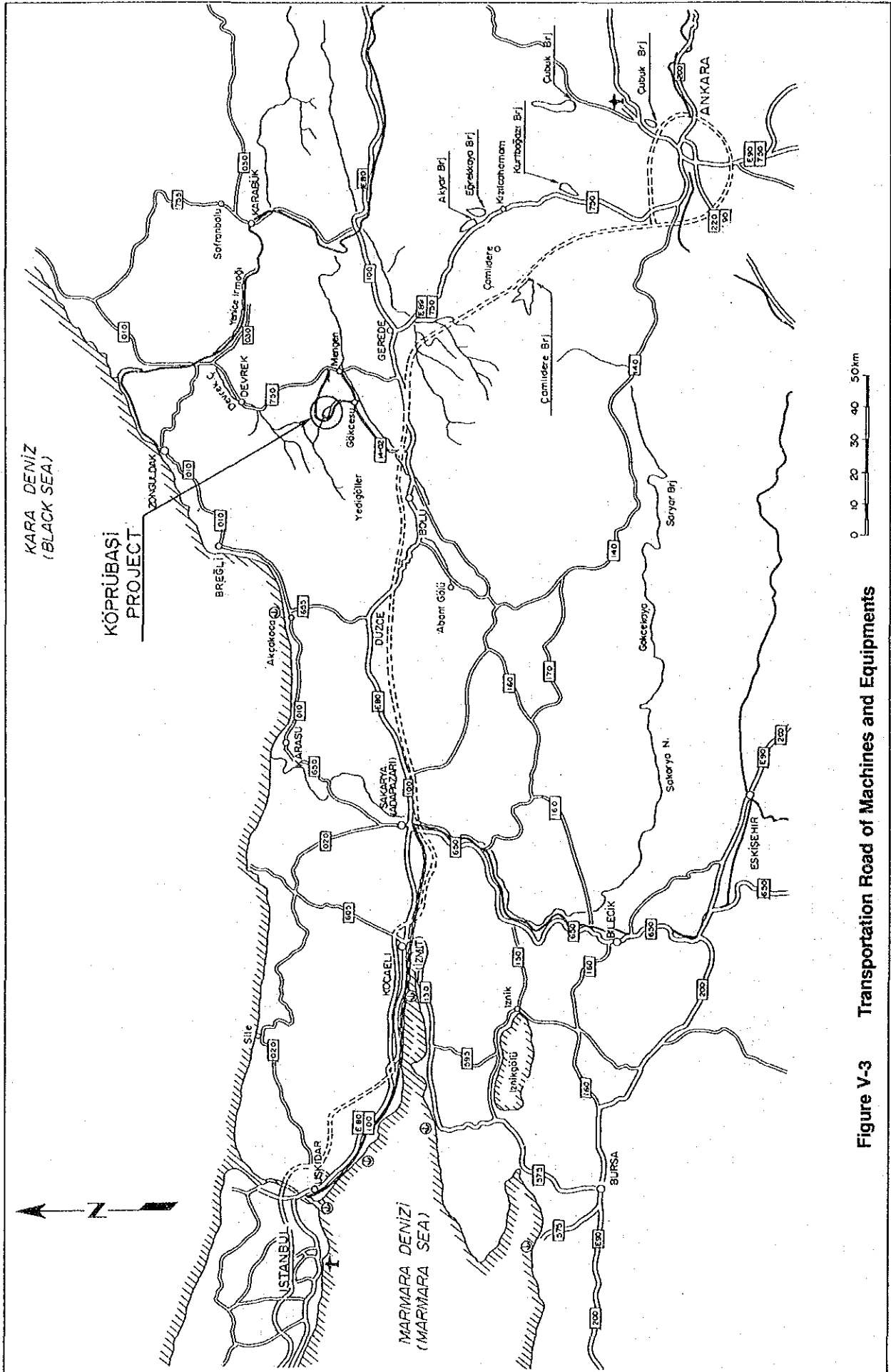


Figure V-3 Transportation Road of Machines and Equipments

Table V-1

Principal Civil Works

Item	Description	Civil Works	
Diversion Tunnel	D=6.0m L=390m	Tunnel ex. Lining conc.	16,400 m ³ 4,100 m ³
Cofferdam		Embankment	87,000 m ³
Dam	H=110m L=537m	Ex. in open Em. of Core Em. of Filter Em. of Rock Riprap	553,000 m ³ 757,000 m ³ 735,000 m ³ 3,067,000 m ³ 132,000 m ³
Spillway	W=260m L=180m W=13m, H=14.5m	Ex. in open Concrete Gate	356,000 m ³ 44,800 m ³ 2
Power Intake	D=3.4m, L=41.5m W=2.5m x 5.0m, H=57.7m	Ex. in open Tunnel ex. Shaft ex. Concrete Gate	26,200 m ³ 750 m ³ 1,700 m ³ 2,190 m ³ 1
Penstock	(D=3.4m, L=248mx1) (D=2.2m ~ 1.70m L=17mx2)	Tunnel ex. Plug conc. Steel Penstock	4,850 m ³ 2,410 m ³ 715 t
Powerhouse	W=16m, H=35.3m L=62m	Ex. in underground Concrete	31,000 m ³ 9,100 m ³
Access Tunnel	W=5m, H=5m L=1,100m	Tunnel ex. Lining conc.	32,300 m ³ 4,250 m ³
Tailrace Tunnel	D=4.6m, L=4,850m	Tunnel ex. Lining conc.	120,000 m ³ 25,000 m ³
Switchyard	W=60m x 80m	Ex. in open Concrete	53,000 m ³ 2,400 m ³

Table V-2

Machinery for the Project

Item		Machinery		Nos.
Dam	Core and Filter	Wheel loader	4.5 m ³ class	2
		Dump truck	32 t class	8
		Bulldozer	32 t class	5
		Vibratory roller	15 t class	2
	Rock	Wheel loader	8.5 m ³ class	2
		Dump truck	45 t class	8
		Bulldozer	43 t class	5
		Vibratory roller	15 t class	2
		Shovel	1.2 m ³ class	2
Tunnel	Tunnel Ex.	Jumbo	3 boom	4
		Rocker shovel	0.6 m ³	4
	Concrete	Concrete pump	60 m ³ /hr	4
		Concrete plant	0.75 m ³ /min	2
		Aggregate plant	150 t/hr	1

Table V-3 Construction Schedule

Item	Quantity	-1st				1st				2nd				3rd				4th				5th			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Preparatory Works																									
Access Road																									
Diversion Tunnel	D:6.0m L:390m																								
Coffer Dam																									
D a m	Ex: 553x10 ³ m ³ Em: 4.691x10 ³ m ³																								
Spillway	Grouting: 1.350 t Ex: 356,000 m ³ Conc: 44,800 m ³																								
Outlet Works																									
Intake	Ex: 28,700 m ³ Conc: 2,300 m ³																								
Penstock	D: 3.40m L: 390m L=248m x 1.7m x 2 2 nd - 1.70m																								
Powerhouse	Access Tunnel L: 1.100m Cable Tunnel L: 424m																								
Tailrace Tunnel	Ex: 31,000 m ³ Conc: 9,100 m ³																								
Switchyard	D: 460m L: 4,850m Ex: 53,000 m ³ Conc: 2,400 m ³																								
Hydraulic Equipment	Outlet Valve: 1 unit Spill. Gate : 2 units Intake Gate : 1 unit Draft Gate : 2 units Penstock : 715 t																								
Electro-Mechanical Equip.																									
Transmission Line																									

V.1.2 Environment Effects during Construction Work and Countermeasure

(1) Alteration of Topography

a) Collection of Aggregate and Disposal of Waste Soil

(i) Degree of Alteration

The aggregate and so forth being used at the dam construction cover the core material (clay), the rocks for filling, and the sand and gravel which are the raw materials of concrete.

Figure V-1 shows the locations of material collection sites. Table V-4 shows the quantities to be gathered.

Table V-4 Amount and Location of Material

Material	Location	Amount
Clay	Near Kesebükü village in reservoir area	800
Rock	Near dam site in reservoir Area and the slope of mountain near reservoir	4,000
Gravel & Stone	River bed of down stream near outlet point (Back water point on Çay project)	500

The concrete plant is to be installed at one location at the periphery of electric power station site and near the outlet point, respectively.

In addition, the soil disposal yard is planned at 2 locations between the coffer dam point and the dam main body.

(ii) Environmental Influence and Countermeasure

The topography and geology in the aggregate collection sites and the residual soil disposal sites have not precious characteristics in view of the topography and geology. In addition, no topography exists that is valuable in the landscape. The historical relics as the cultural assets do not exist at the core material and rock collection sites.

i) Collection of Core Materials and Rocks

The core materials and rocks are mainly collected from the future reservoir area in order to decrease the natural destruction down to the minimum.

One part of rocks is planned to be collected outside the reservoir area located in the vicinity of dam site. The pine forest exists on the upper part of slope near this site.

The slope is covered by rough shrubs according to the vegetation map, and its vegetation is very poor (Figure V-4).

Because the collection of rocks from this point is to be done at the place avoiding the forest, it is not estimated to exert a great influence on the natural environment, and these works shall be done intensively as much as possible and minimized as necessary.

The reinforcement countermeasure of slope shall be taken to the excavated slope so that there may appear no fear of landslide and the like in the future.



Figure V-4 Present Scene of Material Collection Site

The forestation of pines can be considered at the left land.

It is estimated that there is no problem to the noise and vibrations generated by the construction work because the work site is remote from the inhabitant houses, and the dynamite work is planned to be done during the limited time zone excluding the early morning and during the night time.

A temporary escape of wild animals by the noise and vibrations are imaginable, but it can be thought that the influence over a long period of time hardly exists. As to the influence to the inhabitants and laborers by the exhaust gas from the construction work vehicles, the exhaust gas from the used vehicles shall be checked and the use plan shall be drafted up and adequately controlled.

ii) Collection of Sand and Gravel and Manufacturing of Concrete

Because the sand and gravel which is the concrete materials are collected from the river bed, the river bed at that location will be dug down and the turbidity is to be generated.

The aquatic organism is mainly occupied by the carps and aquatic plant can not be seen. Low height trees sporadically exist on the periphery of river banks but this area is a naked area mostly of sand and gravel.

Sand and stone are collected from the river

bank. About the influence of this construction work, it can be thought because the fish has an ability to escape there, direct influence for fish is estimated to be small.

Concrete countermeasure for turbid water shall be arranged by the discussion with the related organization.

When manufacturing the aggregate to be used for concrete, the water being used to the plant shall be of purification circulation system, and in principle, should not be discharged into the rivers. Therefore, an exclusive use precipitation pond and so forth shall be installed in the aggregate manufacturing plant, and moreover the produced sludge shall be solidified by a dehydrator, and then be discarded into a soil discarding yard. To install precipitation pond and a aggregation/precipitation facilities and a neutralization tank on the downstream side of concrete mixing plant, and the water shall be released to the downstream side after precipitating the afloat substances and neutralizing the supernatant liquid.

iii) Soil Disposal Yard

The soil disposal yard shall be installed at 2 locations inside the construction work area but the vegetation at this location is poor.

The soil disposal yard end on the upper stream side shall turn the river water to

the downstream side through the underground tunnel by the coffer dam. Drain ports shall be arranged to the periphery for preventing the inflow of rain water and the like.

The protection work shall be done on the face of slope at the soil discarding yard to prevent the outflow of soil and sand.

b) Transportation Route of Materials and Equipment

(i) Degree of Alteration

The contents of Figure V-1 and V-3 are planned for the transportation of construction materials and installation equipment to the project area and each of construction work blocks. In the project, the transportation roads are to be secured by the readjustment of existing roads as much as possible, but the roads in the black portion shown in the figure newly need to be constructed.

(ii) Environmental Influence and Countermeasure

The factors of environmental influence by the revision and change cover the influence on the vegetation, the shrinkage of wild animals' inhabiting space, the discarded soil coming from the construction, the noise and vibration problems.

The transportation routes of materials and equipment pass through the locations shown by the vegetation of Pine, Oak, Beech, but the influence on to the vegetation is small because the routes are to be secured by reinforcing and expanding the width of existing roads. For information,

when starting the construction work, the contraction of construction work area will be attempted so far as possible in order to decrease the environmental influence.

Such influences as the contraction of living space, the noise and the vibrations will be exerted on the wild animals, but the influence is judged to be small because 1) the range of alteration and change is extremely small, 2) the work construction will not be conducted during the night, 3) the reduction of illumination will be tried during the night-time. The waste soil generated by the construction work will be disposed at the soil discarding yard.

c) Electric Power Station and Switchyard

(i) Degree of Alteration

The electric power station is to be installed underground (Figure V-1) while the switchyard is to be constructed on the ground surface in the vicinity of the power station. Scales of both facilities are shown in Table V-1.

(ii) Environmental Influence and Countermeasure

The power station is to be constructed underground, and the vegetation at the ground surface area is poor. Therefore, the influence on the vegetation by the construction work is very small. The environmental effect by installing the facility underground has an influence on the underground water system, but the underground water is not utilized in this area and moreover the present existing quantity is small at the value of 10 Lt/sec or below from the geological

characteristics, and it can be so judged that the influence to the underground water and its utilization is very small.

The switchyard is to be constructed on the ground surface, but the area of that construction work area is 5,000 m², and the vegetation at this point is poor and it can be understood that the influence on the environment is small.

The registration by use of the pines and the like can be imagined as the environment improvement countermeasure at this area after the construction of facilities and as the environment improvement of naked land around the dam and the facilities.

d) Waterway

(i) Degree of Alteration

The waterway is planned so that it may mainly pass the underground of the route as shown in Figure V-1. The ground portion is only the block of 200 m from the water discharge point up to the place just before it. This 200 m block becomes an open conduit made of concrete as shown in Figure V-5. Further, the trees at this point need to be cut down.

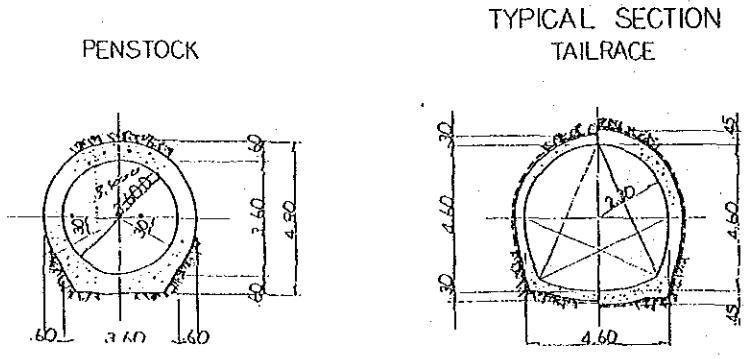
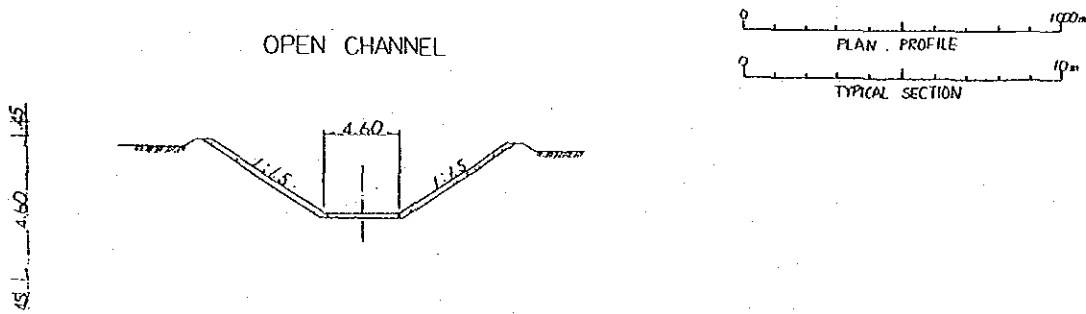
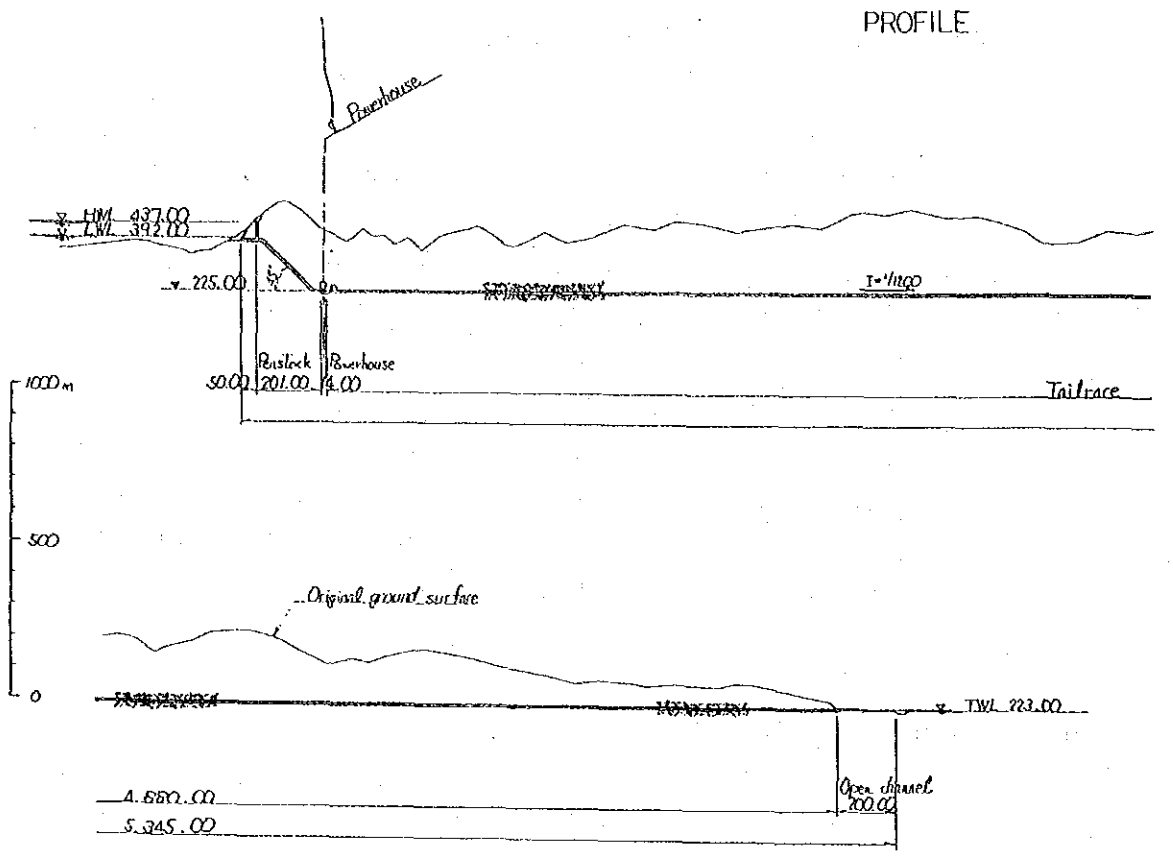


Figure V-5 Profile of Underground Tunnel

(ii) Environmental Influence and Countermeasure

The environmental influence of headrace tunnel is the influence on the underground system, but the underground water is not utilized in this area, and moreover the present existing quantity is small and hence the influence is very small.

The water is discharged while the water level at the open conduit section is being adjusted to the water level of river. The point at 1 km on the downstream side of this point is the back water point of Çay Project.

Because some part of open conduit is passed through small agricultural fields and the end of conduit occupies the small area growing broad leaf trees, such as willow, the necessary lands need to be levelled and the trees needs to be cut down.

The land levelling area and the tree cutting area are approximately 3,600 m² and 400 m², respectively. The trees in object are usually distributed widely in the periphery.

Because the installation of this open conduit crosses over the road being utilized by the inhabitants, such a countermeasure shall be provided as laying a bridge over the water course.

e) Dam Body

(i) Degree of Alteration

The dam is to be installed at the location shown in Figure V-1. The type of dam is rock fill

system, the quantity of rocks and stones being used in the construction work is about 5 million m³ and the dam has the height of some 110 m. The area of this work construction area is 0.4 million m² including the temporary closing and soil disposal yards.

(ii) Environmental Influence and Countermeasure

The vegetation on both the banks of river at this point is very poor, and the area in the vicinity of downstream side is agricultural fields, but these farming fields also include the dam main body construction work block. The factors on natural environmental effect factors in the alteration of topography are mainly those to the river organisms and vegetation as well as to the agricultural fields.

According to the vegetation survey, any precious plants inherent to the area cannot be found. The environmental effect due to the loss of vegetation at this area can be judged to be small.

The aquatic organisms such as aquatic insects and fish are not those living especially only at this point and these can be seen in the vicinity of project area. Therefore, it is supposed that the influence on these organisms is small.

f) Power Transmission Line

(i) Degree of Alteration

Towers of transmission lines are arranged at intervals of 350m.

(ii) Environmental Effect and Countermeasure

Alteration at places to build the transmission line towers, flying obstruction to birds and changes of natural scene are environmental influential factors.

As the ground to be occupied by one tower is estimated to about 100 m², it seems there are no serious influences. However, it is needed to perform the pre-study concern to vegetation along the route on the detailed design stage.

(2) Construction of Facilities

The contact of excavated soil and stone to the river water, the turbidity of river by the outflow of turbid water by the rain falling in the construction work area, and the influence to the aquatic organisms by the turbidity and the like of river involved in the discharge of polluted water from the office and lodging, can be imagined as the influence factors to the natural environment during the construction work.

In addition, the main things are the noise, vibration and the air pollution by the construction work.

a) Employees' Lodgings and Attached Facilities

Preparation of the ground for housing is planned by the excavation and the banking on the left bank at downstream area of dam site.

b) Transportation of Materials

Construction roads are shown in Figure V-1, Figure V-3.

c) Construction of Facilities

(i) Dam Body

In order to prevent the influence on the aquatic organisms in the down stream area of dam, the coffer dam is to be constructed respectively on the upper stream and downstream sides of dam site to the construction work.

The river water is guided to the downstream side of coffer dam on the downstream side by the diversion tunnel just before the coffer dam on the upper stream side and its mixture with the generated turbid water and the like is to be prevented by the dam body construction work.

Further, as regards the turbid water from the construction work area being caused by the rainwater and the concrete mixed discharge water, such a countermeasure shall be taken that they shall first be precipitated and neutralized by the temporarily installed precipitation pond and then its upper clean water shall be discharged into the river. Because the water discharge standard relating to the construction work has not been decided, the water discharge concentration shall be decided by discussion with the related organization.

Because the pH of this river is around 8 and the pH safe to the aquatic organisms ranges from 6.5 through 8.5, the utmost care shall be taken especially to the pH control.

As regards the relationship between the turbidity and the aquatic organisms, the influence on Cyprinus carpio, 1 kind of carp is reported as

follows³⁴⁾. Its reaction appears at the value of around 20,000 ppm for their actions, and they can bear the turbidity of more than 100,000 ppm for a period longer than 1 week. The eggs can be normally fertilized at the turbidity up to 80 ppm and the median hatching concentration ranges from 1,100 to 2,800 ppm. According to the test of algae such as a diatom, there exists such a report that the production of diatoms was prevented at a turbidity higher than 15 ppm.

Concerning the noise and vibrations from equipment and vehicles being used in the construction work, there is no problem because the work site is remote from the houses. Work using dynamite shall be suppressed as much as possible during the night and in the early morning.

No facility for discharging the atmospheric pollutants exists at this area. Such countermeasures as checking the used vehicles and the allocated car control shall be conducted the influence of exhaust gas coming from the work construction vehicles to the inhabitants and laborers.

The lighting during the night must be curtailed down to the minimum necessary lighting because it may exert an influence especially on the wild animals.

(ii) Waterway

The underground tunnel is to be dug for constructing the headrace tunnel. The excavated soils and rocks are transported to the soil disposal yards in the vicinity of dam by the

trucks. The transportation road leading to the soil disposal yards from several locations of tunnel route needs to be readjusted to the ground surface area for this construction work, but because the land utilization of ground surface portion has become the cultivated region, the existing roads shall be utilized as much as possible, and the influence to the agricultural fields by the road construction should be averted. In addition, the safety measures for the inhabitants' comings and goings shall be provided. The discharged water shall be concentrically controlled as the spring water and turbid water countermeasures by the excavation, and shall be released into the river after it has passed through the precipitation pond. It is understood that there is no influence of noise and vibrations due to dynamite explosions at the tunnel because the tunnel exists at underground of about 150 m and is in the route avoiding the inhabitants' houses.

(iii) Electric Power Station and Switchyard

The power station shall be constructed by excavating the underground tunnel through the explosion of dynamites and by pulling out the earth and sand utilizing the said tunnel. The generated earth and sand shall be discarded the soil and sand discarding yard near the dam.

Because the construction work is to be conducted mainly in the underground, it can be understood that no adverse influence will be exerted on the ground surface areas.