the influence given on the forestry industry in this area by the formation of reservoir is judged to be small.

Because the farm products available from the agricultural fields such as the crops, vegetables, fruits, etc. don't differ from those at the peripheral villages, and moreover the farming pattern is in small scale and the said products are for self-support, the influence being exerted on the agricultural industry in the area by the loss of agricultural fields is judged to be small. And the influence given on the livestock industry is also considered to be small.

(2) The project area isn't included inside the natural preservation areas such as the national park and the natural protection areas. No precious species of plant can be found at the project area. The wild animals found in this area are the same species as those inhabiting the national park and the natural protection areas. The formation of reservoir is destined to somewhat narrow their living space, but because these animal species are widely distributed, its influence can be judged to be small.

(3) On the other hand, because there are some relics and regional cultural assets inside the reservoir, the protective countermeasures must be sufficiently taken before enforcing the project based on ample discussion to be held with the concerned agencies.

(4) Because both the nitrogen and phosphorus are in high trend as regards the water quality of Devrek River in object, together with the waste water disposal countermeasure in this basin, the water quality should be continuously monitored for decreasing the influence on the water quality of reservoir in the future.

The dam may bring about the partition of inhabiting areas especially against the fish out of the organisms in the

river, but because the general carp are the main fish in this river and they are not a species especially inhabiting only the river in object and moreover because the reservoir is expanding a new proliferation and inhabiting space, the influence on the fish can be imagined to be small. On the other hand, the inhabitation of trout is reported in the upstream basin of Büyuküsu River. Because they are considered to be of land locked type, it can be thought that there is no influence, but their ecology is to be studied in detail in the future.

(5) About 25 km of water reducing area will be generated by the enforcement of the present project. The natural vegetation in this section is rich, consisting of pines and oaks. Because these species are not those growing by directly absorbing the river water, and because no precious species of plants can not be found, and because the rain falls comparatively much in this area, and because the main inhabiting fish specie of this river is the carp, the influence being exerted on the natural environment can be judged to be small. Further, because no inhabitants nor industries utilizing the river water exist in this section, and moreover the supply of water from the branch flowing into the water reducing section can be expected, the formation of water reduction block can be judged to have no great influence on the natural and social environments in this area including its landscape.

However, water discharge facilities shall be installed in order to sufficiently correspond to the requests for the sight-seeing development in the vicinity of reservoir area and for the water utilization in the regional agricultural industry in the future, or to the demands for the amenity pace involved in sight-seeing development. For information, the water discharge volume from the facilities will be studied when working on the detailed design.

(6) The inhabitants and houses as well as the mosques and schools need to be moved or relocated to other locations for enforcement of the project. The destinations will be decided and compensations will be carried out in full consideration of the inhabitants' intentions.

For the case of using land up to 440 m (Reservoir high water level 437 m + 3 m) altitude, there will be 55 private hoses, three mosques, one primary school, two lodging houses, one 30 m long bridge, 13 km village road, 2 km power distribution cable and 2 km PTT (electricity and telecommunication) line to be submerged. The land area to be expropriated will be 5,794 decar in total, which is composed of 3,038 da forestry land and 2,756 da agriculture land. In addition, there will be about 555 da aggregate collection and material storage field to be needed outside the submerged area. The number of the villagers to be resettled is 392 persons (1992 data).

The compensation amount to cover the losses of all of the above lands, properties and so forth in the submerged area is estimated in the monetary value of 1992 to be 50,328,794,000 TL, including the income losses to be incurred. The compensation amount for the aggregate collection site is estimated to be 852,480,000 TL in the year 1992. Total sum of them becomes 51,181,274,000 TL. When the amount is counted in the monetary value of the year 1993, it is required to reflect the escalation factor of 1.6, and the total sum becomes 81,900,000,000 TL. This is the environmental cost to be incurred during construction phase. This amount also becomes the basis of compensation to be made for the site expropriation.

(7) For construction works, regulations for the construction and the preservation of environment shall be respected by discussions with the related organizations.

Keeping the said results in mind, it can be thought that the present project can be enforced without special influence on the natural and social environments. Detailed content is shown in the draft report of environmental impact study on Köprübaşı hydroelectric power development project (Feb. 1994).

Table 13-1 Environmental Impact, Benefit and Environmental Protection Measure

Classification	Physical and Biological Influences and Utilization of Natural Resources					Socioeconomic Influences				
	Positive factors		Negative Factors			Positive factors		Negative Factors		
Stage	Item	Contents	Item	Applicable Area	Measures to be taken (Cost)	Item	Contents	Item	Applicable Area	Measures to be Taken (Cost)
<During Construction> 1) Modification of Topographic Features			△ Modification of Agricultural Land for securing Construction Material	○Quarry for producing Stone Materials, other than Reservoir ○Water-discharging Points, Deforestation [Points I, K, L, M,and N,] [555 da : Fig.V-10]	＊Slope Protection Work, Minimum modification, Restoration of Land, and Afforestation ＊Minimum modification [to be further reviewed in the D/D Stage.]	◎ Population	＊＊Increase in Population	Objectives to be Compensated	Forests, Agricultural Lands, Houses, Afforested Trees, Fruit Trees, Public Facilities, etc. to be included from the Dam Bottom (343m in Sea Level) to 440m in sea level	
			△ Generation of Noises and Vibration		＊Restriction of work during night (Measurement)	◎ Income (Planned Area / Surrounding Area)	＊＊Increase in Employment	○ Fruit Trees		1,788 (TL 6,346,132,000)
			△ Changes in Air Quality		＊Control Program (Measurement)		＊＊Increase in Social Capital	○ Agricultural Lands Compensation Values to be Calculated Under the Income Capitalization Method.		Area to be Compensated : 3,311 da. within the Reservoir (TL 32,318,820,000) outside the Reservoir (TL 852,460,000)
			× Generation of Turbid Water by Construction Work		＊Sedimentation Basin (Monitoring)	◎ Economy	＊＊Temporary Vitalization of Local Economy	○ House	55 houses, 302 persons	(TL 4,500,000,000)
			× Changes in Water Quality (pH)		＊Regulating Pondage (Monitoring)		＊＊Vitalization of Local Technical Groups	○ Afforested Trees	2,895 trees	(TL 284,842,000)
			△ Illumination for Construction Work		＊Minimum Illumination		＊＊Effect of Economic Diffusion to the Arease	○ Compensation for Public Facilities to be inundated	Mosque (3) Elelsentary School (1) Teachers' Dormitory (2) Bridge (1) Power Line (2km) Telephone Line (2km) Road (7km)	(TL 6,879,000,000)
			× Passage of Construction Vehicles		＊Administration Program				[6 km of a Lakeside Road to be Newly Built]	
Costs of Countermeasures (to be estimated by DSI)										
2) Construction of Facilities			× Generation of Turbid Water by Construction Work		＊Sedimentation Basin (Monitoring)			× Forests	1,979 da	(No Expenses Needed)
			× Changes in Water Quality (pH)		＊Regulating Pondage (Monitoring)			× Decreases in Forest Resources		[Inventory to be inundated is small. Influences upon Forestry is also small.]
			△ Generation of Noises and Vibration		＊Restriction of work during night (Measurement)			× Decreases in Agricultural Production		[Influences upon Local Economy is small because Self-sufficiency is Prevailing.]
			△ Changes in Air Quality		＊Control Program (Measurement)			○ Income to be Realized at Resettled Areas		(Inhabitants' Desires will be Respected in Resettlement Programs. Efforts will be to secure Jobs and Incomes which meet the Resettlers' Desires.
			△ Illumination for Construction Work		＊Minimum Illumination					
			× Passage of Construction Vehicles		＊Administration Program					
Costs of Countermeasures (to be estimated by DSI)										
<After Construction> 1) Possession of Land ① Reservoir ② Facilities	× Separation of Fish Species ○ Changes in landscape.	＊＊ Expansion of Wet Habitats ＊＊ Creation of New Landscape over the lake	△ Agricultural Land to be inundated	(Irrigated area: 426 da and Ordinary Area: 2 ,330 da) Fig. IV-5	[to be further reviewed in the D/D Stage]	○ Landscape utilizing Water	＊＊Increases in Objectives and Income of Tourism ＊＊Bringing up Leisure Industry			
			× Separation of Fish Species (No Precious Species found)							
			× Protected Cultural Heritage to be inundated	(Figs.IV-21 and IV-22)	＊Prior Excavation Survey and Removal [If agreed with the Culture Agency, and to be paid by DSI. Survey to be started before the Construction Work is started]					
			△ Forests to be inundated	(1,979 da)	[to be transferred from the Forest Agency]					
			× Disappearance of Vegetation (No Precious Species found)		Protection of Surrounding Vegetation [Adoption of Underground Power Plant and Water Conduits]					
Costs of Countermeasures (to be estimated by DSI)										
2) Operation of the Facilities ① Reservoir ② Water Discharge ③ Formation of Water Reduction Area			△ Changes in Water Quality and Eutrophication		＊Valley Affluent Water Control Program	○ Income	＊＊Securing Long-Term Employment though small in number of persons to be employed	× Influence upon Irrigated Agriculture in Downstream Areas		[To discharge Water when Needed]
			△ Sedimentation of Sand		＊Operation Program			× Influence upon Potable Water		[No drinking use of River Water]
			△ Discharge of Low-temperature Water		[Temporary Evasion of Fish]	○ Traffic	＊＊Securing Traffic and Physical Distribution Routes			
			× Influence Upon Irrigation in Downstream Areas		[to discharge a Necessary Amount of Water when needed]					
			× Salification of Water							
			× Reduction of Sand in Downstream Areas							
			△ Reduction of Water Volume		＊Addition of Discharging Facilities [to be determined in D/D] ＊Optimization of Maintenance Water Volume					
Costs of Countermeasures (to be estimated by DSI)										
3) Monitoring			△ Changes in Water Quality and Eutrophication		＊Periodic Measurement and Evaluation of Water Quality [BOD,COD,pH,T-N,T-P, Chlorophyll, and Other Wildlife Survey]			Comprehension of Living Environment of Peole to be resettled		
Costs of Countermeasures (to be estimated by DSI)										
Key Points	Utilization of New Environmental Resources		Reduction of Environmental Influences by implementing Appropriate Conservation Measures			Improvement of Local Development Programs for Continued Local Vitality and Fusion with this Project				
Cost Benefits	External Benefit (Ba)	(TL) to be estimated by DSI	Environment Conservation Expenses (Cp-1)		(TL)	Comprehensive External Benefits (Be)	(TL)	External Costs (Ce) TL 51, 181, 274,000, at unit cost for 1992. TL 81,900,000,000 at unit cost for 1993		
			Historic Ruins Excavation Expenses (Cp-2)		(TL) [to be estimated by DSI]	(Including laborers' Income of TL)	To be estimated by DSI			

Notes : 1) Symbols used in the table have the following meanings.
◎ : substantial influence ○ : medium influence △ : small influence or small if appropriate countermeasure is taken × : ignorable influence or ignorable if appropriate countermeasure is taken
2) Underscored items in the table indicate external costs (Ce); asterisked (＊) ones, environment conservation countermeasure (Cp); and double asterisks (＊＊), external benefits (Be) which have economic value of secondary benefits.
3) Most of people to be resettled want to resettle in the adjacent town of Gökçesu and its surroundings. It is necessary to resettle them by sully respecting their desires. Inhabitants should be given priority in employing laborers for construction and dam control engineers after construction.
4) Necessary items in future environment impact assessment are indicated in parentheses in the report. Main items include field measurement of water quality and supplementing of basic data by effecting vegetation survey, and data survey for natural environment and evaluation of scale of costs and benefits in the socioeconomic environment. Total amounts of countermeasure expenses, external benefits, and environment countermeasure expenses will be determined based on the report and DSI will make their calculation thereafter.

Chapter 14 ECONOMIC AND FINANCIAL EVALUATION

Chapter 14

ECONOMIC AND FINANCIAL EVALUATION

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Chapter 14 ECONOMIC AND FINANCIAL EVALUATION

14.1 Economic Evaluation

14.1.1 Methodology

(1) Basic Approach

Economic evaluation is conducted based on indices such as net present value of the project, benefit/cost ratio and economic internal rate of return. These indices are derived from economic benefits of the project and its economic costs. "Discounted Cash Flow" is used for making such indices.

In the meantime, in the case that market prices of the goods and services reflect fully economic value, these market prices obtained may be applied to the costs and benefits in economic evaluation. However, market prices are mostly distorted due to the effect of incomplete market mechanism.

Estimation of costs and benefits shall be conducted to reach its objective of the most appropriate allocation of limited resources. To achieve this objective, market prices of goods and services shall be converted to real benefits and costs to reflect real economic value. The world Bank and other international financing organizations employ international market prices to estimate real project and market price.

On the other hand, economic evaluation for a development project is carried out measuring its socio-economic impact on the country by comparing two cases; the project is developed and the project is not developed. As a rule, development project would have a chance to make an

alternative project not realized due to the consumption of the limited economic resources for this awarded project. Therefore, a selected project has an impact on the country not only in producing its product but also in consuming limited resources.

In this regard, the alternative plant approach is applied to this project. If a project is incorporated in a long range electric power development policy to satisfy future power demand (i.e., if the project is not to be implemented, another means of supply is to be substituted for it), an alternative plant approach will be employed to measure and evaluate economic costs of the proposed project and the alternative project.

(2) Method of Economic Calculation

Economic calculation is determined comparing costs and benefits of the project. In this calculation costs and benefits are taken as follows.

a) Costs

All the costs spent for this project life are summed up, except for the following items.

- Taxes

These payments do not reduce the volume of resources available to economy. Since the economic calculation aims to gain the most appropriate allocation of the economic resources by proceeding with the project, transferred but not consumed cost items like tax are excluded from the calculation.

• Interest

Economic profit means opportunity cost of capital. Opportunity cost of capital results from the economic calculation and this opportunity cost of capital itself includes the interest of borrowed money. Therefore, interest payment shall be deleted from the economic calculation to avoid double-counting.

• Depreciation expense

In economic calculation, costs are shown at the time they occur. Depreciation expense stems from capital investment, then they will be stated in the book-keeping later than the time they occur in the construction period, without incurring any additional cash outflow.

Furthermore, capital costs are already included in the cost items. If the depreciation expense were counted, a double-counting would occur. Therefore, depreciation is deleted.

• Debt payment

Dept payment as well as tax is only transferred cost but not consumed cost. Therefore, debt payment is excluded.

b) Benefit

Costs of the alternative power plant are regarded as the benefits of the proposed project. Development of this proposed project gives the impact to the country consuming the costs, which would have been used as the alternative power plant. Therefore, costs of the alternative power plant are taken as benefit of proposed project.

In the course of the above cost-benefit calculation, the Concepts of Present value (c) and Economic costs (d) are taken into consideration.

c) Present value

For the purpose of economic calculation, present value is considered exclusively. The cost spent in the future includes present value and future value. The future value shall be eliminated. All the costs and benefits are converted to present value using discount rate.

d) Economic Costs (shadow pricing)

Cost estimation is generally based on the actual price prevailing in the market of a country (i.e., the market price). As mentioned before, market prices are usually distorted. To exclude this distortion,market pricing is transferred to shadow pricing. Shadow pricing is applied to all the costs of the project.

Costs of the project are divided into two categories: tradable goods and non tradable goods. As for tradable goods, importable goods are taken at their CIF price, and exportable goods are taken at their FOB price. Non tradable goods are taken at opportunity cost which is equivalent to the international market price. In order to simplify the process, standard conversion factor is often used. The standard conversion factor, determined from total values of major export (FOB) and import (CIF), is used as a general indicator to avoid distorting domestic pricing and to convert this non tradable pricing into international market pricing.

In this economic evaluation, a standard conversion factor (SCF) is calculated based on the latest

economic data. To convert into international market pricing goods, the prices of non tradable goods are multiplied by SCF. SCF is obtained from the calculation formula below.

$$SCF = \frac{CIF + FOB}{CIF + TAX(import) + FOB - TAX(export) + Subsidies}$$

After the selection and dtermination of the value of cost and benefit shown above, the calculation for economic evaluation is carried out using the calculation formura shown below.

e) Economic Evaluation

- Method of Net Present Value

$$\sum \frac{Bn}{(1+i)^n} - \sum \frac{Cn}{(1+i)^n} = Net\ Present\ Value$$

B: benefit, C: cost, i: discount rate
n: Project years

[remarks]
The higher the Net Present Value is, the better the Project is.

- Cost/Benefit Ratio

$$\frac{\sum \frac{Bn}{(1+i)^n}}{\sum \frac{Cn}{(1+i)^n}} = Cost/Benefit\ Ratio$$

[remarks]
The bigger the Cost/Benefit Ratio is, the better the Project is.

- Internal Rate of Return (EIRR, FIRR)

$$\sum \frac{Bn}{(1+i)^n} = \sum \frac{Cn}{(1+i)^n}$$

i: Internal Rate of Return is the rate which offers that the accumulated Present Value benefit and accumulated cost are the same.

[remarks]

- If EIRR is higher than opportunity cost; the better the Project is.
- If FIRR is higher than interest rate, the better the Project is. (FIRR is described in the next chapter 14.2 in detail)

(3) Standard Conversion Factor of the Project

A standard conversion factor (SCF), shown in Table 14-1, was obtained using data of the latest 5 years. As a result, SCF of 0.91 was determined.

Table 14-1 Calculation of Standard Conversion Factor

(Unit: 10^6 US$, %)

	Import			Export		
	Import Price (C.I.F.) (Ia)	Import Tax (b)	Tax Rate (b/a)	Export Price (F.O.B.) (Ec)	Export Subsidy (d)	Subsidy Rate (d/c)
1987	14,158	2,037	14.39	10,190	772	7.58
1988	14,335	1,871	13.05	11,662	716	6.14
1989	15,792	1,983	12.56	11,625	532	4.57
1990	22,302	3,029	13.58	12,959	494	3.81
1991	21,047	3,034	14.42	13,593	452	3.33
Total (Average)	87,634 (17,527)	11,954 (2,391)	13.64	60,029 (12,006)	2,966 (593)	4.94

(SCF)

$$\frac{Ia + EC}{Ia(1 + b/a) + Ec(1 + d/c)}$$

- 5 year average (1987-1991): 0.908 ≒ 0.91

(Note) Export tax has not been imposed for the period; therefore it is not counted in the calculation above.

(4) Selection of Alternative Power Plant

Imported coal-fired thermal power plant is considered to be the most appropriate alternative power plant. The justification of it is as follows.

According to the latest plan of Energy Development in Turkey, it is thought that the Policy of Energy Development comprises the five essentials below.

a) Hydropower, having an advantage of harmonization with environment and utilization of domestic energy resources, is one of the important energy resources produced in Turkey. Therefore, its development has high priority in this energy policy.

b) Taking national energy-security into consideration, oil fired power development is restrained.

c) Instead of the above oil fired power development, natural gas fired power and coal fired power shall be developed and introduced.

d) With a parallel to the development of natural gas fired and coal fired power, lignite fired power shall be installed to some extent in view of the utilization of domestic energy resources.

e) The development of Nuclear Power shall be considered as a future energy.

Considering the policy of energy development above, coal fired power plant has a possibility of being an alternative power project in this economic evaluation.
As for natural gas plant, it is sure that its capital cost is less than that of coal fired power plant, so that natural gas plant might have an economic advantage over coal fired plant, if its fuel price continues to be as low as the present price.

On the other hand, coal has been stable in both price and supply for a long time due to the reason that coal is abundant in various countries. In this respect coal fired thermal power plant has also an economic advantage, if we take a long range view.

Therefore, in our conclusion, we select coal fired thermal power plant as an alternative project in this Köprübaşı economic evaluation.

14.1.2 Economic Costs of the Project

The economic cost of the Project was obtained applying the standard conversion factor (shown in 14.1.1 (3)) to the financial costs obtained in chapter 12 "Construction Planning and Cost Estimation".

The operation and maintenance costs were obtained from the construction costs multiplied by the following values.

Civil facility construction cost..... 0.5%
Hydraulic equipment cost 1.5%
Electro-Mechanical equipment cost 1.5%
Transmission line cost 1.5%

The initial investment in the market and economic costs of the project and the total cost throughout the project life are shown in Table 14-2, Table 14-3 and Table 14-4.

Table 14-2 Initial and Project Life Investment

(Unit: 10^6 TL)

	Initial Investment	Project Life Investment
Market Price	1,092,625	1,401,509
Economic Price	1,031,595	1,328,444

Note: Interest during construction is not considered.

Table 14-3 Initial Investment Cost (Market Price)

(Unit: 10^6 TL)

Year	Civil	Hydro Eq.	El-Mecha.	Trans. Line	Total
1	129,727	0	21,102	0	150,829
2	182,749	0	0	0	182,749
3	245,242	25,381	0	24,909	295,532
4	226,023	22,668	189,915	24,909	463,515
Total	783,741	48,049	211,017	49,818	1,092,625

Note: Interest during construction is not included.

Table 14-4 Initial Investment Cost (Economic Price)

(Unit: 10^6 TL)

Year	Civil	Hydro Eq.	El-Mecha.	Trans. Line	Total
1	121,446	0	20,779	0	142,225
2	173,080	0	0	0	173,080
3	229,870	23,097	0	22,667	275,634
4	210,350	20,628	187,011	22,667	440,656
Total	734,746	43,725	207,790	45,334	1,031,595

Note: Interest during construction is not included.

14.1.3 Parameters and Economic Costs of Alternative Thermal Power Plant

As mentioned before, an imported coal fired thermal power plant was assumed as the alternative facility with which the economic benefit of this project is calculated. In this evaluation method, the economic costs of the alternative thermal power plant are regarded as the benefit to be realized by the project, and they are compared with the economic costs of the project.

The output of the project will be transmitted to the nearest power system of another hydroelectric power station located by the same river. Therefore, the alternative thermal power plant which is taken as the basis of the economic evaluation was assumed to be located at a nearest point on the coast of the Black Sea. The transmission line would be a short power line. The construction costs are assumed to be included in that of the alternative thermal project. The basic criteria used in this evaluation are shown in Table 14-5 and Table 14-6.

Meanwhile Table 14-5 shows some criteria related to costs calculation of Köprübaşı project in addition to that of alternative project.

(1) Parameters and Economic Cost of Alternative Thermal Power Plant

a) Plant Parameters

The plant parameters of the alternative thermal power plant, having potentials equivalent to Köprübaşı project, are described in Table 14-16.

Table 14-5 Basic Criteria for Economic Study

Item	Description
Method of Analysis	Discounted Cash Flow Method
Study Period	50 Years Plus Construction Period
Discount Rate	9.5%
Escalation	Not Considered
Shadow Price Factor (Conversion Factor)	Considered (Standard Conversion Factor: 0.91)
Service life of Facility	
Dam & Reservoir	50 Years
Hydro-power Plant	35 Years
Coal-fired Thermal Plant	25 years
Substation	25 years
Transmission Line	35 Years
Conversion Rate of Currency (As of January, 1993)	US$1 = 8,700 T.L.

Table 14-6 Alternative Thermal Power Plant for Studying Economic Justification

Item	Unit	Coal Fired Plant	Köprübaşı
Installed Capacity	MW	82.8	70.0
Dependable Capacity	MW	82.8	66.0
Losses Transmission Loss Rate Station Service Rate Forced Outage Rate Scheduled Outage Rate	%	 1.4 8.1 4.0 12.0	 1.4 0.3 0.3 2.0
Effective Dependable Capacity	MW	63.4	63.4
Annual Energy Production	kWh	232.806	212.1
Losses Transmission Loss Station Service Loss	%	 1.1 8.8	 0.7 0.3
Annual Available Energy	10^6 kWh	210.0	210.0
Fuel Consumption Rate Coal Oil	 Kg/kWh Kg/kWh	 0.353 0.011	
Unit Fuel Price Coal Oil	 TL/Kg (US$/Kg) TL/Kg (US$/Kg)	 417.6 (0.0480) 1,113.6 (0.1280)	
Construction Cost	10^6 TL	950,875	
Unit Construction Cost	10^6 TL/kW (US$/kW)	11.484 (1320)	
O&M, Administration Cost	10^6 TL/yr	28,526	
Fuel Cost	10^6 TL/yr	37,545	

b) Initial Investment Costs

The economic cost required for construction of the alternative thermal power plant was estimated by applying standard conversion factor of 0.91 to the local currency portion.

Table 14-7 Initial Investment Cost of Alternation Thermal Power Plant (Economic Price)

(Unit: 10^6 TL)

	1st Year	2nd year	3rd year	4th year	Total
Foreign Currency	79,728	79,728	239,185	398,642	797,283
Local Currency	13,977	13,977	41,930	69,884	139,768
Total	93,705	93,705	281,115	468,526	937,051

c) Operation and Maintenance Cost (O&M cost)

O&M cost was obtained by multiplying 3% into the total economic cost of the project. Further to this, local currency part of O&M costs was obtained by multiplying 0.91 (SCF) and the value of the local economic costs and investment together.

d) Fuel Cost

Fuel cost was obtained by multiplying coal price and oil price (417.6 TL/kg, 1,113.6 TL/kg) by the annual energy production.

e) Total Cost during the Project Life

Total cost during the project life is shown in Table 14-8. The total cost includes initial investment, renovation cost after service life, operation and maintenance and fuel cost.

Table 14-8 Net present Values and Benefit-Cost Ratio

(Unit: 10^6 TL)

	Hydropower Project		Alternative Thermal		Difference		%
	Total Cost	Present Value (C)	Total Cost	Present Value (B)	Total	(B-C)	(B/C)
Köprübaşı Project	1,732,563	939,686	5,156,952	1,378,629	3,424,389	438,944	1.47

14.1.4 Economic Evaluation

The results of economic evaluation are shown in Table 14-9.

(1) Net Present Values (B-C) and Benefit-Cost Ratio (B/C)

As indicated by these two indices, the cost of construction and operation of the project is economically superior than the alternative project.

(2) Economic Internal Rate of Return

The discount rate at which the present values of the investments on the Project and on the alternative thermal power plant becomes equal in the first year of the projects, (that is, EIRR) is as indicated in Table 5.

Thus it can be concluded that this project is superior since EIRR (28.98%) exceeds the opportunity cost of capital (9.5%).

Section (1) and (2) above reveals that this Köprübaşı project is feasible from the economic viewpoint.

Table 14-9 Economic Evaluation of Köprübaşi Project

(unit: Million TL)

No.		Year	Kyopru Hydro Power Project				Alternative Thermal Project				(B) - (C)
			Civil Cost	Hyd. Ele. Eq & Tra. Cost	O & M Cost	(C) Total Cost	Construct. Cost	O & M Cost	Fuel Cost	(B) Total cost	
1		1998	121,446	20,779		142,225	93,705			93,705	-48,520
2		1999	173,080	0		173,080	93,705			93,705	-79,375
3		2000	229,870	45,764		275,634	281,115			281,115	5,481
4		2001	210,350	230,306		440,656	468,526			468,526	27,870
5	1	2002			8,082	8,082		28,112	37,545	65,657	57,575
6	2	2003			8,082	8,082		28,112	37,545	65,657	57,575
7	3	2004			8,082	8,082		28,112	37,545	65,657	57,575
8	4	2005			8,082	8,082		28,112	37,545	65,657	57,575
9	5	2006			8,082	8,082		28,112	37,545	65,657	57,575
10	6	2007			8,082	8,082		28,112	37,545	65,657	57,575
11	7	2008			8,082	8,082		28,112	37,545	65,657	57,575
12	8	2009			8,082	8,082		28,112	37,545	65,657	57,575
13	9	2010			8,082	8,082		28,112	37,545	65,657	57,575
14	10	2011			8,082	8,082		28,112	37,545	65,657	57,575
15	11	2012			8,082	8,082		28,112	37,545	65,657	57,575
16	12	2013			8,082	8,082		28,112	37,545	65,657	57,575
17	13	2014			8,082	8,082		28,112	37,545	65,657	57,575
18	14	2015			8,082	8,082		28,112	37,545	65,657	57,575
19	15	2016			8,082	8,082		28,112	37,545	65,657	57,575
20	16	2017			8,082	8,082		28,112	37,545	65,657	57,575
21	17	2018			8,082	8,082		28,112	37,545	65,657	57,575
22	18	2019			8,082	8,082		28,112	37,545	65,657	57,575
23	19	2020			8,082	8,082		28,112	37,545	65,657	57,575
24	20	2021			8,082	8,082		28,112	37,545	65,657	57,575
25	21	2022			8,082	8,082	93,705	28,112	37,545	159,362	151,280
26	22	2023			8,082	8,082	93,705	28,112	37,545	159,362	151,280
27	23	2024			8,082	8,082	281,115	28,112	37,545	346,772	338,690
28	24	2025			8,082	8,082	468,526	28,112	37,545	534,183	526,100
29	25	2026			8,082	8,082		28,112	37,545	65,657	57,575
30	26	2027			8,082	8,082		28,112	37,545	65,657	57,575
31	27	2028			8,082	8,082		28,112	37,545	65,657	57,575
32	28	2029			8,082	8,082		28,112	37,545	65,657	57,575
33	29	2030			8,082	8,082		28,112	37,545	65,657	57,575
34	30	2031			8,082	8,082		28,112	37,545	65,657	57,575
35	31	2032			8,082	8,082		28,112	37,545	65,657	57,575
36	32	2033		20,779	8,082	28,861		28,112	37,545	65,657	36,796
37	33	2034		0	8,082	8,082		28,112	37,545	65,657	57,575
38	34	2035		45,764	8,082	53,846		28,112	37,545	65,657	11,811
39	35	2036		230,306	8,082	238,388		28,112	37,545	65,657	-172,731
40	36	2037			8,082	8,082		28,112	37,545	65,657	57,575
41	37	2038			8,082	8,082		28,112	37,545	65,657	57,575
42	38	2039			8,082	8,082		28,112	37,545	65,657	57,575
43	39	2040			8,082	8,082		28,112	37,545	65,657	57,575
44	40	2041			8,082	8,082		28,112	37,545	65,657	57,575
45	41	2042			8,082	8,082		28,112	37,545	65,657	57,575
46	42	2043			8,082	8,082		28,112	37,545	65,657	57,575
47	43	2044			8,082	8,082		28,112	37,545	65,657	57,575
48	44	2045			8,082	8,082		28,112	37,545	65,657	57,575
49	45	2046			8,082	8,082		28,112	37,545	65,657	57,575
50	46	2047			8,082	8,082		28,112	37,545	65,657	57,575
51	47	2048			8,082	8,082		28,112	37,545	65,657	57,575
52	48	2049			8,082	8,082		28,112	37,545	65,657	57,575
53	49	2050			8,082	8,082		28,112	37,545	65,657	57,575
54	50	2051			8,082	8,082		28,112	37,545	65,657	57,575
55	0	2052									
56	0	2053									
57	0	2054									
T O T A L			734,746	593,698	404,119	1,732,563	1,780,397	1,405,600	1,877,250	5,156,952	3,424,389
Present Value						939,686				1,378,629	438,944
I = 9.5 %										E. I. R. R.	28.98%
										B / C	1.47

Note: O & M Cost = 937051*0.03 = 28,112

14.2 Financial Evaluation

14.2.1 Methodology

In conducting the financial evaluation of the Project, the cash flow at market prices was developed for all costs including the capital invested in the project, taxes, operation and maintenance costs, replacement costs, project controlling costs, etc. This cost cash flow was compared to the benefit cash flow that was obtained by the expected income from the sales of electricity generated by the project, and the financial internal rate of return was calculated by the discounted cash flow method (DCF method).

The discount rate was determined as 9.5% in consultation with DSI.

14.2.2 Financial Costs of the Project

The amount of initial investment and the replacement cost were obtained from Chapter 12, "Construction Planning and Cost Estimation". The following values were selected as the operation and maintenance cost.

Operation and Maintenance Cost:

Civil facilities construction cost x 0.5%
Hydraulic equipment cost x 1.5%%
Electro-Mechanical equipment cost x 1.5%%
Transmission line cost x 1.5%

The financial costs of the Project are as shown in Table 14-10.

Table 14-10 Financial Cost

(Unit: 10^6 TL)

	Initial Investment	O&M Cost
Köprübaşı Project	1,092,625	8,504

14.2.3 Financial Revenue of the Project

The financial income of the project is the electricity sales revenue. The revenue was calculated based on the electricity tariff (931 TL/kWh) applied to the cities of Istanbul, Kocaell, Ankara and Bursa, which seem to be Mega electricity consuming areas near to this project site. In this calculation, 10% of the tariff is deducted from the total thereof, considering the estimation in which the portion of the electricity delivery is 10% in the tariff. It was assumed that the average annual available energy of the project throughout its life is the amount of electricity that can be sold, and the financial income of the project was calculated based on the tariff rate (931 TL/kWh) quoted above.

Table 14-11 Electricity Revenue

	Annual Variable Energy (GWh)	Tariff (TL/kWh)	Annual Electricity Revenue (10^6 TL)
Köprübaşı Project	210.0	621.25	130,462

Note: Tariff is calculated as follows:

931 TL/kWh x 0.90 x 8,700/11,734

Where: 8,700 and 11,734 is the exchange rate (TL/US$) as of Jan. 1993 and as of Sept. 1993, respectively.

14.2.4 Financial Evaluation

As is shown in the Table 14-12, Financial Internal Rate of Return (FIRR) is 9.90%. This rate exceeds the expected average interest rate of 9.5% for borrowing both domestic and foreign currencies (this interest rate can be taken as opportunity cost of capital). Therefore it can be concluded that the project is attractive not only from the economic viewpoint but also from the financial point of view.

Table 14-12 Financial Evaluation of Köprübaşi Project

(unit: Million TL)

No.		Year	Kyopru Hydro Power Project				Electric Tariff Revenue	
			Construct. Cost	Trasm. Line Cost	O & M Cost	(C) Total Cost	(B) Benefit	(B)-(C)
1		1999	129, 727	21, 102		150, 829		-150, 829
2		2000	182, 749	0		182, 749		-182, 749
3		2001	245, 242	50, 290		295, 532		-295, 532
4		2002	226, 023	237, 492		463, 515		-463, 515
5	1	2003			8, 504	8, 504	130, 462	121, 959
6	2	2004			8, 504	8, 504	130, 462	121, 959
7	3	2005			8, 504	8, 504	130, 462	121, 959
8	4	2006			8, 504	8, 504	130, 462	121, 959
9	5	2007			8, 504	8, 504	130, 462	121, 959
10	6	2008			8, 504	8, 504	130, 462	121, 959
11	7	2009			8, 504	8, 504	130, 462	121, 959
12	8	2010			8, 504	8, 504	130, 462	121, 959
13	9	2011			8, 504	8, 504	130, 462	121, 959
14	10	2012			8, 504	8, 504	130, 462	121, 959
15	11	2013			8, 504	8, 504	130, 462	121, 959
16	12	2014			8, 504	8, 504	130, 462	121, 959
17	13	2015			8, 504	8, 504	130, 462	121, 959
18	14	2016			8, 504	8, 504	130, 462	121, 959
19	15	2017			8, 504	8, 504	130, 462	121, 959
20	16	2018			8, 504	8, 504	130, 462	121, 959
21	17	2019			8, 504	8, 504	130, 462	121, 959
22	18	2020			8, 504	8, 504	130, 462	121, 959
23	19	2021			8, 504	8, 504	130, 462	121, 959
24	20	2022			8, 504	8, 504	130, 462	121, 959
25	21	2023			8, 504	8, 504	130, 462	121, 959
26	22	2024			8, 504	8, 504	130, 462	121, 959
27	23	2025			8, 504	8, 504	130, 462	121, 959
28	24	2026			8, 504	8, 504	130, 462	121, 959
29	25	2027			8, 504	8, 504	130, 462	121, 959
30	26	2028			8, 504	8, 504	130, 462	121, 959
31	27	2029			8, 504	8, 504	130, 462	121, 959
32	28	2030			8, 504	8, 504	130, 462	121, 959
33	29	2031			8, 504	8, 504	130, 462	121, 959
34	30	2032			8, 504	8, 504	130, 462	121, 959
35	31	2033			8, 504	8, 504	130, 462	121, 959
36	32	2034		21, 102	8, 504	29, 606	130, 462	100, 857
37	33	2035		0	8, 504	8, 504	130, 462	121, 959
38	34	2036		50, 290	8, 504	58, 794	130, 462	71, 669
39	35	2037		237, 492	8, 504	245, 996	130, 462	-115, 533
40	36	2038			8, 504	8, 504	130, 462	121, 959
41	37	2039			8, 504	8, 504	130, 462	121, 959
42	38	2040			8, 504	8, 504	130, 462	121, 959
43	39	2041			8, 504	8, 504	130, 462	121, 959
44	40	2042			8, 504	8, 504	130, 462	121, 959
45	41	2043			8, 504	8, 504	130, 462	121, 959
46	42	2044			8, 504	8, 504	130, 462	121, 959
47	43	2045			8, 504	8, 504	130, 462	121, 959
48	44	2046			8, 504	8, 504	130, 462	121, 959
49	45	2047			8, 504	8, 504	130, 462	121, 959
50	46	2048			8, 504	8, 504	130, 462	121, 959
51	47	2049			8, 504	8, 504	130, 462	121, 959
52	48	2050			8, 504	8, 504	130, 462	121, 959
53	49	2051			8, 504	8, 504	130, 462	121, 959
54	50	2052			8, 504	8, 504	130, 462	121, 959
55		2053						
56		2054						
57		2055						
T O T A L			783, 741	617, 768	425, 177	1, 826, 686	6, 523, 109	4, 696, 423
							F. I. R. R.	9. 90%

Chapter 15 LOAN REPAYMENT SCHEDULE

Chapter 15

LOAN REPAYMENT SCHEDULE

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Chapter 15 LOAN REPAYMENT SCHEDULE

15.1 Basic Consideration

In general, construction of an electric power facility requires a large amount of initial investment during the construction period, and the return from that investment starts only after the construction is completed. The time required to recover the investment is much longer than that required for production of durable consumer goods. Accordingly, it is quite usual to obtain loans having low interest rate, long grace period and repayment period.

It can be assumed that a large portion of the fund required for implementation of the Project will be supplied by international financing institutions, and the rest by domestic financing agencies. As the proportions of the foreign and domestic funds can not be predicted at this moment, the JICA Team consulted with DSI to assume the following financing conditions,and the repayment schedule was formulated based on these assumptions.

Interest rate: 9.5% is applied to domestic funds and 3.5% is taken as the rate for the international funds. Commitment charge is not considered.

Terms of repayment: Repayment is deferred during the construction period of the project: Repayment of principal and interest in equal amounts in 25 years.

15.2 Required Amount of fund

The required amount of fund is estimated based on the prices as of January, 1993, though the Project is scheduled to be connected to the power grid after the year of 2001. Thus the escalation

of the prices up to and including the construction period must be taken into account as additional cost; however, price escalation in Turkey in recent years is rather abnormal compared to those in other major countries, and it is difficult for the JICA Team to make any projection of the price escalation in the future. Table 15-1 shows fund procurement and repayment schedule.

15. 3 Income and Cost (Profit and Loss Statement)

The return on investment is the income from electricity sale. The present tariff system of TEK consists of two types of contracts and the customer has freedom of selecting one of them: The two stage tariff consisting of a fixed charge and energy charge and the uniform rate contract. The tariff rates differ from one supply area to another.

As it was difficult to find out the average tariff rate as of January, 1993, the tariff applied to typical area (931 TL/kWh) was used as the basis revenue calculation.

The annual operation and maintenance cost of the facilities of the project was assumed as below.

Civil facilities construction cost	x 0.5%
Hydraulic equipment cost	x 1.5%
Electro-Mechanical equipment	x 1.5%
Transmission facilities cost	x 1.5%

The depreciations are calculated by the straight line method with zero residual values and the facility lives are assumed as below.

Civil facilities:	50 years
Hydraulic equipment:	35 years
Electro-Mechanical equipment:	35 years
Transmission facilities:	35 years

Considering all conditions above, Profit and Loss Statement was settled as shown in Table 15-2.

15. 4 Loan Repayment Schedule (Cash Flow)

The source of funds for loan repayment is to be the operating income (the electricity sales revenue minus operation and maintenance cost, depreciation, interest, etc) and the cash reserved by depreciation.

The yearly projections of the cash flow is presented in Table 15-3.

As indicated in the Table 15-3, the capital costs are recovered from revenues in the 14th after the commencement of operation and thereafter revenues exceed capital costs producing profits. Thus it is judged that the capital investment on the project can be safely recovered.

Table 15-1 Fund Requirement and Repayment Schedule

(unit: Million TL)

No.	FUND REQUIREMENT			REPAYMENT SCHEDULE							
				Foreign Currency				Domestic Currency (1)			
	Foreign	Domestic	Total	Interest	Principal	Total	Balance	Interest	Principal	Total	Balance
1	55,231	95,598	150,829	967				4,541			
2	75,314	107,435	182,749	3,251				14,185			
3	74,453	221,079	295,532	5,872				29,789			
4	209,522	253,994	463,516	10,842			414,520	52,355			678,106
5				14,508	10,642	25,151	403,878	64,420	7,432	71,852	670,674
6				14,136	11,015	25,151	392,863	63,714	8,138	71,852	662,537
7				13,750	11,400	25,151	381,462	62,941	8,911	71,852	653,626
8				13,351	11,799	25,151	369,663	62,094	9,757	71,852	643,869
9				12,938	12,212	25,151	357,450	61,168	10,684	71,852	633,185
10				12,511	12,640	25,151	344,811	60,153	11,699	71,852	621,485
11				12,068	13,082	25,151	331,728	59,041	12,811	71,852	608,675
12				11,610	13,540	25,151	318,188	57,824	14,028	71,852	594,647
13				11,137	14,014	25,151	304,174	56,491	15,360	71,852	579,287
14				10,646	14,505	25,151	289,670	55,032	16,819	71,852	562,468
15				10,138	15,012	25,151	274,658	53,434	18,417	71,852	544,050
16				9,613	15,538	25,151	259,120	51,685	20,167	71,852	523,883
17				9,069	16,081	25,151	243,039	49,769	22,083	71,852	501,801
18				8,506	16,644	25,151	226,394	47,671	24,181	71,852	477,620
19				7,924	17,227	25,151	209,168	45,374	26,478	71,852	451,142
20				7,321	17,830	25,151	191,338	42,859	28,993	71,852	422,149
21				6,697	18,454	25,151	172,884	40,104	31,748	71,852	390,402
22				6,051	19,100	25,151	153,784	37,088	34,764	71,852	355,638
23				5,382	19,768	25,151	134,016	33,786	38,066	71,852	317,572
24				4,691	20,460	25,151	113,556	30,169	41,682	71,852	275,890
25				3,974	21,176	25,151	92,380	26,210	45,642	71,852	230,247
26				3,233	21,917	25,151	70,463	21,874	49,978	71,852	180,269
27				2,466	22,684	25,151	47,778	17,126	54,726	71,852	125,543
28				1,672	23,478	25,151	24,300	11,927	59,925	71,852	65,618
29				851	24,300	25,151	0	6,234	65,618	71,852	0
30											
31											
32											
Total	414,520	678,106	1,092,626	235,176	414,520	628,765		1,219,057	678,106	1,796,292	

Table 15-2 Profit and Loss Statement

(unit: Million TL)

No.	Operating Revenue (A)	Operating Expenses O & M	Operating Expenses Depreciation	Total (B)	Operating Income (C)=A-B	Financial Expenses* F.C.	Financial Expenses* D.C.	Total* (D)	Net Income (E)=C-D
1						967	4,541	5,507	
2						3,251	14,185	17,436	
3						5,872	29,789	35,661	
4						10,842	52,355	63,197	
5	130,462	8,504	24,500	33,004	97,458	14,508	64,420	78,928	18,530
6	130,462	8,504	24,500	33,004	97,458	14,136	63,714	77,850	19,608
7	130,462	8,504	24,500	33,004	97,458	13,750	62,941	76,691	20,767
8	130,462	8,504	24,500	33,004	97,458	13,351	62,094	75,446	22,012
9	130,462	8,504	24,500	33,004	97,458	12,938	61,168	74,106	23,352
10	130,462	8,504	24,500	33,004	97,458	12,511	60,153	72,663	24,795
11	130,462	8,504	24,500	33,004	97,458	12,068	59,041	71,109	26,348
12	130,462	8,504	24,500	33,004	97,458	11,610	57,824	69,435	28,023
13	130,462	8,504	24,500	33,004	97,458	11,137	56,491	67,628	29,830
14	130,462	8,504	24,500	33,004	97,458	10,646	55,032	65,678	31,780
15	130,462	8,504	24,500	33,004	97,458	10,138	53,434	63,573	33,885
16	130,462	8,504	24,500	33,004	97,458	9,613	51,685	61,298	36,160
17	130,462	8,504	24,500	33,004	97,458	9,069	49,769	58,838	38,620
18	130,462	8,504	24,500	33,004	97,458	8,506	47,671	56,177	41,280
19	130,462	8,504	24,500	33,004	97,458	7,924	45,374	53,298	44,160
20	130,462	8,504	24,500	33,004	97,458	7,321	42,859	50,179	47,279
21	130,462	8,504	24,500	33,004	97,458	6,697	40,104	46,801	50,657
22	130,462	8,504	24,500	33,004	97,458	6,051	37,088	43,139	54,319
23	130,462	8,504	24,500	33,004	97,458	5,382	33,786	39,168	58,290
24	130,462	8,504	24,500	33,004	97,458	4,691	30,169	34,860	62,598
25	130,462	8,504	24,500	33,004	97,458	3,974	26,210	30,184	67,274
26	130,462	8,504	24,500	33,004	97,458	3,233	21,874	25,107	72,351
27	130,462	8,504	24,500	33,004	97,458	2,466	17,126	19,592	77,866
28	130,462	8,504	24,500	33,004	97,458	1,672	11,927	13,599	83,859
29	130,462	8,504	24,500	33,004	97,458	851	6,234	7,084	90,374
30									
31									
32									
33									
34									
35									
Total	3,261,550	212,600	612,502	825,102	2,436,448	235,176	1,219,057	1,454,233	1,104,016

Table 15-3 Cash Flow Sheet

(unit: Million TL)

No.	Cash Inflow				Cash Outflow					Balance	
	Fund Requirement	Net Income	Depreciation	Total	Construction cost	Principal Repayment F.C.	Principal Repayment D.C.(1)	I.D.C.	Total	Yearly	Accumulation
1	150,829	0	0	150,829	150,829	0	0	5,507	156,336	-5,507	-5,507
2	182,749	0	0	182,749	182,749	0	0	17,436	200,185	-17,436	-22,944
3	295,532	0	0	295,532	295,532	0	0	35,661	331,193	-35,661	-58,605
4	463,516	0	0	463,516	463,516	0	0	63,197	526,713	-63,197	-121,802
5	0	18,530	24,500	43,030	0	10,642	7,432		18,074	24,956	-96,846
6	0	19,608	24,500	44,108	0	11,015	8,138		19,153	24,956	-71,890
7	0	20,767	24,500	45,267	0	11,400	8,911		20,311	24,956	-46,935
8	0	22,012	24,500	46,512	0	10,642	7,432		18,074	28,438	-18,496
9	0	23,352	24,500	47,852	0	11,015	8,138		19,153	28,700	10,203
10	0	24,795	24,500	49,295	0	11,400	8,911		20,311	28,984	39,187
11	0	26,348	24,500	50,849	0	11,799	9,757		21,557	29,292	68,479
12	0	28,023	24,500	52,523	0	12,212	10,684		22,897	29,627	98,106
13	0	29,830	24,500	54,330	0	12,640	11,699		24,339	29,991	128,097
14	0	31,780	24,500	56,280	0	13,082	12,811		25,893	30,387	158,483
15	0	33,885	24,500	58,385	0	13,540	14,028		27,568	30,817	189,301
16	0	36,160	24,500	60,660	0	14,014	15,360		29,374	31,286	220,587
17	0	38,620	24,500	63,120	0	14,505	16,819		31,324	31,796	252,383
18	0	41,280	24,500	65,781	0	15,012	18,417		33,429	32,351	284,734
19	0	44,160	24,500	68,660	0	15,538	20,167		35,704	32,956	317,690
20	0	47,279	24,500	71,779	0	16,081	22,083		38,164	33,614	351,304
21	0	50,657	24,500	75,157	0	16,644	24,181		40,825	34,332	385,636
22	0	54,319	24,500	78,819	0	17,227	26,478		43,705	35,114	420,751
23	0	58,290	24,500	82,790	0	17,830	28,993		46,823	35,967	456,718
24	0	62,598	24,500	87,098	0	18,454	31,748		50,201	36,897	493,614
25	0	67,274	24,500	91,774	0	19,100	34,764		53,863	37,911	531,525
26	0	72,351	24,500	96,851	0	19,768	38,066		57,834	39,017	570,542
27	0	77,866	24,500	102,366	0	20,460	41,682		62,142	40,224	610,766
28	0	83,859	24,500	108,359	0	21,176	45,642		66,818	41,541	652,307
29	0	90,374	24,500	114,874	0	21,917	49,978		71,895	42,978	695,285
30											
31											
32											
33											
34											
35											
Total	1,092,626	1,104,016	612,502	2,809,144	1,092,626	377,115	522,317	121,802	2,113,859	695,285	6,492,671

Chapter 16 FURTHER INVESTIGATION

Chapter 16

FURTHER INVESTIGATION

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Chapter 16 FURTHER INVESTIGATION

16.1 Geological Investigation

Drilling investigations as shown below at Table 16-1 will be required to be conducted for grasp of the permeability at the dam site and the geological properties at the waterway and the powerhouse site.

Table 16-1 Further Drilling Investigation

Drillhole No.	Location	Length (m)	Water Measure-ment	Lugeon Test	Investi-gation	Initial Stress
PH-1	Dam, Left Bank	60	O	O		
PH-2	Dam, Right Bank	50	O	O		
PH-3	Dam, Right Bank	70	O	O		
PH-4	Intake	80	O	O		
PH-5	Underground Powerhouse	220	O	O	O	O
PH-6	Waterway	100	O	O		
PH-7	Waterway	50	O	O		
PH-8	Waterway	50	O	O		

16.2 Environment

This report is excluded the portion which Turkish Government should do in future.

But it is included Draft Report of Environment Impact Study by the request of Republic of Turkey according to Guide Line of Environment Assessment in Republic of Turkey.

This Draft shows the contents which should perform additional investigations at the stage of approval of schedule and Detailed Design.

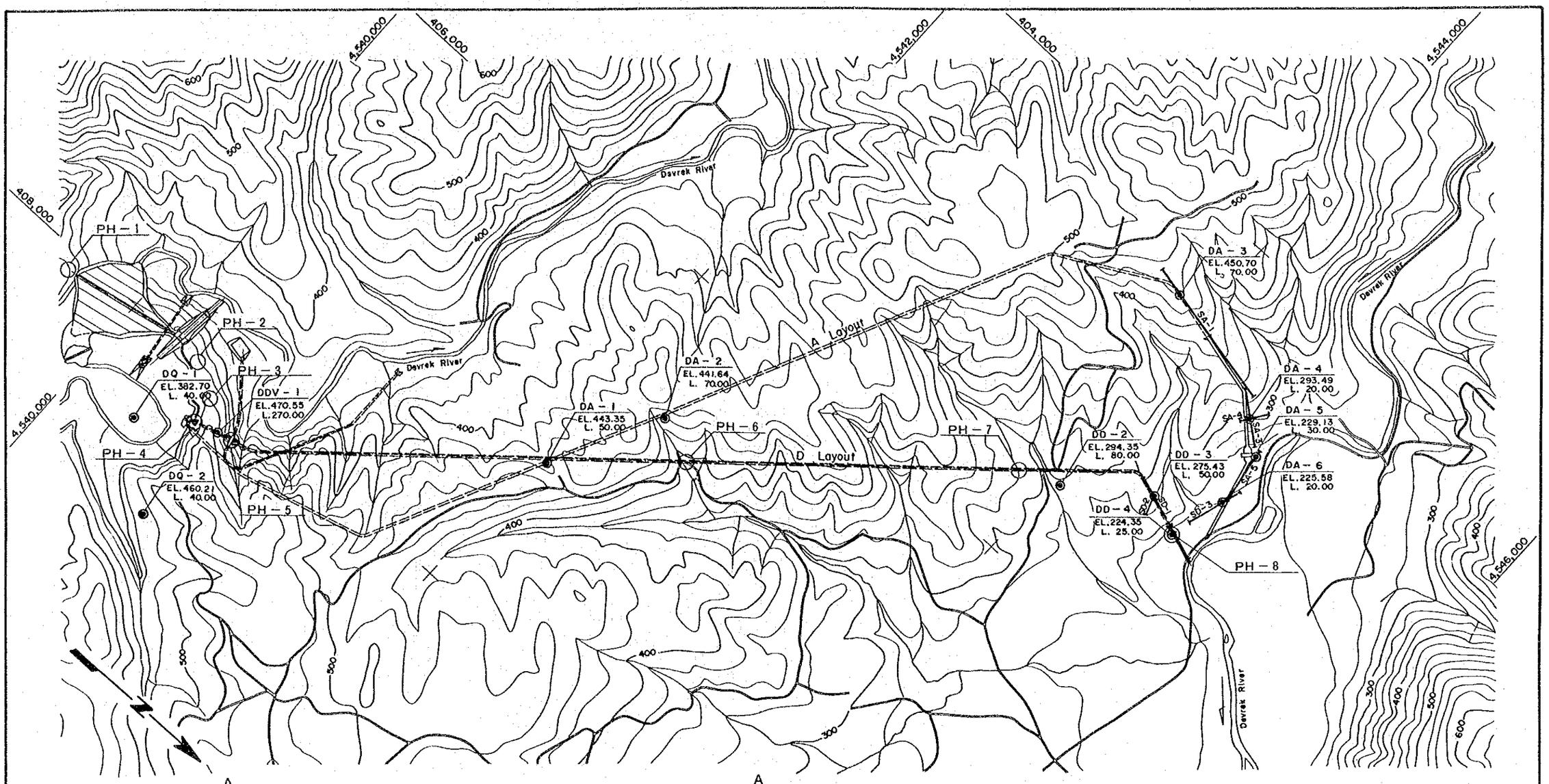
The main Items are as follows:

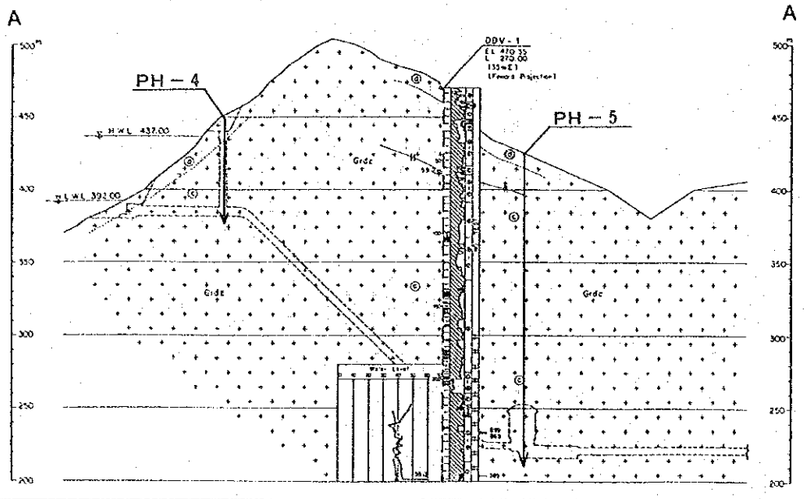
(1) At the stage of Approval of schedule.

- Additional data and its assessment
- Cost Benefit

(2) At the stage of Detailed Design

- Preparation of the newest and longer term data applied by forecast of water quality
- Check of water quantity discharged by dam outlet for keeping at present social environment
- Check of countermeasures against protection of environment during construction
- Cost benefit
- Completion of impact of environment assessment





Legend

DA – 1
EL. 443.35
L. 50.00
Drillholes

SA-1
Seismic Prospecting

PH – 1
Proposed Hole

0 1000m

KÖPRÜBAŞI HYDROELECTRIC POWER DEVELOPMENT PROJECT

LOCATION MAP
OF
FURTHBR INVESTIGATION
PROPOSED HOLE

Figure 16-1

JICA