

INTERNATIONAL CO-OPERATION ON BIOS - THE GOLDEN HORN PROJECT

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INTRODUCTION

As biological and ecological specifications of the environment are considered; pollution problems increase parallel with increasing industrialisation. When technological, scientific financial accumulations and the experience of developed countries are used to solve the environmental problems of developing countries, then positive results will appear due to international co-operation.

A good example of this co-operation is the Golden Horn Project which is occurring in Istanbul. Istanbul is currently undergoing rapid industrialisation and chaotic urbanisation. Having been established for over 2,500 years, and as the most crowded city in Turkey, Istanbul is the commercial, industrial, cultural and artistic centre. Istanbul has 12% of Turkey's population, along with approximately 50% of the country's industry. In the 1950s the beginning of the migration from Anatolia led to a rapid increase in the population of Istanbul. The population profile is as follows:

Year	Population
1950	1,051,352
1960	1,736,641
1970	2,846,608
1975	3,740,401
1980	4,539,493
1985	5,618,807
1988	over 6,000,000

The unhealthily rapid development and the absence of related infrastructures cause serious environmental problems within the city: sewage, industrial pollution, insufficient water supply and transportation problems are the most urgent. In order to solve the sewerage problem the Metropolitan Istanbul Sewerage Project has been established.

The "Golden Horn Project" is the first step in this project and it was effectively launched in 1985. In this paper the Golden Horn Project is described as a part of the Metropolitan Istanbul Sewerage Project, and the need for international co-operation is emphasised.

ISTANBUL, POLLUTION AND SEWERAGE

As mentioned above, Istanbul is the most highly populated city in Turkey with rapid development of industrialisation and awry urbanism from the 1950's migration movement, resulting in slums surrounding the city like city walls.

The insufficiency of the infrastructure and the lack of environmental protection have brought the problems to a chronic state. The inadequacy of sewage disposal seems to be the most important infrastructural problem in settlement areas. In fact, some well-meant attempts have been made earlier concerning this problem with plans and projects prepared.

Historical Development of Sewerage Systems in Istanbul

Between 1918 and 1920 the Istanbul sewerage project was initiated by a French company. Between 1925 and 1937 the Berlin Reconstruction Company, under its Administrator Mr. Wild, continued the project. With these projects the basis was the same, that is, to collect domestic waste waters and rain water by a united sewerage system, then after rough screening and pre-treatment, discharge them into the sea. Both of these projects were achieved to a very limited extent. Between 1959 and 1966 the first master plan relating to the removal of Istanbul city waste waters was prepared by a German Professor, Dr. Dietrich Kehr. In this project the rain water and the domestic waste water was collected using different systems. The rain water was then discharged to the nearest water body. After treatment and chlorination, the domestic waste water was discharged into the Marmara Sea and the Bosphorus.

Mr. Wild's plan was changed by Dr. Kehr, and it was proposed that waste water collection and subsequent discharge into the Bosphorus be carried out through interceptors. Dr. Kehr did not accept the Golden Horn as the receiving body. He wanted to protect the shores of the Marmara Sea by discharging the waste waters into the Bosphorus and he proposed that interceptors be installed along the Golden Horn.

Istanbul Region Water Supply and Sewerage Master Plan and Feasibility Studies were carried out by DAMOC, which is a consortium of consultant companies, on behalf of the United Nations Development Program and WHO, between 1966 and 1970.

As for waste waters not included in the regions making up the Kehr projects, their removal is projected to places in the Bosphorus Region. On top of these places there is the low-density Black Sea water and further down, denser Mediterranean waters. In order to absorb the waste water there are sufficient currents.

Rain water sewerage feasibility studies were carried out by Scandia-Consult Company in 1970-1971. In accordance with the suggestions of this master plan, rain water canals and main interceptors have been constructed at many places in Istanbul. A Master Plan was prepared by Camp-Tekser Consultancy Consortium which revised the Damoc Master plan and Feasibility Studies in 1974-1975. According to this Master Plan, in the Marmara Sea and Bosphorus, oceanographic research studies were carried out. It was decided to take advantage of the two-layer environment particular to the Marmara Sea and the Bosphorus. Waste waters discharged to 30m below the sea level at the Sarayburnu entrance of the Bosphorus, and to the denser lower level deeper than 50m at the Kavaklar Exit should reach the Black Sea diluted to 80%.

In all these studies, the main principles of the Metropolitan Istanbul Sewerage Project have been defined.

The population growth was considerably faster than anticipated and land utilisation more intensive. Because of this, earlier construction plans had to be changed, and project studies enlarged.

Golden Horn

The "Golden Horn" is the name of the 8km long bay, separating the districts of ancient Istanbul and Beyoglu. It is on the European Side of Istanbul. At one time the Golden Horn was a symbol of old Istanbul.

With the beginning of industrial activities in the 1950s, the Golden Horn was densely occupied. The shores are filled with factories, work premises and warehouses. Industrial concerns occupy 71% of the total of 170 hectares of the zone, 28% is occupied with shipyards, and warehouses use 8% of this region. Almost all branches of the industry are represented within the Golden Horn. Shipbuilding, using one fifth of the total area, is followed by the iron-sheet manufacture and chemical industries, 40% of the total area is taken up by metal, electrical and construction appliance industries, textile, food, wood products and machine manufacturers. The industries are concentrated in the districts of Kasimpasa, Eyup, Kagithane and Defterdar districts. The daily industrial liquid waste is approximately 200,000 tons. Of this, 67% is chemical, 27% is washing water, 4% is cooling water, and the rest, waste.

In 1976, 50,000 tons of solid waste were discharged into the Golden Horn. Thus, in the early 1980s the Golden Horn was not so "golden".

THE APPLICATION OF INFRASTRUCTURAL INVESTMENTS

The Metropolitan Istanbul Sewerage Project is a very big project and technical plus financial international co-operation is necessary.

With the establishment of Istanbul water and Sewerage Administration (ISKI), a great advance has been made in this field. The Istanbul Metropolitan Municipality allotted a major part of its investment expenditures for 1985-1988 to the infrastructure. The Golden Horn project involved in the Metropolitan Sewage Project, has an important share in these high-investment expenditures. The World Bank supplied the foreign financing of the investments made for the Golden Horn Project.

In order to supply this finance, the World Bank wanted Turkey to establish an organisation. In 1981 Istanbul Water and Sewerage Administration General Directorate (ISKI) was established. ISKI has its own independent boards. After the 1984 elections, Mr. Ozal became Prime Minister. The principle of his government is to give priority to local authorities in every administrative body. Therefore, in seven big cities, such as Ankara, Istanbul and Izmir, Metropolitan Municipalities were established, with ISKI connected to the Istanbul Metropolitan Municipality. Its functions remain unchanged. Today all investments and planning are done within this particular body.

The realisation of such big projects need not only technical but also financial international co-operation.

Technical Aspects

General Solution for Istanbul

The Metropolitan Istanbul Sewerage Project was guided by Istanbul Water and Sewerage Administration General Directorate (ISKI) Engineers whilst commissioned to a group of specialised domestic and foreign engineering companies: Taylor Binnie and Partners (British), Uluslararası Birlesmis Musavirler (Turkish), Watson Hawksley (British), Motor Columbus (Swiss) and Temel Muhendislik (Turkish).

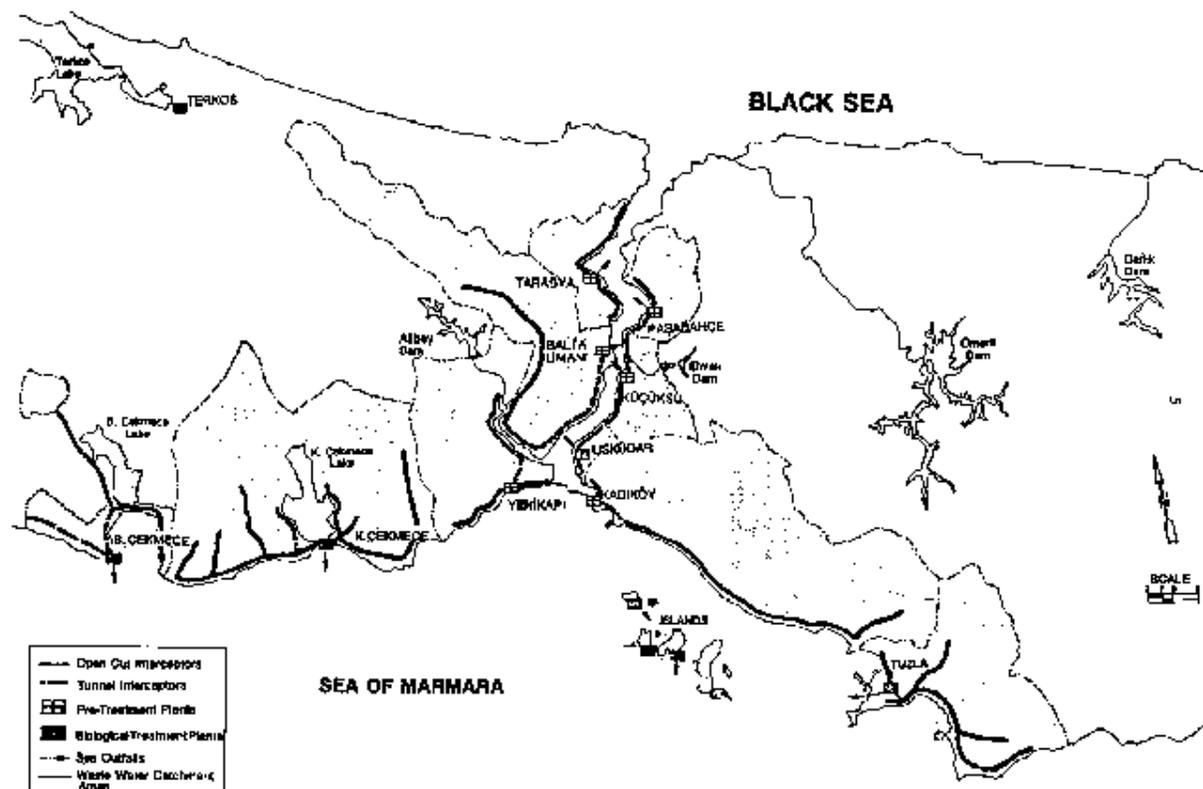


Figure 1: The Metropolitan Istanbul Drainage Catchment Areas and Trunk Sewerage facilities
The Metropolitan Istanbul Drainage Catchment Areas and Trunk Sewerage facilities are shown in Figure 1.

In order to protect Istanbul's existing water sources and to bring about a radical solution to its sewerage problems, the city has been divided into 11 separate drainage catchment areas, from Buyukcekmece in the west to Gebze in the east. This separation also takes into account housing and industrial developments. It is planned to establish treatment plants at Kucukcekmece, Yenikapi, Baltalimani, Tarabya, Pasabahce, Kucuksu, Uskudar, Kadikoy and Tuzla. In Kucukcekmece and Tuzla the plants will function as complete biological treatment plants. Others will be planned as pre-treatment plants. Moreover, these pre-treatment plants are being built in such a way that they can be converted into biological treatment plants in the future.

Solution for Halic

On May 8 1984, the Istanbul Metropolitan Municipal Council decided to save the Golden Horn. Along with this decision, a project for its cleaning and for environmental rearrangement received approval. It is proposed to put an end to the factors polluting the Golden Horn and actualise the environmental rearrangement programme; then, by means of the southern and northern Golden Horn interceptors, enable the circulation and cleaning of the Golden Horn superficial waters. Housing and business units on the two shores of the Horn are under notice to move elsewhere. Meanwhile, expropriations are effected.

A priority is that occupied buildings in a state of collapse, be destroyed. The municipality tries, as far as possible, to protect citizens from becoming homeless or unemployed.

The Istanbul Metropolitan Municipality leads the action by immediately stopping the activities of certain facilities already established on the shores of the Golden Horn. Many industrial ventures will be relocated elsewhere.

The Golden Horn Project is divided into two sub-projects - the Southern Golden Horn Project and the Northern Golden Horn Project.

The Southern Golden Horn Project

This project will serve 2 million people, that is, one third of Istanbul's present population, in a 10 thousand hectare zone. It covers the south and the west of the Golden Horn in areas such as such as Bakirkoy, Gungoren, Esenler, Bayrampasa, Kucukkoy, Gaziosmanpasa, Eyup, Alibeykoy, Zeytinburnu, Faith and Eminonu. Later it will serve up to 3 million people.

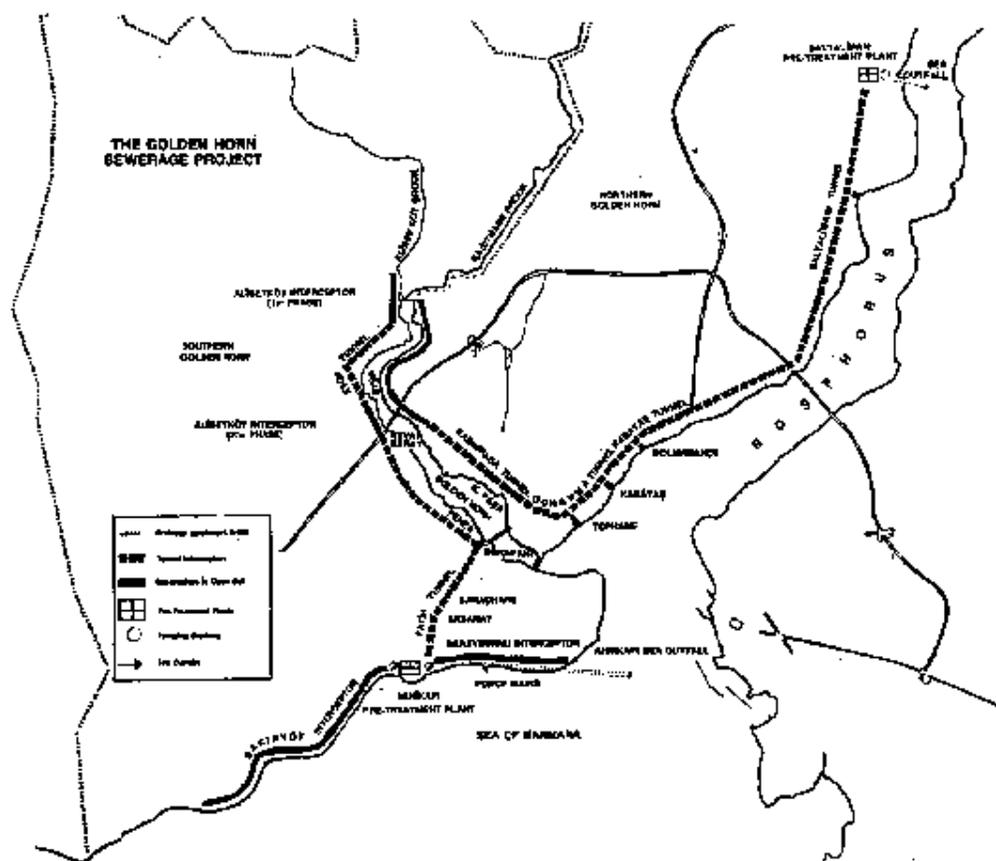


Figure 2: The Golden Horn Sewerage Project Map

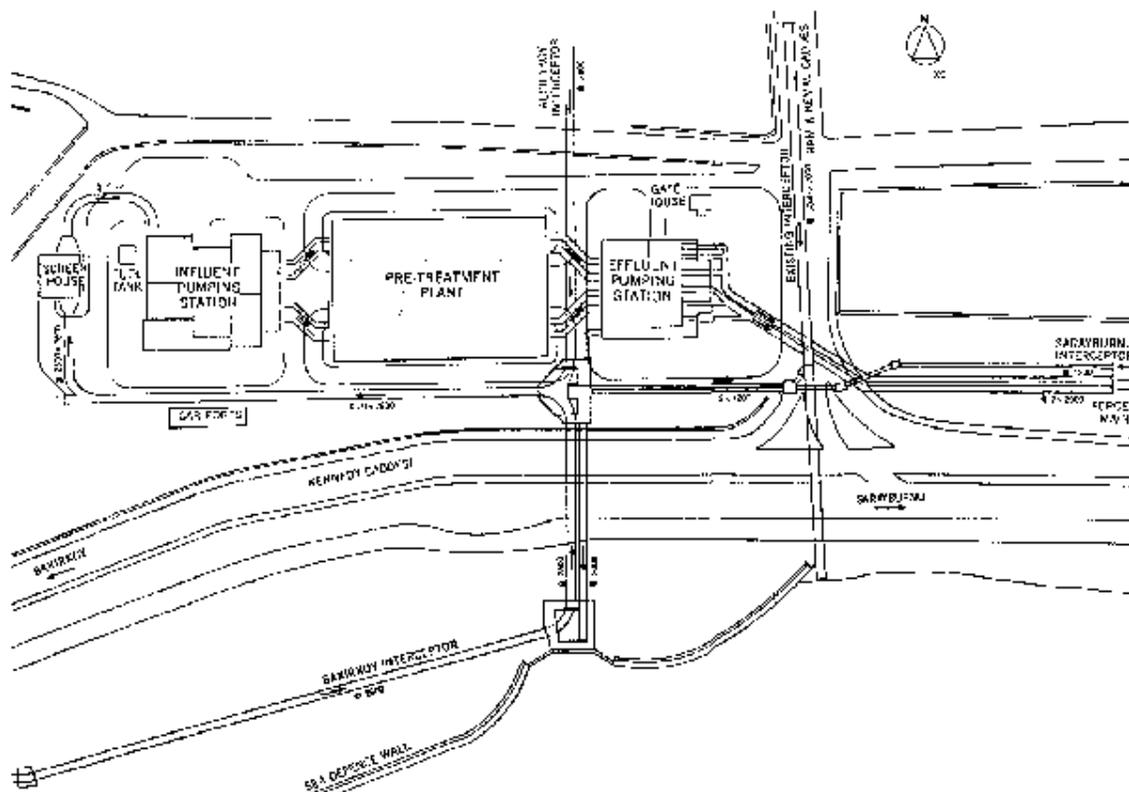


Figure 3: The Yenikapi Pre-treatment Plant Plan

Five separate tenders are made for this project. These are:

- A. Construction of interceptors in open-cut. Construction of Alibeyköy, Bakirköy and Sarayburnu Interceptors and construction of the Sarayburnu Force Mains.

- B. Construction of interceptors in tunnels. Construction of Eyup, Halic, and Fatih tunnels.
- C. Construction of Yenikapi Pump Stations and Pre-treatment Plant.
- D. Procurement and installation of Yenikapi Pump Stations and Pre-treatment Plant and electrical-mechanical equipment.
- E. Construction of the Ahirkapi Sea outfall.

The project comprises 11km of open-cut interceptors. Their diameters vary between 1,200mm and 2,800mm. A further 6.5km of tunnel interceptors, the diameters of which vary between 2,200mm and 2,800mm; a 2 x 2,000mm diameter force mains 2,4km long, a 1,600mm diameter sea outfall line 2 x 1,180m long, a total of 1,000m of sea wall and dock at Yenikapi and Ahirkapi and furthermore, 200,000m² of sea fill.

It is planned to intercept a total of 1,600,000m³ of waste water per day, passing through the Yenikapi Pre-treatment Plant with a daily capacity of 864,000m³ which, by the year 2000, will gradually reach 1,600,000m³.

Waste waters are discharged by two pipes into the bottom currents of the sea at Ahirkapi 1,180m offshore and 60m deep. The Yenikapi Pre-treatment Plant plan is shown in Figure 3.

At the Yenikapi Pre-treatment Plant, coarse wastes over 80mm carried in the waste water arriving at the pre-treatment plant are retained at the coarse screening unit. Coarse wastes remaining on the screens are taken to the screen waste press by a conveyor. Here, solid wastes are compressed, then conveyed to garbage areas. Waste water is then conveyed to the influent pump station. Waste water is continually pumped to the pre-treatment section by means of these pumps. This section consists of parallel channels. Channel inlets have fine screens that serve to retain solid wastes over 20mm. The grit-retaining equipment is used to retain grease and other floating material wastes retained by the screens, which are taken by carriers, compressed and carried to the garbage area.

There is also an ozonisation unit in this section. The ozone generators produce ozone gas, in this way the dense and unpleasant odour produced is eliminated.

After pre-treatment, plant waste waters reach the effluent pump station. Half of the maximum flow is discharged into the sea by gravity. Water discharged by the pumps at the effluent Pumping Station is conveyed via pre-stressed concrete pipes to the sea outfall at Ahirkapi.

The pumps from the pre-treatment plants were bought from a Japanese firm, the ozonisation unit from an English firm and finally the screens and the grit-retaining equipment were bought from a German firm.

TABLE 1

**Istanbul Water Supply and Sewage Project Cost Estimates at
July 8 1988
(\$ million)**

Component	IBRD's Appraisal			Total Project Cost			ISCI's last revision			ISTANBUL WATER SUPPLY AND SEWERAGE PROJECT COST ESTIMATES AT 8 JULY '88
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	
A- Water Distribution										
1. Program for reducing water	1,5	0,2	1,7	1,5	0,2	1,7	1,5	0,2	1,7	
2. Replacement of pipe	34,9	25,5	60,4	24,2	40,0	64,2	24,2	40,0	64,2	
3. Rehabilitation of pumping station	6,2	4,9	11,3	5,0	6,3	11,3	5,0	6,3	11,3	
4. SCADA	10,7	2,8	13,5	10,7	2,8	13,5	10,7	2,8	13,5	
SUBTOTAL	53,3	33,4	86,7	41,4	49,3	90,7	41,4	49,3	90,7	
B- SEWERAGE SYSTEM										
1. Ataköy	2,7	5,1	7,8	1,9	3,3	5,2	2,5	2,7	5,2	
2. K.Çelmece	36,1	43,1	79,2	27,9	19,1	47,0	32,5	14,5	47,0	
3. Kadıköy-Pendik	63,4	79,3	142,7	52,7	35,1	87,8	59,7	28,1	87,8	
4. Tuzla	46,5	65,2	111,7	36,2	21,5	57,7	43,3	16,5	57,8	
5. Üsküdar	3,3	6,2	9,6	1,4	2,2	3,6	1,9	1,7	3,6	
6. Street Sewers	2,1	60,9	62,9	-	120,0	120,0	-	120,0	120,0	
7. Sewer Connections	-	53,9	53,9	-	74,0	74,0	-	74,0	74,0	
8. Baltalımanı	-	-	-	22,4	24,6	47,0	28,1	18,9	47,0	
SUBTOTAL	150,1	315,5	465,6	142,5	299,8	442,3	166,0	276,4	442,4	
C- TRAINING ACT & EQUIP.										
1. Operation & Maintenance	1,1	0,1	1,2	1,1	0,1	1,2	1,1	0,1	1,2	
2. Training in ind waste water	0,1	-	0,1	0,1	-	0,1	0,1	-	0,1	
3. Equipment	9,5	2,0	12,3	9,5	2,0	12,3	9,5	3,2	11,7	
SUBTOTAL	10,6	2,0	12,6	10,6	2,0	12,6	10,6	3,3	13,9	
GRANDTOTAL	210	351,8	561,9	194,5	352,0	546,6	218,0	329,0	547,0	

The Northern Golden Horn Project

This project will serve today's population of 1 million (with a projected 2 million people in the future) living in a region of nearly 6,500 hectares situated north of the Golden Horn, west of the Kagithane Brook and south of Istinye comprising Beyoglu, Sisli, Kagithane, Levent, Ayazaga, Besiktas, Kemerburgaz and Ortakoy.

- A. There are 4 separate tenders in this project:
- B. Northern Golden Horn Interceptors
- C. Kabatas-Baltalımani Tunnels
- D. Baltalımani Pre-treatment Plant and Pumping Station
- E. Baltalımani Sea Outfall.

The projected waste water interceptors are being built in open-cut and tunnels. Waste water, which will pass through the pre-treatment plant with an initial daily capacity of 855.000m³ (year 2000) and a final capacity of 1,100.000m³ (year 2020) will gravitate to the sea outfall point at Baltalımani via a pre-stressed concrete pipe line. It will then be conveyed to bottom currents 70m below the Bosphorus level.

Financial Aspects

In order to realise such an undertaking, as well as technical co-operation, it is necessary to take advantage of international financial co-operation. The financial support for the Golden Horn Project comes from two sources, one, the International Bank for Reconstruction and Development (World Bank), the other, the European Settlement Fund.

The International Bank for Reconstruction and Development gave \$88.1 million for the total Golden Horn Project, for both the Southern and Northern Projects. From this \$88.1 million, \$50 million was used for the Southern Project. The Northern Project will be finished in 1990. The financial support from the International Bank for Reconstruction and Development of the Northern Golden Horn Project amounts to \$38.1 million which is insufficient. So, money-flow from other sources has been arranged. For the construction of a sewage system in Kadıkoy-Pendik, \$142.7 million has been allocated.

The system was finished with only \$90 million. The remaining money is transferred to the Northern Golden Horn Project.

As shown in Table 1, The International Bank for Reconstruction and Development addition to the Istanbul water supply and Sewage Project is \$218 million with local support the financial profile of this project reaches \$547 million. The money from the International Bank for Reconstruction and Development, \$88.1 million, has an interest rate of 11.4%. commitment fee and from the unused part 75%. The paying-back of the loan began in 1987. The repayment system is twice a year, and will be completed in 1999. Thus, twice a year \$3,390.000, plus interest is paid back. For the first 5 years there was no payment. The contract was signed in 1982, but 3 years were needed for the project to begin.

The total money for the Istanbul Water Supply and Sewerage Project, i.e. \$218 million from the International Bank for Reconstruction and Development, has an interest rate of 7.6% and has no repayment for the first 4 1/2 years.

The other financial source, the European Resettlement Fund, from which \$89 million was received, is used for expropriations and for the construction of subcollectors in the Istanbul area. 40% of the total investment has been allocated from this \$89 million. The remaining 60% comes from local sources.

Another source of financial support is the Turkish-Italian Economical Cooperation, which has not yet got off the ground. It is programmed for 1989, and is an inter-governmental contract. If this is realised, \$4.5 million will be donated by the Italian Government.

CONCLUSION

In this paper, the figures for the Southern Golden Horn Project have not been given, because these measurement values have not been accurately prepared. But bios (life) in Golden Horn is now improving since the Southern Golden Horn Project was finished in July 1988. According to figures, the total suspended solids have improved by over 100%. The situation will be even better with the application of the Northern Golden Horn Project, which will be finished in 1990.

As can easily be seen from the Golden Horn example, in order to find the right solutions to bio-environmental protection problems, it is necessary to approach them with sensitivity. International co-operation in technical and economical subjects is a very useful tool.

Especially in developing countries, the environmental problems are usually not considered until some catastrophic results have occurred. These problems must be solved before the first danger signals appear. In solving them, the technological and financial accumulations and experiences of developed countries should be used, and with international co-operation positive results can be achieved such as in the Golden Horn project.

Professor **Ahmet Samsunlu** studied at Hanover Technical University (B.Sc., M.Sc.) and received his doctorate there in environmental engineering. He worked at the Ege University, Izmir, until 1986 where he became Professor, Chairman of the Department of Environmental Engineering and Dean and Vice-Rector of the University. At present, he is the Chairman of the Department of Environmental Engineering at the Technical University of Istanbul. He has been Turkish representative at the European Council for Environment Group, a member of the Turkish National Research Organisation's environmental group and a Board member of the Turkish State Organisation. As a member of Parliament, he was Minister for Housing, City Planning, Resettlement and the Environment.