Year	A.D.	Vehicles
0	1976	630,000
1	1977	720,000
2	1978	800,000
3	1979	880,000
4	1980	970,000
5	1981	1,060,000
6	1982	1,146,000
7	1983	1,223,000
8	1984	1,308,000
9	1985	1,399,000
10	1986	1,500,000
11	1987	1,619,000
12	1988	1,760,000
13	1989	1,850,000
14	1990	1,944,000
15	1991	2,000,000
16	1992	
17	1993	
18	1994	
19	1995	2,200,000
20	1996	
21	1997	
22	1998	
23	1999	
24	2000	2,500,000
25	2001	
26	2002	
27	2003	
28	2004	
29	2005	**2,847,470**

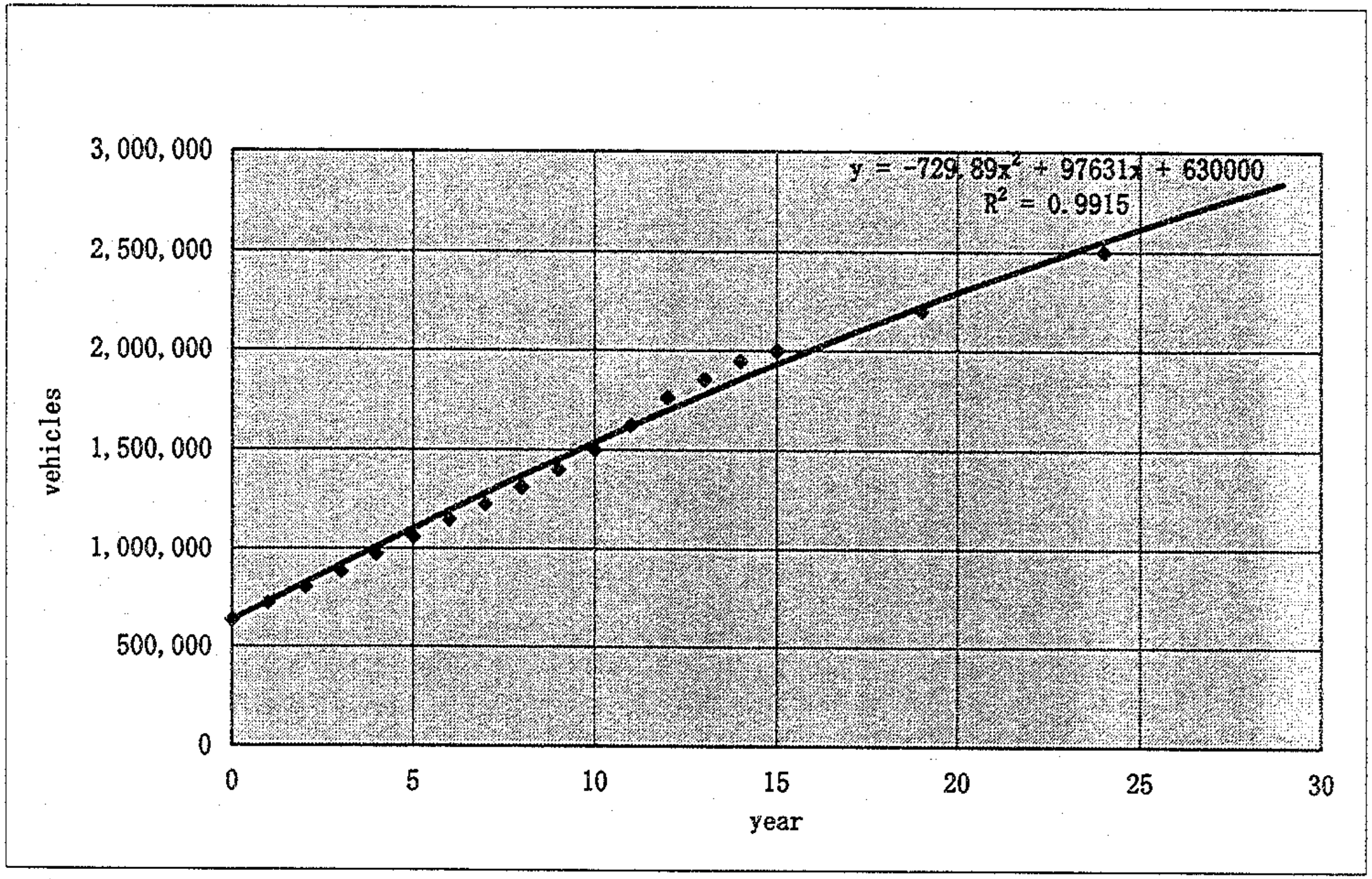

Figure 8.2.3 Projection of Number of Motor Vehicles in Hungary in 2005

Table 8.2.4 Age Distribution of Registered Motor Vehicles in Hungary (1990)

Unit : %

Age (year) / Car type	< 1	2 - 5	6 - 10	10 <	Total
Passenger Car	4.3	27.8	25.9	42.0	80.6
Buse	1.2	33.7	34.0	31.1	3.1
Truck	4.3	33.2	34.9	27.6	16.2
Weighted Average	4.2	28.8	27.6	39.4	100

Since motor vehicles equipped a catalytic converter are considered to satisfy the EC regulation concerning emission standard, the emission factors of (2) shown in Table 8.2.5 can be applied to such vehicles, and those of (1) to older vehicles.

Table 8.2.5 Emission Factors of NOx for Motor Vehicles

Car Type	Emission Factor (g/km)		(2) / (1)
	(1) Uncontrolled	(2) Controled	
Passenger Car	0.80	0.21	0.26
Small Truck	0.92	0.42	0.46
Bus	16.6	9.70	0.58
Large Truck	14.7	8.60	0.56

The emission factor of SO_2 largely depends on the sulfur content of fuels. The Hungarian authorities plan to improve sulfur content of diesel and gasoline as follows:

Fuel	Sulfur Content	
	Present	Future
Diesel	0.2 %	0.05 %
Gasoline	0.05 %	0.04 %

Accordingly, the emission factors shown in Table 8.2.6 can be used.

Table 8.2.6 Emission Factors of SO_2 for Motor Vehicles

Car Type	Emission Factor (g/km)		(2) / (1)
	(1) No fuel Improvement	(2) Fuel improvement	
Passenger Car	0.05	0.04	0.80
Small Truck	0.07	0.056	0.80
Bus	1.55	0.39	0.25
Large Truck	1.37	0.34	0.25

8.3 Future Cases for Prediction of Air Quality

For prediction of future air quality, the following 3 cases are considered:

(1) No air pollution control measures are taken (Case F-0).

(2) Air pollution control measures already planned by the Hungarian authorities and individual enterprises are taken (Case F-1).

(3) Some additional air pollution control measures are taken (Case F-2).

Since the Hungarian authorities and individual enterprises are already planning various air pollution control measures, above case (1) is not conceivable in reality. However, it is included for analysis since the effects of air pollution control measures in other cases can be more clearly demonstrated in comparison to the no pollution control case.

Conditions of above 3 cases are explained below.

8.3.1 Case of No Air Pollution Control (Case F-0)

(1) Power Stations

1) Borsod Power Station

It is assumed that the productions of electricity and heat energy in 2005 are 970 GWh and 2,870 TJ, respectively, as shown in Table 8.2.1.

However, it is also assumed that the productions are carreid out by using the present facilities and the same fuels as the present. Fuel consumption in this case is as follows:

Brown coal (S : 2.2%)	1,557,545 ton/y	(8.5 MJ/kg)
Natural gas	39,116,000 Nm^3/y	(34.0 MJ/m^3)
Oil (S : 2.9%)	145 ton/y	(42.0 MJ/kg)
Total heat value	14,575 TJ	

2) Tiszapalkonya (Tisza I)

It is assumed that the productions of electricity and heat energy in 2005 are 35 GWh and 1,700 TJ, respectively, as shown in Table 8.2.2. The present facilities and the same fuels as the present are assumed to be used. Fuel consumption is as follows:

Brown coal (S : 1.875%)	270,588 ton/y	(8.5 MJ/kg)
Natural gas	7,205,000 Nm^3/y	(34.0 MJ/m^3)
Oil (S : 3.45%)	125 ton/y	(41.0 MJ/kg)
Total heat value	2,550 TJ	

3) Tisza II Power Station

It is assumed that the electricity production in 2005 is 1,581 GWh as shown in Table 8.2.3. Present facilities and the same fuels with the same ratio of gas/oil as that of the present are assumed to be used. Fuel consumption in 2005 is as follows:

Natural gas	172,620,000 Nm^3/y	(34.0 MJ/m^3)
Inert gas	300,918,000 Nm^3/y	(16.2 MJ/m^3)
Oil (S : 3.73%)	110,889 ton/y	(40.2 MJ/kg)
Total heat value	15,210 TJ	

(2) Major Factories

Conditions of major factories in 2005 is assumed to be basically the same as that described in Section 8.2, but energy saving by about 10% is excluded. Estimated fuel consumption of major factories are shown in Tables D8.3.1 (1) through D8.3.1 (3) in Data Book.

(3) Communal Facilities

Population and the number of households in 2005 are assumed to be the same as the present.

Fuel consumption in the heating centers (except power stations) is assumed to be the same as that of the present both in quantity and quality of fuels.

Household consumption of natural gas and other fuels is also assumed to be the same as the present.

(4) Motor Vehicles

As described in 8.2.4, the traffic volume in the target year 2005 would increase by 40% in comparison with present one (1992), and the ratio of anti-pollution motor vehicles would be 6.8% of the future traffic volume. The emission factors of NOx for the anti-pollution vehicles and others is shown in Table 8.2.5. The sulfur contents of diesel and gasoline are assumed to be the same as the present.

8.3.2 Case of Existing Air Pollution Control Plan (Case F-1)

This case largely corresponds to the basic future conditions described in Section 8.2. Air pollution control measures planned by the Hungarian authorities and enterprises are included.

(1) Power Stations

1) Borsod Power Station

CFBC and HFBC systems are introduced as shown in Table 8.2.1. Fuel consumption and energy production by these facilities in 2005 are as shown below:

		CFBC	HFBC	Total
Production of electricity	(GWh)	900	70	970
Production of heat energy	(TJ)	2,000	870	2,870
Brown coal (S : 2.2%)	(ton)	1,108,302	212,874	1,321,176
Natural gas	(1,000 m^3)	3,943	765	4,708
Load (%)		100	60	-
Annual operation rate (%)		79	25	-

2) Tisza I Power Station

Fuel consumption and energy production of Tisza I Power Station is assumed to be the same as that in the no pollution control case as shown below:

Production of electricity	(GWh)	35
Production of heat energy	(TJ)	1,700
Brown coal (S : 1.875%)	(ton)	270,588
Natural gas	(1,000 m^3)	7,205
Oil (S : 3.45%)	(ton)	125

3) Tisza II Power Station

Electricity production and fuel consumption are the same as that in the no pollution control case. But low sulfur oil (S : 1.0%) is to be used in place of the oil used at the present (S : 3.73%).

Production of electricity	(GWh)	1,581
Natural gas	(1,000 m^3)	172,620
Inert gas	(1,000 m^3)	300,918
Oil (S : 1.0%)	(ton)	110,889

(2) Major Factories

The conditions of major factories in fuel consumption are basically the same as that described in Section 8.2 that account for energy saving by about 10%. Estimated fuel consumption of major factories in 2005 is shown in Tables D8.3.2 (1) through D8.3.2 (3) in Data Book.

In addition, emission control measures planned in 4 factories shown in Table 8.3.1 are included. These measures are explained below, and effects in pollutant emission reduction are shown in Tables D8.3.3 (1) and D8.3.3 (2) in Data Book.

Table 8.3.1 Factories Having Pollutant Emission Control Plan

R/N	Name of Factories	Type of Industry	Source No. and Facility	Item for Control Measures	Fuel
03/0	EMO. TEGLA ES CSEREPIPARI VALLALAT PUTNOKI TEGLAGYAR	Brick	P-014 Tunnel kiln	SO2	Coal
15/1	HAMOR RESZVENYTARSASAG	Iron Casting	P-009 etc. 8 Forge furnaces	NOx	Natural gas
15/2	DIOSGYORI ACEL ES VASONTO KFT	Iron Casting	E-001 3 Electric furnaces	Dust	
23/1	TISZAI VEGYI KOMBINAT	Chemical	P-002 3 Nitric acid production lines	NOx (*)	

(*) : The emission standard value is not exceeded, but the emission is still high.

1) EMO. TEGLA ES CSEREPIPARI VALLALAT PUTNOK TEGLAGYAR (R/N : 03/0)

Bricks are formed by uniformly pulverizing clay and coal and mixing them with water and a combustible material such as sawdust. Green bricks are dried by hot air from a tunnel kiln in which the coal and sawdust in the raw material are burnt. The tunnel kiln in question is old. The factory intends to change fuel from coal to natural gas.

2) HAMOR RESZVENYTARSASAG (R/N: 15/1)

In this iron casting plant, there are 8 old forge furnaces of the age between 30 to 60 years.

Natural gas is used as the fuel. They cause large energy losses, and NOx emissions from some furnaces exceed the standard level.

Remodeling of the furnaces into the Rath type is planned in the plant to yield energy saving by 30 to 35% and reduce the NOx emission as achieved in a past experience. However, revamping of the eight furnaces will require HUF 160 million. One alternative considered in the plant is to change energy source from natural gas to electricity. NOx will not be generated and it is said that some of the new products can only be produced by electric arc furnaces.

3) DIOSGYORI ACEL. ES VASONTO KFT (R/N : 15/2)

A large amount of dust is generated in the electric arc furnaces when pig iron and ingots are produced by melting scrap iron and alloys. Dust emissions from the furnaces amount to 40kg per hour.

The following control measures are being planned by the plant.

The E-001 building houses two 17.5t and one 2.5t units. Umbrella-type suctions are installed on the furnaces and exhaust gases are released from the stacks after passing through these suctions and outdoor dust collectors. The details of this scheme are described in 7.2.3.(5).

4) TISZAI VEGYI KOMBINAT (R/N: 23/1)

There are nine production lines in total in the TVK nitric acid plants. Of them, four lines are actually operated.

In 1993, TVK installed de-NOx equipment with good test results. The remaining three lines are planned to have similar de-NOx equipment installed. The process is as follows :

$$NO + NO_2 + 2NH_3 \xrightarrow{230 \text{ to } 300\ ^\circ C} 2N_2 + 3H_2O$$

The catalyst used : V_2O_5/Al_2O_3 (imported)
Amount of emission gases: 18,000 to 20,000 Nm^3/h
NOx concentration reduced : from 0.2% to 0.05% (75% reduction)

5) Other

Measures to control air pollution were needed for the DNM steel mills in Miskolc City. However, the blast furnace, LD converters in the combined steel works, and other equipment have been decided to close by the Government. When the operation of the blast furnace stops by 1996, sintered products from BEM will not be required and air pollutants emitted by BEM will be also eliminated.

(3) Communal Facilities

1) Heating Centers

Conditions of heating centers are assumed to be the same as that of the present.

2) Households

It is assumed that the natural gas supply is expanded to 55% of the households not having the supply at present. Areas to be supplied are in accordance with the plan of the gas company (Tigaz). Percentage of gas-supplied households in each community in the Study Area is shown in Tables D8.3.4 (1) through D8.3.4 (3). As a result, 78% of the total number of households are supplied with the natural gas.

(4) Motor Vehicles

Hungarian government considers the increase of anti-pollution vehicles as a main countermeasure against air pollution caused by motor vehicles. The government has introduced a preferential tax system for import of new vehicles equipped with a catalytic converter, and plans to adopt emission standards that are almost the same levels as that of EC's. The planned new standards are given by "Governmental decree on Air Pollution Abatement" (Ref. B-20), which also intends to promote that replacement.

Age of registered motor vehicle in Hungary is generally high. The average life of the motor vehicles is about 16 years, and the ratio of vehicles aged more than 10 years is approximately 40%. This means that almost all of the motor vehicles used at present would be replaced in 2005. In this case, it can be assumed that all motor vehicles would be replaced with anti-pollution vehicles in 2005 by the existing control plan as mentioned above.

The sulfur contents of diesel and gasoline will be improved as described in Section 8.2.4.

8.3.3 Case of Additional Pollution Control Measures (Case F-2)

This case corresponds to the situation where pollution control measures recommended by the Study Team for some factories are added to the existing air pollution control plan, and natural gas supply for household heating is further expanded.

(1) Major Factories

Factories shown in Table 8.3.2 were selected by the Study Team to recommend emission control measures since pollutant emissions exceeded the emission standard values. These measures are explained below, and effects in pollutant emission reduction are shown in Tables D8.3.5 (1) and D8.3.5 (2).

Table 8.3.2 Factories Selected for Emission Control Measures

R/N	Name of Factories	Type of Industry	Source No. and Facility	Item for Control Measures	Fuel
02/1	OZD KOHASZATI UZEMEN	Iron and Steel	P-036 2 Boilers	SO2	Natural gas Brown coal
03/0	EMO. TEGLA ES CSEREPIPARI VALLALAT PUTNOKI TEGLAGYAR	Brick	P-014 Tunnel kiln	SO2	Coal
04/1	BORSODCHEM	Chemical	P-062 Incinerator	NOx	Waste solvent
09/2	SAGROCHEM KFT.	Chemical	P-055 Incinerator	NOx	Waste solvent and solid
15/2	DIOSGYORI ACEL ES VASONTO KFT	Iron Casting	P-014-1 Heating furnace	NOx	Natural gas
17/1	HEJOCSABA CEMENT-ES MESZIPARI RT	Cement	P-010 Cement kiln	NOx	Natural gas

1) OZD KOHASZATI UZEMEM (R/N : 02-1)

As the service sector of the Ozd metallurgical plant, the company is currently supplying steam and hot water to part of the Ozd City housing complex. The company has eight boilers in total. The source P-036 has two boilers of 30t/h (max) and 28bar (max) used for heat supply. The boilers are multi-fuel firing boilers, using natural gas (40%) and brown coal (60%).

The emission standard of SOx is 8.2 kg/h for P-036, and the brown coal contains sulfur by 0.85 %. It means that the brown coal can be used by 536 kg per hour (8.2 x 100 / 2 / 0.85 / 0.9 = 536 kg) for the emission standard of SOx to be satisfied.

The amount of natural gas required is as follows :

At present,

Coal : 4,000 kg/h (20 MJ/kg)	(59.5 %)
Natural Gas : 1,600 m3/h (34 MJ/m3)	(40.5 %)

For the emission standard to be satisfied, the use of the fuels should be changed as follows:

Coal : 536 kg/h	(8%)
Natural Gas : 3,638 m3/h	(92 %)

There is a possibility that above two boilers will be out of the service in the future. In this case, above measure will not be necessary.

2) EMO. TEGLA ES CSEREPIPARI VALLALAT PUTNOK TEGLAGYAR (R/N : 03/0)

In addition to changing fuel from coal to natural as planned by the plant, increased use of low-sulfur coal as raw material is recommended so that the average sulfur content is decreased to 1.5% against 3% at present.

3) BORSODCHEM RT. (R/N : 04/1)

The NOx concentration of the exhaust gas from a small waste solvent incinerator (60 kg/h) was as high as 4,028 ppm (at 4% O2 conversion). This may be due to presence of N containing matters in the waste for incineration. By the employment of a two-stage combustion type burner, the NOx concentration can be reduced to 150-200 ppm (at 4% O2).

4) SAGROCHEM KFT. (R/N : 9/2)

P-055 is a small incinerator for waste oil (100 kg/h) and solid waste (60 kg/h). The NOx concentration was 813 ppm (at 4% O2) also indicating the presence of N containing matters in the incinerating wastes. The same measure as that for BORSODCHEM is recommended. The NOx concentration can be reduced to 150 - 200 ppm (at 4% O_2).

5) DIOSGYORI ACEL. ES VASONTO KFT (R/N : 15/2)

The source P-014 in question is in the casting fabrication process and is a wheel-type heat treatment furnace which uses natural gas. The old equipment has been in use for 29 years. Retrofitting of this furnace and installation of a recuperator (for energy saving by 10%) are recommended.

6) HEJOCSABA CEMENT-ES MESZIPARI RT (R/N: 17/1)

P-010 is a cement rotary kiln with a suspension preheater (SP).

In the manufacture of cement, the raw material temperature must be maintained at higher than 1,450 °C during the calcination process. A flame temperature of about 1800 °C has to be maintained in the kiln in order to meet this condition. The generation of thermal NOx is therefore unavoidable in the kiln.

One possible measure for this kiln will be employment of oxygen burners as describle in Section 7.3.2 (3). However, since natural gas consumption is 10,000m3/h and O2 consumption will be about twice this amount, availability of oxygen supply equipment will be limited.

The exhaust gas oxygen concentration measured in the kiln stacks was as high as 14.5%. Low air ratio combustion and the use of low-NOx burner are recommended. Reduction of NOx emission up to 30% is possible by selecting an appropriate burner.

(2) Household

As described in Section 8.2.3, almost all towns and villages in the Study Area will be covered by the natural gas supply by the year 2005. Since home heating by brown coal is a significant cause of SO_2 pollution in the heating season, it is recommended that the use of coal be replaced by the natural gas as far as the planned supply network allows.

Percentage of gas-supplied household in each community in this case is also shown in Tables D8.3.4 (1) through D8.3.4 (3). As a result, 86% of the total number of households are supplied with the natural gas.

There are two major economic obstacles to spread the use of the natural gas:

1) Individual households have to bear the costs for the pipe connection and new equipment for heating. These costs are estimated to be HUF 150,000 to 200,000.

2) Price of natural gas is scheduled to be doubled by the end of 1996 making it considerably higher than the price of brown coal as shown below:

a) Natural gas

Assuming annual consumption of 2,000 m^3 per household,
Annual expense is :
$$2{,}000(m^3) \times 34(MJ/m^3) \times 0.53(HUF/MJ) \times 1.1(VAT) \cong 40{,}000HUF$$

b) Brown coal

Assuming annual consumption of 6,600 kg per household,
Annual expense is :
$$6{,}600(kg) \times 14(MJ/kg) \times 0.3234(HUF/MJ) \times 1.1(VAT) \cong 30{,}000HUF$$

Since the use of natural gas is much more convenient than the use of coal, it is considered that many households wish to use the natural gas if the facility costs of HUF 150,000 - 200,000 can be afforded. To promote dissemination of the use of the natural gas, some measures such as the following to support the facility costs are considered to be necessary.

- low-interest, long-term loans
- subsides
- preferential taxation

There exist some financial supporting systems for the purpose of environmental protection. Therefore existing support system such as Central Environmental Protection Fund should be utilized.

8.3.4 Amount of Pollutant Emission in the Future Cases

Based on the future conditions of pollutant sources described for above 3 cases, the emission quantities of SO_2 and NOx were estimated. The annual amounts of SO_2 emission for the three cases are summarized in Table 8.3.4 and Figure 8.3.1, and the same for the NOx emission are summarized in Table 8.3.5 and Figure 8.3.2.

The annual amounts of SO_2 and NOx emissions by the source categories and by grid elements are shown in the subsequent Figures as indicated in Table 8.3.3.

Table 8.3.3 Reference for the Figure Number Which Shows Pollutant Emission by Grid Elements

Pollutant	Source Category	Case F-0 (No control)	Case F-1 (Existing Plan)	Case F-2 (Additional)
SO_2	Industry	Figure 8.3.3	Figure 8.3.7	Figure 8.3.13
	Communal	Figure 5.1.6 same as the present	Figure 8.3.8	Figure 8.3.14
	Motor Vehicle	Figure 8.3.4	Figure 8.3.9	Same as Case F-1
NO_x	Industry	Figure 8.3.5	Figure 8.3.10	Figure 8.3.15
	Communal	Figure 5.1.9 same as the present	Figure 8.3.11	Figure 8.3.16
	Motor Vehicle	Figure 8.3.6	Figure 8.3.12	Same as Case F-1

Table 8.3.4 Amount of SO_2 Emission by Sources and Cases (ton/y)

	Present	Case F-0	Case F-1	Case F-2
Borsod P.S.	31,259	40,636	9,690	9,690
Tisza I. P.S.	34,808	6,962	6,962	6,962
Tisza II. P.S.	15,036	9,172	2,406	2,406
Major Factories	3,350	2,192	1,996	1,804
Communal Facilities	13,084	13,084	4,564	2,963
Motor Vehicles	261	367	105	105
Total	97,798	72,413	25,723	23,930

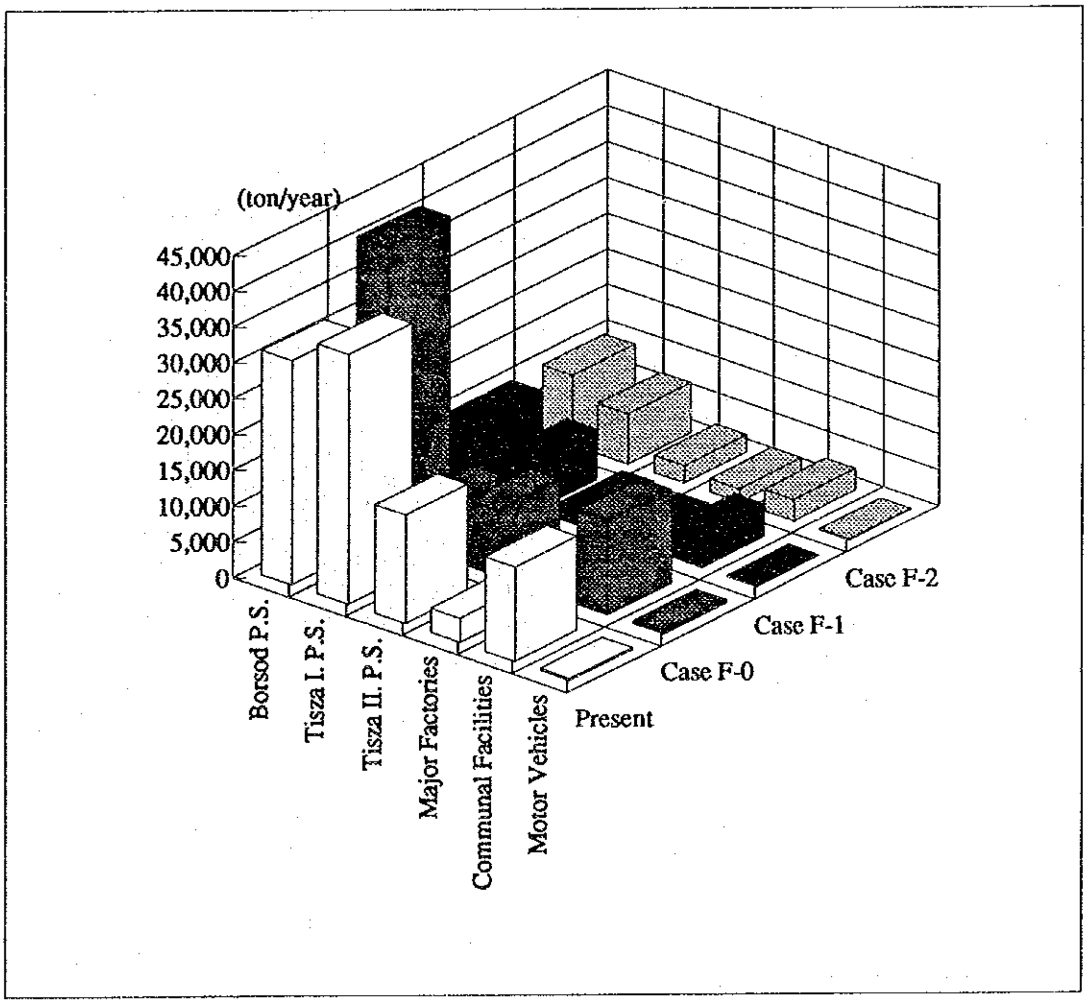

Figure 8.3.1 Amount of SO_2 Emission by Sources and Cases (ton/y)

Table 8.3.5 Amount of NOx Emission by Sources and Cases (ton/y)

	Present	Case F-0	Case F-1	Case F-2
Borsod P.S.	2,135	2,776	1,708	1,708
Tisza I. P.S.	2,882	576	576	576
Tisza II. P.S.	3,148	1,920	1,920	1,920
Major Factories	2,867	2,837	1,571	1,499
Communal Facilities	2,484	2,484	1,435	1,240
Motor Vehicles	2,976	4,098	2,243	2,243
Total	16,492	14,691	9,453	9,186

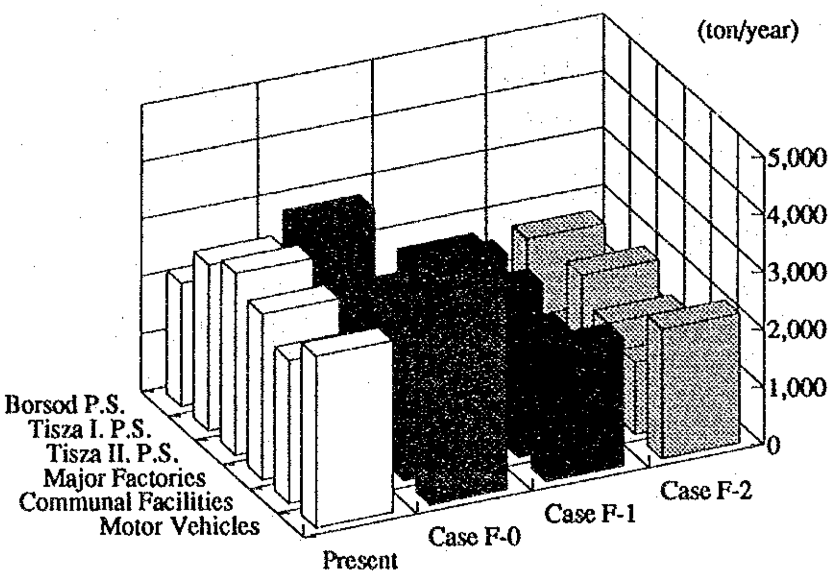

Figure 8.3.2 Amount of NOx Emission by Sources and Cases (ton/y)

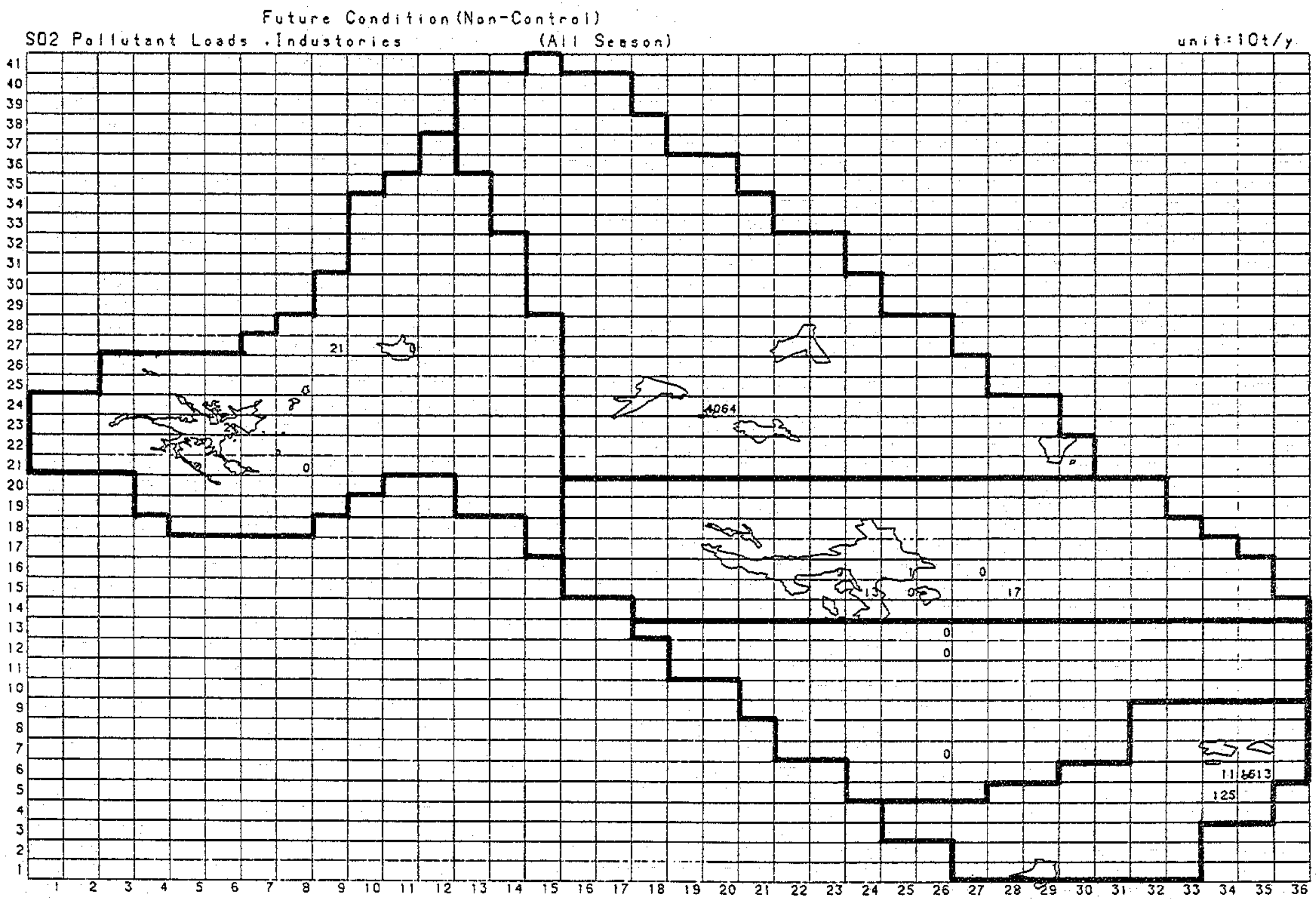

Figure 8.3.3 Annual Amount of SO_2 Emission (Case F-0, Industries)

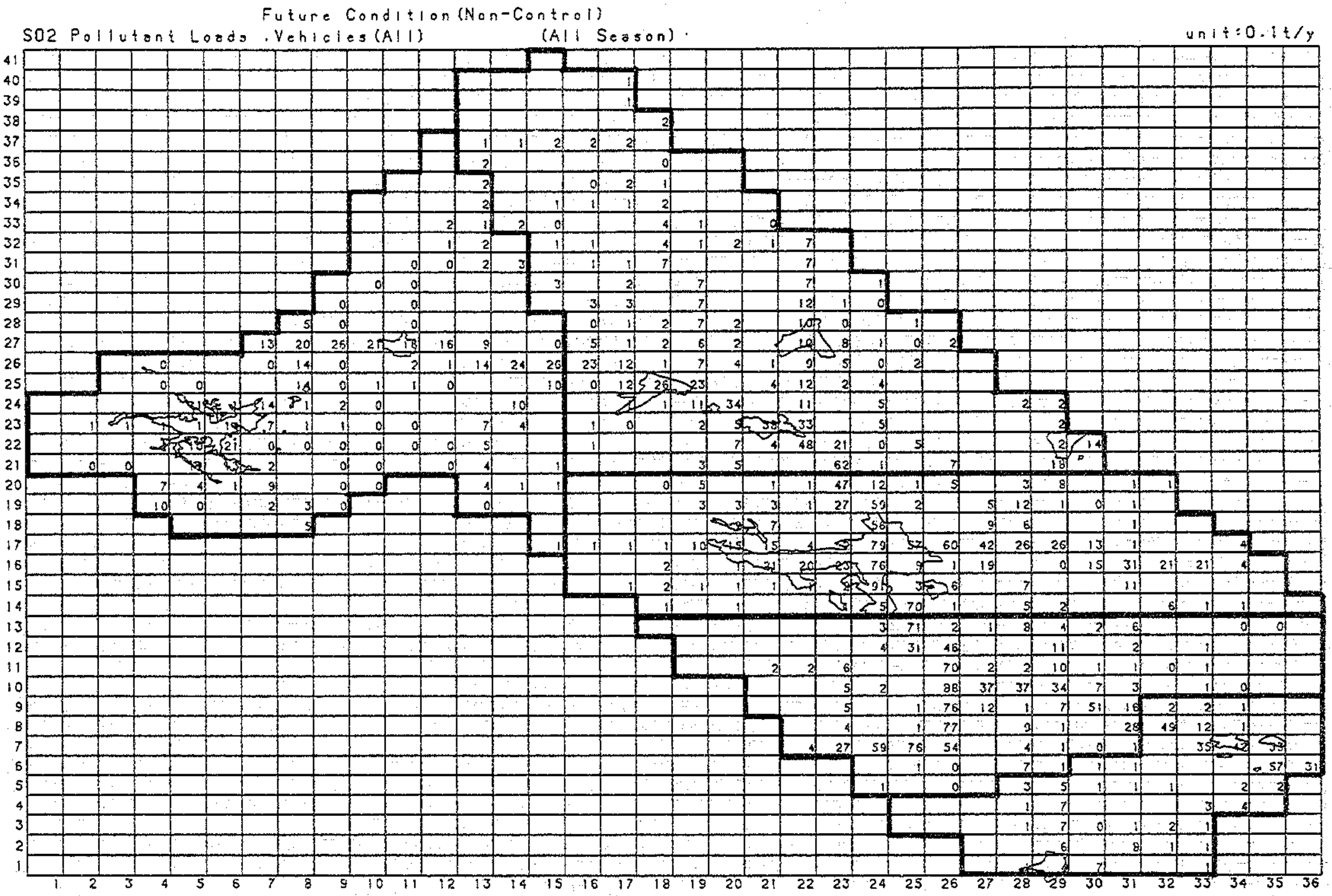

Figure 8.3.4 Annual Amount of SO_2 Emission (Case F-0, Motor Vehicles)

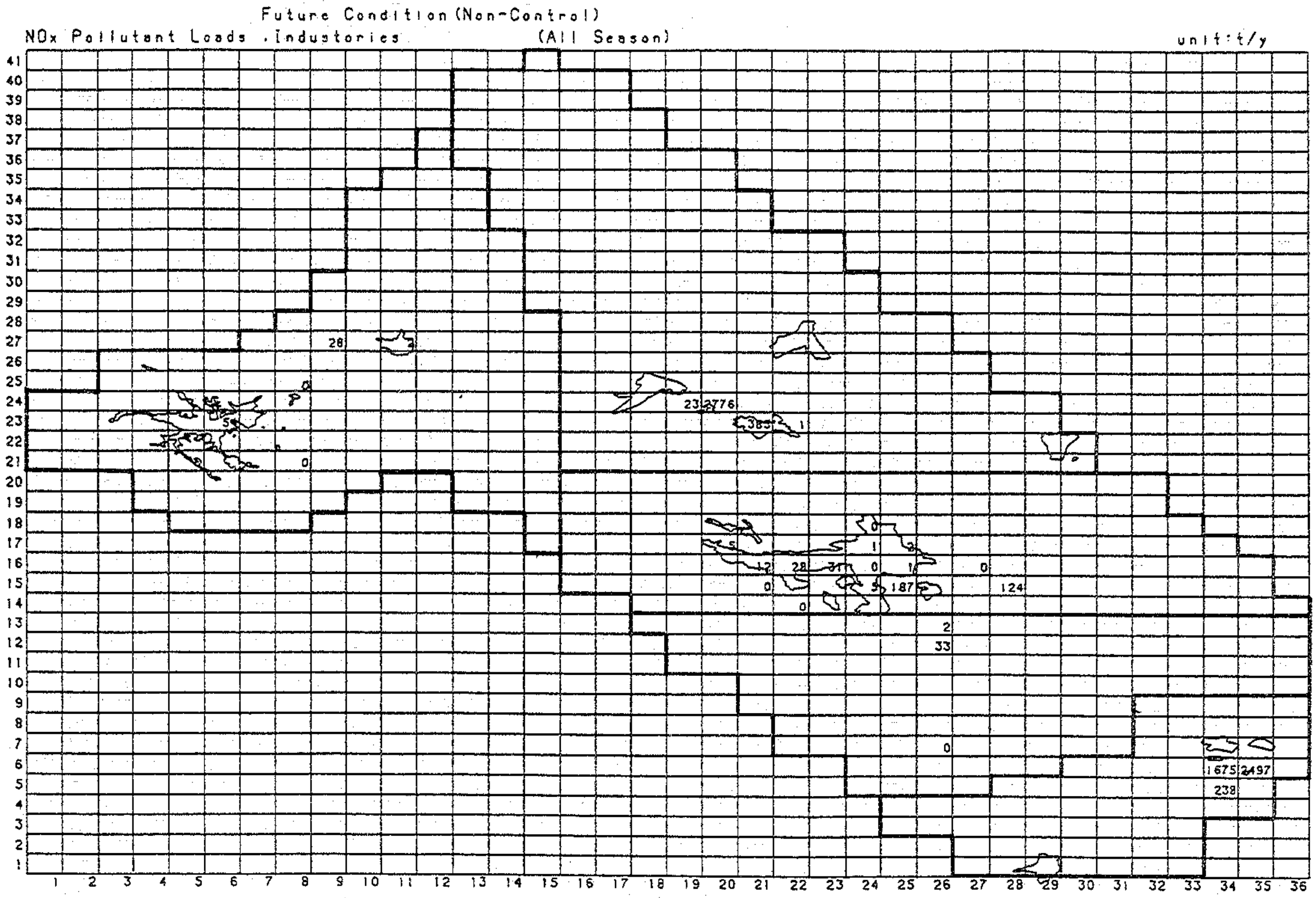

Figure 8.3.5 Annual Amount of NO_x Emission (Case F-0, Industries)

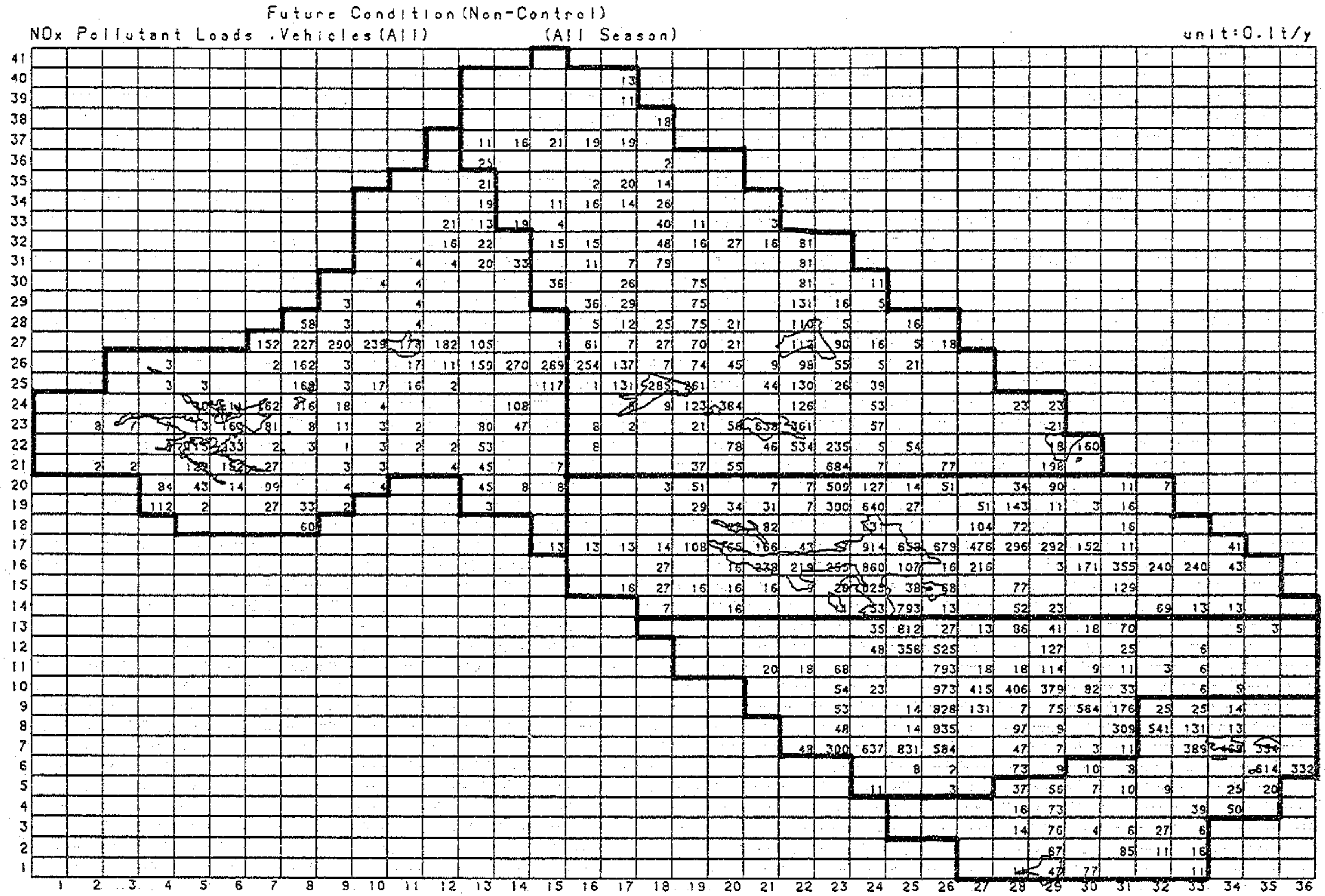

Figure 8.3.6 Annual Amount of NO_x Emission (Case F-0, Motor Vehicles)

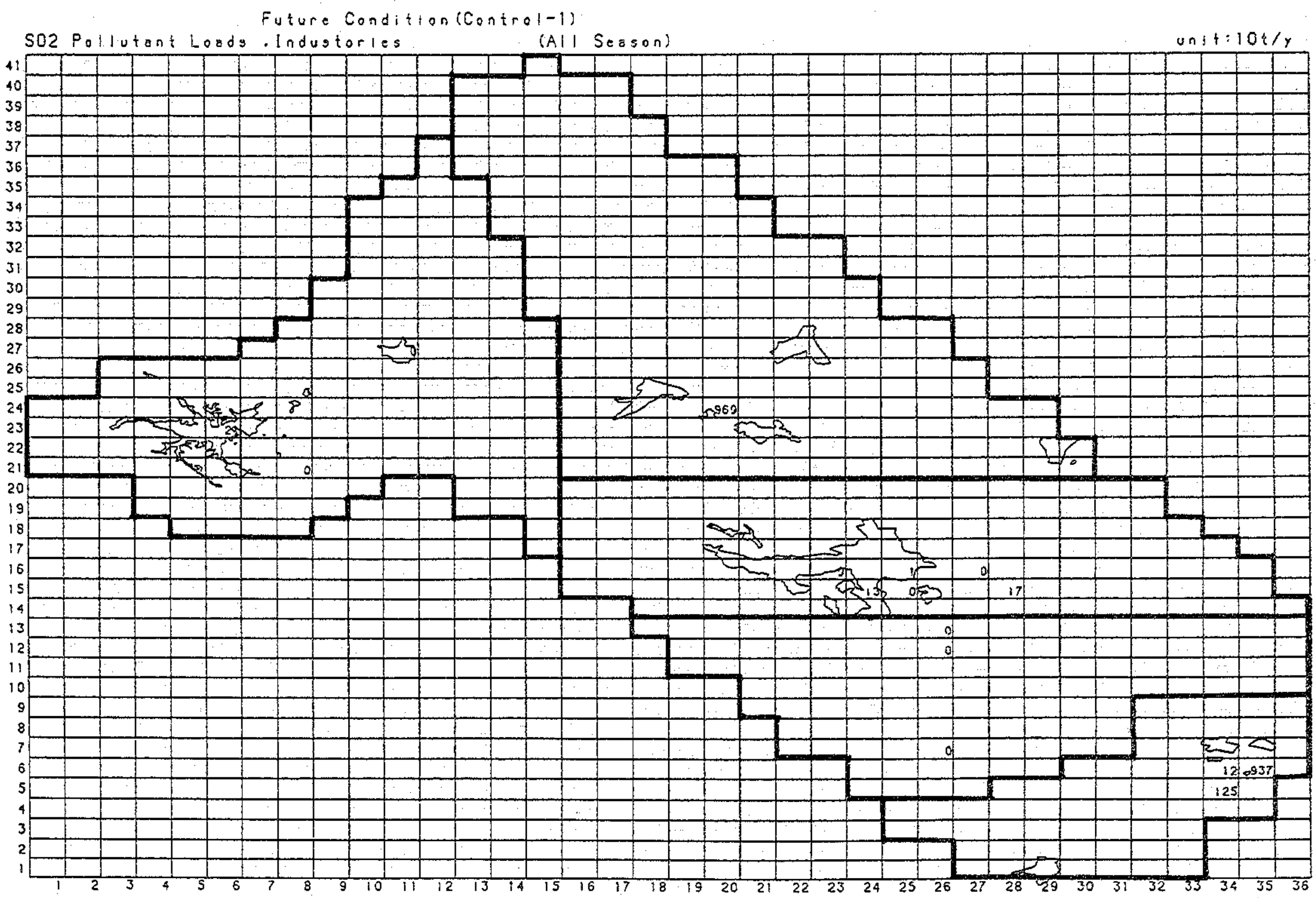

Figure 8.3.7 Annual Amount of SO_2 Emission (Case F-1, Industries)

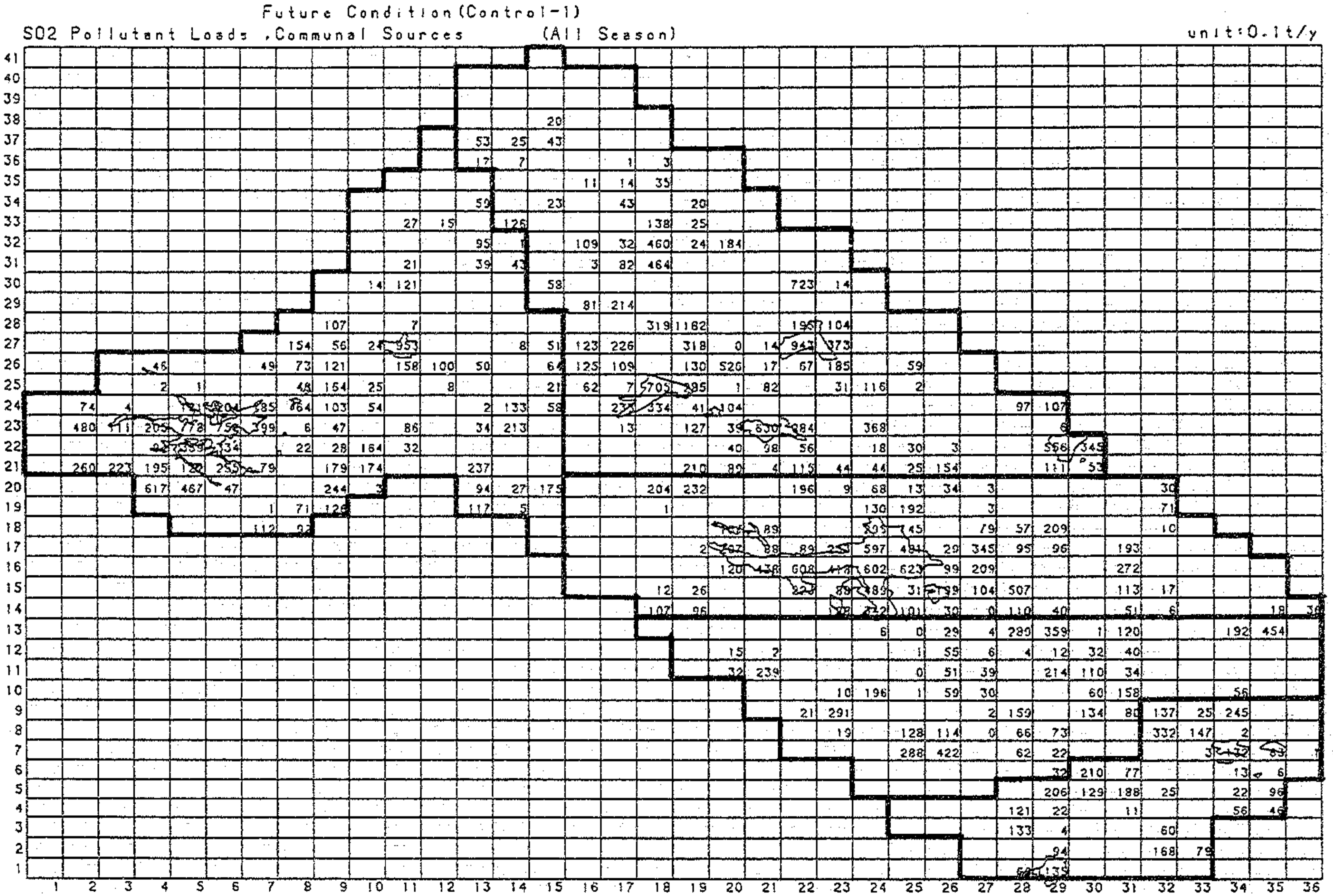

Figure 8.3.8 Annual Amount of SO_2 Emission (Case F-1, Communal)

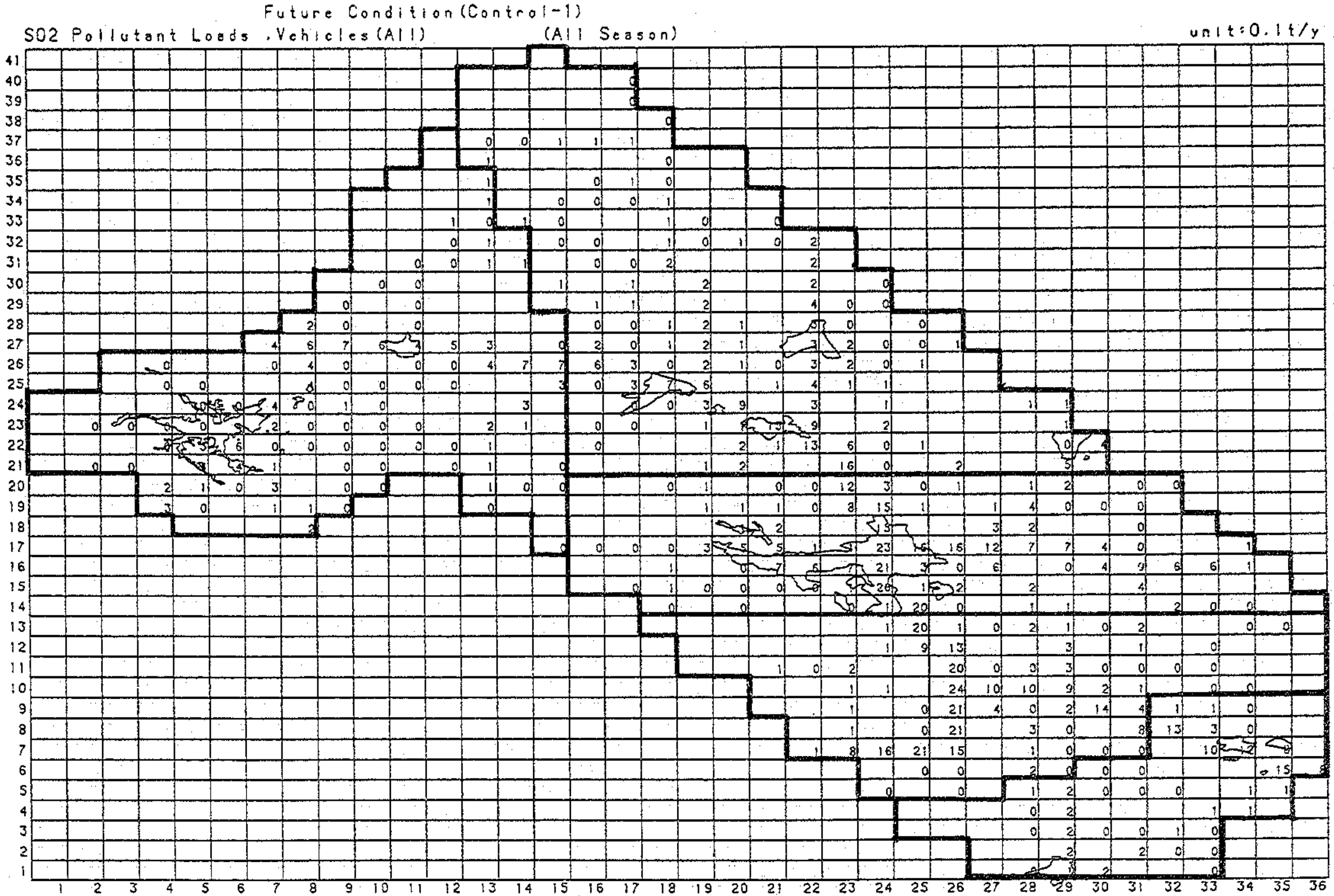

Figure 8.3.9 Annual Amount of SO_2 Emission (Case F-1, Motor Vehicles)

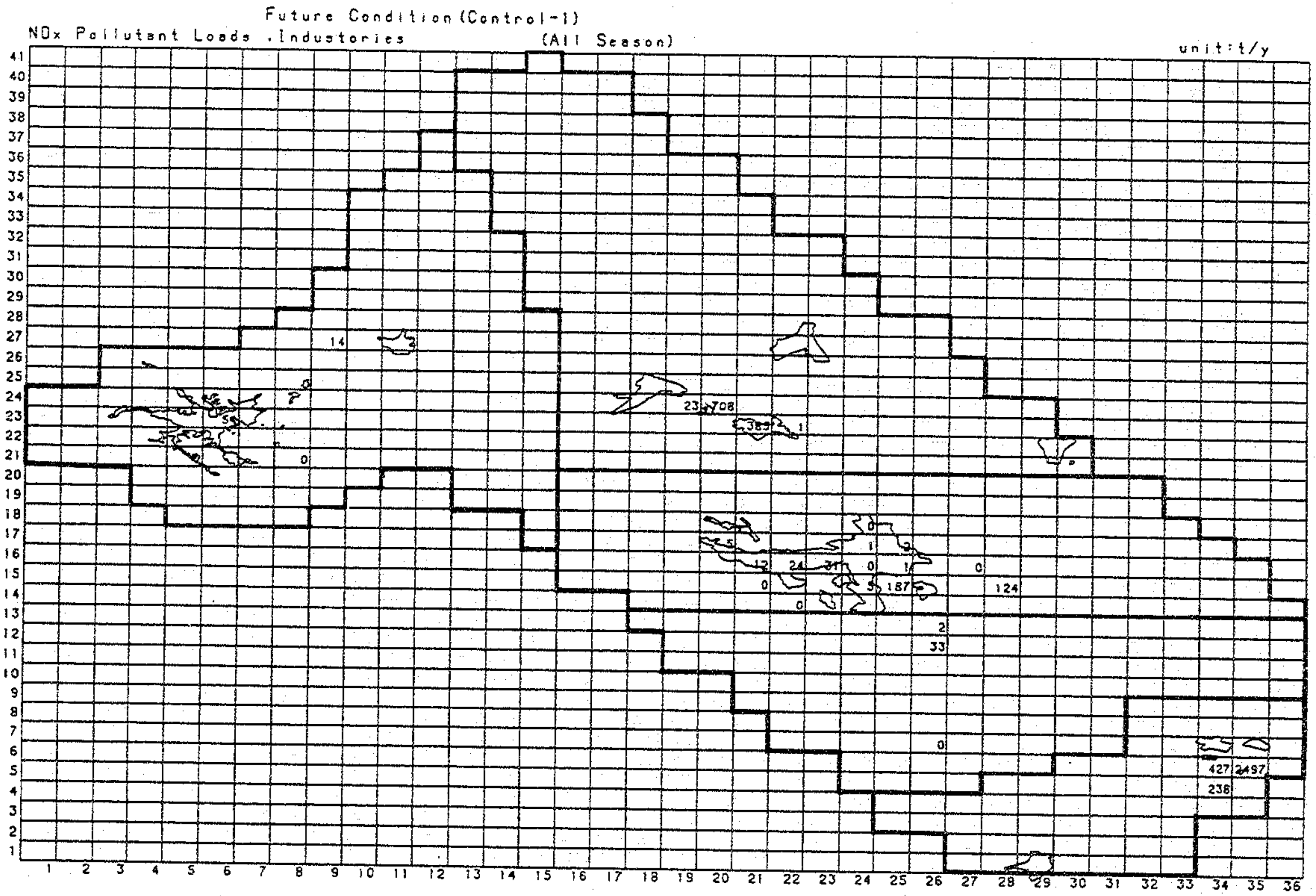

Figure 8.3.10 Annual Amount of NO_x Emission (Case F-1, Industries)

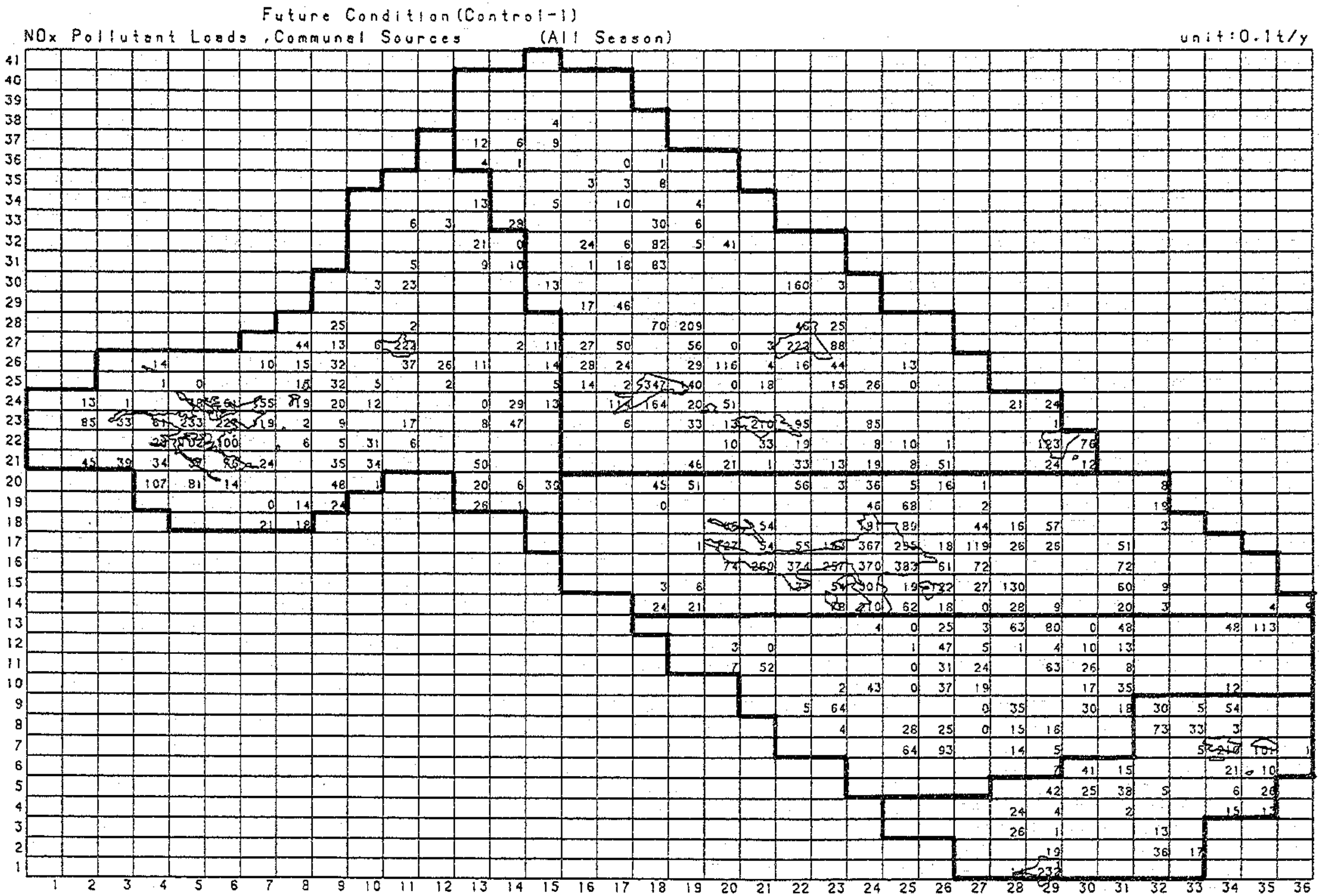

Figure 8.3.11 Annual Amount of NO_x Emission (Case F-1, Communal)

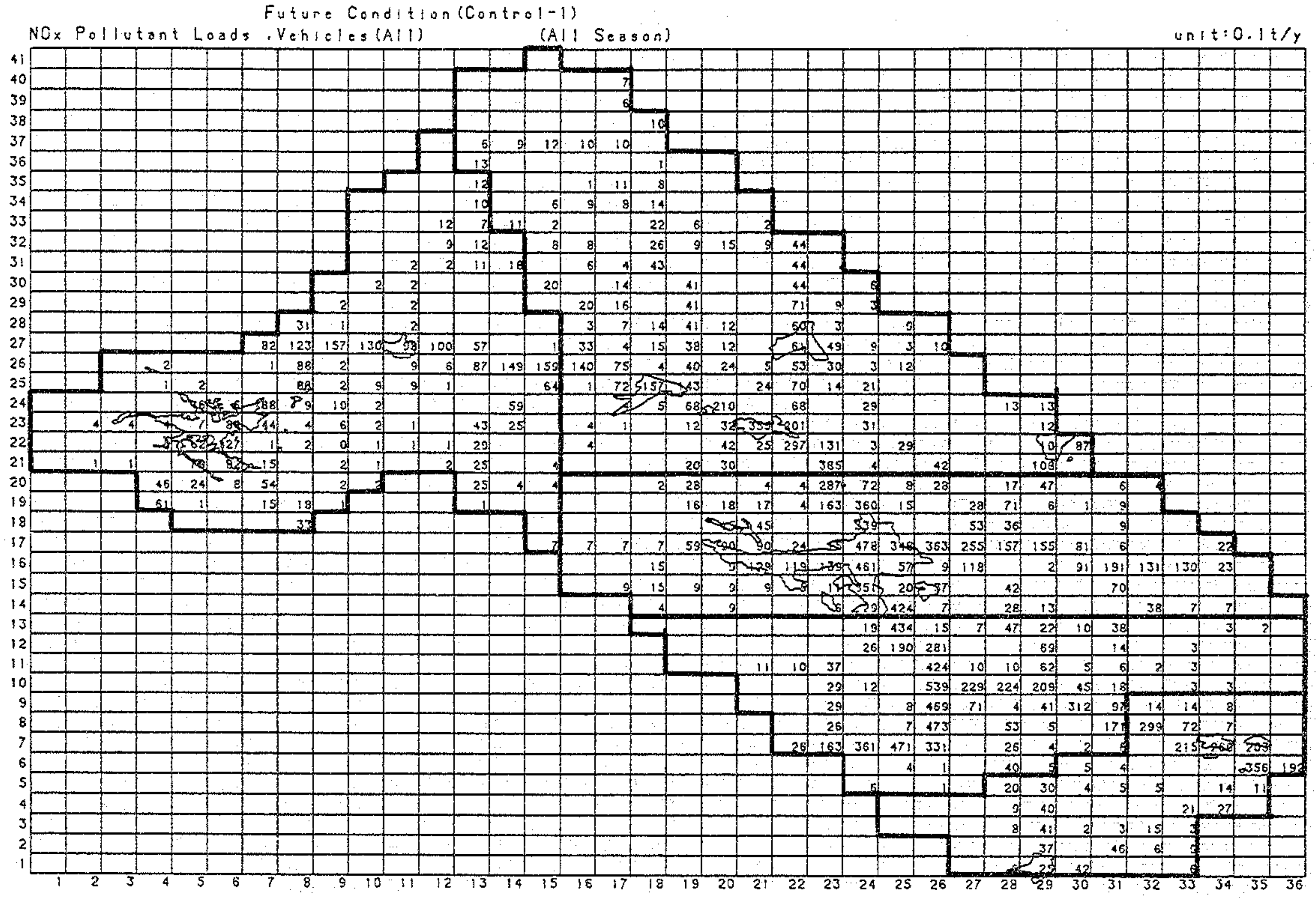

Figure 8.3.12 Annual Amount of NO_x Emission (Case F-1, Motor Vehicles)

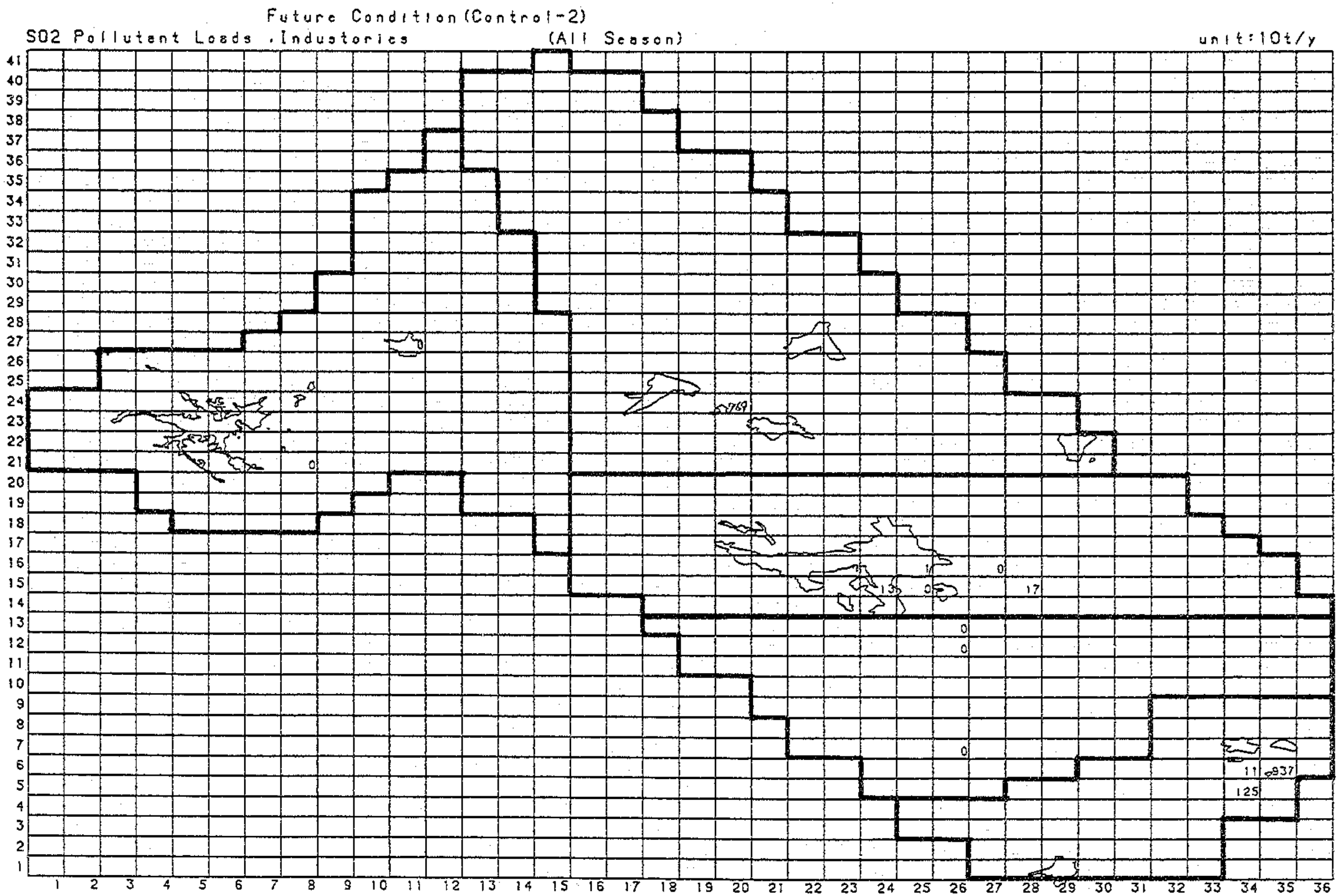

Figure 8.3.13 Annual Amount of SO_2 Emission (Case F-2, Industries)

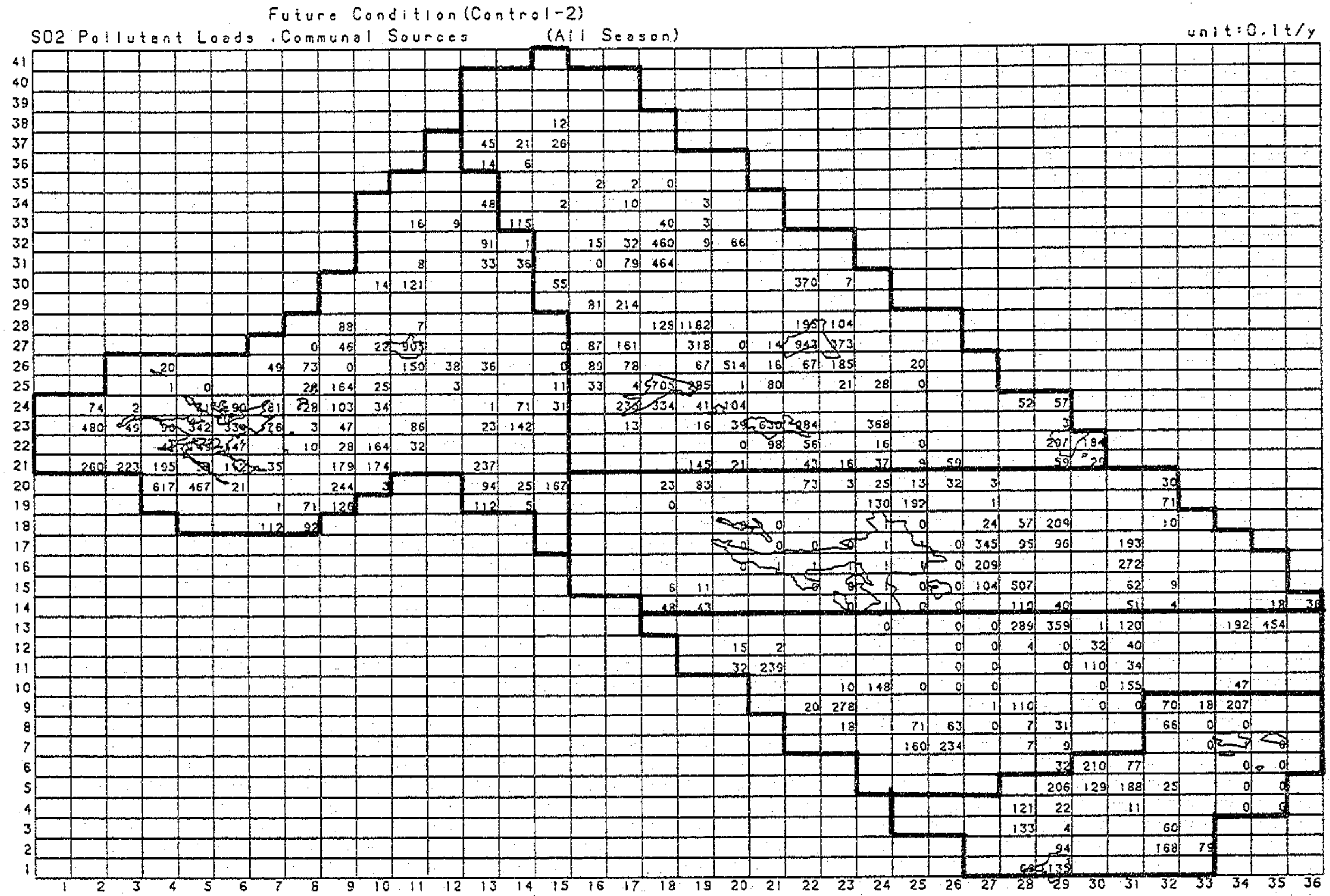

Figure 8.3.14 Annual Amount of SO_2 Emission (Case F-2, Communal)

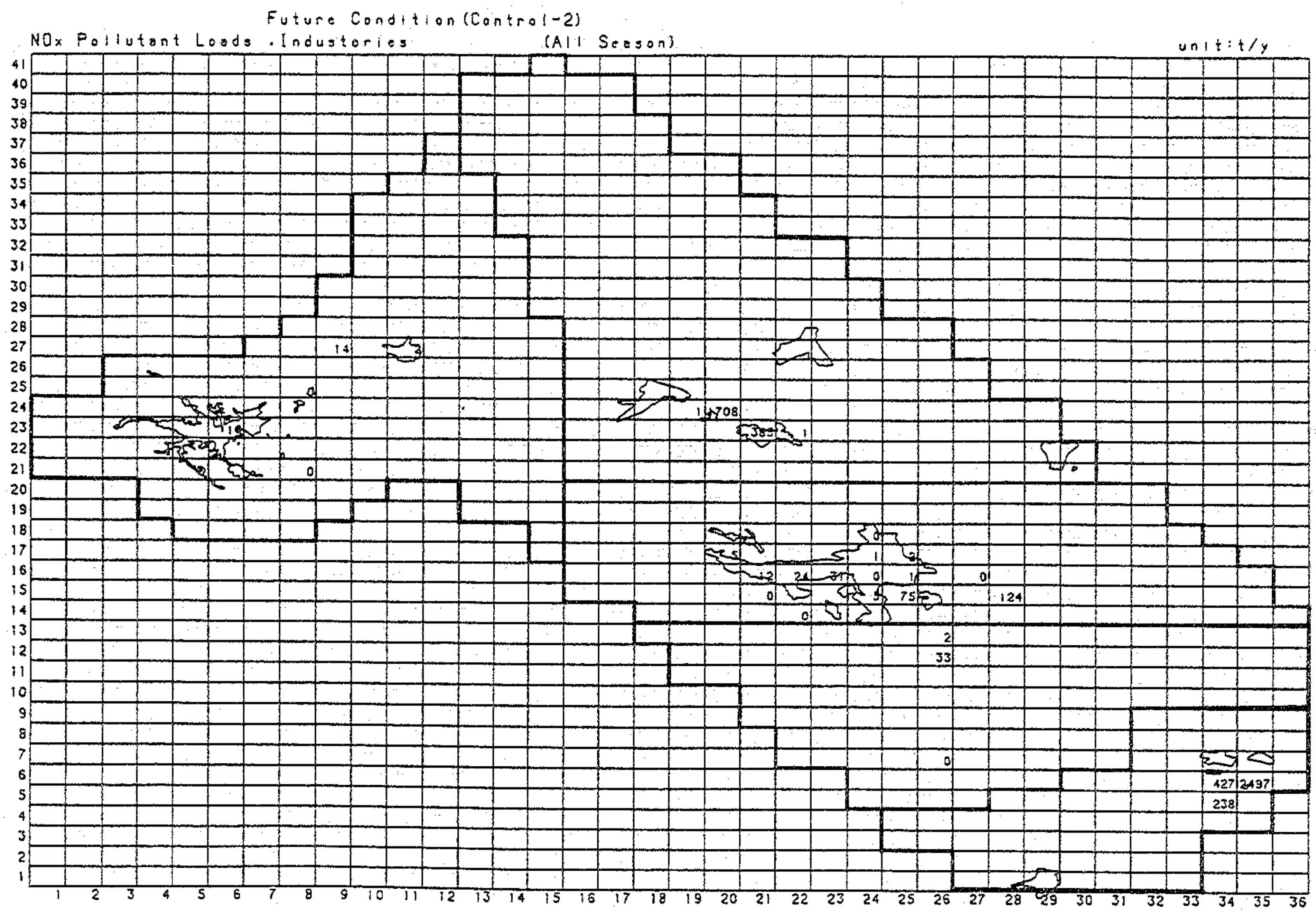

Figure 8.3.15 Annual Amount of NO_x Emission (Case F-2, Industries)

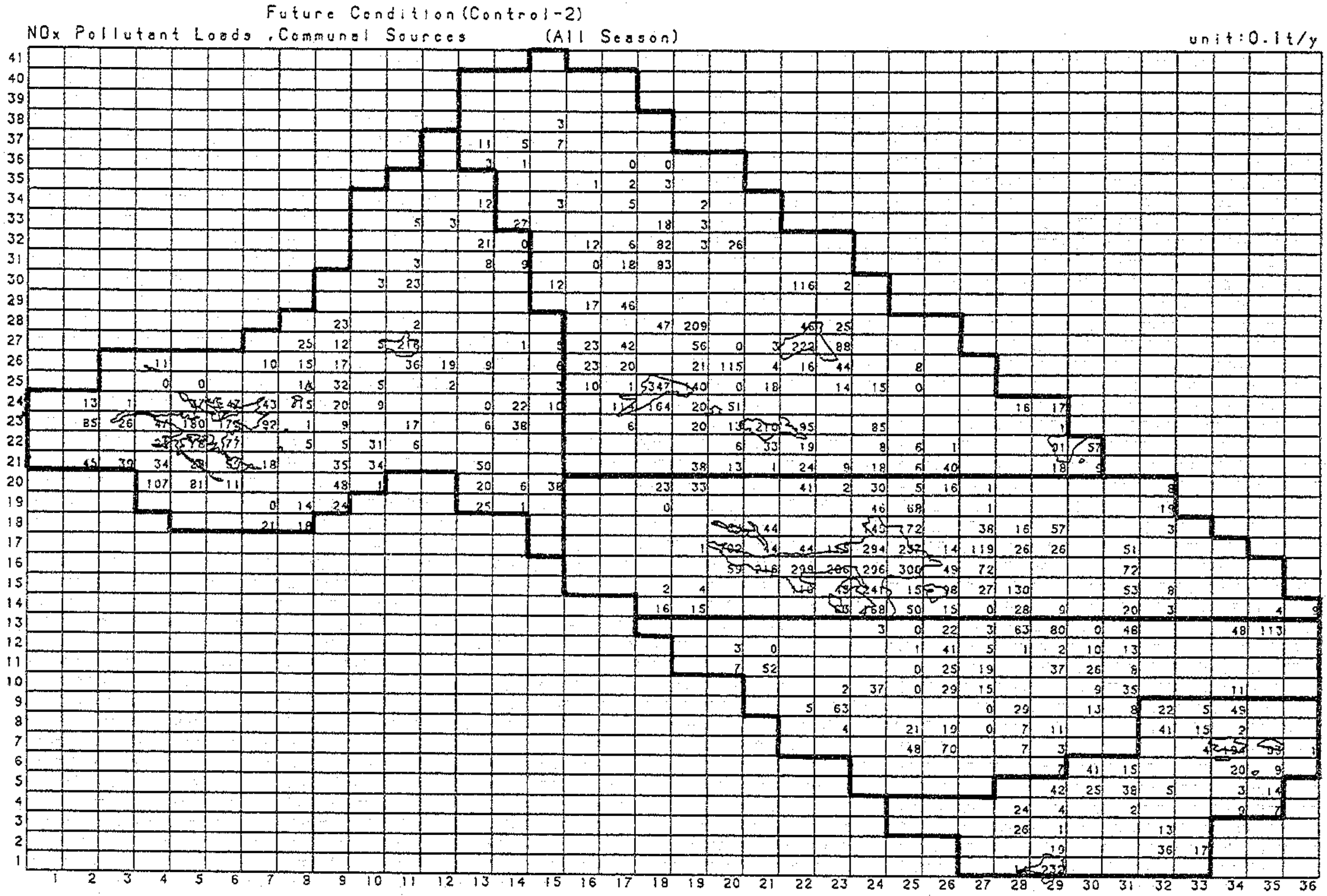

Figure 8.3.16 Annual Amount of NO_x Emission (Case F-2, Communal)

8.4 Prediction of Future Air Quality

Based on the amount of pollutant emissions for the future cases described in Section 8.3.4, ambient air quality of each case was predicted by the simulation model. Since future ambient air quality standards have been proposed by KTM, "long time limit values" in the new standards will be used for discussion of the predicted air quality, and the limit values will be referred to as "the new standards".

8.4.1 No Air Pollution Control (Case F-0)

The annual average and the heating season average concentration distributions of SO_2 are shown in Figures 8.4.1 and 8.4.2, and the same for NO_2 are shown in Figures 8.4.3 and 8.4.4, respectively.

More details are displayed by Figures D8.4.1 through D8.4.3 and D8.4.21 through D8.4.38 in Data Book.

(1) SO_2

Since the distribution of SO_2 emissions is similar to that of the present, the concentration distributions are also similar to those of the present.

The areas where the annual average concentration exceeds the new standard (50 $\mu g/m^3$) are:

- The area along Route 3 and Route 26 from the southern edge of Miskolc to the noth of Kazincbarcika
- Ozd

In the heating season, the areas exceeding the new standard occupy 70 - 80% of the Study Area.

(2) NO_2

The NO_2 distribution pattern is similar to that of the present, but the concentration is slightly lower.

The annual average concentration satisfies the new standard (70 $\mu g/m^3$) in the whole area. In the heating season, however, the new standard is exceeded in the center of Miskolc (See Figure D8.4.32 in Data Book.).

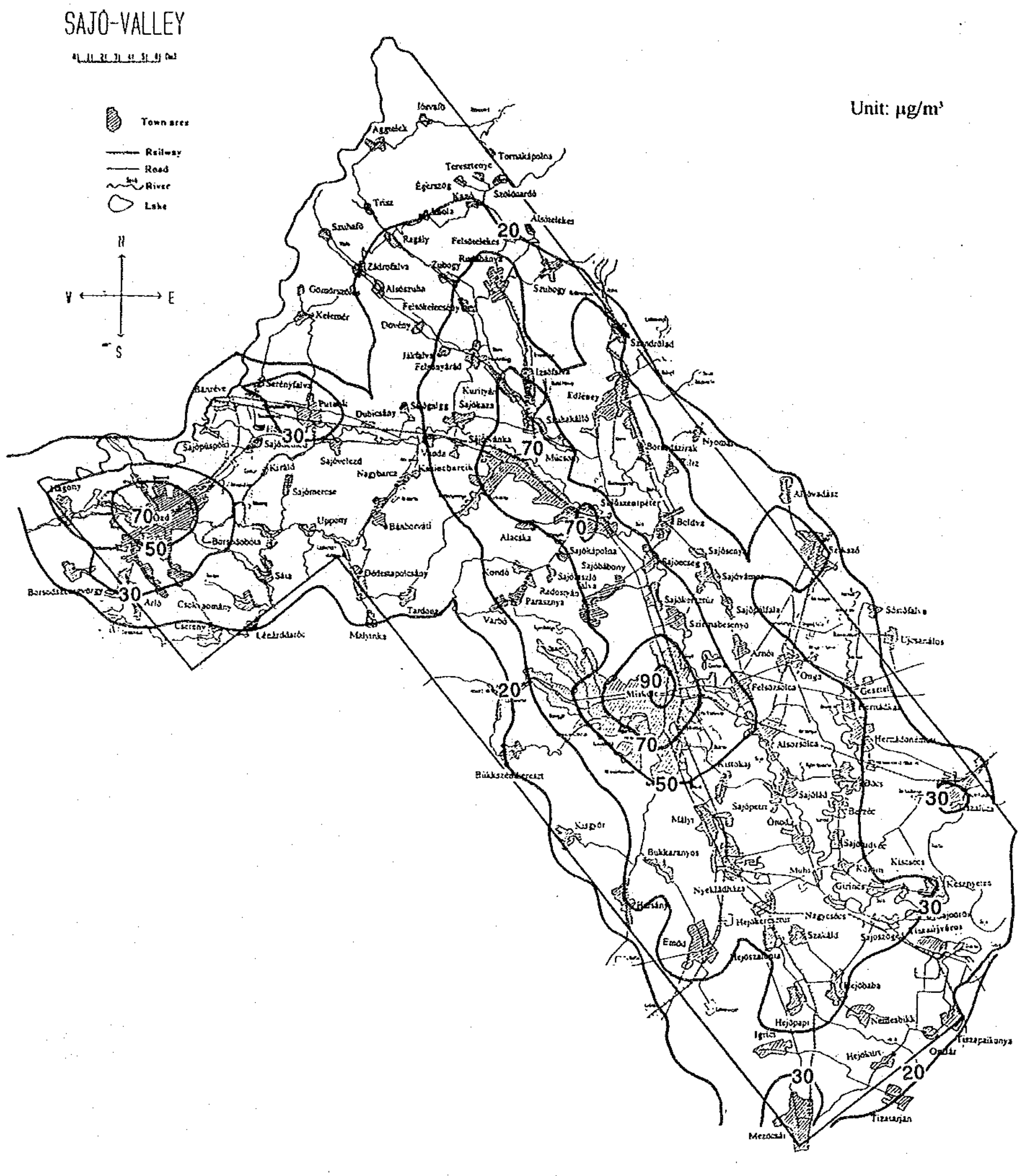

Figure 8.4.1 Annual Average Concentration Isopleth for SO2 (Case F-0, All Sources)

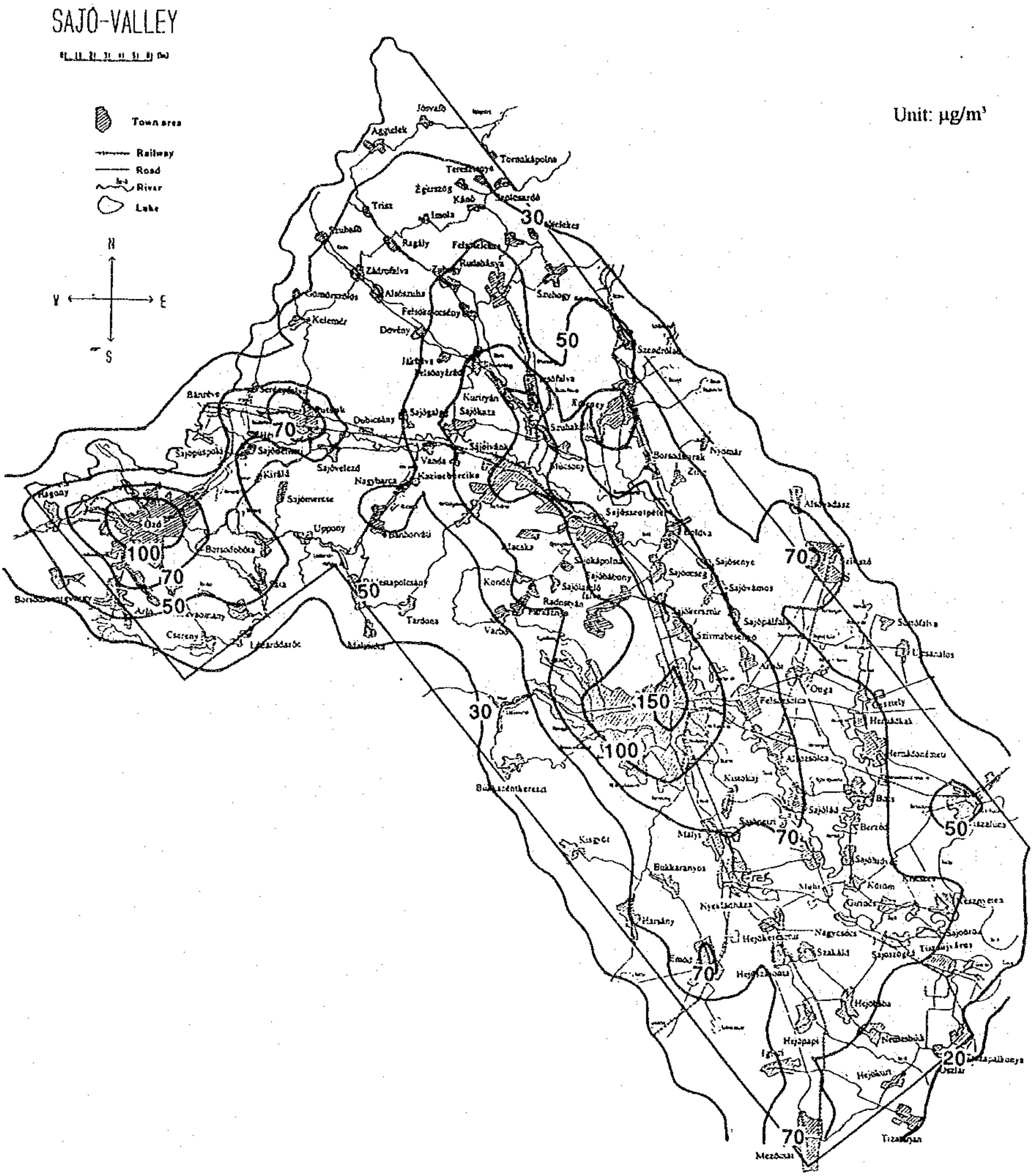

Figure 8.4.2 Average Concentration Isopleth for SO2 in Heating Season (Case F-0, All Sources)

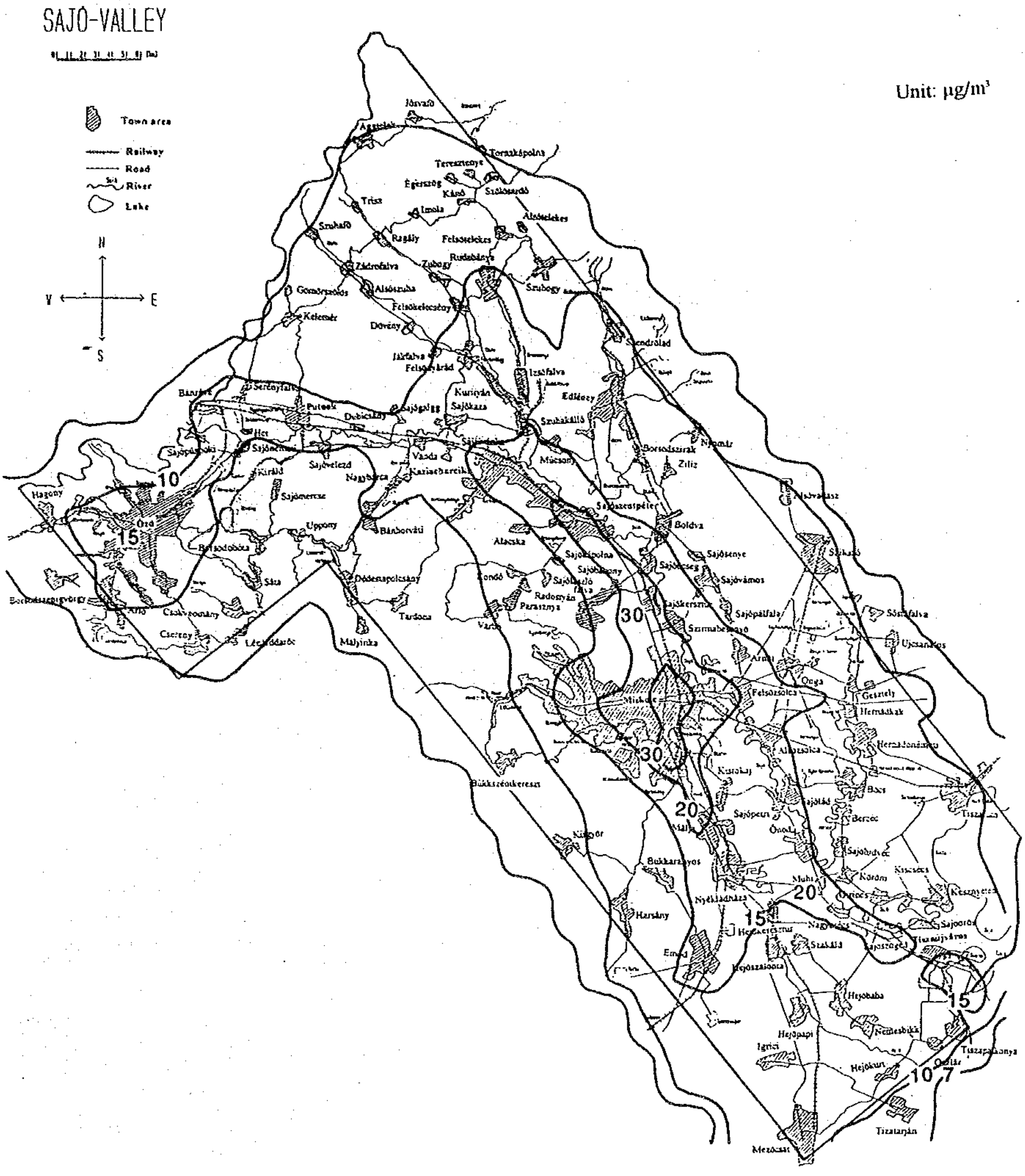

Figure 8.4.3 Annual Average Concentration Isopleth for NO2 (Case F-0, All Sources)

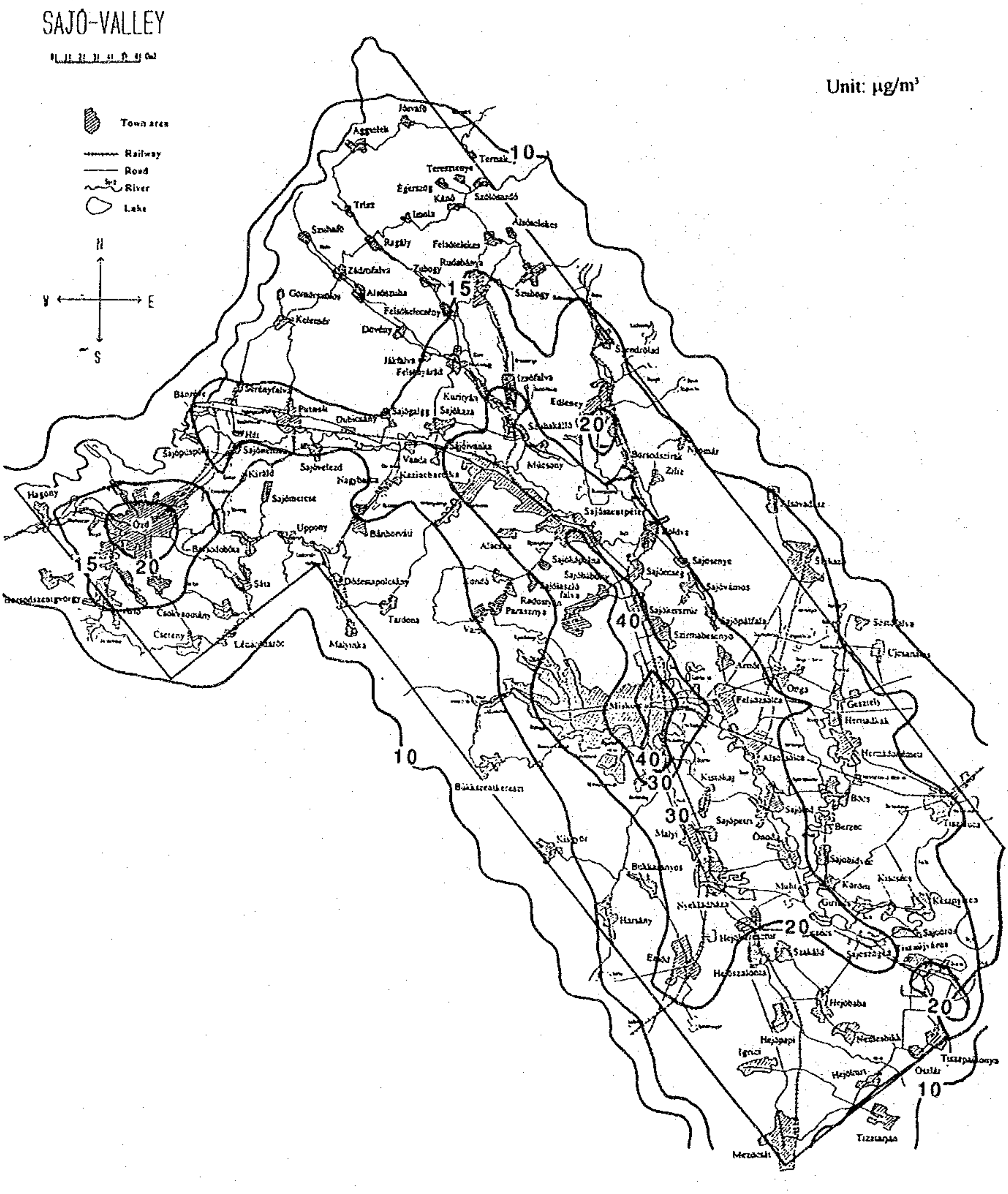

Figure 8.4.4 Average Concentration Isopleth for NO2 in Heating Season (Case F-0, All Sources)

8.4.2 Existing Air Pollution Control Plan (Case F-1)

The annual average and the heating season average concentration distributions of SO_2 are shown in Figures 8.4.5 and 8.4.6, and the same for NO_2 are shown in Figures 8.4.7 and 8.4.8, respectively.

More details are displayed by Figures D8.4.4 through D8.4.7 and D8.4.39 through D8.4.57 in Data Book.

(1) SO_2

The SO_2 concentration is decreased to the level of 1/2 - 1/3 of that of the no pollution control case (Case F-0).

The annual average concentration satisfies the new standard (50 $\mu g/m^3$) in the whole area. In the heating season, however, the new standard is exceeded in the central part of Miskolc.

(2) NO_2

The NO_2 concentration decreases to the level of about 2/3 of that of the no pollution control case. The annual and the heating season average concentrations satisfy the new standard (70 $\mu g/m^3$) in the whole area.

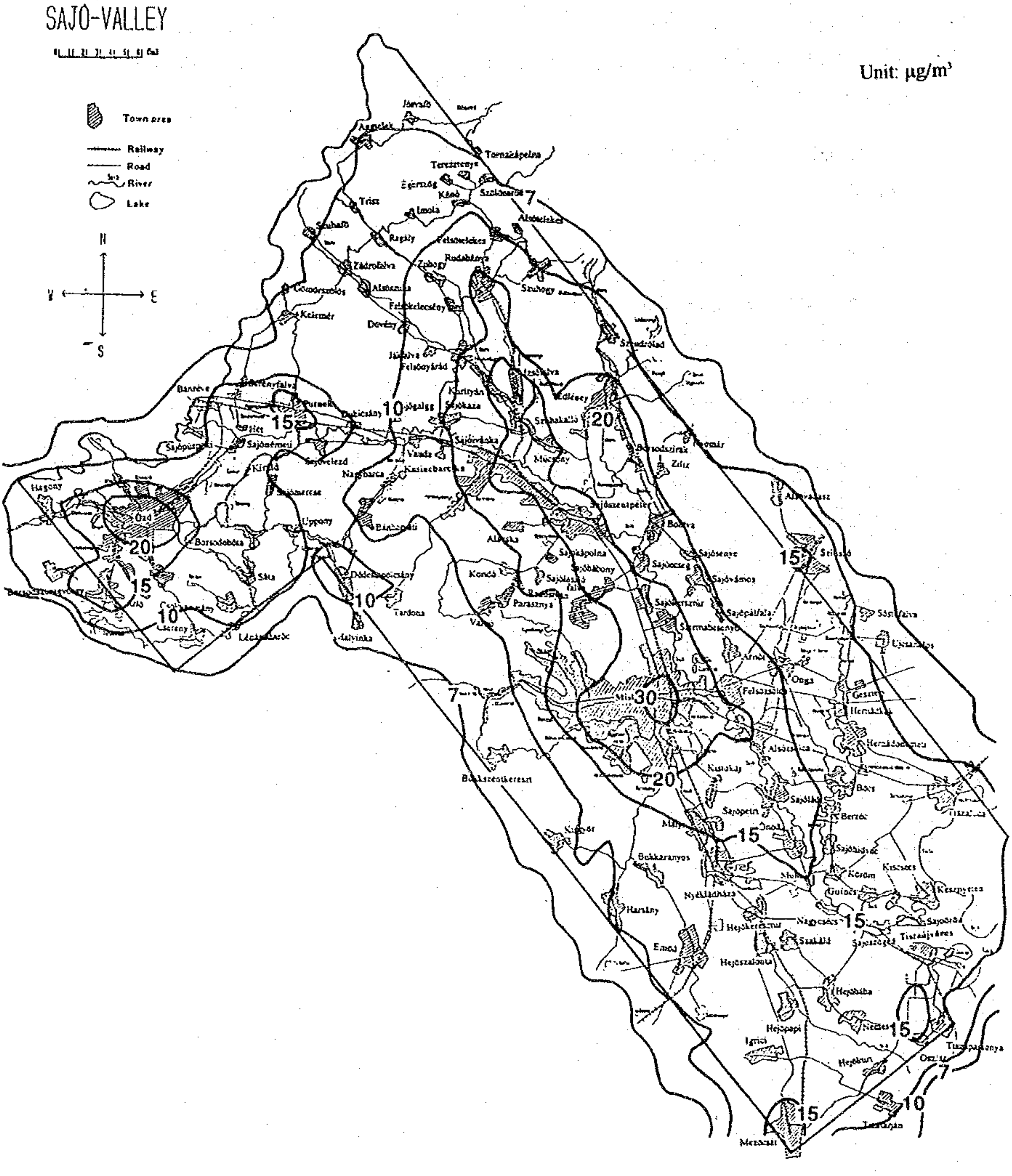

Figure 8.4.5 Annual Average Concentration Isopleth for SO2 (Case F-1, All Sources)

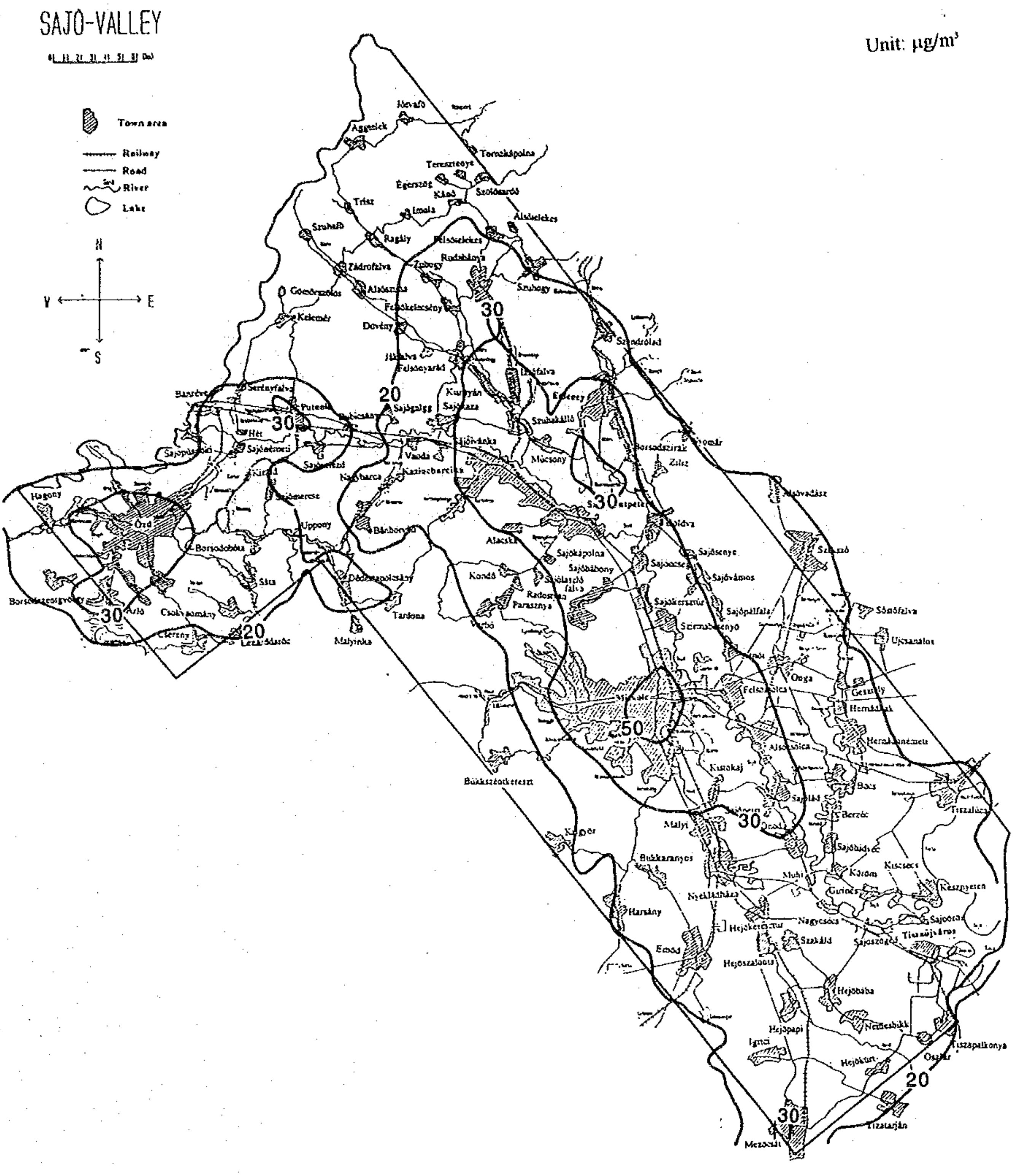

Figure 8.4.6 Average Concentration Isopleth for SO2 in Heating Season (Case F-1, All Sources)

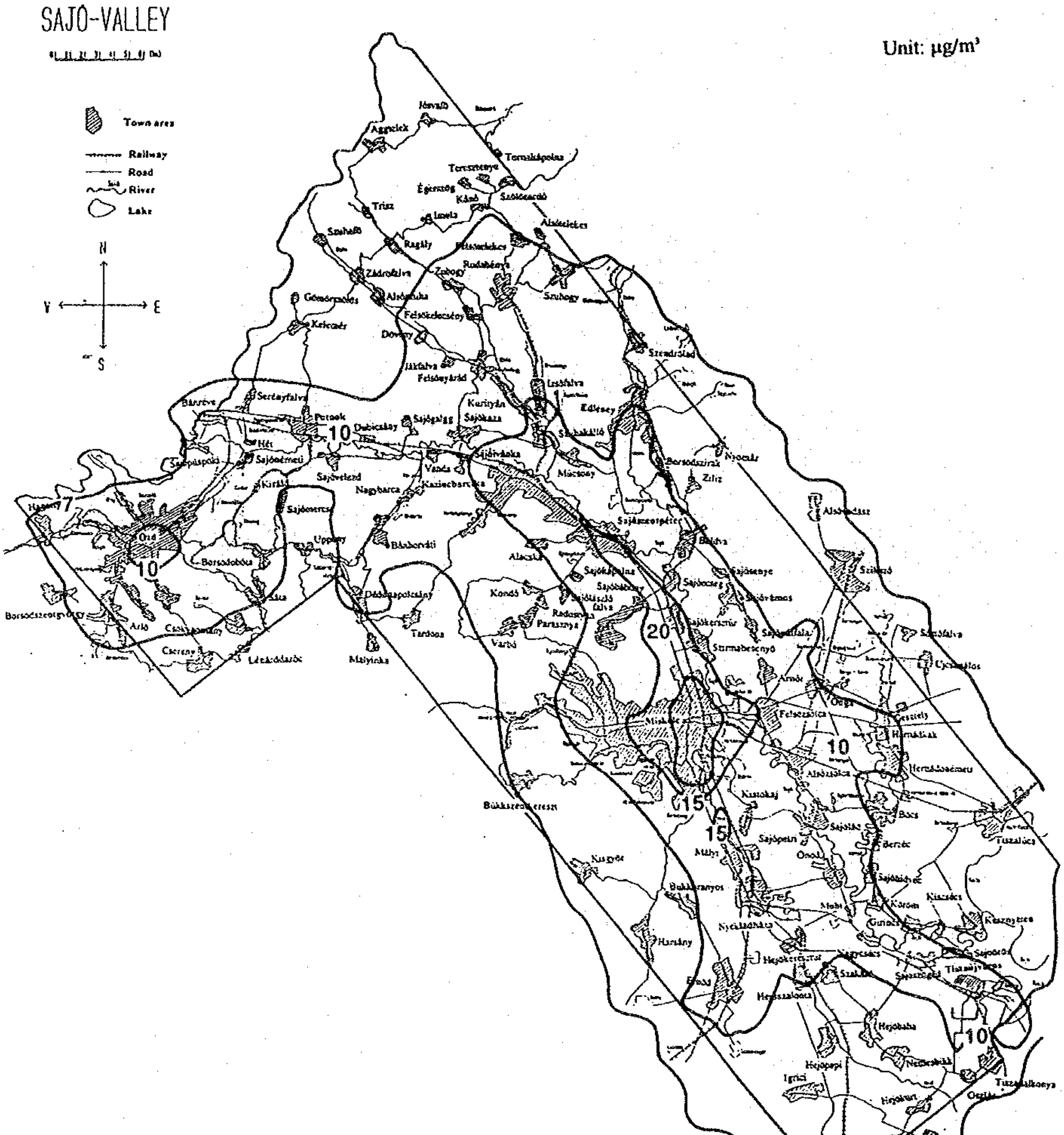

Figure 8.4.7 Annual Average Concentration Isopleth for NO2 (Case F-1, All Sources)

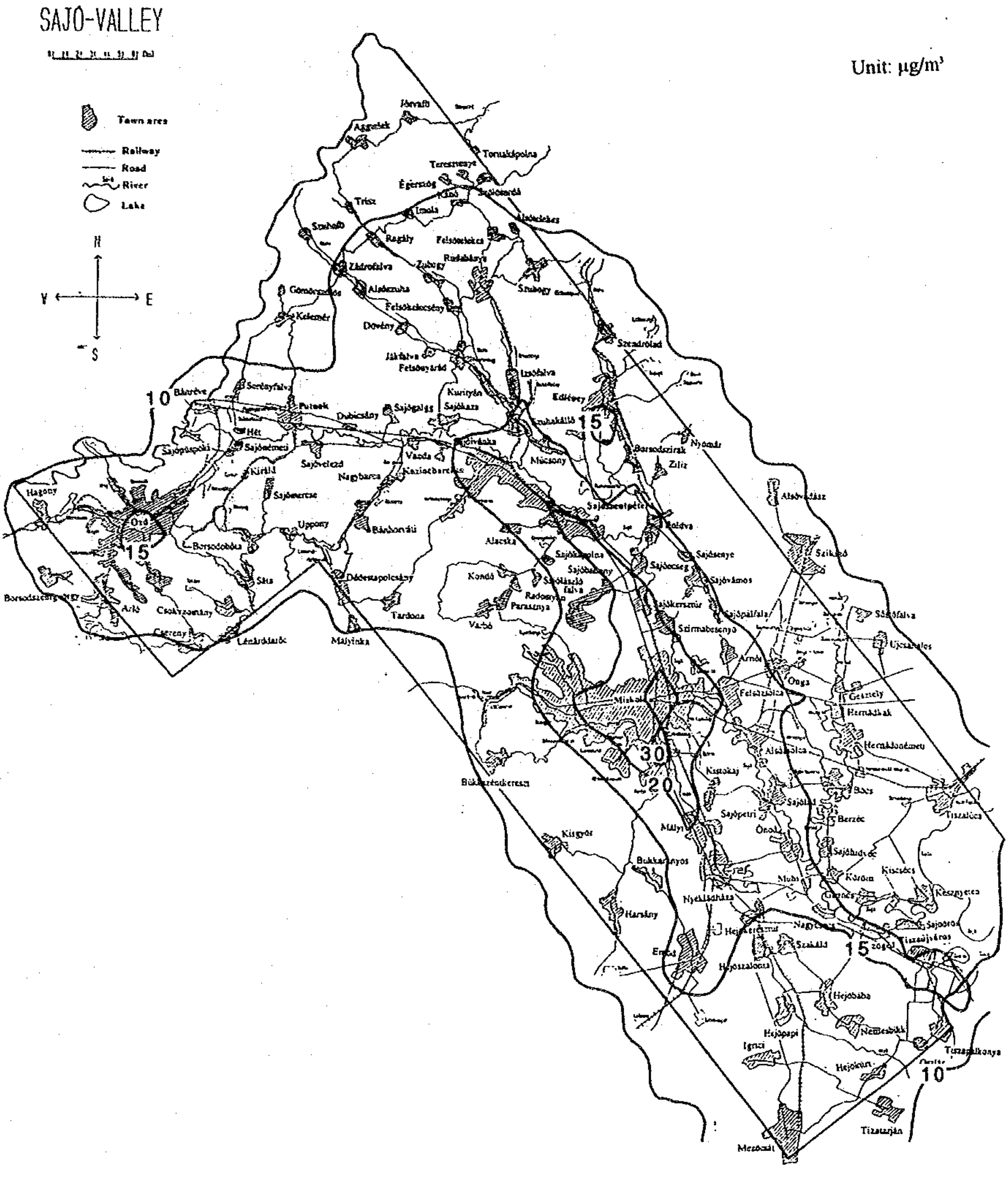

Figure 8.4.8 Average Concentration Isopleth for NO2 in Heating Season (Case F-1, All Sources)

8.4.3 Additional Air Pollution Control (Case F-2)

The annual average and the heating season average concentration distributions of SO_2 are shown in Figures 8.4.9 and 8.4.10, and the same for NO_2 are shown in Figures 8.4.11 and 8.4.12.

More details are displayed by Figures D8.4.19 and D8.4.20, and Figures D8.4.58 through D8.4.69 in Data Book.

(1) SO_2

The SO_2 concentration is further improved beyond the level of Case F-1. The annual and the heating season average concentrations satisfy the new standard (50 $\mu g/m^3$) in the whole area.

(2) NO_2

The NO_2 concentration is further improved beyond the level of Case F-1. There is no problem of NO_2 pollution.

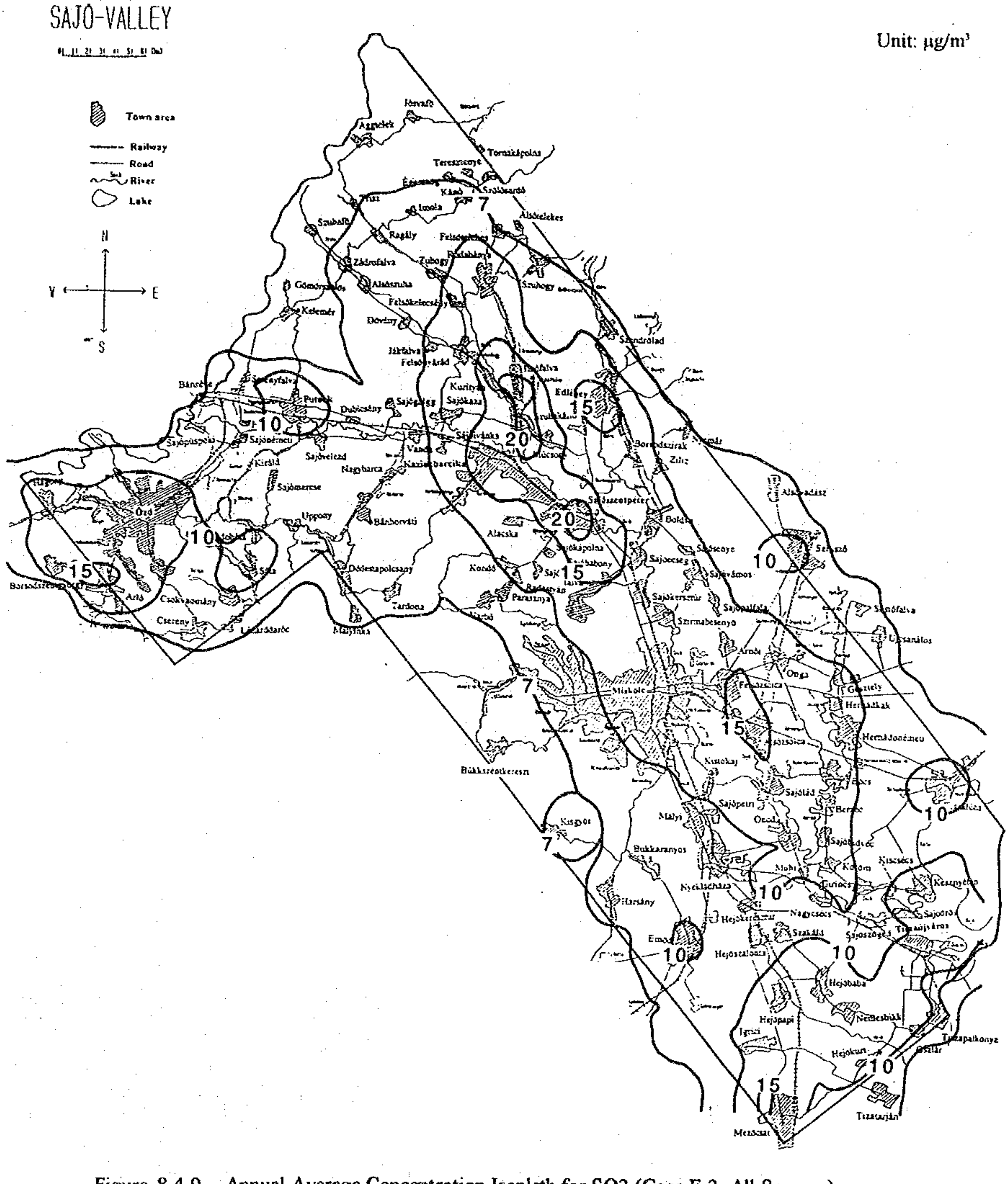

Figure 8.4.9 Annual Average Concentration Isopleth for SO2 (Case F-2, All Sources)

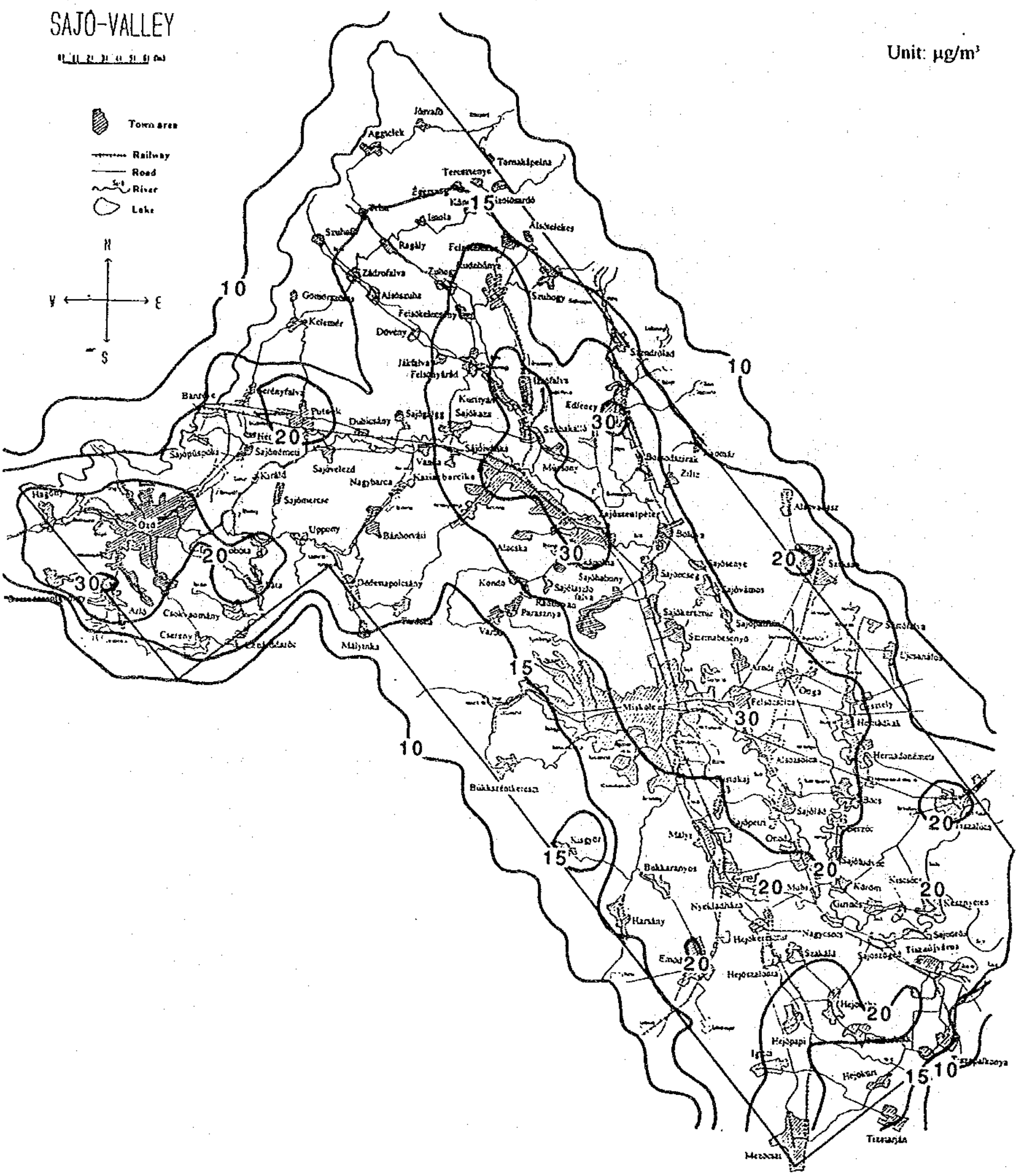

Figure 8.4.10 Average Concentration Isopleth for SO2 in Heating Season (Case F-2, All Sources)

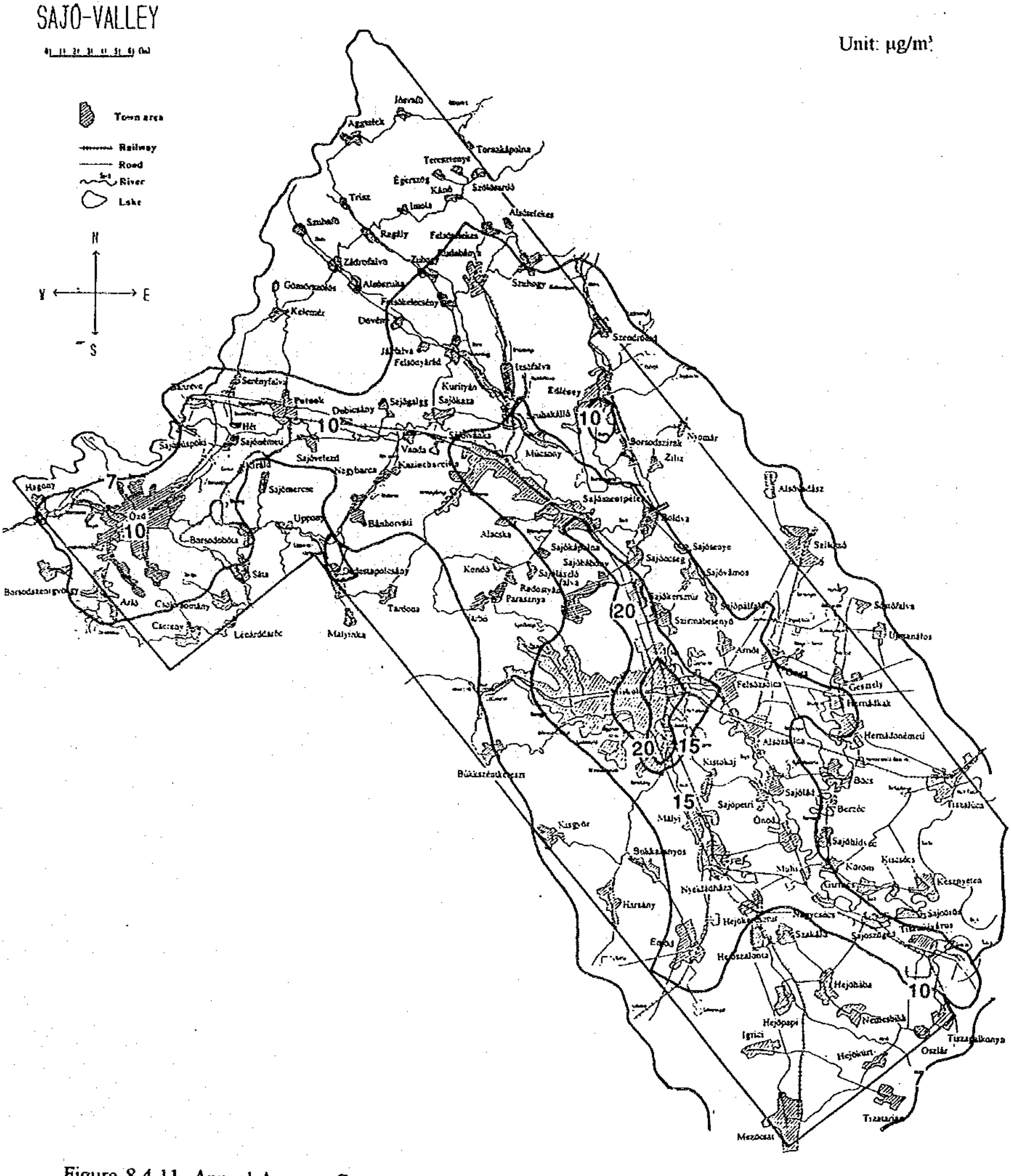

Figure 8.4.11 Annual Average Concentration Isopleth for NO2 (Case F-2, All Sources)

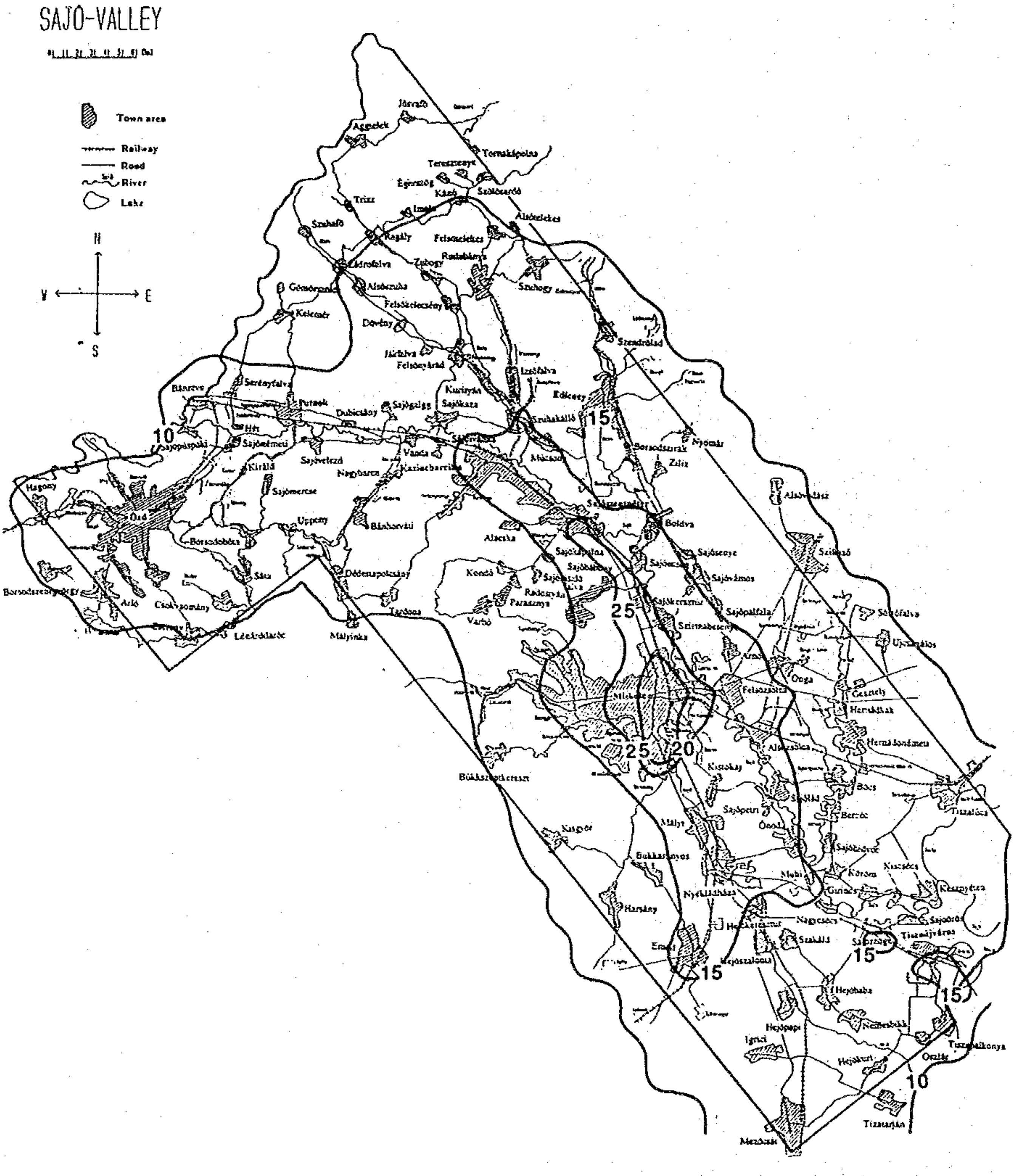

Figure 8.4.12 Average Concentration Isopleth for NO2 in Heating Season (Case F-2, All Sources)

8.4.4 Quantitative Comparison of Air Quality of the Future Cases

In the analysis described above, the differences in air quality between three future cases have been demonstrated by the concentration isopleth figures. In this section, these differences are tried to be quantified. An index of expressing the person-average exposure concentration is introduced as follows:

$$Cp = \sum_{i=1}^{n} (Ci \times Pi) / \sum_{i=1}^{n} Pi$$

where, Cp : Person-average exposure concentration

Ci : Concentration in grid element i

Pi : Population of grid element i

n : Number of grid elements

When the concentration decreases in densely populated areas, Cp decreases rapidly.

Table 8.4.1 shows the person-average exposure concentrations (PAEC) of SO_2 and NO_2 for the future cases obtained by the above equation and their percentages to the no pollution control case.

Table 8.4.1 Person-average Exposure Concentration (PAEC)

Period	Case No.	SO_2		NO_2	
		PAEC ($\mu g/m^3$)	Ratio (%) F-0 = 100	PAEC ($\mu g/m^3$)	Ratio (%) F-0 = 100
Whole year	F-0	52.8	100	18.1	100
	F-1	19.4	36.7	13.1	72.4
	F-2	11.8	22.3	12.5	69.1
Heating season	F-0	93.1	100	25.1	100
	F-1	35.5	38.1	18.3	72.9
	F-2	22.4	24.1	17.3	68.9

As can seen from Table 8.4.1, effects of Cases F-1 and F-2 are particularly large in the reduction of the person-average exposure concentration of SO_2. The reduction of PAEC of SO_2 in Case F-1 from the level of Case F-0 is more than 60%, and that in Case F-2 is nearly 80%.

The reduction of PAEC of NO_2 in Case F-1 is about 27%, and that in Case F-2 is over 30%.

CHAPTER 9

Chapter 9 INTEGRATED AIR POLLUTION CONTROL PLAN

9.1 Cost Estimation

Costs for implementation of air pollution control measures were estimated under the following conditions.

1) Exchange rate

1USD = 100.19 HUF
1USD = 109.35 Japanese Yen
(as of December 15, 1993)

2) Interest rate

The annual interest is assumed to be 5% as employed in direct loans of Japanese government funds. Commissions and an additional interest of an undertaking bank in Hungary is excluded.

Costs for implementation of control measures for motor vehicles are excluded.

Cost estimates already made by Hungarian enterprises are used whenever available. Details of the cost estimation are shown in Tables D9.1.1 through D9.1.7 in Data Book.

9.1.1 Existing Control Plan

(1) Borsod Power Station

a) Initial costs

CFBC system	:	HUF 14,740 million
HFBC system	:	HUF 1,330 million
Ash disposal site for HFBC	:	HUF 1,670 million
Total		HUF 17,740 million

b) Operation costs (exchange losses excluded)

CFBC system (6,920 hr/year)	:	HUF 2,976 million
HFBC system (2,210 hr/year)	:	HUF 282 million
Total		HUF 3,258 million/year

(2) Major Factories

R/N	Factory Name	Object Facility	Control Measure	Initial Cost (million HUF)
03/0	EMO	Tunnel kiln	Fuel change from coal to natural gas	-
15/1	HAMOR	Forge furnace	Improvement of 8 furnaces to the Rath type	160
15/2	DAV	Electric furnace	Suction devices and dust collectors	62
23/1	TVK	Nitric acid production line	Denitration equipment using ammonia	31
Total				253

(3) Households

The costs for house connection of gas pipe and gas-burning equipment are assumed to be HUF 175,000/household.

37,600 households x HUF 175,000 = HUF 6,580 million

(4) Total Initial Cost

The total initial cost for above measures : HUF 24,573 million

9.1.2 Additional Measures

Costs to be added to those of the existing plan are estimated.

(1) Major Factories

R/N	Factory Name	Source No.	Control Measure	Initial Cost (million HUF)
02/1	OZD K.U.	Boiler	Fuel change	-
03/0	EMO	Tunnel kiln	Quality coal as raw material	-
04/1	BORSODCHEM	Incinerator	2-stage combustion	1.65
09/2	SAGROCHEM	Incinerator	2-stage combustion	2.20
15/2	DAV	Heating furnace	Furnace retrofitting Recuperator	60.0 1.65
17/1	HEJOCSABA	Cement kiln	Low-NOx burner	32.1
Total				97.6

(2) Households

Additional 14,800 households are supplied with natural gas. Pipe connection and equipment costs are:

14,800 x HUF 175,000/household = HUF 2,590 million

(3) Total Initial Cost for Additional Measures

The total initial cost for above measures : HUF 2,688 million

(4) Grand Total Initial Cost

Grand total initial cost for the measures in the existing plan and the additional measures is as follows (million HUF):

Borsod Power Station	:	17,740
Major Factories (8 plants)	:	351
Gas supply (52,400 households)	:	9,170
Grand Total		HUF 27,261 million

9.2 Proposed Air Pollution Control Plan

Conditions of pollution sources, control measures, and predicted air quality (SO_2 and NO_2) are summarized in Table 9.2.1 for the present and the three cases of the year 2005.

In Case F-0, the no pollution control case, the predicted concentration of SO_2 seriously exceeds the new ambient air quality standard (50 $\mu g/m^3$ as the long time limit value). The maximum heating-season average concentration occurring in the center of Miskolc is 173 $\mu g/m^3$ which is over 3 times of the new standard.

In Case F-1, the case of existing plans of the Hungarian authorities and enterprises, major air pollution control measures are as follows:

(1) Introduction of CFBC and HFBC systems to Borsod Power Station
(2) Drastic reduction of electricity production in Tisza I Power Station
(3) Use of low-sulfur fuel oil (S : present 3.73% to 1.0%) in Tasza II Power Station
(4) Increase of the natural gas supply covering 78% of all households (57% at present)
(5) Fuel saving by about 10% in major factories and some measures to reduce pollutant emissions in 4 factories

By above measures, the amount of SO_2 emission will be reduced to 26% of the present level, and that of NO_x will be reduced to 57% of the present level. The annual average concentration of SO_2 satisfies the new standard in the whole area. However, the heating-season average concentration of SO_2 does not satisfy the new standards at the central part of Miskolc.

In Case F-2, the additional measures case, the following measures are added to Case F-1:

(1) Further increase of the natural gas supply covering 86% of all households
(2) Some measures to reduce pollutant emissions in 6 factories

These measures reduce the SO_2 emissions by 1,700 ton/y, and the NOx emission by 300 t/y. As a result, the heating-season average concentration of SO_2 satisfies the new standard in the whole area with the highest concentration being 41 $\mu g/m^3$ (the standard : 50 $\mu g/m^3$).

The NO_2 concentration satisfies the new standard (70 $\mu g/m^3$) in all three future cases, and is the lowest in Case F-2.

In view of air quality improvement in the Sajó Valley area, implementation of the air pollution control measures included in Case F-2 is proposed.

Table 9.2.1 Summary of Air Pollution Control Measures and Simulation Results

	Present (1992)	Case F-0 (2005) Without Measure	Case F-1 (2005) With Existing Measures	Case F-2 (2005) With Additional Measures
Borsod P.S.	· Pulverized Coal -Fired Boiler 100t/h x 10 · 600GWh · Pollutant Emission : SO2 31,300t/y (1.0) NOx 2,100t/y (1.0)	· Same Facilities and Fuel as Present · 970GWh (1.62times) · Pollutant Emission : SO2 40,600t/y (1.30) NOx 2,800t/y (1.30)	· Circulation Fluidized Bed Combustion + Hibrid Fluidized Bed Combustion · 970GWh · Pollutant Emission : SO2 9,700t/y (0.31) NOx 1,700t/y (0.80)	Same as Case F-1 · Pollutant Emission : SO2 9,700t/y (0.31) NOx 1,700t/y (0.80)
Tisza I P.S.	· Pulverizes Coal -Fired Boiler 125t/h x 8 (in 1992 6 boilers operated) · 932GWh (1.0) · Pollutant Emission : SO2 35,000t/y (1.0) NOx 2,900t/y (1.0)	· Same Facilities and Fuel as Present · 35GWh (0.04) · Pollutant Emission : SO2 7,000t/y (0.20) NOx 600t/y (0.20)	Same as Case F-0 · Pollutant Emission : SO2 7,000t/y (0.20) NOx 600t/y (0.20)	Same as Case F-1 · Pollutant Emission : SO2 7,000t/y (0.20) NOx 600t/y (0.20)
Tisza II P.S.	· Oil & Gas Mixed Fired Boiler 4 Blocks (670t/h x 4) · 2,616GWh (1.0) · Pollutant Emission : SO2 15,000t/y (1.0) NOx 3,100t/y (1.0)	· Same Facilities and Fuel as Present · 1,581GWh (0.60) · Pollutant Emission : SO2 9,200t/y (0.61) NOx 1,900t/y (0.61)	· Same Facilities as Present · 1,581GWh (0.60) · "S" Contents 3.73% to 1.0% · Pollutant Emission : SO2 2,400t/y (0.16) NOx 1,900t/y (0.16)	Same as Case F-1 · Pollutant Emission : SO2 2,400t/y (0.16) NOx 1,900t/y (0.16)
Major factories	· Fuel Consumption Solid 92,000t/y, Liquid 120,000t/y Gas 1,080Mm3 · Pollutant Emission : SO2 3,400t/y (1.0) NOx 2,900t/y (1.0)	· Fuel consumption increases 28.5% from the present · Pollutant Emission : SO2 2,200t/y (0.64) NOx 2,800t/y (0.99) · Some factories close down	· Fuel save by about 10% from case F-0 · Measures to reduce SO2, NO2 or Dust in 4 factories · Pollutant Emission : SO2 2,000t/y (0.59) NOx 1,600t/y (0.25)	· Measures to reduce SO2 or NO2 in 6 factories in addition to Case F-1 · Pollutant Emission : SO2 1,800t/y (0.53) NOx 1,500t/y (0.23)
Communal Facilities	· 178,000 Households · 57% of Households Supplied with Natural Gas · Pollutant Emission : SO2 13,100t/y (1.0) NOx 2,500t/y (1.0)	· 178,000 Households · 57% of Households Supplied with Natural Gas · Pollutant Emission : SO2 13,100t/y (1.0) NOx 2,500t/y (1.0)	· 178,000 Households · 78% of Households Supplied with Natural Gas · Pollutant Emission : SO2 4,500t/y (0.34) NOx 1,400t/y (0.56)	· 178,000 Households · 86% of Households Supplied with Natural Gas · Pollutant Emission : SO2 3,000t/y (0.23) NOx 1,200t/y (0.48)
Motor Vehicles	· 106,300 Vehicles Registered in Baz County · 2.3% of Motor Vehicles Equipped with Catalytic Converter · Pollutant Emission : SO2 260t/y (1.0) NOx 3,000t/y (1.0)	· 40% of Traffic Volume Increase Over Present · 6.8% of Motor Vehicles Equipped with Catalytic Converter · Pollutant Emission : SO2 370t/y (1.42) NOx 4,100t/y (1.37)	· 40% of Traffic Volume Increase Over Present · 100% of Motor Vehicles Equipped with Catalytic Converter · Pollutant Emission : SO2 110t/y (0.42) NOx 2,200t/y (0.73)	Same as Case F-1 · Pollutant Emission : SO2 110t/y (0.42) NOx 2,200t/y (0.73)
Air Pollution Condition	SO2: A.A.C. Max:100>70 (NS) Total Emission 98,000t/y (1.0) NO2: A.A.C. Max.: 38<70 (S) Total NOx Emission 16,500t/y (1.0)	SO2: A.A.C. Max:100>50 (NS) A.C.H. Max:173>50 (NS) Total Emission 72,400t/y (0.74) NO2: A.A.C. Max:45<70 (S) A.C.H. Max:53<70 (S) Total NOx Emission 14,700t/y (0.89)	SO2: A.A.C. Max:34<50 (S) A.C.H. Max:59>50 (NS) Total Emission 25,700t/y (0.26) NO2: A.A.C. Max:31<70 (S) A.C.H. Max:37<70 (S) Total NOx Emission 9,500t/y (0.57)	SO2: A.A.C. Max:25<50 (S) A.C.H. Max:41<50 (S) Total Emission 24,000t/y (0.24) NO2: A.A.C. Max:29<70 (S) A.C.H. Max:34<70 (S) Total NOx Emission 9,200t/y (0.56)

A.A.C : Annual Average Concentration (unit: $\mu g/m^3$) 、A.C.H. : Average Concentration in Heating Season (unit: $\mu g/m^3$) 、NS : Not Stisfying Standard、S : Satisfying Standard, P.S.: Power Station

9.3 Institutional Measures

9.3.1 Legal Control Measures

It may be stated that the slow progress of air pollution abatement in Hungary partly has originated in the gaps of legislation but has been mainly caused by the lack of coordination and insufficiency in the implementation. Air pollution abatement is the responsibility in common and separately of more than one ministry, however such shared organization and responsibility hinders the efficiency of actions taken in air pollution abatement. The obligatory data declaration serves as a basis for the emission inventories and other control measures. However, in the early years the system functioned with difficulties due to different understanding of regulatory measures by the authorities and polluters. These difficulties were reflected in the problems accompanying the implementation of the mechanism of fining to achieve the reduction or elimination of harmful air pollution. In many cases, the emission limit values and the possibilities in emission reduction determined by the actually available technology are in a discrepancy to a greater extent. The legislation concerning traffic generated air pollution was introduced with delay and up to the present there are gaps in the legislation. In practice, the implementation of qualification (quality control) of the mobile sources and the development of the highway system taking into consideration environmental aspects was not performed coherently and consistently. Emission limit values for major polluting sources are specified in a separate way by a transmission model and by an environmental impact assessment, however such method results in inadequate accuracy because of the lack of ambient air quality monitoring/measurement.

Hungarian government is preparing new legal systems on air pollution abatement to settle the above-mentioned problems. The draft decree and regulations proposed adopts new ideas which seems to be more effective for an air pollution control and more flexible to execute them. Almost all important principles that are indispensable for air pollution abatement and that can be accepted internationally, have been described in the draft act and regulations. Therefore, enactment and enforcement of them are expected as the most probable legal control measures. Remarkable differences between the present legal systems and the proposed ones are as follows:

1) specifying the jurisdiction and the roles of governmental organizations and their administrative tasks in air pollution abatement;
   (Certain administrative bodies will be empowered to coordinate the relating organizations not to hinder the efficiency of actions taken in air pollution abatement.)

2) introduction of "fee for using environment" instead of the present basic fine system concerning stationary air pollution sources;
(By an introduction of "fee for using environment", all operators/owners of air pollution sources shall be liable to pay a "fee for using environment" depending on the total mass of air pollutant emissions. A fee will be paid voluntarily or without a sense of guilty like a tax by the polluter.)

3) modifications of ambient air quality standards and zoning system for their application;
(Modification of ambient air quality standards makes the limit values of SO_2 stricter than present ones.)

4) introduction of concrete technological emission standards (limit values) to certain industries instead of present regional emission standards;
(Polluting sources as thermal power plant and cement industry will be controlled with special care according to the concrete technological emission standards.)

5) stricter emission limit values concerning mobile air polluting sources based on a EC regulation; and
(New regulation concerning mobile air pollution control will encourage the replacement of traditional high-emission motor vehicles by low-emission vehicles equipped with catalyzer.)

6) emphasizing an effective utilization of environmental impact/status assessment for the air pollution abatement.

Gaps and insufficiencies might still remain to some extent even if new act and regulations come into force. Because lots of well-trained talents and optimum executing systems would be needed to realize the objectives of the regulations.

9.3.2 Reinforcement of the Organizations

One of the draft regulations emphasizes that operator/owner of air polluting sources shall appoint an official who is responsible for air pollution protection and is enough educated to direct and control the activity professionally. The other draft regulations emphasize that operator/owner of air polluting sources shall make self-declaration of air pollution data based on the measurement and technical calculation to the competent environmental authority, and that the state and the trend of ambient air quality shall be regularly measured and kept with the help of suitable measuring network. To perform these obligations, qualified talents shall be provided within a short term by the appropriate training or education. Therefore it is necessary to establish a training systems inside or outside of competent environmental authorities in the Study Area.

The draft governmental decree emphasizes an importance of emission/immission monitoring for air pollution control and an effective utilization of environmental impact/status assessment for the air pollution abatement. The draft regulation on emission limit values of stationary air polluting point sources says that the operators of the polluting sources are obliged to measure the emission or to commit the measurement to professional organizations, and that the special emission limit values shall be imposed on the basis of air quality control and environmental impact assessment of spread of pollution. Therefore it is necessary to establish systems which can provide standardized measuring or processing methodology and can provide suggestions and recommendations by an assessment based on the reliable data.

(1) Training Center for Air Pollution Control

One example of the training systems is a regional/local training center as shown in Figure 9.3.1. It might be better from the view point of effective administration that the training center belongs to a certain competent environmental authority like EKF. However it should be operated in cooperation with other organizations and with academic institutions, such as KTM, KHVM, IKM, NM, BAZKF, ANTSZ, University of Miskolc and so on. Because specialists and experts of several fields are needed for trainers. The training center consists of five major sections which roles are as follows.

1) Combustion control section

The section develops a knowledge and a technical skill of the administrative officer/engineer to promote an optimum combustion control and an energy saving in industry. Items to be instructed are technical skill to operate and maintain the combustion equipment, quality control of fuels and methodology for energy saving.

2) Section of air pollution control concerning stationary sources

The section develops a knowledge and a technical skill of the administrative officer/engineer to promote an air pollution control measures for stationary sources. Items to be instructed are legal systems on air pollution control, technical skill to operate and maintain the control equipment and to prepare necessary emergency measures for preventing the dangerous state of air pollution, and methods to report the data concerning air pollution and to train the workers.

3) Section of air pollution control concerning mobile sources

The section develops a knowledge and a technical skill of the administrative officer/engineer to promote an air pollution control measures for mobile sources. Items to be instructed are legal systems on air pollution control, technical skill to install and maintain the control equipment of motor vehicles, and methods to report the data concerning air pollution and to train the manufacturers and the users.

4) Section of measurement and data processing

The section develops a knowledge and a technical skill of the administrative officer/engineer to ensure an accuracy of the measurements and technical calculations of air pollutants. Items to be instructed are legal systems on air pollution control and on quality control of measurement/inspection, technical skill to operate and maintain the measuring equipment and to process the data, and methods to report the data concerning air pollution and to train the workers.

5) Registration section

The section issues a certificate/license for trainees who can accomplish the whole courses and can pass the qualifying examination, and registers their names, registration numbers and biodata. The section also recommends the registered persons by request for the qualified officials/engineers according to their specialties.

(2) Air Pollution Monitoring and Assessment Center

One example of data measuring and processing systems is a regional/local unified center of monitoring and assessment as shown in Figure 9.3.2. It might be better that certain divisions of EKF are developed into the center under the control of EKF. Because difficulty of coordination will affect the efficiency of its operation as shown in the past experience, if the center is an inter-organizational body. The monitoring and assessment center consists of five major sections whose roles are as follows.

1) Ambient air quality monitoring section

Parts of existing division such as Air Cleanness Protection Division of EKF can be developed into this section. The main tasks are monitoring ambient air quality, operation/maintenance of monitoring equipment and processing of measured data. The ambient air quality data from monitoring stations are gathered by a central data acquisition system like a telemeter system. The gathered data are processed and transmitted to the Central Environmental Information System in Budapest. After that, the data are stored in the Data Administration Section in the center and are informed to regional air pollution protection authorities and to local governments.

2) Emission monitoring section (Stationary sources, Mobile sources)

Part of existing division such as Emission Monitoring Division and Information Division of EKF can be developed into the section. The main tasks are emission measurement of both stationary and mobile sources, operation/maintenance of measuring equipment and data processing/storing. The gathered data are processed and transmitted to the Central Environmental Information System in Budapest. Emission data of stationary sources are gathered by the self-declaration system, by the direct measurement and by surprise measurement, and those of mobile sources measured by car inspection systems are informed by BAZKF. After that , the data are stored in the Data Administration Section in the center and are utilized by the competent environmental authorities and local government.

3) Assessment section

Part of division such as Environmental Assessment Division of EKF can be developed into this section. The section conducts environmental impact assessment by request of regional or local governments (BAZ county, city mayor offices) and private sectors with the help of the air pollution simulation models such as the model introduced in this Study. Results of the assessment would be useful information for the environmental protection authorities who need to make a policy, a strategy and a decision on air pollution abatement.

4) Public awareness development section

The section periodically notifies the state of ambient air quality to the public through mass communication or by street display boards to promote public awareness to air pollution problems. It would be helpful for getting the consensus of public opinion on the obligations concerning air pollution abatement, in other words, it would help the public to understand an importance of "fee for using environment" (air pollution fee), vehicles equipped with catalyzer and so on.

5) Data administration section

The section compiles all data measured and keeps them for certain period (10 years). Restored data should be freely utilized for air pollution protection activities by regional or local governments at any time.

9.3.3 Financial Measures for Executing the Control Measures

CEPF (Central Environmental Protection Fund) is expected to be expanded by the newly proposed system of "fee for using environment". CEPF can support not only control measures of industrial polluting sources but also those of domestic sources. According to the annual program for support in 1993, projects for reduction of domestic emissions are selected as high-priority tasks and can be funded by CEPF sources. The projects include building up or extending medium or low pressure gas network, which may extend up to joining individuals into the network. It is predicted that reduction of domestic emissions will contribute to improvement of air quality in the Study Area to a greater extent. Therefore, the project of expanding natural gas supply area for domestic use in the Study Area can be supported by CEPF.

Preferences and tax allowances for activities and products concerning air pollution abatement should be strengthened by some modifications in present taxation system, and should be widely noticed to the public.

All or part of expenses for emission measurement should be paid by the polluters who ask to measure it or who have to be inspected according to the regulation, and should be filled up for a replacement of the measuring equipment or for purchasing articles like standard gases or spare parts.

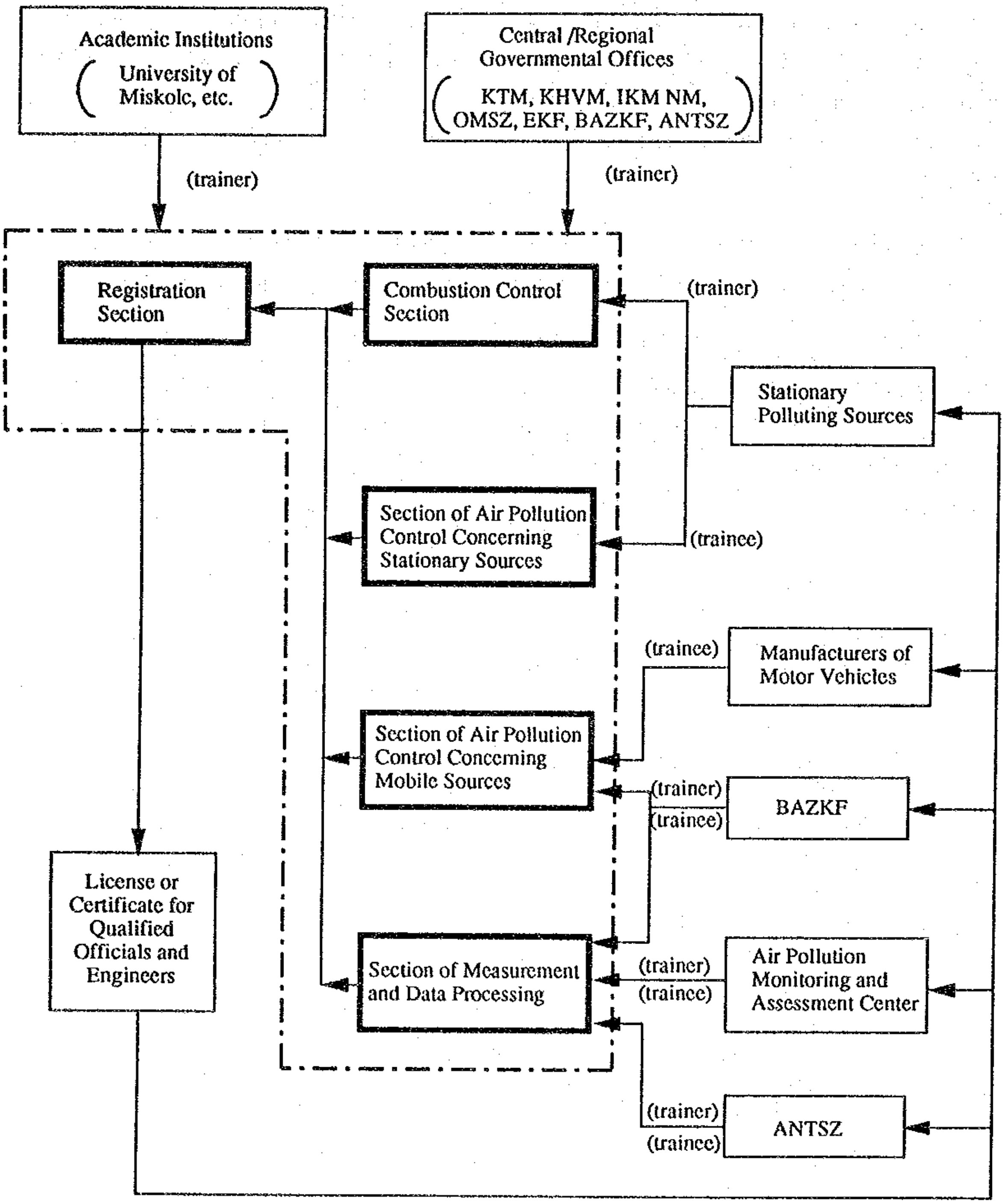

Figure 9.3.1 Conceptual Structure of Training Center for Air Pollution Control

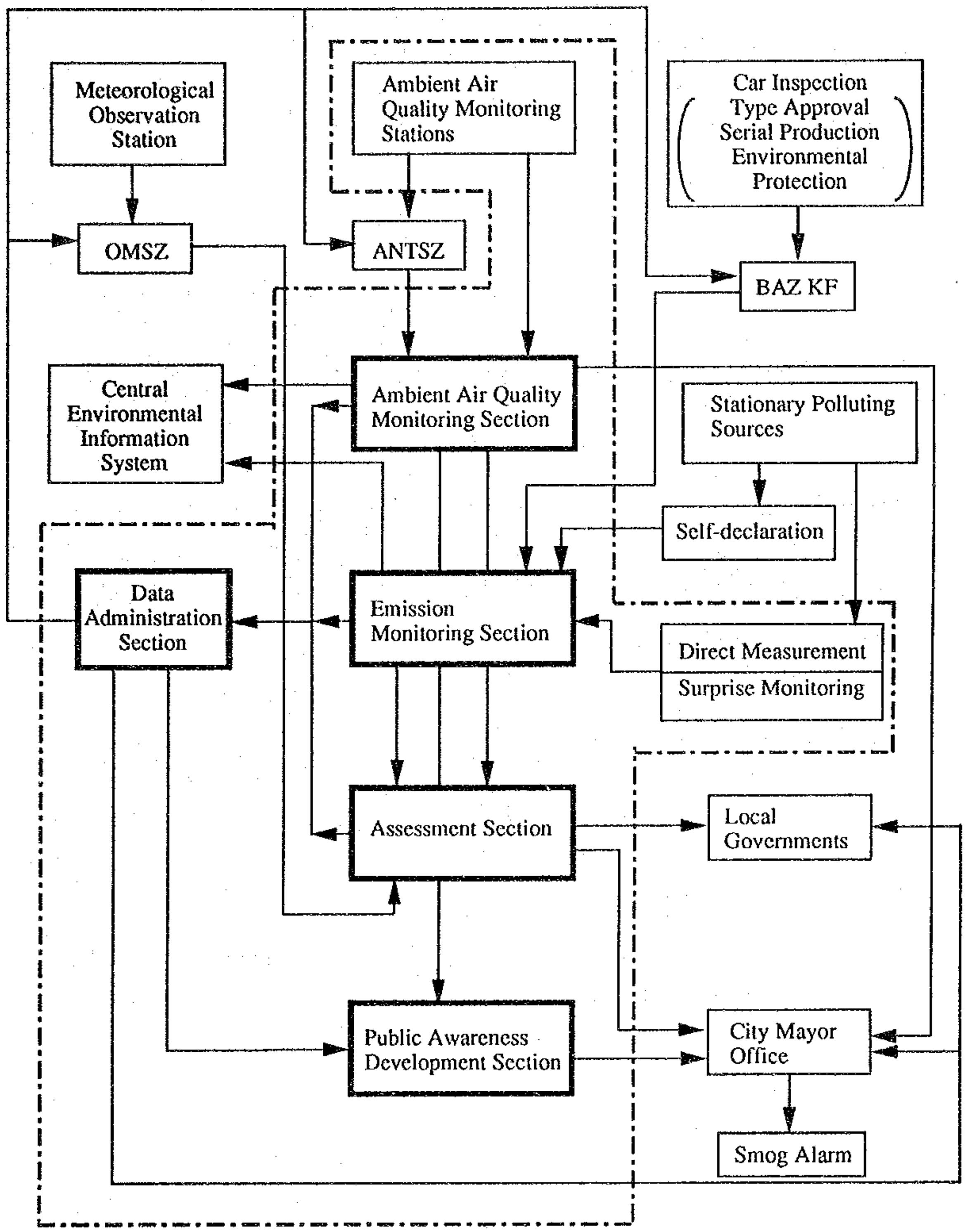

Figure 9.3.2 Conceptual Structure of Air Pollution Monitoring and Assessment Center

9.4 Implementation Program

The structural measures described earlier and the non-structural measures presented in Section 9.3 which support the former should be implemented to improve the air quality in the Sajó Valley area by the target year of 2005. In this Section, an implementation program will be proposed considering the priority of above measures.

(1) Structural Measures

One of the methods to determine the priority of implementing structural measures is to consider the amount of pollutant emission from the sources. Figure 9.4.1 shows the shares of the sources in the total amount of SO_2 emission, and Figure 9.4.2 shows the same for the NOx emission.

In the no pollution control case (Case F-0), the power stations account for 78% of the total SO_2 emission, communal sources account for 18%, major factories 3%, and motor vehicles less than 1%. In this respect, the power stations (especially Borsod P.S.) should be given a high priority in the SO_2 pollution control.

In the case of NOx, the power stations account for 36%, major factories 19%, motor vehicles 28%, and communal sources 17% of the total NOx emission.

Another method to determine the priority is to consider the contribution of each source to the ground-level concentration of the pollutant which is more important in terms of health of the people in the area concerned. The contributing concentrations of the sources at a typical point in Miskolc, Kazincbarcika, Putnok, and Ozd, where population is concentrated, is shown in Table 9.4.1.

The contribution ratio of communal sources in the SO_2 concentration is over 80% at all the points. The ratio particularly increases in the heating season. In this regard, the supply of natural gas to the households should be given a high priority.

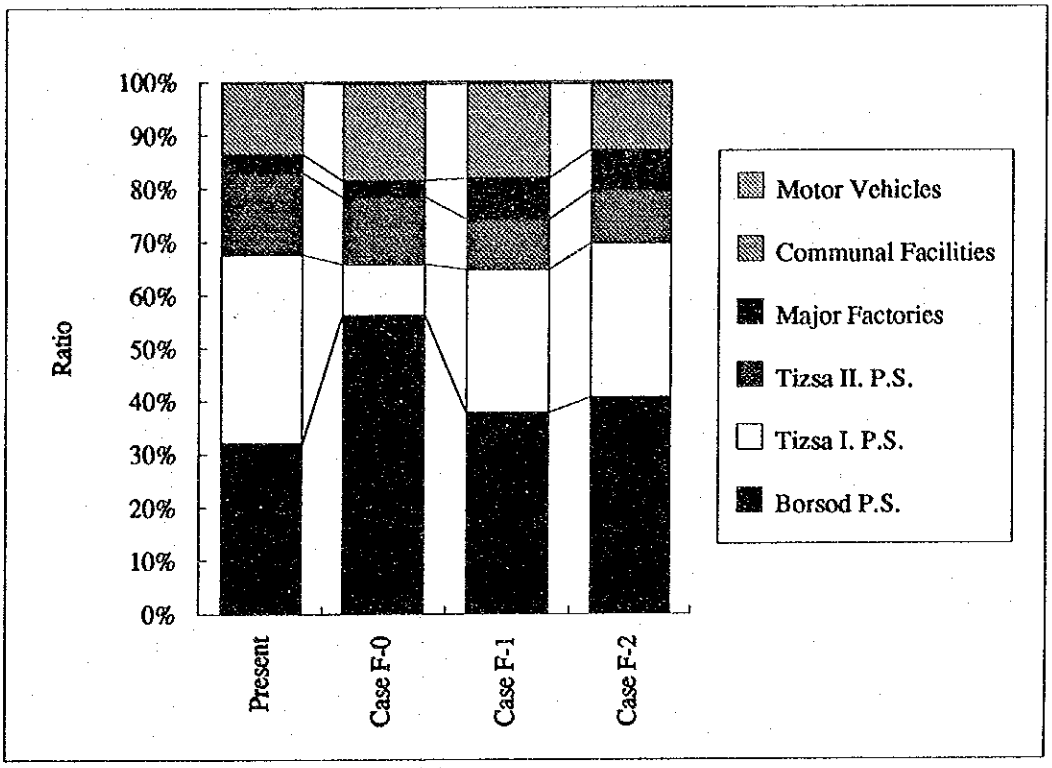

Figure 9.4.1 Shares of Sources in SO_2 Emission

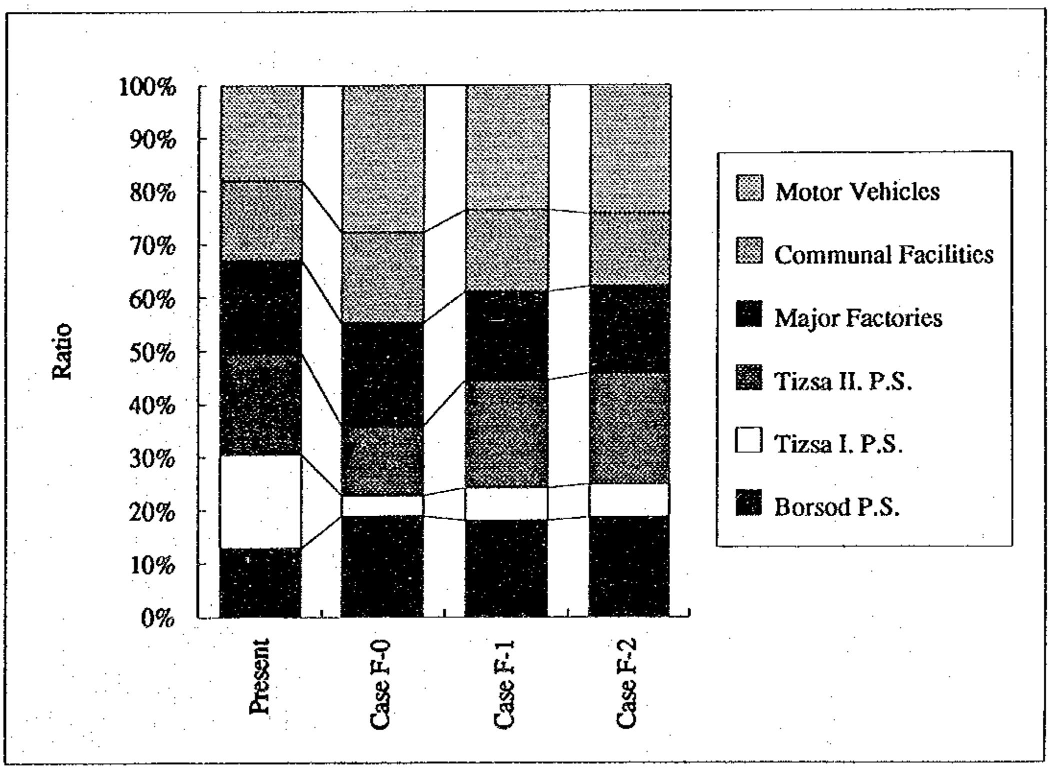

Figure 9.4.2 Shares of Sources in NOx Emission

Table 9.4.1(1) Contribution Concentration and Its Ratio by Sources in Major Cities of The Study Area

SO2

		Present						Case F-0						Case F-1						Case F-2					
		Non-heating		Heating		Whole Year		Non-heating		Heating		Whole Year		Non-heating		Heating		Whole Year		Non-heating		Heating		Whole Year	
		mg/m³	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m	(%)	mg/m3	(%)
Miskolc	Industries	8	27	14	9	11	11	6	20	14	8	10	10	2	20	5	10	3	10	2	50	5	36	3	33
	Communal Sources	19	63	146	90	82	85	19	63	146	88	82	85	7	70	45	88	26	87	1	25	8	57	5	56
	Motor Vehicles	3	10	3	2	3	3	5	17	5	3	5	5	1	10	1	2	1	3	1	25	1	7	1	11
Kazinbarcika	Industries	9	47	10	10	9	15	9	45	10	10	10	16	2	33	3	10	3	17	2	40	3	12	3	19
	Communal Sources	10	53	90	89	50	83	10	50	90	89	50	82	4	67	27	90	15	83	3	60	23	88	13	81
	Motor Vehicles	0	0	1	1	1	2	1	5	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Putonok	Industries	3	30	3	4	3	8	2	22	3	4	3	8	1	33	1	5	1	8	1	33	1	6	1	10
	Communal Sources	7	70	67	96	37	93	7	78	67	94	37	93	2	67	20	95	11	92	2	67	17	94	9	90
	Motor Vehicles	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ozd	Industries	2	13	3	2	2	3	2	13	2	2	2	3	1	17	1	3	1	5	0	0	1	5	1	8
	Communal Sources	13	87	123	98	68	97	13	87	123	98	68	97	5	83	37	97	21	95	2	100	19	95	11	92
	Motor Vehicles	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 9.4.1(2) Contribution Concentration and Its Ratio by Sources in Major Cities of The Study Area

NO2

		Present						Case F-0						Case F-1						Case F-2					
		Non-heating		Heating		Whole Year		Non-heating		Heating		Whole Year		Non-heating		Heating		Whole Year		Non-heating		Heating		Whole Year	
		mg/m³	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m3	(%)	mg/m	(%)	mg/m3	(%)
Miskolc	Industries	1	4	1	3	1	3	1	3	1	2	1	3	1	5	1	4	1	4	1	5	1	4	1	4
	Communal Sources	3	12	16	44	10	31	3	9	16	36	10	26	3	14	11	41	7	29	3	14	9	36	6	26
	Motor Vehicles	22	85	19	53	21	66	30	88	27	61	28	72	17	81	15	56	16	67	17	81	15	60	16	70
Kazinbarcika	Industries	1	20	1	7	1	11	1	17	2	13	1	9	0	0	1	11	1	17	0	0	1	11	1	17
	Communal Sources	1	20	9	64	5	56	1	17	9	56	5	45	1	33	5	56	3	50	1	33	5	56	3	50
	Motor Vehicles	3	60	4	29	3	33	4	67	5	31	5	45	2	67	3	33	2	33	2	67	3	33	2	33
Putonok	Industries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Communal Sources	1	50	6	75	3	60	1	33	6	67	3	60	0	0	2	67	1	50	0	0	2	67	1	50
	Motor Vehicles	1	50	2	25	2	40	2	67	3	33	2	40	1	100	1	33	1	50	1	100	1	33	1	50
Ozd	Industries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Communal Sources	1	33	11	85	7	78	1	33	11	79	7	70	1	50	5	71	3	75	1	50	4	67	2	67
	Motor Vehicles	2	67	2	15	2	22	2	67	3	21	3	30	1	50	2	29	1	25	1	50	2	33	1	33

(2) Non-structural Measures for Air Pollution Control

Non-structural measures are very important as the support to implement the structural measures.

Main non-structural measures proposed are as follows.

(1) Tax finance allowance system
(2) Financial measures
(3) Establishment of air pollution monitoring and assessment center
(4) Establishment of training center for air pollution control
(5) Enforcement of "Governmental Decree on Air Pollution Control"

Enforcement of "Governmental Decree on Air Pollution Control" is most important, because the decree is the foundation of all measures.

(3) Implementation Program

On the basis of above considerations and mutual relation between structural and non-structural measures, an implementation program is proposed as shown in Table 9.4.2.

Table 9.4.2 Implementation Program of Air Pollution Control for Sajo Valley Area

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Cost Estimate
1. Stationary Sources														
(1)Power Station														
1) Borsod Thermal Power Station Pulverized Coal-fired Boilers (100t/h x10) 600GWh in 1992	425GWh		Introduction of CFBC +HFBC 380GWh					780GWh					970GWh	17,740million HUF
2) Tisza I. Thermal Power Station Pulverized Coal-fired Boilers (125t/h x 8) 932GWh in 1992	795GWh		450GWh					120GWh					35GWh	-
3) Tisza II. Thermal Power Station Oil & Gas Mixed Fired Boiler 4 Blocks(670t/h x 4) 2,616GWh in 1992	3,008GWh		3,300GWh					3,805GWh Fuel Control: Sulfur Cont.3.73% to 1.0%					3,581GWh	-
(2)Major Factories							4 factories: Fuel conversion etc.				6 factories: Low NOx burner etc			351million HUF
(3) Communal Facilities **Fuel Conversion (to natural gas)**	57% households supplied with natural gas										86% of households supplied with natural gas			9,170million HUF
2. Mobile Sources														-
(1) Emission Control **Application of EC Regulation**							Promotion of new motor vehicles equipped with catalytic converter							-
(2) Fuel Control														
1) Unleaded fuel							Promotion of new motor vehicles equipped with catalytic converter							-
2) Low Sulphur Fuel		Sulphur content 0.2%						Sulphur content 0.05%						-
3. Institutional Measures (Non-srtuctural measures)														
(1) Tax Allowance System	Existing system							Strengthen System						-
(2) Central Environmental Protection Fund (CEPF)	Existing system						Enlargement of fund							-
(3) Training Center for Air Pollution Control						Establishment				Operation				-
(4) Air Pollution Monitoring & Assessment Center			Establishment						Operation					-
(5) "Governmental Decree on Air Pollution Abatement"				Enforcement										-
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Cost Estimate

CHAPTER 10

Chapter 10 RECOMMENDATIONS

(1) Implementation of New Legal Systems for Air Pollution Control

The Hungarian Government is preparing new legal systems for air pollution control. Implementation of the new regulations and standards would undoubtedly contribute to improvement of air quality in Hungary including the Sajó Valley area. For the successful implementation, the following is recommended.

1) Fostering qualified persons in appropriate institutions in various areas including combustion control, air pollution control, air quality measurement and data processing, air quality assessment, public awareness development, and environmental data administration.

2) Effective utilization of the Central Environmental Protection Fund (CEPF) and strengthening the preferential taxation system to promote air pollution abatement measures including gasification of home heating and energy saving.

(2) Air Quality Monitoring

Ambient air quality monitoring is the foundation of air pollution control management. The Sajó Valley area is now covered by the monitoring network of 16 automatic measuring stations for air quality and meteorology. Important tasks for maximization of functions of the existing monitoring network and for effective utilization of the monitored data include the following:

1) Proper operation and maintenance of measuring equipment and data transmission devices

2) Data examination and processing for evaluation of the air quality

3) Data management for utilization in various works concerning air pollution control

4) Preparation of monthly summary and annual report of the monitoring data

5) Publicity of the state of air quality for stimulating public awareness towards air quality improvement

For strengthening the capability of performing above tasks, close cooperation of the institutions involved in the monitoring and adequate allocation of human resources and budget are recommended.

(3) Energy Saving

Energy consumption per unit output in Hungary is generally much higher in comparison to other developed countries. It also applies to many plants in the Sajó Valley area. To promote energy saving in plants, the following are recommended:

1) Actual status of energy efficiency should be evaluated in each plant. For this purpose, key combustion parameters such as fuel consumption rate and oxygen concentration of combustion gas have to be measured accurately. A fuel flow meter or an appropriate device for determining the fuel consumption rate should be installed on combustion facilities that do not have one currently. Since flue gas measuring ports for number of combustion facilities are provided at inappropriate positions where actual oxygen concentration of the combustion gas is not possible to measure due to air intrusion, the port should be provided at an appropriate place such as the boiler outlet.

2) The oxygen concentration and the temperature of exhaust gas were found to be high at number of combustion facilities, indicating dissipation of heat energy into atmosphere. Amount of air supply should be controlled at an appropriate level, and air intrusion into combustion chamber should be prevented. Waste heat of flue gas should be utilized as much as possible by employing appropriate energy saving devices.

3) Each plant should have an organization to pursue maximum energy utilization efficiency under a director who takes full responsibility in energy saving. It is desirable that the Government prepare guidelines for energy diagnosis and rationalization of energy utilization to be implemented by plants.

(4) Improvement of Borsod Power Plant

Borsod Power Plant is a large pollutant emission source at present with out-dated facilities, but its importance as an energy supplier in the Sajó Valley area will be increased in the future. Therefore, substantial improvements of this power plant in pollution control and energy efficiency are indispensable. An improvement plan has been prepared by the Hungarian Electricity Companies (MVM Rt.) on the basis of the energy policy of the Government in which utilization of the local coal is intended for Borsod Power Plant. Implementation of the improvement plan should be promoted by paying attentions to the following:

1) New installation of the circulating fluidized bed combustion (CFBC) system planned by MVM Rt. is considered to be appropriate and necessary for improvement of the plant under the policies of the Government.

2) Conversions of existing 4 boilers into the hybrid fluidized bed combustion (HFBC) type have been also planned by MVM Rt. Meanwhile, the Government has proposed a regulation that the sulfur removal efficiency of the HFBC system be 60 % or more. The HFBC system was developed by Institute for Electric Power Research (VEIKI) and successfully applied in Ajka Power Plant using the coal produced near Ajka. However, the sulfur removal efficiency of 60 % was not confirmed by the combustion test of the Study Team conducted at Ajka Power Plant in which the Borsod coal was used. Although the efficiency of 60 % is said to be guaranteed by VEIKI in the application the HFBC system to Borsod Power Plant, careful studies are recommended for its success.

(5) Prevention of Emissions of Harmful Substances

In the Sajó Valley area, there are several chemical plants that emit harmful substances such as HCl, H_2SO_4, NH_3, phosgene, and chlorobenzene. Emissions of these substances must be controlled strictly for the safety of people rather than in view of air pollution control. Since these plants have their own plans to eliminate such harmful emissions, their urgent implementation is strongly recommended.

(6) Air Quality Simulation

The degree of influence to the ground level pollutant concentration is not always proportional to the scale of the emission source. Therefore, air quality simulation, such as that employed in this study, is useful for air pollution control planning. For a simulation model to be reliable, accuracy of data on ambient air quality, meteorology, and pollutant emission sources is critically important. Therefore, works to improve these data should be continued systematically. Wide-spread utilization of available simulation models and further development of models for particular purposes, such as analysis of short-term high pollutant concentration phenomenon, are recommended.