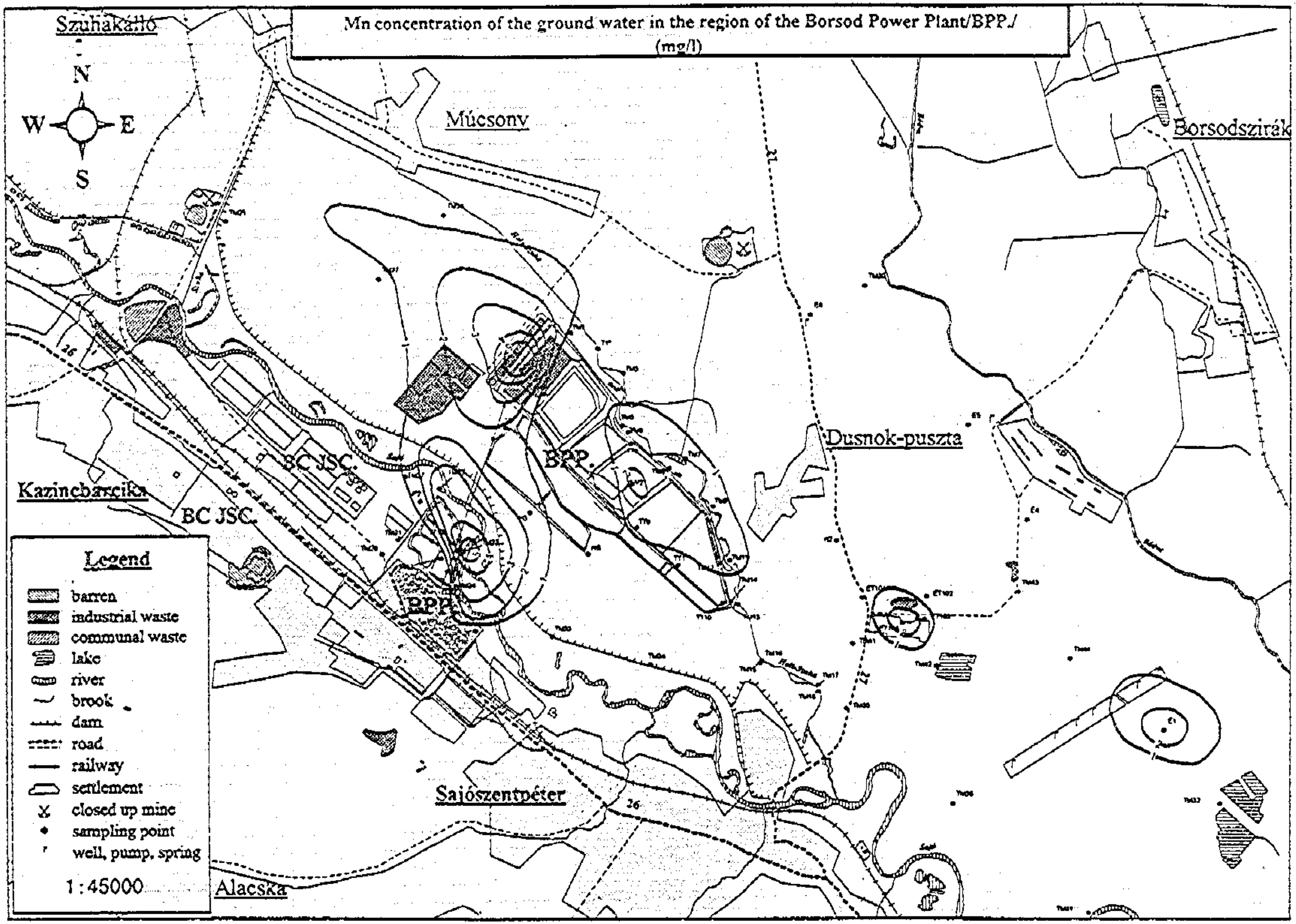


Figure 6.3.26 Mn Concentration of the Groundwater in the Surroundings of Borsod Power Plant

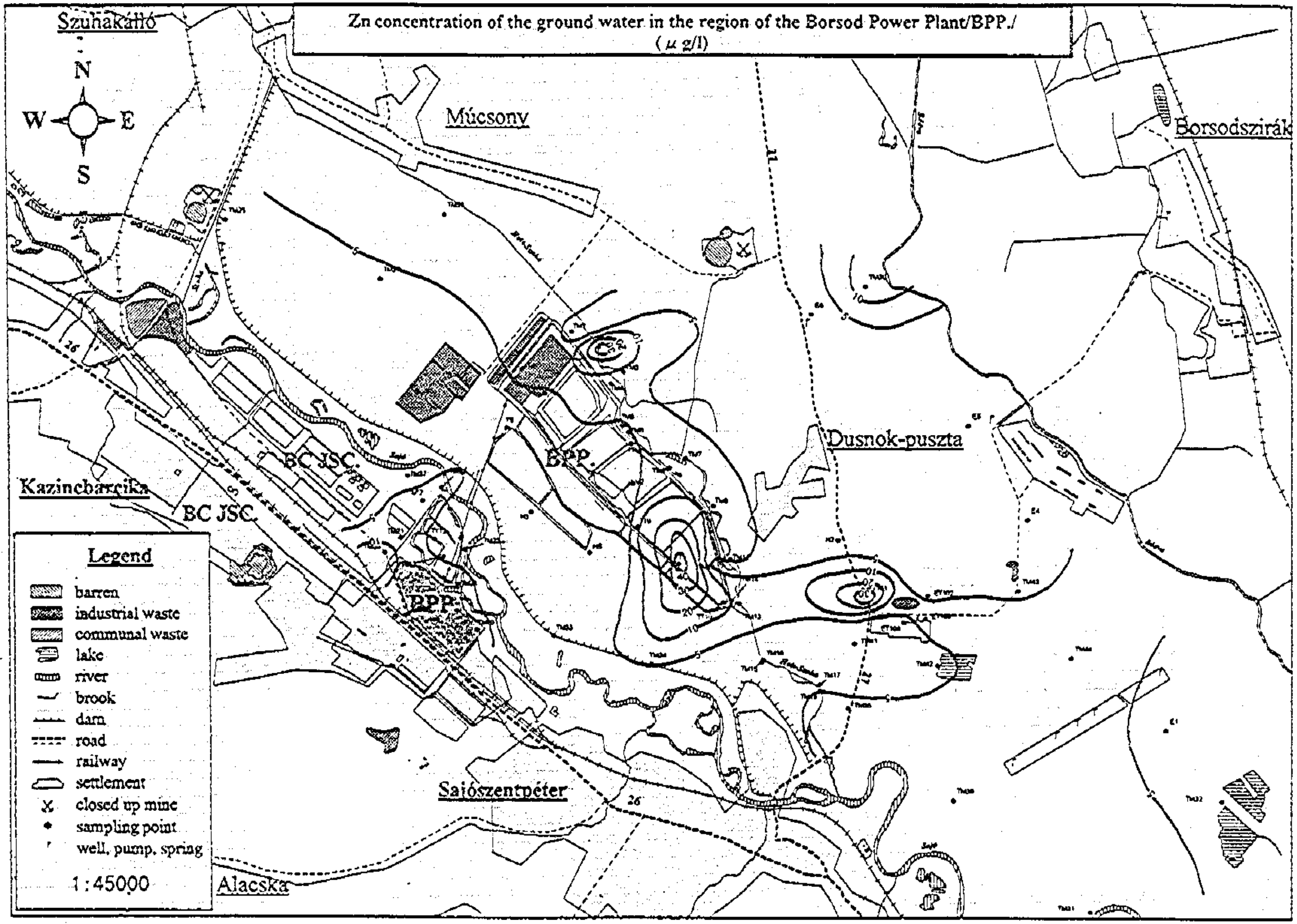


Figure 6.3.27 Zn Concentration of the Groundwater in the Surroundings of Borsod Power Plant

4) Yearly variation of groundwater quality

ERV Co. has conducted secular surveys on hydrology and groundwater quality for a considerable period to protect the two groundwater sources of Borsodszirak Waterworks, I and I/A. The following is a summary of the survey result.

The measurement points are: observation wells (E-1 to E-6, TM-30, TM-35, TM-36, TM-43, TM-44) and the service water source, Borsodszirak I/A. Survey was carried out on pH, NO_3^-, NH_4^+, Cl^-, SO_4^{2-}, Na^+ and electric conductivity.

The yearly variation of SO_4^{2-} and electric conductivity are show in Figure 6.3.28. The details of the yearly variation are included in the Supporting Report .

The yearly variation figures indicate the following points:

The trends of contaminants are classified into the following groups in spite of the variation in their concentration levels. Data of Cl^-, pH and total hardness at point E is excluded.

Group I: Contaminants and points where the level of contamination is declining

Group II: Contaminants and points where the level of contamination is increasing

Group III: Contaminants and points where the fluctuation is too large to judge the overall trend.

Overall trend of the observation wells No.1-No.6 at Borsodszirak I/A can be summarized as follows:

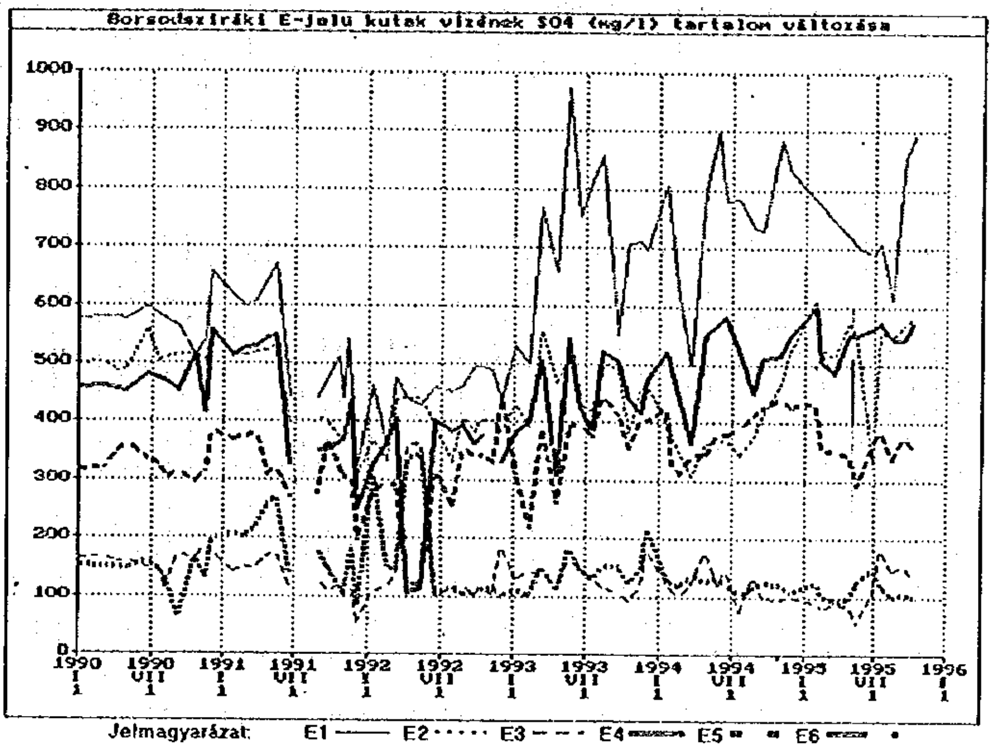
a) SO_4^{2-} : level has been declining in recent years.

b) Cl^- : level has been increasing since 1985.

c) NO_3^- : levels greatly fluctuate and show different trends.

d) NH_4^+ : level has shown large fluctuation. The level has drastically declined since 1989, probably due to the trend of fertilization in the farming land.

In summary, NO_3^- and NH_4^+ are decreasing and Cl^-, Na^+ and electric conductivity are increasing at many points. Overall pH level is clearly declining. Level of SO_4^{2-} differs among the survey points. (Figure 6.3.29)



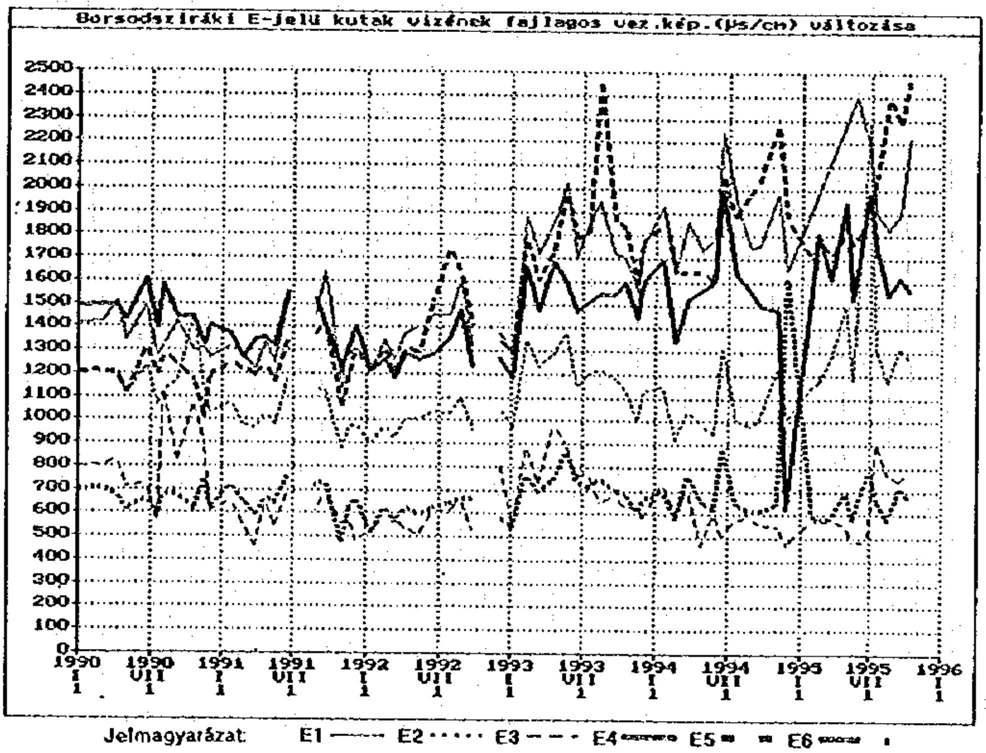


Figure 6.3.28 Annual Variation of SO_4^{2-} Concentration and Conductivity Nearby the Source of City Water (E-1~E-6)

5) Quality of water from private wells in Dusnok-puszta

Four private wells in Dusnok-puszta were optionally selected, and the pH values and electric conductivity were measured. Table 6.3.11 shows the results of measurement.

Table 6.3.11 Quality of water from private wells in Dusnok-puszta

(Feb. 12, 1997)

Location	pH	Electric conductivity (μS/cm)
A	7.10	1988
B	8.01	1797
C	7.76	1546
D	7.71	1966

Compared to the regulatory values applicable to drinking water, the pH values of the water from private wells in Dusnok-puszta are within the allowable range (pH 6.8 to 8.5), or can be considered within the range of competence(pH 7.0 to 8.0). On the other hand, the electric conductivity exceeds the competent value (1350 μ S/cm) on all the spots, and even exceeds the allowable limit (1600 μS/cm) on three spots. Such conductivity proves the presence of high ion content.

According to verbal reports, the water from private wells is still used as drinking water partially. Even high electric conductivity does not always directly affect the human body. The influence of As is negligible at this stage also judging from the contour of groundwater concentration. However, attention should be given in advance to the presence of As from the following reasons:

- Private wells are located close to sludge storage areas.
- The existence of undiscovered waste-reclaim land is possible.
- The inclusion in harmful organic matter that is out of the scope of the survey performed this time is unknown.

6) Surface water

Figure 6.3.29 shows the concentration of SO_4^{2-} distributed in surface water. The details of the concentration of heavy metals and ions distributed in surface water include in the Supporting Report.

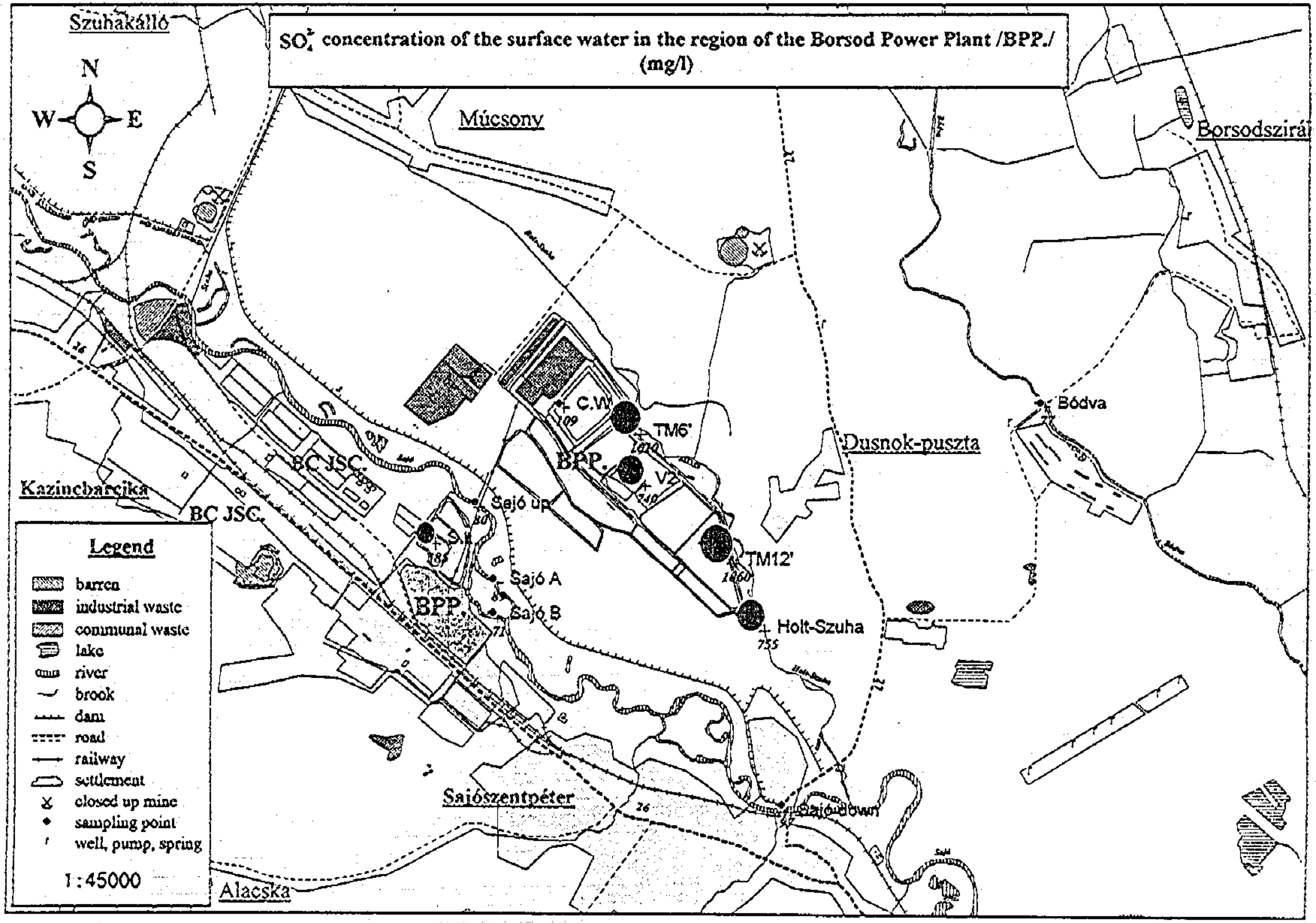


Figure 6.3.29 SO_4^{2-} Concentration of the Surface Water in the Surroundings of Borsod Power Plant

a) As far as surface water is concerned, the concentration of SO_4^{2-} and soluble matter as well as electric conductivity is high in slag and fly ash storage areas and wastewater reservoirs. On the other hand, Cl^- and NO_3^- show high concentration in wastewater reservoirs. Each of such high concentration causes the pollution of groundwater. In addition, As, SO_4^{2-} and NH_4^+ show high concentration in the side drains located near sludge storage areas.

b) As is hardly contained in the waste reservoirs. Nevertheless, it is necessary to pay attention in advance to the following conditions.

The groundwater in the area of the nearest standby sludge storage area (after use) is polluted with As.

As shows high concentration in the side drains located along the coal washing sludge storage area.

7) Survey data of the Borsod Power Plant and evaluation

The observation wells which the Borsod Power Plant have been studying since Jan. 1996 are as follows:

- Wells that have been observed (H-2, H-3)
- Wells selected out of the existing observation well network (TM-7, TM-9, TM-33)
- Observation wells assigned from the Borsodchem Co. (V-1, V-2)
- Newly established observation well (HS)

The geographical distribution of the wells observed on Jan. 17, 1996 is shown in the Supporting Report. Table 6.3.12 shows the results of the quarterly water quality measurement which Borsod Power Plant carries out at these 8 points. Among the results of the groundwater survey conducted by the Study Team in October 1996, this table shows electric conductivity, Cl^-, SO_4^{2-}, Na, and As. Most of these are considered to be from Borsod Power Plant.

The following can be said from the comparison of above 2 sets of data:

a) Each item fell within the quarterly concentration variance except that the data of Borsod Power Plant were lower for As at TM-7, TM-9 and V-2. The differences in As data depend probably on the sample handling and analytical technique.

Table 6.3.12 The Water Quality Measurement Data For The Wells of Borsod Power Plant

	Well Identification		H-2				H-3				HS				TM-7				TM-9				TM-33				V1				V2			
	Sample Nam	Sampling Date 1996	01.15	04.24	07.07	10.01	01.15	04.24	07.07	10.01	01.17	04.24	07.07	10.01	01.17	04.24	07.07	10.01	01.20	04.24	07.07	10.01	01.20	04.24	07.07	10.01	01.20	04.24	07.07	10.01	01.20	04.24	07.07	10.01
The Measurement Results of Borsod Power Plant	COD	mg/l	0.7	0.6	0.7	0.8	3.4	2.4	2.0	1.8	0.9	1.2	1.1	0.9	2.7	2.8	2.7	3.2	1.6	1.7	1.8	1.8	0.8	1.4	1.2	1.1	2.0	1.8	1.7	1.7	1.6	1.5	1.7	1.5
	NO_3^-	mg/l	ND	0.6	0.6	1.0	ND	0.4	ND	0.9	0.2	0.2	ND	0.2	0.4	0.3	0.2	0.4	0.4	0.3	ND	0.4	0.1	0.4	ND	1.1	0.5	0.3	ND	2.4	0.4	0.5	0.1	0.4
	NO_2^-	mg/l	ND	ND	ND	0.01	0.04	0.01	0.01	0.40	0.02	0.01	0.01	0.01	0.03	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	ND	ND	0.01	ND	ND	0.09	0.23	ND	ND	0.01	0.02
	NH_4^+	mg/l	ND	ND	0.12	ND	0.55	0.66	0.30	0.69	0.28	0.31	0.30	0.43	2.00	1.37	3.00	4.10	2.60	2.60	2.50	3.10	0.20	0.11	0.20	0.17	11.4	10.5	9.00	12.6	1.10	1.96	1.00	0.98
	Cl^-	mg/l	183	232	234	238	100	99	117	116	89	79	90	82	107	95	91	78	16	147	91	59	23	24	26	28	64	76	72	73	32	27	33	35
	Fe	mg/l	0.37	0.34	1.16	0.77	3.00	10.7	7.90	8.20	3.70	3.50	2.30	2.40	4.10	4.00	3.70	2.60	1.20	1.00	1.00	0.90	2.30	1.80	1.79	1.15	0.16	0.12	0.13	0.06	0.59	0.49	1.11	0.77
	Mn	mg/l	0.07	0.07	0.07	0.05	1.24	1.30	1.10	1.24	0.25	0.21	0.19	0.18	2.20	1.83	1.47	1.54	1.23	1.14	1.03	0.87	0.38	0.34	0.36	0.23	0.14	0.89	0.76	1.12	1.99	1.32	1.88	2.10
	pH	-	7.1	7.1	7.1	7.5	7.0	6.8	6.3	6.9	7.0	7.1	7.3	7.0	7.0	6.9	7.0	7.0	7.3	7.2	7.4	7.4	7.0	6.9	7.1	7.0	8.3	8.0	8.5	7.9	7.9	7.9	7.9	7.7
	Alkalinity	mmol/l	5.9	6.7	6.2	6.2	4.3	4.4	4.2	4.3	2.7	2.8	2.9	2.6	8.9	8.5	8.1	7.7	11	9.2	5.6	3.7	4.9	5.1	4.8	5.1	1.8	2.0	2.0	2.4	0.7	0.8	1.3	1.1
	Hardness	CaO mg/l	478	573	508	523	258	260	235	283	453	450	417	436	478	421	471	447	391	421	428	425	279	314	321	292	624	575	524	480	416	370	349	350
	Conductivity	μ S/cm	1960	2180	1910	2200	900	900	870	1090	1800	1460	1440	2000	2320	1880	1850	2010	2480	1960	1740	1880	1000	900	920	1000	1980	1880	1840	1940	1330	1200	1180	1350
	Ca	mg/l	254	291	268	274	134	138	128	162	268	275	260	269	279	243	284	253	229	243	256	245	155	183	172	171	387	382	348	325	268	250	229	228
	Mg	mg/l	53.0	72.0	58.0	60.0	30.7	29.1	24.1	24.6	34.3	28.2	23.2	26.0	38.5	35.0	31.5	40.2	31.2	35.0	30.2	35.4	27.5	25.2	34.8	22.7	36.0	17.8	16.2	10.6	18.0	8.7	12.1	13.1
	SO_4^{2-}	mg/l	599	699	682	645	144	163	157	170	805	680	664	695	810	730	732	595	645	553	785	810	254	272	310	224	1080	1063	1044	965	834	608	653	660
	DO	mg/l	0.20	0.22	0.22	0.30	ND	0.17	0.05	0.10	0.10	0.08	0.05	0.10	0.20	0.07	0.05	0.08	0.50	0.08	0.05	0.09	1.10	0.13	0.13	0.22	0.10	0.06	0.07	0.10	0.10	0.08	0.07	0.08
	Water Temp	℃	11.8	9.5	10.6	12.4	10.9	10.2	10.3	11.0	11.2	9.9	10.2	11.3	12.8	10.4	11.7	14.1	12.6	10.6	12.0	13.6	10.6	8.6	10.5	12.6	13.9	14.1	15.3	14.4	13.9	14.5	15.1	14.9
	Water Level	m	5.32	5.22	5.34	5.38	2.13	2.00	2.50	2.51	1.48	1.71	1.88	2.00	2.64	2.73	2.77	2.90	2.76	2.85	2.92	3.05	2.89	2.43	3.21	3.35	12.31	11.85	12.17	12.07	13.24	13.50	13.44	13.75
	Na	mg/l	164	190	180	204	34	37	39	40	119	99	90	102	242	195	172	177	284	259	152	114	13	9.6	10	11	104	129	137	133	44	41	46	45
	K	mg/l	5.2	5.4	5.2	606	3.4	3.9	4.4	3.8	2.4	2.5	1.9	2.6	13.5	18.0	11.5	16.0	26.0	31.0	20.0	24.0	3.8	1.4	1.4	1.3	20.5	37.5	32.0	33.0	10.0	11.8	11.4	9.0
	As	μg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	5	ND	ND	ND	41	29	9	ND	48	20	8	9
	Hg	μg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	ND	0.1	ND	ND	0.1	0.2	ND	ND	ND	0.3	ND	0.2	0.1	0.1	ND	ND	ND	ND	ND
	Cd	μg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	0.5	ND	ND	0.8	ND	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Cr	μg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Cu	μg/l	ND	1	7	5	3	4	6	3	7	5	5	6	7	9	7	7	7	6	6	7	5	2	5	6	11	9	10	12	10	3	7	9
	Ni	μg/l	ND	ND	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Pb	μg/l	ND	ND	ND	ND	ND	ND	ND	ND	7	ND	ND	ND	7	ND	ND	ND	ND	ND	ND	ND	41	ND	ND	ND	5	ND	ND	6	ND	ND	7	ND
	Zn	μg/l	ND	ND	ND	ND	ND	7	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11	13	12	ND	ND	ND	ND	ND	ND	11	ND	ND
	V	μg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JICA Study Team	Conductivity	μ S/cm	2101				933				1415				1770				1318				817				-				1190			
	Cl^-	mg/l	215				110				74				66				55				21				-				34			
	SO_4^{2-}	mg/l	725				164				790				715				580				245				-				715			
	Na	mg/l	192				42				110				154				102				10				-				46			
	As	μg/l	<0.6				0.7				1.0				27.6				8.9				1.2				-				56.4			

b) The concentration tends to fluctuate nearly on the same levels although that of some items fluctuates a little more on some spots.

6.3.5 Quality of River Water

The Sajo river running through the Kazincbarcika region was extremely polluted with heavy metals and organic matter in the past, where the vegetation died out completely to such an extent as to be called the dead river. The quality of water has been rapidly improved in recent years due to recognition of importance of environmental protection, stagnant industrial activities in the valleys and the closing of the pulp plants in Slovakia, which enables the recovery of aquatic life.

The present condition of the rivers is as follows.

(1) Regarding the quality of water in the Sajo river and the Bodva river, the concentrations of both heavy metals and ions are low.

(2) Also for the bottom sediment of the Sajo river, the pollution with heavy metals in the past has been substantially improved, and does not involve any serious problem as the bottom sediment does not. As a result, the improvement in the bottom sediment has contributed remarkably contributed to the improvement in the quality of water.

Table 6.3.13 shows the results of analyzing metals contained in the bottom sediment in the Sajo River. Table 6.3.14 shows the data of the survey in August 1991 with the acid decomposition technique.

- No serious level of heavy metal was found in the sediment of the Sajo river with water extraction, 2M-acid extraction or acid decomposition method. This means the level of heavy metal contamination in this river have greatly improved. The reason of this improvement is probably the stagnant industrial activities in the Sajo river basin. However, 1.36 mg/kg of Hg was found with the acid decomposition method. The level of Hg contamination needs to be monitored.

- According to the examination of the data concerned, the pollution of the sediments in the Sajo river was maximum during the period of 1960 to 1980. Compared to the data at that time, that shown in Table 6.3.13 shows remarkable improvement. The data of the measurement carried out this time by the Study Team shows further improvement. The causes of this rapid purification made by nature are considered as follows. Stagnated industrial activities in recent years, and measures taken for environmental protection in the first place. The bottom sediment was flushed downstream by so large flow of the Sajo river as to often invite floods when it rises, and partially diffused onto flood plains.

- One of the typical heavy metal pollutants from Power Plant is As, but the concentration at present does not need any consideration as the quality of water does not.

(3) Holt-Szuha River which flows near the sludge storage area is still polluted by As and ions due to leachate from the sludge.

Table 6.3.13 Analysis Results of Heavy Metals in the Sediment of the Sajo River (Oct.1996)

(Unit: mg/kg dry base)

Method Metal	Water extraction	2M-acid extraction	Acid decomposition
As	0.038	0.401	1.17
Cd	<0.04	0.640	0.682
Cr	<0.08	4.20	23.5
Cu	0.260	21.5	25.8
Fe	22.8	6707	22436
Hg	<0.002	0.330	1.36
Mn	1.03	571	2068
Pb	<0.5	52.4	59.2
Zn	0.450	159	172

Table 6.3.14 Analysis Results of Heavy Metals in the Sediment of the Sajo River (Aug. 1991)

Location		Hg	Pb	Cu	Zn	Cd	Ni	Cr	As	Fe	Mn
	km	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/kg	g/kg
Sajópüspöki	123.4	0.84	31.6	50.1	150	0.53	28.5	112	21.6	27.86	0.72
Hét	117.8	0.59	61.8	31.1	369	1.24	20.7	100	13.1	20.72	0.61
Sajóvelezd	109.8	0.64	67.2	33.1	379	1.02	21.4	106	13.7	22.46	0.58
Vadna	98.0	0.48	114	20.7	304	2.11	13.9	69.7	9.38	15.93	0.32
Kazincbarcika	90.8	0.56	72.9	35.7	377	0.97	24.6	135	14.9	23.12	0.72
Kazincbarcika	82.4	0.82	82.1	35.5	440	1.46	21.4	116	13.6	22.70	0.56
Sajószentpéter	79.0	1.71	167	55.3	709	5.83	27.7	146	17.2	26.21	0.59
Sajószentpéter	74.5	0.89	61.9	28.1	336	0.97	17.4	103	16.5	18.87	0.44
Sajópecseg	68.1	1.12	88.8	34.6	512	2.19	21.0	123	18.1	21.07	0.71
Sajókeresztúr	64.9	4.32	142	40.7	528	19.5	23.2	113	22.8	23.79	0.69
Szirmabesenyö	61.0	1.87	94.2	44.4	525	9.0	25.2	161	20.4	24.90	0.73
Miskolc	57.2	2.97	160	52.5	995	12.9	28.2	106	23.3	26.20	0.75
Miskolc	54.0	2.10	229	69.9	805	4.43	36.9	330	22.4	36.50	1.11
Felsözsolca	50.7	1.92	201	69.3	834	5.42	35.2	179	23.6	34.00	1.11
Alsózsolca	45.0	1.89	198	68.6	813	5.59	35.6	196	25.0	34.64	1.09
Ónod	36.7	1.01	83.2	35.2	423	1.43	24.7	692	16.6	21.54	0.64
Nagycsécs	26.8	1.01	80.2	42.1	354	11.5	77.8	150	15.0	22.63	0.73
Kesznyéten	11.5	1.50	94.7	47.9	373	3.73	29.8	152	17.0	23.56	0.79
Tiszaujváros	0.2	1.82	113	65.7	530	4.24	37.6	103	21.2	26.28	1.15

Source : Regional Environmental Center for Central and Eastern Europe

6.3.6 Changes in Water Temperature in the Area of the Sajo River

Although the quality of water in the Sajo river has been gradually improved, the problem of thermal effluent caused by cooling water is still present. In particular, the thermal effluent is striking in summer when the water level is low, and the water temperature in the Sajo river rises from 25℃ to 33℃. According to the results of the survey obtained by the Study Team, the water temperature rose from 7.9 ℃ to 12.9℃ on the discharge side as shown in Table 6.3.10. The thermal effluent in summer is affecting the aquatic life.

6.3.7 Soil Contamination Analysis

There is concern about heavy metals contamination such as As due to flue dust from Borsod Power Plant and fly ash from the sludge storage area. There is also the possibility of illegal disposal of solid wastes and heavy metal contamination from other companies, which will be dispersed to the farming land with the Sajo river sediment to cause the contamination of food crops.

Analysis data of heavy metal contamination from "Contamination Assessment and Determination of Prevention Measures for the Sajo Valley (1994)" by the Regional Environmental Center for Central and Eastern Europe (REC) have been obtained. In this study, the analysis was carried out mainly to confirm the accuracy of the existing data.

(1) Sampling points

22 soil sampling points were selected. (Figure 6.3.30). The following points were considered in the selection of sampling points.

- Land with little influence by automobiles
- One control point was selected for comparison between uncultivated and cultivated land (S-6' - point).
- Sampling points, S-12 and S-13, were selected for comparison between the flood plain (S-12) and the terrace (S-13).

(2) Sampling method

Surface soil at the depth of 0 to 15 cm was taken from the 5 points, four corners and the center of a square (20 m x 20 m). The five portions of soil were mixed together to form one composite sample. The sample was stored in a polyethylene container.

(3) Sampling date

Autumn : Oct. 30, 1996
Winter : Jun. 17, 1997

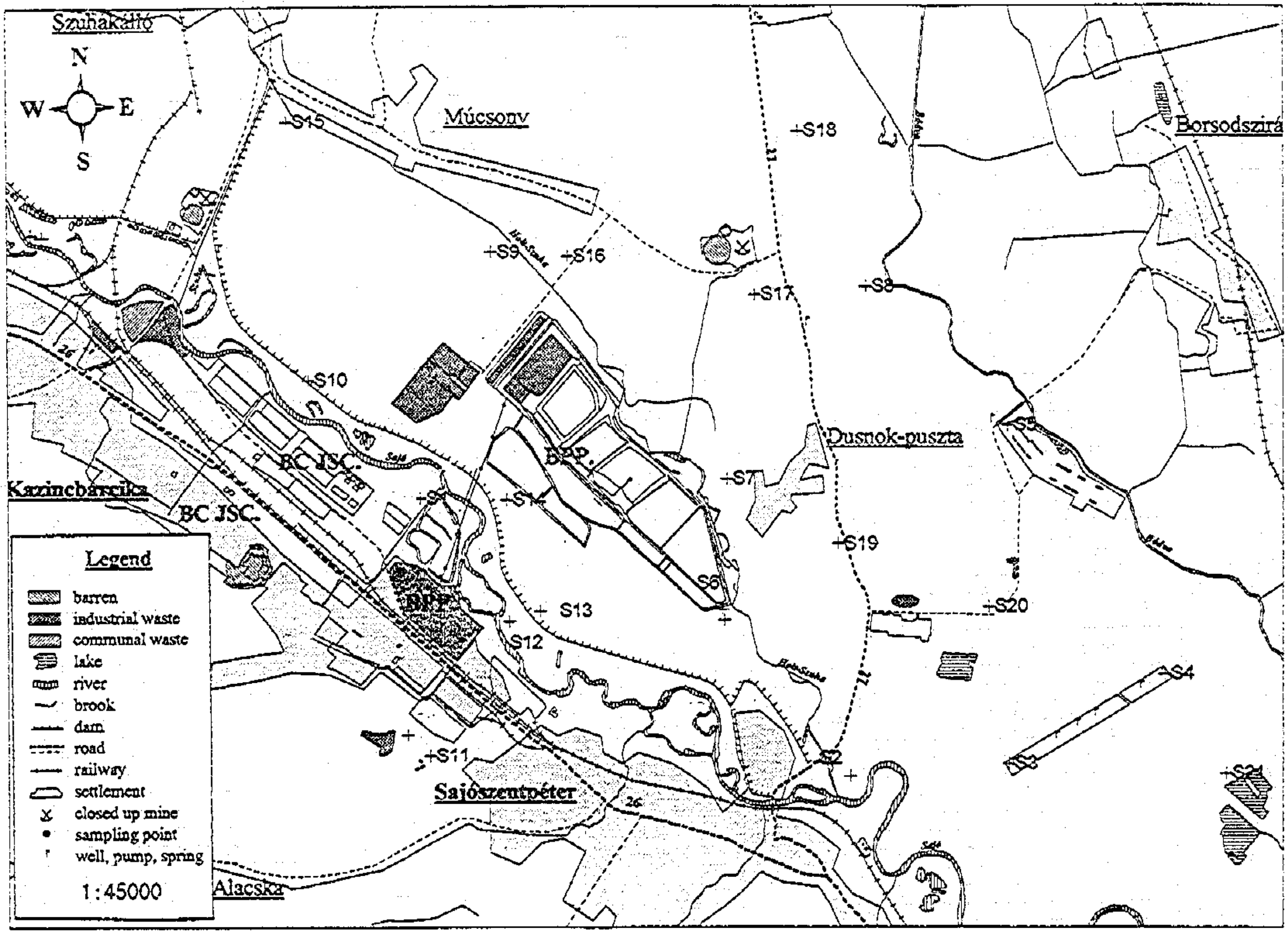


Figure 6.3.30 Sampling points of Soil

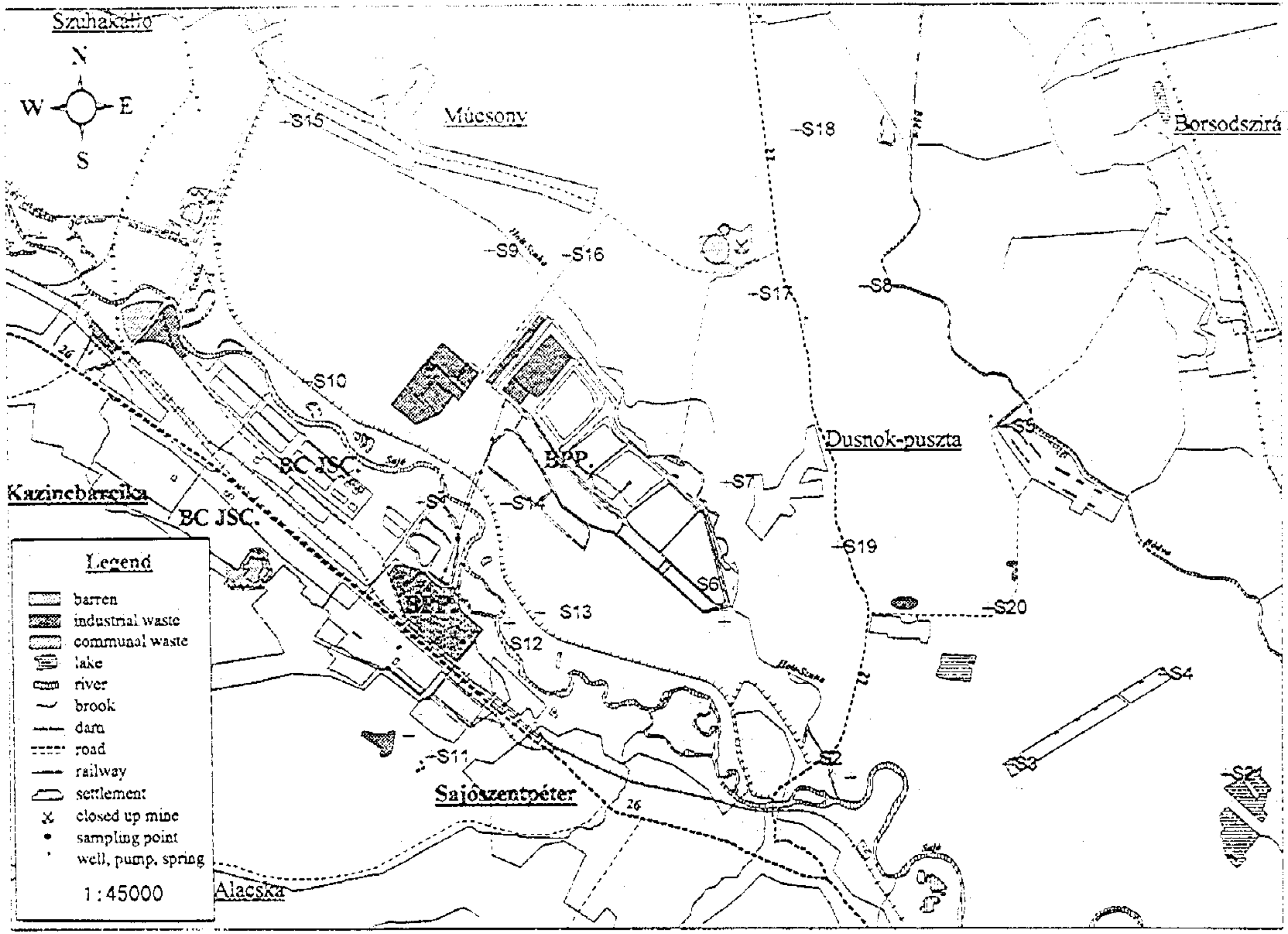


Figure 6.3.30 Sampling points of Soil

(4) Analyzed items

The following items were analyzed.

T-Hg, Org-Hg, As, Cr, Cd, Pb, Cu, Zn, Mn, Fe, SO_4^{2-}

Analysis of Al, Ba, Ca, K, Mg, Na, Ni, S and Ti was added for the samples taken in autumn and prepared with acid decomposition method.

Since sufficient T-Hg for analysis was found in the samples, Org-Hg was considered as below the detection limit.

(5) Analysis method

To evaluate the result of analysis correctly, pre-treatment of the samples, preparation of sample solutions and method of contamination analysis are extremely important. The following is the outline of these analysis methods.

1) Sample preparation

Sample preparation was carried out according to the Hungarian standard as follows:

- The soil sample was well mixed. Approx. 200g of soil was taken onto a plastic tray and dried at the room temperature.
- The dried sample was crushed and sifted with a 2 mm sieve, then powdered with a milling machine.
- Water content of the powder sample was checked to calculate the contamination level of the dried soil.

2) Preparation of sample solution

The following three kinds of sample solution were prepared for heavy metal analysis. Each extraction method follows the Hungarian standard.

a) Water extraction method

Five grams (5 g) of sample was mixed with 45g of water, then shaked for 1 minute and was left for 24 hours. The mixed sample was shaked for 2 hours again and filtered to prepare the sample solution for heavy metal analysis. Analysis of sulfate ion was also carried out with this solution.

b) 2M-acid extraction method

2M-acid is used instead of water to extract heavy metals from the soil. HCl was used to extract As and HNO_3 was used for other heavy metals. The extracted sample as filtered to prepare the sample solution for heavy metal analysis.

c) Acid decomposition method

Soil sample of 2.5g was inserted in a Teflon Bomb (PTFE bomb) to which 5 ml of thick nitric acid (63%) and 2 ml of hydrogen peroxide (30%). 0.1 ml of heptanol were added to the sample as antifoaming agent. The soil sample was decomposed at 130 °C for 4 hours. After cooling down, 10 ml of water was added to the sample and the mixture was filtered to a measuring flask (50 ml). The residue was cleansed with dilute acid, messed-up and diluted to 1/10 level to make the sample solution.

3) Analytical method of heavy metal content

Heavy metals in the sample solutions prepared with water extraction and 2M-acid extraction methods were measured with a GF-AAS and CV-Hg-AAS. SO_4^{2-} in the samples prepared with water extraction method was measured with an UV-SP spectrophotometer. Sample solution prepared with acid decomposition method was analyzed with a method shown in Table 6.3.15. ICP-OES-2 was not included in the survey plan.

Table 6.3.15 Analysis Method of Heavy Metals in Soil

Method	Heavy metals
ICP-OES-1	Cd, Cr, Cu, Fe, Mn, Pb, Zn
ICP-OES-2	Al, Ba, Ca, K, Mg, Na, Ni, S, Ti
GF-AAS	As
CV-Hg-AAS	Hg

4) Analysis result

The result of soil analysis is shown in Tables 6.3.16 though 6.3.18. The following are found from the result of soil analysis:

a) Water extraction method data

High As concentration has been detected on the S-6 positioned very close to the sludge storage area (cassette VI) and on the S-1, S-11 through S-14 positioned near the Power Plant facilities. This clearly proves the influence of Power Plant. Another lot showing high As concentration is S-15 positioned about 4 km NNW from the smoke source in Power Plant. No other remarkable high concentration has been detected. The S-6' is positioned in the farming land located quite close to this lot, and the dilution in the concentration due to soil stirring can be observed. For other components, Hg concentration should be taken into consideration, but the concentration detected so far is too low to invite problem at this stage.

b) 2M-acid extraction method data

Figures 6.3.31 through 6.3.39 show the concentration of heavy metals distributed in the soil.

i) The lots where As concentration has exceeded 2 mg / kg are S-6, S-7, S-11 through S-14 and S-19. Most of these spots are positioned near the Power Plant facilities. Ranking next to these, As concentration is high on the lot S-15. It seems that the lot S-15 positioned NNW from the smoke source have been affected by Power Plant because the wind directions prevailing in this area are NW-N and SSE-S.

ii) The lot S-12 where Cd, Pb, Zn, etc. show high concentration is positioned on the flood plain of the Sajo river. As the comparison of the lot S-12 to S-13 suggests, it seems that the former was affected by the industrial pollution in Sajo River which occurred in the past.

iii) As shows high concentration near the facilities of Borsod Power Plant, but the heavy metals including Cd, Hg, Pb, Zn, etc. tend to show rather low concentration. Namely, the soil pollutant deriving from Borsod Power Plant as the source is limited to As.

Table 6.3.16 (1) Result of Soil Analysis (Water Digestion)

(Water Digestion) (Unit:mg/dry soil kg Oct. 1996)

Component \ Sample	S1	S2	S3	S4	S5	S6	S6'	S7	S8	S9	S10
As	0.214	0.041	<0.007	<0.007	<0.007	0.572	0.080	0.061	0.097	0.060	0.022
Cd	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cr	0.41	0.29	0.39	0.34	0.45	0.26	0.27	0.26	0.47	0.39	0.26
Cu	0.226	0.193	0.182	0.218	0.239	0.129	0.161	0.193	0.229	0.266	0.190
Fe	119.10	54.10	75.18	55.22	55.50	11.73	37.25	50.65	113.90	64.96	51.27
Hg	0.003	0.004	0.004	<0.002	<0.002	0.005	0.004	<0.002	<0.002	0.003	0.003
Mn	0.719	0.207	0.546	0.313	0.334	0.300	0.214	0.359	0.635	0.322	0.326
Pb	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Zn	0.620	0.304	0.238	0.272	0.398	0.186	0.268	0.354	0.584	0.294	0.313
SO4	848	806	896	1034	1232	1173	716	880	856	1062	206

Table 6.3.16 (2) Result of Soil Analysis (Water Digestion)

(Water Digestion) (Unit:mg/dry soil kg Jan. 1997)

Component \ Sample	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21
As	0.154	0.172	0.216	0.144	0.199	0.050	0.080	0.047	0.108	0.056	0.063
Cd	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cr	<0.20	<0.20	<0.20	0.26	<0.20	<0.20	0.40	0.51	<0.20	<0.20	0.26
Cu	0.106	0.197	0.083	0.179	0.199	0.162	0.269	0.227	0.184	0.242	0.331
Fe	51.3	59.0	153.8	150.0	134.1	110.0	242.4	213.5	107.5	141.8	183.0
Hg	<0.002	<0.002	<0.002	0.005	<0.002	<0.002	<0.002	0.004	0.004	<0.002	<0.002
Mn	0.385	0.282	0.483	0.371	0.228	0.206	1.215	1.243	0.395	0.966	0.720
Pb	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Zn	0.346	0.859	0.331	0.664	0.598	0.529	1.266	0.856	0.685	0.713	0.907
SO4	649	191	918	1620	581	623	519	578	450	353	400

Table 6.3.17 (1) Result of Soil Analysis (2M-Acid Digestion)

(2M-Acid Digestion) (Unit:mg/dry soil kg Oct. 1996)

Component \ Sample	S1	S2	S3	S4	S5	S6	S6'	S7	S8	S9	S10
As	1.308	1.013	0.276	0.476	0.488	5.989	1.260	2.644	0.537	1.238	0.525
Cd	0.282	0.221	0.238	0.177	0.366	0.072	0.107	0.138	0.318	0.252	0.163
Cr	3.95	3.45	3.92	5.58	6.84	5.72	5.49	3.59	3.94	4.20	5.44
Cu	13.87	11.30	11.38	18.54	23.85	13.71	14.83	10.41	20.50	18.70	14.61
Fe	3447	4184	3909	5897	7902	6052	5842	4014	3053	5841	6495
Hg	0.097	0.098	0.081	0.078	0.119	0.096	0.080	0.084	0.057	0.125	0.118
Mn	586.6	369.8	436.8	380.8	445.2	480.5	410.0	383.6	558.8	515.2	522.2
Pb	22.70	17.39	19.18	19.31	30.53	14.30	19.70	14.77	16.38	24.08	20.13
Zn	30.88	26.22	22.54	30.87	40.23	28.74	28.14	17.80	40.13	30.10	29.65

Table 6.3.17 (2) Result of Soil Analysis (2M-Acid Digestion)

(2M-Acid Digestion) (Unit:mg/dry soil kg Jan. 1997)

Component \ Sample	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21
As	2.071	2.878	3.305	2.350	1.788	1.247	1.025	0.685	2.211	1.044	0.596
Cd	0.372	0.732	0.234	0.206	0.228	0.191	0.179	0.147	0.184	0.281	0.130
Cr	2.18	3.72	5.05	4.26	2.92	4.98	2.51	3.38	3.32	1.53	3.35
Cu	6.54	18.66	14.49	15.10	15.32	18.08	7.78	10.72	12.71	6.89	12.11
Fe	2687	5988	5977	5908	5276	6715	2273	2943	3839	1759	4349
Hg	0.005	0.004	<0.002	<0.002	0.020	<0.002	<0.002	<0.002	<0.002	0.008	<0.002
Mn	602.2	539.7	516.4	579.3	512.1	348.0	300.1	371.4	340.2	297.8	377.7
Pb	24.69	62.70	23.10	19.59	20.70	19.29	14.16	15.59	16.13	9.99	11.87
Zn	15.26	121.90	28.50	22.89	31.21	24.44	9.90	9.43	18.94	7.54	15.02

Table 6.3.18 (1) Result of Soil Analysis (HNO_3+ N_2O_2Digestion)

(HNO_3+H_2O_2 Digestion) (Unit:mg/dry soil kg Oct. 1996)

Sample / Component	S1	S2	S3	S4	S5	S6	S6'	S7	S8	S9	S10
As	26.7	19.3	19	13.3	41.6	23.9	47.2	66.3	21.7	37.1	26
Cd	0.35	0.26	0.27	0.18	0.37	0.16	0.13	0.18	0.32	0.30	0.19
Cr	42.7	40.2	39.9	48.3	66.6	40.1	32.9	34.6	40.3	45.2	44
Cu	44.3	40.4	43.6	47.9	67.3	43.5	36.1	40.1	54.1	52.6	43.6
Fe	33400	31300	33900	31700	47900	35900	27200	32600	29800	34400	32500
Hg	0.324	0.267	0.211	0.233	0.26	0.206	0.128	0.309	0.132	0.204	0.181
Mn	763	392	607	428	580	527	436	504	707	583	648
Pb	40	31	38	33	58	32	30	26	29	39	37
Zn	121	92.4	94.9	107	162	98.4	68.7	97.3	141	118	92.3
Al	29900	30400	29900	32800	56100	32200	26400	38100	29700	33600	32500
Ba	225	181	186	211	345	215	186	246	232	250	209
Ca	6920	9050	5800	8070	11100	14800	7570	22000	18600	8890	7320
K	6010	6140	4130	4470	5760	3280	3630	4710	9900	4320	3720
Mg	6400	6090	6850	6250	7610	6790	5420	6500	7000	6130	6770
Na	144	170	99	134	192	267	265	775	163	160	258
Ni	41.9	35.5	33.8	40	53.4	27.9	26.1	28.6	39.9	37.1	34.7
S	535	796	472	477	895	403	551	1010	606	1060	496
Ti	185	212	102	115	54.8	98	201	216	193	70	244

Table 6.3.18 (2) Result of Soil Analysis (HNO_3+ N_2O_2Digestion)

(HNO_3+H_2O_2 Digestion) (Unit:mg/dry soil kg Jan. 1997)

Sample / Component	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21
As	14.38	11.29	14.77	7.16	5.38	6.53	6.26	11.14	15.54	5.80	8.67
Cd	0.376	0.738	0.236	0.225	0.234	0.199	0.186	0.162	0.186	0.285	0.136
Cr	13.00	15.82	25.13	21.83	16.76	24.16	18.53	21.31	19.32	14.67	23.70
Cu	10.95	24.52	22.59	20.73	20.39	23.23	13.62	16.41	18.36	12.56	20.95
Fe	14003	17572	24702	22266	18199	23400	16907	17520	19810	15328	27470
Hg	0.275	0.627	0.404	0.446	0.611	0.819	0.063	0.063	0.105	0.078	0.202
Mn	744.3	612.6	662.4	719.0	506.3	440.0	501.0	706.7	456.9	454.8	769.1
Pb	26.43	62.52	26.63	22.18	22.30	21.33	17.30	19.11	18.64	12.54	17.98
Zn	42.48	161.20	72.88	63.21	62.68	66.67	43.31	40.06	57.71	38.00	59.23

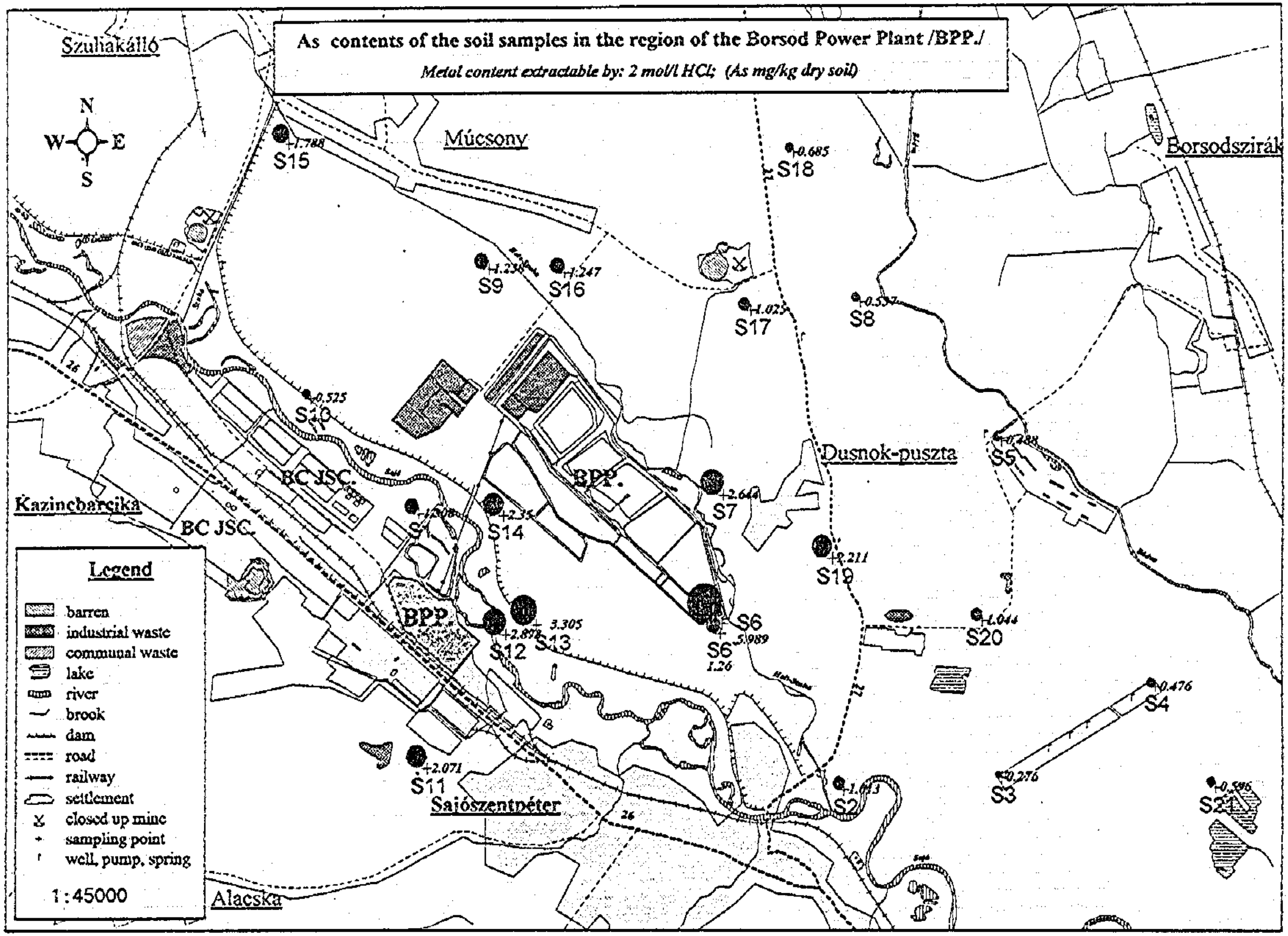


Figure 6.3.31 As Contents of the Soil Samples in the Surroundings of Borsod Power Plant

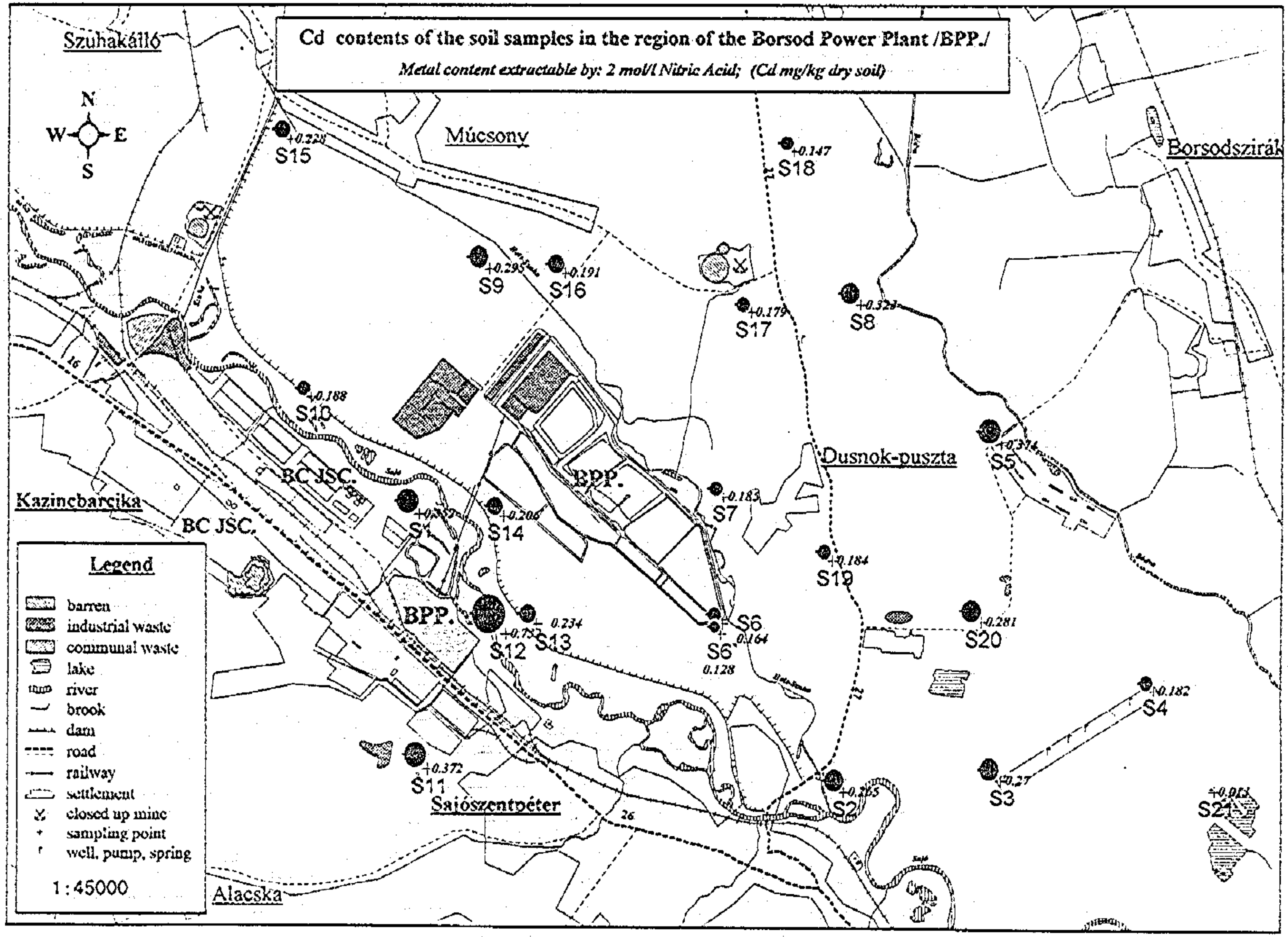


Figure 6.3.32 Cd Contents of the Soil Samples in the Surroundings of Borsod Power Plant

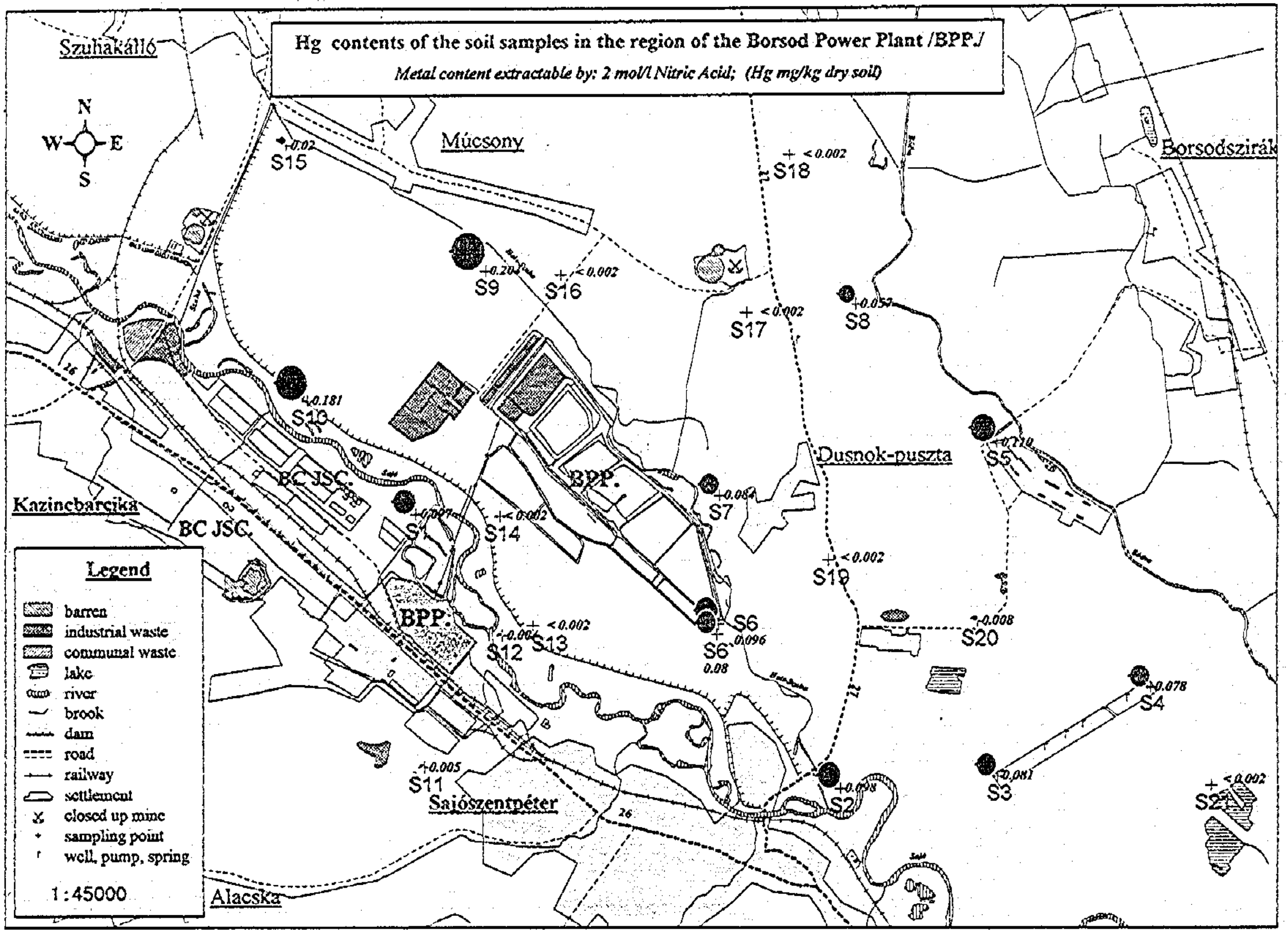


Figure 6.3.33 Hg Contents of the Soil Samples in the Surroundings of Borsod Power Plant

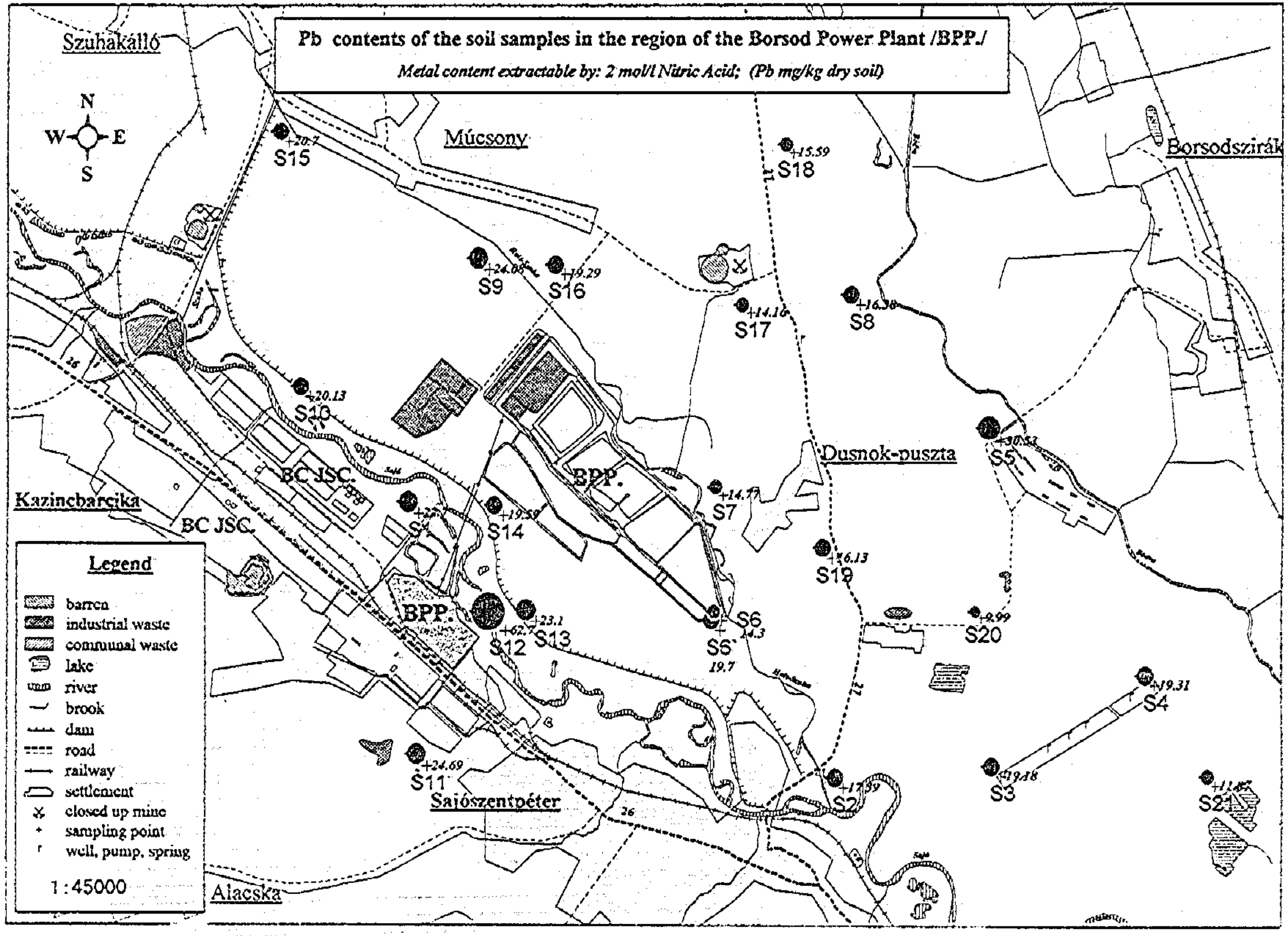


Figure 6.3.34 Pb Contents of the Soil Samples in the Surroundings of Borsod Power Plant

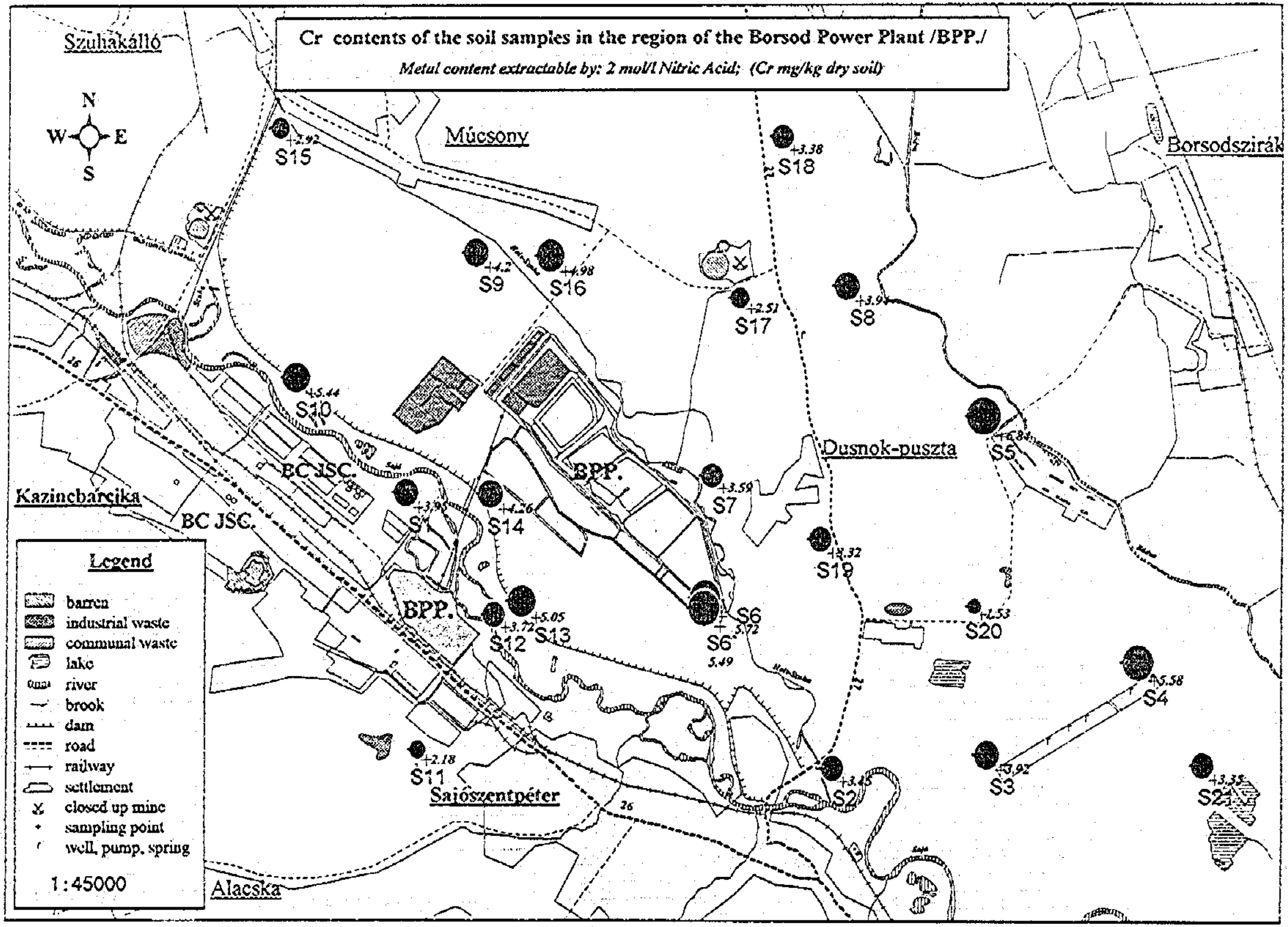


Figure 6.3.35 Cr Contents of the Soil Samples in the Surroundings of Borsod Power Plant

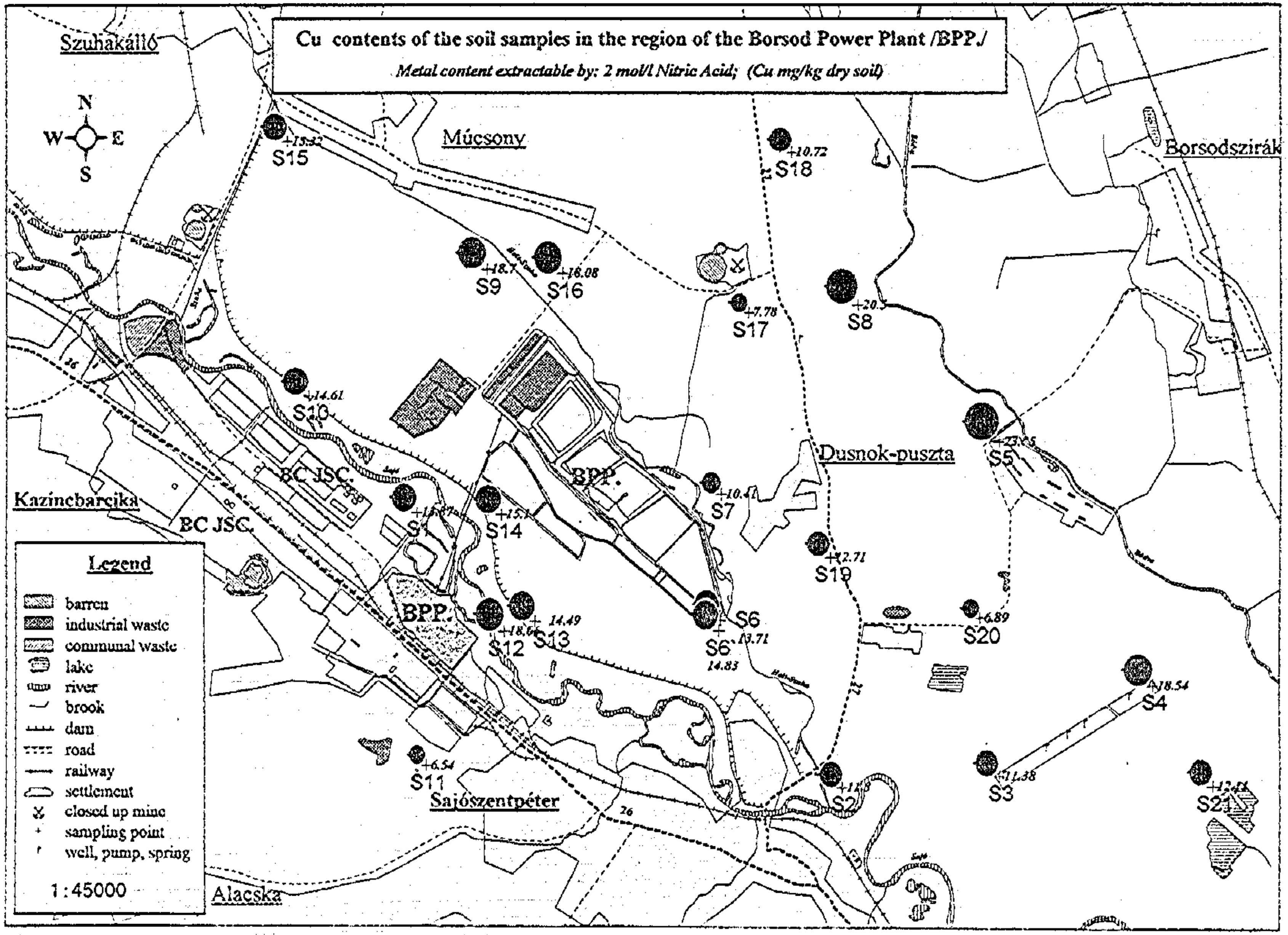


Figure 6.3.36 Cu Contents of the Soil Samples in the Surroundings of Borsod Power Plant

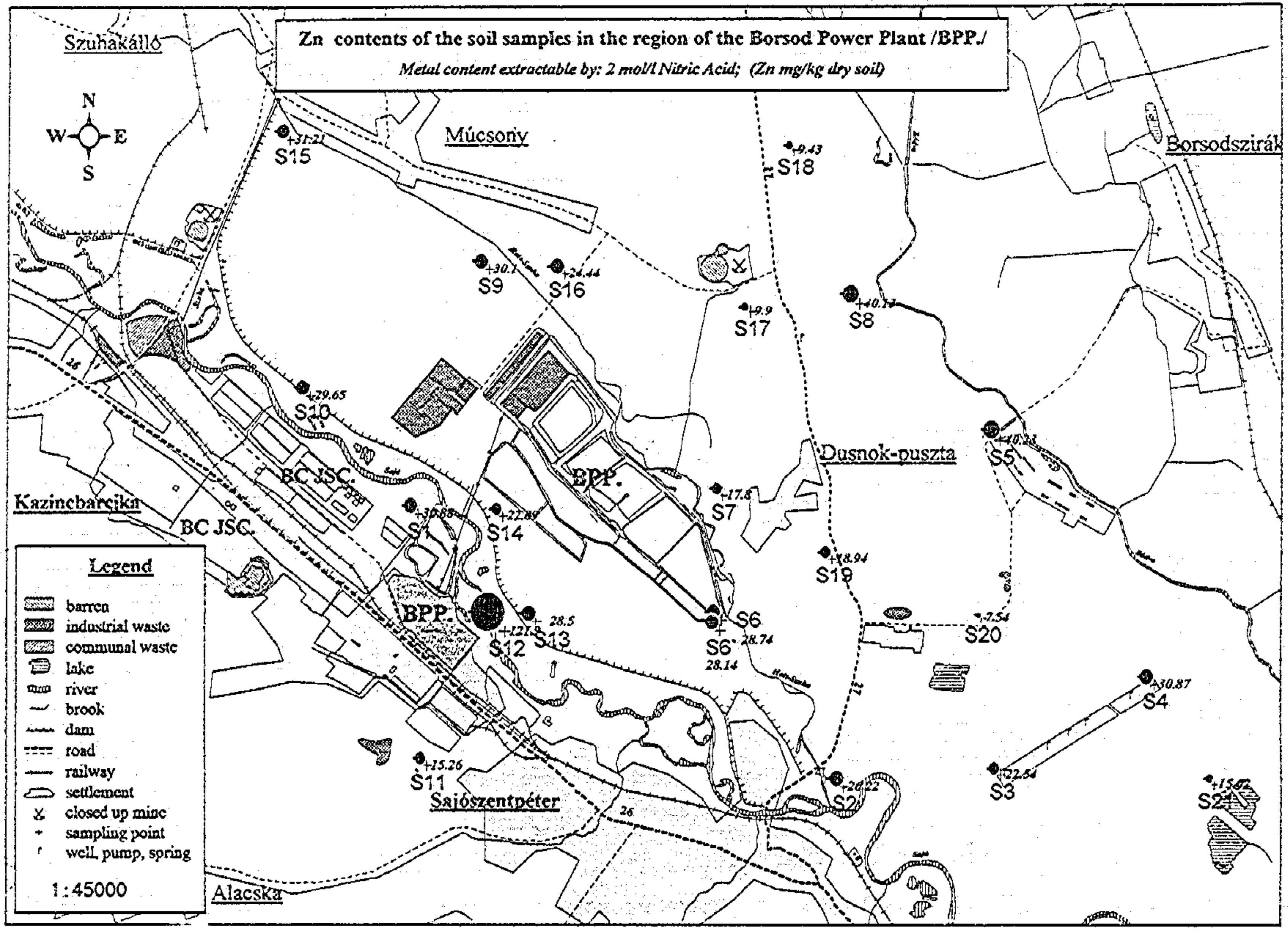


Figure 6.3.37 Zn Contents of the Soil Samples in the Surroundings of Borsod Power Plant

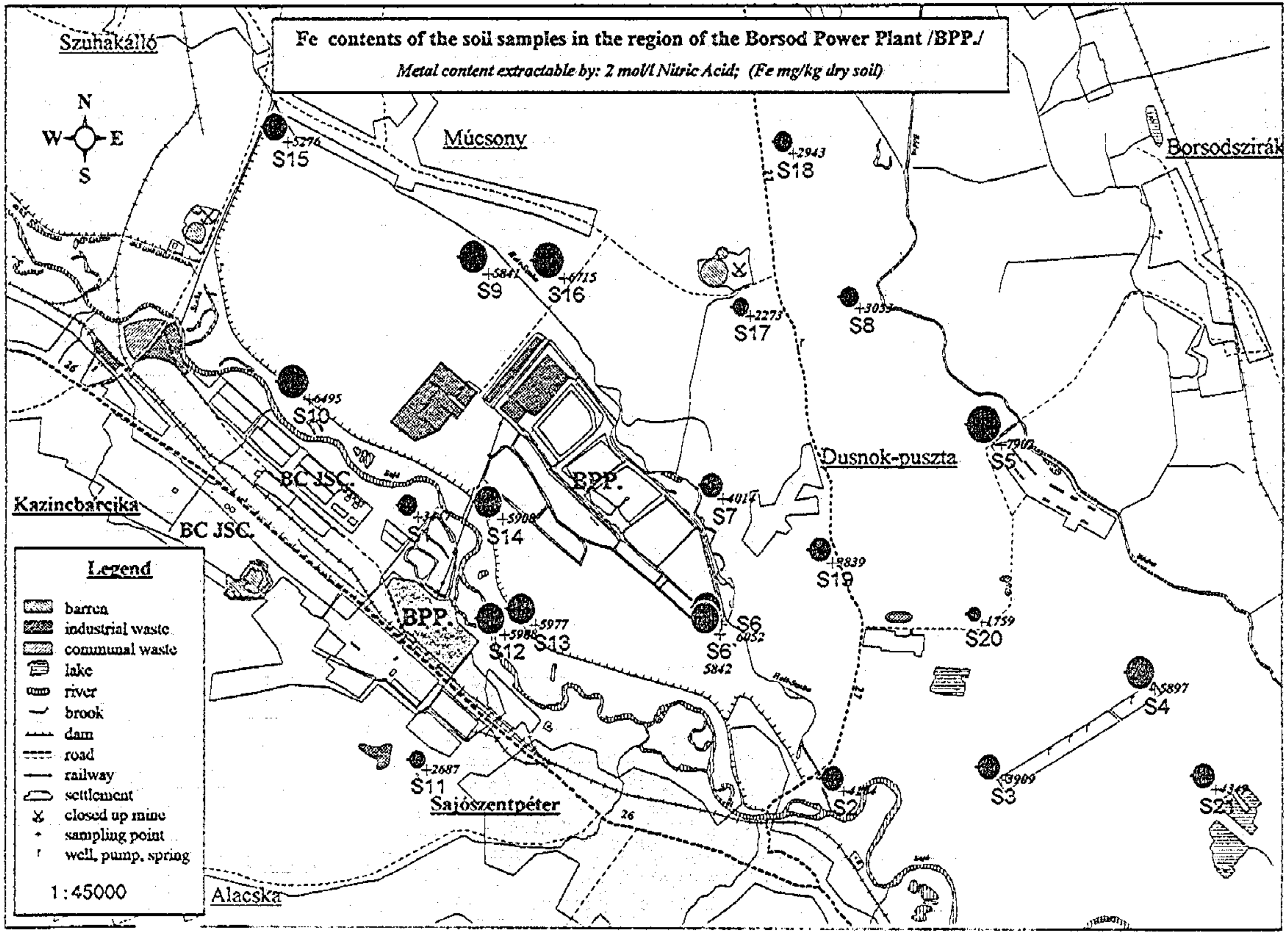


Figure 6.3.38 Fe Contents of the Soil Samples in the Surroundings of Borsod Power Plant

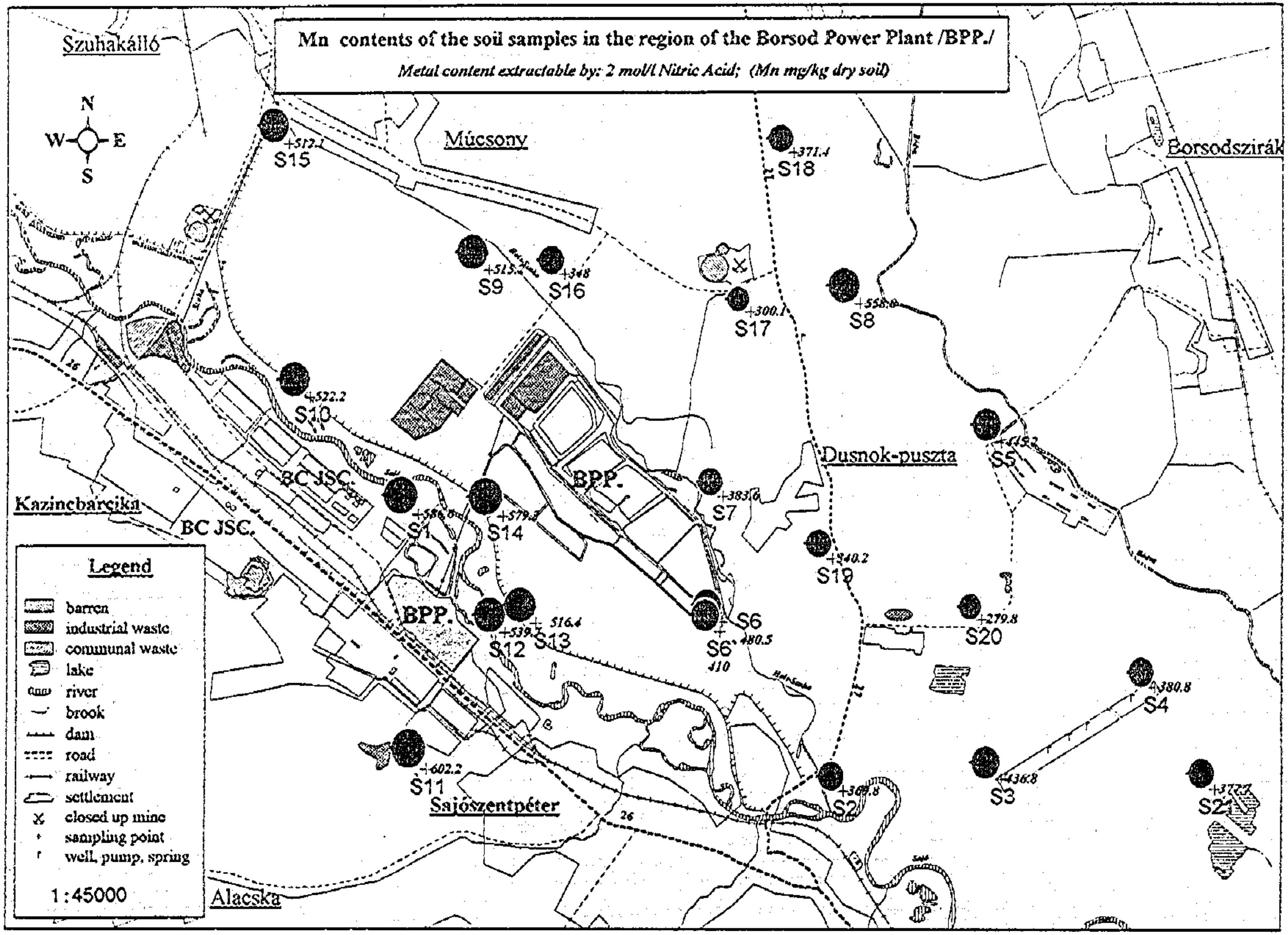


Figure 6.3.39 Mn Contents of the Soil Samples in the Surroundings of Borsod Power Plant

c) Acid decomposition method data

On some lots, As regulatory values applicable by the category of objective substances including soil and groundwater exceed those applicable to the substances contained in soil (for C I, 30 or 50 mg / kg), but such lots are positioned quite close to the facilities of Borsod Power Plant. On other lots, any component has not shown problematic concentration.

d) Existing data evaluation

Figures 6.3.40 through 6.3.43 show the concentration of heavy metals (As, Hg, Cd and Pb) distributed in the soil, based on the data using acid decomposition technique shown in the previously mentioned report (1994) of REC.

Comparing the above data with the data measured by the Study Team, the latter indicate Cd content lower, and As, Cu and Zn content higher while indicating Hg, Mn and Pb content nearly equal. These differences may be caused by difference in analytical methods. It is necessary to take into account the above tendencies.

i) As (Arsenic)

Level of As contamination was relatively higher (5 mg/kg) in Kazincbarcika and Mucsony, but no outstanding level of As was found. Only the sample taken from the dumping site such as sludge storage had an extremely high level of contamination. Because the value of environmental contamination level is much lower than the data of this survey, this value should considered a reference value. Because much As is contained in coal ash, this pattern of contamination distribution may be the influence of the Borsod Power Plants.

ii) Cd (Cadmium)

Level of environmental contamination by Cd exceeded 2 mg/kg at only 2 points in Mucsony. Considering the Cd contents in the coal ash and flue dust, the facilities at Power Plant is not source of contamination.

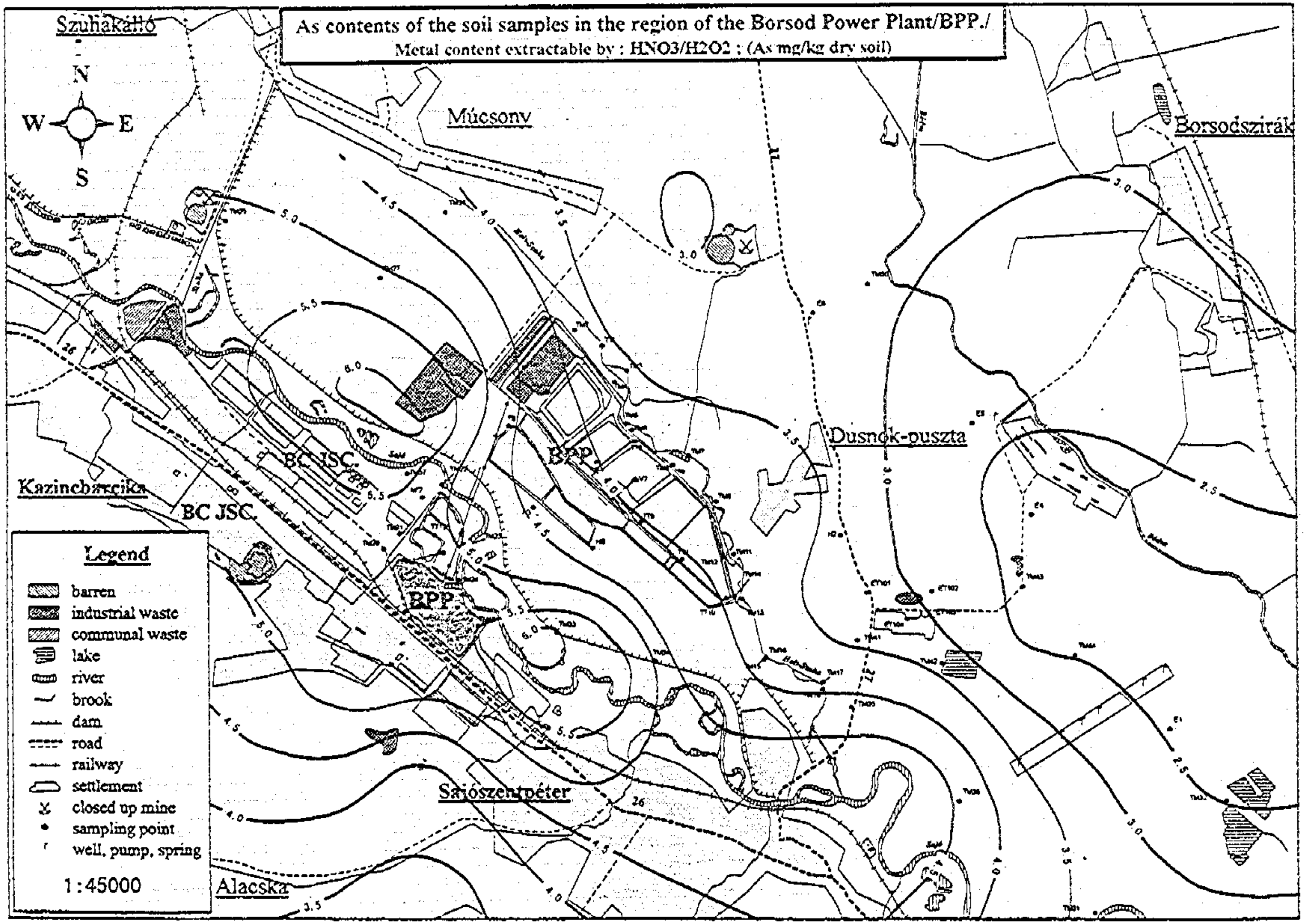


Figure 6.3.40 As Contents of the Soil Samples in the Surroundings of Borsod Power Plant

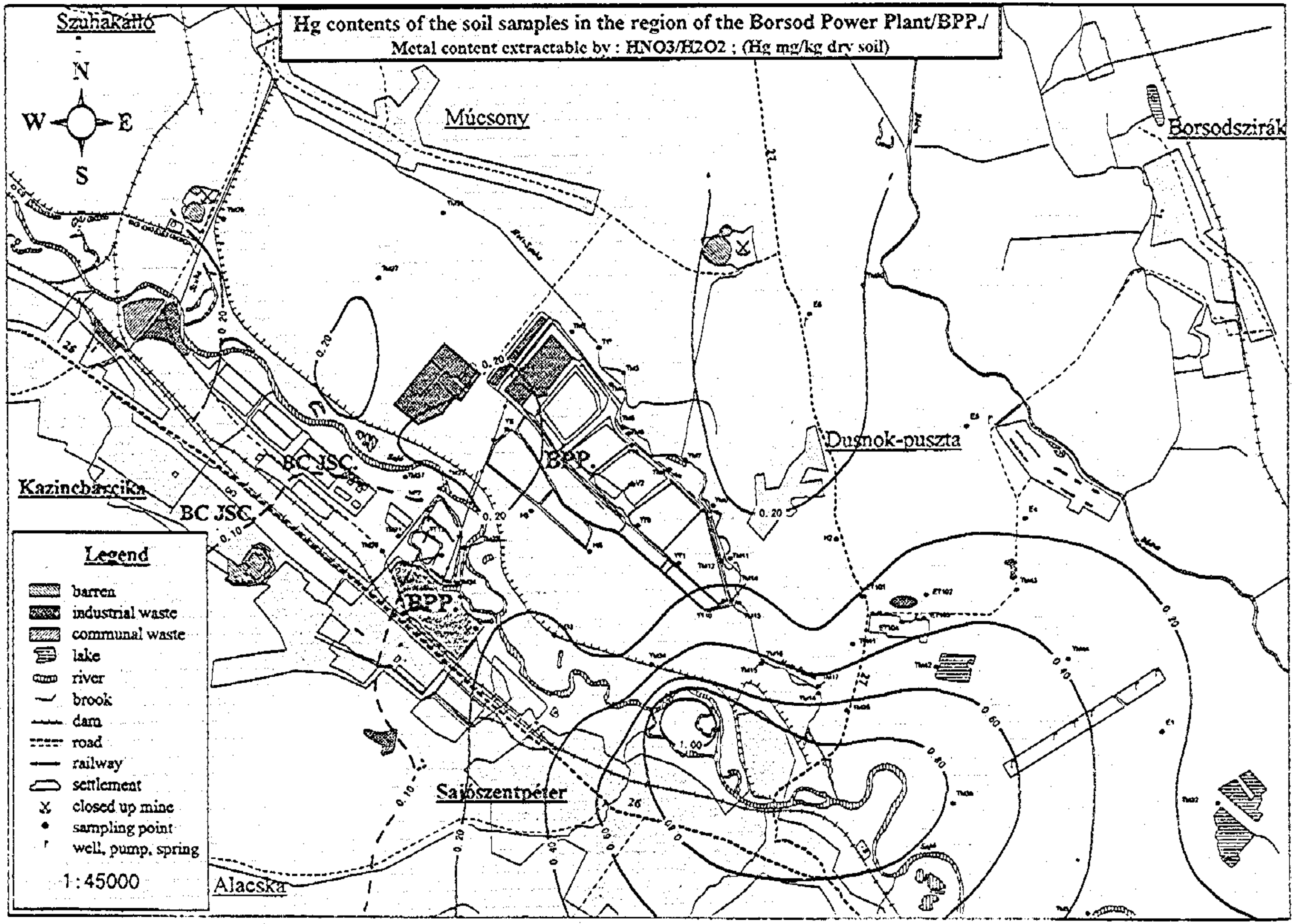


Figure 6.3.41 Hg Contents of the Soil Samples in the Surroundings of Borsod Power Plant

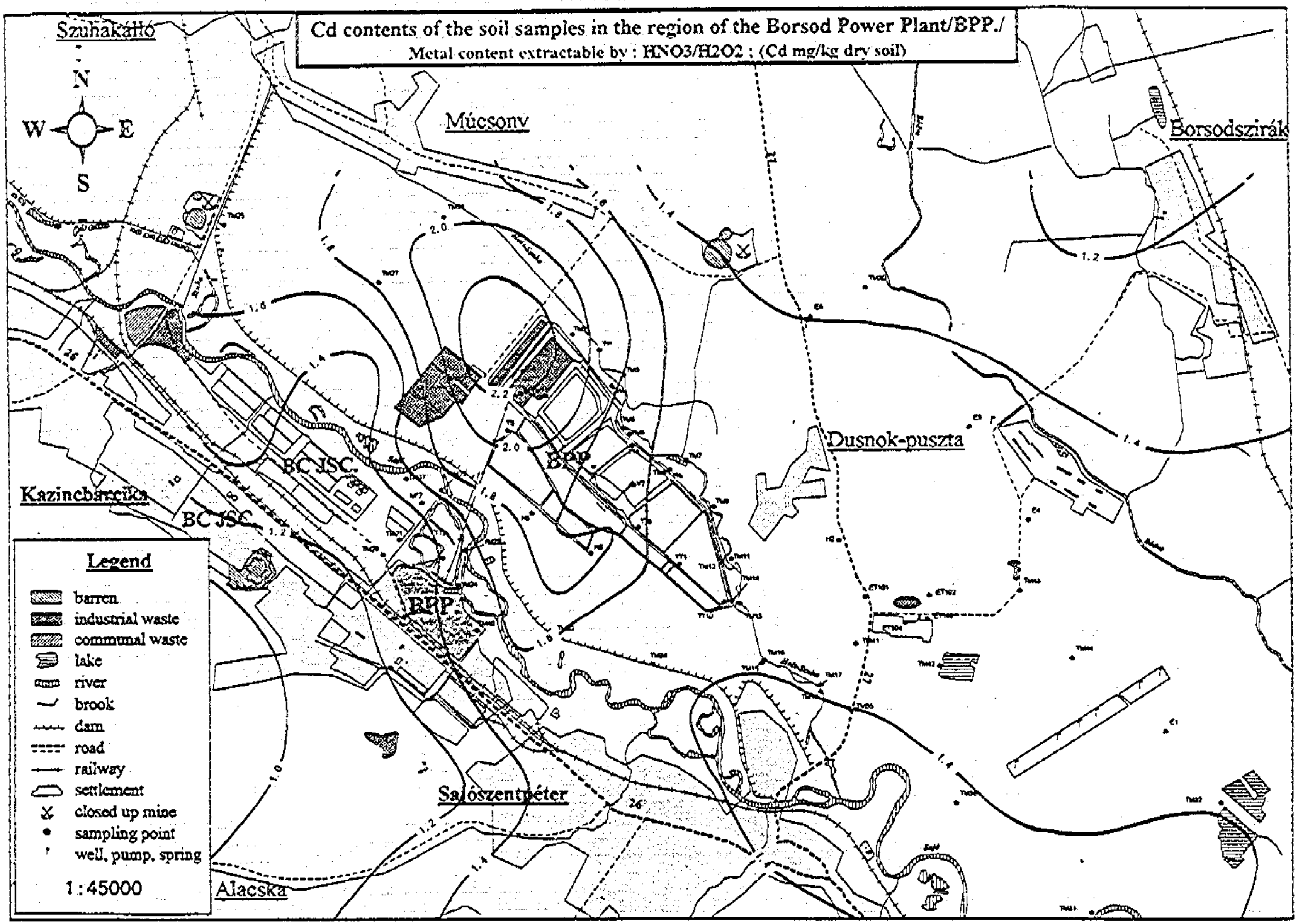


Figure 6.3.42 Cd Contents of the Soil Samples in the Surroundings of Borsod Power Plant

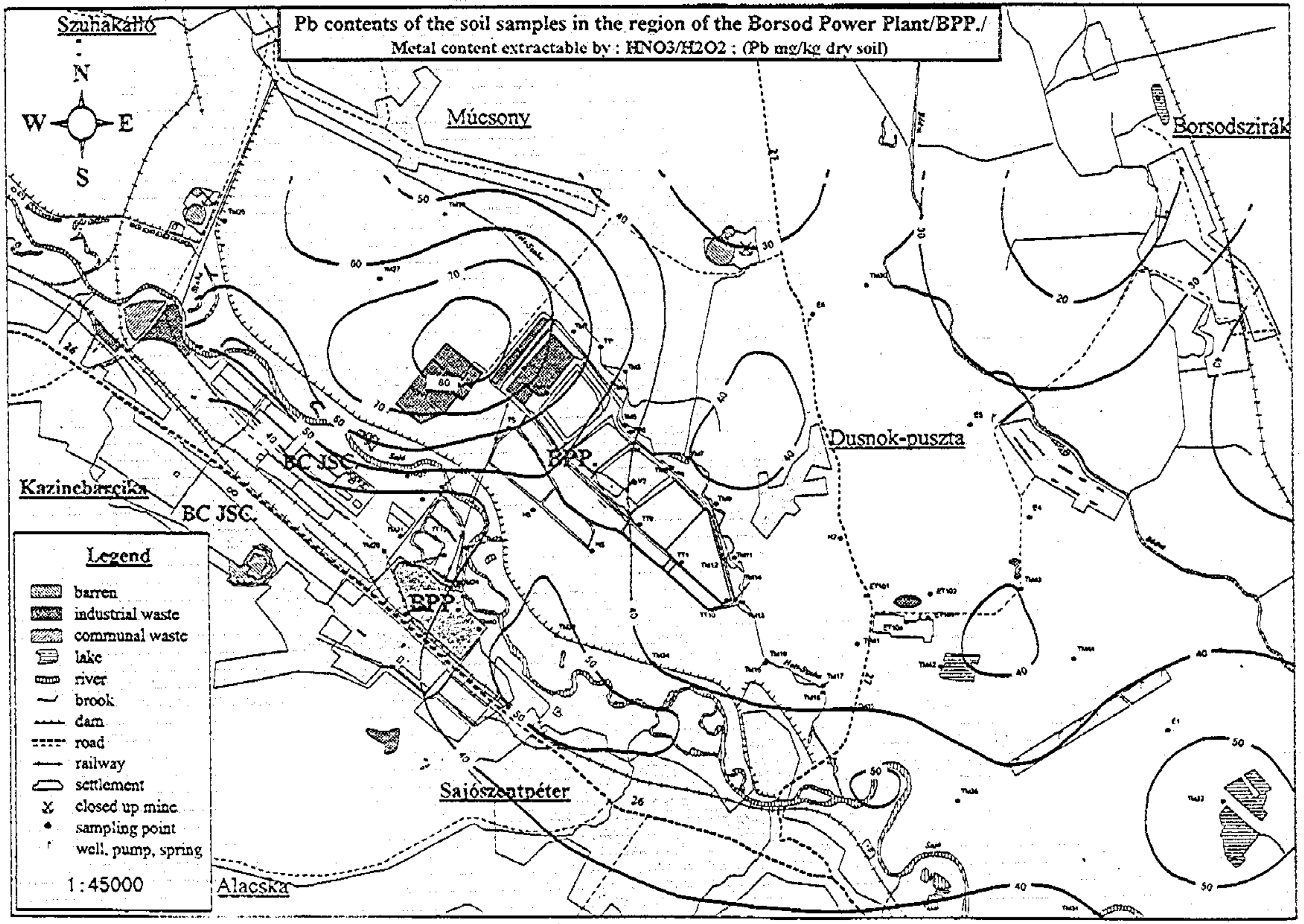


Figure 6.3.43 Pb Contents of the Soil Samples in the Surroundings of Borsod Power Plant

iii) Hg (Mercury)

According to the pattern of Hg contamination, the source is probably Kazincbarcika. Reason of this is that the mercury level is higher at downstream of Kazinobarcika, that high level of Hg has been detected at BVK dumping site, and that the sediment contaminated with Hg due to a flood of Sajo river was mixed with the soil near the Sajo river. However, only several points had the level over 1 mg/kg and the overall level of environmental pollution is not extremely serious. On the other hand, a considerable amount of vapor mercury is discharged from stacks at Borsod Power Plant. Since prevailing wind direction is NNW followed by SSE, attention will be required for the environmental impact of these stacks.

iv) Cu (Copper)

Although the level of environmental pollution is high around the dumping site of industrial waste in Kazincbarcika, no serious contamination has been found.

v) Pb (Lead)

A high level of contamination is found in the industrial area and dumping site of Kazincbarcika and flood basin of Sajo river. This is probably because of automobiles as well as of industrial activities.

6.3.8 Vegetation, Protected Species and Endemic Animals

(1) Outline of survey

For the influence of Borsod Power Plant on natural environment, changes from the past and present environmental situation were surveyed with regard to the central part of Sajo valley taken as the objective, and a proposal was made to recover and create nature from the viewpoint of nature protection.

The survey was conducted based on the field work, data collection, and hearing opinions of native specialists.

(2) Survey areas and Borsod Power Plant

The areas that may be subjected to the influence of Borsod Power Plant is widespread. Even using the experience of the study team so far accumulated, it is difficult to define the areas where the vegetation has been affected or will be affected by Borsod Power Plant. It is also almost impossible to define the degree of the influence on the vegetation. However, it is a fact without doubt that Borsod Power Plant is the largest source.

(3) Influence of Borsod Power Plant on Vegetation, etc.

The details of what Borsod Power Plant has affected or will affect the natural environment in these areas including vegetation are as follows.

1) Construction of Borsod Power Plant

For constructing this Plant, extensive farming land, flood plains along the Sajo river and shrubs were destroyed.

2) Inside and outside coal ash storage areas

Inside coal ash storage areas were mainly farming land and swamps. Outside coal ash storage areas were the farming land located near the Szuha river with vigorous flow at that time. The coal ash storage areas seriously affected the vegetation in the vicinity, and such situation has continued until today.

3) Coal mining

The brown coal consumed in Borsod Power Plant has been furnished from the mines located in the same areas since a long time ago. The brown coal seriously affected the vegetation was that produced by open-cut mining.

4) Air pollution

Borsod Power Plant, one of the most serious sources of air pollution in these areas, has heavily affected the vegetation so far. Until the beginning of the eighties without any EP installed in the Plant, annual discharge of particulate matter and SO_2 was 40,000-60,000 tons and 50,000-60,000 tons, respectively. Although the discharge has decreased so far to 1,000-2,000 tons and about 40,000 tons, respectively, it is still heavily affecting vegetation and animals

5) Influence on the Sajo river

The dams constructed in the Sajo river take in the water as cooling water, and return it to Sajo river as thermal effluent at a temperature of 30-40℃. The thermal effluent is heavily affecting aquatic plants and animals, in particular, when the flow in the river is less.

6) Outside sludge storage

The leachate containing As, SO_4^{2-}, NH_4^+, etc. flows into Sajo River via Holt-Szuha River. The leachate is affecting the vegetation along the Holt-Szuha river.

(4) Present condition of vegetation

Figure 6.3.44 shows the habitats of plants remaining around Borsod Power Plant at present. This proves how seriously the environmental destruction due to artificial development affected the plants and animals.

Natural plants and animals in these areas have disappeared so far to the extent that can be almost called destruction by the social and economic activities. The Supporting Report shows the groups of living plant species.

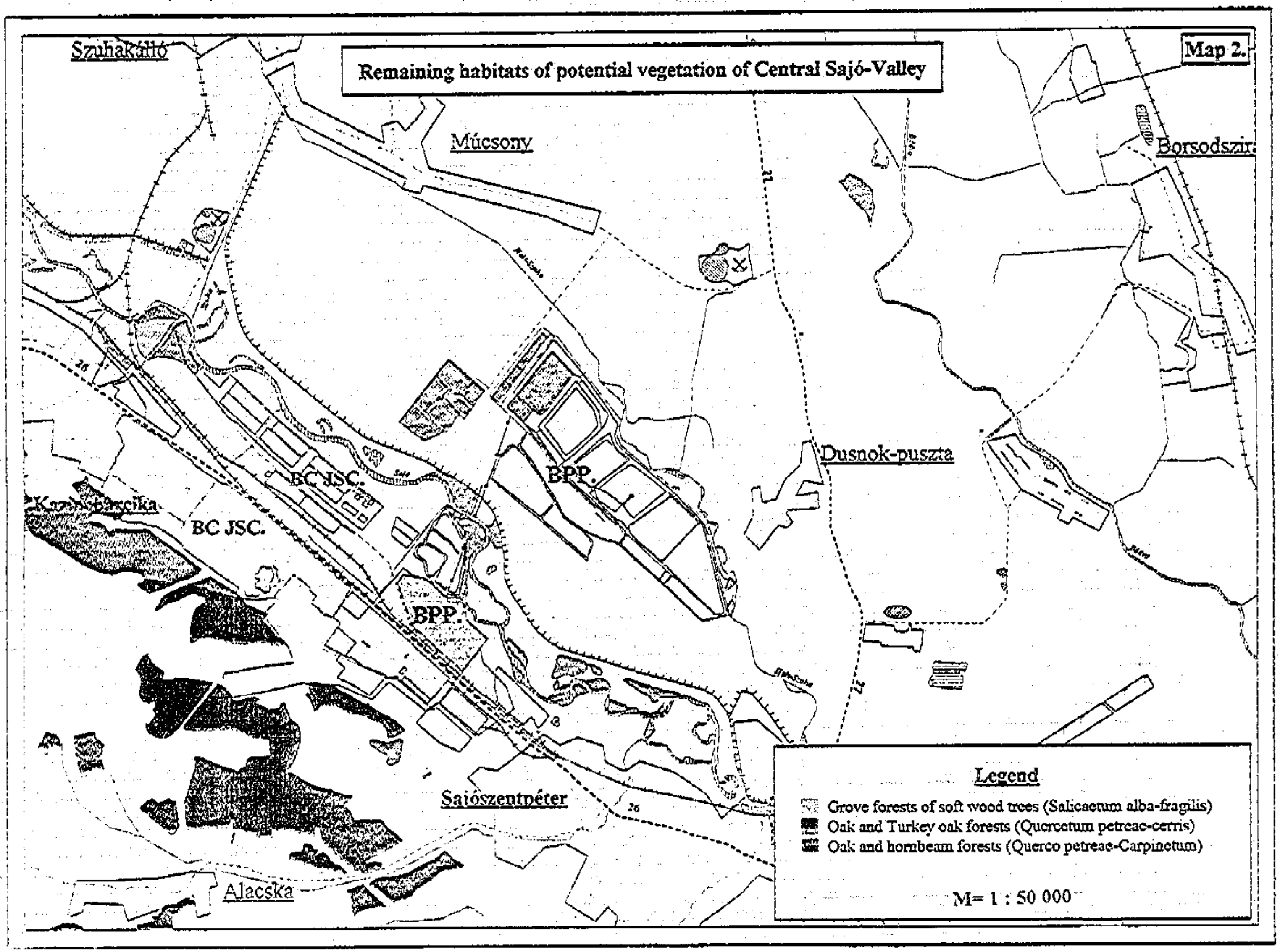
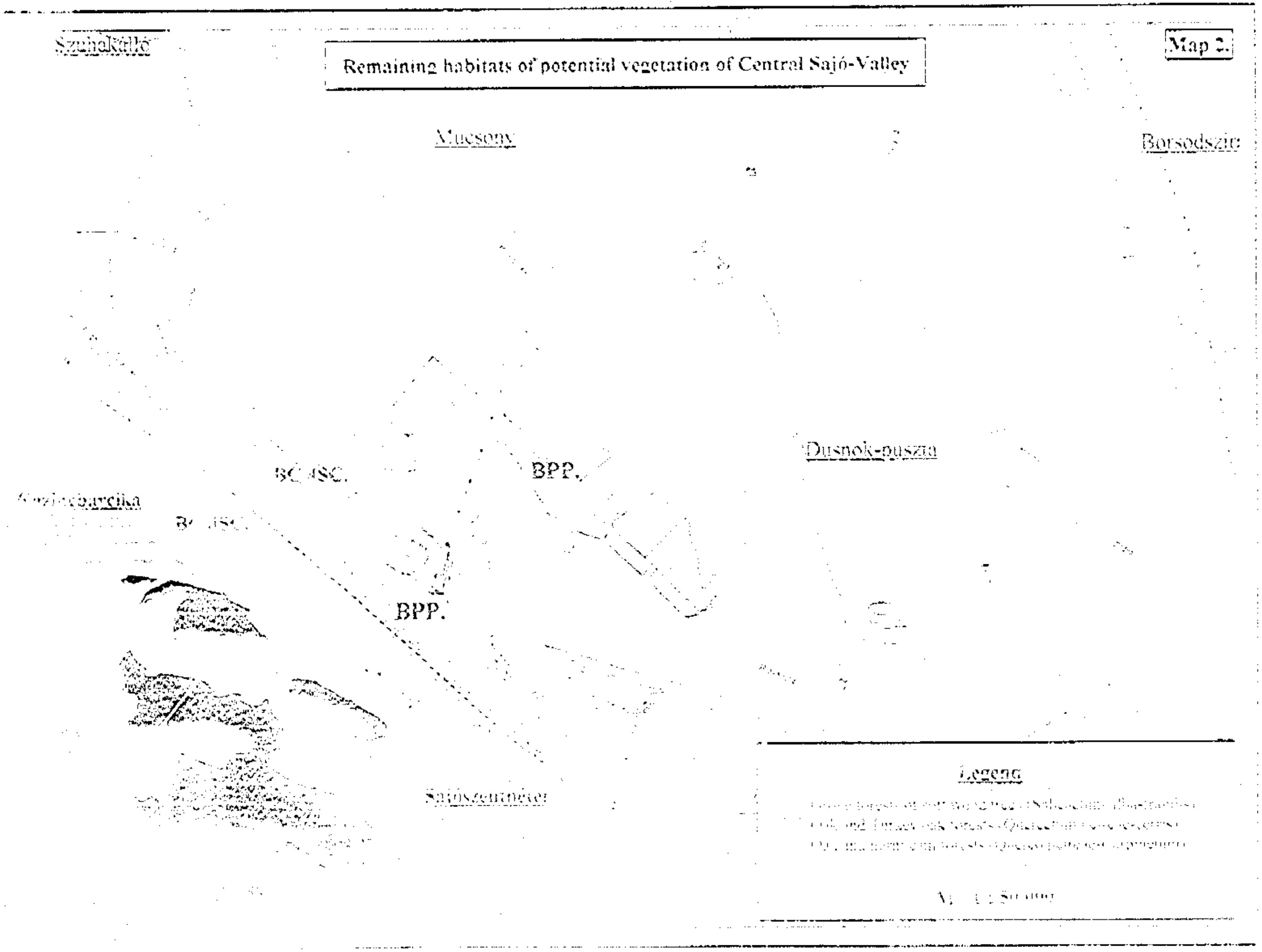


Figure 6.3.44 Remaining Habitats of Potential Vegetation of Central Sajo-Valley


Map 2.
Remaining habitats of potential vegetation of Central Sajó-Valley
Szuhakálló
Muesony
Borsodszir
Dusnok-puszta
BPP.
BPP.
BC/ISC.
Sajószentpéter
Legend

1) Vegetation on hills

a) Forests of oaks and Turkey oaks

The forests of oaks and Turkey oaks on the hills are the most in Hungary located on the hillsides at an altitude of 250-450 m above sea level. These forests cover the valleys along the Sajo river and the hillsides of the tributaries, but have been gradually replaced with farming land, and almost disappeared in the vicinity of Borsod Power Plant. Existing oaks and Turkey oaks can be mainly observed from the high positions on the hills where forest destruction is in progress. According to the native researchers, the main cause of forest destruction is the air pollution brought by the plants and factories located in these areas. Although it is difficult to assess quantitatively the influence of the air pollution caused by such plants and factories, the following changes can be observed including those in the botanical environment.

i) The soil of oak and Turkey oak forests surrounding the industrial areas have been extremely acidified. During the last 20 years, the pH values have fallen by 1.5 to 2.

ii) Natural plants have disappeared or decreased, and have been replaced with those less desirable.

iii) Quercus petraea tends to die and such symptoms can be observed even now.

iv) According to the results of counting the rings of trees, the growth rate has continued decreasing during the last 30 years.

This trend decreases as the forest is located farther from the industrial zone, but can be also found in the areas located far off.

b) Oak and hornbeam forests

These forests can be found on the northern slopes and rear sides in these areas. In the areas where plants and factories are located nearby, the condition is similar to that in oak and Turkey oak forests, the forests located far away are less subjected to damage.

c) Oak forests of tatar maple

These small areas in loess are covered with the community of plants living at a height of 150-200 m. The forests in these areas have completely disappeared due to the use as farming land.

d) Forests consisting of secondary shrubs

These forests have been formed on the areas deforested without reforesting and on ruined farming land, and become dry grassland. In some portions of these areas, the secondary shrubs have been replaced with alien species with higher vital power.

2) Vegetation in flood plains

The main plants found in flood plains are outlined as follows.

a) Oak, ash and elm forests

These forests have disappeared from the areas in alluvial soil located along the Sajo river and the Bodva river basically due to the expansion of farming land and residential land.

b) Soft wood forests

White willow (Salix alba) and black poplar (Populus nigra) were the tree species peculiar to these forests, but most of them have been destroyed by farming land and industrial sites, and replaced with weeds in flood plains or haymaking fields.

c) Willow forests on riversides

Willow forests can be still observed along the Sajo river and the tributaries. In some places, the ground is covered with marshy plants.

d) Reeds

Reeds still remain in these areas, mainly along the Holt-Szuha river. These areas are semi-natural and precious nature protection areas offering the places for living and for obtaining feed for several types of animals.

3) Plants in sludge storage areas and waste dumping areas

Old storage areas where a number of years has elapsed are covered with plants. The composition of the plants depends on the number of years elapsed on each ground.

(5) Present condition of animals

Detailed survey of the animals living in these areas has not been carried out yet. Although sparse data concerning vertebrate animals is available, that of invertebrate animals is unavailable at all. The Supporting Report shows the groups of animal species living in these areas.

1) As a result of the destruction of the habitats mainly for plants and industrial activities, the villages and industrial areas located in the whole neighborhood of these areas take on an aspect of barren land from zoological point of view.

2) The species susceptible to environmental pollution have disappeared and precious species can be no longer observed in these areas.

3) The land animals visually observed by the study team on the spot are certain species of mammals (foxes and rabbits), amphibians and some species of birds. In Hungary, all these species including insects are under the protection of the country.

4) The Sajo river located near Borsod Power Plant became the river of death during the period of violent industrial pollution, and the aquatic life was almost ruined. However, the quality of water has been improved since the beginning of the nineties, and the aquatic life is becoming richer gradually.

(6) Present condition of the influence on nature protection areas

There are two national parks, twenty protection areas and hundred nature protection areas within a circle described with the radius of 25 km from Borsod Power Plant, but no area under special protection is present around this Plant.

Together with other sources, Borsod Power Plant is affecting Aggtelek National Park, Bukk National Park and nature protection areas directly or indirectly by means of the air pollution.

6.3.9 Noise

The noise levels measured in the vicinity of Borsod Power Plant meet applicable environmental standards. BKF laid down the allowable limits of the noise originated from Borsod Power Plant by the law No. 16.632-2/ 1993, taking into consideration the buildings to be protected from the noise. The noise levels and allowable limits in relation to the buildings concerned are as follows.

Measuring point	Noise level(dB)		Limit value(dB)	
	day	night	day	night
The company house of power plant's guard	44	42	57	47
The power plant's employee lodgings	46	45	55	45
The reformatory	45	44	55	45

6.3.10 Vibration

So far any pollution caused by the vibration from Borsod Power Plant has not arisen. Vibration becomes problematic when any construction work is carried out.

6.3.11 Present Condition of Air Pollution Sources

Outlined present condition of the air pollution sources is as follows. The details are shown in Section " 6.5 Environmental Impact Assessment" and the Supporting Report.

(1) Stationary Sources

Based on the discharge of air pollutants from the stationary sources located within a circle described with the radius of 20 km from Borsod Power Plant, it may safely be said as follows.

1) The most of SO_2 (about 95%) is produced by Borsod Power Plant. However, the ratio of contribution to ground concentration far lower.

2) When the data concerning annual discharge is compared between 1993 and 1995, the discharge of both SO_2 and NOx from Borsod Power Plant increased. Particularly, the increase in NOx is remarkable. On the other hand, the trends in other sources show that SO_2 was on the same level, and NOx decreased. However, from the results of examining the data, the Study Team estimated that both SO_2 and NOx remained on the same levels.

(2) Automobiles

1) On the national roads, the number of trucks decreased in 1995 compared to that in 1990, but the total volume of traffic remained almost unchanged.

2) As far as the number of automobiles registered by the car family is concerned, the number of automobile with larger emission factors decreased and that with smaller emission factors increased. The total number of automobiles registered tends to increase.

3) Dieselization of small-sized automobiles in rapid progress in recent years. On the other hand, the total discharge remains almost same without substantial change.

(3) Area Sources

Area sources shall include small-scale stationary sources and traffic on narrow streets in addition to those of consumers.

1) Fuel conversion from solid fuel to natural gas for domestic heating is in progress gradually.

2) It is estimated that the discharge of SO_2 and NOx emitted from small-scale stationary sources and traffic on narrow streets remains same without remarkable change compared to that in 1993.

3) As a whole, the discharge of SO_2 and NOx accelerates the increase in the number of dieselized small-sized automobiles. There is no substantial change in the discharge at this stage, but decrease in the discharge can be expected in the future.

6.3.12 Emission from Borsod Power Plant and Others

(1) Emission from Borsod Power Plant

The level of pollutants in the exhaust gas is already found in the previously mentioned JICA's study (1993), but two more surveys were carried out as well as the survey on the level of air pollutants to improve the analysis precision. In the exhaust gas survey, special pollutants including vapor Hg and vapor As in the flue gas were studied.

1) Survey Period

Autumn : Oct. 29 - Oct. 31, 1996
Winter : Jun. 20 - Jun. 22, 1997

2) Surveyed Source

Boilers No.2 - No.4 at Borsod Power Plant

3) Analyzed Parameters and Analytical Methods

Measured items and methods are described below. Since regulations are to be established for emission of chloride and fluoride, these chemicals were also measured. Flue gas in each boiler is distributed to two flue ducts before EP each of which is provided with measurement inlets. Accordingly, duct at both inlets (the total of inlets is six) was analyzed. NOx, SO_2, CO, CO_2, O_2, Hg, As, chlorides and fluorides were sampled at one place only.

SOx	: Non-dispersive infrared absorption method (NDIR)
NOx	: Chemiluminescence detecton method (CLD)
CO	: Non-dispersive infrared absorption method (NDIR)
DUST	: Isokinetic sampling method (JIS Z 8808) Temperature and velocity of exhaust gas were measured simultaneously.
Combustion parameters	: O_2 and CO_2 concentrations
Vapor Hg	: Impinger absorption-atomic absorption spectrophotometry (AAS)
Fume As	: Impinger absorption-atomic absorption spectrophotometry (AAS)
Chlorides	: Impinger absorption-spectrophotometry (UV-Vis)
Fluorides	: Impinger absorption-spectrophotometry (UV-Vis)

Slug, ash from economizer, and Hg and As in EP ash were analyzed as the specified pollutants of the dust. Analysis was carried out with water extraction and 2M-acid extraction methods, following the standard method in Hungary. Hg and As of the flue gas in dust were also checked as well as those in vapor form.

4) Survey Result

The survey result of the exhaust gas from boilers is shown in Tables 6.3.19 and 6.3.20. Analysis results of Hg and As in slug and fly ash are shown in Table 6.3.21. Table 6.3.22 shows the result of the exhaust gas measurement in the previous JICA study in the Sajo Valley area.

The result of exhaust survey is as follows:

a) Comparison of exhaust gas volume and level from each boiler with data in 1993 shows a similar value although some fluctuations are seen.

b) In terms of O_2 and CO_2 levels, combustion control has improved since 1993.

c) Most of Hg in the flue gas turned into vapor. Only a little Hg is contained in the dust. Contrary to Hg, almost As is contained in the dust. No fume As requires consideration.

d) Levels of chlorides and fluorides were sufficiently lower than the emission standard (HCl: 200 mg/m^3, F: 30 mg/m^3).

e) Levels of Hg elusion from slug and fly ash on average showed no significant difference among sample types of water extraction and 2M-acid extraction methods. The amount of As contained in EP fly ash was several times as much as that in slug or economizer fly ash. The ratio of extracted As with 2M-acid extraction method against that with water extraction was larger than the case of Hg. The cause of high As level in EP fly ash is probably the evaporated As during the combustion process of fuel coal which then is cooled down and collected EP with fly ash. The level of As extracted with water need sufficient countermeasures.

Table 6.3.19 Results of the Boiler Measurement

Date : 29~31, Oct., 1996 (Autumn Season)

Item		Unit	Number of Boilers		
			No.2	No.3	No.4
Gas Temp.		℃	178	187	170
Dry Exhaust Gas		m^3N/h	157010	176267	177508
Comcentration of Exhaust Gas	SO_2	mg/m^3	3923	5454	5152
	NOx	mg/m^3	370	369	334
	CO	mg/m^3	22.6	23.7	24.5
	CO2	%	9.85	9.05	8.2
	O2	%	9.5	10.5	11.6
	Dust	mg/m^3	43.2	187.5	104.5
	Hg (Steam)	mg/m^3	0.0021	0.0020	0.0015
	Hg (Dust)	mg/m^3	0.0003	0.0004	0.0003
	As (Steam)	mg/m^3	$<$0.0004	0.0003	$<$0.0003
	As (Dust)	mg/m^3	0.1477	0.6569	0.5040
	Cl	mg/m^3	19.8	21.9	26.7
	F	mg/m^3	19.9	24.6	18.1
Emission	SO_2	kg/h	617	961	914
	NOx	kg/h	58.1	65.1	59.3
	CO	kg/h	3.55	4.18	4.35
	Dust	kg/h	6.78	33.0	18.6
	T-Hg	kg/h	0.00038	0.00042	0.00032
	T-As	kg/h	0.023	0.116	0.090
	Cl	kg/h	3.10	3.86	4.74
	F	kg/h	3.12	4.34	3.21

Table 6.3.20 Results of the Boiler Measurement

Date : 20～22, Jan., 1997 (Winter Season)

Item		Unit	Number of Boilers		
			No.2	No.3	No.4
Gas Temp.		℃	168	179	167
Dry Exhaust Gas		m^3N/h	132555	147914	169080
Concentration of Exhaust Gas	SO_2	mg/m^3	7049	5235	4411
	NOx	mg/m^3	412	401	337
	CO	mg/m^3	20.2	28.5	44.5
	CO2	%	10.65	8.65	8.05
	O2	%	9.02	10.7	11.5
	Dust	mg/m^3	187.1	326.5	149.5
	Hg (Steam)	mg/m^3	0.0032	0.0021	0.0018
	Hg (Dust)	mg/m^3	0.0004	0.0000	0.0001
	As (Steam)	mg/m^3	0.016	0.0085	0.0055
	As (Dust)	mg/m^3	0.3117	0.4177	0.4713
	Cl	mg/m^3	6.96	25.2	11.6
	F	mg/m^3	14.0	12.4	11.2
Emission	SO_2	kg/h	934	774	746
	NOx	kg/h	54.6	59.3	56.9
	CO	kg/h	2.68	4.22	7.52
	Dust	kg/h	24.8	48.3	25.3
	T-Hg	kg/h	0.00048	0.00032	0.00032
	T-As	kg/h	0.043	0.063	0.081
	Cl	kg/h	0.923	3.73	1.95
	F	kg/h	1.86	1.84	1.89

Table 6.3.21 Analysis Results of As in Slug and Fly Ash

SAMPLE IDENTIFICATION	METHOD OF DISSOLUTION	NUMBER OF BOILERS		
		Hg [mg/l]		
		2	3	4
SLAG	WATER	0,0006	0,0005	0,0007
	ACIDIC	0,002	0,0034	0,0031
ECO FLY ASH	WATER	0,0009	0,001	0,0007
	ACIDIC	0,0013	0,0022	0,0024
EP FLY ASH	WATER	0,0009	0,0009	0,0007
	ACIDIC	0,0027	0,0022	0,0027
		As [mg/l]		
SLAG	WATER	0,018	0,014	0,024
	ACIDIC	5,65	5,8	6,9
EP FLY ASH	WATER	0,052	0,046	0,067
	ACIDIC	6,9	8,55	9,9
EF FLY ASH	WATER	0,309	0,141	0,165
	ACIDIC	39,1	21,5	34,0

COMMENTS:

- AT EVERY CASE 10 g OF DRY SAMPLE WAS SOAKED IN 90 ml OF SOLVENT FOR 24 HOURS
- THE ACID WAS 2M NITRIC ACID
- IN CASES OF SOAKING BY WATER THE pH OF THE SAMPLE BECAME BASIC BECAUSE OF THE LIME CONTENT.

Table 6.3.22 Result of the Exhaust Gas Measurement in the Previous JICA Study

Item \ Boiler No		No1 Boiler	No3 Boiler	No4 Boiler
Concentration of Emission Gas	SO_2 (mg/m³)	5760	6400	4520
	NOx (mg/m³)	259	374	329
	CO (mg/m³)	31	38	75
	Dust (g/m³)	0.50	0.21	0.14
	O_2 (%)	13.5	11.6	12.6
	CO_2 (%)	5.6	7.6	6.2
Emission weight	SO_2 (kg/hr)	1400	1090	868
	NOx (kg/hr)	62.9	63.9	63.1
	CO (kg/hr)	7.59	6.41	14.4
	Dust (kg/hr)	120	40	27
Current	(m/s)	17.8	14.1	16.0
Gas Temperature	(℃)	159	173	205
Dry Emission Gas	(m³N/h)	243000	171000	192000
Fuel Consumption	Natural Gas (m³/hr)	1100	1500	1300
	Brown Coal (t/hr)	*36.80	*35.91	*33.78

Note :* Estimated

(2) Heavy Metal Contents of Coal

Analysis was carried out on heavy metals in Lyuko coal.

Considering that the contamination of groundwater by heavy metals (including As) in coal ash has already been found and that the Hungarian coal contains As, Hg, etc., analysis of heavy metals in coal ash is necessary for the environmental assessment. Vapor Hg and As which are produced during combustion were also analyzed. Dubicsany coal has not been exploited and therefore was not available for analysis.

1) Analyzed metals

Hg, As, Cr, Fe, Cu, Zn, Mn, Ni, Pb, Cd (including vapor Hg and vapor As produced during combustion)

2) Methods of combustion test and analysis

a) Combustion test

Temperature of combustion tube in the test equipment was maintained at 800 °C. A measured amount of coal in a ceramics port was inserted quickly, then burned with constant air supply. Remaining ash was analyzed for heavy metals.

b) Analytical method

i) Preparation of sample solution: Coal ash was decomposed by acid decomposition method to prepare the sample solution. Sample coal was also decomposed directly.

ii) Heavy metal analysis

Atomic absorption spectrophotometry was used. For analysis of vapor Hg, coal was burned in a combustion equipment at 800 °C, then exhaust gas was directly analyzed with a Hg analyzer. The As in combustion gas was collected in a impinger by water absorption method, then analyzed with atomic absorption spectrophotometry.

3) Results of analysis

The results of heavy metal analysis in coal and coal ash are shown in Table 6.3.23 respectively. Vapor As adhered to the silica tube of the combustion equipment and therefore was below detection limit (ND). These results of the analysis with acid decomposition method and other methods allow the following observation:

a) Comparing the level of Hg in coal and that of vapor Hg produced during combustion, most of Hg turns into vapor during combustion at 800 °C.

b) Comparing As levels in coal and coal ash, approx. 70% of As is becoming vapor.

c) A large ratio of Cd diffuses into atmosphere through combustion, followed by Cu and Ni.

d) The level of heavy metals, particularly As, contained in coal ash was low as that obtained by acid decomposition method, but consideration must be given to the fact that most of As contained in fuel coal turns into fume and exhausts. Analysis results of Hg and As (with water extraction and 2M-acid extraction methods) in slug and fly ash shown in Table 6.3.21 therefore must be referred to.

e) Overall contamination level of each contaminant was relatively low. Ash content was also low as that of Lyuko coal. Therefore, it is necessary to pay attention to the handling of data.

Table 6.3.23 Results of Heavy Metals in Coal and Coal Ash

Acid Digestion (Unit : mg /kg, Coal)

Component	Coal			Ash		
	Boiler No. 2	Boiler No. 3	Boiler No. 4	Boiler No. 2	Boiler No. 3	Boiler No. 4
Ash content (800℃ ashing)	32.8%	36.4%	33.6%	-	-	-
Vapor Hg	-	-	-	0.174	0.130	0.154
Hg	0.190	0.168	0.214	-	-	-
As	2.523	1.476	4.430	2.556	1.709	1.628
Cu	9.637	8.762	9.769	13.08	12.63	14.06
Zn	19.98	21.85	25.22	35.81	42.52	38.67
Pb	7.693	12.350	7.060	17.94	22.34	17.87
Cd	0.7858	0.6599	0.7632	ND	ND	ND
Cr	4.839	4.692	5.113	13.12	14.31	14.90
Mn	93.76	90.44	93.68	186.1	195.4	205.2
Fe	10588	8974	11112	16554	17490	19002
Ni	10.84	7.295	8.777	13.51	13.65	14.65

Note : Vapor Hg Analysis Data by JEAC-880 Hg Micro Analyzer

Cd ND → <0.04

6.4 Initial Environmental Examination

The Study Team collected and reviewed past environmental examination results for the study of the influences of the proposed project on the environment.

With additional exsting data and the result of on-site surveys, environmental impacts of the proposed project were carefully studied.

The important environmental items for the initial environmental examinaiton (IEE) are shown in Table 6.4.1.

(1) Social Condition

Borsod Power Plant is located at the area (Kazincbarcika , Sajoszentpeter, Mucsony, Berente) where factories and residential areas have coexisted. About 1500 meters to the north from the Power Plant, there exists a spacious sludge area. Around the sludge area, many farmlands, fields, grazing lands, and pastures exist.

Borsod Power Plant constructed under on these condition of location, is situated in the area designated as a industrial zone earlier from the regional administration. The Study Team considers the environmental impacts to arise, which affect the social condition, from the installation of the Power Plant's new boiler and renovation of the existing facilities, are so small as to be not substantial; except the influence, in the course of construction, to the traffic, which calls for attention.

Regarding the influence relevant to the traffic there , there is a rail road crossing on the access route from No.26 main road to the entrance of the Power Plant. And when the rail road crossing is closed, it will sometimes take more than 10 minutes before it is reopened. Accordingly, it is necessary to review whether the installation of the new access route to the Power Plant is indispensable to or not.

(2) Natural Environment

As for the natural environment, it is necessary to investigate the impacts on such items as protected living creatures, ecosystem, the configuration of lands, soil, hydrology, water quality, and air quality.

Table 6.4.1 Important Environmental Items Selected in IEE

Item of environment		Cause	Present situation, affect on environment and assessment	Decision	Ground of decision	Cautions
Social condition		Reconstruction of a power plant	Accepted due to the location in an industrial area	×	The power plant was constructed in designated industrial area in earlier stage, and the influence on the social condition is negligibly small.	Take necessary consideration for the influences on the traffic during construction
Natural Environment	Precious species and endemic animals	Gas exhausted from flues	Affected by atmospheric pollution	×	It is not said that special species or endemic animals are present in the neighborhood	-
	Vegetation	Gas exhausted from flues or sludge storage areas	Affected. Countermeasures should be taken	△	Disappearance of vegetation by factory development and exhaust gas Impact by thermal effluent and ions	Also take care of National Parks and natural protection areas
	Pollution of ground water	Sludge storage or waste water reservoirs	Pollution is in progress in ground water	○	It is necessary to prevent the influence on the tap water sources	Take into consideration the wells used by the residents as well as other sources of pollution
	Changes in flow and levels in water areas	Water from Sajo River is used as coolant	Plants living alongside the river are being affected	△	The influence will not disappear unless necessary countermeasures are taken.It is absolutely required to take necessary countermeasures	-
	Changes in water temperatu-re in water areas	Ditto	River plants are affected by thermal effluent	△	Ditto	-
	Air pollution	Gas exhausted from flues Sludge storage places	Obvious influence of As, SO_2, NOx and SPM on the environment	○	It is necessary to propose the countermeasures to avoid the influence on the environment	Vapor mercury should be also taken into consideration
	Water pollution	Water leaking from rainwater piping or sludge storage places	Causing water pollution in Sajo River but light	△	Drainage from rainwater piping must be partially improved Leakage of water can be solved by preparing sludge storage areas	-
	Soil pollution	Ashes scattering from fly ash and sludge storage areas	Some areas are polluted by As	○	It is necessary to propose the countermeasures to prevent the pollution	Take into consideration the pollution by the heavy metals from the sources other than those from power plant
	Noise	Noise caused by facilities and works in during construction	Present noise does not exceed the limit	×	It is possible to take the countermeasures to prevent the occurrence of noises	Take into consideration the working environment
	Vibration	Vibration cause by facilities and works in during constriction	Ditto	×	It is possible to take the countermeasures to prevent the occurrence of vibrations.	The occurrence of vibration must be avoided in particular during construction
	Odor	Combustion of coal	Bad smell caused by the power plant has not invited any serious problem	×	It is unnecessary to take any countermeasure	—

Note : ○ Detailed survey of environmental influences and proposal of countermeasures are necessary.

△ It is necessary to examine the measures taken for mitigating the influences on the environment.

× It is necessary to take these facts into consideration but the effect on the environment is negligibly small.

1) Protected and endemic plants and animals in the region

This region is not included in the nature conservation area subject to the Ramsar Convention (Convention of Wetlands of International Importance). No protected and endemic plants and living creatures exist in the vicinity of the Power Plant.

2) Vegetation

The Power Plant, constructed 40 years ago, uses Borsod coal whose sulfur content is high, and has no desulfurization equipment resulting in the continued SO_2 pollution affecting the regional vegetation. Adding to that, seasonal gusts would blow away coal ashes from the sludge storage area which would also affect regional environments.

There exist farm lands near and around the residential and industrial factory area. And vineyards, orchards, private vegetable gardens, and forests is on the slope which surrounds the town. Consequently, though it depends upon what direction the wind blows, the living creatures and plants in the area might be under the influence of the high concentration of SO_2 in the exhaust gas. To the south west and the north far away from the Power Plant, there exist national parks called Bukk-Eger and Aggtelek-Josvafo. These national parks might be under the impact of the exhaust gas, depending on the meteorological conditions.

At the same time, attention must be paid to the possible progress of groundwater pollution and soil pollution with sulfur, namely acidification.

On the other hand, the significantly improved water quality of Sajo River comparing to that in the past, has been confirmed recently, because of the inactive factory operations owing to the stagnant economy around the area and the recognition of the importance of considerations toward the environment. However, discharge of thermal effluent has continued to give some impacts to the flora in and around the Sajo River, especially in summer when the water level of Sajo River is comparatively low.

Accordingly, the following countermeasures are considered to be necessary to mitigate the environmental impacts to the region.

a) Against air pollution, it is necessary to take measures which would achieve not only the emission standards but also the environmental standards. That is possible by changing fuels of existing boilers, installing desulfurization equipment and choosing the CFBC boiler for the new unit.

b) With regard to the thermal effluent, the cooling water re-circulation system, which the Power Plant is now examining its installation, must be applied.

c) On the acidification of soil and groundwater, acid rain and acid gas can be considered to have influenced, but it is necessary to analyze its mechanism and, if necessary, take some kind of measures.

d) In order to prevent the ashes of the sludge storage area from scattering by wind, the measures such as soil covering, and plant cultivation (by planting grass or tree) etc. are indispensable in the sludge storage area.

3) Groundwater pollution

It can be said that there exists groundwater pollution by ion such as As, Cl^-, SO_4^{2-} etc. In order to protect the source of drinking water at Borsodszirak and farm lands, it is necessary to recognize the existing state of groundwater pollution; how it is prevailing and to what extent it is expanding, referring to the checking list of pollution items, and then point out the source of pollution. Thus, the countermeasures against the source of groundwater pollution and the regions where has been contaminated must be made.

The source of the groundwater pollution is not only the Power Plant facilities such as sludge storage area, the pond of standby reservoir, but also the industrial waste repository of Borsodchem Co. and others.

Regarding to countermeasures against these pollution, the thick sludge system, which has been reviewed at Borsod Power Plant, impermeable sheets method, various water protection methods, and its combined application of these methods may be possible to apply to these groundwater pollution. Regarding to groundwater pollution by heavy metals, the pollution from Borsod Power Plant is caused only by As.

Relating to groundwater pollution, it is necessary to propose the countermeasures in order to relieve and protect the environmental impacts, after monitoring, surveillance of environmental impacts and its assessments in advance.

4) Rivers

The water level data of Sajo River were as follows:

Lowest level	:	122.22 mBf	40 cm (1952, Aug.16)
Highest level	:	125.12 mBf	330 cm (1974, Oct. 22)
Monthly average lowest level	:	122.26 mBf	44 cm (1952)
Monthly average highest level	:	124.02 mBf	220cm (1976)
Average flow rate of 1968 - 1977	:	37.3 m^3/s	
Average flow rate water in 1996	:	27.8 m^3/s	

The Figure 6.4.1. shows the frequency of the monthly average water level at the Sajo river from 1951 thought 1992. Also the yearly in-take water quantity of the Sajo river used by the Borsod Power Plant for last several years are shown hereunder, and that tends to decrease.

1990	118,870,800 (m^3/yr)
1991	111,609,000 (m^3/yr)
1992	92,390,400 (m^3/yr)
1993	56,931,600 (m^3/yr)
1994	54,643,800 (m^3/yr)
1995	54,982,800 (m^3/yr)

The in-take water from the Sajo river is mainly used as cooling water. However, when the Sajo river is in the low water level, it can be said that further environmental impacts arise in and around the water front, because of the low water level, together with thermal effluent. Accordingly, it is necessary to implement a cooling water re-circulation system being planned by the Power Plant, as the countermeasure for the variation of water levels and the thermal effluent. Provided that a cooling water re-circulation system is implemented according to the schedule, then the planned average in-take current volume from the Sajo river will be 2,312 m^3/h (Max 2,662 m^3/h). In this case, it is expected that a significant decrease of the environmental impacts caused by the thermal effluent and the variation of water level.

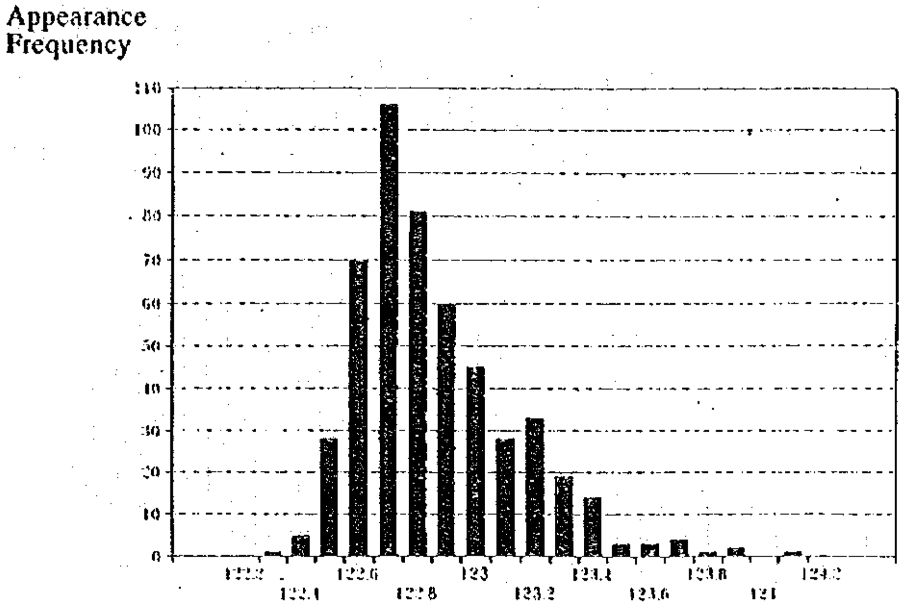


Figure 6.4.1 Appearance Frequency of Monthly Water Level of Sajo River

5) Variation of river water temperature

When the Sajo river is in the low water level, there seems to arise significant environmental impacts to the regional plant life in and around its water front from the rising water temperatures, caused by the thermal effluent. In summer when the Sajo river is in the low water level, almost all flow of Sajo River have been used by Borsod Power Plant, so that the water temperature during July and August at the Sajo river would rise to 25 °C ~ 33 °C. Therefore, it is necessary to have countermeasures against the thermal effluent by installing a cooling water re-circulation system which is planned at the Power Plant. As a result, the environmental impact problem caused by thermal effluent is to be solved.

6) Air pollution

Air pollutants emitted from Borsod Power Plant include SO_2, NOx, SPM (including As in SPM), and vapor Hg. Especially, there are significant environmental impacts to the region caused by SO_2 in the exhaust gas, and the scattering of dust from the sludge storage area.

The SO_2 concentrations for 30 minutes average and daily average, as well as that of NO_2 and NOx, exceeded the environmental standards values.

Also, there are significant amount of dust scattering from the sludge storage area by wind gusts to farm lands and neighboring residential areas, resulting in a serious problem. Countermeasures against such air pollution should be examined and proposed.

Possible air pollution control measures for power plants are shown in Table 6.4.2. Even among these, however, as they can show different effects depending on the manner of execution and each of them has its own characteristics, it is necessary to take an overall review on their suitability..

Table6.4.2 Air Pollution Control Measures for Power Plant and Their Effects

Control Measures			SO_2	NOx	CO	DUST	Heavy metals in exhaust gas	Limeston utilization rate*7	Power generation efficiency	Remarks
Fluidized Bed Combustion	Atmosplenic	CFBC	B	B	D	*1	*1	B		Ash disposal problem
		BFBC	B	B	D	*1	*1	C		ditto
		IFBC	B	B	D	*1	*1	B		ditto
		HFBC	C	B	D	*1	*1	B		ditto
	Pressurized	PFBC	B	A	B	*1	*1	A	B	ditto
Gas ACC			A	C	B	A	A		A	High price
Flue Gas Desulfurization	Semi-dry type	GSA	A*2	C		A*1	A*3	A		Ash disposal problem in the case of coal
		Spray dryer	B	C		B*1	B	B		ditto
	Dry type		A B*4	C		B*1	B*1	B*5		ditto
	Wet type		A	B		B*1	B	A		Wastewater treatment required
Use of Liquid Fuels			*6	C	B	B	B	*4		
Use of Natural Gas			A	B	A	A	A			Clean energy

Legend: A : very good B : good C : some effect D : no effect Blank : irrelivant

*1 Depends on performance of dust collector.
*2 Desulfurizaton rate increases with high performance of dust collector.
*3 Removal of gaseous or fumy metals (Hg, As, etc.) is possible.
*4 Depends on kind of desulfurizer.
*5 No relevance when limestone is not used.
*6 Desulferization may be necessary depending on the sulfur content of fuel.
*7 Limestone utilization rate greatly varies with the sulfur content of fuel.

7) Water pollution

In Sajo River, water quality has remarkably improved as mentioned in Section 6.3.

Regarding to the water pollution of Sajo River caused by Borsod Power Plant, leachate from the sludge storage area and stormwater inflow are pointed out.

The leachate from the sludge storage area has often exceeded the category III limit values of the regulation regarding pH, salt and As. Regarding the quality of stormwater which would flow into the river though drainage ducts, the oil-trap pits of garages and car washing should be improved. (according to Preliminary Environmental Study Reports by the Power Plant)

8) Soil pollution

As to soil pollution, referring to the analysis data of the site works which had been conducted at 22 points in the area near the Power Plant by the Study Team, only As exceeds the environment standard and no other heavy metals exceed the environment standard.

Based on the previous JICA study report, the areas contaminated by Cd, Hg ad Pb can be pointed out. However, the possibility of pollution caused by other sources than the Power Plant cannot be denied, taking into consideration the location of the Power Plant.

Also it can be said that the soil pollution by As has been caused mostly by combustion of coal fuels at the Power Plant in view of large volume of As emission from the Power Plant.

Consequently, some countermeasures must be applied to the exhaust gas to avoid the soil pollution caused by As in the vicinity of the Power Plant.

It is necessary to take countermeasures in order to reduce the quantity of the flue dust from the Power Plant and to prevent the scattering of dust by gust from the sludge storage area. In addition, the countermeasures against excavation soil during construction, pollution of air, soil and water by solid wastes from the Power Plant must be considered.

9) Noise and vibration

a) Noise

According to the data of the "The Preliminary Environmental Study" conducted by Borsod Power Plant, the noise levels around the Power Plant are below the environmental standards.

EKF, in its law No.16.632-2/1993, has regulated the permissible limit value for the noise caused by the operation of Borsod Power Plant in order to protect surrounding buildings.

The actual noise level and the limit value are as mentioned in Section 6.3.

As far as implementation of the new unit project is concerned, there are two regulations relevant to working environments.

- The noise level from its source (facilities)

- The allowance level of noise pressure at working environment

The Hungarian Environmental Standard, MSA 1815/2-83, have regulated as follows;

The noise pressure level	A. : L Aeq =	85 dB(A)
The maximum noise pressure level	A. : L AL =	125 dB(A)

Accordingly, it should be instructed that the supplier of equipment to observe the environmental standards regulated by the Hungarian Noise Level Environmental Standards.

Also, regarding to the environmental impacts caused by noise generated with new equipment, it should be provided with such as sound proofing equipment and device to observe the noise level within the environmental standards provided by law. The source of environmental impacts caused by noise are mainly from such as boiler, turbine, transformer, conveyer, transfer and loading facility of coal yard, etc.

In conclusion, impacts of noise against general and working environment can be avoided by employing appropriate countermeasures. Also adequate countermeasures against noise during the construction period should be taken into consideration.

b) Vibration

Regarding the vibration, it can be said that there will be no impacts to neighboring area after the start of operation of the new unit. The problem of vibration is possible during the construction period. To protect neighboring residents from its impacts including the one caused with working vehicles, suitable measures should be taken.

10) Odor

Borsod Power Plant is located in a industrial zone, and residents also use coal partly for home heating. Therefore, the odor from the Power Plant is of not so much problem at present and the Study Team has not detected the odor from the power plant. Accordingly, it is considered that the impact of odor during the operation of the new unit is negligible and should cause no environmental damage to the area, even in the course of construction.