13.4.3.3 Pollution

a. Air Pollution

Air quality survey is conducted at two stations: up hill A_1 , and down hill A_2 at the boundary of the existing Sofulu disposal site.

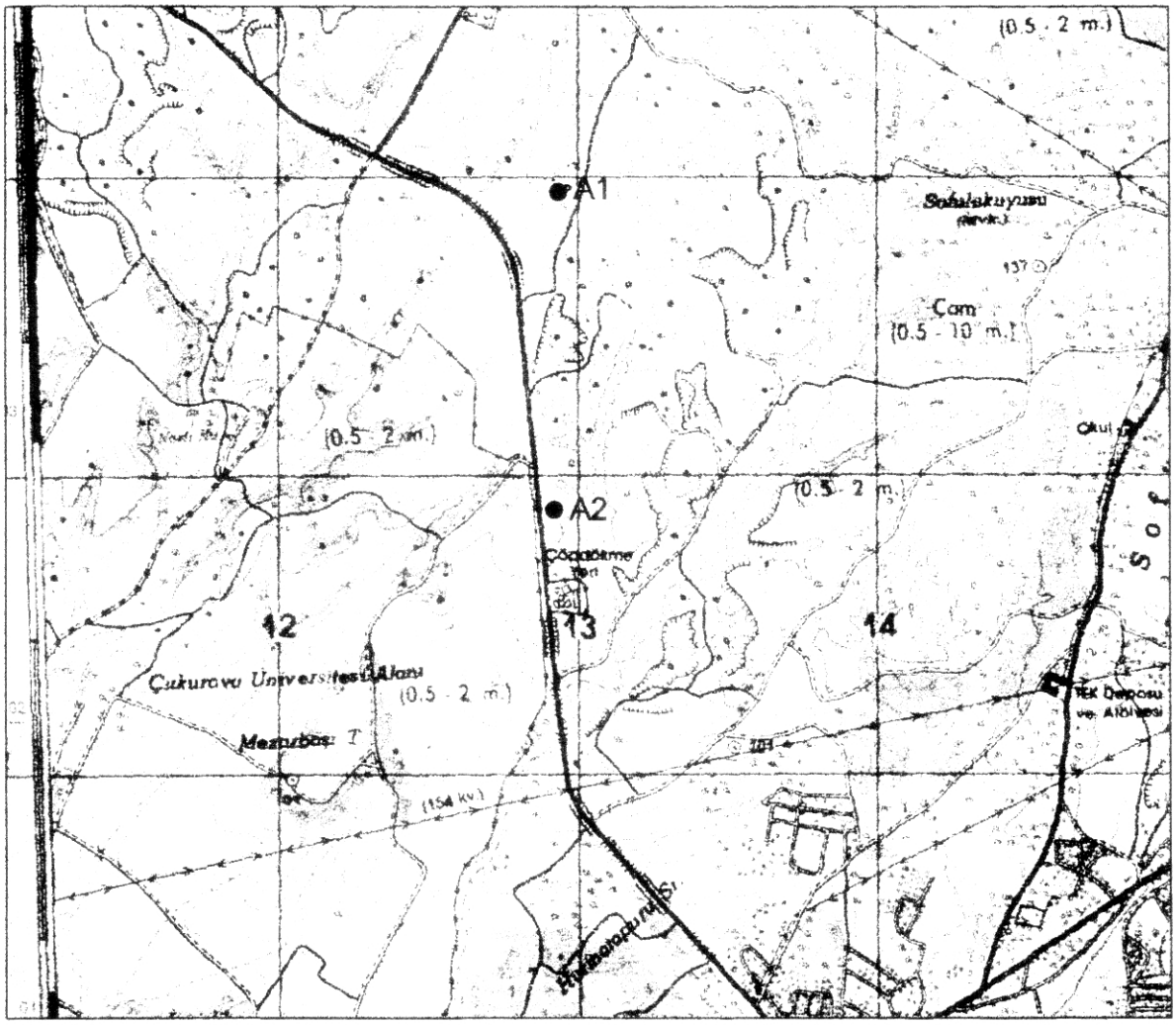
The location of two stations are selected according to the dominant wind direction. Their locations are shown in Figure 13-44.

The air quality survey covers the following items.

- Air Temperature
- Humidity
- Wind Direction
- Wind velocity
- Settled dust
- Sulphur dioxide (SO_2)
- Nitrogen oxides (No_x)
- Cl_2(chlorine)
- Particulate Matter (PM)
- Pb in PM
- Cl^- as HCl

The settled dust has been measured over a period of 24 hours on the same day of analysis of other parameters.

The meteorological data has been recorded by the State Meteorological Institute in Adana , and air quality parameters have been realised with a mobile gas monitor. HCl and chlorine has been determined by analytical techniques and Pb in the particulate matter has been analysed with Atomic Absorption Spectrometer.



- Air sampling points (A1, A2)

Figure 13-44: Air Sampling Points in Sofulu

Table 13-26: Sofulu Air Quality Analysis in May 1999

15.05.1999		
Parameters	Measurement results	
	Uphill	Downhill
Air Temperature	23.2 °C	23.2 °C
Humidity	78 %	78 %
Wind Direction	ESE	ESE
Wind Velocity	0.3 m/sec	0.3 m/sec
Settled Dust	50 µg/m^2 day	150 µg/m^2 day
Sulphur dioxide (SO_2)	11.5 µg/m^3	67.8 µg/m^3
Nitrogen oxide (NO_x)	30.3 µg/m^3	87.4 µg/m^3
Hydrogenchloride (HCl)	<0.5 µg/m^3	0.7 µg/m^3
Particulate Matter (PM)	50 µg/m^3	75 µg/m^3
Lead (Pb)	- µg/m^3	- µg/m^3
Soot	0 Bachara scale	1 Bachara scale
Chlorine (Cl_2)	25 µg/m^3	45 µg/m^3

Table 13-27: Sofulu Air Quality Analysis in June 1999

05.06.1999		
Parameters	Measurement results	
	Uphill	Downhill
Air Temperature	25.7 °C	26 °C
Humidity	78.7 %	78.7 %
Wind Direction	ESE	ESE
Wind Velocity	1.6 m/sec	1.5 m/sec
Settled Dust	55 µg/m^2 day	158 µg/m^2 day
Sulphur dioxide (SO_2)	20 µg/m^3	55.8 µg/m^3
Nitrogen oxide (NO_x)	28 µg/m^3	86.3 µg/m^3
Hydrogenchloride (HCl)	<0.5 µg/m^3	0.8 µg/m^3
Particulate Matter (PM)	50 µg/m^3	75 µg/m^3
Lead (Pb)	0 µg/m^3	0 µg/m^3
Soot	0 Bachara scale	0 Bachara scale
Chlorine (Cl_2)	25 µg/m^3	45 µg/m^3

When the results are evaluated according to the air quality regulation published in the official gazette Nr 192269 on 2.11.1086, the values are found to be below the allowed limits in the regulation.

As seen in Figure 13-22 and Table 13-27 , SO_2 concentrations vary between 11.5–67.8 µ g/m^3 which is far more less than the allowed limits in the regulation. Same arguments can be made for nitrogen oxides and the rest of the measured parameters.

As the waste burns in the dump site, especially dioxins produced by this process, and give a risk to human and its environment. The incomplete combustion during burning results in carbon monoxide formation. CO produces detrimental effects on plant life by several times of exposure at lower level than 100 $\mu g/m^3$. The principle effect of CO on humans and other animals is its interference with the transfer of oxygen through the body.

Therefore, besides having a bad odour, the burning of dumping site must be stopped by taking the necessary precautions such as covering the waste by soil. This will eliminate the risks of combustion products which evolved cancerous gases.

b. Water Pollution

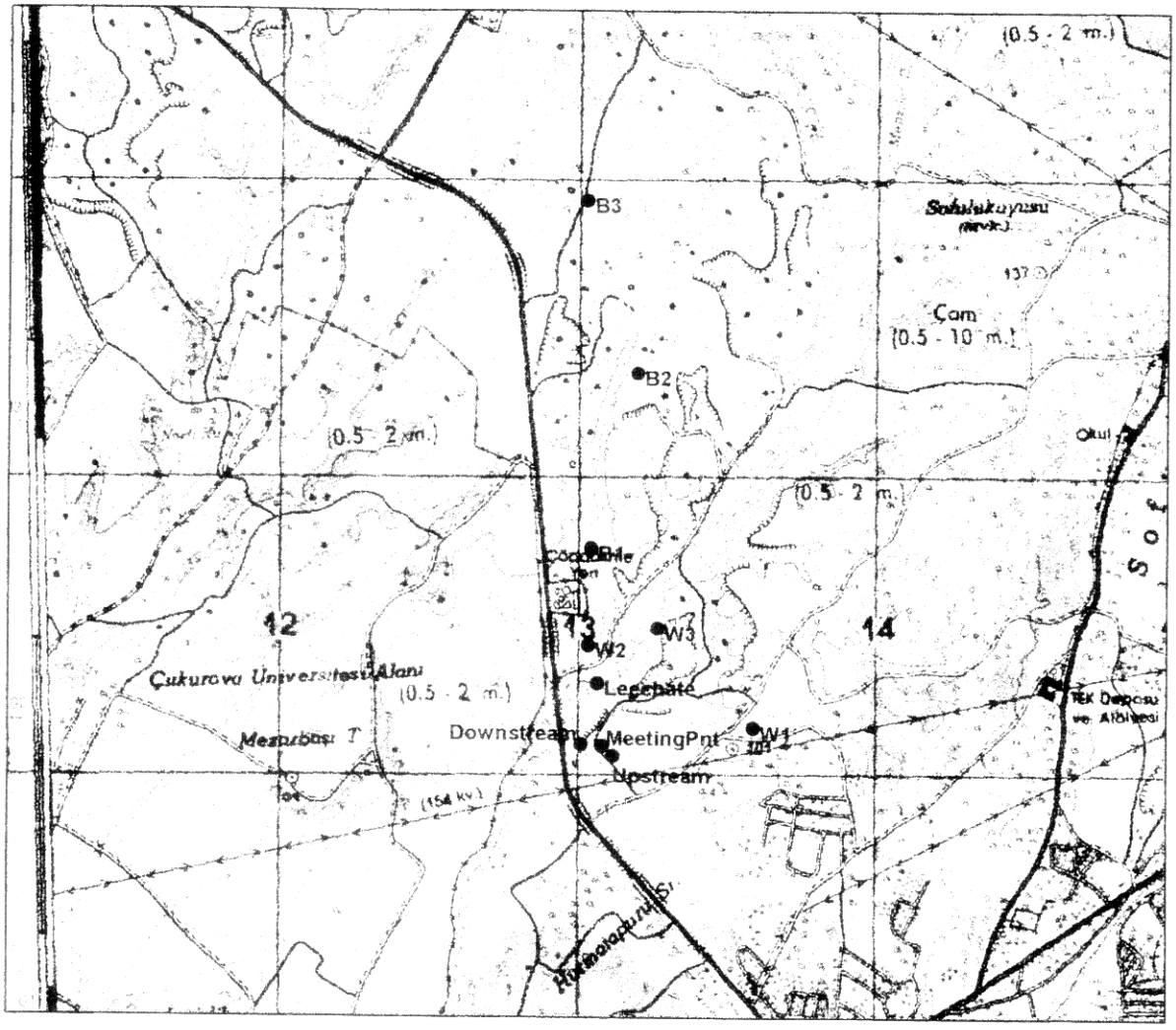
A water quality survey has been carried out in the proposed area in conjunction with the water use survey.

The locations of the wells , boreholes and surface water are shown on Figure 13-45.

The samples are taken twice in one months time after a three days of fine weather, in April and May. The date of the analysis are given on the appropriate tables.

19 parameters are analysed for the water samples.

- Colour
- pH
- Total Dissolved Matter
- DO
- COD
- BOD
- Fecal Coliform(E. Coli)
- T- N
- T – P
- NH_4^+
- Na^+
- Cl^-
- SO_4^{2-}
- Cr^{6+}
- Hg
- Cd
- Pb
- As
- Total Coliform



- **BoreHole 1 (B1)**
- **BoreHole 2 (B2)**
- **BoreHole 3 (B3)**
- **Downstream**
- **Leechate**
- **MeetingPnt**
- **Upstream**
- **Existing Well (W1)**
- **Existing Well (W2)**
- **Existing Well (W3)**

Figure 13-45: Water Sampling Points in Sofulu

Water exists only in one of the boreholes in the Sofulu site. The data are given in Table 13-28.

No *E.coli* was found in the samples, which indicates the absence of fecal contamination. Arsenic concentration is fairly high, which may be due to leaching of ions from the soil.

All the existing wells have high total coliform count and they all have *E. Coli* count changing between 10 – 95 cob/ml which shows the fecal contamination. Hence the consumption of any of these waters constitutes a health risk. The other parameters in the samples show similarities, however this groundwater is not used any more for drinking water purposes. The water requirement of the area is provided by the ASKI well. The results of the ASKI well analysis as seen in Table 13-29 clearly indicate that it is suitable for drinking and daily use purposes.

In the surface water analysis, the results of the upstream reveals that it is suitable, as it is not contaminated by fecal coliform. At the meeting point with the leachate, total coliform count increases and it is contaminated highly as the *E. Coli* count increases to 35,000 cob/ml. In the down stream samples, the total coliform increases to 500,000 cob/ml while *E. coli* decreases to 20,000 because of the dilution with the upstream clear water. BOD and COD results are high at the meeting point which is indicative of the loading from the leachate. These high values reveal that there is considerable pollution originating from the waste dump site.

In the leachate analysis COD and BOD are extremely high which originates from the waste dump site. Total N is high and the concentration is from 335.74 to 340.64 ppm. Hence the leachate may be used for irrigation purposes with this high nitrogen content. The same arguments could be made for NH_4^+, too. *E. coli* is around 350 cob/ml which is indicative of fecal contamination. The grazing animals around the waste dump site must be the origin of this contamination. The leachate lacks dissolved oxygen.

Table 13-28: Surface Water Quality Analysis in Sofulu

Parameters	Upstream				Meeting Point				Downstream				Bridge In Univ.			
	5 Apr.		13 Apr.		5 Apr.		13 Apr.		5 Apr.		13 Apr.		5 Apr.		13 Apr.	
Flowrate	10 L/sec		13 L/sec		13 L/sec		10 L/sec		13 L/sec		13 L/sec		-		-	
PH	7.61		7.83		7.83		7.61		7.81		7.82		8.27		8.25	
TDS*	0.7		1.6		1.1		0.7		1.6		1.1		1.7		1.7	
DO	5.03		1.53		0.59		5.01		1.49		0.6		1.62		1.6	
COD	150		2,250		2,500		155		2,200		2,550		500		500	
BOD	75		420		1,113		75		414		3,140		200		200	
Total N	8.76		180.21		174.51		8.91		179.66		175.01		22.2		22.31	
Total P	2.2		2.45		2.3		2.35		1.2		2.55		7.4		7.25	
$NH4^{+}$	3.86		166.26		169.71		3.95		174.86		168.65		21.86		21.85	
Na^{+}	6.53		5.45		5.36		6.55		5.43		5.38		5.23		5.25	
Cl^{-}	4.1		140.25		140.22		4.1		133.89		139.22		209.89		210.1	
$SO4^{-2}$	33.97		59.1		57.26		34.15		57.26		58.48		104.2		105.15	
Cr^{+6}	-		-		-		-		-		-		-		-	
Hg^{+2}	0.11		0.28		0.33		0.12		0.27		0.3		0.15		-	
Cd	<0.035		<0.035		<0.035		<0.035		<0.035		<0.035		<0.035		<0.035	
Pb	-		0.06		0.06		-		0.06		0.06		-			
As	-		-		-		-		-		-		-		-	
Total Col.	2,900 cob/mL		450,000 Cob/mL		320,000 cob/mL		3,000 cob/mL		500,000 cob/mL		300,000 cob/mL		3,000 cob/mL		3,000 cob/mL	
E. coli	-		25,000 cob/mL		35,000 cob/mL		-		20,000 cob/mL		30,000 cob/mL		-		-	

Unit: mg/l except pH

Table 13-29: Water Quality Analysis at Existing Well in Sofulu

Parameters	E1		E2		E3		A.S.K.I. well	
	27 Apr. 24 May	27 Apr. 24 May	27 Apr. 24 May	27 Apr. 24 May	27 Apr. 24 May	27 Apr. 24 May	27 Apr. 24 May	27 Apr. 24 May
pH	7.41	7.38	8.15	8.1	7.37	7.35	7.22	7.2
TDS*	0.4	0.4	0.6	0.6	0.5	0.5	-	-
DO	5.32	5.3	5.42	5.4	4.98	4.95	6.75	6.7
COD	62	60	50	50	55	55	-	-
BOD	16	16	10	10	8	8	-	-
Total N	13.46	13.4	3.50	3.53	9.30	9.32	5.05	5.01
Total P	0.60	0.55	0.50	0.5	0.03	0.03	0.05	0.05
NH_4^+	3.86	3.85	<0.2	<0.20	<0.2	<0.2	<0.2	<0.2
Na^+	20.00	20.01	82.02	82.1	69.72	69.75	20.26	20.25
Cl-	42.97	42.95	97.70	97.5	50.76	51.21	19.25	19.3
SO_4^{-2}	17.07	17.15	12.51	12.7	211.80	212.1	20.38	21.4
Cr^{+6}	-	-	0.12	0.123	0.06	0.06	-	-
Hg^{+2}	0.08	0.08	0.15	0.15	0.06	0.06	-	-
Cd	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	-	-
As	1.873	-	0.699	-	2.337	-	-	0.06
Pb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Fe	-	9,500 cob/mL	-	4,000 cob/mL	-	19,000 cob/mL	0.06	-
Total Coliform	9,500 cob/mL	95 cob/mL	4,000 cob/mL	10 cob/mL	19,000 cob/mL	75 cob/mL	-	-
E. coli	95 cob/mL		10 cob/mL		75 cob/mL		-	

Unit: mg/l except pH

Table 13-30: Water Quality Analysis at Borehole(B2) in Sofulu

Unit: mg/l except pH (No water in boreholes B1 & B3)

Parameters	5 May	24 May
pH	6.49	6.5
Color	colourless	colourless
TDS*	0.8	0.8
DO	7.3	7.28
COD	150	150
BOD	120	120
Total N	5.09	5.1
Total P	0.90	0.93
NH_4^+	0.56	0.6
Na^+	21.32	21.35
Cl^-	44.30	44.5
SO_4^{-2}	18.05	18.15
Cr^{+6}	-	-
Hg^{+2}	<0.05	<0.05
Cd	<0.030	<0.030
Pb	0.425	0.43
As	0.925	0,93
Total Coliform	145,000 cob/mL	145,000 cob/mL
E. coli	-	- cob/mL

Table 13-31: Sofulu Water Quality Analysis (Leachate)]

Unit: mg/l except pH

Parameters	Measurement results	
	5 May	24 May
Flow rate	2 L/sec	2 L/sec
pH	7.88	7.86
TDS*	6.4	6.8
DO	-	-
COD	>30,000	>30,000
BOD	9,570	9,885
Total N	335.74	340.64
Total P	20.00	23
NH_4^+	329.14	335.15
Na^+	63.80	68.35
Cl^-	663.85	671.23
$SO_4^=$	116.35	128.3
Cr^{+6}	0.00	-
Hg^{+2}	1.35	1.4
Cd^{+2}	<0.035	<0.035
Pb	0.08	0.06
As	<0.05	<0.05
Total Coliform	7,050 cob/mL	7,100 cob/mL
E. coli	350 cob/mL	360 cob/mL

c. Soil Contamination

Landfilling of waste at the dumping site has possibly been contaminating the soil within the site. When it rains, pollutants in the waste liquefy and permeate the ground, thereby contaminating the soil. However, the contaminated soil have not affected the surrounding environment because it had never been hauled to the outside of the site. The issue of groundwater contamination caused by the permeation of rainwater that passes through the contaminated soil section is dealt with in detail in the section on water pollution. There may be a little influence on the surrounding area with waste scattered by wind at the present dumping site in Sofulu.

d. Noise and Vibration

The noise and vibration produced by the bulldozer, and collection vehicles along the access road during the operation of the present dumping site have a little impact to the environment. The landfill is operated 6 days a week and on Sundays 1/2 day. The following equipment is normally available on the site:

- 2 bulldozers
- 1 excavator
- 3 tractors with trailers
- 1 water tanker

It is the bulldozer that produces the biggest noise among them. The power level of noise produced from a bulldozer is almost 110 dB(A). The noise reduces in accordance with the increase of distance at the rate of 20log **r** (**r** is the distance from the source of noise, and in case that the distance is 1,000m, the volume of reduction is 20log 1000 = 60dB(A)). Since only one bulldozer is usually operating on the site and there are very few houses within the radius of 1000m, there is seldom actual impact against the daily life of the surrounding area.

As long as collection vehicles carry heavy loads, they will relatively create a significant amount of noise and vibration. Adana has a mechanised solid waste collection system, with a collection fleet that ranges from tractor trailers, open lorries, and compaction vehicles of different capacities. The type and capacity of the collection fleet including vehicles leased are given in the Table 13-32.

Table 13-32: Types and Capacity of Collection Vehicles

Vehicle Type & Capacity	No. of Vehicles
Compaction truck (16m^3)	24
Compaction truck (12 m^3)	35
Compaction truck (8 m^3)	10
Compaction truck (6 m^3)	23
Tractor trailer (6 m^3)	46*
Tractor trailer (4 m^3)	4
Lorry (10 ton)	1
Total	143
No. of Trips	2

Note: *Tractor trailers(6 m^3) partially trip three times a day.

As the impact of noise on the living environment is evaluated by L_{eq} (Equivalent Noise Level), it is quite obvious that the number of vehicles per hour is a significant factor to consider.

The number of collection vehicles transporting waste to Sofulu dumping site was surveyed during one week. The peak traffic volume appeared between 10:00-11:00pm and the average number of collection vehicles was 168 / 6 x 2 = 54 vehicles / hour in two ways. This volume is very small amount compared with general traffic volume. Therefore, the noise level produced from the collection vehicles is also much smaller than that from general traffic. Moreover, because there exist few houses along the access road, Old Kozan Road, the collection vehicles have little impact to the daily life of people living along the access road.

Vibration level due to landfill equipment and waste collection vehicles have not been estimated by any theoretical method. Instead, the noise level results are considered to be indicative of vibration levels. The impact by vibration is expected to be negligible because the impact by noise is small.

e. Offensive Odour

In case of open dumping, offensive odour is extensively diffused up to several kilometres depending on wind direction and other atmospheric conditions. Fire outbreaks in the dumping site could also impact distant areas due to the rising air current – an issue that has been the focus of many complaints from residents of neighbouring areas. The daily covering of waste with soil would significantly mitigate adverse impacts. However, the daily covering has never been conducted on the present dumping site in Sofulu.

13.5 Impact of the Project on Environment and Mitigation Measures

13.5.1 Preparation of the Land and Activities during Construction and Installation Stage

The detailed information can be obtained in " **Preliminary Design of Sofulu Site Development of Annex 8 in Volume III** ".

Main construction activities consist of planting of green trees in buffer zone, earthworks for disposal site(phase 1, 2 and 3) and intermediate plant site, building of sorting plant and compost plant, and construction of medical waste disposal site and regulation pond.

As shown in Figure 13-46 construction will start from phase 1 and shift to phase 2 and 3 in order. The depth of cutting is approximately 15m and the height of filling is around 14m as shown by the cross section of A-A, B-B and C-C in Figure 13-47. The numbers show the height at the bottom of the site. Phase 3 site is constructed before termination of the operation at phase 2 site.