11.2.5 Design of a Final Disposal Site

a. Examination of Technical Alternatives

The concept described below is applied to the design of the Cimsa disposal site. Although the team proposed to design a new landfill (Phase 2 & 3) without a liner, it was not approved by the MoE. Then, the team changed Phase 2 and 3 originally proposed due to the durability of the liner.

a.1 Phased Site Development and Landfill Operation

The Cimsa disposal site will be developed and operated in 3 phases as described below (refer to Figure 11-1: Overall CIMSA Site Development Plan).

Phase 1:

This phase as shown in Figure 11-1 will be reclaimed by waste filling. The landfill operation will be complete when the height of it reaches to the ultimate use of the landfill. In addition, the surface soil can be used for covering soil for Phase 1 landfill operations.

Phase 2:

This phase as shown in Figure 11-1 will be reclaimed by waste filling. The landfill operation will finish when the height of it reaches to the ultimate use of the landfill. In addition, the surface soil can be used for covering soil for Phase 2 landfill operation.

Phase 3:

The landfill operation area of the Phase 3 is the uppermost section of the catchment area. Since rain in this area will generate leachate by passing the current dump site, it is considered much better to fill up the area by waste than to maintain it as it is (like a reservoir in shape).

a.2 Appropriate Sanitary Level of the Disposal Site

Turkish Solid Waste Regulation requires a 2 mm, high density polyethylene (HDPE) liner at the slope surface of disposal site if there is impermeable layer at the bottom; the disposal site shall be lined accordingly.

b. Preliminary design

b.1 Outline of the Cimsa Disposal Site

The outline of the Cimsa Disposal site is shown on the table below.

Table 11-11: Outline of the Cimsa Disposal Site

Items	Description
Land Area and Proposed Land Use	Total Area :24ha Phase1:Landfill Area :5ha Phase2:Landfill Area :4ha Phase3:Landfill Area :4ha Plant :Area :3ha Medical waste Landfill Are :2ha Buffer zone :Area :6ha
Landfill Volume	Phase / Capacity / Disposal Period Phase 463,000m^3 2002-2003 Phase2 397,000m^3 2004-2004 Phase3 297,000m^3 2005-2005
Road	Approach road(Asphalt paved) :width15.0m,lenght170m Access road(Asphalt paved) : width4.0m,lenght490m Operation road
Control facilities and approach road	Entrance area(Asphalt paved) :1,000m^2 Site office :300m^2 Weigh bridge : 2set Tire washing pit : 1set Gate : 1set Power supply :1set water supply :1set Weighbridge and washing area(conc. paved) :1,000m^2 Parking for heavy vehicle(gravel) :1,000m^2
Leachate control facility	Leachate collection pipe ϕ100mm:2,255m Main leachate drain ϕ200mm:650m Leachate treatment facility:1set
Drain for runoff water	Open concrete drain :725m Pipe drain for rain fall :650m
Environmental protection facilities	Fence :2,040m Buffer zone :2,040m Gas removal facility(Vertical) :780m Gas removal facility(Horizon) :2,255m Monitoring borehole :3set

b.2 Final Disposal Site

b.2.1 Capacity of Final Disposal Site and Disposal Period

Final municipal solid waste disposal volume from Mersin Greater Municipality is shown in Table 11-12.

Table 11-12: Final Disposal Amount in Cimsa

Item	unit	formula	2002	2003	2004	2005
Final Waste Disposal Amount	ton/day	a	440	473	503	593
	ton/year	b	160,799	172,780	183,736	196,729
Waste +Cover soil	m^3/year	c=bx1.2/0.8	241,199	259,170	275,604	295,094
Total	m^3/year	Σc	241,199	500,369	775,973	1,071,067

b.2.2 Bottom and Slope of Final Disposal Site

According to the SWM regulation, a liner will be laid at bottom and slope of the final disposal site to prevent leachate from seeping into the ground. The structure of Bottom and slope are as follows;

- Bottom: Impermeable clay layer (K = 10^{-8} to 10^{-9} m/sec) should be kept as the liner.
- Slope: 60cm impermeable clay layer (K = 10^{-8} to 10^{-9} m/sec) should be kept as the liner. And a 2 mm, high density polyethylene (HDPE) liner should be laid on top of it.

The structure of the bottom of final disposal site is shown on the following figure

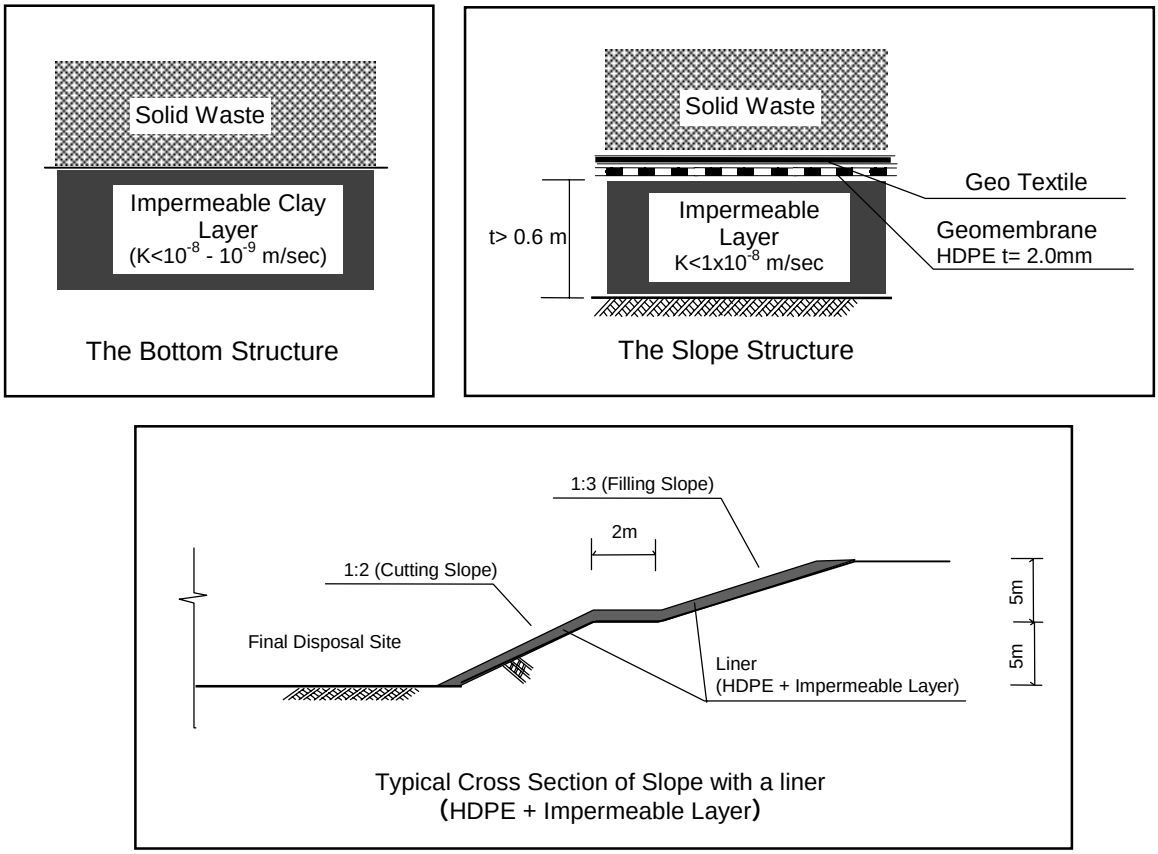

Figure 11-9: Diagrams of the Landfill's Impermeable Strata (Bottom and Slope)

c. Control Facilities and Approach Road

Layout plan of the control facilities is shown on Figure 11-10.

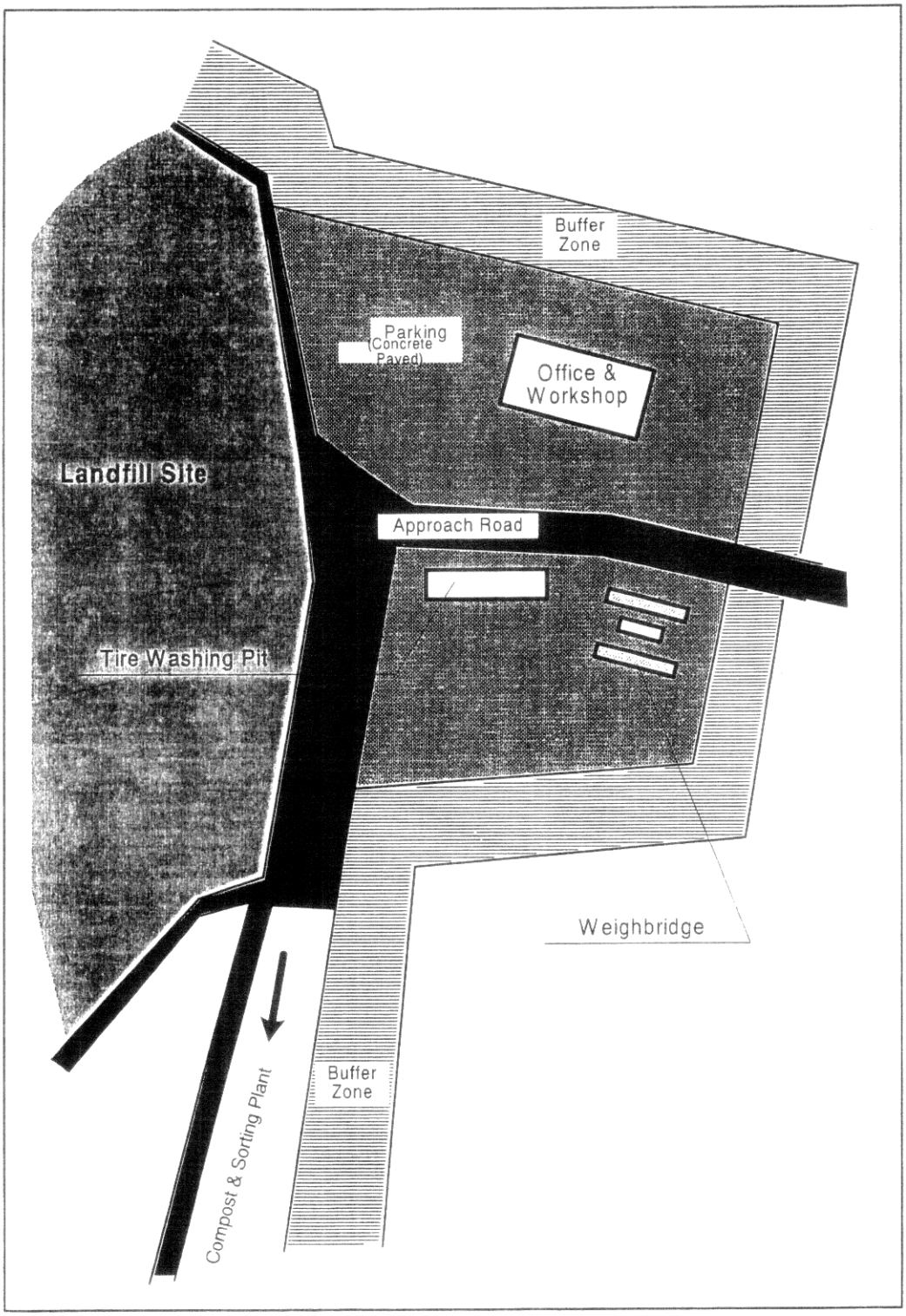

Figure 11-10: Control Facilities and Approach Road in Cimsa

d. Leachate Treatment Facility

d.1 Precipitation and Evaporation

The following table presents monthly values and annual values for average precipitation and evaporation in Mersin. At the sanitary landfill in Mersin the average annual precipitation is 670 mm/year. Evaporation from an area depends on the climatic conditions (temperature, wind and precipitation) and the type of surface.

Table 11-13: Average Precipitation and Evaporation at Mersin

Mersin GM	Month												
mm/month	1	2	3	4	5	6	7	8	9	10	11	12	Year
Average Precipitation	91	86	73	35	29	12	14	3	15	58	103	153	672
Average Potential Evaporation from land	88	94	110	122	133	141	155	165	177	169	117	82	1553
Average Evaporation from lake	46	54	86	114	148	168	200	192	163	119	71	49	1410

d.2 Leachate Quality

This proposed Cimsa landfill site adopted the semi-aerobic structure for the disposal site in order to maintain a lower load to the leachate treatment facilities, and to immediately stabilise the disposed waste in the landfill. The leachate quality for the proposed landfill site is, therefore, designed with a BOD of 2,500 mg/lit., and an SS of 500 mg/lit.

d.3 Effluent Standards

Table 11-14 shows the effluent standards for leachate generated from waste recycling plants and disposal areas.

Table 11-14: Effluent Standards

Parameters	unit	Composite Sample 2-hours	Composite Sample 24-hours
BOD_5	mg/lit.	100	50
COD	mg/lit.	160	100
SS	mg/lit.	200	100
Oil & Grease		20	10
PO_4-P	mg/lit.	2	1
Total Cr	mg/lit.	2	1
Cr^{+6}	mg/lit.	0.5	0.5
Pb	mg/lit.	2	1
CN^-	mg/lit.	1	0.5
Cd	mg/lit.	0.1	-
Fe	mg/lit.	10	-
F^-	mg/lit.	15	-
Cu	mg/lit.	3	-
Zn	mg/lit.	5	-
Fish Bioassay	-	10	-
pH	-	6 - 9	6 - 9

Source: Water pollution control regulation, Office Gazette No. 19919 on 4.9.1988

d.4 Selection of Leachate Treatment Method

At the proposed leachate treatment facility, in order to meet the BOD level (2,500 mg/l) and the effluent standards, the aerated facultative pond, with forced aeration functions, is planned.
Further this treatment facility will use retention ponds from Phase 2, and no leachate will leave the disposal site. The waste stabilisation ponds process may be used in the future.

d.5 Proposed Leachate Treatment Process

The flow of the proposed leachate treatment process is shown in Figure 11-11.

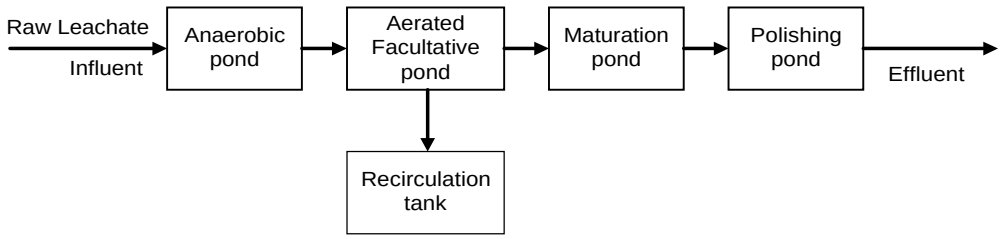

Figure 11-11: Proposed waste stabilisation ponds process

d.6 Treatment Capacity

To determine the scale of the leachate treatment facility, the daily leachate generation figures are required to calculate the design leachate amount.

$Qj=1/1000 \times Ij \times (C_1A_1+C_2A_2)$ （Formula1）

Qj：Design leachate generation amount (m^3/day) for day (j) in a given year.

Ij ：Rainfall amount (mm/day)for day (j) in a given year.

C1：Leachate generation coefficient from area of current landfill operation

C2：Leachate generation coefficient from landfilled area

A1：Area of current landfill operation(m^2)

A2：Landfilled area (m^2)

d.7 Design Leachate Generation Amount

The daily leachate treatment amount is calculated by the following formula.

$Q=1/1000 \times 4.94 \times (0.5 \times 22{,}000+0.3 \times 22{,}000)=86.9 m^3$/day

Based on this result the proposed leachate treatment facility's design leachate generation amount is $90m^3$/day.

d.8 Treatment Ponds Capacity

The volume of each leachate treatment facility pond was calculated and shown in Table 11-15.

Table 11-15: Each Leachate Treatment Pond Volume in Cimsa

ponds	lines	Volume
1. Anaerobic pond	1	470 m^3
2. Aerated Facultative pond	2	890 m^3x4 (Total 3,560 m^3)
3. Maturation pond	1	420 m^3
4. Polishing pond	1	380 m^3

d.9 Layout of the Proposed Leachate Treatment Facility

The layout of the proposed leachate treatment facility is presented in Figure 11-12. The figure also shows the completed sections of Phase 1, and the recirculation pit to be used during Phase 2.

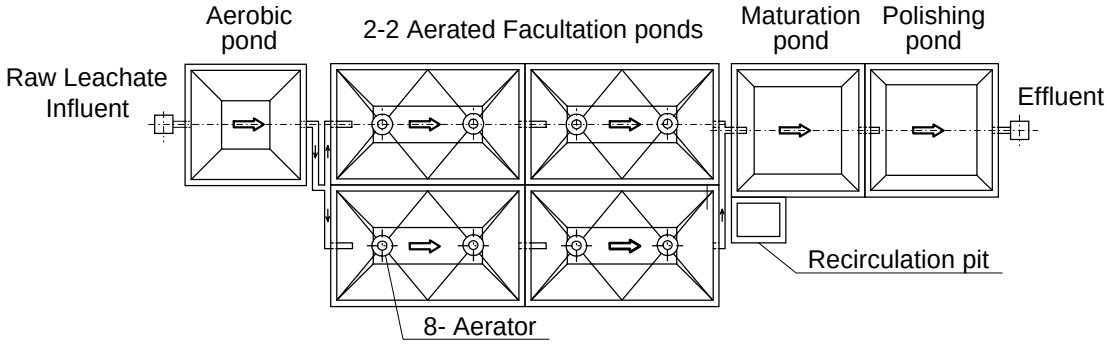

Figure 11-12: Layout of Proposed Leachate Treatment Facility in Cimsa

d.10 Leachate Circulation

d.10.1 Design Leachate Generation Amount

The plan is to operate the leachate Circulation process at the time that Phase 2 is completed. For this reason the maximum leachate amount from landfill operations in Phase 3 was calculated as follows.

$$Q=1/1000 \times 4.94 \times (0.5 \times 41{,}000 + 0.3 \times 81{,}000) = 221.3 m^3/day$$

d.10.2 Determining the Circulation Pump Capacity

The calculation of the recirculation pump's capacity is based on the following conditions.

$$\Sigma Qj = Qj + (C_1 \times R_{j-1})$$

Where Qj：Design leachate amount (m^3/d)on day (j) in a given year

C1：Generation coefficient for the disposal area. (0.5)

Rj：Amount of leachate circulated (m^3/d) to the disposal area by the pump on day (j) in a given year.

The results of the calculations are shown in Table 11-16.

From the results the circulation pump will have a capacity of more than 256m^3/day.

Table 11-16: Results of the Calculation of Capacity of Recirculation Pump and Capacity of Regulation Pond in Cimsa

Capacity of Recirculation Pump (m^3/day)	Capacity of Regulation Pond (m^3)
240	4,970
250	4,370
255.8	4,022
260	3,770
270	3,201

d.10.3 Design of the Recirculation Pump

The following are specifications of the recirculation pump.

- Pump capacity = 0.43 m^3/min :
- Number of pumps : 2 units (1 unit – spare unit)

e. Environmental Protection Facilities

Environmental protection facilities are established in order to protect environmental conditions around landfill site. They are comprised of fence, buffer zone, gas removal facility, leachate treatment facility, liner of landfill bottoms and monitoring borehole.

f. Personnel and Heavy Vehicle Plan

The following personnel and heavy vehicle are required to operate the sanitary landfill.

Table 11-17: Personnel and heavy vehicle plan

Personnel and heavy vehicle	Number
Personnel	
Site Manager	1 person (2002-2005)
Waste controller	1 person (2002-2005)
Operator	4 person (2002-2005)
Driver	3 person (2002-2005)
Worker	2 person (2002-2005)
Security guard	2 person (2002-2005)
Total	13 person (2002-2005)
heavy vehicle	
Bulldozer(230HP)	2Unit (2002-2005)
Excavator(99HP)	1Unit (2002-2005)
Dump truck(8m^3)	3Unit (2002-2005)
Water tanker	1Unit (2002-2005)
Total	7unit (2002-2005)