4.2 Moharam Bey Square Final Disposal Site (MBSDS) Construction Project

4.2.1 Present Environmental Conditions

1) Topography

MBSDS is located at Moharam Bey Square, the entrance to Alexandria. The designed site is in the lowlands surrounded by Cairo-Alex, Desert Road, Agriculture Road, Drinking Water Canal Bank and Airport Access Road. It was a part of Lake Maryut in the past. On the basis of topographical survey results, the height of the surrounding terrain is summarized in Fig. 4-2-1.

The central part of the MBSDS is original ground level, and the surrounding area is 1.0 - 2.0m lower than it because it was the borrow-pit of each bank.

2) Geology

Based on the existing boring data, the location of boreholes, MBSDS soil profiles and MBSDS geological profile are shown in Fig. 4-2-2 to 4-2-5.

According to these figures, the original geological profile of the designed site can be presumed as follows:

- the terrain covering GL to -14.50m is composed of clay, crushed shells, silty clay and clayey silt,
- the terrain covering GL-10.50 to 13.00m has a sand layer, and
- the terrain covering GL-14.50m up to the end of boring has sand layer having N-value 14 to 16.

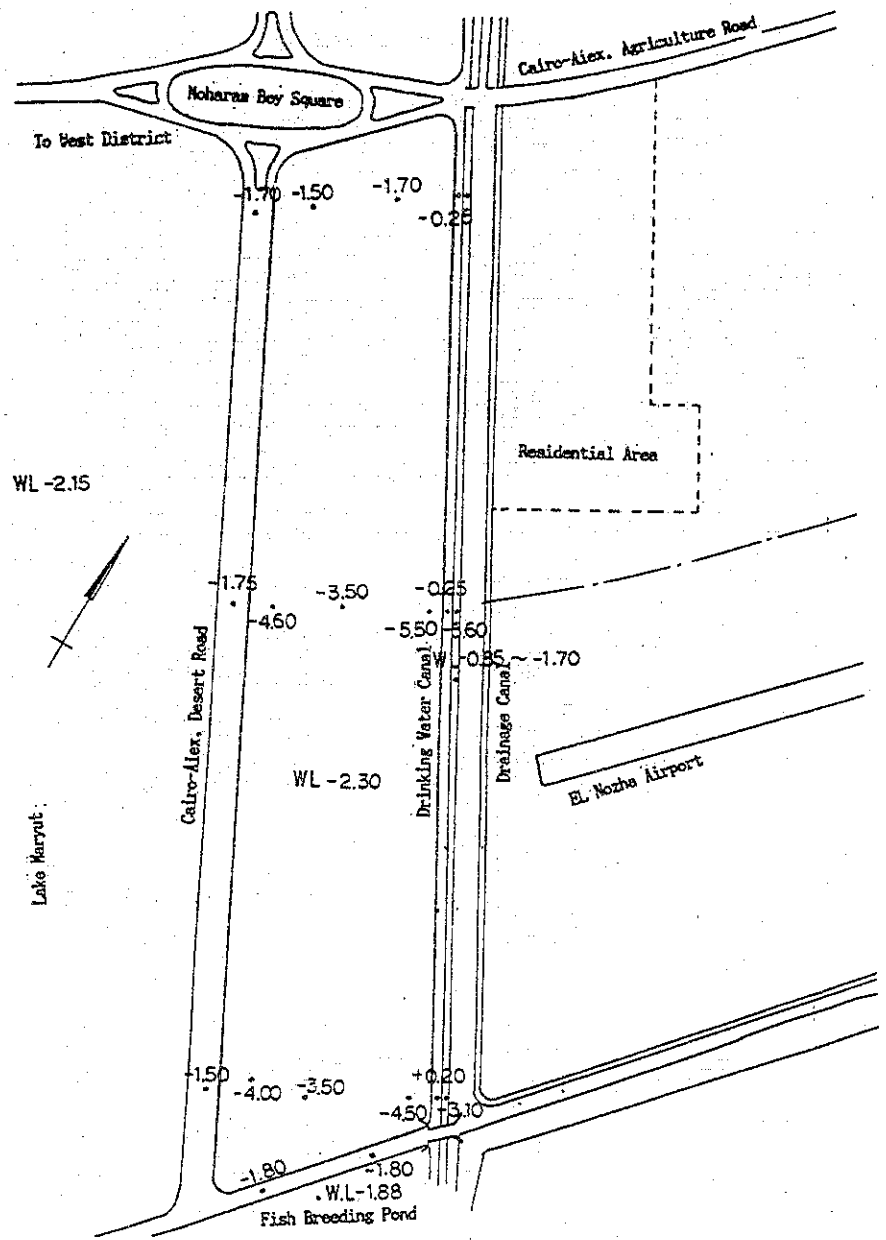


Fig. 4-2-1 ELEVATION IN AND AROUND MBSDS

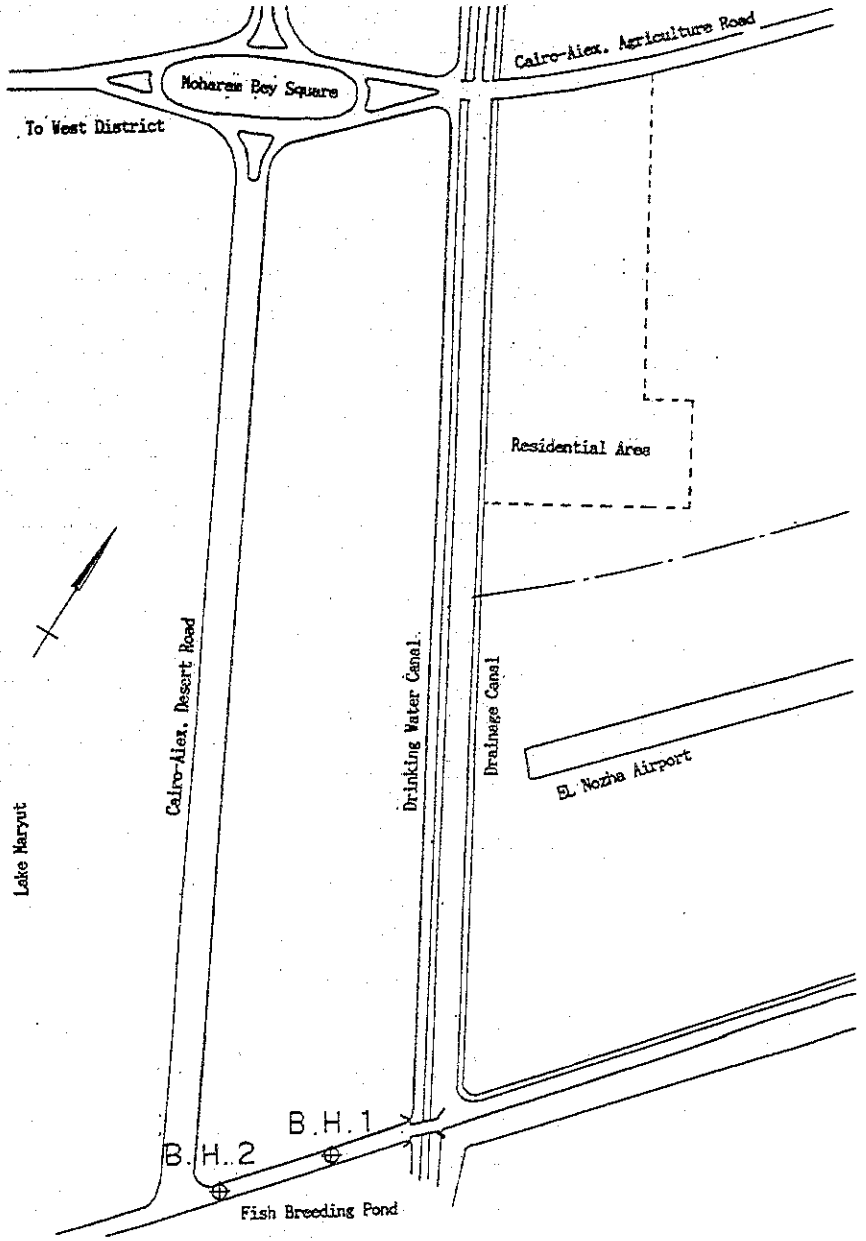


Fig. 4-2-2 LOCATION OF BOREHORES

DATE: April ; 1983 JOB No. 1116 BOREHOLE No.1

JOB : Fish Breeding. DEPTH: 18.00 ms.

LOCATION : Moharem Bek, Alex. W.L : 1.40 ms. below G.L.

Description of Strata	Depth	Legend	Layer Thick.	L.L.	P.I.	Ground Water	Remarks
	meters		meters				N/30 cms.
Ground level.	0.00						
Filling: Sand, stone pieces, Asphalt, pottery & some roots	0.50		0.50				
Filling: light grey, mixture of sand, silt, crushed shells & stone pieces with bad odour.	1.00		0.50				
Filling: Sand, silt, minute calcareous fragments, stone pieces & organic matter.	2.00		1.00				
Grey, soft Clay, shells & crushed shells.	3.70		1.70				
Dark grey, soft Clay, slightly silt.	5.00		1.30	135	36.54		
Dark grey, medium Clay, slightly silt.	7.00		2.00	121	34.33		
Light grey, silty Clay with high % age of calcareous material.	8.00		1.00				
Brown, clayey Silt with stone pieces.	9.00		1.00				
Brown, silty Clay.	11.0		2.00				
Brown, medium siliceous Sand with minute cal. fragments.	12.0		1.00				9
Brown, medium sandy silty Clay with minute cal. frag.	12.10		0.10				
Light brown, med/c. sil. Sand with minute cal. frag.	13.0		0.90				
Brown, medium silty Clay with cal. peck & minute cal. fragments.	13.50		0.50				
Dark brown, stiff silty Clay.	14.50		1.00				12
Brown, fine to medium siliceous Sand.	15.20		0.70				
Dark brown, medium silty Clay.	15.50		0.30				
Sand stone pieces.	15.80		0.30				20
Light brown, fine to medium siliceous & calcareous Sands.			2.20				
End of boring.	18.00						

Additional Remarks : No Warranty is given that the information shown represents conditions throughout the project site.

TEST RESULTS

Depth of Sample	ms	4.5 – 5.0	6.5 – 7.0	12.10 – 13.0		14.5 – 15.2		15.8 – 18.0	
Bulk Density	t/m³	1.35	1.39	γ_L	γ_d	γ_L	γ_d	γ_L	γ_d
Dry Density	t/m³	0.63	0.70	1.52	1.79	1.30	1.54	1.32	1.56
Water Content	%	115.63	99.90	—		—		—	
Unconfined Compressive Strength	kg/cm²	0.141	0.218	—		—		—	
Shear - Cohesion	kg/cm²	0.075	0.178	Φ_L	Φ_d	Φ_L	Φ_d	Φ_L	Φ_d
Shear - Angel of Friction		4° 23'	13° 16'	33 30	39 50	34 34	36 50	36 48	38 58
Specific Gravity		2.76	2.74	2.67		2.67		2.66	
Consolidation Test		—	Fig.(16)	—		—		—	

Undisturbed Sample ●

Disturbed Sample ■

Sulphate Test SO_3

N — Number of Blows For Standard Penetration Test.

W.L — Water level in Borehole.

Source ; Geotechnical Investigations ; Study of Test Borings, Geology, Groundwater, Soil Properties & Foundations for Fish Breedling Project at Moharam Bay, Alexandria

Fig. 4-2-3 MBSDS SOIL PROFILE NO. 1

DATE: April; 1983 JOB No.1116 BOREHOLE No. 2

JOB : Fish Breeding. DEPTH: 17.50 ms.

LOCATION : Moharem Bek, Alex. W.L : 1.10 ms. below G.L.

Description of Strata	Depth	Legend	Layer Thick.	L.L.	P.I.	Ground Water	Remarks
	meters		meters				N/30 cms.
Ground level.	0.00						
Filling: Sand, stone pieces & minute calcareous frag.	0.20		0.20				
Filling: Sand stone pieces, silt & minute cal. frag.	1.00		0.80				
Grey, soft clay, shells & crushed shells.	2.00		1.00				
Shells & crushed shells.	2.70		0.70				
Grey, soft clay shells & crushed shells.	4.00		1.30				
Dark grey, soft Clay, slightly silt	6.00		2.00	129	33.69		
Dark grey, medium Clay, slightly silt.	7.00		1.00	131	38.66		
Light grey, silty Clay with stone pieces & high % age of calcareous material.	8.00		1.00	120	33.50		
Brown, clayey Silt.	9.00		1.00				
Brown, medium silty Clay.	10.50		1.50				
Light brown, fine to medium siliceous Sand with minute cal. frag.	11.50		1.00				9
Light brown, sandy Silt with small aggl.	12.50		1.00				7
Brown, fine to medium siliceous silty Sand with minute cal. frag.	13.00		0.50				
Light brown, medium silty Clay with cal. frag.	13.50		0.50				
Dark brown, stiff silty Clay.	14.50		1.00				
Brown, fine to medium siliceous Sand with small agglomerations & minute cal. frag.	15.00		0.50				14
Brown, fine to medium siliceous Sand with minute cal. frag.			2.50				
End of boring	17.50						

Additional Remarks : No Warranty is given that the information shown represents conditions throughout the project site.

TEST RESULTS

Depth of Sample	ms	4.0 – 5.0	5.0 – 6.0	6.0 – 7.0	10.50 – 11.50		15.0 – 17.50	
Bulk Density	t/m³	1.36	1.40	1.39	γ_L	γ_D	γ_L	γ_D
Dry Density	t/m²	0.65	0.65	0.69	1.43	1.75	1.33	1.59
Water Content	%	108.24	111.45	102.04	—		—	
Unconfined Compressive Strength	kg/cm²	—	0.141	0.206	—		—	
Shear - Cohesion	kg/cm²	0.186	—	0.183	Φ_L	Φ_D	Φ_L	Φ_D
Shear - Angel of Friction		3° 6'	—	1° 16'	35 39	38 55	35 51	39° 00'
Specific Gravity		2.75	2.73	2.79	2.56		2.68	
Consolidation Test		Fig.(17)	—	Fig.(18)	—		—	

Undisturbed Sample ●

Disturbed Sample ■

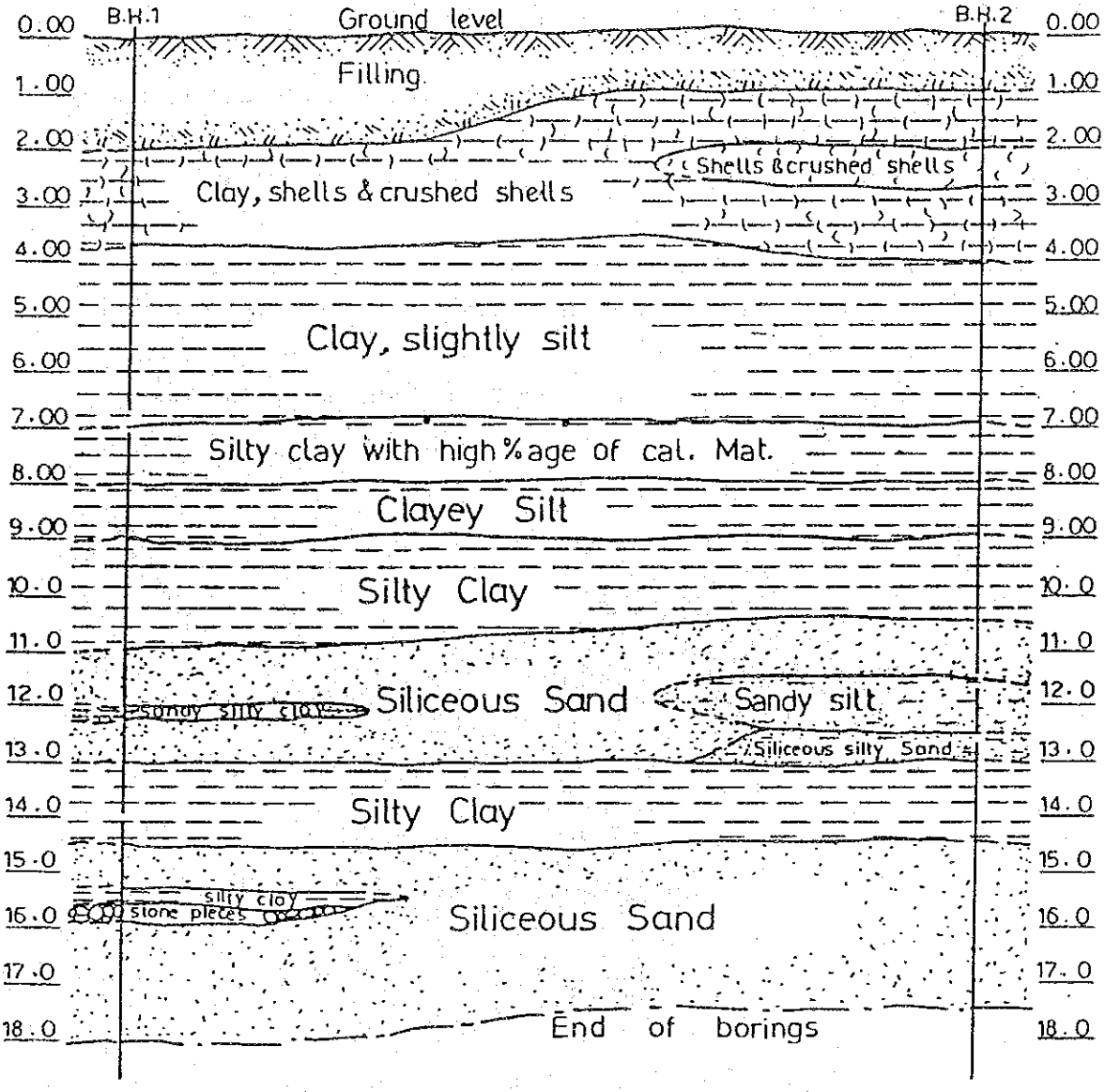
Sulphate Test SO_3

N — Number of Blows For Standard Penetration Test.

W.L — Water Level in Borehole.

Source : Geotechnical Investigations ; Study of Test Borings, Geology, Groundwater, Soil Properties & Foundations for Fish Breedling Project at Moharam Bay, Alexandria

Fig. 4-2-4 MBSDS SOIL PROFILE NO. 2



Source ; Geotechnical Investigations ; Study of Test Borings, Geology, Groundwater, Soil Properties & Foundations for Fish Breedling Project at Moharam Bay, Alexandria

Fig. 4-2-5 MBSDS GEOLOGICAL PROFILE

3) Landuse of Surrounding Areas

The landuse status of the area surrounding the planned disposal area is indicated in Fig. 4-2-6.
In the area, which is located to the northeast of the planned area, there are a secondary school and a residential area beyond Drinking Water Canal, as well as farmlands and Airport stretching on the extension.

In the northwest of the planned area there is Moharam Bey Square. Factories, warehouses, offices and other buildings are located side by side along Agricultural Road and other roads. In the southwest and south of the planned area there is a lake, and in the southeast farmlands.

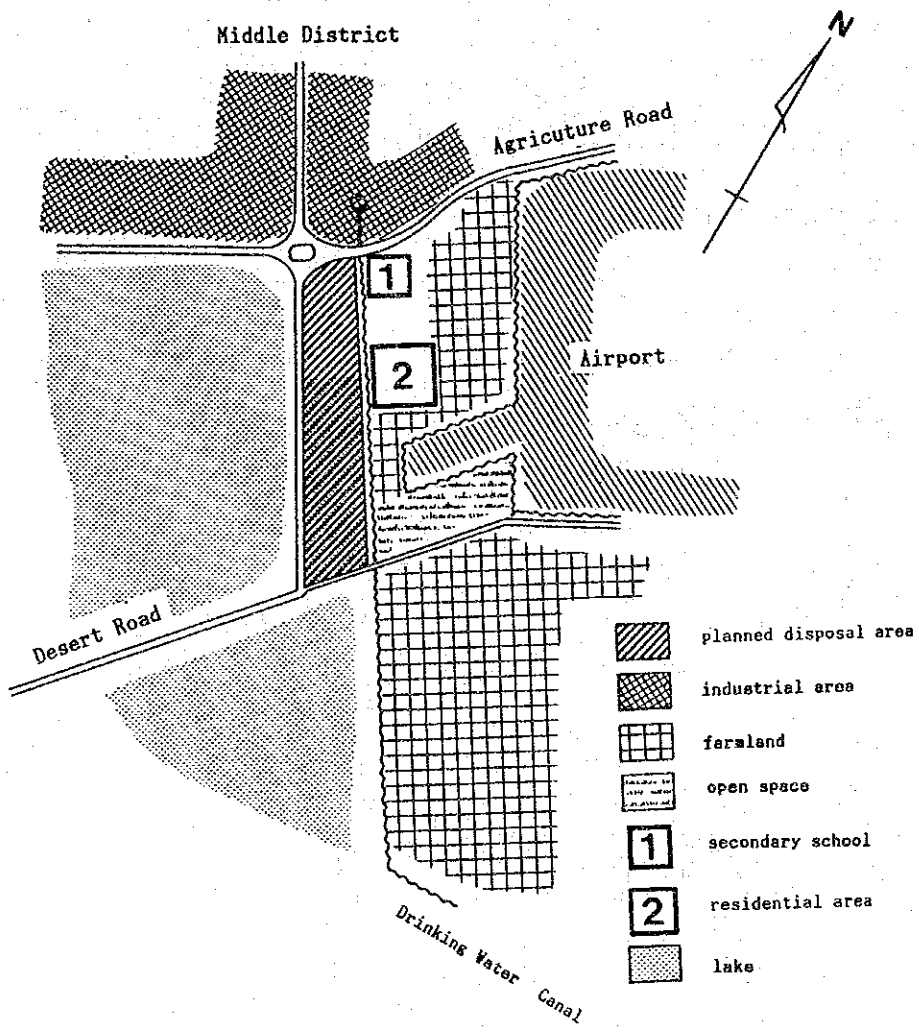


Fig. 4-2-6 LANDUSE OF SURROUNDING AREAS

4) Climate

(1) Wind Direction and Wind Speed

Data concerning the average wind speed and wind direction in five years from 1975 to 1979 are indicated in Fig. 4-2-7. The highest wind speed, roughly 18km/h or 5m/sec, was recorded in February, March and April, while the lowest wind speed, approximately 13km/h or 3.5m/sec, in October.

The predominant wind direction is N and NW: IN THE DIRECTION OF THE Mediteranean Sea throughout the year. The southwest wind observed in December and January is in the direction of the desert located in the west of the planned area. The northeast and east wind observed in Spring and Fall is in the direction of the Delta and agricultural land.

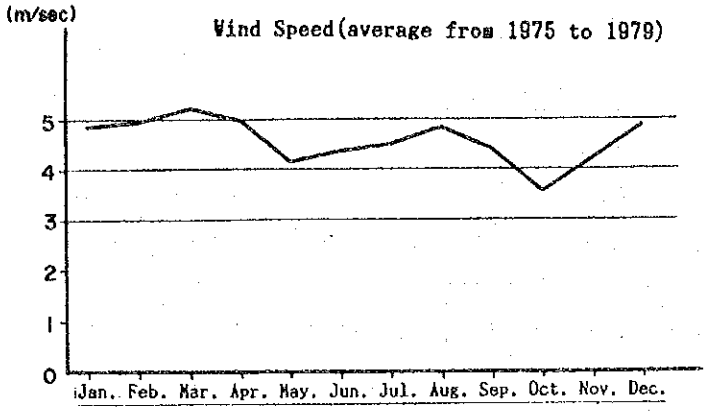
(2) Rainfall

Data concerning the average rainfall recorded in five years from 1975 to 1979 are indicated in Fig. 4-2-8. The annual precipitation is 167mm on the average; in winter the monthly precipitation is 20-60mm on the average, while in summer little rainfall is recorded.

(3) Temperature and Humidity

The average temperature and humidity in five years from 1975 to 1979 is indicated in Fig. 4-2-9.

The average temperature in summer was 25°-26°C, and 14°-16°C in winter. There is little rainfall in summer, but the humidity records a high degree of 70%, and the relative humidity throughout the year records a high degree of no less than 65%.



Wind Direction(average from 1975 to 1979)

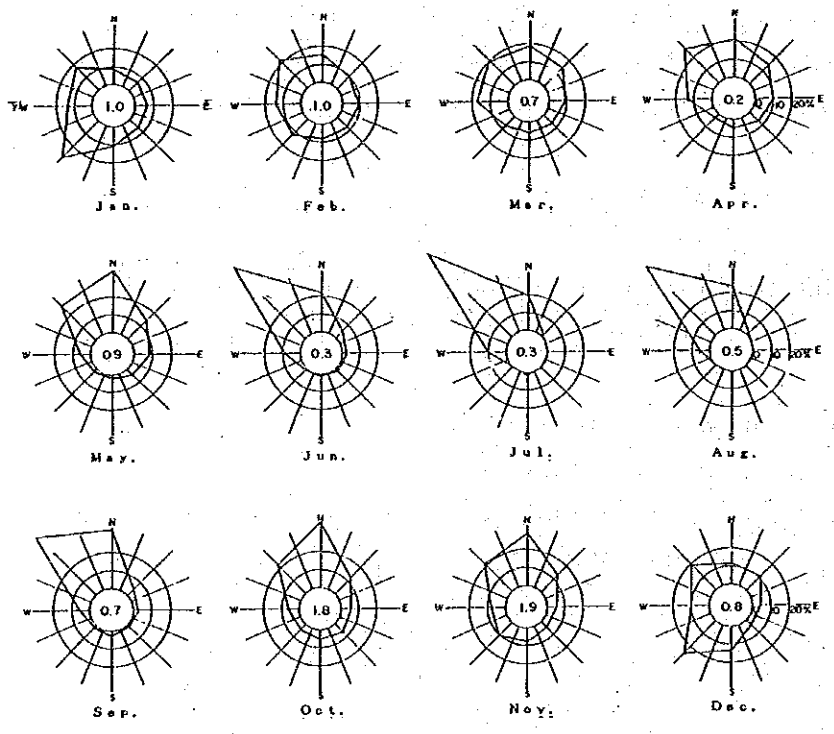


Fig. 4-2-7 WIND SPEED AND WIND DIRECTION

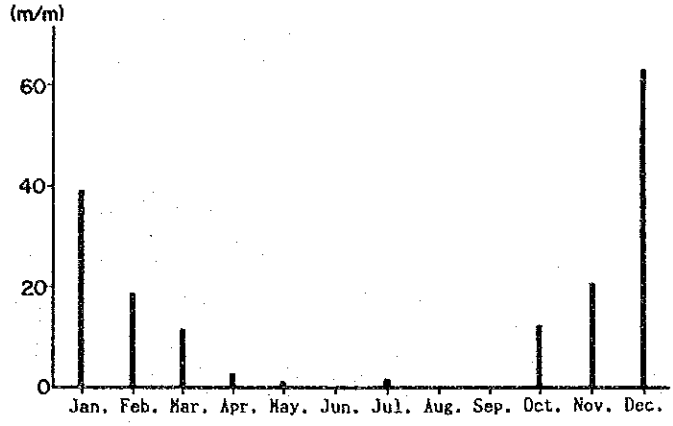
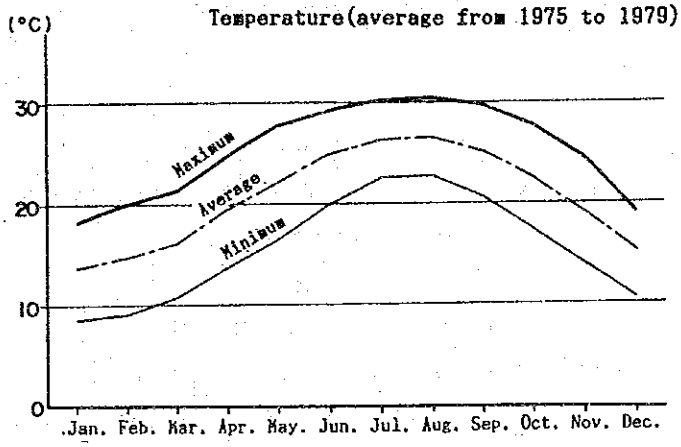


Fig. 4-2-8 RAINFALL (average from 1975 to 1979)



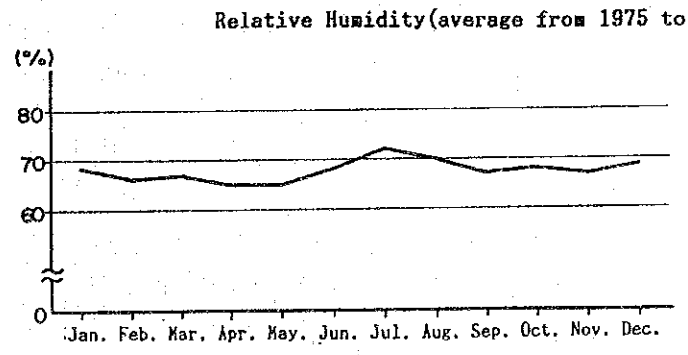


Fig. 4-2-9 TEPERATURE AND RELATIVE HUMIDITY

5) Atmospheric Conditions

(1) Air Pollution

Solid wastes delivered to dump sites in the city tend to dry quickly and to be burned spontaneously because of the climatological conditions, little rainfall and heavy sunshine, in Alexandria. In many sites in the city lots of solid wastes are burned on the ground. The surfaces of the ground in sites are covered with burned ashes. In addition, a significant amount of dust is scattered in the air due to entry and exit of garbage carts, dumping of solid wastes, ground leveling by buldosers, and so on. The actual measurement survey, which was conducted chiefly at Airport Dump Site in November, 1984, shows that the dust ratio in and around the Dump Site is high and the ratio becomes lower according to the distance from the site. The relationship between dust ratio and wind direction is significant. Settled dust and suspended particulate dust show an identical tendency.

Of all values confirmed, every value recorded near the site went beyond the standards to be observed, 260mg/m^3/24h for suspended particulate dust and 50 tons/$mile^2$/month for settled dust.

Water sprinkling is carried out at Moharam Bey Dump Site, the planned area, to prevent spontaneous combustion of solid wastes, but the state of generation of suspended particulate dust and settled dust represents the same conditions at the above Airport Dump Site.

As is apparent from landuse of the surrounding areas and climatological conditions, dust generated in Moharam Bey has scattered to Drinking Water Canal, Secondary School, the existing residential area and its vicinity throughout the year, which might affect people's health condition.

(2) Offensive Odor

According to interviews with residents in and around dump sites, people living in areas within approximately 500m from dump sites feel an offensive odor during a season when they live on the lee. They say that children in family abhor the odor and try to close windows. The aforementioned residential area, located adjacent to Moharam Bey, is ill-furnished with a sewage system, and, since residents' concern is directed towards odor in the sewage system, the odor given off from Moharam Bey Dump Site has not so far become an issue.

6) Water Quality

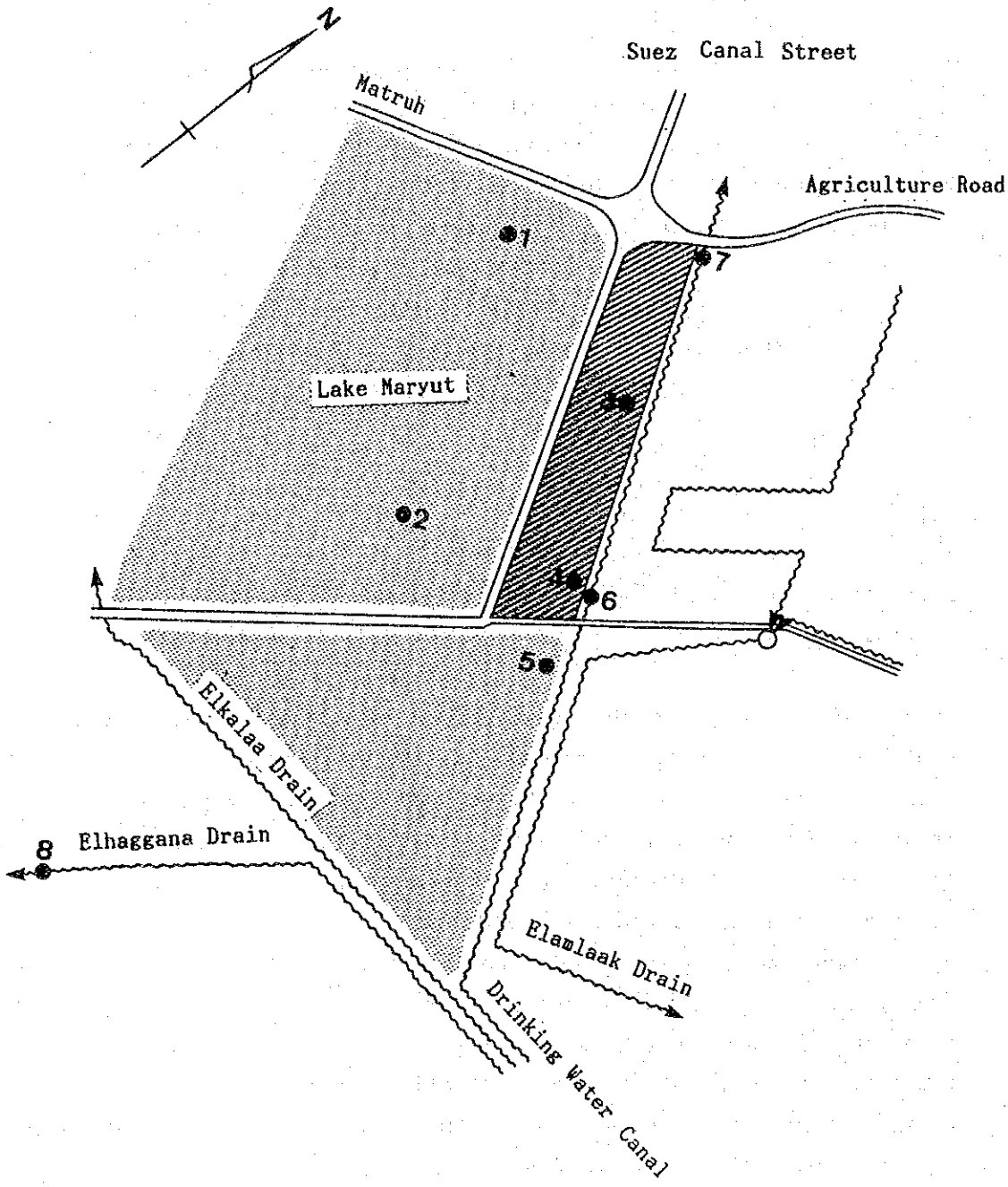
(1) Canal and Lake Water

A map describing canals and lakes in and around the planned area is shown in Fig. 4-2-10.

In the northeast of the planned area, Drinking Water Canal runs from the southeast to northwest directions. In the southwest of the designed area there is Lake Maryout, and in the southeast the Fish Breeding Basin (306 fedans). Additionally, as indicated in the figure, drainage systems for Elamlaak, Elkalaa and Elhaggana are laid. Lake Maryout has been used as fishing grounds, but, because sewage water discharged from its surrounding area flows into this lake, water pollution in the lake has been aggravating, while functioning as a natural sewage disposal system. The Fish Breeding Basin was built, as its title shows, to breed fish, and improvements on this Basin have presently been made. Elamlaak and Elkalaa Drains are used as a sewage system, and Elhaggana drain as a drainage waterway for reclaimed farmlands.

(2) Water Quality

The water sampling places for chemical analysis of water conducted in August, 1985 and its analytical results are indicated in Fig. 4-2-10 and Table 4-2-1.



(Numbers show water sampling places)

Fig. 4-2-10 SITUATION OF WATERWAYS AND LAKES

Tab. 4-2-1 ANALYSIS OF WATER QUALITY

Results of Chemical Analyses of Water
Samples from Lake Maryout

Parameter \ Sample No.	1	2	3	4	5	6	7	8
Temp.-℃	31	31	30	30	30	30	30	29
pH	7.5	7.5	7.5	7.5	6.5	7.5	7.0	7.0
Alkalinity mg $CaCo_3$/l	450	500	370	410	250	200	210	340
Total Hardness mg $CaCo_3$/l	520	550	570	1520	180	140	150	950
DO mg/l	10.6	6.0	0.0	2.0	8.0	8.0	8.5	6.5
BOD mg/l	160	260	200	160	100	2.0	2.0	100
COD mg/l	200	325	250	210	130	21.5	240	110
NH_2 - N mg/l	2.5	2.5	0.24	0.24	0.02	0.02	0.02	0.24
NO_2 - N mg/l	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.04
NO_3 - N mg/l	0.16	0.36	0.16	0.12	0.08	0.16	0.24	0.08
PO_4 - P mg/l	5.7	8.3	0.6	0.6	0.60	0.01	0.01	0.04
SO_4 - S mg/l	12	14	25	25	12	70	70	37
Cl - mg/l	760	850	3500	3400	95	40	45	260
T.S.	2564	2253	4757	5652	465	315	314	3821
F.S.	1673	1871	3993	3681	335	266	255	2981
Volatile Solids	891	382	764	1871	130	49	59	
D.S.	1889	1210	4360	3328	413	300	287	3546
S.S.	682	1043	397	2324	42.0	15	27	275

Results of Bacteriological Analyses of Water
Samples from Lake Maryout

Sample No.	MPN/100 ml Coliform group Number	Plate count / ml
1	4,600,000	330,000
2	46,000,000	3,120,000
3	460,000	38,000
4	4,600	5,500
5	11,000	13,800
6	2,100	10,500
7	4,600	29,000

These analyses were carried out under the supervision of Prof. Dr. Olfat El Sebaie.

Director of
Environmental Health Studies,
Analysis and Research Unit.

No. 1 and No. 2 points were selected to grasp the state of water pollution in Lake Maryout. In spite of the fact that DO is oversaturated at No. 1 point, BOD shows a high value of 160mg/l. This is presumably due to air dissolution occurred when waste water from factories is discharged into the lake. The presumable reason for high Cl-, COD, BOD, NH_4-N and PO_4-P values is that untreated sewage water and waste water discharged from factories flow directly into the lake. It is more accurate to say that it is not a lake but a large drainage waterway. DO is significantly lowering AT No. 3 and No. 4 points. NH_4-N and PO_4-P values are lower than those observed at No. 1 and No. 2 points, presumably because of effect of solid wastes in the dump site, based on which it seems that anaerobic dissolution of animals and plants have been progressing. COD and BOD values are high at these points. Although NH_4-N and PO_4-P showed higher values at No. 5 point than those at No. 1 and No. 2 points, it can be assumed that there occurs water purification caused by cultivated fish.

No. 6 and No. 7 points are the water source of utility water, and, judging from the analytical results, the data gained at these two points are almost identical with those gained at middle-class rivers in Japan, into which water discharged from houses flow.

The state of conditions at No. 8 point is not generally different from that of No. 1 - No. 5 points.

7) Traffic Condition

(1) Traffic Volume

The road network around the planned area is shown in Fig. 4-2-11. Agriculture Road and Desert Road, two trunk roads, cross at Moharam Bey Square adjacent to the planned area. This square, a crucial traffic point, plays a role of leading the traffic from the capital city, Cairo, to downtown Alexandria. More than 60 thousand cars pass through this square every day.
The crosssectional traffic volume of each route is stated in Fig. 4-2-11.

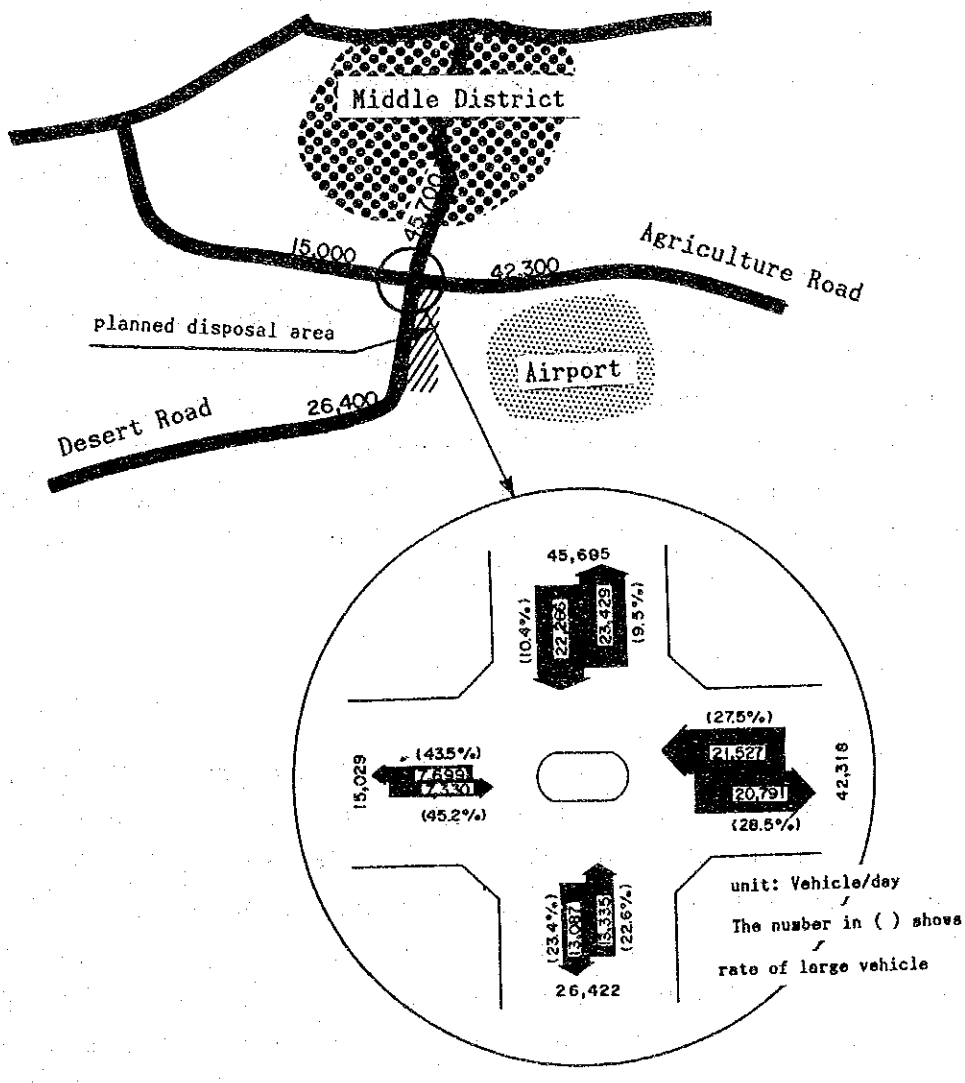


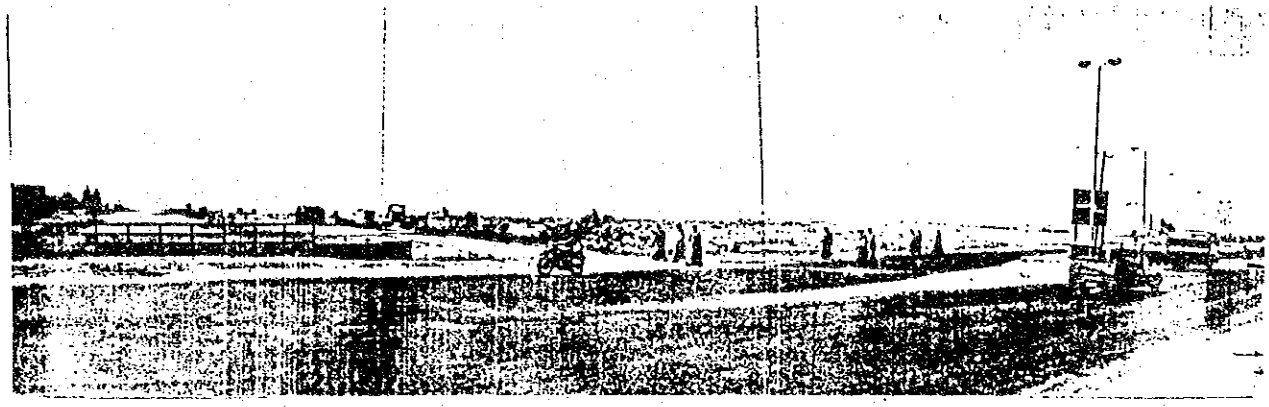
Fig. 4-2-11 ROAD NETWORK AND TRAFFIC VOLUME

(2) Environmental Impact by Traffic

Noises of road traffic are mainly due to engines in motion, waste gas and tires. In Alexandria we can see that horn sound is larger than these noises. Horn sound is relatively of higher than these noises. Horn sound is relatively of higher frequency, and, in some case, the sound is more offensive than engine noise. Around the planned area, factories, warehouses, offices and other buildings are built, Comparatively small effect on living environment caused by traffic was observed in this area, excluding a residential area and a secondary school which are located in the northeast of the planned area, but, noises caused by traffic has affected people living in 4 - 5 storied collective dwelling buildings along Suez Canal Street which connects Middle District and Moharam Bey Square. Noises generated by heavy-duty machines and garbage carts in service at Moharam Bey Square Site have little effect on peoples' lives because banks built on both sides of Drinking Water Canal percept and reduce the noises. But, since the secondary school is located close to Agriculture Road which is utilized by 40,000 cars per day, effect caused by traffic noise can not be overlooked.

8) Landscape

There is no element of remarkable landscape to be conserved in and around the planned area, however, it is located close to the crossroad of 2 trunk roads, Agriculture Road and Desert Road, which connect the capital city, Cairo and Alexandria. The existing dump site is seen on the left side of Agriculture Road and right side of Desert Road. They dump solid wastes in this site in an open dumping method. Therefore, it has caused most unfavorable effect on landscape such as a scattering of solid wastes which cover a wide space, suspended particulate dust, smoke caused by spontaneous combustion, dust generated by running of heavy-duty machines and garbage carts, birds schooling on solid waste heaps, water pollution caused by dissolution of solid wastes, and so on. This negative effect displeases people who visit Alexandria.



Landscape from Agriculture Road

9) Others

Open dumping of solid wastes is carried out at present at Moharam Bey Square. Since this Square is located in a right angle to the extension of the airport runway, if the open dumping continues to be performed, there might arise a possibility that generation of smoke and flying of birds will be an impediment to departure and arrival of airplanes. Therefore, it is inadequate to select this area as an area for the said project. Especially, birds, if absorbed into a jet engine mechanism, could be cause of engine trouble.

4.2.2 Planned disposal amount and landfill period

1) Planned service area

In estimating the solid waste amount disposed of by landfill at MBSDS, it is necessary to select a planned service area. For this project we estimate the quantity of solid waste disposed of by landfill with the following districts as planned service.

- Middle District
- Gomrok District
- Part of West District: Karmouz Sub-District

The reason for selection of the above districts as the planned service area for disposal of MBSDS is stated as follows:

a) It is economically efficient to select these districts because of geographical conditions in Alexandria.

b) MBSDS is located in Middle District.

c) Except for sea there is little open space in Gomrok District. Application of sea reclamation method requires an extremely high disposal cost, and, at present, is inappropriate. Therefore, MBSDS is the only and nearest disposal site.

d) The present condition in West District is the same as that of Gomrok District except Lake Maryut. Various conditions make it difficult to use Lake Maryut at present. Judging from the state of traffic conditions and geographical conditions, it is economically efficient to deliver solid wastes in Karmouz Sub-District to MBSDS.

e) These districts are identical with present service area for disposal at MBSDS.

2) Collection, Treatment and Disposal Flow

The flow chart for collection, treatment and disposal of solid wastes presently carried out at the planned service area for disposal is described in Fig. 4-2-12. A plan is made to construct, additionally to this flow, a 300 ton/day compost plant.

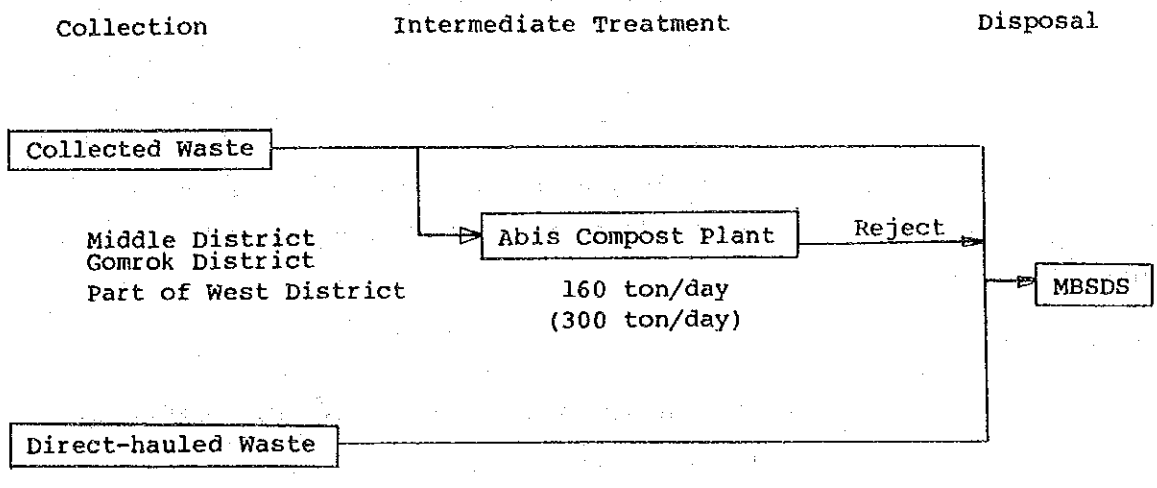


Fig. 4-2-12 FLOW CHART FOR COLLECTION, TREATMENT AND DISPOSAL OF SOLID WASTES AT THE PLANNED SERVICE AREA

3) Planned disposal amount

The amount of solid wastes disposed of at MBSDS, as stated in Item 2.12 of Supporting Report, is summarized in Tab. 4-2-2.

Tab. 4-2-2 SOLID WASTE AMOUNT DISPOSED OF AT THE MBSDS IN 1985

Item / District	Collected Waste	Direct-hauled Waste	Total
Middle District	340 ton/day	N.A.	N.A.
Gomrok District	210 ton/day	N.A.	N.A.
Part of West District	94 ton/day	N.A.	N.A.
Total	644 ton/day	**22 ton/day	666 ton/day

*Estimated by last year's survey

The amount of solid wastes generated at the planned service area for disposal in 1985, calculated according to the Master Plan, is summarized in Tab. 4-2-3.

Tab. 4-2-3 SOLID WASTE AMOUNT GENERATED IN PLANNED SERVICE AREA FOR DISPOSAL IN 1985

District	Amount of Waste
Middle District	*396 ton/day
Gomrok District	196 ton/day
Part of West District	86 ton/day
Total	678 ton/day

*excluding 18 ton/day of vacationer's wastes

It is presumed that solid waste amount mentioned in Tables 4-2-2 and 4-2-3 is almost equal, taking into account the running ratio of Abis Plant and the totalization aberation. Therefore, the amount of solid wastes generated in the planned service for disposal, which is presumed on the Master Plan, is used as the planned disposal amount.

The calculation of landfill quantity at MBSDS is done based on the following conditions.

a. Planned service for disposal

Middle District, Gomrok District and Part of West District.

b. Planned disposal

The planned disposal amount should be the amount of solid wastes generated in planned service area, which is presumed on the Master Plan, including vacationer's wastes and compost reject.

c. Intermediate treatment facilities

The existing Abis Compost Plant (processing quantity: 160 ton/day, running ratio: 300 day/year) New Abis Compost Plant (processing quantity: 300 ton/day, running ratio: 300 day/year, timing of commencement of operation: July 1990)

The calculation of the disposal amount was done assuming the case where New Abis Compost Plant will be constructed. The results of calculation are summarized in Tab. 4-2-4.

S.R.Tab.4-2-4

SOLID WASTE QUANTITY DISPOSED OF AT MBSDS & QUARRY DISPOSAL SITE
(WITH NEW ABIS COMPORT PLANT)

ITEMS	Year	* 1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
DAILY ton/day	Middle District	396	404	411	418	426	433	445	456	467	478	489	500	512	525	538	550
	Gomork District	196	200	204	207	211	215	221	227	233	239	245	252	258	264	270	276
	Part of West Dist	86	87	89	91	92	94	96	98	100	101	103	105	106	108	110	112
	Sub-Total	678	691	704	716	729	742	762	781	800	818	837	857	876	897	918	938
	Vacationer Waste	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
	Waste Treated at Compost Plant	-160	-160	-160	-160	-160	-160 -460	-460	-460	-460	-460	-460	-460	-460	-460	-460	-460
	Ratio of (%) Compost Reject	29.8	30.1	30.5	30.9	31.2	31.6	31.8	32.0	32.2	32.4	32.6	32.8	32.9	33.0	33.1	33.2
	Compost Reject	48	48	49	49	50	98	146	147	148	149	150	151	151	152	152	153
ANNUAL ton/year	Generated Waste	101	252	256	261	266	270	278	285	292	298	305	312	319	327	335	342
	Vacationer Waste	0.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	Waste Treated at Compost Plant	-20	-48	-48	-48	-48	-93	-138	-138	-138	-138	-138	-138	-138	-138	-138	-138
	Sub-Total	81	205	210	214	219	179	141	148	155	162	169	176	183	191	198	205
	Cumulative Sum	81	287	498	713	932	1112	1253	1402	1558	1720	1889	2066	2249	2440	2639	2845
unit 1000	Compost Reject	6	14	14	14	15	29	43	44	44	44	45	45	45	45	45	45
	Cumulative Sum	87	301	512	727	947	1141	1297	1446	1602	1765	1934	2111	2294	2486	2684	2809

* From 1st of August, 1985

4) Timing of Commencement of Sanitary Landfill

Although it is uncertain at present when the sanitary landfill work at MBSDS will start, it should be scheduled for summer of 1987 for this planning. The reason for this decision is as follows:

a. If the landfill work progresses as it stands now, the work will be carried out under the runway approach zone of the airport by that time. Therefore, it is essential to avoid occurrence of fire and the flock of birds.

Total Area of MBSDS	55.2 ha
Remaining Area (as of August 1985)	46.2 ha
Remaining Area (as of July 1987)	23.9 ha

b. The timing of commencement of operation of New Abis Compost Plant will be in 1990.
in order to cope with a remote dump site, it is required to continue to use MBSDS for more days.

c. The new fiscal year of Egypt starts in July.
Therefore, it can be interpreted that the budget for execution of sanitary landfill work will be established in the beginning of 1987.

On the basis of the above presupposition, MBSDS will be divided into 3 separate portions for landfill plan as follows:

a. landfill site in an open dumping method applied as today

b. sanitary landfill site

c. dump site utilized in the transitional period from a. to b., dump site during the construction period for b., soil cover is possible.

5) Planned landfill volume

On the basis of the aforementioned planned disposal amount and timing of the commencement of sanitary landfill, the planned landfill volume is calculated using the following coefficients.

a.	unit weight of municipal waste (refer to Note 1)	0.8 ton/m^3
b.	unit weight of compost reject (refer to Note 1)	0.6 ton/m^3
c.	unit weight of cover soil	1.6 ton/m^3
d.	ratio of cover soil to landfilled waste volume	1/7

Note 1: Refer to 3.4 of Supporting Report
Note 2: Refer to Landfill Project, 5-2-6.

The planned landfill volume in the planned service area for disposal calculated up to the year 2000 is stated in Tab. 4-2-5 and is illustrated in Fig. 4-2-13.

S.R.Tab.4-2-5

PLANNED LANDFILL VOLUME

(WITH NEW ABIS COMPORT PLANT)

unit;thousand

ITEMS		Year	Formula	Unit	* 1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
PLANNED	1	Municipal Waste		ton/ year	81	205	210	214	219	179	141	148	155	162	169	176	183	191	198	205
	2	Compost Reject		"	6	14	14	14	15	29	43	44	44	44	45	45	45	45	45	45
	3	Sub-Total	(1)+(2)	"	87	220	225	229	234	208	185	192	200	206	214	221	228	236	244	251
LANDFILLED	4	Municipal Waste	(1)/0.8 ton/m3	m3/ year	102	257	263	268	274	224	177	185	194	202	211	220	229	238	248	257
	5	Compost Reject	(2)/0.6 ton/m3	"	10	24	24	24	25	49	73	73	74	74	75	75	75	76	76	76
	6	Sub-Total	(4)+(5)	"	112	281	287	292	299	273	250	258	268	276	286	295	304	314	324	333
	7	Cover Soil	(6)/7	"	0	0	** 21	42	43	39	36	37	38	39	41	42	43	45	46	48
	8	Sub-Total	(6)+(7)	"	112	281	308	334	342	312	286	295	306	315	327	337	347	359	370	381
	9	Cumulative Sum		m3	112	393	701	1035	1377	1689	1975	2270	2576	2891	3218	3555	3902	4261	4631	5012
	10	Final Cover Soil		m3			157	32	44	44			33	11		22	22		44	

* From 1st of August, 1985
** From 1st of July, 1987

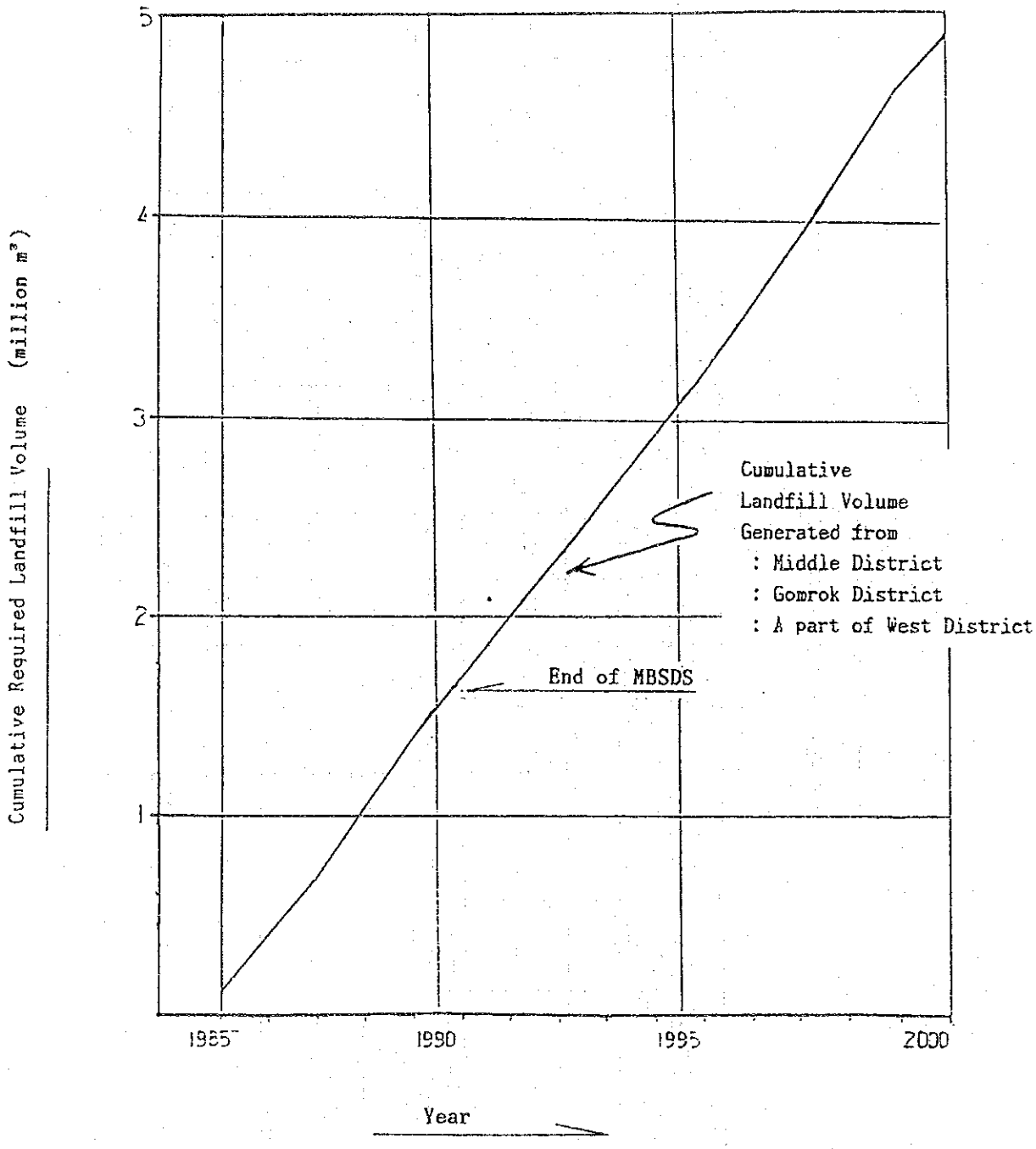


Fig. 4-2-13 CUMULATIVE LANDFILL VOLUME

6) Calculation of Landfill capacity

Based on the results of topographic survey conducted in August 1985, the landfill capacity of MBSDS is calculated. Prior to calculation the height of waste landfil is decided as - 1.70m (1.7m below the average sea level). The reason for this decision is stated as follows:

a. LWL (Low Water Level) of DWC (Drinking Water Canal) is -1.70m, and, if solid wastes are landfilled, going beyond this height, it will cause a risk of pollution at DWC.

b. Except for bank of DWC, the height of the surrounding ground level is generally -1.70m.

c. Since it is located in the runway approach zone to the airport, it is not desirable to mound the ground, going beyond the present height of the surrounding area.

With the height, -1.70m, of the completed landfill, the remaining landfill capacity as of August 1985 is 925,000m^3. Taking into account the settlement height, 50cm, of the existing ground, the above remaining landfill capacity becomes 1,162,000m^3. (Refer to Tab. 4-2-6 to 4-2-7). Furthermore, adding the excavation volume of the bottom of the site for securing cover soil, the figure becomes 1,617,000m^3.
(Refer to Table 4-2-8.)

S.R.Tab.4-2-6 LANDFILL CAPACITY

Section	Distance	Landfell Volume			Comulateve Volume
		Area	Average Area	Volume	
	m	m2	m2	m3	m3
13	0				
13'	95	290	145	14,000	
10	295	670	480	142,000	156,000
9	272	760	715	194,000	350,000
8	104	700	730	76,000	426,000
7	95	740	720	68,000	494,000
6	56	710	725	41,000	535,000
5	88	750	730	64,000	599,000
4	79	750	750	59,000	658,000
3	127	730	740	94,000	752,000
2	70	730	730	51,000	803,000
1	101	680	705	71,000	874,000
1'	25	680	680	17,000	891,000
0	101	0	340	34,000	925,000
Sub-Total				925,000	

S.R.Tab.4-2-7 LANDFILL CAPACITY
(INCLUDE SETTLEMENT)

Section	Distance	Landfell Volume			Comulateve Volume
		Area	Average Area	Volume	
	m	m2	m2	m3	m3
13	0	0	0		
13'	95	440	220	21,000	
10	295	830	640	189,000	210,000
9	272	930	880	239,000	449,000
8	104	860	900	96,000	543,000
7	95	910	890	85,000	628,000
6	56	880	895	50,000	678,000
5	88	920	900	79,000	757,000
4	79	920	920	73,000	830,000
3	127	900	910	116,000	946,000
2	70	900	900	63,000	1009,000
1	101	850	880	89,000	1098,000
1'	25	850	850	21,000	1119,000
0	101	0	430	43,000	1162,000
Sub-Total				1162,000	
Excavation Volume				455,000	
Total				1617,000	

S.R.Tab.4-2-8 EXCAVATION VOLUME

Section	Distance	Excavation			Comulateve Volume
		Area	Average Area	Volume	
	m	m2	m2	m3	m3
0	0				
1'	101	920	460	46,000	
1	25	920	920	23,000	69,000
2	101	880	900	91,000	160,000
3	70	880	880	62,000	222,000
4	127	830	860	109,000	331,000
5	79	830	830	66,000	397,000
5 + 69	69	850	840	58,000	455,000
Total				455,000	

7) Presumption of Landfill Period

In estimating the landfill period of MBSDS based on the aforementioned planned landfill volume and landfill capacity, the period is mentioned in Tab. 4-2-9.

Tab. 4-2-9 LANDFILL PERIOD OF MBSDS

Site	Land Area (m^2)	Date of Commence-ment	Date of Comple-tion	Landfill Volume (m^3)	Cumulative sum (m^3)
Open Dumping Site	90,000 (filled) 223,000 (remained)	Aug.,1985	June, 19878	537,000	537,000
Dumping Site During Con-struction	64,000	July, 1987	Dec., 1987	161,000	699,000
Sanitary Landfill Site	175,000	Jan., 1988	Oct., 1990	918,000	1,617,000
Total	552,000	--	--	1,617,000	--

8) Calculation of Settlement

The settlement volume of the soft layer of MBSDS, due to landfill of solid wastes, is calculated using the following formula.

The total settlement volume is calculated as:

$$S = Sc + St$$

the following formula is used:

$$Sc = \frac{eo - e}{1 + eo} \times H$$

$$St = \frac{1}{100} \times A \times rtE \times HE$$

Each symbol represents:

S : Total settlement volume (cm)
Sc : Settlement volume by consolidation (cm)
St : Instantaneous settlement volume (cm)
eo : Initial voil ratio
e : Void ratio after termination of consolidation
H : Thickness of each poor subsoil (cm)
A : Constant of instantaneous settlement of ground (cm)
rtE : Unit weight of banking soil (g/cm^3)
HE : Height of banking

With the result of calculation, the total settlement is 69.8cm. Taking the settlement time into consideration, 50cm settlement is considered for the calculation of landfill capacity of MBSDS.

4.2.3 Plan for construction of facilities

(1) Facilities of the final disposal site

The final disposal site consists of the undermentioned facilities, and the construction should be implemented in conformity with an appropriate planning, design and execution scheme.

- Pre-processing facilities
- Facilities for preventing the outflow of waste such as retaining walls and the like
- Seepage control facilities
- Collection and drainage facilities for storm water and the like
- Collection and drainage facilities for leachate and the like
- Leachate treatment facilities
- Facilities for preventing wastes from scattering
- Facilities to cope with gas generated in the disposal site
- Fire prevention facilities
- Facilities for inspection and administration
- Site access roads
- Gate and fences

Contents of these facilities are stated in Table 4-2-10. These facilities at the final disposal site are roughly categorized as follows:

- Landfill Site
- Facilities for inspection and administration

Tab. 4-2-10 FACILITIES OF FINAL DISPOSAL SITE

Type of Facility	Contents of Facility
*Pre-processing facilities	Crusher (excluding a bulky waste processing facility)
Facilities for preventing the outflow of waste such as retaining walls and the like	Storage (enclosing) embankment, retaining walls and the like
Seepage control facilities	Seepage control work
Collection and drainage facilities for storm water and the like	Storm water drainage facilities (N-shape gutter, inlet, etc.) Ground water drainage facilities (underdrain and the like)
Collection and drainage facilities for leachate and the like	leachate collection and drainage facilities (collection pipe, collection pit, driving pipe etc.) Miscellaneous drainage (Drainage facilities for waste water of domestic, carmash and truck scale - sewage pipe, inlet, manhole, etc.
Leachate treatment facilities	Leachate treatment work
Facilities for preventing wastes from scattering	Fence for preventing wastes from scattering, etc.
Facilities for cope with gas generated in the disposal site	Gas removal pipe, etc.
Fire prevention facilities	Hydrant, Fire prevention tank, etc.
Facilities for inspection and administration	Truck-scale, car wash, administrative building (or weighing building, etc.)
Site access road	Outside access road, inside access road
Gates and fences	Gate and blind fence

Note:

Since bulky solid wastes can be compacted and crushed to a certain extent, a crusher as pre-processing facilities is not necessary.

Facilities for Environmental Conservation

This section is provided to plan for facilities except those for environmental conservation.

2) Facilities Plan

a. Pre-processing facility

Not planned in particular. A certain extent of crushing can be done by compactor as a landfill equipment.

b. Facilities for preventing the outflow of waste such as retaining walls and the like

Since the site is located in the lowlands surrounded by banks, these facilities is not necessary upto the same height as that of the surrounding ground. In addition, since this site is located in adjoining to the DWC as well as in the runway approach zone of the airport, as stated in the landfill plan, these facilities are not planned, since the landfill work will not be performed going beyond LWL of DWC.

c. Collection and drainage facilities for storm water and the like

Judging from the average annual precipitation, 184.5mm, and the final cover soil, which will make the Elevation of ground equal to -1.10m, the ground level will become higher than that of surrounding areas, excluding DWC. For this reason, this facility will not be planned.

Ground water drainage facility will not be planned because seepage control facility is not installed.

d. Seepage control facilities

Not planned. The reason for this decision is stated in f., leachate control facility.

e. Collection and drainage facilities for leachate and the like

Leachate collection and drainage facility is mentioned in f., leachate control facility. Waste water is carried to the leachate regulating pond by concrete pipe, and naturally treated in this pond.

f. Leachate control facility

The most critical improvement conditions for MBSDS are for waste water (leachate) seeping out of the site. This has a lot to do with anti-pollution measures of DWC in particular. These measures include the following 2 proposals.

- Complete shut-off of waste water (leachate) by seepage control work such as laying impermeable rubber sheet inside the site.

- Leachate control measures by suppressing the underground water level at the site for disposal to lower than the water level of DWC.

For this project the latter plan should be applied for the next reason.

- Although it is possible to completely shut off the site for disposal by sanitary landfill to be newly constructed, to carry out anti-pollution measures for the portion which is already landfilled until the opening of the sanitary site is difficult, if the former plan is applied.

- Seepage control work for the open dumping site and attachment portions of the sanitary landfill site for disposal is difficult, if the former plan is applied.

- Underground water control work for seepage control facility is difficult.

- The latter plan is reasonable in construction cost.

- Differential settlement will be anticipated.

As for possibility of waste water seeping out of the site, it is conceivable that the underground water pollution, contamination of Lake Maryut and pollution of Fish Breeding Pond will possibly occur. However, seepage control facility will not be planned at these places for the following reason. Instead, they should be monitored for uncertain points of seep-out waste water as stated later and should be ready for an emergency.

(1) The normal underground water level of MBSDS is lower than that of other areas.

(2) Compared with bank of DWC, those at other 2 places are wide and rigid.

(3) Underground water utilization is not carried out at surrounding areas.

Leachate control facility includes the following facilities, and details of plans are mentioned in (4).

(1) Filter

1.0m in width, 4.0m in height, 460m in length
composed of sand and gravel

(2) Leachate collection pipe

300mm in diameter, 450m in length, perforated concrete pipe.

(3) Sewage pump

100mm in diameter, discharge rate: 0.262m^3/min, total pump head: 33.0m, sewage pump: 2 units

(4) Collection pit and pump station

Automatic controll equipment (provided with water level gauge for automatic start and pause)

(5) Leachet pipe

80mm in diameter, 920m in length, steel pipe

(6) Leachate regulating pond

Effective capacity: $570m^3$

(To be constructed by excavating the landfill site, lined with soil cover soil)

g. Leachate treatment facilities

Not planned. Since the aforementioned leachate regulating pond designed as a part of leachate control facility is comparatively shallow, it has oxidation effect and sedimentation effect, contributing for reducing both BOD and COD.

b. Facilities for preventing wastes from scattering

A concrete block masonry fence with 2m height will be constructed around the disposal site, with the purpose of preventing the intrusion of animals and functioning as a screen as well.

i. Facilities for inspection and administration

A truck scale, car wash and office building will be planned as follows:

- Truck scale

4-point supporting load cell type, remote control digital indicator, on-ground type: The maximum weighing capacity of 30 tons will be planned. The reason for this decision is as follows:

(a) Easy for maintenance and operation
(b) Electricity is available at the site
(c) Ground water level is high

- Car wash

In order to prevent a trunk road, Alex-Cairo Desert Road, from being polluted by collection vehicles, pool type car wash will be provided, as shown in the drawings. A water tap will be equipped, beside the pool-type car wash in order to make it possible to wash the car body itself as necessary.

- Office building

It is conceivable to build an office building equipped with a weighing office and various other functions. However, it is enough to prepare space for weighing work recess and storage for various tools and materials, in case, the solid waste management work is carried out at other places.

In addition, it will be more efficient to contain all spaces into one building, not making each space set up at different places.

Necesssary space is as follows:

- weighing room
- recess room
- simple office
- shower room
- single kitchen
- lavatory
- store

It is considered that each of the above should not necessarily be given independent space. If the weighing room, clerical work office, etc. are in the same space, the entire size can be minimized, it steps up cost efficiency. Details concerning this space allocation is stated in the drawings.

j. Site access road

The existing Alex-Cairo Road and Agriculture Road will be utilized as the out-site access road.
As for the in-site access road, a gravel-metaling road will be constructed, as shown in the drawings. The outline of construction is stated as follows.

Total Length -------- 2,060m
Width of Pavement -------- 8m
Thickness of Pavement ---- 15m (gravel)

3) Facilities layout plan

It is essential to bear in mind the following matters for the planning layout of facilities.

a. Having to negative effect on the surrounding areas by paying attention to the state of landuse conditions in the surrounding areas.

b. Having a superior traffic flow for entry and exit of collection vehicles and cover soil carrier.

c. Paying attention to entry and exit places of the disposal site, because of heavy traffic at the Desert and Agriculture Road.

d. Separating collection vehicles and other cars as much as possible at the Desert and Agriculture Road.

e. Necessity to secure a wide stock yard for cover soil (approximately 210 thousand m^3)

f. Avoiding a solid waste landfill site as much as possible for location of the office building, truck scale and other structures.

g. Avoiding adjacentness for constructing a leachate regulating pond to DWC.

h. Capability of smooth service of solid waste inspection and weighing, even when a number of collection vehicles enter the site.

As a result of considering these matter, the planned layout of facilities provided as shown in Fig. 5-2-3 in main report.

4) Design of leachate control facility

a. Policy

It is indipensable to keep the underground water level of MBSDS lower than LWL of DWC for the operation of this disposal site.

MBSDS is surrounded with waters beyond roads and bank in 3 directions except the north.

The survey and DWC water level observation (July - September 1985) conducted in August 1985 showed the water level of each area.

MBSDS	----------	-2.30m
West Side (Lake Maryut)	----------	-2.15m
South Side (Fish Breeding Pond)	----	-1.88m
East Side (DWC) HWL	----------	-0.85m
LWL	----------	-1.70m

Based on these survey data it is apparent that the DWC water level, even at the LWL, is the highest.
Aside from precipitation, assuming that there is no effect of artesian aquifer, the underground water level at MBSDS will be lower than that of DWC. The artesian aquifer was not confirmed on the basis of the existing boring (data which were gained by 3 shafts bored into the GL -10m point.) Therefore, the measures for ascending water going beyond the water level of DWC at MBSDS will be directed only towards precipitation. The most dangerous conditions for ascending water level at MBSDS caused by rainfall are stated as follows:

- DWC is in the state of LWL.

- The underground water level of MBSDS is the same as LWL of DWC.

It is hardly possible to predict the above state of conditions, but, on the presumption of these conditions and at the occurrence of certain ratio of precipitation, leachate control facility to suppress the ascension of underground water level of MBSDS and to prevent pollutio at DWS should be planned. In planning for controlling leachate volume, the following basic ideas concerning the calculation of leachate volume are suggested.

- To calculate the volume by judging the leachate volume collected in leachate collection pipe through a filter.

- The whole precipitation will be judged as leachate for pumping up to the leachate regulating pond.

Water level ascension at the MBSDS is caused by the precipitation. With the difference in water level between the site and DWC, leachate permeates into DWC. The time required for the permeance is calculated by Darcy's law using the difference in water level. Water level of the MBSDS should be lowered than that of DWC before leachate permeates into the MBSDS. The discharge rate of the pump is calculated with the leachate discharge and the permeable time.

b. Discharge rate of pump

Comparing the former and the latter calculation methods in the preceding item, the latter method should be applied for the following reason.

- Condition for construction of leachate control facilities is that ground water level of MBSDS goes beyond LWL of DWC. Therefore, to calculate the leachate volume except this condition will never lead to the design of pollution prevention for DWC.

- If soil cover will not be carried out, the completed height will be -1.70m, lower than that of the surrounding areas.

- The objective is to prevent DWC from being polluted, not to design leachate treatment facilities.

As the design of a leachate control facility, the calculation, for draining the whole precipitation volume into a leachate regulating pond of the site within a certain period of time, is carried out as follows.

- Probable precipitation per day, in (mm/day)

With the service years of the disposal site plus 2 years, the 5-year probable precipitation should be calculated by the Thomas Plot method. The result of it is as follows:
(Refer to Fig. 4-2-14)

I_5 = 58.0mm

- Area of Landfill Site

Total Area = 65 ha
Catchment Area = 10 ha
Area of Landfill Site = 55 ha

- Difference in water level between the underground water level of MBSDS and the water level of DWC; h

h = 0.058 x 650,000 ÷ 550,000 = 0.069 (m)

- Days required for performance; D
  Coefficient of permeability: K
  $k = 3{,}360 \times 10^{-3}$ cm/sec
  Hydraulic gradient; i

$$i = \frac{\text{difference of water level}}{\text{length of permeance}}$$

$$= \frac{0.069}{8.0}$$

$$= 0.00863$$

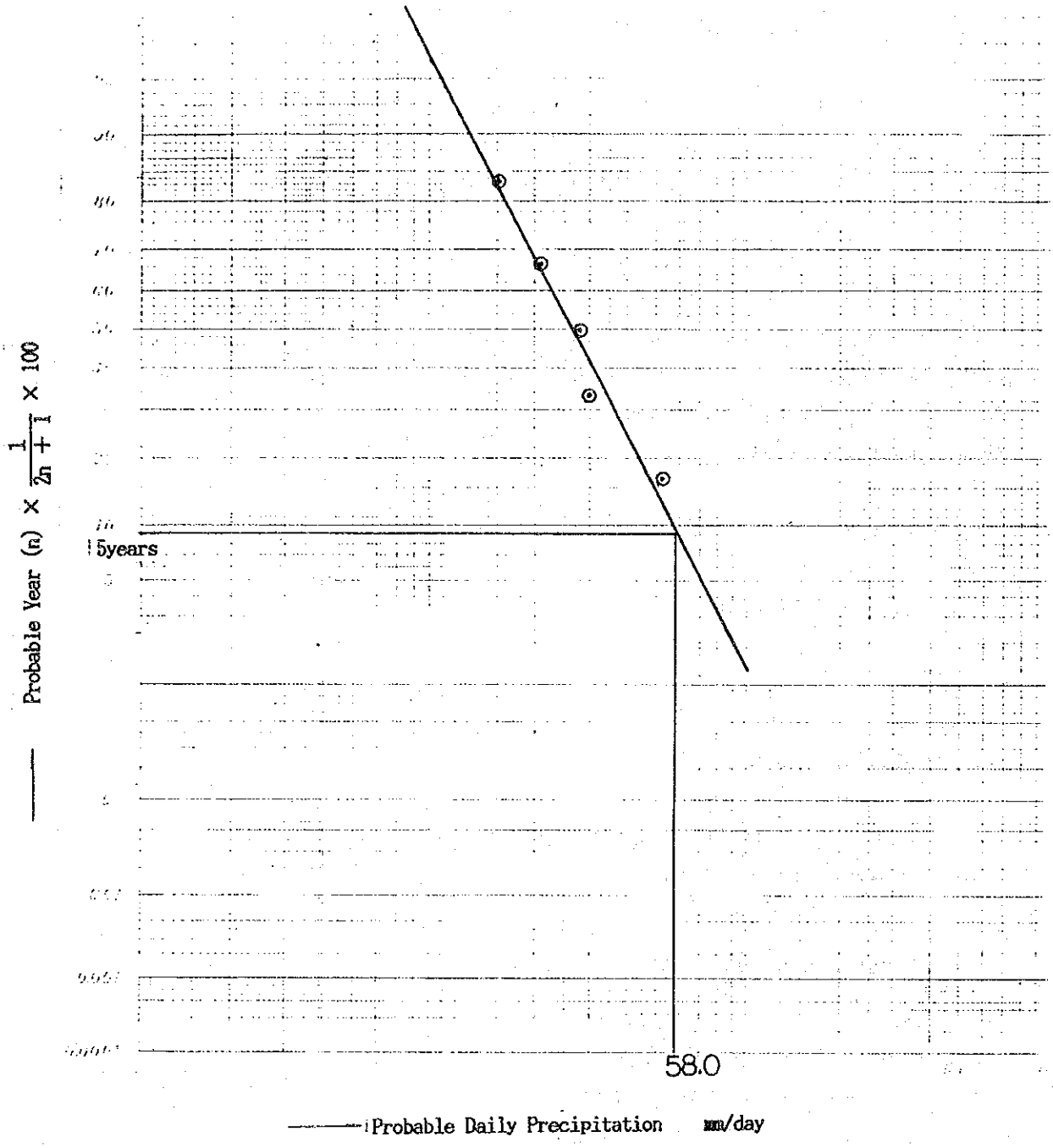


Fig. 4-2-14 PROBABLE DAILY PRECIPITATION BY THOMAS PLOT METHOD

Velocity of permeance (Vp) is drawn up by the Darcy's Law

$$Vp = 3.360 \times 10^{-3} \times 0.00863 \times \frac{86400}{100}$$

$$= 0.025 m/day$$

Here D is calculated as follow:

$$D = \frac{\text{length of permeance}}{Vp}$$

$$= 320 \text{ days}$$

- Water Drainage Volume Q

Taking into account the safety factor as 3.0 for the aforementioned days required for permeance (D), the days for leachate drainage will be 100 days. Therefore the water drainage volume (Q) is calculated as follows:

$$Q = 0.058 \times 650,000 \div 100$$

$$= 377 m^3/day$$

$$= 0.262 m^3/minuste$$

$$= 0.0043 m^3/sec$$

c. Selection of Drainage Pump

- Calculation of Pump Head

Actual pump head; Hr = 0m

Head loss; HF

diameter of leachate pipe, D=0.080m

(Steel pipe C=100)

length, L=1,500m

Using Hazen-Williams formula,

$$H = 10,666 \times c^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$$

$$= 30.7m$$

If plumbing loss around the pump station and discharge loss are considered as 2.0m totally, whole head loss comes as follow.

$HF = 30.7 + 2.0$

$= 32.7 \fallingdotseq 33.0m$

Based on the above calculation, the total pump head (HT) is,

$HT = HR + HF$

$= 33.0m$

- Selection of Pump

Taking leachate quality and so on into account, type of pump to be installed will be submergible pump for waste water.
Conditions for calculation of pump capacity are as follows:

$Q = 0.262m^3/minute$
$HT = 33.0m$
$F = 50\ Hz$
$P = 7.5\ KW$

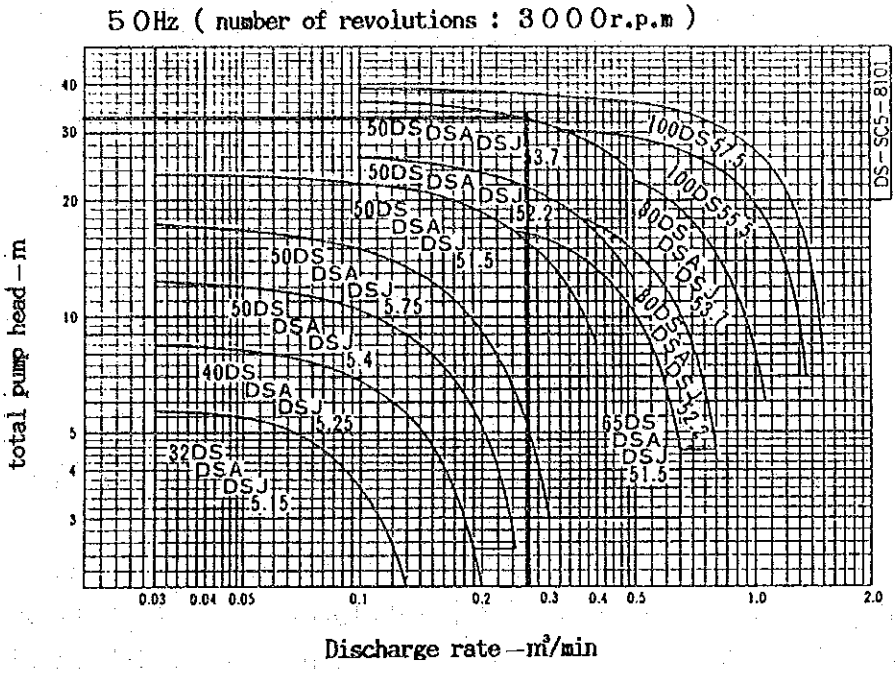


Fig. 4-2-15 PUMP SELECTION DIAGRRM

Based on the above diagram, the type of pump to be selected is,

Dia. 100 x 0.262m^3/min x 33.0m x 2 units

(one pump will be provided for spare)

4.2.4 Landfill Plan

1) Basic Policy

The following basic policy is sustained for preparation of landfill plan.

a. Solid wastes are spread and compacted sufficiently.

b. The scattering of solid wastes is minimized.

c. The diffusion of offensive odor is minimized.

d. Stabilization of wastes as early as possible is arranged.

Compaction of solid wastes is necessary for lengthening the service life of the landfill site, which also is helpful to lessen settlement after completion of landfill. Furthermore, to prevent solid wastes from scattering and diffusion of offensive odor is required in order to conserve the surrounding environment. For the ultimate use of the completed landfill site, early stabilization of the landfilled site is necessary to secure safety for use of the site.

2) Landfill structure

The landfill structure is classified into five types; anareobic landfill, anaerobic sanitary landfill, modified anaerobic sanitary landfill, semi-aerobic sanitary landfill, and aerobic sanitary landfill. The evaluation of landfill structure follows this order. It is a proven fact that the more evolved landfill structure is, the more contributive to elimination of pollution factors.

Figure Fig. 4-2-16 shows types of landfill structures.

a. Anaerobic landfill

Leachate generated in solid waste layers is scarcely drained but remains inside, that keeps landfill always in an anaerobic state. Quality of leachate is extremely deteriorated, which causes rank odour and breeding of vector and vermin (flies, rats, etc.). Anaerobic landfill can be said to be an uncontrolled landfill structure.

b. Anaerobic sanitary landfill

Overlay with cover material is made each time when waste layer reaches a certain thickness. Though this prevents generation of rank odour, fire, vector and vermin, the problems of leachate and gas generation remain.

c. Modified anaerobic sanitary landfill

In addition to overlay with cover material, drainage is provided to drain accumulated leachate at the landfill bottom. On this arrangement, the quality of leachate is much improved as compared with the above two cases.

d. Semi-aerobic sanitary landfill

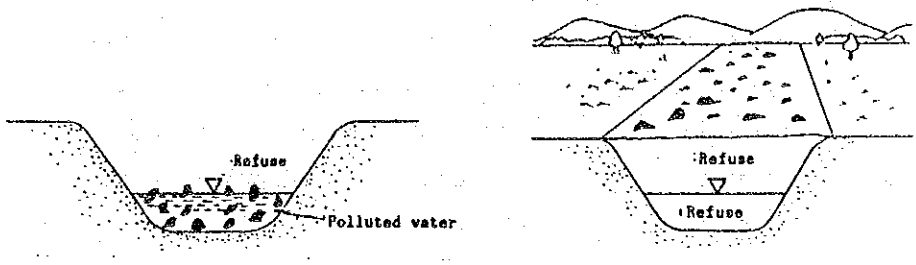
Accumulated leachate at landfill bottom is promptly discharged through a drain pipe. The pipe also permits the natural inflow of air. This structure speeds up the decomposition of solid waste. The quality of leachate is also much improved.

e. Aerobic sanitary landfill

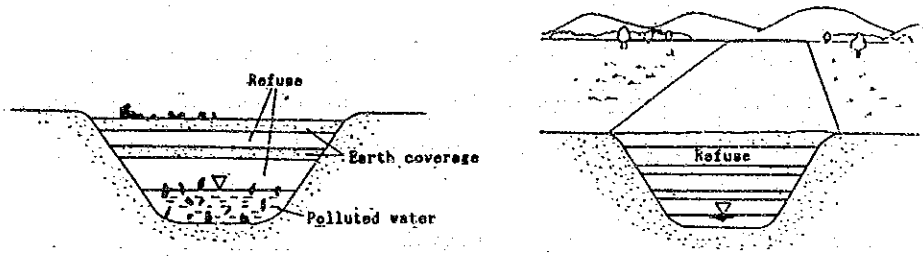
Air is forcibly fed into waste layers in order to keep them in an aerobic condition so that the solid waste is rapidly decomposed and stabilized. Leachate quality is highly improved with this method. A difficulty with this method is its high operating cost.

The landfill structures of every disposal sites in Alexandria are the anaerobic landfill stated in a. Taking into account topographical and geological conditions as well as established basic policy of this project, the landfill structure to be applied to the MBSDS is the modified anaerobic sanitary landfill.

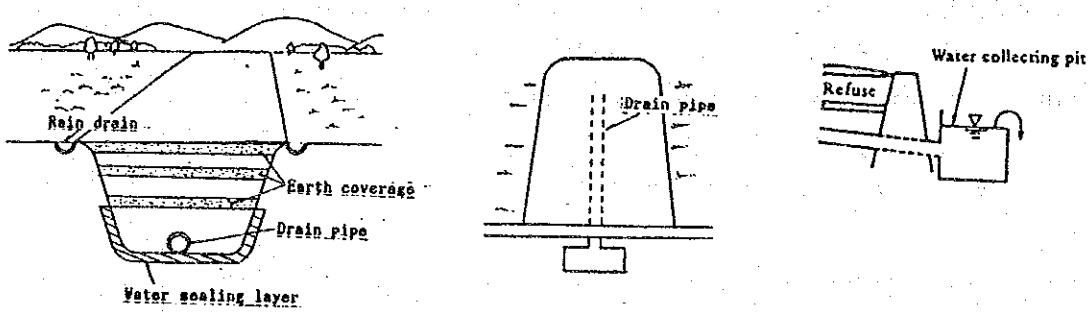
1. Anavrobic landfill



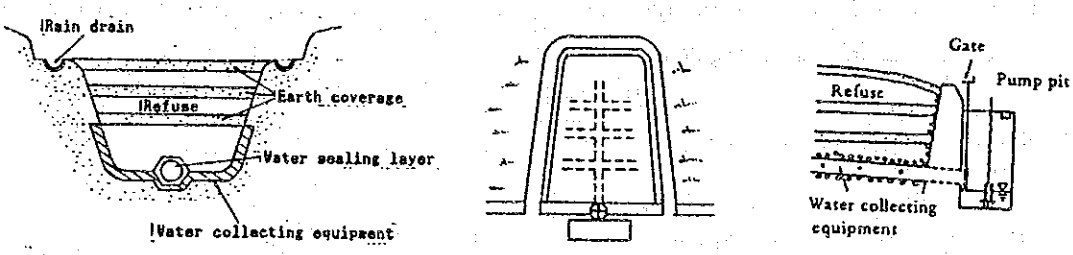
2. Anavrobic sanitary landfill



3. Modified sanitary landfill



4. Semi-aerobic landfill



5. Aerobic landfill

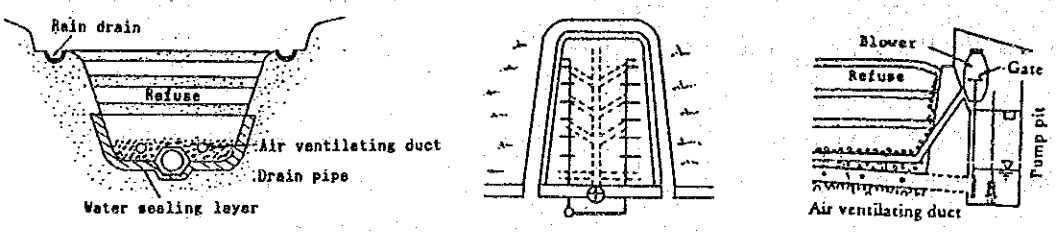
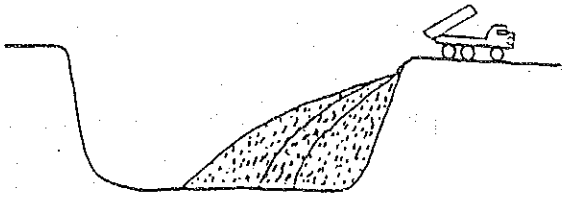


Fig. 4-2-16 LANDFILL STRUCTURE

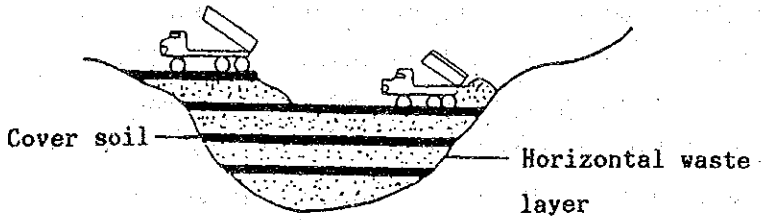
3) Landfill Method

The landfill method includes open dumping, sandwitch and cell method. The open dumping method has conventionally been carried out at every dump site in Alexandria, but, through this method, a highly-compacted landfill cannot be expected, nor scattering of wastes, generation of offensive odor, breeding of vectors and insects, and so on can be prevented.

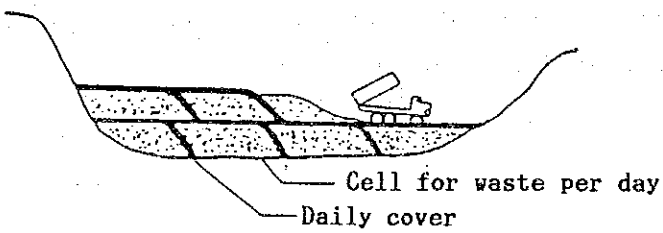
The sandwitch method is applied by landfilling solid wastes horizontally, and covering soil over the ground, through which to form different layers. In the case where a landfill site is narrow, this method is effective, but if the site is wide, solid wastes are left uncovered for a couple days, causing unfavorable results of offensive odor and so on.
The cell method is applied by covering soil on solid wastes every day. Through this method a highly-compacted landfill can be expected and it is considered possible to prevent scattering of solid wastes, generation of offensive odor and breeding of vectors and insects.
Since the landfill site is wide at the MBSDS, compared with its landfill volume, the sandwitch method is applied, the exposure time period of solid wastes lengthens. Therefore, the cell method as a basic policy of landfill work should be applied.



Open Dumping Method



Sandwich Method



'Cell Method

Fig. 4-2-17 LANDFILL METHOD

4) Cover Soil

Cover material should be obtained by excavation in the bottom of the site. The reason for this decision is stated as follows:

a. There is no appropriate borrowing site for cover soil in the surrounding area.
(It is impossible to obtain cover material at the farmland.)

b. The cover material are procured at desert, and these material are inappropriate for the park scheduled to be a ultimate use of the completed site.

c. Compared with procured materials (5LE/m^3), the materials obtained at the site (4.4 LE/m^3) are reasonable in price.

d. To excavate the bottom of the landfill site and use it as cover material will increase the landfill capacity of the disposal site.

The thickness of the cover soil must be decided by giving thought to the ultimate use of the site, environmental conservation plan, traffic of collection vehicles and economic efficiency. In lights of the ultimate use of the completed site, the favorable thickness of final cover is 1.0m or more and for daily and intermediate cover, the preferable thickness is more than 15cm. However each thickness is decided the following criteria, because of economic and engineering reasons. (Excavation is costly)

- daily --- 15cm
- intermediate cover (only for 1st layer) --- 15cm
- final cover --- 50cm

Taking excavation and settlement into account, the ratio of cover soil to landfill volume is calculated as follow.

- depth of landfill : Dm
- completed site level : H1 = -1.7m
- excavation level : H2 = -7.1m
  (in the case where excavation is carried out for neçessary cover soil volume.)
- settlement volume : S = 0.5m

Therefore, the D is calculated as

$$D = H1 - H2 + S = \underline{5.9m}$$

Hereat, the section of the landfill is as follows:

thickness of solid waste layer	;	2 x 2.725 = 5.45m
daily cover	;	2 x 0.15 = 0.30m
intermediate cover	;	0.15m

The solid waste volume for landfill is:

$V2 = 820m^3/day$ as of 1989.

Therefore, the size of each cell is: 2.73m x 17.33m x 17.33m.

Assuming that the gradient of side slope of a cell is described as 1:3.0, the daily cover (Vc) and the intermediate cover (Vi) can be represented by the following calculation:

$$Vc = [(17.33 \times 17.33) + 2 \times (17.33 \times 2.65^2 \times 7.95^2)] \times 0.15$$
$$= 92.4m^3/day$$

$$Vi = 17.33 \times 17.33 \times 0.15 \div 2$$
$$= 22.5m^3/day$$

Therefore, the ratio of cover soil to landfilled waste volume is calculated as follow:

$$(Vc + Vi) \; ; \; Vs = 114.9:820$$
$$= 1:7.14$$

Then, considering operation loss, the ratio of cover soil to landfilled waste volume is 1:7.

Assuming that the existing landfill site will be covered by soil 50cm to conserve the surrounding environment, the cover soil volume is calculated as follows.

Tab. 4-2-11 COVER SOIL REQUIRED IN MBSDS

Item / Site	Area	Daily and Intermediate Cover	Final Cover	Total
	ha	m^3	m^3	m^3
Open Dumping Site	31.3	0	157,000	157,000
Dumping Site During Construction	6.4	21,000	32,000	53,000
Sanitary Landfill Site	17.5	124,000	88,000	212,000
Total	55.2	145,000	277,000	422,000

Cover material can be secured by excavating the bottom of the disposal site. If excavated to the width of 260m and the depth upts -7.1m, 455,000m^3 cover soil can be obtained, as shown in Tab. 4-2-8.

5) Landfill equipment Plan

Judging from topographical and geological conditions as well as quality of solid wastes aT MBSDS, it is essential to consider the following conditions to prepare the landfill equipment plan.

a. Since there is a necessity that water-filled portion should be landfilled, equipment, which functions with the high running ratio even in the poor ground, is suitable to the landfill.

b. The wastes to be landfilled consist of combustibles and non-combustibles, and contains wastes which should be crushed. Therefore, equipment with certain extent of crushing capacity is necessary.

c. Since a large amount of garbage will be disposed of at the site, it is essential to carry out soil cover every day.

d. Not only for ultimate use of the completed site, but for keeping sanitary condition as well as longthening the lifeexpectancy of the disposal site, equipment with high efficiency in compaction is suitable. Contents of work concerning each landfill equipment at landfill site is shown in Tab. 4-2-12.

Tab. 4-2-12 CONTENTS OF THE WORKS OF THE LANDFILL EQUIPMENT

Waste Handling	Cover Material Handling	Others
Pushing (moving)	Excavation	Levelling (site access road & unloading site)
Crushing	Loading, Hauling spreading & levelling	Site maintenance
Compaction	Compaction	

Features of each equipment for landfill to suit the above work contents is indicated in Tab. 4-2-13.

Tab. 4-2-13 COMPARISON OF LANDFILL EQUIPMENT PERFORMANCE

Machine Type	Waste Handling			Soil Covering		
	Level-ing	Compact-ing	Trench-ing	Level-ing	Compact-ing	Trench-ihg
Crawler-dozer (Bulldozer)	Excel-lent	Good	Fair	Excel-lent	Good	Poor
Crawler-loader (Tractor shovel)	Good	Good	Excel-lent	Good	Good	Poor
Wheel-dozer	Excel-ent	Good	Fair	Good	Good	Poor
Wheel-loader	Good	Good	Fair	Good	Good	Poor
Scrape-dozer (Scraper)	Poor	Poor	Good	Excel-ent	Poor	Poor
Power shovel	Poor	Poor	Excel-lent	Fair	Poor	Poor
Landfill compactor	Excel-lent	Excel-lent	Poor	Good	Excel-lent	Poor

Source: The text by Japan Environmental Sanitation Center

Explanations are provided to select the followings as landfill equipment at the MBSDS.

a. Landfill compactor

For pushing, moving, crushing and compaction of solid wastes. Since both combustibles and non-combustibles are landfilled, and the pre-processing facilities for solid wastes, which demand crushing are not planned for economic reason, it is favorable to add landfill equipment with superb crushing capacity. A landfill compactor excells in crushability, and it is better in compaction, pushing and moving than other types of equipment.

b. Back hoe

For excavation and loading of cover material. A back hoe is inferior to a crawler-loader in loading capacity, but is excellent in excavation specially that of the under ground. Not only for MBSDS but for other disposal sites, cover materials will be obtained by excavation and levelling of the ground. For this reason the back hoe should be applied.

c. Dump truck

For hauling of cover material. If a scrape-dozer is applied, it is possible to excavate for cover material and haul it by the same equipment. However, there still remains an problem of running and excavation on the poor ground, high purchase cost, and inapplicability for other purposes, excavation should be done by back hoe, and hauling by dump truck.

d. Bulldozer

For leveling and compaction of cover material. A bulldozer excells in levelling and compaction of soil, and is most widely used. Considering that the site is located on the poor ground, a bulldozer for swanp should be utilized.

e. Motor sprinkler

As stated in Item, Environmental Conservation Plan, in order to prevent scattering of dust and solid wastes as well as a fire prevention measure, a water sprinkling vehicle equipped with a fire-extinguishing pump should be purchased for daily landfill work. Particularly, the vehicle is prerequisite for the work carried out in summer.

According to Haulage Frequency Survey conducted at the Air Port Dump Site in September 1984, the maximum weekly fluctuation of frequency in collection vehicles number was 1.12 times higher than the average value, and as the maximum daily fluctuation the peak hour shares, in average, 12.7% of the daily trip numbers. The peak volume of hauled solid wastes became 14.2% of the total daily volume, and if the safety ratio of 20% is considered, it becomes 17.0%.

Therefore, the work capacity of the abovementioned landfill equipment is calculated with the serviceable hours, 6 hours. Type of equipment and the number of equipment units required for sanitary landfill work at MBSDS are stated as follows:

a.	Landfill compactor	20 ton class	2 units
b.	Back-hoe	0.7m^3 class	1 unit
c.	Dump truck	11 ton class	2 units
d.	Bulldozer (for use in swamp)	14 ton class	1 unit
e.	Motor sprinkler	10m^3	1 unit

6) Operation

The operation at the landfill site is outlined in the Drawings. With reference to this figure, the operation is mentioned as follows.

a. Site access road

The route to the working face for collection vehicles is stated in the Drawings. The collection vehicle passes through the gate and truck scale from Moharam Bey Square, and reaches the disposal site, going through Site Access Road constructed at the existing, landfill site. Approach roads should be constructed with the interval of every 100m by landfilling solid wastes. Since the Site Access Road is a trunk route of MBSDS, it will be gravel-metalled, but each approach road will be constructed by compaction of cover soil. Gas removal pipes will be laid along these approach roads.

b. Special lot

Relatively less polluted solid wastes such as debris will be landfilled at areas along DWC. No special lot used during a rainy season will be prepared, but the area beside the paved Site Access Road should be utilized. Approach roads will be constructed as many as possible during a dry season. As for sewage sludges which are highly polluted wastes, they will be landfilled in a remote area afar from DWC.

c. Cover soil

As stated above, the cover soil will be obtained by excavating the disposal site. The excavated soil will temporarily be stocked at the existing landfill site. The temporary stock yard should be mounded at the height of 2.5m or less, from the standpoint of construction and maintenance.

d. Landfill method

Landfill will be carried out for 2 separate layers. Water presently kept at MBSDS will be drained, but the landfill work in the 1st layer will be carried out in the terrain containing some amount of water.
Therefore, for the first layer solid wastes will be dumped at the site and thereafter, will be compacted from the above.
The 2nd layer will be a completely dry site, and solid wastes will be landfilled in an ideal way of being compacted from the below.

e. Cell

As stated in Fig. 4-2-18, the depth of the 1st layer will be approximately 3.0m. The shape of the cell is indicated in the figure, judging from the daily landfill volume of solid wastes:

The thickness of a cover soil should be approximately 30cm in the upper portion, including an intermediate cover, and approximately 15cm in the side portion.

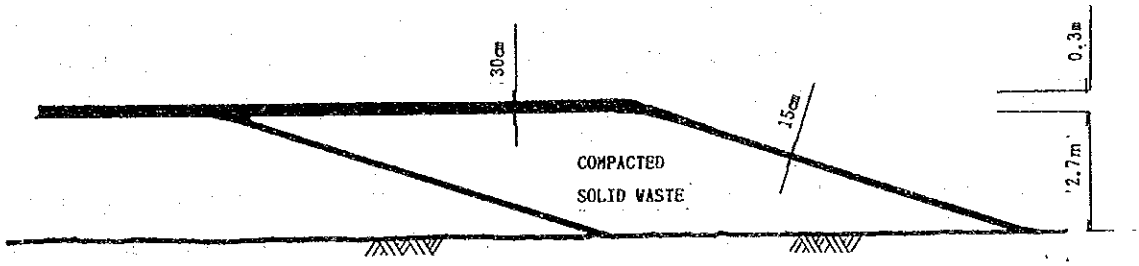


Fig. 4-2-18 FIGURE OF A CELL

f. Level of the completed site

The diposal site will be excavated -7.1m in depth, and 260m in width. The landfill height in the 1st layer should be about -4.4m, and the finished height in the 2nd layer should be -1.7m, equivalent to LWL of DWC. Furthermore, with the final cover (50cm) being done, the level of the completed site will be -1.2m.

g. Method of wastes volume reduction

The best method of volume reduction applied at the landfill site will be done by compressing and compacting solid wastes and cover soil by equipment for compaction such as bulldozer and compactor. The compaction ratio increases by stepping up the number of compactions, which at the same time reduces volume of solid wastes already landfilled in the site. But, a high degree of compaction will impede air contained in solid wastes for flowing and, in some case, might result in a delayed progress of decomposition. Therefore, the most effective approach is 5 - 6 times compaction for about 30cm layer.

The volume reduction by crushing solid wastes is the most effective, and side-effects can be expected as follows. For these reasons the landfill compactor is palnned.

- Since superficial are of solid wastes increases by crushing, which will enlarge contact area for oxidation, it makes anaerobic decomposition active.

- The increased superficial area will increase maintainability of water in the landfilled wastes, and, thereby, facilitate control of generated waste water.

- In the process of mixing and crushing of solid wastes, rotten and organic substances such as foods are crushed into fineness, which prevents insects and vectors from being fed.

- Paper and plastics will be broken into small pieces and mixed, which will prevent scattering of solid wastes by wind.

- Spread of offensive odor can be suppressed.

- Volume reduction by compaction of solid wastes and increase in life expectacy of the landfill site can possibly be expected.

- Stabilization can rapidly occur, and if an anaerobic landfill measure is taken, air will evenly spread in solid wastes and activate rapid decomposition, which facilitates landuse of the reclaimed land.

h. Method of landfill work

Daily landfill work is carried out according to the following method.

- Daily landfill work is carried out according to the following method. In order to secure safety during work at the disposal site, guidance for vehicles for entry and dumping must be provided.

- Dumped solid wastes must be crushed and levelled by compactor, and be given enough compaction at the same time.

- Earth cover should, in principle, be done at the time of completion of work. But, in the situations of heavy wind and unfavorable wind direction, there might be a possibility that solid wastes will be scattered and cause negative effect; the earth cover should be carried out each time as necessary.

- Disinfectant should be applied, as necessary, prior to the soil cover.

- The earth cover should be carried out every day after the completion of landfill work. For this work, not only covering sand and soil over solid waste layers, but also equipment such as bulldozer should be used to provide the layer with enough compaction.

- There might be a possibility that combustible gasses such as methane will generate; a regular inspection should be conducted to see if gas will be given off. If the gas reaches the hazardous density level, adjustment for gas removal facility should immediately be conducted.

4.2.5 Environmental Conservation Plan

1) Countermeasures for Gas Generation and Fire Prevention

a. Measures coping with the gas generation

It is presumed that the main contents of gas generated at the landfill site are methan (CH4) and carbon dioxide (CO2). Generally, these gasses generated at the landfill site are spurted or exhausted mainly from a weak landfilled part which is located between the landfill site and the surrounding structures such as embankment. Therefore, countermeasure for removing gas by removal facility should be taken to prevent flow of gas in the solid wastes and an accident from taking place at an unpredictable spot by gas spurt. The effective method is to artificially ventilate and exhaust the solid wastes layers.

The conceivable countermeasure work for gas generation includes ventilation, well water pumping and exhaustion. However, since it is impossible to qualitatively measure the effect of each work, the most economically efficient countermeasure must be taken, ventilation.

The concrete measure for exhaustion is done by installing perforated pipes surrounded by gravel by penetrating cells of wastes landfilled. The interval between each pipe is 50m, and these pipes will be installed as landfill work progresses.

b. Fire Prevention Measures

Since this disposal site is located adjacent to the airport, it is anticipated that the fire occured in the site might cause a serious trouble to airplanes. For this reason an effective fire prevention measure should be taken. The conceivable cause of fire at the final disposal site can be a ignition and explosion of combustible gasses such as methane, spontaneous combustion of combustibles by lens effect on glass wastes, ignition and explosion of fuels for landfill equipment and so on. Although the method of burning combustible gasses such as methane can be applied, it should not be the policy to install spontaneous combustion equipment for gas because gas removal facility to be installed at the disposal site could remove enough generated gas.

Spontaneous combustion caused by lens effect on glass wastes should be prevented by timely soil cover. Fuels for landfill equipment should strictly be controlled, and, in order to prevent fire caused by carelessly thrown cigarettes, a measure such as no-smoking rule should be taken at the landfill site. In addition to above various measures, it is planned to purchase a motor sprinkler equipped with a fire-extinguishing pump against an emergency.

2) Countermeasures for prevention from the massive generation of rodents and insects

Flies, mosquitoes, vectors and birds very often swarm at the final disposal site, which causes a problem to be tackled. Especially, a flock of birds produces a serious problem for MBSDS because of the airport. Therefore, it is essential to work out a measure to prevent breeding of vectors, insects and so forth as much as possible.
The most effective measure is to carry out daily earth cover by cell method, and it is important to prohibit solid wastes from being exposed and standing water from being produced. Spread of insecticides can be possible, if necessary.

3) Countermeasures for prevention from dispersion of offensive odor

A conceivable cause of offensive odor is solid wastes themselves and decomposition of wastes after landfilled, and the odor caused by anaerobic fermentation is said to be more offensive than that caused by aerobic fermentation because of volume and quality of generated gas. The effective measure is to throughly earth cover organic solid wastes, which are a cause of offensive odor, and to keep the inside of the landfill site in a good aerobic state of conditions by immediately draining rain water.

4) Environmental monitoring

In the process of carrying out landfill work, they should prepared a monitoring (or supervision) plan, which includes water quality inspection and scattering of solid wastes, in order to conserve the environmental conditions of the final disposal site.

a. Water quality monitoring

The objects, for which water quality monitoring for water contamination by leachate from MBSDS shall be carried out, include DWC, Fish Breeding Pond and underground water. As for DWC and FBP (Fish Breeding Pond), it is essential to set up a systematical structure which can conduct periodical water quality inspection in collaboration with the Water General Authority and the General Authority for Fish Resources Development. It is not planned to design a monitoring system for underground water, because there is no adequate place for monitoring well, and DWC and FBP can substitute for this place.

b. Monitoring for solid wastes

For the monitoring for wastes, the following items should be done at MBSDS.

- Inspection for scattering of solid wastes

A periodical patrol should be conducted for scattering of wastes particularly outside the landfill site, and once the scattering is observed elimination of scattered wastes must be conducted.

- Spot check examination of solid wastes

In receiving direct hauled wastes, a timely spot-check examination must be conducted to inquire whether the wastes include unsuitable one, such as noxious materials.

- Patrol in and aroud the disposal site

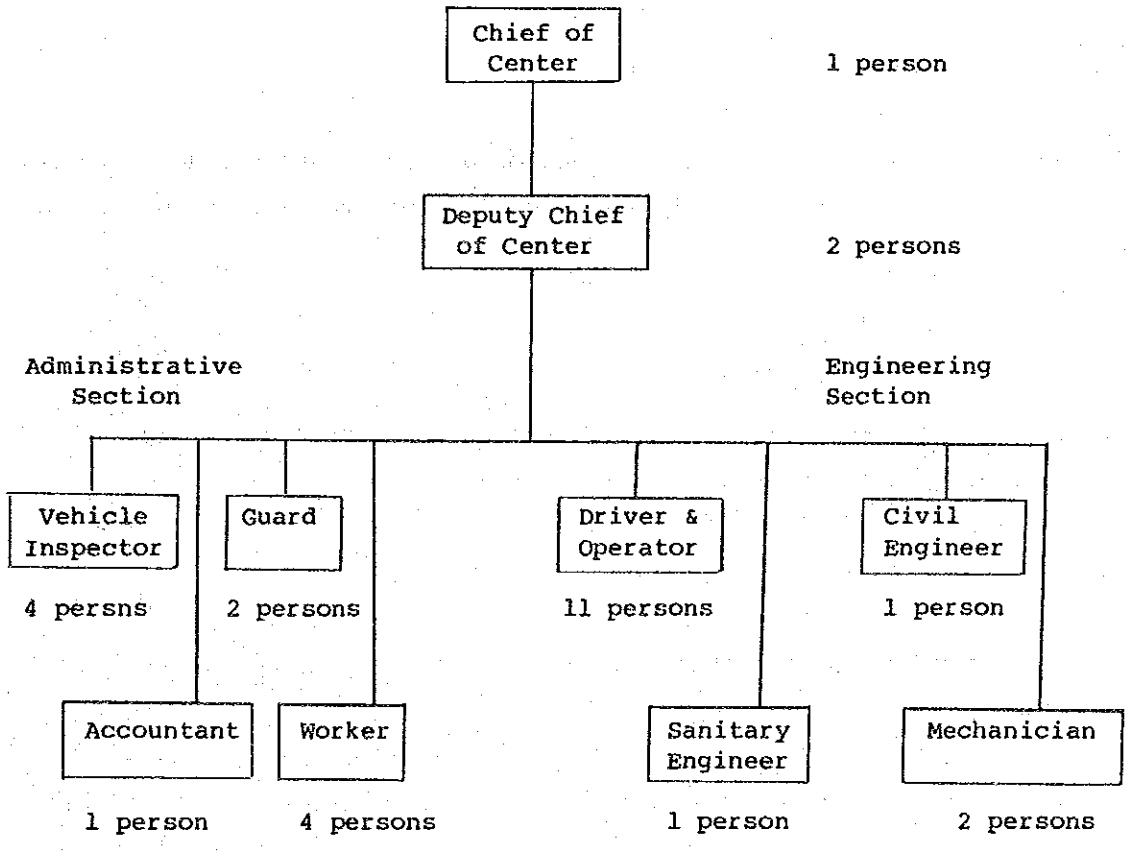
In order to prevent solid wastes hauled in by unauthorized people from being dumped in the site, a periodical patrol must be conducted in and around the disposal site.

4.2.6 Maintenance and Management Plan

1) Organization Structure

MBSDS is organized and managed by 8 different organizations at present. But, with the establishment of the Cleansing Authority, the MBSDS Landfill Center is organized as a work-site operational department of the Authority. This center will be responsible for managing operations of MBSDS. Fig. 4-2-19 shows the organization chart of MBSDS Sanitary Landfill Center.

Tab. 4-2-19 MBSDS LANDFILL CENTER ORGANIZATION MAP



2) Personnel Plan

According to the above organization chart, the work outline for each staff member and the number of personnel are stated. The total number of staff members is 28.

a. Chief of Center --- 1 person

Representative of the Landfill Center who controls the entire structure and talks with the Central Office.

b. Deputy Chief of Center --- 1 person

Assistant to the Chief who controls mainly internal routine work of the Center and gives instructions for clerical, maintenance and managerial work at the Center along with the Chief.

c. Vehicle Inspector --- 4 persons

Their work includes weighing and inspection of hauled wastes, daily patrol of disposal site facilities, collection of fee on direct-hauled waste and ordinary clerical work.

d. Accountant --- 1 person

His work includes the whole phases of accounting ork at the Center, including calculation of fee on direct-hauled waste.

e. Guard --- 2 persons

Their work covers supervision for illegal entry and dumping, as well as night-time patrol.

f. Worker --- 4 persons

Their work covers guidance for collection vehicles, installation of gas removal facility pipes, fire prevention control as well as other necessary works for operation of the disposal site.

g. Driver and Operator --- 11 persons

Their work includes levelling and compaction of hauled solid wastes, loading and hauling of cover soil, leveling and compaction of cover soil, driving of motor sprinkler for fire prevention, construction and maintenance of site access road and installation of gas removal facility, as well as daily maintenance of equipment.

h. Civil Engineer --- 1 person

His work covers preparation and supervision of landfill plan, safety control of landfill work, planning and supervision of necessary civil engineering work, guidance for maintenance and repair of site access road, as well as examination of environmental conservation measures.

i. mechanician --- 2 persons

Their work includes maintenance and simple repair work of machinery.

j. Sanitary Engineer --- 1 person

His work includes sanitary control of the disposal site, monitoring for environmental conservation, health control for workers and supervision of leachate control facility.

3) Operation Manual

An operation manual must precisely be studied along with the organization structure at the stage of preparation for detailed design. The basic concept for preparation of the operation manual based on the above organization chart is stated as follows:

a. Work System

Solid wastes are hauled and received around the clock at MBSDS presently, but it should be the policy to receive them, in principle, during daytime (AM 6:00 - PM 6:00) in this plan. The reason for this decision is mentioned as follows:

- It is dangerous to receive wastes and carry out landfill work during night-time.

- For this reason lighting facilities shall be installed at the landfill site for safety during night-time to receive wastes.

- It is financially burdensome to install and operate lighting facilities.

- It is disadvantageous for landing and departure of airplanes to install lighting facilities at the runway approach zone to El Nazha Airport.

For the above reason the duel shift system should be taken with the service hours, starting at AM 6:00 - PM 2:00 and at AM 11:00 - PM 6:00. All gates must be closed during night-time with only night watchmen stationed.

b. Landfill Site

The landfill operation is stated in detail in Section 4.2.4 of Supporting Report. A landfill plan which includes a cell preparation method and control of cover materials must be prepared by civil engineer and he should give necessary instructions to drivers and operators for operation and safety-control of landfill work.
Therefore, although the Chief and the Deputy Chief of Center are responsible for management of the entire disposal site, civil engineer should be responsible for the operation and maintenance on the technical side of landfill work.

c. Site access and approach road

A site access and approach roads will be constructed along the lines with the landfill plan. As the work progresses, conditions for the roads will be changed. Therefore, it is necessary to improve and maintain the roads to meet these changes. Width of the approach road should be stationed 4.5m or more to keep proper flow of vehicles for haulage of wastes, even along a temporary road. In the case where there arises a necessity, sand

and gravel must be placed on the approach road and should be compacted in order to secure the traffic of collection vehicles. in addition, safety devices such as directions, guard rails and curve mirrors must be equipped with a dangerous spot to prevent a traffic accident, thereby giving directions for speed limit and traffic limitations.

d. Leachate control facility

This facility should be installed to suppress the underground water level of the site lower than LWL of DWC, which at the same time prevents DWC from being polluted. An automatic control device equipped with water gauge for start and pause of a pump should be installed to start running of the pump when the underground water level is coming closer to the water level of DWC. The operation of the pump will make permeance of drinking water from DWC into the disposal site. Therefore, the pump should be set the starting water level difference of 10cm. (5-year probable daily precipitation I5 = 5.8cm) The sanitary engineer should be responsible for control of the entire facility, and, if necessary, he should carry out maintenance and repair work in collaboration with mechanicians and civil engineer. The sanitary engineer should plan and execute an environmental conservation measures necessary for pollution prevention at DWC and the leachate regulating pond. He should also perform a periodical monitoring along with the Water General Authority and General Authority for Fish Resources Development.

e. Safety Control

Safety control measures covering the entire disposal site must be worked out as follows under the leadership of the Chief of Center as a person in charge.

- To organize a fire prevention team with the operator as a key person of motor sprinkler equipped with a fire extinguishing pump.

- To prepare periodical fire practices against an emergency including use of cover soil with the fire prevention team.

- A direction indicating such as "no fire" should be shown at a dangerous spot for fire prevention including a gas generating place.

- No entry posts, which indicates name, person in charge, address, phone number for inquiry and so on of the disposal site, must be set up at several places along the fence to indicate the final disposal site, because the controllable size of the site is large.

- Explosives and insecticides must be stocked in a warehouse or other proper buildings which must be locked.

- The entry door to the pump station must be locked.

- The landfill equipment and materials must be stocked in the designated place, and a car stop should be installed, if necessary.

- Cover soil must be piled low to prevent them from being fallen apart.

f. Sanitary Conrol

Under the leadership of the sanitary engineer, a measure should be worked out along with the environmental conservation plan. In collaboration with the Water General Authority and the General Authority for Fish Resources Development as well as other institutions concerned, a periodical water quality inspection should be conducted, and, if necessary, a measure for water conservation should be taken.

The sanitary engineer will perform a monitoring for wastes periodically as well. Since there are many insanitary aspects in the process of landfill work, the office building is planned including shower facilities which are used to wash bodies after completion of the work, lavatory, those for document filing and recess. These facilities are periodically inspected. A regular medical check-up should be conducted to check employee's physical condition, and the places where first-aids and a clinic are provided should clearly be stated to provide a timely medical examination.

g. Maintenance of Landfill Equipment

Landfill equipment, most of which is originally used as civil construction work, causes an unpredictable trouble which is not particular to civil work field because of dealing with the wastes.

Particularly, since rotten organic materials are landfilled at this disposal site, it causes a lot of problems; such as rust attributable to gasses like sulfuretted hydrogen and ammonia which are produced by anaerobical decomposition of organic materials, wires and pieces of steel wound or stuck in a joined part of caterpillar, which causes tear and wear, and clogging of radiator by dust and wastes.

Landfill equipment is expensive; in order to use the equipment efficiently, it is essential for personnel in charge of operating the equipment to be familiar with the mechanism. For this purpose they should have a chance to get manufacturer's explanation, and they may take training course, if necessary, to receive operational instructions. Additionally, it is prerequisite for well-experienced workers to conduct daily inspection, maintenance and repair work.
Inspection should be made for each part, such as engine, rudder devices, plade and bucket, electric parts, and tires and suspentions, and if a trouble and abnormalities are confirmed, they should be immediately repaired, so that they can be kept in a serviceable condition.

After completion of the work, filthy parts must be cleaned. Based on reports from driver and operator, a simple repair work should be done at the site.
For the repair work which cannot be done t the site, a report should be sent to the central work shop for consignment of the work.

h. Emergency System

In order to prepare against accident, fire and other emergency, it is essential to adjust the system for contacting. For this purpose directions should be given to the whole personnel how to cope with emergency situations and with whom to contact, and to clarify the places and persons for contact as follows.

- Chief of Center andCentral Office
- Fire Department
- Clinic
- Ambulance
- Police Department

i. Collection of fee for direct-hauled waste

Direct-hauled wastes such as debris, sewage sludge and port waste are disposed free of charge at MBSDS today. With the establishment of the Authority, when the MBSDS Sanitary Landfill Center is set up, it is worth reviewing to consider collecting disposal fee from those who directly hauled wastes. It will be an effective self-financing method for the Authority.

4.2.7 Plan for ultimate use of the completed site

As for the ultimate use of the completed site at MBSDS today, the Planning Department of the Governorate has the following plans.

- International Garden Project
- Housing Complex Project for New Couples

But, these plans are still in the conceptual stage, and the detailed plan is not made yet. In making the plan, the basic considerations are stated as follows. We would be pleased, if the following will be useful for the Planning Department to make a plan. The concept of ultimate use of the completed site, which we, as a study team, summarized, is stated in the Drawings.

1) Basic Considerations

For the ultimate use of the completed site at the final disposal site, required conditions for reclaimed land are as follows:

- Little land settlement of the reclaimed land, and relatively shorter period of time.

- The foundation maintains a high bearing capacity.

- No landslide occurs at the slope of the site.

- No combustible gas and offensive odor generate.

- Having no negative effect on the durability of structures such as the foundation.

- Land being suitable for plant growth

If these conditions meet, a high degree of landuse like an ordinary land is possible. But, even if either of these conditions do not meet, the ultimate use of the completed site will be possible with step-by-step application. Therefore, these conditions are not necessarily absolute conditions.

2) Site Conditions

Noticeable points in the site conditions of MBSDS are stated as follows:

- The site is located at the junction of Desert Road and Agriculture Road which connect Cairo and Alexandria.

- The site is located within 10km close to Middle District, the center of the city, and the Alexandria Central Station.

- The site is located adjacent to El Nazha Airport, the main aeronautical entrance to Alexandria.

- The site is located close to waters such as DWC, Fish Breeding Pond and Lake Maryut beyond the bank and roads.

3) Decomposition and Stabilization of Landfilled Wastes

In designing the ultimate use of the completed site, it becomes an issue how far the decomposition of landfilled wastes has progressed. Particularly, the time period required for decomposition of septic organic substances contained in wastes has effect on stabilization of the foundation. For this reason, it is crucial for ultimate use of the completed site.

For example, according to the results of the survey conducted for solid wastes excavated 3 to 5 years after completion of the landfill work at the final disposal site to grasp the decomposition process of septic organic substances, the reduction ratio of organic substances showed 63 - 78%. it is presumed that except for artificially produced and processed organic substances, which do not exist in nature, such as undercomposable materials including plastic and rubber, most solid wastes are finally decomposed 4 - 6 years later Various survey and study reports show that the time period required for stabilization of the landfill site is influenced by the time for decomposition of organic substances (septic material) contained in wastes. Despite the difference in structure and location of the final disposal site, at least 3 - 4 years are necessary for the process of decomposition of organic substances, and it is conceivable that settlement and generation of gas occur, which might restrict the ultimate use of the completed site.

4) Settlement

The settlement of the landfilled site and cracking in the ground occur due to decomposition of landfilled wastes, drainage of leachate and compaction of cover soil. Generally, the settlement of the reclaimed land is referred to as follows:

- The settlement volume issmall, if caused by inorganic solid wastes such as debris.

- The settlement volume is large in heavy rainfall districts.

- The settlement volume increases as the depth of landfill site increases.

- The settlement lasts for a long period of time, and the settlement volume sometimes may amount to a few % to 30% of the depth of the reclaimed land.

The settlement occurring at the final disposal site is conceivably caused by dead weight of wastes and decomposition of organic substances. For the standpoint of the ultimate use of the reclaimed land, in order to quickly stabilize the settlement, it is crucial to select types of wastes, improve crushing and compaction, activate decomposition of organic substances at the initial stage of dumping and compact solid waste layers.

5) Bearing capacity of the completed site

It is necessary to grasp the bearing capacity of the reclaimed land for purposes such as execution of the ultimate use of the completed site. According to the survey results for a standard penetration test at the reclaimed land, N values stayed within 2 - 15, but the greatest percentage showed 3 - 8.
The plate bearing test conducted at the reclaimed land showed widely different K-value in 2 cases, namely in the case where a sandy gravel layer with 1.6m in thickness was placed on wastes, and the other case where no cover soil was placed. Based on this test result, it will presumably impossible to utilize the reclaimed land for foundation of structure as it stands, if no cover soil is placed. Judging from each example, as for ultimate use of the completed site, it seems impossible to construct roads and buildings until settlement is suppressed.
However, it is possible to utilize a wide stretch of landuse after termination of decomposition of wastes and stabilization of the settlement. As mentioned above, it is infeasible to utilize the completed site immediately after completion of landfill work as an ordinary reclaimed land. Therefore, an effective and safe method is to utilize the reclaimed land separately during the period until when the foundation is stabilized and after the time when the foundation is stabilized.

6) Actual Examples of Ultimate Use of the Completed Site

As for the ultimate use of the completed site, the land used immediately after reclamation is for a car park, golf links, farmland, park, playground and so forth. On the land reclaimed many years ago, a school building and an office building are constructed.
From a standpoint of plant growth, tall trees which spread roots soon after completion of reclamation work are hard to grow due to gasses such as methane and sulfureted hydrogen contained under the reclaimed land and a change in temperature; on the other hand an underbrush like turf grows fast. it is essential to sufficiently study the thickness of the final soil cover, depending on a purpose of ultimate use of the completed site.

- Ultimate use for Farmland

A number of ultimate use cases for the completed site are intended for farmlands by reclaiming swamp and mountainous area (valley) to a levelled ground suitable to farmland through landfilling wastes. In order to use the land as a farmland, it is required, in most cases, to select a final cover soil as a soil suitable to farming, and to make the thickness of cover soil approximately 1 - 2m. Additionally, in order to prevent crops from being affected by generated gas, it is essential to install gas removal facility. A periodical inspection and maintenance are necessary because of distortion and impairment of gas removal pipes and rain water drains due to settlement of the foundation. Especially, gas removal facility, if the perforated pipe is clogged and impaired, will cause spread of generated gas over the farmland and wither crops to death. In order to obviate negative effect caused by gas, a periodical examination for state of conditions of generated gas should be conducted, and, thereby, a necessary measure should be worked out.

- Ultimate Use for Sporting Facilities and Parks

A number of disposal sites are used for ultimate use of the completed site as a soccer ground, sports facilities and a park.
In order to use the site as these facilities, it is easy and simple to decide nature and thickness of cover soil, compared with the ultimate use for farmland.

Considering that a number of people including children and the elderly use the facilities more often than the farmland, it is prerequisite to pay attention to handling and place of generated gas.
The generated gas is treated by diffusing into air and burning, but, if the releasing height of gas diffusion and exhaust gas by burning is low, those gases remain in the utilized facilities, depending on climatological conditions such as wind direction, which displeases people by offensive odor. It is desirable to decide the ultimate use for such as park, taking aesthetic elements into account.

- Ultimate Use for Car Park

As for the ultimate use of the completed site for a car park, although there still remains a problem, handling of rusts produced on cars by gas, the improvement work for ultimate use of the completed land is easy and simple compared with that for farmlands and parks. Inspection for gas removal facility and generated gas should be conducted in the same manner as that for other use, but there arises a small number of problems such as settlement in comparison with other cases for ultimate use of the completed site.

7) Recommendation for Ultimate Use

As for the final disposal system in Alexandria, securing disposal sites is not systematically done, nor the ultimate use of the completed site is planned for most of disposal sites.

In the result, the ultimate use of the completed site by landfill becomes limited due to unreclaimed portions of the land, poor foundation, generation of combustible gasses and offensive odor and settlement of the ground. In order to widely and effectively utilize the land after reclamation, it is essential to design the ultimate use of the completed site at the stage of designing for the final disposal site, and operate and maintain the disposal site taking into account the ultimate use of the completed site at the time of landfill. For example, if a park is planned as a ultimate use of the completed site, the site should not only reclaimed at a flat level, but for a mound and hillock. At the same time

inorganic substances should be landfilled instead of organic substances (domestic waste) in portions to be used as a road, in the case where there is a plan to build a road in the park. In this way a controlled reclamation work should be carried out by dividing the area to be reclaimed taking into account the ultimate use of the completed site, and it makes the reclaimed land to be utilized widely and effectively.
As a characteristic of the city Alexandria, there is extremely little open space except sea shores. The per-person size of the park in Alexandria is _____m^2/person, which is smaller than that of Tokyo, ____ m^2/person, often referred to as a city meager in space. Additionally, that of London is _____m^2/person, and that of New York is ____ m^2/person. There is almost few sporting facilities except membership system sports clubs. Soccer games played on road are daily views in this city, which is not only dangerous but disadvantageous to sound growup of youth who succeeds to the next generation. With the development of motorization, the number of registered cars is increasing year after year. In spite of that, there is almost little parking space in the city except public roads. Although there is more space than in Cairo, the cause of traffic jam is, in many cases, attributable to parking of cars on the road. In order to solve this problem, the city authority is speeding up construction of a parking building, but it is hardly an effective measure. Based on the above study results, the following ultimate use of the completed site, MBSDS is recommended.

a. To use the land as an international garden is favorable judging from characteristic of the reclaimed land. But for the preparation of the plan, careful consideration should be paid on the selection of plant and recovering of soil suitable for plant.

a. Housing complex for new couples should not be carried out soon after completion of landfill work. The time period, at least 5 - 6 years, should be considered for decomposition of organic substances and stabilization of settlement. The housing complex should be constructed after stop of gas generation. Even after the gas stop, construction of a high-rise building is unfavorable because of the poor foundation.

c. Until when the housing complex for new couples is constructed, a use of a car park is recommendable. MBSDS is located at the entrance to Alexandria from a suburban area. Therefore, they should limit the increasing number of private cars running from suburbs into the city, make them park at MBSDS and utilize a mas-transportation system such as bus to enter the city. it would be a solution to the problem of serious traffic congestion to speed up construction of parking buildings in the city, during the time when they limit traffic of those private cars.

d. Construction of sports facilities such as soccer ground, tennis court and athletic ground except buildings is recommendable. Alexandria lacks most in these facilities. Therefore, the facilities should be utilized free of charge as much as possible, and by the whole citizens even by payment of fee. The above recommendable points are summaried in the Drawings. As a plan of the ultimate use of the completed site, it is expected that they should build up a consensus from various institutions concerned as well as make this figure as an assistance for securing construction cost.

4.2.8 Environmental Impact Assessment

1) Atmospheric Conditions

(1) Air Pollution

Substances which generate at the final disposal site and pollute the air can be dust scattered by solid wastes as well as smoke and dust caused by spontaneous combustion. For this project a viable fire prevention measure is scheduled to be carried out, because the disposal site is located adjacent to the airport. More specifically, the following measures are studied.

i) installation of gas ventilation facilities
ii) timely soil cover
iii) strict control of fuels for landfill equipment
iv) no-smoking in the site
v) preparation of water sprinkling vehicles

It is possible to suppress the generation of dust and smoke by applying the above plans.

(2) Offensive Odor

The possible cause of offensive odor generated at the final disposal site can be solid waste itself and decomposition of solid wastes after landfill work for disposal. It is disclosed that the odor caused by anaerobic fermentation as decomposition of solid wastes is more offensive than that caused by aerobic fermentation as decomposition of solid wastes is more offensive than that cuased by aerobic fermention. For this project it is suggested that soil cover should thoroughly be done on organic solid wastes which cause the offensive odor. By this method the problem of offensive odor could be solved. Additionally, as a part of the measure to keep the inside of the landfilled site in an aerobic state of conditions, it is essential to drain rain water quickly, but, since there is little precipitation in Alexandria throughout year and a great amount of rain is evaporated. Therefore, it can be said that there remains no problem.

2) Water Quality

For this project one of the most dangerous environmental effect is the flow-out of waste water, and, especially, the pollution in Drinking Water Canal is a serious issue. It is planned that the ground level of solid waste layers should be suppressed lower than that of Drinking Water Canal, above which final covers will be placed, and rain water kept on these covers will be draned into the control pond in the disposal site.
More specifically, by applying sand gravel filters the leachet water should be led into water drainage pipes, which thereafter should be saved in the leachate water control pond in the site by waste water pumps to evaporate the water.
Therefore, it can be expected that water pollution at Drinking Water Canal can be avoided, but a monitoring for inspection of water quality should never fail to be conducted. As for Lake Maryut and Fish Breeding Pond, mounted roads with the width of 12 and 32m, which divides each of these two places, are constructed. For this reason, leachate waste water, even if it occurs, will only be a small amount, and it is anticipated that it will not be a major cause of pollution in both the lake and the pond.

3) Traffic Conditions

(1) Traffic Volume

The traffic volume for entry into the final disposal site will decrease lower than that of today because of expected reduction of delivered amount due to the increased production output of composts.
Since the present delivery road will be chosen as the future delivery road, it can be said that effect on the ordinary traffic will never vary.

(2) Environmental Impact by Traffic

As stated above, the number of cars entering the final disposal site will decrease. However, as for Suez Canal Street which connects Maharam Bey Square with middle District, since cars bound for the compost plant utilize this road, the number of garbage carts and other related vehicles will increase by 1.24 times with the annual increase in amount of solid wastes; - namely, it will become 50 cars/hour in calculation by 4 ton vehicle. This is only 2% of the ordinary traffic volume, 2,900 cars/hour (12-hour average during day-time) at this street, and the state of pollution problem will not vary from that of today.

(4) Landscape

Through sanitary landfill, they can eliminate unfavorable factors for scenery such as scattering of solid wastes, generation of smoke by spontaneous combustion and schooling of birds, if they properly operate the control of the work and perform sufficient soil cover. But, the planned disposal site is adjacent to a crucial point, the crossing section of 2 trunk roads - Agriculture Road and Desert Road. For this project the circumference of the site is scheduled to be surrounded by 2m high concrete block fences, which prevents vehicles running towards Alexandria from watching solid waste disposal activities. Furthermore, if the financial conditions allow, a blind must be built by implantation of plants.

5) Others

The planned site is located in the direction of the extension of the airport runway, hardly an appropriate place. Presently, the open dumping is carried out, so that, if it continues, there will be a possibility that the dumping will cause an impediment to departure and arrival of airplanes. The sanitary landfill planned for this project applies a cell method, and, since soil cover will be carried day to day, it can be expected that the method will prevent spontaneous combustion and flying of birds. Therefore, it is essential to change the open dumping method to a sanitary landfill method as early as possible.

4.2.9 Estimation of the Project Cost

1) Construction work of sanitary landfill disposal site

The outline of the MBSDS construction work and the required landfill equipment are summarized in the Main Report Section 5.2. In this section, the constructin work of sanitary landfill disposal site is mentioned in details.

a. Excavation of the site, haulage and storage

- excavation width	260m
- excavation depth	EL=-7.1m
- excavation length	572m
- excavation volume	455,000m^3
	(refer to Tab. 4.2.8)

b. Site Access Road

- Length	2,060m
- Gravel Metaling	2,472m^3
(thickness 15cm, crushed stone)	
- Gravel Leveling	16,480m^2

c. Leachate Control Facility

- Pump Station	
Sewage pump	2 units
($Q=0.262m^3/min$, HT=33.0m, F=50HZ, Dia. 100)	
Control Box	1 unit
(with automatic control device)	
Building (width 2.7m, length 2.7m)	$7.3m^2$
Collection pit	1 unit
- Leachate Pipe (steel pipe dia 80m/m)	920m
- Leachate Regulating Pond	1 unit
excavation	$1,682m^3$
earth lining	$589m^3$
- Filter	460m
Sand	$828m^3$
Gravel	$1,472m^3$
- leachate Collection Facility	450m
excavation	$234m^3$
perforated concrete pipe dia. 300	450m
sand	$104m^3$
gravel	$411m^3$

d. Office and Inspection Facilities

- Office Building

construction size		$198.0m^2$
total floor size		$180.0m^2$
structure	----------	reinforced concrete blocks
finishing (outside)		
outer wall	:	coated concrete blocks
roof	:	reinforced concrete with water-preventin sheet
column and beam	:	reinforced concrete
furniture	:	oil painted wooden furniture
finishing (inside)		
floor	:	color mortar
inner wall	:	vinyl paint
ceiling	:	vinyl paint

- Truck Scale	1 set
main body	1 set
installation work	1 set of work
- Car Wash	1 set
excavation	$35m^3$
plain concrete	$24m^3$
gravel	$14m^3$
rainforced concrete pipe dia. 300	20m
steel gratings (600xl,000x65)	14 sets
L-shaped steel	1.6 ton
e. Fence	4,100m
- concrete block masonry (H=2.0m)	4,100m
- gate (steel)	3 sets
f. Gas Removal Facility	
- horizontal	
gravel	$1,518m^3$
- vertical	
gravel	$98m^3$
perforated PVC pipe dia. 100	402m

2) Estimation of the construction cost

Tab. 4-2-14 BREAKDOWN OF CONSTRUCTION COST OF MBSDS

(unit: LE)

WORKS ITEMS	UNIT	Q'TY	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
A. Earth Work					
a. Excavation	m^3	455,000	391,300	837,200	1,228,500
b. Haulage	m^3	455,000	245,700	527,800	773,500
Sub-total			637,000	1,365,000	2,0002,000
B. Site Access Road					
a. Crushed Stone	m^3	2,472	-	17,300	17,300
b. Leveling	m^2	16,480	1,470	3,490	4,960
Sub-total			1,470	20,790	22,260
C. Leachate Control Facility					
a. Building	m^2	7.3	-	2,190	2,190
b. Sewage Pump (dia.100*33m*7.5Kw)	Nos.	2	9,330	29,330	38,660
c. Pump Pit	Nos.	1	4,140	3,450	7,590
d. Leachate Pipe	m	920	5,490	13,990	19,480
e. Leachate Regulating Pond	Nos.	1	2,760	5,340	8,100
f. Filter	m	460	1,150	36,480	37,630
g. Leachate Collection Facility	m	450	5,050	17,480	22,530
Sub-total			27,920	108,260	136,180
D. Office & Inspection Facility					
a. Building	m^2	180	-	90,000	90,000
b. Truck Scale	Nos.	1	51,600	9,100	60,700
c. Car Wash	Nos.	1	7,400	3,870	11,270
Sub-total			59,000	102,970	161,970
E. Fence					
a. Fence	m	4,100		102,500	102,500
b. Gate	Nos.	3	10,290	4,410	14,700
Sub-total			10,290	106,910	117,200
F. Gas Removal Facility					
a. Horizontal			760	28,990	29,750
b. Vertical			1,580	1,760	3,340
Sub-total			2,340	30,750	33,090
Grand Total			738,020	1,734,680	2,472,700

Tab. 4-2-15 PURCHASE, DEPRECIATION AND FUEL COST OF LANDFILL EQUIPMENT
(MBSDS)

ITEMS / LANDFILL EQUIPMENT	TYPE	UNIT PRICE LE/NO.	NUMBER NOS.	PURCHASE PRICE LE	MAINTE-NANCE & REPAIRING COST LE	DEPRECI-ATION COST LE	SPARE PART LE	UNIT FUEL COMSUMP-TION l/day/No.	FUEL COST LE	OIL & OTHER COST LE
Back-hoe	0.4m^3	81,000	-	-	-	-	-	57	-	-
"	0.7m^3	121,000	1	121,000	14,520	24,200	12,100	90	4,930	990
Dump Truck	11 ton	51,900	2	103,800	12,460	20,760	10,380	66	7,220	1,440
Bulldozer (for swamp)	14 ton	108,300	1	108,300	13,000	21,660	10,830	60	3,290	660
Bulldozer	14 ton	104,900	-	-	-	-	-	60	-	-
"	17 ton	131,300	-	-	-	-	-	84	-	-
Landfill Compactor	20 ton	284,600	2	569,200	68,300	113,840	56,920	180	19,720	3,940
"	30 ton	408,300	-	-	-	-	-	270	-	-
Motor Sprinkler		121,000	1	121,000	14,520	24,200	12,100	66	3,610	720
Total			7	1,023,300	122,800	204,660	102,330		38,770	7,750

N.B.; Residual value is 10% of purchase price.
Depreciation period is five years
Oil and other cost is 20% of Fuel cost

Fig. 4-2-16 BREAKDOWN OF CONSTRUCTION COST OF ENVIRONMENT CONSERVATION COUNTERMEASURES IN THE COMPLETED SITE

(Unit: LE)

WORKS ITEMS	UNIT	Q'TY	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
A. Final Cover					
a. Leveling	m^3	157,000	78,500	172,700	251,200
B. Leachate Control Facility					
a. Excavation	m^3	25,000	21,500	46,000	67,500
b. Backfill	m^3	17,300	14,710	51,040	65,705
c. Filter	m	1,250	3,130	99,130	102,260
d. Leachate Collection Facility	m	1,250	14,030	48,560	62,590
			53,370	244,730	298,100
Grand Total			131,870	417,430	549,300

4.2.10. Quarry disposal sites

(1) Planning Conditions

Various coditions for preparing plan of Quarry Disposal Site are stated as follows;

a. Locations

Ameriyah District, approximately 35Km away from the center of Alexandria.

b. Landuse

Mainly desert. Farmlands and private houses are seen on parts of the site.

c. Access Road

Along Alex-Matrouh Road which is located roughly 5Km from Cairo-Ales. Desert Road.

d. Geology

Stable ground of diluvium deposit, being composed of lime stone, calcareous or sandy soil.

e. Planned Disposal Amount

The planned service area is the same as MBSDS.
The planned disposal amount and the landfill volume are stated in S.R.Tab.4-2-4. and S.R.Tab.4-2-5.

f. Landfill Capacity

The landfill capacity of Quarry Disposal Site varies, depending on each site. Therefore, it is impossible to calculate the

landfill capacity without conducting a topographic survey at each site. For thes project the landfill capacity, 1 million m3, which was caluculated by a rough topographic survey conducted at King Maryut Site, the most prospective site compared with other sites, should be applied to ther sites to facilitate the plan.

(2) Characteristics of the Plan

a. Plan for Construction of the Facilities

The required facilities should be planned basically in accordance with the MBSDS project, and sanitary landfill for disposal should be carried out. The required facilities should be planned according to the conditions of each site. Since a number of sites are taken up for planning, the plan is illustrated in the Drawings, with the plan for King Maryut Site as a reference. The required facilities are outlined in S.R.Tab. 4-7-17.

S.R.Tab. 4-2-17 FACILITY OF QUARRY DISPOSAL SITE

ITEM	Content	Unit	Quantity	Remark
A. SITE ACCESS ROAD	Gravel Metaling Width 8m Thickness 15cm	m	1,000	
B. OFFICE & INSPECTION FACILITY				
a.Building		m2	180	
b.Truck Scale	30ton	Unit	1	
c.Car Wash	Pool Type	Unit	1	
C. FENCE				
a.Fence	Concrete Block t=20cm	m	2,000	
b.Gate	Steel	Unit	1	
D. GAS REMOVAL FACILITY	Perforated & Gravel	m	5,800	

b. Landfill Plan

Basically, sanitary landfill should be carried out. As shown in the Drawings, cover soil is obtained by excavation of the bottom of the site for the first layer. The 2nd and upper layers should be landfilled with cover soil from the borrow-pit. The landfill method, plan for landfill equipment and landfill operation should be considered pursuant to the plan for MBSDS. The landfill equipment plan is shown in S.R.Tab.4-2-18.

S.R.Tab.4-2-18. Landfill Equipment Plan

Name	Contents	Unit	Quantity
a. Back-hoe	0.7 m3	Unit	1
b. Dump truck	11 ton	Units	2
c. Bulldozer for swamp	14 ton	Unit	1
d. Landfill compactor	20 ton	Units	2
e. Motor sprinkler	10 m3	Unit	1

c. Plan for Environmental Conservation, and for Operation and Maintenance

Compacted with MBSDS, Quarry Disposal Site is far more favorable as a disposal site in terms of surrounding environmental conditions. In this respect, it can be said that a relatively moderate plan for environmental conservation should be made. However, Quarry Disposal Site is scheduled to be used as a residential area for the Master Plan 2005 year project. As a matter of fact, a large percentage of the rapidly increasing population in Alexandria is beginning to settle in this area.

Therefore, it should be concluded, from a long-term perspective, that a plan in accordance with the environmental conservation plan for MBSDS is desirable. As the required manpower is mentioned below, if the New Abis Compost Plant starts to operate, the solid waste quantity will not vary in a great measure in comparison with that in 1988; for this reason the manpower is the same with that of MBSDS. For above reason the maintenance plan should be made in accordance with that of MBSDS.

Chief	1 person
Deputy chief	1 person
Vehicle inspector	4 persons
Accoutant	1 person
Guard	2 persons
Worker	4 persons
Driver & operator	11 persons
Civil engineer	1 person
Mechanic	2 persons
Sanitary engineer	1 person
Total	28 persons

d. Plan for Ultimate Use of the Completed Site

As mentioned in detail in S.R.5.2.7., the plan for ultimate use has to be made taking into account the characteristics of the reclaimed disposal site. Additionally, if the future landuse for a residential area is considered, the following ultimate use plan is desired.

- Public Garden and RecreationGround

- Sports Feild

- Car Park

(3) Estimation of Construction Cost

a. Construction Cost

Based on price standard in 1985, the construction cost as well as purchase price of landfill equipment are summarized in S.R.Tab.4-2-19 and S.R.Tab.1-2-20.

S.R.Tab.4-2-19 BREAKDOWN OF CONSTRUCTION COST OF QUARRY DISPOSAL SITE

unit ; LE

WORKS ITEMS	UNIT	Q'TY	TOTAL
A. SITE ACCESS ROAD (1000m)			
a.Crushed Stone	m3	1,200	8,400
b.Levelling	m2	8,000	2,410
Sub-Total			10,810
B. OFFICE & INSPECTION FACILITY			
a.Building	m2	180	90,000
b.Truck Scale	Unit	1	60,700
c.Car Wash	Unit	1	11,270
Sub-Total			161,970
C. FENCE			
a.Fence	m	2,000	50,000
b.Gate	set	1	14,700
Sub-Total			64,700
D. GAS REMOVAL FACILITY			
a.Horizontal	m	5,000	41,750
b.Vertical	m	800	6,680
Sub-Total			48,430
TOTAL			285,910

S.R.Tab.4-2-20 PURCHASE COST OF LANDFILL EQUIPMENT

ITEMS / LANDFILL EQUIPMENT	TYPE	UNIT PRICE	NUMBER	PURCHASE PRICE	SPACE PART COST
		LE/NO.	NOS.	LE	LE
Back-hoe	0.7 m3	121,000	1	121,000	12,100
Dump Truck	11 ton	51,900	2	103,800	10,380
Bulldozer (for swamp)	14 ton	108,300	1	108,300	10,830
Landfill Compactor	20 ton	284,600	2	569,200	56,920
Motor Sprinkler		121,000	1	121,000	12,100
Total			7	1023,300	102,330

b. Project Cost

The project cost is calculated by the unit prices as of 1985.

The project cost amount to 1,517 thousand ■E. When the price contingency is included, the cost amount to 1,535 thousand ■E.

The project cost is tabulated below;

S.R.Tab.4-2-20 Project Cost of a Quarry Disposal Site

unit; 1000 LE

ITEM	COST
a. Construction of a quarry disposal site	286
b. Procurement of Landfill Equipment	1,126
c. Engineering Service	76
d. Physical Contigency	29
Sub-Total	1,517
e. Price Contigency	18
TOTAL	1,535

Note; Physical Contigency : 10% of a
Price Contigency : 5% of (a+c)