SECTION 7

COMPOST PLANT AND COST ESTIMATION

SECTION 7 COMPOSTING FACILITIES AND COST ESTIMATION

7.1 SYSTEM OF THE COMPOST PLANT

(1) Design Basis

Composting system consists of the following procedures for better quality compost production referring to the pilot study conducted from June 2001 at the old compost plant in Al-Bassa.

(1) Receiving waste

(2) Removal of non-compostable material by hand sorting

(3) Shredding by pulverizing classifier

(4) Fermentation with turning by wheel loader

(5) Maturing with turning by wheel loader

(6) Refining of coarse compost by screen

(2) Planning Specification

Table 7.1.1 shows planning specification of Lattakia compost plant.

Table 7.1.1 shows Planning Specification of Lattakia Compost Plant

No.	Item		Rehabilitation of Old Plant	New Plant
1	Waste Treatment Amount		50 ton/day	150 ton/day
2	Actual Operating Time		12 hours（6hours/shift x 2shifst）	
3	Equipment Capacity		4.2 t/h	12.5 t/h
4	Composting Method			
	1) Piling in fermentation yard		By wheel loader	By wheel loader
	2) Turning in fermentation yard		By wheel loader	By tuning machine
	3) Removing to maturing yard		By wheel loader	By wheel loader
	4) Turning in maturing yard		By wheel loader	By tuning machine
5	Screening			
	1) Treatment stage		Single stage	Single stage
	2) Opening of sieve		10 mm	10 mm
6	Composing period			
	1) Fermentation		2Weeks (with turning on every day)	
	2) Fermentation		6Weeks (with turning once a week)	
7	Building Works			
	1) Composting Building	Reception building	Existing repair	25 x 30 = 750 m^2
		Pretreatment building	10 x 18 = 180 m^2	12 x 30 = 360 m^2
	2) Cover roof of fermentation yard		Existing repair	70 x 114 = 7,980 m^2
	3) Cover roof of maturing yard		Existing repair	None
	4) Administration building		Existing	8 x 25 = 200 m^2
	5) Accessory building		None	Garage, Shower room, Guard house

(3) Waste Composition

Design basis of waste composition for Lattakia compost plant have calculated according to the waste quality survey done by JICA study team in July and waste quality analysis in compost pilot study as shown in Table 7.1.2.

(4) Material Balance

Detailed material balance calculation sheet is shown in Table 7.1.3.

7.2 OPERATION AND MAINTENANCE PLAN

(1) Operation Organization

At initial stage the plant will be operated by one shift operation of 26 persons and the next stage will be operated by two shift operation of 38 persons by 2010(Target year of master plan) as shown in Table 7.2.1.

Table 7.2.1 Number of Operational Personnel

(Person)

Item		Initial stage (from 2003)	Next stage (from 2010)	Remarks
Administration		6	4(6*)	*See note.
Operation	Reception area	3	4	
	Hand sorting area	4	8	
	Shredding area	2	4	
	Fermentation area	2	4	
	Maturing area	2	4	
	Screening area	2	4	
	Others	3	4	
Maintenance		2	2	
Total		26	38(*40)	

Note) *2 persons, i.e. compost division manager and secretary are concurrent with new compost plant to be constructed in Qasia in 2010.

Detailed number of operational personnel is shown in shown in Table 7.2.2.

Table 7.1.2 Waste Composition in Lattakia City

		Survey	Source	Organic		Paper		Plastic		Non-compostable Metal		Glass		Others		Sub-total		Total
				Food, Veg.														
Market	Base Data	Winter	IR	94.2		0.8		1.2		0.1		0.0		3.7		5.8		100
		Summer	DFR	94.3		1.5		3.9		0.0		0.1		0.2		5.7		100
		Average		94.3		1.2		2.6		0.1		0.1		2.0		5.8		100
		Pilot Study		72.4		6.0		11.6		1.2		0.9		7.9		27.6		100
	Design Basis	(Average)		83.3		3.6		7.1		0.6		0.5		4.9		16.7		100
Domestic	Base Data	Winter	IR	70.5		10.2		8.0		1.7		1.6		8.0		29.5		100
		Summer	DFR	74.4		7.9		8.8		1.3		0.8		6.8		25.6		100
		Average		72.5		9.1		8.4		1.5		1.2		7.4		27.6		100
		Pilot Study																
		Organic	100%	83.5		3.8		10.3		0.2		0.6		1.6		16.5		100
			78%	65.1	93%	3.0	36%	8.0	54%	0.2	15%	0.5	20%	1.2	33%	12.9	43%	78
					↓		↓		↓		↓		↓		↓			
					90%		50%		50%		50%		50%		40%			
		Non-organic	100%	22.0		23.7		30.5		3.9		8.3		11.6		78.0		100
			22%	4.8	7%	5.2	64%	6.7	46%	0.9	85%	1.8	80%	2.6	67%	17.2	57%	22
					↓		↓		↓		↓		↓		↓			
					10%		50%		50%		50%		50%		60%			
		Total	100%	70.0	100%	8.2	100%	14.7	100%	1.0	100%	2.3	100%	3.8	100%	30.0	100%	100
	Design Basis	Organic	78%	65.2		4.5		4.2		0.8		0.6		3.0		13.0		78
			100%	83.6		5.8		5.4		1.0		0.8		3.8		16.7		100
		Non-organic	22%	7.2		4.5		4.2		0.8		0.6		4.4		14.5		21.8
			100%	32.9		20.6		19.1		3.4		2.7		20.2		66.0		99
Design Basis																		
F/S	Market Waste		25 t/d	41.7		1.8		3.5		0.3		0.2		2.5		8.3		50
(Al-Bassa)	Domestic Waste		25 t/d	41.8		2.9		2.7		0.5		0.4		1.9		8.4		50
	Total		50 t/d	83.5		4.7		6.2		0.8		0.6		4.4		16.7		100
Qasia	Market Waste		23 t/d	12.8		0.5		1.1		0.1		0.1		0.8		2.6		15
	Domestic Waste		127 t/d	70.8		4.9		4.6		0.8		0.7		3.2		14.1		85
	Total		150 t/d	83.6		5.5		5.6		0.9		0.7		4.0		16.7		100
M/P	Market Waste		48 t/d	20.0		0.9		1.7		0.2		0.1		1.2		4.0		24
	Domestic Waste		152 t/d	63.5		4.4		4.1		0.7		0.6		2.9		12.7		76
	Total		200 t/d	83.5		5.3		5.8		0.9		0.7		4.1		16.7		100

Table 7.1.3 Material Balance of Lattakia Compost Plant

				Total	Waste/Compost				Recycle	Reject	Drain	Gas	Vaper	Addition	Total
					S-total	Dry M	Water	Humidity							
				%	%	%	%	%	%		%	%		%	%
Market Wate	100.0			100.0	100.0	40.0	60.0	60.0							
↓															
Hand Sorting		→	5.0		5.0	4.8	0.3	5.0	5.0						
↓	95.0			95.0	95.0	35.3	59.8	62.9							
↓		→	1.0		1.0	0.0	1.0	100			1.0				
↓	94.0			94.0	94.0	35.3	58.8	62.5							
Shredding		→	10.0		10.0	9.5	0.5	5.0		10.0					
↓	84.0			84.0	84.0	25.8	58.3	69.3							
↓		←	-15.0		-15.0	-9.0	-6.0	40.0						-15.0	
↓	99.0			99.0	99.0	34.8	64.3	64.9							
Fermentation		→	1.3		1.3	1.3	0.0	0.0				5.0			
												1.3			
↓	74.4			74.4	74.4	33.5	40.9	55.0					23.4		
Matuaring		→	0.4		0.4	0.4	0.0	0.0				1.7			
												0.4			
↓	55.0			55.0	55.0	33.0	22.0	40.0					18.9		
↓		→	15.0		15.0	9.0	6.0	40.0						15.0	
	40.0			40.0	40.0	24.0	16.0	40.0							
Screen		→	15.0		15.0	9.0	6.0	40.0		15.0					
↓															
Fine Compost	25.0			25.0	25.0	15.0	10.0	40.0							
	25.0				25.0	15.0	10.0		5.0	25.0	1.0	1.7	42.2	0.0	100.0

Table 7.2.2 Number of Operating Personnel in Lattakia Master Plan

			Rehabilitation of Existing Plant:50t/d (2shift)								New Plant in Casia:150t/d (2shift)								Ground Total
			Staff	Morning Shift			Night Shift			Total	Staff	Morning Shift			Night Shift			Total	
				Op.	Worker	S.-total	Op.	Worker	S.-total			Op.	Worker	S.-total	Op.	Worker	S.-total		
1. Plant Operation																			2
	Truck Scale	Oprater		1		1	1		1	2		(Center)		0	(Center)		0	0	
	Reception Hall	Wheel loader		1		1	1		1	2		1		2	1		2	4	6
		Assistant worker											1			1			
	Hand sorting	Sorting			4	4		4	4	8			8	9		8	9	18	26
		Assistant Worker											1			1			
	Shredding/Classifying	Operation chief		1		2	1		2	4		1		3	1		3	6	10
		Shredder/Classifier										1			1				
		Assistant worker			1			1					1			1			
	Fermentation	Wheel loader		1		2	1		2	4		1		2	1		2	4	8
		Turning machine										1			1				
		Assistant Worker			1			1											
	Maturing	Wheel loader		1		2	1		2	4		1		3	1		3	6	10
		Turning machine										1			1				
		Assistant Worker			1			1					1			1			
	Screening	Screen		1		2	1		2	4		1		2	1		2	4	8
		Wheel loader		1			1					1			1				
		Assistant worker																	
	Others	Dump track		1		2	1		2	4		1		2	1		2	4	8
		Guard			1			1					1			1			
		Sub-total		8	8	16	8	8	16	32	0	10	13	23	10	13	23	46	78
2.Maintenance																			
	Mechanical			1		2			0	2		1		2			0	2	2
	Electrical			1								1							
		Sub-total		2	0	2	0	0	0	2		2	0	2	0	0	0	2	4
3.Administration																			
	Manager									0	1							1	1
	Chief Engineer		1							1	1							1	2
	Engineer		1							1	1							1	2
	Account		1							1	1							1	2
	Secretary									0	1							1	1
	Others		1							1	1							1	2
		Sub-total	4							4	6							6	10
		Total	4	10	8	18	8	8	16	38	6	12	13	25	10	13	23	54	92

7.3 COST ESTIMATION

7.3.1 Construction cost

Construction cost of Homs compost plant is estimated as follows:

(1)	Equipment	165,000 SP
(2)	Civil and foundation	34,000 SP
	Sub-total	199,000 SP
(3)	Design	11,470 SP
	Total	210,470 SP

Cost breakdown is shown in Table 7.3.1.

7.3.2 Operation and Maintenance Cost

(1) Income

Incomes consist of sales of compost and recyclable material as followers:

		Year 2006	Year 2010
(1)	Compost	678,000 SP/year	1,356,000 SP/year
(2)	Recyclable material	1,008,000 SP/year	1,922,000 SP/year
	Total	1,686,000 SP/year	3,278,000 SP/year

(2) Expenses

Expenses consist of personnel cost, utility cost and maintenance cost as followers:

		Year 2006	Year 2010
(1)	Personnel cost	2,422,000 SP/year	3,256,000 SP/year
(2)	Utility cost	741,000 SP/year	1,481,000 SP/year
(3)	Maintenance cost	390,000 SP/year	780,000 SP/year
	Total	3,553,000 SP/year	5,517,000 SP/year

Breakdown of operation and maintenance cost is shown in Table 7.3.2.

Table 7.3.2 Cost Breakdown Table of Lattakia Compost Plant (1)

1US$= 121 yen, ('01)
1US$= 49 SP, ('01)
1SP= 2.5 yen, ('01)

	Planning Condition		
1	Waste Generation Amount	t/d	50
2	Waste Receiving Amount	t/d	50
3	Operating hour	h	12
4	Equipment Capacity	t/h	4.2

		Unit	Spec.	Unit c.	Q'ty	SP	10^3 yen	Cost
A	Equipment							
1	Receptio Facility (Trck Scale)	t	50	1,250	1	1,250	3,125	4,060
2	Pre-treatment Facility							
	1) Conveyors	t/h						
	-Waste feeding conveyor	t/h	4.2	27,600	1	yen		27,600
	-Other conveyors							
	-Hand sorting conveyor	t/h	4.2	310	1	310	775	1,010
	-Compostable conveyor	t/h	3.8	170	1	170	425	550
	2) Bag breaker	t/h	-	-	-	-	-	-
	4) Shurreder with classifier	t/h	3.8	146,400	1	yen		146,400
	5) Others		3.8	19,940	1	yen		19,940
3	Fermentation Facility							
	1) Turning machine	m3/h	-	-	-	-	-	-
	2) Fermented material conveyer	t/h	-	-	-	-	-	-
4	Refining Facility (Screen)		1.5	33,600	1	yen		33,600
5	Miscellaneous Facility							
	1) Air compresor, others	t/h	3.8					
	2) Tanks	t/h	3.8	7,890	1	yen		7,890
	3) Pumps	t/h	3.8	730	1	yen		730
	4) Pipe, Duct, Support, Chute,etc.	t/h	3.8	8,920	1	yen		8,920
6	Electric Equipment	kw	150	25,190	1	yen		25,190
7	Auxiliary Equipment							
	1) Workshop Equipment			1,860	1	yen		1,860
	2) Emergency disel generator	kVA	200	2,000	1	2,000	5,000	6,500
8	Vehicle							
	1) Wheel loader (big)		$2m^3$	5,000	2	10,000	25,000	32,500
	2) Wheel loader (small)		$0.8m^3$	1,750	1	1,750	4,375	5,690
	3) Dump Truck		8t	5,000	1	5,000	12,500	16,250
9	Spare Parts							
	1) for Equipment		5%	13,888	1	yen		13,890
	2) for Vehicles		10%	5,444	1	yen		5,440
	A-total							358,020
B	Installation Works							
	1) Mechanical Works	t	122t	15	122	1,830	4,575	5,950
	2) Electrical Works	kw	142kw	4	142	568	1,420	1,850
	3) Temporary Works			13,300	1	yen		13,300
	4) Supervisor			30,100	1	yen		30,100
	5) Removal of Obstracles			1,106	1	1,106	2,764	3,590
	B-total							51,200
	Equipment Total (A+B)							409,220

Table 7.3.2 Cost Breakdown Table of Lattakia Compost Plant (2)

1US$= 121 yen, ('01)
1US$= 49 SP, ('01)
1SP= 2.5 yen, ('01)

	Planning Condition		
1	Waste Generation Amount	t/d	50
2	Waste Receiving Amount	t/d	50
3	Operating hour	h	12
4	Equipment Capacity	t/h	4.2

		Unit	Spec.	Unit c.	Q'ty	SP	10^3 yen	Cost
C	Bulding							
	1) Compost Building							
	-Reception Building	m^2	Repair	4.0	270	1,080	2,700	3,510
	-Pretreatment Building	m^2	20x35	16.5	700	11,550	28,875	37,540
	-Control office	m^2						
	2) Fermentation Yard CoverRoof	m^2	Repair	4.0	1,388	5,552	13,880	18,040
	3) Maturing Yard Roof Cover	m^2	Repair	4.0	1,638	6,552	16,380	21,290
	4) Administration Building	m^2						
	5) Workshop/Garage	m^2						
	6) Guard House	m^2						
	C-total							80,380
D	Civil Works							
	1) Waste Hopper pit		4x7x3	300	1	300	750	980
	2) Foundation							
	-Conveyors	t	4	110	1	110	275	360
	-Shredder	t	42	192	1	192	480	620
	-Screen	t	10	83	1	83	206	270
	3) Partition Wall							
	-Recycle area	m	25	100	1	100	250	330
	-Shredding Area	m	11	60	1	60	150	200
	4) Pavement							
	-Pre sorting area/Stock yard	m	15x15	1.5	228	342	855	1,110
	-Shredding area	m	20x50	1.5	1000	1,500	3,750	4,880
	-Fermentation area	m						
	-Maturing area	m						
	-Internal road	m	7x100	0.5	700	350	875	1,140
	5) Extelia							
	6) Preliminary works							
	7) Comon Temporary Works							
	8) Transportation							
	9) Site Expence							
	10) General management Cost							
	D-total							9,890
	Civil and Building Total (C+D)							90,270
	Ground Total							499,490

Table 7.3.2 Operation and Maintenance Cost of Lattakia Compost Plant (3)

		Al-Bassa, Initial Stage/1Shift Operation (2006)							Al-Bassa, Next Stage/2shift Operation (2010)						
Basic Condition	Treatment Capacity	25 t/d							50 t/d						
	Compost Production	6 t/d	25%						13 t/d	25%					
	Operating Time	6 h/d							12 h/d						
	Operating Days	310 d/y							310 d/y						
		Quantity			Unit Price		Sum		Quantity			Unit Price		Sum	
Income	Compost	6 t/d	1,938 t/y		350 SP/t		678	10^3SP/y 40%	13 t/d	3,875 t/y		350 SP/t		1,356	10^3SP/y 41%
	Recyclable Material														
	Paper	0.2 t/d	62 t/y		1,500 SP/t		93	10^3SP/y 6%	0.6 t/d	186 t/y		1,500 SP/t		279	10^3SP/y 9%
	Plastic	0.9	279		3,000		837	50%	1.6	496		3,000		1,488	45%
	Metal	0.1	31		1,000		31	2%	0.2	62		1,000		62	2%
	Glass	0.1	31		1,500		47	3%	0.2	62		1,500		93	3%
	Sub-total	1.3 5%	403				1,008	60%	2.6 5%	806				1,922	59%
	Total						1,686	100%						3,278	100%
Costs	Personnel														
	Manager		1	Person	163	10^3SP/y	163	10^3SP/y 5%		Person		163	10^3SP/y	0	10^3SP/y 0%
	Chief engineer		1		147		147	4%	1			147		147	3%
	Accountant class		1		128		128	4%	1			128		128	2%
	Secretary class		1		107		107	3%	1			107		107	2%
	Engineer class		2		128		256	7%	1			128		128	2%
	Operator class		11		87		962	27%	18			87		1,574	29%
	Worker class		9		73		659	19%	16			73		1,171	21%
	Sub-total		26				2,422	68%	38					3,256	59%
	Utility														
	Electricity	50 kw	93,000 kwh/y		7.0 SP/kwh		651	10^3SP/y 18%	50 kw	186,000 kwh/y		7.0 SP/kwh		1,302	10^3SP/y 24%
	Water	3 t/d	775 t/y		18.0 SP/t		14	0%	5 t/d	1,550 t/y		18.0 SP/t		28	1%
	Fuel	38 lit/d	11,625 lit/y		6.5 SP/lit		76	2%	75 lit/d	23,250 lit/y		6.5 SP/lit		151	3%
	Sub-total						741	21%						1,481	27%
	Maintenance work						390	10^3SP/y 11%						780	10^3SP/y 14%
	Total						3,553	100%						5,517	100%
Balance							-1,867							-2,238	

Construction Cost	Al-Bassa	10^3Yen	10^3US$	10^3SP
Equipment		409,220	3,400	165,000
Civil and Building		90,270	700	34,000
Sub-total		499,490	4,100	199,000
Design	7%	28,645	236	11,470
Total		528,135	4,336	210,470

Exchange Rate			
1US$=	121	yen	('01)
1SP=	2.5	yen	('01)
1US$=	49	SP	('01)

SECTION 8

FACILITY PLANNING AND COST ESTIMATION

SECTION 8 FACILITY PLANNING AND COST ESTIMATION

8.1 METEOROLOGICAL DATA CONSIDERED IN FACILITY PLANNING

Meteorological data shown in the following tables are considered in the facility planning of this study.

Table 8.1.1 Average Monthly Temperature (Mean) in Lattakia

(Unit: Degree

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	10.2	11.9	14.6	17.4	19.9	23.2	26.0	26.4	24.8	23.1	19.3	15.2
1991	12.1	12.3	15.1	18.4	19.8	23.0	25.7	26.6	25.1	22.8	18.3	12.3
1992	9.1	9.1	12.3	16.6	19.8	22.8	25.3	26.7	25.0	22.6	17.4	10.7
1993	11.4	10.5	13.7	17.5	19.2	23.7	26.2	27.0	25.1	24.8	15.6	15.2
1994	14.2	12.9	14.7	19.2	20.5	24.0	25.9	26.3	27.0	24.9	17.1	11.8
1995	13.2	13.5	15.3	16.4	20.6	24.5	26.4	27.2	25.2	21.7	15.7	13.0
1996	11.6	13.3	14.2	16.7	21.7	24.2	26.6	27.1	25.2	21.3	18.7	15.8
1997	12.8	11.2	12.8	16.1	20.8	24.2	26.8	26.1	24.5	22.5	18.6	14.5
1998	11.6	12.4	14.0	18.8	21.5	24.1	26.8	28.8	26.4	23.4	20.2	15.1
1999	n.a.	14.2	15.5	17.4	21.7	24.7	27.3	28.0	26.5	23.0	17.8	15.7
Average	11.8	12.1	14.2	17.5	20.6	23.8	26.3	27.0	25.5	23.0	17.9	13.9

Table 8.1.2 Average Monthly Temperature (Max.) in Lattakia

(Unit: Degree

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	14.3	15.5	19.0	21.5	23.7	26.0	27.8	28.8	28.1	27.1	23.5	19.4
1991	16.1	16.0	18.5	22.4	22.7	25.6	27.3	28.4	28.4	26.4	22.5	15.5
1992	13.2	12.4	16.5	20.5	23.4	25.3	27.7	29.4	28.8	26.8	21.8	14.0
1993	15.0	14.2	18.0	21.3	22.2	26.9	28.9	29.5	28.5	30.2	19.8	19.2
1994	17.7	16.4	18.3	23.8	23.9	26.7	27.5	28.6	30.3	29.4	20.8	15.4
1995	16.7	17.6	18.9	20.3	24.3	27.1	28.4	29.5	28.3	26.3	20.1	16.9
1996	14.9	17.0	17.3	20.3	25.6	27.7	29.0	29.6	28.0	25.2	23.5	19.0
1997	16.9	15.1	16.8	19.7	24.6	26.9	29.3	27.9	28.3	26.6	22.8	17.9
1998	15.4	16.7	17.8	22.9	25.1	26.7	28.9	31.8	29.6	28.3	24.2	18.8
1999	n.a.	18.1	19.5	20.8	25.5	26.9	29.0	30.1	30.3	26.6	22.2	19.8
Average	15.6	15.9	18.1	21.4	24.1	26.6	28.4	29.4	28.9	27.3	22.1	17.6

Table 8.1.3 Average Monthly Temperature (Min.) in Lattakia

(Unit: Degree

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	6.0	8.3	10.1	13.2	16.1	20.3	24.2	23.9	21.5	19.1	15.1	11.0
1991	8.0	8.5	11.7	14.4	16.9	20.4	24.0	24.8	21.8	19.2	14.1	9.1
1992	4.9	5.7	8.1	12.7	16.1	20.2	22.8	24.0	21.1	18.4	12.9	7.4
1993	7.7	6.7	9.3	13.6	16.2	20.5	23.4	24.5	21.7	19.4	11.3	11.1
1994	10.7	9.3	11.0	14.6	17.0	21.2	24.3	23.9	23.6	20.3	13.3	8.2
1995	9.7	9.4	11.6	12.4	16.9	21.9	24.4	24.8	22.0	17.1	11.3	9.0
1996	8.3	9.6	11.1	13.1	17.7	20.7	24.2	24.5	22.4	17.3	13.9	12.5
1997	8.6	7.3	8.8	12.5	16.9	21.5	24.3	24.3	20.7	18.3	14.3	11.0
1998	7.8	8.1	10.2	14.6	17.8	21.4	24.6	25.8	23.2	18.5	16.2	11.4
1999	9.6	10.2	11.4	14.0	17.9	22.4	25.5	25.8	22.7	19.4	13.4	11.5
Average	8.1	8.3	10.3	13.5	17.0	21.1	24.2	24.6	22.1	18.7	13.6	10.2

Table 8.1.4 Monthly Precipitation in Lattakia

(Unit: mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
1990	64.8	99.8	26.9	6.7	8.5	19.0	6.2	0.2	0.0	27.7	66.2	36.8	362.8
1991	160.4	72.8	98.9	59.5	22.0	0.0	0.2	0.0	0.0	85.7	201.5	343.2	1,044.2
1992	61.6	127.7	47.7	10.1	30.8	12.1	0.0	0.1	2.6	11.3	81.8	183.2	569.0
1993	78.8	53.3	120.6	8.8	97.3	1.7	0.0	0.0	0.0	33.8	25.8	21.2	441.3
1994	264.2	170.2	31.4	14.7	49.7	0.0	0.3	76.2	1.3	78.7	203.5	98.1	988.3
1995	64.8	136.9	35.9	67.7	9.7	0.0	0.5	0.0	0.0	36.6	109.3	65.2	526.6
1996	230.3	40.7	187.6	32.8	4.7	6.7	0.0	0.0	1.0	156.7	12.5	235.2	908.2
1997	28.5	50.3	28.2	53.0	3.6	1.0	0.0	9.7	36.3	123.1	114.5	142.1	590.3
1998	94.1	10.4	116.5	32.1	30.3	0.0	0.0	0.0	7.0	10.2	92.4	316.1	709.1
1999	91.8	62.5	74.0	87.2	0.0	6.9	0.0	0.0	24.0	152.8	29.8	70.0	599.0
Average	113.9	82.5	76.8	37.3	25.7	4.7	0.7	8.6	7.2	71.7	93.7	151.1	673.9

Table 8.1.5 Monthly Average Humidity in Lattakia

(Unit: %)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
1990	54	62	60	67	71	73	76	74	69	59	59	54	65
1991	62	58	69	66	71	79	76	76	69	63	64	68	68
1992	59	61	57	70	73	78	73	74	61	68	50	67	66
1993	63	62	63	64	76	73	72	76	67	50	55	64	65
1994	70	65	69	65	73	71	78	77	74	62	64	61	69
1995	69	70	65	71	72	76	77	74	69	61	57	63	69
1996	69	64	71	66	74	69	75	74	71	66	58	73	69
1997	61	62	55	64	75	75	74	74	65	68	63	68	67
1998	66	57	65	68	73	78	79	73	69	59	69	71	69
Average	64	62	64	67	73	75	76	75	68	62	60	65	67

Table 8.1.6 Monthly Average Wind Speed in Lattakia

(Unit: m/sec)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
1990	3.8	5.7	3.3	3.7	3.2	3.9	4.1	3.5	3.0	3.5	3.7	3.9	3.8
1991	3.5	4.4	3.5	4.7	4.1	2.7	4.0	3.2	2.6	1.8	1.7	3.8	3.3
1992	2.7	3.7	2.1	2.9	4.4	4.8	4.6	3.4	2.9	2.4	3.6	3.1	3.4
1993	3.4	4.1	4.7	3.8	3.3	3.8	3.7	4.6	4.0	2.4	3.8	3.5	3.8
1994	4.2	5.2	3.1	4.5	3.6	4.6	5.9	3.6	2.0	1.9	4.4	n.a.	–
1995	4.6	2.9	4.6	3.9	3.7	4.0	4.5	3.2	2.8	1.7	2.8	1.7	3.4
1996	2.3	2.1	3.6	4.0	2.9	n.a.	2.8	3.7	4.3	3.0	2.2	3.7	–
1997	3.6	3.6	4.2	4.7	3.4	3.8	4.5	5.8	3.7	2.7	2.7	4.5	3.9
1998	3.7	3.2	4.3	2.8	3.6	3.7	4.8	3.5	3.9	3.2	3.7	3.9	3.7
Average	3.5	3.9	3.7	3.9	3.6	3.9	4.3	3.8	3.2	2.5	3.2	3.5	3.6

8.2 OPERATION AND MAINTENANCE MANUAL OF SANITARY LANDFILL

This manual stipulates the guidelines for application, operation and maintenance of sanitary landfill systems by explaining the components of the system, the required facilities for management of the site, such as weigh-bridge/truck scale and site office, and field operations. The contents also cover monitoring facilities that are indispensable for protection of the surrounding environment of the site.

The contents of this manual refer mainly to the *"Explanation of Design Guidelines of Solid Waste Final Disposal Site, May 1993,"* which was issued under the supervision of the Ministry of Health and Welfare, Japan. Therefore, some alterations will be required to suit the local conditions here.

8.2.1 Components of Sanitary Landfill System

(1) Management of Sanitary Landfill System

For the proper management of sanitary landfill systems, facilities for control of operations and monitoring, a site office, access roads and other administrative facilities should be constructed to involve the proper control of solid waste quality and quantity. Landfill operations involving landfill waste, layers and facilities should also be managed in a proper manner. Major management items of sanitary landfill systems are as shown in Table 8.2.1 below.

Table 8.2.1 Management Items of Sanitary Landfill System

	Management Items	Remarks
Sanitary Landfill System	Landfill Waste	Records of waste quality and quantity
	Landfill Work	Cover material, landfill plan, plan of safety and sanitary health
	Landfill Layer	Leachate and gas generation, ground settlement, etc.
	Facilities	Proper maintenance and repair of all facilities
	Others	Countermeasure for fire, disaster, etc.

(2) Facilities for Sanitary Landfill System

Facilities required for sanitary landfill systems are classified into landfill control facilities and related facilities. Landfill control facilities should include incoming vehicles control facility, monitoring facility and site office, whose function is to record and control the quality and quantity of landfill waste as well as to monitor possible impacts. Related facilities, such as access roads, garage and workshop, are necessary for effective management and operation of the disposal site. Whenever necessary, depending on the local characteristics of the disposal site, noise insulation walls and measures against insects and crows must also be considered. Main facilities of sanitary landfill system are shown in Table 8.2.2.

Table 8.2.2 Main Facilities of Sanitary Landfill System

Classification	Main Facilities
Landfill Control Facilities	Incoming vehicles control facility Monitoring facility Site office
Related Facilities	Access roads Others (Garage, Workshop, Vehicle washing facility, Littering prevention facility, Notice board, Gate, Fire prevention, Disaster prevention pond and other auxiliary facilities)

8.2.2 Landfill Control Facilities

(1) Incoming Vehicles Control Facility

1) Installation of Weigh-bridge (Truck Scale)

a. Checking Landfill Waste

Landfill waste should be checked for smooth operations as well as to prevent land pollution due to inclusion of harmful substances. Therefore, the type, components, quality and quantity of the solid waste must be carefully checked before unloading the waste on the landfill area.

Landfill waste without passing through an intermediate treatment facility is usually checked by its outward appearance. Therefore, it would be convenient if a platform is built near the weigh-bridge so that the components on the truck can be inspected. When necessary, the solid waste should be firstly unloaded and then inspected. A place for inspection would thus be required.

b. Classification of Weigh-bridges (Truck Scales)

In sanitary landfill systems, a weigh-bridge or truck scale should be constructed at the entrance to the landfill site to weigh and record the landfill waste. The weigh-bridge or truck scale weighs the truck loaded with the landfill waste before the truck goes into the landfill site. Weigh-bridges are generally classified into three (3) systems: mechanical system, load cell system and lever load cell system. The mechanical system has a scale face with a pendulum or digital indications. The load cell and lever load cell systems also have digital scales, but each of them has different measurement principles. The load cell weigh-bridge has recently become popular because the mechanism is simple and thus, easy to maintain.

2) Weigh-bridge Design

The following factors should be considered before selecting the weigh-bridge system.

a. Number of Weigh-bridges to be installed

The total number of collection vehicles per day and maximum number of collection vehicles at peak delivery hours should be considered before deciding on the number of weigh-bridges to be installed. In particular, when the weigh-bridge is to be installed near public roads, the maximum number of collection vehicles at peak hours should be carefully surveyed at intervals of 15 to 30 minutes.

In an economical viewpoint, only one weigh-bridge is thought to be enough. However, additional number of weigh-bridges should be considered if excessive waiting time for measurement is predicted and a large number of vehicles have to wait and affect the traffic on the public road nearby.

b. Maximum Weighing Capacity of Weigh-bridge

The maximum weighing capacity of the weigh-bridge should be set up several times more than the total weight of the collection vehicle so as to provide room for unusually heavy collection vehicles. In general, the maximum weighing capacity of 10 to 30 tons is usually used.

c. Location of Weigh-bridge

The weigh-bridge must be placed at a strategic location where vehicles will pass through whenever entering and leaving the disposal site.

d. Introduction of Automatic Weighing System

The automatic weighing system using a computer has an advantage in not only managing landfill waste to be carried in but also in reducing the time for making daily, monthly and annual reports. Data that should be put in the computer is presented in the following Tables 12.3.1 and 12.3.2.

e. Necessity of Regular Inspection

When a weigh-bridge is used as a toll gate, regular inspection of the system should be made to ensure proper measurements.

3) Investigations of Solid Waste Quality

Besides checking to see if the solid waste meet the requirements set, the quality of solid waste should also be investigated. By knowing the quality of the landfill waste, the type of gas generated in the landfill, the leachate quality, and the amount of settlement due to compaction of the landfill layer can be understood. This is an important data not only for designing the usage of the completed landfill site but also for finding the future landfill sites. When samples of the solid waste are to be taken, a place of inspection to take the samples after the landfill waste is dumped should be prepared, if possible.

4) Analysis of Control Data

The data on the weights and results of the inspection of the waste should be analyzed on a regular basis for each type of solid waste and the site filled.

Usually, daily, monthly and annual reports are to be prepared. Time of deliveries should be clearly announced and strictly followed. The daily report should be turned in after one-day operation. On the first day of the month, the monthly report of the previous month should be submitted to a site manager while the monthly information are included in the annual reports.

5) Landfill Records

The landfill waste volume, quality, place, time of land-filling, solid waste type, etc., are all quite important data which should be recorded. The required input information and output record are shown in Tables 8.2.3 and 8.2.4.

Table 8.2.3 Input Information (Example)

Items
(1) Date
(2) Entry Time
(3) Departure Time
(4) Contractor's Name
(5) Driver's Name
(6) Vehicle Registration Number
(7) Waste Type
(8) Collection Points (Route)
(9) Gross Load
(10) Unloaded Weight
(11) Net Load

Table 8.2.4 Required Information for Management of Sanitary Landfill

Required Information
(1) Number of collection vehicle
(2) The total waste amount brought into the site
(3) Classification of waste type and each amount
(4) Classification of waste generation in each collection area
(5) Waste charge calculation and issuing of bill

Note: Daily report, monthly report and annual report should cover the above items (1) to (5).

(2) Monitoring Facilities

1) Objective of Installation of Monitoring Facilities

Installation of monitoring facilities has the following three (3) objectives:

- Monitoring the landfill layers;
- Monitoring the environment; and
- Reflections on the future plans

Considerations of each item are described below.

a. Monitoring the Landfill Layers

The landfill waste during the course or after a landfill operation should be checked to monitor changes in the solid waste component, trace and measure the amount of settlement in the landfill layers. The data obtained can be used for designing future leachate treatment plants, estimating the expected useful life of the site and considering a post closure plan for completed landfill site.

b. Monitoring the Environment

The environment should be monitored during and after landfill operations to assess the environmental impacts or to equip the sanitary landfill system from points of environmental conservation and antipollution measures.

c. Reflections on the Future Plans

The amount of data collected or analyzed will determine how well future projects can be planned. Therefore, it is important that data on solid waste component, leachate, underground water, gas, bad odors and other environmental qualities be regularly collected.

2) Implementation of Regular Monitoring

Following items should be monitored on a regular basis:

- Landfill layers;
- Leachate and discharged water;
- Groundwater;
- Gas;
- Bad odors; and
- Others

Considerations of each item are described below.

a. Landfill Layers

The landfill waste will change with the years. Therefore, it is important that a certain specified landfill layer is sampled and analyzed, and its quality change recorded at regular intervals.

However, it would be very difficult to obtain a sample of a typical landfill waste since landfill waste is not homogeneous. As such, monitoring of the waste quality changes has to be taken on a macro basis. For example, landfill layers settle due to waste decomposition by gasification or leachate formation. If a plate can be placed in the layers to measure subsidence due to pressure or organic matter decomposition, changes of the landfill waste quality could be traced.

b. Leachate and Discharged Water

As part of the management and maintenance of a sanitary landfill system, parameters and frequency of testing for the discharged water quality should be carefully examined. In terms of leachate monitoring, the testing should also be done for the water flowing into the leachate treatment facility. The amount of pollutants and harmful substances in the water flowing out of a landfill site, i.e., leachate, should be measured. In addition, the discharged water quality should also be monitored to prevent pollution of water in the areas where treated water is discharged. The proposed monitoring scheme is shown in Table 8.2.5.

Table 8.2.5 Proposed Monitoring Scheme for Leachate and Discharged Water

Sampling Place	Monitoring Parameters	Frequency
Leachate reservoir pond and discharged water	pH, CN, Pb, T-Hg, Cd, BOD, COD, SS, Color	1/month

c. Groundwater

The groundwater in areas surrounding the sanitary landfill system should be monitored for the following reasons:

- To check whether or not the natural or artificial liner system in the site is effective; and
- If the natural or artificial liner system is not effective, to monitor the extent of impacts of pollutants discharged into the groundwater and the lives of inhabitants in the area.

Therefore, the monitoring facilities established should enable determination of the possible usage and the quality of groundwater in the areas around the sanitary landfill system. With these concepts in mind, the number, location and depth of monitoring wells required should be carefully decided.

Before considering the above, at least one well should be placed directly below the direction of the groundwater flow in the landfill. For monitoring, the amount of seepage should be surveyed before the pollutants in the water are dispersed into the groundwater.

In addition, the second monitoring well should be built downstream where the dispersion of pollutants has the highest possible and fastest effects. The monitoring wells should be as deep as possible but in reality, the depth of wells is usually set up depending on the water table. The wells, in principle, should be more than 100 mm in diameter with a strainer at the water table.

The water quality inspection by monitoring wells can be divided into regular and routine inspection. Regular inspection includes inspections on the land-use in the neighboring areas. Routine inspection requires immediate detection of pollutant leakage. Therefore, instruments like pH meters or electric conductivity meters are usually prepared for measuring changes in the water quality at the groundwater collection and discharge facility or the monitoring wells located directly below the

landfill site. It is recommended that the result of measurement be recorded on paper in the routine inspection. In the regular inspection, on the other hand, the water quality should be checked at the same time of each year at each monitoring well because groundwater quality varies from season to season. Figure 8.2.1 shows a typical groundwater monitoring well and Table 8.2.6 shows the proposed monitoring scheme of groundwater.

Table 8.2.6 Proposed Monitoring Scheme for Groundwater

Sampling Points	Monitoring Parameters	Frequency
Monitoring Well	pH, CN, Pb, T-Hg, Cd, BOD, COD, SS, Color	1/month

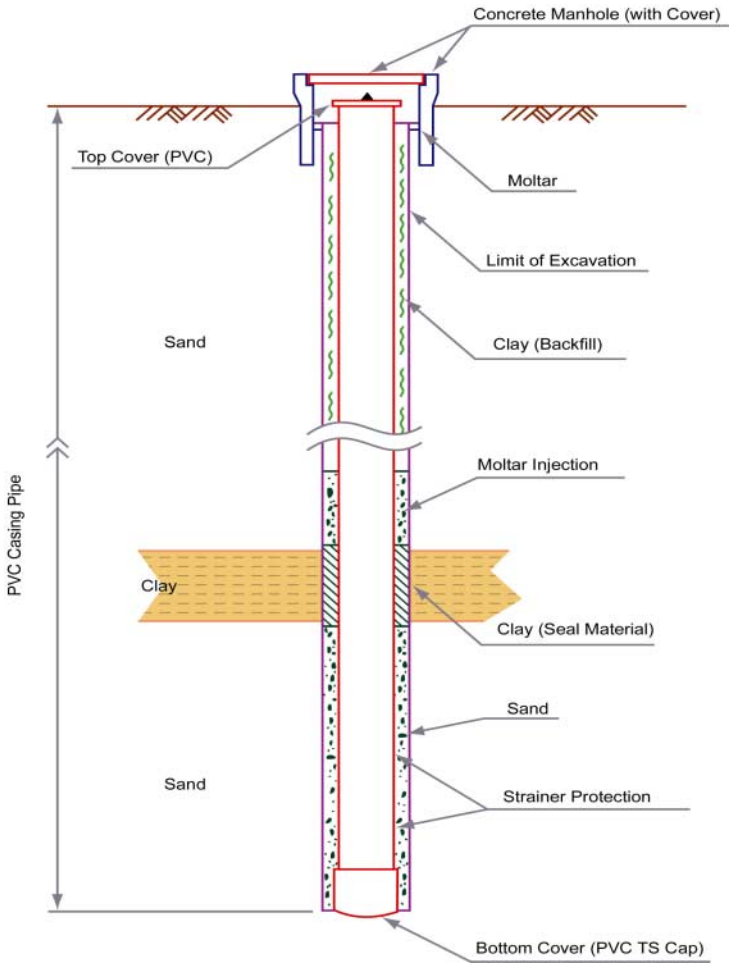


Figure 8.2.1 Typical Groundwater Monitoring Well

d. Gas

When waste with organic substances is buried in a landfill site, monitoring of generated gas will help to determine the decomposition condition of the landfill waste. Even in a landfill that is used for filling mainly of incombustible waste, it is recommendable that composition of the waste carried in is also monitored since the waste may include many organic substances.

Generated gas can be monitored by using gas-venting facilities in the landfill. Monitoring parameters and frequency for gas should be determined flexibly depending on age of the landfill and characteristics of generated gas. In other words, the monitoring should be carried out much more frequently when gas generation actively occurs; however, monitoring frequencies can be reduced during stable periods. Table 8.2.7 below shows the monitoring scheme for gas.

Table 8.2.7 Proposed Monitoring Scheme for Gas

Sampling Point	Monitoring Parameters	Frequency
Gas outlet pipe	Temperature and humidity of original air, Temperature and volume of gas, Composition analysis (CH_4, CO_2, CO_2 and O_2)	1/month

e. Bad Odors

Monitoring points and times for bad odors should be decided taking into consideration the living conditions in the surrounding area as well as the weather conditions. Monitoring of bad odors is usually conducted once a day in every 6 months at 2 or 3 places on the landfill site boundaries.

There are two (2) methods for measurement of bad odors: instrument method and sensory test method. The instrument method measures eight (8) parameters, namely, ammonia, thiorumethane, hydrogen sulfide, methyl sulfide, triethylamine, acute aldehyde, styrene and methyl disulfide by using instrument. The sensory test method is carried out in comparison with three test bags by the sense of smell. However, the method should be selected after considering the solid waste quality and the local conditions.

f. Others

Besides the above-stated items, other impacts on the environment like noise, vibrations, fauna and flora should also be considered, if necessary.

(3) Site Office

The sanitary landfill system should be systematically operated to protect the environment, promote safety of the facilities and improve the cost effectiveness. In this sense, inspection and weighing of the landfill waste, checking of landfill progress and conditions, securing of cover soil materials, and operation, maintenance and monitoring of leachate treatment facilities should be carried out in a proper manner. The site office, so as to accomplish this, should be equipped with management office, test laboratory and analytical room, worker's rest room, locker room, showers, a room for boiling water, canteen, toilets and conference room, if possible. Ventilation, telecommunication, and other utilities should also be considered. In any case, the type of facility or room required at a site will depend on the scale of the landfill site, management policies, and the number of employees and managers at the site.

The site office should be placed in a convenient position to enable easy control of landfill waste or landfill operation itself.

8.2.3 Related Facilities

(1) Access Roads

The access roads or approach roads to the landfill site can be divided into two parts: public roads and roads leading from the public roads up to the disposal site.

Surveys on the use of existing public roads should be made to comprehend the characteristics of the locality. The road width and structure should be checked to ensure that it is suitable for collection vehicles to transport solid waste through the road. When a public road is also used as a route for transporting solid waste, road signs to indicate this dual purpose must also be erected. The junction should be designed so as not to obstruct the flow of present traffic. Usually, most of the roads leading from the public roads up to the final disposal site are newly built ones.

The access roads should be designed carefully in consideration of their route, alignment, width and structures to fit these features to the site requirements for the landfill area. In particular, if the approach roads are to become public roads in future, special considerations are required. They must be built in such that no problem occurs when solid waste is accidentally dropped onto the road and repairs are to be made on the approach road itself. All other necessary measures should be considered to prevent accidents from happening.

(2) Others

1) Garage/Workshop

Garages, petrol station, warehouses, and workshop for machine inspection and maintenance should be installed, if possible. Landfill sites are usually located in a suburb of a city, so that it is difficult to carry out the preventive maintenance work on a daily basis. It is thus recommendable to provide these facilities against machine troubles and failures. Tools and equipment for minor repairs and the minimum level of spare parts such as oil filters, tire tubes and fan belts should be stored in the warehouse.

2) Vehicle Washing Facility

To prevent the collection vehicles from carrying dirt onto the public roads, a vehicle washing facility should be installed on the existing site roads. The facility should be located near the exit of the site.

3) Littering Prevention Facility (Buffer Zone)

To prevent solid waste from littering or flowing out of the landfill site, cover soil should be provided as soon as possible. However, the amount of cover soil is not always necessarily enough because of geological conditions in the region. In this case, a littering prevention facility or buffer zone must be installed. Littering prevention fences should be about 3 or 4 times as high as the height of perimeter fencing that is built on the site boundary. Additionally, for protection against strong winds or seasonal winds, trees may be planted around the site.

If the waste is composed mainly of ash that is easily dispersed, water should be sprayed on the waste to prevent dust from rising. Considerations should be taken against excessive watering because excessive watering will make handling of the waste worse.

There is a limit, in some cases, to prevent waste dispersion only by structure and height of fence. Therefore, it would be more effective if the waste is divided into dispersible and non-dispersible waste when delivered into the landfill site. Accordingly, the dispersible waste will be dumped into a depression area that is designated for the exclusive use of this type of waste.

Fences are constructed for preventing not only trespassing on the site and littering the waste, but also exposing the unsightly site. The fences must be strong against the wind but from an economical point of view, a height of less than 3 m would be sufficient. In a landfill site where there are many naturally vegetated trees such as mountainous area, for example, these trees may also have the same function as a fence or buffer zone.

4) Notice Board/Gate

A notice board should be built at the entrance of the site to indicate clearly the purpose of the landfill site. The items to be clearly marked on the board should be as shown in the following Figure 8.2.2, a typical design of the notice board.

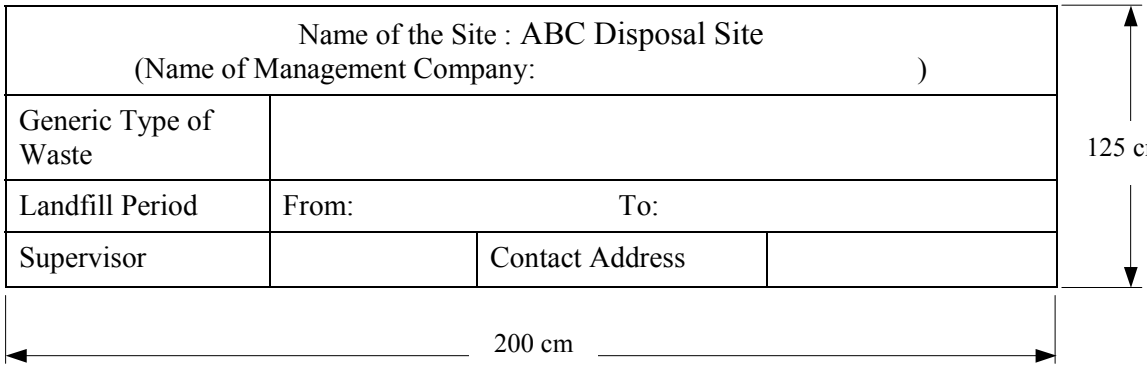


Figure 8.2.2 Example of Notice Board

In addition, a gate should be built at all entrances and exits of the landfill site. At the end of the daily work, the gate should be closed and locked to prevent entrance to the site by someone especially at night.

5) Fire Prevention Facility

Fire at the sanitary landfill system usually results from the generation of combustible gas like methane due to decomposition of food waste or other substances containing organic matter. Firstly, to prevent the outbreak of fire, it is advisable that daily cover soil work is carried out. When gas leakage occurs on the landfilling area through cracks or holes on the ground, glass pieces in the waste may sometimes act as tiny lenses to focus solar energy and thus causing fires. Secondly, generated gases should be removed as fast as possible by means of gas vents. Release of the gas into the atmosphere would prevent explosions, and withering of trees around the site would stop.

It is extremely difficult to extinguish a fire that breaks out in the gas vent facility. If water is poured into the gas venting pipes, a very dangerous subterranean explosion may occur. Special attention should be taken in this case. Fire extinguishers, water and sand for extinguishing fires should be made fully available. In the sanitary landfill system, it would be better if the cover soil itself is fireproof. Stockpiles of cover soil should be made available, so that fires could be extinguished by covering the soil and stopping the supply of oxygen for the fire. Also, dump trucks, dozer shovels and other heavy equipment should be ready for use in the site when necessary.

When inflammable fuel for machine and equipment or insecticides are used in the site, they should be handled in accordance with the rules on handling of dangerous substances.

The most important thing to prevent fires is extinguishing of fires at the initial stage. Therefore, daily routine inspection of the site is important.

6) Disaster Prevention Pond

Since leachate control facilities for runoff overflow are to be installed in the sanitary landfill system, the design concept of a disaster prevention pond is different from that of the pond in a residential area development project. Rainwater in a landfill site is temporarily stored in the leachate control facility, such as the leachate retention pond.

The sanitary landfill system should also have the function of a flood control facility. Especially in a plain area, the rainwater in a trench type of landfilling has to be pumped out. In this case, the area that is equivalent to the landfill area is deducted from the total watershed area. Consequently, a disaster prevention pond would not always be necessary since the landfill area would take charge of storing peak flooding water.

When final or intermediate cover soil is effective in removing surface runoff that will then be drained by rainwater collection and drainage facilities, outflow of rainwater from the landfill site will increase. Therefore, the importance of rainwater control facility at the landfill site will be the greatest when landfilling is completed.

The disaster prevention pond should be designed in consideration of the following items:

- Watershed area;
- Landfill area;
- Layout of rainwater collection and drainage facility;
- Development area other than landfill area; and
- Flow capacity of the downstream river.

8.2.4 Safety Measures

The landfill site should be fenced off to prevent trespassing on the site because most parts of the site are dangerous places. The fencing off is also to prevent other people from dumping their own waste illegally especially in the nighttime. Net fences or barbwire fences are usually used for enclosing the sanitary landfill system, while corrugated plates are used to fence off the area from public roads or residential areas.

These fences could be easily damaged and therefore, it will be important for them to be inspected and maintained regularly. Since the area to be controlled is usually large, name of landfill site and supervisor, address and contact telephone number should be indicated clearly on signboards put up at several strategic locations. In addition, signboards showing *"UNAUTHORIZED ENTRY FORBIDDEN"*, for example, should be installed.

Inspection and maintenance of landfill site, dangerous places in particular, should also be carried out to prevent waste pickers or children from climbing over the fences and entering the enclosed area. The following measures to deal with dangerous places should be carefully considered:

- Dangerous substances or insecticides should be placed in a warehouse under lock and key;
- Leachate treatment facilities and the leachate control pond should be fenced off, and the entrance/exit to them be properly locked up;
- Manholes should have heavy lids;
- Gas venting facilities should be fenced off with barbwires and a sign showing "DANGER" be placed on the fence;
- Landfill equipment should be kept in a designated place and a buffer area should be established if necessary;
- Sand and gravel used for cover soil should be piled to a safe height so that they will not collapse; and
- Depending on the progress of landfilling, surface drainage should be elaborately performed since potholes are easily formed and water is easily collected.

Corrugated plate fences should also be regularly inspected since heavy rains and winds easily damage them. Lighting during nights is also important for safety and prevention of illegal dumping. Light bulbs and power line should be regularly inspected. Security guards should always be stationed during nights and holidays, if necessary.

8.2.5 Landfill Operation

(1) Types of Landfill Operation

Landfill operation means the whole series of work that includes delivery of solid waste into the landfill area, spreading, mixing and covering soil and all related temporary work. Types of operation are given in Table 8.2.8, and, in short, the operation comprises landfill work, cover soil work, site road work and slope adjustment work.

Table 8.2.8 Types of Landfill Operation

	Major Work	Items to be considered
Landfill Operation	Landfill Work	- Landfill method - Order of landfilling - Spreading and compaction - Separate landfilling
	Cover Soil Work	- Daily cover - Intermediate cover - Final cover - Selection of cover material - Application of cover material - Control of cover soil
	Site Road Work	- Main roads - Branch roads
	Slope Adjustment Work	- Safety slope - Types of adjustment (tree-planting, grass, etc.)

The primary function of the sanitary landfill system is to promote stabilization of solid waste placed on the landfill area so as not to cause environmental problems. Simultaneously, it is also important that effective and economic solid waste disposal within a limited landfill area be considered. Therefore, the following matters should be considered comprehensively before proceeding with the landfill operation:

- Surrounding environment;
- Natural conditions, such as geography of the landfill site and meteorological condition;
- Types and amounts of solid waste generated per day; and
- Financial and technical capability of the management organization.

The close relationship between composition of the landfill operation and the required function of the sanitary landfill system is shown in Table 8.2.9. Landfill work should not only depend on intuition and experiences of a supervisor of the work, but decisions on the work should also be made based on results of appropriate surveys on the technical and economic aspects. That is to say, supervisors or managers of the landfill site should understand fully about the function required for the sanitary landfill system described in Table 8.2.9.

If much attention is paid to efficiency of the landfill work, careful considerations should go to landfill method and period, spreading and compaction of landfill waste, and the thickness of the landfill waste and cover soil. If stabilization of the landfill waste is to be given priority, the landfill method, selection of cover soil material and compaction method that will not hinder the process of landfill waste stabilization should be considered. In addition, if necessary, separate landfilling depending on types of solid waste should be introduced. On the other hand, when leachate and gas quality or quantity is of great importance, the order of landfilling and cover soil work should be considered.

Table 8.2.9 Relationship between Composition of the Landfill Operation and the Required Function of the Sanitary Landfill System

Landfill Operation	Landfill Work				Cover Soil Work				Site Road Work		Others
Required Function	Landfill Method	Order of Landfilling	Spreading /Compaction	Separate Landfilling	Selection of Cover Material	Daily Cover	Intermediate Cover	Final Cover	Main Roads	Branch Roads	Slope Adjustment Work
Efficiency of landfill work	A		A			A	A	A	A	A	A
Stabilization of waste	A	B	A	A	A	B	B	B			
Leachate quality		B	B	B	A	B	B	B			
Leachate volume		B	B	B	A	A	A	A			
Gas quality			B	B	A	B	B	A			
Settlement	B		A	B	B	B	B	B			
Prevention of littering waste			A		B	A					
Physical characteristics	A		A	A	B	B	A	A			
Post-closure land use	A	B	A	A	B	B	B	A			A
Workability	A	B	A	B	A	A	A		A	A	A
Cost effectiveness	A	B	A	A	A	B	B	B	B	B	B
Maintenance		B	A	A					A	A	
Disaster prevention		B	B		B	A	B	B			A

Note: A – Close relation, B – Some relation

(2) Landfill Work

The method and order of landfill should be carefully selected in the following order:

- Secure the required landfill volume;
- Promote stabilization of the landfill;
- Create a physically strong foundation for post-closure land use; and
- Improve efficiency of the landfill work.

In particular, enhancement of post-closure land use will require consideration of separate landfill methods for each type of solid waste. Additionally, data on the amounts and types of landfill waste, and changes of landfill area should be recorded for future reference or maintenance of the landfill site.

1) Landfill Method

a. Area Method/Cell Method

The area method should be introduced when the original ground is unsuitable for excavation of trenches. Earth dike with a height of one lift (2-3m) should be firstly constructed to get the support for compaction. The waste should be unloaded at the toe of the earth dike, and spread and compacted on the slope of the dike in a series of layers that vary in depth from 30 cm to 60 cm. The recommended slope of these layers is 1 to 3. The area method is illustrated in Figure 8.2.3. The width of the working face should be as narrow as possible to confine the waste to the smallest possible area, but it should also be wide enough to give necessary maneuverability to bulldozers.

At the end of each day's operation, a 15-cm to 30-cm layer of cover soil should be placed over that daily-completed fill. This daily-completed fill including the cover soil is called a cell. However, in the case of a large landfill site where the amount of solid waste disposed is more than 200 tons per day, two or more cells should be constructed each day. To avoid the decrease of structural stability, a smaller cell would be better. The waste should be unloaded at the top of the last cell, spread and compacted. When all the area is covered by one layer of cells, it is called a lift. One more lift can be constructed on top of the preceding lift whenever it does not surpass the final topography set by the design.

If a small amount of usable cover soil is available at the landfill site, the ramp variation of the area method is used as shown in Figure 8.2.4. In this method solid wastes are placed and compacted as described for the area method and are partially or wholly covered with earth scrapped from the bottom of the ramp.

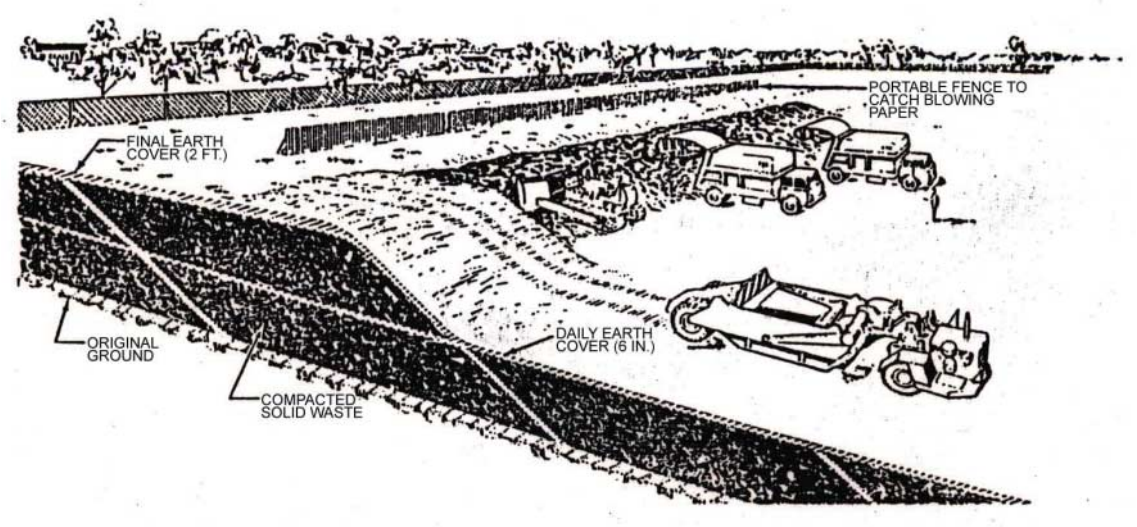


Figure 8.2.3 Area Method

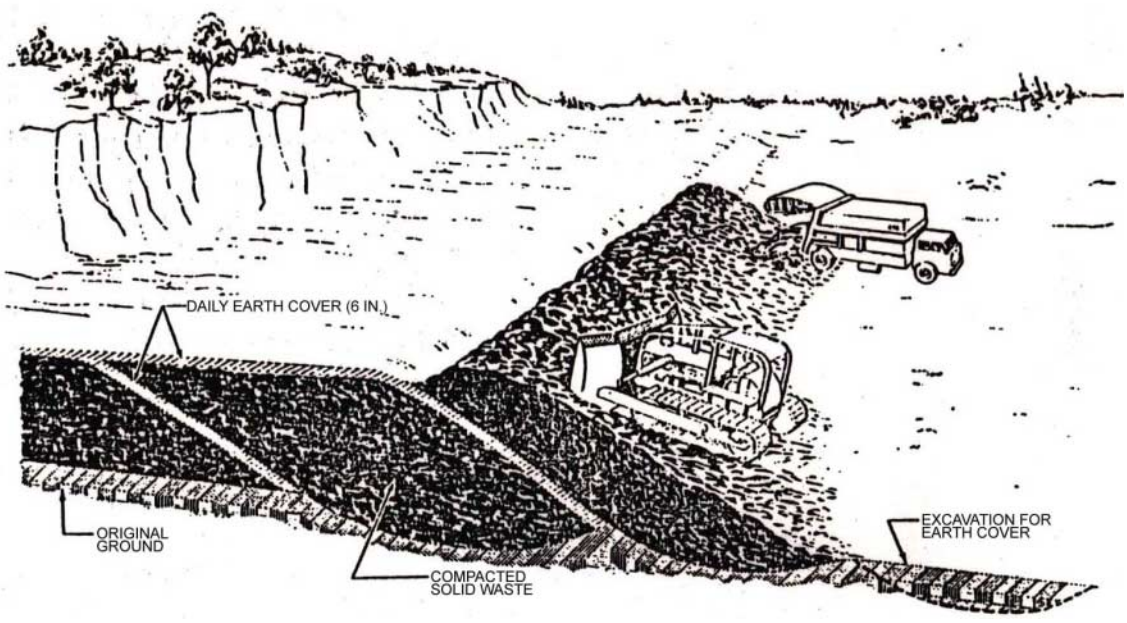


Figure 8.2.4 Progressive Slope or Ramp Method

b. Trench Method

This method is suited for a place where the original ground is relatively level and the water table is not near the surface. In this case, the excavation of trenches give on-site cover soil as well as support for compaction. Solid waste is placed in trenches varying from 30 to 120 m in length, 1 to 2 m in depth and 5 to 8 m in width. To start the process, a portion of the trench is dug and the earth is stockpiled to form an embankment behind the first trench. Waste is then placed in the trench, spread into thin layers of from 30 to 60cm with the slope of 1 to 3 and compacted. As described for the area method, cover soil is placed near the completed fill at the end of each day's operation. Cover soil is obtained by excavating an adjacent trench or continuing the trench that is being filled.

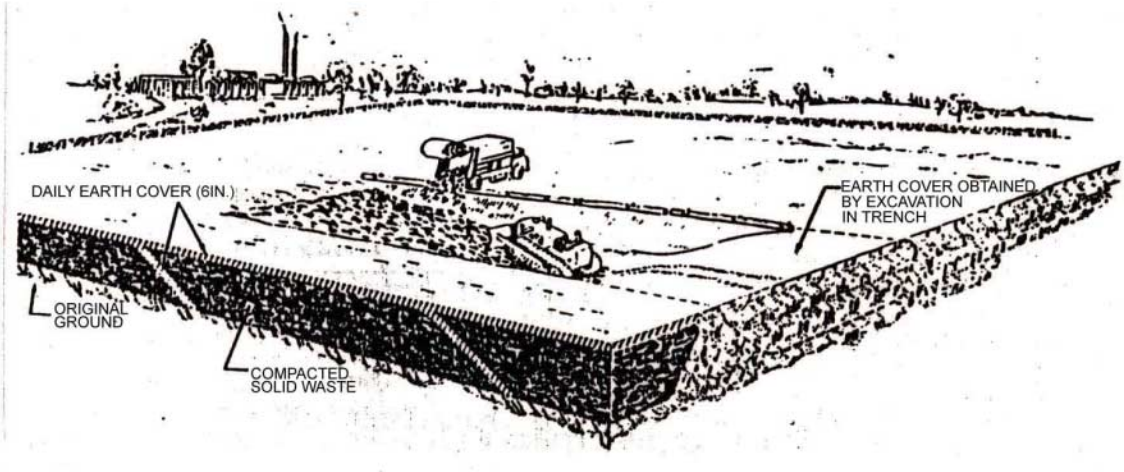


Figure 8.2.5 Trench Method

2) Cell Construction

a. Sandwich Method

This method is shown in Figure 8.2.6 below. Solid waste is laid horizontally covering soil layer by turns. This method is usually used to landfill in a narrow valley. When a wide area is to be filled-up, the cell method as shown in Figure 8.2.7 is applied.

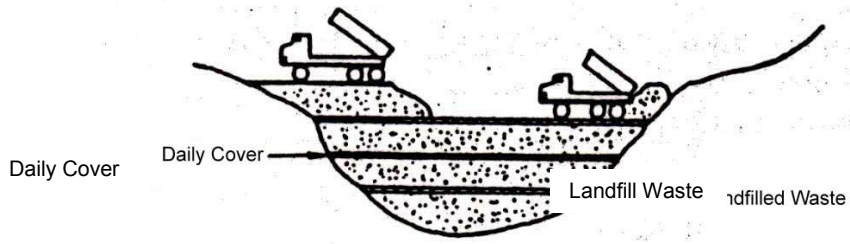


Figure 8.2.6 Sandwich Method

(3) Cell Method

This method, as shown in Figure 8.2.7, is widely used for the landfill method of sanitary landfill systems nowadays. This has a cell of solid waste topped with a layer of cover soil. The size of each cell is determined by the amount of solid waste filled per day. Since each cell is thought to be an independent landfill area, it acts as a fire-breaker. Each cell also prevents the waste from being scattered, the emission of bad odors and breeding of harmful vectors. The disadvantage of this method is that the cell hampers gas generation and water flow within the landfill.

Figure 8.2.7 Cell Method

1) Order of Landfilling

There are two (2) orders in terms of landfilling, namely:

- Landfill starts from the upstream to the downstream; and
- Landfill starts from the downstream to the upstream.

In the former method, easy access to the landfill area via the filled-up area is possible. During the early stages of landfilling, rainwater absorbed into the inner landfill layers are easily discharged. However, it is difficult to remove the rainwater from the unfilled areas. Rainwater on liners on the bottom of the landfill will result in slipping of the landfill layer as well. Sometimes the liners may even be damaged.

On the other hand, the latter method overcomes the above-said difficulties in the former method. Therefore, if the order of landfilling is decided, geography of the area, rainfall pattern, leachate treatment method and rainwater treatment method should be given sufficient consideration.

2) Spreading and Compaction

a. Methods of Spreading and Compaction

Figure 8.2.8 depicts two (2) methods of spreading and compaction for the solid waste dumped from the collection vehicles: *"Push Down"* or *"Push Up"* the waste on a slope by bulldozer or a loader.

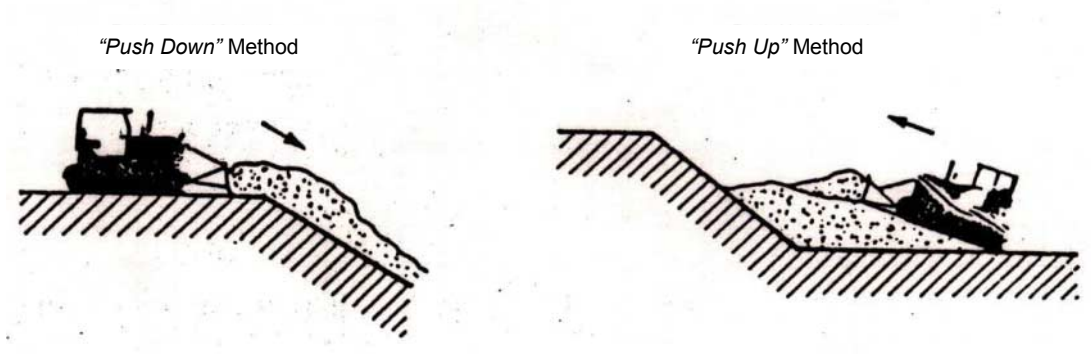


Figure 8.2.8 Spreading/Compaction Method

"Mounting Up" method that is applied for *"Push Up"* method is shown in Figure 8.2.9. This method is used when a cell on a plain ground is made.

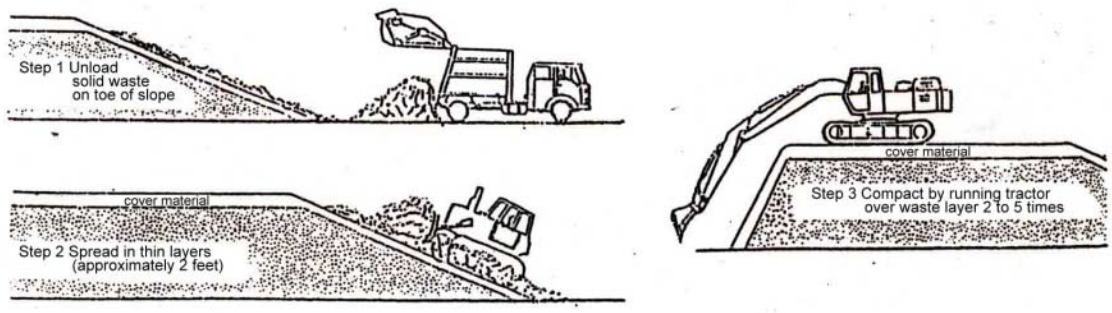


Figure 8.2.9 Mounting Up Method

In the case of pushing the solid waste down the slope, it is difficult to spread the waste into a uniform thickness. The bottom part of the slope tends to be thicker. Mixing and compaction is also difficult. On the other hand, it is easier to make uniform landfill layers when pushed up on the slope. Compaction is also easier.

Therefore, when the compaction layer has to be established as soon as possible, the *"Push Up"* method is preferable. Even so, choosing which method is better depends on the following considerations:

- Types and composition of solid waste;
- Topographical condition; and
- Equipment for landfilling.

The spreading and compaction of the solid waste delivered will affect largely the capacity of landfill, stabilization of landfill layer, post-closure land use, and environmental conservation. It is therefore important that when spreading and compacting solid waste, the component and shape of the waste, landfill type, landfill method, order of land-filling and types of machines used are to be considered together with the following items:

- The spreading is not too thick. For example, normal thickness is about 30 to 50 cm when normal spreading and compaction machine is used.
- The landfill layer should be made as uniform as possible and, if necessary, the solid waste be pushed up on a slope when spreading and compaction of the waste is made. A slope gradient of about 1 to 3 (about 20 degrees) is normally recommended.
- The thickness of each layer should be determined after considerations are given to the component and type of waste, and the post-closure land use plan. At any rate, each layer should be generally less than 3 m thick. When the site is to be used immediately after closing or used for multi-purposes rather than sports ground and a park, the layers should be about 2 m thick.

The typical operation of spreading and compaction is shown in Figures 8.2.10 and 8.2.11.

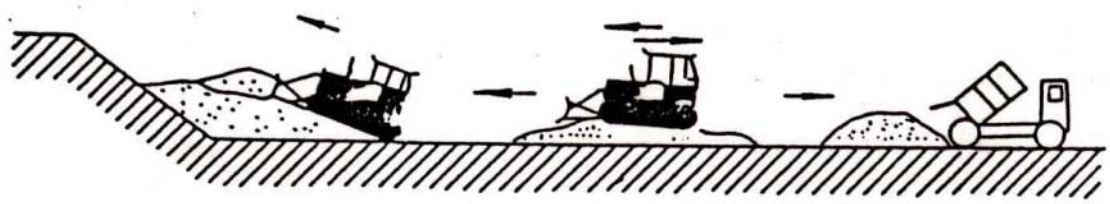


Figure 8.2.10 Operation of Spreading/Compaction

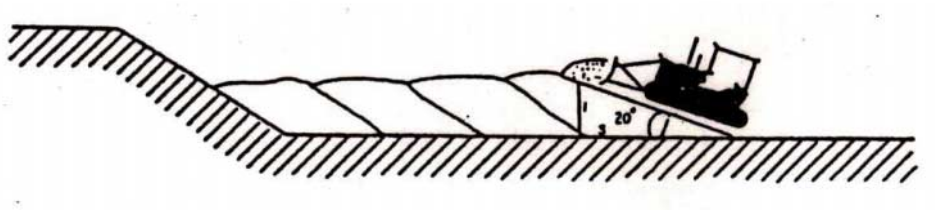


Figure 8.2.11 Pushing Up and Compacting the Waste Simultaneously

b. Landfill Equipment

- **Selection of Landfill Equipment**

Landfill equipment should be selected after considerations are given to the topographical features and size of the site, landfill method, and types of solid waste disposed in the sanitary landfill system. Landfill equipment can be classified into the following, depending on their functions:

(a) Equipment to spread and compact a landfill layer of uniform thickness;

(b) Equipment for excavation and covering soil; and

(c) Other equipment required for smooth landfill operation.

Tractors such as crawler tractors and wheel tractors are usually used in (i) and (ii). The crawler tractors is called a bulldozer or tractor shovel depending on the type of arm attached to the tractor like for instance, buckets or blades. These tractors have different purposes.

In this manner, different equipment has different characteristics and therefore has to be properly selected according to its usage.

Besides this, equipment relevant to (iii), such as water tankers, disinfecting trucks and fire-fighting trucks, may also be required on large-scale landfill sites.

- **Number of Equipment Required**

The required number of equipment in a landfill project depends on the following:

- Daily amount of waste disposed at the landfill;
- Amount of waste delivered at peak times;
- Size of the sanitary landfill system;
- Efficiency of landfill equipment;

- Operation hours per day;
- Maintenance and repair; and
- Economical aspect.

- **Notes on the Use of Landfill Equipment**

Most of the landfill equipment used is equipment for construction purposes. For this reason, the equipment sometimes breaks down in a different manner as compared to equipment in other construction sites. These failures, for example, result from corrosive gases, such as hydrogen sulfide or ammonium salts, which are produced during the decomposition process.

Furthermore, wear and tear in caterpillars due to wires or metal parts or even clogging of the mesh of radiator due to dusts or dirt also usually occurs. It is thus always advisable that spare parts be made available in good condition.

3) Separate Landfilling

Separate landfilling is a method in which the landfill site is divided into small sections and filled with different types of solid waste. This is different from the section landfill method in which the unfilled site is distinguished from the filled site in order to reduce the amount of leachate generated.

There are very few examples of separate landfilling; however, they have several advantages as follows:

- Ease of foundation management;
- Usable land after closure; and
- Ease of leachate monitoring.

On the other hand, the following disadvantages may arise.

- Increase of landfill cost;
- Decrease of landfill volume; and
- Increase of number of landfill equipment.

(4) Cover Soil Work

1) Effectiveness and Necessity of Cover Soil

In the sanitary landfill system, cover soil is indispensable for conservation of the surrounding environment. The cover soil would prevent dispersing of bad odors, scattering of waste, and breeding of vectors and harmful insects. It would also prevent catching and spreading of fires on the site. In addition, it would provide good appearance for the neighborhood. Further, from an operation and management point of view, it would allow easy solid waste spreading and compaction work, and prevent rainwater from seeping into the inner layers of the landfill site and thus make the leachate volume reduced.

Moreover, if a large amount of cover soil is used, the landfill volume capacity will become less and the permeability and breathability of the landfill will decrease. This will bring detrimental effects in such that organic waste may not decompose very well. Therefore, the thickness and type of cover soil should be properly selected considering the purpose of cover soil and type of filled-up waste.

Availability of cover material is another important issue when preparing a cover soil work plan. It may depend on the geological condition of the landfill site and the financial capability of the management organization. If new cover soil material is not available, the old filled-up waste that was buried for about 3 to 6 months ago can be utilized effectively for cover soil. General considerations of the cover soil work are summarized below:

- The filled-up waste should never be left as it is. It must always be covered with soil whose thickness depends on the type of waste and cover material used.
- Cover soil should be laid in a designated area to prevent gas dispersion and fire and to secure traffic of collection vehicles, when necessary.
- A final cover soil should be laid on the last layer of the filled waste. In this case, the thickness of the final cover soil should be determined in consideration of the way for which a completed landfill site would be used.
- Cover soil material should be selected depending on its purpose. Enough amount of the material should be provided to complete the landfill plan, and its quality should be suitable to operate the landfilling economically.
- The cover soil should properly cover the landfill wastes. It should be sufficiently spread and compacted with a proper thickness and gradient in designated places.

2) Type of Cover Soil

Depending on the purpose, cover soil can be classified into daily, intermediate and final cover soil.

a. Daily Cover Soil

When the landfill layer reaches the thickness as specified in the design document, or when a one-day portion of the landfill work is completed, soil cover should be provided on the layer. The purposes of the daily cover soil are the following:

- To prevent the scattering of waste;
- To control bad odors; and
- To stop the growth of harmful vectors like flies.

b. Intermediate Cover Soil

This cover soil, apart from the daily cover soil, should be provided in accordance with the progress of landfill work. The purposes of the intermediate cover soil are the following:

- To provide foundation of roads for the collection vehicles; and

- To provide drainage of rainwater away from landfill areas that will be left for a considerably long period.

c. Final Cover Soil

When all the landfill work is finished, final cover soil should be placed on top of the last layer. The purposes of the final cover soil are the following:

- To provide of good appearance for the neighborhood;
- To enhance usability of the post-closure land; and
- To reduce leachate volume.

3) Selection of Cover Soil

The cover soil is generally categorized depending on the grain size and clay content. The consistency or permeability of the cover soil will then differ according to different categories used.

In most cases, easily available earth and sand are usually used for the cover soil. In this case, the following types of soil should be avoided as much as possible.

- Extremely acidic or alkaline soil;
- Soil containing harmful substances;
- Soil that could deteriorate the leachate quality; and
- Soil that would hamper the growth of plants.

Appropriate characteristics of soil depending on the type of cover soil are briefly described below.

a. Daily Cover Soil

As much as possible, a permeable and porous sand type of soil should be used to render easy spreading and compaction of the solid waste, to stabilize the landfill layer and not to hinder waste decomposition process. Nevertheless, a porous cover soil is not suitable for preventing dispersion of bad odors. Therefore, when such types of soil are used, the cover layer should be made as thin as possible to prevent the soil from becoming anaerobic.

b. Intermediate Cover Soil

Clayey soil that does not have good breathability is suitable to prevent disorderly dispersion of gases and seeping of rainwater. On the other hand, when the cover soil is to be used as a foundation for roads, crusher stones are recommended.

c. Final Cover Soil

The final cover soil should be resistant to corrosion by rainwater, of low permeability and suitable for plants. Thus, a loam type of soil, which contains some decomposers and humus property, is recommended. When earth and sand from a construction site are used, they should be checked carefully for toxic substances.

4) Determination of Thickness

The thickness of cover soil should be determined by the purpose of cover soil, composition, type and shape of solid waste to be disposed, and the surrounding environmental condition. According to the type of cover soil, the thickness is generally set up as below.

a. Daily Cover Soil

- Mainly combustible waste and large in size waste : 30 to 50 cm
- Crushed waste and ash : 15 to 20 cm

When impermeable soil such as silt or clay is used, the cover soil should be as thin as possible. When uncrushed waste is used, the thickness is usually about 45 cm; while, cover soil of crushed waste is about 20 cm thick.

b. Intermediate Cover Soil

- Cover soil is to be exposed for a fairly long time : 50 cm

c. Final Cover Soil

- Grass or low plants and bushes are planted : more than 50 cm
- Medium height to tall trees are planted : more than 1.0 m

If a post-closure land use plan is prepared by the time the landfill site is closed, the cover soil of the proper type and thickness as designed in the plan should be provided. However, in most cases, availability of the closed landfill site requires a considerably long time since the land subsidence is predicted. In this case, therefore, an appropriate thickness for planting trees should be secured temporarily to improve the site landscape.

When construction debris is used for final cover soil, the root condition of plants on the soil is to be checked after 7 to 8 years. A study clearly shows that the growth of roots is almost similar and it did not depend on the type of soil. It has been found that drainage conditions of the landfill site had a great effect on root growth. Depending on the type of trees, the roots were within a depth of 1 m. Therefore, when medium or tall trees are to be planted, the final cover soil should be more than 1 m deep.

5) Operation and Maintenance of the Cover Soil

The cover soil should be spread uniformly and compacted by using the appropriate type of landfill equipment, which would depend on the thickness, area and type of the cover soil.

In particular, it would take some time for the final cover soil on a slope to stabilize, and care must be taken to prevent this final layer from being eroded by rainwater. It is therefore recommended that the slope gradient should be 20 to 30 degrees, while the gradient of about 2 to 3% would be reasonable on plain areas.

Cover soil work is usually carried out by a landfill layer, and spreading and compaction equipment. In the case of the final cover soil work, graders or rollers used in road construction are recommended.

Maintenance of the cover soil is an integral part of the maintenance of post-closure land, besides leachate and gas treatment. The surface of the final cover soil will sink, crack and form potholes due to decomposition and consolidation of the filled waste. This may result in increase of leachate volume, leakage of gas, erosion of the cover soil, landslides and fires. A survey on subsidence of the post-closure land gave the following findings:

- The landfill site subsides deeper when combustible waste is disposed and shallower when incombustible waste, such as construction debris, is disposed;
- The deeper the landfill the deeper the site subsides;
- The site subsidence continues for several years; and
- The amount of subsidence varies from a few percent to 30% of the landfill thickness.

In particular, if the surface of the landfill area depresses or cracks, rainwater will seep into the inner layers via these areas. This will thus result in increasing the amount of estimated leachate volume. Additionally, these areas will also become points for gas release. Therefore, the surface of the final cover soil and condition of plants should be checked and maintained periodically.

(5) Site Road Work

1) Characteristics of Site Road

Site roads are constructed for traffic of collection vehicles in the sanitary landfill system. There are mainly three (3) kinds of roads, as follows:

(a) Roads that are buried under the landfill layer with the progress of landfill operation;

(b) Roads that finish operating when the landfill work is completed; and

(c) Roads that are continuously used for operation and management of the landfill control facilities.

Major characteristics of the site roads are summarized below:

- Installation and route of the roads are determined by a landfill work plan;
- Operation life of the roads is generally short because of covering the landfill layer on the roads;
- Topographic condition of the site restrict the route of the roads;
- The roads are usually constructed on a liner system for leachate control; and
- Care tends to be lacking for operation and management of the roads.

2) Design and Planning of Site Road

a. Design Components of Site Roads

The site roads should be designed to secure safety and smooth traffic of the collection vehicles. To accomplish this, the following design components of the site roads should be examined:

(a) Geometric structure of the road : Road width, number of traffic lanes, plane and longitudinal lines;

(b) Pavement structure of the road : Thickness of paving, pavement type (asphalt-concrete, cement-concrete, gravel, etc.)

(c) Others : Safety measures, guidance and instruction facilities, drainage facilities, etc.

The above-said components to be determined require the following data and information sufficiently:

- Number of traffic vehicles (daily average and peak hours);
- Size of the vehicles and specifications of the vehicles, such as traffic speed;
- Topographic condition; and
- Level of service, i.e., degree of structure required.

b. Design Criteria of Site Roads

The design of the site roads should be made in accordance with regulations of road structure and construction in the country where the sanitary landfill system is to be established. The following design considerations describe a recommendable level of road structure for reference.

- **Design Traffic Volume**

The design traffic volume should be determined based on the traffic volume at peak hours since collection vehicles often go to the landfill site intensively. If the site road is connecting to a public road with heavy traffic, the number of traffic vehicles in a short period, such as 30 or 15 minutes, should be considered.

- **Road Width**

Although the road width depends on the traffic volume and shape of the vehicles, the following typical available widths should be adopted:

- Single lane : 3.5 m
- Two lanes : 6 m

- **Longitudinal Slope of the Road**

It is recommended that the road slope should be as gentle as possible. In case that there are many topographical restrictions in a mountainous area, the maximum slope should be less than 12%. In particular, slip prevention and stoppage measure should be installed properly when the road is constructed in a snowy or frozen area.

- **Cross Slope of the Road**

In terms of operation and maintenance of the road, rainwater should be drained immediately. Therefore, the cross slope should be at least 3%.

- **Pavement Structure**

Considering trafficability of the vehicles, workability of road maintenance and strength of the road, the minimum level of pavement should be the gravel type.

- **Safety Measures**

The site roads in a mountainous area or high place should be equipped with guardrails.

(6) Slope Adjustment Work

1) Design Concept of Slope Adjustment Work

Dimension and slope of the landfill layer are primarily determined taking into consideration how required landfill volume is secured based on topographic and geological conditions of the site. In this sense, it is preferable that the dimension of the slope should be large and the slope of the layer should be steep. However, a large-scale slope may not suit the landfill work, post-closure land use and conservation of the surrounding environment. Furthermore, improper slope construction may result in erosion and collapse of the slope if it rains and deteriorate the surrounding environment. It is thus of importance that the slope has to be kept safe considering the following matters:

(a) The slope of the landfill layer should be as gentle as possible, and its dimension should be as small as possible;

(b) Sufficient distance between toe of the slope and top of the retaining structure should be secured, so that the weight of the landfill layer will not affect the retaining structure;

(c) Appropriate measures should be taken, so that the slope will not erode by rainfall;

(d) The slope of the landfill layer and slope adjustment should be designed in harmony with the surrounding environment; and

(e) Ease of construction for covering soil on the slope should be considered.

The safety factor of the slope of the landfill layer is generally calculated by the stability against rotation slip. In this calculation, the dynamic characteristics of the solid waste should be set up, such as internal angle and coefficient of cohesion, considering the following factors:

- Type and shape of the waste;
- Compacting condition of the landfill layer;
- Thickness of the layer;
- Water content of the layer; and
- Age of the layer.

2) Types of Slope Adjustment Work

There are two (2) cases to be considered in the slope adjustment work, as shown in Figure 8.2.12.

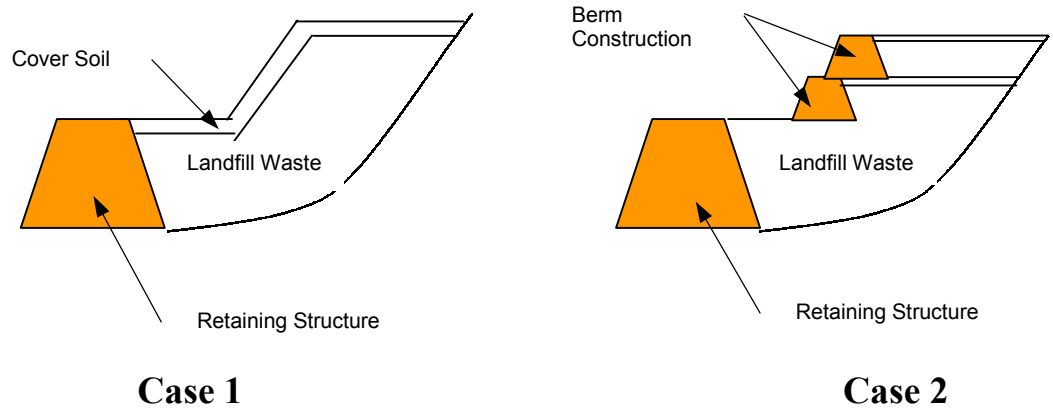


Figure 8.2.12 Types of Slope Adjustment

In Case 1, the slope is adjusted by the solid waste itself and the landfill work can develop the slope of the waste simultaneously. This case can be easily operated, but sufficient compaction of the waste would be difficult. In addition, the final cover could not be done until the elevation of the waste has reached the design landfill height.

On the other hand, in Case 2 where a berm is built in the landfill area, sufficient compaction of the slope could be made resulting in less subsidence of the ground. This will also bring a good foundation for the post-closure land use. Thus, it is recommended that Case 2 be adopted for the slope adjustment work.

3) Method of Slope Adjustment Work

a. Design of Berm Construction

A berm that is built in the landfill area forms a slope of the final landfill. It is therefore suitable to construct a small berm whose height is set up in accordance with the landfill height to secure the required landfill volume. In this sense, the height of berm should be 3 to 5 m. It is also important to have sufficient horizontal distance between berms if several berms are constructed one by one and the dimensions of slope become relatively large.

b. Slope Stability

Slope stability depends on the characteristics of the waste to be filled because the landfill slope is usually built on the landfill waste and its back and sides are surrounded with the waste.

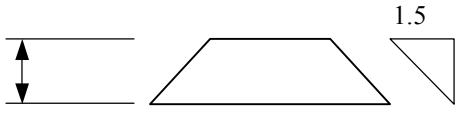
Typical slopes are shown in the following table according to landfill materials and height of the landfill although the slope should be finally determined by calculating the slope stability as a whole.

Table 8.2.10 Typical Slope depending on Landfill Materials and Height of the Landfill

Landfill Materials	Height of the Landfill[*1]	Slope[*2]
Grainy Sand, Gravel and Sand mixed with Gravel	Less than 5 m	1.5 : 1 to 1.8 : 1
	5 to 15 m	1.8 : 1 to 2.0 : 1
Not Grainy Sand	Less than 10 m	1.5 : 1 to 1.8 : 1
Rock	Less than 10 m	1.8 : 1 to 2.0 : 1
	10 to 20 m	1.8 : 1 to 2.0 : 1
Sandy Soil, Stiff Clayey Soil, Stiff Clay	Less than 5 m	1.5 : 1 to 1.8 : 1
	5 to 10 m	1.8 : 1 to 2.0 : 1
Soft Clayey Soil	Less than 5 m	1.8 : 1 to 2.0 : 1

Note:

[*1] Height of the Landfill



[*2] Slope; for example 1.5 : 1

4) Landscape of the Slope

While safety of the slope adjustment work should be considered as the first priority, its feature should also be in conformity with the surrounding environment. The slope adjustment work will therefore have a function of protection of the slope as well as landscaping from aesthetic viewpoints.

The condition that earth and sand of the slope are exposed may deteriorate the surrounding environment and result in erosion of the slope due to heavy rain. Thus, the slope should be covered shortly after it has been built, by the following methods:

(a) Providing structural measures, such as slope protection concrete;

(b) Planting trees; and

(c) Spraying seeds of plants.

The method suitable for the landfill slope should be decided by its conformity with the surrounding environment, post-closure land use, expected life of the landfill site and cost of the work. Considering the construction period, spraying seeds of plants is recommended because of the following reasons:

- The slope has not yet stabilized and continues to subside; and
- The work tends to be affected by gas generated from decomposition of the waste.

Technical consideration to be taken when the seed spraying method is adopted is summarized as follows:

- Slope features, such as slope and length;
- Geological condition, such as fertilization of soil, hardness of soil, etc.;
- Meteorological condition, such as atmospheric temperature, precipitation, wind force, etc.;

- Regional condition, such as hours of sunshine, damage from saltwater, degree of humidity, etc.; and
- Ease of construction.

8.3 COST ESTIMATION

Major work items and costs of the master plan and the priority project are shown in the following tables.

(1) Improvement of Disposal Site and Landfill Operation

Table 8.3.1 Landfill Operation in Zone I & II at Al-Bassa Disposal Site

(Unit: SYP/year)

Item	Unit	Quantity	Unit Price	Amount
Rental Fee of Heavy Equipment (Bulldozer)	day	365	9,800	3,577,000
Rental Fee of Heavy Equipment (Excavator)	day	365	7,840	2,861,600
Rental Fee of Heavy Equipment (Dump Truck)	day	365	5,880	2,146,200
Material for Operation Road (Gravel: t=0.2m)	m^3	600	250	150,000
Material for Final Cover Soil (Clay: t=0.5m)	m^3	23,000	200	4,600,000
Gas Exhaust Facility (h=4.5m)	unit	12	4,500	54,000
Leachate Collection Facility (D=30cm)	m	350	350	122,500
Netted Fence (h=2.0m)	m	550	1,500	825,000
Sub-total				14,336,300
Contingency (10%)				1,433,630
Total				15,770,000

Note: It is assumed that landfill operation in Zone I & II is carried by rented equipment.

Table 8.3.2 Rearrangement of Existing Accumulated Waste in Zone I & II at Al-Bassa Disposal Site

(Unit: SYP)

Item	Unit	Quantity	Unit Price	Amount
Rental Fee of Heavy Equipment (Bulldozer)	day	68	9,800	666,400
Sub-total				666,400
Contingency (10%)				66,640
Total				730,000

Note: The rearrangement work need to rent a bulldozer in addition to the equipment for landfill operation.

Table 8.3.3 Rearrangement of Existing Accumulated Waste in Zone III at Al-Bassa Disposal Site

(Unit: SYP)

Item	Unit	Quantity	Unit Price	Amount
Excavation of Waste	m^3	72,800	55	4,004,000
Landfill of Existing Waste	m^3	72,800	65	4,732,000
Final Cover Soil incl. Embankment (Clay: t=0.5m)	m^3	15,200	265	4,028,000
Slope Adjusting	m^2	10,000	10	100,000
Gas Exhaust Facility (h=4.0m)	unit	8	4,000	32,000
Operation Road (Gravel: t=20cm)	m^2	3,000	200	600,000
Sub-total				13,496,000
Contingency (10%)				1,349,600
Total				14,850,000

Table 8.3.4 Construction of Tentative Disposal Site in Zone III at Al-Bassa Disposal Site

(Unit: SYP)

Item	Unit	Quantity	Unit Price	Amount
Excavation (Sand)	m^3	240,000	55	13,200,000
Embankment (Sand)	m^3	140,000	65	9,100,000
Slope Adjusting	m^2	60,000	10	600,000
Liner Laying (Clay: t=0.6m)	m^2	160,000	160	25,600,000
Leachate Collection Pipe (D=30cm)	m	1,000	1,100	1,100,000
Leachate Recirculation System	unit	1	5,000,000	5,000,000
Netted Fence (h=2.0m)	m	2,100	1,500	3,150,000
Gate (steel, w=6m)	unit	1	40,000	40,000
Drain (Excavation of Ditch)	m	2,400	30	72,000
Improvement of Access Road (w=7m)	m	1,200	3,500	4,200,000
Operation Road (Gravel, w=7m)	m^2	2,500	200	500,000
Main Control Building	m^2	50	7,500	375,000
External Work: Electric Wire	m	2,500	1,000	2,500,000
External Work: Telephone Line	m	2,500	100	250,000
External Work: Water Supply Pipe (D=50mm)	m	2,500	500	1,250,000
Sub-total				66,937,000
Contingency (10%)				6,693,700
Total				73,630,000

Table 8.3.5 Landfill Operation in Zone III at Al-Bassa Disposal Site

(Unit: SYP/year)

Item	Unit	Quantity	Unit Price	Amount
Material for Operation Road (Gravel: t=0.2m)	m^3	700	250	175,000
Material for Final Cover Soil (Clay: t=0.5m)	m^3	21,000	200	4,200,000
Gas Exhaust Facility (h=5.5m)	unit	11	5,500	60,500
Sub-total				4,435,500
Contingency (10%)				443,550
Total				4,880,000

Table 8.3.6 Construction of Qasia Inter-municipal Disposal Site

(Unit: SYP)

Item	Unit	Quantity	Unit Price	Amount
(Construction of Management Facilities)				
Excavation	m^3	800,000	55	44,000,000
Banking	m^3	190,000	65	12,350,000
Slope Adjusting	m^2	36,000	10	360,000
Groundwater Collection Pipe (D=60cm)	m	1,200	2,800	3,360,000
Drain (Gutter, 40/40cm)	m	1,100	1,400	1,540,000
Flood Control Facility	unit	1	580,000	580,000
On-site Road	m^2	4,000	380	1,520,000
Curbstone	m	7,000	265	1,855,000
Netted Fence (h=2.0m)	m	4,200	1,500	6,300,000
Gate (steel, w=6m)	unit	2	40,000	80,000
Operation Road (Gravel, w=7m)	m^2	50,000	200	10,000,000
Main Control Building	m^2	410	7,500	3,075,000
Truck-scale Building	m^2	18	7,500	135,000
Truck-scale Installation	unit	2	2,728,000	5,456,000
Guardhouse	m^2	14	7,500	105,000
External Work: Electric Wire	m	1,700	1,000	1,700,000
External Work: Telephone Line	m	1,700	100	170,000
External Work: Water Supply Pipe (D=50mm)	m	1,700	500	850,000
Monitoring Well (D=350mm, 50m)	unit	1	85,000	85,000
(Costruction of Landfill Site for Phase 1)				
Excavation (t=30cm)	m^3	55,000	55	3,025,000
Embankment	m^3	55,000	65	3,575,000
Slope Adjusting	m^2	11,000	10	110,000
Liner Laying (Clay: t=0.6m)	m^2	180,000	160	28,800,000
Leachate Collection Pipe (D=60cm)	m	500	2,800	1,400,000
Leachate Collection Pipe (D=30cm)	m	3,300	1,100	3,630,000
Leachate Re-circulation System	unit	1	5,000,000	5,000,000
Drain (Ditch)	m	500	30	15,000
Sub-total				139,076,000
Contingency (10%)				13,907,600
Total				152,980,000

Tablle 8.3.7 Landfill Operation at Qasia Inter-municipal Disposal Site

(Unit: SYP/year)

Item	Unit	Quantity	Unit Price	Amount
Material for Operation Road (Gravel: t=0.2m)	m^3	800	250	200,000
Material for Cover Soil (Clay)	m^3	31,000	200	6,200,000
Gas Exhaust Facility (h=5.0m)	unit	11	5,000	55,000
Sub-total				6,455,000
Contingency (10%)				645,500
Total				7,100,000

Table 8.3.8 Construction of Transfer Station in Lattakia Governorate

(Unit: SYP)

Item	Unit	Quantity	Unit Price	Amount
Excavation	m^3	2,200	55	121,000
Banking	m^3	3,600	65	234,000
Slope Adjusting	m^2	410	10	4,100
Netted Fence (h=2.0m)	m	390	1,500	585,000
Gate (steel, w=10m)	unit	1	70,000	70,000
Drain (Gutter, 30/30cm)	m	380	1,000	380,000
In-site Road	m	3,100	3,500	10,850,000
Curbstone	m	550	265	145,750
Retaining Wall (h=2m)	m	100	15,000	1,500,000
Concrete Pavement (Re-loading station)	m^2	1,250	1,100	1,375,000
Control Building	m^2	180	7,500	1,350,000
Guard House	m^2	25	7,500	187,500
Workshop	m^2	102	7,500	765,000
Storage	m^2	65	6,000	390,000
Truck-scale Installation	unit	1	2,480,000	2,480,000
External Work: Electric Wire	m	500	1,000	500,000
External Work: Telephone Line	m	500	100	50,000
External Work: Water Supply Pipe (D=50mm)	m	500	500	250,000
Sub-total				21,237,350
Contingency (10%)				2,123,735
Total				23,360,000

Note: The summed up cost is for the construction of one transfer station.

SECTION 9

INSTITUTION AND ORGANIZATION

SECTION 9 INSTITUTION AND ORGANIZATION

9.1 GENERAL

The Master Plan (the M/P) requires comprehension of the current situations, scrutiny on them about Solid Waste Management (the SWM) and then how to rationally streamline the present system and/or establish a new institution of the SWM without infringement of present laws and regulations now in force as to the fields of organization and institution including legal aspects in line with the other fields on the SWM toward the target year 2010.

The M/P shall be formulated based on the above-mentioned policies, starting with overview of the present organizational structures related to the SWM.

9.1.1 Present situation of relevant organizations on the SWM

(1) Local Governments responsible for the SWM under the direction of the Central Government, especially, the Ministry of Local Administration

1) The Ministry of Local Administration (the MOLA)

The MOLA is expected to be the central authority supervising the local administration system in Syria in 2006 and 2010 while likewise the Ministry of Health (the MOH) to be responsible for public health, the Ministry of State for Environmental Affairs (the MSEA) to be responsible for environmental matters and the other Ministries to be responsible for their respective domains through the respective Directorates in the respective Governorates.

2) Lattakia Governorate

The Lattakia Governorate (the Lattakia Governorate Council headed by Governor who is appointed by the Central Government) is one of the fourteen Governorates in the local administration system under the MOLA in Syria and controls its local governments (municipalities) such as 4 cities, 16 towns, 77 villages and rural units which have the responsibility for the SWM in the respective territories.

3) Lattakia, Jableh, Al Haffeh and Qurdaha Cities

The Study area covers the four cities, i.e., Lattakia City (the Lattakia City Council headed by Mayor directly under the Lattakia Governorate) as the capital of the Lattakia Governorate and the other three Cities (respective City Councils headed by respective Mayors under the Executive Office of Lattakia Governorate). Each city holds a Cleansing Department to carry out the SWM for the city in cooperation with Vehicle Affairs, a Garage Department and a Garage of the Cities respectively.

Present Organization Chart is referred to Figure No. … 1

4) Lattakia City

- The City (with a population of 375,435 in 2001) has 6 Affairs and 9 Divisions with 1,888 personnel in total as of 2001. The SWM is related to 3 Affairs such as the Health (667 persons including 612 at the Cleansing Department in 2001), the Vehicle (255 persons in 2001) and the Technical (563 persons in 2001) Affairs as well as the Compost Plant Division (32 persons moved to the Cleansing Department in April, 2001 because of the Compost Plant Division closed).
- The Cleansing Department (612 including 79 drivers of the Vehicle Affairs plus 32 persons transferred from the Compost Plant Division in April, 2001) conducts the SWM with Mechanical Sweeping Section (59 persons), Occupancy of Pavement & Road Section (23 persons), Manual Collection & Sweeping Section (487 persons) and Workers Section (43 persons) under the Health Affairs in Lattakia City while the Final Disposal site (1 person) also works under the Health Affairs.

  Present Organization Chart is referred to Figure No. … 2

5) Jableh City

- The City (with a population of 92,729 in 2001) under the control of the Town Facilities of Lattakia Governorate Executive Office (the LGEO) holds 2 Affairs, i.e., Health and Administrative Affairs, and 2 Departments, i.e., Financial and Technical Departments.
- The Cleansing Department (77 persons including 12 drivers from the Technical Department) carries out the SWM in the City under the Health Affairs.

  The 77 persons are deployed at Cleansing Section (40 persons comprising 35 Essential workers and 5 Stand-by workers), Vehicle Workers' Section (20 persons comprising13 workers for Compactors, 6 workers for Tractors and 1 worker for Sweeper), Drivers' Section (12 drivers from the Technical Department) and Observers' Section (4 persons).

  Present Organization Chart is referred to Figure No. …3

6) Al-Haffeh City

- The City (with a population of 23,516 in 2001) under the control of the LGEO has 6 departments and affairs (35 persons in total), one of which is the Health Affairs (17 persons) being composed of the Cleansing Department (15 persons comprising 11 sweeping workers and 4 collection workers) and the Slaughter House (2 persons).

- The Cleansing Department (15 persons) manages in the SWM for the City in cooperation with 3 drivers of the Garage.
  Present Organization Chart is referred to Figure No. … 4

7) Qurdaha City

- The City (with a population of 49,291 in 2001) under the control of the LGEO keeps 4 departments, i.e., the Garage (10 drivers), the Cleansing (25 persons), the Financial (11 staff) and the Technical (10 persons) Departments.
- The Cleansing Department (25 persons) has 2 sections, i.e., the Fixed Workers' (5 persons) and the Seasonal Workers' (20 laborers) Sections, and conducts the SWM operation in a close cooperation with 10 drivers of the Garage Department.
  Present Organization Chart is referred to Figure No. …4

9.1.2 Mater Plan (the M/P) in 2010

Al-Qasia was decided as the waste final disposal site for Lattakia and the Three surrounding Cities toward 2010 at the third meeting of New Disposal Site Selection Committee on August 16, 2001. Al-Qasia is regarded as the last final-disposal site in the territory of the Lattakia Governorate.

Institutional arrangement on the Lattakia Governorate level is considered essential for both the location of Al-Qasia which exists about 18 km from the Lattakia City, about 8 km from the Al Haffeh City, about 35 – 40 km far from the Jableh and the Qurdaha Cities, and introduction of such waste treatment in a stretch of land as a sanitary landfill.

In addition, the institutional arrangement on the Governorate level is also necessary for the Cities under the difficult circumstances that procurement of machinery equipment and facility depends on the respective Cities, albeit it is stipulated in the Local Administration Law of October 10, 1974 that local governments (the Cities in this case) ought to have the responsibility for their SWM respectively.

(Number of persons in respective institutions for the M/P on the SWM in 2010)

- Lattakia Governorate New SWM Institution: 174 persons
- Lattakia City Cleansing Department: 465 persons
- Jableh City Cleansing Department: 104 persons
- Qurdaha City Cleansing Department: 44 persons
- Al-Haffeh City Cleansing Department: 32 persons

  (Number of the total persons on the SWM: 819 persons)

(1) Establishment of New Institution on the SWM :

The Lattakia Goverorate Council (headed by Governor) shall establish a New SWM Institution for the SWM in the four Cities under the Executive Office for Town Facilities in a close cooperation with the Lattakia City Council (headed by Mayor) to efficiently make the SWM in the broader area of the four Cities toward 2010.

1) The New SWM Institution :176 persons

Planned Organization Chart is referred to Figure No. … 5.

The New SWM Institution (174 persons in total) shall be composed of : -

- Office of General Manager: 1 person
- Financial Division: 3 persons
- Compost Plant Division: 92 persons
- Recycling Center Division: 35 persons
- New Disposal Site (Al-Qasia) Division: 19 persons
- Transfer Station Division: 14 persons, and
- Medical Waste Management Division: 12 persons.

The number of persons is decided to be minimum. Increase and/or decrease of the number shall be decided as necessary after deliberation of persons qualified for their kinds and volume of work.

2) Recruit of the persons

The persons shall be recruited first from the existing personnel of the four Cities, inter alia, the Cleansing Departments (612 persons of the Lattakia, 77 persons of the Jableh, 15 persons of the Al-Haffeh and 25 persons of the Qurdaha), the Vehicle and/or the Garage Departments, the other affairs and/or departments, regardless of their present posts if they are well qualified and hold aptitude for new posts of the Institution.

In case that well qualified persons suitable for the new posts will not be found out of the existing organizations, they shall be recruited from other manpower sources. Particularly, the manager of the Compost Plant Division had better be an agricultural engineer capable of fruitfully making management with economic and financial knowledge.

In addition, the manager of the Medical Waste Management Division is considered requiring some medical knowledge like, at least, a sanitary engineer.

3) Financial Division in 2010 : 3 persons

The Division is required for waste treatment and disposal at a stretch of land like the case of Lattakia City and the three surrounding Cities.

Manager shall have responsible for financial matters on raising funds and making a budget necessary for the Institution inquiring General Manager as well as Lattakia Mayor and Executive Office for Town Facilities, checking whether expenditures of the five Divisions will be properly used, keeping financial documents, checking if a contracted-out private transport company will financially go well as contracted in case of a contract-out scheme taken up (like the case of Damascus) for the waste transportation from the transfer stations to Al-Qasia and so on.

The staff should be obedient to the Manager and manage in book keeping of the five Division, making financial statements, checking current positions of the Divisions financially, examining a contracted-out private company from a view point of finance of the Institution, and the like.

4) Compost Plant Division in 2010 : 92 persons

Planned Organization Chart is referred to Figure No. … 6

- Planned Capacity : 200 ton/day approximately (about 146 t., from Lattakia, 32 t., from Jableh transfer station, 7 t., from Haffeh and 15 t., from Qurdaha transfer station respectively. Separated Domestic Waste 406.6t., approximately x 0.5 x 0.78 = 158t., Market Waste 48.2t., approximately, and Waste from Restaurants & Hotels 5t., approximately; thus, Total 211.2t./day)
- Compost Products : 40 t./day (20%) or 50 t./day (25%) in total (Quality as much as possible referred to the Standard No.2014 <Approval Decision No.244> of August 31, 1998 published by the Syrian Organization for Standardization and Metrology<the SASMO> under the Ministry of Industry.)
- Plant : 25 t./day (on a material base of organic source- separated waste in one shift operation as a pilot plant) to be expected from a donor country in the form of Grant-Aid presumably at around the year 2004, another 25 t./day-plant (1 + 1 =2 shifts, i.e., 50 t., in total) to be prepared pursuant to growth of demand in the ensuing years and the other 150t./day-plant (2 shifts) to be provided for Qasia site in 2008.
- Location : 50t./day-plant (25 t./day-pilot plant + 25t./day-continuous plant) near El Hemi village at Al-Bassa about 15 km from the center of Lattakia City before the completion of Al-Qasis final disposal site in 2007 and 150t./day-plant (2 shifts) to be prepared at about 3 ha., within Al-Qasia waste final disposal area in 2008 and 2009.

- Minimal personnel : 92 engineers and workers to be divided into two groups for both the plant (37 persons for 50 t./day) at Al-Bassa and the plant (55 persons for 150 t./day) at Al-Qasia in appropriate manner or to be served concurrently by day or by working hour.
- Working day : 310 days a year (26 days a month)
- Sales channel of compost products : mainly Farmers' Union (actually farmers of cooperatives under the Farmers' Union)
- Ownership : Lattakia Governorate (Al-Bassa site in compliance with the direction of Lattakia Mayor under the umbrella of the Lattakia Goverorate)

5) Recycling Center Division : 35 persons

Planned Organization Chart is referred to Figure No. … 5

Segregation waste collection shall essentially be introduced in 2003 for management of the Recycling Center in line with enhancement of public awareness on wastes because valued materials contain in non-organic wastes such as paper, plastic, iron, glass, etc., some of which will be reusable as they are or by appropriate treatment.

The Recycling Center Division aims as an objective waste at shop wastes scarcely containing organic wastes and non-organic (22% approximately) domestic-separated wastes.

- Amount of daily-generated non-organic waste for recycling : 40 ton/day estimated (27 t., from Lattakia, 7 t., from Jableh transfer station, 2 t., from Haffeh and 4 t., from Qurdaha transfer station)
- Location : Al-Bassa (20 t./day = 14 t., from Lattakia + 3 t., from Jableh + 2 t., from Qurdaha and 1 t., from Haffeh) and Al-Qasia (20 ton/day).
- Personnel : 35 persons in total at both Al-Bassa (19 persons) and Al-Qasia (16 + 3 holding the posts concurrently) sites who are the minimum number of persons. Although the manager is okayed as holding the post concurrently, the other engineers and workers may slightly be increased in number according to the necessity of personnel growth.
- Ownership : Lattakia Governorate Council (Al-Bassa site to be legally transferred to the Lattakia Goverorate before 2008)

6) New Disposal Site (Al-Qasia) Division :19 persons

Planned Organization Chart is referred to Figure No. … 5

- Amount of daily-transported waste : 307 ton/day approximately in 2010
  The waste of 307 t./day is calculated through various inter-mediate treatments such as the Compost Plant, the Recycling Center, Middlemen (Private Sector)

etc., from the generation amount of the domestic, commercial, road and park wastes in the 4 Cities, i.e., 508 t./day.

In addition to that, the seasonal (July, August and September) waste of 52 t./day approximately is expected to, the waste 11 t./day from small-scale industries expected to, and the medical waste of 3.1 t./day approximately, i.e., 2.8 t., directly from hospitals and clinics and 03. t., as ash through an incinerator is expected to transport direct to Al-Qasia.

Once Al-Qasia will be prepared to use in 2008, the number of 19 persons shall be necessary for achieving operation of a sanitary landfill system. By the completion of Al-Qasia, Al-Bassa will be compelled to use as a waste final disposal site with the proposed ways of amelioration and operation.

- Minimal personnel : 19 persons in total for Al-Qasia
- Ownership : Lattakia Goverorate.

7) Transfer Station (the T/S) : 14 persons in total

Planned Organization Chart is referred to Figure No. … 5

The 2 T/Ss for Jableh and Qurdaha are expected to initiate the construction in 2006 at places from 3 km from the respective centers of the 2 Cities as a division of the Institution (holding 6 container trucks for 12 containers in total as mentioned below).

- Jableh T/S : 3 persons 7 containers with a capacity of 20 m3 and 4 units of the arm-roll truck to be prepared by the Institution or in contract with Private Sector (referred to as the case of Damascus)

  The waste of about 79 t./day out of 83 t./day generated is estimated to transport to the T/S.
- Qurdaha T/S :3 persons 5 containers with a capacity of 20 m3 and 2 units of the arm-roll truck to be prepared by the Institution or in contract with Private Sectors (like the case of Damascus)

  The waste of 38 t./day out of 40 t./day generated is estimated to transfer to the T/S. The 3 persons at the respective 2 stations shall manage as supervisors in recording waste amount to be transferred at the stations.
- Ownership : Lattakia Goverorate
- Private Sector for waste transportation from the T/Ss to Al-Qasia

  In case that the transportation will be left to Private Sector, a public announcement shall be made for qualification to transportation companies in order to pick out qualified companies for a Short List. The qualified companies are in a position to offer a tender for the transportation.

The procedures shall be listened for study to the Damascus Cleansing Department beforehand.

8) Medical Waste Management Division (10 persons)

Planned Organization Chart is referred to Figure No. … 5

- Personnel : 10 persons (Manager requires aptitude for and qualification of medical or sanitary experiences and knowledge, Collection includes 2 drivers, 3 engineers are required for intermediate incineration and 2 workers are in charge of Al-Qasia site)
- Establishment of the Division scheme and facility : The whole year period of 2009. The operation will begin in 2010 after the incineration plant and facility will be prepared by the Institution.
- Recommendation on countermeasures by completion of the incinerator :
  It is recommendable apart from prior to a final decision that a practical method should be applied as a temporary way to medical wastes such as a request for National Hospital (having an incinerator) and/or burial in a proper-sized receptacle made of thick concrete in which slacked lime, Ca(OH)2, at least is evenly scattered over the wastes before covering soil is provided them with.

9) Hazardous wastes

- Hazardous wastes should be considered treated with various methods inherent in individual peculiarities of the wastes.
- Thus, the Governorate level is not in a position to cope with problems of hazardous wastes, so that the National level is required to cope with the problems.
  That is why the M/P excludes hazardous wastes because of the Study on the Governorate level.

(2) Ratification of personnel in the existing Cleansing Departments

Streamlining is considered stepwise needed for the Departments according to introduction of new vehicles, heavy machinery equipment and facilities toward the year 2010.

Surplus persons should be transferred to the New SWM Institution which would be managed by Lattakia Governor's initiative, albeit aptitude and qualification of the persons might hamper the reshaffule.

For example, jobs of stand-by persons are hardly understood by and unknown to the public.

Attention should be paid to Figures Nos. … 2 and 3.

1) Lattakia City Cleansing Department : 465 persons (including 173 drivers)

- Manager: 1 person
- Financial Administration Section: 3 persons
- Public Awareness Section: 3 persons
- Cleansing Section: 341 persons
- Sweeping section: 53 persons
- Occupancy of Payment and Road Section: 21 persons
- Other Department Service Section: 43 persons

New Organization Chart is referred to Figure No. … 9.

- Financial/Administration Section (including personnel matters) : 3 persons
  The Section shall be set up directly under the Cleansing Department to efficiently collect waste collection fee from citizens and surely impose levy of fine and/or penalty on violators in cooperation with the Occupancy of Payment & Road Section as well as a Tax Office. The Section shall be in charge of financial statements, specially, controlling budget and expenditure.
- Public Awareness Section : 3 persons (Chief : 1 and Staff : 2)
  The Section shall be created in the Cleansing Department to enhance citizens' public awareness on wastes and to guide and cooperate with the persons in the same sections of the other City Cleansing Departments.
- Cleansing Section : 341 persons (including 148 drivers)
  The number of persons is decreased from 487 to 341.
  To the contrary, the number of drivers shows about 1.9 times compared to the present number (79 drivers) because of procurement of new vehicles toward 2010.
  Mechanized way of the waste collection and street sweeping is likely to reduce work in the manual waste collection and street weeping. That is way that workers are lessened in number with a calculation of vehicle units and a necessary number of workers for the vehicles.
  Essential is upgrading of workers' qualification by dint of on-job vocational training toward 2010 in parallel with attainment of the waste source-separate collection.
- Sweeping Section : 53 persons (including 22 drivers)
  The number of persons shall be considered sufficient in light of foreseeable circumstances related to increase of vehicles.
- Occupancy of Payment and Road Section : 21 persons (including 3 drivers)
  The Section shall remain unchanged in number of necessary persons for activity.

- Surplus persons : 147 persons
  As some number of persons (lesser than 56) has moved to the Recycling and Disposal Department in 2003 when it was set up, the remaining number of persons (more than 91) shall be transferred to the New SWM Institution after deliberation of individual aptitude and qualification of those persons in order that the New SWM Institution may go fully well as planned. Thus, the number of the 147 persons shall be excluded in the Lattakia Cleansing Department.

2) Jableh Cleansing Department : 104 persons (including 33 drivers)

- Manager: 1 person
- Financial/Administration Section: 3 persons
- Public Awareness Section: 1 person
- Driver's Section: 33 persons
- Worker-for-Vehicle Section: 56 persons
- Essential Cleansing Workers' Section: 10 persons

- Financial/Administration Section (3 persons) including personnel matters shall be set up anew directly under the head of the Department and manage in the same matters as elucidated above in the case of Lattakia City.
- Public awareness Section : 1 person
  The Section shall continue to carry out the work for enlightening citizens' public awareness on wastes through public campaigns in cooperation with and under the guidance of the Public Awareness Section of the Lattakia Cleansing Department.
- Drivers' Section : 33 drivers from the Vehicle Affairs
  33 drivers shall be at least needed in light of increase waste collection equipment according to growth of the waste. Collected waste shall be transported to Al Bassa final disposal site until readiness of Al Qasia final disposal site in 2008.
- Worker-for-Vehicle Section : 56 persons
  Increase of vehicles' number will lead to increase of workers for vehicles at a proportion of the increased rate to cover a manual way of waste collection, even though the population is expected to be 117,752 in 2010.
- Essential Cleansing Workers' Section : 10 persons
  About 10 workers shall remain to collect waste with handcarts at narrow lanes like an old-town district. Mechanization of the waste collection will lessen the number of manual collection workers.

- Jableh T/S : 3 persons
  3 persons shall taken into account for the T/S, though they will belong to the New SWM Institution of the Lattakia Gorvernorate Council.
- On-the-Job vocational training shall be indispensable for the persons to make an upgrade of their qualification.

3) Qurdaha Cleansing Department : 44 persons (including 16 drivers in 2010)

− Manager:	1 person
− Financial/Administration Section:	1 person
− Public Awareness Section:	1 person
− Drivers' Section:	16 persons
− Worker-for-Vehicle Section:	20 persons
− Workers' Section:	5 persons

- Financial/Administration (including personnel matters) Section : 2 persons
  The Section shall be added anew under the cleansing department to fulfill the same duties as those of Lattakia in cooperation with the Tax Collection Section of the Financial Department.
- Public Awareness Section : 1 person
  The Section shall be created for activity to enhance citizens' public awareness on wastes through public campaigns in a close cooperation with and under the guidance of the Pubic Awareness Section of the Lattakia City Cleansing Department.
- Drivers' Section : 16 persons (from the Garage Department)
  It is planned to introduce 6 waste collection vehicles, 1 mechanical sweeper and 1 tank truck to the City for the F/S in or before 2006. Those vehicles will require 16 drivers in 2 shifts belonging to the Garage Department.
- Workers-for-Vehicle section : 20 persons
  20 persons shall be calculated enough for 8 vehicles, taking into account support from the Central Government to the City because of a sacred place as a location of the late President's and his eldest son's mausoleum.
- Workers' Section : 5 persons
  The existing fixed workers will remain unchanged due to waste collection by vehicle at a large part, so that only the existing persons will be sufficient.
- Qurdaha T/S : 3 persons
  3 persons shall be taken into account albeit they will belong to the New SWM Institution of the Lattakia Governorate. Thus the 3 persons shall be excluded.

4) Al Haffeh City Cleansing Department : 32 persons (including 8 drivers in 2010)

- Manager: 1 person
- Financial/Administration Section: 1 person
- Public Awareness Section: 1 person
- Drivers' Section: 8 persons
- Worker-for-Vehicle Section: 16 persons
- Collection Workers' Section: 5 persons

- Financial/Administration (including personnel matters Section : 1 person
  The Section shall be in charge of those duties of the same Section of the Lattkia Governorate in cooperation with the Tax Collection Section of the Financial Department.
- Public Awareness Section : 1 person
  The Section shall be created for enlightening citizens' public awareness on wastes through public campaigns in cooperation with and under the guidance of the Public Awareness Section of the Lattakia Cleansing Department.
- Drivers' Section : 8 persons
  5 vehicles will be provided the City with by 2010. The Garage Department shall manage in operation of those vehicles by 8 drivers.
- Workers-for-Vehicle Section : 16 persons
  About 16 workers shall be necessary for the waste collection by vehicle from households and on the roads in a small city with a population of less than thirty thousand.
- Collection Workers' Section : 5 persons
  Vehicle collection will be prevailing, so that handcart workers shall be limited. Thus, the existing number of persons shall be enough.

(3) Materialization of "Polluters-Pay" principle

It is important for the citizens to realize "Polluters-Pay" principle by increase of waste collection fee and improvement of fee collection ratio.

1) Reduction of subvention from the Central Government

Waste collection fee should be increased in terms of "Polluters-Pay" principle within the categorized ceiling ratio fixed by the Central Government to reduce subsidy from the Central Government to local governments as much as possible.

If the increase would surpass an expected amount in levels even though the fee collection ratio could reach about 100%, a request should be made to the Central

Government for revising a ceiling of the waste collection fee by decree to realize "Polluters-Pay" principle.

2) Implementation of fine and penalty

Although City Council Executive Offices have promulgated "Orders" against violators of the existing regulations for fines and penalties, levy of the fines and penalties is dubious in thoroughgoing implementation according to the JICA team's interview with relevant authorities.

It is absolutely essential to exhaustively collect the fines and penalties from the violators of the regulations on the matters related to the SWM.

9.1.3 Legal Framework

(1) Basic Law

1) The Local Administration Law (the LAL) of October 10, 1974

The LAL shall be stringently kept and obeyed for the alteration and the amelioration of the SWM scheme in Lattakia City and the 3 surrounding Cities on the M/P in 2010.

2) Environmental Protection Law (the EPL)

The EPL was drafted but is not approved yet by cabinet to date, 2001. Once the EPL is approved, the M/P for the said 4 Cities in 2010 shall abide by the EPL and the alteration and/or improvement of the SWM scheme.

3) Other basic laws

Other basic laws including the Financial Law of 1994 relating to the SWM shall be respected for the M/P on the SWM in 2010.

(2) Decree, Order, Regulation, etc.

1) It is indispensable for the SWM to be obedient to the decrees, their amendments approved by President and/or Governor, the orders, regulations and their amendments approved by Governor and/or City Council.

2) New Decrees shall be promulgated for the establishment of the New SWM Institution under the direction of the Executive Office for Town Facilities as well as Lattakia Mayor under Lattakia Goverorate Council (headed by Governor), at the time of : -

- The contract for Compost Plant to be concluded with a donor probably in 2003, and prospectively the contract for the subsequent Compost Plant to be concluded presumably in 2008,
- Construction commencement of the 2 T/Ss in 2006,

- Contract-Out to a Private Sector for waste transport activity from the 2 T/Ss to Al-Qasia final disposal site concerning tender and contract arrangements with the private sector in the beginning year of construction ; 2006,
- Construction commencement of Al-Qasia waste final disposal site in 2006 and the Recycling Center in 2008,
- Beforehand commencement of Al-Bassa site improvement probably at the end of 2002, and
- Initiating implementation of Medical Waste Management scheme at the end of 2002 and facilities at the beginning of 2009.

3) New Orders shall be issued to the public for such additional sections by city as : -

- Financial/Administration Section, and
- Public Awareness Section.

(3) Standard, Guideline etc.

Standards and Guidelines shall hardly be regarded in light of the status quo as legitimately compulsory regulations but be as much as possible obeyed for implementation of matters.

- The SASMO standard : The Standard No. 2014 (Approval Decision No. 244) of August 31, 1998 was published by the Syrian Arab Organization for Standardization and Metrology (the SASMO), inter alia, the Organic Materials Department of the Chemical Standards Directorate (10 personnel) under the Ministry of Industry.
- Current Environmental Law has excluded the EIA aspects. Nevertheless the EIA has been carried out referring to the EU or International Organization's system since realization of environmental importance arisen in Syria. Quasi-EIA shall be implemented in light of those products mentioned above.

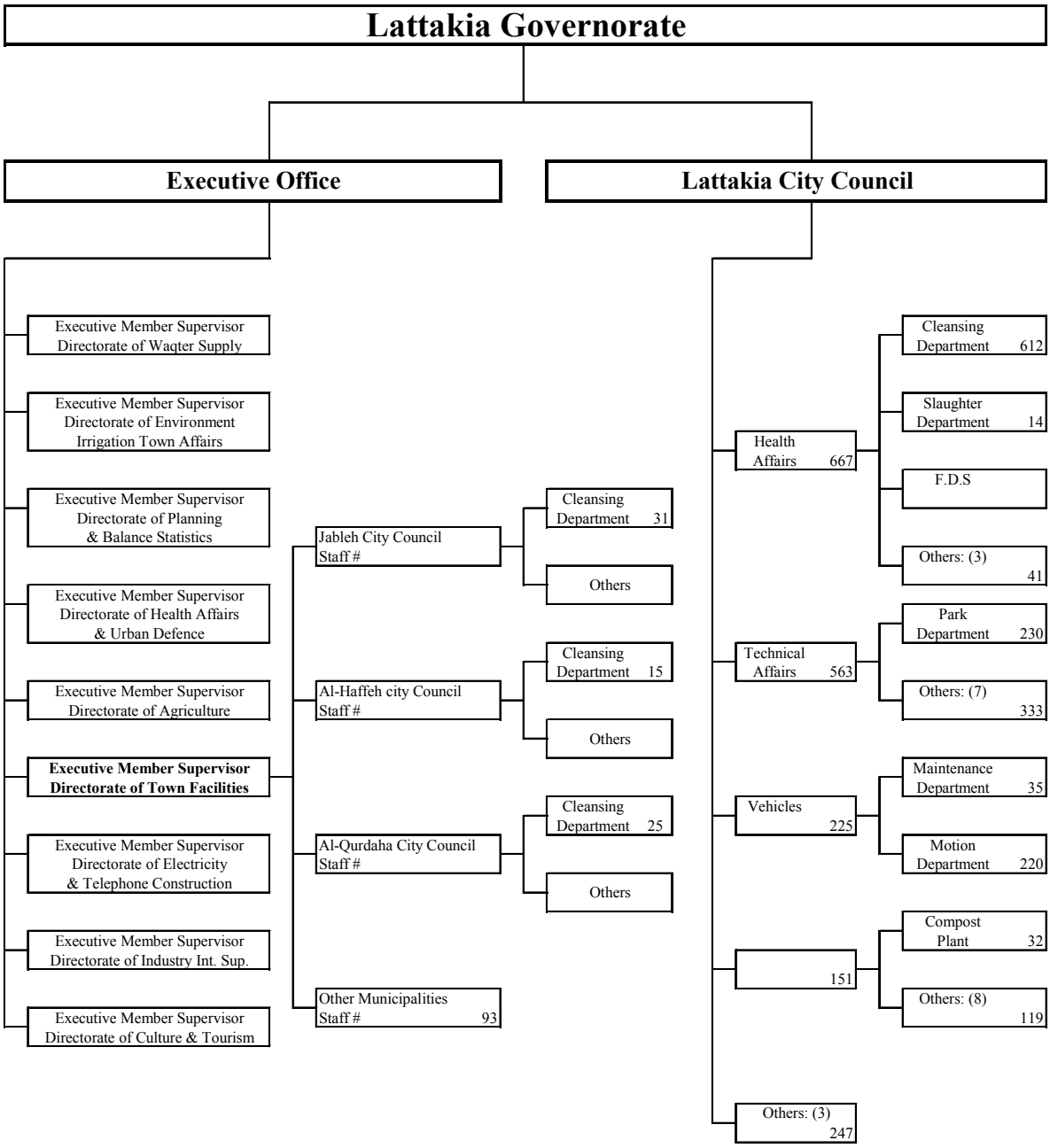

Lattakia Governorate
Executive Office
Lattakia City Council
Executive Member Supervisor Directorate of Waqter Supply
Executive Member Supervisor Directorate of Environment Irrigation Town Affairs
Executive Member Supervisor Directorate of Planning & Balance Statistics
Executive Member Supervisor Directorate of Health Affairs & Urban Defence
Executive Member Supervisor Directorate of Agriculture
Executive Member Supervisor Directorate of Town Facilities
Executive Member Supervisor Directorate of Electricity & Telephone Construction
Executive Member Supervisor Directorate of Industry Int. Sup.
Executive Member Supervisor Directorate of Culture & Tourism
Jableh City Council Staff #
Cleansing Department 31
Others
Al-Haffeh city Council Staff #
Cleansing Department 15
Others
Al-Qurdaha City Council Staff #
Cleansing Department 25
Others
Other Municipalities Staff # 93
Health Affairs 667
Cleansing Department 612
Slaughter Department 14
F.D.S
Others: (3) 41
Technical Affairs 563
Park Department 230
Others: (7) 333
Vehicles 225
Maintenance Department 35
Motion Department 220
151
Compost Plant 32
Others: (8) 119
Others: (3) 247

Figure No. 1

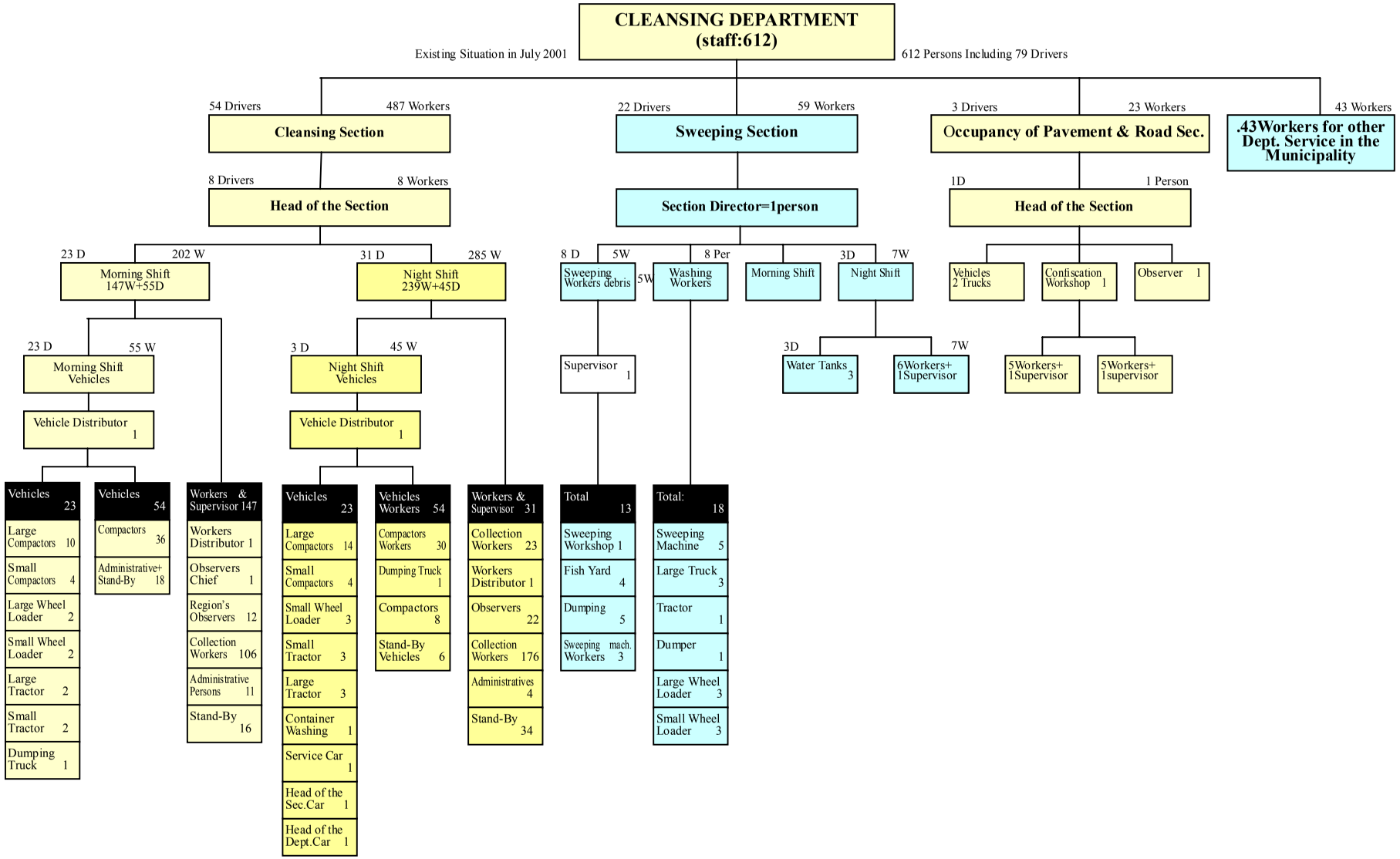

CLEANSING DEPARTMENT
(staff:612)
Existing Situation in July 2001
612 Persons Including 79 Drivers
54 Drivers
487 Workers
Cleansing Section
22 Drivers
59 Workers
Sweeping Section
3 Drivers
23 Workers
Occupancy of Pavement & Road Sec.
43 Workers
.43Workers for other Dept. Service in the Municipality
8 Drivers
8 Workers
Head of the Section
Section Director=1person
1D
1 Person
Head of the Section
23 D
202 W
Morning Shift 147W+55D
31 D
285 W
Night Shift 239W+45D
8 D
5W
Sweeping Workers debris
5W
8 Per
Washing Workers
Morning Shift
3D
7W
Night Shift
Vehicles 2 Trucks
Confiscation Workshop 1
Observer 1
23 D
55 W
Morning Shift Vehicles
3 D
45 W
Night Shift Vehicles
Supervisor 1
3D
Water Tanks 3
7W
6Workers+ 1Supervisor
5Workers+ 1Supervisor
5Workers+ 1supervisor
Vehicle Distributor 1
Vehicle Distributor 1
Vehicles 23
Large Compactors 10
Small Compactors 4
Large Wheel Loader 2
Small Wheel Loader 2
Large Tractor 2
Small Tractor 2
Dumping Truck 1
Vehicles 54
Compactors 36
Administrative+ Stand-By 18
Workers & Supervisor 147
Workers Distributor 1
Observers Chief 1
Region's Observers 12
Collection Workers 106
Administrative Persons 11
Stand-By 16
Vehicles 23
Large Compactors 14
Small Compactors 4
Small Wheel Loader 3
Small Tractor 3
Large Tractor 3
Container Washing 1
Service Car 1
Head of the Sec.Car 1
Head of the Dept.Car 1
Vehicles Workers 54
Compactors Workers 30
Dumping Truck 1
Compactors 8
Stand-By Vehicles 6
Workers & Supervisor 31
Collection Workers 23
Workers Distributor 1
Observers 22
Collection Workers 176
Administratives 4
Stand-By 34
Total 13
Sweeping Workshop 1
Fish Yard 4
Dumping 5
Sweeping mach. Workers 3
Total: 18
Sweeping Machine 5
Large Truck 3
Tractor 1
Dumper 1
Large Wheel Loader 3
Small Wheel Loader 3

Figure No. 2

JABLEH CLEANSING DEPARTMENT

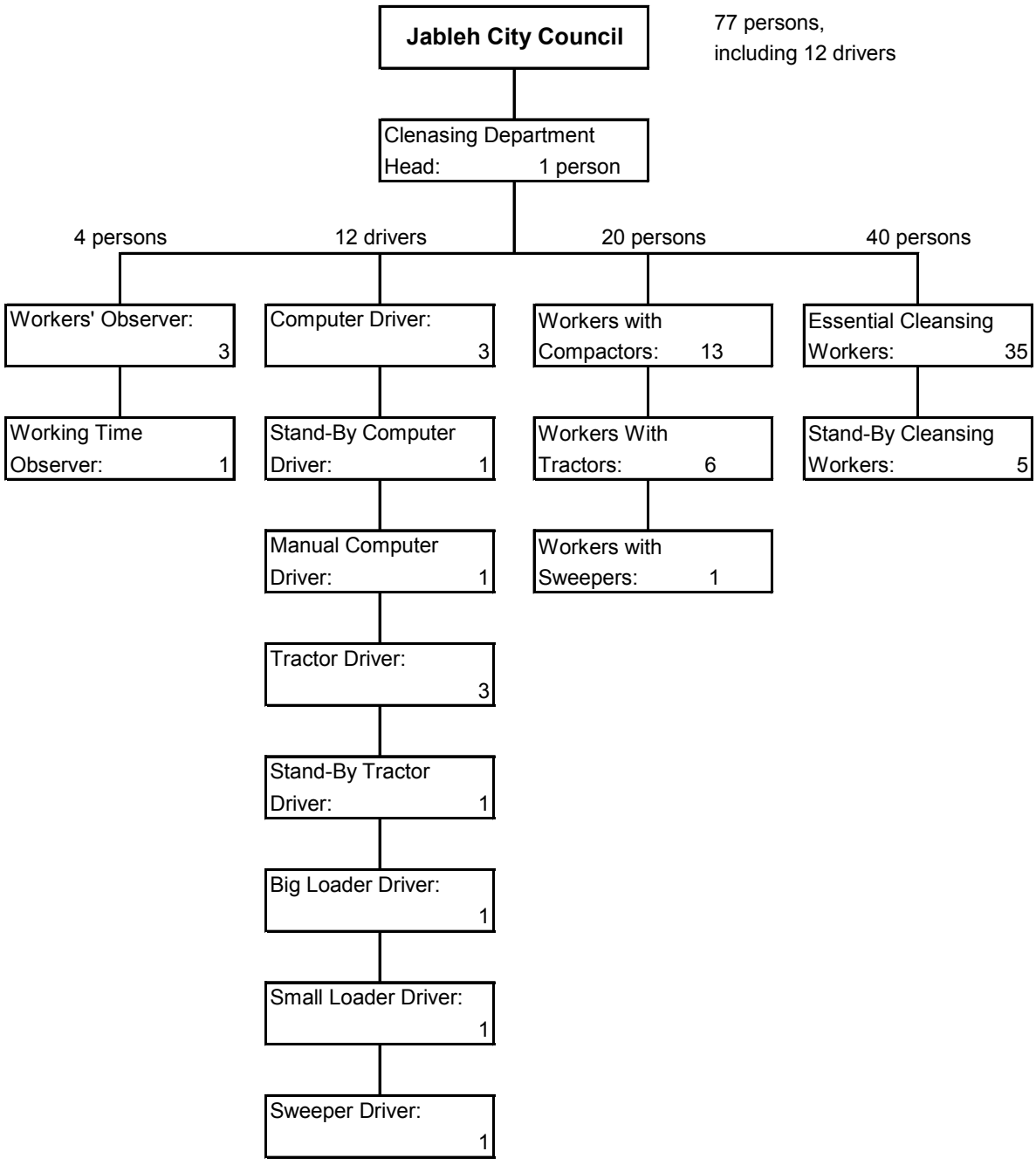
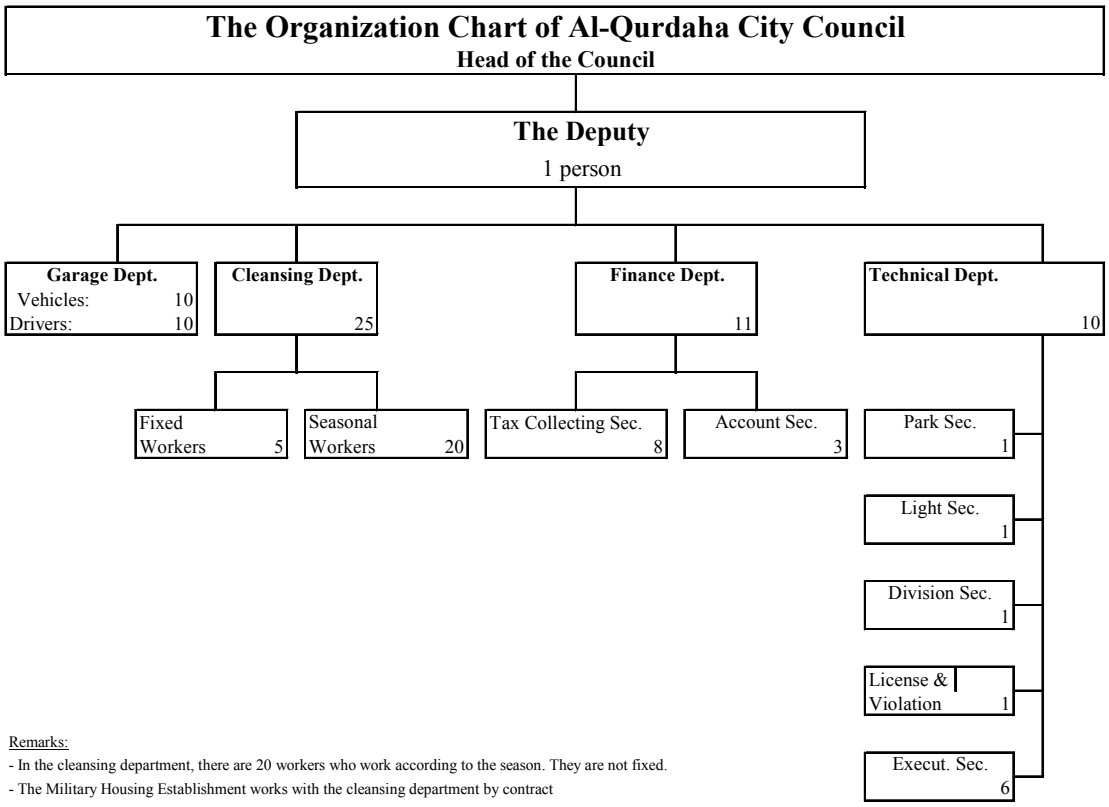


Figure No. 3


The Organization Chart of Al-Qurdaha City Council
Head of the Council
The Deputy
1 person
Garage Dept.
Vehicles: 10
Drivers: 10
Cleansing Dept.
25
Finance Dept.
11
Technical Dept.
10
Fixed Workers 5
Seasonal Workers 20
Tax Collecting Sec. 8
Account Sec. 3
Park Sec. 1
Light Sec. 1
Division Sec. 1
License & Violation 1
Execut. Sec. 6
Remarks:
- In the cleansing department, there are 20 workers who work according to the season. They are not fixed.
- The Military Housing Establishment works with the cleansing department by contract

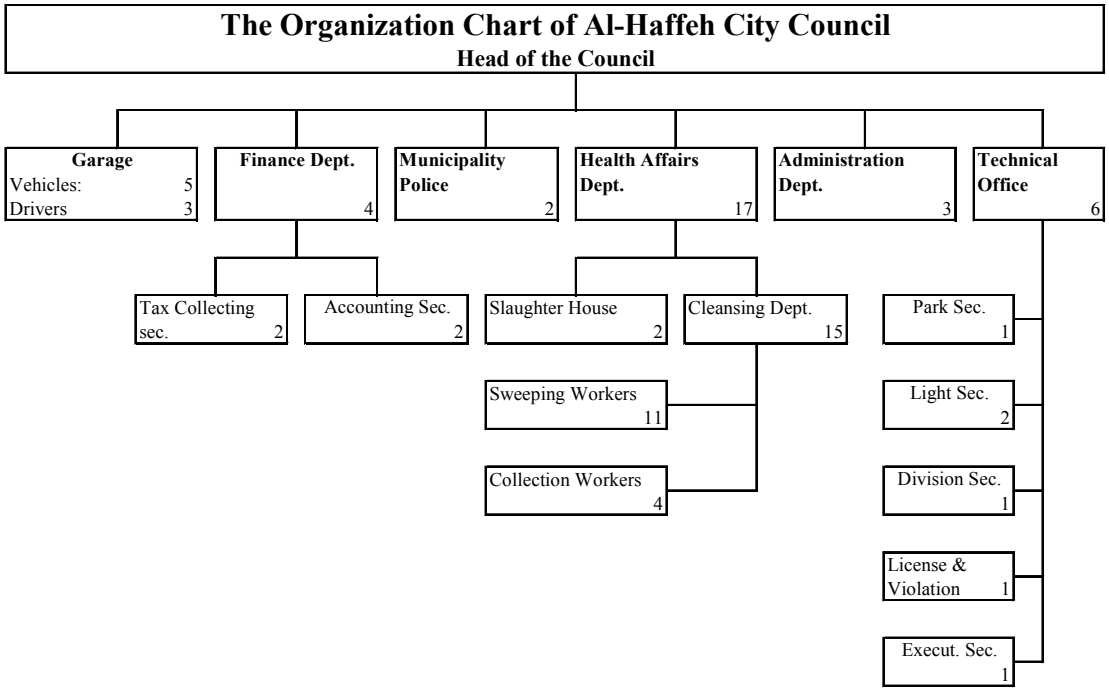

The Organization Chart of Al-Haffeh City Council
Head of the Council
Garage
Vehicles: 5
Drivers 3
Finance Dept. 4
Municipality Police 2
Health Affairs Dept. 17
Administration Dept. 3
Technical Office 6
Tax Collecting sec. 2
Accounting Sec. 2
Slaughter House 2
Cleansing Dept. 15
Park Sec. 1
Sweeping Workers 11
Light Sec. 2
Collection Workers 4
Division Sec. 1
License & Violation 1
Execut. Sec. 1

Figure No. 4

STRUCTUE OF NEW INSTITUTION

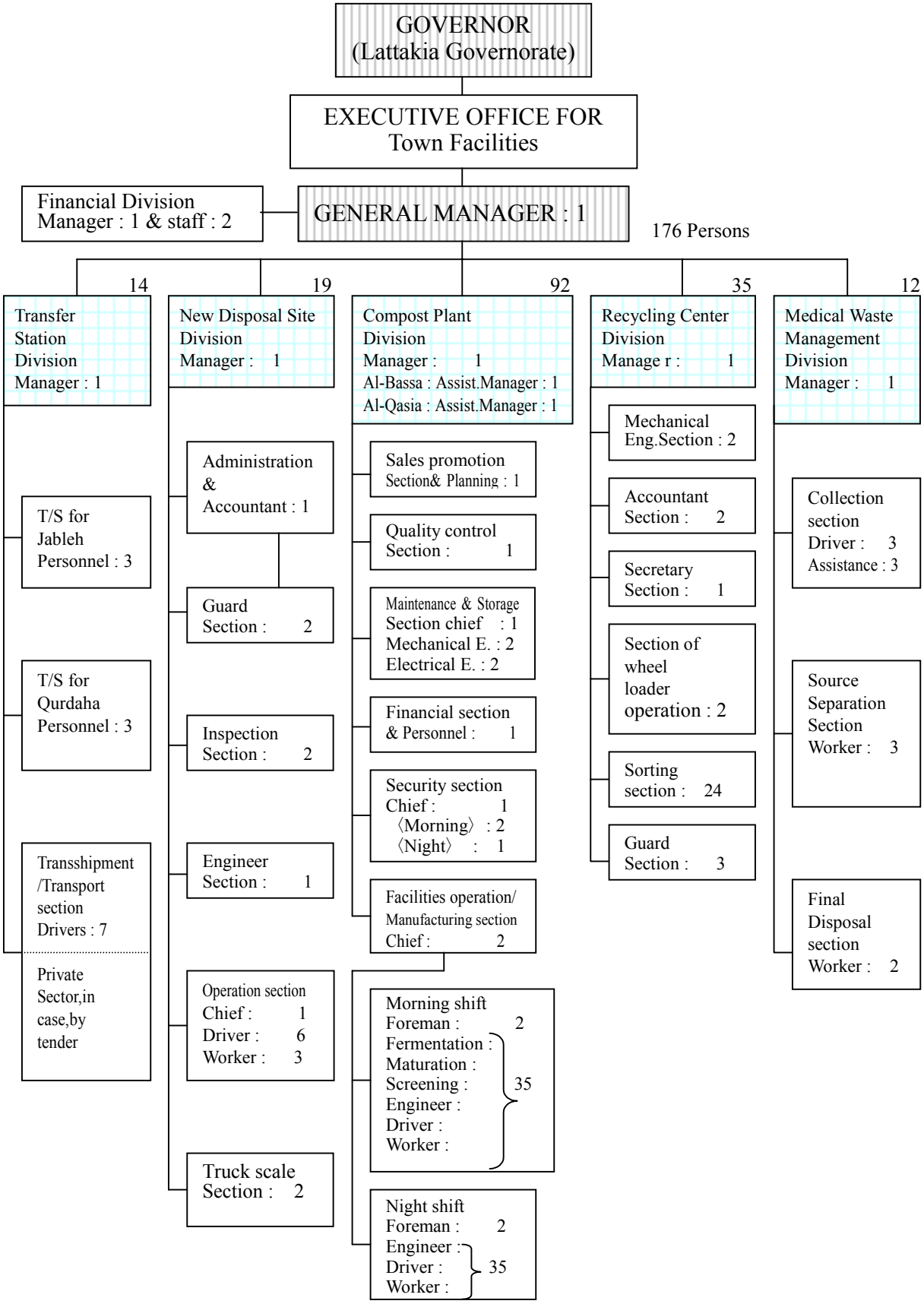
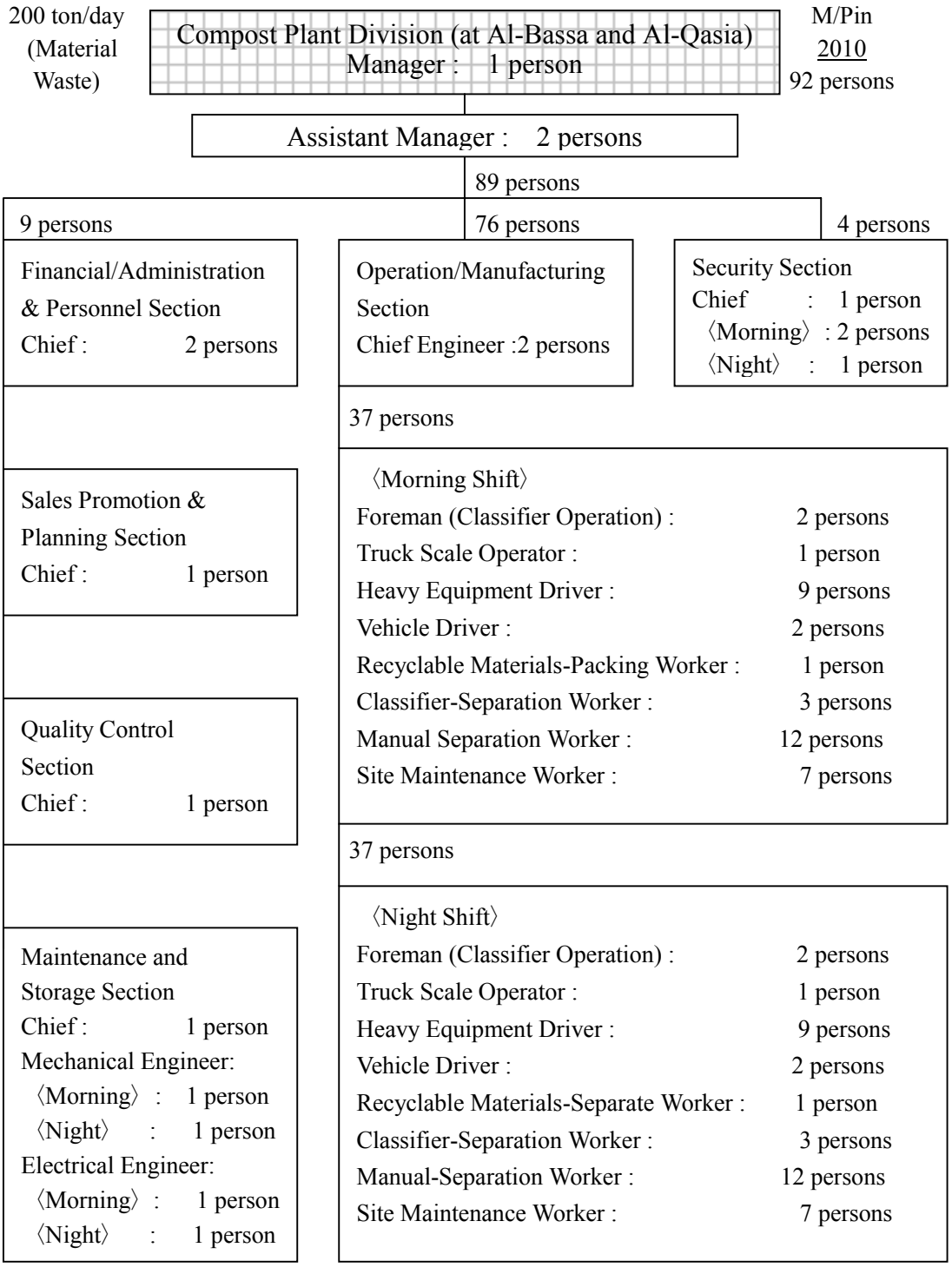
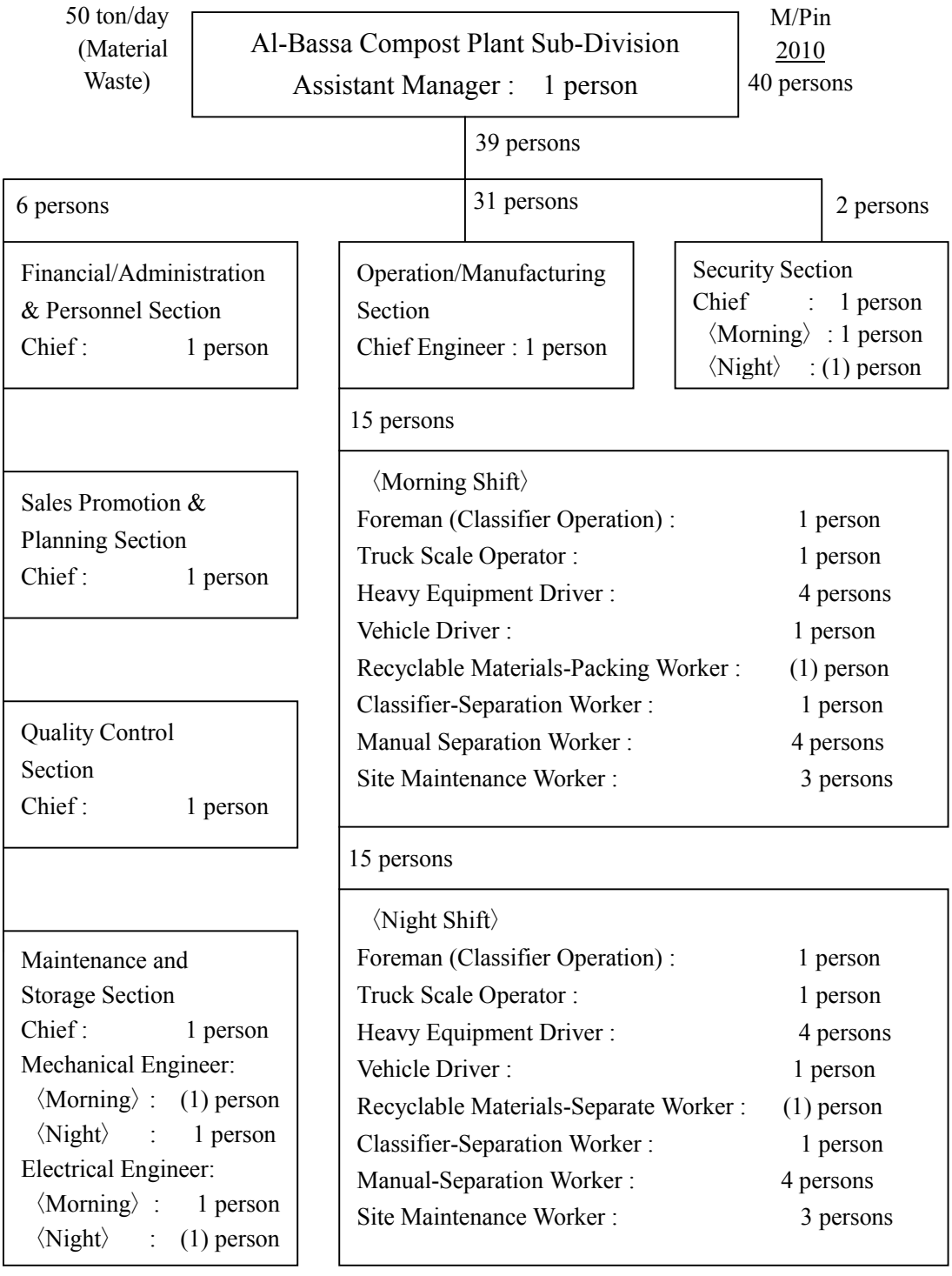


Figure No.5 Organization Chart of Executive Office for Town Facilities Lattakia Governorate



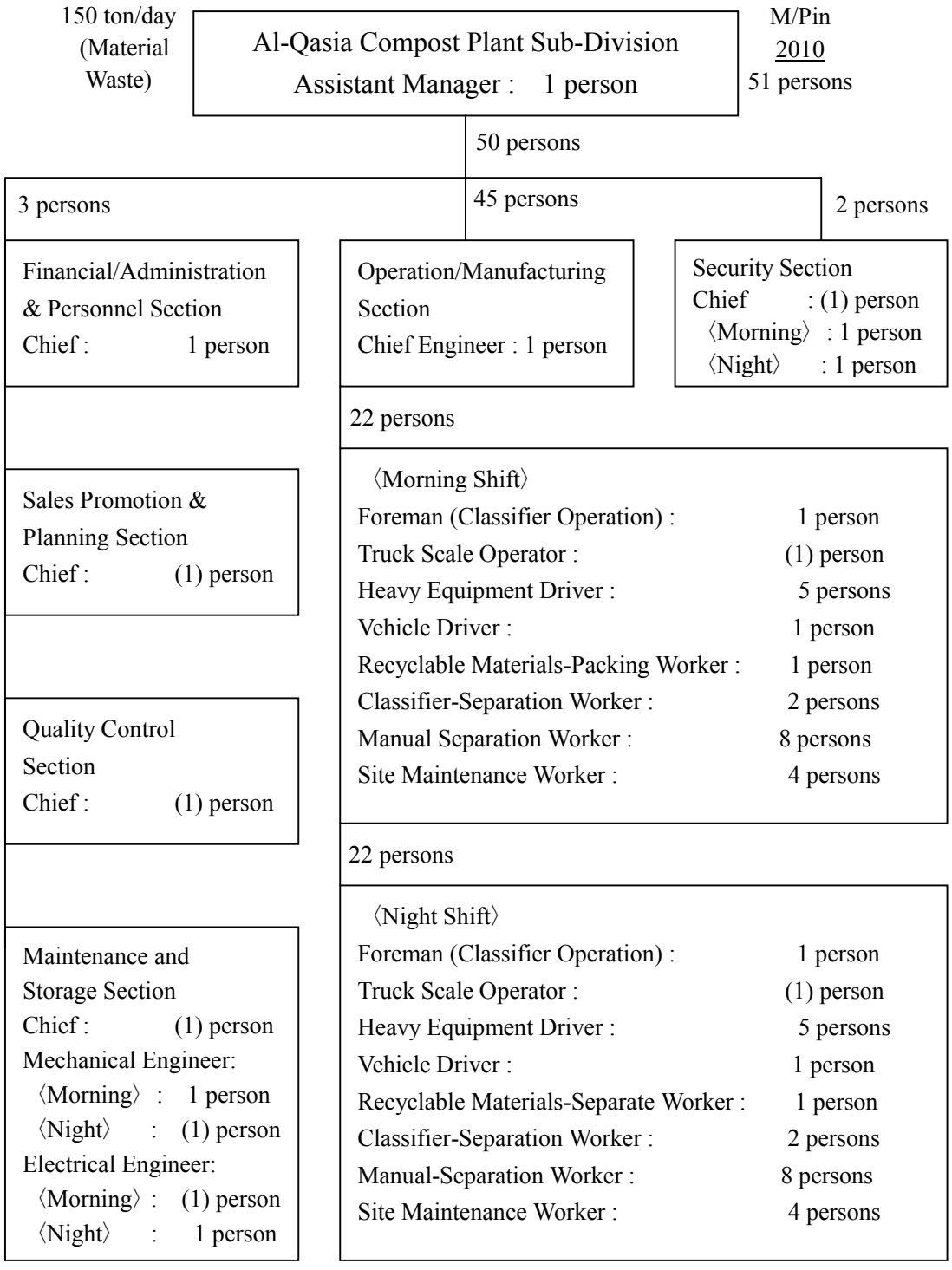
Note : Number of persons in ( ) holds the post concurrently

Figure No. 6



Note : Number of persons in ( ) holds the post concurrently

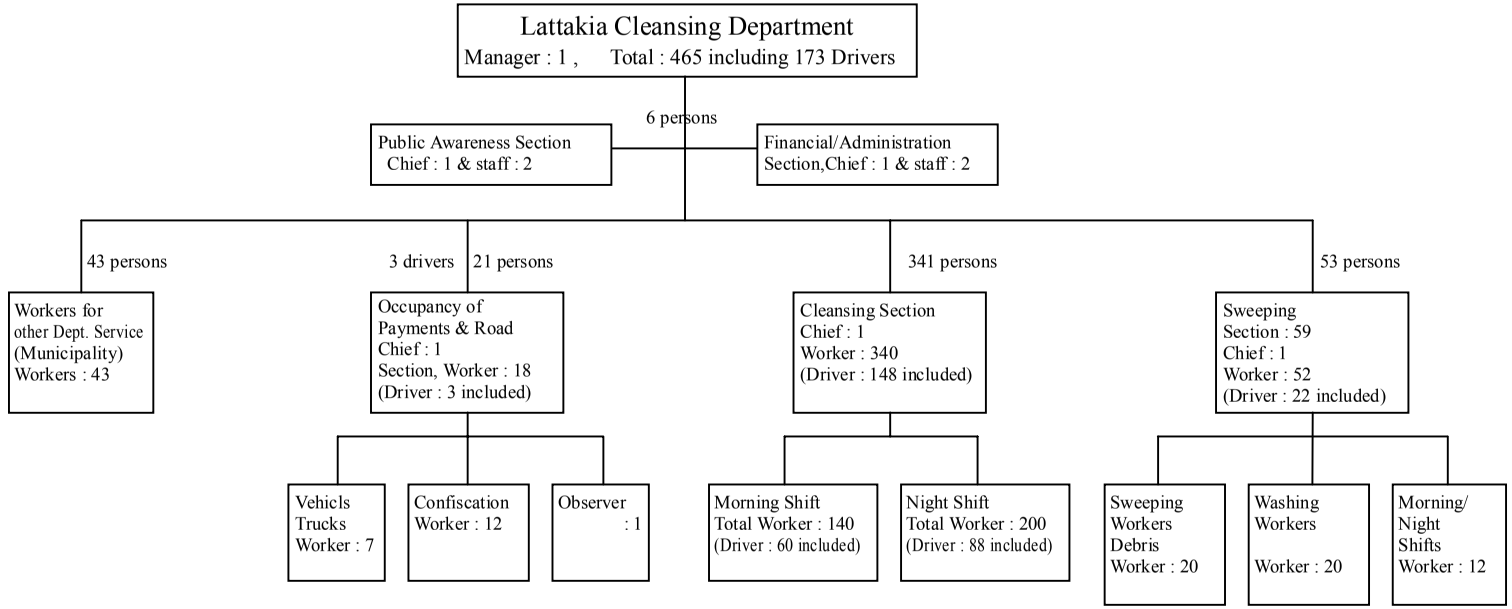
Figure No. 7



Note : Number of persons in ( ) holds the post concurrently

Figure No. 8

M/P in the Year 2010



Note : (1) More than 50 units of vehicles are likely to reduce the number of manual operating workers to improve the ways of waste collections and street sweeping, even though a growth of population (476,747 in 2010) is expected.

(2) Transferred Persons to New SWM Institution of Lattakia Governorate shall be selected in light of their aptitude and qualification enough to manage in their new posts.

Figure No. 9

9.2 INSTITUTIONAL ARRANGEMENT ON THE PRIORITY PROJECT

9.2.1 Arrangement of relevant organizational institutions and legal systems

Lattakia Governor (Governorate) is responsible for the province of Lattakia Governorate including Lattakia City and the Three surrounding Cities, i.e., Jableh City, Qurdaha City and Al-Haffeh City through an Executive Office for Town Facilities of the Lattakia Governorate Council.

Priority projects shall be carried out as an urgent project by initiative of the Lattakia City Council (Mayor) for the reason why the main place for the urgent projects is located practically under the control of Lattakia Mayor.

(Institutional Arrangement)

- Lattakia City Recycling and Disposal Department: 56 persons (plus 11 persons)
- Lattakia City Cleansing Department: 510 persons in case of
- Jableh City Cleansing Department: 102 persons extension)
- Qurdaha City Cleansing Department: 44 persons
- Al-Haffeh City Cleansing Department: 32 persons

Total: 744 persons (755 persons)

(Legal Arrangement)

- Establishment of a Recycling and Disposal Department (the RDD): Year 2002
- Transfer of Ownership from the RDD to a New SWM Institution: Year 2006

(1) Recycling and Disposal Department (the RDD) : 56 persons in total
Ownership is the Lattakia City Council.

The Recycling and Disposal Department (the RDD) shall be established anew on condition that the New SWM Institution as formulated in the M/P shall legitimately hold the right to inherit all right and responsibility from the RDD in 2006 toward 2008 when Qasia final disposal site will be operated. The RDD shall be set up independent of and in parallel with the Lattakia Cleansing Department under the Health Affairs of the Lattakia City Council (Mayor).

Unifiable cooperation with each other among the 4 Cities is indispensable for the SWM at a stretch of land like the 4 Cities together. Coordination meetings shall periodically be held by head of the Cleansing Departments in the 4 Cities to ameliorate ways of the waste generation from households, to implement ways of the waste-source segregation,

to upgrade efficiency of the waste collection and street sweeping, to haul the waste to Al-Bassa-disposal site, to enhance public awareness of the citizens on the waste, etc.

1) Recruit of necessary personnel for the RDD

a. Selection of the personnel from the Lattakia Cleansing Department

All the members of the RDD shall be transferred first from the members of the existing Cleansing Department of Lattakia City including drivers from the Vehicles' Affairs after deliberation of their aptitudes and qualifications for the new posts of the RDD.

b. Other manpower sources

Capable and qualified persons shall be looked for in other manpower sources in any other departments and/or sections of Lattakia City and outside the City in case of difficulty to find persons in the Cleansing Department suitable for the new posts of the RDD.

2) Al-Bassa Section for Rehabilitation and Landfill Improvement : 11 persons

- Chief Engineer and Supervisor: 1 person
- Accountant: 1 person
- Planner and Inspector: 1 person
- Driver and Operator: 4 persons
- Worker: 2 persons
- Guard: 2 persons

By those members, the work shall be initiated in 2003 and 2004, possibly ensuing years until Al-Qasia final disposal site will be ready for operation in 2008.

3) Recycling Center Section : 44 persons

a. Compost Plant Rehabilitation Sub-Section : 25 persons

- Chief (Agricultural) Engineer and Quality Controller: 1 person
- General affairs/Financial and Sales Promotion: 1 person
- Planning/Maintenance and Storage: 1 person
- Security and Guard: 2 persons
- Manufacturing Unit (20 persons)
  - Foreman (Classifier Operator): 1 person
  - Mechanical Engineer: 1 person
  - Electrical engineer: 1 person
  - Truck Scale Operator: 1 person

- Heavy Equipment Driver: 1 person
- Light Equipment Vehicle Driver: (1) person
- Fermentation Technician: 1 person
- Maturation Technician: 1 person
- Screening Technician: 1 person
- Recyclable Materials – Packing Worker: 2 persons
- Classifier – Separation Worker: 1 person
- Manual Separation Worker: 8 persons
- Site Maintenance Worker: 1 person

The amount of compost products will be expected to be 5 (20%) or 6 (25%) ton./day from 25 t./day- materials of organic source-separated waste.

The Second Stage for one more line of the Plant (additional engineers and workers excluding the Chief Engineer) shall be decided to install at Al Bassa depending on a favorable trend of sales and/or demand of the compost produced at the First Stage (Priority Project) Plant of 25 ton/day in the three years from 2005 through 2007.

((REMARKS))

- Case of another 25 t./day-extension : 11 persons to be added, i.e., 36 persons for 50 t./day-plant in total before or in 2006 by transfer of ownership from Lattakia City to Lattakia Governorate due to readiness for raising funds for the extension and counting on growth of sales or demand
- Utilization of some remaining persons (some number of persons qualified for the first 25 t./day-plant requiring 56 persons and the said some remaining number of persons to be deducted from some remaining number of persons) from the remaining 102 persons in total of the Lattakia City Cleansing Department

b. Sorting Center Sub-Section (19 persons)

- Chief Engineer: 1 person
- Mechanical Engineer: 1 person
- Accountant: 1 person
- Secretary: 1 person
- Manual Sorting Worker: 12 persons
- Driver (for Wheel Loader): 1 person
- Guard: 2 persons

Ownership of the RDD shall be legitimately changed from the Lattakia City Council (Mayor) to the Lattakia Governorate Council (Goveornor) in the form of amalgamation of both the Institutions right in 2006 when Qasia site will be prepared.

(2) Ratification of Lattakia, Jableh, Qurdaha and Al-Hahheh City Cleansing Departments

1) Lattakia Cleansing Department : 510 persons (including 123 drivers in total)

102 persons shall be streamlined as follows including 56 persons for the RDD (on condition that all the necessary members could be covered by the surplus member from the Cleansing Department in aptitude and qualification)

− Manager:	1 person
− Financial/Administration Section:	3 persons
− Public Awareness Section:	3 persons
− Cleansing Section:	393 persons
− Sweeping Section:	46 persons
− Occupancy of Payment & Road Section:	21 persons
− Other Department Service Section:	43 persons

- Financial/Administration Section : 3 persons (to be afresh increased) The Section shall be sep up anew and still hold 3 persons in 2006 to fulfill its duties full well such as a thoroughgoing waste-collection fee and levy of fine and penalty in cooperation with Occupancy of Payments & Roads Section as well as a Tax Office in order that the "Polluters-Pay" principle may be materialized.
- Public Awareness Section :3 persons (to be created) The Section shall be created to enlighten citizens' public awareness on wastes through public campaigns coordinating with the other Public Awareness Sections of the Cleansing Departments in the Three surrounding Cities.
- Cleansing Section : 393 workers (including 98 drivers) Thus, 95 workers to be decreased.

  Increment of waste collection street sweeping vehicles shall be likely to reduce the number of manual waste collection workers and street sweepers. 36 units of waste collection vehicles, 5 units of new street sweepers and tank trucks are planned to prepare before 2006. Thus, the Morning Shift will be operated by 159 workers including 40 drivers and the Night Shift by 233 workers including 58 drivers.

- Sweeping Section : 46 persons (including 22 drivers)
  Since 59 persons could not be reached by cumulative total number of the persons mentioned in the detailed organization chart delivered to the JICA team on July 24, 2001 from the manager of the Cleansing Department, some surplus (stand-by, or not-always necessary) persons are considered included in the Section. Thus, 13 persons shall be reduced for streamlining.
- Occupancy of Payment & Road Sections : 21 persons (2 to be decreased)
  From a streamlining point of view, reduction of 2 persons shall be covered with upgrading the remaining personnel (21 persons including 3 drivers) by on-the job hard training to effectively attain their duties well.
- Transferred persons to the RDD : 56 persons (to be decreased)
  Attention is made to that the number of the reduced (56) persons shall not be always transferred to the RDD.
  Without sticking only to workers, an appropriate selection way shall be applied to the transferable members considering their aptitudes and qualifications among all persons of the Cleansing Department (612 including 79 drivers from Vehicle Affairs).

2) Jableh City Cleansing Department : 102 persons (including 33 drivers)

− Financial/Administration Section	2 persons
− Public Awareness Section:	1 person
− Drivers' Section:	33 persons
− Workers-for-Vehicle Section:	56 persons
− Essential Cleansing Workers' Section:	10 persons

- Financial/Administration Section : 2 persons (to be added afresh)
  The 2 persons shall manage in the same matters as described above in the case of Lattakia City in cooperation with a Tax Office of Jableh City.
- Public Awareness Section : 1 person (to be created)
  The Section shall be in charge of enhancement of citizens' public awareness on wastes through public campaigns in cooperation with and under the guidance of the Public Awareness Section of the Lattakia City Cleansing Department.
- Drivers' Section : 33 drivers from the Vehicle Affairs
  33 drivers shall be at least needed in light of increase of waste collection equipment according to growth of the waste. Collected waste shall be transported to Al Bassa final disposal site until readiness of Al Qasia final disposal site in 2008.

- Workers-for-Vehicle Section : 56 persons
  Increase of vehicles' number will lead to increase of workers for the vehicles. The present ratio of the workers for the vehicles is 1.7 which will be used for the 33 drivers in 2006.
- Essential Cleansing Workers' Section : 10 persons (30 persons to be lessened)
  About 10 workers shall remain to collect waste with handcarts at narrow lanes like an old- town district.
- Jableh T/S : 3 persons
  3 persons shall be taken into account for the T/S, though they will belong to the New SWM Institution of the Lattakia Governorate Council.

3) Qurdaha City Cleansing Department : 44 persons (including 16 drivers from the Garage Department)

− Manager:	1 person
− Financial/Administration Section:	1 person
− Public Awareness Section:	1 persons
− Drivers' Section:	16 persons
− Worker-for-Vehicle section:	20 persons
− Workers' Section:	5 persons

- Financial/Administration Section including personnel matters : 1 person
  The Section shall be added afresh under the Cleaning Department to fulfill the same duties as those of Lattakia City in cooperation with the Tax Collection Section of the Financial Department.
- Public Awareness Section : 1 person
  The Section shall be created to enhance citizens' public awareness on wastes through public campaigns in cooperation with and under the guidance of the Public Awareness Section of the Lattakia Cleansing Department.
- Drivers' Section : 16 persons (from the Garage Department)
  It is planned to introduce 6 waste collection vehicles, 1 mechanical sweeper and 1 tank truck to the City for the F/S before 2006. Those vehicles will require 16 drivers in 2 shifts belonging to the Garage Department.
- Worker-for-Vehicle Section : 20 persons
  About 20 workers will be considered enough for 8 vehicles, taking into account support from the Central Government to the City because of a sacred place as the location of the late President's and his eldest son's mausoleum.
- Worker's Section : 5 persons
  The existing fixed workers will remain unchanged due to waste collection by

vehicle at a large part, so that only the existing workers will be considered sufficient.

- Qurdaha T/S : 3 persons
  3 persons shall be taken into account albeit they will belong to the New SWM Institution of the Lattakia Governorate.

4) Al Haffeh Cleansing Department : 32 persons (including 8 persons from the Garage)

− Manager:	1 person
− Financial/Administration Section:	1 person
− Public Awareness Section:	1 person
− Drivers' Section:	8 persons
− Worker-for-Vehicle Section:	16 persons
− Collection Workers' Section:	5 persons

- Financial/Administrative Section : 1 person
  The Section shall be added under the Cleansing Department to be in charge of those duties of the same Section of the Lattakia Cleansing Department in cooperation with the Tax Collection Section of the Financial Department.
- Public Awareness Section : 1 person
  The Section shall be created for enlightening citizens' public awareness on wastes through public campaigns in cooperation with and under the guidance of the Public Awareness Section of Lattakia Cleansing Department.
- Drivers' Section : 8 persons (from the Garage)
  Based on the planning, 5 units of vehicles shall be needed for growth of waste generation in 2006. Waste collection by vehicle will be effective and efficient at the place with upward and down-ward slopes of the roads. Corresponding to the circumstances of the City, the number of drivers shall be set to be 8 persons.
- Worker-for Vehicle Section : 16 persons
  About 16 persons shall be necessary for the waste collection by vehicle from households and on the road in a small city with a population of less than thirty thousand.
- Collection Workers' Section : 4 persons
  Vehicle collection will be considered prevailing, so that hand cart workers will be limited. Thus, the existing number of persons shall be enough.

(3) Arrangement of the Relevant Legal System

The Local Administration Law of October 10, 1974 shall be obeyed first for the legal arrangement.

1) Requirements for the matters within Lattakia City

a. First Proponent : Mayor of Lattakia City (after culmination of oral and/or written agreement on the under-mentioned matters with the Lattakia City Cleansing Department)

- City Council (headed by Mayor)
  The Mayor of the Lattakia City shall submit application documents to the Lattakia City Council for : -
  i) Establishment of the Lattakia City Recycling and Disposal Department (the RDD) : 2002 for the establishment of the RDD in 2003,
  ii) Reshuffle of the Lattakia City Cleansing Department : 2002 for the establishment of the RDD and realization of the reshuffle for the Cleansing Department in 2003, and
  iii) Procurement of equipment and facilities for both the RDD and the Cleansing Department : 2002 for materialization of the procurement in 2003 and 2004.
- The Mayor as a head of the Lattakia City Council shall submit the application documents to the Lattakia Governorate Council (headed by Governor) for approval of the application documents after agreement of the Lattakia City Council on the application documents.

b. Second Proponent : Governor of the Lattakia Governorate

- The Lattakia Governorate Council (headed by Governor)
  The Governor shall take up the above-mentioned i), ii) and iii) matters with the Lattakia Governorate Council to obtain its approval and agreement.
- The Governor as a head of the Lattakia Governorate Council shall submit the application documents to the Central Government, practically the Ministry of Local Administration (headed by Minister).

c. Resolution to be made by the Central Government

- The Ministry of Local Administration
  The Ministry shall consult relevant Ministries, if any, to gain agreement on the i), ii) and iii) matters from them.
- A Decree shall be promulgated with number and date on the i), ii) and iii) matters by the Minister of Local Administration under delegation of power from the President.

(4) Requirements for the matters of Inter-Municipalities in the Lattakia Governorate

Procedures will be the same as or similar to the aforementioned processes.

1) Decrees or Orders to be issued by Governor or Mayor based on the Decree of the Minister of Local Administration

a. Governor is entitled to issue decrees or orders within the purview of his capacity based on the Decree.

b. Mayor shall consult the Governor beforehand orally or in writing to issue decrees or orders based on the Decree.

c. Establishment of the New SWM Institution in the Lattakia Governorate

- The Governor shall prepare the necessary arrangements for the establishment of the iv) New SWM Institution within 2006 including amalgamation of the RDD with the New SWM Institution for operational commencement of the New SWM Institution at the very beginning of 2007.
- The Governor (Head of the Governorate Council) shall comply with a formality as described above.
- The Governor shall instruct the Mayors of Lattakia City, Jableh City, Qurdaha City and Al-Haffeh City to take proceedings for : -

  v) Merging the RDD with the New SWM Institution in 2007,

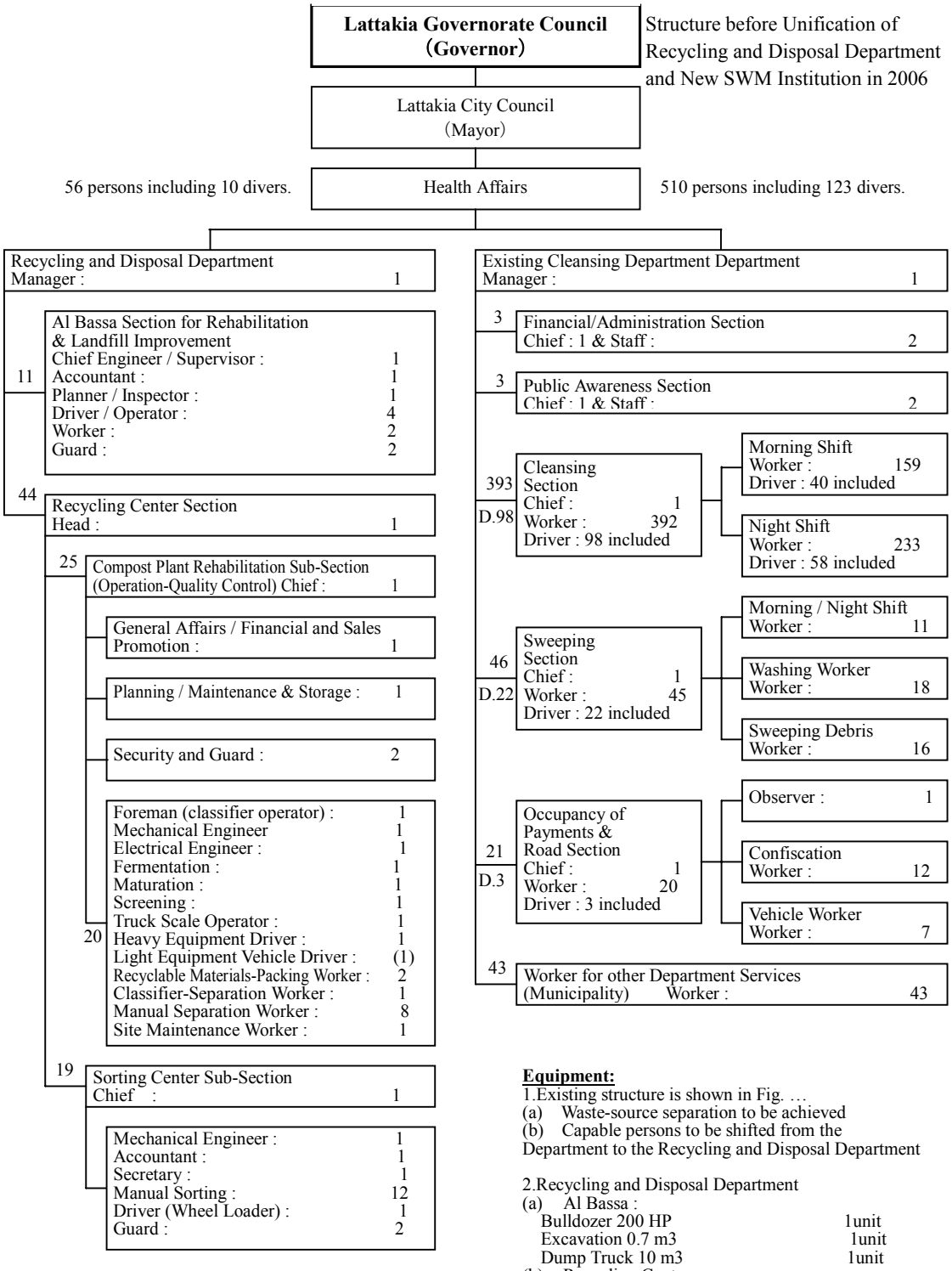
  vi) Establishment of the Jableh and Qurdaha T/Ss within 2006, and

  vii) Another procurement of equipment and facility including addition, in parallel with, arrange for himself to add : -

  viii) Recycling Center Division to in 2008, and

  ix) Medical Waste Management Division to the New SWM Institution in 2009.

F/S in the Year 2006



Equipment:

1.Existing structure is shown in Fig. …
(a) Waste-source separation to be achieved
(b) Capable persons to be shifted from the Department to the Recycling and Disposal Department

2.Recycling and Disposal Department
(a) Al Bassa :
Bulldozer 200 HP 1unit
Excavation 0.7 m3 1unit
Dump Truck 10 m3 1unit
(b) Recycling Center
A Set of Compost Plant 1unit
Truck Scale (computerized 40t) 1unit
Wheel loader (for compost & sorting) 2unit

Figure

SECTION 10

ECONOMIC AND FINANCIAL ANALYSIS ON MUNICIPAL BUDGET

SECTION 10 ECONOMIC AND FINANCIAL ANALYSIS ON MUNICIPAL BUDGET

10.1 FINANCIAL ISSUE

The financial plan for SWM cannot be divorced from the overall budgeting system applied in Lattakia and in Syria. Until the overall budget system is reformed, funding for implementation of the SWM Master-plan, or a master-plan for any other sector, cannot be guaranteed.

Hence, while it is well beyond the scope of this Master-Plan to undertake a reform of the Government Budgetary procedures in Syria, a very brief outline of the changes that are needed is given below.

Program Budgeting

The current structure of budget appropriations is based on systems first introduced in developed countries over a century ago, when the overall scale of Government operations was much smaller, and the scope of services managed by Governments far more limited. At that stage informal ways to manage the costs of individual programs were considered adequate, but as the complexity of Government increased, it was found necessary to reform the appropriation system. Most developed countries have now changed to program budgeting, and it is time for Syria to follow this example. Under this system funds are allocated not by expense categories but by programs and then sub-programs.

This change in budget systems must be accompanied by organizational changes. Program managers must become responsible for all expenditures in their program, and their sub-ordinates become responsible to their manager for their component of the program.

This change has several key benefits:

- The total cost of each program, and component within it can be clearly and accurately identified
- Managers are fully aware of the costs of their actions. They are responsible for their own budget and have an incentive to introduce money saving improvements
- Detailed information can be used by managers to identify incremental improvements in their areas which cannot be identified by high level planners

So for example under these revised structures, the director of the Cleansing Department would have a specific budget which included all expenditures required for his service. He would have control of the budget for both cleansing vehicles and drivers who operate these vehicles, and the power to modify schedules shifts etc. to reduce overall costs. It is impossible to reform a single sector as responsibilities must be re-organized amongst many sectors.

Integration of operating and capital budgets

As part of the transformation to program budgeting, capital and recurrent budgets should be integrated. At present these are developed separately with little regard for the effects of one upon the other. At present the prime responsibility for these two budgets is often split between different levels of Government. For example in SWM the prime responsibility for recurrent budgets now lies with the local Government, but these have little influence over capital acquisitions. These lie almost exclusively within the gift of the central Government, and are sometimes made in kind rather than money. Integration should be designed to ensure that:

- The same entity is responsible for both recurrent and capital budgets;
- These budgets are co-ordinated;
- Resources are built up over time to ensure that sufficient funds are available when required to meet major capital purchases.

Clarification of responsibilities, powers and tax sharing arrangements between local and Central Governments

While the final authority in all budget matters would appear to lie with the Central Government, the actual interactions between the various levels of Government are in practice quite complex. Perhaps they could best be described as a system where "everyone is responsible, so no one is responsible". This relationship is of course sensitive politically and every country has had to develop its own system to suit its own political environment. Never the less some general principles have been established as highly desirable:

- Each service should be the responsibility of only one level of Government to prevent "buck-passing" between different political levels;
- As far as possible each level of Government should be responsible for raising the funds needed to manage the services for which they are responsible;
- Where there is a need to transfer funds between different levels of Government, this should be managed through long term agreements, where the amount to be transferred each year is predictable and calculated according to an agreed formula. As far as possible one-off grants should be avoided;
- All fund transfer arrangements must ensure that recipient administrations still have an incentive to manage their own revenue collections effectively. (Current arrangements, which leave open the possibility of special grants from higher levels to make up for shortfalls in local revenue collections are not conducive to effective local revenue collections).

User-pays principle

It is now a widely accepted principle of Government budgeting that the taxes and charges imposed on the users of the services should cover the costs of those services. This principle has been established to improve the allocation of resources in the economy as it is now generally accepted that the willingness of consumers to pay (i.e. the market's judgment) is usually the best available (if imperfect) measure of the value

of the service to the economy. This principle can be changed in the following circumstances:

- Where the service is necessary in the public interest, and some consumers of the service are too poor to pay for the service. In these cases the provision of the service to poor households may be subsidized from the general budget. Solid Waste collection is such a case. If waste is not collected, a public health hazard is created for the whole population. Thus subsidy of the service provided to poor households is justified if they are unable to pay;
- Where there is a clear market failure and as a result consumers are not aware of the true value of the service. In these circumstances a subsidy of the service may be justified for a limited time. A compost plant potentially fits into this category. Currently farmers are unaware of the true value of compost, and are only prepared to pay a fraction of its true value. However the subsidy should be paid out of the budget of the sector which is receiving the benefits. Thus the subsidies that will be necessary to operate any compost plants should be provided though the Ministry of Agriculture Budget, not municipal budgets. (Within the Ministry of Agriculture Budget, a program needs to be created to promote organic fertilizers. This will need to include extensive field trials on its use, extension programs to educate farmers and a subsidy to municipal or other bodies operating compost plants)

Improved tax collection procedures

Maintaining and upgrading tax collection systems to minimize tax evasion and avoidance is a major problem in all countries. This study has not examined national tax collection systems, but has looked at collections of taxes and fees at a local level. Avoidance and evasion is particularly widespread at this level, and a combined approach by local and central Government is needed to improve collection.

From a local perspective, there are two major problems:

- The records of persons or entities liable to pay local taxes and charges are very inaccurate, not recording a third or more of persons liable to pay local taxes and charges;
- Local authorities lack powers to force payment of taxes.

The tax records of the municipality need to be updated urgently, and the records held by separate departments should be integrated. Detailed proposals for immediate implementation by the municipality are shown later. In the medium term however the main responsibility for reform will lie with the central Government. There is an urgent need to upgrade the cadastral and land registration systems to ensure that ownership of all property throughout Syria is properly registered.[1] This is best managed at a national level. Development of an effective land registration system is critical to development of a modern market economy, and should be regarded as a top priority by the national Government.[2] It is a fundamental foundation stone for financial systems in

[1] In Lattakia at present it is estimated that over 30% of houses are "informal" or "random". That is title to the land and buildings is not properly recorded, and land use and planning documents either do not exist at all or are seriously deficient. In Homs it is estimated that this figure may be as high as 40%.
[2] We understand that some proposals have been developed to regularize ownership records for "random" housing in Syria, but have not reviewed these proposals under this study

all developed countries, underpinning much of the lending to business and citizens in these countries. It can also form an accurate database from which liabilities for local property taxes and charges can be calculated. The development of such a system will take up to ten years.

The central Government also needs to review the powers that it delegates to local government to ensure collection. Even once an effective central land register is constructed, collection of these taxes and charges may be actually carried out by the municipal government.[3] However these need more effective sanctions to ensure that all the landowners liable to pay local taxes and charges actually do so.

Alternatives if reforms to the structure of the budget are delayed

If the Government does not carry out fundamental procedural reforms to the budget system, then the only other practical alternative is for the Government to agree to widespread privatization in the SWM sector. It would also have to agree to contracts with the private sector that allow the operators proper legal protection for the collection of service fees from the Government. In the absence of fundamental reforms to the budget system, this is the only practicable method to ensure that funding is available when required for investment in and operation of the system. The written enforceable contract for the provision of the service is a commitment by the Government that cannot be by-passed, unlike a forward budget commitment under the existing budget systems. While budgetary powers and responsibilities remain diffused amongst diverse government entities it is practically impossible to ensure long term commitments are maintained.

Transition to Program Budgeting

The financial section of the master-plan is in effect the outline of a long range program budget for the sector. It assumes at least an hypothetical re-organization of the current municipal budget.

The user pays principle can only be introduced gradually. The targets that have been used for cost recovery when calculating tariffs are shown in the following table.

Funding Asset Replacement

To ensure that the system is sustainable it is necessary to develop procedures that guaranteee that funds will be available when required to replace essential assets. The objective of this Masterplan is to make the municipal council responsible for asset replacement by 2010. The sources of funds will be:

(1) Upto 2005: By special grant from central Government (which the Central Govt will procure either as a loan or grant). In other words, the current system will continue

(2) From 2005 to 2010 From a combination of

- Municipal Asset Replacement Fund (to be established in 2005 – see below)

[3] Several alternative models for collection exist, some involving collection directly by local Governments, some involving collection by the central government on behalf of local government.

- From Grants received by Central Government and transferred to Municipal Council by special grant either in cash or kind
- Loans taken out by Central Government but treated as the responsibility of council both for payment of interest and repayment of capital

(3) After 2010. From a combination of

- Municipal Asset Replacement Fund (to be established in 2005 – see below)
- Loans taken out by Council

To ensure that these sources of funds are available the following steps will be necessary

- Tariffs to be increased to cover operating costs by 2005 and further to cover both operating costs and capital charges (depreciation and interest) by 2010
- Revenues surplus to cash operating costs to be paid into a special Municipal Asset Replacement Fund which should be established by 2005. Moneys in this fund can only be appropriated for the acquisition of new assets for the Municipality. (These surpluses should appear from 2005 onwards)
- Where assets are acquired through (foreign) grants, a notional depreciation charge (after 2005) and a notional interest charge (at 7% after 2010) is to be considered as part of the capital charges that should be included in the calculation of tariffs.
- Tariffs must be increased progressively over the 2005-2010 period so that by 2010 payments into the Municipal Asset Replacement Fund equal capital charges, including these notional charges
- In the case of the compost plant where the main beneficiary is the agricultural sector, not the municipality, the payment of the actual or notional capital charge should be made from the Budget Allocation of the Ministry of Agriculture. If this charge is paid by MoA, then it need not be included in the calculation of tariffs.
- From 2010, municipalities be granted the right to borrow funds, and be granted a Sovereign Guarantee by the Central Government as long as they meet various prudential requirements concerning their own finances and subject to a ceiling for the total of all loans for which such a guarantee is granted. This ceiling would be set annually by the Ministry of Finance in the light of general economic conditions.

The financial restructuring targets are shown in Table 10.1.1.

Table 10.1.1 Financial Restructuring Targets

Field	By year 2005	By year 2010
Budget structure	• Introduction of full program budgeting • Separation of collection and transfer/disposal budgets • (Reform of organization structures to conform with budgetary principles) • Formalization of all financial transfers to the municipality through grant agreements and/or revenue sharing arrangements • Transfer arrangements to be based on predictable formulas allowing forward planning	
Definition of tax base	• Integration of all schedules within the council of taxpayers liable to local taxes and charges • Improving accuracy of the master schedule to include at least 80% of persons and businesses liable for local taxes and charges	• Introduction of new land titling and building registration system to include 99% or better of all land owners and details of buildings thereon (national responsibility) • Transfer of master schedule for liabilities for local taxes and charges to the new land registration system
Tax collection procedures	• Strengthening of powers granted to local councils to ensure taxes and charges can be collected • Improvement of existing collection systems with a target collection rate of 90% of charges due according to the schedule	• Integration of all local collection procedures to ensure an "integrated account" presented to local taxpayers • Improved collection to ensure that 99% of taxes and charges payable according to master schedule are collected.
Revenue targets	• Revenues collected to cover cash operating costs (excluding interest) • Each user group to pay its share of costs, except low income residents (to be covered by special grant)	• Revenues collected to cover operating and capital costs • Revenues collected to cover capital costs (depreciation etc) to be paid into Asset Replacement Fund
Grant arrangements	• Subsidy for low-income households formalized • Five year agreement to cover grants for capital costs between municipality and central Government • Where capital is provided to municipalities by means of a foreign grant (either in cash or in kind) to the Central Government, the municipality will pay a depreciation charge into a special fund earmarked for asset replacement.	• Agreement for grants to cover capital costs to be replaced by agreement for Government Guarantee for borrowings by Council to fund new capital works • Municipal council will pay both a depreciation charge and a notional interest charge (calculated at 7%) on the value of all equipment provided through grants. These will be paid into a special fund earmarked for asset replacement.
Loan arrangements	• Loans for acquisition of equipment by municipalities to be arranged by Central Govt, but interest and capital repayments to be treated as responsibilities of the municipalities	• Arrangements finalized to allow municipalities to borrow funds for asset procurement under a guarantee issued by the Central Govt.

Tariff Structure

For residential areas. The implementation of the user-pays principle must take account of the practical difficulties of measuring usage of the service, especially where it is impracticable to meter the usage by individual households.[4] In some countries where communal containers are used, the charge per accommodation unit is based on the number of persons registered as living in this unit. In practice the records of residency are very inaccurate, and we do not recommend that Lattakia change to such a system. In practice it would complicate the calculation of charges payable, but would not make these charges any more representative.

The current structure of charges based on residences (varying according to location and street frontage) is considered appropriate. It is in the opinion of the team a realistic compromise between administrative simplicity, equity and predictions of use by individual residences. [5]

We therefore recommend that the relativities implicit in Decree 17 are retained and that all these rates are increased by the same percentage. The financial plan therefore is concerned only with average charges. The recalculation of Decree 17 and associated schedules is left to the local side.

For commercial and Industrial users. There is a very large variation in the size of these establishments. The application of the current system seems to be quite arbitrary for large enterprises. We therefore recommend the introduction of a dual system:

- For large enterprises who have dedicated waste containers for their own use; These should be charged according to the number of containers emptied by the council.[6] To encourage source separation lower charges may be levied for containers for separated wastes, but penalties applied if separation standards are not met.
- For smaller enterprises who use communal containers, the current system will have to be maintained.

Application of Tariff Principles and Targets

The application of these principles and targets is illustrated in the following three tables. These tables contain projections of the Lattakia City Budget on the Assumption that Alternative I is adopted. If one of the other Alternatives is adopted substantially higher tariffs will be needed, and larger grants and loans from the Central Government to the municipality will be required.

The revenue targets and cash flow (Lattakia only recurrent budget) are shown in Table 10.1.2 and Table 10.1.3, respectively.

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[4] In systems where each household is issued with its own container(s) then charges can be based on the number of containers emptied for each household. This is not practicable where communal containers are used.

[5] The current manual records were not in a form amenable to analysis by the external consultants. In any case Decree 17 will have to be updated once the city starts to update the records of all residences in the city.

[6] Existing health regulations may need to be revised to ensure that the Health Department has appropriate powers to require large enterprises to accept a sufficient number of containers.

Table 10.1.2 Revenue Targets

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	*Total cost recovery long term (incl interest)*	
Population	366,000	374,784	383,779	392,990	402,421	412,079	421,969	432,097	442,467	453,086		
Household size	6	6	6	6	6	6	6	6	6	6		
Number of households	61,000	62,464	63,963	65,498	67,070	68,680	70,328	72,016	73,744	75,514		
Propn in tax base	65%	69%	73%	76%	80%	92%	94%	95%	97%	99%		
Households in tax base	39,650	42,944	46,373	49,942	53,656	63,048	65,827	68,703	71,680	74,759		
Proportion paying	65%	71%	78%	84%	90%	92%	94%	95%	97%	99%		
Number paying	25,773	30,598	35,939	41,827	48,291	57,878	61,614	65,543	69,673	74,012		
Average charge	150	180	216	259	311	373	448	537	645	774		
max incr 20% p.a.												
Collected	3,865,875	5,507,568	7,762,886	10,841,500	15,020,293	21,602,921	27,596,881	35,227,860	44,936,914	57,282,545		
Target	*50,373,926*	*47,088,422*	*47,199,730*	*45,496,438*	*46,035,605*	*51,869,805*	*51,403,395*	*54,627,326*	*55,532,998*	*63,612,427*	*98,774,502*	
Businesses in City	18,000	18,360	18,727	19,102	19,484	19,873	20,271	20,676	21,090	21,512		
Proportion in tax base	79%	82%	85%	87%	90%	92%	94%	95%	97%	99%		
Businesses registered	14,259	15,039	15,845	16,677	17,535	18,244	18,974	19,725	20,499	21,297		
Proportion paying	65%	71%	77%	84%	90%	92%	94%	95%	97%	99%		
Number paying	9,208	10,667	12,246	13,949	15,782	16,748	17,759	18,818	19,925	21,084		
Average charge	3,106	3,106	3,106	3,106	3,106	3,106	3,106	3,106	3,106	3,106		
Collected	28,600,000	33,134,034	38,037,342	43,326,870	49,020,171	52,020,598	55,162,234	58,450,344	61,890,362	65,487,898		
Target	*17,395,313*	*16,260,750*	*16,299,188*	*15,711,000*	*15,897,188*	*17,911,875*	*17,750,813*	*18,864,113*	*19,176,863*	*21,966,881*	*34,109,181*	
Tipping Fees - other cities	0	0	0	0	0	4,204,957	4,231,371	4,241,613	5,008,430	5,016,246		
Total fees collected Lattakia	32,465,875	38,641,602	45,800,228	54,168,370	64,040,464	77,828,475	86,990,486	97,919,817	111,835,705	127,786,690		
ALTERNATIVE I												
O&M	92,775,000	86,724,000	86,929,000	83,792,000	84,785,000	91,212,000	90,353,000	91,775,000	91,551,000	92,122,000		
Capital	0	213,619,000	13,200,000	30,360,000	157,612,000	43,180,000	0	45,156,000	18,920,000	143,091,000		
Target O&M plus depn of 10%	92,775,000	86,724,000	86,929,000	83,792,000	84,785,000	95,530,000	94,671,000	100,608,600	102,276,600	117,156,700		
on assets acquired from 2005									*Long term target (incl interest)*		*181,915,630*	
Attributed												
Lattakia Domestic 278/512	50,373,926	47,088,422	47,199,730	45,496,438	46,035,605	51,869,805	51,403,395	54,627,326	55,532,998	63,612,427	*98,774,502*	
Lattakia Commercial 96/512	17,395,313	16,260,750	16,299,188	15,711,000	15,897,188	17,911,875	17,750,813	18,864,113	19,176,863	21,966,881	*34,109,181*	
New Disposal site												
O&M	0	0	0	0	0	4,548,000	4,568,000	4,606,000	4,647,000	4,676,000		
Capital	0	0	0	0	110,530,000	780,000	0	28,040,000	0	121,771,000		
O&M plus depn 10%					0	15,601,000	15,699,000	15,737,000	18,582,000	18,611,000		
attrib to other cities *138/512					0	4,204,957	4,231,371	4,241,613	5,008,430	5,016,246		

Table 10.1.3 Cash Flow – Lattakia Only Recurrent Budget

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
memo items											
Collection - Lattakia											
O&M	67,769,238	59,732,621	60,693,918	58,378,332	59,087,617	63,305,344	62,663,262	63,674,230	63,480,656	63,876,570	
Capital	0	56,699,000	8,800,000	30,360,000	39,416,000	22,000,000	0	11,730,000	8,800,000	8,800,000	
Disposal											
O&M	0	4,951,000	3,840,000	3,873,000	3,895,000	4,548,000	4,568,000	4,606,000	4,647,000	4,676,000	
Capital	0	108,920,000	0	0	110,530,000	780,000	0	28,040,000	0	121,771,000	
RECURRENT BUDGET SWM Program											
Revenues											
Fees - Households	3,865,875	5,507,568	7,762,886	10,841,500	15,020,293	21,602,921	27,596,881	35,227,860	44,936,914	57,282,545	
less rebate Low Income			-143,757	-619,036	-1,340,546	-2,506,820	-3,818,507	-5,529,815	-7,750,599	-10,620,056	
Fees - Commercial	28,600,000	33,134,034	38,037,342	43,326,870	49,020,171	52,020,598	55,162,234	58,450,344	61,890,362	65,487,898	
Fees - tipping	0	0	0	0	0	4,204,957	4,231,371	4,241,613	5,008,430	5,016,246	
Total Fees collected	32,465,875	38,641,602	45,656,471	53,549,333	62,699,918	75,321,655	83,171,979	92,390,002	104,085,107	117,166,634	
Subsidy for low income fr Central Govt	0	0	143,757	619,036	1,340,546	2,506,820	3,818,507	5,529,815	7,750,599	10,620,056	
Transfer from Gen Mun. Budget or special grant from Central Govt	35,303,363	26,042,019	18,733,690	8,082,962							
	67,769,238	64,683,621	64,533,918	62,251,332	64,040,464	77,828,475	86,990,486	97,919,817	111,835,705	127,786,690	
Expenses											
O&M collection	67,769,238	59,732,621	60,693,918	58,378,332	59,087,617	63,305,344	62,663,262	63,674,230	63,480,656	63,876,570	
O&M disposal	0	4,951,000	3,840,000	3,873,000	3,895,000	4,548,000	4,568,000	4,606,000	4,647,000	4,676,000	
Interest on loans	0	0	0	0	0	0	0	0	0	0	
Transfer to Asset Replacement Fund					1,057,847	9,975,132	19,759,225	29,639,586	43,708,049	59,234,119	
	67,769,238	64,683,621	64,533,918	62,251,332	64,040,464	77,828,475	86,990,486	97,919,817	111,835,705	127,786,690	
ASSET REPLACEMENT FUND											
Opening Balance					0	1,057,847	11,032,978	30,792,203	20,661,789	55,569,838	
Transfers in from Recurrent Budget					1,057,847	9,975,132	19,759,225	29,639,586	43,708,049	59,234,119	
Transfers out to Capital Budget					0	0	0	-39,770,000	-8,800,000	-50,000,000	
Closing Balance					1,057,847	11,032,978	30,792,203	20,661,789	55,569,838	64,803,958	
CAPITAL BUDGET SWM program											
Revenue											*Totals*
Grants from Central Govt		165,619,000	8,800,000	30,360,000	149,946,000	22,780,000	0				*377,505,000*
Loans from Central Govt											*0*
Loans in name of Municipality										80,571,000	*80,571,000*
transfers from Asset Replacement Fund								39,770,000	8,800,000	50,000,000	*98,570,000*
	0	165,619,000	8,800,000	30,360,000	149,946,000	22,780,000	0	39,770,000	8,800,000	130,571,000	
Expenditure											
Disposal Site	0	108,920,000	0	0	110,530,000	780,000	0	28,040,000	0	121,771,000	
Collection	0	56,699,000	8,800,000	30,360,000	39,416,000	22,000,000	0	11,730,000	8,800,000	8,800,000	
	0	165,619,000	8,800,000	30,360,000	149,946,000	22,780,000	0	39,770,000	8,800,000	130,571,000	

Currently there is massive cross subsidization of households by commercial users of the SWM system. This requires massive rises in domestic tariffs. There are political limits to how rapidly these tariffs can be increased, and these will eventually have to be determined by the local side. To illustrate these principles we have limited annual tariff rises to 20%.

Targets

In the tables above, the revenues that would need to be collected to meet the targets set in Table 1.7.25 are shown in italics. These targets are

- Covering O&M costs by 2005
- Covering O&M plus some capital costs by 2010. (This has been interpreted as 10% depreciation only on those assets acquired post 2005)
- Covering all O&M and full capital costs after 2010. (This has been interpreted as 10% depreciation on existing assets and 7% interest on outstanding loans. The total capital expenditure over the ten year period 2001-2010 has been taken as an estimate of the average book value of assets before depreciation in the long term {say post 2020). The value of loans outstanding has been assumed to be half of the original cost of this equipment.

Even allowing domestic tariffs to rise 20% each year collections still do not reach the target by 2010. Hence tariffs for commercial users have been kept constant even though the total collections (assuming the targets to improve compliance are successful) will exceed the target for this group. As a result some cross-subsidization continues, (though at a lower rate), but total collections are closer to the long term target.

Subsidies to Users from Low income housing areas

The rapid rise in tariffs would affect low income families adversely, and so an explicit scheme to subsidize low income users has been assumed. This would be funded by the Central Government. The details of this scheme have been left to the local side to determine, but for the purposes of financial modeling, it is assumed that:

- 25% of households will be covered by the scheme
- For these households the charge will be capped at 200 SYP/ year

In the table showing Revenue targets (1.7.26) the subsidy is not shown. The revenue collected from households is assumed to include the subsidy from the Government. However in the table illustrating the Recurrent Budget (1.7.27) this subsidy is shown explicitly.

Capital Budget

The projections above are based on Alternative I. If the City can adjust tariffs and improve collection rates as rapidly as shown in Table 1.7.26 – 28, then the city can take responsibility for Capital and Recurrent Budgets after 2010. Similarly if Alternative II is chosen, the city should be able to assume responsibility for both budgets, although its financial position will not be quite as good.

However if Alternatives III or IV are chosen, then the city will not be capable of assuming responsibility for these budgets in 2010. It will require substantial subsidies from the Ministry of Agriculture, and we await the views of the Steering Committee on the possibility of establishing such a long term commitment.

10.2 ECONOMIC ISSUES

This section is concerned with the economic rather than financial issues surrounding various projects, especially compost plants identified both in the Masterplan for Lattakia and surrounding cities presented in this report and in the Masterplan already prepared for Homs city.[7] Financial aspects of the Masterplan for Lattakia are dealt with in Section 1.7.11

Sanitary Land-fill – the base case

The Masterplan's basic strategy is the introduction of a minimum cost but effective collection system with disposal of all waste in a sanitary landfill. (The location of the potential disposal sites will require the use of a transfer station(s) to consolidate loads). The Masterplan calls for the introduction of intermediate processing only when this can be economically and financially justified.

This is identical to the basic strategy proposed for the City of Homs. In both cases these strategies involve additional costs when compared to existing systems. Most of these additional costs are for the conversion from open dumping to sanitary landfill.

The conversion from open dumping to sanitary land-fill creates very significant public health and environmental benefits which are much greater than the costs, though these benefits are extremely difficult to quantify. It is almost universally accepted that sanitary landfill provides the minimum level of treatment required to guarantee public health. Hence it is usual to regard sanitary landfill as an essential service, and to design management systems to minimize its overall cost, rather than try to calculate a benefit-cost ratio.

Hence in this report we have not tried to measure the benefits of changing to sanitary landfill, but rather have assumed that sanitary land-fill is the base case. Cost-benefit analyses of other intermediate processing options are measured relative to sanitary landfill as the base case, not relative to the existing open dumping system.

Economic/Environmental effects of Compost plants.

The effects of a compost plant from an economic perspective may be treated in three groups:

Municipal

For the Municipality the main effects are already captured in the financial analysis. The establishment of a compost plant requires upgrading of the collection system to either separate the waste at source or through some sorting process before waste is fed into the composting system proper. However this is managed, significant additional costs must be incurred in waste collection and handling, and these costs must be included as a debit in an economic evaluation of a compost plant.

[7] Masterplan for SWM in Homs City prepared by COWI Consultants and funded by METAP. Current Version is Final Draft, last revised December 2000.

In some countries it has been possible through various waste management policies to force waste generators to incur most of these additional costs directly. This has helped to improve the financial viability of compost plants in these countries. In the master plans for Lattakia and Homs no practical way of shifting these costs directly to generators could be found, and hence these costs are borne initially by the Municipality. Hence they are included already in the financial evaluation of the masterplans. However even if these costs could be shifted directly to the waste generators, they would remain a cost that had to be included in the economic evaluation.

The reduction in volumes of waste that must be sent to landfill is often mentioned as a benefit of a compost plant. This results in two benefit streams. First there is a reduction in the cost of land-fill operations. This has already been calculated in the financial evaluation of the Masterplan, but it should be noted that these savings are small compared with the costs of operation of the compost plant. Secondly the reduction in the size of land-fills is seen as an environmental benefit and is discussed in the next section.

Environmental Effects

Undoubtedly treatment of wastes in a compost plant offer substantial environmental benefits compared to the current system of open dumping. However the base case for the Masterplan is sanitary landfill. In estimating the environmental benefits of additional intermediate processing, we must compare the operation of the proposed compost plant and the associated sanitary landfill which receives the remaining solid wastes, with a larger sanitary landfill which receives all the solid wastes.

Currently the dumping of wastes at Al Basra causes a massive loss of amenity by destroying the visual attractiveness of what was potentially a major tourist area. The real culprit however is not the absence of composting facilities, but the choice (probably by default) of an inappropriate site. Once landfill is transferred to an appropriate location and is conducted properly, the visual impact will be minimal and the benefits of reducing the volume dumped will then be very small.

If both sanitary landfill and compost plants are operated properly there appears to be very little difference in the overall environmental impact,[8] except for the beneficial impact of the compost on agricultural lands included under agricultural benefits.

Unfortunately there is a significant risk[9] that in future insufficient funds will be assigned for the operation of the SWM system, resulting in improper operation of parts

[8] Reduction in Greenhouse Gases is sometimes mentioned as an environmental benefit of composting. However the net benefit is tiny. The decomposition process in compost making is aerobic (takes place in the presence of air) while the decomposition process in landfill in and landfill is anaerobic (it occurs in the absence of air. Hence the mixture of gases produced is different, but after allowing for their different reactivity as greenhouse gases (Methane is far more reactive than carbon dioxide) the net difference in greenhouse gas emissions is only 0.07kg of CO_2 equivalent per ton of waste treated or say 0.2 kg of CO_2 equivalent per ton of compost produced Assigning a value of $25 per ton per ton of CO_2 equivalent saved (This figure is taken from prices ruling in the emerging tradeable emissions markets) the value is about SYP 0.25 (less than $US 0.01) per ton of compost produced.

[9] This risk is discussed at more length in the section project risks. A review of budgets over the past decade show that no major city in Syria has been able to provide sufficient funds for the proper operations of its SWM system. The area that has been most adversely affected is final disposal

of the system. As the sales of compost will not cover the cash operating costs of the compost plants, the shortage of budget funds for its operation is a significant risk.

Operational failures in the collection/separation system or composting plant could result in undesirable pollutants entering the compost stream.

Agricultural

The use of compost on agricultural lands potentially can increase the value of agricultural output significantly, and in the longer term improve the soil condition reducing the risk of turning marginal agricultural land into desert. The realization of many of these benefits however will depend on quite significant policy changes in the Agricultural and Irrigation sectors.

In the base case it is assumed that current agricultural policies remain unchanged. In the evaluation of the benefits of the compost plant, two scenarios are considered; first with no change in current agricultural land and secondly with significant changes in agricultural policy towards land use and water use.

Before discussing these benefits in detail, we would remark that a municipal SWM project would not normally become involved in such major policy issues in Agriculture. The importance of such policies to the success of a compost plant project points to the need for changes in the institutional structure underpinning a compost project. There is a need for Agriculture to take an active role in promoting the project. Indeed the municipal authorities should not embark on major compost plants until the Ministry of Agriculture decides to provide active and substantial support for the project. This should include a subsidy to promote compost use. This could be provided either as a subsidy for the purchase of compost or a direct subsidy to the municipal bodies for the operation of plants allowing the compost to be priced at a level acceptable to farmers.

The value of compost to Agriculture Normally the economic valuation of an agricultural input would be based on agricultural trails of the input. These would normally involve fairly complex statistical controls to try to isolate the technical linkages and effects of individual inputs. The agronomy involved may be quite complex, but the final economic evaluation relatively simple.

Unfortunately no significant controlled agricultural experiments on the use of compost have been conducted in Syria, and so a more theoretical approach must be taken to estimate the benefits. This is outlined below, both to show how the potential benefits have been calculated and also to illustrate the very considerable uncertainty that must be attached to these estimates given the total absence of local data on the effects of compost.

Effects of Compost, along with animal manure, is usually referred to as an organic fertilizer[10]. It has three main effects on crops:

- Provides additional nutrients to plants (particularly Nitrogen and Phosphorus)
- By improving the physical structure of the soil promotes stronger root growth

[10] The practice of planting legumes (which fix atmospheric Nitrogen) and then ploughing the crop in could also be included in this category.

- By improving the physical structure of the soil improves moisture retention.

Manure has similar, but quantitatively different, effects)

A nutrient provider. Organic fertilizers deliver nutrients to plants rather differently from chemical fertilizers. Chemical fertilizers usually dissolve quite quickly in the soil moisture into forms useable by plants. However these chemicals can be washed out of the root zone quite quickly making them unavailable to plants. Organic fertilizers on the other hand only break down slowly in the soil, and not all the nutrients may be released during a single crop cycle. On the other hand far less of these nutrients is likely to be flushed out of the root zone. Usage patterns for fertilizers may therefore be different, with chemical fertilizers applied several times in small doses during crop growth while organic fertilizers may be applied just once during soil preparation.

When organic and chemical fertilizers are used together the effects may be greater than the sum of their separate effects. This can occur as the organic fertilizer may help retain the chemical fertilizer in the root zone, reducing the loss through flushing.

Thus it is impossible to produce a simple but accurate relationship between chemical and organic fertilizers even as providers of nutrients. The relationship depends on the type of crop, local soil conditions, climate, irrigation procedures and other factors (hence the need for local agricultural research to determine the best methods and patterns of application).

For the purposes of this evaluation, we have had to assume that organic and inorganic fertilizers deliver the same proportion of their nutrients during a crop cycle and that these nutrients have an identical effect on the crop. The economic value assigned to compost as a provider of plant nutrients can therefore easily be calculated as the cost of an equivalent quantity of chemical fertilizers containing the same quantities of basic nutrients.[11]

However a further complication is created by the fact that the proportion of the three key nutrients, Nitrogen, Phosphorus and Potassium in compost cannot be altered. The optimal balance of nutrients varies greatly with soil conditions and types of crops, and any detailed program by the Ministry of Agriculture to promote compost use will need to carry out considerable research and analysis of local conditions. The best guide available is the balance of fertilizers currently used by farmers. The following table identifies fertilizer use by farmers over the past five years.[12]

The aggregate fertilizer use (1996 – 2000) is shown in Table 10.2.1.

If there was no other way of generating this additional growth then indeed the (economic) value of the compost would be set by the value of the additional crops. However the economic value cannot exceed the cost of the most effective method of generating this additional value. In this case there is a plentiful supply of chemical fertilizer, and so the economic value cannot exceed the cost of the chemical fertilizer needed to achieve the same effect, even though this is less than the value of the additional production. In other words economic value measures values when the most efficient production process is employed. Note however that even though a similar effect might be achieved even more cheaply with manure, there is insufficient manure to meet all fertilizer needs. Hence at the margin additional crops have to be generated via using chemical fertilizer rather than manure. Thus the value of the compost must be compared to the cost of the chemical fertilizer, not manure which is, at least hypothetically, already fully used.

[12] There are significant discrepancies between these figures and those reported by the Ministry of Agriculture in the National Statistics which remain unexplained

Table 10.2.1 Aggregate Fertilizer Use 1996-2000 Fertilizer supplied to co-operatives through Agricultural Bank

Fertilizer	Tons supplied	Nutrient	Tons	Ratio nutrient
Urea	20,342	N	20,013	100
NH_4NO_3 (33%N)	18,919			
NH_4NO_3 (30%N)	14,708			
Super-phosphate	10,244	P_2O_5	4,712	24
K_2SO_4	4,414	K_2O	1,457	7

Source: Farmers Union

The best guide to the composition of compost expected in Lattakia and Homs is the composition of compost currently produced in Damascus. The waste stream in Damascus is likely to be similar to the waste streams in other cities in Syria.

The composition of compost shown in the following table is the average of only two samples from the Damascus plant. The proportions of N and K in the two samples were similar and consistent with analyses of samples from Alexandria, Egypt. The content of P varied greatly (from 0.6% to 1.6%) and was rather lower than the proportion from samples in Alexandria(1.72). This uncertainty has little effect on the economic valuation as some of the P present in compost is probably surplus to requirements in many soils in Syria.

The proportion of nutrients present in the compost that can be used will vary according to soil type and crop type. Current fertilizer usage indicates that soils are typically poor in N and so it is expected that in most applications, all the N present in the compost will be used by the plants, though possibly for some legume crops some of the N will be superfluous. For a significant number of crops in some Syrian soils, some of the P present in the compost will be superfluous to requirements, but if the compost is used in association with chemical fertilizers to supply additional N then most of the P can probably be used. (Research however is needed to determine how best to combine the use of chemical fertilizer and compost under local conditions.)

If the current practice of farmers is rational, then it would appear that soils in Syria are typically rich in K, and that little of the K present in the compost will be beneficial to plants. There will of course be exceptions – areas deficient in K and crops that have a high requirement for K where all the K present in the compost is likely to be used. But in many cases probably less than 10% of the K will be useful to plants. Thus the value of the nutrients in the compost will vary widely depending on soil condition and crop type, and so the following table provides an estimate of the typical value, and the maximum value where all nutrients are useful to the plants.

The nutrient content, chemical equipments and economic valuation nutrient value are shown in Table 10.2.2 and Table 10.2.3, respectively.

Table 10.2.2 Nutrient Content and chemical equivalences Per ton of compost

Nutrient	Kg	Equivalent Fertilizer Type	Kg	Useable Typical (kg)	Maximum (kg)
N	9.9	Urea	21.5	21.5	21.5
P_2O_5	11.1	Super-phosphate	24	24	24
K_2O	11.0	K_2SO_4	33	3	33

Source: Ministry of Agriculture and Study Team

Table 10.2.3 Economic Valuation Nutrient value of 1 ton of compost

(in SYP)

Chemical	Price		Valuation (typical)		Valuation (maximum)	
	Local	World	Local prices	World prices	Local prices	World prices
Urea	7.7	4.8	165	103	165	103
Super-phosphate	8.3	6.8	199	163	199	163
K_2SO_4	12.1	4.3	36	13	399	142
Total			400	279	763	408

Source: World Bank, Central Statistical Bureau

An economic valuation should be based on world prices for tradeable commodities as these represent the economic or overall resource costs to the local economy. However world prices for fertilizers are highly cyclic and are currently fairly depressed. Properly then these should be adjusted to reflect the average predicted over the period of the study. Given the shortage of time and the extreme uncertainty in other aspects of these estimates, it is reasonable to take the value based on local prices (which are far more stable) as a first approximation.

As a soil improver, in addition to providing nutrients, compost improves the physical structure of the soil, promoting better root growth in turn supporting higher crop yields. It also helps the soil retain moisture reducing the amount of water that needs to be applied to support optimal growth. The size of these effects depend critically on soil type and previous condition, weather, type of crop, cultivation practices and many other factors.

The alternatives to compost for improving the structure of the soil are the use of manure, peat moss, the growing of legumes for ploughing back into the soil and leaving fields fallow for a season. Manure is widely accepted and used in Syria, but supplies do not meet demand. Hence it cannot be used as a benchmark to value compost. Peat moss is so expensive that widespread use is hard to justify. It is generally accepted that compost use is economically more effective than ploughing back legume crops or leaving fields fallow. Hence the appropriate way to value the compost is by the increase in crop yield. From the gross increase in yield must be subtracted the effect of additional nutrients that could be supplied more cheaply using chemical fertilizers. (This component was valued above by equating it to the cost of the (chemical) fertilizer).

Unfortunately hardly any local research has been carried out either to estimate the scale of these effects or to determine appropriate cultivation practices to maximize effectiveness under Syrian conditions.

There are very few reports of controlled experiments on the use of compost, and of these few provide for controls against no treatment and treatment with an equivalent quantity of chemical fertilizer. As a result it is necessary to extrapolate from results of experiments with manure.

Of these the most comprehensive is a report of long term experiments at Bahteem[13], which reports that after continuous application of organic fertilizer for 43 years, average crop yields (averaged over three years) increased by 112% when compared to the

[13] Taha et al; (1966)

control group with no treatment, and by 49% compared to a control group treated with chemical fertilizer only. Dosage details are incomplete.

The following table, Table 10.2.4, summarizes results of another experiment with manure in Egypt

Table 10.2.4 Effect of Prolonged Application of Chemical and Organic Manures on Crop Yields (Evaluation of Results 1919-1955) Values given as % of Control Group

Crop	Control	Mineral Fertilizers		Manure	
		Nitrogen	Nitrogen + Phosphorus	Relative to control	Relative to N+P
Cotton	100	143	188	181	96
Wheat	100	147	192	264	138
Maize	100	155	229	245	107
Clover	100	100	265	437	165

Source: Alaa El-Din et al (1983)

Reports from Japan[14] indicate a generally lower response from the application of organic fertilizers, as might be expected given the very different soil and climatic conditions, but are helpful in comparing the effect of compost and manure. These experiments show a similar response under Japanese conditions providing some justification for extrapolating projections for compost from Egyptian results for manure.

These Japanese results also show similar effects from the regular application of 2 tons per hectare before planting of each crop, and the one-off application of 16 tons per hectare. While the full details of dosage rates in the Egyptian experiments are not yet available, we have assumed that the long term application is equivalent to an one off application of 16 tons/hectare. (This is also similar to recommended application rates in the JICA study of the Alexandria Compost plant of between 15 and 25 tons depending on crop.)

The Japanese results show much less variability in effects on different crops than the Egyptian results. This may be due to the different soil and climatic conditions or might reflect the difficulty in determining effects even in properly controlled experiments. In any case they indicate an urgent need to examine effects with local studies in Syria.

To identify the possible scale of benefits, pending detailed research in Syria under local conditions, we have assumed that a single application of 20 tons/ha on poor soils will increase crop yields by 20% as a result of the improved soil condition, or 1% per ton/hectare. (This is additional to the effect of the nutrients contained in the compost.) The gross value of this additional yield is the economic benefit derived from the compost, as it is assumed that no other additional expenses are associated with using the compost to generate additional output (except where otherwise noted).

In areas where there the soil is already in good condition and has a high organic content , one would expect that the effect is far less pronounced. This is undoubtedly

[14] "Yukibutsu Seyoo no Riron to Oyo" (Theory and Application for Utilization of Organic Materials) issued by Nosan Gyoson Bunka Kyokai (Cultural Association of Agricultural and Fishing Communities) NGBK, Japan, 1973

the main reason for the large differences in results reported in Egyptian and Japanese controlled experiments. At this stage therefore we cannot even provide an estimate for the effects in the richer soil areas which are currently providing most of the output of vegetables sold in local markets. It must also be noted that substantial increase in yields of these crops will also be associated with additional expenses for cultivation, picking and handling of the crop. These costs can only be determined after a detailed examination of farm budgets.

Table 10.2.5 shows the agriculture yields in value in Syria.

Table 10.2.5 Agricultural Yields in Value terms For typical crops in Syria

Crop	Yield t/ha Av 1995-9	Local farm- gate price SYP/t	World Price SYP/t	Value/ha SYP
Irrigated crops				
Tomato	32.78	10,000		327,800
Potato	19.05	5,000		95,255
Cucumbers	19.92	15,000		298,800
Cotton	3.56	30,750		109,470
Rainfed crops				
Wheat	1.83	11,300	5,500	10,065
Barley	1.26	7,000	4,300	5,418
Lentil	0.58	17,000		9,860
Chick peas	1.12	17,800		19,936
Tomato	11.74	10,000		
Potato	10.97	5,000		
Cucumbers	-			

Source: Ministry of Agriculture; Central Bureau of Statistics; Interviews

Thus we would conclude that the economic benefit of the compost as a soil improver in areas where only cereal crops can be grown, is of the order of 100 to 200 Syrian Pounds per ton of compost.

For high value crops such as vegetables the economic benefits are potentially larger, possibly even of the order of 1000 SYP/ton or more. The upside however is capped by the potential to divert manure to better uses. While all available manure in Syria is apparently already being used, it is far from clear that this is being used to the maximum advantage. Manure and compost are in economic terms substitutable products, and so properly speaking the production of additional compost should be viewed as increasing the total supply of organic fertilizer which in aggregate should be directed to the highest value uses. In the absence of additional supplies of compost, rational planning would require the diversion of manure from some of its current applications to any applications where the value of organic fertilizers is extremely high. The true value of additional supplies (either of compost or manure) then are the value in these applications from which the manure was temporarily diverted. This certainly caps the value that can be assigned for compost even in the case of very high value crops.

Reduction in water requirements. The conditioning of the soil also improves water retention, reducing the amount of water that needs to be applied to stimulate growth. For crops that are rainfed this basically allows them to survive better during dry periods. The effect on plant growth has already been captured above.

For irrigated crops however, the reduced needs for water allow a reduction in the amount of water used in existing fields. This potentially can release water (a scarce resource in many parts of Syria) for the irrigation of additional areas. This can create additional benefits. However it is unlikely that these benefits will be realized until there is a change in policy and pricing principles for water to encourage farmers to treat it as a scarce resource.

In many areas the availability of water limits the area that can be irrigated, and is the most critical constraint on the expansion of agricultural output. Where this constraint can be relaxed, any additional economic surplus can be attributed to relaxing of this the most critical constraint. The economic benefit is not the total value of the additional production, as other economic costs must be incurred in making this additional production. Properly speaking the benefit is the producer surplus from this production.[15]

There are few reported results on the effect of compost on water requirements.[16] The most relevant is from a trail in the United Arab Emirates where the application of 18.8 tons per hectare of compost on sandy soils resulted in the reduction in water use of between 18% and 63%, depending on the crop type. These reductions in water use would allow an increase in the area irrigated by the same water of between 22% and 270%. The sandy soils of the near desert regions of the UAE might be expected to show some of the largest benefits from the addition of compost.

Simply to illustrate possible effects, we have taken a figure of 30% for the increase in area that can be cultivated. Given the application rate this means that 1 ton of compost is attributed to adding 0.016 ha to the area that can be irrigated. The gross value of production from this area will of course again depend on the crop and many other considerations. In the areas where water retention is a real issue, the potential for vegetable crops is probably limited. Growing of low value crops such as cereals in such conditions cannot be economically justified, and so we would base estimates of potential benefits on medium value industrial crops such as cotton. Again for illustration we have taken a figure of 100,000 SYP/ha as an average value of production per hectare (see Table x) so the additional gross production might be valued at 1600 SYP.

The producer surplus from this gross production level is unlikely to exceed 15% or 240 SYP[17].

Therefore in the short term therefore it would be imprudent to assume an economic benefit from better water retention of higher than 240 SYP per ton of compost. Of course in the longer term once a research program has established the areas and crops

[15] Some evaluations have attempted to quantify this benefit by estimating the costs saved by the opportunity to reduce the size of irrigation reticulation systems. This approach is inappropriate as all investment in irrigation systems are sunk costs (both literally and in an economic sense). It is therefore impossible to realize actual savings here.

[16] Unfortunately in countries with significant agricultural research programs either the priority for water retention is relatively low (e.g. Japan) or widespread use of compost is impracticable due to large distances between generation and use points (e.g. Australia)

[17] To determine this figure accurately farm budget would need to be analysed in detail. This figure of 20% has been taken from general economic considerations, on the assumption that the allocation of resources in the sector is fairly rational. Of course it is possible that some very attractive production options have not been recognized to date by the farming community, and in this case an even higher figure might be possible. Given the historically high level of price intervention in the sector this possibility cannot be discounted.

which will receive the most benefit, a much higher figure might be achieved. While it is pure speculation it seems possible that this figure could rise to 1000SYP a ton or even more in arid areas reliant on limited groundwater supplies for irrigation. However realization of such high benefits would also require a complete change in the approach to crop selection, with the key selection criteria being the value created per litre of water used. This would see the abandonment of current policies that allow low value crops such as wheat to be grown in these regions.

Effects on salination. Reducing water use can help reduce the salination of land in some circumstances.[18] However under Syrian conditions, where water tables generally are dropping, it is believed, pending more scientific research, that this effect is minimal.

[18] For example in Australia where there are large irrigated areas fed with surface water diverted from catchments hundreds or thousands of kilometres distant, heavy use of irrigation water has led to a rise in water tables and salination problems where salt has been dissolved by this rising groundwater. The water circulation patterns in aquifers in Syria however appear to follow quite different patterns.

SECTION 11

PUBLIC AWARENESS AND COMMUNITY PARTICIPATION

SECTION 11 PUBLIC AWARENESS AND COMMUNITY PARTICIPATION

11.1 SURVEY LOCATIONS

11.1.1 Lattakia City

The survey in *Lattakia* City took place on 10th and 11th of February 2001. The survey included households (High, Middle and Low Incomes), the commercial and medical establishments as follows:

(1) Households

- **1st day: 10th February 2001:** 140 samples were surveyed in the *Middle Income Areas* of *Al Jamhuria* St., *Syria* St., 8th of March St. and the surrounding lanes and avenues.
- **2nd day: 11th February 2001:** 120 samples were surveyed in the *Low Income Area* of *Al-Ramel* Camp, the City Center and *Hay Al-Zeraa* (*Al-Reji*). In addition, 45 samples were surveyed in *High-Income areas* of *Al Sewar* and *Al Amercan* St. and the surroundings.

(2) Commercial and Business Establishments

- **2nd day: 11th February 2001:** The survey was done in this day for 18 commercial and business establishments as shown in Table 11.1.1.

Table 11.1.1 List of the Commercial Establishment (*Lattakia* City)

Commercial Activity	Address
Al Nur Hotel (Two stars) (*)	14 Ramadan St.- Al Sheikh Daher
Riviera Hotel (Four stars) (*)	Al Sheikh Daher
Restaurant (Al Siwar)	Southern Cornaich
Restaurant (Spiro)	City Council / Al Cornaich
8 Retailers (Chicken, meat, fish, grocery, …etc)	Market
Photo shop	Ogarit Square
Tailor	Al Kamlieh
3 Handcrafts	Market/Ogarit St.
Garments Shop	Bazar St.

Note:(*) As classified by Ministry of Tourism

(3) Medical Establishments

- **2nd day: 11th February 2001:** The survey was done in this day for 9 Medical Establishments as shown in Table 11.1.2.

Table 11.1.2 List of the Medical Establishments (Lattakia)

Medical Establishment	Address	Status
The National Hospital	Baghdad St.	Public
Al Slaybeh Clinic	Al Slaybeh	Public
Escenturi Clinic	Escenturi	Public
Al Hekmeh Laboratory for medical and hormones analysis	Al Amercan St.	Private
Central Hospital	8 March St.	Private
Al Assad Hospital	8 March St.	Public

Medical Establishment	Address	Status
A medical analytical laboratory	8 March St.	Private
Al Tabiat Hospital	Al Tabiat	Private
Al Razi Hospital	Baghdad St.	Private

11.1.2 Jableh City

The survey in *Jableh* City took place on 12th of February 2001. The survey included households (High, Middle and Low Income), commercial establishments and medical Establishments as follows:

(1) Households

- **12th of February 2001:** 50 samples were surveyed in the *Middle Income Areas* of *Al Amara*, *Al Ezzi* and *Jub Juikha* and the surroundings. In addition, 49 samples were surveyed in the *Low Income Area* of *Al-Malek Faisal*, *Al Zawia* and *Al Faid.* And 20 samples were surveyed in *High-Income areas* of *Al Jammiat* and *Al Villat* and the surroundings.

(2) Commercial Establishments

- **12th February 2001,** Survey was done on this day for 6 commercial establishments as shown Table 11.1.3.

Table 11.1.3 List of the Commercial Establishment (*Jableh* City)

Commercial Activity	Address
Restaurant (Sadfeh al zuzu)	Northern Cornaich
Restaurant (Mureb)	Southern Cornaich
Stationary shop	Al Zawieh St.
Grocery Shop	Al Minaa St.
Retailer (Butcher)	Al Malek Fisal St, Vegetable & Fruit Market
Sweet Maker	Hanano St.

(3) Medical Establishments

- **12th February 2001:** The survey was done on this day for 3 medical establishments as shown Table 11.1.4.

Table 11.1.4 List of the Medical Establishments (*Jableh* City)

Medical Establishment	Address	Public/Private
Medical Care Establishment	Al Baladiah Square	Public
Dr. Abraham Naama' Hospital	Abraham Naama St.	Public
Fawaz Al Asad' Hospital	Al Amara St.	Private

11.1.3 Al-Haffeh City

The survey in *Al-Haffeh* City took place on 14th of February 2001. The survey included households (most of which are Middle and Low income living in the same areas), the commercial and Medical establishments as follows:

(1) Household

- **14th of February 2001:** 43 samples were surveyed in the *Middle and low Income Areas* of the Northern *Hay*, the Southern *Hay* and *Omar Ben Al Bitar* St. and the surroundings. No high-income areas were assumed to find in this city.

(2) Commercial Establishments

- **14th of February 2001:** The survey was done on this day for 7 commercial establishments as shown in Table 11.1.5.

Table 11.1.5 List of the Commercial Establishment (*Al Haffeh* City)

Commercial Activity	Address
3 – Grocery Shops	Al Madaress St. Tarboush St.
2 - Snack shops	Al Madaress St. the Market
Pharmacy	Next to the Court
Public School (Al Kazemiah)	Al-Haffeh

(3) Medical Establishments

- **14th of February 2001:** The survey was done on this day for 2 medical establishments as shown in Table 11.1.6.

Table 11.1.6 List of The Medical Establishments (Al-*Haffeh* City)

Hospital or Clinic Name	Address	Public/Private
Al-Haffeh Medical Care Establishment	Al-Haffeh	Public
Al Ameen Laboratory for medical analysis	Al-Haffeh	Private

11.1.4 Qurdaha City

The survey for *Qurdaha* City took place on 14th of February 2001. The survey included households (most of which are middle and low income living in the same areas), the commercial and Medical establishments as follows:

(1) Household

- **14th of February 2001:** 39 samples were surveyed in the *Middle and low Income Areas* of *Alloush, Shehab Al-Deen*, *Al Wahda* and the City Center and the surroundings. No high-income areas were assumed to find in this city.

(2) Commercial Establishments

- **14th of February 2001:** The survey was done on this day for 6 commercial establishments as shown in Table 11.1.7.

Table 11.1.7 List of the Commercial Establishment (*Qurdaha* City)

Commercial Activity	Address
Barber	Main Road
Traditional Restaurant	Mafrak Al Nawafrah
Shop (Shoos)	Post Office Corner
Pharmacy	AbdulMunem Riad St.
Shop (Dresses)	Al Fidaa St.
Grocer's	Al Baath St.

(3) Medical Establishments

- **14th of February 2001:** The survey was done on this day for 2 medical establishments as shown in Table 11.1.8.

Table 11.1.8 List of the Medical Establishments (*Qurdaha* City)

Medical Establishment	Address	Public/Private
Basel Al Assad Hospital	Al Qurdaha, Shditi	Public
Area Medical Care Clinic	Al Qurdaha, Mukadamin St.	Public

11.2 RESULTS OF THE OPINION SURVEY DURING THE FIRST COMMUNITY EXPLANATORY MEETING

Lattakia Governorate Hall
27th June 2001
19:00 p.m. - 21:30 p.m.

Number of Attendants:	61	(Receiving Questionnaires)
Number of Answers	44	
Participation Rate	72.13%	(44/61)

Distribution of Answers

11.2.1 The Slogan

Slogan One	24	(54.55%)
Slogan Two	8	(18.18%)
Slogan Three	5	(11.36%)
Other Proposed Slogans	7	(16%)

- Wastes of Today are Raw Materials for Tomorrow
- Let us be More Beautiful Through Making our City More Beautiful By Cleaning it
- Let Us Apply the Slogan "Development and Environment Conservation"
- Our City is Beautiful, Keep it Clean
- Let Us make Our City Beautiful and Clean Free of Wastes for the future of Our Children
- Towards a More beautiful City
- With Your Participation You Guaranty Better Life for Your Children

11.2.2 Selection of the Colors for the Containers

Agree with the Proposed Colors	33	(75%)
Non Agree	11	(25%)

Other Propositions for the Colors of Organic Containers

- Green 5
- Yellow 2
- Blue 1
- Orange 1
- Red 1

Other Propositions for the Colors of Non Organic Containers

- Blue 3

- Light Green 1
- Silver 1
- Red 1
- Orange 1
- Yellow 1
- Brawn 1
- Metallic 1

11.2.3 The Selection of the Study Area for The Campaign on Waste Separation

Agree on the Proposed Area	37	84.1%
Non Agree	7	15.9%

Other Areas Proposed

- Chekhdaher (Martacla) 1
- Tabbiyaat (and Skantoury) 1
- Mashrou Al-Zen 4
- Al- farous 3

11.3 COMMUNITY EXPLANATORY MEETING 2

Arabic Culture Center
Monday 18 June 2001

Mr. Mouhammad Safi Abou Dan (Governor of Lattakia)

- Domestic Solid Waste is the main environmental problem in the city of Lattakia.
- The current Solid Waste Management is unscientific; this project will suggest new ways of handling solid wastes.

Mr. Abe (Team Leader of the JICA Study Team)

- Notify to the first meeting (27 May 2001) and its results.
- Asking for some cases to be take care of:
  - Taking care of the Solid Waste.
  - Knowing what is its quantity and composition.
  - What is the level of acceptance of the city dwellers about Solid Waste Collection, the place of disposal and the way of disposal?
- Presentation of some statistics about Solid Waste in the Aria of the Study:
  - The rate of the generated Solid Waste in Lattakia of the high-income buildings is 0.562 Kg/person/day.
  - A considerable amount of Solid Waste are generated from the cities of the study:
    300 t/day in Lattakia.
    60 t/day in Jableh.
    6 t/day in Qurdaha.
    4 t/day in Al-Haffeh.
  - Lattakia's Solid Waste composition:
    90% of the markets Solid Waste are an Organic Waste.
    70% of the households Solid Waste are Non-organic waste.
  - Public Awareness Survey:
    0% of Lattakia dwellers receive Waste Collection services.
    0% of Lattakia dwellers are satisfied with Waste Collection done by the municipality.
- Solid Waste Management in the city of Lattakia should be improved.
- Selection of the Slogan "Let's Keep our City Clean and Beautiful" and a suggestion of another Slogan "Sorting at Source is the Base for Cleanliness".

Eng. Yahya Masri (Head of the Counterpart Team, Lattakia Municipality)

- Presentation of results of Meeting 1
- Finale decisions on:
  - Slogan: "Let's Keep our City Clean and Beautiful".

- Location of the Aria for the Campaign on Waste Separation: Al-Slaibah.
  Colors of the Containers:
  Non-organic Waste: Blue.
  Organic Waste: Violet.
- Presentation of the finale Slogan.

Dr. Yarob Badr (Leader of Local Consultant Team)

- Presentation of the organizing structure of the Campaigns between:
  - JICA Study Team.
  - Counterpart Team.
  - Local Consultant Team.
  - Local Partners.
- Presentation of the Public Awareness Campaigns:
  - Waste Separation at Source Campaign:
    The aria: Aslaibah, divided into 3 levels of income.
    Public Awareness Survey of 200 Households
    (before the Campaign).
    Waste Separation at Source Campaign:
    Black Nylon bag: Organic waste.
    Transparent Nylon bag: Non-organic waste.
    Public Awareness Survey of 200 Households (after the Campaign).
    2 Visits to Al-Bassa dump.
  - Demonstration Camping at Al-Mahabba Festival.
    Presentation of the Slogan: "Put the Waste in the Container"
    Location of the Demonstration Campaign.
    Presentation of the activities in the Demonstration Campaign:
    Exhibition.
    Team distributing leaflets.
  - TV Campaign: Short Television Film for 20 minutes to include:
    The Shock: The problem of Solid Waste in the Cities of the Study.
    Analysis: The importance of Solid Waste Sorting at Source to obtain clean fertilizers.
    JICA Study Team activities:
    The Study.
    The rehabilitation of Al-Bassa dump.
    The experimental project of the fertilizers factory.
    The Campaigns.
    The Future of Domestic Solid Waste Separation at the Cities of the Study.

Eng. Seif Eddin Salman (Director of Sportive City)

- Information about the Sportive City:
  - Location: to the north of the Lattakia city.
  - Aria: 156 Hectares.

  - 60% Green arias.
  - 40% Sportive constructions.
- Compositions of the Sportive City.
- The Contribution of the Sportive City to the Public Awareness:
  - Defining a suitable Location for the Demonstration Campaign.
  - Defining Locations for the Containers (15 sites).
  - Manufacturing a number of doubled-baskets for the use of the people.
  - Manufacturing a number of signboard with the suggested slogan.
  - Coordinating with the Al-Mahaba Festival Management to reserve one page in all the festival brochures for the Campaign.
- The impacts of the Sportive City Campaign:
  - Public Awareness of 25,000 visitors per day (during Al-Mahaba festival).
  - A continues mechanism to get red of the Solid Waste of the Sportive City.
  - A preliminary project to be applied on the level of Lattakia City.

Eng. Josevine Nassar (Women's Union in Lattakia)

- Identifying Women's Union and it's objectives.
- The structure of Women's Union in Lattakia.
- The relationship with JICA about Solid Waste Management:
  - Preliminary meeting through the Counterpart Team in January 2001.
  - Organizing Public Awareness Meetings on Solid Waste Sorting.
  - Community Explanatory meeting with:
    The Study Team.
    The Counterpart Team.
    The consultant Team.
- The participation of the Women's Union to the Campaign:
  - Helping in defining the households.
  - Helping in the preliminary survey.
  - Realizing the Solid Waste Separation at Source Campaign (Survey and public Awareness).
  - Helping in realizing 2 visits to the Al-Bassa dump.
- Conclusion:
  - An effective contribution to the Solid Waste Separation at Source experimental Campaign.
  - Spread the Public Awareness Campaign on Solid Waste Sorting all over the Cities of the Study through the Women's Union's offices and units.

- A future role for the Women Union to spread the case and to transfer it to be a public case.

Ms. Lubaba Youness (Visual Media, Syrian TV)

- Presentation of Visual Media role in environmental issues especially which concern all of the community.
- Presentation of some suggestions:
  - The most important is the way of directing the film and who much it can attract people.
  - A suggestion to briefly explain the Campaign on the Syrian TV as advertising before or after the news.
  - Explaining the campaign and all its activities through "Sea Letter" program on the Syrian TV.
  - A suggestion to hold a TV conference.

The Discussion:

(1) Maher Ramadan (City Council):

Question: Is there any chance that the TV campaign has a negative impact as showing the city as a dirty one especially for the tourists? A suggestion is that the film should be accompanied with the appropriate comment, or will be played on the Syrian Local Channel only.

Mr. Mouhammad Safi Abou Dan (Governor of Lattakia):

Answer: The timing of playing the film may be inappropriate, we do not want the tourists to have a bad influence of the city and react negatively.

(2) **D. Zoher Kerbek** (Chairman, Syndicate of Medicine):

Question: Are explaining, advertising and Public Awareness enough for such a case? Is there any huge step may take place after the realization of this study on the city level and when?

Mr. Mouhammad Safi Abou Dan (Governor of Lattakia):

Answer: It is not a theoretical study, it is a practical one, after the Solid Waste Separation we will see how well is the people response, and do they sort their waste? Do they put it in the suitable container? That will be a good indicator if this study is applicable, and if so there will be important steps in this field on the city level.

(3) **Bassam Aabden** (City Council)

Suggestion: Public Awareness is the main issue in the field of Waste Separation, a suggestion is to benefit from the spiritual effects of the speeches in the mosques and churches.

Mr. Mouhammad Safi Abou Dan (Governor of Lattakia):

Answer: A suggestion is to send a letter to the spiritual departments and leaders in Lattakia explaining the study and asking for their contribution.

Mr. Sajee Kerkmaz (Journalist)

Notice:

- There is deference between the Arabic translation and the English one of the slogan.
- Also it is necessary to benefit from the Non-visual Media.

Mr. Mouhammad Safi Abou Dan (Governor of Lattakia):

The contributions of Women's Union, Syrian TV and the Sportive City are big and important, and we wish from other unions and departments to contribute with a working paper in these campaigns.

Thanks for all the contributors, and especially for the JICA Study Team.

11.4 FINAL COMMUNITY EXPLANATORY MEETING 3

Syndicate of Engineers Club
Sunday 19 Aug 2001 at 12 h 00

Number of Attendance: 65

Report:

The meeting concentrated on explanation of the contents, details, results and evaluation of the Public Awareness Campaigns (waste separation at source; demonstration campaign at Al-Mahaba Festival; TV Campaign). The lecturers were **Mr. Yamauchi**, **Mr. Igarashi**, **Dr. Badr** and **Mr. Masri**. The meeting also demonstrated the role of JICA Study Team and the prospective guideline for the Syrian Team, with the assessment of common participation in awareness campaigns, and projection of the video program prepared by the Local Consultant Team.

The discussion presided by **Eng. Issam Wakil** Mayer of Lattakia City in association with **Dr. Awad**, coordinator. The Discussions among the invited audience focused on the following:

- **Eng. Maher Ramadan** (Member of City Council of Lattakia) :
  - The possibility of using Al-Mahaba Festival Camp for other festivals.
  - What is next to the departure of the JICA Study Team.
  - Will be there financial support for the promotion of the current landfill disposal site, or to the new landfill site.
  - Importance of using the containers found in Al-Mahaba Festival, in other places.
- **Eng. Fater Maya** (Deputy Mayor of Lattakia):
  - The campaign was very successful; but what is next!
  - Hopes to establish a new hygienic landfill system. JICA Study Team has put this hope on the way.
  - Has there been any analysis of the solid waste components and amounts in the containers in Al-Mahaba Festival Campaign?
- **Eng. Kamal Hammoud** (Director of Urban Planning, Lattakia municipality):
  - What were the results of the campaign as regards the commitment of the people to the matter of Al-Mahaba Festival containers and the separation of the solid wastes (organic – non organic).
  - Are there alternative solutions to solid waste disposal in Lattakia region.
  - What is new about the new landfill project.
- **Mrs. Josephene Besmarje** (Women's Union):
  - Hopes that this Al-Mahaba Festival campaign will be a start towards other continuous campaigns.

  - There was no adequate introduction of the campaigns in the city, particularly to the schools and kindergartens.
  - Thanks to all people contributed in the success of these campaigns which were truly useful and important to the region.

- **Mr. Ibrahim Rkaj** (Syrian TV, Lattakia):
  - The necessity to establish regulations to control the solid waste disposal.
  - The necessity of permanent municipal watchers in the streets.

Local consultants (Mr. Awad and Mr. Badr) replied to the raised points by technical and scientific explanations.

The meeting ended with Eng. Issam Wakil, Lattakia City Mayor, who explained the positive reflection and effect of the campaigns on the prospective solid waste management in Lattakia Region. Eng. Issam confirmed the importance of the citizen's awareness regards solid waste separation, together with the required following up by the municipality regards rehabilitation of the current Landfill and compost plant, and the establishment of an another Landfill site in the future and other relevant procedures.

At the end of the meeting, **Eng. Issam Wakil** Mayer of Lattakia City developed official points of views and future expectations:

- To focus on public awareness oriented towered children (schools, summer camps and kindergartens).
- To benefit from frequent future occasions to organize similar exhibitions and to implement the same exhalation in the next Al-Mahaba Festival of the sportive city.
- To continue efforts on Waste Separation by making use of available local facilities.
- To request for JICA future grant to provide necessary equipment and machinery in order to continue the rehabilitation of Al-Bassa Landfill and vehicles to improve Waste collection.

PART III

FEASIBILITY STUDY ON THE COMPOST PLANT IN HOMS

SECTION 1

PRODUCTION OF BETTER QUALITY OF COMPOST

SECTION 1 SOLID WASTE MANAGEMENT PLAN

1.1 SITE OF THE COMPOST PLANT

JICA Study Team was informed that there are two potential site for the compost plant, one is at Maghlia new disposal site and another is Dir Baalbeh existing disposal site. The Team submitted the proposal for the site of compost plant as shown in Reference-1 that recommend the adjacent area of the Dir Baalbeh existing disposal site.

Based on recommendation, Homs city council decided to allocate the adjacent land of existing disposal site with following conditions.

a. Rehabilitation of existing disposal site

b. Construction of a compost plant

c. Construction of a transfer station

REFERENCE 1

SITE OF THE COMPOST PLANT

1. Background

The JICA Study Team is conducting a feasibility study for a compost plant in Homs according to the scope of works agreed between the Syrian side and the Japanese side. The Study Team has been informed that there are two potential sites for the compost plant – the present disposal site (Dir Baalbeh) and the proposed new disposal site at Maghlia.

2. Master Plan and Phased Development

The Master plan for SWM in Homs city has been prepared by COWI consultants (METAP-EIB Study). The city administration has adopted in principle Scenario II presented in that report.

Under this scenario, a new final disposal site will be constructed about 30 km from the city. This is necessary as the existing site is almost full, and there is very little scope for expanding the existing site. The city wishes to close and rehabilitate the existing site as quickly as possible to minimize current adverse environmental effects on the city.

The city has chosen Maghlia as the new final disposal site. All the potential sites are a significant distance from the city, so even if this choice is changed, it will be necessary to construct and operate a transfer station on the city outskirts. A site adjacent to the existing disposal site has provisionally been chosen for the transfer station.

Scenario II includes the phased development of composting and material recycling facilities in conjunction with the development of separate collection systems to ensure the quality of compost and recycled materials. The timing of these developments will be determined by technical and financial feasibility.

Composting facilities (and associated collection systems) will be developed in three phases:

Phase	Feedstock	Plant	Capacity	Associated Collection system
I	Plant and vegetable (green) matter only	Operated with mobile equipment No fixed reactor	7,500 t/year (25 t/day) to be extended later (11,000 t/year)	Special collection system in market area only. Delivery of green wastes from parks to be organized by Parks Section.
II	Organic matter from household garbage (including animal residues)	To include reactor to ensure adequate fermentation of animal matter	4,000 t/year (15 t/day) *	Separate collection system in limited high/meddle income housing area.
III	Organic matter from household garbage (including animal residues)	Organic matter from household garbage (including animal residues)	35,000 t/year (120 t/day) to be doubled when demand justifies	More extensive separate collection system in high/middle income housing areas

Note: * As recommended in the Master Plan. A large pilot plant may be considered in the feasibility study.

The scenario also includes the development of building material recycling (mainly crushing of masonry to produce aggregates) and central sorting. While this feasibility study does not cover these facility it needs to be considered when identifying sites for the compost plant.

The feasibility study covers site(s) and plant(s) for Phase I and II only. However the selection of the site(s) should consider the potential construction of Phase III at a later date.

3. The potential sites

The two potential sites are:

(1) Near the boundary of the existing disposal site. The existing disposal site will need to continue functioning as a disposal site until at least the year 2004. The actual siting of the plant will need to allow for the continued operation of disposal operations. Reclaimed areas of the disposal site might be useable as dumping areas where compost is left to mature, but any plant will need to be constructed on firm ground outside the existing perimeter. The main attraction of this site is its proximity to the city. This will minimize transport costs both for feedstock and final product improving the financial viability.

(2) Within the new disposal site at Maghlia. The main attraction of this site is that it removes any risk of an environmental impact on the city

Comparison of sites

	Old disposal site	Maghlia
Environ-mental	Very few residents within a 1.5km cordon. If operated properly, should have minimal environmental impact Some impacts (mainly odours) on the city if plant operated incorrectly and wind direction is adverse. If developed in conjunction with rehabilitation of existing site there should be an overall improvement of the environment. Acceptability of siting plant near existing cemetery needs to be considered by Syrian side	Remoteness from city ensures no environmental impact on city. Rejected material may be transferred directly to landfill. Any leachates can be treated directly by systems installed for landfill operations. No impacts on residents from spillages by farmers collecting compost.
Access/ logistics	Will share access facilities with transfer station. Very close to sources of feedstock. Closer to anticipated customers	Will share access facilities with landfill site. However these are not immediately available. (New 5km access road and widening of 10km of rural road required for the new disposal site)
Utilities	Can be shared with transfer station and/or building material recycling site. Can be provided almost immediately at this site	Can be shared with disposal site. Given current remoteness of location some delays in provision can be expected.
Financial	Proximity to feedstock and customers will reduce operating costs and increase selling price making site more financially viable	
Other	Could be brought into operation quickly	Operation before constructing the landfill which could be after 2004, is not feasible

4. Time Constraints for The Phase I and Phase II

The phasing of the development is constrained by both financial and physical factors:

Feedstock Availability

Collection system for Phase I and II can be developed very quickly.
Collection system for Phase III will require longer to develop.

Site Availability

Old disposal site available immediately. Operations could be commenced as soon as construction finished.

Maghlia site available almost immediately for construction. However commencement of operations (including Phase I and Phase II plant) before commissioning of new disposal site (2004 or later) impracticable.

Financial viability and finance availability

None of these plants can be constructed until finance can be arranged either through grants or loans. The improved financial viability of the old site may speed up the finalization of financing for Phase I and Phase II.

5. Recommendations

a. The Phase I and Phase II plant be located at the existing disposal site. Its development should be co-ordinated with rehabilitation of the disposal site to maximize environmental benefits. Also it is desireble to co-ordinate the development of the transfer station and recycling plant.

b. The Phase III plant (full scale plant for separated household organic wastes) could be sited at Maghlia. The final decision to proceed with this phase would only be taken once the Phase II plant verifies both the technical and financial viability of the projected plant.

6. Reasons

a. For the Phase I and II plant the existing disposal site has been recommended as:

- Lower transport costs for feedstock and compost will improve financial performance
- Plant can be brought into operation earlier on this site as it is available immediately and feedstock can be provided almost immediately
- Potential for overall environmental improvement of existing disposal site if development properly co-ordinated
- Low environmental risks to the city even in event of malfunctioning of the plant
- Minimal rejected matter material from this site for transportation to final disposal site.

b. For Phase III plant (Full scale plant for separated household organic waste) the Maghlia site has been recommended as

- Large site will be available in Maghlia site.
- Higher risks of malfunctioning and potentially more objectionable odours favours more remote site
- As development of separate collection system will take some time, the delay in commissioning a plant at the Maghlia site will not be a disadvantage.

SECTION 2

SOLID WASTE AMOUNT AND COMPOSITION ANALYSIS

SECTION 2 SOLID WASTE AMOUNT AND COMPOSITION ANALYSIS

2.1 SOLID WASTE AMOUNT AND QUALITY SURVEY

2.1.1 Objective of the Survey

The objective of the solid waste amount survey at source was to identify the waste generation rates from household and commercial activities and sampling and laboratory analysis of solid waste. The sampling area is selected in Homs City.

2.1.2 Methodology of the Survey

(1) Survey Period

The Survey was carried out summer over eight consecutive days. The survey started on June 3 and ended on June 10, 2001. The samples were received on June 4, 2001.

(2) Number of Collected Samples and Locations

The total number of collected samples is 112. The following Table 2.1.1 will show the number and location of collected samples and each generated place.

Table 2.1.1 Samples Number and Generated Place

Category	Generated Place	Homs City	Total
Household	High Income	20	20
	Middle Income	40	40
	Low Income	30	30
Commercial	Shopping Street	3	3
	Private Office	3	3
	Restaurant	3	3
	Hotel	2	2
Public Institution	Public Office	2	2
	School	2	2
Market		3	3
Public Place	Road	2	2
	Public Garden	2	2
Total		112 (110)	112 (110)

The number of collected samples for middle and high income areas was revised based on the information received from the Counterpart Team concerning the percentage of high, middle and low income locations to the total population of Homs City. These percentages are described as follow:

- High Income: 20%.
- Middle Income: 50%.
- Low Income: 30%.

The schools samples were omitted due to school closure for the summer holiday. Thus the actual number of collected samples was (110).

The following Table 2.1.2 will show the locations of the collected samples by districts in Homs City.

Table 2.1.2 Location of Collected Samples by District

Generated Place	District Name
High Income	Al-Fardos and Al-Ghouta Districts.
Middle Income	Karm Al-Shami and Bab Hood Districts.
Low income	Karm Al-Zeitoun, Wadi El-Dahab and Karm Elouz Districts.
Shopping Street	Al- Bughtaseya and Bab- Hood Districts.
Private Office	Al- Bughtaseya District.
Restaurant	The City Orchards and Al- Hamedeya District.
Hotel	Al- Fardos and Bab-Hood Districts.
Public Office	Bab Hood and Al- Mahatta Districts.
Market	Al- Hamedeya, Bab Essiba and Bab Hood Districts.
Road	Al- Hamedya and Al- Mahatta Districts.
Public Garden	Bab Hood and Karm Elouz Districts

Location map to show the above locations of the collected samples is attached.

(3) Method for Selection for the Sample Locations

In order to get representative results on the generated quantities as well as their composition, JICA Study Team, in cooperation with the Counterpart Team, selected the locations of the samples to fulfill the survey goals taking into consideration the following for each category and generating place:

- Household samples, high, middle and low, represent three income levels and are located in districts of highest population density of the Homs City.
- Shopping Street samples were selected by choosing three shops located in three different commercial streets in Homs City Center. The selected shops represent the major commercial activities such as clothing, shoes, women's wear and men's wear.
- Private Office samples were selected to represent the different activities such as legal, engineering and tourism companies.
- Restaurant samples were selected by choosing three typical types and sizes of Homs restaurants such big, medium and fast food restaurant.
- Hotel samples were selected to represent the two types of hotels available in Homs City such as five star hotel (large hotel) and popular hotel (small hotel).
- Public office samples were selected to represent typical public offices in Homs by choosing big and medium size public offices.
- Market samples were selected to represent three sizes of markets, large, medium and small. The market locations were selected to represent the actual types of markets that serve the three income levels (high, middle and low).
- Road sweeping samples were selected for branch and minor streets. Mechanical sweepers sweep the main streets in Homs City.
- Public park samples were selected to represent medium and large size gardens. Both kinds are common in Homs.

(4) Waste Sample Collection System

1) Residential Areas (High, Middle and Low Income Household)

- Before proceeding with the survey for measurements, an interview was conducted with each of the chosen householders to explain the purpose and method of the survey. Upon receiving the approval of the householder to participate in the survey, data concerning number of inhabitants, floor area and code number were recorded.
- Distribute of marked bags (Approx. 40 liter capacity) to each household one day before collection day.
- Collect the plastic bags filled with solid waste from each household at a fixed time in the morning and bring it to the measuring yard.

2) Commercial Areas (Shopping streets, Private offices, Restaurants and Hotels)

- Before proceeding with the survey for measurements, an interview was conducted with each of the sampled owners/or representatives to explain the purpose and method of the survey. Upon receiving their approval to participate in the survey, data concerning number of staff, floor area and code number of the sample was recorded. For Private offices data concerning the activity was recorded. Also, the number of beds in the hotels was recorded.
- The above steps for households were followed.

3) Public Institutions (Public Offices)

- Before proceeding with the survey for measurements, an interview was conducted with the public office manager to explain the purpose and the method of the survey. Upon receiving the approval of the manager to participate in the survey, the data concerning the number of staff, floor area and code number.
- The above steps for households were followed.

4) Markets

- Before proceeding with the survey for measurements, an interview was conducted with the market/shops owners to explain the purpose and method of the survey. Upon receiving the approval of the owner to participate in the survey, data concerning the floor area of shops and code number of the sample was recorded.
- The above steps for households were followed.

5) Public Places (Roads and Public Parks)

- Before proceeding with the survey for measurements, the manual street sweeping supervisor was requested to collect the generated wastes daily in the distributed plastic bags instead of sending it to the containers. The data concerning the swept length, street length, garden area and code numbers.
- The above steps for households were followed.

6) Waste Measurement and Recording

- Upon completion the collection procedure, the samples were transferred to the measuring yard.
- The samples were categorized using a ticket fixed to the plastic bag to show the code number for each household (high, middle and low income), commercial area, market, etc.
- Measuring the weight of each sample and recording the weight on the respective record sheet.
- Measuring the volume for each sample by opening the plastic bag and emptying the wastes into a scaled 40 liter plastic barrel. To measure volume accurately, lift the barrel to a height of about 30 cm and drop it. Repeat lifting and dropping three times. Record the volume on the respective record sheet.
- After recording the weight and volume, the bulk density (kg/l) and the unit generation for households (kg/cap./day & l/cap./day), markets (kg/100 m^2/day & l/100 m^2/day), etc.

2.1.3 Survey Results:

The main purpose of the survey and analysis was to determine the unit generation rate, bulk density, composition of wastes and the physical content of the generated municipal wastes in Homs City.

(1) Unit Generation and Bulk Density:

The results of the unit generation and bulk density for each category of the survey items are shown in Tables 2.1.3, 2.1.4 and 2.1.5.

Table 2.1.3 Unit Generation Rate and Bulk Density for Household

Generated Place	Unit Generation (kg/cap./day)	Bulk Density (kg/l)	Average Unit Generation (kg/cap./day)	Average Bulk Density (kg/l)
High Income	0.644	0.361	0.537	0.248
Middle Income	0.550	0.185		
Low income	0.448	0.255		

It is clear from the above table that the unit generation is proportional to the income level.

The average unit generation for the three income levels (0.537 kg/cap/day) is slightly higher than the result recorded by METAP Study (0.454 kg/capita/day), but it is almost the same as Lattakia City and is the normal average in developing countries.

Table 2.1.4 Bulk Density and Unit Generation Rate for Commercial Activities

Place of Generation	Unit Generation ($kg/100m^2/day$)	Bulk Density (kg/l)
Shopping Street	7.020	0.042
Private Office	0.576	0.074
Restaurant	37.227	0.311
Hotel	3.624	0.141
Public Office	0.236	0.052

Table 2.1.5 Bulk Density and Unit Generation Rate for Public Institution, Market and Public Spaces

Place of generation	Unit Generation ($g/100m^2/day$)	Bulk Density (g/l)
Public Office	0.236	0.052
Market	58.811	0.211
Public Park	0.947	0.101
Road	22.785 kg / 100 m/day	0.210

2.2 WASTE QUALITY

2.2.1 Purpose of the Survey and Number of Samples:

The purpose of the survey is to obtain precise measurements for the composition analysis (wet base) and to prepare the representative samples for chemical analysis and Carbon/Nitrogen ratio, were measured the following number of samples shown in Table 2.2.1.

Table 2.2.1 Samples Number

Category	Generated Place	No. of Samples
Household	High Income	2
	Middle Income	4
	Low Income	3
Commercial	Shopping Street	2
	Private Office	2
	Restaurant	2
	Hotel	2
Public Institution	Public Office	2
Market		3
Public Place	Road	(2)
	Public Garden	(2)
Total		22 (26)

Note: Samples value in the ( ) are applied for the composition and bulk density survey.

2.2.2 Methodology of Composition Analysis and Laboratory Samples

(1) Survey Period

Composition analysis and laboratory samples were taken according to the following Table 2.2.2.

Table 2.2.2 Schedule of Implementing Composition Analysis & Laboratory Samples

Day	Day-3 June 05		Day-4 June 06		Day-5 June 07		Day-6 June 08		Day-7 June 09		Day-8 June 10	
Analysis	LS	Comp	LS	Comp	LS	Comp	LS	Comp	LS	Comp	LS	Comp
High income	■	■	■	■								
Middle income	■	■	Two Samples		■	■						
Low income	■	■	■	■	■	■						
Shopping St.	■	■	■	■								
Private office	■	■	■	■								
Restaurant							Two Samples					
Hotel					■	■	■	■				
Public office			■	■	■	■						
Market			■	■	■	■	■	■				
Road			■	■			■	■				
Public park							Two Samples					

Note: LS= Laboratory Sample Comp.= Composition Analysis

(2) Methodology for Analysis

After the analysis of solid waste composition, same samples were sent to laboratory to make further analysis.

Analysis was done on organic components (food and vegetable) of solid waste concerning pH, moisture contents. After dry the organic components, C, N and C/N ratio was measured.

1) Methodology of Composition Analysis for Small and Medium Weight

- Upon completion of weight and volume, mix the collected wastes on one day for one income level. For example the ten low income households are mixed together and then prior to sorting.
- Sorting, separately, the voluminous materials of the mixed wastes, which are mainly the combustible materials (food, paper, plastic, textile, wood and leather).
- Sieving the remaining part of the waste using 5mm sieve to bring out materials of diameter less than 5mm. This material is mainly rice and tea for the surveyed household; it is dust and sand in the other categories.
- Continue sorting, separately, the non-combustibles (glass, metal, ceramic and sand & stone).
- Measuring the weight of all individual materials and calculating the percentage of each weight to the total weight.
- In order to prepare a representative sample for the laboratory a weight of approximately two kilograms was prepared by mixing each material with its percentage to the total weight.
- The laboratory samples were securely bagged and sent to the laboratory.

2) Methodology of Composition for Received Heavy Weight Samples

- Dumping of the received waste from big restaurants or big hotels.
- Taking out the voluminous wastes (bully textiles, plastics, wood and metal) from the above solid waste.
- Dividing the remaining wastes into quarters and selecting the opposite two quarters.
- Adding parts, after cutting, from each material of the voluminous wastes to the selected two quarters in (c) to have a composition which is representative of the received wastes.
- Re-mixing the waste in order to have homogenous waste.
- Repeating step (c) until a reasonable weight (20-40kg) of the sample is reached depending on the original amount of received waste.
- Repeating the above mentioned steps (a-g) for small and medium weight samples.

(3) Results of Composition Analysis

Result of analysis is shown in Table 2.2.3 and 2.2.4.

Table 2.2.3 Quality of Organic Components (Food and Vegetable) of Solid Waste in Homs

Type of waste	Percentage of Organic	pH	Moisture (%)	Dry components (%)			C/N
				Total	C	N	
Domestic waste	52	6.9	72.0	28.0	7.5	0.5	13.8
Commercial Waste	52.4	7.0	69.4	30.6	8.1	0.6	17.5
Office waste	51.1	6.6	53.8	46.3	12.5	0.9	14.8

Note: Only food and vegetables, other components, such as plastic textile, wood and non-organic, are excluded.

Table 2.2.4 Quality of Organic Components of Solid Waste in Homs

No.	Sample source	Organic (%)	pH	Moisture (%)	Dry component (%)			C/N
					Total	C	N	
4	High income	54.2	7.0	87.0	13.0	3.33	0.27	12.5
9	High income	54.0	7.0	63.0	37.0	9.51	0.85	11.2
3	Middle income	54.6	6.5	75.0	25.0	6.35	0.60	10.6
10	Middle income	44.0	6.7	81.0	19.0	5.97	0.40	15.0
12	Middle income	54.0	6.8	87.0	13.0	3.34	0.23	14.3
17	Middle income	51.0	7.3	75.0	25.0	6.85	0.75	9.1
1	Low income	53.0	7.5	83.0	17.0	4.47.	0.32	13.8
8	Low income	49.0	6.5	45.0	55.0	15.73	0.88	17.9
14	Low income	54.0	6.4	52.0	48.0	12.34	0.62	19.8
	Domestic average	52.0	6.9	72.0	28.0	7.5	0.5	13.8
2	Shopping street	54.7	7.0	60.0	40.0	10.12	0.56	18.1
13	Shopping street	54.4	7.2	68.0	32.0	8.16	0.35	23.2
22	Restaurant	52.5	6.8	79.0	21.0	5.59	0.48	11.6
19	Restaurant	52.2	7.2	62.0	38.0	10.15	0.84	12.1
20	Hotel	54.0	6.6	50.0	50.0	12.85	1.10	11.7
15	Hotel	48.0	7.0	78.0	22.0	6.38	0.26	24.2
7	Market	52.0	7.4	81.0	19.0	5.09	0.15.	33.5
18	Market	52.0	6.8	65.0	35.0	10.08.	1.02	9.9
21	Market	52.0	7.0	82.0	18.0	4.82	0.36	13.4
	Commpercila average	52.4	7.0	69.4	30.6	8.1	0.6	17.5
5	Private office	53.0	6.3	46.0	54.0	14.20	1.24	11.4
6	Public office	55.0	6.6	51.0	49.0	12.35	1.08	11.5
11	Public office	53.0	6.9	53.0	47.0	12.36	0.56	21.9
16	Public office	43.5	6.6	65.0	35.0	11.06	0.77	14.4
	Office average	51.1	6.6	53.8	46.3	12.5	0.9	14.8

The following Table 2.2.5 shows the results obtained from the composition analysis for various household income levels (high, medium and low). Table 2.2.6 shows the results for Commercial areas, Markets, Public Institutions and Public spaces.

Table 2.2.5 Solid Waste Composition (%) for Domestic Wastes

Income Level	High	Middle	Low	Aver.
Food & vegetable	67.7	58.6	53.1	59.8
Paper	14.0	12.3	8.8	11.7
Plastic	10.7	12.7	11.5	11.6
Rubber & leather	0.4	0.8	1.4	0.9
Wood	-	1.0	0.3	0.4
Textile	0.7	6.4	5.1	4.1
Metal	1.0	0.9	0.9	1.0
Glass	1.5	3.1	1.8	2.1
Ceramic	1.5	0.5	1.5	1.2
Stone & Sand	-	0.6	10.4	3.7
Other < 5mm	1.1	1.0	3.6	1.9
Bones	0.8	0.9	-	0.5
Plant leaf	-	-	-	-
Other > 5mm	0.5	1.1	1.5	1.0
Total	100.0	100.0	100.0	100.0

Table 2.2.6 Solid Waste Composition (%) for Commercial Areas, Markets, Public Institutions and Public Spaces

Category	Shop	Private Office	Restaurant	Hotel	Public Office	Market	Road	Park
Food & Vegetables	25.0	-	72.4	35.3	4.5	94.3	1.5	7.2
Paper	43.2	33.3	14.5	4.8	65.8	1.7	9.6	8.9
Plastic	26.0	36.5	6.1	9.1	13.4	2.9	12.9	5.9
Rubber & Leather	1.4	-	-	0.1	-	-	0.6	-
Wood	0.1	-	0.2	0.8	-	0.2	0.8	0.3
Textile	-	-	0.2	2.4	-	-	0.6	0.3
Metal	2.9	-	1.1	5.2	4.5	0.0	1.5	-
Glass	-	-	0.8	0.9	-	0.1	-	1.3
Ceramic	-	-	0.3	1.4	-	-	-	-
Stone & Sand	1.4	-	-	30.4	-	0.1	42.7	2.7
Other < 5 mm.	0.2	30.2	3.9	-	9.2	0.5	-	-
Bones	-	-	0.4	1.4	-	-	-	0.6
Plant leaf	-	-	-	8.3	-	-	-	66.9
Other > 5mm.	-	-	-	-	2.8	0.2	29.8	5.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(4) Comments and Conclusion

1) Comments

The average percentage of food and vegetables is slightly lower than those obtained in METAP Study for the following reasons.

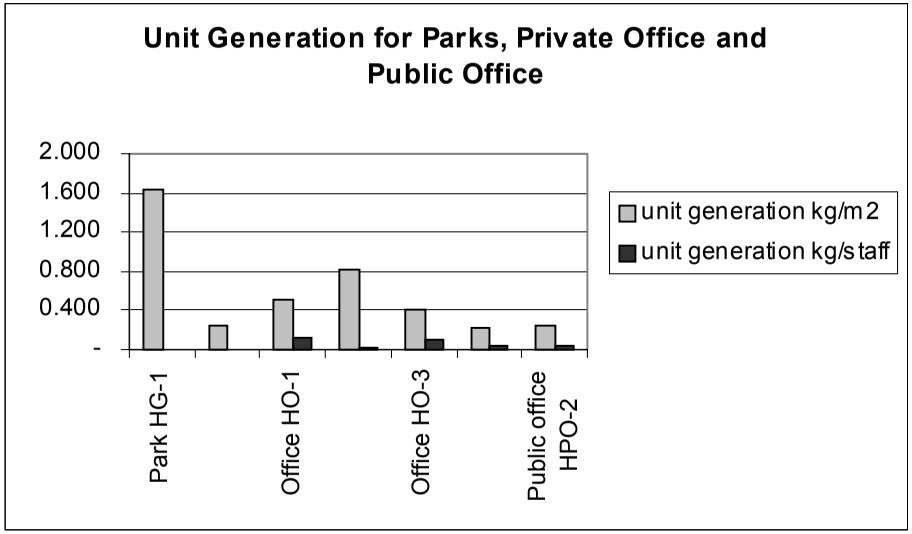
- Some of the samples received from low income areas contained rocks and sand in addition to damaged children toys. Thus the percentage of food and vegetables for low income area was low and compared to the general average of household.
- The sample period coincided with the start of summer holidays. Not surprisingly some of the sample s received from medium income areas contained

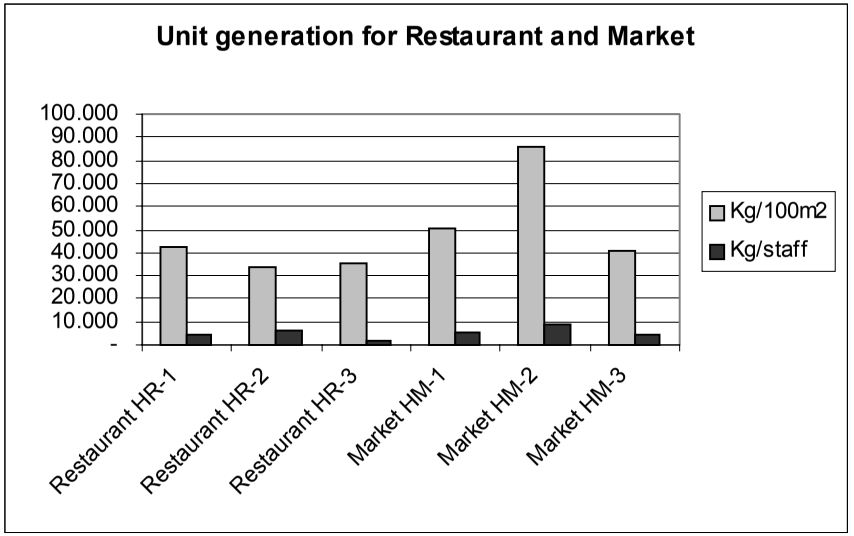
a high percentage of paper, mainly textbooks and notebooks discarded after examinations.

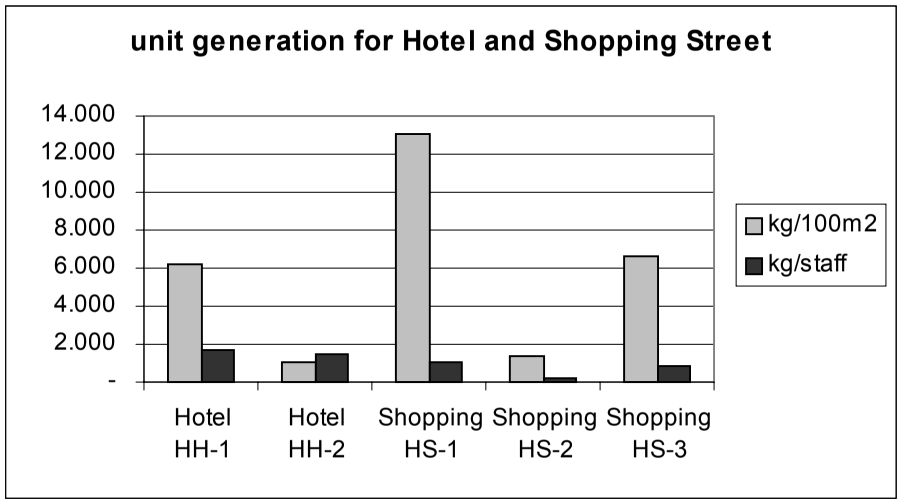
- Six batteries, one neon lamp and two syringes were found in household samples.
- Some of the samples were wet. For this, no explanation was found.

2) Conclusion

It is necessary that the Homs City (Cleansing Department) should make periodically such composition analysis to have the average yearly percentage of solid waste composition.


Unit Generation for Parks, Private Office and Public Office
2.000
1.600
1.200
0.800
0.400
-
Park HG-1
Office HO-1
Office HO-3
Public office HPO-2
unit generation kg/m2
unit generation kg/staff


Unit generation for Restaurant and Market
100.000
90.000
80.000
70.000
60.000
50.000
40.000
30.000
20.000
10.000
-
Restaurant HR-1
Restaurant HR-2
Restaurant HR-3
Market HM-1
Market HM-2
Market HM-3
Kg/100m2
Kg/staff


unit generation for Hotel and Shopping Street
14.000
12.000
10.000
8.000
6.000
4.000
2.000
-
Hotel HH-1
Hotel HH-2
Shopping HS-1
Shopping HS-2
Shopping HS-3
kg/100m2
kg/staff

Unit generation in Private and Public Places

	kg/100m^2	kg/staff	kg/100 l.m	Bulk Dens.
Park HG-1	1.640	-		0.095
Park HG-2	0.253	-		0.106
Office HO-1	0.507	0.127		0.077
Office HO-2	0.810	0.030		0.034
Office HO-3	0.410	0.103		0.11
Public office HPO-1	0.232	0.037		0.051
Public office HPO-2	0.239	0.036		0.052
Hotel HH-1	6.226	1.724		0.148
Hotel HH-2	1.021	1.430		0.134
Shopping HS-1	13.079	1.066		0.084
Shopping HS-2	1.379	0.201		0.021
Shopping HS-3	6.603	0.802		0.02
Restaurant HR-1	42.791	4.755		0.247
Restaurant HR-2	33.373	6.007		0.422
Restaurant HR-3	35.516	2.131		0.263
Market HM-1	50.099	5.427		0.156
Market HM-2	86.014	8.888		0.307
Market HM-3	40.321	4.032		0.17
Road HR-2 (m)	-	-	20.89	0.238
Road HR-2 (m)	-	-	24.68	0.181

Average Unit Generation, and Bulk Density for Commercial Activities

Category	Average Unit Generation (kg/100 m^2)	Average Bulk Density (kg/l)
Shopping Street	7.020	0.042
Private Office	0.576	0.074
Restaurant	37.227	0.311
Hotel	3.624	0.141

Average Unit Generation and Bulk Density for Public Institution

Category	Average Unit Generation (kg/100 m^2)	Average Bulk Density (kg/l)
Public Office	0.236	0.052

Average Unit Generation and Bulk Density for Market

Category	Average Unit Generation (kg/100 m^2)	Average Bulk Density (kg/l)
Market	6.116	0.211

Average Unit Generation and Bulk Density for Public Place

Category	Average Unit Generation (kg/100 L.M.)	Average Bulk Density (kg/l)
Road	22.785	0.210

Average Unit Generation and Bulk Density for Public Place

Category	Average Unit Generation (kg/100 m^2)	Average Bulk Density (kg/l)
Garden	1.640	0.101

Summary of Unit Generation of Commercial, Public Institution, Market and Public Place

Commercial	Area	Employee	Other	Weight				Volume			
				Waste	Rate/Area	Rate/Staff	Rate-other	Waste Vol	Rate/Area	Rate/Staff	Rate-other
Shopping HS-1	106.0	13.0		97.0	13.074	1.066		1,149.0	154.9	12.6	
Shopping HS-2	72.0	5.0		7.0	1.397	0.201		330.0	65.5	9.4	
Shopping HS-3	170.0	14.0		78.6	6.603	0.802		3,986.5	335.0	40.7	
Restaurant HR-1	500.0	45.0		1,497.7	42.791	4.755		6,057.1	173.1	19.2	
Restaurant HR-2	36.0	2.0		84.1	33.373	6.007		199.5	79.2	14.3	
Restaurant HR-3	36.0	6.0		89.5	35.516	2.131		340.0	134.9	8.1	
Hotel HH-1	4,430.0	160.0	188.0	1,930.6	6.226	1.724	1.467	13,083.0	42.2	11.7	9.9
Hotel HH-2	700.0	5.0	52.0	50.1	1.021	1.430	0.138	373.5	7.6	10.7	1.0
Market HM-1	65.0	6.0		228.0	50.099	5.427		1,465.0	322.0	34.9	
Market HM-2	62.0	6.0		373.3	86.014	8.888		1,215.0	280.0	28.9	
Market HM-3	60.0	6.0		169.4	40.321	4.032		994.5	236.8	23.7	
Office HO-1	50.0	2.0		1.8	0.507	0.127		23.0	6.6	1.6	
Office HO-2	30.0	8.0		1.7	0.810	0.030		50.0	23.8	0.9	
Office HO-3	50.0	2.0		1.4	0.410	0.103		13.0	3.7	0.9	
Public office HPO-1	1,000.0	63.0		16.3	0.232	0.037		321.5	4.6	0.7	
Public office HPO-2	600.0	40.0		10.1	0.239	0.036		194.5	4.6	0.7	
Road HRO-1 (m)			100.0	146.2			20.89	614.0			87.7
Road HRO-2 (m)			100.0	172.8			24.68	955.0			136.4
Park HG-1	1,200.0			137.8	1.640			1,450.0	17.3		
Park HG-2	22,000.0			390.0	0.253			3,685.0	2.4		

General Summary of Daily Results for Composition Analysis

Source	high Income.		Middle Income.		Low Income.		Shop. Street		Private Office		Restaurant		Hotel		Public Office		Market		Road		Public Park	
	weight	%	weight	%	weight	%	weight	%	weight	%	weight	%	weight	%.	weight	%	weight	%	weight	%.	weight	%
Food, veget..	26.33	68.5%	41.52	60.3%	58.56	50.2%	8.64	30.5%	0	0.0%	24.46	78.4%	29.88	54.3%	0.17	5.1%	102.53	93.8%	0.70	1.5%	6.10	7.0%
Paper	5.41	14.1%	8.08	11.7%	10.11	8.7%	10.4	36.7%	0.22	34.1%	3.41	10.9%	4.21	7.7%	2.23	66.4%	1.97	1.8%	4.42	9.4%	7.60	8.8%
Plastic	4.08	10.6%	8.39	12.2%	12.86	11.0%	7.21	25.5%	0.235	36.4%	1.56	5.0%	4.87	8.9%	0.46	13.7%	3.58	3.3%	6.05	12.9%	5.40	6.2%
Rubber, leather	0.14	0.4%	0.65	0.9%	1.63	1.4%	0.5	1.8%	0	0.0%	0	0.0%	0.08	0.1%	0	0.0%	0.00	0.0%	0.28	0.6%	0.00	0.0%
Wood	0	0.0%	0.64	0.9%	0.44	0.4%	0.01	0.0%	0	0.0%	0.1	0.3%	0.7	1.3%	0	0.0%	0.23	0.2%	0.36	0.8%	0.28	0.3%
Textile	0.29	0.8%	3.98	5.8%	5.97	5.1%	0	0.0%	0	0.0%	0.11	0.4%	1.75	3.2%	0	0.0%	0.00	0.0%	0.28	0.6%	0.30	0.3%
Metal	0.36	0.9%	0.7	1.0%	0.99	0.8%	1.03	3.6%	0	0.0%	0.28	0.9%	1.74	3.2%	0.13	3.9%	0.03	0.0%	0.70	1.5%	0.00	0.0%
Glass	0.59	1.5%	2.26	3.3%	2.28	2.0%	0	0.0%	0	0.0%	0.36	1.2%	0.83	1.5%	0	0.0%	0.14	0.1%	0.00	0.0%	1.10	1.3%
Ceramic	0.46	1.2%	0.42	0.6%	1.535	1.3%	0	0.0%	0	0.0%	0.15	0.5%	1.23	2.2%	0	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Stone, Sand	0	0.0%	0.45	0.7%	15.275	13.1%	0.5	1.8%	0	0.0%	0	0.0%	6.69	12.2%	0	0.0%	0.11	0.1%	20.41	43.4%	2.54	2.9%
Other <5mm	0.4	1.0%	0.62	0.9%	4.67	4.0%	0.03	0.1%	0.19	29.5%	0.68	2.2%	0	0.0%	0.29	8.6%	0.53	0.5%	0.00	0.0%	0.00	0.0%
Bones	0.24	0.6%	0.48	0.7%	0	0.0%	0	0.0%	0	0.0%	0.07	0.2%	1.2	2.2%	0	0.0%	0.00	0.0%	0.00	0.0%	0.44	0.5%
Plant leaf	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1.82	3.3%	0	0.0%	0.00	0.0%	0.00	0.0%	58.05	66.9%
Other >5mm	0.15	0.4%	0.7	1.0%	2.24	1.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.08	2.4%	0.22	0.2%	13.80	29.4%	4.93	5.7%
Total	38.45	100%	68.89	100%	116.56	100%	28.32	100%	0.645	100%	31.18	100%	55	100%	3.36	100%	109.34	100%	47.00	100%	86.74	100%

2.3 SOLID WASTE AMOUNT TRANSPORTED TO THE EXISTING FINAL DISPOSAL IN HOMS

2.3.1 Objective of the Survey

The collected solid waste in Homs City is transported to the existing final disposal site in Dir Baalbeh. The survey aims to determine the amount of solid waste is transported to the disposal site. The survey will determine the service ratio of solid waste collection in Homs City.

2.3.2 Methodology of the Survey

(1) Survey Period

The Survey was carried out in summer season for eight continuos days during the period from August 11 to August 18, 2001.

(2) Method of Survey

The survey includes all vehicles entering the disposal site along the whole day from morning to the evening time. Time of arrival and departure, type and plate numbers of the vehicle were recorded. Also, records for the weight of collection vehicles from Homs City were recorded. There is no weigh bridge located at the entrance of Dir Baalbeh disposal site. To avoid the delay of the collection of wastes in the city, samples for each type of the used collection vehicles were weighted empty and full by using a private sector weigh bridge. These weights, gross and net, of the vehicle samples were applied in the records for the same type of the incoming vehicles to the final disposal site for the same type.

All of the vehicles were recorded in the format as shown in Table 2.3.1.

Table 2.3.1 Format of Record

Plate No.	Type of vehicle	Vehicle Weight (kg)			Time		Generated District	Waste Type	Remark
		Empty	Loading	Net	Arrival	Departure			

Note: It is noted that vehicle weight is weighted only several times for each vehicle type because there are no truck scale at disposal site.

2.3.3 Results of the Survey

The summary of the survey results is shown in Table 2.3.2. Number of trips was 156/ day in average. Concerning waste amount, it seems that there are some confusion on the net weight of each vehicle type.

Table 2.3.3 shows the difference of recorded weight and estimated weight. The weight of dump truck is estimated as volume x 0.5 ton/m^3 x 0.9. The transported amount is calculated as 735 ton/day in average based on above formula.

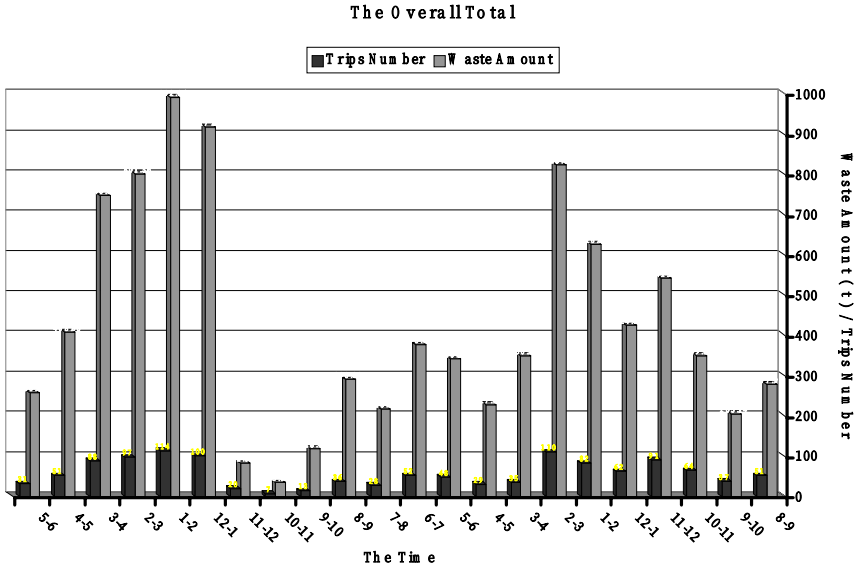
This amount includes the construction debris and industrial. Other results are shown in the following tables and figures.

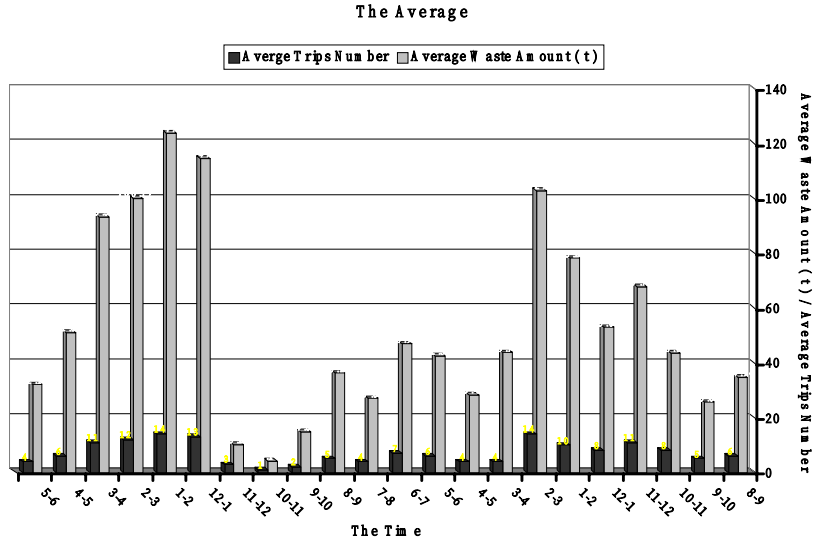
Table 2.3.2 Estimated Waste Amount Disposed at Dir Baalbeh Disposal Site (Homs)

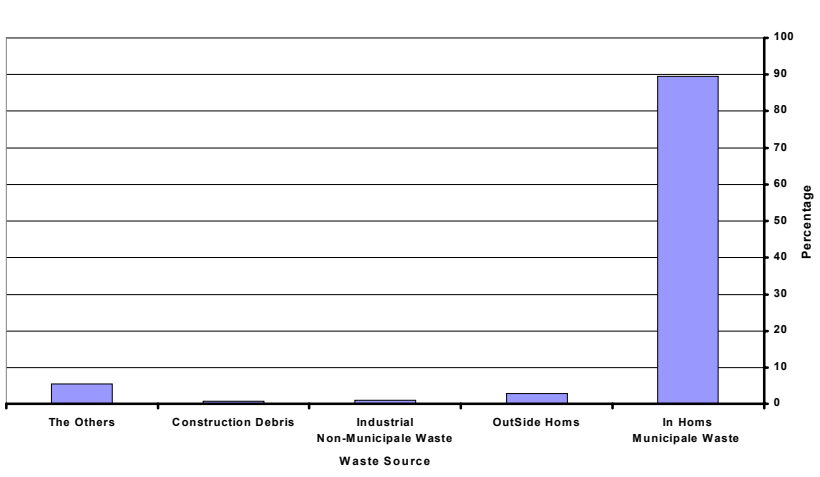
The Day		Saturday		Sunday		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Average for 8 Day	
The Date	Weight	8/11/2001		8/12/2001		8/13/2001		8/14/2001		8/15/2001		8/16/2001		8/17/2001		8/18/2001			
Vehicle Type		Trips	Net Weight	Trips	Net Weight	Trips	Net Weight	Trips	Net Weight	Trips	Net Weight	Trips	Net Weight	Trips	Net Weight	Trips	Net Weight	Trips	Net Weight
Freight Liner	8,100	30	243,000	35	283,500	31	251,100	42	340,200	33	267,300	36	291,600	28	332,100	41	332,100	34.5	279,450
International	6,480	3	19,440	2	12,960	2	12,960	2	12,960	2	12,960	3	19,440	1	6,480	3	19,440	2.3	14,580
Mack	6,480	28	181,440	44	285,120	37	239,760	34	220,320	35	226,800	39	252,720	25	162,000	35	226,800	34.6	224,370
Tractor	1,800	41	73,800	41	73,800	43	77,400	39	70,200	46	82,800	50	90,000	37	66,600	46	82,800	42.9	71,175
Zeil	2,160		-	2	4,320	3	6,480	3	6,480	3	6,480	3	6,480	2	4,320	5	10,800	2.6	5,670
Zetoyr Tractor	1,800	1	1,800		-		-		-		-		-		-		-		-
Nissan Dump Truck	5,400	1	5,400	5	27,000	5	27,000	5	27,000	2	10,800	8	43,200		-	4	21,600	3.8	20,250
Fiat Dump Truck	5,400	1	5,400	2	10,800	2	10,800	1	5,400		-	3	16,200		-	5	27,000	1.8	9,450
Dump Truck	5,400	1	5,400		-		-		-	1	5,400		-		-		-	0.3	1,350
Big Toyota	4,320	1	4,320	10	43,200	4	17,280	10	43,200	9	38,880	12	51,840	13	56,160	11	47,520	8.8	37,800
Small Toyota	1,620	14	22,680	18	29,160	15	24,300	13	21,060	18	29,160	20	32,400	17	27,540	20	32,400	16.9	27,338
Skoda	-		-		-		-		-		-		-		-		-		-
66/Military	4,600		-	2	9,200	2	9,200	2	9,200	2	9,200	3	13,800	2	9,200	2	9,200	1.9	8,625
Mercides	5,400		-	4	21,600	3	16,200	3	16,200	7	37,800	8	43,200	10	54,000	4	21,600	4.9	26,325
Hundai	1,080		-		-	1	1,080		-		-	1	1,080	1	1,080	1	1,080	0.5	540
Kamaz	5,400		-		-		-		-		-		-		-		-	0.1	675
Mercides Dump Truck	2,700		-		-		-	2	5,400		-		-		-		-	0.3	675
Truck (3 wheels)	300		-		-		-	1	300		-		-		-		-	0.1	38
Mercides 196	5,400		-		-		-	1	5,400		-		-		-		-	0.1	675
Total		121	562,680	165	800,660	149	698,960	158	783,320	158	727,580	186	861,960	136	614,180	177	832,340	156	734,985

Table 2.3.3 Difference of Recorded Weight and Estimated Weight

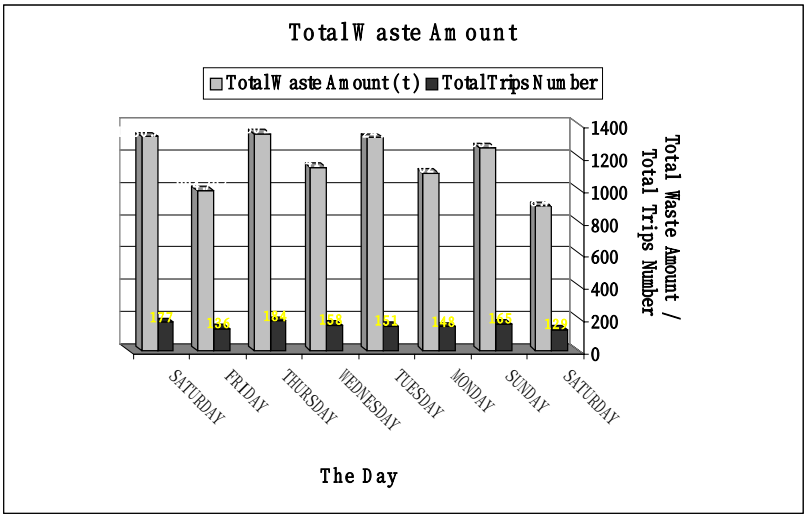
	Recorded weight (a) kg	Estimated weight (b) kg	Difference (a/b)
Compactor vehicle			
Freight liner (15m^3)	11.827	8,100	146%
Mack (12m^3)	10,785	6,480	166%
Zeil (4m^3)	4,496	2,160	208%
Mercedes (10m^3)	6,564	5,400	122%
Big Toyota (8m^3)	5,943	4,320	138%
Small Toyota (3m^3)	1,632	1,620	101%
Dump truck			
Tractor (4m^3)	4,306	1,800	239%
Nissan dump truck (12m^3)	7,103	5,400	132%
Fiat dump truck (12m^3)	11,716	5,400	217%
Mercedes Dump truck (6m^3)	2,850	2,700	106%


The Overall Total
Trips Number
Waste Amount
Waste Amount (t) / Trips Number
The Time


The Average
Averge Trips Number
Average Waste Amount (t)
Average Waste Amount (t) / Average Trips Number
The Time


Waste Amount at Dump. Site
Percentage
The Others
Construction Debris
Industrial Non-Municipale Waste
OutSide Homs
In Homs Municipale Waste
Waste Source

The Day	The Date	Municipal Waste		Non-Municipal Waste		
		In Homs	Outside Homs			The Others
Saturday	2001/8/11	778.20	42.93			73.19
Total (t)	Sub Total	821.13		77.36		
Overall (t)	Total	898.49				
Sunday	2001/8/12	1189.50	6.40			51.92
Total (t)	Sub Total	1195.90		67.24		
Overall (t)	Total	1263.14				
Monday	2001/8/13	1013.14	16.39			46.27
Total (t)	Sub Total	1029.53		73.10		
Overall (t)	Total	1102.63				
Tuseday	2001/8/14	1231.04	14.93			56.15
Total (t)	Sub Total	1245.97		78.70		
Overall (t)	Total	1324.67				
Wednesday	2001/8/15	996.52	47.28			64.66
Total (t)	Sub Total	1043.80		97.48		
Overall (t)	Total	1141.28				
Thuresday	2001/8/16	1174.55	36.61			87.91
Total (t)	Sub Total	1211.16		139.00		
Overall (t)	Total	1350.16				
Friday	2001/8/17	894.31	43.40			45.76
Total (t)	Sub Total	937.71		57.00		
Overall (t)	Total	994.71				
Saturday	2001/8/18	1142.72	74.25			98.44
Total (t)	Sub Total	1216.97		113.80		
Overall (t)	Total	1330.77				
	Total	Municipal Waste		Non-Municipal Waste		
		In Homs	Outside Homs			The Others
		8419.98	282.19	94.67	84.71	524.30
	Total	Municipal Waste		Non-Municipal Waste		
		In Homs	Outside Homs			The Others
		1052.50	35.27	11.83	10.59	65.54



SECTION 3

COMPOSTING PLAN

SECTION 3 COMPOSITING PLAN

3.1 COMPOST DEMAND SURVEY

3.1.1 General

The objective of the survey is to determine the extent of the potential market for compost in Homs. The survey was started on 11th June 2001 and collected data through interviews with selected farmers in the study area. General conditions are as follows:

(1) Study Area

Study area is within 50 km from proposed new compost plant in Homs.

(2) Survey Method

The survey is made by interviewing the following assembly, cooperative, organic fertilizer seller, and 80 selected farmers by questionnaires as well as showing typical samples of compost produced in the existing compost plant in Damascus.

- Farmers Union
- Assembly
- Farmers cooperative

(3) Selection of Farmers to be Interviewed

- 80 large-scale farmers are selected for the interview within 50 km from proposed new compost plant

3.1.2 Collection of Related Information

Main collected information is as follows.

(1) General Information

1) Farmers' Union Organization

Homs Farmers' Union consists of seven (7) Assemblies, i.e. Eastern Center, Weatern Center, Ar-Rastan, Tall-Qusair, Al-Mokharram and Tadmour. These Assemblies consist of 627 cooperatives and 2 cooperatives belong to the Union directry.

Figure 3.1.1 shows Homs Farmers' Union Organization Chart.

2) Market Flow of Fertilizer

It is supposed that the farmers purchase organic fertilizer such as cow manure from sellers and chemical fertilizer from the farmers' Assembly as same way as Lattakia.

3) Land Use

277,000 ha, approximately 6.6 % of total area in Homs in 1999, is cultivated land as shown in Table 3.1.1.

Table 3.1.1 Land Use in Lattakia in 1998

Land		Area (1,000ha)
Cultivated land	Irrigated	50
	Non-irrigated	227
	Sub-total	277
Uncultivated		138
Sub-total of arable land		415
Uncultivable land		1,145
Steppe and Pasture		2,617
Forest		46
Total		4,223

Source: The Statistics Bureau in The Ministry of Agriculture

4) Chemical Fertilizers

Around 10,000 to 20,000 ton of chemical fertilizer is utilized every year and the selling cost range from approximately 5,000 to 12,000 SP/ton. The detail is shown in Table 3.1.2 and 3.1.3.

Table 3.1.2 Production and Price of Chemical Fertilizers

Fertilizers	Nitrogen			Phosphate	Potassium	Total
	Urea	33% Nitrate	30% Nitrate	P_2O_5	K_2O	
Price (SP per ton)	6,820	6,300	5,165	8,180	12,100	-
Production (ton)						
1995	9,013			4,506	776	14,295
1996	8,870			3,685	735	13,290
1997	8,101			3,116	595	11,812
1998	9,026			3,681	677	13,384
1999	7,527			3,168	616	11,311

Source: The Statistics Bureau in The Ministry of Agriculture

Table 3.1.3 Agricultural Bank Sales of Chemical Fertilizers

	Supper Phosphate	Urea 46%	Ammonium 30%	Total
1999	4,273	9,078	4,911	18,263
2000	6,121	9,626	3,682	19,429

Source: Agricultural Bank

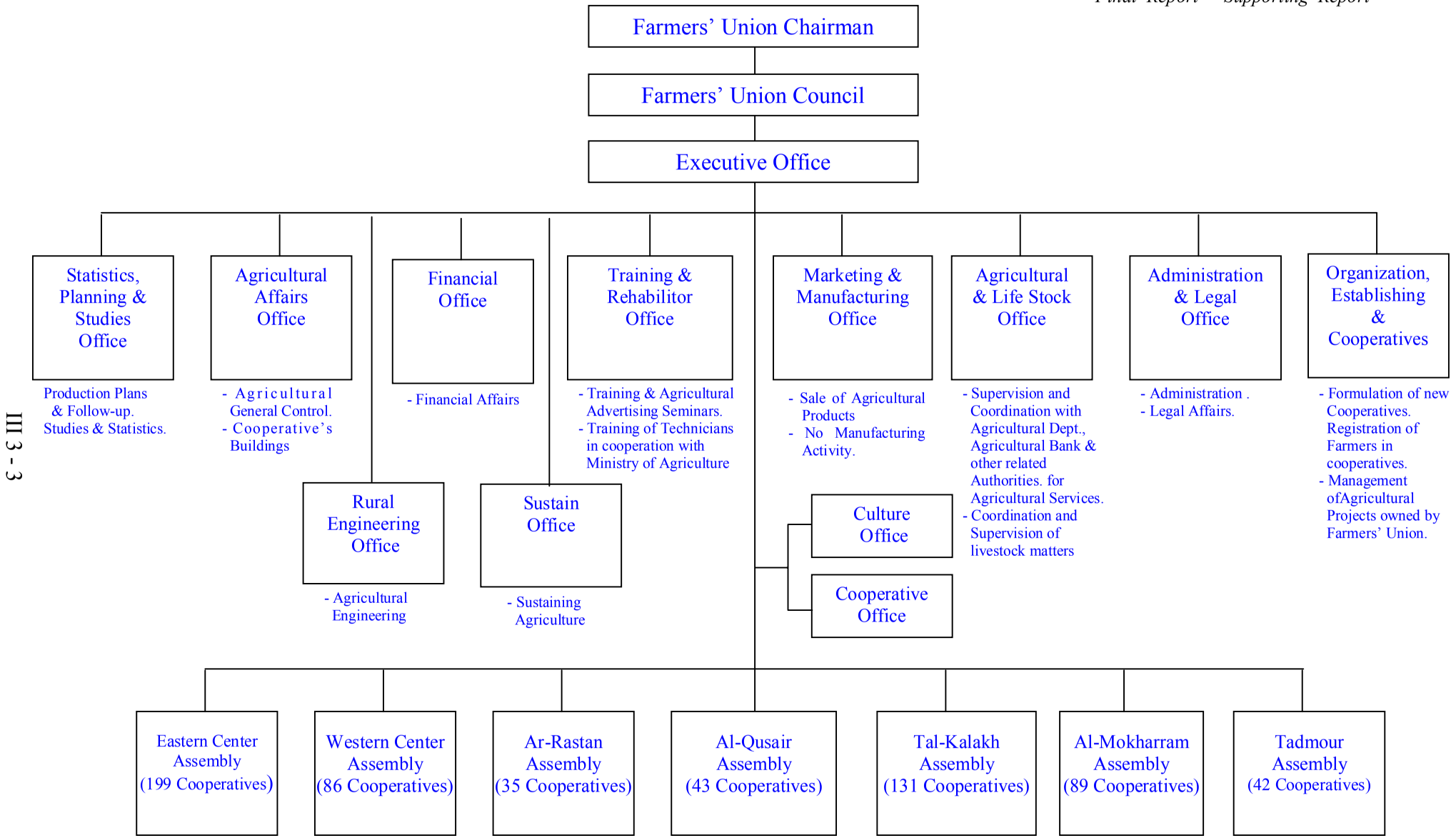


Figure 3.1.1 Farmers' Union Chart

5) Organic Fertilizers

Approximately 550,000 ton to 850,000 ton of organic fertilizes are produced every year and the selling cost ranges from 900 to 1,700 SP/ton as shown in Table 3.1.4.

Table 3.1.4 Production and Price of Organic Fertilizers

Year	Cattle	Sheep and Goats	Poultry	Total
Price (SP per ton)	900	1,000	1,700	-
1995	268,152	230,374	781,670	577,196
1996	290,551	240,344	89,415	620,310
1997	305,478	252,599	90,817	648,894
1998	416,736	347,488	88,067	852,291
1999	441,130	297,181	105,526	843,837

Source: Estimated value using number of livestock

6) Agricultural Production

In 1999 about 52 % of agricultural production was Crops, Vegetables and 48 % was fruits. Table 3.1.5 shows the agricultural production in the last 5 years.

Table 3.1.5 Agricultural Production

Year	Crops and Vegetable		Fruits		Total	
	IRRI	NON-IRR	IRRI	NON-IRR	IRRI	NON-IRR
1995	41,917	204,600	10,578	63,083	52,495	267,683
	246,517		73,661		320,178	
1996	42,486	147,279	10,556	68,782	53,042	216,061
	189,765		79,338		269,103	
1997	344,934	153,068	68,033	140,244	412,967	293,312
	498,002		208,277		706,279	
1998	344,103	170,583	90,184	251,660	434,287	422,243
	514,686		341,844		856,530	
1999	221,947	64,385	97,182	172,106	319,129	236,491
	286,332		269,288		555,620	

Source: The Statistics Bureau in The Ministry of Agriculture

(2) Soil Condition

1) Agricultural Settlement

Syria was divided into five agricultural settlement zones. Homs includes all of these zones.

a. First one: Distinguished by annual rainfall over 350 mm. The first zone itself was divided for two divisions:

- An area with annual rainfall over 600 mm. Where non-irrigated crops could be successfully planted.
- An area with annual rainfall between 350-600, and not less than 300 mm during two thirds of the related period i.e. it is possible to get two yield crops seasons each three years.

b. Second zone: Distinguished by annual rainfall rate between 250-350 mm and less than 250mm, during two third of related years. It is possible to get two barley seasons each three year besides planting. Barley wheat pluses and summer crops could be planted.

c. Third zone with annual rainfall rate over 250 mm and not less than this during the half of the relative years i.e. it is possible to get one or two yield seasons each three years. The main crop is barley. Pluses could be planted.

d. Fourth (Marginal) zone: Distinguished by annual rainfall rate between 200-250 mm and not less than 200 mm, during the half of the related years. Barely is planted in this zone and is good as permanent grazing land.

e. Fifth (Desert or semi -desert) zone: It covers what remains of the governorate land. It is not suitable for non irrigated planting.

2) Soil Group

Homs is the biggest governorate in Syria having approximately 4 million hector area equivalent to 22% of the area of Syria.

However, approximately 60% of soil in Homs is desert and 16% belongs to Gypsiferous (infertile land)

The detail is shown in Table 3.1.6.

Table 3.1.6 Soil Condition of Lattakia
Total Area *(Hectare)*

	Eastern Center Assembly	Western Center Assembly	Talkalakh Assembly	Ar-rastan Assembly	Al-mokharram Assembly	Al-qusair Assembly	Tadmour Assembly	Total
First Zone	50,199	227,660	336,650	141,546	-	29,031	-	448,436
Second Zone	342,157	-	-	64,750	164,094	71,209	-	478,116
Third Zone	133,701	-	-	-	356,145	98,116	-	587,962
Fourth Zone	515,087	-	-	-	36,790	900	-	552,777
Fifth Zone	3,754	-	-	-	-	-	20,144	23,898
Total	1,044,889	227,660	336,650	206,296	557,029	199,296	20,144	2,591,964

Source: Farmers' Unoin

(1,000 hectares)

Soil Groups	Red Mediterranean	Grumusol	Cinamonic	Desert	Gypsiferous	Groundwater Soil	Total
Area	38	157	936	2,395	672	24	4,222

Source: The Statistics Bureau in the Ministry of Agriculture

Red Mediterranean Group: This group describes the soil formed at the Mediterranean coast (for this reason it called Mediterranean)or similar soils. It is a mix of clay, sand, and lime. The clay may be yellow, black, or red. The red is the most common (for this reason it called red).

Grumusol: Dark red and brown soils. Fertile land

Cinamonic: Brownish yellow soils. Fertile land

Desert: Deserty land (Sand or soil have very low content of organic matter). Infertile land

Gypsiferous: Soil has a high contents of gypsum. Infertile land

Groundwater Soil: The soil formed by ground water. Fertile land.

3.1.3 Interview Survey of Farmers' Awareness of Compost

The interview was done using questionnaire and showing sample of compost produced in Damascus compost plant.

The interview sheet (questionnaire) and result are attached as Appendix.

Survey conclusions are as follows:

(1) Questionnaire

The questionnaire included the following items:

(1) General Information: distance form the compost plant to be constructed, planted area etc.

(2) Soil Condition: Land origin [Q1], Soil type [Q2], and Soil problems (if any)[Q3]

(3) Crop and Planted Area: Cereal crops [Q4], Vegetables [Q5], Fruits [Q6], Industrial [Q7]

(4) Irrigation: Irrigation system [Q8], Irrigation source [Q9], Water availability [Q10], Water quality [Q11],

(5) Fertilizer: Chemical fertilizer [Q12], Organic fertilizer [Q13], Compost and its effects [Q14], [Q15], [Q16], [Q17], [Q18], [Q19]

(6) Farm Management: Annual income [Q20], Subsidy [Q21], Annual cost [Q22]

(7) Suggestions: Other suggestions to the compost plant (if any) [Q23]

(2) Farmer Attitudes Toward Compost

1) knowledge about Compost

Farmers who have a knowledge about compost: 19 %
Farmers who have not a knowledge about compost: 81 %
(Summary-Q14)

2) Utilization of the Compost (for farmers who know the compost)

Farmers who utilize the compost: 0%
Farmers who do not utilize the compost: 100%
(Summary- Q15)

3) Reasons for not Utilization the Compost (for farmers who know the compost)

Crops do not require: 13%
Don't sure from its effects: 33%
Not available: 54%
(Summary – Q16)

4) Farmers' attitudes toward Compost

Positive attitude:	81%
Negative attitude:	4%
Doubtful attitude:	15%

(Summary-Q17)

5) Interest in Knowledge about the Compost and its Effects

Yes:	75%
No:	22.5%
No decision:	2.5%

(Summary –Q18)

6) Interest in Purchasing Compost

Yes:	70% *
No:	26%
No decision:	4%

(Summary- Q19-1)

(12.5% of them make the condition that compost must be tested)

(3) Conclusions from Farmers' Attitudes

The following conclusions could be drawn from the farmers attitudes:

1) Shortage in Awareness about Compost and its Effects

Shortage in awareness about compost and its effects are very clear when the summary of the questionnaire's results are reviewed. This shortage could be shown in the following:

- 81 % do not have knowledge about compost. (Summary-Q14)
- 33 % from the farmers who have a knowledge about compost do not sure from its effects.(Summary-Q16)
- 20 % of the all 80 farmers have the opinion that compost must be tested before distributing it to them.(Summary-Q25)

2) Good Interest in Compost

75% of the farmers are interested in knowledge about compost and its effects.

Table 3.1.7 shows the answer to the questionnaire from farmers who have knowledge about compost.

Table 3.1.7 Answer to Questionnaire

No.			1	2	3	4	5	6	7	8
			6	8	21	28	29	41	54	64
Farm General Data		Owner	Abdollah Swees	Haidar Hwees	Talal Al-Boza	Mamon Al-Eter	Mosstafa Raed	Abdou Frish	Ibrahim Yousef	Solayman Sardeh
		Village	Talbiseh	Talbiseh	Tal Ward	Al-Qusair	Al-Qusiar	Al-Ghor	Rabah	Al-Hwash
		Region	Al-Rastan	Al-Rastan	Al-Mokharram	Al-Qusair	Al-Qusiar	Talkalakh	Talkalakh	Talkalakh
		Area (Donom)*	465	215	560	3	18	40	10	35
Soil Condition	Q1	Land Origin	Traditional farming	Traditional farming	Traditional Farming	Traditional farming	Traditional farming	Traditional farming	Traditional farming	Traditional farming
	Q2	Soil Type	Dark brown and red clay	Dark brown and red clay	White calcareous & Dark Brown	White calcareous	White calcareous	White and black calcareous	Dark brown and Black calcareous	Dark brown and red clay
	Q3	Soil Problem(s)	-	-	-	-	-	-	-	-
(kind-Area [Donom]-production [Ton])	Q4	cereal	Aniseed 20D- 1.5T	Wheat 60D-18T Barely-140D- 28T Chick pea - 15D - 1.5T	Wheat-150D- 6T Barely-250D-12T	-	-	Wheat-20D-5T Barely-20D-5T	-	-
	Q5	Vegetables	-	-	-	-	-	-	-	-
	Q6	Fruits	Olive - 45D - (Young trees)	-	Almond-120D- (Young trees0) Olive-40D- (Young trees)	Apple- 3D- 2T	Apple-40D- 40T-	-	Grape-4D-1T Apple-5D-5T	Olive -20D-40T
	Q7	Industrial	-	-	-	-	-	-	-	Tobacco-15D-4T
Irrigation	Q8	System	Surface	Non irrigated	Non Irrigated	Drip	Surface & drip	Non irrigated	Surface	Sprinkle and drip
	Q9	Source	Groundwater			Groundwater	Groundwater		Surface canal	Surface canal
	Q10	Availability	Not sufficient			Sufficient	Sufficient		Sufficient	Sufficient
	Q11	Quality	Good			Good	Good		Good	Good
Fertilizers Quantity in Ton	Q12	Chemical	10	4	-	0.2	3	0.5	0.4	1
	Q13	Organic	20	-	1	3	3	-	5	2
Farm Economics (SP.)	Q20	Income	2,000,000	300,000	100,000	30,000	250,000	80,000	60,000	220,000
	Q21-Q22	Expenses	700,000	100,000	-	5,000	50,000	25,000	20,000	100,000
		Profit	1,300,000	200,000	100,000	25,000	200,000	55,000	40,000	120,000
		Loose	-	-	-	-	-	-	-	-
Attitudes Toward Compost	Q14	Knowledge	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Q15	Utilizing	No	No	No	No	No	No	No	No
	Q16	Reasons for not purchasing	Not available	Not available	Crops do not need	Not available	Not available	Crops do not require	Not available	Do not no its real effects
	Q17	Opinion	Good	Good	Must be tested	Good	Good	Good	Good	Good
	Q18	Interest in purchasing	Yes	Yes	No	Yes	Yes	No	Yes	Yes if it tested to be good
	Q19	Possible purchased quantity(Ton)	20	20T	No decision	3	3	-	2	No decision
Suggestions (for Compost)	Q23		Establish distribution centers	Establish distribution centers	Compost with high quality	Compost with good quality	Low price	-	Establishing distribution centers	Compost must be tested

No.			9	10	11	12	13	14	15
			65	67	68	69	71	78	80
Farm General Data		Owner	Ebrahim Msardeh	Soheel khoori	Mttanious Makhkhool	Elias Safar	Jorjos Kassab	Hani Mathla	Esa Al-Tarsha
		Village	Al-Hwash	Al-Hwash	Al-Mosherfeh	Zaidal	Zaidal	Qattineh	Qattineh
		Region	Talkalakh	Talkalakh	Homs	Homs	Homs	Homs	Homs
		Area (Donom)*	75	15	90	1180	123	30	23
Soil Condition	Q1	Land Origin	Traditional farming	Traditional farming	Reclaimed land	Traditional farming	Traditional farming & reclaimed	Traditional farming	Traditional farming
	Q2	Soil Type	White calcareous and red clay	White calcareous and red clay	Dark brown	Dark brown and red clay	Dark brown	Silt	Dark brown
	Q3	Soil Problem(s)	-	-	-	-	-	-	-
(kind- Area [Donom]-production [Ton])	Q4	cereal	-	-	Barely-14D-2T	Wheat - 200D- 80T	Wheat - 40D - 8T	Wheat -15D - 5T	Wheat -13D - 2T Barely -10D - 2T
	Q5	Vegetables	Potato-15D-20T	Potato-2D-0.5T	Eggplant-1D-3T	Potato –100D- 200T Cabbage–40D – 100T Tomato– 400D- 3000T Green pea – 60D- 40T Water melon –50D – 400T Sugar beet – 80D- 400T	Potato-20D - 40T Cabbage-5D - 20T Cauliflower-5D - 35T Eggplant-3D- 4T	Potato-15D - 5T	Potato-5D- 8T Sugar beet-5D - 8T
	Q6	Fruits	Apple-15D-30T Olive-20D-12T	Olive-6D-2T	Grape-45D-12T Almond - 15D - (Young trees)	Almond -250D- (Young trees)	Almond-40D - 35T Olive-15D - 3T	-	-
	Q7	Industrial	Tobacco-25D-5T	Tobacco-2D-0.4T	-	-	-	-	-
Irrigation	Q8	System	Sprinkle and drip	Sprinkle and drip	Surface	Surface -sprinkle - drip	Sprinkle	Sprinkle	Sprinkle
	Q9	Source	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Ground water	Ground water
	Q10	Availability	Sufficient	Sufficient	Not sufficient	Sufficient	Not sufficient	Sufficient	Sufficient
	Q11	Quality	Good	Good	Good	Good	Good	Good	Good
Fertilizers Quantity in Ton	Q12	Chemical	2	0.5	0.2	18	2	1.2	2
	Q13	Organic	15	2	3	1000	35	12	12
Farm Economics (SP.)	Q20	Income	450,000	120,000	120,000	10,000,000	200,000	170,000	180,000
	Q21-Q22	Expenses	150,000	25,000	10,000	4,000,000	50,000	70,000	80,000
		Profit	300,000	95,000	110,000	6,000,000	150,000	100,000	100,000
		Loose	-	-	-	-	-	-	-
Attitudes Toward Compost	Q14	Knowledge	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Q15	Utilizing	No	No	No	No	No	No	No
	Q16	Reasons for not purchasing	Do not its real effects	Do not know its real effects	Do not know its real effects	Not available	Not available	Do not know its real effects	Not available
	Q17	Opinion	No decision	Good	Good	Good	Good	Must be tested	Must be tested
	Q18	Interest in purchasing	No(use organic fertilizer)	Yes	Yes	Yes	Yes	Yes (After testing compost)	Yes (After testing compost)
	Q19	Possible purchased quantity(Ton)	-	1	3	200	15	8	5
Suggestions (for Compost)	Q23		No decision	Good quality	Plant must be far from the region	Compost must be tested	Low price	Compost must be tested	Compost must be tested

3.1.4 Estimated Amount of Compost Demand in Homs

According to results of compost demand survey, compost demand in Homs could be estimated for four levels as follows.

(1) Compost Demand at Level 0

Level 0 will consider that there is no demand at present since there are no farmers using compost at present.

(2) Compost Demand at Levels 1

Level 1 and next level 2 will consider only the 15 farmers who have knowledge or experience with compost.

The survey shows the following data about these 15 farmers:

a. 8 farmers do not utilize compost because it is not available

- 7 of them are willing to purchase the compost if it is available in good quality, low price, and proper distribution (Applying 263 ton/year for 2,014donom). It is noted that one of 7 farmers owns 1,180 donoms and wants to buy 200 ton of compost. Therefore, other six (6) farmers have 843 donoms and want to buy 63 ton of compost.
- 1 farmer of them is willing to purchase the compost after being tested and turn to be good (Applying 5 ton/year for 23donom).

b. 5 farmers do not utilize compost because they don't know it real effects.

- 3 of them are willing to purchase compost (17 ton/year for 158donom) after the compost being tested ant turn to be good.
- 2 of them are not interested in purchasing compost.

c. 2 farmers said that there is no need for compost in there farms.

Level 1 demand estimation will depend on the farmers who are willing to purchase compost without the condition of testing compost.

1) Level 1-1

- Based on number of farmers:
  (7-person/80 person) x 2,771,690x (263 ton/year / 2,014donom)
  = 31,670 ton/year (86.8 ton/day)

- Based on the farms area:
  (2,014 donom/7,573 donom) x 2,771,690 x (263 ton/year / 2,014donom)
  = 96,250 ton/year (263.7 ton/day)

2) Level 1-2

One farmer has an extraordinary farm's area. If we exclude it, then:

- Based on number of farmers:
  (6 person/79 person) x 2,771,690x (63 ton/year / 843donom)
  = 15,900 ton/year (43.6 ton/day)
- Based on the farms area:
  (843 donom/6,394 donom) x 2,771,690 x (63 ton/year / 843donom)
  = 27,310 ton/year (74,8 ton/day)

If we take a conservative estimation the compost demand during this period could be approximately 50 ton/day.

(3) Compost Demand at Level 2

This demand estimation will depend on the farmers who are willing to purchase compost after the compost tested and turn to be good.

- Based on number of farmers:
  (4 person/80 person) x 2,771,690x (17 ton/year / 158donom)
  = 14,910 ton/year (40.9 ton/day)
- Based on the farms area:
  (158 donom/7,573 donom) x 2,771,690 x (17 ton/year / 185donom)
  = 6,220 ton/year (17.0 ton/day)

If we take a conservative estimation the additional compost demand during this period could be 25 ton/day.

This quantity must be added to the quantity at level 1.

Therefore, the compost demand at level 2 will be approximately 75 ton/day.

(4) Compost Demand at Level 3

At level 3, the farmers who have not any knowledge about compost according to the survey and they get this knowledge during the last periods, will be considered in compost production.

The survey shows for these farmers:

- 70% of the farmers are willing to purchasing compost.
- Total area of this farmers land is 4,892 donom.
- Total area of surveyed farms is 7,573 donom.
- These farmers apply 0.125 ton of compost per donom.
- Homs has an are of under cropland of 2,771,690 donom.

Therefore, Homs demand of compost at this level is:

- Based on the number of farmers

0.7 (70%) x 0.125 (ton/donom) x 2,771,690 (donom) = 242,523 ton/year

As a conservative estimation* we can adopt the number 200,000 ton/year as Homs demand for Compost, that mean 550ton/day

* About 12.5% of farmers who want to purchase compost make a condition that compost must be tested and proved to be suitable for them.

- Based of the farms area

0.65 (4,892/7,573) x 0.125 (ton/day) x 2,771,690 (donom) = 225,199 ton

As a conservative estimation* we can adopt the number 180,000 Ton/Year as Homs demand for Compost. That mean 500 ton/day.

* About 12.5% of farmers who want to purchase compost make a condition that compost must be tested and proved to be suitable for them.

We could choose the number 500 ton/day as an conservative number.

3.2 OUTLINE OF MASTER PLAN FOR COMPOST PLANT

According to the Master plan prepared by COWI consulting Engineers and Planners AS (Mediterranean Environmental Technical Assistance / METAB – European Investment Bank/EIB Study), Compose plant will be implemented as follows.

3.2.1 Waste from Vegetable Markets, Parks and Gardens

(1) Composting Scheme

The first step in possible implementation of composting schemes in the City of Homs will be to introduce composting of waste from vegetable markets, parks and gardens. These wastes (green waste) will be relatively easy to separate and the waste will also be suitable for a simple composting process and result in high quality compost.

(2) Cost Estimate

Base on the waste amounts recorded in the City of Home a plant with a capacity of 7,500 ton/year is found suitable. The following costs estimate has been prepared for the composting plant (all prices in 2 ,000 level)

d. Investments: 1.5 mill SP

e. Annual operation and maintenance costs

- Capital cost: 3.5 mill SP
- Operation costs: 2.9 mill SP
- Cost per unit: 850 SP/ ton excl. sale of compost
- Cost per unit: 2,100 SP/ton compost excl. sale of compost

f. Sale of compost: 3 mill SP (3,000 ton compost/year x 1,000 SP/ton compost)

3.2.2 Household Waste

(1) Initial Step

1) Test Trial Period

The implementation of a new landfill site with related transfer facilities has the highest priority in the future waste management system of the City of Homs.

Furthermore, implementation of composting plant for waste from vegetable markets, parks and gardens is recommended as the first step in the introduction of composting.

In order to establish the necessary capacity in the City of Homs to cope with the new waste systems it is suggested to postpone the start of the composting test trial for household waste to 2006-2008. The trial should go on for 1.5-2 years in order to ensure reliable operation experience through all the seasons and full matured compost, which has been analyzed and tested in terms of growth media.

2) Test Plant Location

The test plant is suggested located at an area adjacent to the transfer station. This area is situated east of the village Zeal that is a kind of suburb of Homs City or at the existing dumpsite. The area at Zeal is surrounded by agricultural land mainly used for olive and fruit production. This may cause some restrictions on the composting process procedures in order to reduce the risks of airborne emissions to the neighboring areas.

3) Test Plant Outline

Considering the aim of the test trial, the outline of the test compost plant will be rather simple as the annual quantity will be only about 4,000 ton.

An area of 8,000-10,000 m^2 is leveled and paved and surrounded by a 2m high fence. Surface water is collected in ditches and an internal sewer system connected to a collection pond/well. By pumping the collected water is discharged on the material to be composted.

The area is divided into three zones: an unloading/control zone, a composting process zone and a compost storage zone. The zones are flexible in terms of position and extend.

The machinery needed includes a wheel loader with a big bucket, a mobile shredder and a drum sieve. The latter machine could be rented.

4) Composting Concept

The process concept of the test plant will be windrow composting without forced aeration. The process includes the following steps: unloading and control of quality of the delivered waste and mechanical feeding of the mobile shredder by the wheel loader (the shredder establishes a low windrow). Every second day two low windrows are compiled into one big windrow. Frequent turning over of the big windrows during 3-4 months (once a week in the start).

By use of the wheel loader. Maturing of the compost in big heaps for 2-4 months until the compost is fully decomposed and stable. Screening of the compost in the specified particle size.

5) Cost Estimate

The following costs estimate has been prepared for the test plant with a capacity of 4,000 ton/year (all prices in 2,000 level)

g. Investments: 16 mill SP

h. Annual operation and maintenance costs

- Capital cost: 2.7 mill SP
- Operation costs: 2.4 mill SP
- Cost per unit: 1,300 SP/ ton excl. sale of compost
- Cost per unit: 3,200 SP/ton compost excl. sale of compost

i. Sale of compost: 1.6 mill SP (1,600 ton compost/year x 1,000 SP/ton compost)

(2) Further Steps

Based on the collected experience regarding the collection scheme, the plant operation and the obtained compost quality, decisions are made concerning the development of the composting scheme. Provided the test trial is successful, the composting plant is extended to the capacity of 35,000 ton p.a. and later on to 70,000 ton p.a. Treating such a quantity will require extended control of the decomposing processes as to facilitate the possibility of taking immediate actions in case something unexpected is happening in the process.

(3) Step 2

1) Developed Outline

It is suggested to establish a rotating drum to ensure a controlled start up of the processes before the material is placed in windrows to decompose. The waste retention time in the rotating drum is determined when detailing the outline. The windrows are placed on the paved area, which - to some extend - will be equipped with built-in aeration channels to ensure forced aeration of the material.

2) Cost Estimate

The following costs estimate has been prepared for the extension of the plant with to a total capacity of 35,000 ton/year (all prices in 2000 level)

a. Additional investments: 127 mill SP

b. Annual operation and maintenance costs

- Capital cost: 21 mill. SP
- Operation costs: 14 mill SP
- Cost per unit: 1,000 SP/ ton excl. sale of compost
- Cost per unit: 2,500 SP/ton compost excl. sale of compost

c. Sale of compost: 14 mill SP (14,000 ton compost/year x 1,000 SP/ton compost)

(4) Step 3

1) Developed Outline

It is necessary to enlarge the rotating drum and the composting/maturing areas to cope with the increased quantities.

2) Cost Estimate

The following costs estimate has been prepared for the extension of the plant with to a total capacity of 70,000 ton/year (all prices in 2,000 level exclusive of moms):

a. Additional investments: 128 mill SP

b. Annual operation and maintenance costs

- Capital cost: 40 mill. SP
- Operation costs: 28 mill SP
- Cost per unit: 930 SP/ ton excl. sale of compost
- Cost per unit: 2,300 SP/ton compost excl. sale of compost

c. Sale of compost: 28 mill SP (28,000 ton compost/year) x 1,000 SP/ton)

SECTION 4

COLLECTION AND TRANSPORT

SECTION 4 COLLECTION AND TRANSPORT

4.1 TIME AND MOTION STUDY IN HOMS

4.1.1 Purpose of the Study

The purpose of this study is to understand the present waste collection situation in Homs.

The main scope of this study is as follows:

- Effective using of the collection facility
- Efficiency of the operation system of solid waste collection and transport
- Discharge method and discharged location
- Workers' activity

4.1.2 Study schedule

Four trucks were selected to represent the following collection and transport element.

- Truck type
- Collection area
- Discharge method
- Collection shift

Time schedule of this study is as follows:

Table 4.1.1 Collection Vehicle for TIME and Motion Study

Date	Maker	Vehicle type	Studied area	Studied shift
2001/07/17	Mack ($10m^3$)	Compactor with loading system	Baba-Amr (low income)	Morning (7 a.m. to 3 p.m.)
2001/07/18	Toyota ($8m^3$)	Compactor with loading system	Wadi Al-Dahab (low income)	Morning (7 a.m. to 3 p.m.)
2001/07/19	Toyota ($3m^3$)	Manual fill Compactor	Old city, Market	Night (9 p.m. to 5 a.m.)
2001/07/21	Freight Liner ($15m^3$)	Compactor with loading system	Al-Ghouta (high-income)	Night (9 p.m. to 5 a.m.)

Study results in Homs are summarized in Table 4.1.2.

Table 4.1.2 Results of Time and Motion Study in Homs

Veh No.	Maker	Type of Vehicle	Shift	Capacity (m^3)	No. of Worker*	Trips	Total Collected Amount (t)	Crew's Workload (t/crew)	Collection Efficiency (min/ton)	Transport Velocity (km/hr)
1	Mack	Mechanical Compactor	Morning	10	3	3	17.6	5.9	13.4	19.4
2	Toyota	Mechanical Compactor	Morning	8	4	2	10.9	2.7	29.4	21.4
3	Toyota	Mechanical Compactor	Night	3	3	2	3.6	1.2	28.1	15.2
4	Heil	Mechanical Compactor	Night	15	3	3	9.3	3.1	36.2	31.5

4.2 PRESENT VEHICLES IN HOMS

(1) Municipal Waste Collection equipment

Table 4.2.1 Present waste Collection Equipment in Homs

Type	Manufacturer	Load capacity (m^3)	Nos.	Purchase year
Compactor	Heil (Freight Liner)	15	4	1996
		15	5	1997
		15	2	1998
	Zel	4	1	1957
	Mack	10	11	1978
	Mercedes	10	1	1954
	Kamaz	10	1	1980
	Nissan	10	1	1999 (Engine 1975)
	Toyota	8	4	1986
	Toyota	3	5	1986
Tractor	Somega	4	3	1973
	Forat	4	7	1993
		4	3	1995
		4	4	1997
Dump Truck	Mercedes	6	1	1954
	Nissan	12	1	1975
	Fiat	12	2	1975
Total			56	
Wheel				
Loader	Case	2	1	1995
	Case	0.5	1	1995
	Denber	0.5	2	1993

Source: Cleanliness division in Homs city

Note: Excluded out of use.

Table 4.2.2 Present sweeping equipment in Homs

Type	Maker	Load capacity (m^3)	Nos.	Purchased year
Sweeper	Eligin	1	6	1975
Water Tank	KMC	5	1	1971
Water Tank	Fiat	12	1	1975
Tractor	(Syria)	4	3	1994
			1	1995
Total			12	

Source: Cleanliness division in Homs city

Table 4.2.3 Present Equipment for Construction Debris in Homs

Type	Maker	Load capacity (m^3)	Nos.	Purchased year	Purposes
Insecticide truck	(Syria)	0.5	2	1995	Insecticide
		2	3	1995	
		4	1	1995	
	KMC (US)		1	1970	
	GMC (US)		1	1960	
	Avia (Romania)		1	1960	
Transfer truck	Fiat		3	1965	Transferring workers/ workshop
	Avia		1	1970	
Vehicle	Toyota		1	1988	Transport for supervisors
	Mazda		1	1996	
Motorcycle	(Russia)		1	1970	
Dump truck	Fiat	12	1	1975	Dir Baalbeh D/S
Loader	(Germany)	2	1	1999	
Total			18		

Source: Cleanliness division in Homs city

4.3 OPERATION AND MAINTENANCE

4.3.1 Data of Collection Vehicle for Priority Project

(1) Basic Condition

Basic condition: Collection efficiency in the collection area

	20 min/ton for container collection 35 min/ton for hand collection
Transport speed	30 km/h
Tractor speed	15 km/h
Discharge time	10 min
Rest	60 min
Working period in one shift	8 hours (incl. 1hr' rest)

(2) Available Trips and Capacity for each Equipment

Table 4.3.1 Load capacity for each equipment in 2006

Vehicle type	Capacity	Available trips per one shift	Load capacity per one shift (ton/shift/unit)	Necessity vehicles (unit)
Medium compactor	$8m^3$	3.38	9.73	39
Small compactor	$4m^3$	3.65	5.26	6
Dump truck	$6m^3$	3.29	5.68	5
(Heil compactor)	$15m^3$	2.24	12.10	11
(Nissan compactor)	$10m^3$	2.96	10.65	1
(Tractor)	$4m^3$	2.90	3.34	14
Total				76

Note: ( ) indicates present vehicles used in 2006

4.4 COST OF SOLID WASTE COLLECTION AND TRANSPORTATION

(1) Conditions for Estimation

(1) Salaries

Supervisor:	127,983 sp/year
Driver:	87,456 sp/year
Collection worker:	73,200 sp/year

(2) Fuel and lubricants

Fuel (diesel) unit cost:	6.5 sp/liter
Operation time:	8 hours
Lubricants:	20% of annual fuel cost

Table 4.4.1 Fuel and Lubricants Cost for each Equipment Unit

Vehicle type	HP	Fuel consumption	Amount of fuel		Annual fuel cost	Total (incl. Lubricants)
		Lit/hp/hr	Lit/day	Lit/year	Sp/unit	Sp/unit
Large compactor	300	0.04	96	28,032	182,208	218,650
Medium compactor	140	0.04	44.8	13,082	85,030	102,036
Small compactor	110	0.04	35.2	10,278	66,810	80,172
Tractor			52.7	15,388	100,025	120,030
Dump truck	120	0.04	38.4	11,213	72,883	87,460
Wheel loader	120	0.115	110.4	32,237	209,539	251,447
Others	120	0.03	28.8	8,410	54,662	65,595
Mechanical sweeper	110	0.048	42.24	12,334	80,172	96,206
tank truck	120	0.03	28.8	8,410	54,662	65,595

(3) Maintenance and repairs (40% of vehicle cost)/(vehicle age)

(4) Indirect cost and misc. 20% of the above costs

Investment costs covered purchase of equipment for renewal. Costs and haulage capacities are shown below:

Table 4.4.2 Unit Cost of Equipments to be Procured

	(SP)
8 m^3 compactor	3,424,000
4 m^3 compactor	2,336,000
6 m^3 dump truck	1,784,000
Wheel loader	7,008,000
Others	2,816,000
3,000 liter tank truck	2,816,000
3 m^3 road sweeper	4,096,000
1 m^3 container	6,500

Investment cost and operation cost from the year 2001 to 2006 is shown in the following Table 4.4.3.

Table 4.4.3 Total cost for collection and transport from 2001 to 2006

(Unit: SYP)

Year	Investment Cost	O/M Cost	Total
2001		113,268,657	113,268,657
2002		113,268,657	113,268,657
2003	201,995,500	112,654,734	314,650,234
2004		112,654,734	112,654,734
2005		112,654,734	112,654,734
2006		112,654,734	112,654,734
Total	201,995,500	677,156,248	879,151,748

Table 4.4.4 Procurement and O/M Cost in Homs

(Unit: SYP)

	Unit	2001	2002	2003	2004	2005	2006
1. Personnel	SP	72,442,176	72,442,176	71,072,676	71,072,676	71,072,676	71,072,676
2. Fuel and Lubricants	SP	11,354,838	11,354,838	11,761,162	11,761,162	11,761,162	11,761,162
3. Maintenance and Repairs	SP	10,593,533	10,593,533	11,045,107	11,045,107	11,045,107	11,045,107
4. Indirect and Misc. Cost	SP	18,878,109	18,878,109	18,775,789	18,775,789	18,775,789	18,775,789
Total O/M Cost	SP	113,268,657	113,268,657	112,654,734	112,654,734	112,654,734	112,654,734
Procurement Cost	SP			201,995,500			
Total Cost	SP	113,268,657	113,268,657	314,650,234	112,654,734	112,654,734	112,654,734

SECTION 5

ENVIRONMENTAL CONSIDERATIONS

SECTION 5 ENVIRONMENTAL CONSIDERATIONS

5.1 OUTLINE OF THE STUDY AREA

The Study Area, Dir Baalbeh Disposal Site, lies on the north edge of the City where is on the right side of highway direction to Hama and Allepo shown in Figure 5.1.1 and the adjacent land scenes are shown in Figure 5.1.2. It is flat land and land use of the area is mainly agricultural use except eastern side of the site that there is a cemetery. In addition, there is no future development plan in this area according to the General Plan.

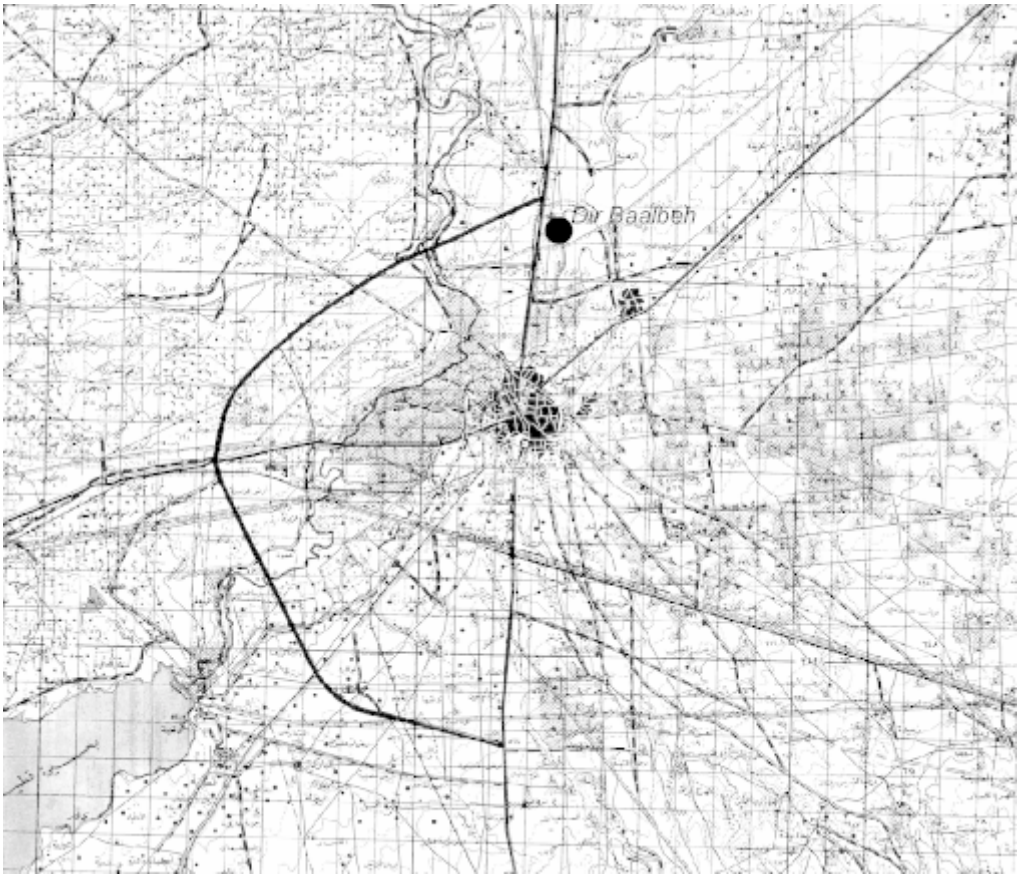


Figure 5.1.1 Location of the Study Area

Occurring smoke from the disposal site

Cemetery lies on the next land (east side)

Figure 5.1.2 Scene of the Adjacent Lands

5.2 ENVIRONMENTAL BASELINE SURVEY IN HOMS

The survey is composed of three parts, water quality analysis, opinion pool survey and secondary information collection in order to obtain baseline parameter for environmental impact survey. The survey was consigned to the Unit of Professional Practice at Chemical Engineering Department, Chemical and Petroleum Engineering Faculty, Al-Baath University. Primary parameters are summarized as follows:

5.2.1 Surface Water Quality Survey

Water quality in the area and adjacent surface water were analysed and the sampling location and the results are summarized as follows:

(1) Sampling Locations

Ground Water

- Sample 1: well of dip 100 m, production from 60 m, flow rate of 1.5 inches Tube, irrigational area about 700 m^2
- Sample 2: well of dip 97 m, production from 75 m, flow rate of 3.0 inches Tube, irrigational area about 3300 m^2
- Sample 3: well of dip 100 m, production from 60 m, flow rate of 3.0 inches Tube, irrigational area about 1700 m^2
- Sample 6: well of dip 85m, production from 46 m, flow rate of 1.5 inches Tube, irrigational area about 2000 m^2

Irrigation Water

- Sample 4: Irrigation Channel Water located at –Alkarabis Sample 5: Orontes River Water located at Abbara casino

Channel Water

- Samples Analysis contains pH, COD (Chemical Oxygen Demand), BOD5 (Biochemical Oxygen Demand), SS (Suspended Solids), DO (Dissolved Oxygen), NO_3^-, PO_4^3, Cl, Escherchia, Coli (colony of bacteria/mL) and heavy metal, Fe, Zn, Cd, Pb, As, Hg.

Table 5.2.1 Sample 1 (Groundwater)

	Items	Unit	Syr. Stand. Drinking.	Syr. Stand. Irrigation	Result	Methods (*)
1	PH	mg/L	7-8.5	6.5-8.5	7.23	HACH one combination PH electric method
2	COD	mg/L	1-2	-	2.2	Dichromate Reactor Digestion method
3	BOD_5	mg/L	0	4	1	Respirometric method (using The BOD Track Apparatus)
4	SS	mg/L	-	-	3	Photometric method Wavelength 810 nm
5	DO	mg/L	-	4	7.81	Aside modification of Winchers method using the Digital Titration
6	$N\text{-}NO_3^-$	mg/L	40	60	14.4	Wavelength 410 nm
7	PO_4^{3-}	mg/L	0.5	3.5	0.05	Wavelength 430 nm
8	T-Cl	mg/L	200	150	0.01	Amperometric forward titration Using the digital titration
9	Fe	mg/L	1	-	0.17	Wavelength 477 nm

	Items	Unit	Syr. Stand. Drinking.	Syr. Stand. Irrigation	Result	Methods (*)
10	Zn	mg/L	5	-	0.09	Zincon method Wavelength 620 nm
11	Cd	µg/L	10.0	10.0	13.0	Dithizone method Wavelength 515 nm
12	Pb	µg/L	5.0	-	1	Wavelength 477 nm
13	As	µg/L	0.05	0.1	0.043	Silver diethyldithiocarbamate Method and wavelength 520 nm
14	Hg	µg/l	1.0	1.0	0,8	Mercury extraction method
15	Conductivity	µS/cm	200	1200	183	
16	Escherchia Coli	Colony of bacteria/100mL	0	-	3	Membrane Filtration method

Note: (*) HACH water analysis Handbook (ISO 9001 certified), HACH Company Loveland, Colorado, U.S./A., Copyright 1997, by Hach Company

Table 5.2.2 Sample 2 (groundwater)

	Items	Unit	Syr. Stand. Drinking.	Syr. Stand. Irrigation	Result	Methods (*)
1	PH	mg/L	7-8.5	6.5-8.5	7.4	HACH one combination PH electric method
2	COD	Mg/L	1-2	-	2.7	Dichromate Reactor Digestion method
3	BOD_5	mg/L	0	4	2	Respirometric method (using the BOD Trak Apparatus)
4	SS	mg/L	-	-	1	Photometric method Wavelength 810 nm
5	DO	mg/L	-	4	8.39	Aside modification of Winchers method using the Digital Titration
6	$N\text{-}NO_3^-$	mg/L	40	60	13.1	Wavelength 410 nm
7	PO_4^{3-}	mg/L	0.5	3.5	0.01	Wavelength 430 nm
8	Cl	mg/L	200	150	0.04	Amperometric forward titration Using the digital titration
9	Fe	mg/L	1	-	0.08	Wavelength 477 nm
10	Zn	mg/L	5	-	0,11	Zincon method Wavelength 620 nm
11	Cd	µg/L	10.0	10.0	11.2	Dithizone method Wavelength 515 nm
12	Pb	µg/L	5.0	-	2	Wavelength 477 nm
13	As	mg/L	0.05	0.1	0,04	Silver diethyldithiocarbamate Method and wavelength 520 nm
14	Hg	µg/L	1.0	1.0	0,4	Mercury extraction method
15	Escherchia Coli	colony of bacteria/100mL	0	-	3	Membrane Filtration method

Note: (*) HACH water analysis Handbook (ISO 9001 certified), HACH Company Loveland, Colorado, U.S./A., Copyright 1997, by Hach Company

Table 5.2.3 Sample 3 (groundwater)

	Items	Unit	Syr. Stand. Drinking.	Syr. Stand. Irrigation	Result	Methods (*)
1	PH	mg/L	7-8.5	6.5-8.5	7.54	HACH one combination PH electric method
2	COD	mg/L	1-2	-	3.5	Dichromate Reactor Digestion method
3	BOD_5	mg/L	0	4	1	Respirometric method (using The BODTrak Apparatus)
4	SS	mg/L	-	-	1	Photometric method Wavelength 810 nm

	Items	Unit	Syr. Stand. Drinking.	Syr. Stand. Irrigation	Result	Methods (*)
5	DO	mg/L	-	4	8.01	Azide modification of Winkher method using the Digital Titration
6	NO_3^-	mg/L	40	60	10.8	Wavelength 410 nm
7	PO_4^{3-}	mg/L	0.5	3.5	0.02	Wavelength 430 nm
8	T-Cl	mg/L	200	150	0.04	Amperometric forward titration using the digital titration
9	Fe	mg/L	1	-	0.04	Wavelength 477 nm
10	Zn	mg/L	5	-	0.10	Zincon method Wavelength 620 nm
11	Cd	µg/L	10.0	10.0	11.1	Dithizone method wavelength 515 nm
12	Pb	µg/L	5.0	-	3	Wavelength 477 nm
13	As	mg/L	0.05	0.1	0.042	Silver diethyldithiocarbamate Method and wavelength 520 nm
14	Hg	µg/L	1.0	1.0	0.42	Mercury extraction method
15	Escherchia Coli	Colony of bacteria/100mL	0	-	4	Membrane Filtration method

Note: (*) HACH water analysis Handbook (ISO 9001 certified), HACH Company Loveland, Colorado, U.S./A., Copyright 1997, by Hach Company

Table 5.2.4 Sample 4 (Orontes irrigation channel)

	Items	Unit	Syr. Stand. Drinking.	Syr. Stand. Irrigation	Result	Methods (*)
1	PH	mg/L	7-8.5	6.5-8.5	7.80	HACH one combination PH electric method
2	COD	mg/L	1-2	-	93	Dichromate Reactor Digestion method
3	BOD_5	mg/L	0	4	1	Respirometric method (using the BODTrak Apparatus)
4	SS	mg/L	-	-	32	Photometric method Wavelength 810 nm
5	DO	mg/L	-	4	6.74	Azide modification of Winkher Method using the Digital Titration
6	NO_3^-	mg/L	40	60	0.7	Wavelength 410 nm
7	PO_4^{3-}	mg/L	0.5	3.5	5.8	Wavelenght 30mm
8	T-Cl	mg/L	200	150	0.03	Amperometric forward titration using the digital titration
9	Fe	mg/L	1	-	0.12	Wavelength 477 nm
10	Zn	mg/L	5	-	0.11	Zincon method Wavelength 620 nm
11	Cd	µg/L	10.0	10.0	30.5	Dithizone method Wavelength 515 nm
12	Pb	µg/L	5.0	-	2.0	Wavelength 477 nm
13	As	mg/L	0.05	0.1	0.198	Silver diethyldithiocarbamate Method and wavelength 520 nm
14	Hg	µg/L	1.0	1.0	0,5	Mercury extraction method
15	Escherchia Coli	Colony of bacteria/100mL	0	-	195	Membrane Filtration method

Note:(*) HACH water analysis Handbook (ISO 9001 certified), HACH Company Loveland, Colorado, U.S./A., Copyright 1997, by Hach Company

Table 5.2.5 Sample 5 (Orontes river)

	Items	Unit	Syr. Stand. Drinking.	Syr. Stand. Irrigation	Result	Methods (*)
1	PH	mg/L	7-8.5	6.5-8.5	7.57	HACH one combination PH electric method
2	COD	mg/L	1-2	-	107	Dichromate Reactor Digestion method
3	BOD_5	mg/L	0	4	6.1	Respirometric method (using the BODTrak Apparatus)
4	SS	mg/L	-	-	6	Photometric method Wavelength 810 nm
5	DO	mg/L	-	4	5.55	Azide modification of Winkher Method using the Digital Titration
6	NO_3^-	mg/L	40	60	1.5	Wavelength 410 nm
7	PO_4^{3-}	mg/L	0.5	3.5	5.3	Wavelength 430 nm
8	Cl	mg/L	200	150	0.05	Amperometric forward titration using the digital titration
9	Fe	mg/L	1	-	0.19	Wavelength 477 nm
10	Zn	mg/L	5	-	0	Zircon method Wavelength 620 nm
11	Cd	µg/L	10.0	10.0	33.5	Dithizone method Wavelength 515 nm
12	Pb	µg/L	5.0	-	Under range	Wavelength 477 nm
13	As	mg/L	0.05	0.1	0.06	Silver diethyldithiocarbamate Method and wavelength 520 nm
14	Hg	µg/L	1.0	1.0	0,35	Mercury extraction method
15	Escherchia Coli	Colony of bacteria/100mL	0	-	200	Membrane Filtration method

Note: (*) HACH water analysis Handbook (ISO 9001 certified), HACH Company Loveland, Colorado, U.S./A., Copyright 1997, by Hach Company

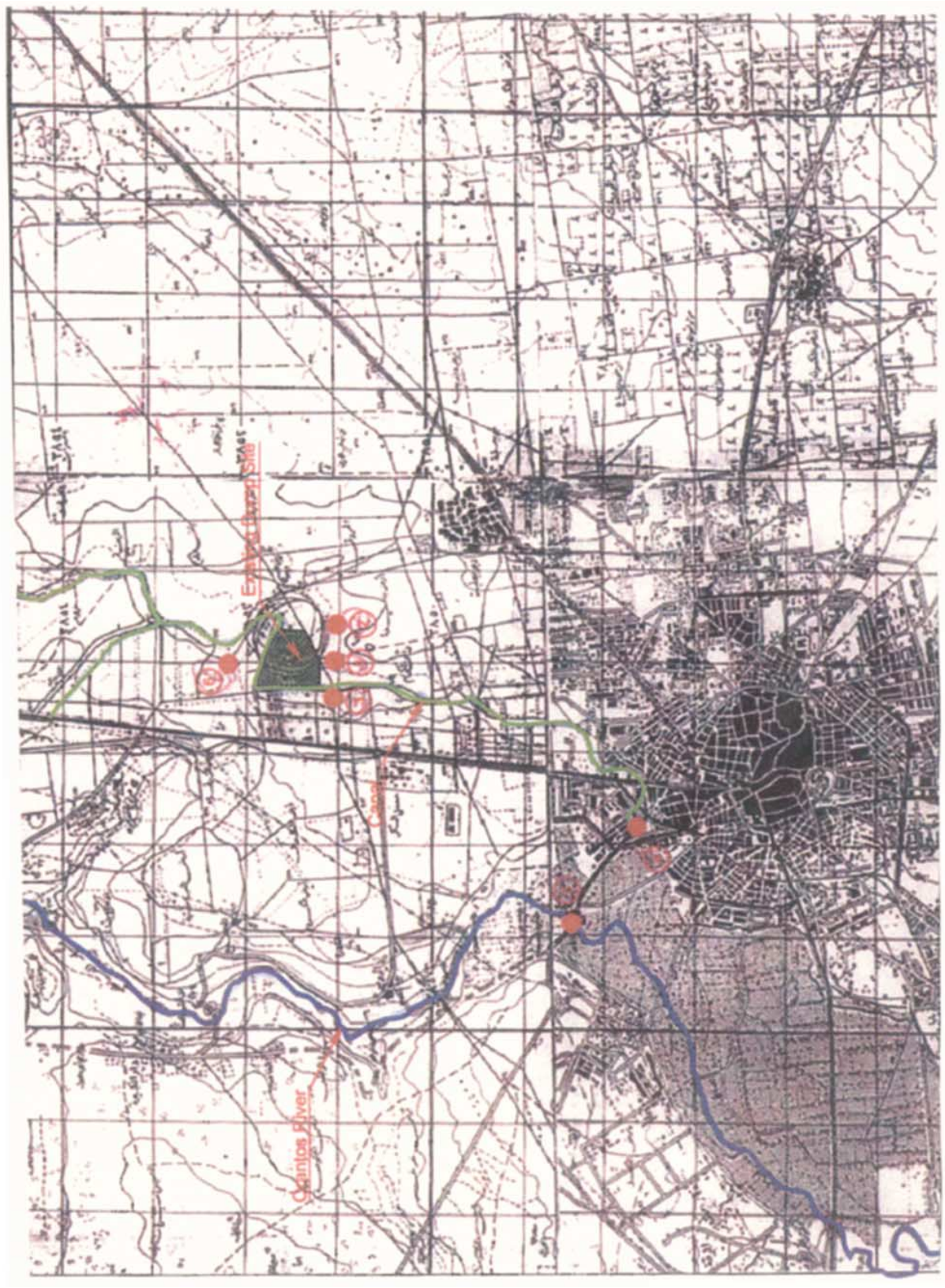


Figure 5.2.3 Location of the Water Samplings

Table 5.2.6 Sample 6 (groundwater)

	Items	Unit	Syr. Stand. Drinking.	Syr. Stand. Irrigation	Result	Methods (*)
1	PH	mg/L	7-8.5	6.5-8.5	7.80	HACH one combination PH electric method
2	COD	mg/L	1-2	-	3.2	Dichromate Reactor Digestion method
3	BOD_5	mg/L	0	4	1	Respirometric method (using The BODTrak Apparatus)
4	SS	mg/L	-	-	2	Photometric method Wavelength 810 nm
5	DO	mg/L	-	4	7.04	Azide modification of Winkher Method using the Digital Titration
6	NO_3^-	mg/L	40	60	14.3	Wavelength 410 nm
7	PO_4^{3-}	mg/L	0.5	3.5	0.47	Wavelength 430 nm
8	Cl	mg/L	200	150	0.04	Amperometric forward titration using the digital titration
9	Fe	mg/L	1	-	0.09	Wavelength 477 nm
10	Zn	mg/L	5	-	0	Zincon method Wavelength 620 nm
11	Cd	µg/L	10.0	10.0	38.00	Dithizone method Wavelength 515 nm
12	Pb	µg/L	5.0	-	Under range	Wavelength 477 nm
13	As	mg/L	0.05	0.1	0.042	Silver diethyldithiocarbamate Method and wavelength 520 nm
14	Hg	µg/L	1.0	1.0	0.35	Mercury extraction method
15	Escherchia Coli	Colony of bacteria/100mlL	0	-	3	Membrane Filtration method

Note: (*) HACH water analysis Handbook (ISO 9001 certified), HACH Company Loveland, Colorado, U.S./A., Copyright 1997, by Hach Company

Table 5.2.7 Syrian Safe Drinking Water Act (Standard No. 45)

	Admissible (mg/L)	Upper limit (mg/L)
$CaCO_3$	300	650
PH	7 - 8.5 unit	6.5 - 9.2
Fe	0.3	1.0
Mn	0.1	0.5
Zn	5	15
Cu	1	1.5
Mg	50	150
Ca	75	200
SO_4^{2-}	200	400
Cl^-	200	600
F^-	0.6	1.5
NO_3^-	15	40
NH_3	0	Trace
NO_2^-	0	0
PO_4^{2-}		0.5
Pb		0.05
Se		0.01
As		0.05
Cr^{6+}		0.05
CN^-		0.001
Cd		0.01
E.Coli		1/100 mL
COD		1 - 2 mg/L
BOD_5	0	0

5.2.2 Houshold Interview Survey

This interview survey was carried out for proposed Homs Cleansing Center in order to attain public opinions from citizens who live in adjacent area to the proposed site and its environs.

Subject survey area was within 5km radius of the site and the total number of sampling is 50 samples. The method of survey was household interview with questionnaire by interviewer including following main points. The sample questionnaire is attached end of this section.

- Attribute of household.
- Present situation of existing disposal waste disposal site
- Proposed Homs cleansing centre.
- Scavenging on the site (for Scavengers).
- Information to be provided by the interviewer.

(1) Summary of the Survey

Single total of each question is summarized in Table 5.1.1 and the characteristics are explained in next section.

(2) Survey Results

- More then 44 men and 6 woman from the citizens who lives in adjacent area told their opinion in order to attain public opinions from citizens to the proposed site.
- Of which the total interviewee, 40% were farmer, 20 % were scavengers, 20 % worker with low education (les then 9 classes) and the last 20% were high educational workers from the area.
- 96% know the existing disposal site and 88% have problems from odor, smoke, insects, 86% feel odour from the site at rainy season.
- 42% use the water from the wells for drinking and irrigation.
- 18 % only have benefit from the disposal site and 82 don't have, 40% thinks that some of there family had illness from the site, like skin problems, fever, stomach illness.
- only 62 % like that the current disposal to be rehabilitated.
- 66 % agree that the current site must cover with soil and planting with tree, 22 % don't believe that any tree will grow there.
- 12 % says we don't know if it is good.
- **58 % don't agree with the construction of transfer station or composting plant or storing centre or proposed Homs Cleaning Centre** and 38 % agree with it.
- But 80 % don't have any other opinion on proposed HCC, and 84 % don't have any opinion on solid waste management in Homs Municipality.

Table 5.2.8 Summary of the Survey

1-3 Sex	Count	Percent	1-4 occup	Count	Percent	1-7	Count	Percent
M	44	88.00	S	10	20.00	bigamy	1	2.00
F	6	12.00	F	20	40.00	married	41	82.00
N=	50		WLE	10	20.00	single	8	16.00
			WHE	10	20.00	N=	50	
			N=	50				
1-13	Count	Percent	1-14	Count	Percent	1-15	Count	Percent
Other	13	26.00	Other	9	18.00	No	30	60.00
Well	21	42.00	Conrete	41	82.00	Yes	20	40.00
Water	16	32.00	N=	50		No=	50	
N=	50							
2-1	Count	Percent	2-2	Count	Percent	2-4	Count	Percent
Yes	48	96.00	No	6	12.00	No	41	82.00
No	2	4.00	Yes	44	88.00	Yes	9	18.00
N=	50		N=	50		N=	50	
2-6	Count	Percent	2-8	Count	Percent	2-10	Count	Percent
No	30	60.00	No	18	36.00	No	7	14.00
Yes	20	40.00	Yes	32	64.00	Yes	43	86.00
N=	50		N=	50		N=	50	
2-13	Count	Percent	2-15	Count	Percent	2-17	Count	Percent
No	7	14.00	Yes	31	62.00	No	20	40.00
Yes	43	86.00	No	19	38.00	Yes	30	60.00
N=	50		N=	50		N=	50	
2-19	Count	Percent	3-1	Count	Percent	3-3	Count	Percent
No	22	44.00	No	14	28.00	I don't	6	12.00
Yes	28	56.00	Yes	36	72.00	Yes	33	66.00
N=	50		N=	50		No	11	22.00
						N=	50	
3-5	Count	Percent	3-7	Count	Percent	3-9	Count	Percent
Idon't	4	8.00	I don't	6	12.00	Yes	15	30.00
Yes	17	34.00	Yes	15	30.00	No	28	56.00
No	29	58.00	No	29	58.00	I don't	7	14.00
N=	50		N=	50		N=	50	
3-11	Count	Percent	3-13	Count	Percent	3-15	Count	Percent
Yes	16	32.00	No	40	80.00	no	42	84.00
Idon't	15	30.00	Yes	10	20.00	I don't	1	2.00
No	19	38.00	N=	50		yes	7	14.00
N=	50					N=	50	
3-17	Count	Percent	3-18	Count	Percent	3-19	Count	Percent
no	23	46.00	I don't	1	2.00	I don't	2	4.00
yes	27	54.00	no	11	22.00	no	8	16.00
N=	50		yes	38	76.00	yes	40	80.00
			N=	50		N=	50	
4-1	Count	Percent	4-2	Count	Percent	4-4	Count	Percent
Yes	9	90.00	Yes	9	90.00	No	5	50.00
No	1	10.00	No	1	10.00	Yes	5	50.00
N=	10		N=	10		N=	10	

Note: F: Farmer, S=Scavenger, WLE= Low educational workers from near villages, WHE=High educational workers

- 54 % thinks that the rehabilitation of current site will reduce a negative environmental impacts (problems) and
- 75 % think that the transfer station has negative environmental impact. and
- 80 % think that the composting plant have negative environment impact. But 50 % think that the future environmental impact will be the same.
- 90 % of scavengers agree that the income is good and they want to continue this job, only 59 % of them wont to work in HCC such as sorting the municipal waste.

The most of people lives there (near the disposal site) are from poor category. scavengers on the disposal site work for sorting municipal waste and they receive good income form them so that it is not important to have new cleaning centre.

And the farmer there doesn't agree with rehabilitation of existing disposal site or have storing, storing centre or they want to relocate the disposal site.

The Questionnaire for Household Interview Survey in HOMS

The Study on
Solid Waste Management at Local Cities in the Syrian Arab republic (JICA)

1-Attribute of household:

1-1 Address (Area or Zone)
1-2 Age:
1-3 Sex:
1-4 Occupation:
1-5 Place of your work:
1-6 How long do you live there:
1-7 Marital status:
1-8 Number of family members:
1-9 Age of your family members:
1-10 Education status of interviewee:
1-11 You're monthly income and a total family monthly income:
1-12 How do you dispose your household waste?
1-13 Drinking water source:
Water supply Well Others
1-14 Structure of your house
Concrete Brick Others (wooden, tent, etc.)
1-15 Do you have telephone?
Yes No

2-Present situation of the existing waste disposal site:

2-1 Do you know the existing disposal site in Homs Municipality?
Yes No
1. Bayadha 2. Dier Baalbeh 3. Zidal 4. Toudmor Road
2-2 Are there any problems (odor, noise traffic, smoke, fire, insects, scattering plastic bags, etc.) there?
Yes No
2-3 If Yes, please describe your problem.
2-4 Do you get any benefit from the disposal site?
Yes No
2-5 If yes, please describe your benefit (breeding animals, scavenging, etc.) from the site
2-6 Did you or your family have any illness?
Yes No
2-7 If Yes, please describe the illness.
2-8 Do you use well water?
Yes No
2-9 If Yes, how do you use the well water (for drinking, irrigation, etc.)?
2-10 Do you feel odor from the site?
Yes No
2-11 If Yes, please describe the magnitude of odor
Very bad Bad Nothing
2-12 When do you feel odor?
All the time A few Rainy season Night time Day time
2-13 Do you think that current disposal site should be closed?
Yes No
2-14 If Yes, Please describe your reason.
2-15 Do you think that current disposal site should be rehabilitated?
Yes No
2-16 If yes, what is the main concern of your rehabilitation idea. Please describe your idea.
2-17 Do you think that it is necessary to facilitate treatment facilities of municipal waste?
Yes No
2-18 If yes, what kind of facilities is it necessary to facilitate. Please describe.
2-19 Do you have any other opinion (scattering plastic bags) for the site?
Yes No
2-20 If yes, please describe your idea.

3-Proposed Homs Cleansing Center:

3-1 Homs Cleansing Center (rehabilitated landfill site, composting plant, transfer station and sorting center) is proposed on the site by Homs Municipality. Do you know this proposal?
Yes No

3-2 If Yes, how did you know?
3-3 Do you agree with the rehabilitation of current dump site (covering soil and planting trees and shrubs)?

Yes No I do not know

3-4 If No, please describe your opinion.
3-5 Do you agree with the construction of transfer station (transport municipal waste from the city to the station and re-transport to a new final disposal site (Maghlia)) on the site?
Yes No I do not know

3-6 If No, please describe your opinion.
3-7 Do you agree with the construction of composting plant (producing organic manure from organic municipal waste)?
Yes No I do not know

3-8 If No, please describe your opinion.
3-9 Do you agree with construction of sorting center (sorting organic and Non-organic wastes, and organic waste will be material of compost) on the site?
Yes No I do not know
3-10 If No, please describe your opinion.
3-11 Do you agree with proposed Homs Cleansing Center?
Yes No
3-12 If No, please describe your opinion; if Yes, please describe your opinion.
3-13 Do you have any other opinion on proposed Homs Cleansing Center?
Yes No
3-14 If Yes, please describe your opinion.
3-15 Do you have any opinion on solid waste management in Homs Municipality?
Yes No
3-16 If Yes, please describe your opinion.
3-17 Do you think the rehabilitation of the current disposal site will reduce a negative environmental impact (problems)?
Yes No
3-18 Do you think the transfer station will have negative impacts (problems)?
Yes No
3-19 Do you think the composting plant will have negative impact (problems)?
Yes No
3-20 In total, how do you evaluate the future environmental impacts compared to present conditions?
Getting worse Same Getting better

4- Scavenging on the Site. (for scavengers)

4-1 How do you evaluate your work, is it good income?
Yes No
4-2 Do you want to continue this job?
Yes No
4-3 What do you think if the disposal site is closed? Please describe.

4-4 Do you want to continue this work if the cleansing canter provides job opportunities such as sorting municipal waste
Yes No

Information to be Provided by the Interviewer:

Interview location:
Inside the disposal site:
< 1 km < 2 km < 5 km > 5 km

Interviewee category:
Farmer (F)
Scavenger (s)
From near villages Low educational workers (wle)
High educational workers (whe).

5.2.3 Secondary Data and Information Collection

Available secondary information related to the projects including social and natural environment, as described below, were obtained for further environmental impact study. The detail is shown in data book.

1) Social environmental conditions

- Administrative boudary
- Demography and community coditions
- Economic Activities
- Current land use and land use regulations
- Water usage and water rights including subterranan wate
- Transport conditions
- Infrastructure and Public Facilities
- Archaeological and Historical Attributes
- Hygiene and Public health condition
- Related Environmental legislations

2) Natural Environment conditions

- Hydrological condititions
- Meteorological conditions
- Geological, topographical, and soil conditions
- Surface and subterranean water quality
- Flora and fauna
- Lanscape and visual amenity
- Air pollution
- Noise and vibration
- Odor

5.3 ENVIRONMENTAL EVALUATION OF HOMS

5.3.1 General

The environmental evaluation on the proposed feasibility projects was conducted according to applicable legal system in Syria and other references. The aim of the evaluation is to identify potential significant impacts and to make mitigation measures to those impacts.

The anticipated environmental impacts of the priority project are mostly beneficial in terms of urban environment and public health. Actually proposed project category is an urban environmental improvement. Significant beneficial effects of the project include improvement of living environment and public health conditions through proper waste collection, haulage and disposal.

Environmental impact study was carried out for the selected proposed feasibility study projects, which may have consequences as explained below.

(1) Development of HOMS Cleansing Centre at Dir Baalbeh (Composting plant, transfer station and rehabilitation of disposal site)

(2) Establishment of medical waste management in HOMS

5.3.2 Potential Impact of Environment

(1) HOMS Cleansing Centre at Dir Baalbeh

The Cleansing centre is located in the northern edge of the city with flat arable land where is away from urbanized area. Characteristics of the land use are represented by suburban activities such as agriculture, industry, public facility (cemetery), etc. There are a few resident there. The identified potential impacts through a qualitative assessment in each project shown in Table 5.3.1 are explained as follows:

1) Composting and Sorting Centre

The project is proposed on existing disposal site in Dir Baalbeh and the purpose of the project is to recycle the waste collected form the city.

It is predicted minor potential impacts, which are offensive odour, water pollution (surface and groundwater) and public health (vectors and pests) during the operation stage. Nevertheless the proposed plan may avoid such issues. The proper fermentation process will minimize the odour. The residual water will be used for encouraging fermentation process and will not be discharged to out side of the site. The heart generated by the fermentation process will exterminate vermin in the process.

Hence, there is no major negative impact on this project.

2) Transfer Station

The transfer station may cause surface and ground water degradation and offensive odour during the operation stage, which is after year 2006 when the Maghlia disposal site is opened.

The station's capacity is 800 tones per day and 140 transfer vehicles get in and out the station a day. It is not so small amount, hence the station will affect to scattering wastes there.

Table 5.3.1 Summery of Potential Impacts on HOMS Cleansing Centre

Major facilities, activities Which may cause impacts			Composting Plant, Sorting Centre and Transfer Station						Rehabilitation of Dir Baaleh Site					
			Before Operation		Operation				Before Operation		Operation			
			Reclamation and spatial occupancy	Operation of construction equipment	Occupancy of land	Operation of vehicle	Operation of facilities	Corpus of people and goods	Reclamation and spatial occupancy	Operation of construction equipment	Occupancy of land	Operation of vehicle	Operation of facilities	Corpus of people and goods
Social Environment	1.	Resettlement												
	2.	Economic Activities												
	3.	Traffic and Public Facilities												
	4.	Split of Communities												
	5.	Cultural Property												
	6.	Water Rights and Rights of Common												
	7.	Public Health Condition												
	8.	Waste												
	9.	Hazards (Risk)												
Natural Environment	10.	Topography and Geology												
	11.	Soil Erosion												
	12.	Ground Water												
	13.	Hydrological Situation												
	14.	Coastal Zone												
	15.	Flora and Fauna												
	16.	Meteorology												
	17.	Landscape			✓						✓			
Pollution	18.	Air Pollution												
	19.	Water Pollution					✓						✓	
	20.	Soil Contamination												
	21.	Noise and Vibration								✓				
	22.	Land Subsidence												
	23.	Offensive Odour					✓							

Note: "✓" shows potential impact of environment. "✓✓✓": high, "✓✓": moderate, "✓": low, no indication: negligible

3) Rehabilitation of Existing Disposal Site

The most concern is water quality degradation by the operation up to year 2005. Even sufficient facilities are planed on the rehabilitation; leachate water may cause water bodies for both surface water and groundwater. In addition, the project aims to improve the existing disposal site.

(2) Medical waste management in HOMS

The project is proposed for medical facilities, hospitals and clinics, in the city. Source separation in different type of the medical waste using colour coding, pre-treatment of infectious waste, haulage of the infectious waste by appropriate collection vehicle and disposal in separated site from municipal waste are proposed on the project. Consequently there is neither significant nor minor environmental impact if the operation carries out properly.

5.3.3 Mitigation Measures

Mitigation measures to the potential impacts on the feasibility projects are explained as follows:

(1) Development of HOMS Cleansing Centre at Dir Baalbeh (Composting plant and transfer station)

Surface and groundwater are potential impacts caused by transfer station in Dir Baalbeh so that the maintenance of the proper sanitary conditions within the transfer station and surrounding area is required, and the wastewater and leachate on the site shall be collected. In addition, monitoring of ground water quality shall be measured using monitoring wells. Furthermore it is essential that landscaping could also be considered in order to improve ecosystem in the site and visual amenity of the solid waste disposal facilities.

(2) Development of HOMS Cleansing Centre at Dir Baalbeh (Rehabilitation of Existing Disposal Site)

In order for enhancement of the landfill management, monitoring for ground water and surface water in the site and its vicinity is essential. General mitigation measures are shown in Table 5.3.2 and these are recommended to review.

Table 5.3.2 Mitigation Measures of Landfill

Measures	Design stage		Operation stage	
	Engineering Design	Design option	Construction	Operation
Measures at source	▪ Drainage system ▪ Leachate collection and treatment system ▪ Impermeable facility ▪ Gas tap ▪ Scattering prevention net	▪ Dust prevention techniques Noise and Vibration ▪ Selection of Low noise and vibration method of construction ▪ Adoption of low noise and vibration equipment	▪ Reduction of emission by heavy construction machine and vehicle ▪ Adoption of low noise and vibration equipments ▪ Surface and groundwater degradation during the construction	▪ Planting and sprinkle water on the landfill (Scattering prevention) ▪ Soil covering on the waste (Odour and vermin prevention) ▪ Leachate collection and treatment (water pollution prevention) ▪ Gas tapping of landfill site ▪ Waste quality monitoring
Impact mitigation measures			▪ Limitation of chemical usage for construction works ▪ Adoption of low noise and vibration equipment ▪ Scattering prevention by tree buffer or screen fence	▪ Establishment of water quality monitoring (surface and ground water)
Natural environmental preservation measures	▪ Design with nature ▪ Structural design with characteristics of topography and geology ▪ Design with visual amenity (height, form, colour)	▪ Adoption of surface soil preservation ▪ Adoption of slope preservation ▪ Adoption of transplantation ▪ Adoption of flora and fauna conservation	▪ Surface soil deposit ▪ Tree deposit ▪ Minimization of earth work and cutting tree	▪ Soil covering (visual amenity) ▪ Extermination of vermin during land filling ▪ Establishment of Environmental monitoring

Moreover, in addition, leachate management is a key of the landfill management and its component shown in Table 5.3.3 will help to enhance mitigation of environmental impacts. The major points are explained as follows:

- Minimization of leachate generation
- Contaminant of leachate within the landfill
- Control over leachate quality
- Collection and disposal of leachate as it is generated
- Monitoring
- Contingency plans

Table 5.3.3 Key Component of Leachate Management

Key Items	Contents
Minimization of leachate generation	▪ Control of surface and groundwater inputs ▪ Minimization of amount of precipitation coming into contact with waste by use of small cell ▪ Conservative design of cell size ▪ Phased disposal and progressive restoration ▪ Use of low permeability cap ▪ Shaping of final landform to encourage surface water run-off away from active phases ▪ Control of liquid waste input ▪ Use of solidification process as an alternative to direct landfill of waste
Contaminant of leachate within the landfill	▪ Use of a double or composite liner system incorporating protection of the synthetic liner (500mm clay layer is proposed on this project) ▪ Construction of the liner above the maximum ground water recovery level ▪ Retention of sufficient unsaturated zone to provide for attenuation of leachate ▪ Perimeter and cell bunding with low permeability bund walls ▪ Low permeability of cap ▪ Quality control of liner installation
Control over leachate quality	▪ Leaching tests on incoming waste ▪ Ban on specific wastes ▪ Recirculation
Collection and disposal of leachate as it is generated	▪ Lechate collection pipe work system ▪ Leachate collection sumps within each phase ▪ Pumps for removal of leachate to a specification which will resist attack from high-strength leachate ▪ Leachate treatment prior to discharge to sewer system
Monitoring	▪ Internal leachate monitoring to measure head of leachate ▪ Interspace drain monitoring to check for leachate ▪ Groundwater monitoring borehole for long term monitoring ▪ The aim should be to monitor at source of the contaminants as well as along the potential groundwater pathways
Contingency plans	▪ in the event of the groundwater contamination being detected

Reference: Environmental Assessment for Waste Treatment and Disposal Facilities, Judith Petts and Gev Eduljee

(3) Establishment of medical waste management in HOMS

The plans itself is sophisticated so that the operation body shall be well trained before the operation. Especially special paying attention shall be made for handling and disposing infectious medical wastes.

5.3.4 Conclusion

The proposed feasibility study projects are for waste disposal management, which are effects on improvement of current waste disposal management. All of the feasibility project plans are well coordinated and these projects will not cause major negative environmental impact. While mitigation measures made in the course of this section shall be considered when the detail design carries out.

In spite of the mitigation measures, construction and operation shall properly be done according to the plans proposed in the study.

Hence, under these conditions, the proposed projects will not have major negative environmental impacts caused by the these project implementation and the projects will bring beneficial impacts as it is waste disposal management improvement.