CHAPTER 5 REHABILITATION AND OPERATION IMPROVEMENT OF AL-BASSA DISPOSAL SITE

5.1 REHABILITATION OF AL-BASSA DISPOSAL SITE

5.1.1 Planning Policies for the Rehabilitation of Al-Bassa Disposal Site

The rehabilitation works of Al-Bassa disposal site is divided into 2 stages as proposed in the master plan; Zone I & II and Zone III. Zone I & II are planned to operate up to the year 2003 as the extension of the pilot study, using the existing accumulated waste as the filling material of the embankment. The operational period of Zone III is planned for 2004-2007. The incoming daily waste into Zone III will be accommodated by a tentative disposal site which will be constructed in the same zone, while the existing accumulated waste will be rearranged into an area with final cover soil.

It is proposed that the rehabilitation of Zone III will be carried out by a contract, while Zone I & II are to be rehabilitated by the Lattakia city council as a budgetary measure as the extension of the pilot study. The objective volumes of both existing accumulated waste and daily incoming waste are summarized for the rehabilitation works as shown in Figure 5.1.1.

Table 5.1.1 Objective Waste Amount for the Rehabilitation Works

Zone	Operational Period	Existing Accumulated Waste (m3)	Daily Incoming Waste* (m3)	Total Volume of Waste (m3)
I & II	2001-2003	86,100	345,000	431,100
III	2004-2007	72,800	686,400	759,200

Note: The objective waste amount of the daily incoming waste is summed up including needed amount of cover soil which is assumed to be 20 % of the amount of disposed waste.

The objective waste amount in Zone I & II is summed up at 431,100 m^3 in which 86,100 m^3 will be rearranged into embankment as filling material. Landfill of the daily incoming waste will be carried out in the embankment. The rearrangement of the existing accumulated waste and the landfill work for the daily incoming waste will be carried out using rented heavy equipment through budgetary measures of the Lattakia city council.

As for Zone III, the objective waste amount is summed up at 759,200 m^3. Of the existing accumulated waste at 72,800 m^3 will be collected into an area and covered by a layer of soil as the final cover soil, while landfill of the daily incoming waste will be carried out at a tentative disposal site. The tentative disposal site will be constructed adjacent to the above-mentioned area for the rearrangement of the existing accumulated waste.

In order to carry out the rehabilitation of Zone III, heavy equipment which should be required for the controlled landfill at the tentative disposal site in 2004 would be procured first.

5.1.2 Facility Plan for the Rehabilitation

(1) Outline of the Required Facilities for the Rehabilitation in Zone I & II

The following descriptions give an outline of the major facilities in Zone I & II.

1) Waste Retaining Structure

In order to accommodate daily incoming waste up to the year 2003, embankment will be constructed in Zone I & II. Since stabilization of the existing accumulated waste has reached an advanced stage in addition to economical reasons, it is proposed that the waste is utilized as filling material of the embankment. A layer of soil will cover the rearranged waste as the core of embankment. Taking into account working easiness and flexibility for the future ultimate land use, inclination of the slope is recommended at 1:4.

2) Leachate Collection and Drainage Facility

At the bottom of landfill zone that is enclosed by the embankment, several section of leachate collection pipes should be provided in order to improve working conditions for daily landfill operation, especially in rainy season of winter. This facility is composed of perforated pipes covered by gravel. Through the leachate collection pipes, the generated leachate will be discharged into a pond that will be prepared for the improvement of the working conditions at the lowest area.

3) Gas Exhaust Equipment

Gas exhaust equipment should be installed to extract various gases and vapors evolving the decomposition of organic materials in the waste. The equipment is composed of perforated pipes covered by crushed stones and wrapped with wire baskets.

4) On-site Road

Gravel roads should be provided within the landfill site in accordance with the progress of landfill. This road would be used for access by the vehicles delivering wastes and cover soil and also the vehicles used for site management.

5) Enclosing Fence

The embankment of landfill site should be enclosed by fence for the purposes of prevention of waste outflow, access control and identification of the boundary.

(2) Outline of the Required Facilities for the Rehabilitation in Zone III

The following descriptions give an outline of the major facilities in Zone III.

1) Waste Retaining Structure for the Existing Accumulated Waste

Since stabilization of the existing accumulated waste has mostly reached an advanced stage, it will be rearranged into an area and covered by a layer of final cover soil whose material is recommended clay soil in order to minimize leachate generation in terms of its impermeability. A gas removal facility will be installed in this area. Taking into

account working easiness and flexibility for the future ultimate land use, inclination of the slope is recommended at 1:4.

2) Waste Retaining Structure of the Tentative Disposal Site

For the daily landfill operation, the tentative disposal site will be enclosed by an embankment, which is filled by sand and covered by clay layer. Inclination of the embankment's slope is also recommended at 1:4.

3) Leachate Collection and Drainage Facility

At the bottom of landfill zone of the tentative disposal site a clay soil layer should be prepared to prevent the leachate from infiltrating the underground. On the clay lining, several sections of perforated pipes covered by gravel should be provided in order to retain and drain the percolated leachate.

4) Leachate Control Reservoir

The leachate collected from the leachate drainage facilities during rainy season should be totally retained in the leachate control reservoir. Taking into account the sandy soil condition of the site, the structure of the reservoir will be reinforced concrete. Several blowers and a pump will be installed in the reservoir in order to accelerate sedimentation of organic materials and re-circulate the leachate into landfill zone for the prevention of spillover.

5) Rainwater Collection Facility

The surface water from the unused landfill zone and the used landfill zone with final cover soil should be discharged to the sea through excavated ditches.

6) Gas Exhaust Equipment

Gas exhaust equipment should be installed to extract various gases and vapors evolving the decomposition of organic materials in the waste. The equipment is composed of perforated pipes covered by crushed stones and wrapped with wire baskets.

7) Access Road

A section of approx. 1.2 km of access road from main road to the tentative disposal site will be improved as asphalt pavement because the present condition is very poor. In addition, a gravel road should be provided within the landfill site. This road would be used for access by the vehicles delivering wastes and cover soil and also the vehicles used for site management.

8) Control Building

In order to operate controlled landfill, management tasks will be required such as demarcation of landfill locations, control of landfill height, inspection of landfill method and so on. A control building should be constructed for the staff who will be in charge of those tasks.

9) Enclosing Fence

Both of the rearrangement site for the existing accumulated waste and the tentative disposal site should be enclosed by fence for the purposes of prevention of waste outflow, access control and identification of the boundary.

(3) Designing Outline of the Rehabilitation of Al-Bassa Disposal Site

Taking into account the summed up amount of existing accumulated waste and daily incoming waste in each zone as well as required facilities, typical longitudinal cross sections of the rehabilitation is proposed as shown in Figure 5.1.1 and Figure 5.1.2.

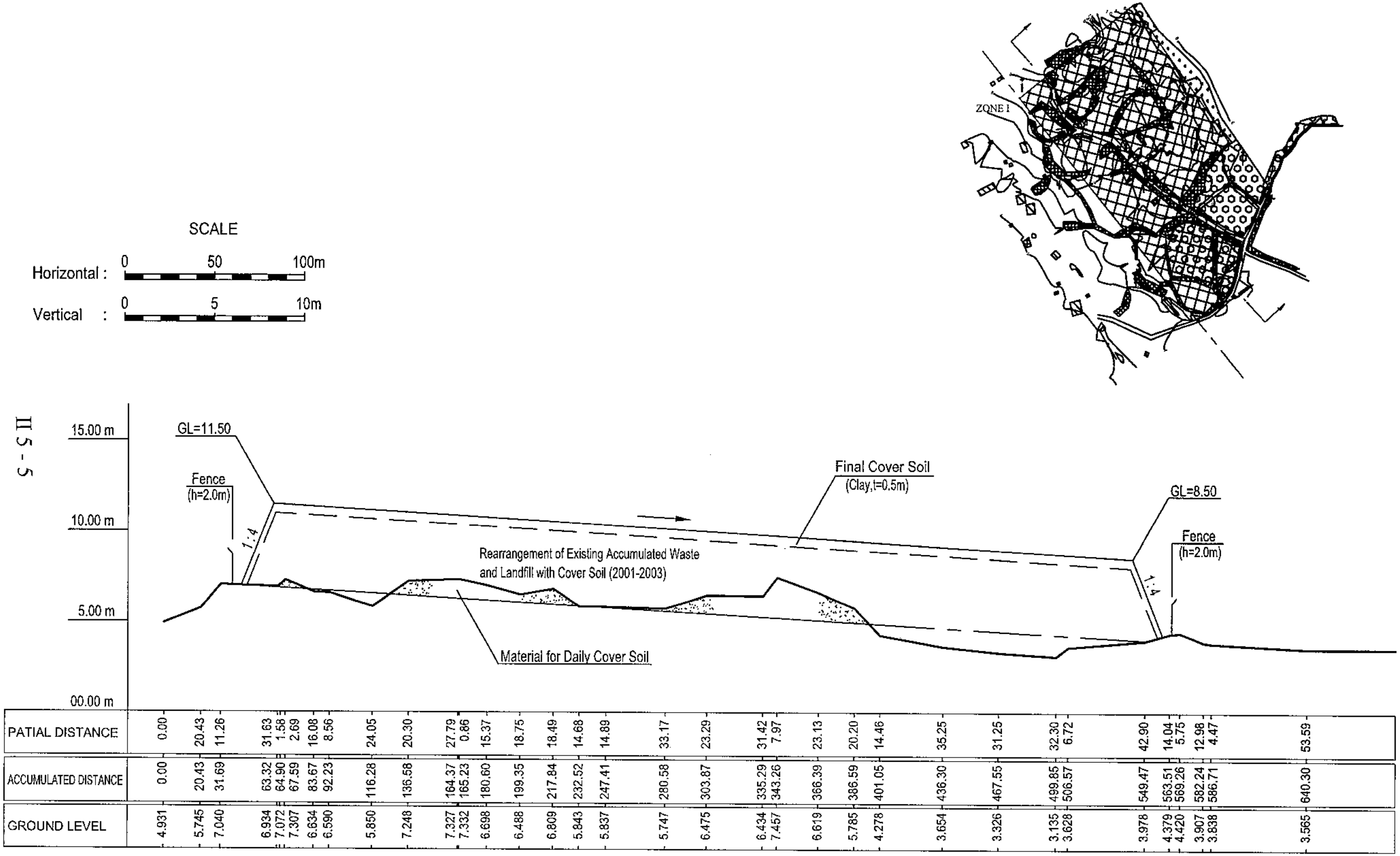
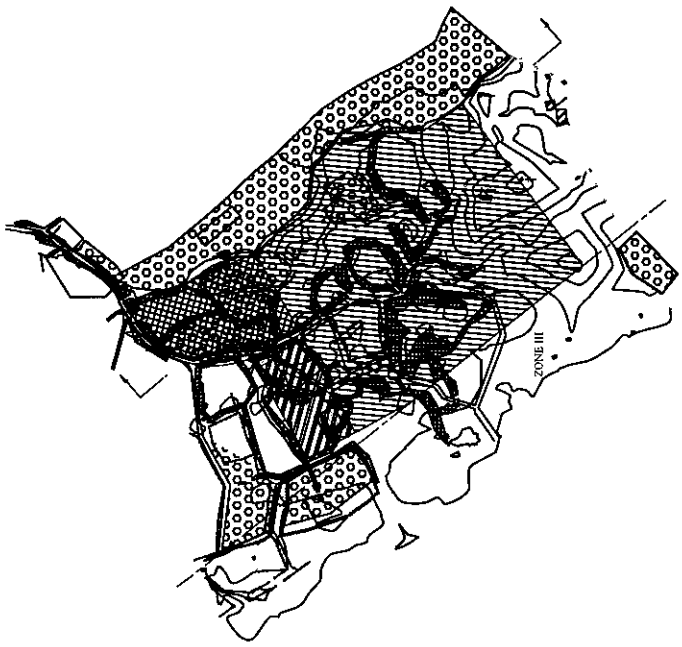


Figure 5.1.1 Typical Longitudinal Cross Section of the Rehabilitation in Zone I & II



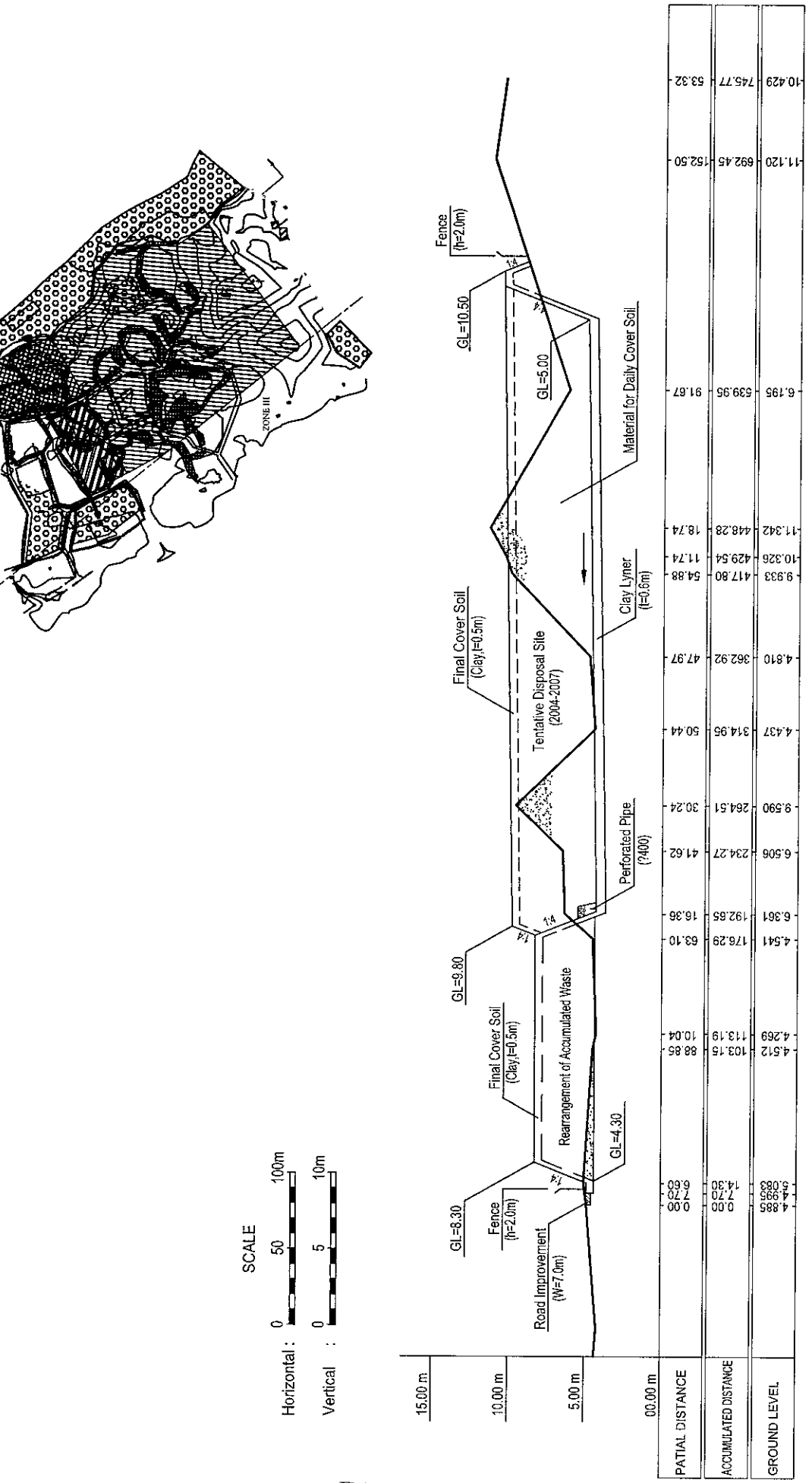


Figure 5.1.2 Typical Longitudinal Cross Section of the Rehabilitation in Zone III

(4) Facility Plan

1) Zone I and II

The main facilities required for development of Zones I and II at Al-Bassa disposal site is shown in Table 5.1.2.

Table 5.1.2 Major Facilities in Al-Bassa Disposal Site (Zone I & II)

Major facilities	Specification	Quantity
Disposal area	Are including surrounding embankment	112,400m^2
Leachate collection facility	Perforated RC pipe, diameter: 300mm	1,000m
Gas removal facility	Length: 4.5m	12 nos.
Operation road	Width: 5m, gravel road	1,500m
Enclosing fence	Net fence, height: 2m	1,600m

2) Zone III

The main facilities required for development of Zone III at Al-Bassa disposal site are shown in Table 5.1.3.

Table 5.1.3 Major Facilities in Al-Bassa Disposal Site (Zone III)

Major facilities	Specification	Quantity
1. Area for re-arrangement of existing accumulated waste		
Disposal area	Are including surrounding embankment Cover soil, thickness: 50cm	30,400m^2
Gas removal facility	Length: 4.0m	8 nos.
2. Area for construction of medium-term disposal site		
Capacity		700,000m^3
Liner	Clay laying, thickness: 60cm	165,800m^2
Leachate collection facility	Perforated RC pipe, diameter: 300mm	1,000m
Leachate control reservoir	Leachate re-circulation system: 1,250m^3	1 nos.
Rainwater collection facility		2,400m
Gas removal facility		45 nos.
Access road	Width: 7m, asphalt pavement	1,200m
Operation road	Width: 7m, gravel pavement	500m
Control building		50m^2
Enclosing fence	Net fence, height: 2m	2,100m

5.1.3 Procurement of Heavy Equipment and Operational Organization

(1) Planning Conditions

It is assumed that the rehabilitation works in Zone I & II will be carried out by the Lattakia city council with rented equipment needed to the landfill operation and construction of embankment as the extension of pilot study. Besides, the rehabilitation in Zone III is assumed to be carried out by a contract.

Major planning conditions for the rehabilitation works are shown as follows.

1) Design Waste Amount to be Disposed

The necessary heavy equipment and manpower is estimated based on the waste amount designed to be disposed in the target year (2006) of the priority project. The designed waste amount in 2006 is at 390 ton/day, as summarized in Table 7.3.2 in the previous section 7.3.1.

2) Working Hours

It is assumed that the working hours per day is 7 hours consisting of landfill work and cover soil work. Excavation and transportation of cover soil begin when the daily landfill work is half-finished. The cover soil is dumped on the landfill waste. If the daily landfill work is completed, the dumped cover soil is spread and compacted by bulldozer.

3) Availability of Heavy Equipment and Personnel

The heavy equipment cannot be operated at 100 % of their capacity all the time in because of breakdown or required maintenance of heavy equipment. It is assumed that rented heavy equipment will be used in case of a breakdown or maintenance.

As for the personnel involved in the landfill operation, a total of 7 days off in a month can be considered because of their holidays and leaves. Thus the availability is as follows.

Availability of personnel: 80 % (23 / 30 = 0.8)

(2) Number of Required Equipment

The necessary equipment is estimated based on the above-mentioned planning conditions, as shown in Table 5.1.4.

Table 5.1.4 Number of Required Equipment

Equipment	Specification	Quantity
Bulldozer	200HP	1
Excavator	Bucket: 0.7m^3	1
Dump truck	10 ton	1

In order to carryout the landfill operation and construction of the tentative disposal site, the above tabulated equipment should be procured by the end of the year 2003.

The necessary heavy equipment to be rented by the Lattakia city council up to the year 2003 is assumed to be the same as the above-mentioned figures, taking into account the actual works implemented in the pilot study.

(3) Required Manpower

The required manpower is estimated based on the above-mentioned planning conditions, as shown in Table 5.1.5.

Table 5.1.5 Number of Required Manpower in 2006

Item	Quantity
Site Manager	1 (1)
Secretary (accountant)	1 (1)
Site Inspector	2 (1)
Chief Operator	1
Operator/Driver	6
Worker	2 (1)
Guard	2 (2)
Total	15 (6)

Note: Figure in parenthesis shows the required number of manpower up to the year 2003.

The required manpower for the rehabilitation of Zone I & II (for 2001-2003) is estimated from the experience of the pilot study.

5.2 OPERATION IMPROVEMENT OF DISPOSAL SITE

(1) Outline of Proposed Rehabilitation Works

1) Rehabilitation Works in Zone I & II

At the first stage of the rehabilitation works, a certain section of the embankment will be constructed using rented heavy vehicles as the extension of the pilot study. The filling material of the embankment is the existing accumulated wastes that are dispersed in Zone I and II. The objective accumulated waste amount to be rearranged into embankment is estimated at 86,100 m^3 The rearranged wastes are to be spread and compacted, and then covered by a layer of soil. Landfill of the daily incoming waste will be carried out within the embankment. Figure 5.2.1 shows the typical cross section of landfill site that will be constructed by the rehabilitation works in Zone I & II.

The summed up amount of daily incoming waste for 2001-2003 is estimated at 345,000 m^3 including the needed amount of cover soil. Controlled landfill as combination of "cell method" and "push-up method" is proposed as the landfill method for the daily incoming waste.

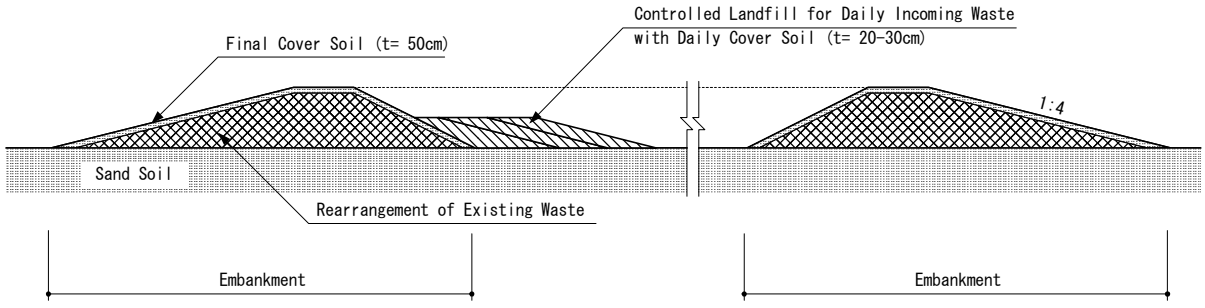


Figure 5.2.1 Typical Cross Section of Landfill Site in Zone I & II

2) Rehabilitation Works in Zone III

For the rehabilitation works in Zone III, the objective accumulated waste amount to be rearranged is estimated at 72,800 m^3 including dispersed piles of waste along the access road. The whole of the objective waste will be collected by heavy equipment, and transported into an area for rearrangement of existing accumulated waste. The transported wastes are covered by a layer of final cover soil after being spread and compacted by bulldozer. Gas exhaust facilities are to be installed following the rearrangement work.

Tentative disposal site will be constructed adjacent to the above-mentioned area. The embankment of the landfill site is to be constructed using sand of surroundings as the filling material, and covered by a layer of clay soil. The same layer as the liner will also cover the bottom of the landfill site for the prevention of leachate spilling. The daily incoming waste for 2004-2007 will be accommodated within this area. The estimated waste amount is at 686,400 m^3 including the needed amount of cover soil. Controlled landfill will be also adopted as the landfill method for the daily incoming waste.

(2) Landfill Operation Improvement

"Controlled Landfill is the method for the waste disposal used worldwide which minimizes the environmental impacts and protects public health. Waste to be disposed should be compacted and covered with a layer of soil and after all disposal operations have been completed, alternative land use is possible.

Solid waste must be sufficiently spread and compacted so as to stabilize the landfill area and to prolong the lifetime of disposal site. Soil cover must be placed systematically and periodically after landfilling of each year and/or cell of the waste.

1) Landfill Method

In order to perform the sufficient spreading and compaction of the waste, combination of the "cell method" and the "push-up method" is proposed for the operation improvement, since it was adopted for the pilot study in Zone I. The following items show the procedure of the landfill method.

- Waste spreading should not be too thick. The waste thickness of each layer shall be about 30 cm, which is effective for compaction work carried out by landfill equipment (bulldozer).
- Landfill layer and/or cell should be made as uniform as possible by the push-up method, taking into consideration the waste compaction efficiency. Gradient of the waste slope is proposed at 1:4, in order to ensure effective operation of landfill equipment.
- Thickness of each waste cell should less than 3 meters, according to waste characteristics of mixed municipal waste and efficiency of landfill work.

2) Cover Soil

Covering soil is the basic and the most effective countermeasures to environmental impacts created at the waste disposal sites. Covering soil, which consists of daily/periodical and final covering, shall be carried out at proper times during landfill operation, in order to prevent the waste scattering, offensive odor, harmful insects, waste-self burning, reduction of leachate amount and so on. The thickness of daily/periodical cover soil is proposed as follows.

- Daily/Periodical Cover Soil: 20-30cm
- Final Cover Soil: 50cm

As for the material of the final cover soil for the rehabilitation of Al-Bassa disposal site, a layer of clay soil is recommended in terms of its impermeability in order to minimize the leachate amount since the generation of leachate is mainly closely related to precipitation.

CHAPTER 6 ENHANCEMENT OF PUBLIC AWARENESS

6.1 INTRODUCTION

As feasible systems in the priority projects of this study, it has been proposed to introduce a waste separate collection system and a composting system using the separated waste into the future SWM in the study area. Therefore, residents' cooperation on waste separation at source (source separation) is extremely necessary to introduce such systems to SWM. The most important action to get such cooperation is to heightening public awareness on SWM as well as separate collection.

There have been, however, a few activities of public awareness on SWM in *Lattakia* and the three surrounding cities. The present situation on the activities is implemented infrequently and impermanently on a small scale. Namely, it is mentioned that the activities are not well organized from planning stage to the implementation stage for their SWM. This is due to several constraint factors of including lack of specific plans, experts, know-how, tools, information and budgets, and so on.

In order to efficiently introduce such new systems to the future SWM in the study area, consequently, related activities on enhancing of the public awareness shall be aggressively carried out by the public authorities as part of SWM. That is, activities on the public awareness shall be placed as an importance on SWM in the study area.

Taking account of the systems as well as the constraint factors in the feasibility study, several appropriate actions to heighten public awareness of SWM are proposed as follows.

6.2 ORGANIZATIONAL ARRANGEMENT

6.2.1 Public Awareness Section

In the priority projects, new waste collection vehicles will be procured in 2003 for *Lattakia* and the surrounding three cities. As well, preparation of source separation starts in 2004, and the separate collection actually represents 26% of the households of *Lattakia* City as the initial target from 2005 with the several collection vehicles procured in 2003.

In accordance with these schedules, actions on heightening public awareness on source separation should be prepared in the study area. Therefore, each city shall prepare a public awareness section to enforce necessary actions on the public awareness in SWM before the schedules as shown in Table 6.2.1.

Table 6.2.1 Organizational Arrangement

City	New Section	Position	Persons	Establishment Year
Lattakia	Public Awareness Section	Cleansing Department	3	2002
Jableh	Public Awareness Section	Cleansing Department	1	2002
Al-Haffeh	Public Awareness Section	Cleansing Department	1	2002
Qurdaha	Public Awareness Section	Cleansing Department	1	2002

6.2.2 Necessary Staff and Expected Roles

(1) Lattakia City

For the introduction of inter-municipal waste treatment including the collection system and the composting system in the study area, *Lattakia* City shall play an important part in SWM of the region including *Jableh*, *Al-Haffeh* and *Qurdaha*. Namely, the public awareness section in the cleansing department of *Lattakia* should have leadership in order to coordinate a partnership with the other three surrounding cities on activities for the public awareness. Therefore, three people in charge of the public awareness are required to implement the related activities as summarized in Table 6.2.2.

Table 6.2.2 Necessary Staff in *Lattakia*

Position	Number	Expertise	Main Activities
Section Chief	1	Public Health Expert or Sanitary Engineer	Management and Planning
Staff A	1	Public Health Expert	Coordination on related activities
Staff B	1	Social Science Expert	Coordination on related activities
Total	3	-	-

In addition, housewives' cooperation is extremely necessary for activities on source separation. From the point of view of social consideration, accordingly, a staff member in Table 6.2.2 might be a female.

(2) Jableh, Al-Haffeh and Qurdaha

It is reasonable to consider that activities for public awareness in the three surrounding cities may be implemented in cooperation and coordination with *Lattakia* City for the reason that the inter-municipal waste treatment system is going to be introduced as mentioned above. Therefore, in each neighboring city, one person shall be assigned to be in charge of the public awareness and prepare the related activities in each city and to coordinate *Lattakia* with the other cities.

6.3 CAMPAIGNS

Campaigns on SWM and source separation should be lunched as affirmative actions on heightening public awareness on SWM as follows.

6.3.1 Topics and Campaigns' Timing

The campaigns shall be planned and conducted in parallel with the schedule of the events and topics of the priority projects.

According to the implementation schedule of the priority projects in the feasibility study targeted year 2006, the main events and topics as well as suitable timing for launching the campaigns are summarized in Table 6.3.1.

Table 6.3.1 Topics in Priority Projects and Campaign Timing in F/S

	Topics	2001	2002	2003	2004	2005	2006
1	Improvement of Collection/Vehicles			New Vehicles Phase1	New Collection System		
2	Separate Collection				Preparation		
3	Improvement *Al-Bassa* Disposal Site			Rehabilitation			
4	Recycle Center at *Al-Bassa*			Compost/Sorting			
5	New Disposal Site in *Qasia*						Construction
6	Transfer Station						Construction
Public Awareness Section			Introduction				
Timing of the Campaigns		△	▲	▲	▲	▲	▲

: Preparation, Procurement, Rehabilitation & Construction : Implementation △: JICA's Campaign ▲: Campaigns

6.3.2 Approach

In order to anticipate possible resident and community involvement and their positive cooperation on the campaigns, an approach for the campaigns shall be employed with a participatory approach with the concept of community participation as shown in Chapter 3 in Part IV in this report.

6.3.3 Publicity & Demonstration Campaigns

(1) Publicity Campaigns

The publicity campaigns shall be planned and implemented to advertise widely the following information on the future actions on SWM in advance to the population in the study area through the mass media and printed materials.

- Opening of the Public Awareness Section
- Procurement of new collection vehicles
- Introduction of new collection systems
- Rehabilitation and construction of related facilities including the recycle center, disposal sites and transfer stations

Therefore, the following are the necessary Publicity campaigns to be lunched.

1) Publicity Campaign on Opening of the Public Awareness Section

In 2002, the public awareness section in each city is organized and operated as a new function. Therefore, a publicity campaign on opening of the section shall be lunched in 2003 for one day to inform of their functions and the expected roles of the population.

2) Publicity Campaign on New Collection Systems and Vehicles

In 2003, new collection and sweeping vehicles are procured in steps for collection in the future, sweeping, and the waste separate collection system. Therefore, a publicity campaign on a new collection system and new vehicles shall be launched in 2003 spanning several days before the implementation of the new system to disseminate and instruct information concerning the population.

3) Publicity Campaign on Rehabilitation of the Related Facilities in *Al-Bassa*

From 2003 to 2004, the present compost plant and the final disposal site in *Al*-B*assa*, will be improved as a recycle center (consisting of a compost plant and sorting center) and a controlled disposal site respectively. Therefore, a publicity campaign on the new center and the disposal site shall be launched in 2003 lasting several days before the implementation of the new facilities to disseminate information concerning the population.

4) Publicity Campaign on Constriction of the New Facilities

In 2006, a new controlled disposal site is scheduled to be constructed in *Qasie* for the operation of a new inter-municipality waste treatment system, which includes a recycle center (compost plant and sorting center). Therefore, a publicity campaign on the recycle center and the disposal site shall be lunched in 2006 lasting several days before the implementation of the new facilities to disseminate information concerning the population.

(2) Demonstration Campaigns

Demonstration campaigns are planned and will be implemented to demonstrate the following topics on the future SWM in advance for the population in the study area.

- Commencement of the new collection system
- Commencement of operation of the recycle center and the controlled disposal site in *Al-Bassa*.

Therefore, the following are the necessary demonstration campaigns to be launched.

1) Demonstration Campaign on New Collection System

In 2004, waste collection will be increased from 70 % to 85 % with the procurement of new collection vehicles in 2003. Accordingly, a demonstration campaign on the new collection system shall be launched at the start of the new system in 2004 for one week to demonstrate and show the new system and the new collection vehicles to the population. In addition, the campaign shall include publicity on the future waste separate collection system to get the residents' cooperation and community participation in advance for the implementation of the source separation.

2) Demonstration Campaign on Operation of the Related Facilities in *Al-Bassa*

In 2005, the recycle center (including the sorting center and rehabilitated compost plant) and the controlled disposal in *Al-Bassa* fully starts operation. Therefore, a demonstration campaign on the facilities shall be lunched in 2005 for one week at the

starting time of the operation to demonstrate and allow inspection of the facilities of the site to the population.

6.3.4 Source Separation Campaign

(1) Basic Activities

In 2005, a source separation system starts in selected areas of *Lattakia*, *Jabla*, *Al-Haffeh* and *Qurdaha.* The ratio of the separation is 26% of total amount of the solid waste from 2005 to 2009, and is scheduled to increase to 48% in 2010. Therefore, campaigns for source separation shall be lunched in each city in 2004 before the start of the separation system in 2005 as follows:

- To demonstrate source separation methods to source residents of selected areas.
- To demonstrate use of a set of waste containers (a set of two containers, one is for organic and other is for non-organic). As for the implementation, several sets of waste containers (a set of organic container and non-organic container) may be constructed and set up in the campaign for heightening public awareness on separation as an education tool even though the separate collection has not been implemented. The JICA study team produced and set up such sets of containers at the demonstration campaign held in the Sport City in *Lattakia* as a pilot study in August 2001. The details of the JICA's demonstration campaign appear in Chapter 3 in Part IV of this report
- To get a full scale residents' cooperation on the future separate collection system.
- To visit the recycle center in *Al-Bassa* and show the process of composting using separated waste.

(2) Targets

The target households of the camping as well as the source separation system are estimated based on the population forecast and the scheduled separate collection ratio on so on and summarized as shown in Table 6.3.2. They shall be chosen in the proposed areas of the separate collection in 2005.

Table 6.3.2 Targets of the Campaign and the Source Separation System

Activities	Year	Target Households			
		Lattakia	*Jableh*	*Al-Haffeh*	*Qurdaha*
The Source Separation Campaign	2004	200	100	50	50
Start of The Source Separation System	2005	20,500	5,100	1,300	2,700

Note: Number of family members per household is estimated to 5.3 person/ household (Syrian Statistics)

The campaign shall be implemented at the same time in four cities (*Lattakia*, *Jableh*, *Al-Haffeh* and *Qurdaha*) to produce sufficient effects. Accordingly, cooperative relationships among the four cities are necessary for the implementation of the campaign.

(3) Methods

As for know-how of the source separation campaign, each city may adapt the methods of the same campaign in *Lattakia* in August 2001, which was executed by the JICA Study Team as one of the pilot studies. Based on the results of questionnaire surveys, which was conducted during the campaign, it is evaluated that the length of the campaign shall be more than one month. The details of the campaign appear in Chapter 3 in Part IV in this report.

(4) Women's Cooperation

Women's, especially housewives', cooperation is extremely necessary for the source separation campaign. From the point of view of social considerations as well as women in development (WID) accordingly, the positive cooperation of the women's union and related community entities is expected in the women's involvement in the campaign.

6.3.5 Regular Campaigns and Activities

In addition to the specific campaigns discussed above, in order to heighten public awareness on the environment and SWM, continuous efforts shall be made with the following general actions.

- Regular campaigns such as a yearly campaign at the Sport City in *Lattakia*
- Periodic Activities such as setting up "Cleansing Day" and "Week of Clean City".

(1) Yearly Campaign

As one of the important actions for the continual efforts, a yearly campaign should be implemented during *AL Mahabba* Festival at the Sport City in *Lattakia* every year, in accordance with same methods of the demonstration campaign in August 2001. The details of the campaign appear in Chapter 3 in Part IV in this report.

The yearly campaign shall have specific themes every year. Based on the topics of SWM from 2002 to 2006 during the Fusibility Study, etc., the suitable themes are proposed as shown in Table 6.3.3.

Table 6.3.3 Yearly Themes for the Yearly Campaign

Year	Yearly Themes
2002	• Present situation and future SWM in the region • Expected activities of Public Awareness Section in each city
2003	• Present collection system and New collection system with procured new collection vehicles • Present situation of final disposal and recycling in the region
2004	• Rehabilitation of the compost plant and construction of the sorting center • Necessity of source separation and resident's cooperation
2005	• Compost from separated waste • Environmental improvement and benefit from the source separation and the recycling activities
2006	• Construction the inter-municipality waste treatment system • Creation of recycle cities and an environmentally friend society

(2) Regular Activities

As regular activities, specific periods shall be prepared for heightening public awareness of SWM as follows.

1) Cleansing Day

A Cleansing Day shall be set up once a year as a public day or a public holiday in *Lattakia* and the surrounding three cities. The day may be selected at the day when the public awareness section is set up in each city in 2002, at the "Arabic Environmental Day (14th October), or other important day related to SWM in the region.

The day cerebrates the opening the section (or other specific topic) and recognizes the importance of "Cleansing" with several activities:

- A ceremony of the day
- Dissemination related information through the mass media and printed materials
- Demonstration on Cleansing such as reduction methods of domestic waste
- Others

2) Cleansing Week for Schoolchildren

The Cleansing Week shall be set up twice a year for the mandatory schools in *Lattakia* and the surrounding three cities. The week instructs importance of "Cleansing" to the schoolchildren and to improve schoolchildren's awareness on SWM. During the week, activities to be taken shall be planned in cooperation between the public awareness section and the education directorate in *Lattakia*.

6.3.6 Necessary Preparation

(1) List of the Campaigns and Regular Activities

Table 6.3.4 shows the list of the campaigns and regular activities.

Table 6.3.4 Specific Campaigns and Regular Activities

Year	Specific Campaigns	Yearly Campaigns and Regular Activities
2002	• Publicity Campaign for Opening the Public Awareness Section (1 day)	• Yearly Campaign during *Al Mahabba* Festival at the Sport Center in *Lattakia* (10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2003	• Publicity Campaign on New Collection Systems and Vehicles (3 days) • Publicity Campaign on Rehabilitation of the related Facilities in Al-Bassa (3 days)	• Yearly Campaign during *Al Mahabba* Festival at the Sport Center in *Lattakia* (10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2004	• Demonstration Campaign on New Collection System (1 week) • Source Separation Campaign (More than one month)	• Yearly Campaign during *Al Mahabba* Festival at the Sport Center in *Lattakia* (10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2005	• Demonstration Campaign on Operation of the Related Facilities in *Al-Bassa* (1 week)	• Yearly Campaign during *Al Mahabba* Festival at the Sport Center in *Lattakia* (10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)

Year	Specific Campaigns	Yearly Campaigns and Regular Activities
2006	• Publicity Campaign on Construction of the New Facilities in *Qasia* (3 days)	• Yearly Campaign during *Al Mahabba* Festival at the Sport Center in *Lattakia* (10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)

Note: Numerical values in the parenthesis stand for the expected day(s), Week or Month.

(2) Basic Preparation for the Campaigns and Regular Activities

To implement each campaign and activity, much preparation is required including manpower and materials. As a matter of fact, each preparation must be sufficiently discussed in every preparation stage of the campaign and the activities.

However, the basic preparations to facilitate future preparation are summarized as shown in Table 6.3.5. Additionally, all preparation in the campaigns launched by the JICA Study Team from June to August as one of the pilot studies may be referenced and adapted for the preparation of the future campaigns and regular activities.

Table 6.3.5 Basic Preparation for the Campaigns and the Activities

Year	Basic Preparation Items
2002	• Manpower • Setting of a venue of the Opening Campaign • Signboards and other necessary campaign tools like T-shirt and key-holder for the Opening Campaign • Printed materials for the Opening Campaign, the Yearly Campaign, the Cleaning Day and the Week • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities
2003	• Manpower • Printed materials for the Publicity Campaigns, the Yearly Campaign, the Cleaning Day and the Week • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities
2004	• Manpower • Setting of a venue of the Demonstration Campaign • Signboards and other necessary campaign tools like T-shirt and key-holder for the Demonstration Campaign • Printed materials for the Demonstration Campaign, the Yearly Campaign, the Cleaning Day and the Week • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities
2005	• Manpower • Setting of a venue of the Demonstration Campaign • Signboards and other necessary campaign tools like T-shirt and key-holder for the Demonstration Campaign • Printed materials for the Demonstration Campaign, the Source Separation Campaign, the Yearly Campaign, the Cleaning Day and the Week • Plastic Bags and other necessary items for the Source Separation Campaign • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities
2006	• Manpower • Printed materials for the Publicity Campaign, the Yearly Campaign, the Cleaning Day and the Week • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities

6.4 OTHER ACTIVITIES

6.4.1 Consideration for Scavengers

Many scavengers (waste pickers) exist at the dumping site in *Al-Bassa* at present. The scavengers at the site are exposed to the following dangers.

- There is high risk to the scavengers of traffic accidents with the waste collection vehicles during tipping
- The risk of the accidents will be higher than now especially after the introduction of new waste collection vehicles and the heavy vehicles to the site in 2003
- Another risk for scavengers is infection by serious communicable diseases from infectious waste at the site

(1) Actions

From the point of view of social consideration, some measures must be taken to prevent such accidents at the disposal site. In order to avoid such accidents and to maintain safe operation of the heavy vehicles, the following actions are required.

- To inform to the vehicle drivers and the scavengers about the dangers of traffic accidents at the site
- To create regulations to avoid such accident between the drivers and the scavengers
- To educate the scavengers of the risks of the medical waste
- Timing and Schedule

The timing and schedule of the actions related to the scavengers are shown in Table 6.4.1.

Table 6.4.1 Timing and Schedule for the Actions on Scavengers

Year	Actions
2002	• To create mutual trust between scavengers and the section through dialogs • To inform to the vehicle drivers and the scavengers about dangers of traffic accident in the site through printed material and on-site oral presentations • To create a regulation for waste tipping and scavenging in accordance with vehicle schedules, tipping areas and so on. • To educate the risks of medical waste to the scavengers through printed materials and on-site oral presentations
2003	• To inform to the scavengers about schedules of new collection system with new collection vehicles • To inform to the scavengers about schedules of improvement of the dumping site and introduction of heavy vehicles • To review the regulations between waste tipping and scavenging in accordance with new vehicle schedules, tipping areas and so on.
2004	• To review the regulations between waste tipping and scavenging in accordance with new vehicle schedules, tipping areas and so on. • To inform to the scavenger about the separate collection system from 2005
2005	• To review the regulations between waste tipping and scavenging in accordance with new vehicle schedules, tipping areas and so on. • To inform to the scavenger about start of the separate collection system
2006	• To review the regulations between waste tipping and scavenging in accordance with new vehicle schedules, tipping areas and so on.

6.4.2 Internal Training

Internal training shall be planned and conducted for the staff of the public awareness section in each city to raise their capacity to handle activities on heightening public awareness concerns as follows.

(1) Seminars and Regular Training

Especially, in year 2002, the establishment of the sections, joint training seminars to all the staff of the sections of the four cities shall be held frequently to insure that they have enough knowledge on their expected activities. From 2003, regular training shall be scheduled cooperatively by the four cities to upgrade their skills at least once a year. The schedule of the necessary seminar and training are summarized in Table 6.4.2.

Table 6.4.2 Internal Seminar and Training Schedule

Year	Seminars and Training	Number of Times
2002	Joint Seminar	Three times
2003-	Regular Joint Training	Once a Year

(2) Possible Lecturers

For the effective implementation of the training, the public awareness sections may refer to experiences on related activities conducted by some official and public entities as summarized in Table 6.4.3. They have conducted many activities on public awareness and campaigns in their field respectively. The public awareness sections may invite people who are in charge of public awareness in the various related organizations as possible lecturers for the seminars and training.

Table 6.4.3 Related Activities on Public Awareness by Other Entities

Entities	Local Offices	Activities
Ministry of Education	*Lattakia* Education Directorate	School Health and Hygiene Education
Ministry of Environment	*Lattakia* Environment Directorate	Environmental Education
Ministry of Health	*Lattakia* Health Directorate	Health and Hygiene Education
Women's Union	*Lattakia* Branch of Women's Union	Women's Health and Hygiene Education

CHAPTER 7 INSTITUTIONAL DEVELOPMENT

7.1 CLEANSING ORGANIZATION IN EACH CITY

In line with the procurement of collection equipment for carrying out waste collection and improvement of street sweeping, it is necessary to prepare the cleaning organization in each city. The required personnel in each city in 2006 are as shown in Table 7.1.1. Since the project aims to improve the efficiency of primary collection and other work based on procurement of collection equipment and cooperation from citizens, it is planned for personnel to be decreased in Lattakia. Accordingly, it is necessary to actively promote reassignment of personnel to treatment and disposal work.

Table 7.1.1 Required Personnel on SWM in 2006

(Unit: person)

Item	Lattakia	Jableh	Qurdaha	Al-Haffeh	Total
Manager	1	1	1	1	4
Administration	3	1	1	1	6
Collection	132	50	19	19	220
Road sweeping	426	40	17	7	490
Others *)	59	1	1	1	62
Total	621	93	39	29	782
Current personnel	723	77	32	18	838

Note: *) Others consist of road occupancy, construction debris handling and public relation.

7.2 ARRANGEMENT OF THE TREATMENT AND DISPOSAL SETUP

Construction of a recycling center and disposal site at Al-Bassa shall be carried out in the project. Therefore, it is necessary to establish an operation and management organization for these facilities. Required personnel in the operating setup are as indicated in Table 7.2.1.

Table 7.2.1 Required Personnel in Al-Bassa Recycling Center & Disposal Site

(Unit: person)

Item	Compost plant	Sorting center	Disposal site	Total
Person	26 (12)	17 *)	15	58 (12)

Note: *) Manager and engineer are not included because they will jointly work at Recycling center

( ) shows the additional person in case the plant operate by two shifts

The new organization shall initially be established under the supervision of Lattakia Municipal Government. Moreover, as is described in the Master Plan, when introducing medical waste collection and constructing the new disposal site, this organization will need to be regarded as part of Lattakia Governorate.

CHAPTER 8 COST OF PRIORITY PROJECT

8.1 INVESTMENT COST

The estimated investment cost of the priority project is shown in Table 8.1.1. Total investment cost of priority project will be 551.9 million SP.

Table 8.1.1 Investment Cost of the Priority Project

(Unit: Thousand SP)

Item		Investment cost
1. Collection & Road Sweeping	Collection equipment	155,557
2. Recycling Center	Compost plant	199,000
	Sorting center	33,260
3. Al-Bassa Disposal Site	Zone I & II	730
	Zone III	88,480
	Disposal equipment	29,840
4. Public Awareness		8,965
5. Organization set-up		-
Sub-total		515,832
6. Engineering service		36,108
Total		551,940

8.2 OPERATION AND MAINTENANCE COST

Operation and maintenance cost of the priority project is shown in Table 8.2.1. As shown in the table, total operation and maintenance cost in year 2006 will be approx. SP 100 million.

Table 8.2.1 Operation and Maintenance Cost for the Priority Project in 2006

(Unit: Thousand SP/year)

Item		O/M cost
1. Collection & Road Sweeping	Collection equipment	88,172
2. Recycling Center	Compost plant	3,553
	Sorting center	2,995
3. Al-Bassa Disposal Site	Landfill operation	8,966
4. Others		1,097
Sub-total		104,743
5. Income for selling	Compost	678
	Recyclables	4,093
Total		99,972

Note: Depreciation is not included

CHAPTER 9 FINANCIAL PLAN

9.1 INVESTMENT PLAN

(1) Annual Investment

Project investment based on the priority works implementation schedule is as indicated in Table 9.1.1. It will be necessary to cover project cost of SP 551.9 million.

(2) Sources of Finance

Sources of finance for the project are not as yet decided. Since Lattakia and the three surrounding cities do not possess funds and it will be necessary to revise the law and implement large-scale increases in fees in order to repay investment costs, funds other than those from the municipality own budget will be required for the immediate future.

Furthermore, to ensure continuation of the solid waste management, it will be necessary to secure final disposal sites into the future. Therefore, as is indicated in the Master Plan, it is necessary for Qasia disposal site to be constructed in 2008. Concerning investment for Qasia disposal site and costs of renewing waste collection facilities and equipment in future, it will be necessary for cities to cover these expenses via their own funds or loans.

Table 9.1.1 Financial Plan

(1) Investment and O/M Cost

(Unit: SP1,000)

	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011	2,012	2,013	2,014	2,015	2,016	2,017	2,018	2,019	2,020	
1. Construction																					
Disposal site	0	730	81,505	36,815		76,490	77,370	0	0	0			29,840			76,490	77,370				456,610
Transfer station						23,360	72,060										48,700				144,120
Compost plant			116,500	82,500	0	0								21,776					141,912		362,688
Sortin center			14,000	19,260										5,260					15,850		54,370
Collection			155,557				110,888		0			49,096	155,557			0	110,888		0		581,986
Medical																					0
Public Awareness		1,494	1,868	2,241	1,868	1,494															8,965
Engineering		156	26,364	9,857	131	7,094	18,353														61,955
Sub total	0	2,380	395,794	150,673	1,999	108,438	278,671	0	0	0	0	49,096	185,397	27,036	0	76,490	236,958	0	157,762	0	1,670,694
2. Operation																					
Disposal site	8,195	16,390	16,390	8,310	8,946	8,966	8,996	12,620	12,640	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	238,843
Transfer station								7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	96,031
Compost plant					3,553	3,553	3,553	3,553	5,517	5,517	5,517	5,517	5,517	5,517	5,517	5,517	5,517	5,517	5,517	5,517	80,416
Sortin center					2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	47,280
Collection	110,981	110,981	88,172	88,172	88,172	88,172	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	1,754,290
Medical				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Others		1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	20,843
Sub total	119,176	128,468	105,659	97,579	104,723	104,743	100,861	111,872	113,856	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	2,237,703
Total	119,176	130,848	501,453	248,252	106,722	213,181	379,532	111,872	113,856	113,706	113,706	162,802	299,103	140,742	113,706	190,196	350,664	113,706	271,468	113,706	3,908,397

(2) Cash Flow

(Unit: SP1,000)

Revenue	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011	2,012	2,013	2,014	2,015	2,016	2,017	2,018	2,019	2,020	
1. Remaining																					0
Fee from HH	7,600	14,205	14,587	36,095	37,066	38,063	143,631	147,495	151,462	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	2,301,106
Fee from comercial	30,000	36,426	36,426	36,426	36,426	36,426	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	1,324,654
Sub sidy	89,461	77,837	72,800	36,400	36,400	36,400															349,298
Sales of compost					678	678	678	678	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	18,984
Sales of reusable					4,093	4,093	4,093	4,093	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	76,456
Sub total	127,061	128,468	123,813	108,921	114,663	115,660	227,868	231,732	237,291	241,366	241,366	241,366	241,366	241,366	241,366	241,366	241,366	241,366	241,366	241,366	4,070,498
Grant (100%)	0	2,380	395,794	150,673																	548,847
Loan (70%)					1,399	75,907	195,070	0	0	0	0	34,367	129,778	18,925	0	53,543	165,871	0	110,433	0	785,293
Sub total	127,061	130,847	519,607	259,594	116,062	191,567	422,938	231,732	237,291	241,366	241,366	275,733	371,144	260,291	241,366	294,909	407,236	241,366	351,799	241,366	5,404,638
2. Expense																					0
Capital invest	7,885	2,380	395,794	150,673	1,999	108,438	278,671	0	0	0	0	49,096	185,397	27,036	0	76,490	236,958	0	157,762	0	1,678,579
Operation	119,176	128,468	105,659	97,579	104,723	104,743	100,861	111,872	113,856	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	2,237,703
Loan repayment					0	140	7,731	27,238	27,238	27,238	27,238	27,238	30,674	43,652	45,545	45,405	43,168	40,248	40,248	51,292	484,291
Loan interest(8%)					0	112	6,173	21,160	18,981	16,802	14,623	12,444	13,015	20,943	18,965	15,321	15,972	25,789	22,569	28,184	251,054
Sub total	127,061	130,848	501,453	248,252	106,722	213,433	393,436	160,270	160,075	157,746	155,567	202,484	342,792	205,337	178,215	250,922	409,805	179,743	334,285	193,181	4,651,627
Balance	0	-0	18,154	11,342	9,340	-21,866	29,502	71,462	77,216	83,620	85,799	73,249	28,352	54,954	63,150	43,987	-2,568	61,623	17,514	48,184	753,011
Accumulation	0	-0	18,153	29,495	38,836	16,969	46,471	117,933	195,149	278,769	364,568	437,817	466,168	521,122	584,272	628,259	625,690	687,313	704,827	753,011	
Remaining loan	0	0	0	0	1,399	77,166	264,505	237,267	210,030	182,792	155,555	162,684	261,788	237,061	191,517	199,655	322,357	282,109	352,294	301,002	
Total debt	0	-0	18,153	29,495	37,436	-60,197	-218,034	-119,335	-14,881	95,977	209,013	275,132	204,380	284,061	392,755	428,604	303,333	405,204	352,533	452,009	
Debt ratio	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	6.1%	20.9%	19.5%	18.2%	17.3%	16.4%	18.1%	26.8%	26.7%	25.2%	24.5%	27.4%	26.0%	32.9%	

9.2 REVENUE AND EXPENDITURE OF SWM

(1) Cleansing Fees and Revenue

Waste treatment costs excluding depreciation expenses will be SP 100.0 million/year in 2006, and it will be necessary to depend on revenue from cleansing fees and subsidies from the general budget of municipal government to cover these costs.

For the immediate future, it will be necessary to keep cleansing fees fixed and strive to raise collection rates. However, in 2006, it will be necessary to revise the present legal limit for household cleansing fees to SP 500/year/household in Lattakia and SP 200/year/household in the other cities (fees of business establishment will be same as present). As a result of this revision, assuming the collection rate is 80%, revenue from fees in 2006 will be SP 38.1 million from household fees and SP 36.4 million from business establishment fees, making SP 74.5 million/year in total. Moreover, concerning 2007 and onwards, since it will be possible to pay for the new disposal site via loans, as is indicated in the Master Plan, it will be necessary to amend the law concerning cleansing fees and raise fees even more.

(2) Expenditure

Leaving aside depreciation cost and taking revenue from compost and reusable material sales into account, expenditure in Lattakia and the three other cities in 2006 will be SP 100.0 million. Therefore, in order to cover the operation and maintenance cost, it will be necessary for each city to outlay costs equivalent to roughly half of existing subsidies (SP 36.4 million) in 2006 too. Moreover, from 2007 onwards, in addition to operation and maintenance costs, it will be necessary to make loan repayments and interest payments.

(3) Cash Flow

From 2006 onwards, it will be necessary for investment in Qasia disposal site and transfer stations and renewal of facilities and equipment to be carried out according to the Master Plan. Moreover, it will be necessary for cities to cover these expenses via their own funds or loans. The cash flow in this case is as shown in Table 9.1.1. Concerning investment from 2006 onwards, this will need to be implemented with ample consideration given to raising cleansing fees even further.

CHAPTER 10 ENVIRONMENTAL EVALUATION IN LATTAKIA

10.1 TECHNICAL EVALUATION

The following technical systems are proposed in the master plan:

- Improvement of collection and street sweeping
- Introduction of source separate collection
- Construction of Lattakia recycle center (rehabilitation of the former compost plant and construction of a sorting center)
- Rehabilitation and improvement of operation at Al-Bassa disposal site

(1) Improvement of Collection and Street Sweeping

The target for waste collection in 2006 is 85%, and the types of waste to be collected are domestic waste, commercial waste, park and road waste, non-infectious medical waste and small-scale factory waste.

When introducing new collection equipment, considering topographical conditions in the collection districts, vehicles shall basically consist of medium size compactors rather than the present large size vehicles. Also, equipment required for source separate collection and street sweeping shall be provided. Existing collection systems shall be respected so that container collection as a rule is carried out in Lattakia, Jableh and Qurdaha and collection in plastic bags is carried out in Al-Haffeh. It is judged that implementation of these measures will enable the collection target to be achieved and is comfortably feasible in technical terms.

(2) Introduction of Source Separate Collection

The target amount of source separate collection as a ratio of generated domestic waste shall be 26% in 2006 (approximately 10,000 households). Source separate collection was carried out in the Pilot Study, and active participation of citizens was obtained at this time. Therefore, it is judged that source separate collection is very possible if carried out in tandem with PR campaigns.

(3) Construction of Lattakia Recycle Center (Rehabilitation of the Old Compost Plant and Construction of a Sorting Center)

a. Rehabilitation of the Old Compost Plant

In carrying out rehabilitation of the old compost plant at Al-Bassa, all equipment shall be renewed but the existing buildings shall be repaired and utilized as much as possible.

This facility is regarded as a pilot plant for the compost plant (150 tons/day) proposed to commence services in 2010, and it will become a model for quality control and sales control of compost products and screened reusable materials. Rehabilitation shall be carried out in phases with operation being initially conducted over one shift (25 tons/day) and later being increased to two shifts (50 tons/day) when the quality and demand for compost have been confirmed.

To sum up, this facility presents no technical problems and is thought to be comfortably feasible.

b. Construction of the Sorting Center

The sorting center will recover paper, fibers, plastics, metals and glass and will have a capacity of 20 tons/day.

Considering that this facility will target inorganic waste that is separated at the source and will adopt simple but sure manual screening in the reusable materials recovery process, this facility is judged to be very feasible in technical terms.

(4) Rehabilitation and Improvement of Operation of Al-Bassa Disposal Site

Rehabilitation of Al-Bassa disposal site shall be implemented over two phases, i.e. Zone I and II in the first phase, and Zone III in the second phase. All work components are an extension of the technology that was implemented in the Pilot Study, and in Zone III, water barrier works, leachate treatment site and storm water drainage facilities are added to these. As for the landfilling method, the push-up/cell system and earth covering method implemented in the Pilot Study shall be introduced. Therefore, the rehabilitation and improved operation of Al-Bassa disposal site is judged to be technically viable.

10.2 ECONOMIC AND FINANCIAL EVALUATION

10.2.1 Economic Evaluation

In the economic assessment, economic cost and benefit estimation and cost-benefit analysis are conducted, and the economic internal rate of return is computed. Moreover, since a feature of the solid waste management is that final disposal sites need to be secured, assessment is conducted assuming that Qasia final disposal site is constructed as indicated in the Master Plan. However, construction of the planned compost plant and sorting center at Qasia is excluded in the analysis.

(1) Economic Cost

In carrying out economic assessment, financial costs are directly converted into economic costs.

(2) Economic Benefits

Benefits resulting from implementation of the project can be considered as follows.

a. Elimination of solid waste: protection of the urban living environment, improvement of public sanitation
b. Introduction of source separate collection: enlightenment of citizen awareness
c. Compost production: recovery of reusable materials, reduction of chemical fertilizer, increase in production, improvement of production quality, reduction of irrigation water consumption, reduction of disposal quantities, reduction of global warming gases, recovery of reusable materials
d. Recovery of reusable materials: recovery of reusable materials, reduction of final disposal quantities

e. Improvement of existing disposal sites and construction of new disposal site: surrounding environmental protection, promotion of coastal road construction, vacant site use

Out of the above, quantifiable benefits are as follows: 1) benefits resulting from removal of solid waste, 2) benefits of compost production, and 3) benefits of reusable materials recovery. The economic value of these benefits is as follows.

a. Concerning the solid waste elimination effect, the amount beneficiaries are willing to pay shall be the benefit. Judging from the findings of the citizen awareness survey, the average amount beneficiaries are willing to pay is SP 132/month in Lattakia. It is guessed that stores have similar willingness to pay according to the amount of waste. Taking this willingness to pay, the number of households and waste collection rate into account, the estimated benefit will be SP 196.2 million in 2006. Incidentally, this amount beneficiaries are willing to pay roughly works out at 1% of income and is a fair level.

b. Effect of compost production
The project intends to introduce a 50-tons/day compost plant, and this will initially handle 25 tons/day of waste and produce 6.25 tons/day of compost up to 2010. From 2010 onwards, it is planned for the plant to handle 50 tons/day of waste and produce 12.5 tons/day of compost. The effects of composting can be divided into the fertilizer reduction effect, agricultural production increased income effect, and water consumption reduction effect. In economic terms, these effects work out as SP 580, SP 1,500 and SP 500 per ton of compost respectively. It is estimated that this benefit will be SP 5.0 million in 2005 and SP 10.0 million in 2010.

c. Reusable materials recovery effect
In the project, it is planned to recover 1.25 tons/day of reusable materials at the compost plant for the foreseeable future and 2.5 tons/day in 2010. Moreover, at the sorting center, it is planned to recover five 5 tons/day of reusable materials. It is estimated that this benefit will be SP 4.1 million in 2005 and SP 5.0 million in 2010.

(3) Economic Internal Rate of Return

Calculating from the above estimates of cost and benefit, the economic internal rate of return works out as 9.2% as indicated in Table 10.2.1.

This is a low figure for the economic internal rate of return when compared to other projects. However, in addition to the above quantifiable effects, when non-quantifiable effects such as reduction of final disposal quantities (37.5 tons/day in compost treatment, 5 tons/day at sorting facilities), environmental improvement at Al-Bassa disposal site, and promotion of tourism resulting thereof are taken into account, it is possible to view the project as a viable undertaking. Moreover, the fact that project implementation will enable waste disposal to be carried out over the long term at Qasia in Lattakia Province is extremely important.

Table 10.2.1 FIRR for the Priority Project

(Unit: SP million)

Year	Balance	Coat			Benefit			
		Total	Invest	Operation	Total	Willingness	Compost	Reusable
2001	0.0	0.0	0.0		0.0			
2002	−2.4	2.4	2.4		0.0			
2003	−320.4	501.6	395.9	105.7	181.2	181.2		
2004	−62.3	248.3	150.7	97.6	186.0	186.0		
2005	88.7	111.4	6.7	104.7	200.1	191.0	5.0	4.1
2006	−7.9	213.2	108.5	104.7	205.3	196.2	5.0	4.1
2007	−169.2	379.7	278.8	100.9	210.5	201.4	5.0	4.1
2008	104.1	111.9	0.0	111.9	216.0	206.9	5.0	4.1
2009	107.6	113.9	0.0	113.9	221.5	212.4	5.0	4.1
2010	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2011	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2012	70.3	162.8	49.1	113.7	233.1	218.1	10.0	5.0
2013	−73.2	306.3	192.6	113.7	233.1	218.1	10.0	5.0
2014	92.3	140.8	27.1	113.7	233.1	218.1	10.0	5.0
2015	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2016	42.9	190.2	76.5	113.7	233.1	218.1	10.0	5.0
2017	−117.6	350.7	237.0	113.7	233.1	218.1	10.0	5.0
2018	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2019	−38.4	271.5	157.8	113.7	233.1	218.1	10.0	5.0
2020	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2021	345.7	−345.7	−345.7					
Total	657.6	3,327.5	1,337.4	1,990.1	3,985.1	3,774.6	135.0	75.5
IRR	9.2%							

10.2.2 Financial Evaluation

The results of the economic analysis indicate that the project is a viable undertaking. Meanwhile, it will be necessary to procure funds other than those from the municipality own budget to cover investment costs when actually implementing the project. Moreover, as is indicated in the Master Plan and financial plan, it will be necessary to raise cleansing fees by 2010 in order to ensure sustained operation of the solid waste management. However, since the ratio of cleansing fees following the price increases will still only be around 1% of household income, this will not prove to be a major burden. Moreover, if investment until 2005 can be subsidized, it will be possible to sustain the solid waste management by financing investment from 2006 onwards using 30% own funds and 70% loans.

Furthermore, the compost plant and sorting center can cover operation and maintenance costs excluding personnel expenses by means of revenue from the sale of compost and reusable materials.

10.3 ENVIRONMENTAL EVALUATIONS - LATTAKIA

Two subject projects were selected among the feasibility study projects according to proposed environmental guideline in Syria. Those two projects are located in the existing disposal site in Al-Bassa and both projects aim to improve existing waste disposal. The location of the sites is shown in Figure 10.3.1.

- Development of Lattakia Recycling Center (Composting plant and sorting center)
- Rehabilitation and rearrangement of Al-Bassa Disposal site and improvement of operation of final disposal site

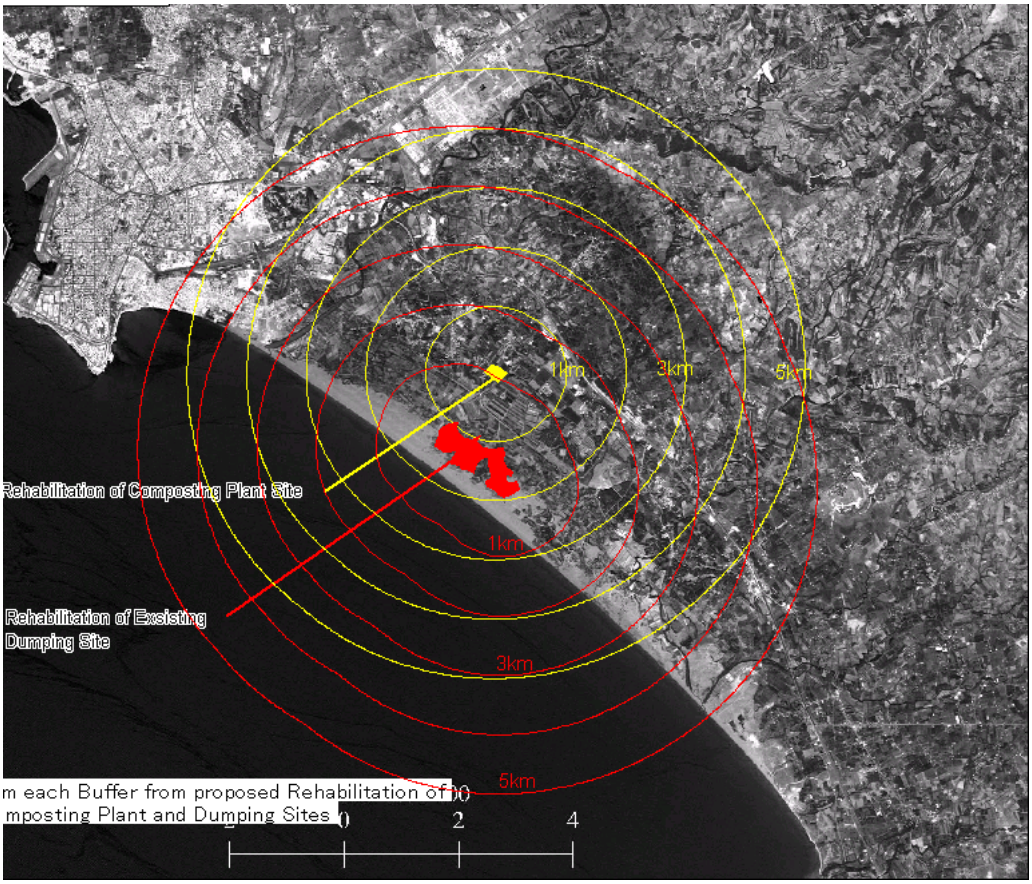


Figure 10.3.1 Location of SWM Facilities in Al-Bassa

(4) Potential Impact and Its Mitigation Measures

1) Lattakia Recycling Center

The project aims to renew existing composting facility and most of the facility there except building is renewed. Hence, it is minimized adverse environmental impact caused by project implementation. Although, it is doubt about offensive odour to a few houses located next to the site during the operation stage. Potential impact and its mitigation measures are examined as follows:

a. Offensive Odour, noise and vermin

Offensive odour is occurred during the compost production process. It is minimized by proper fermentation of the organic waste at approximately 70 degree Celsius so that the odour will be minimized. In addition to this, the heat will exterminate vectors and pests. Generation of vermin will be minimized in the site. Then, low rotary motion of the classifier machine, which is used at beginning of the waste classification, high

noise will not be generated. A key point of the mitigation measure is proper operation so that skilled staff should be assigned.

b. Leachate

It is unavoidable aspect that water percolates from organic waste. Residual water namely leachate is recycled in the process of compost production according to the plan. Consequently leachate will not be discharged except residues. However, it is essential that water quality shall be monitored periodically in case of deterioration of ground water by unexpected percolation.

2) Rehabilitation and rearrangement of Al-Bassa Disposal site

As well as Lattakia Recycle Center, the project aims to rehabilitate and rearrangement of existing disposal site using sanitary landfill method. It is therefore significant adverse environmental impact will not be occurred by the project implementation. However, proper leachate management and landscape shall be considered during the design and operation stage. Potential and its mitigation measure are examined as follows:

a. Deterioration of Water Quality by Leachate

Leachate management of landfill site is a key issue on environmental consideration of waste disposal management. The mitigation measures shall be taken from design stage and the design shall include the measures in order to minimize adverse impacts. In addition to this, it is important that periodical waster quality monitoring in the site shall be done during the operation stage. Key component of leachate management is shown in following table.

b. Restoration and Preservation of Coastal Landscape

Costal landscape shall be restored that presently disorder waste management has deteriorated the landscape when the site is rehabilitated. The plan proposes soil coverage in order to avoid scattering of the waste, offensive odour and spontaneous combustion. Planting trees and shrubs are quite helpful to maintain coastal ecosystem. The restoration of coastal landscape shall be considered after the disposal site closed due to valuable coastal area originally.

Table 10.3.1 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

(5) Conclusion

Proposed plans, recycling center and rehabilitation of Al-Bassa disposal site, include sufficient component and well-organized schemes will have no major negative potential impact of environment.

Appropriate construction and operation with mitigation measures are the conditions for minimization of the environmental impacts.

The improvement of collection system will improve the service efficiency of collection and haulage of the waste to the disposal site, as a result, living environment and public health condition will be advanced.

Consequently the proposed projects have beneficial impacts on the environment and public health condition, and Lattakia, Jableh. Al-Haffeh and Qurdaha municipalities will receive environmental benefit from the projects.

10.4 SOCIAL CONSIDERATIONS

(1) Fee Collection and Low Income Groups

The project aims to build the financial base of the solid waste management based on the principle of burden by beneficiaries. Accordingly, since it is important to raise cleansing fees for this purpose, the burden placed on low-income households may increase. In consideration of this, the fee collection rate is set low at 80%. Moreover, since households with income of no more than SP 4,000/month account for 14%, exemption of cleansing fees for low-income groups is possible.

(2) Employment Opportunities

The cleansing utility in Lattakia and the three surrounding cities employs 838 workers. In the present situation, since cooperation by citizens is scarce and there is a shortage of equipment, many personnel are engaged in primary collection and street sweeping. In the project, however, since it is intended to procure equipment and secure the cooperation of citizens in relieving the burden of primary collection, it should be possible to reduce personnel provided that sufficient cooperation is forthcoming from citizens. However, the project intends to respect existing systems and consider additional personnel for realizing appropriate treatment and disposal in future, and therefore additional employment opportunities will be secured. For this reason, manual sorting lines are planned at the compost plant and sorting center in order to recover reusable materials.

(3) Waste-pickers

There are approximately 60 waste-pickers at Al-Bassa disposal site and they recover plastic and metal reusable materials. Cooperation will be required from waste-pickers in order to implement earth covering and prevent environmental pollution at the final disposal sites. This is also required in order to secure safety of work. Concerning this point, moves to achieve cooperation were already started in the Pilot Study with the trial implementation of work methods in harmony with waste-pickers and registering of waste-pickers. These activities shall be further advanced in the project.

Moreover, in the project it is planned to carry out source separation of domestic waste into organic waste and inorganic waste. Organic waste shall be treated at the compost plant, and reusable materials shall be taken from inorganic waste at the sorting center. Since inorganic waste contains a lot of reusable materials, efficient recovery is possible. Therefore, recovery at the sorting center is more desirable than recovery at the disposal site in terms of both work environment and quality of recovered materials. When implementing the project, an appropriate recovery system shall be constructed while cooperation is sought from waste-pickers.

CHAPTER 11 RECOMMENDATIONS

11.1 SYSTEM OF FEES

In order to secure the sustained operation of the solid waste management, it is necessary to procure and renew the necessary equipment and secure funds for doing this. For this reason, cleansing fees must be modified to appropriate levels. In Lattakia and the three surrounding cities, it is first necessary to increase the collection rate of fees from domestic users. Next, domestic fees need to be revised so that they are SP 500/year/household in Lattakia and SP 200/year/household in the surrounding three cities.

In the long term, revision of the national law on fees will be necessary, and fee systems on the national and municipal levels must be established so that around 1% of household incomes is collected.

11.2 ESTABLISHMENT OF SYSTEMS FOR EQUIPMENT RENEWAL

Apart from tractors, all waste collection vehicles and heavy machinery are imported items. Even if local governments intend to use their budgets for purchasing such equipment, they are unable to purchase and renew waste collection equipment because they have no foreign currency. Accordingly, central government subsidization is relied on for purchasing all waste collection vehicles. However, the central government is also financially restricted and can only respond to part of the need. As a result, each city in Syria is confronted with equipment shortages and deterioration.

Cities in future will need to advance fee collection that covers equipment costs including depreciation costs. This will enable them to raise funds for procuring equipment. At the same time, in order to overcome the above situation, it is necessary for local governments to cooperate in establishing a special fund for equipment renewal and setting up a system for the import and purchase of waste collection equipment with support from the Ministry of Local Government. Sources of finance and functions of this fund are as follows:

Sources of finance:

a. Accumulation of part of cleansing fee income in each municipality (for example, 5%)

b. Central government subsidies (for example, 30%)

c. Repayment by the benefiting local authorities

Roles:

a. Review of local authority purchasing plans

b. Import and distribution of cleansing equipment

c. Financial control

11.3 PROMOTION OF COMPOST USE

Composting is a common means of recycling organic waste, however, there is little point in doing this if farmers do not use the compost product. Accordingly, it is first necessary to produce good quality compost, while at the same time farmers must promote the utilization of compost. For this purpose, the following measures are required:

a. Promotion of study and research into the effects and uses of compost

b. Dissemination of the effects and uses of compost

c. Encouragement of compost use

11.4 ESTABLISHMENT OF INTER-MUNICIPAL SYSTEMS

The financial base of small and medium municipalities is fragile. Therefore, the leading city in each Governorate should take the initiative in cooperation with Governorate governments in building inter-municipal waste management systems that incorporate these smaller municipalities. The project will be a model undertaking in this respect, and it is hoped that similar systems are adopted in other regions too.

11.5 ESTABLISHMENT OF HAZARDOUS WASTE MANAGEMENT SYSTEM

Hazardous waste needs to be treated and disposed according to its properties. If one considers the present capacity of local authorities, it is necessary for such a treatment and disposal system to be advanced under the initiative of the central government.

PART III

FEASIBILITY STUDY ON THE COMPOST PLANT IN HOMS

PART III FEASIBILITY STUDY ON THE COMPOST PLANT AT HOMS CITY

CHAPTER 1 INTRODUCTION

The master plan on solid waste management for Homs City has been prepared by the METAP-EIB study, which is still being conducted and was presented in the revised interim report in January 2001. The major proposal of the master plan is that the existing disposal site at Dir Baalbeh be rehabilitated and closed as soon as possible. A new disposal site will be constructed at Manglia about 30 km away from the city center of Homs. A transfer station will be constructed at the present disposal site and several recycling systems including a compost plant for market and green waste and source separated domestic waste will be introduced.

Recommendation of introduction related to recycling is as follows:

(1) Up Until 2004

a. Existing private recycling schemes maintained in areas without public a separation collection scheme

b. Establishment of pretreatment facility for healthcare waste

c. Demolition waste treatment facility established at existing dumpsite area in 2002.

(2) Up Until 2010

a. Existing private recycling schemes maintained in areas without public source separation collection scheme

b. Compost plant for park/market waste established in 2005 (Capacity 7,500 ton /year)

c. A pilot plant for testing of composting of organic waste from high/middle income household areas established in 2007 (Capacity 4,000 ton/year)

d. Pilot plant for testing of central sorting of source separated domestic waste and commercial waste etc, established in 2007 (Capacity 5,000 ton/year)

(3) Up Until 2020

a. Existing private recycling schemes maintained in areas without public source separation collection scheme

b. Extension of the compost plant for park/market waste in 2011 (Total 11,000 ton/year)

c. c.Full scale plant for composting of organic waste from high/middle income household areas established in 2011 (Capacity 35,000 ton/year) and extended in 2013 (Total 70,000)

d. Full scale sorting facility for central sorting of source separated household waste and commercial waste etc, established in 2011 (capacity 75,000 ton/year)

e. Replacement of worn out equipment for pre-treatment facility for healthcare waste

This study is aims to prepare a feasibility study for the compost plant based on the above master plan.

CHAPTER 2 REVIEW OF THE MASTER PLAN ON THE SOLID WASTE MANAGEMENT IN HOMS CITY

2.1 OUTLINE

In the master plan for solid waste management in Homs City, Maghlia located approximately 26 km northwest of Homs City has been selected from a number of candidate sites as the location of the new disposal site. Also, concerning the project scenario, out of the three alternatives to 1) construct the most economic and basic system, 2) adopt the basis system and introduce partial recycling, and 3) introduce full-scale recycling, the plan to adopt a basic system and also introduce partial recycling was selected. This plan entails the phased introduction of recycling for construction waste materials, a compost plant and a sorting center. Moreover, for this purpose, it is planned to introduce source separate collection of domestic waste. Incidentally, Japanese cooperation is anticipated for provision of the collection equipment.

2.2 MAJOR COMPONENTS OF THE MASTER PLAN UP TO 2010

The Master plan on the solid waste management in Homs is prepared by METAP-EIB. It is proposed several components to improve solid waste management in Homs as shown in Table 2.2.1.

Table 2.2.1 Major components of the Master Plan in Homs

	Short term (2001-2004)	Medium term (2005-2010)
Collection	(1) Replacement of worn out equipment (2) Separate collection of hazardous waste - Healthcare waste - Industrial hazardous waste	(1) Replacement and extension of collection capacity (2) Separate collection - Vegetable markets and parks/gardens (3) Test of source separation - High/middle income household (4) Test of separate collection - Commercial
Transportation	(1)Establishment of a transfer station at Dir Baalbeh	
Recycling/treatment	(1) Establishment of pretreatment facility for healthcare waste (2) Establishment of demolition waste treatment	(1) Biological treatment facility (composting plant) - Park/market waste (2) Pilot plant for biological treatment - Organic waste from high/middle income household (3) Pilot plant for central sorting
Landfill disposal	(1) Disposal at new landfill site (Maghlia) - Municipal waste - Non-hazardous industrial waste - Sewage sludge (special section) - Hazardous/healthcare waste (special section)	(1) Disposal at new landfill site (Maghlia) - Municipal waste - Non-hazardous industrial waste - Sewage sludge (special section) - Hazardous/healthcare waste (special section)
Medical waste	(1) Separate collection (2) Pretreatment facility (3) Special section	

Note: The Revised Interim Report January 2001

Homs City shall take necessary action to realize the Master plan from the short term requirements then the medium term requirements. The compost plant is included in the medium term requirements as the plant for market/park waste and the pilot plant for organic waste from high/middle income household.

Addition to above, the rehabilitation and improvement of operation at present disposal site are necessity for Homs City because the present disposal site shall be used until the new disposal site will be opened.

The master plan clearly indicates that the construction of a new disposal site at Magliah and a transfer station at Dir Baalbeh, and replacement of the worn out collection of equipment are the basic and major requirements in short term. However, the financial source for these components is not clear.

One of the aims of this JICA Study is to prepare the feasibility study for a compost plant.

2.3 COMPOST PLANT

It is proposed that the master plan for Homs City be implemented over the following stages. Moreover, although no clear statement is given concerning the site of the compost plant, two candidate sites that can be considered are the existing disposal site and the new disposal site at Maghlia. Therefore it is necessary to carry out site selection upon carrying out comparison of these two sites.

a. Market and garden waste composting facility

- Construct a facility for treating 7,500 tons/year (approximately 25 tons/day) in 2005.
- Expand this to 11,000 tons/year (approximately 35 tons/day) in 2011.

b. Separated domestic inorganic waste composting facility

- Construct a 4,000 tons/year (approximately 15 tons/day) test plant in 2007.
- Build a 35,000 tons/year (approximately 100 tons/day) full-scale plant in 2011.
- Expand this to 70,000 tons/year (approximately 200 tons/day) in 2013.

2.4 DESIGN POPULATION AND QUANTITY OF WASTE

The population of Homs City in the 1994 census was 814,201, and it is estimated that this will increase to 1,002,306 by 2001 and 1,130,732 by 2005 judging from the subsequent annual rate of growth of 3%. The amount of waste according to the master plan is as shown in Table 2.3.1.

Table 2.3.1 Waste Generation Amount Forecast in Homs

(Unit: ton/year)

Waste type/ Year	2000	2005	2010
Domestic waste	152,700	178,600	210,500
Commercial waste	24,400	28,600	33,700
Public facility waste	46,100	48,900	51,400
Industrial waste	33,900	39,100	45,100
Medical waste	400	500	600
Total	257,100	295,200	341,300
Waste amount per day	704 ton/day	809 ton/day	935 ton/day

Source : Interim Report, Homs Solid Waste Management Study

CHAPTER 3 SOLID WASTE MANAGEMENT IN HOMS CITY AT PRESENT

3.1 SOLID WASTE AMOUNT

Based on the findings of a survey of incoming vehicles to the site in August 2001, the average amount of waste at this time was 734 tons/day, although the survey was conduced during the summer when waste discharge increases seasonally. During this period, mainly Heil and Mack compactors making on average three trips per day collected approximately 500 tons/day of waste. Since the estimated amount of generated waste in 2000 is 704 tons/day, this means that 1.04 times the average amount was carried into the site during the survey period.

3.2 COLLECTION AND TRANSPORT

(1) Equipment

The equipment currently used in waste collection and street sweeping is as indicated in Table 3.1.1.

Equipment that was purchased prior to 1990 and has been in use for more than 10 years consists of 24 compactors, four (4) tractors and four (4) dump trucks. Also, six (6) mechanical sweepers and two (2) tank trucks were also purchased before 1990.

Table 3.1.1 Current Equipment for Collection and Road Sweeping

Equipment	Brand	Capacity (m^3)	Quantity (nos.)	Production year	Trip number
Compactor	Heil	15	4	1996	2.5
	Heil	15	5	1997	2.5
	Heil	15	2	1998	2.5
	Zel	4	1	1957	3
	Mack	12	11	1978	2.5
	Mercedes	10	1	1954	2.5
	Kamaz	10	1	1980	2.5
	Nissan*	10	1	1975／99	2.5
	Toyota	8	4	1986	3
	Toyota	3	5	1986	4
Tractor	Somega	4	3	1973	2.5
	Forat	4	7	1993	2.5
	Forat	4	3	1995	2.5
	Forat	4	4	1997	2.5
Dump truck	Mercedes	6	1	1954	3
	Nissan	12	1	1975	3
	Fiat	12	2	1975	3
Wheel loader	Case	2	1	1995	
	Case	0.5	1	1995	
	Denber	0.5	2	1993	
M. Sweeper	Eligin	1	6	1975	
Water tank	KMC	5	1	1971	
	Fiat	12	1	1975	
Tractor	Forat	4	3	1994	
	Forat	4	1	1995	

(2) Personnel

The numbers of municipal employees engaged in waste collection and street sweeping are as shown in Table 3.1.2.

Table 3.1.2 Number of Staffs for Waste Collection and Road Sweeping

(Unit: person)

Item/ Shift	Morning 7:00-15:00	Service 14:00-22:00	Night 21:00-5:00	Market 17:00-1:00	Total
Truck	117	33	62	―	212
Market	81	―	44	50	175
Plant & dirt	26	―	11	―	37
General	150	61	344	―	555
Total	374	94	461	50	979

(3) Collection Activities

Solid waste collection is conducted with a 4-shift system according to the area and the working time. The working area is divided into three (3) areas; one is the city center and the main streets, the second is the legal housing area and the third is the illegal housing area.

a. Daytime shift (7:00-15:00): On the daytime shift, solid waste from roads in the illegal housing area, city center, special area (market, industrial area and bus station) and new villages (Eldowair and Haswia) are collected. Also, the main road is swept between 7:00 and 15:00.

b. Night shift (21:00-5:00): Solid waste from the old city is collected on this shift using small compactors because there are many narrow streets. Solid waste from the legal housing area is collected on this shift using mainly new compactor vehicles and also old compactor vehicles. Five tractors are used to collect construction debris on this shift in the legal housing area.

c. Third shift (17:00-1:00): Solid waste from the city center and main streets is collected on this shift.

d. Special shift (14:00-22:00): This shift is an emergency and/or service shift from 14:00-22:00) to complete work if there is any shortage and requests to collect waste from containers on main streets and street sweeping of some streets.

3.3 INTERMEDIATE TREATMENT AND FINAL DISPOSAL

There are no intermediate treatment facilities in Homs City. All collected waste is disposed at Dir Baalbeh disposal site which located in the north of Homs City approximately 6 km from the city center.

Dir Baalbeh is the only final disposal site in Homs city and has an area of about 30 ha. Smoke and odor from the field burning of waste has been a source of environmental pollution for many years. As waste is just dumped without soil covering, solid waste is burned continuously. Several days each winter, the wind changes from the northeast direction and dumpsite smoke and odor contaminate the city center. Also, beside the site is the cemetery of Homs city. It is a standing joke that the citizens of Homs continue to suffer the effects of dumpsite pollution ever after death.

Rehabilitation of the disposal site has started. But only 2 ha have been covered with soil to date. It is recommended that rehabilitation shall proceed and improvement of the operation of the final disposal site shall be conducted because this site shall be used until a new final disposal site starts operation.

3.4 MEDICAL WASTE MANAGEMENT

3.4.1 Law and Legislation concerning Medical Waste

(1) Law

There is no law related to medical waste management. However, the Law of Local Administration gives local municipalities the authority to make decisions, regulations and rules related to solid waste management and to impose levies. However, nationwide interest is gradually increasing.

The minister of State for Environmental Affairs has instructed (in the letter no. 2404 on October 2000) the local administrations through the Ministry of Local Administration (MOLA) to use incinerators for medical waste treatment, or to treat these wastes inside hospitals by applying modern technologies, which transform infectious waste into safe waste.

(2) Guidelines

There are no official guidelines related to medical waste management. However, one manual was proposed as a guideline in the study of medical waste management conducted by Syrian Environmental Technologies and Tebodin Consultants & Engineers in August 1999.

(3) Local Regulation

Based on the Law of Local Administration (Law No. 151), one clause is regulated that 500 SYP/month to 20,000 SYP/month should be charged to private hospitals for the municipality's collection service in Homs.

3.4.2 Administration

There is no definite role of ministries related to medical waste management. However, three ministries, Ministry of Health (MOH), Ministry of Local Administration (MOLA) and Ministry of State for Environment Affairs (MOES) are involved in medical waste management.

There is no designated department dealing with medical waste management. However, the Health Directorate of the Homs Governorate is responsible for health affairs. The Cleansing Division of the Health Affairs Directorate under Homs City Council takes the collection service of the wastes generated in some hospitals in Homs City (not all medical wastes are collected by the service).

A committee was established to discuss the issues related to the medical waste management in April 2001 by the order of the Governor in Homs City. The committee is composed of 4 members of Homs municipality, the head is from Health Directorate, 2 members from Homs municipality and the rest from the Homs Governorate.

3.4.3 Social/Religious Aspects

The religious aspects were surveyed by interviews with priests and sheiks. The following is a summary.

- Landfilling is the basic method for treating human medical wastes
- Incinerating human organs is not allowed, unless general health risks are identified
- In the event of perceived public health risk as a result of land filling any suitable alternative method can be applied.
- Using human organs (e.g. placenta) for a noble purpose is allowed, however, the owner's permission is required.
- Infectious waste (solid/liquid) should be suitably treated.

3.4.4 Current Medical Waste Situation

(1) Medical Establishments

According to the interview survey with the relevant authorities and the existing reports, four types of medical establishments were confirmed in Homs City. The number of hospitals and beds is shown in Table 3.4.1.

Table 3.4.1 Hospitals in Homs City

Types of Hospitals	No. of Hospitals	Bed No.	Remarks
Public hospital	3	416	Under jurisdiction of health directorate
Private hospital	21	322	
NGO hospital	3	181	
Military hospital	1	326	Under jurisdiction of military
Total	28	1,245	

(2) Generation of Medical Waste

There is no official data related to generated amount of medical waste. According to "Homs Solid Waste Management Study, Inception Report, January 2000", the annual generation amount of medical waste in 1999 is estimated as 400 ton.

(3) On-Site Treatment

The on-site treatment inside medical establishments was surveyed for the following treatment methods by conducting interviews with the persons concerned and inspection of the facilities:

- Separation
- Packaging
- Labeling / color coding
- On-site transport
- Storage
- On-site treatment
- Training Program

- Management

a. Separation: No separation or classification was identified. Only placenta and parts of organs are separated to be land filled. There is no separation for non-organic medical waste, and it is commonly treated and disposed of in the same way as general waste.

b. Packaging: There is no efficient method for packing medical wastes. Vinyl bags are used for all type of medical wastes.

c. Labeling/Color Coding: No labeling or color-coding was identified during the survey. Some hospitals use white bags, and some use yellow strips to tie the bags. However, most hospitals use black bags which are the same as other general waste.

d. On-site Transport: Medical wastes are collected in corrugated cardboard boxes or vinyl bags as mentioned before at the entrance of the nursing centers and the wards. In most cases they do not use specifically assigned carts for transport.

e. Storage: Most of the medical establishments have no storage for medical wastes. They put them at the entrance of nursing stations or wards and transport them to temporary collection points outside the facility.

f. On-site treatment: The most common sterilization methods in medical establishments were dry thermal treatment and autoclave. There is no incinerator operating in Homs City.

g. Training Program: There is no training related to medical waste management.

h. Management: According to the questionnaire survey, no facilities have a specific department/organization for medical waste management.

(4) Off-Site Treatment

Generally, no medical waste treatment was identified. Medical waste is disposed of at the existing open dumping site. However, the blood bank sends blood waste to Hamat Cement factory to be incinerated inside a clinker furnace.

According to the interview with the Military Hospital, which was under rehabilitation during the JICA Study, they had sold some types of medical waste to the markets 2 years before. Films and liquids of radiography and other non-organic wastes had been sold by contract. Placentas had been stored and delivered to a French medical company for extracting/refining into hormone drugs (many hospitals mentioned that this has been stopped.)

a. Collection/Transport

Some medical wastes from private hospitals in Homs City were collected and transported by the cleansing department of Homs Municipality. According to the survey of JICA Study Team, the Homs Municipality collect the medical wastes generated from 22 hospitals in one municipality collection vehicle. Collection amount of 30 to 110 kg/day was identified from the register. However, not all the wastes are collected each day, and the number of hospital collections and the collection amount fluctuates depending on the daily generation of each hospital. The medical wastes of other medical establishments are directly hauled into the container outside and transported together with other general wastes by municipality collection vehicles to the final dumping site.

b. Intermediate Treatment

There is no intermediate treatment from the generator to the final disposal site. Al-Watani Hospital, which is the largest public hospital in Homs City, has an old incinerator inside the hospital. However, the incinerator is not operating.

c. Final Disposal

There is an existing landfill for open dumping located approximately 5 to 6 km north of Homs City center. No sanitary and environmental measures are taken. There is no special area for infectious wastes and no care is taken.

3.5 ORGANIZATION AND INSTITUTIONS

The municipal cleansing department implements solid waste management in Homs City. The Cleansing Department is composed of sections in charge of general affairs (6 personnel), disposal sites (8), waste collection and street sweeping (979), technology (21), cleansing vehicles control, penalties (14) and pest control (28, also responsible for container cleaning), etc. In all, the Cleansing Department is operated by 1,056 employees consisting of 441 regular employees and 615 temporary employees. Also, the Parks Department is responsible for managing construction waste materials.

3.6 ECONOMIC AND FINANCIAL CONDITIONS

Homs City Council is facing a very tight budget situation. The real situation is rather more serious than indicated by the budget as actual expenditures are close to budget estimates, while revenues actually collected have fallen well below budget estimates. It should be noted that until five years ago the Council was not responsible for collecting local charges, and so has little experience in revenue budgeting. This may help explain these large discrepancies.

(1) Gross Regional Domestic Product

The gross regional domestic product of Homs Governorate in 1998 was SP 52,768 million, and the per capita figure was SP 34,130. Gross regional domestic product in Homs City is estimated as SP 31,494 judging from the population ratio. Moreover, assuming the economic growth rate after 1998 to be 2%, it is estimated that gross regional domestic product and per capita GRDP in 2001 will be SP 33,420 million and SP 33,343 respectively.

(2) Domestic Income and Expenditure

Refer to the findings of the citizen awareness survey in Lattakia, if domestic income is assumed to be approximately 60% of gross regional domestic product, this works out as approximately SP 20,000/year/person. Incidentally, it is estimated that 15% of households have income of SP 4,000 or less.

(3) Budget

1) Budget of Homs City

The following table summarizes the budget of the City, presented according to the Budget appropriation provisions of the Ministry of Local Administration.

Table 3.6.1 Budget of Homs City

(Unit: Thousand SP)

Item	1996	1997	1998	1999	2000	2001
Income						
Taxes & Fees	411,131	422,075	296,696	319,705	326,600	328,689
Receipts from investment	50,278	71,102	112,029	67,611	178,300	217,300
Other Local fees and Taxes	304,191	141,392	63,807	47,195	47,665	58,660
Other income	0	0	50,000	0	50,000	50000
Total	765,600	634,569	522,532	434,511	522,970	654,649
Expenditure						
Salaries	127,205	139,434	157,242	155,060	169,145	182,795
Administrative expenses	148,385	167,267	147,285	130,324	132,550	122,700
Capital expenditures	451,929	426,068	406,198	108,187	275,000	325,000
Transfers	4,901	5,425	5,416	5,239	5,420	5,204
Debt service & commitments	33,180	68,825	66,823	90,396	20,450	18,950
Cultural center	0	0	0	0	0	0
Total	765,600	807,019	782,964	489,206	602,565	654,649

The budget position of the city is far worse than this table indicates as the budget estimates for revenues will not be reached for 2000 and are very unlikely to be reached for 2001. The biggest single revenue shortfall will be in real estate sales. Real estate sales (item 7415) in the first 9 months of 2000 only realized 9% of the annual target. Overall revenue collection in the first nine months of 2000 was only 38% of the annual target, and if the collection rate does not improve in the final three months then the shortfall for the year would be over 300 million Syrian Pounds. Given the current state of the real estate market we believe that the Council will again only realize a very small fraction of its target for real estate sales in 2001.

Further we understand that the city has outstanding current liabilities of the order of 500 to 600 million Syrian pounds. These are not shown in the budget, but are roughly equal to total annual revenues. Most of these liabilities are to state owned construction companies, and there does not appear to be any provision in the budget to cover repayment of these liabilities. Eventually the City will have to seek a special grant from the central Government to pay off these liabilities.

The current position has arisen largely because the Council became a property speculator in the real estate boom of the late 1990's. This boom affected many cities in Syria, and was driven by several years of good economic growth. The boom was particularly sharp as real estate is one of the few investments trusted by the Syrian middle class who lack other investment opportunities. The downturn which is continuing has therefore been equally sharp and is expected to continue for several years.

As a result the budget situation of the city will remain critical for several years. This experience however should help the city focus on its future budget strategy. During the boom it was very tempting to believe that it would be easier to raise revenues from property speculation rather than by painstakingly building up the local tax base, but it is now time for the city to review its overall strategy.

2) Current Solid Waste Management Budget

The formal budget of the city does not itemize expenditures by programs, and so it is impossible to identify accurately the real cost of the SWM service. However estimates have been made in the Master Plan recently prepared for the city. Note however that the following budget only covers recurrent cash expenses. No provision is made for depreciation of existing equipment, or alternatively allowance made for capital expenditures on new equipment.

In Homs, cleansing fee is collected from households and commercial entities. Cleansing fee for household is ranged form 75 to 250 SP/year (for medium income households, it is 150 SP/year). Income from cleansing fees in 2000 was SP 80 million (SP 6 million from households and SP 74 million from commercial entities), accounting for 61.5% of waste management costs. However, SP 74 million (92.5%) of this income is collected from business establishments, which means that it will be necessary to strengthen fee collection from households in future. These collected fees are equivalent to 0.23% of gross regional domestic product.

Table 3.6.2 Solid Waste Management Budget

(Unit: Thousand SP)

Item	SWM Component	City Budget
Expenditures		
Salaries wages etc	72,378	152,565
Food Medicaments and cloths	15,300	17,500
Fuel oil and Lubricants	5,100	15,000
Insecticides & acids	200	200
Maintenance	18,650	40,000
• Vehicles & spare parts	(17,000)	
• Tools & Instruments for cleansing workers	(1,000)	
• Maint. Handcarts	(150)	
• Maint. Containers	(500)	
Total	111,628	
Revenues		
Commercial & Industrial	74,000	
Domestic	6,000	
Total	80,000	

Source: Inception Report "SWM Master Plan for Homs City" prepared by COWI Consultants, December 2000 under the METAP program

Currently then charges levied for SWM only cover 70% of the recurrent cash expenses, though this could probably be improved with better tax collection procedures.

3) Future SWM Budget

It must be noted that the current SWM system in Homs is not satisfactory. It involves open dumping resulting in severe degradation of the environment and public health. The Master Plan already prepared for the city calls for the introduction of sanitary landfill to bring the service upto the minimum level acceptable for a modern city. This will raise the cost of the service significantly at a time when the city budget is already under massive strain.

The Master Plan[1] calls for an investment of 552 million Syrian Pounds in the first five years just to bring the service upto an acceptable standard, replacing worn out collection equipment, developing a new sanitary land fill site and constructing new transfer facilities. It estimates that annual Operating costs will increase by 30 million Syrian pounds. In addition further funds will be needed to close the existing disposal site, but the amount was not estimated in the Master Plan which was intended to develop strategies for future management of the service.

The impact on the already stretched budget of the municipality will depend on the options adopted by the Central Government to fund the implementation of the Master Plan.

[1] Final Interim Report, COWI Consultants , prepared under the METAP program

CHAPTER 4 FRAMEWORK OF THE CONSTRUCTION OF COMPOST PLANT IN HOMS CITY

4.1 SCALE OF THE COMPOST PLANT

The master plan proposes that the compost plant be introduced in stages. The first stage is construction of a simple plant with capacity of 25 tons/day for the composting of market/green waste, and the second stage is a pilot plant with capacity of 15 tons/day for the composting of domestic organic waste. The third stage is the construction of a full-scale compost plant (100 tons/day, two lines) which is proposed for 2010 onwards following confirmation of demand and feasibility at the pilot plant.

Therefore, the following three alternatives for the capacity of the compost plant are considered.

Alternative 1 Simple compost plant targeting market waste (25 tons/day)

Alternative 2 Pilot plant targeting market waste and domestic organic waste (40 tons/day)

Alternative 3 Larger pilot plant (50-100 tons/day)

To develop a full-scale compost plant in future, it is necessary to first construct a pilot plant targeting organic domestic waste with market waste. According to the results of the compost demand survey, it is reported that demand exists for approximately 44 tons/day, although this depends on the quality and price of compost. When this demand is converted into plant scale, this is equivalent to approximately 120 tons/day. Therefore, scale of the compost plant shall initially be set at 50 tons/day, with the possibility of this being increased to 100 tons/day in two-shift operation after the demand for compost has been confirmed.

4.2 SITE OF THE COMPOST PLANT

The site of the compost plant was decided at Dir Baalbeh, the land adjacent to the present disposal site, following comparison with the new Maghlia disposal site. Land covering an area of 8.6 ha has already been secured at this site. However, since there have been numerous complaints against the present site for a long time now, when constructing the compost plant, it will be necessary to carry out rehabilitation of the existing disposal site and improvement of disposal work (implementation of earth covering). Moreover, since there are demands for the early construction of the new disposal site, in order to build the compost plant ahead of the new disposal site, it will be necessary to construct a transfer station at the same time.

4.3 NECESSARY PROJECT COMPONENTS

It is necessary to introduce separate collection of domestic waste to produce good quality compost. Therefore, it is important to coordinate the replacement of old collection equipment with the introduction of separate collection. Without proper replacement of old equipment, introduction of separate collection will be difficult.

Proper medical waste management is another important issue in Homs. No effective treatment facilities for infectious waste is available in Homs at present. It is necessary to prepare a treatment facility at this site to introduce an appropriate medical waste management system in steps.

As mentioned above, a compost plant shall be developed together with following components and the site shall be developed as a cleansing center for solid waste management in Homs.

(1) Construction of compost plant

(2) Rehabilitation of existing disposal site and improvement of disposal operation

(3) Construction of transfer station

(4) Improvement of solid waste collection and introduction of separate collection

(5) Medical waste treatment

Figure 4.3.1 shows the location of proposed SWM facilities in Homs.

4.4 SCHEDULE OF IMPLEMENTATION

When one considers the deteriorated current state of collection equipment in Homs City, it is desirable to implement the above project as soon as possible. However, when project design, procurement, construction schedule and budget measures are taken into account, the actual schedule will see implementation of planning and design in the first half of 2002 and procurement and construction in 2003 and 2004.

The earliest that equipment for disposal site improvement can be procured is the start of 2004, which is still another 2.5 years away. Until then, rehabilitation of the existing disposal site must be continued. Furthermore, when carrying out future disposal, Homs City must rent the necessary heavy machinery and implement earth covering in order to mitigate environmental pollution. Homs City will need to bear the burden of these costs.

Additionally, construction of a new disposal site is an essential condition for improvement of the solid waste management in Homs City. The Syrian side shall implement construction of the new site at the same time as construction of the compost plant. Operations are expected to start for the new disposal in 2005, or at the latest in 2006.

4.5 SOLID WASTE AMOUNT AND COMPOSITION

Solid waste amount is estimated in METAP-EIB Study as shown in Table 2.3.1.

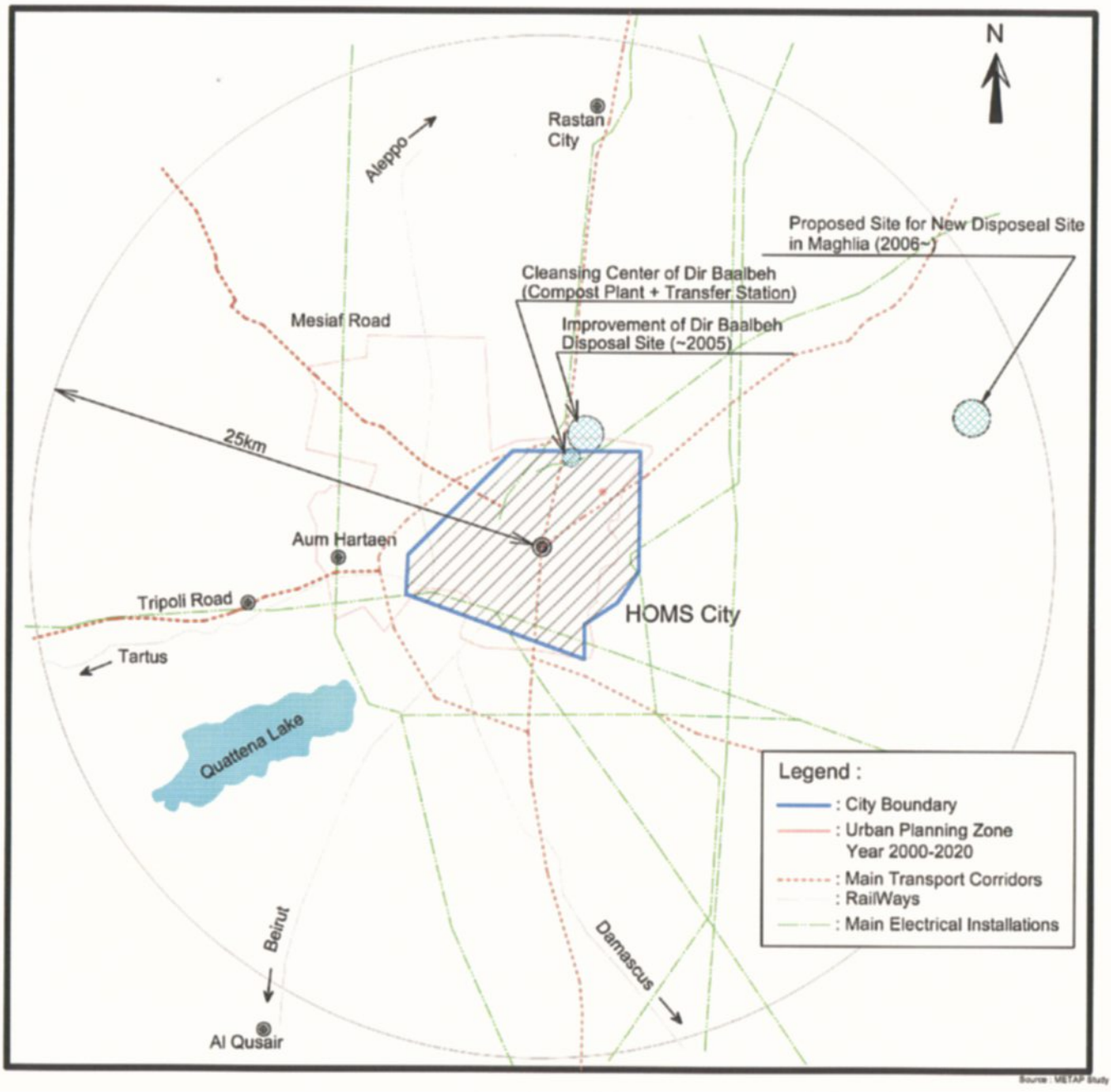


Figure 4.3.1 Location of Proposed SWM Facilities in Homs

CHAPTER 5 WASTE COLLECTION IMPROVEMENT AND INTRODUCTION OF SOURCE SEPARATION

5.1 IMPROVEMENT POLICY AND WASTE COLLECTION AMOUNT

(1) Waste Collection Improvement Policy

The waste collection rate in Homs City is just 72%, and improvement is especially required in outlying low-income districts. Therefore, in addition to improving the collection rate to 85%, source separate collection shall be introduced in line with construction of the compost plant. The project target year shall be 2006. Moreover, it is planned to construct a new disposal site at Maghlia, which is located 26 km northwest of Homs City. Concerning transport of waste to the new disposal site, it is planned to construct a cleansing center next to the existing disposal site and carry out transferred transport. Accordingly, collected waste will be transported to and disposed at the existing disposal site for the immediate future. Moreover, following construction of the new disposal site, waste will be carried to the transfer station located next to the existing disposal site. Also, it is planned to transport separated organic waste to the compost plant.

a. Project year: 2006 (collected waste is transported to the compost plant or transfer station)
b. The target waste collection rate in 2006 shall be 85%. Domestic waste, commercial waste (including market waste), public facilities waste, and non-infectious hospital waste shall be collected. Also, harmless waste generated by small and medium size factories in the city shall be collected separately.
c. Source separate collection targeting organic waste and inorganic waste shall be introduced from middle and high-income districts. In line with the scale of the compost plant, it is planned to start source separate collection from collection of 50 tons/day of organic waste. Moreover, market waste shall be collected as organic waste and treated at the compost plant. As for other districts, mixed collection shall be continued as at present.

(2) Waste Collection Amount

The planned amount of waste collection in 2006 is 614 tons/day as indicated in Table 5.1.1.

Table 5.1.1 Collection Amount Target by Waste Type in 2006

(Unit: ton/day)

Waste Type	Generation Amount	Collection Amount
Domestic waste	504.7	429.2
Separated organic	-	30.3
Separated in-organic	-	8.5
Mixed	-	390.4
Commercial waste	80.9	71.1
Market (organic)	-	19.7
Others (mixed)	-	51.4
Public facility waste	135.4	113.5
Total	721.0	613.8

(3) Waste Collection System

In the case of mixed collection and container collection of organic waste, the present system shall be respected and container collection shall basically be conducted on a daily basis. Collection is currently done mainly by large compactors, however, considering conditions in the target area, medium size compactors shall be introduced.

Concerning collection of inorganic waste, since generated quantities are small and it would not be difficult for households to temporarily keep the waste in the house, this shall be discharged in plastic bags and collected twice per week. Moreover, since plastic bags will be loaded manually, small compactors shall be introduced.

(4) Street Sweeping

Present street sweeping practices shall be maintained, i.e. mechanical street sweeping shall be implemented on main roads and manual street sweeping shall be conducted on minor roads at the same time as primary collection. The extension of main roads is 95.5 km and sweeping is carried out two or three times per day on important roads.

5.2 EQUIPMENT PROCUREMENT PLAN

It is considered that vehicles purchased after 1990 can still be used in 2006; meanwhile, since vehicles purchased prior to 1990 will be more than 15 years old by 2006, they will need to be renewed.

The equipment required in order to improve the waste collection rate to 85% and to carry out source separate collection is as indicated in Table 5.2.1. The required number of collection vehicles is 86, of which it will be necessary to procure 50. Moreover, nine (9) street sweeping vehicles will be required, and it will be necessary to purchase all of these.

Table 5.2.1 Equipment for Collection and Road Sweeping in 2006

Item	Vehicle Type	Number of Vehicles
Collection	Large compactor	(12)
	Medium compactor	39
	Small compactor	6
	Dump truck	5
	Tractor	(14)
	Wheel loader	(3)
	Total	50 (29)
Road Sweeping	Road sweeper	6
	Tank truck	3
	Total	9 (0)

Note: ( ) shows the number of existing equipment which can be used in 2006

5.3 OPERATION AND MAINTENANCE PLAN

Waste collection and street sweeping work shall be implemented as shown in Table 5.3.1.

Table 5.3.1 Waste Collection and Street Sweeping Work

Item		Contents
1.	Collection day	In principal, daily collection.
2.	Collection system	Two (2) shifts operation, day and night, and necessary vehicles and personnel for each shift shall be arranged (8 operation hours).
3.	Organization of waste collection crew	One driver for a collection vehicle with 2 workers. One supervisor for every 5 vehicles. One supervisor, one driver and one worker for a wheel loader.
4.	Organization of street sweeping crew	One operator with one sweeper. For manual sweeping, one handcart for each worker. One team consists of one supervisor and ten workers.
5.	Method of discharging	Daily discharging of mixed collection and separated organic waste to containers. Discharging of separated inorganic waste in plastic bags to collection points twice a week.
6.	Maintenance of equipment	Daily maintenance shall be carried out by driver and periodical inspection and repairing shall be contracted out to a specialized private company.

The numbers of personnel required for waste collection and street sweeping are as indicated in Table 5.3.2. In line with the future procurement of equipment and improvement of citizen cooperation, it will be necessary to reduce personnel conducting manual work and to switch over those surplus people to the waste treatment and disposal divisions, for the purpose of cost reduction in waste disposal.

Table 5.3.2 Required Personnel for Collection and Road Sweeping in 2006

Item	Number of personnel
Collection	
Supervisor	20
Driver	88
Worker	172
Sub-total	280
Sweeping	
Supervisor	56
Driver	15
Worker	15
Manual sweeper	528
Sub-total	614
Total	894

CHAPTER 6 DEVELOPMENT OF HOMS CLEANSING CENTER AT DIR BAALBEH

6.1 GENERAL

A cleansing center, to function as the foundation of the solid waste management in Homs City, shall be constructed on land adjoining the existing disposal site (Dir Baalbeh). Project components of the cleansing center are composting facilities, transfer station and medical waste treatment facilities. Also, site shall be secured for future construction of a sorting center. The layout of Homs City cleansing center is shown in Figure 6.1.1.

Figure 6.1.1 Layout Plan of Homs Cleansing Center

6.2 COMPOST PLANT

6.2.1 Plant Preparation Policy and Capacity

At the present time, Homs city has no compost plant and no compost produced from municipal solid waste is used in Homs. Furthermore almost all farmers have no knowledge of compost. Therefore the demand for compost is uncertain.

However, according to the compost demand survey, farmers are interested in buying the compost and want to know the effectiveness of compost.

In consideration of above situation, it is recommended that the compost plant will be constructed as pilot plant for the following purposes:

(1) Establishment of composting technology

(2) Confirmation of compost quality

(3) Expansion of compost use

(4) Confirmation of compost demand.

The plant capacity is recommended at 50 ton/day by one shift operation for the initial stage. This is because the compost plant should treat 25 ton/day of market waste mentioned in the master plan and also 25 ton/day of source separated domestic waste for the full-scale compost plant in future.

However the plant will be designed to treat 100 ton/day of waste in two-shift operations in case that compost quality and demand are asserted after the operation.

6.2.2 Planning Conditions

The planning conditions for the compost plant are indicated in Table 6.2.1.

Table 6.2.1 Planning Condition of Compost Plant in Homs

Item	Planning Condition
Location	Dir Baalbeh
Operation year	2005
Capacity	1 shift operation: 50 ton/day（2 shift operation in future: 100 ton/day）
Receiving waste	1 shift operation: Market waste (25 ton) & separated domestic waste (25 ton) (2 shift operation: Market waste (25 ton) & separated domestic waste (75 ton)
Material balance*)	Compost product：25% Recyclables：5% Residue：25%
Operation hour	Receiving hour：21:00 – 05:00（Stock at the receiving yard） Operation hour：07:00 – 15:00（Actual working hour: 6 hours）

Note: *) shows the ratio (%) against receiving waste amount

(1) Waste Quality

Based on the waste quality survey in Homs and waste separation campaign in Lattakia, planned waste quality received at the compost plant is settled as shown in Table 6.2.2.

Table 6.2.2 Waste Quality for the Plan

(Unit: %, Wet base)

Waste type	Food, vegetable	Paper	Plastic	Metal	Glass	Others	Total
Market	83.4	3.9	7.3	0.6	0.5	4.5	100
Domestic	73.0	8.4	7.5	0.6	1.5	9.0	100
Design	75.6	7.3	7.4	0.6	1.2	7.9	100

Note: Design waste quality is calculated as a weighted average between market and domestic waste.

(2) Waste Amount

As mentioned above, design value of total waste amount is 100 ton/day and market waste amount is 25 ton/day, consequently separated domestic waste becomes 75 ton/day.

(3) Composting system

The composting system consists of the following procedures for improved 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 in-organic (non-compost) material by hand sorting

(3) Shredding by pulverizing classifier

(4) Fermentation with mixing by turning machine

(5) Maturing with mixing by turning machine

(6) Refining of coarse compost by screen

System flow diagram is shown in Figure 6.2.1.

(4) Equipment Capacity

The compost plant will be operated in two-shift operations at maximum operation capacity of 100 ton/day,

The actual equipment operating time is 6hour/shift x 2shift =12 hours, and therefore, equipment capacity required will be 100ton / 12 hour = 8.4 ton/hour.

(5) Operation Organization

At the initial stage the plant will be operated in a one shift operation of 32 people and the next stage will be operated in two-shift operations of 50 people from 2005(Target year of new final disposal site operation start).

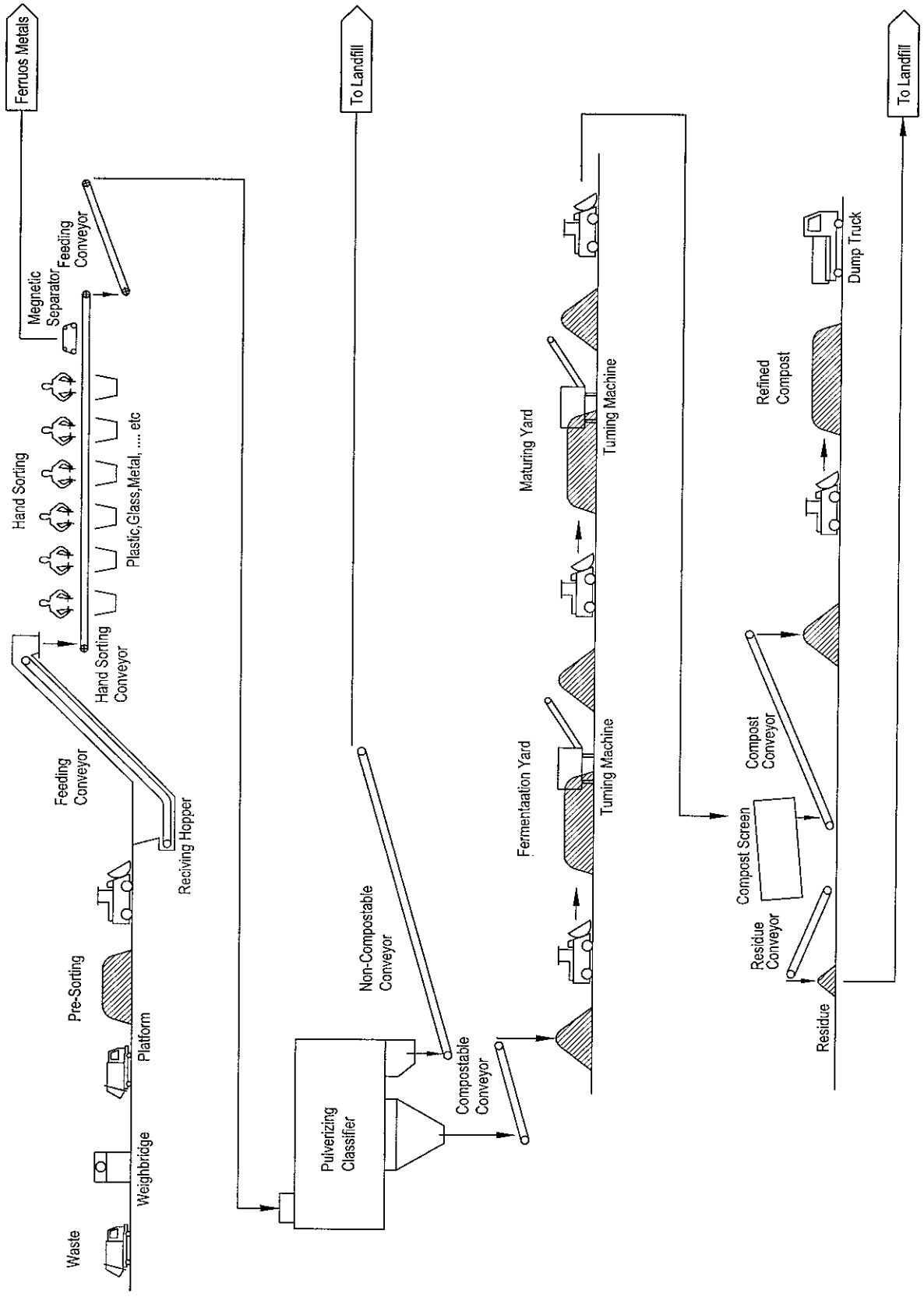
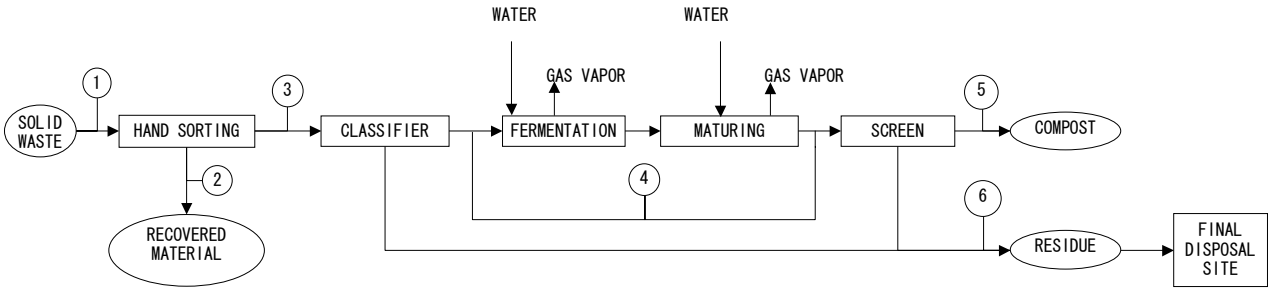


Figure 6.2.1 Schematic Flow Diagram of Compost Plant

6.2.3 Material Balance

Material balance at 50 ton/day operation is shown in Figure 6.2.2.



ITEM	① MSW INPUT	② RECOVERD MATERIAL	③ AFTER HAND SORTING	④ RECYCLE COMPOST	⑤ FINE COMPOST	⑥ TOTAL RESIDUE
WET WEIGHT (t)	100.0	6.4	93.6	16.0	25.0	25.0

① SOLID WASTE	COMPSITION (%)	WEIGHT (t)
FOOD, VEGETABLE	75.6	75.6
PAPER	7.3	7.3
PLASTIC	7.4	7.4
METAL	0.6	0.6
GLASS	1.2	1.2
OTHERS	7.9	7.9
TOTAL	100	100

RECOVERED MATERIAL	
MATERIAL	② HAND SORTING
PAPER	1.8
PLASTIC	3.7
METAL	0.3
GLASS	0.6
TOTAL	6.4

INPUT(t/d)		OUTPUT (t/d)	
SOLID WASTE	100.0	CONPOST	25.0
WATER	0.6	RESIDUE	25.0
		RECOVERED MATERIAL	6.4
		GAS VAPOR	44.2
TOTAL	100.6	TOTAL	100.6

Figure 6.2.2 Material Balance Sheet of Homs Compost Plant (1 shift, 50 t/day)

From this material balance it is possible to predict the followings:

(1) Approximately 6 ton/day (6% of received waste) of recyclable material such as plastic and metal is recovered.

(2) Approximately 25 ton/day (25% of received waste) of compost is produced.

(3) Approximately 25 ton/day (25% of received waste) of residue is removed to final disposal site.

6.2.4 General Layout

General layout of compost plant at 50 ton/day operation is shown in Figure 6.2.3.

6.2.5 Facility Plan

Table 6.2.3 shows an outline of the facilities required for construction of the compost plant. The material balance of the plant and site facility plan are shown in Figure 6.2.1 and 6.2.2, respectively.

Table 6.2.3 Contents of Compost Plant Facilities

Process	Facility/ Equipment	Q'ty	Specification
Reception (Reception bldg.)	Truck scale	1	50 ton, load cell type
	Pre-sorting yard	1	450 m^2, open-air
	Feeding conveyor	1	10 t/h, apron conveyor, 10 m^3 hopper
Hand sorting	Hand sorting conveyor	1	10 t/h, belt conveyor, 3.7 kw
	Magnetic separator	1	10 t/h, 2.2 kw
	Sorted waste conveyor	1	10 t/h, belt conveyor, 3.7 kw
Pulverizing	Pulverizer	1	7.6 t/h, rotary blade type, 180 kw
	Conveyor	1	7.6 t/h, belt conveyor: 2.2 t/h, belt conveyor
Fermentation/ Maturing	Primary fermentation yard	1	Fermentation period: 2 weeks, 5,400 m^2, open-air
	Secondary fermentation yard	1	Fermentation period: 6 weeks, 7,200 m^2, open air
Refining	Screen	1	2.5 t/h, trommel type, 3.7 kw
	Conveyor	1	2.5 t/h, belt conveyor: 0.4 t/h, belt conveyor
Equipment	Wheel loader	4	1.2 m^3: 3 nos.: 3.1 m^3: 1nos.
	Dump truck	1	8 ton
Others	Electricity	1	300kVA
	Control facilities	1	Control house, parking, guard house, etc.

(1) Reception equipment

Market waste and separated domestic waste transported by collecting vehicles are weighed by truck scale at the entrance of the cleansing center and unloaded on the pre-sorting area.

The pre-sorting area has one (1) day storing capacity for mitigating the daily fluctuation of waste.

Unloaded waste on the pre-sorting area is charged into the waste hopper with feeding conveyor by wheel loader after removal of bulky waste such as tire, timber boxes and so on.

(2) Hand Sorting Equipment

The waste is fed constantly from the waste hopper to the hand-sorting conveyor by feeding conveyor. Before hand sorting waste bags are broken by the bag breaker located at outlet of the waste hopper.

Paper, plastic, metals and glass are recovered by hand sorting workers standing on the both side of the hand sorting conveyor.

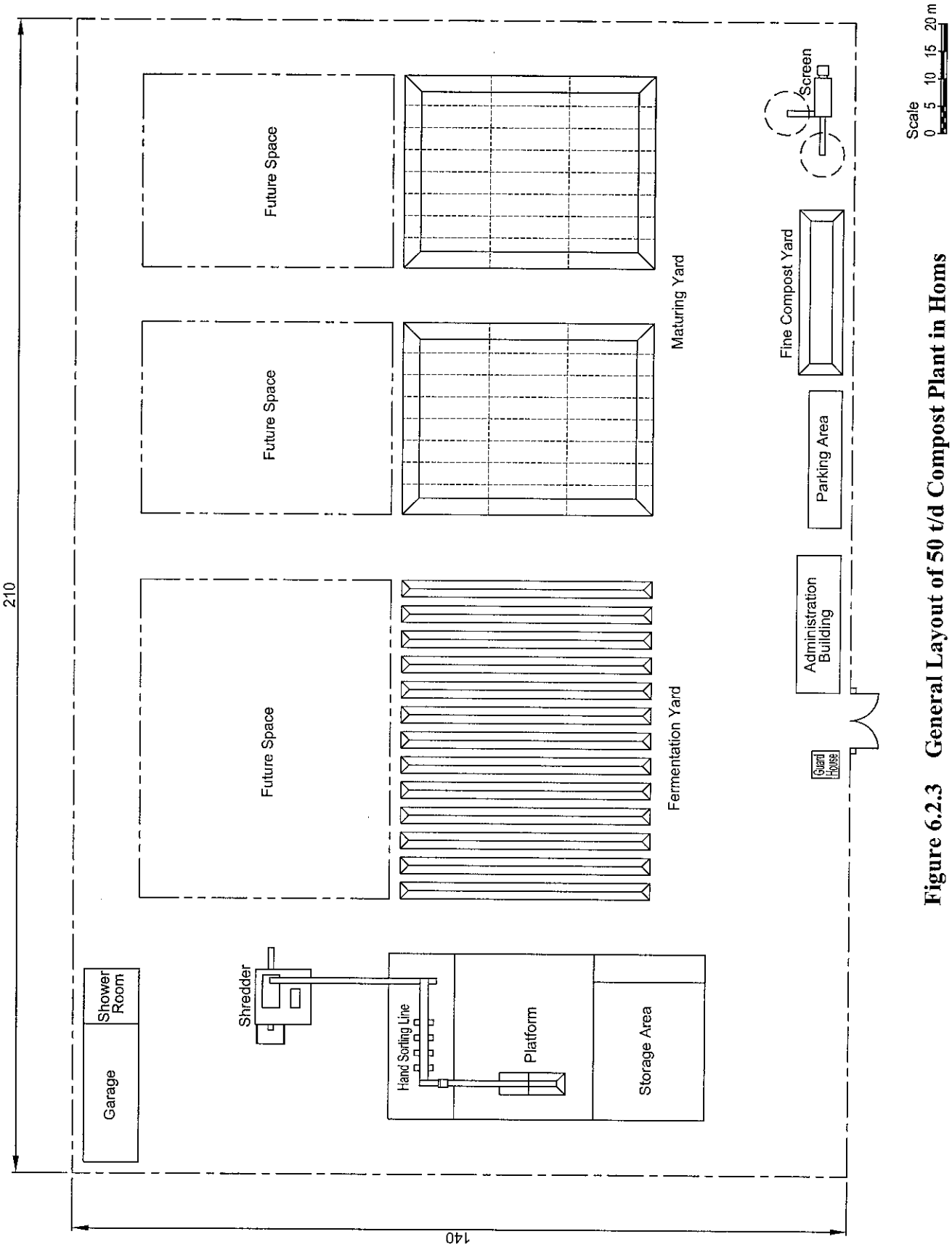


Figure 6.2.3 General Layout of 50 t/d Compost Plant in Homs

Recovered materials are stored on ground floors located under the hand sorting conveyor.

And the sorted waste is fed to pulverizer by feeding conveyor.

(3) Pulverizing equipment

In the pulverizer organic material such as vegetable in the waste are pulverized to small peaces of less than 50 mm and non-organic material such as plastics are separated from the waste.

Pulverized and separated compost-able material are conveyed to the fermentation yard by the compost-able material conveyor.

Separated residue is conveyed to the residue storage by conveyor.

(4) Fermentation equipment

Compost-able materials are piled by wheel loader and turned once a day by turning machine while the maturing process takes place.

As fermenting temperature exceeding 65 deg. C, vermin and harmful microbes are killed and organic material fermentation is promoted during about two (2) weeks with moisture content control.

Fermented waste is transported to the maturing yard by wheel loader.

(5) Maturing equipment

The fermented waste is piled up by wheel loader in the maturing yard. They are regularly turned also by turning machine while the maturing process takes place during about six (6) weeks under the control of moisture content.

Matured compost is transported to the refining equipment by wheel loader.

(6) Refining equipment

The matured compost fed to the compost screen, where foreign matter like glass, stone, plastics, etc. is effectively removed and adjusted the grain size.

(7) Vehicles

Four (4) wheel loaders are required as follows:

(1) For charging waste into the receiving hopper

(2) For removing compost material from the pulverizer to fermentation yard

(3) For removing fermented waste from fermentation yard to maturing yard

(4) For removing matured compost from maturing yard to refining equipment and delivery of fine compost.

One (1) dump truck is also required for removing residue to final disposal site.

6.2.6 Compost Demand and Sales Plan

As a result of the compost demand survey implemented in the Study, it is estimated that demand for compost in and around Homs City is approximately 16,000 tons/year.

Table 6.2.4 shows the quantities of compost produced and reusable materials recovered at the composting plant together with the sales revenue from each. It is forecast that sales of compost product and recovered reusable materials could generate annual income worth approximately SP 7,363,000/year in the case of two-shift operation.

Table 6.2.4 Amount of Compost Product and Sorted Recyclables

Item	1 shift operation (50 ton/day)		2 shift operation (100 ton/day)	
	Amount (ton/year)	Income (SP/year)	Amount (ton/year)	Income (SP/year)
Compost product	3,875	1,356,000	7,750	2,713,000
Recyclables	992	2,325,000	1,984	4,650,000
Total		3,681,000		7,363,000

6.2.7 Operation Management Plan

The rehabilitated compost plant will be operated by 32 people of one shift operation at initial, however, in 2006 will be operated by 50 people of two-shift operation as shown in Table 6.2.5.

Table 6.2.5 Number of Operational Personnel

(Person)

Item		Initial stage (2006)	Next stage (2010)	Remarks
Administration		6	6	
Operation	Reception area	4	4*	*See note.
	Hand sorting area	7	14	
	Shredding area	3	6	
	Fermentation area	2	4	
	Maturing area	3	6	
	Screening area	2	4	
	Others	3	4	
Maintenance		2	2	
Total		32	50	

Note: * Truck scale operator is not included in this number because they are counted as transfer station operator.

6.3 TRANSFER STATION

6.3.1 Planning Conditions of Transfer Station

(1) Planning Policies

The Dir Baalbeh disposal site is planned to close in the near future, and a new candidate disposal site has been selected at Maghlia. It is expected that the new site will be constructed by the year 2005 and its operation will start in 2006. The new site is located northeast of Homs City away from the city center of approx. 26 km radius. Thus, it is needed to construct a transfer station in accordance with the construction of

the new disposal site, and the candidate site is selected within the proposed cleansing center at Dir Baalbeh.

The planning policies of the Dir Baalbeh transfer station are proposed as follows.

- All waste carried into the transfer station will be tentatively unloaded from collection vehicles at re-loading station, and reloaded to transfer vehicles in directly
- Simple system and cost saving for the construction and operation shall be considered
- The leveling plan of the transfer station shall be made in careful consideration of the present topographic features of the proposed site
- Smooth traffic and operation of collection/transfer vehicles will be carefully taken into account for the site plan
- Layout plan of the transfer station shall be designed to minimize the environmental impacts in the surrounding area

(2) Planning Conditions

Planning conditions of Dir Baalbeh transfer station are shown in Table 6.3.1.

Table 6.3.1 Planning Condition of Transfer Station

Item	Planning condition
Location	Dir Baalbeh
Operation start year	2005
Service area	Homs city
Waste transfer distance	30 km
Area	2.5 hectare（Total area of Homs cleansing center）
Waste amount transferred	2006：702 ton/day 2010：788 ton/day
Capacity	800 ton/day
Re-loading system	Direct loading
Number of re-loading station	1
Upper level of re-loading station	GL+484.80（4.5m higher than lower level）
Receiving waste type	Domestic waste, commercial waste, road sweeping waste, small & medium scale industrial waste
Operation hour	Receiving hour：21:00 – 05:00（Stock at the receiving yard） Operation hour : 07:00 – 19:00（Actual working hour: 10 hours）
Transfer vehicle operation	3.5 trips/day/unit (average)

The plant capacity of transfer station is planned to accommodate the incoming waste volume in 2010.

(3) Major Facilities of Transfer Station

Dir Baalbeh transfer station is composed of the following major facilities, and the design concept is described as follows.

1) Receiving Facility

Near the entrance of cleansing center, receiving facilities shall be constructed. Incoming collection vehicles and outgoing empty vehicles shall be weighed here by using truck-scales so as to obtain data for solid waste management. Collected data will be processed and reported periodically. This receiving facility will be also utilized for incoming/outgoing vehicle from/to compost plant and sorting center.

2) Site Interior Road

In order to keep the smooth traffic and operation of transfer station, site interior roads are basically planned for one-way traffic; 4.0m width for collection vehicles and 5.0m for transfer vehicles respectively.

3) Waste Re-loading Station

Direct-load type is proposed for the waste transfer method in the transfer station. Two level arrangements shall be introduced in this method. Taking into account the height of proposed transfer vehicle (semi-trailer) and smooth operation of waste re-loading works, the upper staging level of re-loading station is set at 4.5m higher than the lower level. One waste re-loading station is to be provided for the transfer station.

4) Parking for Transfer Vehicles

In order to maintain a smooth entry and exit of waste transfer vehicle to/from the parking area, forward-in and forward-out is adopted in the layout plan.

5) Green/Buffer Zone

Green/buffer zone will be provided along the perimeter of transfer station and/or cleansing center in terms of environmental protection measures.

6.3.2 Facility and Equipment Plan

(1) Required Number of Re-loading Stations and Transfer Vehicles

The necessary number of re-loading stations and heavy equipment is calculated based on the amount of incoming waste for 2010.

1) Re-loading Station

The necessary number of re-loading stations is calculated based on the following Conditions.

Conditions

- Hauled-in waste amount in 2010: 788 ton/day
- Waste re-loading amount at the peak hour: 15% of total incoming waste
- Unit weight of waste: 0.4 ton/m^3
- Applied waste transfer vehicle: 40m^3 semi-trailer
- Waste re-loading vehicle at transfer station: 3 m^3 wheel loader

The calculation of the required number of re-loading stations is as follows.

Calculation

- Waste amount at peak hour
  (788 ton/day x 15%) / 0.4ton/m^3 = 295m^3
- Possible re-loading amount per hour
  153m^3/hour/unit
- Required number of re-loading stations
  295 m^3 / 153 m^3/hour/unit = 1.9
  Therefore, 2 re-loading stations are required.

2) Heavy Equipment

In accordance with above calculation, two wheel loaders (3-m^3 capacity) are needed at the re-loading stations for re-loading.

As for the necessary number of transfer vehicles, the calculation is based on the following conditions.

Conditions

- Hauled-in waste amount in 2010: 788 ton/day
- Unit weight of waste: 0.4 ton/m^3
- Applied waste transfer vehicle: 40m^3 semi-trailer
- Trip number of waste transfer vehicle: 3.5 trip/unit
- Vehicle's mobility efficiency: 0.85
- Peak ratio: 1.35

The calculation of the required number of transfer vehicles is as follows.

Calculation

- Capacity of semi-trailer
  40 m^3 x 0.4ton/ m^3 = 16 ton/unit
- Daily hauling capacity of semi trailer
  16 ton/unit x 3.5 x 0.85 = 47.6 ton/day/unit
- Required number of transfer vehicles
  788ton/day / 47.6ton/day/unit x 1.35 = 22.3
  Therefore, 23 semi-trailers are required in 2010.

The transfer station is planned to begin operation in 2006, and the waste amount to be transferred is at 702 ton/day. The necessary number of transfer vehicles in the first year of operation is estimated at 20 units.

(2) Facility Plan

1) Layout Plan

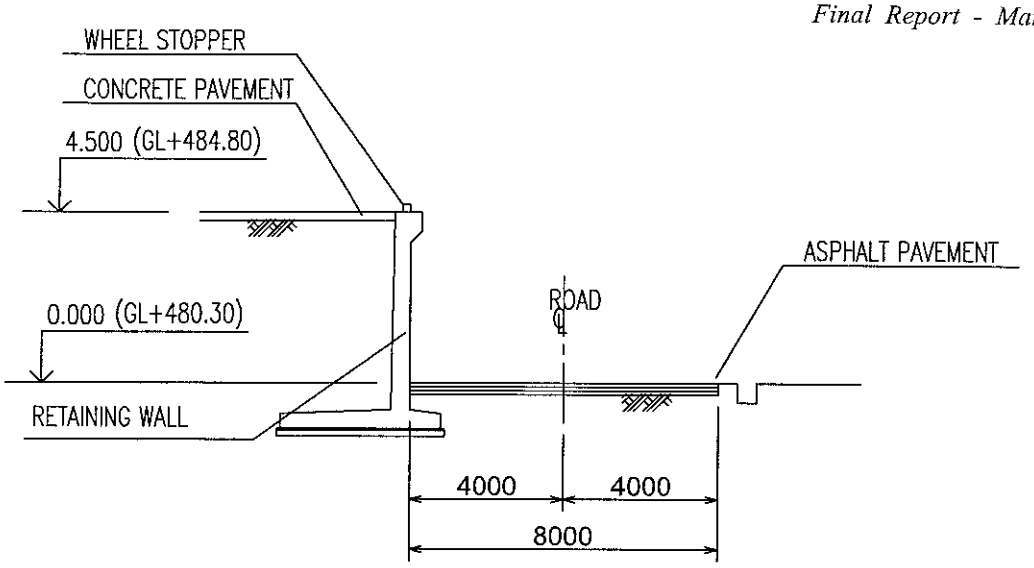
The layout plan of the transfer station has been proposed taking into account the necessary number of facilities and equipment and so on, as shown in Figure 6.3.1.

2) Facilities

The main facilities and equipment of the transfer station are shown in Table 6.3.2. Moreover, design layout of the plant is shown in Figure 6.3.1.

Table 6.3.2 Major Facilities of Transfer Station

Item	Facility/ Equipment	Quantity	Remarks
Common facilities in Cleansing Center	Area	86,000m^2	
	Gate	2 units	W=16m (main gate) & 6m (sub gate)
	Fence	920m	H=2m (surroundings of cleansing center)
	Green/ buffer zone	13,000m^2	
	Drainage	1,200m	350mm x 350mm
	Well	1 unit	Diameter: 350mm
	On-site road	7,200m^2	Asphalt pavement
	Main control building	410m^2	
	Rest house for workers	270m^2	
	Guardhouse	14m^2	
	Truck-scale house	18m^2	
	Truck-scale	2 unit	50 ton, load cell type
Transfer station	Retaining wall	80m	H=4.5m
	Upper level (re-loading stn.)	2,600m^2	Concrete pavement
	Waste storage yard (upper)	700m^2	
	Yard (lower)	6,500m^2	Parking, etc./ asphalt pavement
	Control house	14m^2	
	Fuel station	1 unit	
	Car washing facility	1 unit	
Equipment for transfer station	Wheel loader	2 units	3m^3
	Pick-up	1 unit	



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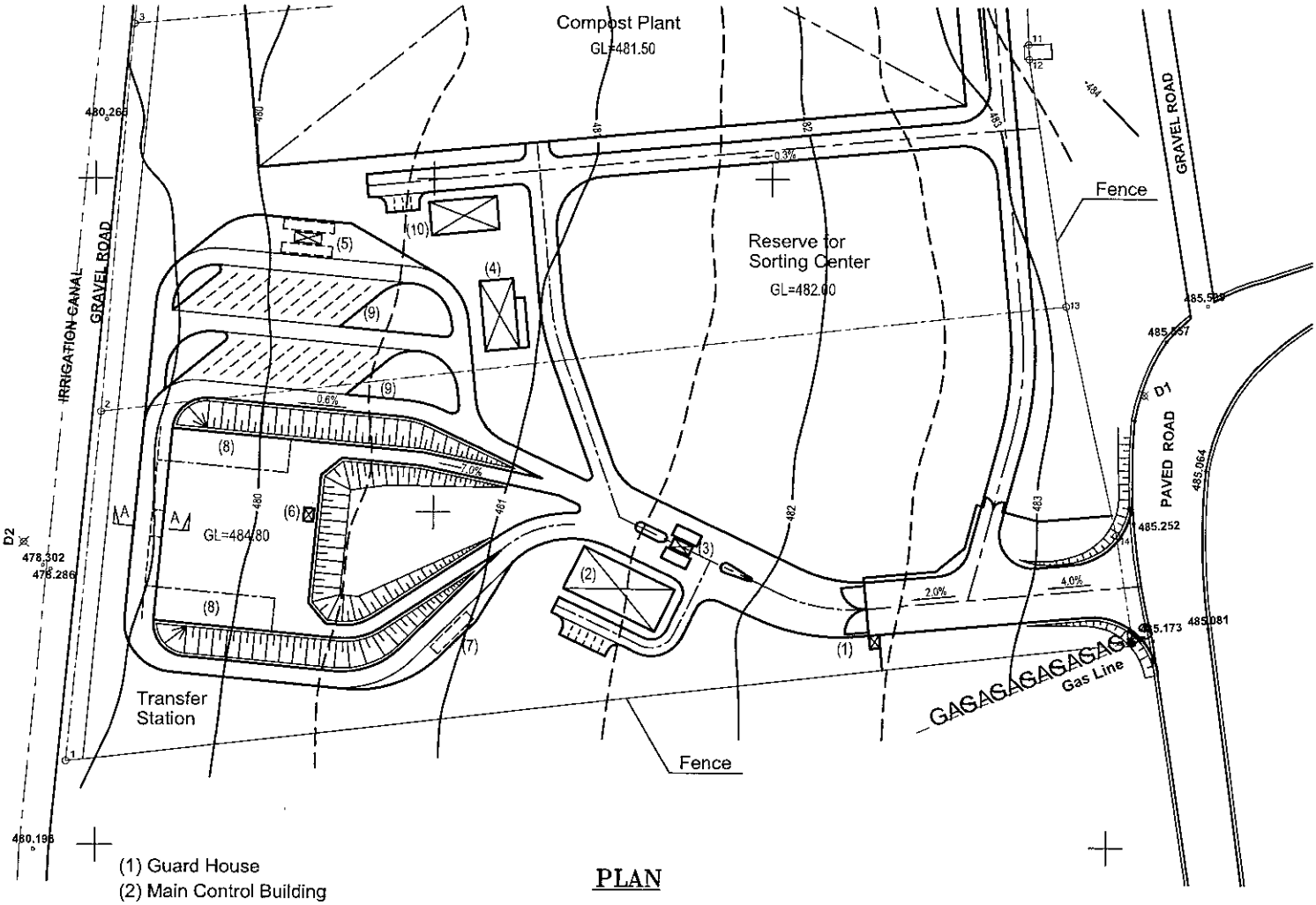


PLAN

(1) Guard House
(2) Main Control Building
(3) Truck Scale
(4) Workers' Rest House
(5) Fuel Station
(6) Control Building
(7) Car Washing
(8) Waste Storage Yard
(9) Parking for Transfer Vehicle
(10) Medical Waste Treatment Center

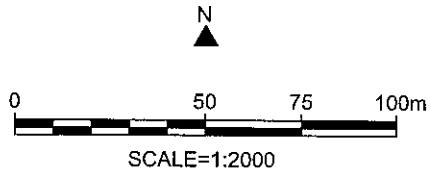


Figure 6.3.1 Layout Plan of Transfer Station

(3) Equipment Plan

Open-top semi trailers of 40m^3 capacity, equipped with ejection plate for waste unloading at disposal site and cover to prevent waste scattering during waste transportation, are used for the waste transportation from Dir Baalbeh transfer station to Maghlia disposal site. (This equipment is not included in F/S scope of the JICA study.)

Wastes carried into the transfer station during night are tentatively unloaded to the waste storage yard, and the stored wastes will be re-loaded into semi-trailers by wheel loaders in daytime.

In addition, a pick-up vehicle (4WD) is needed for patrol and other miscellaneous duties within the cleansing center. Table 6.3.3 shows the required equipment for the transfer station in the target year 2006 of priority project.

Table 6.3.3 List of Equipment at Dir Baalbeh Transfer Station

Equipment	Number	Operation
Wheel Loader (3m^3)	2 (2)	- Rearrangement works for unloaded waste from collection vehicles in nighttime at waste storage yards - Waste carriage from waste storage yards to re-loading stations and loading to semi-trailers at the re-loading stations
Pick-up (4WD)	1 (1)	- Patrol and other miscellaneous duties within the cleansing center

Note: Figures in parenthesis shows the required necessary equipment for 2010.

(4) Operation Plan

Projected staff requirements can be estimated in accordance with the number of staff needed to satisfactory carryout daily work at the transfer station. Table 6.3.4 shows the detailed staff and composition of the team for the transfer station for 2006.

Table 6.3.4 Operational Organization of the Transfer Station

Staffing	Number	Responsibilities
Site Manager	1	All the responsibility of management/operation of transfer station
Secretary (accountant)	1	Control of the schedule of site manager and daily management of accounts at the site
Truck-scale Operator	3	Operation of truck-scale to measure the waste quantity and quality of hauling vehicles for both transfer station and compost plant including processing and reporting of the collected data
Chief Engineer	1	Management of all engineering matters including planning and conduct of suitable operation
Inspector	3	Control of incoming/outgoing hauling vehicles
Chief Mechanic	1	Responsible for maintenance of vehicles, mainly transfer vehicles
Operator (wheel loader)	5	Handling of waste that is temporary stored at the yard Daytime: 2 +1 = 3 Nighttime: 1+ 1 = 2
Worker	8	Supporting of waste re-loading, Vehicle maintenance, Operation of fuel station, and Other miscellaneous works
Guard	4	Safety of transfer station (daytime 2, nighttime 2)
Total	27	

Note: Drivers of transport vehicles are not included.

CHAPTER 7 REHABILITATION OF EXISTING DISPOSAL SITE AND OPERATION IMPROVEMENT

7.1 REHABILITATION OF PRESENT DISPOSAL SITE

7.1.1 Introduction

Homs City has been advancing rehabilitation of the existing disposal site at Dir Baalbeh since January 2001. Earth covering and installation of gas removal pipes have been carried out over approximately 2 ha in the northwest section. However, since there is a shortage of equipment for implementing landfill disposal work, earth covering is not implemented in other sections. Since it takes time to procure heavy equipment, it is necessary for the city to raise the budget for renting machinery for carrying out earth covering.

Moreover, in Homs City, following the METAP study, construction of a new disposal site is planned at Maghlia some 30 km to the east of the city center. Since the new disposal site is schedule to be commissioned in 2006, the rehabilitation plan for Dir Baalbeh was compiled assuming that this site will continue to be used until 2005.

7.1.2 Present Situation of the Site

The existing Dir Baalbeh disposal site is located about 6 km from the city center of Homs. It has been utilized since 1947, and its area is estimated at approx. 25 hectares surrounded by irrigation canals and agricultural land. The topographic condition is mostly plain on the whole, but the center of the site forms a slightly elevated hillock. Accordingly, the site inclines gently from the center hillock to its boundary. Several sections of operation roads whose conditions are very poor pass through the accumulated waste. Of the western part of the disposal site, accumulated waste is denser than other parts. Although the dumping site has been utilized for over 50 years, the volume of the accumulated waste seems relatively small. It is deemed that open burning and scavenger activities have largely reduced the volume of the accumulated waste.

Homs City is now rearranging a part of the accumulated waste at a northern area of 2 hectares as a pilot project. The rearranged waste is covered by soil that is excavated from vicinities to the project site within Dir Baalbeh dumpsite, and several gas-releasing facilities are installed at certain interval.

Average yearly rainfall for the past 10 years in Homs has been around 350 mm while in Lattakia it is around 670 mm. From the viewpoint of the precipitation, it is deemed that the condition of leachate at Dir Baalbeh is not worse than Al-Bassa disposal site in Lattakia since the generation of leachate is closely related to mainly the precipitation. However, during the rainy season in winter, it is observed that the operation roads within the site became muddy caused by leachate as well as rainwater.

7.1.3 Planning Issues on the Rehabilitation

Apart from the conditions of leachate, the most urgent issue in Dir Baalbeh dumpsite is to improve the method of disposal from open dumping to controlled landfill with daily cover soil. Although the cover soil is a very primitive countermeasure, its practice in the area of pilot project has proved the efficiency in terms of prevention of fly infestation, offensive odor and open burning. Therefore, the method of cover soil should be at least applied into the whole of the disposal site for both rearrangement of the existing accumulated waste and treatment of daily incoming waste.

In order to carry out the controlled landfill in a proper manner, it is necessary to secure working space to deal with the daily incoming waste. Since a relatively thick layer of waste due to long-term usage covers the dumpsite, only necessary portions of the accumulated waste should be rearranged appropriately in the initial stage of the rehabilitation project in order to improve the working conditions for daily haulage of waste and daily landfill. Also an embankment along the border between dumpsite and the surroundings should be simultaneously constructed using the accumulated waste as ifilling material, in order to prevent spilling over of waste into the surroundings and improve its external scenery.

As for the remained areas that will not be rearranged for securing working space and the embankment, the accumulated waste of those areas should be covered by soil after its compaction and leveling works as soon as possible.

In addition, paving gravel on the operation road and installing ditches along both sides of the operation road will much improve its poor condition especially during winter season.

7.1.4 Capacity Requirement for Daily Incoming Waste in Dir Baalbeh Disposal Site

Homs City has decided to construct a new disposal site at Maghlia. Although the construction schedule has not been fixed yet, it is expected that the new disposal site will open in the year 2006. Therefore, Dir Baalbeh disposal site is to be operated up to the year 2005. In accordance with this estimation, capacity requirement of daily incoming waste in Dir Baalbeh disposal site is calculated as shown in Table 7.1.1.

Table 7.1.1 Capacity Requirement for Daily Incoming Waste up to the Year 2005

	Year	2001	2002	2003	2004	2005
Waste Generation						
Household Waste	ton/year	157,501	162,478	167,613	172,909	178,615
Commercial Waste	ton/year	25,222	26,019	26,841	27,689	28,603
Public Facility Waste	ton/year	47,027	47,497	47,972	48,452	48,936
Workshop Waste	ton/year	24,477	25,250	26,048	26,871	27,758
Manufacturing Waste	ton/year	10,404	10,612	10,824	11,041	11,262
Hazardous Waste	ton/year	-2,303	-2,357	-2,411	-2,468	-2,526
Healthcare Waste	ton/year	426	439	453	467	480
Sub-total	ton/year	262,754	269,938	277,340	284,961	293,128
Collection Ratio	%	85%	85%	85%	85%	85%
Total	ton/year	223,341	229,447	235,739	242,217	249,159
Residue from Compost	ton/year	0	0	0	0	0
Collectable Waste	ton/year	223,341	229,447	235,739	242,217	249,159
Waste into Compost Plant	ton/year	0	0	0	0	0
Waste into Disposal Site	ton/year	223,341	229,447	235,739	242,217	249,159
Compacted Waste	m3/year	223,341	229,447	235,739	242,217	249,159
Cover Soil	m3/year	44,668	45,889	47,148	48,443	49,832
Required Landfill Volume	m3/year	268,009	275,336	282,887	290,660	298,991
Accumulated Landfill Volume	m3	268,009	543,345	826,232	1,116,892	1,415,883

Source: Homs Solid Waste Management Study - METAP, Interim Report, August 2000

Notes: 1) Manufacturing waste includes hazardous waste that is planned not to carry into the site.
2) Healthcare waste is planned to carry into a certain area within the disposal site.
3) Bulk density of waste in the site is assumed to be 1.0 ton/m3 in the estimation.
4) Volume of cover soil for landfill is assumed to be 20% of the volume of compacted waste.

7.1.5 Planning Policies for the Rehabilitation of Dir Baalbeh Disposal Site

It is deemed that the necessary heavy equipment for the controlled landfill will be procured by the end of the year 2003. The pilot project of the rehabilitation by Homs City should be extended including controlled landfill for daily incoming waste. Operation of daily cover soil is the minimum requirement in terms of minimization of environmental impacts in the surroundings. It is expected that Homs City will carry out this rehabilitation project with budgetary measures for renting the required heavy equipment and so on.

It is proposed that the operation of Dir Baalbeh disposal site should be planned by a zoning scheme because of the above-mentioned procurement schedule, the condition of the accumulated waste and effective/efficient utilization of the site. Since the accumulated waste in the western part of the site is denser than the other part, the western part should be utilized at first and carried out final cover soil as soon as possible if the planned landfill is completed. The eastern part of the site is planned to accommodate daily incoming waste of later stage. In other words, Homs City should first rehabilitate the western part of the disposal site carrying out the controlled landfill of daily incoming waste up to the year 2003, while the eastern part would be constructed as a tentative disposal site for 2004-2005 with rented equipment or by contract. Outline of the zoning scheme of Dir Baalbeh disposal site is shown in Figure 6.1.1 in the previous section.

Table 7.1.2 shows the objective daily incoming waste amount in each zone.

Table 7.1.2 Objective Daily Incoming Waste Amount of in Each Zone

Zone	Operational Period	Total Amount of Daily Incoming Waste (m^3)
A	2001-2003	826,200
B	2004-2005	589,700

Note: The objective daily incoming waste amount includes needed amount of cover soil.

The necessary heavy equipment for the controlled landfill at the tentative disposal site will be procured first. The procured equipment will be transferred to Maghlia disposal site, after the closure of Dir Baalbeh disposal site.

7.1.6 Facility Plan

The main facilities required for rehabilitation of the disposal site are as shown in Table 7.1.3.

Table 7.1.3 Major Facilities in Dir Baalbeh Disposal Site

Major facilities	Specification	Quantity
Zone A		
Disposal area	Including surrounding embankment	180,000m^2
Operation road	W=5m, gravel pavement	2,000m
as removal facility	L=6.0m/nos.	48 nos.
Zone B		
Capacity		600,000m^3
Leachate collection facility	Perforated RC pipe, diameter: 300mm	1,000m
Leachate control reservoir	Leachate circulation system, capacity=325m^3	1 nos.
Rainwater collection facility	400mm x 400mm	2,400m
Gas removal facility		19 nos.
Operation road	W=7m, gravel pavement	850m
Zone A&B（common facility）		
Enclosing fence	H=2.0m	2,100m
Green/ buffer zone		27,000m^2

(1) Outline of the Required Facilities for the Rehabilitation in Zone A

It is assumed that the rehabilitation task in Zone A will be carried out by Homs city council with budgetary measures up to the year 2003 as the extension of the pilot project. The following descriptions give an outline of the major facilities for the rehabilitation.

1) Waste Retaining Structure

In order to accommodate daily incoming waste up to the year 2003, an embankment will be constructed enclosing Zone A. A certain portion of the existing accumulated waste, which should be stabilized at an advanced stage, will be utilized as the filling material for the embankment. A layer of soil will cover the rearranged waste. Taking into account working easiness and flexibility for the future ultimate land use, inclination of the slope is recommended at 1:4.

2) Gas Exhaust Equipment

Gas exhaust equipment should be installed to extract various gases and vapors evolving the decomposition of organic materials in the waste. The equipment is composed of perforated PVC pipes covered by crushed stones and wrapped with wire baskets.

3) On-site Road

Graveled roads should be provided within the landfill site in accordance with the progress of landfill. This road would be used for access by the vehicles delivering wastes and cover soil and also the vehicles used for site management.

(2) Outline of the Required Facilities for the Rehabilitation in Zone B

The following descriptions give an outline of the major facilities for the tentative disposal site of Zone B. Enclosing fence and green/buffer zone will be provided along the perimeter of the whole of Dir Baalbeh disposal site in terms of the access control, identification of the boundary and the scenery improvement.

1) Waste Retaining Structure of the Tentative Disposal Site

For the daily landfill operation, an embankment will enclose the tentative disposal site. Since stabilization of the existing accumulated waste in Dir Baalbeh disposal site has reached at an advanced stage in addition to the economical reason, a certain portion of the accumulated waste in Zone B will be utilized as filling material of the embankment and covered by a layer of soil. Taking into account working easiness and flexibility for the future ultimate land use, inclination of the slope is recommended at 1:4.

2) Leachate Collection and Drainage Facility

At the bottom of landfill zone of the tentative disposal, several sections of perforated pipes covered by gravel should be provided in order to retain and drain the percolated leachate. Since the soil layer of the site is judged as nearly impermeable by the geographic survey of this study, it is deemed that lining of the bottom of landfill zone is not necessary.

3) Leachate Control Reservoir

The leachate collected from the leachate drainage facilities during rainy season should be totally retained in the leachate control reservoir. The structure of the reservoir will be reinforced concrete. Several blowers and a pump will be installed in the reservoir in order to accelerate sedimentation of organic materials and re-circulate the leachate into landfill zone for the prevention of spillover. The location of the leachate control reservoir is proposed at northeastern corner of the tentative disposal site because of the topographic conditions.

4) Rainwater Collection Facility

Unpolluted surface water from completed landfill zone with final cover soil will discharge into canal through gutters.

5) Gas Exhaust Equipment

Gas exhaust equipment should be installed to extract various gases and vapors evolving the decomposition of organic materials in the waste. The equipment is composed of perforated PVC pipes covered by crushed stones and wrapped with wire baskets.

6) Access Road

A section of planned road in the cleansing center will be the access road to the tentative disposal site. The present access road to the northern area of the site will be closed in order to control incoming/outgoing vehicles in one entrance. In addition, a gravel road should be provided within the landfill site. This road would be used for access by the vehicles delivering wastes and cover soil and also the vehicles used for site management.

7) Enclosing Fence

An enclosing fence along the perimeter of the whole of Dir Baalbeh disposal site, which consists of Zone A, Zone B and a leachate control reservoir, will be provided in for the prevention of waste outflow, access control and identification of the boundary.

8) Green/Buffer Zone

Green/buffer zone will be also provided along the perimeter of the whole of the disposal site in terms of environmental protection measures.

(3) Designing Outline of the Rehabilitation of Dir Baalbeh Disposal Site

Taking into account the zoning scheme and the objective amount of daily incoming waste in each zone as well as required facilities, typical longitudinal cross section of the rehabilitation of Dir Baalbeh disposal site is proposed as shown in Figure 7.1.1.

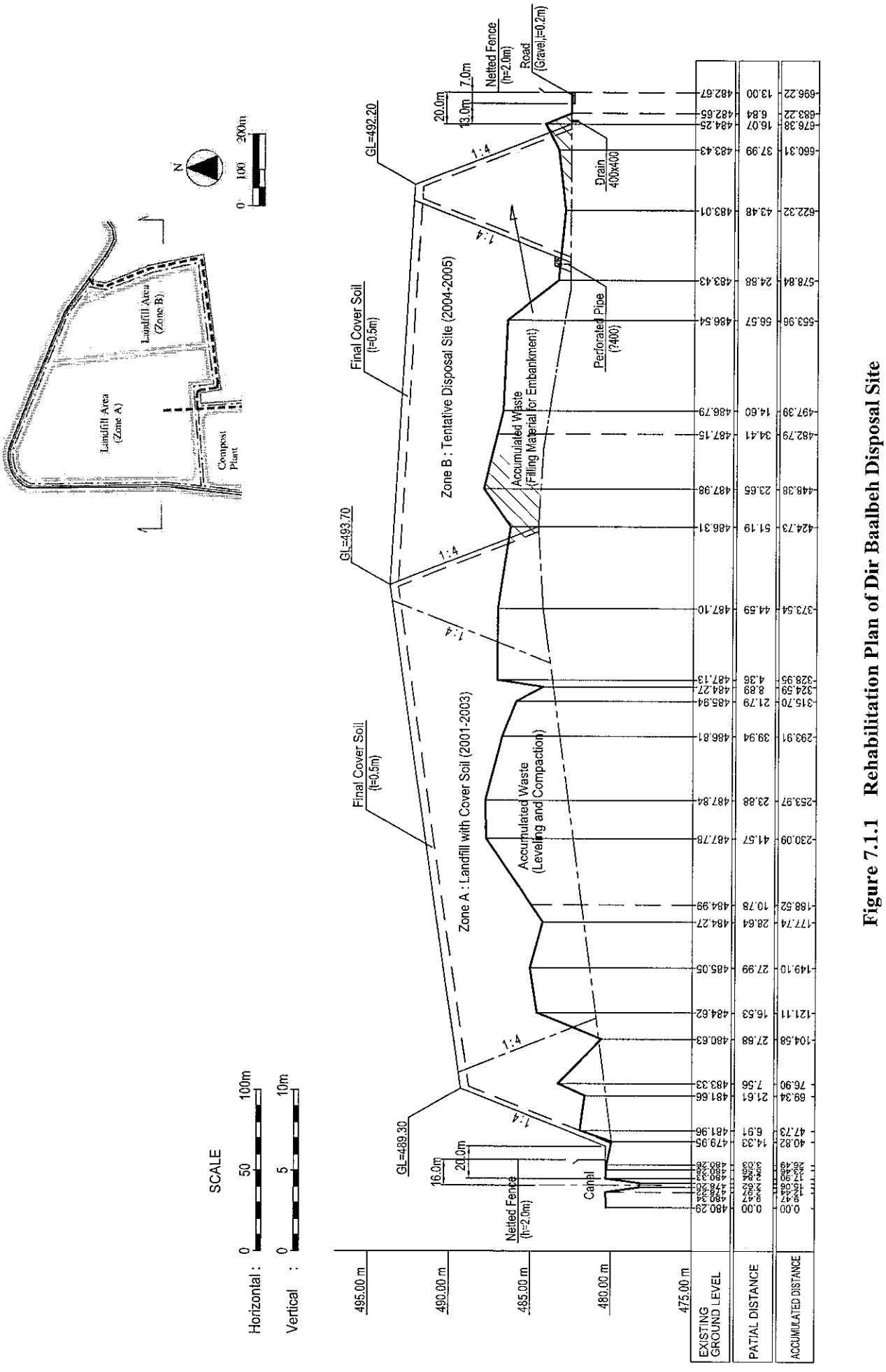


Figure 7.1.1 Rehabilitation Plan of Dir Baalbeh Disposal Site

7.1.7 Procurement of Heavy Equipment and Operational Organization

(1) Planning Conditions

Major planning conditions for the rehabilitation works are shown as follows.

1) Design Waste Amount to be Disposed

The required heavy equipment and manpower is estimated based on designed waste amount to be disposed in the target year 2006 of the priority project. The designed waste amount in 2006 is at 702 ton/day.

2) Working Hours

It is assumed that the working hours per day is 7 hours consisting of landfill work and cover soil work. Excavation and transportation of cover soil begin when the daily landfill work is half-finished. The cover soil is dumped on the landfill waste. If the daily landfill work is completed, the dumped cover soil is spread and compacted by bulldozer.

3) Availability of Heavy Equipment and Personnel

The heavy equipment cannot be operated at 100 % of their capacity all the time because of breakdown or required maintenance of heavy equipment. It is assumed that rented heavy equipment is used in case of a breakdown or maintenance.

As for the personnel involved in the landfill operation, a total of 7 days off in a month can be considered because of their holidays and leaves. Thus the availability is as follows.

Availability of personnel: 80 % (23 / 30 = 0.8)

(2) Number of Required Equipment

The required number of equipment is estimated based on the above-mentioned planning conditions, as shown in Table 7.1.4.

Table 7.1.4 Number of Required Equipment in 2006

Item		Quantity
Bulldozer	(200HP)	2
	(Landfill)	(2)
	(Cover Soil)	(1)
Excavator	($0.7m^3$)	1
Dump Truck	(10 ton)	1

In order to carry out the landfill operation at the tentative disposal site, the above-tabulated equipment should be procured by the end of the year 2003. It is planned that these heavy vehicles will be transferred to Maghlia disposal site in 2006.

The required number of heavy equipment for the rehabilitation of Zone A is the same as above tabulated number, and assumed to be rented by Homs city council with its budgetary measures.

(3) Number of Required Manpower

Since the operation of the tentative disposal site is planned up to the year 2005, the required manpower in Dir Baalbeh tentative disposal site is estimated for only its operational period based on the above-mentioned planning conditions, as shown in Table 7.1.5.

Table 7.1.5 Number of Required Manpower for 2004-2005

Item	Quantity
Site Manager	1 (1)
Site Inspector	1 (1)
Chief Operator	1 (1)
Operator/Driver	6
Worker	2 (1)
Guard	2 (2)
Total	12 (6)

Note: Figure in parenthesis shows an assumption of the required number of manpower up to the year 2003.

Office and rest house for the staff in Dir Baalbeh disposal site will be provided as a common facility in the cleansing center. Some of the staff will be transferred to Maghlia disposal site when Dir Baalbeh disposal site is closed.

7.2 OPERATION IMPROVEMENT OF DISPOSAL SITE

(1) Outline of Proposed Rehabilitation Works in Zone B

1) Rehabilitation Works in Zone A

At the first stage of the rehabilitation works, a certain section of embankment will be constructed using rented heavy vehicles and carryout controlled landfill for daily incoming waste simultaneously. The filling material of the embankment is the existing accumulated waste from nearby the working site. The rearranged wastes are to be spread and compacted, and then covered by a layer of soil. Landfill of the daily incoming waste will be carried out within the embankment.

The total amount of daily incoming waste for 2001-2003 is estimated at 826,200 m^3 including the required amount of cover soil. Controlled landfill as combination of "cell method" and "push-up method" is proposed as the landfill method for the daily incoming waste.

2) Rehabilitation Works in Zone B

The rehabilitation work in Zone B is to be mainly the construction of the tentative disposal site. The embankment of the tentative disposal site is to be constructed using accumulated wastes within the zone as the filling material, and covered by a layer of soil. The same layer as the liner will also cover the bottom of the landfill site for the prevention of leachate spilling. The daily incoming waste for 2004-2005 will be

accommodated within this area. The estimated waste amount is at approx. 560,000 cubic meter. Controlled landfill will be also adopted as the landfill method for the daily incoming waste.

(2) Landfill Operation Improvement

The "Controlled Landfill" is a method for the waste disposal used worldwide which minimizes the environmental impacts and protects public health. Waste to be disposed should be compacted and covered with a layer of soil and after all disposal operations have been completed, alternative land use is possible.

Solid waste must be sufficiently spread and compacted so as to stabilize the landfill area and to prolong the lifetime of disposal site. Soil cover must be placed systematically and periodically after land-filling of each year and/or cell of the waste.

1) Landfill Method

In order to perform the sufficient spreading and compaction of the waste, combination of the "cell method" and the "push-up method" is proposed for the operation improvement. The following items show the procedure of the landfill method.

- Waste spreading should not be too thick. The waste thickness of each layer shall be about 30 cm, which is effective for compaction work carried out by landfill equipment (bulldozer).
- Landfill layer and/or cell should be made as uniform as possible by the push-up method, taking into consideration the waste compaction efficiency. Gradient of the waste slope is proposed at 1:4, in order to ensure effective operation of landfill equipment.
- Thickness of each waste cell should less than 3 meters, according to waste characteristics of mixed municipal waste and efficiency of landfill work.

2) Cover Soil

Covering soil is the basic and the most effective countermeasures to environmental impacts created at the waste disposal sites. Covering soil, which consists of daily/periodical and final covering, shall be carried out at proper times during landfill operation, in order to prevent the waste scattering, offensive odor, harmful insects, waste-self burning, reduction of leachate amount and so on. The thickness of daily/periodical cover soil is proposed as follows.

- Daily/Periodical Cover Soil: 20-30cm
- Final Cover Soil: 50cm

As for the material of the final cover soil for the rehabilitation of Dir Baalbeh disposal site, a layer of clay soil is recommended in terms of its impermeability in order to minimize the leachate amount since the generation of leachate is closely related to mainly precipitation.

CHAPTER 8 ESTABLISHMENT OF MEDICAL WASTE MANAGEMENT IN HOMS CITY

8.1 GENERAL

The medical waste management in Homs City is currently in poor condition, and an appropriate treatment plan is strongly requested by the City.

Medical waste management should be established independently from other waste because of its infectious risk.

Its ultimate goal to is to reduce the environmental or infectious risk at any stage from its generation to final disposal.

8.2 BASIC APPROACH FOR APPROPRIATE TREATMENT

8.2.1 Definition of Medical Waste

The medical waste generated in medical waste establishments are mainly classified as follows.

- Infectious waste
- Hospital general waste
- Chemical and pharmaceutical waste including radioactive waste
- Pathological waste

Above waste classifications are defined in Table 8.2.1 in this study.

Table 8.2.1 Definition of Medical Waste

Waste Category	Description of Examples
Infectious waste	Waste suspected to be infectious: Laboratory cultures, waste from isolation wards, tissues, materials or equipment that have been in contact with infected patients, excreta, sharps such as needles, scalpels and knives
Hospital general waste	The waste that can be dealt with by the normal domestic and urban waste management systems (food waste, papers, etc.)
Chemical and pharmaceutical waste	Waste containing chemical substances, waste containing pharmaceuticals, wastes with high content of heavy metals, pressurized containers, radioactive waste
Pathological waste	Human tissues of fluids e.g. body parts, other body fluids and fetuses

8.2.2 Basic Flow of Medical Waste Treatment

The medical waste should be treated as follows.

At first, the medical waste should be appropriately separated into each classification defined in Table 8.2.1.

The appropriate treatment system for the chemical and pharmaceutical waste generated in medical establishment should be established in a national level because these waste include various chemicals. As for the pathological waste, a proper treatment method will be incineration or burying after disinfections at special place. An appropriate system should be selected considering the religion and tradition of residents in Homs.

The hospital general waste should be treated by the municipal waste management system.

The schematic flow of above treatment is shown in Figure 8.2.1.

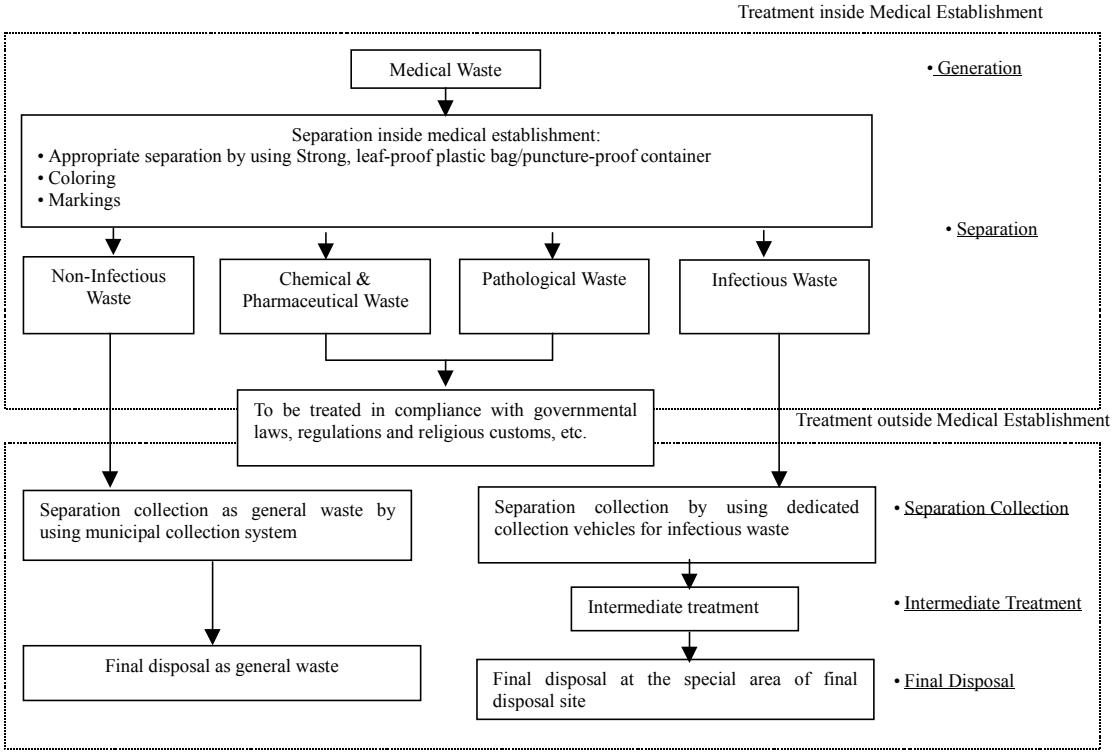


Figure 8.2.1 Treatment Flow for Medical Waste

8.2.3 Treatment Inside Medical Establishment

Source separation is a basic requirement for the appropriate treatment of medical waste. The appropriate method of color-coding and markings of medical waste must be required for separation. The appropriate packing using dedicated containers, color-coding and markings should be applied for the separation at the medical establishment.

Table 8.2.2 shows the recommended method for source separation inside medical establishments.

Table 8.2.2 Recommended Color-coding, Markings and Type of Containers

Type of Waste		Color-coding & Markings	Type of Container
Infectious waste	Highly infectious waste	Yellow, marked "HIGHLY INFECTIOUS"	Strong, leak-proof plastic bag or container capable of being autoclaved
	Other infectious waste, pathological and anatomical waste	Yellow	Leak-proof plastic bag or container
	Sharps	Yellow, marked "SHARPS"	Puncture-proof container
Chemical and pharmaceutical waste	Chemical and pharmaceutical waste	Brown	Plastic bag or container
	Radioactive waste	-	Lead box, labeled with the radioactive symbol
General hospital waste		Black	Plastic bag

Source: "Safe management of waste from health-care activities", WHO, 1999.

8.2.4 Treatment Outside Medical Establishment

(1) Collection/Transportation

At present, some medical waste (infectious waste) are collected by the same compactor truck as other general waste in Homs City.

However, the following problems were identified.

- The uncovered structure of the compactor truck may cause the infectious risk during collection and transport
- Not all the waste generated in the medical establishments are collected by the above collection vehicle
- Most of the medical waste are hauled in the containers at the roadsides for curbside collection same as general waste

Therefore, the separate collection especially for collecting the infectious medical waste by using dedicated collection vehicle meeting the following conditions should be required.

- The structure of the truck bed should be a closed leak-proof truck
- Prevention of the corrosion due to the long use by using corrosion prevention material such as stainless steel

Above collection should be conducted by the collection section separate from the general wastes. This separate collection should be implemented by year 2005.

(2) Intermediate Treatment

The present manner of direct dumping of medical waste at the existing open dumping site may cause the contamination due to the microorganism and the poor condition of public hygiene. Therefore, some proper intermediate treatments will be necessary to stabilize the pathogenic bacteria by sterilizing/disinfecting and volume reduction at the same time.

Incineration, chemical treatment, wet/steam thermal disinfection and microwave irradiation method will be possible options as intermediate treatment.

Chemical treatment is usually used in a liquid state, which requires the appropriate concentration of the solution and requires strict maintenance for the post-treatment.

The wet/steam thermal treatment is to utilize the wet thermal effect that destroys bio-organisms with temperatures over 120 degree Celsius and pressure of 1 kg/cm^2. Autoclaving is the typical process for treatment. This method requires strict maintenance for controlling the steam and pressure and a process for volume reduction for proper treatment. However, this system has an advantage related to the effect of sterilization/disinfection of infectious waste compared to other systems.

Incineration has the advantage of being volume reduction and is commonly used in Europe and Japan.

(3) Final Disposal

At present, there is no sanitary landfill in Homs City, and the medical waste is dumped in an open dumping site that has no special area for disposing this waste.

The final landfill site is essential for receiving the treated medical waste.

The infectious medical waste should be disposed of in a special area in compliance with the following requirement.

- Adequate sealing at the base and side to minimize the leachate from the waste
- Adequate measures for leachate collection and treatment if necessary
- Daily covering (25cm) of the infectious waste
- Surface water collection trenches around site boundaries
- Embankment of final cover soil (50 cm) to minimize rainwater infiltration when each phase of landfill is completed

8.3 DETERMINATION OF APPROPRIATE TREATMENT

Technical alternatives will be discussed here especially for the infectious waste. General hospital waste should be treated by the municipal waste management system as other municipal waste. The chemical and pharmaceutical waste should be appropriately treated in compliance with governmental laws/regulations or religious customs.

Some treatment will be necessary for the sterilization/disinfection of infectious waste before disposal at the final disposal site. A centralized intermediate treatment system will be effective from the view of cost performance in treating small amounts of infectious waste.

The source separation as mentioned above for each waste type should be carried out inside the medical establishment. The separate collection for the infectious waste should be carried out using dedicated collection vehicles by the newly established body. The intermediate treatment follows the separate collection. Finally, the treated infectious waste should be disposed of at the final disposal site.

Therefore, the appropriate treatment for the infectious waste should be composed of (Source separation) + (Separate collection) + (Intermediate treatment) + (Final disposal at the special area of the final disposal site).

The present treatment for the waste blood pack at the cement kiln plant near Homs City should be continued also in the future.

Incineration or wet thermal treatment will be a viable option for centralized intermediate treatment.

Wet thermal treatment has the following advantages over incineration.

- No emission of hazardous air pollutants
- Destruction of microorganism is established for the wet thermal condition under pressurized steam condition with the temperature over 120 centigrade degree

In addition, incineration is not supported by the city.

Therefore, a centralized wet thermal treatment can be selected for the intermediate treatment.

8.4 IMPLEMENTATION PLAN

8.4.1 Basic Task for Implementation

The appropriate management of the medical waste should require the phased development from the establishment of institutional framework and system development to the procurement and construction of relevant equipment and/or facilities to be required for realizing this framework. Especially, the establishment of separation systems including supplying and distributing the dedicated containers should be immediately implemented. The organization for collection, transportation, intermediate treatment and final disposal should be also established

Table 8.4.1 shows the summary of the tasks for above requirement to be the responsibility of the authorities concerned.

Table 8.4.1 Task Items required for Appropriate Treatment of Medical Waste

Task Items required for Appropriate Treatment		Relevant Authorities	Target Year
1	Establishment of regulation/degrees related to medical waste management	Governorate / Municipality	Up to 2003
2	Establishment of manual for medical waste management	Governorate / Municipality	Up to 2003
3	Establishment of separation / coloring system for medical waste	Governorate / Municipality	Up to 2003
4	Establishment of supply / distribution system for dedicated containers for medical waste	Governorate / Municipality / Medical Establishment	Up to 2003
5	Establishment of separate collection system for dedicated vehicles for medical waste	Governorate / Municipality	Up to 2003
6	Establishment of operation (collection, transportation, intermediate treatment & final disposal) body for medical waste treatment	Governorate / Municipality	Up to 2005
7	Establishment of final disposal system for medical waste	Governorate / Municipality	Up to 2003

Task Items required for Appropriate Treatment		Relevant Authorities	Target Year
8	Establishment for environmental standards for introduction of intermediate treatment equipment / facilities	Government / Governorate	Up to 2005
9	Construction of special area at final disposal site for infectious and chemical waste	Governorate / Municipality	Up to 2005
10	Procurement of dedicated collection vehicle for infectious medical waste	Government / Governorate	Up to 2005
11	Procurement & construction of intermediate treatment facility	Government / Governorate / Municipality	Up to 2005

8.4.2 Estimated Generation Amount

The amount of medical waste generated is estimated in Table 8.4.2.

Table 8.4.2 Estimated Generation Amount of Medical Waste

Unit: ton/day

Type of Waste	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Infectious waste	0.57	0.60	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82
General hospital waste	0.26	0.27	0.28	0.29	0.31	0.32	0.33	0.34	0.36	0.37
Other wastes	0.32	0.33	0.34	0.36	0.38	0.39	0.41	0.42	0.44	0.45

Notes: 1. Source: Homs Solid Waste Management Study, Interim Report, August 2000, METAP
2. 5 % is allocated for chemical waste to total waste generation.

8.4.3 Equipment / Facility Plan

(1) Medical Establishment for Treatment

The appropriate treatment should target all types of medical establishments.

Table 8.4.3 shows the summary of the number of the medical establishment in the study area.

Table 8.4.3 Summary of Medical Establishments

Type of Medical Establishment	Number
Public hospital	3
Private hospital	21
NGO Hospital	3
Military Hospital	1
Health center	11
Blood Bank	1
Clinics	600
Total	640

(2) Collection Vehicle

For the study area, 3 (three) collection vehicles will be required as follows. One collection vehicle will collect the waste from 28 major hospitals. The infectious and chemical waste of the clinics will be assumed to be stored in the health center in the neighborhood and collected by one collection vehicle, while the clinics that cannot store any wastes in the neighborhood will be collected by another collection vehicle.

- 28 major hospitals: Daily collection by 1 collection vehicle
- Health Center: Daily collection by 1 collection vehicle

- Clinics that cannot store wastes: Twice a week collection by 1 collection vehicle

The basic specifications of the dedicated collection vehicle are as follows.

- The track bed shall have a closed structure made of stainless steel in order to have considerable endurance for agent/medicine and chemicals

(3) Intermediate Treatment Facility

Autoclave is the typical process of wet thermal treatment and commonly used in USA. The basic process for sterilization/disinfection of microorganism utilizes the wet thermal state under high temperature over 120 Centigrade and high pressure of approximately 100 kPa. The penetration of steam into the waste will be necessary for assuring the effect of sterilization/disinfection. After sterilization/disinfection, the additional vacuum process is necessary to remove the moisture from the waste. Therefore, the pressure control for high vacuum and high pressure will be required. The compaction / shredding system should be equipped additionally in order to reduce waste volume.

Thus, the system should be composed of the following components.

- Waste receiving unit
- Autoclaving unit equipped with vacuum system for penetration of steam and removing moisture
- Compactor / Shredding system for volume reduction
- Steam generation unit when there is no facility

Approximately, the capacity of 100 kg/h will be required for the study.

(4) Final Disposal

The special area at the final disposal sites should be necessary as discussed in Chapter 8.2.3. The daily cover soil with the thickness of 0.25 m should conducted within the day and the final cover soil with the thickness of 0.5 m should be conducted.

A special area is necessary for two schemes of developing the landfill, namely, at the rehabilitation of existing open dumping site by the year 2005 and at the future new landfill site by the year 2010.

An area of 1 ha of special section will be necessary at the minimum at the existing and new landfill.

8.4.4 Procurement/Installation Plan

(1) General

The appropriate collection and treatment system should be established for medical waste management. As a priority for implementation, the procurement of collection vehicles and intermediate treatment facility and its installation will be essential for the appropriate treatment.

(2) Procurement/Installation Schedule

The appropriate treatment system should be established by the year 2005. Therefore, the schedule for procurement and installation is shown in Table 8.4.4.

Table 8.4.4 Procurement/Installation Schedule

Item		2001	2002	2003	2004	2005
Dedicated Collection Vehicle						
	Procurement			▬		
	Operation				▬	▬
Intermediate Treatment Facility						
	Procurement				▬	
	Installation					▬
	Operation					▬

(3) Equipment Requirement for Procurement

The equipment list for the dedicated collection vehicles and intermediate treatment facility and their basic specifications are shown in Table 8.4.5.

Table 8.4.5 Equipment List

Name of Equipment		Quantity	Basic Specifications
Dedicated Collection Vehicle		3 nos.	• Van type comprising of stainless steel vessel and chassis • Vessel: - Closed and barn door type with manual locking device - Material: Stainless steel - Thickness of vessel: 3.0 mm • Vehicle: - Max payload: 2 t - Gross vehicle weight: Approx. 4 - 5 t
Intermediate Treatment facility			
	Autoclave system	1 unit	• High-vacuum steam sterilization system combined with compaction unit intended to handle regulated waste • Capacity: 100 kg/h
	Compactor	1 unit	• Capacity: 100 kg/h
	Boiler	1 unit	• Capacity: 50 kg/h (Steam generation)

8.4.5 Operation and Maintenance

(1) Operational Body

Medical waste management should be independent from other waste management from the view of reduction of infectious risk and efficiency of operation.

The medical waste management should be operated by the newly established body.

The established organization should be comprised of the following sections.

- Source separation section: Enlightenment of source separation and management for dedicated containers
- Collection section: Collection work

- Intermediate treatment section: Operating and maintenance of the intermediate treatment facility
- Final disposal section: Operating and maintenance of the special area at the final landfill site

The organization is shown in Figure 8.4.1.

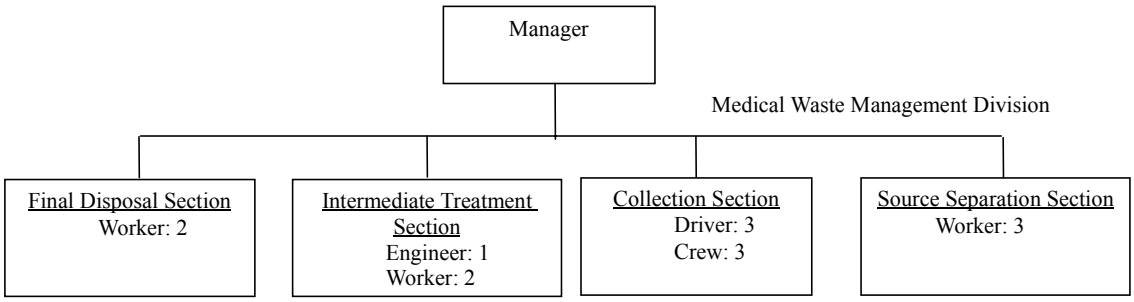


Figure 8.4.1 Organization Chart of Operational Body

(2) Containers for Source Separation

Separation manners should be conducted as shown in Table 8.2.2.

For the appropriate separation at each generation source, dedicated containers will be necessary. The number of containers is estimated as shown in Table 8.4.6.

The containers of 60-80 litter will be used in a large hospital, while the containers of 20-40 litter in a small hospital and others. The required number of containers is estimated based on the field investigation of the existing medical establishment. Number of containers will need the modification in the future according to the generation amount of infection waste obtained through an actual source separation at the medical establishment.

Table 8.4.6 Required Number of Containers per Day

Type of Medical Establishment	Number of Establishment (A)	Number of Plastic Bag for Infectious Waste by Type of Establishment (B)	Number of Hard Cardboard Box for Sharps by Type of Establishment (C)	Number of Plastic Bags by Type of Establishment (D=A x B)	Number of Hard Cardboard Box by Type of Establishment (E= A x C)
Public Hospital	3	5	3	15	9
Private Hospital	21	3	1	63	21
NGO Hospital	3	3	1	9	3
Military Hospital	1	3	1	3	1
Health Center	11	2	1	22	11
Blood Bank	1	-	-	-	-
Clinics	600	1	1	600	600
Total	640	-	-	712	645

CHAPTER 9 ENHANCEMENT OF PUBLIC AWARENESS

9.1 INTRODUCTION

As feasible systems in the priority projects of this study, introduction of a waste separate collection system and a composting system using the separated waste into the future SWM in the study area has been proposed. Therefore, residents' cooperation on waste separation at source is extremely required to introduce such systems to SWM. The most important action to get such cooperation is to heightening public awareness on SWM as well as the separate collection.

There have been however, few activities on public awareness for SWM in *Homs* City. Currently, activities are implemented infrequently and impermanently on a small scale. Namely, it is mentioned that the activities are not well organized from planning stage to implementation stage in their SWM. Is seems that this is due to several factors of constraints including lack of specific plans, experts, know-how, tools, information and budgets, and so on.

In order to introduce efficiently such new systems to the future SWM in *Homs*, consequently, related activities on enhancing public awareness must be aggressively carried out by the public authorities as one of SWM. That is, activities on the public awareness shall be regarded as an important part of SWM in the study area.

Taking account of the systems as well as the factors of constraints, in the feasibility study, several appropriate actions on heightening the public awareness in SWM are proposed as follows.

9.2 ORGANIZATIONAL ARRANGEMENT

In the priority projects, new waste collection vehicles will be procured in 2003 for *Homs* City. In addition, preparation of source separation starts in 2004, and the separate collection actually accounts for 28% of the households of *Homs* City as the initial target from 2005 with the several collection vehicles to be procured in 2003.

9.2.1 Public Awareness Section

In accordance with these schedules, actions on heightening public awareness on source separation should be prepared in the study area. Therefore, *Homs* City shall prepare a public awareness section to enforce necessary actions on the public awareness in SWM before the schedules as shown in Table 9.2.1.

Table 9.2.1 Organizational Arrangement

New Section	Position	People	Establishment Year
Public Awareness Section	Cleansing Department	3	2002

9.2.2 Necessary Staff

For the introduction of new waste collection system and the composting system of *Homs* City, the section will conduct various activities to enhance of public awareness on

SWM in accordance with the future schedule of SWM from 2002. Therefore, three people in charge of the public awareness section of the department are required to implement the related activities as summarized in Table 9.2.2:

Table 9.2.2 Necessary Staff in *Homs*

Position	No.	Expertise	Main Activities
Section Chief	1	Public Health Expert or Sanitary Engineer	Management and Planning
Staff A	1	Public Health Expert	Coordination on related activities
Staff B	1	Social Science Expert	Coordination on related activities
Total	3	-	-

In addition, the cooperation of housewives is extremely necessary for activities regarding source separation. From the point of view of social consideration, accordingly, one of the staff in Table 9.2.2 may be a female.

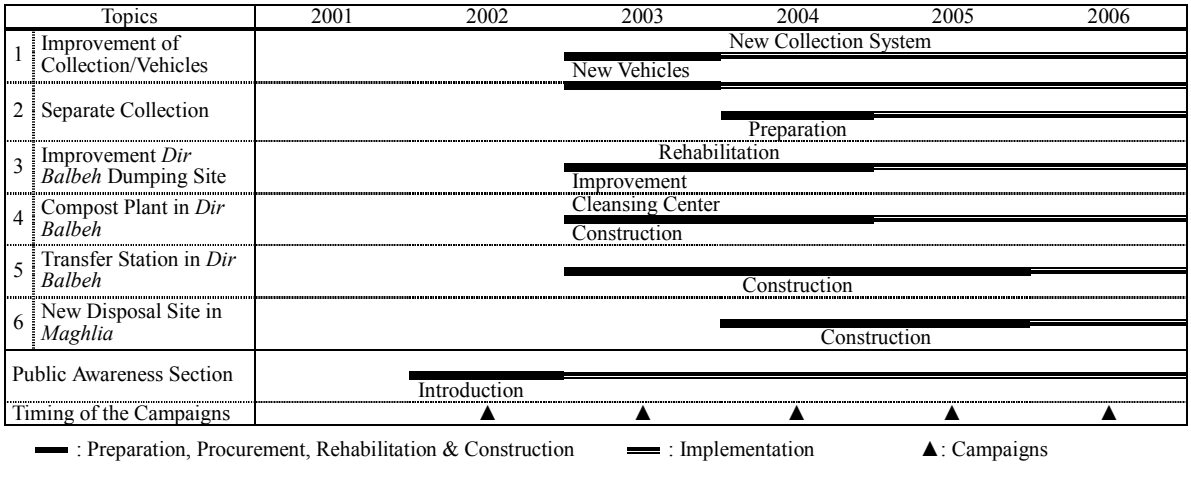
9.3 CAMPAIGNS

Campaigns on SWM and source separation should be launched as substantial actions on heightening public awareness on SWM as follows.

9.3.1 Topics and Campaigns' Timing

The campaigns shall be planned and conducted in parallel with the schedule of the events and topics in the priority projects. According to the implementation schedule of the priority projects in the feasibility study targeted for the year 2006, the main events and topics as well as suitable timing for launching the campaigns are summarized in Table 9.3.1.

Table 9.3.1 Topics in Priority Projects and Campaign Timing in F/S



9.3.2 Approach

In anticipation of possible resident and community involvement and their positive cooperation in the campaigns, an approach will be employed for the campaigns for a participatory approach with the concept of community participation.

This approach was introduced in the demonstration campaign conducted by the JICA Study Team as a pilot study during *Al Mahabba* Festival in August 2001 at the Sport City in *Lattakia*. The basic idea and details appear in Chapter 3 in Part IV in this report.

9.3.3 Publicity & Demonstration Campaigns

(1) Publicity Campaigns

The publicity campaigns are planned and implemented to widely advertise the following information on the future actions on SWM in advance to the population in the study area through the mass media and printed materials.

- Opening of the public awareness section
- Procurement of new collection vehicles
- Introduction of new collection system
- Rehabilitation of the present dumping site and construction of related facilities including a compost plant, new transfer station and new disposal site.

Therefore, the following are the necessary publicity campaigns to be launched.

1) Publicity Campaign on Opening of the Public Awareness Section

In 2002, the public awareness section in each city is organized and operated as a new function. Therefore, a publicity campaign on opening of the section shall be launched in 2003 for one day to inform their functions and expected roles to the population.

2) Publicity Campaign on New Collection System and Vehicles

In 2003, new collection and sweeping vehicles are procured in steps for future collection, sweeping, and the waste separate collection system. Therefore, a publicity campaign on the new collection system and new vehicles shall be launched in 2003 spanning several days before the implementation of the new system to disseminate and educate information concerning the population.

3) Publicity Campaign on Rehabilitation of the disposal site in *Dir Baalbeh*

From 2003 to 2004, the present final disposal site will be improved and rehabilitated to a controlled disposal site in *Dir Baalbeh*. Therefore, one publicity campaign on the improved disposal site will be launched in 2003 lasting several days before the implementation of the facility to disseminate information concerning the population.

4) Publicity Campaign on Constriction of the Cleansing Center

From 2003 to 2004, a compost plant is to be constructed as a function of the cleansing center (including a transfer station, a medical waste facility and others) in *Dir Baalbeh*. Therefore, one publicity campaign on the new plant shall be launched in 2003 lasting several days before the implementation of the facility to disseminate information concerning the population.

5) Publicity Campaign on Constriction of New Facilities

In 2006, a new transfer station in *Dir Baalbeh* and a controlled disposal site is scheduled to start operations. Therefore, a publicity campaign on the transfer station and the disposal site shall be launched in 2005 lasting several days before the implementation of the new facilities to disseminate information concerned to the population.

(2) Demonstration Campaigns

Demonstration campaigns are planned and will be implemented to demonstrate the following topics on the future SWM in advance for the population in the study area.

- Commencement of the new collection system
- Commencement of operation of the compost plant, the controlled disposal site in *Dir Baalbeh* and the new disposal site in *Maghlia*

Therefore, the following are the necessary demonstration campaigns to be launched.

1) Demonstration Campaign on New Collection System

In 2004, the waste collection coverage will increase from 70 % to 85 with new collection vehicles to be procured in 2003. Accordingly, a demonstration campaign on the new collection system shall be launched at the start of the new system in 2004 for one week to demonstrate and show the new system and the new collection vehicles to the population. In addition, the campaign shall include publicity on the future waste collection system to get the residents' cooperation and community participation in advance for the implementation of the source separation, which is scheduled to start in 2005.

2) Demonstration Campaign on Operation of the Cleansing Center in *Dir Baalbeh*

In 2005, the compost plant and the controlled disposal in *Dir Baalbeh* will fully start operation. Therefore, a demonstration campaign on the facilities shall be launched in 2005 for one week at the start of operations to demonstrate and allow inspection of the facilities site to the population.

3) Demonstration Campaign on Construction of New Facilities

In 2006, a new transfer station in *Dir Baalbeh* and a new controlled disposal site will start operations. Therefore, a demonstration campaign on the transfer station and the disposal site shall be launched in 2006 for one week at the start of operations of the new facilities to disseminate information concerning the population.

9.3.4 Source Separation Campaign

(1) Basic Activities

In 2005, a source separation system starts in selected areas in *Homs* City. The ratio of the separation is 28% of total amount of the solid waste from 2005. Therefore,

campaigns for source separation shall be launched in each city in 2004 before the start of the separation system in 2005 as follows:

- To demonstrate know-how of source separation methods to the residents of selected areas.
- To demonstrate a set of waste containers (a set of two containers, one is for organic and other is for non-organic). As for the implementation, several sets of waste containers (a set of organic container and non-organic container) may be constructed and set up in the campaign to heighten public awareness on the separation as an education tool even though the separate collection has not been actually implemented. The JICA study team produced and set up such sets of containers at the demonstration campaign held in the Sport City in *Lattakia* as a pilot study in August 2001. The details of the JICA's demonstration campaign appear in Chapter 3.
- To fully get the cooperation of the residents on future separate collection system
- To visit the recycle center in and show the process of composting using separated waste.

(2) Targets

The target households of the camping as well as the source separation system are estimated based on the population forecast and the scheduled separate collection ratio, etc., and summarized as shown in Table 9.3.2. They shall be chosen in the proposed area of the separate collection system in 2005.

Table 9.3.2 Targets of the Campaign and the Source Separation System

Activities	Year	Target Households
The Source Separation Campaign	2004	200
Start of The Source Separation System	2005	22,500

Note: Number of family members per household is estimated to 5.3 person/ household (Syrian Statistics)

(3) Methods

As for know-how of the source separation campaign, each city may adapt the methods of the campaign in *Lattakia* in August 2001, which was executed by the JICA Study Team as one of the pilot studies. Based on the results of questionnaire surveys, which was conducted during the campaign, it is evaluated that the length of the campaign should be more than one month. The details of the campaign appear in Chapter 3 in Part IV of this report.

(4) Women's Cooperation

Women's, especially housewives' cooperation is extremely necessary for the source separation campaign. From the point of view of social consideration as well as women in development (WID), the cooperation of women's union and related community entities is definitely expected for the women's involvement in the campaign.

9.3.5 Regular Campaigns and Activities

In addition to the specific campaigns discussed above, for heightening public awareness on environment and SWM, continual efforts shall be done as follows.

- Regular campaigns such as a yearly campaign
- Periodic Activities such as setting up "Cleansing Day" and "Week of Clean City".

(1) Yearly Campaign

As one of the important actions for the continual efforts, a yearly campaign should be implemented every year, in accordance with same methods of the demonstration campaign during *Al Mahabba* Festival at the Sport City in *Lattakia* in August 2001. The details of the campaign appear in Chapter 3 in Part IV of this report.

The yearly campaign should have specific themes every year. Based on the topics of SWM from 2002 to 2006 during the Feasibility Study and so on suitable themes are proposed as shown in Table 9.3.3.

Table 9.3.3 Yearly Themes for the Yearly Campaign

Year	Yearly Themes
2002	• Present situation and future SWM in the region • Expected activities of Public Awareness Section in each city
2003	• Present collection system and New collection system with procured new collection vehicles • Present situation of final disposal and recycling in the region
2004	• Construction of new compost plant in *Dir Baalbeh* • Necessity of source separation and future resident's cooperation
2005	• Compost from separated waste • Environmental improvement and benefit from the source separation and the recycling activities
2006	• Operation of new disposal site and the treatment system • Creation of recycle cities and an environmentally friend society

(2) Regular Activities

As regular activities, specific periods shall be prepared for heightening public awareness of SWM as follows.

1) Cleansing Day

The Cleansing Day shall be set up once a year as a public day or a public holiday in *Homs* City. The day may be selected at the day when the public awareness section is set up in each city in 2002, at the "Arabic Environmental Day (14^{th} October), or other important day related to SWM in *Homs*.

The day cerebrates the opening the section (or other specific topic) and recognizes the importance of "Cleansing" with several activities:

- A ceremony of the day
- Dissemination related information through the mass media and printed materials

- Demonstration on Cleansing such as reduction methods of domestic waste
- Others

2) Cleansing Week for Schoolchildren

A cleansing week shall be set up twice a year for mandatory schools in *Homs*. The week instructs importance of "Cleansing" to the schoolchildren and to improve schoolchildren's awareness of SWM. During the week, activities to be taken shall be planned in cooperation between the public awareness section and the education directorate in *Homs*.

9.3.6 Necessary Preparation

(1) List of the Campaigns and Regular Activities

Table 9.3.4 shows the list of the campaigns and regular activities.

Table 9.3.4 Specific Campaigns and Regular Activities

Year	Specific Campaigns	Yearly Campaigns and Regular Activities
2002	• Publicity Campaign for Opening the Public Awareness Section (1 day)	• Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2003	• Publicity Campaign on New Collection System and Vehicles (3 days) • Publicity Campaign on improvement of disposal site and construction of the compost plant in *Dir Baalbeh* (3 days)	• Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2004	• Demonstration Campaign on New Collection System (1 week) • Source Separation Campaign (More than one month)	• Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2005	• Publicity Campaign on Construction of the transfer station and the new disposal site (3 days) • Demonstration Campaign on Operation of the Cleansing Center in *Dir Baalbeh* (1 week)	• Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2006	• Demonstration Campaign on operation of the New Facilities in XXX (3 days)	• Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)

Note: Numerical values in the parenthesis stand for the expected day(s), Week or Month

(2) Basic Preparation for the Campaigns and Regular Activities

To implement each campaign and activity, much preparation is required including manpower and materials. As a matter of fact, each preparation must be sufficiently discussed in every preparation stage of the campaign and activities.

However, the basic preparations to facilitate future preparation are summarized in Table 9.3.5. As well as all preparation in the campaigns launched by the JICA Study Team from June to August. One of the pilot studies may be referenced and adapted for the

preparation in future campaigns and regular activities, which appears in Chapter 3 in Part IV or this report.

Table 9.3.5 Basic Preparation for the Campaigns and the Activities

Year	Basic Preparation Items
2002	• Manpower • Setting of venues of the Opening Campaign and Demonstration Campaigns • Signboards and other necessary campaign tools like T-shirt and key-holder for the Opening Campaign • Printed materials for the Opening Campaign, the Yearly Campaign, the Cleaning Day and the Week • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities
2003	• Manpower • Printed materials for the Publicity Campaigns, the Yearly Campaign, the Cleaning Day and the Week • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities
2004	• Manpower • Setting of a venue of the Demonstration Campaign • Signboards and other necessary campaign tools like T-shirt and key-holder for the Demonstration Campaign • Printed materials for the Demonstration Campaign, the Yearly Campaign, the Cleaning Day and the Week • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities
2005	• Manpower • Setting of a venue of the Demonstration Campaign • Signboards and other necessary campaign tools like T-shirt and key-holder for the Demonstration Campaign • Printed materials for the Demonstration Campaign, the Source Separation Campaign, the Yearly Campaign, the Cleaning Day and the Week • Plastic Bags and other necessary items for the Source Separation Campaign • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities
2006	• Manpower • Printed materials for the Publicity Campaign, the Yearly Campaign, the Cleaning Day and the Week • TV News programs including preparation of a video and newspaper for the campaigns and the activities • Questionnaire Forms for the evaluation of the campaigns and the activities

9.4 OTHER ACTIVITIES

9.4.1 Consideration for Scavengers

Many scavengers (waste pickers) currently exist in the disposal site. The scavengers in the site will be exposed to the following dangers.

- Scavengers may be involved in traffic accidents with waste collection vehicles during the tipping

- The risk of the accidents will be higher than now especially after the introduction of new waste collection vehicles and heavy vehicles to the site in 2003.
- Infection of a serious communicable disease from infectious waste in the site.

(1) Actions

From the point of view of social consideration, some measures should be taken against such accidents in the disposal site. In order to avoid such accidents and to maintain safe operation of the heavy vehicles, the following actions are required.

- To inform to the vehicle drivers and the scavengers about the danger of traffic accidents
- To create a regulation to avoid such accidents between the drivers and the scavengers
- To educate the scavengers about the risks of the medical waste
- Timing and Schedule

The timing and schedule of the actions related to the scavengers are shown in Table 9.4.1.

Table 9.4.1 Timing and Schedule for the Actions on Scavengers

Year	Actions
2002	• To create mutual trust between scavengers and the section through dialogs • To inform to the vehicle drivers and the scavengers about dangerous of traffic accident in the site through a printed material and an on-site oral presentation • To create a regulation between waste tipping and scavenging in accordance with vehicle schedules, tipping areas and so on • To instruct the risks of medical waste to the scavengers through a printed material and an on-site oral presentation
2003	• To inform to the scavengers about schedules of new collection system with new collection vehicles • To inform to the scavengers about schedules of improvement of the dumping site and introduction of heavy vehicles • To review the regulation between waste tipping and scavenging in accordance with new vehicle schedules, tipping areas and so on.
2004	• To review the regulation between waste tipping and scavenging in accordance with new vehicle schedules, tipping areas and so on • To inform to the scavenger about the separate collection system from 2005
2005	• To review the regulation between waste tipping and scavenging in accordance with new vehicle schedules, tipping areas and so on • To inform to the scavenger about start of the separate collection system and operation of new disposal site in *Maghlia*
2006	• To create a new regulation at the new disposal site in *Maghlia* between waste tipping and scavenging in accordance with new vehicle schedules, tipping areas and so on

9.4.2 Internal Training

Internal training shall be planned and conducted for the staff on the public awareness section to raise their capacity to handle activities on heightening public awareness concerned, as follows.

(1) Seminars and Regular Training

Especially, in year 2002 with the establishment of the section, training seminars to all the staff of the section of *Homs* shall be held frequently so they can have enough knowledge for their expected activities. From 2003, regular training shall be scheduled to upgrade their skills at least once a year. The schedule of the necessary seminars and training is summarized in Table9.4.2.

Table 9.4.2 Internal Seminar and Training Schedule

Year	Seminars and Training	Number of Times
2002	Joint Seminar	Three times
2003 –	Regular Joint Training	Once a Year

(2) Possible Lecturers

For the effective implementation of the training, the public awareness sections may refer to experiences on related activities conducted by some of the official and public entities as summarized in Table 9.4.3 because that they have conducted many activities on public awareness and campaigns in their field respectively. The public awareness section may invite people who are in charge of public awareness in each related organization as possible lecturers to the seminars and training.

Table 9.4.3 Related Activities on Public Awareness by Other Entities

Entities	Local Offices	Activities
Ministry of Education	*Homs* Education Directorate	School Health and Hygiene Education
Ministry of Environment	*Homs* Environment Directorate	Environmental Education
Ministry of Health	*Homs* Health Directorate	Health and Hygiene Education
Women's Union	*Homs* Branch of Women's Union	Women's Health and Hygiene Education

CHAPTER 10 INSTITUTIONAL ARRANGEMENT

10.1 ORGANIZATION OF HOMS CITY CLEANSING DEPARTMENT

It will be necessary to reorganize the Homs City Cleansing Department in line with the improvement of waste collection and street sweeping and procurement of equipment. In the project, it is planned to improve the efficiency of solid waste primary collection work, etc. through providing equipment and securing cooperation from citizens. Therefore, since it is planned to reduce personnel working in the Cleansing Department, it will be necessary to switch over those surplus people to the waste treatment and disposal divisions. Necessary personnel in Homs City are as indicated in Table 10.1.1.

Table 10.1.1 Required Personnel on SWM in Homs City

Item	Person
Manager	1
Administration	6
Collection	280
Road sweeping (include primary collection)	614
Others *)	66
Total	967
Current personnel	1,056

Note: *) Others consist of maintenance, road occupancy, pest control and public relation.

10.2 CLEANSING CENTER

Since it is planned to newly construct a cleansing center in the project, it will be in charge of the transfer station, compost plant and medical waste. Moreover, until the new disposal site at Maghlia opens, the cleansing center shall be responsible for final disposal carried out at the adjoining Dir Baalbeh disposal site. The necessary organization and personnel are as indicated in Table 10.2.1.

Table 10.2.1 Required Personnel in Homs Cleansing Center

	Compost plant	Transfer station	Disposal site	Medical waste	Total
Personnel	32 (50)	27	12	15	86

Note: ( ) shows the additional person in case the plant operate by two shifts

CHAPTER 11 PROJECT COST

11.1 CONDITIONS OF COST ESTIMATION

Investment cost of the Master Plan is estimated based on the following conditions.

- Exchange Rate US$1.00 = SYP 49 (June 2001)
  US$1.00 = Yen 121 (June 2001)
- Price As of June, 2001

11.2 INVESTMENT COST

Investment cost of the feasibility study projects related to the compost plant in Homs is shown in Table 11.2.1. Total investment cost of the projects is estimated to SP 775.7 million. New disposal site in Maghlia will start operation in 2006; however, investment cost of it is not included in this JICA study.

Table 11.2.1 Investment Cost

(Unit: Thousand SP)

Item		Investment cost
1. Collection & Road Sweeping	Collection equipment	201,996
2. Cleansing Center	Compost plant	350,000
	Transfer station	64,604
3. Dir Baalbeh Disposal Site	Rehabilitation	30,817
	Disposal equipment	45,960
4. Medical Waste Treatment		22,280
5. Public Awareness		9,341
6. Organization set-up		-
Sub-total		724,998
7. Engineering service		50,750
Total		775,748

11.3 OPERATION AND MAINTENANCE COST

Operation and maintenance cost of the projects is shown in Table 11.3.1. As shown in the table, total operation and maintenance cost in year 2006 will be approx. SP 142.2 million.

Waste transfer system will be introduced in Homs in accordance with the opening of new disposal site in Maghlia. Waste transfer activity will be contracted out to the private company.

Table 11.3.1 Operation and Maintenance Cost in 2006

(Unit: Thousand SP)

Item		O/M cost	Remarks
1. Collection & Road Sweeping	Collection equipment	111,535	
2. Cleansing Center	Compost plant	4,861	One shift operation
	Transfer station	11,296	Transfer: contract-out
3. Dir Baalbeh Disposal Site	Landfill operation	15,592	
4. Medical Waste Treatment		2,098	
5. Others		524	
Sub-total		145,906	
6. Income for selling	Compost	-1,356	One shift operation
	Recyclables	-2,325	One shift operation
Total		142,225	

Note: Depreciation is not included

CHAPTER 12 FINANCIAL PLAN

12.1 INVESTMENT PLAN

(1) Annual Investment

Project investment based on the priority works implementation schedule is as indicated in Table 12.2.1. It will be necessary to cover project cost of SP 775.8 million.

(2) Sources of Finance

Sources of finance for the project are not as yet decided. Since Homs City does not possess funds and it will be necessary to revise the law and implement large-scale increases in fees in order to repay investment costs, subsidization (grants) from the funds other than those from the municipality own budget will be required for the immediate future.

Furthermore, to ensure continuation of the solid waste management, it will be necessary to secure final disposal sites into the future. Therefore, as is indicated in the master plan, it is necessary for Maghlia disposal site to be constructed in 2006. Concerning investment for Maghlia disposal site and costs of renewing waste collection facilities and equipment in future, it will be necessary for cities to cover these expenses via their own funds or loans.

12.2 REVENUE AND EXPENDITURE OF SWM

(1) Cleansing Fees and Revenue

Waste treatment costs excluding depreciation expenses will be SP 142.2 million in 2006, and it will be necessary to depend on revenue from cleansing fees and general budget from the municipal government to cover these costs.

For the immediate future, it will be necessary to keep cleansing fees fixed and strive to raise collection rates. If the collection rate is raised to 80%, revenue from household fees will be SP 25.1 million (currently 6 million) and revenue from business establishment fees will be SP 74 million (same as present). However, in 2006, it will be necessary to revise the present legal limit for household cleansing fees to SP 500/year/household. As a result of this revision, assuming the collection rate is 80%, revenue from fees in 2006 will be SP 85.3 million from household fees and SP 74 million from business establishment fees, making SP 159.3 million in total. Moreover, in Homs City, since it will be necessary to pay for the new disposal site via loans, in future it will be necessary to revise the law on cleansing fees and raise the household fee to SP 1,000/day. Moreover, even following this revision, since fees will still only account for around 1% of household incomes, it is considered to be an affordable level for citizens

(2) Expenditure

Leaving aside depreciation cost and taking revenue from compost and reusable material sales into account, expenditure in Homs City in 2006 will be SP 142.2 million.

Therefore, in order to cover the operation and maintenance cost, it will be necessary for the city to outlay costs equivalent to roughly half of existing subsidies (SP 31.6 million) in 2006 too. Moreover, from 2007 onwards, in addition to operation and maintenance costs, it will be necessary to make loan repayments and interest payments.

(3) Cash Flow

Assuming that construction of the new disposal site will be carried out using loans according to the master plan, cash flow will be as indicated in Table 12.2.1. By implementing the project with central government subsidies and carrying out revision of cleansing fees, it should be possible to build a setup that allows new disposal site construction and other investments to be covered by loans.

Table 12.2.1 Financial Plan

(1) Investment and O/M Cost

(Unit: SP1,000)

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Investment cost																						
	Capacity building																					0
	Collection equipment			201,996					93,300					201,996					93,300			590,592
	Transfer facility			21,582	43,022										21,440							86,044
	Sorting center																					
	Compost plant			214,000	136,000										32,500				118,730	118,730		619,960
	Landfill				3,300	63,700			3,300	63,700			95,200				67,000				8,000	304,200
	Access road				450	8,300																8,750
	Dir Baalbeh			30,817																		30,817
	Equipment			45,960										45,960								91,920
	Healthecare waste			22,280										6,480						15,800		44,560
	Landfill																					0
	Public awareness		1,494	1,868	2,241	2,241	1,494															9,338
	Enginnering		105	37,695	12,688	157	105															50,750
	Sub total	0	1,599	576,198	197,701	74,398	1,599	0	96,600	63,700	0	0	95,200	254,436	53,940	0	67,000	0	212,030	134,530	8,000	1,836,931
Operation cost																						
	General cleansing	112,149	112,149	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	2,231,928
	Sep. collection																					0
	Market																					0
	Healthecare																					0
	Household waste																					0
	Transfer station																					0
	Station					4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	68,560
	Transportation						7,011	7,141	7,126	7,267	7,418	7,418	7,418	7,418	7,418	7,418	7,418	7,418	7,418	7,418	7,418	110,145
	Compost plant					4,861	4,861	4,861	8,249	8,249	8,249	8,249	8,249	8,249	8,249	8,249	8,249	8,249	8,249	8,249	8,249	121,820
	Sanitary landfill						15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	227,310
	Access road						438	438	438	438	438	438	438	438	438	438	438	438	438	438	438	6,570
	Dir Baalbeh	14,647	29,294	29,294	15,154	15,154																103,543
	Healthecare waste																					0
	Treatment					2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	33,568
	Lanfill																					0
	Oterhs		524	524	524	524	524	524	524	524	524	524	524	524	524	524	524	524	524	524	524	9,956
	Total	126,796	141,967	141,353	127,213	138,457	145,906	146,036	149,411	149,550	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	2,913,400

(2) Cash Flow

(Unit: SP1,000)

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
1	Revenue																					
	Remaining																					0
	Fee from HH	6,000	31,187	32,142	82,812	85,338	85,338	85,338	85,338	85,338	85,338	170,677	170,677	170,677	170,677	170,677	170,677	170,677	170,677	170,677	170,677	2,370,936
	Fee form comercial	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	1,480,000
	Subsidy	48,971	48,971	48,971	48,971	48,971	48,971															293,826
	Sales of compost					1,356	1,356	1,356	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	39,337
	Sales of reusable					2,325	2,325	2,325	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	67,425
	Sub total	128,971	154,158	155,113	205,783	211,990	211,990	163,019	166,701	166,701	166,701	252,040	252,040	252,040	252,040	252,040	252,040	252,040	252,040	252,040	252,040	4,251,524
	Grant	0	1,599	576,198	181,263	2,241																761,301
	Loan				16,438	72,157	799	0	48,300	31,850	0	0	47,600	127,218	26,970	0	33,500	0	106,015	67,265	5,600	583,713
	Total	128,971	155,757	731,312	403,485	286,388	212,790	163,019	215,001	198,551	166,701	252,040	299,640	379,258	279,010	252,040	285,540	252,040	358,055	319,305	257,640	5,596,538
2	Expence																					
	Capital investment	0	1,599	576,198	197,701	74,398	1,599	0	96,600	63,700	0	0	95,200	254,436	53,940	0	67,000	0	212,030	134,530	8,000	1,836,931
	Operation	126,796	141,967	141,353	127,213	138,457	145,906	146,036	149,411	149,550	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	2,913,400
	Loan repayment		0	0	0	1,644	8,860	8,939	8,939	13,769	16,954	16,954	16,954	21,714	34,436	35,489	28,274	31,544	31,544	37,315	40,857	354,189
	Interest		0	0	0	1,315	6,956	6,311	5,596	8,745	10,191	8,835	7,479	9,930	18,371	17,773	14,934	15,352	12,829	18,786	21,182	184,587
	Total	126,796	143,566	717,551	324,914	215,814	163,320	161,287	260,547	235,764	176,847	175,491	269,334	435,782	256,448	202,964	259,909	196,597	406,104	340,333	219,740	5,289,107
3	Balance	2,175	12,191	13,760	78,570	70,574	49,469	1,733	-45,545	-37,213	-10,146	76,549	30,305	-56,524	22,562	49,076	25,631	55,442	-48,049	-21,028	37,899	307,431
	Accumulation	2,175	14,366	28,126	106,697	177,271	226,740	228,473	182,927	145,714	135,569	212,118	242,423	185,899	208,460	257,536	283,167	338,609	290,560	269,532	307,431	
	Remaining loan	0	0	0	16,438	86,951	78,891	69,952	109,312	127,393	110,438	93,484	124,129	229,633	222,167	186,677	191,904	160,360	234,831	264,781	229,524	
	Tota debt	2,175	14,366	28,126	90,258	90,319	147,849	158,521	73,615	18,321	25,130	118,634	118,294	-43,734	-13,706	70,859	91,263	178,249	55,729	4,751	77,907	
	Dept ratio	0.0%	0.0%	0.0%	0.0%	1.4%	7.5%	9.4%	8.7%	13.5%	16.3%	10.2%	9.7%	12.6%	21.0%	21.1%	17.1%	18.6%	17.6%	22.3%	24.6%	

CHAPTER 13 ENVIRONMENTAL EVALUATION OF HOMS

13.1 GENERAL

The environmental evaluation on the proposed feasibility projects was conducted according to the 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 the 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 Center at Dir Baalbeh (Composting plant, transfer station and rehabilitation of disposal site)

(2) Establishment of medical waste management in HOMS

13.2 POTENTIAL IMPACT OF ENVIRONMENT

(1) HOMS Cleansing Center at Dir Baalbeh

The Cleansing center 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 13.2.1 are explained as follows:

1) Composting and Sorting Center

The project is proposed on an 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 odor, 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 odor. The residual water will be used for encouraging fermentation process and will not be discharged out side of the site. The heat generated by the fermentation process will exterminate vermin in the process.

Hence, there are no major negative impacts for this project.

2) Transfer Station

The transfer station may cause surface and ground water degradation and offensive odor 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 enter and leave the station everyday. It is not a small amount, hence the station will have an affect of scattering wastes there.

Table 13.2.1 Summery of Potential Impacts of Environmental on HOMS Cleansing Center

		Major facilities, activities which may cause impacts	Composting Plant, Sorting Center 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 Odor					✓							

Note: "✓" shows potential impact of environment. "✓✓✓": high, "✓✓": moderate, "✓": low, no indication: negligible

3) Rehabilitation of Existing Disposal Site

The main concern is water quality degradation by the operation up to year 2005. Even if sufficient facilities are planed for the rehabilitation; leachate water may cause 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 with different types for the medical waste using color 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 is carried out properly.

13.3 MITIGATION MEASURES

Mitigation measures for potential impact on the feasibility of the projects are explained as follows:

(1) Development of HOMS Cleansing Center at Dir Baalbeh (Composting plant and transfer station)

Surface and groundwater are potential impacts caused by the transfer station in Dir Baalbeh so that the maintenance of proper sanitary conditions within the transfer station and surrounding area is necessary, 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 also be considered in order to improve the ecosystem at the site and visual amenity of the solid waste disposal facilities.

(2) Development of HOMS Cleansing Center at Dir Baalbeh (Rehabilitation of Existing Disposal Site)

In order to enhance landfill management, monitoring for ground water and surface water at the site and its vicinity is essential. General mitigation measures are shown in Table 13.3.1 and these are recommended for review.

Table 13.3.1 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 (Odor 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, color)	▪ 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, leachate management is a key point of the landfill management and its components shown in Table 13.3.2 and 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 13.3.2 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 ▪ Re-circulation
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 ▪ Inter-space 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. Special attention shall be paid when handling and disposing infectious medical wastes.

13.4 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.

CHAPTER 14 PROJECT EVALUATION

14.1 TECHNICAL EVALUATION

The following technical systems are proposed in the Homs City compost plant construction project:

- Construction of Homs cleansing center (compost plant and transfer station)
- Improvement of waste collection and street sweeping
- Introduction of source separate collection
- Rehabilitation and improvement of operation of Dir Baalbeh disposal site
- Medical waste treatment

(1) Construction of Homs Cleansing Center

a. Compost Plant Construction

Based on the findings of the METAP-EIB study, the new compost plant shall be treated as a pilot plant and its scale of operations shall be increased in phases. Operation shall initially be conducted over one shift (50 tons/day) and later be increased to two shifts (100 tons/day) when the quality and demand for compost have been confirmed. Moreover, the METAP-EIB study proposes that the plant initially function as a demonstration facility targeting market waste, however, in this study, it is intended to accept both market waste and domestic organic waste that is separated at the source, in order to pave the way for upgrading to a full-scale plant. To sum up, this facility presents no technical problems and is thought to be quite feasible.

b. Transfer Station Construction

It has already been decided to construct a new disposal site at Maghlia some 30 km northwest of Homs City center, and this is scheduled to commence services in 2006. Based on this, it is planned to introduce a transfer transport system for carrying out efficient collection and transport. In response to these prior plans, the study intends to construct a transfer station possessing a plant capacity of 800 tons/day. It has been decided to adopt direct reloading and a technically simple management and operation system at the station. Therefore the proposed transfer station is judged to be technically valid.

(2) Improvement of Collection and Street Sweeping

Homs City possesses 72 waste collection vehicles (including 35 compactors), but more than half of these (40) have already been in use for 10 years or more and the level of services is declining as a result of equipment deterioration.

The study aims to increase the waste collection rate from approximately 72% at present to 85% by expanding services in outlying areas by the target year of 2006. Concerning renewal of collection equipment, in consideration of local topographical conditions, unification of equipment models and introduction of source separate collection, medium size compactors shall be introduced. Also, some small compactors shall be included in

order to handle waste discharged in plastic bags. Targeted waste shall be domestic waste, commercial waste (including market waste) and non-infectious medical waste. It is judged that implementation of these measures will enable the collection rate to be raised to 85% and is very feasible in technical terms.

(3) Introduction of Source Separation

In order to introduce recycling and produce good quality compost, source separate collection shall be introduced. This shall be done in phases in line with the commissioning timing of the compost plant.

When introducing source separate collection, as was carried out in the Pilot Study in Lattakia, it is essential to obtain the active participation and cooperation of citizens. Therefore, it is important to implement source separate collection in tandem with campaigns to enhance citizen awareness.

(4) Rehabilitation and Operation Improvement of Dir Baalbeh Disposal Site

Since it is scheduled for Homs cleansing center to be constructed next to Dir Baalbeh disposal site, it will be necessary to carry out rehabilitation of this site for environmental reasons. As was mentioned previously, since the new disposal site at Maghlia is set to start operation in 2006, rehabilitation of Dir Baalbeh disposal site was planned based on the assumption that the cleansing center commences operation by 2005.

Rehabilitation of Dir Baalbeh disposal site shall be implemented over two phases with the disposal area divided into Zone A and Zone B. The rehabilitation in both zones is an extension of the technical contents implemented in the Pilot Study at Lattakia. Also, leachate treatment ponds and storm water drainage facilities shall be added in Zone B. Concerning the sanitary landfilling method, definite earth covering shall be conducted in order to mitigate impact on the surrounding environment. In conclusion, it is judged that the above rehabilitation and operation improvement of Dir Baalbeh disposal site is technically valid.

(5) Medical Waste Treatment

Medical waste hardly undergoes any separation treatment in hospitals, and its disposal too is carried out mixed with urban waste. These appalling conditions have led to concerns being raised over impact on human heath in all stages from generation through to collection and disposal.

In the study, medical waste is classified into four groups and proposals are made concerning treatment of infectious waste that requires particular attention. In order to completely separate this waste from other urban waste from generation through to treatment, it is planned to introduce special collection vehicles and high-pressure steam disinfection devices, etc. From the viewpoint of securing the proper treatment of medical waste, this proposal is considered to be technically valid.

14.2 ECONOMIC AND FINANCIAL EVALUATION

(1) Economic Evaluation

In the economic assessment, economic cost and benefit estimation and cost-benefit analysis are conducted, and the economic internal rate of return is computed. Moreover, since a feature of the solid waste management is that final disposal sites need to be secured, assessment is conducted assuming that Maghlia final disposal site is constructed as indicated in the master plan.

1) Economic Cost

In carrying out economic assessment, financial costs are directly converted into economic costs.

2) Economic Benefits

Benefits resulting from implementation of the project can be considered as follows.

a. Elimination of solid waste: protection of the urban living environment, improvement of public sanitation
b. Introduction of source separate collection: enlightenment of citizen awareness
c. Compost production: recovery of reusable materials, reduction of chemical fertilizer, increase in production, improvement of production quality, reduction of irrigation water consumption, reduction of disposal quantities, reduction of global warming gases, recovery of reusable materials
d. Recovery of reusable materials: recovery of reusable materials, reduction of final disposal quantities
e. Improvement of existing disposal sites and construction of new disposal site: surrounding environmental protection, promotion of coastal road construction, vacant site use

Out of the above, quantifiable benefits are as follows: 1) benefits resulting from removal of solid waste, 2) benefits of compost production, and 3) benefits of reusable materials recovery. The economic value of these benefits is as follows.

a. Concerning the solid waste elimination effect, the amount beneficiaries are willing to pay shall be the benefit. Using the findings of the citizen awareness survey implemented in Lattakia, the average amount beneficiaries are willing to pay shall be set at roughly 1% of average household income. Concerning stores, etc. since SP 74 million is already collected in Homs City, this shall be regarded as the amount beneficiaries are willing to pay. Taking this willingness to pay, number of households and waste collection rate into account, the estimated benefit will be SP 266.2 million in 2005.
b. Effect of compost production
   The project intends to introduce a 100-tons/day compost plant, and this will initially handle 50 tons/day of waste and produce 12.5 tons/day of compost. From 2008 onwards, it is planned for the plant to handle 100 tons/day of waste and produce 25 tons/day of compost. The effects of composting can be divided into the fertilizer reduction effect, agricultural production increased income effect, and water consumption reduction effect. In economic terms, these

effects work out as SP 580, SP 1,500 and SP 500 per ton of compost respectively. It is estimated that this benefit will be SP 10.0 million in 2005 and SP 20.0 million in 2010.

c. Reusable materials recovery effect
In the project, it is planned to recover 2.5 tons/day of reusable materials at the compost plant for the foreseeable future and 5 tons/day in 2010. It is estimated that this benefit will be SP 2.3 million in 2005 and SP 4.7 million in 2010.

3) Economic Internal Rate of Return

Calculating from the above estimates of cost and benefit, the economic internal rate of return works out as 11.7, shown in Table 13.2.1.

This is a high figure for the solid waste management. Moreover, in addition to the above quantifiable effects, there are non-quantifiable effects such as reduction of final disposal quantities (75 tons/day in compost treatment) and environmental improvement at the existing disposal site. Since the existing disposal site has been the subject of numerous complaints in the past, it is judged that environmental improvement of the site will contribute to environmental improvement of Homs City overall and is a valid undertaking. Moreover, the fact that project implementation will enable waste disposal to be carried out until the new disposal site at Maghlia is ready is extremely important in terms of realizing the master plan.

14.2.1 Financial Evaluation

The results of the economic analysis indicate that the project is a viable undertaking. Meanwhile, it will be necessary to procure funds other than those from the municipality own budget to cover investment costs when actually implementing the project. Moreover, as is indicated in the master plan, it will be necessary to raise cleansing fees by 2010 in order to ensure sustained operation of the solid waste management. However, since the ratio of cleansing fees following the price increases will still only be around 1% of household income, this will not prove to be a major burden. Moreover, if the project is implemented, it will be possible to sustain the solid waste management by financing investment from 2006 onwards using 30% own funds and 70% loans.

Furthermore, the compost plant and sorting center can cover operation and maintenance costs excluding personnel expenses by means of revenue from the sale of compost and reusable materials.

Table 14.2.1 FIRR for the Priority Project

(Unit: SP million)

Year	Balance	Cost			Benefit			
		Total	Invest	Operation	Total	Willingness	Compost	Reusable
2001	0.0	0.0	0.0	0.0	0.0			
2002	-1.6	1.6	1.6	0.0	0.0			
2003	-462.1	717.1	576.3	140.8	255.0	255.0		
2004	-63.9	324.4	197.7	126.7	260.5	260.5		
2005	66.2	212.3	74.4	137.9	278.5	266.2	10.0	2.3
2006	131.5	147.0	1.6	145.4	278.5	266.2	10.0	2.3
2007	133.0	145.5	0.0	145.5	278.5	266.2	10.0	2.3
2008	45.4	245.5	96.6	148.9	290.9	266.2	20.0	4.7
2009	78.2	212.7	63.7	149.0	290.9	266.2	20.0	4.7
2010	141.7	149.2	0.0	149.2	290.9	266.2	20.0	4.7
2011	141.7	149.2	0.0	149.2	290.9	266.2	20.0	4.7
2012	46.5	244.4	95.2	149.2	290.9	266.2	20.0	4.7
2013	-112.8	403.7	254.5	149.2	290.9	266.2	20.0	4.7
2014	87.8	203.1	53.9	149.2	290.9	266.2	20.0	4.7
2015	141.7	149.2	0.0	149.2	290.9	266.2	20.0	4.7
2016	74.7	216.2	67.0	149.2	290.9	266.2	20.0	4.7
2017	141.7	149.2	0.0	149.2	290.9	266.2	20.0	4.7
2018	-86.1	377.0	227.8	149.2	290.9	266.2	20.0	4.7
2019	23.0	267.9	118.7	149.2	290.9	266.2	20.0	4.7
2020	133.7	157.2	8.0	149.2	290.9	266.2	20.0	4.7
2021	0.0	0.0	0.0					
Total	660.7	4,472.4	1,837.0	2,635.4	5,133.1	4,775.1	289.9	68.0
EIRR	11.7%							

14.3 ENVIRONMENTAL EVALUATION

Two subject projects were selected among the feasibility study projects according to proposed environmental guideline in Syria. HOMS cleansing center is proposed in existing disposal site called Dir Baalbeh. The project aims to rehabilitate the disposal site and to construct a composting plant and a transfer station, which is for a new landfill site in Maghlia. In addition, medical waste management in Homs is subject to the evaluation.

- Development of HOMS Cleansing Center at Dir Baalbeh (Composting plant, transfer station and rehabilitation of disposal site)
- Establishment of medical waste management in HOMS

Occurring smoke from the disposal site

Cemetery lies on the next land (east side)

Figure 14.3.1 Scene of the Adjacent Lands

(1) Potential Impact of Environment and Its Mitigation Measures

1) HOMS Cleansing Center at Dir Baalbeh (Composting plant, transfer station and rehabilitation of disposal site)

The project is composed of three projects namely composting plant, transfer station and rehabilitation of existing disposal site. A new landfill site is planed in Maghlia (Northwest suburb) and the landfill site will start to operate year 2006. The transfer station is used for transferring municipal waste from Homs.

a. Composting Plant and Sorting Center

In operation stage, offensive odour and surface and ground water degradation are concerned on adverse environmental impacts, however, the plants were well-facilitated design and there are fewer inhabitants there. Land use of adjacent area is mostly agriculture and cemetery is located next to the site. Thus, there is negligible impact, although it is essential that monitoring shall be done as well as other solid waste management facilities there.

b. Transfer Station

In connection with opening of the new inter-municipal landfill site, this facility starts to operate. According to the plan, the capacity is 800 tones per day and nearly the capacity is used. In other word, transfer trucks carry in and out the waste 140 times a day. It is doubt about scattering the waste, offensive odour and percolating liquid when they operate. Hence, the operation management shall be considered transferring schedule, which the trucks do not gather at same time, and loading the waste shall be appropriated and maintenance of the facility shall be sufficient.

c. Rehabilitation of Existing Disposal Site

A primary measure, soil covering, is proposed in order to avoid spontaneous combustion, scattering the waste and mitigation of the offensive odour. However, 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. Thus, the leachate management shown in section 10.1 shall be carefully considered.

2) Establishment of 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. A key issue of the management in terms of environmental mitigation is how to operate and how to maintain. Hence, proper operation and skilled staff shall be considered.

(2) 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.

14.4 SOCIAL CONSIDERATIONS

(1) Fee Collection and Low Income Groups

The project aims to build the financial base of the solid waste management based on the beneficiaries to pay principle. Accordingly, since it is important to raise cleansing fees for this purpose, the burden placed on low-income households may increase. In consideration of this, the fee collection rate is set at a low of 80%. Moreover, since households with income of no more than SP 4,000/month account for just 14% of all households, exemption of cleansing fees for low-income groups is possible.

(2) Employment Opportunities

The cleansing utility in Homs City employs 1,056 workers. In the present situation, since cooperation by citizens is scarce and there is a shortage of equipment, many personnel are engaged in primary collection and street sweeping. In the project, however, since it is intended to procure equipment and secure the cooperation of citizens in relieving the burden of primary collection, it should be possible to reduce personnel provided that sufficient cooperation is forthcoming from citizens. a However, the project intends to respect existing systems and consider additional personnel for realizing appropriate treatment and disposal in future, and therefore additional employment opportunities will be secured. For this reason, manual sorting lines are planned at the compost plant and sorting center in order to recover reusable materials.

(3) Waste-pickers

There are approximately 100 waste-pickers at the existing disposal site in Homs City and they recover plastic and metal reusable materials. In the project, it is planned to carry out separation of domestic waste into organic waste and inorganic waste at the source. Initially, it is planned to treat organic waste at the compost plant and to dispose of inorganic waste at the disposal site. Since inorganic waste contains a lot of reusable materials, efficient recovery is possible and it is thought that waste-pickers can make a contribution to the working environment. It is planned to construct a sorting center in future, and it should be possible to obtain cooperation in the building of an appropriate recovery system within this work.

Cooperation will be required from waste-pickers in order to implement earth covering and prevent environmental pollution at the final disposal sites. This is also required in order to secure safety of work. Concerning this point, it is intended to adopt a cautious approach while bearing in mind the experience gained during the Pilot Study in Lattakia.

CHAPTER 15 RECOMMENDATIONS

15.1 SYSTEM OF FEES

In order to secure the sustained operation of the solid waste management, it is necessary to procure and renew the necessary equipment and secure funds for doing this. For this reason, cleansing fees must be modified to appropriate levels. In Homs City, it is first necessary to increase the collection rate of fees from domestic users. Next, domestic fees need to be revised so that they are SP 500/year/household.

In the long term, revision of the national law on fees will be necessary, and fee systems on the national and municipal levels must be established so that around 1% of household incomes is collected.

15.2 ESTABLISHMENT OF SYSTEMS FOR EQUIPMENT RENEWAL

Apart from tractors, all waste collection vehicles and heavy machinery are imported items. Even if local governments intend to use their budgets for purchasing such equipment, they are unable to purchase and renew waste collection equipment because they have no foreign currency. Accordingly, central government subsidization is relied on for purchasing all waste collection vehicles. However, the central government is also financially restricted and can only respond to part of the need. As a result, each city in Syria is confronted with equipment shortages and deterioration.

Cities in future will need to advance fee collection that covers equipment costs including depreciation costs. This will enable them to raise funds for procuring equipment. At the same time, in order to overcome the above situation, it is necessary for local governments to cooperate in establishing a special fund for equipment renewal and setting up a system for the import and purchase of waste collection equipment with support from the Ministry of Local Government. Sources of finance and functions of this fund are as follows:

Sources of finance:

a. Accumulation of part of cleansing fee income in each municipality (for example, 5%)
b. Central government subsidies (for example, 30%)
c. Repayment by the benefiting local authorities

Roles:

a. Review of local authority purchasing plans
b. Import and distribution of cleansing equipment
c. Financial control

15.3 PROMOTION OF COMPOST USE

Composting is a common means of recycling organic waste, however, there is little point in doing this if farmers do not use the compost product. Accordingly, it is first necessary to produce good quality compost, while at the same time, farmers must

promote the utilization of compost. For this purpose, the following measures are required. Particularly in Homs City and its environs, since awareness of compost is low, it will be important for the purpose of expanding demand to spread know-how about the effects and methods of use of compost in cooperation with agricultural agencies.

a. Promotion of study and research into the effects and uses of compost
b. Dissemination of the effects and uses of compost
c. Encouragement of compost use

15.4 COOPERATION WITH SURROUNDING MUNICIPALITIES

The financial base of small and medium municipalities is fragile. Therefore, Homs City should take the initiative in cooperation with the Governorate in building an inter-municipal waste management system that incorporates these smaller municipalities. Concerning Maghlia new disposal site, transfer facilities and treatment of medical waste, in consideration of utilization by surrounding cities, it is desirable that the area as a whole tackle improvement of the sanitary environment and prevention of illegal disposal.

15.5 ESTABLISHMENT OF HAZARDOUS WASTE MANAGEMENT SYSTEM

Hazardous waste needs to be treated and disposed according to its properties. If one considers the present capacity of local authorities, it is necessary for such a treatment and disposal system to be advanced under the initiative of the central government.

PART IV

PILOT STUDY IN LATTAKIA