

## **7.2 MSWM Master Plan**

### **7.2.1 Technical System of MSWM Master Plan**

Main points of the optimum technical system for the MSWM Master Plan are described below and the outline of the system is summarized in Table 7.2.1a.

#### **a. Collection System**

The present curb collection system is a highly efficient form of collection and is considered appropriate for well developed areas like area A.

On the other hand, the container or bell collection system will be provided for area B because of the area's poor infrastructure (roads and electric cables).

The present container collection system is a highly efficient and inexpensive collection system which is considered appropriate for large generation sources such as commercial areas, markets, hospitals, institutions and factories.

Consequently, the following collection systems shall be provided:

**Area A:** Curb collection system using compactor trucks

**Area B:** Container collection system using hoist trucks or bell collection system using compactor trucks

**Large generation sources:** Container collection system using hoist trucks or compactor trucks with container

#### **b. Street Sweeping and Park and Green Area Cleansing**

Manual street sweeping and park and green area cleansing should be implemented in the Study Area to counteract the high unemployment rate.

**Detachable container type is recommended to increase collection efficiency and maintain cleanliness.**

**c. Construction of sanitary landfill in ANPLS**

The installation of water treatment facilities in ANPLS for leachate control is desirable, but because of the enormous capital it would require the following phased-measures for leachate control were proposed instead:

**Year 2000: Sanitary Landfill Level 3**

- the installation of liners for seepage control
- the installation of leachate collection, circulation and monitoring facilities.

**Year 2010: Sanitary Landfill Level 4**

- the installation of leachate treatment facilities

The measures for the improvement of the lake water quality will be focused on sewage treatment, because sewage concentration is higher than leachate, the effect of leachate is minor in comparison. Therefore, the most cost effective way to treat contaminated water entering the lake would be to construct a sewage plant, and to treat the waste leachate at the same plant, since its reduced volume will not affect the capacity or production of the plant. Financially, this will minimize the capital required for the improvement of the water quality of Lake Managua.

**d. Equipment Operation & Maintenance**

The present **Los Cocos Workshop** for the Public Cleansing Office shall be improved in order to carry out preliminary maintenance of vehicles and equipment for cleansing services.

Table 7.2.1a Outline of the MSWM Master Plan's Technical System

Item	Year	1995	2000	2010
<b>1. GENERAL</b>				
Total Population		1,127,605	1,452,900	2,069,347
Urban Area Population		877,817	1,131,053	1,610,944
Service Population		675,919	1,017,947	1,610,944
<b>2. WASTE STREAM</b>				
Generation		921.2 tons/day	1,280.4 tons/day	2,171.8 tons/day
Self-disposal		198.1 tons/day	196.4 tons/day	223.3 tons/day
Recycled Amount at Generation Sources		17.9 tons/day	26.2 tons/day	47.0 tons/day
Collection		662.5 tons/day	758.6 tons/day	1,448 tons/day
Recycled Amount (Recycling Material)		14.0 tons/day	20.1 tons/day	36.4 tons/day
Direct Haulage		43.2 tons/day	299.2 tons/day	453.5 tons/day
Final Disposal		692.3 tons/day	1,037.7 tons/day	1,865.1 tons/day
<b>3. DISCHARGE &amp; STORAGE</b>				
Type of Containers				
- Residential area A		Nylon sacks or plastic bags	Nylon sacks or plastic bags	Nylon sacks or plastic bags
- Residential area B		Open heaping	Communal containers/ Nylon sacks or plastic bags	Communal containers/ Nylon sacks or plastic bags
- Large generation sources (commercial areas, markets, hospitals, institutions, etc.)		Communal containers	Communal containers	Communal containers
- Street sweeping, parks & green areas		Open heaping	Communal containers	Communal containers
<b>4. COLLECTION &amp; HAULAGE</b>				
Collection Ratio		77 %	90 %	100 %
Service Population and ratio		675,919(77.0%)	1,017,947(90%)	1,610,944(100%)
- in Area A(%)		585,504(66.7%)	754,412(66.7%)	1,074,449(66.7%)
- in Area B(%)		90,415(10.3%)	263,535(23.3%)	536,444(33.3%)
Non-service Population and ratio		201,898(23.0%)	113,105(10%)	0(0%)

<b>Collection System</b> - Residential area (A) - Residential area (B) - Large generation sources	Curb collection Open heaping Container	Curb collection Container/Bell collection Container	Curb collection Container/Bell collection Container
<b>Collection Frequency</b> - Residential area (A) - Residential area (B) - Large generation sources	Thrice a week Irregular Everyday except holidays	Thrice a week Thrice a week Everyday except holidays	Thrice a week Thrice a week Everyday except holidays
<b>Collection Vehicles</b> - Residential area (A) - Residential area (B) - Large generation sources	Compactor trucks without public containers Wheel loaders & dump trucks Compactor trucks with public containers/Roll-on, Roll-off trucks	Compactor trucks without public containers Hoist trucks with containers/Compactor trucks without public containers Compactor trucks with public containers	Compactor trucks without public containers Hoist trucks with containers/Compactor trucks without public containers Compactor trucks with public containers
<b>Haulage System</b>	Direct; by collection vehicles	Direct; by collection vehicles	Direct; by collection vehicles
<b>Main Equipment (Unit)</b> - Compactor(15.3m <sup>3</sup> ) - Compactor with container - Hoist truck - Container (1m <sup>3</sup> ) - Container (7m <sup>3</sup> )	47 4 (4) (Roll-on Roll-off Truck) Approx.250 units(0.83 m <sup>3</sup> ) Approx.20 units(15 m <sup>3</sup> )	55 3 20 155 127	86 4 71 228 293
<b>5. STREET SWEEPING</b> Sweeping System Covered Road Length Main Equipment (Unit) - Open Truck - Container (1m <sup>3</sup> )	Manual sweeping 331 Km Combination of wheel loader and dump truck - -	Manual sweeping 350 Km 2 115	Manual sweeping 350 Km 2 116
<b>6. PARK &amp; GREEN AREA</b> Cleansing System Cleansing Area	Manual sweeping 16.7 ha	Manual Sweeping 45 ha	Manual sweeping 45 ha

<b>Main Equipment (Unit)</b>	Combination of wheel loader and dump truck		
- Hoist Truck	-	1	1
- Container (7m <sup>3</sup> )	-	4	4
<b>7. INTERMEDIATE TREATMENT</b>	None	None to be introduced	None to be introduced
<b>8. FINAL DISPOSAL</b>			
Landfill Method	Sanitary landfill Level 1: controlled tipping	Sanitary landfill Level 3	Sanitary landfill Level 4
Disposal Site	Acahualinca	Acahualinca N.P.L.S	Acahualinca N.P.L.S
Area of the Site	40 ha	93 ha.	93 ha.
Landfill Owner	Municipality	Municipality	Municipality
Distance from Main Generation Source	6.5 km	8.3 km	8.3 km
Topography	Flat	Flat	Flat
Service Area	Municipality	Municipality	Municipality
Waste Subject	Municipal and non-hazardous industrial wastes.	Municipal and non-hazardous industrial wastes.	Municipal and non-hazardous industrial wastes.
Year of Commencement	1975	1997	1997
Estimated Expiry Date	1997	2010	2010
Former Land Use	Arable land		
Future Land Use	Park	Park	Park
Working Hours	6:00 - 18:00	6:00 - 18:00	6:00 - 18:00
<b>Main Equipment (Unit)</b>			
- Bulldozer	2	5	8
- Landfill Compactor	4	3	4
- Wheel loader	0	1	1
- Dump Truck	0	2	3
- Motor Grader	0	1	1
- Wheel Excavator	0	1	1
- Water Tanker	2	1	1
- Pick-up Truck	0	2	2
<b>9. EQUIPMENT OPERATION &amp; MAINTENANCE</b>			
<b>Vehicle Depot</b>			
- location workshop	Los Cocos workshop	Los Cocos Workshop	Los Cocos Workshop
- location	Los Cocos workshop	Los Cocos Workshop	Los Cocos Workshop
- responsible organization	Public Cleansing Office (PCO)	PCO	PCO
- number of personnel	37	43	43

## 7.2.2 Institutional System of MSWM Master Plan

Main points of the optimum institutional system for the MSWM Master Plan are described below and the outline of the system is summarized in Table 7.2.2f.

### a. Administration and Organization

The future administration and organization structure for the MSWM corresponding with the optimum technical system was proposed in consideration of the following:

- i) The Municipality of Managua will remain in charge of the Solid Waste Management activities through the PCO (Public Cleansing Office), which will be partly in charge of the operational activities and also the control and supervision of the activities carried out by private enterprises.
- ii) The PCO will be directly in charge of refuse collection in poor city areas (areas not capable of paying the full cost of services provided), collection of industrial, heavy commercial refuse (including market wastes) and hospital waste - services that mainly provide the revenues of the municipality and PCO.
- iii) PCO will also conduct disposal operations (at the Acahualinca landfill), as it might become a potential PCO source of revenue.
- iv) Vehicle and equipment operation and preventive maintenance will be conducted by the Los Cocos workshop which will be placed under the jurisdiction of the PCO. Other maintenance work that cannot be accommodated in this workshop will be delegated to private workshops or the central workshop.
- v) Collection services for Area A (where residents can fully afford collection services) will be carried out by private concession. This also includes the collection of waste fees. The total amount of fee collected shall be able to cover the operation cost, including taxes, profits, etc., and the rental fee for the use of municipal trucks and other equipment. The rental fee will be used to subsidize the cost of the collection services in area B.

The street sweeping services and waste transportation services to the landfill site in this area will be carried out by the PCO.

- vi) The micro enterprise's way of supplementing collection activities in Area B may be used in the future. Although the same situation may happen, changes may still take place depending on the willingness of the residents to take the initiative and support the organization of a group of workers.

**aa. Public Cleansing Office New Organizational Chart**

Regardless of the changes in administration and organization, the existing system can be improved through the following measures:

- Better definition of responsibilities of the District Offices (DO) under the District Coordination Office (DCO), the Public Cleansing Office (PCO) under the Municipal Works and Service Head Office (MWSHO), and the Department of Environmental Education (DEE) under the Environmental Protection Head Office (EPHO).
- Better coordination in the street sweeping and dump removal activities of the PCO and DO.
- Expedite maintenance of vehicles and equipment; hiring a private workshop on a permanent basis to take care of major repair works of most needed equipment and vehicles.

In order to achieve the institutional system suggested, the organization for the PCO shown in Figure 7.2.2a was proposed.

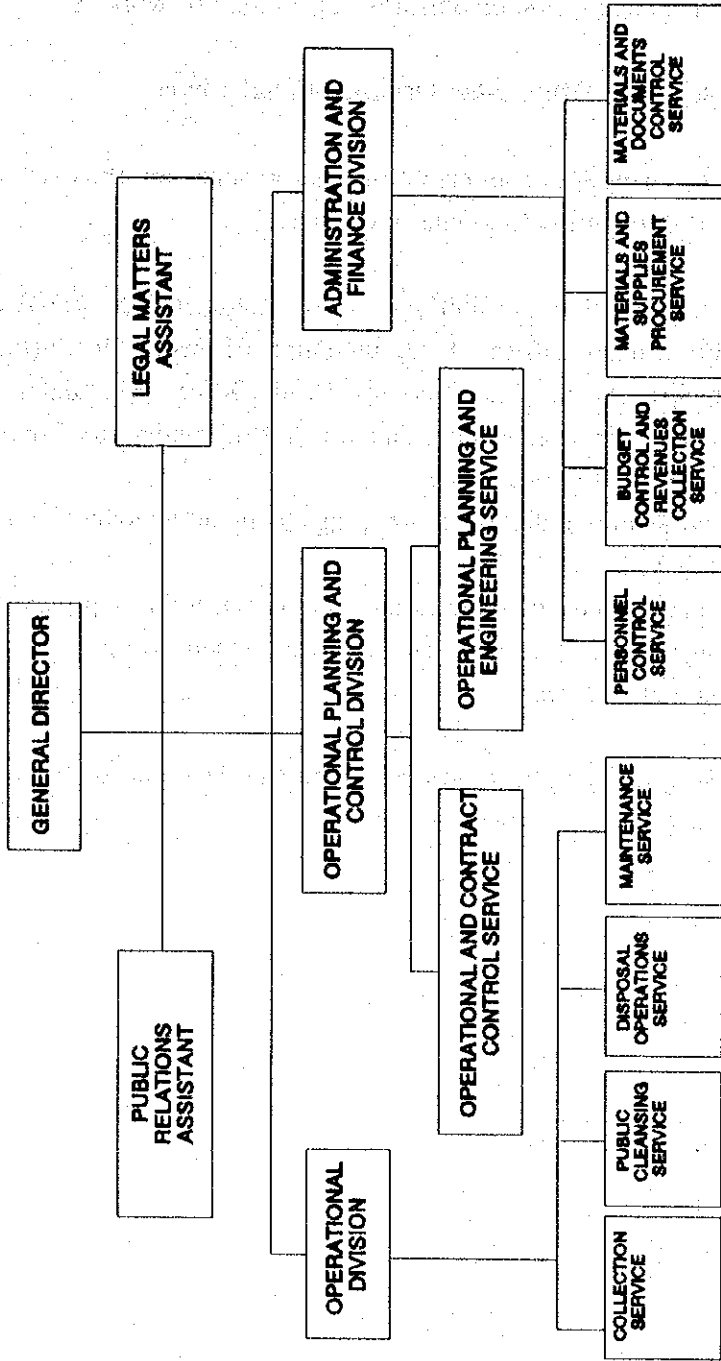


Figure 7.2.2a Proposed Organizational Chart of PCO



The main responsibilities and duties of the units in this organization are:

<b>General Director</b>	Supervision of all PCO activities, and their necessary representation
<b>Public Relations Assistant</b>	Management of all environmental education programs as well as press relations and the media.
<b>Legal Matters Assistant</b>	Supervision of all legal problems connected to the PCO, including those with employees. Acts as the director's advisor on legal matters.
<b>Operational Division</b>	Supervision of all operations (collection, disposal and street cleansing) in areas not included in the concession. The head of this division also represents the General-Director when necessary
<b>Operation Planning and Control Division</b>	Supervision of all divisional planning, control and engineering activities
<b>Administration and Finance Division</b>	In charge of all matters concerning personnel, materials, budget and revenues
<b>Collection Service</b>	Responsible for refuse collection in Area B.
<b>Public Cleansing Service</b>	Responsible for cleansing of public areas in Area A.
<b>Disposal Operations Service</b>	Responsible for operations at the Acahualinca Sanitary Landfill
<b>Maintenance Service</b>	Responsible for the activities developed at the Los Cocos workshop as well as the supervision and control of repairs in private shops.
<b>Personnel Control Service</b>	Responsible for the daily attendance of the employees, personnel records as well as internal relations in the PCO
<b>Budget Control and Revenues</b>	Responsible for control of revenues and expenses, collection of disposal fee at the Acahualinca

**Fee Collection Service** Sanitary Landfill, collection of fees for the collection of industrial, large commercial and hospital wastes, and responsible for the rental fee paid by the concessionaire.

**Materials and Supplies Control Service** Responsible for the general acquisition of parts, supplies and materials for operational, administrative and maintenance services.

**Materials and Documents Control Service** Responsible for storage and distribution of supplies and materials and for the control of document flow within the PCO

**ab. Privatization**

According to the policy of the municipality, the privatization of MSWM which should be managed by the municipality is proposed as follows:

Table 7.2.2a Proposed Privatization System

Generation sources	Executing Agency	Revenue sources for ALMA
Collection Area A	Private (Concession)	-License Fee -Rental Fee -Tipping Fee
Collection Area B	ALMA	Waste Fee (partial)
Large Generation Sources	ALMA	Waste Fee
Street Sweeping	ALMA	(Property Tax)
Direct Haulage	-	Tipping Fee

In order to realize these goals, the privatization of collection services for Collection Area A (mainly high and middle income households) will be achieved according to the following steps:

- the year 2000: 50% of households in Collection Area A will be covered by privatized services
- the year 2010:100% of households in Collection Area A will be covered by privatized services

**b. Legislation**

The establishment of proper and sound legislations on solid waste management is an urgent matter for Managua, since there are no Sanitation Codes particularly

dealing with this subject. The Public Cleansing Code shall basically define the different types of wastes produced in the city and determine the responsibility and means for storage, transportation, treatment and disposal of each waste category.

The section delegated with the above responsibilities shall define the duties not only of the citizenry, but also of the municipal government. It shall also specifically determine violations of the Code, rating their magnitude, establishing the corresponding fines to be imposed, and most importantly, assign somebody to supervise these duties.

Prior to the enforcement of the Code, an education program will be carried out to inform the public of their rights and duties.

The effect of the enforcement of the sanitation code program will be evaluated jointly by the Municipality of Managua, the Health Ministry and the national police, and the results shall be used as bases for the preparation of the Public Cleansing Code.

#### **c. Training Program**

A much needed training program shall be prepared for all levels of management in the Public Cleansing Office. The number of personnel to be trained and the type of courses to be offered will be determined before commencing the training program, as well as the people to supervise the program and the courses. The organization and planning of this training program should be consigned to an institution specializing in this field.

Accordingly, INATEC (Instituto Tecnológico Nacional) was initially recommended. INATEC is an autonomous but government affiliated institution in Nicaragua administered by 4 members: 2 representatives of a private enterprise and 2 representatives of the government.

INATEC deals either with formal training as with assistance programs such as the creation and development of micro enterprises among the poor inhabitants of the country, professional rehabilitation projects, housing construction, etc. The training program for Solid Waste Management is recommended not only for the city of Managua but nationwide.

Finally, established professionals are also recommended to attend the specialized courses on solid waste management offered in other Latin American countries and elsewhere by the Pan American Health Organization, the chapter on solid waste of

The Inter-American Environmental and Sanitation Association and other specialized institutions.

**d. Public Cooperation**

In order to gain acceptance for the proposed solid waste system, the formulation of a public education program is imperative. The need for a sanitary and efficient system should be made clear to the public. The most effective public cooperation is attained voluntarily through informative, educational, and persuasive measures. Public cooperation can be obtained through the following:

- Public relations and communication
- Good relations through effective SWM
- Public education
- Handling complaints

**da. Public Relations and Communications**

Public relations are methods and activities that should be employed by the municipality to promote a favorable relationship with the public.

Residents are to be informed about SWM i.e. magnitude of the problem, costs, organization of the system, collection schedules and their deviations, rules for collection and penalties, new methods of waste disposal, etc..

**db. Good Relations Through Effective SWM**

All municipal employees are obliged to be courteous and polite to the public who are in effect customers. Solid waste collectors, in particular should be more polite as they have more direct contact with residents than those working in other sections. This calls for proper training of the employees to conduct waste collection and thus eliminating complaints and promoting better public relations. The employees should look presentable, be courteous and answer in clear and definite terms whatever queries are put to them. The language and the tone of voice used by the workers should be considerate.

#### **dc. Public Education**

The carelessness and thoughtlessness of citizens and their disregard for even the simplest rules of cleanliness and sanitation, is reflected in littered streets, alleys, parks, vacant lots, and even private premises. This tends to produce an untidy appearance throughout the community and a general lowering of public morale.

While ordinances, rules, regulations, and penalties have their rightful place in a solid waste management plan, their enforcement leaves much to be desired. It has been found that as a part of the public communication program, a much easier and more sensible solution is to secure public cooperation through public education.

The following public education programs will be considered:

- Citizen groups, such as the church, chamber of commerce, women's institutes, boy scouts etc.
- Public education through the media, such as newspapers, television etc.
- Seasonal clean-up campaigns
- Education programs for school children
- Clean-up campaigns include sanitation parades, decoration with pro-cleanliness posters, and trash baskets, reminders for the public to keep their city clean.

Public education should be related to enforcement; prosecution often is reserved for cases involving habitual violations which could result in health hazards and public nuisances. However, every effort should be made to remind residents of their obligations to cooperate with the municipality in the operation of the solid waste management program.

#### **dd. Handling Complaints**

The number of complaints are often indicators of how successful a city's cleansing services are conducted: positive criticisms often pave the way towards an improved implementation of these services.

#### **de. Establishment of Community Organizations for Improvement of Sanitary Conditions**

In squat areas, community participation is an important issue for the successful implementation of the collection system.

In these areas the residents are forced to live without basic public services, and the

lack of waste collection service creates many registered illegal dump sites in various places. The residents of these areas have economic limitations; malnutrition is common especially in infants and access to preventive medicine is low. In addition, basic knowledge of public health is low in squat areas due to lack of education.

Generally speaking, providing collection services to these areas is not a top priority as other matters must be attended to such as legalization of land tenure, improvement of housing facilities, drinking water, electricity, unemployment etc..

However, it is advisable to combine the collection project with another equally important one, thereby forming an attractive package. Those sanitary improvement activities should be carried out through community organization.

**e. Financial Plan**

**ea. Basic Concept**

The financial plan required to attain the targets of the MSWM Master Plan was examined according to the process shown in Figure 7.2.2b.

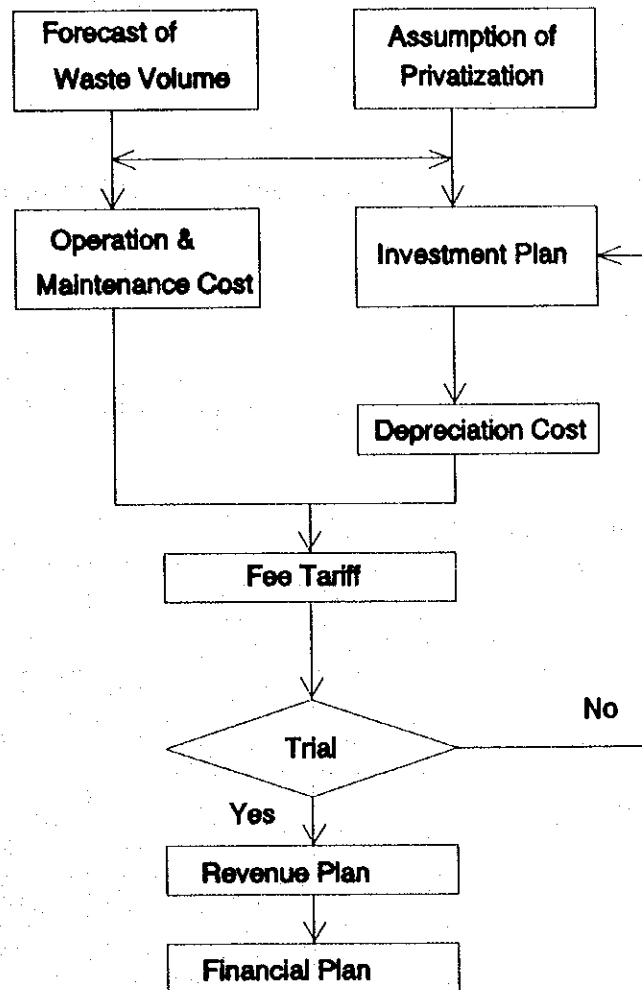


Figure 7.2.2b Financial Planning Process

**eb. Expenditure Plan**

The MSWM expenditure mainly consists of O&M, depreciation and investment cost.

**eba. Major Assumptions**

In order to estimate the MSWM expenditure, the following assumptions were established.

**i. O&M Cost**

- O&M cost for 1995, 2000 and 2010 is estimated below based on the 1995 unit cost;

Table 7.2.2b MSWM O & M Cost

	Total Cost (C\$million)			Unit Cost (C\$/ton)		
	1995	2000	2010	1995	2000	2010
Collection	9.59	14.04	22.85	56.2	50.7	43.2
Public Area Cleansing	7.02	5.26	5.26	1074.5	679.8	679.8
Final Disposal	0.68	5.99	12.32	2.7	15.8	18.1
Workshop	0.27	1.02	1.02	1.6	3.7	1.9
Promotion	0.00	0.67	0.74	0.0	2.4	1.4
Total	17.57	26.98	42.19	102.9	97.4	79.8

- The annual operation and maintenance cost, consisting of the fuel and lubricant, maintenance fees such as parts etc., and personnel expenses, was calculated considering the partial privatization of collection services.
- The operation and maintenance cost of collection services under private concession is assumed to be 30% less than the Municipality's.
- 50 % and 100% of the waste collection services in collection area A is assumed to be privatized in 2000 and 2010, respectively.

**ii. Depreciation cost**

- The depreciation costs of equipment and facilities are derived by dividing the investments by the life span defined in Table 8.1.1c.



### iii. Investment plan and resources

- It is assumed that the investment for collection services will be financed by loans and foreign subsidies from 1998 to 2000 to cope with the whole collection volume in 2000. After 2001, the municipality will purchase collection vehicles in accordance with the yearly increase in waste amount. Private companies will also purchase collection vehicles for efficient collection and haulage services. In this estimation, the collection activities of private companies are assumed to be 30% more efficient than that of the municipality.
- The assumed investment for the disposal site is divided into the following 3 stages:
  - 1998-1999 Initial earthworks necessary to set up the sanitary landfill and earthworks for a disposal area that can accommodate about half of the Master Plan waste volume.
  - 2003-2005 The earthworks for a disposal area that will accommodate the other half of the Master Plan waste amount.
  - 2008-2010 Construction of section III in ANPLS whose capacity will be able to accommodate 2.1 million cubic meters of waste three years after 2010. Also leachate treatment facilities will be installed to up- grade the sanitary landfill to level 4.
- It is assumed that the initial purchase cost from 1998 to 2000 of collection vehicles for the expansion of collection services in Collection Area B will be financed through foreign subsidies. The replacement of vehicles (27 compactors) granted before this study will be financed by the Municipality. After 2001, the Municipality of Managua and Concessionaires will finance the cost for the repair of collection vehicles and the purchase of new ones.
- The construction cost of the sanitary landfill in the first phase will be divided between the foreign counterpart and the Municipality of Managua. The share of the foreign counterpart is assumed to be 80%, including the cost for the purchase of heavy equipment.
- Loans will be made under the following conditions to finance the purchase cost of collection vehicles for Area A and commercial areas.

Repayment terms - 10 years with a 3 year grace period

Interest - 8 % per year

- The Municipality of Managua will finance the equipment for street cleansing and the maintenance of parks and green areas.

**ebb. Expenditure Plan**

O&M, depreciation, and investment costs were estimated and summarized in Table 7.2.2e.

**ec. Revenue Plan**

**eca. Revenue Sources**

In order to secure an independent financial resource for the cleansing services proposed in the Master Plan for the year 2010, the following should be considered:

- Establishment of a "Beneficiary-Pay Principle"
- Imposition of fees in accordance with the economic standing of the residents
- Appropriate allocation of budget from the general budget of the municipality.

The revenue sources and money flow system of fee collection are shown in Figure 7.2.2c.

The partial payment of fee will be imposed even on Area B, which is basically economically impoverished, in accordance with the Beneficiary-Pay Principle. The remaining cleansing expenses will be covered by the municipality, area A and large generation sources (cross subsidy).

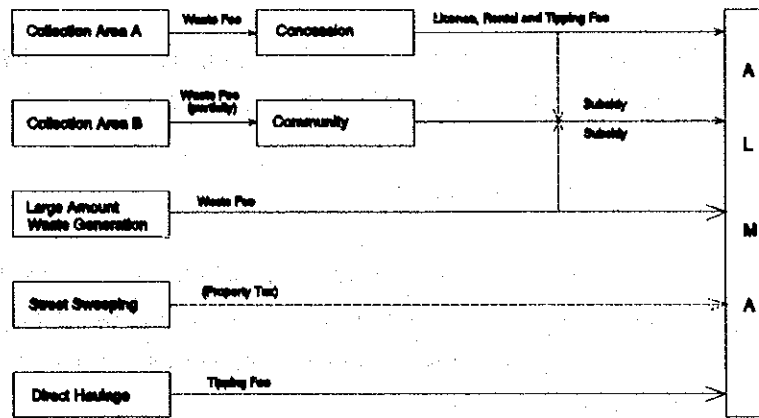
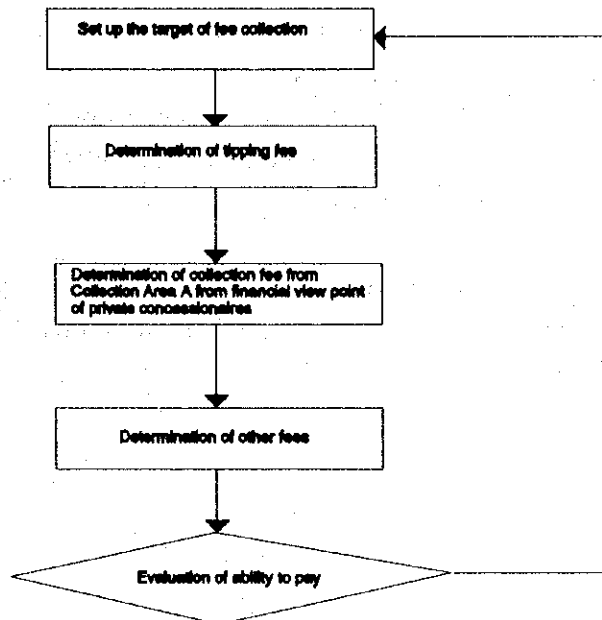


Figure 7.2.2c Revenue Sources and Money Flow System of Fee Collection

**ecb. Fee Tariff**

The fee tariff will be determined by the following steps:



**first step: Set up the target collection fee**

- The collection rate will be drastically increased from 10 – 95% within four or five years. The target collection rate for 2000 and 2010 is set at 95%.

**second step: Determination of tipping fees**

- Tipping fees will be imposed to cover the whole costs from 2000 to 2006 needed to maintain the sanitary landfill, including the operation and maintenance costs, depreciation costs and management costs. Loan interests will be taken into account after 2007.

**third step: Determination of collection fee**

- In this trial calculation, the total cost from 2001 to 2010 is taken into account, including the operation costs, tipping fees, rental fees of vehicles, license fee, loan interests (12.5 % in real term) and taxes. Although the services offered by private companies are efficient, they are more expensive than the services offered by the municipality.

**fourth step: Determination of other fees**

- After 2000, the fees imposed on residents will go up in order to cover the operation and maintenance costs.
- A unit cost will be established for fee collection in commercial areas and companies, in consideration of the future fee collection system which will be based on discharged waste volume.

The fee tariff estimated from the above mentioned trial calculation is shown in Table 7.2.2c. The fee collection ratio established and used for the calculation is shown in 7.2.2d.

Table 7.2.2c Fee Tariff

Description	1995	2000	2005	2010	1995	2000	2005	2010	
Waste Fee	Collection Area A (C\$/month/meter)				Collection Area B (C\$/month/household)				
	Residential (A)	3.00	6.57	7.56	8.92	64.3	140.8	161.9	191.1
	Residential (B)	2.00	4.38	5.04	5.94	23.8	52.1	59.9	70.7
	Traditional	1.00	2.19	2.52	2.97	10.0	21.9	25.2	29.7
	Popular	0.75	1.64	1.89	2.23	7.5	16.4	18.9	22.3
	Collection Area B (C\$/month/household)								
	Bell Collection	2.00	4.38	6.50	8.00				
	Container Collection	1.00	2.19	3.25	4.00				
	Commercial & Companies (C\$/ton)								
	Collection	175.1	612.2	655.1	741.3				
Tipping Fee	Direct Haul				2.7	99.2	99.2	112.3	

\* : Waste fee includes tipping fee

Table 7.2.2d Fee Collection Ratio (%)

	1994	2000	2010
Collection Area A			
- Residential (A)	52	95	95
- Residential (B)	55	95	95
- Traditional	10	95	95
- Popular	10	95	95
Collection Area B			
- Bell Collection	0	50	95
- Container Collection	0	50	95
Commercial & Companies	100	100	100

**ecc. Revenue Plan**

Revenue plan examined based on the fee tariff was summarized in Table 7.2.2c.

**ed. Financial Plan**

Financial plan estimated from expenditure and revenue plan is shown in Table 7.2.2e.

Table 7.2.2e Financial Plan (ALMA)

(unit: mill. C\$)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>1. Expenditures</b>																
1.1 O&M Costs	17.57	18.27	19.06	21.19	22.81	23.41	23.68	23.86	24.37	24.63	24.27	24.01	23.20	24.04	25.14	29.46
1.2 Investment	0.00	0.00	0.00	95.90	103.77	75.42	2.10	2.00	58.81	58.13	67.83	52.43	34.51	102.89	106.30	100.19
Sub-total (1)	17.57	18.27	19.06	117.09	126.58	98.83	25.78	25.86	83.18	82.76	92.10	76.44	57.71	126.93	131.44	129.65
<b>2. Costs</b>																
2.1 O&M Costs	17.57	18.27	19.06	21.19	22.81	23.41	23.68	23.86	24.37	24.63	24.27	24.01	23.20	24.04	25.14	29.46
2.2 Depreciation	0.00	0.00	0.00	4.71	9.77	46.15	46.43	46.79	47.43	47.93	47.50	50.75	48.83	50.25	52.24	54.17
2.3 Interests etc	0.00	0.31	0.00	0.00	0.00	0.00	6.03	6.03	6.03	5.17	4.31	3.45	2.59	1.72	0.86	0.00
Sub-total (2)	17.57	18.58	19.06	25.90	32.58	69.56	76.14	76.68	77.83	77.73	76.08	78.21	74.62	76.01	78.24	83.63
<b>3. Revenues</b>																
3.1 Waste Fee	8.04	12.54	14.75	17.13	19.49	45.87	47.02	45.76	45.86	45.89	49.62	49.26	48.78	49.78	50.84	59.20
3.2 Revenues from Private Concessionaires	0.00	0.00	0.00	0.00	0.00	11.59	12.88	14.22	15.65	17.13	23.13	25.25	19.61	22.00	24.67	40.99
3.3 ALMA Budget	7.02	7.02	7.02	7.02	7.02	19.21	19.97	20.76	21.60	22.47	18.04	18.63	19.05	20.62	21.72	13.24
Sub-total (3)	15.06	19.56	21.77	24.15	26.51	76.67	79.87	80.74	83.11	85.49	90.79	93.14	87.44	92.04	97.23	113.43
4. Balance = (3)-(2)	-2.51	0.98	2.71	-1.75	-6.07	7.11	3.73	4.06	5.28	7.76	14.71	14.93	12.82	16.03	18.99	29.80
<b>5. Investment Resources</b>																
5.1 Foreign Aid	0.00	0.00	0.00	85.19	93.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.2 Loan	0.00	0.00	0.00	0.00	0.00	75.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.3 ALMA Capital Budget	0.00	0.00	0.00	10.70	10.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.4 Reserved Funds	0.00	0.00	0.00	0.00	0.00	0.00	2.10	2.00	58.81	58.13	67.83	52.43	34.51	102.89	106.30	100.19
5.5 Sub-total	0.00	0.00	0.00	95.89	103.77	75.42	2.10	2.00	58.81	58.13	67.83	52.43	34.51	102.89	106.30	100.19

Table 7.7.2f Outline of the MSWM Master Plan's Institutional System

Items	Year	1995	2000	2010
<b>1. GENERAL</b>				
Total Population		1,071,868	1,452,900	2,069,347
Urban Area Population		834,427	1,131,053	1,610,944
Service Population		642,100	1,017,947	1,610,944
<b>2. ADMINISTRATION AND ORGANIZATION</b>				
Responsible Organization		Public Cleansing Office	Public Cleansing Office	Public Cleansing Office
Organization Chart		Refer to ANNEX F.3	Refer to M/R Chapter 7	Refer to M/R Chapter 7
Number of Personnel				
- Administration		Administration 19	54	54
		Planning & Manage 2		
		Inspection 12		
- Collection & Haulage		Collection 221	190	204
- Public Area Cleansing		Street Sweeping 206	369	369
		Park & Green 35		
- Final Disposal		Final Disposal 20	31	36
- Equipment Maintenance		Equipment Mainte. 24	43	43
<b>TOTAL</b>		<b>539 persons</b>	<b>687 persons</b>	<b>706 persons</b>
Type of Management				
- Collection & Haulage Area A		Municipality(PCO)	Municipality(50%), Concession(50%)	Concession(100%)
Area B		-	Municipality(PCO)	Municipality(PCO)
Large Generation Sources		Municipality(PCO)	Municipality(PCO)	Municipality(PCO)
- Street Sweeping		Municipality(DO)	Municipality(PCO)	Municipality(PCO)
- Final Disposal		Municipality(POO)	Municipality(PCO)	Municipality(PCO)
- Equipment O&M		Municipal(PCO)	Municipality(PCO)	Municipality(PCO)
- Public Relation Assistant		-	Municipality(PCO)	Municipality(PCO)
- Budget Control		-	Municipality(PCO)	Municipality(PCO)
<b>3. FINANCE</b>				
Budget (million C\$)				
- for the whole municipality		205.2	273.4	414.9
- for MSWM		17.6	69.6	80.3
Collection & Haulage		9.6	27.2	30.1
Public Cleansing Service		7.0	5.8	5.8
Disposal		0.7	34.3	42.1
Workshop		0.3	1.5	1.5
Promotion		0.0	0.8	0.8
- unit cost(C\$/ton)				
Collection & haulage		56.2	98.2	56.9
Public Cleansing Service		1071.4	753.4	753.4
Disposal		2.8	90.4	61.8
Workshop		1.6	5.5	2.9
Promotion		0.0	2.7	1.6
State of Cadastre Registration		Incomplete	Completed	Completed
Fee Charging				
- Collection area A		Waste fee depends on the frontal length of the premises	Waste fee is collected by the concessionaire	Waste fee is collected by the concessionaire
- Collection area B		(No collection service)	Waste fee and subsidy from Municipality	Waste fee and subsidy from Municipality
- Large generation sources		Waste fee	Waste fee based on the volume of the waste	Waste fee based on the volume of the waste,
- directly hauled to disposal site		no charge	tipping fee based on the amount of the waste	tipping fee based on the amount of the waste

Items	Year	1995	2000	2010
<b>4. PRIVATIZATION</b>		Not established	Semi-privatization	Semi-privatization
Method of Privatization	-		Concession	Concession
Work Share of Private Contractor	-		50% of Area A	100% of Area A
<b>5. REGULATION &amp; GUIDELINES</b>		None		
For Littering			Public Cleansing Code	Public Cleansing Code
For Storage, Discharge and Collection			Solid Waste Management Code <SWM Code>	Solid Waste Management Code <SWM Code>
For Final Disposal			Solid Waste Management Code <SWM Code>	Solid Waste Management Code <SWM Code>
<b>6. PUBLIC COOPERATION</b>		None		
Responsible Organization			Public communications assistant	Public communications assistant
Method of Public Education			by using VIDEO set	by using VIDEO set

### 7.3 Phased Implementation Plan

#### 7.3.1 Examination of Implementation Plan

The Master Plan shall cover a period of 15 years, from 1995 to 2010. Upon consideration of the limited resources of the municipality for SWM, the goal of the Master Plan shall be pursued in a stepwise manner.

The plan was divided into the following three stages and the target year was finalized during the meeting concerning the Inception Report which was carried out with the Nicaraguan Coordinating Committee.

Table 7.3.1a Target Years

Plan	Period
Master Plan	1995 - 2010
- Medium Term Improvement Plan	2001 - 2010
- Short Term Improvement Plan for Feasibility Study	1997 - 2000
- Immediate Improvement Plan	present - 1996



**a. Targets in each Implementation Period**

The targets established for each implementation period are shown in Table 7.3.1b.

**Table 7.3.1b Targets and Implementation Period**

Targets		Implementation Period
1.	<b>Immediate Improvement Plan</b>	Present – 1996
1.1	<b>Technical Improvement</b> <ul style="list-style-type: none"> <li>- To improve collection efficiency</li> <li>- To establish the system for collection area expansion</li> <li>- To establish the system for the sanitation of the area</li> <li>- To sanitize the present Acahualinca disposal site</li> <li>- To execute public education programs on sanitation</li> </ul>	
1.2	<b>Institutional Improvement</b> <ul style="list-style-type: none"> <li>- Settlement of the new section in PCO to follow up the pilot projects</li> <li>- Increase waste fee collection ratio</li> <li>- Starting the planning and control process</li> <li>- Establishment of a training program for staff</li> <li>- Establishment of supervision structure for illegal dumping of waste</li> <li>- Initiation of administrative improvements</li> </ul>	
2.	<b>Short Term Improvement Plan</b> <ul style="list-style-type: none"> <li>- To attain 90% collection service</li> <li>- To start sanitary landfill with leachate circulation (Level 3)</li> <li>- To improve workshop</li> <li>- To establish sanitary education program</li> </ul>	1997 – 2000
3.	<b>Medium Term Improvement Plan</b> <ul style="list-style-type: none"> <li>- To attain 100% collection service</li> <li>- To start sanitary landfill with leachate treatment (Level 4)</li> </ul>	2001 – 2010

**b. Concrete Measures**

**ba. Concrete Measures to attain the Targets of the Immediate Improvement Plan**

Table 7.3.1c shows the concrete measures to be taken in order to attain the targets of the Immediate Improvement Plan. The effectivity of these measures were confirmed in the pilot projects conducted during the 3rd field survey in Nicaragua.

**Table 7.3.1c Concrete Measures to attain the Targets of the Immediate Improvement Plan**

Targets (Improvement)	Concrete Measures
<p><b>1. Technical Improvement</b></p> <p>1.1 To improve collection efficiency</p> <p>1.2 To establish the system for collection area expansion</p> <p>1.3 To establish the system for the sanitation of the area</p> <p>1.4 To sanitize the present Acahualinca disposal site</p> <p>1.5 To execute public education programs on sanitation</p>	<ul style="list-style-type: none"> <li>- By using data obtained from truck scale</li> <li>- Through organization of community associations and promotional activities by the District Office</li> <li>- Establishment of waste fee collection system by community in squat areas</li> <li>- Through organization of community associations and promotional activities by the District Office;</li> <li>- Establishment of funds to improve area condition, i.e. roads and drains</li> <li>- Construction of dike</li> <li>- Improvement of approach road</li> <li>- Transfer of techniques, i.e., daily waste covering, construction of gas removal facility</li> <li>- Education program on sanitation using videos and booklets</li> <li>- Promotional activities by the District Office and Environmental Protection Head Office</li> </ul>
<p><b>2. Institutional Improvement</b></p> <p>2.1 Settlement of the new section in PCO (Public Cleansing Office) to follow up the pilot projects</p> <p>2.2 Increase waste fee collection ratio</p> <p>2.3 Starting the planning and control process</p> <p>2.4 Establishment of a training program</p> <p>2.5 Establishment of supervision structure for illegal dumping of waste</p> <p>2.6 Initiation of administrative improvements</p>	<p>These activities can be carried out by the existing municipal staff, provided that training is supplied and proper support is given by the Managua municipal authorities.</p>

**bb. Concrete Measures to attain the Targets of the Short Term Improvement Plan**

Table 7.3.1d shows the concrete measures for the attainment of the short term improvement plan targets.

**Table 7.3.1d Concrete Measures to attain the Targets of the Short Term Improvement Plan**

Targets		Concrete Measures	
1.	To attain 90% collection service	-	Provision of cleansing equipment of good quality
		-	Improvement of the collection and public area cleansing system
2.	To start sanitary landfill with leachate circulation (Level 3)	-	Construction of the Acahualinca newly proposed landfill site (ANPLS)
		-	Installation of the leachate circulation facilities
		-	Operation of sanitary landfill (Level 3)
3.	To improve maintenance capability	-	Improvement of present Los Cocos workshop for maintenance of cleansing equipment
4.	To establish public education programs on sanitation	-	Promotion of public cooperation and participation using materials on sanitation

**bc. Concrete Measures to attain the Targets of the Medium Term Improvement Plan**

Table 7.3.1e shows the concrete measures for the attainment of the medium term improvement plan targets.

**Table 7.3.1e Concrete Measures to attain the Targets of the Medium Term Improvement Plan**

Targets		Concrete Measures	
1.	To attain 100% collection service	-	Provision of cleansing equipment of good quality
2.	To start sanitary landfill with leachate treatment (Level 4)	-	Installation of the leachate treatment facilities
		-	Operation of sanitary landfill (Level 4)

**7.3.2 Phased Implementation Plan**

To accomplish the targets set for each phase, the concrete measures above mentioned will be pursued in a stepwise manner, taking into account the financial situation, financial burden of the citizens, and the nature of the project.

The phased implementation plan to achieve the MSWM Master Plan for the Municipality of Managua is summarized and illustrated in Figures 7.3.2a , 7.3.2b.

1. The first part of the document is a list of names and titles, including the names of the authors and the titles of their works. This list is organized in a structured manner, likely serving as a table of contents or a directory for the document's contents.

2. The second part of the document contains a series of numbered entries, each corresponding to a specific item or topic. These entries are arranged in a list format, providing a clear and organized overview of the document's structure. The numbering likely indicates the sequence or order of the items being discussed.

3. The third part of the document appears to be a detailed description or explanation of the items listed in the previous sections. This section provides the necessary context and information to understand the significance and content of each item. It may include references to other works or sources, as well as detailed descriptions of the items themselves.

4. The final part of the document is a concluding section, which may contain a summary of the key points discussed throughout the document. This section serves to tie together the various elements and provide a final perspective on the overall content. It may also include any necessary acknowledgments or references to the sources used in the document.

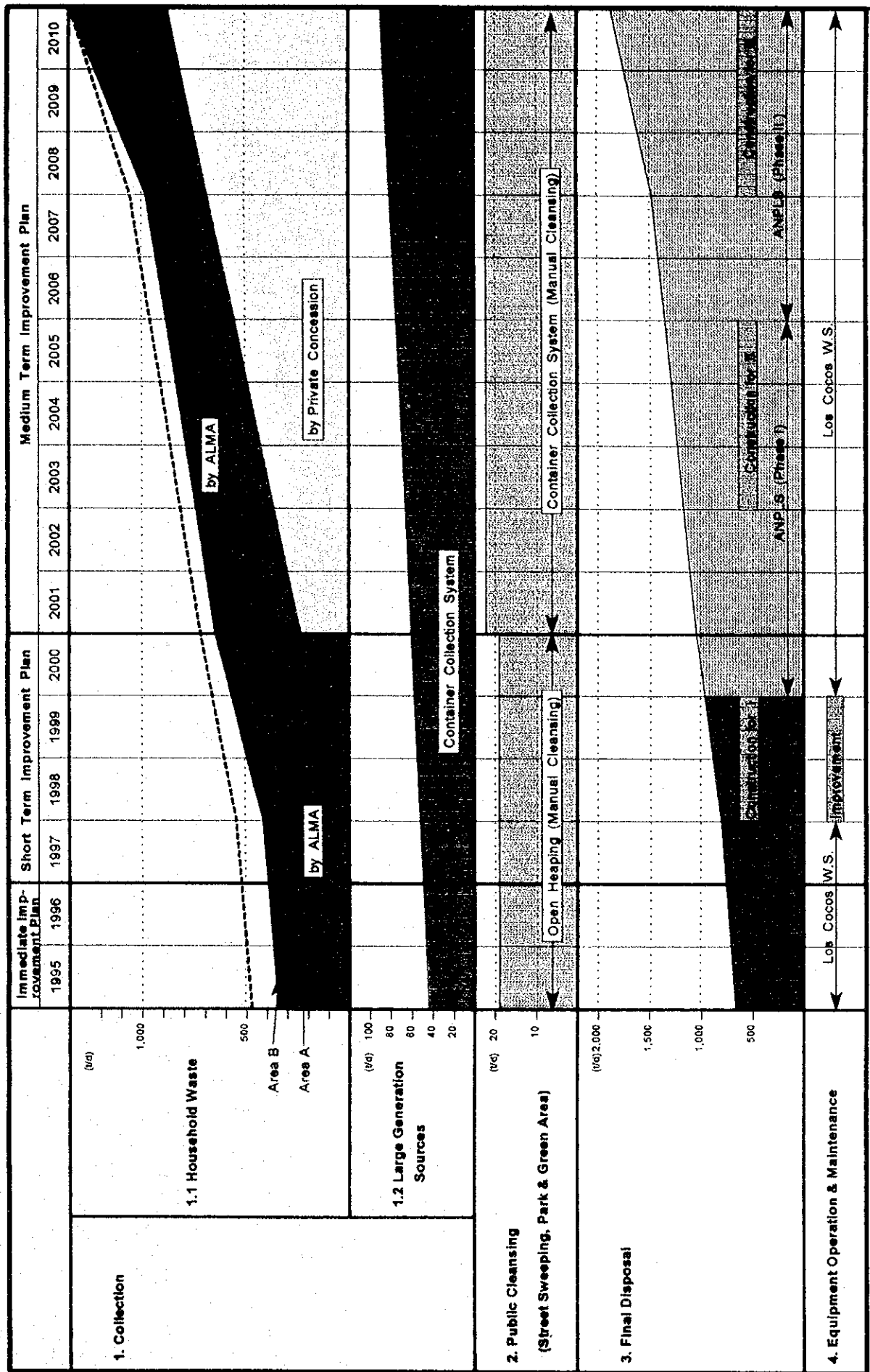


Figure 7.3.2a Phased Implementation Plan for Technical System of MSWM Master Plan

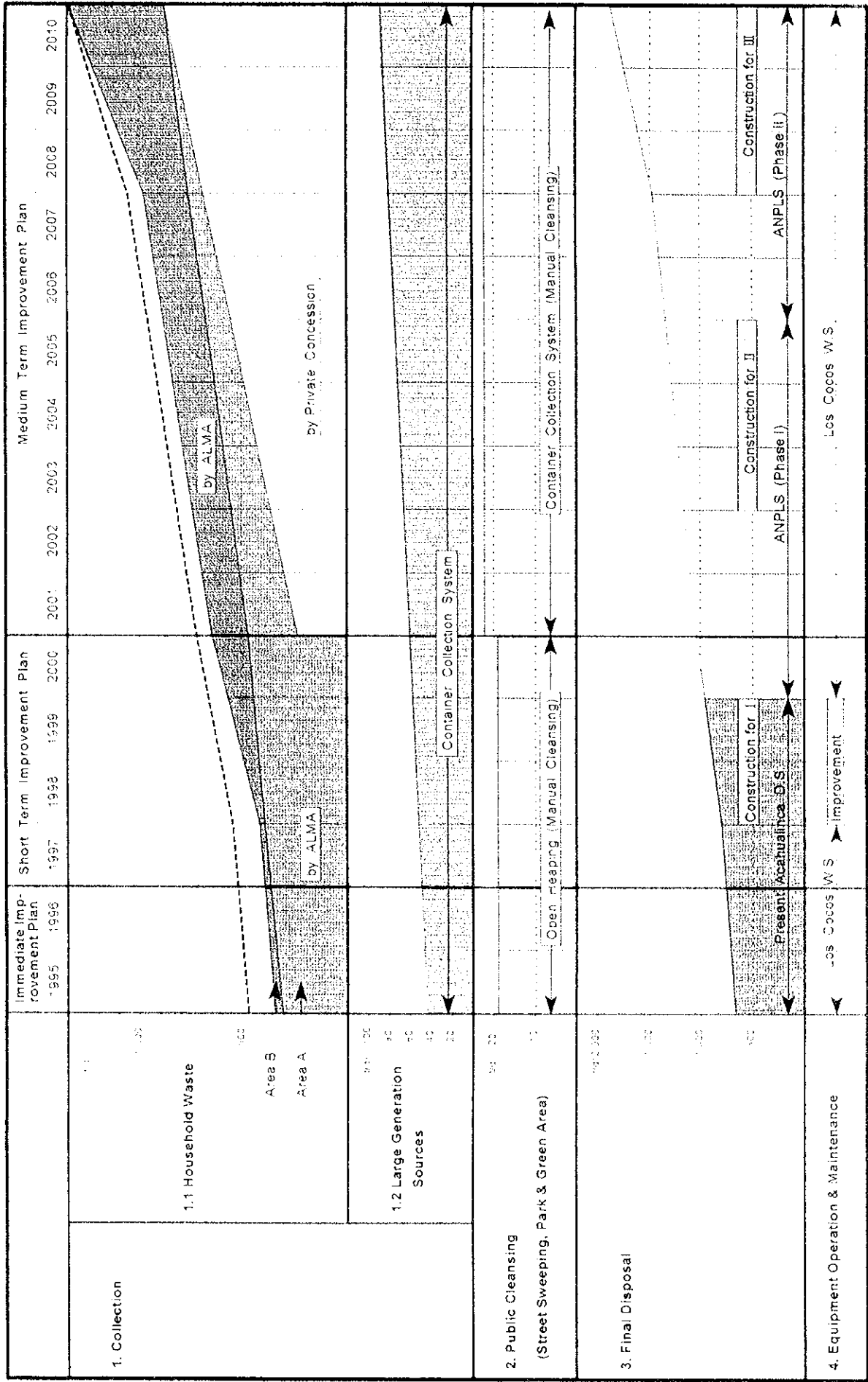


Figure 7.3.2a Phased Implementation Plan for Technical System of MSWM Master Plan



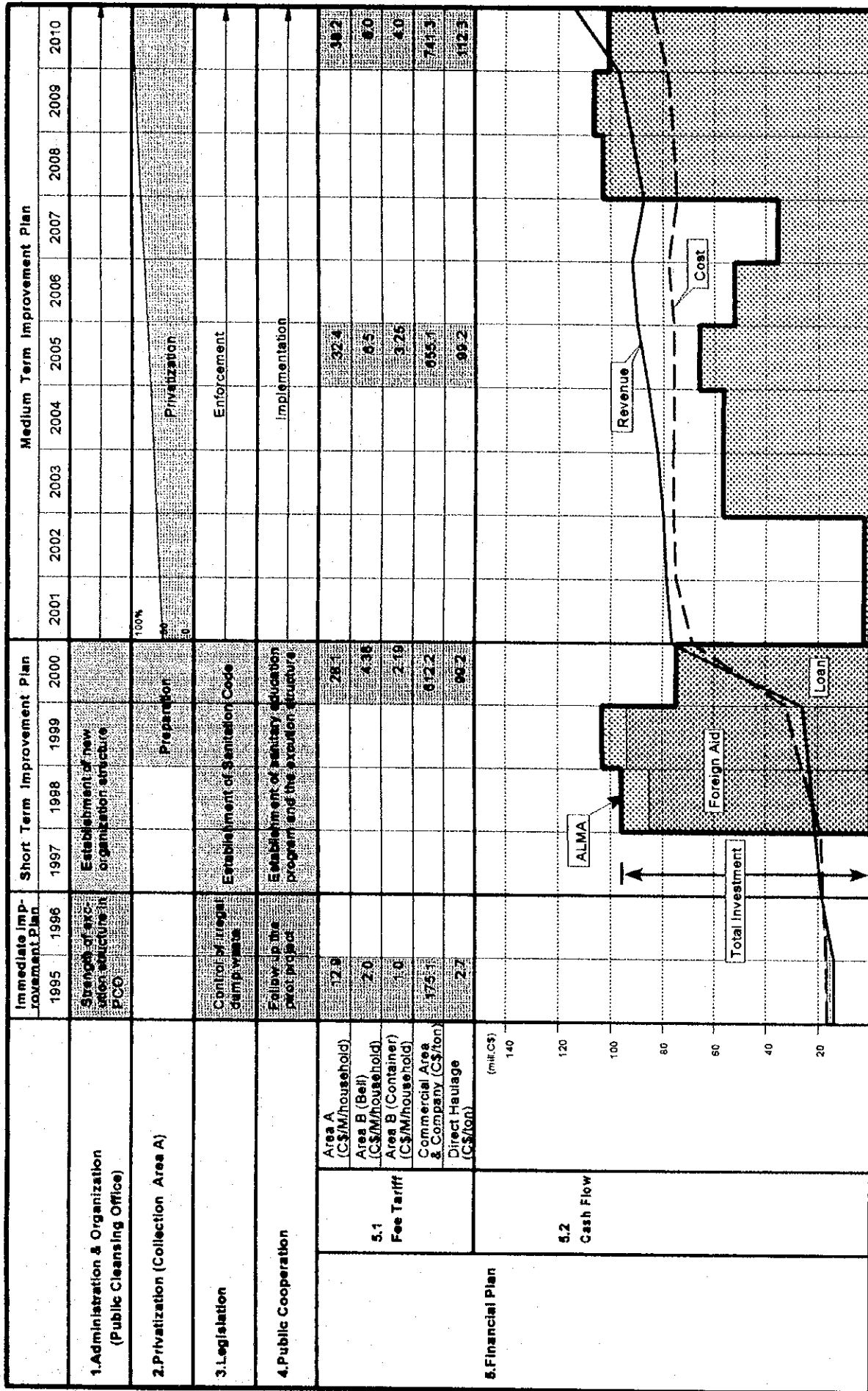


Figure 7.3.2b Phased Implementation Plan for Institutional System of MSWM Master Plan



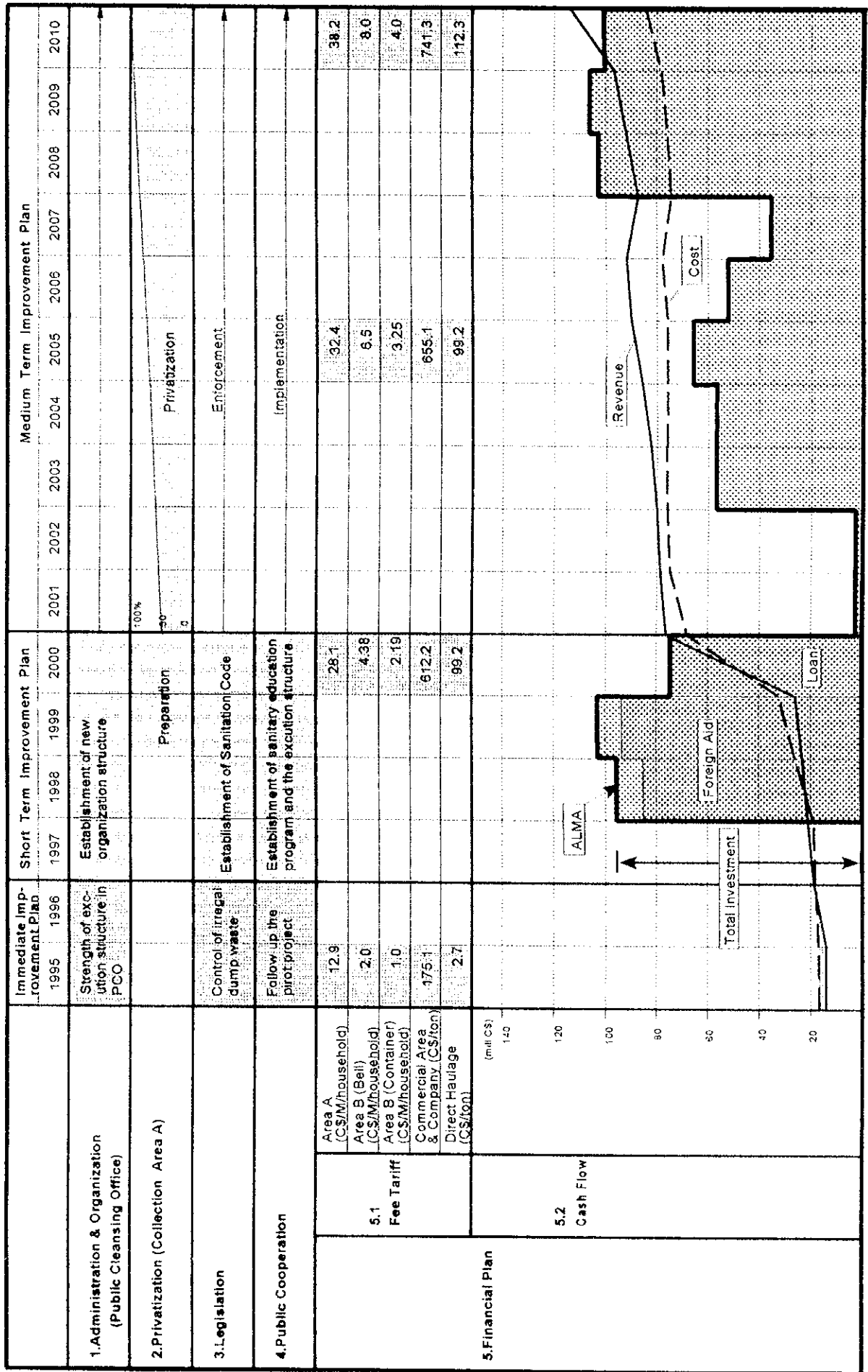


Figure 7.3.2b Phased Implementation Plan for Institutional System of MSWM Master Plan



# **CHAPTER 8**

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## **PILOT PROJECTS**



## **CHAPTER 8 PILOT PROJECTS**

*This chapter describes the pilot projects, i.e. collection experiment, sanitary landfill experiment, and public education campaign.*

### **8.1 Objectives of the Experiments**

Pilot projects were carried out according to the following objectives:

- to determine the feasibility of the proposed Master Plan
- to establish a more practical plan
- to demonstrate upgraded services and environmental improvement impacts
- to obtain the basic data for the preliminary design of the F/S

Based on the discussion between the Coordinating Committee and the Study Team, the following pilot projects were proposed and implemented for the second phase of the study project:

- Collection Experiment
- Sanitary Landfill Experiment
- Public Education Campaign

### **8.2 Collection Experiment**

#### **8.2.1 Background**

##### **a. Present Waste Collection Services**

Collection services cover 77.0% of the urban area of Managua City, while non-collection areas make up the remaining 23.0%.

The collection area is divided into areas A and B according to the system of collection. In Collection Area A, the curb collection system is practiced: compactor trucks (15.3m<sup>3</sup>) collect the wastes discharged by residents in front of their premises. In contrast to Area A, Area B is predominantly made up of slums

and has poor infrastructure and wastes are discharged in registered illegal dump sites and collected by municipal wheel loaders and dump trucks.

The non-collection area is mainly composed of temporary settlements as in Collection Area B, and wastes are not collected in this area due to lack of suitable equipment.

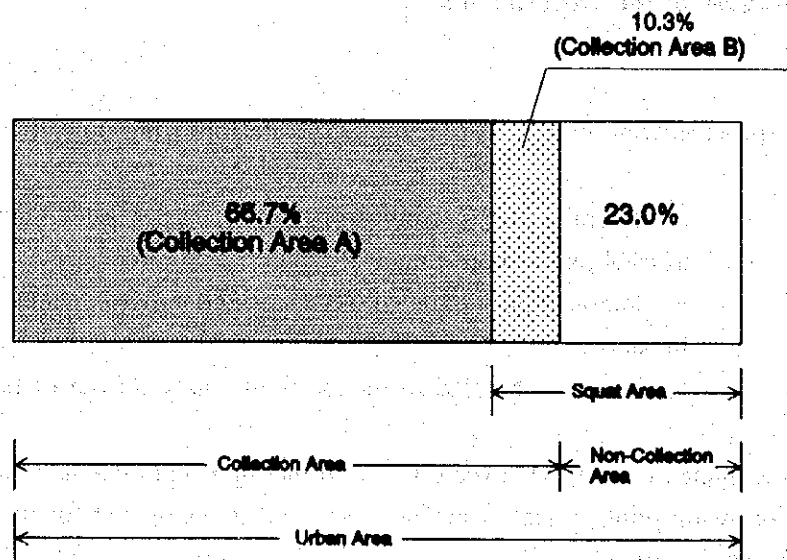


Figure 8.2.1a Urban Area Definition in terms of Collection Services

**b. Non-collection Area**

This area is mostly made up of squat settlements and has very poor infrastructure; illegally installed electric wirings and water pipes to obtain electricity and water supply. Furthermore, road conditions are bad and there are no sewage drains.

Residents in this area are forced to live without basic public services, and the absence of waste collection services creates many registered illegal dump sites in various places. The economic means of the residents are very restricted, malnutrition is common especially in infants and access to preventive medicine is limited. In addition, basic knowledge of public health is low in squat areas due to lack of education.

Generally speaking, collection service was never a priority in these areas as there are other matters of prior importance such as legalization of land tenure, improvement of housing facilities, drinking water, electricity, employment, etc..

Therefore it is advisable to combine the collection project with another equally important one, thereby forming an attractive package.

### **8.2.2 Objectives**

The collection system in the well developed Collection Area A will be modified, but compactor trucks will still be used. Collection services will be expanded in Area B where sanitary conditions are not satisfactory.

The objectives of the collection experiment are to examine the following possibilities:

- establishment of proper collection and haulage system
- establishment of beneficiary pay principle system
- establishment of monitoring system to prohibit the discharge of waste other than household waste (industrial and construction waste)
- establishment of an environmental cleansing system through community activities
- establishment of roads and drains improvement system carried out by the community with municipal assistance

### **8.2.3 Outline of Experiment**

The outline and procedure of the collection experiment are shown in Figure 8.2.3a.

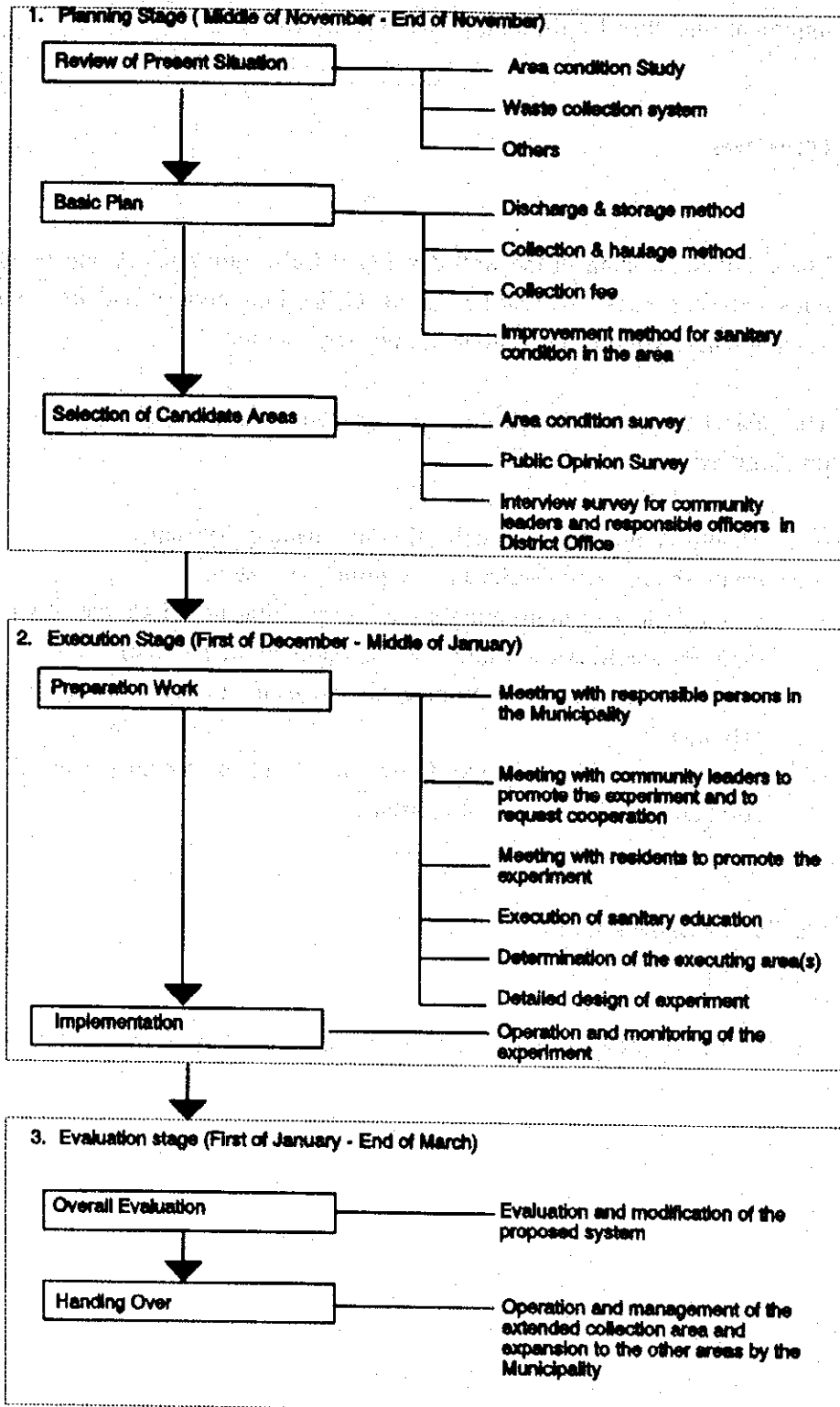


Figure 8.2.3a Outline and Procedure of Experiment



## **8.2.4 Planning Stage**

### **a. Basic Plan of Experiment**

#### **aa. Basic Conditions for Planning**

There are mainly two area conditions in Area B: areas without and with vehicular access roads. According to the General Urbanization Plan for Managua, the former is categorized as spontaneous settlements making up about 60% of Area B, while the latter is categorized as progressive settlements covering 40% of the area.

The basic plan was made based on the conditions in Area B.

#### **ab. Outline of Basic Plan**

The basic plan used in the experiment is shown in Table 8.2.4a.

Table 8.2.4a Outline of Basic Plan

Collection System	Container Collection System		Compactor Collection System	
	Direct Discharge	Primary Collection	Bell Collection	Station Collection
<b>1. AREA CONDITION</b>	applied to narrow areas without access roads for collection vehicles	applied to narrow areas without access roads for collection vehicles	applied to areas with main roads for collection vehicles	applied to areas with main roads for collection vehicles
<b>2. STORAGE</b>	Not necessary	Necessary	Necessary	Necessary
<b>3. DISCHARGE</b> - Point - Time - Vessel - Management	Container Anytime Any vessel  Community	In front of premises Fixed time Bags, baskets, etc.  Residents	Compactor Fixed time Bags, baskets, etc.  Not necessary	Station Fixed time Nylon sacks or plastic bags Community
<b>4. COLLECTION</b> (Primary) - Management  (Secondary) - Management - Frequency  - Type of vehicle	-  Municipality twice or thrice a week depending on the number of households in the area Roll-on Roll-off trucks	Community  Municipality twice or thrice a week depending on the number of households in the area Roll-on Roll-off trucks	-  Municipality thrice a week  Compactor trucks	-  Municipality thrice a week  Compactor trucks
<b>5. WASTE FEE</b>	C\$3 (C\$ 1 for improvement of area condition)	C\$3 (C\$1 for salary of primary collector and C\$1 for improvement of area condition)	C\$3 (C\$ 1 for improvement of area condition)	C\$3 (C\$ 1 for improvement of area condition)
<b>6. SANITATION OF AREA CONDITION</b> - Area cleansing activity - Area improvement activity	Prior to the experiment, the selected area(s) will be cleaned by the community activity with the assistance of the Public Cleansing Office. Prior to the experiment, the roads and drains in the selected area(s) will be improved by the community with the assistance of the District Coordination Office.			

## b. Selection of Candidate Areas

The Nicaraguan counterparts and the Study Team selected five candidate areas for the experiment based on the following points of view:

- Non-collection area
- Area condition
- strong demand for collection services

The selected five candidate areas are listed below and shown in Figure 5.1.4d.

- Hialeah (District 3)
- Cesar Sandino (District 5)
- Carlos Marx (District 6)
- Villa Canada (District 6)
- Waspan Norte (District 6)

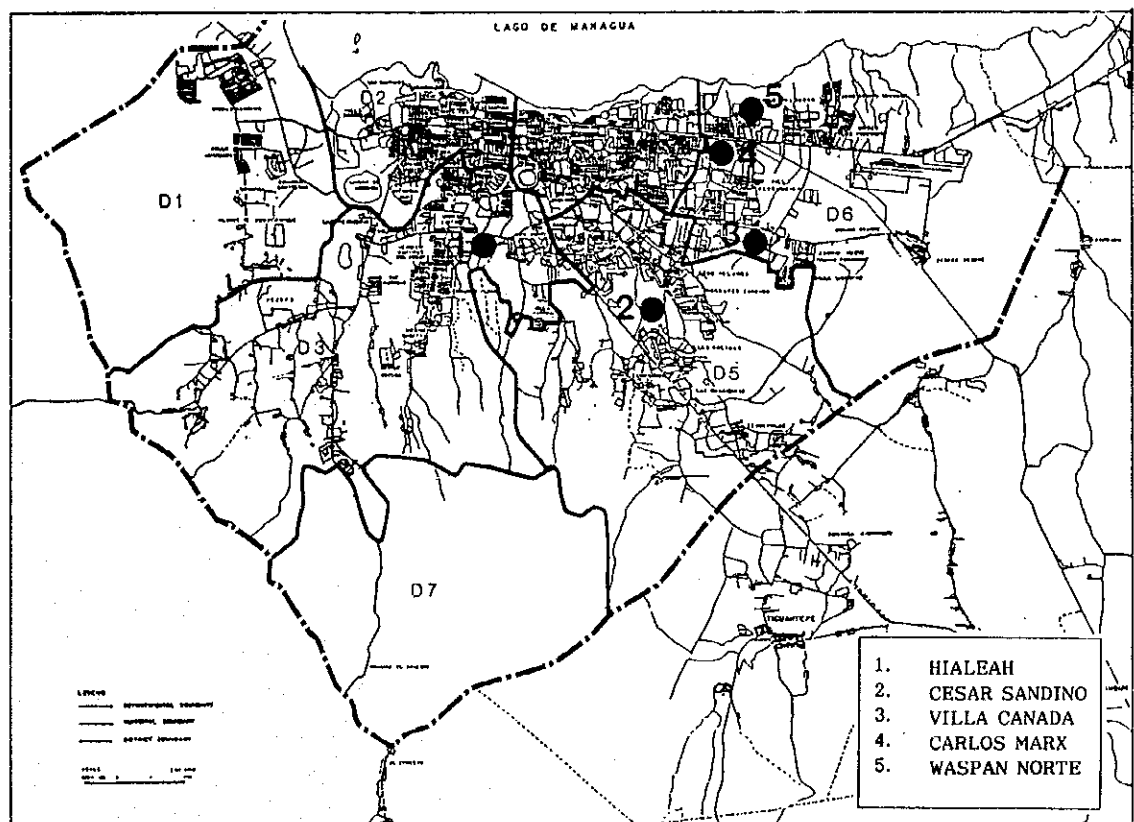


Figure 8.2.4b Candidate Areas for Collection Experiment

## **8.2.5 Execution Stage**

### **a. Preparation Work**

The following preparation works were executed prior to the commencement of the experiment:

- meeting with related agencies and persons in the Municipality to ask for their cooperation in the experiment
- meeting with community leaders
- meeting with residents
- implementation of education programs on sanitation

### **aa. Preparation Schedule for the Experiment**

The preparation works were executed according to the following schedule.

Table 8.2.5a Preparation Schedule for the Experiment

DATE	Schedule
17 November (Thu)	Meeting with counterparts about basic plan of experiment
18 November (Fri)	Meeting with counterparts about basic plan of experiment
19 November (Sat)	Area condition survey
20 November (Sun)	Area condition survey
21 November (Mon)	Area condition survey
22 November (Tue)	Meeting with delegates of District Offices
23 November (Wed)	Meeting with district officers (District 3, 5, 6)
24 November (Thu)	Meeting with community leaders (Hialeah)
25 November (Fri)	
26 November (Sat)	Meeting with community leaders (Villa Canada, Carlos Marx, Waspan Norte)
27 November (Sun)	Meeting with residents (Waspan)
28 November (Mon)	Meeting with community leaders (Sandino, Hialeah)
29 November (Tue)	Meeting with residents (Hialeah)
30 November (Wed)	Meeting with residents (Villa Canada)
01 December (Thu)	
02 December (Fri)	Meeting with residents (Carlos Marx)
03 December (Sat)	Meeting with residents (Waspan Norte, Cesar Sandino)
04 December (Sun)	
05 December (Mon)	Selection of experiment area(s)
06 December (Tue)	Meeting with district officers and community leaders
07 December (Wed)	Meeting with district officers and community leaders
08 December (Thu)	Detailed design
09 December (Fri)	Detailed design
10 December (Sat)	Area cleansing and improvement activity
11 December (Sun)	Area cleansing and improvement activity
12 December (Mon)	Commencement of collection service
13 December (Tue)	

**ab. Establishment of an Executing Organization in the Municipality**

Meetings with municipal officers involved were held in order to achieve the following objectives:

- To explain the objectives and details of the experiment
- To request for cooperation and participation in the experiment
- To involve all related agencies and persons

The following executing organization was established during the meeting to assist the experiment.

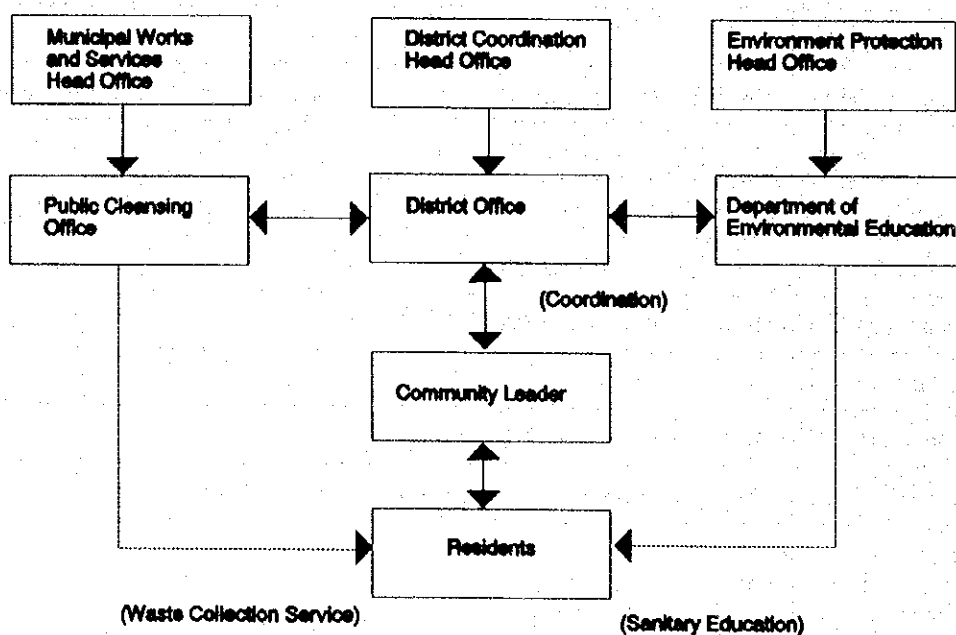


Figure 8.2.5a Executing Organization in the Municipality

**ac. Meetings with Community Leaders**

The meetings with community leaders were held in order to achieve the following objectives:

- To explain the experiments and make them understandable to those present
- To request cooperation and participation in the experiment
- To educate the residents in the area on sanitation

**ad. Meetings with Residents**

**ada. Objectives**

The meetings with residents were held according to the following objectives:

- to execute education campaigns on sanitation
- to confirm the demand for collection services
- to confirm the amount of cooperation available to the experiment
- to count the number of households willing to participate in the experiment

**adb. Schedule**

Meetings with residents were held according to the following schedule. Due to the absence of any community facility, the meetings were held in vacant areas in the communities.

Waspan Norte	-	27 November (Sun),	10:00 ~ 12:00
Hialeah	-	29 November (Tue),	17:00 ~ 19:00
Villa Canada	-	30 November (Wed),	16:00 ~ 18:00
Carlos Marx	-	2 December (Fri),	17:00 ~ 19:00
Waspan Norte	-	3 December (Sat),	10:00 ~ 12:00
Cesar Sandino	-	3 December (Sat),	15:00 ~ 17:00

**adc. Sanitary Public Education**

Various issues on sanitation were touched during the meetings with the residents. The contents of this education program are detailed in 8.4, Public Education Campaign.

**ae. Determination of Subject Areas**

As described in the previous chapter, the objective of the collection experiment is to examine the workability of the manner of collection proposed in the Basic Plan. In addition, due to the very limited financial capability of the municipality and difficulties in obtaining public cooperation, a stepwise approach is proposed in order to achieve the targets of the Basic Plan. The Study Team set up the following criteria for the final selection of the experimental areas with due consideration of the basic policies of the study and the limited period allotted to the experiment (1 month):

- i The municipality should continue carrying out the activities in the experiment which were meant for the following: 1) extension of collection services, 2) establishment of the Beneficiary-Pay Principle, 3) establishment of an efficient and reliable collection system and 4) establishment of public cooperation, even after the Study Team has completed the experiment. In so doing, favorable results may be obtained.
- ii Public cooperation is especially essential to the container and bell collection system. The results of the experiment will be able to prove the extent of the residents' willingness to cooperate and participate.
- iii Consequently, a participation ratio of more than 20% should be achieved for the experiment and collection work.
- iv New strategies should be formulated for the expansion of collection services in other areas.

Based on the above mentioned criteria, Cesar Sandino (D-5), Carlos Marx (D-6) and Waspan Norte (D-6) were selected as areas for the collection experiment. The community in Hialeah was not able to submit the list of willing household participants by the closing date, while Villa Canada was excluded due to low participation ratio.

The number and percentage of households wishing to participate are shown in Table 8.2.5b.



Table 8.2.5b Determination of Subject Areas

	Hialeah (D-3)	Cesar Sandino (D-5)	Villa Canada (D-6)	Carlos Marx (D-6)	Waspan Norte (D-6)
1. Proposed collection system	Compactor	Compactor	Container	Container	Container
2. Total number of households	200	300	425	197	163
3. Number of households wishing to participate	-	63	45	72	82
4. Ratio (%) (3/2)	-	21.0	10.5	36.5	50.3
5. Final selection	No	Yes	No	Yes	Yes

**af. Detailed Design**

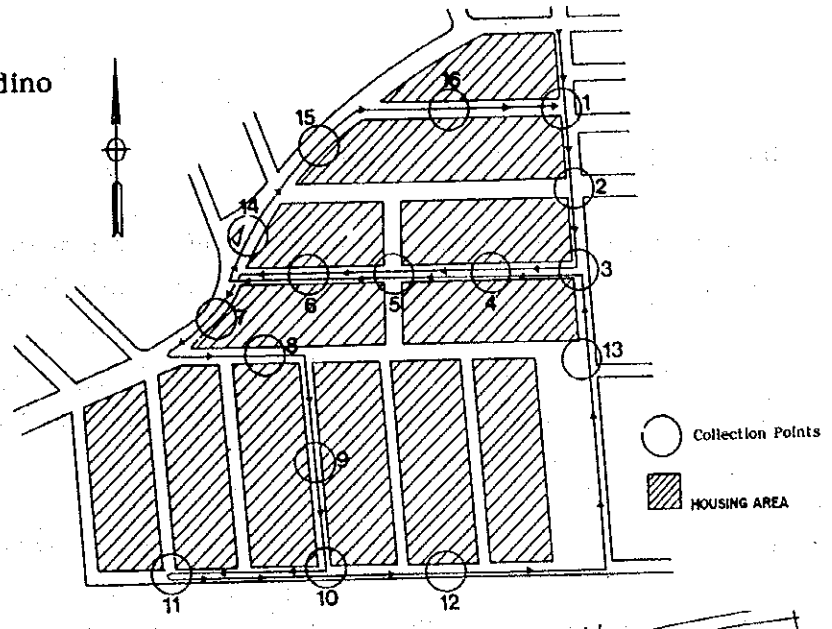
**afa. Detailed Design for collection**

Detailed design (discharge method, primary collection system, collection frequency, collection days, time, point/route and fee) was planned based on the condition of the areas selected for the experiment, and is shown in Table 8.2.5c, Figure 8.2.5a.

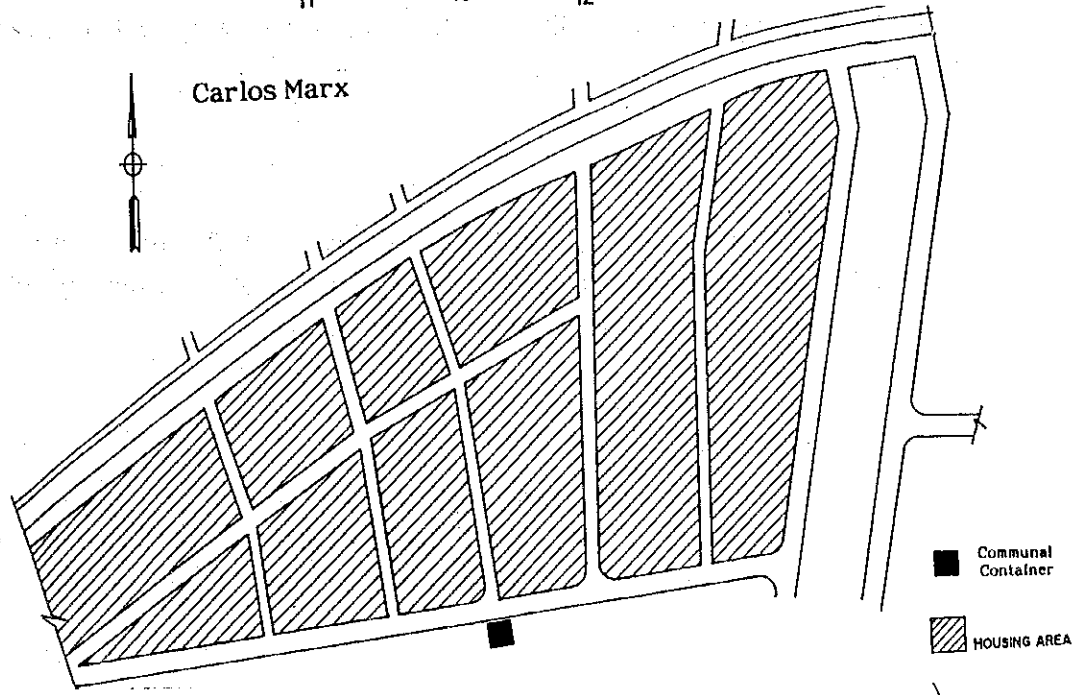
Table 8.2.5c Detailed Design

Name of Area		Cesar Sandino (D-5)	Carlos Marx (D-6)	Waspan Norte (D-6)
Discharge and Storage		Residents discharge their waste directly to collection vehicle	Residents discharge their waste in front of premises using plastic bags or sacks	Residents discharge their waste in front of premises using plastic bags or sacks
Primary Collection		-	Primary collection is done before the arrival of the collection vehicle Sun., Wed.	Primary collection is done before the arrival of the collection vehicle Mon., Thu.
Collection Work by the Municipality	Collection Frequency	thrice a week	twice a week	twice a week
	Collection Days in a week	Tuesday, Thursday, Saturday, first collection day - 13 December (Tue)	Monday, Thursday, first collection day - 15 December (Thu)	Tuesday, Friday, first collection day - 13 December (Tue)
	Collection Time	7:00 am	7:00 am	7:00 am
	Collection Point and Route	refer to Figure 5.1.5a	refer to Figure 5.1.5b	refer to Figure 5.1.5c
Collection Fee		<p>CS 3</p> <p>2/3 of total fee amount will be paid to the Municipality.</p> <p>Remaining 1/3 of total fee amount will be used for cleansing activities in the community.</p>	<p>CS 3</p> <p>1/3 of total fee amount will be paid to the Municipality.</p> <p>Remaining 2/3 of total fee amount will be used for cleansing and improvement activities in the community.</p>	<p>CS 3</p> <p>1/3 of total fee amount will be paid to the Municipality.</p> <p>Remaining 2/3 of total fee amount will be used for primary collector compensation and cleansing improvement activities in the community.</p>

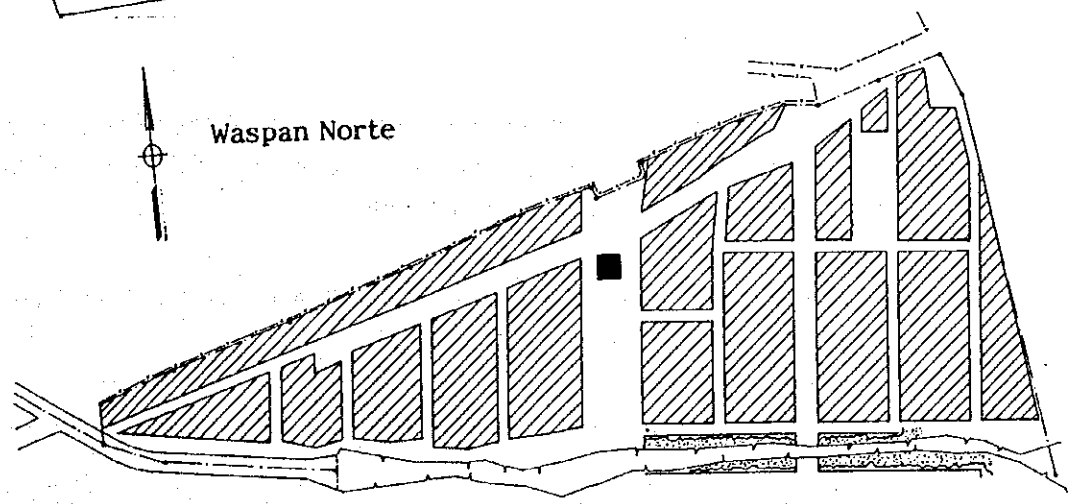
Cesar Sandino



Carlos Marx



Waspan Norte



HOUSING AREA      Communal Container

Figure 8.2.5a Collection Route and Locations of Communal Container Set Up

#### **afb. Construction of container bed**

In view of the Municipality's aim to extend its collection services, four 15m<sup>3</sup> communal containers were repaired for the collection experiment.

In order to prevent damages, container beds were constructed in Carlos Marx and Waspan Norte. At the same time, sloping platforms with steps were constructed on the beds to facilitate discharge.

#### **afc. Detailed plan for the improvement of the sanitary condition in Area B**

To improve the sanitary condition in the area, the following two activities were planned:

- **Cleansing activity**

Vacant areas, canals and roadsides are usually littered with wastes. These wastes shall be collected by the community prior to the implementation of collection services with the help of the PCO and District Offices.

- **Improvement activity**

The absence of drains in the area leaves drainage flowing freely on roads. The community should do something about this condition prior to the implementation of collection services with the help of the municipality.

#### **b. Implementation**

The collection experiment was implemented in three areas from December 10, 1994 to January 11, 1995. In order to examine the feasibility of the proposed plan, the following were carried out in the experiment:

- time and motion study (collection time, distance for collection, and amount of waste to be collected)
- public opinion survey
- examination of operation and management system of the Public Cleansing Office
- examination of coordination and assistance system of District Offices
- examination of public education system organized by the Department of Environmental Education
- examination of promotion and fee collection system in the community

- examination of working efficiency of primary collectors.

**ba. Time and Motion Survey for Collection Experiment**

The objectives of the survey are:

- To examine the proposed collection system in the Basic Plan
- To compare the efficiency of the present collection system and collection experiment

**bab. Contents of the Survey**

The route of vehicles assigned in the experiment areas were traced in the survey.

The details of the survey are described in Section E.5 of ANNEX E.

**bac. Method of the Survey**

The details of the survey are mentioned in Section E.5 of ANNEX E.

**bad. Results**

The results of the time and motion survey are described below.

- i. The routes of the collection experiment were included in the existing collection routes.
  - Cesar Sandino was included in route 9
  - Carlos Marx and Waspan Norte were included in the route for markets

Collection work in Cesar Sandino was set after regular collection work has been carried out. At first, collection in Cesar Sandino was carried out an hour ahead or later than originally planned due to traffic and vehicle conditions, but finally it was carried out before the beginning of the regular collection route instead of later, as was originally planned.

- ii. The waste collection service was done based on the basic plan. The collection from houses and the haulage to communal containers by the primary collector was done twice a week. The haulage from the containers to the disposal site was carried out by the Municipality the day after primary collection.

During the time and motion survey, however, it was observed that the communal container was not full. This is assumed to be because of the following:

- unfamiliarity of primary collector with container sites
- ineffective coordination between primary and municipal collection

iii. Bell collection in Cesar Sandino took 54 minutes. A total of 223 families participated in the collection experiment spending an average collection time (per family) of about 15 seconds. The efficiency of the collection work was a result of the cooperation of the residents.

#### **bb. Public Opinion Survey for Collection Experiment**

##### **bba. Objectives of the Survey**

The main objectives of the POS (Public Opinion Survey) are described as follows:

- to confirm the changes in the awareness of the community before and during the collection experiment.
- to check the suitability of the collection system proposed in the collection experiment.

##### **bbb. Survey Period**

POS was conducted in December 21 and 22, 1994 to compare the degree of awareness of the community before and during the collection experiment.

##### **bbc. Survey Areas and Number of Samples**

The households covered by the POS were selected from the collection experiment areas. A total of 30 households, 10 from each of the three chosen collection areas, were selected.

##### **bbd. Method of survey**

Every resident was interviewed in the POS and the answers obtained were computerized and are described in the next section.

##### **bbe. Results**

- About 75% of residents in the 3 experiment areas receive solid waste

collection services.

- Around 90% of the residents store their waste before collection.
- More than 70% of the residents know the collection day.
- More than 70% of the residents receive collection services at a fixed time.
- 100% of the residents think that the cooperation of neighbors and/or community is necessary to keep the area clean.
- More than 85% of the residents are satisfied with the collection work performance of the primary collector and the Municipality.
- More than 80% of the residents think that the collection service provided in their area is suitable.
- More than 90% of the residents think that the sanitary conditions of their areas have changed after the collection experiment began.
- Residents answered that they would like to use the funds collected from the residents of their community to:
  - . improve the drains
  - . improve the roads
  - . construct community facilities such as street lights, etc.
- 100% of the residents want to continue receiving collection services.

**bc. Examination of Coordination and Assistance System through District Offices**

District Offices extended the following services during the experiment:

- i. Social workers or persons in charge of municipal services assisted in the community works needed for the experiment, such as hiring primary collectors, contracting residents for the services and fee collection.
- ii. District Office 6 lent the use of their hand carts for primary collection to the communities of Carlos Marx and Waspan Norte.
- iii. District Offices assisted the cleansing and road improvement activities of the communities at the beginning and during the experiment.
- iv. District Office 5 held meetings in Cesar Sandino to encourage resident participation in the experiment. Authorities of the Department of Environmental Education also carried out campaigns on sanitation.

**bd. Examination of Public Education System by the Department of Environmental Education**

The Department of Environmental Education implemented the following during the experiment:

- i. Carried out campaigns on sanitation in Cesar Sandino.
- ii. Carried out campaigns on sanitation using the audio visual tools prepared by the Study Team in the following days:

5 January 1995: Cesar Sandino

6 January 1995: Carlos Marx

9 January, 1995: Waspan Norte

**be. Examination of Promotion and Fee Collection System in the Community**

The following works were implemented by the organization exclusively established for the experiment:

- i. Contracting a primary collector according to the conditions prepared by the Study Team.
- ii. Contracting residents for collection services according to the terms prepared by the Study Team.

Table 8.2.5d shows the number and percentage of households contracted before and during the experiment, including the increase in the percentage of contracted households.



Table 8.2.5d Number and Percentage of Households contracted by the community for the experiment

	Cesar Sandino	Carlos Marx	Waspan Norte	Total
(1) Total number of households	300	197	163	660
(2) Number of households contracted before the experiment	63	72	82	217
(3) Number of households contracted during the experiment	223	180	90	493
(4) Percentage of households contracted before the experiment (%) (2)/(1)	21%	36.5%	50.3%	32.9%
(5) Percentage of households contracted during the experiment (%) (3)/(1)	74.3%	91.4%	55.2%	74.7%
(6) Increase in percentage (%) (5)-(4)	53.3%	54.9%	4.9%	41.8%

iii. Household Fee Collection was carried out as follows:

- fee collection from January 2 - 5, 1995
- 5 January 1995 was the primary collector's pay day
- 5 January 1995 was the day for distribution of fees collected

The amount of fees collected from the residents in the experiment is shown in Table 8.2.5e.

Table 8.2.e. Amount of Collected Fee

	Cesar Sandino	Carlos Marx	Waspan Norte	Total
Total Amount of Fee (C\$)	669	540	270	1,479
Salary for Primary Collector (C\$)	0	180	90	270
Waste Collection Fee (C\$)	446	180	90	716
Money for Area Improvement (C\$)	223	180	90	493

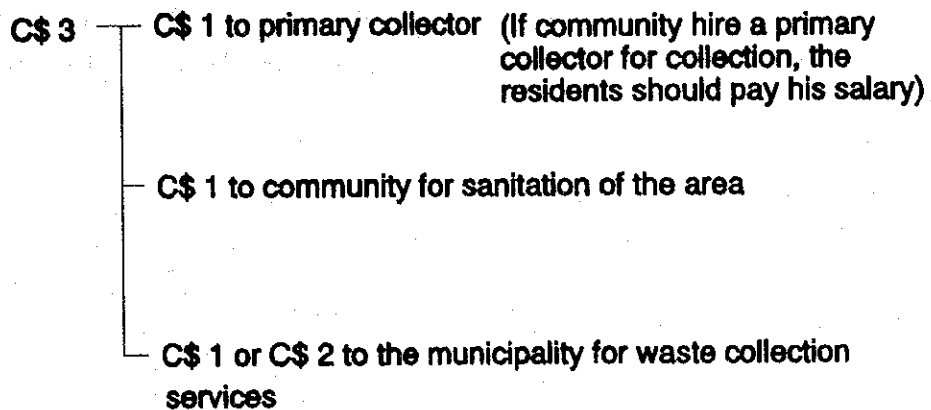
- iv. The organization established exclusively for the experiment acts as the mediator between the residents and the municipality, relaying every request made by the former to the latter and passing information from the latter to the former.

## 8.2.6 Findings

- i. The container and bell collection system requires a lot more public cooperation than the other collection systems. Although only 33 % of the residents agreed to participate in the experiment, an increase of 41 % was observed during the experiment when the total number of participants (contracted households) rose to 493. Moreover, 80% of the households receiving collection services found the collection system suitable. These figures indicate the residents' approval of the experimental collection systems, and consequently prove the feasibility of extending collection services to these areas through these collection systems.
- ii. The organization structure shown in Figure 8.2.5a was established to provide assistance to the experiment and proved to be very important in the extension of collection services.
- iii. To effectively carry out the experiment, an organization responsible for promoting sanitation was established. The responsibilities of the organization are as follows:
  - contracting primary collectors
  - contracting residents for collection services
  - fee collection and management
  - act as a mediator between the residents and the Municipality to establish coordination in sanitation activities

The establishment of an organization in the community is proven to be necessary not only for the extension of collection services but for the sanitation of the squat areas as well.

- iv. The primary collection system incorporated in the container collection system was proven to be effective in the squat areas and, therefore, should be implemented for the extension of services to other areas.
- v. The waste fee collection system in squat areas was established as follows:



A community organization made up of three members was organized to manage the fees collected. The communities hand the collected fees over to the Municipality. The Study Team recommended the separate management of the fees from the general finances of the municipality. It further recommended that the fees should be managed by the Public Cleansing Office.

- vi. With the assistance of the district offices and the Public Cleansing Office, the community carried out cleansing and improvement activities. The district offices and Public Cleansing Offices also assisted these activities during the experiment.

However, some roads and drains were not improved or repaired due to geological influences and lack of equipment.

These activities were proven to be necessary to sanitize the squat areas.

- vii. The construction of the platform to facilitate discharge was proven to be effective especially for children and primary collectors.
- viii. The community of Hialeah requested to be included in the experiment after the selection of experimental areas was finalized. The household percentage eager to participate in the experiment exceeded 90%.

The Study Team recommended the inclusion of Hialeah in the experiment to the Municipality for collection area extension and in accordance with the basic plan proposed in the collection experiment.

Thereafter the Municipality started the preparations necessary for the implementation of collection services in the area from 5 January 1995.

### **8.3 Sanitary Landfill Experiment**

#### **8.3.1 Background**

The disposal site in Acahualinca has been operating for almost 20 years since it opened in 1975 and its space has increased to about 40 ha. Based on the information given by the Public Cleansing Office, almost half of the landfill has been filled and will be continued to be filled until the entire landfill area is even. The remaining landfill area is shown in Figure 8.2.1a. The remaining capacity of the present Acahualinca disposal site is estimated to be around 1,220,000 m<sup>3</sup>, a capacity capable of accommodating the volume of wastes to be disposed over the next 5 years.

The present disposal site in Acahualinca is in a terrible state. More than 200 scavengers, as well as animals and birds looking for food waste, can be seen at the site. Wastes dumped in the site are also scattered and those lighter in weight usually get blown away to the surrounding area.

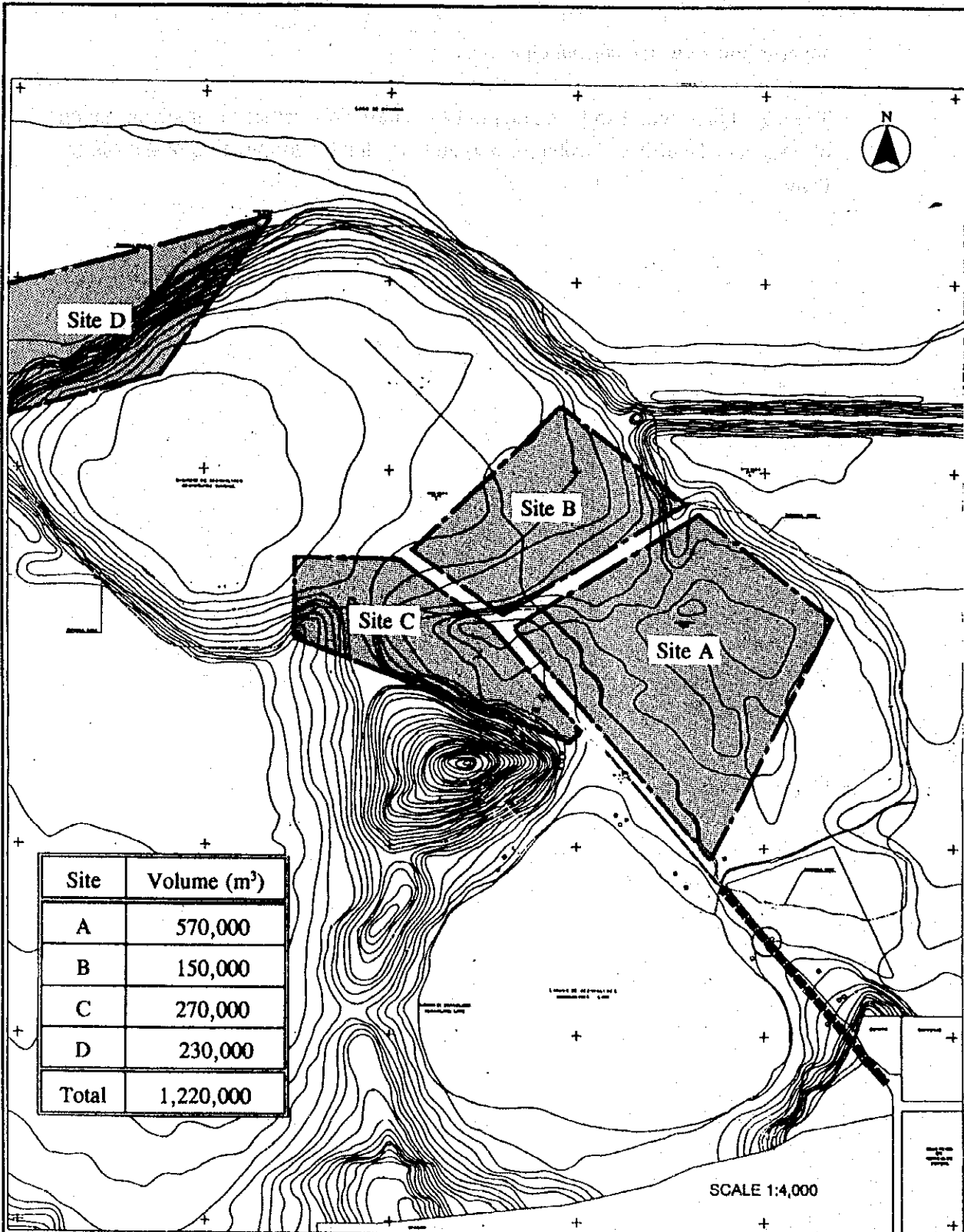
The shoreline of Lake Managua formerly divides the lake from the disposal site. However, the annual decrease in lake water level has created a distance between the two. The view of the shoreline is not very pretty to see as it is now covered with heaps of waste. It is feared that this condition will cause further deterioration of the lake water quality if water level rises up to its former height.

Furthermore, the natural combustion of disposed wastes due to putrefaction can be observed over a wide area. The smoke densely covers the disposal site and can be seen from any elevated point in Managua City.

Given these conditions, the Study Team proposed the relocation of the present disposal site to an area 2 km to the west. The Study Team also proposed the implementation of sanitary landfill in the master plan for the proposed new landfill site in Acahualinca to keep the environment in sanitary condition and prevent any

adverse impact to the surrounding area.

The experiment will also be carried out to determine whether the implementation of a sanitary landfill is feasible or not, and also for the formulation of the Master Plan.



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Figure 8.3.1a  
Remaining Landfill Area in the Present Acahualinca Disposal Site

### **8.3.2 Objectives of the Sanitary Landfill Experiment**

The sanitary landfill experiment aims to inform the people in the neighboring areas of the importance of sanitary landfill practices. The objectives of the sanitary landfill experiment are described below:

- (1) to sanitize the area of the present Acahualinca disposal site as the immediate improvement plan described in Chapter 6.
- (2) to verify the workability of sanitary landfill works proposed in the Master Plan

### **8.3.3 Contents of Sanitary Landfill Experiment**

The Study Team and ALMA agreed to cooperate in the conduct of the following items, based on the above objectives.

- (1) Immediate improvement measures
  - improvement of approach road
  - covering of wastes
  - construction of dike
- (2) Verification of the workability of sanitary landfill works
  - covering of wastes
  - construction of dike
  - installation of gas removal facilities

#### **a. Improvement of approach road**

The approach road, which is impassable in the rainy season because it subsides and gets very muddy, impedes the operation of the landfill works. Because of the unpaved condition of the approach road, haulage is not effectively carried out and vehicles consume a lot of fuel. Consequently, the approach road will be improved to smoothly implement landfill works.

**b. Covering of wastes**

Scattering of wastes, generation of bad odors, propagation of insects and fire are the usual occurrences in the present Acahualinca disposal site due to the uncovered state of the wastes. To create a sanitary condition, wastes in the present dumping site were covered daily and for the last time after landfill works are completed.

**c. Construction of dike**

Some of the wastes in the present disposal site overflow into the neighboring area due to the absence of a definite boundary, thereby corrupting the surrounding environment. Therefore a dike was constructed to act as a clear boundary between the surrounding area and the disposal site. To maintain a clean and good environment, the heaps of waste surrounding the dike will be leveled and covered with soil.

In addition to the above, the present dumping site should be enclosed by a dike to prevent uncontrolled tipping and spreading of wastes. Dike construction should be carried out prior to the daily waste covering operation.

**d. Installation of gas removal facilities**

The condition of the part of the disposal site where landfill works are completed is anaerobic. The anaerobic decomposition of organic waste materials produces 40 - 60% methane, 60 - 40% carbon dioxide and various other gases. The emission of these gases often result in explosions which interrupt the spreading or compaction work. Deoxygenation, on the other hand, injures vegetation in the recently recultivated surface of the landfill and the surrounding area. Therefore, the installation of gas removal facilities was taken into account.

The above mentioned items to be carried out in the sanitary landfill experiment are summarized in Figure 8.3.3a. These items were carried out by the JICA Study Team and the Public Cleansing Office, as shown in the following table. Furthermore, the role assignments were decided taking the following into account:

- the limited period allotted to the experiment
- the use of Public Cleansing Office equipment and the preferred execution of the works by PCO
- the implementation of the remaining works by the JICA Study Team



**Table 8.3.3a Role Assignment for the Sanitary Landfill Experiment**

Items for the Experiment	JICA	ALMA
<b>1. Improvement of approach road</b>	Plan, Construction Supervision	Supervision
<b>2. Covering of wastes</b>	Plan, Supervision	Construction, Supervision
<b>3. Construction of dike</b>	Plan, Supervision	Construction, Supervision
<b>4. Installation of Gas removal facilities</b>	Plan, Construction, Supervision	Construction Supervision

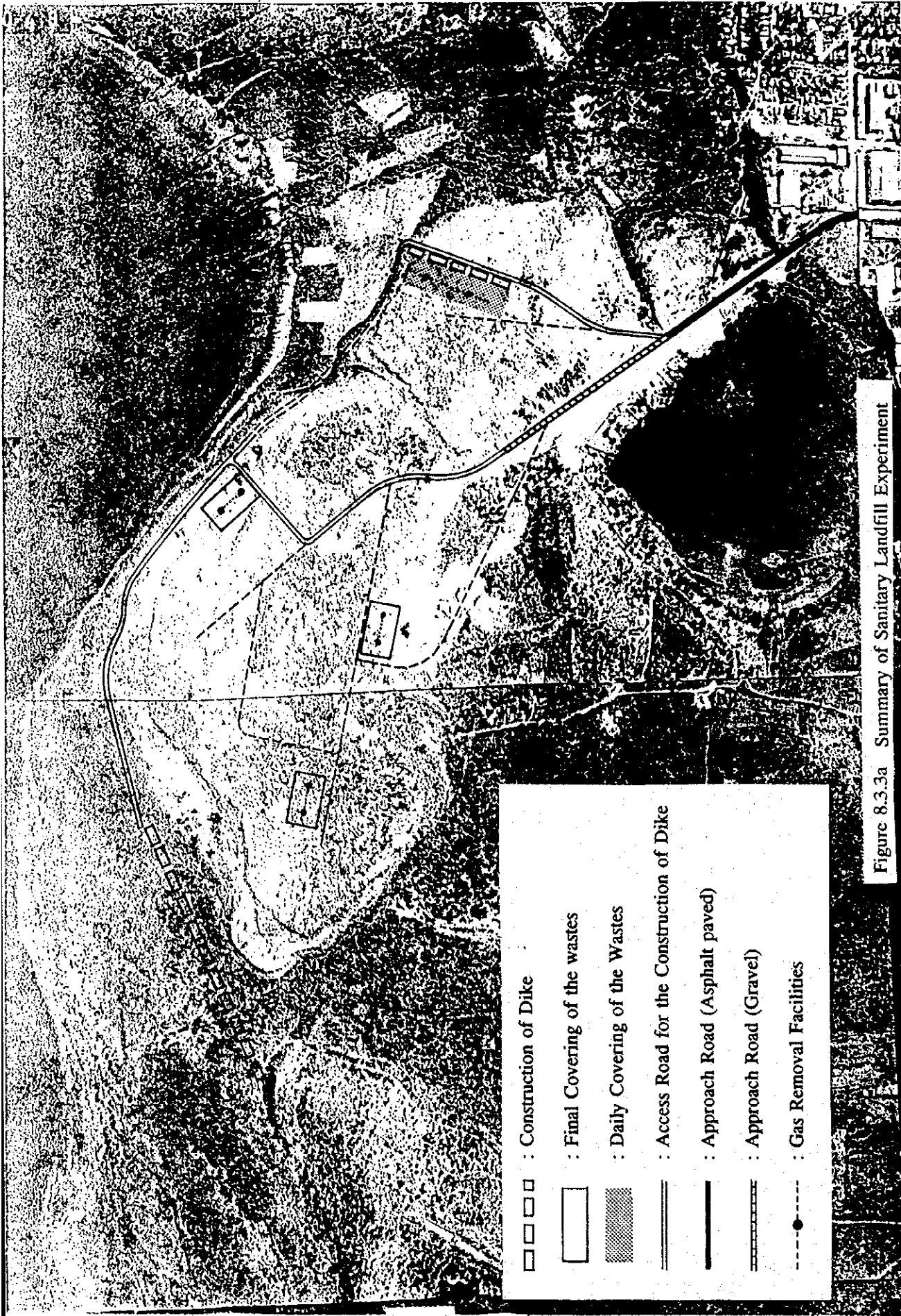


Figure 8.3.3a Summary of Sanitary Landfill Experiment

### **8.3.4 Execution Method**

#### **a. Improvement of Approach Road**

A section of the present approach road, which is 250m from the avenue to the end of the truck scale constructed in the previous phase, is paved with asphalt and its vertical alignment has been partially changed. The following section, which is 300m in the direction of the landfill site, is paved with gravel. The level of the approach road was also raised to about 1.0m. The present gate should be replaced with a new one.

#### **b. Covering of Wastes**

Waste covering is carried out by the Public Cleansing Office under the supervision of the JICA Study Team and the counterpart in areas where landfill work is completed or in progress. The Cleansing Office executed the final covering of the wastes at the area where landfill was completed in collaboration with the Municipal Maintenance Office who supplied the equipment needed. The Public Cleansing Office should supervise the daily covering of wastes since its further continuance is most desirable even after the experiment.

##### **ba. Final Covering of Wastes**

Almost half of the landfill works in the present Acahualinca disposal site have been completed. The volume of waste disposed in this area is about 15m deep. Final covering has not been carried out.

The final covering of wastes is carried out at the three areas selected for the installation of gas removal facilities. The areas covered measured 2,800m<sup>2</sup> (40m x 70m), and the thickness of the layer was 50cm with due consideration of future vegetation.

##### **bc. Daily Covering of Wastes**

There are 4 sites available for landfill in the present Acahualinca disposal site. The current dumping area used for landfill (December 1994) is located near the entrance of the disposal site and measures approximately 60,000m<sup>2</sup> with an estimated capacity of 570,000m<sup>3</sup>. The Municipal Cleansing Office carries out daily waste covering activities at the northern part of this area.

At the beginning of the experiment, daily covering activities were planned to be carried out daily. However, the presence of numerous scavengers near the heavy equipment used in the dumping area led to alterations for safety reasons. The methods involved in the waste covering operation, e.g., heaping, compacting and covering, are carried out 2 days after the wastes are dumped, giving scavengers sufficient time to go ahead with their business.

According to the analysis of wastes carried out at the truck scale, soil makes up 15% of the incoming waste volume. Because the Municipal Cleansing Office does not have enough equipment to haul soil from the borrow pits within the Acahualinca disposal site, and since this activity would require additional capital, the use of soil in incoming waste is recommended for covering activities in view of the economic condition of the Study Area and for the possible continuance of the activity which is essential in the sanitation of the disposal site.

#### **c. Construction of Dike**

The construction of dikes was proposed to build a boundary between the disposal site and Lake Managua and an enclosure of the current dumping site where the daily covering works will be carried out. The Public Cleansing Office constructed these dikes under the supervision of the JICA Study team and counterparts, using wastes to build the dike body to curtail construction costs.

Since access to the dike is necessary, the Public Cleansing Office and Municipal Maintenance Work Office are currently constructing an access road using the flat band on the slope of the heap of wastes. The access road is 8m wide to accommodate two way traffic and will be as extensive as possible for maintenance purposes.

#### **d. Installation of Gas Removal Facilities**

Gas removal facilities are installed in the areas where landfill works have been completed or ongoing. The JICA Study Team was in charge of the installation in the former, while the Municipal Cleansing Office was responsible for the installation in the latter. The JICA Study Team consigned the installation works to a local construction firm.

##### **da. Gas Removal Facilities in the Area where Landfill Work is Completed**

The selection of the three areas to be installed with gas removal facilities was made

depending on the period of years the landfill works have been carried out. Landfill works in the first selected area were carried out about 10 – 20 years ago, the 2nd area about 5 – 15 years ago, and the 3rd area about 5 years ago. As previously mentioned, these areas are covered with soil as thick as 50cm and are each equipped with 2 gas removal facilities.

**db. Gas Removal Facilities in Areas where Landfill Works are Ongoing**

The gas removal facilities are installed in areas where the daily covering experiment is carried out by the Public Cleansing Office under the supervision of the JICA Study Team.

**8.3.5 Findings**

The sanitary landfill experiment was commenced from early December 1994. The experiment period was so short that the objectives of the experiment could not be obtained. However, findings recognized through the experiment are as follows:

- A total 550m approach road consisting 250m asphalt paved road and 300m gravel was improved. Some pavement works were carried out at night so as not to disturb landfill operations. The improvement of the approach road was very effective for the smooth access of collection vehicles to the dumping site. Also, landfill operation will be possible even during heavy rains. Therefore the purpose of this experiment was achieved completely.
- A road was constructed inside the site by the construction department of ALMA for the construction of dike at northwest end of disposal site. This road will be used for maintenance purposes after the completion of landfill. This road is connected to the approach road above-mentioned. Landfill can be carried out in the whole area.
- Final waste covering activities were done by the construction department of ALMA in the area where landfill is completed because the Public Cleansing Office does not have enough equipment for earth works. Heavy equipment shall be prepared by PCO for the final covering of waste. This activity shall be considered as a regular activity in the disposal site. However, final waste covering activities did not prevent the scattering of waste, generation of bad odor, and flocking of birds, etc., in the area for long.
- Daily waste covering was executed by PCO. The soil brought from the city

was heaped beside the normal waste and was used as covering material after waste compaction. The presence of many scavengers prowling around the landfill compactor hampered compaction work. However, the dumping site became more and more sanitary every day after the daily covering of the waste commenced - which needed no addition to the budget.

- Gas removal facilities were installed by the Study Team at the area where the final covering was done. Methane gas was measured by using the portable sensor during and after the facilities were installed. The Study Team confirmed the presence of methane gas but was not able to measure the volume produced. However, a detailed observation of methane gas production shall be done to protect the people engaged in landfill operations from explosion and fire accidents. In addition, ALMA also independently installed one at the current dumping site. The material for gas removal facilities was made from construction waste.
- The enclosing dike was made from waste matter. It made the boundary clear and prevented waste from scattering to surrounding areas. PCO recognized the benefits of the dike and started to extend the enclosing dike further.

The sanitary landfill experiment was concluded to be almost successful as it has proven that the Municipality of Managua is capable of sustaining sanitary landfill level 3 operations, except for the leachate circulation system.

## **8.4 Public Education Campaign**

### **8.4.1 Background**

Generally, public sanitary education consists of planned attempts to improve individual, group and communal behavior through lectures, events and advertising. However, in Nicaragua, as in most underdeveloped countries, public sanitary education has always been a response to urgent issues affecting the population rather than a long term goal. Governmental organizations lack resources, justifying the use of funds only when the issue in question has immediate and serious physical and political consequences.

Therefore, in Nicaragua, public sanitary education campaigns have been historically directed primarily towards the achievement of short term goals, placing special emphasis on matters affecting large segments of the population. This practice has

created a habit among the Nicaraguan institutions responsible for the formulation of public education policies and among the population responding to them of planning and implementing public sanitary education according to the degree of urgency and seriousness of the matters dealt with in the campaigns.

However, most educational techniques widely utilized in other countries to transmit campaign messages to the public are ineffective in Nicaragua. The low literacy rates, the economic crisis and the history of conflicts and natural disasters that have befallen Nicaragua have particularly rendered such techniques that are appealing to the moral values society useless.

Therefore, public education campaigns must put emphasis on fear. They must instill fear in the minds of the population regarding the consequences for the disregard of campaigns and its measures. On the other hand, the campaign must contain a positive message, because a campaign based solely on fear can create panic and disturb the MSWM services in a country like Nicaragua.

#### **8.4.2 Objectives of the Public Education Campaign**

With this background in mind, the objectives of the Public Education Campaign were set as follows:

- Explain the magnitude and urgency of the solid waste issue in the City of Managua.
- Stress the benefits of an adequate solid waste management and harm of an improper one on public health, welfare and the environment as related to the daily life of the general population.
- Point out that only through the active participation of the whole population can the problems related with solid waste in the community be solved.
- Underline the costs involved in solid waste management as a public service, and the effects of the populations improper waste management habits on SWM, i.e. illegal dumping increases the costs and reduces efficiency and so forth. Also, explain the problems faced by the Municipality in extending services to non collection areas.
- Promote adequate disposal habits and public participation in matters related to solid waste management, in particular on cleansing, storage and disposal

manners as well as maintenance and use of facilities and equipment.

### 8.4.3 Methods of Public Education Campaign

Generally public education methods are divided into campaigns targeting the general or large segments of the population and those trying to reach limited and confined target groups. The first method utilizes mainly the mass media or indiscriminate general campaigns, while the second concentrates on reaching specific groups through costume designed campaigns, events and lectures.

The mass media can be used through paid advertising and through press releases and other forms of free coverage in television, radio, newspapers and magazines. In the long run this method is very effective because it reaches vast amounts of people at the same time, but because the message has to be very vague and general because of the diversity of the audience, its effectiveness is very difficult to evaluate in the short run. Also, this method is the most expensive and complicated, as large amounts of money and long periods of time are required to implement a campaign.

The techniques to reach limited target groups are endless and are generally divided between those targeting area groups, i.e. community centers, neighborhood associations, sports clubs and so forth, and those targeting social groups determined by such things as age, gender and religion, i.e. schools, women associations, churches, etc.

In targeting area groups, the goal is to focus the issue on its effects on the residents, thus appealing to the sense of community and brotherhood, creating a sense of awareness in which the residents of a certain area influence and control each other to change and/or modify inadequate habits. The problem with this method is finding a proper way to transmit the idea, because the educational level and the attention span of the average Nicaraguan citizen is very limited.

Social groups have the obvious advantage of having very narrow and precise target audiences. Schools particularly present an effective audience because children are very impressionable, curious and idealistic, so that it is very easy to transmit the message. However, by the same principle, it is also very easy for them to forget the issue at stake. Therefore, the biggest challenge regarding public education at schools is to design the campaign in such a way that they remember the main points of the campaign.



For the public sanitary education campaign, it would be best to utilize as many techniques as possible to evaluate their effectiveness. However, we must keep in mind that since in this particular case the campaign is a pilot project, the education methods must be selected based on their effectiveness in reaching determined target groups rather than in changing general customs and behaviors, so that its effects can be properly evaluated in the Study.

Therefore, the techniques selected for the Public Sanitary Education Experiment concentrate on meetings with the communities and lecturing at schools.

#### **8.4.4 Public Education Campaign Tools**

After determining the public education techniques, proper campaign tools must be prepared to increase their effectiveness. Besides the obvious background study and preparation of the lecturers, educational videos and booklets were prepared. The contents of this two educational tools are summarized below.

##### **a. Educational Video**

In a country with scarce economic, cultural and technical resources such as Nicaragua, any message transmitted in a high-tech medium, such as a video, is bound to gain automatic attention and credibility from the public. Moreover, a video can show very descriptive images of the present reality of the audience, so that they understand that it relates directly to them and not to some worldwide fashion trend.

However, since the target audience for the video are socially diverse groups such as communities and schools, it is impossible to produce custom made videos for each target group. Therefore, the video must be aimed in a way that it can be effective with as wide a range of the population as possible without losing its usefulness with specific target groups. The goal is to be as specific as possible without excluding a particular segment of the population.

The conclusion by the Study Team was to make a video targeted to the younger audience. The rationale being that youth is more susceptible and impressible, and at the same time they can have a strong influence on the older population. Moreover, within the youth, older teenagers were selected as the main target because children look up to them and adults don't find the message patronizing or condescending.

Regarding the contents and structure of the video, it had to be short, simple, concise and direct, so that the audience's mind does not have time to wonder off. The video's scenario is summarized below:

- The main characters are a boy and a girl in their late teens, very cheerful and enthusiastic and very "cool", using slang terminology and listening to modern music.
- The scenario follows the following format:
  - . Present MSWM situation in Managua in all its crudity (to catch the audience's attention);
  - . Effects that this situation can have on each one of the members of the population in terms of health and the environment, such as pollution from burning dumps and leachate, and the vector threat from flies, rats and mosquitos transporting diseases as carrying agents (underline the importance of the issue through fear of the consequences);
  - . Proper cleaning, storage and disposal of solid waste (there are ways to avoid suffering the consequences of inadequate SWM manners); and
  - . Benefits to the public as individuals as well as a community following these steps (positive final message conditioned to taking the preceding measures).
- The images concentrate on popular spots of Managua so that the whole audience relates to it.
- The issues are transmitted as warnings rather than as condescending messages.

The video is identified by the slogan "¿Que Pasa con la Basura?" (What is going on with waste?) and lasts for approximately 7 minutes.

#### **b. Educational Booklet**

The educational booklet must be designed to fit several purposes. It should complement the video so that they can be used jointly and it must be more general than the video so that its use is not confined to school education or community lectures. With this in mind, the booklet was designed as follows:

- Small, short and simple to avoid initial rejection by the public.
- Colorful and made with quality materials to encourage the people to keep it

and study it.

- Layout with little text and many pictures and illustrations to avoid boredom.
- Impersonal text, with a general vocabulary not restricted to any particular age, gender, income, social, religious or interest group.
- Plot supportive of the video, i.e. present situation – harmful consequences – adequate measures to avoid such consequences – benefits of taking the measures.

The booklet is also identified by the slogan "¿Que Pasa con la Basura?"(What is going on with waste?) to create a homogeneous and global campaign by defining a unified message and it has twelve full colored and high quality pages.

#### **8.4.5 Implementation of the Public Sanitary Education**

As mentioned before, the methods selected by the Study Team for public sanitary education were through meetings with the community and school lectures.

##### **a. Meetings with the Community**

Public Sanitary Education through community meetings was carried out by the Study Team as part of the Collection Experiment (refer to section 8.2 of this chapter), and separately as a public education campaign in itself. Although both works are deeply interrelated, we must make a differentiation because of the slightly different campaign goals. The differences, goals, campaigns, etc. are summarized as follows:

##### **aa. Meetings with the community for the Collection Experiment**

In the Collection Experiment the purpose of the education program is not only to increase public awareness on SWM related issues, but also to promote the Collection Experiment itself and gain support and participation from the Community involved. Using the same rationale utilized for the general public education campaign, the main concern is to motivate a certain target community which currently doesn't receive collection services from the Municipality, to take initiatives to start a collection system.

This meetings were carried out at all candidate communities for the collection experiment. During this meetings, the following issues were discussed:

- Benefits to health and the environment of the collection experiment
- Relationship between diseases and solid waste
- Common diseases in that community at present
- Benefits of a regular waste collection
- Labor problems associated with solid waste related diseases
- Disease prevention
- The solid waste generated by each individual should be his responsibility, while the environment should be everybody's
- Need for changes in bad habits and attitudes
- Need for cooperation by the community
- How to cooperate with the collection experiment

From all the candidate communities, three were selected to carry out the collection experiment, at which time further meetings were held to discuss in further detail the said experiment. To insure the effectiveness of the collection experiment and consequently of public sanitary education, the district officers, community leaders and residents of the selected areas agreed to:

- Attend and help prepare meetings among all parties involved
- Announce the meetings to the residents and other relevant persons asking them to attend
- Attend and cooperate in all cleansing activities
- Explain to all the residents the benefits of the collection experiment and the subsequent advantages of a proper SWM
- Organization of a task force to manage the collection experiment
- Promote the implementation of the measures applied to the collection experiment well beyond the finalization of the experiment

During the meetings, the Study Team observed that the main concerns of the residents were diseases related with SWM, specially "dengue" which at the time was affecting large parts of the population. However, when the issue turned towards the environment and long term goals, people automatically became uninterested and absent minded.

**ab. Meetings with the Community for Public Sanitary Education**

Apart from the Collection Experiment, several meetings were held with members of the three communities selected for the Collection Experiment. These communities were chosen because of their low income levels and lack of education. The Study Team wanted to test the educational tools under extreme conditions, to evaluate their potential and usefulness.

A television and video set were carried to three communities. A lecture was performed by a member of the counterpart and a member of the Study Team, the video was shown and the booklets were distributed. In all cases it was observed that, although most people didn't understand everything, they were very interested, asking many questions and listening with attention. The residents, as in other areas and in previous meetings, were mainly concerned with SWM related diseases, and what measures they could take to avoid them.

#### **b. Public Sanitary Education at Schools**

As mentioned before, the main emphasis of the public sanitary education directed toward target groups was directed to children of scholastic age. However, regrettably schools in Nicaragua have summer holidays from the end of November until the beginning of February, so that the Study Team could not implement the campaign in schools.

Nevertheless, the younger members, particularly children, of the audience in community meetings were observed to be the most receptive to the video, booklet and issues discussed. The positive response from the youth during these meetings allow us to affirm, with a certain degree of certainty, that the public sanitary education designed by the Study Team would be very effective in educating school children.

#### **8.4.6 Findings**

Residents, as previously expected, are concerned with current SWM related issues such as diseases, aesthetics of their community and the consequences of an inadequate management system on their children and relatives. They are not concerned with long term effects and consequences and preservation of the environment as long as it doesn't affect them physically.

District offices have good organizational structures which can be very helpful in public education campaigns and other matters in need of communal participation. Also, the social promotion departments of the districts are very useful in obtaining public participation in such activities as the collection experiment, system modification and evaluations.

Surprisingly enough, residents presented a strong willingness to cooperate and participate in projects as long as their areas benefit from it, specially those projects

related with sanitation or disease control. They also have some experience in the development and organization of communal projects. However, it must be noted that the Nicaraguan citizen, by nature, agrees to cooperate and participate in principle, but in fact is a lot less willing than he originally expressed.

The Environmental Bureau has a well organized Environmental Education Department managing and coordinating public education campaigns. This department has extensive experience regarding public education and has a history of strong cooperation with the district offices and the residents. The Environmental Education Department implements public education in three stages: publicity through the mass media and other channels; public awareness through lectures and person to person contacts; and practice through implementation events in which segments of the population such as communities and schools are asked to carry out measures stated in the campaigns in an experimental capacity, allowing the public to see for themselves the reality of the issues discussed in the public awareness campaigns.

Furthermore, the Municipality of Managua has approved a project by which the Environmental Bureau will increase its financial and physical resources. This project includes the construction of an environmental library and a video projection room which the Municipality plans to use in the future for environmental public education campaigns and programs. Also, the Environmental Bureau will use the educational tools prepared by the Study Team to maintain public education regarding SWM beyond the study period.

#### **8.4.7 Recommendations**

The Environmental Education Department should carry out all public education programs in the future for the municipality. However, since environmental education is a broad subject, it should implement the campaigns not only as general environmental education effort, but also as specific goals to educate determined target groups specially in SWM related issues. For this purpose the Public Cleansing Office should have a social awareness, social promotion or public education section to cooperate with the Environmental Education Department in the coordination of all activities related with communal participation with the solid waste system in Managua.

Moreover, this new section as well as the Public Cleansing Office itself, should maintain the current relationship with the district offices, based on cooperation and assistance in achieving goals. Without the active participation of the citizens or an

organism to coordinate and promote participation, it will be very difficult if not impossible to achieve any improvement.

The Municipality of Managua should establish a budget for the Environmental Education Department solely for the promotion and implementation of public sanitation programs and activities to achieve long term educational goals, besides the present assignment of budget according to the urgency of the issues. The budget should be sufficient to implement public sanitary education permanently. Also, the Public Cleansing Office should have its own budget for its own public education section, so that it can cooperate and participate in all public education activities regarding SWM and other public cleansing programs.

The Nicaraguan Health Ministry or MINSA is responsible for the welfare of all citizens, the Municipality should therefore coordinate its efforts with them to increase efficiency and reduce costs. Furthermore, MINSA has a Health Education Department and social workers which can be very helpful to the Municipality in implementing public education and citizen participation programs.

The Press Office of the Municipality of Managua should play an important role in the public sanitary education efforts. The Cleansing Department and specially the Environmental Education Department should inform the Press Office periodically about the environmental and health situation in Managua and their campaigns, events and other efforts to educate the public. At the same time the Press Office should constantly issue press releases to publications, television, and radio stations. The population should become accustomed to seeing environmental issues in the media, keeping them informed on all efforts carried out by the municipality as well as all issues in need of attention in the community regarding the environment.

The Environmental Education Department should use the educational tools prepared by the Study Team to carry out public education. Specifically, this department should establish a program using those tools, and invite schools to attend environmental education sessions at the future environmental library and video projection room.

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# **CHAPTER 9**

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## **IMMEDIATE IMPROVEMENT NEEDS AND PLAN**



## **CHAPTER 9 IMMEDIATE IMPROVEMENT NEEDS AND PLAN**

*This chapter describes the immediate improvement needs and their corresponding measures, to effectively improve the present situation and to prove the project's potential of becoming a model for future improvement.*

### **9.1 Criteria for Identification of Immediate Improvement Needs**

The implementation of an immediate improvement plan is very important in view of the fact that the Basic Plan targets can be pursued only through step-wise improvement.

Immediate improvement needs were identified based on the following criteria:

- i Possibility of immediate improvement
- ii Efficient but inexpensive use of existing resources
- iii Achievement of tangible improvement effects in the short term
- iv Possibility of becoming a model for future improvement

### **9.2 Immediate Improvement Plan of Technical System**

#### **9.2.1 Measures for each Immediate Improvement Need**

The measures for each immediate improvement need identified based on the criteria were examined mainly by the pilot projects. The immediate improvement needs and improvement measures are shown in Table 9.2.1a.

Table 9.2.1a Immediate Improvement Needs and Improvement Measures

	Immediate Improvement Needs	Improvement Measures
1.	Improvement of collection work efficiency	Data from truck scale
2.	Establishment of the collection system in a squat area	Collection Experiment
3.	Establishment of the system for the sanitation of the squat area	Collection Experiment
4.	Sanitation of the present Acahualinca disposal site	Sanitary Landfill Experiment
5.	Establishment of waste fee collection system in the squat area	Collection Experiment
6.	Establishment of community organization for the sanitation of the squat area	Collection Experiment
7.	Execution of public education on sanitation	Collection Experiment & Public Education Campaign

## 9.2.2 Immediate Improvement Plan

Immediate improvement needs and their corresponding measures were identified and studied, respectively, to effectively improve the present situation using existing and available resources and curtail enormous expenses, and to prove the project's potential of becoming a model for future improvement. The results led to the projection of the following immediate improvement plan.

### a. Improvement of Collection Work Efficiency

The data obtained by truck scale installed at Acahualinca disposal site is useful to the management of collection vehicles. Data on file were computerized and analyzed by the Study Team using the EXCEL system, and the following are the output:

- i List of registered vehicles by incoming waste classification
- ii Daily, weekly and monthly number of incoming vehicles in accordance with:
  - classification of incoming wastes
  - categories of generation source
  - responsible organization for collection and haulage
  - type of wastes hauled directly
- iii Daily, weekly and monthly disposal amount according to the above-mentioned categories.

Public Cleansing Office should therefore continue the operation program even after the experiment to be able to constantly analyze data and improve collection work efficiency.

**b. Establishment of a Collection System in the Squat Area**

More than 70% of the households in the experiment area participated in the collection experiment. The figures are indicative of the residents approval of the collection systems carried out in the experiment. Therefore, the container collection system using a primary collector and bell collection system using compactor trucks are the collection systems suitable to squat areas, and through these collection systems, collection areas can be extended.

In order to serve the entire city, the Municipality should follow the methods carried out in the collection experiment.

**c. Establishment of the System for the Sanitation of the Squat Area**

Aside from waste collection services, the following activities were implemented during the collection experiment to prove the feasibility of the system:

- **Cleansing activities**

Littering is widely observed in vacant areas, channels and roadsides. The community cleaned the area with the help of the PCO and district offices prior to the arrival of cleansing services.

- **Improvement activities**

The absence of a drainage system in the area leaves drain water flowing freely on roads. With the help of the municipality, the community constructed drains and improved road conditions prior to the start of collection services.

The improvement activities are also important in the sanitation of an area. Therefore, the Municipality should not only establish a waste collection system but a sanitation system as well.

**d. Sanitation of the present Acahualinca Disposal Site**

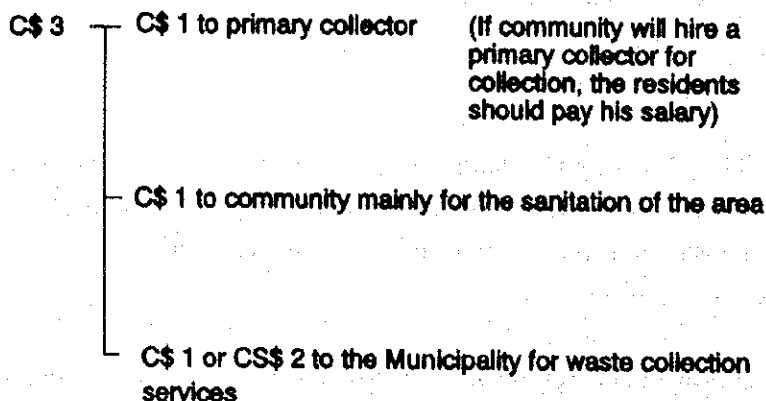
Waste covering activities and the construction of dikes are effective countermeasures for the sanitation of the disposal site. The present disposal operation cost will not be affected by the daily waste covering and dike construction activities because these activities do not require any additional investment, as explained in previous sections. Accordingly, the Public Cleansing Office (PCO) must continue carrying out these measures after the sanitary landfill experiment is completed as they can afford to do so.

Final waste covering operations need twice as much soil used in the daily covering operations and would therefore cause PCO extra expenses for hiring haulage services as it does not have enough haulage equipment. But since it is very important to the sanitation of the Acahualinca disposal site and the future utilization of the area, PCO is requested to carry out such operations, employing any means possible.

PCO is also requested to devise measures that would regulate scavenger activities in the disposal site, as these usually make the area insanitary.

**e. Establishment of Waste Fee Collection System in Squat Areas**

The experiment proved that the following waste fee collection system is necessary to extend collection services to the entire city area.



The Municipality should therefore establish a waste fee collection system in squat areas according to the basic plan proposed in the collection experiment.

**f. Establishment of Community Organizations for the Sanitation of Squat Areas**

The roles of the community organization are as follows:

- contract primary collectors
- contract residents for collection services
- fee collection and management
- establish coordination between the residents and Municipality regarding sanitation activities

The experiment proved the importance of the role of the community and the establishment of a community organization in the extension of collection services to the entire city area and the sanitation of squat areas.

The District Offices should assist the communities in the establishment of organizations based on the basic plan proposed in the collection experiment.

**g. Execution of Public Education Programs on Sanitary Issues**

The execution of public education activities on sanitary issues is proven to be essential for the achievement of the targets of the MSWM Master Plan.

The Municipality should establish public education programs on sanitary issues based on the pilot project conducted by the Study Team.

**9.3 Immediate Improvement Plan of Institutional System**

The immediate institutional improvement plan, without further significant expenses, will be developed based on the following steps:

- i. Settlement of a new section in the PCO to follow up the pilot projects
- ii. Increase waste fee collection ratio
- iii. Starting the planning and control process
- iv. Establishment of a training program

- v. Establishment of supervision structure for illegally dumped waste
- vi. Initiation of administrative improvement works

These activities can be carried out by the existing municipal staff, provided that training is supplied and proper support is given by the Managuan municipal authorities.

**a. Settlement of the New Section in PCO**

In order to achieve the proposed technical system, the new section should be established to follow up the pilot projects. The roles of the new section will be as follows:

- Coordination between municipal authorities related to the pilot projects, specially between the District Office (DO) and the Department of Environmental Education (DEE)
- Supervision of collection area provided with container or bell collection service, sanitary landfill operation and public education campaign through educational videos and booklets
- Expansion of collection area by using methods introduced in the collection experiment

**b. Increase Waste Fee Collection Ratio**

The fees to be collected in the proposed system and the ways to achieve it are:

- Collection fee in Area A : to be collected jointly with the concessionaire
- Collection fee in Area B : to be established according to the proposal based on the collection experiment on squat areas
- Collection fee of commercial and industrial activities: to be made according to a new cadastre based on the amount and type of wastes produced by each business or industry.
- Tipping fee: to be collected at the sanitary landfill gate, based on the amount of waste (ton).
- Rental fee: to be charged to the concessionaires for the use of municipal trucks

Before shifting to the proposed system, in order to ensure the cleansing budget, the Municipality should make an effort to get the understanding and cooperation of residents for cleansing services and to rigidly train the fee collection staff.



**c. Starting the Planning and Control Process**

The data obtained from the truck scale installed at the Acahualinca disposal site is a useful means of checking the efficiency of cleansing work. The planning and control system using the data should be commenced by the PCO.

**d. Establishment of Training Program**

The institutional administrative and managerial administrative training program shall be formed based on the available courses provided by national and international institutions.

Concerning operational activities, maintenance and vehicle related activities should be given special assistance by vehicle dealers and suppliers.

As for other specific operational activities, Public Cleansing Office officials should attend short courses available in Latin America or, if possible, a specific course should be organized in Managua with the help of a national institution on education.

**e. Establishment of Supervision Structure for Illegal Dumping of Waste**

There are countless illegal dump sites in the city. National authorities, e.g., MINSA, National Police and ALMA, should control the development of these sites.

They should carry out the following:

- MINSA should promote understanding and cooperation among residents, factories, etc.
- Control and supervision of illegal dumping activities by the National Police
- Cleaning of wastes dumped in specified areas by ALMA

**f. Initiation of the Administrative Improvement Works**

The improvement of the administrative organs would largely depend on the willingness of the Managuan officials. It is very important to note however that the establishment of either the human resources policy or materials and supplies control system would require a new organizational structure. The personnel involved should also undergo training.

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