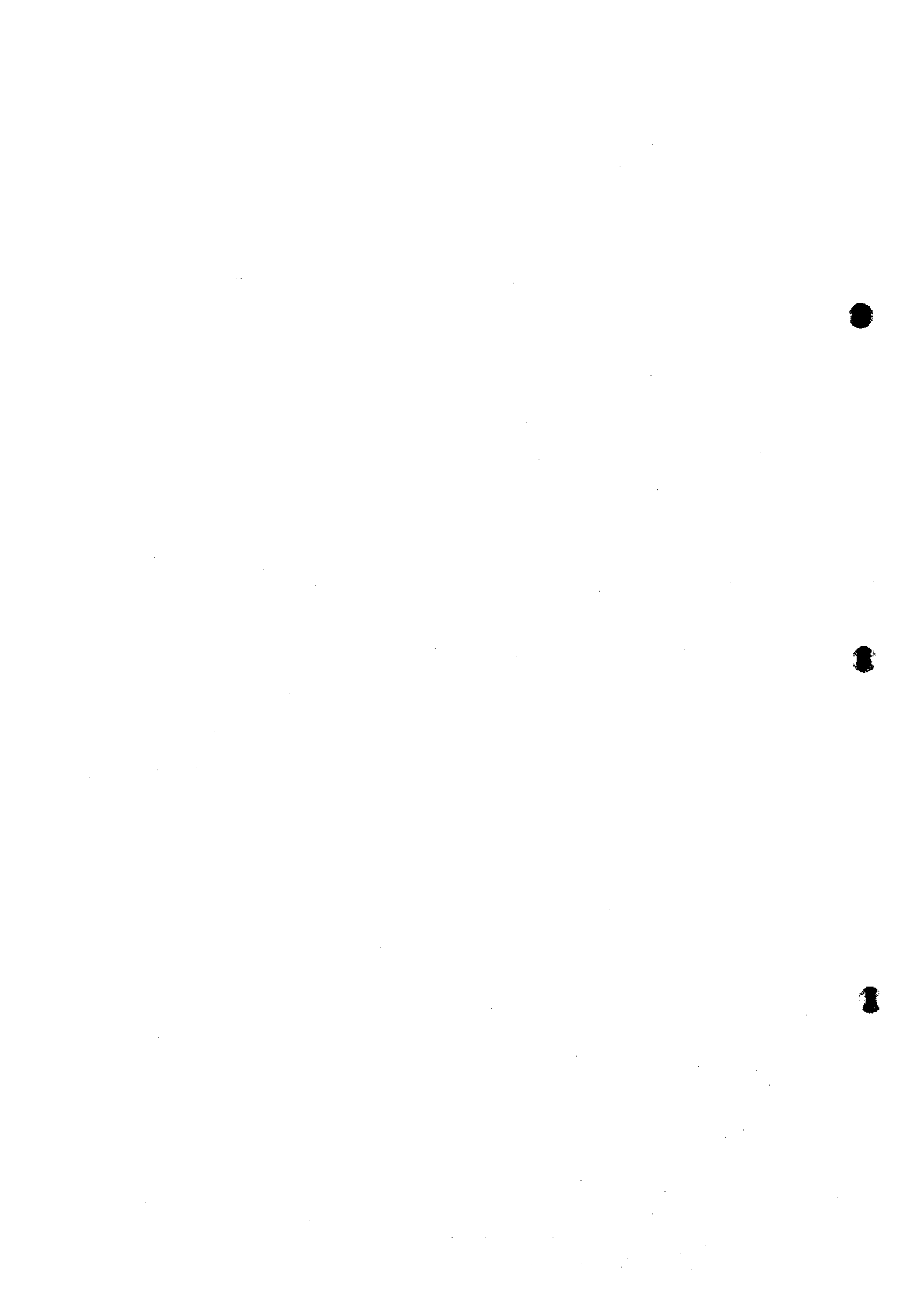


CHAPTER 3

Frameworks of the Priority Projects



3 Frameworks of the Priority Projects

3.1 Selection of Priority Projects

3.1.1 Examination of Priority Projects

Priority projects were selected from the projects from the M/P for USE field, namely, municipal solid waste management, water supply management and domestic wastewater management. Selection of priority projects was examined based on the M/P as follows.

a. Municipal Solid Waste Management

The municipal solid waste management sector faces various problems ranging from collection/haulage to final disposal so that the urgent but comprehensive measures for its improvement are vital. In the M/P, it was suggested that the improvement of collection/haulage system and the establishment of appropriate final disposal by sanitary landfill was given priority. Hence, the "Refuse Collection System Improvement Project" and "New Municipal SW Disposal Site Development Project" were selected as priority projects.

b. Water Supply Management

At present, the water supply coverage rate in Granada City area is over ninety percent, which exceeds INAA's target (eighty five percent of the urban population) in the year 2010. Even if the future population increase in the urban area is taken into account, INAA's target coverage is expected to be reached through proper maintenance of the present water supply infrastructure and its expansion if necessary. Therefore, it was judged that water supply management is not a priority project in this Study.

c. Domestic Wastewater Management

The F/S on the areas where the sewer system improvement is projected in 2010 was undertaken by Inter-American Development Bank's (IDB) in December 1996. INAA intends to carry out the projects on the sewer system and pump stations in line with the plans in this F/S with IDB's finance.

In the INAA's sewerage system development project, sewage treatment measures (i.e., introduction of aeration in the existing Tepetate sewage treatment plant and lagoon expansion in its adjacent areas) are planned in order to cope with the future increase in sewage to be treated. The F/S for the extension of the sewage treatment plant was already completed by INAA with IDB's finance (the final report was also completed in December 1996). Moreover, in March 1997, the landowner's permission to enter the proposed sewage treatment plant extension site, which is adjacent to Tepetate sewage treatment plant, could not be obtained and it was impossible to conduct on-site investigations (topographical and geological surveys) in the 3rd Study Work in Nicaragua (from June to August 1997).

Therefore, the Study Team decided not to include the expansion of the sewer system and sewage treatment plant in the priority projects with the agreement of the Nicaraguan side.

As a result, a domestic wastewater management project in the areas not covered in INAA's sewer development plan by 2010 was selected as a priority project in the domestic wastewater management sector.

However, the majority of the areas where a sewer system is not proposed are slum squatter areas, that is, the urban fringe areas (UFA). The UFA has been expanding without any planning with an influx of people on lower income. In these areas, not only the domestic wastewater treatment system, but also other USE infrastructure such as stormwater drainage and access road, indispensable for waste collection services, are in a poor conditions. This is fundamentally different from the areas where a sewer system is proposed. Therefore, it is essential to improve and integrate the four USE sectors: municipal solid waste management; water supply management; domestic wastewater management; and stormwater drainage, in order to improve the USE of UFAs. Accordingly, the "Model Community Integrated USE Improvement Project" was selected as a priority project.

3.1.2 Selection of Priority Projects

Based on the above examination, the following projects were selected as priority projects in this Study and the F/S was carried out.

1. A New Municipal SW Disposal Site Development Project.
2. Refuse Collection System Improvement Project.
3. Model Community Integrated USE Improvement Project.

Regarding the location of the final disposal site for "A New Municipal SW Disposal Site Development Project", Granada City approved the use of candidate site B: San Jose de la Viuda (SJV) to be a future disposal site, which was selected from the two candidate sites, based on the suggestions by the Study Team.

3.1.3 Initial Environmental Examination (IEE)

An Environmental Impact Assessment (EIA) is compulsory in the Nicaraguan legislation (Decree No. 45-94). "A New Municipal SW Disposal Site Development Project" is the only project to undergo an EIA (Decree No. 45-94) of the three priority projects stated above. Works required for the EIA and the contents of works, necessary to carry out in the F/S, are defined in this regard as the Initial Environmental Examination (IEE).

The Ministry of Environment and Natural Resources (MARENA) issued a "General Guideline for Proposal Elaboration: Terms of Reference for EIA of Municipal Sanitary Landfill (hereinafter MARENA's TOR)" for the Study in response to the Team's request in February 1997. Meanwhile, "JICA Environmental Guidelines" were also used as a reference to supplement the IEE works of the Study.

The IEE consisted of the following steps:

- Step-1 General screening and scoping assessments were made based on MARENA's TOR and JICA Environmental Guidelines. In other words, all environmental items were be listed for scoping.
- Step-2 Scoping was carried out in order to identify the environmental items necessary for the F/S EIA of SJV. In other words, each environmental item listed based

on MARENA's TOR and JICA Guidelines were initially evaluated (i.e., to rank the foreseeable impacts of each environmental items in a brief concise rapid manner).

Step-3 The contents of the EIA (i.e., required work) and possible impact were proposed for each scoped environmental item.

Step-4 Works required for EIA were summarized.

As a result of the IEB, the works required for EIA are summarized as follows:

Topographical Survey, Geological Survey, Hydrological Survey; Traffic Survey; Noise and Vibration Survey; Odor Survey; Water Quality Survey; Air Quality Survey; Soil Pollution Survey; Fauna and Flora Survey; Economic Survey; Land Use Survey; Risk Assessment of the Landfill Site; Meteorological data collection and analysis; Urban Development Planning; Water use in the area; Landscape assessment with a photomontage; Cultural property survey; Estimation of construction waste (from the project); Research on location and availability of soil suitable for use as an impermeable liner and coverage.

3.2 Frameworks for Priority Projects

Prior to the F/S of the priority projects, the following framework was set up by the Study Team.

3.2.1 Components of the Priority Projects and Project Evaluation Method

a. Components of the Priority Projects

The priority projects were composed of various projects. The each priority project and its executing body are summarized below:

Table 3-1: Components of the Priority Projects and Executing Bodies

Components of the Priority Projects	Project executing body
Refuse Collection System Improvement Project	Granada City
A New Municipal SW Disposal Site Development Project	Granada City
Model Community Integrated USE Improvement Project	
1)Water Supply System Improvement Project	1)INAA
2)Refuse Collection Improvement Project	2)Granada City
3)On-Site Domestic Wastewater Treatment System Improvement Project	3)INAA
4)Stormwater Drainage Improvement Project	4)Granada City

b. Project Evaluation Method

The priority projects are evaluated in terms of technical, social, environmental, financial, and economic aspects. The most important evaluation is the financial evaluation which ascertains whether the executing body of the aforementioned priority projects can be financially carry out, operated and managed. Accordingly, judging from the previous

table, the priority projects were divided into the following two projects (F/S-1 and F/S-2) and the project evaluation was carried out respectively.

F/S-1: Municipal Solid Waste Management System Improvement Project

The financial evaluation examines whether or not Granada City is financially capable of implementing the Municipal Solid Waste Management System Improvement Project which is the combination of two projects; Refuse Collection System Improvement Project (including refuse collection improvement, a component of Model Community Integrated USE Improvement Project) and A New Municipal SW Disposal Site Development Project.

Likewise, technical, social, environmental, and economic evaluation examines the competence of the project executing body, Granada Municipality, in the F/S-1: Municipal Solid Waste Management System Improvement Project.

F/S-2: Model Community Integrated USE Improvement Project

The financial evaluation examines whether or not the main project executive body concerned is financially capable of implementing its project. The evaluation was carried out separately for the water supply system and domestic wastewater treatment system with INAA as the main project executing body, and for the stormwater drainage improvement project with Granada City as the main executing body.

Economic evaluation of the projects implemented by the two executing bodies mentioned above examines the feasibility of the projects from the national economic aspect. That is to say, financial costs and benefits used in the financial analysis was converted as economic costs and benefit using relevant conversion factors. Economic Internal Rate of Return (EIRR), calculated based on the total benefit, taking environmental benefit into account, and economic cost, by correcting the distortion of domestic market prices to economic prices, were referred for the economic evaluation.

Technical, social, environmental evaluations were made for the Model Community Integrated USE Improvement Project, which includes refuse collection system improvement.

3.2.2 Framework for Municipal Solid Waste Management System Improvement Project (F/S-1)

a. Refuse Collection System Improvement Project

a.1 Outline of Collection System

Area	Collection method	Vehicle used
Urban core area	Curb collection with a bell notice	Compactor trucks
Urban fringe/semi-urban area	Point collection with a bell notice	Compactor trucks
Public area cleaning and clean-up operation	Manual sweeping and cleaning	Tipper trucks and a wheel loader for the clean-up operation

a.2 The Improvement of the Vehicles/Equipment Maintenance Capacity

The present "Modulo de Operacion" work shop shall be renovated and equipment and tools to enable "preventive maintenance" shall be installed for the maintenance of collection vehicles and heavy machinery.

a.3 Main Proposals for the Organizational Improvement

Items	Proposals for the Improvement
1. Main executing body	Refuse Collection and Public Cleansing Section, Urban Environment Maintenance Department, Granada Municipality
2. Fee collection method	Examine possibility of joint billing with water or electricity bill.
3. Service charge rate	The fee for household waste shall be set in accordance with the level of waste collection service. <ul style="list-style-type: none"> • Highest rate: Curb collection with street sweeping service area • Average rate: Curb collection without street sweeping service area • Lowest rate: Point collection service area Regarding commercial and institutional waste, in principle, the fee will be set in proportion to the amount of waste generated.
4. Contract to private sector	It is recommended that the municipality directly manage and not entrust provision of services to the private sector until its operation and supervising ability is established. Regarding the type of privatization, "contracting out" shall be adopted in principle and adoption of "concessions" shall be avoided as much as possible.

a.4 A New Municipal SW Disposal Site Development Project

Items	Contents of the project
1. Impermeable liner	Install an impermeable liner using clayey material.
2. Leachate treatment	As for the leachate treatment, one option will be selected from the following two to carry out a basic design for the F/S. <ol style="list-style-type: none"> 1) Control and/or dilute the leachate quality to an acceptable concentration level and treat it at the Tepetate sewage treatment plant. 2) Treat the leachate within the disposal site.
3. Organization for operation	Refuse collection and Public Cleansing Section, Urban Environment Maintenance Department, Granada Municipality
4. Disposal fee	As for waste directly brought in, fees to cover landfill operation cost (including equipment depreciation) shall be collected.
5. Hazardous industrial solid waste and infectious medical waste	No hazardous industrial solid waste and infectious medical waste are to be accepted at the new municipal waste disposal site.

3.2.3 Framework for Model Community Integrated USE Improvement Project (F/S-2)

a. The Urban Fringe Area (UFA)

The UFA is newly developed in the peripheries of the existing city. Although the UFA is developed around Granada City, communities with the following conditions were

selected as candidate areas for "A Model Community Integrated USE Improvement Project" in this Study"

- A community which is not included in INAA's sewerage project for the year 2010.
- A community developed in the south of the city with a relatively high population density.
- Investigations such as topographic survey were carried out for the areas selected as the candidate areas (C1, C2, C3 and C7) for the Model Community.

The present conditions of the candidate areas are as follows;

Table 3-2: The Present Conditions of Model Community Candidate Areas

Zone	Community	Community Development Period	Water Supply System	Waste Collection	Domestic Wastewater Treatment	Stormwater Drainage	Roads
C ₁	Eddy Ruiz, etc.	1980 onward	Provided	Irregular Collection	Latrine for night soil, sullage is untreated	Not Provided	Not Paved
C ₂	Adelita, etc.	1980 onward	Provided	Irregular Collection	Latrine for night soil, sullage is untreated	Not Provided	Not paved
C ₃	El Rosario, etc.	Before 1980	Provided	Irregular Collection	Latrine for night soil, sullage is untreated	Not Provided	Not Paved
C ₇	San Ignacio	1980 onward	Will be provided if a certain size of community is developed	No Collection	Partly no toilet system. Sullage is untreated.	Not Provided	Not Paved

The size of the areas, present population and population density of the candidate areas, and its future population projection stated in INAA's plan are as follows.

Table 3-3: Population and Population Density of the Model Community Candidate Areas

Zone	Area (ha)	1995		2000		2005		2010	
		Population (person)	Population Density (person/ha)	Population (person)	Population Density (person/ha)	Population (person)	Population Density (person/ha)	Population (person)	Population Density (person/ha)
C ₁	33	4,997	153	5,466	167	5,979	183	6,658	204
C ₂	31	3,992	130	4,608	150	5,319	173	6,251	204
C ₃	67	7,789	117	8,471	127	9,213	138	10,201	153
C ₇	60	868	14	1,899	31	4,147	69	9,224	153
Total	191	17,646	92	20,444	107	24,658	129	32,334	169
Areas subject to the sewerage system	559	53,525	96	59,652	107	66,698	119	74,266	133

b. Selection of Model Community Areas

As the previous two tables illustrate, the conditions observed in these areas are as follows:

- According to INAA¹, in 1995, the C1, C2 and C3 areas had a population density exceeding 100 persons/ha and the population density of C1 and C2 is estimated to exceed 200 persons/ha in 2010.
- In contrast, the population density of C7 in 1995 was only 14 persons/ha.
- C1, C2 and C3 have streets along which the construction of facilities (e.g. pipelines and wastewater treatment facility, road improvement) can be planned. Such a plan is not possible for C7 as it has no streets.
- Accordingly, C1, C2, C3 (population of approximately 23,000) where the 1995 population density of more than 100 persons/ha is forecast to further increase in 2010, will be given priority for the improvement. Realistic planning is possible for these areas as streets are already established in these areas.

Therefore, C1, C2 and C3 will have to be subject to the M/P of Model Community Integrated USE Improvement. The M/P assumes construction of facilities by 2010 for these areas. The areas where the improvement of the facility will be completed by 2005, starting in 2001 are subject to F/S. This is based on the assumptions that the improvement ratio increases regularly by 2010.

¹ ESTUDIO DE RIORIZACION DE INVERSIONES EN SECTOR DE AGUA POTABLEY ALCANTARILLADO SANITARIO, ALCANTARILLADO SANITARIO DE LA CIUDAD DE GRANADA, DICIEMBRE 1996, I.N.A.A. ITS, Lotti, Iamsa

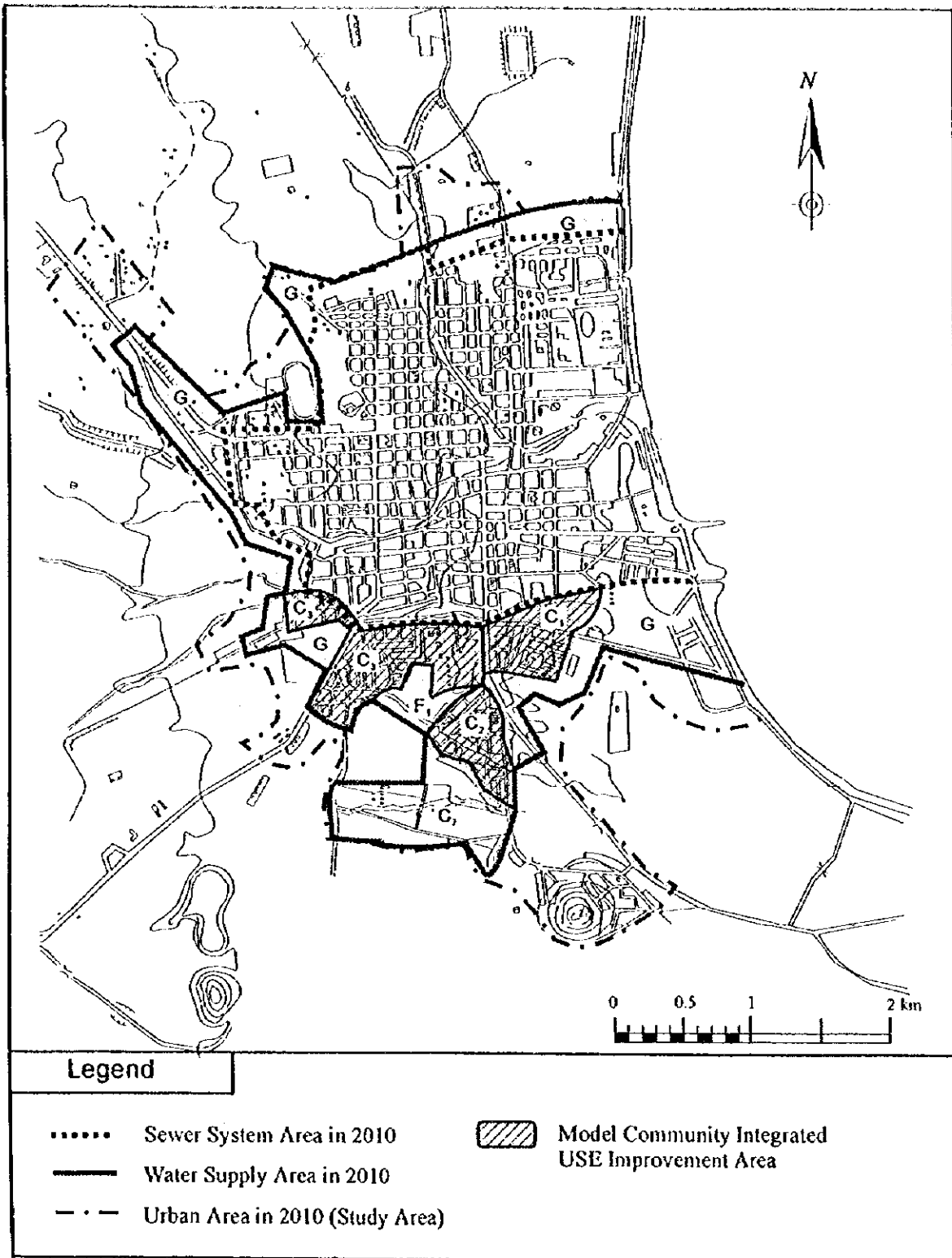


Figure 3-1: Location of the Model Community

c. Framework for Water Supply System Improvement Project

The majority of the model communities are located in the UFA of the city and the residents in these areas are on low income. In most cases in developing countries, there are no taps in each household in the UFA and a communal tap is usually shared by neighbors. However, the majority of the households in the UFA in the major cities in Nicaragua have taps. This can be highly evaluated as the outcome of the efforts made by Nicaraguan government, and people concerned with INAA. The majority of the UFA are provided with the water supply system in Granada City. The Model Community in this Study is also provided with the water supply system.

The water supply coverage was one of the top priorities in USE improvement, however, the buried depth of the water pipe was extremely shallow in many cases. This caused the water pipes to burst frequently. Meanwhile the shallow water pipes buried in roads made repairs and stormwater drainage provision difficult. This problem can be solved for the areas where water supply system is not yet provided if INAA strictly complies with the norm of water pipe buried depth (i.e. more than 1.2 meter). As for the areas where the water supply system is already provided, the problem related to the shallow buried depth of the water pipes can be solved by improving it simultaneously when other USE infrastructure works are newly provided.

As a conclusion deduced from the facts above, water supply system project is not adopted as a component of F/S-2 at this time with the following reasons:

1. A water supply system is provided in the majority of residential areas in the model community, which is defined as C₁, C₂, C₃, C₇ and whose topography is surveyed in this Study. There is no urbanization plan for these areas except for the population forecast shown in Table 3-3 so that a water supply plan can not be detailed for the areas.
2. The water supply improvement in the community where the system is already provided will be mainly repair work of damaged water pipes, connection of new houses from existing branches. Or the existing water supply system will be renovated when other USE infrastructure is newly provided.

d. Framework for Refuse Collection Improvement Project

As was clarified in the "Experiment on Improvement of Refuse Collection System" carried out in Eddy Ruiz III and "Experiment on Improvement of Arroyo Zacateligue Sanitation Environment", a point collection system, which strictly stipulates the rules on waste discharge (place, time, and method), is basically accepted by residents. Moreover, it was found that if a regular collection service is provided, the problems of illegal dumping in vacant land and rivers by the residents will be solved. Furthermore, judging from the observation on the amount of waste discharged per week from each waste collection point in the experiments, it is possible to reduce costs by reducing collection frequency from three times to twice a week.

Thus, regarding waste collection method, ways to share collection cost, encouraging resident participation, and providing public education, plans will be promoted in the F/S based on the outcome of the aforementioned pilot projects. Moreover, financial evaluation of this component (Refuse Collection Improvement Project) of F/S-2 is

covered by the financial evaluation of F/S-1: Municipal Solid Waste Management System Improvement Project.

e. Framework for On-Site Domestic Wastewater Treatment System Improvement Project

e.1 Role of each related Institution

Related institution Items	Granada Municipality	INAA	Recipient Residents	Remarks
Project Planning	Supporting	Main	Consensus among residents should be organized.	MINSA: Public education, enhancing public awareness
Land Acquisition	Main	Main	Support	Nothing in particular
Project Cost Sharing	No cost sharing in principle	Main	Share the cost partially as much as possible (cost of connection, etc.)	Securing the support from the aid agencies as much as possible
Facility Construction	None (in principle)	Main	Labor provision (if possible)	Contractor to be employed
Operation & Maintenance of the Facility	None (in principle)	Disposal of sludge generated at the facility	O&M of the facility as much as possible (e.g., catch pit cleaning individually)	Nothing in particular
Service Charges	Nothing in particular	Collection sewerage bill	Pay sewerage bill	Nothing in particular

e.2 Establishing Priorities

Judging from the pilot project (i.e., Experiment on Domestic Wastewater Collective Treatment System in Adelita), the on-site domestic wastewater treatment system requires a significant amount of construction cost. Moreover, in order to implement the project, various issues (e.g., land acquisition, cooperation and participation of residents, etc.) need to be solved. The questionnaire survey that polled 155 residents in the model community showed that they consider the priorities in USE establishment were (ranked in order of importance) domestic wastewater treatment, refuse collection, stormwater drainage and water supply system. This is to say, residents living in the model community expressed a strong desire for the domestic wastewater treatment project to be implemented first, in his/her community. Therefore, the priorities in improving the facilities in the model community should be set in consideration of the following:

- Setting a priority on communities where problems on USE are serious.
- A community, which has already agreed to and determined the site for the construction of the facility based on residents' consensus, should receive priority among the communities prioritized in the above consideration.
- Moreover, give further priority to the community which expressed the intention of bearing a portion of construction cost (e.g., cost of internal connection).

f. Framework for Stormwater Drainage Improvement Project

f.1 Technical Aspect of the Improvement

Regarding stormwater drainage in the model community, it is suggested that the stormwater drainage improvement should be planned to maximize the use of road

surface as a drainage channel. In practice, existing drainage and outfall to rivers should be reinforced when the road is being rehabilitated. The reasons are outlined as follows.

- The USE infrastructure in the model community area is in a poor condition in every aspect. If all the infrastructure is to be improved, a huge amount of capital is required. However, Granada Municipality does not have the financial resources to cover the cost. Therefore, it is vital to adopt a method that will reduce the financial burden as much as possible when planning improvements of any USE infrastructure.
- The method which utilizes the roads as drainage channels has been adopted in some parts of the existing urban area of the city.
- As mentioned above, the buried depth of the water pipes are very shallow in almost all of the model community. Therefore if a new stormwater drainage system is to be proposed, it is necessary to reinstall all water pipes.
- As rainfall intensity in Granada is significantly high (e.g., 61.6 mm/hr as a six month probability), the stormwater drains would require a large dimension.

f.2 The Role of each Related Institution

Related institution Items	Granada Municipality	Recipient Residents	Remarks
Project Planning	Main	Consensus among residents should be organized.	MCT: Technical support
Land Acquisition	Main	Supporting	Cooperation by MCT
Project Cost Sharing	Main	Sharing the cost partially as much as possible (e.g. by labor provision, etc.)	Securing the support from the aid agencies as much as possible
Facility Construction	Main	Labor provision (if possible)	Contractor to be employed
Operation and Maintenance of the facility	Main	Road cleaning etc.	Nothing in particular

f.3 Setting Priorities

The improvement of roads, which also serve as stormwater drainage, requires a considerable amount of construction cost. Moreover, in order to implement the project, various issues (e.g., land acquisition, cooperation and participation of residents, etc.) need to be solved. The establishment of roads which also served as stormwater drainage is indispensable not only for the stormwater, but also for the implementation of the refuse collection improvement project. Therefore, the priorities in improving the facilities in the model community should be set in consideration of the following:

- Setting a priority on communities where road access is hindered when it rains.
- A community, which has already agreed to and determined the sites and construction of drainage channels based on, should receive priority among the communities prioritized in the above consideration.
- Moreover, give further priority to the community which expressed the intention of bearing a portion of construction cost (e.g., including labor provision).

CHAPTER 4

*F/S - 1:
Municipal SWM System
Improvement Project*

4 F/S-1: Municipal SWM System Improvement Project

4.1 Outline of the Municipal SWM System Improvement Project

a. Target

The Municipal SWM System Improvement Project aims to improve solid waste collection, haulage transportation and disposal systems between 2001 and 2005 in order to achieve the targets shown in Table 4-1.

Table 4-1: Targets of Municipal Solid Waste Management System Improvement Project

Item	Unit	1996 (At the time of the Study)	2001	2003	2005
Population in Granada City	persons	96,996	126,307	147,830	171,618
Population within Study area	persons	76,250	100,382	107,330	114,760
Waste generation amount (A)	ton/day	57.1	80.3	88.5	97.5
Waste discharge amount (B)	ton/day	43.2	62.8	70.1	78.2
Waste collection amount (C)	ton/day	35.4	56.5	63.1	70.4
Coverage Rate (C/B)	%	81.9	90	90	90
Population served	persons	48,037	89,083	96,249	101,843
Street Sweeping	km	35	35	37	40
Final disposal					
Disposal amount	thousand m ³ /year	16.8	26.8	29.8	33.1
Name of the disposal site	-	La Joya	SJV a new landfill site		
Level of disposal method	-	Level 1	Level 4		

b. Outline of Municipal SWM System Improvement Project

The outline of the project proposed to realize the targets in Table 4-1 are shown in Table 4-2.

Table 4-2: Outline of Municipal SWM System Improvement Project

Projects	Contents
1. Refuse Collection System Improvement Project	
1.1 Refuse Collection System Improvement	<ul style="list-style-type: none"> • Procurement of equipment: • General collection (street/point) • 12m³ compactor truck: 5 Units in 2000, 1 in 2002, 1 in 2004 • Special collection service • 1 10m³ tipper truck (2000), • 1 wheel loader (2000)
1.2 Improvement of Street Sweeping	<ul style="list-style-type: none"> • Procurement of equipment: • m³ compactor trucks (included in the above) • 30 hand cart units

Projects	Contents
1.3 Improvement of the Modulo de Operacion Workshop	<ul style="list-style-type: none"> • Renovation in 2000, Operation from 2001. • Renovation works: operation yard, inspection pit, water tank, lighting, electrical system, etc. • Procurement of equipment, tools, etc.
2. SJV A New Municipal SW Disposal Site Development Project	<ul style="list-style-type: none"> • Construction in 2000, Operation from 2001. • Level of Sanitary Landfill: level 4 (i.e., sanitary landfill with a leachate treatment facility) • Total volume (till 2010): 436,700 m³, • Volume of F/S period (till 2005): 179,400 m³ • Major facilities: One landfill section for 5 years (3.5 ha), regulation pond, facultative lagoon, maturation pond, access road, office, stormwater drainage system, etc. • Procurement of landfill equipment: 1 bulldozer, 1 backhoe, 1 tipper truck, and 1 water tanker
3. Improvement of Administrative System	<ul style="list-style-type: none"> • Strengthening of the UEMB (Urban Environmental Maintenance Bureau, and procurement of office equipment • Improvement of organizational system

4.2 Field Investigation

In the 3rd Study Work in Nicaragua, the field investigations necessary for the F/S of Municipal Solid Waste Management System Improvement Project (F/S-1) was carried out.

4.2.1 Refuse Collection System Improvement Project

A survey was carried out on "Modulo de Operacion" maintenance workshop, which maintains and repairs vehicles and heavy machinery, etc. owned by Granada Municipality at present, for the Refuse Collection System Improvement Project.

4.2.2 A New Municipal SW Disposal Site Development Project

The following surveys, necessary for formulating A New Municipal SW Disposal Site Development Project and its Environmental Impact Assessment (EIA), were conducted.

1. Topographical survey of the SJV site
2. Route survey from the SJV site to Tepetate sewage treatment plant
3. Geological survey of SJV
4. Environmental Baseline Survey of SJV. It comprises: water quality survey; air quality survey; hydrological survey; noise and vibration survey; traffic volume survey; odor survey; soil analysis; flora and fauna survey; economic activities survey; land use survey; water use survey; landscape analysis by photo-montage; cultural heritage survey; borrow pit survey for cover soil and soil for an impermeable liner.

4.3 Refuse Collection System Improvement Project

4.3.1 Refuse Collection System Improvement Service

a. Classification of Collection Service

The collection service planned shall be classified in consideration of the conditions of the areas and quality of services required. The classification of the areas is shown in Figure 4-1. The collection service is classified into the 4 categories as follows:

1. **Curb Collection Area A: CCA**
Urban Core Area with street sweeping services
2. **Curb Collection Area B: CCB**
Urban Core Area/Semi-Urban Area without street sweeping
3. **Point Collection Area: PCA**
Urban Fringe/Semi-Urban Area without street sweeping
4. **Special Collection Service: SCS**
Special collection services to collect bulky waste, the large amount of garden waste etc., and removal of illegally dumped waste and sedimented soil.

Based on the collection service plan classified above, the waste collection amount and rate to be achieved during the F/S period are summarized in the following table. Moreover, besides the municipal collection service, directly hauled non-hazardous and industrial wastes, etc. were taken into account.

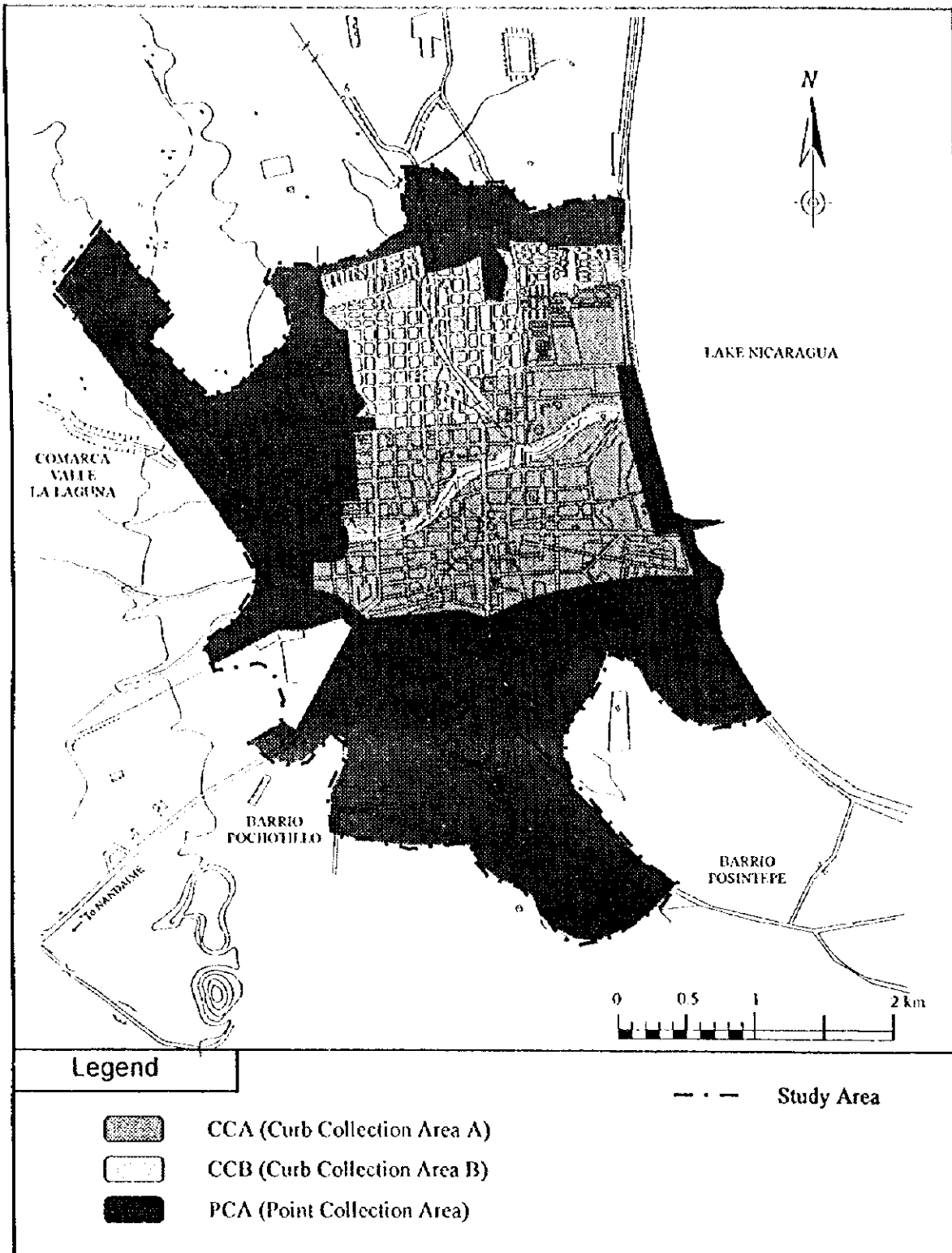


Figure 4-1: Classification of Waste Collection Areas

Table 4-3: Waste Collection Plan

Item	code	Unit	1996	2001	2002	2003	2004	2005
Total generation amount	a+b+c	ton/day	57.1	80.3	84.2	88.5	92.7	97.5
Discharge amount (including street sweeping amount)	a	ton/day	43.2	62.8	66.2	70.1	73.9	78.2
Self disposal amount	b	ton/day	8.9	10.5	10.6	10.7	10.7	10.8
Recycling at generation	c	ton/day	5.0	7.0	7.4	7.7	8.1	8.5
Collection rate	(A/a)	%	81.9	90.0	90.0	90.0	90.0	90.0
Total collection amount (A)	A=e+h+j	population (person)	48,037	89,083	92,115	95,249	98,491	101,843
		ton/day	35.4	56.5	59.6	63.1	66.5	70.4
Curb Collection Area A		population (person)	--	35,633	36,845	38,099	39,397	40,737
	General waste : d	ton/day	--	24.0	25.3	26.6	28.1	29.7
	Street sweeping waste : e	ton/day	--	1.3	1.3	1.4	1.4	1.5
Curb Collection Area B		population (person)	--	26,725	27,635	28,575	29,547	30,553
	f	ton/day	--	15.1	16.0	17.0	17.9	19.0
Point Collection Area		population (person)	--	26,725	27,635	28,575	29,547	30,553
	g	ton/day	--	15.1	16.0	17.0	17.9	19.0
Household waste (street sweeping amount not included)	h=d+f+g	ton/day	--	54.2	57.3	60.6	63.9	67.7
Special Collection Service	Illegally dumped waste: i	ton/day	--	6.3	6.6	7.0	7.4	7.8
	Bulky waste: j	ton/day	--	1.0	1.0	1.1	1.2	1.2
Other wastes (direct haulage)	k	ton/day	2.0	2.2	2.2	2.2	2.3	2.3

b. Waste Collection Frequency

The frequency of waste collection shall be as follows;

Curb Collection Area A: 4 times/week

Curb Collection Area B: 3 times/week

Point Collection Area: 2 times/week

c. Waste Collection Vehicle

A compactor truck (12m³) was selected to perform street/point collection of waste as it is more economical compared with a tipper truck. A tipper truck was selected as a vehicle for special collection services since it can gain access to area where road conditions are poor to collect bulky waste and illegally dumped wastes, which are often dumped into the riverside or close to the areas with poorly maintained roads.

Waste collection vehicles are planned for respective collection services as follows;

Table 4-4: Waste Collection Vehicle Plan

Collection Service	Type of Vehicles	Code	Waste Collection Amount (ton/day)		
			Year 2001	Year 2003	Year 2005
General collection service CCA CCB PCA	12m ³ compactor truck	e h	55.5	62.0	69.2
Special collection service	10m ³ tipper truck Wheel loader	i j	7.3	8.1	9.0
Total			62.8	70.1	69.2

d. Quantification of Required Equipment

The required number of equipment are calculated as shown in the table below, based on the waste collection vehicle plan.

Table 4-5: Waste Collection Equipment Plan

Collection service	Type of vehicle	Number of Trips (times/day)	Waste Haulage Amount (ton/day/truck)	Number of Vehicles		
				2001	2003	2005
General collection service CCA CCB PCA	12 m ³ compactor truck	3	13.09	5	6	7
Special collection service	10 m ³ tipper truck Wheel loader	4	14.55	1	1	1
Total				6	7	8

e. Maintenance of Equipment

The location and size of a maintenance shop and a motor pool for the planned vehicles were examined in view of: distribution of collection service areas in Granada City; road infrastructure and conditions; disposal site location and collection/haulage distance; and initial investment costs for construction and its O&M cost. The renovation of Modulo de Operacion (MDO) is proposed in order to double its function as a maintenance shop and motor pool. The maintenance of equipment could be carried out at MDO, owned by Granada Municipality, so that it is unnecessary to spend a large amount of capital to procure new property and to construct a motor pool and a maintenance shop (refer to Figure 4-2).

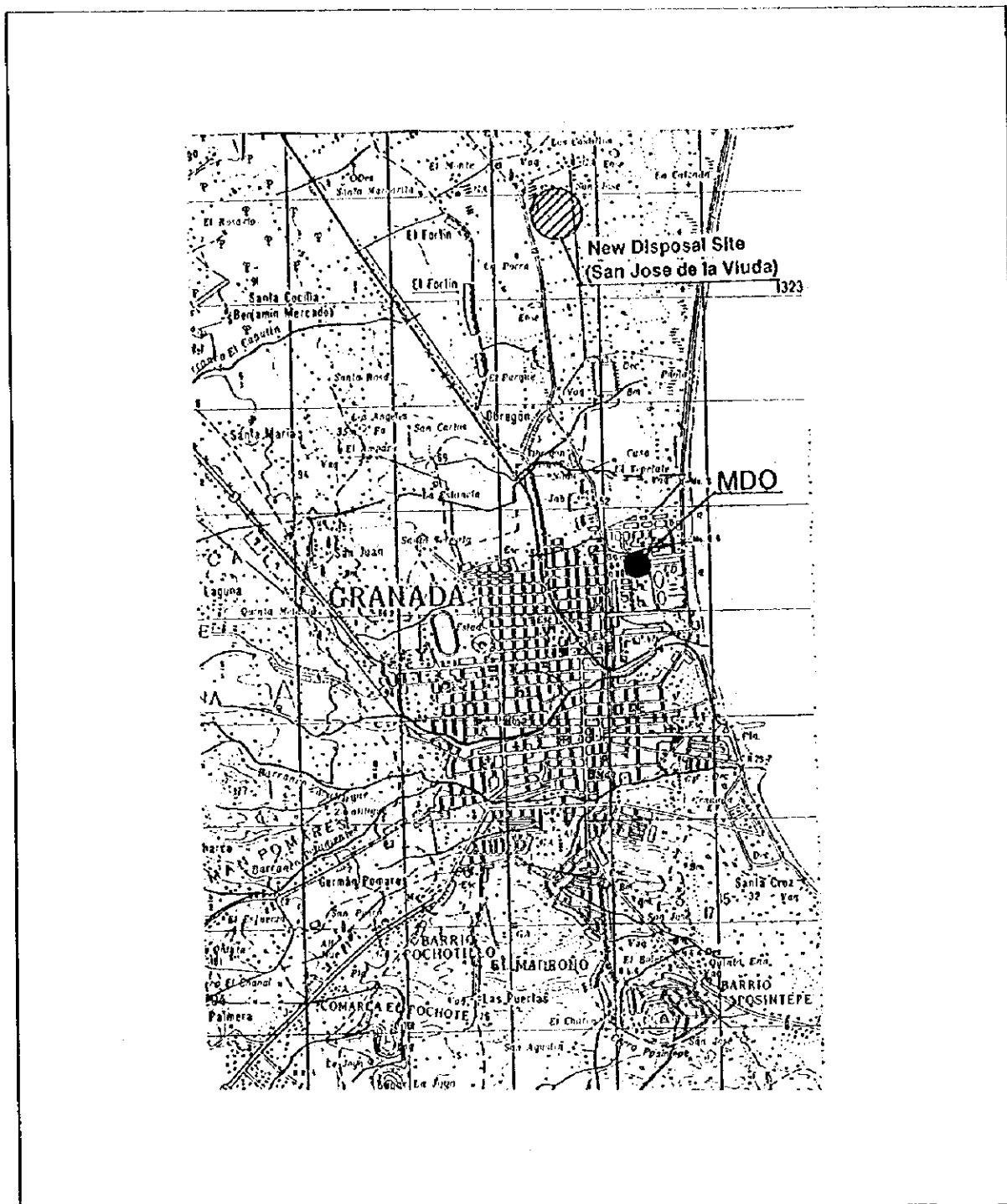


Figure 4-2: MDO Location Plan

4.3.2 Improvement of Street Sweeping

Street sweeping shall be carried out manually by using hand carts in Curb Collection Area A. The waste collected shall be placed along the roadside to be collected together with household waste in CCA by the curb collection service. The improvement proposals for street sweeping till the year 2005 is outlined in Table 4-6 below:

Table 4-6: Improvement of Street Sweeping

Item	Unit	2001	2002	2003	2004	2005
Length of road swept	km	35	36	37	39	40
Waste collection vehicle (12m ³ compactor truck)	units	0 ^{*1}	0 ^{*1}	0 ^{*1}	0 ^{*1}	0 ^{*1}
Driver of waste collection vehicle	person	0 ^{*1}	0 ^{*1}	0 ^{*1}	0 ^{*1}	0 ^{*1}
Hand cart	Nos	30	30	30	30	30
Sweeping worker	person	30	30	30	30	30

Note: ^{*1}: As the vehicles required for collecting street sweeping waste are quantified as vehicles for general collection, it is not quantified here.

4.3.3 Improvement of the Modulo de Operacion (MDO) Workshop

Modulo de Operacion workshop, which is now used as a garage for the trucks and machinery (e.g., motor grader and wheel loader) owned by Granada Municipality shall be renovated as shown in Figure 4-3. MDO shall also serve as a workshop for the waste collection vehicles and disposal site equipment. The activities of the workshop shall be limited to routine and preventive maintenance and breakdown repair shall be entrusted to private workshop. As Granada Municipality owns the MDO workshop, there is no need to acquire additional land property for improvement. The main contents of the improvement plan are as follows:

a. Operation Yard

At present, the operation yard in front of the workshop building is unpaved so that when it rains, the mud prevents vehicles from entering the workshop. As a solution, the operation yard shall be paved with concrete and also a drainage ditch shall be installed in order to drain stormwater. The outline of the operation yard improvement is shown in Table 4-7.

Table 4-7: Outline of Operation Yard Improvement

Contents		Quantity
Pavement	Concrete paving (t=20cm)	A=1,400m ²
Drainage ditch	U-shaped side ditch (U300×300)	L=40m

b. Lighting Works

As slates are used for the roof of the present workshop building, the workshop interior is dark and not fully utilized. Therefore, a part of the present roof (approximately 180 m²) shall be replaced with transparent roofing materials in order to improve the working

environment of the workshop (Refer to Figure 4-5: Roof Improvement Plan of MDO Workshop).

c. Facilities and Tools for Maintenance

Although breakdown repairs are planned to be entrusted to the private workshops, the present workshop is not sufficiently equipped even for routine and preventive maintenance of refuse collection vehicles and heavy machinery of the disposal site. Thus, the following facilities and tools shall be newly provided and electrical system also be improved for a larger capacity as shown in Table 4-8 below.

Table 4-8: Improvement of Facilities and Tools for Maintenance

Contents	Quantity
For general maintenance and repair	One set
Tire repair equipment	One set
Battery equipment	One set
Inspection pit	One set
Parts and tool storage	One set
Electrical system	One set

d. Installation of Car Wash

A car wash shall be installed to prevent vehicles and heavy machinery from corrosion caused by waste during collection and landfill work. It will also make routine inspections of the vehicles easier, and to prolong service life of the vehicles.

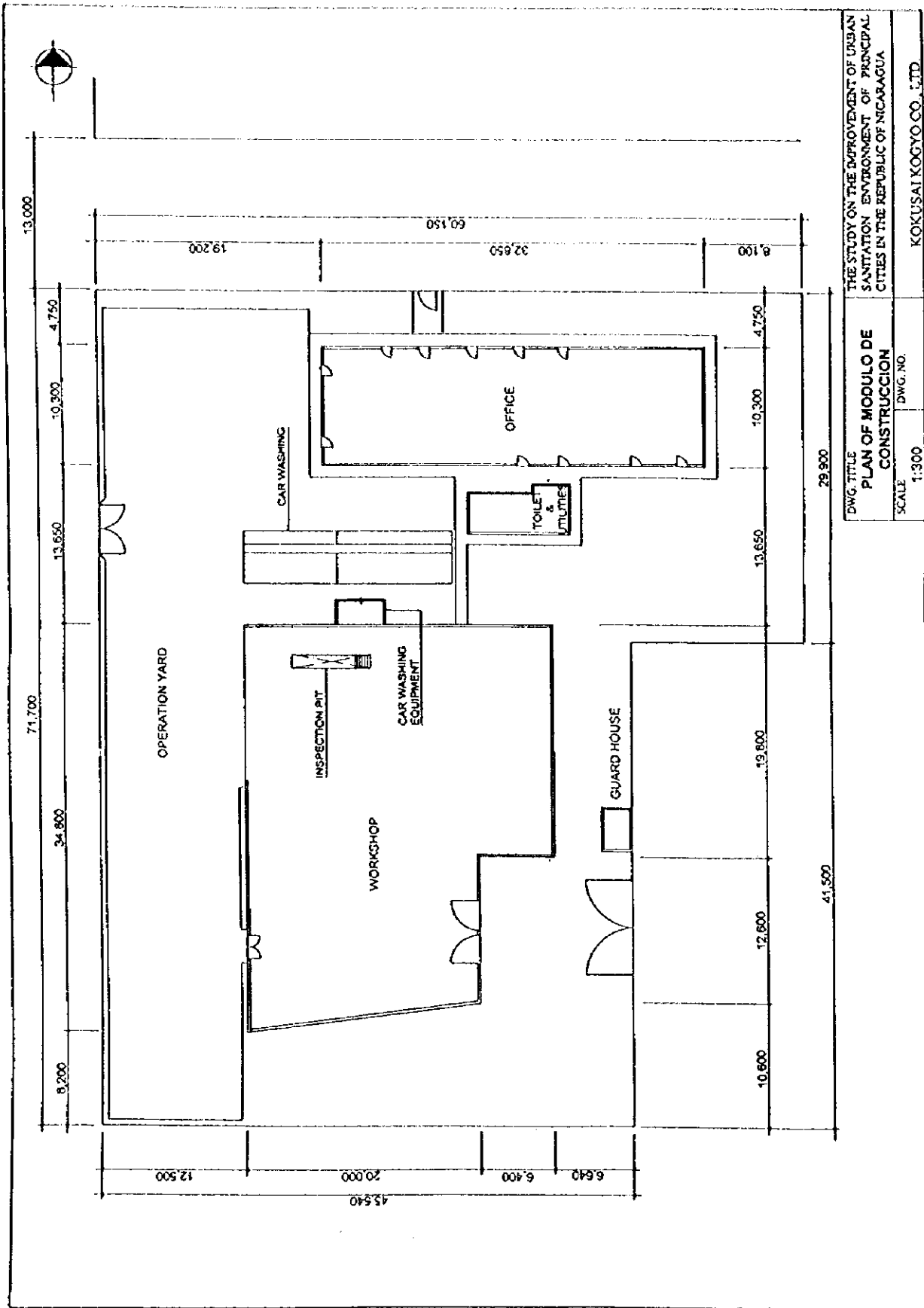


Figure 4-3: Improvement of MDO Workshop

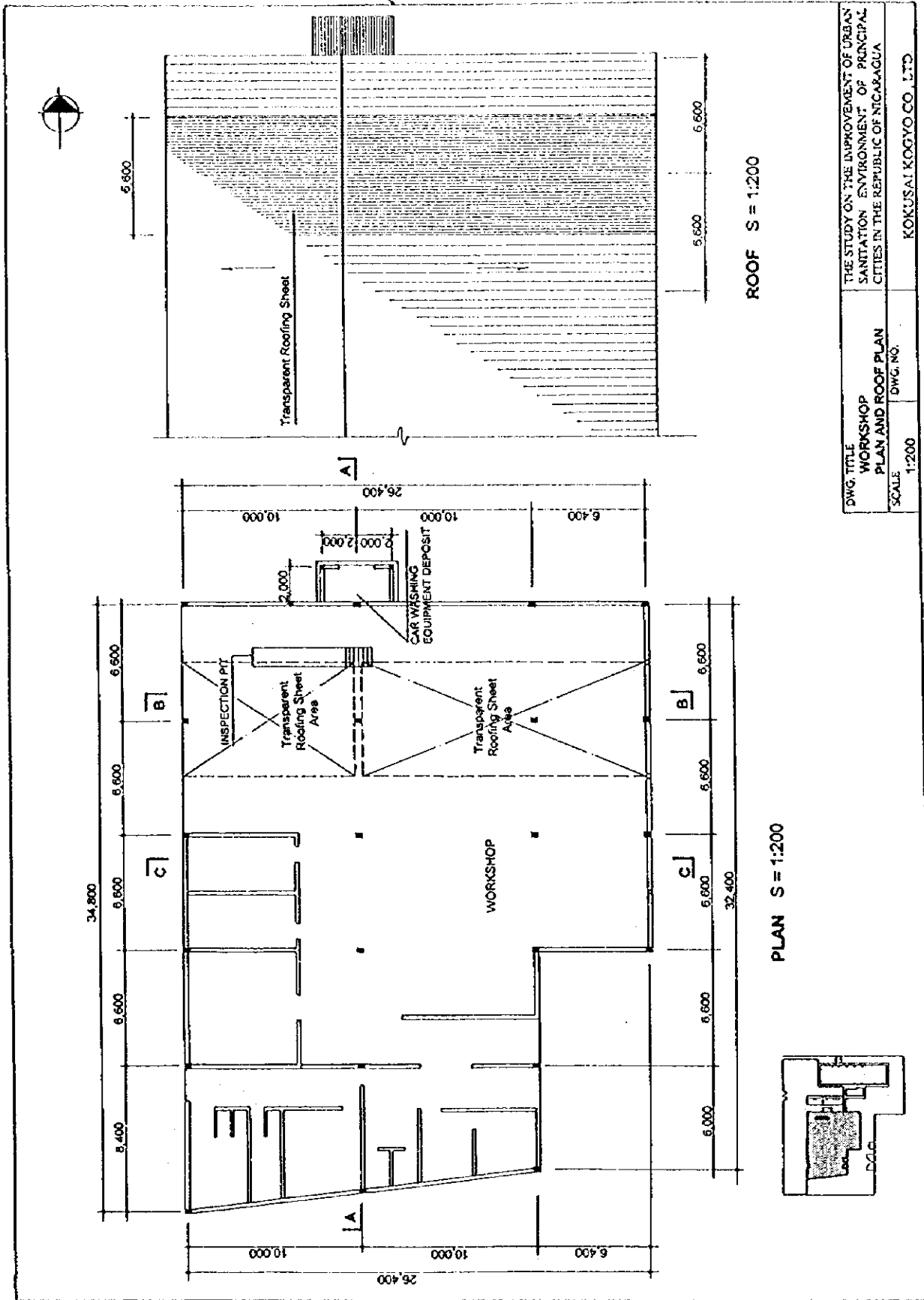
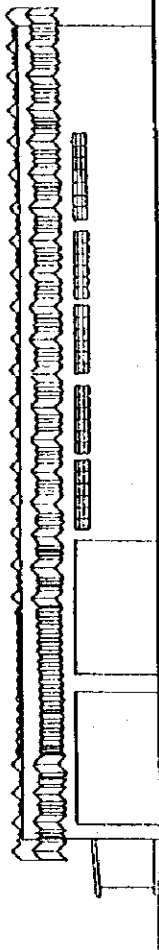
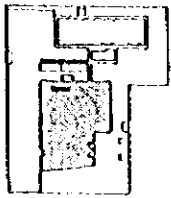
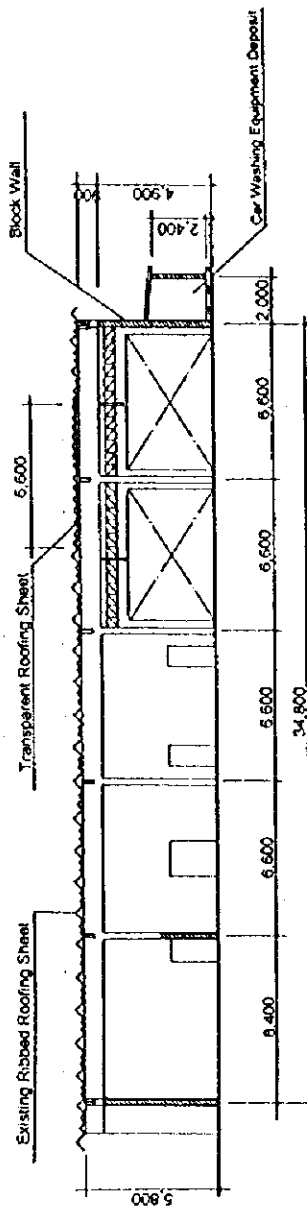


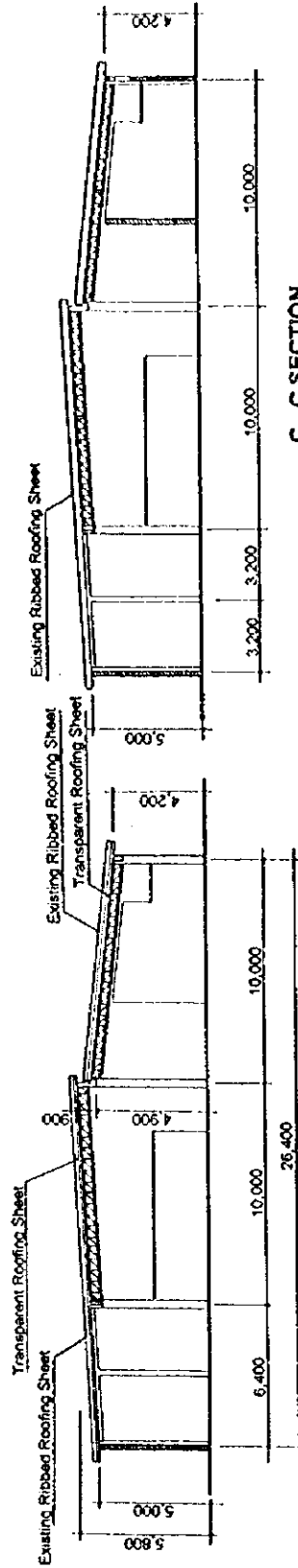
Figure 4-4: MDO Workshop Improvement



WEST ELEVATION



A - A SECTION



B - B SECTION

C - C SECTION

DWG. TITLE		THE STUDY ON THE IMPROVEMENT OF URBAN SANITATION ENVIRONMENT OF PRINCIPAL CITIES IN THE REPUBLIC OF NICARAGUA
WORKSHOP ELEVATION AND SECTIONS		
SCALE	DWG. NO.	KOKUSAI KOGYO CO., LTD.
1:200		

Figure 4-5: Roof Improvement of MDO Workshop

4.4 SJV A New Municipal SW Disposal Site Development Project

A new Municipal SW disposal site shall be constructed in San Jose de la Viuda (SJV) site, which is located approximately 5km from the city center.

a. Appropriate Improvement Level of SJV A New Municipal SW Disposal Site

a.1 Examination on the Necessity of an Impermeable Liner

The financial evaluation in IT/R (2) clarified that the construction and operation of a sanitary landfill site with an impermeable liner (i.e., more than level 3) bring about increase of cost sharing by both the residents and Granada Municipality. This is because the cost of a sanitary landfill with an impermeable liner is twice as much as one without it. Thus, in the 3rd Study Work in Nicaragua, meetings were held among MARENA, INIFOM, and Granada Municipality etc., to review the appropriate level of improvement of a municipal SW disposal site, with the focus on the necessity of an impermeable liner. Whether or not residents can bear the increased cost was also examined in these meetings.

As a result, it was concluded, at first, that even though cost sharing by the residents and the municipality will increase, an impermeable liner should be installed, considering conservation of Lake Nicaragua's water quality and the surrounding areas. Furthermore, mutual agreement has been reached to install an impermeable liner with clay, which enables local constructors in Nicaragua to undertake construction and thus minimizes construction cost of the facility. Consequently, the level of improvement of the disposal site shall either be level 3 or 4. Leachate treatment technology would be required for the project, even though the impermeable clay liner can be constructed by a local constructor with less cost.

Judging from the rainfall data of Granada City, it is difficult to apply level 3 as percolation of untreated leachate in to wetlands or Lake Nicaragua is inevitable during and after rainfall. Therefore, a level 4 sanitary landfill which requires leachate treatment facility is examined here.

a.2 Examination of Leachate Treatment System

The Study Team discussed with the Nicaraguan side as to whether or not the design of leachate treatment, in which leachate is diluted to an acceptable concentration and to be treated at Tepetate sewage treatment plant, is feasible or not. A definitive conclusion could not be reached by INAA at that time, in view of the limited capacity of the present plant. Consequently, it was mutually agreed that the two options below should be compared and examined in the 3rd Study Work in Japan by the Study Team. One of the two options were selected in order to carry out the F/S.

- 1) Leachate should be diluted to an acceptable level and to be treated at Tepetate sewage treatment plant.
- 2) An independent leachate treatment system to be installed at the SJV site.

The problems of the two options can be summarized as follows:

Table 4-9: Comparative Study of Leachate Treatment System

	Technical Problem	Institutional Problem
1) Leachate treated at Tepetate Sewage Treatment Plant	<ul style="list-style-type: none"> The amount of diluted leachate constitutes a significant increase in the influent of the sewage treatment plant in view of its capacity. Therefore, the expansion of the sewage treatment plant becomes indispensable. 	<ul style="list-style-type: none"> The service of INAA's finances for the expansion of the plant is still undecided. It was decided that the expansion of Tepetate plant is not possible in the Study, because the landowner of the site did not permit the Team to enter the site for field investigations. Furthermore, INAA expected IDB funds for the expansion.
2) Leachate treated at the disposal site	<ul style="list-style-type: none"> Considerable increase in construction cost and operation and maintenance cost. Whether or not the municipality is technically capable of operating and managing the treatment facility. Where to discharge the treated effluent. 	<ul style="list-style-type: none"> Operation and maintenance costs increase.

a.3 Selection of Leachate Treatment System

First of all, the Study Team examined a closed system which does not require treatment outside the disposal site by recirculating leachate back to the disposal site, except during heavy rain.

It was found that, even a 6,000 m³ regulation pond that is designed for regulating the fluctuation in leachate generation, 250 m³/day of raw leachate still needs to be treated outside of the disposal site (based on the precipitation data and an assumption that an average BOD concentration of raw leachate generated is 1,000mg/l).

On the other hand, if the leachate is to be treated at Tepetate sewage treatment plant, it should be diluted to the permissible concentration level (i.e., BOD 400mg/l). In this case, the total amount of leachate to be treated reaches 625m³/day (= 1000(mg/l)/400(mg/l) × 250(m³/day)).

Therefore, it became clear that even if the treatment capacity of Tepetate plant is increased by installing aerator in it, the marginal (i.e., 240m³/day in 2005) of the plant is much smaller than what is required for the treatment of diluted leachate treatment.

Accordingly, it also became clear that this case (i.e., leachate treatment by sewage plant) inevitably requires the expansion of Tepetate sewage treatment plant which had been excluded from priority projects in this Study, with the reason stated in the table above.

Therefore, leachate shall be treated within SJV site in this project. The on-site leachate treatment shall be through a facultative lagoon and a maturation pond, which is basically the same treatment used in the Tepetate sewage treatment plant. The outline of the treatment facility is summarized in the following table.

Table 4-10: Outline of Leachate Treatment Facility

Intake water quality	BOD: 1,000 mg/l, S S:200mg/l
Treated water quality	BOD: < 100 mg/l
Treatment capacity	250m ³ /day
Treatment method	Facultative lagoon + Maturation pond
Facility volume	
Regulation pond	6,000 m ³
Facultative lagoon	5,700 m ²
Maturation pond	1,250 m ³

a.4 Future Policy

In order to realize a sanitary landfill operation, the executing body (i.e., Granada Municipality) should not only solve technical problems but also the issues of considerable financial burden sharing for its construction, and operation and management. Therefore, the Study Team classified appropriate levels of sanitary landfill improvement into the following four levels and recommended its improvement in a stepwise manner in accordance with the financial capability.

- Level 1: Controlled tipping (casual soil covering)
- Level 2: Sanitary Landfill with a dike and daily soil covering (without an impermeable liner)
- Level 3: Sanitary Landfill with leachate circulation (an impermeable liner, leachate collection and leachate circulation facility) (**As mentioned in a previous section, judging from the rainfall data of Granada City, discharge of untreated leachate into public water sometimes becomes necessary during and/or after rains, no examination was carried out for Level 3 options in this Study.*)
- Level 4: Sanitary Landfill with leachate treatment (an impermeable liner, leachate collection and leachate treatment facility).

Approximate costs of the SJV project for the sanitary landfill level options are summarized in the Table 4-11.

Table 4-11: Approximate Cost Comparison of Different Sanitary Landfill Level

Case	Cost (C\$ 1,000)	Construction Cost (C\$ 1,000)	O&M Cost (C\$ 1,000)	Total (C\$ 1,000)	Unit Disposal Cost (C\$/ton)
Case-A: Level 2		13,535 (20,729)	4,630	18,165 (25,359)	62.3 (87.0)
Case-B: Level 4 Treatment at Tepetate Sewage Treatment Plant		42,353 (49,547)	5,823	48,176 (55,370)	165.3 (190.0)
Case-C: Level 4 Treatment at SJV Disposal Site		42,992 (50,186)	4,890	47,882 (55,076)	164.3 (188.9)
Case-C/Case-A		3.2 (2.4)	1.1	2.6 (2.2)	2.6 (2.2)

Note: Operation period of SJV disposal site is assumed for ten years starting in 2001 and ending in 2010. Total treated amount of waste during this time is estimated as 291.5 thousand ton (364.6 thousand m³). The figures in parentheses include the disposal site equipment cost.

The present La Joya disposal site improved greatly by implementing the pilot project. However, its sanitary landfill level is Level 1. From the result of the discussion with the related institutions in the 3rd Study Work in Nicaragua, an impermeable liner should be used for SJV disposal site even though the cost burden on both residents and the municipality increases. Therefore, the preliminary design of SJV disposal site project followed sanitary landfill level 4 protocols. However, it should be noted that Table 4-11 shows that sanitary landfill level 4 requires heavier financial burden compared with that of level 2.

As present La Joya disposal site is located close to the groundwater well, the source of water supply, therefore contamination of the water source became a big concern. Thus, the closure of La Joya disposal site and early establishment of SJV disposal site are urgent issues to be solved in the municipal SWM problem in Granada Municipality.

Therefore, in case no grant aid can be secured from either domestic or foreign institutions, it is necessary to examine the possibility of improving the sanitary landfill level step by step.

c. Outline of the Plan

The outline of the SJV a new final disposal site project is as follows (Refer to Figure 4-6);

Name: New San Jose de la Viuda (SJV) Disposal Site

Location: San Jose de la Viuda (SJV) district, along Granada-Santa Rosa Road

Site Areas: Approximately 40ha

Present Land Use: Pasture and agricultural land

Ownership of the Site: Proposed site is privately owned (two landowners).

Waste Subject to Landfill: household waste, commercial waste, institutional waste, market waste, street sweeping waste, bulky waste, garden waste, non-hazardous industrial waste, non-hazardous medical waste, and construction waste.

Proposed Landfill Period: Ten years from 2001 to 2010 (the M/P period), although extension of the period is possible.

Development Schedule of Landfill Section and its Capacity:

Landfill section	Area (ha)	Landfill Capacity (thousand m ³)	Construction Period (year)	Service Life (year)	Period in Use (year)
1	3.5	179.4	2000	5	2001-2005
2	3.5	258.3	2005	5	2006-2010
Total	7.0	437.7	-	10	-

Landfill Structure: An impermeable bottom liner, leachate treatment, daily soil coverage

Final Elevation: +46.5m (above sea level)

Final Height: Approximately 1.0 to 2.0 m above the surface of Granada-Santa Rosa Road

Thickness: 8.5m

Scavengers: Not allowed to enter

Operation hours: 8:00 a.m. to 5:00 p.m.

Major Facilities: Site office, approach road, weighbridge, tire wash pit, fence, gate, maintenance road, rainwater drainage system, water and electricity supply, water tank, buffer zone, leachate collection treatment facility, monitoring wells, etc.

Landfill equipment:

Machinery	Specification	Use	2001	2002	2003	2004	2005
Bulldozer	219 Hp	Levelling, Compaction	1	1	1	1	1
Backhoe	83 Hp	Excavation of cover soil, maintenance of the site	1	1	1	1	1
Tipper Truck	8 ton	Transporting cover soil and other materials	1	1	1	1	1
Water tanker	6-7 ton	Sprinkle water within the site	1	1	1	1	1

Monitoring: Environmental monitoring shall be carried out for groundwater, leachate generated and treated effluent, for the parameters and frequency listed in Table 4-12. Four monitoring wells (two upstream and two downstream of the groundwater source) shall be installed. The leachate quality shall be monitored at the inflow and outflow of the treatment facility.

Table 4-12: Items for Environmental Monitoring

Parameter	Groundwater	Leachate
Color	once per week	daily
pH	once per week	once per week
BOD	once per year	twice per year
COD	once per year	twice per year
SS	once per year	twice per year
Electric conductivity	once per week	once per week
NH ₄ -N	once per year	twice per year
Cl ⁻	once per year	twice per year
SO ₄	once per year	twice per year
Fe	once per year	twice per year
E. coli.	once per year	twice per year

Land use after closure: After the landfill operation is completed, a hill of about 5.5 to 8.5m height will be formed. An ecological park with an observatory will be constructed on the hill, which will be integrated with surrounding ecology such as Lake Nicaragua, the wetlands and forests. The observatory could also provide views of the volcanic mountains and the Lake around Granada City.

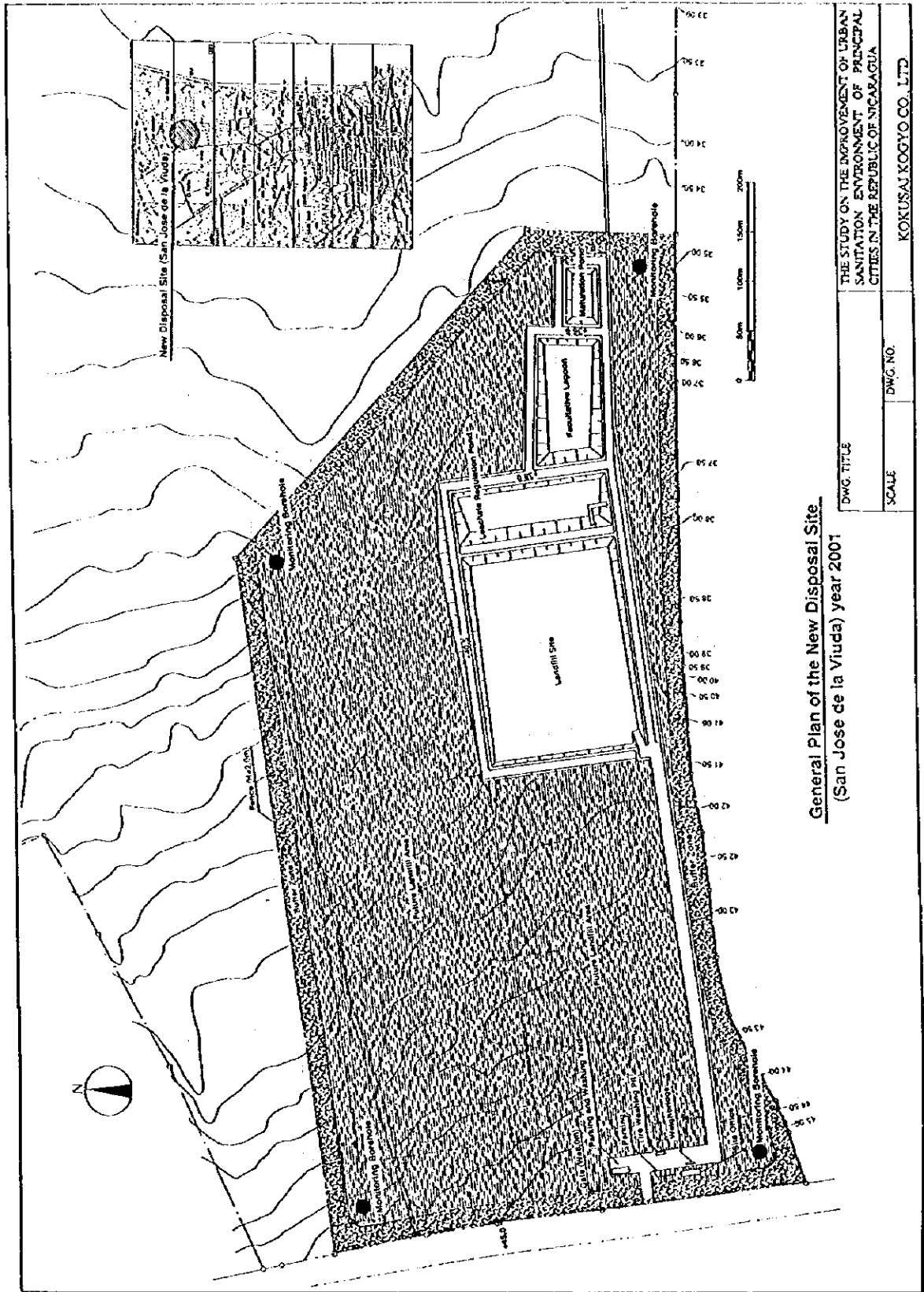


Figure 4-6: SJV A New Disposal Site Plan

4.5 Institutional System Improvement Plan

4.5.1 Administration and Organization

a. General

In general, the cleanliness of a city depends on the willingness and cooperation of the citizens and authority responsible for its maintenance. In order to gain the confidence, cooperation and support of the community, the waste collection service must be regular; meaning the tasks should be performed on schedule, i.e. on designated days and times.

The collection system in Granada does not have this essential characteristic, resulting in a poor USE. The causes and results of this poor Municipal SWM are outlined below.

a.1 Reasons for the Inadequate Municipal SWM System

- unplanned and uncontrolled operations.
- lack of manpower and low equipment productivity.
- low fee collection rate, although the SW fees are relatively inexpensive.
- unsuitable and insufficient equipment.
- lack of public cooperation for cleansing and willingness to pay for the municipal services.
- unsatisfactory organizational structure for managing the SW system as well as equipment maintenance.
- lack of personnel training and facilities.

a.2 Results of the Inadequate Municipal SWM System

- generally unsatisfactory sanitary conditions in the city, mostly outside the historic center.
- dissatisfaction expressed by the public and subsequent low cooperation for urban cleansing; reluctance to pay for services.
- high overall sanitation cost; to aggravate this condition, additional costs have to be borne to counteract pollution and damage caused by inadequate maintenance of drains and other urban systems.

Aiming to counteract the present situation, the M/P emphasized the improvement of municipal capabilities (organization, human resources, regulation) in addition to the acquisition of adequate equipment (vehicles, machines) and the construction of a sanitary landfill.

b. Organizational Structure

The municipal organizational structure has improved considerably during the last twelve months, but some aspects need further enhancement.

- Municipal SWM services and street and drainage maintenance are under the same bureau that covers too broad a spectrum.
- The maintenance of vehicles and machines that are used for refuse collection & disposal are under a different bureau, even though they play a crucial role in the SWM sector.

The M/P proposed the establishment of a Bureau of Public Works and Services as well as a Bureau of Urban Environmental Maintenance. The Bureau of Urban Environmental Maintenance should comprise three departments: the Department of Waste Collection & Public Area Cleaning, Department of Parks and Gardens Maintenance, and Department of Vehicles and Equipment (see Figure 4-7). The following two points must be emphasized:

- The close support of the vehicles and equipment distribution and maintenance sections should be mandatory because any delay or trouble in supplying vehicles or equipment would interfere with the refuse collection and disposal services. Cleansing services must be provided regularly and the support would play a crucial role because expensive equipment, that requires a lot of care and control, will be used.
- The vast and expensive improvement in SWM, as proposed in the Master Plan, needs an organized and strong department, as well as a competent director of the Urban Environmental Maintenance Bureau (UEMB). This would not be practical if the bureau is too diversified.

The department of Refuse Collection and Public Area Cleaning should be divided into four sections: Planning and Control, Refuse Collection, Public Area Cleaning, Waste Disposal. The Refuse Collection, Public Area Cleaning and Refuse Disposal Sections are to be divided into various units according to the duties of each section. It is important to take into account that these units will not be headed by chiefs but led by operational team leaders; as units are not administrative divisions it will cut bureaucracy and facilitate day to day operations as well as distribution of equipment and control.

The Planning and Control Section should prepare the operational plans and programs, and continuously evaluate the operational performance and costs, as well as compile relevant documents for all administrative levels.

The success of the SWM system depends on continuous financial support based on fees that are collected efficiently. Therefore, the cleansing fee will be jointly billed with INAA's water charges, and the Tax Collection and Audit Departments under the Bureau of Administration and Finance will manage the revenue from the cleansing fees collected by INAA. These departments will be indispensable for setting appropriate tariff levels and establishing a sound collection method, rather than depending on the collectors' discretion, in order to effectively regulate the revenue.

When the USE improvement M/P is initiated, the Bureau of Urban Environmental Maintenance should be established immediately, in order to manage the new equipment and sanitary landfill. The employees required for Municipal SWM in the Urban Environmental Maintenance Bureau are presented in Table 4-13.

Table 4-13: Required Employees for Municipal SWM in the Urban
Environmental Maintenance Bureau

Organization	Responsible Person	Qualification	Level of Experience	Initial Training	Number of Employees
Bureau of Urban Environmental Maintenance	Director	Eng./Arch.	High	Specialized Information	1
Steering Committee Member	N/A	N/A	High		1
Secretary	N/A	N/A	Medium		1
Departments:					
1. Refuse Collection and Public Area Cleaning	Head of Department	Eng./Arch.	Medium	Managerial	71
2. Vehicle and Equipment	Head of Department	Eng.	Medium	Managerial	13
Sections:					
1. Refuse Collection	Section Chief	Tech.	Medium	Operational	27
2. Public Area Cleaning	Section Chief	Tech.	Medium	Operational	32
3. Refuse Disposal	Section Chief	Tech.	Medium	Operational	9
4. Planning and Control	Section Chief	Eng./Stat./Econ.	Medium/High*	Operational	2
5. Garage and Distribution	Section Chief	Tech.	High	Operational	3
6. Vehicle Maintenance	Section Chief	Tech.	High	Operational	3
7. Equipment Maintenance	Section Chief	Tech.	High	Operational	3
8. Spare Parts and Materials' Warehouse	Section Chief	Tech./Admin.	High	Operational	3

Note: Eng. = Engineer Arch. = Architect Admin. = Administrator
 Tech. = Technician Stat. = Statistician Econ. = Economist
 N/A = Not applicable

* If the Section Chief is not a graduate, a high level of experience would be expected.

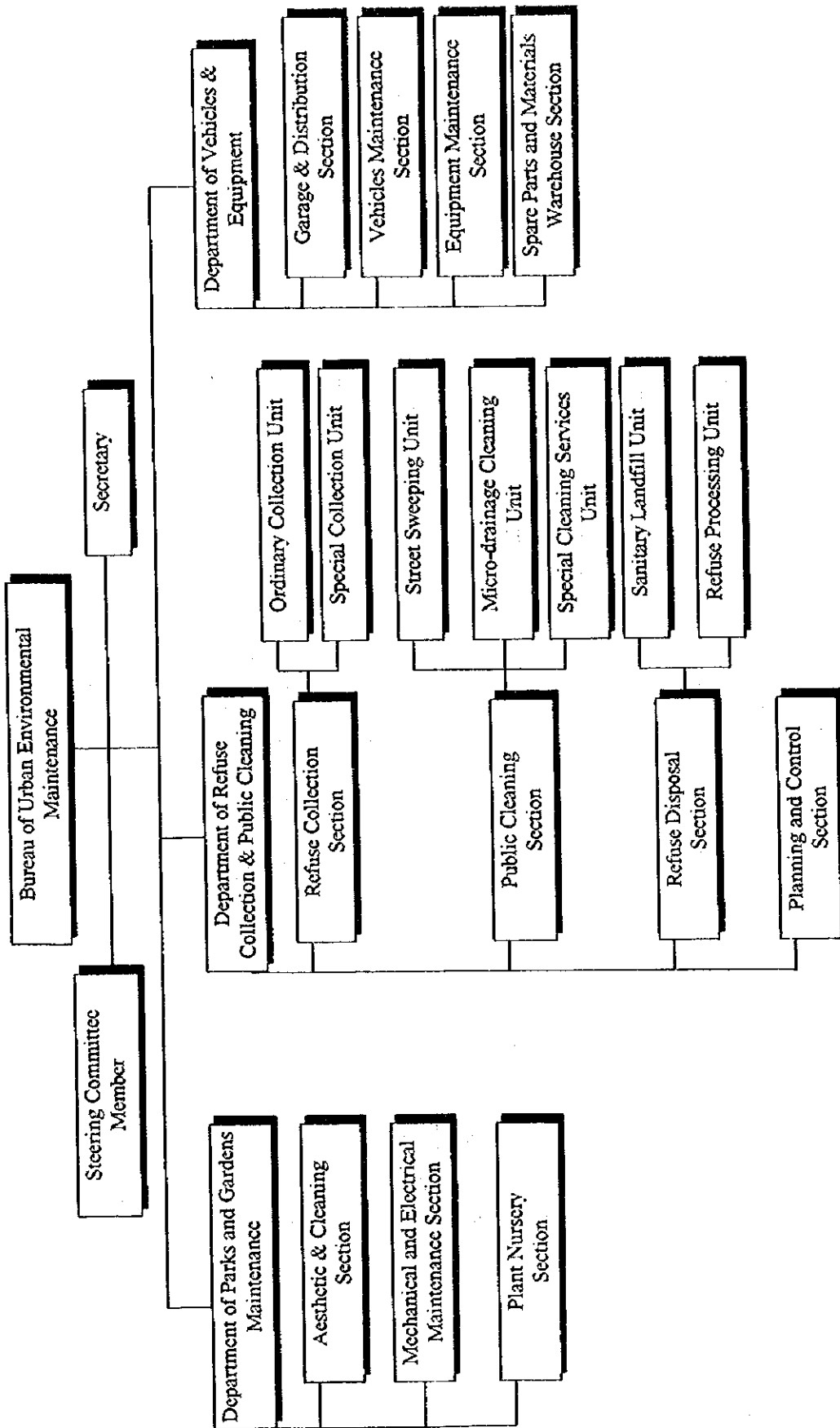


Figure 4-7: Organizational Structure of the Bureau of UEM

4.5.2 Monitoring, Control and Information Management System

a. General

Monitoring would qualitatively and quantitatively evaluate the effectiveness of the Municipal SWM system. It should precede regulation and contracting out of services. **Monitoring** is strictly a municipal function.

Municipal SWM operations performed by the municipality require more than just monitoring; performance evaluation and control have to be achieved before further plans and actions can be made. **Control** is an operational and managerial function.

In both cases, **documentation** should be compiled with details for different levels of decision: operational, managerial and directive.

Control, monitoring, documentation, planning and propositions for projects are important components of *Planning and Control* that must be implemented by the Municipal SWM sector.

b. Monitoring

Operators of SWM services should present to the Planning & Control Section a **Performance Review** containing past achievements as well as details on production, manpower, vehicle and equipment, final disposal of the waste, etc. If the services include disposal site operation, accounts on origin of waste and covering soil should be included. All information must be substantiated and supported qualitatively (such as through **Environmental Monitoring** of the disposal site, **Inspection Report** by the municipal inspectors, **Public Complaints and Response Report** consolidated periodically, and **Public Opinion Surveys** on SWM services) in order that a sound managerial evaluation can be achieved.

c. Control

The executing bodies should control human resources, use and maintenance of vehicles and equipment, materials, and performance (production, manpower, time spent and collection route). Indices of productivity and costs may then be calculated in order to evaluate the SWM system.

The control system may comprise the following items:

- **Personnel Assignment Roster (CDP - Cuadro de Distribucion de Personal)**: gives daily information on the allocation of personnel and those off-duty.
- **Service Order (OS - Orden de Servicio)**: lists tasks assigned to each team, vehicle, equipment and material required, and results to be expected. There should be enough space to write in the outcome and any other comments. Normal services should be conducted frequently and a "permanent OS" should be given each month to the team leader. For services performed occasionally, an "occasional OS" should be given on the day to the team leader.
- **Transportation Record (BDT - Boletin de Transporte)**: information on vehicle usage and primary maintenance; daily performance (collection area and destination of waste, travel distance and time, waste volume per trip and collection route) and any other comments.

- **Vehicle Inactivity Notice (BIV - Boletín de Inactividad de Vehículos):** daily information on idle vehicles and the reasons.
- **Vehicle and Equipment Register (Carpeta del Vehículo o Equipo):** information on vehicle and equipment acquisition, warranty, monthly performance, monthly hydraulic and lubricant oil consumption (liters/km or /work hours), complex maintenance and costs. This document will enable a detailed maintenance planning, estimation of economic life as well as vehicle performance and costs.
- **Fuel, Lubricants, Hydraulic Oil and Pneumatics Report:** this must be compiled by the primary maintenance sector (garages) and expressed as indices for technical and economic analyses.
- **Sanitary Landfill Control :** should comprise the **Material Entrance Inspection Report (CEM - Control de Entrada de Materiales)** and the **Landfill Operation Notice (BORS - Boletín de Operación de Relleno Sanitario)**; CEM should contain information on the origin, category and quantity of each material received daily. The BORS should contain information on machine and vehicle usage (productive and inactive hours), fuel, lubricants and hydraulic oil consumption, operators. In addition to these, a vehicle/equipment file should be kept.

d. Documentation

For **central operational control**, five documents should be reviewed daily: CDP, BDT, BIV, OS ("occasional") and CEM. These documents would indicate unusual incidents that have occurred and how they were resolved.

The BDT performance data on collection routes and BIV should be expressed graphically: a series of graphs for each collection route, and for each vehicle.

Some weeks it will be sufficient to give a summary of the service performance: if the graphs show a regular pattern (except for seasonal or incidental variations) then so is the collection service - an essential quality. Any daily deviation should result in an administrative inquiry and subsequent punishment of those responsible.

The BIV graphs will express the poor quality or inadequacy of: the maintenance procedures, maintenance structure, and/or the vehicle.

For **managerial control**, objective monthly reports should be prepared; they must be summarized, illustrated with graphs, and provide indices on production, manpower, vehicle, equipment, materials, contracted services, and costs. Cost control or evaluation should be set to a medium target, according to an improved structure of the municipality.

For **directive deliberation**, a concise monthly report should be compiled based on the managerial report.

4.5.3 Legislation and Enforcement

a. General

The team proposes that the municipality formulate a Regulation on SWM under the **Municipal Ordinance**. It should include eleven topics as follows:

1. Definitions and General Concepts
2. Municipal Solid Waste
3. Domestic Solid Waste
4. Medical Solid Waste
5. Industrial Solid Waste (ISW)
6. Solid Waste Recycling and Resource Recovery
7. Solid Waste Disposal
8. Management and Operation of Services
9. Duties of Those Providing and Receiving Services
10. Costs and Penalties
11. Temporary Conditions.

For the provision, improvement and payment of services in a given area, a prerequisite will be the applicability of the articles in the SWM Regulation. This means that in order to implement a planned SWM, the Regulation must be introduced with a Tariff Plan. Due to practical reasons, this plan should be implemented progressively, area by area.

4.5.4 Details of the Regulation on SWM

Part 1: Definitions and General Concept

The legal basis of the Regulation, its subjects and aims, should be introduced; a glossary should be presented in a clear manner, so that it is transparent both legally and to the general population.

Part 2: Municipal SW

The responsibilities of the citizens for public area cleaning, cleaning and maintenance of riverbeds and vacant areas should be established. Services will be provided to clean and maintain these areas.

Part 3: Domestic SW

The responsibilities of the generators should be defined concerning their wastes, methods of segregation for resource recovery, use of containers and storage, and when and how waste should be discharged for collection. Normal, occasional and special (including domestic hazardous waste) wastes will be considered separately.

Part 4: Medical SW

The responsibility of the generators should be defined including primary classification and methods of segregation for different types of medical solid waste, container and storage methods, the types of waste accepted by the municipal collection and disposal, as well as when and how these waste have to be discharged for municipal collection and disposal. Legal responsibilities for medical SW would fall on MARENA, but the municipality has the responsibility to assist and protect the people and the environment.

Part 5: ISW

The responsibility of the generators should be defined including primary classification and methods of segregation for different types of industrial solid waste, container and storage methods, the types of waste accepted by the municipal collection and disposal, as well as when and how these waste have to be discharged for municipal collection and disposal. Legal responsibilities for industrial SW would fall on MARENA, but the municipality has the responsibility to assist and protect the people and the environment.

Part 6: SW Recycling and Resource Recovery

This part should provide incentives for material segregation at homes, commercial, institutional and industrial establishments aiming to re-use or recycle said materials. It should provide incentives for individuals and cooperatives to collect these materials separately and sell them, and regulate this system so that ordinary public collection services are not disturbed. It should also promote public services for resource recovery, such as recycling and composting, and the use of these materials by citizens.

Part 7: SW Disposal

This section should state that disposal operations will be conducted in a sanitary landfill, and that citizens may use it: waste disposal in any other site will be forbidden except in sites previously approved by the municipality.

Part 8: Management & Operation of Services

The exclusive responsibility of the municipality should be expressed regarding: (a) regulating, planning, fixing charges and monitoring results (qualitatively and quantitatively) of the services operated either directly or indirectly by the municipality; (b) contracting out operation of services or authorizing others to perform services related to solid waste, except for medical SW and ISW; it should express the possibility of transferring the operation of cleansing services to a private company either through a contract or a concession, setting their duties as well as rights of the beneficiaries, according to planned services.

Part 9: Duties of Those Providing and Receiving Services

This section should define the duties of the citizens as generators of waste and the customers of the cleansing services, bearing in mind that cooperation and ability to pay will determine the quality of the service; the duties of those who provide waste collection and disposal services, i.e. the municipality and other private enterprises, should also be stated.

Part 10: Cost & Penalties

The criteria for refuse collection charges should be established for normal, occasional and the special services for domestic, institutional, commercial, industrial and medical institutions. This criteria should consider a progressive cost recovery of up to one year, after completely implementing a regular and satisfactory service in a given area; however refuse collection charges should be subsidized with municipal taxes, aiming to make the fees acceptable according to the citizens' financial capabilities. The criteria should be based the level of services proposed by the Study Team.

It should establish a penalty system for those who violate the Regulation, both the citizens and private operators of cleansing services.

Part 11: Temporary Conditions

Conditions for the transitional period should be defined until the implementation of a regular SWM is complete.

Together with the municipality, MINSA has the obligation to regulate health services, including medical SWM; MARENA has the obligation to regulate hazardous solid waste, including those generated in medical institutions and industries.

The municipality should not wait for other authorities to take action before it considers its own interests. It should seek these actions but start enforcement as referred to in parts 4 and 5.

It should be very useful if the municipality and MINSA establish a code of practice or instructions on on-site management of medical SW in Granada as a pilot scheme. This document should start by fixing the classification of different medical wastes:

- Non-hazardous - to be handled as domestic waste.
- Infectious (including sharps) - requires special handling and disposal at the generators' expense.
- Hazardous - chemicals (including expired medicine and solvents) that require special handling and final disposal *not by the municipality, but according to MARENA's instructions.*

The document should define: 1) the loading methods for different wastes that are accepted by the municipal collection service, 2) discharge procedures and charges to be paid for municipal services, and 3) the alternative methods for the disposal of wastes.

4.5.5 Contract System to Private Sector

a. General

As suggested in Part 8 of the proposed regulation on SWM, some responsibilities are exclusive to the municipality. However, the municipality may contract or commission private enterprises to operate a part or the whole SWM services.

The main requirement of the municipality is to be capable of performing its exclusive functions, specify duties of the private enterprise and the payments for its services. It should also be able to monitor (evaluate) the effectiveness of the services, be in a position to terminate any agreement with the private enterprise if their SWM services are unsatisfactory or due to breach of contract, and in severe cases, penalize them according to the contract. The capability of the municipality would be highly dependent on the sufficient improvement of its structure, normative standards and, in particular, human resources invested into planning and control of the SWM sector.

Contracting operational as well as auxiliary services (e.g. vehicles and equipment maintenance, etc.) would be a good option to compensate for the lack in equipment and skilled personnel; this would only require a basic qualification.

Concession of services, that includes direct payment from citizens to a private enterprise, is a very advanced option, because establishing tariff levels for a whole urban area with various income levels and urban needs is difficult. Equally, it would be extremely difficult if services for some of the urban area (usually affluent areas) are to be provided by a third party while the rest have to rely on municipal services.

b. Institutional Alternatives for Municipal SWM

The municipality may operate the Municipal SWM system through one of its departments ("direct administration"), a municipal authority, or a municipal enterprise ("indirect administration"). It may also contract or commission services to a private enterprise.

As a general rule, public organizations operate with low efficiency, incurring higher running costs in comparison to private organizations. However, it is inherent to such organizations to show more interest in social and public issues.

Conversely, private enterprises are profit oriented, aiming for high efficiency and prices; they constantly depend on market competition and on public enforcement and monitoring of SWM services.

A healthy mixture of public and private interests and actions is desirable to develop a good Municipal SWM system, and possible when the municipality is organized and capable of establishing the rules and standards, managing the budget, and monitoring the services. The municipality must also be in a position to have sufficient resources and be able to prevent the monopolization of SWM services.

A private enterprise may operate through a contract or concession with the municipality. Through a contract, the enterprise receives payment for specified services, based on pre-established conditions and prices. Through a concession, the enterprise directly charges the beneficiaries, at negotiated or pre-established conditions and prices according to parameters fixed either by the municipality or the private company.

Waste collection/disposal services for commercial customers are often performed through informal concessions. But services for domestic beneficiaries need stricter parameters, especially for economically heterogeneous areas predominantly made up of poor people. In this case, one understandable risk is the enterprises' neglect of collecting waste from beneficiaries that are not able to pay, or refuse to pay unreasonable charges. Both cases would incur serious sanitation problems for the community, and a political and administrative problem for the municipality.

Enterprises are often requested to have efficient equipment and be financially able to provide adequate services, even during peaks in demand. But there are also potentials for micro-enterprises to participate in this market either as cooperatives, contractors or concessionaires (*). Of course, the municipality should set uniform mandatory conditions for both, normal and micro enterprises, considering the interest of all citizens that pay for the services, and not just the interest of the service provider.

() INIFOM promoted an interesting trial: PROMIDS - Integrated Management of Solid Waste Projects, developed as pilot projects in four municipalities (with a total of 2548 households/14480 urban inhabitants) in Masaya Department: Niquinohomo, Catarina, San Juan de Oriente, and Nandasmo. This was in preparation for a larger PROMIDS (15 municipalities with a total of 8627 households/47914 urban*

inhabitants) with estimated investments of US\$ 575,633.63, 82% of which is expected to be covered by foreign organizations.

Women Micro-Enterprises, with the approval of the municipalities to sweep streets, collected all municipal waste using animal pulled cars and delivered waste to the disposal site where trenches were built and operated by the municipality. The micro-enterprises directly charge the customers according to a price list approved by the municipality. Residences pay every fortnight according to the length of the property: CS 5.00 (3 to 5m), CS 8.00 (5.1 to 7m) or CS 12.00 (more than 7m). Revenue from the fees reached break even point after operating for only three months.

(extracted from "PROMIDS and Annexes", edited by INIFOM - Urban Development and Municipal Services Director's Office - December 1996 and February 1997.)

Three important results must be considered from this trial:

- 1. Citizens were able to pay the service provider directly without political intervention.*
- 2. The tariffs were not cheap. Furthermore, it did not cover the whole SWM service, probably due to the small scale of the collection system.*
- 3. The concept could be implemented in very small cities; it is not applicable to a city the size of Granada, firstly due to the distance of the disposal site, which would require transfer stations and several micro-enterprises to operate the system. Also, the municipality must be capable of setting the tariffs, monitoring the services and building and operating transfer stations; furthermore, it would be almost impossible, due to social and political pressure, to revert back to the old collection system after the implementation of such system.*

c. Conclusion

The contracting out of services to compensate for the shortage in equipment, material and human resources is recommended, firstly for vehicles and equipment maintenance, but also for additional or complementary public cleaning, refuse collection and disposal services.

Regular operations of the Refuse Collection & Public Cleaning Department may not be contracted unless the department is organized and fully capable of planning, regulating and fixing parameters for the operations and costs, and monitoring the transferred services. Training of personnel for these functions is essential.

Concession of services could be introduced in the long run, after a sufficient, well established and accepted tariff plan is established, in conjunction with a capable municipal department, as considered above. Both situations also depend on capable personnel and enterprises in the market offering cleansing services. These conditions do not seem to exist at this moment.

4.5.6 Human Resources Development

For now, the gradual improvement of human resources through specific operational training is recommended. Furthermore such enhancement should be selected in accordance with the targets that are set.

The training program should be produced and evaluated by advisors to the mayor.

Managerial Training:

- The training course for the director and section chiefs of the Refuse Collection and Public Cleaning Department should include criteria and goals, employee motivation strategies, as well as operation and cost monitoring and control.
- The training course for the director and section chiefs of the Vehicles & Equipment Department should include criteria for vehicles and equipment use, as well as the control of their operation, maintenance and costs.

Operational Training:

- The training course offered to personnel in the Planning and Control, Garage & Distribution, Vehicles Maintenance, and Equipment Maintenance sections should cover planning and control of operations, operational and service cost.
- The training course offered to the employees of the Refuse Collection, Public Cleaning, Refuse Disposal Sections should cover technical execution of the services. Inspection and evaluation of the services should be covered in the training for the inspectors of these sections.

It is very important to select directors and chiefs according to their previous experiences and qualifications, which should match their duties in their operational branches and divisions.

4.6 Calculation of Project Cost

The result of cost estimation for the F/S-1: Municipal SWM System Improvement Project for respective years is shown below.

Table 4-14: Cost Estimation of F/S-1: Municipal SWM System Improvement Project

Unit: C\$ 1,000

Category	Category	Item	2000	2001	2002	2003	2004	2005	Total	
Direct Cost	Collection & Transport	Inves. for equipment	5,700	853	-	67	853	-	7,473	
		Operation cost for labor	-	695	805	805	805	915	4,025	
		Operation cost for material & fuel	-	218	251	251	251	283	1,254	
		O & M Cost	-	162	187	187	187	211	934	
		Sub-total	5,700	1,928	1,234	1,310	2,096	1,409	13,686	
	Street Sweeping	Inves. for equipment	Including collection & transport							
		Operation cost for labor		206	206	206	206	206	1,030	
		Operation cost for material & fuel	Including collection & transport							
		O & M Cost	Including collection & transport							
		Sub-total		206	206	206	206	206	1,030	

Category	Category	Item	2000	2001	2002	2003	2004	2005	Total
	Final Disposal (SJV A New Disposal Site)	Inves. for facilities (Inc. land acquisition cost)	34,922	-	-	-	-	-	34,922
		Inves. for equipment	3,597	-	-	-	-	-	3,597
		Operation cost for labor	-	203	203	203	203	203	1,015
		Operation cost for material & fuel	-	108	116	120	126	135	605
		O & M Cost	-	139	139	139	139	139	695
		Sub-total	38,589	450	458	462	468	477	40,904
		Direct Cost Total		44,289	2,584	1,907	1,978	2,770	2,092
Indirect Cost	Maintenance Workshop & Motor Pool	Inves. for facilities	1,285	-	-	-	-	-	1,285
		Inves. for equipment	1,444	-	-	-	-	-	1,444
		Operation cost for labor	-	319	319	319	319	319	1,595
		Operation cost for material & fuel	-	5	5	5	5	5	25
		O & M Cost	-	5	5	5	5	5	25
		Sub-total	2,729	329	329	329	329	329	4,374
	Administration	Inves. for facilities	Including maintenance shop and car pool						
		Inves. for equipment	Including maintenance shop and car pool						
		Operation cost for labor	-	288	288	288	288	288	1,440
		Operation cost for material & fuel	Including maintenance shop and car pool						
		Spare parts & repair	Including maintenance shop and car pool						
Sub-total	-	288	288	288	288	288	1,440		
Indirect Cost Total		2,729	617	617	617	617	617	5,814	
Ground Total		47,018	3,201	2,524	2,595	3,387	2,709	61,434	

4.7 Financial Analysis

The objective of the financial analysis is to evaluate the SWM Master Plan for Granada City and to select a financially sustainable plan.

a. Conditions of the Analysis

The conditions adopted for the financial analysis are shown in the table below.

Project Life	31 years, from 2000 until 2030
Executing Organ	Granada Municipality will be the executing body, but a part of the services will be contracted out to a private collection company.
Investment Plan	The M/P proposes the construction of the San Jose de la Viuda (SJV) disposal site in the northern part of the city after the closure of the La Joya disposal site in 2001. The financial analysis was therefore carried out assuming that in 2000, Granada Municipality will purchase all vehicles required for the collection, haulage and disposal of wastes to the SJV final disposal site.
Residual Value	The residual value of the collection vehicles, plants, landfill equipment in the year 2031 was considered
Cut-off Rate	A cut-off rate of 8.5%, which is also equivalent to the prime rate of the Central Bank of Nicaragua in 1997, was assumed. The cost to be covered by the grant was excluded from the project cost items subject to the financial analysis.

b. Case Studies

Three case studies were established for the financial analysis.

- Financial Source: Financial source for an investment costs for the project
- Revenue Source 1: Waste fee collection system
- Revenue Source 2: Total budget allocated for cleansing services from municipal tax revenue

b.1 Financial Source for a Part of the Project Cost

The following possibilities were considered for this case.

Case A	To acquire a loan for the total investment amount
Case B	To acquire grant aid to cover 90% of the investment for the construction of the final disposal site, procurement of landfill equipment and collection vehicles, and improvement of workshop in 2000.
Case C	To acquire grant aid to cover the entire investment for the construction of the final disposal site, procurement of landfill equipment and collection vehicles, and improvement of workshop in 2000.

b.2 Refuse Fee Collection System

Granada Municipality directly collects refuse fees from service recipients, but because the present collection rate is extremely low, 16.3%, the system is not functioning at all. Further, the tax reforms currently being promoted in the country deprives the municipality of the power to reinforce the direct collection system. As a result, the Team proposes a plan to combine the collection of charges for household waste (ordinary households) with the water supply charges of INAA, who had a 96% collection rate in 1996. As for the waste other than household, in view of the fact that discharge volume significantly varies by generation source, and that it is favorable to have dischargers shoulder the expenses for waste they generate, the Team proposes charges according to discharge volume for wastes generated in commercial and business sectors. It is recommended to attach waste collection charges to taxes imposed in the municipality, such as business tax, for effective collection. Thus, as before, waste collection charges are planned to be collected through the municipal tax section.

b.3 Total Budget Allocated for Cleaning Services from the Municipal Tax Revenue

The following possibilities were considered for this case.

Case A	Very optimistic assumptions regarding increase in municipal tax revenue (6.7% per annum) and budget allocation for SWM (12% per annum)
Case B	Assuming the present increase in municipal tax revenue (5.4% per annum) and budget allocation for SWM (10% per annum).
Case C	Very pessimistic assumptions regarding increase in municipal tax revenue (3.3% per annum) and budget allocation for SWM (8% per annum)

c. Waste Fee Collection System

The following were the conditions established to determine the waste fee collection system.

c.1 Household Waste

Target Population	All households that will receive waste collection services
RCC (Refuse Collection Charge)	The refuse collection charge is set as follows, based on the service level: <ul style="list-style-type: none"> • High service charge (CCA): C\$15/household/month • Ordinary service charge (CCB) C\$10/household/month • Low service charge (PCA) C\$5/household/month
Collection Rate	82% (attained by multiplying the present water supply collection rate of 96% with the water supply coverage rate, in 2000, of 85%).
Collection Cost Rate	5% (5% of the collection charge will be allocated to cover the INAA fee collection service expenses and commission).

c.2 Other Waste

Target Population	Commercial and business institutions, as well as all municipal waste generators that will receive waste collection services
RCC	The refuse collection charge is set according to waste volume, as shown below. <ul style="list-style-type: none"> Collection service C\$363/ton (will basically cover the cost for collection, haulage and final disposal services) Direct haulage C\$222/ton (will basically cover the cost for final disposal services)
Collection Rate	100%
Collection Cost	0% (will be collected with other municipal taxes)

d. Forecast Increase in Municipal Tax Revenue and SWM Budget

The total budget to be allocated for SWM from the municipal tax revenue was estimated according to the assumed increase in tax revenues and the budget rate for cleaning services.

d.1 Forecast on Municipal Taxes

d.1.1 Municipal Taxes

The municipal tax revenue of Granada Municipality is broken down into 64% municipal tax and 13% service tax.

Tax payments from business establishments make up 52% of the municipal tax. However, tax reforms propose the lowering of the tax rate to 1% in 2000 from the present rate of 2%. Accordingly, the municipality needs to fill up the deficit that would result from this proposal. Although nothing concrete has been decided, the municipality is currently reinforcing the collection system for real property tax, vehicle tax and service charges, to secure the funds required.

d.1.2 Forecast Tax Revenue Growth Rate

The tax revenue growth rate was estimated based on the following factors:

- effect of cuts in business tax rates on actual tax revenue deductions (share of business tax in annual revenues)

- maximum amount collectible for other municipal taxes (tax revenue potential growth rate and potential maximum collectible rate)

d.1.3 Effect of Cuts in Business Tax Rates

Business tax rates will be cut from the present rate of 2% to 1.5% in 1998, and 1% in 2000, to stimulate economic activities and increase annual revenues as a result. The table below shows the possible scenarios that may result from tax rate cuts.

Case 1	hardly no impact; the same annual revenue increase rate can be expected in proportion to GRDP
Case 2	with tax rate cuts, 75% of the annual revenue rate of Case 1 in 2005 can be expected.
Case 3	tax rate cuts will have a direct impact, 50% of the annual revenue rate of Case 1 in 2005 can be expected.

d.1.4 Tax Revenue Potential Growth Rate

As long as the tax rate remains constant, the tax revenue potential growth rate is basically influenced by the municipal economic growth rate. Accordingly, the GRDP growth rate of Granada Municipality (6% from 1995-2000, 5% from 2001-2005) estimated by the Study Team was adopted as the potential growth rate of each tax revenue.

d.1.5 Potential Maximum Collectible Rate for Tax Revenues

The study determined the potential collectible rate of tax revenues by taking the budget (B) as maximum budget of the past 4 years and dividing it (A/B) by the actual tax revenue (A). The potential maximum collectible rate of revenues from vehicle tax, fixed property tax and service charges was estimated based on data on annual budgets and actual revenues for the past 4 years, as shown in the table below.

Municipal Tax	1995 Actual Tax Revenues (A)	1994-1997 Maximum Budget (B)	Collectible Rate (A/B)
Vehicle Tax	C\$376,000 (2.9%)	C\$1,105,000	0.34
Fixed Property Tax	C\$847,000 (6.5%)	C\$5,488,000	0.15
Service Charges	C\$1,797,000 (15.5%)	C\$2,043,000	0.88

Note: * figures within the () are contribution to municipal annual revenues

Because the potential rate that can be collected from vehicle and fixed property taxes is low, the target tax revenue potential growth rate should be higher than the target GRDP growth rate of 5.3%. Accordingly, a 70% potential collectible rate will be targeted for vehicle and fixed property taxes by 2005.

d.1.6 Tax Revenue Growth Rate

Based on the potential rate specified in the preceding section, the tax revenue growth rate was estimated by creating optimistic, moderate, and pessimistic scenarios as shown below.

Municipal Tax	Tax Revenue Growth Rate			Maximum Collection Rate
	Optimistic Scenario	Moderate Scenario	Pessimistic Scenario	
Business Tax	5.3%	2.9%	-1.7%	100%
Vehicle Tax	13.7%	12.9%	12.1%	70%
Fixed Property Tax	16.3%	15.5%	14.6%	70%
Service Charges/Others	5.4%	5.4%	5.4%	90%
Average Service Charges in Total	6.7%	5.4%	3.4%	90%

d.2 Budget Allocation for SWM from Municipal Tax Revenues

As shown in the table below, the budget allocated for SWM services for the past 4 years ranges around 10%.

	1994	1995	1996	1997
SWM Budget	8.4%	10.0%	11.5%	10.1%

Taking this into account, the changes in the budget allocation rate for SWM services were estimated as shown in below.

Scenarios	Budget Allocation Rate
Optimistic Scenario	to incur a 0.2% annual increase in the current budget allocation rate of 10%; the budget allocation rate for 2005 is estimated at 12%.
Moderate Scenario	to maintain the current budget allocation rate; the budget allocation rate for 2005 is estimated at 10%.
Pessimistic Scenario	to reduce the current budget allocation rate of 10% annually; the budget allocation rate for 2005 is estimated at 8%.

d.3 Financial Internal Rate of Return (FIRR)

The FIRR was calculated for a total of 9 cases ($3 \times 3 = 9$): combination of the three cases for the acquisition of funds for the project costs (A: use of a loan to fully cover expenses; B: acquire grant aid to cover 90% of the investment for final disposal site construction, collection vehicles procurement and workshop improvement; C: acquire grant aid to cover 100% of the investment for final disposal site construction, collection vehicles procurement and plant improvement) and the three scenarios to forecast the budget allocation for SWM. The results are shown in the table below.

Table 4-15: FIRR of Each Financial Case Study

Investment Plan	Forecast Revenue	Case	FIRR (%)	R/E
By Loan (Full Investment Cost)	Optimistic	A-1	n.a	0.7291
	Most Probable	A-2	n.a	0.7046
	Pessimistic	A-3	n.a	0.5986
Grant Aid (for 90% of the investment required in 2000)	Optimistic	B-1	16.4	1.2357
	Most Probable	B-2	4.7	1.1280
	Pessimistic	B-3	-0.4	0.9875
Grant Aid (for entire investment required in 2000)	Optimistic	C-1	37.4	1.2938
	Most Probable	C-2	13.0	1.1766
	Pessimistic	C-3	1.2	1.0391

d.4 Cash Flow & Profitability

The cash flow and the statement of profit and loss for case C-2 were carried out and shown below. C-2 proposes covering the total investment cost for 2000 by grant aid, the joint collection of refuse collection and water supply charges, and the most appropriate tax revenue growth rate and SWM budget.

Table 4-16: Cash Flow of the Municipal Solid Waste Management System Improvement Project

Unit : C\$ 1,000

	2000	2001	2002	2003	2004	2005	Total 2000-2005
a.1 Financing							
Grant	47,018						47,018
Loan		853	0	67	853	0	1,773
Total	47,018	853	0	67	853	0	48,791
a.2 Revenue							
Collection and Disposal		2,211	2,403	2,598	2,822	3,065	13,099
Residents		1,310	1,449	1,604	1,775	1,966	8,104
Commercial, etc.		901	954	994	1,047	1,009	4,995
Self-Transfer		194	194	194	203	203	988
GM Budget Allocation		1,885	1,980	2,079	2,183	2,292	10,419
Total		4,290	4,577	4,871	5,208	5,560	24,506
Cash-in	47,018	5,143	4,577	4,938	6,061	5,560	73,297
b.1 Investment	47,018	853	0	67	853	0	48,791
b.2 Expenditure							
Existing System		0	0	0	0	0	0
Proposed System							
O/M Cost		2,348	2,524	2,528	2,534	2,709	12,643
Interest		4	9	9	13	18	53
Fee-collection		65	72	80	89	98	405
Total		2,418	2,605	2,617	2,636	2,825	13,101
Cash-out	47,018	3,271	2,605	2,684	3,489	2,825	61,892
c. Reserves	0	1,872	3,844	6,098	8,670	11,405	11,405

Table 4-17: Profit & Loss Statement of the Municipal Solid Waste Management System Improvement Project

Unit : C\$1,000

	2000	2001	2002	2003	2004	2005	Total 2001-2005
a. Revenue		4,290	4,577	4,871	5,208	5,560	24,506
b. Cost							
b.1 Expenditure		2,418	2,065	2,617	2,636	2,825	13,101
b.2 Depreciation		0	110	110	110	219	549
Cost Total		2,418	2,715	2,727	2,746	3,044	13,650
c. Profit		1,872	1,862	2,144	2,462	2,516	10,856

The profit and loss statement shows positive results, clearly indicating the capability to secure C\$11 million to cover the investment cost after 2006.

4.8 Environmental Impact Assessment (EIA) of SJV Site

4.8.1 Scope of EIA Work

a. Background

An Environmental Impact Assessment (EIA) is compulsory in the Nicaraguan legislation (Decree No. 45-94). It is judged in view of Decree No. 45-94 that the New Municipal SW Disposal Site Development Project in the SJV site should be subject to an EIA. Works required for the EIA and the contents of the works are defined in this regard herewith as the Initial Environmental Examination (IEE).

The Ministry of Environment and Natural Resources (MARENA) issued a "General Guideline for Proposal Elaboration: Terms of Reference for Environmental Impact Assessment of Municipal Sanitary Landfills" for the Study in response to the Team's request in February 1997 (hereinafter MARENA's TOR). Meanwhile, Team also referred JICA Environmental Guidelines¹ as a supplement to this IEE works.

b. IEE Steps

The IEE consisted of the following steps:

- Step-1 General screening and scoping assessments were made based on MARENA's TOR and using JICA Environmental Guidelines as a supplement. In other words, all environmental items should be listed for scoping.
- Step-2 Scoping should be carried out for the SJV in order to identify the environmental items which requires an Environmental Impact Assessment (EIA) for the F/S. In other words, Each environmental item listed based on MARENA's TOR and JICA Guidelines were initially evaluated (i.e., to rank the foreseen impacts of each environmental items in a brief and concise manner).
- Step-3 Consequently, the contents of the EIA (i.e., required work) and possible impacts were proposed for each scoped environmental item.

¹ Environmental Guidelines for Infrastructure Projects No. VI Solid Waste management, JICA, Sept 1992

Step-4 Works required for EIA are summarized.

c. Scope of EIA Study

Based on the IBE, works required for EIA were summarized.(see Table 4-18)

Table 4-18: List of Works required for EIA

Work No.	Description of Works Required for EIA
1	Topographical Survey
2	Geological Survey
3	Hydrological Survey
4	Traffic Survey
5	Noise and Vibration Survey
6	Baseline Odor Survey
7	Baseline Water Quality Survey
8	Baseline Air Quality Survey
9	Baseline Soil Pollution Survey
10	Baseline Fauna and Flora Survey
11	Economic Survey
12	Land Use Survey
13	Risk Assessment of the Landfill Site
14	Meteorological data collection and analysis
15	Urban Development Plan
16	Water Use in area
17	Landscape assessment with photomontage
18	Cultural property survey
19	Estimation of construction waste (from the project)
20	Research on location and availability of soil suitable for use as impermeable liner and coverage

In response, an Environmental Baseline Survey (e.g., Topographical Survey, Geological Survey, Hydrological Survey, Traffic Survey, Noise and Vibration Survey, Odor Survey, Water Quality Survey, Air Quality Survey, Soil Pollution Survey, Fauna and Flora Survey, etc.) were carried out. Detailed results of the Environmental Baseline Survey are presented in Chapter 8 of the Data Book: Volume V.

The Environmental Impact Assessment for SJV New Municipal SW Disposal Site is outlined inline with the terms of reference (TOR), presented by the Ministry of the Environment and Natural Resources (MARENA), which principally consist of:

- Description of the Project
- Limits of the Influence Area.
- Environmental Situation of the Influence Area.
- Analysis of the Environmental Impacts .
- Mitigation Measures.
- Environmental Management Program.

- Forecast of the Environmental Quality of the Influence Area.

4.8.2 Description of the Project

The description of the project is summarized in Table 4-19 below. Detailed descriptions are presented in Section 4.2 of this report.

Table 4-19: Outline of the Disposal Site

Items	Description
Land Area	around 40 ha
Access road (from the city to the site)	asphalt paved: width 4.0m, length 3 km
Reception area	asphalt paved: width 7.0m, length 30m; width 15.0m, length 120m, Site office: approximately 100 m ² Weighbridge: 1 set: 3 x 12m Tire washing pit: 1 set: 4 x 15m 8m wide gate: 1 set electric lighting water and power supply
Parking and washing yard	600m ² , roof: 7 x 15m
Approach road (in the site)	gravel paved: width 7.0m, length 440m
Maintenance road	gravel paved: width 3.0m, length 770m
Enclosing structure of landfill	width 10m, height 2m, length 700m
Landfill liner	clay liner: thickness 150cm; sand layer: thickness 60cm
Leachate collection	perforated PVC pipe: ϕ 200mm; open main ditch
Leachate treatment	regulation pond : 6,000 m ³ , facultative lagoon : 5,700m ² , maturation pond : 1,250m ³
Gas removal	perforated concrete pipe ϕ 200mm at 40m intervals
Surface drainage	vee type lined ditch: width 2m, length 1,600m
Fence	2m height fence: length 2,600m
Planting (buffer zone)	eucalyptus :3,000
Monitoring borehole	4 borehole: depth 35m

4.8.3 Limit of the Influence Area

a. Definition of the Limits

With respect to the current land use and the environmental quality, the limits will not surpass 40 ha that are going to be developed for the construction and operation of the sanitary landfill including area required for buffer zone and other related facilities.

With respect to the traffic increase, vibration and noise in the zone, it can be said that its impact will be limited to the project site and the access road (Granada-Santa Rosa) from the junction of the city entrance (Chico Tripa Grocery) to the project site entrance.

With respect to excavation and transport of the clay material used for the impermeable liner, it can be said that its effect will be limited to the borrow pit of clay material and its transport route.

b. Justification of the limits of the influence area

b.1 Project site influence area

Forty hectares (40ha) of land in current use will be affected in 40 ha, because these areas will no longer be used for the cattle raising, neither for any agricultural cultivation. The areas neighboring to the project site will not be influenced by the noise and the vibration produced by the heavy machinery operating in the same, due to the construction of the buffer zone (fast growing tree planting), which will soften the impact of these parameters.

There will be no dust increase in the zone, because the access road on which the waste collection vehicles travel will be paved. Also, the landfill operation will be provided of a water tanker with sprinkling hose in order to control the dust that could be produced in the landfill operation.

Due to daily covering of the solid waste by soil, there will be no bad odors generation neither diseases transmitting vector proliferation. With respect to solid waste scattering to the surroundings, with the installation of a mobile fence at active landfill cell, buffer zone by tall trees and the construction of the fence bordering the project site, there will be no exit of the scatters out of the site.

The Poultry Farm, located to approximately 700m to the north of the construction area of the landfill, will not be influenced by any factor generated by the operation of this, such as noise, vibration, dust or odors, due to the distance and to the fact that the direction of the wind is of east to west and it is located at the far north of the site proposed for the construction of the Sanitary Landfill.

b.2 Access road influence area

On the other hand, the asphalt pavement of the access road (Granada-Santa Rosa) up to the project site reduces problems of: noise, dust and vibration. In spite of the fact that the traffic on the access road will be increased by waste collection vehicles, the impact with respect to noise, dust and vibration will be reduced considerably by the pavement.

The traffic on the access road will be a little increased by the traffic of the waste collection vehicles. However, its negative impact will be insignificant compared with the current total traffic volume and in consideration of beneficial impact of the road improvement to neighbors (e.g., IUCASA, Cartosol, Avicola San Felipe etc.).

b.3 Excavation/transport of clay material influence area

At the construction stage, appropriate measures to preventive negative impacts by clay excavation (noise, dust, etc.) will be provided at the borrow site. Or the contractor selected for the work will find a clay borrow pit where such negative impacts will not arise (e.g., far from residents and/or installations). Meanwhile, at the end of excavation, borrow pit closure works to facilitate the recovery of original environmental setting will be provided (such as smooth grading and appropriate drainage of the site).

Roads for transporting the clay will be well maintained by the contractor to minimize the negative impacts (such as road surface grading and water spaying on the road). In addition to that, speed of transporting trucks will be controlled in order to avoid traffic accidents.

c. Impacts on the water bodies and ecosystems

There will be minimal impacts on the water bodies, due to the impermeable bottom liner and leachate treatment system proposed for the landfill. The bottom impermeable liner has a thickness of 150 cm of compacted clay, which prevents the leakage of leachate to the undergroundwater. Meanwhile, leachate collection system and treatment lagoons improve the leachate quality to a permissible level.

With respect to the ecosystems, the area where the sanitary landfill is projected is used for cattle breeding and no kind of plant in danger of extinction are found therein. Although vegetation of the project area will be removed at the construction period, effect on the micro-climate of the area will be nil due to afforestation for the buffer zone.

4.8.4 Environmental Situation of the Influence Area

Present environmental situation of the influence area (i.e., SJV site) were identified by the Environmental Baseline Survey. Outcome of the Environmental Baseline Survey are presented in the Chapter 5 of Annex Q: Volume IV.

Measuring points of the Environmental Baseline Survey are indicated in Figure 4-8 below.

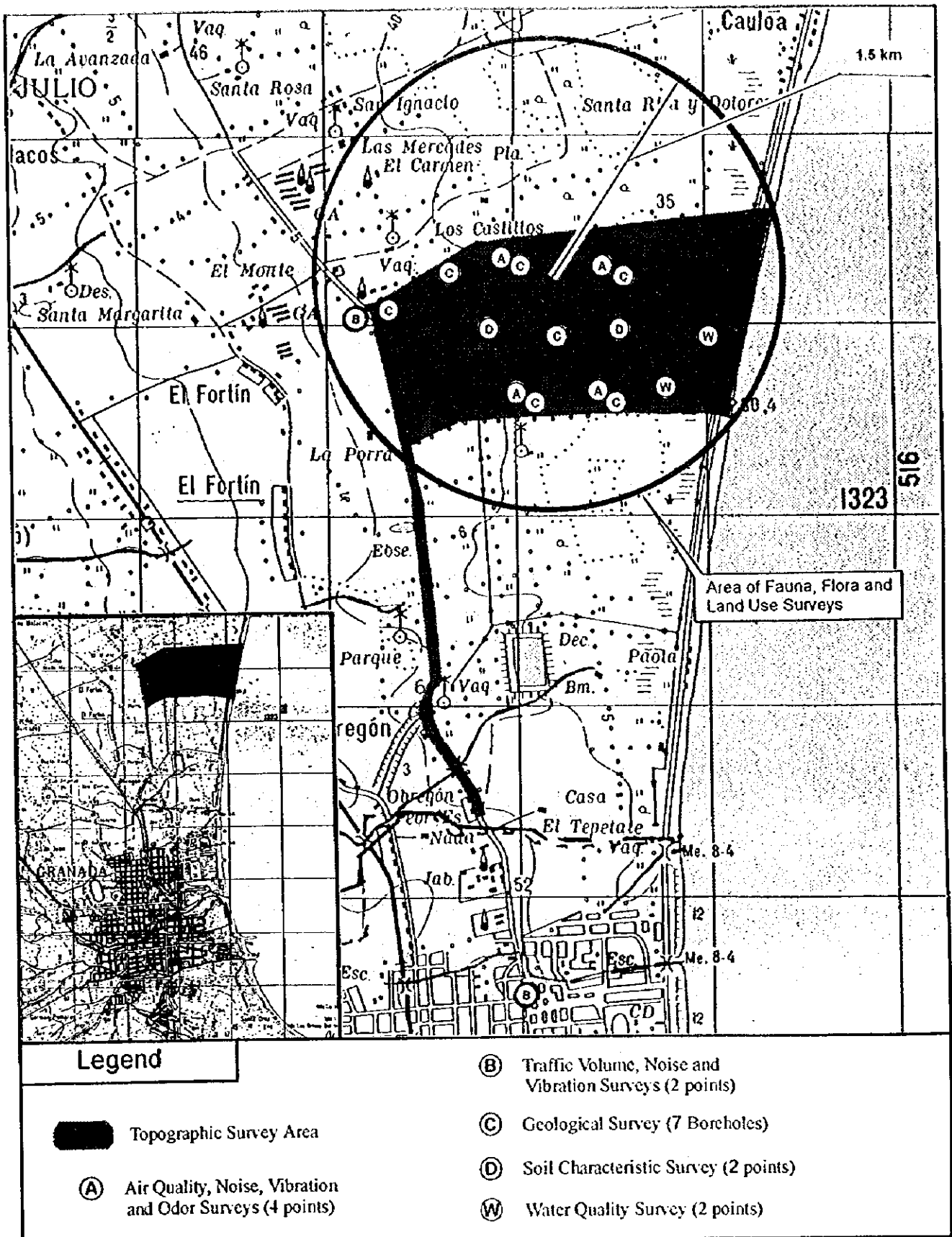


Figure 4-8: Environmental Baseline Survey Measurement Location