

4 Feasibility Study of Priority Projects

4.1 Implementation of Pilot Projects

4.1.1 Objectives of Pilot Projects

The preconception was that many difficulties will arise in implementing the plan suggested in the M/P. Consequently, pilot projects were carried out in this Study in order to anticipate the problems which could arise and its countermeasure in planning and implementing priority projects subject to the F/S. The objectives of the pilot projects are outlined below:

1. To examine the workability of the technical system proposed in the M/P.
2. To obtain basic data for the preliminary design of the F/S.
3. To enhance public awareness and cooperation on USE improvements.
4. To demonstrate a feasible level of cooperation between national, municipal and non-governmental entities in working together for an USE improvement project.
5. To demonstrate some improvement measures to the persons concerned with USE and the public.

4.1.2 Implementation of Pilot Projects

a. Pilot Project Plan

Based on the objectives above, the following projects are planned as pilot projects.

- Beautify Granada Campaign
- Experiment on Improvement of the Refuse Collection System
- Experiment on Improvement of Arroyo Zacatiligue Sanitation Environment
- Experiment on Sanitary Landfill Operation at La Joya Disposal Site
- Experiment on Domestic Wastewater Collective Treatment System

b. Implementation of Pilot Projects

Pilot projects require tangible results within a short period of three months obtaining necessary data to implement the F/S. In this context, pilot projects listed below were carried out during the 3rd Study Work in Nicaragua (June to August, 1997): the Nicaraguan side took the leading role, supported by the Study Team.

Table 4-1: Contents of Pilot Projects

| Pilot Project | M/P's Recommendation for Improvement | Related Projects subject to the F/S | Contents of the Pilot Project |
|---|--|--|---|
| 1. Beautify Granada Campaign | <ul style="list-style-type: none"> Promotion of public awareness and citizens' co-operation Providing sanitary education | <ul style="list-style-type: none"> A New Municipal SW Disposal Site Development Project Refuse Collection System Improvement Project Model Community Integrated USE Improvement Project | <ul style="list-style-type: none"> Holding a poster contest Publicity work using signboards, placards, posters, stickers, and cars with loud-speakers Holding seminars and workshops on sanitary education |
| 2. Experiment on Improvement of the Refuse Collection System | <ul style="list-style-type: none"> Expanding waste collection service by a "point collection system" Securing citizens' cooperation for the waste collection service | <ul style="list-style-type: none"> Refuse Collection System Improvement Project Model Community Integrated USE Improvement Project | <ul style="list-style-type: none"> Constructing 6 waste collection bays and installing 40 waste containers Expanding publicity and providing public education Providing punctual, periodical waste collection service |
| 3. Experiment on Improvement of Arroyo Zacateligue Sanitation Environment | <ul style="list-style-type: none"> Elimination of illegal dumping Improvement of waste collection service by a "point collection system" Securing citizens' co-operation for the waste collection service | <ul style="list-style-type: none"> Refuse Collection System Improvement Project | <ul style="list-style-type: none"> Removing illegally dumped waste and cleaning the arroyo Constructing 4 waste collection bays and installing 20 waste containers Expanding publicity and providing public education Providing punctual, periodical waste collection service |
| 4. Experiment on Sanitary Landfill Operation at La Joya Disposal Site | <ul style="list-style-type: none"> Construction of a sanitary landfill disposal site | <ul style="list-style-type: none"> A New Municipal SW Disposal Site Development Project | <ul style="list-style-type: none"> Accumulation, shaping and compaction of waste, soil coverage, construction of drainage channels Installation of gas removal pipes and fencing Improvement of access road |
| 5. Experiment on Domestic Wastewater Collective Treatment System | <ul style="list-style-type: none"> Improvement of domestic wastewater treatment system for no sewer projected area | <ul style="list-style-type: none"> Model Community Integrated USE Improvement Project | <ul style="list-style-type: none"> Construction, operation and maintenance of the domestic wastewater collective treatment system including sewer piping and household connections Expanding publicity and providing public education |

4.1.3 The Facts Found Out by Implementing Pilot Projects

The following are very important conclusions reached through implementing pilot projects with regard to the contents of the M/P, planning and implementation of F/S projects.

a. Beautify Granada Campaign

As can be seen from the results of the questionnaire surveys carried out before and during the campaign, citizens in Granada perceive that their city has a sanitary environmental problem; the citizens' co-operation is indispensable for the improvement of the present condition. Furthermore, they are also fully aware of the need to providing public education through which citizens can enhance their awareness on the problems regarding sanitation and learn what they could do.

A special feature of the recent campaign has been its linkage with the pilot projects (b.) through (e.) below, which were designed to actually improve USE. Furthermore, as cooperation from the citizens is vital for implementing these four projects, campaigning to gain cooperation through community based organizations smaller than Barrio/Reparto units (i.e., organization per road stretch or block stretch) were carried out. Through many meetings held to gain co-operation from the pilot project area residents, the importance of activities at the grass root level to enhance public awareness, which requires time and steady efforts, was reconfirmed by Granada Municipality, respective counterpart and the study team.

b. Experiment on Improvement of Refuse Collection System

The "point collection system", which strictly stipulates the rules (place, time and method) on waste discharge, was basically accepted and observed by the residents. However, the extent to which the rule "maintaining cleanliness of the waste collection point" was observed varied widely, community by community. This is mainly due to the differences of how and to what extent local community leaders carefully give the instruction regarding the waste discharge rules to each household using the waste collection points. Therefore in future, in expanding waste collection services by the "point collection system", residents' co-operation, publicity and public education is indispensable.

Considering the observation of waste generation amount per week for each waste collection point and cost sharing ability of both Granada City and residents in the community subject to the experiment, it is recommended that the cost of waste collection services in such areas should be reduced by decreasing the collection frequency from three times to twice a week.

The questionnaire surveys that polled 18 residents after the experiment showed that the majority (89%) of the residents were satisfied with the point collection system. Furthermore, all residents replied that waste collection bays were effective for the conservation of USE within the community. The amount residents are willing to pay (WTP) for waste collection services remained the same as before the experiment with an average of C\$ 3.3/month. Although the percentage of residents willing to pay dropped from 89% to 83%, no other significant changes could be observed. This is an extremely important fact and the conclusions based on them are as follows:

1. Although residents are willing to pay for the waste collection services, the amount they can pay is very limited.
2. Therefore, it is indispensable for some measures to be taken to reduce the amount residents have to share of the waste collection fee by cutting the cost of the collection service in the model district.

c. Experiment on Improvement of Arroyo Zacateligue Sanitation Environment

The result of questionnaire surveys that polled 36 residents after the experiments showed that the percentage of residents who dump their wastes into the river drastically reduced from 75% to 24%. This fact illustrates that illegal dumping by the residents living along the river will be prevented if regular waste collection service is provided. Accordingly, the provision of regular and reliable waste collection service is vital in order to prevent illegal dumping of waste. The active co-operation by citizens in clean-up activities of the lake shore and Zacateligue River proved that public education programs and campaign for the residents significantly contribute to the elimination of illegal dumping.

d. Experiment on Sanitary Landfill Operation at La Joya Disposal Site

The Experiment on Sanitary Landfill Operation at La Joya Disposal Site resulted in considerable improvement of the site, shifting from an open dumping site to a level 1 sanitary landfill site. To quantitatively evaluate the effects of the improvement works, the same group of people interviewed in the questionnaire survey prior to the commencement of the experiment were, once again, invited to the disposal site to see its newly improved state. As before, the group was asked to answer questionnaires. The results of this post-experimental questionnaire showed that all residents agreed that the disposal site conditions improved and are content with the operation of the level 1 sanitary landfill site.

e. Experiment on Domestic Wastewater Collective Treatment System

As a result of the questionnaire surveys polling 42 households after the construction of the facility, all residents replied that: 1) the USE of the community improved, 2) the domestic wastewater treatment facility constructed into their satisfaction, and 3) they will cooperate in the maintenance and operation of the facility. Moreover, the majority (67%) of the residents replied that they would like to remodel their toilets into a flush type at their own cost in the future. As can be seen above, domestic wastewater treatment is an extremely important issue for the USE for the residents in the model community. According to the results of the intake water quality analysis before the facility construction on September 17, 1997, at a local laboratory entrusted by the Study Team, and samples taken and analyzed by INAA on the same day, neither septic tank nor filter trench has not served its original purpose. This is due to the insufficient increase in microbes, that enhance the purification of wastewater. In the case of domestic wastewater, although it varies according to the characteristic of the wastewater, it generally takes about half a year for the microbes to increase in these treatment facilities and to produce stable effluents. Therefore, continuous observation is required to monitor the effect of the facilities.

The tasks and its countermeasures on Domestic Wastewater Collective Treatment System Construction, that was clarified through implementing the pilot projects, are summarized below.

Table 4-2: Tasks and Countermeasures

| Tasks | Countermeasures |
|---|---|
| Securing treatment facility sites | In order to secure land for the treatment facility to be constructed with less financial burden, the following countermeasures can be considered; 1) Utilization of public sites. 2) In case private property is used, free land offering (land donation, free land use) in exchange of tax exemption, etc. |
| Obtaining agreement from the beneficiaries (residents) for the construction of facilities | It is judged that agreement from the residents can be obtained if full explanation is given to them regarding the benefits residents can receive from the facility constructed and obligation residents need to assume for constructing facility. |
| Sharing construction costs and operation & maintenance cost | It is difficult for INAA to cover all construction costs of on-site domestic wastewater treatment facilities in the model community with its own funds. Operation and maintenance cost can be fully covered as it is minimal. Accordingly, it is vital to examine the way to secure both domestic and foreign aid for the facility construction. Regarding internal connection to the catch pit of the each household and improvement of the drainage facility within residences, it is necessary for residents to find means to carry them out by themselves under the supervision of INAA, in case they can not afford to share the cost. |

4.2 Selection of Priority Projects

4.2.1 Selection of Priority Projects

Priority projects were selected from the projects which constitute the M/P for USE in the respective fields, namely, municipal solid waste management, water supply management and domestic wastewater management. Priority project selection was examined based on the M/P as follows. As a result, F/S-1 and F/S-2 below were selected as priority projects.

F/S-1: Municipal SWM System Improvement Project

The municipal solid waste management field embraces problems ranging from collection and haulage to final disposal so that urgent but comprehensive measures for improvement is vital. Hence, F/S-1 comprises two projects: "Refuse Collection System Improvement Project" and "New Municipal SW Disposal Site Development Project".

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

The majority of the areas where a sewer system is not provided are slum squatter areas, i.e., the urban fringe area (UFA). The UFA has been expanding without any planning with the large influx of people mainly composed of the low income bracket. In these areas, not only the domestic wastewater treatment facility, but also other USE infrastructure such as stormwater drainage and access road, that is indispensable for the waste collection service, are in a poor condition. This is fundamentally different from the areas where a sewer system exists. Therefore, it is essential to improve, in an integrated manner, the four sectors: municipal solid waste management; water supply management; domestic wastewater management; and stormwater drainage, in order to improve the USE of UFA's. Accordingly, the "Model Community Integrated USE Improvement Project" was selected as a priority project.

4.2.2 Initial Environmental Examination (IEE)

An Environmental Impact Assessment (EIA) is compulsory under the Nicaraguan legislation (Decree No. 45-94). "A New Municipal SW Disposal Site Development Project" is the only project subject to EIA legally, of the priority projects stated previously.

The Ministry of Environment and Natural Resources (MARENA) issued "General Guidelines for Proposal Elaboration: Terms of Reference for the EIA of Municipal Sanitary Landfill" for the Study in response to the Team's request. Meanwhile, in addition to MARENA's Terms of Reference for the EIA, "JICA Environmental Guidelines" was referred to as a supplement for the IEE of the Study.

As a result of the IEE, works required for EIA were 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 photomontage; Cultural Property Survey; Estimation of construction waste (from the project); Research on location and availability of soil suitable as an impermeable liner and coverage.

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

4.3.1 Refuse Collection Improvement Project

a. Target

Municipal SWM System Improvement Project aims to improve the solid waste collection, transportation and disposal systems between 2001 and 2005 in order to attain the targets shown in Table 4-3.

Table 4-3: Targets of Municipal Solid Waste Management System Improvement Project

| Item | Unit | 1996 (At the time of the Study) | 2001 | 2003 | 2005 |
|---|-------------------------------|---------------------------------------|-------------------------------|---------|---------|
| Municipal SWM System Improvement Project | | | | | |
| Population in Granada City | persons | 102,253 | 130,349 | 138,825 | 147,830 |
| Population the 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 | 95,249 | 101,843 |
| Length of road swept | km | 35 | 35 | 37 | 40 |
| Final disposal | | | | | |
| Disposal amount | thousand m ³ /year | 8 | 26.8 | 29.8 | 33.1 |
| Name of the disposal site | - | La Joya | SJV a new final disposal site | | |
| Level of disposal method | - | Level 1 | | | |
| | | | Level 4 | | |

b. Outline of the Municipal SWM System Improvement Project

The outline of the project which is proposed to realize the targets in Table 4-3 are shown in Table 4-4.

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

| | Contents |
|--|--|
| 1. Refuse Collection System Improvement Project | |
| 1.1 Refuse Collection System Improvement (Refer to Figure 4-1) | Procurement of equipment: General collection (street/point) <ul style="list-style-type: none"> • 12m³ compactor truck: 5 units in 2000, 1 in 2002, 1 in 2004 Special collection service <ul style="list-style-type: none"> • 1 of 10m³ tipper truck (2000), • 1 of wheel loader (2000) |
| 1.2 Improvement of Street Sweeping | Procurement of equipment: <ul style="list-style-type: none"> • 12 m³ compactor trucks (included in the above) • 30 units of hand carts |
| 1.3 Improvement of the Modulo de Operacion Workshop (Refer to Figure 4-2) | <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 (Refer to Figure 4-3) | <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 the Administrative System | <ul style="list-style-type: none"> • Strengthening of the UEMB (Urban Environmental Maintenance Bureau), and procurement of office equipment • Improvement of the organizational system |

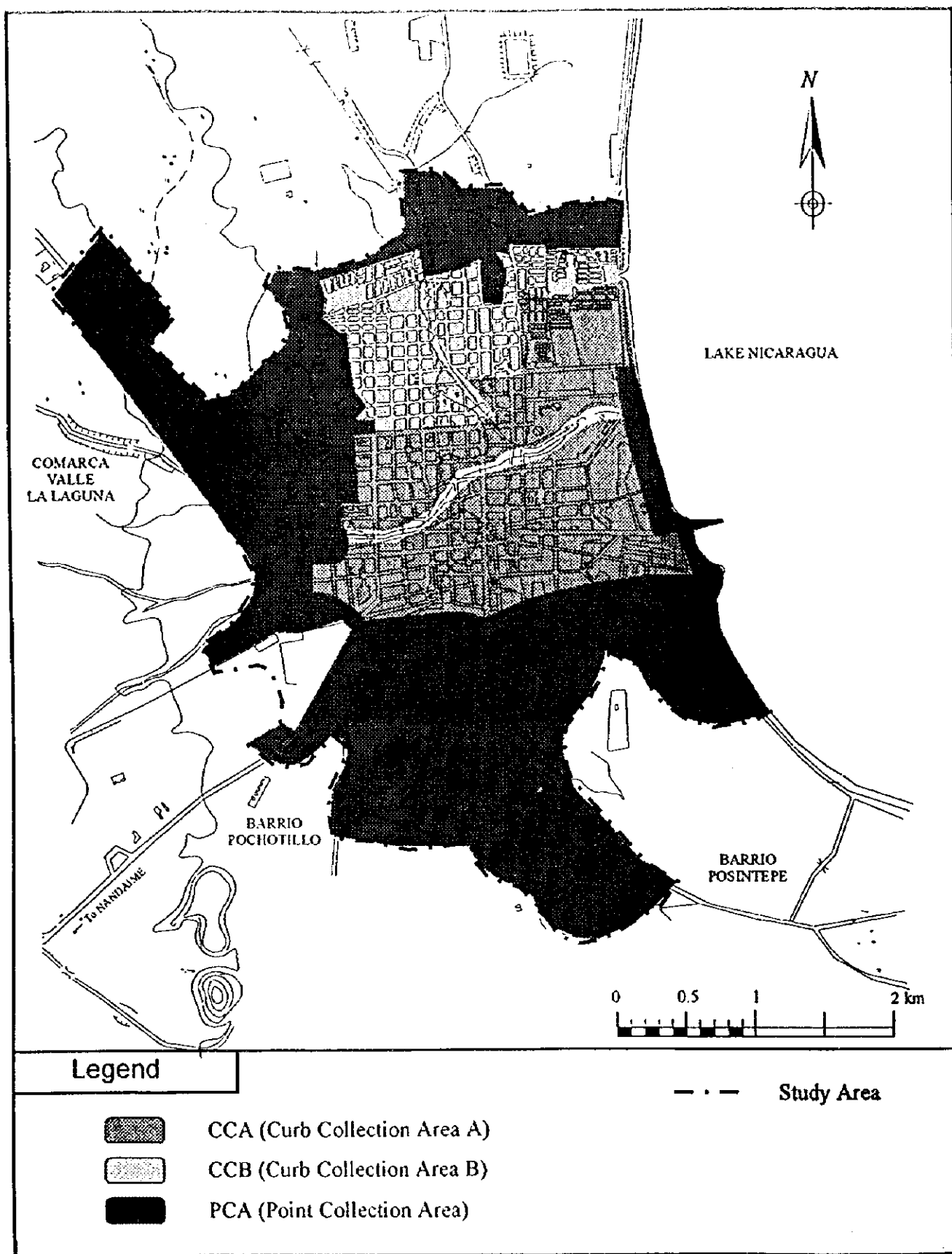


Figure 4-1: Classification of Waste Collection Areas

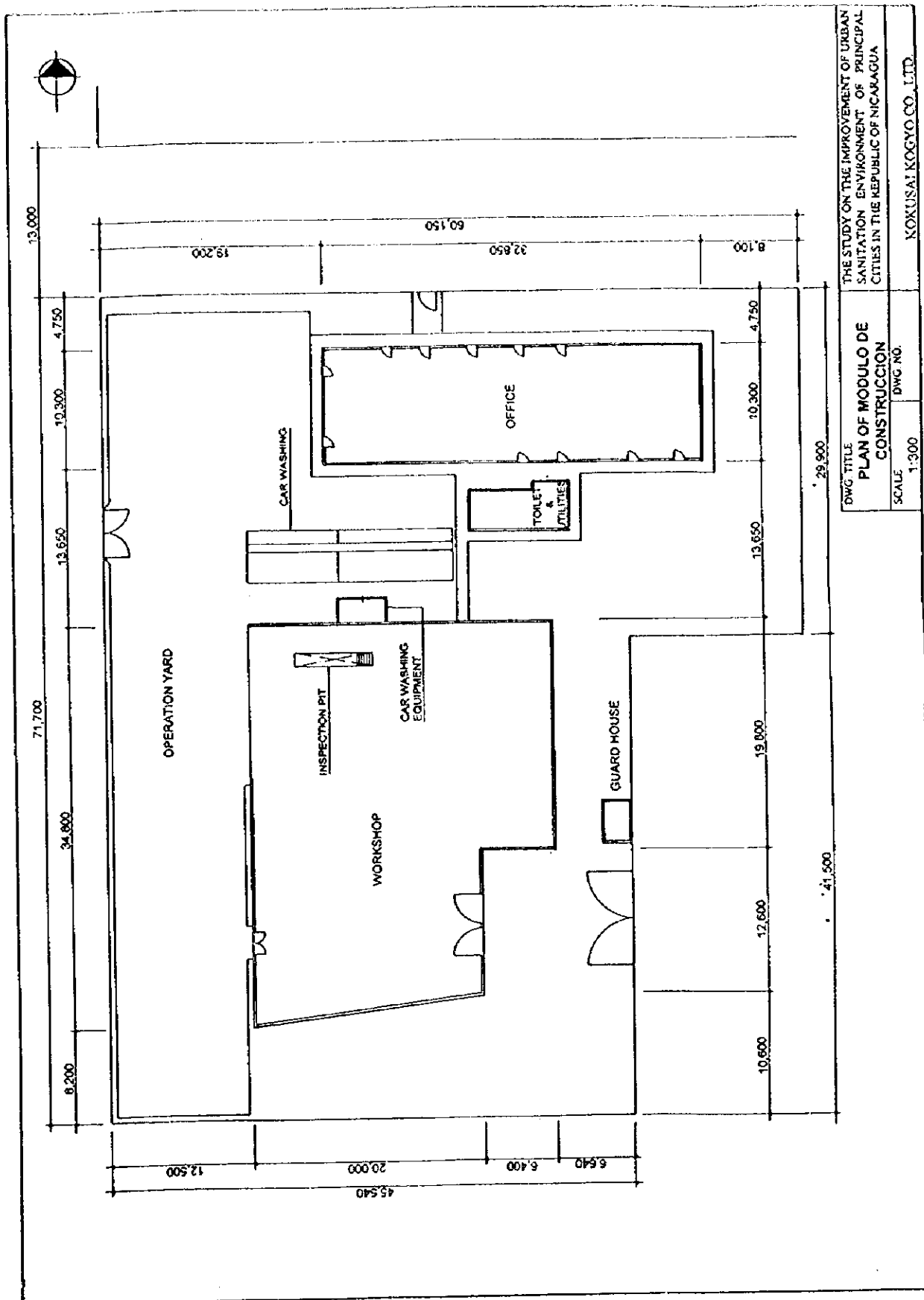


Figure 4-2: Improvement of MDO Workshop (1)

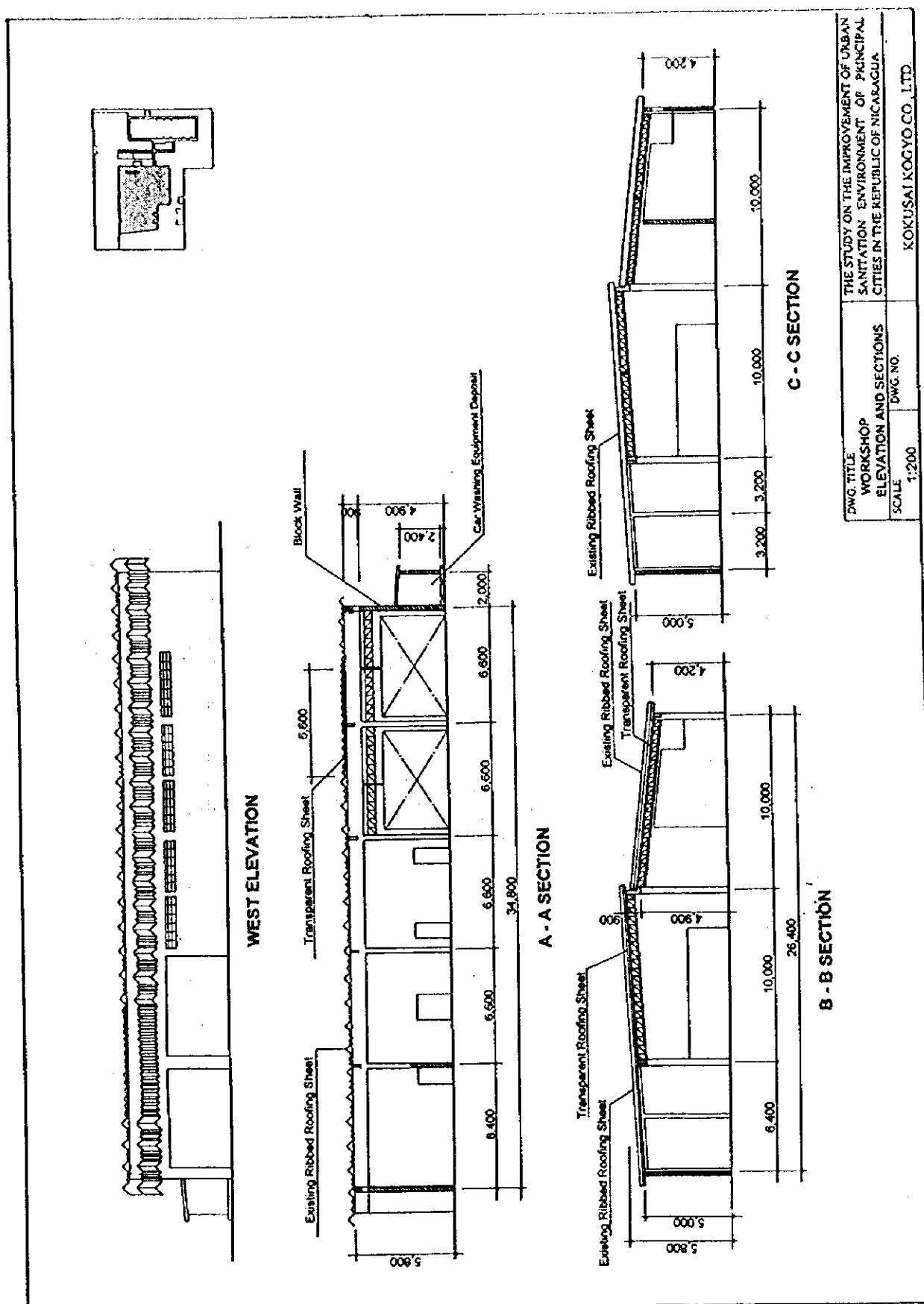
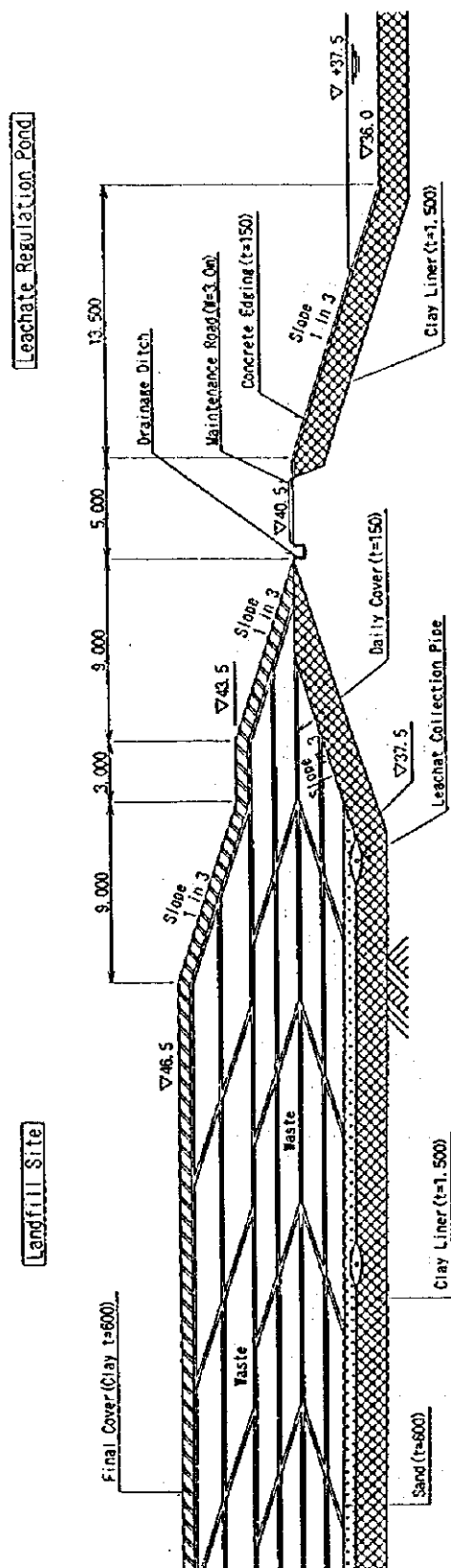
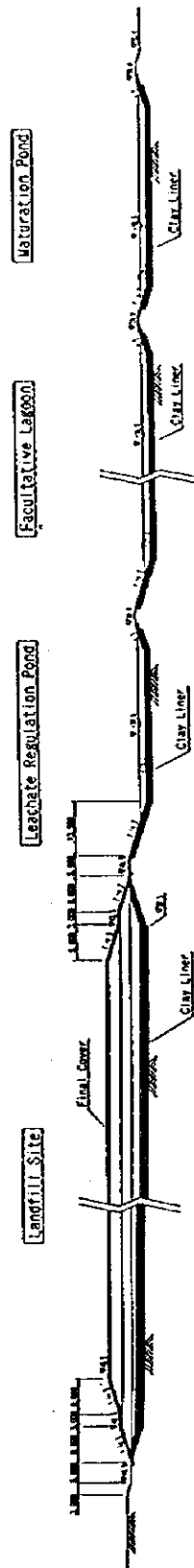


Figure 4-4: Improvement of MDO Workshop (3)

DETAIL SECTION S=1:200



LONGITUDINAL SECTION S=1:1,000



| | | |
|------------|---|-------------------------|
| DWG. TITLE | THE STUDY ON THE IMPROVEMENT OF URBAN SANITATION ENVIRONMENT OF PRINCIPAL CITIES IN THE REPUBLIC OF NICARAGUA | |
| SCALE | DWG. NO. | KOKUSAI KOGYO CO., LTD. |

Figure 4-6: SJV A New Disposal Site Plan (2)

4.3.2 Institutional System Improvement Plan

a. Administration and Organization

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 Refuse 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.

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 85 persons in total.

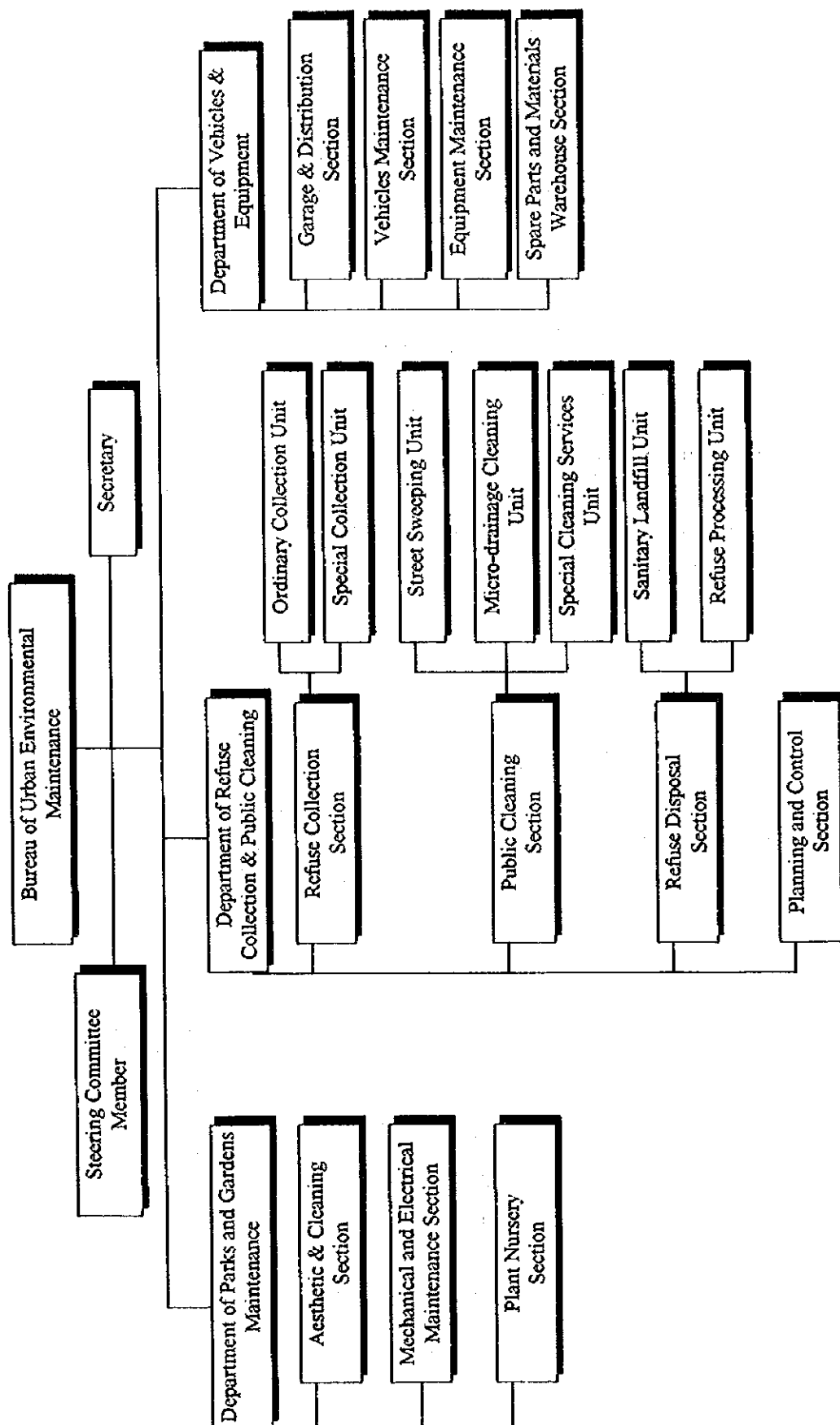


Figure 4-7: Organizational Structure of the Bureau of UEM

b. Monitoring, Control and Information Management System

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.

c. Legislation and Enforcement

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
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.

In order to implement a planned SWM, the Regulation must be introduced with a Tariff Plan.

d. Contract System to Private Sector

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.

e. 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.

4.3.3 Calculation of Project Cost

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

Table 4-5: Cost Estimation of F/S-1: Municipal SWM System Improvement Project

Unit: C\$ 1,000

Unit: \$ 1,000

| Category | Category | Item | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Total |
|----------------|---|---|---|-------|-------|-------|-------|--------|--------|
| Direct Costs | Collection & Transport | Inves. for equipment | 5,700 | 853 | - | 67 | 85 | - | 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 |
| | Final Disposal (SJVA New Disposal Site) | Inves. for facilities (Inc. land acquisition) | 34,992 | - | - | - | - | - | 34,992 |
| | | 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 | 55,620 |
| Indirect Costs | 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 workshop & motor pool | | | | | | |
| | | Inves. for equipment | Including maintenance workshop & motor pool | | | | | | |
| | | Operation cost for labor | - | 288 | 288 | 288 | 288 | 288 | 1,440 |
| | | Operation cost for material & fuel | Including maintenance workshop & motor pool | | | | | | |
| | | Spare parts & repair | Including maintenance workshop & motor 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 | |

4.3.4 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 Body | Granada Municipality will be the executing body, but some of the services will be contracted out to a private collection company. |
| Investment Plan | The M/P proposed 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 the municipal tax revenue

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

The following possibilities were considered for financial sources.

| | |
|---------------|--|
| 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 charges 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, that had a 96% collection rate in 1996. As for the other waste, 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 by 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 municipal taxation.

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 (3.4% 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 institutions and businesses, 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. 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 estate 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 the tax 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 and 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 the 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 in parenthesis are contributions to the 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 4-6: 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 losses 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 4-7: Cash Flow of the Municipal Solid Waste Management System Improvement Project (Case C-2)

Unit: C\$ 1,000

| | 2000 | 2001 | 2003 | 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 4-8: Profit & Loss Statement of the Municipal Solid Waste Management System Improvement Project (Case C-2)

Unit : C\$1,000

| | 2000 | 2001 | 2003 | 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 | 2,605 | 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.

4.3.5 Environmental Impact Assessment (EIA) of SJV A New Municipal SW Disposal Site Development Project

a. Outcome of EIA

a.1 EIA Report

The EIA for SJV A New Municipal SW Disposal Site Development Project is outlined in line 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
- Limit 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

a.2 Outcome of EIA

SJV A New Municipal SW Disposal Site is planned to be a level 4 sanitary landfill. In order to minimize its impact on the surrounding areas, various mitigation measures were formulated. This will reduce most of the adverse impact caused by the construction, operation and closure of the disposal site to a permissible level. In particularly, the amount of the leachate generated from the disposal site shall be minimized as much as possible and furthermore, an impermeable liner shall prevent it from penetrating the ground water and then collected through leachate collecting pipes, connected to a regulation pond, and then treated at a facultative lagoon and a maturation pond to a concentration level that is permissible. Therefore, the newly proposed disposal site cannot be envisaged to be a cause for ground water contamination as was in the case with a present La Joya disposal site.

Negative impacts (dust, vibration, noise, and increase of traffic volume) caused by the collection vehicles will be improved by the asphalt pavement of the present access road (Granada-Santa Rosa Road).

During the landfill operation period and after its closure, the landscape of the site is altered as landfill work involves topographical alteration. However, it is obstructed by the buffer zone, and after the landfill is completed, re-vegetation over the final covering of the landfill improves the landscape. Therefore, no negative impact landscape alteration is envisaged. Regarding the land use plan after closure, an ecological park construction is proposed by integrating surrounding natural resources such as a waste hill of about 7.5m, existing wetlands, forests, and Lake Nicaragua. This will bring about not only environmental improvement, but also benefits residents in the neighboring areas and the whole of Granada Municipality.

In the sanitary landfill, daily soil coverage on waste will be carried out, and therefore proliferation of vermin that carry various pathogens could substantially be controlled and avoided. Therefore, it is not expected that the sanitary landfill project produces impacts of disease vectors proliferation toward the poultry farm, San Felipe. On the other hand, at the poultry farm, the present activities and insanitary conditions are already attracting some vermin (e.g., roof rats *L. Rattus rattus* are attracted by poultry feeds, Zopilotes *L. Coragyps atratus* are attracted by untreated residues from fowl meat processing).

The policy of prohibiting scavenging at the new disposal site will result in a loss of income and livelihood for scavengers and middlemen currently operating at the La Joya disposal site, a decrease in the amount of waste materials recycled, and a slight upset to the recycling system in the city. However, the negative impacts will be marginal because the number of scavengers affected will be less than 30. Furthermore, it is recommended that recycling be promoted by segregation at the source in order to mitigate these negative impacts, and also to improve the recycling rate.

The important points regarding the positive impacts of the project are that the present La Joya disposal site (although it is substantially improved by the pilot project), from which untreated leachate is currently permeating the ground, will be closed and become a level 4 sanitary landfill disposal site with a leachate treatment facility. Above all, since the present La Joya disposal site is located upstream of the INAA's wells, the main water supply source in Granada City today, its closure and the shift to the new final disposal site, that does not affect ground water, is urgent. Accordingly, the benefits brought about from this plan is very high.

It is expected that due to mitigation measures to be carried out during each stage (i.e., construction, operation and closure and post-closure stages) of the project, the environmental quality during and after the project should be maintained equal to the current conditions.

b. Obtaining an Environmental Permit

As was stated in the EIA report, the negative impact brought about by the implementation of the SJV A New Municipal SW Disposal Site Development Project is within permissible parameters and is minimal. On the other hand, there are several positive impacts on USE in Granada City, such as closure of the La Joya disposal site that is very likely to impose serious negative impacts on the environment through contamination of the ground water resources. Therefore, the project shall be carried out based on the work process stated in the Implementation Plan. Granada Municipality, which is the proponent of SJV A New Municipal SW Disposal Site Development

Project, needs to submit this EIA report and obtain an environmental permit in accordance with "EIA and Regulation to obtain an Environmental Permit (Decree No. 45-94)" in order to carry out the project promptly.

4.3.6 Project Evaluation

The project evaluation for the Municipal SWM System Improvement Project was carried out from technical, social, environmental, financial and economical perspectives.

a. Technical Evaluation

The technical systems proposed in the priority projects are mainly constituted of two sub-systems: a final disposal system; and a collection and transportation system which is basically the same as the present system. Therefore, the technical evaluation was carried out from the viewpoint of whether or not the proposed technical systems can be properly operated, managed, and maintained.

a.1 Collection and Transportation System

There is no problem in continuing the "curb collection system" that is currently undertaken without any problems even in the urbanized areas in Granada Municipality.

Regarding the point collection system which will be introduced in the UFA, the biggest concern is whether or not cooperation from the residents can be obtained. In this regard, pilot projects confirmed that resident's cooperation can be obtained if waste collection bays are installed within 50 m from their houses, and discharge methods are fully explained to them. Therefore, the problems will be solved by giving full consideration to the location of collection bays from housing and explaining discharge methods to residents.

The major concern in introducing compactor trucks as waste collection vehicles is the maintenance capability (in particular the hydraulic systems). In the principal cities in Nicaragua, (such as Managua and Leon), the majority of the collection vehicles are compactor trucks and the maintenance skills are already acquired in these cities. Therefore, if the maintenance engineers for collection vehicles in Granada Municipality receive training in these cities, they can acquire the necessary maintenance skills. Furthermore, mechanics of the MDO who will have to be in charge of the compactor trucks' maintenance already deal with more complicated maintenance for hydraulic systems of a wheel loader and a motorgrader. Therefore, there should be no problems for them to acquire these skills. Tipper trucks instead of compactor trucks are planned to be used for the removal of illegally dumped waste and sedimented soil, which frequently cause the breakdown of hydraulic systems.

A total of six collection vehicles needs to be in operation in 2001 and eight in 2005 so that only four vehicles shall operate additionally. Therefore, the mechanics should be capable of operating and maintaining this small number of additional vehicles.

As was mentioned above, the present mechanics of MDO workshop have certain technical abilities to maintain the equipment. However, the facility and repair equipment of the existing workshop is extremely poor. Thus, the MDO's operation and maintenance system for refuse collection vehicles and landfill equipment shall be

strengthened through improvement of the MDO facilities: such as the operation yard pavement, lighting improvements, and also procurement of repair equipment and tools.

a.2 Street Sweeping

Street sweeping shall be basically carried out manually as it is now, no operational and maintenance problems are expected to arise.

a.3 Final Disposal

The final disposal method in Granada has improved through the La Joya pilot project by shifting from open dumping to the first step of a sanitary landfill, level 1: controlled tipping with casual soil covering. However, in SJV A New Municipal SW Disposal Site Development Project, the level of disposal method is to be advanced directly to level 4: i.e., impermeable liner, leachate collection and treatment. This would not only place financial burden sharing but also technical problems. Therefore, key issues, technically, and its countermeasures are summarized in the table below.

Table 4-9: Key Issues and Solutions for Level 4 Landfill Implementation

| Key Issues | Solutions |
|---|--|
| Availability of cover soil | They geological survey for the proposed site revealed that the surface layer of the site composed of either clay, silt or sand, which can be used as cover soil. Therefore, it can be procured within the site and there is no need to secure borrow pits. |
| Availability of clay material for the impermeable liner | Clay material with a permeability coefficient of 10^{-7} (cm/sec) can be obtained 20 km north east of the proposed facility construction site. |
| Construction of an impermeable liner | A foreign contractor with the experience of impermeable liner construction, (or a local contractor with relevant engineering skills) is indispensable for the construction. |
| Construction of a leachate treatment facility | A foreign contractor with the experience of leachate treatment facilities construction, (or a local contractor with relevant engineering skills) is indispensable for the construction. |
| Operation of a leachate treatment facility | A foreign expert with the experience of operating leachate treatment facility (or a Nicaraguan with relevant experiences) is indispensable for the operation. |
| Operation of level 4 landfill | Foreign experts with the experience of operating level 4 landfills (or local experts with relevant experiences) are indispensable for the operation. |

As stated above, for the construction, operation and maintenance of the level 4 landfill, foreign assistance not only for financing, but also for the technical aspects are indispensable. However, Granada's experiences on the level 4 sanitary landfill (construction, operation and maintenance) will be a valuable technical asset not only for Granada but for many Nicaraguan cities that face problems of surface and ground water pollution by municipal dumping sites.

a.4 Conclusion of Technical Evaluation

Judging from all the technical aspects, it is anticipated that Granada Municipality, with the present technical levels will find it difficult to deal with the construction, operation and maintenance of a level 4 sanitary landfill site. However, it is strongly expected that these level 4 technologies should become commonplace in Nicaragua in order to preserve the USE and to avoid contamination of precious water resources. In this

regard, foreign assistance on both financial and technical aspects should be sought to solve these problems.

The technical systems proposed, other than the level 4 landfill, are not complicated and are appropriate for the present technical level of Granada Municipality.

b. Social Evaluation

The Municipal SWM System Improvement Project will bring about various benefits. The number of beneficiaries of the project, who have recently benefited from collection services and an improved USE, will reach approximately 54,000 persons. As a knock-on effect of the improved waste collection, it will contribute to less drain blockages caused by refuse clogging (which in turn will reduce flooding areas and frequency), and consequently increase road life and reduce road maintenance expenditures and pollution of surface and ground water. The improved USE and aesthetic scenery in the city will introduce various positive impacts such as encouraging foreign and domestic investment, promoting the tourist industry and raising property values in the city.

At present where waste collection service is insufficient, illegal dumping into the rivers nearby and vacant land is frequently observed. In the UFA's, mainly composed of residents on low income, and among others where refuse collection service is absent, illegal dumping is prominent. The questionnaire surveys in the pilot project confirmed that if regular and reliable refuse collection service is provided, illegal dumping will definitely decrease. This illustrates that by implementing this project, the USE of the low income areas will be considerably improved and accordingly, it will contribute to eliminate the social equity.

The technical systems proposed, except for the point collection system for the UFA and a level 4 landfill, have been widely accepted by Granada's citizens, thus far they are socially compatible. Regarding the point collection system, pilot projects confirmed that cooperation from the residents can be obtained if public education is provided and publicity is carried out. As for the introduction of a sanitary landfill, the questionnaire surveys were polled the same group of people who were invited to see the La Joya disposal site before and after the experiment, in order to investigate the impact of the improvement project quantitatively. As a result, all appreciated that the disposal site has improved. The Experiment on Sanitary Landfill Operation at La Joya Disposal Site was designed to improve the situation from open dumping to sanitary landfill level 1. Therefore, level 4 will greatly improve the environment of the surrounding areas than level 1. In conclusion, it can be judged that the introduction of a sanitary landfill will be welcomed by citizen and socially acceptable.

c. Environmental Evaluation

Although the implementation of the SJV A New Municipal SW Disposal Site Development Project brings various impacts to its environment, the EIA concluded that the predicted positive impacts would outnumber the negative impacts; all negative impacts could be mitigated within acceptable limits by carrying out various mitigation countermeasures.

d. Financial Evaluation

- (1) According to the POS, the citizens' willingness to pay in Granada City is C\$ 8.54 per month per household. This financial evaluation employs a three tiered domestic waste collection fee system: the high rate of C\$ 15/month/household, average C\$ 10/month/household and low C\$ 5/month/household, based on the present charges. Following this, beneficiaries also are stratified into three division and each is estimated to represent 40%, 30% and 30% in total. Waste collection fees for non residential waste is, based on the Beneficiary-Pays-Principle, defined as C\$ 362/ton.
- (2) If a loan is acquired to cover the entire project cost, the R/E would be less than 1; the FIRR calculation indicates that the project would be financially unfeasible.
- (3) If grant aid is to be acquired for 90% of the investment required in 2000 (only Case B-1, where the forecast revenue is optimistic), it would incur an FIRR (16.4%) that is higher than the cut-off rate (8.5%).
- (4) If grant aid is to be acquired for the entire investment required in 2000 (Case C-2, where the forecast increase in municipal tax rates and SWM budget is most probable) it would incur an FIRR (13%) higher than the cut-off rate. In this case, the profit and loss statement would be in the black and an internal reserve of C\$11 million can be accumulated by 2005, enabling Granada Municipality to independently provide for the investments required after 2005.

e. Economic Evaluation

The economic evaluation is carried out using the Economic Internal Rate of Return (EIRR) as a basis. The EIRR was calculated using the total project cost, which is determined by revising irregularities in the domestic market prices based on economic prices, and the overall project benefits, both of which took environmental benefits into account.

Of the cases in A, that proposes the acquisition of a loan to cover the entire project cost, the EIRR was calculated for A-2, that proposes the joint collection of refuse collection and water supply charges and a very appropriate tax revenue growth rate and SWM budget allocation.

The EIRR was calculated at 4.6% taking the present fee paid by the residents as a benefit. Although it is less than the cut-off rate, the project expenses will not run into deficits as the revenue would exceed the expenses. In the case where only the beneficiaries' willingness to pay is considered as a benefit, the EIRR was estimated at 2.8%.

The calculation, which took environmental benefits (e.g., improvements in public health and sanitation, increase in land prices and higher consumption due to developments in the tourist industry) into account in addition to the present fee paid, resulted in an EIRR of 13.3%. Because it exceeds the cut-off rate, the implementation of the project is presumed to contribute to the national economic development.

f. Total Evaluation

As a total evaluation, it was concluded that the implementation of the Municipal SWM System Improvement Project was feasible from technical, social, environmental, financial, and economic aspects. It is a pre-condition for conservation of USE and public health of Granada Municipality, and for sustainable development of the Municipal activities.

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

4.4.1 The selection of Model Communities

a. Present Condition of Urban Fringe Area (UFA)

The majority of the areas where sewer systems are not provided in INAA's sewer development plan in 2010 are slum squatter areas, i.e., the urban fringe area (UFA). In these areas, the USE infrastructure is in a poor condition and it is essential to improve, in an integrated manner, the four USE sectors: municipal solid waste management; water supply management; domestic wastewater management; and stormwater drainage, in order to improve the USE of UFA's. Accordingly, communities rated as C₁, C₂, C₃, C₇ (total area amounts to 200 ha) in INAA's community classification for its sewerage system, were selected and a topographical survey was carried out.

The size of the areas, present population and population density of the community subject to the UFA survey, and its future population projection stated in INAA's plan are shown in the table below.

Table 4-10: Population and Population Density of the Community for UFA Survey

| 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. The selection of Model Community

The infrastructure related to USE in the community subject to the UFA survey is in sufficiently except for the water supply system. However, the population density of the model community is higher than that of areas subject to the sewerage system provision,

except for C7. Moreover, the population density of Wards in Tokyo in 1995, famous for its high population density, was 128 persons/ha. This illustrates that the population density of the model community is high and the impact of the poor USE infrastructure is grave.

C1, C2 and C3 have streets along which the construction of on-site domestic wastewater treatment facilities and stormwater drainage facilities can be planned. Such plans are not possible for C7 as it has no streets.

Accordingly, C1, C2 and C3 were selected as model communities subject to the "Model Communities Integrated USE Improvement Project" (Refer to Figure 4-5). In the M/P, improvements of the USE by 2010 for these areas is set as its target. The areas where the improvement of the facility is to be completed by 2005, starting in 2001, are subject to the F/S. This is based on the assumptions that the improvement rate increases regularly by 2010.

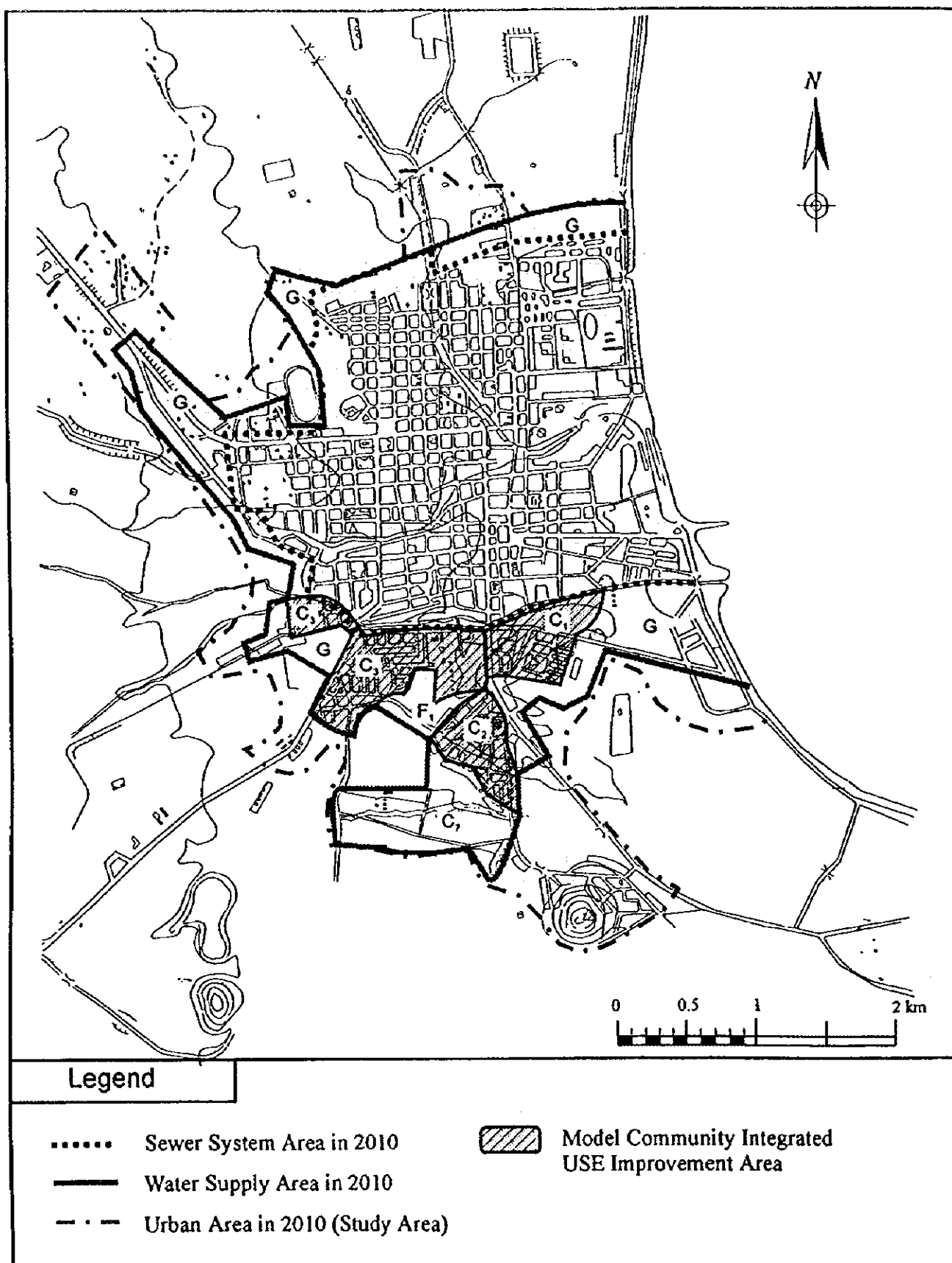


Figure 4-8: Location of Model Community

4.4.2 Outline of Model Community Integrated USE Improvement Project

a. Target

In order to improve the USE of the model community, it is essential to improve, in an integrated manner, the four USE sectors: municipal solid waste management, water supply management, domestic wastewater management; and stormwater drainage. The on-site domestic wastewater treatment facilities need to be constructed in a small sized community as a "treatment block" (composed of a group of a few to several tens of households). In the "Model Community Integrated USE Improvement Project", it is important to pay attention to the fact that the improvement of the facility becomes possible only when consensus with the residents on the facility improvement per treatment block are formed.

The Model Community Integrated USE Improvement Project aims to improve each of the respective areas, such as water supply system, municipal solid waste management, domestic wastewater treatment, and stormwater drainage project, with the target shown in the Table 4-11 below.

Table 4-11: Target Figure for Model Community Integrated USE Improvement Project

| Item | Unit | 1997 | 2001 | 2002 | 2003 | 2004 | 2005 |
|--|----------|---------|---------|---------|---------|---------|---------|
| Population in Granada Municipality | person | 107,795 | 130,349 | 134,520 | 138,825 | 143,267 | 147,830 |
| Population in the Study Area | person | 76,250 | 100,382 | 103,795 | 107,330 | 110,979 | 114,760 |
| Population in the model community | person | 17,484 | 18,938 | 19,331 | 19,724 | 20,118 | 20,511 |
| Water supply system improvement | | | | | | | |
| Population served by a water supply system | person | 17,484 | 18,938 | 19,331 | 19,724 | 20,118 | 20,511 |
| Water supply coverage (% of population) | % | 100 | 100 | 100 | 100 | 100 | 100 |
| Population subject to the improvement (increased population) | person | 0 | 393 | 786 | 1,179 | 1,573 | 1,966 |
| Refuse Collection Improvement Project | | | | | | | |
| Population served by a collection service | person | 17,484 | 18,938 | 19,331 | 19,724 | 20,118 | 20,511 |
| Waste discharge amount | ton/day | 7.8 | 13.8 | 14.3 | 14.8 | 15.3 | 15.8 |
| Waste collection rate | % | 82 | 100 | 100 | 100 | 100 | 100 |
| Waste collection amount | ton/day | 6.4 | 13.8 | 14.3 | 14.8 | 15.3 | 15.8 |
| On-site domestic wastewater treatment system improvement | | | | | | | |
| Population served | person | 300 | 2,311 | 4,622 | 6,933 | 9,244 | 11,555 |
| Number of districts for collective treatment | district | 1 | 17 | 34 | 52 | 70 | 88 |
| Coverage rate (% of population) | % | 1.7 | 12.2 | 23.9 | 35.2 | 45.9 | 56.3 |
| Stormwater drainage improvement project | | | | | | | |
| Beneficiary population | person | 0 | 2,311 | 4,622 | 6,933 | 9,244 | 11,555 |
| Length of drains (road pavement) extended | km | 0 | 1.3 | 2.5 | 3.8 | 5.1 | 6.4 |

b. Outline of the Model Community Integrated USE Improvement Project

Table 4-12 gives the outline of the project planned to realize the target set in Table 4-11.

Table 4-12: Outline of Model Community Integrated USE Improvement Project

| Project | Outline | | | | | | | | | | | | | | | |
|---|--|--------|-------------|---------------|-------------|---------------|-------------------|---|---|----------|----------|-----------------|-----|-----|-----------|---------|
| 1. Water Supply System Improvement Project | Model communities are located in the areas where a water supply system is already provided. Water supply coverage is 100 % now and will be in the future. Accordingly, INAA planned to improve the facility necessary to deal with the increased population in the model communities each year. | | | | | | | | | | | | | | | |
| 2. Refuse Collection System Improvement Project | Point collection system, where waste collection frequency is twice a week, is adopted in the Model Community Integrated USE Improvement Project. | | | | | | | | | | | | | | | |
| 3. On-site Domestic Wastewater Treatment System Improvement Project (Refer to Figure 4-9, Figure 4-10, and Figure 4-11) | <div>1. The on-site domestic wastewater treatment system shall be constructed by 2005 (treatment communities: 88, population subject to treatment 11,555, treatment facility: 88, total extended length of pipeline: 11.6 km).</div> <div>2. The on-site collective treatment system which comprises a few to several tens of households as one treatment unit.</div> <div>3. Main facility: Catch Pit, Sewer (PVC 100mm 150mm), Manhole, Septic Tank, Filter Trench</div> <div>4. Water quality of treatment water</div> <table><thead><tr><th></th><th>Raw water</th><th>Target</th><th>Septic Tank</th><th>Filter Trench</th></tr></thead><tbody><tr><td>BOD removal rate:</td><td>-</td><td>-</td><td>55 - 70%</td><td>55 - 70%</td></tr><tr><td>BOD (mg./ltr.):</td><td>340</td><td>110</td><td>153 - 102</td><td>77 - 51</td></tr></tbody></table> | | Raw water | Target | Septic Tank | Filter Trench | BOD removal rate: | - | - | 55 - 70% | 55 - 70% | BOD (mg./ltr.): | 340 | 110 | 153 - 102 | 77 - 51 |
| | Raw water | Target | Septic Tank | Filter Trench | | | | | | | | | | | | |
| BOD removal rate: | - | - | 55 - 70% | 55 - 70% | | | | | | | | | | | | |
| BOD (mg./ltr.): | 340 | 110 | 153 - 102 | 77 - 51 | | | | | | | | | | | | |
| 7. Stormwater Drainage Improvement Project (Refer to Figure 4-12, and Figure 4-13) | <div>(1) Improvement of concrete/block pavement roads, 6,370m in total, which also serves as stormwater drain, and installation of 10 outfalls by 2005.</div> <div>(2) Regarding the roads which also serve as stormwater drains, three types of road widths (4m, 5m, 6m) are adopted in accordance with the significance of the roads.</div> | | | | | | | | | | | | | | | |
| 8. Organizational system to promote the Model Community Integrated USE Improvement Project | <div>• Establishing a Steering Committee which promotes the Model Community Integrated USE Improvement Project.</div> <div>• Formation of a task force in INAA, Granada Municipality, and MINSA/SILAIS, respectively, in order to promote the Model Community Integrated USE Improvement Project.</div> | | | | | | | | | | | | | | | |

Note: Upon consideration of community consensus and O&M system of a DWW treatment system, one block which is the smallest neighborhood community is planned as one treatment community. If several blocks manage to create a treatment community, the unit construction cost(per household) for a treatment facility can be reduced though the cost of connection to the pipeline can not be reduced(See Annex R). Therefore, if consensus among multiple communities and O&M system can be established, it is desirable to have a DWW treatment system for several blocks in order to reduce the cost.

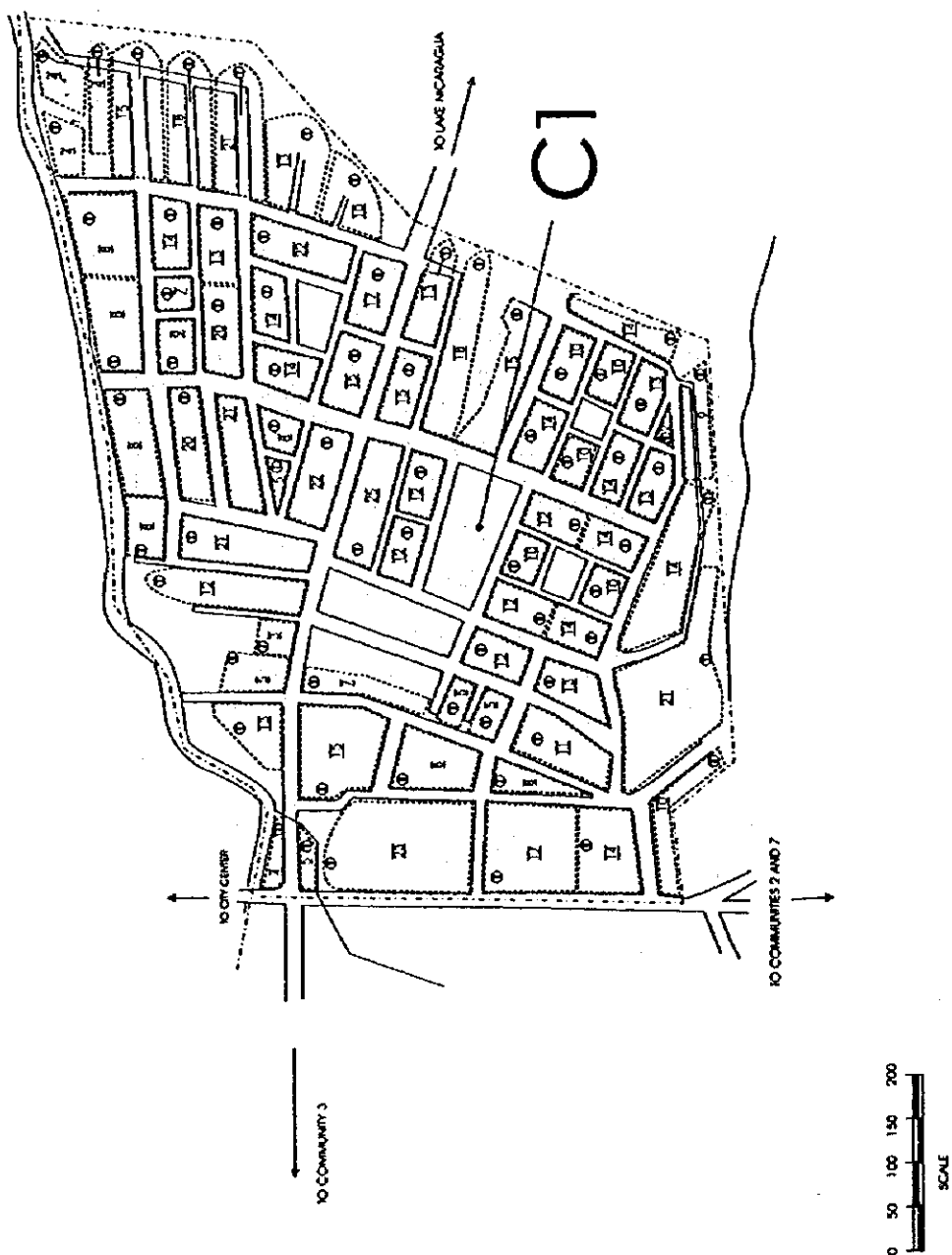


Figure 4-9: Domestic Wastewater Treatment System Improvement Project (1)

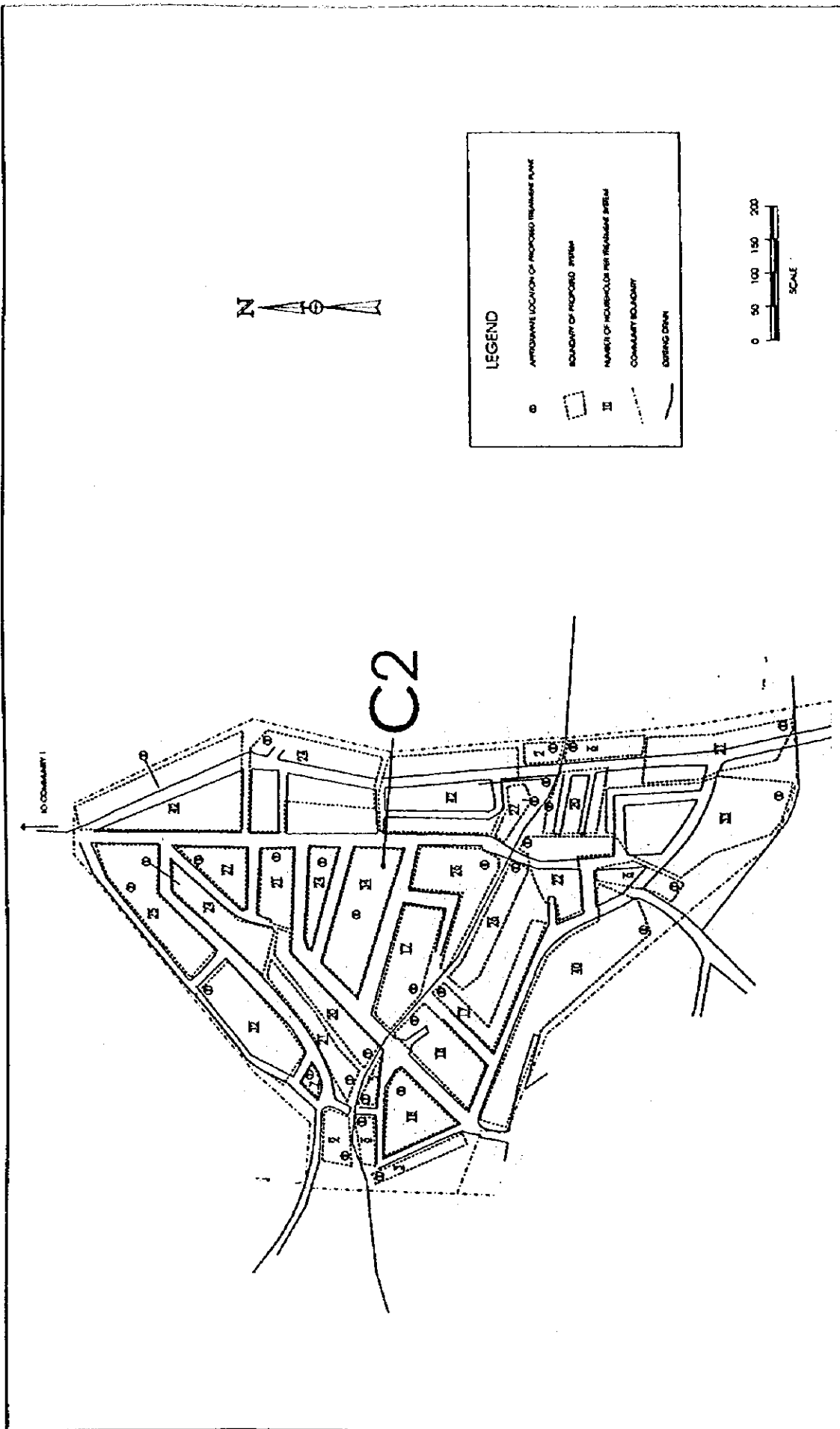


Figure 4-10: Domestic Wastewater Treatment System Improvement Project (2)

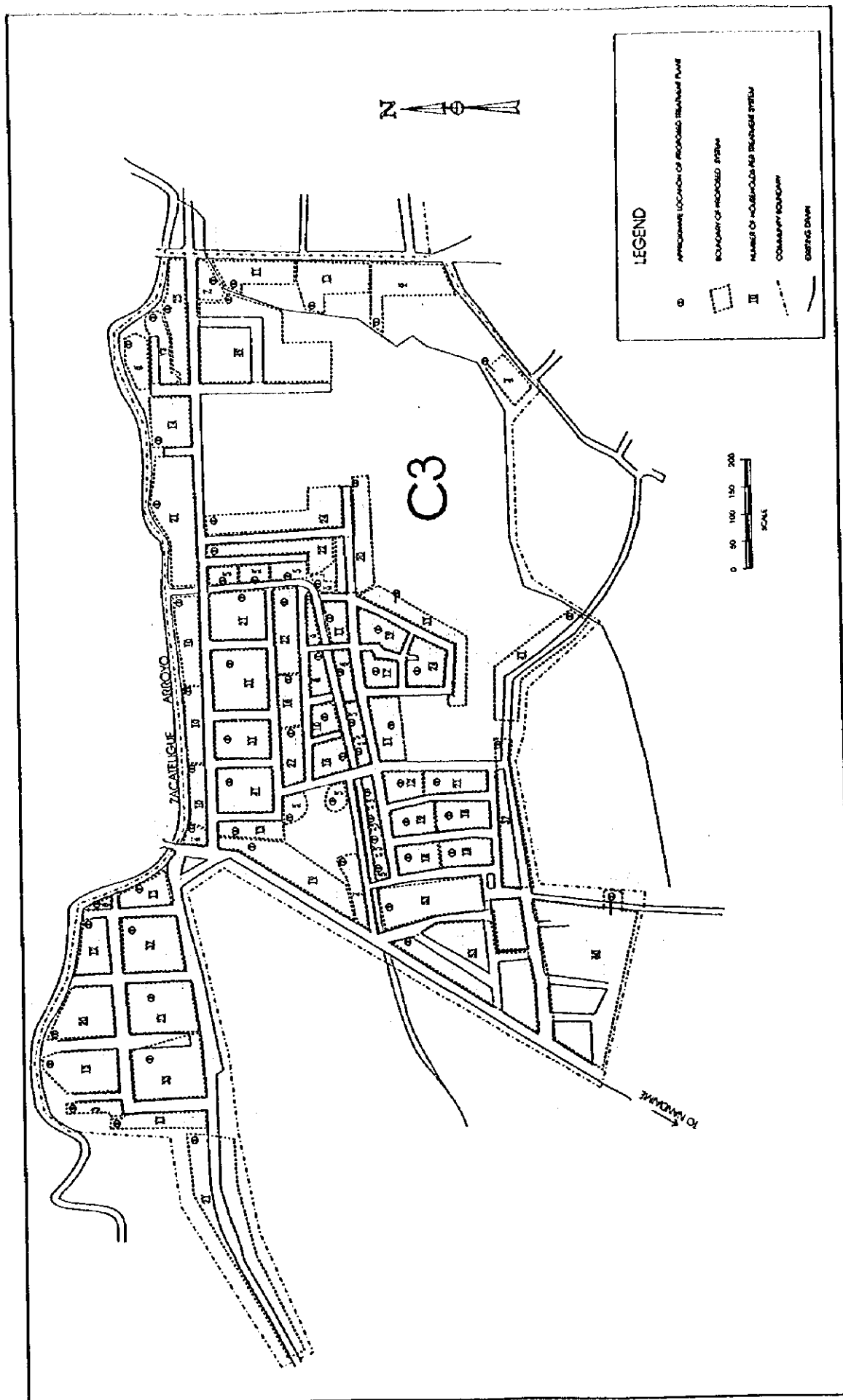


Figure 4-11: Domestic Wastewater Treatment System Improvement Project (3)

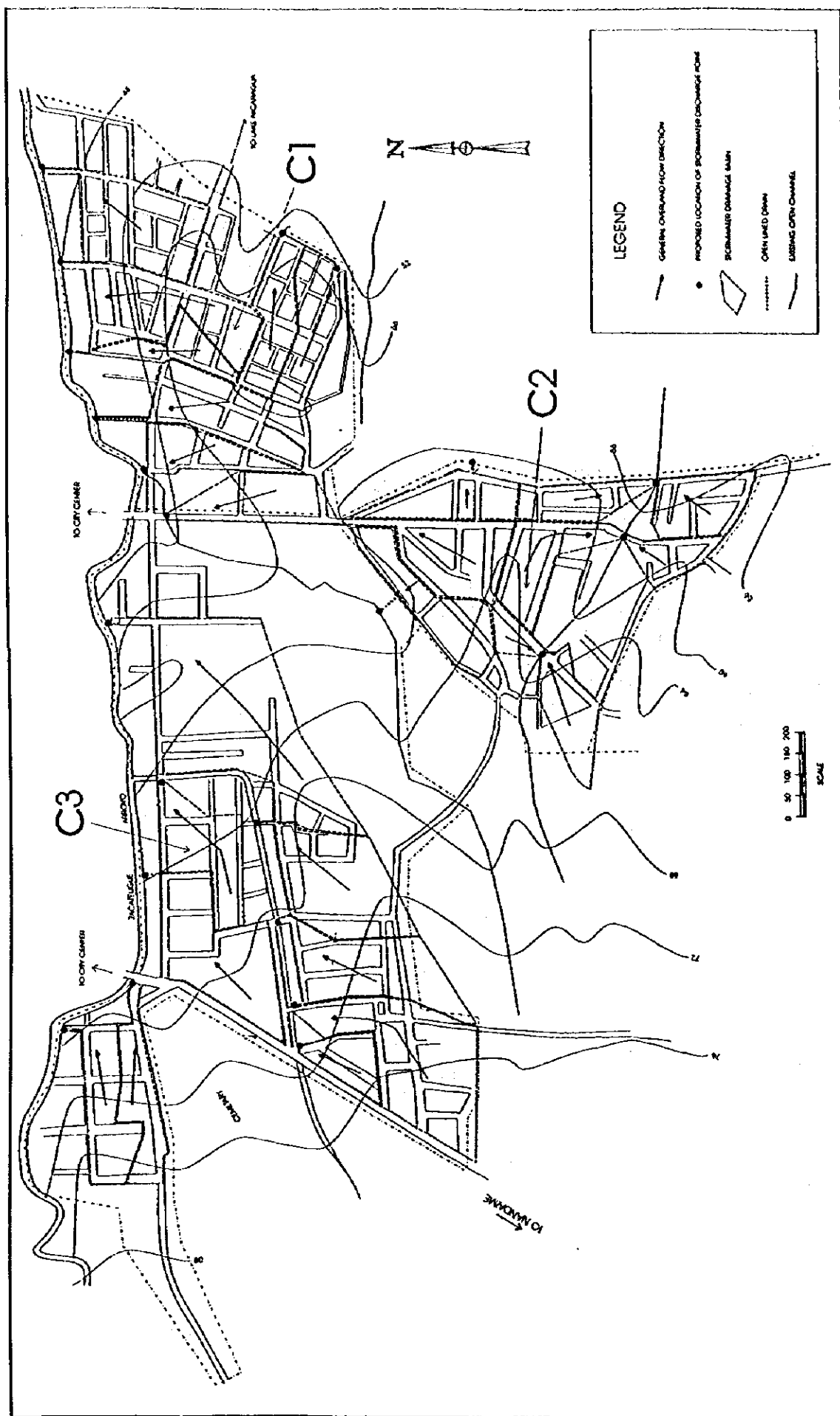


Figure 4-12: Rain Water Drainage Improvement Project (1)

4.4.3 Institutional System

a. On-site Domestic Wastewater Treatment System Improvement Project

a.1 Roles of Related Institutions

The model community will require 176 systems for on-site DWW collection and treatment to accommodate the estimated population of 23,110 inhabitants by the year 2010, and will require an investment of US\$ 3,320,000 and funds to cover operational costs of US\$ 330,000 during this period.

As the local population cannot generate all the investment costs, external funds would be needed. However, the beneficiaries should pay the operational costs; the public must be motivated to do so. Institutional reform must be initiated in order to raise funds and manage external grants as well as motivate and encourage the communities to pay the operational costs.

The project would be called the "Special Program for Model Community Integrated USE Improvement Project" (PECM) and would be a joint venture among INAA, the Municipality and MINSA/SILAI. The three authorities should create a steering committee: each committee member will work in their special field, but aiming to reach a common goal. This means that INAA will be the executing body that will manage the on-site DWW treatment system, but the municipality and MINSA/SILAI will be indispensable for realizing the PECM. The steering committee's president will be elected annually from the committees' members and an executive secretary should be employed.

The on-site DWW treatment system in a given area must be integrated with a special drainage system that is managed by the municipality. The steering committee must oversee the two systems as they both need technical and social integration as well as external funding.

The location of an on-site treatment system is dependent on the physical ground conditions, housing design as well as acceptance by the community. Each community should be involved in the PECM as they will be paying for the services and maintaining the facilities. The joint task of the three authorities will be to motivate the community to become involved; this would be a necessary criteria prior to the installation of the system. The duties and responsibilities of the four key players are outlined below.

Table 4-13: The Role of Each Institution in the DWW Treatment System Improvement Project

| Related institution Items | Granada Municipality | INAA | Recipient Residents | Remarks |
|---------------------------|------------------------------|------|--|--|
| Projects 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 |

| Related institution Items | Granada Municipality | INAA | Recipient Residents | Remarks |
|---|--------------------------|---|--|------------------------------|
| 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 of sewerage bill | Pay sewerage bill | Nothing in particular |

a.2 Steering Committee

The steering committee should comprise three representatives from the institutions involved, that is INAA/Region IV, MINSA/SILAIS and Granada Municipality. The representatives should elect a chairman who will take the post for a one year term. An executive secretary should attend to the administrative needs of the committee. Figure 4-14 illustrates the proposed structure of the committee. The main tasks and duties that the committee must perform are as follows:

- to formulate directives for the PECM.
- to conduct the planning and design of the projects proposed by the executive authorities, and evaluate their practical, technical and financial feasibility.
- to request finances for the approved systems to the responsible national institution (or international organizations if the committee has the legal authority).

a.3 INAA

INAA's regional office should diversify and lead the DWW Treatment System Improvement Project, as the executive member of the steering committee. A task force will be set up within INAA(Granada) for the model community integrated USE improvement project. It should be able to raise funds, apportion finance for the DWW Treatment System Improvement Project and work with the municipality and MINSA/SILAIS during the planning phase. The task force will develop feasibility studies and the DWW Treatment System Improvement Project for the different priority areas; the central office in Managua, with its skilled personnel, will be in charge of technical and economic matters for the task force. As the DWW Treatment System Improvement Project is expanded to cover many areas, the task force should be enlarged gradually to provide supervision for the construction works and maintenance needs. INAA's representative in the steering committee will coordinate and monitor INAA activities related to the PECM; the project will be incorporated into INAA's general responsibility. The representative will also coordinate and work with the other institutions involved in planning and community relations. These activities will be developed according to the steering committee's directives in conjunction with the activities performed by the other two authorities involved. INAA's representative will supervise civil works and financial activities related to the PECM. Figure 4-15 illustrates the functional scheme for INAA/Region IV.

a.4 The Municipality

The municipality requires the improvement of its organizational structure and legal framework, and enhancement of its human resources, with emphasis on the following:

- Organize and set up a task force for the model community integrated USE improvement project.
- assignment of an executive for the PECM, a member of the task force who will be the municipality's representative in the steering committee and coordinator of its operations in the project, with the same duties as INAA's representative.
- revision of the Municipal Ordinance, providing legal support on matters related to the DWW Treatment System Improvement Project, and to restrict urban development and construction without planning, as proposed in the M/P.

Figure 4-17 illustrates the functional scheme for the municipality.

a.5 MINSa

The role of the regional MINSa/SILAIS(Granada) in the project will be to motivate the public and provide sanitary and health education. The MINSa/SILAIS(Granada) representative in the steering committee should be selected from the task force member, and also be an expert and should act as a coordinator between MINSa/SILAIS and the other two authorities. Educational resources for public education regarding the PECM may be supplied by the central Sanitary Education Department of MINSa. Investments into the PECM will be offset by the reduction in the number of diseases, vermin and other damages to sanitation. Table 4-16 illustrates the functional scheme for MINSa/SILAIS (Granada).

b. Stormwater Drainage Improvement Project

An investment of US\$ 1,410,000 will be required for the Stormwater Drainage Improvement Project in the model community area to accommodate an estimated population of 23,110 inhabitants by the year 2010: US\$ 141,000 will be spent per annum to extend the drains until the target year.

As the local population cannot generate all the investment cost, external funds would be needed. However, the beneficiaries should participate in the maintenance of the facilities; the public must be motivated to do so. Institutional reform must be initiated in order to raise funds and manage external grants as well as motivate and encourage the communities to maintain the streets outside their property.

The municipality should not levy charges on the beneficiaries to cover the maintenance costs, however, USE improvements will increase property values as well as enable SW collection vehicles to enter areas previously inaccessible. Therefore, the municipality should be able to recover maintenance costs from the increase in various indirect taxes generated by the improved micro-drainage system.

Because surface drains and on-site DWW treatment systems are interrelated, it would be pragmatic to integrate the two into the PECM: communities that are able to simultaneously implement these improvements will be given a higher priority.

The steering committee for the PECM will oversee the improvements in both the surface drains and the on-site DWW treatment systems: the municipality will be responsible for matters pertaining to the drainage system, the other two authorities will contribute to the integrated planning and encourage communities to agree with the improvements and their responsibilities that comes with it.

The responsibility of the municipality will also be similar to that of the INAA Managua central office in that engineering works, i.e., design, construction and maintenance of the facilities will be undertaken by the New Constructions Section of the Bureau of Public Works and Services. Similarly, financial matters pertaining to the PECM will be the responsibility of the Accounting and Budget Control Sections of the Bureau of Administration and Finance. The municipal representative will work closely with the Public Relations Assistant and the Bureau of Municipal Planning and Projects regarding planning and community relations during the program.

Table 4-14: The Role of Those Involved in the Rain Water Drainage Improvement Project

| Related institution Items | Granada Municipality | Beneficiary 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 cleansing etc. | Nothing in particular |

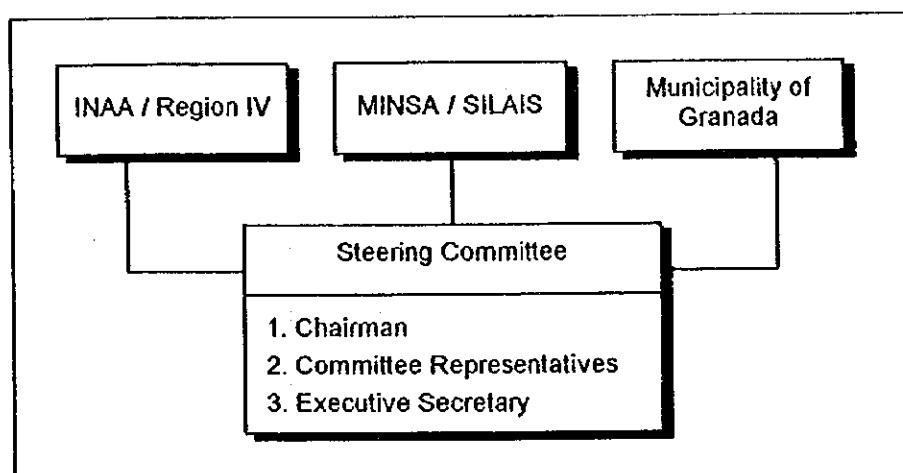


Figure 4-14: Structure of the Steering Committee

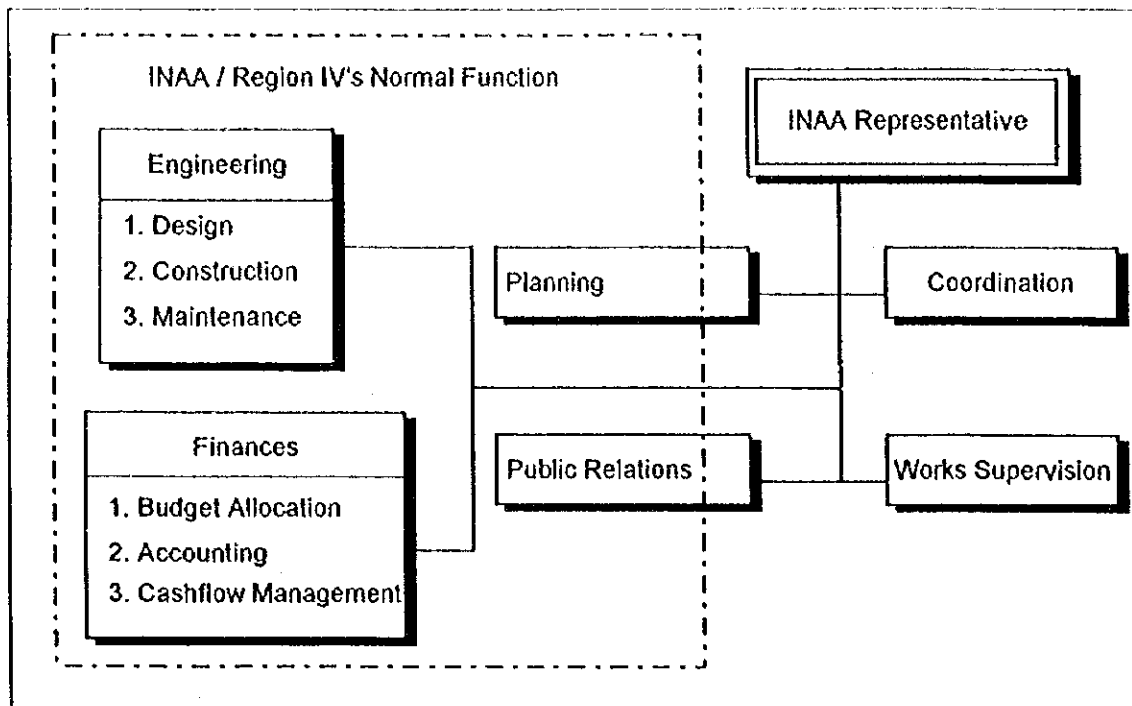


Figure 4-15: Functional Scheme for INAA / Region IV and INAA's Steering Committee Representative

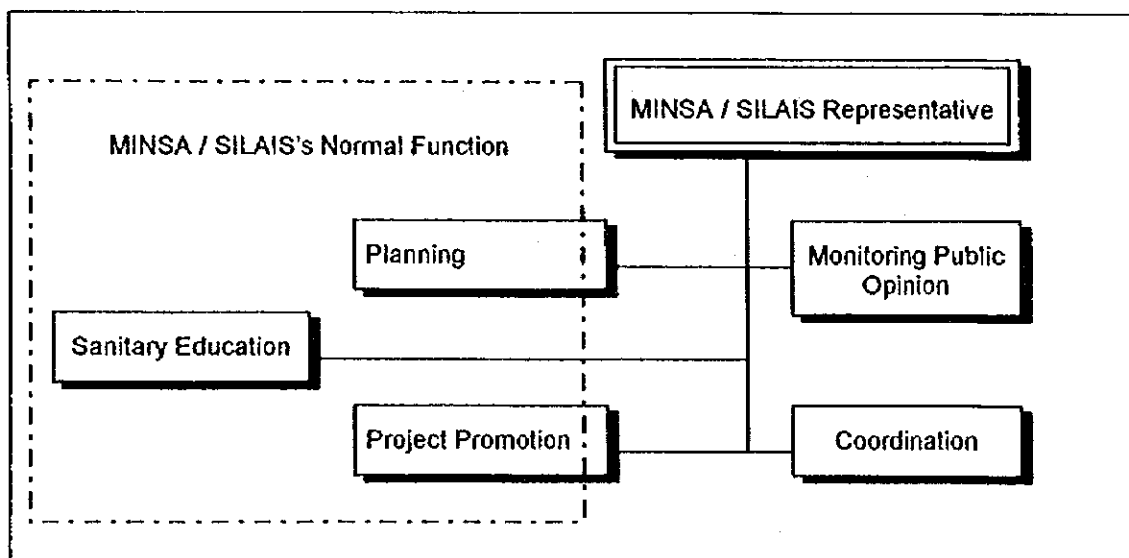


Figure 4-16: Functional Scheme for MINSA and SILAIS's Representative

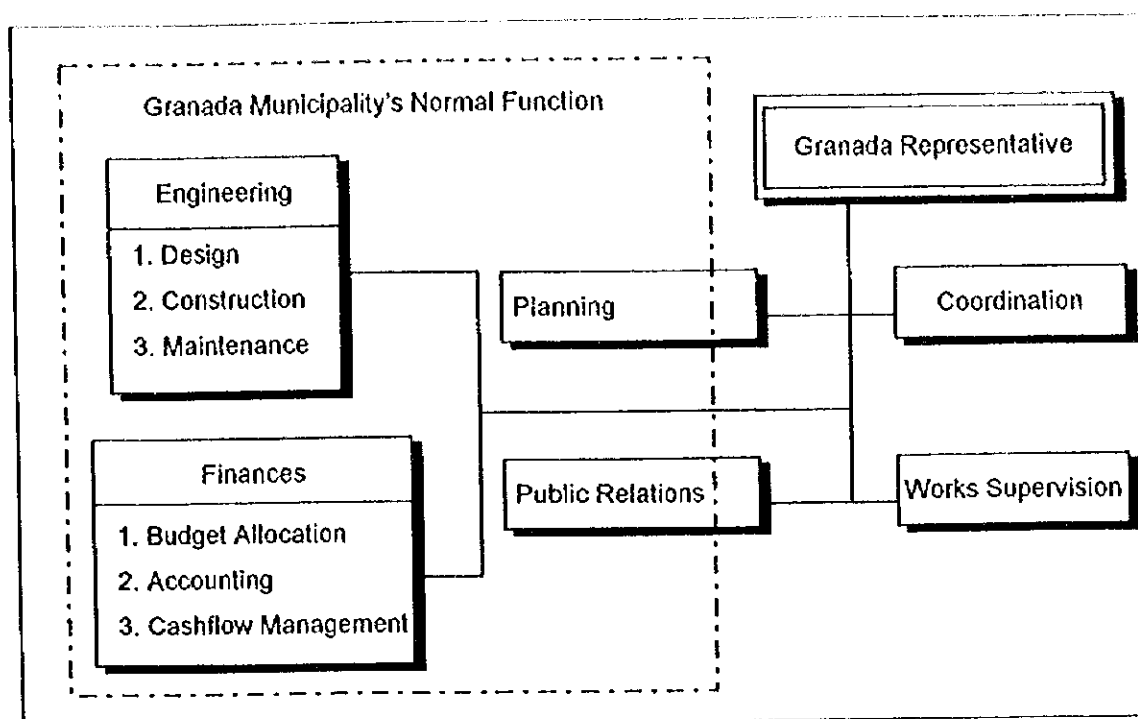


Figure 4-17: Functional Scheme for Granada Municipality and Granada's Steering Committee Representative

4.4.4 Project Cost

Table 4-15 shows the result of annual cost estimation required for priority projects(F/S)

Table 4-15: Cost Estimation of F/S-2: Model community Integrated USE Improvement Project

Unit: C\$ 1,000

| Category | Item | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Total |
|--|--|-------|-------|-------|-------|-------|------|--------|
| Water supply system improvement | Investment | 1,022 | 1,022 | 1,022 | 1,025 | 1,022 | - | 5,113 |
| | O & M cost | 0 | 24 | 48 | 72 | 96 | 120 | 360 |
| | Sub-total | 1,022 | 1,046 | 1,070 | 1,097 | 1,118 | 120 | 5,473 |
| Refuse collection Improvement | Investment and O & M costs are included in the Municipal Solid Waste Management System Improvement Project | | | | | | | |
| On-site DWW treatment system improvement | Investment | 3,189 | 3,189 | 3,189 | 3,191 | 3,191 | - | 15,949 |
| | Operation cost (labor cost) | - | 23 | 46 | 70 | 93 | 116 | 348 |
| | O & M cost | - | 35 | 70 | 104 | 139 | 174 | 522 |
| | Sub-total | 3,189 | 3,247 | 3,305 | 3,365 | 3,423 | 290 | 16,819 |
| Stormwater drainage improvement | Investment (facility) | 1,357 | 1,357 | 1,357 | 1,357 | 1,357 | - | 6,785 |
| | O & M cost | - | 7 | 14 | 20 | 27 | 34 | 102 |
| | Sub-total | 1,357 | 1,364 | 1,371 | 1,377 | 1,384 | 34 | 6,887 |
| Total | | 5,568 | 5,657 | 5,746 | 5,839 | 5,925 | 444 | 29,179 |

4.4.5 Financial Analysis of INAA

a. Conditions for Financial Evaluation

The conditions used for the financial evaluation are shown in the table below.

| | |
|-----------------|---|
| Project Life | 31 years, from 2000 until 2031 |
| Executing Body | INAA |
| Investment Plan | Improvement of on-site domestic wastewater treatment system and water supply system to accommodate the increase in population. |
| Residents Roles | Every household that receives the service should bear the cost of internal pipe connection(to the catch pit) . The facilities will be constructed on (1) public land within the area, or (2) private land donated by a resident/residents. Therefore, all costs for internal pipe connections and land acquisition is excluded from the project cost. |
| Residual Value | The residual value of the water supply and domestic wastewater treatment systems 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. |

The model community is entirely covered by the water supply services, and on-site domestic wastewater treatment system installation is also planned for the area. However, water supply improvements should also be carried out to cope with the increase in population.

Along with the installation of the domestic wastewater treatment system (on-site), the investment required from 2000 to 2004 to improve the water supply system in order to cope with the increase in population, and the O&M costs for 2001 to 2005 were calculated as shown below.

a.1 Investment Cost

unit: C\$1,000

| | New Investment | Renewal Costs | Total |
|--------------------------------------|----------------|---------------|---------------|
| Water Supply System | 5,113 | 0 | 5,113 |
| Domestic Wastewater Treatment System | 15,949 | 0 | 15,949 |
| Total | 21,062 | 0 | 21,062 |

a.2 Annual Expenditures

unit: C\$1,000

| | | 1995 | 2000 | 2001 - 2005 (average) |
|-----------------------------------|--------------------------------|------|------|--------------------------|
| Proposed System | Water Supply | | 37 | 437 |
| | Wastewater Treatment (on-site) | | 16 | 601 |
| Existing System + Proposed System | Water Supply | 818 | 941 | 1,341 |
| | Wastewater Treatment (on-site) | | 16 | 601 |

Note: Cost for proposed system(the year 2000) is a predicted interest portion for investment in the same year.

b. Cases for Financial Evaluation

For the financial evaluation, various cases were established to determine the appropriate financial source for the domestic wastewater treatment system.

- Financial Source: Financial source for investment costs for the project
- Source of Revenue: Service charge

b.1 Financial Source

The following six (6) cases were considered to determine the most feasible financial source.

| | |
|----------|--|
| Case A | Proposes the use of a loan to cover the entire investment cost |
| Case B-1 | Proposes the use of grant aid to cover only the investment costs for the installation of a domestic wastewater treatment system in 2000. |
| Case B-2 | Proposes the use of grant aid to cover the investment costs for the installation of a domestic wastewater treatment system in 2000-2001. |
| Case B-3 | Proposes the use of grant aid to cover the investment costs for the installation of a domestic wastewater treatment system in 2000-2002. |
| Case B-4 | Proposes the use of grant aid to cover the investment costs for the installation of a domestic wastewater treatment system in 2000-2003. |
| Case B-5 | Proposes the use of grant aid to cover the investment costs for the installation of a domestic wastewater treatment system in 2000-2004. |

For the improvement of the water supply system, the acquisition of a loan to cover the required investment cost was planned.

b.2 Source of Revenue

Households will be charged C\$16.7/household/month (the average amount households in Granada Municipality paid for sewerage services in 1996) for the use of the on-site domestic wastewater treatment system, the same amount charged for the monthly use of the sewers (off-site domestic wastewater treatment system). The collection rate for the on-site domestic wastewater treatment system is assumed to be equal to the present collection rate of 96%.

For water supply, the monthly fee was set at C\$49.8/household/month, the average amount households in Granada Municipality were capable of paying in 1996. The fee collected from the current users of the water supply system in model communities will be also included in the calculation of revenues (96% collection rate).

c. FIRR

The FIRR was calculated for the 6 cases considered to determine the appropriate financial source. The results are shown below.

| Investment Cost | Case | FIRR (%) | R/E |
|--|------|----------|--------|
| By a loan (total investment cost) | A | 3.9 | 1.2398 |
| Grant aid for investment costs in 2000 only | B-1 | 5.7 | 1.2955 |
| Grant aid for investment costs in 2000-2001 | B-2 | 8.2 | 1.3511 |
| Grant aid for investment costs in 2000-2002 | B-3 | 12.4 | 1.4068 |
| Grant aid for investment costs in 2000-2003 | B-4 | 20.0 | 1.4624 |
| Grant aid for entire costs for domestic wastewater treatment system construction | B-5 | 32.7 | 1.5181 |

Note: *The above plan includes the O&M expenses for the existing water supply system.

d. Cash Flow

If a grant aid is used to cover the investment costs from 2000-2002 for the installation of the domestic wastewater treatment system, the FIRR would be 12.4%, higher than the cut-off rate of 8.5%. The cash flow and profit and loss are shown in the following tables.

Table 4-16: Cash Flow of the Water Supply System Improvement & Domestic Wastewater Treatment System Installation Projects in the Model Community (Case B-3)

Unit: C\$1,000

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Total |
|------------------------|-------|-------|-------|-------|-------|-------|--------|
| a.1 Financing | | | | | | | |
| Grant | 3,189 | 3,189 | 3,189 | 0 | 0 | | 9,567 |
| Loan | 1,022 | 1,022 | 1,022 | 4,216 | 4,213 | | 11,495 |
| Sub-total | 4,211 | 4,211 | 4,211 | 4,216 | 4,213 | 0 | 21,062 |
| a.2 Revenue | | | | | | | |
| Fee | | | | | | | |
| Residents | | 1,946 | 2,062 | 2,177 | 2,293 | 2,408 | 10,886 |
| Sub-total | 0 | 1,946 | 2,062 | 2,177 | 2,293 | 2,408 | 10,886 |
| Cash-in | 4,211 | 6,157 | 6,273 | 6,393 | 6,506 | 2,408 | 31,948 |
| b.1 Investment | 4,211 | 4,211 | 4,211 | 4,216 | 4,213 | 0 | 21,062 |
| b.2 Expenditure | | | | | | | |
| Existing System | | 904 | 904 | 904 | 904 | 904 | 4,520 |
| Proposed System | | | | | | | |
| O/M Cost | | 82 | 164 | 246 | 328 | 410 | 1,230 |
| Interest | 37 | 112 | 188 | 279 | 386 | 477 | 1,479 |
| Fee-collection | | 68 | 72 | 76 | 80 | 84 | 380 |
| Sub-total | 37 | 1,166 | 1,328 | 1,505 | 1,698 | 1,875 | 7,609 |
| Cash-out | 4,248 | 5,377 | 5,539 | 5,721 | 5,911 | 1,875 | 28,671 |
| c. Reserves | -37 | 743 | 1,477 | 2,149 | 2,744 | 3,277 | 3,277 |

Table 4-17: Profit & Loss Statement of the Water Supply System Improvement & Domestic Wastewater Treatment System Installation Projects in the Model Community (Case B-3)

Unit: C\$ 1,000

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Total 2000-2005 |
|--------------------|------|-------|-------|-------|-------|-------|--------------------|
| a.1 Revenue | | 1,946 | 2,062 | 2,177 | 2,293 | 2,408 | 10,886 |
| b. Cost | | | | | | | |
| b.1 Expenditure | 37 | 1,166 | 1,328 | 1,505 | 1,698 | 1,875 | 7,609 |
| b.2 Depreciation | | 34 | 68 | 102 | 243 | 383 | 830 |
| Cost Total | 37 | 1,200 | 1,396 | 1,607 | 1,941 | 2,258 | 8,439 |
| c. Profit and Loss | -37 | 746 | 666 | 570 | 352 | 150 | 2,447 |

The tables show that the revenue from collection fees will be able to cover the O&M costs as well as the depreciation costs and interest rate not covered by the grant aid. An amount of C\$ 3,600,000 can also be accumulated by 2005.

e. Balance in Revenue & Expenditures

As in the area to be covered by the sewerage improvement project, the conduct of new projects are also considered infeasible in the model communities. Even with a 3 year grant aid for the installation of the on-site domestic wastewater treatment system, the project finances from 2001 to 2005 are estimated to result in a deficit. However, the project finances for the entire model community may be in the black if the revenue from the fees collected for the use of the existing water supply system is added to the investment, that is given that a 3 year grant is secured.

Unit: C\$ 1,000

| | | 1995 | 2000 | 2001-2005 (average) | 2001-2005 (total) |
|--------------------------------|---------------------------------|------|------|------------------------|----------------------|
| New Projects | Water Supply | | -38 | -320 | -1,602 |
| | Wastewater Treatment (on-site)* | | 0 | -34 | -169 |
| New Projects + Existing System | Water Supply | 825 | 890 | 607 | 3,035 |
| | Wastewater Treatment (on-site) | | 0 | -34 | -169 |
| | Total area | 825 | 890 | 573 | 2,866 |

Note: * the above balance in revenue and expenditures was assumed based on case B-3, that proposes the use of grant aid to cover the entire investment from 2000 to 2002.

f. Balance in Revenue & Expenditures of INAA Region IV

The balance in the revenue and expenditures of INAA Region IV, with grant(s) for three years' investment in the domestic wastewater treatment system(on-site), was calculated as shown below.

Unit: C\$ 1,000

| | 1995 | 2001-2005 (average) | 2001-2005 (total) |
|-----------------------------|--------|------------------------|----------------------|
| Water Supply System | 3,169 | 2,546 | 12,730 |
| Wastewater Treatment System | | | |
| off-site | 405 | -63 | -316 |
| on-site | | -34 | -169 |
| Administration | -2,256 | -1,812 | -9,062 |
| INAA Region IV Total | 1,318 | 637 | 3,183 |

The above table shows that to sustain the project, grant aid should be acquired to cover the investment costs required for the installation of the domestic wastewater treatment system in the 2000-2002 period.

4.4.6 Financial Analysis of Granada Municipality

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. |
| Investment Plan | Stormwater drains will be improved along with the installation of the on-site domestic wastewater treatment system. |
| Residual Value | The residual value of the roads and outfalls in 2031 was considered, assuming that they have a life span of 30 years. |
| 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 1977, 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

Case studies were established for the financial analysis of the following two items:

- Financial Source: Financial source for investment costs of the project
- Source of Revenue: Budget to be allocated from vehicle tax revenues for the stormwater drainage improvement project

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

The following cases were established to determine the financial source for a part of the project cost:

| | |
|--------|---|
| Case A | The entire project cost will be shouldered by Granada Municipality. |
| Case B | To acquire grant aid covering only the investment for the roads and outfall works in 2000 |
| Case C | To acquire grant aid covering the investment for the roads and outfall works in 2000 and 2001 |
| Case D | To acquire grant aid covering the investment for the roads and outfall works in 2000 and 2002 |

b.2 Budget Allocated from Vehicle Tax Revenues for the Rain Water Drainage Improvement Project

Revenues from vehicle tax are the assumed source of financing for the stormwater drainage improvement project. Vehicle tax revenues were not the target source of finance for the road improvement project. But if an agreement is reached with the municipal committee regarding the use of these revenues, they shall be used to subsidize the expenses for the stormwater drainage improvement project. Accordingly, the three cases below were assumed to estimate the vehicle tax growth rate and the percentage of the revenues to be allocated for the improvement of stormwater drainage. The cases were classified into three scenarios, e.g., optimistic, moderate and pessimistic, and the assumed percentage of the revenues for allocation were 30%, 20% and 10%.

| | |
|--------|---|
| Case a | Very optimistic assumptions regarding increase in vehicle tax rate (13.7% per annum) and budget allocation for stormwater drainage improvement (30% per annum) |
| Case b | Assuming a moderate increase in vehicle tax rate (12.9% per annum) and budget allocation for stormwater drainage improvement (20% per annum) |
| Case c | Very pessimistic assumptions regarding increase in vehicle tax rate (12.1% per annum) and budget allocation for stormwater drainage improvement (10% per annum) |

c. FIRR

The FIRR was calculated for a total of 12 cases resulting from the combination of the above 3 cases for vehicle tax rate increase, and the 4 cases for the financial source ($3 \times 4 = 12$). The results are shown in the table below.

| | | Case | FIRR(%) | R/E |
|--|------------------------|------|---------|--------|
| Loan (for total investment cost) | Optimistic Assumption | A-a | 2.9 | 1.4674 |
| | Moderate Assumption | A-b | n.a. | 0.9452 |
| | Pessimistic Assumption | A-c | n.a. | 0.4430 |
| Grant aid for investments in 2000 only | Optimistic Assumption | B-a | 5.1 | 1.6597 |
| | Moderate Assumption | B-b | 1.1 | 1.1425 |
| | Pessimistic Assumption | B-c | n.a. | 0.6403 |
| Grant aid for 2000- 2001 | Optimistic Assumption | C-a | 8.8 | 1.8519 |
| | Moderate Assumption | C-b | 3.5 | 1.3398 |
| | Pessimistic Assumption | C-b | n.a. | 0.8377 |
| Grant aid for 2000-2002 | Optimistic Assumption | D-a | 18.9 | 2.0441 |
| | Moderate Assumption | D-b | 8.3 | 1.5371 |
| | Pessimistic Assumption | D-c | 0.5 | 1.0350 |

The case considered to be most appropriate is the one which assumes a 12.9% increase in vehicle tax rate, a 20% increase in budget allocation, and the acquisition of grant aid to cover the investment from 2000 until 2002. The FIRR for this case was calculated at 8.3%, quite close to the cut-off rate of 8.5%. Accordingly, to implement the stormwater drainage improvement project, grant aid should be acquired to cover the investment for a period of 3 years, from 2000 to 2002.

d. Cash Flow and Profit & Loss

The cash flow and the statement of profit and loss for Case D-b are shown in the following tables. Case D-b proposes covering the investment for a three year period, from 2000 to 2002, by grant aid, assuming a 12.9% increase in vehicle tax rate and a 20% increase in budget allocation.

Table 4-18: Cash Flow of the Rain Water Drainage Improvement Project (Case D-b)

Unit : C\$ 1,000

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Total 2000-2005 |
|------------------------|-------|-------|-------|-------|-------|------|--------------------|
| a.1 Financing | | | | | | | |
| Grant | 1,357 | 1,357 | 1,357 | 0 | 0 | 0 | 4,071 |
| Loan | 0 | 0 | 0 | 1,357 | 1,357 | 0 | 2,714 |
| Sub-total | 1,357 | 1,357 | 1,357 | 1,357 | 1,357 | 0 | 6,785 |
| a.2 Revenue | | | | | | | |
| Budget Allocation | 0 | 138 | 156 | 176 | 199 | 224 | 893 |
| Sub-total | 0 | 138 | 156 | 176 | 199 | 224 | 893 |
| Cash-in | 1,357 | 1,495 | 1,513 | 1,533 | 1,556 | 224 | 7,678 |
| b.1 Investment | 1,357 | 1,357 | 1,357 | 1,357 | 1,357 | 0 | 6,785 |
| b.2 Expenditure | | | | | | | |
| O/M Cost | 0 | 7 | 14 | 20 | 27 | 34 | 102 |
| Interest | 0 | 0 | 0 | 7 | 20 | 27 | 54 |
| Sub-total | 0 | 7 | 14 | 27 | 47 | 61 | 156 |
| Cash-out | 1,357 | 1,364 | 1,371 | 1,383 | 1,404 | 61 | 6,939 |
| c. Reserves | 0 | 132 | 274 | 424 | 576 | 739 | 739 |

Table 4-19: Profit and Loss Statement of the Rain Water Drainage Improvement Project (Case D-b)

Unit : C\$ 1,000

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Total 2000-2005 |
|---------------------------|------|------|------|------|------|------|--------------------|
| a.1 Revenue | 0 | 138 | 156 | 176 | 199 | 224 | 893 |
| b. Cost | | | | | | | |
| b.1. Expenditure | 0 | 7 | 14 | 27 | 47 | 61 | 156 |
| b.2 Depreciation | | 0 | 0 | 0 | 45 | 90 | 135 |
| Cost Total | 0 | 7 | 14 | 27 | 92 | 151 | 291 |
| c. Profit and Loss | 0 | 131 | 142 | 149 | 107 | 73 | 602 |

4.4.7 Project Evaluation

The project evaluation of the Model Community Integrated USE Improvement Project was carried out from technical, social, environmental, financial, and economic aspects.

a. Technical Evaluation

Technical systems proposed in the Model Community Integrated USE Improvement Project comprises the following four subs-systems: namely, (1) water supply system

improvement to deal with the increasing population, (2) refuse collection improvement by the point collection system, (3) on-site domestic wastewater treatment system improvement, (4) stormwater drainage improvement. Therefore, the technical evaluation was carried out from the perspective of whether or not the proposed technical systems can be properly operated, maintained, and managed.

a.1 Water Supply System

No technical problems can be predicted as the technical systems proposed are the same as that of INAA's current systems. Moreover, as INAA, currently providing water to 64,400 people (as of 1995), will be in charge of the construction, operation, maintenance, and management of this improvement, there will be no problems in dealing with an increase of approximately 2,000 people.

a.2 Refuse Collection Improvement

The greatest concern in newly introducing the "point collection system" in the model communities is whether cooperation from the residents can be fully achieved or not. In this regard, the pilot project confirmed that residents' cooperation can be obtained. As was stated in the technical evaluation in the Municipal Solid Waste Management System Improvement Project section, no problems can be envisaged with regard to other technical issues (e.g., refuse collection vehicles and the final disposal site) of this improvement..

a.3 On-Site Domestic Wastewater Treatment System Improvement

Since the On-Site Domestic Wastewater Treatment System was experimentally introduced in this Study, considering the characteristics of the model communities, there are a number of unknown factors. Therefore, the technical evaluation of the system hinges on the results of the experimental operation of the Adelita II on-site domestic wastewater treatment system, which was built for a pilot project and started its operation at the end of August, 1997. The actual capacity of the facility cannot be judged at present, as it generally takes about a half year to let the microbes increase to bring about stable bio-degradation mechanisms in the treatment facilities. Therefore, continuous monitoring is required to observe the efficiency of the facilities.

However, the technology used in this on-site domestic wastewater treatment system has already been widely disseminated in Granada Municipality, except for the filter trench. Therefore, problems in the application of this technology are not envisaged except for the filter trench, which needs to be judged from the operation results. Moreover, as INAA, presently providing sewerage services for about 15,700 people (as of 1995), will be in charge of the construction, operation, maintenance, and management, with the residents' cooperation, there will be no problems in dealing with an increase in approximately 12,000 people.

a.4 Stormwater Drainage Improvement

Stormwater drainage improvement shall basically focus on the improvement of roads that also serve as stormwater drains, and of drainage outfalls. Roads that also serve as stormwater drains will be paved with concrete blocks; a common practice in UFA's in Granada Municipality. Moreover, outfalls shall be improved with the riprap drains, using mortar and stones, and installation of gabions as a flow dissipater, both of which

are common practices in Nicaragua. Therefore, there will be no problems in its construction, operation and maintenance, and management of this improvement.

b. Social Evaluation

The Model Community Integrated USE Improvement Project aims to improve overall USE in the UFA, where population density is high and impact of poor USE infrastructure on people is very serious. Therefore, the implementation of the project will bring various benefits. As a direct impact of this F/S project, the number of people who will benefit reaches 1,966 for the water supply system improvement project, 6,200 for the refuse collection improvement, 11,555 for both the on-site domestic wastewater treatment system, and stormwater drainage improvement. As a knock-on effect, it will contribute to less drain blockages caused by refuse clogging as well as flooding; a road life will be prolonged and surface water pollution by domestic wastewater reduced. The improved sanitary condition and landscape will generate various significant positive impacts, such as encouraging both domestic and foreign investment, promoting the tourist industry and appreciating land prices.

The UFA is an area where socially vulnerable poor people live and the basic infrastructure of the city is in an extremely poor condition compared with other parts of the city. Improvement of USE in these areas has been a long standing issue not only in Nicaragua, but also in other developing countries. Leaving the USE of UFA in Nicaragua is its current state is the epitome of the social injustice, commonplace in the developing countries and leads to social instability. The implementation of this plan is very important as it will contribute to eliminate social unfairness thus shifting toward social stability.

Moreover, judging from the questionnaire surveys carried out before and after the projects in the model communities, almost all residents in the area are hoping for improvements of USE in the model community, even though they have to share some burden. Public participation is the precondition to this Plan, from the planning phase to implementation, and the operation and maintenance phase. The positive indication from the residents towards the implementation of this Plan illustrates that it is socially appropriate.

Judging from the facts above, the Model Community Integrated USE Improvement Project is fully acceptable in view of social aspects.

c. Environmental Evaluation

Although the implementation of the Model Community Integrated USE Improvement Project brings various impacts to its surroundings, it became clear that the predicted positive impacts stated below would outnumber the predicted negative impacts (e.g., slight offensive odor from domestic wastewater treatment facility):

- By offering safe and clean drinking water, public health in the model community will be enhanced.
- By providing refuse collection service, illegal dumping will be reduced and sanitary environment in the model community will improve. Furthermore, purification of rivers and Lake Nicaragua will be promoted.

- Pollution on the road surface and the drainage channels by discharge of untreated domestic wastewater will be prevented.
- Damage caused by inundation in the model community will be prevented, road pavement improves traffic conditions, and reduces the dust and noise level.

d. Financial Evaluation

d.1 Assessment of Projects with INAA as the Main Executing Body

1. Based on the total revenue and expenditures of the water supply and sewage services in INAA Region IV (the sewer projected area which is profitable was also included in the calculation of revenues), the water supply system improvement and on-site domestic wastewater system improvement projects in the model communities, mainly with INAA as the main executing body, were considered to be unfeasible unless a part of the expenses for the domestic wastewater project is covered by grant aid.
2. The conduct of the on-site domestic wastewater treatment system improvement project would not be financially feasible with an FIRR of 0.8% on its own even if grant aid is secured to cover the entire investment in 2000~2003. Although, in this case, the balance of payment for 2001~2005 will be in the black.
3. To make new projects in model communities financially feasible and profitable, the revenues of the existing water supply system should be included in the calculation.
4. The on-site domestic wastewater treatment system improvement and water supply system improvement projects in the model communities are financially feasible with an FIRR of 12.4% exceeding the cost of opportunity if fees are collected from the users of these facilities, and if a part (investment for three years from 2000-2002) of the on-site domestic wastewater treatment system improvement project expenses is covered by grant aid.
5. For the sustainable conduct of the on-site domestic wastewater treatment system improvement project in the model communities, at least domestic and external grant aid to cover the investment for 2000-2002 should be acquired.

d.2 Assessment of Projects with Granada Municipality as the Main Executing Body

Granada Municipality is the main executing body for refuse collection improvement and stormwater drainage improvement projects; the former has already been assessed through the Municipal Solid Waste Management System Improvement Project.

The investment cost and O&M expenses in the model communities were calculated and shown below, based on the ratio of increase in the number of beneficiaries in the model communities to the increase in the number of beneficiaries in the entire municipality.

Unit: C\$1,000

| | Investment Cost | O&M Expenses | |
|--------------------|----------------------------------|-------------------------|-----------------------|
| | Total Investment in 2000~2005 | Average in 2001~2005 | Total in 2001~2005 |
| Collection Service | 1,875 | 208 | 1,038 |

The low service charge of C\$5/household/month was set as the refuse collection fee for the model community, which is the center of service operations.

With the above conditions, the revenue of the collection service in the model communities was calculated as shown below.

Unit: C\$1,000

| | 2001~2005 (average) | 2001~2005 (total) |
|----------------|------------------------|----------------------|
| Revenue | 195 | 977 |
| Cost | 445 | 2,226 |
| O&M costs only | (208) | (1,038) |
| Loss | -250 | -1,249 |

1. Although the revenue and expenditures put the finances in the red, more than 90% of the O&M costs can be covered.
2. The calculation of the FIRR was not possible as the R/E is less than 1. Accordingly, this would not be financially feasible.

The stormwater drainage improvement project would be sustainable if: (1) grant aid is secured to cover the investment for the 3 year period, between 2000 and 2002, (2) 70% of the vehicle taxes can be collected, and (3) 20% of the collected amount is appropriated for the stormwater drainage improvement project. However, further discussions should be carried out to determine the possibility of using the bulk of the revenue from vehicle taxes for the stormwater drainage improvement project. In any case, having Granada Municipality shoulder the entire cost would be extremely unrealistic. Therefore, the project should be implemented using internal and external grant aid.

d.3 Residents' Ability to Pay

The following parameters were used to determine whether the service charge established is appropriate in view of the residents' ability to pay:

- For the estimation of water rates, C\$49.8/month/household, - the average water bill of the total population in Granada City -, is applied, since data on an average water bill in the model area is not available, even though it could be less than the estimated value. The WTP of residents who do not receive this service in the three cities (Leon, Chinandega and Granada) is C\$14.9/household/month.
- Domestic wastewater treatment fee is estimated as C\$16.7/month/household, that is the average rate paid in Granada City. The WTP of residents who do not receive this service in the three cities (Leon, Chinandega and Granada) is C\$14.9/household/month.

- Waste collection fee is C\$5/household/month since the type of collection is Point Collection, whereas. WTP is C\$3.3/household/month in the pilot project area.
- Assuming that the average household income in the model communities is 70% (C\$890/household/month) of the average household income in Granada Municipality.
- Assuming that the average household income is going to increase in proportion with the GRDP per capita (assuming that the average household income in 2005 will be C\$940/household/month). GRDP increases 5.4% per annum, however, the population growth rate is 4.8% and, therefore, per capita GRDP growth rate is only 0.8% per year.

The results of the analysis show that the service charge established would be exorbitant, as it would amount to 7.6% of the household income in 2001 to 2005. However, the water service charge will be relieved where water consumption is less, and this will automatically reduce the service charge of domestic wastewater treatment. The average water consumption rate in the model area is lower than the rest of the city. It may be assumed that the average service charge in the area will be lower than the value used in the calculation. Therefore, the maximum amount that a household in the area is required to shoulder should be 7.6% of the household income.

Table 4-20: Service Charges and their Percentage of Household Income

Unit: C\$1,000

| | | 1995 | 2005 |
|--------------------------------|--|------|------|
| Average Income (C\$/month) | | 890 | 940 |
| Water Supply | Fee(C\$/month) | 49.8 | 49.8 |
| | Percent of recipient household income(%) | 5.60 | 5.30 |
| Wastewater Management(on-site) | Fee(C\$/month) | 0 | 16.7 |
| | Percent of recipient household income(%) | 0 | 1.78 |
| Municipal SWM | Fee(C\$/month) | 0 | 5 |
| | Percent of recipient household income(%) | 0 | 0.53 |
| Total | Fee(C\$/month) | 49.8 | 71.5 |
| | Percent of recipient household income(%) | 5.58 | 7.61 |

The project would need to be implemented in conjunction with macro-economic policies such as creation of jobs.

e. Economic Evaluation

The benefits considered for the economic evaluation were: (1) the willingness to pay of the households currently not receiving the service, based on the POS results, (2) environmental improvement benefits (improvements in public health and sanitation, increase in land prices, increased consumption due to developments in the tourist industry), and (3) the fee currently paid by the residents. The EIRR and the ratio of the cost to the benefits (B/C) under a 0% discount rate were calculated for the following 3 cases:

Case 1: Considering the willingness to pay of the residents in the 3 cities surveyed (POS) as a benefit

Case 2: Considering the willingness to pay (as in case 1 above) and environmental improvement impacts (improvements in public health and sanitation, increase in land prices, increased consumption due to developments in the tourist industry) as benefits. The environmental benefits were represented in terms of household benefits.

Case 3: Considering the fee currently paid by the residents as a benefit.

In contrast to the financial evaluation, the economic evaluation of the project was carried out only considering as benefits the willingness and ability to pay of the additional population in the periods 2000~2001, 2000~2002, 2000~2003, 2000~2004, and 2000~2005.

Table 4-21: Economic Evaluation Results

| Projects | Case 1 | | Case 2 | | Case 3 | |
|---|--------------------|--------|--------------------|---------|--------------------|--------|
| | EIRR(%) | B/C | EIRR(%) | B/C | EIRR(%) | B/C |
| Water Supply* | C\$14.90/month | | C\$88.0/month | | C\$49.8/month | |
| | n.a | 0.2484 | 4.2 | 1.4671 | -1.9 | 0.8301 |
| Domestic Wastewater Treatment (on-site) | C\$8.32/month | | C\$29.0/month | | C\$16.7/month | |
| | n.a | 0.2898 | 0.1 | 1.0100 | -4.9 | 0.5816 |
| Solid Waste Management | C\$6.48/month | | C\$79.6/month | | C\$5.0/month | |
| | 15.1 | 1.1434 | 490.8 | 25.0198 | -8.1 | 0.8296 |
| Rain Water Drainage Improvement | 20% of Vehicle tax | | 30% of Vehicle tax | | 20% of Vehicle tax | |
| | -4.5 | 0.4697 | 4.1 | 1.6338 | 0.1 | 1.0069 |
| Entire Model Community | -8.9 | 0.3363 | 3.9 | 1.8340 | -2.8 | 0.7286 |

Note: * only the additional population

The EIRR for Case 1, which considers the willingness to pay of residents currently not receiving the service as a benefit, was difficult to calculate because the B/C was considerably low. The EIRR for Case 2, which considers the willingness to pay of the residents and the environmental improvement impacts as benefits, was calculated at 4.1%. Although this would put the finances in the black, it is lower than the cut-off rate. As for Case 3, which considers as a benefit the amount currently paid by the residents - the water supply fee and waste collection fee of C\$5/household/month was based on this amount - the EIRR calculation for the model community resulted in a negative value.

None of the EIRR's calculated for the three cases exceeded the cut-off rate of 8.5%. However, the implementation of this project is considered to contribute to the national economic development in view of the various favorable impacts it has on the environment, which, although were not measured during the study, are expected to help in the preservation of potable water resources, in particular the conservation of Lake Nicaragua, the favorable potable water source for Managua City in the future.

f. Total Evaluation

As a total evaluation, it was concluded that the implementation of the Model Community Integrated USE Improvement Project was feasible in technical, social, environmental, financial, and economic aspects; a condition for conservation of USE and public health of Granada Municipality, and for sustainable development of the municipal activities.