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NICARAGUA INSTITUTE OF MUNICIPALITY
FORMATION (INIFOM)
THE REPUBLIC OF NICARAGUA

社会開発調査部報告書

**THE STUDY ON
THE IMPROVEMENT OF
URBAN SANITATION ENVIRONMENT
OF
PRINCIPAL CITIES
IN
THE REPUBLIC OF NICARAGUA
(LEON, CHINANDEGA, AND GRANADA)**

FINAL REPORT

VOLUME I

EXECUTIVE SUMMARY

JANUARY 1998

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PREFACE

In response to the request from the Government of the Republic of Nicaragua, the Government of Japan decided to conduct the Study on the Improvement of Urban Sanitation Environment of Principal Cities in the Republic of Nicaragua and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nicaragua a study team headed by Mr. Susumu Shimura, KOKUSAI KOGYO CO., LTD., four times between July 1996 to November 1997.

The team held discussions with the officials concerned of the Government of Nicaragua, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Nicaragua for their close cooperation extended to the team.

January, 1998



Kimio Fujita
President

Japan International Cooperation Agency



January 1998

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Dear Mr. Fujita

Letter of Transmittal

We are pleased to submit the report on the Study on the Improvement of Urban Sanitation Environment of Principal Cities in the Republic of Nicaragua.

The Study consists of: the Basic Study on the USE (Urban Sanitation Environment) for the three major cities in Nicaragua (Leon, Chinandega and Granada); formulation of the USE M/P (Master Plan) until the year 2010 for Granada and the USE Conceptual M/Ps for Leon and Chinandega; and the F/S (Feasibility Study) on the first priority projects.

The Basic Study on the USE identified the current state of the USE in the three cities which was evaluated. Based on the results of the Basic Study, Granada City was selected as the first priority city.

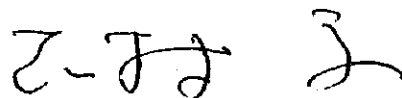
An USE M/P, which includes various sectors, such as water supply, domestic waste water management, municipal SWM (Solid Waste Management), etc., was formulated for Granada City. USE Conceptual M/Ps were compiled for Leon and Chinandega respectively in order to encourage the two cities to formulate M/Ps and subsequently carry out F/Ss on the priority projects by themselves.

The feasibility study was conducted on the first priority projects in the USE M/P for Granada, i.e. the Municipal SWM System Improvement Project and the Model Community Integrated USE Improvement Project. Both projects were evaluated from financial, economic, technical, social and environmental aspects. The results inferred the projects would be feasible in every aspect.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of Health and Welfare and the Ministry of Construction. Also in the Republic of Nicaragua, we also wish to express our deep gratitude to the INIFOM, MCE, INAA, MINSA, MARENA, INETER, Granada Municipality, Leon Municipality, Chinandega Municipality, the Embassy of Japan and the JICA office in the Republic of Nicaragua.

Finally, we hope that this report will help improve and enhance the USE of Granada, Leon and Chinandega.

Yours Sincerely,



Susumu Shimura

Team Leader

The Study on the Improvement of Urban
Sanitation Environment of Principal Cities
in the Republic of Nicaragua



Outline of the Project

1 Outline of Priority Projects

This Study consists of the following three phases. In Phase I : The Basic Study, was carried out in the three principal cities, Leon, Chinandega and Granada. Granada City was selected as a priority city based on the result of the Basic Study. In Phase II, the Urban Sanitation Environment Master Plan(USE M/P) was formulated for Granada City, and Urban Sanitation Environment Conceptual Master Plans(USE Conceptual M/Ps) were formulated for Leon and Chinandega respectively. In Phase III : The Feasibility Study on the First Priority Projects was conducted for Granada City.

Two priority projects, F/S-1 and F/S-2 below, were selected from the projects which constitute the M/P for USE in the respective field, namely, municipal solid waste management, water supply management and domestic wastewater management.

- F/S-1: Municipal SW Management System Improvement Project
- F/S-2: Model Community Integrated USE Improvement Project

1.1 Municipal SWM System 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 1.

Table 1: 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 within Study area	persons	76,250	100,382	107,330	114,760
Waste generation amount (A)	ton/day	57.1	80.3	88.5	97.5
Waste discharge amount (B)	ton/day	43.2	62.8	70.1	78.2
Waste collection amount (C)	ton/day	35.4	56.5	63.1	70.4
Coverage Rate (C/B)	%	81.9	90	90	90
Population served	persons	48,037	89,083	95,249	101,843
Length of road swept	km	35	35	37	40
Final disposal					
Disposal amount	thousand m ³ /year	16.8	26.8	29.8	33.1
Name of the disposal site	-	La Joya	SJV a new final disposal site		
Level of disposal method	-	Level 1	Level 4		

b. Outline of Municipal SWM System Improvement Project

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

Table 2: Outline of 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 10m³ tipper truck (2000), • 1 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 of hand carts units
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 4-5)	<ul style="list-style-type: none"> • Construction in 2000, Operation from 2001. • Level of Sanitary Landfill: level 4 (i.e., sanitary landfill with a leachate treatment facility) • Total volume (till 2010): 436,700 m³, • Volume of F/S period (till 2005): 179,400 m³ • Major facilities: One landfill section for 5 years (3.5 ha), regulation pond, facultative lagoon, maturation pond, access road, office, stormwater drainage system, etc. • Procurement of landfill equipment: 1 bulldozer, 1 backhoe, 1 tipper truck, and 1 water tanker
3. Improvement of Administrative System	<ul style="list-style-type: none"> • Strengthening of UEMB (Urban Environmental Maintenance Bureau, and procurement of office equipment • Improvement of organizational system

1.2 Outline of Model Community Integrated USE Improvement Project

a. Target

The Model Community Integrated USE Improvement Project aims to improve the respective areas, such as water supply system, municipal solid waste management, domestic wastewater treatment, and stormwater drainage improvement project, with the target shown in Table 3 below.

Table 3: 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 water supply system is served	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 that collection service is served	person	14,337	18,938	19,331	19,724	20,118	20,511
waste discharge amount	ton/day	12.0	13.8	14.3	14.8	15.3	15.8
waste collection rate	%	82	100	100	100	100	100
waste collection amount	ton/day	9.8	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
Rain water 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 Model Community Integrated USE Improvement Project

Table 3 states the outline of the project planned to realize the target set in Table 3.

Table 4: Outline of Model Community Integrated USE Improvement Project

Project	Outline															
1. Water Supply System Improvement Project	Model communities are located in the areas where water supply system is already provided. Water supply coverage is 100 % now and in the future. Accordingly, INAA planned to improve necessary facility 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 Waste Water Treatment System Improvement Project (Refer to Figure 4-10 and 4-11)	<div>1. 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. On-site collective treatment system which comprises a few to several tens of households as one treatment unit.</div> <div>3. Principal facility: Catch Pit, Sewer (PVC 100mm 150mm), Manhole, Septic Tank, Filter Trench</div> <div>4. Water quality of treatment water</div> <table><tr><th></th><th>Raw water</th><th>Target</th><th>Septic Tank</th><th>Filter Trench</th></tr><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></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												

Project	Outline
4. Stormwater Drainage Improvement Project (Refer to Figure 4-12 and 4-13)	(1) Improvement of concrete/block pavement roads, 6,370m in total, which also serves as stormwater drain, and installation of 10 outfalls by 2005 (2) Regarding the roads which also serve as stormwater drains, three types of width of roads (4m, 5m, 6m) are adopted in accordance with the significance of the roads.
5. Organizational system to promote Model community Integrated USE Improvement Project	<ul style="list-style-type: none"> • Establishing a Steering Committee which promotes Model Community Integrated USE Improvement Project. • Formation of task force in INAA, Granada Municipality, and MINSA/SILAIS respectively in order to promote Model Community Integrated USE Improvement Project.

2 Project Evaluation of the Priority Projects

2.1 Project Cost

Table 5 shows the investment amount in the project cost for the priority projects.

Table 5: Priority Projects and the Project Cost (Investment Amount)

Unit: C\$ 1,000

		Investment Amount							Grant Aid			
		2000	2001	2002	2003	2004	2005	Total	2000	2001	2002	Total
Municipal Solid Waste Management System Improvement Project	Equip.	5,182	775	0	61	775	-	6,793	5,182	-	-	5,182
	Facility	1,168	-	-	-	-	-	1,168	1,168	-	-	1,168
	Equip.	1,313	-	-	-	-	-	1,313	1,313	-	-	1,313
	Sub-Total	2,481	-	-	-	-	-	2,481	2,481	-	-	2,481
	Facility	31,865	-	-	-	-	-	31,865	31,265	-	-	31,265
	Equip.	3,270	-	-	-	-	-	3,270	3,270	-	-	3,270
	Sub-Total	35,135	-	-	-	-	-	35,135	34,535	-	-	34,535
	Design/Supervision	4,220	78	-	6	78	-	4,382	4,220	-	-	4,220
	Sub-Total	47,018	853	-	67	853	-	48,791	46,418	-	-	46,418
Model Community Integrated USE Improvement Project	Water Supply/Domestic Waste Water Treatment System Improvement Project	6,642	6,865	7,101	7,342	7,590	-	35,540	-	-	-	-
	Improvement of water supply system to deal with the population increase in the community.	2,899	2,899	2,899	2,901	2,901	-	14,499	2,899	2,899	2,899	8,697
	Improvement of on-site domestic wastewater treatment system	9,541	9,764	10,000	10,243	10,491	-	50,039	2,899	2,899	2,899	8,697
	Sub-Total	1,234	1,234	1,234	1,234	1,234	-	6,170	1,234	1,234	1,234	3,702
	Stormwater drainage/Road Improvement Project	1,077	1,099	1,123	1,147	1,172	-	5,618	413	413	413	1,239
	Design/Supervision	11,852	12,097	12,357	12,624	12,897	-	61,827	4,546	4,546	4,546	13,638
	Sub-Total	58,870	12,950	12,357	12,691	13,750	-	110,618	50,964	4,546	4,546	60,056
Grand Total												

2.2 Project Evaluation of Priority Projects

a. Municipal Solid Waste Management System Improvement Project (F/S-1)

The result of the financial evaluation shows that:

- if grant aid is to be acquired for the entire investment cost for the year of 2000,;
- if forecast increase (5.4%) in municipal tax revenue and current budget allocation rate for SWM (10%) of total budget is expected, which falls into moderate scenario; and
- moreover, regarding waste collection charges, household refuse collection charges are collected according to the different collection service levels (high rate (CCA): C\$ 15/household/month, normal rate (CCB): C\$ 10/household/month, low rate (PCA): C\$ 5/household/month), and refuse collection charges for other wastes are collected according to the amount of waste generated (unit rate charge of C\$ 363/ton for covering actual collection and disposal costs)

FIRR is calculated at 13% which is higher than the cut-off rate, and the project is financially feasible. 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 investments required after 2005.

Economic evaluation clarified that:

(1) if the entire project cost were covered by loan, (2) tax revenue growth of the municipality (5.4%) and SWM budget allocation (10%) is the most appropriate case, (3) if WTP (according to the result of the POS) were taken as a benefit and furthermore, environmental benefits (public health improvements, increase in land prices and real estate values and increased consumption due to developments in the tourist industry) were taken into account, the EIRR is calculated at 13.3%, which exceeds the cut-off rate of 8.5%. Therefore, the implementation of the project is presumed to contribute to the national economic development.

As a total evaluation, it is concluded that the implementation of the Municipal SWM System Improvement Project is feasible in technical, social, environmental, financial, and economic aspects, as it is a prerequisite for conservation of USE and public health of Granada Municipality, and for sustainable development of the municipal activities.

b. Model Community Integrated USE Improvement Project (F/S-2)

The result of financial evaluation for water supply system and on-site domestic wastewater treatment system improvement projects, in which INAA is the main executing body, showed that:

- if grant aid covers the investment cost for on-site domestic wastewater treatment system for three years from 2000 to 2002, and
- if charges (C\$ 49.8 /household/month for water supply and C\$ 16.7/household/month for wastewater) were collected from the beneficiaries of water supply and on-site domestic wastewater treatment in the model communities,

FIRR is calculated at 12.4%, which exceeds the cut-off rate. Therefore, the projects are financially feasible. In this case, the profit and loss statement would be in the black and an internal reserve of C\$3.28 million can be accumulated by 2005, enabling INAA to independently provide investments required after 2005.

The result of the financial evaluation for the stormwater drainage improvement project, in which Granada Municipality is the main executing body showed that:

- if grant aid covers investment cost for stormwater drainage improvement for three years from 2000 to 2002.
- if 70 % of potential revenue from vehicle tax shall be collected.
- if 20% of it is allocated to the stormwater drainage improvement project.

FIRR is calculated at 8.3% and is almost the same as the cut-off rate (8.5%). Therefore, the project is financially feasible. In this case, the profit and loss statement would be in the black and an internal reserve of C\$ 220 thousand can be accumulated by 2005, enabling Granada Municipality to independently provide investments required after 2005.

The economic evaluation was carried out for the entire "Model Community Integrated USE Improvement Project" including water supply system improvement, refuse collection improvement, on-site domestic wastewater treatment system improvement and stormwater drainage improvement. The evaluation revealed that; (1) if the entire project cost were covered by loan, and (2) if WTP (according to the result of the POS) of the beneficiaries increased by the implementation of the projects and environmental benefits (impact on public health improvement, increase in land prices and real estate values and increased consumption due to developments in the tourist industry) were taken into account, EIRR was calculated at 1.3%. Although this would put the finances in the black, it is extremely lower than the cut-off rate. However, the implementation of this project is considered to contribute to the national economic development in view of the various favorable impacts, which, although were not measured during the study such as the preservation of Lake Nicaragua as a future potable water supply source for the capital, Managua City.

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

c. Source of Funds

The results of the financial analysis of the Municipal Solid Waste Management System Improvement Project indicate the need to cover the investment cost required in 2000 for one of the take-off priority projects of the Master Plan either by Central Government subsidy or the acquisition of grant aid from foreign countries, etc. Other expenses to be incurred in this project for the replacement of vehicles and equipment, facility expansion, etc., will be covered using internal reserves from waste collection fees and disposal fees, and the budget allocated from municipal tax revenues.

Based on the results of the financial analysis of the Model Community USE Integrated Improvement Project, the investment required for a 3 year period, from 2000~2002, for the on-site domestic wastewater treatment system installation and stormwater drainage improvement projects should be covered either by Central Government subsidy or the acquisition of grant aid. After this period, any expenses incurred to sustain these projects will be covered by internal reserves from water supply and sewage charges, and the budget allocated from municipal tax revenues.

In order to increase municipal tax revenue, business tax revenue should be increased with promoting tourism, inter-regional trade and so on. Tax collection rates on vehicle tax and the fixed property tax should be also raised. For this, Granada Municipality should establish a database for taxation such as the cadastre, inventory of business establishments and vehicle owners, etc. and ensure a sound tax collection rate every year. In addition, a social system that does not tolerate tax evasion and other illegal practices should be created through clarification of administrative systems to demand tax payment, cautioning and imposing penalties on non payment of taxes. Furthermore, the municipal government should improve its tax collection capacity through training of tax collect.

In addition, to establish a sound financial system, an accurate method of calculating the expenses should be formed first in order to efficiently conduct operations. Next, the use of funds accumulated from waste collection fees, and water supply and sewage charges should be limited to the operation and maintenance of the waste management, water supply, and on-site domestic wastewater treatment systems.

The prerequisites that would make this Master Plan and its priority projects financially feasible are outlined in the following table.

Table 5: Prerequisites to Make Priority Projects Financially Feasible

Priority Project	Items	Conditions
Municipal Solid Waste Management System Improvement Project (F/S-1)	Municipal Tax Revenues	<ul style="list-style-type: none"> Tax revenue of Granada City should be increased an average by 5.4% 1995-2005 in total as below: <ul style="list-style-type: none"> An annual increase rate of 2.9% on business tax revenue will be secured, despite future cuts of business tax rate; from the current 2% to 1.5% in 1998 and 1% in 2000. An annual increase rate of 12.9% on vehicle tax revenue will be secured. An annual increase rate of 15.5% on fixed property tax revenue will be secured. An annual increase rate of 5.4% on service fee will be secured.
	Budget Allocation for Solid Waste Management Services	<ul style="list-style-type: none"> The current budget allocation rate of 10% will be maintained until 2005.
	Household Waste Collection Fee	<ul style="list-style-type: none"> Joint billing with the water supply charges Refuse collection fee: <ul style="list-style-type: none"> The refuse collection fee is set as follows according to the collection service level: high service charge: C\$15/household/month; ordinary service charge: C\$10/household/month; low service charge: C\$5/household/month. Refuse collection fee collection rate: 82% Refuse collection fee collection expenses: <ul style="list-style-type: none"> 5% of the collected refuse collection fee will be paid to INAA.

Priority Project	Items	Conditions
	Other Waste Collection Fee	<ul style="list-style-type: none"> As it is favorable to combine the collection fee with municipal taxes such as business tax, for efficient collection, collection shall be relegated to the municipal tax office as before. Refuse collection fee: The refuse collection fee is set as follows based on waste volume: C\$363/ton for waste collection and disposal; C\$222/ton as waste disposal cost (directly transported by generators). Waste collection fee collection rate: 100%
	Source of Funds	<ul style="list-style-type: none"> The entire investment cost for 2000 shall be covered by grant aid.
Organizational System (F/S-1)		<ul style="list-style-type: none"> Establishment of Urban Environmental Maintenance Bureau (UEMB) Enactment of regulation on SWM Joint billing of waste collection fees and water supply charges Promote education programs for the residents
Model Community USE Integrated Improvement Project (F/S-2) Works to be carried out by INAA	Source of Revenue	<ul style="list-style-type: none"> Collect charges from the entire beneficiaries of the water supply system and on-site domestic wastewater treatment system in the model community. The average water charge of C\$49.8/household/month in the entire Granada Municipality in 1996 will be collected from the model community beneficiaries for water supply services (collection rate of 96%). Beneficiaries in the model community will pay C\$16.7/household/month (the average sewer charges paid in Granada Municipality in 1996) for the use of the on-site domestic wastewater treatment system (collection rate of 96%).
	Source of Funds	<ul style="list-style-type: none"> The entire investment cost from 2000 to 2002 will be covered by grant aid.
Model Community USE Integrated Improvement Project (F/S-2) Works to be carried out by Granada Municipality	Source of Revenue	<ul style="list-style-type: none"> 20% of revenues from vehicle taxes will be allocated for roads and stormwater drainage improvement (this budgetary measure does not exist at present). An annual increase rate of 12.9% on vehicle tax revenue will be secured.
	Source of Funds	<ul style="list-style-type: none"> The entire investment cost from 2000 to 2002 will be covered by grant aid.
Organizational System		<ul style="list-style-type: none"> Establish a steering committee for PECM made up of representatives from INAA, Granada Municipality, and MINSA/SILAIS. Formation of task force in INAA, Granada Municipality and MINSA/SILAIS respectively in order to promote "Model Community USE Integrated Improvement Project". Promote education programs for the residents.

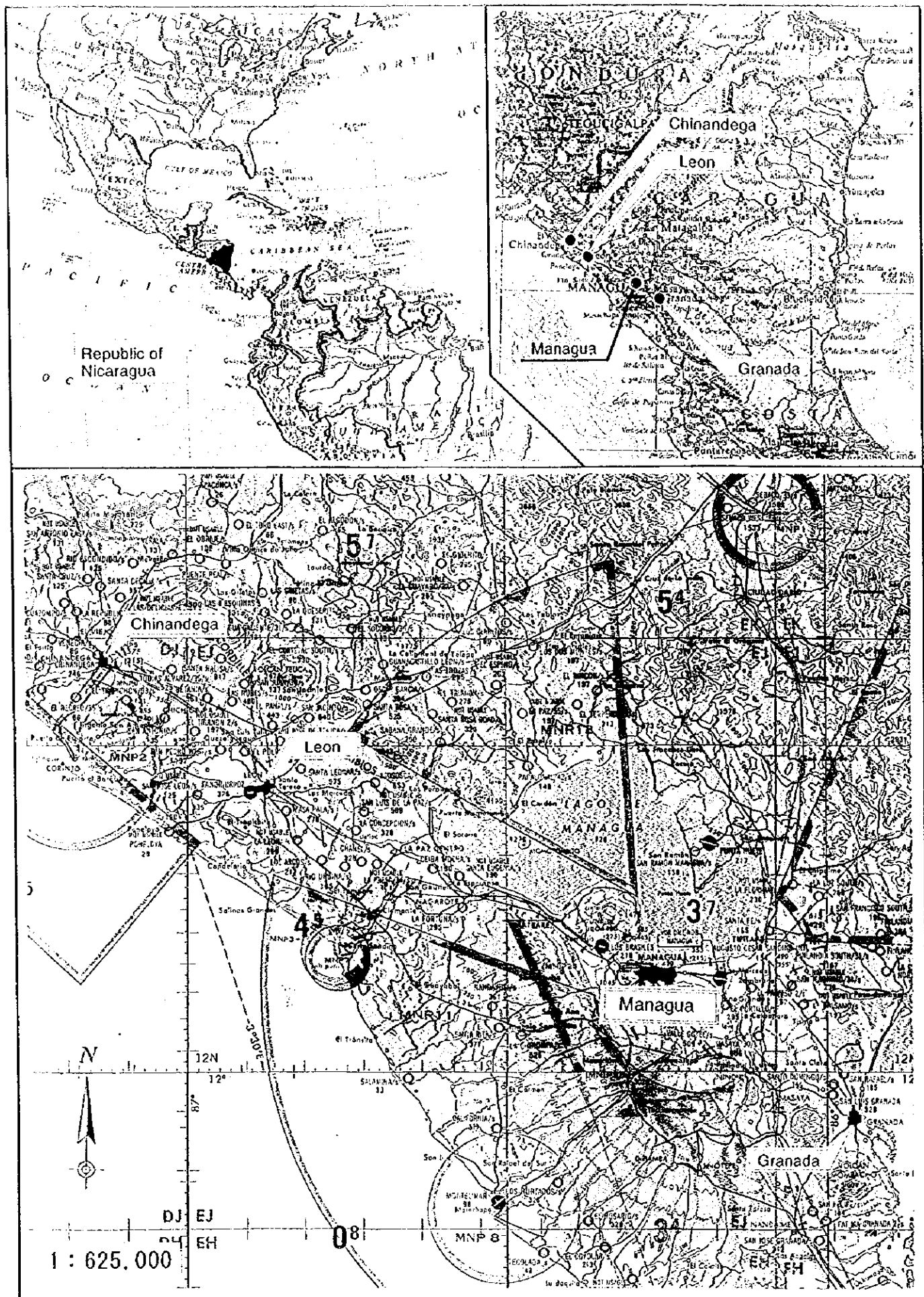
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List of Volumes

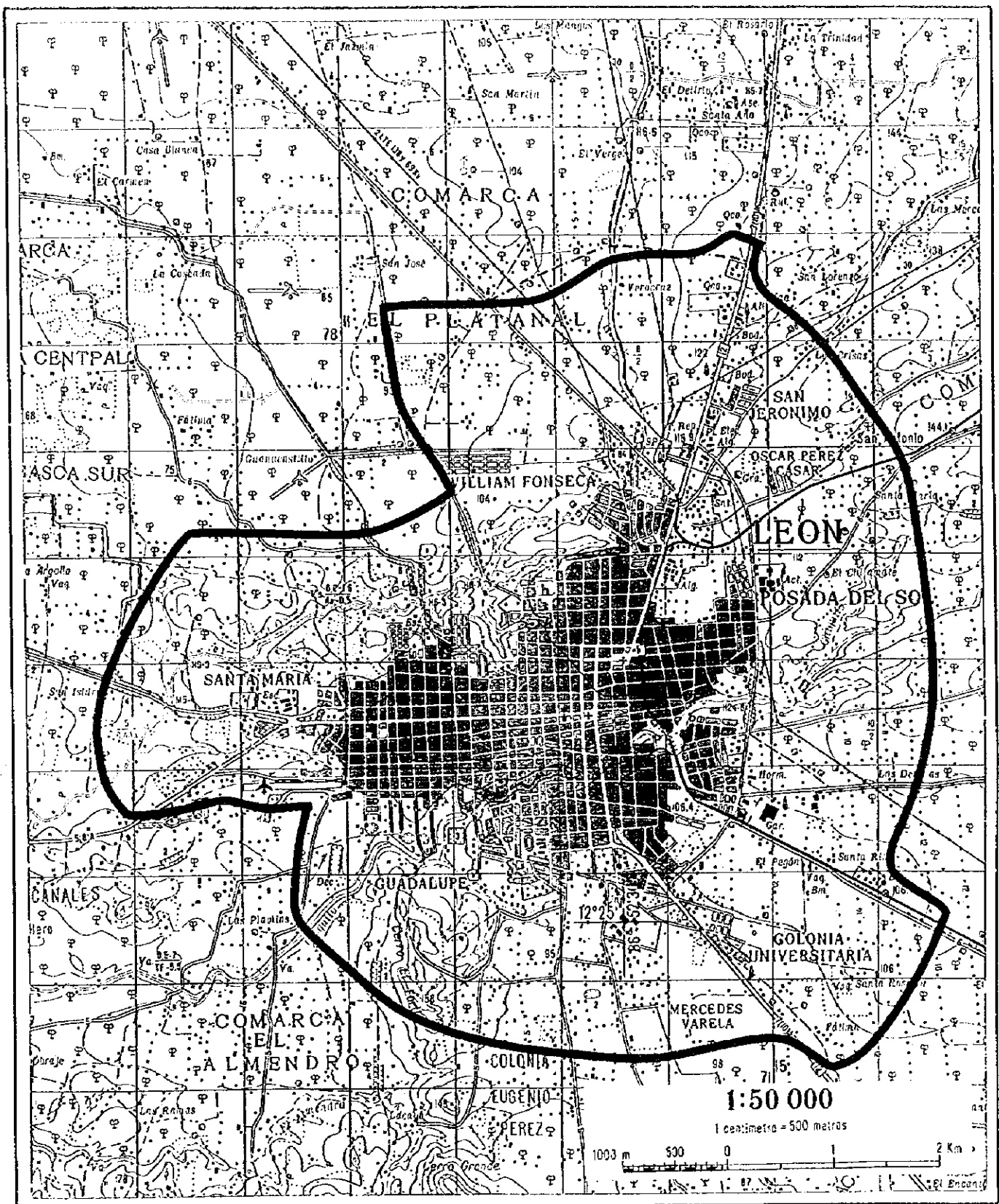
- Volume I Executive Summary
- Volume I(S) Executive Summary (Spanish Version)
- Volume II Main Report for the M/P and Conceptual M/Ps
- Volume II(S) Main Report for the M/P and Conceptual M/Ps (Spanish Version)
- Volume III Main Report for the Feasibility Study
- Volume III(S) Main Report for the Feasibility Study (Spanish Version)
- Volume IV Annex
- Volume V Data Book

This is the Executive Summary.

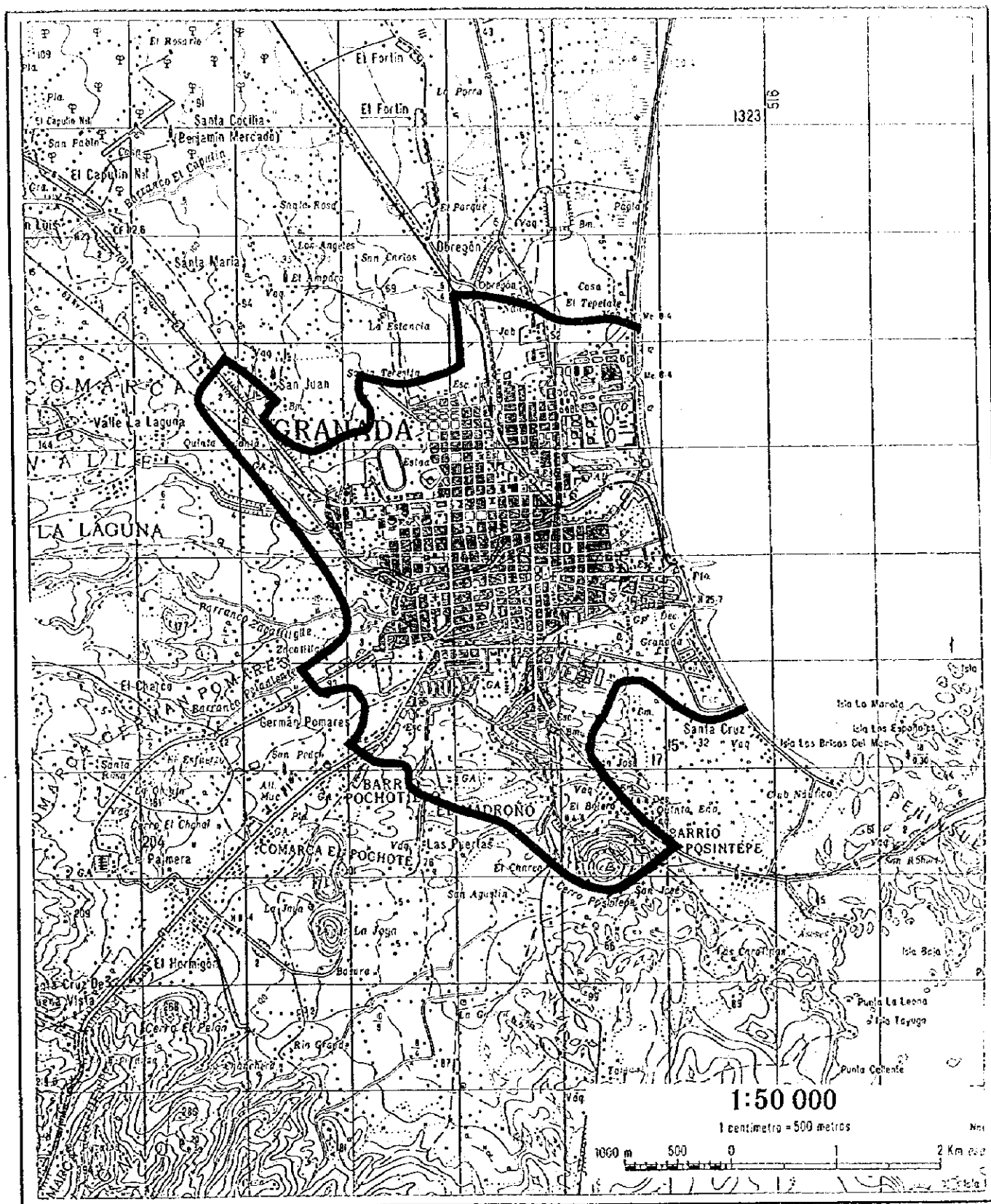
In this report, the project cost is estimated using the September 1997 price and at an exchange rate of 1US\$ = 120.00 Japanese Yen = 9.60 Cordoba.



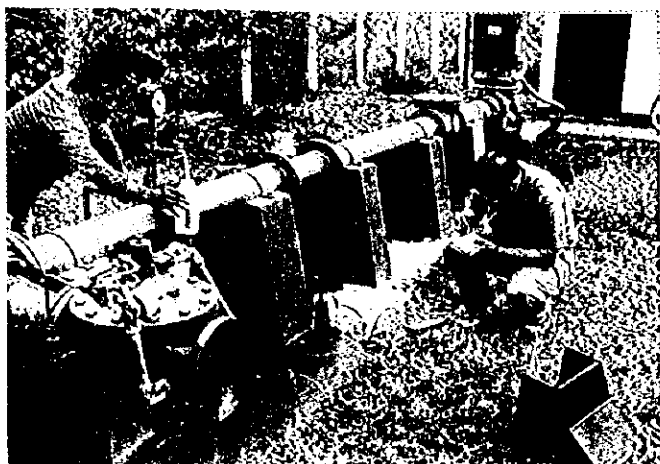
Map 1 : The Location Map of the Study Area



Map 2 : The Location Map of the Study Area (Leon)



Map 4 : The Location Map of the Study Area (Granada)



Water Quality Survey

Sampling in a well used for water supply in Granada.



Water Quality Survey

Checking waste water from the present sewage plant.



Water Quality Survey

The present situation of the Chiquito river in Leon.



Water Pollution Loading Survey

A manhole which is a sampling point for the survey.



Waste Amount and Composition Survey
Sampling for the waste composition survey.



Waste Amount and Composition Survey
The physical composition analysis.



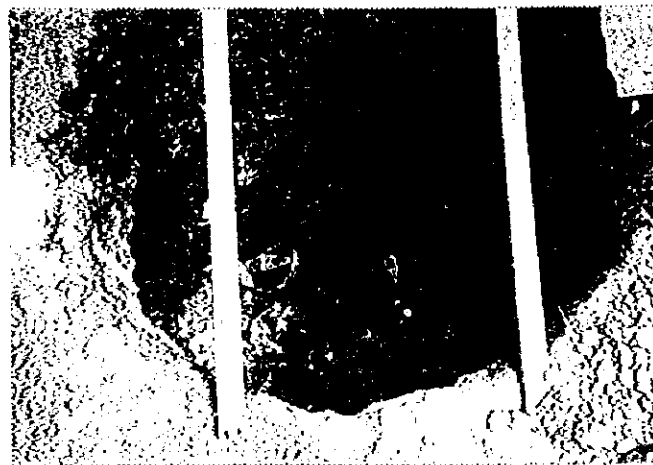
Industrial/Medical Waste Survey
A flour milling factory. Industrial waste survey is carried out through interviews and field surveys to factories.



Industrial/Medical Waste Survey
Inside of a soap factory in Granada.



Industrial/Medical Waste Survey
Discharged medical waste is collected and disposed of in the final disposal site together with municipal solid waste without separating.



Industrial/Medical Waste Survey
Infectious/hazardous waste is burned off and buried inside a hospital yard.



The municipal final disposal site in Leon located on top of a hill spreads not only soil and groundwater contamination in its down stream but also air polluted and scenic damages on the landscape.



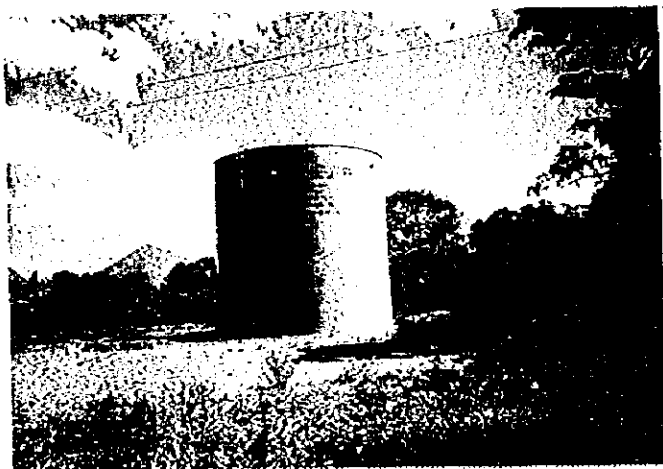
Rio Chiquito is polluted with industrial waste water of tannery, soap/detergent factories.



El Cocal Sewage Treatment Plant.



The final disposal site receives industrial waste without control.



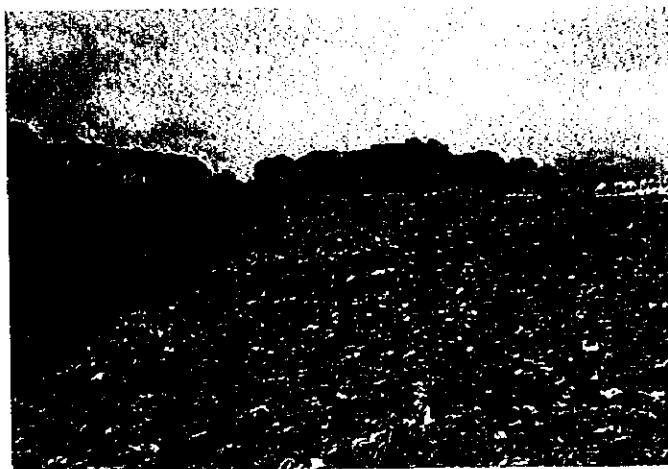
They use groundwater for service water. The groundwater pumped up is delivered to water tanks in the city to supply water to residents.



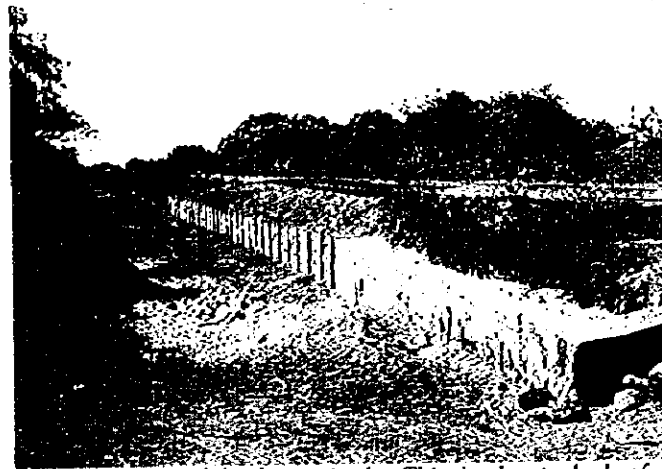
A scene of waste collection service.



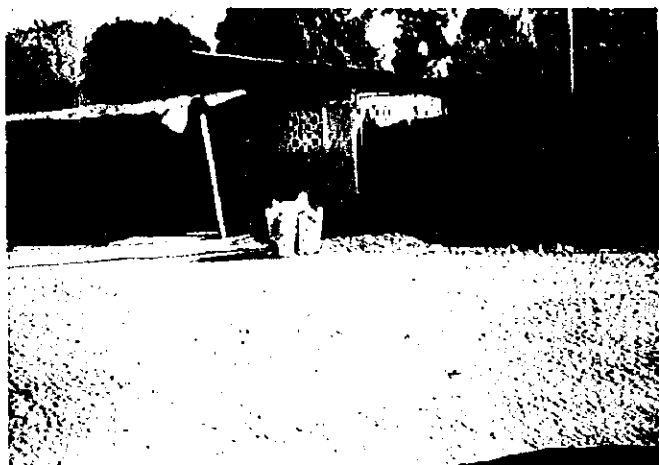
The municipal final disposal site located along the Rio Acome continuously pollutes the river and its downstream lands, (although some people uses the river water for washing and bathing).



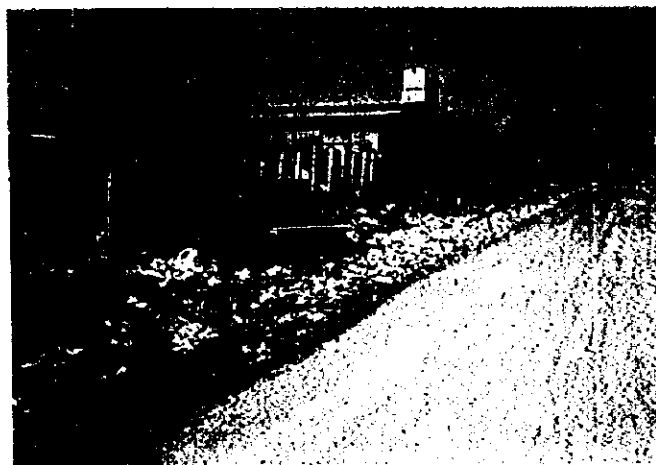
Swage Treatment Plant.



Damages of road bank repaired. This is due to lack of a macro-drainage management.



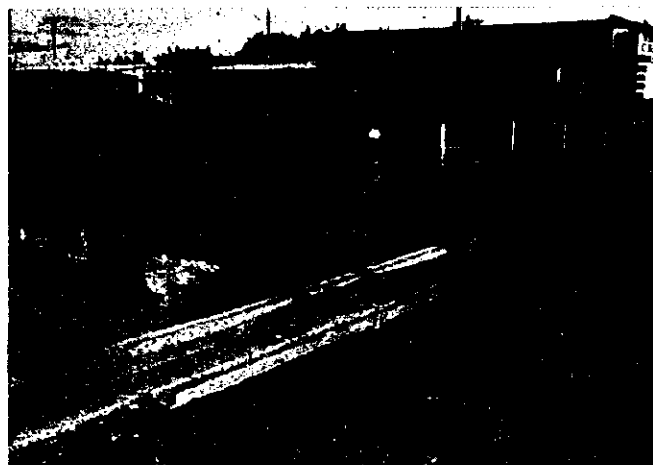
Plastic bags are used as a discharge container for waste collection services. They reuse the plastic bags repeatedly.



Illegal dumping on the road side is seen here and there in suburb. Wastes discharged illegally shut the drain in rainy season



Waste dumped in the municipal final disposal site along the crater pollutes groundwater. It is anticipated that INAA's wells in its downstream become contaminated.



Damage of rain water drainage system.



Arroyo Zocateligue is contaminated with illegal dumps of solid waste and discharge of domestic/industrial waste water.



Unsanitary conditions are created with stagnant domestic waste water and uncollected (or illegally duped) waste in urban fringe areas.

Plate 6 : Present Situation of the Candidate Site for Priority Projects - Workshop, Final Disposal Site, Model Area



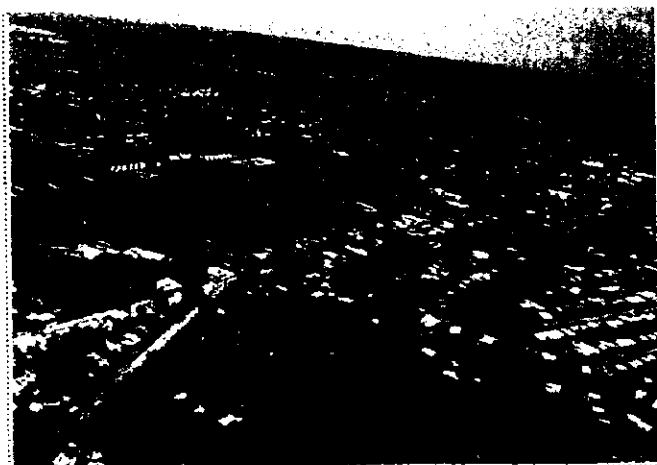
An appearance of the present workshop. This building was constructed originally as a market



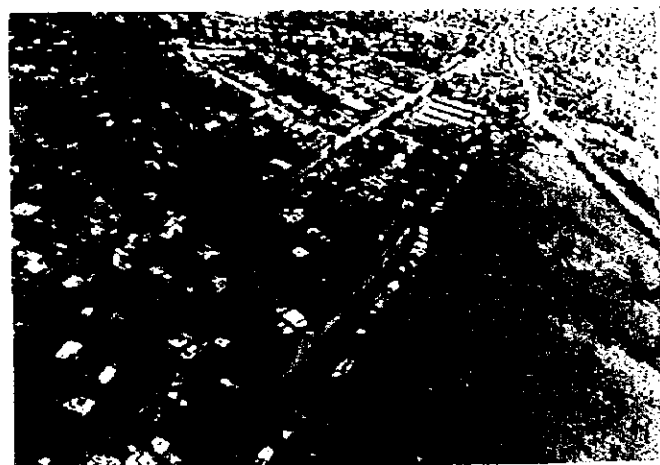
There is scarcely any spare parts and maintenance equipment inside of the workshop.



The SJV (San Jose de la Viuda) candidate site for a new municipal solid waste disposal site.



Model area C-1 (right side) and C-3 (left side).



Model area C-2.

Plate 7: Pilot Projects (I) Beautify Granada Campaign, Experiment on Improvement of Refuse Collection System & Experiment on Improvement of Arroyo Zacatellague Sanitation Environment



A banner showing "Beautify Granada", the catch phrase for the campaign (along the Masaya highway).



Waste collection experiment for data gathering in La Sirena (left-hand side: the campaign poster).



Work shops always gathered many community members with high motivation (La Talupujera).



Well recognized was communal dedication for the newly introduced collection system: refuse discharge following the time schedule; good maintenance and clean usage of collection bays and containers (a collection bay in Eddy Ruiz III).



Cooperative arroyo cleansing work (La Talupujera).



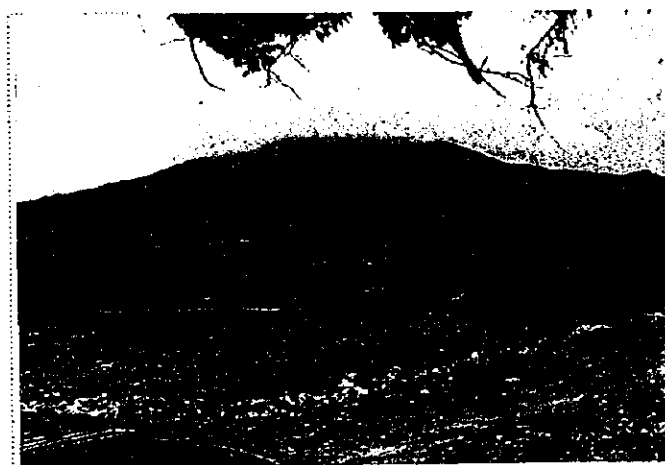
Commendation ceremony in Casa de Los Leones on July 30, 1997 (Poster contest).



La Joya dump site before the project: full of tons of waste and ill odors.



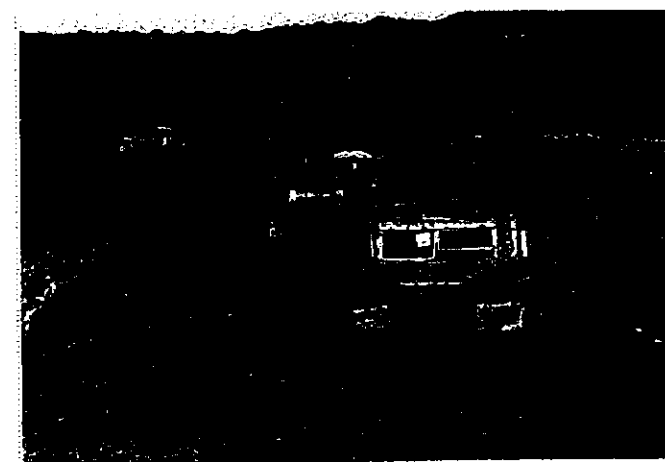
Odor check by the Team



Waste accumulation completed.



Operation Completed (an amazing view from the sky). No one could deny its neat renewal and environmental improvement.



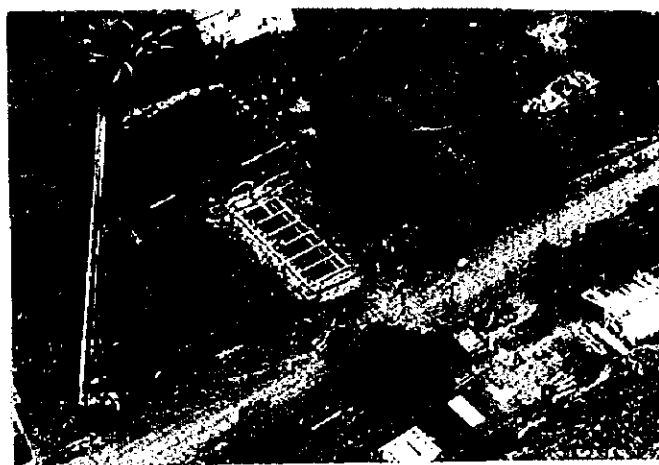
Final covering in action.



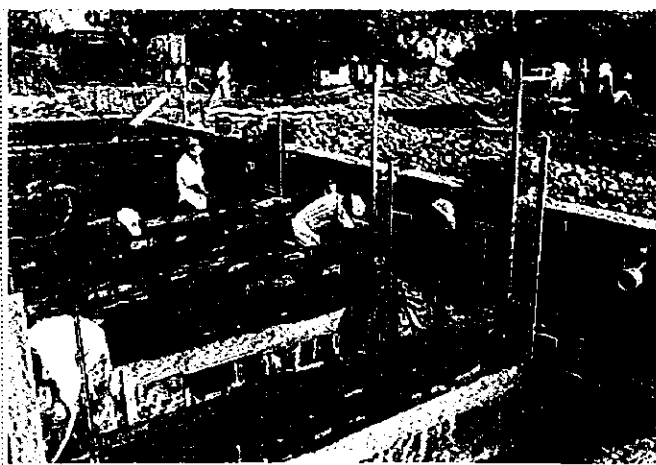
An inauguration ceremony was held on August 30, 1997 with honored guests including the minister of INAA, the Japanese ambassador to Nicaragua, the mayor and so on.



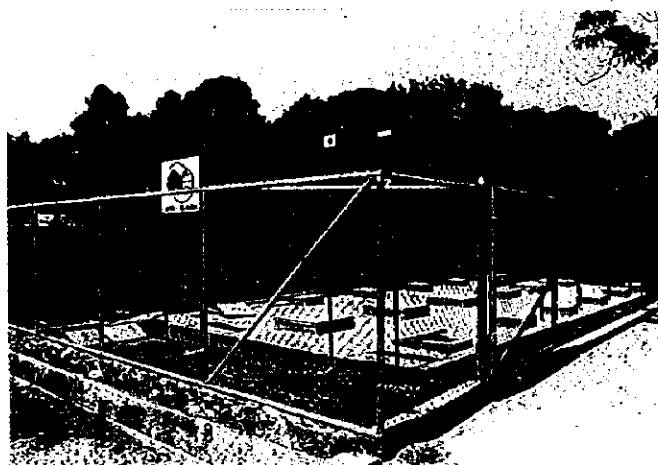
Very early stage of the facility construction in Adelita II.



Treatment facility from the sky. Process of the construction and location of a septic tank and filter trenches are easily understood.



Brick work of a 'septic tank'.



The treatment facility construction completed.



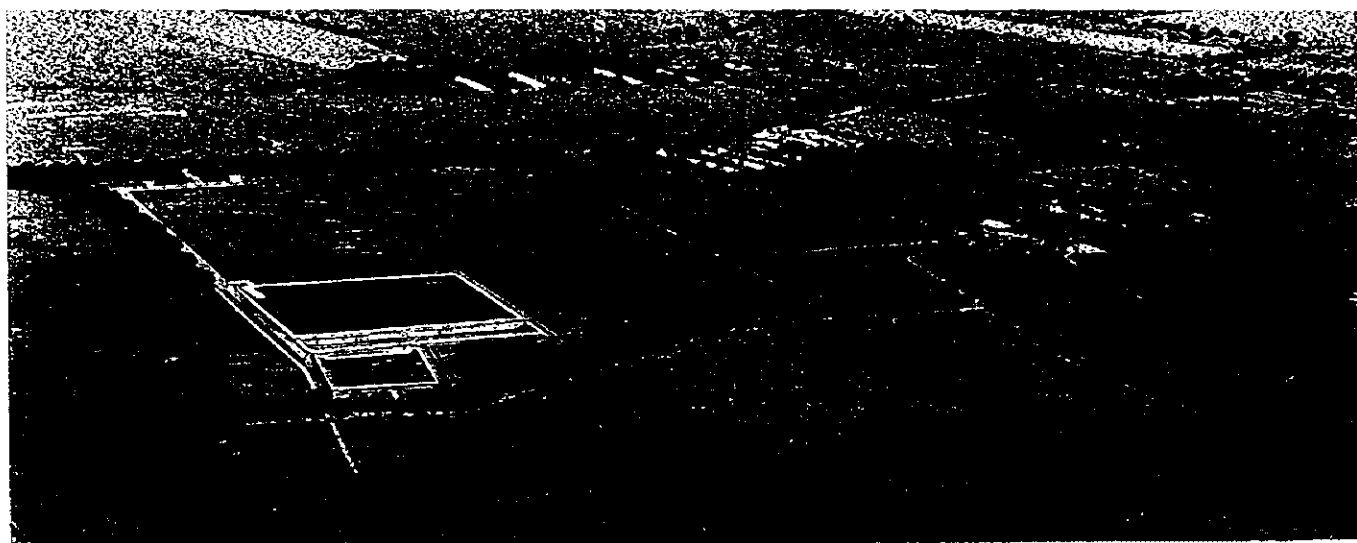
Construction created new job opportunities with positive impact on the communal economy (right-hand side: newly emerged 'mini shop').



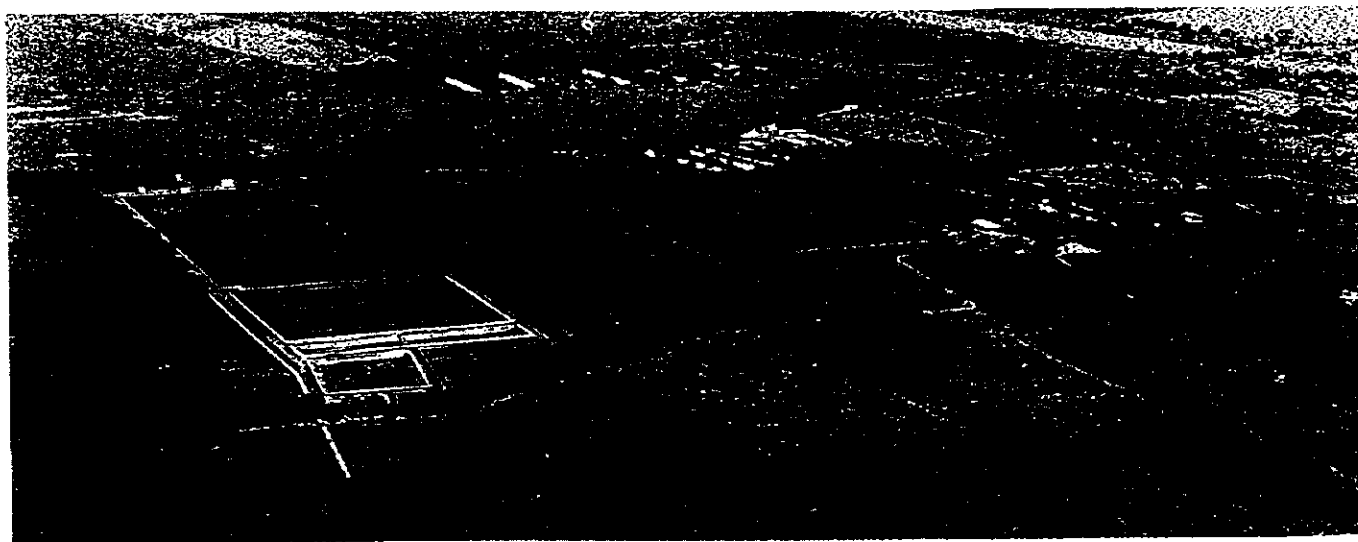
An inauguration ceremony was held on August 30, 1997 with honored guests including the minister of INAA, the Japanese ambassador to Nicaragua, the mayor and so on.



San Jose de la Viuda (SJV) Present Landscape



San Jose de la Viuda (SJV) Landscape Expected in 2001



San Jose de la Viuda (SJV) Landscape Expected in 2005



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List of Abbreviations

ACEM	:	Malaria Control and Eradication Area
ADES	:	Agency of Social Economic Development (Agencia de Desarrollo Económico Social)
AFD	:	Administration and Finance Department
ALMA	:	Municipal Government of Managua (Alcaldía de Managua)
AMUNIC	:	Nicaraguan Institute of Engineers and Architects
ARI	:	Average Recurrence Interval
AT	:	Ambient Temperature
ATP	:	Ability to Pay
BAVINIC	:	Housing Bank of Nicaragua (Banco de la Vivienda de Nicaragua)
BCN	:	Nicaraguan Central Bank (Banco Central de Nicaragua)
BDT	:	Transport Bulletin (Boletín de Transporte)
BID	:	Interamerican Development Bank (Banco Interamericano de Desarrollo)
BIV	:	Vehicle Inactivity Bulletin (Boletín de Inactividad de Vehículos)
BOD	:	Biochemical Oxygen Demand (5 day)
BORS	:	Landfill Operation Bulletin (Boletín de Operación de Relleno Sanitario)
BPP	:	Beneficiary Pays Principle
CDP	:	Personnel Distribution Board (Cuadro de Distribución de Personal)
CEM	:	Materials Entrance Control (Control de Entrada de Materiales)
CEPRODEL	:	Local Development Promotion Center (NGO) (Centro de Promoción del Desarrollo Local (ONG))
CHISPA	:	Centro de Crédito de Capacitación Humanística Integral Sistemática de la Pequeña Empresa
CIRA	:	Investigation Center on Aquatic Resources
CL	:	Controlled Landfill
CNA	:	National Environmental Agency
CNRH	:	National Commission of Water Resources
COD	:	Chemical Oxygen Demand
CONAVIAH	:	National Commission of Housing and Human Settlements (Comisión Nacional de Vivienda y Asentamientos Humanos)
DC	:	the Development Committee
DENACAL	:	Departamento Nacional de Acueductos y Alcantarillados
DO	:	Dissolved Oxygen
DSW	:	Domestic Solid Waste
DW	:	Domestic Waste
DWW	:	Domestic Wastewater
DWWCTS	:	Domestic Wastewater Collective Treatment System
DWWM	:	Domestic Wastewater Management
EAP	:	Economically Active Population
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
ENACAL	:	Empresa Nicaragüense de Acueductos y Alcantarillados Sanitarios
ENEL	:	Nicaraguan Electric Company (Compañía Nicaragüense de Electricidad)
ENITEL	:	Nicaraguan Telecommunication Company
EPD	:	Environmental Protection Department
EU	:	European Union
EUDOF	:	Physical Program for Urban Development

F/S	:	Feasibility Study
FIDEG	:	International Foundation for Global Economic Challenge (Fundación Internacional para el Desafío Económico Global)
FINCA	:	International Community Assistance Board
FIRR	:	Financial Internal Rate of Return
FISE	:	Emergency Social Investment Fund (Fondo de Inversión Social de Emergencia)
FPC	:	First Priority City
GDP	:	Gross Domestic Product
GRDP	:	Gross Regional Domestic Product
HSW	:	Health Services Solid Waste
HW	:	Hazardous Waste
IDS	:	Inundation Damage Survey
IL	:	Inert Landfill
IMWS	:	Industrial /Medical Waste Management Survey
INAA	:	Nicaragua Institute of Waterworks and Sewerage (Instituto Nicaragüense de Acueductos y Alcantarillados)
INATEC	:	Instituto Nacional Tecnológico
INE	:	Nicaraguan Institute of Energy (Instituto Nicaragüense de Energía)
INEC	:	National Institute of Statistics and Census (Instituto Nacional de Estadísticas y Censos)
INETER	:	Nicaraguan Institute of Territorial Studies (Instituto Nicaragüense de Estudios Territoriales)
INIFOM	:	Nicaraguan Institute of Municipal Development (Instituto Nicaragüense de Fomento Municipal)
INSSBI	:	Institution of Nicaraguan Social Security and Welfare
IRENA	:	Nicaraguan Natural Resources and Environmental Institute
ISW	:	Industrial Solid Waste
ISWM	:	Industrial Solid Waste Management
IW	:	Industrial Waste
IWM	:	Industrial Waste Management
IWS	:	Industrial Waste Survey
IWW	:	Industrial Wastewater
IWWM	:	Industrial Wastewater Management
JICA	:	Japan International Cooperation Agency
JUVED	:	Neighborhood Development Board
M.G.	:	Municipal Government
M/M	:	Minutes of Meeting
M/P	:	Master Plan
MAG	:	Ministry of Agriculture and Livestock (Ministerio de Agricultura y Ganadería)
MARENA	:	Ministry of Environment and Natural Resources (Ministerio del Ambiente y Recursos Naturales)
MAS	:	Ministry of Welfare (Ministerio de Acción Social)
MCE	:	Ministry of Foreign Cooperation (Ministerio de Cooperación Externa)
MCT	:	Ministry of Construction and Transport (Ministerio de Construcción y Transporte)
MDO	:	Modulo de Operación (Workshop)
MED	:	Ministry of Education (Ministerio de Educación)

MEDE	:	Ministry of Economy and Development (Ministerio de Economía y Desarrollo)
MG	:	Municipal Government
MGC	:	Municipal Government of Chinandega (Alcadía de Chinandega)
MGG	:	Municipal Government of Granada (Alcadía de Granada)
MGL	:	Municipal Government of Leon (Alcadía de Leon)
MINSAL	:	Ministry of Health (Ministerio de Salud)
MITRAB	:	Ministry of Labor (Ministerio del Trabajo)
MITUR	:	Ministry of Tourism (Ministerio de Turismo)
MSD	:	Municipal Services Department
MSW	:	Municipal Solid Waste
MSWM	:	Municipal Solid Waste Management
MTP	:	Municipal Tributary Plan
MWS	:	Medical Waste Survey
NHW	:	Non-Hazardous Waste
NIW	:	Non-infectious Waste
OPS	:	Pan American Health Organization (Organización Panamericana de la Salud)
OS	:	Service Order (Orden de Servicio)
PEA	:	Economic Active Population
PECM	:	Special Program for Model Community Integrated Urban Sanitation Environment Project
POS	:	Public Opinion Survey
PPP	:	Polluter Pays Principle
PSW	:	Public Solid Waste
RAAN	:	North Atlantic Autonomous Region
RAAS	:	South Atlantic Autonomous Region
RCRA	:	Resource Conservation and Recovery Act
RPD	:	Research and Projects Department
RW	:	Rain Water
S/W	:	Scope of Work
SCL	:	Strictly Controlled Landfill
SILAIS	:	Local System of Integral Attention and Health (Sistemas Locales de Atención Integrada)
SILVAH	:	Local Information System on Housing and Human Settlements (Sistema de Información Local de Vivienda y Asentamientos Humanos)
SISCAT	:	Cadastre System
SJV	:	San Jose de la Vuida
SPD	:	the Social Promotion Department
SPDMG	:	the Social Promotion Department of the Municipality in Granada
SS	:	Suspended Solid
ST	:	Sample Temperature
STP	:	Sewage Treatment Plant
SW	:	Solid Waste
SWD	:	Solid Waste Disposal
SWM	:	Solid Waste Management
SWR	:	Solid Waste Recovery
TELCOR	:	Nicaraguan Institute of Post and Telecommunications (Instituto Nicaragüense de Telecomunicaciones y Correos)

UEMB	:	Bureau of Urban Environmental Maintenance
UFA	:	Urban Fringe Area
UFW	:	Unaccounted for Water
UNICEF	:	United Nations Children's Fund
UROC	:	Unidades de Rehidratación Oral Comunitaria
USE	:	Urban Sanitation Environment
WACS	:	Waste Amount and Composition Survey
WID	:	Women in Development
WPLS	:	Water Pollution Loading Survey
WS	:	Water Supply
WTP	:	Willingness to Pay
WW	:	Wastewater

Definitions

Concession Contract	A contract system in which the contractor which is entrusted refuse collection and transportation work in a certain area are granted the right to collect RCC from its beneficiaries.
Contracting out	A contract system in which the client make payment to the contractor in return for performing refuse collection and transportation work.
Concessionaire	The contractor that works in the concession contract.
Level of Sanitary Landfill	Study Team classified the level of sanitary landfill into the following four levels.
Level 1:	Controlled tipping (casual soil covering)
Level 2:	Sanitary landfill with dike and daily soil covering (without an impermeable liner)
Level 3:	Sanitary landfill with leachate circulation (Impermeable liner, leachate collection and circulation facility)
Level 4:	Sanitary landfill with leachate treatment (Impermeable liner, leachate collection, and leachate treatment facility)
Micro-drainage	Drainage channel or river, whose basin is small and located within the municipal boundary.
Macro-drainage	Drainage channel or river, whose basin and/or catchment area is large and stretches over plural municipalities.