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THE REPUBLIC OF NICARAGUA

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

**FINAL REPORT**

**VOLUME II**

**MAIN REPORT FOR THE M/P  
AND CONCEPTUAL M/Ps**

**JANUARY 1998**

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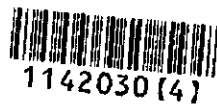
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1142030(4)

## 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



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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.

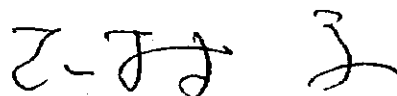
An USE M/P, which includes various sectors, such as water supply, domestic waste water management, municipal SWM (Solid Waste Management), etc., was formulated for Granada City. USE Conceptual M/Ps were compiled for Leon and Chinandega respectively in order to encourage the two cities to formulate M/Ps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



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Susumu Shimura  
Team Leader  
The Study on the Improvement of Urban  
Sanitation Environment of Principal Cities  
in the Republic of Nicaragua

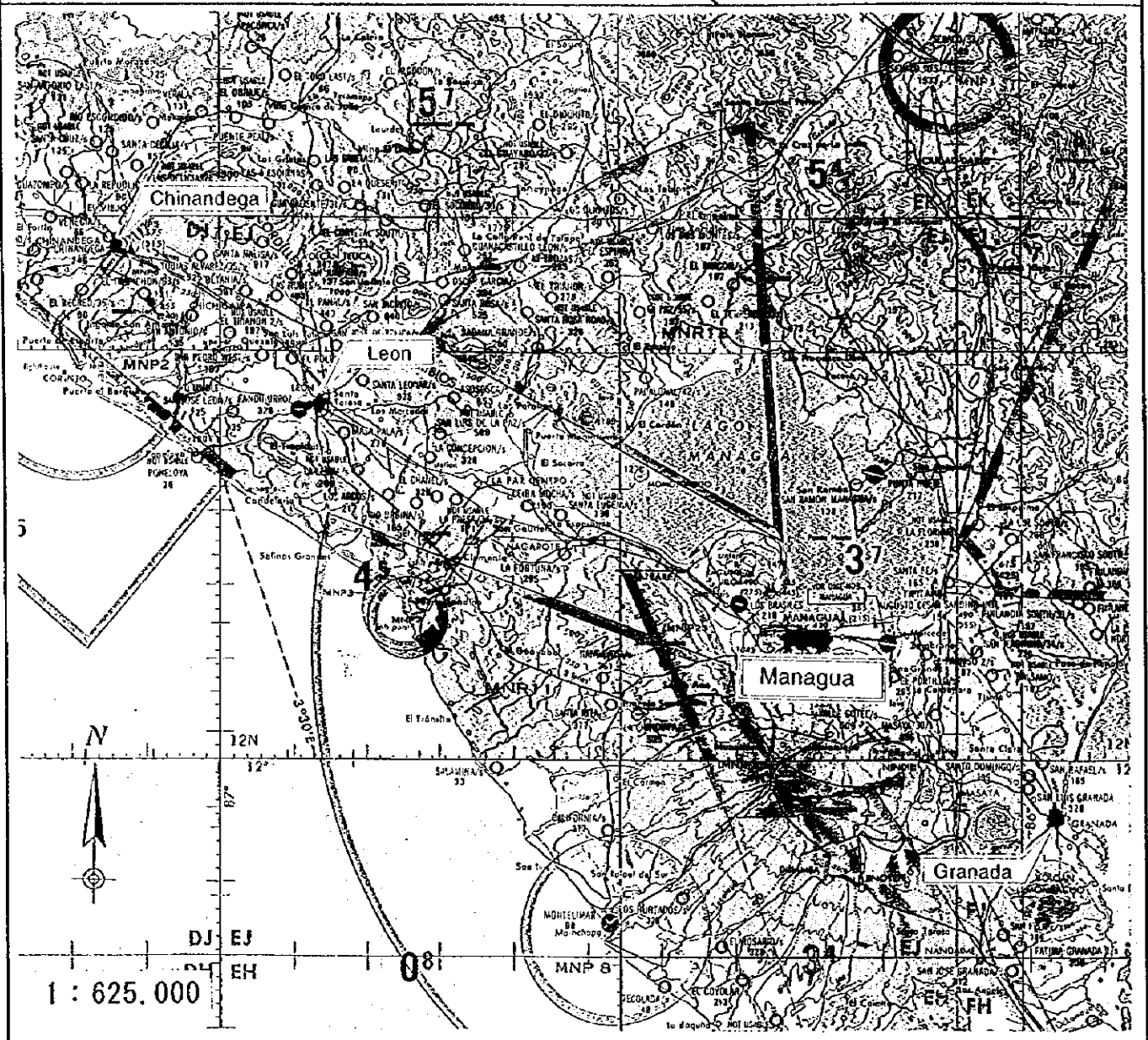
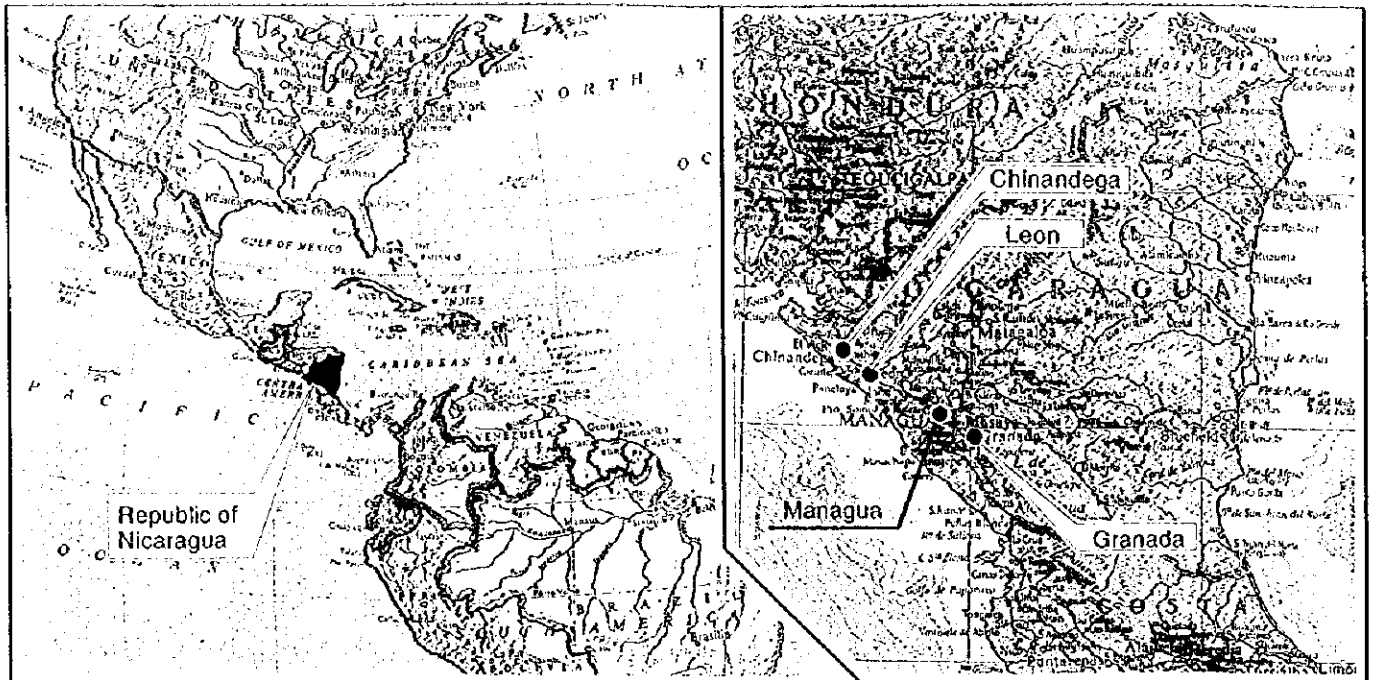
**The Study on the Improvement of Urban Sanitation Environment  
of Principal Cities in the Republic of Nicaragua  
(Leon, Chinandega, and Granada)**

**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

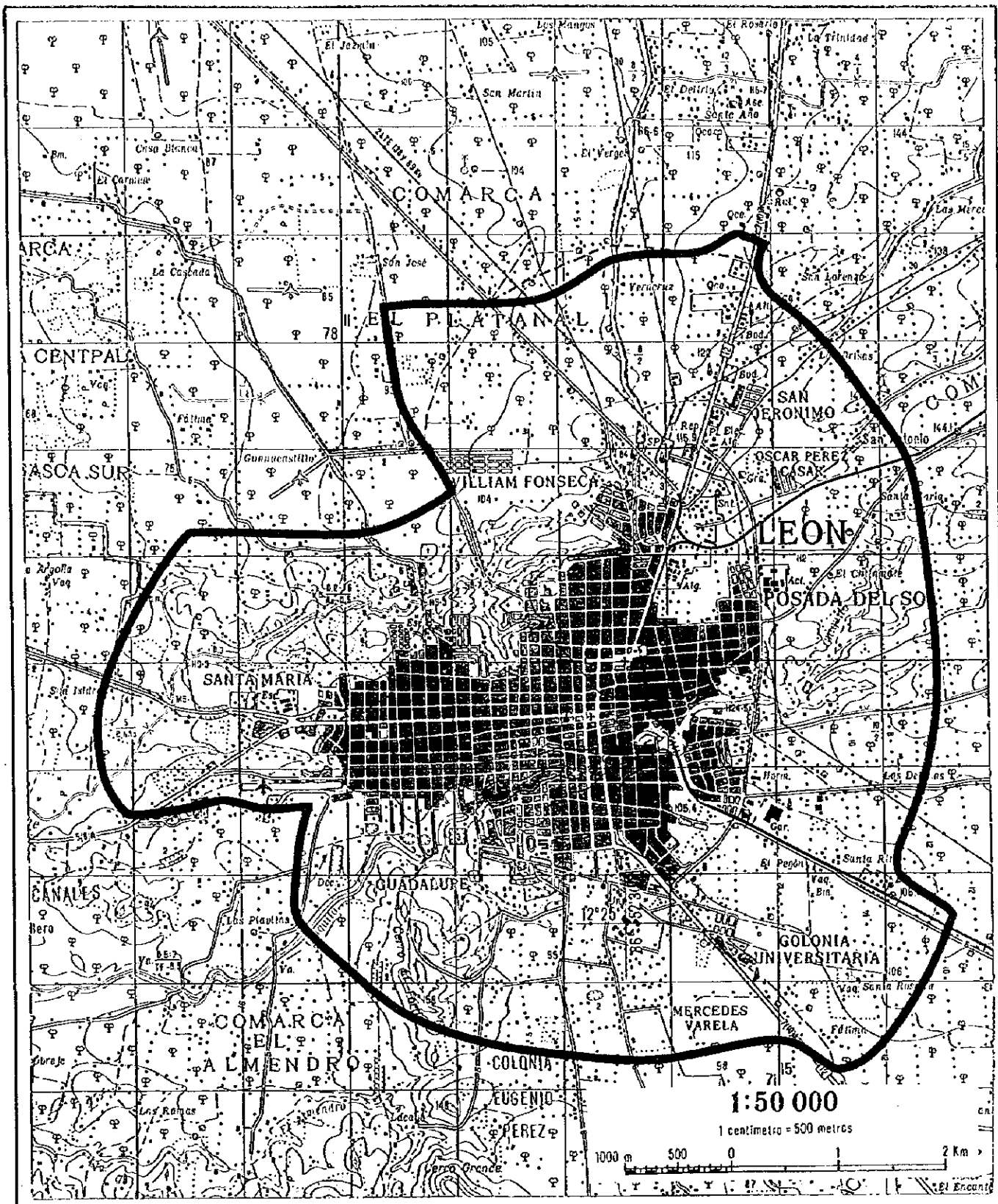
***This is the Main Report for the Master Plan and  
Conceptual M/Ps.***

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.

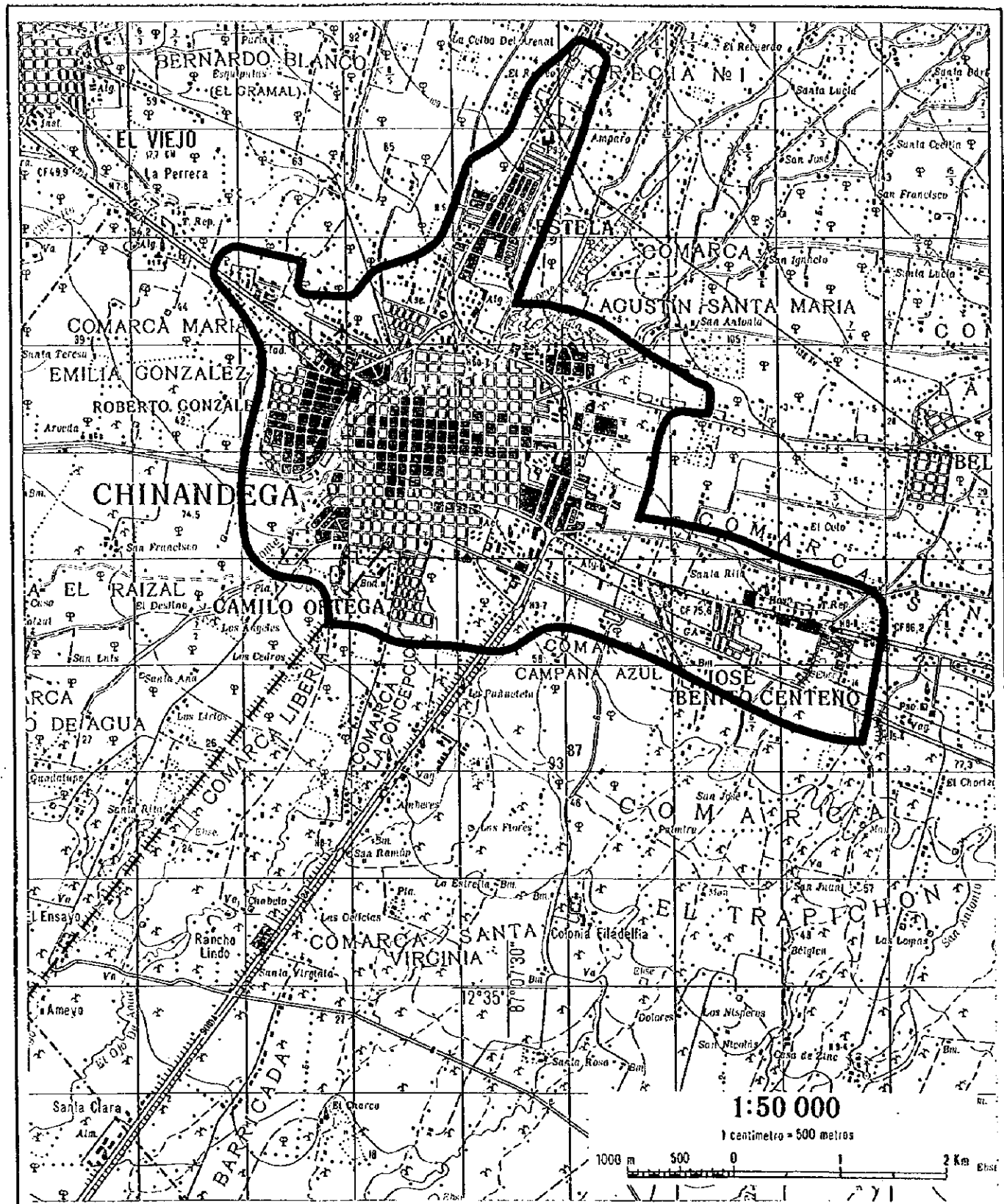


**Map 1 : The Location Map of the Study Area**

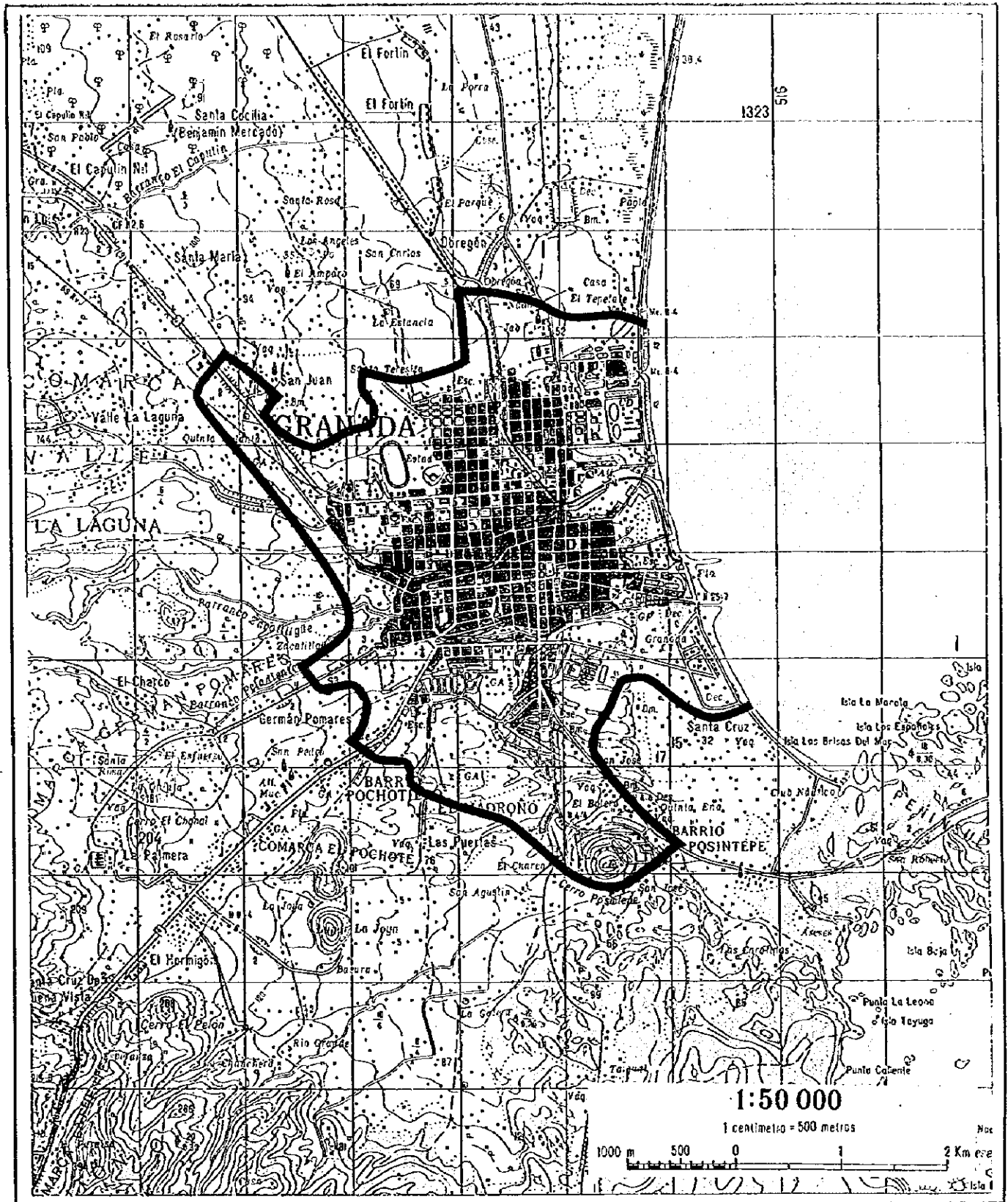




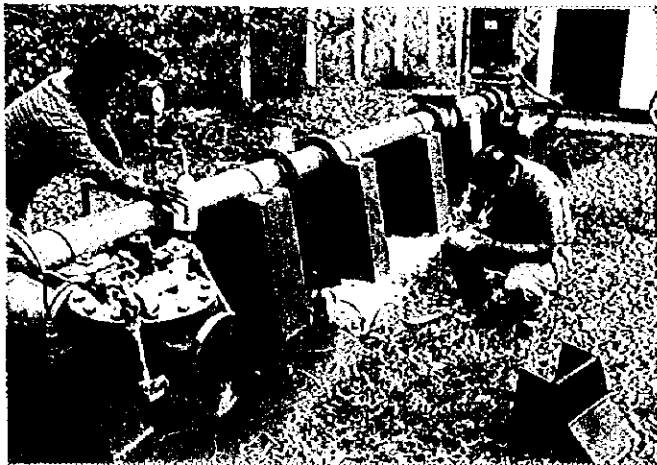
**Map 2 : The Location Map of the Study Area (Leon)**



**Map 3 : The Location Map of the Study Area (Chinandega)**



**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.*



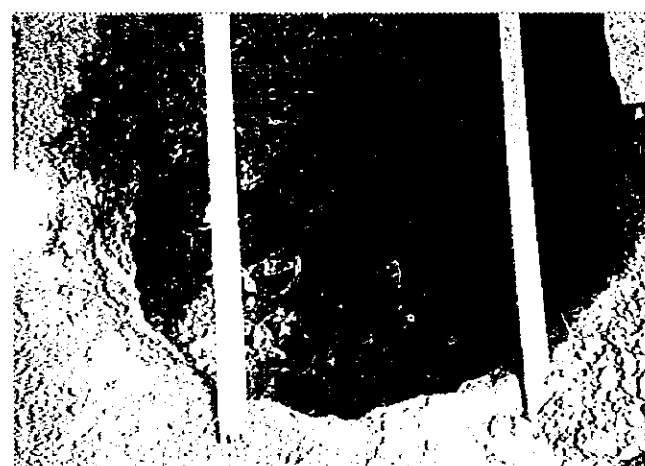
*Industrial/Medical Waste Survey*  
*A flour milling factory. Industrial waste survey is carried out through interviews and field surveys to factories.*



*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.*

*Plate 3 : Present Situation of the Urban Sanitation Environment (1) Leon*

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*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.*



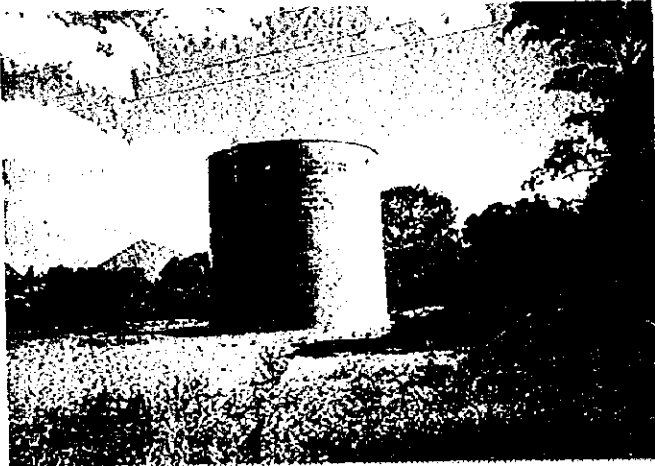
*Rio Chiquito is polluted with industrial waste water of tannery, soap/detergent factories.*



*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.*



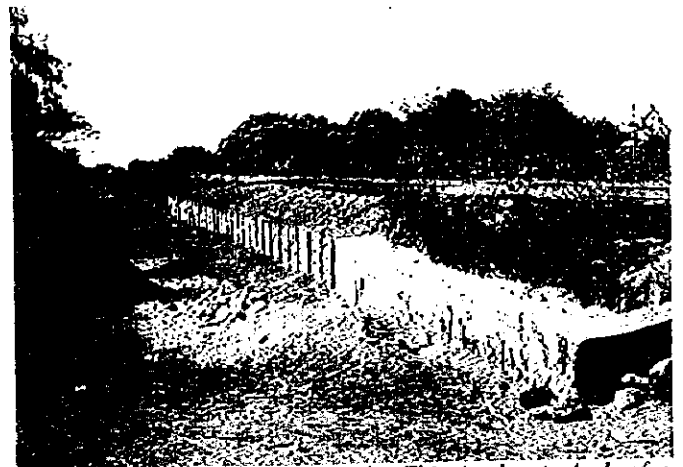
*A scene of waste collection service.*



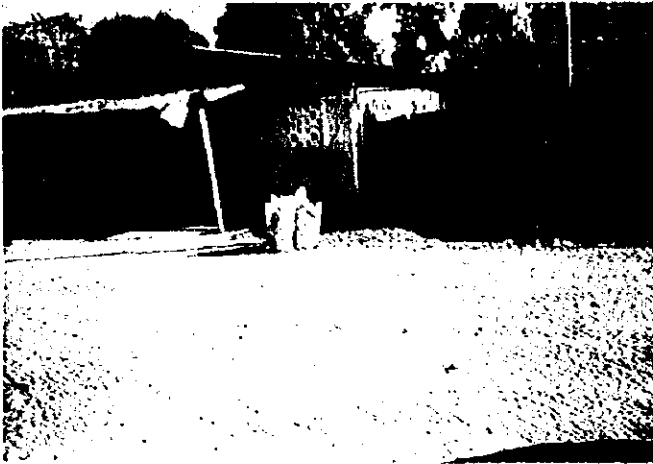
*The municipal final disposal site located along the Rio Acome continuously pollutes the river and its downstream lands, (although some people uses the river water for washing and bathing).*



*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 Zacateligue 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*



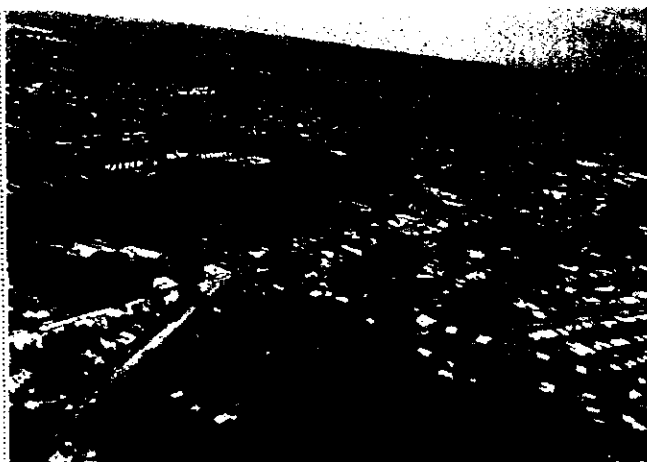
*An appearance of the present workshop. This building was constructed originally as a market*



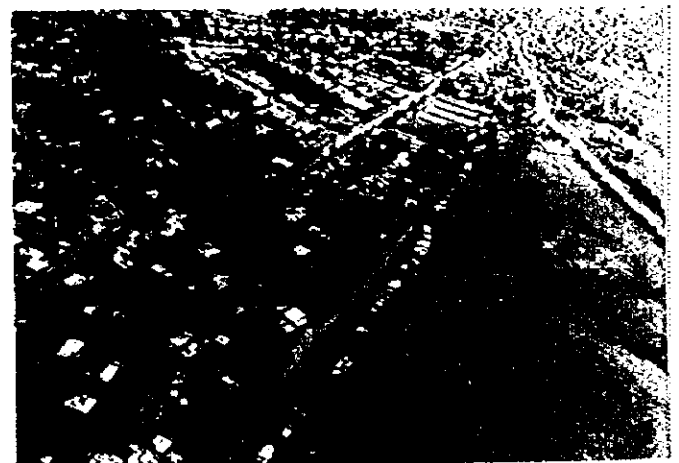
*There is scarcely any spare parts and maintenance equipment inside of the workshop.*



*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 (1) Beautify Granada Campaign, Experiment on Improvement of Refuse Collection System & Experiment on Improvement of Arroyo Zacateligue 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).*



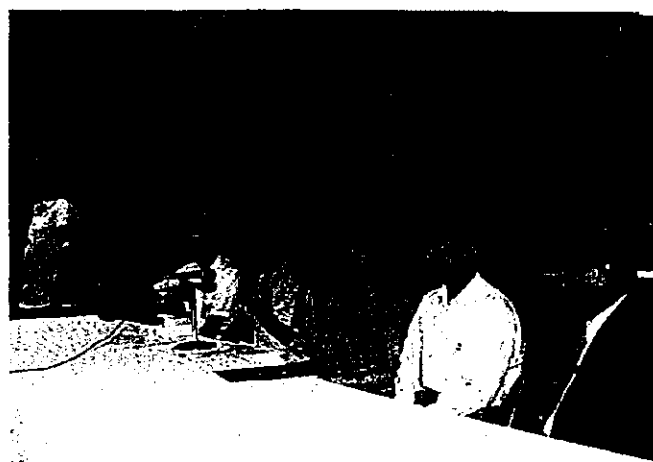
*Work shops always gathered many community members with high motivation (La Talupujera).*



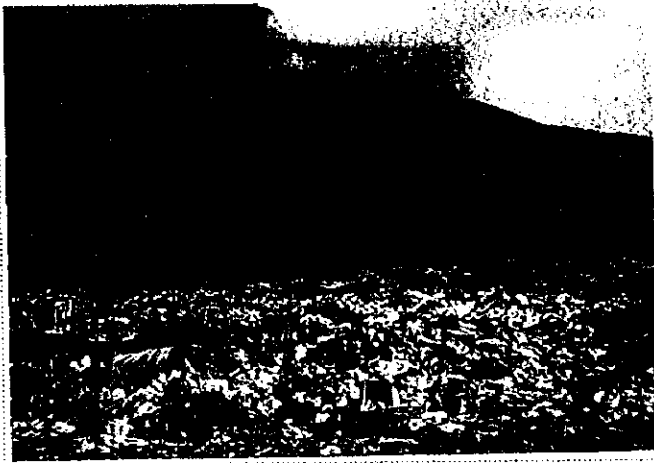
*Well recognized was communal dedication for the newly introduced collection system: refuse discharge following the time schedule; good maintenance and clean usage of collection bays and containers (a collection bay in Eddy Ruiz III).*



*Cooperative arroyo cleansing work (La Talupujera).*



*Commutation 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.*



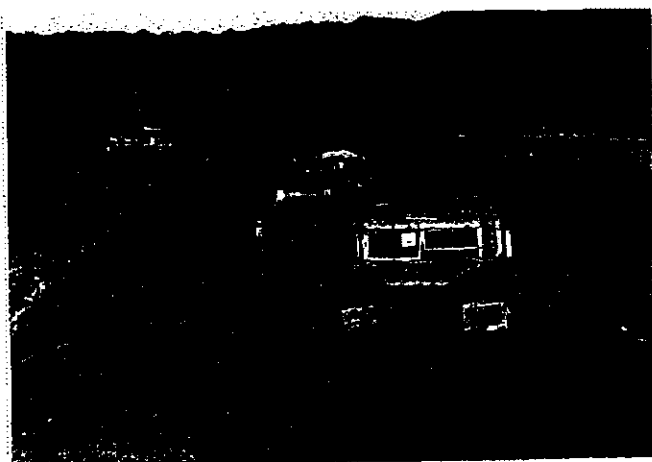
*Odor check by the Team*



*Waste accumulation completed.*



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



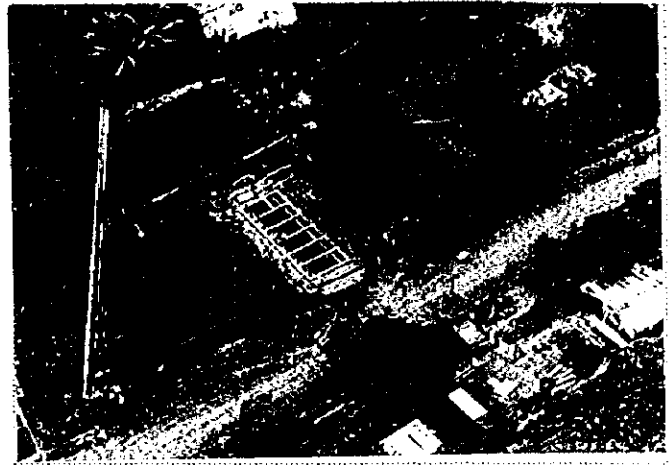
*Final covering in action.*



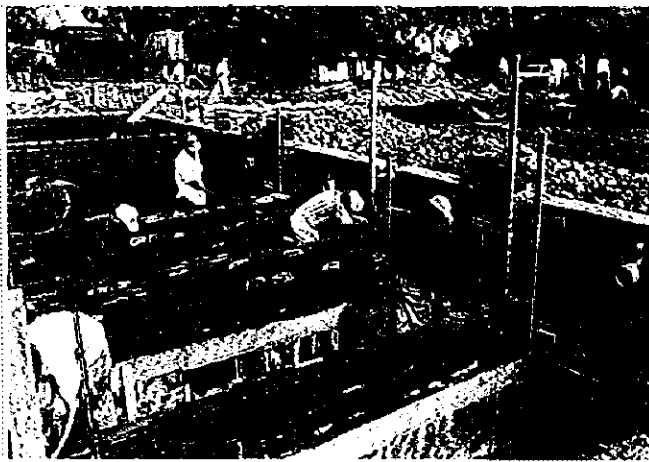
*An inauguration ceremony was held on August 30, 1997 with honored guests including the minister of INAA, the Japanese ambassador to Nicaragua, the mayor and so on.*



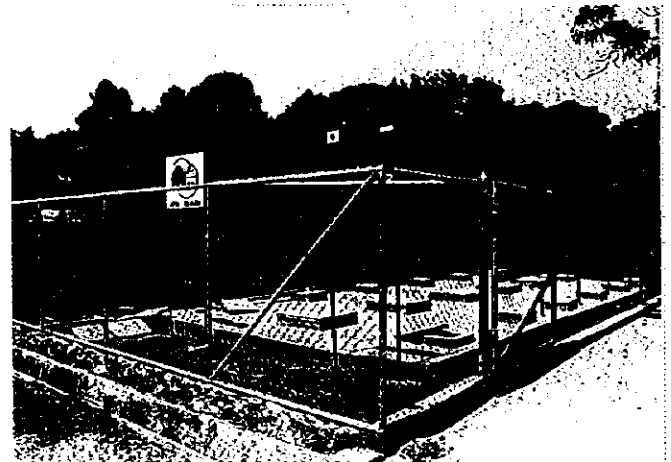
Very early stage of the facility construction in Adelita II.



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').

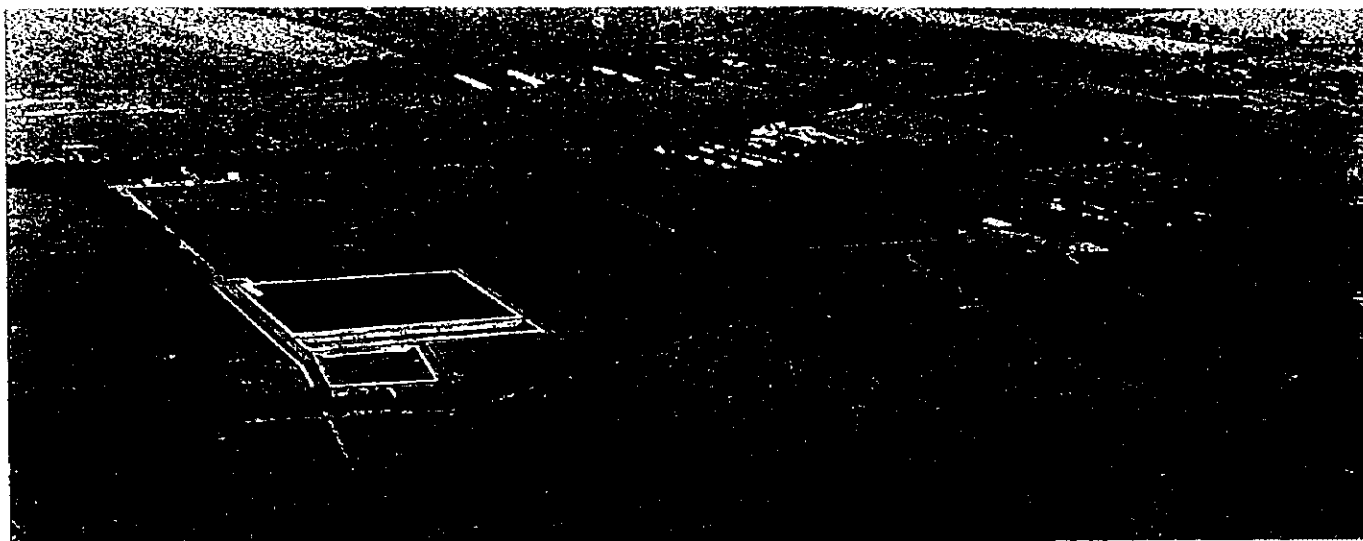


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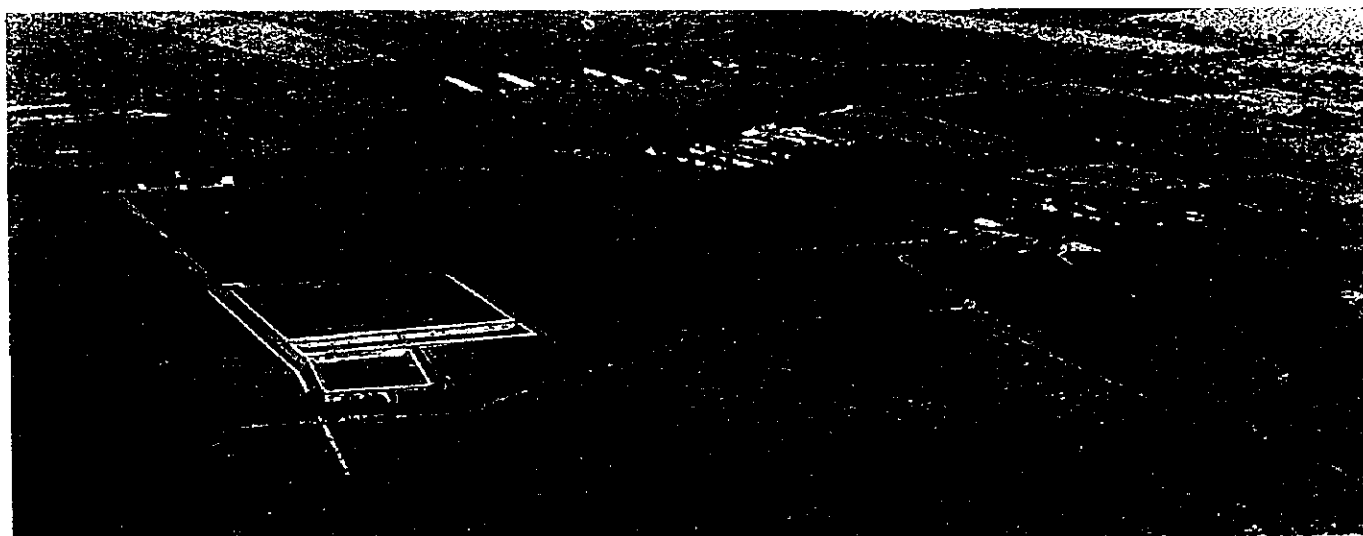
*Plate 10 : Present and Future Landscape of SJV New Disposal Site*



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
EUDOPF	:	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 (Alcaldía de Chinandega)
MGG	:	Municipal Government of Granada (Alcaldía de Granada)
MGL	:	Municipal Government of Leon (Alcaldía de Leon)
MINSA	:	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
NHIW	:	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)

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

### Definitions

Concession Contract	A contract system in which the contractor entrusted with refuse collection and haulage in a given area, and 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 haulage.
Concessionaire	The contractor that works in the concession contract.
Level of Sanitary Landfill	Study Team classified sanitary landfills 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.