J.3.2 Storm Water Control

a. Technical System

a.1 General Conditions

The annual precipitation for the past 28 years average about 1,920mm, although data in this period fluctuated considerably, as mentioned in Chapter 1. The highest rain intensity for the past 20 years was 158.1mm/hr in 1982. The ten year (1/10 year) probable rainfall intensity was 93.9mm/hr, and the five year (1/5 year) probable rainfall intensity was 79.2mm/hr[4]. The rainfall data is attached to Chapter 5 of Data Book in Volume V.

There are no authorities responsible for planning storm water management. The Works and Internal Services Department, however, is in charge of the construction and maintenance of storm water drain, while the Emergency Operation Center is in charge of disaster relief.

The department of Works and Internal Services conducts the construction and maintenance of storm water drains because of its importance to its main responsibility. Although the municipality is supposed to be responsible for storm water drainage control according to Law on Municipalities No. 40-88, it is trying to persuade INAA to take over the said responsibility, since INAA is currently responsible for wastewater drainage control. Because storm water usually mixes with wastewater and vice versa, the municipality believes INAA should be responsible for storm water drainage as well.

a.2 Inundation Damage

a.2.1 Questionnaire Survey on Inundation Damage

A questionnaire survey was conducted on 56 families, two from each of the areas the municipalities thought were most prone to inundation, as mentioned in Annex I in Volume IV, 'Inundation Damage Survey'.

This section shall only elaborate on the results of the survey conducted in Chinandega City.

The total number of inundation prone areas in Chinandega was 10, therefore, the total number of interviewed families was 20. These areas are shown in Annex I in Volume IV.

Results of the Survey

The results of the survey are shown in Annex I in Volume IV.

Of the 20 interviewees, 15 (75%, 15/20) have had inundation damage, and all suffered from it more than twice a year.

Depth of inundation varies from 5cm to 50cm. Eight (8) interviewees (53%, 8/15) answered that inundation continued from 1 to 3 hours, while 5 interviewees (33%, 5/15) answered that it continued for more than 24 hours.

13 interviewees (87%, 13/15) answered that their houses were damaged by inundation, but the number who reported damage to household goods only totaled 5 (33%, 5/15).

On inundation and disease, 10 interviewees (67%, 10/15) answered that they have suffered from diseases, mainly cold, malaria and dengue fever, caused by inundation.

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[4] INITER

Only one interviewee said his business suffered from inundation. Eight (8) interviewees (53%, 8/15) answered a loss of C$ 0 to 500, 5 interviewees (33%, 5/15) stated a loss of C$ 500 to 1,000, and 4 interviewees (27%, 4/15) stated a loss worth C$ 1,000 to 5,000.

a.2.2 Public Opinion Survey on Inundation Damage

The Public Opinion Survey (POS) was carried out at random and did not only cover inundation prone areas. According to the results of the survey, 28% of the interviewees answered that inundation significantly affected their daily life, while 19% have experienced flood damage.

b. Institutional System

The urban drainage system maintenance is considered an INAA attribution, but the municipality eventually cleans the gallery entrance (sedimentation boxes). The very permeable soil minimizes flooding risk. Works and Internal Services Department takes in charge the maintenance and new pavements and drains construction, involving 16 employees.

It is relevant the water flow reduction in the principal river of the city.

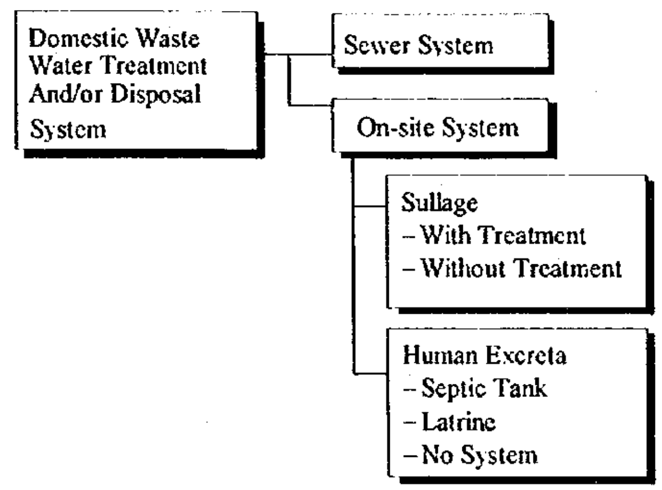
The possibility to draw up a cadastre and locate graphically the pluvial drainage system may be considered through the SISCAT already in usage in the Financial Department.

J.3.3 Domestic Waste Water Management

a. Technical System

a.1 Outline of the Technical System

The present DWW treatment and/or disposal system consists of a sewer system and an on-site system. However, some areas are not covered by any system at all. The on-site system is generally made up of a septic tank and latrine.



Source: INAA-Region II

Figure J-10: Outline of Technical System

a.2 Sewer System

a.2.1 Service Coverage

The sewer system currently covers 43.9% of Chinandega City, and 45.3% of the households covered by the potable water supply services of INAA are connected to the sewer system.

Table J-52: Service Coverage

	Household			Population (persons)		
	Number	Ratio (%)		Number	Ration (%)	
Total Number	16,935		100	97,387		100
Water Supplied	12,533	74.0	100	72,077	74.0	100
Sewer Connection	5,695	33.6	45.4	32,752	33.6	45.4

Source: INAA

a.2.2 Sewage Drainage Basin

The current system has two principal drainage basins, and the first one covers the Chinandega downtown area on the left bank of the Acome River, where the existing sewers are located. The second one covers the entire northern side of the Acome River that comprises several sub-basins connected to the right bank of the Acome River.

Reparto El Naranjo, which is located in one of the sub-basins, discharges wastewater into the central system through the pumping station named "El Naranjo". This system presently covers approximately 1200 citizens, serving only 200 lots in the reparto.

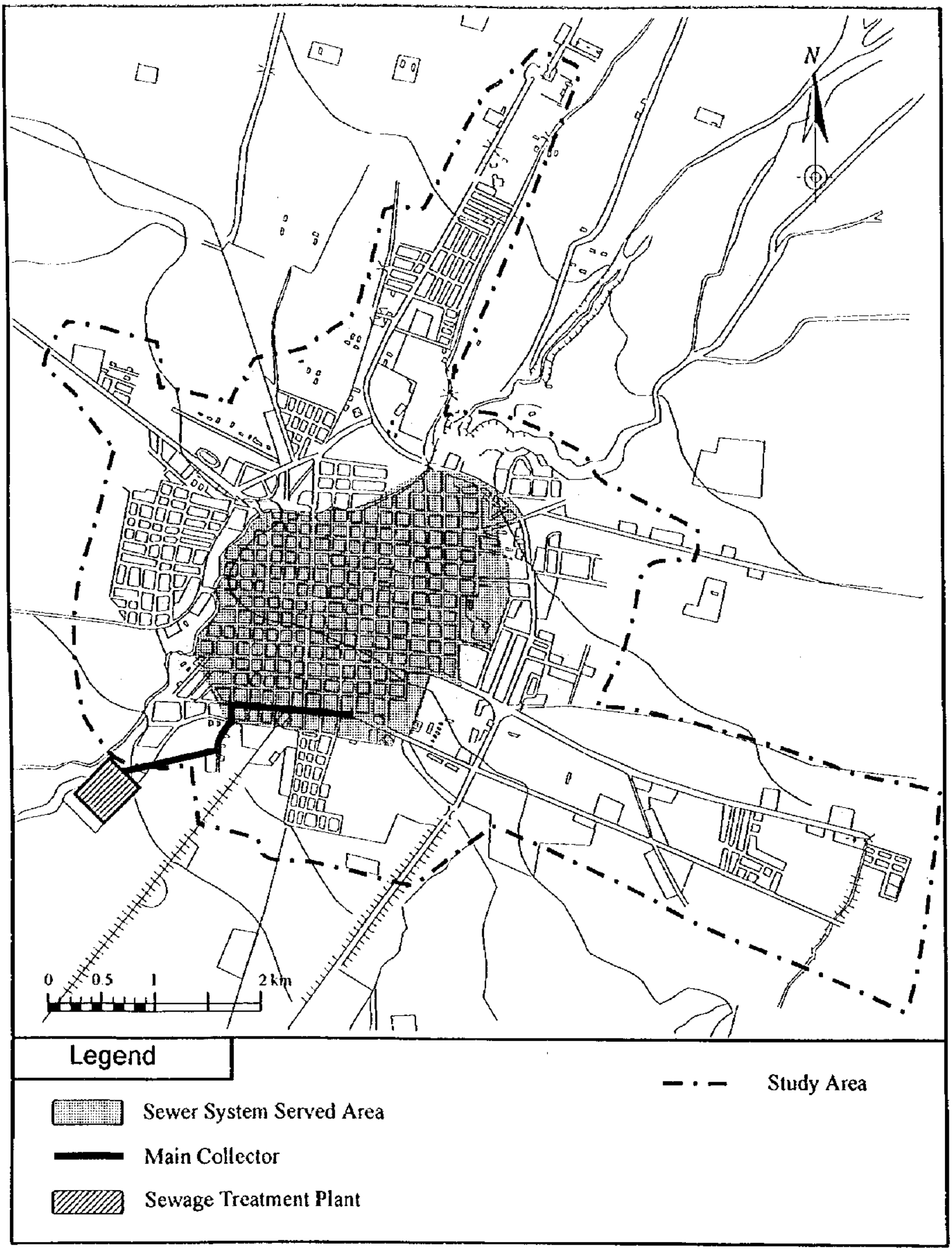


Figure J-11: Sewage Drainage Basin

Table J-53: General Data on Sewage Drainage Basin

Item		Total
Population (persons)		
	Total Basin Population	97,387
	Connected to sewers	32,752
Number of Households		
	Total No. of Households in the Basin	12,533
	Connected to sewers	5,695
Approximate Basin Area (ha)		257
Waste Water Amount (m^3/day)		6,600

Source: INAA Comments for PR (1)

a.2.3 Sewage Collection Systems

The sewage collection system in Chinandega comprises a 45,500 m sewer network and a pump station.

i. Sewer Network

The sewage system in Chinandega covers approximately 50% of the total urban area. The northern part of the city lacks a sewer system.

The current system covers the central part of the urban area of the city, which is bordered to the north and west by the Acome River, to the south by the cemetery, and to the east by the Guasaule highway.

Sewage from the central zone of the city is drained by pipes of various lengths (150 to 250 mm) to the south where it is then transported to the treatment site by main pipelines with a diameter from 600 to 750 mm. These main sewers are installed in the southern part of the cemetery, and discharge sewage into a facultative stabilization lagoon.

The total length of the sewer system is 45,500 m, although it is only equal to 116,000m of street length in the central zone. Sewers cover 39.2% of the total street length.

Table J-54: Length of Sewer Network in Chinandega

Diameter (mm)	Total Length (m)
150	1,200
200	22.300
250	18.500
600	2,700
750	800
Total	45,500

Source: INAA - Region II (July 1996)

It is reported that there is a high number of illegal storm water drain connections to the sewer system. These storm water drainage originate from households or streets and reduce the hydraulic capacity of the sewer network.

ii. Pumping Station

The report on specific studies on stabilization lagoons conducted by BID/INAA in October 1993 presents data and information on the "El Naranjo" pumping station. According to the report, the system has only one wastewater pumping station, which is located in Reparto El Naranjo along the El Viejo/Chinandega highway.

The pumping station has been recently rehabilitated and installed with electric-equipment. The specifications of this pumping station are shown in Table J-55.

Table J-55: Specifications of "El Naranjo" Pumping Station

General Information	
Location	El Naranjo
Construction Year	1975
Catchment area (ha)	3.0
Technical Specifications	
Suction Pit Main Structure Size Useful Volume	 Reinforced Concrete 2.0 m^{ϕ} x 6.6 m^{H} 9.1 m^3
Pumping Equipment Number of Pumps Type Capacity Prime Mover	 1 Submersible 12.7 l/sec. Electric Motor 5 ^{HP} x 1,750 ^{rpm}
Daily Working Hour	4 hr/day

a.2.4 Sewage Treatment

i. Treatment Plant

Two facultative stabilization lagoons are used to treat wastewater discharged in the Chinandega sewer system. These lagoons are located in the southwestern part of the city, and their outflows are directed toward the Acome River.

The principal characteristics of those two lagoons, according to the data supplied by the Region II Subsidiary, are as follows.

Table J-56: Lagoon Characteristics

	Old Lagoon	New Lagoon
Type of Lagoon	Facultative	
Length x Width x Depth (m)	205.6^{L} x 99.0^{W}x 2.0^{H}	199.3^{L} x 92.7^{W}x 2.0^{H}
Average Shallow Area (m^2)	21,589	19,348
Average Water Volume (m^3)	43,118	38,696
Design Treatment Capacity (m^3/day)	4,579	
Design Intake Water Quality (mg/l)	BOD: 300, E coli: 5 x 10^7 NMP/100ml	
Design Treated Water Quality (mg/l)	BOD: 40, E coli: 2.6 x 10^6 NMP/100ml	

The total volume of the treatment plant is approximately 81,814 m^3.

INAA analyzed residual water in the plant on May 14, 1996, and the results are shown in the following table.

Table J-57: Data on Chinandega Lagoon

Parameters	Unit	Intake	Outlet		River Water		Discharge Limit	For Irrigation
			Lagoon I	Lagoon II		Lower		
No. of the report	-	057/96	058/96	059/96		061/96		
Sampling Date	-	514/96	5/14/96	5/14/96		5/14/96		
Average Flow	l/s	93.13	34.63	6.27		-		
Ambient Temperature	°C	30.63	30.63	30.63		30.63		
Water Temperature	°C	30.00	30.25	30.25		34.00		
pH	-	7.08	7.75	7.75	6 -9	8.00	6 - 9	6.5 - 8.5
Dissolved Oxygen	mg/l	0.00	6.09	5.85		6.10		
Settleable Solids	mg/l	12.00	0.10	0.10	1.0	2.00	1.0	
Total Solids	mg/l	958	790	746		544		120
BOD	mg/l	480	120	80	90	80	90	120
COD	mg/l	840	440	432	180	184	180	200
Alkalinity	mg/l	349	349	308	246	267		
Nitrites	mg/l	0.10	0.20	0.20	1.30	1.20		
Nitrates	mg/l	7.4	22.00	22.00	16.00	16.00		
Phosphates	mg/l	64.00	57.00	59.00	5.20	15.40		
Fixed Solids	mg/l	402	362	286	276	344		
Volatile Solids	mg/l	556	428	460	134	200		
Dissolved Solids	mg/l	684	562	530	290	390		
Suspended Solids	mg/l	274	228	216	120	154	80	
Fecal Coliforms	NMP/100ml	$2.7x10^8$	$2.2x10^7$	$1.1x10^7$	$1.1x10^6$	$1.7x10^6$	$1x10^4$	1,000

Upper * : Upstream of treatment plant outlet,
Lower* : Downstream of treatment plant outlet
Source : INAA - Management of Technical Standardization (July 1996)
Note : The parameters of flow, temperature, pH and dissolved oxygen, correspond to the averages of the eight samples in the field.

The COD and suspended solid concentrations in the discharge of the lagoon do not comply with the stipulated limits for each of the items, mainly due to the significant amount of algae in the effluent. The concentration of the BOD, COD, phosphorous, volatile solids, dissolved solids, and suspended solids was observed to be higher downstream than upstream. The water quality of the river was also observed to contain high levels of fecal coliforms prior to the discharge of effluents from the lagoon.

ii. Water and BOD Balance

The water and BOD balance in May 1996 were projected based on available data and assumptions for relative indicators listed in Table J-58.

Table J-58: Available Data and Assumptions for Water Balance and BOD Balance Estimation

Item	unit	Amount	Remarks
Population			
a. Water Supply	persons	72,077	
b. Sewer Connect	persons	32,753	
Water Production			
c. Annual Production	m^3/year	5,083,403	1995
d. Daily Production	m^3/day	13,927	c./365
e. Water Production Ratio	l /p/d	193.2	d./a.
Water Consumption			
f. Annual Consumption	m^3/year	3,657,990	f.1995
g. Daily Consumption	m^3/day	10,022	f./365
h. Water Consumption Ratio	l /p/d	139.0	g./a.
Sewage Treatment			
i. Annual Intake	m^3/year	2,405,703	1995
j. Daily Intake	m^3/day	6,591	i./365
k. Sewage Generation Ratio	l /p/d	201.1	j./b
l. BOD Generation Ratio	g/p/d	58.2	Results of WPLS
m. Discharge Ratio	%	100	to supplied water
n. Intake BOD Concentration	mg/l	480	measured May/14/96

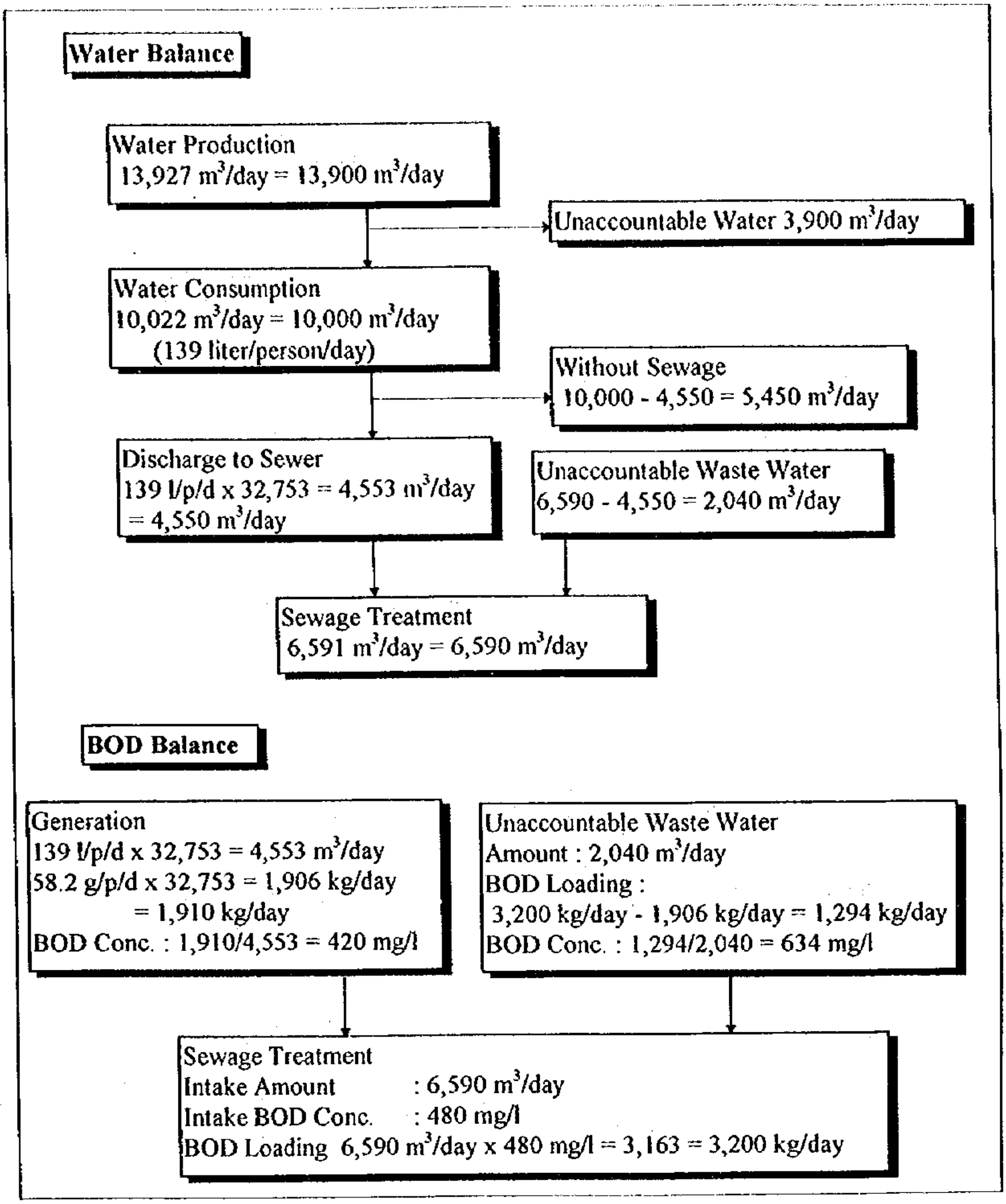


Figure J-12: Water and BOD Balance in Chinandega Sewage System

The water and BOD balance estimates imply:

- Approximately 2,000 m^3/day of accountable wastewater filters into the sewerage system even under the assumption that 100% of potable water consumed reaches the lagoon.

- Where BOD generation per person is assumed at 58.2 g/person/day (results of WPLS), BOD concentration in unaccountable wastewater totals approximately 634 mg/l.

Assuming that this unknown wastewater volume originates from household drains unidentified by INAA, the population discharging unknown quantities of wastewater into the sewer will amount to 19,931, as calculated below.

- 1,160 kg/day ÷ 58.2 g/person/day = 19,931 persons

  The assumed total population was determined based on the total BOD load of the unaccountable wastewater volume (1,160 kg/day) and the BOD generation per person of 58.2 g/person/day (results of WPLS).

Accordingly, the urban population connected to the sewer system totals 52,700, equivalent to about 73% of the population covered by the water supply services. The wastewater generation ratio of this population is estimated at 107 liters/person/day, as calculated below.

- 6,590 m^3/day ÷ 52,700 persons = 125 liters/person/day

However, in view of the present situation of the sewer network, it is difficult to assume a 70% sewerage coverage in the Chinandega urban area. Further, the BOD calculation indicates that the BOD concentration of unaccountable wastewater volume is too high for DWW. Therefore, if the results of the laboratory analysis of BOD are reliable, the source of the unknown wastewater might not be households but could possibly be industrial wastewater.

iii. Treatment Capacity

The outflow of the existing lagoons in the southern part of the city are directed towards the Acome River.

The principal characteristics of the lagoons are as shown in the following table:

Table J-59: Lagoon Characteristics

	Old Lagoon	New Lagoon
Type of Lagoon	Facultative	
Dimensions (m)	$205.6^L \times 99.0^W \times 2.0^H$	$199.3^L \times 92.7^W \times 2.0^H$
Average Shallow Area (m^2)	21,589	19,348
Average Water Volume (m^3)	43,118	38,696

The evaluation of the current conditions of the lagoons was fundamentally directed to:

i. qualitative observation of the data obtained from latest water analysis;

ii. calculation of a maximum possible flow to be treated in the present lagoons.

The figures and indicators resulting from the latest analysis executed by INAA on May 14, 1996 are assessed to be reliable. The ratio of BOD, COD, and fecal coliforms removed during treatment in the lagoons were analyzed and shown in the following table.

Table J-60: Efficiency of Stabilization Lagoons

	Removal Rate (%)	
	Lagoon I	Lagoon II
BOD	75.0	83.3
COD	47.6	48.6
Fecal Coliforms	91.9	95.9

Source: INAA - Region II (June 1996)

The retention time in Lagoon I is 14.4 days, and in Lagoon II, 71.4 days.

It can be deduced that other wastewater (storm water or industrial wastewaters) have also been discharged into the lagoons in addition to DWW, because even with a short retention time, an 80 to 90% reduction in BOD concentration was observed. The INAA Pre-feasibility Study also confirms a sharp increase (sixfold) in flow into the lagoon when it rains in the city.

This condition implies the need to eliminate storm water interconnections.

The maximum potential flow to be treated in these lagoons is calculated based on the values of parameters used to determine the quality of wastewater that actually flows into the lagoons and the established standard discharge limits (the calculation is shown below).

Meanwhile the calculations for the two facultative lagoons in Chinandega should be verified, only taking organic load into account since the reduction of pathogens is not the primary aim of this treatment process.

INAA standard BOD discharge: 90 mg/l

Calculation of the maximum flow of Lagoons I and II in terms of BOD (90 mg/l) discharge is as follows:

i. Lagoon I

BOD inflow: Li = 480 mg/l
Treated BOD: Le = 90 mg/l
$Q = (A \times 18 \times p(1.05)^{T-20}) / (Li-Le)$ ---------- (Marais)
Where:

A = 21,589 m^2
p = 2.0 m
T = 25°C
Li = 480 mg/l
Le = 90 mg/l
Q = 2,543 m^3/day or 29.4 liters/sec

ii. " Lagoon II"

BOD inflow: Li = 480 mg/l
Treated BOD: Le = 90 mg/l
$Q = (A \times 18 \times p(1.05)^{T-20}) / (Li-Le)$ ---------- (Marais)

Where:

A = 19,348 m^2
p = 2.0 m
T = 25°C
Li = 480 mg/l
Le = 90 mg/l
Q = 2,279 m^3/day or 26.4 liters/sec

The flow into Lagoon I amounts to 34.63 liters/sec, which is 30% more than the maximum flow of discharge that would produce BOD concentrations below the set norm. The BOD concentration in lagoon I is about 120 mg/l and the discharge flow during sampling time was 34.63 liters/sec, which also justifies the calculation.

On the other hand, the flow into Lagoon II amounts to 6.27 liters/sec and is quite smaller than the maximum flow that could produce the established organic load levels.

The BOD concentration in lagoon II is about 80 mg/l and the discharge flow during sampling time was 6.27 liters/sec, which also justifies the calculation.

Consequently, the maximum flow that could produce the established level of organic load is 29.4 liters/sec for Lagoon I and 26.4 liters/sec for Lagoon II, a total of 55.8 liters/sec. A flow smaller than this value is discharged into the treatment plant.

It should be noted that the above analysis only covered organic load due to reasons previously mentioned.

a.2.5 Discharge Point

Effluents in the stabilization lagoons are currently discharged into the Acome River which is also observed to be extremely polluted with effluents from industries and slaughterhouse, as well as DWW.

The Acome River originates about 2 km from the north of the city. It has very little flow which further decreases in the dry season, disqualifying it as a potential recipient of wastewater.

The Acome River and the creeks in the city are the first connection points of wastewater, and domestic and industrial solid waste. The seriousness of this problem intensifies because the drains of households along the river courses directly discharge DWW into the river.

a.3 Other Domestic Waste Water Treatment System

Of the urban households not covered by the sewer system, 4.0% use septic tanks and 46.6% use pit latrines. Latrines usually have an average life of three to five years after which a new one is built nearby. The rest of the households not connected dig holes in the ground.

In the zones without a sewer system, shallow street drains are used for domestic effluent discharge.

Table J-61: Sanitation System in the Urban Area

Sanitation System	Household Ratio
Sewer System	38.8%
Septic Tank	4.0%
Latrine	46.6%
None	10.6%
Total	100%

Source: INAA Region II (Aug/1996)

b. Institutional System

The INAA is in charge of wastewater, and manages the sewerage system and a biological facultative lagoon treatment plant.

J.3.4 Industrial Waste Management

a. Technical System

a.1 Generation Sources

Table J-65 shows a list of major factories and main products. Major factories consist of 2 industrial categories (see Table J-66): CIIU3512 is most likely to generate hazardous waste.

Table J-62: List of Major factories in Chinandega

CIIU	Name of Companies	No. of Employees	Main Products
3111	AVICOLA GUADALUPE (POULTRY FARM)	20	Chicken
3111	MATADERO MUNICIPAL	14	Beef and pork slaughter
3111	PORCINA SAN BENITO (PIG FARM)	52	Pork meat
3114	EMPACADORA ECUANICA (SHRIMP FACTORY)	202	Shrimp processing company
3115	AMOLONCA	Closed	Decortication of sesame
3115	GRACAS Y ACEITES S.A.	111	Oil factory
3115	INVERCIONES (Santa Fe)	28	Sesame
3116	INDUSTRIAS LA VIRGEN ALPHA	11	Peanuts processing
3116	INSDUSTRIA GENIMA S.A. (FLOUR COMPANY)	80	Flour and bran
3116	MANICERA, S.A.	348	Peanuts production
3116	SEMILLA Y PROCESOS S.A. (SEMPRO)	320	Peanuts
3122	ALIMENTOS MEJORADOS S.A. (ALMESA)	60	Animal food
3131	FABRICA DE LICORES Bell	Closed	Rum and alcohol production
3512	INSECTICIDA SAN CRISTOBAL (INSECTICIDE COMPANY)	20	Pesticides and fertilizers
	Total Number of Employees	1,266	

Table J-63: Number of Factories and Employees

Category	CIIU	Number of Factories		Number of Employees	
		Number	Ratio	Number	Ratio
Food	3111	3	25.0%	86	6.8%
	3114	1	8.3%	202	16.0%
	3115	2	16.7%	139	11.0%
	3116	4	33.3%	759	60.0%
	3122	1	8.3%	60	4.7%
Chemicals	3512	1	8.3%	20	1.6%
Total		12	100%	1,266	100%

a.2 Generation Amount

Table J-64 shows the estimated waste generation amount based on the industrial waste survey.

Table J-64: Waste Generation Amount in Chinandega (1996)

Waste Water (ton/year)	Solid Waste (ton/year)	Total (ton/year)
5,526	6,370	11,896

a.2.1 Waste Water

Figure J-13 shows the estimated wastewater generation amount of respective industrial categories based on the factories survey. CIIU3114 (Fish and other marine foods) and CIIU3115 (Animal and vegetable oil) are the largest wastewater generation sources in Chinandaga. Waste water from CIIU3231 and CIIU 3115 may contain high concentrations of organic materials, and wastewater from CIIU3512 (Fertilizer, Pesticides, etc.) may also contain hazardous materials.

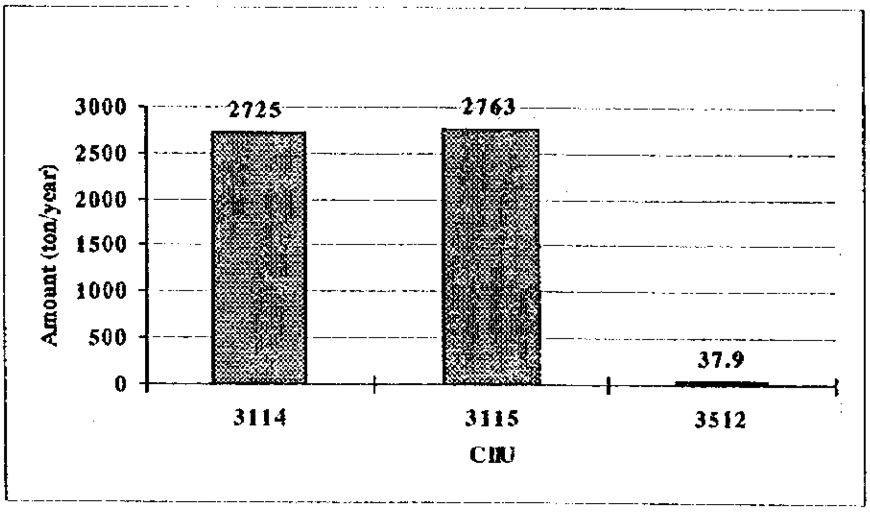


Figure J-13: Waste Water Generation Amount

a.2.2 Solid Waste

Figure J-14 shows estimated solid waste generation amount of respective industrial categories based on the factories survey. CIIU3116 (processing of dry seeds) is the largest solid waste generation source in Chinandaga, and solid waste from these industries may contain non-hazardous organic material.

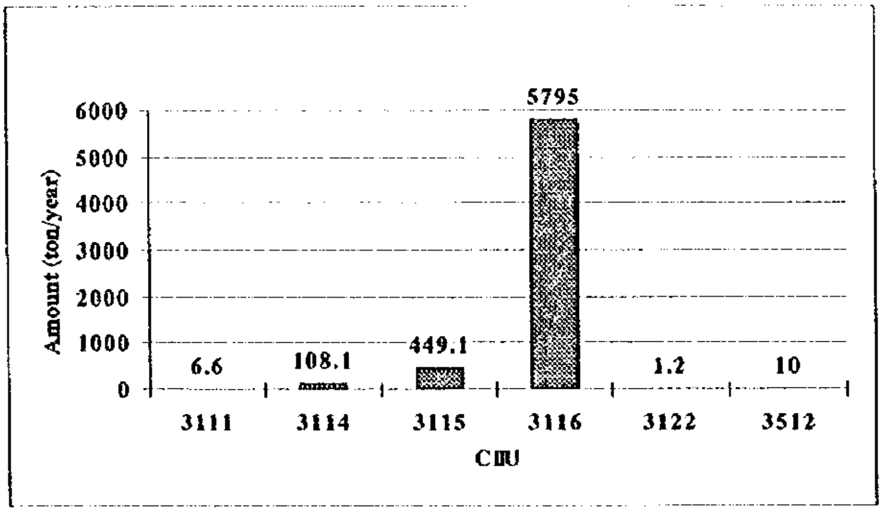


Figure J-14: Solid Waste Generation Amount

a.3 Treatment and Disposal

a.3.1 Waste Water

The outcome of industrial waste survey indicated that 50% of IWW generated is treated, and the main treatment methods is "dehydration". However, "dehydration" implies that industrial wastewater is partially evaporated by a lagoon system. Waste water (50% of generation amount) is directly discharged into the environment (e.g., rivers, etc.) without treatment.

a.3.2 Solid Waste

Eighty two percent of SW generated is treated, and treatment methods consist of bio-degradation and burning (open burning).

Solid waste disposal methods are landfill (69% of generation amount) and recycling (0.3% of generation amount), and major disposal sites are without municipal landfill site (73% of disposal amount).

b. Institutional System

b.1 Institutional Waste Water

The local industries do not have treatment plants, and the effluents are discharged into the soil, water bodies, or sewerage systems.

The competent organisms to regulate and control wastewater are MARENA, INAA, MINSA, and the municipality at a subsidiary level.

b.2 Industrial Solid Waste

Industries do not pay taxes for SWM; they usually deliver the refuse to the municipal dumping site or burn it on-site.

Control of ISW is performed by the mnicipality and MINSA/SILAIS inspections.

Law No. 217-96 confirms the municipal competence on non-hazardous waste and fixes directives for HWM that should be enforced by MINSA and MARENA. MARENA should also regulate sludge handling and disposal, according to Decree No. 33-95.

Local critical activities are: the airports used for spraying of pesticides, farmer products mixers, foundries and electronic workshops, and gas stations.

J.3.5 Municipal SWM

In the Public Opinion Survey, a few (28%, 22/80) interviewees were affected by solid waste problems. The present situation regarding Municipal Solid Waste Management is described below.

a. Technical System

The Municipal Solid Waste Management in Chinandega City is executed by thebMunicipal Services and Administration Department of Chinandega Municipality.

a.1 Discharge and Storage

The study team observed that there is no source separation of waste. The wastes in reusable plastic bags or drums from houses are discharged at curbsides. And some detachable containers, 7.5m^3, are placed at markets and other spots.

Many people use reusable plastic bags: 46% of dischargers used them according to the report of Study About the "System of Garbage Collection and Treatment in 41 Municipalities of Nicaragua".

a.2 Collection and Transportation

i. Equipment

The Municipal Services and Administration Department has collection vehicles described in Table J-65 for waste collection and transportation. The equipment are parked at the 'Municipal Workshop'.

All the tractors are old and their performances have deteriorated. To make matters worse, the combination of a tractor and a trailer is inappropriate for the waste collection work.

Table J-65: Collection Equipment

Item	No.	Years	Made in	Remarks
Tractor and Trailer	6	16	Russia	
Container Truck	1	3	Japan	donated by Holland
Container	6	3	Germany	

ii. Frequency

Collection frequency for each kind of waste is shown in Table J-66. Thirty seven personnel are assigned for the work, the working day is 10.5 hours, from 6:00 to 12:00 and 13:30 to 18:00.

Table J-66: Collection Frequency

Waste Category	Frequency
a. Residential areas	a. 2 times a week
b. Commercial areas	b. 2 times a week
c. Market areas	c. 2 times a day
d. Medical facilities	d. everyday
e. Institutions	e. 2 times a week
f. Industries	f. own means
g. Road sweeping	g. 2 times a week

iii. Coverage Rate

The collection service coverage rate is: 81.6% in relation to the waste amount and 51.0% to the population.

a.3 Street Sweeping

The total length of streets cleaned by the Municipal Service Department is 44.6 km out of a total of 90.8 km.

The streets in the city are fairly clean. Besides the official cleaners of the MSD, inhabitants were often seen sweeping the streets in front of their houses.

Table J-67: Total Length of Roads in the Study Area

Type	Length
Asphalt	23.4 km
Block paved	13.7 km
Concrete	0.3 km
Soil	53.4 km
Total	90.8 km

a.4 Intermediate Treatment and Recycling

There are no intermediate treatment facilities, and organized recycling was not observed in the study area. Only glass bottles, cardboard, iron, aluminum and cotton were collected by individuals for reuse.

The recycling amount is 8.5 ton/day at generation sources and 0.4 ton/day at the disposal site. Total recycling amount is 8.9 ton/day in Chinandega.

a.5 Final Disposal

The municipality has one landfill located 4 km southwest of the city center. The landfill has been used for more than 25 years.[5]

This landfill site is operated by one bulldozer used for 15 years. There are no facilities such as a weighbridge, or an administration hut in the landfill.

[5] Municipal officer, Chinandega

There are about 50 scavengers from the neighborhood at the landfill.

The landfill is located on the left bank of the Acome River. The disposal method at the landfill is open dumping into the Acome River. The wastes thrown have been polluting the river, and contaminate not only the surface water of the river, but also the groundwater and the environment along the river.

The waste disposal amount is 40.5 ton/day in the rainy season.

a.6 Maintenance of Vehicles and Equipment

The maintenance shop for repairing the waste disposal equipment owned by the municipality is the 'Municipal Workshop' located in the northwestern part of the city. There are 7 employees at the workshop.

This workshop has very little maintenance equipment. The maintenance work is executed considerably well for its limited budget.

The workshop shop deals with not only the waste disposal equipment, but also other trucks and construction equipment belonging to the municipality.

a.7 Illegal Dumping

Wastes dumped illegally are observed at many places in the city, especially along rivers and ditches. They cause rivers and ditches to overflow during heavy rains, and are considered to be focal points of epidemic diseases.

The illegal dumping amount is estimated to be 8.9 ton/day in the rainy season.

b. Institutional System

The services are performed by street sweeping, Collection and Disposal sector, under MSD, involving 83 workers and 4 supervisors: two for street sweeping and two for collection inspection.

The collection routes are pre-fixed in a plan.

The dumping site is located between the cemetery and a small river. It is covered daily with earth and is managed by the bulldozer operator and an auxiliary.

MINSA/SILAIS cooperates with the municipality and provides legal support to sanctions, when necessary.

The tax concerning SWM is monthly collected. About 45% of the beneficiaries of the services do not pay the tax, claiming financial difficulties and unemployment.

J.3.6 Medical SWM

a. Technical System

a.1 Segregation of Infectious/Hazardous Medical Wastes

Infectious/hazardous medical wastes are not segregated well: 1 medical institution (14%) segregates infectious/hazardous wastes in case they are produced with such type wastes. Three institutions (43%) segregate partially, such as hypodermic needles etc. Two institutions (29%) do not segregate the medical wastes, and the remaining (14%) institution does not produce infectious/hazardous medical wastes.

The municipality recently started an experimental incineration project of hypodermic needles in a pit in the corner of the municipality disposal site, working together with a JICA volunteer. The needles are collected from two major medical institutions.

The municipality has a future plan to increase the types of wastes and the number of medical institutions.

a.2 Treatment of Infectious/Hazardous Medical Wastes

The treatment method is incineration or no treatment. Incineration is divided into two types. One is a modern incinerator which is installed in Hospital Espana, which is the only one in three cities, and the other is a primitive on-site open air incineration pit .

The municipality started a project to incinerate hypodermic needles collected from 2 medical institutions in a pit at the corner of the municipal disposal site. The municipality has a plan to expand the types of wastes to incinerate, and the number of medical institutions.

a.3 Collection and Haulage

Domestic waste is collected by the public collection service from 6 medical institutions (86%). However, 1 medical institution (C/S) (14%) does not receive any service. Infectious / hazardous medical wastes are collected from 2 institutions (29%) through public collection service.

Two institutions (29%) are satisfied with the current public collection service. However, the other 5 institutions (71%) are not.

a.4 Disposal

The wastes are disposed of at the municipal final disposal site or at the place where the waste is incinerated at the open air site in the premise of the institution.

a.5 Training and Education

Five (71%) medical institutions have written instructions. As regards to the frequency of training, only 1 institution (14%) holds training once a month, 5 institutions (71%) at the beginning of employment and 1 institution (14%) never.

b. Institutional System

The municipal service collects and disposes of MSW together with domestic and commercial refuse. There are no internal segregation or special services.

J.4 Present USE in Granada

J.4.1 Water Supply

a. Technical System

a.1 Service Coverage

The report on "Performance Indicators" in May 1996 indicates that the water supply service population in the urban area of Granada is estimated at 88.7%, that is 64,411 persons out of the 71,783 total urban population (see Table J-68).

However, the Environmental Action Plan of Granada (June 1996) indicates that of the total number of urban households, 86.4% are connected to the drinking water supply network, 4.9% obtain water from neighbors, 3% from other barrios, 1.3% from private wells, 1.1% haul water, and 3% collect stormwater, lake water, etc.

Table J-68: Service Coverage

	Households	Population (persons)	Area (km^2)
Total Number	12,651	71,783	13.5
Water Supplied	11,352	64,411	8.43
Service Coverage	89.7	89.7	62.4

Source: INAA Performance Indicators (May 1996)

a.2 Indicators

a.2.1 Water Unaccounted for (1991 to 1995)

The ratio of UFW (Water Unaccounted for) in 1995 was about 43% of the amount of water produced. The data for the last five years, however, show a decrease in the UFW ratio obtained in Granada. An increase in metered water supply connections has also been observed.

Table J-69: Potable Water Production and Consumption

Year	Production (m^3/year)	Consumption (m^3/year)	UFW (m^3/year)	UFW ratio (%)	Household Connections		
					with meter	without meter	Total
1991	7,187,739	3,509,535	3,678,204	51	5,526	4,021(42%)	9,546.58
1992	7,651,660	3,679,684	3,971,976	52	5,482	4,694 (46%)	10,175.54
1993	7,037,128	3,729,128	3,308,000	47	6,485	4,444 (41%)	10,928.59
1994	7,035,549	3,433,830	3,601,719	51	9,214	1,895 (17%)	11,108.83
1995	6,107,590	3,454,251	2,653,339	43	9,026	2,478 (22%)	11,503.78
1996	-	-	-	-	8,855	2,886 (25%)	11,740.75

Source: INAA - Planning Management (July 1996)

a.2.2 Type of Connection

The number of connections in the urban area of Granada currently totals 11,352 (July 1996), 95% of which are for household use.

Table J-70: Current Type of Connection (July 1996)

Type of Connection	Quantity	Ratio (%)
Household	11,085	97.6
Industrial	19	0.2
Commercial	182	1.6
Government	66	0.6
Total	11,352	100.0

Source: INAA - Region IV (July 1996)

a.2.3 Water Production and Consumption

i. Water Consumption Ratio

Water production and consumption from 1991 to 1995 are tabulated in Table J-71.

Table J-71: Water Production and Consumption Ratio

	Production (m^3/year)	Consumption (m^3/year)	Service Population		Ratio (l/person/day)	
			No. of Households	No. of Persons*	Production	Consumption
1991	7,187,739	3,509,535	9,547	52,509	375.0	183.1
1992	7,651,660	3,679,684	10,176	55,968	374.6	180.1
1993	7,037,128	3,729,128	10,929	60,110	320.7	170.0
1994	7,035,549	3,433,830	11,109	61,100	315.5	154.0
1995	6,107,590	3,454,251	11,352	64,411	259.8	146.3

The current average water consumption is 146 liters/person/day (UFW not included). This is slightly below the guideline value of 160 liters/person/day proposed by INAA in the Pre-feasibility Study for cities with a population exceeding 50,000.

ii. Coefficient for Yearly Fluctuation

Based on the monthly production data of the last six months, it is deemed reasonable to apply a coefficient of 1.25 (i.e., 25% increase in the peak) to cope with annual fluctuation.

iii. Coefficient for Daily Fluctuation

Based on the data obtained from the study on the Granada stabilization lagoon conducted by BID/INAA in January 1994 (Annex 2 of the report), a coefficient equivalent to 1.70 (i.e., 70% increase in the peak) should be applied to cope with daily fluctuations is deemed necessary.

a.3 Organizational Structure of the INAA Branch in Granada

The INAA office in Granada has a total of fifty five (55) employees. Extra personnel are hired when the work load is high.

The current number of water supply connections is 11,352, and nearly 5 employees are assigned per one thousand connections.

a.4 Supply Sources

The present water supply source for Granada is the aquifer found in alluvial and volcanic deposits. These deposits normally present good water quality.

The water supply network of Granada City is fed by two well fields: Quinta Ena along the road toward el Puerto de Asese, and El Escudo along the road toward El Pochotillo.

In the well field of Quinta Ena, there are four deep wells in operation, namely Quinta Ena I, II, III and IV. On the other hand, in the well field of El Escudo, two wells identified as El Escudo I and II are installed. The table below presents the characteristics of these existing wells.

Table J-72: Characteristics of Existing Wells

Description	Capacity (l/sec)	Installation Year	Power (Hp)	Operation Time (hours/day)
Quinta Ena 1	47.3	1976	125	10.3
Quinta Ena 2	38.5	1977	125	11.7
Quinta Ena 3	38.2	1983	125	14.5
Quinta Ena 4	43.4	1990	125	13.1
El Escudo 1	78.2	1990	150	13.8
El Escudo 2	46.8	1993	150	14.5
Total	292.4	-	-	-

Source: INAA - Region IV (July 1996)

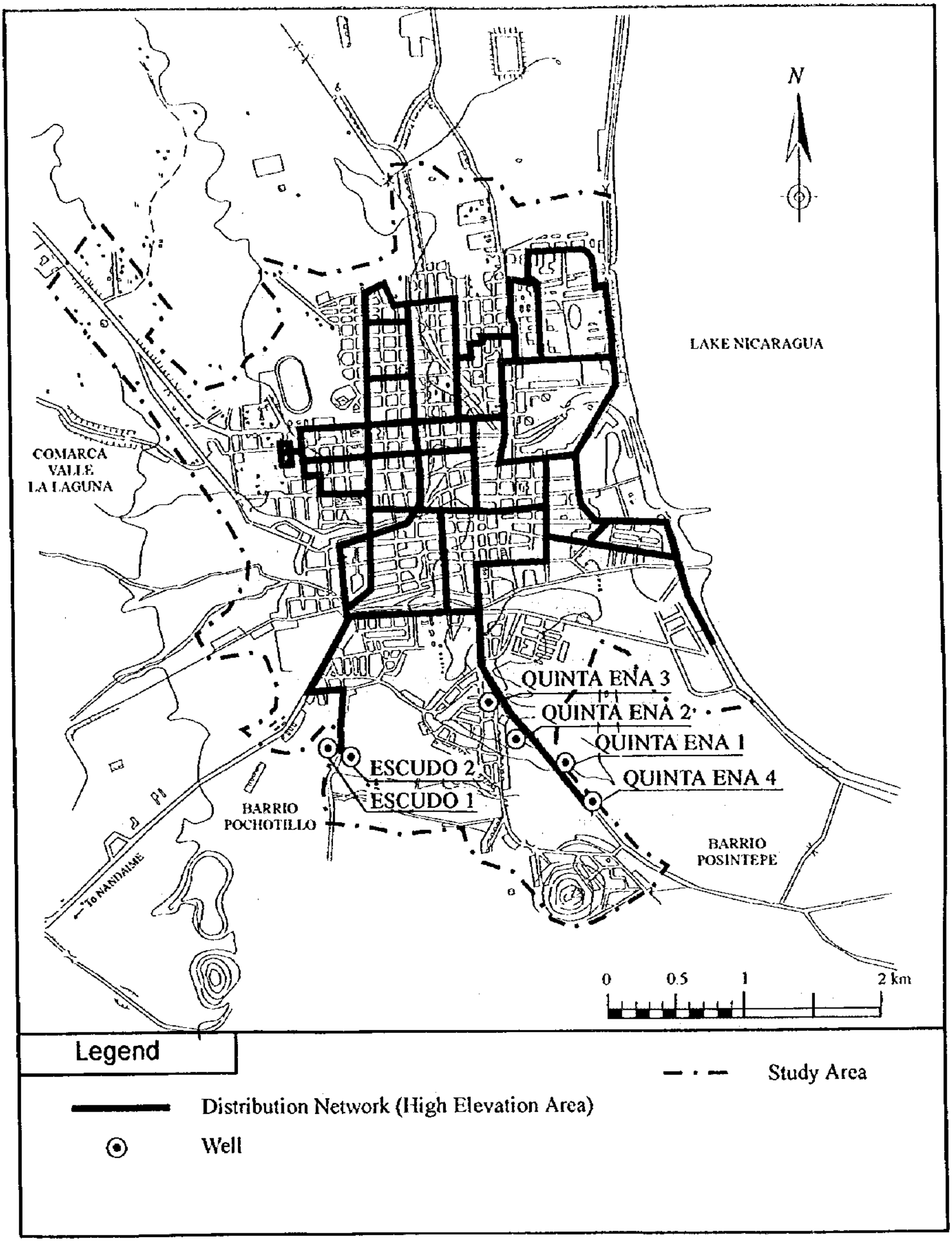


Figure J-15: Location of Existing Wells

The production of each existing deep well varies by operation hour. The following table details the monthly production and pumping hours of each well.

Table J-73: Data on Existing Wells in 1996

Well			1996					
Name	Data	unit	January	February	March	April	May	June
Quinta Ena I	Production	m^3	75,172	47,775	NT	26,028	73,631	38,619
	Pumping	hr.	439	279	NT	152	430	172
Quinta Ena II	Production	m^3	4,926	9,418	29,413	20,285	9,128	39,237
	Pumping	hr.	34	65	203	140	63	271
Quinta Ena III	Production	m^3	110,667	106,240	112,880	103,625	103,222	97,588
	Pumping	hr.	550	528	561	515	513	485
Quinta Ena IV	Production	m^3	23,889	47,321	66,189	66,950	69,993	67,611
	Pumping	hr.	167	311	435	440	460	445
Escudo I	Production	m^3	100,932	103,683	106,884	106,477	112,102	104,873
	Pumping	hr.	427	437	456	454	468	438
Escudo II	Production	m^3	164,290	164,001	165,884	142,541	145,355	148,114
	Pumping	hr.	556	554	552	489	475	482
Total	**Production**	**m^3**	**479,876**	**478,438**	**481,238**	**465,905**	**513,431**	**496,142**
	Pumping	**hr.**	**2,163**	**2,174**	**2,207**	**2,190**	**2,409**	**2,293**

Source: INAA - Region IV (July 1996)

The six wells have an average daily flow of 16,538 m^3/day (65.5% of maximum capacity) during the operation hours in June 1996 as shown in the table above. Meanwhile, a 24 hour well pumping operation would produce a maximum of 25,263 m^3/day (292.4 liters/sec).

A large number of the wells are not equipped with flux measuring gauges, therefore, the water production values indicated in the table above are estimates.

a.5 Water Quality

a.5.1 Well Water Quality

Specific reports on the water quality of the wells in Granada have been made, some of which are:

i. Diagnosis of the Current State of the Drinking Water Supply Wells in Granada City (March 1993)

ii. Environmental Action Plan of Granada (August 1996)

With the exception of Quinta Ena IV well, which contains nitrate levels above the permissible limit, the quality of the water in the well fields analyzed met the established drinking water norms.

The table below shows the values derived from the last analysis made by INAA on November 2, 1995.

Table J-74: Current Well Water Quality

Item	unit	Q.E.I	Q.E.II	Q.E.III	Q.E.IV	Esc. I	Esc. II	INAA's Maximum Limits
Sampling date	-	11/2/95	11/2/95	11/2/95	11/2/95	11/2/95	11/2/95	
Aspect	-	clear	clear	clear	clear	clear	clear	
Temperature	°C	30.5	30.5	31.0	31.0	31.5	31.5	18 - 30
Color	-	1.0	1.0	1.5	2.0	1.0	1.0	15
Turbidity	-	0.2	0.3	0.5	0.1	0.2	0.2	5
Dissolved Solids	mg/l	210	180	160	270	250	190	1,000
Conductivity	s/cm	420	364	335	530	500	380	400
pH	-	7.2	7.4	7.4	7.2	7.4	7.3	6.5 - 8.5
Total Hardness	mg/l	232	200	188	316	200	200	500
Alkalinity	mg/l	128	119	118	143	129	131	-
Calcium	mg/l	70	56	53	83	56	58	250
Magnesium	mg/l	14	15	14	26	15	13.6	50
Total Iron	mg/l	0.00	0.03	0.13	0.03	0.24	0.03	0.3
Sodium	mg/l	-	-	-	-	-	-	200
Bicarbonates	mg/l	156	145	144	175	157	160	-
Carbonates	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	-
Chloride	mg/l	37.0	30.0	18.0	48.0	55.0	25.0	250
Sulfates	mg/l	7.0	4.0	4.0	4.0	12.0	5.0	250
Nitrates	mg/l	14.4	9.2	7.8	56.0	8.3	6.6	50
Nitrites	mg/l	0.00	0.00	0.00	0.00	0.00	0.00	Tr
Fluorine	mg/l	0.00	0.00	0.00	0.00	0.00	0.00	0.7 - 1.5
Saturation Index	-	-0.30	-0.30	-0.30	-0.20	-0.20	-0.30	-

Source: INAA - Region IV

The groundwater sources of the deep wells in Granada are considered slightly alkaline, and the pH values range from 7.2 to 7.4. Therefore, the screens of the wells in this area are subject to scaling.

The chloride, sulfates, carbonates, calcium and magnesium concentrations in the groundwater sources of these wells are found to be far below the maximum permissible limit. The concentration of dissolved solids was found to be between 160 mg/l to 270 mg/l, averaging 205 mg/l in the Quinta Ena wells and 220 mg/l in El Escudo. The nitrate values (excluding Quinta Ena IV well) fluctuate between 6.6 mg/l and 14.4 mg/l.

The Quinta Ena IV well shows a nitrate concentration of 56 mg/l, which is above the maximum limit of 50 mg/l. Attention has been brought to the situation in the last analytical reports on the Granada drinking water quality.

a.5.2 Chlorine Consumption

The amount of chlorine in the water supplied to the city of Granada depends on the residual chlorine level in the distribution network: the residual chlorine should be kept to a minimum of 0.5 mg/l. Residual chlorine distribution is monitored daily in Granada.

Table J-75: Chlorine Consumption in Granada

Months in 1996	Gas Chlorine (kg)
January	1,156
February	612
March	476
April	476
May	408
June	612
July	612
Total	4,352
Monthly Average	544

Source: INAA - Region IV (July 1996)

a.6 Water Transmission

The system has transmission pipelines connecting the wells to the storage tanks, all of which are connected to the distribution network. A new transmission pipeline of 600 mm in diameter and 2,342m in length, which is also connected to the distribution network, was recently constructed.

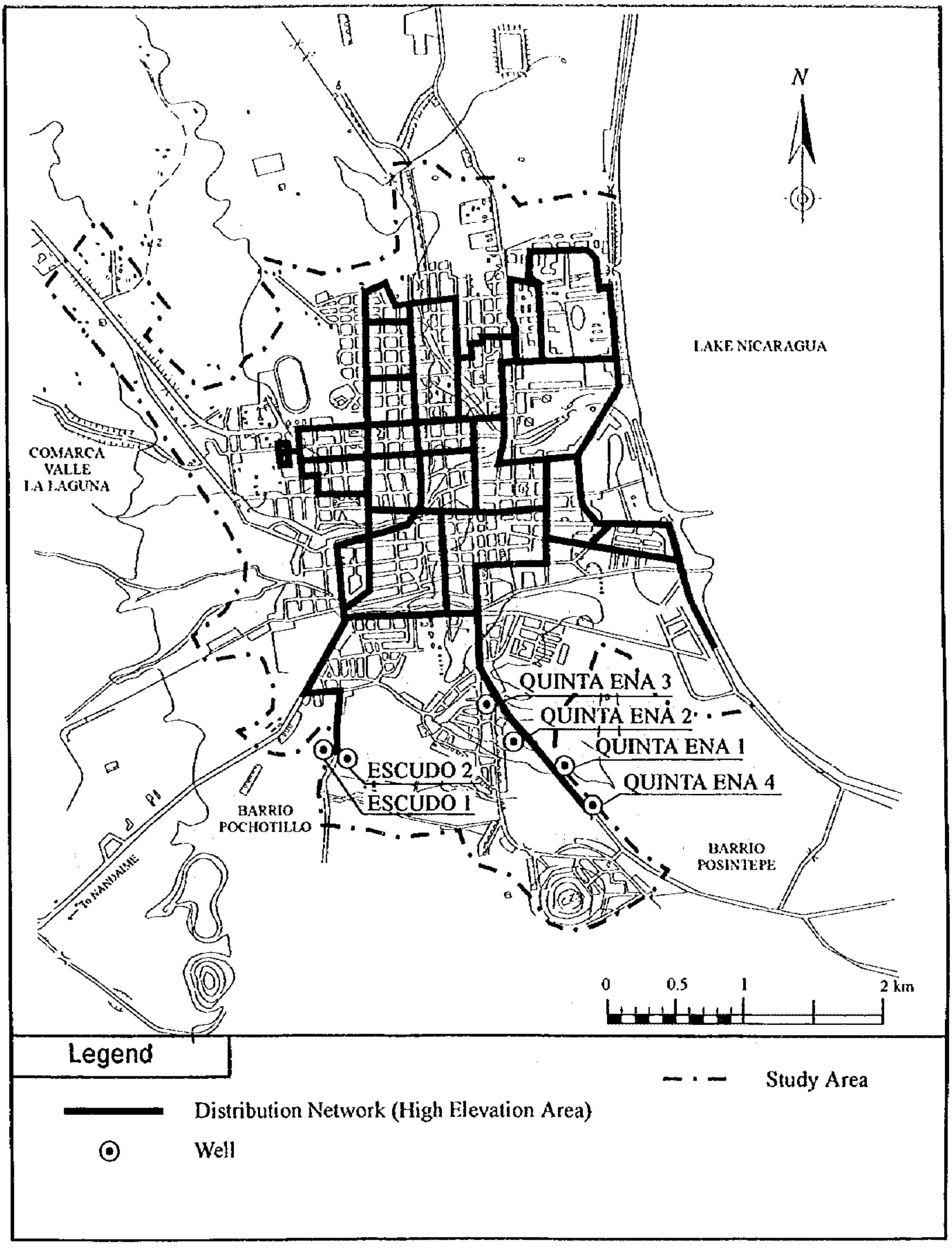


Figure J-16: Present Water Supply and Distribution System

a.7 Storage

According to the "Criteria for the Preliminary Design of the Drinking Water Systems" employed by INAA, the storage tanks are necessary for the following reasons:

- To compensate for the difference between instant public demand and production.
- To ensure minimal contact time, no less than 20 minutes, for chlorination.
- To provide water in case of interruption of the services.
- To provide water for emergency use (in case of fire).

Water is currently stored in four steel tanks of different capacity. These tanks are located in one area in the western part of the city.

Construction of tank No.4 will be completed soon and will probably be used from August 1996.

At present, two tanks (tanks 1 and 2) provide the water distribution network to the city. The new tank (No. 4) will be added to the system.

Tank No. 3 currently serves as a storage for water distributed to two barrios, El Capullo and Reparto San Juan, located at higher elevations. Pumping of water from the tank to the barrios is not carried out continuously; around four to five hours for each barrio.

The tanks do not receive water sometimes due to pumping failures resulting from interruptions in electric power.

The INAA Pre-feasibility Study Report states that the reservoirs do not receive water directly from the wells, and that they initially convey water to the network.

Table J-76: General Data on Existing Storage Tanks

Tank Name	Capacity (m^3)	Max. Elev. (m)	Bottom Elev. (m)	Diameter (m)	Const. Year
One	2,840	89.57	83.50	19.5	1975
Two	1,890	92.53	83.50	16.0	1967
Three	946	92.39	83.25	10.6	1967
Four	2,680	92.98	83.50	18.9	1996
Total	8,356	-	-		-

Source: INAA - Region IV (July 1996)

a.8 Distribution net

The distribution network in Granada City has a total of 98,447 m pipelines, and 68% of the total length is made up of pipelines 100 mm or less in diameter.

The system consists of three types of pipe materials: PVC, cast iron and asbestos cement.

The water pressure in the distribution network is generally acceptable. However, water pressure is not very strong, sometimes below the minimal head of 15m, at the southwest and northwest zones which are highly elevated.

The barrios El Capullo and Reparto San Juan are located in elevations of about 7.0 m higher than the existing reservoirs, therefore, water is distributed to these areas through a storage tank constructed within the area.

Table J-77: Distribution Network Structure

Diameter (mm)	PVC (m)	Cast iron (m)	Asbestos Cement (m)	Total (m)	Ratio (%)
50	27,784	3,810	-	31,594	32.0
75	730	2,094	15,163	17,987	18.3
100	740	2,900	13,470	17,110	17.4
150	230	-	10,270	10,500	10.7
200	-	1,694	5,194	6,878	7.0
250	-	2,850	5,058	7,908	8.0
300	-	-	2,590	2,590	2.6
350	-	-	2,780	2,780	2.8
400	-	-	1,100	1,100	1.2
Total	29,484	55,625	13,338	98,447	100.0
Ratio (%)	30.0	56.5	13.5	100.0	1.0

Source: INAA - Region IV (July 1996)

b. Institutional System

The service is performed by INAA - Region IV - Granada Branch that allocates 48 people for water supply and wastewater service.

During 1995, the city was supplied with 6,107,590 m^3 of water and 930,312 m^3 (15.2%) of wastewater was treated.

Table J-78: Economic Data on Water Supply and Sewage for Granada in 1995

Unit: C$ 1,000

Income/Expenditure	Water	Sewage	Total
Operational Incomes	8,952	797	9,751
Operational Expenditures	6,144	3	6,147
Total Incomes			9,751
Total Expenditures (depreciation included)			8,433
Results			+ 1,318

Source: INAA/General Accounting System

J.4.2 Storm Water Control

a. Technical System

a.1 General Conditions

The annual precipitation for the past 17 years average about 1,517mm, although data in this period fluctuated considerably, as mentioned in Chapter 1. The highest rain intensity for the past 17 years was 78.4mm/hr in 1980. The ten year (1/10 year) probable rainfall intensity was 66.7mm/hr, and the five year (1/5 year) probable rainfall intensity was 58.3mm/hr[6]. The rainfall data is attached to Chapter 5 of Data Book in Volume V.

There are no authorities responsible for planning storm water management. The Municipal Services Department, however, is in charge of the construction and maintenance of storm water drains, while the Emergency Operation Center is in charge of disaster relief.

The Municipal Services Department conducts the construction and maintenance of storm water drains because of its importance to its main responsibility. Although the municipality is supposed to be responsible for storm water drainage control according to Law on Municipalities No. 40-88, it is trying to persuade INAA to take over the said responsibility, since INAA is currently responsible for wastewater drainage control. Because storm water usually mixes with wastewater and vice versa, the municipality believes INAA should be responsible for storm water drainage as well.

a.2 Inundation Damage

a.2.1 Questionnaire Survey on Inundation Damage

A questionnaire survey was conducted on 56 families, two from each of the areas the municipalities thought were prone to inundation, as mentioned in Annex I in Volume IV, 'Inundation Damage Survey'.

This section shall only elaborate on the results of the survey conducted in Granada City.

The total number of inundation prone areas in Granada was 3, therefore, the total number of interviewed families was 6. These areas are shown in Annex I in Volume IV.

Results of the Survey

The results of the survey are shown in Annex I in Volume IV.

All 6 interviewees answered that they have experienced inundation damage, and suffered more than twice a year.

Depth of inundation varies from 5cm to 100cm. Two (2) interviewees answered that inundation continues from 1 to 3 hours, 3 interviewees answered 3 to 6 hours, and 1 interviewee 6 to 24 hours.

All of the interviewees answered that their houses were damaged by inundation, and the number who reported damage to household goods totaled 4.

On inundation and disease, 4 of 6 families answered that they have suffered from diseases, mainly cold, malaria and dengue fever, caused by inundation.

None of the interviewees suffered from business damage by inundation. One (1) of 6 interviewees stated a loss of C$ 0 to 500, while the 5 other interviewees stated a loss worth C$ 500 to 1,000.

a.2.2 Public Opinion Survey on Inundation Damage

The Public Opinion Survey (POS) was carried out at random and did not only cover inundation prone areas. According to the results of the survey, 25% of the interviewees

[6] INITER

answered that inundation significantly affected their daily life, while 16% have experienced flood damage.

b. Institutional System

The city is crossed by several small rivers and channels flowing into lake Nicaragua, that make drainage a very critical sanitary problem in Granada.

All kinds of liquid and solid wastes are discharged in these water flows, sometimes dried, blocking the drainage and being jumped to the lake during storms.

Considering these reasons, the Municipal Services Department (MSD) includes two sectors with 15 employees: Riverbed Maintenance, and Street Maintenance, besides Solid Waste Services.

The control of irregular discharges into the pluvial drains should be done by INAA.

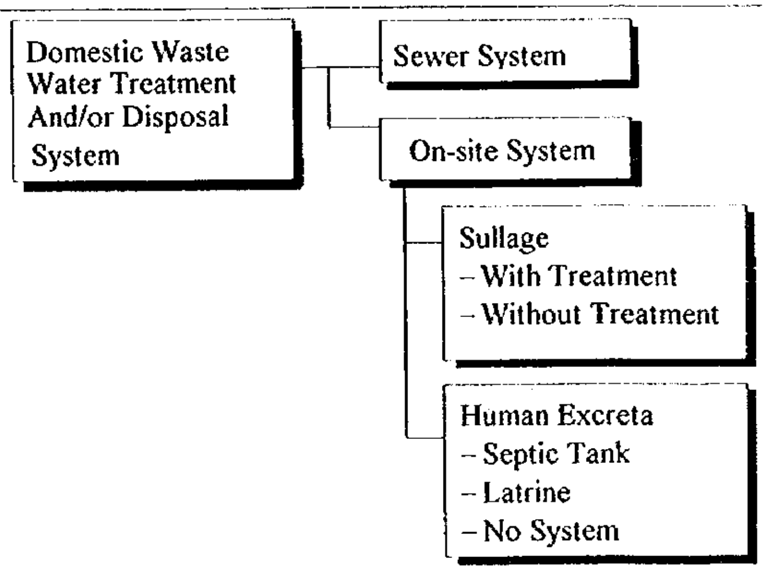
The possibility to draw up a cadastre should be considered and locate graphically the pluvial drainage system through the SISCAT already in usage, in the Red Estate Cadaster Office.

J.4.3 Domestic Waste Water Management

a. Technical System

a.1 Outline of the Technical System

The present DWW treatment and/or disposal system consists of a sewer system and an on-site system. However, some areas are not covered by any system at all. The on-site system is generally made up of a septic tank and latrine.



Source: INAA-Region IV

Figure J-17: Outline of Technical System

a.2 Sewer System

a.2.1 Service Coverage

The sewer system currently covers 21.9% of the Granada urban area.

The household drinking water connections currently total 11,352 units. The number of households that are currently charged for sewage collection services is 2,768 units, approximately 24.4% of the total number of households covered by the potable water supply services of INAA.

Table J-79: Service Coverage

	Household			Population (persons)		
	Number	Ratio (%)		Number	Ratio (%)	
Total Number	12,651		100	71,783		100
Water Supplied	11,352	89.7	100	64,411	89.7	100
Sewer Connection	2,768	21.9	24.4	15,706	21.9	24.4

Source : INAA

a.2.2 Sewage Drainage Basin

The current system has two principal drainage basins, and the first extends cover the historic urban center of Granada. The second extends over Reparto Villa Sandino.

The sewage system in Granada covers the central part of the area for urban development. There is also a pumping station in Reparto Villa Sandino, which is located in the northwestern part of the city. This pumping station transports residual water from Reparto Villa Sandino to the sewerage mains, which carry wastewater by gravity to the treatment site.

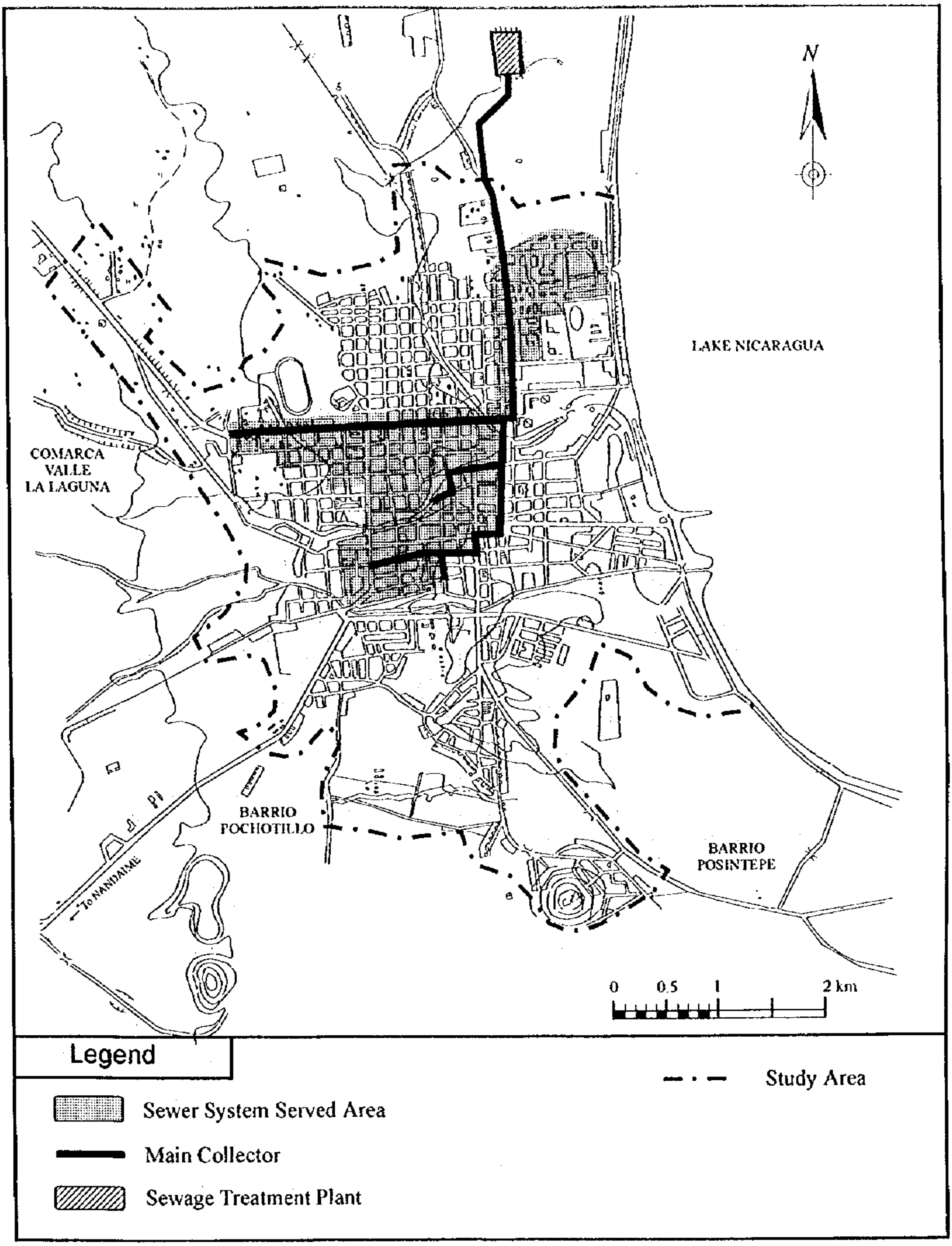


Figure J-18: Sewage Drainage Basin

Table J-80: General Data on Sewage Drainage Basin

Item		Total
Population (persons)		
	Total Basin Population	71,783
	Connected to sewers	15,706
Number of Households		
	Total No. of Households in the Basin	12,651
	Connected to sewers	2,768
Approximate Basin Area (km^2)		4.42
Waste Water Amount (m^3/day)		2,600

a.2.3 Sewage Collection Systems

The sewage collection system in Granada comprises a 27,874 m sewer network and a pump station.

i. Sewer Network

The sewage system in Granada covers approximately 33% of the total urban area. The northwest sector lacks a sewer system.

The system covers two zones: a low elevation zone (Villa Sandino sector) measuring 45 hectares and a high elevation zone that covers 115.14 hectares of the 327.67 hectares.

The low elevation zone discharges its wastewaters into the pumping station, which carries these wastes to the stabilization lagoons. The high elevation zone drains its wastewaters by gravity directly toward the lagoons through the sewer mains.

The total length of the existing sewer system is 27,874 m covering an estimated total street length of 131,000 m. It is therefore assumed that the sewer collectors cover 21.3% of the total street length.

Pipes ranging from 200 to 750 mm are installed northwards in the central zone of the city. The main sewer, 750 mm in diameter, conveys wastewaters to the treatment site.

The Villa Sandino effluent is conveyed by the main sewer to a pumping station, and routed to the treatment site through a 300 mm pipeline.

ii. Pumping Station at Villa Sandino

The report on specific studies on stabilization lagoons conducted by BID/INAA in January 1994 presents the following data and information on the pumping station in Villa Sandino.

Table J-81: Specifications of the Villa Sandino Pumping Station

General Information	
Location	Villa Sandino
Construction Year	1975
Catchment area (ha)	45
Technical Specifications	
Inlet Box Main Structure Screen	 Reinforced concrete Steel bar
Suction Pit Main Structure Useful Volume	Reinforced concrete $14.8m^3$ for submersible pump (retention time: 14 min) $21.0m^3$ for vertical shaft pump (retention time: 20 min)
Pumping Equipment Number of Pumps Type Power	 2 submersible pump and vertical shaft pump Electric Motor

a.2.4 Sewage Treatment Plant

i. Treatment Plant

Two facultative lagoons are used to treat wastewater discharged into the Granada sewer system. These lagoons are operated alternately. The second lagoon is subdivided by walls which organize the flow into the lagoon.

These lagoons are located in the northern part of the city, around 1,200 m from Villa Sandino and 200 m from the coast of Lake Nicaragua, in the sector better known as "Tepetate".

The treated flow is released in a lining channel in the trapezoidal section approximately 61 m long. Afterwards, it flows over private pasture.

The principal characteristics of the lagoons are tabulated in Table J-82.

Table J-82: Lagoon Characteristics

	Lagoon No.1	Lagoon No.2
Type of Lagoon	Facultative and Mature	
Dimensions (m)	$258^L \times 80^W \times 2^H$	$254^L \times 76^W \times 2^H$
Average Shallow Area (m^2)	20,640	19,304
Average Water Volume (m^3)	38,608	37,264
Design Treatment Capacity (m^3/day)	3,450	
Design Intake Water Quality (mg/l)	BOD: 250	
Design Treated Water Quality (mg/l)	BOD: 29	

The total volume of the treatment plant is $75,904m^3$ as indicated in the latest INAA report (July 4, 1996).

INAA analyzed the residual waters in the plant on July 4, 1996, and the results are shown in the following table.

Table J-83: Data on Granada Lagoons

Parameters	Unit	Intake	Outlet	Discharge Limit	For Irrigation
Report Number	-	071/96	072/96		
Sampling Date	-	June/25/96	June/25/96		
Average Flow	l/s	39.6	20.6		
Air temperature	°C	29.4	29.4		
Water temperature	°C	31.3	32.0		
pH	-	7.4	7.9	6 -9	6.5 - 8.5
Dissolved Oxygen	mg/l	0.0	5.4		
Settleable Solids	mg/l	4.5	0.0	1.0	
Total Solids	mg/l	812	762		120
BOD	mg/l	440	280	90	120
COD	mg/l	500	300	180	200
Alkalinity	mg/l	268	247		
Nitrites	mg/l	0.1	0.2		
Nitrates	mg/l	4.5	6.0		
Phosphates	mg/l	29.3	32.5		
Fixed Solids	mg/l	440	432		
Volatile Solids	mg/l	372	330		
Dissolved Solids	mg/l	554	520		
Suspended Solids	mg/l	258	242	80	
Fecal Coliform	NMP/100ml	$50x10^6$	$1.7x10^4$	$1x10^4$	1,000

Source: INAA - Management of Technical Norms (July 1996)

Meanwhile flow fluctuation measured on June 25, 1996 is shown in Figure J-19.

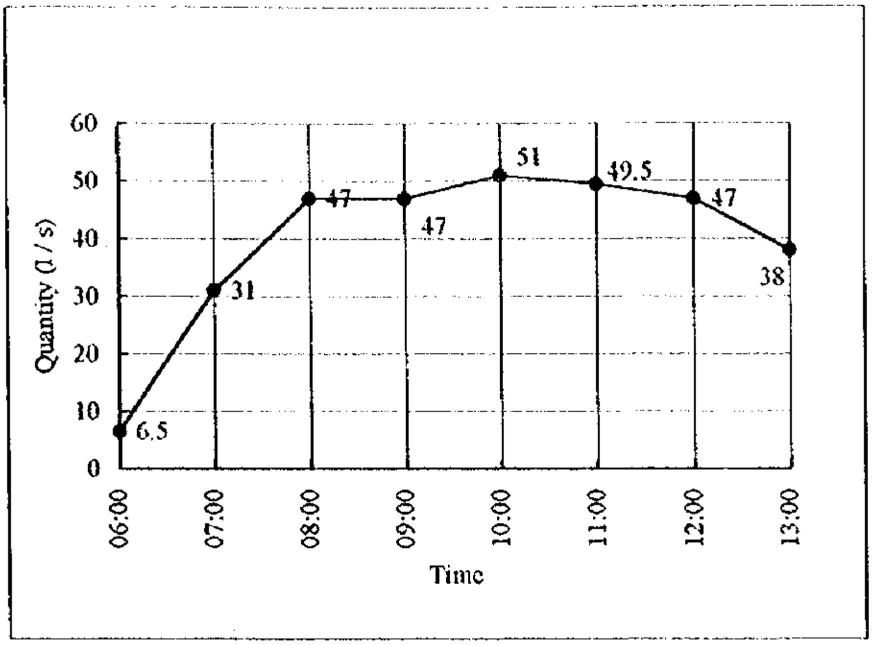


Figure J-19: Hourly Variation in Intake Sewage Quantity

These data complement the specific studies on stabilization lagoons made in January 1994 under the BID/INAA program.

ii. Water Balance and BOD Balance

The water and BOD balance were projected based on the available 1995 data and assumptions for relative indicators listed in Table J-84.

Table J-84: Available Data and Assumptions for Water Balance and BOD Balance Estimation

Item	unit	Amount	Remarks
Population			
a. Water Supply Service Population	persons	64,411	1995 data
b. Connected to Sewers	persons	15,706	
Water Production			
c. Annual Production	m^3/year	6,108,590	1995 data
d. Daily Production	m^3/day	16,736	c./365
e. Water Production Ratio	l /p/d	259.8	d./a.
Water Consumption			
f. Annual Consumption	m^3/year	3,454,251	1995 data
g. Daily Consumption	m^3/day	9,464	f./365
h. Water Consumption Ratio	l /p/d	146.9	g./a.
Sewage Treatment			
i. Daily Intake	m^3/day	2,592	
j. Sewage Generation Ratio	l /p/d	165	i./b.
k. BOD Generation Ratio	g/p/d	55.0	Results of WPLS
l. Discharge Ratio	%	100	to supplied water
m. Intake BOD Concentration	mg/l	440	measured on 6/25/96

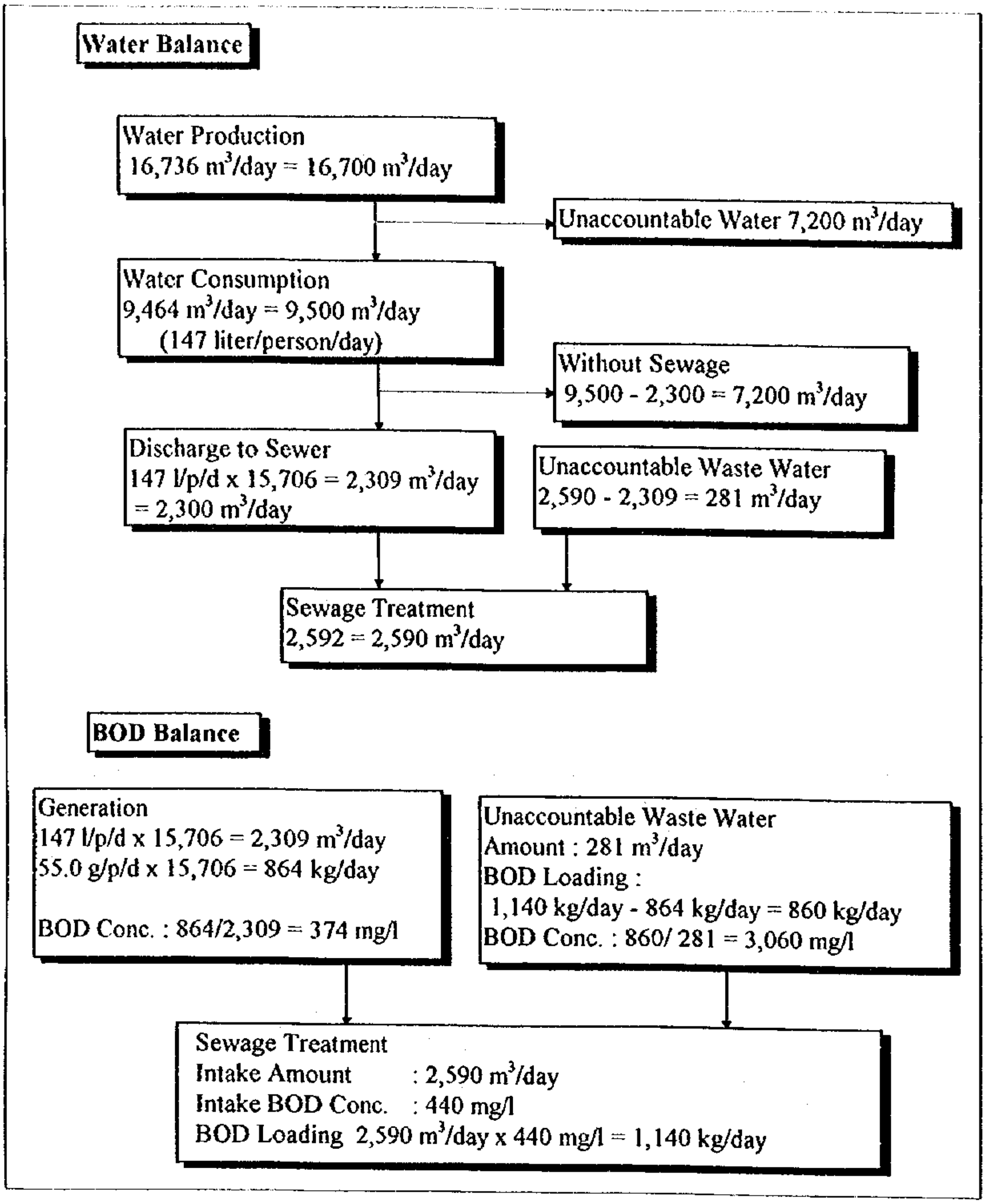


Figure J-20: Water Balance and BOD Balance in Granada Sewage System

The water balance and BOD balance estimates imply:

- Approximately 280 m^3/day of unaccountable wastewater filters into the sewer system, even under the assumption that 100% of potable water consumed reaches the lagoon.

- Where BOD generation per person is assumed at 52.5g/person/day (results of WPLS), BOD concentration in unaccountable wastewater totals approximately 3,060 mg/l.

Assuming that this unaccountable wastewater volume originates from household drains unidentified by INAA, the population discharging unknown quantities of wastewater into the sewer will amount to 15,636, as calculated below.

- 860 kg/day ÷ 55 g/person/day = 15,636 persons

  The assumed total population was determined based on the total BOD load of the unaccountable wastewater volume (860 kg/day) and the BOD generation of 55 g/person/day (results of WPLS).

Accordingly, the urban population connected to the sewer system totals 31,340 persons, equivalent to about 49% of the population covered by the water supply services. The wastewater generation ratio of this population is estimated at 83 liters/person/day, as calculated below.

- 3,590 m^3/day ÷ 31,340 persons = 83 liters/person/day

However, in view of the present situation of the sewer network, it is difficult to assume a 49% sewerage coverage in the Granada urban area. Further, the BOD calculation indicates that the BOD concentration of unaccountable wastewater quality is too high for DWW. Therefore, if the results of the laboratory analysis of BOD are reliable, the source of the unknown wastewater might not be households but could possibly be industrial wastewater.

iii. Treatment Capacity

The existing lagoons are located to the north of the city, about 1,200 m from Villa Sandino and 200 m from the coast of Lake Nicaragua, in the sector known as "Tepetate".

The principal characteristics of the lagoons are shown in the table below.

Table J-85: Lagoon Characteristics

	Lagoon No.1	Lagoon No.2
Type of Lagoon	Facultative	
Dimensions (m)	$258^{L} \times 80^{W} \times 2^{H}$	$254^{L} \times 76^{W} \times 2^{H}$
Average Shallow Area (m^2)	20,640	19,304
Average Water Volume (m^3)	38,608	37,296

The evaluation of the current conditions of the lagoons was fundamentally directed to:

i. qualitative observation of data obtained from latest water analysis.

ii. calculation of a maximum possible flow to be treated in the present lagoons.

The figures and indicators resulting from the latest analysis executed by INAA on June 25, 1996 were used to determine the current conditions of the lagoons. The ratio of

BOD, COD and fecal coliforms removed during treatment in the lagoons were analyzed and shown in the following table.

Table J-86: Efficiency of Stabilization Lagoons

	Removal Rate (%)
	Lagoon I
BOD	36.4
COD	40.0
Fecal Coliforms	99.97

The retention time in Lagoon I was observed at 22.1 days.

Because the retention time is quite long, a 90% reduction in BOD should have been attained. But as the results are contradictory, it can be deduced that other wastewater have also been discharged into the lagoons in addition to DWW. The INAA Pre-feasibility Study also confirms an abrupt increase (threefold) in flow during the rainy season.

The maximum potential flow to be treated in these lagoons is calculated based on the values of parameters used to determine the quality of wastewater that actually flows into the lagoons and the established standard discharge limits (the calculation is shown below).

Meanwhile the calculations for the two facultative lagoons in Granada, which are operated alternately, should be verified only taking organic load into account, since the reduction of pathogens is not the primary aim of this treatment process.

INAA standard BOD discharge: 90 mg/l

Calculation of the maximum flow of Lagoons I and II in terms of BOD (90 mg/l) discharge:

BOD inflow: Li = 440 mg/l
Treated BOD: Le = 90 mg/l
$Q = (A \times 18 \times p(1.05)^{T-20}) / (Li - Le)$ ----------- (Marais)

Where:

$A = 39{,}944\ m^2$
$p = 2.0\ m$
$T = 25^{\circ}C$
$Li = 440$ mg/l
$Le = 90$ mg/l
$Q = 5{,}244\ m^3$/day or 61 liters/sec

In view of the reduction in organic load, we can conclude that the lagoons have a treatment capacity of 5,200 m^3/day. On the other hand, only about 20% of the urban population is covered by the sewage collection services, and the present sewage flow into the lagoons is around 2,600 m^3/day. From these conditions we may deduce that the lagoons can accommodate the drainage of thrice the present service population in the urban area (18% x 3 = 54%). However, Table J-87 indicates that BOD and COD removal ratios are small, a condition that may be attributed to either of the following:

- unstable retention time in the lagoon due to storm water intrusion as pointed out by the INAA Pre-feasibility Study.
- intrusion of substances that impede breakdown of organic contents.
- error in laboratory analysis.

Generally, the COD/BOD level in DWW is approximately 2. Waste waters flowing into the lagoons of Leon and Chinandega were assumed to be domestic in make up as the COD/BOD was approximately 1.8 mg/l. On the other hand, wastewater flowing into the Granada lagoon only had a COD/BOD of 1.1 mg/l.

Table J-87: Comparison of COD/BOD Levels

	Leon	Chinandega	Granada
BOD (mg/l)	320	480	440
COD (mg/l)	568.6	840	500
COD/BOD	1.8	1.8	1.1

Assuming that the analyses of the quality of wastewater in the three cities were conducted under similar efficient and proper laboratory practices, we can conclude that the DWWs discharged into the sewers of Granada contain wastewater containing significant amounts of biodegradable substances and oxidizing agents.

Waste water with these elements is usually identified as coming from industrial sources. Industries generating wastewater containing a COD of 1.0 mg/l are thought to use raw materials that are bio-degradable (e.g., saccharide). These industries may be producing confectioneries, or beverage and brewery industries.

a.2.5 Discharge Point

The city of Granada has no effluent discharge point. Granada lagoon discharges its effluent into a pond on private land, and the effluent is considered to permeate the area.

a.3 Other Domestic Waste Water Treatment Systems

Of the urban households not covered by the sewer system, 40.9% use septic tanks, and 29.5% use pit latrines. Latrines usually have an average life of three to five years after which a new one is built nearby.

In the area without a sewer system, shallow street drains are used for domestic effluent discharge.

Table J-88: Sanitation Systems in the Urban Area

Sanitation System	Household Ratio
Sewer System	18.7%
Septic Tank	40.9%
Latrine	28.8%
None	11.6%
Total	100%

Source: INAA Region IV (Sept.1996)

b. Institutional System

INAA is in charge of wastewater, and manages the sewage collector system and a biological (facultative lagoon) treatment plant.

J.4.4 Industrial Waste Management

a. Technical System

a.1 Generation Sources

Table J-89 shows a list of major factories and main products. The major factories consist of 4 industrial categories (see Table J-90): CIIU3231,3523 is most likely to generate hazardous waste.

Table J-89: List of Major Factories in Granada

CIIU	Name of Companies	No. of Employees	Main Products
3111	AVICOLA SAN FELIPE S.A. (POULTRY)	101	Chicken
3115	INDUSTRIA NACIONAL AGRICOLA	43	Decorticator
3122	MOLINOS DE NICARAGUA S.A. (MONISA)	175	Wheat and animal food
3211	TEXTILES DEL LAGO S.A. (TEXLASA)	79	Tread and texture
3219	AGROTEX S.A.	10	T-shirts
3231	REPTILES DE NICARAGUA (REPTINIC)	26	Leather and reptile skins
3411	IUCASA	63	Toilet paper
3412	CORTONOSOL	15	Solid cardboard
3522	INDUSTRIAS FARMACEUTICAS CEGUEL S.A.	98	Pharmaceutical products
3523	E. CHAMORRO Y CIA, LTD.	100	Soap
3523	PREGO	110	Soap production
Total Number of Employees		820	

Table J-90: Number of Factories and Employees

Category	CIIU	Number of Factories		Number of Employees	
		Number	Ratio	Number	Ratio
Food	3111	1	9.1%	101	12.3%
	3115	1	9.1%	43	5.2%
	3122	1	9.1%	175	21.3%
Clothing	3211	1	9.1%	79	9.6%
	3219	1	9.1%	10	1.2%
	3231	1	9.1%	26	3.2%
Paper	3411	1	9.1%	63	7.7%
	3412	1	9.1%	15	1.8%
Chemicals	3522	1	9.1%	98	12.0%
	3523	2	18.2%	210	25.6%
Total		11	100%	820	100%

a.2 Generation Amount

Table J-91 shows the estimated waste generation amount based on the factories survey.

Table J-91: Waste Generation Amount in Granada (1996)

Waste Water (ton/year)	Solid Waste (ton/year)	Total (ton/year)
1,044,910	1,007	1,045,917

a.2.1 Waste Water

Figure J-21 shows the estimated wastewater generation amount of respective industrial categories based on the factories survey. CIIU3523 (soap, detergents, shampoos, etc.) are the largest wastewater generation sources in Granada. Waste water from CIIU3231 may contain oil, fat, and chemicals (e.g., sodium hydroxide)

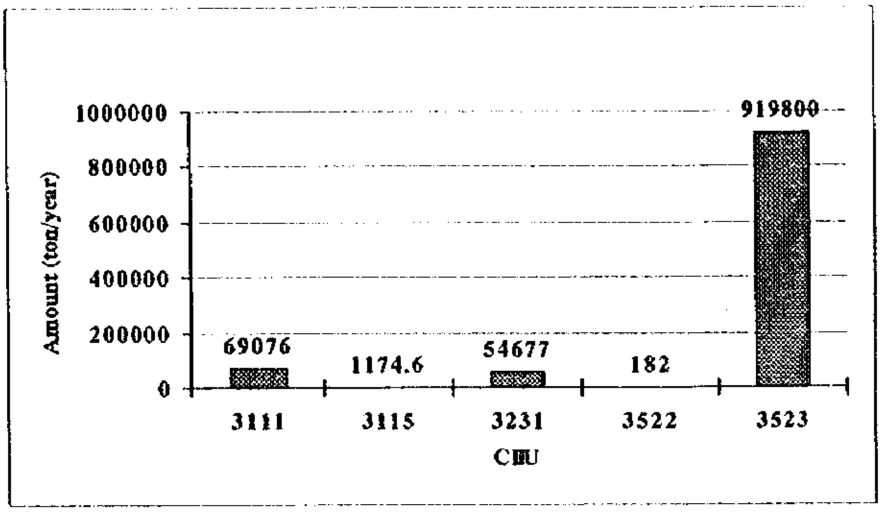


Figure J-21: Waste Water Generation Amount

a.2.2 Solid Waste

Figure J-22 shows the estimated solid waste generation amount of respective industrial categories based on the factories survey. CIIU3111 (livestock slaughtering and meat production) is the largest solid waste generation source in Granada, and solid waste from these industries may contain non-hazardous organic materials.

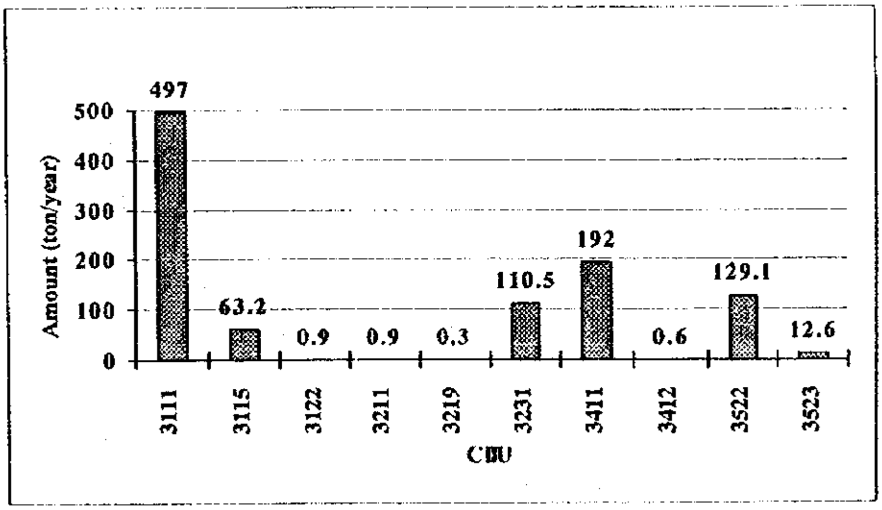


Figure J-22: Solid Waste Generation Amount

a.3 Treatment and Disposal

a.3.1 Waster Water

Generated wastewater is discharged into public water bodies (e.g., rivers) without treatment.

a.3.2 Solid Waste

Thirty two percent of SW generated is treated, and treatment method consists of bio-degradation and burning (open burning).

Solid waste disposal methods are landfill (33% of generation amount) and recycling (40% of generation amount), and major disposal sites are municipal landfill sites (76% of disposal amount).

b. Institutional System

b.1 Industrial Waste Water

The local industries do not have treatment plants, and the effluents are discharged into the soil, water bodies, or sewage systems.

The entities responsible for regulation and control of wastewater are MARENA, INAA, MINSA, and the municipality at a subsidiary level.

b.2 Industrial Solid Waste

Industries pay taxes for "ordinary" public services, that do not include ISW collection-disposal. The ISW must be collected and disposed of by its generator - that usually implies delivering the waste to the municipal disposal site.

Control on ISW is performed by the municipality and MINSA/SILAIS inspections.

Law No. 217-96 confirms the municipal competence on non-hazardous waste, and fix directives for HWM that should be enforced by MINSA and MARENA. MARENA should also regulate sludge handling and disposal, according to Decree No. 33-95.

J.4.5 Municipal SWM

It was found through the Public Opinion Survey that a considerable number (43%, 34/80) of interviewees were much affected by solid waste problems. The present situation regarding Municipal Solid Waste Management is described below.

a. Technical System

The Municipal Solid Waste Management in Granada City is executed by the Municipal Services Department of Granada Municipality.

a.1 Discharge and Storage

The study team observed that there is no source separation of waste at waste generation points. The waste put in reusable plastic bags or drums from houses are discharged at curbsides.

Many people use reusable plastic bags: 60% of waste dischargers used them according to the report of Study About the System of Garbage Collection and Treatment in 41 Municipalities of Nicaragua.

a.2 Collection and Transportation

i. Equipment

The Municipal Service Department has collection vehicles described in Table J-92 for waste collection and transportation. The equipment are parked at Tallar depot near a market in the city.

All of the equipment are old and their performances have deteriorated. This impedes an efficient waste collection services.

Table J-92: Collection Equipment

Item	No.	Years	Made in	Remarks
Tractor and Trailer	2	15	Russia	One is out of order.
Dump Truck	1	30	Japan	Under repair
Flat Truck	3	15 (1) 8 (2)	Russia	

ii. Frequency

Collection frequency for each kind of waste is shown in Table J-93: Thirty two personnel are assigned for the work, the working day is from 6:00 to 17:00.

Table J-93: Collection Frequency

Waste Category	Frequency
a. Residential areas	a. 2 - 3 times a week
b. Commercial areas	b. 6 times a week
c. Market areas	c. everyday
d. Medical facilities	d. everyday
e. Institutions	e. 2 - 3 times a week
f. Industries	f. own means
g. Road sweeping	g. everyday

iii. Coverage rate

The collection service coverage rate is: 82.0% in relation to the waste amount and 63.0% to the population.

a.3 Street Sweeping

The total length of streets cleaned by Municipal Service Department is 34.5 km out of a total of 49.2 km, including 5 parks.

The streets in the city are fairly clean, especially the central part of the city. Around the market, although large amounts of waste are generated, the place is kept clean as the cleansing service is done frequently.

Table J-94: Total Length of Roads in the Study Area

Type	Length
Paved	34.2 km
Unpaved	15.0 km
Total	49.2 km

a.4 Intermediate Treatment and Recycling

There are no intermediate treatment facilities and organized recycling was not observed in the study area. Only paper and cardboard are collected by individuals for reuse.

The recycling amount is 5.0 ton/day at generation sources and 0.5 ton/day at the disposal site. Total recycling amount is 5.5 ton/day in Granada.

a.5 Final Disposal

The municipality has one landfill located 5 km southwest of the city center. The landfill has been used since 1976[7].

This landfill site is operated by one personnel from the Municipal Service Department for registering the amount of waste brought in and has one bulldozer used for 17 years. The bulldozer is in operation about once a week, and only pushes away waste dumped around the entrance without covering it with soil.

There are no facilities such as a weighbridge, or an administration hut except for the boundary along the south side of the landfill.

The landfill is located next to the southernmost crater which is one of three craters along the north of the landfill. A crater is a pass of rain to groundwater. It is, therefore, feared that leachate from the landfill may have contaminated the groundwater flowing under the craters from which some of INAA's pumps are taking water for tap water. This problem was also pointed out on the report, 'Inpacto Ambiental del Basurero Existente "La Joya" Granada', studied by Centro para la Investigation de Recursos Acuaticos, CIRA.

The waste disposal amount is 36.9 ton/day in Granada.

a.6 Maintenance of Vehicles and Equipment

A maintenance shop for repairing the waste disposal equipment owned by the municipality is 'Plantelito' located in the northern part of the city. There are three mechanics in the workshop.

This workshop has few maintenance equipment and spare parts due to the limited budget. The workshop was built for a market, so it is not suitable for providing adequate maintenance and repairs.

a.7 Illegal Dumping

Wastes dumped illegally are observed at many places in the city, especially along rivers and ditches. They cause rivers and ditches to overflow during heavy rains, and are considered to be focal points of epidemic diseases.

[7] Impacto Ambiental del Basurero Existente "LaJoya" Granada, CIRA, 1996

The illegal dumping amount is estimated to be 7.8 ton/day in Granada.

b. Institutional System

The services are in charge of SW Services Sector (1 responsible), under MSD; and comprise domiciliary collection (28 workers, 1 supervisor, 4 vehicle drivers), street cleansing (28 workers, 3 supervisors) and refuse disposal (1 supervisor of the dumping site).

The dumping site (beside a volcano crater) is contaminating the groundwater and there are new site and design of a sanitary landfill to substitute it.

MINSA/SILAIS cooperates with the municipality and gives legal support to sanctions, when necessary.

The tax concerning to SWM is monthly charged but only houses located in central axis (at central area) and in same district centers. The estimated beneficiaries are 12,000 houses (19,000 should be the total houses in the urban area) but only 850 (7,1%) pay tax, and the major reason is "deficient service" - according to explanation of municipal functionaries.

There are no collection planning nor control of services.

b.1 Industrial Solid Waste

Industries do not pay SWM taxes, they either manage their own waste or hire private collectors that pick up the refuse and dump it into channels, or deliver it to the municipal dumping site.

These are few local industries (soap, detergent) and critical sites are gasoline stations, deposits for agrochemical and contaminated grounds with these products and packages.

Control on ISW is performed by the municipality and MINSA/SILAIS inspections.

Law No. 217-96 confirms the municipal competence on non-hazardous waste, and fixes directives for HWM that should be enforced by MINSA and MARENA.

MARENA should also regulate sludge handling and disposal, according to Decree No. 33-95.

J.4.6 Medical SWM

a. Technical System

a.1 Segregation of Infectious / Hazardous Medical Waste

Segregation of Infectious/hazardous medical waste is poor in Granada, namely, 2 medical institutions (33%) including a laboratory segregate their waste, but 2 institutions (33%) partially, 1 institution (17%) does not separate their waste, and 1 institution (17%) did not reply.

a.2 Treatment of Infectious / Hazardous Waste

The treatment methods are incineration (primitive incineration plant or incineration at open-air pit), sterilization (autoclave) in 4 institutions or immediate burial without treatment. In the regional laboratory, since a primitive incineration plant is used, surrounding people are complaining about the smoke and the odor generated from the chimney. The laboratory disposes of blood waste into a cement concrete pit with a lid.

a.3 Collection and haulage

Six institutions (100%) receive public collection service. The service is daily for 5 of them (80%). One institution (20%) is satisfied with the current collection service, but the remaining 4 (80%) are not satisfied.

a.4 Disposal

Although only 3 institutions gave answer on the disposal sites; either the municipal landfill site or the inside the premises of the institution.

a.5 Training and Education

Two medical institutions (33%) provide written instructions. The remaining 4 institutions (67%) do not. Frequency of training at the beginning of employment was at 4 institutions (67%), once a year (17%) and never (17%).

b. Institutional System

The municipal service collects and disposes of MSW together with domestic and commercial refuse. There are no internal segregation or special services.

ANNEX K

Selection of a First Priority City

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K Selection of a First Priority City

K.1 Criteria for Selection of a First Priority City

K.1.1 Requirements for a First Priority City

The purposes of the selection of a first priority city are:

- to concentrate the limited resources and times of the Study into one city (from geographically distanced 3 cities) for formulating both an M/P and F/S, in order to produce the Study's outcome in a most effective manner, in view of the Japanese Government Aid's Policy which supports self-help efforts of recipient countries; and
- for the other 2 cities, to formulate conceptual M/Ps to a certain level in order to encourage self-reliance of the other cities could be introduced for formulating M/P and F/S by themselves.

In other words, formulation of the M/P and execution of F/S are limited to the first priority city. The Study should contribute to the improvement of USE of three cities which is an essential objective of the Study.

First of all, in view of the purposes of the Study mentioned above, **the first priority city (FPC) should be the city that has the utmost needs (among 3 cities) for formulating an M/P for USE improvement by the Study**. In other words, two other cities should have the capability and/or support in formulating M/Ps by themselves based on the conceptual M/Ps to be prepared by the Team.

On the other hand, formulating the M/P for FPC indicates the potential **benefits** that are realized only when related projects are implemented. In this context therefore and in view of aiming for the effectiveness of the Study, the FPC should be the city that will gain the highest expected value of the benefits in the following aspects:

1. **Economic benefits expected:** e.g., prevention of future cost for alleviating contamination regarding USE, and/or benefits in externality (i.e., benefits of other sectors than USE sectors).
2. **Social benefits expected:** contribution towards social fairness and justice e.g., social welfare, beneficial impacts on vulnerable people (e.g., absolute poor, women), health benefit, etc.

Although formulation of the M/P indicates the potential benefits, they are obtained only when the M/P projects area actually implemented step. Therefore, the FPC should be the city that at least keeps a certain level of **capability** in implementing respective projects.

K.1.2 Evaluation Items

Based on the above-mentioned requirements for the FPC, the 4 principal evaluation items for the selection are summarized below.

1. Needs in formulating M/P.
2. Economic benefits expected.

3. Social welfare contribution.
4. Capability to implement relative projects.

The contents of the 4 principal evaluation items are described below.

a. Needs in Formulating M/P

Needs for formulating a M/P is an essential item for evaluation and a primary requirement for the first priority city (FPC).

The first key evaluation component for the needs in formulating the M/P is the seriousness of current outstanding problems on USE (urban sanitation environment), i.e., urgent needs in improvement of USE. The seriousness of the current problems on USE, which are caused by insufficient water supply management, wastewater management and SWM, are evaluated as shown in Table K-1.

As for the second component for the evaluation item, paying attention to the facts that the problems are caused mainly due to the lack of a proper plan for the improvement of USE, the absence of plans, such as a city development M/P (which is the superior plan of an USE improvement plan), etc., is evaluated.

The current problems on USE caused by the absence of the plans are evaluated.

Finally, the current planning deficiency of the 3 cities is examined regarding available resources in the municipality as well as external supports in planning.

The detailed evaluation elements, and its evaluation indices and methods are summarized in Table K-1.

Table K-1: Detailed Evaluation Elements, Indices and Methods for Needs in Formulating M/P

Detailed Evaluation Elements	Evaluation Indices and Method
1. Urgent Needs in Improvement of USE	
1.1 Contamination of drinking water sources	Whether the contamination is identified and/or pointed out by previous studies including this Study or not.
1.2 Contamination of surface water	Whether the contamination is identified and/or pointed out by previous studies including this Study or not.
1.3 Contamination of ground water	Whether the contamination is identified and/or pointed out by previous studies including this Study or not.
1.4 Inundation	Existence of inundation damage and its degree.
1.5 Public nuisance (offensive odor, etc.)	Existence of public nuisance due to the insufficient USE facilities and their degree.
1.6 Adverse impacts on fishery and agriculture	Existence of adverse impacts on fishery/agriculture and their degree.
1.7 Aesthetic degradation	Existence of aesthetic degradation and their degree.
1.8 Averse impacts on tourism	Existence of adverse impacts on tourism and their degree.
1.9 Adverse impacts on fauna/flora	Existence of adverse impacts on endangered habitats/species and their degree.
1.10 Needs expressed by citizen	Needs on the improvement of USE expressed by citizen through the public opinion survey.

Detailed Evaluation Elements	Evaluation Indices and Method
2. Absence of Plans	
2.1 City development M/P	Existence of the plan
2.2 Water supply system improvement plan	Existence of the plan
2.3 Sewerage system improvement plan	Existence of the plan
2.4 Industrial wastewater management plan	Existence of the plan
2.5 Storm water management plan	Existence of the plan
2.6 Municipal SWM plan	Existence of the plan
2.7 Industrial SWM plan	Existence of the plan
2.8 Medical SWM plan	Existence of the plan
3. Problems caused by the Absence of the Plans	
3.1 Absence of Industrial wastewater management plan	Existence of the problems caused by the absence of the plan and their degree.
3.2 Absence of storm water management plan	Existence of the problems caused by the absence of the plan and their degree.
3.3 Absence of municipal SWM plan	Existence of the problems caused by the absence of the plan and their degree.
3.4 Absence of Industrial SWM plan	Existence of the problems caused by the absence of the plan and their degree.
3.5 Absence of medical SWM plan	Existence of the problems caused by the absence of the plan and their degree.
4. Planning Deficiency	
4.1 Planning capability of municipality (part-1)	Number of municipality's planning staffs per 1,000 citizen.
4.2 Planning capability of municipality (part-2)	Amount of municipality's planning budget per citizen.
4.3 External supports in planning (part-1)	Number of foreign/domestic organizations which supported the municipality for past 3 years.
4.4 External supports in planning (part-2)	Amount (per citizen) of financial support obtained from foreign and domestic organizations.

b. Economic Benefits Expected

The economic benefits expected through formulation and implementation of the USE M/P are classified into "economic benefits expected on USE sectors" and "those expected on other USE sectors". Both benefits are evaluated, **under condition that current USE situation will continue without improvement in future,** in terms of the benefits that are realized as the prevention of future loss and remediation cost.

The detailed evaluation elements, and its evaluation indices and methods are summarized in Table K-2.

Table K-2: Detailed Evaluation Elements, Indices and Methods for Economic Benefits Expected

Detailed Evaluation Elements	Evaluation Indices and Method
1. Economic Benefits expected on USE Sectors	
1.1 Prevention of drinking water contamination (municipal level)	Future damages envisaged and its degree.
1.2 Prevention of drinking water contamination (regional level)	Future damages envisaged and its degree.
1.3 Prevention of surface water contamination	Future damages envisaged and its degree.
1.4 Prevention of ground water contamination	Future damages envisaged and its degree.
1.5 Prevention of inundation	Future damages envisaged and its degree.
1.6 Prevention of public nuisance	Future damages envisaged and its degree.
2. Economic Benefits expected on other than USE Sectors	
2.1 Prevention of adverse impacts on fishery and agriculture	Future damages envisaged and its degree.
2.2 Prevention of aesthetic degradation	Future damages envisaged and its degree.
2.3 Prevention of adverse impacts on tourism	Number of foreign tourists per citizen.
2.4 Prevention of adverse impacts on fauna/flora	Future damages envisaged and its degree.

c. Social Welfare Contribution

The social welfare contribution by formulation and implementation of the USE M/P are classified into "contribution to social equity, such as equalization of coverage rates of water supply and sewerage", and "contribution to improvement and equalization of health indicators". Both contributions are to be evaluated from the viewpoint that current indices will be improved and equalized through formulation of the USE M/P and projects implementation.

The detailed evaluation elements, and its evaluation indices and methods are summarized in Table K-3.

Table K-3: Detailed Evaluation Elements, Indices and Methods for Social Welfare Contribution

Detailed Evaluation Elements	Evaluation Indices and Method
1. Contribution to Social Equity	
1.1 Coverage rate of water supply system	Coverage rate obtained by the Study.
1.2 Coverage rate of sewer system	Coverage rate obtained by the Study.
1.3 Coverage rate of toilet	Coverage rate obtained by the Study.
1.4 Coverage rate of refuse collection service	Coverage rate obtained by the Study.
1.5 Coverage rate of pluvial drainage	Coverage rate obtained by the Study.
1.6 Amount of foreign aid per citizen	Data obtained by the Study.
1.7 Amount of subsidy from central government per citizen	Data obtained by the Study.

Detailed Evaluation Elements	Evaluation Indices and Method
1.8 Expenditure for water supply system improvement (per citizen)	Data obtained by the Study.
1.9 Expenditure for sewerage system improvement per citizen	Data obtained by the Study.
1.10 Expenditure for SWM per citizen	Data obtained by the Study.
1.11 GRDP	Data obtained by the Study.
1.12 Unemployment rate	Data obtained by the Study.
2. Contribution to the Improvement of Health Indicators	
2.1 Maternal death rate	Data obtained by the Study.
2.2 Neonatal death rate	Data obtained by the Study.
2.3 Morbidity rate of major epidemic diseases	Data obtained by the Study.
2.4 Mortality rate of major epidemic diseases	Data obtained by the Study.
2.5 Health damage by poor USE facilities	Data obtained by the Study.

d. Capability to Implement Relative Projects

The capability to implement relative projects of the USE M/P is classified into "financial capability of the executing body and citizen" and "administrative implementation capability of the executing body and supporting organization". Both evaluation components are to be evaluated regarding the capability which will be required for the implementation of the M/P.

The detailed evaluation elements, and its evaluation indices and methods are summarized in Table K-4.

Table K-4: Detailed Evaluation Elements, Indices and Methods for Capability to Implement Relative Projects

Detailed Evaluation Elements	Evaluation Indices and Method
1. Financial Capability of Executing Body and Citizen	
1.1 Financial capability of municipality	Municipal expenditure in 1995 per citizen
1.2 Financial capability of citizen (part-1)	Municipal tax incomes in 1995 per citizen
1.3 Financial capability of citizen (part-2)	Citizen's payment amount for water and refuse collection services obtained by POS.
2. Administrative Implementation Capability	
2.1 Administrative capability of municipal staffs	Amount of foreign/domestic supports per municipal staff.
2.2 Administrative capability of receiving foreign/domestic supports	Amount of foreign/domestic supports on USE sector per citizen

e. Evaluation Items

Based on the above examination, the structure of evaluation items is summarized as shown in Table K-5.

Table K-5: Structure of Evaluation Items for the Selection of a First Priority City

Principal Evaluation Items	Key Evaluation Components	Detailed Evaluation Elements
Needs in formulating M/P	1. Urgent needs in improvement of USE (seriousness of current outstanding problems)	1. Contamination of drinking water and surface/ground water, inundation, public nuisance (offensive odor, etc.), outstanding adverse impacts on fishery/agriculture, landscape, tourism, fauna/flora, needs expressed by citizen.
	2. Absence of plans	2.1 City development M/P 2.2 Water supply sector 2.3 Sewage sector (sewerage and other domestic wastewater, industrial wastewater, storm water management) 2.4 SWM sector (municipal, industrial and medical SWM)
	3. Problems caused by the absence of the plans	3.1 Absence of industrial wastewater management plan 3.2 Absence of storm water management plan 3.3 Absence of SWM plans
	4. Planning deficiency	4.1 Resource insufficiency in municipality's planning (manpower and budget of planning department) 4.2 External supports in planning (foreign and institutional assistance)
Economic Benefits expected	1. Economic benefits expected on USE sectors	1.1 Prevention of future loss and remediation (contamination of drinking water and surface/ground water, inundation, public nuisance)
	2. Economic benefits expected on other than USE sectors	2.1 Prevention of future loss (fishery/agriculture, landscape, tourism, fauna/flora)
Social Welfare Contribution	1. Social equity	1.1 Coverage rate of water supply, sewerage, toilets, refuse collection and pluvial drainage 1.2 Amounts of foreign aid and subsidy from central government per citizen 1.3 USE expenditures for each sector per citizen 1.4 Beneficial impact on vulnerable people (GDP, unemployed rate, etc.)
	2. Health indicator	2.1 Neonatal and maternal mortality rate 2.2 Morbidity/mortality rate of major epidemics 2.3 Health damage by poor USE facilities
Capability to implement Relative Projects	1. Financial capability of executing body and citizen	1.1 Financial capability of executing body (budgets, etc.) 1.2 Financial capability of citizen (tax payment, willingness to pay by POS)
	2. Administrative implementation capability	2.1 Administrative capability of municipality 2.2 Administrative capability of receiving foreign/domestic supports

K.1.3 Point Weighting of Evaluation

a. Point Weighting for Principal Evaluation Items

The evaluation is carried out on each detailed element which shall have point weighting. The points for each detailed evaluation elements are decided depending upon availability of the data for evaluation. At the meeting on the discussion of P/R (1), the Team proposed the following point weighting to the Nicaraguan side regarding the point allocation for the 4 principal evaluation items and the Nicaraguan side approved the proposal.

Needs in formulating M/P:	50
Economic benefits expected:	20
Social welfare contribution:	20
Capability to implement relative projects:	10
Total:	**100**

The reasons of proposed point weighting are described below.

1. **Needs in formulating a M/P** is the essential and primary requirement for the first priority city (FPC) as stated above. In other words, the FPC is to be selected by evaluating needs for formulating a M/P.
2. Since at this stage it is not known that what sectors and/or projects will be components derived from the M/P, estimation of **Economic Benefits expected** and **Social Welfare Contribution** from projects are considerably conditional and subject to many assumptions. Therefore, it is not reasonable to place a large weighting on conditional benefits expected.
3. The Team would like to place the same weighting on both "economic benefits expected" and "social welfare contribution".
4. Team judges "**Capability to implement Relative Projects**" should receive a smaller weighting than "economic benefits expected" or "social welfare contribution". Because this 4th principal evaluation item (capability to implement relative projects) is contradictory to the 1st principal evaluation item (needs in formulating M/P). In other words, the cities which have **capability to implement relative projects** should be capable of formulating M/Ps by themselves based on the conceptual M/Ps to be prepared by the Team.

b. Point Allocation for Detailed Evaluation Elements

Table K-6 summarizes evaluation criteria and point allocation for "Needs in Formulating M/P". Table K-7 summarizes evaluation criteria and point allocation for "Economic Benefits Expected". Table K-8 summarizes evaluation criteria and points allocation for "Social Welfare Contribution". Table K-9 summarizes evaluation criteria and points allocation for "Capability to Implement Relative Projects".

Table K-6: Evaluation Criteria and Points Allocation for Needs in Formulating M/P

Detailed Evaluation Elements	Points	Evaluation Criteria
1. Urgent Needs in Improvement of USE		
1.1 Contamination of drinking water	0	The contamination has neither been identified nor pointed out.
	1	The contamination has been identified or pointed out, but is not serious.
	2	The contamination has been identified, it requires water purification.
1.2 Contamination of surface water	0	The contamination has neither been identified nor pointed out.
	1	There may be contamination, but it has not been identified.
	2	The contamination has been identified.
1.3 Contamination of ground water	0	The contamination has neither been identified nor pointed out.
	1	There may be contamination, but it has not been identified.
	2	The contamination has been identified.
1.4 Inundation	0	No damage by inundation or negligible.
	1	There has been a little damage by inundation.
	2	There has been serious damage such as casualties.
1.5 Public nuisance (offensive odor, etc.)	0	No nuisance.
	1	A little nuisance.
	2	Notable nuisance.
1.6 Adverse impacts on fishery and agriculture	0	No adverse impacts.
	1	There are adverse impacts but degree of them is not known.
	2	Notable adverse impacts.
1.7 Aesthetic degradation	0	No degradation.
	1	A little degradation.
	2	Notable degradation.
1.8 Averse impacts on tourism	0	No adverse impacts.
	1	There are adverse impacts but degree of them is not known.
	2	Notable adverse impacts.
1.9 Adverse impacts on fauna/flora	0	No adverse impacts.
	1	There are adverse impacts but degree of them is not known.
	2	Adverse impacts are envisaged.
1.10 Needs expressed by citizen	0	Lowest needs among the 3 cities.
	1	Medium among the 3 cities.
	2	Highest needs among the 3 cities.
2. Absence of Plans		
2.1 City development M/P	0	Presence.
	2	Absence.
2.2 Water supply system plan	0	Presence.
	2	Absence.
2.3 Sewerage system improvement plan	0	Presence.
	2	Absence.
2.4 Industrial wastewater management plan	0	Presence.
	1	Presence but not sufficient plan.
	2	Absence.
2.5 Storm water management plan	0	Presence.
	2	Absence..
2.6 Municipal SWM plan	0	Presence.
	1	Presence but not sufficient plan.
	2	Absence.
2.7 Industrial SWM plan	0	Presence.
	2	Absence.
2.8 Medical SWM plan	0	Presence.
	2	Absence.

Detailed Evaluation Elements	Points	Evaluation Criteria
3. Problems caused by the Absence of the Plans		
3.1 Problems due to the absence of Industrial wastewater management plan	0	No specific problems.
	1	There is a plan but its implementation is not sufficient.
	2	There are serious problems due to the absence of the plan.
3.2 Problems due to the absence of storm water management plan	0	There are no or little damage.
	1	There are damages due to the absence of the plan.
	2	There are significant damages due to the absence of the plan.
3.3 Problems due to the absence of municipal SWM plan	0	No specific problems.
	1	There is a plan but its implementation is not sufficient. There are certain problems.
	2	There are serious problems, in spite of the presence of the plan.
3.4 Problems due to the absence of Industrial SWM plan	0	No specific problems.
	1	There is a plan but its implementation is not sufficient.
	2	There are serious problems due to the absence of the plan.
3.5 Problems due to the absence of medical SWM plan	0	No specific problems.
	1	There are certain adverse impacts.
	2	There are serious problems.
4. Planning Deficiency		
4.1 Planning capability of municipality (Part - 1)	0	Highest capability among the 3 cities
	1	Medium capability among the 3 cities
	2	Lowest capability among the 3 cities
4.2 Planning capability of municipality (Part - 2)	0	Highest capability among the 3 cities
	1	Medium capability among the 3 cities
	2	Lowest capability among the 3 cities
4.3 External supports in planning (Part - 1)	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
4.4 External supports in planning (Part - 2)	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities

Table K-7: Evaluation Criteria and Points Allocation for Economic Benefits Expected

Detailed Evaluation Elements	Points	Evaluation Criteria
1. Economic Benefits ecpected on USE Sectors		
1.1 Prevention of drinking water contamination (municipal level)	0	No damages are envisaged
	1	Damages might be limited partially.
	2	Serious damages are envisaged
1.2 Prevention of drinking water contamination (regional level)	0	No damages are envisaged
	1	Damages might be limited partially.
	2	Serious damages are envisaged
1.3 Prevention of surface water contamination	0	No damages are envisaged
	1	Damages are envisaged but degree of them are not known
	2	Serious damages are envisaged due to closed water area
1.4 Prevention of ground water contamination	0	No damages are envisaged
	1	Minor damages are envisaged
	2	Serious damages are envisaged

Detailed Evaluation Elements	Points	Evaluation Criteria
1.5 Prevention of inundation	0	No damages are envisaged
	1	Damages are envisaged but degree of them are not known
	2	Serious damages are envisaged
1.6 Prevention of public nuisance (offensive odor, etc.)	0	No damages are envisaged
	1	Damages are envisaged but degree of them are not known
	2	Serious damages are envisaged
2. Economic Benefits expected on other than USE Sectors		
2.1 Prevention of adverse impacts on fishery and agriculture	0	No damages are envisaged
	1	Damages are envisaged but degree of them are not known
	2	Serious damages are envisaged
2.2 Prevention of aesthetic degradation	0	No damages are envisaged
	1	Minor damages are envisaged
	2	Serious damages are envisaged
2.3 Prevention of adverse impacts on tourism	0	Smallest impacts among the 3 cities
	1	Medium impacts among the 3 cities
	2	Largest impacts among the 3 cities
2.4 Prevention of adverse impacts on fauna/flora	0	No damages are envisaged
	1	Minor damages are envisaged
	2	Substantial damages are envisaged

Table K-8: Evaluation Criteria and Points Allocation for Social Welfare Contribution

Detailed Evaluation Elements	Points	Evaluation Criteria
1. Contribution to Social Equity		
1.1 Coverage rate of water supply system	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.2 Coverage rate of sewer system	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.3 Coverage rate of toilet	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.4 Coverage rate of refuse collection service	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.5 Coverage rate of pluvial drainage	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.6 Amount of foreign aid per citizen	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.7 Amount of subsidy from central government per citizen	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities

Detailed Evaluation Elements	Points	Evaluation Criteria
1.8 Expenditure for water supply system improvement (per citizen)	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.9 Expenditure for sewerage system improvement per citizen	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.10 Expenditure for SWM per citizen	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.11 GRDP	0	Highest among the 3 cities
	1	Medium among the 3 cities
	2	Lowest among the 3 cities
1.12 Unemployment rate	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities
2. Contribution to the Improvement of Health Indicators		
2.1 Maternal death rate	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities
2.2 Neonatal death rate	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities
2.3 Morbidity rate of major epidemic diseases	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities
2.4 Mortality rate of major epidemic diseases	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities
2.5 Health damage by poor USE facilities	0	Less or unknown
	1	Comparatively many
	2	Comparatively serious

Table K-9: Evaluation Criteria and Points Allocation for Capability to Implement Relative Projects

Detailed Evaluation Elements	Points	Evaluation Criteria
1. Economic Capability of Executing Body and Citizen		
1.1 Financial capability of municipality	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities
1.2 Financial capability of Citizen (Part-1)	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities
1.3 Financial capability of citizen (Part - 2)	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities

Detailed Evaluation Elements	Points	Evaluation Criteria
2. Administrative Implementation Capability		
2.1 Administrative capability of municipal staffs	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities
2.2 Administrative capability of receiving foreign/domestic supports	0	Lowest among the 3 cities
	1	Medium among the 3 cities
	2	Highest among the 3 cities

K.2 Evaluation of Each Elements

K.2.1 Evaluation Principles

Where various authoritative organizations are interrelated with USE improvement plans, one of the methods could be to evaluate the M/P as an integration of respective authorities' views. However on the other hand, the M/P itself is aimed for an improvement of USE in the selected city, even though it is related with several sectors that other authorities are in charge of. Therefore, this evaluation examines those 3 cities comparatively.

Meanwhile, data and information on which this evaluation is based are the data and information that the Team obtained during the First Work in Nicaragua (i.e., data and information presented in the Progress Report (1) and related comments by the counterpart).

Furthermore, it is not intended that evaluation items cover all of the cities situation, but it is intended that evaluation items be limited so far as to the USE situation in 3 cities.

K.2.2 Detailed Elemental Evaluation

a. Evaluation Criteria for Needs in Formulating M/P

a.1 Urgent Needs in Improvement of USE

a.1.1 Contamination of Drinking Water

Drinking water sources in the 3 cities are well water. Although NO_3-N values in some wells in 3 cities shows a tendency of increase to date, it has not become a serious problem (i.e.: Point-1 is given to this common situation.). However, some wells in Granada shows high BOD values that require "slow filtration" according to the water quality classification of INAA's Pre-F/S report[1]. Therefore, judging that serious contamination is found and purification is needed, two points are given to Granada.

a.1.2 Contamination of Surface Water

Main rivers and water channels are polluted with industrial and domestic wastewater. Therefore all 3 cities receive two points.

[1] Estudio de Priorizacion de Inversiones en el Sector de Agua Potable y Alcantarillado Sanitario: Marzo 1996

a.1.3 Contamination of Ground Water

In Leon and Chinandega, pollution problems by agrochemical pollution are highly suspected, meanwhile in Granada underground water contamination with leachate from the present SW final disposal site and with industrial wastewater are highly suspected. Therefore, all 3 cities receive two points.

a.1.4 Inundation

Although POS regarding "inundation experiences" resulted in the same level in the 3 cities (Leon: 25%, Chinandega: 28%, and Granada: 25%), the Team's field survey recognized serious flood damages including road bank erosion and casualties in northern part of Chinandega. Therefore, Leon and Granada receive one point and two points are given to Chinandega.

a.1.5 Public Nuisance (offensive odor, etc.)

Public nuisance may include air pollution, water pollution, noise, vibration, offensive odor, etc. Water pollution by untreated wastewater and offensive odor from SW open dumping site are obvious in the 3 cities. Therefore, they all receive two points due to outstanding public nuisances.

a.1.6 Adverse Impacts on Fishery and Agriculture

Water pollution by wastewater is prominent in all 3 cities: Rio Chiquito (Leon), Rio Atoya (Chinandega) and Lake Nicaragua (Granada) receive the wastewater. Fishery and agriculture that utilize the wastewater might suffer from negative impacts. However, since the level of degradation by wastewater is unknown, one point is given to the 3 cities.

a.1.7 Aesthetic Degradation

Aesthetic degradation in respective cities are:

- in Leon, present SW disposal site deteriorates the city's scenic aesthetics in many angles towards the historic fort remains.
- in Chinandega, present SW disposal site is located along the Rio Acome.
- in Granada, the aesthetics of Nicaragua lake is deteriorated, since wastewater discharged and SW illegally disposed of in channels flow into the lake.

Therefore, all 3 cities receive two points due to outstanding aesthetic degradation.

a.1.8 Averse Impacts on Tourism

As indicated in the above section, negative impact on scenery is prominent in the 3 cities, causing adverse impacts on tourism. However, since promotion of tourism has just recently started in the 3 cities, the extent of the impact on tourism is not reported. Therefore, one point is given to all 3 cities.

a.1.9 Adverse Impacts on Fauna/Flora

Rare and endangered species are not found in Leon and Chinandega. On the other hand, importance of fresh water shark and fauna/flora near islands in the lake Nicaragua is pointed out. Therefore, Granada receives two points.

a.1.10 Needs Expressed by Citizen

According to the POS results, needs expressed by of citizens of the c cities vary respectively regarding water, wastewater, and solid waste. However, on average, needs expressed by 3 the citizens are similar. (With regard to POS questions of 1-Q-23, -24, -25, 2-Q-9, 4-Q-4, -10 outstanding differences of citizen's needs among the 3 cities are not observed.)

a.2 Absence of Plans

a.2.1 City Development M/P

As for a city development M/P which could be superior to a USE improvement plan, Leon consolidated it with the assistance of the Dutch government in January 1996[2]. Although Chinandega and Granada have their city development M/P, which are almost outdated today because it was formulated more than 10 years ago. Therefore they could not be qualified as superior to a M/P for USE improvement plan.

a.2.2 Water Supply System Improvement Plan

All 3 cities have a water supply system improvement plan (target being 95% coverage on population in 2020) and improvements are being implemented.

a.2.3 Sewerage System Improvement Plan

All 3 cities have a sewerage system improvement plan (target being 75% coverage on population for Leon and Chinandega and 85% for Granada in 2020) and improvement are being implemented.

a.2.4 Industrial Wastewater Management Plan

Leon, with support of Spanish aid, has the "Rio Chiquito Improvement Plan" which include industrial wastewater management. However since it does not cover the whole of the city, it does not suffice as the city's industrial wastewater management plan. Consequently, Leon receives one point and the other 2 cities receive two points.

a.2.5 Stormwater Management Plan

In all 3 cities, not only relevant plans are absent but also the responsible body for storm water management are unclear. Therefore, two points are given to all 3 cities.

a.2.6 Municipal SWM Plan

Three cities have relevant plans through the INIFOM study (i.e., Estudio sobre el Sistema de Recoleccion y Tratamiento de Nicaragua). However, it is judged that those are insufficient. Granada, in addition to that, has an SWM plan produced by CIRA (Estudio del Manejo de los Desechos Sólidos de la Ciudad de Granada). Therefore, Granada receives no point, and the other 2 cities receive one point.

a.2.7 Industrial SWM Plan

None of the cities have an Industrial SWM plan.

[2] "Plan Maestro Structural"(Structural Master Plan of Leon in January 1996)

a.2.8 Medical SWM Plan

None of the cities have a Medical SWM plan. However, Chinandega plans and implements separate disposal of sharps, being one of the sources of infection. Therefore, Chinandega receives one point and the other two.

a.3 Problems Caused by the Absence of the Plans

a.3.1 Absence of Industrial Wastewater Management Plan

Leon has the industrial wastewater management plan of "Rio Chiquito", which does not cover the whole city nor substantiate relevant control. Therefore water pollution occurs in public water courses. The other 2 cities do not have any industrial wastewater management plan and related pollution are observed. Therefore, one point is given to Leon and two points to Chinandega and Granada.

a.3.2 Absence of Stormwater Management Plan

Storm water management plan lacks in all 3 cities and related problems (such as drainage facilities shortage, inappropriate facilities, insufficient operation and maintenance, etc.) occur in all 3 cities. On the other hand, actual damage produced in Chinandega is the most serious among 3 cities. Therefore two points are given to Chinandega and one point to Leon and Granada.

a.3.3 Absence of Municipal SWM Plan

All these cities have a municipal SWM plan, however they are recently planned and therefore are not yet implemented. In particular, urgent improvement of final disposal is awaited since all final disposal sites in 3 cities are polluting potable water sources and surface waters which might create secondary pollution impacts. Therefore, two points are equally given to all 3 cities.

a.3.4 Absence of Industrial SWM Plan

Since none of the cities have an industrial SWM plan, industrial SW including hazardous waste are disposed of at municipal final disposal sites without control.

a.3.5 Absence of Medical SWM Plan

Since none of the cities have a medical SWM plan, treatment/disposal of infectious and/or hazardous waste differs depending upon medical institutions. Interrelation between mal-practices of medical SWM and infections breakout is envisaged, although it is not verified. Chinandega practices separate collection of sharps and it could be contributed for a reduction of infections. Therefore, two points are given to Leon and Granada, one to Chinandega.

a.4 Planning Deficiency

In order to compare planning capability, staff number and budget in1996 allocated for urban planning division of the 3 cities are surveyed through interview to related officials. The following table shows the comparisons.

Table K-10: Comparison of planning capability in 3 cities

	Staff number (person)	Staff number per 1000 citizen	Budget allocated (C$/year)	Budget per citizen (C$/year)
Leon	12	0.07	584,520	3.62
Chinandega	9	0.08	329,824	2.82
Granada	4	0.04	294,360	3.03

Source: Leon: Urban Planning and Control Division
Chinandega : Departamento de Planificacion, Vivienda y Urbanismo
Granada : Direccion de Conservacion, Control y Revitalization del Centro Historico de la Ciudad

a.4.1 Planning Capability of Municipality (part-1)

In view of the municipal staff in planning for 1000 citizens, Leon, Chinandega, and Granada receive one point, no point, and two points respectively.

a.4.2 Planning Capability of Municipality (part-2)

In view of the budget allocated per citizen, Leon receives no point, Chinandega two points, and Granada one point.

a.4.3 External Supports in Planning (part-1)

Comparing international and domestic organizations which participated in recent USE improvement projects in the 3 cities (excluding IDB and FISE), there are 9 organizations (ACDI, Japan, Zaragoza, Utrechit, Austria, Prode-Mujer, Hambrug, Oxford, Catalonia) in Leon, 9 organizations (PRODEL, ASDI, ACDI, Leverkusen, Japan, Saskia-bodelier, Holland, Molins de Reis, COSUDE) in Chinandega, and 4 organizations (Frankfurt, ACDI, POBLADORES, Japan) in Granada. Therefore one point is given to Leon and Chinandega, and two points are given to Granada.

a.4.4 External Supports in Planning (part-2)

Comparing the total aid amount of recent projects related with USE improvement in the 3 cities, Leon, Chinandega and Granada received US$7,426,701 US$3,471,080 and US$1,730,796 respectively.

Table K-11: Aid amount received per citizen

	Project Cost expressed in US$	Project Cost expressed in C$	Total Project Cost received in US$	Population	Received Amount per Person (US$/population)
Leon	3,726,941	29,598,076	7,426,701	161,530	**46.0**
Chinandega	2,377,400	8,749,443	3,471,080	117,037	**29.7**
Granada	454,949	10,206,777	1,730,796	96,996	**17.8**

Note : It is assumed that US$ 1= C$ 8.0. this time.

b. Economic Benefits Expected

b.1 Economic Benefits Expected on USE Sectors

b.1.1 Prevention of Drinking Water Contamination (municipal level)

The potable water sources in the 3 cities are form wells. In Leon and Chinandega, major groundwater polluting sources (such as wastewater and SW disposal sites) are located downstream of groundwater flows. The majority of wells in the 2 cities are located upstream. Therefore, water pollution by deficiencies of USE facilities might be limited to some wells downstream in the 2 cities. Meanwhile, groundwater pollution by agrochemicals are not categorized as "pollution by deficiencies of USE facilities".

However, in Granada, the present SW disposal site is located upstream of groundwater flows. Therefore serious damages are.

Consequently one point is given to Leon and Chinandega and two points are to Granada.

b.1.2 Prevention of Drinking Water Contamination (regional level)

Nicaragua lake, being a good quality fresh water lake, is expected to serve in future as a drinking water source for the capital Managua. Therefore, its pollution will lead to the "anticipation of serious damages" of regional drinking water sources. Granada receives two points.

b.1.3 Prevention of Surface Water Contamination

Rivers and water courses in the 3 cities are polluted with industrial and domestic wastewater. Related damages are envisaged, but their degree of contamination are not known (one point). Surface water contamination may lead to serious pollution of a closed water area. Minamata disease in Japan is a typical example of tragic water pollution in an enclosed water area. Where all surface water in Granada flow to the closed water body (i.e., Lake Nicaragua), it receives two points.

b.1.4 Prevention of Ground Water Contamination

All 3 cities lie on highly permeable ground. Therefore untreated wastewater might be causing serious damages to ground water.

b.1.5 Prevention of Inundation

All 3 cities lack an inundation prevention plan. Chinandega suffers the most out of the 3 cities from flood and inundation. Therefore, Leon and Granada receive one point, and Chinandega, two points.

b.1.6 Prevention of Public Nuisance

Public nuisances is evident in 3 cities. Outstanding damages are envisaged for the 3 cities.

b.2 Economic Benefits Expected on Oher than USE Sectors

b.2.1 Prevention of adverse impacts on fishery and agriculture

Water pollution by wastewater discharged is evident in the 3 cities. Therefore, fishery and agriculture that utilize these water may suffer seriously in the future.

b.2.2 Prevention of Aesthetic Degradation

Aesthetic degradation is outstanding today in 3 cities. Therefore this may also be eminent in the future, if the present situation continues unabated.

b.2.3 Prevention of Adverse Impacts on Tourism

The number of foreign tourists visiting the 3 cities in 1994 are estimated as follows based on the statistics on from 1995.

Table K-12: Annual Foreign Tourists

	Foreigners visited (person)	Ratio of foreign tourists (%)	Foreign tourists (persons)	Foreign tourists per citizen
Leon	41,933	65.3	27,382	0.17
Chinandega	22,234	24.8	5,514	0.05
Granada	56,295	81.6	45,937	0.47

Source : Encuesta Turistica, 1995

As the figures on foreign tourists per citizen indicate, prevention of adverse impacts on tourism will rank Granada at the first place, Leon in second and Chinandega at the last place.

b.2.4 Prevention of Adverse Impacts on Fauna/Flora

Since valuable fauna/flora in Leon and Chinandega are not reported to the Team, it is judged that adverse impacts on them are negligible. Meanwhile, fresh water shark and valuable fauna/flora near islands in the Nicaragua lake are reported, therefore it is judged that those in Granada might suffer adverse impacts of water pollution by untreated wastewater.

c. Social Welfare Contribution

c.1 Contribution to Social Equity

c.1.1 Coverage Rate of Water Supply System

Water supply coverage in Leon, Chinandega, and Granada are: 92.2%, 74.0%, and 89.7% respectively.

c.1.2 Coverage Rate of Sewer System

Sewer system coverage in Leon, Chinandega, and Granada are: 55.5%, 33.6%, and 21.9% respectively.

c.1.3 Coverage Rate of Toilet

Toilet system coverage in Leon, Chinandega, and Granada are: 92.6%, 89.4%, and 88.4% respectively.

c.1.4 Coverage Rate of Refuse Collection Service

Refuse collection coverage (estimated from the WACS results) in terms of waste amount are: Leon 88.7%, Chinandega 78.4%, and Granada 82.2%. Therefore, no point for Leon, two points for Chinandega, and one point for Granada are given.

c.1.5 Coverage Rate of Pluvial Drainage

Data on area covered with pluvial drainage system are not available for the 3 cities. Road pavement rates are referred for this evaluation, in view that drainage are, in many cases, improved when roads are paved. Pavement rates in Leon, Chinandega, and Granada are 46%, 41%, and 70% respectively. Therefore, one point for Leon, two points for Chinandega, and no point for Granada are given.

c.1.6 Amount of Foreign Aid per Person

Foreign aid amount in 1995 for the 3 cities are as follows.

Table K-13: Foreign Aid Amount in 1995

	Foreign aid amount (C$1,000/year)	Population (person)	Foreign aid amount per individual (C$/person)
Leon	12,652	161,530	**78.3**
Chinandega	570	117,037	**4.9**
Granada	930	96,996	**9.6**

Source : Leon : Informe Mensual de Ingresos (1995/12)
Chinandega : Informe Trimestral de Ingresos (1995/Cuatro)
Granada : Informe Mensual de Ingresos (1995/12)

c.1.7 Amount of Subsidy from Central Government per Person

Amount of subsidy from the central government in 1995 for the 3 cities are as follows.

Table K-14: Subsidy from Central Government in 1995

	Central government subsidy amount (C$ 1,000/year)	Population (person)	Central government subsidy amount per individual (C$/person)
Leon	216	161,530	**1.3**
Chinandega	160	117,037	**1.4**
Granada	15	96,996	**0.2**

Source : Leon : Informe Mensual de Ingresos (1995/12)
Chinandega : Informe Trimestral de Ingresos (1995/Cuatro)
Granada : Informe Mensual de Ingresos (1995/12)

c.1.8 Expenditure for Water Supply System Improvement (per Person)

Expenditure for water supply system improvement in 1995 for the 3 cities are as follows.

Table K-15: Expenditure for Water Supply System Improvement in 1995

	Expenditure for water supply system improvement (C$ 1,000/year)	Population (person)	Expenditure for water supply system improvement per individual (C$/person)
Leon	7,470	161,530	46.3
Chinandega	3,910	117,037	33.4
Granada	6,144	96,996	63.3

Source : INAA

c.1.9 Expenditure for Sewerage System Improvement per Citizen

Expenditure for sewer system improvement in 1995 for the 3 cities are as follows.

Table K-16: Expenditure for Sewerage System Improvement in 1995

	Expenditure for sewerage system improvement (C$ 1,000/year)	Population (person)	Expenditure for sewerage system improvement per individual (C$/person)
Leon	407	161,530	2.5
Chinandega	102	117,037	0.9
Granada	3	96,996	0.0

Source : INAA

c.1.10 Expenditure for SWM per Citizen

Expenditure for SWM in 1995 for the 3 cities are as follows.

Table K-17: Expenditure for SWM in 1995

	Expenditure for SWM improvement (C$ 1,000/year)	Population (person)	Expenditure for SWM per individual (C$/person)
Leon	1,954	161,530	12.1
Chinandega	1,015	117,037	8.7
Granada	1,355	96,996	14.0

Source : Leon : Informe Mensual de Egresos (1995/12)
Chinandega : Informe Trimestral de Egresos (1995/Cuatro)
Granada : Informe Mensual de Egresos (1995/12)

c.1.11 Gross Regional Domestic Product (GRDP)

Since data on GRDP are not available, regional income (for each "departamento") are calculated based on the INSSBI data on the number of employee and average income. Then GDP is distributed to each category of economic activities. The GRDPs are summarized below.

Table K-18: Gross Regional Domestic Product in 1995

	GRDP (C$ 1,000/year)	Department population (person)	GRDP per person (C$/person)
Leon	726,800	336,894	**2,157**
Chinandega	1,935,100	350,212	**5,525**
Granada	523,000	155,683	**3,359**

Source : Anuario Estadistico, INSSBI 1995, INEC

c.1.12 Unemployment Rate

Unemployment rates for Leon, Chinandega, and Granada are calculated as 10.3%, 8.5%, and 9.2% respectively, based upon statistical data[3] (1995) of MITRAB.

c.2 Contribution to the Improvement of Health Indicators

c.2.1 Maternal death Rate

The table below shows data on "maternal death" and "neonatal death" in 1993 to 1995 for 3 cities.

Table K-19: Maternal Death and Neonatal Death in 1993 - 1995

	Municipality Population	Maternal Death (3 years average)	Maternal Death Rate (* /1000 population)	Neonatal Death (3 years average)	Neonatal Death Rate (* /1000 population)
Leon	161,530	3.0	**0.019**	52.0	**0.32**
Chinandega	117,037	1.7	**0.015**	24.0	**0.21**
Granada	96,996	2.7	**0.028**	23.3	**0.24**

Note : * Since data on total number of maternity and birth are not available, rates are calculated per 1000 citizens.

In view of "maternal death rate" as one of public health indicator, Leon, Chinandega, and Granada receive one point, no point, and two points respectively.

c.2.2 Neonatal death Rate

In view of "neonatal death rate" as a public health indicator, Leon, Chinandega, and Granada receive two points, no point, and one point respectively.

c.2.3 Morbidity Rate of Major Epidemic

Data on morbidity and mortality of major epidemic (diarrhea, cholera, malaria, dengue, respiratory diseases) in 1993 to 1995 in 3 cities are summarized in the table below.

Table K-20: Morbidity and Mortality of Major Epidemic Diseases in 1993 - 1995

	Municipality Population	Morbidity (3 years average)	Morbidity Rate per 1000 population	Mortality (3 years average)	Mortality Rate per 1000 population
Leon	161,530	56,940	353	53.7	0.33
Chinandega	117,037	34,359	294	65.0	0.56
Granada	96,996	22,933	236	35.3	0.36

Source : MINSA

[3] Estadisticas Sociolaborales de la Ciudad de Leon, Chinandega, Granada, Octubre 1995

In view of "morbidity rate" of communicable diseases as a public health indicator, Leon, Chinandega, and Granada receive two points, one point, and no point respectively.

c.2.4 Mortality Rate of Major Epidemic Diseases

As "mortality rate" of communicable diseases is a public health indicator, Leon, Chinandega, and Granada receive no point, two points, and one point respectively.

c.2.5 Health Damage by Poor USE Facilities

Health damages caused directly due to insufficient USE facilities (e.g., water supply, sewerage, solid waste facilities, etc.) are not reported from the 3 cities. Therefore no point are given to all 3 cities.

d. Capability to Implement Relative Projects

d.1 Financial Capability of Executing Body and Citizen

d.1.1 Financial Capability of Municipality

Allocation of municipal budget recorded in 1995 for the 3 cities are summarized in the table below.

Table K-21: Disbursement of Municipal Budget in 1995

	Disbursement of municipal budget (C$ 1,000/year)	Citizen population (person)	Disbursement of municipal budget per citizen (C$/person)
Leon	34,206	161,530	**212**
Chinandega	15,084	117,037	**129**
Granada	13,616	96,996	**140**

Source : Leon : Informe Mensual de Egresos (1995/12)
Chinandega : Informe Trimestral de Egresos (1995/Cuatro)
Granada : Informe Mensual de Egresos (1995/12)

d.1.2 Financial Capability of Citizen (part-1)

Municipal tax income recorded in 1995 for the 3 cities are summarized in the table below.

Table K-22: Municipal Tax Income in 1995

	Municipal taxes income (C$1,000/year)	Citizen population (person)	Municipal taxes income per citizen (C$/person)
Leon	15,621	161,530	**96.7**
Chinandega	12,309	117,037	**105.2**
Granada	11,609	96,996	**119.7**

Source : Leon : Informe Mensual de Egresos (1995/12)
Chinandega : Informe Trimestral de Egresos (1995/Cuatro)
Granada : Informe Mensual de Egresos (1995/12)

d.1.3 Financial Capability of Citizen (part-2)

Average payment for water supply and SW collection services (from the POS results) in the 3 cities are shown in the table below. (POS samples on payers of sewer charges are so small that sufficient data to compare the 3 cities were not obtained.)

It revealed that the average payments for the services in Leon is significantly higher than those in the other 2 cities. Therefore, two points are given to Leon and one point is given to the other 2 cities.

Table K-23: Citizen's Payment for Water Supply/SW Collection Services (POS Results)

	Water supply		SW collection	
	Beneficiary/ 80 sample	Payment average	Beneficiary/ 80 sample	Payment average
Leon	73/80	C$81.62/year	46/80	C$25.20/year
Chinandega	72/80	C$68.76/year	47/80	C$17.60/year
Granada	80/80	C$71.10/year	48/80	C$7.38/year

d.2 Administrative Implementation Capability

d.2.1 Administrative Capability of Municipal Staff

Total amount of foreign/domestic projects supporting USE improvement in the 3 cities in the last 3 years are summarized in the table below.

In view of project handling amount per municipal staff, administrative capabilities are examined: Leon is the highest and Granada the lowest ranking among the 3 cities.

Table K-24: Administrative Capability of Municipal Staff

	Total project cost received (US$)	Municipality staff number	Project handling ability of staff (US$/person)
Leon	7,426,701	437	16,995
Chinandega	3,471,080	383	9,063
Granada	1,730,796	391	4,427

d.2.2 Administrative Capability of Receiving Foreign/Domestic Supports

In order to implement projects proposed through a M/P, administrative capability to receive supports (including recruitment of external financial support) is one of the requirements for the FPC. Aid received per citizen of the 3 cities in the last 3 years are shown in Table 11, which suggests ranking of the administrative capacity of receiving supports: Leon two points, Chinandega one point, and Granada no point.

Meanwhile, the capability to respond Team's request (e.g., provision of data and information from the municipal counterpart) also ranks in order of Leon, Chinandega, and Granada.