社会開発協力部報告書

No. 9

LOCAL WATER UTILITIES ADMINISTRATION

MASTER PLAN AND FEASIBILITY STUDY OF THE LOCAL WATER SUPPLY PROJECTS IN THE REPUBLIC OF THE PHILIPPINES

LEGASPI CITY WATER DISTRICT

JUNE 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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JUNE 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

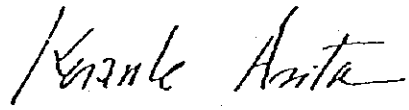
In response to the request of the Government of the Republic of the Philippines, the Japanese Government decided to cooperate in formulating a master plan and making a feasibility study on the Local Water Supply Project and entrusted the work to the Japan International Cooperation Agency (JICA).

The JICA sent to the Philippines a survey team from 28 June 1981 to 27 December 1981. The team exchanged views with the officials concerned of the Government of the Philippines and conducted field surveys in the Ilocos Norte Province (Laoag City, Bacarra Municipality, Pasquin Municipality, Vintar Municipality and Paoay Municipality), the Albay Province (Legaspi City and Daraga Municipality) and the Bohol Province (Tagbilaran City). After the team returned to Japan, further studies were made and the present report has been prepared.

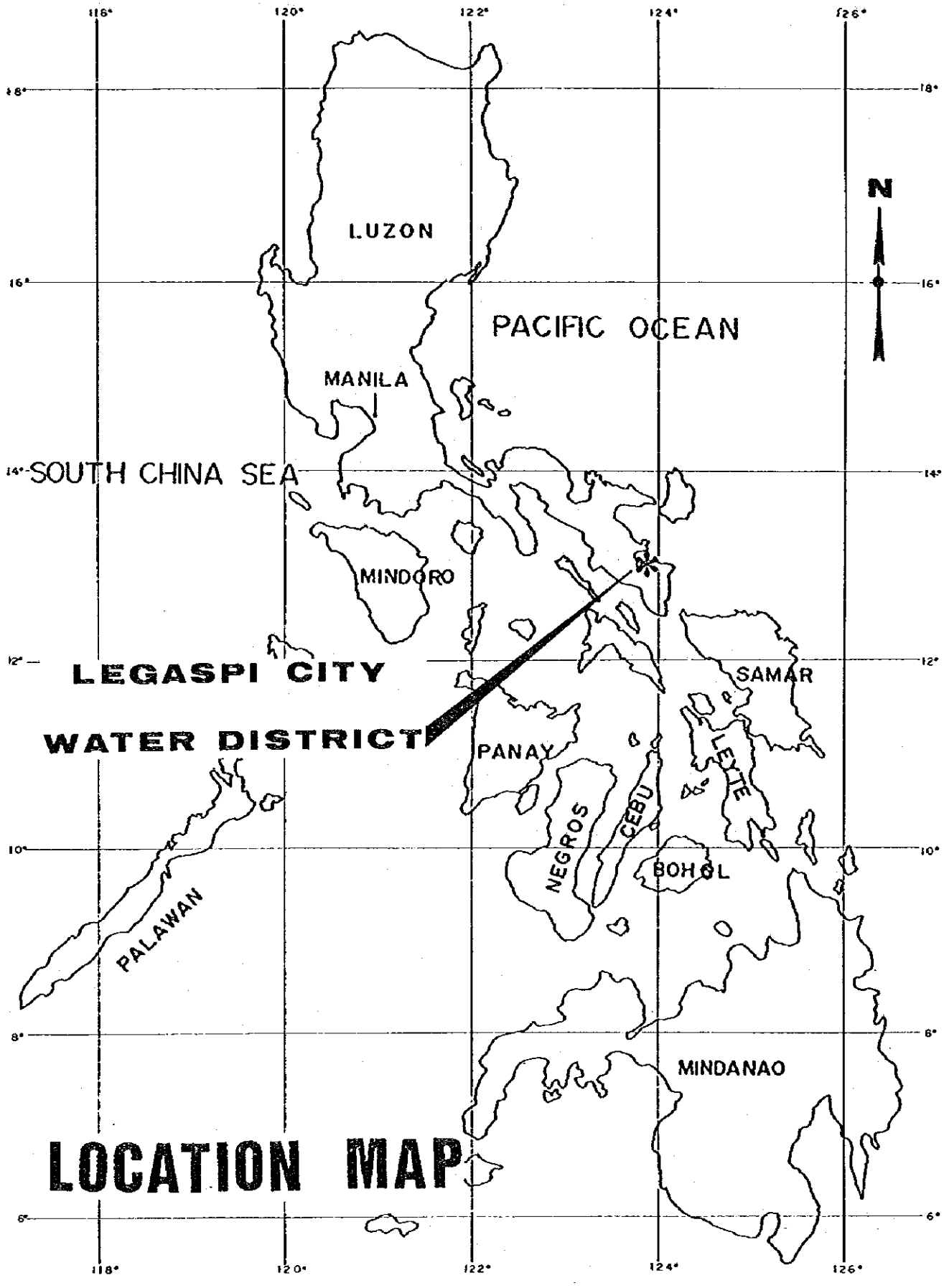
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

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

June, 1982



Keisuke Arita
President
Japan International
Cooperation Agency


LUZON
PACIFIC OCEAN
MANILA
SOUTH CHINA SEA
MINDORO
LEGASPI CITY
WATER DISTRICT
SAMAR
PANAY
LEYTE
CEBU
NEGROS
BOHOL
PALAWAN
MINDANAO
N
LOCATION MAP
0 20 40 80 120 160 200 240 280 miles
0 40 80 160 240 320 400 km

LIST OF CONTENTS

PART THREE: FEASIBILITY STUDY

APPENDIXES

ABBREVIATIONS

GOP	- the Government of the Republic of the Philippines
GOJ	- the Government of Japan
JICA	- the Japan International Cooperation Agency
LWUA	- the Local Water Utilities Administration
WD	- Water District
WTC	- willingness-to-connect
BPWS	- the Bohol Provincial Waterworks System
APWS	- the Albay Provincial Waterworks System
INMW	- the Ilocos Norte Metropolitan Waterworks
NEDA	- National Economic Development Authority
NCSO	- National Census and Statistics Office
BCGS	- Bureau of Coast and Geodetic Survey
NIA	- National Irrigation Administration
PAGASA	- Philippine Atmospheric, Geophysical and Astronomical Services Administration
NWRC	- National Water Resources Council
DPWTC	- Department of Public Works, Transportation and Communications
MPW	- Ministry of Public Works

mm	- millimeters
cm	- centimeters
m	- meters
km	- kilometers
cm^2, sq cm	- square centimeters
m^2, sq m	- square meters
km^2, sq km	- square kilometers
m^3, cu m	- cubic meters
cm/sec	- centimeters per second
m/sec	- meters per second
m^3/sec	- cubic meters per second
m^3/min, cu m/min	- cubic meters per minute

m^3/h, cu m/h	- cubic meter per hour
m^3/day, cu m/day	- cubic meters per day
l/sec	- liters per second
l/min	- liters per minute
l/c/d	- liters per capita per day
kg/cm^2, kg/sq cm	- kilograms per square centimeter
ha	- hectare
%	- percents
°C	- degrees centigrade
mg/l	- miligrams per liter
FTU	- function turbidity unit
pH	- potential of Hydrogen
ppm	- parts per million
mm/year	- *millimeters per year*
hp	- horse - power
rpm	- revolutions per minute
V	- volt
A	- ampere
kWh	- kilowatt-hour
kVA	- kilovolt-ampere
MVA	- mega volt-ampere
kW	- kilowatt
PVC	- polyvinyl chloride pipe
ACP	- asbestos cement pipe
CIP	- cast iron pipe
DIP	- ductile iron pipe
GSP	- galvanized steel pipe
SP	- steel pipe
Fig	- Figure

Currency Equivalent

US$1.00 = ₱7.80 (Philippine Peso)

Fiscal Year Period

from Jan. 1 to Dec. 31

SUMMARY

I. General

1.1 Physical and Socioeconomic Conditions

The Water District consists of Legaspi City, where are two poblacions, Old Albay and Legaspi Port. The poblacions have developed on the alluvial plain along the Yawa River, which divides the area to the mountain foot of Volcano Mayon and the densely inhabited plain. Major features are as follows.

(1)	Location:	Southeast of the Luzon Island in the Philippines; 500 km away from Manila
(2)	Topography:	Alluvial plain, sea coast and Mt. Mayon (2,462 m)
(3)	Climate:	Tropical climate with plentiful precipitation and high temperature Rainfall = 3,260 mm/year Not much variable temperature throughout the day and the year (Average = 27.0°C)
(4)	Population	98,790 in 1980, with 2.3 % of annual growth rate
(5)	Socio-Economic Conditions:	Identified as a commercial, trading center and educational center Dialect: Bicol (98%) Religion: Roman Catholic (98%) Public Water Supply: Existing, however poorly supplying Sewerage System: Not existing Electricity: 39 % in electrification Transportation: One airport, one seaport, one railway and highways

1.2 Existing Water Supply

Until the formation of the Water District in October, 1981, this District had been served by the waterworks of the Provincial Government including Daraga Municipality. Main water sources of the said waterworks are located in the municipal area of Daraga. Therefore, the District is situated on the farthest part from the water sources. Water supply conditions are most deplorable with extremely low water pressure; some places have no water at all during daytime. Features of the water supply of the District are as follows.

(1)	System:	Started in 1920's with Banadero Spring and in 1930's with Budiao Spring. Presently managed by Legaspi City Water District.
(2)	Water Source:	Two major springs of Budiao and Banadero
(3)	Distribution System:	28,310 m of distribution pipelines (200 mm - 50 mm in diameter) No regulating reservoirs
(4)	Present Water Use:	Maximum supply = 2,320 cu m/day Served Population = 18,600 Service Connections = Total 1,405 including 1,184 domestic connections
(5)	Water Rate:	Peso 11.0 per month for domestic (Minimum charge for the first 20 cu m)

II. Master Plan

A period from the present up to the year 2010 was taken for the design period of the master plan of Legaspi City Water District water supply. Percentage of served population to total population was planned to gradually rise from the present 19% to 64% at the end of the design period. Based on the served population, future water demand was projected.

All potential water sources to meet the projected water demand were investigated in and around the project area, including springs, groundwater and riverbed water. Selected water sources are Buyoan spring and riverbed water of the Yawa River.

The whole master plan period was divided into three Phases I, II and III. Phase I covers a period up to the year 1987 and plans to develop the spring water at Buyoan, together with improvement works of the existing water supply facilities. Phase II covers a period up to the year 1993 after Phase I. The rest period in Phase III, which will be subdivided into a few subphases, as required.

Major figures and work items are tabulated below.

(1)	Target Year:	Phase I	= 1987
		Phase II	= 1993
		Phase III	= 2010
(2)	Service Area:	Present	: 790 ha
		1987	: 1,130 ha
		1993	: 2,100 ha
		2010	: 3,450 ha
(3)	Population Projection:	Present	: 98,790
		1987	: 111,930
		1993	: 122,390
		2010	: 149,900

(4) Served Population:

Present	:	18,600 (19%)
1987	:	24,520 (22%)
1993	:	55,030 (45%)
2010	:	95,260 (64%)

(5) Water Demand:

Present	:	2,320 cu m/day
1987	:	6,410 cu m/day
1993	:	13,220 cu m/day
2010	:	25,880 cu m/day

(6) Water Source:

1987	:	Buyoan Spring
1993	:	Plus Yawa Riverbed water
2010	:	Additional Yawa Riverbed water

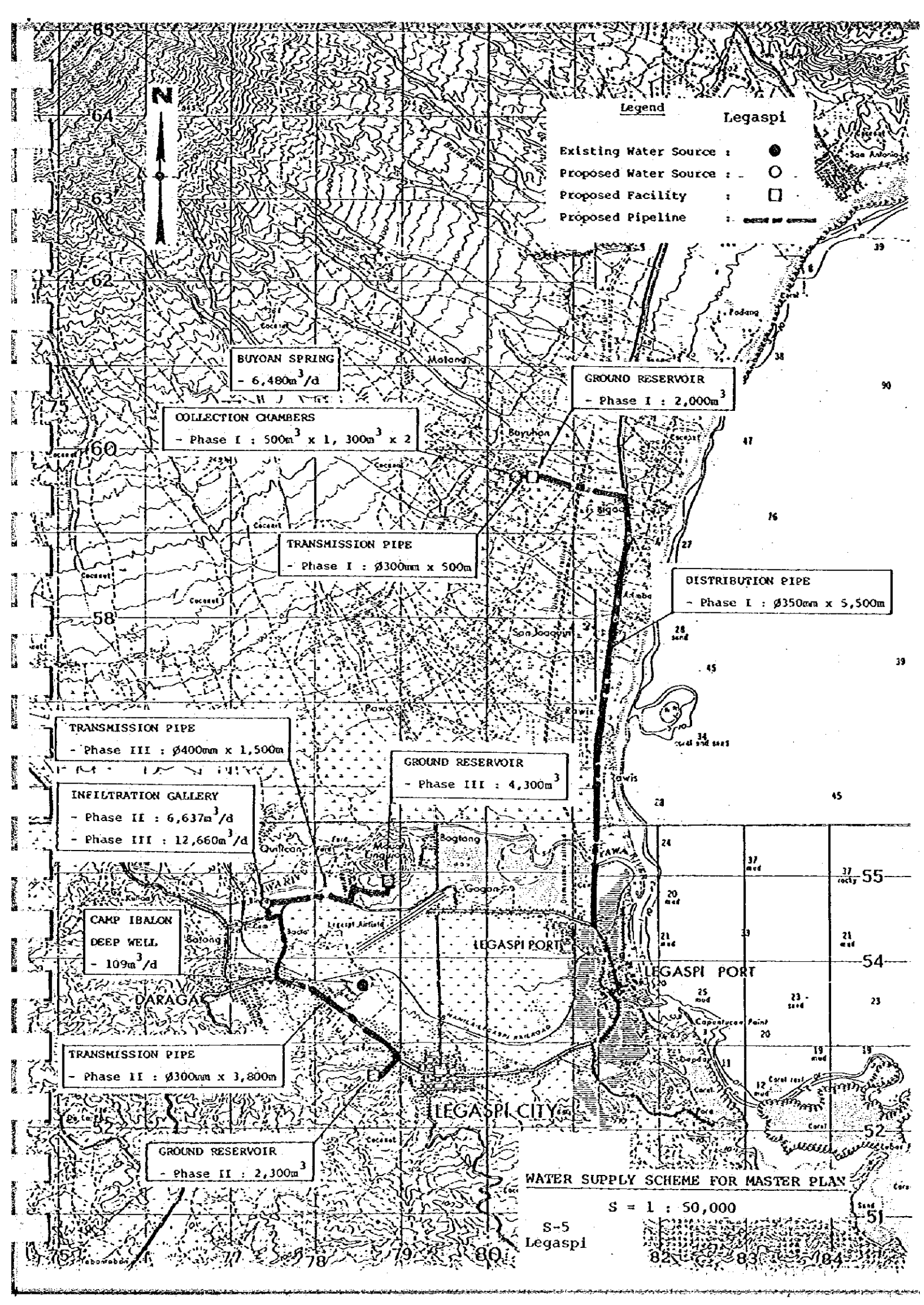
(7) Facilities to be Constructed:

See page 6 .

(8) Project Cost:

	Phase I	Phase II	Phase III
Foreign	$1.04 M	$ 2.49 M	$ 3.67 M
Local	$0.85 M	$ 1.61 M	$ 2.28 M
Total	$1.89 M	$ 4.10 M	$ 5.95 M

(Costs as of July 1981: Not including price escalation)


Legend
Legaspi
Existing Water Source :
Proposed Water Source :
Proposed Facility :
Proposed Pipeline :
BUYOAN SPRING
- 6,480m3/d
COLLECTION CHAMBERS
- Phase I : 500m3 x 1, 300m3 x 2
GROUND RESERVOIR
- Phase I : 2,000m3
TRANSMISSION PIPE
- Phase I : Ø300mm x 500m
DISTRIBUTION PIPE
- Phase I : Ø350mm x 5,500m
TRANSMISSION PIPE
- Phase III : Ø400mm x 1,500m
GROUND RESERVOIR
- Phase III : 4,300m3
INFILTRATION GALLERY
- Phase II : 6,637m3/d
- Phase III : 12,660m3/d
CAMP IBALON
DEEP WELL
- 109m3/d
TRANSMISSION PIPE
- Phase II : Ø300mm x 3,800m
GROUND RESERVOIR
- Phase II : 2,300m3
LEGASPI PORT
LEGASPI CITY
DARAGA
WATER SUPPLY SCHEME FOR MASTER PLAN
S = 1 : 50,000
S-5
Legaspi

Facilities to be Constructed

Phase I	Phase II	Phase III
i) Buyoan Spring System	i) Infiltration Gallery, System I	i) Infiltration Gallery, System II
a. Collection chambers	a. Infiltration gallery	a. Infiltration gallery
b. Reservoir	b. Reservoir	b. Reservoir
c. Transmission pipeline from the intake to the reservoir	c. Transmission pipeline from the gallery to the reservoir	c. Transmission pipeline from the gallery to the reservoir
d. Bulk meters	d. Bulk meters	d. Bulk meters
e. Chlorinators	e. Chlorinators	e. Chlorinators
ii) Others	ii) Others	ii) Others
a. Distribution pipelines	a. Expansion of distribution pipelines	a. Expansion of distribution pipelines
b. Water meters	b. Water meters	b. Water meters
c. Fire hydrants	c. Fire hydrants	c. Fire hydrants

III. Feasibility Study

Feasibility study was carried out for two potential cases: Case 1 study was made on the Phase I project, and Case 2 study on the combined project of Phases I and II. Case 1 study includes the development of Buyoan spring, and Case 2 study includes, in addition, the development of riverbed water of the Yawa River.

The results of both Case study indicate that both projects are feasible. The only difference is that the Case 2 project is to given a government subsidy of 20% of the total project cost.

(1) Implementation Schedule:

Phase I	:	1982 - 1986
Phase I + II	:	1982 - 1988

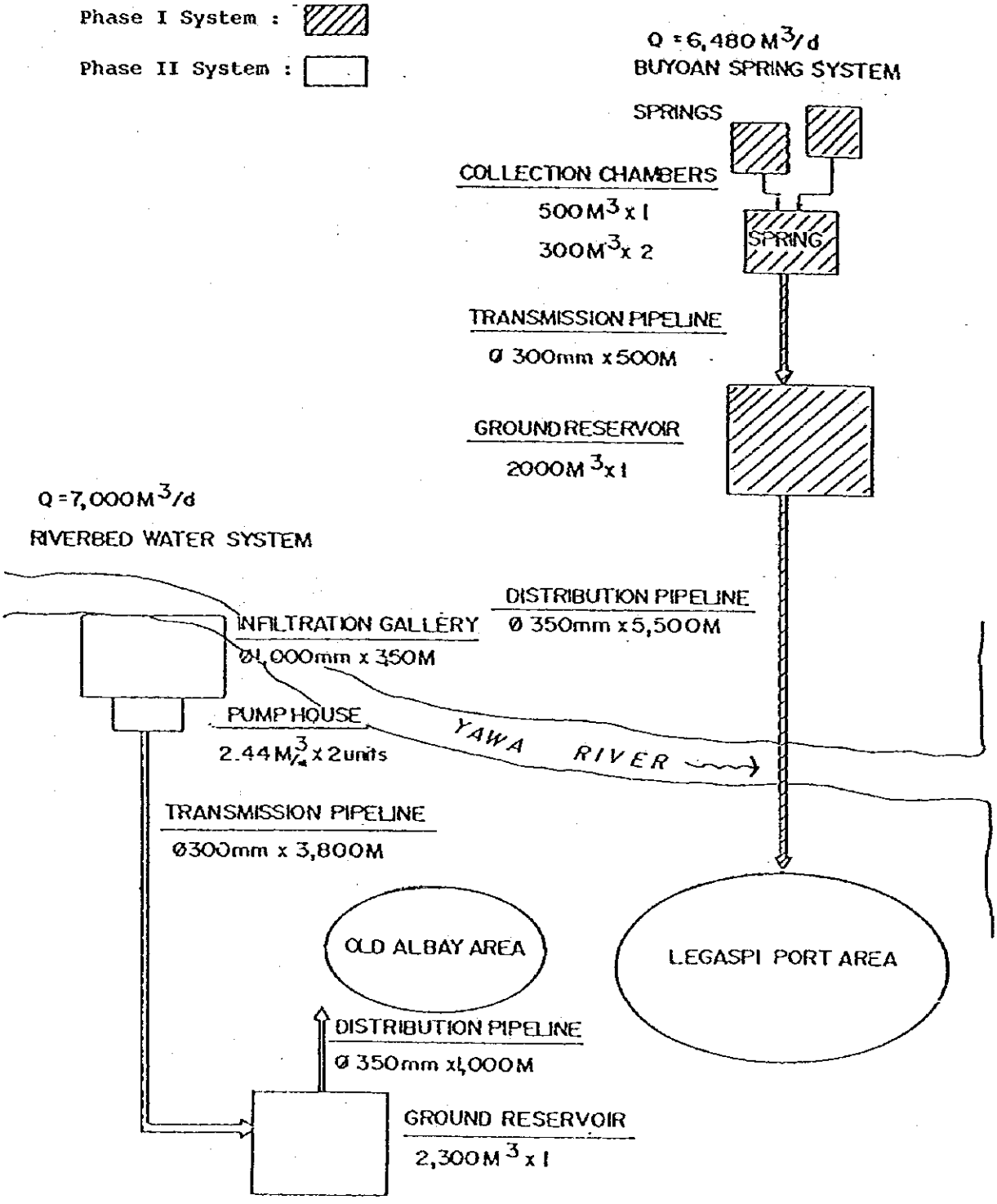
(2) Project Costs:

	Phase I	Phase I + II
Foreign	$1.64 M	$4.92 M
Local	$1.37 M	$3.72 M
Total	$3.01 M	$8.64 M

(Costs including price escalation according to implementation schedule)

(3) Financial Feasibility:

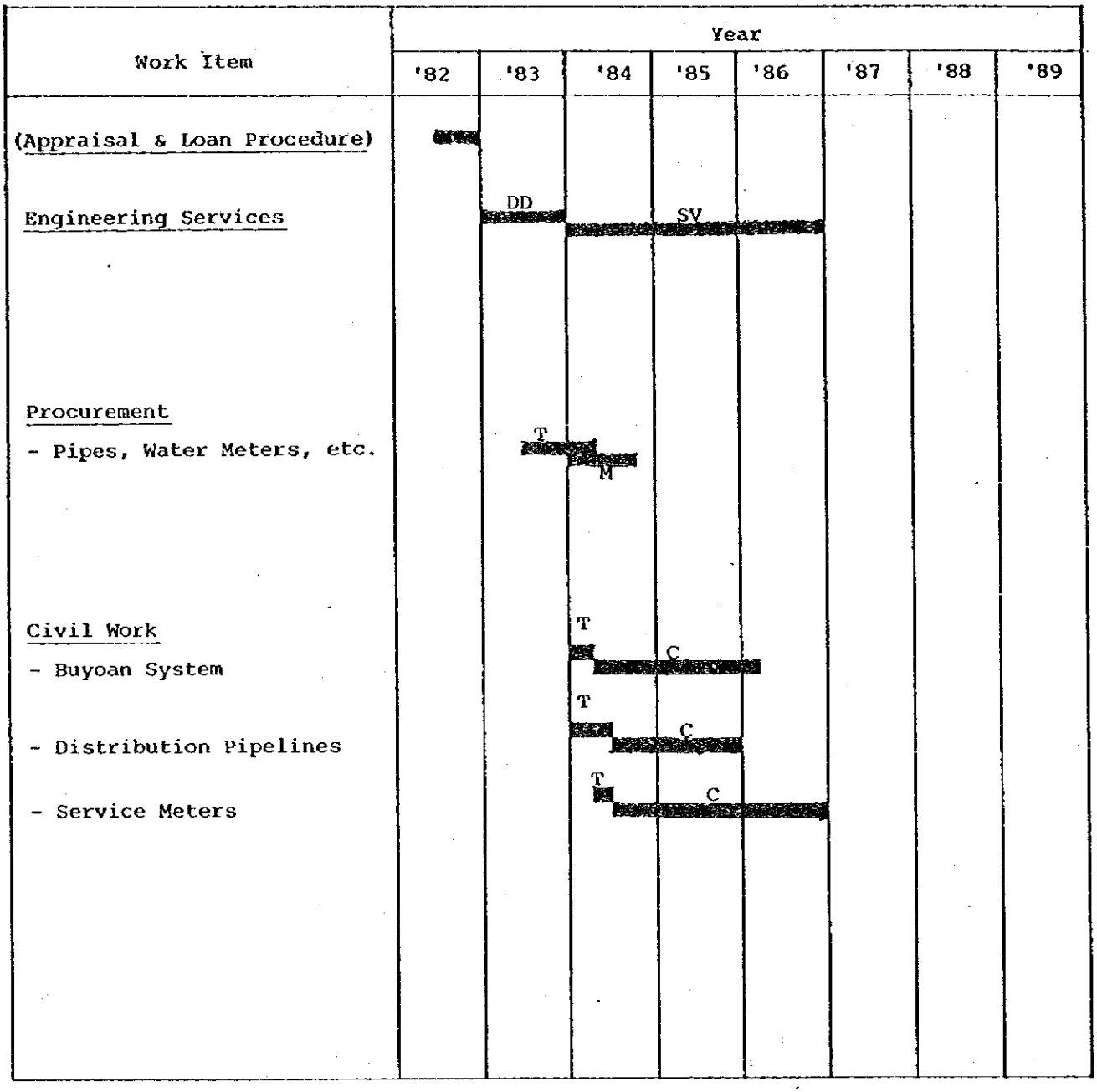
Phase I	:	Feasible
Phase I + II	:	Feasible with government subsidy of 20% of total investment cost



Proposed Water Supply System for Phase I and Phase II

Construction Schedule

(Phase I, Target Year: 1987)



Note: DD = Detailed Design
SV = Supervision of Construction
T = Tendering Procedure (Advertisement/Tendering/Evaluation/Award)
M = Manufacturing & Shipping
C = Construction/Installation

Legaspi

Project Cost for Phase I (Target Year: 1987)

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Items	Cost		
	Total Cost	Foreign Currency Component	Local Currency Component
A. Buyoan System	8,413	4,133	4,280
B. Reinforcement/Expansion of Distribution Pipelines	1,773	1,188	585
C. Other Equipment	1,513	1,102	411
Sub Total	11,699	6,423	5,276
Detailed Design Cost (10.5%)	1,228	737	491
Supervision Cost (3.5 %)	409	246	163
Land Cost	78	_	78
Total	13,414	7,406	6,008
Physical Contingency (10 %)	1,342	741	601
Total	14,756	8,147	6,609
Price Contingency	8,681	4,626	4,055
Grand Total (Project Cost)	23,437	12,773	10,664
	(Equivalent to US$3.01 M)	(Equivalent to US$1.64 M)	(Equivalent to US$1.37 M)

Water Rate Schedule

(Phase I)

DOMESTIC AND GOVERNMENTAL SERVICE CONNECTIONS, 1/2"

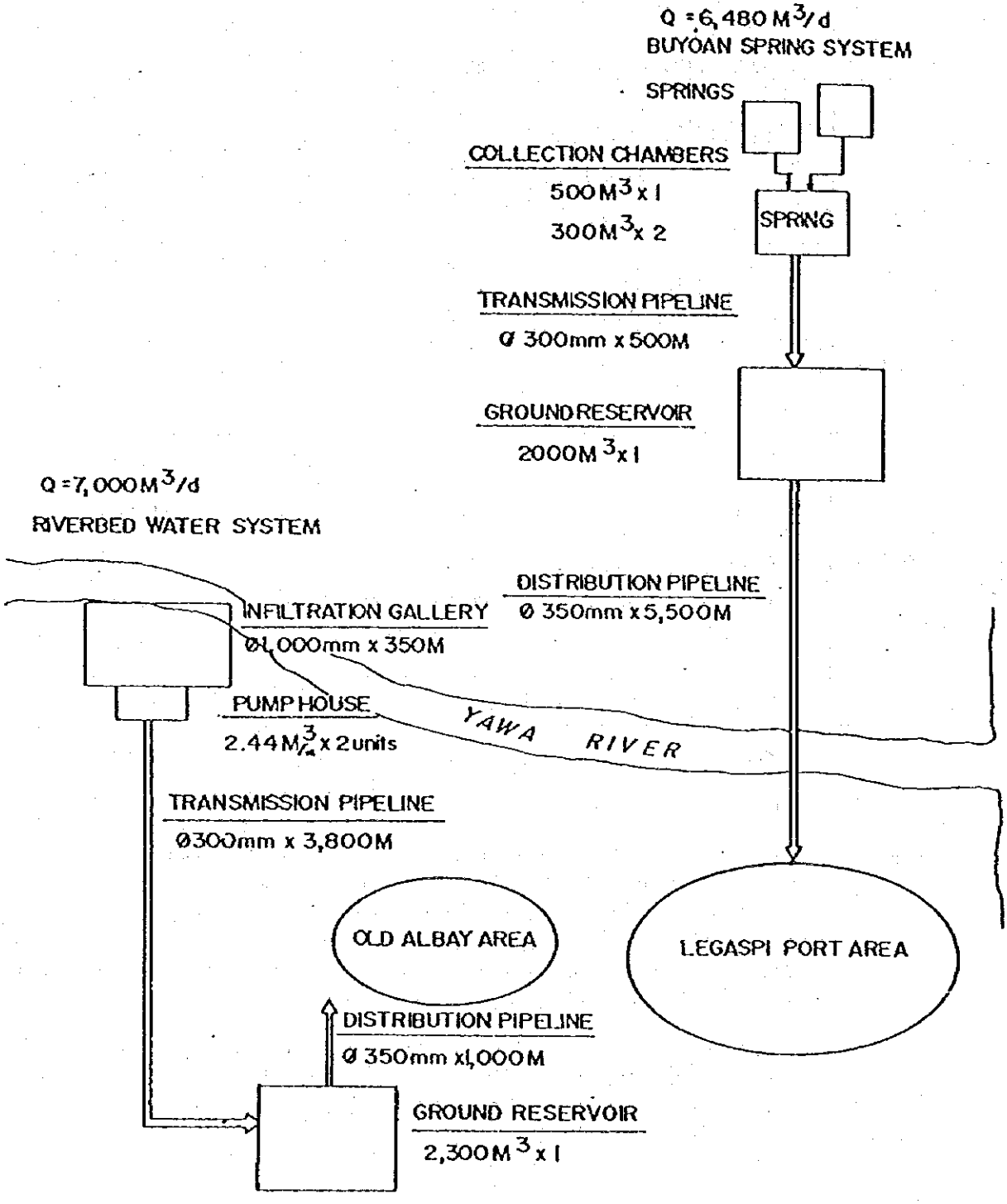
Year	First 10 m^3 1/	Charge for Each Added m^3 2/			Charge 3/ per Revenue Unit
		11-20	21-45	over 45	
1981	15.00	0.72	0.84	1.02	0.60
1982	15.00	0.72	0.84	1.02	0.60
1983	22.50	1.08	1.26	1.53	0.90
1984	36.25	1.74	2.03	2.47	1.45
1985	36.25	1.74	2.03	2.47	1.45
1986	36.25	1.74	2.03	2.47	1.45
1987	37.50	1.80	2.10	2.55	1.50
1988	42.50	2.04	2.38	2.89	1.70
1989	42.50	2.04	2.38	2.89	1.70
1990	42.50	2.04	2.38	2.89	1.70
1991	57.50	2.76	3.22	3.91	2.30
1992	62.50	3.00	3.50	4.25	2.50
1993	70.00	3.36	3.92	4.76	2.80

Note: 1/ To obtain charge per m^3 for the first 10 m^3 classified by connection size, multiply R.U. charge shown in 3/ above by the following connection size factors.

Domestic : 1.0 for 3/8"; 2.5 for 1/2"; 4.0 for 3/4"; 8 for 1"
Commerical: 5.0 for 1/2"; 8.0 for 3/4"; 16.0 for 1"; 40.0 for 1 1/2"

2/ To obtain charge for each added m^3, multiply R.U. charges shown in 3/ by the following block factors.

Domestic : 1.2 for 11-20 m^3; 1.4 for 21-45 m^3; 1.7 for over 45 m^3
Commercial: 2.4 for 21-45 m^3; 2.8 for 45-100 m^3; 2.4 for over 100 m^3

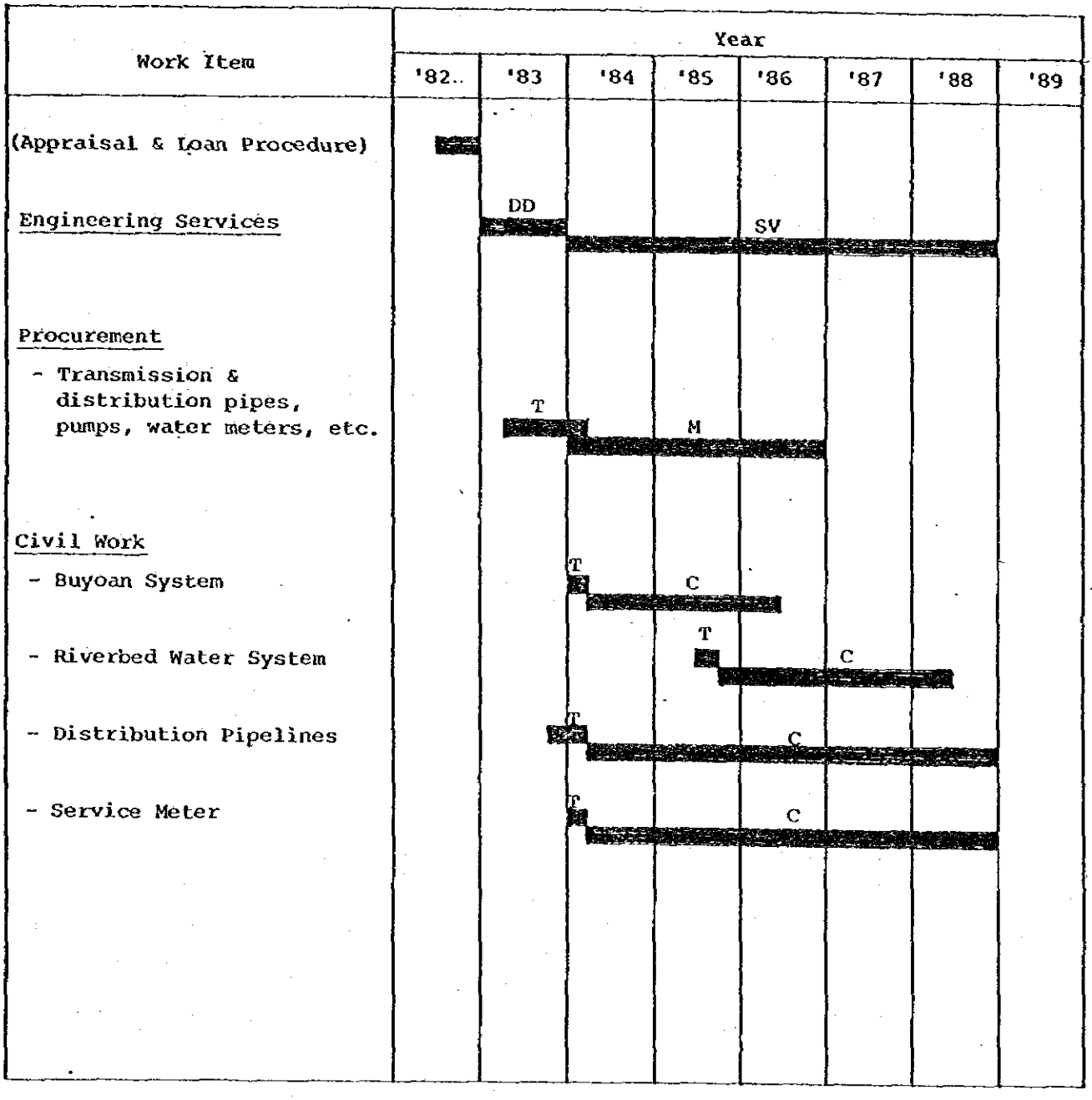


Proposed Water Supply System

(Target Year : 1993) Phase I + II

Construction Schedule (Phase I + II)

(Target Year : 1993)



Note: DD = Detailed Design
SV = Supervision of Construction
T = Tendering Procedure (Advertisement/Tendering/Evaluation/Award)
M = Manufacturing & Shipping
C = Construction/Installation

Legaspi

Project Cost for Phase I + II (Target Year: 1993)

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Items	Cost		
	Total Cost	Foreign Currency Component	Local Currency Component
A. Buyoan System	8,413	4,133	4,280
B. Riverbed Water System	9,670	4,903	4,767
C. Reinforcement/Expansion of Distribution Pipelines	4,663	3,124	1,539
D. Other Equipment	7,880	5,939	1,941
Sub Total	30,626	18,099	12,527
Detailed Design Cost (10.5%)	3,216	1,901	1,315
Supervision Cost (3.5 %)	1,072	634	438
Land Cost	143	-	143
Total	35,057	20,634	14,423
Physical Contingency (10 %)	3,506	2,064	1,442
Total	38,563	22,698	15,865
Price Contingency	28,839	15,659	13,180
Grand Total (Project Cost)	67,402 (Equivalent to US$8.64 M)	38,357 (Equivalent to US$4.92 M)	29,045 (Equivalent to US$3.72 M)

RECOMMENDATIONS

1. Implementation of the Project

The water supply Master Plan proposed a long term development program up to the year of 2010, and recommended its implementation by stages, namely, Phase I up to 1987, Phase II up to 1993, and Phase III up to the final target year 2010.

In accordance with the above recommendation, the present feasibility study was made with regard to two cases, i.e., Case 1 for Phase I project, of which the major intention is to maximize use of the existing facilities, together with urgent improvements and reinforcement works, and Case 2 for a combined project to Phase I and II, which includes, in addition to the Phase I works, development of a new water source/s and pipeline extension works.

The results of the study of the two cases indicate that both cases are technically and financially feasible, meeting satisfactorily the basic requirements concerning loan ceiling, water rate and consumers' paying ability. Case 2, however, is based on the given conditions that a national subsidy equivalent to 20% of the total project cost will be provided to the project.

As regards implementing the water supply development project, it is desirable to consider the Case 2 project, because it can meet the water requirement over a medium term future, contributing to the unimpeded social development of the community concerned. Decision of the implementation must be made solely depending on the national policy. If case 1 should be selected for implementation, the Phase II project should, needless to say, follow immediately the Phase I project.

2. Technical Recommendations

1) Periodic Review of Master Plan

In preparing and drawing out the present water supply master plan and feasibility study some assumptions were inevitably made owing to insufficiency of necessary data, and furthermore, the projected development of the area, together with water consumption, may possibly differ from the actual future development. Therefore, review and revision of the present report is recommended from time to time as required, at least once every five years after the commencement of the operation of Phase I or before implementation of the subsequent phases.

2) Population and Water Demand

Population growth may be influenced by changes in the social conditions and industrial development in the area, and water demand will be affected accordingly. Therefore, population, both total and served, and water demand should be continuously reviewed, and in addition the categorized water demand should be calculated. It is advisable to revise the projected figures in the master plan according to the above review.

3) Water Loss and Metering

Loss of water from the water supply system means insufficient operation and maintenance of resources and loss of revenue to the district. To maintain sound management and self-sustaining Water District, loss of water must be prevented by all means. Loss of water can be known by the metering of water production and consumption, and, by analyzing the results of metering, causes of and remedies for such loss can be established. Installation and maintenance of meters, on account of this, is essential for production points and all consumers' connections.

4) Future Merger of the Two Water Districts

The water demand in the short term can be met, as planned in the present master plan, by springs rather closely located to the two water districts, namely Legaspi City WD and Daraga WD. The water demand in the long term projection, however, has to be met by more costly developments of water sources on a large scale. In order to attain the least cost system construction and management of the water supply in the areas concerned, it is most desirable for the two water districts to merge as early as practicable.

5) Safety and Palatability of Water

The existing water supply system of the Legaspi City and Daraga WDs has chlorination equipments to disinfect the water to supply. To insure the safety of tap water, chlorination has to be constantly conducted, but the existing equipment is not necessarily well attended to satisfy this purpose. Some improvement is required.

The water from the deep well located near Camp Ibalon has fairly strong objectionable odor. The odor can be removed by aeration. In case the well is to be used continuously in the future, removal of odor is recommendable for better palatability.

6) Arrangement for Transition Period

It was only recently that the two water districts, Legaspi City and Daraga, were formed and the operation of the water supply facilities and management of the water supply business were started on an independent basis. However, until completion of the water source facilities of the Legaspi City WD, the bulk supply from the Daraga water system must be continued. In this connection, the following technical arrangement is recommended.

1. To install a bulk meter on each of the two distribution mains that cross the border of the two districts.
2. To make full use of the deep well at Camp Ibalon.

7) Improvement of Plumbing Systems

Since the water pressure has been extremely low so far, most of the plumbing system have been built in an abnormal way, namely, corporation cocks are fitted at the bottom of pipe, or pumps are installed onto the main, or private storage tanks and pumps are provided to plumbing systems. When the water pressure is heightened to the normal level by the project, all these devices will become causes for water loss. Therefore, all the plumbing systems must be checked and irregular devices be taken away. On the other hand, when there is an application for connection to the main, the design must be checked before execution so as to make sure the design is made in accordance with normal practice.

8) Measures to be Immediately Taken

Reduction of leakage and wastage is the most effective measure to substantially increase water supply. As water shortage in the served area is presently very acute, it is recommended, that the newly formed water district, should concentrate its effort on reduction of leakage and wastage even before the proposed project is started. Water thus saved can alleviate the suffering of the customers from water shortage, and may in addition be supplied to new customers. Besides, the financial position of the water district will be accordingly improved.

At present, leakage and wastage from the plumbing systems account for more than half that of the whole water supply system. Therefore, to maximize the results of the leakage abatement activities, all existing service systems should be inspected, and all leaks thereof be repaired.

Further, to discourage wasteful use of water, all the connections should be metered. If required, fund necessary for metering should be borrowed on a short term basis, though the cost for meter procurement and installation is provided in the present project cost.

9) Riverbed Observation

It is recommended to study the long-period seasonal movement of the riverbed of the Yawa, although the present planning selected a site for infiltration gallery which is considered to hardly be affected by flow, before construction and thereafter, in order to keep the original function of infiltration gallery to be installed.

10) Riverbed Water Quality

Although the riverbed water has presently good quality suitable for drinking, it may undergo changes in the future when more population concentrate along the river. Against such probable pollution of the river water, and further riverbed water, the following is recommended.

(1) To observe the variation of the riverwater quality by regular sampling and analysis.
(2) To observe the variation of the riverbed water quality after the commencement of the infiltration gallery operation.
(3) To watch the siting of factories which may discharge wastewater.
(4) To record the increase of population in the river basin.

When any sign of undesirable pollution is noticed, measures must be taken against wastewater with harmful quality, or for installation of a sewerage system, or addition of treatment processes to riverbed water, such as chlorination plus sand filtration method.

11) Water Right

Intake of water for water supply from water sources, such as springs and riverbed water, and construction of facilities for such water intake should be authorized/approved by authorities in charge in compliance with relevant laws and regulations. It is, therefore, recommended that formal procedures for such authorization/approval be taken before the implementation of the present project.

PART ONE: GENERAL

1. Introduction

1.1 Authorization

The present report on water supply master plan and feasibility study is prepared in accordance with the terms of reference of the Contract for the Engineering Services (the work) made between the Japan International Cooperation Agency (JICA) and Nihon Suido Consultants, Co., Ltd. (the Consultant) on June 22, 1981. The work was earlier requested by the Government of the Philippines to the Government of Japan, and the latter decided to undertake the work through JICA within the frame of the international cooperation program. With regard to execution of the present work, the leading agency of the Government of the Philippines is the Local Water Utilities Administration (LWUA).

1.2 Objective and Scope

The objective of the work is to establish a comprehensive water supply plan for the Legaspi City Water District (Study area) for a long term period up to the year of 2010, including preparation of a project having a highest priority for immediate implementation. The project, with such priority, will be studied with regard to its feasibility in the aspects both technical and financial in PART THREE.

The scope of the master plan covers:

1) Data collection and analysis,
2) Establishment of the target year for planning,
3) Definition of served area for planning,
4) Estimation of population,
5) Estimation of water demand,

6) Study of present status of waterworks,
7) Study of water source,
8) Planning of water supply system,
9) Rough estimation of costs for construction, operation and maintenance,
10) Preparation of implementation schedule,
11) Study of Interim Program,
12) Socio-economic study, and
13) Studies of organization, operation and management plan.

The scope of the feasibility study covers:

1) Definition of the target year,
2) Definition of project area,
3) Estimation of population to be served,
4) Estimation of the water demand,
5) Study of improvement of existing facilities,
6) Study of water source,
7) Study of required facilities and layout of facilities,
8) Study of design criteria,
9) Preliminary design,
10) Preparation of construction schedule,
11) Study of construction materials and labour force and study of construction ability of local contractors,
12) Preparation of construction method and procurement method of materials and equipments,
13) Estimation of costs for construction, operation and maintenance,
14) Estimation of benefits,
15) Financial analysis,
16) Studies of organization, operation and management plan, and
17) Preparation of Implementation program.

1.3 Terminology

The following words and terms in the present report mean as set forth below:

(a) Water District - local water district formed pursuant to the Provincial Water Utilities Act.
(b) Rural Waterworks Association - a rural waterworks association organized pursuant to the Executive Order No. 577.
(c) Level I system - developed point source, such as artesian well or protected spring, generally suited for clusters of around 15 households for a shallow well and 50 households for a deep well.
(d) Level II system - Level I plus a system of communal faucets, generally suited for more dense clusters of around 100 households.
(e) Level III system - system of individual house connections.
(f) Point Source - generally a protected well or a spring with no distribution system, which has a distance to the farthest user of no more than 250 m.
(g) Poblacion - an urbanized area in a city/town
(h) Barangay - a political unit or community in a city/town, however "Barangay" in this Report refers to that which is located outside of a poblacion.

1.4 Compilation of the Report

The existing water supply system was formerly owned and operated by the Albay Provincial Waterworks System and covers most of three poblacions of Daraga, Old Albay and Legaspi Port, and some barangays along the transmission lines. However, two water districts, one for the Municipality of Daraga and the other for the City of Legaspi, were formed in October 1981, the water supply system has been split into two systems under separate ownership and management, although the facilities have physically some connections. Real separation of the existing system can be achieved only when the plan are implemented to a large extent. Taking into account these circumstances, Part One: General of the present report will describe the general conditions and the water supply systems of the Provincial Waterworks area immediately before the formation of the two water districts, Legaspi City and Daraga, and Appendices covering all studies and investigations performed in the same area will be attached.

2. Present Conditions of the Study Area

2.1 Natural Conditions

2.1.1 Location

The study area consisting of the City of Legaspi and the Municipality of Daraga is located in the southeast of the Albay Province along the seacoast. The area is about 500 km away from Manila, and is linked with the latter by highway, railroad and airway. In addition, there is a good seaport, which connects with other ports in the country for transportation of goods. The City of Legaspi is the capital of the Province and forms a center of local administration, education and commerce.

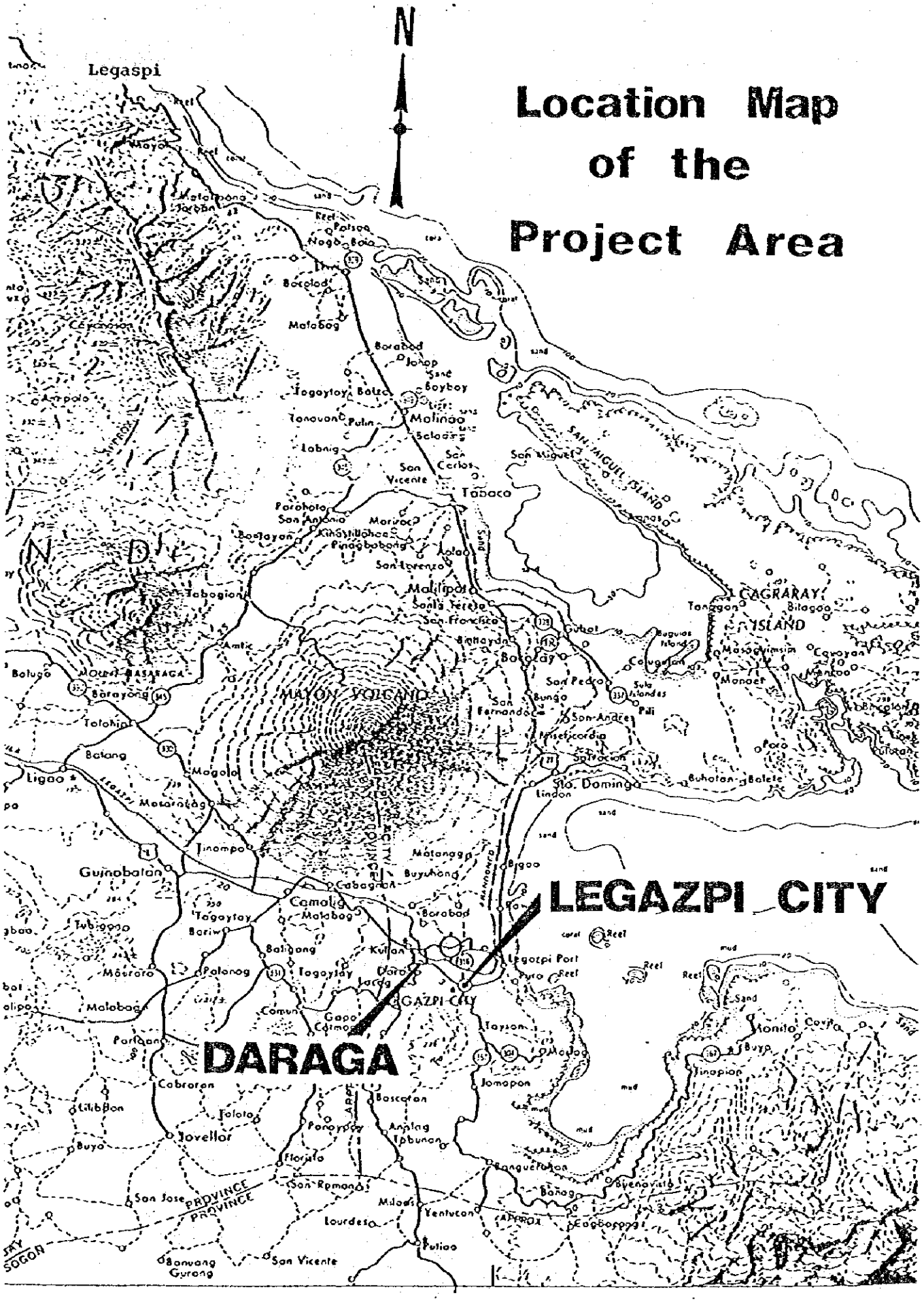
2.1.2 Topography

The study area includes mountains, an alluvial plain and the seacoast. An outstanding one of the mountains is the active volcano Mt. Mayon with an elevation of 2,462 m above sea level, which rises in the north of the area. Its gently sloped foot spreads into the study area, and to the sea on the east.

The Yawa River, which flows from west to east along the southern end of the volcano foot, has developed an alluvial plain. The built-up areas of the Daraga municipality and the Legaspi city are situated in this plain.

In the center of the plain and on the south bank of the Yawa River, there is Mt. Linguion, 165 m high, which is an old extinct volcano.

In the south of the study area, the lower Catabrean mountains stretch toward far south beyond the boundary of the area.


N
Location Map
of the
Project Area
Legaspi
MAYON VOLCANO
LEGAZPI CITY
DARAGA
CAGRARAY
ISLAND
SAN MIGUEL ISLAND
PROVINCE
PROVINCE
Scale 1:250,000
5 0 5 10 15 20 25 30 Kilometers

Three poblacions, Daraga, Old Albay and Legaspi Port, are in the plain with fairly dense population. The last named poblacion has a seaport, constructed taking advantage of the favorably shaped seacoast.

2.1.3 Geology

Geologically, the study area has three distinct areas, i.e., the Mt. Mayon, the alluvial plain and the lower Catabrean mountanous areas.

The Mt. Mayon area comprises lava flows, andesite, scoria and volcanic ash in the higher portion of the mountain slope, and mud-flows in addition to the above in the lower portion. The latter portion is predominantly covered with mud-flows, forming the gentle and smooth slope of the vast mountain skirts.

The alluvial plain has formations consisting of lapilli, volcanic sand ash, and clay. All these originate from the eruptions of Mt. Mayon and the formations of the lower mountains. The alluvial plain has been formed by the Yawa River with the transported material.

The lower mountainous area is formed of the Daraga formation, which consists of lava flows, agglomerates, volcanic breccia, tuff with interbeds of conglomerates, sand and shale.

2.1.4 Climate

The study area belongs to the tropical climate zone, with plentiful precipitation all through the year and high temperature. The period from November to January, in particular, is prominent in rainfall having a maximum monthly average of 415.3 mm, and the period from February to October has a high monthly average of 223.4 mm. The annual average rainfall is 3,256.4 mm (normal 1951-70), which is higher than that of the whole country, 2,500 mm. The area has no definite dry season.

The temperature is generally high and not much variable through the day and the year. The annual mean temperature is 27.0°C.

The area is situated on the typhoon belt and in the latter half of the year it is rather frequently hit by typhoons. Tropical depressions pass the area bringing abundant rains during the high rainfall months.

Table 1.2.1 Climate Record, Legaspi City

(Period: 1951 - 1970, Normal)
Source of Data: Annual Climatological River (PAGASA, March 1980)

Month	Rainfall (mm)	Rainy Days	Relative Humidity (%)
January	301.5	22	84
February	176.1	17	82
March	207.5	17	82
April	172.6	17	82
May	182.1	14	82
June	205.3	16	82
July	229.8	19	84
August	282.8	20	85
September	247.2	20	85
October	307.2	20	85
November	478.2	21	85
December	466.2	23	85
Annual	3,256.4	226	84

2.2 Population

The Population Census conducted in May 1980 registered a population of 98,787 for Legaspi City and that of 73,213 for Daraga; or an increase of 10,409 persons over the 1975 censual figures of 88,378 for Legaspi City and an increase of 9,948 persons for Daraga.

Table 1.2.2 (1) Past Population Trend: Legaspi City
(1970 - 1980)

Barangay	Population			Average Annual Growth Rates (%)		
	1970	1975	1980	1970-75	1975-80	1970-80
LEGASPI PORT DISTRICT						
1. Arimbay	1,422	1,653	1,817	3.1	1.9	2.5
2. Bagon Abre	460	558	745	3.9	6.0	4.9
3. Bigaa	2,816	3,036	3,262	1.5	1.4	1.5
4. Buyuan	1,463	1,934	2,117	5.7	1.8	3.8
5. Dap-dap	1,714	1,447	1,911	-3.4	5.7	1.1
6. Dita	532	634	724	3.6	2.7	3.1
7. Gogon	2,259	1,585	2,770	-7.3	11.8	2.1
8. Legaspi City Proper (u)	35,911	19,694	19,291	-	-0.4	-
9. Padang	901	996	1,450	2.0	7.8	4.9
10. Puro	2,154	2,639	3,069	4.1	3.1	3.6
11. Rawis	1,783	2,163	2,381	3.9	1.9	2.9
12. San Joaquin	785	905	1,105	2.9	4.1	3.5
13. San Roque	4,137	3,106	3,234	-5.9	0.8	-2.5
14. Tamadyan	482	576	611	3.6	1.2	2.4
Sub-Total	57,179	40,926	44,487	-	1.7	-
Note: (u) Urban						
ALBAY DISTRICT						
1. Bagacay	885	826	904	-1.4	1.8	0.2
2. Banquerohan	2,588	2,354	2,671	-1.9	2.6	0.3
3. Bariis	1,352	1,490	1,611	2.0	1.6	1.8
4. Bogna	2,463	2,580	2,946	0.9	2.7	1.8
5. Bogtong	1,496	1,707	1,974	2.7	2.9	2.8
6. Buenavista	352	403	530	2.7	5.6	4.2

- to be continued -

Table 1.2.2 (2) Past Population Trend: Legaspi City
(1970 - 1980)

Barangay	Population			Average Annual Growth Rates (%)		
	1970	1975	1980	1970-75	1975-80	1970-80
7. Cagbacong	1,619	1,705	2,045	1.0	3.7	2.4
8. Poblacion (u)		18,030	21,530	-	3.6	-
9. Cruzada	1,410	1,507	1,760	1.3	3.2	2.2
10. Estanza	1,533	1,683	1,927	1.9	2.7	2.3
11. Homapon	2,014	2,249	2,378	2.2	1.1	1.7
12. Imalnod	811	902	944	2.1	0.9	1.5
13. Mabini	625	841	937	6.1	2.2	4.1
14. Maritawa	828	1,020	1,282	4.3	4.7	4.5
15. Maslog	2,568	2,701	2,682	1.0	-0.1	0.4
16. Pawa	2,049	2,196	2,323	1.4	1.1	1.3
17. San Francisco	1,132	1,157	1,457	0.4	4.7	2.6
18. Taysan	3,186	4,101	4,399	5.2	1.4	3.3
Sub-Total	26,911	47,452	54,300	-	2.7	-
T O T A L	84,090	88,378	98,787	1.00	2.3	1.62

Note: (u) Urban

Table 1.2.3 (1) Past Population Trend: Daraga Municipality
(1970 - 1980)

Barangay	Population			Average Annual Growth Rates (%)		
	1970	1975	1980	1970-75	1975-80	1970-80
1. Alcala	1,503	1,607	1,768	1.3	1.9	1.6
2. Alobo	439	536	581	4.1	1.6	2.8
3. Anislag	2,218	2,448	2,819	2.0	2.9	2.4
4. Bagumbayan	951	1,121	1,280	3.3	2.7	3.0
5. Balinad	1,031	1,190	1,331	2.9	1.1	2.6
6. Banadero	917	1,070	1,158	3.1	1.6	2.4
7. Banag	1,268	1,314	1,775	0.7	6.2	3.4
8. Bascaran	1,608	1,698	2,241	1.1	5.7	3.4
9. Bigao	675	731	657	1.6	-2.2	-0.3
10. Binitayan	1,144	1,579	2,323	6.7	8.0	7.3
11. Bognalon	463	539	610	3.1	2.5	2.8
12. Budiao	985	1,218	1,417	4.3	3.1	3.7
13. Burgos	729	778	831	1.3	1.3	1.3
14. Busay	748	985	1,228	5.7	4.5	5.1
15. Canarom	543	520	587	-0.9	2.6	0.8
16. Culiat	576	780	861	6.3	2.0	4.1
17. De la Paz	444	426	482	-0.8	2.5	0.8
18. Dinoronan	368	407	386	2.0	-1.1	0.5
19. Gabawan	871	971	1,223	2.2	4.7	3.5
20. Gapo	1,240	1,591	1,520	5.1	-0.9	2.1
21. Ibaugan	317	382	447	3.8	3.2	3.5
22. Inarado	968	1,129	1,193	3.1	1.1	2.1
23. Kidaco	337	410	512	4.0	4.5	4.3
24. Kilicao	1,775	1,696	2,182	-0.9	5.2	2.1
25. Kimantong	1,176	1,252	1,527	1.3	4.1	2.6
26. Kinawitan	462	421	421	1.9	0	1.9
27. Kiwalo	571	656	709	2.8	1.6	2.2

- to be continued -

Table 1.2.3 (2) Past Population Trend: Daraga Municipality (1970 - 1980)

Barangay	Population			Average Annual Growth Rates (%)		
	1970	1975	1980	1970-75	1975-80	1970-80
28. Lacag	1,702	1,846	2,037	1.6	2.0	1.8
29. Mabini	443	509	611	2.8	3.7	3.3
30. Malabog	2,255	2,413	2,579	1.4	1.3	1.4
31. Melobago	395	423	495	1.4	3.2	2.3
32. Maopi	697	861	874	4.3	0.3	2.3
33. Maropoy	2,348	2,535	3,161	1.5	4.5	3.0
34. Matong	549	468	839	-3.2	12.4	4.3
35. Mayon	850	990	992	3.1	-	1.6
36. Mi-Isi	443	475	731	1.4	9.0	5.1
37. Nabasan	540	656	637	4.0	-0.6	1.7
38. Namantao	915	955	1,111	0.9	3.1	2.0
39. Pancan	670	593	638	-2.5	1.5	-0.5
40. Penafrancia	992	1,028	1,301	0.7	4.8	2.7
41. Poblacion	(4,389)	4,011	3,956	-1.8	-0.3	-1.0
42. Sagpan	3,545	3,577	4,696	0.2	5.6	2.9
43. Salvacion	1,161	1,311	1,780	2.5	6.3	4.4
44. San Rafael	217	216	306	-	7.2	3.5
45. San Ramon	1,363	1,369	1,373	-	-	0.1
46. San Roque	3,123	3,732	3,852	3.6	0.6	2.0
47. San Vicente Grande	891	779	758	-2.7	-0.5	-1.6
48. San Vicente Pequeno	132	181	192	6.5	1.2	3.8
49. Sipi	1,187	1,843	2,192	9.2	3.5	6.3
50. Tabon-tabon	827	930	1,058	2.4	2.6	2.5
51. Tagas	1,757	2,259	2,902	5.2	5.1	5.1
52. Talahib	683	694	732	0.3	1.1	0.7
53. Willamemmosa	1,035	1,156	1,340	2.2	3.0	2.6
T O T A L	58,335	63,265	73,213	1.63	2.96	2.30

These increases in terms of average annual growth are 2.3 percent for Legaspi City and 3.0 percent for Daraga.

The population in Legaspi City is distributed among 69 barangays in which 40,821 or 41 percent of the total is concentrated in urban areas while 57,966 or 59 percent is living in rural areas.

In Daraga, the urban population concentrated in the poblacion and the five neighboring barangays is estimated to be 25,889 or 35 percent of Daraga total population with the rural area population being 47,324 or 65 percetn of the total.

Populations both for Legaspi City and Daraga classified by barangay and their past trends, 1970 - 1980, are shown in Tables 1.2.2 and 1.2.3.

2.3 Socio-Economic Conditions

The study area consists of the City of Legaspi and the Municipality of Daraga. From the socio-economic point of view, Legaspi City and Daraga can be observed as one area. This is particularly true in the field of economic activities. They are both basically agricultural. In trade and commerce, Legaspi City and Daraga are complementing each other, as they serve their combined population and residents of the surrounding areas as well. The study area is becoming the commercial center of the Albay Province.

Manufacturing industries in the study area are of the small-scaled cottage type, with exception only of the Legaspi Oil Company and the Isalog Pulp and Paper Mill.

The household income in the study area remains considerably low, and nearly 80 percent of the urban households and 75 percent of the rural households are producing nearly one-fourth of the food they consume in order to cover the shortage of their monthly income.

Bicol is spoken by 98 percent of the population in the study area, and 99.3 percent of the people in Daraga and 96.5 percent of Legazenos are Roman Catholic.

Males and females are almost the same in number in the study area. More than half of the population in the area are under 20 years old.

The education level in the study area is high, reflecting the fact that the area is the educational center of the Bicol Region.

The dwelling conditions in the study area are, though improving, still poor with more than 70 percent of dwelling units roofed with nipa.

The transportation system in the study area includes one airport, one seaport and one railway line. The area, in addition, is served by a number of buslines and spot-to-spot jeepney transportation. The pavement ratio of the study area's roads is considerably high compared with other municipalities.

There have been proposed 18 communal irrigation systems in the study area but so far only one project is on-going.

The study area is being served by a provincial water supply system, though its service is not so satisfactory.

Electric power is being supplied by a semi-government entity, with an energization of 39.1 percent.

In the past five years, 1976 to 1980, Gastro-Enteritis, a typical water-borne disease, ranked 7th in the causes of both morbidity and mortality in Legaspi City. In Daraga, it ranked also 7th in the causes of mortality and 10th in the causes of morbidity.

The study area has 12 hospitals whose total bed capacity amounts to 861. The ratio of the households with flush-type and water-sealed toilets amounts to 50.2 percent in Legaspi City and 41.0 percent in Daraga.

For details, please refer to Appendix 5.

3. Existing Water Supply

3.1 General

The major existing water supply system in the study area is the water works system that was formerly owned and operated by the Provincial Government. The system serves three poblacions, Daraga, Old Albay and Legaspi Port. In addition, there are Level II systems in some barangays which are located far away from the poblacions. Further, there are a number of Level I systems, scattered in the three poblancions and barangays.

As regards the Level III system, details of which are dealt with in the following sections with a view to preparing most realistic water supply master plan, the present water supply conditions are far from satisfactory, due to deterioration of the water supply facilities and damages to water sources and transmission systems by the latest flood. Most of the served area has no water in the day time, and even in areas where water is available for 24 hours a day the water pressure is too low for use.

3.2 Water Sources

The water sources currently used by Level III, II and I systems in the study area are springs, deep wells and shallow wells, as shown in Table 1.3.1. Water quality of major water sources and drinking water quality standard in the Philippines are shown in Appendix 1. Details of which are summarized below.

(1) Springs

Springs are very widely used for water supply in the study area. Main supply sources of the Albay Provincial Waterworks System are also springs, namely Budiao I, Budiao II, Banadero and Daraga Springs. Most

Table 1.3.1 Conditions of Existing Water Sources

Name of Source	Kind of Source	Level	Production (cu m/d)	Place	Odor 1/ Intensity	Color (Unit)
Budiao I	Spring	III	3,600 2/	Daraga	0	0
Budiao II	Spring	III	3,760 2/	Daraga	0	0
Banadero	Spring	III	2,940 2/	Daraga	1	0
Daraga	Spring	III	154 2/	Daraga	1	10
Camp Ibalon	Deepwell	III	109 2/	Legaspi	3	15
Bogtong	Spring	II	850 3/	Legaspi	1	0
Salbacion	Spring	II	-	Daraga	0	0
Tinapian	Spring	II	5,180 3/	Manito	0	0
Lacag	Spring	II	260 3/	Daraga	0	30
Buyoan	Spring	I	7,230 3/	Legaspi	0	0
Tinago	Deepwell	I	35 3/	Legaspi	4	20
Malabog	Spring	I	-	Daraga	2	0
Bicol	Deepwell	Private	-	Daraga	4	8
Binato	Deepwell	Private	-	Legaspi	5	40
Imperial St.	Shallowwell	Private	-	Legaspi	0	0
Daraga	Shallowwell	Private	-	Daraga	0	0
Curuzada	Shallowwell	Private	-	Legaspi	4	0

Note

1/

Odor Intensity	Description of Odor
0	Non
1	Barely perceptible
2	Perceptible
3	Easily perceptible
4	Strong
5	Intense

2/ According to data obtained from the Provincial Waterworks

3/ Measured by the Team

of the springs in the study area are located at the foot of Mt. Mayon, and the yield of each of these springs is fairly large. Their characteristics are that 1) they are located at high elevations, about 100 m or more above sea level, 2) their yields vary according to seasons, and 3) the water quality of the springs at the foot of that mountain is generally good, having few bacteria and little odor, low concentrations of dissolved matters and turbidity.

Other springs located at Mt. Linguion and the lower mountains are not much in yield, and some of them have odor of hydrogen sulfide.

(2) Deep Wells

Some deep wells have been sunk in the poblacion area for use by Level II and I systems and sometimes for private use. Almost all of the deep well water has very poor quality as shown in Table 1.3.1 and Appendix 1, having strong odor of hydrogen sulfide and high value of color, which may derive from the characteristics of the formations ejected from the volcano. Removal of odor and color is not practically recommendable. (Refer to Appendix 1)

(3) Shallow Wells

Shallow wells are used mostly for private domestic use. They have rather good quality compared with that of the deep wells as shown in Table 1.3.1 and Appendix 1.

3.3 Distribution System

The existing distribution system of Level III, of which water sources are mentioned in Table 1.3.1 in the foregoing section is composed of mainly two systems of Budiao and Banadero springs. The system does not, in a precise meaning, have a transmission system, but the pipeline between the intake and the entrance at the poblacion of Daraga will be termed transmission line, and the networks covering the three poblacions of Daraga, Old Albay and Legaspi Port will be called distribution system, for convenience of description. The system is illustrated in Figs. 1.3.2, 1.3.3. and 1.3.4.

(1) Budiao Spring System

The Budiao spring system serves, by gravity, mainly the two poblacions of Daraga and Old Albay through the transmission line, 200 mm in diameter and 5 km in length, consisting of ACP and CIP, constructed in 1960. This system has been reinforced with a spring located in the Daraga poblacion and a deep well sunk near Camp Ibalon. Production of the above two sources is being pumped directly into the distribution networks. Even with this enforcement, water is insufficient and water pressure in both transmission and distribution lines is extremely low.

Presently, the water intake at the spring is less than 3,900 cu m/day, which is the calculated carrying capacity of the pipeline, against the yield 7,360 cu m/day, as reported in Appendix 6.

(2) Banadero Spring System

The Banadero spring system serves, by gravity, the poblacions of Legaspi Port through the transmission line and a distribution main laid on the north side of the served area. The transmission line is 150 mm in diameter, 4 km in length and of ACP, constructed in 1970. This system is currently out of service because of serious damage by a typhoon in June 1981.

Water intake at the spring is none at present. The capacity of the pipeline is estimated at 2,200 cu m/day against the recorded yield 2,940 cu m/day.

(3) Distribution Networks

First distribution pipelines were installed in 1927 and since then extensions of pipelines were made in 1950's and 1970's. Pipe materials are of cast iron, steel, asbestos cement and galvanized iron. (Refer to Table 1.3.2.)

Tthere are several public faucets on the Budiao transmission pipeline and in the poblacion; they are presently used by neighboring people. Fire hydrants were installed in 1930's, however, they are not sufficient

in numbers and their actual function is in doubt. Air valves and blow-off rbanches are equipped to some extent.

Supply conditions are from satisfactory, and Old Albay and Legaspi Port, in particular, have no water during daytime. Some consumers take water by pump from the main during night time as water pressure is very low. As described in Appendix 3, water pressure recording was made only in the Daraga area for the above reason.

As regards leakage, visible leaks on the ground surface are very rare, but this fact leads to suspicion that invisible underground leaks may exist. To ascertain actual conditions of the existing pipelines, some representative spots were dug to inspect the soil and the conditions of pipe corrosion. Major findings of the investigation were that pH of the soil was generally higher than 7, sulfate concentrations ranged from 91 ppm to 182 ppm, and chloride contents were in a range of 0.7 ppm to 16.9 ppm. Exterior surface of the laid pipe had encrustations, but pittings of the pip wall were not detected.

From the above conditions, as well as the results of water analysis, leaks may, it is concluded, be attributable to the aging of the pipelines and the poor maintenance of all the facilities; it may not be caused by soil corrosiveness.

Table 1.3.2 Existing Distribution Pipeline

Diameter (mm)	Length (m)			Material
	Legaspi	Daraga	Total	
200	2,405	5,125	7,530	CCI, ACP SP
175	3,500	5,000	8,500	SP
150	8,360	4,375	12,735	CCI, ACP
100	8,638	2,515	11,153	CCI, ACP
75	4,632	2,850	8,255	ACP, GI
50	1,043			GI
Total	28,308	19,865	48,173	

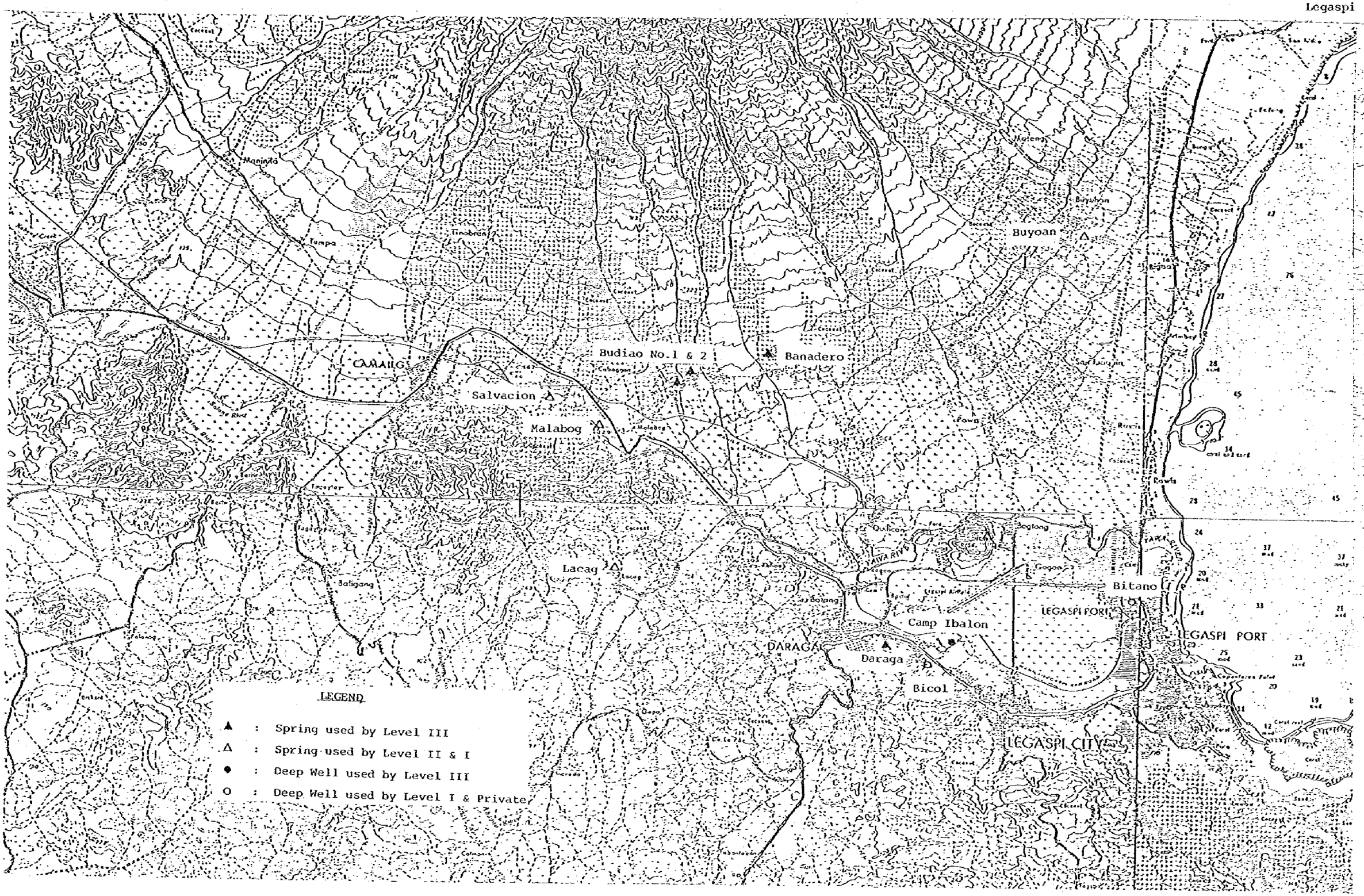


Fig 1.3.1 Location of Existing Water Sources

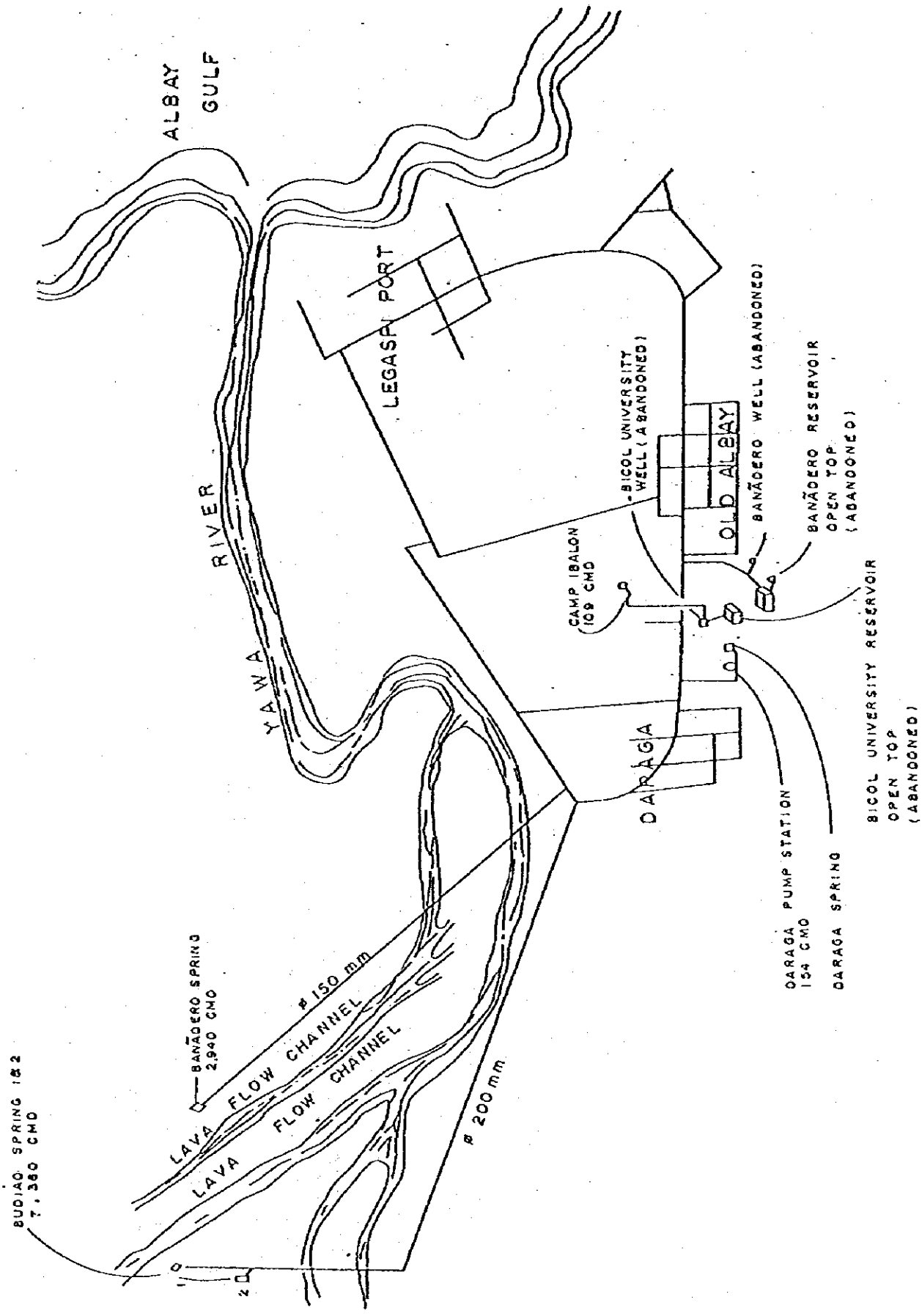


Fig 1.3.2 Existing Water Supply System

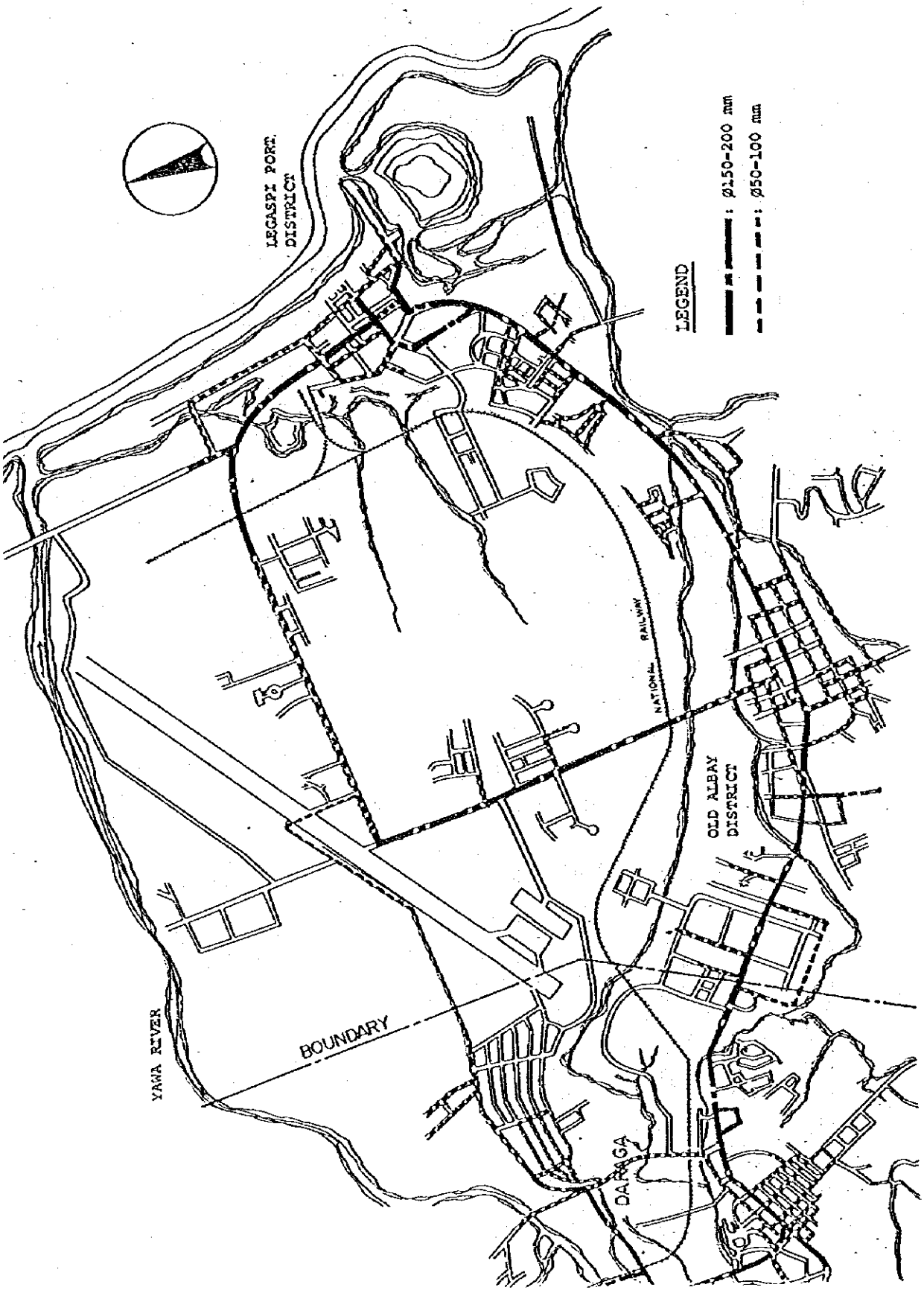


Fig 1.3.3 Existing Distribution Network (Legaspi)

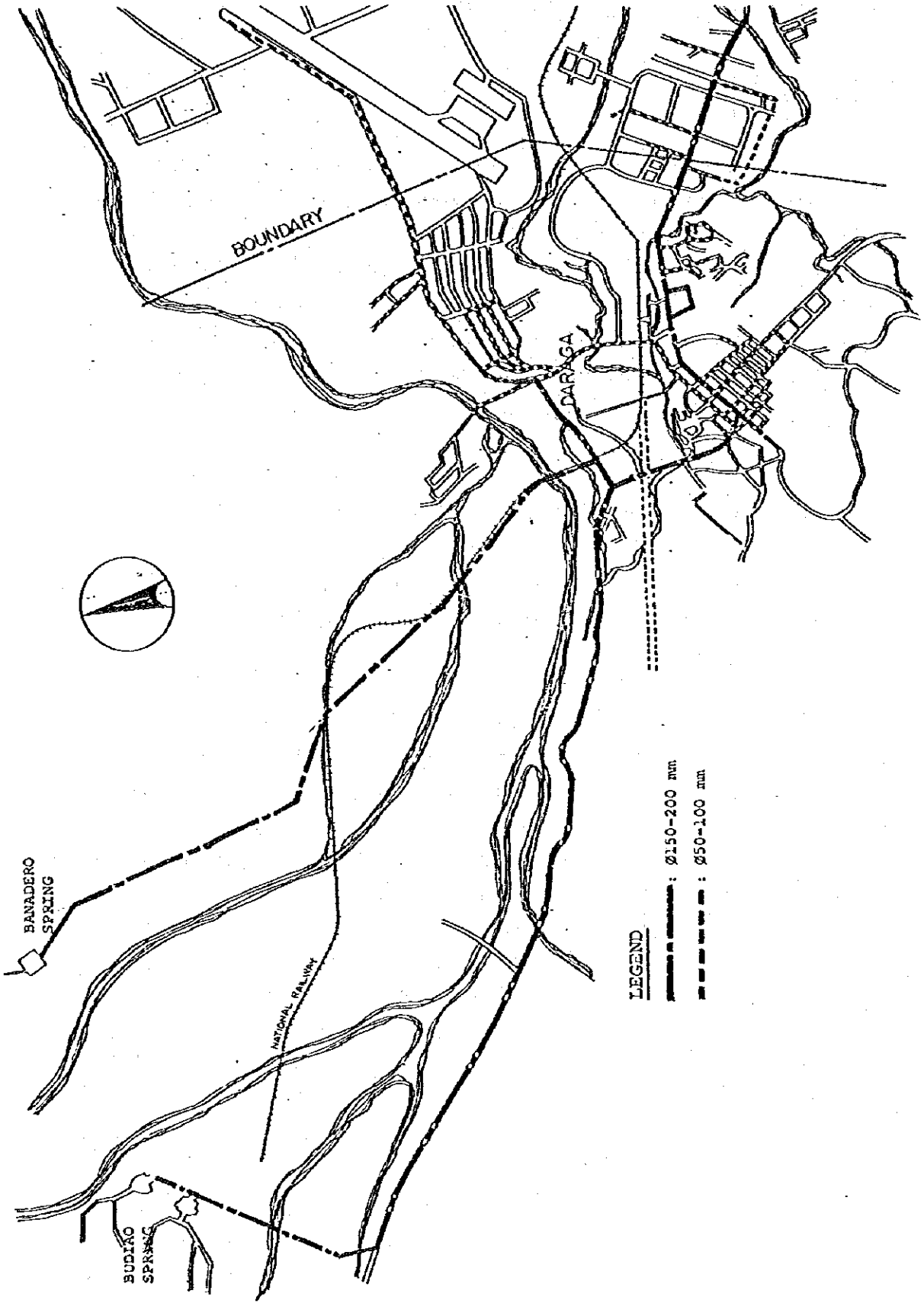


Fig 1.3.4 Existing Distribution Network (Daraga)

3.4 Present Water Use

Present sources of water supplies for the study area are 1) Budiao I and II springs, 2) Banadero spring, 3) Daraga spring, and 4) Camp Ibalon deep well. Total production amounts from the above sources are estimated as 10,563 cu m/d,details are described in 3.2 Water Sources. As stated in the preceding section, however, the Budiao transmission pipeline has only a carrying capacity of 3,900 cu m/d against the yield of 7,360 cu m/d The Banadero spring system has not been functioning since June 1981 because of the serious damage caused by a typhoon.

At present the total amount of water supply for Albay Provincial Waterworks System is estimated as 4,163 cu m/d at a maximum basis.

According to the APWS office, the served population is approximately 36,500 in total which may be split into two as 18,600 and 17,900 for Legaspi and Daraga respectively.

The present service connections are 1,405 and 1,229 for Legaspi and Daraga respectively. Out of the above total connections, the metered service connections are only 115 or 8 per cent of the total and 186 or 15 per cent in Legaspi and Daraga respectively. The breakdown of service connections by use categories in Legaspi and Daraga is shown in a table below.

Table 1.3.3 Present Service Connections

Use Category	Legaspi	Daraga
Domestic	1,184	1,125
Commercial	151	81
Industrial	5	12
Institutional	27	5
Public stand pipes	38	6
Total	1,405	1,229

Total Legaspi and Daraga 2,634

System loss and leakage are not obtainable from the balance of supply and consumption due to the shortage of supply and the very low pressure in the system, which is causing a suppressed supply conditions for the consumer.

3.5 Present Water Rates

3.5.1 Procedure for Determining Water Rates

The original establishment of water rates and their changes are recommended by the Waterworks Superintendent through the Provincial Treasurer to the Provincial Governor. Based on the initiative of the Provincial Governor, the Sangguniang Panlalawigan (Provincial Board) deliberates upon and approves the recommended water rates. A public hearing is sometime conducted by the Sangguniang Panlalawigan for this purpose.

3.5.2 Present Schedule of Water Rates

The present water rates were approved in 1977. As shown in Table 1.3.4, the minimum water rates are p11.00 for domestic consumption; p19.00 for commercial; and p23.00 for industrial consumption.

Legaspi

3.5.3 Billing and Disconnection

Water bills are rendered monthly to consumers by bill collectors. The bills are then paid within a period of five days. Disconnection is usually ordered for delinquent consumers who fail to pay the water bills after the period of five days.

Table 1.3.4 Present Schedule of Water Rates

1. Flat Rate

Domestic	- p11.00 for the first faucet, plus p3.00 for each additional faucet or outlet
Commercial	- p19.00 for the first faucet, plus p4.00 each additional faucet or outlet
Industrial	- p23.00 for the first faucet, plus p5.00 for each additional faucet or outlet

2. Meter Rate

Domestic	- p11.00 minimum charge for the first 20 cu m.
	p 0.30 per cu m. for the first additional 10 cu m.
	p 0.20 per cu m. for the first additional 20 cu m.
	p 0.15 per cu m. for all additional consumption
Commercial	- p19.00 minimum charge for the first 20 cu m.
	- p 0.40 per cu m. for the first additional 20 cu m.
	- p 0.30 per cu m. for the first additional 40 cu m.
	- p 0.20 per cu m. for the first additional 60 cu m.
	- p 0.15 per cu m. for all additional consumption
Industrial	- p23.00 minimum charge for the first 20 cu m.
	- p 0.50 per cu m. for the first additional 30 cu m.
	- p 0.40 per cu m. for the first additional 40 cu m.
	- p 0.30 per cu m. for the first additional 60 cu m.
	- p 0.20 per cu m. for the first additional 80 cu m.
	- p 0.15 per cu m. for all additional consumption

Source of Data: Albay Provincial Waterworks System.

3.6 Present Institutional Water Supply Practice 1/

3.6.1 Responsible Agency

The Albay Provincial Waterworks is owned and operated by the Provincial Government of Albay. Its Superintendent and other staff members are all Provincial Government Officials and employees.

3.6.2 Policy-making Function

The policy-making function relating to water supply and the implementation of those policies are carried out by the Provincial Governor, subject to the resolution or approval of the Sangguniang Panlalawigan (Provincial Board).

Remarks: 1/ As described in Part One: 1.4 Compilation of the Report, the existing water supply system was formerly owned and operated by the Albay Provincial Waterworks System; two water districts, one for Legaspi City and the other for the municipality of Daraga, were formed in October 1981. The former water supply system has been split into two systems under the separate ownership and management; institutional development of the two districts is in process of organization now under the assistance of LWUA. Taking into account these circumstances, this section will treat the institutional water supply practice of the Albay Provincial Waterworks System that is the situation just before the formation of the two water districts.

3.6.3 Direct Responsibility

The direct responsibility for important tasks such as the preparation and execution of annual budgets for the Waterworks and recommendation of changes in water rates is placed in the Provincial Treasurer. In these important matters, the role of the Waterworks Superintendent is indirect and limited to the presentation of necessary reference data to the Provincial Treasurer.

3.6.4 Accounting and Finance

The accounting of the Waterworks is not separated from that of the Provincial Government, and the income and expenditures of the Waterworks are accounted as part of the Provincial income and expenditures. The expenditures of the Waterworks System consist of "personal service", "maintenance and other operating expenses", and "capital outlay", which are subdivided into 15 items. These expenses and outlays are financed by collected water rates, other consumers contributions and provincial government subsidies. Tables 1.3.5 and 1.3.6 show the income and expenditures of the Waterworks for 1979 and 1980 and its budget for 1981. The annual surplus or deficit is not carried over to the following fiscal term, but is incorporated into the surplus or deficit of the Provincial Government accounts. The Provincial Audit audits the accounts.

3.6.5 Relationship with Consumers

The relationship of the Waterworks with the consumers is governed by the Provincial Tax Code and the Contract on Water Services which is made between the Provincial Government and each consumer.

3.6.6 Organization

The staff of the Waterworks is organized as shown in Fig 1.3.5, and consists of the superintendent and other 39 staff members, who are grouped into two divisions, i.e., "Technical Division" and "Administrative Division".

3.6.7 Office Procedures

The description of the assignments to each staff member is given by the Provincial Governor but the functional relationship among the staff members is not clear enough to show the chains of command. Delegation of authority and inter-division communication are being done at the discretion of each staff member in charge. The Waterworks has no written office procedures and no manuals for the maintenance and operation of the water supply facilities.

3.6.8 Personnel Management

The Waterworks has no established system of recruitment. The Waterworks Superintendent recommends placements and promotions of the personnel to the Provincial Governor. The Waterworks has no programs for personnel training. New-comers are usually trained by senior staff members on the job.

Legaspi

Table 1.3.5 Statement of Income and Expenses
(1979 - 1980)

Republic of the Philippines
PROVINCE OF ALBAY
LEGAZPI
Office of the Provincial Treasurer

August 17, 1981

The Provincial Waterworks Superintendent
Legaspi City

S i r :

In connection with your letter dated August 10, 1981 hereunder is the Statement of Income and Expenses for the period 1979-1980:

	1979	1980
INCOME:		
Water Fees Collections	P 334,728.23	P 332,982.67
EXPENSES:		
Salaries & Wages	P 208,076.89	P 238,456.48
Life & Retirement Cont.	9,998.23	11,155.53
Medicare Contributions	1,696.52	1,877.26
State Insurance	1,622.09	1,597.70
Living Allowance	12,700.00	11,650.00
Travel & Transportation	15,915.80	13,525.80
Supplies & Materials	40,459.05	30,734.41
Gasoline & Spare Parts	30,568.57	48,138.05
Communication	950.09	1,005.43
Repair & Equipment	859.00	928.00
Other Services	300.00	63.25
Capital Outlay	48,164.60	-
T o t a l	P 379,248.49	P 364,124.72

Very truly yours,

NICANOR MIRANDA
Asst. Provincial Treasurer
For and in the absence of the
Provincial Treasurer

Local Budget Preparation Form No. 152

PROGRAM APPROPRIATION AND OBLIGATIONS BY OBJECTS

Agency: Water Management Service

Unit/Department: Provincial Waterworks

ALBAY

APPROPRIATION LANGUAGE

Page No. 109

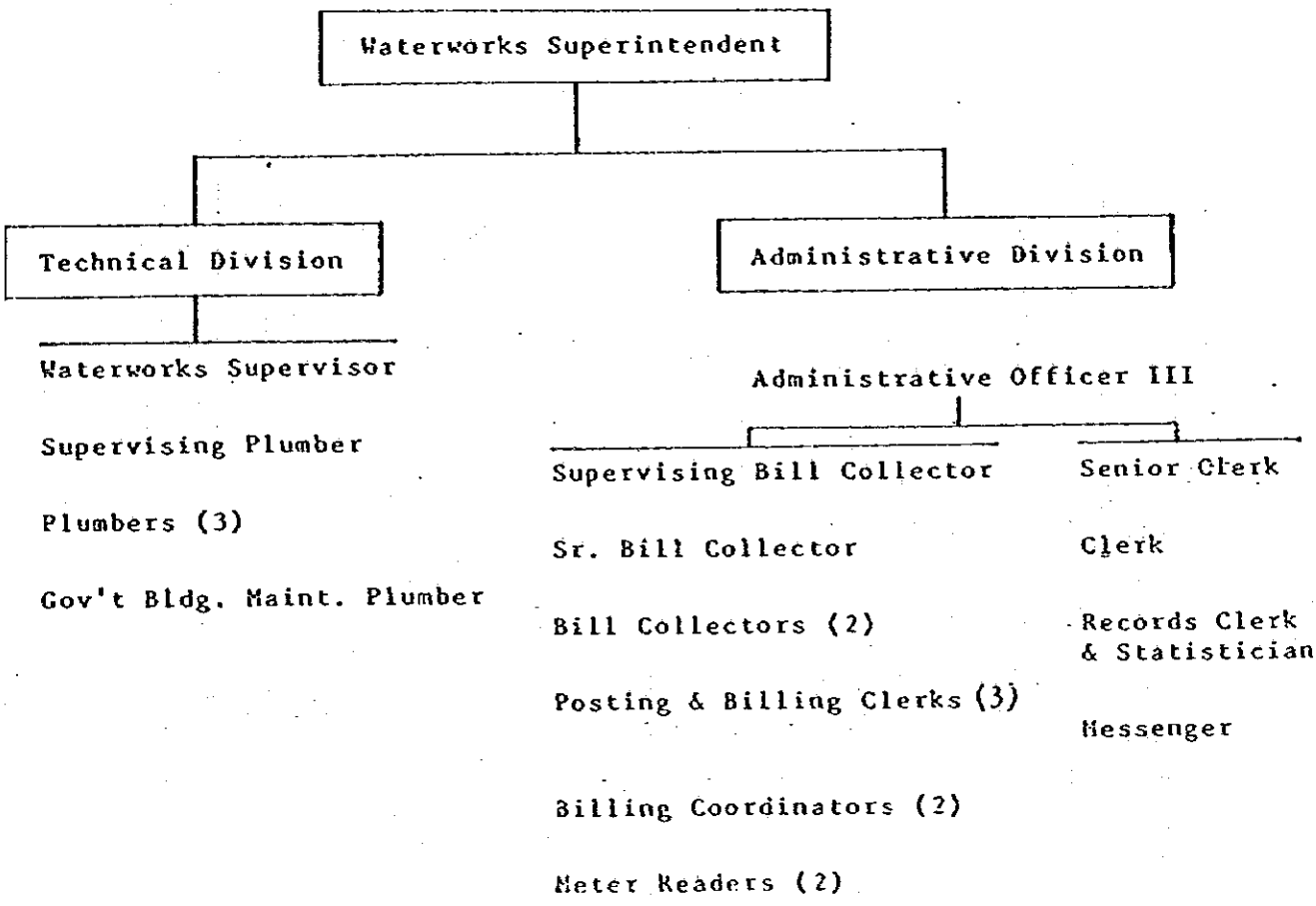
OBJECT OF EXPENDITURES	Past Year 79 (Actual)	Current Year 80 (Estimate)	Budget Year 81
Obligations by Objects of Expenditures by Projects:			
Water Management Services			
I. Personal Services			
a. Salaries	₱ 238,[illegible].59	₱ 294,501.00	₱ 116,352.00
b. Insurance Contributions	9,9[illegible].28	27,978.00	11,054.00
c. Retirement Contributions	1,6[illegible].92	3,225.00	1,5[illegible].00
d. Medicare Contributions	1,6[illegible].59	2,946.00	[illegible]
e. State Insurance	[illegible]	19,440.00	[illegible]
f. Living Allowance			
Sub-Total	[illegible]	₱ 348,090.00	₱ 149,[illegible]
II. Maintenance & Other Operating Expenditures:			
a. Travel & transportation	₱ 15,9[illegible].30	₱ 11,000.00	₱ 6,[illegible]
b. Supplies & Materials	[illegible]	44,000.00	16,000.00
c. Gasoline & Spare Parts	[illegible]	[illegible]	[illegible]
d. Freight	-	-	-
e. Repair of Equipment	[illegible].00	2,000.00	[illegible]
f. Illumination	-	-	-
g. Communication	[illegible].00	440.00	[illegible]
h. Other Services	300.00	16,500.00	[illegible]
i. Representation Allowance	-	-	-
Sub-Total	₱ [illegible]	₱ [illegible]	₱ [illegible]
Capital Outlay			
a. Equipment	₱ 6,559.00	₱ -	₱ -
Sub-Total	₱ 6,559.00	₱ -	₱ -
T O T A L	₱ 337,972.89	₱ 453,230.00	₱ 165,119.00

Legaspi

Fig. 1.3.5 Organization Chart

of

Albay Provincial Waterworks



PART TWO: MASTER PLAN

1. General
2. Target Year and Served Area
3. Projection of Population and Water Demand
4. Water Sources
5. Proposed Water Supply System
6. Cost Estimate
7. Implementation Schedule
8. Organization and Management

Legaspi

1. General

This Part discusses and draws out a water supply master plan for the Legaspi City Water District newly formed taking over most of the water supply system formerly owned and operated by the Albay Provincial Waterworks System. The master plan will treat the Level III system as a mainstay of water supply in the District.

The master plan will project the needs for water supply over a long range future and present a water supply system to meet the growing water demand. Means and ways to cope with the chronically existent and near future water requirement, in particular, will be dealt with fairly in detail. Based thereon, the feasibility of a project covering a short range future, which is essential for implementation thereof, will be studied in the following Part Three.

Since this District is obliged to continuously be supplied with water by the Daraga Water District, also newly formed, until the new water source system is completed, the master plan will take into due consideration the implementation schedule of construction work including the arrangement necessary for the transition period.

2. Target Year and Served Area

2.1 Target Year

(a) Phase I

The purpose of this Phase project is to establish new water supply system by developing water source/s, which has to meet the projected water requirement of the Phase, within as short a period as possible. Existing distribution pipelines will be used in the Phase with reinforcement works to some extent.

Taking into account the work volume, financial constraints and the required time for foreign financing, six years time is considered optimal. As illustrated in Fig 2.7.1, the Phase I project will require about 4 1/2 years from the commencement of the master planning and feasibility study until completion of the construction works, that is, the completion is in the early 1986. Therefore, the target year, which is defined as the year when the designed supply capacity equals to the water demand, must be at least a few years ahead of 1986. And during the period between the completion of the work and the target year, preparation for the succeeding Phase II project must be made. As is known from the barchart in the Fig, 2 years for this period is a most realistic solution, not giving much inconvenience to the consumers, nor making the construction cost of Phase I unbearably high. After all considered as above, the target year of Phase I is proposed as 1987.

(b) Phase II

Major purpose of this Phase project is to provide water for all consumers of the served area which is realized in the previous Phase and for additional population in the thereafter extended built-up area, and to upgrade the level of consumption in accordance with the improvement of the whole national living standard.

Legaspi

For this Phase, six years time is also considered appropriate from the same standpoint as Phase I. Therefore, the target year is proposed as 1993.

(c) Phase III

Long range planning of public facilities in the Philippines 1/ is currently being made with the year of 2010 as the target year. As water supply is one of the public utilities, the said year is employed as the target year of the present master planning.

Remarks: 1/ The LWUA's recent project, Water Supply of Ten Provincial Areas (5th Package), also aims to prepare a Master Plan upto the year 2010.

2.2 Served Area

The Local Water District Law stipulates that a water district, when formed, covers all the municipal or city area, but on the other hand the Executive Order 577 (an order concerning formation of RWA s) allows that Level I and II systems be constructed and maintained in the area of the water district in consideration of economy and early realization of water supply services.

Served area, for which water supply is being planned by the present master plan is, in accordance with the intention of the above Law and Executive Order, delineated to confine such an area to the existing built-up area for the short term plan, and to the anticipated built-up area as the final served area for the long range plan.

General topography, natural barriers, and zoning plans are also concidered in determining served area limits by each phase. Based on technical, topographic, and socio-economic conciderations, the served area boundaries for different phases of program implementation are determined as follows, and shown in Fig 2.2.1.

1. Present Served Area- the area presently served by existing system, 790 ha approximatly.
2. Phase I Served Area- the reinforcement and the extention of present served area, where minimum investment is required but maximum number of persons can be served to create a high impact/ effectiveness on the consumers in the WD. The Phase I served area is extended approximately by 340 ha totaling to 1,130 ha.
3. Phase II Served Area- further extension of served area into 2,100 ha, taking into account the extent of development within the design year of 1993 in the WD.
4. Master Plan Served Area- the total area within the WD jurisdiction where service can be provided technically and financially. In this study, the main objective is to

provide water service to the maximum number of persons within the area in the Master Plan period. The expanded served area is 3,450 ha in total in the year 2010.

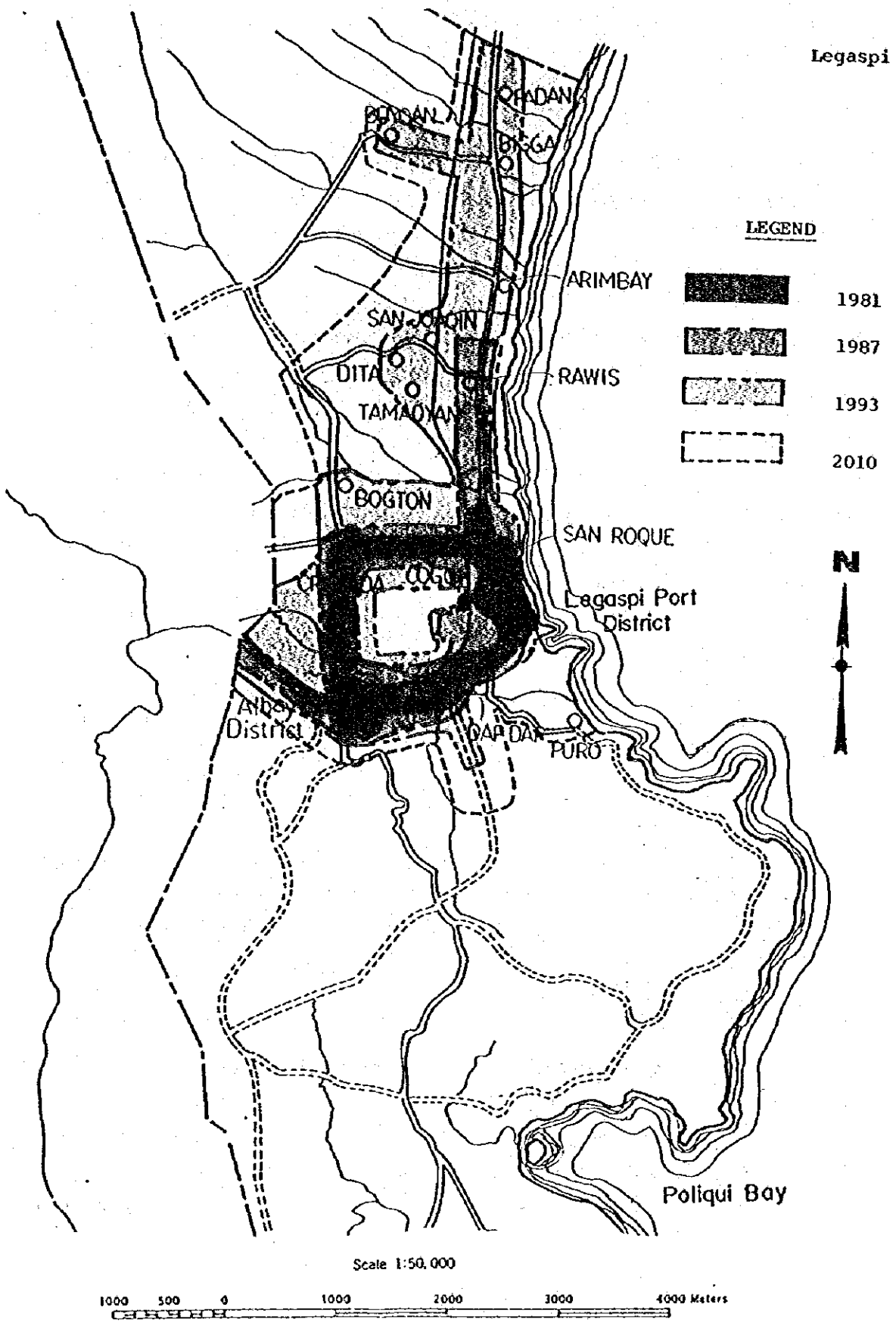


Fig 2.2.1 Served Area

3. Projection of Population and Water Demand

3.1 Population Projection

To estimate the study area population which is one of the basic factors of water requirement, the past census made by the National Census and Statistics Office (NCSO) is used as the most reliable demographic data.

The total study area population is projected on the basis of separate projections for barangays both in the city core or poblacion and rural areas within the study area. The method of past trend extrapolation is applied for population projection of such "micro-economic" areas of barangays in this study.

The procedure or the methodology of population projection for this study is included in Appendix 7. Based on the said methodology, population projections for the study area have been worked out.

Population trends indicate that the population in the study area would increase from 98,787 in 1980 to 149,900 in the year 2010. The projected population by the design year is tabulated in Table 2.3.1 and graphically shown in Fig. 2.3.1. Population projections by barangay are shown in Table 2.3.2.

The high and low growth of population projections in the study area have been made separately from the adopted one. Regarding the high projection, the high series of NEDA-POPCOM projection[1/] is introduced as a useful data for the high population projection. While, the low growth of population in the study area is projected as shown in Table 2.3.3.

Remarks: 1/ Population Dimension of Planning,
III Population Projection of Cities and
Municipalities in the Philippines 1970 - 2000.

The population in the served area is projected by design year based on the served area which is discussed in the proceding section of 2.2 Served Area. The population in the served area is shown in Table 2.3.4.

The coverage of served population for the Master Plan has been projected based on the above population in the served area taking account of the willingness-to-connect (WTC) of the projected consumers and future improvement of the consumers living standard.

The average percentage of WTC in the Phase II project area is 53%, which is obtained by a market research made in this study. Based on the market study the percentage of WTC of the urban and rural areas for future planning is projected as shown below.

Average Percentage of WTC

	1987	1993	2010
Urban Area	50	80	100
Rulal Area	20	50	80

The served population which is estimated approximately 18,600 or 19% of the total population in the city in 1980 would increase to 24,520 or 22% in 1987, 55,030 or 45% in 1993, and 95,260 or 64% in 2010, respectively. The served population by design year is shown in Table 2.3.5 and graphically shown in Fig. 2.3.2. The served population by barangay is shown in Table 2.3.6.

Note: As the results of projection of population served, percentage of population served to total population would not reach high value. This is due to following characteristics of scattered barangays of this area which would not been included in the served area because of economic reason.

Characteristics of these barangays:

1) Population density is rather low,
2) Distance from poblacion is far, and/or
3) Topographical elevation is rather high.

Legaspi

Table 2.3.1 Legaspi City WD Population Projection

	1980	1987	1993	2010
1. Urban	40,821	43,898	51,735	58,890
2. Rural	57,966	68,029	70,651	91,010
Total	98,787	111,927	122,386	149,900
Average annual increase (%)		1.6	1.5	1.2

Table 2.3.3 Legaspi City WD High and Low Growth Population Projection

	1980 T.P	A.G.R (%)	1987 T.P	A.G.R (%)	1993 T.P	A.G.R (%)	2010 T.P
1. High Projection	110,899	3.2	138,290	3.0	165,130	3.1	277,470
2. Medium Projection	98,787	1.6	111,927	1.5	122,386	1.2	149,900
3. Low Projection	98,787	1.44	109,190	1.2	117,290	0.96	137,970

Remarks: T.P - Total population
A.G.R - Average annual growth rate

Fig 2.3.1 Population Projection

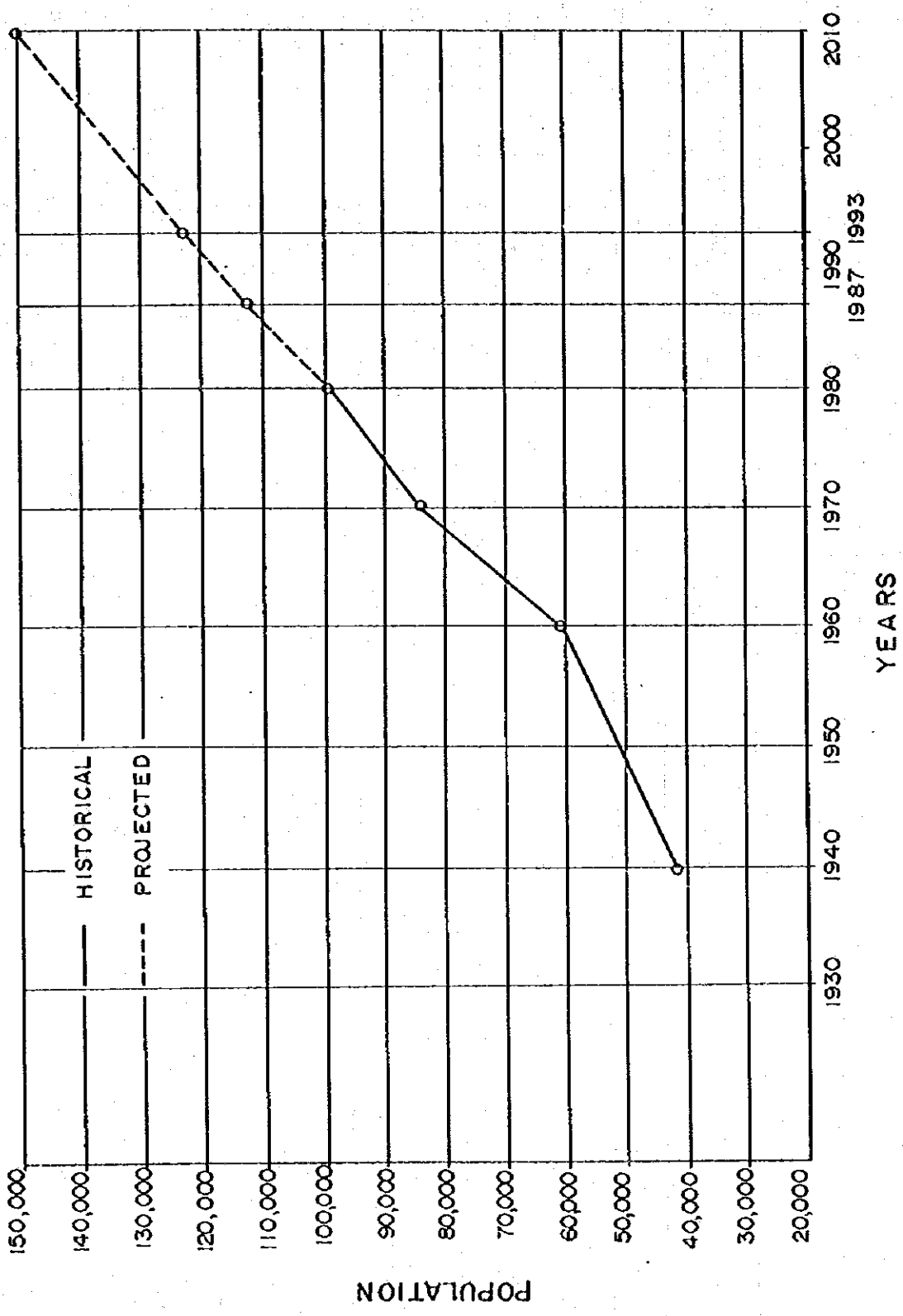


Table 2.3.2 Population Projection (1980 - 2010)

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
LEGAZPI PORT DISTRICT												
1. Arimbay	102	1,817	17.8	2.5	2,160	21.2	2.5	2,404	23.6	2.2	3,480	34.1
2. Bagong Abre	119	745	6.3	4.9	1,041	8.7	3.5	1,280	10.8	2.2	1,853	15.6
3. Bigaa	117	3,262	27.9	1.5	3,620	30.9	1.5	3,958	33.8	1.5	5,098	43.6
4. Buyoan	427	2,117	5.0	3.8	2,749	6.4	3.0	3,282	7.7	2.2	4,751	11.1
5. Dap-dap	20	1,911	95.6	1.1	2,063	103.2	1.0	2,190	109.5	1.0	2,384	119.2
6. Dita	44	724	16.5	3.1	896	20.4	3.0	1,070	24.3	2.0	1,498	34.0
7. Gogon	131	2,770	21.1	2.1	3,204	24.5	2.0	3,608	27.5	2.0	5,052	38.6
8. Legazpi City Proper (u)	1,716	19,291	11.2	0.4	19,838	11.6	0.3	20,198	11.8	0.3	21,253	12.4
9. Padang	329	1,450	4.4	4.9	2,027	6.2	3.5	2,492	7.6	2.2	3,608	11.0
10. Puro	541	3,069	5.7	3.6	3,931	7.3	3.3	4,773	8.8	2.0	6,683	12.4
11. Rawis	177	2,381	13.5	2.9	2,908	16.4	3.0	3,472	19.6	2.2	5,026	28.4
12. San Joaquin	46	1,105	24.0	3.5	1,406	30.6	3.0	1,678	36.5	2.2	2,431	52.8
13. San Roque	22	3,234	147.0	0	3,234	147.0	0	3,234	147.0	0	3,234	147.0
14. Tamadyon	46	611	13.3	2.4	721	15.7	2.0	812	17.7	1.5	1,046	22.7
Sub-total	3,837	44,487	11.6		49,798	13.0		54,451	14.2		67,397	17.6
ALBAY DISTRICT												
1. Bagacay	119	904	7.6	1.8	1,024	8.6	1.5	1,120	9.4	1.2	1,372	11.5
2. Banquerohan	1,394	2,671	1.9	0.3	2,728	2.0	0.3	2,777	2.0	0.2	2,873	2.1
3. Bariis	1,124	1,611	1.4	1.8	1,825	1.6	1.5	1,996	1.8	1.2	2,445	2.2
4. Bogna	769	2,946	3.8	1.8	3,338	4.3	1.5	3,650	4.7	1.2	4,471	5.8
5. Bogtong	106	1,974	18.6	2.8	2,395	22.6	2.0	2,697	25.4	1.5	3,475	32.8
6. Buenavista	1,319	530	0.4	4.2	707	0.5	3.5	869	0.7	2.0	1,217	0.9

- to be continued -

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
7. Cagbacong	1,775	2,045	1.2	2.4	2,414	1.4	2.0	2,719	1.5	1.5	3,502	2.0
8. Poblacion (u)	-	21,530	-	1.6	24,060	-	1.0	25,561	-	0.8	29,269	-
9. Cruzada	127	1,760	13.9	2.6	2,103	16.6	2.0	2,368	18.6	2.0	3,316	26.1
10. Estanza	596	1,927	3.2	2.3	2,259	3.8	2.0	2,544	4.3	1.5	3,277	5.5
11. Mamapon	710	2,378	3.3	1.7	2,676	3.8	1.5	2,926	4.1	1.2	3,584	5.0
12. Imalrod	371	944	2.5	1.5	1,048	2.8	1.5	1,146	3.1	1.2	1,404	3.8
13. Mabini	444	937	2.1	4.1	1,241	2.8	3.5	1,526	3.4	2.0	2,137	4.8
14. Maritawa	689	1,282	1.9	4.5	1,745	2.5	3.5	2,145	3.1	2.0	3,004	4.4
15. Masloc	667	2,682	4.0	0.4	2,758	4.1	0.4	2,825	4.2	0.2	2,923	4.4
16. Pawa	380	2,323	6.1	1.3	2,543	6.7	1.0	2,699	7.1	0.5	2,938	7.7
17. San Francisco	883	1,457	1.7	2.6	1,744	2.0	2.0	1,964	2.2	2.0	2,750	3.1
18. Taysan	1,128	4,399	3.9	3.3	5,521	4.9	2.5	6,403	5.7	1.7	8,546	7.6
Sub-total	12,601	54,300	4.3		62,129	4.9		67,935	5.4		82,503	6.5
T O T A L	16,438	98,787	6.0	1.6	111,927	6.8	1.5	122,386	7.4	1.2	149,900	9.1

Note: (u) Urban

Legaspi

Table 2.3.4 Projected Population in The Served Area in Legaspi City W/D

	1980			1987			1993			2010		
	T.P	P.S.A	%	T.P	P.S.A	%	T.P	P.S.A	%	T.P	P.S.A	%
Urban area	40,821	40,821	100	43,898	43,898	100	51,735	51,735	100	58,890	58,890	100
Rural area	57,966	4,385	8	68,029	12,855	19	70,651	27,289	39	91,010	45,464	50
Total	98,787	45,206	46	111,927	56,753	51	122,386	79,024	65	149,900	104,354	70

Remarks: T.P - Total population in the study area
P.S.A - Population in the served area
% - per cent of the total population (P.S.A/T.P x 100)

Table 2.3.5 Projected Served Population in Legaspi City W/D

	1980			1987			1993			2010		
	P.S.A	S.P	%	P.S.A	S.P	%	P.S.A	S.P	%	P.S.A	S.P	%
Urban area	40,821	18,600	46	43,898	21,950	50	51,735	41,390	80	58,890	58,890	100
Rural area	4,385	0	0	12,855	2,570	20	27,289	13,640	50	45,464	36,370	80
Total	45,206	18,600	41	56,753	24,520	43	79,024	55,030	70	104,354	95,260	91

Remarks: P.S.A - Population in the served area
S.P - Served population
% - per cent of the P.S.A (S.P/P.S.A x 100)

Table 2.3.6 Served Population and Served Area

Barrangay	1980-Present Served Area				1987-Served Area (Phase I Program)				1993-Served Area (Phase II Program)				2010-Served Area (Phase XII Program)			
	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)
Urban Area																
Albay D					9,920	50	860	25.5	16,160	80	1,200	30.5	21,253	100	1,370	36.9
Legaspi Port D	18,600	46	790	23.5	12,030	50			20,450	80			29,269	100		
Gogon					640	20	70	9.1	2,890	80	90	32.1	5,052	100	100	50.5
Cruzada					420	20	60	7	1,890	80	90	21	3,316	100	100	33.2
Rural Area																
San Joaquin					280	20	30	9.3	840	50	30	28	1,940	80	40	48.5
Rawis					580	20	90	6.4	1,740	50	90	19.3	4,020	80	140	28.7
San Roque					650	20	20	32.5	1,620	50	20	81	2,590	80	20	129.5
Padang									1,250	50	160	7.8	2,890	80	260	11.1
Buyuan									1,640	50	210	7.8	3,800	80	340	11.1
Bigaa									1,980	50	60	33	4,080	80	90	45.3
Arimbay									1,200	50	50	24	2,780	80	80	34.8
Dita									540	50	20	27	1,200	80	40	30
Tamaoyan									400	50	20	20	840	80	- 40	21
Bogton									1,340	50	50	26.8	2,780	80	80	34.8
Dap Dap									1,090	50	20	54.5	1,910	80	20	95.5
Pawa													2,200	80	300	7.3
Puro													5,340	80	430	12.4
Total	18,600		790		24,520		1,130		55,030		2,100		95,260		3,450	
Average				23.5				21.7				26.2				27.6

Remarks: S.P. - Served population
% T.P - Per cent to the total population
S.A - Served area in hectare
P.D - Served population density, persons per hectare

Note: Gogon and Cruzada are presently classified as rural; however, the two are considered to become urban in Phase II.

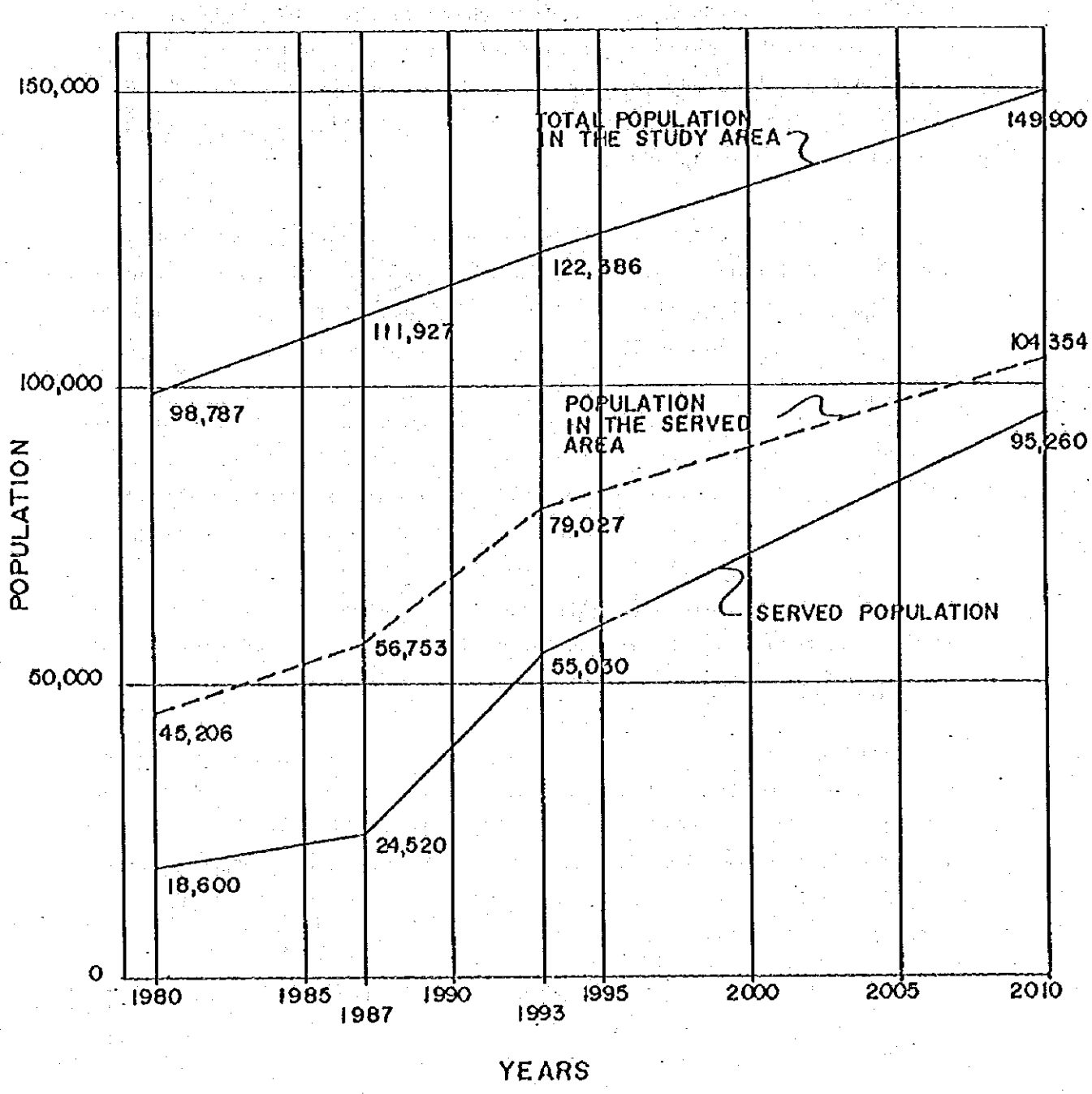


Fig 2.3.2 Served Population

3.2 Water Demand

Water demand projection in this section is undertaken to obtain a basis for a long range water supply plan until the Master Plan target year 2010. The water demand projection years are 1987, 1993 and 2010 conforming to the design years of this study. The water demand projections for this study are worked out based on the concept or the methodology indicated in the Procedure of Projection of Population and Water Demand in Appendix 7 .

Water demand projections have been made separately for domestic, commercial and industrial, and institutional demands, and for unaccounted-for-water. The categories of water use adopted herein are those presently prescribed in the LWUA's methodology manual.

The average unit consumption figure, which is the amount of water required to satisfactorily supply to all consumers on a continuous 24-hour basis, was developed for each of urban and rural demand areas. The unit consumption figures are qualified as theoretical since there is insufficient data available to develop accurate unit consumptions. The theoretical unit consumption figures are therefore subject to careful review and adjustment after the First Phase program is completed and consumers have an adequate continuous supply of water.

Summary of water demand projections by the design year and category of water use are shown in Table 2.3.7. Served population and average day water demand by demand area are shown in Table 2.3.8. Based on the design criteria for planning, included in Appendix 6 , maximum day water demands and peak hour water demands are calculated and shown in Table 2.3.9.

Table 2.3.7

Legaspi City WD Average Day Water Demand in Urban Area

(In m^3/day)

Use Category \ Year	1987	1993	2010
Domestic	2,963	6,126	10,306
Commercial and Industrial	373	993	2,945
Institutional	44	124	236
Accounted-forwater	3,380	7,243	13,487
Unaccounted-for-water	1,734	2,401	3,356
Total	5,114	9,644	16,843
Population Served	21,950	41,390	58,890
Per Capita Use(lpcd)	233	233	286

Legaspi City WD Average Day Water Demand in Rural Area

(In m^3/day)

Use Category \ Year	1987	1993	2010
Domestic	177	1,064	3,637
Commercial and Industrial	-	-	-
Institutional	5	41	145
Accounted-for-water	182	1,105	3,782
Unaccounted-for-water	52	273	946
Total	234	1,378	4,728
Population Served	2,570	13,640	36,370
Per Capita Use(lpcd)	91	101	130

Table 2.3.8 Served Population and Average Day Water Demand

Year		Served Population	Liters per Capita per Day (lpcd)	Average Day Demand (cu m/day)
1981	Urban	18,600	104	1,940
	Rural	-	-	-
	Total	18,600	104	1,940
1987	Urban	21,950	233	5,114
	Rural	2,570	91	234
	Total	24,520	218	5,348
1993	Urban	41,390	233	9,644
	Rural	13,640	101	1,378
	Total	55,030	200	11,022
2010	Urban	58,890	286	16,843
	Rural	36,370	130	4,728
	Total	95,260	226	21,571

Table 2.3.9 Fluctuations in Water Demand
(cu m/day)

Year	Average Day Demand = A.D.	Maximum Day Demand = A.D. x 1.2	Peak Hour Demand = A.D. x 1.5
1981	1,940	2,320	-
1987	5,348	6,418	8,022
1993	11,022	13,226	16,533
2010	21,570	25,884	32,355

4. Water Sources

This section discusses water sources to be adopted in each phase in accordance with the projected water demand. In selecting optimal water sources, due considerations, technical and financial, will be made.

Presently, Legaspi is served by the existing water supply system which covers both Daraga and Legaspi and has its water sources, in the Daraga area. But the water sources are to be used for water supply in the Daraga area, when the presently-proposed water supply project is implemented. Therefore, potential water sources in and around Legaspi will be examined about their suitability.

For convenience of explanation, Fig 2.4.1, and Table 2.4.1 are prepared. The Figure illustrates, in a schematical form, the relationship of supply sources and consuming areas.

Note: Use of groundwater to be taken by deep wells in this area is not recommended in this study because of the defect of water quality. Deep groundwater in the area is found to contain odor and color; both to unpermissible extents. They are due to geological conditions influenced by eruptions of active Mayon Volcano.

Odor contained in the groundwater can be removed by simple aeration method; however, to remove color requires complicated treatment processes which are not practicable for public water supply, such as rapid sand filtration method plus activated carbon treatment.

(Above consideration is based on the study results of existing deep wells, depths of which are less than 70 m. From the view point of geological and hydrogeological conditions, groundwater deeper than 70 m is also considered to contain odor and color.) (Please refer to Appendix 4.)

Legaspi

4.1 Phase I

Water demand of Phase I is estimated at 6,418 cu m/day, which requires new source/s with additional capacity of 6,309 cu m/day. Available water sources are springs, wells in and around the study area, and the Yawa River. Water sources which have considerable quantity are shown in Table 2.4.2.

In the table, Buyoan Spring or Riverbed Water of the Yawa River is more feasible than others for new source of the phase. Of the two feasible sources, Buyoan Spring is considered to have higher priority for the following reasons.

(1) The available capacity of the spring can meet the water demand of Phase I.
(2) It is presently evident that the spring has seasonally unchangeable yield.
(3) The water quality of the spring conforms to the drinking water standard.
(4) Water distribution can be made by gravity.
(5) The spring system requires least construction costs (Ref. Table 2.4.2).

Table 2.4.1 Conditions of Potential Sources

	Capacity	Distance from Poblacion (km)	Water Quality
1. Buyoan Spring	6,480 m^3/day 1/	6	Good
2. Riverbed Water on the Yawa	2 to 4 m^3/sec of surface flow	1 to 2	Good
3. Tinapian Spring	5,180 m^3/day	33	Good
4. Surface Water on the Yawa	2 to 4 m/sec of surface flow	1 to 2	Requires full treatment
5. Deep Wells in the City	about 1,000 m^3/day/well	0 to 1	Requires odor and color removal

1/ The figure is the balance of the spring yield less 750 cu m/day for nearby Barangays.

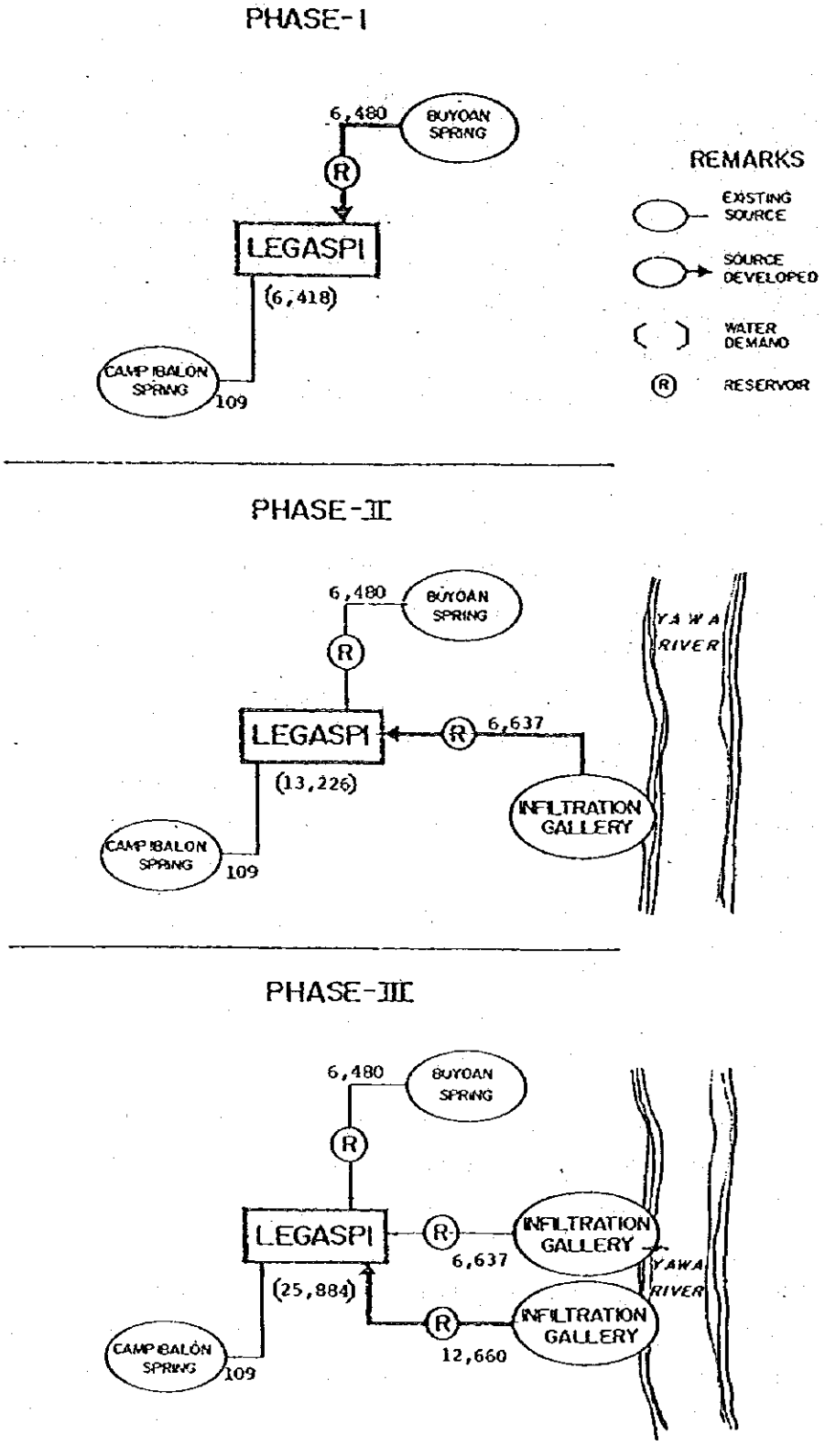


Fig 2.4.1 Water Sources in Each Phase Project

4.2 Phase II

Water demand of the Phase II is 13,226 cu m/day which exceeds the amount to be provided in the Phase I using the water of Buyoan Spring and the existing supply system. Therefore, a new water source in addition to the spring has to be developed to meet the water demand of the Phase. It is necessary to develop additional 6,637 cu m/d of water amount by the new source.

As shown in the above Table 2.4.1, the top priority source for this phase is riverbed water of the Yawa River. The construction cost is less expensive and the location is near the area to be supplied. Riverbed water will surely be obtained by an infiltration gallery at a rate more than 6,637 cu m/d, judged from the soil formation under and along the River. Further, the riverbed water will require no treatment except chlorination. A most suitable location of the gallery from the viewpoint of both quantity and quality of water is considered to be a point at the right bank of the Yawa River just after the confluence with a tributary.

4.3 Phase III

Water demand in the long-range plan up to the year 2010 is 25,884 cu m/d, which requires another water source/s, as is seen in Table 2.4.3.

Similarly to the case of the Phase II, the use of riverbed water of the Yawa River is recommended by constructing another facilities. Water quality and unit production per perforated pipe will precisely be known by the Phase II work, the results of which should be utilized for the planning of the subsequent works.

As regards the construction of infiltration galleries on the Yawa River, the Daraga Water District is also obliged to take riverbed water from the same river. Under this circumstance, it is most recommendable that the water source development be carried out under a joint venture of the two districts. Such joint undertaking would produce most economical solution for the water source development.

Table 2.4.2 Comparison of Alternative Water Sources (1987)

Sources	Buyoan Spring	Riverbed Water on the Yawa River at (1) Old Albay	Reservoir at (2) Lingnon[1/]	Reservoir at (3) Lingnon[2/]
Capacity (m^3/d)	6,480	more than 10,000		
Distance from poblacion (km)	6.0	4.8	5.7	5.6
Necessary Facilities				
Chamber (m^3)	-	-	-	-
Infiltration Gallery (m^3/d)		6,300	6,300	6,300
Pump Station (h=m, l/sec)	-	54/73	60/73	60/73
Reservoir (m^3)	2,000	2,000	2,000	2,000
Transmission Pipes (km)	0.5	3.8	3.2	3.2
Distribution Pipes (km)	5.5	1.0	2.5	2.4
Construction Cost[3/]				
Chamber	1,780	-	-	-
Infiltration Gallery	-	1,260	1,260	1,260
Pump Station	-	1,150	1,190	1,190
Reservoir	1,800	1,800	1,800	1,800
Transmission Pipes	490	3,710	3,120	3,120
Distribution Pipes	4,345	790	1,980	1,900
Total Cost	8,415	8,710	9,380	9,270

1/ Distributed from the reservoir via Legaspi Port to Old Albay.

2/ Distributed from the reservoir via Old Albay to Legaspi Port.

3/ In thousand Pesos

Table 2.4.3 Water Sources for Master Plan Period

Phase	Existing (1980)	Phase I (1987)	Phase II (1993)	Phase III (2010)
Population served	19,000	24,520	55,030	95,260
Water Demand (cu m/d)	4,400	6,418	13,226	25,884
Existing Water Source and Capacity (cu m/d)	1/ 4 springs (10,454)	1 well 109	Buyoan spring 6,480 plus well 109	Buyoan spring 6,480 plus Riverbed water 6,637 plus well 109
New Requirement (cu m/d)	-	6,309	6,637	12,658
Additional source	-	Buyoan spring	Riverbed water	Riverbed water 2/

1/ The 4 springs belong to Daraga Water District since October 1981.

2/ Some shallow wells dug on the riverbed and outcrops of riverbed water which are being used by inhabitants nearby have good water quality, not requiring treatment for domestic use.

Location of the infiltration gallery on the Yawa River should be placed on the right bank of the river; between upstream site of Isalog Pulp & Paper Mill and downstream of the conjunction point of two branch streams.

5. Proposed Water Supply System

5.1 General

The water supply system to be provided for the water district is planned hereunder based on the present conditions of the existing water supply system, the projected water demand and available water sources, so far described. Design criteria to be used for the planning are prepared as presented in Appendix 6, which are worked out taking into account the Technical Standard Manual prepared by LWUA.

5.2 Basic Concept of Planning

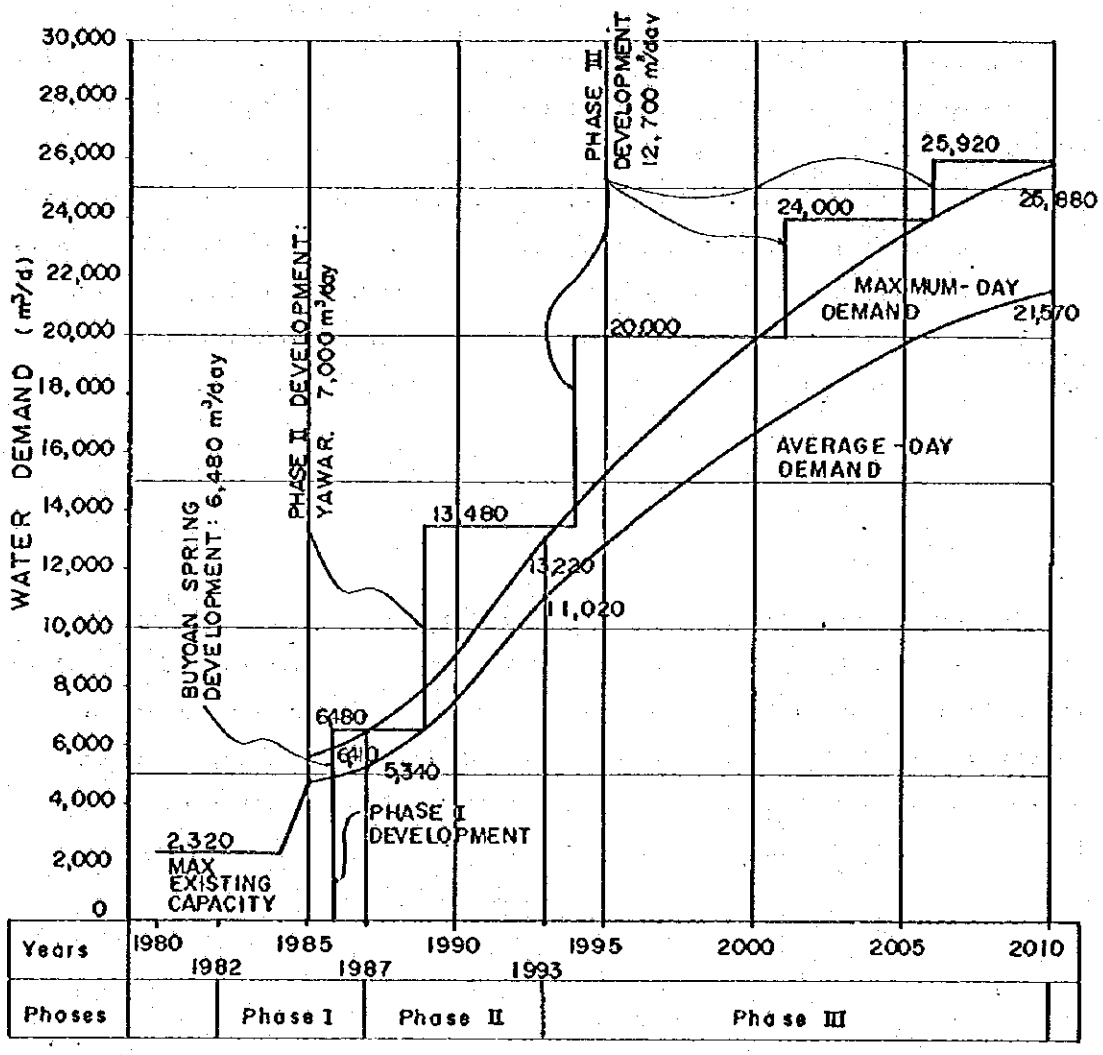
In the Phase I, a new water supply system will be constructed taking water from the Buyoan spring. Until its completion, the district will continuously be supplied by the Daraga water district. Major works, therefore, required in the phase are construction of the new system including all works from the intake up to the primary distribution main to connect with the existing distribution networks in the Legaspi Port area.

In Phase II, the water district requires an additional water source. This requirement will be met by developing riverbed water of the Yawa River.

In Phase III, the incremental water demand in the phase will also be met expanding the riverbed water facilities built in the previous phase.

The above approach to meeting future requirements is presented in Fig 2.5.1. As illustrated, only maximum day demands will be met from the sources; peak hour demand will be furnished by additional supply from the proposed storage facilities.

Fig 2.5.1 Water Demand and Source of Supply



5.3 Works of Each Phase

Works to be executed in accordance with the basic concept of planning stated in the foregoing section are presented in Table 2.5.1, together with water demand and supply capacity to be added in each phase. Major works are outlined as follows.

(a) Phase I

A new system utilizing the Buyoan spring, with its available full capacity of 6,480 cu m/day, will be constructed. The system includes all facilities required for intake, transmission, storage, primary distribution main and other necessary appurtenances. The primary main will be connected with the existing distribution network in the Legaspi Port and Old Albay area. In addition, the deep well at Camp Ibalon will continuously be used. Regarding distribution pipelines, reinforcement and rehabilitation will be made as required. All service connections will be metered.

(b) Phase II

To meet the incremental water demand in Phase II, a new system with the riverbed water of the Yawa River will be constructed, complete with infiltration gallery, a pumping station, transmission main, a reservoir and distribution mains. The infiltration gallery should be located on the right bank of the Yawa River. Distribution pipelines will be extended to newly developed areas.

(c) Phase III

Water requirement in this phase will also be met by the riverbed water of the Yawa River, complete with construction of infiltration gallery, a reservoir, pipelines and others.

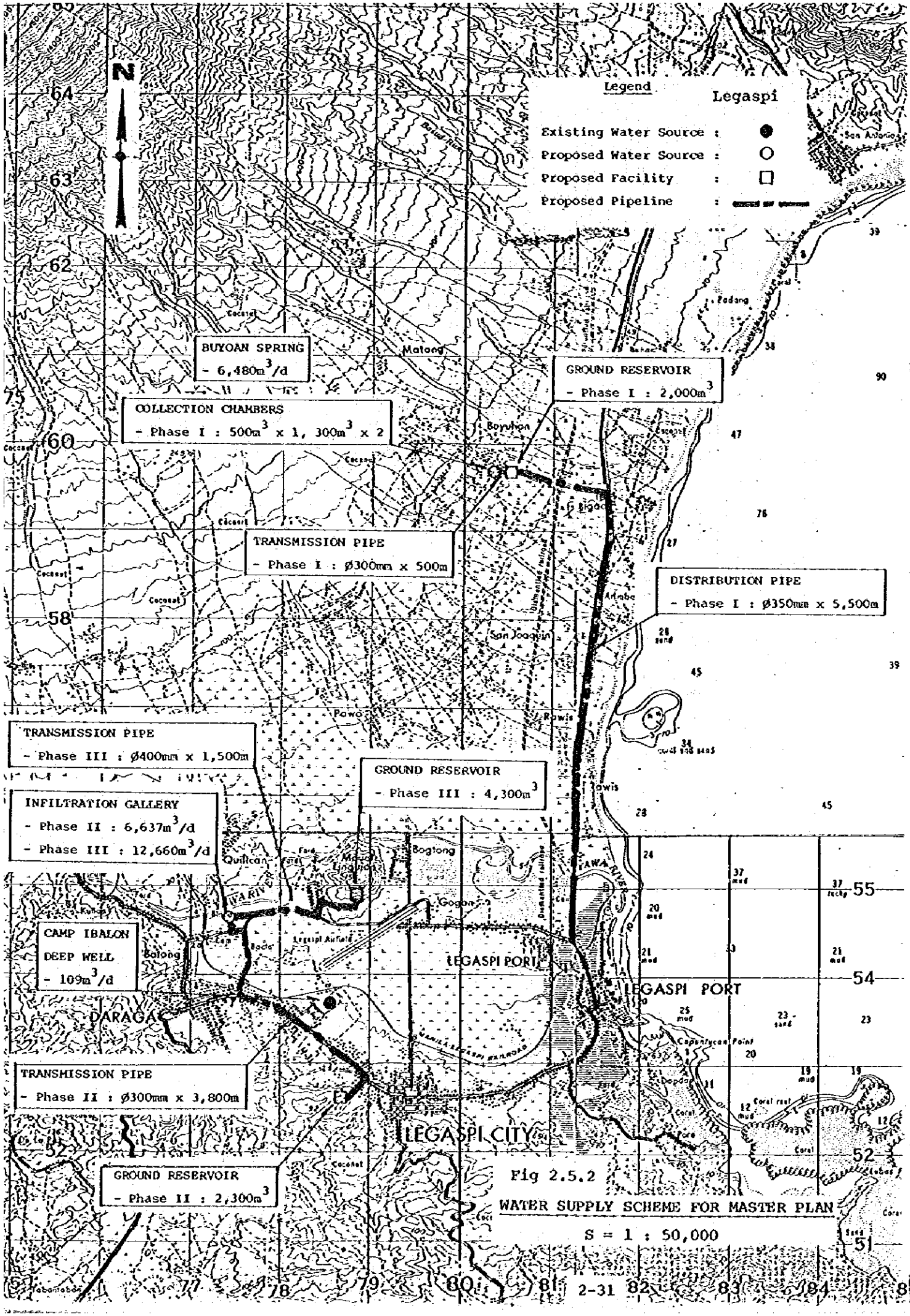


Fig 2.5.2

WATER SUPPLY SCHEME FOR MASTER PLAN

S = 1 : 50,000

Table 2.5.1 Description of Necessary Works in Each Phase

(Unit: cu m/d)

	Phase I (1987)	Phase II (1993)	Phase III (2010)
Water Demand	6,418	13,226	25,884
Source Capacity	109 1/	6,589	13,226
Needed Additional Capacity	6,309	6,637	12,658
Necessary Works	(1) Buyoan Spring System	(1) Infiltration Gallery System I	(1) Infiltration Gallery System II
	a. Three Collection Chamber	a. Infiltration Gallery	a. Infiltration Gallery
	b. Reservoir	b. Reservoir	b. Reservoir
	c. T/P 2/ from the intake to the reservoir	c. T/P from the gallery to the reservoir	c. T/P from the gallery to the reservoir
	d. Three bulk meters	d. Two bulk meters	d. Two bulk meters
	e. Chlorinator	e. Chlorinator	e. Chlorinator
	(2) Others	(2) Others	(2) Others
	a. Distribution pipelines	a. Expansion of distribution pipelines	a. expansion of distribution pipelines
	b. Water meters	b. Water meters	b. Water meters
	c. Fire hydrants	c. Fire hydrants	c. Fire hydrants

1/ Capacity of Camp Ibalon Well

2/ Transmission pipeline

6. Cost Estimate

Summary of the project costs of Master Plan are shown in Table 2.6.1, 2.6.2 and 2.6.3. The costs are broken down into foreign and local currency components. Cost for engineering and physical contingency are allowed in addition to the construction costs.

Conditions and assumptions on which the estimation is carried out are as below, and cost data relating to the estimation are attached to the Report as Appendix 8.

1) All of costs and prices presented in the Table are as of July 1981.
2) Unit costs, as far as available, are taken from the list of costs prepared by LWUA[1/].
3) Unit costs not included in the above list are current prices in the market.
4) Some of the unit costs of LWUA are modified so as to fit for the present project.
5) Local currency portion for the above includes costs for handling, storage and local transportation.
6) Engineering costs are assumed as following percentages of the basic construction cost:
   - For feasibility study = 2.5%,
   - For detailed design = 10.5%, and
   - For construction supervision = 3.5%
7) Physical contingency is allowed by 10 percent of the basic construction cost and engineering cost.
8) Foreign currency exchange rate applied is: US$1.00 = ₱7.80.

1/ Addendum to Methodology Manual, 1981.

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Table 2.6.1 Project Cost for Phase I

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. Buyoan System				
a) Collection Chamber	500 m^3 x 1 300 m^3 x 2	1,780	445	1,335
b) Transmission Pipeline	ø300 mm x 500 m	488	327	161
c) Distribution Pipeline	ø350 mm x 5,500 m	4,345	2,911	1,434
d) Ground Reservoir	2,000 m^3 x 1	1,800	450	1,350
B. Distribution Pipeline				
	ø300 mm x 1,500 m	975	653	322
	ø150 mm x 500 m	138	92	46
	ø100 mm x 1,000 m	180	121	59
	ø 75 mm x 2,000 m	240	161	79
	ø 50 mm x 3,000 m	240	161	79
C. Other Equipment				
a) Service Meter	ø13 mm x 1,331 pcs	866	667	199
b) Bulk Meter	ø350 mm x 1 ø300 mm x 1	20	16	4
c) Valve	ø300 mm - ø75 mm 21 pcs	126	92	34
d) Fire Hydrant	32 pcs	216	143	73
e) Chlorinator	1 set	10	9	1
f) Vehicle	2 units	140	70	70
g) Spareparts		135	105	30

- to be continued -

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
Sub Total		11,699	6,423	5,276
Feasibility Study Cost (2.5%)		-	-	-
Detailed Design Cost (10.5%)		1,228	737	491
Supervision Cost (3.5%)		409	246	163
Land Cost		78	-	78
Sub Total		13,414	7,406	6,008
Physical Contingency (10%)		1,342	741	601
Total		14,756	8,147	6,609
Equivalent to US $		1.89 M	1.04 M	0.85 M

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Table 2.6.2 Project Cost for Phase II

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. Riverbed Water System				
a) Infiltration Gallery	ø1,000 mm x 350 m	1,400	350	1,050
b) Pump House with Pumps	2.44 m^3/min x 60 m x 2	1,700	1,020	680
c) Transmission Main	ø300 mm x 3,800 m	3,710	2,486	1,224
d) Ground Reservoir	2,300 m^3 x 1	2,070	518	1,552
e) Distribution Main	ø350 mm x 1,000 m	790	529	261
B. Distribution Pipeline	ø200 mm x 700 m	273	183	90
	ø150 mm x 1,030 m	283	190	93
	ø100 mm x 2,420 m	436	292	144
	ø 75 mm x 12,300 m	1,476	989	487
	ø 50 mm x 56,400 m	4,512	3,023	1,489
C. Other Equipment				
a) Service Meter	ø13 mm x 8,877 pcs	5,769	4,442	1,327
b) Bulk Meter	ø350 mm x 1 ø200 mm x 1 ø100 mm x 1	27	22	5
c) Valve	ø300 mm - ø75 mm 51 pcs	306	223	83
d) Fire Hydrant	48 pcs	320	211	109
e) Chlorinator	1 set	10	9	1

- to be continued -

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
f) Vehicle	1 unit	70	35	35
g) Spareparts		405	316	89
D. Administration Building		770	154	616
E. Operation Center		590	212	378
Sub Total		24,917	15,204	9,713
Feasibility Study Cost (2.5%)		623	374	249
Detailed Design Cost (10.5%)		2,616	1,570	1,046
Supervision Cost (3.5%)		872	523	349
Land Cost		65	-	65
Sub Total		29,093	17,671	11,422
Physical Contingency (10%)		2,909	1,767	1,142
Total		32,002	19,438	12,564
Equivalent to US $		4.10 M	2.49 M	1.61 M

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Table 2.6.3 Project Cost for Phase III

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. Infiltration Gallery System				
a) Infiltration Gallery	ø1,000 mm x 650 m	2,600	650	1,950
b) Intake Pump Station	146.5 l/s, H=60 m	1,792	1,075	717
c) Transmission Pipe	ø400 mm x 1,500 m	2,070	1,387	683
d) Ground Reservoir	4,300 m^3 x 1	2,876	719	2,157
B. Distribution Pipe	ø450 mm x 1,500m	1,575	1,055	520
	ø300 mm x 4,000m	2,600	1,742	858
	ø200 mm x 6,000m	2,340	1,568	772
	ø150 mm x 5,000m	1,375	921	454
	ø100 mm x 4,000m	720	482	238
	ø 75 mm x 20,000m	2,400	1,608	792
	ø 50 mm x 90,000m	7,200	4,824	2,376
C. Other Equipment				
a) Service Meter	ø13 mm x 9,100 pcs	5,915	4,555	1,360
b) Bulk Meter	ø450 mm x 1 pc ø400 mm x 1	20	16	4
c) Valve	436 pcs	1,186	866	320
d) Fire Hydrant	110 pcs	792	523	269
e) Chlorinator	1 unit	10	9	1

- to be continued -

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
f) Vehicle	3 cars	210	105	105
g) Spareparts		414	323	91
Sub Total		36,095	22,428	13,667
Feasibility Study Cost (2.5%)		902	541	361
Detailed Design Cost (10.5%)		3,790	2,274	1,516
Supervision Cost (3.5%)		1,263	758	505
Land Cost		125	-	125
Sub Total		42,175	26,001	16,174
Physical Contingency (10%)		4,218	2,600	1,618
Total		46,393	28,601	17,792
Equivalent to US $		5.95 M	3.67 M	2.28 M

7. Implementation Schedule

In accordance with the target years set forth in Section 2 and in consideration of works described in Section 5, the implementation schedule of the whole project of the master plan is worked out and shown in Fig 2.7.1. Major points to be noted about the implementation schedule are as follows.

(1) Phase I

1) The period from present up to the commissioning of the major facilities is estimated based on the detailed time elements of individual work items.

2) The period between the above commissioning and the target year is set so that actual data on water supply planning factors can be collected.

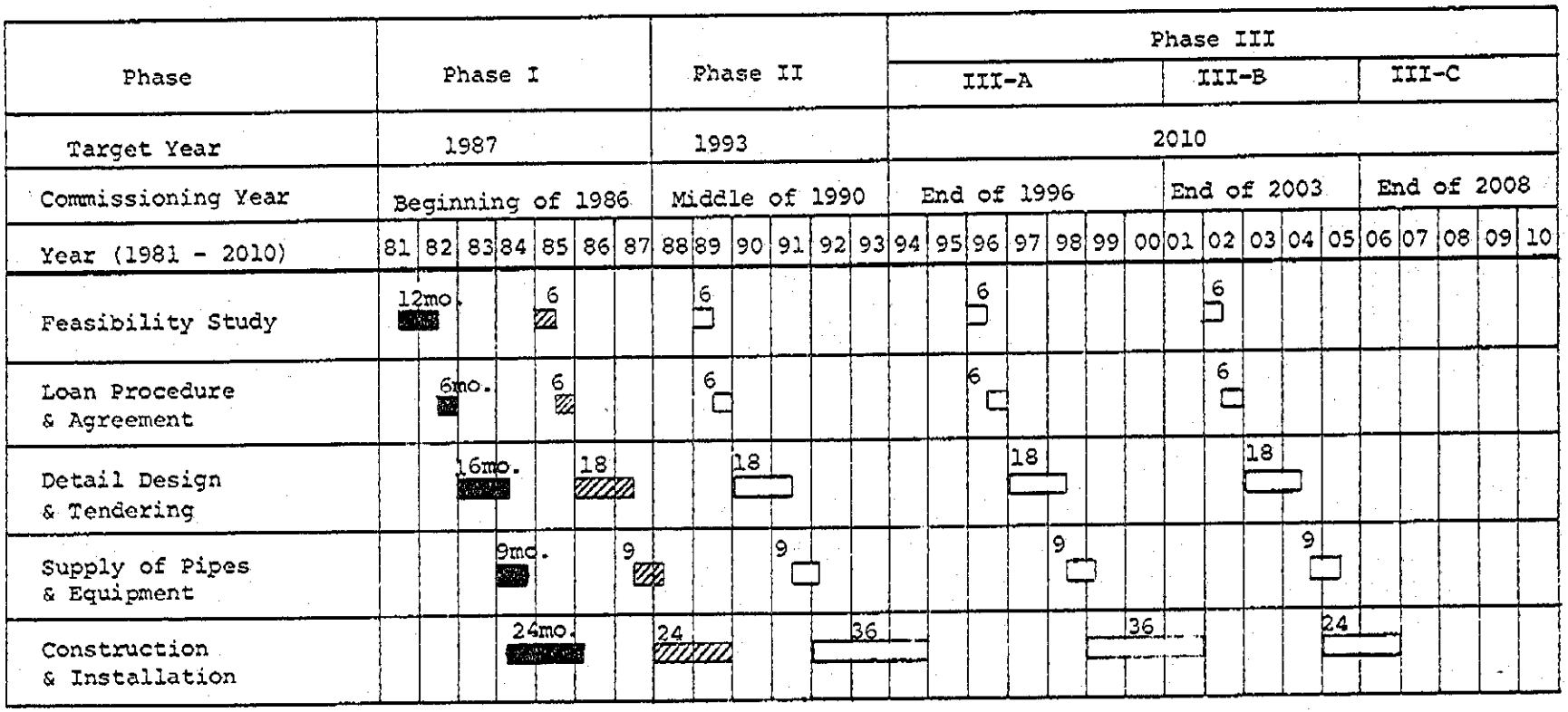
3) Start of engineering works for Phase II project is placed just after the commissioning and before the target year, so that the planning of the Phase II project can be made employing actual data and the construction of the said project can be commenced as early as possible.

(2) Phases II and III

1) Commissioning of the Phase II facilities is scheduled two years after the Phase I target year. It may result in slight shortage of the supply capacity. But, depending on the actual development of the supply conditions, the time of commissioning can be advanced to some extent, or a small cut of maximum day demand may be tolerated by the consumers.

2) Implementation of the Phase III project is planned in a similar way to Phase II. All explanations above are applicable to this phase as well.

Fig 2.7.1 Implementation Schedule for Master Plan



Legaspi

8. Organization and Management

The existing organization as described in 3. "Existing Water Supply" of Part One is recommended to be reorganized into a "water district" as defind under PD 198 (as amended by PD 768 and 1479), whose organizational set-up is required to conform with LWUA guidances and requirements.

These LWUA guidances and requirements are found to be effective and practical to strengthen the functional capacity of the organization in the following three respects:

a. Technical
b. Commercial
c. Administrative and Financial

The review of the functional capacities of the existing management reveals that its commercial capacity is comparatively weaker than other capacities. It is therefore recommended that the personnel for commercial activities be strengthened. With future expansion of the water district, a manager responsible for commercial functions will become necessary in addition to those for administrative and technical functions.

The number of water district employees depends primarily on the total number of service connections; or more employees for more connections.

Regards should be paid to the quality of water districts employees. Employees need training to enhance their capability. Salaries should also be attractive enough to recruit efficient employees.

PART THREE: FEASIBILITY STUDY

1. General
2. Target Year and Project Area
3. Estimation of Population Served and Water Demand
4. Immediate Improvement and Expansion Works
5. Water Source
6. Design Criteria, Alternative Plans and Preliminary Design
7. Construction, Operation and Management Schedule
8. Materials, Labor Force and Contractor's Ability
9. Construction and Procurement Methods
10. Cost Estimate
11. Organization and Operation and Management Plan
12. Financial Feasibility Analysis
13. Economic Feasibility Analysis
14. Alternative Feasibility Study

1. General

This Part Three treats the feasibility study for two different cases of project formation. One case (Case 1) is for a project of Phase I (Target Year: 1987) defined in Part Two: Master Plan, and the other case (Case 2) is intended to make, in addition, an alternative study for a project comprising Phase I and Phase II (Target Year: 1993) as defined in the Master Plan.

The project of Case 1 aims, basically, to meet the currently unsatisfied water demand and also increasing needs in the immediate future by rehabilitating the existing deteriorated water facilities and adding some expansion works. On the other hand, the alternative study for Case 2 explores the feasibility and suitability of the project with Phases I and II combined, as stated above, which extends over a medium terms of about ten years after the commencement of project construction. The main purpose of this project, if found to be feasible, is to secure reliable drinking water supply over a fairly long period and remove restraints of poor water service, experienced long since, on the development of the city as a local commercial and industrial center.

2. Target Year and Project Area

2.1 Target Year for Study

As described in the preceding section the present feasibility study deals with the two cases, thus the target year for study, in this section, represents two different periods of Phase I and Phase II defined in the master plan. Phase I program is starting from the year 1982 up to the year 1987 and Phase II program covers the period of another 6 years from 1988 up to 1993.

2.2 Project Area

The project area for the feasibility study is delineated as the poblacion areas of Albay District and Legaspi Port District including rural barangays presently served by the existing water supply systems and their adjoining areas which are considered to develop and require water supply within the period until the end of target year of the study.

The Legaspi City WD's project area for the Phase I covers approximately 1130 ha mostly in the pblacion area including the present served area of 790 ha and rural barangays enroute of pipeline from Buyoan Spring. In Phase II the served area is expanded to 2,100 ha in 1993; takes in the thereafter extended built-up area adjoining the poblacion area and rural barangays located in between Buyoan Spring and Yawa river.

Present served area and projected areas by phase are shown in Fig 2.2.1 and Table 2.3.6.

3. Estimation of Population Served and Water Demand

3.1 Estimation of Population Served

Based on the projected total population in the study area and the projected served area by design year, which are described in the Part Two: Master Plan, the population in the served area is estimated annually for the feasibility study period of Phase I (1987) and Phase II (1993).

The annual population in the served area in each demand area is extrapolated based on the master plan projection figures in the design years of 1987 and 1993, as shown in Table 3.3.1.

The coverage of served population for the feasibility study in the projected served area has been estimated based on the above population in the served area taking account of the willingness-to-connect of the projected consumers and future improvement of the consumer's living standard.

The annual served population in each demand area is estimated up to the year 1993 and shown in Table 3.3.2 and Fig 3.3.1.

3.2 Estimation of Water Demand

The overall average day water demand for the WD is estimated based on the served population and the average unit water demand, which is including demands for domestic, commercial/industrial, institutional and unaccounted-for-water. The annual average day demand is extrapolated from the demands in the design years of 1987 and 1993, taking account of the sources of supply and the extended served area as well as the served population, and shown in Table 3.3.3.

Table 3.3.1 Projected Population in Served Area in Legaspi WD

	Urban Area		Rural Area		Total Area	
Years	T.P	P.S.A	T.P	P.S.A	T.P	P.S.A
1980	40,821	40,821	57,966		98,787	45,206
1981	41,250	41,250	59,310	5,000	100,560	46,250
1982	41,680	41,680	60,680	5,460	102,360	47,140
1983	42,110	42,110	62,080	5,590	104,190	47,700
1984	42,550	42,550	63,520	5,720	106,070	48,270
1985	43,000	43,000	64,990	6,500	107,990	49,500
1986	43,450	43,450	66,490	9,970	109,940	53,420
1987	43,898	43,898	68,029	12,855	111,927	56,753
1988	45,120	45,120	68,460	13,690	113,580	58,810
1989	46,370	46,370	68,890	13,780	115,260	60,150
1990	47,660	47,660	69,330	17,330	116,990	64,990
1991	48,980	48,980	69,770	20,930	118,750	69,910
1992	50,340	50,340	70,210	24,570	120,550	74,910
1993	51,735	51,735	70,651	27,289	122,386	79,024
2010	58,890	58,890	91,010	45,464	149,900	104,354

Note : T.P - Total Population in the Study Area
P.S.A - Population in the Served Area

Table 3.3.2 Projected Population Served in Legaspi WD

Years	Urban Area		Rural Area		Total Area	
	P.S.A	P.S	P.S.A	P.S	P.S.A	P.S
1980	40,821	18,600	4,385	-	45,206	18,600
1981	41,250	18,600	5,000	-	46,250	18,600
1982	41,680	19,200	5,460	-	47,140	19,200
1983	42,110	20,400	5,590	-	47,700	20,400
1984	42,550	20,900	5,720	-	48,270	20,900
1985	43,000	21,100	6,500	1,000	49,500	22,100
1986	43,450	21,500	9,970	1,800	53,420	23,300
1987	43,898	21,950	12,855	2,570	56,753	24,520
1988	45,120	23,900	13,690	4,200	58,810	28,100
1989	46,370	26,400	13,780	6,000	60,180	32,400
1990	47,660	29,400	17,330	7,800	64,990	37,200
1991	48,980	32,800	20,930	9,800	69,910	42,000
1992	50,340	36,800	24,570	11,700	74,910	48,500
1993	51,735	41,390	27,289	13,640	79,024	55,030
2010	58,890	58,890	45,464	36,370	104,354	95,260

Note : P.S.A - Population in the Served Area
P.S - Population Served

Fig 3.3.1 Projected Served Population

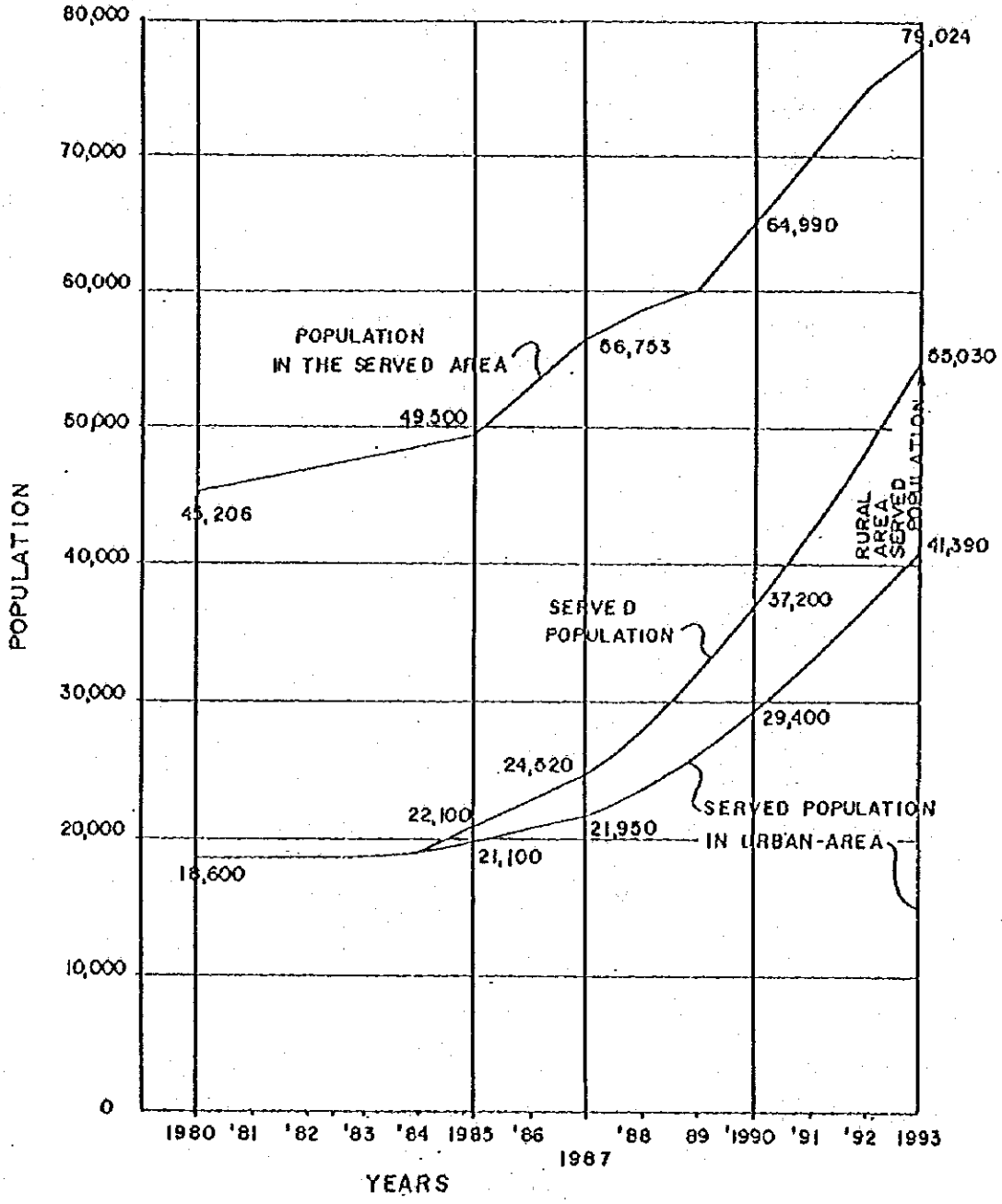


Table 3.3.3 Estimated Water Demand in Legaspi WD

	Urban Area		Rural Area		Total Area	
Years	P.S	W.D	P.S	W.D	P.S	W.D
1980	18,600	2,320	-	-	18,600	2,320
1981	18,600	2,320	-	-	18,600	2,320
1982	19,200	2,320	-	-	19,200	2,320
1983	20,400	2,350	-	-	20,400	2,350
1984	20,900	2,400	-	-	20,900	2,400
1985	21,100	4,594	1,000	89	22,100	4,683
1986	21,500	4,846	1,800	162	23,300	5,008
1987	21,950	5,114	2,570	234	24,520	5,348
1988	23,900	5,569	4,200	391	28,100	5,960
1989	26,400	6,151	6,000	570	32,400	6,721
1990	29,400	6,850	7,800	749	37,200	7,599
1991	32,800	7,642	9,800	960	42,600	8,602
1992	36,800	9,800	11,700	1,158	48,500	9,732
1993	41,390	9,644	13,640	1,378	55,030	11,022
2010	58,890	16,843	36,370	4,728	95,260	21,571

Note : P.S - Population Served
W.D - Average Day Water Demand

4. Immediate Improvement and Expansion Works

The project area is in an extremely poor water supply condition, as summarized below from description in 3. Existing Water Supply in PART ONE of the Report.

1) Water pressure is too low throughout the day and the periphery of the project area cannot get water from the water supply system. It is due to the fact that the present water demand has outgrown the supply capacity of the existing water supply system and the decreased supply capacity of transmission pipelines damaged by the recent flood.

2) The deep well which has been sunk to strengthen the water supply capacity and those deep wells drilled for inhabitants in the area have poor quality with odor.

3) Recently, two water districts, Legaspi City and Daraga, were formed separately from the APWS and the water source facilities of the existing water supply system were transfered to the Darage WD. And in the near future, the water source facilities are to be used for the Darage WD, and the Legaspi WD has to construct its own water source facilities.

4) The metered service connections are only 115, or 8 percent of the total.

New meters should be installed at all service connections that do not presently have meters. Existing meters that cannot be repaired should also be replaced with new meters. All pending applications for service connection should be processed and meters installed in those areas where distribution facilities exist or can be extended at minimum cost.

It is recommended that the WD purchase available spare parts for the repair of existing meters and also purchase 13 mm diameter 10,200 meters so that the above recommendation is realized.

5) Existing networks in the poblacion are not necessarily enough in size and routes. Distribution pipelines, therefore will be reinforced by the project.

Works proposed to cope with the recent situation are as follows, as detailed in the master plan in PART TWO.

4.1 Phase I Program

1) Buyoan Spring

The Buyoan spring will be firstly developed with a full development capacity of 6,480 cu m/day as a main water source for the WD. This spring source will solely serve for the WD's demand upto the year 1987.

2) Bulk and House Meters

Bulk meters to measure water supplied in bulk by the Daraga WD and produced by the District's own facilities will be installed, and all house connections will be metered; for this measurement 13 mm dia approx 1,330 meters are to be added to the planned service connections for this project.

3) Transmission Mains

New transmission mains from Buyoan spring to the new storage reservoir having a capacity of 75 l/sec with diameter of 300 mm and length of 500 m will be constructed. This transmission main is followed by a 350 mm pipe distribution main with a length of 5,500 m from the reservoir to the entrance of the poblacion area of Legaspi Port.

4) Distribution Mains

Distribution mains will be strengthened in the present served area and extended to the newly developed and developing areas. The first phase provides for the installation of the following primary and secondary distribution mains.

Diameter	Length
350 mm	5,500 m
300 mm	1,500 m
150 mm	500 m
100 mm	1,000 m
75 mm	2,000 m
50 mm	3,000 m

4.2 Phase II Program

1) Riverbed Water

The riverbed water on the Yawa River will be developed in the Phase II program as the second water source for the WD. Design capacity of this source is 7,000 cu m/day sized to meet the max day demand in the Phase II (1993).

2) Transmission and Distribution Main

Transmission mains from Yawa River side pumping station to the new storage reservoir on the Old Albay Hill with diameter of 300 mm and length of 3,800 m will be constructed. The second phase will provide for the installation of the following primary and secondary distribution mains in the present and extended served areas.

Diameter	Length
350 mm	1,000 m
200 mm	700 m
150 mm	1,030 m
100 mm	2,420 m
75 mm	12,300 m
50 mm	56,400 m

5. Water Sources

Potential water sources in the study area were extensively investigated, as reported in Appendix 4. Study on Water Sources. Water sources which can meet the future water requirement in the Water District are the Buyoan spring and the riverbed water of the Yawa River. Regarding other water sources, Bogtong spring can be used for the Water District, although the yield is quite limited, other springs are located uneconomically far away or yields are too small. Groundwater in the project area, however, is being used for the existing water supply system and for private use; deep groundwater has strong objectionable odor and shallow groundwater is not much in yield. As far as other water sources are available, groundwater should be avoided from the WD's water sources. Water sources to be tapped for the project as described below in the order of development.

5.1 Phase I Program

Buyoan Spring: the spring has a yield of about 7,230 cu m/day. Presently, the inhabitants nearby are using the water and there is a water supply plan of a Level II system for barangays which are located along the seacoast near the spring, and its withdrawal will be 600 cu m/day, leaving 750 cu m/day for the inhabitants nearby and for the stream which is used by local people. The water quality is suitable for drinking. The elevation of the spring, 74 m above sea level is high enough for gravity supply for the District.

5.2 Phase II Program

Riverbed Water of the Yawa River: the surface water of the River is partly used by a paper mill located in Daraga. There is no precedent of riverbed water use along the River. The results of the field investigation during the present study revealed that the River has a high potential of riverbed water. The River