APPENDICES

APPENDIX 3.5.6 NUVELCO POWER RATES (As of August 1986)

1. Residential Consumers

First 15 kwh	₱ 31.80 per month (Minimum Charges)
Over 15 kwh	₱ 2.24 per kwh

2. Commercial Consumers

First 15 kwh	₱ 43.20 per month (Minimum Charges)
Over 15 kwh	₱ 2.28 per kwh

3. Industrial Consumers

Demand Charges	₱ 15.00 per kwh
Plus Energy Charge	₱ 2.11 per kwh

APPENDIX 4.2.1 SURVEY FOR ESTIMATION OF "C" VALUE

As one of the factors for evaluation of the present status of transmission/distribution pipelines, the estimated "C" valve provides an important information to determine the capacity of such pipelines to deliver water. Furthermore, it can contribute to the development of a plan of water supply system associated with the determination of pipe diameter.

There are three (3) major transmission/distribution lines in the study area.

Location:	Pipe Material & Length:
a. Borrobbob Spring to reservoir	ϕ200 mm, CCI, 4,300 m
b. Reservoir to Bayombong	ϕ250 mm, CCI, 1,200 m
c. Bayombong to Solano	ϕ250 mm, CCI, 5,000 m

Since all of these pipelines were installed at the time of inauguration of the waterworks, their general backgrounds are more or less the same. Thus the "C" valve survey was carried out in a certain representative span of the pipeline, which can follow the selected criteria below:

a. Leakage shall be minimal and easily measured.

b. No service pipe is connected within the survey span.

c. Water pressure can be measured easily.

d. Ground elevation in the survey span is known or can be surveyed.

Through the reconnaissance survey, all the said pipeline routes were evaluated with the above criteria. Only the span from the Borrobbob Spring up to Barangay Masoc with approximate length of 1,400 m was identified. The survey section is shown in FIGURE 4.2.1.1.

Due to the lack of electric supply in the survey area, two (2) units o 12 V car battery was utilized for the power supply.

This "C" valve survey was carried out simultaneously with the topographic survey of the subject pipeline from the spring to the reservoir to measure elevations of the two points and the distance between them.

Considering the time lag between the two (2) survey points, the Ultrasonic Flow Meter was initially installed at the downstreamed side (Masoc) until the measurement at the upstream side (spring) was completed.

The results of the field measurement and the "C" valve estimation are presented in FIGURE 4.2.1.2.

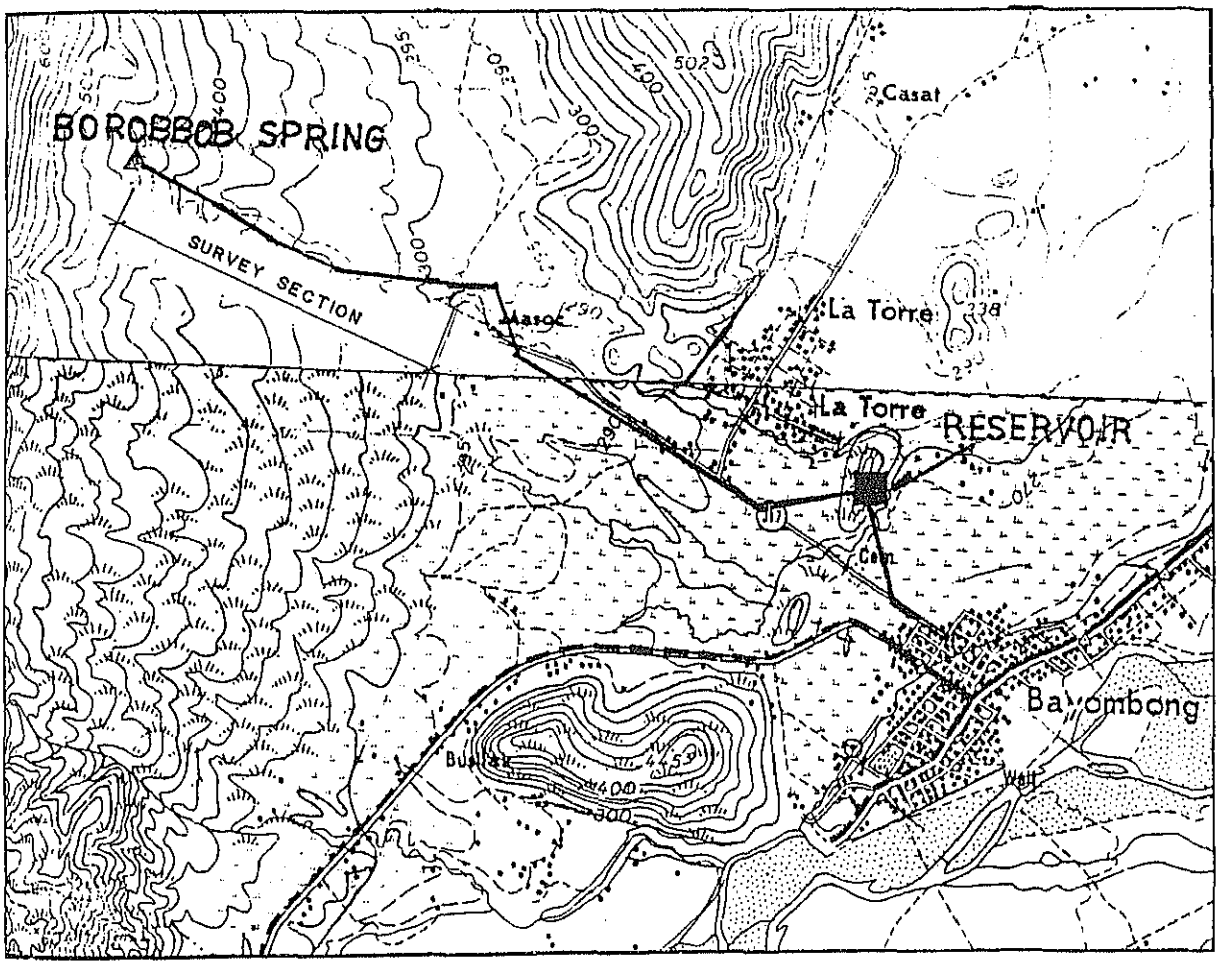
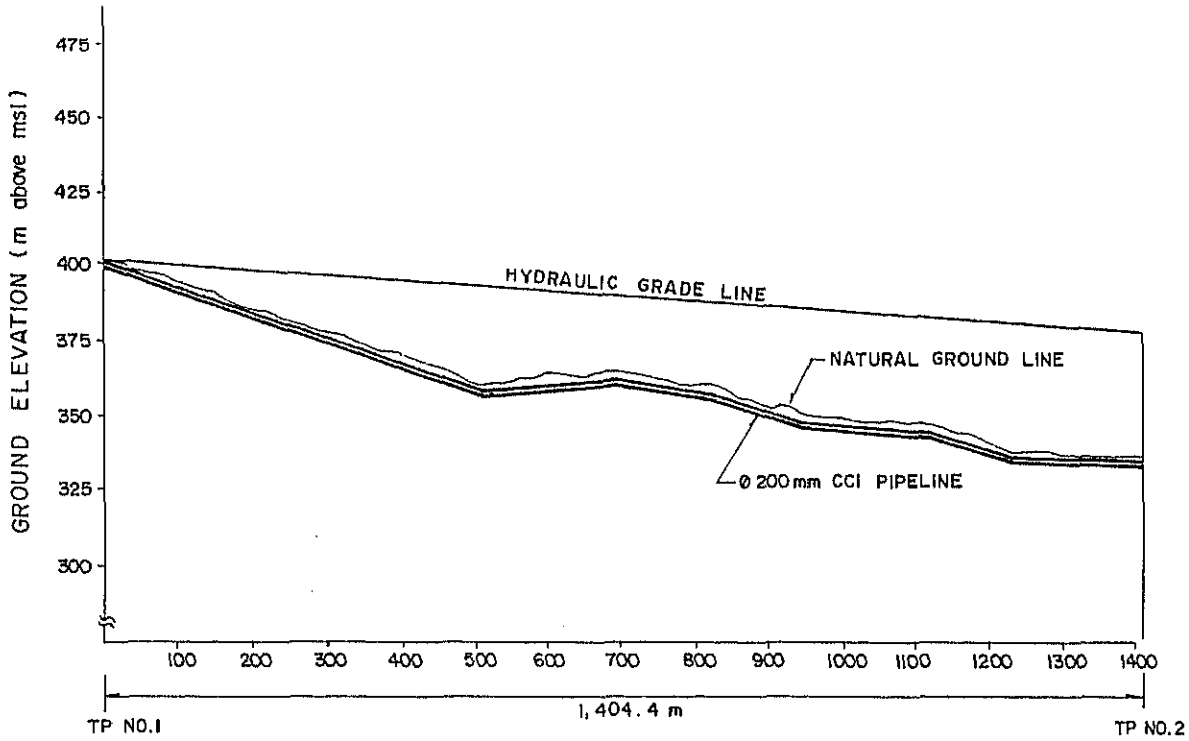


FIGURE 4.2.1.1 LOCATION OF SURVEY SECTION



TP NO.1

$Q = 200\ m^3/hr = 0.0556\ m^3/sec$

ELEVATION = 402.6 m above MSL
(Center of pipe)

PRESSURE HEAD = 0 m

PIPE DIAMETER = 200 mm

DATE OF TEST = 16 JULY 1986

TP NO. 2

$Q = 197\ m^3/hr = 0.0547\ m^3/sec$

ELEVATION = 336.0 m above MSL
(Center of pipe)

PRESSURE HEAD = 4.3 kg/cm^2 = 43 m

PIPE DIAMETER = 200 mm

DATE OF TEST = 16 JULY 1986

COMPUTATION:

$$C = 3.59028 \times Q \times D^{-2.63} \times H_{LOSS}^{-0.54} \times L^{0.54}$$

THUS;

$$C = 3.59028 \times (5.52 \times 10^{-2}) \times 0.2^{-2.63} \times 23.6^{-0.54} \times 1404.4^{0.54}$$

$$C = 125$$

WHERE:

$Q_{AVE} = 5.52 \times 10^{-2}\ m^3/sec$

$D = 0.2\ m$

$H_{LOSS} = 402.6 - 336.0 - 43$
$= 23.6\ m$

$L = 1.404.4\ m$

FIGURE 4.2.1.2
ESTIMATION OF "C" VALUE

APPENDIX 4.2.2 WATER PRESSURE TEST IN THE SERVICE AREA

To determine the measuring points, the following conditions were taken into account:

a. Measuring points were selected so as to develop a contour line of water pressure in the survey area.

b. Several points along the major distribution lines were so selected to monitor the variation of water pressure through the day in relation to the water use.

Considering the above mentioned conditions, a total of 27 measuring points; 12 points for Bayombong and 15 points for Solano, were identified through the preliminary survey.

Since the survey area consists of two towns, the field measurements was carried out one after another.

The highest and lowest water pressures through the day obtained from the field measurment are presented in TABLES 4.2.2.1 and 4.2.2.2.

From the field measurement result, the following facts are obtained:

a. The highest water pressure was observed at 0.49 kg/sq. cm during the peak demand hours in Bayombong and 0.35 kg/sq.cm during the less demand hours in Solano, respectively.

b. The lowest data was 0 kg/sq. cm both in Bayombong and Solano.

TABLE 4.2.2.1 WATER PRESSURE IN BAYOMBONG:

Measuring Point	LOCATION	GL (m)	HIGHEST PRESSURE kg/sq.cm	HIGHEST PRESSURE Time Range	LOWEST PRESSURE kg/sq.cm	LOWEST PRESSURE Time Range
1	Corner Ponce St./ Nat'l Road	+ 269.29	0.21	7:00-12:00	0	22:00
2	Corner Squing/ Nat'l Road	+ 270.56	0.35	6:00-12:00	0	21:00- 1:00
3	Along Luna St.	+ 269.76	0.35	8:00-13:00	0.11	22:00-16:00
4	Corner Nat'l Rd/ Mkt.	+ 271.00	0.49	9:00	0.07	18:00- 5:00
5	San Nicolas St.	+ 273.00	0.14	9:00-13:00	0.107	18:00-20:00
6	Corner Gonong St./ Rizal St.	+ 274.10	0.07	constant	0.07	constant
7	Corner Mabini St./ Rizal St.	+ 273.07	0.14	0:00-14:00	0.07	19:00- 6:00
8	Corner Sgt. B. Peres St./ Rizal St.	+ 272.02	0.21	8:30-12:00	0	19:00- 6:00
9	Corner Burgos St./ Gadingan St.	+ 271.34	0.32	8:00-12:00	0.04	21:00- 5:00
10	Corner Burgos St./ Zulueta St.	+ 270.66	0.21	7:00-12:00	0.11	18:00- 4:00
11	Corner Rizal St./ Ponce St.	+ 269.35	0.11	9:30-11:30	0.04	17:00- 8:00
12	Corner Gomez St./ Burgos St.	+ 272.51	0.35	6:00- 7:00	0	13:00-19:00

TABLE 4.2.2.2 WATER PRESSURE IN SOLANO:

Measuring Point	LOCATION	GL (m)	HIGHEST PRESSURE kg/sq.cm	Time Range	LOWEST PRESSURE kg/sq.cm	Time Range
1	Boundary-Bayombong/ Solano	+ 256.60	0.15	10:00-13:00	0.04	12:00- 6:00
2	Corner Bintacan/ Layebana	+ 250.05	0.28	12:00-22:00	0.12	12:00- 5:00
3	Corner Homapa/ Gaddang	+ 250.24	0.21	14:00-23:00	0.13	12:00-10:00
4	Corner Layebana/ Cementerio	+ 250.98	0.35	16:00-22:00	0.14	5:00- 6:00
5	Corner Aratal/ Layebana	+ 251.50	0.21	14:00-21:00	0.11	23:00- 9:00
6	Corner Layebana/ Yogad	+ 252.88	0.29	13:00-23:00	0.04	9:00-12:00
7	Near to corner Burgos /Lumabang	+ 254.41	0.26	10:00-14:00	0	12:00
8	Corner Burgos/ Nat'l Rd.	+ 254.93	0.21	16:00-21:00	0.11	23:00- 6:00
9	Corner Burgos/ Gaddang	+ 253.58	0.21	10:00-14:00 15:00-20:00	0.07	22:00
10	Corner Gaddang/ Mabini	+ 253.23	0.14	11:00-24:00	0	0:00- 6:00
11	Corner Washington/ Bontal	+ 253.00	0.11	16:00-21:00	0	12:00-15:00
12	Corner Bonifacio/ Bacarmo	+ 252.05	0.21	15:00-22:00	0.07	0:00- 5:00
13	Corner Lumabang/ Washington	+ 253.17	0.11	20:00-21:00	0	23:00- 5:00
14	Corner Mabini/ Cemetery	+ 254.24	0.17	13:00-16:00	0.07	16:00- 6:00

APPENDIX 4.3.1 DISCHARGE RATE OF SPRING

The collected water at the spring box flows into the transmission line. However, it was confirmed during Phase I survey that the water which overflowed and leaked from the spring box flowed into nearby streams.

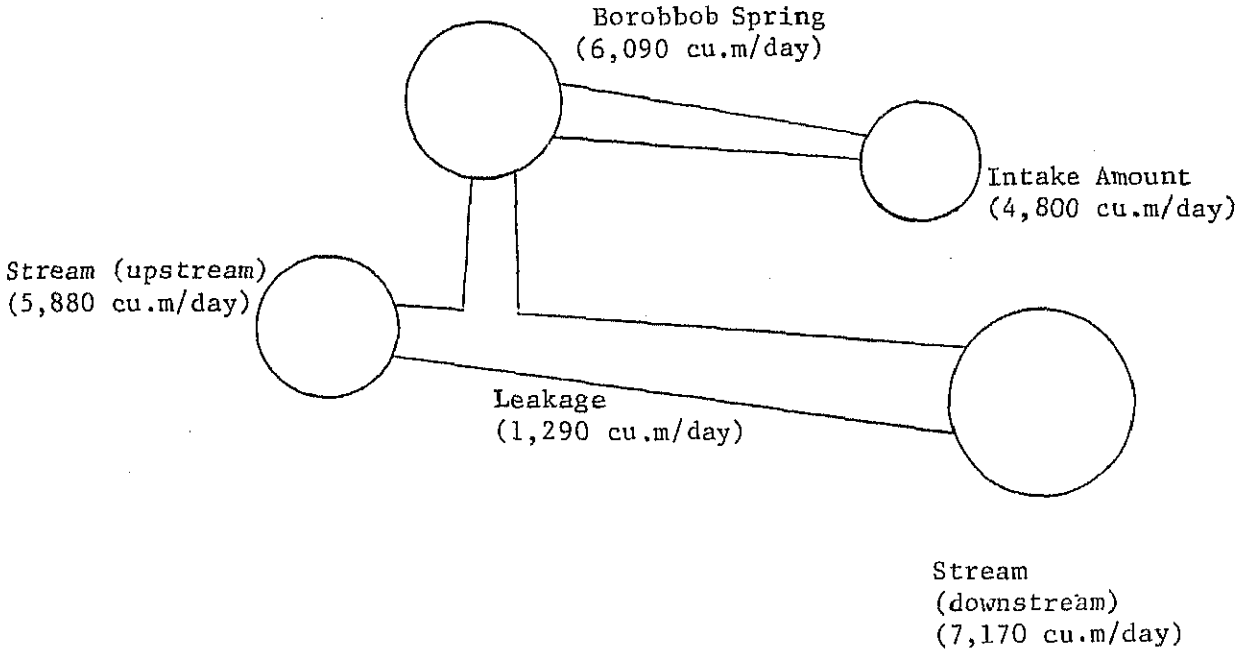
The measurement of flow rate was conducted to cover the total water collected at the spring. The following are the manner of measurement done in consideration of the present conditions at the spring site.

1) When there was an overflow from the spring box, the flow rate was estimated by measuring the overflow depth at the top of the spring box.
2) The total water volume which flowed into the nearby stream was estimated using the flow rates of the nearby stream at two points before and after joining the water from the spring box. The flow rate of the stream at two points was measured by means of a current meter.
3) The intake amount for water supply was measured at the outlet of the spring box (8-inch diameter, CCI) using the Ultrasonic Flow Meter.

The interval of flow rate measurement at the outlet pipe of the spring had been scheduled at every one (1) minute for an approximately one (1) hour duration so as to obtain an average intake amount.

The intake amount measured is approximately 4,800 cu.m/day(July, 1986) which corresponds to 4,740 cu.m/day measured in the Phase I survey. On the other hand, there was no overflow from the spring box, except the leakage at an amount of 1,290 cu.m/day. Thus, the total discharge of the Borrobbob Spring is considered to be approximately 6,090 cu.m/day. The spring discharge and the intake amount are illustrated in FIGURE 4.3.1.1.

FIGURE 4.3.1.1 WATER BALANCE AT BOROBBOB SPRING (As of July, 1986)



The total discharge of 6,090 cu.m/day is being considered as the minimum potential discharge at the end of the dry season because the actual start of the rainy season in the study area was delayed at the time of the field survey.

The same measurement conducted in April 1986 resulted that about 6,260 cu.m/day overflowed and leaked from the spring box.

APPENDIX 4.5.1 SURVEY FOR ESTIMATION OF UNACCOUNTED-FOR WATER/NOT UTILIZED WATER

The following conditions were considered for the selection of a sample study area:

a) The area shall be a representative of the whole study area so as to reflect the survey output in the entire service area.

b) The volume of transmitted/distributed water and water consumption/ accounted-for-water in the selected area should be measured/ estimated at a reasonable level of reliability.

On the other hand, there are several constraints as identified during the Phase I Study for implementation of this survey as follows:

a) No quantitative data/record on the water transmission/distribution and the water consumption is available from the Provincial Water-Works Office.

b) Two (2) different groups of water supply services have been practiced in the existing system;

- Barangays Masoc and La Torre, which are rural barangays of Bayombong municipality, are served on a continuous 24-hour basis with high water pressure (3.8 kg/sq.cm to 4.3 kg/sq. cm). Service pipes are directly connected to the transmission line between the section of the Borobbob Spring and the reservoir.

- The town propers of Bayombong and Solano are supplied from the reservoir via their respective transmission line for 14 hours a day (4:00 AM to 9:00 PM).

Under the above mentioned conditions, the scope of the survey for this subject was determined to cover the entire service area. The study of un-accounted-for water/not utilized water accordingly included some sections of transmisison/distribution lines and four service areas as enumerated

below.

a) Masoc/La Torre area along the transmission line
b) Town proper of Bayombong
c) Bonfal area along the transmisison line
d) Town proper of Solano

The section of transmission line between the spring and the reservoir was specially taken into account based on the result of analysis in the Phase I survey. It was identified that some 660 cu. m/day was distributed to the area in barangay Masoc and La Torre along the transmission line. The distributed amount corresponds to the water consumption for more than 400 households based on a common consumption per household. However there are only 118 connections in the said area. In this connection, the study of not utilized water in this section was a highlight among others.

A total of eight flow rate measuring points were selected along the transmission/distribution line from the spring to the proper of Solano to cover the above mentioned study areas. In other words, those points that are inlet and outlet of the clustered areas/town propers served by the Waterworks in addition to the outlet of the spring and the reservoir; were covered as shown in FIGURE 4.5.1.1. TABLE 4.5.1.1 presents detailed information on the measuring points.

TABLE 4.5.1.1 MEASURING POINS OF FLOW RATE

Survey Point No.	Purpose	Location
1	Intake Volume	ϕ 200 mm CCI pipe at 10 m downstream from springbox (exposed pipe)
2	Transmitted volume from spring to entrance of Brgy. Masoc	ϕ 200 mm CCI pipe at Masoc Ranch Guard House (exposed pipe)
3	Distributed volume to Brgy. Masoc	ϕ 200 mm CCI pipe near boundary of Brgys. Masoc and La Torre (excavated pipe)
4	Transmitted volume to the reservoir	ϕ 200 mm CCI pipe at the entrance of reservoir (exposed pipe)
5	Transmitted volume from reservoir	ϕ 300 mm CCI pipe near outlet of reservoir

6	Transmitted volume to Solano area and part of Bayombong	ϕ259 mm CCI pipe at river crossing in Bayombong town proper (exposed pipe)
7	Transmitted volume to Solano area and Brgy. Bonfal of Bayombong	ϕ250 mm CCI pipe at highway junction (exposed pipe)
8	Transmitted volume to Solano area	ϕ250 mm CCI pipe near municipal boundary of Bayombong and Solano (exposed pipe)

A supplementary investigation on the unit water consumption in the absence of water meter through the area was planned to get information on the present water consumption. The actual water consumption per connection was field measured using two sets of water meter. The survey was conducted in the three major service areas; Masoc/La Torre, Bayombong and Solano areas, having installed the water meter at about random- selected 10 connections in each area for one day measurement of water consumption. An interview with the concessionaires was also supplemented to collect additional information on the actual population served per connection.

A flow chart for estimation of unaccounted-for-water/not utilized water using the survey result is shown in FIGURE 4.5.1.2.

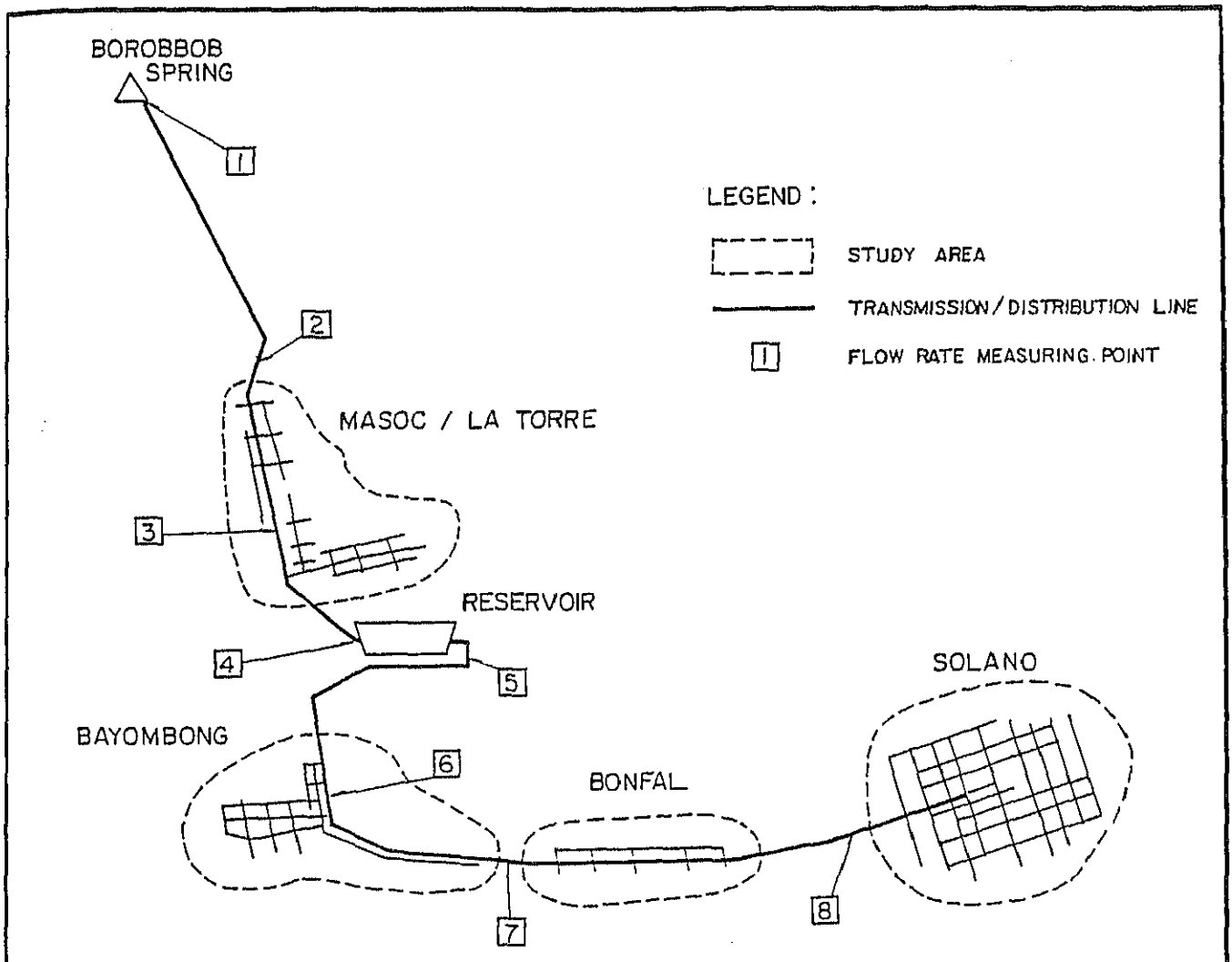
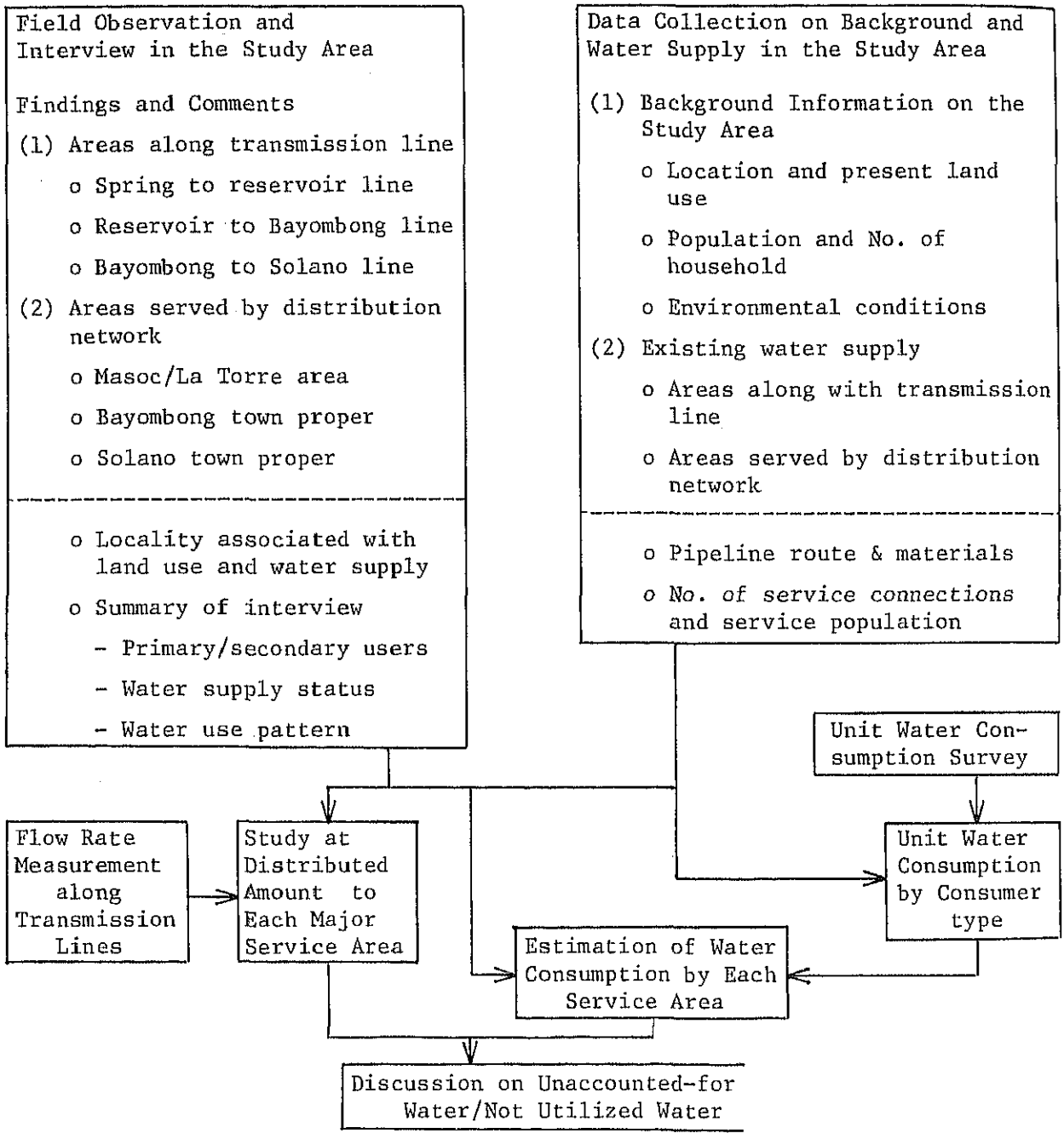


FIGURE 4.5.1.1
STUDY AREA OF
UNACCOUNTED FOR WATER /
NOT UTILIZED WATER
BAYOMBONG - SOLANO

FIGURE 4.5.1.2 FLOW CHART FOR ESTIMATION OF UNACCOUNTED-FOR WATER/ NOT UTILIZED WATER



Background information and existing water supply

a) Masoc/La Torre Area

Barangay Masoc is located on the hilly area near the mountain flank where the Borobbob Spring is situated. Houses are distributed along the provincial road connecting to the town proper of Bayombong via Barangay La Torre .

Barangay La Torre is located rather down hill of Masoc along the said provincial road. The households in this barangay are also located along the provincial road.

The land in the Masoc/La Torre service area is mainly used for agricultural purposes (rice field). At the backside of houses, especially in Masoc, there are many small scale fish onds owned by farmers. Also covered in rural households are piggery and "Carabao" (Filipino; water buffalo). Commercial land use is limited in the Masoc/La Torre service area. Only small scale business establishments, i.e., "Sari-Sari Store" are existing. Likewise, most of the economic activities in this area are agriculture and fish-breeding, and consumable goods are purchased in the Bayombong town proper.

b) Bayombong Town Proper Area

As a capital town of Nueva Vizcaya, there are many government offices and schools in the town proper of Bayombong. Most of government offices are located within the capital compound of the province at the northern part of the town proper. Schools, colleges and universities are scattered in the town proper. A public market is located in the western part of the town proper.

Likewise, the town proper is used mainly for residential and institutional purposes and commercial area is limited along the national road Route 5 which is running across the town proper.

The east end of the town proper is facing the flood plain of Magat River, west end is up to a bypass of the said national road, south end is up to hilly area, and north side is opened to Solano area.

c) Solano Town Proper Area

Solano town proper is located five (5) km north of Bayombong. This area is a center of commercial activities of the province. The national road Route 5 coming from Bayombong runs across the town proper going to Santiago, Isabela Province.

Likewise, commcercial establishments are concentrated along the national roads and the residential area is surrounding the commercial zone. A public market is located at the northeastern part of the town proper.

The water supply status in the entire service area is summarized as follows:

a) The area directly connected to the transmission line (Borobbob Spring reservoir) on a continuous 24-hour supply basis with comparatively high pressure; Masoc/La Torre area

b) The area served from the reservoir for 17-hours a day; Town proper of Bayombong and Solano and Bonfal area.

Masoc/La Torre area is being served with a water pressure ranging from 3.8 kg/sq.cm at Masoc Elementary School to 4.3 kg/sq.cm in La Torre area, while the rest of the existing service is seriously suffering from low water pressure throughout the day and these is obviously no water supply in the afternoon.

1) Number of Connections in the service area.

The number of connections by consumers type is listed in TABLE 4.5.1.2. Majority of the connections (more than 95 percent) is for domestic use and there are some instituitional and commercial connections and public faucets.

TABLE 4.5.1.2 NUMBER OF CONNECTIONS BY CONSUMER TYPE

Area	Domestic	Institutional	Commercial	Public Market	Total
Masoc/La Torre	130	2	-	2	134
Bayombong	570	18	-	4	592
Bayombong to Solano	71	-	-	-	71
Solano	528	9	10	1	548
Total	1,299	29	10	7	1,345

2) Served Population in the Study Area

The actual served population consists of primary users and secondary users/borrowers as confirmed through the interview with inhabitants.

The interview for the domestic connections was conducted in the service areas of Masoc/La Torre, Bayombong, and Solano. Approximately 20 to 40 households in each area were covered considering the total number of registered concessionaires. Average percentages of the number of borrowers to that of primary users were estimated at 60% in Masoc/La Torre and Solano areas, and 45% in Bayombong and Bonfal areas.

The actual population served was estimated using the interview result as shown in TABLE 4.5.1.3. The served population for the public faucet is based on the interview covering all faucets in the area.

TABLE 4.5.1.3 SERVED POPULATION BY THE STUDY AREA:

Area	Domestic Connection				Public Faucet	Total	R.M.
	No. of Conn.	Primary	Barrower	Total			
Masoc/La Torre	130	658	395	1,053	51	1,104	
Bayombong	570	2,874	1,293	4,167	45	4,212	
Bayombong to Solano	71	359	162	521	-	521	
Solano	528	2,847	1,708	4,555	22	4,577	
Total	1,331	6,738	3,558	10,296	118	10,414	

Result of Flow Rate Measurement

The result of flow rate measurement at the selected points is summarized in TABLE 4.5.1.4.

TABLE 4.5.1.4 RESULT OF FLOW RATE MEASUREMENT

Measuring Point	Flow Rate (cu.m/day)
1	4,800
2	4,730
3	4,060
4	3,790
5	3,350
6	2,190
7	2,230
8	1,790

A schematic diagram of transmitted/distributed water is shown in FIGURE 4.5.1.3. Of the total 4,800 cu.m/day intake amount, 20% or 940 cu.m/day is distributed to Masoc/La Torre area and 78.5% or 3, 790 cu. m/day is transmitted to the reservoir, while 1.5% or 70 cu.m/day is /leaked along the transmission line. From the reservoir, a total of 3,350 cu.m/day is distributed to the respective service area; 36% or 1,200 cu.m/day for Bayombong, 11% or 360 cu.m/day for Bonfal area; and the rest, 53% or 1,790 cu.m/day for Solano.

Based on the estimation of distributed water and accounted-for water/utilized water, the unaccounted-for water/not utilized water was assessed as shown in FIGURE 4.5.1.4.

As a whole, approximately 40% of the total distributed amount is estimated to be utilized in the present service area or about 60 % is assumed to be unaccounted-for water/not utilized water.

Major causes of high percentage of the unaccounted-for water/not utilized water may be the presence of unknown consumption and leakage and wastage.

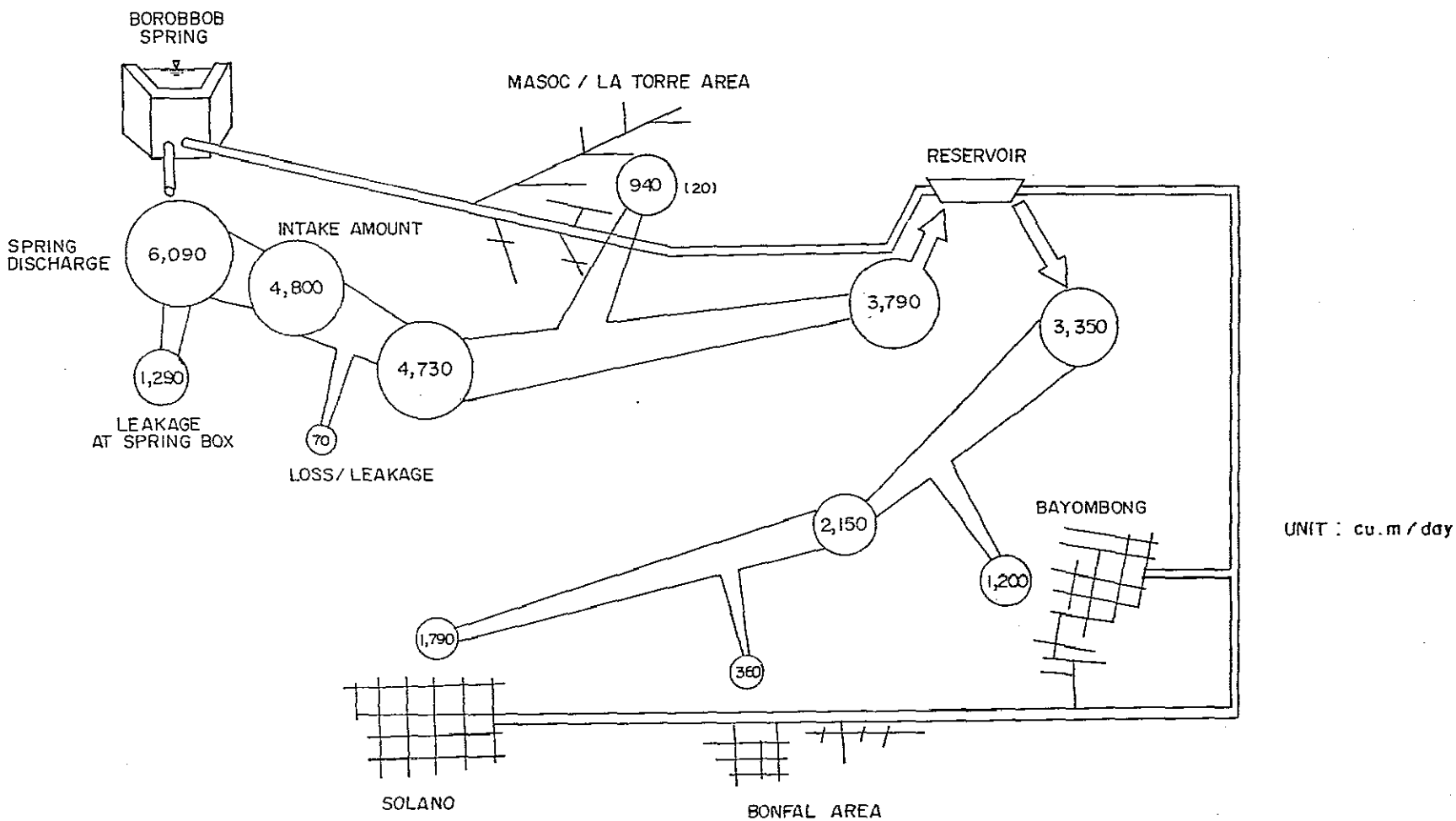


FIGURE 4.5.1.3

TRANSMITTED / DISTRIBUTED AMOUNT

BAYOMBONG - SOLANO, NUEVA VIZCAYA

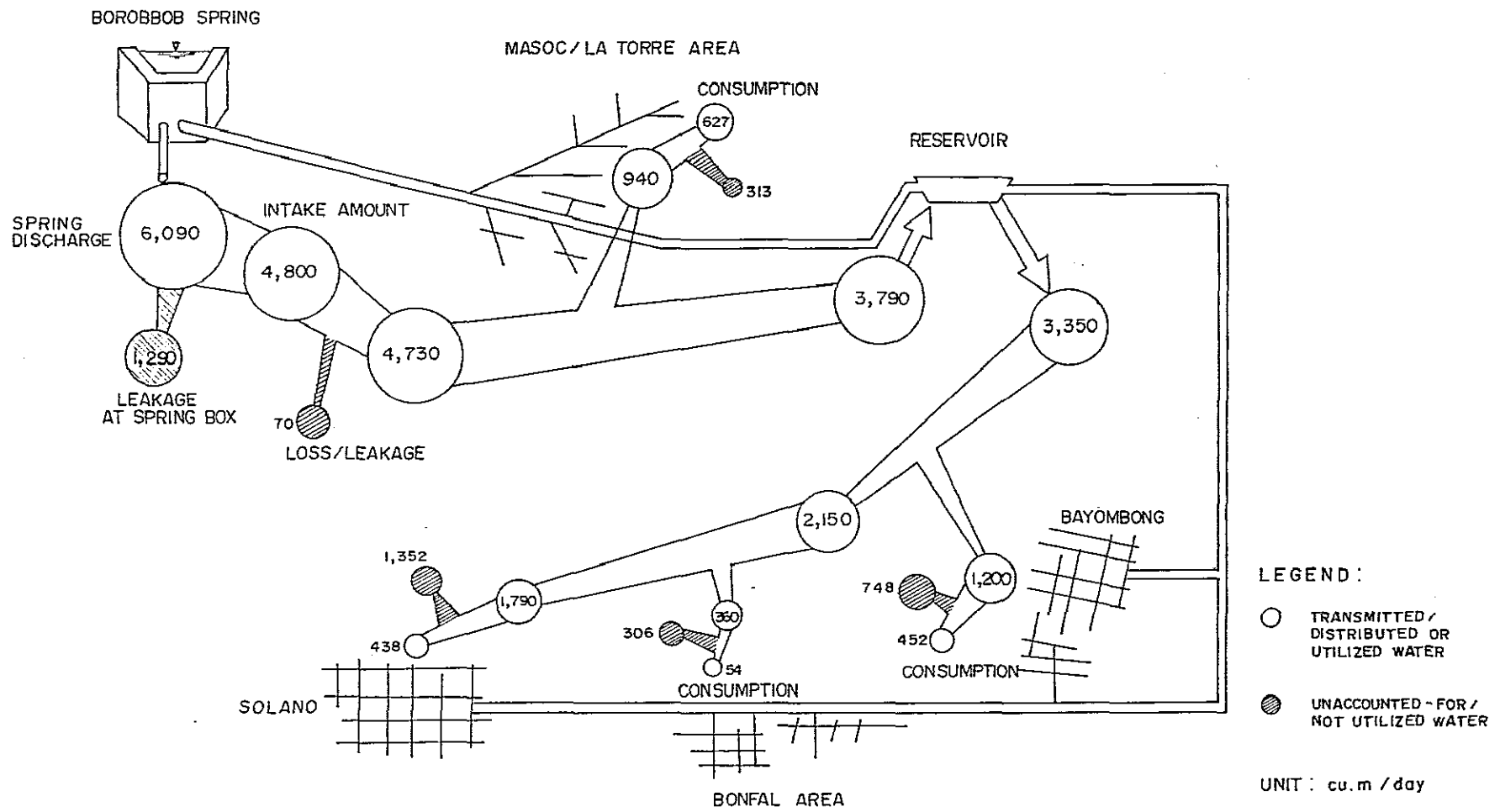
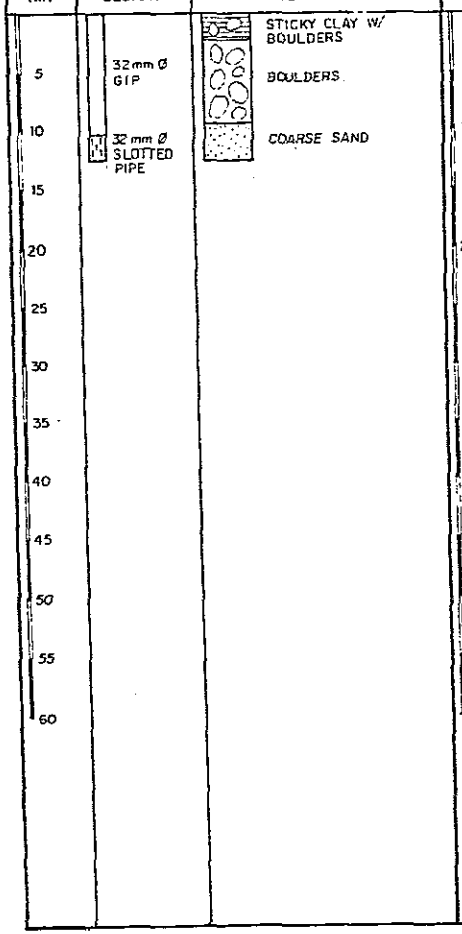


FIGURE 4.5.1.4
UNACCOUNTED-FOR WATER/
NOT UTILIZED WATER
BAYOMBONG - SOLANO, NUEVA VIZCAYA

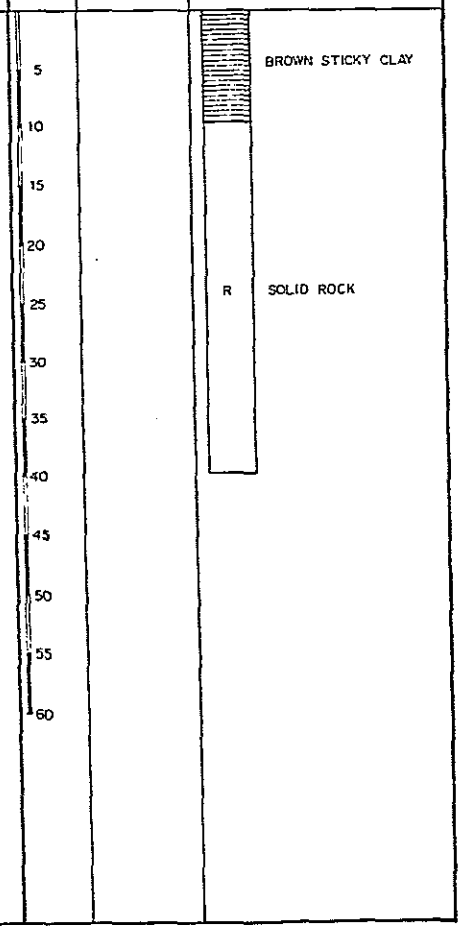
LWUA/JICA WELL NO. 1
OWNER'S NO. 52-85-03
LOCATION : UDDIAWAN, SOLANO

GROUND ELEVATION : 280 m
WELL DEPTH : 12 m
CASING DEPTH : 12 m
CASING DIAMETER : 32 mm
STATIC WATER LEVEL : 7.2 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



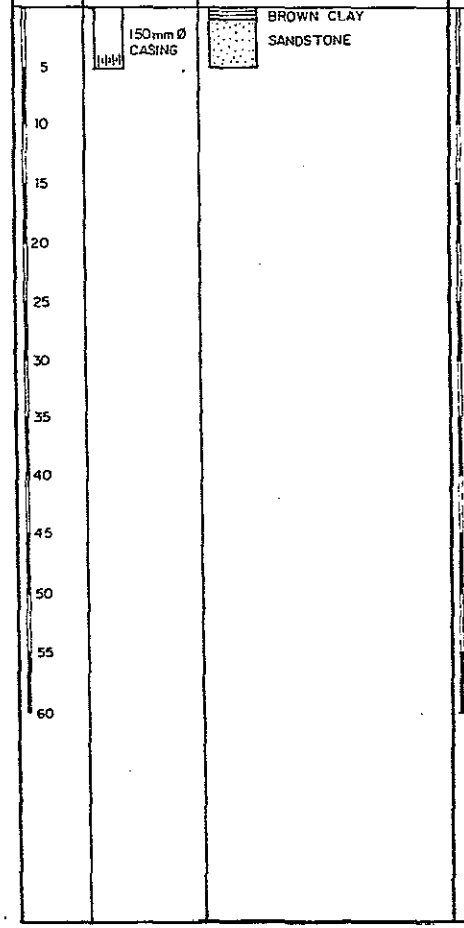
LWUA/JICA WELL NO. 4
OWNER'S NO. 6766
LOCATION : LATTAUAN, SOLANO

GROUND ELEVATION : 278 m
WELL DEPTH : 40 m
CASING DEPTH :
CASING DIAMETER : 112 mm
STATIC WATER LEVEL : 4.6 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



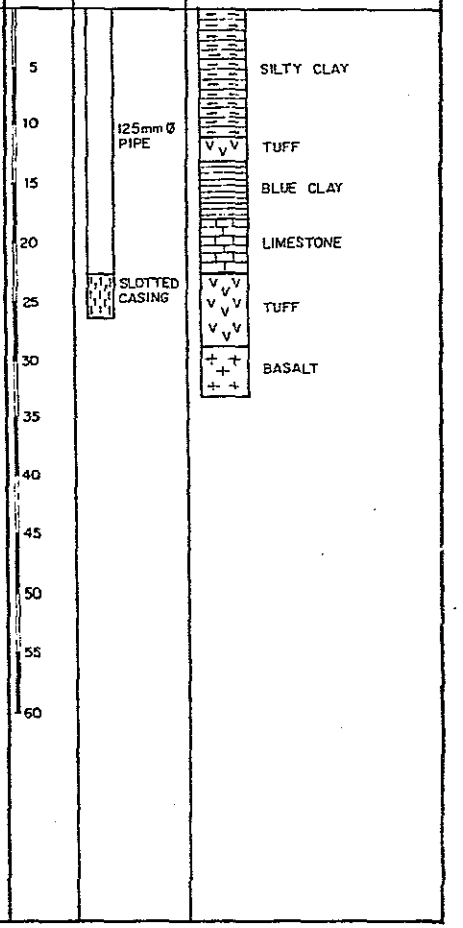
LWUA/JICA WELL NO. 5
OWNER'S NO. 9048
LOCATION : AGGUB PLAZA, SOLANO

GROUND ELEVATION : 245 m
WELL DEPTH : 5.2 m
CASING DEPTH : 4.9 m
CASING DIAMETER : 150 mm
STATIC WATER LEVEL : 1.6 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



LWUA/JICA WELL NO. 9
OWNER'S NO. 52-84-07
LOCATION : CONCEPCION BLISS, SOLANO

GROUND ELEVATION : 320 m
WELL DEPTH : 31.2 m
CASING DEPTH : 25.2 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 12.0 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



APPENDIX 6.6.2
WELL LITHOLOGIC LOGS
BAYOMBONG - SOLANO

LWUA/JICA WELL NO. 11
OWNER'S NO. 20973
LOCATION : BANGAR, SOLANO

GROUND ELEVATION : 225 m
WELL DEPTH : 9.2 m
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 1.8 m BGL
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :

DEPTH (m)	WELL DESIGN	STRATA DESCRIPTION
5		SANDY SOIL
10		SAND AND GRAVEL
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		

LWUA/JICA WELL NO. 14
OWNER'S NO. 40601
LOCATION : SOLANO NORTH E/S, SOLANO

GROUND ELEVATION : 250 m
WELL DEPTH : 13.7 m
CASING DEPTH : 13.7 m
CASING DIAMETER :
STATIC WATER LEVEL : 0.9 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :

DEPTH (m)	WELL DESIGN	STRATA DESCRIPTION
5		CLAY W/ SAND
10		COARSE SAND W/ CLAY COARSE SAND W/BOULDERS BOULDERS W/ SAND BOULDERS BOULDERS W/ SAND AND GRAVEL
15		SAND AND GRAVEL
20		
25		
30		
35		
40		
45		
50		
55		
60		

LWUA/JICA WELL NO. 15
OWNER'S NO. 6761
LOCATION : PUBLIC MARKET, SOLANO

GROUND ELEVATION : 250 m
WELL DEPTH : 23.2 m
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 0.9 m bgl
DISCHARGE :
SPECIFIC CAPACITY : 2.07
TRANSMISSIVITY :

DEPTH (m)	WELL DESIGN	STRATA DESCRIPTION
5		CLAY WITH SAND
10		SANDSTONE
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		

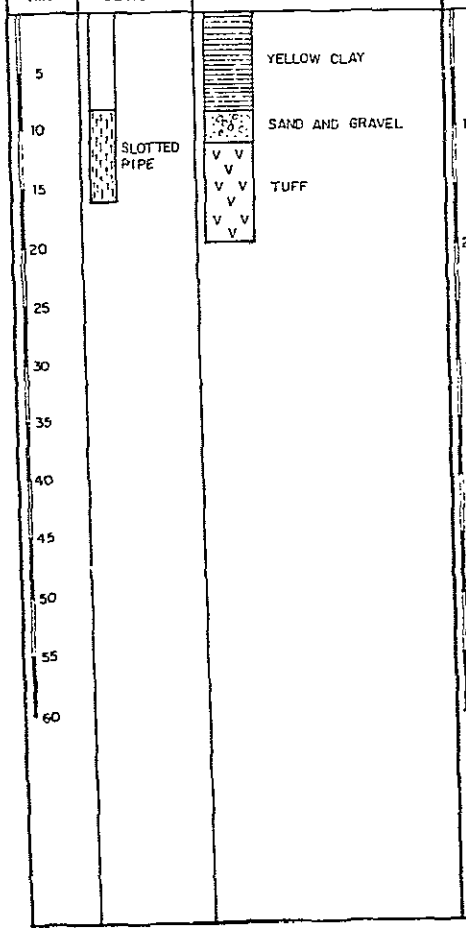
LWUA/JICA WELL NO. 17
OWNER'S NO. 52-82-10
LOCATION : CURIFANG, SOLANO

GROUND ELEVATION : 245 m
WELL DEPTH : 15.2 m
CASING DEPTH : 10.4 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 4.2 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :

DEPTH (m)	WELL DESIGN	STRATA DESCRIPTION
5	125mmØ CASING	CLAY TUFF
10	SLOTTED PIPE	BOULDER FINE SAND
15		BASALT
20		
25		
30		
35		
40		
45		
50		
55		
60		

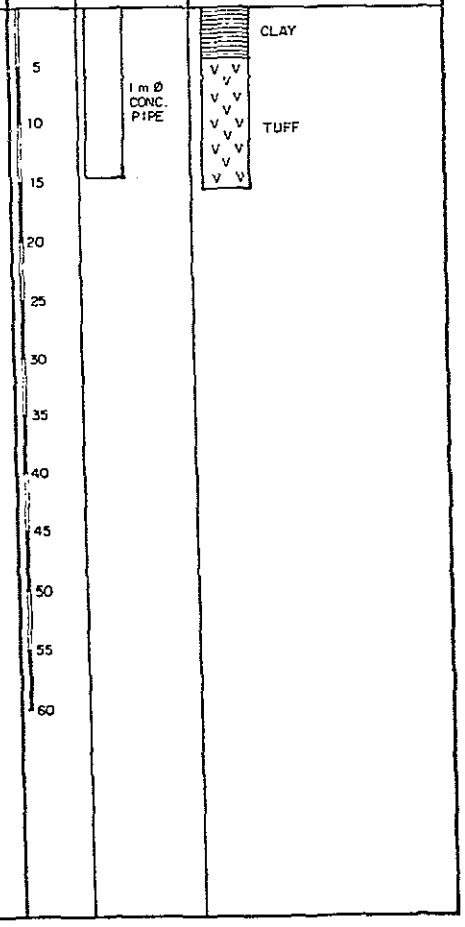
LWUA/JICA WELL NO. 18
OWNER'S NO. 52-85-03
LOCATION : BUGNAY, QUIRINO, SOLANO

GROUND ELEVATION : 240 m
WELL DEPTH : 18.5 m
CASING DEPTH : 15.5 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 4.1 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



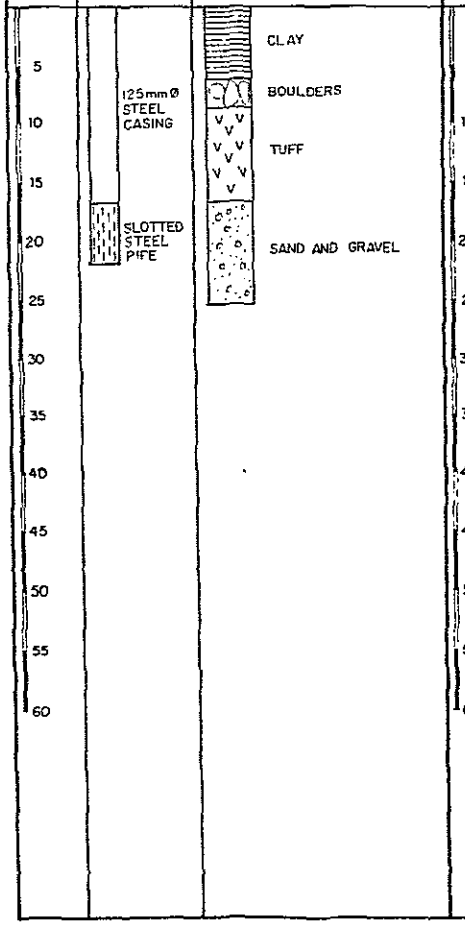
LWUA/JICA WELL NO. 19
OWNER'S NO.
LOCATION : CLIRIFANG, SOLANO

GROUND ELEVATION :
WELL DEPTH : 15 m
CASING DEPTH : 14 m
CASING DIAMETER : 1 m
STATIC WATER LEVEL : 11.2 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



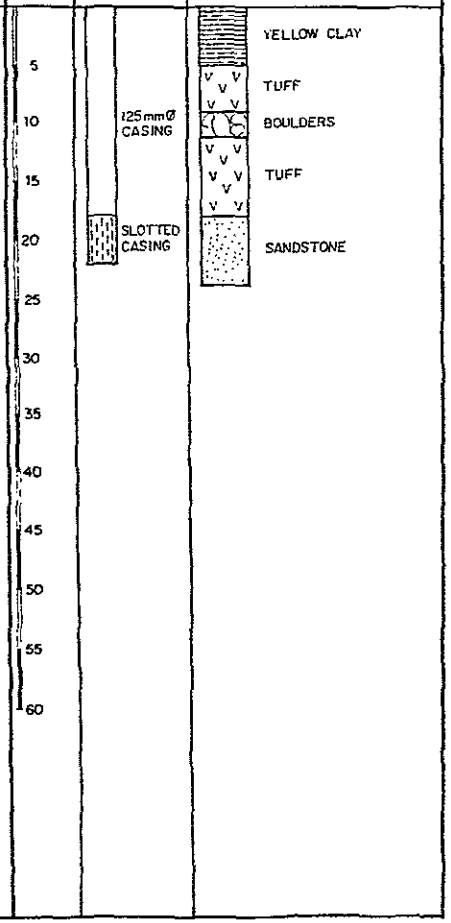
LWUA/JICA WELL NO. 21
OWNER'S NO. 52-82-07
LOCATION : LA TORRE E/S, BAYOMBONG

GROUND ELEVATION : 280 m
WELL DEPTH : 24.5 m
CASING DEPTH : 21.4 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 1.8 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



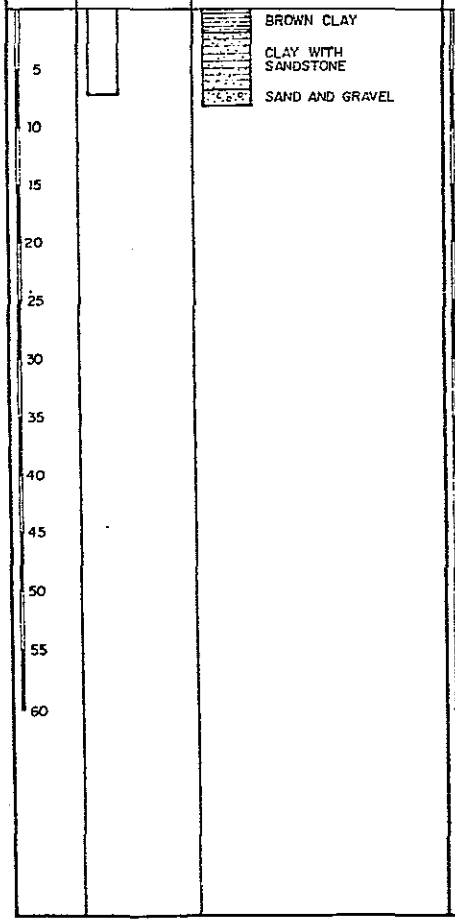
LWUA/JICA WELL NO. 22
OWNER'S NO. 52-82-08
LOCATION : LUYANG, BAYOMBONG

GROUND ELEVATION : 280 m
WELL DEPTH : 23 m
CASING DEPTH : 21.9 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 2.9 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



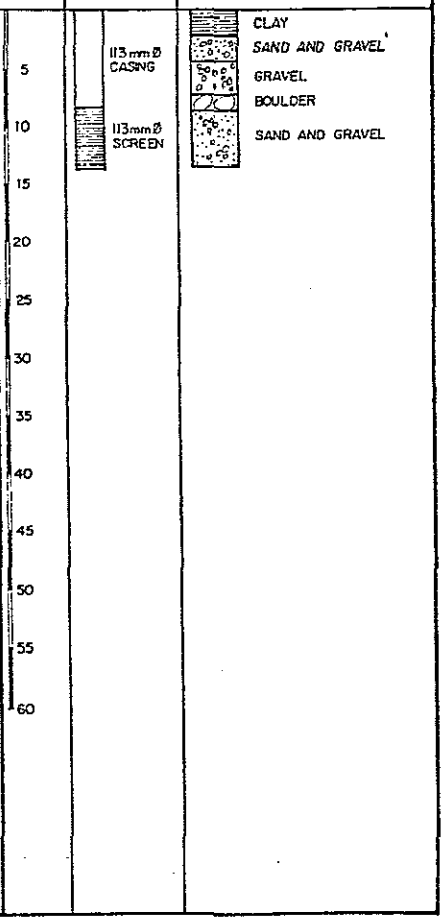
LWUA/JICA WELL NO. 23
OWNER'S NO. 9042
LOCATION : BONFAL SCH., BAYOMBONG

GROUND ELEVATION : 265 m
WELL DEPTH : 7.6 m
CASING DEPTH : 7.0 m
CASING DIAMETER : 150 mm
STATIC WATER LEVEL : 2.8 m bgl
DISCHARGE :
SPECIFIC CAPACITY : 0.3l
TRANSMISSIVITY :



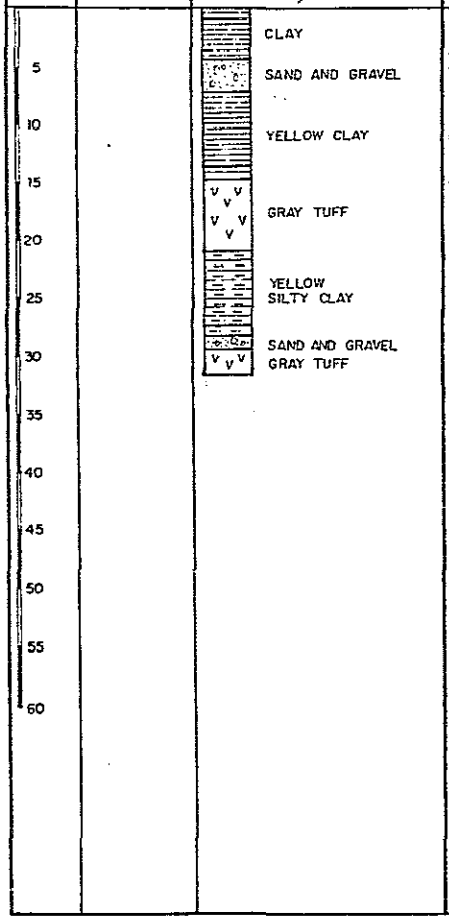
LWUA/JICA WELL NO. 29
OWNER'S NO. 52-76-31
LOCATION : BAY WEST SCH., BAYOMBONG

GROUND ELEVATION : 265 m
WELL DEPTH : 12.8 m
CASING DEPTH : 12.8 m
CASING DIAMETER : 112 mm
STATIC WATER LEVEL : 1.2 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



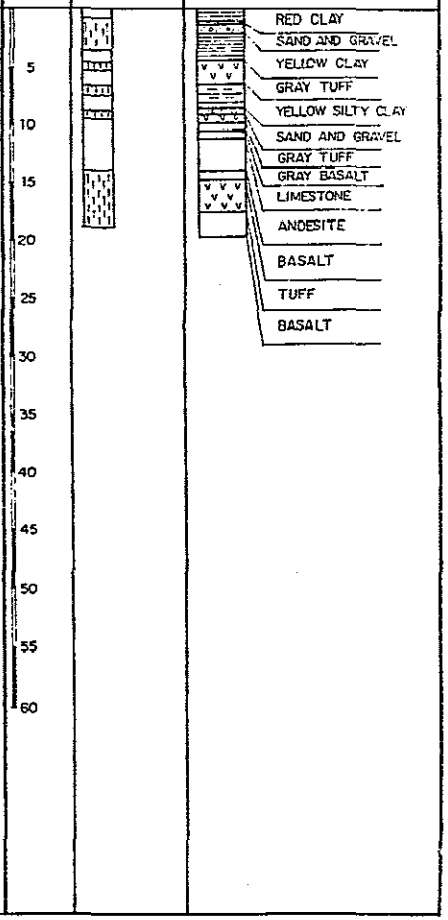
LWUA/JICA WELL NO. 31
OWNER'S NO. 53-83-02
LOCATION : MFEMVRH, BAYOMBONG

GROUND ELEVATION : 290 m
WELL DEPTH : 30 m
CASING DEPTH :
CASING DIAMETER : 150 mm
STATIC WATER LEVEL : 2.6 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



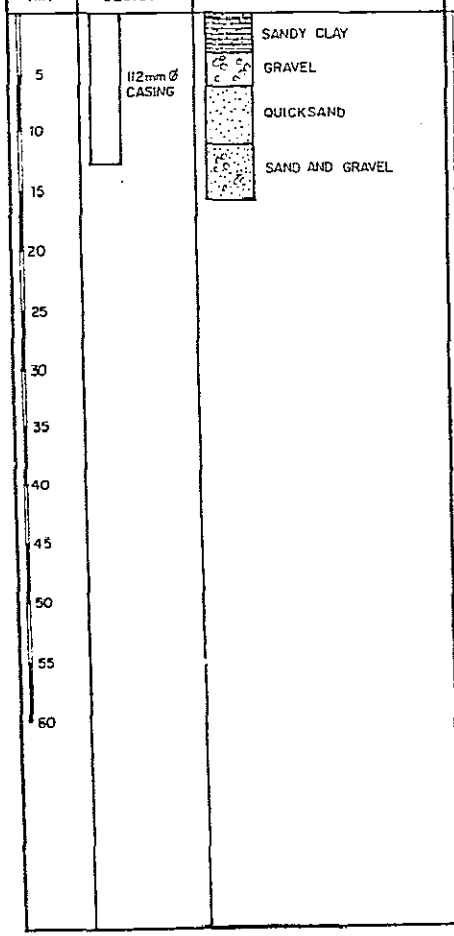
LWUA/JICA WELL NO. 32
OWNER'S NO.
LOCATION : MFEMVRH, BAYOMBONG

GROUND ELEVATION : 290 m
WELL DEPTH : 18.6 m
CASING DEPTH : 16.8 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 2.7 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



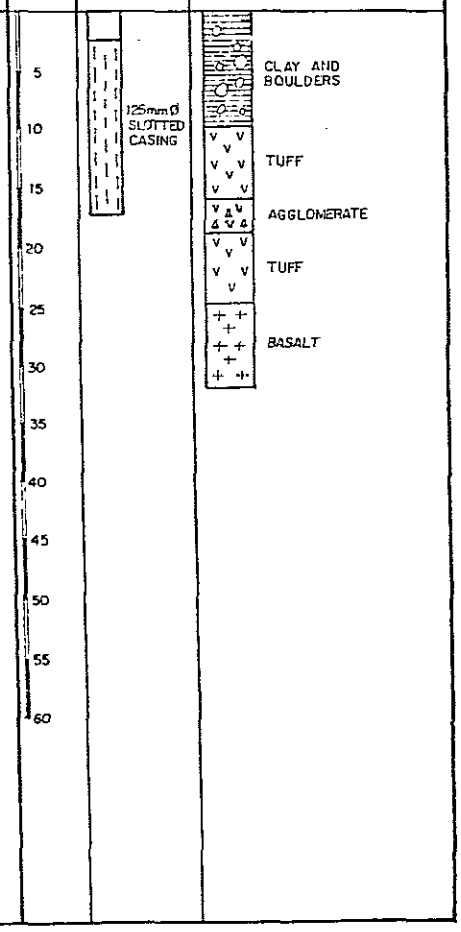
LWUA / JICA WELL NO. 33
OWNER'S NO. 52-76-25
LOCATION : BAY CENTRAL SCH., BAYOMBONG

GROUND ELEVATION : 270 m
WELL DEPTH : 15.2 m
CASING DEPTH : 12.2 m
CASING DIAMETER : 112 mm
STATIC WATER LEVEL : 1.7 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



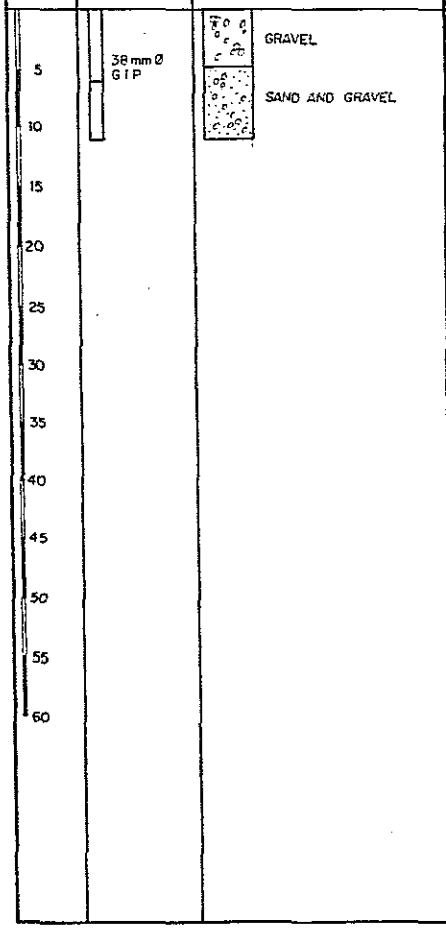
LWUA / JICA WELL NO. 34
OWNER'S NO. 52-83-03
LOCATION : NVSIT, BAYOMBONG

GROUND ELEVATION : 285 m
WELL DEPTH : 30.5 m
CASING DEPTH : 16.5 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 1.8 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



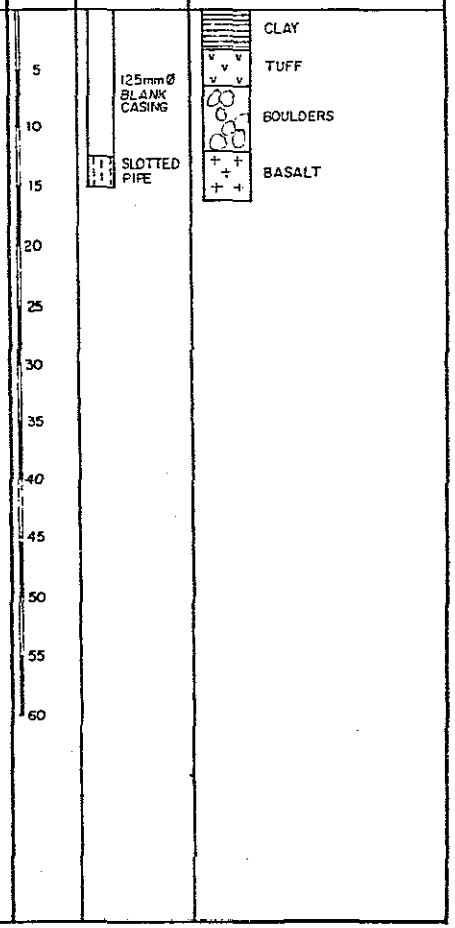
LWUA / JICA WELL NO. 35
OWNER'S NO. 52-76-06
LOCATION : DIV OFF, POBLACION, BAYOMBONG

GROUND ELEVATION : 270 m
WELL DEPTH : 10.7 m
CASING DEPTH : 10.7 m
CASING DIAMETER : 38 mm
STATIC WATER LEVEL : 1.6 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



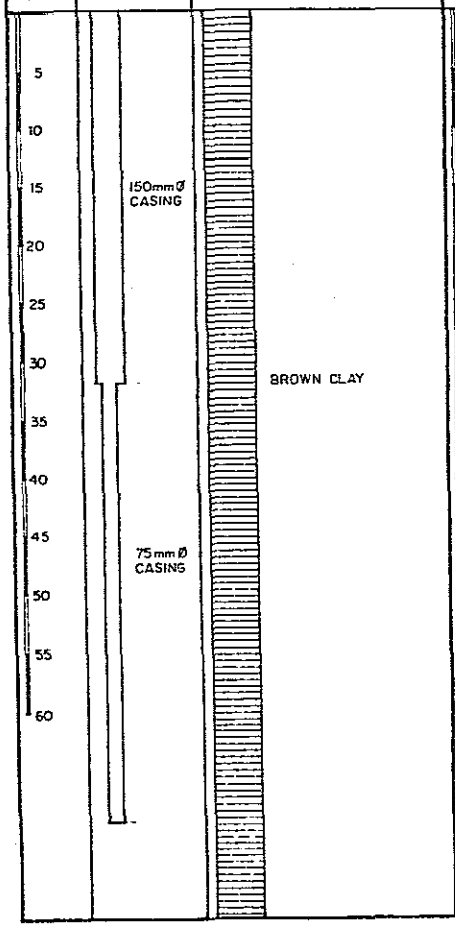
LWUA / JICA WELL NO. 39
OWNER'S NO. 52-82-25
LOCATION : VISTA ALEGRE, BAYOMBONG

GROUND ELEVATION : 275 m
WELL DEPTH : 15.5 m
CASING DEPTH : 14.4 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 6.8 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



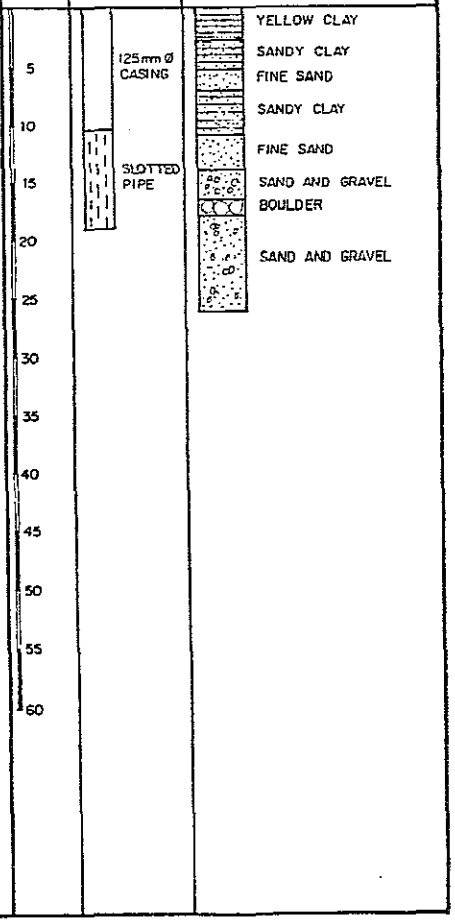
LWUA / JICA WELL NO. 40
OWNER'S NO. 6760
LOCATION : BUSILAC SCH., BAYOMBONG

GROUND ELEVATION : 300 m
WELL DEPTH : 71.3 m
CASING DEPTH : 67.1 / 30.5 m
CASING DIAMETER : 150 / 75 mm
STATIC WATER LEVEL : 18.5 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



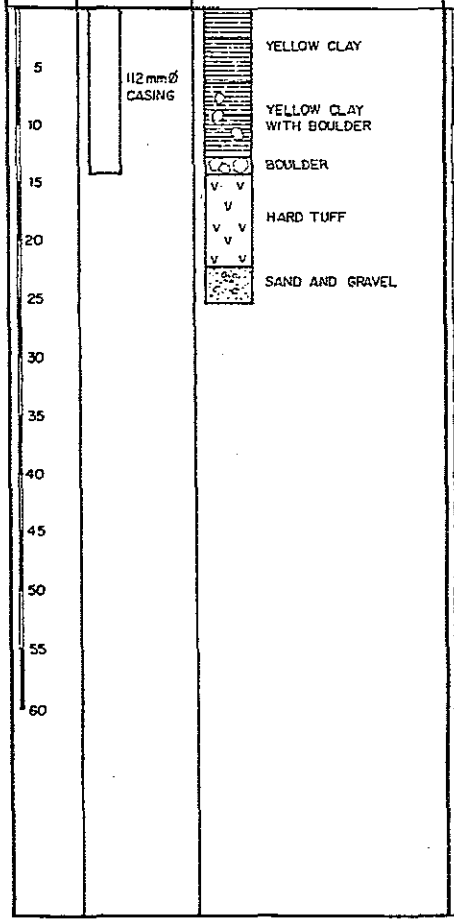
LWUA / JICA WELL NO. 43
OWNER'S NO. 52-85-04
LOCATION : LATUYOT, MAGAPUY, BAYOMBONG

GROUND ELEVATION : 290 m
WELL DEPTH : 25 m
CASING DEPTH : 18 m
CASING DIAMETER : 125 mm
STATIC WATER LEVEL : 2.6 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



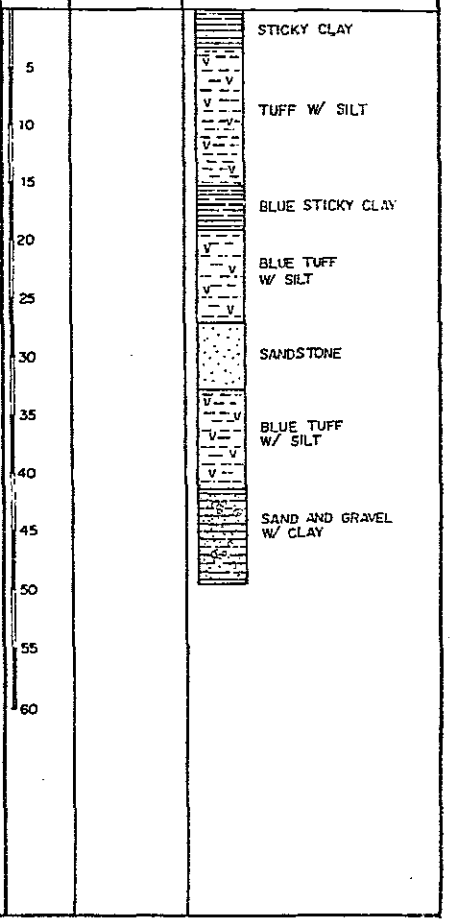
LWUA / JICA WELL NO. 45
OWNER'S NO. 52-76-19
LOCATION : VISTA HILLS, BAYOMBONG

GROUND ELEVATION : 300 m
WELL DEPTH : 24.4 m
CASING DEPTH : 13.7 m
CASING DIAMETER : 112 mm
STATIC WATER LEVEL : 2.9 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



LWUA / JICA WELL NO. 46
OWNER'S NO.
LOCATION : PIEZA, IBONG, SOLANO

GROUND ELEVATION : 230 m
WELL DEPTH : 47.3 m
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 7.9 m bgl
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :



APPENDIX 6.7.1 WATER QUALITY EXAMINATION

(1) Sampling Points

Water samples were collected from the total of 12 sampling points for physical, chemical and bacteriological examination as shown in TABLE 6.7.1.1 and FIGURE 6.7.1.1.

TABLE 6.7.1.1 SAMPLING POINTS

	Physical & Chemical	Bacteriological
1. Reservoir inlet from spring	0	X
2. Service connection in Bayombong	0	0
3. Service connection in Solano	0	X
4. Shallow well, Magat River flood plain	0	X
5. Surface water, Magat River	0	X
6. Shallow well, Uddiawan Solano	0	X
7. Deep well, Lattauan, Solano	0	X
8. Shallow well, Curipang, Solano	0	X
9. Shallow well, Bonfal, Bayombong	0	X
10. Shallow well, Bayombong Town Proper	0	X
11. Shallow well, Puy, Bayombong	0	X
12. Shallow well, Vista Hill, Bayombong	0	X

(2) Sampling and pretreatment

Water samples were collected and pretreated in such a manner as to correspond to their respective chemical constituents as analyzed in the laboratory.

Sample Container and Pretreatment	Items to be analyzed
o 1,000 ml polyethelene bottle	Water Temperature, EC, pH TDS, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, SO_4^{2-}, CO_3^{2-}, HCO_3^{-}, Cl^{-},
	Fe^{2+}, Mn
o 500 ml polyethylene bottle with 1 ml of conc. H_2SO_4 to maintain pH below 1.0	NH_3-N, NO_3-N, Fe^{+}

FIGURE 6.7.1.1 LOCATION OF SAMPLING POINTS

2) Laboratory examination

The procedure of water quality analysis was based on the Philippine Standard Methods for the Analysis of Air and Water (Vol. 2). The result of laboratory examination is presented in TABLE 6.7.3.

o 100 ml pre-disinfected polyethylene bottle — Coliform Group Bacteria

In addition to the chemical pretreatment, all the collected water samples in polyethylene bottles were kept in black polyethylene bags with crushed ice to maintain water temperature below 4C during its transportation to the laboratory.

(3) Field examination

Water temperature, pH and EC were measured in the field water sampling.

Implementation Procedure

Since the collected water samples were to be delivered to the laboratory within 8-hours from the time of sampling, the water sampling and field examination were carried out in the early morning from 6:30 AM to 8:30 AM on 14 August 1986.

(4) Result of water quality examination

1) Field examination

The results of field examination is presented in TABLE 6.7.2.

TABLE 6.7.2 RESULT OF FIELD EXAMINATION

Sample No.	WT(°C)	pH	EC (micro-S/cm)
1	25.8	7.04	491
2	27.1	7.22	487
3	25.8	7.34	478
4	26.2	7.06	521
5	25.8	7.83	272
6	27.1	6.94	550
7	27.1	6.63	580
8	26.2	7.17	484
9	26.0	6.84	485
10	26.2	6.55	603
11	25.8	6.08	910
12	25.8	6.04	680

TABLE 6.7.3 WATER QUALITY ANALYSIS AT LABORATORY

Sample No. & Location		Turb. (FTU)	TDS (mg/l)	PM (-)	EC (mg/l)	Alk. (mg/l)	Hard. (mg/l)	Acid. (mg/l)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	CO3 (mg/l)	HCO3 (mg/l)	Cl (mg/l)	SO4 (mg/l)	Fe (mg/l)	MM (mg/l)	Colitus (MPN)	NO_3-N (mg/l)	NH_4-N (mg/l)
1.	Reservoir inlet	0.79	352	7.11	550	247	240	12	23.0	0.6	26.8	42.0	0	301.3	18.6	14.0	0.075	Nil	-	3.32	Nil
2.	Faucet in Bayombong	0.76	333	7.44	520	209	325	12	20.0	0.5	42.0	29.2	0	255.0	37.1	14.0	0.17	0.05	-	2.99	Nil
3.	Faucet in Solano	0.54	326	7.56	510	190	217	9.0	19.0	0.5	48.0	23.6	0	231.8	27.9	14.0	0.10	Nil	-	3.04	Nil
4.	S.W. Flood Plain	0.91	374	7.48	585	190	255	18.0	19.0	0.5	38.8	38.4	0	231.8	32.5	72.0	0.03	Nil	-	0.52	Nil
5.	Magat River	74.5	205	7.94	320	102	142	0	13.0	0.4	24.0	19.9	45.6	31.7	18.6	37.0	0.19	0.08	-	2.69	Nil
6.	S.W. Uddia-uan	19.5	397	7.12	620	275	277	20.0	24.0	0.2	62.8	29.2	0	335.5	23.2	12.0	0.12	Nil	-	3.33	Nil
7.	S.W. Latta-uan	3.64	394	7.25	615	266	285	35.0	19.0	0.5	72.0	25.5	0	324.5	23.2	22.0	0.12	Nil	-	0.99	Nil
8.	S.W. Curipang	1.26	326	7.53	510	218	232	9.0	19.0	0.4	68.8	14.6	0	266.0	18.0	20.0	0.12	Nil	-	2.42	Nil
9.	S.W. Bonfal	0.72	352	7.29	550	209	247	12.0	19.0	0.4	66.0	19.9	0	255.0	23.2	23.0	0.12	Nil	-	4.70	Nil
10.	S.W. Bayom-bong	22.3	442	7.06	690	275	300	18.0	23.0	0.4	90.0	18.2	0	335.5	37.1	29.0	0.10	Nil	-	2.00	Nil
11.	S.W. Vista Hill	0.93	634	6.86	990	114	457	32.0	31.0	1.3	110.8	43.7	0	139.1	37.1	345.0	0.11	Nil	-	9.42	Nil
12.	S.W. Magapay	0.84	480	7.04	750	304	360	22.0	11.0	1.0	102.0	25.5	0	370.9	32.5	38.0	0.075	Nil	-	-	Nil

Philippine National Standard for Drinking Water

Water Quality: Physical, Chemical and Radiological Requirements

Parameter		Maximum Permissible level*
Turbidity		5 units
Color		5 units (s) **
Odor		Unobejctionable
Threshold odor number		Note more than 3
Taste		Unobjectionable
Total Solids		500 (s)
pH		6.5 - 8.5
Phenolic substances		0.001
Radioactive Subs.	Gross Alpha	3 pCi/1
	Gross Beta	30pCi/1
Trace Elements	Arsenic	0.05
	Barium	1.0
	Cadmium	0.01
	Chromium	0.05
	Copper	1.0
	Cyanide	0.05
	Fluoride	0.6
	Iron	1.0
	Lead	0.05
	Manganese	0.5 (s)
	Mercury	0.002
	Selenium	0.01
	Zinc	5.0 (s)
Organic Cehmicals :	Synthetic Detergents (MBAS)	0.5
	Oil & Grease	Nil
Persistent Pesticides :	Aldrin	0.001
	DDT	0.05
	Dieldrin	0.001
	Chlordane	0.003
	Endrin	0.0002
	Heptachlor	0.0001
	Lindane	0.004
	Toxaphane	0.005
	Methoxychlor	0.1
	2,4 --E	0.1
	2, 4, 5 -- T	0.01
PCB		Nil
Other Chemicals :	Calcium	75
	Chloride	200 (s)
	Magnesium	50 (s)
	Nitrate (NO_3)	30
	Sulfate	200 (s)
	Hydrogen sulfide	0.05 (s)

Bacteriological Quality Standards

Minimum Requirements on Bacteriological Quality

a) Chlorinated or Otherwise Disinfected Supplies

Efficient treatment culminating in chlorination or some other form of disinfection should yield a water free or any coliform organism however polluted the original raw water may have been. In practice it should not be possible to demonstrate the presence of coliform organisms in any sample of 100mℓ. The efficacy of the purification process and method of sampling should be looked into when a sample of the water entering the distribution system does not conform to this standard. In testing chlorinated water, presumptive positive tubes should always be subjected to appropriate confirmatory tests.

b) Non-disinfected Supplies

Where supplies of this sort exist, no water entering the distribution system should be considered satisfactory if it yields E coli in 100mℓ. If E. coli is absent, the presence of not more than 3 coliform organisms per 100mℓ may be tolerated in occasional samples from established non-disinfected pipes supplies, provided that they have been regularly and frequently tested and that the catchment area and storage conditions are found to be satisfactory. If repeated samples show the presence of coliform organisms, steps should then be taken to discover and, if possible, remove the source of pollution. If the number of coliform organisms increases to more than 3 per 100mℓ, the supply should be considered unsuitable for use without disinfection.

c) Individual or Small Community Supplies

Where supply of waters are individual wells, bores and springs everything possible should be done to prevent pollution of the water. It should be possible to reduce the coliform count of water from even a shallow well to less than 10 per 100mℓ. Persistent failure to achieve this, particularly if E. coli is repeatedly found, should, as a general rule lead to chlorination or boiling of the water for domestic consumption.

* All units are in mg/ℓ unless, otherwise stated.

** (s) – Secondary standards; compliance with the standard and analysis are not obligatory.

APPENDIX 7.1.1 Excerpt from LWUA Methodology Manual

F. COST COMPARISON

General

Anaylsis and evaluation of alternative are based largely on present-worth cost studies, taking into consideration the salvage valuse after the design period. Cost comparison is based on present worth of net disbursement during the period of 1980-2010 without any escalation factor applied to the 1980 unit prices.

If the differences between net PW cost of an alternative and that of the least-cost alternative is within the limit of cost estimating accuracy (10-15%) further cost comparison shall be made applying escalation factor to 1980 unit prices. For escalation rates, refer to Chapter VII-C: Escalation Rates. Moreover, non-economic parameters may also be influence the selection of the recommended plan.

Construction Cost

Construction cost estimates of the proposed improvements are based on the projected July 1980 unit prices. All estimates on imported materials are based on an exchange rate of ₱7.40 per 1 US dollar. Further, it is assumed that no custom duty will be charged on items imported for the public water supply project. The cost of any facility to be replaced during the design period (1980-2010) is included under the capital cost for the particular year.

Annual Cost

Annual costs are all costs associated with the maintenance, operation, and management of the project. These include labor, power, chemical and maintenance costs. These estimates are carried out for the period 1980-2010. The present-worth cost of annual expenditure is based on uniform and gradient series at a given interest.

Personnel and maintenance costs may abruptly increase as additional facilities are put into operation - e.g., the power cost at a pump station increases in relation to the daily pumpage of water.

Salvage Value

The salvage values of facilities at the end of the design period 2010 are important in calculating net present worth of the total expenditures. It is assumed that the value of a facility depreciates linearly throughout its service life therefore, a facility with longer service life depreciates less than a facility with shorter service life (Refer to Table VI-1 for service life of different facilities). Moreover, a facility constructed at a later stage has higher salvage value than one constructed at an earlier stage.

TABLE VI-1 SERVICE LIFE CATEGORIES OF FACILITIES

Civil Works	Economic Life	Equipment	Economic Life
Wells	30 years	Wells (pumping engine or motors)	15 years
Springs	50	Springs (vales, pipes)	50
Transmission Mains	50	Transmission (pipes, valves)	50
Storage Facilities	50	Storage (valves, pipes, level gauge, etc.)	50
Disinfection Facilities	50	Disinfection facilities (chlorinators, mechanical equipment and filter equipment, pipes, valves)	15
Distribution Mains	50	Distribution mains (pipes, valves)	50
Internal Network	50	Internal networks (pipes, valves)	50
Service Connections	50	Service connections (meters, pipes)	50
Fire Hydrants	50	Operational buildings (workshop, etc.)	15
Operational Buildings	50	Fire hydrants	30
		Vehicles	7

Net Present Worth

The net present worth cost of an alternative scheme is the difference between the total present worth of capital cost and annual cost minus the present worth of salvage values.

For Construction Cost:

$$C_n = C_c - C_s$$

$$C_c = C \times \frac{1}{(1+i)^n} \qquad C_c = C \times \frac{1}{(1+i)^{nx}} \times \left(1 - \frac{nx - n}{SL}\right)$$

For Annual Cost:

$$C_c = A_c \times \frac{1}{(1+i)^n}$$

where,

C_n = net present worth comparable cost

C_c = present worth of construction cost

C_s = present worth of salvage value (design year)

C = construction cost

SL = service life

i = discount rate

nx = number of years between design year and base year

n = number of years between year of construction and base year

A_c = annual cost

APPENDIX 7.2.1 ALTERNATIVE STUDY OF WATER INTAKE FACILITY

7.2.1.1. Hydraulic Simulation of Technical Alternatives

The infiltration gallery and the radial well are considered as the alternatives for water intake facility. To determine the design parameter of each facility, the following hydraulic simulation was carried out.

Radial Well

$$Q = \quad x\ k\ x\ (H^2 - h^2)/In(R/r_o)$$

where,

Q = planned yield; 12,880 cu.m/day

k = permeability coefficient; $2x10^{-3}$ m/sec

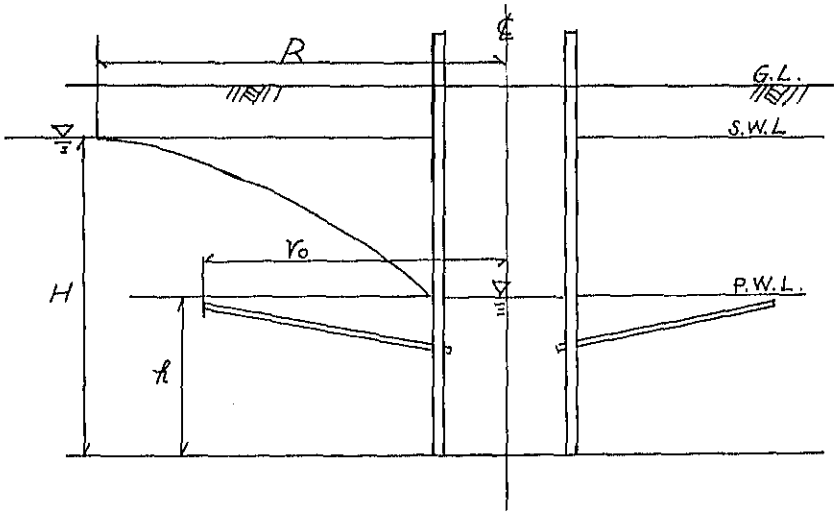
H = aquifer thickness; 9 m

h = effective aquifer thickness during pumping (m)

R = radius of influence area; 250 m

r_o = radius of radial collector (m)

H - h = drawdown (m)



Through the trial simulation of the above formula, the design parameter of the radial well was determined to be 2 m for the effective aquifer thickness and 10 m for the darius of radial collector. By these parameters, the planned yield is computed to be approximately 13,000 cu.m/day.Thus, two units of radial well can meet the required water demand.

Infiltration Gallery

$$Q = k \times L \times (H^2 - h_o^2) \times R^{-1} \times (t + 0.5 \times r_o)/h_o \times {}^4 (2 \times h_o - t)/h_o$$

where,

Q = planned yield; 12,880 cu.m/day

k = permeability coefficient; 2×10^{-3} m/sec

L = length of gallery (m)

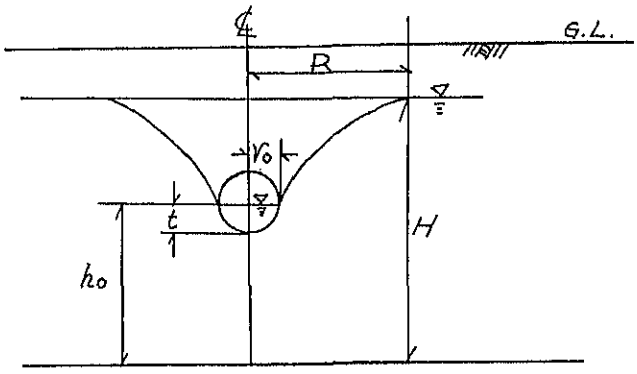
H = aquifer thickness; 14 m

h_o = height of gallery from the bottom of aquifer; 10 m

R = radius of influence area; 250 m

t = depth of water in gallery (m)

r_o = radius of gallery (m)



As well as the radial well, the design parameter of infiltration gallery was determined to be 1.5 m for both the depth of water in gallery and the radius of gallery, and 355 m for the gallery length. By these parameters, the planned yield is computed to be approximately 13,000 cu.m/day.

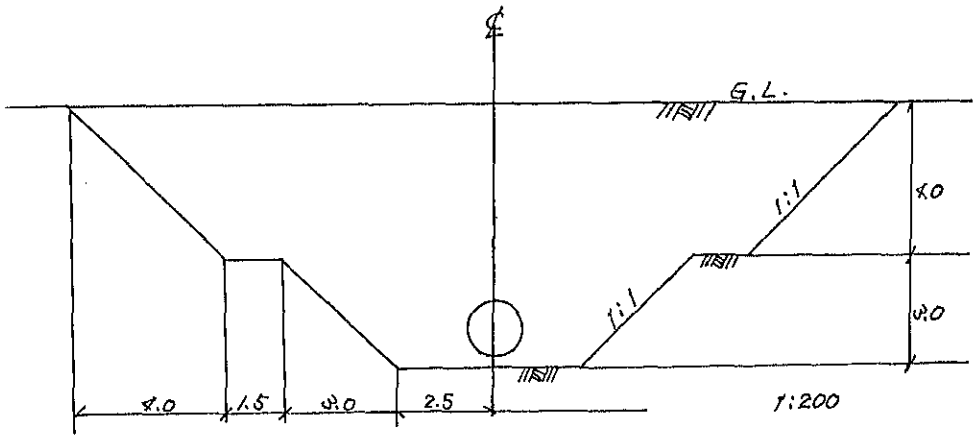
7.2.1.2. Cost Estimates

Radial Well

The construction cost of the radial well is estimated to be approximately ₱1,240,000 per one unit, as shown in TABLE 7.2.1.1.

Infiltration Gallery

In order to install the infiltration gallery in the river bed, the volume of excavation and backfilling with relevant civil works is required. The following is a rough scketch of the cross-section of river bed excavation.



The given cross-section has an area of 96 sq.m. When 355 m of the required length of infiltration gallery is taken into account, the total excavation volume will be about 34,000 cu.m. At ₱103/cu.m of the unit cost for excavation, this work item will require at about ₱3.5 million.

7.2.1.3 Conclusion

In accordance with the above cost estimates, it is clear that the radial well is quite economical than the infiltration gallery.

TABLE 7.2.1.1 COST ESTIMATES OF RADIAL WELL

Item		Description	Unit	Q'ty	Unit Cost (Peso)	Cost (Peso)
1. Concrete Caisson						
1.1	Steel Shoe	ϕ5.0 m(ID) x ϕ6.0 m(OD) x 1.0 m(H) (t=6 mm)	kg	2,400	26	62,400
1.2	Escavation	ϕ6.0 m x 11.5 m(D)	cu.m	325	103	33,475
1.3	Concrete (3,000 psi)	Caisson: ϕ5.0 m(ID) x ϕ6.0 m(OD) x 16.5 m(H) for wall ϕ5.0 m(ID) x 1.5 m(H) for anchor	cu.m	172	1,170	201,240
		Cover with slab: ϕ6.0 m x 0.2 m(H) + (0.3x0.3x4.8x4 - 0.3x0.3x0.3x2)	cu.m	7.3	1,170	8,540
1.4	Reinforcement Steel Bar	20 kg for every 1.0 cu.m of concrete	kg	3,586	15	53,790
1.5	Formwork	Caisson: (ϕ5.0 m x ϕ6.0 m) x 16.5 m(H)	sq.m	570	110	62,700
		Cover/slab: ϕ6.0 m for horizontal	sq.m	28.3	140	3,960
		0.3x(0.75x4x1.4x4)x4 for vertical	sq.m	10.3	110	1,130
	Total for Item 1					427,235
2. Radial Collector						
2.1	Collector Pipe	GI, ϕ75 mm x 4 m (ϕ12 mm, 400 holes) x 48 collectors	m	192	270	51,840
		GI, ϕ75 mm x 2 m (ϕ12 mm, 300 holes) x 48 collectors	m	96	270	25,920
		GI, ϕ75 mm x 2.5 m (blank) x 48 collectors	m	120	180	21,600
		GI, Cap, ϕ75 mm	pcs.	48	30	1,440
2.2	Gate Valve	ϕ75 mm	pcs.	48	2,690	129,120
2.3	Water Stopper	ϕ75 mm	pcs.	48	1,340	64,320
2.4	Horizontal Boring	Caisson Wall, t=0.5 m	holes	48	1,500	72,000
		Radial Well, 7 m x 48 collectors	m	336	1,160	389,760
	Total for Item 2					756,000
	TOTAL OF ITEM 1 & 2					1,183,235
3.	Temporary Facility	5% of Total of Item 1 & 2				59,162
	TOTAL COST					1,242,397

APPENDIX 7.2.2 DATA ON THE UNIT COST FOR ESTIMATION OF PROJECT COST

(1) Deep Well Construction : Peso

Depth (m)	Casing size (m/m)	Cost
200	250	940,000
200	300	1,160,000
250	150	640,000

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	17	-	-	-	20	37
Civil Works	33	8	5	-	17	63
Total	50	8	5	-	37	100

(2) Deep Well Pump Station (Electric Motor Drive) : Thousand Peso

KW	Cost
7	450
15	560
22	640
29	720
37	790
44	840
51	890
59	960
66	1,020
74	1,080

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	9	-	-	42	5	56
Civil Works	21	9	5	-	9	44
Total	30	9	5	42	14	100

(3) Booster Pump Station

$$C = (72.16 - 13.68 \log Q) \times Q^{(0.42 + 0.1 \log Q)} \times H^{0.305(\log Q - 0.7)^{(6/H - 0.25)}}$$

where,

C = cost for electric motor drive (thousand peso)

Q = design capacity (l/sec)

H = total dynamic head (m)

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	11	-	-	53	2	66
Civil Works	17	9	6	-	2	34
Total	28	9	6	53	4	100

(4) Radial Well

Inner Diameter(m)	Inner Depth (m)	Collection Pipe Length (m/hole)	Unit Cost (₱)
5	10	7.5	1,240,000
6	16	12.5	1,760,000

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	1	-	-	18	1	20
Civil Works	25	2	2	-	51	80
Total	26	2	2	18	52	100

(5) Pipeline Cost

Following pipe materials are presently available in the Philippines:

- GI (galvanized iron),
- PE (poly-ethylene),
- PB (poly-butylene),
- PVC (poly-vinyl-chloride),
- SP (steep pipe),
- CI (cost iron), and
- AC (asbestos cement).

Among these materials, the use of CI pipe is limited due to its high cost and AC pipe is also rare by safety reason.

Followings are comparison of unit cost at the 1985 price level.

(Unit: ₱/m)

Diameter(mm)	GI	PE	PB	PVC	SP
13	20.8	13.8	9.1	-	-
19	24.7	19.9	13.6	-	-
25	32.3	25.3	22.0	-	-
38	59.2	41.5	44.7	-	-
50	87.5	61.4	76.4	33.9	-
63	117.7	-	-	48.0	-
75	180.3	-	-	81.3	-
100	230.8	-	-	122.4	235.0
150	-	-	-	256.9	250.0
200	-	-	-	506.5	290.0
250	-	-	-	-	315.0
300	-	-	-	-	425.0
400	-	-	-	-	520.0
500	-	-	-	-	700.0
600	-	-	-	-	890.0

Based on the above comparison, SP is advantageous for the diameter of 200 mm and above than PVC. Thus, for the cost estimates of major transmission and distribution pipes, SP is considered for diameter of 200 mm and above, while PVC for diameter of less than 150 mm taking into account the transportation cost and easy installation.

Diameter (mm)	Unit Cost (₱/m)
150(PVC)	410
200(SP)	520
250(")	630
300(")	760
350(")	900
400(")	970
450(")	1,160
500(")	1,330
600(")	1,600
700(")	1,910

Source : LWUA Design Dept.

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	23	-	-	4	27	54
Civil Works	17	7	4	-	18	46
Total	40	7	4	4	45	100

(6) Valve In-place Cost

Diameter (mm)	Gate Valve (₱)	Butterfly Valve (₱)
50	1,700	-
75	2,900	-
100	3,900	-
150	5,300	-
200	6,700	-
250	11,200	-
300	-	34,800
350	-	74,400
400	-	95,200
450	-	125,900
500	-	174,000
600	-	243,600
700	-	313,200

Source : LWUA Design Dept.

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	9	-	-	63	5	77
Civil Works	12	3	6	-	2	23
Total	21	3	6	63	7	100

(7) Internal Network

Population Density (Person/ha)	Total Length of Pipeline (m/ha)	Unit Cost (₱/ha) Diameter (100/150)	Unit Cost (₱/ha) Diameter (75/100)
50	64	18,300	14,900
60	67	19,300	15,700
75	72	20,900	16,800
100	80	23,100	18,700
150	90	25,700	21,000
200	100	28,300	-
250	108	30,400	-
300	116	32,500	-

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	22	-	-	7	27	56
Civil Works	17	7	4	-	16	44
Total	39	7	4	7	43	100

(8) In-place of Service Connections

Diameter (inch)	Without Meter ₱/unit	With Meter ₱/unit	Meters ₱/unit
1/2	450	810	400
5/8 - 3/4	520	1,280	880

SERVICE CONNECTION WITHOUT METER

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	9	-	-	60	2.5	71.5
Civil Works	17	3	6	-	2.5	28.5
Total	26	3	6	60	5	100

SERVICE CONNECTION WITHOUT METER
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	4	-	-	83	2	89
Civil Works	6	1	3	-	1	11
Total	10	1	3	83	3	100

(9) Fire Hydrant In-place Cost

Type	Size (mm)	Unit Cost (₱)
Commercial	150	16,800
Residential	100	9,400

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	8	-	-	57	5	70
Civil Works	10	8	10	-	2	30
Total	18	8	10	57	7	100

(10) Elevated Tank/Ground Reservoir

Elevated Tank: $C = 0.615\ H^{1.144} V^{0.749}$

Ground Reservoir: $C = 20.05\ V^{0.639}$

where, C = cost (thousand peso)

H = overflow elevation above ground level

V = storage volume (cu.m)

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	4	-	-	3	2	9
Civil Works	53	5	7	-	26	91
Total	57	5	7	3	28	100

(11) Gas Chlorinator In-place Cost

Type	Water Flow Condition	Maximum Chlorine Feed (kg/day)	Unit cost 1/ (₱)
I-A	constant	22	98,100
I-B	constant	45	119,100
II-A	Variable	22	147,700
II-B	Variable	45	169,300

1/ Empty gas cylinders and automatic switchover include

TYPE I-A, I-B
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	15	-	-	41	5	61
Civil Works	25	6	3	-	5	39
Total	40	6	3	41	10	100

TYPE II-A, II-B
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	21	-	-	53	2	76
Civil Works	12	6	2	-	4	24
Total	33	6	2	53	6	100

(12) Administration & Operation Building

Future Service Population	Administration Bldg. (Thousand Peso)	Operation Center (Thousand Peso)
30,000	1,000	810
40,000	1,110	890
50,000	1,220	990
60,000	1,320	1,090
70,000	1,410	1,180
80,000	1,500	1,280
100,000	1,610	1,380
110,000	1,820	1,590

ADMINISTRATION BUILDING
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	20	-	-	-	16	36
Civil Works	42	7	5	-	10	64
Total	62	7	5	-	26	100

OPERATION CENTER
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	14	-	-	30	6	50
Civil Works	26	10	5	-	9	50
Total	40	10	5	30	15	100

(13) Energy Cost

$$C = Np \times h \times Pu \times (Em)^{-1}$$

$$Np = Q \times g \times H \times (Eff. \times 1{,}000)^{-1}$$

where,

C = cost (thousand peso)
Np = pump power demand (kw)
h = hours of operation
P_u = unit power cost (₱/kwH)
E_m = motor efficiency (0.85)
Q = water pumped (kg/sec)
g = gravity constant (9.81m/sq.sec)
H = manometric head (m)
Eff. = pump efficiency (average = 0.70)

(14) Chemical Cost

$$C = (\text{Annual Water Demand}) \cdot D \cdot U_{CL} \times 10^{-3}$$

where,

C = annual cost for chlorine (₱)
D = chlorine dosage (mg/l)
U_{CL} = unit cost of chlorine gas (₱/kg)

(15) Minimum Cost Diameter

Following cost function is applied to determine the most economical diameter of pipelines that are not simulated by the network analysis.

$$Dmin. = 187.7\ Q^{0.486}\ C^{-0.315}\ (Ec/Oe)^{0.17}$$

where,

Dmin. = minimum cost diameter
Q = water flow (l/sec)
C = "C" value (Hazen William Formula)
Ec = energy cost (₱/kwh)
Oe = overall efficiency

APPENDIX 7.3.1 COMPUTER-AIDED HYDRAULIC ANALYSIS OF DISTRIBUTION SYSTEM (Bayombong-Solano)

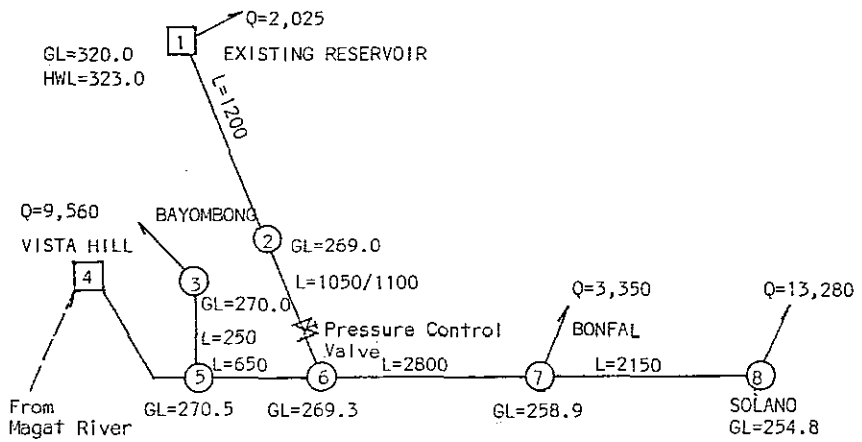
o List of Computed Cases

Alternative	D-1-(1)	(2010/Dry & Rainy Season)
	D-1-(2)	(2010/Dry & Rainy Season)
	D-2-(1)	(2010)
	D-2-(2)	(2010/Dry & Rainy Season)
	D-2-(2)-A	(1995, 2010/Dry & Rainy Season)
	D-2-(2)-A	(Fire at Solano)
	D-2-(2)-B	(1995, 2010/Dry & Rainy Season)
	ML-1	(2010)
	ML-1	(Fire at La Torre)
	ML-2	(2010/Masoc)
	ML-2	(2010/La Torre)
	ML-2	(Fire at Masoc, Fire at La Torre)
	ML-3	(2010)
	ML-3	(Fire at La Torre)

o Note

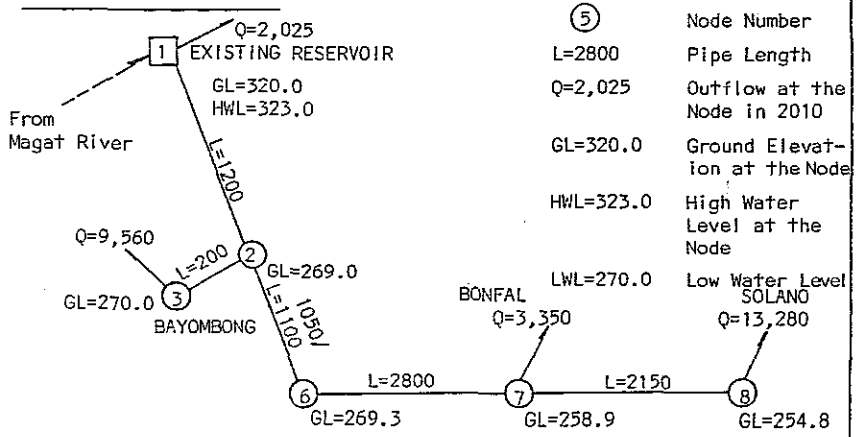
This appendix shows the results of Hydraulic Analysis aided by the computer. The distribution network is shown in the figure of following page. The nodes, however, with no flow and 20.00 m in Dynamic Head was treated as a dummy node. Those nodes can be ignored and have no relation to the computation results.

ALTERNATIVE D-1-(1)



Note: Node Nos. 9, 10 & 11 are dummy nodes for the Pressure Control Valve.

ALTERNATIVE D-2-(1)

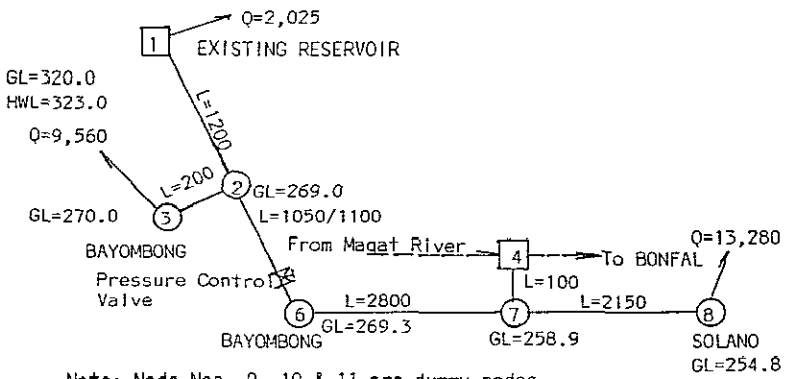


LEGEND:

(5)	Node Number
L=2800	Pipe Length
Q=2,025	Outflow at the Node in 2010
GL=320.0	Ground Elevation at the Node
HWL=323.0	High Water Level at the Node
LWL=270.0	Low Water Level

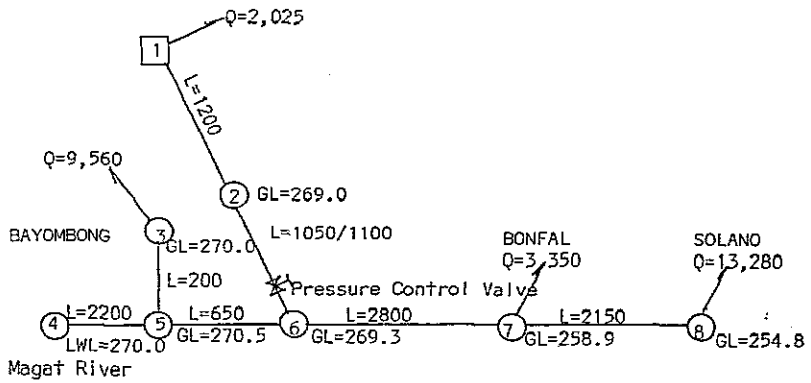
Note: Node Nos. 4 & 5 are dummy node.

ALTERNATIVE D-1-(2)



Note: Node Nos. 9, 10 & 11 are dummy nodes for the Pressure Control Valve.

ALTERNATIVE D-2-(2)



Note: Node Nos. 9,10 & 11 are dummy nodes for for the Pressure Control Valve.

SCHEMATIC PLAN OF DISTRIBUTION ALTERNATIVES FOR HYDRAULIC ANALYSIS

ALTERNATIVE D-1-(1) Dry Season
2 Reservoir System (Existing & Vista Hill), Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	2025.00	320.00	0.00	3.00
2	269.70	0.00	316.74	47.04	53.30
3	270.00	9560.00	277.01	7.01	53.00
4	270.00	-18094.00	300.29	30.29	53.00
5	270.50	0.00	296.03	25.53	52.50
6	269.30	0.00	293.80	24.50	53.70
7	258.90	3350.00	283.02	24.12	64.10
8	254.80	13280.00	274.17	19.37	68.20
9	269.30	0.00	313.81	44.51	53.70
10	0.00	0.00	293.81	293.81	323.00
11	0.00	0.00	313.80	313.80	323.00

Iteration Times : 40

ALTERNATIVE D-1-(1) Rainy Season
2 Reservoir System (Existing & Vista Hill), Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	2025.00	320.00	0.00	3.00
2	269.70	0.00	308.23	38.53	53.30
3	270.00	9560.00	278.06	8.06	53.00
4	270.00	-9960.00	298.50	28.50	53.00
5	270.50	0.00	297.09	26.59	52.50
6	269.30	0.00	297.08	27.78	53.70
7	258.90	3350.00	286.30	27.40	64.10
8	254.80	13280.00	277.45	22.66	68.20
9	269.30	0.00	297.64	28.34	53.70
10	0.00	0.00	297.14	297.14	323.00
11	0.00	0.00	297.56	297.56	323.00

Iteration Times : 32

ALTERNATIVE D-1-(1) Dry Season
2 Reservoir System (Existing & Vista Hill), Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	1200.	120.	-5006.	-0.82	-3.26	-2.71
2	2	1	250.	1200.	120.	-3099.	-0.73	-3.26	-2.71
3	2	9	250.	1050.	120.	3147.	0.74	2.93	2.79
4	2	9	300.	1100.	120.	4958.	0.81	2.93	2.66
5	3	5	200.	250.	110.	-9560.	-3.52	-19.03	-76.11
6	4	5	500.	1750.	120.	18094.	1.07	4.26	2.43
7	5	6	350.	650.	120.	8534.	1.03	2.24	3.44
8	6	10	350.	5.	120.	-8105.	-0.97	-0.02	-3.13
9	6	7	250.	2800.	120.	3744.	0.88	10.78	3.85
10	6	7	400.	2800.	120.	12886.	1.19	10.78	3.85
11	7	8	250.	2150.	120.	3880.	0.91	8.84	4.11
12	7	8	350.	2150.	120.	9400.	1.13	8.84	4.11
13	9	11	350.	5.	120.	8105.	0.97	0.02	3.13

ALTERNATIVE D-1-(1) Rainy Season
2 Reservoir System (Existing & Vista Hill), Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	1200.	120.	-10018.	-1.64	-11.77	-9.81
2	2	1	250.	1200.	120.	-6202.	-1.46	-11.77	-9.81
3	2	9	250.	1050.	120.	6299.	1.49	10.59	10.09
4	2	9	300.	1100.	120.	9922.	1.62	10.59	9.63
5	3	5	200.	250.	110.	-9560.	-3.52	-19.03	-76.11
6	4	5	500.	1750.	120.	9960.	0.59	1.41	0.81
7	5	6	350.	650.	120.	402.	0.05	0.01	0.01
8	6	10	350.	5.	120.	-16221.	-1.95	-0.06	-11.30
9	6	7	250.	2800.	120.	3744.	0.88	10.78	3.85
10	6	7	400.	2800.	120.	12886.	1.19	10.78	3.85
11	7	8	250.	2150.	120.	3880.	0.91	8.84	4.11
12	7	8	350.	2150.	120.	9400.	1.13	8.84	4.11
13	9	11	350.	5.	120.	16221.	1.95	0.06	11.30

ALTERNATIVE D-1-(2) Dry Season
2 Reservoir System (Existing & Bonfal), Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	2025.00	320.00	0.00	3.00
2	269.70	0.00	281.72	12.02	53.30
3	270.00	9560.00	277.51	7.51	53.00
4	258.90	-14739.00	283.36	24.46	64.10
5	270.50	0.00	290.50	20.00	52.50
6	269.30	0.00	282.20	12.90	53.70
7	258.90	0.00	283.08	24.18	64.10
8	254.80	13280.00	274.24	19.44	68.20
9	269.70	0.00	316.74	47.04	53.30
10	0.00	0.00	281.74	281.74	323.00
11	0.00	0.00	316.72	316.72	323.00

Iteration Times : 39

ALTERNATIVE D-1-(2) Rainy Season
2 Reservoir System (Existing & Bonfal), Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	2025.00	320.00	0.00	3.00
2	269.70	0.00	305.14	35.44	53.30
3	270.00	9560.00	300.92	30.92	53.00
4	258.90	-6605.00	282.48	23.58	64.10
5	270.50	0.00	290.50	20.00	52.50
6	269.30	0.00	297.12	27.82	53.70
7	258.90	0.00	282.42	23.52	64.10
8	254.80	13280.00	273.57	18.77	68.20
9	269.70	0.00	308.19	38.49	53.30
10	0.00	0.00	305.19	305.19	323.00
11	0.00	0.00	308.14	308.14	323.00

Iteration Times : 40

ALTERNATIVE D-1-(2) Dry Season
2 Reservoir System (Existing & Bonfal), Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu. m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	10	350.	5.	120.	-8107.	-0.98	-0.02	-3.13
2	2	6	250.	1050.	120.	-1182.	-0.28	-0.48	-0.46
3	2	6	150.	1100.	110.	-276.	-0.18	-0.48	-0.43
4	2	3	200.	200.	110.	4780.	1.76	4.22	21.08
5	2	3	200.	200.	110.	4780.	1.76	4.22	21.08
6	4	7	450.	100.	120.	14738.	1.07	0.28	2.78
7	6	7	250.	2800.	120.	-966.	-0.23	-0.88	-0.31
8	6	7	200.	2800.	110.	-492.	-0.18	-0.88	-0.31
9	7	8	250.	2150.	120.	3880.	0.91	8.84	4.11
10	7	8	350.	2150.	120.	9400.	1.13	8.84	4.11
11	9	1	300.	1200.	120.	-5009.	-0.82	-3.26	-2.72
12	9	1	250.	1200.	120.	-3101.	-0.73	-3.26	-2.72
13	9	11	350.	5.	120.	8107.	0.98	0.02	3.13

ALTERNATIVE D-1-(2) Rainy Season
2 Reservoir System (Existing & Bonfal), Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu. m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	10	350.	5.	120.	-16249.	-1.95	-0.06	-11.33
2	2	6	250.	1050.	120.	5419.	1.28	8.02	7.64
3	2	6	150.	1100.	110.	1264.	0.83	8.02	7.29
4	2	3	200.	200.	110.	4780.	1.76	4.22	21.08
5	2	3	200.	200.	110.	4780.	1.76	4.22	21.08
6	4	7	450.	100.	120.	6597.	0.48	0.06	0.63
7	6	7	250.	2800.	120.	4427.	1.04	14.70	5.25
8	6	7	200.	2800.	110.	2256.	0.83	14.70	5.25
9	7	8	250.	2150.	120.	3880.	0.91	8.84	4.11
10	7	8	350.	2150.	120.	9400.	1.13	8.84	4.11
11	9	1	300.	1200.	120.	-10036.	-1.64	-11.81	-9.84
12	9	1	250.	1200.	120.	-6213.	-1.46	-11.81	-9.84
13	9	11	350.	5.	120.	16249.	1.95	0.06	11.33

ALTERNATIVE D-2-(2) Dry Season
1 Reservoir System, Transmission to the Town Proper, Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	2025.00	320.00	0.00	3.00
2	269.70	0.00	317.33	47.63	53.30
3	270.00	9560.00	280.50	10.50	53.00
4	270.00	-21469.00	298.33	28.33	53.00
5	270.50	0.00	295.72	25.22	52.50
6	269.30	0.00	293.55	24.25	53.70
7	258.90	3350.00	282.77	23.87	64.10
8	254.80	13280.00	273.93	19.13	68.20
9	269.30	0.00	315.56	46.26	53.70
10	0.00	0.00	293.56	293.56	323.00
11	0.00	0.00	315.55	315.55	323.00

Iteration Times : 54

ALTERNATIVE D-2-(2) Rainy Season
1 Reservoir System, Transmission to the Town Proper, Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	2025.00	320.00	0.00	3.00
2	269.70	0.00	309.04	39.34	53.30
3	270.00	9560.00	282.25	12.25	53.00
4	270.00	-16047.00	298.99	28.99	53.00
5	270.50	0.00	297.47	26.97	52.50
6	269.30	0.00	296.77	27.47	53.70
7	258.90	3350.00	285.99	27.09	64.10
8	254.80	13280.00	277.14	22.34	68.20
9	269.30	0.00	301.79	32.49	53.70
10	0.00	0.00	296.79	296.79	323.00
11	0.00	0.00	301.77	301.77	323.00

Iteration Times : 50

ALTERNATIVE D-2-(2) Dry Season
1 Reservoir System, Transmission to the Town Proper, Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	--to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	1200.	120.	-4500.	-0.74	-2.67	-2.23
2	2	1	100.	1200.	110.	-229.	-0.34	-2.67	-2.23
3	2	9	250.	1050.	120.	2394.	0.56	1.77	1.68
4	2	9	250.	1100.	120.	2335.	0.55	1.77	1.61
5	3	5	200.	200.	110.	-9560.	-3.52	-15.22	-76.11
6	4	5	600.	2200.	130.	21469.	0.88	2.61	1.19
7	5	6	400.	650.	120.	11909.	1.10	2.16	3.33
8	6	10	350.	5.	120.	-4729.	-0.57	-0.01	-1.15
9	6	7	250.	2800.	120.	3744.	0.88	10.78	3.85
10	6	7	400.	2800.	120.	12886.	1.19	10.78	3.85
11	7	8	250.	2150.	120.	3880.	0.91	8.84	4.11
12	7	8	350.	2150.	120.	9400.	1.13	8.84	4.11
13	9	11	350.	5.	120.	4729.	0.57	0.01	1.15

ALTERNATIVE D-2-(2) Rainy Season
1 Reservoir System, Transmission to the Town Proper, Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	--to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	1200.	120.	-9643.	-1.58	-10.96	-9.14
2	2	1	100.	1200.	110.	-492.	-0.72	-10.96	-9.14
3	2	9	250.	1050.	120.	5131.	1.21	7.25	6.90
4	2	9	250.	1100.	120.	5004.	1.18	7.25	6.59
5	3	5	200.	200.	110.	-9560.	-3.52	-15.22	-76.11
6	4	5	600.	2200.	130.	16047.	0.66	1.52	0.69
7	5	6	400.	650.	120.	6487.	0.60	0.70	1.08
8	6	10	350.	5.	120.	-10135.	-1.22	-0.02	-4.73
9	6	7	250.	2800.	120.	3744.	0.88	10.78	3.85
10	6	7	400.	2800.	120.	12886.	1.19	10.78	3.85
11	7	8	250.	2150.	120.	3880.	0.91	8.84	4.11
12	7	8	350.	2150.	120.	9400.	1.13	8.84	4.11
13	9	11	350.	5.	120.	10135.	1.22	0.02	4.73

ALTERNATIVE D-2-(1) Both Season
1 Reservoir System, Transmission to the Existing Reservoir, Year2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	2025.00	320.00	0.00	3.00
2	269.70	0.00	311.58	41.88	53.30
3	270.00	9560.00	296.36	26.36	53.00
4	258.90	0.00	278.90	20.00	64.10
5	270.50	0.00	290.50	20.00	52.50
6	269.30	0.00	300.49	31.19	53.70
7	258.90	3350.00	283.03	24.13	64.10
8	254.80	13280.00	274.19	19.39	68.20

Iteration Times : 4

ALTERNATIVE D-2-(1) Both Season
1 Reservoir System, Transmission to the Existing Reservoir, Year2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	1200.	120.	-8362.	-1.37	-8.42	-7.02
2	2	1	400.	1200.	120.	-17820.	-1.64	-8.42	-7.02
3	2	6	250.	1050.	120.	6455.	1.52	11.09	10.56
4	2	6	300.	1100.	120.	10159.	1.67	11.09	10.08
5	2	3	200.	200.	110.	9560.	3.52	15.22	76.11
6	6	7	250.	2800.	120.	4858.	1.15	17.46	6.24
7	6	7	350.	2800.	120.	11769.	1.42	17.46	6.24
8	7	8	250.	2150.	120.	3880.	0.91	8.84	4.11
9	7	8	350.	2150.	120.	9400.	1.13	8.84	4.11

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 1995, Dry Season, Modification of ALT. D-2-(2)

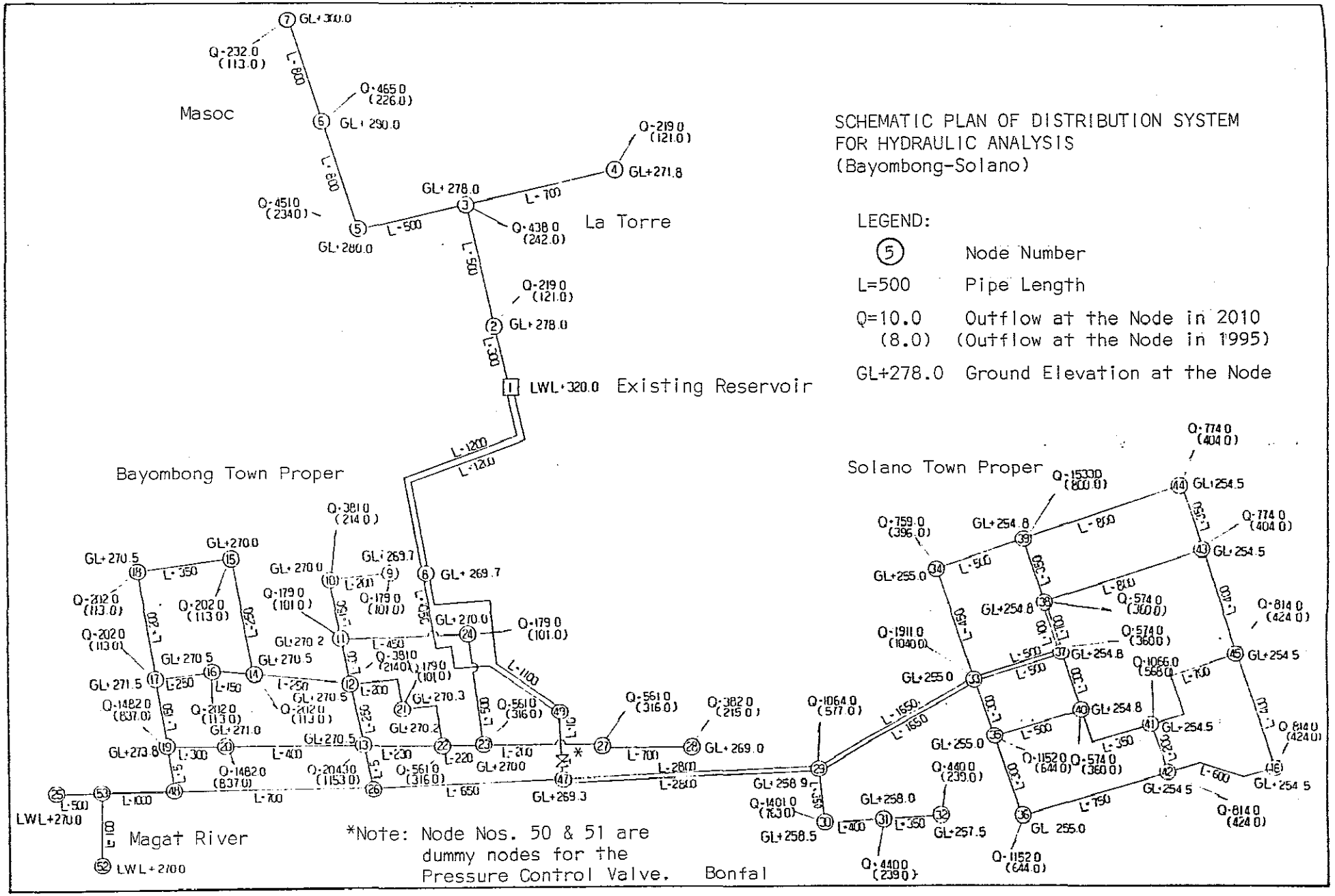
<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	300.	120.	-1057.	-0.17	-0.05	-0.15
2	2	3	300.	500.	120.	936.	0.15	0.06	0.12
3	3	4	150.	700.	110.	121.	0.08	0.07	0.09
4	3	5	250.	500.	120.	573.	0.14	0.06	0.12
5	5	6	250.	800.	120.	339.	0.08	0.04	0.05
6	6	7	250.	800.	120.	113.	0.03	0.00	0.01
7	8	1	300.	1200.	120.	-5713.	-0.94	-4.16	-3.47
8	8	1	100.	1200.	110.	-291.	-0.43	-4.16	-3.47
9	8	49	250.	1050.	120.	3040.	0.72	2.75	2.62
10	8	49	250.	1100.	120.	2964.	0.70	2.75	2.50
11	9	10	200.	200.	110.	-102.	-0.04	0.00	-0.02
12	10	11	200.	150.	110.	-316.	-0.12	-0.02	-0.14
13	11	12	200.	100.	110.	-522.	-0.19	-0.03	-0.35
14	11	24	100.	450.	110.	105.	0.15	0.23	0.52
15	12	13	200.	250.	110.	-969.	-0.36	-0.27	-1.10
16	12	14	200.	250.	110.	139.	0.05	0.01	0.03
17	12	21	100.	200.	110.	93.	0.14	0.08	0.42
18	13	20	200.	400.	110.	639.	0.24	0.20	0.51
19	13	22	200.	230.	110.	1168.	0.43	0.36	1.55
20	13	26	250.	5.	120.	-3934.	-0.93	-0.02	-4.22
21	14	15	100.	250.	110.	113.	0.17	0.15	0.60
22	14	16	200.	150.	110.	-88.	-0.03	0.00	-0.01
23	16	17	100.	250.	110.	-201.	-0.30	-0.44	-1.75
24	17	18	100.	200.	110.	113.	0.17	0.12	0.60
25	17	19	150.	150.	110.	-427.	-0.28	-0.15	-0.99
26	19	20	100.	300.	110.	198.	0.29	0.51	1.69
27	19	48	200.	5.	110.	-1465.	-0.54	-0.01	-2.36
28	21	22	100.	300.	110.	-8.	-0.01	0.00	0.00
29	22	23	200.	220.	110.	844.	0.31	0.19	0.85
30	23	24	100.	500.	110.	-4.	-0.01	0.00	0.00
31	23	27	200.	200.	110.	531.	0.20	0.07	0.36
32	25	53	500.	500.	120.	8476.	0.50	0.30	0.60
33	26	48	500.	700.	120.	-7010.	-0.41	-0.29	-0.42
34	26	47	400.	650.	120.	3075.	0.28	0.18	0.27
35	27	28	200.	700.	110.	215.	0.08	0.05	0.07
36	29	47	250.	2800.	120.	-2042.	-0.48	-3.51	-1.25
37	29	47	400.	2800.	120.	-7029.	-0.65	-3.51	-1.25
38	29	30	200.	350.	110.	1241.	0.46	0.61	1.74
39	29	33	250.	1650.	120.	7253.	1.71	21.62	13.10
40	30	31	150.	400.	110.	478.	0.31	0.48	1.20
41	31	32	150.	350.	110.	239.	0.16	0.12	0.33
42	33	34	150.	450.	110.	396.	0.26	0.38	0.85
43	33	35	200.	300.	110.	1288.	0.47	0.56	1.86
44	33	37	250.	500.	120.	4529.	1.07	2.74	5.48
45	35	36	150.	300.	110.	644.	0.42	0.63	2.09
46	37	38	200.	100.	110.	1968.	0.73	0.41	4.08
47	37	40	200.	300.	110.	2200.	0.81	1.50	5.01
48	38	39	200.	350.	110.	800.	0.29	0.27	0.77
49	38	43	200.	800.	110.	808.	0.30	0.63	0.78
50	40	41	200.	350.	110.	1840.	0.68	1.26	3.60
51	41	42	200.	200.	110.	848.	0.31	0.17	0.86
52	41	45	150.	700.	110.	424.	0.28	0.67	0.96
53	42	46	150.	600.	110.	424.	0.28	0.58	0.96
54	43	44	150.	350.	110.	404.	0.26	0.31	0.88
55	47	50	350.	10.	120.	-6004.	-0.72	-0.02	-1.79

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 1995, Dry Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	48	53	600.	1000.	130.	-8476.	-0.35	-0.21	-0.21
57	49	51	350.	10.	120.	6004.	0.72	0.02	1.79


SCHEMATIC PLAN OF DISTRIBUTION SYSTEM
FOR HYDRAULIC ANALYSIS
(Bayombong-Solano)
LEGEND:
5 Node Number
L=500 Pipe Length
Q=10.0 Outflow at the Node in 2010
(8.0) (Outflow at the Node in 1995)
GL+278.0 Ground Elevation at the Node
Masoc
La Torre
Existing Reservoir
LWL+320.0
Bayombong Town Proper
Solano Town Proper
Magat River
LWL+270.0
LWL+270.0
Bonfal
*Note: Node Nos. 50 & 51 are
dummy nodes for the
Pressure Control Valve.

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 1995, Dry Season, Modification of ALT. D-2-(2)

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	121.00	319.95	41.95	45.00
3	278.00	242.00	319.89	41.89	45.00
4	271.80	121.00	319.83	48.03	51.20
5	280.00	234.00	319.83	39.83	43.00
6	290.00	226.00	319.80	29.80	33.00
7	300.00	113.00	319.79	19.79	23.00
8	269.70	0.00	315.84	46.14	53.30
9	269.70	101.00	292.40	22.70	53.30
10	270.00	214.00	292.40	22.40	53.00
11	270.20	101.00	292.42	22.22	52.80
12	270.50	214.00	292.46	21.96	52.50
13	270.50	1153.00	292.73	22.23	52.50
14	270.50	113.00	292.45	21.95	52.50
15	270.00	113.00	292.30	22.30	53.00
16	270.50	113.00	292.45	21.95	52.50
17	271.50	113.00	292.89	21.39	51.50
18	270.50	113.00	292.77	22.27	52.50
19	273.80	837.00	293.03	19.23	49.20
20	271.00	837.00	292.53	21.53	52.00
21	270.30	101.00	292.37	22.07	52.70
22	270.20	316.00	292.37	22.17	52.80
23	270.00	316.00	292.19	22.19	53.00
24	270.00	101.00	292.19	22.19	53.00
25	270.00	-8477.00	293.56	23.56	53.00
26	270.50	0.00	292.75	22.25	52.50
27	269.30	316.00	292.11	22.81	53.70
28	269.00	215.00	292.07	23.07	54.00
29	258.90	577.00	289.07	30.17	64.10
30	258.50	763.00	288.46	29.96	64.50
31	258.00	239.00	287.98	29.98	65.00
32	257.50	239.00	287.86	30.36	65.50
33	255.00	1040.00	267.45	12.45	68.00
34	255.00	396.00	267.07	12.07	68.00
35	255.00	644.00	266.89	11.89	68.00
36	255.00	644.00	266.26	11.26	68.00
37	254.80	360.00	264.71	9.91	68.20
38	254.80	360.00	264.30	9.50	68.20
39	254.80	800.00	264.03	9.23	68.20
40	254.50	360.00	263.21	8.71	68.50
41	254.50	568.00	261.95	7.45	68.50
42	254.50	424.00	261.78	7.28	68.50
43	254.50	404.00	263.68	9.18	68.50
44	254.50	404.00	263.37	8.87	68.50
45	254.50	424.00	261.27	6.77	68.50
46	254.50	424.00	261.20	6.70	68.50
47	269.30	0.00	292.57	23.27	53.70
48	273.80	0.00	293.05	19.25	49.20
49	269.30	0.00	313.09	43.79	53.70
50	0.00	0.00	292.59	292.59	323.00
51	0.00	0.00	313.07	313.07	323.00
52	270.00	0.00	290.00	20.00	53.00
53	275.00	0.00	293.26	18.26	48.00

Iteration Times : 43

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 1995, Rainy Season, Modification of ALT. D-2-(2)

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	121.00	319.95	41.95	45.00
3	278.00	242.00	319.89	41.89	45.00
4	271.80	121.00	319.83	48.03	51.20
5	280.00	234.00	319.83	39.83	43.00
6	290.00	226.00	319.80	29.80	33.00
7	300.00	113.00	319.79	19.79	23.00
8	269.70	0.00	305.73	36.03	53.30
9	269.70	101.00	292.73	23.03	53.30
10	270.00	214.00	292.73	22.73	53.00
11	270.20	101.00	292.75	22.55	52.80
12	270.50	214.00	292.79	22.29	52.50
13	270.50	1153.00	293.09	22.59	52.50
14	270.50	113.00	292.77	22.27	52.50
15	270.00	113.00	292.62	22.62	53.00
16	270.50	113.00	292.77	22.27	52.50
17	271.50	113.00	293.00	21.50	51.50
18	270.50	113.00	292.88	22.38	52.50
19	273.80	837.00	293.12	19.32	49.20
20	271.00	837.00	292.85	21.85	52.00
21	270.30	101.00	292.72	22.42	52.70
22	270.20	316.00	292.72	22.52	52.80
23	270.00	316.00	292.53	22.53	53.00
24	270.00	101.00	292.53	22.53	53.00
25	270.00	-2825.00	293.19	23.19	53.00
26	270.50	0.00	293.11	22.61	52.50
27	269.30	316.00	292.46	23.16	53.70
28	269.00	215.00	292.41	23.41	54.00
29	258.90	577.00	289.73	30.83	64.10
30	258.50	763.00	289.12	30.62	64.50
31	258.00	239.00	288.64	30.64	65.00
32	257.50	239.00	288.52	31.02	65.50
33	255.00	1040.00	268.11	13.11	68.00
34	255.00	396.00	267.73	12.73	68.00
35	255.00	644.00	267.55	12.55	68.00
36	255.00	644.00	266.93	11.93	68.00
37	254.80	360.00	265.37	10.57	68.20
38	254.80	360.00	264.96	10.16	68.20
39	254.80	800.00	264.69	9.89	68.20
40	254.50	360.00	263.87	9.37	68.50
41	254.50	568.00	262.61	8.11	68.50
42	254.50	424.00	262.44	7.94	68.50
43	254.50	404.00	264.34	9.84	68.50
44	254.50	404.00	264.03	9.53	68.50
45	254.50	424.00	261.93	7.43	68.50
46	254.50	424.00	261.86	7.36	68.50
47	269.30	0.00	293.24	23.94	53.70
48	273.80	0.00	293.13	19.33	49.20
49	269.30	0.00	296.30	27.00	53.70
50	0.00	0.00	293.30	293.30	323.00
51	0.00	0.00	296.24	296.24	323.00
52	270.00	0.00	290.00	20.00	53.00
53	275.00	0.00	293.15	18.15	48.00

Iteration Times : 39

ALT. D-2-(2)-A. Recommended Plan, Single Pipeline Alignment
Year 1995, Rainy Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	300.	120.	-1057.	-0.17	-0.05	-0.15
2	2	3	300.	500.	120.	936.	0.15	0.06	0.12
3	3	4	150.	700.	110.	121.	0.08	0.07	0.09
4	3	5	250.	500.	120.	573.	0.14	0.06	0.12
5	5	6	250.	800.	120.	339.	0.08	0.04	0.05
6	6	7	250.	800.	120.	113.	0.03	0.00	0.01
7	8	1	300.	1200.	120.	-11117.	-1.82	-14.27	-11.89
8	8	1	100.	1200.	110.	-567.	-0.84	-14.27	-11.89
9	8	49	250.	1050.	120.	5915.	1.39	9.43	8.98
10	8	49	250.	1100.	120.	5769.	1.36	9.43	8.57
11	9	10	200.	200.	110.	-102.	-0.04	0.00	-0.02
12	10	11	200.	150.	110.	-317.	-0.12	-0.02	-0.14
13	11	12	200.	100.	110.	-520.	-0.19	-0.03	-0.35
14	11	24	100.	450.	110.	101.	0.15	0.22	0.49
15	12	13	200.	250.	110.	-1020.	-0.38	-0.30	-1.21
16	12	14	200.	250.	110.	201.	0.07	0.01	0.06
17	12	21	100.	200.	110.	84.	0.12	0.07	0.35
18	13	20	200.	400.	110.	697.	0.26	0.24	0.60
19	13	22	200.	230.	110.	1185.	0.44	0.37	1.59
20	13	26	250.	5.	120.	-4063.	-0.96	-0.02	-4.48
21	14	15	100.	250.	110.	113.	0.17	0.15	0.60
22	14	16	200.	150.	110.	-30.	-0.01	0.00	0.00
23	16	17	100.	250.	110.	-143.	-0.21	-0.23	-0.93
24	17	18	100.	200.	110.	113.	0.17	0.12	0.60
25	17	19	150.	150.	110.	-369.	-0.24	-0.11	-0.75
26	19	20	100.	300.	110.	140.	0.21	0.27	0.89
27	19	48	200.	5.	110.	-1352.	-0.50	-0.01	-2.03
28	21	22	100.	300.	110.	-17.	-0.02	-0.01	-0.02
29	22	23	200.	220.	110.	851.	0.31	0.19	0.86
30	23	24	100.	500.	110.	0.	0.00	0.00	0.00
31	23	27	200.	200.	110.	531.	0.20	0.07	0.36
32	25	53	500.	500.	120.	2822.	0.17	0.04	0.08
33	26	48	500.	700.	120.	-1465.	-0.09	-0.02	-0.02
34	26	47	400.	650.	120.	-2604.	-0.24	-0.13	-0.20
35	27	28	200.	700.	110.	215.	0.08	0.05	0.07
36	29	47	250.	2800.	120.	-2042.	-0.48	-3.51	-1.25
37	29	47	400.	2800.	120.	-7029.	-0.65	-3.51	-1.25
38	29	30	200.	350.	110.	1241.	0.46	0.61	1.74
39	29	33	250.	1650.	120.	7253.	1.71	21.62	13.10
40	30	31	150.	400.	110.	478.	0.31	0.48	1.20
41	31	32	150.	350.	110.	239.	0.16	0.12	0.33
42	33	34	150.	450.	110.	395.	0.26	0.38	0.85
43	33	35	200.	300.	110.	1288.	0.47	0.56	1.86
44	33	37	250.	500.	120.	4529.	1.07	2.74	5.48
45	35	36	150.	300.	110.	644.	0.42	0.63	2.09
46	37	38	200.	100.	110.	1968.	0.73	0.41	4.08
47	37	40	200.	300.	110.	2200.	0.81	1.50	5.01
48	38	39	200.	350.	110.	800.	0.29	0.27	0.77
49	38	43	200.	800.	110.	808.	0.30	0.63	0.78
50	40	41	200.	350.	110.	1840.	0.68	1.26	3.60
51	41	42	200.	200.	110.	848.	0.31	0.17	0.86
52	41	45	150.	700.	110.	424.	0.28	0.67	0.96
53	42	46	150.	600.	110.	424.	0.28	0.58	0.96
54	43	44	150.	350.	110.	404.	0.26	0.31	0.88
55	47	50	350.	10.	120.	-11684.	-1.41	-0.06	-6.15

ALT. D-2-(2)-A. Recommended Plan, Single Pipeline Alignment
Year 1995, Rainy Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	48	53	600.	1000.	130.	-2822.	-0.12	-0.03	-0.03
57	49	51	350.	10.	120.	11684.	1.41	0.06	6.15

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2)

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	219.00	319.85	41.85	45.00
3	278.00	438.00	319.64	41.64	45.00
4	271.80	219.00	319.44	47.64	51.20
5	280.00	451.00	319.43	39.43	43.00
6	290.00	465.00	319.29	29.29	33.00
7	300.00	232.00	319.27	19.27	23.00
8	269.70	0.00	317.34	47.64	53.30
9	269.70	179.00	288.87	19.17	53.30
10	270.00	381.00	288.88	18.88	53.00
11	270.20	179.00	288.94	18.74	52.80
12	270.50	381.00	289.04	18.54	52.50
13	270.50	2043.00	289.67	19.17	52.50
14	270.50	202.00	289.04	18.54	52.50
15	270.00	202.00	289.04	19.04	53.00
16	270.50	202.00	289.05	18.55	52.50
17	271.50	202.00	290.75	19.25	51.50
18	270.50	202.00	289.57	19.07	52.50
19	273.80	1482.00	291.47	17.67	49.20
20	271.00	1482.00	289.18	18.18	52.00
21	270.30	179.00	288.69	18.39	52.70
22	270.20	561.00	288.69	18.49	52.80
23	270.00	561.00	288.15	18.15	53.00
24	270.00	179.00	288.17	18.17	53.00
25	270.00	-12883.00	293.35	23.35	53.00
26	270.50	0.00	289.73	19.23	52.50
27	269.30	561.00	287.95	18.65	53.70
28	269.00	382.00	287.81	18.81	54.00
29	258.90	1064.00	276.79	17.89	64.10
30	258.50	1401.00	274.91	16.41	64.50
31	258.00	440.00	273.42	15.42	65.00
32	257.50	440.00	273.06	15.56	65.50
33	255.00	1911.00	269.99	14.99	68.00
34	255.00	759.00	267.78	12.78	68.00
35	255.00	1152.00	267.57	12.57	68.00
36	255.00	1152.00	264.94	9.94	68.00
37	254.80	574.00	268.06	13.26	68.20
38	254.80	574.00	267.28	12.48	68.20
39	254.80	1533.00	266.35	11.55	68.20
40	254.50	574.00	265.69	11.19	68.50
41	254.50	1066.00	263.39	8.89	68.50
42	254.50	814.00	263.09	8.59	68.50
43	254.50	774.00	264.00	9.50	68.50
44	254.50	774.00	263.57	9.07	68.50
45	254.50	814.00	262.97	8.47	68.50
46	254.50	814.00	262.05	7.55	68.50
47	269.30	0.00	287.57	18.27	53.70
48	273.80	0.00	291.51	17.71	49.20
49	269.30	0.00	315.58	46.28	53.70
50	0.00	0.00	287.58	287.58	323.00
51	0.00	0.00	315.57	315.57	323.00
52	270.00	-8588.00	293.04	23.04	53.00
53	275.00	0.00	292.70	17.70	48.00

Iteration Times : 66

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	300.	120.	-2024.	-0.33	-0.15	-0.51
2	2	3	300.	500.	120.	1805.	0.30	0.21	0.41
3	3	4	150.	700.	110.	219.	0.14	0.20	0.28
4	3	5	250.	500.	120.	1148.	0.27	0.22	0.43
5	5	6	250.	800.	120.	697.	0.16	0.14	0.17
6	6	7	250.	800.	120.	232.	0.05	0.02	0.02
7	8	1	300.	1200.	120.	-4491.	-0.74	-2.66	-2.22
8	8	1	100.	1200.	110.	-229.	-0.34	-2.66	-2.22
9	8	49	250.	1050.	120.	2389.	0.56	1.76	1.68
10	8	49	250.	1100.	120.	2330.	0.55	1.76	1.60
11	9	10	200.	200.	110.	-179.	-0.07	-0.01	-0.05
12	10	11	200.	150.	110.	-560.	-0.21	-0.06	-0.40
13	11	12	200.	100.	110.	-938.	-0.35	-0.10	-1.03
14	11	24	100.	450.	110.	199.	0.29	0.77	1.71
15	12	13	200.	250.	110.	-1521.	-0.56	-0.63	-2.53
16	12	14	200.	250.	110.	9.	0.00	0.00	0.00
17	12	21	100.	200.	110.	200.	0.30	0.35	1.73
18	13	20	200.	400.	110.	1036.	0.38	0.50	1.24
19	13	22	200.	230.	110.	2024.	0.75	0.99	4.29
20	13	26	250.	5.	120.	-6623.	-1.56	-0.06	-11.07
21	14	15	100.	250.	110.	16.	0.02	0.00	0.02
22	14	16	200.	150.	110.	-217.	-0.08	-0.01	-0.07
23	15	18	100.	350.	110.	-186.	-0.27	-0.53	-1.51
24	16	17	100.	250.	110.	-419.	-0.62	-1.70	-6.78
25	17	18	100.	200.	110.	388.	0.57	1.18	5.90
26	17	19	150.	150.	110.	-1009.	-0.66	-0.72	-4.80
27	19	20	100.	300.	110.	446.	0.66	2.29	7.64
28	19	48	200.	5.	110.	-2937.	-1.08	-0.04	-8.56
29	21	22	100.	300.	110.	21.	0.03	0.01	0.03
30	22	23	200.	220.	110.	1484.	0.55	0.53	2.42
31	23	24	100.	500.	110.	-20.	-0.03	-0.01	-0.02
32	23	27	200.	200.	110.	943.	0.35	0.21	1.04
33	25	53	500.	500.	120.	12883.	0.76	0.65	1.30
34	26	48	500.	700.	120.	-16534.	-1.09	-1.78	-2.55
35	26	47	400.	650.	120.	11911.	1.10	2.16	3.33
36	27	28	200.	700.	110.	382.	0.14	0.14	0.20
37	29	47	250.	2800.	120.	-3744.	-0.88	-10.78	-3.85
38	29	47	400.	2800.	120.	-12886.	-1.19	-10.78	-3.85
39	29	30	200.	350.	110.	2281.	0.84	1.88	5.36
40	29	33	250.	1650.	120.	3881.	0.92	6.79	4.12
41	29	33	350.	1650.	120.	9404.	1.13	6.79	4.12
42	30	31	150.	400.	110.	880.	0.58	1.49	3.73
43	31	32	150.	350.	110.	440.	0.29	0.36	1.03
44	33	34	150.	450.	110.	1022.	0.67	2.21	4.92
45	33	35	200.	300.	110.	2851.	1.05	2.43	8.10
46	33	37	250.	500.	120.	3751.	0.88	1.93	3.86
47	33	37	250.	500.	120.	3751.	0.88	1.93	3.86
48	34	39	100.	500.	110.	263.	0.39	1.43	2.86
49	35	36	150.	300.	110.	1395.	0.91	2.62	8.75
50	35	40	100.	500.	110.	304.	0.45	1.88	3.75
51	36	42	100.	750.	110.	243.	0.36	1.85	2.47
52	37	38	200.	100.	110.	2798.	1.03	0.78	7.82
53	37	38	150.	100.	110.	1313.	0.86	0.78	7.82
54	37	40	200.	300.	110.	2816.	1.04	2.37	7.91
55	38	39	200.	350.	110.	1562.	0.58	0.93	2.66

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	38	43	200.	800.	110.	1975.	0.73	3.28	4.10
57	39	44	100.	800.	110.	292.	0.43	2.78	3.48
58	40	41	200.	350.	110.	2546.	0.94	2.30	6.57
59	41	42	200.	200.	110.	1152.	0.42	0.30	1.51
60	41	45	150.	700.	110.	328.	0.21	0.42	0.60
61	42	46	150.	600.	110.	581.	0.38	1.04	1.73
62	43	44	150.	350.	110.	482.	0.32	0.43	1.22
63	43	45	150.	400.	110.	719.	0.47	1.03	2.57
64	45	46	100.	400.	110.	233.	0.34	0.92	2.30
65	47	50	350.	10.	120.	-4720.	-0.57	-0.01	-1.15
66	48	53	600.	1000.	130.	-21471.	-0.88	-1.19	-1.19
67	49	51	350.	10.	120.	4720.	0.57	0.01	1.15
68	52	53	350.	100.	120.	8588.	1.03	0.35	3.48

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	300.	120.	-2024.	-0.33	-0.15	-0.51
2	2	3	300.	500.	120.	1805.	0.30	0.21	0.41
3	3	4	150.	700.	110.	219.	0.14	0.20	0.28
4	3	5	250.	500.	120.	1148.	0.27	0.22	0.43
5	5	6	250.	800.	120.	697.	0.16	0.14	0.17
6	6	7	250.	800.	120.	230.	0.05	0.02	0.02
7	8	1	300.	1200.	120.	-9630.	-1.58	-10.94	-9.11
8	8	1	100.	1200.	110.	-491.	-0.72	-10.94	-9.11
9	8	49	250.	1050.	120.	5124.	1.21	7.23	6.88
10	8	49	250.	1100.	120.	4997.	1.18	7.23	6.57
11	9	10	200.	200.	110.	-178.	-0.07	-0.01	-0.05
12	10	11	200.	150.	110.	-559.	-0.21	-0.06	-0.40
13	11	12	200.	100.	110.	-930.	-0.34	-0.10	-1.02
14	11	24	100.	450.	110.	192.	0.28	0.72	1.61
15	12	13	200.	250.	110.	-1624.	-0.60	-0.71	-2.86
16	12	14	200.	250.	110.	130.	0.05	0.01	0.03
17	12	21	100.	200.	110.	183.	0.27	0.29	1.47
18	13	20	200.	400.	110.	1119.	0.41	0.57	1.43
19	13	22	200.	230.	110.	2047.	0.75	1.01	4.38
20	13	26	250.	5.	120.	-6829.	-1.61	-0.06	-11.72
21	14	15	100.	250.	110.	56.	0.10	0.06	0.22
22	14	16	200.	150.	110.	-137.	-0.05	0.00	-0.03
23	15	18	100.	350.	110.	-136.	-0.20	-0.30	-0.84
24	16	17	100.	250.	110.	-339.	-0.50	-1.15	-4.59
25	17	18	100.	200.	110.	338.	0.50	0.91	4.56
26	17	19	150.	150.	110.	-879.	-0.58	-0.56	-3.72
27	19	20	100.	300.	110.	363.	0.53	1.56	5.21
28	19	48	200.	5.	110.	-2721.	-1.00	-0.04	-7.43
29	21	22	100.	300.	110.	5.	0.01	0.00	0.00
30	22	23	200.	220.	110.	1490.	0.55	0.54	2.44
31	23	24	100.	500.	110.	-13.	-0.02	-0.01	-0.01
32	23	27	200.	200.	110.	943.	0.35	0.21	1.04
33	25	53	500.	500.	120.	12038.	0.71	0.57	1.14
34	26	48	500.	700.	120.	-13330.	-0.79	-0.97	-1.38
35	26	47	400.	650.	120.	6502.	0.60	0.71	1.08
36	27	28	200.	700.	110.	382.	0.14	0.14	0.20
37	29	47	250.	2800.	120.	-3743.	-0.88	-10.78	-3.85
38	29	47	400.	2800.	120.	-12886.	-1.19	-10.78	-3.85
39	29	30	200.	350.	110.	2281.	0.84	1.88	5.36
40	29	33	250.	1650.	120.	3881.	0.92	6.79	4.12
41	29	33	350.	1650.	120.	9403.	1.13	6.79	4.12
42	30	31	150.	400.	110.	880.	0.58	1.49	3.73
43	31	32	150.	350.	110.	440.	0.29	0.36	1.03
44	33	34	150.	450.	110.	1022.	0.67	2.21	4.92
45	33	35	200.	300.	110.	2851.	1.05	2.43	8.10
46	33	37	250.	500.	120.	3751.	0.88	1.93	3.86
47	33	37	250.	500.	120.	3751.	0.88	1.93	3.86
48	34	39	100.	500.	110.	263.	0.39	1.43	2.86
49	35	36	150.	300.	110.	1395.	0.91	2.62	8.75
50	35	40	100.	500.	110.	304.	0.45	1.88	3.75
51	36	42	100.	750.	110.	243.	0.36	1.85	2.47
52	37	38	200.	100.	110.	2798.	1.03	0.78	7.82
53	37	38	150.	100.	110.	1313.	0.86	0.78	7.82
54	37	40	200.	300.	110.	2816.	1.04	2.37	7.91
55	38	39	200.	350.	110.	1562.	0.58	0.93	2.66

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	38	43	200.	800.	110.	1975.	0.73	3.28	4.10
57	39	44	100.	800.	110.	292.	0.43	2.78	3.48
58	40	41	200.	350.	110.	2546.	0.94	2.30	6.57
59	41	42	200.	200.	110.	1152.	0.42	0.30	1.51
60	41	45	150.	700.	110.	328.	0.21	0.42	0.60
61	42	46	150.	600.	110.	581.	0.38	1.04	1.73
62	43	44	150.	350.	110.	482.	0.32	0.43	1.22
63	43	45	150.	400.	110.	719.	0.47	1.03	2.57
64	45	46	100.	400.	110.	233.	0.34	0.92	2.30
65	47	50	350.	10.	120.	-10121.	-1.22	-0.05	-4.72
66	48	53	600.	1000.	130.	-16051.	-0.66	-0.69	-0.69
67	49	51	350.	10.	120.	10121.	1.22	0.05	4.72
68	52	53	350.	100.	120.	4013.	0.48	0.09	0.85

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2)

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	219.00	319.85	41.85	45.00
3	278.00	438.00	319.64	41.64	45.00
4	271.80	219.00	319.44	47.64	51.20
5	280.00	451.00	319.43	39.43	43.00
6	290.00	465.00	319.29	29.29	33.00
7	300.00	232.00	319.27	19.27	23.00
8	269.70	0.00	309.06	39.36	53.30
9	269.70	179.00	290.55	20.85	53.30
10	270.00	381.00	290.56	20.56	53.00
11	270.20	179.00	290.62	20.42	52.80
12	270.50	381.00	290.72	20.22	52.50
13	270.50	2043.00	291.43	20.93	52.50
14	270.50	202.00	290.71	20.21	52.50
15	270.00	202.00	290.66	20.66	53.00
16	270.50	202.00	290.72	20.22	52.50
17	271.50	202.00	291.87	20.37	51.50
18	270.50	202.00	290.95	20.45	52.50
19	273.80	1482.00	292.42	18.62	49.20
20	271.00	1482.00	290.86	19.86	52.00
21	270.30	179.00	290.43	20.13	52.70
22	270.20	561.00	290.43	20.23	52.80
23	270.00	561.00	289.89	19.89	53.00
24	270.00	179.00	289.90	19.90	53.00
25	270.00	-12037.00	293.72	23.72	53.00
26	270.50	0.00	291.49	20.99	52.50
27	269.30	561.00	289.68	20.38	53.70
28	269.00	382.00	289.54	20.54	54.00
29	258.90	1064.00	280.01	21.11	64.10
30	258.50	1401.00	278.13	19.63	64.50
31	258.00	440.00	276.64	18.64	65.00
32	257.50	440.00	276.28	18.78	65.50
33	255.00	1911.00	273.22	18.22	68.00
34	255.00	759.00	271.01	16.01	68.00
35	255.00	1152.00	270.79	15.79	68.00
36	255.00	1152.00	268.16	13.16	68.00
37	254.80	574.00	271.29	16.49	68.20
38	254.80	574.00	270.50	15.70	68.20
39	254.80	1533.00	269.57	14.77	68.20
40	254.50	574.00	268.91	14.41	68.50
41	254.50	1066.00	266.61	12.11	68.50
42	254.50	814.00	266.31	11.81	68.50
43	254.50	774.00	267.22	12.72	68.50
44	254.50	774.00	266.79	12.29	68.50
45	254.50	814.00	266.19	11.69	68.50
46	254.50	814.00	265.28	10.78	68.50
47	269.30	0.00	290.79	21.49	53.70
48	273.80	0.00	292.46	18.66	49.20
49	269.30	0.00	301.83	32.53	53.70
50	0.00	0.00	290.83	290.83	323.00
51	0.00	0.00	301.79	301.79	323.00
52	270.00	-4012.00	293.24	23.24	53.00
53	275.00	0.00	293.15	18.15	48.00

Iteration Times : 30

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2), Fire at SOLANO

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	132.00	319.94	41.94	45.00
3	278.00	264.00	319.86	41.86	45.00
4	271.80	132.00	319.78	47.98	51.20
5	280.00	272.00	319.78	39.78	43.00
6	290.00	280.00	319.72	29.72	33.00
7	300.00	140.00	319.71	19.71	23.00
8	269.70	0.00	318.60	48.90	53.30
9	269.70	108.00	291.09	21.39	53.30
10	270.00	230.00	291.09	21.09	53.00
11	270.20	108.00	291.11	20.91	52.80
12	270.50	230.00	291.16	20.66	52.50
13	270.50	1231.00	291.37	20.87	52.50
14	270.50	122.00	291.16	20.66	52.50
15	270.00	122.00	291.17	21.17	53.00
16	270.50	122.00	291.17	20.67	52.50
17	271.50	122.00	292.11	20.61	51.50
18	270.50	122.00	291.51	21.01	52.50
19	273.80	893.00	292.48	18.68	49.20
20	271.00	893.00	291.20	20.20	52.00
21	270.30	108.00	291.00	20.70	52.70
22	270.20	338.00	290.99	20.79	52.80
23	270.00	338.00	290.78	20.78	53.00
24	270.00	108.00	290.79	20.79	53.00
25	293.50	0.00	293.50	0.00	29.50
26	270.50	0.00	291.39	20.89	52.50
27	269.30	338.00	290.70	21.40	53.70
28	269.00	230.00	290.65	21.65	54.00
29	258.90	641.00	282.02	23.12	64.10
30	258.50	844.00	281.29	22.79	64.50
31	258.00	265.00	280.71	22.71	65.00
32	257.50	265.00	280.56	23.06	65.50
33	255.00	1152.00	276.56	21.56	68.00
34	255.00	458.00	275.16	20.16	68.00
35	255.00	694.00	275.17	20.17	68.00
36	255.00	694.00	273.62	18.62	68.00
37	254.80	346.00	274.51	19.71	68.20
38	254.80	346.00	273.46	18.66	68.20
39	254.80	924.00	272.86	18.06	68.20
40	254.50	346.00	272.49	17.99	68.50
41	254.50	643.00	270.10	15.60	68.50
42	254.50	491.00	269.90	15.40	68.50
43	254.50	2366.00	265.23	10.73	68.50
44	254.50	2366.00	260.72	6.22	68.50
45	254.50	491.00	266.60	12.10	68.50
46	254.50	491.00	268.06	13.56	68.50
47	269.30	0.00	289.68	20.38	53.70
48	273.80	0.00	292.50	18.70	49.20
49	269.30	0.00	317.68	48.38	53.70
50	0.00	0.00	289.68	289.68	323.00
51	0.00	0.00	317.68	317.68	323.00
52	293.50	0.00	293.50	0.00	29.50
53	275.00	0.00	293.21	18.21	48.00

Iteration Times : 41

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2), Fire at SOLANO

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	300.	120.	-1220.	-0.20	-0.06	-0.20
2	2	3	300.	500.	120.	1088.	0.18	0.08	0.16
3	3	4	150.	700.	110.	132.	0.09	0.08	0.11
4	3	5	250.	500.	120.	692.	0.16	0.08	0.17
5	5	6	250.	800.	120.	420.	0.10	0.05	0.07
6	6	7	250.	800.	120.	140.	0.03	0.01	0.01
7	8	1	300.	1200.	120.	-3168.	-0.52	-1.40	-1.16
8	8	1	100.	1200.	110.	-151.	-0.24	-1.40	-1.16
9	8	49	250.	1050.	120.	1685.	0.40	0.92	0.88
10	8	49	250.	1100.	120.	1644.	0.39	0.92	0.84
11	9	10	200.	200.	110.	-108.	-0.04	0.00	-0.02
12	10	11	200.	150.	110.	-338.	-0.12	-0.02	-0.16
13	11	12	200.	100.	110.	-570.	-0.21	-0.04	-0.41
14	11	24	100.	450.	110.	124.	0.18	0.32	0.72
15	12	13	200.	250.	110.	-844.	-0.31	-0.21	-0.85
16	12	14	200.	250.	110.	-87.	-0.03	0.00	-0.01
17	12	21	100.	200.	110.	130.	0.19	0.16	0.78
18	13	20	200.	400.	110.	568.	0.21	0.16	0.41
19	13	22	200.	230.	110.	1205.	0.44	0.38	1.64
20	13	26	250.	5.	120.	-3849.	-0.91	-0.02	-4.05
21	14	15	100.	250.	110.	-26.	-0.04	-0.01	-0.04
22	14	16	200.	150.	110.	-184.	-0.07	-0.01	-0.05
23	15	18	100.	350.	110.	-148.	-0.22	-0.34	-0.98
24	16	17	100.	250.	110.	-306.	-0.45	-0.95	-3.79
25	17	18	100.	200.	110.	270.	0.40	0.60	3.00
26	17	19	150.	150.	110.	-697.	-0.46	-0.36	-2.42
27	19	20	100.	300.	110.	325.	0.48	1.27	4.24
28	19	48	200.	5.	110.	-1915.	-0.71	-0.02	-3.88
29	21	22	100.	300.	110.	22.	0.03	0.01	0.03
30	22	23	200.	220.	110.	890.	0.33	0.21	0.94
31	23	24	100.	500.	110.	-16.	-0.02	-0.01	-0.02
32	23	27	200.	200.	110.	568.	0.21	0.08	0.41
33	26	48	500.	700.	120.	-14345.	-0.85	-1.11	-1.58
34	26	47	400.	650.	120.	10496.	0.97	1.71	2.63
35	27	28	200.	700.	110.	230.	0.08	0.05	0.08
36	29	47	250.	2800.	120.	-3112.	-0.73	-7.65	-2.73
37	29	47	400.	2800.	120.	-10711.	-0.99	-7.65	-2.73
38	29	30	200.	350.	110.	1374.	0.51	0.73	2.10
39	29	33	250.	1650.	120.	3450.	0.81	5.46	3.31
40	29	33	350.	1650.	120.	8358.	1.01	5.46	3.31
41	30	31	150.	400.	110.	530.	0.35	0.58	1.46
42	31	32	150.	350.	110.	265.	0.17	0.14	0.40
43	33	34	150.	450.	110.	798.	0.52	1.40	3.11
44	33	35	200.	300.	110.	2110.	0.78	1.39	4.64
45	33	37	250.	500.	120.	3874.	0.91	2.05	4.10
46	33	37	250.	500.	120.	3874.	0.91	2.05	4.10
47	34	39	100.	500.	110.	340.	0.50	2.30	4.60
48	35	36	150.	300.	110.	1048.	0.69	1.55	5.15
49	35	40	100.	500.	110.	368.	0.54	2.68	5.36
50	36	42	100.	750.	110.	354.	0.52	3.73	4.97
51	37	38	200.	100.	110.	3282.	1.21	1.05	10.51
52	37	38	150.	100.	110.	1540.	1.01	1.05	10.51
53	37	40	200.	300.	110.	2580.	0.95	2.02	6.73
54	38	39	200.	350.	110.	1231.	0.45	0.60	1.71
55	38	43	200.	800.	110.	3245.	1.20	8.23	10.29

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2), Fire at SOLANO

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	39	44	100.	800.	110.	647.	0.95	12.14	15.18
57	40	41	200.	350.	110.	2602.	0.96	2.39	6.84
58	41	42	200.	200.	110.	928.	0.34	0.20	1.01
59	41	45	150.	700.	110.	1031.	0.68	3.50	5.00
60	42	46	150.	600.	110.	791.	0.52	1.84	3.06
61	43	44	150.	350.	110.	1719.	1.13	4.51	12.89
62	43	45	150.	400.	110.	-840.	-0.55	-1.37	-3.42
63	45	46	100.	400.	110.	-300.	-0.44	-1.46	-3.66
64	47	50	350.	10.	120.	-3329.	-0.40	-0.01	-0.60
65	48	53	600.	1000.	130.	-16260.	-0.67	-0.71	-0.71
66	49	51	350.	10.	120.	3329.	0.40	0.01	0.60
67	53	25	500.	500.	120.	-8410.	-0.50	-0.29	-0.59
68	53	52	350.	100.	120.	-7850.	-0.94	-0.29	-2.95

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2), Fire at SOLANO

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	132.00	319.94	41.94	45.00
3	278.00	264.00	319.86	41.86	45.00
4	271.80	132.00	319.78	47.98	51.20
5	280.00	272.00	319.78	39.78	43.00
6	290.00	280.00	319.72	29.72	33.00
7	300.00	140.00	319.72	19.72	23.00
8	269.70	0.00	310.02	40.32	53.30
9	269.70	108.00	292.32	22.62	53.30
10	270.00	230.00	292.33	22.33	53.00
11	270.20	108.00	292.35	22.15	52.80
12	270.50	230.00	292.39	21.89	52.50
13	270.50	1231.00	292.67	22.17	52.50
14	270.50	122.00	292.39	21.89	52.50
15	270.00	122.00	292.37	22.37	53.00
16	270.50	122.00	292.39	21.89	52.50
17	271.50	122.00	292.86	21.36	51.50
18	270.50	122.00	292.49	21.99	52.50
19	273.80	893.00	293.08	19.28	49.20
20	271.00	893.00	292.45	21.45	52.00
21	270.30	108.00	292.28	21.98	52.70
22	270.20	338.00	292.28	22.08	52.80
23	270.00	338.00	292.07	22.07	53.00
24	270.00	108.00	292.07	22.07	53.00
25	293.50	0.00	293.50	0.00	29.50
26	270.50	0.00	292.69	22.19	52.50
27	269.30	338.00	291.98	22.68	53.70
28	269.00	230.00	291.93	22.93	54.00
29	258.90	641.00	284.73	25.83	64.10
30	258.50	844.00	283.99	25.49	64.50
31	258.00	265.00	283.41	25.41	65.00
32	257.50	265.00	283.27	25.77	65.50
33	255.00	1152.00	279.27	24.27	68.00
34	255.00	458.00	277.87	22.87	68.00
35	255.00	694.00	277.87	22.87	68.00
36	255.00	694.00	276.33	21.33	68.00
37	254.80	346.00	277.21	22.41	68.20
38	254.80	346.00	276.16	21.36	68.20
39	254.80	924.00	275.57	20.77	68.20
40	254.50	346.00	275.20	20.70	68.50
41	254.50	643.00	272.80	18.30	68.50
42	254.50	491.00	272.60	18.10	68.50
43	254.50	2366.00	267.93	13.43	68.50
44	254.50	2366.00	263.42	8.92	68.50
45	254.50	491.00	269.30	14.80	68.50
46	254.50	491.00	270.76	16.26	68.50
47	269.30	0.00	292.38	23.08	53.70
48	273.80	0.00	293.10	19.30	49.20
49	269.30	0.00	303.42	34.12	53.70
50	0.00	0.00	292.42	292.42	323.00
51	0.00	0.00	303.38	303.38	323.00
52	293.50	0.00	293.50	0.00	29.50
53	275.00	0.00	293.38	18.38	48.00

Iteration Times : 36

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2), Fire at SOLANO

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	300.	120.	-1220.	-0.20	-0.06	-0.20
2	2	3	300.	500.	120.	1088.	0.18	0.08	0.16
3	3	4	150.	700.	110.	132.	0.09	0.08	0.11
4	3	5	250.	500.	120.	692.	0.16	0.08	0.17
5	5	6	250.	800.	120.	420.	0.10	0.05	0.07
6	6	7	250.	800.	120.	135.	0.03	0.01	0.01
7	8	1	300.	1200.	120.	-9166.	-1.50	-9.98	-8.32
8	8	1	100.	1200.	110.	-467.	-0.69	-9.98	-8.32
9	8	49	250.	1050.	120.	4877.	1.15	6.60	6.28
10	8	49	250.	1100.	120.	4756.	1.12	6.60	6.00
11	9	10	200.	200.	110.	-108.	-0.04	0.00	-0.02
12	10	11	200.	150.	110.	-338.	-0.12	-0.02	-0.16
13	11	12	200.	100.	110.	-562.	-0.21	-0.04	-0.40
14	11	24	100.	450.	110.	116.	0.17	0.28	0.63
15	12	13	200.	250.	110.	-976.	-0.36	-0.28	-1.11
16	12	14	200.	250.	110.	73.	0.03	0.00	0.01
17	12	21	100.	200.	110.	111.	0.16	0.12	0.58
18	13	20	200.	400.	110.	670.	0.25	0.22	0.55
19	13	22	200.	230.	110.	1233.	0.45	0.39	1.72
20	13	26	250.	5.	120.	-4111.	-0.97	-0.02	-4.58
21	14	15	100.	250.	110.	38.	0.06	0.02	0.08
22	14	16	200.	150.	110.	-86.	-0.03	0.00	-0.01
23	15	18	100.	350.	110.	-84.	-0.12	-0.12	-0.35
24	16	17	100.	250.	110.	-208.	-0.31	-0.47	-1.86
25	17	18	100.	200.	110.	206.	0.30	0.37	1.83
26	17	19	150.	150.	110.	-537.	-0.35	-0.22	-1.49
27	19	20	100.	300.	110.	223.	0.33	0.63	2.11
28	19	48	200.	5.	110.	-1652.	-0.61	-0.01	-2.95
29	21	22	100.	300.	110.	3.	0.00	0.00	0.00
30	22	23	200.	220.	110.	898.	0.33	0.21	0.95
31	23	24	100.	500.	110.	-8.	-0.01	0.00	0.00
32	23	27	200.	200.	110.	568.	0.21	0.08	0.41
33	26	48	500.	700.	120.	-8301.	-0.49	-0.40	-0.58
34	26	47	400.	650.	120.	4190.	0.39	0.31	0.48
35	27	28	200.	700.	110.	230.	0.08	0.05	0.08
36	29	47	250.	2800.	120.	-3112.	-0.73	-7.65	-2.73
37	29	47	400.	2800.	120.	-10711.	-0.99	-7.65	-2.73
38	29	30	200.	350.	110.	1374.	0.51	0.73	2.10
39	29	33	250.	1650.	120.	3450.	0.81	5.46	3.31
40	29	33	350.	1650.	120.	8358.	1.01	5.46	3.31
41	30	31	150.	400.	110.	530.	0.35	0.58	1.46
42	31	32	150.	350.	110.	265.	0.17	0.14	0.40
43	33	34	150.	450.	110.	798.	0.52	1.40	3.11
44	33	35	200.	300.	110.	2110.	0.78	1.39	4.64
45	33	37	250.	500.	120.	3874.	0.91	2.05	4.10
46	33	37	250.	500.	120.	3874.	0.91	2.05	4.10
47	34	39	100.	500.	110.	340.	0.50	2.30	4.60
48	35	36	150.	300.	110.	1048.	0.69	1.55	5.15
49	35	40	100.	500.	110.	368.	0.54	2.68	5.36
50	36	42	100.	750.	110.	354.	0.52	3.73	4.97
51	37	38	200.	100.	110.	3282.	1.21	1.05	10.51
52	37	38	150.	100.	110.	1540.	1.01	1.05	10.51
53	37	40	200.	300.	110.	2580.	0.95	2.02	6.73
54	38	39	200.	350.	110.	1231.	0.45	0.60	1.71
55	38	43	200.	800.	110.	3245.	1.20	8.23	10.29

ALT. D-2-(2)-A, Recommended Plan, Single Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2), Fire at SOLANO

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	39	44	100.	800.	110.	647.	0.95	12.14	15.18
57	40	41	200.	350.	110.	2602.	0.96	2.39	6.84
58	41	42	200.	200.	110.	928.	0.34	0.20	1.01
59	41	45	150.	700.	110.	1031.	0.68	3.50	5.00
60	42	46	150.	600.	110.	791.	0.52	1.84	3.06
61	43	44	150.	350.	110.	1719.	1.13	4.51	12.89
62	43	45	150.	400.	110.	-840.	-0.55	-1.37	-3.42
63	45	46	100.	400.	110.	-300.	-0.44	-1.46	-3.66
64	47	50	350.	10.	120.	-9633.	-1.16	-0.04	-4.30
65	48	53	600.	1000.	130.	-9953.	-0.41	-0.29	-0.29
66	49	51	350.	10.	120.	9633.	1.16	0.04	4.30
67	53	25	500.	500.	120.	-5148.	-0.30	-0.12	-0.24
68	53	52	350.	100.	120.	-4805.	-0.58	-0.12	-1.19

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 1995, Dry Season, Modification of ALT. D-2-(2)

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	121.00	319.61	41.61	45.00
3	278.00	242.00	319.10	41.10	45.00
4	271.80	121.00	319.03	47.23	51.20
5	280.00	234.00	319.04	39.04	43.00
6	290.00	226.00	319.00	29.00	33.00
7	300.00	113.00	319.00	19.00	23.00
8	269.70	0.00	315.86	46.16	53.30
9	269.70	101.00	290.07	20.37	53.30
10	270.00	214.00	290.07	20.07	53.00
11	270.20	101.00	290.09	19.89	52.80
12	270.50	214.00	290.13	19.63	52.50
13	270.50	1153.00	290.33	19.83	52.50
14	270.50	113.00	290.13	19.63	52.50
15	270.00	113.00	289.98	19.98	53.00
16	270.50	113.00	290.14	19.64	52.50
17	271.50	113.00	291.57	20.07	51.50
18	270.50	113.00	291.45	20.95	52.50
19	273.80	837.00	291.85	18.05	49.20
20	271.00	837.00	290.22	19.22	52.00
21	270.30	101.00	290.00	19.70	52.70
22	270.20	316.00	289.99	19.79	52.80
23	270.00	316.00	289.81	19.81	53.00
24	270.00	101.00	289.81	19.81	53.00
25	270.00	-8477.00	293.16	23.16	53.00
26	270.50	0.00	290.35	19.85	52.50
27	269.30	316.00	289.74	20.44	53.70
28	269.00	215.00	289.69	20.69	54.00
29	258.90	577.00	279.24	20.34	64.10
30	258.50	763.00	278.64	20.14	64.50
31	258.00	239.00	278.15	20.15	65.00
32	257.50	239.00	278.04	20.54	65.50
33	255.00	1040.00	269.16	14.16	68.00
34	255.00	396.00	268.78	13.78	68.00
35	255.00	644.00	268.60	13.60	68.00
36	255.00	644.00	267.98	12.98	68.00
37	254.80	360.00	266.42	11.62	68.20
38	254.80	360.00	266.02	11.22	68.20
39	254.80	800.00	265.75	10.95	68.20
40	254.50	360.00	264.92	10.42	68.50
41	254.50	568.00	263.66	9.16	68.50
42	254.50	424.00	263.49	8.99	68.50
43	254.50	404.00	265.39	10.89	68.50
44	254.50	404.00	265.08	10.58	68.50
45	254.50	424.00	262.99	8.49	68.50
46	254.50	424.00	262.91	8.41	68.50
47	269.30	0.00	288.60	19.30	53.70
48	273.80	0.00	291.87	18.07	49.20
49	269.30	0.00	313.12	43.82	53.70
50	0.00	0.00	288.62	288.62	323.00
51	0.00	0.00	313.10	313.10	323.00
52	270.00	0.00	290.00	20.00	53.00
53	275.00	0.00	292.87	17.87	48.00

Iteration Times : 38

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 1995, Dry Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	200.	300.	110.	-1057.	-0.39	-0.39	-1.29
2	2	3	200.	500.	110.	936.	0.34	0.51	1.03
3	3	4	150.	700.	110.	121.	0.08	0.07	0.09
4	3	5	250.	500.	120.	573.	0.14	0.06	0.12
5	5	6	250.	800.	120.	339.	0.08	0.04	0.05
6	6	7	250.	800.	120.	112.	0.03	0.00	0.01
7	8	1	300.	1200.	120.	-5702.	-0.93	-4.14	-3.45
8	8	1	100.	1200.	110.	-291.	-0.43	-4.14	-3.45
9	8	49	250.	1050.	120.	3034.	0.72	2.74	2.61
10	8	49	250.	1100.	120.	2958.	0.70	2.74	2.49
11	9	10	200.	200.	110.	-101.	-0.04	0.00	-0.02
12	10	11	200.	150.	110.	-316.	-0.12	-0.02	-0.14
13	11	12	200.	100.	110.	-531.	-0.20	-0.04	-0.36
14	11	24	100.	450.	110.	114.	0.17	0.28	0.61
15	12	13	200.	250.	110.	-822.	-0.30	-0.20	-0.81
16	12	14	200.	250.	110.	-42.	-0.02	0.00	0.00
17	12	21	100.	200.	110.	118.	0.17	0.13	0.65
18	13	20	200.	400.	110.	465.	0.17	0.11	0.28
19	13	22	200.	230.	110.	1133.	0.42	0.34	1.47
20	13	26	250.	5.	120.	-3577.	-0.84	-0.02	-3.54
21	14	15	100.	250.	110.	113.	0.17	0.15	0.60
22	14	16	200.	150.	110.	-268.	-0.10	-0.02	-0.10
23	16	17	100.	250.	110.	-381.	-0.56	-1.43	-5.70
24	17	18	100.	200.	110.	113.	0.17	0.12	0.60
25	17	19	150.	150.	110.	-607.	-0.40	-0.28	-1.88
26	19	20	100.	300.	110.	372.	0.55	1.63	5.45
27	19	48	200.	5.	110.	-1818.	-0.67	-0.02	-3.52
28	21	22	100.	300.	110.	17.	0.02	0.01	0.02
29	22	23	200.	220.	110.	834.	0.31	0.18	0.83
30	23	24	100.	500.	110.	-13.	-0.02	-0.01	-0.01
31	23	27	200.	200.	110.	531.	0.20	0.07	0.36
32	25	53	500.	500.	120.	8477.	0.50	0.30	0.60
33	26	48	350.	700.	120.	-6659.	-0.80	-1.52	-2.17
34	26	47	250.	650.	120.	3082.	0.73	1.75	2.69
35	27	28	200.	700.	110.	215.	0.08	0.05	0.07
36	29	47	250.	2800.	120.	-3468.	-0.82	-9.36	-3.34
37	29	47	300.	2800.	120.	-5602.	-0.92	-9.36	-3.34
38	29	30	200.	350.	110.	1241.	0.46	0.61	1.74
39	29	33	250.	1650.	120.	4804.	1.13	10.08	6.11
40	29	33	200.	1650.	110.	2449.	0.90	10.08	6.11
41	30	31	150.	400.	110.	478.	0.31	0.48	1.20
42	31	32	150.	350.	110.	239.	0.16	0.12	0.33
43	33	34	150.	450.	110.	396.	0.26	0.38	0.85
44	33	35	200.	300.	110.	1268.	0.47	0.56	1.86
45	33	37	250.	500.	120.	4528.	1.07	2.74	5.48
46	35	36	150.	300.	110.	644.	0.42	0.63	2.09
47	37	38	200.	100.	110.	1968.	0.73	0.41	4.08
48	37	40	200.	300.	110.	2200.	0.81	1.50	5.01
49	38	39	200.	350.	110.	800.	0.29	0.27	0.77
50	38	43	200.	800.	110.	808.	0.30	0.63	0.78
51	40	41	200.	350.	110.	1840.	0.68	1.26	3.60
52	41	42	200.	200.	110.	848.	0.31	0.17	0.86
53	41	45	150.	700.	110.	424.	0.28	0.67	0.96
54	42	46	150.	600.	110.	424.	0.28	0.58	0.96
55	43	44	150.	350.	110.	404.	0.26	0.31	0.88

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 1995, Dry Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	47	50	350.	10.	120.	-5992.	-0.72	-0.02	-1.79
57	48	53	450.	1000.	120.	-8477.	-0.62	-1.00	-1.00
58	49	51	350.	10.	120.	5992.	0.72	0.02	1.79

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 1995, Rainy Season, Modification of ALT. D-2-(2)

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	121.00	319.61	41.61	45.00
3	278.00	242.00	319.10	41.10	45.00
4	271.80	121.00	319.03	47.23	51.20
5	280.00	234.00	319.04	39.04	43.00
6	290.00	226.00	319.00	29.00	33.00
7	300.00	113.00	319.00	19.00	23.00
8	269.70	0.00	305.76	36.06	53.30
9	269.70	101.00	292.65	22.95	53.30
10	270.00	214.00	292.66	22.66	53.00
11	270.20	101.00	292.68	22.48	52.80
12	270.50	214.00	292.71	22.21	52.50
13	270.50	1153.00	293.01	22.51	52.50
14	270.50	113.00	292.70	22.20	52.50
15	270.00	113.00	292.55	22.55	53.00
16	270.50	113.00	292.70	22.20	52.50
17	271.50	113.00	292.98	21.48	51.50
18	270.50	113.00	292.86	22.36	52.50
19	273.80	837.00	293.11	19.31	49.20
20	271.00	837.00	292.78	21.78	52.00
21	270.30	101.00	292.64	22.34	52.70
22	270.20	316.00	292.64	22.44	52.80
23	270.00	316.00	292.45	22.45	53.00
24	270.00	101.00	292.45	22.45	53.00
25	270.00	-2825.00	293.29	23.29	53.00
26	270.50	0.00	293.03	22.53	52.50
27	269.30	316.00	292.38	23.08	53.70
28	269.00	215.00	292.34	23.34	54.00
29	258.90	577.00	284.93	26.03	64.10
30	258.50	763.00	284.33	25.83	64.50
31	258.00	239.00	283.85	25.85	65.00
32	257.50	239.00	283.73	26.23	65.50
33	255.00	1040.00	274.85	19.85	68.00
34	255.00	396.00	274.47	19.47	68.00
35	255.00	644.00	274.29	19.29	68.00
36	255.00	644.00	273.67	18.67	68.00
37	254.80	360.00	272.11	17.31	68.20
38	254.80	360.00	271.71	16.91	68.20
39	254.80	800.00	271.44	16.64	68.20
40	254.50	360.00	270.61	16.11	68.50
41	254.50	568.00	269.35	14.85	68.50
42	254.50	424.00	269.18	14.68	68.50
43	254.50	404.00	271.08	16.58	68.50
44	254.50	404.00	270.77	16.27	68.50
45	254.50	424.00	268.68	14.18	68.50
46	254.50	424.00	268.60	14.10	68.50
47	269.30	0.00	294.29	24.99	53.70
48	273.80	0.00	293.12	19.32	49.20
49	269.30	0.00	296.36	27.06	53.70
50	0.00	0.00	294.36	294.36	323.00
51	0.00	0.00	296.29	296.29	323.00
52	270.00	0.00	290.00	20.00	53.00
53	275.00	0.00	293.25	18.25	48.00

Iteration Times : 54

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 1995, Rainy Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	200.	300.	110.	-1057.	-0.39	-0.39	-1.29
2	2	3	200.	500.	110.	936.	0.34	0.51	1.03
3	3	4	150.	700.	110.	121.	0.08	0.07	0.09
4	3	5	250.	500.	120.	573.	0.14	0.06	0.12
5	5	6	250.	800.	120.	339.	0.08	0.04	0.05
6	6	7	250.	800.	120.	113.	0.03	0.00	0.01
7	8	1	300.	1200.	120.	-11103.	-1.82	-14.24	-11.86
8	8	1	100.	1200.	110.	-566.	-0.83	-14.24	-11.86
9	8	49	250.	1050.	120.	5908.	1.39	9.41	8.96
10	8	49	250.	1100.	120.	5761.	1.36	9.41	8.55
11	9	10	200.	200.	110.	-102.	-0.04	0.00	-0.02
12	10	11	200.	150.	110.	-317.	-0.12	-0.02	-0.14
13	11	12	200.	100.	110.	-521.	-0.19	-0.03	-0.35
14	11	24	100.	450.	110.	102.	0.15	0.22	0.50
15	12	13	200.	250.	110.	-1005.	-0.37	-0.29	-1.17
16	12	14	200.	250.	110.	183.	0.07	0.01	0.05
17	12	21	100.	200.	110.	87.	0.13	0.07	0.37
18	13	20	200.	400.	110.	681.	0.25	0.23	0.57
19	13	22	200.	230.	110.	1179.	0.43	0.36	1.58
20	13	26	250.	5.	120.	-4025.	-0.95	-0.02	-4.40
21	14	15	100.	250.	110.	113.	0.17	0.15	0.60
22	14	16	200.	150.	110.	-47.	-0.02	0.00	0.00
23	16	17	100.	250.	110.	-160.	-0.24	-0.28	-1.14
24	17	18	100.	200.	110.	113.	0.17	0.12	0.60
25	17	19	150.	150.	110.	-386.	-0.25	-0.12	-0.81
26	19	20	100.	300.	110.	156.	0.23	0.33	1.09
27	19	48	200.	5.	110.	-1385.	-0.51	-0.01	-2.13
28	21	22	100.	300.	110.	-15.	-0.02	0.00	-0.01
29	22	23	200.	220.	110.	848.	0.31	0.19	0.86
30	23	24	100.	500.	110.	-1.	0.00	0.00	0.00
31	23	27	200.	200.	110.	531.	0.20	0.07	0.36
32	25	53	500.	500.	120.	2822.	0.17	0.04	0.08
33	26	48	350.	700.	120.	-1436.	-0.17	-0.09	-0.13
34	26	47	250.	650.	120.	-2591.	-0.61	-1.27	-1.95
35	27	28	200.	700.	110.	215.	0.08	0.05	0.07
36	29	47	250.	2800.	120.	-3469.	-0.82	-9.36	-3.34
37	29	47	300.	2800.	120.	-5603.	-0.92	-9.36	-3.34
38	29	30	200.	350.	110.	1241.	0.46	0.61	1.74
39	29	33	250.	1650.	120.	4804.	1.13	10.08	6.11
40	29	33	200.	1650.	110.	2449.	0.90	10.08	6.11
41	30	31	150.	400.	110.	478.	0.31	0.48	1.20
42	31	32	150.	350.	110.	239.	0.16	0.12	0.33
43	33	34	150.	450.	110.	396.	0.26	0.38	0.85
44	33	35	200.	300.	110.	1288.	0.47	0.56	1.86
45	33	37	250.	500.	120.	4529.	1.07	2.74	5.48
46	35	36	150.	300.	110.	644.	0.42	0.63	2.09
47	37	38	200.	100.	110.	1968.	0.73	0.41	4.08
48	37	40	200.	300.	110.	2200.	0.81	1.50	5.01
49	38	39	200.	350.	110.	800.	0.29	0.27	0.77
50	38	43	200.	800.	110.	808.	0.30	0.63	0.78
51	40	41	200.	350.	110.	1840.	0.68	1.26	3.60
52	41	42	200.	200.	110.	848.	0.31	0.17	0.86
53	41	45	150.	700.	110.	424.	0.28	0.67	0.96
54	42	46	150.	600.	110.	424.	0.28	0.58	0.96
55	43	44	150.	350.	110.	404.	0.26	0.31	0.88

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 1995, Rainy Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	47	50	350.	10.	120.	-11669.	-1.40	-0.06	-6.14
57	48	53	450.	1000.	120.	-2822.	-0.21	-0.13	-0.13
58	49	51	350.	10.	120.	11669.	1.40	0.06	6.14

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2)

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	219.00	319.83	41.83	45.00
3	278.00	438.00	319.60	41.60	45.00
4	271.80	219.00	319.40	47.60	51.20
5	280.00	451.00	319.38	39.38	43.00
6	290.00	465.00	319.24	29.24	33.00
7	300.00	232.00	319.22	19.22	23.00
8	269.70	0.00	317.33	47.63	53.30
9	269.70	179.00	288.40	18.70	53.30
10	270.00	381.00	288.41	18.41	53.00
11	270.20	179.00	288.47	18.27	52.80
12	270.50	381.00	288.57	18.07	52.50
13	270.50	2043.00	289.19	18.69	52.50
14	270.50	202.00	288.57	18.07	52.50
15	270.00	202.00	288.57	18.57	53.00
16	270.50	202.00	288.58	18.08	52.50
17	271.50	202.00	290.40	18.90	51.50
18	270.50	202.00	289.16	18.66	52.50
19	273.80	1482.00	291.16	17.36	49.20
20	271.00	1482.00	288.71	17.71	52.00
21	270.30	179.00	288.22	17.92	52.70
22	270.20	561.00	288.21	18.01	52.80
23	270.00	561.00	287.67	17.67	53.00
24	270.00	179.00	287.69	17.69	53.00
25	270.00	-12883.00	293.40	23.40	53.00
26	270.50	0.00	289.24	18.74	52.50
27	269.30	561.00	287.47	18.17	53.70
28	269.00	382.00	287.33	18.33	54.00
29	258.90	1064.00	278.52	19.62	64.10
30	258.50	1401.00	276.41	17.91	64.50
31	258.00	440.00	274.92	16.92	65.00
32	257.50	440.00	274.56	17.06	65.50
33	255.00	1911.00	273.38	18.38	68.00
34	255.00	759.00	271.17	16.17	68.00
35	255.00	1152.00	270.95	15.95	68.00
36	255.00	1152.00	268.33	13.33	68.00
37	254.80	574.00	271.45	16.65	68.20
38	254.80	574.00	270.67	15.87	68.20
39	254.80	1533.00	269.74	14.94	68.20
40	254.50	574.00	269.07	14.57	68.50
41	254.50	1066.00	266.78	12.28	68.50
42	254.50	814.00	266.47	11.97	68.50
43	254.50	774.00	267.38	12.88	68.50
44	254.50	774.00	266.95	12.45	68.50
45	254.50	814.00	266.36	11.86	68.50
46	254.50	814.00	265.44	10.94	68.50
47	269.30	0.00	287.06	17.76	53.70
48	273.80	0.00	291.20	17.40	49.20
49	269.30	0.00	315.57	46.27	53.70
50	0.00	0.00	287.07	287.07	323.00
51	0.00	0.00	315.56	315.56	323.00
52	270.00	-8588.00	293.10	23.10	53.00
53	275.00	0.00	292.75	17.75	48.00

Iteration Times : 45

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2)

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	320.00	0.00	320.00	0.00	3.00
2	278.00	219.00	319.83	41.83	45.00
3	278.00	438.00	319.60	41.60	45.00
4	271.80	219.00	319.40	47.60	51.20
5	280.00	451.00	319.38	39.38	43.00
6	290.00	465.00	319.24	29.24	33.00
7	300.00	232.00	319.22	19.22	23.00
8	269.70	0.00	309.06	39.36	53.30
9	269.70	179.00	290.05	20.35	53.30
10	270.00	381.00	290.06	20.06	53.00
11	270.20	179.00	290.12	19.92	52.80
12	270.50	381.00	290.22	19.72	52.50
13	270.50	2043.00	290.93	20.43	52.50
14	270.50	202.00	290.22	19.72	52.50
15	270.00	202.00	290.17	20.17	53.00
16	270.50	202.00	290.22	19.72	52.50
17	271.50	202.00	291.44	19.94	51.50
18	270.50	202.00	290.49	19.99	52.50
19	273.80	1482.00	292.01	18.21	49.20
20	271.00	1482.00	290.37	19.37	52.00
21	270.30	179.00	289.92	19.62	52.70
22	270.20	561.00	289.92	19.72	52.80
23	270.00	561.00	289.39	19.39	53.00
24	270.00	179.00	289.39	19.39	53.00
25	270.00	-12037.00	293.53	23.53	53.00
26	270.50	0.00	290.99	20.49	52.50
27	269.30	561.00	289.18	19.88	53.70
28	269.00	382.00	289.04	20.04	54.00
29	258.90	1064.00	281.74	22.84	64.10
30	258.50	1401.00	279.63	21.13	64.50
31	258.00	440.00	278.14	20.14	65.00
32	257.50	440.00	277.78	20.28	65.50
33	255.00	1911.00	276.60	21.60	68.00
34	255.00	759.00	274.39	19.39	68.00
35	255.00	1152.00	274.17	19.17	68.00
36	255.00	1152.00	271.55	16.55	68.00
37	254.80	574.00	274.67	19.87	68.20
38	254.80	574.00	273.88	19.08	68.20
39	254.80	1533.00	272.95	18.15	68.20
40	254.50	574.00	272.29	17.79	68.50
41	254.50	1066.00	269.99	15.49	68.50
42	254.50	814.00	269.69	15.19	68.50
43	254.50	774.00	270.60	16.10	68.50
44	254.50	774.00	270.17	15.67	68.50
45	254.50	814.00	269.57	15.07	68.50
46	254.50	814.00	268.66	14.16	68.50
47	269.30	0.00	290.27	20.97	53.70
48	273.80	0.00	292.05	18.25	49.20
49	269.30	0.00	301.82	32.52	53.70
50	0.00	0.00	290.32	290.32	323.00
51	0.00	0.00	301.77	301.77	323.00
52	270.00	-4012.00	293.04	23.04	53.00
53	275.00	0.00	292.95	17.95	48.00

Iteration Times : 30

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	200.	300.	110.	-683.	-0.25	-0.17	-0.57
2	2	1	250.	300.	120.	-1341.	-0.32	-0.17	-0.57
3	2	3	200.	500.	110.	609.	0.22	0.23	0.47
4	2	3	250.	500.	120.	1196.	0.28	0.23	0.47
5	3	4	150.	700.	110.	219.	0.14	0.20	0.28
6	3	5	250.	500.	120.	1148.	0.27	0.22	0.43
7	5	6	250.	800.	120.	697.	0.16	0.14	0.17
8	6	7	250.	800.	120.	232.	0.05	0.02	0.02
9	8	1	300.	1200.	120.	-4495.	-0.74	-2.67	-2.22
10	8	1	100.	1200.	110.	-229.	-0.34	-2.67	-2.22
11	8	49	250.	1050.	120.	2392.	0.56	1.76	1.68
12	8	49	250.	1100.	120.	2332.	0.55	1.76	1.60
13	9	10	200.	200.	110.	-179.	-0.07	-0.01	-0.05
14	10	11	200.	150.	110.	-560.	-0.21	-0.06	-0.40
15	11	12	200.	100.	110.	-940.	-0.35	-0.10	-1.04
16	11	24	100.	450.	110.	200.	0.30	0.78	1.73
17	12	13	200.	250.	110.	-1499.	-0.55	-0.62	-2.46
18	12	14	200.	250.	110.	-18.	-0.01	0.00	0.00
19	12	21	100.	200.	110.	203.	0.30	0.36	1.78
20	13	20	200.	400.	110.	1019.	0.38	0.48	1.20
21	13	22	200.	230.	110.	2019.	0.74	0.98	4.27
22	13	26	250.	5.	120.	-6581.	-1.55	-0.05	-10.94
23	14	15	100.	250.	110.	5.	0.01	0.00	0.00
24	14	16	200.	150.	110.	-233.	-0.09	-0.01	-0.08
25	15	18	100.	350.	110.	-197.	-0.29	-0.59	-1.68
26	16	17	100.	250.	110.	-435.	-0.64	-1.82	-7.28
27	17	18	100.	200.	110.	399.	0.59	1.24	6.21
28	17	19	150.	150.	110.	-1036.	-0.68	-0.76	-5.04
29	19	20	100.	300.	110.	463.	0.68	2.45	8.18
30	19	48	200.	5.	110.	-2981.	-1.10	-0.04	-8.80
31	21	22	100.	300.	110.	24.	0.04	0.01	0.04
32	22	23	200.	220.	110.	1483.	0.55	0.53	2.41
33	23	24	100.	500.	110.	-21.	-0.03	-0.01	-0.03
34	23	27	200.	200.	110.	943.	0.35	0.21	1.04
35	25	53	500.	500.	120.	12883.	0.76	0.65	1.30
36	26	48	350.	700.	120.	-7638.	-0.92	-1.96	-2.80
37	26	48	400.	700.	120.	-10852.	-1.00	-1.96	-2.80
38	26	47	250.	650.	120.	3479.	0.82	2.18	3.36
39	26	47	350.	650.	120.	8429.	1.01	2.18	3.36
40	27	28	200.	700.	110.	382.	0.14	0.14	0.20
41	29	47	250.	2800.	120.	-3301.	-0.78	-8.54	-3.05
42	29	47	300.	2800.	120.	-5332.	-0.87	-8.54	-3.05
43	29	47	350.	2800.	120.	-7997.	-0.96	-8.54	-3.05
44	29	30	150.	350.	110.	1141.	0.75	2.11	6.03
45	29	30	150.	350.	110.	1141.	0.75	2.11	6.03
46	29	33	250.	1650.	120.	3339.	0.79	5.14	3.11
47	29	33	200.	1650.	120.	1857.	0.68	5.14	3.11
48	29	33	350.	1650.	120.	8090.	0.97	5.14	3.11
49	30	31	150.	400.	110.	880.	0.58	1.49	3.73
50	31	32	150.	350.	110.	440.	0.29	0.36	1.03
51	33	34	150.	450.	110.	1022.	0.67	2.21	4.92
52	33	35	200.	300.	110.	2851.	1.05	2.43	8.10
53	33	37	250.	500.	120.	3751.	0.88	1.93	3.86
54	33	37	250.	500.	120.	3751.	0.88	1.93	3.86
55	34	39	100.	500.	110.	263.	0.39	1.43	2.86

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 2010, Dry Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	35	36	150.	300.	110.	1395.	0.91	2.62	8.75
57	35	40	100.	500.	110.	304.	0.45	1.88	3.75
58	36	42	100.	750.	110.	243.	0.36	1.85	2.47
59	37	38	200.	100.	110.	2798.	1.03	0.78	7.82
60	37	38	150.	100.	110.	1313.	0.86	0.78	7.82
61	37	40	200.	300.	110.	2816.	1.04	2.37	7.91
62	38	39	200.	350.	110.	1562.	0.58	0.93	2.66
63	38	43	200.	800.	110.	1975.	0.73	3.28	4.10
64	39	44	100.	800.	110.	292.	0.43	2.78	3.48
65	40	41	200.	350.	110.	2546.	0.94	2.30	6.57
66	41	42	200.	200.	110.	1152.	0.42	0.30	1.51
67	41	45	150.	700.	110.	328.	0.21	0.42	0.60
68	42	46	150.	600.	110.	581.	0.38	1.04	1.73
69	43	44	150.	350.	110.	482.	0.32	0.43	1.22
70	43	45	150.	400.	110.	719.	0.47	1.03	2.57
71	45	46	100.	400.	110.	233.	0.34	0.92	2.30
72	47	50	350.	10.	120.	-4724.	-0.57	-0.01	-1.15
73	48	53	450.	1000.	120.	-10735.	-0.78	-1.55	-1.55
74	48	53	450.	1000.	120.	-10735.	-0.78	-1.55	-1.55
75	49	51	350.	10.	120.	4724.	0.57	0.01	1.15
76	52	53	350.	100.	120.	8588.	1.03	0.35	3.48

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2)

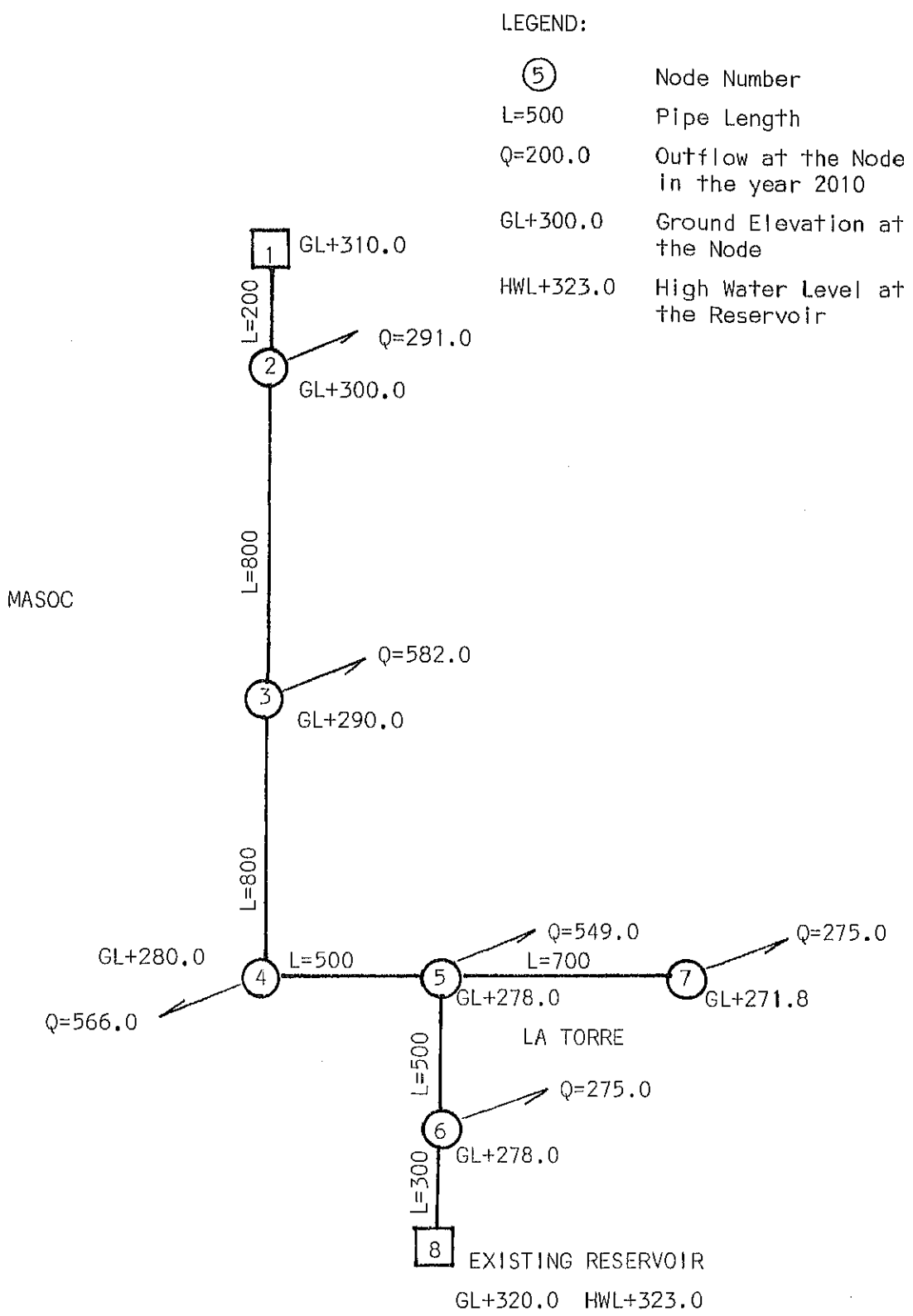
<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	200.	300.	110.	-683.	-0.25	-0.17	-0.57
2	2	1	250.	300.	120.	-1341.	-0.32	-0.17	-0.57
3	2	3	200.	500.	110.	609.	0.22	0.23	0.47
4	2	3	250.	500.	120.	1196.	0.28	0.23	0.47
5	3	4	150.	700.	110.	219.	0.14	0.20	0.28
6	3	5	250.	500.	120.	1148.	0.27	0.22	0.43
7	5	6	250.	800.	120.	697.	0.16	0.14	0.17
8	6	7	250.	800.	120.	230.	0.05	0.02	0.02
9	8	1	300.	1200.	120.	-9634.	-1.58	-10.94	-9.12
10	8	1	100.	1200.	110.	-491.	-0.72	-10.94	-9.12
11	8	49	250.	1050.	120.	5126.	1.21	7.23	6.89
12	8	49	250.	1100.	120.	4999.	1.18	7.23	6.58
13	9	10	200.	200.	110.	-179.	-0.07	-0.01	-0.05
14	10	11	200.	150.	110.	-559.	-0.21	-0.06	-0.40
15	11	12	200.	100.	110.	-931.	-0.34	-0.10	-1.02
16	11	24	100.	450.	110.	193.	0.28	0.73	1.62
17	12	13	200.	250.	110.	-1611.	-0.59	-0.70	-2.81
18	12	14	200.	250.	110.	114.	0.04	0.01	0.02
19	12	21	100.	200.	110.	186.	0.27	0.30	1.50
20	13	20	200.	400.	110.	1108.	0.41	0.56	1.41
21	13	22	200.	230.	110.	2044.	0.75	1.01	4.37
22	13	26	250.	5.	120.	-6803.	-1.60	-0.06	-11.64
23	14	15	100.	250.	110.	60.	0.09	0.05	0.19
24	14	16	200.	150.	110.	-147.	-0.05	-0.01	-0.03
25	15	18	100.	350.	110.	-142.	-0.21	-0.32	-0.92
26	16	17	100.	250.	110.	-349.	-0.51	-1.21	-4.85
27	17	18	100.	200.	110.	344.	0.51	0.94	4.72
28	17	19	150.	150.	110.	-895.	-0.59	-0.58	-3.85
29	19	20	100.	300.	110.	374.	0.55	1.65	5.50
30	19	48	200.	5.	110.	-2749.	-1.01	-0.04	-7.57
31	21	22	100.	300.	110.	7.	0.01	0.00	0.00
32	22	23	200.	220.	110.	1490.	0.55	0.54	2.43
33	23	24	100.	500.	110.	-14.	-0.02	-0.01	-0.01
34	23	27	200.	200.	110.	943.	0.35	0.21	1.04
35	25	53	500.	500.	120.	12038.	0.71	0.57	1.14
36	26	48	350.	700.	120.	-5495.	-0.66	-1.07	-1.52
37	26	48	400.	700.	120.	-7807.	-0.72	-1.07	-1.52
38	26	47	250.	650.	120.	1899.	0.45	0.71	1.10
39	26	47	350.	650.	120.	4601.	0.55	0.71	1.10
40	27	28	200.	700.	110.	382.	0.14	0.14	0.20
41	29	47	250.	2800.	120.	-3301.	-0.78	-8.54	-3.05
42	29	47	300.	2800.	120.	-5332.	-0.87	-8.54	-3.05
43	29	47	350.	2800.	120.	-7997.	-0.96	-8.54	-3.05
44	29	30	150.	350.	110.	1140.	0.75	2.11	6.03
45	29	30	150.	350.	110.	1140.	0.75	2.11	6.03
46	29	33	250.	1650.	120.	3339.	0.79	5.14	3.11
47	29	33	200.	1650.	120.	1657.	0.68	5.14	3.11
48	29	33	350.	1650.	120.	8089.	0.97	5.14	3.11
49	30	31	150.	400.	110.	880.	0.58	1.49	3.73
50	31	32	150.	350.	110.	440.	0.29	0.36	1.03
51	33	34	150.	450.	110.	1022.	0.67	2.21	4.92
52	33	35	200.	300.	110.	2851.	1.05	2.43	8.10
53	33	37	250.	500.	120.	3751.	0.88	1.93	3.86
54	33	37	250.	500.	120.	3751.	0.88	1.93	3.86
55	34	39	100.	500.	110.	263.	0.39	1.43	2.86

ALT. D-2-(2)-B, Recommended Plan, Parallel Pipeline Alignment
Year 2010, Rainy Season, Modification of ALT. D-2-(2)

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
56	35	36	150.	300.	110.	1395.	0.91	2.62	8.75
57	35	40	100.	500.	110.	304.	0.45	1.88	3.75
58	36	42	100.	750.	110.	243.	0.36	1.85	2.47
59	37	38	200.	100.	110.	2798.	1.03	0.78	7.82
60	37	38	150.	100.	110.	1313.	0.86	0.78	7.82
61	37	40	200.	300.	110.	2816.	1.04	2.37	7.91
62	38	39	200.	350.	110.	1562.	0.58	0.93	2.66
63	38	43	200.	800.	110.	1975.	0.73	3.28	4.10
64	39	44	100.	800.	110.	292.	0.43	2.78	3.48
65	40	41	200.	350.	110.	2546.	0.94	2.30	6.57
66	41	42	200.	200.	110.	1152.	0.42	0.30	1.51
67	41	45	150.	700.	110.	328.	0.21	0.42	0.60
68	42	46	150.	600.	110.	581.	0.38	1.04	1.73
69	43	44	150.	350.	110.	482.	0.32	0.43	1.22
70	43	45	150.	400.	110.	719.	0.47	1.03	2.57
71	45	46	100.	400.	110.	233.	0.34	0.92	2.30
72	47	50	350.	10.	120.	-10125.	-1.22	-0.05	-4.72
73	48	53	450.	1000.	120.	-8025.	-0.58	-0.90	-0.90
74	48	53	450.	1000.	120.	-8025.	-0.58	-0.90	-0.90
75	49	51	350.	10.	120.	10125.	1.22	0.05	4.72
76	52	53	350.	100.	120.	4013.	0.48	0.09	0.85



SCHEMATIC PLAN OF DISTRIBUTION SYSTEM FOR HYDRAULIC ANALYSIS
(Bayombong-Solano, Masoc/La Torre Area)

ALTERNATIVE ML-2, Masoc/La Torre Area (Masoc)
2 Reservoir System (New & Existing), Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	310.00	0.00	310.00	0.00	13.00
2	300.00	291.00	309.69	9.69	23.00
3	290.00	582.00	308.97	18.97	33.00
4	280.00	291.00	308.58	28.58	43.00

Iteration Times : 14

ALTERNATIVE ML-2, Masoc/La Torre Area (Masoc)
2 Reservoir System (New & Existing), Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu. m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	200.	200.	110.	-1164.	-0.43	-0.31	-1.54
2	2	3	200.	800.	110.	873.	0.32	0.72	0.90
3	3	4	150.	800.	110.	291.	0.19	0.38	0.48

ALTERNATIVE ML-2, Masoc/La Torre Area (La Torre)
2 Reservoir System (New & Existing), Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	310.00	0.00	330.00	20.00	13.00
2	300.00	0.00	320.00	20.00	23.00
3	290.00	0.00	310.00	20.00	33.00
4	280.00	275.00	316.35	36.35	43.00
5	278.00	549.00	316.56	38.56	45.00
6	278.00	275.00	319.37	41.37	45.00
7	271.80	275.00	316.26	44.46	51.20
8	320.00	0.00	320.00	0.00	3.00

Iteration Times : 10

ALTERNATIVE ML-2, Masoc/La Torre Area (La Torre)
2 Reservoir System (New & Existing), Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu. m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	4	5	150.	500.	110.	-274.	-0.18	-0.22	-0.43
2	5	6	150.	500.	110.	-1098.	-0.72	-2.81	-5.62
3	5	7	150.	700.	110.	275.	0.18	0.30	0.43
4	6	8	200.	300.	110.	-1373.	-0.51	-0.63	-2.09

ALTERNATIVE ML-1, Masoc/La Torre Area
1 Reservoir System (New Reservoir), Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	310.00	0.00	310.00	0.00	4.00
2	300.00	291.00	309.85	9.85	14.00
3	290.00	582.00	308.65	18.65	24.00
4	280.00	565.00	307.96	27.96	34.00
5	278.00	549.00	307.27	29.27	36.00
6	278.00	275.00	307.05	29.05	36.00
7	271.80	275.00	306.97	35.17	42.20

Iteration Times : 14

ALTERNATIVE ML-1, Masoc/La Torre Area
1 Reservoir System (New Reservoir), Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	200.	120.	-2533.	-0.41	-0.15	-0.77
2	2	3	250.	800.	120.	2247.	0.53	1.20	1.50
3	3	4	250.	800.	120.	1565.	0.39	0.69	0.86
4	4	5	200.	500.	110.	1099.	0.40	0.69	1.39
5	5	6	150.	500.	110.	275.	0.18	0.22	0.43
6	5	7	150.	700.	110.	275.	0.18	0.30	0.43

ALTERNATIVE ML-1, Masoc/La Torre Area
1 Reservoir System (New Reservoir), Year 2010, Fire at LA TORRE

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	310.00	0.00	310.00	0.00	4.00
2	300.00	145.00	309.45	9.45	14.00
3	290.00	291.00	304.34	14.34	24.00
4	280.00	283.00	299.77	19.77	34.00
5	278.00	2174.00	290.93	12.93	36.00
6	278.00	137.00	290.87	12.87	36.00
7	271.80	2037.00	278.59	6.79	42.20

Iteration Times : 10

ALTERNATIVE ML-1, Masoc/La Torre Area
1 Reservoir System (New Reservoir), Year 2010, Fire at LA TORRE

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	300.	200.	120.	-5057.	-0.83	-0.55	-2.76
2	2	3	250.	800.	120.	4920.	1.16	5.11	6.39
3	3	4	250.	800.	120.	4629.	1.09	4.56	5.71
4	4	5	200.	500.	110.	4347.	1.60	8.84	17.68
5	5	6	150.	500.	110.	137.	0.09	0.06	0.12
6	5	7	150.	700.	110.	2037.	1.33	12.35	17.64

ALTERNATIVE ML-2, Masoc/La Torre Area
2 Reservoir System (New & Existing), Year 2010, Fire at MASOC

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	310.00	0.00	310.00	0.00	13.00
2	300.00	145.00	308.92	8.92	23.00
3	290.00	291.00	305.07	15.07	33.00
4	280.00	4083.00	293.14	13.14	43.00
5	278.00	274.00	303.50	25.50	45.00
6	278.00	137.00	317.70	39.70	45.00
7	271.80	137.00	303.42	31.62	51.20
8	320.00	0.00	320.00	0.00	3.00

Iteration Times : 18

ALTERNATIVE ML-2, Masoc/La Torre Area
2 Reservoir System (New & Existing), Year 2010, Fire at MASOC

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	200.	200.	110.	-2296.	-0.85	-1.08	-5.42
2	2	3	200.	800.	110.	2151.	0.79	3.85	4.81
3	3	4	150.	800.	110.	1860.	1.22	11.93	14.91
4	4	5	150.	500.	110.	-2223.	-1.46	-10.36	-20.73
5	5	6	150.	500.	110.	-2634.	-1.72	-14.19	-28.38
6	5	7	150.	700.	110.	136.	0.09	0.08	0.12
7	6	8	200.	300.	110.	-2771.	-1.02	-2.30	-7.68

ALTERNATIVE ML-2, Masoc/La Torre Area
2 Reservoir System (New & Existing), Year 2010, Fire at LA TORRE

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	310.00	0.00	310.00	0.00	13.00
2	300.00	145.00	309.31	9.31	23.00
3	290.00	291.00	306.92	16.92	33.00
4	280.00	283.00	300.16	20.16	43.00
5	278.00	2174.00	297.41	19.41	45.00
6	278.00	137.00	316.88	38.88	45.00
7	271.80	2037.00	285.06	13.26	51.20
8	320.00	0.00	320.00	0.00	3.00

Iteration Times : 10

ALTERNATIVE ML-2, Masoc/La Torre Area
2 Reservoir System (New & Existing), Year 2010, Fire at LA TORRE

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	200.	200.	110.	-1805.	-0.67	-0.69	-3.47
2	2	3	200.	800.	110.	1660.	0.61	2.38	2.98
3	3	4	150.	800.	110.	1369.	0.90	6.76	8.45
4	4	5	150.	500.	110.	1086.	0.71	2.75	5.51
5	5	6	150.	500.	110.	-3125.	-2.05	-19.48	-38.95
6	5	7	150.	700.	110.	2037.	1.33	12.35	17.64
7	6	8	200.	300.	110.	-3262.	-1.20	-3.12	-10.39

ALTERNATIVE ML-3, Masoc/La Torre Area
1 Reservoir System (Existing Reservoir), Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	310.00	0.00	330.00	20.00	13.00
2	300.00	291.00	318.89	18.89	23.00
3	290.00	582.00	318.92	28.92	33.00
4	280.00	566.00	319.13	39.13	43.00
5	278.00	549.00	319.46	41.46	45.00
6	278.00	275.00	319.77	41.77	45.00
7	271.80	275.00	319.15	47.35	51.20
8	320.00	0.00	320.00	0.00	3.00

Iteration Times : 27

ALTERNATIVE ML-3, Masoc/La Torre Area
1 Reservoir System (Existing Reservoir), Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	3	250.	800.	120.	-292.	-0.07	-0.03	-0.03
2	3	4	250.	800.	120.	-873.	-0.21	-0.21	-0.26
3	4	5	250.	500.	120.	-1439.	-0.34	-0.33	-0.66
4	5	6	300.	500.	120.	-2263.	-0.37	-0.31	-0.62
5	5	7	150.	700.	110.	275.	0.18	0.30	0.43
6	6	8	300.	300.	120.	-2538.	-0.42	-0.23	-0.77

ALTERNATIVE ML-3, Masoc/La Torre Area
1 Reservoir System (Existing Reservoir), Year 2010, Fire at MASOC

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	310.00	0.00	330.00	20.00	13.00
2	300.00	3945.00	307.86	7.86	23.00
3	290.00	291.00	311.25	21.25	33.00
4	280.00	283.00	315.12	35.12	43.00
5	278.00	274.00	317.85	39.85	45.00
6	278.00	137.00	319.17	41.17	45.00
7	271.80	137.00	317.77	45.97	51.20
8	320.00	0.00	320.00	0.00	3.00

Iteration Times : 18

ALTERNATIVE ML-3, Masoc/La Torre Area
1 Reservoir System (Existing Reservoir), Year 2010, Fire at MASOC

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	3	250.	800.	120.	-3945.	-0.93	-3.39	-4.24
2	3	4	250.	800.	120.	-4236.	-1.00	-3.87	-4.84
3	4	5	250.	500.	120.	-4519.	-1.07	-2.73	-5.46
4	5	6	300.	500.	120.	-4930.	-0.81	-1.32	-2.64
5	5	7	150.	700.	110.	136.	0.09	0.08	0.12
6	6	8	300.	300.	120.	-5067.	-0.83	-0.83	-2.77

APPENDIX 8.2.1.A BREAKDOWN OF COST ESTIMATES

(Unit: thousand Pesos)

Bayombong-Solano	UNIT COST	Phase I (Stage 1)		Phase I (Stage 2)		Phase I Total		Phase II Cost	
ITEM		NUMBER	COST	NUMBER	COST	NUMBER	COST	NUMBER	COST
1 SOURCE FACILITY									
(1)Sprinng Box Rehabili.	30000	1	30	0	0	1	30	0	0
Drain Pipe D=250	340	10	3	0	0	10	3	0	0
Valve D=250	11200	1	11	0	0	1	11	0	0
(2)RADIAL WELL	1240000	0	0	1	1240	1	1240	1	1240
WELL PUMP 22kw	358000	0	0	3	1074	3	1074	3	1074
Pump House on Well	820000	0	0	1	820	1	820	1	820
(3)Electric Sub-station			0		0		0	150KVA	2580
SUB-TOTAL			44		3134		3178		5714
2 TRANSMISSION FACILITIES									
Main Pipe D=250 (Steel)	630	4300	2709	0	0	4300	2709		0
Valve D=250	11200	2	22	0	0	2	22		0
SUB-TOTAL			2731		0		2731		0
3 DISTRIBUTION FACILITIES									
(1)Chlorination Facility	98100	1	98	1	98	2	196	0	0
(2)Distribution pipes									
1)Main Pipes									
D=100 (PVC Pipe)	250	1200	300	0	0	1200	300	0	0
D=150 (PVC Pipe)	410	700	287	3300	1353	4000	1640	500	205
D=200 (Steel Pipe)	520	0	0	1155	601	1155	601	0	0
D=250 (Steel Pipe)	630	3200	2016	5	3	3205	2019	500	315
D=300 (Steel Pipe)	760	800	608	0	0	800	608	0	0
D=350 (Steel Pipe)	900	10	9	0	0	10	9	1650	1485
D=400 (Steel Pipe)	970	2800	2716	650	631	3450	3347	0	0
D=500 (Steel Pipe)	1330	0	0	1100	1463	1100	1463	0	0
D=600 (Steel Pipe)	1600	0	0	1000	1600	1000	1600	0	0
RIVER CROSSING CD=2.0m	2090	0	0	100	209	100	209	100	209
D=500 Materials	718	0	0	100	72	100	72	0	0
D=350 Materials	486	0	0	0	0	0	0	100	49
2)Valves									
D=100 (Gate Valve)	3900	1	4	0	0	1	4	0	0
D=150 (Gate Valve)	5300	2	11	11	58	13	69	2	11
D=200 (Gate Valve)	6700	0	0	5	34	5	34	0	0
D=250 (Gate Valve)	11200	8	89	1	11	9	100	2	22
D=300 (Butterfly Valve)	34800	3	104	0	0	3	104	0	0
D=350 (Butterfly Valve)	74400	1	74	0	0	1	74	2	149
D=400 (Butterfly Valve)	95200	1	95	1	95	2	190	0	0
D=500 (Butterfly Valve)	174000	0	0	2	348	2	348	0	0
D=600 (Butterfly Valve)	243600	0	0	1	244	1	244	0	0
Prssre Cntrl Valve 350	390000	1	390	0	0	1	390	0	0
3)Internal Network									1762
UPTO 1990	5152		5152		0		5152		
UPTO 1995	2930		0		2930		2930		
4)Service Connections									
D=1/2	810	1685	1365	4608	3733	6293	5098	6791	5501
D=3/4	1280	9	12	10	15	19	27	13	17
5)Rehabilitation									
Water Meter 1/2''	400	1309	524	0	0	1309	524		
Old Laterals			488	0	0	0	488		
Service Connect.wo/Metr	480	669	321	0	0	669	321		
6)Flow Meter									
D=250	93000	1	93	0	0	1	93		0
D=300	126000	1	126	0	0	1	126		0
D=400	215000	0	0	1	215	1	215		0
7)Fire Protection									
D=150	16800	0	0	0	0	0	0	34	571
D=100	9400	0	0	0	0	0	0	151	1419
SUB-TOTAL			14882		13713		28595		11715
4 1)Administration Bldg.								1	1320
2)Operation Center		1	1090			1	1090		
SUB-TOTAL		1	1090		0	1	1090	1	1320
5 Land Acquisition	35.75	2225	158	0	0	2225	158		0
Vehicle	300000	2	600	1	300	3	900	1	300
Stored Material & Equip.			214		196		410		205
SUB-TOTAL			972		496		1468		505
6 Replacement of Equipment			0		0		0		7425
T O T A L			19719		17343		37062		26679
7 Leakage Detection	240	1338	321	0	0	1338	321		0
GRAND TOTAL			20040		17343		37383		26679

(Unit: thousand Pesos)

Bayombong-Solano	UNIT COST	1988		1989		1990		1991	
ITEM		NO	COST	NO	COST	NO	COST	NO	COST
1 SOURCE FACILITY									
(1)Sprinng Box Rehabili.	30000		0	1	30		0		0
Drain Pipe D=250	340		0	10	3		0		0
Valve D=250	11200		0	1	11		0		0
(2)RADIAL WELL	1240000		0		0		0	1	1240
WELL PUMP 22kw	358000		0		0		0	2	716
Pump House on Well	820000		0		0		0	1	820
(3)Electric Sub-station			0		0		0		0
SUB-TOTAL			0		44		0		2776
2 TRANSMISSION FACILITIES									
Main Pipe D=250 (Steel)	630		0	4300	2709		0		0
Valve D=250	11200		0	2	22		0		0
SUB-TOTAL			0		2731		0		0
3 DISTRIBUTION FACILITIES									
(1)Chlorination Facility	98100		0	1	98		0	1	98
(2)Distribution pipes		1988		1989		1990		1991	
1)Main Pipes									
D=100 (PVC Pipe)	250		0		0	1200	300		0
D=150 (PVC Pipe)	410		0	700	287		0	3300	1353
D=200 (Steel Pipe)	520		0		0		0	1155	601
D=250 (Steel Pipe)	630		0	2100	1323	1100	693	5	3
D=300 (Steel Pipe)	760		0	800	608		0		0
D=350 (Steel Pipe)	900		0		0	10	9		0
D=400 (Steel Pipe)	970		0		0	2800	2716	650	631
D=500 (Steel Pipe)	1330		0		0		0	1100	1463
D=600 (Steel Pipe)	1600		0		0		0	1000	1600
RIVER CROSSING CD=2.0m	2090		0		0		0	100	209
D=500 Materials	718		0		0		0	100	72
D=350 Materials	486		0		0		0		0
2)Valves		1988		1989		1990		1991	
D=100 (Gate Valve)	3900		0		0	1	4		0
D=150 (Gate Valve)	5300		0	2	11		0	11	58
D=200 (Gate Valve)	6700		0		0		0	5	34
D=250 (Gate Valve)	11200		0	6	67	2	22	1	11
D=300 (Butterfly Valve)	34800		0	3	104		0		0
D=350 (Butterfly Valve)	74400		0		0	1	74		0
D=400 (Butterfly Valve)	95200		0		0	1	95	1	95
D=500 (Butterfly Valve)	174000		0		0		0	2	348
D=600 (Butterfly Valve)	243600		0		0		0	1	244
Prssre Cntrl Valve 350	390000		0		0	1	390		0
3)Internal Network									
UPTO 1990	5152		0		2576		2576		
UPTO 1995	2930								586
4)Service Connections									
D=1/2	810	0	0	843	683	842	682	921	746
D=3/4	1280	5	6	2	3	2	3	2	3
5)Rehabilitation									
Water Meter 1/2''	400	1309	524	0	0	0	0		
Old Laterals			0		244		244		
Service Connect.wo/Metr	480	223	107	223	107	223	107		
6)Flow Meter									
D=250	93000		0	1	93		0		0
D=300	126000		0	1	126		0		0
D=400	215000		0		0		0	1	215
7)Fire Protection									
D=150	16800		0						
D=100	9400		0						
SUB-TOTAL			637		6330		7915		8370
4 1)Administration Bldg.									
2)Operation Center				1	1090				
SUB-TOTAL			0	1	1090		0		0
5 Land Acquisition	35.75	2225	158		0		0		0
Vehicle	300000	1	300	1	300		0	1	300
Stored Material & Equip.			12		108		94		109
SUB-TOTAL			470		408		94		409
6 Replacement of Equipment			0		0		0		0
T O T A L			1107		10603		8009		11555
7 Leakage Detection	240	446	107	446	107	446	107		0
GRAND TOTAL			1214		10710		8116		11555

(Unit: thousand Pesos)

Bayombong-Solano	UNIT COST	1992		1993		1994		1995	
ITEM		NO	COST	NO	COST	NO	COST	NO	COST
1 SOURCE FACILITY									
(1)Sprinng Box Rehabili.	30000		0		0		0		0
Drain Pipe D=250	340		0		0		0		0
Valve D=250	11200		0		0		0		0
(2)RADIAL WELL	1240000		0		0		0		0
. WELL PUMP 22kw	358000		0	1	358		0		0
Pump House on Well	820000		0		0		0		0
(3)Electric Sub-station			0		0		0		0
SUB-TOTAL			0		358		0		0
2 TRANSMISSION FACILITIES									
Main Pipe D=250 (Steel)	630		0		0		0		0
Valve D=250	11200		0		0		0		0
SUB-TOTAL			0		0		0		0
3 DISTRIBUTION FACILITIES									
(1)Chlorination Facility	98100		0		0		0		0
(2)Distribution pipes		1992		1993		1994		1995	
1)Main Pipes									
D=100 (PVC Pipe)	250		0		0		0		0
D=150 (PVC Pipe)	410		0		0		0		0
D=200 (Steel Pipe)	520		0		0		0		0
D=250 (Steel Pipe)	630		0		0		0		0
D=300 (Steel Pipe)	760		0		0		0		0
D=350 (Steel Pipe)	900		0		0		0		0
D=400 (Steel Pipe)	970		0		0		0		0
D=500 (Steel Pipe)	1330		0		0		0		0
D=600 (Steel Pipe)	1600		0		0		0		0
RIVER CROSSING CD=2.0m	2090		0		0		0		0
D=500 Materials	718		0		0		0		0
D=350 Materials	486		0		0		0		0
2)Valves		1992							
D=100 (Gate Valve)	3900		0		0		0		0
D=150 (Gate Valve)	5300		0		0		0		0
D=200 (Gate Valve)	6700		0		0		0		0
D=250 (Gate Valve)	11200		0		0		0		0
D=300 (Butterfly Valve)	34800		0		0		0		0
D=350 (Butterfly Valve)	74400		0		0		0		0
D=400 (Butterfly Valve)	95200		0		0		0		0
D=500 (Butterfly Valve)	174000		0		0		0		0
D=600 (Butterfly Valve)	243600		0		0		0		0
Prssre Cntrl Valve 350	390000		0		0		0		0
3)Internal Network									
UPTO 1990	5152								
UPTO 1995	2930		586		586		586		586
4)Service Connections									
D=1/2	810	922	747	922	747	922	747	921	746
D=3/4	1280	2	3	2	3	2	3	2	3
5)Rehabilitation									
Water Meter 1/2''	400								
Old Laterals									
Service Connect.wo/Metr	480								
6)Flow Meter									
D=250	93000		0		0		0		0
D=300	126000		0		0		0		0
D=400	215000		0		0		0		0
7)Fire Protection									
D=150	16800								
D=100	9400								
SUB-TOTAL			1336		1336		1336		1335
4 1)Administration Bldg.									
2)Operation Center									
SUB-TOTAL			0		0		0		0
5 Land Acquisition	35.75		0		0		0		0
Vehicle	300000		0		0		0		0
Stored Material & Equip.			20		27		20		20
SUB-TOTAL			20		27		20		20
6 Replacement of Equipment			0		0		0		0
T O T A L			1356		1721		1356		1355
7 Leakage Detection	240		0		0		0		0
GRAND TOTAL			1356		1721		1356		1355

APPENDIX 8.2.1.B PROJECT COST WITH FOREIGN AND LOCAL CURRENCY BREAKDOWN (1986 Price Level, Bayombong-Solano)

SUMMARY

Phase I, Stage 1

(Unit: thousand ₱)

	F.E.C	Local	Total
Direct Construction Cost	10,903	8,816	19,719
Physical Cont. (8% of D.C.C.)	873	705	1,578
Sub Total	11,776	9,521	21,297
Leakage Detection	-	321	321
Detailed Design (10% of S.T. in Stage 1 & Stage 2)	2,002	2,001	4,003
Construction Supervision (4% of S.T.)	426	426	852
Total	14,204	12,269	26,473

Phase I, Stage 2

(Unit: thousand ₱)

	F.E.C	Local	Total
Direct Construction Cost	10,540	6,803	17,343
Physical Cont. (8% of D.C.C.)	843	544	1,387
Sub Total	11,383	7,347	18,730
Construction Supervision (4% of S.T.)	231	518	749
Total	11,614	7,865	19,479

Phase II

(Unit: thousand ₱)

	F.E.C	Local	Total
Direct Construction Cost	18,376	8,308	26,684
Physical Cont. (8% of D.C.C.)	1,470	665	2,135
Sub Total	19,846	8,973	28,819
Detailed Design (10% of S.T.)	1,441	1,441	2,882
Construction Supervision (4% of S.T.)	1,153	-	1,153
Total	22,440	10,414	32,854

The following tables show the breakdown of the project cost in each design year. The unit of all figures is thousand pesos. Project cost is further broken down into the Foreign Exchange Compornent and the Local Currency Compornent. Abbreviations in the tables are as follows:

COST	---	Construction Cost
C.FEC	---	Cost for Civil Work in the Foreign Exchange Compornent
C.DOM	---	Cost for Civil Work in the Local Currency Compornent
C.D.UNSKL	---	Cost for Unskilled Laborer of Civil Works in the Local Currency Compornent.
E.FEC	---	Cost for Equipments in the Foreign Exchange Compornent
E.DOM	---	Cost for Equipments in the Local Currency Compornent

COST = C.FEC + C.DOM + E.FEC + E.DOM

The exchange rates used in the cost estimates are as follows:

₱20 = $1

$1 = ¥155

BAYOMBONG-SOLANO	1988						1989						1990					
No. ITEM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1.0 SOURCE FACILITY																		
(1)SPRING INTAKE BOX																		
1)Intake Box Rehabilitati	0.0	0.0	0.0	0.0	0.0	0.0	30.0	12.0	18.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Drain Pipe D=250	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	1.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0
3)Valve D=250	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.2	2.3	0.7	7.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)RADIAL WELL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)PUMPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4)PUMP HOUSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	44.0	12.2	20.3	5.2	9.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	0.0	0.0	0.0	0.0	0.0	0.0	2709.0	487.6	758.5	108.4	839.8	623.1	0.0	0.0	0.0	0.0	0.0	0.0
(2)Valves	0.0	0.0	0.0	0.0	0.0	0.0	22.0	0.4	4.6	1.3	15.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	2731.0	488.0	763.1	109.7	854.8	625.1	0.0	0.0	0.0	0.0	0.0	0.0
3.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)Pump Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)Chlorination Facility	0.0	0.0	0.0	0.0	0.0	0.0	98.0	4.9	33.3	2.9	45.1	14.7	0.0	0.0	0.0	0.0	0.0	0.0
(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5)Distribution pipes																		
1)Main Pipes	0.0	0.0	0.0	0.0	0.0	0.0	2218.0	399.2	621.0	88.7	687.7	510.1	3718.0	669.2	1041.0	148.7	1152.6	855.1
2)River Crossing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)River Crossing Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Valves	0.0	0.0	0.0	0.0	0.0	0.0	182.0	3.6	38.2	10.9	123.8	16.4	195.0	3.9	41.0	11.7	132.6	17.6
5)Pressure Control Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	390.0	0.0	0.0	0.0	390.0	0.0
5)Internal Network	0.0	0.0	0.0	0.0	0.0	0.0	2576.0	412.2	721.3	103.0	875.8	566.7	2576.0	412.2	721.3	103.0	875.8	566.7
6)Service Connections	6.0	0.1	0.6	0.2	5.1	0.2	686.0	6.9	68.6	20.6	583.1	27.4	685.0	6.9	68.5	20.6	582.2	27.4
7)Water Meter	524.0	0.0	0.0	0.0	524.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Srvc Concln Rhbltn wo/M	107.0	2.7	27.8	6.4	66.9	9.6	107.0	2.7	27.8	6.4	66.9	9.6	107.0	2.7	27.8	6.4	66.9	9.6
9)Lateral Rehabilitation	0.0	0.0	0.0	0.0	0.0	0.0	244.0	39.0	68.3	9.8	83.0	53.7	244.0	39.0	68.3	9.8	83.0	53.7
10)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	219.0	0.0	0.0	0.0	219.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11)Fire Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	637.0	2.8	28.4	6.6	596.0	9.8	6330.0	868.5	1578.5	242.3	2684.4	1198.6	7915.0	1133.9	1967.9	300.2	3283.1	1530.1
4.0 1)Administration Bldg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	1090.0	98.1	446.9	54.5	392.4	152.6	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	1090.0	98.1	446.9	54.5	392.4	152.6	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	637.0	2.8	28.4	6.6	596.0	9.8	10195.0	1466.8	2808.8	411.7	3940.8	1978.6	7915.0	1133.9	1967.9	300.2	3283.1	1530.1
5.0 Land Acquisition	158.0		158.0				0.0		0.0				0.0		0.0			
Vehicle	300.0				150.0	150.0	300.0				150.0	150.0	0.0				0.0	0.0
Stored Material & Equip.	12.0				10.1	1.9	108.0				90.7	17.3	94.0				79.0	15.0
SUB-TOTAL	470.0	0.0	158.0		160.1	151.9	408.0	0.0	0.0		240.7	167.3	94.0	0.0	0.0		79.0	15.0
6.0 Replacement of Equip.																		
1)PUMPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Chlorinator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6)Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7)Stored Material & Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0 Leak Detection	107.0		107.0				107.0		107.0				107.0		107.0			
GRAND TOTAL	1214.0	2.8	293.4	6.6	756.1	161.7	10710.0	1466.8	2915.8	411.7	4181.5	2145.9	8116.0	1133.9	2074.9	300.2	3362.1	1545.1

BAYOMBONG-SOLANO	1988						1989						1990					
No. ITEM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1 Spring Facilities	0.0	0.0	0.0	0.0	0.0	0.0	44.0	12.2	20.3	5.2	9.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0
2 Radial Well Facilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Transmission Facilities	0.0	0.0	0.0	0.0	0.0	0.0	2731.0	488.0	763.1	109.7	854.8	625.1	0.0	0.0	0.0	0.0	0.0	0.0
5 Disinfection Facilities	0.0	0.0	0.0	0.0	0.0	0.0	98.0	4.9	33.3	2.9	45.1	14.7	0.0	0.0	0.0	0.0	0.0	0.0
6 Distribution Faciulities	0.0	0.0	0.0	0.0	0.0	0.0	5439.0	854.0	1448.8	212.4	1989.3	1146.9	7123.0	1124.3	1871.6	273.2	2634.0	1493.1
7 Service Connection	637.0	2.8	28.4	6.6	596.0	9.8	793.0	9.6	96.4	27.0	650.0	37.0	792.0	9.6	96.3	27.0	649.1	37.0
8 Land Acquisition	158.0	0.0	158.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9 Admin.Bldg. & Ope.Ctr.	0.0	0.0	0.0	0.0	0.0	0.0	1090.0	98.1	446.9	54.5	392.4	152.6	0.0	0.0	0.0	0.0	0.0	0.0
10 Vehicle & Stored Material	312.0	0.0	0.0	0.0	160.1	151.9	408.0	0.0	0.0	0.0	240.7	167.3	94.0	0.0	0.0	0.0	79.0	15.0
11 Replacement of Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB TOTAL	1107.0	2.8	186.4	6.6	756.1	161.7	10603.0	1466.8	2808.8	411.7	4181.5	2145.9	8009.0	1133.9	1967.9	300.2	3362.1	1545.1
12 Leak Detection	107.0		107.0				107.0		107.0				107.0		107.0			
TOTAL	1211.0	2.8	293.4	6.6	756.1	161.7	10710.0	1466.8	2915.8	411.7	4181.5	2145.9	8116.0	1133.9	2074.9	300.2	3362.1	1545.1

BAYONBONG-SOLANO	Phase I (Stage 1)						1991						1992					
No. ITEM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1.0 SOURCE FACILITY																		
(1)SPRING INTAKE BOX																		
1)Intake Box Rehabilitati	30.0	12.0	18.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Drain Pipe D=250	3.0	0.0	0.0	0.0	1.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)Valve D=250	11.0	0.2	2.3	0.7	7.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)RADIAL WELL	0.0	0.0	0.0	0.0	0.0	0.0	1210.0	632.4	359.6	24.8	235.6	12.4	0.0	0.0	0.0	0.0	0.0	0.0
(3)PUMPS	0.0	0.0	0.0	0.0	0.0	0.0	716.0	0.0	0.0	0.0	601.4	114.6	0.0	0.0	0.0	0.0	0.0	0.0
(4)PUMP HOUSE	0.0	0.0	0.0	0.0	0.0	0.0	820.0	49.2	770.8	147.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	44.0	12.2	20.3	5.2	9.2	2.3	2776.0	681.6	1130.4	172.4	837.0	127.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	2709.0	487.6	758.5	108.4	839.8	623.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)Valves	22.0	0.4	4.6	1.3	15.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	2731.0	488.0	763.1	109.7	854.8	625.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)Pump Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)Chlorination Facility	98.0	4.9	33.3	2.9	45.1	14.7	98.0	4.9	33.3	2.9	45.1	14.7	0.0	0.0	0.0	0.0	0.0	0.0
(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5)Distribution pipes																		
1)Main Pipes	5936.0	1068.4	1662.0	237.4	1840.3	1365.2	5651.0	1017.2	1582.3	226.0	1751.8	1299.7	0.0	0.0	0.0	0.0	0.0	0.0
2)River Crossing	0.0	0.0	0.0	0.0	0.0	0.0	209.0	89.9	119.1	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)River Crossing Material	0.0	0.0	0.0	0.0	0.0	0.0	72.0	0.0	0.0	0.0	41.0	31.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Valves	377.0	7.5	79.2	22.6	256.4	34.0	790.0	15.8	165.9	47.4	537.2	71.1	0.0	0.0	0.0	0.0	0.0	0.0
5)Pressure Control Valve	390.0	0.0	0.0	0.0	390.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Internal Network	5152.0	824.4	1442.6	206.0	1751.6	1133.4	586.0	93.8	164.1	23.4	199.2	128.9	586.0	93.8	164.1	23.4	199.2	128.9
6)Service Connections	1377.0	13.9	137.7	41.4	1170.4	55.0	749.0	7.5	74.9	22.5	636.6	30.0	750.0	7.5	75.0	22.5	637.5	30.0
7)Water Meter	524.0	0.0	0.0	0.0	524.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Srvc Cnnctn Rhbltn wo/M	321.0	8.1	83.4	19.2	200.7	28.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9)Lateral Rehabilitation	468.0	78.0	136.6	19.6	166.0	107.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10)Flow Meter	219.0	0.0	0.0	0.0	219.0	0.0	215.0	0.0	0.0	0.0	215.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11)Fire Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	14882.0	2005.2	3574.8	549.1	6563.5	2738.5	8370.0	1229.1	2139.6	338.9	3425.9	1575.4	1336.0	101.3	239.1	45.9	836.7	158.9
4.0 1)Administration Bldg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Operation Center	1090.0	98.1	446.9	54.5	392.4	152.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	1090.0	98.1	446.9	54.5	392.4	152.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	18747.0	2603.5	4805.1	718.5	7819.9	3518.5	11146.0	1910.7	3270.0	511.3	4262.9	1702.4	1336.0	101.3	239.1	45.9	836.7	158.9
5.0 Land Acquisition	158.0	0.0	158.0	0.0	0.0	0.0	0.0		0.0				0.0		0.0			
Vehicle	600.0	0.0	0.0	0.0	300.0	300.0	300.0				150.0	150.0	0.0				0.0	0.0
Stored Material & Equip.	214.0	0.0	0.0	0.0	179.8	34.2	109.0				91.6	17.4	20.0				16.8	3.2
SUB-TOTAL	972.0	0.0	158.0	0.0	479.8	334.2	409.0	0.0	0.0		241.6	167.4	20.0	0.0	0.0		16.8	3.2
6.0 Replacement of Equip.																		
1)PUMPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Chlorinator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6)Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7)Stored Material & Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0 Leak Detection	321.0	0.0	321.0	0.0	0.0	0.0			0.0									
GRAND TOTAL	20040.0	2603.5	5284.1	718.5	8299.7	3852.7	11555.0	1910.7	3270.0	511.3	4504.5	1869.8	1356.0	101.3	239.1	45.9	853.5	162.1

BAYONBONG-SOLANO	Phase I (Stage 1)						1991						1992					
No. ITEM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1 Spring Facilities	44.0	12.2	20.3	5.2	9.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 Radial Well Facilities	0.0	0.0	0.0	0.0	0.0	0.0	2776.0	681.6	1130.4	172.4	837.0	127.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Transmission Facilities	2731.0	488.0	763.1	109.7	854.8	625.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Disinfection Facilities	98.0	4.9	33.3	2.9	45.1	14.7	98.0	4.9	33.3	2.9	45.1	14.7	0.0	0.0	0.0	0.0	0.0	0.0
6 Distribution Faciulities	12562.0	1978.3	3320.4	485.6	4623.3	2640.0	7523.0	1216.7	2031.4	313.5	2744.2	1530.7	586.0	93.8	164.1	23.4	199.2	128.9
7 Service Connection	2222.0	22.0	221.1	60.6	1895.1	83.8	749.0	7.5	74.9	22.5	636.6	30.0	750.0	7.5	75.0	22.5	637.5	30.0
8 Land Acquisition	158.0	0.0	158.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9 Admin.Bldg. & Ope.Ctr.	1090.0	98.1	446.9	54.5	392.4	152.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 Vehicle & Stored Material	814.0	0.0	0.0	0.0	479.8	334.2	409.0	0.0	0.0	0.0	241.6	167.4	20.0	0.0	0.0	0.0	16.8	3.2
11 Replacement of Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB TOTAL	19719.0	2603.5	4963.1	718.5	8299.7	3852.7	11555.0	1910.7	3270.0	511.3	4504.5	1869.8	1356.0	101.3	239.1	45.9	853.5	162.1
12 Leak Detection	321.0	0.0	321.0	0.0	0.0	0.0	0.0		0.0				0.0		0.0			
TOTAL	20040.0	2603.5	5284.1	718.5	8299.7	3852.7	11555.0	1910.7	3270.0	511.3	4504.5	1869.8	1356.0	101.3	239.1	45.9	853.5	162.1

BAYOMBONG-SOLANO	1993						1994						1995					
No. ITEM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1.0 SOURCE FACILITY																		
(1)SPRING INTAKE BOX																		
1)Intake Box Rehabilitati	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Drain Pipe D=250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)Valve D=250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)RADIAL WELL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)PUMPS	358.0	0.0	0.0	0.0	300.7	57.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4)PUMP HOUSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	358.0	0.0	0.0	0.0	300.7	57.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)Valves	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)Pump Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)Chlorination Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5)Distribution pipes																		
1)Main Pipes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)River Crossing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)River Crossing Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Valves	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Pressure Control Valve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Internal Network	586.0	93.8	164.1	23.4	199.2	128.9	586.0	93.8	164.1	23.4	199.2	128.9	586.0	93.8	164.1	23.4	199.2	128.9
6)Service Connections	750.0	7.5	75.0	22.5	637.5	30.0	750.0	7.5	75.0	22.5	637.5	30.0	749.0	7.5	74.9	22.5	636.6	30.0
7)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Srvc Concln Rhblta wo/M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9)Lateral Rehabilitation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11)Fire Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	1336.0	101.3	239.1	45.9	836.7	158.9	1336.0	101.3	239.1	45.9	836.7	158.9	1335.0	101.3	239.0	45.9	835.8	158.9
4.0 1)Administration Bldg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1694.0	101.3	239.1	45.9	1137.4	216.2	1336.0	101.3	239.1	45.9	836.7	158.9	1335.0	101.3	239.0	45.9	835.8	158.9
5.0 Land Acquisition	0.0		0.0				0.0		0.0				0.0		0.0			
Vehicle	0.0				0.0	0.0	0.0				0.0	0.0	0.0				0.0	0.0
Stored Material & Equip.	27.0				22.7	4.3	20.0				16.8	3.2	20.0				16.8	3.2
SUB-TOTAL	27.0	0.0	0.0		22.7	4.3	20.0	0.0	0.0		16.8	3.2	20.0	0.0	0.0		16.8	3.2
6.0 Replacement of Equip.																		
1)PUMPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Chlorinator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6)Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7)Stored Material & Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0 Leak Detection																		
GRAND TOTAL	1721.0	101.3	239.1	45.9	1160.1	220.5	1356.0	101.3	239.1	45.9	853.5	162.1	1355.0	101.3	239.0	45.9	852.6	162.1

BAYOMBONG-SOLANO	1993						1994						1995					
No. ITEM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1 Spring Facilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 Radial Well Facilities	358.0	0.0	0.0	0.0	300.7	57.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Transmission Facilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Disinfection Facilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 Distribution Faciulities	586.0	93.8	164.1	23.4	199.2	128.9	586.0	93.8	164.1	23.4	199.2	128.9	586.0	93.8	164.1	23.4	199.2	128.9
7 Service Connection	750.0	7.5	75.0	22.5	637.5	30.0	750.0	7.5	75.0	22.5	637.5	30.0	749.0	7.5	74.9	22.5	636.6	30.0
8 Land Acquisition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9 Admin-Bldg. & Ope.Ctr.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 Vehicle & Stored Material	27.0	0.0	0.0	0.0	22.7	4.3	20.0	0.0	0.0	0.0	16.8	3.2	20.0	0.0	0.0	0.0	16.8	3.2
11 Replacement of Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB TOTAL	1721.0	101.3	239.1	45.9	1160.1	220.5	1356.0	101.3	239.1	45.9	853.5	162.1	1355.0	101.3	239.0	45.9	852.6	162.1
12 Leak Detection	0.0		0.0				0.0		0.0				0.0		0.0			
TOTAL	1721.0	101.3	239.1	45.9	1160.1	220.5	1356.0	101.3	239.1	45.9	853.5	162.1	1355.0	101.3	239.0	45.9	852.6	162.1

BAYOMBONG-SOLANO	Phase I (Stage 2)						Phase I Total						Phase II					
No. ITEM	COST	C.FEC	C.DOM	C.D.UNSKU	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKU	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKU	E.FEC	E.DOM
1.0 SOURCE FACILITY																		
(1)SPRING INTAKE BOX																		
1)Intake Box Rehabilitati	0.0	0.0	0.0	0.0	0.0	0.0	30.0	12.0	18.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Drain Pipe D=250	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	1.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0
3)Valve D=250	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.2	2.3	0.7	7.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)RADIAL WELL	1240.0	632.4	359.6	24.8	235.6	12.4	1240.0	632.4	359.6	24.8	235.6	12.4	1240.0	632.4	359.6	24.8	235.6	12.4
(3)PUMPS	1074.0	0.0	0.0	0.0	902.1	171.9	1074.0	0.0	0.0	0.0	902.1	171.9	1074.0	0.0	0.0	0.0	902.2	171.8
(4)PUMP HOUSE	820.0	49.2	770.8	147.6	0.0	0.0	820.0	49.2	770.8	147.6	0.0	0.0	820.0	49.2	770.8	147.6	0.0	0.0
SUB-TOTAL	3134.0	681.6	1130.4	172.4	1137.7	184.3	3178.0	693.8	1150.7	177.6	1146.9	186.6	3134.0	681.6	1130.4	172.4	1137.8	184.2
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	0.0	0.0	0.0	0.0	0.0	0.0	2709.0	487.6	758.5	108.4	839.8	623.1	0.0	0.0	0.0	0.0	0.0	0.0
(2)Valves	0.0	0.0	0.0	0.0	0.0	0.0	22.0	0.4	4.6	1.3	15.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	2731.0	488.0	763.1	109.7	854.8	625.1	0.0	0.0	0.0	0.0	0.0	0.0
3.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)Pump Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)Chlorination Facility	98.0	4.9	33.3	2.9	45.1	14.7	196.0	9.8	66.6	5.8	90.2	29.4	0.0	0.0	0.0	0.0	0.0	0.0
(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2580.0	399.9	567.6	51.6	1354.5	258.0
(5)Distribution pipes																		
1)Main Pipes	5651.0	1017.2	1582.3	226.0	1751.8	1299.7	11587.0	2085.6	3244.3	463.4	3592.1	2664.0	2005.0	360.9	561.4	80.2	621.5	461.2
2)River Crossing	209.0	89.9	119.1	16.7	0.0	0.0	209.0	89.9	119.1	16.7	0.0	0.0	209.0	89.9	119.1	16.7	0.0	0.0
3)River Crossing Material	72.0	0.0	0.0	0.0	41.0	31.0	72.0	0.0	0.0	0.0	41.0	31.0	49.0	0.0	0.0	0.0	27.9	21.1
4)Valves	790.0	15.8	165.9	47.4	537.2	71.1	1167.0	23.3	245.1	70.0	793.6	105.1	182.0	3.6	38.2	10.9	123.8	16.4
5)Pressure Control Valve	0.0	0.0	0.0	0.0	0.0	0.0	390.0	0.0	0.0	0.0	390.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Internal Network	2930.0	469.0	820.5	117.0	996.0	644.5	8082.0	1293.1	2263.1	323.0	2747.6	1777.9	1762.0	281.9	493.4	70.5	599.1	387.6
6)Service Connections	3748.0	37.5	374.8	112.5	3185.7	150.0	5125.0	51.4	512.5	153.9	4356.1	205.0	5518.0	55.2	551.8	165.5	4690.3	220.7
7)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	524.0	0.0	0.0	0.0	524.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Srvc Concln Rhbltn wo/M	0.0	0.0	0.0	0.0	0.0	0.0	321.0	8.1	83.4	19.2	200.7	28.8	0.0	0.0	0.0	0.0	0.0	0.0
9)Lateral Rehabilitation	0.0	0.0	0.0	0.0	0.0	0.0	488.0	78.0	136.6	19.6	166.0	107.4	0.0	0.0	0.0	0.0	0.0	0.0
10)Flow Meter	215.0	0.0	0.0	0.0	215.0	0.0	434.0	0.0	0.0	0.0	434.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11)Fire Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1995.0	39.9	558.6	199.5	1236.9	159.6
SUB-TOTAL	13713.0	1634.3	3095.9	522.5	6771.8	2211.0	28595.0	3639.5	6670.7	1071.6	13335.3	4949.5	14300.0	1231.3	2890.1	594.9	8654.0	1524.6
4.0 1)Administration Bldg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1320.0	132.0	712.8	66.0	211.2	264.0
2)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	1090.0	98.1	446.9	54.5	392.4	152.6	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	1090.0	98.1	446.9	54.5	392.4	152.6	1320.0	132.0	712.8	66.0	211.2	264.0
TOTAL	16847.0	2315.9	4226.3	694.9	7909.5	2395.3	35594.0	4919.4	9031.4	1413.4	15729.4	5913.8	18754.0	2044.9	4733.3	833.3	10003.0	1972.8
5.0 Land Acquisition	0.0	0.0	0.0	0.0	0.0	0.0	158.0	0.0	158.0	0.0	0.0	0.0	0.0		0.0			
Vehicle	300.0	0.0	0.0	0.0	150.0	150.0	900.0	0.0	0.0	0.0	450.0	450.0	300.0				150.0	150.0
Stored Material & Equip.	196.0	0.0	0.0	0.0	164.7	31.3	410.0	0.0	0.0	0.0	344.5	65.5	205.0				172.2	32.8
SUB-TOTAL	496.0	0.0	0.0	0.0	314.7	181.3	1468.0	0.0	158.0	0.0	794.5	515.5	505.0	0.0	0.0		322.2	182.8
6.0 Replacement of Equip.																		
1)PUMPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1074.0	0.0	0.0	0.0	902.2	171.8
2)Chlorinator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120.0	0.0	0.0	0.0	90.0	30.0
3)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	434.0	0.0	0.0	0.0	434.0	0.0
4)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3058.0	0.0	0.0	0.0	3058.0	0.0
5)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	545.0	0.0	0.0	0.0	392.4	152.6
6)Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2100.0	0.0	0.0	0.0	1050.0	1050.0
7)Stored Material & Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.0	0.0	0.0	0.0	79.0	15.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7425.0	0.0	0.0	0.0	6005.6	1419.4
7.0 Leak Detection	0.0	0.0	0.0	0.0	0.0	0.0	321.0	0.0	321.0	0.0	0.0	0.0	0.0					
GRAND TOTAL	17343.0	2315.9	4226.3	694.9	8224.2	2576.6	37383.0	4919.4	9510.4	1413.4	16523.9	6429.3	26684.0	2044.9	4733.3	833.3	16330.8	3575.0

BAYOMBONG-SOLANO	Phase I (Stage 2)						Phase I Total						Phase II					
No. ITEM	COST	C.FEC	C.DOM	C.D.UNSKU	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKU	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKU	E.FEC	E.DOM
1 Spring Facilities	0.0	0.0	0.0	0.0	0.0	0.0	44.0	12.2	20.3	5.2	9.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0
2 Radial Well Facilities	3134.0	681.6	1130.4	172.4	1137.7	184.3	3134.0	681.6	1130.4	172.4	1137.7	184.3	3134.0	681.6	1130.4	172.4	1137.8	184.2
3 Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2580.0	399.9	567.6	51.6	1354.5	258.0
4 Transmission Facilities	0.0	0.0	0.0	0.0	0.0	0.0	2731.0	488.0	763.1	109.7	854.8	625.1	0.0	0.0	0.0	0.0	0.0	0.0
5 Disinfection Facilities	98.0	4.9	33.3	2.9	45.1	14.7	196.0	9.8	66.6	5.8	90.2	29.4	0.0	0.0	0.0	0.0	0.0	0.0
6 Distribution Faciulities	9867.0	1591.9	2087.8	407.1	3541.0	2046.3	22429.0	3570.2	6008.2	892.7	8164.3	4686.3	6202.0	776.2	1770.7	377.8	2609.2	1045.9
7 Service Connection	3748.0	37.5	374.8	112.5	3185.7	150.0	5970.0	59.5	595.9	173.1	5080.8	233.8	5518.0	55.2	551.8	165.5	4690.3	220.7
8 Land Acquisition	0.0	0.0	0.0	0.0	0.0	0.0	158.0	0.0	158.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9 Admin.Bldg. & Ope.Ctr.	0.0	0.0	0.0	0.0	0.0	0.0	1090.0	98.1	446.9	54.5	392.4	152.6	1320.0	132.0	712.8	66.0	211.2	264.0
10 Vehicle & Stored Material	496.0	0.0	0.0	0.0	314.7	181.3	1310.0	0.0	0.0	0.0	794.5	515.5	505.0	0.0	0.0	0.0	322.2	182.8
11 Replacement of Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7425.0	0.0	0.0	0.0	6005.6	1419.4
SUB TOTAL	17343.0	2315.9	4226.3	694.9	8224.2	2576.6	37062.0	4919.4	9180.4	1413.4	16523.9	6429.3	26684.0	2044.9	4733.3	833.3	16330.8	3575.0
12 Leak Detection	0.0	0.0	0.0	0.0	0.0	0.0	321.0	0.0	321.0	0.0	0.0	0.0						
TOTAL	17343.0	2315.9	4226.3	694.9	8224.2	2576.6	37383.0	4919.4	9510.4	1413.4	16523.9	6429.3	26684.0	2044.9	4733.3	833.3	16330.8	3575.0

APPENDIX 8.2.1.C OPERATION AND MAINTENANCE COST (Bayombong-Solano)

(cost; thousand peso)

Item		Stage 1	Stage 2	Phase II
		Cost	Cost	Cost
Operation & Maintenance Cost				
Salary	920 ₱/M.M	475	541	640
Power	2.11 ₱/kwH	0	63	409
Chemical	31 ₱/kg	35	81	154
Miscellaneous		355	794	1,441
Maintenance		242	594	1,112
Total		1,107	2,073	3,756

APPENDIX 9.3.1 MARKET SURVEY

The market survey was conducted by interviews to the residents in the study area using the LWUA's interview sheet as per attached in the end of this section.

The total number of respondents and its estimated coverage ratio to the total number of households in the study area are as follows:

Total Number of Respondents	Estimated Total Household	Coverage Ratio to Total Household
5,808	14,276	41 %

The results of the market survey are obtained as shown in TABLEs 9.3.1.1 and 9.3.1.2.

From the market survey, the income distribution of the respondents is shown as follows:

Income Bracket1/	Bayombong		Solano		Total	
	Ave. Pesos	Number	Ave. Pesos	Number	Ave. Pesos	Number
₱900 and below	618	802	637	927	628	1,729
₱901 to ₱1500	1,233	737	1,215	899	1,223	1,636
₱1,501 to ₱2,500	2,040	396	2,089	445	2,066	841
₱2,501 to ₱4,500	3,339	321	3,363	319	3,351	640
₱4,501 and above	7,108	133	6,834	151	6,962	284

The existing sources of water of the respondents and their willingness to connect to each source of water are :

1/ Residential, excluding no-income and no-answer

TABLE 9.3.1.1 MARKET SURVEY SUMMARY (Bayombong)

Total Number of Respondents: 2625

1. Distribution According to Building Type

		No.	%
a.	Residential	2429	92.53
b.	Commercial	196	7.47
c.	Industrial	0	0.00

2. Distribution According to Source of Water

		No.	%
a.	Connected to System	577	21.98
b.	Neighbor's Connection	37	1.41
c.	Public Faucet	10	0.38
d.	Private System	1998	76.11
e.	Water Vendor	0	0.00
f.	Others	3	0.11

3. Average Persons Per Household

a.	Residential / Number of Sample	5.85	/	2424
b.	Commercial / Number of Sample	11.50	/	188
c.	Industrial / Number of Sample	0.00	/	0

4. Willingness To Connect (%)

		Residential	Commercial	Industrial	Total
a.	Yes	57.27	51.53	0.00	56.84
b.	No	18.77	9.18	0.00	18.06
c.	Undecided	3.17	2.55	0.00	3.12
d.	W/ Own Conn.	20.79	36.73	0.00	21.98

5. Average Monthly Water Needs

	Type / Number of Sample		Residential	Commercial	Industrial
a.	Kerosene Can /	2126	37.38	65.67	0.00
b.	Drum /	202	4.92	6.82	0.00
c.	Gallon /	42	16.00	132.50	0.00
d.	Others /	197	46.85	18.33	0.00

6. Ave. Monthly Electric Bills for Residential Users (PESO): 72.31
   Number of Effective Respondents : 1953

7. Income Distribution
   (Residential, Excluding No-Income and No-Answer)

		AVE.PESO	NUMBER
a.	P900 and Below	618	802
b.	P901 to P1500	1233	737
c.	P1501 to P2500	2040	396
d.	P2501 to P4500	3339	321
e.	P4501 and Above	7108	133

TABLE 9.3.1.2 MARKET SURVEY SUMMARY
(Solano)

Total Number of Respondents: 3183

1. Distribution According to Building Type

		No.	%
a. Residential	:	2827	88.82
b. Commercial	:	345	10.84
c. Industrial	:	11	0.35

2. Distribution According to Source of Water

		No.	%
a. Connected to System	:	409	12.85
b. Neighbor's Connection	:	44	1.38
c. Public Faucet	:	9	0.28
d. Private System	:	2636	82.81
e. Water Vendor	:	1	0.03
f. Others	:	84	2.64

3. Average Persons Per Household

a. Residential / Number of Sample	:	5.57	/	2823
b. Commercial / Number of Sample	:	5.54	/	337
c. Industrial / Number of Sample	:	10.60	/	10

4. Willingness To Connect (%)

		Residential	Commercial	Industrial	Total
a. Yes	:	49.17	56.23	27.27	49.86
b. No	:	34.21	18.26	0.00	32.36
c. Undecided	:	5.16	2.90	9.09	4.93
d. W/ Own Conn.	:	11.46	22.61	63.64	12.85

5. Average Monthly Water Needs

Type / Number of Sample			:	Residential	Commercial	Industrial
a. Kerosene Can	/	2824	:	37.05	43.61	57.22
b. Drum	/	225	:	4.76	6.98	2.00
c. Gallon	/	54	:	253.15	253.33	5.00
d. Others	/	17	:	9.21	3.00	0.00

6. Ave. Monthly Electric Bills for Residential Users (PESO): 69.09
Number of Effective Respondents : 2322

7. Income Distribution
(Residential, Excluding No-Income and No-Answer)

		AVE.PESO	NUMBER
a. P900 and Below	:	637	927
b. P901 to P1500	:	1215	899
c. P1501 to P2500	:	2089	445
d. P2501 to P4500	:	3363	319
e. P4501 and Above	:	6834	151

Sources of Water	Distribution	Willingness to Connect	
		Yes	No
(1) Bayombong			
Connected to System	22	-	-
Private System	76	73	23
(2) Solano			
Connected to System	13	-	-
Private System	82	56	38
(3) Total			
Connected to System	17	-	-
Private System	80	63	31

The private system is the major source of water for the respondents. Only 1% of the respondents depend on neighbor's connection, public faucet, water vendors and others for water sources. From the above table, it is observed that the majority of the respondents are willing to connect to the waterworks system.

The following are the distribution of water sources and the respondent's willingness to connect according to income bracket also obtained from the market survey.

TABLE 9.3.1.3 DISTRIBUTION OF WILLINGNESS TO CONNECT BY INCOME BRACKET

Sources of Water	Income Bracket				
	₱900 & below	₱901-P1,500	₱1,501-P2,500	₱2,501-P4,500	₱4,501- & above
(1) Bayombong					
Connected to System	11 %	20 %	28 %	34 %	36 %
Private System	86	78	71	64	64
Willingness to Connect					
Yes	56	58	61	55	53
No	30	18	9	8	7
Undecided					
With Own Connection					
(2) Solano					
Connected to System	6	10	14	22	30
Private System	88	87	83	73	66
Willingness to Connect					
Yes	43	51	58	57	50
No	46	34	24	17	15
Undecided	5	5	5	4	5
With Own Connection	6	10	13	22	30

From the above, it is observed that low income group mainly depends on private system while the high income group is gradually depending more on the existing system for water.

As the result of the market survey, the respondent's willingness to connect is summarized shown as follows :

Answer	Bayombong	Solano
Yes	57 %	50 %
No	18	32
Undecided	3	5
With own connection	22	13

Note : With respect to type of users, residential users account for 93% in Bayombong and 89% in Solano, respectively.

It is observed from the results of the survey that the over the half of respondents from all income brackets are willing to connect to the waterworks system.

Judging from the above, it seems that the majority of the residents are willing to connect to the new system when the expansion of the water supply system is completed in Bayombong-Solano.

INTERVIEW SHEET FORMAT USED IN THE MARKET SURVEY

BLOCK NO. _____ CITY/MUNICIPALITY _____ BARANGAY _____ ZONE _____ STREET _____

Stop No.	Building Type			User Code 1/	PPH	Willing to Connect		Ave. Water Needs 2/	Ave. Electric Bill	Average Monthly Family Income					Bldg. Cond. Code 3/	Respondent
	Res	Com	Ind			YES	NO			₱900 and Below	₱901 to ₱1,500	₱1,501 to ₱2,500	₱2,501 to ₱4,500	₱4,501 and Above		

1/ USER CODE
- C - Connected to System
- NC - Neighbor's Connection
- PF - Public Faucet
- PS - Private System (Elec./Hand Pump)
- V - Water Vendor
- O - Others, specify

2/ Consumption Code
- KC - Kero-Can or Gray Container
- D - Drum
- G - Gallon
- O - Others

3/ Building Condition Code
- A - Very Good
- B - Good
- C - Fair
- D - Poor

I certify that the above information are true and correct.

_____
Interviewer

APPENDIX 9.7.1 FINANCIAL INTERNAL RATE OF RETURN (FIRR)

In the calculation of Financial Internal Rate of Return (FIRR), the following two indicators are normally used to evaluate financial profitability of a project.

(1) Internal Rate of Return on Investment (IRROI)

The term IRROI indicates the internal rate of return on total capital investment, and assesses the profitability of the Project as a whole and the ability to recover funds invested in the Project.

The IRROI is calculated based on the assumption that the total capital investment is covered by its own capital. Therefore, the financial conditions such as the loan conditions on borrowed capital, changes on the ratio of equity to total capital requirement and others have no effect on the IRROI. Accordingly, the IRROI indicates the profitability of the Project itself.

(2) Internal Rate of Return on Equity (IRROE)

The term IRROE indicates the internal rate of return on equity, and assesses the profitability only with respect to equity and the ability to recover funds invested in the Project as equity. Here, the IRROE is calculated on the basis of such financial conditions proper to the Project as the loan conditions on borrowed capital and amount of capital owned.

In this study, the FIRR was calculated using the same method applied in the study report of the BACOLOD CITY WATER DISTRICT PHASE II WATER SUPPLY FEASIBILITY STUDY, DRAFT REPORT VOLUME 3 by LWUA.

APPENDIX 9.8.1 FINANCIAL RECOMMENDATION

The proposed water rates of 1/2 inch connections for commercial users, and 3/4 inch connections for domestic and commercial users to achieve financial self-sufficiency are as follows :

(1) Water rate for 1/2 inch connections of commercial users

Period	Rate/ Unit	First 10cu.m	11-20cu.m	21-35cu.m	Above 35cu.m
1988	₱1.0	₱ 50.0	₱ 6.6	₱ 9.0	₱12.0
1989	1.5	75.0	9.8	13.6	18.0
1990	2.0	100.0	13.0	18.0	24.0
1991	2.4	120.0	15.6	21.6	28.8
1992	2.6	130.0	17.0	23.4	31.2
1993	3.2	160.0	20.8	28.8	38.4
1994	3.4	170.0	22.2	30.6	40.8
1995	3.4	170.0	22.2	30.6	40.8
1996	4.2	210.0	27.4	37.8	50.4
1997	4.8	240.0	31.2	43.2	57.6

(2) Water rate for 3/4 inch connection of domestic users

Period	Rate/ Unit	First 10cu.m	11-20cu.m	21-35cu.m	Above 35cu.m
1988	₱1.0	₱ 40.0	₱ 5.3	₱ 7.2	₱ 9.6
1989	1.5	60.0	7.8	10.9	14.4
1990	2.0	80.0	10.4	14.4	19.2
1991	2.4	96.0	12.5	17.3	23.0
1992	2.6	104.0	13.6	18.7	25.0
1993	3.2	128.0	16.6	23.0	30.7
1994	3.4	136.0	17.8	24.5	32.6
1995	3.4	136.0	17.8	24.5	32.6
1996	4.2	168.0	21.9	30.2	40.3
1997	4.8	192.0	25.0	34.6	46.1

(3) Water rate for 3/4 inch connection of commercial users

Period	Rate/ Unit	First 10cu.m	11-20cu.m	21-35cu.m	Above 35cu.m
1988	₱1.0	₱80.0	₱10.6	₱14.4	₱19.2
1989	1.5	120.0	15.6	21.8	28.8
1990	2.0	160.0	20.8	28.8	38.4
1991	2.4	192.0	25.0	34.6	46.0
1992	2.6	208.0	27.2	37.4	50.0
1993	3.2	256.0	33.2	46.0	61.4
1994	3.4	272.0	35.6	49.0	65.2
1995	3.4	272.0	35.6	49.0	65.2
1996	4.2	336.0	43.8	60.4	80.6
1997	4.8	384.0	50.0	69.2	92.2

LIST OF PERSONS CONCERNED

LIST OF PERSONS CONCERNED

ADVISORY COMMITTEE MEMBERS

Dr. Kiyoshi Yamada	-	Chairman of Committee, Professor, Ritsumeikan University
Mr. Hisashi Watanabe	-	Member, for Water Supply System Planning, Nagoya City
Mr. Masahiro Takai	-	Member, for Water Source Planning, Kobe City
Mr. Tsutomu Sakagawa (Predecessor: Mr. Yoshiro Kaburagi)	-	Member, for Water Supply System Planning, Ministry of Health and Welfare
Mr. Shozo Matsuura (Predecessor: Mr. Yoichi Seki)	-	Coordinator, Japan International Cooperation Agency (JICA)

LWUA OFFICIALS

Mr. Porthos P. Alma Jose	-	Administrator
Col. Carlos C. Leaño, Jr.	-	Ex-General Manager
Mr. Salvador J. Rivera	-	Sr. Deputy Administrator
Mr. Ibarra J. Olgado	-	Deputy Administrator for Regulatory
Mr. Daniel I. Castillo	-	Deputy Administrator for Finance
Mr. Vitaliano J. dela Vega	-	Deputy Administrator for Engineering
Mr. Alfredo B. Espino	-	Manager, Planning Department
Mr. Isidoro A. Yee	-	Asst. Manager, Planning Department
Mr. Roberto B. Binag	-	Manager, Water Systems Development Division
Mr. Eriberto R. Calubaquib	-	Manager, Water Resources Division
Mr. Antonio R. de Vera	-	Project Manager IV
Mr. Armando T. Fernandes	-	Manager, Construction Department
Mr. Arador R. Sambo	-	Manager, Water District Formation/ Review Department
Mr. Francis C. Joven	-	Manager, Formation of Water District Division

LWUA OFFICIALS (CONT'D)

Mr. Hector A. Dayrit	-	Manager, Rates Division
Mr. Teofilo R. Palaganas	-	Area Manager, Advisory Services Div.
Mr. Henry I. Pacis	-	Water District Development Officer
Mrs. Jean C. Leoncio	-	Manager, Loan Evaluation Division

OTHER AGENCIES

NIA CONSULTANTS INC.

Mr. Isidro Digal	-	Manager, Planning Division
Mr. Lorenzo N. Macaspac	-	Professional Mechanical Engineer

NWRC

Atty. Elena Luz J. Alojipan	-	Hearing Officer, IV

MWSS

Mr. Antonio E. Kaimo	-	Acting Department Manager, Planning and Design Department

ANGELES CITY

Mr. Francisco G. Nepomuceno	-	City Mayor
Atty. Filomeno Espiritu	-	City Treasurer
Mr. Filomeno M. Bonifacio, Jr.	-	City Engineer
Mr. Romeo P. Calara	-	Sr. Mechancial Engineer

DAGUPAN CITY

Mr. Liberato L. Reyna, Sr.	-	City Mayor
Mr. Cipriano M. Manaois	-	Ex-Mayor
Mr. Juanito A. Pajaro	-	City Treasurer
Mr. Silverio C. Coquia	-	Waterworks Superintendent
Mr. Manuel B. Ravanzo	-	City Development Coordinator

CABUYAO, STA. ROSA AND BIÑAN

Atty. Felicismo T. San Luis	-	Governor, Province of Laguna
Mr. Romeo G. Ballesteros	-	Provincial Civil Security Officer
Mr. Dante T. Reyes	-	Executive Assistant/Development Coordinator
Mr. Catalino Caparas	-	Waterworks Supervisor, Province of Laguna
Mr. Isidro T. Hildawa	-	Mayor, Municipality of Cabuyao
Mr. Cesar E. Nepomuceno	-	Mayor, Municipality of Sts. Rosa
Mr. Noe C. Zarate	-	Mayor, Municipality of Biñan
Mrs. Josefa L. Pradel	-	Municipal Development Coordinator, Cabuyao
Mr. Felizardo P. Manto	-	Municipal Planning and Development Coordinator, Sta. Rosa
Mr. Carito P. Torres	-	Municipal Census Officer, Sta. Rosa

BAYOMBONG AND SOLANO

Mrs. Belen F. Calderon	-	Governor, Province of Nueva Vizcaya
Mrs. Natalia F. Dumlao	-	Ex-Governor
Mr. Clamente G. Bacani	-	Provincial Secretary
Mr. Artemio P. Bahia	-	Provincial Attorney
Mr. Jesus M. Calata	-	Provincial Engineer
Mr. Tomas C. Garra	-	Supervising Project Analyst Provincial Planning & Develop't Office
Mr. Geoffrey B. Magday	-	Concurrent Provincial Waterworks Officer
Capt. Federico M. Bolusan	-	Provincial Waterworks Supervisor
Mr. John Bagasao	-	Mayor, Municipality of Bayombong
Mr. Lunbert Galima	-	Mayor, Municipality of Solano

STUDY TEAM MEMBERS

Mr. Toru Hayashi	-	Team Leader Legistration/Organization Nippon Jogesuido Sekkei Co., Ltd. (NJS)
Mr. Masatoshi Momose	-	Water Supply System Planning, NJS
Mr. Chikara Amitani	-	Water Supply System Planning, NJS
Mr. Masuomi Hiroyama	-	Transmission/Distribution System Planning, NJS
Mr. Hideaki Fukui	-	Transmission/Distribution System Planning, NJS
Mr. Takafumi Kiguchi	-	Facility Design, NJS
Mr. Yukio Maejima	-	Water Source Planning, NJS
Mr. Fumiaki Ichino	-	Water Source Planning, Richo Soil Investigation Co., Ltd.
Mr. Mitsuo Tsutsumi	-	Well Development, NJS
Mr. Masaaki Awamoto	-	Financial and Economic Analysis, Techno Consultants, Inc.

MINUTES OF THE MEETINGS

MINUTES OF THE MEETING
MUNICIPAL WATER SUPPLY
PROJECT STUDY

Manila, March 25, 1986

Toru Hayashi
Study Team Leader
Japan International
Cooperation Agency

Atty. Ibarra Olgado
Officer in charge
LWUA

MINUTES OF THE MEETING

A series of meetings between JICA survey team and LWUA personnel regarding the Inception Report were held during March 18 to March 24, 1986 to confirm the objectives, scope of work and schedule for implementation of the study. Also discussed during the meetings were undertakings by both parties and approaches to the project.

The following are the items agreed upon:

1. Objective of the Study

The *objective of the study is to prepare Basic* Development Plan and Short Term Development Plan for the water supply projects in the following four project areas.

1. Angeles City, Pampanga
2. Dagupan City, Pangasinan
3. Cabuyao, Sta. Rosa and Binan, Laguna
4. Bayombong and Solano, Nueva Vizcaya

2. Scope of the Study

The study will be conducted in four (4) phases including works both in the Philippines and in Japan. The following are the outline of each phase:

2.1 Phase I: Formulation of Basic Development Plan

a) Collection and review of data and information available
b) Implementation of field survey
c) Outline of Basic Development Plan
d) Preparation of framework for the Feasibility Study
e) Preparatory work for implementation of Phase II study

2.2 Phase II: Field Investigation for Preparation of Feasibility Study

a) *Field Investigation*

- o Geoelectric prospecting
- o Test well drilling and pumping test
- o Inventory of wells and pumping tests of selected existing wells
- o Measurement of yield at springs

- o Testing of existing pumps
- o Measurement of unaccounted-for-water and hydraulic survey
- o Investigation of existing water supply facilities

b) Study of availability of materials and equipment for construction and improvement of water supply facilities and capability of local contractors

c) Review of design criteria for design of proposed water supply facilities

d) Study of the alternative water supply schemes

2.3 Phase III: Preparation of Feasibility Study (Draft Final Report)

a) Preliminary design of the recommended water supply systems among alternatives

b) Recommendation on organization/management of the system and establishment of water districts

c) Implementation schedule

d) Cost estimation for construction, operation, and maintenance of the system

e) Financial study

2.4 Phase IV: Preparation of Final Report

3. Approach to the Project

3.1 Development of Master Plan

a) Study Area

Study of fundamentals for the development of Master Plan will be made covering the entire city/municipality. However, the plan for the water supply system should be limited to those areas to be covered by level II/III systems.

b) Target Year

The base year for planning is 1986 in principle and target year is 2010. In addition, the years, 1990, 1995 and 2000 shall be considered although detailed study, such as breakdown of population by sub-area shall be only made for the present, 1990 and 2010.

c) Plan of Water Supply System

Layout of the existing and proposed pipelines and other major facilities will be shown on the map

d) Rough Cost Estimates

Rough cost estimates will be made using cost data prepared by the LWUA for feasibility studies.

e) Water Sources

Based on the data on water resources collected during Phase I, applicable water sources will be recommended to meet the water demands and other conditions including socio-economic needs.

f) Establishment of the Water District

Information on the willingness by the cities and municipalities as well as present problem areas in management of the existing water supply systems will be collected and evaluated to make recommendations for implementation of the water supply project.

3.2 Preparation of Framework for the Short Term Development Plan

a) Previous reports, if any, prepared by the city/municipality will be reviewed. The subject area will be recommended in consideration of existing service area, potential water resources, needs and willingness of the inhabitants, and financial viability. Marketing surveys will be conducted by the LWUA financial specialists to support the study.

b) Target Year

The base year is 1986 in principle and target year is 1990 for the four project areas.

c) Water Sources

Existing water sources including springs and deep wells will be evaluated to their maximum safe capacities. Improvement of existing source facilities and new development requirements will also be studied.

d) Preparatory work for the field survey during Phase II.

Most of the measurements in the field will be conducted during the Phase II. Since the work for test well drilling is critical, timely arrangement/procurement of equipment and material at the initial stage of the Phase II is indispensable. Detailed discussion to reach an agreement for the purpose between two parties will be made during the last two weeks of Phase I period reflecting the result of field survey and collected information. Responsibilities by each party for implementation of the field examination will be accomplished in accordance with the minutes exchanged on October 23, 1985.

4. Schedule for Implementation of the Study

4.1 Phase I

JICA team started field work from March 17 and is scheduled to finish its Phase I work on April 27. Discussions on the methodologies and required arrangements as well as collection and review of data will be conducted in Manila during first half of the study period. Field trip to the subject cities/municipalities will be done within two weeks during latter half of the study period. The outline of the basic development plan and framework of the short term plan will be prepared by the end of this Phase. Detailed schedule is attached herewith.

4.2 Phase II to Phase IV

Phase II field work is tentatively scheduled to start from the beginning of June 1986 and Final Report will be submitted at the end of February 1987 in Phase IV period.

5. Undertakings by JICA and LWUA

In accordance with the agreement between JICA and LWUA signed on October 23, 1985, each party will accomplish its responsibilities.

SCHEDULE FOR IMPLEMENTATION OF THE STUDY

Date		Activities		
March 17	Mon	1st Group: Tokyo-Manila, visit to Japan Embassy & JICA.		
18	Tue	A.M.: Courtesy call on LWUA, P.M.: Explanation of and discussions on Inception Report.		
19	Wed	Discussions on Inception Report, data collection and required arrangements.		
20	Thur	Preparation of minutes and data collection.		
21	Fri	Exchange of minutes.		
22	Sat	Inner meeting of Survey Team.		
(23)	Sun	- do -		
24	Mon	Collection and review of data and information.		
25	Tue	2nd Group: Tokyo-Manila, review of data and information.		
26	Wed	. Analysis of data and information collected. . Preparatory work for the field survey		
△27	Thur	)		
△28	Fri	)		
△29	Sat	) Analysis of data and information collected.		
(30)	Sun	)	B Group: Manila-Dagupan/ Dagupan City	C Group: Manila-Dagupan
31	Mon	A Group: Cabuyao, etc.		Dagupan City
April 1	Tue	. Data collection	. Data collection	
2	Wed	. Field Survey	. Field Survey	
		. Discussions with officers	. Discussions with officers	
3	Thur			Bayombong, Solano
4	Fri			
5	Sat	Preparation of Field/ Report	Preparation of Field Report	C Group: Dagupan
(6)	Sun	- do -	- do -	Dagupan-Manila
7	Mon	A Group: Angeles City	B Group: Bayombong & Solano	Cabuyao, etc.
8	Tue	. Data collection	. Data collection	
9	Wed	. Field Survey	. Field Survey	Angeles City
	Thu	. Discussions with officers	. Discussions with officers	
11	Fri			

April 12	Sat	Preparation of Field Report	Preparation of Field Report
13	Sun	- do -	B Group: Dagupan-Manila
14	Mon	Review of data and information	
15	Tue	Preparation of Basic Development Plan and Framework of short term plan	
16	Wed	- do -	
17	Thur	- do -	
18	Fri	- do -	
19	Sat	- do -	
20	Sun	Preparation of Report	
21	Mon	Preparation of Report	
22	Tue	- do -	
23	Wed	- do -	
24	Thur	Meeting with LWUA	
25	Fri	Meeting with LWUA and visit to JICA and Embassy	
26	Sat	Inner meeting	
27	Sun	Manila - Tokyo	

MINUTES OF MEETING

MUNICIPAL WATER SUPPLY PROJECT STUDY

Manila, June 18, 1986

Toru Hayashi
Study Team Leader
Japan International
Cooperation Agency

Borthos P. Alma Jose
Administrator
Local Water Utilities
Administration

MINUTES OF THE MEETING

A series of meeting between the JICA study team and LWUA officials regarding the Phase II Study Program for the Municipal Water Supply Project were held from June 9 to June 18, 1986 to confirm the placement of the Progress Report, scope of work and schedule of implementation of the study. Also discussed during the meeting were undertakings by both parties and approaches to the Phase II Study.

The following are the items agreed upon:

1. Progress Report

The study team submitted ten (10) copies of the Progress Report to LWUA on June 8, 1986.

2. Contents of the Phase II Study

2.1 Plan of Water Supply System

A plan of water supply system for the years 2010 and 1995 shall be prepared showing relationship of the major facilities and shall be incorporated in the Final Reports.

2.2 Basic Development Plan

The Basic Development Plan (2010) is recommended in the Progress Report as a result of the alternative study including potential water sources and required facilities. Supplemental description and schematic drawings will be prepared. Cost comparison between alternatives will be made based on the present cost.

2.3 Short Term Development Plan

The water supply system for the immediate improvement (1995) should be planned considering the relation to the Basic Development Plan.

2.4 Hydraulic Calculation

Hydraulic calculation on the recommended water supply system should be carried out.

2.5 Target Year

The target year for the immediate improvement is 1995. Required study for the fundamentals will be made for the year 1986 (base year), 1995 (immediate improvement) and 2010 (long term development), respectively. Implementation schedule for the year 1990 may also be included as the stage 1 of the immediate improvement program.

2.6 Design Criteria

Design criteria for feasibility study should follow the LWUA guidelines. To some extent, however, alternatives may be accepted if reasons are justifiable.

2.7 Composition of Reports

Composition of Interim Report and Draft Final Report will be finalized through the discussion between the Study Team and LWUA during the Phase II Study period.

3. Arrangement for Phase II Study

3.1 Land acquisition for Test Well Sites

LWUA shall at its own expense, be responsible for the land acquisition for test wells prior to the scheduled test well drilling.

3.2 Preparation for Drilling Equipment

In accordance with the Minutes of Meeting between JICA and LWUA dated October 23, 1985, LWUA shall at its own expense, be responsible for the provision of equipment for test well drilling.

One drilling rig shall be provided within the month of June, and another one beginning July.

Test well drilling in the three study areas shall be completed within the Phase II Study period.

3.3 Safekeeping of Materials for Test Wells

LWUA shall be responsible for safekeeping of materials for test wells which are supplied by JICA.

3.4 Field Survey

1. Schedule of the LWUA Engineers

Required arrangements be made by the LWUA according to the following schedule:

Rodolfo Oamil	:	6/16 - 7/15 (Angeles City)
Allen Lowe	:	7/16 - 8/15 (Cabuyao, Sta. Rosa, Biñan)
Abelardo Buencamino	:	6/16 - 7/13 (Dagupan)
Melchor Casil	:	7/13 - 8/16 (Bayombong & Solano)

Schedule for the two hydrogeologists will be decided after making arrangement of drilling machine.

2. Living allowance and travel cost for LWUA Engineers

LWUA is responsible for LWUA Engineer and well drillers.

In accordance with the schedule, they may work on Saturday/Sunday, if necessary.

3. Vehicle arrangement

Land Cruiser : LWUA will provide a vehicle (Land Cruiser) for the survey in Dagupan and Bayombong and Solano from June 16 (Mon) to August 15, 1986.

4. Preparation of road map for Cabuyao, Sta. Rosa and Biñan.

LWUA (Allen) will prepare and confirm (in the area) the road network for the subject area planned in the progress report. Aerial photograph be utilized for this purpose. This work should be completed by the beginning of July.

3.5 Market Survey

LWUA shall conduct the Market Survey for Angeles City on the third week of June.

3.6 Water Quality Analysis

Necessary arrangements for water quality analysis will be made at the LWUA laboratory or other institutions.

3.7 Electric Logging Equipment

LWUA will provide the study team with a set of electric logging equipment.

3.8 Data on Unit Cost

LWUA shall assist the study team in the collection of necessary data for unit cost.

22 September 1986

MINUTES OF AGREEMENT BETWEEN LWUA AND JICA

Discussions on the Interim Report and the requirement for completion of the Draft Final Report were made between the two parties (JICA and LWUA) from September 18 to 22, 1986. Fundamentals for planning water supply system for the four study areas and basic approach/figures which were incorporated in the Interim Report were agreed upon discussions. In addition, the following major subjects were confirmed by the two parties:

(1) Completion of Test Well Construction

The scheduled test well construction at the three sites, Dagupan, Angeles, and Sta. Rosa is behind schedule due to the delay of procurement of well drilling equipment, repair of broken equipment, land acquisition for test well sites as well as unfavorable weather.

Under these circumstances, the parties agreed that LWUA will make all efforts to catch up with the delay of construction.

(2) Draft Final Report

The major items to be included in the report are as follows:

Chapter 1 Summary and Recommendations
Chapter 2 General Background
Chapter 3 Description of the Study Area
Chapter 4 Existing System
Chapter 5 Population and Water Demand Projections
Chapter 6 Water Resources
Chapter 7 Analysis and Evaluation of Alternatives
Chapter 8 Recommended Plan
Chapter 9 Financial Feasibility Analysis
Chapter 10 Economic Feasibility Analysis
Chapter 11 Organization and Management Study

Drawings to be prepared comprise general plan and standard drawings for major facilities.

Noted:

ALFREDO H. ESPINO
Planning Manager

TORU HAYASHI
Team Leader - JICA