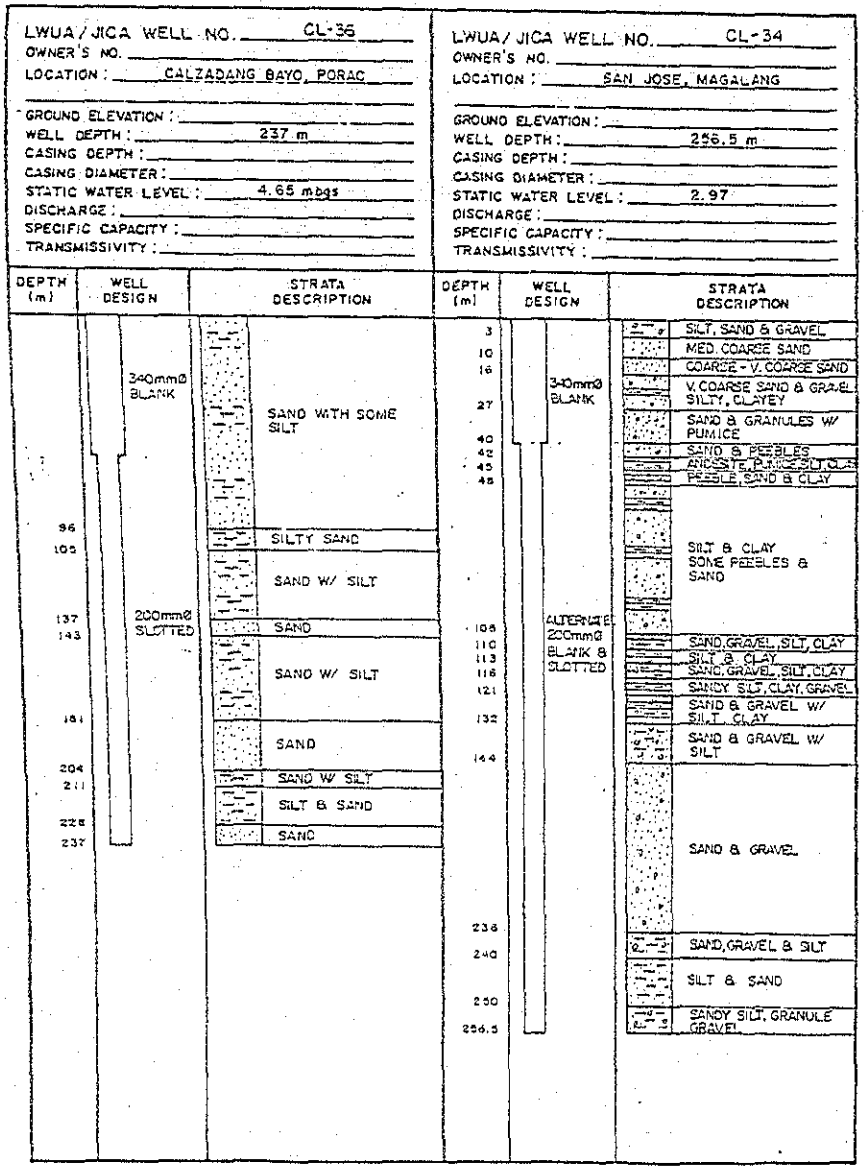
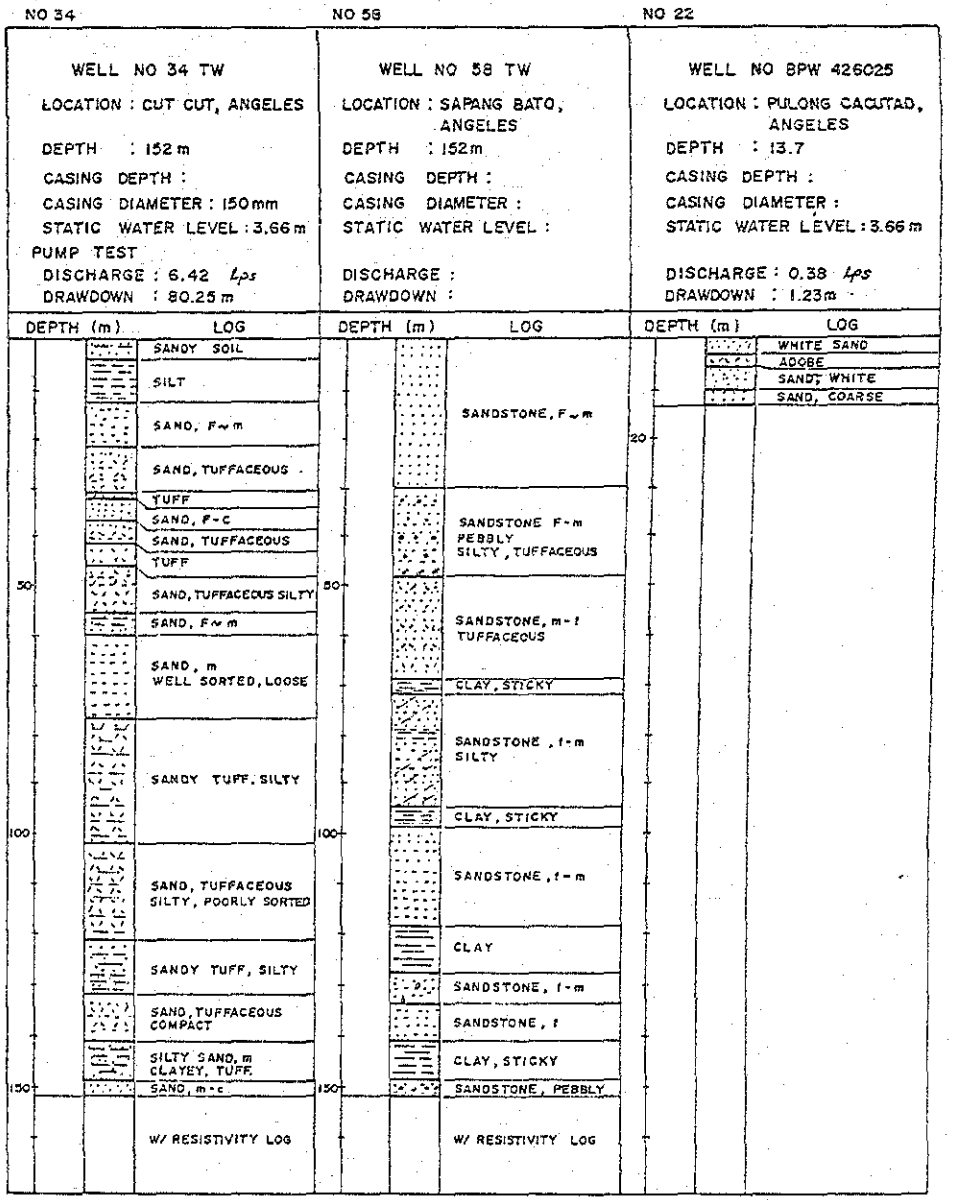
APPENDIX 6.6.1 EXISTING WELL INVENTORY IN PAMPANGA PROVINCE

Well No JICA	Original	Depth Well (m)	Tested Yield (l/min)	Drawdown (m)	Specific Capacity (l/min/m)	Trans-missivity (m^2/day)	Location Barangay /	Municipality
	CL-34	244	3,705	19.5	190	400		Magalang
	CL-35	237	2,543	25.4	100	180		Porac
	CL-38	240	4,201	13.5	311	610		Sta.Ana
	CL-41	256	6,052	14.7	412	900		Bacalor
	Ex-20	204	1,694	29.5	57	110	St Rosario	Magalang
1	PS- 1	153	1,892	18.3	90	-	Mabini st	Angeles
2	PS- 2	243	821	19.8	42	-	Mabini st	Angeles
3	PS- 3	126	394	18.3	22	-	Mabini st	Angeles
4	PS- 4	80	394	15.0	17.5	-	Kullat st	Angeles
5	PS- 5	110	985	14.6	67	-	Balagtas	Angeles
6	PS- 6	120	985	6.4	154	-	Pandan	Angeles
7	PS- 7	214	821	13.7	60	-	San Joaquin	Angeles
8	PS- 8	104	755	13.7	55	-	Pampang	Angeles
9	PS- 9	110	181	15.3	12	-	St Cristo	Angeles
10	PS-10	92	657	18.3	36	-	McArther	Angeles
11	PS-11	98	493	15.3	32	-	Mirasol	Angeles
14	PS-14	148	602	3.7	163	370	Ele school	Angeles
16	17991	27	64	1.3	49	-	Mining	Angeles
19	17992	34	76	0.6	127	-	Pandan	Angeles
20	17995	49	26	1.5	17	-	Sapalibutad	Angeles
22	426025	14	22	1.2	18	-	Pulun Cacutud	Ageles
24	BWS- 6	183	1,970	14.6	141	-	Lakandula	Ageles
27	43673	57	227	3.1	73	-	Balibago	Ageles
29	BWS- 4	183	1,325	25.6	52	-	Balibago	Ageles
30	BWS- 2	85	1,473	20.4	72	-	Josefa Subd	Ageles
31	17994	25	22	2.7	8	-	Pamcang	Ageles
32	17993	25	133	0.9	144	-	Pampang	Ageles
34	TW	152	385	80.3	4.8	-	Cutcut	Ageles
39	13159	16	57	1.6	35	-	Calzadang	Porac
40	43672	32	33	1.1	35	-	Senora	Porac
41	13156	19	30	1.6	19	-	Macantian	Porac
42	13155	15	140	0.6	229	-	Macantian	Porac
43	13155	13	30	0.9	34	-	Macantian	Porac
44	13153	12	49	0.3	164	-	Mnibaug	Porac
46	19352	46	76	0.9	84	-	St Cruz	Angeles
46	19353	44	38	2.7	14	-	St Cruz	Angeles
46	22091	20	38	1.5	25	-	Pulung Maiaba	Porac
52	426253	49	38	1.2	32	-	Pasbulbulu	Porac
53	426622	49	26	3.1	8.4	-	Margot	Angeles
54	426039	40	30	2.1	14	-	Margot	Angeles
55	426032	62	19	8.0	2.4	-	Margot	Angeles
57	3234	64	38	1.5	25	-	Saparbato	Angeles
59	6653	60	22	5.4	4.2	-	Saparbato	Angeles
61	20241	106	530	4.6	116	-	Clark A.B.	Angeles
62	20771	26	38	0.3	126	-	Baluga VIII	Angeles
63	17989	25	66	0.6	105	-	Malabanas	Angeles
65	C- 5	208	-	-	-	160	Calzadang	Porac
66	BWS- 7	92	1,806	3.5	212	-	Dau	Angeles
67	BWS- 8	92	2,496	15.9	157	-	Henson VIII	Angeles
68	EPZA	92	869	8.3	104	150	Export Proc	Angeles
70	426111	68	56	1.8	31	-	Balibago	Angeles
71	13162	21	38	0.3	126	-	Sepungbulaon	Porac
72	17040	24	56	1.5	37	-	Sepungbulaon	Porac
73	14784	21	26	4.9	5.4	-	Pulong Santol	Porac
74	18069	37	45	1.5	30	-	Planas	Porac
75	5957	32	26	1.5	17	-	Planas	Porac
76	17183	28	26	3.7	7	-	Palat	Porac
77	13161	22	38	0.6	63	-	Mitla	Porac
78	42601	40	26	0.6	43	-	Mitla	Porac
79	13159	12	56	1.5	37	-	Calzadang	Porac
80	43671	24	33	0.9	41	-	Balubad	Porac
81	426017	30	38	2.5	15	-	Cangatba	Porac

APPENDIX 6.6.2 WELL LITHOLOGIC LOGS (ANGELES CITY, PAMPANGA)





NO. 40

LWUA well no. 43672 (BPW)

LOCATION : BO. SEÑORA
PORAC, PAMPANGA
DEPTH : 30.0 M
CASING DEPTH :
CASING DIAMETER
STATIC WATER LEVEL
PUMP TEST DATA
DISCHARGE : 0.631 LPS
DRAWDOWN :

DEPTH | LOG

- SAND
- BLUE CLAY
- SAND & GRAVEL
- ADOBE
- SANDSTONE

30

NO. 44

LWUA well no. 22091 (BPW)

LOCATION : BO. PULUNGMABA
PORAC, PAMPANGA
DEPTH : 20.1 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 14.63 M
PUMP TEST DATA
DISCHARGE : 0.63 LPS
DRAWDOWN :

DEPTH | LOG

- SAND ROCK
- SAND W/ STONE
- SAND
- COARSE SAND W/ GRAVEL

30

LWUA well no. 13158 (BPW)

LOCATION : BO MANIBAOG
PORAC, PAMPANGA
DEPTH : 11.9 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 5.18 M
PUMP TEST DATA
DISCHARGE : 0.82
DRAWDOWN :

DEPTH | LOG

- SANDY CLAY W/ BOULDER
- SAND & GRAVEL

30

NO 56

WELL NO BPW 531715

LOCATION : MARGOT, ANGELES
DEPTH : 161.6 m
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 24.39m
PUMP TEST
DISCHARGE : 9.46 Lps
DRAWDOWN :

DEPTH (m) | LOG

- SAND
- ADOBE
- BOULDER
- SANDSTONE
- ADOBE
- SANDY CLAY
- SAND & GRAVEL
- SANDY CLAY W/GRAVEL
- LOOSE ROCK
- ADOBE (TUFF)
- SAND & GRAVEL
- SANDY CLAY
- LOOSE ROCK
- SANDY CLAY

50
100
150
161.6

NO 52

WELL NO BPW 426253

LOCATION : PASBUL, PORAC
DEPTH : 48.8 m
CASING DEPTH : 48.8m
CASING DIAMETER : 100
STATIC WATER LEVEL : 26.2m
DISCHARGE : 0.63 Lps
DRAWDOWN :

DEPTH (m) | LOG

- SAND, F
- SAND, C
- ADOBE, SOFT
- SAND & GRAVEL, COMPACT
- SAND, C
- SANDY CLAY
- ADOBE
- SAND, F
- SAND, F~C

40.7
50
100

WELL NO

LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
DISCHARGE :
DRAWNDOWN :

DEPTH (m) | LOG

NO. 55

LWUA well no. BPW-426032

LOCATION : BO. MARGOT, ANGELES CITY, PAMP.
DEPTH : 62.30 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL 27.44
PUMP TEST DATA
DISCHARGE : 0.32 LPS
DRAWDOWN :

DEPTH LOG

SAND
COARSE SAND
CLAY
SAND
SAND & GRAVEL
SANDY CLAY
ADOBE CLAY
SAND
ADOBE CLAY
ADOBE ROCK
62.30

LWUA well no. BPW-436622

LOCATION : MARGOT, ANGELES CITY, PAMPANGA
DEPTH : 48.78 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 27.44
PUMP TEST DATA
DISCHARGE : 0.44 LPS
DRAWDOWN :

DEPTH LOG

SAND
BOULDER
SAND ROCK
SAND
COARSE SAND
48.78

LWUA well no. BPW-10857

LOCATION : BO. LOURDES, ANGELES CITY, PAMP.
DEPTH : 106.10 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 4.26
PUMP TEST DATA
DISCHARGE : 18.93 LPS
DRAWDOWN :

DEPTH LOG

SAND
106.10

NO. 61

LWUA well no. BPW 6286

LOCATION : KULIAT, BO. LOURDES ANGELES CITY, PAMP.
DEPTH : 103.65 M
CASING DEPTH :
CASING DIAMETER
STATIC WATER LEVEL 2.44
PUMP TEST DATA
DISCHARGE : 7.57 LPS
DRAWDOWN :

DEPTH LOG

SAND
ADOBE STONE
BLUE SANDY CLAY
YELLOW SANDY CLAY
YELLOW CLAY
COARSE SAND W/ GRAVEL
ADOBE CLAY
SAND STONE
YELLOW CLAY
SAND STONE
YELLOW CLAY

LWUA well no. BPW 20241

LOCATION : CLARK FIELD ANGELES CITY, PAMP.
DEPTH : 106.10 M
CASING DEPTH :
CASING DIAMETER
STATIC WATER LEVEL : 25.91
PUMP TEST DATA
DISCHARGE : 8.83 LPS
DRAWDOWN :

DEPTH LOG

SAND
COARSE SAND
GRAVEL
SAND
SAND STONE

NO. 62

LWUA well no. BPW 20771

LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :

DEPTH LOG

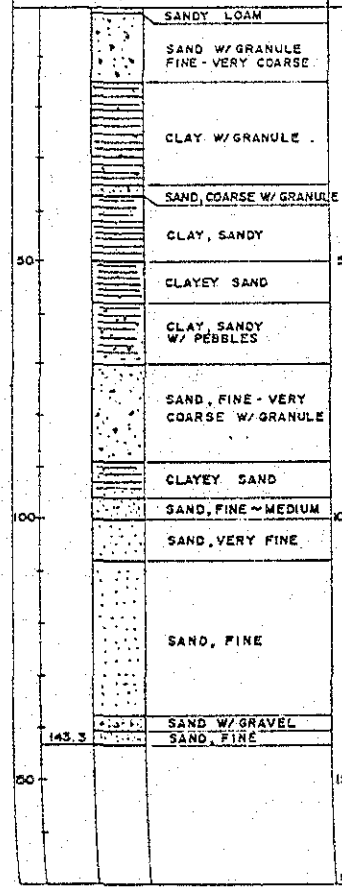
SAND & GRAVEL
LOOSE ROCK
FINE SAND
COARSE SAND
STICKY CLAY
COARSE SAND
CORAL
COARSE SAND

NO 69

WELL NO C-4

LOCATION : STA. MARIA, MABALACAT
DEPTH : 143.3m
CASING DEPTH : 135.6 m
CASING DIAMETER : 400/300mm
STATIC WATER LEVEL : 1.22
PUMP TEST
DISCHARGE :
DRAWDOWN :

DEPTH (m) LOG



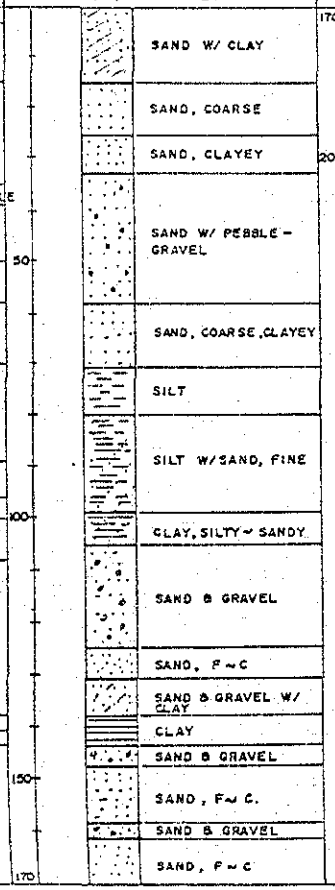
NO 65

WELL NO C-5

LOCATION : CALSADONG BAYO PORAC
DEPTH : 208.8 m
CASING DEPTH : 208.8 m
CASING DIAMETER : 400/300 mm
STATIC WATER LEVEL : 6.67

DISCHARGE :
DRAWDOWN :

DEPTH (m) LOG



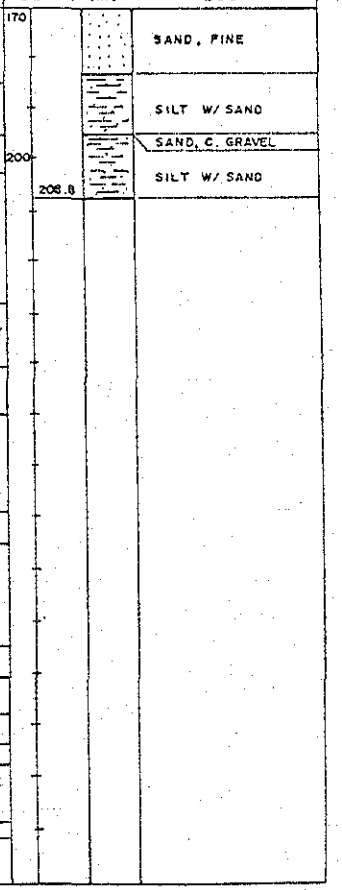
NO 65

WELL NO (Cont.')

LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :

DISCHARGE :
DRAWDOWN :

DEPTH (m) LOG

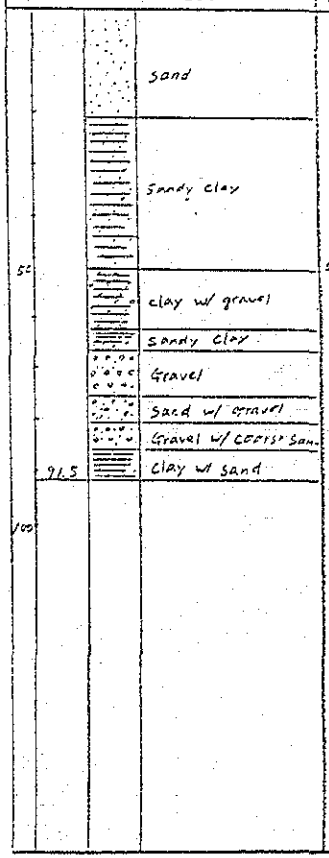


NO. 67

LWUA Well No. BWS 8

LOCATION : Henson Village, Balibago
DEPTH : 91.5
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL: 6.10
PUMP TEST DATA
DISCHARGE: 11.6 LPS
DRAWDOWN: 15.81

DEPTH LOG

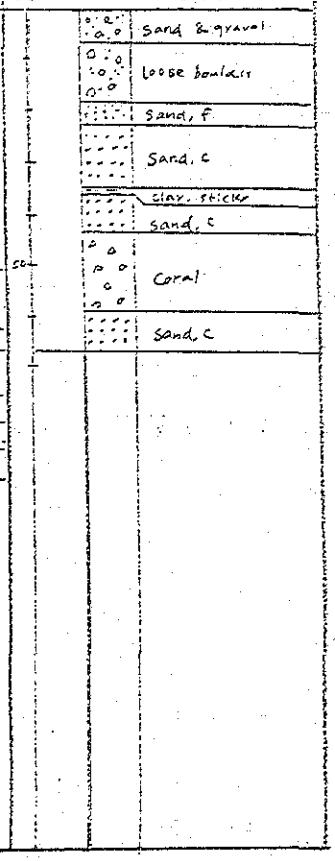


NO. 70

LWUA well no. #26/11

LOCATION : Balibago, Angeles
DEPTH : 69.5m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL: 2.74m
PUMP TEST DATA
DISCHARGE: 0.94 LPS
DRAWDOWN:

DEPTH LOG

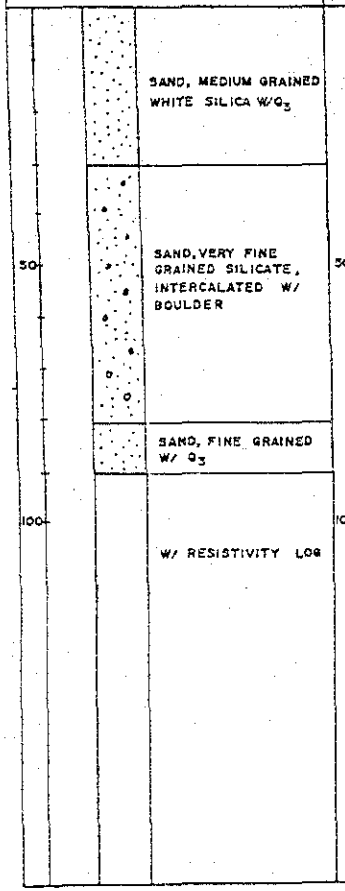


NO. 68

WELL NO EPZA

LOCATION : EXPORT PROCESSING ZONE
DEPTH : 91.5 m
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST
DISCHARGE : 14.49 lps
DRAWDOWN : 8.33 m

DEPTH (m) LOG



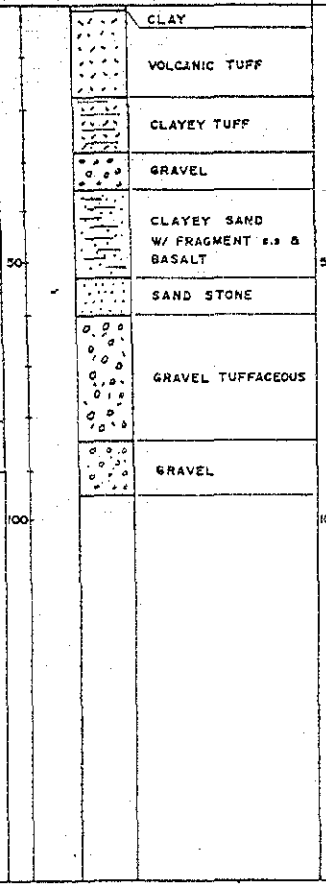
NO. 81

WELL NO C-20A

LOCATION : PULONG BOLO, ANGELES
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :

DISCHARGE :
DRAWDOWN :

DEPTH (m) LOG



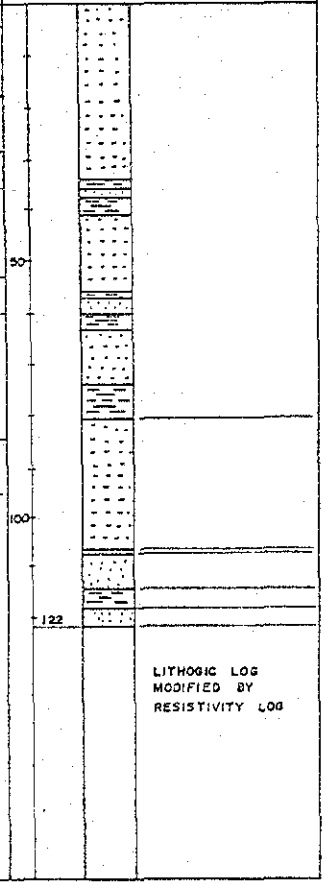
NO. 17

WELL NO CAPAYA II

LOCATION : CAPAYA II
DEPTH : 122 m
CASING DEPTH : 122 m
CASING DIAMETER :
STATIC WATER LEVEL :

DISCHARGE :
DRAWDOWN :

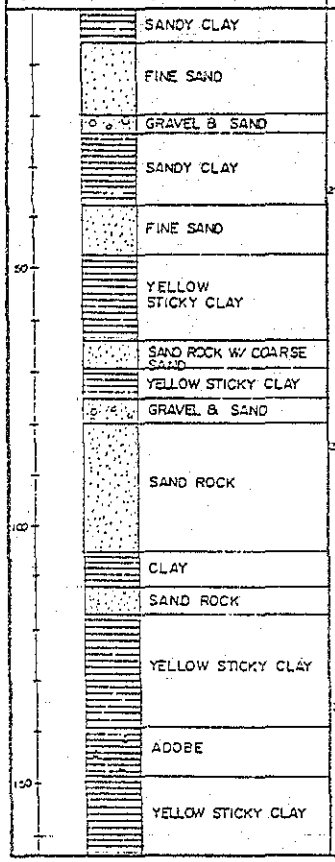
DEPTH (m) LOG



LWUA Well No. BPW-4901

LOCATION : HERANDA ST. ANGELES CITY, PAMPANGA
DEPTH : 271.34 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 7.32 M
PUMP TEST DATE :
DISCHARGE : 4.73 LPS
DRAWDOWN :

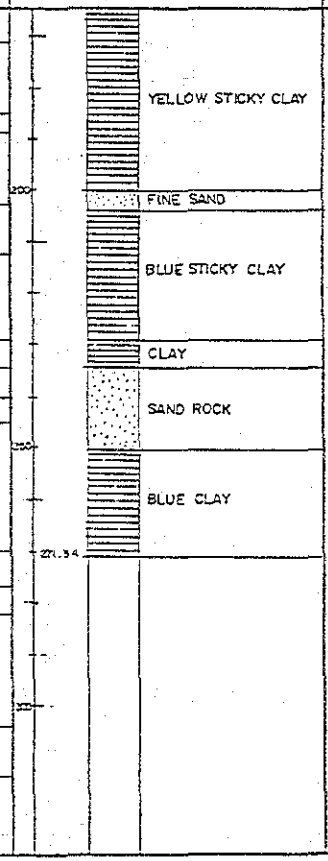
DEPTH LOG



LWUA Well No. BPW-4901 (CONT.)

LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :

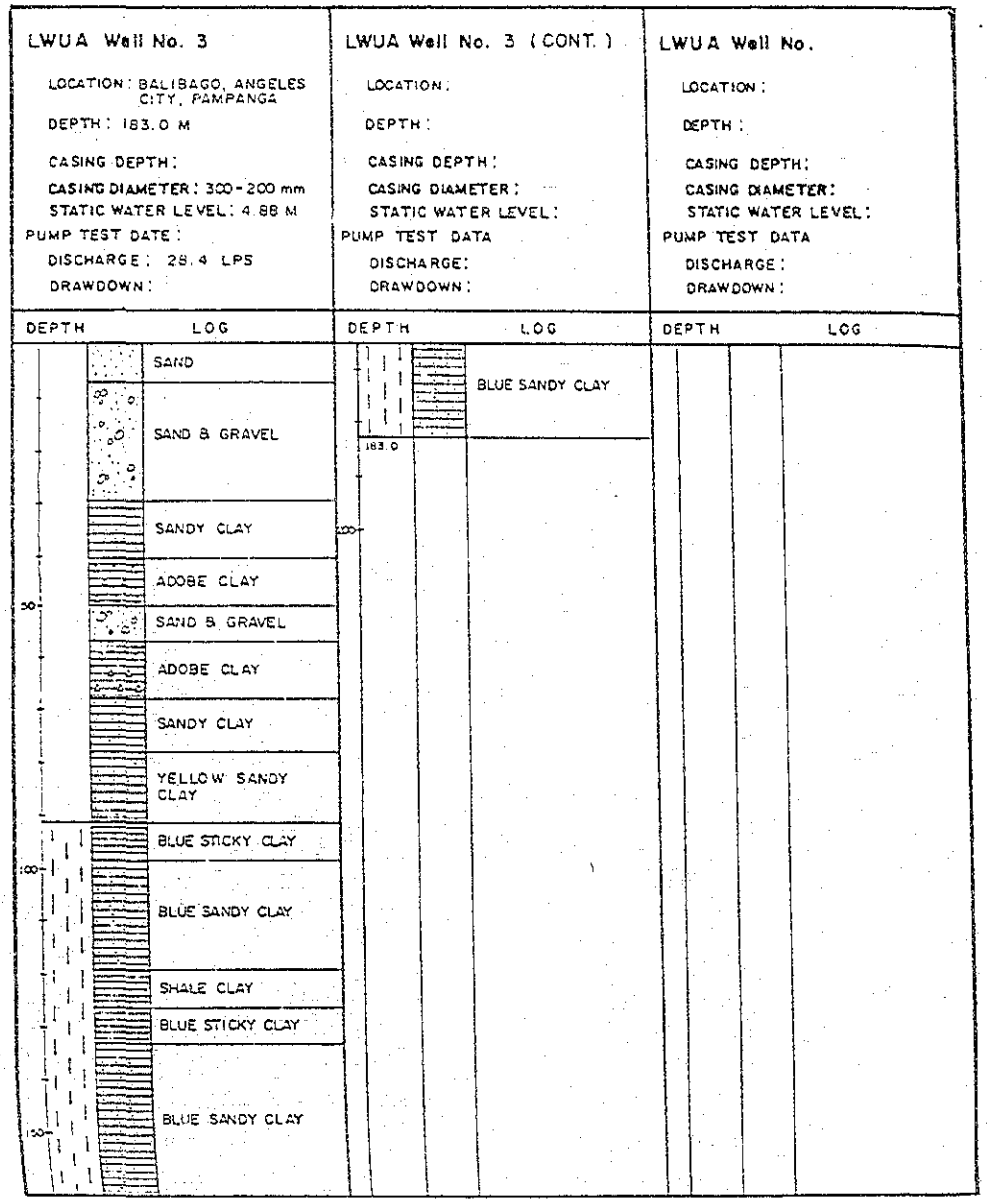
DEPTH LOG

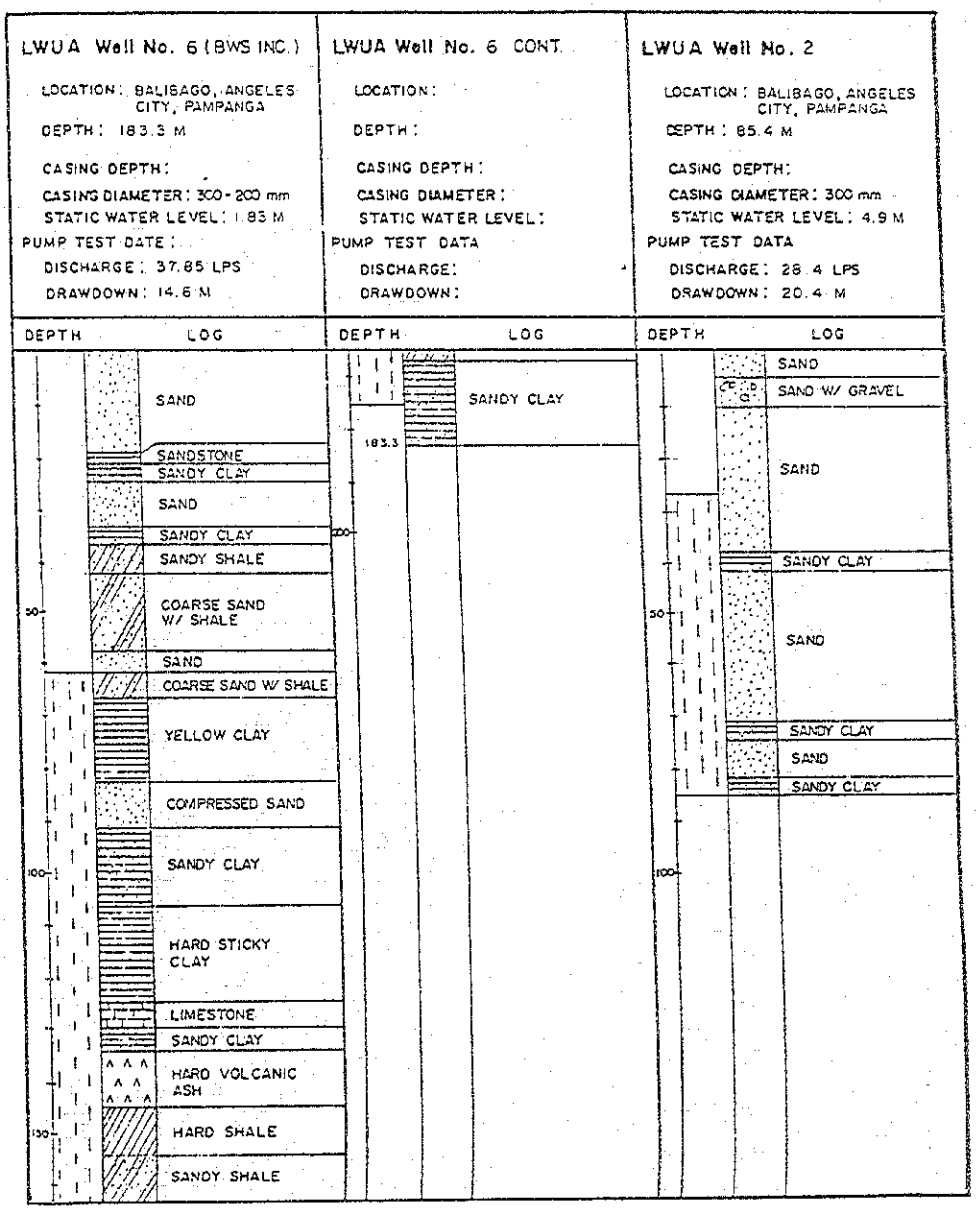


LWUA Well No.

LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :

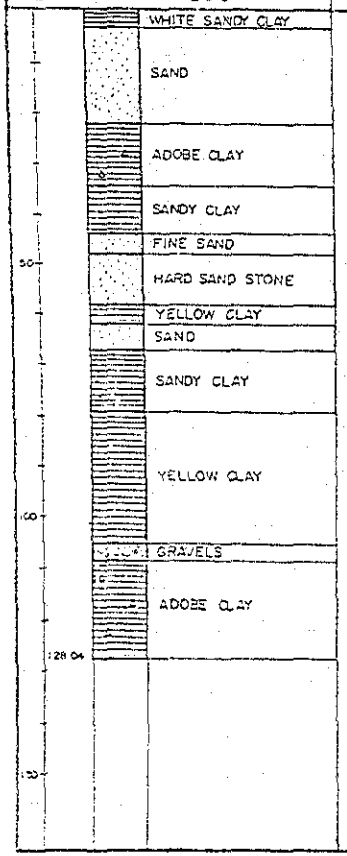
DEPTH LOG


LWUA Well No. 3
LOCATION : BALIBAGO, ANGELES CITY, PAMPANGA
DEPTH : 183.0 M
CASING DEPTH :
CASING DIAMETER : 300 - 200 mm
STATIC WATER LEVEL : 4.88 M
PUMP TEST DATE :
DISCHARGE : 28.4 LPS
DRAWDOWN :
DEPTH
LOG
SAND
SAND & GRAVEL
SANDY CLAY
ADOBE CLAY
SAND & GRAVEL
ADOBE CLAY
SANDY CLAY
YELLOW SANDY CLAY
BLUE STICKY CLAY
BLUE SANDY CLAY
SHALE CLAY
BLUE STICKY CLAY
BLUE SANDY CLAY
50
100
150
LWUA Well No. 3 (CONT.)
LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :
DEPTH
LOG
183.0
BLUE SANDY CLAY
100
LWUA Well No.
LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :
DEPTH
LOG


LWUA Well No. 6 (BWS INC.)
LOCATION : BALIBAGO, ANGELES CITY, PAMPANGA
DEPTH : 183.3 M
CASING DEPTH :
CASING DIAMETER : 300 - 200 mm
STATIC WATER LEVEL : 1.83 M
PUMP TEST DATE :
DISCHARGE : 37.85 LPS
DRAWDOWN : 14.6 M
DEPTH
LOG
SAND
SANDSTONE
SANDY CLAY
SAND
SANDY CLAY
SANDY SHALE
COARSE SAND W/ SHALE
SAND
COARSE SAND W/ SHALE
YELLOW CLAY
COMPRESSED SAND
SANDY CLAY
HARD STICKY CLAY
LIMESTONE
SANDY CLAY
HARD VOLCANIC ASH
HARD SHALE
SANDY SHALE
50
100
150
LWUA Well No. 6 CONT.
LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :
DEPTH
LOG
183.3
SANDY CLAY
100
LWUA Well No. 2
LOCATION : BALIBAGO, ANGELES CITY, PAMPANGA
DEPTH : 85.4 M
CASING DEPTH :
CASING DIAMETER : 300 mm
STATIC WATER LEVEL : 4.9 M
PUMP TEST DATA
DISCHARGE : 28.4 LPS
DRAWDOWN : 20.4 M
DEPTH
LOG
SAND
SAND W/ GRAVEL
SAND
SANDY CLAY
SAND
SANDY CLAY
SAND
SANDY CLAY
50
100

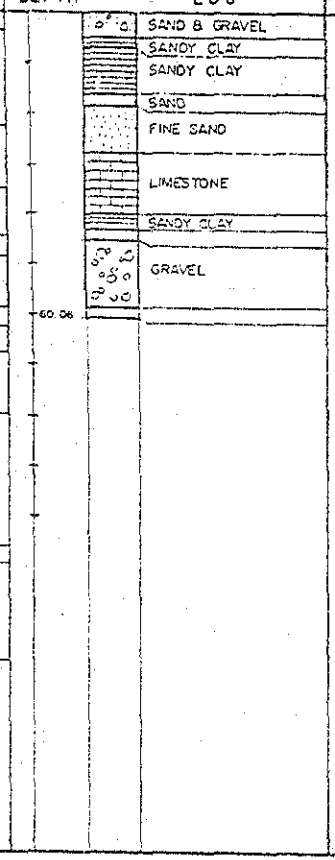
LWUA well no. BPW 5440 (3)

LOCATION :
DEPTH : 128.04 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 2.44
PUMP TEST DATA
DISCHARGE : 7.57 LPS
DRAWDOWN :



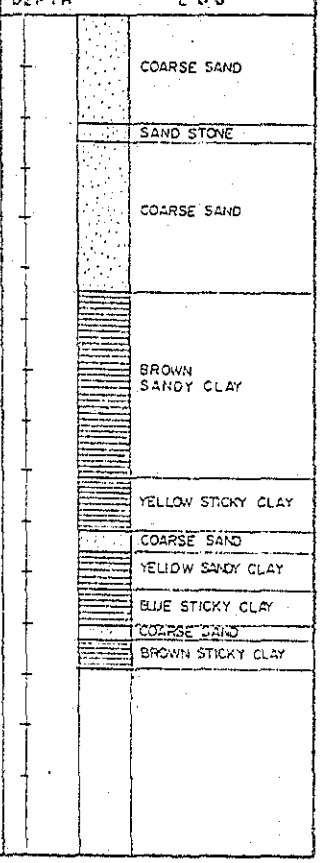
LWUA well no. BPW 6663

LOCATION :
DEPTH : 60.06 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 26.83
PUMP TEST DATA
DISCHARGE : 0.38 LPS
DRAWDOWN :



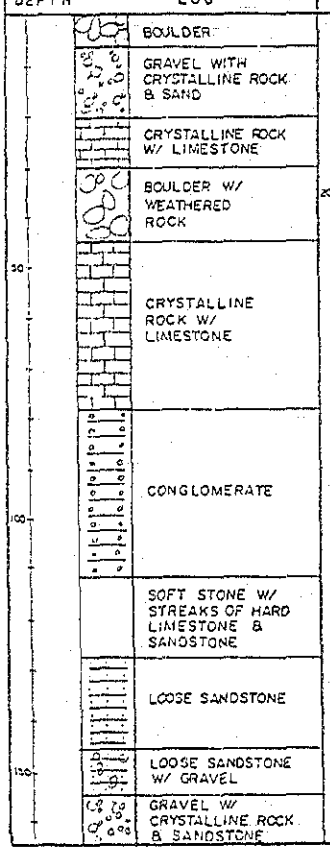
LWUA well no. BPW 10863

LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 0.91
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :



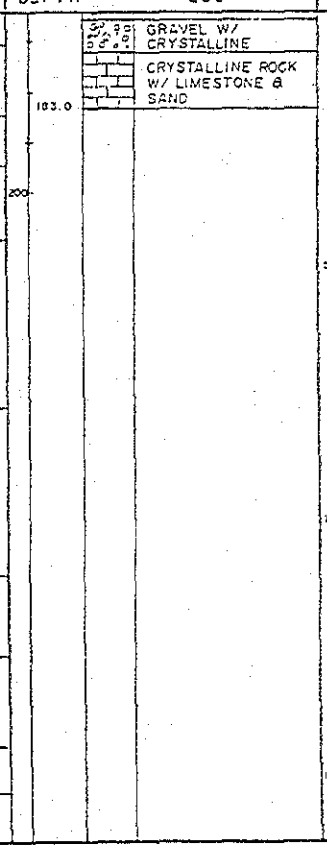
LWUA Well No. 4

LOCATION : BALIBAGO, ANGELES CITY, PAMPANGA
DEPTH : 183.0 M
CASING DEPTH :
CASING DIAMETER : 300 - 200 mm
STATIC WATER LEVEL : 4.9 M
PUMP TEST DATE :
DISCHARGE : 22.08 LPS
DRAWDOWN : 25.6



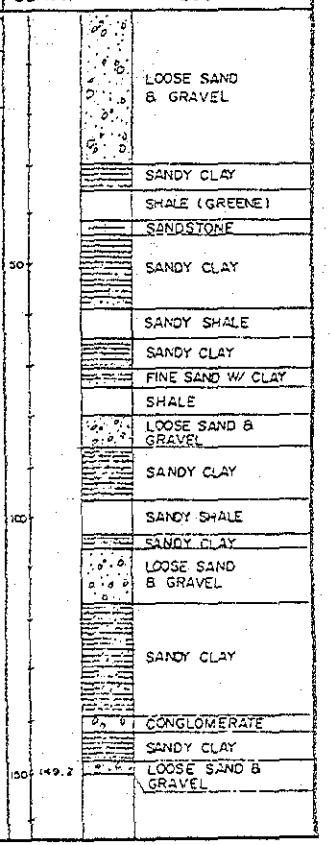
LWUA Well No. 4 (CONT.)

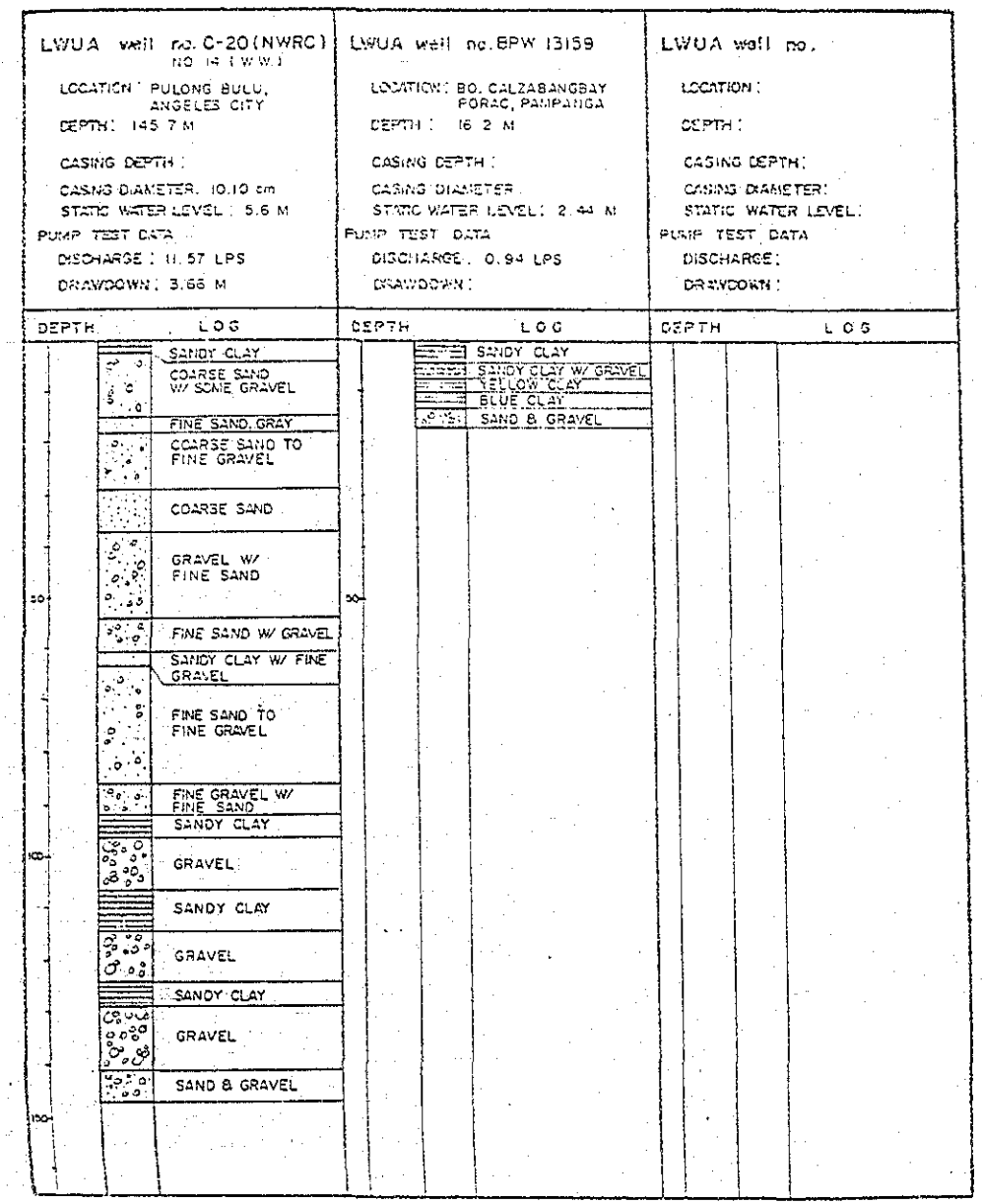
LOCATION :
DEPTH :
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :

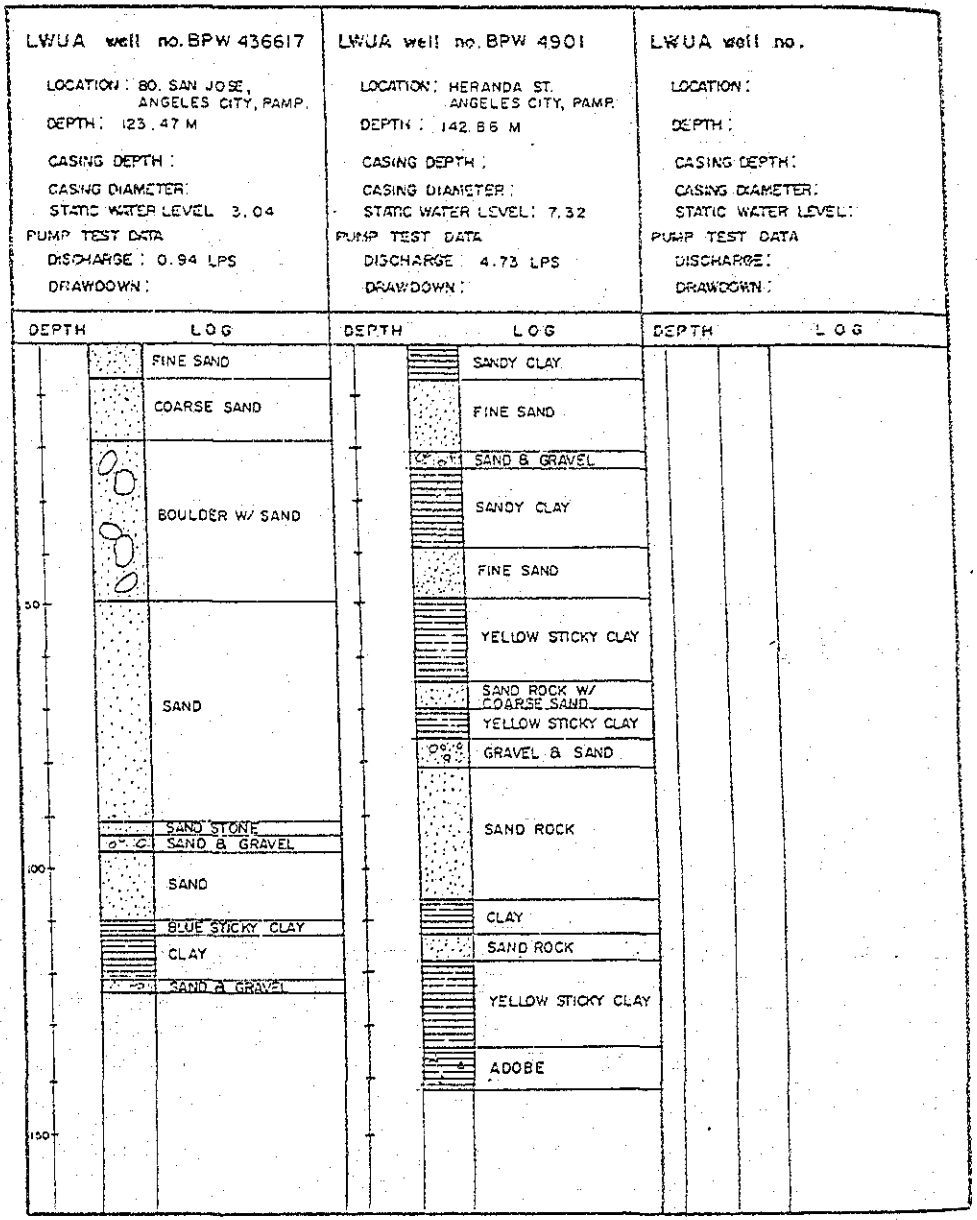


LWUA Well No. 5

LOCATION : BALIBAGO, ANGELES CITY, PAMPANGA
DEPTH : 149.2 M
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL : 4.9 M
PUMP TEST DATA
DISCHARGE : 22.08 LPS
DRAWDOWN :

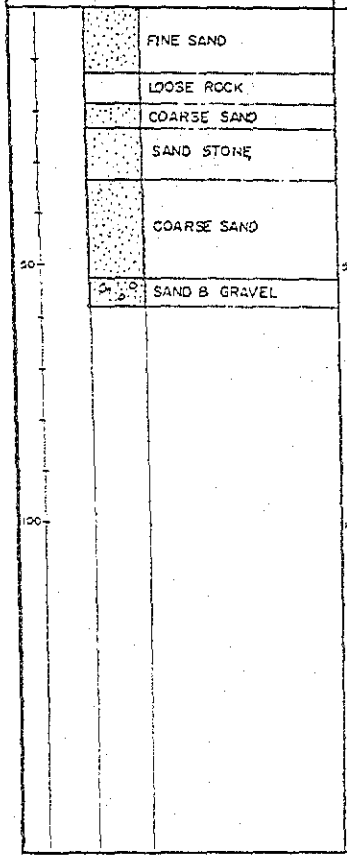



LWUA well no. C-20 (NWRC) NO 14 (WW)
LOCATION: PULONG BULU, ANGELES CITY
DEPTH: 145.7 M
CASING DEPTH:
CASING DIAMETER: 10.10 cm
STATIC WATER LEVEL: 5.6 M
PUMP TEST DATA
DISCHARGE: 11.57 LPS
DRAWDOWN: 3.66 M
DEPTH
LOG
SANDY CLAY
COARSE SAND W/ SOME GRAVEL
FINE SAND, GRAY
COARSE SAND TO FINE GRAVEL
COARSE SAND
GRAVEL W/ FINE SAND
FINE SAND W/ GRAVEL
SANDY CLAY W/ FINE GRAVEL
FINE SAND TO FINE GRAVEL
FINE GRAVEL W/ FINE SAND
SANDY CLAY
GRAVEL
SANDY CLAY
GRAVEL
SANDY CLAY
GRAVEL
SAND & GRAVEL
50
100
150
LWUA well no. BPW 13159
LOCATION: BO. CALZABANGBAY FORAC, PAMPANGA
DEPTH: 16.2 M
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL: 2.44 M
PUMP TEST DATA
DISCHARGE: 0.94 LPS
DRAWDOWN:
DEPTH
LOG
SANDY CLAY
SANDY CLAY W/ GRAVEL
YELLOW CLAY
BLUE CLAY
SAND & GRAVEL
50
LWUA well no.
LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG


LWUA well no. BPW 436617
LOCATION: BO. SAN JOSE, ANGELES CITY, PAMP.
DEPTH: 123.47 M
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL 3.04
PUMP TEST DATA
DISCHARGE: 0.94 LPS
DRAWDOWN:
DEPTH
LOG
FINE SAND
COARSE SAND
BOULDER W/ SAND
SAND
SAND STONE
SAND & GRAVEL
SAND
BLUE STICKY CLAY
CLAY
SAND & GRAVEL
50
100
150
LWUA well no. BPW 4901
LOCATION: HERANDA ST. ANGELES CITY, PAMP.
DEPTH: 142.86 M
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL: 7.32
PUMP TEST DATA
DISCHARGE: 4.73 LPS
DRAWDOWN:
DEPTH
LOG
SANDY CLAY
FINE SAND
SAND & GRAVEL
SANDY CLAY
FINE SAND
YELLOW STICKY CLAY
SAND ROCK W/ COARSE SAND
YELLOW STICKY CLAY
GRAVEL & SAND
SAND ROCK
CLAY
SAND ROCK
YELLOW STICKY CLAY
ADOBE
LWUA well no.
LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG

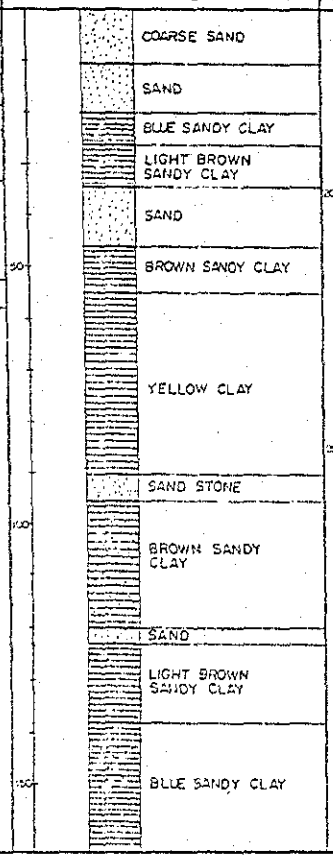
LWUA Well No. BPW-43678

LOCATION: BALIBAGO, ANGELES CITY, PAMPANGA
DEPTH: 56.70 M
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL: 2.44 M
PUMP TEST DATE:
DISCHARGE: 3.78 LPS
DRAWDOWN:



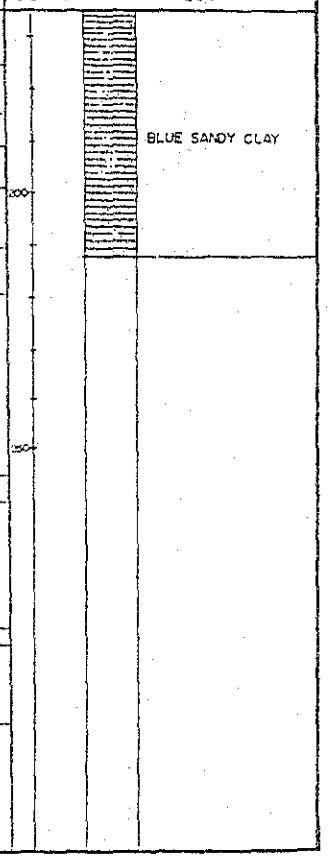
LWUA Well No. BPW-10864

LOCATION: SAN ANGELO SUBD. ANGELES CITY, PAMP.
DEPTH: 213.41 M
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL: 3.65 M
PUMP TEST DATA
DISCHARGE: 15.78 LPS
DRAWDOWN:



LWUA Well No. (CONT.)

LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:



APPENDIX 6.7.1 Selection of Water Quality Examination Points

Selection of these source were done in consideration of the following favors.

- The points are located strategically i.e. possibly covering the whole municipality whereby the results would be representative of the overall condition in the area.
- Samples were collected from areas where water quality is reported to be undesirable.
- Accessibility and easy facilitation for sampling

Over selection of these points was done comprising of:

- Eleven (11) deep wells int he city water supply system (ACWS)
- Five (5) deep wells in the private/public system
- Five (5) shallow wells
- One (1) river
- Four (4) water taps on the service pipe for bacteriological analysis the location of these points is shown in FIGURE 6.7.1.1.

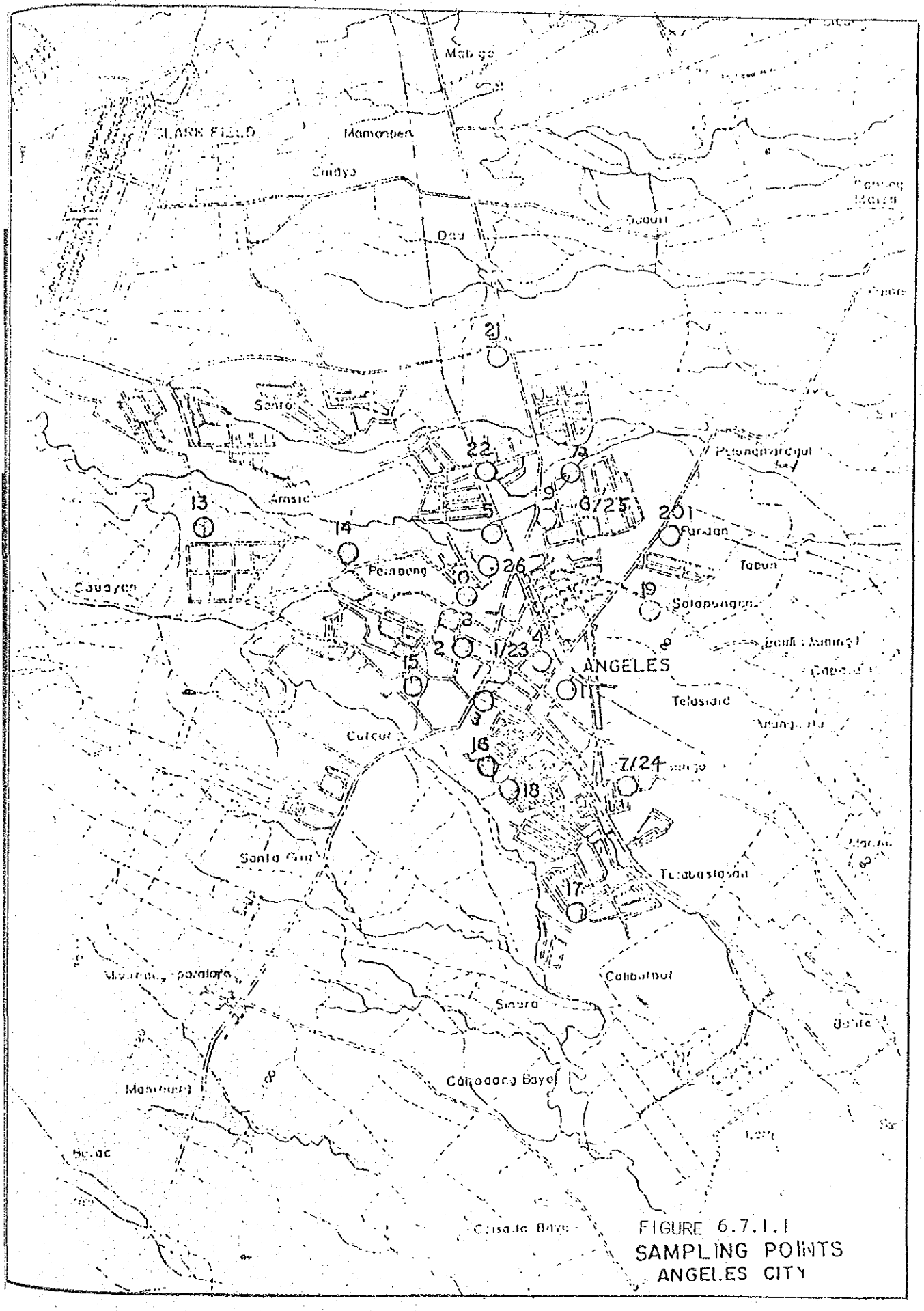


FIGURE 6.7.1.1
SAMPLING POINTS
ANGELES CITY

APPENDIX 6.7.2 WATER QUALITY ANALYSIS - ANGELES CITY

Sample No.	Well No.	Location	* Group	Turb. (FTU)	TDS (mg/l)	pH (-)	EC (μS/cm)	Alk. (mg/l)	Hard. (mg/l)	Acid. (mg/l)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	CO_3 (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Fe (mg/l)	Mn (mg/l)	E.Coli. (MPN)	NO_3-N (mg/l)	NH_4-N (mg/l)
1	ACWS 1	Mabini	A	0.52	128	6.45	147	75	75	84	12.5	2.0	16.4	8.3	0	91.5	18.6	3	0.03	nil	-	3.15	nil
2	ACWS 2	Mabini	A	0.61	195	6.89	255	133	127	22	13	2.1	30.0	12.6	0	162.3	18.6	4	0.03	0.05	-	1.63	nil
3	ACWS 3	Rizal	A	0.40	147	6.45	140	85	97	42	10	2.0	30.0	5.3	0	103.7	18.6	1	0.08	nil	-	2.46	nil
4	ACWS 4	Kuliot	A	0.38	154	6.45	190	95	97	53	13	2.0	25.8	7.3	0	115.9	18.6	2.5	0.05	nil	-	3.95	nil
5	ACWS 5	Balagtas	A	0.48	154	6.45	130	105	97	37	12.5	2.1	20.8	10.9	0	128.1	13.9	1.5	0.03	nil	-	3.95	nil
6	ACWS 6	Pandan	A	0.43	179	6.08	185	110	90	26	22.5	2.0	24.0	7.3	0	134.2	18.6	3.0	0.05	nil	-	6.15	nil
7	ACWS 7	San Joaquin	A	0.43	192	6.85	268	122	112	15	20.0	1.7	24.0	12.6	0	148.8	18.6	5.0	0.05	nil	-	1.14	nil
8	ACWS 8	Pampang Road	A	2.08	147	6.32	150	95	90	33	17.5	1.7	12.0	14.6	0	115.9	13.9	1.5	0.10	nil	-	3.91	nil
9	ACWS 10	McArthur	A	0.41	154	6.15	159	95	82	24	20.0	2.0	20.8	7.3	0	115.9	13.9	1.5	0.15	0.10	-	4.18	nil
10	ACWS 12	Loudrdes N.E.	A	0.50	128	6.09	160	85	75	22	13	2.1	20.8	5.6	0	103.7	13.9	1	0.10	0.10	-	4.58	nil
11	ACWS 14	Ang Elementary School	A	0.52	125	6.52	155	75	75	29	10	2	24	3.6	0	91.5	11.6	3	0.10	0.10	-	2.46	nil
12		Abacan River (Balibago Brdg.)	D	382.	122	7.83	150	66	75	11	8	4.2	20.8	5.6	0	80.5	18.6	7	0.80	0.30	-	6.47	0.07
13	ACWS 50	Timog Park Subd., Cutcut	B	0.56	154	7.09	180	101	97	9	10.5	2	24	8.9	0	126.88	18.6	3	0.12	0.10	-	2.38	nil
14	ACWS 31	Pampang (BPW #17934)	C	0.81	115	6.25	140	70	75	11	6.5	2.3	21	3.6	0	85.4	13.9	3	0.08	nil	-	7.43	nil
15	ACWS 34A	Nepo Subd., Cutcut	C	18.15	160	6.84	260	66	97	15	8.0	2.6	20.8	10.9	0	80.5	18.6	32	0.56	0.10	-	0.80	nil
16	ACWS 36	Villa Teresa Subd.	B	0.62	122	6.58	158	75	75	22	10.5	2.3	15.0	9.1	0	91.5	23.2	4.0	0.12	nil	-	4.65	nil
17	ACWS 37	L & S Subd., Domingo	B	0.42	179	6.41	210	104	112	15	15.5	2.1	18.0	16.3	0	126.9	27.9	14.0	0.10	0.10	-	1.32	nil
18	ACWS 64	Villa Angelina Subd.	C	1.89	102	6.70	142	70	67	15	8	2.2	14.8	7.3	0	85.4	9.3	6.5	0.25	0.10	-	2.95	nil
19	ACWS 16	Mining (BPW #17991)	C	90.0	256	6.65	419	123	127	24	20	5.3	44.8	3.6	0	150.1	41.8	11.0	0.65	0.50	-	3.19	nil
20	ACWS 19A	Pandan (near BPW #17992)	C	5.99	173	5.76	237	85	97	33	10.5	5.2	26.8	7.3	0	103.7	27.9	16.0	0.35	0.10	-	8.17	nil
21	ACWS 26	Balibago (BLVS #1)	B	10.55	160	7.61	220	84	90	20	10	3.1	18	10.9	0	102.5	13.9	11.5	0.30	0.30	-	3.02	nil
22	ACWS 29	Balibago (BLVS #4)	B	0.35	144	7.68	210	104	90	20	8	2.2	24	7.3	0	126.9	13.9	3	0.11	0.10	-	2.34	nil
23	ACWS 1	Mabini St.	E	-																	+	-	-
24	ACWS 7	San Jaguin	E	-																	0	-	-
25	ACWS 6	Pandan	E	-																	0	-	-
26	Faucet	City Engineer's Office	E	-																	0	-	-

*: Category; A - Deep wells in the city water supply system
B - Deep wells in private/public system
C - Shallow wells
D - River
E - Water taps on the service pipe

Philippine National Standards 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)

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

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

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.

APPENDIX 7.2.1 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) 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	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 Depart

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

(5) 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 Depart

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

(6) Internal Network

Population Density (Person/ha)	Total Length of Pipeline (m/ha)	Unit Cost (₱/ha) Diameter (100/150)	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

(7) 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

(8) 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

(9) 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

(10) 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

(11) 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

(12) Energy Cost

$$C = N_p (h)(Pu)(Em)^{-1}$$

where,

C = cost (thousand peso)

N_p = pump power demand (kw)

h = hours of operation

P_u = unit power cost (₱/kwH)

E_m = motor efficiency (0.85)

(13) 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)

(14) 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 7.2.2 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 7.3.1 Cost Estimates of Water Source Alternatives

(Unit : ₱x1,000)

Required Facilities	Unit Cost (₱)	Alternative S-1		Alternative S-2		Alternative S-3	
		Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
Water Sources							
Deep Well	940,000	18	16,920	11	10,340	-	-
Deep Well Pump	640,000	18	11,520	11	7,040	-	-
River Water Intake							
Booster Pump (226 l/s, H=25m)	-	-	-	1	3,694	-	-
Booster Pump (600 l/s, H=40m)	-	-	-	-	-	1	8,414
Sub Total			28,440		21,074		8,414
Transmission Line							
ϕ200 mm	520	4,700 m	2,444	2,700 m	1,404	-	-
ϕ250 mm	630	2,300 m	1,449	2,300 m	1,449	-	-
ϕ300 mm	760	500 m	380	-	-	-	-
ϕ400 mm	970	500 m	485	-	-	-	-
ϕ450 mm	1,160	2,800 m	3,248	-	-	-	-
ϕ600 mm	1,600	-	-	10,000 m	16,000	-	-
ϕ700 mm	1,910	-	-	-	-	10,000	19,100
Sub Total			8,006		18,853		19,100
Treatment Facility							
Slow Sand Filter	-	-	-	3,900 sq.m	8,190	10,280 sq.m	18,504
TOTAL CONSTRUCTION COST			36,846		48,117		46,018
Operation & Maintenance(15 years)							
Energy	0.30/kWH	52,003 MWH	15,610	44,320 MWH	13,296	52,000 MWH	15,600
Maintenance (10% of Construction Cost)			3,685		4,812		4,602
TOTAL			19,295		18,108		20,202
GRAND TOTAL			56,141		66,225		66,220

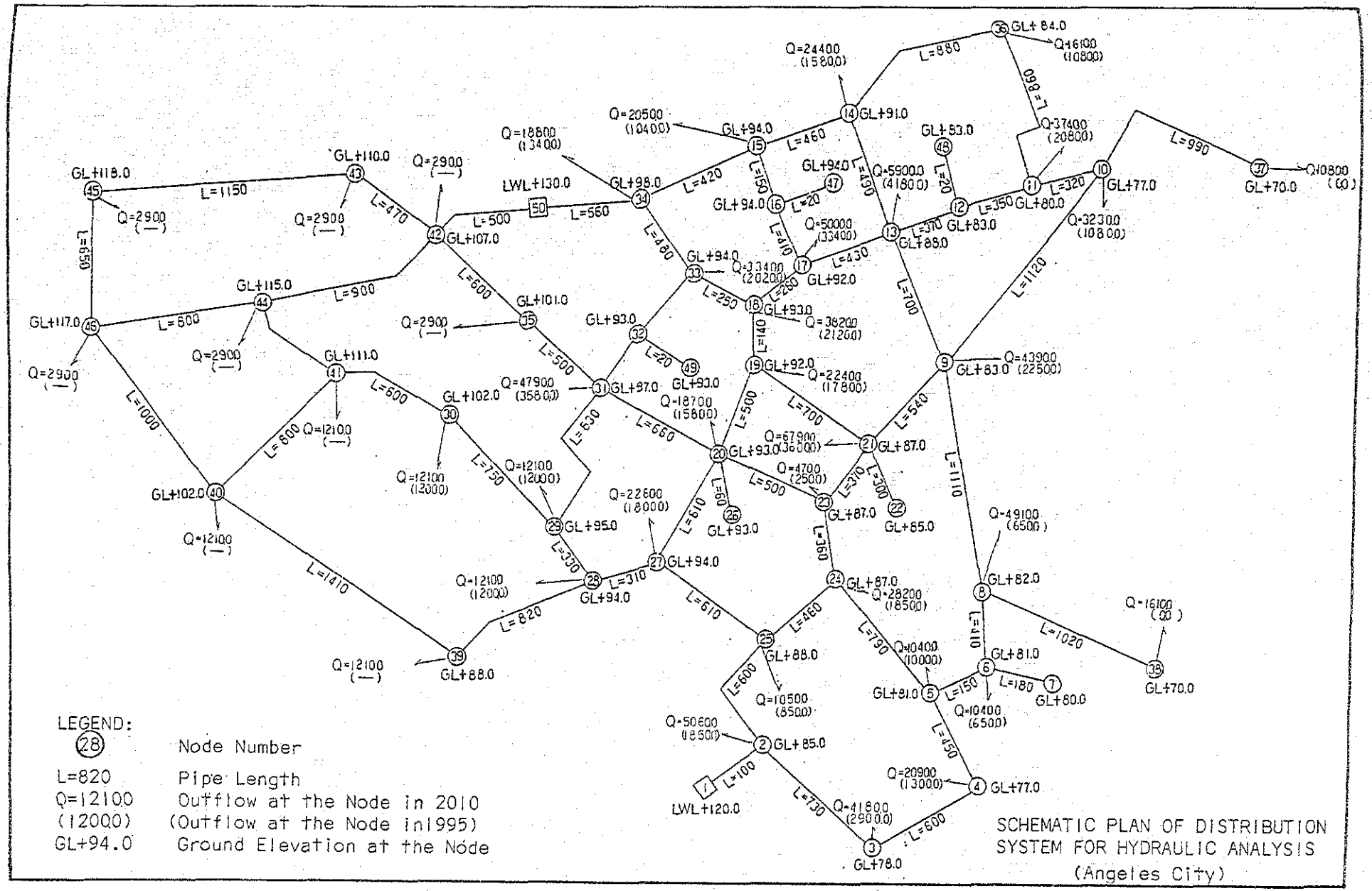
APPENDIX 7.3.2 COMPUTER-AIDED HYDRAULIC ANALYSIS OF DISTRIBUTION SYSTEM (Angeles City)

o List of Computed Cases

Alternative	D-1	(2010)	
	D-2	(2010)	
	D-3	(2010)	Southwest Area
	D-3/D-4	(2010)	Northeast Area
	D-4-A	(1995, 2010)	Southwest Area
	D-4-B	(1995, 2010)	Southwest Area

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.


LEGEND:
(28) Node Number
L=820 Pipe Length
Q=12100 Outflow at the Node in 2010
(12000) (Outflow at the Node in1995)
GL+94.0 Ground Elevation at the Node
SCHEMATIC PLAN OF DISTRIBUTION SYSTEM FOR HYDRAULIC ANALYSIS
(Angeles City)

ALTERNATIVE D-1
1 Supply System w/2 Reservoirs, Year2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	120.00	0.00	120.00	0.00	10.00
2	85.00	5060.00	119.83	34.83	45.00
3	78.00	4180.00	116.98	38.98	52.00
4	77.00	2090.00	115.56	38.56	53.00
5	81.00	1040.00	114.77	33.77	49.00
6	81.00	1040.00	114.41	33.41	49.00
7	80.00	-1400.00	116.00	36.00	50.00
8	82.00	4910.00	112.39	30.39	48.00
9	83.00	4390.00	107.86	24.86	47.00
10	77.00	3230.00	104.18	27.18	53.00
11	80.00	3740.00	103.62	23.62	50.00
12	83.00	0.00	104.61	21.61	47.00
13	88.00	5900.00	105.60	17.60	42.00
14	91.00	2440.00	105.40	14.40	39.00
15	94.00	2050.00	106.10	12.10	36.00
16	94.00	0.00	106.19	12.19	36.00
17	92.00	5000.00	106.19	14.19	38.00
18	93.00	3820.00	107.37	14.37	37.00
19	92.00	2240.00	108.01	16.01	38.00
20	93.00	1870.00	111.31	18.31	37.00
21	87.00	6790.00	110.12	23.12	43.00
22	85.00	-2900.00	120.30	35.30	45.00
23	87.00	470.00	113.05	26.05	43.00
24	87.00	2820.00	114.63	27.63	43.00
25	88.00	1050.00	116.17	28.17	42.00
26	93.00	-2700.00	111.75	18.75	37.00
27	94.00	2250.00	114.01	20.01	36.00
28	94.00	1210.00	113.44	19.44	36.00
29	95.00	1210.00	112.88	17.88	35.00
30	102.00	1210.00	112.52	10.52	28.00
31	97.00	4790.00	113.01	16.01	33.00
32	93.00	0.00	111.50	18.50	37.00
33	94.00	3340.00	108.39	14.39	36.00
34	98.00	1880.00	109.70	11.70	32.00
35	101.00	290.00	118.77	17.77	29.00
36	84.00	1610.00	101.69	17.69	46.00
37	70.00	1080.00	98.79	28.79	60.00
38	70.00	1610.00	100.75	30.75	60.00
39	88.00	1210.00	112.86	24.86	42.00
40	102.00	1210.00	112.19	10.19	28.00
41	111.00	1210.00	125.31	14.31	19.00
42	107.00	290.00	125.91	18.91	23.00
43	110.00	290.00	125.86	15.86	20.00
44	115.00	290.00	125.55	10.55	15.00
45	118.00	290.00	125.72	7.72	12.00
46	117.00	290.00	125.46	8.46	13.00
47	94.00	-1600.00	106.42	12.42	35.00
48	83.00	-1600.00	104.84	21.84	47.00
49	93.00	-1300.00	111.65	18.65	37.00
50	130.00	0.00	130.00	0.00	0.00

Iteration Times : 20

ALTERNATIVE D-1
1 Supply System w/2 Reservoirs, 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	600.	100.	130.	-26224.	-1.07	-0.17	-1.72
2	2	1	600.	100.	130.	-26224.	-1.07	-0.17	-1.72
3	2	3	450.	730.	120.	17698.	1.29	2.85	3.90
4	2	25	500.	600.	120.	29691.	1.75	3.66	6.09
5	3	4	450.	600.	120.	13518.	0.98	1.42	2.37
6	4	5	450.	450.	120.	11428.	0.83	0.78	1.74
7	5	6	400.	150.	120.	10020.	0.92	0.36	2.42
8	5	24	200.	790.	110.	367.	0.14	0.14	0.18
9	6	7	150.	180.	110.	-1400.	-0.92	-1.59	-8.81
10	6	8	350.	410.	120.	10380.	1.25	2.03	4.94
11	8	38	150.	1020.	110.	1610.	1.05	11.64	11.41
12	8	9	250.	1110.	120.	3860.	0.91	4.52	4.08
13	9	10	300.	1120.	120.	5553.	0.91	3.68	3.29
14	9	13	250.	700.	120.	3406.	0.80	2.26	3.23
15	9	21	350.	540.	120.	-9498.	-1.14	-2.26	-4.18
16	10	37	150.	990.	110.	1080.	0.71	5.39	5.45
17	10	11	200.	320.	110.	1243.	0.45	0.56	1.74
18	11	36	150.	860.	110.	669.	0.44	1.93	2.25
19	11	12	250.	350.	120.	-3167.	-0.75	-0.99	-2.82
20	12	13	200.	370.	110.	-1567.	-0.58	-0.99	-2.67
21	12	48	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
22	13	14	250.	490.	120.	1111.	0.26	0.20	0.41
23	13	17	350.	430.	120.	-5172.	-0.62	-0.58	-1.36
24	14	36	150.	880.	110.	941.	0.62	3.71	4.22
25	14	15	250.	460.	120.	-2270.	-0.54	-0.70	-1.52
26	15	16	250.	150.	120.	-1379.	-0.33	-0.09	-0.61
27	15	34	200.	420.	110.	-2940.	-1.08	-3.60	-8.57
28	16	17	250.	410.	120.	220.	0.05	0.01	0.02
29	16	47	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
30	17	18	350.	260.	120.	-9951.	-1.20	-1.19	-4.57
31	18	19	350.	140.	120.	-9906.	-1.19	-0.63	-4.53
32	18	33	250.	250.	120.	-3665.	-0.91	-1.02	-4.09
33	19	20	350.	500.	120.	-12146.	-1.46	-3.31	-6.61
34	20	26	200.	60.	110.	-2700.	-0.99	-0.44	-7.32
35	20	27	250.	610.	120.	-4030.	-0.95	-2.69	-4.41
36	20	31	350.	660.	120.	-7286.	-0.88	-1.69	-2.57
37	21	22	150.	360.	110.	-2900.	-1.90	-10.18	-33.93
38	21	23	350.	370.	120.	-13378.	-1.61	-2.93	-7.91
39	23	24	400.	360.	120.	-13848.	-1.28	-1.58	-4.40
40	24	25	450.	460.	120.	-16301.	-1.19	-1.54	-3.35
41	25	27	400.	610.	120.	12340.	1.14	2.17	3.55
42	27	28	350.	310.	120.	6050.	0.73	0.56	1.82
43	28	29	250.	330.	120.	2420.	0.57	0.57	1.72
44	28	39	300.	820.	120.	2420.	0.40	0.58	0.71
45	29	30	250.	750.	120.	1210.	0.29	0.36	0.48
46	31	35	350.	500.	120.	-16397.	-1.97	-5.75	-11.53
47	31	32	250.	300.	120.	4322.	1.02	1.51	5.02
48	32	33	250.	380.	120.	5622.	1.33	3.11	8.17
49	32	49	150.	20.	110.	-1300.	-0.85	-0.15	-7.68
50	33	34	200.	480.	110.	-1584.	-0.58	-1.31	-2.73
51	34	50	200.	560.	110.	-6404.	-2.36	-20.30	-36.24
52	35	42	350.	600.	120.	-16687.	-2.01	-7.14	-11.91
53	39	40	250.	1410.	120.	1210.	0.29	0.67	0.48
54	41	44	250.	500.	120.	-1210.	-0.29	-0.24	-0.48
55	42	43	250.	470.	120.	580.	0.14	0.06	0.12

ALTERNATIVE D-1
1 Supply System w/2 Reservoirs, 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)
56	42	44	300.	900.	120.	1790.	0.29	0.36	0.40
57	42	50	400.	500.	120.	-19347.	-1.78	-4.09	-8.17
58	43	45	200.	1150.	110.	290.	0.11	0.14	0.12
59	44	46	200.	800.	110.	290.	0.11	0.09	0.12

ALTERNATIVE D-2
1 Supply System w/1 Reservoir, Year2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	120.00	0.00	120.00	0.00	0.00
2	85.00	5060.00	119.84	34.84	35.00
3	78.00	4180.00	116.85	38.85	42.00
4	77.00	2090.00	114.51	37.51	43.00
5	81.00	1040.00	113.42	32.42	39.00
6	81.00	1040.00	112.83	31.83	39.00
7	80.00	-1400.00	114.41	34.41	40.00
8	82.00	4910.00	111.09	29.09	38.00
9	83.00	4390.00	108.19	25.19	37.00
10	77.00	3230.00	100.62	23.62	43.00
11	80.00	3740.00	100.39	20.39	40.00
12	83.00	0.00	104.35	21.35	37.00
13	88.00	5900.00	105.64	17.64	32.00
14	91.00	2440.00	105.13	14.13	29.00
15	94.00	2050.00	106.68	12.68	26.00
16	94.00	0.00	106.99	12.99	26.00
17	92.00	5000.00	106.85	14.85	26.00
18	93.00	3820.00	107.24	14.24	27.00
19	92.00	2240.00	107.73	15.73	28.00
20	93.00	1870.00	110.39	17.39	27.00
21	87.00	6790.00	111.02	24.02	33.00
22	85.00	-2900.00	121.20	36.20	35.00
23	87.00	470.00	113.98	26.98	33.00
24	87.00	2820.00	115.67	28.67	33.00
25	88.00	1050.00	117.80	29.80	32.00
26	93.00	-2700.00	110.83	17.83	27.00
27	94.00	2260.00	113.95	19.95	26.00
28	94.00	1210.00	113.38	19.38	26.00
29	95.00	1210.00	111.41	16.41	25.00
30	102.00	1210.00	110.17	8.17	18.00
31	97.00	4790.00	109.14	12.14	23.00
32	93.00	0.00	108.65	15.65	27.00
33	94.00	3340.00	107.96	13.96	26.00
34	98.00	1880.00	109.29	11.29	22.00
35	101.00	290.00	108.24	7.24	19.00
36	84.00	1610.00	99.53	15.53	36.00
37	70.00	1080.00	95.23	25.23	50.00
38	70.00	1610.00	99.45	29.45	50.00
39	88.00	1210.00	111.97	23.97	32.00
40	102.00	1210.00	109.64	7.64	18.00
41	111.00	1210.00	123.81	12.81	9.00
42	107.00	290.00	127.26	20.26	13.00
43	110.00	290.00	127.06	17.06	10.00
44	115.00	290.00	124.64	9.64	5.00
45	118.00	290.00	126.51	8.51	2.00
46	117.00	290.00	124.26	7.26	3.00
47	94.00	-1600.00	107.22	13.22	26.00
48	83.00	-1600.00	104.57	21.57	37.00
49	93.00	-1300.00	108.80	15.80	27.00
50	105.00	-2900.00	127.01	22.01	15.00
51	0.00	0.00	128.24	128.24	120.00
52	0.00	0.00	107.26	107.26	120.00

Iteration Times : 18

ALTERNATIVE D-2
1 Supply System w/1 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	700.	100.	130.	-37650.	-1.13	-0.16	-1.58
2	2	1	700.	100.	130.	-37650.	-1.13	-0.16	-1.58
3	2	3	400.	730.	120.	13324.	1.23	2.99	4.10
4	2	25	700.	600.	130.	56916.	1.71	2.04	3.40
5	3	4	350.	600.	120.	9144.	1.10	2.34	3.91
6	4	5	350.	450.	120.	7054.	0.85	1.09	2.42
7	5	6	350.	150.	120.	9196.	1.11	0.59	3.95
8	5	24	250.	790.	120.	-3183.	-0.75	-2.25	-2.85
9	6	7	150.	180.	110.	-1400.	-0.92	-1.59	-8.81
10	6	8	350.	410.	120.	9555.	1.15	1.74	4.24
11	8	38	150.	1020.	110.	1510.	1.05	11.64	11.41
12	8	9	250.	1110.	120.	3036.	0.72	2.90	2.61
13	9	10	250.	1120.	120.	5073.	1.20	7.57	6.76
14	9	13	350.	700.	120.	8798.	1.06	2.55	3.64
15	9	21	400.	540.	120.	-15225.	-1.40	-2.83	-5.24
16	10	37	150.	990.	110.	1080.	0.71	5.39	5.45
17	10	11	200.	320.	110.	763.	0.28	0.23	0.70
18	11	36	150.	860.	110.	435.	0.28	0.87	1.01
19	11	12	200.	350.	110.	-3412.	-1.26	-3.95	-11.29
20	12	13	200.	370.	110.	-1812.	-0.67	-1.29	-3.50
21	12	48	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
22	13	14	250.	490.	120.	1841.	0.43	0.51	1.03
23	13	17	150.	430.	110.	-754.	-0.49	-1.20	-2.80
24	14	36	150.	880.	110.	1175.	0.77	5.61	6.37
25	14	15	200.	460.	110.	-1775.	-0.65	-1.55	-3.37
26	15	16	200.	150.	110.	-1355.	-0.50	-0.31	-2.04
27	15	34	200.	420.	110.	-2470.	-0.91	-2.61	-6.21
28	16	17	150.	410.	110.	245.	0.16	0.14	0.35
29	16	47	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
30	17	18	350.	260.	120.	-5509.	-0.66	-0.40	-1.53
31	18	19	350.	140.	120.	-8568.	-1.03	-0.49	-3.46
32	18	33	150.	250.	110.	-761.	-0.50	-0.71	-2.85
33	19	20	350.	500.	120.	-10808.	-1.30	-2.66	-5.33
34	20	26	200.	60.	110.	-2700.	-0.99	-0.44	-7.32
35	20	27	450.	610.	120.	-21969.	-1.60	-3.55	-5.83
36	20	31	450.	660.	120.	11991.	0.87	1.25	1.90
37	21	22	150.	300.	110.	-2900.	-1.90	-10.18	-33.93
38	21	23	400.	370.	120.	-19115.	-1.76	-2.96	-7.99
39	23	24	450.	360.	120.	-19585.	-1.43	-1.70	-4.71
40	24	25	500.	460.	120.	-25587.	-1.51	-2.13	-4.63
41	25	27	500.	610.	120.	30279.	1.78	3.85	6.32
42	27	28	350.	310.	120.	6050.	0.73	0.56	1.82
43	28	29	200.	330.	110.	2420.	0.89	1.97	5.98
44	28	39	250.	820.	120.	2420.	0.57	1.41	1.72
45	29	30	200.	750.	110.	1210.	0.45	1.24	1.66
46	31	35	350.	500.	120.	6001.	0.72	0.90	1.79
47	31	32	200.	300.	110.	1200.	0.44	0.49	1.63
48	32	33	250.	380.	120.	2501.	0.59	0.69	1.82
49	32	49	150.	20.	110.	-1300.	-0.85	-0.15	-7.58
50	33	34	200.	480.	110.	-1601.	-0.59	-1.33	-2.78
51	34	50	200.	560.	110.	-5951.	-2.19	-17.72	-31.63
52	35	52	350.	600.	120.	5711.	0.69	0.98	1.63
53	39	40	200.	1410.	110.	1210.	0.45	2.34	1.66
54	41	44	200.	500.	110.	-1210.	-0.45	-0.83	-1.66
55	42	43	200.	470.	110.	580.	0.21	0.20	0.42

ALTERNATIVE D-2
1 Supply System w/1 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)
56	42	44	200.	900.	120.	1790.	0.66	2.62	2.91
57	42	50	350.	500.	120.	3051.	0.37	0.26	0.51
58	42	51	350.	600.	120.	-5711.	-0.69	-0.98	-1.63
59	43	45	150.	1150.	110.	290.	0.19	0.55	0.48
60	44	46	150.	800.	110.	290.	0.19	0.38	0.48

ALTERNATIVE D-3
2 Supply Systems w/3 Reservoirs, Southwest Area, Year2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	120.00	0.00	120.00	0.00	10.00
2	85.00	5060.00	119.84	34.84	45.00
3	78.00	4180.00	117.05	39.05	52.00
4	77.00	2090.00	115.68	38.68	53.00
5	81.00	1040.00	114.92	33.92	49.00
6	81.00	1040.00	114.56	33.56	49.00
7	80.00	-1400.00	116.15	36.15	50.00
8	82.00	4910.00	112.53	30.53	48.00
9	83.00	4390.00	108.01	25.01	47.00
10	77.00	3230.00	104.29	27.29	53.00
11	80.00	3740.00	103.71	23.71	50.00
12	83.00	0.00	104.68	21.68	47.00
13	88.00	5900.00	105.64	17.64	42.00
14	91.00	2440.00	105.43	14.43	39.00
15	94.00	2050.00	106.12	12.12	36.00
16	94.00	0.00	106.21	12.21	36.00
17	92.00	5000.00	106.20	14.20	38.00
18	93.00	3820.00	107.37	14.37	37.00
19	92.00	2240.00	106.00	16.00	38.00
20	93.00	1870.00	111.31	18.31	37.00
21	87.00	6790.00	110.32	23.32	43.00
22	85.00	-2900.00	120.50	35.50	45.00
23	87.00	470.00	113.29	26.29	43.00
24	87.00	2820.00	114.90	27.90	43.00
25	88.00	1050.00	116.50	28.50	42.00
26	93.00	-2700.00	111.75	18.75	37.00
27	94.00	2260.00	114.87	20.87	36.00
28	94.00	1210.00	114.65	20.65	36.00
29	95.00	1210.00	114.09	19.09	35.00
30	102.00	1210.00	113.73	11.73	28.00
31	97.00	4790.00	112.74	15.74	33.00
32	93.00	0.00	111.31	18.31	37.00
33	94.00	3340.00	108.34	14.34	36.00
34	98.00	1880.00	109.68	11.68	32.00
35	101.00	290.00	118.01	17.01	29.00
36	84.00	1610.00	101.75	17.75	46.00
37	70.00	1080.00	98.90	28.90	60.00
38	70.00	1610.00	100.90	30.90	60.00
39	88.00	0.00	108.00	20.00	42.00
40	102.00	0.00	122.00	20.00	28.00
41	111.00	0.00	131.00	20.00	19.00
42	107.00	0.00	127.00	20.00	23.00
43	110.00	0.00	130.00	20.00	20.00
44	115.00	0.00	135.00	20.00	15.00
45	118.00	0.00	138.00	20.00	12.00
46	117.00	0.00	137.00	20.00	13.00
47	94.00	-1600.00	106.44	12.44	36.00
48	83.00	-1600.00	104.90	21.90	47.00
49	93.00	-1300.00	111.47	18.47	37.00
50	130.00	0.00	130.00	0.00	0.00

Iteration Times : 19

ALTERNATIVE D-3
2 Supply Systems w/3 Reservoirs, Southwest Area, 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	600.	100.	130.	-25400.	-1.04	-0.16	-1.62
2	2	1	600.	100.	130.	-25400.	-1.04	-0.16	-1.62
3	2	3	450.	730.	120.	17473.	1.27	2.78	3.81
4	2	25	500.	600.	120.	28267.	1.67	3.34	5.56
5	3	4	450.	600.	120.	13293.	0.97	1.38	2.30
6	4	5	450.	450.	120.	11203.	0.82	0.75	1.67
7	5	6	400.	150.	120.	10022.	0.92	0.36	2.42
8	5	24	200.	790.	110.	141.	0.05	0.02	0.03
9	6	7	150.	180.	110.	-1400.	-0.92	-1.59	-8.81
10	6	8	350.	410.	120.	10382.	1.25	2.03	4.94
11	8	38	150.	1020.	110.	1610.	1.05	11.64	11.41
12	8	9	250.	1110.	120.	3862.	0.91	4.53	4.08
13	9	10	300.	1120.	120.	5583.	0.91	3.72	3.32
14	9	13	250.	700.	120.	3492.	0.82	2.37	3.39
15	9	21	350.	540.	120.	-9603.	-1.16	-2.31	-4.28
16	10	37	150.	990.	110.	1080.	0.71	5.39	5.45
17	10	11	200.	320.	110.	1273.	0.47	0.58	1.82
18	11	36	150.	860.	110.	674.	0.44	1.95	2.27
19	11	12	250.	350.	120.	-3141.	-0.74	-0.97	-2.78
20	12	13	200.	370.	110.	-1541.	-0.57	-0.96	-2.59
21	12	48	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
22	13	14	250.	490.	120.	1129.	0.27	0.20	0.42
23	13	17	350.	430.	120.	-5077.	-0.61	-0.57	-1.31
24	14	36	150.	880.	110.	936.	0.61	3.68	4.18
25	14	15	250.	450.	120.	-2248.	-0.53	-0.69	-1.50
26	15	16	250.	150.	120.	-1375.	-0.32	-0.09	-0.60
27	15	34	200.	420.	110.	-2922.	-1.08	-3.56	-8.48
28	16	17	250.	410.	120.	224.	0.05	0.01	0.02
29	16	47	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
30	17	18	350.	260.	120.	-9852.	-1.19	-1.17	-4.49
31	18	19	350.	140.	120.	-9913.	-1.19	-0.64	-4.54
32	18	33	250.	250.	120.	-3759.	-0.89	-0.97	-3.88
33	19	20	350.	500.	120.	-12153.	-1.46	-3.31	-6.62
34	20	26	200.	60.	110.	-2700.	-0.99	-0.44	-7.32
35	20	27	250.	610.	120.	-4685.	-1.10	-3.56	-5.83
36	20	31	350.	650.	120.	-6638.	-0.80	-1.43	-2.16
37	21	22	150.	300.	110.	-2900.	-1.90	-10.18	-33.93
38	21	23	350.	370.	120.	-13493.	-1.62	-2.97	-8.03
39	23	24	400.	350.	120.	-13963.	-1.29	-1.61	-4.47
40	24	25	450.	450.	120.	-16642.	-1.21	-1.60	-3.48
41	25	27	400.	610.	120.	10575.	0.97	1.63	2.67
42	27	28	350.	310.	120.	3630.	0.44	0.22	0.71
43	28	29	250.	330.	120.	2420.	0.57	0.57	1.72
44	29	30	250.	750.	120.	1210.	0.29	0.36	0.48
45	31	35	350.	500.	120.	-15522.	-1.88	-5.27	-10.54
46	31	32	250.	300.	120.	4193.	0.99	1.42	4.75
47	32	33	250.	380.	120.	5493.	1.30	2.98	7.83
48	32	49	150.	20.	110.	-1300.	-0.85	-0.15	-7.68
49	33	34	200.	480.	110.	-1605.	-0.59	-1.34	-2.80
50	34	50	200.	550.	110.	-6408.	-2.36	-20.32	-36.28
51	35	50	350.	1100.	120.	-15912.	-1.91	-11.99	-10.90

ALTERNATIVE D-3, D-4(Recommended Plan):-A(Single P.);-B(Parallel P.)
2 Supply Systems w/2 or 3 Reservoirs, Northeast Area, Year2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	120.00	0.00	140.00	20.00	10.00
2	85.00	0.00	105.00	20.00	45.00
3	78.00	0.00	98.00	20.00	52.00
4	77.00	0.00	97.00	20.00	53.00
5	81.00	0.00	101.00	20.00	49.00
6	81.00	0.00	101.00	20.00	49.00
7	80.00	0.00	100.00	20.00	50.00
8	82.00	0.00	102.00	20.00	48.00
9	83.00	0.00	103.00	20.00	47.00
10	77.00	0.00	97.00	20.00	53.00
11	80.00	0.00	100.00	20.00	50.00
12	83.00	0.00	103.00	20.00	47.00
13	88.00	0.00	108.00	20.00	42.00
14	91.00	0.00	111.00	20.00	39.00
15	94.00	0.00	114.00	20.00	36.00
16	94.00	0.00	114.00	20.00	36.00
17	92.00	0.00	112.00	20.00	38.00
18	93.00	0.00	113.00	20.00	37.00
19	92.00	0.00	112.00	20.00	38.00
20	93.00	0.00	113.00	20.00	37.00
21	87.00	0.00	107.00	20.00	43.00
22	85.00	0.00	105.00	20.00	45.00
23	87.00	0.00	107.00	20.00	43.00
24	87.00	0.00	107.00	20.00	43.00
25	88.00	0.00	108.00	20.00	42.00
26	93.00	0.00	113.00	20.00	37.00
27	94.00	0.00	114.00	20.00	36.00
28	94.00	0.00	114.00	20.00	36.00
29	95.00	0.00	115.00	20.00	35.00
30	102.00	0.00	122.00	20.00	28.00
31	97.00	0.00	117.00	20.00	33.00
32	93.00	0.00	113.00	20.00	37.00
33	94.00	0.00	114.00	20.00	36.00
34	98.00	0.00	118.00	20.00	32.00
35	101.00	0.00	121.00	20.00	29.00
36	84.00	0.00	104.00	20.00	46.00
37	70.00	0.00	90.00	20.00	60.00
38	70.00	0.00	90.00	20.00	60.00
39	88.00	1210.00	111.25	23.25	42.00
40	102.00	1210.00	120.73	18.73	28.00
41	111.00	1210.00	120.80	9.80	19.00
42	107.00	290.00	120.94	13.94	23.00
43	110.00	290.00	121.41	11.41	20.00
44	115.00	290.00	124.25	9.25	15.00
45	118.00	290.00	129.93	11.93	12.00
46	117.00	290.00	126.63	9.63	13.00
47	94.00	0.00	114.00	20.00	36.00
48	83.00	0.00	103.00	20.00	47.00
49	93.00	0.00	113.00	20.00	37.00
50	130.00	0.00	150.00	20.00	0.00
51	130.00	0.00	130.00	0.00	0.00

Iteration Times : 21

ALTERNATIVE D-3, D-4(Recommended Plan):-A(Single P.);-B(Parallel P.)
2 Supply Systems w/2 or 3 Reservoirs, Northeast Area, 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	39	40	150.	1410.	110.	-1210.	-0.79	-9.48	-6.72
2	40	46	200.	1000.	110.	-2402.	-0.88	-5.90	-5.90
3	40	41	75.	800.	110.	-18.	-0.05	-0.06	-0.08
4	41	44	150.	500.	110.	-1228.	-0.80	-3.45	-6.91
5	42	43	100.	470.	110.	-149.	-0.22	-0.47	-1.00
6	42	44	75.	900.	110.	-141.	-0.37	-3.31	-3.67
7	43	45	100.	1150.	110.	-439.	-0.65	-8.52	-7.41
8	44	45	200.	800.	110.	-1659.	-0.61	-2.38	-2.97
9	45	51	250.	10.	120.	-5080.	-1.20	-0.07	-6.77
10	45	46	250.	650.	120.	4351.	1.03	3.31	5.09

ALTERNATIVE D-4-A (Recommended Plan, Single Pipeline Alignment)
2 Supply Systems w/2 Reservoirs, Southwest Area, Year1995

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	120.00	0.00	120.00	0.00	0.00
2	85.00	1850.00	119.86	34.86	35.00
3	78.00	2900.00	119.36	41.36	42.00
4	77.00	1300.00	119.19	42.19	43.00
5	81.00	1000.00	119.16	38.16	39.00
6	81.00	650.00	119.16	38.16	39.00
7	80.00	-1400.00	120.75	40.75	40.00
8	82.00	650.00	119.15	37.15	38.00
9	83.00	2250.00	116.94	33.94	37.00
10	77.00	1080.00	109.63	32.63	43.00
11	80.00	2080.00	111.38	31.38	40.00
12	83.00	0.00	114.81	31.81	37.00
13	88.00	4160.00	115.79	27.79	32.00
14	91.00	1580.00	105.60	14.60	29.00
15	94.00	1040.00	108.88	14.88	26.00
16	94.00	0.00	109.59	15.59	26.00
17	92.00	3340.00	114.05	22.05	28.00
18	93.00	2120.00	114.25	21.26	27.00
19	92.00	1760.00	114.57	22.57	28.00
20	93.00	1580.00	116.27	23.27	27.00
21	87.00	3600.00	117.80	30.80	33.00
22	85.00	-2900.00	127.98	42.98	35.00
23	87.00	250.00	118.49	31.49	33.00
24	87.00	1850.00	118.88	31.88	33.00
25	88.00	850.00	119.31	31.31	32.00
26	93.00	-2700.00	116.71	23.71	27.00
27	94.00	1800.00	117.25	23.25	26.00
28	94.00	1200.00	116.14	22.14	26.00
29	95.00	1200.00	114.20	19.20	25.00
30	102.00	1200.00	112.98	10.98	18.00
31	97.00	3580.00	116.14	19.14	23.00
32	93.00	0.00	109.83	16.83	27.00
33	94.00	2020.00	109.63	15.63	26.00
34	98.00	1340.00	109.99	11.99	22.00
35	101.00	0.00	121.00	20.00	19.00
36	84.00	1080.00	100.81	16.81	36.00
37	70.00	0.00	90.00	20.00	50.00
38	70.00	0.00	90.00	20.00	50.00
39	88.00	0.00	108.00	20.00	32.00
40	102.00	0.00	122.00	20.00	18.00
41	111.00	0.00	131.00	20.00	9.00
42	107.00	0.00	127.00	20.00	13.00
43	110.00	0.00	130.00	20.00	10.00
44	115.00	0.00	135.00	20.00	5.00
45	118.00	0.00	138.00	20.00	2.00
46	117.00	0.00	137.00	20.00	3.00
47	94.00	-1600.00	109.82	15.82	26.00
48	83.00	-1600.00	115.03	32.03	37.00
49	93.00	-1300.00	109.99	16.99	27.00
50	105.00	-2900.00	114.67	9.67	15.00

Iteration Times : 36

ALTERNATIVE D-4-A (Recommended Plan, Single Pipeline Alignment)
2 Supply Systems w/2 Reservoirs, Southwest Area, Year1995

<< 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	700.	100.	130.	-34958.	-1.05	-0.14	-1.38
2	2	3	400.	730.	120.	5108.	0.47	0.51	0.69
3	2	25	700.	600.	130.	28000.	0.84	0.55	0.92
4	3	4	350.	600.	120.	2207.	0.27	0.17	0.28
5	4	5	350.	450.	120.	907.	0.11	0.02	0.05
6	5	6	350.	150.	120.	-99.	-0.01	0.00	0.00
7	6	7	150.	160.	110.	-1400.	-0.92	-1.59	-8.81
8	6	8	350.	410.	120.	650.	0.08	0.01	0.03
9	9	13	350.	700.	120.	5740.	0.69	1.16	1.65
10	9	21	400.	540.	120.	-7990.	-0.74	-0.86	-1.59
11	10	11	150.	320.	110.	-1080.	-0.71	-1.74	-5.45
12	11	12	200.	350.	110.	-3160.	-1.16	-3.43	-9.80
13	12	13	200.	370.	110.	-1560.	-0.57	-0.98	-2.65
14	12	48	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
15	14	36	150.	880.	110.	1080.	0.71	4.79	5.45
16	14	15	200.	460.	110.	-2660.	-0.98	-3.28	-7.12
17	15	16	200.	150.	110.	-2140.	-0.79	-0.71	-4.76
18	15	34	200.	420.	110.	-1560.	-0.57	-1.11	-2.65
19	16	17	100.	410.	110.	-540.	-0.80	-4.46	-10.87
20	16	47	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
21	17	18	350.	250.	120.	-3880.	-0.47	-0.21	-0.80
22	18	19	350.	140.	120.	-6720.	-0.81	-0.31	-2.21
23	18	33	100.	250.	110.	720.	1.06	4.63	18.52
24	19	20	350.	500.	120.	-8500.	-1.02	-1.71	-3.41
25	20	26	200.	60.	110.	-2700.	-0.99	-0.44	-7.32
26	20	27	450.	610.	120.	-10960.	-0.80	-0.98	-1.61
27	20	31	450.	660.	120.	3580.	0.25	0.13	0.20
28	21	22	150.	300.	110.	-2900.	-1.90	-10.18	-33.93
29	21	23	400.	370.	120.	-8690.	-0.80	-0.69	-1.85
30	23	24	450.	360.	120.	-8940.	-0.65	-0.40	-1.10
31	24	25	500.	460.	120.	-10790.	-0.64	-0.43	-0.93
32	25	27	450.	610.	120.	16360.	1.19	2.05	3.38
33	27	28	250.	310.	120.	3600.	0.85	1.11	3.58
34	28	29	200.	330.	110.	2400.	0.88	1.94	5.89
35	29	30	200.	750.	110.	1200.	0.44	1.22	1.63
36	32	33	250.	380.	120.	1300.	0.31	0.21	0.54
37	32	49	150.	20.	110.	-1300.	-0.85	-0.15	-7.58
38	34	50	200.	560.	110.	-2900.	-1.07	-4.68	-8.36

ALTERNATIVE D-4-A (Recommended Plan, Single Pipeline Alignment)
2 Supply Systems w/2 Reservoirs, Southwest Area, Year2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	120.00	0.00	120.00	0.00	0.00
2	85.00	5060.00	119.86	34.86	35.00
3	78.00	4180.00	116.90	38.90	42.00
4	77.00	2090.00	114.58	37.58	43.00
5	81.00	1040.00	113.51	32.51	39.00
6	81.00	1040.00	112.91	31.91	39.00
7	80.00	-1400.00	114.50	34.50	40.00
8	82.00	4910.00	111.15	29.15	38.00
9	83.00	4390.00	108.14	25.14	37.00
10	77.00	3230.00	100.70	23.70	43.00
11	80.00	3740.00	99.89	19.89	40.00
12	83.00	0.00	103.95	20.95	37.00
13	88.00	5900.00	105.32	17.32	32.00
14	91.00	2440.00	104.54	13.54	29.00
15	94.00	2050.00	105.38	11.38	26.00
16	94.00	0.00	105.91	11.91	26.00
17	92.00	5000.00	106.65	14.65	28.00
18	93.00	3820.00	107.12	14.12	27.00
19	92.00	2240.00	107.75	15.75	28.00
20	93.00	1870.00	111.03	18.03	27.00
21	87.00	6790.00	111.11	24.11	33.00
22	85.00	-2900.00	121.28	36.28	35.00
23	87.00	470.00	114.17	27.17	33.00
24	87.00	2820.00	115.93	28.93	33.00
25	88.00	1050.00	118.14	30.14	32.00
26	93.00	-2700.00	111.47	18.47	27.00
27	94.00	2260.00	113.71	19.71	26.00
28	94.00	1210.00	112.58	18.58	26.00
29	95.00	1210.00	110.61	15.61	25.00
30	102.00	1210.00	109.37	7.37	18.00
31	97.00	4790.00	110.50	13.50	23.00
32	93.00	0.00	108.59	15.59	27.00
33	94.00	3340.00	107.09	13.09	26.00
34	98.00	1860.00	106.45	8.45	22.00
35	101.00	290.00	110.26	9.26	19.00
36	84.00	1610.00	98.99	14.99	36.00
37	70.00	1080.00	95.31	25.31	50.00
38	70.00	1610.00	99.51	29.51	50.00
39	88.00	1210.00	108.00	20.00	32.00
40	102.00	1210.00	122.00	20.00	18.00
41	111.00	1210.00	131.00	20.00	9.00
42	107.00	290.00	127.00	20.00	13.00
43	110.00	290.00	130.00	20.00	10.00
44	115.00	290.00	135.00	20.00	5.00
45	118.00	290.00	138.00	20.00	2.00
46	117.00	290.00	137.00	20.00	3.00
47	94.00	-1600.00	106.13	12.13	26.00
48	83.00	-1500.00	104.18	21.18	37.00
49	93.00	-1300.00	108.75	15.75	27.00
50	105.00	-2900.00	111.13	6.13	15.00

Iteration Times : 19

ALTERNATIVE D-4-A (Recommended Plan, Single Pipeline Alignment)
2 Supply Systems w/2 Reservoirs, Southwest Area, 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	700.	100.	130.	-35107.	-1.06	-0.14	-1.39
2	2	1	700.	100.	130.	-35107.	-1.06	-0.14	-1.39
3	2	3	400.	730.	120.	13261.	1.22	2.96	4.06
4	2	25	700.	600.	130.	51894.	1.56	1.72	2.87
5	3	4	350.	600.	120.	9081.	1.09	2.31	3.86
6	4	5	350.	450.	120.	6991.	0.84	1.07	2.38
7	5	6	350.	150.	120.	9260.	1.11	0.60	4.00
8	5	24	250.	790.	120.	-3309.	-0.78	-2.42	-3.06
9	6	7	150.	180.	110.	-1400.	-0.92	-1.59	-8.81
10	6	8	350.	410.	120.	9620.	1.16	1.76	4.29
11	8	38	150.	1020.	110.	1610.	1.05	11.64	11.41
12	8	9	250.	1110.	120.	3100.	0.73	3.01	2.71
13	9	10	250.	1120.	120.	5026.	1.19	7.44	6.64
14	9	13	350.	700.	120.	9296.	1.12	2.82	4.03
15	9	21	400.	540.	120.	-15612.	-1.44	-2.97	-5.49
16	10	37	150.	990.	110.	1080.	0.71	5.39	5.45
17	10	11	150.	320.	110.	716.	0.47	0.81	2.54
18	11	36	150.	860.	110.	442.	0.29	0.89	1.04
19	11	12	200.	350.	110.	-3465.	-1.28	-4.07	-11.62
20	12	13	200.	370.	110.	-1865.	-0.69	-1.37	-3.69
21	12	48	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
22	13	14	250.	490.	120.	2227.	0.55	0.78	1.60
23	13	17	150.	430.	110.	-796.	-0.52	-1.33	-3.10
24	14	36	150.	880.	110.	1168.	0.77	5.55	6.30
25	14	15	200.	460.	110.	-1281.	-0.47	-0.85	-1.84
26	15	16	200.	150.	110.	-1806.	-0.67	-0.52	-3.48
27	15	34	200.	420.	110.	-1525.	-0.56	-1.07	-2.54
28	16	17	100.	410.	110.	-206.	-0.30	-0.75	-1.82
29	16	47	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
30	17	18	350.	260.	120.	-6001.	-0.72	-0.47	-1.79
31	18	19	350.	140.	120.	-9866.	-1.19	-0.63	-4.50
32	18	33	100.	250.	110.	45.	0.01	0.03	0.11
33	19	20	350.	500.	120.	-12106.	-1.46	-3.29	-6.57
34	20	26	200.	60.	110.	-2700.	-0.99	-0.44	-7.32
35	20	27	450.	610.	120.	-18854.	-1.37	-2.68	-4.39
36	20	31	450.	660.	120.	7579.	0.55	0.54	0.81
37	21	22	150.	300.	110.	-2900.	-1.90	-10.18	-33.93
38	21	23	400.	370.	120.	-19502.	-1.80	-3.07	-8.29
39	23	24	450.	350.	120.	-19972.	-1.45	-1.75	-4.88
40	24	25	500.	460.	120.	-26101.	-1.54	-2.21	-4.80
41	25	27	450.	610.	120.	24744.	1.80	4.43	7.26
42	27	28	250.	310.	120.	3630.	0.86	1.13	3.64
43	28	29	200.	330.	110.	2420.	0.89	1.97	5.98
44	29	30	200.	750.	110.	1210.	0.45	1.24	1.66
45	31	35	150.	500.	110.	290.	0.19	0.24	0.48
46	31	32	200.	300.	110.	2499.	0.92	1.90	6.34
47	32	33	250.	380.	120.	3800.	0.90	1.50	3.96
48	32	49	150.	20.	110.	-1300.	-0.85	-0.15	-7.68
49	33	34	150.	480.	110.	505.	0.33	0.64	1.33
50	34	50	200.	560.	110.	-2900.	-1.07	-4.68	-8.36

ALTERNATIVE D-4-B (Parallel Pipeline Alignment of Recommended Plan)
2 Supply Systems w/2 Reservoirs, Southwest Area, Year1995

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	120.00	0.00	120.00	0.00	0.00
2	85.00	1850.00	119.86	34.86	35.00
3	78.00	2900.00	114.76	36.76	42.00
4	77.00	1300.00	111.58	34.58	43.00
5	81.00	1000.00	111.09	30.09	39.00
6	81.00	650.00	111.03	30.03	39.00
7	80.00	-1400.00	112.62	32.62	40.00
8	82.00	650.00	110.86	28.86	38.00
9	83.00	2250.00	109.10	26.10	37.00
10	77.00	1080.00	86.56	9.56	43.00
11	80.00	2080.00	88.30	8.30	40.00
12	83.00	0.00	102.23	19.23	37.00
13	88.00	4180.00	106.21	18.21	32.00
14	91.00	1580.00	105.53	14.53	29.00
15	94.00	1040.00	110.47	16.47	26.00
16	94.00	0.00	111.82	17.82	26.00
17	92.00	3340.00	111.22	19.22	28.00
18	93.00	2120.00	111.63	18.63	27.00
19	92.00	1780.00	112.14	20.14	28.00
20	93.00	1580.00	113.53	20.53	27.00
21	87.00	3600.00	112.08	25.08	33.00
22	85.00	-2900.00	122.25	37.25	35.00
23	87.00	250.00	114.49	27.49	33.00
24	87.00	1850.00	115.67	28.67	33.00
25	88.00	850.00	117.05	29.05	32.00
26	93.00	-2700.00	113.97	20.97	27.00
27	94.00	1800.00	115.11	21.11	26.00
28	94.00	1200.00	114.00	20.00	26.00
29	95.00	1200.00	112.06	17.06	25.00
30	102.00	1200.00	110.84	8.84	18.00
31	97.00	3580.00	112.99	15.99	23.00
32	93.00	0.00	111.59	18.59	27.00
33	94.00	2020.00	110.48	16.48	26.00
34	98.00	1340.00	113.18	15.18	22.00
35	101.00	0.00	121.00	20.00	19.00
36	84.00	1080.00	100.73	16.73	36.00
37	70.00	0.00	90.00	20.00	50.00
38	70.00	0.00	90.00	20.00	50.00
39	88.00	0.00	108.00	20.00	32.00
40	102.00	0.00	122.00	20.00	16.00
41	111.00	0.00	131.00	20.00	9.00
42	107.00	0.00	127.00	20.00	13.00
43	110.00	0.00	130.00	20.00	10.00
44	115.00	0.00	135.00	20.00	5.00
45	118.00	0.00	138.00	20.00	2.00
46	117.00	0.00	137.00	20.00	3.00
47	94.00	-1600.00	112.05	18.05	26.00
48	83.00	-1600.00	102.45	19.45	37.00
49	93.00	-1300.00	111.75	18.75	27.00
50	105.00	-2900.00	117.86	12.86	15.00

Iteration Times : 18

ALTERNATIVE D-4-B (Parallel Pipeline Alignment of Recommended Plan)
2 Supply Systems w/2 Reservoirs, Southwest Area, Year1995

<< 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	700.	100.	130.	-34946.	-1.05	-0.14	-1.38
2	2	3	250.	730.	120.	5166.	1.22	5.10	6.99
3	2	25	500.	600.	130.	27931.	1.65	2.81	4.69
4	3	4	200.	600.	110.	2266.	0.83	3.18	5.29
5	4	5	200.	450.	110.	966.	0.36	0.49	1.09
6	5	6	250.	150.	120.	1083.	0.26	0.06	0.39
7	5	24	150.	790.	110.	-1116.	-0.73	-4.58	-5.79
8	6	7	150.	180.	110.	-1400.	-0.92	-1.59	-8.81
9	6	8	300.	410.	120.	1834.	0.30	0.17	0.42
10	8	9	200.	1110.	110.	1184.	0.44	1.76	1.59
11	9	13	300.	700.	120.	6279.	1.03	2.89	4.13
12	9	21	300.	540.	120.	-7345.	-1.20	-2.98	-5.52
13	10	11	150.	320.	110.	-1080.	-0.71	-1.74	-5.45
14	11	12	150.	350.	110.	-3160.	-2.07	-13.92	-39.77
15	12	13	150.	370.	110.	-1560.	-1.02	-3.98	-10.76
16	12	48	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
17	13	14	200.	490.	110.	1100.	0.41	0.68	1.39
18	13	17	100.	430.	110.	-561.	-0.83	-5.02	-11.67
19	14	36	150.	880.	110.	1080.	0.71	4.79	5.45
20	14	15	150.	460.	110.	-1560.	-1.02	-4.95	-10.76
21	15	16	150.	150.	110.	-1417.	-0.93	-1.35	-9.01
22	15	34	150.	420.	110.	-1182.	-0.77	-2.70	-6.44
23	16	17	100.	410.	110.	183.	0.27	0.60	1.47
24	16	47	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
25	17	18	300.	260.	120.	-3718.	-0.61	-0.41	-1.56
26	18	19	300.	140.	120.	-5838.	-0.96	-0.50	-3.61
27	19	20	350.	500.	120.	-7618.	-0.92	-1.39	-2.79
28	20	26	200.	50.	110.	-2700.	-0.99	-0.44	-7.32
29	20	27	400.	610.	120.	-10419.	-0.95	-1.58	-2.60
30	20	31	350.	660.	120.	3922.	0.47	0.54	0.81
31	21	22	150.	300.	110.	-2900.	-1.90	-10.18	-33.93
32	21	23	300.	370.	120.	-8045.	-1.32	-2.42	-6.53
33	23	24	350.	360.	120.	-8295.	-1.00	-1.17	-3.26
34	24	25	400.	460.	120.	-11252.	-1.04	-1.38	-3.00
35	25	27	450.	610.	120.	15819.	1.15	1.93	3.17
36	27	28	250.	310.	120.	3600.	0.85	1.11	3.58
37	28	29	200.	330.	110.	2400.	0.88	1.94	5.89
38	29	30	200.	750.	110.	1200.	0.44	1.22	1.63
39	31	32	100.	300.	110.	342.	0.50	1.40	4.66
40	32	33	200.	380.	110.	1642.	0.61	1.11	2.92
41	32	49	150.	20.	110.	-1300.	-0.85	-0.15	-7.68
42	33	34	100.	480.	110.	-378.	-0.56	-2.69	-5.61
43	34	50	200.	560.	110.	-2900.	-1.07	-4.68	-8.36

ALTERNATIVE D-4-B (Parallel Pipeline Alignment of Recommended Plan)
2 Supply Systems w/2 Reservoirs, Southwest Area, Year2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	120.00	0.00	120.00	0.00	0.00
2	85.00	5060.00	119.86	34.86	35.00
3	78.00	4180.00	116.94	38.94	42.00
4	77.00	2090.00	114.11	37.11	43.00
5	81.00	1040.00	112.81	31.81	39.00
6	81.00	1040.00	112.07	31.07	39.00
7	80.00	-1400.00	113.65	33.65	40.00
8	82.00	4910.00	110.19	28.19	38.00
9	83.00	4390.00	106.99	23.99	37.00
10	77.00	3230.00	99.48	22.48	43.00
11	80.00	3740.00	98.61	18.61	40.00
12	83.00	0.00	103.15	20.15	37.00
13	88.00	5900.00	104.66	16.66	32.00
14	91.00	2440.00	103.14	12.14	29.00
15	94.00	2050.00	104.64	10.64	26.00
16	94.00	0.00	105.25	11.25	26.00
17	92.00	5000.00	106.35	14.35	28.00
18	93.00	3820.00	107.03	14.03	27.00
19	92.00	2240.00	107.89	15.89	28.00
20	93.00	1870.00	111.38	18.38	27.00
21	87.00	5790.00	110.51	23.51	33.00
22	85.00	-2900.00	120.69	35.69	35.00
23	87.00	470.00	114.11	27.11	33.00
24	87.00	2820.00	115.84	28.84	33.00
25	88.00	1050.00	118.27	30.27	32.00
26	93.00	-2700.00	111.82	18.82	27.00
27	94.00	2260.00	113.76	19.76	26.00
28	94.00	1210.00	112.63	18.63	26.00
29	95.00	1210.00	110.66	15.66	25.00
30	102.00	1210.00	109.42	7.42	18.00
31	97.00	4790.00	110.70	13.70	23.00
32	93.00	0.00	109.42	16.42	27.00
33	94.00	3340.00	107.04	13.04	26.00
34	98.00	1880.00	105.53	7.53	22.00
35	101.00	290.00	110.46	9.46	19.00
36	84.00	1610.00	97.68	13.68	36.00
37	70.00	1080.00	94.09	24.09	50.00
38	70.00	1610.00	98.56	28.56	50.00
39	88.00	1210.00	108.00	20.00	32.00
40	102.00	1210.00	122.00	20.00	18.00
41	111.00	1210.00	131.00	20.00	9.00
42	107.00	290.00	127.00	20.00	13.00
43	110.00	290.00	130.00	20.00	10.00
44	115.00	290.00	135.00	20.00	5.00
45	118.00	290.00	138.00	20.00	2.00
46	117.00	290.00	137.00	20.00	3.00
47	94.00	-1600.00	105.48	11.48	26.00
48	83.00	-1600.00	103.38	20.38	37.00
49	93.00	-1300.00	109.57	16.57	27.00
50	105.00	-2900.00	110.21	5.21	15.00

Iteration Times : 17

ALTERNATIVE D-4-B (Parallel Pipeline Alignment of Recommended Plan)
2 Supply Systems w/2 Reservoirs, Southwest Area, 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	700.	100.	130.	-35109.	-1.06	-0.14	-1.39
2	2	3	250.	730.	120.	3819.	0.90	2.92	4.00
3	2	25	500.	600.	120.	18941.	1.12	1.59	2.65
4	2	1	700.	100.	130.	-35109.	-1.06	-0.14	-1.39
5	2	3	350.	730.	120.	9253.	1.11	2.92	4.00
6	2	25	600.	600.	130.	33144.	1.36	1.59	2.65
7	3	4	200.	600.	110.	2133.	0.79	2.84	4.73
8	3	4	300.	600.	120.	6759.	1.11	2.84	4.73
9	4	5	200.	450.	110.	1632.	0.60	1.30	2.88
10	4	5	300.	450.	120.	5171.	0.85	1.30	2.88
11	5	6	250.	150.	120.	4280.	1.01	0.74	4.93
12	5	24	150.	790.	110.	-894.	-0.59	-3.03	-3.84
13	5	6	250.	150.	120.	4280.	1.01	0.74	4.93
14	5	24	200.	790.	110.	-1905.	-0.70	-3.03	-3.84
15	6	7	150.	180.	110.	-1400.	-0.92	-1.59	-8.81
16	6	8	300.	410.	120.	6635.	1.09	1.88	4.57
17	6	8	200.	410.	120.	2285.	0.84	1.88	4.57
18	8	9	200.	1110.	110.	1634.	0.60	3.21	2.89
19	8	38	150.	1020.	110.	1610.	1.05	11.64	11.41
20	8	9	150.	1110.	110.	767.	0.50	3.21	2.89
21	9	13	300.	700.	120.	5580.	0.91	2.32	3.32
22	9	21	300.	540.	120.	-8037.	-1.32	-3.52	-6.52
23	9	10	250.	1120.	120.	5051.	1.19	7.51	6.70
24	9	13	250.	700.	120.	3455.	0.81	2.32	3.32
25	9	21	300.	540.	120.	-8037.	-1.32	-3.52	-6.52
26	10	11	150.	320.	110.	741.	0.49	0.87	2.71
27	10	37	150.	990.	110.	1080.	0.71	5.39	5.45
28	11	12	150.	250.	110.	-1725.	-1.13	-4.54	-12.97
29	11	36	150.	850.	110.	451.	0.30	0.93	1.08
30	11	12	150.	350.	110.	-1725.	-1.13	-4.54	-12.97
31	12	13	150.	370.	110.	-925.	-0.61	-1.51	-4.09
32	12	48	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
33	12	13	150.	370.	110.	-925.	-0.61	-1.51	-4.09
34	13	14	200.	490.	110.	1701.	0.63	1.52	3.11
35	13	17	100.	430.	110.	-311.	-0.46	-1.68	-3.91
36	13	14	150.	490.	110.	798.	0.52	1.52	3.11
37	13	17	150.	430.	110.	-903.	-0.59	-1.68	-3.91
38	14	36	150.	880.	110.	1159.	0.76	5.46	6.20
39	14	15	150.	460.	110.	-818.	-0.54	-1.50	-3.26
40	14	15	100.	460.	110.	-282.	-0.42	-1.50	-3.26
41	15	16	150.	150.	110.	-927.	-0.61	-0.62	-4.10
42	15	34	150.	420.	110.	-648.	-0.42	-0.89	-2.12
43	15	16	150.	150.	110.	-927.	-0.61	-0.62	-4.10
44	15	34	150.	420.	110.	-648.	-0.42	-0.89	-2.12
45	16	17	100.	410.	110.	-253.	-0.37	-1.09	-2.67
46	15	47	150.	20.	110.	-1600.	-1.05	-0.23	-11.28
47	17	18	300.	260.	120.	-4915.	-0.80	-0.68	-2.62
48	17	18	200.	260.	110.	-1551.	-0.57	-0.68	-2.62
49	18	19	300.	140.	120.	-7798.	-1.28	-0.86	-6.17
50	18	19	200.	140.	110.	-2461.	-0.91	-0.86	-6.17
51	18	33	100.	250.	110.	-27.	-0.04	-0.01	-0.04
52	19	20	350.	500.	120.	-12499.	-1.50	-3.49	-6.97
53	20	26	200.	60.	110.	-2700.	-0.99	-0.44	-7.32
54	20	27	400.	610.	120.	-12994.	-1.20	-2.39	-3.91
55	20	31	350.	660.	120.	4454.	0.54	0.68	1.03

ALTERNATIVE D-4-B (Parallel Pipeline Alignment of Recommended Plan)
2 Supply Systems w/2 Reservoirs, Southwest Area, 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)
56	20	27	300.	610.	120.	-6098.	-1.00	-2.39	-3.91
57	20	31	300.	660.	120.	2959.	0.49	0.68	1.03
58	21	22	150.	300.	110.	-2900.	-1.90	-10.18	-33.93
59	21	23	300.	370.	120.	-9982.	-1.63	-3.60	-9.74
60	21	23	300.	370.	120.	-9982.	-1.63	-3.60	-9.74
61	23	24	350.	360.	120.	-10217.	-1.23	-1.73	-4.80
62	23	24	350.	360.	120.	-10217.	-1.23	-1.73	-4.80
63	24	25	400.	460.	120.	-15291.	-1.41	-2.43	-5.28
64	24	25	350.	460.	120.	-10762.	-1.29	-2.43	-5.28
65	25	27	450.	610.	120.	24982.	1.82	4.51	7.39
66	27	28	250.	310.	120.	3630.	0.86	1.13	3.64
67	28	29	200.	330.	110.	2420.	0.89	1.97	5.98
68	29	30	200.	750.	110.	1210.	0.45	1.24	1.66
69	31	32	100.	300.	110.	326.	0.48	1.28	4.27
70	31	35	150.	500.	110.	290.	0.19	0.24	0.48
71	31	32	200.	300.	110.	2018.	0.74	1.28	4.27
72	32	33	200.	380.	110.	2480.	0.91	2.38	6.26
73	32	49	150.	20.	110.	-1300.	-0.85	-0.15	-7.68
74	32	33	150.	380.	110.	1164.	0.76	2.38	6.26
75	33	34	100.	480.	110.	277.	0.41	1.51	3.15
76	34	50	200.	560.	110.	-2900.	-1.07	-4.68	-8.36

APPENDIX 7.3.3 Cost Estimates of Alterntive Water Supply Systems

(1) Water Sources (Common Facilities)

- o Replacement of Pumps at existing wells
  5 pumps x 320,000 ₱/pump = ₱ 1,600,000
- o Reconstruction of one existing well
  940,000 ₱/well + 640,000 ₱/pump = ₱ 1,580,000
- o Pump installation at test well ₱ 640,000
- o 16 new well construction
  16 wells x (940,000 ₱/well + 640,000 ₱/well)
  = ₱25,280,000

TOTAL ₱29,100,000

(2) Transmission Line

(Unit : ₱x1,000)

Pipe	Unit Cost	Alternative D-1		Alternative D-2		Alternative D-3		Alternative D-4	
	(₱)	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
ϕ200 mm	520	4,500 m	2,340	3,500 m	1,820	5,500 m	2,860	4,500 m	2,340
ϕ250 mm	630	500 m	315	1,000 m	630	500 m	315	1,000 m	630
ϕ350 mm	900	500 m	450	1,000 m	900	500 m	450	1,000 m	900
ϕ400 mm	970	1,000 m	970	1,500 m	1,455	500 m	485	500 m	485
ϕ500 mm	1,330	500 m	665	500 m	665	500 m	665	500 m	665
TOTAL		7,000 m	4,740	7,500 m	5,470	7,500 m	4,775	7,500 m	5,020

(3) Reservoir

Costs were estimated based on the cost functions adopted in the LWUA Methodology Manual.

Alternative D-1

Ground Reservoir : Q = 3,525 cu.m ₱ 3,705,000
Q = 9,531 cu.m ₱ 6,996,000
TOTAL ₱10,701,000

Alternative D-2			
Ground Reservoir	:	Q = 13,056 cu.m	₱ 8,554,000
Alternative D-3			
Elevated Tank (H=15 m)	:	Q = 458 cu.m x 2 ₱ 1,339,000 x 2=	₱ 2,678,000
Ground Reservoir	:	Q = 4,026 cu.m	₱ 4,034,000
		Q = 8,175 cu.m	₱ 6,342,000
		TOTAL	₱13,054,000
Alternative D-4			
Elevated Tank	:	Same as Alt.D-3	₱ 2,678,000
Ground Reservoir	:	Q = 12,201 cu.m	₱ 8,192,000
		TOTAL	₱10,870,000

(4) Booster Pump Station

Costs were estimated based on the cost functions adopted in the LWUA Methodology Manual.

Alternative D-1		
Q = 52,448 cu.m/day = 610 l/sec H = 50m		₱ 8,863,000
Q = 19,347 cu.m/day = 230 l/sec H = 40m		₱ 4,106,000
	TOTAL	₱12,969,000
Alternative D-2		
Q = 75,300 cu.m/day = 880 l/sec H = 50m		₱11,814,000
Q = 5,711 cu.m/day = 70 l/sec H = 20m		₱ 1,532,000
	TOTAL	₱13,346,000
Alternative D-3		
Q = 50,800 cu.m/day = 590 l/sec H = 50m		₱ 8,638,000
Q = 22,320 cu.m/day = 290 l/sec H = 40m		₱ 4,856,000
	TOTAL	₱13,494,000
Alternative D-4		
Q = 70,214 cu.m/day = 820 l/sec H = 50m		₱11,171,000
	TOTAL	₱11,171,000

(5) Energy Consumption

Unit Cost : 0.3 ₱/KWH, Operation Period : 15 years

Alternative D-1

Deep Well Pump : 4,432.7 MWH/year x 15 years x 0.3 ₱/KWH = ₱19,947,000

Booster Pump : (2,217 MWH/year + 568.6 MWH/year) x 15 years x 0.3 ₱/KWH = ₱12,535,000

TOTAL = ₱32,482,000

Alternative D-2

Deep Well Pump	: Same as Alternative D-1		₱19,947,000
Booster Pump	: 2,904.6 MWH/year x 15 years x 0.3 ₱/KWH	=	₱13,071,000
	TOTAL	=	₱33,018,000

Alternative D-3

Deep Well Pump	: Same as Alternative D-1		₱19,947,000
Booster Pump	: 2,937.7 MWH/year x 15 years x 0.3 ₱/KWH	=	₱13,220,000
	TOTAL	=	₱33,167,000

Alternative D-4

Deep Well Pump	: Same as Alternative D-1		₱19,947,000
Booster Pump	: 2,892.9 MWH/year x 15 years x 0.3 ₱/KWH	=	₱13,018,000
	TOTAL	=	₱32,965,000

(6) Labor

Unit Cost : ₱ 2,000/MM

Alternative D-1 and D-2

₱ 2,000/MM x 2 persons x 15 years = ₱ 720,000

Alternative D-3 and D-4

₱ 2,000/MM x 3 persons x 15 years = ₱ 1,080,000

APPENDIX 8.2.1.A BREAKDOWN OF COST ESTIMATES

(Unit: thousand Pesos)

Angeles ITEM	UNIT COST	Phase I(Stage 1) NUMBER	Phase I(Stage 1) COST	Phase I(Stage 2) NUMBER	Phase I(Stage 2) COST	Phase I Total NUMBER	Phase I Total COST	Phase II Cost NUMBER	Phase II Cost COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	940000	1	940	6	5640	7	6580	10	9400
(2)DEEP WELL PUMP w/HOUSE	640000	2	1280	6	3840	8	5120	10	6400
Well Pump	320000	5	1600	0	0	5	1600	0	0
Flow Meter D=150	62000	7	434	6	372	13	806	10	620
SUB-TOTAL			4254		9852		14106		16420
2 TRANSMISSION FACILITIES									
Main Pipes									
D=200 (Steel Pipe)	520	0	0	1500	780	1500	780	3500	1820
D=350 (Steel Pipe)	900	0	0	500	450	500	450	500	450
D=400 (Steel Pipe)	970	0	0	500	485	500	485	500	485
D=500 (Steel Pipe)	1330	0	0	0	0	0	0	2800	3724
SUB-TOTAL		0	0	0	1715	0	1715		6479
3 DISTRIBUTION FACILITIES									
(1)Reservoir			4202	0	0		4202		6210
(2)Pump Facility (Eqip.)			1301		3765		5066		4246
-do- (Civil)			2228		0		2228		2187
(3)Chlrnte Facility 22kg/d	98100	7	687	1	98	8	785	3	294
(4)Elevated Tank	1339000	0	0	0	0	0	0	2	2678
(5)Electric Sub-station		1	2757						5131
(6)Distribution pipes									
1)Main Pipes									
D=150 (PVC Pipe)	410	1440	590	300	123	1740	713	6190	2538
D=200 (Steel Pipe)	520	2370	1233	1080	562	3450	1795	2100	1092
D=250 (Steel Pipe)	630	380	239	310	195	690	434	4170	2627
D=350 (Steel Pipe)	900	2800	2520	410	369	3210	2889	0	0
D=400 (Steel Pipe)	970	1640	1591	0	0	1640	1591	0	0
D=450 (Steel Pipe)	1160	2240	2599	0	0	2240	2599	0	0
D=500 (Steel Pipe)	1330	460	612	0	0	460	612	0	0
D=700 (Steel Pipe)	1910	700	1337	0	0	700	1337	100	191
2)Valves									
D=150 (Gate Valve)	5300	5	26	1	5	6	31	21	111
D=200 (Gate Valve)	6700	8	54	4	27	12	81	7	47
D=250 (Gate Valve)	11200	1	11	1	11	2	22	14	157
D=350 (Butterfly Valve)	74400	9	670	1	74	10	744	0	0
D=400 (Butterfly Valve)	95200	5	476	0	0	5	476	0	0
D=450 (Butterfly Valve)	125900	7	882	0	0	7	882	0	0
D=500 (Butterfly Valve)	174000	1	174	0	0	1	174	0	0
D=700 (Butterfly Valve)	313200	2	626	0	0	2	626	0	0
3)Internal Network									
Commercial 100pop/ha	23100	0	0	0	0	0	0	75	1733
Commercial 150pop/ha	25700	0	0	46	1181	46	1181		0
Residential 100pop/ha	18700	140	2618	0	0	140	2618	672	12566
Residential 150pop/ha	21000	0	0	403	8463	403	8463		0
4)Service Conections									
D=1/2	810	3940	3192	14370	11640	18310	14832	17540	14207
D=3/4	1280	20	26	30	40	50	66	30	38
5)Rehabilitation									
Water Meter 1/2''	400	2878	1151	0	0	2878	1151		
Old Laterals			857		0		857		
Service Connect.wo/Metr	480	1440	690	0	0	1440	690		
Service Connect.w/Meter	880	625	550	0	0	625	550		
6)Flow Meter D=400	215000	1	215	0	0	1	215	1	215
7)Fire Protection									
D=150	16800	0	0	0	0	0	0	95	1596
D=100	9400	0	0	0	0	0	0	430	4042
SUB-TOTAL			34114		26553		60667		61906
4 1)Administration Bldg.								1	1820
2)Operation Center		1	1590			1	1590	1	1090
SUB-TOTAL		1	1590	0	0	1	1590	2	2910
5 Land Acquisition	120	2900	348	2000	240	4900	588	9300	1116
Vehicle	300000	2	600	4	1200	6	1800	4	1200
Stored Material & Equip.			438		519		957		964
SUB-TOTAL			1386		1959		3345		3280
6 Replacement of Equipment			0		0		0		26093
T O T A L			41344		40079		81423		117088
7 Leak Detection	240	4128	990	0	0	4128	990		0
GRAND TOTAL			42334		40079		82413		117088

(Unit: thousand Pesos)

Angeles		1988		1989		1990		1991	
ITEM	UNIT COST	NO	COST	NO	COST	NO	COST	NO	COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	940000		0	1	940		0	2	1880
(2)DEEP WELL PUMP w/HOUSE	640000		0	2	1280		0	2	1280
Well Pump	320000		0		0	5	1600	0	0
Flow Meter D=150	62000		0	2	124	5	310	2	124
SUB-TOTAL			0		2344		1910		3284
2 TRANSMISSION FACILITIES									
Main Pipes									
D=200 (Steel Pipe)	520		0		0		0		0
D=350 (Steel Pipe)	900		0		0		0	500	450
D=400 (Steel Pipe)	970		0		0		0	500	485
D=500 (Steel Pipe)	1330		0		0		0		0
SUB-TOTAL			0		0		0		935
3 DISTRIBUTION FACILITIES									
(1)Reservoir				4292	4202				
(2)Pump Facility (Equip.)					651		650		753
-do- (Civil)					2228				
(3)Chlrntn Facility 22kg/d	98100			2	196	5	491	1	98
(4)Elevated Tank	1339000				0	0	0	0	0
(5)Electric Sub-station				1	2757				
(6)Distribution pipes		1988		1989		1990		1991	
1)Main Pipes									
D=150 (PVC Pipe)	410		0	240	98	1200	492	300	123
D=200 (Steel Pipe)	520		0	1490	775	880	458	1080	562
D=250 (Steel Pipe)	630		0	380	239	0	0	310	195
D=350 (Steel Pipe)	900		0	1500	1350	1300	1170	410	369
D=400 (Steel Pipe)	970		0	910	883	730	708	0	0
D=450 (Steel Pipe)	1160		0	1580	1833	660	766	0	0
D=500 (Steel Pipe)	1330		0	460	612		0	0	0
D=700 (Steel Pipe)	1910		0	700	1337		0		0
2)Valves									
D=150 (Gate Valve)	5300		0	1	5	4	21	1	5
D=200 (Gate Valve)	6700		0	5	34	3	20	4	27
D=250 (Gate Valve)	11200		0	1	11	0	0	1	11
D=350 (Butterfly Valve)	74400		0	5	372	4	298	1	74
D=400 (Butterfly Valve)	95200		0	3	286	2	190	0	0
D=450 (Butterfly Valve)	125900		0	5	630	2	252	0	0
D=500 (Butterfly Valve)	174000		0	1	174		0	0	0
D=700 (Butterfly Valve)	313200		0	2	626		0	0	0
3)Internal Network									
Commercial 100pop/ha	23100		0		0		0		0
Commercial 150pop/ha	25700		0		0		0	10	257
Residential 100pop/ha	18700		0	70	1309	70	1309		0
Residential 150pop/ha	21000		0		0		0	81	1701
4)Service Conections									
D=1/2	810		0	1970	1596	1970	1596	2874	2328
D=3/4	1280		0	10	13	10	13	6	8
5)Rehabilitation									
Water Meter 1/2''	400	2878	1151	0	0	0	0		
Old Laterals					429		428		
Service Connect.wo/Metr	480	480	230	480	230	480	230		
Service Connect.w/Meter	880	209	184	208	183	208	183		
6)Flow Meter D=400	215000	0	0	1	215	0	0	0	0
7)Fire Protection									
D=150	16800								
D=100	9400								
SUB-TOTAL			1565		23274		9275		6511
4 (1)Administration Bldg.									
2)Operation Center				1	1590				
SUB-TOTAL			0	1	1590		0		0
5 Land Acquisition	120	2900	348		0		0	2000	240
Vehicle	300000	2	600		0		0	1	300
Stored Material & Equip.			30		246		162		136
SUB-TOTAL			978		246		162		676
6 Replacement of Equipment									
T O T A L			2543		27454		11347		11406
7 Leak Detection	240	1376	330	1376	330	1376	330		0
GRAND TOTAL			2873		27784		11677		11406

(Unit: thousand Pesos)

Angeles ITEM	UNIT COST	1992 NO	1992 COST	1993 NO	1993 COST	1994 NO	1994 COST	1995 NO	1995 COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	940000	1	940	1	940	1	940	1	940
(2)DEEP WELL PUMP w/HOUSE	640000	1	640	1	640	1	640	1	640
Well Pump	320000	0	0	0	0	0	0	0	0
Flow Meter D=150	62000	1	62	1	62	1	62	1	62
SUB-TOTAL			1642	3	1642	3	1642	3	1642
2 TRANSMISSION FACILITIES									
Main Pipes			0		0		0		0
D=200 (Steel Pipe)	520	500	260	500	260	500	260		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
SUB-TOTAL			260		260		260		0
3 DISTRIBUTION FACILITIES									
(1)Reservoir									
(2)Pump Facility (Eqip.)			753		753		753		753
-do- (Civil)									
(3)Chlrnte Facility 22kg/d	98100		0		0	0	0		0
(4)Elevated Tank	1339000	0	0	0	0	0	0		0
(5)Electric Sub-station									
(6)Distribution pipes		1992		1993		1994		1995	
1)Main Pipes									
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=350 (Steel Pipe)	900		0		0		0		0
D=400 (Steel Pipe)	970		0		0		0		0
D=450 (Steel Pipe)	1160		0		0		0		0
D=500 (Steel Pipe)	1330		0		0		0		0
D=700 (Steel Pipe)	1910		0		0		0		0
2)Valves									
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=350 (Butterfly Valve)	74400		0		0		0		0
D=400 (Butterfly Valve)	95200		0		0		0		0
D=450 (Butterfly Valve)	125900		0		0		0		0
D=500 (Butterfly Valve)	174000		0		0		0		0
D=700 (Butterfly Valve)	313200		0		0		0		0
3)Internal Network									
Commercial 100pop/ha	23100		0		0		0		0
Commercial 150pop/ha	25700	9	231	9	231	9	231	9	231
Residential 100pop/ha	18700		0		0		0		0
Residential 150pop/ha	21000	81	1701	81	1701	80	1680	80	1680
4)Service Conections									
D=1/2	810	2874	2328	2874	2328	2874	2328	2874	2328
D=3/4	1280	6	8	6	8	6	8	6	8
5)Rehabilitation									
Water Meter 1/2''	400								
Old Laterals									
Service Connect.wo/Metr	480								
Service Connect.w/Meter	880								
6)Flow Meter D=400	215000	0	0	0	0	0	0	0	0
7)Fire Protection									
D=150	16800								
D=100	9400								
SUB-TOTAL			5021		5021		5000		5000
4 (1)Administration Bldg.									
(2)Operation Center									
SUB-TOTAL			0		0		0		0
5 Land Acquisition	120		0		0		0		0
Vehicle	300000	1	300	1	300	1	300		0
Stored Material & Equip.			97		97		96		93
SUB-TOTAL			397		397		396		93
6 Replacement of Equipment									
T O T A L			7320		7320		7298		6735
7 Leak Detection	240								
GRAND TOTAL			7320		7320		7298		6735

APPENDIX 8.2.1.B PROJECT COST WITH FOREIGN AND LOCAL CURRENCY BREAKDOWN (1986 Price Level, Angeles City)

SUMMARY

Phase I, Stage 1

(Unit: thousand ₱)

	F.E.C	Local	Total
Direct Construction Cost	23,052	18,292	41,344
Physical Cont. (8% of D.C.C.)	1,844	1,464	3,308
Sub Total	24,896	19,756	44,652
Leakage Detection	-	990	990
Detailed Design (10% of S.T. in Stage 1 & Stage 2)	4,397	4,397	8,794
Construction Supervision (4% of S.T.)	893	893	1,786
Total	30,186	26,036	56,222

Phase I, Stage 2

(Unit: thousand ₱)

	F.E.C	Local	Total
Direct Construction Cost	25,221	14,858	40,079
Physical Cont. (8% of D.C.C.)	2,018	1,188	3,206
Sub Total	27,239	16,046	43,285
Construction Supervision (4% of S.T.)	228	1,503	1,731
Total	27,467	17,549	45,016

Phase II

(Unit: thousand ₱)

	F.E.C	Local	Total
Direct Construction Cost	71,592	45,496	117,088
Physical Cont. (8% of D.C.C.)	5,727	3,640	9,367
Sub Total	77,319	49,136	126,455
Detailed Design (10% of S.T.)	6,323	6,323	12,646
Construction Supervision (4% of S.T.)	-	5,058	5,058
Total	83,642	60,517	144,159

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

Angeles		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)DEEP WELL	0.0	0.0	0.0	0.0	0.0	0.0	940.0	159.8	432.4	47.0	188.0	159.8	0.0	0.0	0.0	0.0	0.0	0.0
	(2)PUMPING FACILITY																		
	1)Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	1280.0	115.2	448.0	64.0	601.6	115.2	0.0	0.0	0.0	0.0	0.0	0.0
	2)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	124.0	0.0	0.0	0.0	124.0	0.0	310.0	0.0	0.0	0.0	310.0	0.0
	(3)PUMP REPLACEMENT													1600.0				1344.0	256.0
	SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	2344.0	275.0	880.4	111.0	913.6	275.0	1910.0	0.0	0.0	0.0	1654.0	256.0
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
	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	4202.0	1092.5	2731.3	294.1	210.1	168.1	0.0	0.0	0.0	0.0	0.0	0.0
	(2)Pump Facility (Equip)	0.0	0.0	0.0	0.0	0.0	0.0	651.0	0.0	0.0	0.0	540.3	110.7	650.0	0.0	0.0	0.0	539.5	110.5
	Pump Facility (Civil)	0.0	0.0	0.0	0.0	0.0	0.0	2228.0	133.7	2094.3	401.0	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	196.0	9.8	66.6	5.9	90.2	29.4	491.0	24.6	166.9	14.7	225.8	73.7
	(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	2757.0	427.3	606.5	55.1	1447.5	275.7	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	7127.0	1282.9	1995.6	285.1	2209.3	1630.2	3594.0	646.9	1006.3	143.8	1114.2	826.6
	2)Valves	0.0	0.0	0.0	0.0	0.0	0.0	2138.0	42.8	449.0	128.3	1453.8	192.4	781.0	15.6	164.0	46.9	531.1	70.3
	3)Internal Network	0.0	0.0	0.0	0.0	0.0	0.0	1309.0	209.4	366.5	52.4	445.1	288.0	1309.0	209.4	366.5	52.4	445.1	288.0
	4)Service Connections	0.0	0.0	0.0	0.0	0.0	0.0	1609.0	16.1	160.9	48.3	1367.6	64.4	1609.0	16.1	160.9	48.3	1367.6	64.4
	5)Water Meter	1151.0	0.0	0.0	0.0	1151.0	0.0	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)Srvc Cnnctn Rhbltn wo/M	230.0	5.8	59.8	13.8	143.7	20.7	230.0	5.8	59.8	13.8	143.7	20.7	230.0	5.8	59.8	13.8	143.7	20.7
	7)Srvc Cnnctn Rhbltn w/M	184.0	1.8	18.4	5.5	156.4	7.4	183.0	1.8	18.3	5.5	155.6	7.3	183.0	1.8	18.3	5.5	155.6	7.3
	8)Lateral Rehabilitation	0.0	0.0	0.0	0.0	0.0	0.0	429.0	68.6	120.1	17.2	145.9	84.4	428.0	77.0	119.8	17.1	132.8	98.4
	9)Flow Meter	0.0	0.0	0.0	0.0	0.0	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
	10)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	1565.0	7.6	78.2	19.3	1451.1	28.1	23274.0	3290.7	8008.9	1306.7	8424.1	2890.3	9275.0	997.2	2062.5	342.5	4655.4	1559.9
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
	2)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	1590.0	143.1	651.9	79.5	572.4	222.6		0.0	0.0	0.0	0.0	0.0
	SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	1590.0	143.1	651.9	79.5	572.4	222.6	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	1565.0	7.6	78.2	19.3	1451.1	28.1	27208.0	3708.8	10201.2	1497.2	9910.1	3387.9	11185.0	997.2	2062.5	342.5	6309.4	1815.9
5.0	Land Acquisition	348.0		348.0				0.0		0.0				0.0		0.0			
	Vehicle	600.0				300.0	300.0	0.0				0.0	0.0	0.0				0.0	0.0
	Stored Material & Equip.	30.0				25.2	4.8	246.0				206.6	39.4	162.0				136.1	25.9
	SUB-TOTAL	978.0	0.0	348.0		325.2	304.8	246.0	0.0	0.0		206.6	39.4	162.0	0.0	0.0		136.1	25.9
6.0	Replacement of Equipment																		
	1)Deep Well Pump	0.0	0.0	0.0	0.0	0.0	0.0	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)Booster Pump	0.0	0.0	0.0	0.0	0.0	0.0	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)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
	5)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
	6)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
	7)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
	8)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	Leakage Detection	330.0		330.0				330.0		330.0				330.0		330.0			
	GRAND TOTAL	2873.0	7.6	756.2	19.3	1776.3	332.9	27784.0	3708.8	10531.2	1497.2	10116.7	3427.3	11677.0	997.2	2392.5	342.5	6445.5	1841.8

Angeles		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	Deep Well Facilities	0.0	0.0	0.0	0.0	0.0	0.0	2344.0	275.0	880.4	111.0	913.6	275.0	1910.0	0.0	0.0	0.0	1654.0	256.0
2	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
3	Purification Plant	0.0	0.0	0.0	0.0	0.0	0.0	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	Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	4202.0	1092.5	2731.3	294.1	210.1	168.1	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	196.0	9.8	66.6	5.9	90.2	29.4	491.0	24.6	166.9	14.7	225.8	73.7
6	Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	2757.0	427.3	606.5	55.1	1447.5	275.7	0.0	0.0	0.0	0.0	0.0	0.0
7	Distribution Facilities	0.0	0.0	0.0	0.0	0.0	0.0	14097.0	1737.4	5025.5	884.0	5000.4	2324.7	6762.0	948.9	1656.6	200.2	2702.7	1393.8
8	Service Connection	1565.0	7.6	78.2	19.3	1451.1	28.1	2022.0	23.7	239.0	67.6	1666.9	92.4	2022.0	23.7	239.0	67.6	1666.9	92.4
9	Admini. Bldg. & Ope. Ctr.	0.0	0.0	0.0	0.0	0.0	0.0	1590.0	143.1	651.9	79.5	572.4	222.6	0.0	0.0	0.0	0.0	0.0	0.0
10	Land Acquisition	348.0	0.0	348.0	0.0	0.0	0.0	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	Vehicle & Stored Material	630.0	0.0	0.0	0.0	325.2	304.8	246.0	0.0	0.0	0.0	206.6	39.4	162.0	0.0	0.0	0.0	136.1	25.9
12	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	2543.0	7.6	426.2	19.3	1776.3	332.9	27454.0	3708.8	10201.2	1497.2	10116.7	3427.3	11347.0	997.2	2062.5	342.5	6445.5	1841.8
13	Leakage Detection	330.0	0.0	330.0	0.0	0.0	0.0	330.0	0.0	330.0	0.0	0.0	0.0	330.0	0.0	330.0	0.0	0.0	0.0
	TOTAL	2873.0	7.6	756.2	19.3	1776.3	332.9	27784.0	3708.8	10531.2	1497.2	10116.7	3427.3	11677.0	997.2	2392.5	342.5	6445.5	1841.8

Angeles		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)DEEP WELL	940.0	159.8	432.4	47.0	188.0	159.8	1880.0	319.6	864.8	94.0	376.0	319.6	940.0	159.8	432.4	47.0	188.0	159.8
	(2)PUMPING FACILITY	0.0	0.0	0.0	0.0	0.0	0.0												
	1)Pumping Station	1280.0	115.2	448.0	64.0	601.6	115.2	1280.0	115.2	448.0	64.0	601.6	115.2	640.0	57.6	224.0	32.0	300.8	57.6
	2)Flow Meter	434.0	0.0	0.0	0.0	434.0	0.0	124.0	0.0	0.0	0.0	124.0	0.0	62.0	0.0	0.0	0.0	62.0	0.0
	(3)PUMP REPLACEMENT	1600.0	0.0	0.0	0.0	1344.0	256.0												
	SUB-TOTAL	4254.0	275.0	880.4	111.0	2567.6	531.0	3284.0	434.8	1312.8	158.0	1101.6	434.8	1642.0	217.4	656.4	79.0	550.8	217.4
2.0	TRANSMISSION FACILITIES																		
	(1)Pipelines	0.0	0.0	0.0	0.0	0.0	0.0	935.0	168.3	261.8	37.4	289.8	215.1	260.0	46.8	72.8	10.4	80.6	59.8
	SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	935.0	168.3	261.8	37.4	289.8	215.1	260.0	46.8	72.8	10.4	80.6	59.8
3.0	DISTRIBUTION FACILITIES																		
	(1)Reservoir	4202.0	1092.5	2731.3	294.1	210.1	168.1	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)Pump Facility (Equip)	1301.0	0.0	0.0	0.0	1079.8	221.2	753.0	0.0	0.0	0.0	625.0	128.0	753.0	0.0	0.0	0.0	625.0	128.0
	Pump Facility (Civil)	2228.0	133.7	2004.3	401.0	0.0	0.0	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	687.0	34.4	233.5	20.6	316.0	103.1	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	2757.0	427.3	606.5	55.1	1447.5	275.7	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	10721.0	1928.8	3001.9	428.9	3323.5	2465.8	1249.0	224.8	349.7	50.0	387.2	287.3	0.0	0.0	0.0	0.0	0.0	0.0
	2)Valves	2919.0	58.4	613.0	175.2	1984.9	262.7	117.0	2.3	24.6	7.0	79.6	10.5	0.0	0.0	0.0	0.0	0.0	0.0
	3)Internal Network	2618.0	418.8	733.0	104.8	890.2	570.0	1958.0	313.3	548.2	78.3	665.7	430.8	1932.0	309.1	541.0	77.3	656.9	425.0
	4)Service Connections	3218.0	32.2	321.8	96.6	2735.2	128.8	2336.0	23.4	233.6	70.1	1985.6	93.4	2336.0	23.4	233.6	70.1	1985.6	93.4
	5)Water Meter	1151.0	0.0	0.0	0.0	1151.0	0.0	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)Srvc Cnnctn Rhbltn w/o/M	690.0	17.4	179.4	41.4	431.1	62.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	7)Srvc Cnnctn Rhbltn w/M	550.0	5.4	55.0	16.5	467.6	22.0												
	8)Lateral Rehabilitation	857.0	145.6	239.9	34.3	278.7	192.8	0.0						0.0					
	9)Flow Meter	215.0	0.0	0.0	0.0	215.0	0.0	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)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	34114.0	4295.5	10809.6	1668.5	14530.6	4478.3	6511.0	568.7	1189.4	208.3	3788.2	964.7	5021.0	332.5	774.6	147.4	3267.5	646.4
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	1590.0	143.1	651.9	79.5	572.4	222.6	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	1590.0	143.1	651.9	79.5	572.4	222.6	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	39958.0	4713.6	12341.9	1859.0	17670.6	5231.0	10730.0	1171.8	2764.0	403.7	5179.6	1614.6	6923.0	596.7	1503.8	236.8	3898.9	923.6
5.0	Land Acquisition	348.0	0.0	348.0	0.0	0.0	0.0	240.0		240.0				0.0		0.0			
	Vehicle	600.0	0.0	0.0	0.0	300.0	300.0	300.0				150.0	150.0	300.0				150.0	150.0
	Stored Material & Equip.	438.0	0.0	0.0	0.0	367.9	70.1	136.0				114.2	21.8	97.0				81.5	15.5
	SUB-TOTAL	1386.0	0.0	348.0	0.0	667.9	370.1	676.0	0.0	240.0		264.2	171.8	397.0	0.0	0.0		231.5	165.5
6.0	Replacement of Equipment																		
	1)Deep Well Pump	0.0	0.0	0.0	0.0	0.0	0.0	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)Booster Pump	0.0	0.0	0.0	0.0	0.0	0.0	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)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
	5)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
	6)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
	7)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
	8)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	Leakage Detection	990.0	0.0	990.0	0.0	0.0	0.0		0.0	0.0				0	0.0	0.0			
	GRAND TOTAL	42334.0	4713.6	13679.9	1859.0	18338.5	5602.0	11406.0	1171.8	3004.0	403.7	5443.8	1786.4	7320.0	596.7	1503.8	236.8	4130.4	1089.1

Angeles		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	Deep Well Facilities	4254.0	275.0	880.4	111.0	2567.6	531.0	3284.0	434.8	1312.8	158.0	1101.6	434.8	1642.0	217.4	656.4	79.0	550.8	217.4
2	Transmission Facilities	0.0	0.0	0.0	0.0	0.0	0.0	935.0	168.3	261.8	37.4	289.8	215.1	260.0	46.8	72.8	10.4	80.6	59.8
3	Purification Plant	0.0	0.0	0.0	0.0	0.0	0.0	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	Reservoir	4202.0	1092.5	2731.3	294.1	210.1	168.1	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	687.0	34.4	233.5	20.6	316.0	103.1	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	Electric Sub-station	2757.0	427.3	606.5	55.1	1447.5	275.7	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	Distribution Facilities	20859.0	2686.3	6682.1	1144.2	7772.1	3718.5	4077.0	540.4	922.5	135.3	1757.5	856.6	2685.0	309.1	541.0	77.3	1281.9	553.0
8	Service Connection	5609.0	55.0	556.2	154.5	4784.9	212.9	2336.0	23.4	233.6	70.1	1985.6	93.4	2336.0	23.4	233.6	70.1	1985.6	93.4
9	Admini. Bldg. & Ope. Ctr.	1590.0	143.1	651.9	79.5	572.4	222.6	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	Land Acquisition	348.0	0.0	348.0	0.0	0.0	0.0	240.0	0.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Vehicle & Stored Material	1038.0	0.0	0.0	0.0	667.9	370.1	436.0	0.0	0.0	0.0	264.2	171.8	397.0	0.0	0.0	0.0	231.5	165.5
12	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	41344.0	4713.6	12689.9	1859.0	18338.5	5602.0	11406.0	1171.8	3004.0	403.7	5443.8	1786.4	7320.0	596.7	1503.8	236.8	4130.4	1089.1
13	Leakage Detection	990.0	0.0	990.0	0.0	0.0	0.0	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	42334.0	4713.6	13679.9	1859.0	18338.5	5602.0	11406.0	1171.8	3004.0	403.7	5443.8	1786.4	7320.0	596.7	1503.8	236.8	4130.4	1089.1

Angeles No.	ITEM	1993 COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	1994 COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	1995 COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1.0	SOURCE FACILITY																		
	(1)DEEP WELL	940.0	159.8	432.4	47.0	188.0	159.8	940.0	159.8	432.4	47.0	188.0	159.8	940.0	159.8	432.4	47.0	188.0	159.8
	(2)PUMPING FACILITY																		
	1)Pumping Station	640.0	57.6	224.0	32.0	300.8	57.6	640.0	57.6	224.0	32.0	300.8	57.6	640.0	57.6	224.0	32.0	300.8	57.6
	2)Flow Meter	62.0	0.0	0.0	0.0	62.0	0.0	62.0	0.0	0.0	0.0	62.0	0.0	62.0	0.0	0.0	0.0	62.0	0.0
	(3)PUMP REPLACEMENT																		
	SUB-TOTAL	1642.0	217.4	656.4	79.0	550.8	217.4	1642.0	217.4	656.4	79.0	550.8	217.4	1642.0	217.4	656.4	79.0	550.8	217.4
2.0	TRANSMISSION FACILITIES																		
	(1)Pipelines	260.0	46.8	72.8	10.4	80.6	59.8	260.0	46.8	72.8	10.4	80.6	59.8	0.0	0.0	0.0	0.0	0.0	0.0
	SUB-TOTAL	260.0	46.8	72.8	10.4	80.6	59.8	260.0	46.8	72.8	10.4	80.6	59.8	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 (Equip)	753.0	0.0	0.0	0.0	625.0	128.0	753.0	0.0	0.0	0.0	625.0	128.0	753.0	0.0	0.0	0.0	625.0	128.0
	Pump Facility (Civil)	0.0	0.0	0.0	0.0	0.0	0.0	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)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
	3)Internal Network	1932.0	309.1	541.0	77.3	656.9	425.0	1911.0	305.8	535.1	76.4	649.7	420.4	1911.0	305.8	535.1	76.4	649.7	420.4
	4)Service Connections	2336.0	23.4	233.6	70.1	1985.6	93.4	2336.0	23.4	233.6	70.1	1985.6	93.4	2336.0	23.4	233.6	70.1	1985.6	93.4
	5)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
	6)Srvc Cnnctn Rhbltn 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
	7)Srvc Cnnctn Rhbltn w/Mr																		
	8)Lateral Rehabilitation	0.0						0.0						0.0					
	9)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
	10)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	5021.0	332.5	774.6	147.4	3267.5	646.4	5000.0	329.2	768.7	146.5	3260.3	641.8	5000.0	329.2	768.7	146.5	3260.3	641.8
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	6923.0	506.7	1503.8	236.8	3898.9	923.6	6902.0	593.4	1497.9	235.9	3891.7	919.0	6642.0	546.6	1425.1	225.5	3811.1	859.2
5.0	Land Acquisition	0.0		0.0				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.	97.0				81.5	15.5	96.0				80.6	15.4	93.0				78.1	14.9
	SUB-TOTAL	397.0	0.0	0.0		231.5	165.5	396.0	0.0	0.0		230.6	165.4	93.0	0.0	0.0		78.1	14.9
6.0	Replacement of Equipment																		
	1)Deep Well Pump	0.0	0.0	0.0	0.0	0.0	0.0	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)Booster Pump	0.0	0.0	0.0	0.0	0.0	0.0	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)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
	5)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
	6)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
	7)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
	8)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	Leakage Detection	0	0.0	0.0				0	0.0	0.0				0	0.0	0.0			
	GRAND TOTAL	7320.0	506.7	1503.8	236.8	4130.4	1089.1	7298.0	593.4	1497.9	235.9	4122.3	1084.4	6735.0	546.6	1425.1	225.5	3889.2	874.1

Angeles No.	ITEM	1993 COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	1994 COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	1995 COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1	Deep Well Facilities	1642.0	217.4	656.4	79.0	550.8	217.4	1642.0	217.4	656.4	79.0	550.8	217.4	1642.0	217.4	656.4	79.0	550.8	217.4
2	Transmission Facilities	260.0	46.8	72.8	10.4	80.6	59.8	260.0	46.8	72.8	10.4	80.6	59.8	0.0	0.0	0.0	0.0	0.0	0.0
3	Purification Plant	0.0	0.0	0.0	0.0	0.0	0.0	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	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
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	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
7	Distribution Facilities	2085.0	309.1	541.0	77.3	1281.9	563.0	2664.0	305.8	535.1	76.4	1274.7	548.4	2664.0	305.8	535.1	76.4	1274.7	548.4
8	Service Connection	2336.0	23.4	233.6	70.1	1985.6	93.4	2336.0	23.4	233.6	70.1	1985.6	93.4	2336.0	23.4	233.6	70.1	1985.6	93.4
9	Admini. Bldg. & Opc. 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	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
11	Vehicle & Stored Material	397.0	0.0	0.0	0.0	231.5	165.5	396.0	0.0	0.0	0.0	230.6	165.4	93.0	0.0	0.0	0.0	78.1	14.9
12	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	7320.0	596.7	1503.8	236.8	4130.4	1089.1	7298.0	593.4	1497.9	235.9	4122.3	1084.4	6735.0	546.6	1425.1	225.5	3889.2	874.1
13	Leakage Detection	0.0	0.0	0.0	0.0	0.0	0.0	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	7320.0	596.7	1503.8	236.8	4130.4	1089.1	7298.0	593.4	1497.9	235.9	4122.3	1084.4	6735.0	546.6	1425.1	225.5	3889.2	874.1

Angeles	Phase I (Stage 2)						Phase I Total						Phase II					
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)DEEP WELL	5640.0	958.8	2594.4	282.0	1128.0	958.8	6580.0	1118.6	3026.8	329.0	1316.0	1118.6	9400.0	1598.0	4324.0	470.0	1880.0	1598.0
(2)PUMPING FACILITY																		
1)Pumping Station	3840.0	345.6	1344.0	192.0	1804.8	345.6	5120.0	460.8	1792.0	256.0	2406.4	460.8	6400.0	576.0	2240.0	320.0	3008.0	576.0
2)Flow Meter	372.0	0.0	0.0	0.0	372.0	0.0	806.0	0.0	0.0	0.0	806.0	0.0	620.0	0.0	0.0	0.0	620.0	0.0
(3)PUMP REPLACEMENT							1600.0	0.0	0.0	0.0	1344.0	250.0						
SUB-TOTAL	9852.0	1304.4	3938.4	474.0	3304.8	1304.4	14106.0	1579.4	4818.8	585.0	5872.4	1835.4	16420.0	2174.0	6564.0	790.0	5508.0	2174.0
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	1715.0	308.7	480.2	68.6	531.6	394.5	1715.0	308.7	480.2	68.6	531.6	394.5	6479.0	1166.2	1814.1	259.2	2008.5	1490.2
SUB-TOTAL	1715.0	308.7	480.2	68.6	531.6	394.5	1715.0	308.7	480.2	68.6	531.6	394.5	6479.0	1166.2	1814.1	259.2	2008.5	1490.2
3.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	4202.0	1092.5	2731.3	294.1	210.1	168.1	8888.0	2310.9	5777.2	622.2	444.4	355.5
(2)Pump Facility (Equip)	3765.0	0.0	0.0	0.0	3125.0	640.0	5006.0	0.0	0.0	0.0	4201.8	861.2	4246.0	0.0	0.0	0.0	3524.2	721.8
Pump Facility (Civil)	0.0	0.0	0.0	0.0	0.0	0.0	2228.0	133.7	2094.3	401.0	0.0	0.0	2187.0	131.2	2055.8	393.7	0.0	0.0
(3)Chlorination Facility	98.0	4.9	33.3	2.9	45.1	14.7	785.0	39.3	266.8	23.5	361.1	117.8	291.0	14.7	100.0	8.8	135.2	44.1
(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	2757.0	427.3	606.5	55.1	1447.5	275.7	5131.0	795.3	1128.8	102.6	2693.8	513.1
(5)Distribution pipes																		
1)Main Pipes	1249.0	224.8	349.7	50.0	387.2	287.3	11970.0	2154.6	3351.6	478.9	3710.7	2753.1	6448.0	1160.6	1805.4	257.9	1998.9	1483.0
2)Valves	117.0	2.3	24.6	7.0	79.6	10.5	3036.0	60.7	637.6	182.2	2064.5	273.2	315.0	6.3	66.2	18.9	214.2	28.4
3)Internal Network	9044.0	1543.1	2700.4	385.7	3278.9	2121.6	12262.0	1961.9	3433.4	490.5	4169.1	2697.6	14209.0	2287.8	4003.7	572.0	4861.7	3145.8
4)Service Connections	11080.0	117.0	1168.0	350.5	9928.0	467.0	14898.0	149.2	1489.8	447.1	12663.2	595.8	14245.0	142.5	1424.5	427.4	12108.2	569.8
5)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	1151.0	0.0	0.0	0.0	1151.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6)Srvc Connctn Rhbltn wo/M	0.0	0.0	0.0	0.0	0.0	0.0	690.0	17.4	179.4	41.4	431.1	62.1	0.0	0.0	0.0	0.0	0.0	0.0
7)Srvc Connctn Rhbltn w/M	0.0	0.0	0.0	0.0	0.0	0.0	550.0	5.4	55.0	16.5	467.6	22.0	0.0					
8)Lateral Rehabilitation	0.0	0.0	0.0	0.0	0.0	0.0	857.0	145.6	239.9	34.3	278.7	192.8	0.0					
9)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	215.0	0.0	0.0	0.0	215.0	0.0	215.0	0.0	0.0	0.0	215.0	0.0
10)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	5638.0	112.8	1578.6	563.8	3495.6	451.0
SUB-TOTAL	26553.0	1892.1	4276.0	796.1	16843.8	3541.1	60607.0	6187.6	15085.6	2464.6	31374.4	8019.4	61906.0	6962.1	17940.2	2907.3	29691.2	7312.5
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	1820.0	182.0	982.8	91.0	291.2	364.0
2)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	1590.0	143.1	651.9	79.5	572.4	222.6	1090.0	98.1	446.9	54.5	392.4	152.6
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	1590.0	143.1	651.9	79.5	572.4	222.6	2910.0	280.1	1429.7	145.5	683.6	516.6
TOTAL	38120.0	3505.2	8694.6	1338.7	20680.2	5240.0	78078.0	8218.8	21036.5	3197.7	38350.8	10471.9	87715.0	10582.4	27748.0	4162.0	37891.3	11493.3
5.0 Land Acquisition	240.0	0.0	240.0	0.0	0.0	0.0	588.0	0.0	588.0	0.0	0.0	0.0	1116.0		1116.0			
Vehicle	1200.0	0.0	0.0	0.0	600.0	600.0	1800.0	0.0	0.0	0.0	900.0	900.0	1200.0				600.0	600.0
Stored Material & Equip.	519.0	0.0	0.0	0.0	435.9	83.1	957.0	0.0	0.0	0.0	803.8	153.2	964.0				809.8	154.2
SUB-TOTAL	1959.0	0.0	240.0	0.0	1035.9	683.1	3345.0	0.0	588.0	0.0	1703.8	1053.2	3280.0	0.0	1116.0	0.0	1409.8	754.2
6.0 Replacement of Equipment																		
1)Deep Well Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4480.0	0.0	0.0	0.0	3763.2	716.8
2)Booster Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5066.0	0.0	0.0	0.0	4204.8	861.2
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	1031.0	0.0	0.0	0.0	1031.0	0.0
4)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	480.0	0.0	0.0	0.0	360.0	120.0
5)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	9039.0	0.0	0.0	0.0	9039.0	0.0
6)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	795.0	0.0	0.0	0.0	572.4	222.6
7)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	4800.0	0.0	0.0	0.0	2400.0	2400.0
8)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	402.0	0.0	0.0	0.0	337.7	64.3
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	26093.0	0.0	0.0	0.0	21708.1	4384.9
7.0 Leakage Detection	0.0	0.0	0.0	0.0	0.0	0.0	990.0	0.0	990.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	40079.0	3505.2	8934.6	1338.7	21716.1	5923.1	82413.0	8218.8	22614.5	3197.7	40054.6	11525.1	117088.0	10582.4	28864.0	4162.0	61009.2	16632.4

Angeles	Phase I (Stage 2)						Phase I Total						Phase II					
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 Deep Well Facilities	9852.0	1304.4	3938.4	474.0	3304.8	1304.4	14106.0	1579.4	4818.8	585.0	5872.4	1835.4	16420.0	2174.0	6564.0	790.0	5508.0	2174.0
2 Transmission Facilities	1715.0	308.7	480.2	68.6	531.6	394.5	1715.0	308.7	480.2	68.6	531.6	394.5	6479.0	1166.2	1814.1	259.2	2008.5	1490.2
3 Purification Plant	0.0	0.0	0.0	0.0	0.0	0.0	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 Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	4202.0	1092.5	2731.3	294.1	210.1	168.1	8888.0	2310.9	5777.2	622.2	444.4	355.5
5 Disinfection Facilities	98.0	4.9	33.3	2.9	45.1	14.7	785.0	39.3	266.8	23.5	361.1	117.8	291.0	14.7	100.0	8.8	135.2	44.1
6 Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	2757.0	427.3	606.5	55.1	1447.5	275.7	5131.0	795.3	1128.8	102.6	2693.8	513.1
7 Distribution Facilities	14775.0	1770.2	3074.7	442.7	6870.7	3059.4	35634.0	4456.5	9756.8	1586.9	14642.8	6777.9	33318.0	3698.7	9509.7	1806.3	14309.6	5830.0
8 Service Connection	11080.0	117.0	1168.0	350.5	9928.0	467.0	17289.0	172.0	1724.2	505.0	14712.9	679.9	14245.0	142.5	1424.5	427.4	12108.2	569.8
9 Admini. Bldg. & Ope. Ctr.	0.0	0.0	0.0	0.0	0.0	0.0	1590.0	143.1	651.9	79.5	572.4	222.6	2910.0	280.1	1429.7	145.5	683.6	516.6
10 Land Acquisition	240.0	0.0	240.0	0.0	0.0	0.0	588.0	0.0	588.0	0.0	0.0	0.0	1116.0	0.0	1116.0	0.0	0.0	0.0
11 Vehicle & Stored Material	1719.0	0.0	0.0	0.0	1035.9	683.1	2757.0	0.0	0.0	0.0	1703.8	1053.2	2164.0	0.0	0.0	0.0	1409.8	754.2
12 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	26093.0	0.0	0.0	0.0	21708.1	4384.9
SUB TOTAL	40079.0	3505.2	8934.6	1338.7	21716.1	5923.1	81423.0	8218.8	21624.5	3197.7	40054.6	11525.1	117088.0	10582.4	28864.0	4162.0	61009.2	16632.4
13 Leakage Detection	0.0	0.0	0.0	0.0	0.0	0.0	990.0	0.0	990.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	40079.0	3505.2	8934.6	1338.7	21716.1	5923.1	82413.0	8218.8	22614.5	3197.7	40054.6	11525.1	117088.0	10582.4	28864.0	4162.0	61009.2	16632.4

APPENDIX 8.2.1.C OPERATION AND MAINTENANCE COST (Angeles City)

(cost: thousand peso)

Item		Stage 1 Cost	Stage 2 Cost	Phase II Cost
Operation & Maintenance Cost				
Salary	2,000 ₱/M.M	1,104	1,752	2,688
Power	0.3 ₱/kwH	323	986	2,016
Chemical	27 ₱/kg	95	246	471
Miscellaneous		838	2,207	3,877
Maintenance		629	1,725	3,063
Total		2,989	6,916	12,115

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
6,556	24,025	27%

The results of the market survey are obtained as shown in TABLE 9.3.1.

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

Income Bracket[1/]	Ave.Pesos	Number
₱900 and below	722	903
₱901 to ₱1500	1,292	1,754
₱1,501 to ₱2,500	2,132	1,339
₱2,501 to ₱4,500	3,486	1,358
₱4,501 and above	8,256	945

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

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

TABLE 9.3.1 MARKET SURVEY SUMMARY

Total Number of Respondents: 6556

1. Distribution According to Building Type

		No.	%
a.	Residential	6359	97.00
b.	Commercial	171	2.61
c.	Industrial	26	0.40

2. Distribution According to Source of Water

		No.	%
a.	Connected to System	1653	25.21
b.	Neighbor's Connection	850	12.97
c.	Public Faucet	239	3.65
d.	Private System	3786	57.75
e.	Water Vendor	3	0.05
f.	Others	25	0.38

3. Average Persons Per Household

a.	Residential / Number of Sample	6.55	/	6355
b.	Commercial / Number of Sample	6.83	/	171
c.	Industrial / Number of Sample	9.27	/	26

4. Willingness To Connect (%)

		Residential	Commercial	Industrial	Total
a.	Yes	59.43	49.12	46.15	59.11
b.	No	15.16	19.30	19.23	15.28
c.	Undecided	0.39	0.00	3.85	0.40
d.	W/ Own Conn.	25.02	31.58	30.77	25.21

5. Average Monthly Water Needs

	Type / Number of Sample		Residential	Commercial	Industrial
a.	Kerosene Can /	1032	13.39	23.90	7.75
b.	Drum /	5302	5.99	4.14	5.17
c.	Gallon /	185	97.76	45.21	2.00
d.	Others /	29	63.66	0.10	0.00

6. Ave. Monthly Electric Bills for Residential Users (PESO): 148.18
   Number of Effective Respondents : 6163

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

		AVE.PESO	NUMBER
a.	P900 and Below	722	903
b.	P901 to P1500	1292	1754
c.	P1501 to P2500	2132	1339
d.	P2501 to P4500	3486	1358
e.	P4501 and Above	8256	945

Sources of Water	Distribution	Willingness to Connect	
		Yes	No
Connected to System	25 %	- %	- %
Neighbor's Connection	13	79	21
Public Faucet	4	76	24
Private System	58	79	20

The private system is the major source of water for the respondents, followed by the system, neighbor's connection and public faucets.

In addition, only 0.4% of the respondents depend on water vendors and others for its water sources. The above table shows that majority of the respondents are willing to connect to the waterworks system.

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

TABLE 9.3.2 DISTRIBUTION OF WILLINGNESS TO CONNECT BY INCOME BRACKET

Sources of Water	Income Bracket				
	₱900 & below	₱901-₱1,500	₱1,501-₱2,500	₱2,501-₱4,500	₱4,501- & above
Connected to System	12 %	20 %	27 %	31 %	37 %
Neighbor's Connection	29	19	11	5	2
Public Faucet	8	5	3	1	0
Private System	50	55	58	62	60
Willingness to Connect					
Yes	63	63	60	58	50
No	25	16	13	11	13
Undecided	1	1	0	0	0
With Own Connection	11	20	27	31	36

As the result of the market survey, the respondents' willingness to connect and the user's types are shown as follows :

Answer		Residential	Commercial	Industrial	Total
Yes	:	59.4 %	49.1 %	46.1 %	59.1 %
No	:	15.2	19.3	19.2	15.3
Undecided	:	0.4	0.0	3.3	0.4
With Own Conn.	:	25.0	31.6	30.8	25.2

Residential users account for 97% of the total respondents, so respondents' willingness to connect is approximately 60% of the total, while unwillingness to connect is 15%. It was observed from the results of the survey that the majority of the respondents in all income brackets are willing to connect to the waterworks system.

Judging from the above, it is safe to conclude that the majority of the residents in the study area are willing to connect to the new system when the water supply system is expanded.

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			P900 and Below	P901 to P1,500	P1,501 to P2,500	P2,501 to P4,500	P4,501 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

INTERVIEW SHEET FORMAT USED IN THE MARKET SURVEY

AAPENDIX 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 PROPOSED WATER RATE

The proposed water rates for 1/2 inch connections of commercial users, and 3/4 inch connections of 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	₱ 6.2	₱ 8.0	₱ 10.6
1989	1.2	60.0	7.6	9.6	12.6
1990	1.2	60.0	7.6	9.6	12.6
1991	1.8	90.0	11.2	14.4	19.0
1992	2.7	135.0	16.8	21.6	28.4
1993	2.9	145.0	18.2	23.2	30.4
1994	3.1	155.0	19.4	24.8	32.6
1995	3.1	155.0	19.4	24.8	32.6
1996	3.3	165.0	20.6	26.4	34.6
1997	3.3	165.0	20.6	26.4	34.6

(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	₱ 5.0	₱ 6.4	₱ 8.5
1989	1.2	48.0	6.1	7.7	10.1
1990	1.2	48.0	6.1	7.7	10.1
1991	1.8	72.0	9.0	11.5	15.2
1992	2.7	108.0	13.4	17.3	22.7
1993	2.9	116.0	14.6	18.6	24.3
1994	3.1	124.0	15.5	19.8	26.1
1995	3.1	124.0	15.5	19.8	26.1
1996	3.3	132.0	16.5	21.1	27.7
1997	3.3	132.0	16.5	21.1	27.7

(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	₱10.0	₱12.8	₱17.0
1989	1.2	96.0	12.2	15.4	20.2
1990	1.2	96.0	12.2	15.4	20.2
1991	1.8	144.0	18.0	23.0	30.4
1992	2.7	216.0	26.8	34.6	45.4
1993	2.9	232.0	29.2	37.2	48.6
1994	3.1	248.0	31.0	39.6	52.2
1995	3.1	248.0	31.0	39.6	52.2
1996	3.3	264.0	33.0	42.2	55.4
1997	3.3	264.0	33.0	42.2	55.4

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 BINAN

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	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	