

3. Projection of Population and Water Demand

3.1 Population Projection

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

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

The procedure or the methodology of population projection for this study is included in Appendix 8. Based on the said methodology, population projections for the study area have been worked out.

Population trends indicate that the population in the study area would increase from 151,213 in 1980 to 204,874 in the year 2010. The projected population by city/municipality and the design year is tabulated in Table 2.3.1 and graphically shown in Fig. 2.3.1. Population projections by barangay are shown in Table 2.3.2 thru Table 2.3.6.

The high and low growth of population projection in the study area has been made separately from the adopted one. Regarding the high projection, the high series of NEDA-POPCOM projection^{1/} is introduced as a useful data for the high population projection. While, the low growth of population in the study area is projected as shown in Table 2.3.7.

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

The population in the served area is projected by design year based on the served area which is discussed in the preceding section of 2.2 Served Area. The population in the served area is shown in Table 2.3.8.

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

The average percentage of WTC in the Phase II project area is 62 %, which is obtained by a market research made in the study. Based on the market study the percentage of WTC of the urban and rural area for future planning is projected as shown below:

	<u>Average Percentage of WTC</u>		
	<u>1987</u>	<u>1993</u>	<u>2010</u>
Urban Area	74	94	100
Rural Area	50	70	80

The served population which is estimated approximately 25,000 or 17 % of the total population in 1980 would increase to 44,125 or 27 % in 1987, 72,982 or 41 % in 1993, and 127,660 or 62 % in 2010, respectively. The served population by design years is shown in Table 2.3.9 and graphically shown in Fig. 2.3.2.

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

Characteristics of these barangays:

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

			<u>1980</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Ilocos Norte W/O						
1. Laoag	Urban area		32,365	33,749	34,774	37,216
	Rural area		37,294	41,976	46,088	55,376
	Total		69,659	75,725	80,862	92,592
Average annual increase(%)			1.2	1.1	0.8	
2. Pasuquin	Urban area		4,837	5,044	5,197	5,562
	Rural area		12,976	15,278	17,024	21,201
	Total		17,813	20,322	22,221	26,763
Average annual increase(%)			1.9	1.5	1.1	
3. Bacarra	Urban area		8,001	8,228	8,377	8,666
	Rural area		15,368	17,176	18,113	20,168
	Total		23,369	25,404	26,490	28,834
Average annual increase(%)			1.2	0.7	0.5	
4. Vintar	Urban area		4,217	4,616	4,900	5,611
	Rural area		19,139	21,847	23,865	28,456
	Total		23,356	26,463	28,765	34,067
Average annual increase(%)			1.8	1.4	1.0	
5. Paoay	Urban area		3,240	3,339	3,428	3,646
	Rural area		13,776	15,159	16,325	18,972
	Total		17,016	18,498	19,753	22,618
Average annual increase(%)			1.2	1.1	0.8	
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Total	Urban area		52,660	54,976	56,676	60,701
	Rural area		98,553	111,436	121,415	144,173
	Total		151,213	166,412	178,091	204,874

Table 2.3.1 Population Projection in Ilocos Norte WD

Ilocos

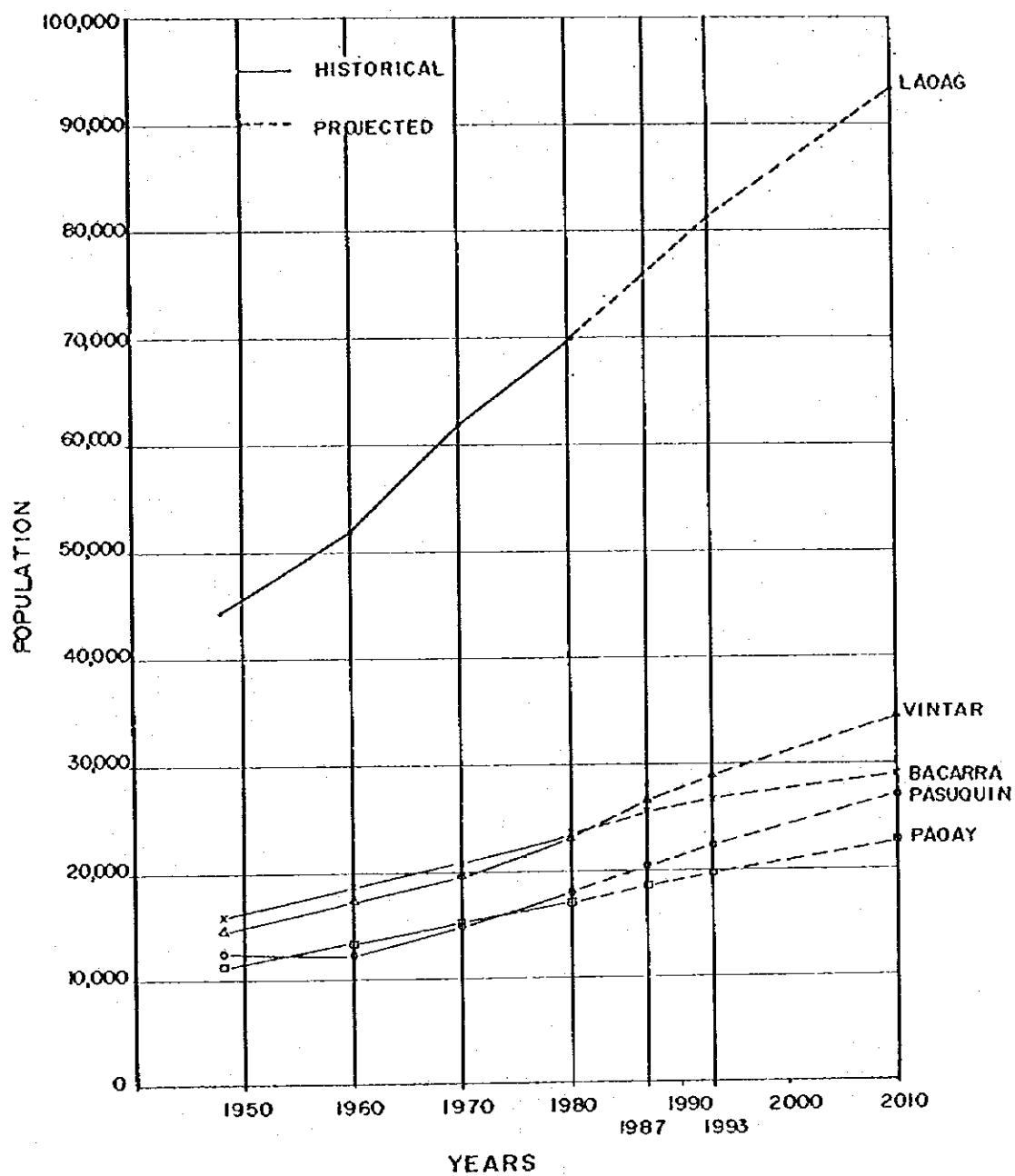


Fig 2.3.1 Ilocos Norte Population Projection
(Medium Series)

Table 2.3.2 Laoag Population Projection

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
1. Apaya	406	712	1.8	0	712	1.8	0	712	1.8	0	712	1.8
2. Araniw	155	585	3.8	1.5	649	4.2	1.5	710	4.6	0.8	813	5.2
3. Bacsil North	690	762	2.3	2.1	881	2.7	2.0	992	3.1	1.2	1,215	3.9
4. Bacsil South	494	796	1.6	3.4	1,006	1.6	2.4	1,161	1.6	1.5	1,495	1.6
5. Balacad	339	1,017	3.0	0.2	807	3.2	0	807	3.4	0	807	3.9
6. Balatong	604	1,000	1.7	1.1	1,098	2.1	1.0	1,166	2.4	0.8	1,335	3.1
7. Barit Vira Pandan	222	1,040	4.7	3.5	1,272	5.4	2.4	1,468	6.1	1.5	1,891	7.8
8. Bencag	217	1,279	5.9	2.0	1,195	6.5	2.0	1,346	7.5	1.5	1,734	9.2
9. Buttong	539	1,098	2.0	1.5	1,420	2.5	1.5	1,628	2.9	1.2	1,994	4.1
10. Caoacan	166	900	9.5	3.2	1,369	10.3	2.4	1,579	10.9	1.9	2,188	12.9
11. Cabungan North	313	1,194	3.8	1.1	972	4.2	1.0	1,032	4.5	1.0	1,222	5.2
12. Cabungan South	255	488	1.9	1.1	738	2.2	1.0	783	2.5	1.0	927	3.0
13. Calayab	275	577	2.1	2.0	1,316	2.4	2.0	1,397	2.7	1.2	1,600	3.3
14. Canangan	293	531	1.8	1.9	560	2.0	2.0	631	2.2	0.8	737	2.5
15. Casili	118	694	5.9	1.5	658	7.0	1.5	644	7.9	1.2	737	9.6
16. Cataban	315	680	2.2	2.5	825	2.4	2.0	929	2.6	0.8	1,138	3.0
17. Cavite	243	545	2.2	1.6	760	2.2	1.5	831	2.2	0	952	2.2
18. Darayday	191	655	3.4	0	545	3.6	0	545	3.9	0.8	643	4.4
19. Cibua North	68	475	19.7	0.8	488	20.9	1.0	503	22.0	0	503	24.1
20. Cibua South	69	1,099	15.9	0.4	934	18.7	0.5	991	21.0	0.8	1,135	25.8
21. Gabu North East	158	699	10.5	1.1	1,289	12.1	2.0	1,452	13.6	1.2	1,778	16.6
22. Gabu North West				2.3	814		2.0	917		1.2	1,123	
23. Gabu Sur				2.2	1,091		2.0	1,229		1.2	1,505	
24. La Paz East				1.8								
25. La Paz East												

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Ilocos

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
26. La Paz Proper	128	415	8.0	0	415	8.3	0	415	8.6	0	415	9.4
27. La Paz Proper		610		0.9	649		1.0	689		0.8	789	
28. La Paz West	162	564	3.5	1.4	622	3.8	1.0	660	4.1	0.8	756	4.7
29. Lagui Sail	410	1,051	2.6	1.6	1,175	2.9	1.5	1,285	3.1	0.8	1,471	3.6
30. Lataag	535	607	0.9	1.2	551	1.0	1.0	585	1.1	0.8	670	1.3
31. Maciladiz	290	828	2.9	1.9	945	3.3	2.0	1,064	3.7	1.2	1,303	4.5
32. Mangato East		483		0	483		0	483		0	483	
33. Mangato West	111	638	10.1	1.6	713	10.8	1.5	780	11.4	0.8	893	12.4
34. Nabutas North		611		0.3	624		0.5	643		0	643	
35. Nabutas South	383	586	3.2	1.3	652	3.3	1.5	713	3.5	0.8	816	3.8
36. Nalbo	154	937	6.1	3.5	1,192	7.7	2.4	1,375	8.9	2.0	1,925	12.5
37. Nangalisan East		838		2.3	983		2.0	1,107		1.5	1,426	
38. Nangalisan West	114	546	12.1	1.3	598	13.9	1.5	654	15.4	1.0	775	19.3
39. Pila	444	991	2.2	1.5	1,100	2.5	1.5	1,203	2.7	0.8	1,378	3.1
40. Poblacion (u)	729	32,365	44.4	0.6	33,749	46.3	0.5	34,774	47.7	0.4	37,216	51.1
41. Ranabulan	269	802	3.0	3.5	766	2.8	2.4	804	3.3	2.0	1,238	4.6
42. Rioeng	413	898	2.2	1.4	990	2.4	1.5	1,083	2.6	1.0	1,283	3.1
43. Salet Bulangon Pasaqui	782	891	1.1	3.5	1,134	1.5	2.4	1,308	1.7	2.0	1,832	2.3
44. San Mateo	306	447	1.5	0.2	453	1.5	0	453	1.5	0	453	1.5
45. Santa Maria	160	811	5.1	2.1	938	5.9	2.0	1,056	6.6	1.5	1,360	8.5
46. Santa Rosa	279	444	1.6	1.0	476	1.7	1.0	505	1.8	0.8	578	2.1
47. Suyo		563		2.8	683		2.0	769		1.2	942	
48. Talingaan	437	759	3.0	1.3	831	3.5	1.0	882	3.8	0.8	1,010	4.5
49. Tangid	365	675	1.8	1.5	749	2.1	1.5	819	2.2	0.8	938	2.6

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Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
50. Vira	604	626	1.0	3.4	791	1.3	2.4	913	1.5	1.5	1,176	1.9
51. Zamboanga	146	729	5.0	1.0	782	5.4	1.0	830	5.7	0.8	950	6.5
TOTAL	12,747	69,659	5.5	1.2	75,725	5.9	1.1	80,862	6.3	0.8	92,592	7.3

Note: (u) Urban

Table 2.3.3 Pasuquin Population Projection

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
1. Batuli	281	174	0.6	2.0	200	0.7	1.8	223	0.8	1.3	278	1.0
2. Binsang	517	539	1.0	4.0	708	1.4	2.5	821	1.6	2.0	1,151	2.2
3. Cababaan Nalbo	125	288	2.3	0.8	305	2.4	0.5	314	2.5	0.5	342	2.7
4. Caruan	443	519	1.2	2.5	617	1.4	2.0	695	1.6	1.3	866	2.0
5. Carusikis	641	473	0.7	4.0	622	1.0	2.5	721	1.1	2.0	1,010	1.6
6. Carusipan	212	345	1.6	2.4	407	1.9	1.8	453	2.1	1.3	570	2.7
7. Dadaeman	126	315	2.5	3.0	387	3.1	2.2	441	3.5	1.3	549	4.4
8. Darupidip	303	282	0.9	0.8	298	1.0	0.5	307	1.0	0.5	334	1.1
9. Davila	1,544	2,084	1.3	2.4	2,460	1.6	1.8	2,738	1.8	1.3	3,450	2.2
10. Dillania	293	372	1.3	0.7	391	1.3	0.5	403	1.4	0.5	439	1.5
11. Dillano	2,438	268	0.1	2.5	319	0.1	1.8	355	0.1	1.3	447	0.2
12. Estancia	1,583	565	0.4	3.5	720	0.5	2.2	820	0.5	1.3	1,021	0.6
13. Naglicuan	358	686	1.9	2.5	814	2.3	1.8	906	2.5	1.3	1,142	3.2
14. Nagsanga	339	530	1.7	2.4	626	1.8	1.8	697	2.1	1.3	878	2.6
15. Nagbangab	238	483	2.0	2.0	555	2.3	1.8	618	2.6	1.3	770	3.2
16. Pangil	273	210	0.8	0.2	213	0.8	0.2	216	0.8	6.5	235	0.9
17. Poblacion (u)	297	4,837	16.3	0.6	5,044	17.0	0.5	5,197	17.5	0.4	5,562	18.7
18. Pragata-Bungro	145	343	2.4	1.8	389	2.7	0.5	401	2.8	0.5	436	3.0
19. Pugupuyan	216	459	2.1	2.5	546	2.5	1.8	608	2.8	1.3	766	3.5
20. Solongan	1,568	226	0.1	5.0	318	0.2	2.5	369	0.2	2.0	529	0.3
21. Salpad	710	255	0.4	3.0	314	0.4	2.2	358	0.5	1.5	461	0.6
22. San Juan	997	817	0.8	2.5	971	1.0	1.6	1,081	1.1	1.3	1,363	1.4
23. Santa Cataling	691	631	0.9	2.0	725	1.0	1.8	819	1.2	1.3	1,020	1.5
24. Santa Matilde	634	312	0.5	2.0	358	0.6	1.8	398	0.6	1.3	496	0.8
25. Sapat	-	307	-	3.5	390	-	2.2	444	-	1.3	553	-

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Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
26. Sulbec	1,372	303	0.2	0.6	316	0.2	0.5	326	0.2	0.5	483	0.4
27. Surong	351	247	0.7	0	247	0.7	0	247	0.7	0	247	0.7
28. Susugaen	965	613	0.7	2.5	752	0.8	1.8	837	0.9	1.3	1,055	1.1
29. Tabungao	236	160	0.7	0	160	0.7	0	160	0.7	0	160	0.7
30. Tadao	1,044	150	0.1	0	150	0.1	0	150	0.1	0	150	0.1
TOTAL	18,940	17,813	0.9	1.9	20,322	1.1	1.5	22,221	1.2	1.1	26,763	1.4

Note: (u) Urban

Table 2.3.4 Bacarra Population Projection

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
1. Bani	217	500	2.3	1.8	567	2.6	1.0	602	2.8	0.8	689	3.2
2. Buyon	274	801	2.9	1.8	907	3.3	1.0	963	3.5	0.8	1,103	4.0
3. Cabaruan	300	965	3.2	1.3	1,056	3.5	1.0	1,121	3.7	0.8	1,284	4.3
4. Cabulalan	307	651	2.1	1.1	703	2.3	0.5	724	2.4	0.3	762	2.5
5. Cabusligan	100	716	7.2	1.4	789	7.9	1.0	838	8.4	0.8	960	9.6
6. Cadaratan	225	1,078	4.8	1.5	1,196	5.3	1.0	1,270	5.6	0.8	1,454	6.5
7. Calicoet-Libong	186	626	3.4	1.7	704	3.8	1.0	747	4.0	0.5	813	4.4
8. Casilian	126	425	3.4	5.0	598	4.7	1.0	635	5.0	0.5	691	5.5
9. Corocor	195	486	2.5	1.8	551	2.8	1.0	585	3.0	0.8	670	3.4
10. Duripes	455	682	1.5	1.5	735	1.6	1.0	780	1.7	0.8	893	2.0
11. Ganagan	414	548	1.3	1.9	625	1.5	1.0	663	1.6	0.5	722	1.7
12. Libcong-Apaleng	350	1,013	2.9	2.0	1,164	3.3	1.0	1,236	3.5	0.8	1,415	4.0
13. Nacupit	528	422	0.8	1.7	475	0.9	1.0	504	1.0	0.8	577	1.1
14. Nambaran	290	631	2.2	1.8	715	2.5	1.0	759	2.6	0.8	869	3.0
15. Natha	108	450	4.2	0.9	479	4.4	0.5	494	4.6	0.3	520	4.8
16. Paninaan	627	346	0.6	0	346	0.6	0	346	0.6	0	346	0.6
17. Paslocan	350	636	1.8	0.7	668	1.9	0.5	688	2.0	0.3	724	2.1
18. Pasugul	250	425	1.7	0	425	1.7	0	425	1.7	0	425	1.7
19. Pipias	105	910	8.7	1.7	1,024	9.8	1.0	1,087	10.4	0.5	1,183	11.3
20. Pulangi	383	643	1.7	1.9	734	1.9	1.1	785	2.0	0.5	854	2.2
21. Pungto	254	429	1.7	1.5	476	1.9	1.0	505	2.0	0.8	578	2.3
22. Poblacion (u)	523	8,001	15.3	0.4	8,228	15.7	0.3	8,377	16.0	0.2	8,666	16.6
23. Sangil	302	712	2.4	2.0	818	2.7	1.0	868	2.9	0.8	994	3.3
24. Tambidao	270	213	0.8	2.0	245	0.9	1.0	260	1.0	0.8	298	1.1
25. Teppang	122	475	3.9	1.5	527	4.3	1.0	559	4.6	0.8	640	5.2
26. Tuburan	537	605	1.1	1.0	649	1.2	0.5	669	1.2	0.3	704	1.3
TOTAL	7,798	23,369	3.0	1.2	25,404	3.3	0.7	26,490	3.4	0.5	28,834	3.7

Note: (u) Urban

Table 2.3.5 Vintar Population Projection

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
1. Abkir	147	824	5.6	1.8	934	6.4	1.5	1,021	6.9	1.1	1,230	8.4
2. Alsem	1,077	466	0.4	2.0	535	0.5	1.5	585	0.5	1.1	705	0.7
3. Bago	2,351	384	0.2	0.9	409	0.2	0.7	426	0.2	0.5	464	0.2
4. Balbulala	441	991	2.2	2.3	1,085	2.5	1.0	1,152	2.6	0.5	1,254	2.8
5. Cabanganen	12,937	702	0.1	2.1	812	0.1	1.5	888	0.1	1.1	1,070	0.1
6. Cabayo	2,213	666	0.3	0.8	704	0.3	0.7	734	0.3	0.5	799	0.4
7. Cabisocolan	735	506	0.8	3.5	758	1.0	2.0	854	1.2	1.5	1,101	1.5
8. Canaan	2,919	644	0.2	2.0	740	0.3	1.5	809	0.3	1.1	974	0.3
9. Colombia	-	434	-	1.9	495	-	1.5	541	-	1.1	652	-
10. Dagupan	2,253	469	0.2	0.6	489	0.2	0.5	504	0.2	0.2	521	0.2
11. Diaton	98	766	7.8	1.2	833	8.5	1.0	884	9.0	0.5	962	9.8
12. Dipitat	2,008	810	0.4	2.2	943	0.5	1.5	1,031	0.5	1.1	1,242	0.6
13. Esperanza	1,910	274	0.1	0	274	0.1	0	274	0.1	0	274	0.1
14. Ester	1,244	1,031	0.8	2.0	1,184	1.0	2.0	1,333	1.1	1.5	1,718	1.4
15. Isic-Isic	6,787	1,047	0.2	1.5	1,162	0.2	1.5	1,271	0.2	1.1	1,530	0.2
16. Lubnac	294	1,152	3.9	3.0	1,416	4.8	2.4	1,634	5.6	1.5	2,106	7.2
17. Nababnanag	-	467	-	1.9	533	-	1.5	583	-	1.1	702	-
18. Malasig Alejo	-	670	-	2.1	775	-	1.5	847	-	1.1	1,020	-
19. Manarang	411	582	1.4	1.1	628	1.5	1.0	667	1.6	0.5	726	1.8
20. Margaag	157	527	3.4	0.7	553	3.5	0.5	570	3.6	0.2	590	3.8
21. Manoroc	3,134	608	0.2	1.1	656	0.2	1.0	696	0.2	0.5	758	0.2
22. Malampa	1,498	508	0.3	1.6	568	0.4	1.5	621	0.4	1.1	748	0.5
23. Paraparoroc	441	766	1.7	3.5	975	2.2	2.0	1,098	2.5	1.5	1,415	3.2
24. Parut	98	769	7.8	3.0	944	9.6	2.5	1,095	11.2	1.5	1,411	14.4
25. Salsalanagui	78	747	9.6	2.1	864	11.1	1.5	945	12.1	1.1	1,138	14.6

Ilocos

-to be continued-

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
26. San Jose	2,321	346	0.1	0	346	0.1	0	346	0.1	0	346	0.1
27. Santo Tomas	-	364	-	2.5	433	-	2.0	488	-	1.5	630	-
28. Tamdagan	2,380	794	0.3	2.4	937	0.4	1.5	1,025	0.4	1.1	1,235	0.5
29. Visaya	3,790	735	0.2	2.3	862	0.2	1.5	943	0.2	1.1	1,135	0.3
30. Poblacion (u)	538	4,217	7.8	1.3	4,616	8.6	1.0	4,900	9.1	1.0	5,611	10.4
TOTAL	52,260	23,356	0.4	1.8	26,463	0.5	1.4	28,765	0.6	1.0	34,067	0.7

Note: (u) Urban

Table 2.3.6 Paay Population Projection

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
1. Bacsil	812	436	0.5	0.2	442	0.5	0.2	447	0.6	0.2	462	0.6
2. Cabaguan	90	252	2.8	0.8	266	3.0	0.8	279	3.1	0.8	319	3.5
3. Cabangaran	257	334	1.3	1.5	371	1.4	1.5	406	1.6	1.2	497	1.9
4. Callaguip	567	1,458	2.6	1.2	1,584	2.8	1.2	1,702	3.0	1.0	2,016	3.6
5. Cayobog	128	304	2.4	1.2	330	2.6	1.2	354	2.8	1.0	419	3.3
6. Dolores (u)	112	493	4.4	0.8	521	4.7	0.8	547	4.9	0.8	626	5.6
7. Laoa	103	221	2.1	0	221	2.1	0	221	2.1	0	221	2.1
8. Masintok	363	525	1.4	0	525	1.4	0	525	1.4	0	525	1.4
9. Monte	360	352	1.0	0	352	1.0	0	352	1.0	0	352	1.0
10. Mumulaan	650	473	0.7	1.8	536	0.8	1.5	586	0.9	1.2	718	1.1
11. Nagbacalan	573	1,877	3.3	1.7	2,112	3.7	1.5	2,296	4.0	1.2	2,812	4.9
12. Nalasin	321	932	2.9	0.9	992	3.1	0.8	1,041	3.2	0.8	1,192	3.7
13. Nanguyudan	119	470	3.9	3.3	590	5.0	3.0	704	5.9	1.2	862	7.2
14. Oaig Abalay Upay	249	376	1.5	1.9	429	1.7	1.5	469	1.9	1.2	574	2.3
15. Panbaran	165	288	1.7	0	288	1.7	0	288	1.7	0	288	1.7
16. Paratong	346	847	2.4	1.1	914	2.6	1.0	970	2.8	1.0	1,149	3.3
17. Pasil	88	621	7.1	0	621	7.1	0	621	7.1	0	621	7.1
18. San Juan	205	233	3.2	0	233	3.9	0	233	4.5	0	233	5.3
19. San Pedro	116	430	3.2	4.2	573	3.9	3.0	684	4.5	1.3	852	5.3
20. Sideg	116	302	2.6	0	302	2.6	0	302	2.6	0	302	2.6
21. Suba	68	932	13.7	3.6	1,194	17.6	2.8	1,409	20.7	1.3	1,755	25.8
22. Sungadan	182	793	4.4	1.6	886	4.9	1.5	969	5.3	1.2	1,187	6.5
23. Surgui	417	657	1.6	0	657	1.6	0	657	1.6	0	657	1.6
24. Veronica (u)	158	226	1.4	0	226	1.4	0	226	1.4	0	226	1.4
25. Poblacion (u)	620	2,521	4.1	0.4	2,592	4.2	0.4	2,655	4.3	0.3	2,794	4.5
26. San Agustin	731	663	0.9	1.6	741	1.0	1.5	810	1.1	1.2	992	1.4
TOTAL	7,800	17,016	2.2	1.2	18,498	2.4	1.1	19,753	2.5	0.8	22,618	2.9

Note: (u) Urban

Table 2.3.7 Ilocos Norte WD High and Low Growth Population Projection

	1980		1987		1993		2010	
	T.P	A.G.R (%)	T.P	A.G.R (%)	T.P	A.G.R (%)	T.P	A.G.R (%)
Ilocos Norte W/D								
1. Lacag High Projection	76,059	2.4	89,690	2.4	103,140	2.3	154,400	2.4
Medium Projection	69,659	1.2	75,725	1.2	80,862	1.1	92,592	0.8
Low Projection	69,659	1.08	75,090	1.08	79,140	0.88	88,210	0.64
2. Pasuquin High Projection	18,206	2.4	32,190	2.4	37,020	2.3	55,420	2.4
Medium Projection	17,813	1.9	20,322	1.9	22,221	1.5	26,763	1.1
Low Projection	17,813	1.71	20,060	1.71	21,540	1.2	25,000	0.88
3. Bacarra High Projection	24,487	2.1	28,330	2.1	31,730	1.9	45,180	2.1
Medium Projection	23,369	1.2	25,404	1.2	26,490	0.7	28,834	0.5
Low Projection	23,369	1.08	25,190	1.08	26,050	0.56	27,880	0.4
4. Vintar High Projection	23,972	2.4	42,380	2.4	48,740	2.3	72,960	2.4
Medium Projection	23,356	1.8	26,463	1.8	28,765	1.4	34,067	1.0
Low Projection	23,356	1.62	26,140	1.62	27,950	1.12	32,000	0.8
5. Paay High Projection	18,751	2.4	33,150	2.4	38,120	2.3	57,070	2.4
Medium Projection	17,016	1.2	18,498	1.2	19,753	1.1	22,618	0.8
Low Projection	17,016	1.08	18,340	1.08	19,330	0.88	21,540	0.64
Total High Projection	161,475		225,740		258,750		358,030	
Medium Projection	151,213		166,412		178,096		204,874	
Low Projection	151,213		164,820		174,010		194,630	

Remarks: T.P - Total population

A.G.R - Average annual growth rate

Based on high assumption of NEDA-POPCOM population projection

Table 2.3.8 Projected Population in The Served Area in Ilocos Norte WD

	1980			1987			1993			2010		
	T.P	P.S.A	%	T.P	P.S.A	%	T.P	P.S.A	%	T.P	P.S.A	%
Ilocos Norte W/D												
1. Laoag												
Urban area	32,365	22,700	70	33,749	33,749	100	34,774	34,774	100	37,216	37,216	100
Rural area	37,294	-	-	41,976	2,262	5	46,088	11,308	25	55,376	35,737	65
Total	69,659	22,700	33	75,725	36,011	48	80,867	46,082	57	92,592	72,953	79
2. Pasuquin												
Urban area	4,837	3,870	80	5,044	5,044	100	5,197	5,197	100	5,562	5,562	100
Rural area	12,976	1,300	10	15,278	1,478	10	17,024	5,343	31	21,201	8,703	41
Total	17,813	5,170	29	20,322	6,522	32	22,221	10,540	47	26,763	14,265	53
3. Bacarra												
Urban area	8,001	7,200	90	8,228	8,228	100	8,377	8,377	100	8,666	8,666	100
Rural area	15,368	2,900	19	17,176	3,391	21	18,113	7,828	43	20,168	17,798	88
Total	23,369	10,100	43	25,404	11,619	46	26,490	16,205	61	28,834	26,464	92
4. Vintar												
Urban area	4,217	-	-	4,616	4,616	100	4,900	4,900	100	5,611	5,611	100
Rural area	19,139	-	-	21,847	-	-	23,865	1,942	8	28,456	10,214	36
Total	23,356	-	-	26,463	4,616	17	28,765	6,842	24	34,067	15,825	46
5. Paoay												
Urban area	3,240	-	-	3,339	3,339	100	3,428	3,428	100	3,646	3,646	100
Rural area	13,776	-	-	15,159	-	-	16,325	2,011	12	18,972	11,203	59
Total	17,016	-	-	18,498	3,339	18	19,753	5,439	28	22,618	14,849	66
Total												
Urban area	52,660	33,770	64	54,976	54,976	100	56,676	56,676	100	60,701	60,701	100
Rural area	98,553	4,200	4	111,436	7,131	6	121,420	28,430	23	144,173	83,655	62
Total	151,213	37,970	25	166,412	62,107	37	178,096	85,106	48	204,874	144,356	73

Remarks: T.P - Total population in the study area

P.S.A - Population in the served area

% - Per cent of the total population (P.S.A/T.P x 100)

Table 2.3.9 Projected Served Population in Ilocos Norte WD

	1980			1987			1993			2010		
	P.S.A	S.P	%	P.S.A	S.P	%	P.S.A	S.P	%	P.S.A	S.P	%
Ilocos Norte W/D												
1. Laoag												
Urban area	22,700	14,000	62	33,749	23,620	70	34,774	31,300	90	37,216	37,216	100
Rural area	-	-	-	2,262	1,140	50	11,308	7,920	70	35,737	28,590	80
Total	22,700	14,000	62	36,011	24,760	69	46,082	39,220	85	72,953	65,806	90
2. Pasuquin												
Urban area	3,870	3,400	88	5,044	4,035	80	5,197	5,197	100	5,562	5,562	100
Rural area	1,300	600	46	1,478	700	47	5,343	4,000	75	8,703	7,000	80
Total	5,170	4,000	77	6,522	4,735	73	10,540	9,197	87	14,265	12,562	88
3. Bacarra												
Urban area	7,200	6,000	83	8,228	6,580	80	8,377	8,377	100	8,666	8,666	100
Rural area	2,900	1,000	34	3,391	1,690	50	7,828	5,480	70	17,798	14,240	80
Total	10,100	7,000	69	11,619	8,270	71	16,205	13,857	86	26,464	22,906	87
4. Vintar												
Urban area	-	-	-	4,616	3,690	80	4,900	4,900	100	5,611	5,611	100
Rural area	-	-	-	-	-	-	1,942	1,170	60	10,214	8,170	80
Total	-	-	-	4,616	3,690	80	6,842	6,070	89	15,825	13,781	87
5. Paoy												
Urban area	-	-	-	3,339	2,670	80	3,428	3,428	100	3,646	3,646	100
Rural area	-	-	-	-	-	-	2,011	1,210	60	11,203	8,959	80
Total	-	-	-	3,339	2,670	80	5,439	4,638	85	14,849	12,605	85
Total												
Urban area	33,770	23,400	69	54,976	40,595	74	56,676	53,202	94	60,701	60,701	100
Rural area	4,200	1,600	38	7,131	3,530	50	28,430	19,780	70	83,655	66,959	80
Total	37,970	25,000	66	62,107	44,125	71	85,106	72,982	86	144,356	127,661	88

Remarks: P.S.A - Population in the served area

S.P - Served population

% - Per cent of the P.S.A (S.P/P.S.A x 100)

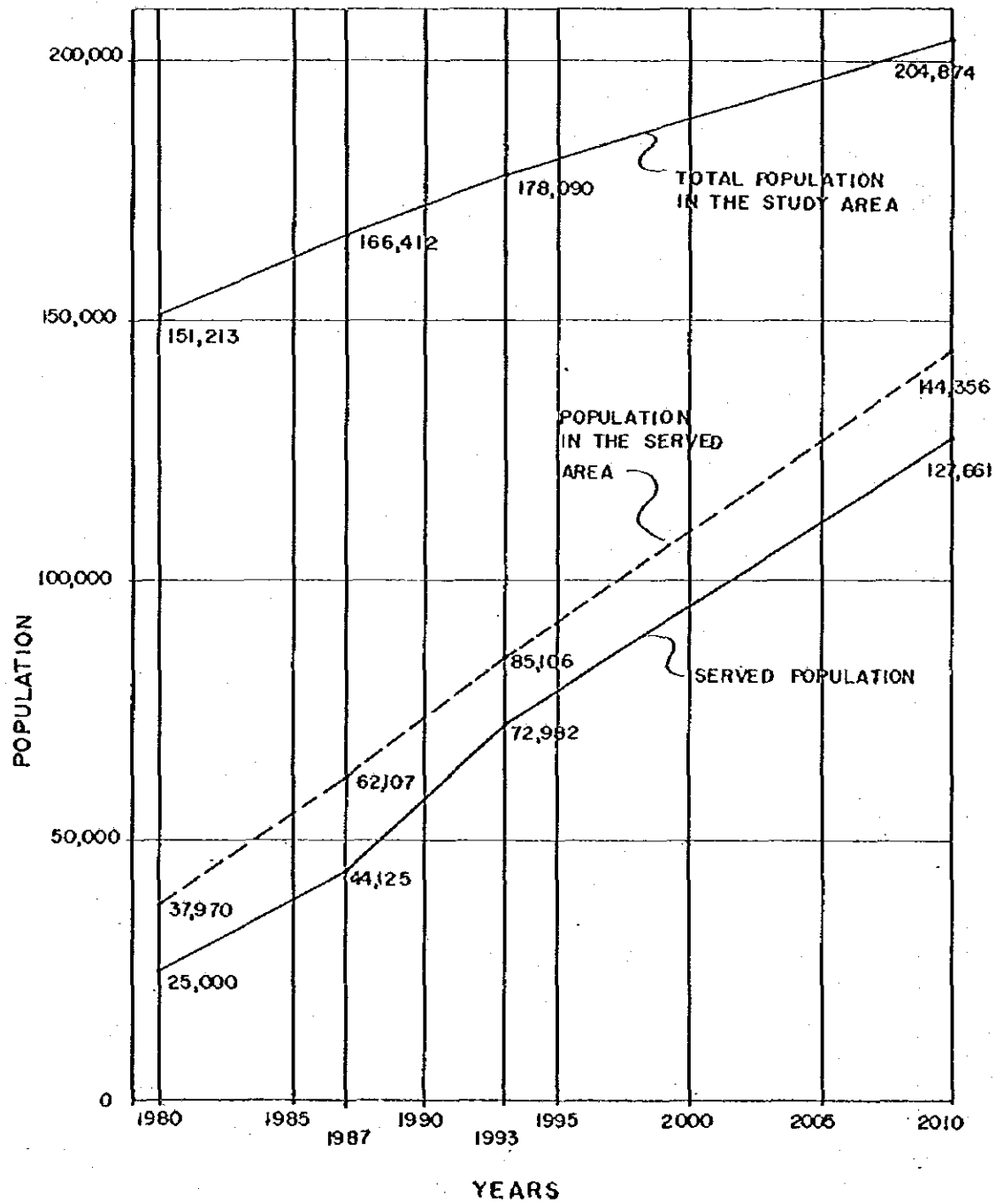


Fig 2.3.2 Served Population

Table 2.3.10 Served Population and Served Area in Laoag

Barrangay	1980-Present Served Area				1987-Served Area (Phase I Program)				1993-Served Area (Phase II Program)				2010-Served Area (Phase III Program)			
	S.P.	% T.P.	S.A. (ha)	P.D. (P/ha)	S.P.	% T.P.	S.A. (ha)	P.D. (P/ha)	S.P.	% T.P.	S.A. (ha)	P.D. (P/ha)	S.P.	% T.P.	S.A. (ha)	P.D. (P/ha)
Urban Area	14,000	43	400	35			729	32.4	31,300	90	729	42.9	37,216	100	729	51.1
Poblacion																
Rural Area																
Barit Vira Pandan					640	50	120	5.3	1,030	70	180	5.7	1,645	80	260	6.3
Rioeng					500	50	80	6.3	760	70	120	6.3	1,026	80	170	6.0
San Mateo									320	70	60	5.3	362	80	120	3.0
Santa Maria									740	70	30	24.7	1,088	80	65	16.7
Suyo									540	70	80	6.8	754	80	170	4.4
Nangalisan East									770	70	30	41	1,142	80	50	35.2
Nangalisan West									460	70			620	80		
Nalbo									960	70	30	32	1,540	80	60	25.7
Buttong									1,140	70	40	28.5	1,595	80	90	17.7
Darayday									580	70	60	9.7	762	80	130	5.9
Raraburan									620	70	50	12.4	990	80	110	9
Lapaz													3,822	80	130	29.4
Tangid													750	80	110	6.8
Cabungaan North													978	80	40	43
Cabungaan South													742	80		
Bencag													1,387	80	70	19.8
Zamboanga													760	80	45	17.3
Cavit													910	80	35	26
Gabu													1,310	80	40	32
Araniw													650	80	50	13
Mangato													1,101	80	30	36.7
Santa Rosa													462	80	80	5.8

-to be continued-

Barangay	1980-Present Served Area					1987-Served Area (Phase I Program)					1993-Served Area (Phase II Program)					2010-Served Area (Phase III Program)				
	S.P	% T.P.	S.A (ha)	P.D (p/ha)		S.P	% T.P	S.A (ha)	P.D (p/ha)		S.P	% T.P	S.A (ha)	P.D (p/ha)		S.P	% T.P	S.A (ha)	P.D (p/ha)	
Bulatong																1,068	80	100	10.7	
Balacad																646	80	150	4.3	
Apaya																570	80	120	4.8	
Pila																1,102	80	130	8.5	
Talingaan																808	80	130	6.2	
Total	14,000		400	35		24,760		929	25.7		39,220		1,409	27.8		65,806		3,214		
Average																			20.5	
Remarks:	S.P Served population					S.P - Per cent to the total population					S.A - Served area in hectare					P.D - Served population density, persons per hectare				

Table 2.3.11 Served Population and Served Area in Pasuquin

Barrangay	1980-Present Served Area				1987-Served Area (Phase I Program)				1993-Served Area (Phase II Program)				2010-Served Area (Phase III Program)			
	S.P.	% T.P.	S.A (ha)	P.D (p/ha)	S.P.	% T.P.	S.A (ha)	P.D (p/ha)	S.P.	% T.P.	S.A (ha)	P.D (p/ha)	S.P.	% T.P.	S.A (ha)	P.D (p/ha)
Urban Area																
Poblacion	3,400	70	200	17	4,035	80	297	13.6	5,197	100	297	17.5	5,562	100	297	18.7
Rural Area																
Nagbangab	220	45	50	4.4	250	50	50	5	460	75	70	6.6	620	80	95	6.5
Sulbec	140	45	140	1	150	50	140	1	240	75	200	1.2	390	80	300	1.3
Batuli	80	45	50	1.6	100	50	50	2	170	75	80	2.1	220	80	110	2
Carusipan	160	45	40	4	200	50	40	5	340	75	60	5.7	460	80	85	5.4
Sinsang									600	75	155	3.9	920	80	210	4.4
Cababaan Nalbo									240	75	40	6	270	80	50	5.4
Nagsanga									520	75	100	5.2	700	80	140	5
Pragata									300	75	40	7.5	350	80	60	5.8
Puyupuyan									450	75	65	6.9	650	85	90	7.2
Naglicuan									680	75	110	6.2	910	80	140	6.5
Caruan													690	80	180	3.8
Estancia													820	80	-300	2.7
Total	4,000		480		4,735		577		9,197		1,217		12,562		2,057	
Average				8.3				8.2				7.6				6.1
Remarks:	S.P.	Served population														
	% T.P.	Per cent to the total population														
	S.A	Served area in hectare														
	P.D	Served population density, persons per hectare														

Table 2.3.12 Served Population and Served Area in Bacarra

Barrangay	1980-Present Served Area				1987-Served Area (Phase I Program)				1993-Served Area (Phase II Program)				2010-Served Area (Phase III Program)			
	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)
Urban Area																
Poblacion	6,000	75	400	15	6,580	80	400	16.5	8,377	100	520	16.1	8,666	100	520	16.7
Rural Area																
Buyon					360	40	50	7.2	670	70	80	8.4	880	80	110	8
Pasiocan					270	40	70	3.9	480	70	110	4.4	580	80	140	4.1
Corocor	1,000				220	40	20	11	410	70	60	6.8	540	80	80	6.8
Cabusligan					320	40	30	10.7	640	70	50	12.8	770	80	50	15.4
Cadaratan					520	45	50	10.4	890	70	70	12.7	1,160	80	90	12.9
Pasugal									400	70	80	5	340	80	100	3.4
Tambidao									180	70	80	2.3	240	80	110	2.2
Bani									420	70	70	6	550	80	90	6.1
Duripes									550	70	140	3.9	710	80	180	3.9
Cabulalaan									500	70	90	5.6	610	80	120	5.1
Cabaruan									340	70	80	4.3	1,030	75	120	8.6
Calioet-Libong													650	75	70	9.3
Casilian													550	75	50	11
Ganagan													580	75	170	3.4
Libtong-Apaleng													1,130	75	140	8.1
Natba													420	75	40	10.5
Pipias													950	75	60	15.8
Pulangi													680	75	150	4.5
Sangil													800	75	120	6.7
Teppang													510	75	50	10.2
Tuburan													560	75	210	2.7
Total	7,000				8,270		620	13.4	13,857		1,430	9.7	22,906		2,750	8.3
Average																

Table 2.3.13 Served Population and Served Area in Vintar

Barrangay	1980-Present Served Area				1997-Served Area (Phase I Program)				1993-Served Area (Phase II Program)				2010-Served Area (Phase III Program)			
	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)
Urban Area	-	-	-	-	3,690	80	300	12.3	4,900	100	300	16.3	5,611	100	300	18.7
Poblacion																
Rural Area																
Malasiq									510	60	-	-	820	80	-	-
Parul									660	60	30	22	910	80	40	22.8
Lubnac													1,690	80	90	18.8
Margaay													470	80	50	9.4
Parparoroc													1,130	80	130	8.7
Diaton													770	80	30	25.7
Abkir													980	80	40	24.5
Columbia													520	80	-	-
Cabisoculan													880	80	220	4
Total									6,070		330		13,781		900	
Average												18.4				15.3
Remarks:	S.P	-	Served population													
	% T.P	-	Per cent to the total population													
	S.A	-	Served area in hectare													
	P.D	-	Served population density, persons per hectare													

Table 2.3.14 Served Population and Served Area in Paoy

Barrangay	1980-Present Served Area					1987-Served Area (Phase I Program)					1993-Served Area (Phase II Program)					2010-Served Area (Phase III Program)				
	S.P	% T.P	S.A (ha)	P.D (p/ha)		S.P	% T.P	S.A (ha)	P.D (p/ha)		S.P	% T.P	S.A (ha)	P.D (p/ha)		S.P	% T.P	S.A (ha)	P.D (p/ha)	
Urban Area																				
Poblacion	2,070		80	200		2,655	100	250			2,794	100	300			2,794	100	300	9.3	
Dolores	420		80	30		547	100	40			626	100	50			626	100	50	12.5	
Verorica	180		80	45		226	100	50			226	100	50			226	100	50	4.5	
Rural Area																				
Nalasin						630	60	90			960	80	100			960	80	100	9.6	
Paratong						580	60	90			920	80	100			920	80	100	9.2	
Suba											1,400	80	50			1,400	80	50	28	
Nagbacalan											2,250	80	170			2,250	80	170	13.2	
Mamulaan											570	80	200			570	80	200	2.9	
Baesil											370	80	240			370	80	240	1.5	
Oaig											460	80	70			460	80	70	6.6	
Callabulp											1,610	80	170			1,610	80	170	9.5	
Masintoc											420	80	110			420	80	110	3.8	
Total	2,670		275			4,638		520			12,608		1,610			12,608		1,610		
Average									9.7										7.8	
Remarks:	S.P - Served population % T.P - Per cent to the total population S.A - Served area in hectare P.D - Served population density, persons per hectare																			

3.2 Water Demand

Water demand projection in this section is undertaken to obtain a basis for a long range water supply plan until the Master Plan target year 2010. The water demand projection years are 1987, 1993 and 2010 conforming to the design years of this study. The water demand projections for this study are worked out based on the concept or the methodology indicated in Appendix 8. Procedure of Projection of Population and Water Demand.

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

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

Summary of water demand projections by the design year and category of water use are shown in Table 2.3.15 Thru Table 2.3.19. Served population and average day water demand in each city/municipality by demand area is shown in Table 2.3.20. Based on the design criteria for planning, included in Appendix 7, maximum day water demands and peak hour water demands in each city/municipality are calculated and shown in Table 2.3.21.

Table 2.3.15

Laoag Average Day Water Demand in Urban Area
(In m³/day)

<u>Use Category</u>	<u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic		3,023	4,226	5,768
Commercial and Industrial		331	657	1,526
Institutional		47	94	149
Accounted-for-water		3,401	4,977	7,443
Unaccounted-for-water		1,748	1,659	1,861
Total		5,149	6,636	9,304
<hr/>				
Population Served		23,620	31,300	37,216
Per Capita Use(lpcd)		218	212	250

Laoag Average Day Water Demand in Rural Area
(In m³/day)

<u>Use Category</u>	<u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic		79	618	2,859
Commercial and Industrial		-	-	-
Institutional		2	24	114
Accounted-for-water		81	642	2,973
Unaccounted-for-water		23	158	744
Total		104	800	3,717
<hr/>				
Population Served		1,140	7,920	28,590
Per Capita Use(lpcd)		91	101	130

Table 2.3.16

Pasuguin Average Day Water Demand in Urban Area
(In m³/day)

<u>Use Category</u>	<u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic		424	598	779
Commercial and Industrial		48	73	133
Institutional		8	16	22
Accounted-for-water		480	687	934
Unaccounted-for-water		246	228	234
Total		726	915	1,168
Population Served		4,035	5,197	5,562
Per Capita Use(lpcd)		180	176	210

Pasuguin Average Day Water Demand in Rural Area
(In m³/day)

<u>Use Category</u>	<u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic		48	312	700
Commercial and Industrial		-	-	-
Institutional		1	12	28
Accounted-for-water		49	324	728
Unaccounted-for-water		15	80	182
Total		64	404	910
Population Served		700	4,000	7,000
Per Capita Use(lpcd)		91	101	130

Table 2.3.17

Bacarra Average Day Water Demand in Urban Area
(In m³/day)

<u>Use Category</u> <u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic	691	963	1,213
Commercial and Industrial	79	117	208
Institutional	13	25	35
Accounted-for-water	783	1,105	1,456
Unaccounted-for-water	401	369	364
Total	1,184	1,474	1,820
Population Served	6,580	8,377	8,666
Per Capita Use(lpcd)	180	176	210

Bacarra Average Day Water Demand in Rural Area
(In m³/day)

<u>Use Category</u> <u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic	117	427	1,424
Commercial and Industrial	-	-	-
Institutional	3	16	57
Accounted-for-water	120	443	1,481
Unaccounted-for-water	34	110	370
Total	154	553	1,851
Population Served	1,690	5,480	14,240
Per Capita Use(lpcd)	91	101	130

Table 2.3.18
Vintar Average Day Water Demand in Urban Area
(In m³/day)

<u>Use Category</u> <u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic	387	564	786
Commercial and Industrial	44	69	135
Institutional	7	15	22
Accounted-for-water	438	648	943
Unaccounted-for-water	226	214	235
Total	664	862	1,178
Population Served	3,690	4,900	5,611
Per Capita Use (lpcd)	180	176	210

Vintar Average Day Water Demand in Rural Area
(In m³/day)

<u>Use Category</u> <u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic	-	91	817
Commercial and Industrial	-	-	-
Institutional	-	4	33
Accounted-for-water	-	95	850
Unaccounted-for-water	-	23	212
Total	-	118	1,062
Population Served	-	1,170	8,170
Per Capita Use (lpcd)	-	101	130

Table 2.3.19
Paoay Average Day Water Demand in Urban Area
(In m³/day)

<u>Use Category</u>	<u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic		280	394	510
Commercial and Industrial		32	48	88
Institutional		5	10	15
Accounted-for-water		317	452	613
Unaccounted-for-water		164	151	153
Total		481	603	766
<hr/>				
Population Served		2,670	3,428	3,646
Per Capita Use(lpcd)		180	176	210

Paoay Average Day Water Demand in Rural Area
(In m³/day)

<u>Use Category</u>	<u>Year</u>	<u>1987</u>	<u>1993</u>	<u>2010</u>
Domestic		-	94	896
Commercial and Industrial		-	-	-
Institutional		-	4	36
Accounted-for-water		-	98	932
Unaccounted-for-water		-	24	233
Total		-	122	1,165
<hr/>				
Population Served		-	1,210	8,960
Per Capita Use(lpcd)		-	101	130

Table 2.3.20 Served Population and Average Day Water Demand in Ilocos Norte WD

City/Municipality	1981			1987			1993			2010		
	S.P	lpcd	A.D (m ³ /day)	S.P	lpcd	A.D (m ³ /day)	S.P	lpcd	A.D (m ³ /day)	S.P	lpcd	A.D (m ³ /day)
1. Laoag Urban area	14,000	-	-	23,620	218	5,149	31,300	212	6,636	37,216	250	9,304
rural area	-	-	-	1,140	91	104	7,920	101	800	28,590	130	3,717
total	14,000	(240)	3,360	24,760	-	5,253	39,220	-	7,436	65,806	-	13,021
2. Pasuquin Urban area	3,400	-	-	4,035	180	726	5,197	176	915	5,562	210	1,168
rural area	600	-	-	700	91	64	4,000	101	404	7,000	130	910
total	4,000	(165)	660	4,735	-	790	9,197	-	1,319	12,562	-	2,078
3. Bacarra Urban area	6,000	-	-	6,580	180	1,184	8,377	176	1,474	8,666	210	1,820
rural area	1,000	-	-	1,690	91	154	5,480	101	553	14,240	130	1,851
total	7,000	(165)	1,160	8,270	-	1,338	13,857	-	2,027	22,906	-	3,671
4. Vintar Urban area	-	-	-	3,690	180	664	4,900	176	862	5,611	210	1,178
rural area	-	-	-	-	-	-	1,170	101	118	8,170	130	1,062
total	-	-	-	3,690	-	664	6,070	-	980	13,781	-	2,240
5. Paoay Urban area	-	-	-	2,670	180	481	3,428	176	603	3,646	210	766
rural area	-	-	-	-	-	-	1,210	101	122	8,989	130	1,165
total	-	-	-	2,670	-	481	4,638	-	725	12,605	-	1,931
Total												
Urban area	23,400	-	-	40,595	-	8,204	53,202	-	10,490	60,701	-	14,236
rural area	1,600	-	-	3,530	-	322	19,780	-	1,997	66,959	-	8,705
total	25,000	(207)	5,180	44,125	193	8,526	72,982	171	12,487	127,660	180	22,941

Remarks: S.P - Served population

lpcd - liters per capita per day

A.D - Average day demand in cu m/day.

Table 2.3.21 Fluctuations in Water Demand in Ilocos Norte WD
(In m³/day)

City/Municipality	1991			1987			1993			2010		
	A.D	M.D	P.H	A.D	M.D	P.H	A.D	M.D	P.H	A.D	M.D	P.H
Laoag	3,360	(3,920)	-	5,253	6,304	7,880	7,436	8,923	11,154	13,021	15,625	19,532
Pasquin	660	(910)	-	790	948	1,185	1,319	1,583	1,979	2,078	2,494	3,117
Bacarra	1,160	(2,230)	-	1,338	1,606	2,007	2,027	2,432	3,040	3,671	4,405	5,507
Vintar	-	-	-	664	797	996	980	1,176	1,470	2,240	2,688	3,360
Pacay	-	-	-	481	577	722	725	870	1,088	1,931	2,317	2,897
Total	5,180	6,060	-	8,526	10,232	12,789	12,487	14,984	18,731	22,941	27,529	34,413

Remarks: A.D - Average day demand
M.D - Maximum day demand = A.D x 1.2
P.H - Peak hour demand = A.D x 1.5

4. Water Sources

The major water sources which are presently being used by Level III systems are springs and riverbed water. In addition, there are deep and shallow groundwater sources in Laoag and Paoay which are not put into service yet because of lack of power facilities. Details of all potential water sources are reported in Appendix 5. Study on Water Sources.

As for springs, those with rather abundant yields are already utilized for water supply. Riverbed water of the Bacarra and the Laoag Rivers is a promising water source as evidenced by the existing infiltration galleries, and the rivers have abundant perennial surface flows, located in the center of the study area. In Paoay, which is situated in the southern end of the area detached from other poblacions, available water sources are not necessarily sufficient as groundwater in the area is more or less saline. Under the above circumstances, water sources to be used for each phase of the master plan are discussed in the following.

For convenience sake, Fig 2.4.1, Fig 2.4.2, Fig. 2.4.3 and Table 2.4.1 are prepared to illustrate, in a schematical form, the relationship of supply sources with respective productions and poblacions with their water demand.

4.1 Phase I

In Phase I, the total capacity of the existing water sources, both those in use and those not in use is sufficient to meet the water demand except in Paoay. Necessary works to make full use of them are primarily to rehabilitate all parts of the intake facilities, deteriorated or damaged, and add power facilities together with piping. Further, to accommodate peak hour demand, storage facilities are to be constructed for all the systems. For Paoay, a new infiltration gallery together with a transmission pipeline will be constructed.

4.2 Phase II

This Phase requires to develop new water sources to meet an increased water demand as shown in Fig 2.4.2. Addition of new water sources is needed in the Laoag and Bacarra areas. In the Laoag area, the feasible water source is riverbed water, which is to be taken by way of infiltration gallery. In Bacarra, riverbed water of the Bacarra River will be taken similarly.

4.3 Phase III

In this Phase, all population centers in the district require a fairly large amount of additional supply. To cope with this increase in demand, the infiltration galleries constructed at the Laoag and Bacarra Rivers in Phases I and II will be expanded together with other related facilities. In the present master plan, therefore, the planning and cost estimate are prepared under this proposition. (Refer to Fig 2.4.3.)

Note: Water Source for Vintar in Phase III:

Water demand for Vintar in Phase III is estimated 2,690 cu m/day. Served area of Vintar is planned to be extended to right side of the Bacarra River, while poblacion of Vintar is situated on the left side of the river. (Refer to Fig 2.4.3.) Of 2,690 cu m/day, 2,200 cu m/day will be for the left side of the river, and the rest, 490 cu m/day for the right side of the river. Vintar infiltration gallery is located on the left bank of the river. To supply to the right side of the river, two alternative plans are considered: 1) Transmission from Vintar infiltration gallery, or 2) Transmission from a reservoir located in Bacarra, to which water is to be from Bacarra infiltration gallery No.2. Comparing above two plans, Alternative 2) is more economical, since transmission distance in the case of Alternative 2) is 3 km, while that of Alternative 1) is 3.5 km and this plan requires construction of a new pipe bridge crossing the river. Therefore, the right side of the river in Vintar will be served from Bacarra area.

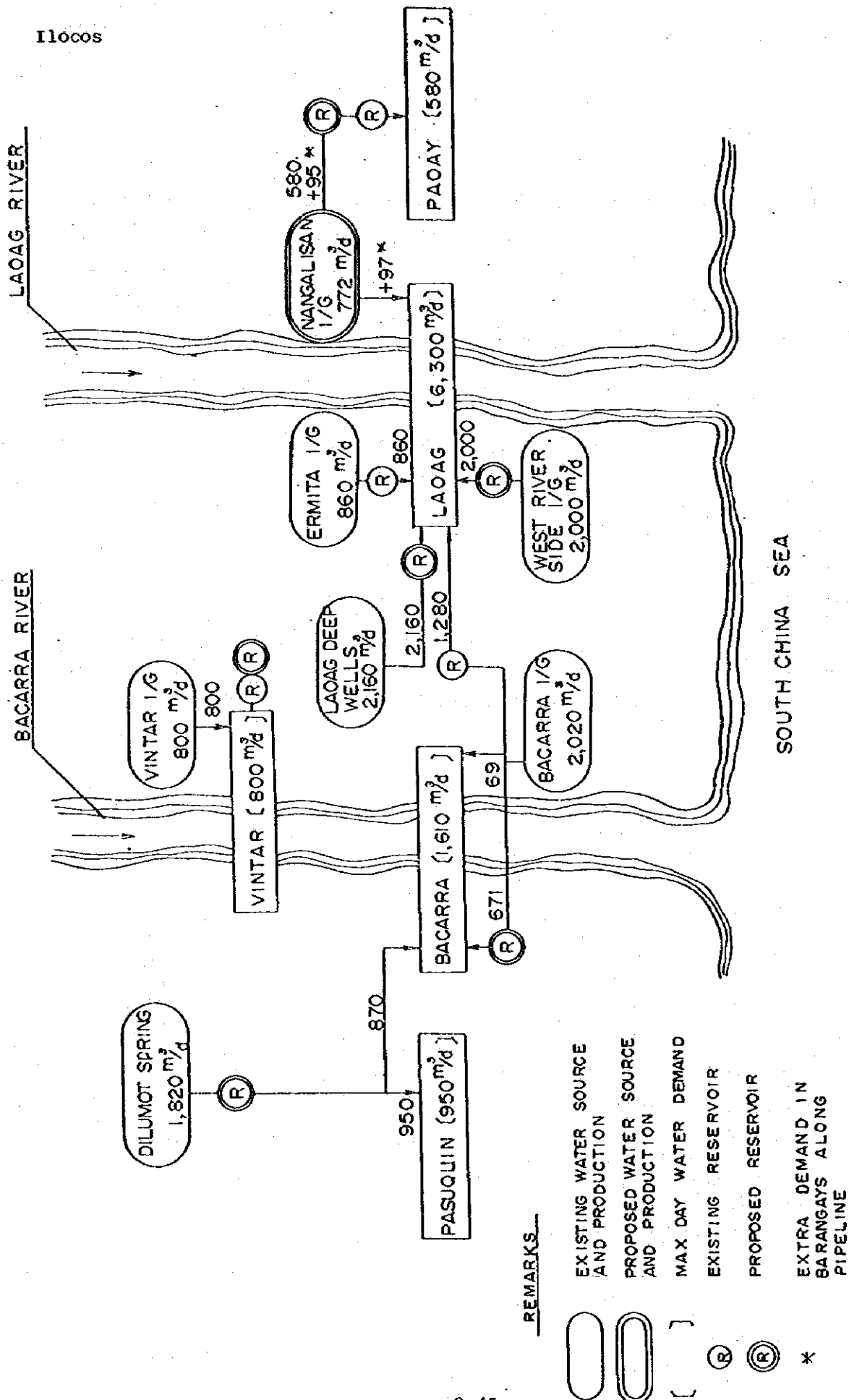


Fig 2.4.1 Water Sources for Phase I

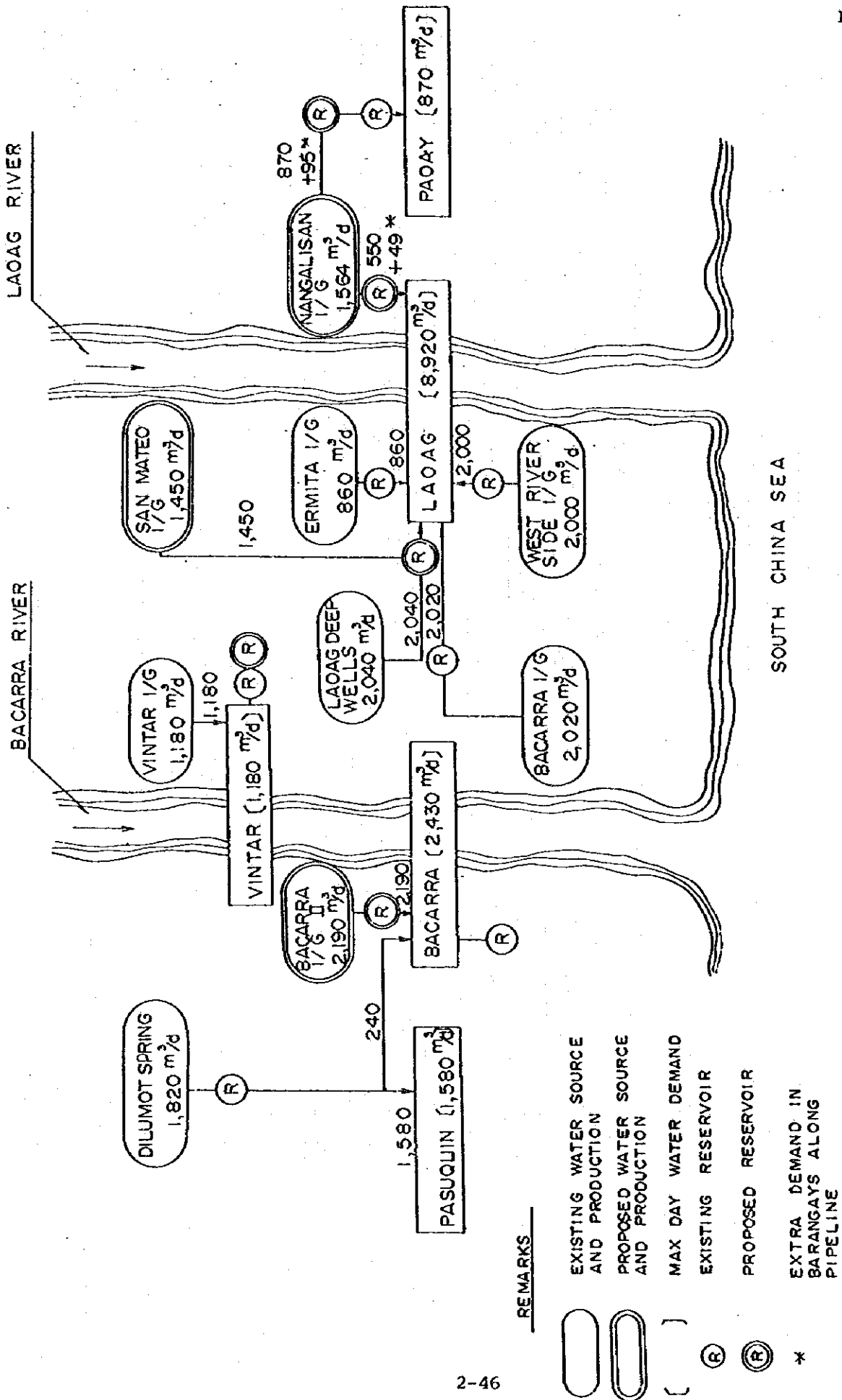


Fig 2.4.2 Water Sources for Phase II

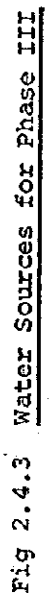


Table 2.4.1 Water Sources for Master Plan (Ilocos Norte WD)

Phase	Laoag	Pasuguin	Bacarra	Vintar	Paoay	Total
Existing Water Sources ^{1/} and Production	E-I/G-680 W-I/G-1,080 B-I/G-1,600 D-1,820	Dilumot	Dilumot	None	None	5,180
Phase I Water Demand ^{2/} Water Sources and Production	6,300 E-I/G-860 W-I/G-2,000 B-I/G-1,280 Deep Well-2,160	950 Dilumot -950	1,610 Dilumot-870 Bacarra I/G- 740	800 Vintar I/G- 800	580 (Nangalisan I/G-580) ^{3/}	10,240 10,240
Phase II Water Demand Water Sources and Production	8,920 Existing-6,920 (San Mateo I/G -1,450 (Nangalisan I/G-550)	1,580 Dilumot -1,580	2,430 Dilumot-240 (Bacarra I/G II-2,190)	1,180 Vintar I/G- 1,180	870 Nangalisan I/G-870	14,980 14,980
Phase III Water Demand Water Sources	15,630 Existing-6,880 (San Mateo I/G -5,944) (Nangalisan I/G-2,806)	2,490 Dilumot-1,620 (Bacarra I/G II-670)	4,410 (Bacarra I/G II-4,410)	2,690 (Vintar I/G -2,200) (Bacarra I/G II-490)	2,320 (Nangalisan I/G-2,320)	27,540 27,540

^{1/} Production (cu m/d)

E-I/G: Ermita Infiltration Gallery

W-I/G: West Riverside Infiltration Gallery

B-I/G: Bacarra Infiltration Gallery

^{2/} Maximum Day Demand^{3/} () Water Sources to be Developed

5. Proposed Water Supply System

5.1 General

The water supply system to be provided for the water district is planned hereunder based on the present conditions of the existing water supply system, the projected water demand and available water sources so far described.

Design criteria to be used for the planning are prepared as presented in Appendix 7, taking into accounts the Technical Standard Manual prepared by LWUA.

5.2 Basic Concept of Planning

Regarding Phase I, water requirement is, except Paoay, within the design capacity of all the existing water sources, although the present actual capacity has fallen below the original to a great extent due to deterioration of the facilities. Therefore, the works to be carried out are basically rehabilitation of the existing facilities so as to utilize them to the full capacity. And in addition remedies of short-comings of the existing facilities are included in the Phase I works to ensure constant supply of safe water under proper pressure.

With regard to Phase II, to cope with the growth of water requirement, additional water supply facilities are planned. Such water requirements consist of both an increase of demand in the served area covered by Phase I and additional areas which have developed after Phase I and an increase of unit consumption due to the growth of economy in the study area.

Phase III project is considered based on the increase of water demand in the year 2010 and available water sources.

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

5.3 Phase I

The total water demand at the end of the target year 1987 is 10,240 cu m/day, which is, together with the demands of individual poblacions, shown in Table 2.3.21. The potential supply capacity of the existing water sources can meet this demand; however, the actual capacity is presently far short of the original capacity, because some parts of the facilities are deteriorated, and essential storage facilities are lacking. Therefore, to make full use of the capacity of the existing water sources, the following works are required and proposed for Phase I, including construction of intake and transmission facilities for Paoay.

(a) Dilumot Spring System

All production of the spring will be supplied to Pasuquin and Bacarra.

- 1) To replace the transmission pipeline from the spring up to a new reservoir.
- 2) To install three break pressure chambers to protect the pipeline from excessive water pressure.
- 3) To construct a reservoir at Pasuquin for full utilization of the spring yield and to maintain necessary pressure for distribution.

(b) Bacarra Infiltration Gallery System

Production of this system will be delivered to Bacarra and Laoag.

- 1) To construct an intake pump station to transmit water to Ligao.
- 2) To construct an elevated reservoir for Bacarra poblacion including transmission pipeline from the existing pump station up to the reservoir.

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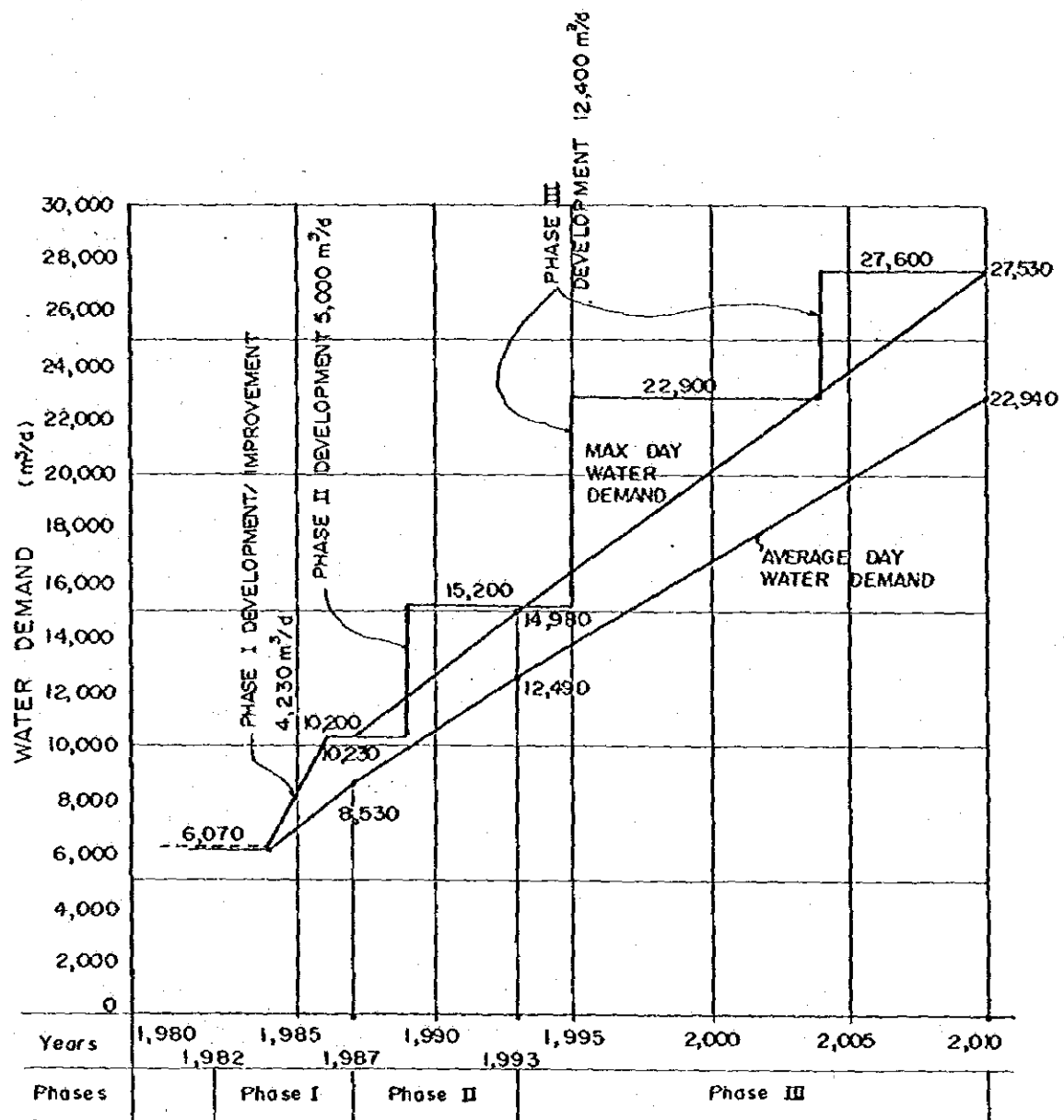


Fig 2.5.1 Water Demands and Sources of Supply in Ilocos Norte WD

- 3) To provide a roof for the existing reservoir at Ligao.

(c) West Riverside Infiltration Gallery System

Production of this system will be supplied to Laoag poblacion.

- 1) To replace the intake pump to increase the supply capacity.
- 2) To construct a ground reservoir.
- 3) To construct an elevated tank to maintain water pressure.

(d) Vintar Infiltration Gallery System

Production of this system will be supplied exclusively to Vintar poblacion.

- 1) To install a pump together with necessary accessories.
- 2) To construct a reservoir at the side of the existing reservoir.

(e) Laoag Deep Well System

All production of wells will be delivered to Laoag poblacion.

- 1) To construct deep well pump stations.
- 2) To install transmission pipe from the deep wells to a new reservoir.
- 3) To construct a reservoir.
- 4) To construct an elevated tank for control of distribution water pressure.

(f) Nangalisan Infiltration Gallery System

This system will be constructed for supply in the Paoay service area.

- 1) To construct an infiltration gallery and intake pumping station.
- 2) To lay a transmission pipeline from the pumping station to the existing elevated tank at Paoay.
- 3) To construct a reservoir midway between the pumping station and the elevated tank.

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5.4 Phase II

The total water demand in Phase II increases up to 14,980 cu m/day. To meet the demand, the following works are required. Major works are construction of two infiltration galleries, one in Bacarra and one in Laoag.

(a) Bacarra Infiltration Gallery II System

To meet the water requirement in Bacarra, an infiltration gallery system will be constructed, complete with infiltration gallery, a pump station, transmission pipeline and a reservoir together with a chlorinator and a bulk meter.

(b) San Mateo Infiltration Gallery System

To meet the water demand increase in Laoag, an infiltration gallery system will be constructed, complete with infiltration gallery, a pump station, transmission pipeline and a reservoir together with a chlorinator and a bulk meter.

(c) Nangalisan Infiltration Gallery System

To newly supply to the southern area of Laoag, the capacity of the infiltration gallery facilities will be expanded, and an elevated tank together with a transmission pipeline therefore will be constructed.

5.5 Phase III

The total water demand in Phase III increases up to 27,530 cu m/day. The following works will additionally be required.

(a) Bacarra Infiltration Gallery II System

To meet the increased water demand in Bacarra, Pasuquin and Vintar,

the capacity of this system will be expanded by addition of facilities of the gallery, intake pump, transmission pipeline and reservoir.

(b) Vintar Infiltration Gallery System

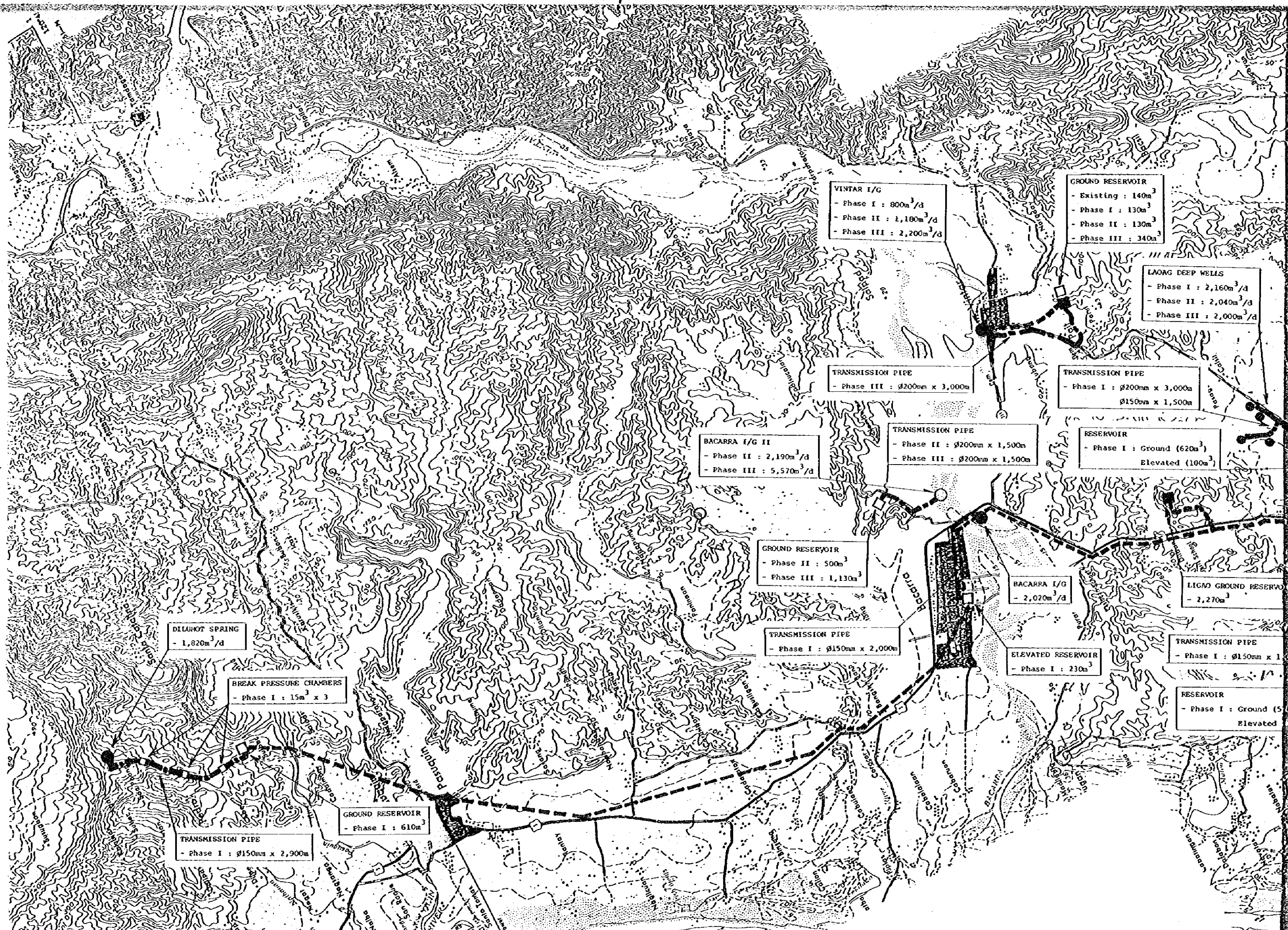
To cope with the increase of water demand in Vintar, addition will be made to the gallery, intake pump and reservoir, together with a new installation of transmission pipeline from the pumping station to the reservoir.

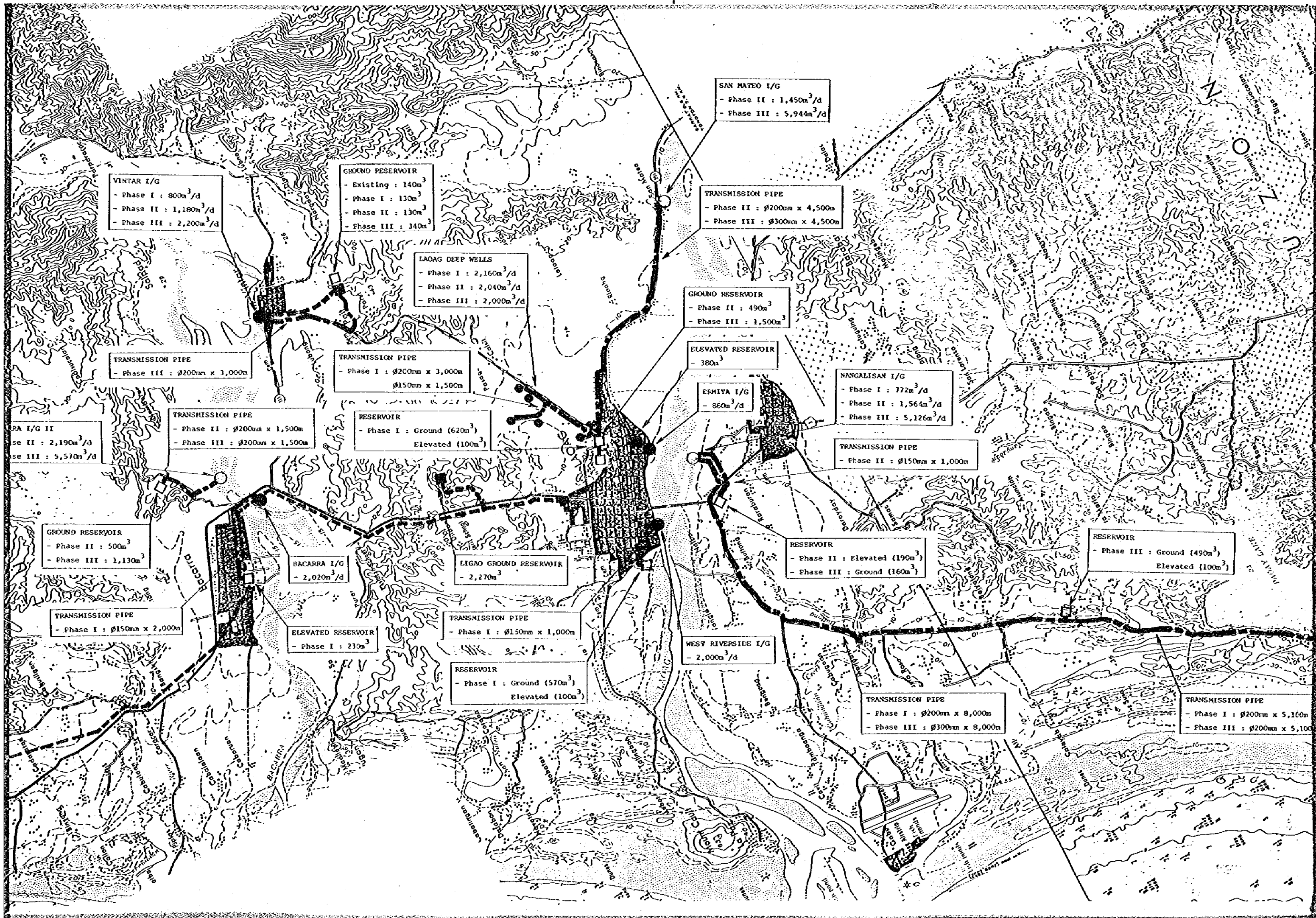
(c) San Mateo Infiltration Gallery System

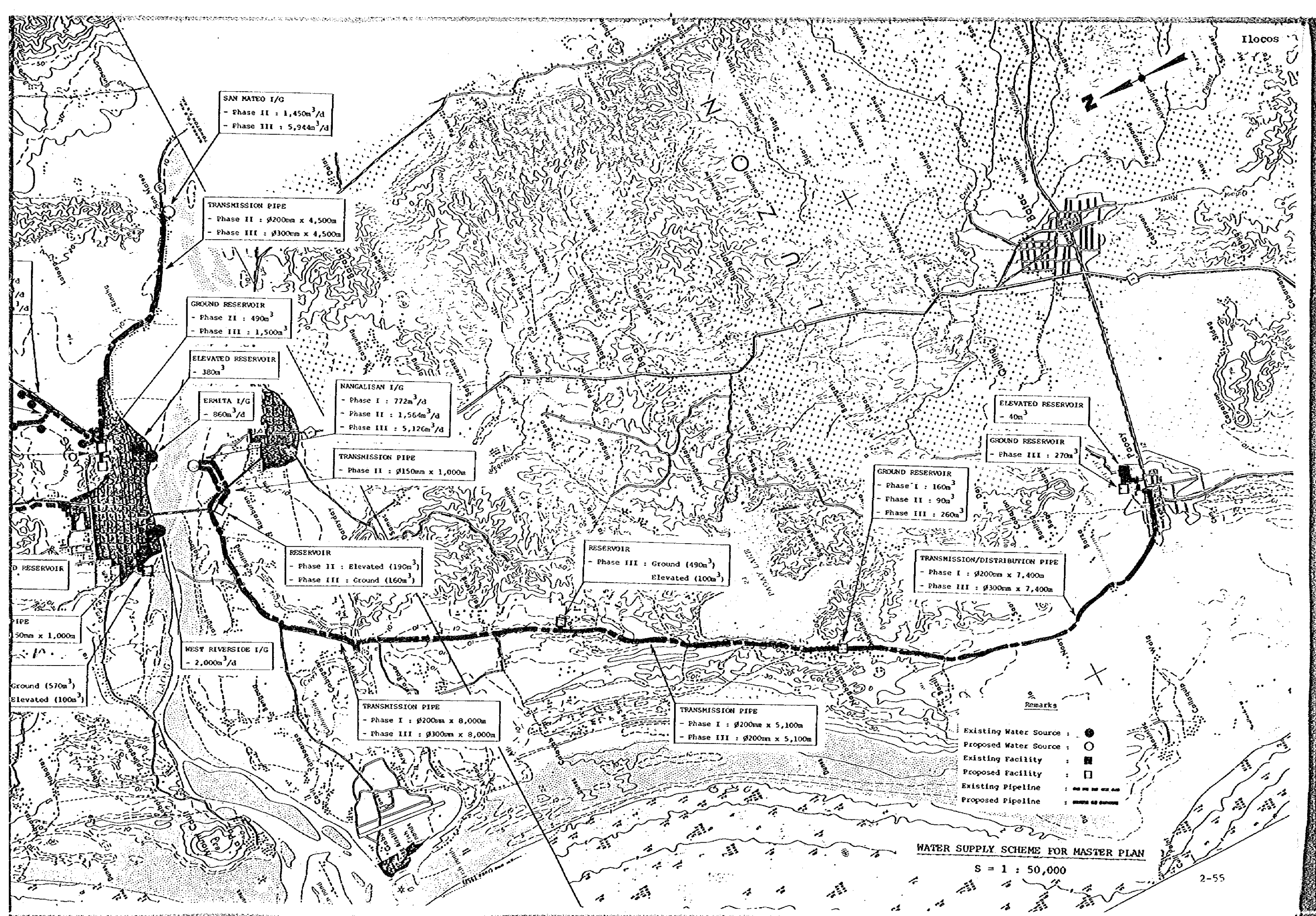
The system will be expanded to the increased water demand in the northern area of Laoag.

(d) Nangalisan Infiltration Gallery System

This system will be augmented to meet the increase in water demand of the southern area of Laoag and the Paoay service area.







6. Cost Estimate

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

Conditions and assumptions on which the estimation is carried out are as below, and cost data relating to the estimation are attached to the Report as Appendix 9.

- 1) All of costs and prices presented in the Table are as of July 1981.
- 2) Unit costs, as far as available, are taken from the list of costs prepared by LWUA^{1/}.
- 3) Unit costs not included in the above list are current prices in the market.
- 4) Some of the unit costs of LWUA are modified so as to fit for the present project.
- 5) Local currency portion for the above includes costs for handling, storage and local transportation.
- 6) Engineering costs are assumed as following percentages of the basic construction cost:
 - For feasibility study = 2.5%,
 - For detailed design = 10.5%, and
 - For construction supervision = 3.5%
- 7) Physical contingency is allowed by 10 percent of the basic construction cost and engineering cost.
- 8) Foreign currency exchange rate applied is: US\$1.00 = P7.80.

^{1/} Addendum to Methodology Manual, 1981.

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Table 2.6.1 Project Cost for Phase I

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. Dilumot Spring				
a) Transmission Pipe	ø150 mm x 2,900 m	1,200	804	396
b) Break Pressure Chamber	15 m ³ x 3	232	58	174
c) Ground Reservoir	610 m ³ x 1	826	207	619
B. Bacarra I/G				
a) Intake Pump Station	15.8 l/s, H=70m	522	313	209
b) Transmission Pipe	ø150 mm x 2,000 m	825	553	272
c) Elevated Reservoir	230 m ³ x 1	980	245	735
d) Roofing of Ligao Reservoir	1,100 m ²	193	48	145
C. West Riverside I/G				
a) Intake Pump	23.1 l/s, H=30m	243	219	24
b) Transmission Pipe	ø150 mm x 1,000 m	275	184	91
c) Ground Reservoir	570 m ³ x 1	791	198	593
d) Distribution Pump Station	28.9 l/s, H=30m	554	332	222
e) Elevated Reservoir	100 m ³ x 1	525	131	394
	- to be continued -			

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
D. Vintar I/G				
a) Intake Pump	13.7 l/s, H=40m	194	175	19
b) Ground Reservoir	130 m ³ x 1	308	77	231
E. Laoag Deep Wells				
a) Pump Station	5.8 l/s, 7kw, 5 units	1,075	602	473
b) Transmission Pipe	ø200 mm x 3,000 m ø150 mm x 1,500 m	1,755 619	1,176 415	579 204
c) Ground Reservoir	620 m ³ x 1	834	209	625
d) Distribution Pump Station	31.3 l/s, H=30m	581	349	232
e) Elevated Reservoir	100 m ³ x 1	525	131	394
F. Nangalisan I/G				
a) Infiltration Gallery	ø1,000 mm x 50 m	200	50	150
b) Intake Pump Station	11.9 l/s, H=60m	404	242	162
c) Transmission Pipe	ø200 mm x 20,500m	7,995	5,357	2,638
d) Ground Reservoir	160 m ³ x 1	351	88	263
G. Distribution Pipe	ø200 mm x 600 m ø150 mm x 7,500 m	234 2,063	157 1,382	77 681
- to be continued -				

Ilocos

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
H. Valve	ø100 mm x 11,000 m	1,980	1,327	653
	ø 50 mm x 5,200 m	416	279	137
	ø200 mm x 15 pcs	92	67	25
	ø150 mm x 32 pcs	136	99	37
	ø100 mm x 39 pcs	131	96	35
	ø 50 mm x 18 pcs	27	20	7
I. Fire Hydrant	128 pcs	858	566	292
J. Bulk Meter	ø300 mm x 1 pc	10	8	2
	ø200 mm x 7 pcs	70	56	14
	ø150 mm x 15 pcs	105	84	21
K. Chlorinator	12 units	120	108	12
L. Service Meter	ø13 mm x 3,200 pcs	2,080	1,602	478
M. Stored Material		305	238	67
N. Vehicle	2 cars	140	70	70
Sub Total		30,774	18,322	12,452
Feasibility Study Cost (2.5%)		-	-	-
Detailed Design Cost (10.5%)		3,231	1,939	1,292
Supervision Cost (3.5%)		1,077	646	431
Land Cost		200	-	200
Sub Total		35,282	20,907	14,375
Physical Contingency (10%)		3,529	2,091	1,438
Total		38,811	22,998	15,813
Equivalent to US \$		4.98 M	2.95 M	2.03 M

Table 2.6.2 Project Cost for Phase II

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. San Mateo I/G				
a) Infiltration Gallery	ø1,000 mm x 80 m	320	80	240
b) Intake Pump Station	16.8 l/s, H = 50m	469	281	188
c) Transmission Pipe	ø200 mm x 4,500 m	2,633	1,764	869
d) Ground Reservoir	490 m ³ x 1	718	180	538
e) Distribution Pump	21.0 l/s, H = 30 m	458	275	183
B. Bacarra I/G II				
a) Infiltration Gallery	ø1,000 mm x 110 m	440	110	330
b) Intake Pump Station	25.3 l/s, H = 50 m	600	360	240
c) Transmission Pipe	ø200 mm x 1,500 mm	878	588	290
d) Ground Reservoir	500 m ³ x 1	727	182	545
C. Vintar I/G				
Ground Reservoir	130 m ³ x 1	308	77	231
D. Bacarra I/G				
Intake Pump Station	7.6 l/s, H = 70 m	338	203	135
- to be continued -				

Ilocos

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
E. Nangalisan I/G				
a) Infiltration Gallery	ø1,000 mm x 30 m	120	30	90
b) Intake Pump Station	6.4 l/s, H = 35 m	238	143	95
c) Transmission Pipe	ø150 mm x 1,000 m	275	184	91
d) Elevated Reservoir	190 m ³ x 1	850	213	637
e) Ground Reservoir	90 m ³ x 1	243	61	182
F. Distribution Pipe				
	ø200 mm x 7,000 m	2,730	1,829	901
	ø150 mm x 9,700 m	2,668	1,788	880
	ø100 mm x 26,900 m	4,842	3,244	1,598
	ø 75 mm x 41,000 m	4,920	3,296	1,624
	ø 50 mm x 62,400 m	4,992	3,345	1,647
G. Valve				
	ø200 mm x 31 pcs	189	138	51
	ø150 mm x 35 pcs	149	109	40
	ø100 mm x 92 pcs	308	225	83
	ø 75 mm x 138 pcs	373	272	101
	ø 50 mm x 209 pcs	314	229	85
H. Fire Hydrant	292 units	1,956	1,291	665
I. Bulk Meter				
	ø200 mm x 4 pcs	40	32	8
	ø150 mm x 4 pcs	28	22	6
	+ to be continued -			

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
J. Chlorinator	4 units	40	36	4
K. Service Meter	ø13 mm x 8,996 pcs	5,847	4,502	1,345
L. Stored Material		400	312	88
M. Administrative Building		880	176	704
N. Operational Center		690	248	442
O. Vehicle	3 cars	210	105	105
Sub Total		41,191	25,930	15,261
Feasibility Study Cost (2.5%)		1,030	618	412
Detailed Design Cost (10.5%)		4,325	2,595	1,730
Supervision Cost (3.5%)		1,442	865	577
Land Cost		100	-	100
Sub Total		48,088	30,008	18,080
Physical Contingency (10%)		4,809	3,001	1,808
Total		52,897	33,009	19,888
Equivalent to US \$		6.78 M	4.23 M	2.55 M

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Table 2.6.3 Project Cost for Phase III

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. Bacarra I/G II				
a) Infiltration Gallery	ø1,000 mm x 170 m	680	170	510
b) Intake Pump	64.5 l/s, H = 60m	551	496	55
c) Transmission Pipe	ø200 mm x 1,500 m	585	392	193
d) Ground Reservoir	1,130 m ³ x 1	1,224	306	918
B. Vintar I/G				
a) Infiltration Galery	ø1,000 mm x 40 m	160	40	120
b) Intake Pump	25.5 l/s, H = 50 m	301	271	30
c) Transmission Pipe	ø200 mm x 3,000 m	1,170	784	386
d) Ground Reservoir	340 m ³ x 1	568	142	426
C. San Mateo I/G				
a) Infiltration Gallery	ø1,000 mm x 230 m	920	230	690
b) Intake Pump	68.8 l/s, H = 60 m	572	515	57
c) Transmission Pipe	ø300 mm x 4,500 m	2,925	1,960	965
d) Ground Reservoir	1,500 m ³ x 1	1,467	367	1,100
e) Distribution Pump	65.1 l/s, H = 30 m	897	538	359
- to be continued -				

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
D. Nangalisan I/G				
a) Infiltration Gallery				
(4,089 m ³ /d)	ø1,000 mm x 160 m	640	160	480
(1,037 m ³ /d)	ø1,000 mm x 30 m	120	30	90
b) Intake Pump	47.3 l/s, H = 65m	470	423	47
	12.0 l/s, H = 40m	180	162	18
c) Transmission Pipe	ø300 mm x 15,400m	10,010	6,707	3,303
	ø200 mm x 5,100m	1,989	1,333	656
d) Ground Reservoir	260 m ³ x 1	479	120	359
e) Ground Reservoir	270 m ³ x 1	491	123	368
	490 m ³ x 1	718	180	538
	160 m ³ x 1	351	88	263
f) Distribution Pump	13.3 l/s, H = 30 m	350	210	140
	25.6 l/s, H = 30 m	516	310	206
	15.0 l/s, H = 30 m	376	226	150
g) Elevated Reservoir	100 m ³ x 1	525	131	394
E. Distribution Pipe	ø250 mm x 4,000 m	2,280	1,528	752
	ø200 mm x 5,500 m	2,145	1,437	708
	ø150 mm x 29,600 m	8,140	5,454	2,686
	ø100 mm x 42,800 m	7,704	5,162	2,542
	ø 75 mm x 26,800 m	3,216	2,155	1,061
	ø 50 mm x 109,700m	8,776	5,880	2,896
	- to be continued -			

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

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
F. Valve	ø300 mm x 11 pcs	127	93	34
	ø250 mm x 14 pcs	117	85	32
	ø200 mm x 25 pcs	153	112	41
	ø150 mm x 99 pcs	421	307	114
	ø100 mm x 143 pcs	479	350	129
	ø 75 mm x 90 pcs	243	177	66
	ø 50 mm x 366 pcs	549	401	148
G. Fire Hydrant	546 pcs	3,658	2,414	1,244
M. Bulk Meter	ø350 mm x 2 pcs	20	16	4
	ø250 mm x 3 pcs	30	24	6
	ø200 mm x 3 pcs	30	24	6
I. Service Meter	ø 13 mm x 11,890 pcs	7,729	5,951	1,778
J. Stored Material		526	410	116
K. Vehicle	3 cars	210	105	105
Sub Total		75,788	48,499	27,289
Feasibility Study Cost (2.5%)		1,895	1,137	758
Detailed Design Cost (10.5%)		7,958	4,775	3,183
Supervision Cost (3.5%)		2,653	1,592	1,061
Land Cost		500	-	500
Sub Total		88,794	56,003	32,791
Physical Contingency (10%)		8,879	5,600	3,279
Total		97,673	61,603	36,070
Equivalent to US \$		12.52 M	7.90 M	4.62 M

7. Implementation Schedule

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

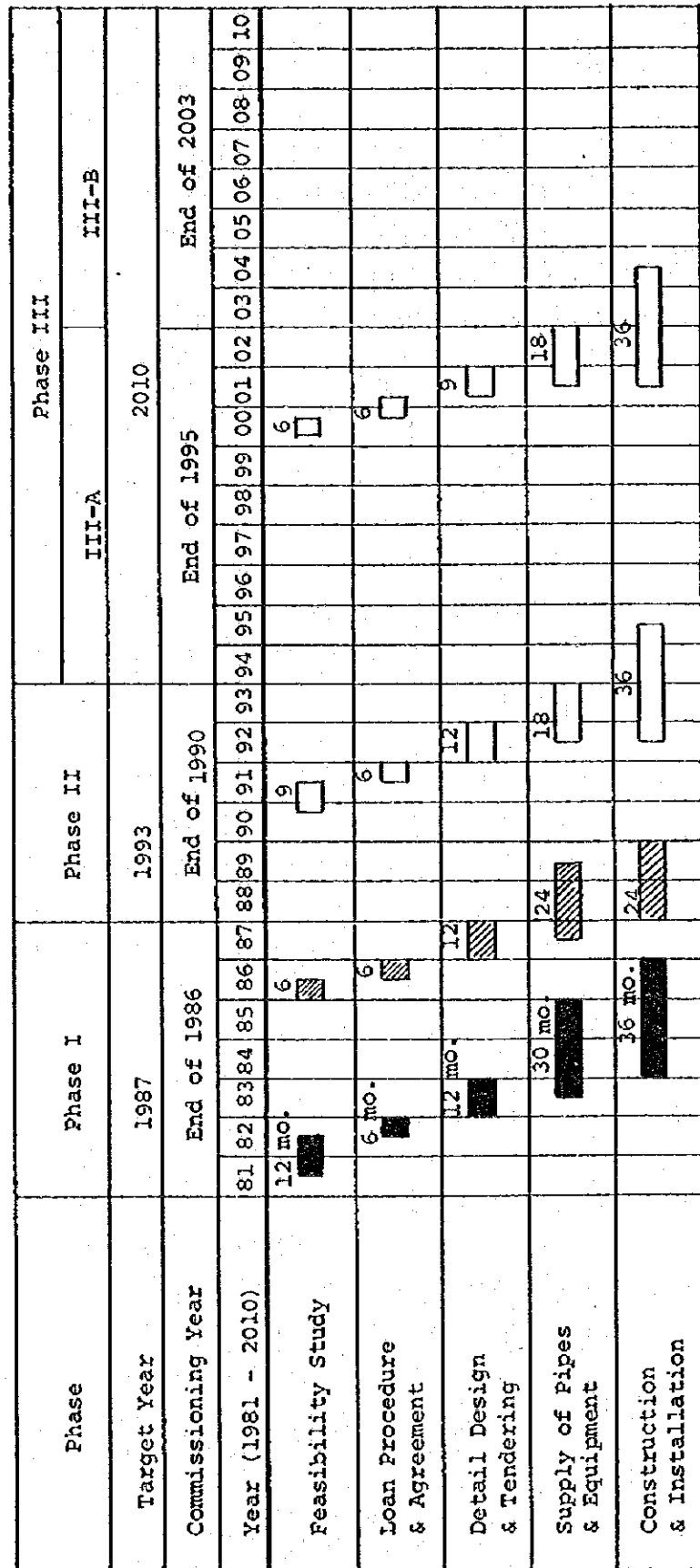
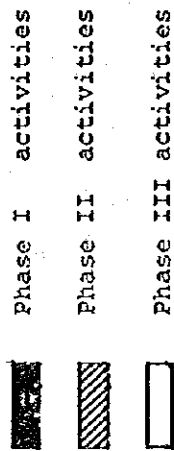
(1) Phase I

- 1) The period from present up to the commissioning of the completed facilities is estimated based on the detailed time elements.
- 2) The period between the above commissioning and the target year is set so that actual data on water supply planning factors can be collected.
- 3) Start of preparation of the detailed design for the Phase II project is placed just after the commissioning and before the target year, so that the planning of the Phase II project can be made employing actual data and the construction of the said project can be commenced as early as possible.

(2) Phase II and III

- 1) Commissioning of the Phase II facilities is scheduled two years after the Phase I target year. It may result in slight shortage of the supply capacity. But, depending on the actual development of the supply conditions, the time of commissioning can be advanced to some extent, or a small cut of maximum day demand may be tolerated by the consumers.
- 2) Implementation of the Phase III project is planned in a similar way to Phase II. All explanations above are applicable to this phase as well.

Fig 2.7.1 Implementation Schedule for Master Plan



8. Organization and Management

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

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

- a. Technical
- b. Commercial
- c. Administrative and Financial

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

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

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

PART THREE: FEASIBILITY STUDY

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

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1. General

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

The project of Case 1 aims, basically, to meet the currently unsatisfied water demand and also needs in the immediate future by rehabilitating the existing deteriorated water facilities and adding some expansion works. On the other hand, the alternative study for Case 2 explores the feasibility and suitability of the project with Phases I and II combined, as stated above, which extends over a medium term of about ten years after the commencement of project construction. Major intention of this project, if proved feasible and practicable, is to secure stable water supply over a comparatively long period and assure the municipalities concerned of development without restraints due to poor water supply as experienced so far.

Further, as there seems to be a possibility of formation of two separate water districts, namely, a water district for Laoag City and another district for the remaining municipalities, a special study for financial aspects of these possible districts will be made and its results be attached to this Part Three.

2. Target Year and Project Area

2.1 Target Year for Study

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

2.2 Project Area

The project area for the feasibility study is delineated as the poblacion areas in Laoag, Pasuquin, Bacarra, Vintar and Paoay including rural barangays presently served by the existing water supply systems and their adjoining areas which are considered to develop and require water supply within the period until the end of target year of the study.

The Ilocos Norte WD's project area for the Phase I covers approximately 2701 ha mostly in the poblacion area including the present served area of 1,280 ha and rural barangays enroute of pipeline from Dilumot Spring. In Phase II the served area is expanded to 4,906 ha in 1993; takes in the thereafter extended built-up area adjoining the poblacion area and rural barangays.

Present served area and projected areas by phase are shown in Fig 2.2.1 through Fig 2.2.5 and Table 2.3.10 through Table 2.3.14.

3. Estimation of Population Served and Water Demand

3.1 Estimation of Population Served

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

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

The coverage of served population for the feasibility study in the projected served area has been estimated based on the above population in the served area taking account of the willingness-to-connect of the projected consumers (See Table 3.3.2) and future improvement of the consumer's living standard.

The annual served population in each demand area is estimated up to the year 1993 and shown in Table 3.3.3 and Fig 3.3.1.

3.2 Estimation of Water Demand

The overall average day water demand for the WD is estimated based on the served population and the average unit water demand, which is including demands for domestic, commercial/industrial, institutional and unaccounted-for-water. The annual average day demand is extrapolated from the demands in the design years of 1987 and 1993, taking account of the sources of supply and the extended served area as well as the served population, and shown in Table 3.3.4.

Table 3.3.1 Projected Population in Served Area in Ilocos Norte WD

<u>Years</u>	<u>Urban Area</u>		<u>Rural Area</u>		<u>Total Area</u>	
	<u>T.P</u>	<u>P.S.A</u>	<u>T.P</u>	<u>P.S.A</u>	<u>T.P</u>	<u>P.S.A</u>
1980	52,388	33,770	98,825	4,200	151,213	37,970
1981	52,750	33,920	100,540	4,280	153,290	38,200
1982	53,110	38,850	102,270	4,330	155,380	43,180
1983	53,480	39,550	104,040	4,400	157,520	43,950
1984	63,850	40,270	105,850	4,470	159,700	44,740
1985	54,220	46,650	107,680	6,750	161,900	53,400
1986	54,600	51,250	109,540	6,860	164,140	58,110
1987	54,976	54,976	111,436	7,131	166,412	62,107
1988	55,260	55,260	113,040	9,290	168,300	64,550
1989	55,540	55,540	114,670	17,080	170,210	72,620
1990	55,820	55,820	116,320	24,110	172,140	79,930
1991	56,100	56,100	118,000	26,210	174,100	82,310
1992	56,390	56,390	119,700	26,580	176,090	82,970
1993	56,676	56,676	121,420	28,430	178,096	85,106
2010	60,701	60,701	144,173	83,655	204,874	144,356

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

P.S.A - Population in the Served Area

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Table 3.3.2 Summary of Market Study for
Willingness-to-Connect in Ilocos Norte

<u>Study Area</u>	<u>Individual Connections</u>	<u>Public Faucet</u>	<u>Total</u>
1. Laoag			
Urban	59%	6%	64% (45%)
2. Laoag			
Rural	47%	6%	53% (0%)
3. Laoag			
Total	<u>56%</u>	<u>6%</u>	<u>62% (35%)</u>
4. Pasuquin	74%	7%	81% (62%)
5. Bacarra	59%	10%	69% (53%)
6. Vintar	75%	5%	80% (0%)
7. Paoay	<u>58%</u>	<u>10%</u>	<u>68% (0%)</u>
Total	62%	7%	69% (35%)

Note: 1. Market study has been conducted in November 1981.

2. The above study areas include 8,677 households in total, both in urban and rural barangays, within the proposed served area in Phase II (1993) program.

3. () present connection coverage as of 1981.

Table 3.3.3 Projected Population Served in Ilocos Norte WD

<u>Years</u>	<u>Urban Area</u>		<u>Rural Area</u>		<u>Total Area</u>	
	<u>P.S.A</u>	<u>P.S</u>	<u>P.S.A</u>	<u>P.S</u>	<u>P.S.A</u>	<u>P.S</u>
1980	33,770	23,400	4,200	1,600	37,970	25,000
1981	33,920	23,400	4,280	1,600	38,200	25,000
1982	38,850	26,400	4,330	1,600	43,180	28,000
1983	39,550	27,100	4,400	1,600	43,960	28,700
1984	40,270	29,600	4,470	1,600	44,740	31,200
1985	46,650	32,450	6,750	2,100	53,400	34,550
1986	51,250	36,550	6,860	2,650	58,110	39,200
1987	54,976	40,595	7,131	3,530	62,107	44,125
1988	55,260	42,800	9,290	5,700	64,660	48,500
1989	55,540	45,050	17,080	8,100	72,620	53,150
1990	55,820	47,200	24,110	11,400	79,930	58,600
1991	56,100	49,300	26,210	14,100	82,310	63,400
1992	56,390	51,250	26,580	16,250	82,970	68,000
1993	56,676	53,202	28,430	19,780	85,106	72,982
2010	60,701	60,701	83,655	66,960	144,356	127,661

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

P.S - Population Served

Table 3.3.4 Estimated Water Demand in Ilocos Norte WD

<u>Years</u>	<u>Urban Area</u>		<u>Rural Area</u>		<u>Total Area</u>	
	<u>P.S</u>	<u>W.D</u> (m ³ /day)	<u>P.S</u>	<u>W.D</u> (m ³ /day)	<u>P.S</u>	<u>W.D</u> (m ³ /day)
1980	23,400	4,915	1,600	265	25,000	5,180
1981	23,400	4,915	1,600	265	25,000	5,180
1982	26,400	5,176	1,600	265	28,000	5,702
1983	27,100	5,214	1,600	265	28,700	5,831
1984	29,600	6,075	1,600	265	31,200	6,340
1985	32,450	6,466	2,100	187	34,550	6,653
1986	36,550	7,343	2,650	239	39,200	7,582
1987	40,595	8,204	3,530	322	44,125	8,526
1988	42,800	8,611	5,700	531	48,500	9,142
1989	45,050	9,041	8,100	770	53,150	9,811
1990	47,200	9,427	11,400	1,095	58,600	10,522
1991	49,300	9,799	14,100	1,383	63,400	11,182
1992	51,250	10,138	16,250	1,658	68,000	11,796
1993	53,202	10,490	19,780	1,997	72,982	12,487
2010	60,701	14,236	66,959	8,705	127,660	22,941

Note: P.S - Population Served

W.D - Average Day Water Demand

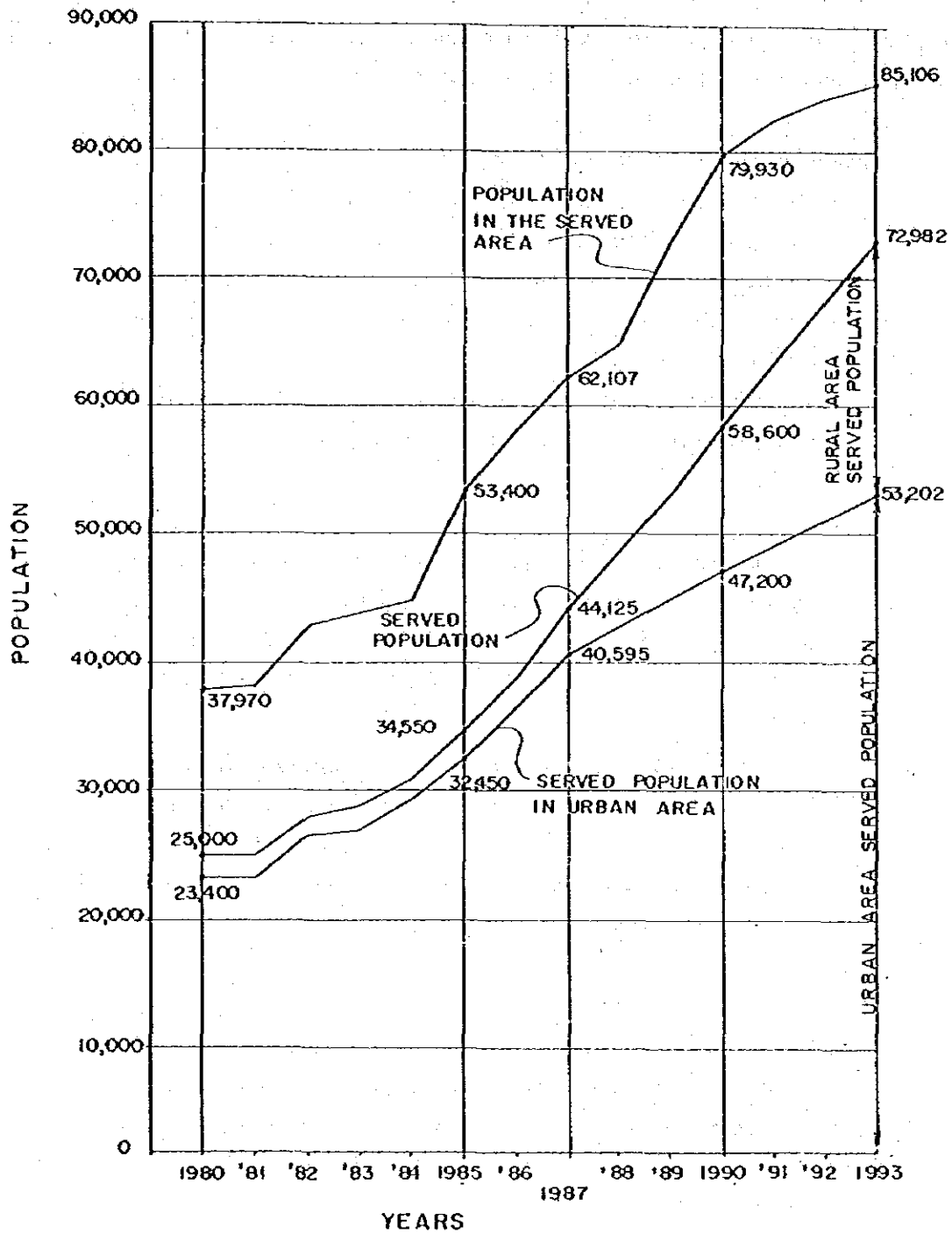


Fig 3.3.1 Projected Served Population in Ilocos Norte WD

4. Immediate Improvement and Expansion Works

Water supply conditions which must be immediately rectified by improvement and expansion works are summarized as below from descriptions in PART ONE: Existing Water Supply.

1) Pasuquin, Bacarra and Laoag

- The transmission pipeline of the Dilumot spring system has much leakage.
- In the above served areas, water pressure is extremely low, with the periphery areas where almost no water available throughout the day.
- The present supply capacity is insufficient even for the present water demand.

2) Vintar

- The poblacion is not yet served by the new water supply system which is completed except the installation of pump and power line.

3) Paoay

- The poblacion once had a water supply system which was abandoned due to salinization of the well water. A new water supply system being constructed by MPW is too small to meet the water demand, and the deep wells sunk by the same have saline water, not potable.

4) Distribution Pipelines

- Existing networks in poblacions are not necessarily enough in sizes and routes. Distribution pipelines, therefore will be reinforced by the project.

4.1 Phase I

(1) Replacement of Part of the Transmission Pipeline:

The upstream portion of the transmission pipeline of the Dilumot spring system where many leaks are occurring will be replaced with $\phi 150$ mm pipe and a length of 2,900 m.

(2) Construction of Break Pressure Chambers:

On the transmission pipeline of the Dilumot spring system, three break pressure chambers will be constructed to protect the pipe from breakage due to extremely high pressure.

(3) Construction of Reservoirs:

Regulating reservoirs will be constructed for the Dilumot spring system and others to utilize fully the production capacity.

(4) Utilization of Vintar Infiltration Gallery; Deep Wells at Laoag

All the above facilities, which are not in use, will be put in service.

(5) Construction of Intake and Transmission Facilities:

A new infiltration gallery will be constructed for water requirement in Paoay with a capacity of 1,564 cu m/d. And the transmission pipeline will be installed with $\phi 200$ mm pipe and a length of 20,500 m.

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(6) Reinforcement of Distribution Pipelines:

The following distribution mains will be reinforced in the developed area.

<u>Diameter</u>	<u>Length</u>
200 mm	650 m
150 mm	7,500 m
100 mm	11,000 m
50 mm	5,200 m

4.2 Phase II

(1) Construction of Infiltration Galleries

To expand the supply capacity in Phase II, two infiltration galleries will be constructed, one for Bacarra with a capacity of 2,190 cu m/d, and the another for Laoag with a capacity of 1,450 cu m/d.

(2) Construction of Reservoirs:

Regulating reservoirs necessary for Phase II in accordance with the development and the expansion of water sources will be constructed.

(3) Extension of Distribution Pipelines:

Distribution mains will be extended in the developed area and developing areas as shown below.

<u>Diameter</u>	<u>Length</u>
200 mm	7,000 m
150 mm	9,700 m
100 mm	26,900 m
75 mm	41,000 m
50 mm	62,400 m

5. Water Sources

Potential water sources in the study area were investigated extensively, as reported in Appendix 5. Study on Water Sources. Presently, springs and riverbed water of the Bacarra and Laoag Rivers are being used for the existing water supply system, and schemes of water supply which take shallow and deep well water are under construction. For the project, all the above-mentioned water sources for Phase I will be utilized to the maximum extent and additional water sources for Phase I and Phase II will be developed to cope with the water demand in the project period. The details are discussed below.

5.1 Phase I

(1) Dilumot Spring

The Dilumot spring represents a few springs located in its vicinity and collected to the same. The total yield varies widely according to the season. The usable quantity in the dry season is estimated at 1,820 cu m/day, as investigated in the field. The existing transmission pipeline is designed to take this amount, which is reported in Appendix 3 of this Report. Originally a regulating reservoir for this system was constructed at the end of the pipeline in Laoag, but due to the growth of water demand in Pasuquin and Bacarra and the decrease in water pressure, the reservoir is not useful for the Dilumot spring system. And a new reservoir for water supply in the served areas of Pasuquin and Bacarra is required. With this measure the full capacity of the spring can be utilized covering the above two poblacions.

(2) Riverbed Water

The riverbed water of the Bacarra River is presently being used to supply water to the Laoag area. The structure constructed to take the riverbed water is the Bacarra infiltration gallery, located at

the left bank of the River. The intake capacity is 2,020 cu m/day. The quality of the riverbed water is potable, with no contamination observed. This system will be continuously used for supply in Laoag and Bacarra.

At Vintar, another riverbed water intake has been constructed at the left bank of the same river, which is not yet put in service. The capacity of this system is estimated to be 1,500 cu m/day. The present plan proposes this system for water supply in the Vintar area.

Regarding the Laoag River, there are two existing riverbed intake systems, West Riverside and Ermita. The capacities are 2,000 cu m/day and 860 cu m/day respectively. The two systems supply to the Laoag area. The structures are similar to that of the Bacarra infiltration gallery. The quality of the riverbed water taken by these two systems is not necessarily good, due to intrusion of domestic waste water from the Laoag poblacion and mixture of the surface water of the River. These systems will be continuously used for the same served area, with chlorination strengthened in the project.

A new infiltration gallery is proposed for water supply to the Paoay area. The proposed site for the system is the opposite side to the existing Ermita gallery.

(3) Groundwater

Deep wells in the Laoag area, sunken already but unoperational yet, will be used for the project by installing pump facilities and necessary piping.

In the Paoay area, an intake system of shallow groundwater has been constructed to supply to the poblacion, but it is not operated due to lack of power connection. As its production capacity is too small, the system will not be used as the main supply source for the area, but is considered useful as a supplementary and standby water source.

5.2 Phase II

(1) Riverbed Water

Two new infiltration galleries are proposed for the project at San Mateo, on the right bank of the Laoag River with a capacity of 1,450 cu m/d and at Bacarra on the right bank of the Bacarra River with a capacity of 2,190 cu m/d. The site for the former is upstream of the existing galleries and at the upstream end of the Laoag Poblacion. Therefore, contamination by domestic waste water can be avoided, and besides the structure of the infiltration gallery will be improved taking into account the shortcomings of the existing galleries. The site proposed for Bacarra is upstream of the existing gallery facility, considering convenience for supplying to the Bacarra poblacion.

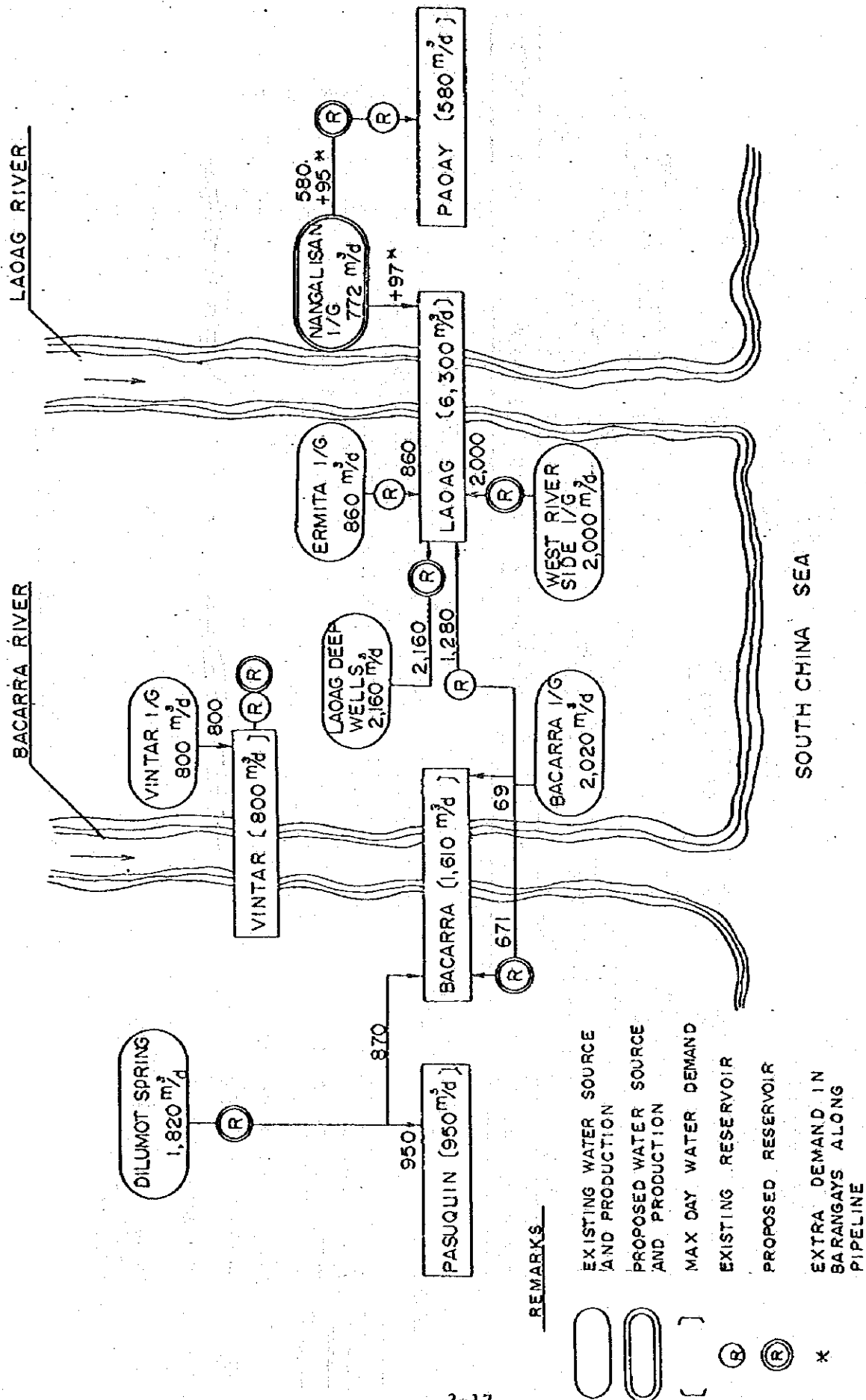


Fig 3.5.1 Water Sources for Phase I

Fig 3.5.2 Water Sources for Phase II

Table 3.5.1 Water Sources for Phase I and Phase IIPhase I

<u>City/Municipality</u>	<u>Max. Day Demand</u>	<u>Water Source and Production</u>
Laoag	6,300 m ³ /d	Ermita I/G - 860 m ³ /d West Riverside I/G - 2,000 Bacarra I/G - 1,280 Deep Well - 2,160
Bacarra	1,610	Dilumot Spring - 870 Bacarra I/G - 740
Pasuquin	950	Dilumot Spring - 950
Vintar	800	Vintar I/G - 800
Paoay	580	Nangalisan I/G - 580
Total	10,240 m³/d	10,240 m³/d

Phase II

Laoag	8,920	Ermita I/G - 860 West Riverside I/G - 2,000 Bacarra I/G - 2,020 Deep Well - 2,040 San Mateo I/G - 1,450 Nangalisan I/G - 550
Bacarra	2,430	Dilumot Spring - 240 Bacarra I/G II - 2,190
Pasuquin	1,580	Dilumot Spring - 1,580
Vintar	1,180	Vintar I/G - 1,180
Paoay	870	Nangalisan I/G - 870
Total	14,980 m³/d	14,980 m³/d