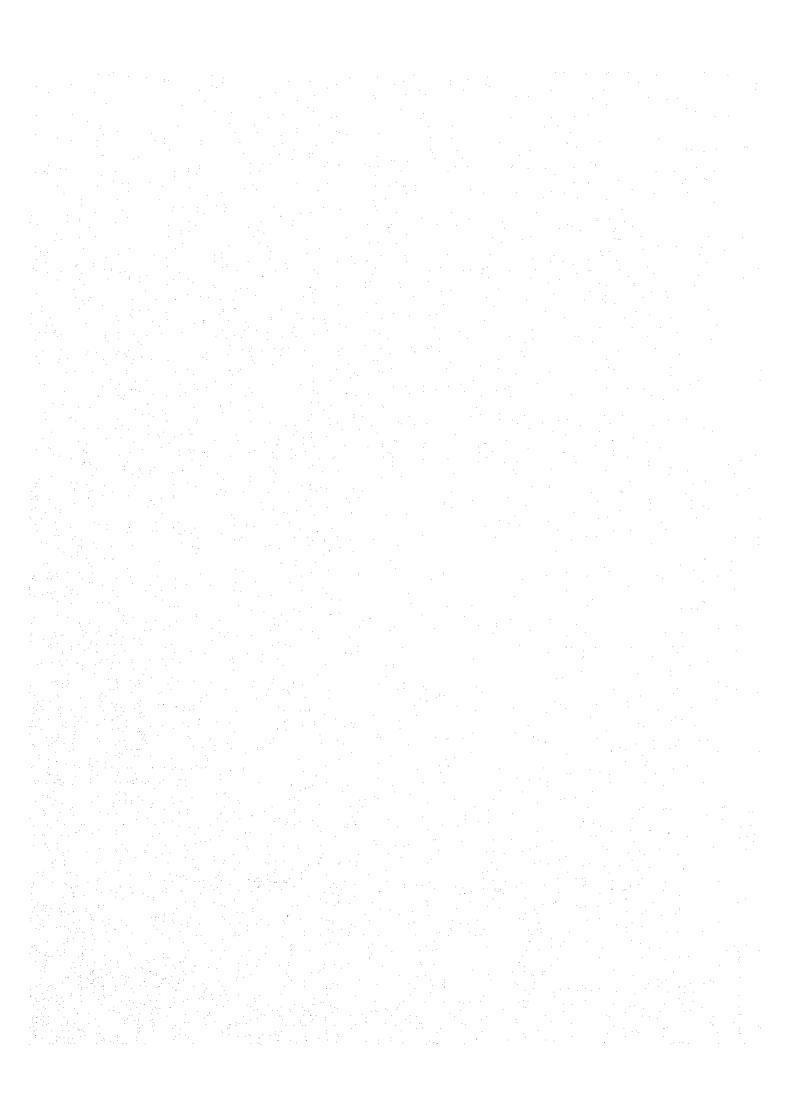
# INFRASTRUCTURAL SURVEY FOR THE DEVELOPMENT OF PASAR IN THE REPUBLIC OF THE PHILIPPINES

# FINAL REPORT

AUGUST 1982

JAPAN INTERNATIONAL COOPERATION AGENCY







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# DEVELOPMENT OF PASAR

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### PREFACE

The Japanese Government decided to conduct a survey on the development of water resources related to the establishment of the PASAR (Philippine Associated Smelting and Refining Corporation) Project and entrusted the Japan International Cooperation Agency (JICA) to carry out the survey. JICA sent a survey team headed by Mr. Kanjiro Wakita to the Philippines from March 7 to April 5, 1982.

The team, in consultation with the officials concerned of the Government of the Republic of the Philippines, conducted a field survey (in Leyte Island, Isabel area). After the team returned to Japan, further studies were made and the present report has been prepared.

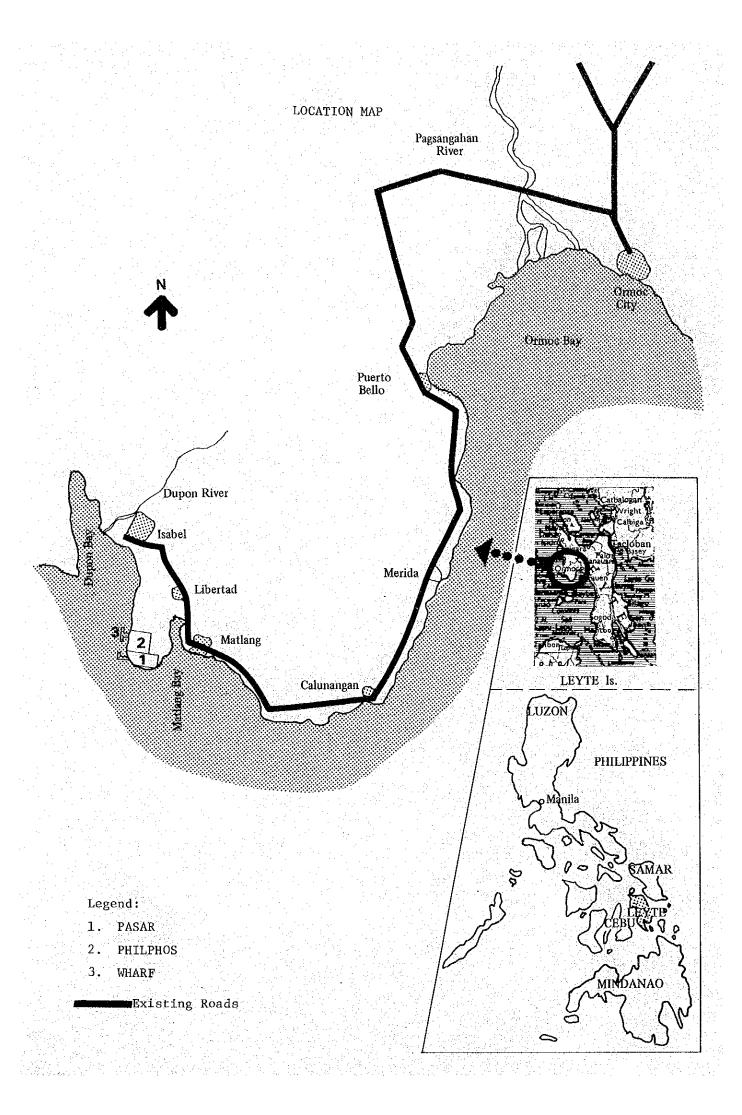
I hope that this report will serve for the development of the Project and contribute to the welfare of community residents.

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

August, 1982

Keisuke Arita President

Japan International Cooperation Agency



### SUMMARY

A survey on the development of water resources related to the establishment of PASAR (Philippine Associated Smelting and Refining Corporation) Project was carried out by a survey team headed by Mr. Kanjiro Wakita from March 7 to April 1982.

The following is a summary of feasibility study conducted for The Development of PASAR in the Republic of the Philippines.

This summary outlines the proposed service area population projections, water demand, development of water sources, transmission route, planned facilities and construction costs.

1. Future Population Projections

The yearly projected population according to districts is shown in Table 1.

### Water Demand

- a. The design period for the water supply scheme covers a span of twenty years from 1985 to 2005.
- b. A list of the proposed water districts and the subjects in served areas are shown in Tables 2 and 3.

	Table 2 Water Distr	<u>1cts</u>
Municipality	Water District	Barangay
	Cabaliwan	Cabaliwan
	Puerto Bello	Puerto Bello Can-Unzo Casildà
MERIDA	Merida	Libas Poblacion Lamanoc
	Calunangan	Macario Libjo Benabaye Mahalit Calunangan
	Matlang	Apale Tubod Matlang Tolingon Bilwang
ISABEL	Tsabel	Libertad Sto. Rosario Mahayag Sto. Niño (Poblacion Sta. Cruz San Roque

Table 1 Projected Population for Each Water District

Cabrillum   Cabrillum   San   1986   1987   1988   1989   1994   1995								Year				
Cabaliwam   Cabaliwam   980   989   1009   1019   1030   1082   1137     Puerto Bello   Casida   1,502   1,618   1,634   1,630   1,619   1,630   1,560   1,560     Puerto Bello   Casida   1,502   1,618   1,137   1,138   1,208   1,208   1,208   1,560     Casida   Casida   1,208   1,328   1,137   1,208	Municipality	District	Barangay & Sitio	1985	1986	1987	1988	1989	1990	1995	2000	2002
Cubulinam				υδρ	080	000	1.000	0.10	020 1	1 082	1.137	1.195
Puerto Bello   1,602   1,618   1,634   1,650   1,667   1,683   1,768   1,196   1,102     Casilida   1,173   1,185   1,197   1,208   1,213   1,235   1,266   1,562     Casilida   1,173   1,185   1,120   1,213   1,236   1,126   1,126     Total   Libro   1,206   1,300   1,321   1,230   1,210   1,213   1,206     Libro   Libro   2,114   1,166   1,121   1,136   1,210   1,213   1,210     Macrida   Bincry (Poblacion)   2,211   2,136   2,804   2,888   3,214   3,853   4,403     Malalit   S38   681   632   708   7124   5,824   5,934   6,539   7,249     Malalit   S38   681   632   708   744   5,014   5,909   1,016     Calumangan   866   1,063   1,091   1,241   1,096   1,001     Calumangan   866   1,063   1,091   1,241   1,096   1,001     Calumangan   866   1,063   1,081   1,103   1,247   1,418   1,027     Total   S38   739   730   731   3,713   4,300   1,241   1,096     Applie   Malaine   1,004   2,104   2,104   2,104   2,104     Total   S,418   1,007   1,247   1,096   1,001     Calumangan   1,007   3,007   3,007   3,007   3,007   3,007     Total   S,418   1,007   2,000   3,007   3,007   3,007     Librard   1,004   1,007   1,007   1,007   1,007     Librard   1,007   1,007   1,007   1,007   1,007   1,007   1,007     Librard   1,007   1,007   1,007   1,007   1,007   1,007   1,007     Librard   1,007   1,007   1,007   1,007   1,007   1,007   1,007   1,007     Librard   1,007   1,007   1,007   1,007   1,007   1,007   1,007   1,007		Cabaliwan	Total	086	686	666	1,009	1.019	1,030	1.082	1,137	1,195
Puerto Bello         Casilda         1,173         1,185         1,197         1,1208         1,121         1,230         1,342         1,230         1,230         1,343         1,396         1,302         1,137         1,189         1,201         1,206         974         1,190         1,100         1,100         1,100         1,100         1,100         1,100         1,100         1,100         1,100         1,100         1,100         1,100         1,100			Prerto Bello	1.602	1.618	1,634	1,650	1,667	1,683	∘ 692' 1	1,860	1,954
Cun-Unzo   839   847   856   864   873   881   926   974     Total   3614   3650   3587   3772   3761   3761   3797   3991   4796     Libas   Libas   1,134   1,136   1,177   1,189   1,204   1,213   1,275   1,340     Lamanoc   1,134   1,136   1,177   1,189   1,204   1,213   1,275   1,340     Mahdit   2,211   2,736   2,884   3,274   3,539   3,853   4,405     Mahdit   348   712   7,284   5,284   5,994   6,579   7,749     Mahdit   358   681   692   708   815   890   1,016     Mahdit   380   712   774   7,99   815   909   1,016     Calumangan   2,910   3,572   3,631   3,713   4,130   4,131   1,418   1,585     Calumangan   2,910   3,572   3,631   3,713   4,130   4,272   4,765   5,326     Total   3,572   3,631   3,713   4,130   4,272   4,765   5,326     Matlang   1,448   1,823   1,895   2,139   2,139   2,730     Libertal   1,488   1,283   3,145   3,508   3,143   3,508     Sia Cha   San Rosano   1,448   1,524   1,524   2,139   2,131   2,500   3,513     Kabel   San Rosano   1,413   2,629   2,631   2,733   3,145   3,508   3,145   2,633   3,132   3,132     Marci (Toblacion)   1,813   2,226   2,314   2,843   1,328   3,986   44,147   4,447   4,475   4,4		Puerto Bello	$oxed{oxed}$	1.173	1.185	1,197	1,208	1,221	1,233	1,296	362	1,431
Total   1,000   1,00				839	847	856	864	873	881	926	9.74	1,023
Merida   Libas   Li296   Li309   Li322   Li335   Li362   Li301   Li202   Li303   Li203   Li203   Li203   Li203   Li204   Li			Total	3.614	3,650	3,687	3,722	3,76 F	3,797	3.991	596 L'5	4,408
Mathang   Linimon   1,154   1,166   1,177   1,189   1,201   1,213   1,275   1,340			Libas	1,296	1,309	1,322	1,335	1,349	1,362	1,431	1,504	1,581
Machina   BRGY (Poblacion)   2,211   2,736   2,804   2,888   3,274   3,3559   3,853   4,405   4,055			Lamanoc	1.154	1,166	1,177	1,189	1,201	1,213	1,275	1,340	1,408
Calumangan         Apolitic         5,211         5,303         5,412         5,824         5,934         6,559         7,249           Malabilic         358         437         434         501         511         570         657           Libjo         280         712         724         748         835         815         909         1,016           Calumangan         866         1,063         1,081         700         716         808         824         919         1,016           Apple         761         934         950         700         716         808         824         919         1,027           Total         761         934         950         971         1,096         1,117         1,448         1,395           Tobal         357         370         371         373         373         494         523           Tobal         353         370         371         372         416         809         1,117         1,448         1,395           Tubod         1,143         1,823         1,893         2,900         3,713         3,713         3,713           Sio, Rosario         1,143         1,435 <th>Merida</th> <th>Merida</th> <th>oblaci</th> <th>2,211</th> <th>2,736</th> <th>2,804</th> <th>2,888</th> <th>3,274</th> <th>3,359</th> <th>&lt; 3,853</th> <th>4.405</th> <th>4,919</th>	Merida	Merida	oblaci	2,211	2,736	2,804	2,888	3,274	3,359	< 3,853	4.405	4,919
Malalith         555         681         642         789         815         909         Li016           Calunangan         Jubjo         580         712         724         740         835         815         909         Li016           Calunangan         866         1,063         1,016         1,016         1,016         1,016         1,016         1,016         1,016         1,016         1,016         1,016         1,017         1,016         1,017 <td< th=""><th></th><th></th><th>Total</th><th>4,661</th><th>5,211</th><th>5,303</th><th>5,412</th><th>5,824</th><th>2,934</th><th>6,559</th><th>7,249</th><th>7,908</th></td<>			Total	4,661	5,211	5,303	5,412	5,824	2,934	6,559	7,249	7,908
Calunangan         Mahalit         555         681         692         708         799         815         909         Li016           Calunangan         Libjo         580         712         724         740         835         851         909         Li061           Bendabye         586         1,083         1,081         1,105         1,247         1,271         1,418         1,585           Bendabye         586         1,063         3,720         3,631         3,713         4,190         4,712         4,765         5,320           Apale         761         3,631         3,713         4,190         4,217         1,246         1,395           Total         3,92         3,73         3,613         3,713         4,166         1,395         3,22           Matlang         1,485         1,823         1,895         2,190         3,273         3,193         3,193           Sta Cruz         1,1445         6,447         6,788         6,2190         7,800         7,800         7,836         3,193         3,193           Sta Cruz         2,140         2,140         2,140         2,140         2,133         3,086         3,193         3,193 </th <th></th> <th></th> <th>Macario</th> <th>348</th> <th>427</th> <th>434</th> <th>444</th> <th>105</th> <th>11S</th> <th>270</th> <th>637</th> <th>697</th>			Macario	348	427	434	444	105	11S	270	637	697
Calunangan         Libjo         580         712         724         740         835         851         909         1,061           Calunangan         866         1,063         1,081         1,105         1,247         1,418         1,585           Benabaye         361         689         700         716         808         824         919         1,027           Apale         761         934         950         971         1,096         4,177         4,165         5,356           Tolong         302         371         363         435         436         4,765         5,356           Tubod         302         371         372         4,167         1,246         1,395         1,396           Tubod         302         371         385         435         494         552           Mallame         1,488         1,823         1,895         2,139         2,186         2,433         2,720           Mallame         2,212         2,789         2,836         6,910         7,806         3,337         3,722         4,161           Sio. Rosario         1,743         2,140         2,173         2,513         3,508         3,508 </th <th></th> <th></th> <th>Mahalit</th> <th>555</th> <th>681</th> <th>692</th> <th>208</th> <th>662</th> <th>815</th> <th>606</th> <th>910'1</th> <th>1,112</th>			Mahalit	555	681	692	208	662	815	606	910'1	1,112
Calunangan   866   1,063   1,105   1,247   1,271   1,418   1,585		į	Libjo	580	712	724	740	835	158	606	1,061	1,161
Penabaye   Sol		C alumangan	Calunangan	998	1,063	1,081	1,105	1,247	1,271	1,418	1,585	1,735
Total			Benabaye	195	689	700	917	808	824	616	1,027	1,124
Tolingon   Sys   730   742   759   857   874   975   1,090   1,117   1,246   1,395   1,100   1,000   1,002   371   385   435   443   494   552   1,090   1,000   1,000   1,485   1,823   1,895   2,139   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,433   2,729   2,181   2,140   2,140   2,146   2,225   2,511   2,560   2,856   3,193   2,1			Total	2,910	3,572	3,631	3,713	4,390	4,272	4,765	5,326	5,829
Matlang         Tolingon         595         730         742         759         857         874         975         1,090           Mutlang         Tubod         302         371         385         435         443         494         552           Bilwang         1,485         1,823         1,853         1,895         2,139         2,181         2,433         2,720           Matlang         2,272         2,789         2,836         2,900         3,273         3,337         3,722         4,161           Total         5,415         6,647         6,788         6,910         7,800         7,952         8,870         9,916         1           Sta. Cruz         1,743         2,140         2,176         2,255         2,511         2,560         2,856         3,592         4,161           Sta. Roque         1,743         2,140         2,176         2,255         2,511         2,560         2,856         3,592         3,793           San Roque         1,241         1,524         1,584         1,584         1,883         1,823         2,900         3,324           Marvel (Poblacion)         1,973         2,422         2,462         2,514         2,6			Apale	761	934	950	126	1,096	1.117	1,246	1,395	1,525
Matlung         Tubod         302         371         385         435         443         494         \$52           Bilwang         1,485         1,823         1,853         1,895         2,139         2,181         2,433         2,720           Mailang         2,272         2,789         2,836         2,900         3,273         3,337         3,722         4,161           Total         5,415         6,647         6,758         6,910         7,800         7,952         8,870         9,916         1           Starchad         1,743         2,140         2,176         2,225         2,511         2,560         2,856         3,193         3,193           Sta. Cruz         Sto. Rosurio         2,141         2,629         2,673         2,733         3,145         3,508         3,298         3,293         2,273         4,161         2,273         3,085         3,145         3,273         3,273         3,273         3,273         3,273         3,273         3,273         4,273         3,145         3,273         4,273         3,145         3,273         3,273         4,273         3,085         3,273         3,273         3,273         3,273         3,273         3,273			Tolingon	595	730	742	759	857	874	975	0601	1,193
Matlang   1,485   1,823   1,895   2,139   2,181   2,433   2,720   47161   1,743   2,172   2,188   2,900   3,273   3,337   3,722   4,161   1,743   2,140   2,176   2,225   2,511   2,560   2,856   3,193   1,193   1,241   1,524   1,584   1,788   1,823   2,970   3,327   3,193   1,			poqnI	302	371	377	385	435	443	494	552	604
Marlang   2,272   2,789   2,836   2,900   3,273   3,337   3,722   4,161   1.70tal   5,415   6,647   6,758   6,910   7,800   7,952   8,870   9,916   1.70tal   1,743   2,140   2,476   2,225   2,514   2,560   2,856   3,793		Ntariang.	Bilwang	1,485	1,823	1,853	1,895	2,139	2,181	2,433	2,720	2.977
Total			Mallang	2,272	5,789	2,836	2,900	3,273	3.337	3,722	4,161	4,554
Clibertand   1,743   2,140   2,176   2,225   2,511   2,560   2,856   3,193   2,132   2,141   2,629   2,673   2,733   3,085   3,145   2,508   3,192   2,141   2,629   2,673   2,733   3,085   3,145   2,508   3,922   2,141   1,524   1,584   1,584   1,788   1,823   2,273   2,273   2,218   2,842   2,612   2,663   2,970   3,329   2,273   2,226   2,2462   2,518   2,842   2,897   3,232   3,614   2,612   2,613   2,814			Total	5,415	6,647	6,758	6,910	7,800	7,952	8,870	9.66	10,853
Sta. Cruz         Sto. Rosurio         2,629         2,673         2,733         3,085         3,145         3,508         3,922         4           San Roque         1,241         1,524         1,549         1,584         1,784         1,823         2,033         2,273           Marveit (Poblacion)         1,813         2,226         2,263         2,314         2,663         2,970         3,324           Sto. Nino (Poblacion)         1,973         2,422         2,462         2,518         2,842         2,897         3,232         3,614           Total         8,911         10,941         11,123         11,374         42,838         13,088         14,599         16,323         3           Grand Total         26,491         31,501         31,501         35,432         36,073         39,866         44,147			Lihertad	1.743	2,140	2,176	2,225	2,511	2,560	2,856	3,193	3,495
Sto. Rosurio         2.629         2.673         2.733         3.085         3.145         3.508         7.922         7           San Roque         1,241         1,524         1,549         1,584         1.788         1.823         2,033         2,274         2,242         2,518         2,842         2,847         3,232         3,614         3,614         1,712         11,374         12,838         13,088         14,599         16,323         1,6,	l Sa De I		Sta. Cruz									
San Roque         1,241         1,524         1,584         1,788         1,823         2,033         2,273           Marvel (Poblacion)         1,813         2,226         2,263         2,314         2,612         2,663         2,970         3,321           Sto. Mino (Poblacion)         1,973         2,462         2,462         2,518         2,842         2,897         3,232         3,614           Total         8,911         10,941         11,123         11,374         12,838         13,088         14,599         16,323         1           Ind Total         26,491         31,010         31,501         32,140         35,432         36,073         39,866         44,147         2,4147			Sto. Rosario	2,14,1	2,629	2,673	2,733	3,085	3,145	3,508	3,922	4,293
Marvel (Poblacion)         1,241         1,524         1,584         1,788         1,823         2,033         2,273           Sto. Nino (Poblacion)         1,813         2,226         2,263         2,314         2,612         2,663         2,970         3,321           Sto. Nino (Poblacion)         1,973         2,462         2,462         2,518         2,842         2,897         3,232         3,614           Total         8,911         10,941         11,123         11,374         42,838         13,088         14,599         16,323         15           Ind Total         26,491         31,010         31,501         32,140         35,432         36,073         39,866         44,147         2,4147			San Roque									
Marvei (Poblacion)         1,813         2,226         2,263         2,314         2,612         2,663         2,970         3,32J           Sto. Nino (Poblacion)         1,973         2,422         2,462         2,518         2,842         2,897         3,232         3,614           Total         8,911         10,941         11,123         11,374         42,838         13,088         14,599         16,323         1           26,491         31,010         31,501         32,140         35,432         36,073         39,866         44,147         4		. Isanci	Mahayag	1.241	1,524	1,549	1,584	1,788	1.823	2,033	2,273	2,488
Sto: Nino (Poblacion)         1,973         2,422         2,462         2,818         2,842         2,897         3,232         3,614           Total         8,911         10,941         11,123         11,374         42,838         13,088         14,599         16,323           26,491         31,501         31,501         32,140         35,432         36,073         39,866         44,147			oblaci	1,813	2,226	2,263	2,314	2,612	2,663	2,970	3,32]	3,635
Total         8,911         10,941         11,123         11,374         12,838         13,088         14,599         16,323           26,491         31,501         32,140         35,432         36,073         39,866         44,147			Sto. Nino (Poblacion)	1.973	2,422	2,462	2,518	2,842	2,897	3,232	3,614	3,956
26,491   31,010   31,501   32,140   35,432   36,073   39,866   44,147			Total	8.911	10.941	11,123	11,374	12,838	13,088	14,599	16,323	17,867
		Grand To	(a)	26,491		100	32,140	35,432	36,073	39,866	44,147	48.060

Table 3 Served Areas

	Served Area	Divisions	Classification
(1)	Communities and	Communities	Domestic Water Institutional Water Commercial Water
	Others	Other Industries (excluding PASAR)	PHILPHOS WHARE LIGHT INDUSTRIES
(2)	PASAR	Industries	PASAR, LEPANTO  Domestic Water  Industrial Water  Operational Water

### c. Service Rate

The water districts were classified into the urban area (Poblacion) and the rural area (Barangay). Water consumers in both areas are expected to switch from the use of public faucets to house connections. Figures 1 and 2 illustrate this predicted trend.

### d. Served Population

Table 4 shows the estimated served population.

District	Service Connection	1985	1986	1987	1988	1989	1990	1995	2000	2005
6 Y 18 1	House Connection	0	49	100	151	204	258	541	767	1,016
Cabaliwan	Public Faucet	980	940	899	858	815	772	541	370	179
Puerto Bello	House Connection	0	183	369	558.	752	949	1,996	2,832	3,747
ruetto Belio	Public Faucet	3,614	3,467	3,318	3,164	3,009	2,848	1,995	1,364	661
Merida	House Connection	1,398	1,709	1,883	2,073	2,388	2,599	3,771	5,169	6,722
Menua	Public Faucet	3,263	3,502	3,420	3,339	3,436	3,335	2,788	2,080	1,186
Calunangan	House Connection	0	179	363.	557	838	1,068	2,383	3,595	4,955
Calunangan	Public Faucet	2,910	3,393	3,268	/3,156	3,352	3,204	2,382	1,731	874
Matlang	House Connection	1,625	2,180	2,399	2,647	3,198	3,483	5,100	7,070	9,225
ata trang	Públic Faucet	3,790	4,467	4,359	4,263	4,602	4,469	3,770	2,846	1,628
Isabel	House Connection	2,673	3,589	3,949	4,356	5,264	5,733	8,394	11,638	15,187
isauci .	Public I aucet	6,238	7,352	7,174	7,018	7,574	7,355	6,205	4,685	2,680
Total	House Connection	5,696	7,889	9,063	10,342	12,644	14,090	22,185	31,07,1	40,852
10(1)	Public Faucet	20,795	23,121	22,438	21,798	22,788	21,983	17,681	13,076	7,208

Fig. 2 Service Rate (Poblacion)

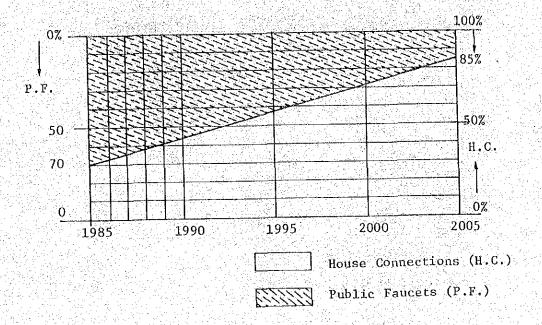
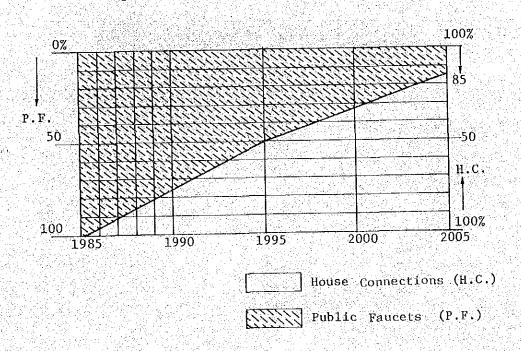


Fig. 3 Service Rate (Barangay & Sitios)



### e. Planned Industrial Production

Table 5 shows the production targets of PHILPHOS and PASAR from 1984 to 2000. The data was provided by the firms themselves.

Table 5 Planned Industrial Production

Ye Firm	ar 1	984	1985	1986	1987	7 19	38 1	989	1990	2000
PASAR (1000MT)		138	138	276	276	2	76	414	414	
PHILPHOS (%)		30	55	65	70	) )	80	85	85	85

### f. Water demand

Shown below is the rate of water demand. (Table 6)

Table 6 Water Demand

[Unit: gpm] YEAR 1988 1985 1986 1978 1990 2000 1989 1995 2005 OBJECT PASAR 1,200 1,600 1,600 1,700 2,100 2,100 2,100 2,100 2,100 1,940 2,080 2,520 **PHILPHOS** 1,800 2,560 2,600 2,600 2,600 2,600 COMMUNI-TIES 915 1,089 1,134 1,183 1,331 1,373 1,650 1,972 2,315 TOTAL 4,629 4,814 5,403 5,991 3,915 6,073 6,350 6,672 7,015

<sup>\*</sup> gpm = gallon per minute

### 3. Development of Water Sources

After investigating and studying possible water sources (ground water and surface water), it has been decided to make use of the ground water found in the plains of Ormoc.

Water intake facilities (deep wells and pumping facilities) are to be constructed in the Malunao area in the form of eleven deep wells (including one stand-by well) which would supply the water requirement amounting to 38,240 cm.m/day. The eleven wells shall form two circles with a junction well at the center. Each well pump shall be linked directly to the junction well. From the junction well, the water shall be transmitted to a receiving basin by means of an aqueduct with a \$600mm. diameter. Electric power for the well shall be supplied by the National Power Corporation. However, diesel generators shall also be installed to provide electric power in case of power failure. The two substations and control rooms which shall house these facilities shall be built near the two junction wells and shall be linked to each well.

The specifications for the wells are listed below:

### (a) Wells

Diameter -  $\phi$ 400 ( $\phi$ 18') Casing  $\phi$ 300 ( $\phi$ 12') Depth - 200 m. No. of wells - 11 (1 stand-by) Lifting Capacity - 4,000 cu.m./day/well

### (b) Submersible Pump

 $\phi$ 150 volute pump Q = 2.8 cum/min./pump H = 51 m. W = 45 kW No. of Pumps = 11 No. of Electromagnetic Flow (1 stand-by) Meters = 11 (c) Junction Well:

No. of wells = 2 200 cu. each  $(10^{m} \times 7^{m} \times 3^{m})$ 

(d) Junction Pipes:

Well to Junction well -  $\phi 250$ , L  $\leq$  1.0 km Junction well to Junction well -  $\phi 400$ , L  $\leq$  2.0 km

(e) Substation and Control Room - 2

Transformer (Indocr Type) 4,160 v./480 v.

No. - 2 units (each with a power capacity for

5 pumps.)

Control panels - with a power capacity for 10 pumps

Control disc - with a power capacity for 10 pumps

Generator & Panel - 2 units (each with a power capacity for 5 pumps)

4. Conveyance Facilities

Conveyance facilities consist of the aqueduct and the receiving tank.

Aqueduct:  $\phi 600$  L = 6.0 Km, pressure -reducing valve, sluice valve

Receiving Basin: 800 cum. (15m x 15m x 4.0m) - 1 unit

5. Transmission Facilities:

From the receiving tank, water shall be transmitted to fixed destinations through transmission mains with the aid of transmission pumps and booster pumps. En route to its final destination (Isabel), water shall be distributed to six water districts. To prevent the occurence of water hammer during

the sudden suspension of the pumps' operations, flywheels and one-way surge tanks (in 3 places) shall be installed.

- (a) Transmission Main  $\phi$ 700 L = 36.0 Km (ductile cast iron pipes or steel pipes)

  One-way surge tanks in 3 places  $(8 \text{ m}^3, 16 \text{ m}^3 \& 6 \text{ m}^3)$
- (b) Transmission Pumping Station:

Pump - double suction volute pump, 250¢ x 150¢.

8.9 cum./min./unit

H = 67 m. 160 kW/pump

No. of pumps - 4 units (including one stand-by)

Valve - 4 units

Hoisting crane - 1 unit - 2 tons capacity

Auxiliary equipment - 1 ump sum

Control Panel - 1 unit

Generator & Panel - 1 unit

(c) Booster Pumping Station

Pump - Double suction volute pump, 250¢ x 150¢,

8.1 cum./min,/unit

H - 67 m 160 kW

No. of pumps - 4 units (1 stand-by)

Valve - 4 units,

Hoisting crane - 1 unit - 2 tons capacity

Auxiliary equipment - lump sum

Control Panel - 1 unit

Generator & Panel - 1 unit

6. Distribution Facilities

Water shall be distributed to six water districts along the transmission route. Six distribution tanks shall store water for distribution to the served areas through the public

faucets although house connections shall become more prevalent with the passage of time. The structure of distribution tank shall be taken to prevent water hammer from affecting the distribution main and service pipes. Each tank shall be equipped with disinfecting facilities. Disinfection shall be realized by chlorination (in this case, the injection of chlorine powder).

Moreover, a booster pump shall be installed in Cabaliwan to supplement insufficient water pressure.

- (a) Distribution Tank for each of the six water districtsElevated tanks or Non-elevated tanks.
- (b) Distribution main and service pipes  $\phi$ 50  $\sim$   $\phi$ 300 L = 38 Km in total length for all districts.
- (c) Booster pump 1 unit.

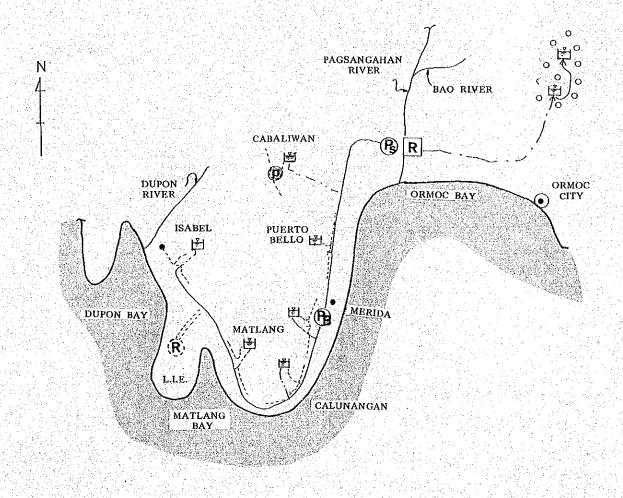
### 7. Control System:

Considering the difficulties involved in operating and managing the whole system, the adoption of a telephone hot-line which shall link the intake facilities, pumping stations and reservoirs (PASAR) has been decided in line of a centralized control system. All communications regarding water level observations and the like shall be conducted via the telephone.

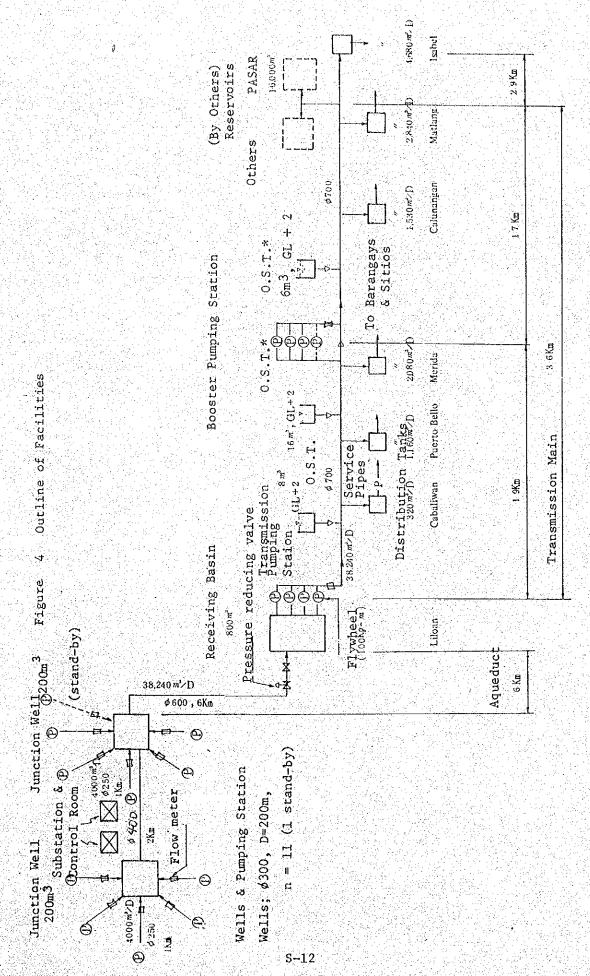
### 8. Outline of the Facilities

Figures 3 and 4 respectively show the outline of the facilities and the entire system.

Figure 3 Outline of the Facilities



LEGEND	Agueduct	Receiving Basin
	Transmission Main	
	Distribution Main	Junction Well
	Service Pipe 발	Distribution Tank
Ps	Transmission Pumping o o Station 0 0	Group of Wells
(P <sub>B</sub> )	Booster Pumping Station	Regulating Reservoir
P	Booster Pump in $(\hat{\mathbf{R}})$ Water District	(By others)



\*0.S.T. = One-way Surge Tank

### 9. Construction Costs and Construction Schedule

An estimate of the construction cost and the proposed construction schedule for Scheme I are shown in Table-7 and Figure-5.

Table 7 Construction Cost
(Scheme I)

Unit (Pesos)

Item		Construction Cost	Notes
	Well	23,419,622	
Basic Construction	Transmission	107,911,248	
Cost	Distribution	16,915,067	
	Administration Building	635,000	
	Operational Center	500,000	
	Subtotal	149,380,937	
Engineering I	ee	11,950,475	
	Subtotal	161,331,412	
Contingencies		<b>8,</b> 066 <b>,</b> 571	5% of 1= 161331412 x 0.05 2
Land		1,000,000	3
Tota		170,397,983	1 + 2 + 3

Figure 5 Construction Schedule

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### 10. Financial and Economic Analysis

(1) The following analyses were done to evaluate the base case. The interest rates used in this study are only assumptions and do not bind all parties concerned.

	Assump	tions $1/$	
Case	Goods to be supplied	Method of raising the fund for construction	Main factors determining unit water price
Base case	Industrial and water supply	70% of the funds with annual interest rate 3.5% and 30% at 8.0%	Redestribution of income, construction cost to be borne by water supplies
Case 1	Industrial water only	All funds with annual interest rate 8.0% 3/	
Case 2	Industrial and water supply	Ditto	Rate set by opinion of residents 4/
Case 3	Ditto	The same as in Base case	Ditto
Case 4	Ditto	Ditto	The same as in Base case

- 1/ Besides the framework, the following conditions are common to all cases.
  - a. Management policy Maintaining equilibrium of the operating entity ..... between the revenues and the expenses for 21 years.
  - b. Method of raising the Borrowing from the operating funds ..... Philippine government (expecting annual interest rate: 9%)
- 2/ Method of the amortization 20 year fixed of funds ..... amortization
- 3/ The banks in Japan are expected to supply the funds at an annual interest rate of 8.0%. However, when actually raising the funds, the financing conditions will become as follows:
  - a. Annual interest rate ..... around 9%
  - b. Terms of financing ..... about 10 years
- 4/ The unit water price into which consideration of the opinion of residents on the water rate is taken is deducted from the facts that the water rate per month and per household will be around 5 pesos in 1985 1987. This is within their income level.

The representative findings of the above four cases in comparison with the ones of base case are as follows.

	Representative	findings
Case	Unit price of Industrial and	Financial situation of the operating entity $1/\sqrt{2}$
Case 1	The industrial water unit price will be approximately the same as that of the base case.	Same as that of base case (because of being treated as a precondition in this case)
Case 2	The industrial water unit price is a little higher than that of	The breakdown point will be i 1977, three years later than that of base case.
	base case. The water unit price will be 1/4 ∿ 1/3 of that of base case. So, the users payment is decreased.	However, dissolution of the cumulative ordinary losses and repayment of debt from the government will not be finished by 2005. The operating entity will probably be on the verge of bankruptcy even after 2005.
Case 3	Ditto	Same as that of base case
Case 4	Both of industrial water and water supply unit price will become higher than those of base case. There is a problem of water unit price from the standpoint of income level.	Bad financial situation will continue for 2\3 years longe than that of base case.

- 1/ This data can be presented from the following three standpoints.
  - a. The point of time when the operating entity breaks even.
  - b. The  $p_0$ int of time when the operating entity covers the ordinary cumulative losses.

c. The point of time when the operating entity repays the government loan.

The following conclusions are derived from representative findings of the four cases outlined above.

- i) It is not industrial water but domestic water supply which will receive the incremental financial benefit over the base case (from comparison of base case with Case 1).
- ii) In setting the unit water price of the base case, equilibrium between the revenues and expenses, construction cost to be borne water supplier, redistribution of income, etc. were taken into consideration.

If other factors are considered, (e.g. taking account of user opinion on the water rate) to set the actual unit water rate, the water rate system will become more favorable to improvement of welfare in the area. In such a case, however, the incremental burden to be borned by the industrial water will remain relatively small (in comparison with Case 2 and Case 3).

111) On the assumption that the operating entity will supply both industrial water and domestic water and that it raises the total funds necessary for the construction of the facilities from commercial banks (assuming the annual interest rate: 8%), it is foreseen that the operating entity will not be financially solvent (from the comparison with Case 2). If the conditions of funding are worse than the ones in base case, the financial situation will become naturally worse (from comparison with Case 4).

Based on the above findings, the base case is found to be financially acceptable.

(2) A public entity is believed to be the most suitable operator to supply the industrial and domestic water, maintains its facilities and manage the water supply business.

PASAR CO., LTD. is in charge of raising the funds for construction of the necessary facilities and constructing them. Thereafter, the newly created public entity will purchase the facilities from PASAR on credit with repayment of a fixed amount (P15,972,000 per year) for twenty years.

(3) FIRR (Financial Internal Rate of Return) and EIRR (Economic Internal Rate of Return) of this business are as follows.

FTRR -	7.9%	
40 - 12 - 12 - 12 - 12 - 12 - 12 - 12 - 1	Base case 16.0%	
ETRR	Construction Cost 17.4%	í.
	down 10%	
	Construction Cost 14.8%	
: : : : : : : : : : : : : : : : : : :	up 10%	

FIRR is fair compared with water projects in other Districts in the Philippines in spite of the relatively large scale of Construction cost of this project.

The EIRR of the three cases listed above are higher or approximately the same as the opportunity cost of capital in the Philippines. (12-15%).

Accordingly, it can be concluded that this business is feasible both from financial and economic viewpoints.

(4) As for the total funds for construction of facilities, the funds for construction of house connections and operation which the operating entity will raise are as follows.

Kinds of funds	Amount of funds (₱1000)	Source of Funding	Time of funding	Reamrks	
Funds for construction of facilities	198,900.7 (current price)	Japan	1983, 1984		
	170,398.0 (at 1982 constant price)				
Operating Funds	56,753.1	Domestic	1985 - 1990	Annual interest rate: 9%	

The operating entity will raise the funds for construction of house connections from the Philippine Government, construct the house connections and will collect the funds (including interest) from the user over 30 years and then make payment to the government.

- (5) Industrial water and domestic unit water prices of the base case are as follows:
  - (1) The price of water to be set on the premise that the revenues and expenses of the business entity shall be balanced not yearly but for 21 years, provided that the forecasted demand for water supply shall be realized.
  - (ii) Aside from the above condition, income redistribution and the people's solvency for water rate shall also be taken into consideration.

The prices of water are shown below:

Unit Water Rate Cost Summary

(Unit: P/m<sup>3</sup>, current price

Period	Industrial water	Water supply through house connec- tion	Water supply through public faucet	(only for Growth Index	reference) Annual growth rate (%)
1982	1,123	0.802	0,723	1.000	
1985 ∿ 1987	1.504	1.074	0.968	1.339	10.2%
1988 ∿ 1990	2.001	1.429	0.288	1.782	10.0
1991 ∿ 1993	2.664	1.902	1.715	2,372	10.0
1994 v 1996	3.545	2.532	2.283	5.157	10.0
1997 ∿ 1999	4.719	3.370	3.038	4.202	10.0
2000 ∿ 2002	5.780	4.128	3.721	5.147	7.0
2003 ∿ 2005	5.780	4.128	3.721	5.147	0

The above prices must be qualified in the following respects.

- i With these prices, the revenues and expenses of the operating entity balance for 21 years, on the assumption that the forecasted demand for water supply will be realized.
- In setting the above prices, the redistribution of income and the user income level have been taken into account in addition to the conditions described in para 1 above.
- iii The water rate which is calculated on the basis of the unit water price is much higher than the existing water rate (₱ 5∿10/month/household), and is near the maximum rate which can be afforded by users in terms of their household income.

- iv. Therfore, at the time of setting the actual unit water price, it will be necessary to give a careful consideration to user opinions in the area in addition to the main factors and conditions described in para i and it above.

  And also, it is essential for the actual water unit price to be high enough to prevent users from abusing the water supply.
- (6) It is possible for the operating entity to repay the funds for construction of the facilities with a 20 year period between 1985 and 2004 (annual amount of repayment: ₱ 15,972,000).

At the same time, it must be pointed out that the annual amount of the repayment puts a heavy burden on the yearly balance of revenues and expenses of the operating entity.

(7) The annual amount of the repayment is relatively large in comparison to the annual revenue for the first five or six years. This situation will bring about a shortage of operating funds and therefore an introduction of funding from the Philippine Government will be needed. In addition for the second period, the operating entity will be burdened with the repayment of the governmental loan and with the amoritization of the loan for the construction of facilities.

Breakeven year for	1994	10th year after
the operating entity		start of operations
Cumulative Breakeven point	1998	14th year "
for the operating entity		
Final year to be amoritize	2001	17th year after
the loan from the Government		start of operations

The cases in which financial conditions or raising the fund for construction are worse than those of base case are as follows.

Case 2	Case 4
1994	1994
After 2005	2000
The cumulative losses	
at end of 2005:	
₽ 49.72 millions	
After 2005	2004
The debt at end	
of 2005;	
₹ 165.84 millions	
	After 2005 The cumulative losses at end of 2005: P 49.72 millions  After 2005 The debt at end of 2005:

- (8) Based on reasons stated below, this project is considered to benefit regional development and to be "public" in nature.
  - a. It is expected that the constant supply of hygienic water will lead to a remarkable decrease in diseases, especially of diseases related to the digestive system. This will not only decrease personal medical expenses but also help stabilize the livelihood of the residents in the area.

Consequently, this project is expected to have a large economic impact.

- b. Through the installation of fire hydrants, losses from fire will decrease.
- c. In the base case, the population will receive a large amount of social benefit.

- d. This project has a good possibility to directly and indirectly increase regional employment in secondary land teritiary industries.
- e. The above benefits will raise the standard of living of the area which will help stumilate mental and economic attitudes promoting the economic development of the area.
- (9) This project is indispensable for PASAR; however, it is impossible to initiate and maintain the project from a commercial base. Since, however, this project has a large impact on regional development and is in the public domain, it is suitable to receive funding from the Japan International Cooperation Agency (JICA).