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REPUBLIC OF THE PHILIPPINES
MINISTRY OF PUBLIC WORKS AND HIGHWAYS

THE PANAY RIVER BASIN-WIDE FLOOD CONTROL STUDY

SUPPORTING REPORT V

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NOVEMBER 198[illegible]

JAPAN INTERNATIONAL COOPERATION AGENCY

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APPENDIX VIII

WATER SUPPLY PLAN

FOR

FINAL REPORT

ON

THE PANAY RIVER BASIN-WIDE

FLOOD CONTROL STUDY

APPENDIX VIII WATER SUPPLY PLAN

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1. Introduction

Water supply study aims at projecting domestic and industrial water deamdns and at recommending a proper method to solve the problems of Roxas Water District (ROX-WD). ROX-WD is the largest system among piped water supply systems in the Panay river basin. Despite several improvements of the system in the past, ROX-WD still has serious problems, one of which is water resources. This problem closely relates to the river improvement project. In this flood control study, a rehabilitation plan, which could be implemented as a part of the river improvement plans, will be examined.

Chapter two describes the present and future water demands. Water demands are projected on the basis of the sales records of ROX-WD, a national water plan named "Rural Water Supply and Sanitation Master Plan" and the feasibility study of ROX-WD. Increasing water demands should be met from river water in future. Therefore water demand is an important factor for the river improvement plan as well.

Chapter three discusses the recommendation of improvement of ROX-WD water supply system. First of all, problems are enumerated, with which ROX-WD is facing at present. Three alternatives are proposed for the purpose of solving the problems. In this Study, alternatives are focused on water sources aspect. Finally, a recommendable rehabilitation plan is selected from the engineering point of view as well as from economic aspects.

2. Demand and Supply of Public Water in the Basin

2.1 Present Condition

In December 1982, the Government prepared a detailed master plan for water supply titled "Rural Water Supply and Sanitation Master Plan". The plan was completed by an inter-agency group coordinated by MPWH and composed of representatives of MHS, MOH, MLG, RWDC, LWUA, MWSS and NWRC. The plan lays down specific policies, targets and action programs for provision of water supply to rural communities in the country.

To rationalize the policies and strategies of water supply program, the following levels of water supply services are set forth in the plan:

(a) Level I - A point source, usually a protected well or a spring with an outlet, with no distribution system, generally suited for rural areas where the houses are thinly scattered, the well/spring outlet being not more than 250 m from the furthest user. A level I facility usually serves around 15 - 50 households.

(b) Level II - A level I plus a communal faucet system, generally suitable for rural areas where houses are clustered densely enough to justify a simple piped distribution system with public stand pipes, at not more than 25 m from the furthest user. Each one communal faucet covers around 4 - 6 households.

(c) Level III - A piped system with individual house connections. It is generally suited for densely inhabited urban areas.

Based on the 1980 Census of Population and Housing in Capiz, only 8230 households or 9.5% of the total households were served by public water systems as shown below.

No. of Households Served by Water Supply Systems
(1980 Census)

Service Level		Total		Urban		Rural	
Public Water System	Level I	3,130	(3.6%)	368	(3.2%)	2,762	(3.7%)
	Level II	2,331	(2.7%)	1,360	(12.1%)	971	(1.3%)
	Level III	2,769	(3.3%)	2,062	(18.4%)	707	(0.9%)
	Sub-total	8,230	(9.5%)	3,790	(33.8%)	4,440	(5.9%)
Other System	Community Water System	665	(0.8%)	290	(2.6%)	375	(0.5%)
	Others	77,545	(89.7%)	7,128	(63.6%)	70,417	(93,6%)
	Sub-total	78,210	(90.5%)	7,418	(66.2%)	70,792	(94.1%)
	Total	86,440	(100.0%)	11,208	(100.0%)	75,232	(100.0%)

The rest were served either by private water system or by individual other sources such as wells, springs, river, etc. Of 8230 households served by public systems, 3130 households or 3.6% are covered by Level I facilities built by MPWH. Capiz Engineering District of MPWH has constructed 450 systems of Level I such as shallow wells and deep wells for recent three years. Therefore more than 15,000 households might be served by the public water systems of Level I by the end of 1984, because each Level I system is expected to cover around 30 household.

There are existing 37 water supply systems of Level II, which were constructed by MPWH during the recent three years. Although only 2331 households were covered by Level II in 1980, more than 7,000 households might be served by Level II systems at the end of 1984 on condition that each Level II system covered average 200 households.

Each municipality in the province of Capiz has a public waterwork system of Level III in an urban area. Of the 17 municipalities, however, only the following 6 waterworks systems are functioning as of the end of 1984 as shown in Table VIII.1-1: Roxas City Water District; Dumarao Water District; Pilar Water District; Dumalag Waterworks; Ivisan Waterworks; and Sigma Waterworks. Other 6 systems are not operated because of malfunctions of pumping systems and some facilities of the systems which were damaged by typhoon "Undang" on November 5, 1984. The rest of

Level III systems are still under construction, so only small portions of town proper are covered by these systems. In any case, these waterworks are located only in the urban areas of the municipalities.

Only around 2300 households might be covered by the public waterworks of Level III as of the end of 1984, in spite of the fact that 2064 households or 18.4% of urban households were already covered by Level III waterworks systems in 1980.

2.2 Public Water Demand Projection in the Basin

In the master plan, the Government intends to install safe and dependable water supply facilities in the shortest time and in the most cost-effective manner. Therefore some practical scenarios are set for the rural water supply sectors in order to implement the foresaid policies quickly. Although the first stage of the scenarios is set to complete by the end of 1983, the implementation of the plan seems to be slow compared with the original program because of the national economic recession. Accordingly, the following scenarios are adopted, which are a modification of the original ones:

(A) Immediate (by the end of 1990)

(a) All barangays will have at least one system of Level I service.

(b) All existing non-operational public wells will be rehabilitated, replaced or repaired.

(c) About 50% of the urban areas and 10% of the rural barangays will have at least one system of Level II service.

(d) About 25% of the urban areas will have Level III service.

(B) Intermediate (by the end of 1995)

(a) About 30% of the rural barangays will have at least one system of Level II system.

(b) The incremental demand for repair and rehabilitation of wells will be satisfied.

(c) All clusters with 50 households or more will have at least one system of Level I service.

(d) All urban areas will have at least one system of Level II service.

(C) Long-range

(a) By the end of 2000, about 50% of all barangays will have at least one system of Level II service.

(b) By the end of 2010, 70% of culsters will have at least one system of Level II service.

(c) By the end of 2005, all urban areas will have level III service.

Based on the preceding scenarios, the following targets are set in terms of population served by public water systems. In rural areas, some isolated households would not be practically and economically served by public water supply systems. Hence, the unserved percentage is not expected to be less than 15% as shown below.

Long-term Targets of Water Supply System Coverage

Area	Service Level	Service Coverage in Percent				
		1990	2000	2010	2020	2030
Urban						
	Level I	50	0	0	0	0
	Level II	25	25	0	0	0
	Level III	25	75	100	100	100
Rural						
	Level I	36	47	52	47	42
	Level II	0	28	33	38	43
	Unserved	64	25	15	15	15

In general, people served by high-level waterworks such as Level III consume more water than those served by low-level water supply systems. In the master plan, therefore, the following criteria are adopted in terms of per capita water consumption: 30 lpcd for Level I; 60 - 75 lpcd for Level II; and 100 lpcd for Level III. Thus, public water requirement up to the year 2030 is shown in Table VIII.1-2 based on those criteria. Domestic water requirement of Levels I, II and III in the year 2030 will amount to 9,476 m^3/day, 22,637 m^3/day and 18,760 m^3/day respectively. The requirement of Level III, however, is calculated by using a constant increase rate of 1.0 lpcd per annum.

In general, the more the water supply facilities has spread, the more the domestic water is consumed. If the plentiful water supply is required in accordance with the increase of water consumption, the diversification of water source would be indispensable. Water systems in urban area will face this problem in a relatively short future, in particular if the systems rely on a deficient source such as springs and wells. In such case, river is considered to be the most pertinent water source for domestic water supply of Level III and municipal use in urban areas. Table VIII.1-3 shows the projection of public water requirement in urban areas of each municipality in the basin up to the year 2030. Total public water requirement in the Panay river basin in 2030 will aggregate 21,700 m^3/day, which may rely on river discharge as source of supply.

3. Improvement of Water Supply Facility of Roxas City

3.1 General

At present, Roxas City Water District (ROX-WD) supplies water to Roxas City. ROX-WD was established in 1976 and is the owner of the entire water supply system.

In Philippines, Local Water Utilities Administration (LWUA) is an agency to control water supply works of municipalities and cities, which have more than 20,000 population. In 1976, Feasibility Study for Water Supply of Second Ten Urban Areas was prepared by LWUA and Camp Dresser and McKee International Inc. (CDM), a consultant in U.S.A., under the contract with LWUA. Improvement work of the water supply system of Roxas City was included in the Feasibility Study (F/S).

Based on the F/S, the water supply system of ROX-WD has been improved partially. A new water treatment plant with capacity of about 8,000 m^3/day was constructed and additional pipeline laid from the plant to the city, with improvement of related facilities such as distribution pipes, transmission pipes and local pump facilities.

Notwithstanding all these improvements, ROX-WD system still has two serious problems on its water supply system at present. One is salt water intrusion of Lower Panay river during dry season (Jan. - Apr.) high tides. Lower Panay river is main water resources of ROX-WD. However, because of the salt water intrusion, the water is not suitable for drinking during the above period. The other is large amount of leakage from distribution pipes.

The purpose of this Study is to identify and recommend a proper method to solve the problems of ROX-WD water supply system.

3.2 Roxas City Water District

3.2.1 History of Roxas City Water District

The water supply system of Roxas City was originally constructed in 1929. It consisted of Sibaguan Well, Catao earth dam and pipelines of 22.5 km in length.

In 1955, another dam was constructed upstream of the first dam at Catao. In 1960, Sibaguan Well was abandoned due to diminishing capacity.

In 1975, Arkabalo intake facilities at Lower Panay river and a treatment plant was constructed to supplement the water supply from Catao source. The plant consisted of a settling basin and two filter basins. The Pump Facilities consisted of two pump units and intake structure.

In 1976, ROX-WD was formed by virtue of Resolution No. 45 passed by the city council of Roxas City. Following its formation, ROX-WD aquired the ownership and management of the entire water supply system from the city government.

In 1978, LWUA and CDM prepared Feasibility Study for Water Supply of Second Ten Urban Areas/1, in which ROX-WD was one of the areas studied.

In 1983, water supply system was partially improved based on an immediate improvement program recommended in F/S.

3.2.2 Existing Water Supply Facilities

At present, water supply facilities consist of source facilities, pump facilities, transmission facilities, water treatment facilities and distribution facilities. Location of these facilities are shown in Figure VIII.3-1 and the system flow is shown in Figure VIII.3-2. Their outlined features are described below.

Source Facilities

At present, ROX-WD has two surface water sources, the Catao source and the Lower Panay river (Arkabalo intake and pump station). There is a dam at Catao, the Catao earth dam located about 8 km southwest of Roxas City, which have a water shed of 85 ha. Catao water is conveyed to a water treatment plant at Arkabalo by grafity. Impoundment behind the Catao earth dam is dependent on the amount of rainfall.

/1: Feasibility Studies for 12 areas have actually been made. These are Roxas City, Urdaneta, Capan, Calamba, Bislig, Silay City, Bangved, Baybay, Cotabato City, San Fernando, Olongapo City and Los Banos.

The Arkabalo intake facilities on the Lower Panay river is located about 4 km southwest of the city. Raw water of the Lower Panay river is taken into an intake pond and then pumped up to water treatment plant located on a hill about 60 m above mean sea level.

Pump Facilities

The pumping facilities of ROX-WD include two pumping units at the Arkabalo station. Each unit consists of a 60 hp diesel engine as prime mover and a turbine pump rated at 2,725 m^3/day for 70 m total head. However, the combined output of two pumps is 4,220 m^3/day.

Transmission Facilities

A 250 mm pipeline to the city was laid when the Catao earth dam was constructed in 1955. As a part of construction of the Arkabalo intake facilities in 1975, a 250 mm pipeline was laid from Arkabalo pumping station to the settling basin of the previous water treatment plant. Another 250 mm pipeline was constructed to connect the settling basin with the Catao source at the junction near the Panay railways.

A 300 mm pipeline from the new water treatment plant to the city was installed in 1983.

Water Treatment Facilities

A new water treatment plant was constructed at Arkabalo in 1983. Capacity of the water treatment plant is about 7,880 m^3/day.

Distribution Facilities

The distribution system of ROX-WD was constructed in 1929, followed by extension of pipeline in 1955 and also in 1975. Present system has approximately 24.6 km of distribution pipelines ranging from 75 to 250 mm in diameter. Twenty-six percent (26%) of the total piping is 75 mm galvanized iron pipe which has been used for about 55 years.

Distribution tank is located in the water treatment plant at Arkabalo. The capacity of the tank is 2,480 m^3.

3.2.3 Water Consumption

Water consumption in ROX-WD in January 1977 is shown in Table VIII.3-1 and that in June 1984 in Table VIII.3-2. From these tables, it is seen that total water production volume of ROX-WD decreased in the period from 1977 to 1984. It is presumed due to the following facts;

(a) In 1977, about 45% of connections have defective meters so that much water was wasted at the connections.

(b) Also in 1977, pumping facilities of Arkabalo station were liable to be operated at unnecessary time, that is, the operation could not follow the change of water demand so that much water was wasted overflowing the settling basin.

By 1984, however, the above defects were almost improved and waste of water has decreased.

On the other hand, there was no notable increase in water consumption during the period, as indicated in the table that total quantities of domestic use, commercial use and industrial use are almost the same in both years.

3.3 Outline of Feasibility Study

LUWA's F/S was prepared in the period from 1976 to 1978 as stated in the previous Section 3.1. At the time, the water supply system of ROX-WD had problems below.

(a) The both water sources, Catao source and the Lower Panay river had not adequate treatment plant, so that the turbidity of supplied water exceeded the permissible limits designated by Philippine National Standards for drinking water.

(b) High saline water had been supplied from the Lower Panay river during high tide time in dry season (from January to April) due to salinity intrusion to the river.

(c) Leakage through distribution system was very large.

(d) In 1977, 45% of service connections had defective meters. Water charge were collected at flat rate for the defective connection. This contributed much to increase volume of waste water.

Several plans to settle the above problems were studied and recommended in the F/S. The proposed improvement plan are summarized herein-below.

3.3.1 Water Demand Projection

In the feasibility study, improvement program up to 2000 is proposed. For formulation of the program, population was projected as shown below.

Projected Population in F/S

Year	Total Population/1	Population in Service Area	Served Population	Service Area (ha)
1975	50,841	25,728	9,188	177
1980	57,100	28,390	14,380	177
1990	75,720	60,230	38,490	545
2000	96,950	85,140	65,940	860

In the F/S, it was assumed that, though domestic use, commercial use, industrial use and institutional use increase along with the rise of living standard, unaccounted-for-water will gradually decrease with achievement of reduction of leakage water through distribution system. The two factors offsetting each other, per capita consumption was estimate not to change during the period from 1980 to 2000.

Per Capita Water Consumption

		1980	1990	2000
Domestic use	lpcd	105	120	135
Commercial/Industrial/Institutional	lpcd	14	19	24
Unaccounted-for-water	lpcd	79	54	40
Per capita water consumption	lpcd	198	193	199

Based on the above served population and per capita water consumption, water demand was projected as shown below. In the projection, the maximum-day demand is assumed to be 1.2 times the average daily water demand.

/1: Covers entire Roxas core city and other 12 barangay

Water Demand Projection

		1980	1990	2000
Per capita water consumption	lpcd	190	193	199
Served population		14,380	38,490	65,940
Average daily water demand	m^3/day	2,850	7,430	13,120
Maximum-day water demand	m^3/day	3,420	8,920	15,740

3.3.2 Recommended Plan

In the F/S, the following counter measures were proposed to settle the problems involved in ROX-WD at the time.

(a) To construct a treatment plant with chemical mixing flocculation, sedimentation, filtration and disinfection to improve water quality.

(b) In the future plan, a new pumping station is constructed beside the Main Panay river and water is pumped up therefrom to the treatment plant, abolishing the existing pump station on the Lower Panay riyer, in order to settle salinity water problem.

(c) In order to reduce leakage through distribution system, old distribution pipes are replaced by new ones.

(d) In order to reduce wastage through service connections, meters are attached to all the connections.

The improvement program including above countermeasure and extension of the water supply system consists of the following 5 steps.

Stage Construction Proposed in F/S

Year	Program	Item	Design Period
1978 - 1979	Immediate Improvement Program	Water Treatment Facilities, 7,880 m^3/day	1988
1980 - 1985	Stage I Phase A of Long-term Construction Program	Pump Station 10,500 m^3/day	1993
		Pipeline ∅400 8.5 km	1993
		Storage Tank 1,000 m^3	1986
1986 - 1990	Stage I Phase B of Long-term Construction Program	Treatment Facilities	1994
		3,940 m^3/day	1994
		Storage Tank 600 m^3	1993

Year	Program	Item	Design Period
1991 - 1995	Stage II Phase A of Long-term Construction Program	Pump Station 5,240 m^3/day	2000
		Pipeline ϕ300 8.5 km	2000
		Treatment Facilities 3,940 m^3/day	2000
		Storage Tank 600 m^3	2000
1996 - 2000	Stage II Phase A of Long-term Construction Program	Expansion of Service area	2000

Of the above five staged programs, the works proposed for the first three steps are detailed as follows:

Immediate Improvement Program (1978 - 1979)

(a) Construction of new water treatment facilities. Capacity of the treatment facilities is about 7,880 m^3/day. The capacity will be adequate for the 1988 maximum day demand.

(b) Installation of about 4.84 km of distribution pipes.

(c) Installation of new 739 connection and repair/replacement of 177 existing service connections.

Stage I Phase A Program (1980 - 1985)

(a) Construction of a new pump station along main Panay river. The pump station will be capable to meet the year 2000 requirement, but with staged installations of pumps and motors. In Phase I-A, a pump/set with a capacity of 10,500 m^3/day will be installed and will be adequate to meet the 1993 projected maximum-day requirement of ROX-WD.

(b) Installation of a 400 mm pipeline, about 8.5 km long, from the new pumping station to the treatment plant.

(c) Construction of a storage tank at Lawaan hill. Capacity of the tank is 1,000 m^3. The capacity is adequate to meet requirement up to the year 1986.

(d) Installation of about 14.7 km of distribution pipes.

(e) Installation of 1,200 service connections in the core city of Roxas, Cadimahan, Punta Tabuc, Tangue, Tiza, Lawaan, Baybay, Dumulog and Banica and repair/replacement of 1,001 existing service connections.

Stage I Phase B Program (1986 - 1990)

(a) Construction of an additional module of treatment facilities with a capacity of 3,940 m^3/day. Total capacity of treatment facilities will be 11,820 m^3/day. The capacity will be adequate to meet the maximum-day requirement in 1994.

(b) Construction of a storage tank with capacity of 600 m^3 at the same site as the storage tank constructed in 1980. Available storage capacity (1,600 m^3) will be adequate to meet the storage requirement up to the year 1993.

(c) Installation of about 8.2 km pipelines.

(d) Installation of 2,013 new service connections.

The estimated construction cost of the above proposed works is shown in Table VIII.3-3.

Present Progress and Future Prospect

Up to the present, only Immediate Improvement Program has been completed. The treatment plant had completed in 1983, 4 years delayed from the original schedule.

The next step of implementation contemplated in the original schedule, is the implementationof Stage I-Phase A which was scheduled to complete by 1980. Actually, however, the implementation is not decided yet. In this implementation stage, it was planned to construct intake facility on the main Panay river to solve the salinity problem and also to extend the water supply area.

Owing partly to limited capacity of supply facilities, during the period from 1977 to 1984.

3.4 Defect of Existing System

3.4.1 Water Source

Catao Source

The Catao impoundment source has no perennial stream in its watershed. The impoundment during wet season varies with the intensity of rainfall. Supply from this source is not reliable. Therefore in the F/S, it was considered not to use the Catao source as a water source of the water supply system. Actually, however, the source is being used as a water source at present. Since this source is able to supply water by gravity, it is recommendable to utilize this source to a possible maximum extent.

Lower Panay River

The Lower Panay river is the other existing source of ROX-WD. During the dry season (especially from January to April), saline water intrudes upstream beyond the Arkabalo intake. As the supply of water from Catao source decrease in such period when rainfall is little/1, most of the required water shall be supplied from the Lower Panay river. Due to these situations, saline water of the Lower Panay river is to be supplied during such period of a year. Problems caused by saline water supply are as follows:

(a) At present, most of households in Roxas City, even those supplied from ROX-WD system, depend on stored rainwater for their drinking water. In the dry season, however, rainfall is little and frequently the stored rainwater becomes out of stock. In such case, people are forced to use saline water supplied from the Lower Panay river or otherwise unsterilized well water for drinking.

/1: The minimum rainfall during the dry season is 47 mm per month. With a drainage of 85 ha, the runoff from the catchment area ranges from the minimum of 533 m^3/day to the maximum of 932 m^3/day, using the volume of runoff formula; $R = KP$ with a coefficient K of 0.4 - 0.7.

(b) Due to high saline water being pumped up to the water supply system, corrosion of machinery is remarkable, causing the increase of maintenance cost. It is reported that parts of pumps were forced to be replaced only 7 years after its installation.

In the F/S, the Lower Panay was considered to be not suitable for water source for future stage due to its saline water intrusion. Instead, the Panay river was proposed as future water source. Against this proposal in the F/S, another alternative plan to use the Lower Panay river as water source is conceivable as explained in the latter Section 3.6.

3.4.2 Distribution System

Based on the F/S plan, all the service connections have been equipped with meters. As the results, waste water has much decreased. Moreover, as the results of construction of distribution tank, it becomes not necessary to operate intake pump for full day. It also contributed in decreasing the waste water as explained in Subsection 3.2.2. It is noted, however, 26% of the existing distribution pipes has been used for more than 55 years and water leakage therefrom seems still much, especially at the night time when water use decreases and water pressure in the pipes rises. In order to reduce this leakage, ROX-WD switched its operation from full time supply to limited hours supply starting in May 1984. The supply time is from 6:00 a.m. to 1:00 p.m. and from 5:00 p.m. to 8:00 p.m., 11 hours in total. In the F/S plan, replacement of old pipes with new ones was proposed. But the replacement has not progressed for up to the present.

As the countermeasure against leakage, it is recommended the limited hours supply should continue as a first-hand measure during progressive replacement of pipes.

3.5 Basic Layout of Improvement Plan

Among the several defects of the existing systems stated above, the most serious defect is the saline water intrustion to the Arkabalo intake at Lower Panay river. Therefore the present study will examine mainly on this water source problem. In order to discuss the problem of water source of the system, the capacity of the sysem shall be determined first. For deciding the capacity, the basic layout of the improvement plan are studied below.

(1) Water demand projection

The F/S forecasted that daily water demand would increase to 4,500 m^3/day by 1984. Actually, however, present demand remains at a level of 2,800 m^3/day. In view of deviation of the actual figure from previous forecast, a revised water demand projection was attempted in this Study.

Served population

Served population seems to have not increased from 1977 to 1984 as represented by a fact that volume of water for domestic use has not increased during the period as explained in Subsection 3.2.3. Then, the served population of a year in the F/S projection is regarded as that in a year 10 years later in this review study.

Water demand

Water demand is classified into three components; (A) domestic use, (B) commercial, industrial, government and public uses, and (C) leakage, wastage and plant use. Each component is estimated as follows:

(A) Domestic use

Actual volume of domestic use as of June 1984 is 963 m^3/sec and the number of household served is 1576. The present per capita consumption is 97 lpcd, assuming the number of persons per household to be 6.3. In the F/S, the per capita consumption of domestic use was assumed to increase in proportion to the rise of living standard. However, it is considered that the living standard of households newly supplied with water is lower than that of the households already supplied. Low consumption by newly connected consumers offsets the increased water consumption by existing consumers, resulting no notable growth of increase of per capita consumption rate. In the projection under this study, therefore, per capita water consumption is assumed at a constant rate of 100 lpcd, almost the same as the present value, throughout the projection period till 1995.

(B) Commercial, Industrial, Government and Public use

The consumption volume of commercial, industrial, government and public uses is considered to increase at an increasing rate of 3% annually, corresponding to population growth rate in the city.

(C) Leakage, Wastage and Plant use

ROX-WD is making effort at present to prevent leakage by adopting limited hour supply, but still the leakage reaches as much as about 40% of total consumption volume. In order to decrease the leakage, replacement of old distribution pipes is needed. The replacement work will, however, require a relatively long period. Therefore the rate of leakage is assumed to be 40%, the same as the present rate, in this water demand projection.

Based on the above basic assumption, future water demand was projected as shown below.

Projected Water Demand

Year		1985	1990	1995
Per Capital Water Consumption	lpcd	100	100	100
Served Population		10,000	14,380	26,430
Domestic use	m^3/day	1,000	1,438	2,643
Commercial/Industrial	m^3/day	700	811	941
Government and Public use, Waste/leakage and Plant use	m^3/day	1,133	1,499	2,389
Average daily demand	m^3/day	2,833	3,748	5,973
Maximum day demand /1	m^3/day	3,683	4,872	7,765

Note: /1 Based on 1.3 times average daily water demand.

(2) Outline and capacity of improvement plan

Based on the revised water demand projection, outline and capacity of improvement plan is studied below. In Philippines, water supply system is designed based on criteria set forth in "Supply and Sanitation Master PLan". According to the Plan, design criteria for determining capacities of main facilities are as follows:

(a) Design period - 5 or 10 years

(b) Pumping hours - 8 or 16 hours

(c) Storage capacity - 1/4 maximum day demand

In the improvement plan, the designing period is assumed to be 10 years, with placing the target year of the plan at 1995. Based on the estimated maximum day demand in 1995 of 7,765 m^3/day, the capacity of major facilities are decided as follows;

(A) Pumping station

The daily pumping time has been taken as 16 hours in order to keep the capacity of pumping facilities as small as possible. The necessary capacity was calculated to be 11,650 m^3/day. Since the capacity of existing pumping facility as the Lower Panay is 4,200 m^3/day, the capacity will have to be increased. As stated before, the intake on the Lower Panay river involves the problem of salt water intrusion. The location of pumping station is discussed in the Section 3.6, together with the measures against salt water intrusion problem.

(B) Water treatment facilities

The present capacity of water treatment facilities is 7,880 m^3/day which is larger than the required capacity of 7,763 m^3/day. There is therefore no necessity to increase the capacity of treatment facilities.

(C) Storage tank

The necessary capacity for the maximum day demand of 7,765 m^3/day is 1,940 m^3 which is smaller than the present storage tank capacity of 2,840 m^3, there is therefore no necessity to its capacity.

(D) Distribution system

Distribution system will be expanded according to the increase of served population as assumed in (1) above.

3.6 Study and Comparison of Alternative Source Facilities

In this Subsection, studies on water source and intake facilities are made. Firstly, process of salt water intrusion into the Lower Panay river is discussed and secondly, alternative sources and intake facilities are explained. Finally, the comparison of these alternatives are made to select an recommendable plan.

3.6.1 Salt Water Intrusion to Lower Panay River

Lower Panay river is about 32 km long from its inlet at the Lower Panay/Pontevedra bifurcation to its river mouth along the river course. The profile of the Lower Panay river is shown in Figure VIII.3-3. The riverbeds of both main and Lower Panay rivers are lower than the mean sea level taking the form of tidal river. According to the site observation, salt water intrudes upstream from its river mouth during high tide time, while the river receives inflow of freshwater from the main Panay river. By contrast, at the salt water flows out from the river mouth during low tide hours, but at the same time freshwater reverses into the main Panay river, especially in the low river water period. During high water period, abundant freshwater flows into the Lower Panay river from the main Panay river.

At the inlet of the Lower Panay river, sediment transported by the main Panay river is liable to deposit as the inlet is located on the corner of meandering. The sand bank so created prevents the inflow of freshwater into the Lower Panay river.

The salt water intrusion is greatest at high tides in the dry season (January to April) when the river discharge is small and reduced also by abstraction for irrigation. The abstraction of irrigation water amounts to 1.8 m^3/sec at the maximum. As there is almost no inflow of freshwater from the main Panay at the time, salt water moves upstream presumable at the same discharge as that pumed up for irrigation. By such mechanism, salt water prism in the Lower Panay river intrudes upstream and beyond the pumping station of ROX-WD.

The location of irrigation water abstractions in this area is shown in Figure VIII.3-4. A preliminary analysis of saltwater intrusion is contained in Appendix I.

3.6.2 Alternative Source Facilities

Two alternative water sources are considered; one is the Lower Panay river and the other the main Panay river. If the Lower Panay river is to be the water source, measure have to be taken against salt water, while this consideration will not be required in case of direct water abstraction from the main Panay river.

The following three alternative plans were compared to select the final plan:

<u>Alternative 1</u> (refer to Figure VIII.3-5)

The water from the main Panay river is diverted to the Lower Panay river by constructing a diversion weir on the main Panay river. Irrigation water (about 1.8 m^3/sec) presently being pumped up from the Lower Panay can also be supplied together with the water for water supply. Constant supply of freshwater will diminish salt water intrusion in the downstream reaches of the river. As the diversion weir, a rubber dam is proposed on grounds of relatively low cost, about 1 km upstream from the present Lower Panay/ Pontevedra bifurcation point.

The Lower Panay river is then connected with the main Panay by a shortcut channel to be newly excavated. At the entrance of the shortcut channel, an intake gate will be installed. An additional pumping station with a capacity of 7,450 m^3/day and a 300 mm dia. pipeline of about 1.4 km long will also be constructed.

<u>Alternative 2</u> (refer to Figure VIII.3-6)

A new pumping station, with capacity of 11,650 m^3/day, will be constructed on the left bank of the main Panay river together with a pipeline of 450 mm in diameter and about 10 km in length between the pumping station and the existing treatment plant.

Alternative 3 (refer to Figure VIII.3-7)

This plan contemplates to divert the water by gravity flow without building a diversion weir on the main Panay river. As is the case of Alternative-1, the design discharge is set at 2.0 m^3/sec to cover both irrigation and water supply uses. The water intake is proposed on the left bank of the main Panay about 1 km upstream from the present Lower Panay/Pontevedra bifurcation. A shortcut channel will be excavated to feed the main Panay water into the Lower Panay.

In order to ensure water inflow at low water - low tide, some riverbed of the Lower Panay river will be excavated at required places to depths shown in Figure VIII.3-16. Moreover, a sand trap/ dredging basin will be provided at the entrance of the shortcut channel to prevent the excessive inflow of sediments into the Lower Panay reach.

A tidal gate will also be constructed on the Lower Panay about 6 km downstream from the existing pumping station, to prevent salt water intrusion. An additional pumping station with capacity of 7,450 m^3/day will be constructed beside the existing pumping station together with a line of 300 mm in diameter and about 1.4 km in length to deliver water to the treatment plant.

The operation of the facilities in this alternative is as follows. At the time of high tide, the tidal gate is closed to prevent salt water intrusion and the intake gate is opened. Then the abundant freshwater of the main Panay flows into the Lower Panay. At the time of low tide in the high water season, there will be no salt intrusion problem, because much water flows into the Lower Panay from the main Panay. At the time of low tide in the low water season, the reverse flow of the Lower Panay to the main Panay can be prevented by closing the intake gate. The closure of two gates, the tidal gate and the intake gate, will confine more than 650,000 m^3 in the Lower Panay river channel. This storage is more than sufficient to supply necessary water of about 2.0 m^3/sec including irrigation use during low tide time of about 6 hours. Figure VIII.3-17 shows the logic of the above descriptions.

For all the above three alternative plans, preliminary design of major structures were prepared as shown in Figures VIII.3-8 to VIII.3-16.

The construction cost of each alternative plan is estimated on the financial cost basis at the price level of 1984 and shown in Tables VIII.3-4 to VIII.3-6. The summary is shown as below.

Construction Cost of Alternative Plans

Alternative Plan	Estimated Construction Cost (₱ x 10^6)
Alternative-1	87.530
Alternative-2	49.411
Alternative-3	55.948

3.6.3 Comparison of Alternatives

The estimated construction cost is the smallest in Alternative-2. However, other technical factors shall also be considered for selecting an optimum plan. Some technical aspects on each plan are described below.

Alternative-1

This plan was evaluated to be the highest cost plan due mainly to a large cost requirement for the diversion weir.

If the diversion weir is constructed by river channel improvement project or irrigation project, the cost of weir can be allocated to other project and, in this case, the plan may become the least cost plan. However, it is not foreseen that the weir will be constructed by other project in the near future at least before 1990. Since the solution of salt water problem of water supply project is urgent, construction of diversion weir by other project shall not be expected. Thus, this plan remains to be a costly plan.

Alternative-2

This plan was assessed to be the least cost plan in regard to the initial investment cost. However, the plan involves the following disadvantages:

(a) At time of future extension of supply capacity in 1995 on ward, this plan will require a larger extension cost, compared with the other two plans, by ₱19.7 x 10^6/1 for installation of an additional 10.5 km transmission pipeline where the costs of other extension works such as pumping station and treatment plant are assumed to be same among all alternatives. If this additional pipeline cost is simply added as a penalty, the total cost of Alternative-2 will be ₱69.5 x 10^6 which is almost comparable with the cost of Alternative-3/2.

(b) This plan requires a larger operation and maintenance costs than the other two plans due to large pumping units included in the scheme.

(c) Salt intrusion in the Lower Panay river will remain unsolved in this plan. This requires a separate measure to be taken for improvement of irrigation water supply.

Alternative-3

This plan is the second least cost plan comparable to Alternative-2. The plan envisages to solve salt water problems in the Lower Panay reaches, thus giving a beneficial effect on irrigation water supply in the area.

The above comparisons indicate that Alternative-3 will be most recommendable chiefly from technical viewpoint. The favorable aspect of Alternative-3 was also confirmed by economic evaluation presented in Subsection 3.7.4 hereinafter.

/1: On an assumption that same size pipeline as adopted in the present design will be installed.

/2: No additional cost will be required at time of extension work for intake and conveyance facilities, since the facilities contemplated in the present design have a capacity to meet the demands up to 2030.

3.7 Economic Evaluation of Improvement Work of ROX-WD

3.7.1 Preconditions of Economic Analysis

Economic appraisal of the Alternative 3 of the ROX-WD improvement plans, which is selected in the previous section, is made, in this section. In the economic analysis, the following criteria were adopted:

(a) The evaluation period is 20 years after the completion of the improvement facilities.

(b) The construction costs included in the analysis are incurred within the first one year.

(c) The costs for connection of new consumers and replacement of metering equipment are disbursed one year before new demands occur.

(d) The costs of existing water supply facilities are not included in the analysis because they are considered as sunk cost.

(e) The salvage value of facilities is regarded as a part of benefits. Hence, it is added to the benefits at the end of the evaluation period.

3.7.2 Estimate of Benefits

(1) Increase in land value

The implementation of water supply project will result in an increase in land values of the service areas. The portion of land values attributable to provision of a public water supply system was estimated in the household survey in Lipa City (May 1975) to be about 22.6% of the market value of the piece of land. On the basis of this survey, it may be conservative to assume that 20% of the value of land could be taken into account as land enhancement type benefits.

The 1984 costs of land based on estimated market value in urban areas of Roxas City are ₱100/m^2 for residential and ₱200/m^2 for municipal and commercial lands. Within the service area, land use is 108.3 ha for residential and 14.5 ha for municipal and commercial, uses. Accordingly, total land value of the service area is estimated as ₱137,300 x 10^3.

Therefore, the land value benefits amounts to ₱27,460x10^3. Thus benefits will accrue just after the completion of the improvement work.

(2) Health benefits

The health benefits are classified into the following three catagories.

The first health benefit is a reduction in the incidence of water-borne disease. Once the project is implemented, there will be a decrease in the amount of time lost by income earners who otherwise suffer from such diseases. According to the satistics of the Department of Health, an average number of 1835 persons out of every 100,000 population in the province of Capiz suffered from waterborne diseases, regardless of age, sex and income class, during a period from 1975 to 1983. The mobidity rate in the service area is assumed to remain constant during the evaluation period.

Since not all of those afflicted with waterborne disease are wage-earners, an adjustment is to be made accordingly. Based on the 1980 Census, the population of productive ages, belonging to the 15 to 64 age group, was 52.2% of the total population in the basin. Therefore only 52.2% of 1835 per 100,000 was assumed to be wage-earners. These wage-earners were assumed to earn ₱15 a day and to be unable to work 15 days per year on average because of their diseases.

The final figure of economic costs of time lost is calculated by multiplying the number of people afflicted with waterborne disease by 52.2%, by ₱15/day and by 15 days/year.

The second health benefit is a reduction in economic costs of the premature death of people afflicted with waterborne diseases. This economic loss is determined by multiplying the number of people who die because of waterborne disease by 52.2% (% wage-eaner) and further by ₱27,940 (value of each death as estimated below).

From 1973 to 1983, an average number of 137.7 out of 100,000 population in the province of Cipiz died because of waterborne diseases. This mortality is assumed to be constant over the evaluation period. The ₱27,940 represent the monetary value of each death. This was derived from the following formula:

$$\sum_{i=1}^{5} \left\{AI/(1+r)^{i-1}\right\} \times (1+AC)$$

where,

AI : Annual income (₱15 x 30 days x 12 months)

AC : Associated cost (20%)

r : Discount rate (8%)

The third health benefit is a reduction of the medical expenses of persons afflicted with waterborne diseases. According to the Provincial Health Officer of Capiz, medical expenses for an adult and a child in hospital are ₱900 and ₱450 respectively, which include hospitalization, medicine and doctor's fee. However, most of afflicted persons, who are not cured in hospital might spend less than those amounts. Therefore it is assumed that the medical expenses is ₱450 per person on an average. Based on this assumption, the total medical expenses incurred due to waterborne diseases were derived by multiplying ₱450 by the number of people afflicted with such diseases.

Another factor to be taken into account is that waterborne diseases are caused not only by a poor water supply system but also due to poor personal hygiene or lack of sewerage facilities. Thus, 40% of the total calculated loss was taken as health benefit directly resulting from poor water supply system. As estimated in Table VIII.3-7, the total health benefit amounts to ₱2.11 million in economic price at 10th year after the improvement work is provided.

(3) Reduction in fire damage

The proposed water supply improvement will result in reliable supply of water for domestic as well as for firefighting purposes. Therefore a reduction in fire damage is expected in the service area. In Roxas city, the average market values of residential building and non-residential building are assumed to be ₱25,800 and ₱228,000 respectively. The number of buildings was counted from the 1/10,000 map prepared in 1984. The number of buildings is assumed to increase at a rate of 2% annually. Average annual fire damage is recorded to be 0.75% of the total value of buildings.

The net reduction in fire damage is then assumed to be 23% taking into account the based on the limited coverage of existing fire hydrant facilities. As summarized in Table VIII.3-8, fire protection benefits amounts to ₱0.54 million at the 10th year.

(4) Beneficial value of water

This benefit called "Consumer satisfaction" is quantified by additional revenue accrued from improvement of water supply. It is recognized that water consumers are really willing to pay more than what they are actually being charged, if water is always supplied in sufficient quantities and potable condition.

This additional value has been estimated to be equal to 50% of the existing water rate for domestic water use and 25% for other water use. Based on the present water rate illustrated in Figure VIII.3-15, the rates per m^3 of water are adjusted upwards to ₱4.50/m^3 for domestic water and ₱6.50/m^3 for others respectively. As shown in Table VIII.3-9, the total beneficial value of water for new connections amounts to ₱37.0 million at 10th year after improvement of water supply condition.

Furthermore, present water consumers already connected to the ROX-WD system are also willing to pay more, once the system is improved. Based on the same estimation as made above, incremental unit values are ₱1.50/m^3 for domestic water and ₱2.20/m^3 for others respectively. Since present annual water consumption is 348,000 m^3 for domestic use and 131,000 m^3 for other use, the beneficial value of water accrued from present connections amounts to ₱8.91 million in economic price at the 10th year after the improvement.

(5) Irrigation

The intake, which is constructed on the main Panay at about 1 km upstream from the diversion point, works not only for water supply system but also for downstream irrigation area. A half of irrigated field in Lower Panay area is not operated during the third crop season because of saline water intrusion. The increment of water by the intake prevents the saline water intrusion and makes it possible to operate irrigation area in the Lower Panay area. The total area of additional irrigated field is estimated at 400 ha. This additional production of crop is expected to be ₱2,087 thousand in 1984, which is a product of additional irrigated field (400 ha) and net income (₱5,217/ha). Furthermore taking the future increment of crop yield and price of product into consideration, the production is estimated at ₱3,769 thousand in the year 1995 at 1984 constant prices. The increasing rate such us crop yield in the future refers to Appendix III, "Flood Damage Study".

3.7.3 Economic Costs

(1) Project costs

The project cost of the improvement plan at economic price amount to ₱30.9 million, by using a conversion factor of 0.82 for local currency portion.

(2) New connection and replacement costs

After the completion of the proposed water supply facilities, the water district gets new customers in the service area. Over the next 10 years, incremental service population arrives to 16,830. Since each new connection costs ₱265 per capita, total new connection costs for 10 years amount to ₱4.46 million. Meters will have to be replaced every 15 years. Streams of new connection and replacement costs are shown in Tables VIII.3-10 to VIII.3-12.

(3) Salvage value (Residual value)

The calculated salvage value is based on the residual service life of the proposed water supply facilities and new connection equipment at the end of the evaluation. The salvage value amounts to ₱28.1 million.

(4) Operating and maintenance costs

Operating and maintenance costs include personnel, power chemicals and other maintenance costs of the proposed plan (i.e. excluding those of the existing facilities). The costs are shown in Tables VIII.3-10 to VIII.3-12.

3.7.4 Evaluation

As a result of this economic evaluation, it is clarified that the net present value and B/C of the improvement work under the condition of a discount rate of 8% are ₱33.3 million and 1.49 respectively. The EIRR would be 16.9% which means that the project should be economically highly efficient.

Economic evaluation was attempted to compare finally the relative merits of three alternative plans. The results of evaluation are detailed in Tables VIII.3-10 to VIII.3-12 and summarized below.

Alternative Plan	Const. Cost (₱ x 10^6)	Present Value/1 (₱ x 10^6)			B/C	EIRR (%)
		Cost	Benefit	B - C		
Alternative 1	83.3	96.6	100.5	3.9	1.04	8.7
Alternative 2	46.7	69.1	79.2	10.1	1.15	10.8
Alternative 3	52.7	67.3	100.5	33.2	1.49	16.9

Note: /1 Discount rate assumed: 8% p.a.

The above indicates that Alternative 3 is the economically most viable plan, where the EIRR is assessed as 16.9%. Thus, this Study recommends implementation of the improvement work of ROX-WD system according to the plan and designs proposed in Alternative 3.

3.8 Financial Evaluation of Improvement Work of ROX-WD

3.8.1 Preconditions of Financial Analysis

In order to assess the project feasibility from a financial viewpoint, financial analysis should be made on the basis of cash flow for the whole of water supply project. However, the recommended water supply project concerned only the works between the water source and pumping facilities. Additionally, the limited financial data are obtained, that is, no statement of accounts of ROX-WD could be obtained from the offices concerned. Therefore, the financial appraisal of the Alternative-3 of the ROX-WD improvement plans is made by recommending water rate estimated for incremental costs and benefits under assumed loan conditions as stated later.

In the financial analysis, the following criteria and assumptions were adopted:

(a) Evaluation horizon is to be 50 years after the completion of the improvement works. Depreciation period is to be 50 years for intake facilities, concrete structures and pipe line and 25 years for gate and pump facilities.

(b) Initial investment cost used for the analysis is to be disbursed in one year. Replacement cost is to be also disbursed in one year after expiration of the depreciation period.

(c) The costs of existing water supply facilities are not to be included in the analysis. They are considered as "sunk cost".

(d) Annual costs are to comprize depreciation cost of investment, stock cost for replacement, interest to the investment, and operation/maintenance cost.

(e) Water revenue is to be estimated on the basis of salable water supplied by the newly improved facilities. The salable water which can contribute to the revenue is to be derived from 60 % of the total water supply by the improved facilities in consideration of water leakage in the distribution system.

(f) Water demand is to be increased annually until 1995 in accordance with the projected water demand after completion of the project.

3.8.2 Loan Condition

Since loan conditions of the project can not be settled at this moment, it is tentatively assumed to be the following three cases.

(a) Case 1: Grant

Both the foreign and local currency portions of the initial investment cost would be financed by a grant base. The replacement cost disbursed after expiration of the depreciation period is prepared under the stock condition of an annual interest rate of 8 %.

(b) Case 2: OECF

The lcoal currency portion of the initial investment cost would be financed by a grant base and the foreign currency portion of the initial investment and the replacement cost would be financed by foreign funds under the loan conditions of an annual interest rate of 3.5% and a repayment period of 30 years including 7 years grace period.

(c) Case 3: ADB

Funds would be financed as same as Case 2 under the loan conditions of an annual interest rate of 10.25 % and a repayment period of 25 years including 5 years grace period. Moreover, commitment charge would be required as an annual interest rate of 0.25 % for the initial investment cost.

3.8.3 Results of Analysis

The financial analysis of the above 3 cases are carried out as shown in Table VIII.3-13 to VIII.3-15. The summary of water rate in 3 cases is shown below.

Water Rate

Year* (Period)	Water rate (Peso/m^3)					
	Case 1		Case 2		Case 3	
	A**	B***	A	B	A	B
1 - 5	2.92	2.92	8.64	8.64	14.38	14.38
6 - 10	2.68	2.52	7.35	6.47	11.50	9.51
11 - 15	2.54	2.35	6.41	5.17	9.38	6.61
16 - 20	2.48	2.35	5.92	4.78	8.19	5.45
21 - 25	2.53	2.35	5.56	4.38	7.29	4.29
26 - 30	2.50	2.35	5.38	4.61	6.98	5.66
31 - 35	2.48	2.35	5.26	4.60	6.81	5.87
36 - 40	2.46	2.35	5.16	4.53	6.60	5.31
41 - 45	2.45	2.35	5.06	4.33	6.38	4.74
46 - 50	2.44	2.35	4.96	4.14	6.14	4.17

* Year after starting service

** Water rate average up to the end of each period

*** Water rate average of every 5 years

As seen above, the required water rate is naturally different by the loan conditions and the period taken for the consideration. It is suggested that LWUA on ROX-WD office would conduct the overall financial analysis referring to the analysis shown in this section.

TABLES

FOR

APPENDIX VIII

TABLE VIII.1-1 FUNCTIONING WATERWORKS (LEVEL III) IN THE PROVINCE OF CAPIZ (AS OF THE END OF 1984)

1.	Name of Municipality	Roxas City	Dumarao	Pilar	Dumalag	Ivisan	Sigma
2.	Operating Organization	Roxas City Water District	Dumarao Water District	Pilar Water District	Municipality of Dumalag	Municipality of Ivisan	Municipality of Sigma
3.	Concerned National Agency	LWUA	LWUA	LWUA	MWSS	MWSS	MPWH
4.	Number of Connection	1,377 (Residential) *1 247 (Others)	244	200	254	99	84
5.	Type	Pumping	Gravity	Gravity	Gravity	Gravity	Gravity
6.	Source	River	Spring	Spring	Spring	Spring	River
7.	Capacity (lps)	92.6	3.8	6.0	2.3	5.2	3.0
8.	Flat Rate (₱/mo.)	-	₱25.60	-	₱10.00	₱10.00	-
9.	Meter Charge	(For Residential)					
	a. Minimum Charge (₱/mo.) (Maximum Vol.)	₱35.00 *2 10 m^3	₱12.80 10 m^3	₱15.00 20 m^3	₱8.90 10 m^3	-	₱12.00 5 m^3
	b. Additional Charge (₱/m^3)	₱2.10 (11 m^3) ₱2.70 (21 m^3) ₱2.40 (31 m^3)	₱0.60 (11 m^3) ₱0.80 (21 m^3) ₱1.10 (37 m^3)	₱1.25 (21 m^3)	₱0.40 (11 m^3)	-	₱2.40 (6 m^3)
10.	Remarks	*1: June 1984 *2: Oct. 1984	Meter Deposit ₱350	Meter Deposit ₱50		Flat Rate Only	

TABLE VIII.1-2 PROJECTED PUBLIC WATER REQUIREMENT

(Unit: m^3/day)

Year	Item			Total	Urban	Rural
1990	Population			572,956	87,037	485,919
	Domestic	Level	I	6,554	1,306	5,248
			II	1,088	1,088	0
			III	2,176	2,176	0
	Municipal & Commercial			1,088	1,088	0
	Total			10,906	5,658	5,248
2000	Population			678,924	102,670	576,254
	Domestic	Level	I	8,125	0	8,125
			II	13,092	1,797	11,295
			III	8,470	8,470	0
	Municipal & Commercial			3,850	3,850	0
	Total			33,537	14,117	19,420
2010	Population			758,046	114,637	643,409
	Domestic	Level	I	10,037	0	10,037
			II	14,863	0	14,863
			III	13,756	13,756	0
	Municipal & Commercial			5,732	5,732	0
	Total			44,388	19,488	24,900
2020	Population			824,525	124,690	699,835
	Domestic	Level	I	9,868	0	9,868
			II	18,616	0	18,616
			III	16,210	16,210	0
	Municipal & Commercial			6,235	6,235	0
	Total			50,929	22,445	28,484
2030	Population			886,059	133,998	752,061
	Domestic	Level	I	9,476	0	9,476
			II	22,637	0	22,637
			III	18,760	18,760	0
	Municipal & Commercial			6,700	6,700	0
	Total			57,573	25,460	32,113

Remarks: Per capita water consumption Level I - 30 lpcd, Level II - 70 lpcd, Level III - 100 lpcs (in 1990) Municipal & Commercial - 50 lpcd (Urban population)

TABLE VIII.1-3 PROJECTED PUBLIC WATER REQUIREMENT OF DOMESTIC AND MUNICIPAL USE BY MUNICIPALITY

(Unit: m^3/day)

Municipality	1990	2000	2010	2020	2030
Roxas City	1,408	5,338	8,445	9,726	11,032
Cuartero	111	399	630	726	823
Dao	97	361	571	658	746
Dumalag	108	398	629	724	821
Dumarao	71	357	565	651	738
Ivisan*	156	591	935	1,077	1,227
Jamindan	59	212	334	385	437
Maayon	162	609	963	1,109	1,258
Mambusao	226	840	1,330	1,532	1,737
Panay	122	463	732	843	957
Panitan	101	359	567	653	741
Pontevedra	123	458	724	834	946
Sapian*	134	488	773	890	1,010
Sigma	101	365	577	664	753
Tapaz	86	326	516	594	674
Lemery*	91	365	578	666	756
Bingawan*	108	391	619	713	809
Total:					
All municipalities	3,264	12,320	19,488	22,445	25,460
Panay basin	2,775	10,485	16,583	19,099	21,658

Remarks: * Municipality of Iloilo

TABLE VIII.3-1 WATER CONSUMPTION AS OF 1977

	As of 1977
Domestic Use (Including borrowers use)	999 m^3/day
Commercial Use	147 m^3/day
Industrial Use	26 m^3/day
Sub-total	1,172 m^3/day
Wastage, Leakage and Other Use (Including Government Use and Plant Use)	2,637 m^3/day
Total Production Volume	3,815 m^3/day

TABLE VIII.3-2 WATER CONSUMPTION AS OF 1984

	As of 1984
Domestic Use (Including borrowers use)	963 m^3/day
Commercial Use	195 m^3/day
Industrrial Use	21 m^3/day
Sub-total	1,179 m^3/day
Government Use	155 m^3/day
Other Use (Public use)	330 m^3/day
Wastage, Leakage and Plant Use	1,109 m^3/day
Total Production Volume	2,773 m^3/day

TABLE VIII.3-3 CONSTRUCTION COST OF F/S PLANS

Item	Immediate Improvement Program (1978-1979)		Stage I Phase A (1980-1985)		Stage I Phase B (1986-1990)	
Source Facilities	-		3,915,000	(10,500 m^3/day)	-	
Treatment Facilities	3,255,500	(7,880 m^3/day)	-		1,611,700	(3,940 m^3/day)
Transmission Facilities	-		6,852,200	(₱400 L=8.5 km)	-	
Distribution Facilities	2,136,300	(4.53 km)	3,478,000	(12.6 km)	4,021,600	(8.18 km)
Storage Facilities	-		685,700	(1,000 m^3)	462,000	(600 m^3)
Laboratory Shop	321,600		-		-	
Administrative Facilities	-		456,400		-	
Meter Repair Plumbing Shop	158,400		-		-	
Internal Net Work	-		688,300	(67.5 ha)	608,200	(59.5 ha)
Service Connections	724,200	(916)	1,607,600	(2,201)	1,680,900	(2,013)
Fire Hydrant	-		436,700	(273 ha)	133,200	(102.0 ha)
Miscellaneous	10,500		-		-	
Sub-total	6,606,500		18,119,900		8,517,600	
Contingencies	954,300		2,581,400		1,156,500	
Engineering	715,700		1,919,800		834,200	
Land	60,000		111,000		21,000	
Total Project Cost	8,336,500		22,732,100		10,529,300	

Remarks: 1978 price base US$ 1 = ₱ 7

TABLE VIII.3-4 CONSTRUCTION COST OF ALTERNATIVE-1

(Unit : Thousand Peso)

No.	Item	Amount F/C	Amount L/C	Total
1.	PREPARATORY WORK (7% of Item No.3)	3,533	1,285	4,818
2.	COMPENSATION	-	35	35
3.	MAIN WORK			
3.1	Diversion Weir	24,104	6,660	30,764
3.2	Approach Channel	913	691	1,604
3.3	Sluice Conduit	3,245	1,606	4,851
3.4	Connecting Channel	513	328	841
3.5	Tidal Gate on Lower Panay River	7,097	2,276	9,373
3.6	Tidal Gate on Straems (2 sites)	4,896	1,520	6,416
3.7	Pumping Station (7,450 m^3/day)	6,156	4,104	10,260
3.8	Pipe Line (ø 300, L=1,400 m)	1,142	298	1,440
3.9	Miscellaneous (5% of Item Nos. 3.1 to 3.8)	2,403	874	3,277
	Sub-total of Item No. 3	50,469	18,357	68,826
	Total of Item Nos. 1 to 3	54,002	19,677	73,679
4.	ENGINEERING & ADMINISTRATION (8% of Item Nos. 1 to 3)	4,320	1,574	5,894
5.	PHYSICAL CONTINGENCY (10% of Item Nos. 1 to 3)	5,832	2,125	7,957
	GROUND TOTAL	64,154	23,376	87,530

(Thou. US$ 4,862.78)

TABLE VIII.3-5 CONSTRUCTION COST OF ALTERNATIVE-2

(Unit : Thousand Peso)

No.	Item	Amount F/C	Amount L/C	Total
1.	PREPARATORY WORK (7% of Item No. 3)	372	229	601
2.	COMPENSATION	–	4	4
3.	MAIN WORK			
3.1	Ground Sill	1,479	745	2,224
3.2	Approach Channel	855	596	1,451
3.3	Sluice Conduit	1,391	783	2,174
3.4	Pumping Station (11,650 m^3/day)	8,064	5,382	13,446
3.5	Pipe Line (ø 450, L=10,000 m)	15,298	4,443	19,741
3.6	Miscellaneous (5% of Item Nos. 3.1 to 3.5)	1,354	597	1,951
	Sub-total of item No. 3	28,441	12,546	40,987
	Total of Item Nos. 1 to 3	28,813	12,779	41,592
4.	ENGINEERING & ADMINISTRATION (8% of Item Nos. 1 to 3)	2,305	1,022	3,327
5.	PHYSICAL CONTINGECY (10% of Item Nos 1 to 4)	3,112	1,380	4,492
	GROUND TOTAL	34,230	15,181	49,411

(Thou. US$ 2,745.06)

TABLE VIII.3-6 CONSTRUCTION COST OF ALTERNATIVE-3

(Unit : Thousand Peso)

No.	Item	Amount		Total
		F/C	L/C	
1.	PREPARATORY WORK (7% of Item No. 3)	2,086	992	3,078
2.	COMPENSATION	-	48	48
3.	MAIN WORK			
3.1	Ground sill	1,479	745	2,224
3.2	Approach Channel	974	691	1,665
3.3	Sluice Conduit	3,609	1,823	5,432
3.4	Dredging Basin	488	448	936
3.5	Connecting Channel	852	540	1,392
3.6	Riverbed Excavation	1,683	1,054	2,737
3.7	Tidal Gate on Lower Panay River	7,097	2,276	9,373
3.8	Tidal Gate on Streams (2 sites)	4,896	1,520	6,416
3.9	Pumping Station (7,450 m^3/day)	6,156	4,104	10,260
3.10	Pipe Line (ϕ 300, L= 1,400 m)	1,142	298	1,440
3.11	MISCELLANEOUS (5% of Item Nos. 3.1 to 3.10)	1,419	675	2,094
	Sub-total of Item No.3	29,795	14,174	43,969
	Total of Item Nos. 1 to 3	31,881	15,214	47,095
4.	ENGINEERING & ADMINISTRATION (8% of Item Nos. 1 to 3)	2,550	1,217	3,767
5.	PHYSICAL CONTINGENCY (10% of Item Nos. 1 to 4)	3,443	1,643	5,086
	GROUND TOTAL	37,874	18,074	55,948

(Thou. US$ 3,108.22)

TABLE VIII.3-7 HEALTH BENEFITS

Year	Served Population	Cost of Time Loss due to Illness *1	Economic Loss due to Premature Death *2	Cost of Medical Expense *3	Total Economic Losses due to Illness	Health Benefits (₱ 1,000)
1985	10,000	21,552	200,831	82,575	304,958	122.0
1986	10,500	22,630	210,873	86,704	320,207	128.1
1987	11,200	24,138	224,931	92,484	341,553	136.6
1988	12,100	26,078	243,006	99,916	369,000	147.6
1989	13,150	28,341	264,093	108,586	401,020	160.4
1990	14,380	30,992	288,795	118,743	438,530	175.4
1991	15,900	34,268	319,321	131,294	484,883	194.0
1992	17,500	37,716	351,454	144,506	533,676	213.5
1993	19,700	42,458	395,637	162,672	600,767	240.3
1994	22,500	48,492	451,870	185,793	686,155	274.5
1995	26,430	56,962	530,796	218,245	806,003	322.4
						2,114.8

*1 52.2% (Productive age population rate) x 1835/100,000 (Mobidity Rate) x S.P. x ₱15/day x 15 days

*2 52.2% x 137.7/100,000 (Mortality Rate) x S.P. x ₱27,940

*3 1835/100,000 x S.P. x ₱450

TABLE VIII.3-8 REDUCTION IN FIRE DAMAGE

Year	Number of Building within Fire Protected Area.*1		Value of Building (₱ 1,000)		Total value of Building (₱ 1,000)	0.75% Overall Reduction in Fire Damage (₱ 1,000)	Fire Damage Benefit
	Residential	Non-Residential	Residential *3	Non-Residential *4			
1985	589	69	12,958	12,834	25,792	193.4	44.4
1986	600	71	13,200	13,206	26,406	198.0	45.5
1987	612	72	13,464	13,392	26,856	201.4	46.3
1988	625	74	13,750	13,764	27,514	206.3	47.4
1989	637	75	14,014	13,950	27,964	209.7	48.2
1990	650	77	14,300	14,322	28,622	214.7	49.3
1991	663	78	14,586	14,508	29,094	218.2	50.1
1992	676	80	14,872	14,880	29,752	223.1	51.3
1993	690	81	15,180	15,066	30,246	226.8	52.1
1994	703	83	15,466	15,438	30,904	231.8	53.3
1995	717	85	15,774	15,810	31,584	236.9	54.4
							542.3

*1 Fire Protected Area is 31 ha within service area of 177 ha. There are 3,294 residential bldgs and 390 non-residential bldgs in the service area in 1984. Annual growth rate of the number of bldgs is assumed to be 2%.
*2 Percentage protection is 23% of overall reduction in fire damage.
*3 ₱22,000/unit
*4 ₱186,000/unit

TABLE VIII.3-9 BENEFICIAL VALUES OF WATER

Year	Incremental Served Population	Incremental Accounted-for-Water(m^3/a)		Water Revenues (₱1.000)		Beneficial Value of Water (₱1,000)	
		Domestic *1	Others *2	Domestic *3	Others *4	Future (₱1.000)	Present (₱1.000)
1985	400	14,600	26,800	65.7	174.2	239.9	810.2
1986	900	32,900	59,800	148.1	388.7	536.8	810.2
1987	1,600	58,400	100,800	262.8	655.2	918.0	810.2
1988	2,500	91,300	150,800	410.9	980.2	1,391.1	810.2
1989	3,550	129,600	210,800	583.2	1,370.2	1,953.4	810.2
1990	4,780	174,500	282,900	785.3	1,838.9	2,624.2	810.2
1991	6,300	230,000	370,900	1,035.0	2,410.9	3,445.9	810.2
1992	7,900	288,400	477,900	1,297.8	3,106.4	4,404.2	810.2
1993	10,100	368,700	606,900	1,659.2	3,944.9	5,604.1	810.2
1994	12,900	470,900	758,900	2,119.1	4,932.9	7,052.0	810.2
1995	16,830	614,300	940,000	2,764.4	6,110.0	8,874.4	810.2
						37,044.0	8,912.2

*1 : 100 lpcd = 36.5 m^3pca *2 : Interporated *3 : ₱4.50/m^3 *4 : ₱6.50/m^3

TABLE VIII.3-10 ECONOMIC ANALYSIS OF ALTERNATIVE-1

(Unit : Thousand Peso)

No.	Construction Cost	Connection & Replacement Cost	O & M Cost	TOTAL COST	Land Value Benefit & Salvage V.	Health Benefit	Fire Damage Benefit	Beneficial Value of Water Future	Beneficial Value of Water Present	Irrigation Benefit	TOTAL BENEFIT
1	83,294	86	-	83,380	-	-	-	-	-	-	-
2	-	196	909	1,105	27,460	122	44	240	810	2,326	31,002
3	-	348	941	1,289	-	128	46	537	810	2,593	4,114
4	-	544	972	1,516	-	137	46	918	810	2,891	4,802
5	-	772	1,002	1,774	-	148	47	1,391	810	3,222	5,618
6	-	1,039	1,033	2,072	-	160	48	1,953	810	3,592	6,563
7	-	1,369	1,064	2,433	-	175	49	2,624	810	3,618	7,276
8	-	1,717	1,155	2,872	-	194	50	3,446	810	3,645	8,145
9	-	2,195	1,246	3,441	-	214	51	4,404	810	3,672	9,151
10	-	2,803	1,336	4,139	-	240	52	5,604	810	3,699	10,405
11	-	3,657	1,427	5,084	-	275	53	7,052	810	3,726	11,916
12	-	-	1,517	1,517	-	322	54	8,874	810	3,769	13,829
13	-	-	1,517	1,517	-	322	54	8,874	810	-	10,060
14	-	-	1,517	1,517	-	322	54	8,874	810	-	10,060
15	-	-	1,517	1,517	-	322	54	8,874	810	-	10,060
16	-	86	1,517	1,603	-	322	54	8,874	810	-	10,060
17	-	196	1,517	1,713	-	322	54	8,874	810	-	10,060
18	-	348	1,517	1,865	-	322	54	8,874	810	-	10,060
19	-	544	1,517	2,061	-	322	54	8,874	810	-	10,060
20	-	772	1,517	2,289	-	322	54	8,874	810	-	10,060
21	-	1,039	1,517	2,556	28,125	322	54	8,874	810	-	38,185
Total	83,294	17,711	26,255	127,260	55,585	5,013	1,026	116,909	16,200	36,753	231,486

(Unit : Thousand Peso)

Discount Rate (%)	Present Worth Cost	Present Worth Benefit	B-C	B/C
0.0	127,260	231,486	104,226	1.82
2.0	116,786	182,295	65,509	1.56
4.0	108,573	146,609	38,035	1.35
6.0	101,996	120,278	18,282	1.18
8.0	96,621	100,523	3,902	1.04
10.0	92,145	85,455	-6,690	0.93
12.0	88,351	73,775	-14,576	0.84
14.0	85,085	64,580	-20,505	0.76
16.0	82,231	57,231	-25,000	0.70
18.0	79,705	51,272	-28,433	0.64
20.0	77,443	46,375	-31,069	0.60
22.0	75,398	42,297	-33,101	0.56

(Unit : Thousand Peso)

Discount Rate (%)	Present Worth Cost	Present Worth Benefit	B/C	B-C
8.40	95,662	97,183	1.02	1,521
8.45	95,544	96,778	1.01	1,234
8.50	95,427	96,375	1.01	948
8.55	95,311	95,976	1.01	665
8.60	95,195	95,579	1.00	384
8.65	95,079	95,184	1.00	105 ***
8.70	94,965	94,792	1.00	-173
8.75	94,850	94,403	1.00	-447
8.80	94,736	94,017	0.99	-719
8.85	94,623	93,632	0.99	-991
8.90	94,510	93,251	0.99	-1,259
8.95	94,398	92,872	0.98	-1,526

TABLE VIII.3-11 ECONOMIC ANALYSIS OF ALTERNATIVE-2

(Unit : Thousand Peso)

No.	Construction Cost	Connection & Replacement Cost	O & M Cost	TOTAL COST	Land Value Benefit & Salvage V.	Health Benefit	Fire Damage Benefit	Beneficial Value of Water Future	Beneficial Value of Water Present	Irrigation Benefit	TOTAL BENEFIT
1	46,675	86	-	46,761	-	-	-	-	-	-	0
2	-	196	1,334	1,530	27,460	122	44	240	810	-	28,676
3	-	348	1,393	1,741	-	128	46	537	810	-	1,521
4	-	544	1,412	1,956	-	137	46	918	810	-	1,911
5	-	772	1,512	2,284	-	148	47	1,391	810	-	2,396
6	-	1,039	1,572	2,611	-	160	48	1,953	810	-	2,971
7	-	1,369	1,631	3,000	-	175	49	2,624	810	-	3,658
8	-	1,717	1,804	3,521	-	194	50	3,446	810	-	4,500
9	-	2,195	1,978	4,173	-	214	51	4,404	810	-	5,479
10	-	2,803	2,151	4,954	-	240	42	5,604	810	-	6,706
11	-	3,657	2,325	5,982	-	275	53	7,052	810	-	8,190
12	-	-	2,498	2,498	-	322	54	8,874	810	-	10,060
13	-	-	2,498	2,498	-	322	54	8,874	810	-	10,060
14	-	-	2,498	2,498	-	322	54	8,874	810	-	10,060
15	-	-	2,498	2,498	-	322	54	8,874	810	-	10,060
16	-	86	2,498	2,584	-	322	54	8,874	810	-	10,060
17	-	196	2,498	2,694	-	322	54	8,874	810	-	10,060
18	-	348	2,498	2,846	-	322	54	8,874	810	-	10,060
19	-	544	2,498	3,042	-	322	54	8,874	810	-	10,060
20	-	772	2,498	3,270	-	322	54	8,874	810	-	10,060
21	-	1,039	2,498	3,537	28,125	322	54	8,874	810	-	38,185
Total	46,675	17,711	42,092	106,478	55,585	5,013	1,026	116,909	16,200	-	194,733

(Unit : Thousand Peso)

Discount Rate (%)	Present Worth Cost	Present Worth Benefit	B-C	B/C
0.0	106,478	194,733	88,255	1.83
2.0	93,204	150,501	57,296	1.61
4.0	83,101	118,929	35,828	1.43
6.0	75,266	96,033	20,767	1.28
8.0	69,081	79,163	10,082	1.15
10.0	64,113	66,534	2,421	1.04
12.0	60,055	56,927	-3,128	0.95
14.0	56,688	49,504	-7,185	0.87
16.0	53,853	43,677	-10,176	0.81
18.0	51,432	39,033	-12,400	0.76
20.0	49,339	35,276	-14,063	0.71
22.0	47,507	32,193	-15,314	0.68

(Unit : Thousand Peso)

Discount Rate (%)	Present Worth Cost	Present Worth Benefit	B/C	B-C
10.40	63,237	64,402	1.02	1,165
10.45	63,129	64,144	1.02	1,015
10.50	63,023	63,887	1.01	864
10.55	62,917	63,632	1.01	715
10.60	62,811	63,379	1.01	568
10.65	62,706	63,127	1.01	421
10.70	62,602	62,877	1.00	275
10.75	62,498	62,629	1.00	131
10.80	62,394	62,383	1.00	-11 ***
10.85	62,291	62,138	1.00	-153
10.90	62,189	61,894	1.00	-295
10.95	62,087	61,653	0.99	-434

TABLE VIII.3-12 ECONOMIC ANALYSIS OF ALTERNATIVE-3

(Unit : Thousand Peso)

No.	Construction Cost	Connection & Replacement Cost	O & M Cost	TOTAL COST	Land Value Benefit & Salvage V.	Health Benefit	Fire Damage Benefit	Beneficial Value of Water Future	Beneficial Value of Water Present	Irrigation Benefit	TOTAL BENEFIT
1	52,655	86	-	52,741	-	-	-	-	-	-	0
2	-	196	800	996	27,460	122	44	240	810	2,326	31,002
3	-	348	831	1,179	-	128	46	537	810	2,593	4,114
4	-	544	848	1,392	-	137	46	918	810	2,891	4,802
5	-	772	910	1,682	-	148	47	1,391	810	3,222	5,618
6	-	1,039	925	1,964	-	160	48	1,953	810	3,592	6,563
7	-	1,369	955	2,324	-	175	49	2,624	810	3,618	7,276
8	-	1,717	1,046	2,763	-	194	50	3,446	810	3,645	8,145
9	-	2,195	1,137	3,332	-	214	51	4,404	810	3,672	9,151
10	-	2,803	1,227	4,030	-	240	52	5,604	810	3,699	10,405
11	-	3,657	1,317	4,974	-	275	53	7,052	810	3,726	11,916
12	-	-	1,408	1,408	-	322	54	8,874	810	3,769	13,829
13	-	-	1,408	1,408	-	322	54	8,874	810	-	10,060
14	-	-	1,408	1,408	-	322	54	8,874	810	-	10,060
15	-	-	1,408	1,408	-	322	54	8,874	810	-	10,060
16	-	86	1,408	1,494	-	322	54	8,874	810	-	10,060
17	-	196	1,408	1,604	-	322	54	8,874	810	-	10,060
18	-	348	1,408	1,756	-	322	54	8,874	810	-	10,060
19	-	544	1,408	1,952	-	322	54	8,874	810	-	10,060
20	-	772	1,408	2,180	-	322	54	8,874	810	-	10,060
21	-	1,039	1,408	2,447	28,125	322	54	8,874	810	-	38,185
Total	52,655	17,711	24,076	94,442	55,585	5,013	1,026	116,909	16,200	36,753	231,486

(Unit : Thousand Peso)

Discount Rate (%)	Present Worth Cost	Present Worth Benefit	B-C	B/C
0.0	94,442	231,486	137,044	2.45
2.0	85,001	182,295	97,294	2.14
4.0	77,689	146,609	68,920	1.89
6.0	71,912	120,278	48,366	1.67
8.0	67,260	100,523	33,262	1.49
10.0	63,447	85,455	22,007	1.35
12.0	60,268	73,775	13,507	1.22
14.0	57,575	64,580	7,005	1.12
16.0	55,260	57,231	1,971	1.04
18.0	53,244	51,272	-1,972	0.96
20.0	51,468	46,375	-5,093	0.90
22.0	49,885	42,297	-7,588	0.85

(Unit : Thousand Peso)

Discount Rate (%)	Present Worth Cost	Present Worth Benefit	B/C	B-C
16.60	54,627	55,314	1.01	687
16.65	54,576	55,160	1.01	584
16.70	54,524	55,006	1.01	482
16.75	54,473	54,853	1.01	380
16.80	54,422	54,701	1.01	279
16.85	54,371	54,550	1.00	179
16.90	54,320	54,399	1.00	79
16.95	54,269	54,250	1.00	-19 ***
17.00	54,219	54,101	1.00	-118
17.05	54,169	53,952	1.00	-217
17.10	54,119	53,805	0.99	-314
17.15	54,069	53,658	0.99	-411

Table VIII.3-13 Financial Viability Analysis of Alternative-3, Case 1 (1)

(Unit: Thousand Peso)

Year in Order	Investment & Replacement (1)	Stock for Replacement/1 (2)	Interest (3)	Operation & Mentenance (4)	Total/2 Cost (5)	Sold Water (M3/Day) (6)	Water Rate Average Up To N-Year/3 (7)	(Peso/M3) 5-Year Average/4 (8)
1	55948	-	-	-	-	-	-	-
2	-	254	-	976	1230	1087	3.10	-
3	-	254	-	1014	1268	1157	3.05	-
4	-	254	-	1034	1288	1227	2.99	-
5	-	254	-	1110	1364	1298	2.96	-
6	-	254	-	1128	1382	1368	2.92	2.92
7	-	254	-	1165	1419	1438	2.88	-
8	-	254	-	1276	1530	1609	2.83	-
9	-	254	-	1386	1640	1780	2.78	-
10	-	254	-	1496	1750	1950	2.73	-
11	-	254	-	1607	1861	2121	2.68	2.52
12	-	254	-	1717	1971	2296	2.64	-
13	-	254	-	1717	1971	2296	2.61	-
14	-	254	-	1717	1971	2296	2.58	-
15	-	254	-	1717	1971	2296	2.56	-
16	-	254	-	1717	1971	2296	2.54	2.35
17	-	254	-	1717	1971	2296	2.53	-
18	-	254	-	1717	1971	2296	2.51	-
19	-	254	-	1717	1971	2296	2.50	-
20	-	254	-	1717	1971	2296	2.49	-
21	-	254	-	1717	1971	2296	2.48	2.35
22	-	254	-	1717	1971	2296	2.48	-
23	-	254	-	1717	1971	2296	2.56	-
24	-	254	-	1717	1971	2296	2.55	-
25	-	254	-	1717	1971	2296	2.54	-
26	-	254	-	1717	1971	2296	2.53	2.35
27	18596	254	-	1717	1971	2296	2.53	-
28	-	254	-	1717	1971	2296	2.52	-
29	-	254	-	1717	1971	2296	2.51	-
30	-	254	-	1717	1971	2296	2.51	-

(to be continued)

Table VIII.3-13 Financial Viability Analysis of Alternative-3, Case 1 (2)

(Unit: Thousand Peso)

Year in Order	Investment & Replacement (1)	Stock for Replacement /1 (2)	Interest (3)	Operation & Mentenance (4)	Total /2 Cost (5)	Sold Water (M3/Day) (6)	Water Rate Average Up To N-Year /3 (7)	(Peso/M3) 5-Year Average /4 (8)
31	-	254	-	1717	1971	2296	2.50	2.35
32	-	254	-	1717	1971	2296	2.49	-
33	-	254	-	1717	1971	2296	2.49	-
34	-	254	-	1717	1971	2296	2.48	-
35	-	254	-	1717	1971	2296	2.48	-
36	-	254	-	1717	1971	2296	2.48	2.35
37	-	254	-	1717	1971	2296	2.47	-
38	-	254	-	1717	1971	2296	2.47	-
39	-	254	-	1717	1971	2296	2.47	-
40	-	254	-	1717	1971	2296	2.46	-
41	-	254	-	1717	1971	2296	2.46	2.35
42	-	254	-	1717	1971	2296	2.46	-
43	-	254	-	1717	1971	2296	2.45	-
44	-	254	-	1717	1971	2296	2.45	-
45	-	254	-	1717	1971	2296	2.45	-
46	-	254	-	1717	1971	2296	2.45	2.35
47	-	254	-	1717	1971	2296	2.44	-
48	-	254	-	1717	1971	2296	2.44	-
49	-	254	-	1717	1971	2296	2.44	-
50	-	254	-	1717	1971	2296	2.44	-
51	-	254	-	1717	1971	2296	2.44	2.35

Remarks:
/1: Stock for replacement is calculated as 18,596/73.11.
(Accumulated figure for 25 years at 8.0% interest rate)

/2: (2) + (4)

/3: ((5)*1000) / ((6)*365) for N-year

/4: ((5)*1000) / ((6)*365) for each 5-year

Table VIII.3-14 Financial Viability Analysis of Alternative-3, Case 2 (1)

(Unit: Thousand Peso)

Year in Order	Investment & Replacement (1)	Depreciation/1 (2)	Interest/2 (3.5 %) (3)	Operation & Mentenance (4)	Total/3 Cost (5)	Sold Water (M3/Day) (6)	Water Rate Average Up To N-Year/4 (7)	(Peso/M3) 5-Year Average/5 (8)
1	55948	-	-	-	-	-	-	-
2	-	1491	1326	976	3793	1087	9.56	-
3	-	1491	1326	1014	3831	1157	9.31	-
4	-	1491	1326	1034	3851	1227	9.06	-
5	-	1491	1326	1110	3927	1298	8.85	-
6	-	1491	1326	1128	3945	1368	8.64	8.64
7	-	1491	1326	1165	3982	1438	8.44	-
8	-	1491	1326	1276	4093	1609	8.18	-
9	-	1491	1326	1386	4203	1780	7.90	-
10	-	1491	1326	1496	4313	1950	7.62	-
11	-	1491	1326	1607	4424	2121	7.35	6.47
12	-	1491	1259	1717	4467	2296	7.09	-
13	-	1491	1193	1717	4401	2296	6.87	-
14	-	1491	1127	1717	4335	2296	6.69	-
15	-	1491	1060	1717	4268	2296	6.54	-
16	-	1491	994	1717	4202	2296	6.41	5.17
17	-	1491	928	1717	4136	2296	6.29	-
18	-	1491	862	1717	4070	2296	6.19	-
19	-	1491	795	1717	4003	2296	6.09	-
20	-	1491	729	1717	3937	2296	6.00	-
21	-	1491	663	1717	3871	2296	5.92	4.78
22	-	1491	597	1717	3805	2296	5.84	-
23	-	1491	530	1717	3738	2296	5.76	-
24	-	1491	464	1717	3672	2296	5.69	-
25	-	1491	398	1717	3606	2296	5.63	-
26	-	1491	331	1717	3539	2296	5.56	4.38
27	18596	1491	265	1717	3473	2296	5.50	-
28	-	1491	850	1717	4058	2296	5.47	-
29	-	1491	783	1717	3991	2296	5.44	-
30	-	1491	717	1717	3925	2296	5.41	-

(to be continued)

Table VIII.3-14 Financial Viability Analysis of Alternative-3, Case 2 (2)

(Unit: Thousand Peso)

Year in Order	Investment & Replacement (1)	Depreciation/1 (2)	Interest/2 (3.5 %) (3)	Operation & Mentenance (4)	Total/3 Cost (5)	Sold Water (M3/Day) (6)	Water Rate Average Up To N-Year/4 (7)	(Peso/M3) 5-Year Average/5 (8)
31	-	1491	651	1717	3859	2296	5.38	4.61
32	-	1491	651	1717	3859	2296	5.35	-
33	-	1491	651	1717	3859	2296	5.33	-
34	-	1491	651	1717	3859	2296	5.30	-
35	-	1491	651	1717	3859	2296	5.28	-
36	-	1491	651	1717	3859	2296	5.26	4.60
37	-	1491	651	1717	3859	2296	5.24	-
38	-	1491	618	1717	3826	2296	5.22	-
39	-	1491	586	1717	3794	2296	5.20	-
40	-	1491	553	1717	3761	2296	5.18	-
41	-	1491	521	1717	3729	2296	5.16	4.53
42	-	1491	488	1717	3696	2296	5.14	-
43	-	1491	456	1717	3664	2296	5.12	-
44	-	1491	423	1717	3631	2296	5.10	-
45	-	1491	391	1717	3599	2296	5.08	-
46	-	1491	358	1717	3566	2296	5.06	4.33
47	-	1491	325	1717	3533	2296	5.04	-
48	-	1491	293	1717	3501	2296	5.02	-
49	-	1491	260	1717	3468	2296	5.00	-
50	-	1491	228	1717	3436	2296	4.98	-
51	-	1491	195	1717	3403	2296	4.96	4.14

Remarks: Annual Interest Rate: 3.5 %
Repayment Period : 30 years including 10 years grace period.

/1: Depreciation: 50 years for civil work, pipe line, etc.
25 years for gate and pump facilities

/2: Interest is calculated for foreign currency portion of investment & replacement costs of previous year and investment & replacement costs are assumed to be repaid for 20 years after 10 years grace period.

/3: (2) + (3) + (4)

/4: ((5)*1000) / ((6)*365) for N-year

/5: ((5)*1000) / ((6)*365) for each 5-year

Table VIII.3-15 Financial Viability Analysis of Alternative-3, Case 3 (1)

(Unit: Thousand Peso)

Year in Order	Investment & Replacement (1)	Depreciation/1 (2)	Interest/2 (10.25 %) (3)	Operation & Mentenance (4)	Total/3 Cost (5)	Sold Water (M3/Day) (6)	Water Rate Average Up To N-Year/4 (7)	(Peso/M3) 5-Year Average/5 (8)
1	55948	-	95	-	95	-	-	-
2	-	1491	3882	976	6349	1087	16.24	-
3	-	1491	3882	1014	6387	1157	15.67	-
4	-	1491	3882	1034	6407	1227	15.18	-
5	-	1491	3882	1110	6483	1298	14.78	-
6	-	1491	3882	1128	6501	1368	14.38	14.38
7	-	1491	3688	1165	6344	1438	13.95	-
8	-	1491	3494	1276	6261	1609	13.37	-
9	-	1491	3300	1386	6177	1780	12.75	-
10	-	1491	3106	1496	6093	1950	12.11	-
11	-	1491	2912	1607	6010	2121	11.50	9.51
12	-	1491	2717	1717	5925	2296	10.91	-
13	-	1491	2523	1717	5731	2296	10.44	-
14	-	1491	2329	1717	5537	2296	10.04	-
15	-	1491	2135	1717	5343	2296	9.69	-
16	-	1491	1941	1717	5149	2296	9.38	6.61
17	-	1491	1747	1717	4955	2296	9.10	-
18	-	1491	1553	1717	4761	2296	8.85	-
19	-	1491	1359	1717	4567	2296	8.62	-
20	-	1491	1165	1717	4373	2296	8.40	-
21	-	1491	971	1717	4179	2296	8.19	5.45
22	-	1491	776	1717	3984	2296	8.00	-
23	-	1491	582	1717	3790	2296	7.81	-
24	-	1491	388	1717	3596	2296	7.63	-
25	-	1491	194	1717	3402	2296	7.46	-
26	-	1491	-	1717	3208	2296	7.29	4.29
27	18596	1491	46	1717	3254	2296	7.14	-
28	-	1491	1906	1717	5114	2296	7.09	-
29	-	1491	1906	1717	5114	2296	7.05	-
30	-	1491	1906	1717	5114	2296	7.02	-

(to be continued)

Table VIII.3-15 Financial Viability Analysis of Alternative-3, Case 3 (2)

(Unit: Thousand Peso)

Year in Order	Investment & Replacement (1)	Depreciation/1 (2)	Interest/2 (10.25 %) (3)	Operation & Mentenance (4)	Total/3 Cost (5)	Sold Water (M3/Day) (6)	Water Rate Average Up To N-Year/4 (7)	(Peso/M3) 5-Year Average/5 (8)
31	-	1491	1906	1717	5114	2296	6.98	5.66
32	-	1491	1906	1717	5114	2296	6.95	-
33	-	1491	1811	1717	5019	2296	6.92	-
34	-	1491	1715	1717	4923	2296	6.88	-
35	-	1491	1620	1717	4828	2296	6.84	-
36	-	1491	1525	1717	4733	2296	6.81	5.87
37	-	1491	1430	1717	4638	2296	6.77	-
38	-	1491	1334	1717	4542	2296	6.73	-
39	-	1491	1239	1717	4447	2296	6.69	-
40	-	1491	1144	1717	4352	2296	6.64	-
41	-	1491	1048	1717	4256	2296	6.60	5.31
42	-	1491	953	1717	4161	2296	6.56	-
43	-	1491	858	1717	4066	2296	6.51	-
44	-	1491	762	1717	3970	2296	6.47	-
45	-	1491	667	1717	3875	2296	6.42	-
46	-	1491	572	1717	3780	2296	6.38	4.74
47	-	1491	477	1717	3685	2296	6.33	-
48	-	1491	381	1717	3589	2296	6.28	-
49	-	1491	286	1717	3494	2296	6.24	-
50	-	1491	191	1717	3399	2296	6.19	-
51	-	1491	95	1717	3303	2296	6.14	4.17

Remarks: Annual Interest RAte: 10.25 %
Commitment Charge : 0.25 %
Repayment Period : 25 years including 5 years grace period.

/1: Depreciation: 50 years for civil work, pipe line, etc.
25 years for gate and pump facilities

/2: Interest is calculated for foreign currency portion of investment & replacement cost of previous year and investment & replacement costs are assumed to be repaid for 20 years after 5 years grace period.

/3: (2) + (3) + (4)

/4: ((5)*1000 / ((6)*365) for N-year

/5: ((5)*1000 / ((6)*365) for each 5-year