POTABLE WATER SUPPLY EXPANSION

THE MANILA SOUTH WATER DISTRIBUTION PROJECT

by

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Prepared for:

Economics and Development Resource Center

Asian Development Bank

1995

Acknowledgments

I am grateful to George Whitlam and Jess Zarandin of the Asian Development Bank for all their help in making this case study possible. Their comments and suggestions have proved very valuable. The assistance of Baher El-Hifnawi and Pastor Lorenzo Jr. on the completion of this report are greatly appreciated. The authors also like to thank the Asian Development Bank for providing the data and information used in the study.

Overview

Inadequate clean water supply and sanitation services have created a high incidence of gastroenteritis[1] and other related health problems in the Philippines. In 1990, only about 65 per cent of the country's urban population had access to potable water, and 80 per cent to sanitary latrines. In the southern region of metropolitan Manila, the water supply problem is especially acute, with only 30 per cent of the region's households having access to piped water in 1990. And, even these households frequently face water shortages and cut-offs due to an inadequate supply and distribution system. The other 70 per cent of the households obtain their water from water vendors and private wells. Neither of these sources provides a desirable alternative to piped water service. The water from both of these sources is often of poor quality, while that of the vendors can also be quite expensive. Furthermore, the heavy reliance on well-water depletes the fresh groundwater, causing contamination by saltwater intrusion and reducing the fertility of the region's land.

The Government of the Philippines has placed high priority on the development of water supply and sanitation. In 1987, it established an inter-agency task force which prepared a Water Supply, Sewerage and Sanitation Master Plan for the Philippines 1988-2000. The master plan sets out detailed sector development objectives, policies, strategies and a proposed investment program.

The Metropolitan Waterworks and Sewerage System now seeks to improve water supply to the greatly under-served southern part of the metropolitan area by extending the coverage of its water distribution system in the area. The MWSS proposes to construct new clear water reservoirs and pumping stations, and expand its network of transmission mains, secondary distribution pipes and service connections, with the aim of bringing sufficient quantities of quality potable water to 85% of the region's households. The project's target

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[1] In 1990, the incidence of gastroenteritis in Metro Manila stood at 345 per 100,000 persons. Asian Development Bank (ADB), "Appraisal of the Manila South Water Distribution Project in the Philippines," November 1991, 3.

population is expected to reach 1.6 million by the year 2004. By increasing both the percentage of households with access to piped water and the quantity of water available to each connected household, the MWSS hopes to reduce the incidence of water-related health problems among Manila's inhabitants.

This paper evaluates the water distribution project using an integrated financial-economic-distributive approach. Economic analysis evaluates the true value of the project's outputs and inputs, adjusting the financial values for any distortions such as taxes, subsidies, or foreign exchange premium, which cause financial prices to differ from true resource values. The results of the economic analysis indicate that the project, with a positive economic NPV of 2,878 million pesos, could make a very positive economic contribution to the Philippines. Furthermore, since the appraisal did not include the economic value of preventing groundwater salinization in the region, nor any additional value to society (beyond that represented by the consumer's willingness to pay) of health improvements among the region's residents, the economic NPV generated by the analysis is actually conservative, understating the project's value to the country.

Financial analysis however, based on the proposed structure of the water tariff, indicates that the financial NPV is -10.79 million pesos, hence, the project may not be financially self-sustainable. The financial returns of the water distribution project are much lower than the economic return for two primary reasons. First, the economic benefits of water are much higher than the financial tariff. The large difference between the financial tariff charged by the project (5.135 pesos per cu m) and the value revealed by consumers when buying from water vendors or when operating private wells (38 pesos per cu m of vendor water, and 3.8 to 7.6 pesos per cu m of well water) indicates that, with the project, paying customers receive a large consumer surplus. Also, the piped water distribution project will be able to supply water much more efficiently and, hence, at a lower price, than current sources (water vendors and wells). With the project, the price of water will fall, and the original water suppliers will reduce production. The resources released by this cutback are a benefit to the overall economy.

A second cause of the project's smaller financial returns is that currently about 50% of the total water supplied by the project earns no revenue, and roughly half of this amount is pilfered water or water provided free. With improvements in the distribution system, the amount of water that earns no revenue is expected to drop to 32% of the total water supplied by 2004. Although this water has an economic value to the user and is included as a benefit in the economic appraisal; it is not associated with any cash inflows to the financial cash flow statement.

A risk analysis of the financial cash flow and economic statement provides a more complete evaluation of the water distribution project, since it permits critical variables to be modeled as probability distributions. Sensitivity analysis, which identifies the critical variables, shows that the financial returns are sensitive to six variables: the water tariff rate; the number of new connections; the increase in real wage rate over time; investment cost overruns; the percentage of non-revenue water; and the duration of time between billing periods (accounts receivable). Based on a series of five-hundred trials employing specified ranges for the critical variables, the results of the risk analysis indicate that the probability of the project having a negative financial NPV is about 54%.

In addition to the critical variables identified above, for the risk analysis of the economic statement probability distributions were assigned to the values of economic benefits per cubic meter of water. Four risk variables were used since the economic benefits per cubic meter of water for both paying and non-paying users differ depending on if the water is used for drinking or for washing. The results of the analysis indicate zero probability of the project having a negative economic return.

Distributive analysis reveals that the major beneficiaries of this project would be the consumers of piped water, including: old customers who would have more reliable access to greater quantities of water; new customers; consumers of free water (both authorized users and

pilferers); and customers who are under-billed. All of these consumers are the beneficiaries of economic externalities, gaining consumer surplus since their valuation of the water is higher than the charged rate of tariff. On the other hand, water vendors and well owners lose producer surplus when they reduce their production. Since the well owners' loss in producer surplus will be more than offset by their gain in consumer surplus, this group should be supportive of the project. Water vendors, however, could be a source of opposition to the project since they will be forced out of the market.

Given the robustness of the project's economic returns, plus the additional environmental and public health benefits mentioned above, this appraisal strongly recommends that MWSS undertake the project. As the equity holder in this project is the government, and not a private corporation, the negative financial NPV can be acceptable since the project generates overall positive economic benefits --provided its financial deficits do not create too much of a strain on the government's budget. In this case, however, almost 65% of the investment cost will be financed through loans from the Asian Development Bank and other financial institutions, who may be reluctant to provide project financing if it appears that MWSS will not be able to generate enough revenues to properly maintain the system. And, as the government of the Philippines will be the guarantor of the loans, any failure of MWSS to meet its debt obligations will add to the financial burdens of the central government.

However, the financial difficulties facing the project are not insurmountable. This case provides an interesting illustration of how integrated economic analysis can be used to improve the financial viability of a project. The large consumer surplus enjoyed by the consumers of piped water indicates that most of these consumers would be willing to pay higher tariffs for their water. The sensitivity analysis suggests that a small real tariff rate increase for the life of the project could be imposed without causing major reductions in demand, thus enabling the project to carry out the annual maintenance of the system in a timely and orderly manner with enough resources left to meet its debt obligations.

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WATER SUPPLY EXPANSION:

THE MANILA SOUTH WATER DISTRIBUTION PROJECT

I. Introduction

The water supply and sanitation services in the Philippines are still inadequate. At the end of 1987, only about 65 per cent of the urban population had access to clean water supply, and 80 per cent to hygienic latrines. In rural areas, the corresponding figures were 61 and 62 per cent respectively. The inadequate water supply and water sanitation facilities are largely responsible for the high incidence of gastroenteritis in the country (about 345 per 100,000 persons in Metro Manila in 1990).[2]

The Government of the Philippines has placed high priority on the development of high quality water supply and sanitation facilities. In 1987, it established an inter-agency task force which prepared a Water Supply, Sewerage and Sanitation Master Plan for the Philippines 1988-2000. The master plan sets out detailed sector development objectives, policies, strategies and a proposed investment program.[3]

In the southern part of Metropolitan Manila, one of the most under-served urban regions of the country, only about 30% of the area's population had access to piped water supply in 1990. The rest relied on private shallow and deep wells and water vendors whose water is expensive and occasionally of doubtful quality. The Metropolitan Waterworks and Sewerage System (MWSS), the agency that operates water supply and distribution schemes in the Metropolitan Manila area and the outlying municipalities in Rizal and Cavite provinces,

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[2] Asian Development Bank (ADB), "Appraisal of the Manila South Water Distribution Project in the Philippines," November 1991, 3.

[3] ADB Appraisal Report, i.

has identified south Manila as the region with the greatest need for increased access to potable piped water. This paper evaluates the agency's proposed expansion of the water distribution system in south manila.

II. Project Description

A. Project Objectives and Scope

The primary objective of the project is to improve the water distribution service of MWSS in the South Manila area, increasing distribution coverage from the current 30% of the population to 85% by the year 2004. Without the project, using the current distribution system, MWSS would be able only to supply about 5% to 10% of consumption needs in 2005, (based on MWSS' projections of population growth and increased demand for water). The secondary objective is to regulate the uncontrolled abstraction of groundwater thereby reducing water contamination by saltwater intrusion and preventing land subsidence.[4]

To achieve these objectives, the project will build two clear water reservoirs and three pumping stations, extend the existing central distribution system in the project area and install more service connections. The primary investment will be completed by 1995, but the project will continue making additional investments in service connections through the year 2004. The project's major facilities, particularly transmission mains, will be designed to meet the supply target for 2004[5].

The project has six components:

Part A: Reservoirs and pumping stations - Construction of two clear water reservoirs and three pumping stations;

[4]ADB Appraisal Report, 10.

[5]ADB Appraisal Report, 10 & 11.

Part B: Transmission mains - Construction of about 31 kilometers of transmission mains;

Part C: Distribution reticulation - Construction of about 308 kilometers of secondary and tertiary pipes;

Part D: Service connections - Installation of about 140,000 service connections and about 590 public standpipes;

Part E: Branch office buildings - Construction of three MWSS branch office buildings; and

Part F: Consulting Services - Local consulting services for the detailed design of the reservoirs and the pumping stations, and for the construction supervision of the pumping stations.

B. Project Cost and Financing

The total cost of the project is estimated at 1,369.5 million 1990 Philippine Pesos. Of the total project cost, 614 million Pesos (about 45%) is foreign currency cost and 755 million Pesos (about 55%) is local currency cost.

The investments in the various components of the project are shown in Table 1. The investments for reservoir and pumping stations, transmission mains and the secondary distribution networks will enable MWSS to have adequate capacity to meet service targets in 2004, while the initial investments in the tertiary distribution and service connections will only meet service targets for 1995. After the initial investment is completed in 1995, MWSS is expected to continue expanding the tertiary networks and service connections up to 2004 when the system is expected to reach its maximum capacity. (See Annex 2 and 3 for a yearly breakdown of initial and additional investments.)

The Asian Development Bank and other financial institutions will finance about 63 per cent of the initial investment cost while the MWSS will cover the rest. The loans, which are

Table 1:
Initial Investment Costs
(million 1990 Philippine Pesos)

Item	Local Currency	Foreign Exchange	Total
A. Civil Works			
1. Water Reservoirs and Pumping Stations	73.801	31.619	105.420
2. Transmission Mains	15.742	36.734	52.476
3. Secondary/Tertiary Network	193.595	64.532	258.127
4. Service Connections	55.082	9.720	64.802
Civil Works Total	**338.220**	**142.605**	**480.825**
B. Equipment and Materials			
1. Water Reservoirs and Pumping Stations	7.977	31.915	39.892
2. Transmission Mains	19.491	77.977	97.468
3. Secondary/Tertiary Network	77.438	309.804	387.242
4. Service Connections	12.960	51.884	64.844
Equipment and Materials Total	**117.866**	**471.580**	**589.446**
C. Office Buildings	7.340		7.340
D. Consulting Services	3.300		3.300
E. Land Cost	25.000		25.000
F. In-House Engineering Service	81.400		81.400
G. Taxes and Duties	182.180		182.180
TOTAL INVESTMENT COST	**755.306**	**614.185**	**1,369.491**

Source: ADB Appraisal Report, 12 & 13.

Table 2:
Financing
(million 1990 Philippine Pesos)

	Local Currency	Foreign Exchange	Total
A. ADB Loans	251.52	614.19	865.70
B. MWSS	503.79		503.79
TOTAL	755.31	614.19	1,369.49

Source of basic data: ADB Appraisal Report, 12 & 13.

disbursed in foreign currency, cover all the foreign exchange cost and 33.3% of the domestic currency cost (Table 2). The nominal interest rate charged for the loan is 10.3% which, under the assumption of a 4% rate of foreign inflation, translates into a real interest rate of approximately 6.1%.[6] MWSS will be the borrower of the loan and will assume the foreign exchange risk, while the Government of the Philippines will be the Guarantor of the loan.

III. Projected Water Consumption and Supply in the Project

The project area, located in the southern part of the MWSS service area (MSA), covers four municipalities: Paranaque, Las Pinas, and Muntinlupa (in Rizal province), and Bacoor (in Cavite province). It has a total land area of 178.9 square kilometers (about 12% of the total MSA area) and a population of one million in 1989 (or about 11% of the total MSA population) that is expected to reach 1.6 million in 2004.

[6] The real interest rate = (nominal interest rate - rate of inflation)/(1 + rate of inflation)

With full implementation of the project, including nearly 140,000 new service connections, MWSS hopes that paid water consumption in the project area will increase from 51,325 cubic meters per day in 1992 to 304,539 cubic meters per day in 2004. MWSS estimated the target annual water consumption for the project area until 2004, nine years after the initial investment period, based on the following assumptions: (1) expected population growth in the project area; (2) the increase in the percentage of the population serviced by MWSS from 30% in 1990 to 85% by 2004; (3) its own annual targets for the installation of new service connections and public service pipes; (4) its own targets for the reduction of non-revenue water (NRW);[7] and (5) an increase in private connection users' average daily consumption from 150 liters per capita in 1990 to 220 liters per capita in 1995 and its stability at that level thereafter. MWSS' proposed schedule for new connections, changes in non-revenue water and increased per capita consumption can be found in the Table of Parameters, Annex 1b.

However, the targets set by MWSS appear to be on the optimistic side and should be regarded as a best case scenario. It is unlikely that the installation of all connections will proceed without any delays up till 2004. In addition, as MWSS has addressed the problem of non-revenue water with varying degrees of success and failure, it is not clear that MWSS will be able to meet the new targets. To account for these factors, the authors of this report assumed that MWSS would be able to install 84% of the connections proposed for installation in any given year.[8] This reduction in the number of service connections has the effect of decreasing projected water consumption.

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[7]Non-revenue water (NRW) is defined as water in the distribution system that does not earn revenue because of leakage, theft, measurement errors, and under-billing.

[8] Investment costs and operating costs are reduced to account for the reduced number of connections.

The modified installation schedule for connections and the projections for demand and supply of water are presented in Annex 5a, 5b and 5c. Annex 5a estimates the demand for water during the connection expansion period (1993 -2004). Since during these years demand for water will be greater than the supply of water, it is assumed that all of the water supplied by the project during the expansion period will be consumed. The amount consumed increases every year, depending directly on the number of private connections and standpipes that the project has installed. Anticipating shortfalls in the installation target, the authors of this study have reduced the number of connections realized each year by about 16%. However, water consumption is also constrained by the capacity of AWSOP, the arm of MWSS that is responsible for supplying treated water. (That is, even if MWSS exceeded expectations in installing new connections and distribution lines, it could not sell more water than AWSOP can provide.)

The treated water production capacity for this region is currently larger than its distribution capacity. AWSOP has a production capacity for this area of about 400,000 cubic meters of water a day. However, since roughly half of that water is non-revenue producing, due to leakage, theft, etc., only about 200,000 cubic meters of water (four times the amount of current consumption in the region) is available for sales. In this analysis, we assume that the AWSOP's treated water production capacity will remain constant, while the percentage of non-revenue water will decline. So, the effective amount of water available from AWSOP will increase over the life of the project.

The demand for water from year 2005 to 2024 is presented in Annex 5b. Since the project is designed to supply enough water to meet demand in 2004, this analysis assumes that the supply and demand for water (at the current tariff rate) will be in equilibrium in 2004. Projected consumption of water from this project, during years 2005 to 2024 was assumed to be the same as that of 2004. (Although population growth in the project area after year 2004 will lead to increased demand for water, the additional investment, operating costs, and

benefits of increasing the distribution network still further to more households are regarded as a separate incremental project and not included in this analysis.) Since, in the deterministic case, we assume that the amount of water consumed annually will be constant from 2004 onwards to the end of the project's life, Annex 5b is necessary only for risk and sensitivity analysis (compare line 276 with cell P227). This table allows us to model the effect of price changes on the amount of water that consumers will demand and on the amount of water that original producers will supply. In the equilibrium state, we assume that 25% of the water consumed is substituting for the water that is now of water vendor quality (for drinking or preparing food), while the remaining 75% will be substituting for water that is of well water quality (for household washing, watering gardens, etc.). In Table 3 below, water distribution in selected years is summarized. Note that by the year 2004, about 20% of the water actually used for drinking or washing is consumed free of charge. We have estimated that the demand for water will be fairly inelastic (-.3 for drinking water and -.5 for washing water), while the

Table 3
Water Distribution in Selected Years
(Cubic Meters per Day)

	1993	1996	1999	2002	2004 +
Incremental Water Distributed	26,564	186,657	260,764	291,293	318,020
Percent Non-Revenue Water (NRW)	50%	38%	35%	32%	32%
TOTAL Inc. NRW	13,282	70,930	91,267	93,214	101,766
NRW from leakage (49% of NRW)	6,508	34,756	44,721	45,675	49,866
NRW consumed (51% of NRW)	6,774	36,174	46,546	47,539	51,901
for Drinking	1,693	9,043	11,637	11,885	12,975
for Washing	5,080	27,131	34,909	35,654	38,926
TOTAL Inc. PAID CONSUMPTION	13,282	115,727	169,497	198,079	216,254
for Drinking	3,321	28,932	42,374	49,520	54,064
for Washing	9,961	86,795	127,123	148,559	162,190

elasticity of supply of water vendors and wells will be relatively more elastic (2.00, and 1.00, respectively).

Total consumption demanded is summarized in Annex 5c, and the incremental demand is compared to the available supply of treated water from AWSOP. Again, this comparison is important for risk and sensitivity analysis, since in the deterministic case, the amount of incremental water demanded is always less than the available treated water supply (after leakage and theft). At the bottom of Annex 5c, we find the incremental nominal sales revenues, which are based on the realized incremental sales volume, times the nominal price of water.

IV. Financial Analysis

A. Assumptions

In addition to the assumptions concerning water supply and demand outlined above, the financial analysis was conducted on the basis of the following assumptions. More detailed information regarding these items may be found in the Table of Parameters, Annex 1a.

1. Cost of operating inputs, excluding labor, are expected to remain constant in real terms throughout the life of the project;

2. The percentage of NRW for each year is based on MWSS' targets. MWSS expects to reduce NRW from 50% in 1993 to 32% in 2001 and to maintain it at that level from 2001 onwards.

3. Income tax - It is assumed MWSS will continue to be exempt from paying corporate income tax. As a government corporation, MWSS is supposed to pay corporate income tax but it has been exempt over the years due to its unfavorable financial conditions;

4. Capital costs exclude interest during construction.

5. Water tariff - The real water tariff is 5.135 pesos per cubic meter in 1990 prices. While the nominal tariff rate will be adjusted annually to reflect inflation, for various political and administrative reasons it is likely that this adjustment will not be made immediately in step with inflation. In the analysis it is assumed a lag in the adjustment of the tariff, that would have the ultimate effect of lowering the effective tariff throughout the life of the project. The lag was modeled by reducing the tariff to approximately 91% of its real value for every year of the project.

6. Project life - The project is estimated to have a useful life of 30 years and the fixed assets are assumed not to have salvage values at the end of the project's life.

7. Wage rate- It is assumed a 2% real increase in wages throughout the life of the project.

8. Accounts receivable are assumed to be three months of revenues. (MWSS has accounts receivables equal to 5.5 months billings in 1990 and is undertaking a program to reduce accounts receivable to three months billing by the end of 1993);

9. Accounts payable - Accounts payable are assumed to be equal to three months of operating expenses except labor.

10. Cash balance - The desired stock of cash balances to be held as working capital are assumed to be one month of all operating expenses;

B. Points of View

The financial viability of the project was analyzed from the investment point of view and from the point of view of equity. The difference between these two views is that from the perspective of total investment, the viability of the project, irrespective of financing, is

analyzed while from the equity's viewpoint the debt and its repayment are also considered in the analysis. As the loans are not subsidized, the net present value from both perspectives is equal.[9] The required real return by equity was taken as 10%.

C. Methodology

The analysis has been conducted in both nominal and real prices to account for the different impacts of inflation.[10] There are both direct and indirect impacts of inflation on the analysis. The indirect impacts, also known as the tax impacts, are not relevant since MWSS does not pay corporate income tax, but would be considered if MWSS' current tax status should change. The direct impact of inflation on the returns to the project take place through changes in accounts receivable, changes in accounts payable and changes in cash balance.[11]

The financial value of the project is estimated by calculating the present value of the projected stream of annual net cash flows. Annexes 5 through 8 show the preliminary tables needed to construct the net cash flow statement--a table of revenues, operating and maintenance expenses, working capital schedule, and loan schedule. After conducting the analysis in current pesos, the nominal cash flows (shown in Annex 9) are deflated to arrive at the real (1991 pesos) cash flows. The net cash flows from the equity's perspective are discounted by the real required rate return of 10 percent to arrive at the net present value (NPV).

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[9] $\text{NPV (Total Investment)}_{@\text{ weighted cost of capital}} = \text{NPV (Equity)}_{@\text{ required return by equity}} + \text{NPV (loan)}_{@\text{ loan interest rate}}$

Since $\text{NPV (loan)}_{@\text{ loan interest rate}} = 0$,
Therefore, $\text{NPV (Total Investment)}_{@\text{ weighted cost of capital}} = \text{NPV (Equity)}_{@\text{ required return by equity}}$

[10] Annex 4 presents the inflation indices for a number of select years.

[11] For a full discussion of the impacts of inflation on the financial analysis of projects, see: Harberger, Arnold and Jenkins Glenn; "Manual for Cost Benefit Analysis of Investment Decisions," chapter 6, 1995.

D. Results

Annex 10 shows the projected real cash flow statements for the proposed project from the total investment point of view and from equity's point of view. The net present value of the project is negative (-10.79 million pesos). The negative result is mostly due to the low water tariff rate, the lag in adjustment for inflation, and the 2.0% real increase in the wage rate. The relatively large impact of the real increase in wages suggests that the nominal average tariff rate should be adjusted by more than the value of inflation and foreign exchange adjustments to counter the effect of increasing real wages.[12]

[12] The sensitivity of the results to the increase in real wages is presented in Annex 18 and discussed in section VII.

A	B	C	D	E	F	G	H	I

MANILA SOUTH WATER DISTRIBUTION PROJECT

ANNEX 1a: TABLE OF PARAMETERS

1. Water tariff rate (1991)		5.135	pesos/cu m.	
Adjustment to Real tariff rate due to time lag in inflation related rate increases		91.25%		
2. Inflation rate				
Domestic 1990-91		12%		
Domestic 1992 - 2024		8.00%		
Foreign		4.00%		
3. Foreign exchange rate 1991(peso/dollar)		28.00		
4. Financing: ADB Loan (In $$)				
% of Domestic Currency Cost funded by loan		33.3%		
% of Foreign Currency Cost funded by loan		100%		
(Loan and loan repayments all in US$$)				
Nominal Interest rate		10.33%		
5. Accts. receivable	3	months		
6. Accts. payable	3	months of direct expenses (O&M excluding labor)		
7. Cash	1	months of direct expenses		
8. Income tax rate	0			
(MWSS as a government corporation is supposed to pay but has been exempt up to the time the project was being appraised)				
9. Discount Rates:				
Equity		10.0%		
Economic		10.3%		

10. Initial Private Connections		
No. of existing connections		38,839
No. of person/existing connection		8.4
Aver.Initial consump(liters/day)		150
11. Initial Shared Standpipes		
No. of existing standpipes		199
No. of persons/standpipe		300
Average consump (liters/day)		40
12. Initial Non-Revenue Water (NRW)		52%
a. Of NRW, percent leakage		49%
b. Of NRW, percent non-leakage		51%
13. Operating & Maint. 1990 pesos/cu m:		1.096
Wages	62.44%	0.684
Chemicals	11.92%	0.131
Power	15.19%	0.166
Supplies & other e	10.44%	0.114
Real Increase in Wage Rate per Year		2.00%
14. Operating Days/Year		365
15. Project Life (years)		30
16. Inv. Cost Overn Fac RISK		0%

A	B	C	D	E	F	G	H	I	J
			ANNEX 1b:	TABLE OF PARAMETERS, Con't.					
				1993	1994	1995	1996	1997	1998
17. AWSOP treated water production capacity cu. m./day(Incl. NRW)			401227						
18. Number of new connections proposed by MWSS each year				11229	19999	19706	19193	17493	12134
19. New connection efficiency (Risk)			84%						
20. Number of persons/connection				8	7.5	7.5	7.5	7.5	7.5
21. Average consumption/person(liters/day)				160	200	220	220	220	220
22. Number of new standpipes each year				36	74	87	85	77	54
23. No. persons/standpipe			300						
24. Average consumption/person (liters/day)			40						
RISK VARIABLE--Ability of MWSS to meet NRW targets:				100%	100%	100%	100%	100%	100%
25. Target Percent Non-Revenue Water (NRW)				50%	46%	42%	38%	35%	35%
a. Of NRW, percent leakage			49%						
b. Of NRW, percent non-leakage (that is, % stolen or authorized free use)			51%						
(Continued from above)									
				1999	2000	2001	2002	2003	2004
18. Number of new connections proposed by MWSS each year				7739	8170	5717	5982	6206	6431
20. Number of persons/connection				7.5	7.5	7.5	7.5	7.5	7.5
21. Average consumption/person(liters/day)				220	220	220	220	220	220
22. Number of new standpipes each year				34	36	25	26	27	28
RISK VARIABLE--Ability of MWSS to meet NRW targets:				100%	100%	100%	100%	100%	100%
25. Target Percent Non-Revenue Water (NRW)				35%	35%	32%	32%	32%	32%

ANNEX 2
MWSS PROPOSED INITIAL INVESTMENT COSTS
(Millions of 1990 pesos)

	1991			1992			1993		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
CIVIL WORKS									
a. Water reservoirs/pumping stations				13.881	5.949	19.830	33.812	14.491	48.303
b. Transmission mains				4.722	11.020	15.742	5.982	13.959	19.941
c. Secondary/Tertiary networks				29.039	9.680	38.719	67.758	22.586	90.344
d. Service connections				8.262	1.458	9.720	19.279	3.402	22.681
CIVIL WORKS TOTAL				55.904	28.107	84.011	126.831	54.438	181.269
EQUIPMENT AND MATERIALS									
a. Water reservoirs/pumping stations				1.398	5.594	6.992	4.088	16.352	20.440
b. Transmission mains				5.848	23.393	29.241	7.406	29.632	37.038
c. Secondary/Tertiary networks				11.616	46.471	58.087	27.103	108.431	135.534
d. Service connections				1.944	7.777	9.721	4.536	18.148	22.684
EQUIPMENT AND MATERIALS TOTAL				20.806	83.235	104.041	43.133	172.563	215.696
OFFICE BUILDINGS				3.670		3.670	3.670		3.670
CONSULTING SERVICES	1.386		1.386	1.089		1.089	0.528		0.528
LAND COST	25.000		25.000						
IN-HOUSE ENGINEERING SERVICES	32.560		32.560	16.280		16.280	16.280		16.280
TAXES AND DUTIES				32.160		32.160	66.670		66.670
TOTAL INVESTMENT COST	58.946		58.946	129.909	111.342	241.251	257.112	227.001	484.113

	1994			1995			TOTAL INVESTMENTS		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
CIVIL WORKS									
a. Water reservoirs	23.009	9.860	32.869	3.099	1.319	4.418	73.801	31.619	105.42
b. Transmission mains	4.250	9.918	14.168	0.788	1.837	2.625	15.742	36.734	52.476
c. Secondary/Tertiary networks	77.438	25.812	103.250	19.360	6.454	25.814	193.595	64.532	258.127
d. Service connections	22.033	3.888	25.921	5.508	0.972	6.480	55.082	9.72	64.802
CIVIL WORKS TOTAL	126.730	49.478	176.208	28.755	10.582	39.337	338.22	142.605	480.825
EQUIPMENT AND MATERIALS									
a. Water reservoirs	1.927	7.710	9.637	0.564	2.259	2.823	7.977	31.915	39.892
b. Transmission mains	5.262	21.054	26.316	0.975	3.898	4.873	19.491	77.977	97.468
c. Secondary/Tertiary networks	30.975	123.922	154.897	7.744	30.980	38.724	77.438	309.804	387.242
d. Service connections	5.184	20.774	25.958	1.296	5.185	6.481	12.96	51.884	64.844
EQUIP & MAT TOTAL	43.348	173.460	216.808	10.579	42.322	52.901	117.866	471.58	589.446
OFFICE BUILDINGS							7.34		7.34
CONSULTING SERVICES	0.297		0.297				3.3		3.3
LAND COST							25		25
IN-HOUSE ENGINEERING SERVICES	12.210		12.210	4.070		4.070	81.4		81.4
TAXES AND DUTIES	67.000		67.000	16.350		16.350	182.18		182.18
TOTAL INVESTMENT COST	249.585	222.938	472.523	59.754	52.904	112.658	755.306	614.185	1369.491

Project Financing Plan
ADB Loan
(Disbursement and Repayments in US $)

	Local	Foreign	Total
Investment Costs In Millions of 1990 Pesos	755.31	614.19	1,369.49
Investment Costs In Millions of 1991 Pesos	845.94	687.89	1,533.83
% ADB Financing	33.3%	100%	
ADB Loan (Millions of 1991 pesos)	281.70	687.89	969.59
ADB Loan (Millions of 1991 $)	10.06	24.57	34.6281

A	B	C	D	E	F	G	H	I	J	K	L
ANNEX 4 INFLATION AND EXCHANGE RATES											
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dom. inf. rate	8.00%										
Dom. inflation index		1.000	1.080	1.166	1.260	1.360	1.469	1.587	1.714	1.851	1.999
For. infl. rate	4.00%										
For. inflation index		1.000	1.040	1.082	1.125	1.170	1.217	1.265	1.316	1.369	1.423
Relative infl. index		1.000	1.038	1.078	1.120	1.163	1.208	1.254	1.302	1.352	1.404
NOMINAL EXCHANGE RATE		28.00	29.08	30.20	31.36	32.56	33.82	35.12	36.47	37.87	39.33

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
ANNEX 5a															
WATER DEMAND During Connection Expansion Period (1993 to 2004)															
For Risk Analysis:															
New connection efficiency		0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
TOTAL CONSUMPTION DEMANDED															
1. Paid Consumption Demanded from Private Connections (Estimates for Expansion Years 1993 -2004)															
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
New Connections Realized			9,432	16,799	16,553	16,122	14,694	10,193	6,501	4,863	4,802	5,025	5,213	5,402	
Ending (Total Connections)		38839	48,271	65,071	81,624	97,746	112,440	122,632	129,133	133,996	140,798	145,823	151,036	156,438	
Cumulative new connections			9,432	26,232	42,785	58,907	73,601	83,793	90,294	97,157	101,959	106,984	112,197	117,599	
No. of persons/connection		8.4	8.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Ave. consumption/person (liters/day)		150	160	200	220	220	220	220	220	220	220	220	220	220	
Total consumption (cu m/day)		48,937	61,787	97,606	134,679	161,280	185,526	202,343	213,070	224,393	232,317	240,608	249,210	258,123	
2. Paid Consumption Demanded from public standpipes (Estimates for Expansion Years 1993 -2004)															
New			36	74	87	85	77	54	34	36	25	26	27	28	
Ending		199	235	309	396	481	558	612	646	682	707	733	760	788	
No. of persons/connection		300	300	300	300	300	300	300	300	300	300	300	300	300	
Ave. consumption/person (liters/day)		40	40	40	40	40	40	40	40	40	40	40	40	40	
Total consumption (cu m/day)		2,388	2,820	3,708	4,752	5,772	6,696	7,344	7,752	8,184	8,484	8,796	9,120	9,456	
3. TOT. CONSUMPTION DEMANDED (1993 -2004)		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
4. Total Paid Consump. demanded		51,325	64,607	101,314	139,431	167,052	192,222	209,687	220,822	232,577	240,801	249,404	258,330	267,579	
Paid Piped water consumption demanded before project (cu. m/day)		51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	
Tot. Incremental paid consumpt. demanded from proj.(cu m/day)		0	13,282	49,989	88,106	115,727	140,897	158,362	169,497	181,252	189,476	198,079	207,004	216,254	

ANNEX 5b

WATER DEMAND following completion of new connections (2005 to 2024)

3. Paid Water Consumption Demanded following completion of New Connections (2005 -2024)

3.1: Paid Drinking Water Consumption (2005 -2024)

Es =	2.00	(Elasticity of Supply of Producers)	
Nd =	-0.3	(Elasticity of Demand of Consumers)	
Qdi =	42,933	(Initial Quantity Demanded)	
Qsi =	42,933	(Initial Quantity Supplied)	
Ws = Es / [Es - {Nd * (Qdi/Qsi)}]	=	0.87	
Wd = -Nd / [Es - {Nd * (Qdi/Qsi)}]	=	0.13	

*New Quantity Demanded Qd1 = Qo + [Nd * Qo * ΔP/Po]

*New Quantity Provided by Water Vendors(or Wells) Qs1 = Qo + [Es * Qo * ΔP/Po]

Initial Market Price	Po=	37.7992	pesos/cu. m
Quant. consumed before Project	Qo=	42,933	cu. m. per day
Minimum vendor price		18.90	pesos/cu. m

			2005	2006	2007	2008	2009	2010	2011	2012	2013
New Market Price	pesos/cu. m	P1=	5.13500	5.13500	5.13500	5.13500	5.13500	5.13500	5.13500	5.13500	5.13500
Total Quantity Demanded*	cu. m. per day	Qd1=	54,063	54,063	54,063	54,063	54,063	54,063	54,063	54,063	54,063
New Quantity Provided by Water Vendors*	cu. m. per day	Qs1 =	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Quantity Demanded from Project (cu.m/day)		Qp=	54,063	54,063	54,063	54,063	54,063	54,063	54,063	54,063	54,063

3.2: Paid Washing Water Consumption (2005 -2024)

Es =	1.00	(Elasticity of Supply of Producers)	
Nd =	-0.50	(Elasticity of Demand of Consumers)	
Qdi =	1,108,823	(Initial Quantity Demanded)	
Qsi =	1,108,823	(Initial Quantity Supplied)	
Ws = Es / [Es - {Nd * (Qdi/Qsi)}]	=	0.667	
Wd = -Nd / [Es - {Nd * (Qdi/Qsi)}]	=	0.333	

Initial Market Price (Aver. Well Price)	Po =	5.690	pesos/cu. m	
Equilib. Quant. before Project	Qo=	1,108,823	cu. m. per day	

			2005	2006	2007	2008	2009	2010	2011	2012	2013
New Market Price	pesos/cu. m	P1=	5.13500	5.13500	5.13500	5.13500	5.13500	5.13500	5.13500	5.13500	5.13500
Total Quantity Demanded*	cu. m. per day	Qd1=	1,162,887	1,162,887	1,162,887	1,162,887	1,162,887	1,162,887	1,162,887	1,162,887	1,162,887
New Quantity Provided by Wells*	cu. m. per day	Qs1 =	1,000,696	1,000,696	1,000,696	1,000,696	1,000,696	1,000,696	1,000,696	1,000,696	1,000,696
Quantity Demanded from Project (cu.m/day)		Qp=	162,190	162,190	162,190	162,190	162,190	162,190	162,190	162,190	162,190
3.3 Tot. Incremental Paid Water Consumption demanded from Project (2005- 2024):			216,254	216,254	216,254	216,254	216,254	216,254	216,254	216,254	216,254

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
							ANNEX 5c								
							TOTAL DEMAND, SUPPLY, and SALES REVENUE								
A) TOTAL CONSUMPTION DEMANDED				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a. Total Paid Consump. demanded over life of project (1993 -2024)				64,607	101,314	139,431	167,052	192,222	209,687	220,822	232,577	240,801	249,404	258,330	267,579
Paid Piped water consumption demanded before project (cu. m/day)				51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325	51,325
Tot. Incremental paid consumpt. demanded from proj.(cu m/day)				13,282	49,989	88,106	115,727	140,897	158,362	169,497	181,252	189,476	198,079	207,004	216,254
B) AVAILABLE SUPPLY and REALIZED CONSUMPTION				1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total AWSOP water supply avail. to paying cust.(cu.m/day), after system leakage, giveaways and theft				200,614	216,663	232,712	248,761	260,798	260,798	260,798	260,798	272,834	272,834	272,834	272,834
Total Paying consumption (must be less than or equal to supply available)(cu m/day)				64,607	101,314	139,431	167,052	192,222	209,687	220,822	232,577	240,801	249,404	258,330	267,579
Incremental Paying consumption (cu m.day)				13,282	49,989	88,106	115,727	140,897	158,362	169,497	181,252	189,476	198,079	207,004	216,254
Incremental water leakage (cu.m/day)				6,508	20,866	31,262	34,756	37,175	41,783	44,721	47,823	43,691	45,675	47,733	49,866
Incremental non-paying consumption (theft and giveaway) cu. m/day				6,774	21,717	32,538	36,174	38,692	43,489	46,546	49,775	45,474	47,539	49,681	51,901
Required incremental supply (Incremental consumption/1-NRW) in cu.m./day				26,564	92,572	151,906	186,657	216,764	243,634	260,764	278,849	278,641	291,293	304,418	318,020
C) TOTAL INCREMENTAL SALES REVENUES															
	1992	1992		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Incremental Sales Volume (cu m/day)				13,282	49,989	88,106	115,727	140,897	158,362	169,497	181,252	189,476	198,079	207,004	216,254
Real Water Tariff (pesos/cu.m)				5.135	5.135	5.135	5.135	5.135	5.135	5.135	5.135	5.135	5.135	5.135	5.135
Nominal water Tariff (pesos/cu.m)				5.47	5.90	6.37	6.88	7.44	8.03	8.67	9.37	10.12	10.93	11.80	12.74
Nominal Revenues (mill. pesos)				26.50	107.70	205.01	290.82	382.39	464.18	536.56	619.67	699.61	789.89	891.52	1,005.86

ANNEX 6
Operating and Maintenance Expenses

Operating and Maintenance Expenses (REAL 1000s of Pesos)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Wages			7,042	25,029	41,893	52,506	62,195	71,303	77,842	84,906
Chemicals			1,267	4,414	7,244	8,901	10,336	11,618	12,434	13,297
Power			1,614	5,625	9,231	11,342	13,172	14,805	15,846	16,945
Maintenance costs			1,109	3,866	6,344	7,796	9,053	10,175	10,891	11,646
Total			11,032	38,935	64,712	80,545	94,756	107,900	117,013	126,793

Operating and Maintenance Expenses (Nominal 1000s of Pesos)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Wages			8,213	31,529	56,995	77,149	98,695	122,200	144,081	169,727
Chemicals			1,477	5,561	9,855	13,078	16,402	19,911	23,015	26,581
Power			1,883	7,086	12,558	16,666	20,902	25,373	29,329	33,872
Maintenance costs			1,294	4,870	8,631	11,454	14,366	17,438	20,158	23,280
Total			12,868	49,047	88,040	118,347	150,366	184,922	216,583	253,460

ANNEX 7
WORKING CAPITAL SCHEDULE

(Nominal, Millions of Pesos)	1992	1993	1994	1995	1996	1997	1998	1999	2000
Number of months accts. rec.(RISK VARIABLE)		3	3	3	3	3	3	3	3
Accounts receivables	0	6.62	26.92	51.25	72.70	95.60	116.04	134.14	154.92
Change in accounts rec.		(6.62)	(20.30)	(24.33)	(21.45)	(22.89)	(20.45)	(18.10)	(20.78)
Cash balance	0	1.07	4.09	7.34	9.86	12.53	15.41	18.05	21.12
Change in cash balance		(1.07)	(3.01)	(3.25)	(2.53)	(2.67)	(2.88)	(2.64)	(3.07)
Accounts payable	0	1.16	4.38	7.76	10.30	12.92	15.68	18.13	20.93
Change in accts. payable		(1.16)	(3.22)	(3.38)	(2.54)	(2.62)	(2.76)	(2.45)	(2.81)

A	B	C	D	E	F	G	H	I	J	K
					ANNEX 8					
					LOAN SCHEDULE					
In Millions of US dollars (Nominal)										
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Beginning Loan		34.63	38.21	42.15	46.51	51.31	56.61	55.66	54.61	53.45
Interest at 10.33%		3.58	3.95	4.35	4.80	5.30	5.85	5.75	5.64	5.52
Repayment							6.80	6.80	6.80	6.80
Interest										
Principal										
Ending loan	34.63	38.21	42.15	46.51	51.31	56.61	55.66	54.61	53.45	52.17
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
DEBT CASH FLOW (Millions of Pesos)										
A. Nominal										
Debt Cash Flow	969.59	0	0	0	0	0	(238.78)	(247.96)	(257.50)	(267.41)
B. Real										
Debt Cash Flow	969.59	0	0	0	0	0	(150.47)	(144.68)	(139.12)	(133.77)

A	B	C	D	E	F	G	H	I	J	K	L

ANNEX 9

NOMINAL PROJECTED FINANCIAL NET BENEFIT STATEMENT

Investment Point of View, (In million pesos)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
INFLOWS										
Revenues			26.50	107.70	205.01	290.82	382.39	464.18	536.56	619.67
Change in accts. rec.			(6.62)	(20.30)	(24.33)	(21.45)	(22.89)	(20.45)	(18.10)	(20.78)
TOTAL INFLOWS			19.87	87.40	180.68	269.36	359.50	443.73	518.46	598.89
OUTFLOWS										
Investments										
Civil works		101.62	236.80	248.61	59.94	54.10	53.25	39.89	27.48	31.33
Equipment and materials		125.85	281.78	305.89	80.61	66.32	65.28	48.90	33.69	38.41
Office buildings		4.44	4.79							
Consulting services	1.55	1.32	0.69	0.42						
Land	28.00	0.00	0.00	0.00						
In-house eng. services	36.47	19.69	21.27	17.23	6.20					
Taxes and duties		38.90	87.10	94.53	24.91					
Operating and maintenance										
Wages			9.20	35.31	63.83	86.41	110.54	136.86	161.37	190.09
Chemicals			1.65	6.23	11.04	14.65	18.37	22.30	25.78	29.77
Power			2.11	7.94	14.07	18.67	23.41	28.42	32.85	37.94
Supplies & other exp.			1.45	5.45	9.67	12.83	16.09	19.53	22.58	26.07
Income tax										
Change in accts. payable			(1.16)	(3.22)	(3.38)	(2.54)	(2.62)	(2.76)	(2.45)	(2.81)
Change in cash balance			1.07	3.01	3.25	2.53	2.67	2.88	2.64	3.07
TOTAL OUTFLOWS	66.02	291.82	646.75	721.40	270.13	252.95	286.99	296.03	303.93	353.88
NET BENEFIT FLOWS	(66.02)	(291.82)	(626.88)	(634.01)	(89.46)	16.41	72.51	147.71	214.53	245.02

ANNEX 18

REAL PROJECTED FINANCIAL NET BENEFIT STATEMENT
Total Investment Point of View
(millions of 1991 pesos)

	1991	1992	1993	1994	1995	1996	1997	2000	2005	2010	2015	2020	2024	2025
INFLOWS														
Revenues			22.72	85.49	150.69	197.93	240.97	309.99	369.85	369.85	369.85	369.85	369.85	
Change in accts. rec.			(5.68)	(16.12)	(17.88)	(14.60)	(14.43)	(10.39)	(6.85)	(6.85)	(6.85)	(6.85)	(6.85)	85.61
TOTAL INFLOWS			17.04	69.38	131.80	183.32	226.55	299.60	363.00	363.00	363.00	363.00	363.00	85.61
OUTFLOWS														
Investments														
Civil works		94.09	203.02	197.35	44.06	36.82	33.56	15.67						
Equipment and materials		116.53	241.58	242.82	59.25	45.14	41.14	19.21						
Office buildings		4.11	4.11											
Consulting services	1.55	1.22	0.59	0.33	0.00									
Land	28.00													
In-house eng. services	36.47	18.23	18.23	13.68	4.56									
Taxes and duties		36.02	74.67	75.04	18.31									
Operating and maintenance														
Wages			7.89	28.03	46.92	58.81	69.66	95.09	119.74	132.20	145.96	161.16	174.44	
Chemicals			1.42	4.94	8.11	9.97	11.58	14.89	16.98	16.98	16.98	16.98	16.98	
Power			1.81	6.30	10.34	12.70	14.75	18.98	21.64	21.64	21.64	21.64	21.64	
Maintenance			1.24	4.33	7.11	8.73	10.14	13.04	14.88	14.88	14.88	14.88	14.88	
Income tax			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Change in accts. payable			(1.00)	(2.55)	(2.49)	(1.73)	(1.65)	(1.40)	(0.88)	(0.88)	(0.88)	(0.88)	(0.88)	11.06
Change in cash balance			0.92	0.69	0.42	0.25	0.21	0.15	0.09	0.10	0.11	0.12	0.12	(15.30)
TOTAL OUTFLOWS	66.02	270.20	554.43	570.97	196.59	178.63	179.28	175.64	172.45	184.92	198.69	213.89	227.18	(4.65)
NET BENEFIT FLOWS	(66.02)	(270.20)	(537.45)	(501.59)	(63.78)	12.64	47.17	123.96	190.55	178.08	164.31	149.11	135.82	90.26
NPV @	7.34%	(18.79)												

REAL PROJECTED FINANCIAL NET BENEFIT STATEMENT
Equity Point of View
(millions of 1991 pesos)

	1991	1992	1993	1994	1995	1996	1997	2000	2005	2010	2015	2020	2024	2025
NCF before financing	(66.02)	(270.20)	(537.45)	(501.59)	(63.78)	12.64	47.17	123.96	190.55	178.08	164.31	149.11	135.82	90.26
Debt Cash Flow	969.59	0.00	0.00	0.00	0.00	0.00	(150.47)	(133.77)	(109.95)	(90.37)	(74.28)			
NCF after financing	903.57	(270.20)	(537.45)	(501.59)	(63.78)	12.64	(103.30)	(9.81)	80.60	87.71	90.04	149.11	135.82	90.26
NPV @ 10.00%	(18.79)													

V. Economic Analysis

The economic analysis is conducted following the Harberger/Jenkins methodology.[13] The appraisal is conducted at the domestic price level to allow for the analysis of the project's externalities, which are estimated by taking the difference between the economic net benefit statement and the financial net benefit statement. The first step in the economic analysis is to determine the national economic parameters, the economic benefit per cubic meter of water, and the economic conversion factors for all the inputs used in the project. These are then used to convert the financial statement of net benefits into an economic statement.

A. National Parameters

1. Economic Cost of Foreign Exchange

The economic cost of foreign exchange was obtained from the study by Jenkins/El-Hifnawi.[14] The economic cost of foreign exchange was found to be 25% higher than the official exchange rate. This premium is due partly to the impact of net import tariffs and tariff-equivalent of quantitative restrictions, and partly to the unsustainable proportion of the current account deficit.

2. Economic cost of capital

The economic cost of capital for the Philippines was also obtained from the study by Jenkins/El-Hifnawi. The cost of 10.3% was estimated as a weighted average of the different domestic net-of-tax saving rates, the gross-of-tax returns on investment for the different sectors, and the marginal cost of foreign borrowing.

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[13] For a discussion of the methodology, see " Manual on ....." Op cit note # 11.

[14] Glenn Jenkins and Mostafa Baher El-Hifnawi, "Economic Parameters for the Appraisal of Investment Projects: Bangladesh, Indonesia, and the Philippines", Report for the Economics and Development Resource Center, Asian Development Bank, 1994.

B . The Economic Value of Water

The water distributed by the project may be used either for drinking or for washing. As the water used for each activity generates different economic benefits, the economic value of each should be estimated separately. In addition, some of the water is used by paying users, while other users pay nothing for the water they consume. The difference in the average willingness to pay of these two consumer groups implies that the benefits they receive are not the same. In our analysis, we have assumed that 25% of the water consumed will be for drinking and cooking, while the remaining 75% will be used for washing purposes

The economic benefits of these four types of water (paid drinking water, paid washing water, free drinking water, free washing water) are estimated below. For paid water consumption, a conversion factor based on the weighted average benefit of the two types of water uses is calculated and applied to the financial statement to obtain the economic value of paid water consumption in each year. For unpaid consumption, the volume of unpaid water consumption in each year was multiplied by the weighted average benefit per cubic meter of water (wash water and drinking water) to arrive at the economic benefit in a given year. The economic benefit per cubic meter of water estimated below is based on production at the end of year 2004, after MWSS has completed its expansion project, including all additional connections. Since the water project is designed to meet consumption requirements at the end of 2004, it is assumed that at this point, water supply and demand will be in equilibrium. In our analysis, the estimation of the economic benefit per unit of water at the end of 2004 was considered to represent the economic value of water throughout the life of the project. A more accurate analysis would estimate a separate economic price per unit for each of the thirty years of the project's life, which would allow the economic price to be adjusted for the economic effect of any de facto rationing which may occur in early years or in some risk scenarios. In this case, it was viewed that the additional accuracy gained did not warrant the increased complexity of the estimations.

1. The Economic Benefits of Wash Water for Paying Consumers

The full economic benefit of washing water distribution by the project to paying customers may be seen in the left graph of Figure 1. The demand curves reflect the willingness to pay for water. The economic benefit of the paid washing water falls into two categories: a) The benefit of the additional consumption ($Qd_1 - Q_0$) by the new consumers, the lightly shaded area under the new demand curve; and b) the benefit of the savings in inputs to well water production (quantity $Q_0 - Qs_1$,) gained by eliminating the need for additional well water production. Over time, it is expected that piped water will replace much of the existing well production. This is shown by the dark shaded area under the supply curve.

An attempt was made to measure the value of water by gathering information on the prices that people in the project area are paying for water. The information was gathered in 1994 from MWSS and private contractors. The survey revealed that the levelized cost of water from private wells ranged from 3.8 pesos/cu m. for households using pressure tanks to 7.6 pesos/cu m for households using overhead storage tanks, with an average cost of 5.69 pesos per cubic meter. The levelized cost was obtained by dividing the present value of the investment and operating costs by the present value of the cubic meters of water produced. (Annex 11 presents the estimates for the willingness to pay for water in the project area.)

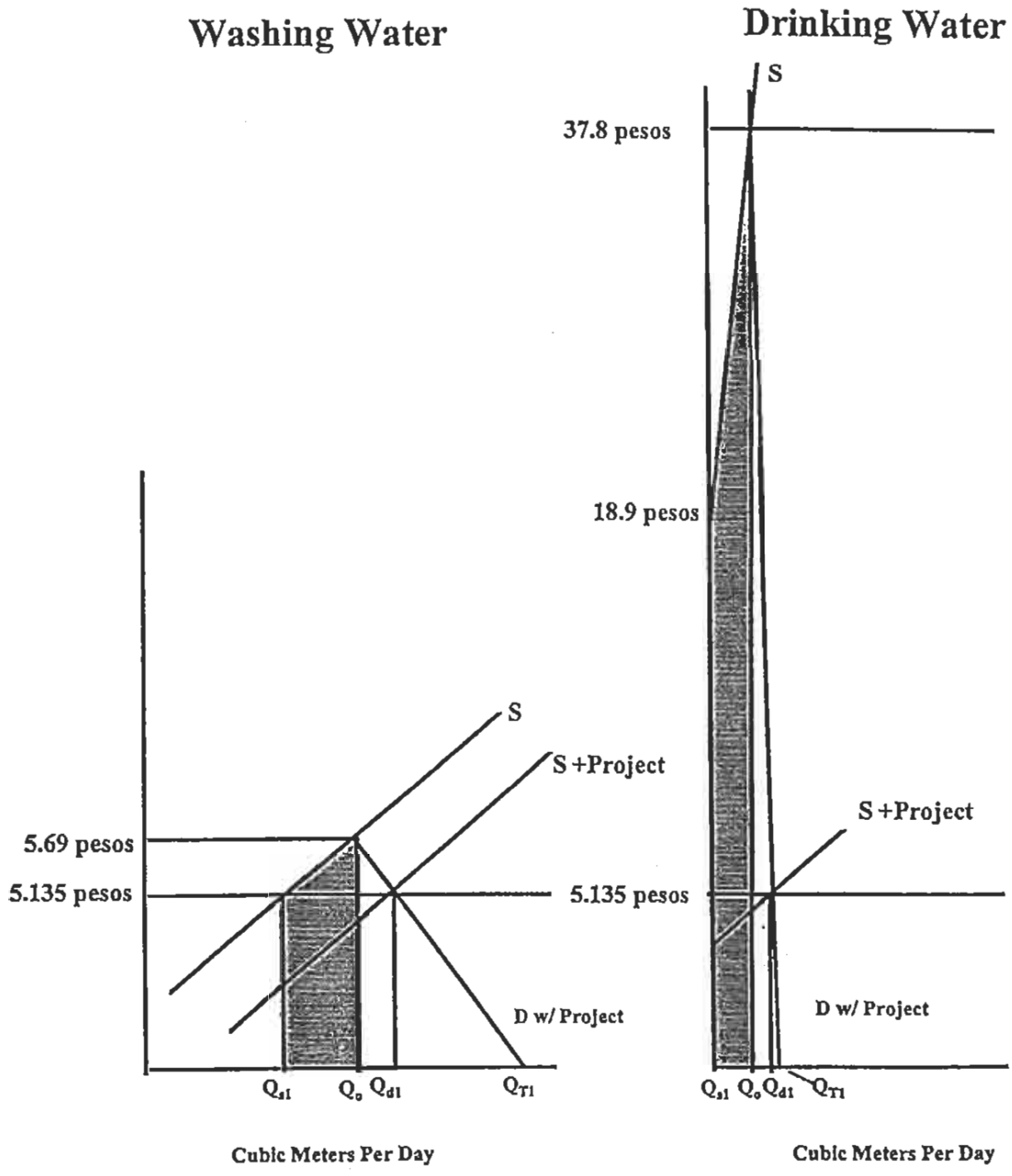
Using this information, and assigning elasticities of supply of well water production (1.00), and demand for wash water consumption(-.5), the benefits depicted in Figure 1 may be quantified. These calculations are shown in Annex 12a. The economic price per cubic meter of well water is 5.41 pesos per cubic meter, a weighted average of the average demand price and the average supply price. (Since there are no taxes or other distortions in the market for washing water, the economic benefit per unit is identical to the average of the original market price, 5.69 pesos, and the new price 5.135 pesos). This value can also be calculated from the graph, as is explained in Annex 12a.

2. The Economic Value of Drinking Water for Paying Consumers

According to the survey, the households in the project area that were not connected to the MWSS system obtained their drinking water largely from water vendors who delivered water to houses. The estimated cost of water from water vendors when adjusted to the 1990 price level was 38 pesos/cu m, which is more than seven times the MWSS tariff of 5.135 pesos/cu m. The very high price is not surprising since water is a necessity and people are willing to pay a lot for water needed for drinking and cooking.

Again, the economic benefit of drinking water distribution by the project may be seen in Figure 1. Since with the project nearly 20% of the water that is used for drinking can now be obtained free, the demand curve for paid drinking water consumption will shift inward if the project is implemented. (This straight proportional shift assumes that the free water is obtained equally by users, regardless of their willingness to pay) The graph on the right shows that, the economic benefit is the benefit of additional consumption (the lightly shaded area under the demand curve), plus the benefit of resources released by the cutback in water distribution by vendors (the dark shaded area under the supply curve), but now the original suppliers are forced entirely out of the market. With the project, the price faced by consumers will fall, and they will increase their consumption a small amount. As they are not likely to drink much more than they previously consumed, we have assigned them a very low elasticity of demand, -.3. Furthermore, when the price falls, water vendors who previously charged 37.8 pesos per cubic meter will reduce their supply. With an assumed elasticity of supply of 2.00, the water vendors will be completely forced out of the market when the price reaches 18.9 pesos per cubic meter. The resources tied up in their water distribution systems will now be available for other productive activities.

Figure 1
The Economic Benefits of Water to Paying Customers



$Q_{d1} - Q_{s1}$ = Incremental Project Water consumed by Paying Users

Annex 12b shows the calculations of the benefits of drinking water to paying users. The economic price per unit of drinking water for paying consumers is 26.93. As noted in Annex 12b, in this case, calculating the benefits based on the graph is preferable, rather than using the weighted average formula. Since the water vendors are completely forced out of the market, using the simple weighted formula would overestimate the economic price of water.

The average economic benefit per cubic meter of water to paying consumers is a weighted average of the benefit of drinking water and the benefit of washing water. Since, in the equilibrium state, 25% of the water consumed will be for drinking and cooking, while the remaining 75% will be used for washing purposes, the average economic benefit per cubic meter equals: (5.412 * .75) + (26.93 * .25) = 10.79 pesos per cubic meter.

3. The Economic Benefits of Water for Non-Paying Consumers

Non-revenue water (NRW) is the water that MWSS pumps through the distribution system but receives no revenue for. The NRW is due to technical (leakage in the distribution system which leads to wastage) and non-technical reasons (pilferage, billing error, and authorized free use). In 1991, it was estimated that 51% of total NRW was wasted in leakage, while the remaining 49% was used free of charge. It is assumed that these percentages would remain unchanged throughout the life of the project, although the overall percentage of non-revenue earning water is expected to decline to 32% of total water. Even though MWSS does not receive any revenues for water used free of charge, this water has a value to the non-paying user and should be included as benefit in the economic analysis. Since non-paying users get their water free, it is reasonable to assume that at the margin, the benefit of the last cubic meter of water consumed by non-paying users is zero. The non-paying customers will have no incentive not to consume more at lower marginal benefit, or perhaps waste it.

Therefore, the average economic benefit per cubic meter of water received by non-paying consumers is less than that of paying consumers.

As shown in the graph, if the price of piped water were to rise above the price of well water (5.69), people would no longer use the piped water for washing and the only free water available would be that arising from drinking water consumption (in the right-hand graph, $Q_{T1} - Q_{d1}$). Since the average price of washing water is 5.69 pesos per cubic meter, we assume that the change in consumer surplus gained by the non-paying consumers ranges between 5.69 and zero pesos per cubic meter. Shown in Annex 12c, the average economic price per cubic meter of free wash water in year 2004 equals 2.84 pesos per cubic meter. The 25% of the free water that is used for drinking creates a change in consumer surplus varying between 37.8 to zero pesos per cubic meter. So, the average economic benefit per cubic meter of drinking water is 18.90 pesos per cubic meter. These calculations are shown in Annex 12d. The overall weighted average benefit of water to non-paying consumers is estimated to be 6.86 pesos per cubic meter. Since this price is in 1990 terms, we must first convert it to 1991 terms before it is used in our net benefit statement. With 1990-1991 inflation at 12%, in 1991 terms, the economic benefit of this water is 7.68 pesos per cubic meter

C. Conversion Factors for Inputs

Most of the conversion factors have been estimated on the basis of the Jenkins/El-Hifnawi study and are presented in Annex 13a and 13b, along with a more complete explanation. A brief discussion follows.

1. Investment Cost Items

The investment cost was broken down by item into civil works, materials and equipment, in-house engineering services, consulting services, land, and taxes and duties; and the conversion factor for each item was determined. The economic cost of civil works is a

weighted average of the economic cost of labor and materials and equipment. The weighting is based on their respective cost shares. The conversion factor (CF) for civil works was estimated to be 0.98. The item 'materials and equipment' was adjusted for foreign exchange premium since import duties and taxes were treated as a separate item. (CF = 1.25)

There were two types of labor services employed in the investment stage of the project: in-house engineering services and independent consultant services. For the consulting services, it is reasonable to assume that they are paid their market value and so their economic cost is equal to the financial cost. (CF = 1.00) For the in-house engineering services, these will be performed by staff members of MWSS. It was assumed that only 70% of the engineering services paid for by the project are incremental, (i.e., 30% of the services performed would have been performed anyway without the project, as a part of normal staff duties); therefore, the conversion factor for these services was taken as 0.7.

The conversion cost for office buildings was taken as in the Jenkins/El-Hifnawi study, CF=1.02. It was assumed that the land market was undistorted and so the financial price was equal to the economic price; CF=1.0. Finally taxes do not represent any resource cost and have an economic cost of zero.

2. Operating Cost Items

The line items under operating and maintenance costs include: wages, chemicals, power, maintenance, changes in accounts payable and changes in cash balance. The conversion factors for chemicals and power were obtained from the Jenkins/El-Hifnawi study and are 0.96 and 1.07 respectively. A CF less than 1 for chemicals reflects the fact that taxes and duties are greater than the foreign exchange premium, while a CF greater than 1 in the case of power reflects, among other things, the subsidized electricity prices. Labor is assumed to be paid its market wage and has a conversion factor of 1.00.

The economic cost of maintenance as a whole is a weighted average of the economic costs of maintenance of the different project components: civil works, buildings, pipes and pumps. The respective cost shares of these items determined their weights and the economic cost of maintenance and its conversion factor were calculated accordingly (CF = 0.96). The conversion factors for changes in accounts receivable and payable are a weighted average of the conversion factors of the components that determine the accounts. Since changes in accounts receivable reflect only one product in this case (water), its conversion factor is simply the same as that of revenue water (2.77). The conversion factor for changes in accounts payable is 1.0, the weighted average of the conversion factors of all of the operating costs (except labor). The conversion factor for changes in cash balance is taken simply as 1.0.

D. Results

The conversion factors obtained above (and summarized in Annex 14) are applied to the real cash flows from the financial analysis to obtain the economic cash flow statement. The economic cash flows are presented in Annex 15. The project has an economic NPV of about 2,878 million 1991 pesos, indicating that the project adds to the net wealth of the Philippines.

The economic returns are much higher than the financial returns, due to two main reasons. First, the economic benefits of water are much higher than the financial tariff. The large difference between the financial tariff charged by the project (5.135 pesos per cu m) and the value revealed by consumers when buying from water vendors or when operating private wells (38 pesos per cu m of vendor water, and 3.8 to 7.6 pesos per cu m of well water) indicates that, with the project, paying customers receive a large consumer surplus. Also, the piped water distribution project will be able to supply water much more efficiently than currents sources. With the project, the price of water will fall, and the original water suppliers will reduce production. The resources released by this cutback are a benefit to the overall economy.

Second, currently about 50% of the total water supplied by the project earns no revenue (expected to drop to 32% by 2004), and roughly half of this amount is pilfered water or water provided free. Although there are no financial receipts associated with this water, it still has an economic value to the user (estimated to be 7.68 pesos per cubic meter) and must be included in the economic net benefit statement.

A	B	C	D	E	F	G	H	I	J	K

ANNEX 11
ESTIMATES OF WILLINGNESS TO PAY FOR WATER

A. Indicators of willingness to pay

1. Using water vendors

(water delivered by truck to households)	1994	1990	Inflation Index
Price (pesos/cu m)	53.33	37.80	1.41

2. Operating private wells

	With overhead tank	Without overhead tank
Capital expenditures (1994 pesos)		
Overhead tank	30,000	
Pressure tank		3,000
Pump	3,500	3,500
Pump house	5,000	5,000
Others (pipes, elec.)	7,500	7,500
TOTAL	46,000	19,000
Operating expenditures (1994 pesos)		
Maintenance (5% of capital)	2,300	950
Electricity	1,620	1,620
TOTAL	3,920	2,570

Year	1	2	3	4	5	6	7	8	9
Water production (cu m/year)	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	
ESTIMATION OF LEVELIZED COST									
a. With overhead tank	46,000	3,920	3,920	3,920	3,920	3,920	3,920	3,920	(6,000)
Present value of cost @10% (1994)	62,285								
Levelized production @ 10%	5,842								
Levelized cost per cubic meter (1994)	11								
Levelized cost in pesos/ cu m (1990)	7.56								
b. Wout overhead tank	19,000	2,570	2,570	2,570	2,570	2,570	2,570	2,570	
Present value of cost @10% (1994)	31,512								
Levelized production @ 10%	5,842								
Levelized cost per cubic meter (1994)	5								
Levelized cost in pesos/ cu m (1990)	3.82								

NOTES:
1. Inflation rate is taken at 12% for 1991, and at an annual rate of 8% for 1992-1994. The cumulative inflation for the period 1990-1994 is 41%.
2. The discount rate used for estimating levelized production and costs is 10%.
3. The overhead tank is assumed to have a productive life of 10 years. The residual value is determined on the basis of the straight line depreciation method.
4. The economic life of the pump is assumed to be 8 years.

A	B	C	D	E	F	G	H

ANNEX 12a
ECONOMIC BENEFITS OF WATER SUPPLY

Benefits to Paying Users

The economic benefits of the incremental water supplied by the project equals the value of increased consumption, plus the value of the resources released by the reduced production of other water sources (vendors and wells). Since water from vendors ("drinking water") is valued more highly than well water ("washing water"), the overall economic benefit of water (Pe) to paying consumers is a weighted average of the two types of water. The economic benefit per cubic meter of water estimated below is based on production at the end of year 2004, after MWSS has completed its expansion project, including all additional connections.

Since the water project is designed to meet consumption requirements at the end of year 2004, it is assumed that at this point, water supply and demand will be in equilibrium. In our analysis, the estimation of water's economic value, or economic price (Pe) per unit, to paying users at the end of 2004, was considered to represent the economic value of water throughout the life of the project. A more complete analysis would estimate a separate economic price per unit for each of the thirty years of the project's life, which would allow the economic price per unit to be adjusted for the effect of any de facto rationing which may occur in some years.

A. Benefits to Paying Users of Water for Washing

Cost incurred to operate private well (from annex 11)			
With overhead tank		7.56	pesos/cu. m
Without overhead tank		3.82	pesos/cu. m
	Average Cost =	5.69	pesos/cu. m
Initial Market Price	Pso = Pdo =	5.69	pesos/cu. m
Estimated Quant. consumed without Project in 2005	Qdo = Qso =	1,108,823	cu. m. per day
New Market Price	Ps1 = Pd_1 =	5.135	pesos/cu. m
Total Quantity Demanded	Qd_1 =	1,162,887	cu. m. per day
New Quantity Provided by Wells	Qs1 =	1,000,696	cu. m. per day
Project Quantity	Qp =	162,190	cu. m. per day
Es =	1.00	(Elasticity of Supply of Producers)	
Nd =	-0.50	(Elasticity of Demand of Consumers)	
Ws = Es / [Es - {Nd * (Qdo/Qso)}]	=	0.667	
Wd = -Nd / [Es - {Nd * (Qdo/Qso)}]	=	0.333	

Economic Price per Unit Pe = Wd * Av.Pd +Ws * Av.Ps

= [.667 * ((Pdo + Pd_1)/2)] + [.333 * ((Pso + Ps_1)/2)]

= 5.412 Pesos per cu. m

Alternatively (Looking at the Graph):

Economic Value of Washing Water/day EV/day = (Qd1 - Qo) * ((Pdo + Pd_1)/2) + (Qo - Qs1)*((Pso+ Ps_1)/2)

= ((1,162,887 - 1,108,823) * ((5.690 + 5.135)/2) + (1,108,823 - 1,000,696)*((5.690 + 5.135)/2)

= 877,843 Pesos per Day

Economic Price per Unit Pe = (877,844 /162,190)

Pe = 5.412 Pesos per cu. m.

Risk Variable 0

Pe After Risk = 5.412

A	B	C	D	E	F	G

ANNEX 12b

B. Benefits to Paying Users of Water for Drinking

		1990 p/cu m		
Initial Market Price		Pso = Pdo =	37.80	pesos/cu. m
Estimated Quant. consumed without Project in 2005		Qo=	42,933	cu. m. per day
Minimum vendor price		Ps_2 =	18.90	pesos/cu. m
New Market Price		Pd_1=	5.135	pesos/cu. m
Total Quantity Demanded*		Qd_1=	54,063	cu. m. per day
New Quantity Provided by Water Vendors*		Qs_1 =	0.0000	cu. m. per day
Project Quantity		Qp=	54,063	cu. m. per day
Es =	2.00	(Elasticity of Supply of Producers)		
Nd =	-0.3	(Elasticity of Demand of Consumers)		
Ws = Es / [Es - {Nd * (Qdo/Qso)}]		=	0.870	
Wd = -Nd / [Es - {Nd * (Qdo/Qso)}]		=	0.130	

Note that since the water vendors completely leave the market
the simple weighted formula(Wd * Av.Pd +Ws * Av.Ps) would overestimate the economic value of resources saved.
Hence, the most straightforward method of estimating economic benefits of drinking water is to refer to the graph.

From at the Graph:

Economic Value of Drinking Water/day

EV/day = $(Qd1 - Qo) * ((Pdo + Pd_1)/2) + (Qo - Qs_1)*((Pso + Ps_1)/2)$

= (54,063 - 42,933) * ((37.8 + 5.135)/2) + (42,933 - 0)*((37.8 +18.90)/2)

= 1,456,064 Pesos per Day

Economic Price per Unit

Pe = (1,456,064 /54,063)

Pe = 26.93 Pesos per cu. m.

Risk Variable 0.00

Pe After Risk = 26.93 Pesos per cu. m.

Average Economic Benefit of Water Consumption to Paying Users:

Overal $Pe = Pe_{wells} * (Qp_{wells}/Qp_{wells} + Qp_{vendors}) + Pe_{vendors} * (Qp_{vendors}/Qp_{wells} + Qp_{vendors})$

= 10.79 Pesos per cu. m.

Conversion Factor = Economic Price (Pe)/ Financial Price

= 10.79 / 5.135

= 2.102

A	B	C	D	E	F	G	H

ANNEX 12c

lenefits toNon-Paying Users

Non-paying users receive water for free, due to authorized free use, under-billing, or theft. Before the project, about fifty percent of the vater distributed by MWSS did not earn revenue. Half of the non-revenue water (51%) was used by non-paying consumers, while the other half was lost due to leakage in the system. Over the course of the project, MWSS aims to reduce the percentage of non-revenue water from 50% to 32% by the end of its expansion investment period in 2004. We assume that non-revenue water remains at 32% throughout the remainder of the project nd that the percentage of non-revenue water that is used by non-payingconsumers remains at 51%.

As with paying users, a portion of the water used by non-paying consumers is for drinking and, on average, has a higher value than he water that they use for washing. In the calculation of the paying users'economic benefits above, in 2004, about 25% of the water supplied by he project is used for drinking, while the remaining 75% is used for other purposes (household washing, watering gardens, etc.). This analysis assumes hat for non-paying consumers, these same proportions hold and 25% of the water consumed is for drinking, while the remaining 75% is for other uses. The economic benefit per cubic meter of water for non-paying users is a weighted average of the per unit benefit of water for drinking and water for washing. The Economic benefit per unit is calculated as of the end of 2004, and this per unit benefit is assumed to hold for all years of the project's life.

A. Benfits to Non- Paying Users of Water for Washing

Seventy-five percent of the water used by consumers without payment is used for washing. Since the average price of well water is 5.69 pesos per cubic meter, we assume that the value of the washing water to non-paying consumers ranges between 5.69 pesos/cu. m. and zero pesos/cu.m. (Since non-paying users receive the water for free, at the margin non-paying users' willingness to pay would be zero.) The economic benefits can be seen in the graph on the following page. Numerical calculations of the economic benefits are shown below.

At the end of 2004:

Estimated total quantity of water used by non-paying users =		51,901	cu. m. per day
Percent of water used for washing =		75%	
The quantity of washing water used by non-paying users =		38,926	cu. m. per day
The value of wash water to non-payers ranges between:		5.69	pesos/cu. m
	and:	0	pesos/cu. m
Total Economic Value of washing water equals [(5.69 + 0)/2] *38,926 =		110,741	pesos per day
		2.84	pesos/cu. m
	Risk Variable	0.00	
	=	2.84	pesos/cu. m

A	B	C	D	E	F	G	H

ANNEX 12d

3. Benfits to Non- Paying Users of Water for Drinking

Twenty-five percent of the water used by consumers without payment is used for drinking. Since the average price of vendor water is 37.8 pesos per cubic meter, we assume that the value of the drinking water to non-paying consumers ranges between 37.8 pesos/cu. m. and zero pesos/cu.m. (Again, since non-paying users receive the water for free, at the margin non-paying users' willingness to pay would be zero.)

At the end of 2004:

Estimated total quantity of water used by non-paying users =	51,901	cu. m. per day
Percent of water used for drinking =	25%	
The quantity of drinking water used by non-paying users =	12,975	cu. m. per day
The value of drinking water to non-payers ranges between:	37.80	pesos/cu. m
and:	0	pesos/cu. m

Total Economic Value of drinking water equals [(5.69 + 0)/2] * 12,975 = 245,226 pesos per day

Pe =	18.90	pesos/cu. m
Risk variable	0.00	
Pe (after Risk) =	18.90	pesos/cu. m

Average Economic Benefit of Water Consumption to Non-Paying Users:

$$\text{Overal Pe} = Pe_{wash} * (Qp_{wash}/Qp_{wash} + Qp_{drink}) + Pe_{drink} * (Qp_{drink}/Qp_{wash} + Qp_{drink})$$

= 6.86 Pesos (1990) per cu. m.

A	B	C	D	E	F

ANNEX 13a
CONVERSION FACTORS FOR PROJECT'S INPUTS

1. Economic cost of foreign exchange* 0.246

2. Economic cost of capital* 10.30%

3. Investment Cost Items

3a. Civil works Conversion Factor = 0.98

Civil works constitutes labor, material and equipment. To find the conomic cost of civil works, one needs to find the economic cost of each component and then find a weighted average. The weighting is based on the respective cost shares.

3b. Material and equipment Conversion Factor = 1.25

Since tariffs and taxes have been treated separately, the only distortion affecting the economic price of this item is due to the foreign exchange premium.

*3c. Office buildings** Conversion Factor = 1.02

The economic cost of this item is a weighted average of the economic costs of all its components.

3d. Consulting services Conversion Factor = 1.00

As there is no reason to pay these consultants more than their market value, their economic cost is considered equal to their financial cost.

3e. Land Conversion Factor = 1.00

As there are no distortions in the land market, the economic price is considered equal to the financial price.

3f. In-House engineering services Conversion Factor = 0.70

It is assumed that 70% of the services are incremental, and would not have been performed without the project. It is also assumed that the providers of these services are paid their market value. Therefore, the conversion factor is 0.7*1.0.

3g. Taxes and duties Conversion Factor = 0.00

These are transfers, and do not reflect any economic costs.

cont'd

A	B	C	D	E	F

ANNEX 13b
CONVERSION FACTORS FOR PROJECT'S INPUTS (cont'd)

4. Operating Cost Items

4a. Wages — Conversion Factor = 1.00

Workers are paid their market value.

*4b. Chemicals** — Conversion Factor = 0.96

The financial price has been adjusted for duties, taxes and the foreign exchange premium.

4c. Power* — Conversion Factor = 1.07

The conversion factor of 1.07 reflects the subidized electricity prices, taxes on inputs, and the foreign exchange premium.

4d. Maintenance — Conversion Factor = 0.96

The economic cost of maintenance is the weighted average of the economic costs of the maintenance of the specific components. These are civil works, buildings, pipes and pumps. Their respective cost shares determine their weights and the economic cost and conversion factor for maintenance are determined accordingly.

4e. Changes in accounts payable — Conversion Factor = 1:00

The conversion factor for accounts payable is the weighted average of all the operating cost items (excluding labor). Ideally one should estimate a conversion factor for each year since the cost shares of the operating cost items are likely to change over time. However, as the item 'changes in accounts payable' is a small cost item and the cost shares of the components of operating costs (excluding labor) do not change much over the life of the project, an average was used. In this case, the average was 1.00.

4f. Changes in cash balance — Conversion Factor = 1.00

The economic cost of the cash held is equal to its financial cost.

4g. Changes in accounts receivable — Conversion Factor = 10.79

The conversion factor for accounts receivable is the weighted average of the conversion factor for all revenue items.

Source: Jenkins, Glenn P. and El-Hifnawi, Mostafa Baher, " Economic Parameters for the Appraisal of nvestment Projects: Bangladesh, Indonesia, and the Philippines" Report for the Economics and Development Resource Center, Asian Development Bank, 1994.

A	B	C	D	E	F

ANNEX 14
SUMMARY OF CONVERSION FACTORS

OUTPUT				
Revenue water	2.10			
Ch. in acc. receivable	2.10			
Non-Revenue water*	Undefined	Economic value	7.68	(1991 pesos per cu m)
INPUTS				
Investment Items				
Civil works	0.98			
Equipment and materials	1.25			
Office buildings	1.02			
Consulting services	1.00			
Land	1.00			
In-house eng. services	0.70			
Taxes and duties	0.00			
Operating and Maintenance items				
Wages	1.00			
Chemicals	0.96			
Power	1.07			
Maintenance	0.96			
Ch. in acc. payable	1.00			
Ch. in cash balance	1.00			

*. Since the financial price for non-revenue water is zero, the conversion factor is undefined.

ANNEX 15

PROJECTED ECONOMIC STATEMENT OF COSTS AND BENEFITS
(million of 1991 pesos)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	Conversion Factor/ Economic Cost *	1991	1992	1993	1994	1995	1996	1997	...2000	...2005	...2010	...2015	...2020	...2024	2025
ECONOMIC BENEFITS															
Benefits to paying users	2.10			47.74	179.69	316.70	415.99	506.46	651.52	777.34	777.34	777.34	777.34	777.34	0.00
Change in accts. rec.	2.10			(11.94)	(33.87)	(37.58)	(30.69)	(30.33)	(21.85)	(14.40)	(14.40)	(14.40)	(14.40)	(14.40)	179.94
Benefits to non-paying users*	7.68			18.99	60.89	91.23	101.42	108.49	139.56	145.52	145.52	145.52	145.52	145.52	0.00
GROSS ECONOMIC BENEFITS				54.80	106.71	370.35	486.73	584.62	769.23	908.46	908.46	908.46	908.46	908.46	179.94
ECONOMIC COSTS															
Investments															
Civil works	0.98		92.21	198.96	193.41	43.18	36.08	32.89	15.36						
Equipment and materials	1.25		145.19	301.01	302.56	73.82	56.24	51.26	23.94						
Office buildings	1.02		4.19	4.19											
Consulting services	1.00	1.55	1.22	0.59	0.33										
Land	1.00	28.00													
In-house eng. services	0.70	25.53	12.76	12.76	9.57										
Taxes and duties	0.00														
Operating and maintenance															
Wages	1.00			7.89	28.03	46.92	58.81	69.66	95.09	119.74	132.20	145.96	161.16	174.44	0.00
Chemicals	0.96			1.36	4.75	7.79	9.57	11.11	14.30	16.31	16.31	16.31	16.31	16.31	0.00
Power	1.07			1.93	6.74	11.06	13.59	15.79	20.31	23.16	23.16	23.16	23.16	23.16	0.00
Supplies & other exp.	0.96			1.19	4.16	6.82	8.38	9.73	12.52	14.28	14.28	14.28	14.28	14.28	0.00
Income tax	0.00														
Change in accts. payable	1.00			(1.00)	(2.55)	(2.49)	(1.73)	(1.65)	(1.40)	(0.88)	(0.88)	(0.88)	(0.88)	(0.88)	11.06
Change in cash balance	1.00			0.92	0.69	0.42	0.25	0.21	0.15	0.09	0.10	0.11	0.12	0.12	(15.70)
GROSS ECONOMIC COSTS		55.08	255.58	529.81	547.68	187.53	181.19	188.99	180.26	172.69	185.16	198.93	214.13	227.43	(4.65)
NET ECONOMIC BENEFITS		(55.08)	(255.58)	(475.01)	(340.98)	182.83	305.54	395.63	588.97	735.77	723.30	709.53	694.33	681.04	184.58
NPV @	10.30%	2,877.55													

* The financial price for non-paying users of water is zero and so the conversion factor is undefined. To find the annual economic benefits for this group, the economic benefit per cubic meter is multiplied by the annual number of cubic feet used.

VI. Distributive Analysis

A distributive analysis is conducted to determine the externalities generated by the project and to identify who benefits and loses by these externalities. The externalities are determined through an analysis of the differences between the economic and financial cash flows. Since financial prices are always expressed at the domestic price level, the economic analysis needs to be expressed at the domestic price level as well to allow for a meaningful comparison of cash flows. The total externalities are estimated as follows:

$$NPV^{ext}_e = NPV^{ec}_e - NPV^{f}_e$$

where:	NPV^{ext}_e	=	NPV of externalities
	NPV^{ec}_e	=	NPV of economic cash flows
	NPV^{f}_e	=	NPV of financial cash flows (all using the economic discount rate)

Applying the above formula results in:

NPV^{ext}_e = 2,877.55 - (377.93)

= 3,255.48 million 1991 pesos

The distribution of these externalities is shown in Annex 16. The total benefits of the project are equal to the financial value of the project, plus the externalities. In the table below is the distribution of the total net benefits of the project, including both its financial value as well as its externalities.

Table 4:
Distribution of Project Net Benefits
millions of 1991 pesos

	Government	Paying Users	Non-Paying Users	Engineering Services	Water Vendors
NPV Proj. @10%	-10.79				
NPV Ext. @10.3%	17.22	2,467.33	939.92	26.53	-195.53
TOTAL	**6.43**	**2,467.33**	**939.92**	**26.53**	**-195.53**

The major beneficiaries of the project are the paying users. They benefit from the externalities of the of the revenue generating water. These externalities are distributed between the consumers/well owners and the water vendors, weighted according to their respective gains or loss in surplus. Annex 16 which presents the estimation and distribution of externalities, shows that paying users would have been willing to pay 2,467 million pesos more for the water than they were charged. The 2,467 million pesos reflect: a) the consumer surplus they gain from the project, b) the loss in producer surplus from reduced well-water operations, (since the consumers are themselves the well owners.), and c)the accounts receivable adjustment for the time value of the three month billing period[15].

Since they get their water free, non-paying users stand to gain 940 million 1991 pesos from the project. Although this group pays nothing for the water they obtain, it is obvious that they receive some benefits from consuming the water. The 940 million pesos is an estimate of how much they value water, and how much they would have been willing to pay for it, if they could not obtain it free.

The engineering services stand to gain 26.5 million pesos from the project due to the fact that only 70% of the services they are paid for are incremental to the project. The remaining 30% would have been performed anyway as part of their regular duties at MWSS. The government would also realize a gain of about 17.22 million 1991 pesos. Although the government gains 162 million in direct duties and taxes on the initial investment, they stand to lose 154 million in foreign exchange premium.[16] These values when combined with the other

[15] If consumers were not able to defer payment for three months the price they would be willing to pay for the water would decline.

[16] Strictly speaking gains and losses of foreign exchange premium are associated with the government as well as any quota holders in the country. Since the amount of the quotas in the Philippines compared to the size of imports is relatively small, all foreign exchange premium have been assumed to be associated with the government.

tax gains and losses, and subsidies on electricity, result in a net gain to the government of 17.22 million pesos.

The clear losers from this project are the water vendors who will be forced out of the market. They will lose about 196 million, which is the loss in their producer surplus net of the adjustment for accounts receivable[17]. The risk of strong political opposition to the project on the part of the water vendors is probably quite low, given the overall project aim to improve the health of one of Manila's most needy regions. However, some steps could still be taken to win the water vendors support for the project.

[17] The vendors receive payment immediately, and not after three months, as is the case with MWSS.

A	B	C	D	E	F	G	H	I	J

ANNEX 16
DISTRIBUTION OF EXTERNALITIES
(millions of 1991 pesos)

	(A) PV Financial at Economic Discount Rate of 10.30%	(B) PV Economic at Economic Discount Rate of 10.30%	(B-A) PV of Externalities
BENEFITS			
Revenue Gener. Water	2,148.23	4,515.02	2,366.79
Change in accts. rec.	(86.22)	(181.21)	(94.99)
Benefits from non-revenue water		939.92	939.92
TOTAL BENEFITS	2,062.01	5,273.74	3,211.73
COSTS			
Investments			
Civil works	510.32	500.11	(10.21)
Equipment and materials	624.87	778.59	153.72
Office buildings	7.11	7.25	0.14
Consulting services	3.39	3.39	0.00
Land	28.00	28.00	0.00
In-house eng. services	81.26	54.72	(26.53)
Taxes and duties	162.32	0.00	(162.32)
Operating and maintenance			
Wages	710.43	710.43	0.00
Chemicals	102.19	98.10	(4.09)
Power	130.22	139.34	9.12
Maintenance	89.50	85.92	(3.58)
Income tax			
Change in accts. payable	(11.54)	(11.54)	0.00
Change in cash balance	1.87	1.87	0.00
TOTAL COSTS	2,439.94	2,396.19	(43.75)
NET BENEFITS	(377.93)	2,877.55	3,255.48

DISTRIBUTION OF EXTERNALITIES

Government	Non-Paying Users	Paying Users*	Engineering Services	Water Vendors
		2,570.50		(203.71)
		(103.17)		8.18
	939.92			
10.21				
(153.72)				
(0.14)				
			26.53	
162.32				
4.09				
(9.12)				
3.58				
17	940	2,467	27	(196)

* As these are the net benefits of the externalities, this includes the the benefits of the consumer surplus on drinking and wash water, minus the loss in well owner's producer surplus, due to the fact that the well owners are the consumers.

consumption can use this type of sensitivity analysis to estimate the tradeoffs between financial sustainability and increased consumption.

Table 5:
Sensitivity of Financial and Economic NPV to Price and Quantity Changes

Price (1991 Pesos per Cubic Meter)	Quantity Consumed* (Cubic Meters per Day in 2005)	Financial NPV (Mlls. of 1991 Pesos)	Economic NPV
4.80	274,671	-141.68	2,917
4.90	274,671	-99.62	2,917
5.00	274,671	-57.57	2,917
5.10	272,213	-19.23	2,902
5.135	**268,155**	**-10.79**	**2,878**
5.20	259,636	2.86	2,825
5.30	243,289	17.17	2,725
5.40	221,179	19.59	2,590
5.50	189,605	2.51	2,397
5.60	140,838	-49.99	2,099
5.70	67,039	-155.70	1,648

* Quantity Consumed includes both paying and non-paying consumption.

As the operations phase of this project is highly labor intensive, the real increase in the wage rate has a large impact on the financial returns to the project. Lowering the annual increase in the real wage rate from 2% to 1% significantly increases the NPV. Clearly, this is

a critical variable that should not be ignored in the analysis. The analysis also shows that a 2% investment cost overrun would lower the project NPV by about 30 million pesos.

Table 6:
Sensitivity of Financial NPV to Real Wage Increases and Cost Overruns

Real Wage Increase	Financial NPV (Mlls. of 1991 Pesos)
-2%	304
-1%	244
0%	173
1%	89
2%	-11
3%	-130
4%	-272
5%	-444

Cost Overruns	Financial NPV (Mlls. of 1991 Pesos)
-2%	18
0%	-11
2%	-40
4%	-68
6%	-96
8%	-125
10%	-154
15%	-225

As shown in Table 7 below, if the project meets just 80% of its target number of installation connections each year, rather than the expected installation efficiency of 84%, the NPV of the project would drop by about 45 million pesos, indicating that small changes in the installation efficiency have a large impact on the financial NPV. As for the percentage of non-revenue water, a 2% reduction would result in a13 million peso increase in NPV.

Table 7:
Sensitivity of Financial NPV to Installation Efficiency and Non-Revenue Water

Installation Efficiency	Financial NPV (Mlls. of 1991 Pesos)
72%	-146
76%	-101
80%	-56
84%	-11
88%	26
92%	50

% of Non-Revenue Water	Financial NPV (Mlls. of 1991 Pesos)
20%	66
30%	4
32%	-11
40%	-129
50%	-282
60%	-422

If the period of accounts receivable does not reach its target level of 3 months from its current level of 5.5 months but instead declines only to 4 months, the net present value of the project will drop by about 30 million pesos.

The impact of inflation on the returns to this project is relatively small primarily due to the absence of the tax effects (the project does not pay any corporate taxes). An increase in the rate of inflation affects the returns of the project adversely through the changes in accounts receivable and in cash balance while the project gains from the changes in accounts payable. In this case, the net impact of an increase in the expected rate of inflation from 8% to 9% results in a 4 million peso reduction in NPV.

Table 8:
Sensitivity of Financial NPV
to Length of Billing Period and Inflation

Billing Period (A/R Months)	Financial NPV (Mlls. of 1991 Pesos)
1.5	33
2.0	18
2.5	4
3.0	-11
3.5	-26
4.0	-40

Domestic Inflation	Financial NPV (Mlls. of 1991 Pesos)
5%	1
6%	-3
7%	-7
8%	-11
9%	-15
10%	-18

A sensitivity analysis was conducted on the economic net present value to see how it would change if the true economic benefit of water varied considerably from our estimated value. Table 9 on the following page looks at the effect of variations in the economic benefit of water to paying users, while the second varies the benefits to non-paying users. Variations in the economic benefits to paying users have a much larger affect on the economic NPV of the project, due to the fact that much more water is used by paying users than by non-paying users.

Table 9:
Sensitivity of Economic NPV
to Variations in the Economic Benefits to Paying Users

Wash Water (Economic Value, Pesos/ Cubic Meter)	Economic NPV (Mlls. of 1991 Pesos)
3.5	2,302
4.0	2,452
4.5	2,603
5.0	2,753
5.412	**2,878**
5.5	2,904
5.5	3,055
6.0	3,205

Drinking Water (Economic Value, Pesos/ Cubic Meter)	Economic NPV (Mlls. of 1991 Pesos)
15	1,680
18	1,981
21	2,282
24	2,583
26.93	**2,878**
27	2,884
30	3,185
33	3,487

Table 10:
Sensitivity of Economic NPV
to Variations in the Economic Benefits to Non-Paying Users

Wash Water (Economic Value, Pesos/ Cubic Meter)	Economic NPV (Mlls. of 1991 Pesos)
1.0	2,688
1.5	2,739
2.0	2,791
2.5	2,842
2.84	**2,878**
3.0	2,893
3.5	2,945
4.0	2,996

Drinking Water (Economic Value, Pesos/ Cubic Meter)	Economic NPV (Mlls. of 1991 Pesos)
9	2,538
12	2,641
15	2,744
18	2,847
18.9	**2,878**
21	2,950
24	3,052
27	3,155

VIII. Risk Analysis of Financial and Economic Returns

The main drawback of the deterministic analysis is the implicit assumption that the single values used for all variables are known with a 100% certainty and consequently that the estimated NPV for the project is 100% certain. To overcome this drawback, a risk analysis was conducted where a number of risk variables was identified on the basis of the sensitivity analysis. The distribution and range of values for these variables were then determined and any possible correlations between them were built in. The outcome of the analysis is also a probability distribution showing the possible returns and the probabilities of their occurrence. The risk variables, and their corresponding ranges of values and probability distributions are shown in Table 11. (Annex 18 shows the input data from the risk variable table in the RiskMaster analysis.)

The expected values of all distributions are the base values used in the deterministic financial analysis. Each of the risk variables, with the exception of the installation efficiency factor for connections, was simulated once and the result was to hold throughout the life of the project. For example, if the simulated period for accounts receivable period was 4 months, this value would be used throughout the life of the project. The underlying assumption is that the agency will successfully meet its target or will fail to meet it and will remain at some other value, in this case 4 months. However, with respect to the installation efficiency of the connections, this could vary from year to year depending on managerial, administrative and political considerations, so a risk variable was assigned to each year from 1993 to 2004.

The results of the risk analysis (Annex 19) show that the expected value of the Financial Equity NPV is -39.07 million 1991 pesos, which is relatively close to the deterministic value of -10.79[18]. One of the most important statistics in the table is the

[18]Risk analysis was conducted using "Riskmaster" a computer software package developed by Savvakis C. Savvides. See "Risk Analysis in Investment Appraisal", HIID Discussion Paper No, 276, October 1988.

Table 11:
Risk Variables, Probability Distributions, and Range Values

Risk variable	Base value	Probability distribution	Minimum value	Maximum value
Ability of MWSS to meet Non-Revenue water targets	100%	normal	-25%	+25%
Investment cost overrun factor	0	normal	-20%	+20%
Paid Washing Water Economic Benefits	5.412	normal	-40%	+40%
Paid Drinking Water Economic Benefits	26.93	normal	-40%	+40%
Free Washing Water Economic Benefits	2.84	normal	-40%	+40%
Free Drinking Water Economic Benefits	18.90	normal	-40%	+40%
			Range value	Probability
Tariff adjustment lag factor[19], 1993-2024	0.9125	step	.75 - .80 .80 - .90 .90 - 1.00 1.00 - 1.10	0.10 0.30 0.50 0.10
Installation efficiency factor for connections	.84	step	.60 - .80 .80 - 1.00	0.30 0.70
Average accounts receivable period, months[20]	3	step	1 - 2 2 - 3 3 - 4 4 - 5	0.10 0.45 0.30 0.15

[19] Note that the upper bound of the distribution for the variable 'tariff adjustment lag factor' was 1.1. The additional 10% was intended to capture the possibility of the project adjusting the tariff in such a way that more than offset losses from previous lags in adjustment.

[20] The probability distribution is based on MWSS' current record and on its program for reducing its level of accounts receivables.

probability of negative return, which is about 58%. The results of the risk analysis confirm the conclusions of the financial analysis that MWSS will stand to lose financially if it undertakes the project under the current regime of water tariffs.

The risk analysis also tested the robustness of the economic returns by allowing the true economic value of the water to vary for both paying and non-paying users. According to the risk analysis, there is zero probability of the project having a negative economic return, even when the economic benefits of both revenue and non-revenue water may vary up to forty per cent above or below the estimations used in the deterministic analysis. The chart in Annex 20 presents the graph of the cumulative distribution for the equity (financial) and economic NPVs of the project.

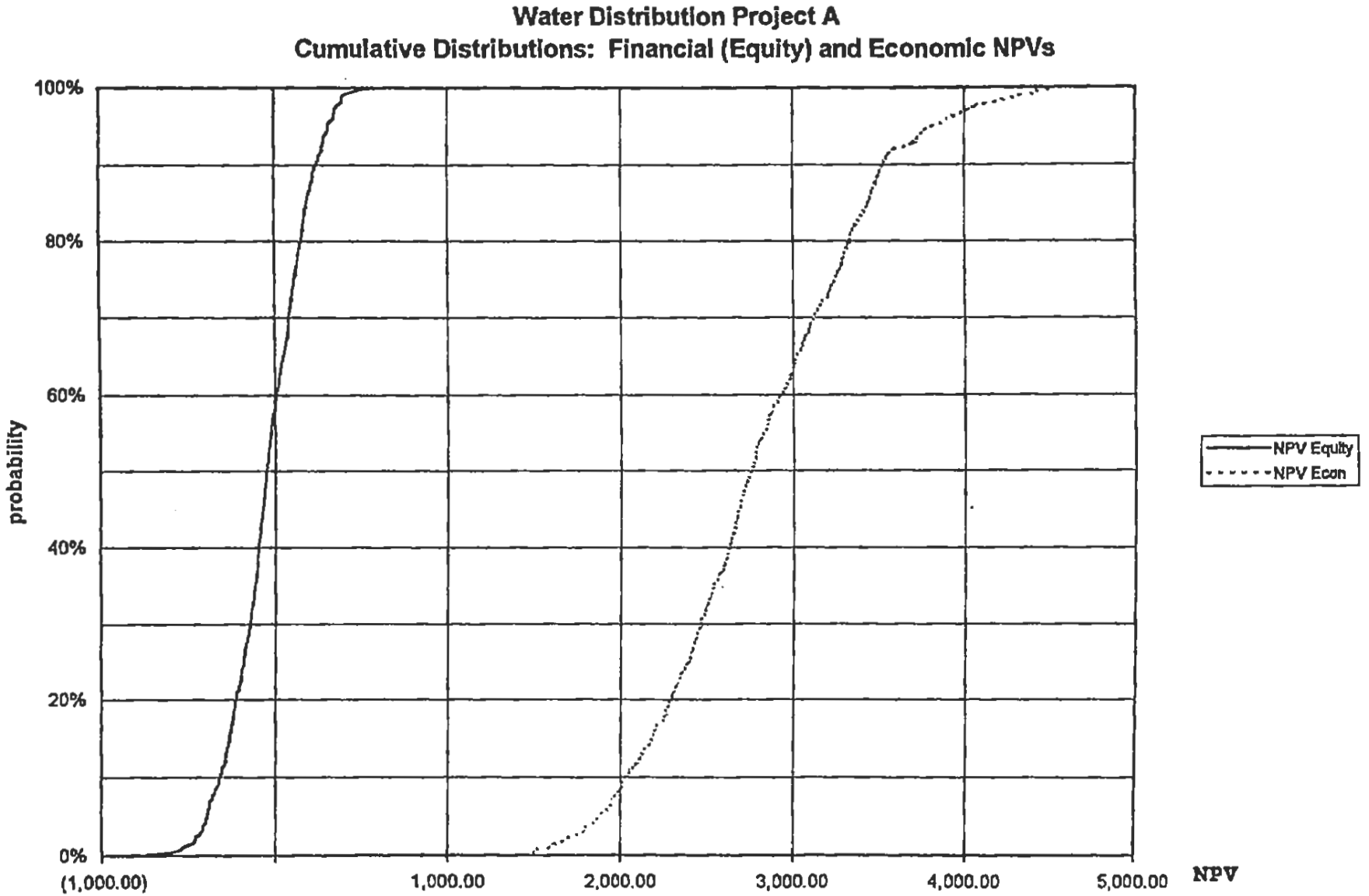
The risk analysis also modeled the expected distribution of the project's net benefits to each of the parties involved. The expected value of the project's net benefits to the government, which includes both the externalities the government receives and the financial NPV of the project has a 56% probability of being negative. Most other groups involved, the paying users, the non-paying users, and engineering services, all had a zero probability of receiving negative net benefits from the project. However, the water vendors had a 100% probability of negative benefits. The distributions of the expected values of the net benefits are depicted graphically in Annex 21, 22, and 23.

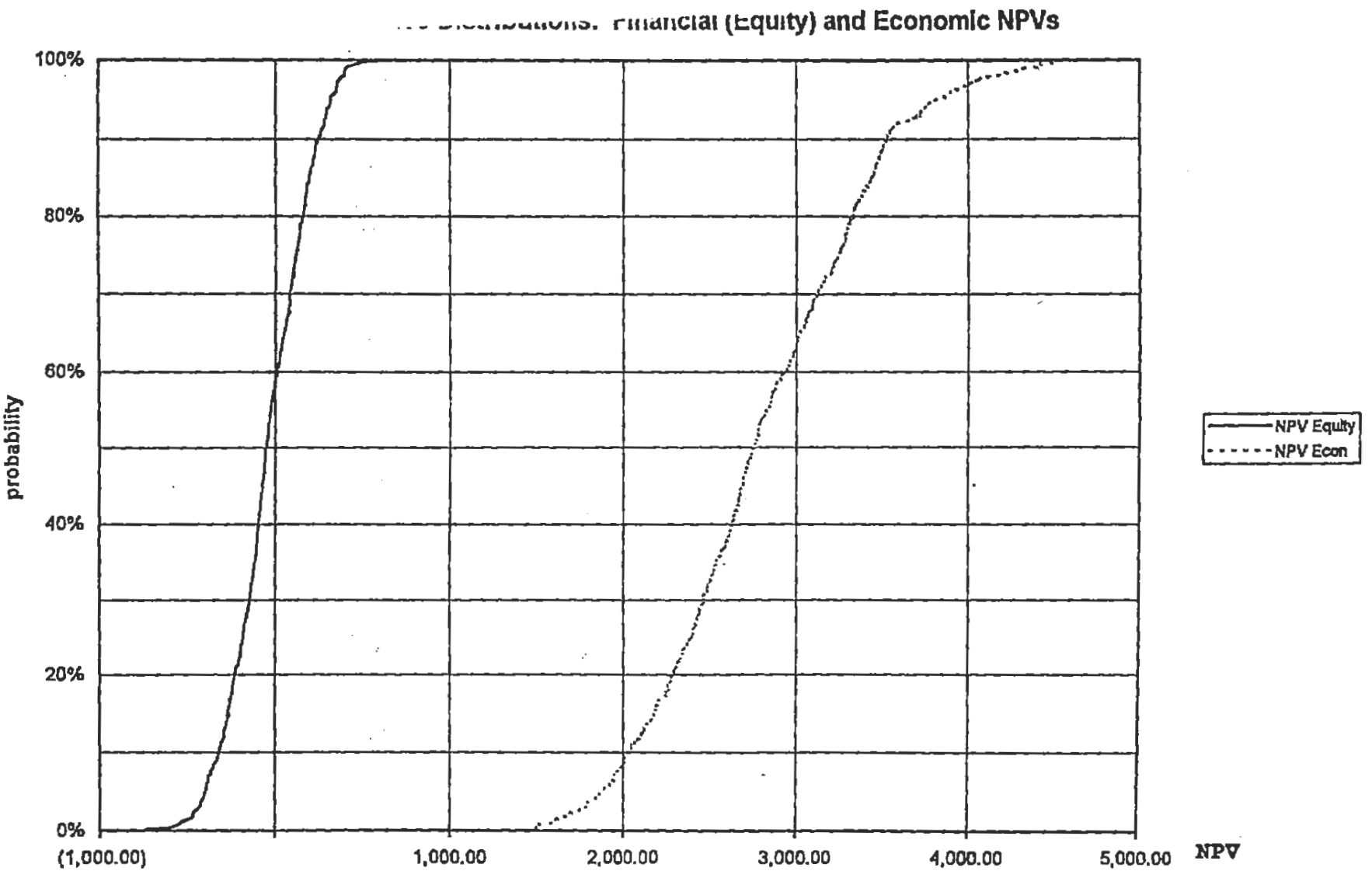
ANNEX 18

Water Distribution Project A											
RV No.	Risk variable Description	Base value	Prob. distr.	Range MIN	Range MAX	Skewness	Truncation MIN	Truncation MAX	Correlations rd_Ve	[-1,	1]
1	Inst. Eff. F 93	0.8	STEP	0.6	1						
2	Inst. Eff. F 94	0.8	STEP	0.6	1						
3	Inst. Eff. F 95	0.8	STEP	0.6	1						
4	Inst. Eff. F 96	0.8	STEP	0.6	1						
5	Inst. Eff. F 97	0.8	STEP	0.6	1						
6	Inst. Eff. F 98	0.8	STEP	0.6	1						
7	Inst. Eff. F 99	0.8	STEP	0.6	1						
8	Inst. Eff. F 00	0.8	STEP	0.6	1						
9	Inst. Eff. F 01	0.8	STEP	0.6	1						
10	Inst. Eff. F 02	0.8	STEP	0.6	1						
11	Inst. Eff. F 03	0.8	STEP	0.6	1						
12	Inst. Eff. F 04	0.8	STEP	0.6	1						
13	% NRW goal met	100%	NORM	-0.25	0.25	0%					
14	Inv. Cost Ovrn	0%	NORM	-20%	20%	0%					
15	Tariff Lag Fac	91%	STEP	75%	110%						
16	A/R Period Mos.	3	STEP	1	5						
17	Wash Ec.Ben N-p	0.00	NORM	-0.40	0.40	0%					
18	Drink Ec.Ben N-	0.00	NORM	-0.40	0.40	0%					
19	Wash Ec.Ben Pay	0	NORM	-0.4	0.4	0%					
20	Drink Ec.Ben Pa	0.00	NORM	-0.40	0.40	0%					

RISK ANALYSIS RESULTS *Water Distribution Project A*

	NPV Equity	NPV Econ	Gov. Ben.	N-P User Ben.	Paying User Ben.	Eng. Ben.	Water Vendors
Expected value	(39.07)	2,806.91	-21.73	927.39	2,433.48	26.66	(193)
Standard deviation	215.25	595.61	214.78	160.89	502.88	1.73	40
Minimum	(729.21)	1,485.26	-708.24	459.03	1,325.66	21.88	(323)
Maximum	598.74	4,533.83	613.43	1,487.49	4,071.14	31.73	(105)
Coefficient of varia	-5.510	0.212	-9.886	0.173	0.207	0.065	-0.207
Probability of negat	58.8%	0.0%	56.2%	0.0%	0.0%	0.0%	100.0%


Water Distribution Project A
Cumulative Distributions: Financial (Equity) and Economic NPVs
100%
80%
60%
40%
20%
0%
probability
(1,000.00)
1,000.00
2,000.00
3,000.00
4,000.00
5,000.00
NPV
NPV Equity
NPV Econ


Financial (Equity) and Economic NPVs
100%
80%
60%
40%
20%
0%
probability
(1,000.00)
1,000.00
2,000.00
3,000.00
4,000.00
5,000.00
NPV
NPV Equity
NPV Econ

Water Distribution Project A
Frequency Distribution of Net Government Benefits