ECONOMIC ANALYSIS

1. **Scope of the analysis.** Economic analysis was undertaken in accordance with the Asian Development Bank (ADB) *Handbook for the Economic Analysis of Health Sector Projects*.[1] The analysis covers subprojects, other than technical assistance, that will be partly or wholly financed from the proceeds of the ADB loan. These consist of (i) the expansion of piped sewerage systems in Medan and Yogyakarta and (ii) the construction of decentralized wastewater-treatment plants in low-cost housing complexes in Medan. The piped sewerage systems and decentralized wastewater treatment plants form part of a series of sanitation service-delivery mechanisms that were considered during project preparation, together with various community-based sanitation systems, which will be fully financed by the city governments themselves. The selection of a delivery mechanism was partly based on estimated net economic benefits. For this reason, sewerage systems were proposed only for city centers, where population densities and environmental pressures are high.

2. **Valuation of economic costs and benefits.** All subproject benefits and costs are expressed in constant April 2010 prices excluding taxes and duties, so that the economic internal rate of return is readily comparable to the discount rate of 12%, which is also expressed in real terms. The economic lifetime of all proposed subprojects was estimated at 20 years. Implementation of all subprojects was assumed to start in 2010. The residual value of the piped sewerage systems was estimated at 10% of investment, and of decentralized wastewater treatment facilities at zero. Table 1 provides an overview of economic costs and benefits considered in the analysis.[2]

Table 1: Valuation of Economic Costs and Benefits

Subproject	Economic Costs	Economic Benefits
Expansion of piped sewerage systems	Construction cost (including procurement of equipment) and operation and management costs	Avoided desludging costs, reduced mortality and morbidity
Construction of decentralized wastewater treatment facilities	Construction cost of decentralized wastewater-treatment plants	Reduced mortality and morbidity

Source: ADB estimates.

3. **Valuation of health benefits: Improvement of piped sewerage systems.** The economic benefits of expanding the Medan and Yogyakarta piped sewerage were valued as follows:

(i) **Health benefits.** The primary objective of constructing or expanding a piped sewerage system is to reduce public health costs associated to the discharge of raw sewage into open water bodies. The avoided health costs of having access to a piped sewerage system are estimated on the order of Rp47,500 per person per year in April 2010 prices. In addition, there are a significant number of indirect beneficiaries of the proposed expansion to the Medan and Yogyakarta sewerage systems. Benefits also estimated at Rp47,500 per person per year accrue mainly to households living in the densely populated city centers, where pollution of ground and surface water is widespread.

[1] ADB. 2000. *Handbook for the Economic Analysis of Health Sector Projects.* Manila.

[2] Increased revenue from connection fees and sewer charges were not included, because these revenues are effectively a transfer payment without economic value, especially since the city governments have made payment for sewer connections compulsory in zones served by a sewer system.

(ii) **Avoided desludging costs.** Once a household is connected to a piped sewerage system, it no longer needs to pay for emptying its septic tank. This benefit was estimated at Rp50,000 per household per year (assuming one desludging every 3 years).

4. **Valuation of health benefits: Construction of decentralized wastewater treatment plants.** As explained in the section on financial analysis, the net financial cash flows of these subprojects are zero because household charges were set to cover desludging expenditures. Health benefits to direct beneficiaries were valued at the same rate as gaining access to a piped sewerage system (i.e., Rp47,500 per person per year, in April 2010 prices).

5. **Results of the economic analysis.** For each subproject covered by the analysis, the estimated economic internal rate of return (EIRR) exceeded the threshold value of 12% and was therefore deemed economically feasible (Table 2).

Table 2: Results of Economic Analysis

Subproject	**EIRR** (%)	**ENPV** (Rp billion)
Expansion of piped sewerage systems		
Kota Medan	13.6	17.8
Kota Yogyakarta	16.1	22.6
Construction of decentralized wastewater treatment plants[a]	13.3	0.03

EIRR = economic internal rate of return, ENPV = economic net present value
[a] Per twin block.
Source: Asian Development Bank..

6. **Sensitivity analysis.** Sensitivity tests were conducted to assess the impact of changes to key variables on the EIRR of the proposed expansion of the Medan and Yogyakarta sewerage systems. The tests indicate that the EIRR of the subprojects will remain above the threshold value of 12% in case of adverse changes to key variables (Table 3), except for an unlikely reduction in health benefits in excess of 10% of the expected value, which would render the subproject in Medan economically infeasible.

Table 3.1: Results of Sensitivity Analysis for Medan Sewerage System

Case	**Change from Base Case** (%)	**EIRR** (%)	**ENPV** (Rp billion)	**Switching Value of ENPV** (%)
Base case		13.6	17.8	
Unfavorable changes				
Construction cost	+10	12.0	0.2	+10.0
O&M cost	+10	13.6	17.3	+411.0
Health benefits	–10	11.8	(2.0)	–9.1
Favorable changes				
Construction cost	–10	15.5	35.5	–10.0
O&M cost	–10	13.7	18.4	–411.0
Health benefits	+10	15.4	37.7	+9.1

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance.
Source: Asian Development Bank.

Table 3.2: Results of Sensitivity Analysis for Yogyakarta Sewerage System

Case	Change from Base Case	EIRR (%)	ENPV (Rp billion)	Switching Value of ENPV (%)
Base case		16.1	22.6	
Unfavorable changes				
Construction cost	+10	14.3	13.9	+25.7
O&M cost	+10	16.0	22.2	+655.6
Health benefits	–10	14.1	11.4	–20.3
Favorable changes				
Construction cost	–10	18.2	31.3	–25.7
O&M cost	–10	16.1	23.0	–655.6
Health benefits	+10	18.0	33.8	+20.3

EIRR = economic internal rate of return, ENPV = economic net present value,
O&M = operation and maintenance.
Source: ADB estimates.