ECONOMIC ANALYSIS

A. Introduction

1. The economic analysis aims to assess the economic viability of the proposed project through standard cost–benefit analysis. It was undertaken separately for each of the two sub-outputs relating to urban infrastructure rehabilitation and development—(i) improved water supply systems, and (ii) improved solid waste collection and management—in the three townships of Mawlamyine, Hpa-An, and Myawaddy. The analysis also covered the improvements to cultural heritage buildings in Mawlamyine. The benefits from the proposed assistance to Hpa-An's industrial zone, and the joint spatial and development planning for Mae Sot and Myawaddy, were considered non-quantifiable, so no economic analysis was conducted for these sub-outputs. However, the cost of these sub-outputs, together with the cost of capacity building, was included in the overall project costs to estimate the project's viability. The results for the outputs of each township and the overall project are summarized below.

B. Demand Analysis

2. The demand for better water supply services is evident from the analysis of existing services undertaken as part of the feasibility study, which assessed the incremental supply needed to provide a reliable water supply to the increasing population of the three project towns. An improved service will need to ensure greater reliability of the water supply to existing users, coverage of existing potential users, and additional supply for new potential users resulting from the expected increase in the city's population. Modelling of the water supply undertaken during project preparation indicated that total demand for water will increase between 2020 and 2040 from about 27,500 cubic meters (m^3) per day to about 66,000 m^3/day in Mawlamyine, from about 8,100 m^3/day to about 20,700m^3/day in Hpa-An, and from about 13,700 m^3/day to about 28,600m^3/ day in Myawaddy.[1] Service provision is expected to increase from about 50%–55% in 2020 to 95% in 2040. The overall population of the project area is expected to increase from about 322,900 in 2020 to about 503,700 in 2040.

3. The demand for improved solid waste collection and management services is closely linked to higher incomes and greater awareness of the need for improvements to the local environment, i.e., better health and economic development. Estimates of increased solid waste production made during project preparation indicated that per capita solid waste production will increase from 0.55 kilograms (kg) per day in 2015 to 0.9 kg/day in 2040. Given the expected population growth, this will result in substantial increases in solid waste production even at the highest possible recycling rates. It is critical that this waste is properly collected and managed.

4. The demand for better water supply and solid waste collection and management services is further reinforced by the estimated incremental willingness to pay (WTP) for improved services as determined in a contingent valuation survey undertaken for all project areas. These WTP estimates are generally equal to or more than the existing charges for the services, indicating a positive WTP.

5. The demand for maintaining and improving the heritage aspects of the historical town of Mawlamyine is demonstrated by the recent and expected growth of international tourism and widely recognized interest in historical buildings. With the project, the existing buildings, which are increasingly decaying, will be upgraded and will provide a tourism focus.

[1] Water demand is estimated for the total township and not just the project area.

C. Economic Rationale

6. Water supply for the three project townships is fed from a combination of piped water supply systems, groundwater from wells and springs, and surface water through rivers, canals, streams, lakes, and rainwater. At present, piped water is only available to a limited number of households and its supply is unreliable. Water supply systems are generally old and in poor condition, with pipes highly susceptible to breakages. The water sources are predominantly the large rivers close to the three townships. Water supply also suffers from high levels of nonrevenue water and low charges for the service. Updating to a modern, efficient system is a critical part of urban development as the country develops. Solid waste collection and management systems are currently at an extremely low level of development; waste collection is minimal but labor-intensive, although little, if any, attention is paid to the workers' health. The systems also use old and dilapidated collection vehicles, and unhygienic landfills that are almost at the end of their lives. Much of the solid waste remains uncollected and is deposited along the roads and in watercourses, with a harmful effect on public health and the environment, i.e., pollution of watercourses and groundwater. As is the case with water supply, waste management must be thoroughly modernized in parallel to the expected urban development. Most historic buildings in Mawlamyine, whether public or private, are currently in poor condition but present a potential tourist attraction. Given the limited availability of funds for their restoration, the establishment of a heritage fund through the project would support the development of the region.

7. Without attention to these key areas, the economic development of the project towns will be severely hampered, and the urban community will continue to suffer from water-related diseases and a poor environment. The proposed project would ensure initial progress in resolving these issues.

D. Least-Cost Analysis

8. The least-cost analysis gave particular attention to the integration of the proposed water treatment plants with other existing and planned water treatment plants, and the layout of the water distribution pipes in the three subproject areas. The conclusion from the analysis was that individual systems should focus predominantly on separate subproject areas, although some connections between systems were envisaged. With respect to the solid waste collection and management subprojects, the least-cost analysis was used to evaluate the options for new landfills, alternative approaches to collection, and the need for transfer stations and their possible location. Based on available information, the least-cost option would involve separate new landfills at the township level, which would be close enough to the township to avoid the need for transfer stations. The analysis also determined an appropriate size for the solid-waste collection vehicles.

E. Major Assumptions and Methodology

9. The economic analysis was conducted using Asian Development Bank (ADB) guidelines.[2] The major assumptions are as follows: (i) project investments will be undertaken over a 7-year implementation period starting in 2017; (ii) the project life will be 32 years for the improved water supply and heritage subprojects, and 25 years for the solid waste management subprojects, both including the 7-year implementation period;[3] (iii) financial costs are based on prevailing prices in mid-2015, are expressed in constant 2015 terms, and are the same as those used in the financial analysis; (iv) economic costs and benefits are valued in kyats (MK) using the domestic price

[2] ADB. 1997. *Guidelines for the Economic Analysis of Projects.* Manila; ADB. 1998. *Guidelines for the Economic Analysis of Water Supply Projects.* Manila; ADB. 2013. *Cost–Benefit Analysis for Development: A Practical Guide.* Manila.

[3] The shorter project life for the solid waste management projects reflects the expected life of the new landfills as defined during project preparation.

numeraire; (v) United States dollar costs are converted to MK using an exchange rate of $1 = MK1280; (vi) economic costs and benefits for traded goods are derived by excluding taxes and duties[4] and then adjusting their values by the shadow exchange rate factor, estimated at 1.026; (vii) economic values of nontraded goods (domestic resources) are the same as their financial values; (viii) skilled labor is adjusted to its economic value using an opportunity cost of scarce labor of 1.0, and unskilled labour is adjusted to its economic value using an opportunity cost of surplus labor of 0.9;[5] (ix) the economic value of land, as a part of land acquisition and resettlement costs, is based on its economic opportunity costs; and (x) the economic opportunity cost of capital is 9%.

F. Economic Evaluation

1. Costs and Benefits

10. **Investment costs.** Project investment costs were estimated based on the subproject designs and agreed package costs. Investment costs were aggregated to the output and overall level by year using a Microsoft Excel-based program, and economic costs were derived using the same program. The economic project cost, including physical contingencies, for each subproject and the overall project are shown in Table A.7.1. Additional investment costs were included for (i) the solid waste collection and management subprojects to cover the cost of creating new cells in the landfill site beyond 2023, so as to ensure its efficient management; (ii) the final filling at the end of the landfill's life, and (iii) an expansion of the compost treatment plant as demand arises.

Table A.7.1: Economic Costs of Project Investments by Output and Overall
(MK billion)

Subproject	Total Cost	2017	2018	2019	2020	2021	2022	2023
1. Mawlamyine water supply	21.06	0.02	9.25	4.08	4.18	3.46	0.07	-
2. Mawlamyine solid waste	12.18	0.18	1.59	4.04	6.08	0.29	-	-
3. Hpa-An water supply	11.75	0.01	4.81	4.32	1.27	1.27	0.07	-
4. Hpa-An solid waste	7.19	0.24	0.25	2.45	3.90	0.35	-	-
5. Myawaddy water supply	8.35	-	3.67	2.93	0.84	0.84	0.07	-
6. Myawaddy solid waste	6.53	0.03	0.03	1.08	4.78	0.60	-	-
7. Mawlamyine heritage	1.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17
8. Myawaddy spatial plan	0.88	0.44	0.44	-	-	-	-	-
9. Project management	9.48	2.51	1.49	1.03	0.75	0.71	0.49	0.53
Total	**78.58**	**3.59**	**21.70**	**20.10**	**21.96**	**7.70**	**0.87**	**0.69**

Source: Asian Development Bank estimates.

11. **Operation and maintenance costs.** Incremental operation and maintenance (O&M) costs were specified based on their feasibility-level designs and were separated into skilled and unskilled labor, electricity, chemicals, maintenance, and administration. Financial O&M costs are the same as those used in the financial analysis and were converted to their economic values using appropriate conversion factors. Incremental O&M costs were assessed at 5% of the investment cost based on the type of work that is expected to be required on an ongoing basis.

12. **Benefits.** Since most of the benefits provided by the project investments cannot be valued

[4] Taxes and duties were set at the same rates as those used in ADB. 2015. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Grant to the Republic of the Union of Myanmar for the Mandalay Urban Services Improvement Project*. Manila. As with that project, no local taxes were identified.

[5] Data were collected during the contingent valuation surveys to assess the extent of under- and unemployment of unskilled workers. The results suggest that an opportunity cost of surplus labor of 0.9 is appropriate.

within traditional markets, project benefits are estimated in terms of WTP using a contingent valuation survey approach. The survey was used to assess beneficiaries' WTP for both improved water supply and improved solid waste collection and covered 1,140 households.[6] The data was analysed using the Probit analysis, including slope and dummy variables to capture differences between townships. Based on the explanatory value and significance of coefficients, the mean WTP for improved water supply was determined at MK266.4/m^3 for Mawlamyine, MK119.4/m^3 for Hpa-An, and MK230.7/m^3 for Myawaddy. WTP for solid waste collection was determined at MK2,949.5/household/month for Mawlamyine, MK3,259.5/household/month for Hpa-An, and MK4,430.1/household/month for Myawaddy. The total WTP for improved water supply was estimated based on WTP for domestic water and WTP for non-domestic water. Domestic water consumption was estimated at 120 liters per capita per day, and an income elasticity of WTP of 0.7 was used to reflect an increase in WTP.[7] Population growth rates are the same as those used in the water demand analysis. The total WTP for non-domestic water was estimated using the same unit value, and an estimate of non-domestic water as 10% of domestic water, as in the demand analysis. A similar approach was used for WTP for solid waste collection but with a slightly lower elasticity of 0.5 and non-domestic solid waste estimated at 20% of total solid waste. All benefits were assumed to be incremental.

13. Benefits for the heritage subproject were estimated based on increases in tourism that can be expected following the renovation of several buildings in Mawlamyine. Current and projected international tourism numbers were based on the results of a recent survey by Japan International Cooperation Agency. Tourism growth rates for the current analysis were set at a more modest level of 7.5% per year up to 2025, 5.0% per year from 2026 to 2030, 2.5% per year from 2031 to 2035, and zero thereafter. Each tourist was estimated to spend an average of 0.1 day's additional time with a daily expenditure of $75.[8] No generated tourism was expected to result from the heritage investments.

2. Economic Analysis Results

14. The base analysis indicates that the overall project is economically viable with an economic internal rate of return (EIRR) of 13.1% and an economic net present value of MK1.13 billion (Table A.7.2). The aggregated outputs are economically viable for Mawlamyine and Myawaddy, with EIRRs of 16.4% and 17.0%, but not for Hpa An, with an EIRR of 8.1%. The EIRRs of the water supply are 17.6% for Mawlamyine, 3.0% for Hpa-An, and 14.8% for Myawaddy, and the EIRRs of the solid waste are 13.0% for Mawlamyine, 15.9% for Hpa-An, and 18.7% for Myawaddy. The heritage output in Mawlamyine has an EIRR of 35.5%. The existing high poverty rate in Hpa An,[9] the very low coverage of the piped water supply,[10] the current availability of free river or spring water, and the lack of awareness of water quality, as well as poor hygiene combine to explain the low WTP for an improved water supply, which is needed as a basic service.

[6] Sixty households were randomly sampled in each of 19 wards, which were randomly sampled from each township, with the number being proportionate to the population: 11 wards in Mawlamyine, 5 in Hpa-An, and 3 in Myawaddy.

[7] Since the available data did not permit estimation of the income elasticity, values were used from a similar study: H. Khan. 2014. *Estimating elasticities of demand and willingness to pay for clean drinking water: empirical evidence from a household level survey in northern Pakistan,* Water and Environmental Journal 28, pp. 145–152.

[8] Daily expenditure comprised hotel accommodation ($25/person including breakfast), meals ($20 for lunch and dinner combined), souvenirs ($20), and other expenditures ($10) based on observation of actual practices in Mawlamyine.

[9] Based on the results of the contingent valuation survey and a per capita income of $1.25/day as the poverty line, the poverty incidence is estimated at 65.1% in Mawlamyine, 65.4% in Hpa-An, and 60.1% in Myawaddy.

[10] The results of the 2014 Household Census for Myanmar indicated that only 1.9% of urban residents of Hpa An had access to piped water for drinking and 12.9% had access to piped water for other purposes, compared with 23.1% and 53.5% in Myawaddy, and 9.2% and 29.7% in Mawlamyine.

3. Sensitivity Analysis

15. Sensitivity analyses were conducted for each of the outputs, the combined outputs in each town, and for the overall project. Switching values were estimated for cost increases and benefit decreases. The results indicate that the overall project is sensitive to either a 10% cost increase or a 10% benefit decrease, with EIRRs of 11.2% or 10.8% and switching values of 1.9% or 1.5%. Individual water supply in Mawlamyine and Myawaddy, improved solid waste management in Hpa An and Myawaddy, and heritage subprojects in Mawlamyine are all sufficiently robust with respect to either a cost increase or a benefit decrease. Improved solid waste management in Mawlamyine is sensitive to either a cost increase or a benefit decrease with a change of 7.4% or 5.6%, resulting in the output becoming economically non-viable.

4. Benefit Distribution and Poverty Impact Analysis

16. A benefit distribution analysis was undertaken in accordance with ADB's Guidelines for the Economic Analysis of Projects (footnote 2) to measure the share of project benefits and costs accrued by the poor. Project costs and quantifiable benefits form the basis for the benefit distribution. The poverty incidences were based on the estimated urban poverty incidence from the contingent valuation survey for the project beneficiaries, with a higher value to reflect greater poverty in the rural areas of the towns that will not benefit from the project. The estimated poverty impact ratio is 0.65 based on the high poverty levels and the implicit subsidies that will be provided.

Table A.7.2: Economic Evaluation of the Overall Project, 2016–2047
(MK million)

	Investment Costs				Recurrent Costs				Benefits				
Year	Water supply	Solid waste	Heritage	Others	Water supply	Solid waste	Heritage	Total Cost	Water supply	Solid waste	Heritage	Total	Net Benefits
2017	24	452	164	2,944	-	-	-	3,585	-	-	-	-	(3,585)
2018	17,727	1,878	165	1,928	-	-	8	21,706	-	-	-	-	(21,706)
2019	11,338	7,566	165	1,030	208	-	16	20,324	1,937	-	-	1,937	(18,387)
2020	6,290	14,755	165	754	815	-	25	22,804	3,241	3,322	-	6,563	(16,241)
2021	5,571	1,249	165	713	963	1,139	33	9,833	3,454	4,930	-	8,384	(1,449)
2022	217	-	165	490	1,037	1,139	41	3,089	3,673	5,109	-	8,782	5,693
2023	-	-	165	529	1,127	1,139	50	3,009	3,904	5,297	-	9,201	6,192
2024	-	1,075	-	-	1,174	1,139	58	3,445	4,149	5,490	294	9,933	6,488
2025	-	8,234	-	-	1,403	1,139	58	10,834	4,411	5,784	631	10,826	(8)
2026	-	-	-	-	1,538	1,139	58	2,735	4,694	6,008	1,018	11,720	8,986
2027	-	690	-	-	1,631	1,139	58	3,517	4,996	6,252	1,459	12,707	9,190
2028	-	1,075	-	-	1,760	1,139	58	4,032	5,306	6,508	1,961	13,775	9,743
2029	-	-	-	-	1,943	1,139	58	3,139	5,634	6,766	2,529	14,929	11,790
2030	-	920	-	-	2,107	1,139	58	4,224	5,982	7,038	3,172	16,192	11,968
2031	-	-	-	-	2,244	1,139	58	3,441	6,340	7,323	3,410	17,074	13,633
2032	-	1,075	-	-	2,244	1,139	58	4,516	6,721	7,623	3,581	17,925	13,409
2033	-	-	-	-	2,244	1,139	58	3,440	7,125	7,938	3,760	18,823	15,382
2034	-	690	-	-	2,244	1,139	58	4,130	7,545	8,255	3,948	19,748	15,618
2035	-	920	-	-	2,244	1,139	58	4,361	7,991	8,588	4,145	20,724	16,364
2036	-	1,075	-	-	2,244	1,139	58	4,516	8,447	8,937	4,353	21,736	17,220
2037	-	-	-	-	2,244	1,139	58	3,440	8,929	9,303	4,461	22,693	19,253
2038	-	-	-	-	2,244	1,139	58	3,440	9,440	9,687	4,573	23,700	20,260
2039	-	-	-	-	2,244	1,139	58	3,440	9,981	10,090	4,687	24,759	21,318
2040	-	-	-	-	2,244	1,139	58	3,440	10,555	10,513	4,804	25,872	22,432
2041	-	1,881	-	-	2,244	1,139	58	5,321	10,899	10,689	4,924	26,513	21,192
2042-48	-	-	-	-	2,244	-	58	2,302	13,646	-	4,924	18,571	16,269
ENPV =	29,492	22,032	753	6,270	8,848	5,472		73,170	32,159	33,051	9,091	74,301	1,131
EIRR =													12.2%

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value.
Source: Asian Development Bank estimates.