ECONOMIC AND FINANCIAL ANALYSIS

1. **Base and project scenarios**. Without urgent rehabilitation works, it is expected that sections targeted under the Road Rehabilitation Project will quickly deteriorate to an unmaintainable level. Road provider and road user costs are compared between with- and without-project scenarios. The with-project case involves reconstruction and strengthening of the existing pavement, double bitumen surface treated chip seal pavement, and improvements to the vertical profile to ensure proper drainage.

2. **Additional financing**. Final bid prices received for the project road sections were much higher than originally appraised, necessitating previous additional financing from the Asian Development Bank (ADB) and other development partners in 2015.[1] The currently proposed additional financing will fund network missing links in highly trafficked areas in Betio and Bairiki. This includes rehabilitation of (i) 4.9 kilometers (km) of the Betio loop road, (ii) 0.6 km of the Betio link road, (iii) 1.4 km of the Bairiki main road, and (iv) 0.5 km of feeder roads in Bairiki. In total, the proposed additional scopes of work are estimated to cost $6.8 million. In particular, this analysis focuses on the economic viability of the Betio Loop Road and Betio Link Road sections targeted by the proposed additional financing (Table 1). These roads represent vital transportation links that connect residences with places of employment and government offices in Kiribati's main population center in South Tarawa.

Table 1: Betio Loop Road and Betio Link Road Sections

Section	Length (meters)	Estimated cost ($)
Betio loop road	4,900	4,311,000
Betio link road	600	269,000
Total	**5,500**	**4,580,000**

Source: Asian Development Bank estimates.

3. **Economic costs**. Project economic costs exclude price contingencies, taxes, duties, royalties, and subsidies. Kiribati uses the Australian dollar (A$) as its domestic currency, and Australia is also the country's main trading partner. Comparative data on price levels between the two countries suggest that Kiribati's real exchange rate vis-à-vis Australia is overvalued by about 12%. Given a shadow exchange rate factor (SERF) of 1.12 and the use of a world price numeraire, a standard conversion factor (SCF) of 0.89 is applied to all non-tradable inputs. Further, a shadow wage rate factor (SWRF) of 0.90 is applied to the unskilled labor component, which is 8% of additional capital costs.[2] Project roads are projected to have an economic life of 20 years, assuming periodic maintenance and strengthening.

4. **Economic benefits**. The benefits to road users were estimated by comparing road user costs between the base and project scenarios. Quantified road user benefits include vehicle

[1] ADB. 2010. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Republic of Kiribati for the Road Rehabilitation Project*. Manila; ADB. 2015. *Report and Recommendation of the President to the Board of Directors: Proposed Grant for Additional Financing to the Republic of Kiribati for the Road Rehabilitation Project*. Manila. While the project's original plans included a section for rehabilitating the Betio causeway road, the causeway and revetment were further damaged by extreme spring tides in January–March 2014 and by the impacts of Cyclone Pam in March 2015. As the revetment is already considered past its design life and exhibits significant deterioration, the Betio causeway pavement and asphalt resurfacing section of the project were deleted from the civil works contract. As these works were removed from the scope, the bridge rehabilitation works were excluded from the economic analysis.

[2] The shadow wage rate factor of 0.90 is consistent with the economic analysis undertaken for the ongoing South Tarawa Sanitation Improvement Sector Project.

operating costs (VOC) and journey time savings, as well as reductions in traffic delay. VOC benefits considered mostly tradable (e.g., imported replacement vehicles and vehicle parts, fuel and oil), except for a small labor component. Time savings are non-tradable and are adjusted accordingly by the SWRF and SCF, consistent with the use of a world price numeraire.

5. **Economic modeling**. Annual streams of economic capital and operating costs are compared with annual economic VOC and time savings benefits to derive net present values (at a discount rate of 12%) and economic internal rates of return (EIRRs). All costs and benefits are expressed in 2016 constant prices. The period of analysis is 20 years, from 2016 to 2035. Sensitivity testing was applied to the EIRR against construction cost, base traffic level, traffic growth rate, and a 1-year delay to project construction.

6. **Road user costs: vehicle operation and time**. Unit cost data for vehicle replacement, tire replacement, fuel, and oil were collected from local suppliers. In the case of gasoline and diesel, the economic cost was assessed using current retail prices excluding duties and taxes. Fuel forms a significant component of VOC. A summary of economic VOC is in Table 2, while estimated with- and without-project VOC are contrasted in Table 3. The economic value of passenger time savings derived from faster travel times on smoother roads are valued using latest available estimates of hourly passenger time costs.

Table 2: Economic Road User Costs

Item	Passenger Car	Passenger Van	Light Truck
Vehicle cost ($)	29,500	41,250	83,250
Tire cost ($)	230	95	165
Fuel cost ($/liter)	1.02	1.02	1.24
Lubricant oil cost ($/liter)	4.50	4.50	4.50
Crew cost ($/hour)	1.83	1.83	1.83
Maintenance labor ($/hour)	13.76	13.76	13.76
Passenger time cost ($/hour)	0.46	0.46	$0.46
Annual utilization (km/year)	15,000	60,000	60,000
Number of passengers	3	8	4

km = kilometer.
Sources: Asian Development Bank and World Bank estimates.

Table 3: Vehicle Operating Costs—With and Without Project

	Without Project			With Project		
	Passenger Car	Passenger Van	Light Truck	Passenger Car	Passenger Van	Light Truck
Betio loop road and Betio link road	0.52	0.53	0.99	0.46	0.44	0.84

Note: Estimated with- and without-project vehicle operating costs for the St. Anne–Airport Intersection segment of the ongoing project are assumed for these additional sections, given similar pre-rehabilitation characteristics (i.e., international roughness indexes and number of potholes).
Sources: Asian Development Bank and World Bank estimates.

7. **Financial sustainability**. Project roads are non-revenue-earning, and were constructed and are operated by the Ministry of Public Works and Utilities (MPWU)—a noncommercial unit that receives annual budget allocations for operation and maintenance of infrastructure assets. During 2013-2016, the MPWU has consistently had A$500,000 allocated for annual maintenance of infrastructure assets. Of this, around one-fifth (A$102,000) is allocated for road maintenance. Such allocations are about double the required annual maintenance funding for

project roads, which cover most of the road network in the population center of South Tarawa. This would leave substantial resources for maintaining other minor roads outside the scope of the project. Recent and ongoing policy reforms are refocusing scarce resources toward funding of essential government functions and services, including infrastructure operation and maintenance.

8. **Road geometry and condition.** The terrain in South Tarawa is flat, with the road positioned about 3 meters above the mean sea level. The existing road is well aligned through its length, and realignment is not necessary. The condition of the existing pavement is generally poor. The average international roughness indexes (IRI) per section was estimated conservatively; derived values correspond to road conditions observed after a period of dry weather and repairs.[3] Periods of wet weather cause rapid deterioration of poorly drained sections, many of which have reverted to gravel pavement. In sealed sections, potholes proliferate during wet conditions, and it is evident that the base roughness values will rise significantly unless the pavement is urgently rehabilitated. However, the coral limestone forms a good subgrade, and pavement failure in the form of rutting, heaving, or shoving is absent.

9. **Traffic forecast.** The vehicle fleet using the project roads has grown rapidly since 2010. However, since population growth in South Tarawa is slowing, traffic growth is expected to moderate. Some increase in vehicle numbers is expected to result from significantly improved road conditions upon completion of the project (Table 4).

Table 4: Traffic Forecast

(%)

Item	Passenger Car	Passenger Van	Light Truck
Share of daily traffic	28	40	32
Traffic growth: 2010–2015	4	4	4
Traffic growth: 2015–2025	3	3	3
Traffic growth: after 2025	2	2	2

Sources: Asian Development Bank estimates and World Bank estimates.

10. **Economic viability.** The additional project sections yield an overall EIRR of 35.6%. Robust economic viability is driven by a combination of high traffic volumes and lower costs per kilometer for these sections relative to other roads previously rehabilitated under the project. As the additional financing funds network missing links in highly trafficked areas, the same high returns reflecting significant transport cost savings from the 6,000 vehicles per day utilizing a much improved pavement wearing course also accrue to these additional sections.[4] Sensitivity analyses shows that the additional project sections maintain EIRRs well above the standard benchmark of 12% even under adverse scenarios, where (i) capital costs increase by as much as 20%, (ii) benefits in the form of cost savings for road users are lower by 20%, (iii) traffic growth is 20% less than projected in the base scenario, thereby reducing the number of target beneficiaries, or (iv) project construction is delayed by 1 year (Table 5).

[3] At an IRI of 6, roads are generally still usable by two-wheel-drive vehicles, albeit at low speeds; an IRI of 8 indicates rough and slow travel that is commonly damaging to two-wheel-drive vehicles.

[4] To put these high rates of return in perspective, consider that South Tarawa roughly has the same population density as Hong Kong or Tokyo. However, whereas these advanced cities have various land-based transportation options, the main road network in South Tarawa represents the only link (there are not even any alternate routes or side streets) connecting people with places of employment, basic services, and markets. High economic viability therefore reflects high demand and benefits from usage of this crucial road network.

Table 5: Summary of Economic Analysis

Item	Base	Capital Costs		Road User Costs		Traffic		Delay
		–20%	+20%	–20%	+20%	–20%	+20%	(+1-yr)
Betio Loop Road								
EIRR (%)	36.3	43.1	31.4	33.3	39.2	35.1	47.4	34.1
ENPV ($ million)	*8.9*	*9.6*	*8.1*	*7.5*	*10.2*	*9.5*	*16.3*	*7.6*
Betio Link Road								
EIRR (%)	24.9	28.9	21.8	20.5	29.0	24.5	36.6	21.3
ENPV ($ million)	*0.3*	*0.4*	*0.3*	*0.2*	*0.4*	*0.4*	*0.8*	*0.2*
Total								
EIRR (%)	**35.6**	**42.1**	**30.8**	**32.5**	**38.6**	**34.4**	**46.7**	**33.1**
ENPV ($ million)	***9.2***	***10.0***	***8.4***	***7.8***	***10.6***	***9.9***	***17.1***	***7.8***
(Switching value)	…	…	*+228.0%*	*(128.6%)*	…	…	…	…

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

11. **Details of project costs and benefits.** The projected net benefit stream under the base scenario for the design life of the Betio loop road and the Betio link road are presented in Tables 6 and 7, respectively. These provide further context regarding the expected magnitudes of annual costs and benefits associated with road rehabilitation works on these additional project sections.

Table 6: Net Benefit Stream of Rehabilitated Betio Loop Road

($ million)

Year	Capital Costs	Maintenance Costs	VOC Savings	Passenger Time	Net Benefits
2016	(4.24)	(0.04)	(0.43)	(0.42)	(5.13)
2017	0.00	(0.04)	0.89	0.87	1.72
2018	0.00	(0.04)	0.92	0.90	1.77
2019	0.00	(0.04)	0.94	0.92	1.83
2020	0.00	(0.04)	0.97	0.95	1.88
2021	0.00	(0.04)	1.00	0.98	1.94
2022	0.00	(0.04)	1.03	1.01	2.00
2023	0.00	(0.04)	1.06	1.04	2.06
2024	0.00	(0.04)	1.09	1.07	2.13
2025	0.00	(0.04)	1.13	1.10	2.19
2026	0.00	(0.04)	1.15	1.12	2.24
2027	0.00	(0.04)	1.17	1.15	2.28
2028	0.00	(0.04)	1.20	1.17	2.33
2029	0.00	(0.04)	1.22	1.19	2.37
2030	0.00	(0.04)	1.24	1.22	2.42
2031	0.00	(0.04)	1.27	1.24	2.47
2032	0.00	(0.04)	1.29	1.27	2.52
2033	0.00	(0.04)	1.32	1.29	2.57
2034	0.00	(0.04)	1.35	1.32	2.63
2035	0.00	(0.04)	1.37	1.34	2.68
EIRR					**36.34%**

( ) = negative, EIRR = economic internal rate of return, VOC = vehicle operating cost.
Source: Asian Development Bank estimates.

Table 7: Net Benefit Stream of Rehabilitated Betio Link Road

($ million)

Year	Capital Costs	Maintenance Costs	VOC Savings	Passenger Time	Net Benefits
2016	(0.26)	(0.04)	(0.04)	(0.02)	(0.36)
2017	0.00	(0.04)	0.08	0.03	0.08
2018	0.00	(0.04)	0.08	0.03	0.08
2019	0.00	(0.04)	0.09	0.03	0.08
2020	0.00	(0.04)	0.09	0.04	0.09
2021	0.00	(0.04)	0.09	0.04	0.09
2022	0.00	(0.04)	0.09	0.04	0.10
2023	0.00	(0.04)	0.10	0.04	0.10
2024	0.00	(0.04)	0.10	0.04	0.10
2025	0.00	(0.04)	0.10	0.04	0.11
2026	0.00	(0.04)	0.11	0.04	0.11
2027	0.00	(0.04)	0.11	0.04	0.11
2028	0.00	(0.04)	0.11	0.04	0.12
2029	0.00	(0.04)	0.11	0.04	0.12
2030	0.00	(0.04)	0.11	0.05	0.12
2031	0.00	(0.04)	0.12	0.05	0.13
2032	0.00	(0.04)	0.12	0.05	0.13
2033	0.00	(0.04)	0.12	0.05	0.13
2034	0.00	(0.04)	0.12	0.05	0.14
2035	0.00	(0.04)	0.13	0.05	0.14
EIRR					**24.86%**

( ) = negative, EIRR = economic internal rate of return, VOC = vehicle operating cost.
Source: Asian Development Bank estimates.