ECONOMIC AND FINANCIAL ANALYSIS

A. General

1. The Kyrgyz Republic economy grew by 4.6% in 2016 and is projected to grow by 3.5% in 2018 and 4.0% in 2019.[1] The number of vehicles registered, the majority of which were secondhand, increased threefold during the period between 2005 and 2015. Table 1 shows vehicle registration numbers in 2015.

Table 1: Registered Vehicles in the Kyrgyz Republic, 2015
(number of vehicles)

Motorcycles	Cars	Buses	Trucks	Trailers	Special Vehicles	Total
6,528	809,260	42,439	121,675	25,548	9,902	1,015,352

Source: Government of the Kyrgyz Republic.

2. Road transport plays a dominant role in the transport system of the Kyrgyz Republic, accounting for up to 58% of cargo and 78% of passenger traffic in 2017. The total length of the road network is about 35,000 kilometers (km), of which 18,585 km are public roads maintained by the Ministry of Transport and Roads (MOTR), with the remaining 16,415 km maintained by cities and villages, and agricultural, industrial, and other entities. Public roads are classified as international (4,100 km, including 2,242 km of international transport corridors), national (5,335 km), and local (9,149 km) roads. There are 7,579 km of paved public roads, including 10 km with cement concrete pavement, 5,698 km with asphalt concrete pavement, and 1,871 km with black gravel pavement. The remainder are gravel roads (9,388 km) and earth roads (1,617 km).

3. International transport corridors carry 75% of road traffic in the country, provide the Kyrgyz Republic with access to regional markets for goods and services, and play an important role in linking main domestic economic centers. From a regional perspective, Central Asia Regional Economic Cooperation (CAREC) Corridors 1 and 3 form a large “X”, with the Kyrgyz Republic at the intersection. Corridor 1 connects the Kyrgyz Republic to the western part of the Russian Federation and Europe to the northwest, and the People’s Republic of China to the east. Corridor 3 links the Kyrgyz Republic to the eastern part of the Russian Federation to the northeast, and the Middle East and South Asia to the southwest. Within the Kyrgyz Republic, the two corridors form a major backbone for domestic and international travel, connecting the country’s northern and southern regions via the capital city of Bishkek.

4. This additional financing is part of a joint effort by development partners to rehabilitate the connector road. These investments strengthen the connection between CAREC corridors 1 and 3, via the Issyk-Kul region. The population of the Issyk-Kul region was 463,900 as of 2015, with the majority living around Issyk-Kul Lake, in particular in the cities of Balykchy and Karakol.[2] The Issyk-Kul region has the potential to become a major tourist destination, but its remoteness and underdeveloped infrastructure hinders its development. The main activity in the region is agriculture, primarily cattle breeding. The connector road also serves the Kumtor gold mine, 80 km south of Issyk-Kul Lake near the border with the People’s Republic of China. Key data on the road sections (sections 1 and 2A defined below) to be rehabilitated under this additional financing is summarized in Table 2.

[1] Asian Development Bank (ADB). 2018. *Asian Development Outlook: How Technology Affects Jobs*. Manila.
[2] Government of the Kyrgyz Republic, National Committee on Statistics. *The Population of O*blasts, *Districts, Cities and Urban Settlements in the Kyrgyz Republic in 2015*. http://www.stat.kg/media/statisticsoperational/cfb97050-ad28-455d-acc1-2c384344d7d0.pdf.

Table 2: Key Data on Road Sections to be Rehabilitated under the Additional Financing

Road Section	Section Details	Expected Output	Length (km)	Scheduled Construction Start	Scheduled Construction End	Scheduled Opening
1	Balykchy 0 km–43 km	Reconstruction into Technical category II, IRI=1.8	43	2019	2021	2022
2A	Kochkor 62+580 km–Epkin 89 km	Reconstruction into Technical category II, IRI=1.8	25	2019	2021	2022

Note: Section numbers have been revised from the original project.
IRI = international roughness index, km = kilometer.
Source: Asian Development Bank estimates.

5. This analysis is an extension to that conducted for the original CAREC Corridors 1 and 3 Connector Road Project,[3] with a focus on those sections to be rehabilitated under the additional financing. The analysis addresses investment costs of those sections based on the updated detailed design, and baseline traffic and traffic forecasts based on the most recent traffic counts conducted in June 2017. All other aspects, such as maintenance and rehabilitation standards, unit costs for vehicle operating costs, and value of time, remain the same as the current project, with the exception of the addition of a performance-based maintenance (PBM) component.

6. **With-project scenario.** The project will improve sections 1 and 2A, and finance the subsequent routine and periodic maintenance of these sections through the introduction of PBM. The originally proposed 3-year defect liability period of the main contractor will be replaced by a 5-year PBM contract with an appropriate service-level agreement. In the fourth year of the PBM, there is an allowance for periodic maintenance to ensure the roads are handed over in excellent condition. PBM routine activities will be necessary to address conditions of road assets such as pothole patching, crack sealing, edge repairs, ditch and shoulder maintenance, and other summer and winter routine maintenance tasks, and will be based on the service-level agreement with performance levels defined for each road asset. Periodic maintenance is assumed to be a thin overlay with asphalt concrete of 50 millimeters applied when international roughness index (IRI) values above 6 are recorded—this to be followed by further routine maintenance as described earlier in this para. Given the currently low budget allocations for road maintenance in the Kyrgyz Republic, this is intended to shift the burden more to the private sector, contributing to the longevity of the improved road sections and enhance the associated economic benefits.

7. **Without-project scenario.** This involves only routine maintenance of the existing road. Without the project, road roughness, as measured by the IRI, would inevitably deteriorate further to an average IRI value of 16 within 12 years, rendering it unmaintainable going forward.

B. Traffic Studies

8. Manual classified traffic counts were conducted for both project road sections, recording data on vehicle type, vehicle country of registration, travel direction, and time (hour) of day. Traffic count results were converted into annual average daily traffic (AADT) by using official weekly and seasonal correlation factors issued by the government. In addition, an origin–

[3] ADB. 2016. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Grant to the Kyrgyz Republic for the Central Asia Regional Economic Cooperation Corridors 1 and 3 Connector Road Project.* Manila.

destination survey was carried out at km 87 in Sosnovka village in August 2015. The origin–destination survey was accompanied by manual classified counts and conducted for a minimum of 12 hours (or as long as daylight permitted). The observed AADT for both project road sections is in Table 3. The Asian Development Bank (ADB) revised the original traffic counts in 2017.

Table 3: Observed Annual Average Daily Traffic, 2017

Road *Section*	*Section Details*	*AADT*
1	Balykchy 0 km–42+939 km.	563
2A	Kochkor 62+580 km–Epkin 89 km	1,498

AADT = annual average daily traffic.
Source: Asian Development Bank estimates.

9. Future traffic was estimated for a 25-year period after the opening of the road sections in 2022. The estimated traffic is divided into (i) normal traffic (i.e., traffic that would use the road in the absence of the project), (ii) generated traffic (i.e., new traffic stimulated by road improvement), and (iii) diverted traffic (i.e., traffic that would divert from other routes to the improved road and collectively make up induced traffic).

10. Normal traffic was assumed to grow in line with gross domestic product (GDP). From 2018 to 2024, GDP growth forecasts from the International Monetary Fund were used, i.e., 4.6% per annum.[4] From 2025, growth was assumed to drop to 4.1% per annum, declining further to 3.6% in 2030 and 3.1% in 2036. Elasticity values used to translate the GDP growth figures into traffic growth rates were 1.2 for passenger vehicles and 1.1 for goods vehicles during 2016–2024, 1.10 and 1.05 during 2025–2029, and 1.05 and 1.00 during 2030–2041. For road section 1, a 1.2% higher growth rate was used during 2018–2029 and about 1.0% higher in 2030–2040 as in the original project preparation to provide consistency. This slightly higher growth rate was necessary because the traffic count in June 2017 was not conducted in the high tourist season (mid-July to late August), which was the case in 2015.

11. The existing condition of the road sections is very poor and traffic demand is suppressed. Rehabilitation of the road sections is conservatively assumed to generate an additional 1% of traffic annually for 10 years after the opening of each road section. Diverted traffic was estimated based on several assumptions made using the results from the origin-destination survey, as well as local knowledge of traffic conditions. Diverted traffic was assumed to be 284 vehicles per day for section 1 and 2,998 vehicles per day for section 2A in the opening year of 2022. The forecast AADT for the project road sections is presented in Table 4.

Table 4: Forecast Annual Average Daily Traffic

Road Section	2020	2025	2030	2035	2040
1	683	1,308	1,712	2,178	2,702
2A	1,756	5,988	7,400	8,887	10,407

Note: Includes generated and diverted traffic.
Source: Asian Development Bank estimates.

C. Economic Costs

12. The economic costs of the roads to be rehabilitated under the additional financing comprise (i) capital investment, which includes civil works, land acquisition and resettlement,[5] as

[4] IMF. 2017. *World Economic Outlook Database.* Washington D.C.
[5] The opportunity cost of land was computed based on net agricultural output foregone.

well as consulting services for construction supervision and social safeguards management; and (ii) road maintenance. Taxes, duties, and financing charges during implementation are not counted as economic costs. Table 5 gives a breakdown of the investment costs for each of the road sections.

13. Financial costs were converted to economic costs in line with ADB's guidelines.[6] The economic analysis was conducted based on the world price numeraire. A distinction was made between traded (on average 60%) and non-traded goods (applying foreign content of 15%) for all cost items. A standard conversion factor of 0.914 was applied to non-traded goods. A shadow wage rate factor of 1 was applied for skilled labor, and 0.80 for unskilled labor. The shadow wage rate factor was calculated in accordance with ADB's guidelines.[7]

Table 5: Financial Cost Estimate
($ million)

Road Section	Land Acquisition and Resettlement	Civil Works	Consulting Services[a]	Taxes	Physical Contingencies	Price Contingencies	Total
1	0.00	37.37	6.82	6.8	3.64	1.91	56.54
2A	0.07	27.92	6.82	5.03	2.75	1.35	43.94
Other[b]	1.53	167.16	14.45	24.33	16.75	18.42	241.58
Total							**342.06**

Note: All costs are in 2017 prices.
[a] Excludes 3.3 million for the road asset management system.
[b] Includes road sections improved under the original project, and those financed by development partners.
Source: Asian Development Bank estimates.

14. For road maintenance costs, a distinction between traded and non-traded goods and shadow pricing was carried out in the same way as in case of the investment costs, with labor and mechanical cost separated. A residual salvage value of the roads is assumed to be equivalent to 30% of the investment cost.

D. Economic Benefits

15. The incremental economic benefits of the project are (i) vehicle operating cost (VOC) savings, (ii) value of time (VOT) savings, and (iii) reduced routine maintenance costs for the government. Benefits were calculated separately for normal and generated traffic. For generated traffic, the "rule of half" was applied as per standard practice, which implies that the net consumer surplus averages half of the change in the generalized cost of travel.

16. **Vehicle operating cost savings.** VOC savings accrue from better traffic conditions and a higher level of service on the improved road. Unit rates for VOCs per km for different IRI values were sourced from the Highway Design and Management model. The IRI values for the upgraded road are forecast to start from 1.8 at completion of the rehabilitation, and remain at 5.0 on average, 25 years thereafter. VOCs were estimated for each vehicle class in mid-2017 prices using data on the price of new vehicles, tires, petrol, lubricating oil, crew wages, annual overhead, cargo, and maintenance costs.

17. **Time cost savings.** Higher permissible vehicle speeds will result from the better alignment, increased level of service, and easier overtaking conditions. Average speeds are

[6] ADB. 2017. *Guidelines for the Economic Analysis of Projects.* Manila.
[7] Footnote 6, Appendix 12

calculated in the Highway Design and Management model by applying speed flow formulae that link average speeds to road type and traffic volumes on roads. The average monthly salary in the Kyrgyz Republic as of January–August 2015 was Som12,617.[8] This equates to Som71.69 per hour based on a 22-day work month and 8 hours of work per day. An adjustment factor of 1.45 was applied for car passengers to account for their relatively higher incomes and an adjustment factor of 0.5 was applied for bus passengers. The value of nonworking time was taken as 20% of the value of working time. The VOT was assumed to increase in line with changes in forecast real GDP per capita. Average vehicle occupancy, which was derived from the origin–destination survey, was about 3.84 persons per car or light vehicle, 7.18 persons per small bus, and 35 persons per large bus. To avoid double counting, VOT calculations did not include any savings related to goods vehicle crew which are already included in the VOC savings calculations. The share of vehicle occupants (including crew) assumed to be traveling for work for each vehicle type is as follows: 33% of car occupants, 100% of light vehicle occupants, and 70% of bus occupants.

18. Disruption to traffic during construction was also taken into account, and is reflected as slightly negative (close to zero) VOT and VOC savings during 2018–2020. For the with-project case, the average speed of small passenger cars was assumed to be 92 km per hour during 2021–2040, while for the without-project case, the average speed was assumed to drop to 39km per hour by 2040.

19. **Routine maintenance cost savings.** The introduction of PBM is assumed to result in reductions in maintenance costs 5 years earlier than otherwise. The World Bank suggests that road agencies adopting PBM across the world have experienced (i) cost savings of 10%–40%; (ii) expenditure certainty, (iii) reductions in their in-house workforces, (iv) improved conditions of contracted road assets and a reduction in the length of roads in poor condition, (v) greater road user satisfaction, and (vi) multiyear financing of a maintenance program.[9] The Washington State Department of Transportation (in the United States) estimated that the prolonged life of road assets from PBM reduced routine maintenance costs by 12% per annum over the economic life of a project.[10] The European Bank for Reconstruction and Development reports that cost savings from PBM in selected countries range from 10% to 50%.[11] Based on these studies, it is conservatively estimated that the PBM for this project will provide 12% savings on routine maintenance costs. Subsequent routine maintenance costs are assumed to be 80% of the PBM final year costs, at $0.7 million per year. These levels of expenditure are sufficient to sustain the improved road conditions for the analysis period.

E. Results of Economic Analysis

20. An economic assessment of the project was carried out using the standard appraisal methodology that compares the incremental benefits against the initial investment costs and required operation and maintenance costs over the 28-year appraisal period (2018–2046). The results are shown in Table 6, expressed as economic internal rate of return (EIRR) and economic net present value (ENPV) at a 9% discount rate. The combined EIRR for road sections 1 and 2A is 22.8% and the ENPV is $143.31 million. These are considered to be

[8] Government of the Kyrgyz Republic, National Statistical Committee. 2015. *Living Standards*. Bishkek.

[9] N. Stankevich, N. Qureshi and C. Queiroz. 2009. *Performance-based Contracting for Preservation and Improvement of Road Assets, Transport Note No. TN-27*, The World Bank. Washington, D.C.

[10] D.R. Luhr and T. C. Rydholm. 2015. *Economic Evaluation of Pavement Management Decisions*. Ninth International Conference on Managing Pavement Assets, Alexandria, Virginia.

[11] European Bank for Reconstruction and Development. 2016. *Policy Paper on Infrastructure: Policy Challenges in the Implementation of Performance-based Contracting for Road Maintenance*. London.

conservative estimates, as the impact on road safety has not been monetized because of lack of data. Table 7 shows the stream of costs and benefits for the project during its economic life. The results indicate that the project is economically viable.

Table 6: Result of the Economic Analysis

Road Section	**ENPV** ($ million)	**EIRR** (%)
1 and 2A	143.31	22.8

EIRR = economic internal rate of return, ENPV = economic net present value.
Note: In 2017 world prices.
Source: Asian Development Bank estimates.

Table 7: Benefit and Cost Streams of Road Sections 1 and 2A
($ million)

Year	Capital Cost	PBM	O&M Winter	O&M Summer	Total Cost	VOC Savings	VOT Savings	Routine Maintenance Cost Savings	Total Benefit	Net Benefit
2018	3.88	0.00	0.00	0.00	3.88	0.00	0.00	0.00	0.00	(3.88)
2019	21.76	0.00	0.00	0.00	21.76	0.00	0.00	0.00	0.00	(21.76)
2020	30.56	0.00	0.00	0.00	30.56	0.00	0.00	0.00	0.00	(30.56)
2021	15.64	0.00	0.00	0.00	15.64	0.00	0.00	0.00	0.00	(15.64)
2022	0.00	0.70	0.00	0.00	0.70	10.83	1.48	0.08	12.39	11.69
2023	0.00	0.71	0.00	0.00	0.71	12.57	1.77	0.09	14.43	13.72
2024	0.00	0.88	0.00	0.00	0.88	14.59	2.10	0.11	16.80	15.91
2025	0.00	0.90	0.00	0.00	0.90	17.16	2.51	0.11	19.78	18.87
2026	0.00	0.93	0.00	0.00	0.93	19.95	2.95	0.11	23.01	22.08
2027	0.00	0.00	0.35	0.36	0.71	22.03	3.29	0.09	25.41	24.70
2028	0.00	0.00	0.35	0.36	0.71	23.73	3.57	0.09	27.39	26.68
2029	0.00	0.00	0.35	0.36	0.71	25.60	3.87	0.09	29.56	28.85
2030	0.00	0.00	0.35	0.36	0.71	27.66	4.19	0.09	31.94	31.23
2031	0.00	0.00	0.35	0.36	0.71	29.60	4.49	0.09	34.18	33.47
2032	0.00	0.00	0.35	0.36	0.71	31.47	4.78	0.09	36.34	35.63
2033	0.00	0.00	0.35	2.69	3.03	32.75	4.99	0.36	38.10	35.07
2034	0.00	0.00	0.35	0.36	0.71	33.85	5.18	0.09	39.12	38.41
2035	0.00	0.00	0.35	0.36	0.71	34.96	5.38	0.09	40.43	39.72
2036	0.00	0.00	0.35	0.36	0.71	36.18	5.61	0.09	41.88	41.17
2037	0.00	0.00	0.35	0.36	0.71	37.15	5.83	0.09	43.07	42.36
2038	0.00	0.00	0.35	0.36	0.71	38.15	6.06	0.09	44.29	43.58
2039	0.00	0.00	0.35	0.36	0.71	39.17	6.30	0.09	45.55	44.84
2040	0.00	0.00	0.35	2.69	3.03	40.22	6.54	0.36	47.13	44.09
2041	0.00	0.00	0.35	0.36	0.71	41.30	6.80	0.09	48.18	47.47
2042	0.00	0.00	0.35	0.36	0.71	42.40	7.07	0.09	49.56	48.85
2043	0.00	0.00	0.35	0.36	0.71	43.54	7.34	0.09	50.97	50.26
2044	0.00	0.00	0.35	0.36	0.71	44.71	7.63	0.09	52.43	51.72
2045	0.00	0.00	0.35	0.36	0.71	45.91	7.93	0.09	53.92	53.21
2046	(21.55)	0.00	0.35	0.36	(20.84)	47.14	8.24	0.09	55.46	76.30
									EIRR (%)	**22.8**
									ENPV	**143.31**

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance, PBM = performance-based maintenance, VOC = vehicle operating cost, VOT = value of time.
Note: Prices are in 2017 world prices (undiscounted).
Source: Asian Development Bank estimates.

21. Sensitivity tests were carried out to determine the effect of variations in key input parameters on the key economic indicators (Table 8). The project is robust against increases in construction cost and lower traffic. One scenario considered the lack of timely provision of maintenance funds (no periodic maintenance intervention after the road is opened to traffic), which would result in a faster deterioration of the surface quality of the road and a lower residual value. It was assumed that periodic maintenance would normally take place every 7 years and the result of not carrying out this maintenance would result in the substantial loss of economic benefits of about 70% from year 7 after the road has been opened, with the residual value of the road decreasing by 50%. Under this scenario, the EIRR drops to 20.4%, highlighting the importance of timely maintenance.

Table 8: Result of the Sensitivity Analysis

Scenario	ENPV ($ million)	EIRR (%)	Switching Value[a] (%)
Base case	143.31	22.8	
10% increase in construction costs	137.66	21.5	253.46
10% decrease in benefits	122.89	21.3	(70.18)
10% increase in construction costs and 10% decrease in benefits	117.24	20.0	
2-year delay in benefits	103.08	18.1	
No periodic maintenance and 20% decrease in residual value	76.60	20.4	

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value
[a] The percent change in the variable needed to make the EIRR equal to the discount rate of 9%.
Source: Asian Development Bank estimates.

F. Results of Financial Analysis

22. The MOTR maintains roads through nine regional road maintenance offices, which undertake maintenance work on an ad hoc basis using a force account approach. Table 9 shows the funds allocated for road maintenance from 2007 to 2017. It shows that the absolute resources (in Som) were generally kept constant. However, the sharp increase in the price of fuel and bitumen (at an average 38% over the period 2012 to 2017) and devaluation of the Som significantly reduced the amount of road works that could be undertaken. Funding between 2015 and 2017 has been at about 1.1%–1.7% of the national budget, which equates to about Som1.6 billion–Som1.8 billion per year. Priority is given to regional corridors.

23. The incremental maintenance costs associated with the project road sections are estimated to be 80% of the annual PBM costs, totaling $16.67 million (undiscounted) during 2027–2046 (Table 7). By 2027, the share of the national budget devoted to road maintenance will need to revert to around 3% (which was about the average during 2007–2009) to meet the maintenance costs of the project road sections.

24. The original project and this additional financing will assist in improving the level of road maintenance works for the entire road network through implementation of a road asset management system. This will support the MOTR in preparing optimized maintenance budgets and enable sufficient budgetary allocations for planned road maintenance. Such work will be coordinated with other development partners with experience in road asset management in the Kyrgyz Republic, including the European Bank for Reconstruction and Development, the Japan International Cooperation Agency, and the World Bank.

Table 9: Budgetary Allocation to the Road Sector, 2007–2017

Year	National Budget (Som million)	Funds for Road Maintenance in National Budget (Som million)	Share of Road Maintenance Funding of the National Budget (%)	United States Dollar–Som Exchange Rate (Som/$)	Funds for Road Maintenance ($ million)
2007	34,136.70	1,058.80	3.10	37.27	28.41
2008	44,698.60	1,564.50	3.50	36.60	42.75
2009	48,105.80	1,293.50	2.69	42.92	30.14
2010	65,666.00	1,552.50	2.36	46.00	33.75
2011	86,099.60	1,344.37	1.56	46.12	29.15
2012	101,521.70	1,684.70	1.66	47.00	35.84
2013	96,679.70	1,846.79	1.91	48.44	38.12
2014	102,899.20	1,730.74	1.68	53.65	32.26
2015	107,657.30	1,792.84	1.67	64.46	27.81
2016	146,853.41	1,618.33	1.10	67.40	24.01
2017	150,150.50	1,804.70	1.20	68.87	26.20

Source: Government of the Kyrgyz Republic, Ministry of Transport and Roads.