ECONOMIC AND FINANCIAL ANALYSIS

A. General

1. Tajikistan is a landlocked mountainous country in Central Asia bordered by Afghanistan, the People's Republic of China, the Kyrgyz Republic and Uzbekistan. Despite its strategic location, the country has a gross domestic product per capita of just $1,037, with 35% of the population living below the poverty line in 2013. Almost 70% of the population lives in rural areas, in a largely mountainous territory (90%), where only 10% of the land is suitable for cultivation.

2. Tajikistan's road network was largely constructed prior to independence. Tajikistan depends heavily on transport corridors to support investment, job creation, trade, and ultimately economic growth and poverty reduction. Ailing transport infrastructure and low network connectivity, coupled with geographic isolation and mountainous terrain, pose significant barriers to the country's economic and social development. In light of this, the Government of Tajikistan has embarked on a long-term program of infrastructure rehabilitation and development.

3. The government has requested ADB assistance to improve portions of the Central Asia Regional Economic Cooperation (CAREC) corridors 2, 5 and 6 by progressively upgrading the 82 kilometer (km) road connecting the capital city of Dushanbe to Kurgonteppa, the capital city of Khatlon province (from there the road continues south to Afghanistan). This is an important road, and the government considers its improvement and widening to be a priority. The project is part of this effort, and will upgrade a 33.2 km section between Dushanbe and Chashmasoron. The project will also improve facilities and safety along this road, strengthen the institutional capacity of the Ministry of Transport (MOT), and complete advance procurement action for the next section of the road to be improved.[1]

4. The road has large potential to support regional integration and inclusive economic growth, but this potential is limited by three factors: (i) road capacity, (ii) road condition, and (iii) road safety. The project will support the government's program to progressively improve the road by (i) expanding its width from two to four lanes, to address the impending capacity constraints; (ii) improving its surface condition through construction of new pavement; and (iii) providing well-designed safety facilities to address existing road safety deficiencies.

Table 1: Key data on road sections

Section ID	Name of the Section	Expected Output	Length (km)
1	0 km–Dushanbe Gate	Repair and overlay of existing four lane road to IRI 1.8	3.4
2–6	Dushanbe Gate–Chashmasoron	Upgrade from current 2 lanes to 4 lanes, and conduct repair and overlay on existing carriageways, to obtain an IRI of 1.8	29.8
Total			**33.2**

ADB = Asian Development Bank, ID = identification, IRI = International Roughness Index, km = kilometer
Source: Asian Development Bank estimates.

[1] ADB has programmed $66 million in 2018 to improve the remaining sections of the Dushanbe–Kurgonteppa road as presented in ADB. 2015. *Country Operations Business Plan: Tajikistan, 2016–2018.* Manila

5. **With-project scenario**. The with-project scenario involves the improvement of 33.2 km of road. For the first 3.4 km, the existing four-lane road will be repaired and overlays applied, to reduce roughness to an International Roughness Index (IRI) of 1.8. For the remaining 29.8 km, the current 2-lane road will be widened to 4 lanes. Repairs and overlays will be applied to the existing carriageways, to achieve an IRI of 1.8. Construction works will start in 2017 and end in 2020, for all road sections. The scheduled opening of the project road is 2021.

6. **Without-project scenario**. The without-project scenario involves routine maintenance of the existing road, including pothole patching, crack sealing, edge repairs as well as other summer and winter routine maintenance. Without the project, road roughness is expected to deteriorate to an average IRI of 16 within 15–16 years, rendering it unmaintainable in the future.

B. Traffic Studies

7. The project road sections were further divided into six homogeneous sub-sections in terms of traffic volume and composition between significant settlements, terrain type and junctions. The results of traffic surveys conducted by the Japan International Cooperation Agency (JICA) in 2015 were validated through further manual counting by ADB consultants to estimate current traffic levels (Table 2).[2]

Table 2: Observed Current Traffic

Section ID	Name of the Section	AADT 2015
1	Km 0 to Dushanbe Gate (km 3. 382)	17,280
2	Dushanbe Gate to Yangikhayot (km 11. 156)	10,547
3	Yangikhayot to start of mountainous section (km 13. 571)	10,547
4	Mountainous section up to km 21.511	7,176
5	End of mountainous section to end of rolling section (km 27.511)	7,176
6	End of rolling section for 2.2km flat (km 33.200)	7,176

AADT = annual average daily traffic, ID = identification, km = kilometer
Source: Japan International Cooperation Agency. 2015. *Data Collection Survey on a Road between Dushanbe and Kurgonteppa in Republic of Tajikistan*. Dushanbe, validated with additional manual traffic counts.

8. Traffic was projected for a 25-year period (2016–2040). The growth rate for normal traffic was based on available GDP forecasts. For 2016–2021, forecasts from the International Monetary Fund were used. Beginning in 2022, growth was assumed to drop to 3.5% per annum, declining further to 3.0% in 2026, to 2.5% in 2031 and to 2.0% in 2036. These adjustments reflect the uncertainty in the longer-term forecasts. Elasticity values were used to translate GDP growth forecasts into traffic growth rates. The elasticity values used for passenger vehicles and goods vehicles (respectively) are 1.20 and 1.10 for years 2016–2025, 1.10 and 1.05 for years 2026-2030, and 1.05 and 1.00 for years 2031–2040.

9. Generated traffic was conservatively estimated to add 1% to the estimated normal traffic, for a period of 10 years after the opening of the project road.

10. With regards to diverted traffic, the Dushanbe–Kurgonteppa road has no alternative routes that could result in diverted traffic using the newly reconstructed road. Therefore, diverted traffic was not included in the traffic forecasts.

[2] Japan International Cooperation Agency. 2015. *Data Collection Survey on a Road between Dushanbe and Kurgonteppa in Republic of Tajikistan*. Dushanbe.

Table 3: Forecast Annual Average Daily Traffic

Section identification	2020	2025	2030	2035	2040
1	21,806	26,763	31,233	35,326	39,150
2–3	13,302	16,315	19,036	21,528	23,855
4–6	9,052	11,106	12,959	14,656	16,241

Note: estimates in number of vehicles, including generated traffic
Source: Japan International Cooperation Agency. 2015. *Data Collection Survey on a Road between Dushanbe and Kurgonteppa in Republic of Tajikistan*. Dushanbe, and Asian Development Bank estimates.

C. Economic Costs

11. The economic costs considered for the analysis comprise (i) capital investment, which includes civil works, land acquisition and resettlement, consulting services for construction supervision and social safeguard compliance, and physical contingency; and (ii) road maintenance.[3] Costs related to taxes, duties, and financing charges during implementation have been excluded. Table 4 gives a breakdown of the capital investment costs for each road section.

12. Financial costs were converted into economic costs in line with ADB guidelines.[4] All project costs and benefits are measured in mid-2016 economic prices based on the world price numeraire. Traded goods are measured at world prices and non-traded inputs at domestic prices less indirect taxes multiplied by a standard conversion factor estimated at 0.942. A shadow wage rate factor of 0.8 for unskilled labor and 1.0 for skilled labor was estimated and applied.

Table 4: Financial Cost Estimate
($ million, 2016 prices)

Section	1	2	3	4	5	6	Total
Land acquisition and resettlement	0.04	0.28	0.05	0.18	0.12	0.13	0.80
Civil works	2.82	21.96	4.10	13.77	9.00	10.43	62.08
Equipment	0.07	0.57	0.11	0.35	0.23	0.27	1.60
Consulting services	0.18	1.41	0.26	0.89	0.58	0.68	4.00
Taxes	0.66	5.08	0.95	3.16	2.08	2.40	14.33
Physical contingencies	0.30	2.35	0.44	1.47	0.96	1.11	6.63
Price contingencies	0.17	1.31	0.25	0.82	0.54	0.63	3.72
Incremental administrative expenses							0.50
Interest during construction							2.72
Total							**96.38**

Source: Asian Development Bank estimates.

13. Long-term maintenance costs have been estimated at $1,500 per km for general summer routine maintenance, $465 per km for winter maintenance, $4.76 per square meter for patching potholes and edge breaks, and $11.80 per square meter for periodic asphalt overlays. These levels of expenditure are compatible with the current budget allocations for maintenance and are sufficient to sustain project road in an improved condition for the project period.

[3] The opportunity cost of land was computed based on net agricultural output foregone.
[4] ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.

14. A residual value equivalent to 30% of the investment cost—estimated by applying the straight-line depreciation method to individual project items based on assumed lifespans—has been included in the economic analysis.

D. Economic Benefits

15. The incremental economic benefits that will accompany the project are (i) vehicle operating cost (VOC) savings, and (ii) time cost savings. Benefits were calculated separately for normal and generated traffic. For generated traffic, the "rule of half" was applied as per standard practice. Benefit streams were applied the standard conversion factor to allow for comparison with costs using the world price numeraire.

16. **Vehicle operating cost savings**. Savings in VOCs accrue from better traffic conditions and a higher level of service on the improved road. Unit rates for VOCs per km by IRI value were calculated using the HDM-4 model. The IRI values for the updated road are forecast to start at 1.8, increasing to an average of 5.0 at the end of the analysis period. VOCs were estimated from data collected from various sources for each representative vehicle in each vehicle class at the end of 2015. Data included the price of new vehicles, tires, petrol, lubricating oil, crew wages, annual overhead, cargo and maintenance costs.

17. **Time cost savings**. Savings in travel time costs will result from higher permissible vehicle speeds, better alignment, smoother pavement, and easier overtaking conditions. Average speeds are calculated using a traffic model by applying speed-flow formulae that links average speeds to road type and traffic volumes. Values of working time were calculated based on existing data on salaries and wages. According to official data, the average monthly salary in Tajikistan during January 2015–February 2016 was TJS910.31 or $115.68, which equates to $0.66 per hour based on 22 days worked per month and 8 hours worked per day. After adding 17% for employers' social payments, the average salary is estimated at $135.35 per month or $0.77 per hour. An income adjustment factor of 1.45 was applied to car passengers to allow for their higher incomes. Conversely, a factor of 0.5 was applied to bus passengers. The value of nonworking time was taken as 20% of the value of working time.

18. Average vehicle occupancy was derived from the 2015 JICA study (footnote 2), with 3.16 persons per car or light vehicle, 6.41 persons per small bus, and 49.33 persons per large bus. Trucks have 1.5 persons, including the driver. As the VOC unit rates include a crew cost component, the time savings calculation did not include those for goods vehicle crews, as this would represent double counting. One third (33%) of all occupants (including crew) of cars, 100% of occupants of heavy vehicles, and 70% of occupants of buses were assumed to be traveling for work. Other occupants were assumed to be traveling for non-work purposes, which included those not active in the labor force.

19. Disruptions in traffic during construction was considered to take place on road section 1, which will be reduced from 4 lanes to 2 to allow for works to take place. Travel time on this road section was assumed to double during construction years. The effect on VOCs was also considered, whereby the slower traffic speed would result in lesser fuel economy and faster deterioration of vehicle parts.

E. Results of Economic Analysis

20. An economic assessment of the project has been carried out using the standard appraisal methodology that compares the incremental benefits derived from reductions in VOCs

and travel time costs resulting from the project, against the initial investment costs and incremental changes in operation and maintenance (O&M) costs over the 25-year appraisal period. The results of the economic analysis are shown in Table 5, expressed as the key economic indicators of benefit–cost ratio, economic internal rate of return (EIRR), and net present value (NPV) at a 12% discount rate. The results indicate that the project is economically viable, for each road section and for the project as a whole. The EIRR for the entire project is 23.5%. The NPV is $90.00 million. The economic indicators are considered to be conservative estimates as the impact on road safety has not been monetized for lack of data. Table 6 shows the stream of costs and benefits over time, for the entire project.

Table 5: Result of the Economic Analysis (2016 prices)

Benefit–Cost Ratio	NPV ($ million)	EIRR (%)
2.80	90.00	23.5

EIRR = economic internal rate of return. NPV = net present value. VOC = vehicle operating cost. VOT = value of time.
Source: Asian Development Bank estimates.

Table 6: Benefit and Cost Streams (2016 world prices, $ million, undiscounted)

Year	Capital Costs	Maintenance costs			VOT Savings	VOC Savings
		Without Project	With Project	Incremental Change		
2017	12.96	0.06	0.05	(0.01)	(0.51)	(0.77)
2018	19.45	0.06	0.05	(0.01)	(0.46)	(0.53)
2019	19.45	0.06	0.05	(0.01)	(0.47)	0.01
2020	12.96	0.06	0.05	(0.01)	(0.35)	1.07
2021	0.00	0.06	0.05	(0.01)	0.69	7.61
2022	0.00	0.06	0.05	(0.01)	1.07	10.55
2023	0.00	0.06	0.05	(0.01)	1.52	14.06
2024	0.00	0.06	0.05	(0.01)	1.99	17.80
2025	0.00	0.06	0.05	(0.01)	2.44	21.41
2026	0.00	0.06	0.05	(0.01)	2.88	24.96
2027	0.00	0.06	0.05	(0.01)	3.32	28.49
2028	0.00	0.06	6.03	5.97	3.76	32.05
2029	0.00	0.06	0.05	(0.01)	4.15	35.49
2030	0.00	0.06	0.05	(0.01)	4.46	38.07
2031	0.00	0.06	0.05	(0.01)	4.76	40.51
2032	0.00	0.06	0.05	(0.01)	5.03	42.72
2033	0.00	0.06	0.05	(0.01)	5.30	44.80
2034	0.00	0.06	0.05	(0.01)	5.59	46.94
2035	0.00	0.06	0.05	(0.01)	5.85	48.91
2036	0.00	0.06	6.03	5.97	6.12	50.86
2037	0.00	0.06	0.05	(0.01)	6.39	54.27
2038	0.00	0.06	0.05	(0.01)	6.62	56.18
2039	0.00	0.06	0.05	(0.01)	6.84	58.00
2040	(19.45)	0.06	0.05	(0.01)	7.05	59.60
					EIRR	**23.5%**
					NPV	**90.00**

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost, VOT = value of time.
Source: Asian Development Bank estimates.

21. Sensitivity tests and calculations of switching values were carried out to determine the effect of variations in key input parameters on the key economic indicators (Table 7). Overall, the project was found to be robust against increased construction costs and reduced traffic

volumes. One scenario considered the lack of timely provision of maintenance funds (no periodic maintenance), which would result in more rapid deterioration of the surface quality of the road, tapering off of benefits, and a lower residual value; it would reduce the economic life of the project by 4 years. Under this scenario, the EIRR drops to 20.0%, highlighting the importance of timely maintenance. In summary, the economic analysis was undertaken in line with ADB guidelines. The project yields an EIRR above 12% and is therefore economically viable.

Table 7: Result of the Sensitivity Analysis (2016 world prices)

Scenario	Benefit–Cost Ratio	NPV ($ million)	EIRR (%)	Switching Value (%)
Base case	2.80	90.00	23.5	N/A
Construction cost: 10% increase	2.56	85.21	22.3	187
VOC savings: 10% reduction	2.55	77.33	22.3	(71)
Travel time cost savings: 10% reduction	2.78	88.68	23.4	N/A
VOC and travel time cost savings: 10% reduction	2.52	76.01	22.2	N/A
Construction cost: 10% increase; VOC & travel time cost savings: 10% decrease	2.30	71.22	21.0	N/A
Lack of maintenance funds	1.80	39.18	20.0	N/A

( ) = negative, EIRR = economic internal rate of return, N/A = not applicable, NPV = net present value, VOC = vehicle operating cost.
Source: Asian Development Bank estimates.

F. Financial Analysis

22. The Dushanbe–Kurgonteppa road has been explicitly tagged as a priority investment in the CAREC Transport and Trade Facilitation Strategy 2020.[5] The project is non-revenue generating. Therefore, aspects of financial sustainability have been assessed from the viewpoint of the ability to ensure the upkeep of the assets created and improved under the project.

23. The government has continuously increased the funding for road maintenance, which doubled from TJS30.3 million in 2009 to TJS60.5 million in 2016 (Table 8). However, road maintenance received a limited share of the available resources for the transport sector during this period.

24. While the routine maintenance costs for the road are expected to increase because the pavement will be wider, the choice of a more durable road design and drainage structures will limit MOT's maintenance requirements for the first 10 years of the project. A reduction in maintenance costs of $0.11 million (undiscounted), compared with the without-project scenario, is expected for 2017–2027.

25. The government is committed to maintaining the project road and facilities at the required standard, as reflected in a specific covenant in the financing agreement. It is therefore expected that adequate funding, ultimately based on the road asset management system (RAMS) developed under the project, will be allocated to the MOT to cover recurrent project costs.

[5] ADB. 2014. *CAREC Transport and Trade Facilitation Strategy, 2020*. Manila.

Table 8: Budgetary Allocation to the Road Sector 2009–2016
(TJS million)

Year	National Budget	MOT Budget	MOT Budget Share of the National Budget[a] (%)	Funds Allocated to Road Maintenance	Road Maintenance Funding Share of MOT Budget (%)
2009	6,008.0	616.0	10.3	30.3	4.9
2010	6,537.0	638.0	9.8	34.0	5.3
2011	8,292.0	919.0	11.1	39.0	4.2
2012	10,860.0	936.0	8.6	46.8	5.0
2013	12,057.0	1,033.0	8.6	54.7	5.3
2014	13,901.0	1,308.0	9.4	57.2	4.4
2015	15,542.0	964.2	6.2	59.6	6.2
2016	18,594.0	864.4	4.6	60.5	7.0

MOT = Ministry of Transport
[a] In 2015, the Ministry of Transport and Communications was split into two ministries (Ministry of Transport and Ministry of Communications), which partly explains the decrease of MOT's share of the national budget.
Source: Ministry of Transport and Ministry of Finance.

26. Although the short- and medium-term sustainability of the project road seems reasonably assured, long-term maintenance requires improvement in the transport sector financial and institutional framework. MOT has begun to pilot outsourcing of road O&M to the private sector. Recent examples include the 358 km Dushanbe–Chanak toll road (2010),[6] and two performance-based maintenance contracts for selected sections (149 km) of the Dushanbe–Kyrgyz border road (2013).[7]

27. The proposed project will pursue a twin-track approach to address the short- and medium-term challenges associated with optimum allocation of O&M funding, and pursue long-term opportunities to expand the revenue base for maintenance.

28. First, the project will initiate the development of a tailored RAMS that will be implemented in two phases, following the overall project phasing (footnote 1). Phase 1 will set up the RAMS framework by conducting a thorough gap analysis, producing methodologies and guidelines for data collection and road condition surveys, and defining a tailored strategy and action plan. Phase 2 will focus on purchasing and setting up computer-based systems, and piloting the RAMS on selected CAREC corridors. Both phases will entail capacity development for MOT and close coordination with other development partners (e.g., the European Bank for Reconstruction and Development, JICA, and the World Bank), all of which have operations that involve some forms of O&M.

29. Second, the project will support policy dialogue that will run in parallel with the progressive improvement of the road, with the view to discussing new financing arrangements for O&M. The project road has good potential for tolling in the long run, considering its strategic location and the high volumes of traffic that will travel on it. In the future, ADB—as the leading development partner in the transport sector—may support additional sector reforms on O&M to help improve MOT's efficiency and sector sustainability.

[6] United Nations Economic Commission for Europe. 2013. *National PPP Readiness Assessment Report: Tajikistan*. Geneva.
[7] ADB. 2013. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Republic of Tajikistan for the CAREC Regional Road Corridor Improvement Project (phase III)*. Manila.