PROJECT CLIMATE RISK ASSESSMENT AND MANAGEMENT REPORT

I. Basic Project Information

Project Title: South Asia Subregional Economic Cooperation Dhaka–Northwest Corridor Road Project, Phase 2
Project Budget: $1,200 million
Location: North–West Bangladesh
Sector: Transport
Themes: Inclusive economic growth, environmentally sustainable growth
Brief Description: The project outputs are (i) Dhaka–Northwest international trade corridor (Phase 2: Elenga–Hatikumrul–Rangpur) upgraded, (ii) institutional capacity of Roads and Highways Department in road operation and management enhanced, and (iii) cost overrun of Dhaka–Northwest international trade corridor (Phase 1: Joydepur–Chandra–Tangail–Elenga) project financed. This climate risk assessment pertains to the first output under which the existing two-lane Elenga–Hatikumrul–Rangpur road will be upgraded to a four-lane road with safety features, dedicated small moving vehicular traffic (SMVT) lane, flyovers at business junctions, and overpasses at intersections to address existing difficulties. The execution of the proposed upgrading will substantially improve road connectivity and efficiency at the Dhaka–Northwest international trade corridor. Appraisal of the third output has already been carried out during the approval of Loan 2949-BAN: South Asia Subregional Economic Cooperation Road Connectivity Project[1] in 2012.

II. Summary of Climate Risk Screening and Assessment

A. Sensitivity of project components to climate/weather conditions and sea level	
Project component	*Sensitivity to climate/weather conditions*
1. Road Embankments	1. Most roadways in Bangladesh get submerged in flood waters and are closed for several days at a stretch during times of continuous monsoon rains and swollen rivers. Based on future climate projections of precipitation magnitude and intensity, road embankments are expected to erode and fail, causing traffic disruptions, loss of lives, property damage, and high economic consequences.
2. Bridges	2. Climate change literature mostly indicate there will be an increase in flood water levels and a reduction of flood return periods in the future. Overtopping and related damages to bridges are imminent.
3. Pavement	3. Although the effects of low temperatures are benign in Bangladesh, extremely high temperatures and increased frequency of heat waves are projected under a future of climate change. Road pavement rutting due to heavy traffic and high

[1] ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Loan and Technical Assistance Grant to the People's Republic of Bangladesh for the South Asia Subregional Economic Cooperation Road Connectivity Project*. Manila (Loan 2949-BAN).

	road surface temperatures, followed by cracking due to the effects of ultraviolet radiation, are possible.
B. Climate risk screening	
Risk topic	*Description of the risk*
1. Precipitation (mm)	1. Although various literature sources have differing projections on precipitation, all agree on its increased intensity and frequency. Spatial pattern of average annual rainfall shows that rainfall is significantly increasing in all regions of Bangladesh. Trend analysis of wet and dry months shows that the number of wet months are increasing and the number of dry months are decreasing in most parts of the country. Heavy rainfall days (over 200 mm/day) have increased significantly by 1.2 days/decade. This indicates that increasing severe monsoon wet months can trigger more rain-related flooding throughout Bangladesh.
2. Flooding	2. The frequency of abnormal floods in Bangladesh has increased substantially in the past decade. Based on the pattern of flood events in the last 55 years, flood severity and frequency have increased in the spatial extent and depth of inundation.
3. Tropical Cyclones	3. In the last century, 1901–2000, the rate of tropical storms striking the Bangladesh coast was one storm per year. Since 1950, the rate of landfall tropical storms has increased by 1.18 per year. A hydrodynamic model predicts more intensified surge heights at the coasts of Bangladesh due to climate change. It also predicts that flooding area, flooding depth, and surge intrusion length will be substantially larger under intensified surge conditions.
4. Temperature (^{o}C)	4. An increase of mean temperature in Bangladesh by 0.097°C/decade has also been observed at 95% level of confidence in the last 50 years. Climate models estimate a steady increase in temperature, with an average increase of 1.4°C in 2050 and 2.4°C in 2100. The number of hot days (maximum temperature > 30°C) and heat wave frequency (consecutive 3 days with maximum temperature greater than the 90th percentile) for the time period 1958–2007 increased by 1.16 days/year at 99% level of confidence (Shahid 2010d).
Climate Risk Classification: ***Medium***	
C. Climate risk assessment A climate risk and vulnerability assessment (CRVA) has been conducted and included in the initial environmental examination (IEE) for the Elenga–Hatikumrul–Rangpur road subproject.	

C = centigrade, mm = millimeter.

III. Climate Risk Management Response within the Project

As there are sufficient evidence that climate change will modify actual risk levels and challenge design guidelines and procedures for the operation and maintenance of road infrastructure, the following concerns are addressed in terms of engineering measures. The additional cost entailed to implement these measures is $55.6 million, which is 7% of the total civil works cost of approximately $742 million.

Design Measure	**Costs ($ million) Elenga–Hatikumrul (33.4 km)**	**Costs ($ million) Hatikumrul–Rangpur (157 km)**
1. Road embankment height: Increase by 37 cm for 33.4 km length (Elenga–Hatikumrul) and 155.89 km length (Hatikumrul–Rangpur)	8.000	37.400
2. Additional freeboard for bridges: Increase in bridge height by 37 cm for 15 nos (total length: 809 meter) bridges (Elenga–Hatikumrul) and 17 nos (total length: 1,113 meter) bridges (Hatikumrul–Rangpur)	0.006	0.007
3. Cross drains: Addition of new box culvert and replacement of pipe culvert with box culvert	0.014	0.100
4. Longitudinal drains: Installation of a longitudinal drainage system to quickly drain water during heavy rainfall. This will need to drain about 20% additional discharge expected from higher rainfall during extreme events.	0.370	1.700
5. Engineering improvement in road pavement: Include improved subgrade as drainage layer (unlike conventional design practice) to improve the quality of granular material required at that layer, block the upward movement of moisture, and lessen the deterioration of the road base. 6. Engineering improvement in road design	1.400	6.600
TOTAL	**9.790**	**45.900**
GRAND TOTAL	**55.6**	

cm = centimeter, km = kilometer, nos = numbers.