

Engineering Geological Evaluation of the Krishna Bhir Landslide, Benighat Rorang, Dhading District, After the 2026 Rasuwa Flood

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Abstract: The Krishna Bhir landslide, located along the Prithvi Highway in Dhading District, Nepal, represents a reactivated, complex slope failure that severed a critical national transportation corridor. This study presents field-based geological observations and structural assessment carried out around the landslide shortly after the 26 August 2026 Rasuwa flood. Results indicate that fluvial toe erosion by the Trishuli River, intensified by flood-induced sediment aggradation and subsequent channel migration, served as the principal triggering factor, removing basal confinement and destabilising the overlying slope mass. Multiple tension cracks were documented across the crown, flanks, and reactivated landslide body, with thicknesses of 2–5 m and separations of 15–35 cm, alongside uphill cracks of 25–30 cm separation and 1–2 m depth, confirming progressive retrogressive deformation. Structural evaluation of the existing retaining and gabion wall systems revealed cracking of 20–50 mm and downward displacement exceeding 30 cm, indicating that mitigation structures have exceeded their functional capacity. Lithological characterisation identified highly weathered, fractured slate and black slate interbedded with carbonate rock and quartz veins, substantially reducing rock-mass strength. A newly constructed road cut above the landslide crown, inclined at approximately 40°, further compromises stability within the weathered central zone despite relative competence in fresher rock. Integrated recommendations encompassing drainage control, slope-angle reduction, benching, selective mass removal, and toe protection are proposed to mitigate future failure risk, underscoring the need for continuous geotechnical monitoring in this active, lithologically weak terrain.

Keywords: *Krishna Bhir, Toe erosion, Tension cracks, Weathered slate, New road cut.*

Introduction

On 26 August 2026, a cascading cryospheric-hydrological disaster struck Rasuwa District in northern Nepal, when an ice-rock avalanche entered the Lhende Khola and generated a debris-laden flash flood in the Bhote Koshi-Trishuli river system. Water levels at Galchhi rose by nearly 9 m within about 30 minutes, and at Malekhu by roughly 7 m, mobilising large volumes of sediment and coarse debris downstream. Along the Prithvi Highway-Trishuli River corridor in Dhading District, the resulting high-magnitude discharge

produced intense fluvial erosion and toe cutting at Krishna Bhir, Benighat Rorang Rural Municipality-7, and the Department of Roads recorded closure of the highway on 30 August 2026 following slope and road failure. Krishna Bhir is one of Nepal's most notorious landslide sites, having first failed in 1999 and blocked the highway for 11 days in 2000 despite subsequent bioengineering, retaining-wall, micro-piling and anchoring works; the 2026 event was its worst structural collapse in 26 years. This study presents field-based geological observations made around the Krishna Bhir landslide shortly after the flood, to characterise the failure mechanism and inform urgent mitigation planning.

Geological setting

The landslide lies in Benighat Rorang Municipality-07, Dhading District (408 m elevation), about 90 km west of Kathmandu along the Prithvi Highway. It falls within the Lesser Himalayan Zone of central Nepal, bounded by the Main Central Thrust to the north and the Main Boundary Thrust to the south, and stratigraphically belongs to the Upper Nuwakot Group of the Nuwakot Complex at the Benighat Slate Formation, with associated Jhiku Carbonate beds, Malekhu Limestone, Robang Slate, Dunga Quartzite and Raduwa Schist. Locally, the upper and middle slope comprises alternating beds of highly fractured carbonaceous slate, while the lower-middle slope exposes a thin quartzite band and thick carbonate beds sandwiched between slate and quartz-veined slate. All units are highly weathered with very poor rock-mass strength, and colluvium deposits in the mid-slope region are highly susceptible to sliding and erosion.

Field observations and results

Field mapping shows the landslide mass is dominated by toppling failure, with steeply dipping (~70°) beds and north-facing joints (~30° in the slide mass) controlling the failure geometry. The Trishuli River progressively undercut the slope toe during the flood: elevated sediment influx raised the riverbed and altered channel

hydraulics, and bank deposition forced a lateral shift of the current toward the slope base. This removed the natural buttress and basal shear resistance, triggering collapse of the highway and slope, and provides a clear example of a toe-erosion-controlled failure (*Figure 1*).



Figure 1, Toe erosion and collapse of the Prithvi Highway above the Trishuli River at Krishna Bhir.

Multiple tension cracks confirm active retrogressive deformation. Within the road and main scarp, cracks indicate a disturbed zone 2–5 m thick with apertures of 15–35 cm (*Figure 2*), pointing to a relatively deep-seated failure rather than superficial cracking. On the uphill side, above the old gabion wall within the pre-existing landslide mass, cracks of 25–30 cm aperture and 1–2 m depth were recorded; similar but less intense cracking had been documented here by the Department of Mines and Geology in 2024, implying that road-cut excavation has since removed lateral confinement while toe failure has propagated upslope.



Figure 2, Tension crack in the road pavement at Krishna Bhir, showing lateral displacement of the road surface.

Structural distress is equally evident: cracks of 20–50 mm were measured in the retaining wall, and gabion units have displaced downward by more than 30 cm, showing that the mitigation structures have been mobilised along with the slide mass and have exceeded their design capacity. A newly cut road section above the landslide crown, inclined at about 40°, exposes highly weathered black slate interbedded with carbonate rock and quartz veins, and an older landslide mass in its central portion. Although a 40° cut can be stable in competent rock, this angle is unsafe in the highly weathered central zone, and the cut itself now reduces toe support for the slope above.

Conclusions and recommendations

The Krishna Bhir landslide is a reactivated, complex failure driven by fluvial toe erosion, weak lithology and anthropogenic slope disturbance. Undercutting by the Trishuli River removed critical toe support, while crown, flank and uphill tension cracks confirm ongoing retrogressive movement, and deformation of the retaining and gabion structures shows that existing mitigation has been exceeded. Highly weathered slate, black slate and carbonate–quartz assemblages further weaken the rock mass, and the new road cut above the crown aggravates instability. Priority measures include surface and subsurface drainage, reducing the cut-slope angle below 40° in weathered slate while retaining steeper angles only in competent rock, benching with backslope drains, selective removal of loose material, and toe protection along the Trishuli River, supported by continuous monitoring and early-warning instrumentation.