

## **Risk watershed analysis: a new approach to manage torrent control structures**

Yann Queff  l  an (1), Simon Carladous (1), Christian Deymier (2), and Olivier Marco (1)

(1) ONF - Natural hazards department, Gap, France (yann.queffelean@onf.fr), (2) ONF - Natural hazards department, Grenoble, France (simon.carladous@onf.fr), (3) ONF - RTM 04, Digne-Les-Bains, France (christian.deymier@onf.fr)

Torrential check dams have been built in French public forests since the 19th century, applying the Restoration and conservation of Mountainous Areas (RTM) laws (1860, 1864, 1882). The RTM department of the National Forestry Office (ONF) helps the government to decide on protective actions to implement within these areas. While more than 100 000 structures were registered in 1964, more than 14 000 check dams are currently registered and maintained within approximately 380 000 ha of RTM public forests.

The RTM department officers thus have a long experience in using check dams for soil restoration, but also in implementing other kinds of torrential protective structures such as sediment traps, embankments, bank protection, and so forth. As a part of the ONF, they are also experienced in forestry engineering. Nevertheless, some limits in torrent control management have been highlighted:

- as existing protective structures are ageing, their effectiveness to protect elements at risk must be assessed but it is a difficult task ;
- as available budget for maintenance is continuously decreasing, priorities have to be made but decisions are difficult : what are the existing check dams functions? what is their expected effect on torrential hazard? is maintenance cost too important given this expected effect to protect elements at risk?

Given these questions, a new policy has been engaged by the RTM department since 2012. A technical overview at the torrential watershed scale is now needed to help better maintenance decisions: it has been called a Risk Watershed Analysis (Etude de Bassin de Risque in French, EBR) and is funded by the government. Its objectives are to:

- recall initial objectives of protective structures : therefore, a detailed archive analysis is made ;
- describe current elements at risk to protect ;
- describe natural hazards at the torrential watershed scale and their evolution since protective structures implementation ;
- describe civil engineering and forestry works that have been implemented within the watershed, including their cost ;
- decide on current protective works to implement (maintenance and new investment).

For each EBR, a multidisciplinary team is involved with specialists in geomorphology, hydrology, hydraulics, geology, civil engineering and forestry. Approximately 1 100 EBRs should be implemented at the national scale, including other natural phenomena such as snow avalanches and rock falls. Since 2012, approximately 10 % have been realized in areas with the most significant elements at risk.

From a practical point of view, these studies have helped a better understanding of torrential watershed conditions and of torrent control expected effect over years. An analysis of these studies will be performed soon to have a first overview of torrent control effect. We claim that these EBRs could be a significant source of information to help a comprehensive evaluation of long-term effectiveness of torrent control.