

# The extraordinary handling of the Val Parghera debris flow

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## INTRODUCTION:

In fall 2012 a landslide mass with a volume of approximately 1'100'000 m<sup>3</sup> has activated in the Swiss Parghera Valley (Val Parghera) above the villages Domat/Ems and Chur. Due to an extraordinary combination of geological, topographic and hydrological factors the landslide liquefied into a perfect debris flow. However, instead of a singular event or one event comprising several mudslides, the entire process continued over several years with up to 20 - 40 mudslide events per year - endangering cantonal and national traffic carriers as well as a large industrial zone. An extraordinary event requires an extraordinary intervention. Within three months after the first mudslide infrastructure worth approximately CHF 20 Mio could thus be saved at the cost of only CHF 7 Mio. The problem focused coping required new methods of risk assessment, project management and strategic planning and coordination. Storing the currently about 400'000 m<sup>3</sup> of debris flow material in the controlled storage site amidst an intensively used living space and economic area posed a special challenge. A new approach to allocate the costs has eventually won recognition among the five project-executing organisations.

## EVENT AND ACTIONS:

In fall 2012, a landslide has activated in the forested upper reach of Val Parghera in the municipal territory of Chur, Switzerland, Canton of Grisons. During the snowmelt in spring 2013 the movements of the landslide intensified drastically and several hundred thousand cubic metres of soil material started to continuously slide down the ravine. The mixture of soil and water formed an increasingly fluid debris flow. High precipitation leads accelerated the process, eventually resulting in countless debris flow waves. On 19th April 2013 the first debris flows reached and abruptly filled the debris basin in the Purchera area on territory of

Domat/Ems. The embankment was immediately breached to redirect the debris flow across the main road onto farmland. During the first couple of months, neither the activity of the landslide nor of the debris flow decreased. To handle the continuous events new embankments were built. The new basin was respectively filled up within a short time and had to be cleared out in an emergency undertaking (Fig.1). To save buildings and infrastructure



Figure 1. Temporary debris dam in the area of Purchera, Domat/Ems with the endangered traffic carrier and the controlled storage site in the background (Photo: AWN Graubünden).

worth several times the investment, the executive staff and the involved departments invested about CHF 7 Mio for extraordinary interventions. At present, an end of the debris flow activity is not foreseeable. The activity seasonally decreases, especially in the summer- and winter months activity is low. Geological monitoring has shown that the landslide comprises a total mass of about 1'100'000 m<sup>3</sup>. Until today, approximately 600'000 m<sup>3</sup> of landslide mass have slid down to the valley, but at least 500'000 m<sup>3</sup> may still be mobilised.

### TEMPORARY OPERATION, MONITORING AND CONTROLLED STORAGE SITE:

The characteristic of the process did not change since April 2013. Therefore, organizational measures remain necessary until a new system of protection structures will be realized - which is expected to be in 2018. The temporary operation includes a constant hazard assessment, a monitoring of the debris flow activity and the management of the temporary embankment in the valley. The 24-hour monitoring system provides data on precipitation, temperature, landslide movement, debris flow activity, debris aggradation at critical locations and filling levels of the debris basin. The collected data, warnings and alerts are constantly transmitted to the responsible organisations via internet to operate a year round on-call service. Thanks to new image-processing methods the average daily deformation of the landslide, smoothed with a running average over 5 days, could be determined, permitting a better understanding of the long-term risk development. The quality of the debris flow material is insufficient for further use. Therefore it has to be stored. After all landfill options in the surroundings had rapidly been exhausted an alternative was urgently needed. In Plarenga, Domat/Ems, a place not far from the basin, a controlled storage site could be set

up. There, more than 600'000 m<sup>3</sup> of material can be stored on farmland. After the deposition, the farmland will be recultivated. The storage site connects to an existing debris cone of the Val Parghera. A first sector could already be returned to agricultural management.

### PROJECT ORGANISATION AND COST ALLOCATION

To successfully manage such a large and complex project, the following sub-projects were set up: Intervention, temporary operation, definite protection structure, material management and storage site. The overall project management is carried out by the Forestry and natural hazards office of the Canton of Grisons, who coordinates different cantonal departments. It is complemented by a steering committee, an advisory commission, a staff unit for hazard assessment and an agricultural group. Total costs are estimated to be around CHF 30 Mio. The cost allocation was a delicate mission, which has eventually been solved with a different methodological approach for each sub-project (Tab.1).

Table 1: Methodical cost allocation for each sub-project.

Sub-project	Methodological cost allocation
Intervention	Associated with each work site (principle of causality)
Temporary operation	Allocation on equal terms to project partners (principle of parity)
Definite protection structure	Risk-based cost allocation with following negotiation (beneficiary pays principle)
Material management and storage site	Allocation on equal terms to project partners (principle of parity)

### KEYWORDS

landslide; Hazard Assessment; Hazard Management; debris flow; intervention

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