

# The Floods of 2005 in Switzerland



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**Federal Department for the Environment, Transport,  
Energy and Communications DETEC**

# Torrential Rivers, Swelling Waters, Sliding Slopes



Major floods occurred in the past and will arise again in the future. Lessons should be drawn from such events to ensure that we are better prepared to deal with them in the future. For this reason, a comprehensive study has been carried out on the floods of August 2005.



The findings of "Ereignisanalyse Hochwasser 2005" (Event Analysis: The Floods of 2005) have been documented in a two-volume expert report (see page 23). This synthesis report summarises the main findings and recommendations of the expert report.



Torrential waters of the river Engelberger Aa below Engelberg OW (23 August 2005, top), rising water level in Lake Lucerne (24 August 2005, centre), sliding slopes near Entlebuch LU (23 August 2005, bottom).



In August 2005 torrential rain fell for days on end across extensive areas north of the Alps in Switzerland. In some locations, more rain fell than had ever been seen since records have been kept. Within a matter of hours, the water in some lakes reached maximum level, brooks and rivers became torrential streams and landslide processes were triggered on numerous slopes. Six people died. The cost of the material damage caused totalled approximately three billion Swiss francs.

Comparable and even more severe events will arise in the future. In order to avoid similar or even worse consequences, we would like and must continue to implement consistent flood protection measures. The process was initiated some time ago, i.e. after the heavy storms of 1987. Protective structures alone are not sufficient, however. As was confirmed in 2005, such structures can all reach a point at which they are overloaded.

Thus integrated risk management is required. The basis for this is comprehensive knowledge of the possible hazards, i.e. hazard maps for example, as well as precipitation and runoff forecasts.

The provision of protection against natural hazards is a political task and a challenge for everyone involved in this area at both administrative and technical level. It also represents a challenge for all citizens. As this report shows, everyone can protect himself or herself against natural hazards to a significant degree by taking individual responsibility.

## **Moritz Leuenberger**

Head of the Federal Department for the Environment, Transport, Energy and Communications DETEC

Keystone/Risch



State of emergency at all levels: emergency services in action in Weesen SG (above); Federal Councilors Samuel Schmid in Sarnen OW (right) and Moritz Leuenberger in Ennetbürgen NW (below right).



Keystone/Della Valle, Flüeler

Reuters/Meier



In Ennetbürgen NW, the streets became canals and there were large volumes of wood debris floating around on Lake Lucerne (cover photo and right, photograph taken on 23 August 2005).

### The clouds are grey, the ground is wet

It was already raining heavily in areas of northern Switzerland, in particular at the beginning of the third week of August 2005. However, summer 2005 made a comeback, temporarily at least: on Tuesday (16 August) and Wednesday (17 August) an intermediate high brought two days of warm sunshine to the region (see diagram below).

After this, a **trough** moved from Great Britain towards France. Increasingly humid masses of air on the eastern flank of this low flowed towards Switzerland and gave rise to some heavy storms: first, in central Switzerland (on Thursday, 18 August) and later also in east and south Switzerland (on Friday and Saturday).

These events alone would not be exceptional for this time of year. Similar conditions arise on several occasions every summer. However, the following **dynamic**, which was crucial for the evolution of the flood event, was built up: on Saturday (20 August), a surface low formed over the Gulf of Genoa which wandered very slowly across northern Italy, the Adriatic and the Balkans over the following two days.

During this phase, warm humid sea air was being freighted from the Mediterranean around the Alps in an anti-clockwise direction. This gave rise to prolonged intensive precipitation on the northern side of the Alps – initially over a wide area in the Pre-Alps and Swiss Central Plateau (21 August) and later predominantly along the northern edge of the Alps (22 August).

### Difficult forecasting

The weather situation which arose in August 2005 is referred to by meteorologists as a **Vb situation** and is not at all uncommon. However, the areas affected by it and the volumes of precipitation to be expected are determined by individual features of the trajectory and speed of the system which are difficult to forecast. Be that as it may, experienced experts – even those from MeteoSwiss, the Swiss national meteorological service – were surprised by the course and impact of the events in August 2005. Many of the weather models in use at the time only identified the actual development of the situation shortly before the devastating rainfall began.

MeteoSwiss gave the first indications of larger volumes of precipitation on Friday (19 August): 50 to 100 millimetres of rain were forecast for the period Saturday to Monday. On Saturday (20 August) the expected precipitation volume was corrected to “probably in excess of 100 millimetres”.

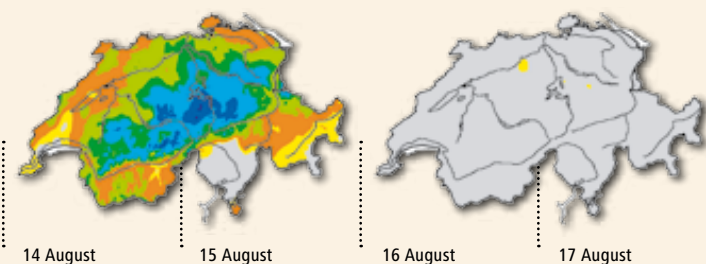
The first storm warning was issued late Sunday morning (21 August), i.e. when the heavy precipitation started: “Up to Tuesday morning widespread rainfall of between **80 and 100 millimetres** is expected on the northern slopes of the Alps. As the melting level is in the region of 2500 to 3000 metres asl, most of the precipitation will end up as runoff.” The reality of the situation was otherwise, however. In some areas, around **200 millimetres** of rain fell up to Thursday.



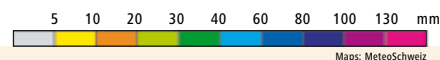
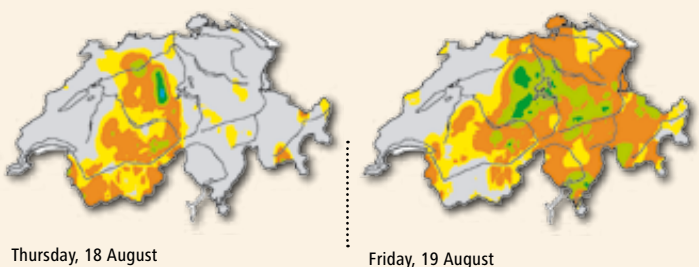
Lucerne in August 2005 (Keystone/Tischler)

Weather events such as that of August 2005 generally arise several times per year. However, it is rare for such a large volume of rain to fall for such a prolonged period over such a large area (see diagrams depicting the precipitation development from 14 to 23 August 2005 below). The meteorological event of August 2005 is comparable with the heavy precipitation events of June 1910, July 1977, August 1987 and May 1999. Prolonged and intensive periods of precipitation may also be expected in Switzerland in the future – possibly more frequently than in the past due to global climate change.

Volumes of rainfall over 48-hour period  
(two-day totals in millimetres)

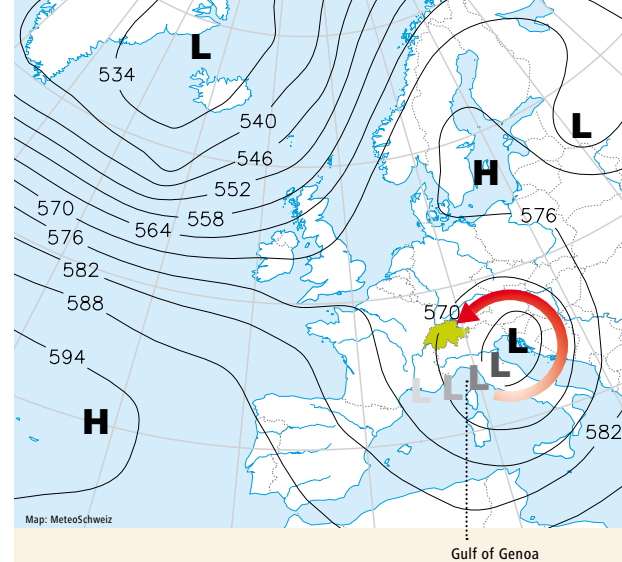


Volumes of rainfall over 24-hour period (8 am – 8 am)  
(daily totals in millimetres)



Maps: MeteoSchweiz

High pressure areas at 500 hPa (approximately 5700 masl)  
on Monday, 22 August 2005, 2 pm (right).



The cause of the intensive precipitation was the low pressure system “Norbert” which moved over the warmed-up Mediterranean and remained temporarily over the Gulf of Genoa and the Adriatic (Vb-depression). As a result, large volumes of warm humid Mediterranean air were driven around the eastern Alps to the northern edge of the Alps and accumulated there. This gave rise to over 100 millimetres of precipitation along the entire northern edge of the Alps in Switzerland on 21 and 22 August 2005, i.e. within a period of 48 hours. The volumes of rainfall were even bigger than this in Emmental, Entlebuch, parts of the Bernese Oberland and in a band extending from the Swiss interior across the Rhine valley to Vorarlberg. Over their long history, twenty-two measurement stations in the region had never recorded such high precipitation values as they did on these two days. Local record values should not be overstated, however. Overall, the precipitation of August 2005 is viewed as a rare but not unique event. Instances of heavy precipitation of this nature must also be expected in the future.

Selection of local maximum values (within a 48-hour period\*)

Measurement station	Precipitation volume	Previous maximum value (with year)	Measurement series since
Einsiedeln SZ	152 mm	142 mm (1978)	1900
Engelberg OW	190 mm	153 mm (1991)	1901
Marbach LU	181 mm	165 mm (2004)	1961
Meiringen BE	205 mm	159 mm (1896)	1889
Napf BE	178 mm	158 mm (1990)	1978

\* Sunday, 21 August (7:40 am), to Tuesday, 23 August (7:40 am)

## Reckoning with probabilities

Following the underestimation of the further development of the situation on Sunday (21 August), the second storm warning described the full extent of the precipitation from Monday morning (22 August). By then, however, extensive damage had already been unleashed in some locations. MeteoSwiss has learned the **necessary lessons** from this event. A series of improvements in weather forecasting in the meantime have contributed to enabling a more accurate understanding and faster assessment of extreme weather situations. For example, since January 2008, MeteoSwiss's **regional forecasting model** has a special high resolution to be able to cope with the specific topographical features of the Alpine region (COSMO-2). The calculation grid in this numerical model has a grid spacing of just 2.2 kilometres.

Moreover, the uncertainty associated with all weather and precipitation forecasts is quantified for some time now using what are known as **ensemble forecasts** (COSMO-LEPS): i.e. several forecasts are calculated on the basis of different initial conditions. As a result, it is possible not only to forecast certain developments but also the **probabilities** of their occurrence. This new development involves not only changes in the working methods used by forecasters; the users of such forecasts must also learn about the complex demands of working with probabilities.

Crisis situations in particular demand clear and fast decision-making. Thus, while information about the **reliability** of a precipitation forecast can constitute an advantage, it clearly also constitutes a major challenge for the decision-makers within the technical authorities, management organisations and intervention forces.

11:12 am

First storm warning issued by MeteoSwiss: heavy precipitation, moderate intensity

7:52 am

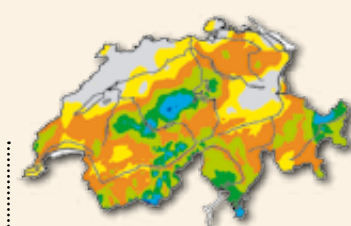
Second storm warning issued by MeteoSwiss: heavy precipitation, high intensity

7:01 pm

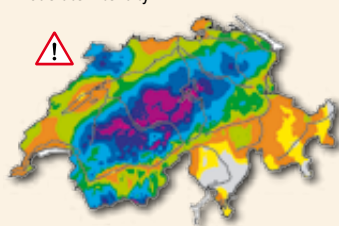
Third storm warning issued by MeteoSwiss: heavy precipitation, even higher intensity

7:37 am

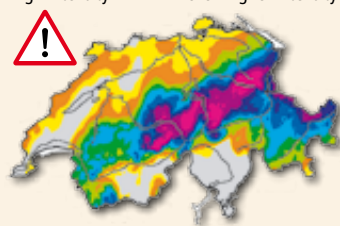
All clear for west and central Switzerland



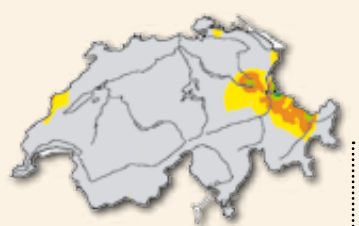
Saturday, 20 August



Sunday, 21 August



Monday, 22 August



Tuesday, 23 August



**Hazard:** state, circumstance or process from which damage can arise. When a hazard is caused by a natural process it is referred to as a **natural hazard**.

## Surprises at local level

The variety of the processes that arose in August 2005 generally matched to the overall pattern that had characterized previous major events. However, there were some surprises at local level. For example, surface-flowing precipitation water also caused considerable damage away from water bodies. The **extreme intensity** of the processes was particularly surprising. The runoff volumes, lake water levels and duration of the effects and volume of the solid matter transported by the water exceeded all previous experience in many places. The main causes were:

- **Swell processes**, for example when the runoff behaviour of a watershed area changes rapidly and thus leads to unexpectedly high levels of runoff.
- **Process changes**, e.g. transition from landslides to debris flows.
- **Process chains**, e.g. deposition of material from landslides in a channel and its mobilisation by the flood-water.

A lot of wood debris accumulated in streams, rivers and lakes and became wedged together at constrictions (below, in the lateral canal of the Aare in Bern Matte), blocked the runoff and resulted in channels bursting their banks in some places. At least 110 000 m<sup>3</sup> of wood was mobilized throughout Switzerland in August 2005, some of which was transported for long stretches. Of this, around two thirds was fresh wood originating from landslides and bank failure (right). The rest comprised equal volumes of windthrow that had been left lying on the ground and construction and fuel wood.



## First comes the water, then the mountain

Floods are dangerous in various respects and, depending on the nature of the water body involved, can unfold in completely different ways. This was also demonstrated by the events in August 2005:

- Dynamic and static **flooding** occurred in many locations as a result of the escape of water from streams and rivers and the overflowing of stationary water bodies.
- The water had considerable erosive force in many places. Bank slopes collapsed or slid. As a result, structures and infrastructure located outside of the actual channel area were also affected. The **lateral and vertical erosion** on some sections of the streams and rivers was so extensive that the channels shifted. The eroded material was deposited over wide areas. This also gave rise to extensive deposits of coarse sediment outside of the channel, a process known as **overbank sedimentation**.
- **Debris flows**, a fast-flowing mix of water and solid matter, were generated in 25 mountain torrent watershed areas.
- At constrictions, such as weirs, bridges and stretches of gorge, the runoff was often hampered by wood debris and other solid materials. The water accumulated behind such **log jams**, escaped from the channels and sought new runoff paths.
- Finally, diked valley rivers proved to be increasingly imperilled. **Dike failure** occurred on the river Aare downstream of Meiringen and **dike overflows** arose in other locations. Fortunately the **seepage**, which arose at older dikes such as the Hagneck Canal, did not expand to cause more extensive damage.

Flooding and the associated channel processes were not the only consequence of the extensive precipitation, however. The soil and subsoil were so heavily saturated with water that many slopes became unstable: **landslides** (soils and rocks moved on a more or less clearly formed nappe to the valley) and **slope-type debris flows** (a mixture of soil material and water flowed down the surface of the slope) occurred as a result. A total of over 5000 landslides and slope-type debris flows were recorded in August 2005.



Rotlaubach near Guttannen BE on 24 August 2005 (Keusen)



Landquart above Klosters GR on 25 August 2005 (Swiss Air Force)



River Aare near Meiringen (BE) on 24 August 2005 (Swiss Air Force)



Lake Brienz on 24 August 2005 (Swiss Air Force)

#### Predominant processes in **mountain torrents**:

- Vertical and lateral erosion
- Blockages
- Dynamic flooding
- Debris flows (photo left)

#### Predominant processes in **mountain rivers**:

- Lateral erosion
- Bed deepening (vertical erosion)
- Bed raising (aggradation)
- Dynamic flooding
- Channel shifting (photo left)

#### Predominant processes in **valley rivers**:

- Lateral erosion
- Bed deepening (vertical erosion)
- Bed raising (aggradation)
- Flooding
- Risk of dike failure (photo left)

#### Predominant processes at **lakes**:

- Large areas of wood debris
- Static flooding (photo left)

### Underestimated hazards

High volumes of sediment transport and extensive lateral erosion occurred in many **mountain torrents** and almost all **mountain rivers** in the precipitation area. Even with sufficient runoff capacity, this gave rise to deposits and blockages in many places which, in turn, caused flooding in adjacent areas. In **valley rivers**, such as the Emme, the Kleine Emme and the Linth, the damage was also mainly due to lateral erosion. The situation on the Aare below Thun and the Reuss below Lucerne was different. Despite the attenuation of the runoff by the upstream lakes, the available runoff capacity was exceeded here.

Other processes also arose in August 2005 which caused extensive damage: i.e. **surface-flowing precipitation water, upwelling groundwater and back-ups in the sewage systems**. The unclear allocation of responsibility and lack of knowledge on the part of the authorities, planners, property owners and insurance companies are among the reasons why these processes are generally paid little attention in the context of flood protection.

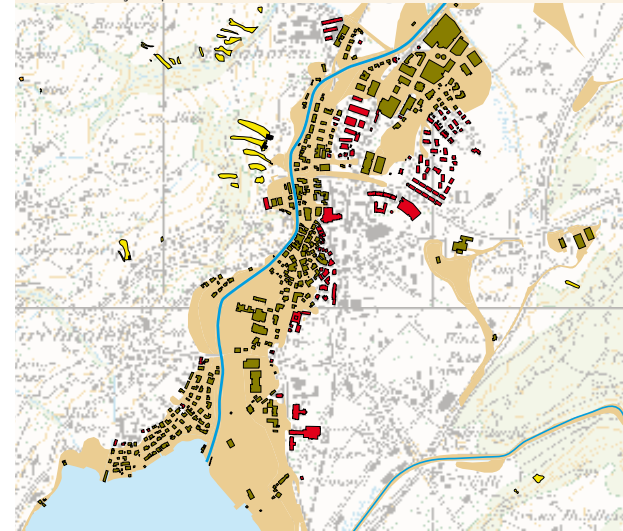


Cause of damage to buildings in Sarnen OW in August 2005:

- Upwelling of groundwater
- Flooding
- Slope-type debris flow
- Flooding
- Slope-type debris flow

It is often overlooked that water can enter not only from above or from the side, but also from below: i.e. through back-ups in sewage systems (photo above) and the upwelling of groundwater (diagram below).

Photo and original map: Canton of Obwalden





A state of emergency in Switzerland

The direct cause of the floods of August 2005 was the heavy precipitation across extended areas on the northern side of the Alps. However, the antecedent conditions prior to the event also contributed to its catastrophic outcome. August had already been very wet that year. As a result, the soil was heavily saturated and unable to absorb the additional precipitation. In addition, the snow line during the critical week was mostly above 2500 metres asl, thus very little of the precipitation fell as snow. The water ran off very quickly everywhere and resulted in the rapid swelling of streams, rivers and lakes and the sliding of slopes and banks.

In Switzerland, the **northern slopes of the Alps** were particularly badly affected. From Simmental to Glarnerland hardly a single valley escaped extensive damage to stream and river courses, transport routes, houses, commercial and industrial operations, infrastructure and agricultural land. Entire valleys remained completely cut off from the world for days.

In the **Alps** themselves there was extensive damage in Prättigau and Unterengadin, from Emmental (valley of the river Emme) to Lake Zug, on Lake Walen and in other areas of east Switzerland; even the **pre-Alps region** was not spared. In the **Swiss Central Plateau**, the floods wreaked havoc along the rivers Aare and Reuss. In addition, **several lakes** flooded their shores: i.e. Lake Brienz, Lake Thun, Lake Biel, Lake Sarnen, Lake Lucerne and Lake Lauerz.

The affected area also extended beyond the Alpenrhein river to the east and north east. Widespread damage was recorded in the **Austrian** federal states of Vorarlberg, Tyrol, Steiermark and Salzburg. In **Germany** southern Bavaria was mainly affected.

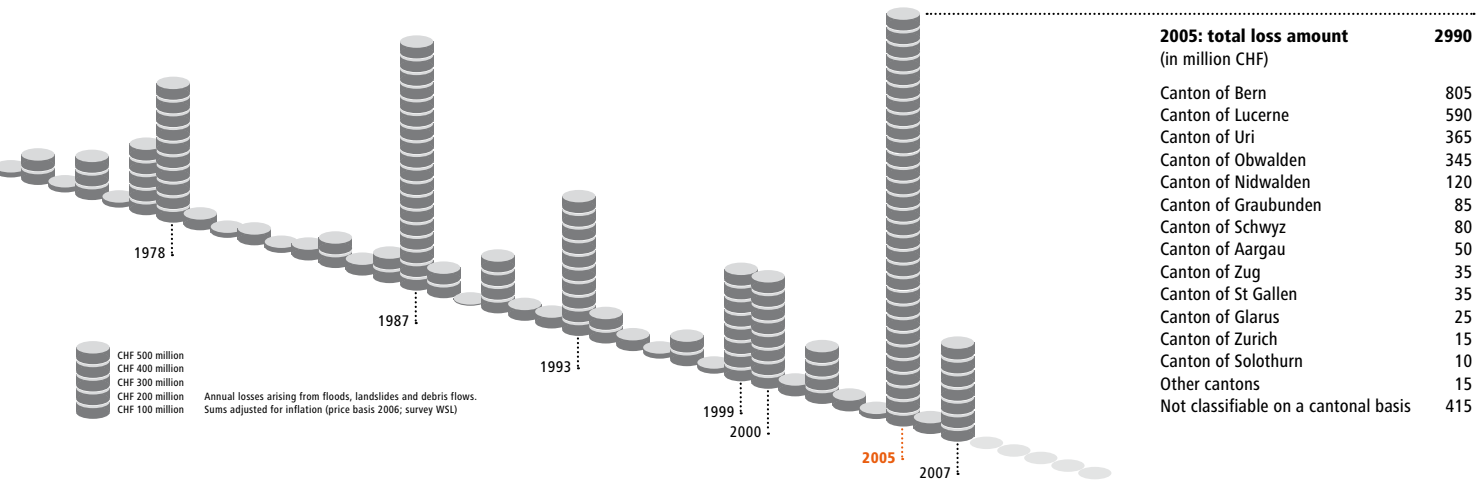
Comparable data on the cost of flood damage has only been available since 1972. Such extensive damage arising from flooding, landslides and debris flows as that experienced in August 2005 had not previously been experienced in the period since 1972 (diagram below). Around 900 municipalities, i.e. approximately one third of all Swiss municipalities, were affected. However, when longer periods are taken into consideration, the scale of the damage in August 2005 emerges as less unique than it does in the context of the post-1972 period: there were several flood events in the 19th century with comparable or even greater extent of damage.

Greatest total losses since 1972

At almost **CHF 3 billion**, the floods of August 2005 gave rise to the most extensive total financial losses ever caused by a single natural event in recent decades in Switzerland (see diagram below with data from 1972). Unfortunately the material destruction was not the end of the story. Six people also lost their lives in the floods and landslides.

In the case of the material damage there is one significant difference between this and previous events: the floods of August 2005 mainly caused damage to **private structures and material assets**. As a result, individuals and companies, or their insurance companies, bore the main burden of the damage. At around **CHF 2 billion**, the cost of the damage to private property was three to four times greater than that caused by all other flood events since 1972. It is particularly striking that approximately one quarter of the private damage was concentrated in the industrial and commercial zones of Emmen-Littau (in the canton of Lucerne) and Altdorf-Bürglen-Schattdorf (in the canton of Uri). In these two areas alone, the flood damage came to a total of over CHF 500 million.

The other damage totalled around **CHF 1 billion** and affected **public infrastructures** (hydraulic structures, roads, conduits) and **railways**. Greater damage only arose in these areas on one previous occasion, i.e. in 1987.





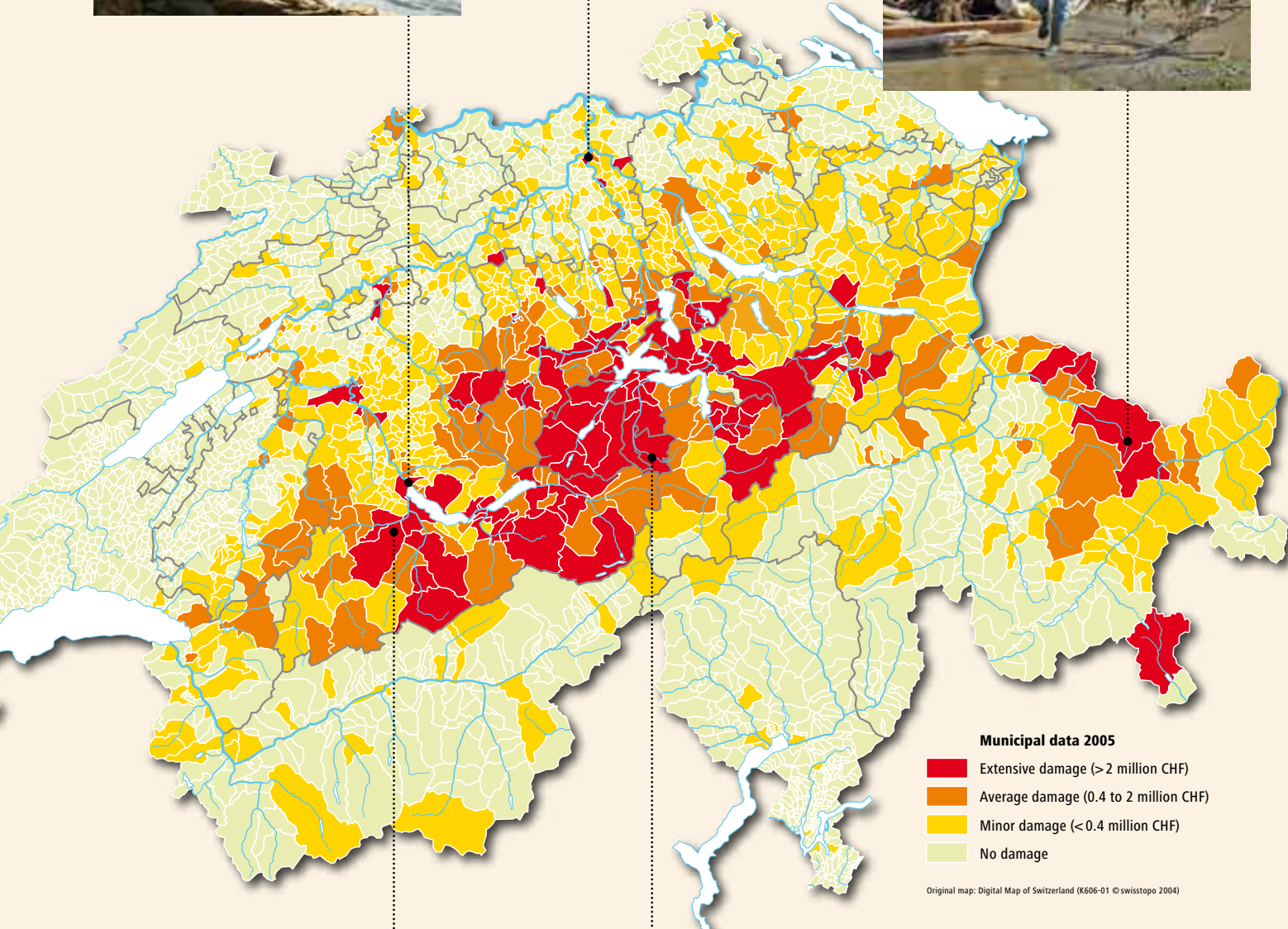
Thun BE on 23 August 2005 (Keystone/Schneider)



Windisch AG on 22 August 2005 (Keystone/Della Bella)



Klosters GR on 24 August 2005 (Keystone/Balzarini)



Oey-Diemtigen BE on 26 August 2005 (Keystone/Kusano)



Engelberg OW on 24 August 2005 (Keystone/Flüeler)

**Risk:** the extent and probability of possible damage that may be caused by an existing hazard. Irrespective of the probability of occurrence of a hazardous process and the extent of the accompanying damage, risk is defined as:

$$\text{risk} = \text{probability} \times \text{impact}$$

## Categorisation in the historical context

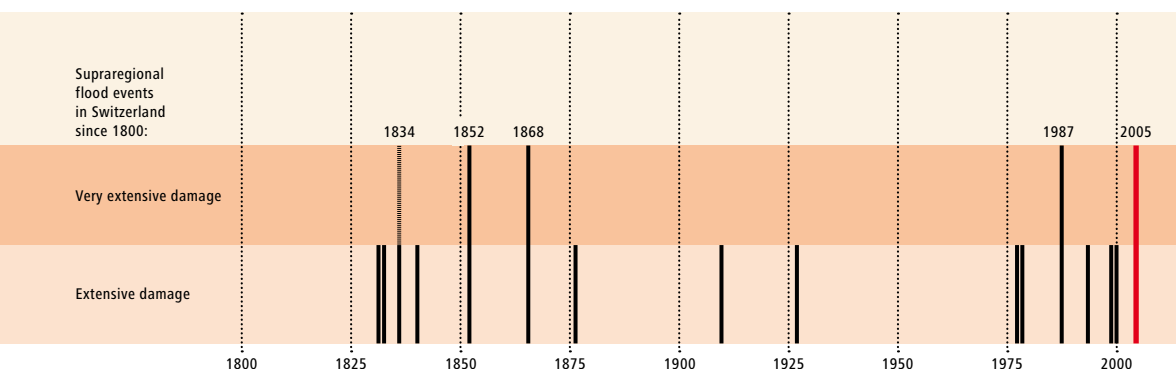
The overall picture of the flood of August 2005 ultimately reflects the pattern that previously characterised such major events. In the period since 1972, for which comparable data are available, the year 2005 stands out, however, for its high **total loss amount** (see page 8).

However, the representative value of a monitoring duration of just over three decades is limited. Thus, even if the corresponding base data are marred by significant uncertainties, a comparison with historical events would appear appropriate. Gaps frequently exist in the documentation of earlier events. Moreover, many conditions have changed over the course of time: on the one hand, the **potential for damage** has increased significantly while, on the other, the structural, technical and organisational **measures** for protection against flooding have been further developed and improved.

Overall it may, however, be viewed as a proven fact that several floods occurred in the 19th century whose extent of damage actually matches or exceeds that of 2005 – depending on the conversion basis used. Thus, when viewed in the context of this longer period of time, the **extent of the damage** caused in August 2005 appears less unique than it does from the short-term perspective. Hence, despite all uncertainties in the assessment, it may be assumed that the flood of August 2005 was **not a unique event** and that the repeated occurrence of similar events must also be expected in the future.

Since the early 19th century, there have been 16 extensive or very extensive floods necessitating supra-cantonal intervention (see bar chart below). In today's monetary terms, the damage they caused totals between CHF 500 million\* and several billions. In the 19th century, such events often claimed dozens of lives. Thanks to comprehensive preventive measures and improved emergency response, the number of victims has decreased significantly in the intervening period.

\* With damage totalling CHF 380 million, the biggest single event in 2007 (8/9 August) remained below this threshold.

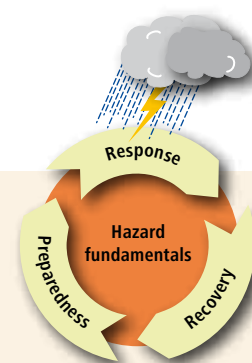


## Scales without upper limits

None of the channel and slope processes that occurred in August 2005 arose for the first time. Nevertheless the events of August 2005 had one **unique characteristic**: first, the floods affected a very wide area, i.e. from the Alpine region to the Alpine foothills and into the Swiss Central Plateau, and, second, in some locations, the damage that arose as a result of the extreme intensity of the channel and slope processes was particularly extensive.

In many places, this gave rise to situations which lay beyond the bounds of **locally available experience**. Conclusions must now be drawn from this that can be applied not only to flood protection but also to **hazard and risk assessment** in general: the scale of the intensity of events does not have any specified maximum values. Everything is possible, including the "inconceivable".

The experience gained in the past culminates today in the acknowledgement that a holistic approach must be adopted to the management of flood events: preparedness, response and recovery complement each other and must be even more closely coordinated. This requires comprehensive hazard information which lies at the centre of cycle of risk (see below).







Flood 1868: debris flow in Zignau, municipality of Trun GR (Coaz)



Flood 1987: lateral erosion in Gurtellen UR (Comet)



Flood 2005: flooding in Schattdorf UR (Swiss Air Force)



Flood 2005: flooding in the Mattequartier of Bern (Swiss Air Force)

## Protection concepts over the course of time

Flood protection concepts also change over the course of time, gradually and in tune with technical, scientific and social progress. Major events promote their implementation.

### 19th century: preparedness, recovery

Comprehensive strategies for protection against flooding were first debated around the mid-19th century. The associated technical and political debates led to the enactment of the Forest Police Act (1876) and the Flood Protection Police Act (1877). Based on these legal provisions, the state implemented major **structural projects** for the stabilisation of mountain torrents and flood-proofing of valley floors. Elementary loss cover became established as part of **mandatory buildings insurance** in the first half of the 20th century.

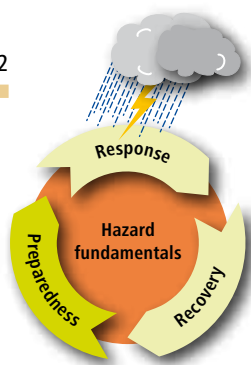
### 1987: hazard fundamentals

There is no such thing as complete protection against natural hazards. Following the events of 1987 – at the latest – it was realised that structural measures alone are not sufficient to guarantee flood protection. Thus, in terms of preventive measures, the priority shifted in favour of **land use** that was suited to the prevailing natural conditions and **spatial planning** that would re-allocate to the lakes, rivers and streams the space that they required. To this end, **hazard maps** had to be developed and **protection objectives** formulated in advance: i.e. responses formulated to the question as to what can happen or what is allowed to happen where. Strategies that take possible **cases of overload** into account are also necessary and this involves **emergency planning** that limits residual risk. The corresponding legal provisions were formulated in 1991 in the new Hydraulic Engineering Act and the new Forests Act.

### 2005: response

The case of overload is reality. Therefore the principles of flood protection must be complemented by the demand for **robust protection concepts** that incorporate capacity for the **overload case**. However, preparedness is not the only area where action is needed; the response to extraordinary events also needs attention. With effective **preparation** and optimally prepared **intervention** the scale of the events and extent of the damage caused can be decisively limited. Management organisations and intervention forces must therefore increasingly focus their **training** on deployment during natural events. This requires not only increased **cooperation** between the actors involved in the field but also the greater **involvement** of the affected population.

The floods of 2005 were not the first occasion to demonstrate that any protective measure can be subject to overload (photos left). Thus, all options for the prevention of damage must be availed of throughout the risk cycle.



There are two fundamentally different approaches to preparedness: existing natural hazards are either warded off at the hazard source or in the area at risk (through measures that reduce the hazard potential), or land use is adapted to the existing natural hazards (through measures that reduce the damage potential). Measures that influence the damage potential take priority.

## Ranking of measures

The question as to which preventive flood-protection measures should be implemented in individual cases remains controversial. The principles here have been clearly specified, not only in the Hydraulic Engineering Act and its associated Hydraulic Engineering Ordinance, but also in the Spatial Planning Act and the Forests Acts. According to these laws, protection concepts must fulfil the following requirements:

- reduce **damage potential**;
- conserve the **functional efficiency** of existing hydraulic engineering structures and installations;
- value **natural habitats**.

Thus, flood protection must be incorporated into the holistic planning of measures which is usually composed of a range of elements:

- The **appropriate maintenance of water bodies** is top priority to guarantee the capacity and effect of existing protective structures in the long term.
- Maintenance measures also include sustainable **protective forest maintenance**.
- **Spatial planning measures** also have a high priority. Local planning and landscape planning that respect existing natural hazards and creates open space for extraordinary events constitute better preparedness than the retrospective safeguarding of indiscriminately defined development zones through the construction of costly protective structures.
- **Near-natural, landscape-appropriate protective structures** should only be built where the maintenance of water bodies and spatial planning measures are insufficient.
- Finally, adapted **local flood-proofing protection measures** and comprehensive **emergency planning** are essential to minimise residual risks.

## Local protection measures

The most efficient preparedness consists in the avoidance of existing natural hazards and not taking any risks in the first place. For this reason, spatial planning measures must be implemented quickly. Where such measures alone are insufficient, structural, technical and organisational measures are also necessary to avert dangers and reduce risks. Local flood-proofing protection measures assume increasing significance in this context: major damage can be prevented through **simple precautions**.

For this reason, developers and planning authorities should be motivated more strongly than hitherto to design, build and, where necessary, upgrade structures and installations in a hazard-appropriate way. Expert consultancy and premium incentives by **insurance companies** already display an incentivising effect in this regard.

Precautionary local protection measures must be designed and developed in the context of preparedness. In the case of temporary measures, it is essential that they be rapidly available and easy to implement (below).

Schuler



Effective local protection measures at Dallenwil NW Power Plant (right): with the help of simple precautionary measures costing approximately CHF 15 000, it was possible to prevent potential damage to buildings and installations in excess of CHF 6 million in August 2005.

Swiss Air Force



Nidwaldner Sachversicherung





## Significant need for modernisation

In general, decisions in the areas of planning and development must be more consciously tailored to existing natural hazards than they were in the past. As part of this approach, all flood protection measures must be tested rigorously for their response during extraordinary events: protective structures must not fail dramatically in the case of exposure to extreme volumes of runoff, sediment or other forces and thus give rise to an uncontrollable escalation in the damage caused. Thus, the **case of overload** is always incorporated into contemporary protection concepts. The planned measures must be designed accordingly and display a robust response capacity (see example below). Older protective structures are often unable to fulfil this requirement, however. Many structures, which originate from the **19th century**, no longer fulfil the technical and ecological requirements applicable today. These include important river training structures, for example on the river Rhone in the canton of Valais, on the river Linth and on the Alpenrhein river. Numerous protective structures which were built in the **mid-20th century** also need to be upgraded and adapted to today's requirements. Their dimensioning was based on experience from the period 1927 to 1977 which was relatively free of exceptional flood events.

The need to upgrade and adapt flood protection structures throughout Switzerland is correspondingly high. The consequences of **climate change** must not be neglected in the course of this ongoing work. Thus, both new structures and the upgrading of existing ones should be designed in a way that enables them to be adapted to the new conditions – for example, higher seasonal runoff or increased solid material transport – at as low a cost as possible.

## Risks remain

The flood events of August 2005 and, now also, those of summer 2007 clearly demonstrated that the case of overload has become reality in many locations: runoff volumes and sediment volumes often far exceeded expectations and the **critical loads** for some preventive measures were reached or even exceeded.

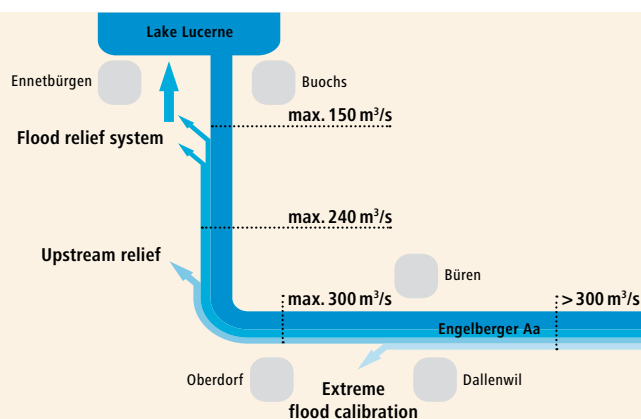
The major challenge consists, therefore, in optimising preventive measures against the background of the uncertainties that always remain in relation to natural hazards. Even very long series of measurements display – statistically speaking – a wide range of variation. This circumstance should be taken into account in the selection of **dimensioning parameters** while the **selection of a suitable system** guarantees that the measures undertaken take suitable account of the residual risk. Thus the clarification of the case of overload is an integral component of the design of all protective measures:

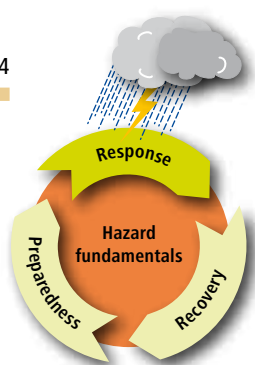
- Which areas are at risk?
- Which processes arise and how do they influence each other?
- How intensive are these processes?

If the **residual risks** are known they can be reduced to an acceptable level through suitable local flood-proofing protection measures and comprehensive emergency planning. However, there are no standard solutions when it comes to dealing with residual risks, be it in association with flooding or other natural hazards. Every locality has its own **individual characteristics** which are dictated by the relevant topography, geology, hydrology, land cover and land use.

The upper limits of scales in nature are practically open-ended. Up-to-date protection concepts take such uncertainties into account by performing robustly in the case of extreme events – i.e. by not failing immediately and increasing the damage caused but by providing space for extraordinary volumes of runoff or sediment. In concrete terms, this requires “safety valves” which can relieve affected channels in such cases (for example through the gradual and deliberate flooding of prepared areas). Such protection concepts have been implemented, for example on the Urner Reuss and Engelberger Aa rivers (see diagram and photo below) and have proven successful there.

Flood relief system Buochs NW on 23 August 2005 (Swiss Air Force)





Response starts not only when streams, rivers and lakes have already become swollen with flood water or landslides have already started to move along the slopes, but at a much earlier stage: i.e. through measures developed in good time which minimise the extent of the damage. These precautionary measures include a well prepared emergency organisation whose intervention is triggered by precipitation and flood forecasts and through monitoring at local level. In this way, the preventive measures make a crucial contribution towards ensuring that the subsequent intervention (temporary protective measures, rescue, recovery, hazard mitigation) can be implemented successfully.

## Intervention in the water, mud and debris

It was not only the course of events during the floods in August 2005 that was exceptional. The general willingness to help and solidarity shown towards the victims were extraordinary. Many members of the fire brigades, police forces, medical services, technical services and specialist authorities far exceeded the call of duty. Civil defence and army units were also deployed. Countless individuals also lent a hand voluntarily.

In retrospect it may be said that the **intervention** in response to the events was basically successful. This emerges particularly clearly in the comparisons with previous events of a similar scope. In the 19th century, supraregional floods regularly claimed numerous lives in a Switzerland that was far less densely populated than is the case today. The number of fatalities in August 2005 was significantly lower as compared with previous events. This is due to the extensive deployment of personnel at all levels, on the one hand, and to the variety of technical options that are now available for such intervention, on the other. However, the extent and intensity of the flood of August 2005 also brought certain organisational and technical **weaknesses** and **gaps** in human resources availability to light. The management organisations and intervention forces in some locations were taken by surprise by the rapidity of the unfolding events.

Technical and human resources are now available for intervention, with the help of which successful rescue operations can be carried out even in very difficult situations: spectacular rescue of the driver of an excavator from the river Reuss near Amsteg UR on 22 August 2005 (below).

RDB/Walker



## Taking the necessary precautions

The preconditions for successful intervention include, first, the implementation of the necessary precautions. Second, the optimal point in time for intervention must not be missed. Thus **preventive measures** are very important. They are prepared well in advance but not initiated until just before the advent of a hazard event. They make a significant contribution to the reduction of damage and protection of the population.

What is primarily involved here is comprehensive **emergency planning** which builds on the existing hazard information. The emergency planning describes both the possible scenarios that can lead to intervention in the case of a flood and the corresponding measures to be undertaken. Emergency planning necessitates, inter alia:

- knowledge of the possible channel and slope processes in the intervention area;
- the provision of the necessary material;
- intervention training and practice for hazardous channel and slope processes;
- the regulation of intervention management;
- the operation and securing of communication links during intervention.

Preventive measures can only be undertaken in good time if the **forecasts** (i.e. precipitation and runoff forecasts) and **local observations** are reliable, if the corresponding **warnings** reach the management organisations at all levels in good time and if the subsequent **alerting** is also correctly understood by the population.

In many instances this was not the case in August 2005. Far from all of those affected by the floods were sufficiently informed to be able to act in good time under their own initiative and within the scope of the possible measures – even if they are moderate: i.e. by removing vehicles from underground garages, clearing out cellars, removing installations from areas at risk, sealing door openings. However, even such minor measures must be planned in advance.

The population's **low level of awareness** in relation to flooding and other natural hazards is a general weakness in the hazard protection system. First, people lack broadly based knowledge about these hazards. Second, there is also a lack of awareness of the fact that individual and hazard-appropriate action can make a crucial contribution to the reduction of the damage caused.





Keystone/Risch

The flood events of August 2005 represented a severe test for the Swiss Civil Protection Concept which had only been reformed the previous year. The concept basically passed this test (fire brigade at work in Weesen SG, above). However, it was not all plain sailing as, in some cases, management organisations and intervention forces were unable to cope due to the spatial spread, extended duration and sporadic course of the events.

### Swiss Civil Protection Concept

Since its reform in 2004, civil protection in Switzerland has been organised as a **joint civil protection system** in which five partner organisations work together: i.e. the police, the fire services, the public health care services, the municipal and cantonal technical services and the Protection and Support service. They provide leadership, protection, rescue and assistance in the management of extraordinary situations and events.

The partner organisations manage such intervention with the help of resources that can be used on a modular basis. The **intervention forces** used are adapted to and, where necessary, reinforced on the basis of the nature and severity of the events (if necessary using also private and military resources).

The **cantons** are in charge of civil protection, however the main responsibility for emergency planning and organisations lies with the **municipalities**. In addition, the **Confederation** may – with the agreement of the cantons – assume responsibility for the coordination or management of the response to major events (Federal Act on Civil Protection). Moreover, if the available civilian resources are insufficient to deal with an event, military resources may also be made available to the management organisations (subsidiary deployment of the army).

The overall responsibility for the safety of the population lies, therefore, with the relevant **executive bodies** (municipal councils, cantonal governments, the Federal Council, i.e. the Swiss government). If several partner organisations are deployed simultaneously and for an extended period, as was the case in the flood of August 2005, the task of managing and coordinating the tasks that arose is assigned to technically qualified and politically legitimised bodies: i.e. the municipal **management organisations** and cantonal **command staffs**.

### Expert knowledge on site

Whether their causes were organisational, technical or related to a lack of human resources, the weaknesses identified in August 2005 have already been eliminated in part. However, gaps still exist at local level which must be overcome to enable the better management of the threat of rapidly swelling floods and other natural hazards than hitherto.

Thus the **training** of management organisations and intervention forces must focus more strongly on intervention during flood events. **Standard situations and behavioural rules** must be integrated into the corresponding training programmes and consistently practised (similar to the approach adopted for fire and chemicals protection).

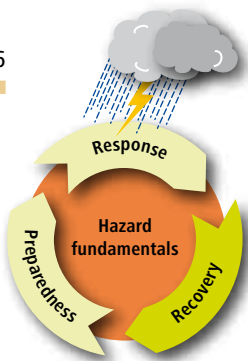
In serious cases, the management organisations and intervention forces must also be able to depend on local expert knowledge to be able to comprehensively assess the situation and make the right decisions. For this reason, existing **local knowledge** should be conserved, supplemented in a targeted way and made more accessible.

In order for this potential to be exhausted more efficiently than in the past, the greater involvement of the affected population is also essential. Thus, intermediaries (known as “multiplicators”) located between the experts and the population are needed who, thanks to their networks, have insight into both the technical fundamentals and local needs and sensitivities (as in the case of the tried-and-tested structures in the avalanche services all correspondingly trained hazard experts who are familiar with local conditions).

Preventive measures pay off quickly and should therefore be stepped up. A comparison of the events of August 2005 with those of August 2007 already demonstrates the benefits of good foresight. The mobile protective systems created in the Mattequartier neighbourhood of Bern are a good example of this (in use on 8 August 2007, below). Despite the fact that the water levels were similar to those two years earlier, they helped to contain the damage at a significantly lower level.

Keystone/Della Valle





Recovery must not be equated with the fastest possible restoration of the exact situation that existed in a particular area prior to a destructive flood. Instead, this phase is concerned with the temporary protection of the affected areas, the suitable shielding of living space and the safeguarding of infrastructure.

## Decision-making under pressure

The immediate response to the floods in August 2005 was also followed by the significantly less spectacular but equally challenging recovery phase. In order to ensure **adequate protection** against further threats and to guarantee the operation of vital infrastructure, blocked channels had to be cleared, damaged dikes secured, mud and debris cleared and blocked transport axes and disconnected conduits replaced as quickly as possible. These immediate measures were also accompanied by **early preventive measures** to eliminate existing safety deficits as quickly as possible.

Far-reaching **decisions** had to be taken under extreme time pressure and without comprehensive clarification as the affected populations expected rapid and binding answers to questions regarding the future of their houses and places of work. What was mainly involved here was the further procedure, the corresponding planning application processes, the duration of the repair operations and their financing.

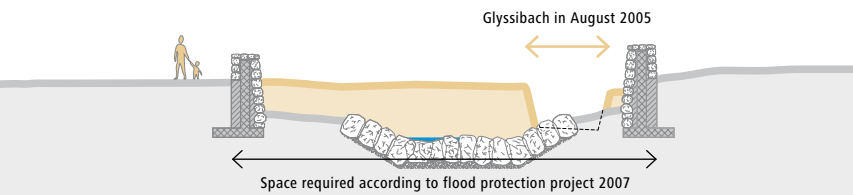
The biggest challenge faced by the authorities at all levels during this phase was the **coordination** of widely varying and, in part, conflicting interests. In some cases, the lack of networking between the different decision-making levels was revealed and, as a result, conflicts arose during hazard and risk assessment and during the planning of measures.

## Action principles

The same principles apply to recovery after a hazard event as those applicable in the phase of preparedness (see page 12). The special circumstances do however give rise to certain difficulties. Numerous decisions must be taken almost simultaneously on a large number of projects. Experts are often in short supply during this phase. Moreover, few **standardised procedures and courses of action** exist for this delicate phase in the risk cycle.

For this reason, the relevant federal authorities created a preliminary list of action principles shortly after the events of August 2005. Its content may be summarised by the following slogan: "The quick solutions of today must not become the problems of tomorrow":

- The space required by water bodies must be kept free, the **spatial requirement of watercourses** must be respected (in accordance with the principles defined in the federal and cantonal hydraulic engineering legislation). Based on this, the newly formed wider cross-section on stretches of water bodies with lateral erosion must be conserved on a permanent basis.
- There can be no doubt that other floods will occur, therefore **flood plains and flood corridors** must also be secured permanently through spatial planning measures.
- Buildings and installations that have been destroyed or severely damaged and are used for inhabitation by humans or animals must not be unthinkingly rebuilt without prior and comprehensive **hazard and risk assessment**.
- As a general rule, wherever buildings or installations have been damaged, **permanent local protection measures** should be mandated.
- **Hazard maps** must be strictly observed and if they are not available their creation must be given top priority.



Swiss Air Force; Source Profile: Canton of Bern



Preliminary judgments must not be made during the recovery phase. The long-term protection against floods (and other natural hazards) is only implemented during the preparedness phase on the basis of detailed hazard and risk assessments. The securing of the spatial requirement which became obvious in many locations after the events of August 2005 is a top priority (left, example Glyssibach in Brienzen, Bern (BE)).



## Improving cooperation

The recovery phase begins on the completion of the intervention required to deal with a flood. Clear **organisational rules** are lacking in some areas for this transition from one phase to the next. It is important that structures and processes be institutionalised and the cooperation between all stakeholders improved.

Flood protection is a **shared task** which involves the participation of a large number of actors: i.e. the authorities and technical services at all levels (municipal, cantonal and federal), on the one hand, and private consultancies, insurance companies, environmental organisations and those directly affected, on the other.

Sound solutions that find broad acceptance can only be achieved through **joint action**. This task is a challenging one and rarely conflict-free.

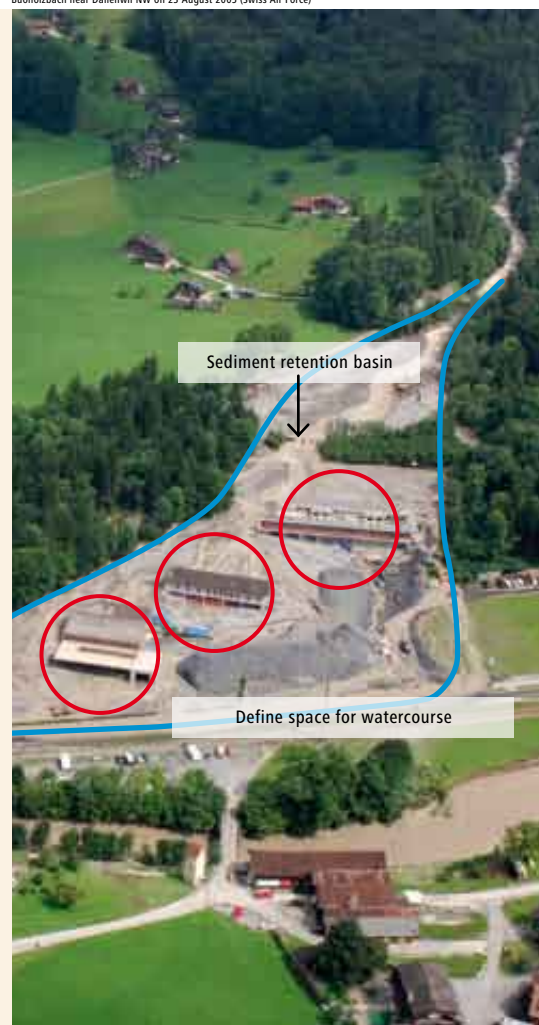
## Emergency concepts as stop-gaps

The destruction or damaging of protective structures causes protection deficits which must be eliminated as quickly as possible. Before destroyed structures are rebuilt, the question arises as to whether their **replacement** really makes sense. In August 2005 many structures were affected which had been erected a considerable time ago. Since then, the expertise available on existing hazards, the processes they trigger and the risks to be taken into account has developed significantly.

Thus the causes that gave rise to the damage or destruction of the structure in question must be clarified in every damage location. This clarification and the design and implementation of follow-up projects takes time, however. This period can be bridged with the help of emergency concepts that reduce the existing protection deficit quickly and effectively. This creates the necessary freedom for the development of **viable solutions** which will guarantee long-term protection.

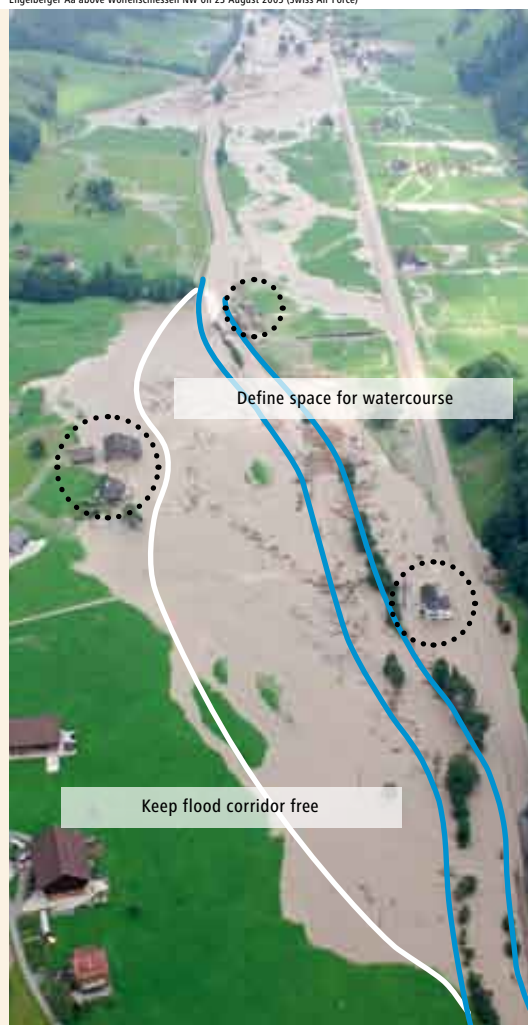
### Principles for action on a mountain torrent

Buholzbach near Dallenwil NW on 23 August 2005 (Swiss Air Force)



### Principles for action on a valley river

Engelberger Aa above Wolfenschiessen NW on 23 August 2005 (Swiss Air Force)



○ No repair without comprehensive hazard assessment

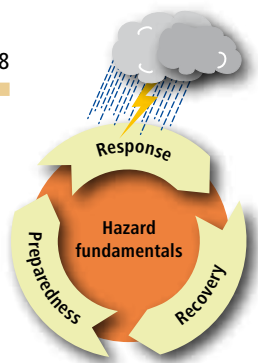
⊙ Local protection measures

The greatest challenge consists in the development of robust and overloadable protection concepts. The area intended for the case of overload must be kept free of buildings and installations. Where this is not possible, the affected buildings and installations must be locally protected (see sketches with principles, left).

# Hazard Fundamentals

## (Hazard Assessment, Hazard Maps)

18



The provision of information that enables the comprehensive assessment of existing hazards and risks is central to all activities. The corresponding products are very important – not only for the planning and implementation of preventive measures. They also help in the response to events and, afterwards, in the recovery of the affected regions.

### “Opening out the fan”

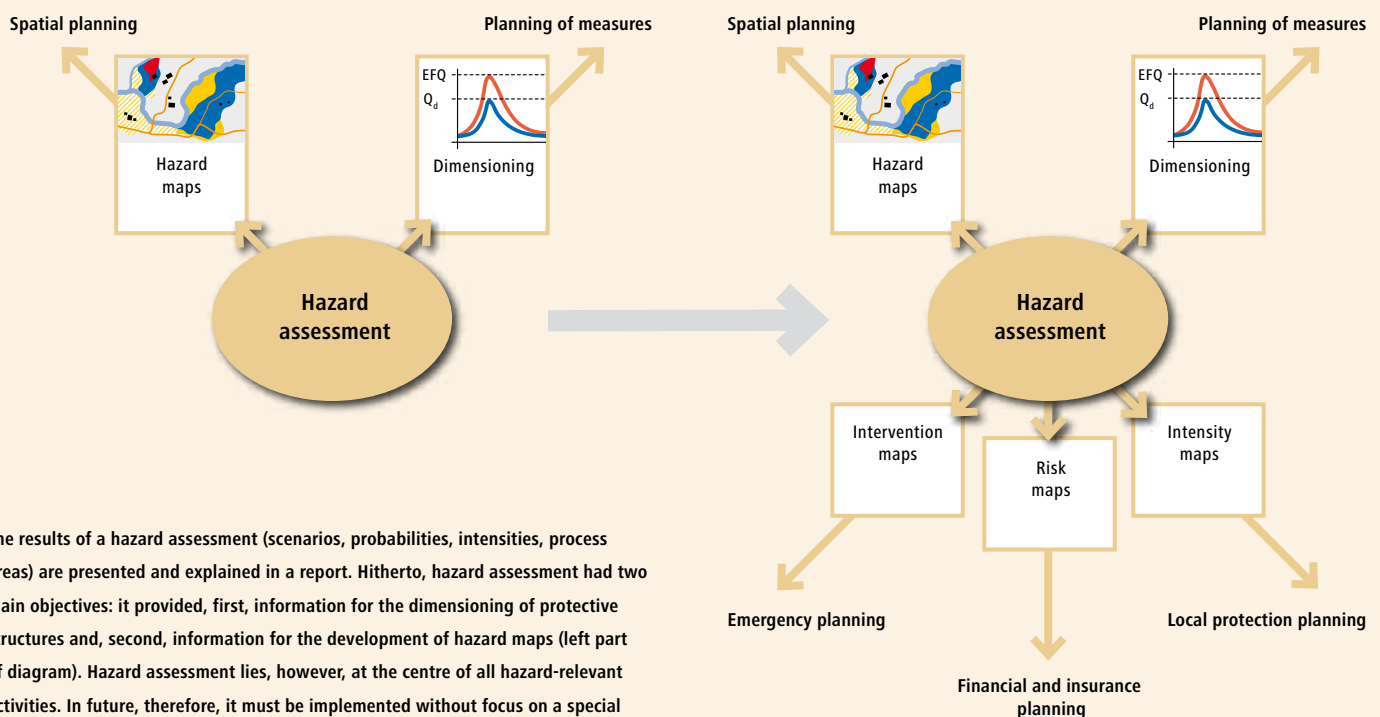
The ways in which channel and slope processes actually unfold in a particular area repeatedly causes surprises. During an event, very different processes are imaginable which may intensify suddenly, change unexpectedly or simply develop differently than anticipated. This phenomenon was also in evidence during the floods of August 2005. This must be taken into account during hazard assessment. The wide-ranging variety of processes and events may be represented with the help of **scenarios**. Even less probable courses of events must not be excluded from the overall consideration without reason. Thus the **threshold processes, process changes and process chains** which lie outside of locally available experience must also be incorporated into the reflections: the resulting scenarios must be representative enough to openly address and demonstrate all possible developments.

### Dealing with uncertainties

In practice the question will arise as to which scenarios are ultimately representative enough to be used as a solid basis for planning and decision making. The classification of events that lie outside of the available area of experience is always associated with uncertainties. It is particularly difficult to assess their **probability** or **return period**. The estimation of their **intensity** and **extent** is usually somewhat easier.

Rare slope processes, in particular, are almost impossible to conceive statistically. **Margins** for their probability of occurrence and intensity can at best be estimated. As opposed to this, sufficiently assured data are often available on channel processes which arise relatively frequently to enable the quantification of probabilities and intensities using **statistical methods**.

The uncertainties that exist in hazard and risk assessment have consequences for the planning and decision-making information to be derived from them. A certain **fuzziness** is characteristic of them which must be taken into account in all decisions and must be clearly communicated to all stakeholders.



The results of a hazard assessment (scenarios, probabilities, intensities, process areas) are presented and explained in a report. Hitherto, hazard assessment had two main objectives: it provided, first, information for the dimensioning of protective structures and, second, information for the development of hazard maps (left part of diagram). Hazard assessment lies, however, at the centre of all hazard-relevant activities. In future, therefore, it must be implemented without focus on a special product and provide the necessary basis for all other areas (right part of diagram).



## Extending the range of products

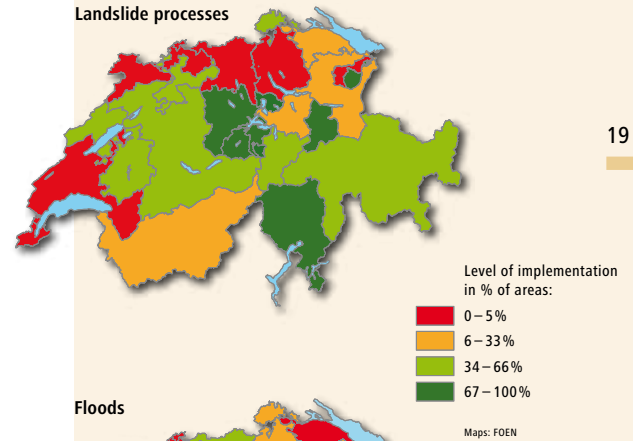
Hazard maps are the most highly regarded product of hazard assessments. Hazard maps were originally conceived as a spatial planning tool. As a cartographical representation of the current hazard situation they form the primary technical basis for the consideration of natural hazards in the development of **land use plans**.

The importance of hazard-relevant information has also been recognised in other areas. As a result, over the course of time, various attempts have been made to cover additional needs with the help of hazard maps, including some that are not directly linked with spatial planning. This has resulted in the gradual **overburdening** of the hazard map as a product.

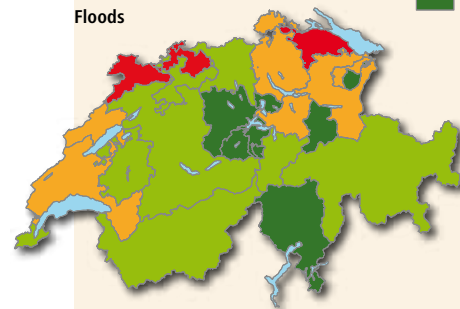
Moreover, information that is significant for other issues could be lost in the conversion into the cartographical applicable for spatial planning purposes. Thus, the emphasis should be placed on hazard assessment and implemented without any focus on a particular product. Based on this a variety of **specific products** – similar to the hazard map – could be derived from the assessment (for example: intervention maps, risk maps and intensity maps).

These significantly **higher requirements** of hazard assessment as compared with previous practices require far more comprehensive documentation. This undoubtedly gives rise to higher costs. However, the increased costs can be justified by the clearly improved transparency of the corresponding considerations and conclusions.

Landslide processes



Floods



## Hazard mapping in Switzerland

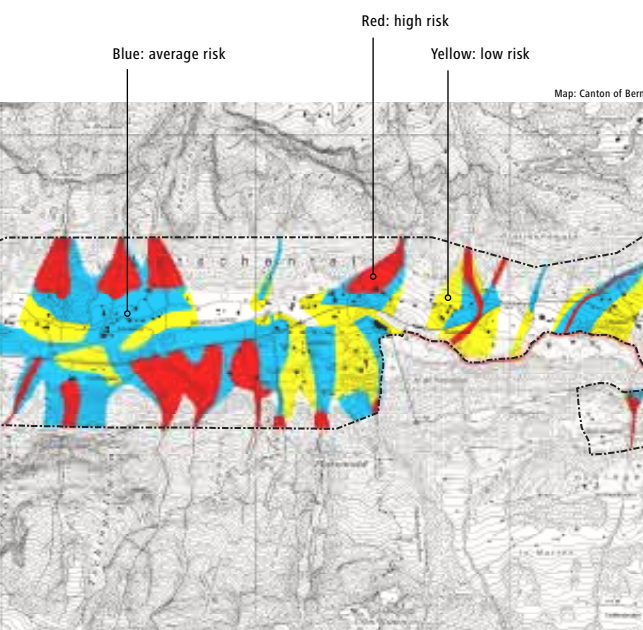
A **country-wide hazard assessment** is currently being carried out for settlement areas in Switzerland, the results of which are being presented in the form of hazard maps for floods, landslides, rockfall processes and avalanches. Hazard maps provide the scientific basis for the implementation of spatial planning measures.

In August 2005, damage arose in almost 900 municipalities as result of channel and slope processes. Of these municipalities, approximately one third had hazard maps. The hazard maps available at the time proved to be largely accurate. The specified hazard zones only failed to coincide with the affected locations in a few places. These cases have been analysed in particular detail in the context of the event analysis so that conclusions can be drawn for the improvement of the hazard assessment.

Around half of the planned hazard maps have been completed in the intervening period. The flood of August 2005 and more recent events prompted the acceleration of the hazard mapping process. In any case, extensive efforts have been made in most **cantons** and the Confederation is doing everything in its power to ensure that hazard maps are available for **all municipalities** throughout Switzerland by 2011 and are rapidly integrated into spatial planning processes.

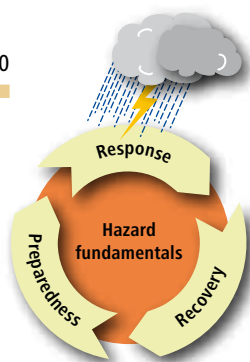
The available hazard maps can be viewed at the relevant cantonal offices or directly at the municipality. Obtaining personal knowledge of the hazard situation at one's place of residence and work is the first step towards taking **individual responsibility** for hazard prevention.

Hazard maps (example Lüttschental BE, left) and the accompanying technical reports contain extensive information about the causes, evolution, extent, intensity and probability of occurrence of natural hazards. Their level of detail reflects this fact. However, hazard maps do not show which risks are associated with the depicted channel and slope processes.



# Hazard Fundamentals (Precipitation and Flood Forecasts, Local Observations)

20



The protection of the population and the basis of its living standards against flooding and other natural hazards is a state task. In order to fulfil this multi-faceted and challenging task, technical offices, management bodies and intervention forces are dependent on reliable information about precipitation and runoff conditions – not only in the course of the management of hazard events, but during all phases of the risk cycle.

## Gaps in the flow of information

Forecasts of expected precipitation and runoff and data from the monitoring of local developments must be processed as quickly as possible and forwarded to the management bodies and intervention forces at all levels so that effective protective measures can be implemented before hazard events arise.

Precipitation and runoff data and local observations are widely available in Switzerland. There is no lack both of state and private institutions which disseminate their information through a wide range of channels. However, the overall performance in August 2005 was not convincing:

- The measurement and monitoring networks operated by the meteorological services, scientific institutions, by the Confederation, cantons and private bodies did not work in **cooperation**, and the exchange of data was further hindered by tariffs.
- Due to **technical problems**, the wide-ranging data supply was often not available where it would have been of benefit during the most critical hours and days.
- In many cases it was not possible to interpret the available data properly because the corresponding **expertise** was not available locally.
- **Structural weaknesses** were evident in the field of flood forecasts. Human resources were inadequate for the management of the crisis situation and the existing reporting systems were insufficient to cope with the impacts that arose.

## Different Scales

A further difficulty lies in the nature of atmospheric processes. Thanks to dense measurement networks and ever-increasing computer capacities, it has been possible to improve the accuracy of weather forecasts on an ongoing basis. Despite this, it is still not possible to provide completely accurate **precipitation forecasts**. The behaviour of the atmosphere is too chaotic for this and a residual element of chance always remains. The ensemble forecasts now in use (see page 5), which specify probabilities, provide additional information about the incidence of certain weather trends – information which must, however, be interpreted.

Yet another obstacle lies in the fact that meteorological models cannot provide detailed forecasts for small catchment areas. This affects **flood forecasting** as hydrological models are dependent on catchment-area-based information. For this reason and also due to uncertainties in the runoff modelling itself, longer-term flood forecasts continue to be affected by considerable uncertainty.

As opposed to this, the methods and models in the field of **short-term forecasts** (known as "nowcasting") can be significantly refined and upgraded. Considerable improvements may be expected here. In order for such information and other information to be of use as a basis for decision making, they must be linked with **local observations** and interpreted. Trained experts are required for this task at all levels.

Only when extraordinary precipitation is forecast in good time can sufficiently reliable flood forecasts be produced and made available to the technical and management bodies (below). In August 2005 this information flow was not optimal. The initial conclusions have already been drawn from this experience, e.g. the need to improve precipitation forecasts and increase the human resources available at federal technical offices.

Schreyenbach/Linthtal GL on 23 August 2005 (Keystone/Risch)

MeteoSwiss (2)





## Better protection against natural hazards

The events of August 2005 clearly highlighted the fact that several **gaps and weaknesses** existed in the area of risk management in Switzerland. Thus, as early as autumn 2005, work began at federal level on the intensive exploration of the very recent experiences in this area. The process targeted both the causes and effects of the events (in the context of the event analysis) and the warning and alerting processes (as part of the OWARNA project).

This revealed that crucial improvements could be quickly implemented at federal level, in particular in the area of **warning and alerting**. The Federal Council pursued these recommendations and passed an entire package of measures:

- In the case of extraordinary natural events, the National Emergency Operations Centre (NEOC) in the Federal Office for Civil Protection (FOCP) will be developed into a national **information and situation centre**.
- Human resources at the Hydrology and Hazard Prevention divisions of the Federal Office for the Environment (FOEN) are being increased to guarantee the availability of **expert consultancy** services for the responsible authorities and situation assessment round the clock during hazard events.
- The meteorological and hydrological **forecasting systems** are to be developed on an ongoing basis.
- A shared information platform is being created to improve the **networking** of technical offices and management bodies (cf. column right).
- The **emergency electricity supply** of warning and alerting systems is to be developed and supported by redundant systems.

At the same time, the **cooperation** between the different technical offices and management bodies at federal, cantonal and municipal level is being examined and optimised at all levels.

### Optimisation of warning and alerting systems in the event of natural hazards (OWARNA).

Under the auspices of the Federal Office of Civil Protection (FOCP) and in cooperation with the National Platform for Natural Hazards (PLANAT) experts from the federal, cantonal and municipal authorities and from the communications sector analysed the events of August 2005 and developed proposals for improvement.

Management bodies (below) and intervention forces rely on the best possible information about the weather trends and runoff development before, during and after a flood event.



Bern-Marzlibad on 22 August 2005 (Keystone/Lehmann)

The events of August 2005 ruthlessly highlighted the weaknesses that existed in relation to organisational, technical and human resources. Some of these problems must be resolved at local, regional and cantonal level as this is where the actual responsibility for flood protection lies. However, structures must also be improved, work processes adopted and general hazard information expanded among the management bodies and technical offices at federal level.

## Joint Natural Hazard Information Platform

The actors at all levels – i.e. Confederation, cantons and municipalities – must set themselves one joint task: i.e. that of improving the **exchange of information** before, during and after an extraordinary event. In many places the necessary knowledge about the threatening weather and volumes of runoff to be expected was lacking, there were coordination problems and contradictory statements were issued.

Such deficits did not arise for the first time in August 2005. For this reason, the authorities that deal with floods and other weather-based natural hazards had already resolved and embarked on the development of the Joint Natural Hazard Information Platform (Gemeinsame Informationsplattform Naturgefahren, GIN). The participants include MeteoSwiss (the Swiss national meteorological service), the Federal Office for the Environment (FOEN, with its Hydrology and Hazard Prevention Divisions) and the WSL Institute for Snow and Avalanche Research (WSL/SLF).

In future, when necessary, these three technical authorities will transmit **joint bulletins** to natural hazards experts, management bodies and intervention forces at all levels. This new instrument will not, however, be able to provide precise forecasts of local developments. Instead, the information transmitted in its bulletins should be combined with **local observations** and evaluated on the basis of solid **local knowledge** before being converted into concrete instructions for action. To this end, the decision-makers need the expert support of local natural hazards experts who are correspondingly trained and prepared for this task.

Keystone/Kusano



Thus, flood protection policy remains an ongoing task which concerns not only the experts but must also and increasingly involve the entire population.



Television channels, radios and print media (see examples) reported on the floods of 2005 in greater detail than ever before. However, the memory of these events has long been replaced by new media impressions and quickly faded – particularly in parts of the country that were not severely affected by the storms at the time. This short term interest is virtually impossible to reconcile with the long-term perspective required in the management of infrequent hazards and risks.



## Event Analysis: The Floods of 2005

This brochure is a **synthesis** of "Ereignisanalyse Hochwasser 2005" (Event Analysis: The Floods of 2005) which was commissioned by the Federal Department for the Environment, Transport, Energy and Communications (DETEC) and was completed in 2008. This project was jointly managed by the Federal Office for the Environment (FOEN, Hazard Prevention Division) and the Swiss Research Institute for Forest, Snow and Landscape (WSL). Other federal and cantonal offices, various university and technical institutes and private consultancies were also involved in this project.

The natural processes that arose, the quality of the available hazard fundamentals and its implementation were analysed, the effect of the protective measures examined and the efficiency of the forecasts, warnings, alerting and crisis management scrutinised. The corresponding insights provide an important basis for future flood protection in Switzerland.

The complete findings of the event analysis are documented in a **two-part report** (cf. right). The first part provides an overview of the processes that occurred and the damage caused, analyses the precipitation and flood forecasts and enables a first classification of the event. The second part contains an in-depth analysis of selected processes and is mainly devoted to the efficiency of measures for natural disaster reduction (preparedness, response, recovery) as well as to hazard fundamentals.



### Part 1: Prozesse, Schäden und erste Einordnung

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- Hydrologie Seen
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- Rutschungen

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### Part 2: Analyse von Prozessen, Massnahmen und Gefahregrundlagen

- Möglichkeiten und Grenzen der Niederschlagsanalysen zum Hochwasser 2005
- Analyse hydrologischer Extremereignisse
- Hanginstabilitäten
- Gerinneprozesse
- Ausgewählte Phänomene im Zusammenhang mit Bauwerken
- Fachtechnische Analyse der Gefahregrundlagen
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## Recommended Websites

**FOCP** – Federal Office for Civil Protection  
[www.civilprotection.admin.ch](http://www.civilprotection.admin.ch)

**FOEN** – Federal Office for the Environment  
[www.environment-switzerland.ch](http://www.environment-switzerland.ch)

**MeteoSwiss** – Federal Office of Meteorology and Climatology  
[www.meteoswiss.admin.ch](http://www.meteoswiss.admin.ch)

**PLANAT** – National Platform for Natural Hazards  
[www.planat.ch](http://www.planat.ch)

**WSL** – Swiss Research Institute for Forest, Snow and Landscape  
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