Swiss Competences in River Engineering and Restoration

Schweizerischer Wasserwirtschaftsverband
Association suisse pour l'aménagement des eaux
Associazione svizzera di economia delle acque

Symposium CIPC KOHS 2014

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Jürg Speerli
Roger Pfammatter
Editors

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Preface

The world is like a river, running along in its bed, this way and that, forming sandbanks by chance and then being forced by these to take a different course. Whereas this all proceeds smoothly and easily and gradually, the river engineers have great difficulties when they seek to counteract this natural behaviour (Goethe).

Goethe recognized that the dynamics of a river can only be controlled to a limited extent by channel modifications and rigid river training works. The term "dynamics" refers to variations in hydromorphology over space and time due to flood discharges and sediment transport. These processes regularly lead to the destruction of habitats, especially in riparian areas, and the creation of space for new habitats. Dynamic watercourses require a lot of space. For example, naturally meandering rivers may migrate laterally within a belt of roughly 5–6 times the width of the channel bed. In the valleys of the Swiss Alps and Pre-Alps the rivers originally divagated over the entire valley floor.

To reclaim land for urban development and agriculture as well as to provide flooding, watercourse alterations were carried out over the last two centuries in Switzerland. Efforts were thus made to impede the dynamics; rivers and streams were channelized, and channel bed widths were optimized with regard to sediment transport. This resulted in monotonous watercourses, with almost no variation in hydraulic or morphological characteristics.

Recognizing the ecological deficit of the Swiss, a new approach in the strategic planning of flood protection projects was promoted by the Swiss Government which gave the basis for the first restoration programs more than 40 years ago. Since then much has been achieved. Nevertheless, today's challenge of river engineers, in collaboration with environmental scientists, is to restore the channelized rivers under the constraints of high urbanization and limited space. The behaviour of river systems is a result of the complex interaction between flow, sediments, morphology and habitats. Furthermore, rivers provide important sources of water supply and energy production in addition to a means of transportation.

Each year the Swiss Commission for Flood Protection (KOHS) of the Swiss Association for Water Management (SWV) organizes a symposium where professionals, officers of public administrations and researchers exchange their experiences on special topics and on-going projects. In 2014 this symposium was organized as a special session of the seventh International Conference on Fluvial Hydraulics "River Flow 2014" at École Polytechnique Fédérale de Lausanne (EPFL), Switzerland. Aside from the Swiss participants, scientists and professionals from all over the world were informed about the Swiss competences in river engineering and restoration. In the presented book, invited and selected contributions regarding the latest tendencies and key-projects in Switzerland are presented to an international community of river engineers and researchers, hoping that they can enrich flood protection and river restoration projects all over the world.

We acknowledge the support of the Swiss Federal Office for the Environment, BG Consulting Engineers, and Hydro Exploitation SA as main sponsors for the proceedings and the River Flow 2014 conference. Further support to the conference and the special Swiss session was given by the following sponsors: e-dric.ch, IM & IUB Engineering, Basler & Hofmann, Met-Flow SA, and AquaVision Engineering; as well as Stucky, groupe-e, Patscheider Partner, HydroCosmos SA, Kissling + Zbinden AG, Ribi SA, and Pöyry. Finally, we recognize the support of the Laboratory of Hydraulic Constructions (LCH) of EPFL and the Swiss Association for Water Management (SWV), which organized the special session «Swiss Competences in River Engineering and Restoration» in the framework of River Flow 2014.

Prof. Dr. Anton J. Schleiss, *Conference Chairman of River Flow 2014*
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Restored Aire River near Geneva (GE), Switzerland. Photo: Bernard Lachat, Biotec.

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Swiss strategy for integrated risk management: Approaches to flood protection and river restoration

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ABSTRACT: the Swiss strategy for integrated risk management is based on a holistic approach seeking the optimal combination of response, recovery and preparedness. This approach has been developed in a strategic report in 2011 into 6 priorities for action: comprehensive knowledge of hazards and risks (1); increased awareness of natural hazards (2); holistic planning of measures (3); protective structures designed to accommodate excess loads (4); emergency preparedness (5); timely identification of hazard events (6). The implementation of these priorities is illustrated with examples from different flood risk management projects in various basins in Switzerland.

1 INTRODUCTION

Switzerland has a long history and experience in dealing with natural hazards. However, only in 1987 in the aftermath of major floods, it became clear that structural measures alone are not sufficient to guarantee protection. Since then spatial planning (master planning and land-use planning) has obtained far greater priority in the context of sustainable and hazard-conscious land use. The idea that sufficient space must be given to watercourses also became accepted.

Recent events in the years 1993, 1999, 2000, 2005 and 2007 also showed that damage could be significantly reduced with the help of modern protection concepts: robustly designed protection structures that are conceived to cope with excess loads are the key factors for successful prevention (Bezzola & Hegg, 2007). Moreover, the damage caused by floods can be reduced by around one fifth if the authorities issue timely warnings and alerts and people takes suitable measures to protect their lives and property as part of their own individual responsibility.

In 1997, the Federal Council founded the National Platform for Natural Hazards, PLANAT, an extraparliamentary commission of the Federal Department of the Environment, Transport, Energy and Communications (DETEC), with the aim of preventing an increase in the damage caused by natural hazards, providing sustainable protection for living space and improving hazard prevention. PLANAT was then commissioned by the Federal Council to develop the strategy entitled Sicherheit vor Naturgefahren ("Safety against Natural Hazards") (PLANAT, 2004). The aim of this strategy is to provide a comparable level of safety throughout Switzerland for all natural hazards that would be ecologically justifiable, economically viable and socially responsible. The PLANAT strategy raises awareness of a risk-based philosophy and promotes integrative risk management in the area of natural hazards.

2 PRINCIPLES OF INTEGRATED RISK MANAGEMENT

2.1 *Risk management approach*

The tasks involved in risk management consist in the continuous monitoring of the relevant factors and periodic recording of the relevant risks (see Figure **1**). Risks should be assessed in relation to their acceptability. The action required and priorities for the steering of future

developments through the implementation of suitable measures are deduced from this information. Through suitable measures, new unacceptable risks are avoided, unacceptable risks alleviated and acceptable risks borne. Intensive risk dialogue between all actors is a precondition for effective risk management. (PLANAT, 2013).

Risk management provides answers to three key questions (see Table **1**):

2.2 *Integrated flood Risk Management (IRM)*

An integrated and holistic risk management assumes that all types of measures for natural disaster reduction are considered. Generally, measures of preparedness, response and recovery (reconstruction) are equally applied. The measures for dealing with natural hazards cover the three phases of the risk cycle (see Figure 2).

Planning flood protection works need to integrate both ecological and security aspects. All measures must complain with sustainability and must provide a good cost-benefit relation.

Integrated flood risk management deals, on one side, with the natural hazard processes and, on the other side, with damages and risks. Sound scientific knowledge in hydrology

Figure 1. Risk management approach (Source: PLANAT, 2013).

Table 1. Three key questions of risk management (Source: PLANAT, 2013).

Question	Answer
What can happen?	The risk analysis is based on systematic and scientific processes. Both the intensity and frequency of natural hazards and the damage to be expected are recorded.
What is allowed to happen?	As part of the risk assessment it is decided which risks are considered acceptable and unacceptable. A risk that is assessed as bearable for good reasons is an acceptable risk.
What should be done?	Future risks are maintained at an acceptable level, existing risks are reduced to an acceptable level and the approach to residual risk is managed through the implementation of measures. Integrative action planning is an optimization process, in which risks and opportunities are weighed up, and proportionality must be maintained in relation to all dimensions of sustainability. The extent to which risks should be avoided, reduced and borne is also decided as part of this process.

and hydraulic are fundamental to evaluate correctly flood hazards. Access to information of land use planning and to insurance data is also necessary for the evaluation of vulnerability and resilience. Only with sufficient appropriate data, flood risk management will achieve an optimal use of all chances to influence hazards and risks.

2.3 *Implementation in a federal state*

As Switzerland is a federal state, the institutional implementation of integrated risk management is based on the delegation of competence at different levels (see Table 2). The responsible actors are involved due to a legal obligation or because they assume individual responsibility. Subsidiarity plays an important role as a principle of delegation.

The federal state defines the strategy and the legislative framework, the cantons and the municipalities implement the strategy through land use planning, as well as maintenance and

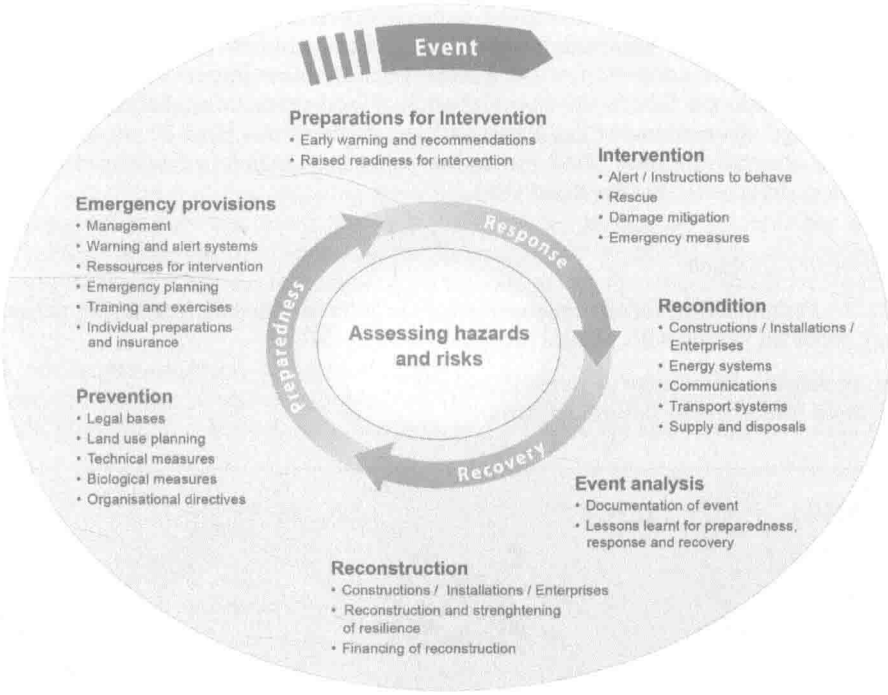

Figure 2. Range of measures involved in integrative risk management and phases in which they are implemented (Source: BABS, 2012).

Table 2. Task sharing in flood risk management.

Level	Tasks
Federal authorities	Legislation, policy, guidelines, financial support, support of research, education, warning and alerting
Cantons (26)	Enforcement of laws, cantonal structure planning, hazard mapping, planning of measures on regional scale, cantonal emergency management
Municipalities (2408)	Communal land use planning, building permissions, planning of measures on local scale, local emergency management
Property owner	Local protection, precautionary measures
Insurance	Mandatory insurance (all buildings), covering the remaining risk

construction of flood protection works. The federal state support hazard mapping and flood protection measures through financial subsidies. Property owners and insurances play an important role, as they have to bear residual risks through flood proofing or compensation.

3 INTEGRATED FLOOD RISK MANAGEMENT WITH EXAMPLES OF ACTUAL FLOOD PROTECTION PROJECTS

3.1 *Actual flood protection projects*

Many flood protection works in Switzerland were realised in the 19th century and need to be completely rehabilitated. Recent flood events in the last 30 years (1987, 1999, 2000, 2005, 2007) have shown that design values should be revised to take into account statistic uncertainties and climatic evolution. Hydraulic capacities that were designed at the beginning of the 20th century are not sufficient to ensure contemporary safety standards, moreover with the development of higher potential damages.

As a result, flood protection works along many rivers in Switzerland are being rehabilitated in order to match modern standards (see Figure 3). The most important actual flood protection project is the third correction of the Rhone River. Another important flood issue is the flooding risk due to the Sihl in the city of Zurich. Flood protection rehabilitation projects are also undergoing on all important alpine and pre-alpine rivers (Aare, Reuss, Linth). These projects can illustrate the way flood protection issues are tackled in Switerzland and how actions are undertaken to reduce flood risks.

3.2 *Priorities of action*

In 2011 the Federal Office for the Environment FOEN has defined 6 priorities for action in a strategy paper on "living with natural hazards" (FOEN, 2011):

1. Comprehensive knowledge of hazards and risks
2. Increased awareness of natural hazards

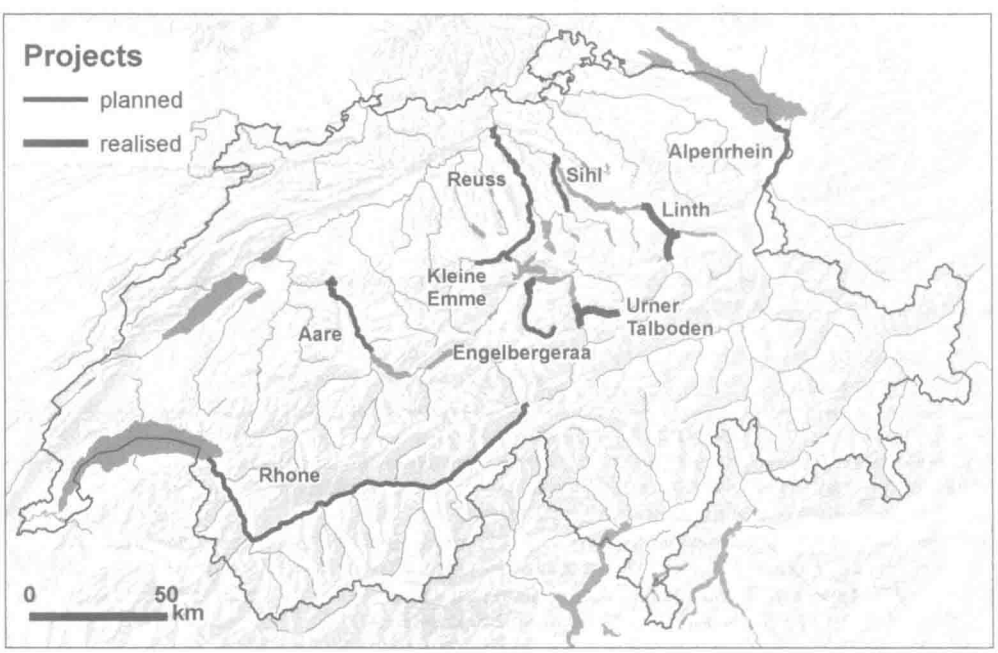

Figure 3. Major projects of flood protection in Switzerland.