# DRIFT WOOD RETENTION TO MINIMIZE FLOOD RISK FOR THE CITY OF ZURICH – PHYSICAL EXPERIMENTS

Sarah Simonett[1], **Martin Detert[2],** and Volker Weitbrecht[3]

## INTRODUCTION

The flood events 2005 and 2007 in the Sihl River flowing through Zurich showed that drift wood can lead to a strongly increased risk of inundation in Zurich, especially in its city center. Actual hydro-numerical simulations show (B&H AG, 2008) that drift wood accumulation at the culverts where the Sihl River flows underneath the central station would lead to large inundation areas in the city center with a return period of 100 to 300 years. The potential damage is approximated with about 2 to 4 billion Euro. A drift wood retention project is planned therefore, 15 km upstream of the central station in the river section Rütiboden where the Sihl River follows a distinct right hand bend. This project is part of an integral concept to save the city of Zurich from larger floods, where also possibilities of flood protection measures of dam heightening, the construction of a release tunnel to Lake Zurich and rising the capacity of the Sihl-lake reservoir 50 km upstream from Zurich are considered.

## THE DRIFT WOOD RETENTION CONCEPT

The drift wood retention project includes the following elements (B&H AG, 2010, see also Fig. 1): The drift wood bypass containing a drift wood rack is installed in the outer bend. The main channel of the Sihl River is moved to a new position in the inner bend, thus the total river cross section gets much wider. A key element is a weir between the drift wood bypass and the main channel. Assuming that the drift wood is floating at the water surface, the idea is to guide it towards the outer bend away from the new main channel over the weir and into the drift wood bypass. The weir is overtopped only during flood scenarios. Concurrently the sediment transport should still take place through the main channel on the right hand side. With the help of the physical scale model, proper functioning of the weir to divide sediment and drift wood into bypass and main channel is tested, while the optimization of the complete structure is the main focus of the present project.

## PHYSICAL MODEL

The physical model is built at a 1:40 scale leading to model dimensions of 20.6 m x 11.3 m and is equipped with a movable bed. Flow and sediment hydrographs of different flood scenarios can be represented. The discharge is automatically added via a PC-controlled gate valve. Sediment is added upstream automatically by a sediment dispenser and retained and weighted during the experiments at the downstream end. The resulting bed levels are measured with laser distance meter mounted on a 3D traversing system. However, it is not possible to measure bed levels during the experimental runs through the water surface. Water levels are measured continuously via ultrasonic sensors to evaluate the backwater effects emerging at the rack. Digital cameras mounted above the physical model record the main processes during the complete experiment. Drift wood and sediment balances are determined after each experiment. To define an appropriate grain size distribution of the model sediment, additional samples have been taken from different locations within and upstream the project perimeter. To transfer the natural grain size distribution into model dimensions three steps are needed. First, the natural grain size distribution is downscaled geometrically. In a second step, the finer fractions have to be coarsened to account for the reduced dimensionless bed friction (Shields parameter). In a third step,

[1] Sarah Simonett. VAW, ETHZ, Switzerland
[2] Dr. Martin Detert. Laboratory of Hydraulics, Hydrology and Glaciology (VAW), ETHZ, Gloriastrasse 37 – 39, CH-8006 Zurich, Switzerland (mdetert@ethz.ch)
[3] Dr. Volker Weitbrecht. VAW, ETHZ, Switzerland

grain sizes smaller than 0.25 mm are removed to avoid misleading scale effects, e.g. due to cohesion or the generation of ripples.

## MODELLING DRIFT WOOD

To represent a natural-like drift wood behavior concerning an initial log jam, we use two different wood classes: 40% branch wood with a diameter of 0.1 – 0.3 m and a length of 1 – 5 m, and 60% trunk wood with a diameter of 0.3 – 0.4 m and a length of 5 – 10 m. This classification is based on field observations of the riparian forest at the Sihl River and on recordings after the large flood from 2005 at Swiss rivers with similar characteristics. In the present study the wood classes are downscaled geometrically and prepared manually from smaller wood branches. To realize a reasonable bouancy the modelled drift wood is watered for a few hours before each experimental run. Both, the effect of finer fractions of wood or leaves, i.e. a completely blocked drift wood rack, and the behavior of single rootstocks is studied by additional experimental runs. Regarding worst case flood scenarios with return periods larger than 300 years a maximum volume of 11.000 $m^3$ drift wood is expected, while in case of 30 – 100 year floods 4.600 $m^3$ are expected (Flussbau AG, 2009). Similar to the modelling of sediment supply, the intensity of drift wood supply follows certain predefined time series.

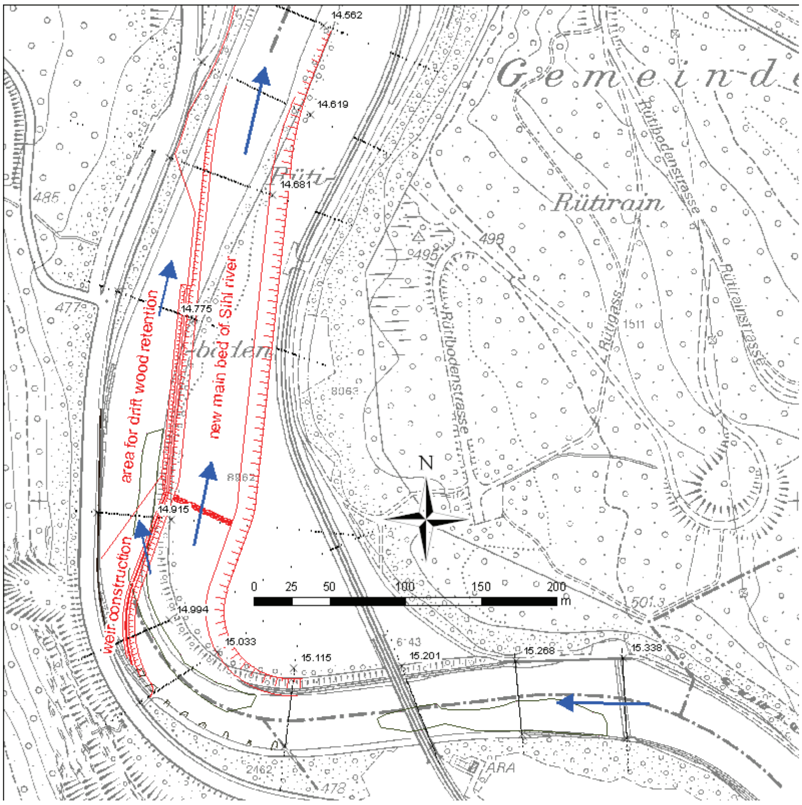


**Fig. 1** Perimeter of the construction-idea of the drift wood retention (top view)

## REFERENCES

B&H AG (2008). Flood hazard map of the city of Zurich (in German), by order of AWEL (Zurich), status date: 24.11.2008.

B&H AG (2010). Drift wood retention Sihl River – specifications for physical modelling tests (in german), by order of AWEL (Zurich), status date: 12.10.2010.

Flussbau AG (2009). Study on the drift wood at the Sihl River (in german), by order of AWEL (Zurich), status date: 15.12.2009.

**Keywords**: drift wood, physical model, flood hazard map, log jam