3.2.3 Log jamming

The intention of the operator was to retain the old weir, which is under a preservation order, and to construct the new weir parallel. However, our general assessment was that an accelerated runoff occurs with a functional old weir due to the local constriction and this will align the debris.

Now, if the new weir, which is located downstream, is in operation, this acceleration will no longer occur and the risk of log jamming is increased. Figure 8 shows an example of a jamming process during a 100-year flood (summer) and the calculated longitudinal water levels. The blue line shows the water level for the existing situation, the red lines for the time after constructing the new weir. The solid line shows the situation if the old weir would remain and the dotted line if old weir would be removed. It is obvious that keeping the old weir would increase the probability of over-topping levees and hence increase flooding probability.

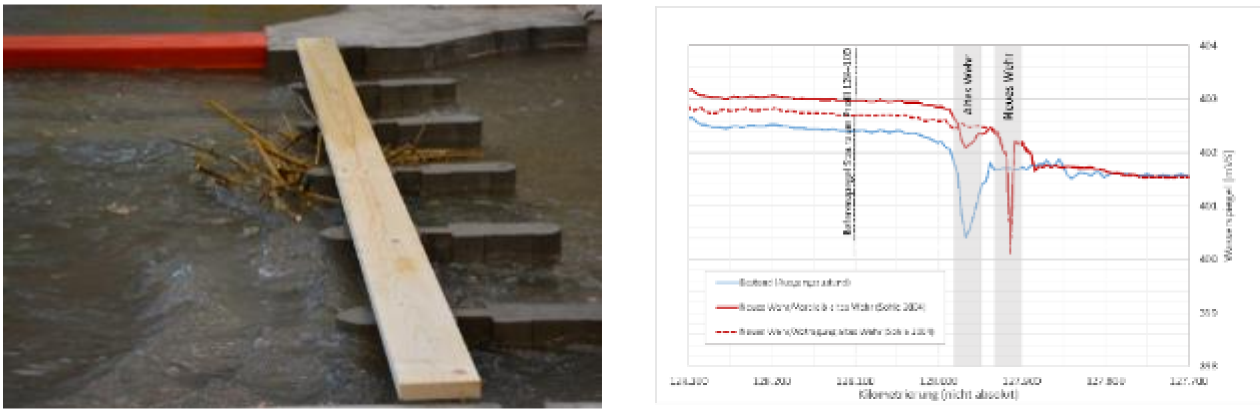

Figure 8. Log jamming during a 100-year flood (summer) and numerically determined longitudinal water levels for different boundary conditions

3.2.4 Downstream fish migration

Knowledge of the upstream migration of fish is sufficiently available today for planning and building functional fish ladders. Regarding downstream fish migration, there is still considerable need for research, especially for potamodrome fish species. Nevertheless, on the part of the authorities the pressure increases to build downstream fish migration facilities in Europe. In the context of this project, technical solutions were proposed to offer the possibility of downstream fish migration via the left side near the drainage channel intake structure, both for bottom orientated and weak-swimming fish floating on the water surface. Fish experiments on the scaled model were not possible, only hydraulic aspects were examined. The functionality of the fish migrating facility has to be checked finally by monitoring the prototype. In the experiment, but also in the numerical model, the entrance structures were optimized with regard to their location. Three-dimensional velocity measurements have been carried out for this purpose. Seven variants were tested and a proposed design of the downstream fish migration facility was defined. Figure 9 shows on the left side the constructions and locations of the entrances for the fish. The right figure highlights the flow velocities in this area. The sectional cut is parallel to the intake structure of the diversion channel. The colors symbolize the flow velocities are in x-direction, meaning in main flow direction into the channel. Y- and z- velocities are indicated with arrows. The y direction is the main flow direction in the Inn river and heading positively to the weir.

On the water surface the velocities point to the direction of the weir and therefore it can be expected, that small fish has the possibility to follow the baffle that prohibits entering of debris into the main diversion channel and to find the entrance of the facility. The bottom-near oriented fish will follow the positive flow direction (y) to the bottom near entrance. The location was defined at a point before the y-direction changes and shows in the opposite side (against the weir).

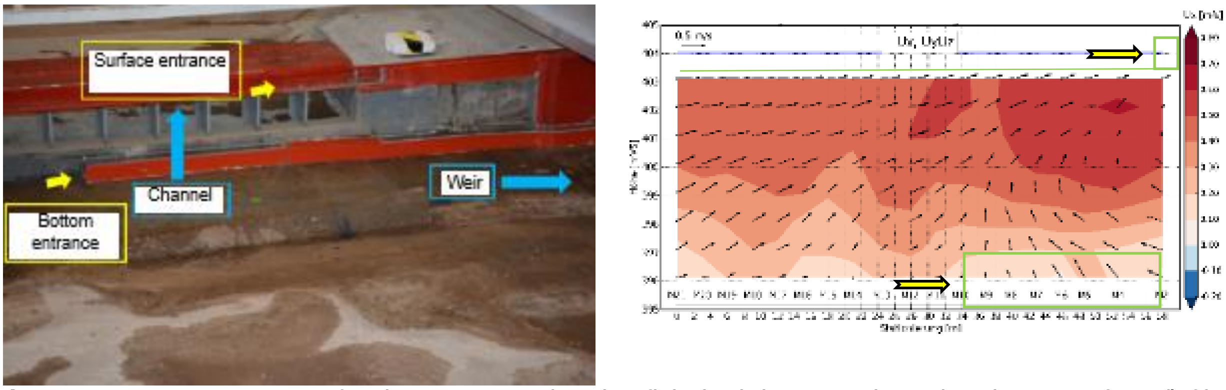

Figure 9. Entrance structure for downstream migrating fish, both bottom oriented and near surface (left), Flow velocities, colors in x-direction, arrows indicate y- and z-directions, location of entrances

4 CONCLUSIONS

The optimization of the elevation of the cofferdams for the construction phase was carried out in numerical models for the upstream and downstream reaches and the findings were tested in the physical model for the downstream part as well.

Concerning the approach flow many modifications in the approach channel, at the intake and at the penstock were performed to get a better and smoother flow. Finally, a solution could be found where the flow to all three turbines could be harmonized.

During the construction period at weir Jettenbach, the existing weir will be still in operation and the old weir shall be removed only after completion of the construction. During this phases, there were some special features that have been extensively tested. Besides the determination of water levels, velocities and shear stresses, the tests also focused on log jamming of the old weir system. The determination of shear stresses were the input for assessing the grain sizes of the river bed protection and the measurement of water levels were necessary for defining the height of the cofferdams.

The design of the stilling basin was based on the results of the sectional model on one hand and on several tests in the full model on the other hand. The length and depth were determined, the functionality improved by installing baffles and the downstream reach secured by a proper scour protection.

The tests and calculations concerning log jamming of the old weir showed that the risk after the construction of the new weir increased significantly compared to the actual state if the old weir remains in the river. As a result of the construction of the new weir, the flow velocities decrease and the water levels increase, leading to a deterioration in the transport of driftwood through the old weir. Hence, the removal of the old weir was recommended.

With regard to downstream fish migration, several variants were tested and in the course of these experiments solutions could be worked out. These findings will give the fish the possibility to pass by the weir both at the bottom and at the water surface.

This contribution gives only a brief overview and an excerpt of results of many tests which have been performed during the project. However, good solutions could be found and it can be expected that the renewal of the existing diversion hydropower plant and its weir will be successful.

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