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Pumping effect on the water depth of a low gradient ditch during extreme rainfall events: a case study of the Porzen ditch, located in the Etsch floodplain, South Tyrol - application of Basement v.2.8 inflow and sink features

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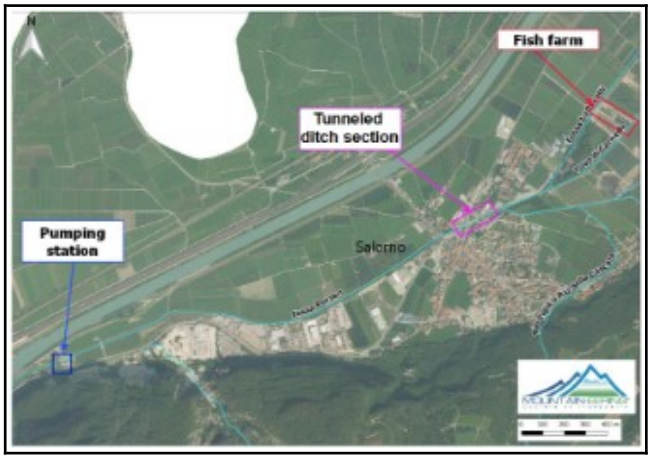
This case study is located in the village of Salorno (South Tyrol), in the floodplain of the Adige River. This land was reclaimed at the end of the 19th century after the rectification of the Adige River due to the construction of the Brenner-railway by the Austrians. The valley bottom is currently mostly grown with apple orchards and drainage ditches have been dug for irrigation purposes; one of these is the Porzen ditch. A fish-farming area, located upstream Salorno, has been repeatedly flooded in recent years due to the overflow of the Porzen ditch, which flows partially tunneled through the village before flowing into the Adige River. The water depth of the Porzen ditch-system is regulated by a pumping station located downstream of Salorno, which can activate several pumps, withdrawing a cumulative flow rate of up to 10 m^3/s. During heavy rainfall conditions, if the water-level of the Adige River exceeds 7.6 m, measured at the Salorno gauging station, the pumps stop the withdrawal and the water-level of the ditch rises, causing the flooding of the fish-farming area and the surrounding cultivated lands upstream the village of Salorno.

Within this context, a study was carried out with the aim of a) developing sounded measures to reduce the hydraulic risk for the fish-farming area, based on the hydraulic analysis of the Porzen ditch-system, integrated with the action of the pumping station. This was modeled as a negative 'source'; b) evaluating the impact of future terrain modifications planned in the countryside surrounding the study area; c) analysing any critical hydraulic issues related to the tunneled section of the ditch, taking into account the effect of the pumping station, if any.

In order to evaluate the overflow dynamics at the fish-farming area, the effectiveness of the proposed mitigation measures and the effects of different flow rate withdrawals, the software BASEMENT v2.8 was applied. The computational domain has an area of 236 ha and the mesh is consists of more than 170000 elements with a maximum size of 5 m^2 in the riverbed and of 30 m^2 in the flood plain. The 2D hydrodynamic model (in particular the Gauckler-Strickler roughness coefficient) was initially calibrated on the August 2021 flood event (~30 year return period). The calibration was carried out through ad hoc topographic surveys, which allowed for a qualitative assessment of the flow extent. The model was implemented using two out of the three input hydrographs as "source", due to the very mild slopes of the study area (0,01%). The effect of the pumping station was modeled as "negative source" and two different conditions were simulated, considering that the pumps operated for the entire duration of the hydrograph and, alternatively, that they stopped during the transit of Adige flood peak.



Different design configurations have been implemented in order to reduce the flooding potential and evaluate the effectiveness of the pumping station in draining the floodplain. The results obtained allow to reproduce and assess the extent of the flood, the effectiveness of installing additional pumps and the hydraulic proof of the tunneled section of the ditch.