



## **Flood protection analysis in artificially drained basins: hydrodynamics and ecology**

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An interdisciplinary study is presented dealing with the flood prevention techniques designed and applied to two artificially drained basins in Northern Italy (Lorno and Galasso, Parma Province).

The analyses about lithology, land use and hydrology are described in Part 1 of the paper; Part 2 summarizes hydrodynamic and environmental aspects. As previously mentioned, many subjects are coupled and a sharp distinction in the information and modelling flow cannot be traced. In particular lack of discharge time series entails a complex coupling of hydrological and hydrodynamic modelling in order to correctly estimate the discharge hydrographs as a function of probability which enter the artificial drainage network from each contributing sub-basin and which propagate along the main channels to build the shape and the volume of the flood wave flowing in the critical final reach of the system, where flooding threatens the populated town of Colorno.

The calibration of the rainfall-runoff hydrological model and the hydrodynamic model, based on the numerical integration of the classical Saint Venant equations, is performed by a trial-and-error procedure trying to match the records dates and effects of flooding, available for the last 60 years in the drainage network and in its downstream reach in particular. The procedure depends on the description of the channel geometry varying along the decades. The hydrological model is run for the rainfall

events which caused some flooding and the corresponding hydrographs are routed through the hydrodynamic code: its results are compared with the local historical observations, in terms of time and place of water levels exceeding bank elevation. Model parameters (both hydrological and hydrodynamic) are adjusted deviating as little as possible from central value of their distributions.

After calibration, the following aspects are dealt with:

1. Hydrodynamic simulation of the behaviour of the critical reach of Lorno and Galasso main channels, under the probabilistic discharge hydrographs in the unmodified configuration, for various downstream boundary conditions (open and closed lock gates).
2. Evaluation of the effects on flood risk reduction when lateral reservoirs are introduced where in the next future three open quarries will make a large storage volume available.
3. Evaluation of the optimal design of the reservoirs in order to foster the ecological restoration of the site, where many birds species are expected to find their natural dwelling; design of hydraulic structures to enhance the environmental function by minimizing the impact of periodical flooding.

The problem of uncertainty in the numerical estimates is also addressed, by conducting a sensitivity analysis over the most important parameters in the hydrological and hydrodynamic simulations.