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## Flood risk assessment of educational and health critical facilities

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Critical facilities are crucial buildings for the community and in case of natural hazards their functionality must be guaranteed. Specific building codes and up-to date studies are commonly available for facing earthquakes, but it is not the same for other natural hazards, such as floods. The older facilities might stand in flood prone areas, but from the recent years such structures are usually built far from the major river network and outside the known inundation areas. Probably this is the most common and, sometimes, the only, mitigation measure adopted against floods. Also, moving critical facilities far from the main river network, means that they are settled near and over the secondary river network, which is often not known in-detail and characterized by small basins with sudden responses, high urbanization, and with heavy modifications to the natural existing drainage system. Moreover, critical facilities are seldom included in flood risk analyses, especially regarding the indirect impacts. The work is based on a case study area located in Florence (Italy), where one major hospital of the central Italy and one relevant learning center of University of Florence are built over a culverted stream, surrounded by the secondary hydrograph network, inside a set of small sub-basins. A hydrological analysis was carried out, and the hydraulic modeling of the stream was implemented with the help of geophysical prospecting. Particular attention was dedicated to the assessment of direct and indirect impacts of the hazard. The direct impacts were studied starting from a collection of all the building-specific installations and systems, then formulating a damage curve in function of the water height. The indirect and intangible impacts, which can worsen the impacts of the flood, were carefully researched and investigated taking in account factors, among others, as the building accessibility during and after the flood event, the expected service disruption time, the possibility of the structure to be used as shelter, the fluctuation of the number of people expected to be in the building during the event, the consequences on people and on the community of the service disruption, the seasonality impact. Eventually, a comprehensive damage (impact) evaluation technique was developed.