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An experimental study on the influence of a detention basin and of building patterns on runoff and diffusive material transport

Jorge Isidoro (1,3), Alexandre Silveira (2), and Eliane Quiles (2)

(1) University of Algarve, Institute of Engineering, Civil Engineering Department, Faro, Portugal (jisidoro@ualg.pt), (2) Institute of Science and Technology, Federal University of Alfenas (UNIFAL-MG), Poços de Caldas-MG, Brazil, (3) Marine and Environmental Sciences Centre (MARE), Coimbra, Portugal

The urbanization process poses major challenges to urban water management. In the last decades these challenges became deeper, as the environmental, social and economic impacts caused by an inadequate planning and management has shown to result in significant losses. Urbanization strongly interferes with the quality of water, as it increases the variety and quantity of pollutants and nutrients that drain urban areas and reach downstream water bodies.

This works aims to simulate a detention basin and different building patterns, and to analyse their influence on runoff and diffusive material transport over a 100 m2 impervious surface. Experiments consisted of applying simulated rainfall over the impervious surface, considering scenarios with different masses of dissolved material and its position regarding the impervious surface outlet, building patterns and rainfall event duration. Oven-dried sodium chloride was used as the dissolved material (simulating a pollutant), and expanded polystyrene blocks were used to simulate buildings. A 125 litre PMMA tank was used to simulate a detention basin. By means of a small pump, runoff water was pumped from the impervious surface to the tank and then slowly released back to the surface, thus increasing detention time. With the experimental runs it was then possible to draw runoff hydrographs and pollutographs.

The holding basin was able to reduce peak runoff, transported diffusive material and to delay the time to peak of the diffusive material. The number and position of buildings, and the position and mass of diffusive material showed to interfere with the peak mass discharge. The time to peak of the mass discharge was related only to the position of the material and to the number of buildings in the scenario without the detention basin. Initial position of the diffusive material showed to influence the start time of the pollutograph in the scenarios with and without the detention basin. The rainfall event duration and number of buildings also interfered in that variable when considering the existence of the detention basin. The mass of diffusive material showed to impact the final time of the pollutograph in both scenarios and the rainfall event duration also impacted the final time of the pollutograph in the scenario without the detention basin. The number of buildings and the rainfall event duration also showed to have impact in the diffusive material transport process.