GIS PROCEDURE FOR THE IDENTIFICATION OF EXISTING INFRASTRUCTURE IN THE FLOODING AREAS

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ABSTRACT:
This paper presents a relatively easy and objective identification manner of the buildings and portions of roads existing in the flood zones which were delineated according to the action stage flooding level height. The flooding zone delineation is achieved on the basis of the digital elevation model of the administrative territory of any commune, a model created once the contour lines from the topographic maps, scale 1:25.000, were digitized. Flood areas were delineated on the entire "digital territory" of the commune, which, in what regards the size and water volumes implied, include far more than what has been previously identified and recorded in the Urban Plan and the Plan of Defense of the Commune.

Keywords: *flooding areas, action stage flooding level, damaged buildings and roads.*

1. INTRODUCTION

In different fields of action, flood management activities is a series of policies, plans and programs for the short, medium and long term, aiming at protecting life, property and the environment against natural risk phenomena. "The plans for protection against floods, hazardous meteorological phenomena, hydro technical constructions accidents and accidental pollution are drawn, in Romania, by those units that have endangered objectives, by the County and Local Committees and with the technical support and coordination of the Water Management Units belonging to the National Administration "Apele Române" (*MAI, 2005; MMGA, 2005*). The purpose of the paper is to propose a GIS procedure for the identification of existing infrastructure (building, roads …) in the flooding areas. This procedure is applied to Baciu commune, having 7 settlements, situated in Cluj County, Romania. The fragmentation of the relief is average, situated within the 700-900 m altitude interval, becoming more preeminent towards the periphery, as the hydrographic network, of the Nadăş Valley and its' tributary rivers becomes more vigorous as it approaches the confluence with the Someş Mic River. The area falls within the continental moderate climate, characteristic for the Western and North-Western regions of Romania, subject to the prevailing Western atmospheric circulation.

2. THE CASE STUDY

For the generation of the Digital Elevation Model, the contour lines were digitized from the topographic map of Cluj County, at a scale of 1:25.000. The object class *Curbe_de_nivel_harta_topo_25000* in the database *Baciu.gdb* was created for this purpose. For the present study, the digital elevation model was created on the basis of the on contour lines layer, which has as attribute the altitude. The command option "Create TIN from feature" of 3D Analyst was used. Further, the layer representing the means of communication, the river network and the built areas were modeled according to the TIN, by assigning them the base height of the digital elevation model (by selecting the

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"Properties", "Obtain heights for layer from surface" option). The physical-geographic characteristics with large impact during the flooding process and slope runoff leaks on the slopes are: slope, vegetation (types and degree of expansion on the territory) and soil.

The effects vegetation has upon runoff can be analyzed by dividing it into three main categories: the effect of forests upon runoff, that of fallow or grassy land areas and the effect of cultivated land.

Fig. 1 Forested areas in the Baciu commune.

The influence of afforestation is manifesting itself positively or negatively on the maximum flow regime by the change they induce in the rainfall patterns, evaporation and drainage conditions. It is difficult to give a general answer to the question to whether or not the forest reduces the maximum stage of flash-floods but, sometimes it can cause an increase. Usually, the forest determines a decrease in the stage of flash-floods but it can also cause an increase. Hence, it is important to build a layer of information concerning the forest management. Their influence on runoff is a complicated and complex process.

Based on research and field observations once can draw some conclusions, which can result in different theoretical proposals and can be put in practice through the future development scenarios**.** In order to achieve this goal, from the **Folosinte_ortofoto** layer were selected only those areas covered by forests and copied into a separate layer **Zone_forestiere**, in the database **Baciu.gdb,** in the **Utilizarea_terenului** feature set. The file obtained is shown in **Fig. 1**.

So as to delineate the areas prone to flooding, in the present study, the data of the available two hydrometric stations were used (**Table 1**).

Table 1. ***The Action, Minor, Moderate and Major Stages and the discharge at the hydrological stations in Aghireşu and Rădaia***

No.	Gauging station	FLOOD STAGE (cm)			CORRESPONDING DISCHARGE (m^3/s)		
		Action Stage	Minor Stage	Moderate and Major Stage	Action Stage	Minor Stage	Moderate and Major Stage
1	AGHIREŞU	100	200	300	1,55	9,26	25,0
2	RĂDAIA	370	420	480	49,3	62,8	80,5

Aghireş gauging station:
- „The Zero level" 440.460 cm
- Reference level 444.286 cm

Rădaia gauging station:
- „The Zero level" 367.520 cm
- Reference level 374.596 cm

Using this information, the **action stage** corresponding flood areas have been drawn, taking into account the height to which water reaches as compared with the contour lines. **Fig. 2** presents in pink, the flood areas highlighted in the new Urban General Plan of the commune, in purple the flood areas. Thus was created the polygon layer Areale_inundatii_ Baciu_ortofoto in the Riscuri dataset. During the drawing process of the area, the terrain configuration was taken into account, as indicated by the orthophoto.

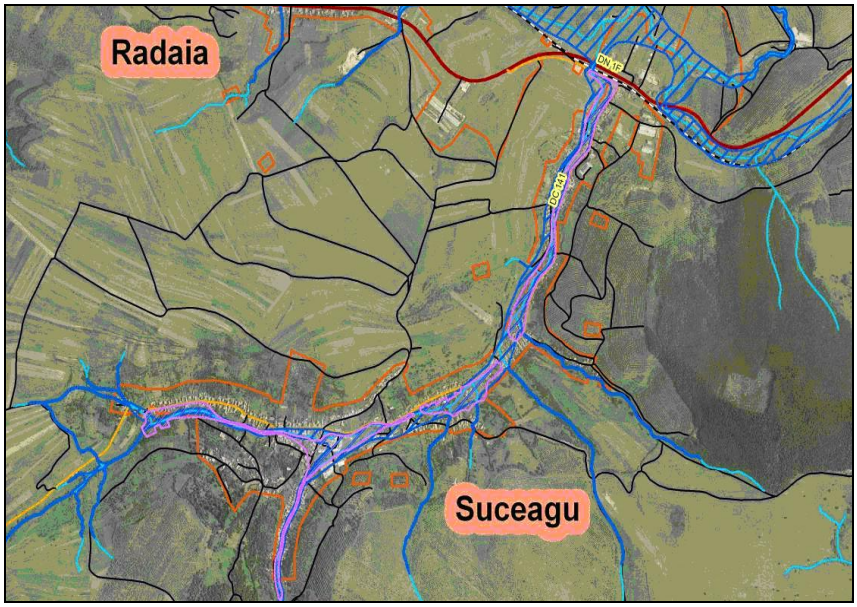

Fig. 2 The designated flood areas: example for Suceagu settlement:
- in pink, topographical delineation of the flooding areas on the flood plain
- in purple, the flash flood areas on the slope

In the database **Baciu.mdb** a data set called *Statii_de_masurare* was created, where the point type layer **Sistemul_informational_hidrometeorologic_judetean** was strored, according to the coordinates of the hydrometric stations in Cluj County.

For the whole of the settlement a construction layer was created, *Constructii_comuna_Baciu*, in the dataset *Construcţii* (*Constructions*) of the **geodatabase Baciu.mdb**. This was achieved by loading objects from the layers belonging to the settlements. All buildings were digitized on the basis of the orthophotomap.

To select the constructions in flood ares, in **ArcToolbox**, **Analysis Tools**, **Overlay**, the **Intersect** command was applied. It calculates the intersection of geometric objects from input layers: **Constructii_comuna_Baciu** and **Areale_inundatii_Baciu_ortophoto**.

The portions of the objects that overlap in both layers were saved in the output layer. The result of this operation is the identifying of those objects representing the buildings located in flood zones, buildings stored in the layer called **Constructii_afectate_ amplasate_in_zone_inundabile** and presented in **Fig. 3**.

To identify the portions of the road under the water, the clip operation was performed on the *Drumuri_ortofoto layer*, according to the polygons that represent the flood areas in the layer *Areale_inundatii_Baciu_ortofotos*.

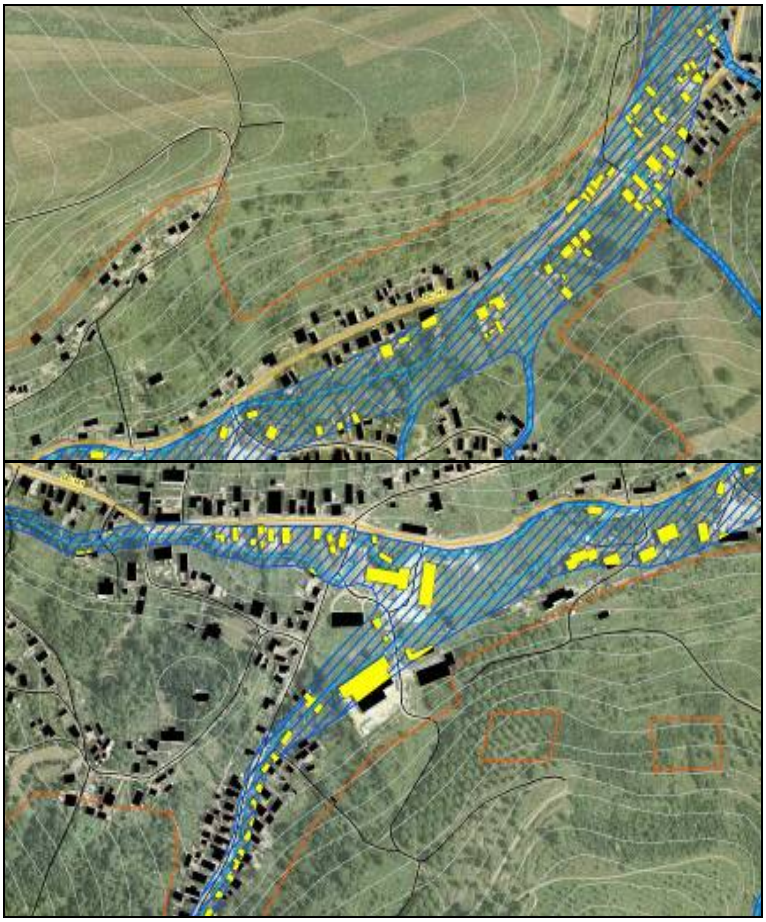

Fig. 3 Construction in the Suceagu Settlement, situated in flood areas.
- in yellow are buildings that are possible subjects to floods.

On the basis of this file was created a layer containing only the portions of national roads, county and communal roads, *Drumuri_nationale_judetene_comunale_afectate* and another separate one for the roads belonging to other categories, *Drumuri_alte_categorii_afectate*. The operations on the database to determine the affected buildings and roads were performed in the **Pagube.mxd** thematic application, saved in the same folder where all data concerning this study is organised. **Fig. 4** represents, for each settlements, the roads sectors affected.

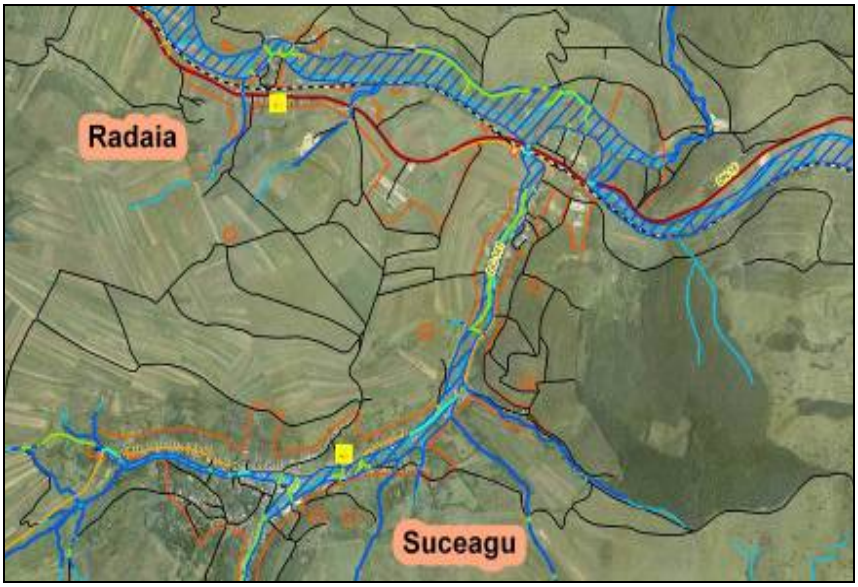

Fig. 4 The affected roads in the Suceagu Settlement.
- In turquoise are the affected county and communal roads

3. CONCLUSIONS

So that the government efforts and those of the competent authorities and agencies and of the community be coordinated and have, as a result, a community prepared to face the flood phenomenon, flood management must be approached in an integrated manner.

It is absolutely necessary to use a spatial database with information and analysis carried out at certain moments in time, which can be updated in real time or at certain times predetermined so as to take relevant measures in order to decrease damage. The fourth coordinate of the data is, obviously, the time.

The information resulting from these types of multidisciplinary analysis, may be at the basis of the introduction, on a national level, of a coherent system of insurance of goods, viable and sustainable.

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