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IDENTIFICATION OF EVACUATION ROUTES FOR FLOOD VICTIMS, ANIMALS AND FOWL FROM BACIU COMMUNE

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Abstract. In the present study evacuation routes were identified for people, animals and fowl from the localities of Baciu commune to the nearest evacuation zones. For each locality, two evacuation zones were assessed, one for people and the other for animals and fowl camping. A spatial database of geodatabase type was created and the roads network was modeled as a Network Dataset.

The performed spatial analyses can improve the strategic planning of the evacuation service and the decision-making process.

Key words. Geodatabase, Network Dataset, Routes.

INTRODUCTION

The transition to the information society requires the adoption of modern technological solutions work. To solve the requirements in such a society, geographical information organized as a spatial data infrastructure is essential. The geoinformatical technologies play a key role in the decision-making process, supporting the choice of the best solutions. We believe that the current international situation, as well as that of our country, implies the restructuring and modernization of professional emergency services to ensure a transparent management using the modern technologies of geoinformatics and with the active, straight involvement of local communities.

By a common ordinance, 638 from May 12, 2005 of the Ministry of Administration and Interior, and 420 from May 11, 2005 of the Ministry of Environment and Forests, was established the Regulation on the management of emergencies arising from floods, hazardous meteorological phenomena, accidents in hydrotechnical constructions and accidental pollution. According to this Regulation, „The protection plans against floods, hazardous meteorological phenomena, accidents in hydrotechnical constructions and accidental pollution are technical documentations, which are composed by the units that hold endangered objectives, by county and local committees, with technical consultation and coordination from the Water Management Systems, and from the Water Departments within the „Romanian Waters" National Administration." The plans are updated every four years, in terms of technical elements and whenever necessary, following organizational changes.

For the affected population, the public authorities involved in emergency management in case of flooding, have to assure the evacuation service. The person responsible for organizing the evacuation should know exactly the number of people, animals and fowls, the house number where they live, the area to which

they will be evacuated, the number and type of vehicles required, the length of the evacuation routes, the necessary fuel quantity for the vehicles, etc.

MATERIAL AND METHOD

In order to execute the analysis, a geodatabase was created. Where necessary, it was populated with information from: the General Urban Plan of the Baciu commune, topographic map with a map scale of 1:25,000, and orthophoto plan at scale 1:5,000. The road network from commune was modeled using the Network Dataset available in the extension Network Analyst from ArcGis 9.2. Using the information existent in the defense plans and provided by hydrological stations, the floodable areas have been delineated, corresponding to the officially established stage of flood attention, taking into account the level at which water reaches relative to the height of contour lines. Following this analysis, the households located in floodable zones were identified. For these we introduced as attributes: house numbers, house type and number of people, animals and fowls living in that household, and the stage when evacuation should occur It was considered that for health and organizational reasons it is better to establish two evacuation areas for each locality: one for people and the other for animals and fowl. For these zones a formal marking system should be implemented, in order to assure their clear identification.

This kind of analysis applied to spatial data revealed the time needed to pass through each route identified by the system, and consists in an attempt of temporal modeling the dynamics of the evacuation process.

For each component locality of the commune, a thematic application was implemented, whereupon the type of spatial analysis was applied corresponding to the identification of the shortest route to run for the evacuation in the specific areas of people, animals and fowl.

The analysis executed on the database for the Baciu locality resulted in a number of 35 homes and 12 annexes to be evacuated. These households provide shelter for 119 people, 69 animals and 150 fowls.

In order to find the transport routes to the evacuation areas, from the vertical menu **Network Analyst** was chosen the option **New Route.** As a result, the **Network Analyst** window was displayed, containing the memory classes: **Stops, Routes, Barriers.**

For each locality, by multiple selection of: type of construction (homes or annexes) and locality, applied in **Query Builder**, the data were loaded sequentially in the memory class **Stops.**

In order that the vehicles carrying flood victims are not overloaded, we consider, that 4 transports are needed, taking into account the capacity of 35 seats of a car. The first route was established for the 9 houses, numbers 673, 677, 681, 682, 683, 683 A, 683 B, 684, and 691, adjacent in territory. The points corresponding to the house numbers were loaded in the class **Stops**. The total number of evacuated persons was 27. The vehicle is moving from the Baciu city hall to the first house, then turn to the following, and then carries people to the single access point in the evacuation zone I of the locality, where they will be taken in evidence, they will subjected to a brief medical

examination, will receive food, water, etc. and will be assigned to a shelter. These two locations were also loaded in the class **Stops,** the city hall as starting point of the route, and the evacuation area as its endpoint. The starting location was introduced by using the button **Create Network Location Tool**  . The handling of an introduced location can be executed with the button **Select/Move Network Location Tool**  . To assure the passenger safety it would be advisable to take on board of the vehicle, beside the driver, a qualified person to provide medical assistance if necessary. To set the first route, in **Layer Properties** in the tab **Analysis Settings,** following settings were assessed, for:

- **Impedance** we selected **Minutes,**
- **Start Time,** the starting time of the transport vehicle was set at 8 a.m. (it can be chosen as needed),
- **Reorder Stops To Find Optimal Route** the appropriate box was marked. This option allows for the automatic setting of stops in order to determine the shortest route,
- **Allow U-Turns** we assigned **Everywhere,** allowing the execution of such turns in the network,
- **Output Shape Type** we selected **True Shape,** so that the route follows the profile of the road segment,
- As unit of measure for the routes, established by **Directions,** we selected **Meters,**
- **Use Time Attribute** was selected **Minutes.**

In the **Accumulation** tab we keyed the summation of arc lengths and of the times allocated for passing through them, and in the **Network Locations** tab we set the search tolerance for stops at 500 meters.

For each locality, appropriate routes were created for three cases:

Case 1. The vehicle travels the route passing through every stop, but without halting. For Baciu, the transport time duration was 42 minutes, starting at 8 a.m. This is the route which the vehicle has to pass through when returning to the city hall, its starting point.

Case 2. At each stop, the vehicle halts for 30 minutes to allow people to take their luggage, and to board, to be transported to the evacuation area. For Baciu, the transport time duration on the first route is 5 hours and 12 minutes.

Case 3. The residence time for each halting at each home is 60 minutes, resulting in a passing through the route time duration of 9 hours and 42 minutes, for the evacuation of the persons from the locality Baciu.

In real life, the waiting time at a location varies from case to case. For the modeling, we can select an average value, or we can introduce different times for each location, established from an *a priori* estimation. Where there are sick or hardly transportable people, or more animals or fowl, the residence time may be longer.

To introduce the waiting times at each evacuated building, in the table corresponding to the stops layer for the attribute **Attr Minutes** the values 0, 30 and 60 were introduced in turn.

RESULTS AND DISCUTION

In Fig. 1 is presented one of the four people evacuation routes identified by the analysis for the Baciu locality, highlighted by the yellow curve. The symbol μ marks the evacuated locations on the yellow highlighted route, and the digit represents the serial number of the stop (location). The access points to the evacuation areas are highlighted with the ⚠ symbol. The polygons representing buildings, marked with red color, are located in the floodable zone.

FIG. 1 - Evacuation route for the flood victims from the baciu locality.

For the evacuation of animals and fowl the same procedure was used, loading in the stops layer the points corresponding to the annexes sheltering animals, and as destination the access point to the second evacuation area assessed for the Baciu locality. The evacuation routes assessed for animals were separated from those for fowl, taking into account the existing capacities of the special transport vehicles. Given the number of domestic animals to be evacuated, it was considered that two transports with the specialized vehicles would be necessary. Fowl can be transported by a single vehicle to the access point in the second evacuation area. The settings for the analysis are similar to those presented above. Using the same methodology we identified the evacuation routes of persons, animals and fowl for all the localities of the commune.

CONCLUSIONS

Our results reveal that the evacuation of people, animals and birds in the locality Baciu can be done within maximum 12 hours. In the Coruşu locality, the evacuation should be executed with residence times of maximum 30 minutes, in order that the maximum time duration does not exceed 14 hours. The evacuation of

people from the Popesti locality takes up to 15 hours, with a residence time of 60 minutes. In the localities Mera and Suceagu the time of residence at each household should be no more than 5 minutes in order that the evacuation time duration does not exceed 24 hours. Transport vehicles should be used for animals and fowl with a capacity as large as possible. For stationary time at each location as close to zero as possible, the vehicles should start on the route from within the respective locality, and not from the city hall of the commune. The evacuations of the localities Rădaia, Sălişte a Nouă, and Popeşti can be executed in acceptable time durations (at most 15 hours with residence times: 60 minutes).

The obtained information highlights the importance of the road quality which constituting the access routes to evacuation areas. Road sections covered with stones or earthen, in poor condition, should be upgraded to be reclassified at least as communal roads. The information presented shows that, unfortunately, the Baciu commune is not ready for an evacuation process within 24 hours, mainly due to the transport infrastructure.

Our spatial analyses can improve the strategic planning in order to assure evacuation service and to support the decision-making process. We believe that such analyses should be performed for any territorial-administrative entity.

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METODOLOGII GIS ÎN ANALIZA SPAȚIILOR VERZI DIN ARIA URBANĂ CONTINUĂ A MUNICIPIULUI ONEŞTI

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Abstract: The main goal of this article is to realize an analysis, both qualitative and quantitative, of the continuous urban area of Onesti city green spaces using GIS techniques and demographical data. In order to fulfill our purpose we mapped all the types of green space, roads, buildings and rivers by using aerial images in TNT Mips 6.9. We proceed by creating an attribute table for green spaces and also for buildings (fields for function, high, number of inhabitants and number of floors), creating a vector with small neighborhood areas (very useful for a detailed analysis), go on using some GIS process like vector-raster conversion, raster properties or functions like buffer zones which allowed us to easily figure it out what is the number of inhabitants that lives further or no than 300 m from municipal park and finish with strong and objectives conclusions.

Keywords: Green spaces, GIS techniques, Oneşti

INTRODUCERE

Importanța spațiilor verzi în ecosistemul urban nu trebuie demonstrată. Ea survine ca urmare a interacțiunilor spațiilor verzi cu celelalte structuri urbane creând astfel o perspectivă ecologică prin care acestea moderează impactul activităților umane, o perspectivă socială prin contribuția la creşterea incluziunii sociale (Chiriac