

ADVANTAGES OF GIS APPLICATION IN PLANNING DOMAIN¹

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ABSTRACT

Nowadays, it is not yet frequent to have a GIS application providing information of the rules of urban design, monitoring the great dynamic of urban transformations in the urban expansion areas.

The use of GIS is a new representation of the city and the manner of making available to the citizen the rules of urban design. In these rules we can include the facilities to build and urbanize as well as the restrictions of land use, originating from the conceptual contents of the urban plans.

Might be GIS used in the management of territory on a municipal level, able to expose with greater ease and efficiency a growing quantity and complexity of information, in the urban design domain?

This article aims to discuss the advantages of using a GIS application in planning domain.

1 INTRODUCTION

1.1 The main tasks in planning domain on Municipal level

The urban expansion areas are the parts in the city for urbanization. They are localized inside the urban perimeters, near to the consolidated areas of the compact city, and they are understood as places for urban growth. Currently they are also for non-urban activities and of low densities.

The concept of suburb or periphery is also linked to the urban expansion areas and it will be comprehensible as a given build-up of territory that surrounds a city centre. It reflects inferiority or dependence relative to the city centre, it has the possibility to provide information about suburban areas and it can stand out for its progressive densification, dominant type of the constructions, social stratification of its inhabitants or in the way of integration in the city.

In Portugal, it is the responsibility of the Municipal Authority (MA) to delimit the urban expansion areas in function of the necessities of urbanization and of the balance of the land use market, which will manifest itself in the opportune exchange or buying of lands with the foresight to make the predicted undertakings easy or the integration of the proposals of the plans such as Municipal Director Plan (MDP).

¹ This article is included in the research for the Master Thesis in Civil Engineering by F. Neves, supervised by Prof. A. L. Virtudes, Department of Civil Engineering and Architecture, University of Beira Interior, 2009, Covilhã - Portugal.

The development of urban expansion areas could be justified because of many reasons. The natural need for new urban areas, given the saturation of the old urban spaces; the search for the balance between the distance to the urbane centre and the increase in value of the environmental quality; and the existence of a culturally-derived root tendency that hold that the possession of land is desirable, associating it with power and prestige. The recent experience in the planning management of urban expansion areas can be analyzed in its positive and negative aspects.

The main positive aspects are the great dynamic in the preparation of plans from the 90's and the growing offer of private plots and urbanizations. The whole country, with a total of 308 municipalities, is covered by MDP, even with lack of more detailed plans that define the urban design, the who, how and when of the urbanization process. This intense practice with MMP resulted in the Portuguese familiarity with the planning rules.

Regarding the main negative aspects of planning domain, we can talk about the stereotypical formulation of the contents of the plans or their slow, inoperative preparation in the planning management and in the framing of private enterprise. Problems still arise on the level of urban perimeters that are oversized, 30 million compared to the current 10 million Portuguese. Therefore, it leads to a waste of infrastructure, an urban void that will never be filled, a dispersion of the building and urbanization within the large urban perimeters. Also the cartography that emanates from the plans of the 90's has been of bad quality causing ambiguities and doubts in the interpretation, principally in zones of limit, besides the non-existence of the register, of the disagreements between maps of land uses and maps of restrictions. These gaps are aggravated in urban expansion areas, with a big dynamic in the alteration of land use.

1.2 The use of GIS in planning domain

GIS, the abbreviation for Geographical Information System, consists of a system with capacity for acquisition, storage, treatment, integration, processing, recuperation, transformation, handling, modeling, updating, analysis and showing of digital information with geo-references, topologically-structured, associated or not with a bank of alphanumeric data. This tool is a system which supports the decision maker where the main purpose is to analyze the characteristic of a geographic data, with the possibility of working with a range of scientific disciplines such as geography, cartography, planning, photogrammetric and remote sensing.

The GIS often developed and introduced into the planning processes applications for characterization, whose purpose is to address the issues and conflicts in the planning management of cases in this area. They constitute a basic element integrated in the MA that presents challenges, new methodologies and processes of work. Given that MA have skills in planning management, the state GIS is increasingly an instrument of analysis and information management, ensuring the effectiveness of the organizational models behind it, contributing to becoming closer to the citizen, allowing the correct use of information and legal aspects, disclose and disseminate the planning information.

Any claim to build, urbanize or implement any other operation planning, requires the prior control of the MA, demanding in the appreciation of the case the compilation of numerous documents, maps and drawings. It is precisely in the appreciation of these processes that the prior knowledge of the rules of construction and of the urbanization on the part of the

citizen who takes the initiative of carrying out such a planning operation, that consultation to a base of data might make the action easy.

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The GIS database guarantees bigger satisfaction of the MA with the following contributions, for clarify the relationship between the local authorities and the citizen in the domain of planning management decisions.

2.1 Procedural Domain

We can say that the procedural agility is the capacity to respond in good time to the external solicitations for a service, namely: specification of the procedural path, of form to avoid the devolution of the process for lack of documents; emission of maps of location automatically and prior indication of the existent of land use restrictions.

The procedural timescale is the capacity to obtain a response in the evaluation of building viability in determined land use in time, integrated in a system that allows the person: to register and to computerize the administrative circuit of a building or an urban process application; to define correctly all the circuits through which the process goes internally; to define terms for all these circuits and alerts for the failure of the same terms and to modernize and to automate the possible services, like in emission of maps and MA extern consultations of the processes.

The professional equity is the guarantee of which the process of evaluation is equitable for all.

2.2 Methodology of a GIS application for Urban Expansion Areas

The application tool GIS of the program ArcGIS (ESRI) was chosen in this case study, because ArcGIS 9.3 makes possible the geo-processing and mapping.

What is claimed is the creation of a GIS application that could contribute for monitoring the process of planning management, in the urban expansion areas. So we divided the work into two main parts: the preparation of maps for the urban, industrial and for urbanization land uses and the urbanization operations (maps of urban design) using ortophotomaps, military maps and maps from the digital MDP.

The gathering of data was based essentially on two sources of information in terms of urban design: the MDP of Belmonte and the urbanization operations.

As for the Municipal Director Plan it was necessary to obtain the military maps (scale 1/25000), as well as the ortophotomaps of the municipality, for a full observation and characterization of the places. Then, it was necessary to scan the maps of MDP, so that it was possible to use this digital format as a of work base, in the definition of the classes of space and of the land uses in ArcGIS – the urban, industrial and for urbanization spaces.

As for the urbanization operations, in addition to the gathering all the necessary data and to choose the appropriate maps of each urbanization, there was inevitably the passage of all maps finish in digital format.

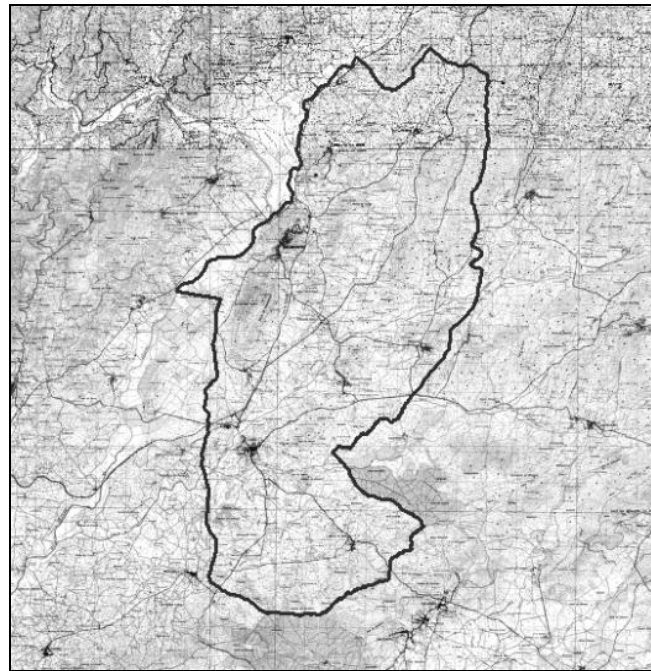


Fig. 1 Limits of Municipality of Belmonte. (Source: F. Neves).

Introduced in a file of ArcGIS were military maps 1/25000 and the ortophotomaps that were already geo-referenced in the system of coordinates “Lisbon Hayford Gauss IGeoE”, which started to be the system adopted for all the images and maps inserted from there onwards. In the introduction of the digitalized image of the map of land uses of the MMP, it was necessary to proceed to the geo-referenciacion. The next step was centered on the creation of files on which the maps are worked. The type of file shape defined, as much for the land use classes, as for the urbanizations it is the polygon, in order that outlines can be created.

It started the process of creating maps of the area that would define classes of the different land uses for the urban area of Belmonte where there are a small percentage of urban perimeters. With the help of the scanned image of the MDP, the overlapped ortophotomaps of the county began to draw up the polygon layer “Spaces – Urban”.

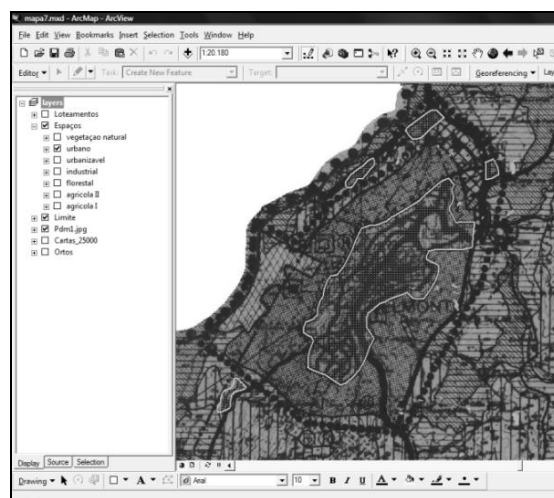


Fig. 2 Urban limits of Belmonte. (Source: F. Neves).

The delimitation of each polygon is associated with a line in the table of that layer. So the layer “Urban” has in its table as many lines as polygons drawn. In this table it is possible to add several attributes to characterize the polygons, such as a name, size or the dimension. This type of functions is extremely useful for the classification of space, storage of information that can import to meet the defined space.

The characterization of urban space is defined as attributes that make the parameters of the urban design a regulation of the Municipal Director Plan, referring to the land uses, i.e.: space: urban, maximum building height [m]: the dominant in the place < 10,00 m; minimum area of the plot [m²]: 300,00 m²; minimum width of the plot [m]: 10,00 m; maximum rate of construction: urbanizations 1 = 0,40; urbanization; 2 = 0,55; Isolated plots = 0,55 and area: variable.

We can conclude that the urban perimeter of Belmonte has 968.492 m² (almost 1,00 Km²), and that the Municipality has 133,00 km². We followed the same methodology for the industrial and for urbanize land uses.



	Altura Máxima Construção	Área Lote Min	Frente Lote Min	Índice Construção Máx	Espaço	area
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	968491,81
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	10,237855
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	476663,63
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	9565,7373
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	9565,7373
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	136313,3
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	17564,184
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	79604,523
	a dominante no local e < 10 m	300 m2	10 m	Loteamentos 1 = 0,40; Lot	Urbano	228139

Fig. 3 Layer Urban attributes. (Source: F. Neves).

3 URBANIZATION CERCA DO CONDE AS A CASE STUDY

In the Municipality of Belmonte there have been 9 urbanizations in the last 10 years (1999 – 2009) in urban expansion areas; case studies; of private initiative. The GIS application was done for all of these 9 urbanizations in urban expansion areas.

After the digitalization of all maps of these urbanizations, as we explained before, this information was put in ArcGIS, without consideration of the entrance coordinates. In this way it was indispensable to go on with the geo-referenciation of the urbanizations, from the ortophotomaps coordinates. In each urbanization layer there are 4 layers:

- “Map”, which correspond to the synthesis map of the digitalized urbanization;
- “Urbanization” with the delimitation;
- “Plot” with the set of plots of the urbanization and;
- “Building area” the layer of the building area of each building of each plot.

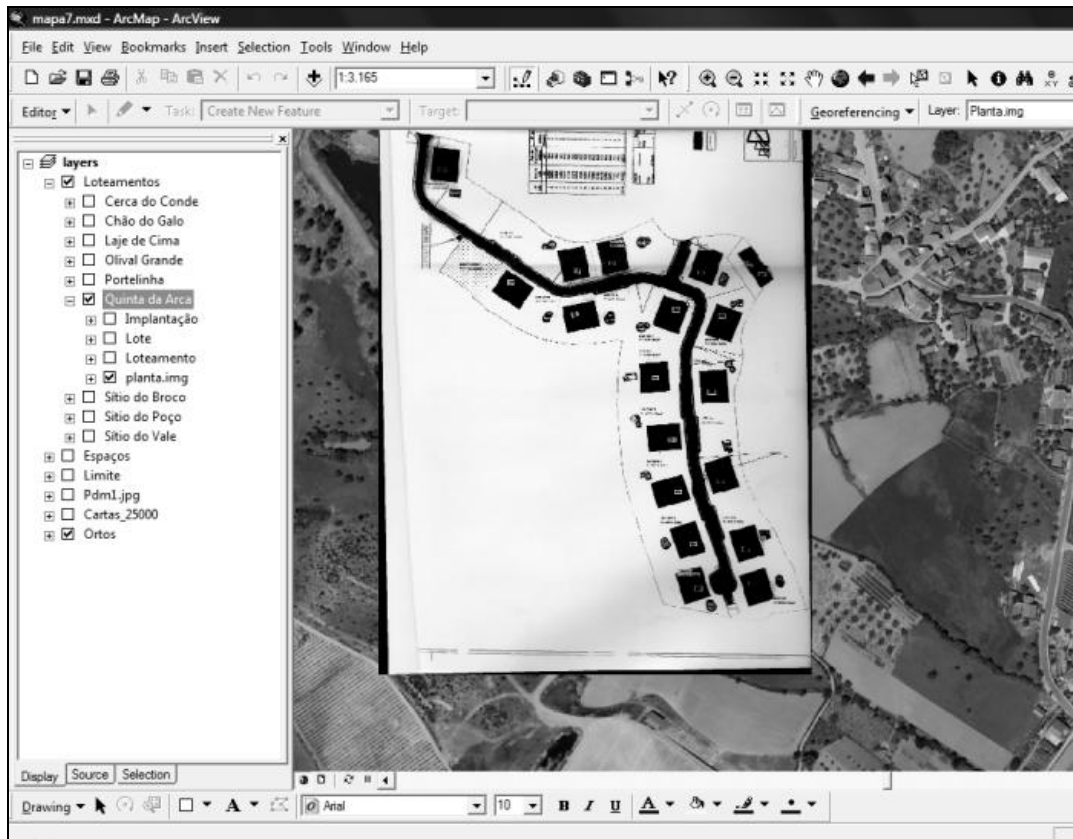


Fig. 4 Urbanization map over an Ortofotomap. (Source: F. Neves).

The urbanization of Cerca do Conde is in the village of Caria, the second biggest in the MH of Belmonte and was approved in 2002. It has about 3,50 ha and 41 plots which the majority is for housing, with only 2 plots for commerce.

The first step for the characterization of this urbanization in ArcGIS passed by its definition according to the map of urbanization geo-referenced; over it to the orthophotomap of the municipality; drawing the limit of the urbanization in the layer blending. The table of attributes of this layer “Urbanization” was filled out by the whole general information on the urbanization, which could interest the technicians and which could have interest in the optics of the user (the citizen), in order to know the potential in terms of urban design of the urbanization, and the restrictions to the construction such as:

- year;
- state of the project;
- number of plots;
- number of houses;
- plots photos;
- localization;
- number of car park places;
- identity of the owners;
- urbanization area;
- collective spaces area;
- equipment;
- green areas and;
- index of construction.

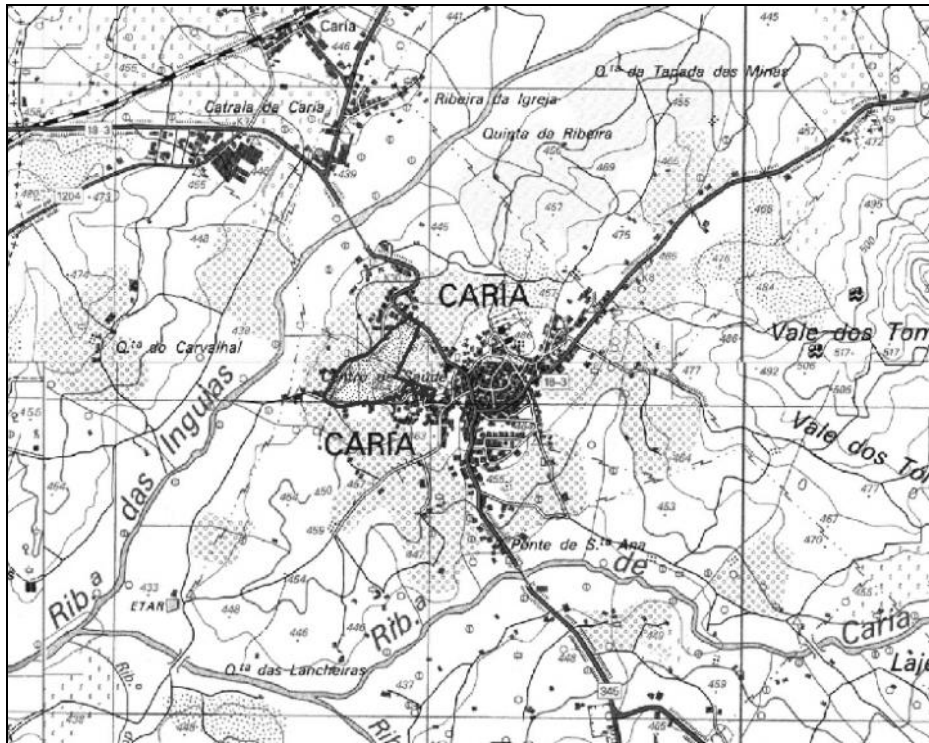



Fig. 5 Urbanization Cerca do Conde over a military map. (Source: F. Neves over a military map).

Through the button “Identify”  of ArcGIS it is possible to have a list of all details of the urbanization, very fast and simple, how to interface any contact with the common citizen. Then, draw up all the plots on the same map in the synthesis of blend layer “Plot”, as in the previous procedure.

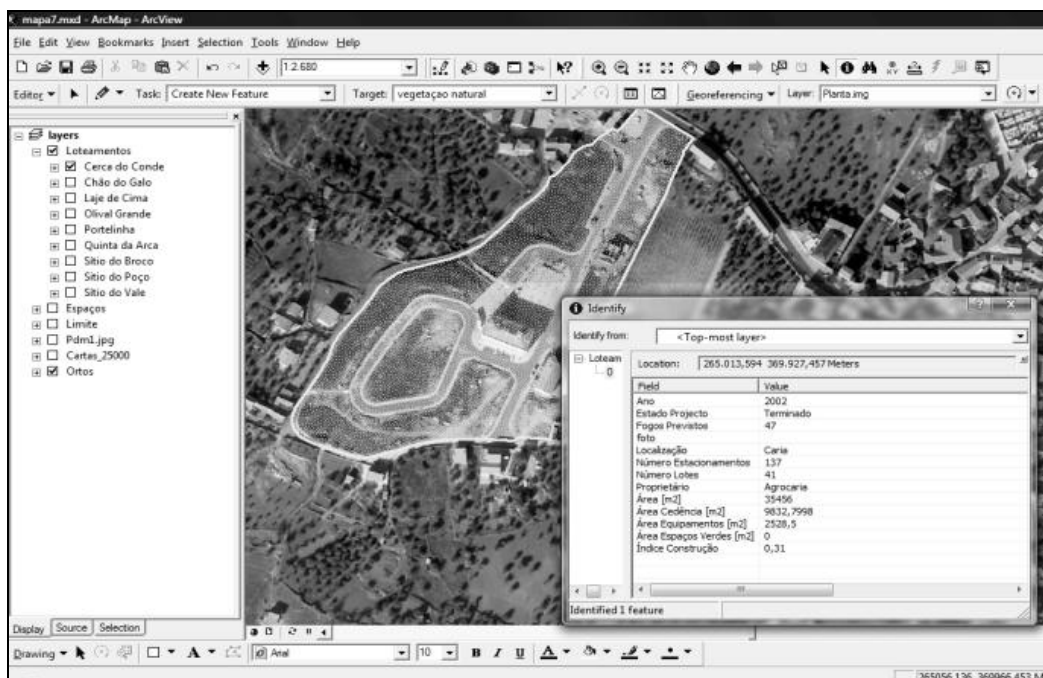


Fig. 6 “Identify” tool of ArcGIS. (Source: F. Neves).

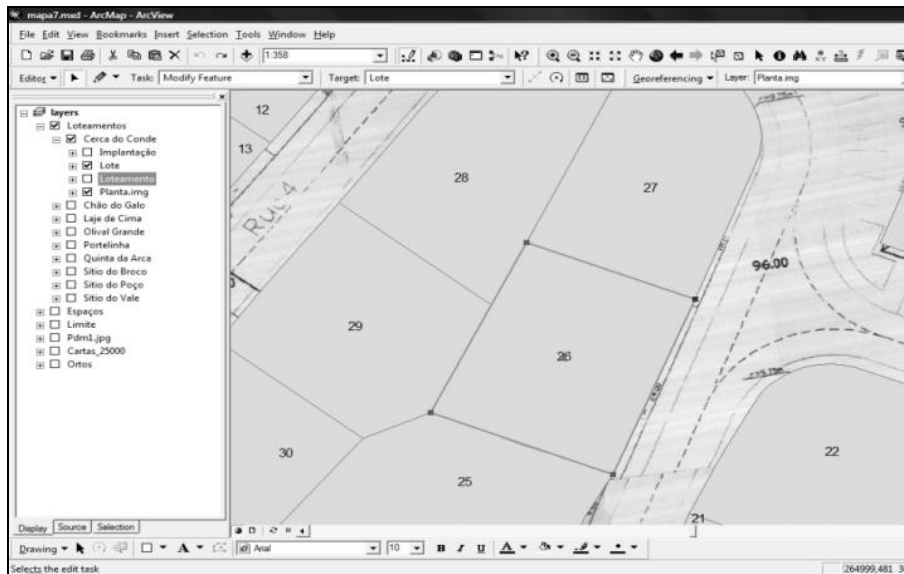



Fig. 7 Plots limits in urbanization Cerca do Conde. (Source: F. Neves).

The table of attributes for the layer “Plot” was filled with information on each specific plot, with more significance given to characterize the urbanization under several perspectives: the plot number, area [m²], current situation and type of occupation.

In addition to the “Urbanization” in the case of the plots it is also possible to know, with this GIS application the characteristics that were given them in the table of the attributes, for the tool “Identify” . After this stage, we can conclude the study of each urbanization, case studies, referring to the polygon of each building.

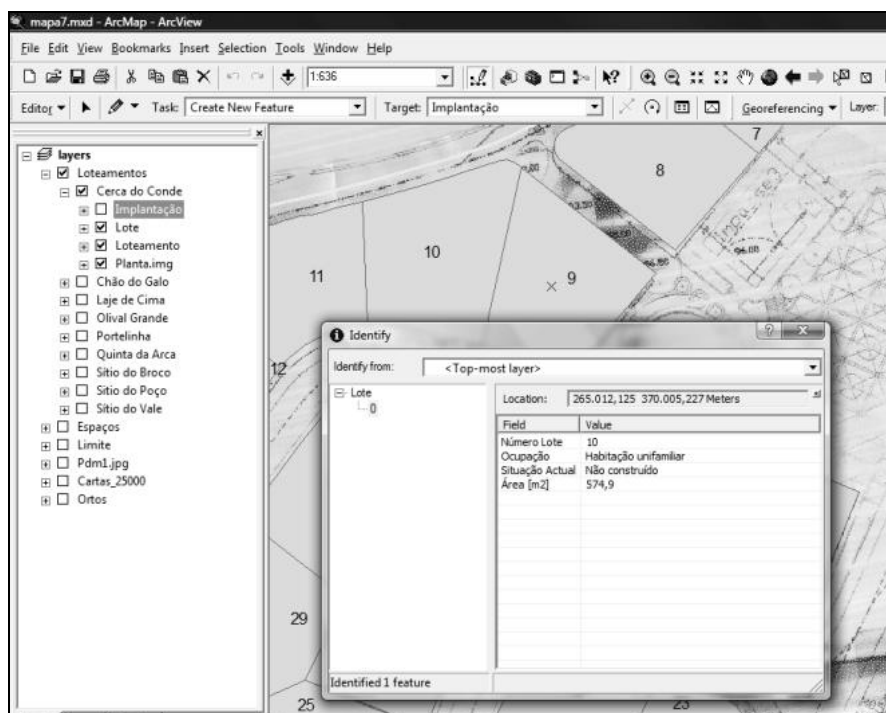


Fig. 8 “Identify” Tool of ArcGIS. (Source: F. Neves).

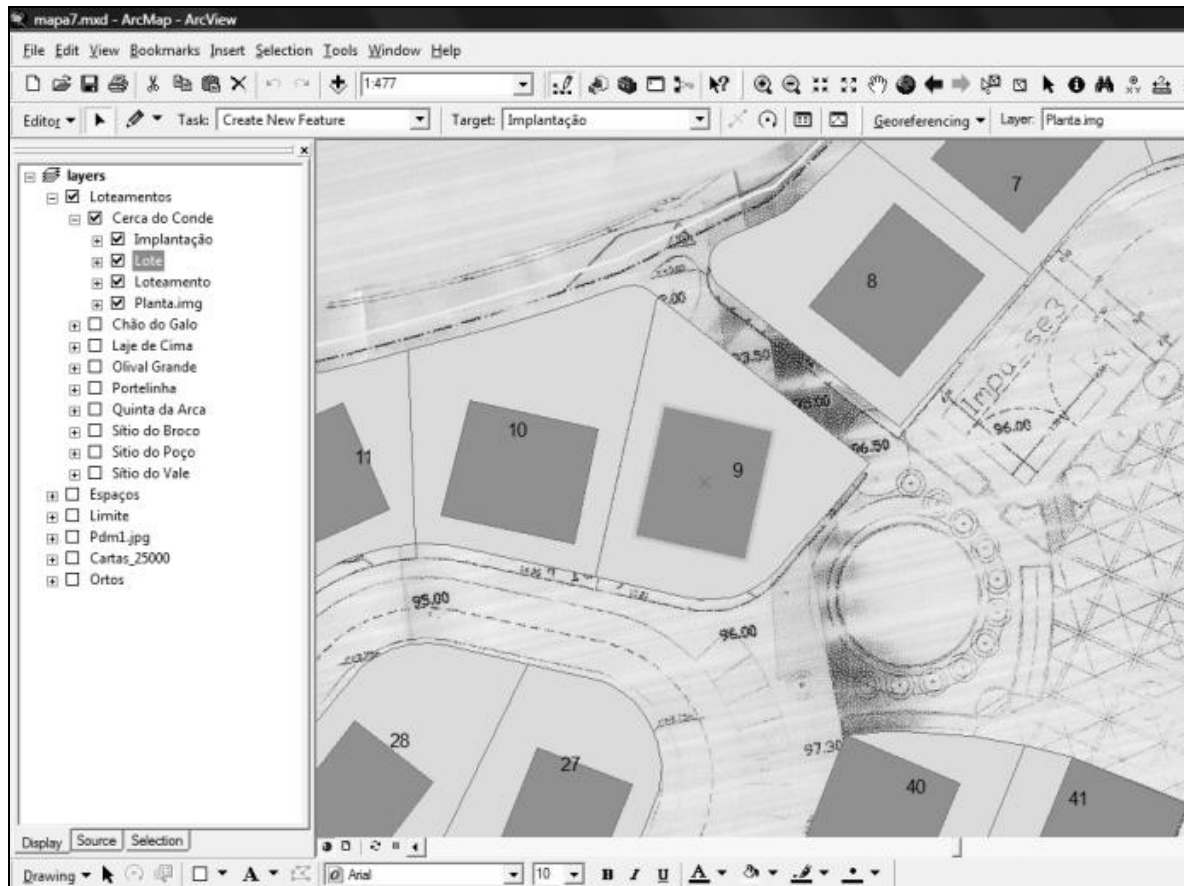



Fig. 9 Delimitation of Buildings Polygons. (Source: F. Neves).

Finally, set up the attributes to give polygons of buildings, which are more specific than those of the plots and filled to the table of attributes properly, according to the data that the synthesis map provides:

- buildings area [m²];
- construction area [m²];
- area of annexes [m²];
- number of levels and;
- number of dwellings.

As was explained for urbanization in general and for their plots, with the tool “Identify”  quick and easy access to the characteristics defined for each polygon of buildings becomes possible in this GIS application in planning domain.

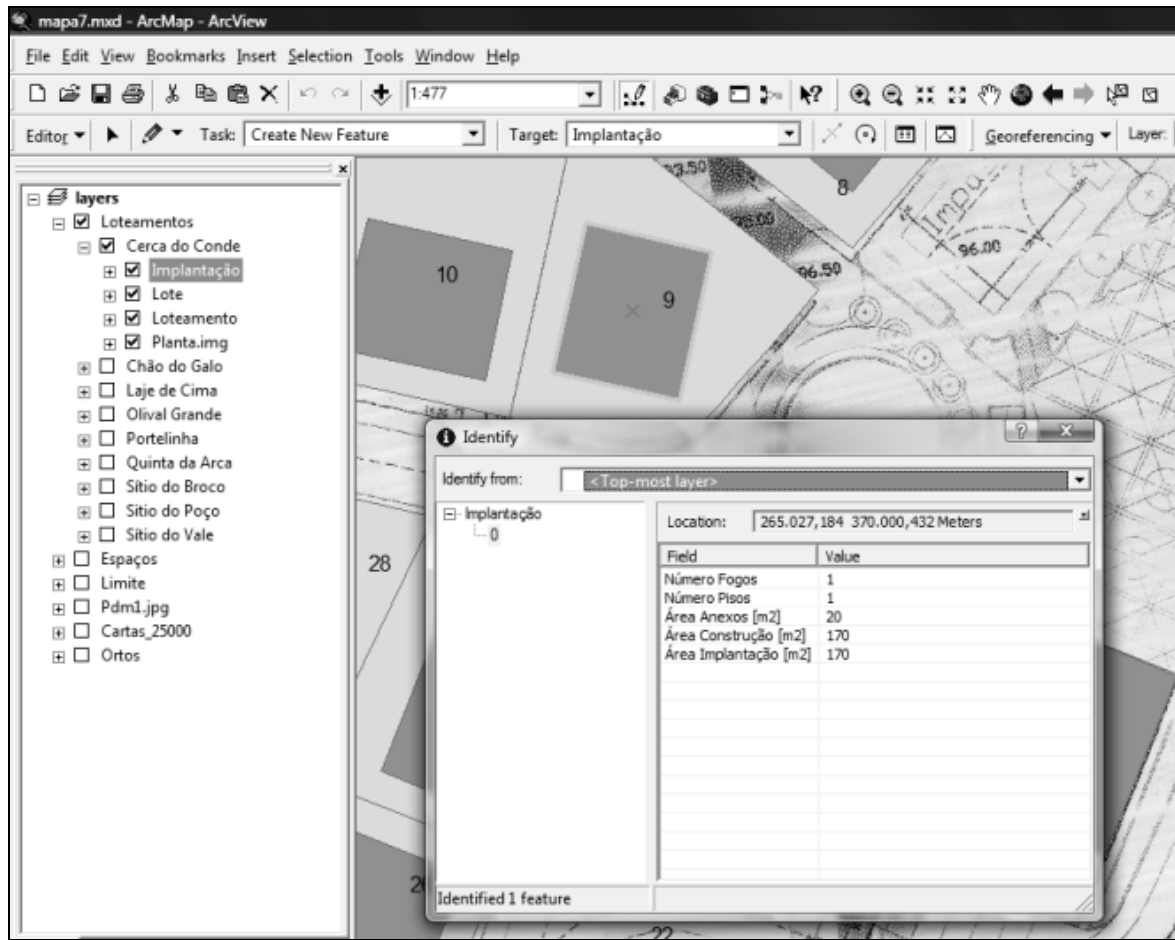


Fig. 10 “Identify” Tool of ArcGIS. (Source: F. Neves).

4 CONCLUSIONS

With this example of GIS application in planning domain we can conclude that is possible to define in the urban expansion areas, a new cartographic tool to clarify the relationship between the Municipal Authorities and the citizen.

This tool will help to address two major challenges that now face the authorities:

- For the Municipal Authorities, whom it allows to have a database of rules for the planning management and to carry out the monitoring.
- For the citizen, to whom it allows conformance to a database with the rules of planning management, in his action of interventive in the territory.

With this type of GIS applications we may make a little more progress in transparency that should characterize the technical action of the Municipal Authorities, as a convergence of their geographical (with the plans and the urbanizations maps) and political dimensions (as a controller of the land use) in the urban design.

Finally, this GIS application will facilitate the action of citizens in their active role of interventive in the territory, providing them with information on the rules and legal aspects of planning, urbanization and building processes.

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