APPLICATION OF GIS IN WATER SUPPLY MANAGEMENT NETWORK

Ymer KUKA[1], Perparim AMETI[2], Besim AJVAZI[3] and Saranda MURSELI[4]

SUMMARY

The aim of this research project is to discuss the role and importance of the GIS in managing the water supply and consumers. Currently, GIS plays a very important role in managing the data with spatial and non-spatial components.
There are several requirements or challenges that are related to GIS integration. One of them is creating or adaption of a GIS model to accurately manage the water supply network. This requires good knowledge of the spatial data and of links between different features, all interconnected to provide appropriate functionalities.
GIS is a technology that offers data processing in appropriate forms for analysis, management and presentations of results based on different requirements.
Based on the options offered, this research project discusses the reasons for creating a GIS model to manage easily and more efficiently the data that comprise a potential water supply network system.

Key words: GIS, consumer, water meters, manholes, water linkage.

1. RESEARCHING AND GATHERING THE REQUIRED INFORMATION

The first step has been the researching and gathering all of the data that are necessary for the flow of the work in the future (the design of the geodatabase)
Management of the digital data can be done through creating the database in shapefile and geodatabase formats (Fig 1). In this case, it has been used the management of digital data through the creation of the database as part of the

[1] **Ma. Ymer KUKA,** ymer.kuka@uni-pr.edu
Geodesy department; University of Prishtina; Prishtina, Kosova. www.uni-pr.edu
[2] **Assoc.Prof.Dr. Perparim AMETI,** perparim.ameti@uni-pr.edu
Geodesy department; University of Prishtina; Prishtina, Kosova. www.uni-pr.edu
[3] **Ma. Besim AJVAZI,** besim.ajvazi@uni-pr.edu
Geodesy department; University of Prishtina; Prishtina, Kosova. www.uni-pr.edu
[4] **Saranda MURSELI,** sarandam@geoland-kosova.com
Geo&Land L.L.C.; Prishtina, Kosova. www.geoland-kosova.co

'personal geodatabase', an option of ArcGIS. A 'personal geodatabase' is a database of Microsoft Access that can store, create questionnaires, and manage spatial and non-spatial data.

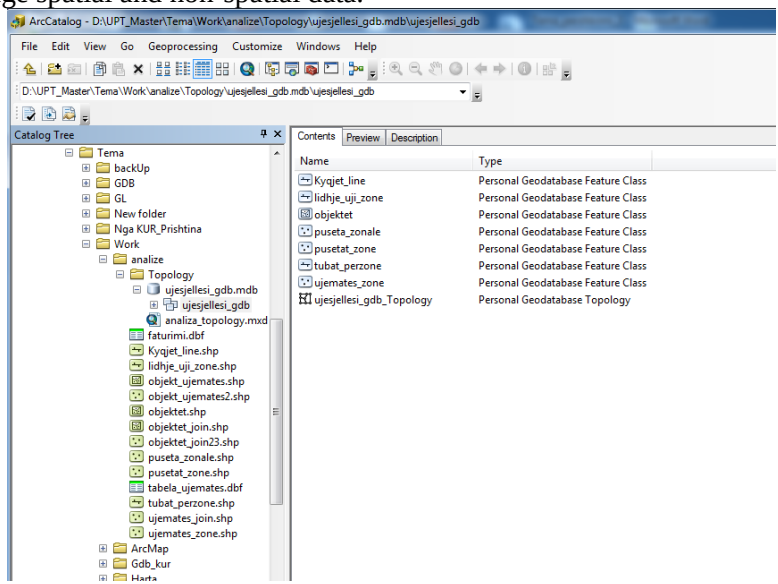

Fig. 1. Shapefile and geodtabase formats

2. GEODATABASE CREATION

The steps for designing the geodatabase begin from:

- Identifying the features and the data that should be included in geodatabase
- Defining the coordinative system KosovaRef01 and spatial representation of the feature
- Defining the structure of the table and descriptive attributes, meaning identifying the field of attributes and type of the column. It can also include the list of the code in attribute, relationship between the tables, and relationship between subtypes, through which the ranking of the attributes and their classifications can be done.
- Defining the rights and responsibilities for creation and maintenance of every feature in database
- Documenting the design of the geodatabase- different methods can be used to describe the design of the geodatabase, like drawings, scheme diagrams and METADATA documents.

Designing the geodatabase through ArcGis enables the geodatabase to be valid and stable, a detailed design of each of the fields-attributes and type, the geospatial scope of each feature, the list of code per each attribute, categorizing based on codes, creating special tables with textual data, creating the link between tables with textual and spatial data, integrating the raster format in the server (Figure 2). In designing the geodatabase, there will be options to design the features, history, and to archive them. This is very important and needed for the future developments and also calculations of different statistics.

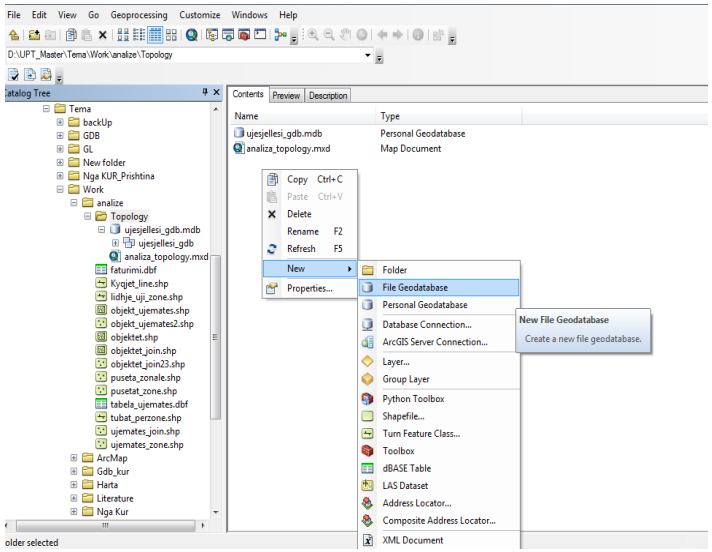

Fig 2. Geodatabase creation

In this step of geodatabase design, the identification of all of the features that will be included has been conducted. The identification of the features and of the data means, defining in details all of the shapes and features in the geospatial aspect in regards to the shape of the feature (polygon, line, point) and also in regards to the attributes that will be included in the feature.

3. CREATION OF THE DATABASE FOR WATER METERS

The database for water meters contains these data (Fig. 3)

Id_ water meter	Not stamped	The number of the water meter
Pressure area	without data	ID_ object
Location of the water meter	Installing the water meter	Usage
The water meter dimensions	Stamping the water meter	Well
Type of water meter	Returning the water meter	In service
Reading the water meter (m3)	in the direction of the flow	The size of the link (coll/mm)
Good situation	Access to the water meter	Composure of the link
Areas in the meter unclear	Tube cleaning	Connection to sewage
S/N unreadable	Repairing water's flow	Sewage in service
S/N does not work	Disconnection of water	The size of the manhole in
Does not work	Remark	sewage
Damaged	The name of the supervisor	The status of the manhole in
Year of installation	The date of the supervisor	sewage
	Septic whole	ID_ manhole

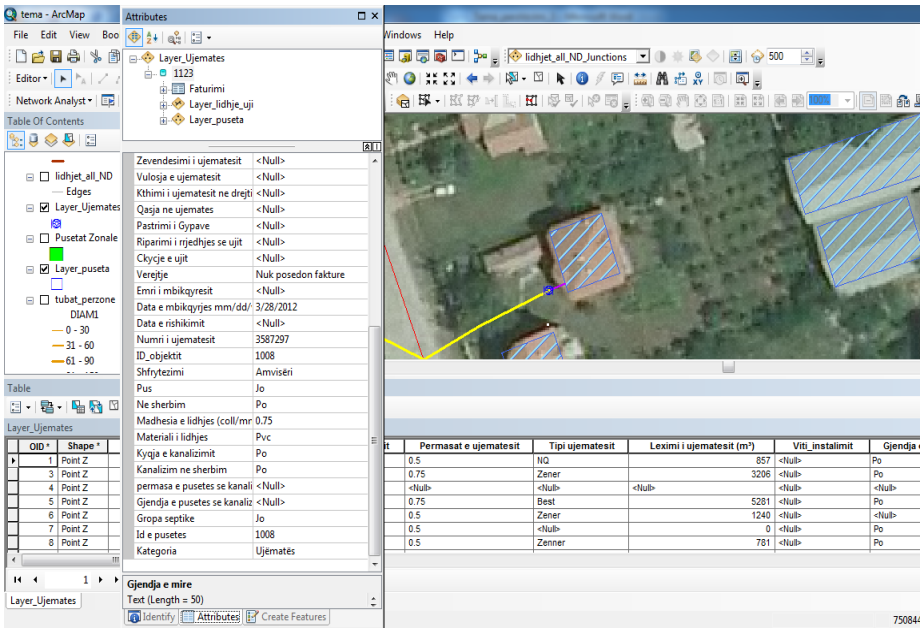

Fig. 3. Water meters in the digital map

4. CREATION OF THE MANHOLES' DATABASE

The database for manholes contains (Fig. 4):

Linkage manhole
Manhole's cover
Manhole's dimensions
Manhole's status
Installing the cover of the manhole
Manhole's cleaning
Unlocking the manholes
Last maintenance
Future maintenance
Manhole's shape
ID of the manhole
ID of the areal manhole
Description

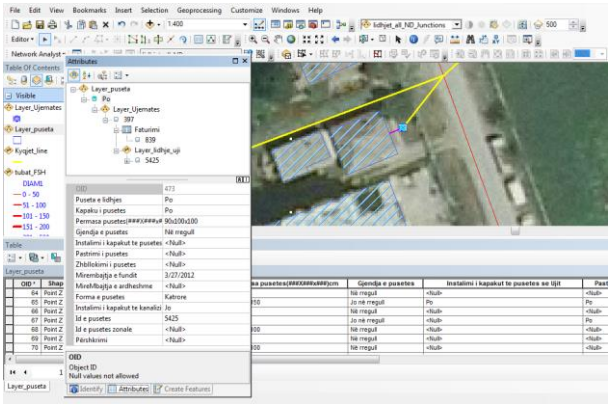

Fig. 4. Zonal Manholes

5. CREATING WATER LINKAGE DATABASE

Water linkage layer does not contain an extended database, just the main attributes that identify the water linkage and determine the links in the database. It will be more in form of a graphical representation in the digital map (Fig. 5)

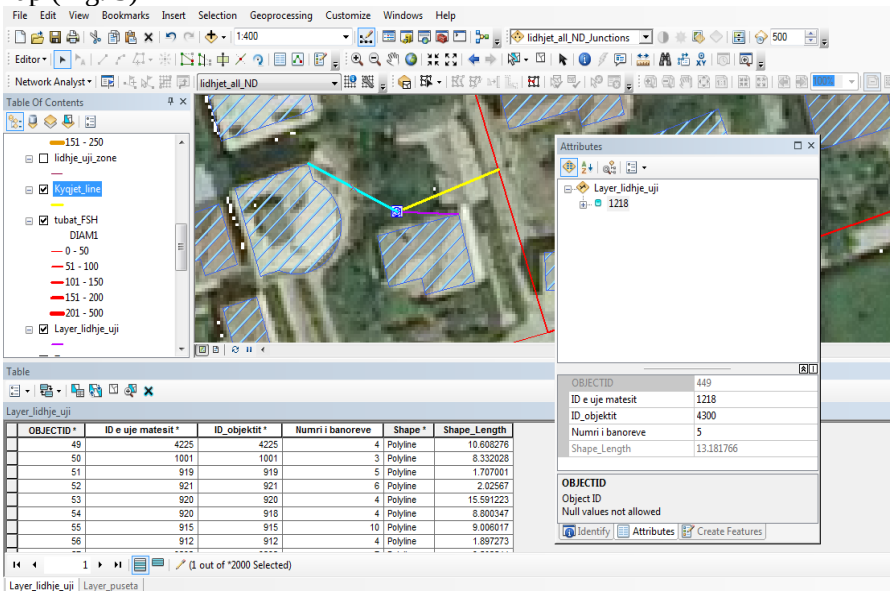

Fig. 5. Water linkage in the digital map

6. GEODETIC MEASUREMENTS AND GATHERING THE DATA FOR THE WATER METERS

Geodetic measurements of the water meters have been conducted through GPS technology and through total stations. The accuracy of geodetic measurements in general has been ±2 cm in position and altitude. Geodetic measurements have been carried out in the cover of the manholes.
Some of the potential data resources for an operating system of GIS can be: government, spatial infrastructure data, regional and municipal governments, data from other private institutions etc.
However, in a GIS project where there is constantly a need for update and gathering new data, it is necessary to determine the easiest way to update and gather data. With this contemporary technology, the gathering of the data can be done directly in the field through tools such as: PDA, HTC etc. These tools, which have the Windows Mobile installed by default, allow for different software and applications to be installed. Such applications enable:

- Gathering the data in the field in a precise and credible way
- Integrating GPS and digital camera in gathering data
- Improving the productivity of a collection of GIS data.

7. CHOOSING THE FORMAT FOR THE DATABASE

Managing the digital data can be conducted through creating the database in shapefile and geodatabase format. In this case, the management of the digital data is being conducted through creating the database in personal geodatabase, an option provided by ArcGIS. A personal geodatabase, is a database of Microsoft Access that can store, make questionnaires, and manage spatial and non-spatial data.

8. CREATING THE DIGITAL MAP

Creating the digital map has been made basing on representing the data in the main layers such as:

- Buildings
- Water meters
- Manholes
- Water linkages
- Areal manholes

If a geodatabase has been designed correctly and the roles and privileges have been defined in dataset, then we could create different maps. The maps have been created in ArcMap, where textual and geospatial data can be updated (fig. 6).

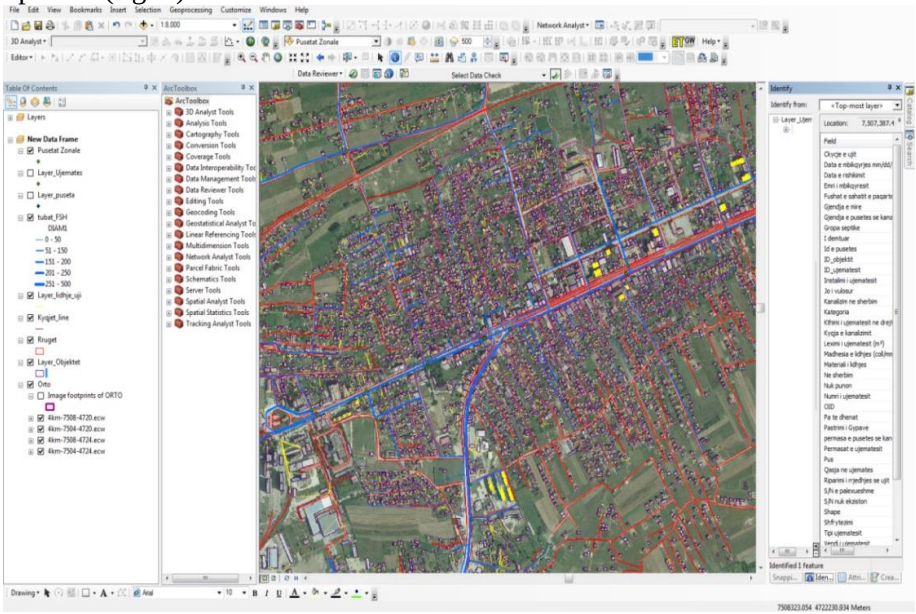

Fig. 6. The map and identification of features

9. GRAPHICAL REPRESENTATION OF DATA

Graphical representation of data has been based on the data classification in the main layers such as: objects, water meters, manholes, and water linkages. During their graphical representation, the required data have been filled in the database based on the data gathered in the field (fig. 7)

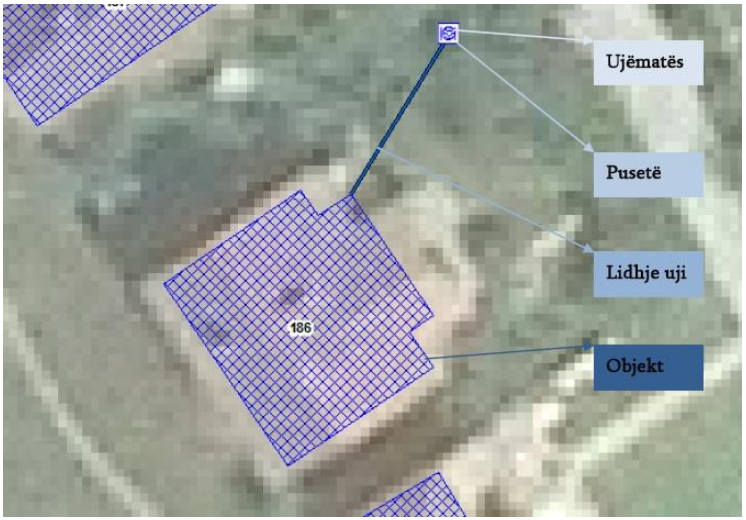

Fig. 7. Data classification

10. APPLYING THE GIS FUNCTIONS IN THE ANALYSIS OF GEOSPATIAL DATA

Below, several data, that can be necessary during work in managing the water supply network through GIS, have been shown. This doesn't mean that all the potential scenarios are present. GIS offers many options to manage spatial and non-spatial data integrated together.

11. IDENTIFYING POTENTIAL DAMAGES DURING THE PERFORMANCE OF ENGINEERING TASKS IN THE FIELD

The main purpose of managing the spatial data through GIS that are interconnected with underground objects, such as water supply network, sewage system, electric system, different cables etc., is to find as quickly and as accurately as possible the location when the need arises. This is possible when after building such networks that deal with spatial data regarding their location in nature. In case of engineering tasks being performed, through geodetic equipment such as GPS and TS, an accurate determination of the location and underground objects is done. This way, potential damages of these objects are avoided. A similar case can be where just one underground object has been damaged, and there is a need to determine the location of the tube to be replaced.

12. DAMAGE OF THE WATER SUPPLY NETWORK AND IDENTIFYING THE SEGMENT OF THE NETWORK THAT REMAINS WITHOUT WATER, INCLUDING THE NUMBER OF THE CONSUMERS THAT ARE CONNECTED TO THAT NETWORK

There are some cases where due to different causes the water supply of costumers that are connected to a certain tube has to be terminated. Using the data available, through the selection function, the tube can be identified. Later, the zonal manhole in which that tube is connected and the costumers that are connected to that tube can be identified (fig. 8).

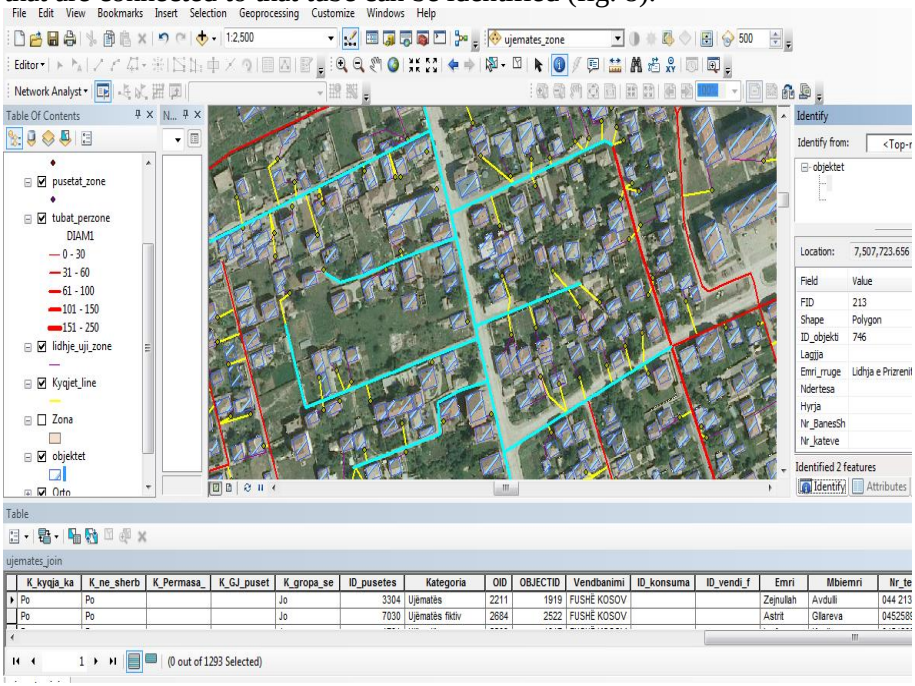

Fig. 8.Selecting tubes where water supply is terminated

Based on the data for each of the features e.g., objects, water meters, manholes and zonal manholes, the link between them has been made, through the Join function. Through this function, data of the layer of objects with the data of the water supply layer have been joined, and thus, the objects that have access to those tubes where the water supply has been terminated are identified (fig. 9).

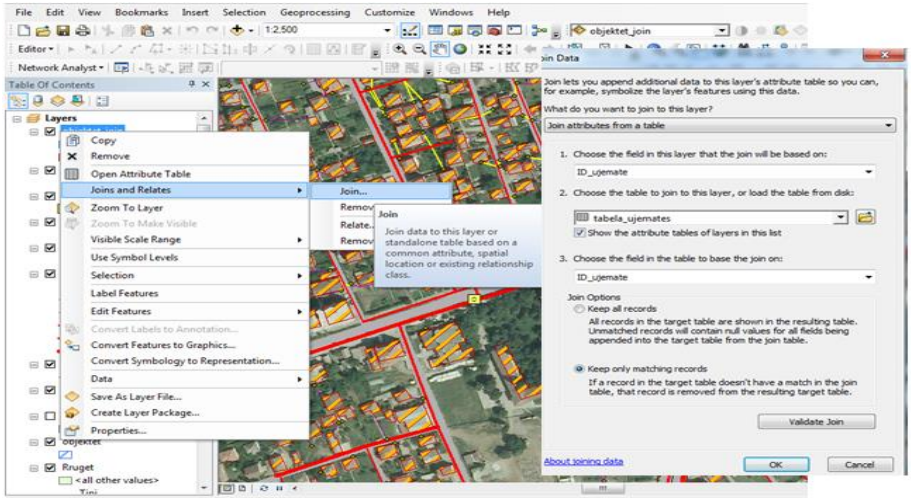

Fig. 9. Connecting the data from different layers (Join function)

Another process is selecting or separating the buildings whose water supply will be terminated. This identification can be done through the Symbology function, then at Unique values category, Menu field the field based on which the selection is to be made is selected (fig. 10).

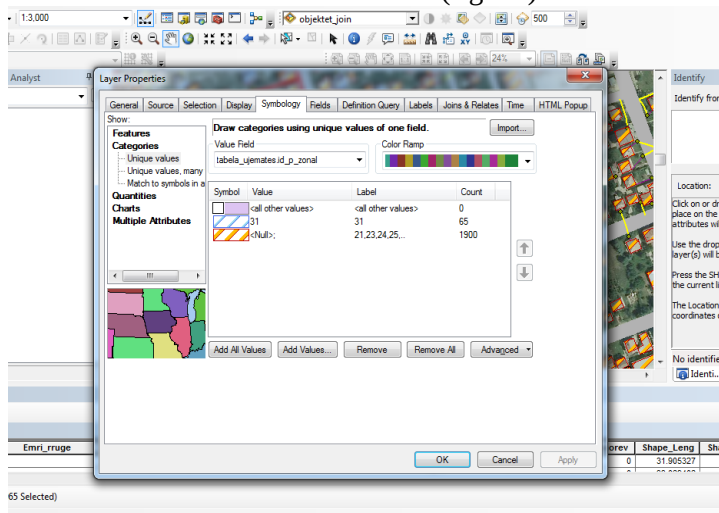

Fig. 10. Symbology function

11.1. Some of compiled maps

Fig. 11. Production of different maps

12. CONCLUSIONS

Witnessing the development of information and computer technology, and also knowing the basic options and concepts of GIS in managing spatial data, applying a system in managing the water supply network and consumers is a necessity.
GIS enables that all the spatial and non-spatial data interconnected in the water supply network to be stored in a unique base. This enables the respective institution to manage, help, advice and supports all the departments and also the consumers themselves in performing tasks and getting information.
Applying GIS will enable the management of the water supply network to be conducted in an easier and efficient way; it will also enable information giving to consumers whenever they need it.

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