CONTRIBUTION ON THE ADDUCTION PIPES CADASTRE FOR POTABLE WATER

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***Abstract**: The adduction pipes are a complex of constructions and installations with the role of transporting the water from the catchment to storage tanks, pumping stations, treatment stations etc. The location of adduction pipes involves a number of problems regarding maintenance, repairs, rehabilitation and modernisation. Adduction pipes have large lengths (tens and hundreds of km) and are located on a land with different property types. The property change on the adduction pipes site in the last 100 years requires a detailed analysis of the cadastre of these objectives. The paper aims to highlight problems such as: defining the owner of the site; delimitation of the sanitary protection area and cadastral classification; the transition way of the site from private property to the property of the water-sewage operator; obtaining real estate and urban water data necessary to monitor the operational process; obtaining real estate data for drawing up the technical rehabilitation projects.*

***Keywords**: interventions; pipes; property; water adductions;*

1. Introduction

The adduction pipes convey the water from the catchment to storage tanks or drinking water treatment stations. The adduction pipe is a complex of installations and annexes with the purpose of water transport over long distances under different assemblage conditions. The location of the pipes involves a number of problems regarding maintenance, current repairs, rehabilitation and modernisation works (Luca, 2015). The pipelines have large lengths (tens and hundreds of km), being located in a varied relief and on a land with different property types. The changes of ownership on the site of the adduction pipes in the last 100 years in Romania require a detailed cadastral analysis for these objectives (Lateş, 2018).

The adduction pipes management works with the cadastre of the respective site land, defining the owner of the land; delimitation of the sanitary protection zone, cadastral classification etc. Obtaining the real estate and urban water data necessary to monitor the operational process is an important objective when elaborating the technical rehabilitation projects (Lateş, 2017). A difficult problem is the transition of the site land from private property to the water-sewage operator's property.

The purpose of the paper is to highlight the real estate cadastre problems solving in conjunction with the management of the adduction pipes located on land differentiated by property title (public, private, association, etc.).

2. Material and research methodology

The studies and researches were carried out in the Iaşi Regional Water Supply System. The System is supplied from two important water sources: a groundwater source located in the Timişeşti area; a surface source formed from the Prut river located in the Ţuţora area. The water supply of the county and especially of Iaşi city is achieved through three adductions from Timişeşti source (Fig. 1) and five adductions from Ţuţora source.

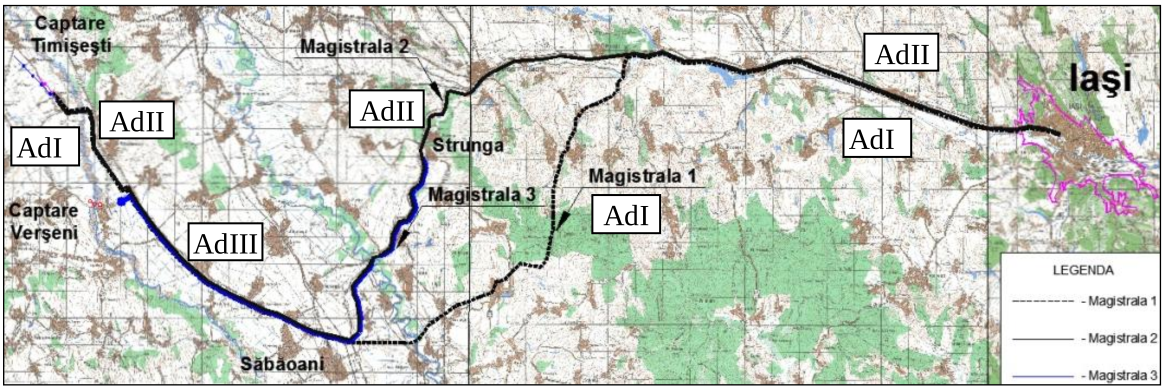


Fig. 1. Timişeşti – Iaşi adduction components (AdI, AdII and AdIII) and their site location

The research was performed on AdI, AdII Timişeşti – Iaşi pipes. The objectives pursued in the theoretical and experimental research were the following (Lateş, 2018):

- analysis of the adduction pipe location in regards to the type of land ownership;
- defining the adduction pipes urban water cadastre components with consideration of the structural components and their field location;
- defining the sanitary protection zones, the access lanes and the intervention work areas for each component of the pipeline in correlation with the cadastre elements;
- the transition mode of the adductions site land from private property to the property of the water supply operator;
- obtaining the real estate and urban water data necessary to monitor the operational process of the adductions, drawing up technical documentation etc.;
- how to use the GIS model when monitoring the operational process of the adduction pipes located on land with different property.

Theoretical research required the adduction pipe location analysis on the site plans made at various time intervals and on orthophotoplans. The data necessary to build the GIS model were collected from the cadastral documentation provided by OCPI Iaşi. SC APAVITAL Iași provided the data regarding the location and the structural and functional characteristics of the pipeline.

The data required for the GIS model are of real estate, cadastral and urban water type. The acquired data are processed and integrated in different working environments. GIS modelling involves combining .xls, .dwg, .shp files. Textual data are classified into columns with specific information. These are subsequently attached to graphical data, resulting from measurements and integrated into specific work environments. All alphanumeric data are processed on areas of interest and are integrated into Excel, Matlab, etc. data programs. The data is pre-processed for import into ArcMap, AutoCAD, ArcGIS, etc. (Jadranka et al., 2008).

The experimental research was carried out on adduction pipe route with the analysis of the structural components and their mode of placement on a different type of property land.

3. Results and discussions

The adduction pipes for the water supply systems are located and built according to the 1819-97 standard and the I.22-1999 and NP 133-2013 norms. The adduction pipe should be located on the public domain, and in the sanitary protection area there must not be agricultural constructions and farms. The route of the adduction should be correlated with the provisions of the General Urbanism Plan (PUG) and the Zonal Urbanism Plan (PUZ). The path of the gravitational adductions must be correlated with the site relief characteristics.

The route of the adduction pipes on the site plan is materialised by the following elements (Luca 2015, SR 1819-97):

- distances to the topometric bollards, or other landmarks present on the route and which have stability over time;
- the angles between the alignments and the elements for drawing the curves;
- the distances to the constructions and installations designed and existing on site;
- the mileage along the length of the pipe;
- marking the identification elements of the pipe in the field.

The adduction pipes in the water supply systems have been made over various periods of time. Some of them are over 100 years old (AdI Timişeşti – Iaşi adduction). The adduction pipe has a great length, situation in which problems arise on the right of ownership of the land it crosses. During 1900 - 1948, part of the site was owned by the state and private owners. Between 1948 and 1990, the location of the pipes was on a state owned land and some communities and restricted to private owners. After 1990, private property was expanded to the detriment of collective and state property.

In a large period of time, during which the adduction pipe is in operation, a series of parameters of land real estate type can modify, materialised by ownership change, the type of land use, the appearance of constructions in the site and in the sanitary protection area etc. All of these require the real estate cadastre on a urban water basis. This cadastre can effectively solve the management of the adduction pipes in operation. The problems to be solved and to which the urban water cadastre contributes are the following:

- the property of the land on which the adduction pipe is located with the annexed constructions, for the delimitation of the areas of sanitary protection in the forms: severe regime, restriction regime and observation regime;
- how to make the adduction pipe access lanes and work areas necessary for repair and rehabilitation works;
- solving the property type of the land for the access corridors and the work areas: rent, compensation, exchange of property, assignment etc.;

In order to solve the proposed problems, the site of the Timișești - Iaşi adduction was taken into consideration and the buildings that are tabulated within the county, in conjunction with the cadastral plans, orthophotoplans, property documents existing in the OCPI database. Thus, it was proceeded to superimpose the buildings tabulated over the route of the adduction (Fig. 2). The results obtained are (Lateş, 2018):

- in Iași county prevail buildings that are not yet tabulated;
- the route of the Timişeşti - Iaşi adduction passes through several territorial administrative units;
- the adduction route goes along the communal, county or national roads, but in many locations it crosses not yet tabulated buildings.

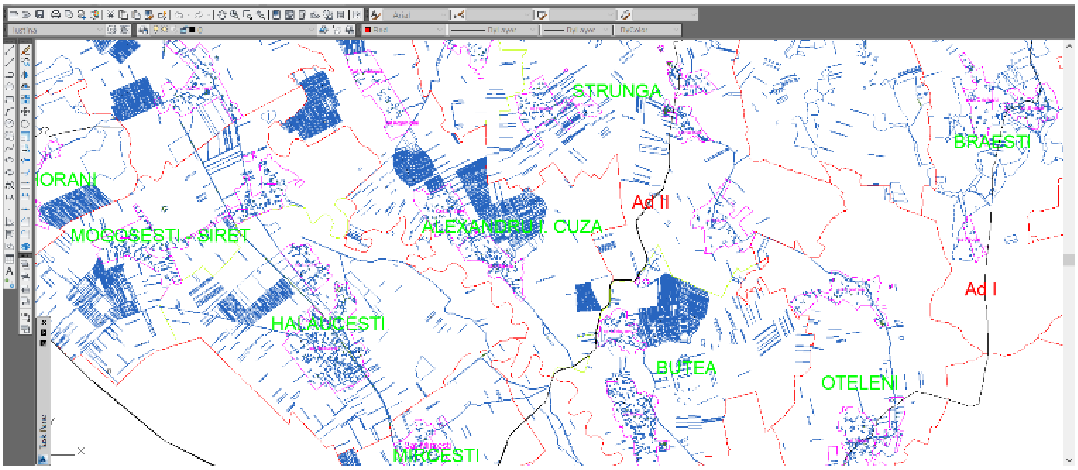


Fig. 2. Visualization of the AdI and AdII Timișești - Iași adduction route in Iași county area

The research and implementation of the GIS monitoring model required the following stages (Lateş, 2018, Bolstad, 2005, Hogaş et al., 2012):

Stage I: Schematisation of the analysis model based on the data collected and processed through the primary study. The data are from the technical documentation from Apavital Iaşi, from OCPI Iaşi.

Stage II: Data acquisition and identification of problem areas along the adduction pipe route. The data for the GIS model are collected from the cadastral documentation provided by OCPI Iaşi (real estate and cadastral type data) and from the urban water technical data taken from Apavital Iaşi (Fig. 3).

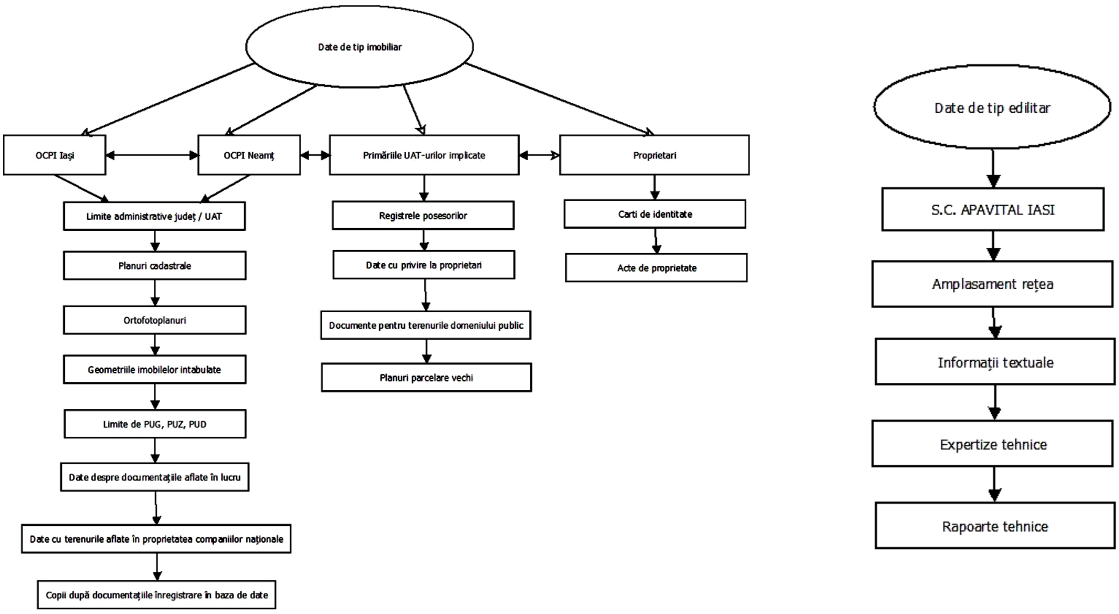


Fig. 3. Data sources for a urban water GIS model

The acquired data are processed and integrated in different work environments. Creating GIS models involves merging .xls, .dwg, .shp files. Textual data are classified into columns with specific information. These are subsequently attached to graphical data resulting from measurements and integrated into specific work environments. All alphanumeric data are processed on areas of interest and are integrated into Excel, Matlab etc. data programs. The data is pre-processed for import into ArcMap, Autocad, etc.

Stage III: The making of the model by correlating the real estate cadastre (measurements, identification of private and public properties, delimitation of the areas with access problems to interventions) with the urban water cadastre. The data collected from the two sources are combined and processed in the AutoCAD program. Verification of the analysis model is carried out using the cadastral plans, orthophotoplans, data taken from the field, photo surveys and measurements.

The route of the adduction is analysed for the selection of areas with technical problems. The real estate documentation for the plots along the route of the adduction are analysed to highlight the litigation or special situations. The selection of problem plots and the analysed data are centralised in tables (Tab. 1, Tab. 2).

Tab. 1. Alphanumeric database for undercrossings and overpassing

No.	Adduction code	Commission year	Dn	Material	Type	Address
0	1	2	3	4	5	6
1	Ad II	1975	1000	PREMO	Sbt	Sârca
	Ad I	1911	600	Cast Iron		Sârca
2	Ad II	1975	1000	PREMO	Sbt	Târgu Frumos
4	Ad II	1975	1000	PREMO	Sbt	A. I. Cuza
6	Ad II	1975	1000	PREMO	Sbt	Butea - Răchiteni
….	…….	……	……	…….	……	…….
Ad – adduction, Sbt – undercrossing, Spt – overpassing						

Tab. 2. Alphanumeric database for route components

No.	Adduction code	Owner	Domain	Cad. no.	Surface	Notes
0	1	7	8	9	10	11
1	Ad II	SCPP	Private	60468	3000	Orchard
	Ad I	SCPP	Private	60569	2500	Orchard
2	Ad II	-	Private	60616	1000	Building
4	Ad II	Butea Commune	Public	62857	2910	Cemetery
6	Ad II	ABA Siret	Private	-		Siret River
….	…….	……..	…..	……	……	…….
Ad – adduction, Sbt – undercrossing, Spt – overpassing,						

Stage IV: Preparation or improvement of the urban water cadastre elements by improving the data regarding the location of the pipes, the material of the pipes, their current structural state, access conditions, interventions in time for repairs, etc. The data is processed and entered into the GIS monitoring model.

Stage V: Signalling the problems encountered on the studied sections and analysing the cases encountered in the study area.

The way of locating the interventions in the adduction pipes is of two types (Fig. 4):

- permanent site, located by geographical coordinates, real estate elements (UAT, field, plot), cadastral (site plan), technical documentation etc.; this category includes valve chambers with hydraulic installations, undercrossings and overpassing constructions, anchoring blocks etc.;
- random site specific to pipe sections, which can be located only by knowing the failure location by geographical coordinates, real estate elements, site plans, field research, etc.

a

b

Fig. 4. Location type of the adduction pipes interventions: a - permanent location, valve chamber on the adduction AdIIa + AdIIb; b - random location, failure on AdI adduction (Luca, 2015).

The adduction pipes AdI and AdII have a common route, in parallel, from the Timişeşti catchment, on the right bank of the Moldova River, to the area of Săbăoani locality, Neamţ county (Fig. 5). The three adduction pipes cross the river near Soci locality, Mirosloveşti commune, Iasi county (Fig. 6).

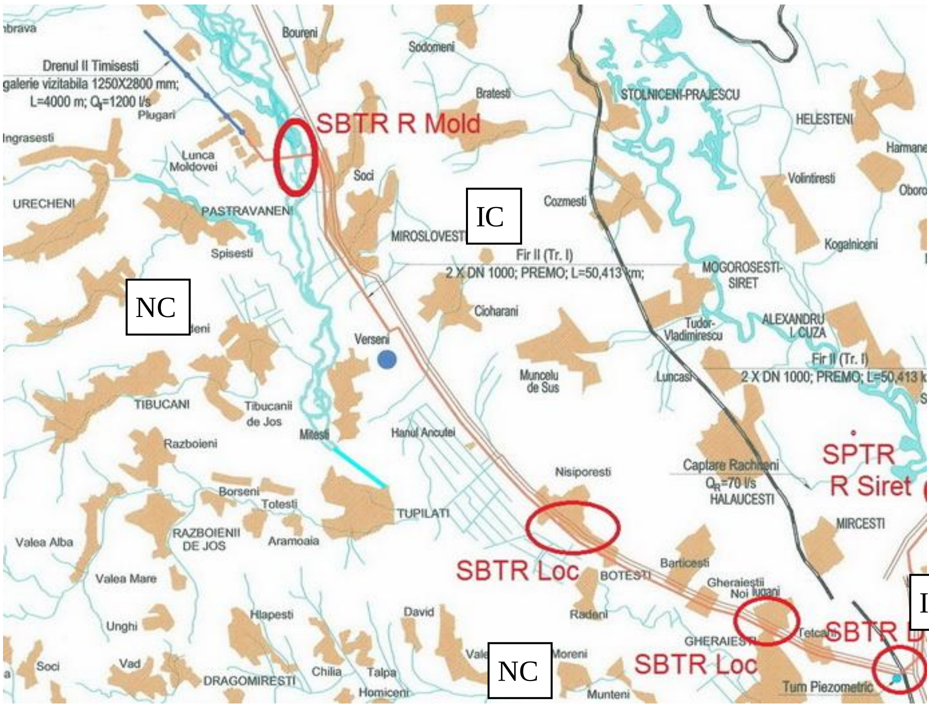
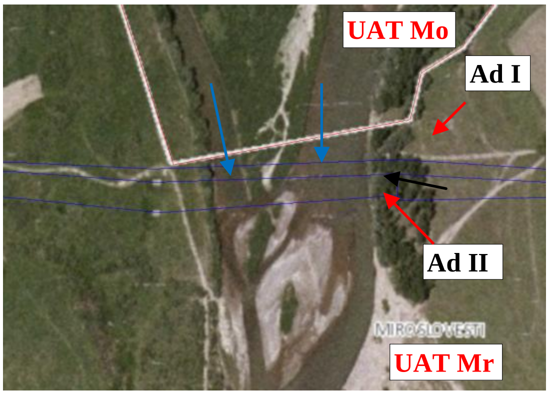


Fig. 5. Analysis plan of the Timişeşti - Săbăoani route of AdI + AdIIa + AdIIb + AdIII adductions from a real estate and urban water point of view: SBTR - undercrossing; NC - Neamţ county; IC - Iaşi county

The Ad I Timişeşti - Iaşi adduction (Carol I Adduction) was commissioned in 1911. The adduction supplied Iaşi city with a flow rate of 300 l/s. The adduction pipe operates gravitationally, a situation that imposed a series of conditions on the site embedding. The AdII adduction was commissioned in 1975.

The route of the AdI, AdII (AdIIa + AdIIb) and AdIII adductions is parallel to the European road E85 until its intersection with DN 28, in the area of Săbăoani locality, Neamţ county. The route of the four pipelines is separated from the area of Săbăoani Piezometer, passing through Neamţ and Iaşi Counties.

Within a case study, the characteristics of the real estate and urban water cadastre were analysed for Moldova River undercrossing by the Timişeşti – Iaşi adduction pipes (Fig. 4). The analysis of the adduction pipes route in the Moldova River undercrossing area highlighted the following cumulative problems from the real estate, cadastral and urban water point of view (Fig. 5).



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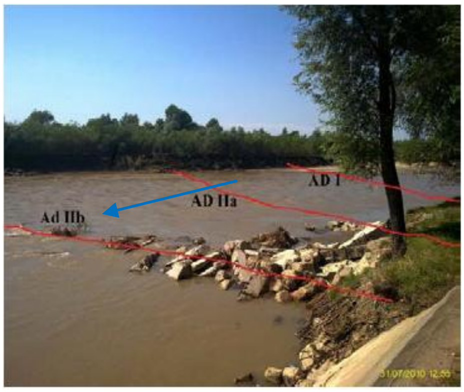

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Fig. 6. The undercrossing area of the Moldova River by the Timişeşti - Iaşi Adduction: a - the orthophotoplan of the river undercrossing; b - view of the undercrossing area by the three pipes (Luca, 2012).

a - the Moldova River is undercrossed by three steel pipes with a diameter of 800 mm (AdI) and 1000 mm (AdIIa - AdIIb); the right bank of the Moldova River is in Neamţ county, and on it are located three pipes and two valve chambers; the left bank is in Iaşi county, and on it are placed five pipes and three valve chambers;

b - the research of documents and the one from the field showed that the property of the land in the undercrossing area is as follows:

1 - the right bank access area is a private property and is an agricultural land;

2 - the riverbed and the two banks are the property of A.B.A. Siret

3 - the access area to the left bank is a public property (Miroslovești town hall) and is occupied by a grazing land;

4 - the pipes and valve chambers on the two banks are the property of Apavital Iaşi;

c - the access to the pipes and valve chambers of the right bank implies the building of an access corridor with dimensions compatible with the working machines; the machines used are trucks, car cranes, excavators, bulldozers etc.; the access corridor is at least 4.0 - 5.0 m wide;

d - performing the intervention works involves the building of a working area on each shore with variable dimensions; the working area can have dimensions of 105.0 x 20.0 m; the work area requires storage spaces, car parking, administrative spaces etc.;

e - the intervention works lead to land degradation and destruction of agricultural crops; land excavation leads to changes in the land structure and pollution of the environment; all these lead to the granting of damages to the owner and restoration works of the environment;

Procedures for solving situations and making access lanes + work areas can be: pipe rerouting, land acquisition by the water utility, land ownership change, renting of land, assignment of land, damage contract (Bârlea et al., 2017).

According to STAS 4165-88, the maximum time to interrupt the water supply and the time to repair the damage is limited for adduction pipes. For gravity pipes made of reinforced concrete with diameter D > 800 mm, a breakdown time of maximum 18 - 24 hours is accepted. The maximum time to interrupt the water supply of the localities with more than 100,000 inhabitants is zero.

4. Conclusions

Interventions on the structural components of the adduction pipes located on land with a different ownership from that of the water operator require the building of access corridor and working areas for technological processes of repair and maintenance.

The making of sanitary protection zones to the adduction pipe components requires the definition of the land ownership type and taking-up a convention between the two owners, of the land and of the pipe.

The access corridor/expropriation corridor must be made according to the legal system of the private or public real estate, by expropriation, assignment contract, rental with the building beneficiary or areas can be created that provide access to certain buildings.

For a proper management of the adduction pipes operation, a monitoring system must be developed, which can be based on a GIS model that corroborates the real estate cadastre with the urban water one.

The water-sewage operators must carry out an adequate monitoring of the access lanes and the work areas to know at any time the type of private or public building and under what conditions they can carry out their activity.

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