

## **ABSTRACT**

towards the PhD thesis: **“HYDROGEOLOGICAL INVESTIGATIONS UPON THE DEPTH AQUIFER FROM BARLAD HYDROGEOLOGICAL BASIN (SOUTH OF MOLDAVIAN PLATFORM)”**

PhD thesis contains a total of seven chapters and is developed on 187 pages, 8 appendices developed on 192 pages, 59 figures, 112 tables, 163 equations, 8 photos and a total of 152 titles.

Then it summarizes the contents of the 7 chapters forming thesis:

***In Chapter I***, entitled "Introduction" it is presents a "Foreword" and "Thesis objectives".

Under the subtitle "Foreword" thanks go to all those who, in one way or another contributed to the development of this thesis.

In connection with the thesis objectives, it is outlined in the thesis that the main objectives are:

1. Improvement to the technique for investigating multilayer aquifer formations.
2. Synthesis technique, centralization and primary processing of data resulted from the hydrogeological investigations.
3. Strategy of the theoretical and practical application of methods, techniques, procedures which can be determined directly and indirectly:
  - global and individual values of the most important physical and hydraulic parameters and characteristics of the investigated aquifer formations: hydraulic conductivity, total porosity, effective porosity and effective transmissivity etc .;
  - subsidence, the radius of influence and optimal flow of the boreholes in multilayer aquifer formations based on data obtained in steady state operation;
  - coefficient and the housed volume individually on each aquifer formation and global on the whole borehole, based on obtained data under permanent operation;
  - the value of the elastic resource of the aquifer formations identified by boreholes.
4. Determination of the optimal exploitable flow of the hydrogeological boreholes belonging to national network and in its catchment Barlad basin.
5. Comparison between the necessary of drinking water flow for the population living in localities situated in Bârlad basin with optimal total exploitable underground flow in order to provide data absolutely necessary for water supply projects in this area widely recognized as deficient in resources water.
6. Practical Considerations on how coverage requirement drinking water basin with water trapped underground Barlad.

In Chapter II, entitled "General considerations towards groundwater" it is presented a brief description of groundwater in national and European context and also considerations towards the use of groundwater in Romania.

This chapter is an overview of the amount of freshwater on Earth territory, its quality and considerations of EU policy on groundwater.

Also in Chapter 2 there are presented briefly the water quantities in Water Basin Administrations belonging to the National Administration "ROMANIAN WATERS" and the quantities of consumed and reported groundwater for each administration separately. It concludes a very important fact: Romania groundwater at a total consumed enough (about 3.66% of the potential).

In Chapter III entitled "Analysis of the natural" is a description of the catchment Bârlad in terms of: geographical location, geology and paleogeographic evolution, geomorphological characteristics of the relief, climate, hydrological regime and hydrogeological characteristics.

Geographical location and boundaries are specified by describing the location, amount and length of the occupied river Barlad area by various authors, altitude and average slope of the basin.

Geology and paleogeographic evolution Barlad basin are presented in the context of the two areas to which it belongs geo: Moldavian Platform in the north and center and depression or Bârladului Platform (Scythian) in the south. It is emphasized that arose Bârladului platform by dipping southern part of the Moldavian Platform and northern sector of Promontoiului north - Dobrogea. It also shows that Bârladului Platform base is made up of crystalline schists with intrusions of igneous rocks. When they mentioned the fact that the largest share in the basin have Sarmatian deposits and deposits Meotiene and ancient watercourses intercepted belonging Barlad basin belonging Basarabian as undergrowth of Sarmatian.

In terms morphographical and morphometric territory covers a mild relief with rare occurrences of tremendous relief. Yet here meets the highest energy of the entire plateau relief of Moldova. The main geomorphological subunits are: Central Moldavian Plateau, Tutova Hills Hills jaw and Tecuciului Plain.

The climate is characterized as temperate - continental with occasional excesses. The average yearly temperature is 8.9 0C to 9.8 0C Plopana and Onești Barlad and 9.7 0C in Galati. Multiannual amount of precipitation is 515 mm / year and the annual average wind speed has values of 2-3 m / s at Plopana and 3.0 m / s in Barlad.

In terms Barlad river basin comes from Bear Valley, Neamt County at an altitude of 370 m. The most important tributaries are ZELETIN and Tecucelul. Annual average flow of the river is Barlad: 0.34 m<sup>3</sup> / s to Bacesti, 1.56 m<sup>3</sup> / s Negresti 2.86 m<sup>3</sup> / s in Vaslui, 6.35 m<sup>3</sup> / s Barlad and 8.39 m<sup>3</sup> / s in Galati

In terms Hydrogeological yes groundwater reserves in relation to other areas of the country, are modest. Hydro include: groundwater aquifers, groundwater alluvial deposits consisting of meadow; ground terrace deposits; interfluvial loess deposits and groundwater aquifers Base Depth are multilayer and are stationed in horizons of Basarabian, Kersonianului, Meotjanului, Pontian, Dacian and Romanian.

In Chapter IV, entitled "Current state of knowledge in hydrogeological investigations" presents three major aspects of hydro and their investigation:

- The first is related to knowledge hydro basin in geological context of the territory Barlad;
- The second refers to hydro metodicile investigation;
- Third elaborate on the technical processing and interpretation of data from hydrogeological investigations.

Regarding the first problem in Chapter IV.2. I made a brief history of research and studies conducted on hydro geological character of the study area. In this regard, we note

that inquiries concerning this issue are relatively recent (1960). During these years a large number of scholars have sought to identify aspects of the hydro geology. It was noted that most enlightening information was provided by Mr. Panaitescu VE in 2008, with the publication of the paper: "aquifer and deep basin Barlad". As a conclusion of all the research is that hydro Barlad basin belonging in terms of geological genesis Sarmatian environment and in particular Basarabian the northern part of the basin, upper Sarmatian (Kersonian, Meotian, Pontian) the central area Bârladului Plateau and aquifer formations belonging to the Pliocene (Dacian, Romanian) were identified in the southern basin Barlad.

Regarding hydrostructures investigation techniques, the sentence was allocated a relatively large number of pages (about 24) given their great importance both a practical and theoretical - scientific. He insisted on presenting special geophysical methods (geophysical borehole and surface geophysics) starting, growing more, to occupy a main investigation in modern technologies - study and hydro. presentations included: description of the theoretical principles underlying the measurement, metering mode, and finally the presentation of diagraphys.

Regarding the technical processing and interpretation of data derived from field measurements, insisted on presenting calculation methods applicable in specific cases encountered in field measurements conducted in the catchment Barlad: Drilling singular (without piezometers) perfect type (based on impermeable layer) in the field of hydro single or multilayer operating in steady and permanent, pumping single and / or multiple test and return to maximum flow.

For each situation were detailed theoretical and practical aspects of computing. A particular fact is the play for the first time in the published literature in our country, the technique of approach to the calculation of hydrogeological parameters particularly important data of test results return (operating impermanent).

Chapter V entitled "hydrogeological investigations of groundwater bodies deep basin Barlad" has the highest percentage of space allocated thesis (101 pages) and is, in fact, the contribution that we have tried to bring in the field concerned.

The chapter begins by presenting definitions of technical expressions we observed that the literature in the field, they are given different interpretations depending on the school were formed authors.

The following is a summary of the overall data and in particular those measured in the 25 technical hydrogeological boreholes that are part of the national network hydrogeological basin on the territory Barlad. Specify that these data were accessed with the approval of the Prut River Basin Administration - Barlad which is based in Iasi. Regarding data should be noted that for each drilling side were presented in the thesis the following data: administrative location, and geomorphological river; vertical positioning of each drilling aquifer layers; filtration column type and material of the filter was carried around the column; age aquifer layers; textural description of the aquifer layers, bit diameter and diameter of the column filter, the total thickness of the aquifer formations; granulometry aquifer layers as grain curves; tables with test data measured efficiency (value pairs pumped flow - bump); tables with measured data recovery test (time value pairs - hydrodynamic level).

Data processing included:

- determination by direct and indirect methods, the global drilling and hydraulic conductivities individually on each aquifer wells identified in the 25 investigated. In calculations was used a new algorithm using numerical methods, which essentially improves the current way of calculating the overall hydraulic conductivity and the hydraulic conductivity of the aquifer layers using a method based on empirical equations that express the relation between hydraulic

- conductivity and grain rock. It was developed as a method for correcting the values determined by empirical equations;
- transmissivity determining the value of the index curve equation and the equation of the curve bump - specific rate for all 25 wells that were set out in Annexes thesis (for drilling Alexander Vlahuță which was drilling landmark, was drawn up and play "in extenso" the sentence calculations and results);
  - determination of the "storage coefficient" and optimum shading using for the first time in the literature of the new standard curves Cooper, Bredehoeft and Papadopoulos. To this end, had to be developed an algorithm that could be solved numerically using standard MATLAB function `fminsearch.m` and after solving the storage coefficient was calculated and optimum shading of drilling;
  - determining optimal cutting capacity (optimal flow) in compliance requirement "in any one of aquifer layers permissible speed is not exceeded." The novelty compared to how it is done today in practice is that the calculations described above have made it possible to determine distinguished from each aquifer formation that speeds around the column filter in the filter or in current practice, working with a single speed critical throughout drilling. On this occasion the result and that can increase the flow value captured by armouring water enters the critical layer. We have shown that this method is applicable in 17 of the 25 investigated boreholes;
  - determination of areas related to the 25 wells in the basin hydrogeological investigation Barlad. To this were drawn, hydrological criteria, limits basin and then using the medians were drawn boundaries for each hydrogeological drilling. They planimetric in AUTOCAD environment, areas.
  - reserve determination of groundwater stored in the aquifer layers belonging Bârlad catchment and bladders. The determination of these two important volumes of water could be done only after the following parameters were calculated: effective porosity (effective); specific storage coefficient and the average reduction piezometric load corresponding measured data and processed by the technique outlined above.

***In Chapter VI*** to give a sense pragmatic studies and researches in this chapter was intended that an assessment of drinking water requirements of the population residing in occupied territory Barlad basin to compare them with the available data (total optimum flow and storage volume) offered by groundwater investigated.

In this context, it was found that the catchment area residents Barlad are a number of 647,735 inhabitants according to the census of 2013. For these inhabitants was calculated based on valid norms current water demand and could find a particularly favorable: 82 drilling with optimal flow average of the 25 investigated boreholes could feed all these people drinking water daily. Also, if it could be used all water which is available in the underground aquifer layers Barlad basin (assuming that it would be better in terms of quality) would be possible to meet drinking water needs for the entire population looks up for 983 years (no doubt, in practical terms can be extracted entire amount as relatively small radius of influence of each drill thousands of wells would be required for extraction). However, this hypothetical calculation highlights the immense possibilities offered by an underground aquifer even considered modest in terms of quantity as the corresponding Barlad basin.

Chapter VII summarizes the main conclusions and contributions stresses that it brings sentence.

## **1. Conclusions and contributions**

As practical conclusions and contributions are proof meritorious work or not, a doctoral thesis to resume a full, as they were presented in the thesis.

### **CONCLUSIONS**

1. The site's current hydrogeological boreholes national network in Bârlad catchment area, not uniformly cover the surface and therefore extrapolation of data from the entire basin show a certain degree of uncertainty. It requires the implementation of new network thickening investigation boreholes, especially in the north of the area under study and beyond.

2. In many of the investigated hydrogeological pumping wells were made at rates well below their real value. It requires that in future campaigns investigation of these wells to pump higher flow rates, a benchmark is calculated flow and unevenness in this thesis. In this way (higher flow rates) would increase the interest of investors to capture these groundwater.

3. Data processing has shown that effective three pumping tests, as is done currently in our country are not always conclusive. This is because since this is an experimentally determined curve, three points rather to a right. For this reason it is proposed that the minimum number of pumping efficiency to be 5.

4. Technical measurements of land in our country must, necessarily, even if state-funded drilling adapted existing rules in world literature in the field. We refer to the need for measurements in the presence of a piezometer drilling investigated. In this way would "escape" the use, processing, empirical formulas, which would lead to increased precision and accuracy.

5. It must, necessarily, from drilling to be exploited, taking measurements on test efficiency and return for each aquifer formation in hand. We consider sanding situations in practice often reported are caused by not knowing precisely differentiated hydraulic characteristics of each party separately and adopting a single-speed drill and no entry corresponding to the minimum speed disadvantageous from this point of view, formations aquifers.

### **CONTRIBUTIONS.**

1. Were derived equations for calculating the integral hydraulic conductivity based on test drilling efficiency, optimization solved by numerical methods. The method was applied for all 25 wells investigated.

2. Were calculated by indirect methods, hydraulic conductivity values of each aquifer formations identified in the 25 boreholes and was designed an algorithm for correcting their value according to the average hydraulic conductivity determined first pumping drilling. Default values were determined and transmisivității each aquifer and integrated drilling.

3. It was designed and implemented an algorithm that uses data recovery test (non-permanent operating mode) to determine the coefficient of storage. Specify that in the literature of our country no data on how to exploit scientific practice or test of recovery.

4. It was noticed for the first time in the literature that a party armouring the deep aquifer wells can bring in some situations, beneficial results in terms of value captured flow. In this respect, it was determined that the flow can increase the critical configurations armouring 17 of the 25 wells investigated.

5. Were calculated for the first time, flow and optimal bumps for water collection from the 25 wells belonging to the national network hydrogeological located in the catchment area Bârlad. Existing data is either the average flow is the maximum flow on drilling results from measurements but not optimal flow related to all strata aquifer

permeability. So do not consider the possibility of exceeding, at a certain formations, allowable input speed. Related to this calculation showed that the water supply to all residents in the catchment Barlad, would be sufficient 82 such wells operating at optimum flow.

6. It was calculated coefficient and storage volume and value bladders on each side and drilling throughout the basin. The result is a volume of storage in aquifers deep formations under Bârlad catchment area of 3.397 billion m<sup>3</sup>. It was also calculated that the volume of water that could be exploited would be enough to supply water for 983 years, all residents in the catchment Barlad.

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