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INTERFERENCES PAST - PRESENT - FUTURE, IN THE WATER SUPPLY OF TIMIŞOARA MUNICIPALITY FROM UNDERGROUND WATER SOURCES

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Abstract: The study of groundwater in the current period has the tendency of an integrative approach by interacting with more others fields such as: microbiology, chemistry, geology and fields application such as: agriculture, water management, construction, land management. Currently, satellite techniques, remote instruments and mobile equipment for in-situ testing are used in the study of groundwater. The water sources represent a vulnerable and limited renewable natural resource and it is a natural heritage that need to be protected and rationally exploited. In this context the paper presents the evolution in time, the present and the perspective of the water supply from underground sources of the Municipality of Timisoara. Also presented the current situation of the water supply system from underground sources for Timisoara, as well as the development objectives of AQUATIM S.A as a regional operator for the future of water supply from underground sources.

Keywords: underground water resources, capture fronts, water treatment plants, water supply systems, regional drinking water operator.

1. INTRODUCTION

The need for drinking water sources dates back to prehistoric times. From the beginning human settlements are linked or have been near watercourses.

The Euphrates, the Indus, the Ganges, the Tiber, the Yan-Tse are the main courses on which the first human civilization appeared.

According to the archaeological testimonies on the existence of centralized water supply systems, during the Nippur civilization, from Sumerian about 5,000 years ago there was an arched drainage with stones fixed by descending feathers, the water being collected through wells.

Worldwide, scientific developments in the field of hydrogeology appeared at the beginning of the 19th century in Western Europe in an attempt to find unpolluted drinking water for developing cities and developing drainage and drying of land for mining and construction purposes.

Hydrogeology has developed as an empirical science through the interplay between the conceptualization and mathematical solution of stream cases, and the observations and evaluation of the physical characteristics and behavior of aquifers and groundwater resources.

In a complete vision the study of groundwater in the current period has the tendency of an integrative approach by interacting with more fields such as: microbiology, chemistry, geology, respectively application fields such as: agriculture, water management, construction, land management.

Currently, satellite techniques, remote instruments and mobile equipment for in-situ testing are used in the study of groundwater.

Water sources represent a vulnerable and limited renewable natural resource and represent a natural heritage to be protected and exploited rationally.

Under global warming conditions, the sustainable management of water resources, the preservation of the self-regulating capacity and the support of the aquatic ecosystems is very important.

Water management must provide solutions for the present and future for the supply of water to the population and economy.

Thus, sustainable development means according to the definition given by the Brundland Commission (1987), "development that meets the needs of the present without compromising the needs of future generations in meeting their needs". At international level, the policy of sustainable water management is defined by Agenda 21, elaborated document following the Rio Conference (1992).

1.1 Groundwater resources in Romania

In the context of recent years, in Romania, 142 groundwater bodies have been identified according to the "National Water Management Plan in Romania.

The groundwater resources are characterized by:

- the theoretical resource of 9.6 billion m3 (representing 7.13% of the total water resources), of which freaticwater 4.7 billion m3 and deep groundwater 4.9 billion m3
- the usable resource being 5.4 billion m3

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According to the provisions of the Framework Directive 2000/60 / EC the delimitation of the deep water bodies has been done for the areas where there are significant aquifers as impotence for water supply, and exploitable flows greater than 10 m3 / day.

The groundwater monitoring network was designed to provide a coherent overall picture of the qualitative and quantitative status of groundwater bodies for each river basin.

According to the Water Framework Directive, the "groundwater body" is a distinct volume of groundwater from an aquifer or more significant aquifers of importance for water supply, with operating flows greater than 10 m3 / day.

In the natural regime of the groundwaters, changes have occurred in quality and quantity due to pollution of hydrotechnical, hydro-ameliorative works that have appeared.

Thus, from a quantitative point of view, the good condition of the groundwater body is when the available groundwater resources are not exceeded by the long-term average annual catch rate.

From a qualitative point of view according to the recommendations of the European guide in the field, elaborated within the Joint Strategy for the implementation of the Framework Directive, using the following criteria:

- the water balance
- connection with surface waters
- influence on terrestrial ecosystems dependent of groundwater
- salt water intrusion or other intrusions

Evaluation of the qualitative (chemical) status of groundwater bodies was carried out according to the "Guidance on groundwater status and trend assessments" - groundwater of the European Commission

On an overall evaluation according to the information received from the 11 Water Administrations of the National Administration „Romanian Waters", on the assessment carried out in all the hydrographic basins, on water bodies, we find a critical situation of aquifer quality in many areas of the country.

This critical state is influenced by the exogenous anthropogenic impact, even though the volume of industrial production and agrozootechnical production has been greatly reduced, which led to the decrease of the qualities of polluted substances discharged into natural receivers.

From the analysis of the data following the monitoring of the physico-chemical parameters at the wells located in the groundwater layer, most of the exceedances were recorded in the indicators: organic substances, nitrogenous, nitrogenous, ammonium, chlorides, total hardness, or, manganese, phosphates, lead. Most hirostructures were exposed to nitrate contamination.

Thus, 10.5% of all monitored wells exceeded the concentration of the nitrogen indicator.

In this sense, most of the wells monitored by the County Public Health Departments present the exceedances of the concentrations to almost all the group of nutrients, which represents a real danger for the health of the majority rural population, imposing measures to connect all the localities to centralized feeding systems. with drinking water.

According to experts from the National Administration "Romanian Waters" explains the contamination of the groundwater aquifer by multiple causes: washing the soil through atmospheric precipitation, irrigation water, surface water in which waste water was evacuated, application of chemical fertilizers on arable land, pollution on the platforms of the large chemical combines, pharmaceutical companies, and taking into account the hydrodynamic character and the hydraulic conductivity of the water, other aquifers can be depreciated over time.

Pollution factors that qualitatively affect the quality of the groundwater can be grouped into the following categories:

- products resulting from industrial processes
- petroleum products
- chemicals especially agricultural ones causing diffuse pollution
- household products
- products from animal husbandry
- heavy metals
- radioactivity
- improper exploitation of wastewater treatment plants
- not correlating the development of the localities with the sewerage works
- poor management and storage of sludge resulting from wastewater treatment plants

The pollution of the groundwater as mentioned above most often leads to an irreversible character, with serious consequences on the possibilities of using the deep water for drinking water purposes.

It is known that the treatment activities of these contaminated groundwater sources involve complex and costly treatability processes.

Water resources must be exploited in a sustainable way and protected for both the present and future generations.

Groundwater resources are a strategic source and have advantages such as:

- is reliable in the dry season or drought due to underground reserves
- in the absence of pollutants, it becomes a cheap source to use, because it requires simplified or even absent treatment for drinking water.

2. THE HISTORY OF THE WATER SUPPLY SYSTEM IN TIMISOARA

Timisoara in the 18th century

After a 44-day siege, the Habsburg troops, under the command of Prince Eugene de Savoya, entered Timisoara on October 18, 1716.

The first measure that Claude Florimond de Mercy - the Habsburg governor of Banat Timisoara - had to solve was the problem of drinking water. Thus, in 1722, he delegated the creation of six wells in the northern part of the city, in the Palanca Mare.

The French hydrotechnician A. La Casse, in 1727 begins the descaling of the river, both upstream, towards Făget and Becicherecu, up to the Danube, for the purpose of constructing a waterway. The canal was completed in 1728, and the first variant of the Bega waterway allows the first ship to arrive, in November 1732, from Pancevo to Timisoara.

In 1781, Emperor Joseph II promulgates the decree by which Timisoara becomes a free royal city.

The locality benefits from a series of rights, as well as obligations. Thus, Timisoara City Hall receives the water pumping station, as well as its distribution network.

The hydraulic machine fed 14 fountains

. Thus, the construction of the basins was necessary because the pumps distributed a large amount of water, which was relatively constant.

As the water consumption varied according to the hours, the surplus of water, reached the plume, was stored in the basin and could be used at any time.

Thus, the water loss of the installation is delayed.

The usefulness of the double pipes was in case one was damaged or damaged: immediately the water flow that would be redirected, from the visiting home, through the second pipe, and the first was immediately repaired.

Another recommendation concerned is the periodic cleaning of the first sections of pipes from the water tower to the city.

This hydraulic-mechanical water supply system of Timisoara was also the first scale built on the territory of Romania.

At the beginning of the 19th century, the water network expanded, and the number of public jets increased to 16, which led to the emergence of difficulties in the operation of the installation and the network.

The water distribution network suffers from the moral wear of component parts.

Figure 1. Wooden pipe with iron circles

The water supply of the city of Timisoara continued to be done through the fountains during about 40 years.

Attempts to find drinking water needed by the inhabitants, the system of capture, adduction and distribution began only in 1888 and lasted until 1912-1914, when the water plant and sewage system were created.

2.1. Water supply. The first form of organization of public services in the country

The water supply of the city in centralized system was realized in 1914, with the commissioning of the treatment station, called Plant no. 1, and a 87.4 km drinking water distribution network.

Plant no. 1 was located in the southeastern of the city. The treatment station had a aeration spray step, a pre-filtering step and a filtration step. Thus, iron and manganese salts were removed from the water.

In order to identify the underground sources of drinking water, hydrographic studies were carried out in the vicinity of the city.

Between 1894 and 1895, the Bauroth Salbach company in Dresden, designated by the town hall, made 18 deep wells in the Timisoara area of North Sânandrei.

Between 1897 and 1899, the company Orbàni I. made 10 holes in the Mehala area. Under the coordination of Stan Vidrighin, employed in 1904 as chief engineer of the technical service of the City Hall of Timisoara, the research drills are continued both in the north of the city and in the southeast, between the towns of Moşniţa, Urseni and Giroc, in total 139 research probes.

Following these studies, Vidrighin concluded that the water resources found correspond qualitatively and that they can ensure the amount of water needed to develop the city in the future.

The total flow, estimated to be available, was 15,000 cubic meters / day.

When designing the water plant, Vidrighin took into account the following aspects: the water consumption for the 46,000 inhabitants was 4,600 cubic meters / day, the maximum expected flow for the further development of the city was 6,000 cubic meters / day.

Particular importance was given to counting future consumers, but also to the location of water fountains.

The distribution network put into operation in 1914 was branched, the main pipes were not closed in the circuit.

To compensate for the maximum daily consumption, two water castles were built at the ends of the network. The castles were permanently supervised by employees.

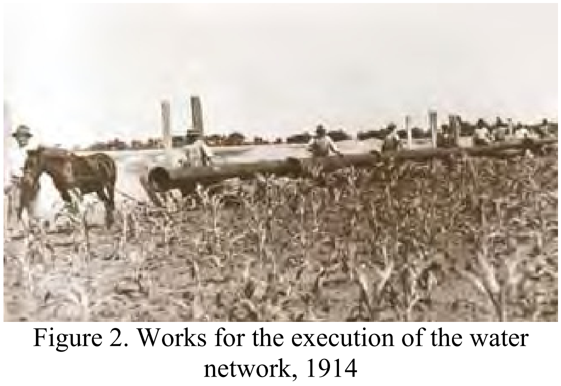

Figure 2. Works for the execution of the water network, 1914

3. THE CURRENT SITUATION OF THE WATER SUPPLY SYSTEM FROM UNDERGROUND SOURCES TIMIŞOARA

3.1. The underground water resources for Timisoara Municipality

In Timis county, centralized systems for drinking water supply are mainly made from groundwater sources. The municipality of Timişoara is supplied with water from two different water sources, namely a surface source that is the Bega channel and several fronts for groundwater respectively, the water supply system is administered by "Aquatim S.A.".

The initial source for the city of Timisoara was the groundwater, but with the development of the city, this source was supplemented with treated water from the Bega river, using a much larger amount of surface water today than the groundwater.

Currently surface water is collected from the Bega channel, so that in the Bega water treatment station, water treatment is ensured for the purpose of drinking water and respectively the distribution and pressures to the consumer ensuring approximately 70-75% of the city's water needs and the groundwater that it is caught from deep boreholes.

These boreholes provide about 25-30% of the city's needs and the treatment for the purposes of drinking water and respectively the distribution and pressure to the consumer are carried out through the Urseni and Ronaţ treatment stations.

Thus, in the municipality of Timisoara the groundwater represents an alternative and complementary source to the surface source.

3.2. The technological process for the groundwater treatment plant

Groundwater capture is achieved through two capture fronts, as follows:

3.2.1 The capture front Timişoara South East (the old front), which captures water from depths between 60-80 m, with a projected capacity of 200 l / s. The 16 boreholes are organized in groups of wells, these being named as follows: GF III with 5 boreholes (a, b, c, d, e), GF IV with 5 boreholes (a, b, c, d, e), GF V with 4 boreholes (a, b, c, d), GF VI with 2 boreholes (b, e), all wells being equipped with submersible pumps

In addition to the 4 groups of wells there are also 3 boreholes in the STA-Urseni precinct: F1c, F1d and F1e, equipped with submersible pumps.

3.2.2 The capture front Timişoara Est (new front), which captures water from depths between 110 - 160 m, through 40 boreholes, with a projected flow of 600 l / s. The 40 boreholes are equipped with submersible pumps

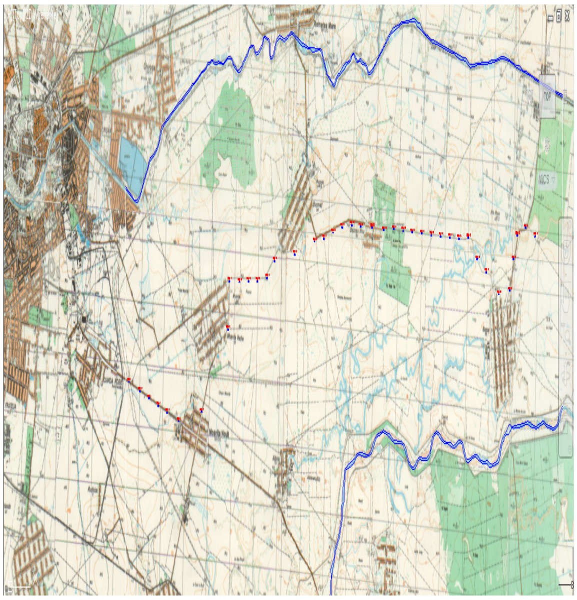

Figure 3. The location of the East Timişoara capture front

Table. 1. The situation of the pumping holes in the capture front Timişoara Est

Nr. foraj	Nhd [m]	Nhs [m]	Q [l/s]	Pmot [kW]	Pompe Submersibile
F1	22.00	6.50	4	5.5	Gr.Sp30x5
F2	21.50	12.50	4.2	5.5	Gr.Sp30x4
F3	21.90	10.80	4.1	5.5	Gr.Sp46x3
F4		10.60		5.5	Gr.Sp30x5
F5	23.00	11.60	4.1	5.5	Lowara
F6	22.50	12.40	4.9	5.5	Gr.Sp30x5
F7	23.40	8.80	4.4	7.5	Gr.Sp46x3
F8	23.20	13.00	7.5	4.0	LOWARA
F9	21.60	13.50	6	5.5	Gr.Sp30x6
F10	22.00	11.70	5.5	7.5	Gr.Sp46x4
F11		10.20		5.5	Gr.Sp30x4
F12		11.00		5.5	Gr.Sp46x3
F13		11.50		7.5	Gr.Sp30x6
F14	22.10	12.10	6	4.0	LOWARA
F15	15.50	7.00	16.8	9.0	Gr.Sp 60x5
F16	22.00	7.10	21	11.0	Gr.Sp77x3
F17	20.80	9.20	9.8	7.5	Gr.Sp60x3
F18	17.60	8.10	13.4	9.0	Gr.Sp60x5
F19	21.50	8.00	19	11.0	Gr. Sp75x4
F20	22.40	13.10	9.7	11.0	Gr.Sp77x3
F21	21.80		11.2	7.5	Gr.Sp46x4
F22	20.80	11.80	7.5	7.5	Gr.Sp46x4
F23	22.10	8.00	11	7.5	Gr.Sp46x4
F24	22.50	8.70	11	11.0	Gr.Sp46x4
F25	22.70	8.00	5	7.5	Gr.Sp30x5
F26	23.50	9.40	4.8	4.0	LOWARA
F27	21.00	7.80	7.2	5.5	Gr.Sp46x5
F28	19.80	6.80	6.5	7.5	Gr.Sp46x4
F29	21.00	7.50	7	4.0	LOWARA
F30	22.10	8.40	10.33	7.5	Gr.Sp46x4
F31	19.60	8.20	5.8	4.0	Gr.Sp.30x4
F32	16.50	6.40	4	4.0	Gr.Sp30x4
F33	21.00	7.10	7	4.0	LOWARA
F34	21.00	9.70	4.5	5.5	Gr. Sp30x6
F35	23.00	10.00	9.2	7.5	Gr.Sp46x5
F36	18.00	9.40	20.5	11.0	Gr.Sp77x3
F37	21.50	10.50	10	5.5	Gr.Sp46x4-C
F38	21.50	9.70	8.2	5.5	Gr.Sp46x4-C
F39		7.20		5.5	Gr.Sp46x4-C
F40	19.00	6.50	7.2	5.5	Gd.200L10x3

3.3 The water adduction in Urseni is performed on the two pumping fronts as follows:

3.3.1. The capture front Timisoara South East

The water from the 4 groups of wells reaches the treatment station through 3 adducts (from GF III, from GF V + GF VI), all from cast iron, and from GF IV which is from Polyethylene having diameters between 250 and 400 mm. The 3 adducts have the following lengths:

a. The adduction pipe from Group III fountains - total length 2790 m;

b. The pipeline of the Group IV wells - total length 3194 m.

c. The pipeline from the V + VI wells - total length 9005 m.

Figure 4. Fontains Group

3.3.2. The capture front Timisoara Est

The water from the 40 boreholes reaches the treatment station through a telescopic adduction, consisting of 3 sections with diameters of 600 mm, 800 mm and 1000 mm.

The pipeline is made of pre-compressed reinforced concrete (PREMO) tubes. At the changes of direction and at the overpasses of the irrigation channels encountered on the route of the pipeline (11 in total), the precompressed reinforced concrete tubes are joined with steel sections of the same size. Total length of the pipeline = 25 km.

The measurement of the flow of the captured water is done with an ultrasonic flow meter of type kROHNE Dn = 1000 mm.

3.4.Treatment technology STA Urseni

Currently the old Plant 1 is no longer in operation, part of it being transformed into a museum.

Figure 5. Deferuginator's building - Water plant no. 1

The groundwater treatment technology in STA-Urseni extension is achieved through the following treatment steps:

3.4.1. Water aeration is done in aeration basins, constructed of concrete. Water aeration is performed with the purpose of increasing oxygen concentration in water, desorption of dissolved gases (CO_2, H_2S) and partial oxidation of bivalent iron and bivalent manganese.

The water-to-air contact time is 5-10 minutes, ensuring an increase in oxygen concentration from 0.4 mg / l to near saturation.

3.4.2. Water filtration is carried out in two filtration stages I and II. In the first stage of filtration the iron and a small part of the manganese are retained, and in the second stage the manganese is retained. The filtration is done in quick open filters with free level and quartz sand filter layer. The height of the filter layer in both steps is 0.8-1.2m and the height of the water column above the sand in both steps is 0.6-0.8m. Filtration speed for Step I is 6-8m / h, and for Step II 4-6m / h. The granulation of the sand in step I is 2-3mm and in step II 1-2mm. Step I has 6 filtration tanks and Step II has 8 filtration tanks. The supply of aerated water is made through open channels of concrete, and the discharge of the dirty water from the washing of the filters is done through a concrete channel made under the supply channel. The washing of the filters is done by mixing water with air with the intensity of the water flow of 10 l / s / sqm and the intensity of the air flow of 18 l / s / mp.

3.4.3. The decanting of the water from the washing of the filters is carried out in two decanters, each having a capacity of 600mc., two scrapers for sludge and the resulting sludge pumping plant. The sludge is filtered through two sludge beds and the filtered water is channeled.

3.4.4. The disinfection of the filtered water is carried out with chlorine in doses ranging from 2-3mg / dmc, ensuring a contact time of 30min. After the storage step a final correction can be made so that at the outlet the drinking water has a residual free chlorine concentration of 0.5 mg / dmc.

3.4.5. The storage of drinking water is carried out in 3 tanks: two tanks (5000 cubic meters) with a total capacity of 10,000 cubic meters and a 3000 cubic meters reservoir. The tanks are fed through a pipe with Dn 1000mm and in the valve chamber Dn 900mm, of which each tank is fed by a pipe Dn 800mm.

Under the second stage of filtration is placed a tank, with a capacity of 3000 cubic meters, which provides the volume of water needed to wash the filters.

3.4.6. The pumping of drinking water in the distribution network is achieved by the pumping stage comprising four distribution pumps.

Figure 6. Distribution pumps

4. THE DEVELOPMENT OBJECTIVES OF AQUATIM S.A AS A REGIONAL WATER SUPPLY OPERATOR

The main objectives of the development of AQUATIM S.A as a regional water supply operator are the following:

a) Promoting and participating in the elaboration of policies, management and engineering of integrated competitiveness in the field of water supply and sewerage systems;

b) Promotion and competitive development of the following areas: strategy, research, education, innovation, production, marketing and efficient use of, water sources, drinking water, sludge, biogas and new processes and sustainable non-polluting technologies:

- capture, judicious treatment of water sources for purification through the use of innovative and sustainable technologies with maximum efficiency in terms of quality and quantity
- distribution of drinking water by promoting the preventive maintenance of distribution systems, by promoting innovative methods, equipment and materials in order to minimize water losses
- promoting innovative and sustainable processes and technologies, energy efficiency, materials, treatment reagents and equipment, material flow management, waste recovery in the field of activity;
- development of the business sector in the field of water supply and sewerage system, by supporting the sector of innovation, production of materials, reagents, equipment and innovative technologies, stimulating the market demand for all categories of users.

c) Supporting the development of companies in the field, setting up new companies and attracting new investments in the economic field of interest.

Timis county predominantly as water supply systems has been under the coverage area of Aquatim SA regional operator since 2010. To cover the area of operation and operability in exploiting these water supply systems, 5 branches have been set up around the cities: Sânnicolau Mare, Jimbolia, Buziaş, Deta, Făget. The localities around Timisoara have been integrated into the operating structures of the municipality of Timisoara.

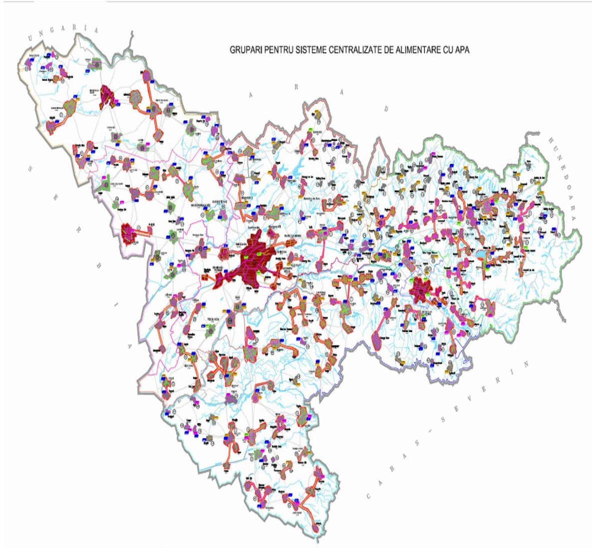

Figure 7. Groupings for centralized water supply systems

Aquatim S.A owns 23 water treatment plants and about 1800 km of distribution network.

The predominant water source, namely in 21 of the treatment stations, is supplied from deep water sources, the other 2 representing as the source of water surface water of the Begea canal.

Groundwater supply systems are classified as follows (Fig.5):

1.Water boreholes that through pumping pumps in treatment plants quantifying a number of 134 drillings and 21 water treatment stations

2.Plants that collect the water from boreholes thought pump equipped with disinfection systems, storage and repopulation quantifying a number of 64 boreholes and 38 water plants

3. Water boreholes that pump directly into the distribution system, quantifying a number of 57 holes

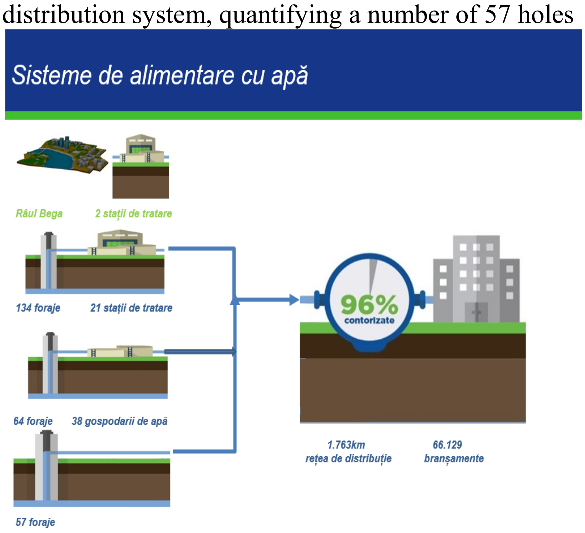

Figure 8. Water supply systems managed by AQUATIM S.A

4.1 New perspective objectives of the operator Aquatim S.A.

The Aquatim operator's policy is to make major investments in water infrastructure and environmental protection in Timiș County from non-reimbursable European funds.

The project has as specific objectives works on the rehabilitation of the water supply system and wastewater collection systems in the agglomerations: Timisoara (Sânmihaiu Român and Utvin localities), Buziaș, Jimbolia, Deta and Recaș.

The Large Infrastructure Operational Program (POIM) envisages investments for environmental infrastructure works in the amount of 180 million euros, of which 135.6 million euros non-reimbursable funds from the European Union, 20.7 million euros from the state budget, 3.2 million from the local budget and 20.5 million euros co-financing Aquatim. With the help of this project, the City of Timişoara will benefit from investments of 51 million euros. Thus, through European funding programs as well as from investments financed from own sources, major investments will be made in the rehabilitation and re-equipping of the capture fronts.

Systematized will be realized retechnologization, rehabilitation and optimization of the drilling through:

Hydraulic works

For the rehabilitation of the boreholes, from the point of view of the construction works it is proposed to carry out the following works:

- boreholes inspection and rehabilitation / clearing where necessary according to the inspection report
- replacement of all hydraulic equipment (pipes, fittings, accessories and existing joint systems)
- replacing the water meters with electromagnetic flowmeters

Architectural and civil intervention works:

- the complete undoing of the interior and exterior plastering both at the fireplaces and at the drilling booths and the restoration
- the removal and restoration of waterproofing

Restoration of electrical installations systematizing them for energy efficiency. Implementation of automation works for remote control and surveillance. Provision of drilling with pumps equipped with freeway converters and translators for monitoring levels in boreholes.

Boreholes monitoring programs should provide a general, coherent picture of the water status of each borehole from a quantitative point of view, in order to detect the presence of trends in anthropically induced long-term pollutant concentrations and to ensure compliance with the objectives of the protected areas.

Groundwater monitoring programs include:

- the quantitative and qualitative monitoring program;
- the qualitative monitoring program for monitoring and operational

Groundwater status monitoring is required for:

- Evaluation of the quantitative state of the groundwater bodies;
- Estimation of direction and flow from groundwater bodies;
- Validation of the risk assessment procedure;
- Evaluation of long-term trends of various quantitative and qualitative parameters, as a result of changes in natural conditions and due to anthropic activity;
- Establishing the chemical state for all the groundwater bodies identified to be at risk of not achieving good condition;
- Identification of the presence of important and continuous trends of increasing concentrations of pollutants;
- Evaluating the change (reversal) of the trends in the concentration of pollutants in the groundwater;
- Establishing, designing and evaluating the program of measures.

5. CONCLUSIONS

Groundwater resources are a strategic source and present advantages such as: it is reliable in the dry season or drought due to underground reserves, in the absence of pollutants it becomes a cheap source to use, because it requires a simplified or even absent treatment in order to be cleaned compared to the surface sources..

Groundwater resources need to be exploited rationally and in a sustainable manner.

Thus, AQUATIM S.A through the European funding programs as well as from investments financed from their own sources will realize investments for rehabilitation and re-equipping the capture fronts for both efficiency and quantity and quality assurance of the drinking water supply service.

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