# CHARACTERISTICS AND MALFANCTIONS OF THE WATER NETWORK - DRINKING WATER SUPPLY AND SEWERAGE IN THE SATU MARE MUNICIPALITY

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**Abstract. Charaxteristics and malfunctions of the drinking water supply and sewerage network in Satu Mare.** The beginnings of centralized drinking water supply in the metropolitan area date back to the beginning of the 20th century when a project is being developed focusing on the underground sources afferent to Somes' alluvial cone at the expense of other sources. The source raises the issue of water deferring and demanganizing due to its high Fe and Mn content. The age of the adduction network causes defects that require rehabilitation of the old supply chain trunks. The sewage capacity - the discharge of meteoric and domestic water is outweighed by heavy rainfall resulting in outbreaks in certain urban areas with floods in inland waters. The phenomenon is favored by the flatness of the relief, the clogging of the evacuation network and the inconsistency between the urban dynamics and the existing sewerage network.

**Key-words:** malfunction, supply and distribution system, sewerage, Satu Mare.

## 1. INTRODUCTION

Satu Mare municipality is located in Romania's north-western extremity, on the alluvial cone of Someş River, in Someş Plain. The beginnings of man's life in the area are lost in the mist of history. Nowadays, it is a modern city with 115000 inhabitants. Many times, the city's water supplying was made from point sources such as fountains or directly from Someş River. Water was improper for people's consume so that water diseases were common.

The first concerns related to the systematization of drinking water start with the project of the engineer Zarka Elemer who drew up a municipal water supply plan in 1897. He drew up the project considering a population of 60000 inhabitants, a consumption of 150 l/day per capita resulting in a consumption of 9,000 m³/day. Thus, a series of deepwater wells were built, drilled at a depth of 110 m in the area of Grădina Romei Park. Chemical analyzes have revealed the presence of an increased amount of iron and manganese requiring the use of active coal, gravel and sand filters arranged in layers according to their granulometry. The

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water treatment was carried out at the Water Plant near the wells in the Grădina Romei Park. The water distribution was carried out by means of a pumping station with a preset pressure. In 1911 the Water and Sewerage Enterprise of Satu Mare was established. Over time, several variants have been proposed to increase the water discharges, so that starting with 1971, the underground wells of Mărtineşti-Micula are being built in several stages. In stage I the wells P 2 - P 12 were drilled, in stage II the wells P13 - P21 were put into operation. Stage III included the commissioning of the wells P22 - P37, and in the last stage was registered the commissioning of the wells P 38 - P 56, this last stage ending in 1990. The water coming from the Mărtineşti - Micula front is drinkable in the Mărtineşti Water Factory. The filtration is carried out using the double free level filtration method using quartz sand layers impregnated with manganese dioxide ($MnO_2$). At present, the two water plants provide a discharge of around 1200 mc/s for end users.

## 2. DATA AND METHOD

The data were obtained from various state institutions including the Romanian Waters Administration, RAC (Apaserv Satu Mare), the National Meteorological Administration, as well as various bibliographic sources. The research methods approached consisted in direct field observation, analysis and interpretation of written, tabular and cartographic materials. The Microsoft Office package was used to process statistical data. For future scenarios marking we chosed the six-degree polynomial equation for the alleviation of errors and for a better trend fidelity.

## 3. RESULTS AND DISCUTIONS

The captation of drinking water necessary for the supply of the Satu Mare municipality is made from underground sources by means of some captation wells at the depth of 60 - 125 m distributed in two locations: Grădina Romei and Mărtinesti - Micula. The presence of iron and manganese in captated water implies the use of special filters for deferring and demanganizing water, resulting in high costs and a more laborious process to improving water quality.

### 3.1. Drinking water supply network

At the level of the year 2008 there were 22.5 km of adductions from the well network to the two water treatment plants. A number of wells do not work, need to be refurbished or rehabilitated. The first order arteries are arranged in the form of a central ring on both sides of the Someş River, from where they branch out and are connected to the interior and to the peripheral areas.

**3.1.1. The Mărtineşti - Micula captation front** represents the main captation of the Satu Mare urban area, being carried out between 1969 and 1995. It consists of a network of wells arranged in the form of a linear alignment between the localities of Mărtineşti and Micula. The alignment takes place in the northern part of the municipality between the Someş River in the south and Tur River in the north. The captation front consists of 64 wells (P2 - P65) with depths raging between 100 - 125 m, Ø = 12 ¾ located at a distance of 250 - 300 m from each other. The distribution of the wells in the Mărtineşti -Micula captation front is shown in Fig. 1, and the captation stages in Table 1.

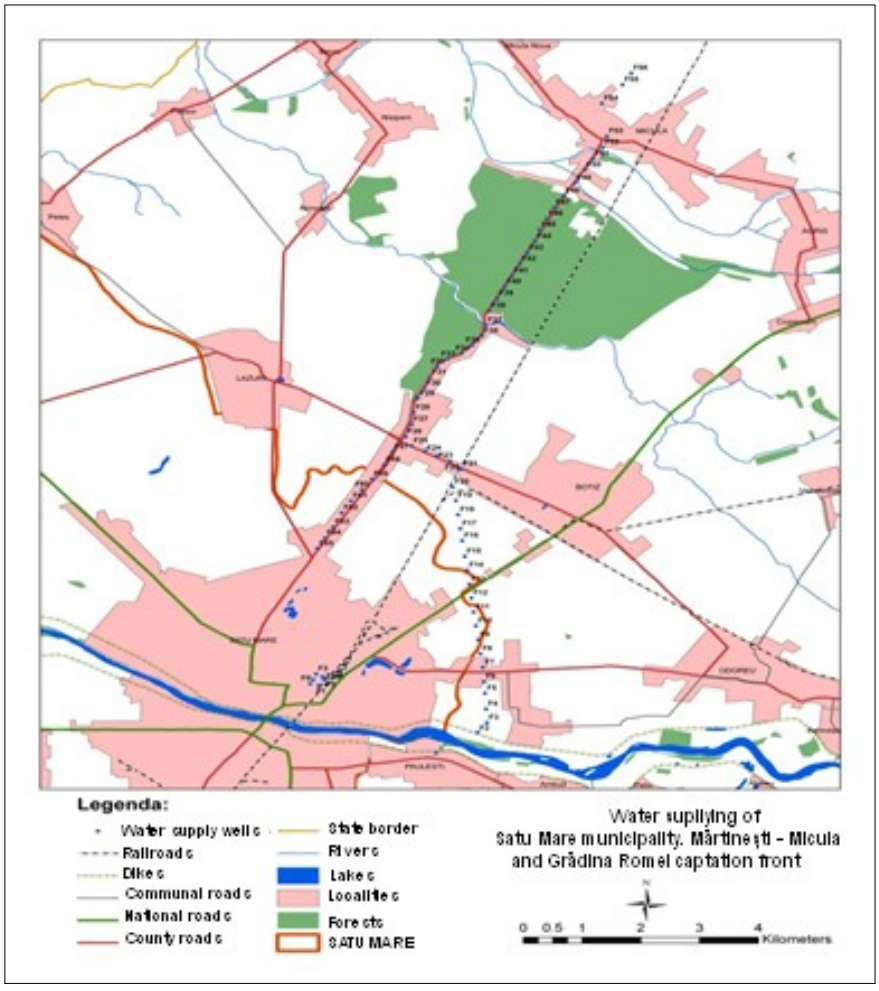


**Fig.1.** Wells distribution on the Mărtineşti - Micula
and Grădina Romei captation front (Source : RAC Satu Mare)

**Table 1.** Commissiong stages of Mărtineşti – Micula captation*

| *Wells number* | *Commissiong stage* |
|---|---|
| **7 (P2-P8)** | **1971** |
| **3 (P9-P11)** | **1973** |
| **10 (P12-P21)** | **1974-1977** |
| **16 (P22-P37)** | **1978-1982** |
| **16 (P38-P53)** | **1983-1988** |
| **3 (P54-P56)** | **1991** |
| **4 (P57-P60)** | **1994** |
| **5 (P61-P65)** | **1994-1995** |

* Source: RAC Satu Mare (explain RAC)

**3.1.2. The Grădina Romei captation front,** located in the Grădina Romei Park, in the immediate vicinity of city's CFR's railway station, consists of 8 wells with an average depth of 60 to 125 m. The captation's stages and technical parameters are shown in Table 2.

**Table 2.** The technical parameters of the grădina Romei captation front

| *Wells number* | *Diameter* | *Depth* | *Commissiong stage* |
|---|---|---|---|
| **2 (P1-2)** | **8** | **60** | **1930** |
| **6 (P3-8)** | **12¾** | **125** | **1977-1979** |

*** Source: RAC Satu Mare**

### 3.2. Drinking water distribution systems

Drinking water distribution systems consist of several elements, such as transport and distribution pipelines, pumping stations, reservoirs, derivations and counters.

The length and characteristics of the arteries and the distribution network are shown in Table 3.

**Table 3**. Characteristics of the drinking water distribution network in Satu Mare*

| **Fabrication material** | **Lenght (km)** |
|---|---|
| Asbestos | 132,4 |
| Cast iron | 10,8 |
| Steel | 8,05 |
| Premo | 7,5 |
| Polyethylene | 8,5 |
| PVC | 0,32 |
| other materials | 0,1 |

***Source: RAC Satu Mare**

The total network length is 167.7 km, 20% of the total being more than 35 years old. Between 15 and 35 years old are 53% of the total distribution network, and 27% are under 15 years old (Fig. 2).

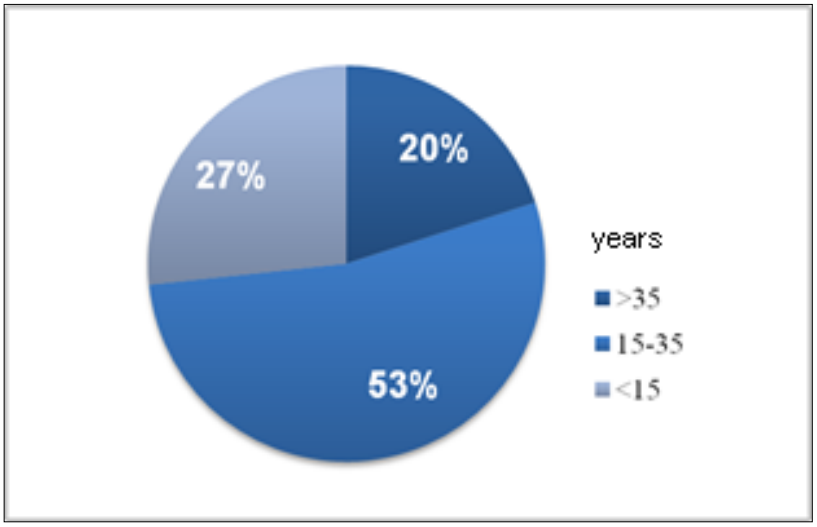


**Fig. 2.** Percentage distribution of drinking water supply network's age in Satu Mare (Source: RAC Satu **Mare)**

The distribution system is organized into three distinct sectors depending on the location of the three pumping stations in the city. The three pumping stations are interconnected, two of them being located at the Mărtineşti Water Plant and the Old Plant (Grădina Romei), and a compensation station is located in the western part of the urban area. A maximum flow rate of 1300 l/s was anticipated from the Mărtineşti - Micula captation front, and 100 l/s for the Grădina Romei captation front.

### 3.3 Evacuation of residual and meteoric water

Domestic wastewater and rainwater are taken over by a network of sewers and sewerage pipes that converge to the water treatment plant located downstream of municipality on the right bank of the Someş River.

Some of the rainwater is drained through the mixed sewerage network and the other is directed directly into the emissary by collecting channels and only a small part infiltrates inbto the underground or is subject to the evaporation process.

The emmisary of evacuated residual water is the Someş River, which has a multi-annual average discharge of 135 $m^3/s$ (1970-2006) in the evacuation section.

The sewage treatment plant has a single escape mouth, located on the right bank of the Someş River, downstream of the built perimeter. Under the water management agreement no. 23 of 19.02.1986, the water discharge into the Someş River of residual water collected from the urban perimeter was regulated. Thus, the daily maximum discharge quantities are between 1000 l/s (dry weather) and 2100 l/s (rainy weather).

Domestic, industrial and meteoric waters are collected through a sewerage system constructed in a unitary system, except for the Micro 17 and Carpaţi II districts located in the southern urban area, where it is built a divisor system. The total length of the sewerage networks and sewers is 176.95 km.

Of the total length of existing networks, 9.7% are older than 37 years, 38% are between 17-37 years of age and 52.3% are under 17 years. In the studied area, as a flat area, due to the low level differences, the sewage and meteoric sewage and sewage canalization and transport of residual and meteoric waters to the sewage treatment plant are made by means of 7 pumping stations.

### 3.4. Malfunctions of captation, canalization and evacuation systems

The malfunctions occurring in the normal functioning of water captation, distribution and evacuation systems in Satu Mare are determined by natural and anthropogenic factors.

The malfunctions that arise from the action of natural factors consist of:

- grinding and clogging of wells, which leads to refurbishing and demolition works with additional economic costs;
- the very low land slope prevents the gravitational discharge of the domestic waters and implicitly the necessity to use the mentioned pumping stations with very high economic costs;
- the non-existent slope of the land induces, despite frequent pumping, clogging of the network with the possibility of sludge deposition and implicitly the occurrence of the phenomenon of anaerobic fermentation with release of methane and hydrogen sulfide. The phenomenon is present in almost all the neighborhoods of the city including the central area, being betrayed by the unpleasant odors emanating from the canalization-escape network during summer season;
- the unstable ground due to the presence of a sandy covers causing pipelines to move and the leak, with untreated water infiltrationg into the ground;
- torrential rains determine the dislodginf of dust and sand particles into the sewer network, clogging and frequently damaging the pumping stations;

The malfunctions generated by the anthropic factors consist of:

- inappropriate design, in a unitary system, of most water evacuation systems. There are two municipal districts (Micro 17 and Carpaţi II), where there is a separate evacuation system;

- the great length of the evacuation networks leads to frequent damages of the pipelines, especially in the central and northern areas of the city;

- the current sub-dimension of the sewerage network - the evacuation that causes heavy rainfall; evacuation incapacity the meteoric and even domestic (in unitary areas) discharges with sewage effluents in the lower sectors of the city (photo 1);

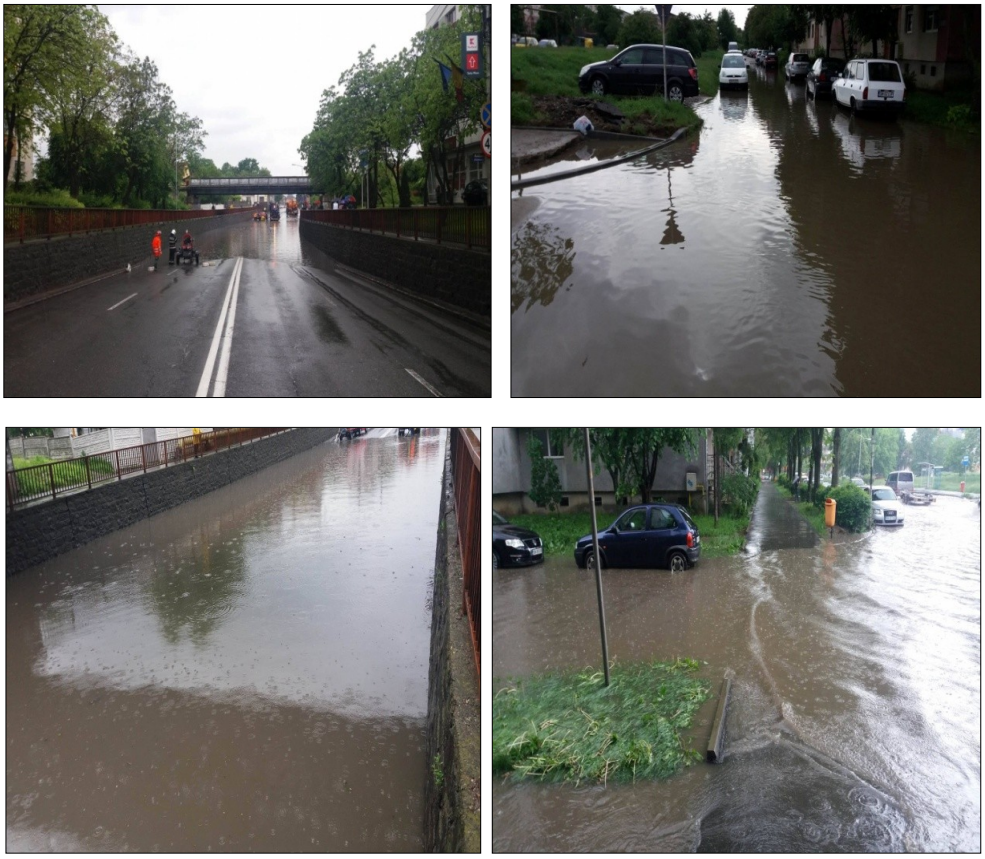

**Photo 1.** Capacity exceeding for the Soarelui and Gelu pumping stations of the drainage network at torrential precipitation (13.05.2017).
(Source: personal photo)

## 4. CONCLUSIONS

The water supllying of the studied urban area is performed exclusively from underground, from medium-sized aquifers cantonated in Someş alluvial cone.

The 72 captation wells were made in several stages included in the period 1930-1995, many of them requiring sand trapping and refurbishments.

The water distribution system is influenced by a number of factors, including land morphology, street network architecture, urbanization dynamics, etc.

The most part of the evacuation system is of mixed type and the gravitational evacuation is excluded due to the small land level differences that require the use of a pumping evacuation network.

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