ENVIRONMENTAL RESPONSE TO MINING EXPANSION IN TIMOČKA KRAJINA

ENVIRONMENT OF TIMOČKA KRAJINA

WHAT AIR WE BREATHE

WHAT KIND OF WATER WE DRINK

ZAJEČAR, 2023.

INTRODUCTION

This publication was prepared as part of the project "Environmental response to mining expansion in Timočka Krajina". The main goal of the project is to contribute to the improvement of the environment in Timočka Krajina by raising the awareness of citizens to actively participate in public policies and decision-making in the field of environmental protection and climate change in accordance with the best practices in the EU.
Activities on the project are:

- Formation of a database on the state of the environment,
- Collection of existing results of air and water quality monitoring, additional analysis of water, sediments and ichthyofauna in the rivers the Black Timok, the Great Timok, the Borska reka River,the Pek River, the Danube at the confluence of the Timok.
- Analysis, selection and archiving of existing public policy documents on the environment of the cities of Zaječar and Bor,
- Initiation of initiatives for the adoption of plans, programs and decisions on air quality in the City of Zaječar, innovation of public air policies in the City of Bor and planning of budget funds for the implementation of the said documents.
- Launching an initiative to protect the biodiversity of Rgotsko Lake and implementing the law that obliges the mining company Jugokaolin Ltd, the owner of the quartz sand mine, to carry out the reclamation and remediation of the abandoned surface mine.
- Monitoring of court proceedings that are conducted due to endangerment of the environment.
- Publication of studio and documentary TV shows, informative media content, animated and documentary films, research texts, photographs and publications about the impact of pollutants on the environment in Timočka Krajina, as well as organizing environmental film festivals, children's plays and workshops for young people (with live broadcasts on online platforms), preparation and presentation of expert papers.
- Formation and operation of a CSO coalition, training of CSO representatives and local self-government units on legislation and the EU Green Agenda, the Green Deal for the Western Balkans and national and local public policy documents in the field of environmental protection, as well as strengthening cooperation and communication channels between CSOs and decision maker.

The project "Environmental response to mining expansion in Timočka Krajina" is implemented in the period 16.1.2022 until 16.5.2024. This project is financed by the European Union and implemented by the Association "Za česme", the Association of Young Researchers Bor, the Civic Library "Evropa" Bor and the "Children's Center" Zaječar.

PART I
WHAT AIR WE BREATHE

I. A. Air quality in Bor

The most significant part of the recent history of the city of Bor is connected with deposits of copper ore, precious metals and non-metals. In addition to the exploitation of copper ore deposits, metallurgical processing and production of blister and electrolytic copper and precious metals, sulfuric acid factories were built in order to use the sulfur released by the processing of copper concentrate, as well as numerous processing capacities, energy and water management facilities, and the industrial production in other places of the Republic of Serbia.

The agglomeration of Bor has been known for mining and processing copper ore and precious metals for more than a century. At the beginning of the last century, in 1903, a deposit of copper ore was discovered. Initially, it was underground exploitation, later excavations were carried out at three more surface mines in Bor and its surroundings. A company called the French Society of Bor Mines, the Saint George (Sveti Đorđe) concession, started copper mining in 1904. Between 1904 and 1929, the ore mined in the Bor mine contained 15% to 20% copper, so it was directly transported to the metallurgical processing plants. The first pilot plant for the preparation of concentrate started operating in 1929, with a processing capacity of 25-30 tons per day. After the Second World War, the mine was nationalized and in that period intensive reconstruction of equipment and facilities took place. During 1951, a new company was formed under the name Mining and smelting basin Bor - RTB Bor.

In the period 1960-1970. , RTB Bor went through two development phases and reached the production of more than 150,000 tons of cathode copper per year. In addition to the smelter with the technology of melting copper concentrate in a flame furnace, sulfuric acid factories were built in order to process smelter gases and reduce air pollution.

In the first phase of development, one smelter line with a flame furnace and the first sulfuric acid factory were built. In the next phase, the processing capacity of copper concentrate was increased by building another smelting line and two sulfuric acid factories.

The old surface mine in Bor was reducing production, so new mines were opened: the RTH surface mine in Bor and the surface mine in Veliki Krivelje with new flotation. This required the construction of a new flotation tailings pond between the villages of Veliki Krivelj and Oštrelj. Another sulfuric acid factory was built in the metallurgical-chemical complex because the oldest factory stopped working in the meantime.

In the 1990s, a new surface mine, Cerovo, near Veliki Krivelj, was opened. The smelter was reconstructed by changing the technological process of smelting and instead of a flame furnace, a flash furnace was built, a new sulfuric acid factory with double catalysis and absorption, and a waste water neutralization plant. The goal of this project was to protect the environment, better use of raw materials and increase energy efficiency.

Mining activities left a strong impact on the surrounding landscape, which is characterized by large surface mines (total area of over 1,800 hectares). Due to mining operations during the last century, the topography of the terrain has been significantly changed. Microclimatic changes are the result of changes in the morphology of the terrain, which is mostly reflected in the change of the wind rose. Due to the construction of high mining dumps (high plans), there was a change in the direction of the winds and an increase in the period without wind (silence). This led to an increase in air pollution in Bor, because natural ventilation was reduced.

In the last ten years, intensive geological research has been carried out in the Republic of Serbia by foreign companies. In the mining and smelting basin of Bor, there was an ownership transformation during 2018. Zijin, one of the world's leading mining companies in the production of copper and precious metals, became a strategic partner. A new company SerbiaCopper doo was formed, with Zijin's share of 63% and the Republic of Serbia with 37% of the capital.

The management of the company is led by the management of Zijin. The new company launched a number of projects to increase mining and metallurgical production. Works on the expansion of the mines in Veliki Krivelj, Cerovo, Majdanpek and Jama in Bor are underway. Works are also being carried out on the reconstruction and increase of the capacity for flotation concentration of copper ore in Majdanpek, Veliki Krivelj and Bor and the expansion of the flotation tailings pond in Krivelj and Majdanpek. The capacities of the smelter are being expanded and a new sulfuric acid factory and a new electrolysis plant are being built. Zijin became the owner of the Čukaru Peki site in the immediate vicinity of Bor. Mining and flotation facilities were built, as well as landfills for mining waste, flotation tailings and pyrite.

All these projects were accompanied by the construction of new infrastructure facilities. Except for the facilities of the Čukaru Peki mine, for other facilities, the legally prescribed Environmental Impact Assessment Study was not done or adopted before construction, but was done during the started or completed construction.

The agglomeration of Bor is facing a new development cycle that will inevitably reflect and lead to changes in the environment. For this reason, all measures provided for by law must be taken at the level of the state and local community in order for the development to be in accordance with the determinations of sustainable development, and in order not to endanger the capacities of the environment with negative consequences for people's health and quality of life.

Industrial activities in Bor, especially those related to RTB Bor, have caused a number of negative environmental impacts in the region (including impact on air, water and soil) and have raised serious concerns about the effects they lead to on human health and the state of flora and fauna in the agglomeration of Bor and on the territory of the town of Zaječar. The fact that the main polluter is also the main employer in the agglomeration, formerly RTB Bor and today Zijin with its separate companies Serbia ZiJin Cooper and Serbia ZiJin Mining, emphasizes the need to solve economic and environmental problems while respecting the broader economic and social context and interests in order to survival and sustainable development of local communities.

Air pollution in the urban environment of the city of Bor occurs during mining operations and various metallurgical processes that take place in the copper smelter in Bor.

In addition, energy plants (Energana RTB Bor and Toplana Bor) are also a significant source of air pollution in Bor.

The copper ore that is mined today in the mines in the area of the Bor agglomeration contains 4-5 times less copper (about 0.43%) compared to the period 50 years ago. In this sense, during the process of flotation beneficiation of copper ore, 50-60 t of flotation tailings are separated to obtain 1 t of concentrate, i.e. for the production of 1 t of copper, it is necessary to dig 300-400 t of ore.

Until 2015, copper was obtained in the smelter in Bor by the classic pyrometallurgical process, which includes the following processes: roasting of concentrate in fluosolid reactors, melting of roast in flame furnaces, conversion of copper and flame refining of blister copper. The ore smelted in the copper smelter in Bor is of the chalcopyrite-pyrite type with an increased content of arsenic, which is found in the form of enargite (Cu_3AsS_4) and tenantite ($Cu_6 [Cu_4 (Fe, Zn)_2] As_4S_{13}$).
Oxidation, roasting and melting of such mineral forms lead to an increase in heavy metal oxides and SO_2, which are emitted in certain quantities into the air and contaminate the environment. Outdated copper production technology (classic flame furnace pyrometallurgy and use of SO_2 gas to produce H_2SO_4 with recovery rate <60%) was the main source of pollution of large areas around the smelter (air, water and soil). Gases from the roasting and conversion process were processed in sulfuric acid plants with single catalysis, while waste gases from flame furnaces with about 1% sulfur dioxide were released into the atmosphere.
In the old smelter (which operated until 2015), copper concentrate was mixed with smelters (quartz and limestone). Such a batch is first roasted to remove sulfur. The average chemical composition of the prepared batch is: 20% Cu, 33% S, 25-27% Fe, 16% SiO_2, 2% Al_2O_3, 0.5% CaO, 0.5% MgO and the rest from 1% to 3%. A number of elements are included in the rest from 1% to 3%, most often they are companions of copper ore: As, Pb, Zn, Cd, Ni, Hg, Sb, Se, Bi, Te, Ag, Au, Pt, Pd, Rh, Cr, Mn, Mo, Ge, Ga, Ba, Be, Tl, Ti, B and others. Their content is variable, some elements are represented in a concentration of a few ppm, or parts of a ppm, while the content of others can range up to several percent (eg Zn and Pb). On average, the content of As, Pb, Zn and Cd in domestic concentrates processed in the smelter in Bor ranges from 0.7% to 2%, and the total content of trace elements ranges from 0.3% to 1%.
During all technological stages of the copper production process, considerable amounts of gases (SO_2, NO_x, CO, CO_2, and others) are released, as well as suspended particles containing toxic metals. During the operation of the old smelter in Bor, 400-700 t of SO_2, as well as 3-4 t of smoke, dust and volatile substances were released into the atmosphere daily through unprocessed waste gases.
The amount of harmful substances that irreversibly escape from the chimney into the atmosphere depends on many factors, such as: the choice of the technological procedure for copper ore processing, the composition of the input raw material, the type of energy source, the temperature and duration of the process, the type and amount of process gases, and the like. Common to almost all technological procedures used in the processing of copper ore is that As, Pb, Zn, Bi and Sb are one of the most toxic substances.
The average content of arsenic in the copper concentrate processed in the smelter in Bor is between 0.05 and 0.15%. A slightly higher content of arsenic is contained in boron concentrate, 0.5-0.8%. Before the melting process itself, several types of concentrates and solvents (quartz and limestone) are usually mixed so that the final arsenic content in the resulting batch does not exceed 0.5%. Bearing in mind that 1,500 to 1,800 tons of concentrate were delivered to the old smelter in Bor per day for processing, this arsenic content is also significant.
In order to reduce the emission of waste gases, organizational and other measures were taken. A Plan for reducing the emission of waste gases from the smelter was adopted, which provided for the reduction of processing, the stopping of some aggregates, the increase of gas traction in the

sulfuric acid factory and the stopping of smelter production in case of high concentrations of sulfur dioxide in the city and its surroundings. The plan defines the rights and obligations of the responsible persons who manage the production process for the implementation of the plan. A gas dispersion study was made depending on the capacity of the smelter and meteorological conditions. A forecast of sulfur dioxide concentrations in the city and its surroundings was made every hour for the next three days. Based on that forecast, production, stoppage and overhaul programs were drawn up depending on meteorological conditions in order to reduce air pollution with sulfur dioxide.

Instructions on the quality of imported concentrates that may be processed in the smelter have been drawn up. The guidelines define the maximum content of arsenic and certain heavy metals. Responsible persons in the smelter could only receive concentrates if the content of these elements was below the prescribed maximum. As a result, the concentrations of lead, zinc, cadmium, nickel, mercury and other heavy metals in the environment were always within the immission limit values.

Element	Content %	Note
Se	0,02	
Bi	0,05	
Sb	0,3	
Cd	0,01	
As	0,2	
Zn	3	
Pb	2	
Pb + Zn	5	
S	32	
Co	0,05	
Ni	0,1	
F	0,02	
Hg	5	ppm

Table 1. Typical content of impurities in copper concentrate
(Source: Instructions on the control procedure of copper concentrate, RTB Bor, Bor, 2008)

The Government of Serbia made significant efforts to secure a commodity loan from abroad for the reconstruction of the copper smelter and the sulfuric acid factory in Bor and financially assisted the realization of the project. The goals of the project were to protect the environment and increase energy efficiency. The fuel was replaced in the melting process. Instead of coal, fuel oil and oxygen are used, which encourage the combustion of sulfur, which becomes the main energy source for melting the batch. The project changed the technological process in the smelter. Instead of the process of frying and melting in a flame furnace, the process of drying the batch and melting in a flash furnace was applied. Now the waste gases produced by the melting and converting process are taken to a newly built sulfuric acid factory with double catalysis. According to the project and study on environmental impact assessment, the utilization of sulfur dioxide has increased to 98.5%, that is, a maximum of 1.5% of this gas produced by the melting process should be released into the atmosphere. The environmental impact assessment study of the smelter reconstruction project and the construction of a sulfuric acid factory prescribes the content of arsenic and heavy metals in the concentrates, which must not be exceeded.

Element %	Majdanpek	Krivelj	Cerovo	Import	Total
As	0,01	0,01	0,13	0,02	0,04
Pb	0,14	0,02	0,15	0,06	0,08
Zn	0,32	0,09	0,70	0,03	0,27
Ni	0,01	0,01	0,00	0,01	0,01
Co	0,02	0,02	0,01	0,01	0,02
Sb	0,01	0,01	0,01	0,01	0,01
Bi	0,02	0,03	0,03	0,01	0,02
Se	0,01	0,02	0,01	0,01	0,01

Table 2. Content of "impurities" in copper concentrate
(Source: Faculty of Technological Metallurgy in Belgrade: Study on environmental impact assessment of the project Reconstruction of the smelter and construction of a new sulfuric acid factory on cadastral plot no. 4400/48 KO Bor2, p. 65, Belgrade 2011)

The Ministry of Environmental Protection approved this study, and these values are considered the standard for concentrates that can be used for metallurgical processing.

Significant amounts of energy sources (coal, coke, fuel oil, wood) were consumed during the pyrometallurgical process of roasting and melting copper sulfide concentrates in a flame furnace. Now coal is out of use. Additionally, a significant amount of liquid fuel is consumed for transporting ore and tailings. During the ore mining phase, significant amounts of explosives are consumed, which release nitrogen oxides during the explosion.

Mining excavations degrade the environment by excavating large areas and depths, whereby only a small percentage of the ore excavations are used in metallurgical processing. All that unused, residual material represents tailings (overburden) that is deposited on large areas, creating new hills that are the source of suspended particle emissions.

In Bor, there is an abandoned surface mine on the outskirts of the town. Tailings from the Veliki Krivelj surface mine are transported and deposited by belts, and in the process a large amount of dust is released, which endangers metallurgical facilities, the settlement of Brezonik and the town.

Flotation tailings are a major source of dust. In Bor, there are old flotation tailings and tailings of ore body "X" which is in exploitation. The old flotation tailings are exempted from the ownership of the Mining and Smelting Basin of Bor and are the property of the state. A loan from the World Bank was granted to the state for their recultivation. Projects were done, but recultivation and remediation according to those projects was not done. As the project term expired, the state had to return the unused funds, and the tailings remained a constant source of dust, without any measures to protect the vulnerable population.

The flotation tailings from the Veliki Krivelj flotation are deposited in the tailings pond in the valley of the Kriveljska reka River upstream of the village of Oštrelj. This tailings dump consists of two fields, one of which is in exploitation, while the other is abandoned and is a source of dust whose occasional high concentration threatens the village.

Slag and ash from heating and power plants contain a number of harmful substances (Ba, As, Mn, Pb, Cu, Ni, V, Ti, Co) that are concentrated there during the process of burning coal (Stevanović, 2013). Recently, they have been disposed of in an unorganized and unsecured, newly formed landfill, without any documentation, on the edge of an abandoned mine in Bor, on the very edge of the city.

Dust on surface mines is raised by machinery (drills, excavators) with their work, as well as means of transport. Large amounts of dust are generated during each blasting. There can be added dust and fuel combustion products that were created during the exploitation, transportation and processing of copper ores.

The amount and chemical composition of respirable particles in the urban-industrial zone of the city of Bor depends on many factors, primarily on the amount and composition of raw materials processed in the mining and metallurgical complex, the operating mode of the H2SO4 factory, the installed technology and equipment, the condition in which the equipment is installed findings, the correct operation of dusting devices, meteorological conditions, etc.

Based on data from the references given in the Air Quality Plan for the Bor agglomeration, the areas affected by polluted air include a third of the area of the Bor agglomeration (298 km^2).

The study on environmental impact assessment of the reconstruction of the smelter and the construction of a new sulfuric acid factory is accompanied by appropriate technical documentation, which also contains a study on the dispersion of sulfur dioxide, nitrogen oxides and dust, before, during the implementation of the project and during the exploitation of reconstructed and newly built plants. At the same time, it was requested that after the commissioning of the plant, a new dispersion study would be prepared, which would more accurately show the potential concentrations and the areas of possible increased concentrations. Such a study has not been done to date, although it is a condition for obtaining an integrated permit.

The new Čukaru Peki mine started operations in 2021. Exploration work was carried out by various mining companies. The company Nevsun prepared a technical pre-feasibility study from 2018 on the composition of ore, concentrate and the concept of mining and flotation of ore. In that study, the expected content of "impurities" in the concentrate was given and it was stated that the ore contains high concentrations of arsenic that will remain in the concentrate even after processing.

In table 3, related to the mentioned study, the contents of the elements in the concentrate are given. A high content of arsenic was found, and the study states that such concentrates will not be processed in metallurgical plants in Bor.

Element	Unit of measure	Pure concentrate	Complex concentrate
As	g/t	0,64	2,21
Hg	g/t	2,2	1,9
Pb	g/t	196	290
Zn	g/t	938	168
Ni	g/t	76	33
Co	g/t	<8	24
Sb	g/t	103	290
Bi	g/t	<80	<100
Se	g/t	<100	<50

Table 3. Content of "impurities" in concentrates from the Čukaru Peki mine
(Source: Nevsun recourses ltd, NI 43 - 101 Tehnical Report - Timok Copper - Gold Project, Upper Zone Prefeasibility Study and Recource Estimate for the Lower Zone, 2018)

These results indicate that the content of arsenic and heavy metals is much higher than the prescribed content in concentrates that can be processed in a smelter.

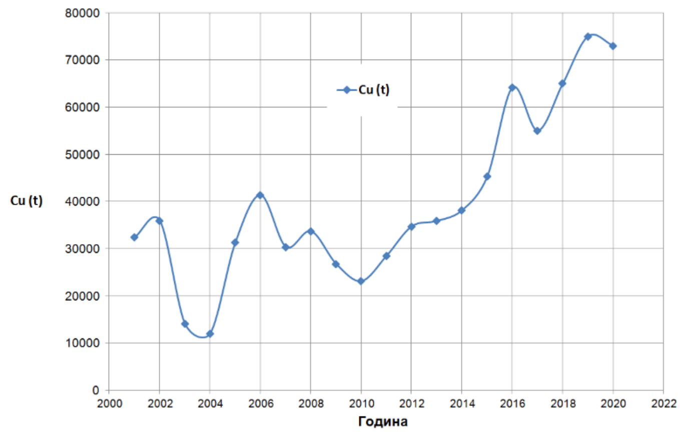
A system of national and local air quality monitoring has been established in the Agglomeration of Bor. Five automatic measuring stations are in the national system, while local monitoring is carried out in the wider area of the city and its surroundings.

The aim of this analysis is to present the air quality in the city of Bor in the period 2010 - 2022, where the concentrations of sulfur dioxide and concentrations of dust particles, PM10, as well as the content of arsenic, lead, cadmium and nickel in PM10 will be analyzed.

The production of cathode copper in the metallurgical plants of the Copper Smelter and Refinery in Bor ranged from 10,000 t/year in 2004 to 45,000 in 2015. The reconstruction of the smelter increased the capacities, so in 2016 it increased to over 60,000 t/year. and in 2019, 2020 and 2021 to over 70,000 t/year.

The sulfuric acid plant accepts smelter gases in order to produce acid and reduce the emission of sulfur dioxide into the atmosphere. In the period from 2010-2016, one sulfuric acid factory operated with single catalysis and absorption, with dilapidated equipment and insufficient capacity to accept all smelter gases. That is why there was a large emission of sulfur dioxide and high concentrations at all measuring points in the city and its surroundings. Simultaneously with the reconstruction of the smelter, a new sulfuric acid factory was built with modern technology of double catalysis and absorption. It accepted 98.5% of the gases produced in the smelter, and the emission and concentrations of sulfur dioxide in the city were reduced even though the production of copper was increased.

The change in the ownership structure and the arrival of a strategic partner lead to the import of concentrates in order for the smelter to realize its projected processing capacity. This leads to an increase in concentrations from 2019 to the second half of 2021. In September 2021, the collection of smelter waste gases was improved and a plant for desulfurization and gypsum production was built, which was reflected in the reduction of emissions from aggregates and the improvement of the situation in the city. In the second half of April 2022, the work of metallurgy was stopped due to the increase in capacity and the construction of new facilities. The emission of gas was gradually reduced, and in May it stopped completely, which was reflected in reduced concentration of sulfur dioxide.



Graphic 1: Production of cathode copper in the Bor smelter in the period 2000-2020

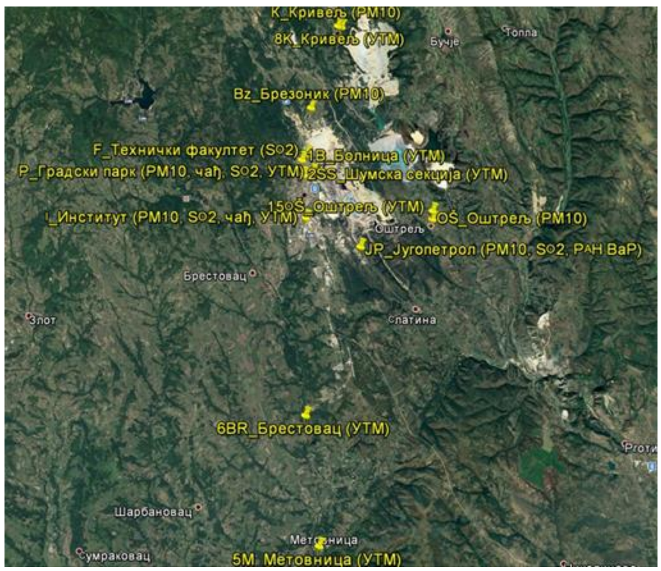
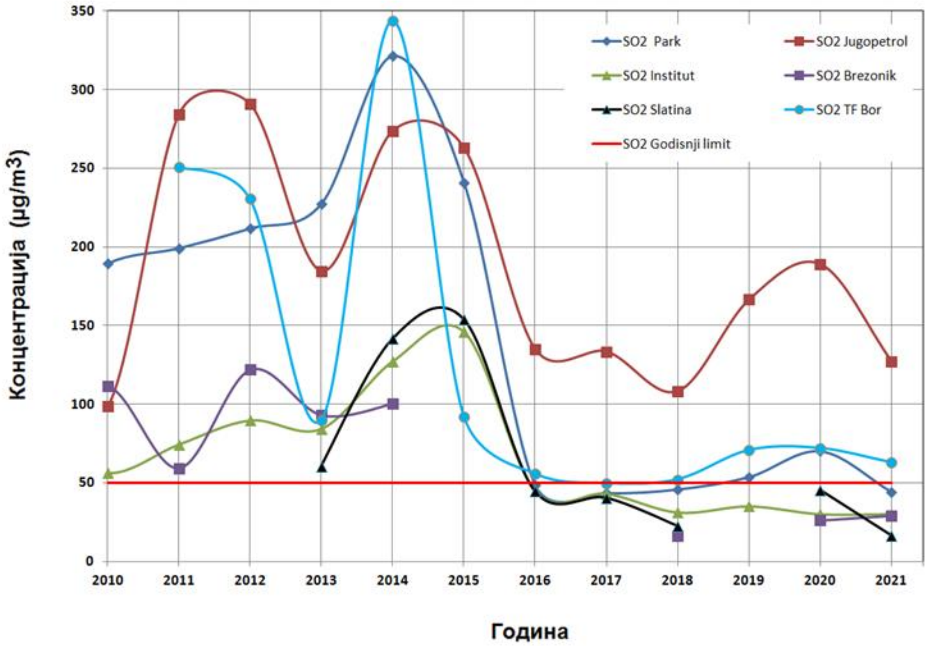


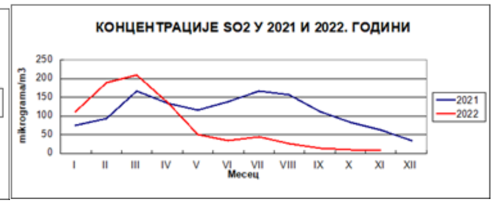
Figure 1: Measuring points of National and Local air quality monitoring



Graphic 2: Average annual concentrations of sulfur dioxide in the period 2010 - 2021. (Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)

This was reflected in the reduction of the number of days of sulfur dioxide concentration exceedances at all measuring points, and it is best demonstrated at the most threatened measuring point, at Jugopetrol. It is clearly noticeable that after September 2021 and the commissioning of the desulfurization plant, the number of days with sulfur dioxide exceedances is significantly lower, but at the beginning of 2022, the number of days with exceedances increases again. By stopping the operation of the smelter in April 2022, there are no longer an excess of daily concentrations of sulfur dioxide at this measuring point. In 2020, sulfur dioxide concentrations exceeded the permitted average daily value for 119 days, and in the first four months of 2022 for 62 days. There have been no overdrafts since April. At this measuring point, the average monthly concentrations in 2022 were higher than in 2021, probably because an effort was made to process as much copper concentrate as possible due to the planned stoppage. From April until the end of the year, concentrations are many times lower, which indicates that the smelter is the biggest source of sulfur dioxide.

In addition to the technological and technical measures, concentrations dangerous to people's health continued to appear. In 2021, there were 4 such concentrations in the city center for a total duration of 17 hours, and in Brezonik 2 times for a total duration of 6 hours.



Graphic 3 (left): Number of days of exceeding sulfur dioxide at the measuring point Jugopetrol in 2021 - 2022.

Graphic 4 (right): Average monthly concentrations of sulfur dioxide at the measuring site Jugopetrol in 2021 and 2022

(Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)

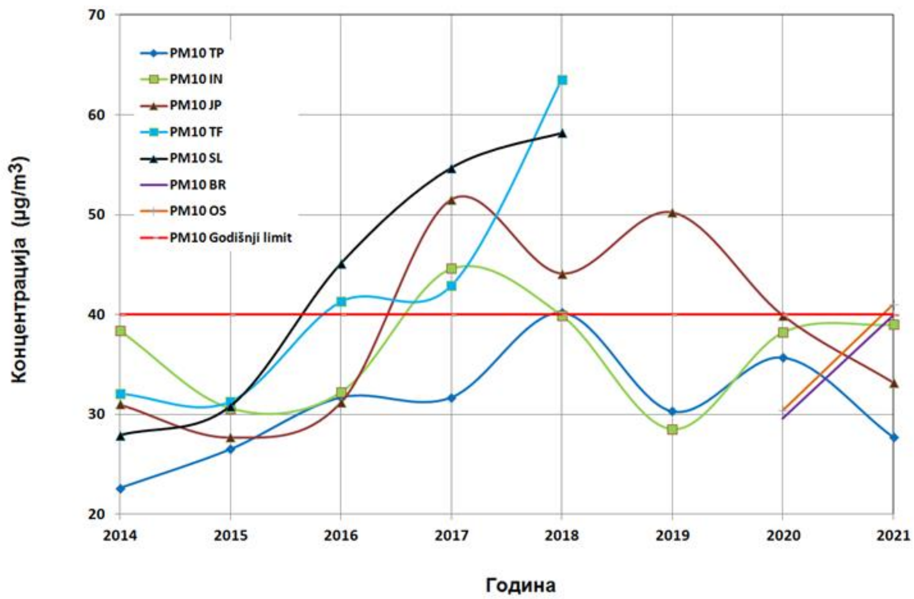
The sources of dust are depots of mining waste and flotation tailings and metallurgy. With the increase in production, the concentrations of PM10 dust particles also increased at all measurement points. With the construction of a new smelter, there is an improvement and a decrease in the value of the measured concentrations. Concentrations of PM10 dust particles are monitored at 6 measuring points in the local monitoring network.

The expansion of mining is reflected in the increased exploitation of ore at the open pits in Veliki Krivelj and Cerovo and the increase in the amount of deposited mining tailings in the old open pit in Bor and in the landfills in Krivelj, in the increasing amount of deposited flotation tailings in the tailings pits in Krivelj RTH in Bor and the lack of water for covering the dry water surfaces of tailings ponds in Bor and Krivelj. With the opening of the new Čukaru Peki mine, tailings are excavated, which are deposited in the landfill near the pit and threaten the village of Metovnica with dust.

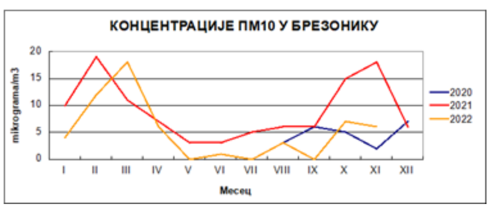
The Ministry of Mining and Energy issued a mining waste management permission to SerbiaZiJinMining for the Čukaru Peki mine. Waste is disposed of in landfills, which will represent large sources of dust that will cover the territories of Bor and Zaječar:

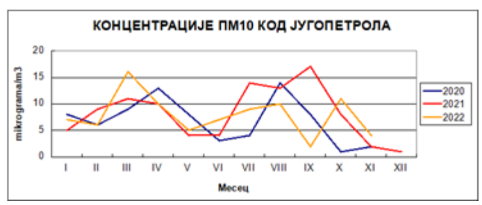
- unmineralized pit waste at a 20-meter-high landfill, without a dam, in the amount of 3,911,600 t,
- poorly mineralized pit waste at a 20-meter-high landfill without a dam, amounting to 1,104,300 t,
- pyrite concentrate, hazardous waste, at a landfill with a dam 47 meters high, amount 5,822,000 t,
- flotation tailings, hazardous waste, at the landfill with a dam 59 meters high, amount 9,821,00 t.

For these new landfills, a system of mini-monitoring of air quality at five measuring points was ordered.



Graphиц 5: Average annual concentrations of PM10 in Bor in the period 2014 - 2021.
(Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)

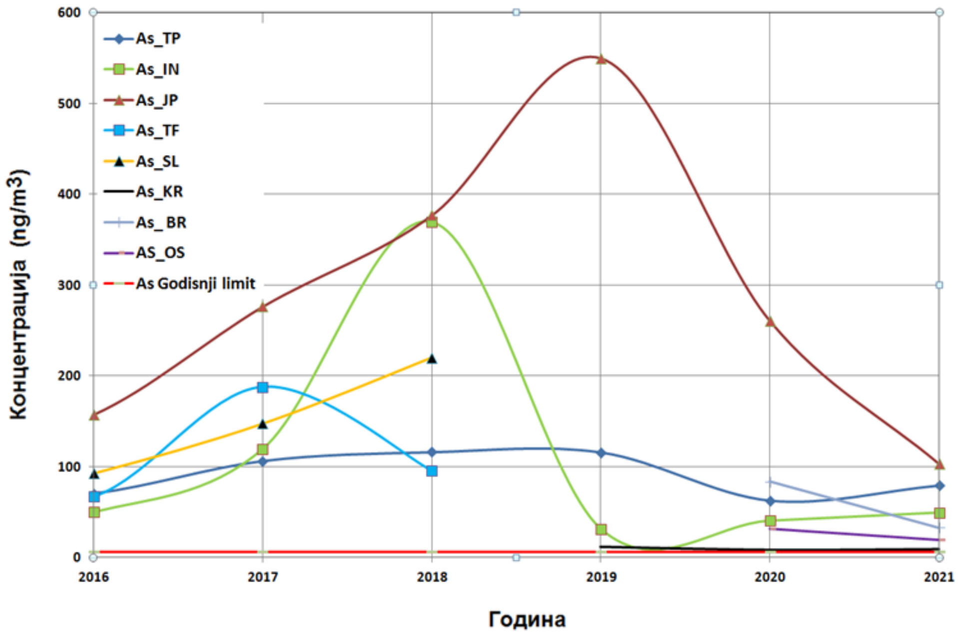




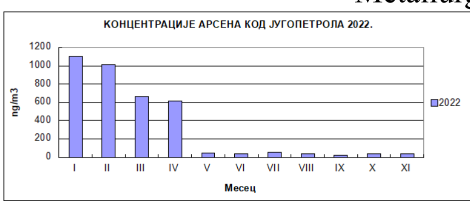
Graphic 6: Number of days with exceeded daily PM10 concentrations in Brezonik
Graphic 7: Number of days with exceeded daily PM10 concentrations at Jugopetrol
(Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)

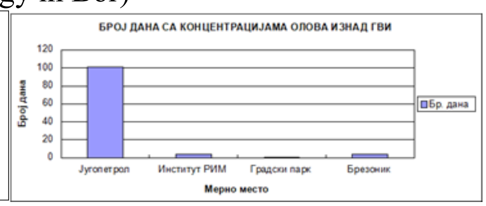
During the calendar year, the concentration of PM10 particles is allowed to exceed the immission limit value of 50 µg/m3 for 35 days. At the measuring point Brezonik, this value was exceeded 109 days in 2021 and 57 days in 2022. At Jugopetrol, it was recorded 77 days in 2020, 98 days in 2021 and 87 days in 2022.

The concentrations of arsenic in PM10 daily exceed the permitted concentrations many times over at all measuring points. The maximum daily concentrations are in several destinations and even a hundred times higher than the permitted immission limit values. The maximum values are recorded at the measuring point Jugopetrol. Thus, in 2020, at this measuring point, the maximum daily concentration was 3,008.6 ng/m3 per cubic meter of air, which is 501 times higher than the permitted level, in 2021 it was 2088.1, i.e. 348 times higher than the permitted level, and in 2022, 1100.6 in the month of January. After stopping the smelter, the concentrations are many times lower, but they still exceed the permitted values.



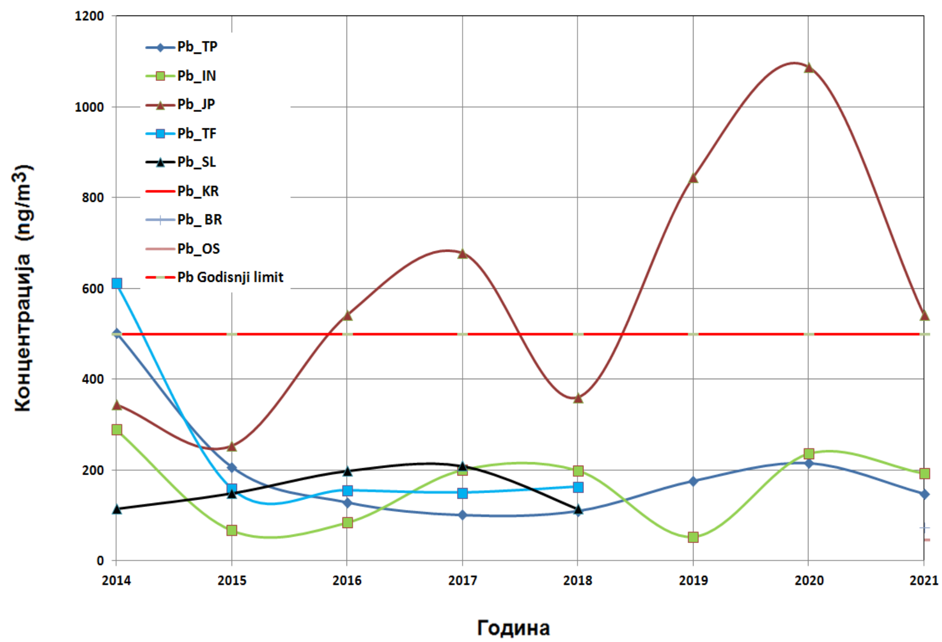
Graphic 8: Average annual concentrations of arsenic in PM10 in Bor in the period 2014 - 2021 (Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)



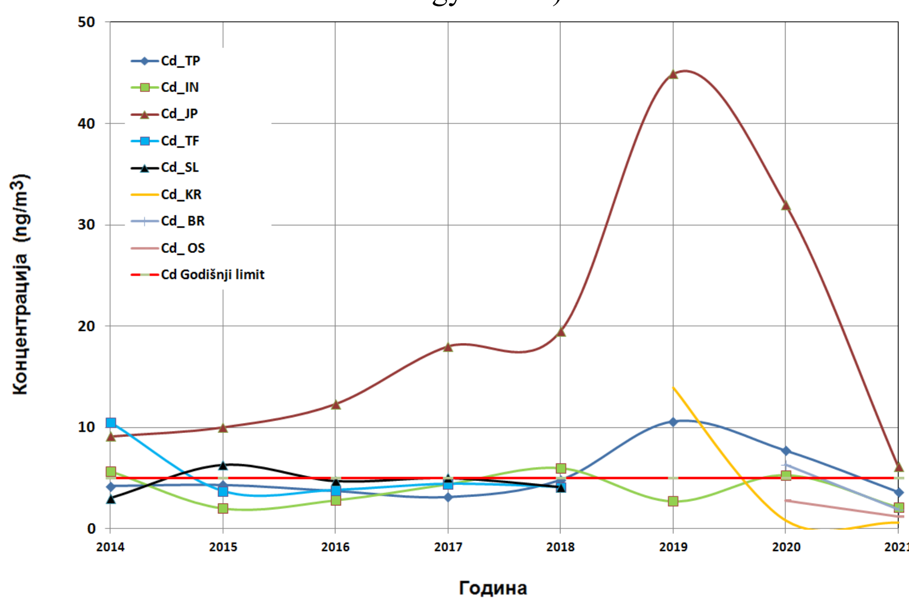


Graphic 9: Average daily arsenic concentrations at Jugopetrol in 2022.
Graphic 10: Number of days with lead concentrations above the 2021 GVI.
(Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)

Elevated concentrations of lead in PM10 particles appear at the measuring points near Jugopetrol, near the Institute, in the City Park and in Brezonik. In 2021, at Jugopetrol, the permitted daily concentration was exceeded for 101 days, at the Institute and in Brezonik for four days, and in Gradski Park for one day.

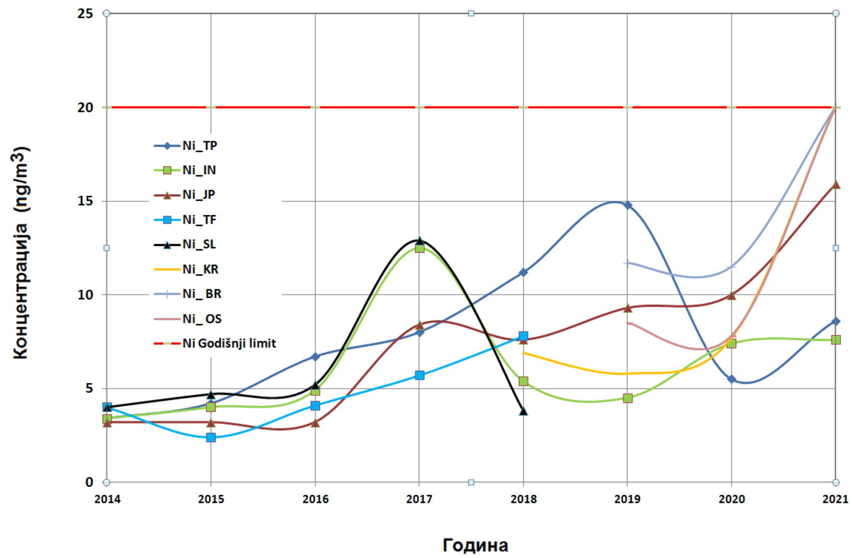


Graphic 11: Average annual concentrations of lead in PM10 in Bor during the period 2014 - 2021. year
(Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)



Graph 12: Average annual concentrations of cadmium in PM10 in Bor in the period 2014 - 2021.
(Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)

Cadmium concentrations above the permitted limits have been increasing rapidly since 2019.The maximum values were recorded at the Jugopetrol measuring site that year.



Graphic 13: Average annual concentrations of nickel in PM10 in Bor in the period 2014 - 2021. (Source: Monthly reports on the results of air quality monitoring of the Institute of Mining and Metallurgy in Bor)

The Environmental Protection Agency of the Republic of Serbia, based on the results of measurements in the national and local monitoring networks, categorizes air quality:

- The first category, clean or slightly polluted air, includes air in which the limit values for any pollutant have not been exceeded.
- The second category, moderately polluted air, includes air where the limit values of nitrogen dioxide are exceeded, but the tolerance value is not exceeded, and the limit values for other pollutants are not exceeded either.
- The third category, excessively polluted air, includes air in which the limit values for one or more pollutants have been exceeded.

The Agency evaluated that the air in Bor in 2017 and 2018 was of the first category, and from 2019 - 2021 it was of the third category:

	2017	2018	2019	2020	2021
ГРАД БОР	I	I	III	III	III

The increase in production in metallurgy led to an increase in the emission of sulfur dioxide and powdery substances and the deterioration of air quality in the city and its surroundings.

I. B. Air quality in Zaječar

The Zaječar area is characterized by the shutdown of industrial plants that were the biggest polluters: Crystal Factory, Porcelain Factory, "Jes Timok" Zaječar Slaughterhouse, Leather and Textile Industry (KTK Zaječar), Metal Processing Industry Plant "Arsenije Spasić", "Imlek" Zaječar, while some plants significantly reduced their production. In the current period, the industrial activity is dominated by facilities for the processing of plastics (production of cables, PVC granules, measuring transformers), food industry (beer production, processing and storage of fruits and vegetables, cold storage), agricultural activities (pig farm, poultry farm), tannery activity (tanning and leather processing). Industrial activity is located in work zones at several locations on the suburbs of the city, while the brewery is located in the city center (bearing in mind that the brewery was built in 1895).
Two mines for underground coal exploitation are active in this area: Lignite Mine "Lubnica" from Lubnica and Anthracite Mine "Vrška Čuka" Avramica, as part of EPS-JP for underground coal exploitation "Resavica". Limestone mining takes place at two locations. The "Čokonjar" deposit and the "Rgotski krš" deposit are quarries within the Road Company "Zaječar" in Zaječar. In the area of the village of Rgotina, quartz sand is being exploited as part of the company "Jugokaolin". A new mine of copper and precious metals with pit mining and flotation tailings "Čukaru Peki" was opened in the territory of the City of Bor, but on the very edge of the territory of the City of Zaječar, so in the future it will have a significant impact on dust pollution in the territories of Gamzigrad and Nikolicevo. Wastewater from the mine in Bor littered the shores of the Great Timok with pyrite tailings. It is estimated that over 2,000 hectares of the most fertile land in the valley of these rivers is filled with tailings blown by the wind.
There are two asphalt bases in operation: the Asphalt base of the "Zaječar" road company in the area of the village of Vražogrnac and the "Minićevo" asphalt base of the company "Ogranak Integral Inženjering Niš" from Niš, in the area of the village of Selačka.
In recent years, the number of orchards has increased. They are protected from ground frost by burning straw, resulting the smoke in the village of Vražogrnac. This village is also threatened by fumes and aerosols of pesticides during the spraying of these orchards.
Private entrepreneurship in the area of Zaječar is realized in the field of trade, catering and trucking activities, but also in the field of production and services (health, dentistry, veterinary medicine, information). All business entities regularly monitor the air at their emitters (twice a year) and based on the test results, they are not the dominant source of air pollution in the territory of Zaječar.
The following state roads pass through the area of Zaječar: Route IB state road No. 35 passes through the town of Zaječar from the direction of Negotin towards Knjaževac, through the streets of Miloš Obilić and Grljanski put, with a total length of 3,064 km. The route of state road IB order number 36 passes through the inhabited town of Zaječar from the direction of Boljevac towards the Vrško Čuk border crossing (Serbia-Bulgaria border), the streets of Nikola Pašić, 7 September, Obilićev venc, Ljuba Nešić and Bolnički put, with a total length of 4,052 km. The route of the state road IIA order number 165 passes through the inhabited town of Zaječar, from the direction of Negotin to the direction of Zvezdan, through the streets of Negotinski put, Crvena Armija and Stanoj Gačić, with a total length of 4,104 km. The route of the state road IIA order number 169 passes through the town of Zaječar, from the direction of Šipikovo to the direction of Bučje, through the streets Izvorski put, Šljivarski put, with a total length of 2,002 km.

About 2,890 households and 145 buildings in the category of institutions and institutions in the inner city area are supplied with heat energy by the district heating system. The coverage of heat energy supply to households is quite low and amounts to about 21.5%. The existing district heating system of the City of Zaječar consists of four independent heating systems with separate heat sources (boiler houses):

- "Pivara" boiler house, ul. Železnička no. 2 Zaječar; above-ground tank with a maximum storage capacity of 589 t, installed capacity of 19 MW;
- "Kraljevica" boiler house, "Kraljevica" settlement bb Zaječar; above-ground tank with a maximum storage capacity of 152 t, installed power of 4.5 MW and 2.5 MW;
- "Plaža" boiler house, "Popova plaža" settlement, Zaječar, detached building; above-ground tank with a maximum storage capacity of 23 t, installed capacity of 1.5 MW;
- "Ključ" boiler house, corner of 14. Srpska Udarne Brigade and Kolubarske Zaječar streets; underground tank with a maximum storage capacity of 184 t, installed capacity of 2.5 MW and 4.5 MW.

The annual consumption of energy varies depending on the weather and amounts to 3,100 - 3,500 t/year. All boiler houses use fuel oil as an energy source - medium S heating oil.
Air quality in the territory of Zaječar has been monitored for many years (over 30 years). In particular, attention was focused on air quality during the period of operation of large polluters such as the Crystal Factory. The Institute for Public Health "Timok" in Zaječar continuously monitored the concentrations of pollutants in the air on the territory of the city until 2016. During 2009, in cooperation with the Environmental Protection Agency of the Republic of Serbia, as part of the establishment of a state network for automatic air quality monitoring in Serbia, a station for automatic air quality measurement of the inner city zone was set up, at the location between Krfska and Pana Đukić streets (narrow city center). Automatic air quality measuring station detects SO2, NO2 and SO in real time. Starting in 2019, a device for measuring the fraction of suspended particles RM10 was installed at the location next to the automatic air quality monitoring station.

ANNUAL VALUE OF CONCENTRATION OF POLLUTING SUBSTANCES									
SO_2			NO_2			PM10		CO	
µg/m³	No. of days with >1265 µg/m³	No. of hours with >350 µg/m³	µg/m³	No of days with > 85 µg/m³	No. of hours with >150 µg/m³	µg/m³	No. of days with >50 µg/m³	µg/m³	No. of days with >5 µg/m³
21	0	0	17	0	0	62	140	1,03	0

Table 4: Concentrations of pollutants in Zaječar in 2021
(Source: Agency for the Protection of the Animal Environment of the Republic of Serbia)

Due to the high concentrations of PM10 particles, the Environmental Protection Agency assessed that the air quality in Zaječar is of the 3rd category.

	2017	2018	2019	2020	2021
City of Zajecar			III	III	III

PART II
WHAT KIND OF WATER WE DRINK
II. A. Surface water

The Timok Basin

The River Timok, the most downstream tributary of the Danube in Serbia (basin area 4,630 km2), is formed by the confluence of the White Timok (2,150 km2) and the Black Timok (1,269 km2) near Zaječar. From the village of Bregovo to the mouth of the Danube (on a length of 15.5 km), the Timok is a border river between Serbia and Bulgaria. The average outflows of some watercourses (the Svrljiški Timok and the White Timok) are at the level of the average for Serbia (5.7 $l/s/km^2$) and are around 6.2 $l/s/km^2$. The rivers in the northern part (the Pek, the Šaška reka River and Borska reka River) have slightly higher specific outflows of about 7-9 $l/s/km^2$, as well as the northeastern part of the Spatial Plan area (the Trgoviški Timok) about 10 $l/s/km^2$, thanks to watercourses from Old mountains. The highest specific discharge has the upper course of the Black Timok (Bogovina dam profile) with about 13.3 $l/s/km^2$. Water resources are temporally very uneven, with large differences in the flow of small and large waters.
The town of Zaječar is located near the Black and White Timok. The Veliki Timok is formed by the confluence of the White and Black Timok, about 2.5 km northeast of the town of Zaječar, from where it flows in a northeast direction, where it flows into the Danube about 85.7 km downstream.
The municipality of Bor belongs to the low-water area, which is unable to meet the water needs of its settlements, mining and industry by drawing water only from springs on its own territory. The main reason is the very large temporal unevenness of the springs from which the settlements are supplied with drinking water. The main watercourses on the territory of the City of Bor are: the Zlotska reka River, the Brestovačka reka River, the Borska reka River, the Kriveljska reka River and the Ravna reka River. The Zlotska reka River is not polluted and its springs have been captured and wells have been built for the city's water supply. Also, a water catchment was made, from which Borsko Lake is occasionally filled with water in the case of its low level. It flows into the Black Timok near Selište. A dam was built on the confluence of the Valja Mare river and Žoni river (that make up the Brestovačka reka River) and Borsko Lake was created. The Brestovačka reka River flows through the Brestovačka spa and the villages of Brestovac and Metovnica. Communal waste water flows into it from the weekend settlements next to Borsko Lake, Brestovačka spa and urban settlements: Banjsko polje, Bor 2 and Metalurg. Waste water from the exploratory work of the new Čukaru Peki mine flowed into the Brestovacka reka River downstream from the village of Brestovac, and with the beginning of mine exploitation, partially also from the pit and mine flotation. On the Brestovačka reka River, before the discharge of waste water from the Čukaru Peki mine, a water catchment was made for the needs of this mine. The Borska reka River was cut upstream from Bor due to the opening of surface mines. The water of this river was diverted into Kriveljska reka River. In the bed of the Borka reka River, downstream from the city, there is a dry bed into which communal waste water, mine leachate from the waste disposal site and flotation tailings and from the pit, as well as untreated communal waste water, are discharged. In recent years, in its basin, downstream from the village of Slatina, pyrite tailings and flotation tailings of the new Čukaru Peki mine have been built. It represents an open waste water collector and is one of the most polluted rivers in the world. It flows into the Black Timok near Vražogrnac. In the basin of the Kriveljska reka River, there are

surface mines of the Cerovo and Veliki Krivelj mines, from which water flows without purification into this watercourse. Wastewater from the mining waste disposal site also flows into it. Downstream from Veliki Krivelj, tailings ponds were built in its valley, and the river was channeled under them through a tunnel and collector. Due to damage to the collector, polluted water from the tailings pond is entering the river. The Kriveljska reka River flows into the Borska River downstream from the village of Slatina. The Ravna reka Rriver is also affected by mining. There are quartz sand, limestone and limestone mines in its basin. It flows into the Borska reka River downstream from the confluence of the Kriveljska reka River.

Ecological and chemical status of the Great Timok and Pek Basins

With the adoption of the Law on Water in 2010 and the adoption of by-laws harmonized with it, the conditions were created for monitoring in the Republic of Serbia to be organized in accordance with the requirements of the EU Water Framework Directive (2000/60/EC). The first monitoring program of the status of surface water bodies in Serbia, which is aligned with the requirements of this directive, started in 2012. One of the key objectives of the directive is to protect the status of aquatic ecosystems, prevent further deterioration and/or improve the status of aquatic ecosystems. The success of implementing these key objectives of the directive, which are identical to the basic objective in the field of water protection as proclaimed by "Water Management Plan", is evaluated by the change in the status of water bodies.
River water quality is controlled according to national and local plans. The Ministry of Environmental Protection, through the Environmental Protection Agency, carries out regular monitoring of surface waters and reservoirs and sludge in them. Based on the monitoring results, it determines their ecological status from excellent to poor. In the period from 2000 to 2014, the Black Timok was controlled near Savinac, before the confluence of the rivers from the territory of Bor, and in Zaječar; the Borska reka River near Slatina and Rgotina; the Kriveljska reka River in Mali Krivelj and near Slatina; the White River near Slatina; the Great Timok near Vražogrnac, Čokonjar and Srbovo, and the river Pek near Kučevo, Neresnica and Kusić. Based on the results of biological and physical-chemical monitoring, the status of these rivers was determined:

Color	Status
(blue)	Excellent
(green)	Good
(yellow)	Moderate
(orange)	Poor
(red)	Bad

Table 5: Indicators of surface water status
(Source: Status of surface waters of Serbia, Monitoring Analysis and Design, Environmental Protection Agency of the Republic of Serbia, 2015)

It was assessed that the ecological status of the Black Timok near Savinac is poor. The ecological status of the Kriveljska reka River near Mali Krivelj is moderate, but downstream of the mines and flotation tailings is bad. The Borska reka River has a bad status along its entire course up to the confluence with the Great Timok, which makes its status bad. Due to self-purification and sedimentation of silt in the lake of the hydroelectric power plant near Čokanjar, there is a slight improvement in the status of the Great Timok downstream. The ecological status of the Pek River near Kučevo is poor, and moderate downstream.

Watercourse	Station	Biological elements of quality			Physical - chemical quality	Specific pollutants	Assessment of ecological status / potential
		Phytoplankton	Phytobenthos	Water macroinvertebrates			
The Black Timok	Savinac						
The Black Timok	Zaječar						
The Kriveljska River	Mali Krivelj						
The Kriveljska River	Slatina						
The Borska River	Staltina						
The Borska Rive	Rgotina						
The Great Timok	Vražogrnac						
The Great Timok	Srbovo						
The Great Timok	Čokonjar						
The River Pek	Kučevo						
The River Pek	Neresnica						
The River Pek	Kusici						

Table 6: Status of the rivers of the Great Timok and Pek basins in 2014
(Source: Status of surface waters of Serbia, period 2017 - 2019, Monitoring analysis and design, Environmental Protection Agency of the Republic of Serbia, 2021)

The mentioned study was the basis for the design of surface water monitoring. With the 2018-2019 monitoring program, new analyzes were performed and the categorization of watercourses was carried out and their status determined. In order to determine the final status of the water body, in addition to the assessment of the ecological status, an assessment of the chemical status was also carried out. Status Tags:

Color	Status
	Excellent
	Good
	Moderate
	Poor
	Bad

Table 5: Indicators of surface water status
(Source: Status of surface waters of Serbia in 2017-2019, Environmental Protection Agency of the Republic of Serbia, 2021.)

Watercourse	Class	Station	Biological elements of quality					Physical - chemical quality	Specific pollutants	Assessment of ecological status / potential
			Phytoplankton	Phytobenthos	Macrophytes	Water macroinvertebrates	Fish			
The Great Timok	2	Srbovo								
The Pek	2	Kusići								
The Danube	1	Tekija								
The Danube	1	Brza Palanka								
The Danube	1	Radujevac								

Table 8: Status of the rivers of the Great Timok, Pek and Danube basins downstream of the inflow
(Source: Status of surface waters in Serbia, period 2017 - 2019, Environmental Protection Agency of the Republic of Serbia, 2021)

The chemical status of surface waters is determined by checking whether the environmental quality standards (EQS) for priority and hazardous substances are met. The chemical status of water bodies is evaluated based on the monitoring results and is expressed as "good status" and "good status not achieved", in case at least one limit value prescribed by the Regulation on limit values of priority and priority hazardous substances polluting surface waters is exceeded.

Color	Status
	Good
	Good status not achieved

Table 9: Presentation of the assessment of the chemical status of water bodies of surface waters

Based on the results of the examination of priority hazardous substances, as part of the three-year monitoring program, authoritative values (average annual values and maximum measured values) were determined, which were compared with the values of environmental quality standards, i.e. the average annual concentration and the maximum allowed concentration prescribed by the aforementioned Regulation. The assessment included only parameters where analytical methods were applied with detection limits equal to or lower than the value of 30% of the relevant environmental quality standard.
The status of the Great Timok and the Pek basins was not determined, but only of the Danube. At Tekija, the status of the Danube was bad due to the concentration of mercury in the water, and it was good in Brza Palanka.

Watercourse	Class	Measurement place	Year of examination	Chemical status	Cause of not achieving good status	The maximum measured concentration
						μ/l
The Danube	1	Tekija	2017-2019		Hg-dissolved	0,09
The Danube	1	Brza Palanka	2017-2019			

Table 10: Status of the rivers of the Great Timok, the Pek and the Danube basins downstream of the Pek and the Black Timok estuaries in 2019
(Source: Status of surface waters in Serbia 2017 - 2019, Monitoring analysis and design, Environmental Protection Agency of the Republic of Serbia, 2015)

River sediment

Sediment plays an important role in material cycling processes in the aquatic environment and affects the transport of a significant number of nutrients and pollutants. Sediment in the rivers in the territory of the city of Bor downstream from surface mines and flotation tailings originates from the spilling of mine waters into watercourses as well as the penetration of flotation tailings into them. The Borska reka River and the Kriveljska reka River, which feed more into the Great Timok, are particularly at risk. The Brestovačka reka River, which flows into the Black Timok upstream from Zaječar, is threatened by mining operations at the new Čukaru Peka mine. Upstream from surface mines, most of the sediment in surface waters originates from the surface of soil erosion and is mainly composed of mineral components.
The Environmental Protection Agency tested the concentration of heavy metals in the sediments of rivers and reservoirs in 2015. The results of analyzes from the study Quality of river sediments and reservoirs of Serbia, Environmental Protection Agency, are cited below:
The assessment of the sediment quality, in relation to the zinc content, showed that the measured concentration in the sediment of the Pek River, on the Neresnica profile (1462mg/kg), exceeds the limit values, which indicates a level of serious and toxic effect on aquatic life.
The highest value of copper was measured in the Pek River sediment sample, sampled on the

Neresnica profile. The assessment of the quality of the sediment, in relation to the copper content, showed that the measured concentrations in the sediment of the Pek River, on the profiles of Neresnica (1190mg/kg) and Kusići (198mg/kg), exceed the limit values, which indicates a level of serious and toxic effect on the aquatic living world.

Graphics 14 and 15: Concentrations of zinc and nickel in sediments
(Source: Quality of sediments of rivers and reservoirs of Serbia, Environmental Protection Agency)

The highest value of lead was registered in the Pek River sediment sample, sampled on the Neresnica profile. The assessment of the sediment quality, in relation to the lead content, showed that the measured concentration in the sediment of the Pek River, on the Neresnica profile (275mg/kg) exceeds the limit values, which indicates a level of serious and toxic effect on aquatic life.

The highest value of cadmium was registered in the Pek River sediment sample, sampled on the Blagojev kamen profile. The assessment of the sediment quality, in relation to the cadmium content, showed that the measured concentration in the sediment of the Pek River, on the Blagojev kamen profile (112.40 mg/kg) exceeds the defined limit values, which indicates a level of probable, medium, serious and toxic effect on aquatic life.

The assessment of sediment quality, in relation to the nickel content, showed that the measured concentrations in the sediments of the Pek River on the Kučevo profile (190mg/kg) exceed the indicated limit values, which indicates a level of medium, serious and toxic effect on aquatic life.

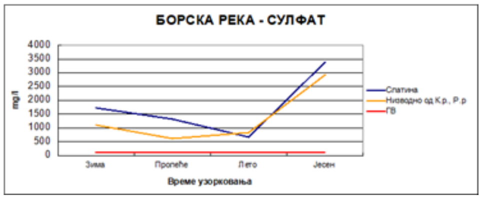
The highest value of arsenic was registered in the Pek River sediment sample, sampled on the Blagojev kamen profile. The assessment of the sediment quality, in relation to the arsenic content, showed that the measured concentration in the sediment of the Pek River, on the Blagojev kamen profile (1246.4mg/kg) exceeds the defined limit values, which indicates a level of medium, serious and toxic effect on aquatic life the world.

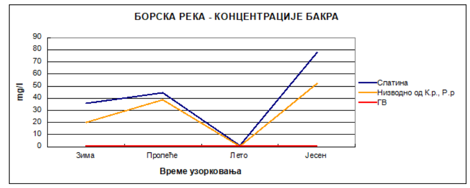
Local monitoring of the surface waters of the Brestovačka reka River, the Borska reka River and the Kriveljska reka River

The City of Bor has a regular water monitoring on its territory. During 2019 - 2021, control was carried out 4 times a year on all important watercourses.

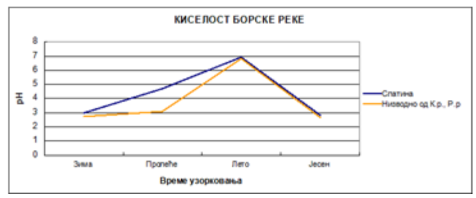
The Brestovačka reka River is controlled upstream and downstream from the Brestovačka spa and the Banjsko polje settlement and after the outflow of waste water from the Čukaru Peki mine. In all samples, the concentrations of phosphorus and orthophosphate were above the permitted values downstream from Brestovačka spa. The concentration of arsenic downstream of the water outflow from the Čukaru Peki mine was above the permitted values only in September 2021.

Special attention was paid to the examination of the waters of the rivers next to the Cerovo mine, which join the Kriveljska reka River downstream of the mine and upstream of Veliki Krivelj. The results of all tested samples showed that the Cerova reka River and the Valja Mare River, the rivers that merge to form the Kriveljska reka River, are polluted with sulfates and copper due to leachate flowing from the open-pit Cerovo mine and from the tailings dump. The Kriveljska reka River is also polluted before entering the village, and the concentration of sulfate and copper increases downstream from the flotation tailings.





Graphic 16: Sulfate concentration in the Borska River; Graphic 17: Concentration of copper in Borska River



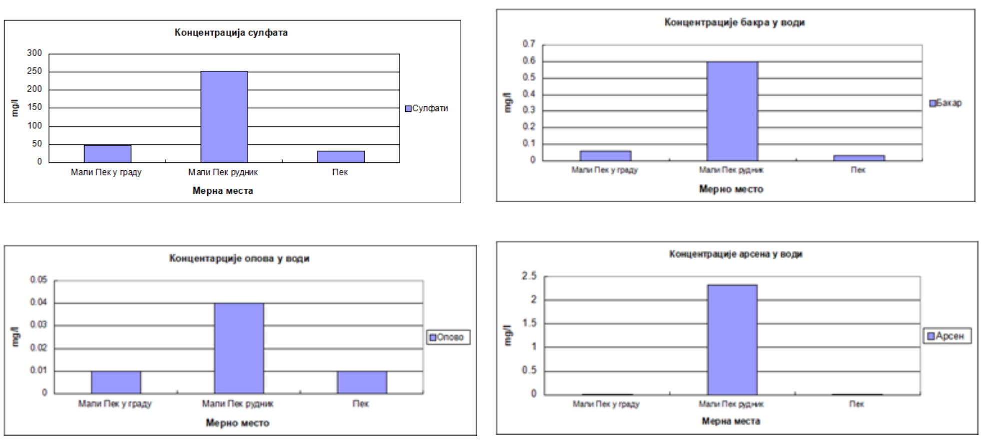
Graphic 18: Concentration of arsenic in the water of the Borska River; Graphic 19: Acidity of the Borska River
(Source: Reports on water analysis 2021, Institute of occupation health, Novi Sad)

Borska Reka is an open waste water collector. It flows through the village of Slatina and represents a permanent danger to the health of the inhabitants. There is no need to talk about the quality of life next to this river. High sulfate content is the cause of low pH value. Analyzes from 2021 speak about the impact of metallurgy on water quality. The pH value was satisfactory only in the summer period because the sampling was done during the shutdown of the smelter and the sulfuric acid factory. In that period, there were lower concentrations of sulfate as well as copper and arsenic. Downstream from the village, the Kriveljska reka River and the Ravna reka River flow into the Borska reka River. The clean water of the Ravna River dilutes the water in the Borska River, so all values are more favorable, but still far above the permitted values for the IV class of watercourses.

River monitoring in the basin of the River Pek

The River Small Pek flows through the municipality of Majdanpek (its length is about 15 km), and its river course passes through the copper mine in Majdanpek. The source of the river Great Pek is in the Homolje mountains. The length of the Great Pek is about 28 km. The Great and the Small Pek rivers form the Pek river. Pek River (29 km long), flows into the Danube near Veliko Gradište. Within INTEREG - IPA project PA2.O13. "Study on the impact of copper mining in Majdanpek on the Danube" during 2020, tests were carried out on rivers in the Pek basin. Based on the results, it can be concluded that intensive mining activities in the municipality of Majdanpek affect the quality of surface water. The lower pH values of the Small Pek water can be explained by the inflow of mining waters from the surface mine of the South Region and drainage water from the North Region into the river Small Pek. Water from the ore flotation filtration plant affected the pH value of the sample taken from the Great Pek river. The analysis of metal concentration showed a significant increase in copper and iron ions in the locations around the copper mine in Majdanpek, and this increased in the period when lower pH values and lower flow were recorded. The concentration of lead in several locations during the monitoring period was higher than the maximum allowed concentration of 14 µg/l prescribed by the Regulation on emission limit values of priority and priority hazardous substances that pollute surface waters and deadlines for their achievement (Official Gazette of the RS, number 24/2014). The presence of arsenic, manganese, zinc and nickel was observed in the analyzed water samples, which is the result of the different mineral composition of the ore in the mining complex in Majdanpek.

In February and March 2021, accumulated water was pumped from the surface mines into the Small Pek river. There was public alarm in the settlements on the coast of the Pek. In Kučevo, the wells for the city's water supply were turned off. The Regulatory Institute for Environmental Protection and Young Researchers from Bor organized the sampling of water and mud from the rivers the Small Pek and the Pek. The results showed a multiple increase in the presence of sulfate, copper, lead and arsenic in the water downstream from the mine, which indicated the influence of the pumped waters on the pollution of the Small Pek and the Pek.



Graphic 20-23: Concentration of sulfate (up, left), concentration of copper (up, right), concentration of lead (down, left), concentration of arsenic in the River Pek (Source: Report of the Institute for Public Health "Timok" Zaječar, 2021)

The water analysis was done immediately after the cessation of pumping, as the citizens testified, during the day, but occasional pumping continued during the night.

At the same time, sediment analyzes were performed. These analyzes showed that the sediment in the Small Pek River is extremely polluted. The content of arsenic in the sediment was almost 3 times higher than the remediation values, and copper was almost ten times higher. Remediation or storage of ground material in controlled conditions with special protection measures is mandatory to prevent the spread of pollutants into the environment.

Substance (mg/kg)	Limit value	Verification level	Remedial value	Measured in the mud of the Small Pek
Arsenic (As)	55	55	55	**147,6**
Cadmium (Cd)	2	7,5	12	4,83
Copper (Cu)	36	90	190	**1882,0**
Lead (Pb)	530	530	530	526,9

Table 11: Results of the analysis of sediments from the river bed of the Small Pek river
(Source: Report of the Institute of Mining and Metallurgy from Bor)

The Regulatory Institute for Renewable Energy and the Environment initiated criminal proceedings against SerbiaZiJinCopper. The company admitted its guilt and, using the institution of opportunity, entered into an agreement to pay certain funds for humanitarian purposes.

II. B. Quality of water from the fountains

Bor

Next to the stream in Bor, there were springs and fountains that were buried by the expansion of the city. A small number of them remain, testifying to the wealth of spring water in this area. Memorial fountains and water fountains have been erected in the villages, from which the inhabitants are traditionally supplied with water, especially in villages where there is no water supply to all houses, or in dry periods of the year. The mineral water fountains in Brestovacka spa is significant.
In the 19th century, the water from the Brestovačka spa was examined by doctor Hruschauer in Vienna, and Baron Herder compared this water with the waters from the spas of Switzerland and Tyrol. Josif Pančić places the springs in Brestovačka spa ahead of all the Serbian springs and right behind the Karlsbad springs in terms of healing properties. The water at the springs is between 32-40°C. The waters are oligomineral and contain potassium, calcium, sodium, magnesium, chlorine, iodine, sulfates, carbonates, etc. Today, there are four captured springs in the spa, and they are named after their healing properties, for the kidneys, stomach, eyes and nerves.
In the city itself, fountains from captured springs are located in peripheral municipalities: Sever, Staro Selište and Metalurg. Fountains from captured natural springs in Slatina, Brestovac, Gornjan, Bučje Luka, and Tanda are significant.
The city of Bor regularly controls the quality of water from these fountains. In 2021, the inspection was carried out twice, and the results on correctness are shown in the following table.

Location	Name and type of spring	Time of sampling	Quality control	Causes of unsafe drinking water
Local community Sever	Public fountain, Captured spring	26.07.	Bacteriologically defective water	Increased presence of Pseudomonas aeruginosa
		10. 11.	Safe	

Local community Staro Selište	Public fountain, Captured spring	26.07.	Safe	
		10.11.	Bacteriologically defective water	Increased presence of coliform bacteria and coliform bacteria of fecal origin
Local community Staro Selište Hajdučka voda	Public fountain, Captured spring	26.07	Chemically defective water	Increased nitrate content
		10.11.	Chemically defective water	Increased nitrate content
Local community Metalurg	Public fountain, Captured spring	26.07	Bacteriologically defective water	Increased presence of Streptococcus fecal origin
		10.11.	Safe	
Gornjane - Elementary school	Public fountain, village water supply	27.07.	Bacteriologically defective water	Increased presence of Streptococcus and coliform bacteria of fecal origin, pseudomonas aeruginosa
		15.11.	Safe	
Gornjane - near the monument in Krušar	Public fountain, Captured spring	27.07.	Safe	
		15.11.	Bacteriologically defective water	Increased presence of Streptococcus fecal origin
Gornjane - Elementary school in Krušar	Public fountain, Captured spring	27.07.	Safe	
Gornjane – Bele vode	Public fountain, Captured spring	27.07.	Bacteriologically defective water	Increased presence of coliform bacteria of fecal origin, Proteus species, pseudomonas aeruginosa
		15.11.	Bacteriologically defective water	Increased presence of Streptococcus fecal origin
Tanda – center of the village	Public fountain, Captured spring			
		07.11.	Safe	
Bučje	Public fountain, Captured spring	27.07	Bacteriologically defective water	Increased presence of coliform bacteria of fecal origin, Proteus species, pseudomonas aeruginosa
		15.11.	Bacteriologically defective water	Increased presence of coliform bacteria

				of fecal origin and Streptococcus of fecal origin
Bučje – Hladna voda	Public fountain, Captured spring	27.07.	Bacteriologically defective water	Increased presence of Streptococcus fecal origin, coliform bacteria of fecal origin, Proteus species
		15.11.	Bacteriologically defective water	Increased presence of coliform bacteria in total
Oštrelj	Public fountain, village water supply	27.07.	Safe	
		15.11.	Safe	
Brestovac	Artesian fountain	27.07.	The water can be used for drinking	pH
		15.11.	The water can be used for drinking	pH
Slatina - Šćubej	Public fountain, Captured spring	27.07.	Safe	
		15.11.	Safe	
Zagrađe	Public fountain, Captured spring			
		15.11.	Chemically defective water	Increased nitrate content
Tanda	Public fountain, Captured spring	25.07.	Safe	
Luka – center of the village	Public fountain, Captured spring	25.07.	Bacteriologically defective water	Increased presence of coliform bacteria in total and coliform bacteria of fecal origin
		15.11.	Bacteriologically defective water	Increased presence of coliform bacteria of fecal origin
Weekend settlement of Savača	Public fountain, Captured spring	10.11.	Bacteriologically defective water	Increased presence of coliform bacteria of fecal origin and Pseudomonas aeruginosa

Borsko Lake - bus interchang	Public fountain, Captured spring	10.11.	Safe	
Brestovačka spa - water for the kidneys	Public fountain, Captured spring	26.07.	Bacteriologically defective water	Increased presence of Streptococcus fecal origin
		10.11.	Safe	
Brestovačka spa - water for the stomach	Public fountain, Captured spring	26.07.	Bacteriologically defective water	pH, Increased presence of Streptococcus fecal origin
		10.11.	The water can be used for drinking	pH
Brestovačka spa - water for the eyes	Public fountain, Captured spring	26.07	Bacteriologically defective water	Increased presence of Pseudomonas aeruginosa
		10.11.	Safe	
Brestovačka spa - water for the nerves	Public fountain, Captured spring	26.07.	Safe	
		10.11.	The water can be used for drinking	pH

Table 12: Results of water analysis from fountains in Bor in 2021
(Source: Reports of the Institute for Public Health "Timok", Zaječar)

(red)	Bacteriologically defective water
(orange)	Chemically defective drinking water
(green)	The water is safe for drinking

During 2022, water was sampled from 23 fountains. In July, out of 21 controlled water fountains, 12 water was defective (1 chemically, and 11 bacteriologically) for drinking, and in November, 20 water fountains were controlled, and 10 water was defective (1 chemically, and 10 bacteriologically).

In 2021, the water was tested from 21 fountains: from 16 the water was safe for drinking, and from 5 it was defective (2 chemically and 3 bacteriologically).

The water from the "Hajdučka voda" fountain was always defective due to the presence of an increased amount of nitrates. The sudden increase in the number of bacteriologically defective waters is worrying. All this indicates that it is necessary to determine the sanitary protection zones of the source.

Zaječar

Millions of years ago there was a lake in the area of today's Zaječar basin - the remnant of the prehistoric Paratethys sea. It was formed in the Neogene, a period of time that began about 23 years ago and ended a little more than two million years ago. Then, in a shallow water environment, a series of Neogene sediments were deposited - layers of clay, sandstone and other materials and rocks. Water receded from the area of today's Zaječar in the period between nine and four million years ago, after which the terrestrial phase took over, which is still ongoing. However, as a geological memory of the sea-lake phase of the Zaječar basin, water-bearing Neogene sediments containing water-bearing horizons have remained. And precisely in those zones, artesian springs were formed - underground water that is under great pressure and the basis for most of the public (artesian) fountains in the city. Soon after liberation from the Turks and annexation to Serbia in 1833, Zaječar became an administrative seat, where numerous craftsmans and merchants began to come. Over time, the town expanded, so it was necessary to offer new solutions related to water supply. Water was then used from dug wells and it was mixed with water from pits, so at the end of the 19th century there were many diseases in Zaječar due to defective drinking water. This problem was also pointed out by the first Zaječar doctors, Laza Ilić and Dušan Petrović, who established that there were many children suffering from typhoid and that the town needed different drinking water, not from the existing wells. At his insistence, the first artesian wells were created. The oldest fountain in Zaječar was built in 1895 in the city center, on the "Great Market". It was built in honor of the people of Zaječar who died in the wars against the Turks in 1833 and from 1876 to 1878, as well as the Bulgarians in 1885, which is why it was called the Memorial Fountain. At first, it got its water from the hill of Kraljevica, that is, from the fountain of King Alexander, which was also the first form of public water supply in the city. This fountain, named after King Alexander Obrenović, was built at the end of the 19th century by workers and the army building the defense bastion "Eastern Fortress". In a similar way, the fountain of Queen Natalija, Alexander's mother and wife of King Milan Obrenović, was erected near the bastion on Koilova Čuka, on the other side of the city. These fountains are important for Zaječar because they can be considered the forerunners of all fountains from the following century and both were created by capturing springs. About 100 fountains have been built in Zaječar for more than a century, of which about thirty are currently functioning. In March 2015, 270.69 liters of water per minute flowed through the pipes of 39 fountains in Zaječar, while in 2001, the total flow in 54 of them was 444 liters per minute.

NAME OF THE FOUNTAIN	**FLOW**	**TEMPERATURE ^0C**	**GROUNDWATER LEVEL**	**CHARACTERISTIC OF WATER**
Memorial fountain on the Square	Flow - 1994 – pumping test from 5 l/s with a reduction of 17 m, 2018 – it is not measured	16,7	The depth of the well is 274 meters. Groundwater level - subartesian level at 0.5 m below ground level.	The water is of the bicarbonate sodium type. After the chemical analysis, it was safe for drinking according to all parameters.
Fountain „Zelengora“	Flow - 1995 - 0,132 l/s, 2017 - 0,09 l/s	16,2	There is no technical data on the exact location and depth of the well. Groundwater level - outflow, piezo	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of

			pressure was not measured	water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Fountain in the area of Kraljevica suburb	Flow -1995–0,064 l/s, 2017-0,064 l/s	16,5	No technical data. Groundwater level - no measurements were made	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Fountain „Ključ 3“	Flow -1983– 0.7 l/s, 2018 – 0.065 l/s	14,7	The depth of the well is 78.3 meters. Groundwater level - outflow, piezo pressure was not measured	Hydrocarbonate sodium type, during several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Marko’s fountain	Flow - 1934 - 0.21 l/s, 2018 - 0.022 l/s	15,7	The exact location of the well, which is 212 meters deep, is unknown. Groundwater level - outflow, piezo pressure was not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Tacko’s fountain	Flow - 1995 – 0,03 l/s, 2018 - 0,056 l/s	16	Groundwater level - subartesian, below ground level - outflow.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Ostrvce Fountain (near the cattle market)	Flow -1987- 1 л/с, 2018-0,225 л/с	21,7	The depth of the well is 415.4 meters. Groundwater level -	It is characterized by increased content of sulfur (S) and pH value

			after the well was drilled, the piezo pressure was 0.43 bar	(up to 8.8).
Two brothers Fountain	Flow - 1995 - 0.1 l/s, 2018 - 0.081 l/s,	15,5	Groundwater level - outflow, piezo pressure was not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except for occasionally slightly increased values for turbidity and iron (Fe).
Fountain "Near the tannery". ”	Flow - 1995 - 0,132 l/s, 2018 - 0,012 l/s	16,7	The depth of the well is 134 meters. Groundwater level - outflow, piezo pressure was not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except for occasionally slightly increased pH values (up to 8.9).
Đorđević's fountain	Flow 2004 - 0,2 l/s, 2018 - 0,125 l/s,	15,5	The well is about 160 meters deep	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
The fountain on the old Zvezdan road	Flow 1983 - 0,15 l/s, 2018 - 0,05 l/s,	15,3	The well is 106 meters deep.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.l

Fountain“Two pipes”	Flow 1983 - 1,2 l/s, 2018 - 0,43 l/s,	16	The depth of the exploration well is 183.60 meters. Outflow, piezo pressure not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Fountain in Krfska street	Flow 1995 - 0,036 l/s, 2017 - 0,03 l/s,	15,7	There is no technical data about the well.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, until the drying (August 2014) caused by the heat pump of the hotel "Srbija-Tis". After it flowed again in March 2015, the water was occasionally not recommended for drinking due to increased values for turbidity (up to 7.4 NTU), iron (Fe up to 0.72mg/l) and ammonia (NH_3 1.12 mg/l).
Nedeljko’s fountain	Flow 1982 - 2,4 l/s 2018 - 0,3 l/s.	15,2	Depth of the well 150 - 154 meters	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Fountain near secondary schools	Flow - 1937 unknown, 1995 - 0,08 l/s, 2018 - 0,04 l/s.	15,2	There is no technical data about the well. Outfow, piezo pressure not measured	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for

				Public Health "Timok" Zaječar, deviations of the measured parameters were occasionally noted, and in the last ten years the water was not recommended for drinking several times. The reason for this was slightly increased values for turbidity (up to 7.2 NTU) and iron (Fe up to 0.74mg/l).
Milošević's fountain	Flow 1995 - 0,06 l/s, 2018 - 0,081 l/s.	15,7	There is no technical data about the well. Outfow, piezo pressure not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except occasionally slightly increased values for turbidity (up to 7.8 NTU) and iron (Fe up to 0.69mg/l). .
Fountain in Branko Perić street	Flow 1985 - 0,166 l/s, 2018 -0,7 l/s.	17	There is no technical data about the well. Outfow, piezo pressure not measured	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Fountain near railway station	Flow 1995 - 0,035 l/s, 0,033 l/s	14,5 - 17	There is no technical data about the well. Outfow, piezo pressure not measured	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except occasionally slightly increased values for turbidity (up to 8.6 NTU), iron (Fe up to

				0.63mg/l) and pH (up to 8.9).
Fountain “Podliv 1”	Flow 1986 - 1,13 l/s, 2018 - 0,242 l/s	14,8	The depth of the well is 134 meters, the pressure is 0.26 bar	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Janković’s fountain	Flow 1992 - 0,038 l/s, 2018 - 0,070 l/s	16	The depth of the well is 188 meters. Outflow, piezo pressure not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of the water quality carried out by the Institute for Public Health "Timok" Zaječar was occasionally not recommended for drinking due to increased turbidity (up to 7.3 NTU) and iron (Fe 0.62 mg/l).
Fountain near “Voćar“”	The first fountain: flow 1954 - 1 l/s, 2018 – dried up; The second fountain : 1991 - 0,05 l/s, 0,014 l/s.	The first fountain 1954 - 19; The second fountain 1991 - 21, 2018 - 18,2	The depth of the well is 374 meters. Outflow, piezo pressure not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, deviations of the measured parameters were occasionally noted, and in the last ten years the water was not recommended for drinking several times. The reason for this was slightly increased pH values (up to 8.8).

Pajić’s fountain	From 2010 to 2013 dried up. Flow 1984 -0,5 l/s, 2018 - 0,025 l/s	14	The depth of the well is 171 meters, outflow, piezo pressure not measured. In the period from 2013 to 2015, there was no occurrence of the outflow.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar was occasionally not recommended for drinking due to increased turbidity (up to 8.10 NTU).
The fountain in the yard of the elementary school "Hajduk Veljko"	Flow 1995 - 0,03 l/s, 2018 - 0,021 l/s	14	One of several fountains connected to the same artesian well for which there is no technical data. The groundwater level was not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Musa’s fountain	Flow 1992 - 0,13 l/s, 2018 - 0,0 92 l/s	15,7	There is no technical data about the well. Outfow, piezo pressure not measured	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded..
Fountain near „Popova plaža“	Flow 2005 - 0,04 l/s, 2018 0,038 l/s.	15,3	There is no technical data about the well. Outfow, piezo pressure not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except for occasionally slightly increased values for ammonia (NH_3 up to 1.3 mg/l) and turbidity (up to 7.4 NTU).
The fountain in the grounds of the former	Flow 2018 - 0,4 l/s	15,4	There is no data about the depth of	There are no chemical analyzes for this

"Timočanka" factory			the well	fountain.
Fountain in the „Ključ 3“ suburb	Flow 2013 - 0,054 l/s, 2018 - 0,067 l/s.	15	There is no data about the depth of the well	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded.
Fountain near the elementary school "Ljubica Radosavljević Nada ”	Flow 1984 - 1,1 l/s, in August 2018 – dried up	16	The depth of the well is 175 meters. After drilling, the pressure was 0.6 bar	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except occasionally slightly increased values for turbidity (up to 7.6 NTU) and iron (Fe up to 0.61 mg/l).
Fountain near the former restaurant "Česma"	Flow 1995 - 0,027 l/s, 2018 - 0,275 l/s	15,8	There is no data	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except occasionally slightly increased values for turbidity (up to 7.2 NTU) and ammonia (NH_3 up to 1.19 mg/l).
The fountain near the former "Louvre" hotel	Flow 1995 - 0,068 l/s, 2018 - 0,057 l/s	16,6	There is no technical data about the well. Outfow, piezo pressure not measured.	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever

				recorded, except occasionally slightly increased values for turbidity (up to 7.4 NTU) and iron (NH3 up to 1.3 mg/ l).
Fountain of Milan Miljković	Flow 2013 - 0,024 l/s, 2018 is not measured	It is not measured	There is no information about the depth of the well. Currently sub-arterial at an elevation of 0.5 meters from ground level	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, deviations of measured parameters were never recorded, except occasionally slightly increased values for turbidity and iron (Fe).
The fountain near the football field "Kablovi"	Flow 1995 - 0,06l/s, 2018 - 0,03 l/s	14	There is no data	The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations were ever recorded.
Fountain near the "Kopaonik" warehouse	Flow 2005 - 0,032 l/s, 2018 - 0,04 l/S	14,8	There is no technical data, the exact location and depth of the well is unknown	The tests were done at the point of the second fountain, and as it is a matter of water from one well, the same values are recorded. The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except for occasionally slightly increased pH values (up to 8.8).
The fountain near the Kopaonok bridge	Flow 2005 - 0,032 l/s, 2018 - 0,015 l/s	14,8	There is no technical data, the exact location and depth of the well is unknown	The tests were done at the point of the second fountain, and as it is a matter of water from one well, the same values are recorded.

				The water is of the bicarbonate sodium type. During several decades of continuous bacteriological and chemical testing of water quality carried out by the Institute for Public Health "Timok" Zaječar, no deviations of the measured parameters were ever recorded, except for occasionally slightly increased pH values (up to 8.8).
Fountain in Oskoruša suburb	It is not known when it dried up, connected to the city's water supply network.		Subarterial, unknown level	
Turkish fountain	Flow 1932 - 0,183 l/s, 2018 – dried up		The well was drilled at 114 meters, water was used from a depth of 103 meters.	During the Second World War, there was a sign with a warning in German that the water was not for drinking. For more than four decades, water has not flowed from this fountain.

Table: 13. Fountains in Zaječar
(Source: Website of the Association Za Drinking fountains, https://www.zacesme.rs/cesme/, 28.12.2022)

The underground waters of Zajčar are threatened by natural and anthropogenic factors. Climate change leads to dry periods. Periods without rain are most pronounced in Timočka Krajina. They lead to a lowering of the groundwater level. Water is a renewable natural resource. Increasing use leads to endange the possibility for it to recirculate in nature, which leads to it also becoming a non-renewable resource. Thus, in Zaječar, in the hotel "Srbija - Tis", a heat pump was installed in order to use geothermal energy for heating. This led to the drying up of 5 fountains in 2014. Due to the drying up of the fountain in Krfska Street and four other fountains, on March 8, 2015, citizens gathered around this fountain to express their dissatisfaction and sign a petition for the protection of public artesian fountains. When, under public pressure, the hotel's heat pump was turned off at the end of March 2015, water flowed from the taps again. Association "Za Drinking Fountains" initiated criminal proceedings for environmental damage against the hotel owner. The owner of the hotel was sentenced to a prison sentence of 6 months (suspended). Unplanned urban construction without adequate communal infrastructure can lead to pollution of surface and underground water. The opening of the Čukaru Peki mine, whose waste water flows into the Black Timok upstream of the city, represents a constant, potential danger of pollution of the underground waters of the Zaječar basin. It is necessary to take comprehensive, multidisciplinary measures to protect groundwater, because the quality and quantity of groundwater is increasingly endangered.

On the initiative of the Association "Za Drinking Fountains", the City of Zaječar started the procedure of determining and verifying the underground water reserves of the Zaječar Neogene basin. In 2018, the Faculty of Mining Geology of the University of Belgrade developed the Project of Applied Hydrogeological Research of the Zaječar Neogene Basin, from which the public artesian fountains are captured on the territory of the city of Zaječar. On the basis of this Project, the Ministry of Mining and Energy of the RS adopted decision no. 310-02-00836/2018-02, which granted the City of Zaječar an exploration field of 9.13 km2 and which included almost all public artesian fountains. Also, according to the Project, the purpose of the water is classified as drinking water. In the course of conducting hydrogeological research, the Commission formed by the Ministry of Mining and Energy repeatedly insisted on changing the purpose of water use and reducing the research field.

Finally, based on the Elaborate on reserves defining the categories, classes, quantities and quality of groundwater, the Ministry of Mining and Energy issued a Decision determining and certifying the classified reserves of groundwater in the city of Zaječar No. 310-02-02162/2021-02 of October 20, 2022. With this decision, artesian waters were illegally classified into the category of technical waters. Also, this Decision recognizes only 8 public artesian taps out of 32 that were included in the investigative works. Declaring the water from the public artesian fountains in Zaječar as technical water, the Ministry of Mining and Energy left the artesian fountains without any form of protection.

The Working group for the implementation of the Decision on the protection of artesian and sub-artesian fountains in the territory of the City of Zaječar and the Agreement for the preservation, legalization, revitalization and protection of artesian fountains in Zaječar (concluded between the City of Zaječar and the Association "Za Drinking fountains") noted numerous irregularities and illegalities throughout the procedure and when making this decision.

On the order of the Working Group, the City of Zaječar filed a complaint with the Administrative Court against such an illegal Decision. At the time of writing this analysis, a court decision has not yet been made regarding the lawsuit filed by the City of Zaječar. The Association "Za Drinking Fountains", together with citizens and institutions of the local community, continues to work on determining and verifying underground water reserves, so that the Ministry of Energy and Energy will adopt a new decision that would state the existence of at least 32 public artesian fountains whose water is regularly sampled and analyzed by the Institute for public health "Timok" and classified artesian water in the category of drinking water, which it has been doing for a century.