
BELGRADE WATERWORKS GROUNDWATER SOURCE

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ABSTRACT

Paper deals with Belgrade Waterworks groundwater source (BWW GWS), its characteristics, conception of protection programme, contaminations on source and with parameters of groundwater quality degradation. Groundwaters present natural heritage with their strategic and slow renewable natural resources attributes, and as such they require priority in protection. It is of greatest need that existing source is to be protected and used optimally for producing quality drinkable water. The concept of source protection programme should be based on regular water quality monitoring, identification of contaminators, defining areas of their influences on the source and their permanent control. However, in the last 10 years, but drastically in the last 3, because of the overall situation in the country, it is very characteristic downfall in volume of business, organisation and the level of supply of the technical equipment.

Key words: groundwater source, waterworks, protection, monitoring

1. INTRODUCTION

Origins and ways of contaminations, processes that lead to endangering of riverwaters quality features, as well as bank infiltrated and groundwaters, are different in their nature, volume, level of influence, frequency of their appearance and ways of emerging. Origins of the contamination are of industrial, agricultural, traffic and thermoenergetic, as well as, especially in the last several years, existence of illegal civil constructing. During NATO strikes several different targets were in the inner zone of sanitary protection. In respect to that, there were not implemented any kind of activities in relation to environmental protection.

It is necessary to start with active protection of source, accept today EU legislation, implement monitoring system, develop dynamic inspection institutions, and manage with quality of BWW GWS through the information and simulation systems.

2. CHARACTERISTICS OF BWW GWS

Introduction

At the late eighties, BWW was very powerful company, with significant their own investments, which were in accordance with the needs of 1.5 million people developing Belgrade. Huge investments were made in structuring of source facilities. Level of maintenance of these facilities were very high. Protection of source used to be implemented very strictly, if we are to judge from today point of view. Source monitoring had functioned on the satisfactory level. Many investigations, studies and projects were done in aim of further sustaining and developing of source.

Last 10 years, especially last 3, have seen very characteristic degradation of whole business and technical concept. The consequences of that are severe water shortages during the summer period which are the direct epidemic threat for the city of 2 million. GWS is endangered with the maintenance aspects of both, quantity and quality of water.

Facilities

BWW GWS is a subsystem of water engineering system of BWW, and it is consisting of water overtaking facilities incorporated in the nature, hydrogeological and hydrological environment. Source is consisting number of radial wells in alluvial plane of the Sava river and vertical wells. There are 99 radial wells, and 46 vertical wells. Source exploitation capacity is about 5 m³/s.

Geology

There are deposits of older quaternary sediments just above underlying tertiary clays. Thickness of the sediments, which is consisting of gravels and sands, is variable and vary a range of 5 - 20 m. Above sediments, going further to the terrain surface, deposited are alluvial overlying sediments, presented by fine silts, sands, sandy clays, muds and loams, with thickness of 1.5 up to more than 10 m.

Recharging

Aquifer which is formed in alluvial and delluvial deposits in downstream Sava river, from Belgrade to Šabac, is recharging partly with surface water one that in form of atmospheric precipitations comes to the surface of this area, especially in parts where the aquifer is open towards surface of terrain. Larger amounts of surface waters, which are coming from the peripheral parts of Sava alluvion, particularly from north - east and south periphery, from the catchment surfaces that gravitate towards this aquifer, infiltrate on the peripheral parts of alluvion, doing in that way recharging of aquifer in certain level. This aquifer is recharging as well partly with water that forms as ground stream in valleys of river Sava tributaries, as well with waters from some rivers that flow on surface of Sava alluvion and then infiltrate in aquifer.

In river Sava alluvion, groundwater level is in a certain correlation with a Sava water table level. Aquifer recharging mechanism, is insufficiently studied and bilancelly researched.

Quality

Classification of these waters were made by O. A. Alekin standards. By anions, waters are classified in hydro carbonate class. By cations, waters are classified in calcium - manganese and sodium - potassium class. Widely present are iron and manganese related bacteriums, more and more sulphur and coliform bacteriums, fungi and protozoa species.

Monitoring

Discontinuance in using contemporary analytical techniques, lack of necessary equipment and materials, have made that quality of BWG GW was not examined regularly in the last 10 years (only occasionally), and from 1999. almost not at all.

Protectional Systems

Designed facilities / systems for protection of source are not constructed. That is channel network for collecting and evacuating of contaminated storm waters, facilities for treatment of industrial waters, protection system of cargo railway station Makiš, and so on. BWG GWS is endangered, not only from the aspect of yield declining, but also the aspect of degradation of groundwater quality. Environmental protection in the area of city of Belgrade, including GWS, is on the lowest possible level.

3. CONCEPTION OF PROTECTION PROGRAMME

WATER QUALITY of river Sava, as a span of the BWG GWS system, is directly dependent of the status of water protection in its catchment. Subsystem of GW overtaking, in case of an accident on the Sava river, in any case, is less vulnerable than subsystem of river water overtaking.

CONCEPTION of the source protection programme should be based on permanent water quality monitoring, identification of contaminators, defining areas of their influences on the source and their permanent control. By existing regulation, the sanitary zones and areas are defined in administrative way, as follows:

1. Direct sanitary protection zone (zone of strict supervision)
2. Inner sanitary protection zone (zone of restriction)
3. Wider sanitary protection zone (zone of supervision)
4. Protection area

STATE of some parts of source and implementation of protection measures are not in accordance with existing restricting conditions, not only in the area itself, but also in quantity and quality of water. Governmental (republic, city and municipality) inspectorate institutions were not able to implement prescribed measures by law, to protect source, because of the overall situation in the last 10 years.

4. CONTAMINATIONS ON THE BWG GWS

Origins and ways of contaminations, processes that lead to endangering of riverwaters quality features, as well as bank infiltrated and groundwaters, are different in their nature, volume, level of influence, frequency of their appearance and ways of emerging. BWG

GWS contaminants are of industrial nature (clothing, metal, metallurgic, leather, food, pharmaceutical, timber industry), agricultural activities (pesticides, herbicides, composts, artificial compounds), traffic infrastructures (highways, railways, waterways), thermoenergetic facilities (ash landfills), etc. In the inner zone of sanitary protection there are number of oil tanks. Sewer, used and industrial waters exhaust in recipients, river Sava and underground formations without any treatment.

ACCIDENTS. In the last several years, on the territory of city of Belgrade, particularly in the source zones of sanitary protection, there happened many accidents. Effusion of crude oil in river Sava (1979), leakage of xilol (1984), oil leakage (1988), effusion of vinyl chloride monomer (1990), acid leakage (1996) are only some of the examples. The fact is that in all cases, additional monitoring had defined originate conditions, contaminant was removed from the surface of terrain, and nothing has been done for soil and groundwater remediation.

NATO strikes have had several aims which are located in sanitary protection zones:

- tanks of heating plant in New Belgrade,
- oil tanks and ammunition storages in Topčider river catchment,
- oil tanks of NIS Jugopetrol in Čukarica,
- storage of Ministry of Police in Makiš,
- systems for electrical energy supply in Boljevci.

Company BWW did not conduct any measures or activities to define consequences of bombardments to environment.

5. PARAMETERS OF DEGRADATION OF BWW GW QUALITY

State of equipment of Department for Sanitary Control Laboratory is not up to the standards required for the company that attempts to satisfy needs of 2 million consumers. This is in regard to oldness of equipment, and also in regard to ability to identify certain parameters of water quality.

PHYSICAL AND CHEMICAL ASPECTS. The results of analysing available data about physical and chemical aspects of water quality, will be presented in final paper.

BIOLOGICAL ASPECT. Demotion of BWW GW quality in one hand is the result of biological activities of certain microorganisms. Existence of Fe and Mn bacteriums is proved through the years of examinations. The newest examinations show also existence of sulphur and coliform bacteriums, some anaerobic fungi, which are the proof of organic kind of contamination. From tome to time, present are also protozoa species. All these microorganisms that are found in underground formations come from the surface or from the surface waters. With their activities they take apart in dynamic formation of mineral deposits, carbonates, ferry and manganese hydroxide, forming slimes and silts, and degrading groundwater quality. Potential food reserves for these organisms are organic contaminations. During these activities, different bacteriums produce characteristic smell and strengthen their colors. Water that is overtaken with wells contains more and more dissolved organic and inorganic materials, with significant change of smell and taste of water itself.