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Surface water monitoring system of river basins

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Abstract. ***The article discusses a real-time flood risk monitoring, management and control system based on two different methods for monitoring the quantity and quality of available water - ultrasonic and visual.***

Keywords: ***control, monitoring, surface water, real time system***

I. INTRODUCTION

Surface waters, which mainly include rivers and lakes, are an important part of the country's water balance. As the main source of water for domestic and industrial purposes, they are subject to constant control in terms of quality and quantity. The purpose of water quality monitoring is to determine the state of water by observing key indicators that affect human health and the viability of ecosystems. Surface water monitoring provides information on water status for all regions of the country. It is carried out according to pre-approved programs developed by the basin directorates in accordance with the specifics of water bodies and their characteristics and in accordance with Ordinance № 1 of 11.04.2011 on water monitoring, issued by the MoEW. The programs can be for control, operational and, if necessary, research monitoring, respectively. The development of the programs takes into account a number of indicators, including the type of water bodies, their boundaries, determination of specific reference conditions for the type of water bodies and a system for classification of their condition, analysis of the impact of human activities and others. These include the performance of hydrological and morphological observations such as volume, water quantity and water level, on the basis of which the ecological and chemical status of the water body as well as its ecological potential are determined. The frequency of monitoring of the selected elements for quality and quantity and others is determined. The programs also include the preparation of a project of the monitoring network. A necessary requirement is that the network defined by the programs provides information on the ecological, chemical and quantitative status of surface waters.

II. TYPES OF MONITORING

A. Operational monitoring

The subject of monitoring for operational monitoring are water bodies for which there is a risk of non-fulfillment of the objectives set in the river basin management plan. The purpose of operational monitoring is to determine the status of these water bodies and assess any changes. Operational monitoring is performed for all water bodies that are considered to be at risk of failing to meet environmental objectives, as well as for water bodies into which pollutants are discharged. The type of source shall be taken into account when selecting and determining the number of monitoring points. Ordinance 1 states that in order to assess the magnitude of the pressure on surface water bodies during the operational monitoring, the quality indicative pressure elements must be monitored. To assess the impact of this pressure, monitoring is carried out on: parameters indicative of the biological quality element, or elements that are most sensitive to the pressure to which water bodies are exposed; all discharged priority and priority hazardous substances and other pollutants discharged in significant quantities; parameters indicative of the hydromorphological quality element most sensitive to the identified pressure.

B. Control monitoring

Control monitoring provides information on the state of the waters, on the basis of which effective future monitoring programs can be drawn up, as well as an assessment of long-term changes in natural conditions and as a result of human activity. In order to correctly assess the condition of surface waters, it is necessary to perform control monitoring of a sufficient number of

surface water bodies. The control monitoring monitors parameters indicative of all biological quality elements, hydromorphological quality elements and basic physico-chemical quality elements, pollutants from the list of priority substances discharged into the respective river basin or sub-basin, other specific pollutants that are discharged in significant quantities. Control monitoring is aimed primarily at water bodies identified as "not at risk" or "probably at risk", in order to supplement the necessary information and data to determine their status. Control monitoring needs to cover a sufficient number of surface water bodies in order to obtain comprehensive and reliable information on the overall state of surface water within the river basin or sub-basin. Among the criteria to be taken into account when selecting monitoring points are: the presence of running water with a significant amount of water; standing water with a significant water volume; Protected Areas; the specifics of the different quality elements and the different impacts; the direction of the spread of pollution and the prevailing currents for coastal sea waters and others.

C. Exploratory monitoring

Exploratory monitoring occurs in several cases. Among them are cases where environmental standards are exceeded and the reason for this is unknown; when the results of the control monitoring show that the objectives of environmental protection cannot be met, and at the same time the implementation of the operational monitoring to establish the reasons for this has not yet started. Exploratory monitoring is also carried out to establish the impact and scale of accidental pollution. The indicators that are observed are divided into three main groups: basic physicochemical - temperature, pH, insoluble matter, electrical conductivity, nutrients (NH4-N, NO3-N, PO4), dissolved oxygen, oxygen saturation, permanganate oxidation, BOD, COD, iron, manganese, sulfates, chlorides, etc.; priority substances - highly toxic, persistent and easily bioaccumulative substances and specific pollutants - organic substances, heavy metals and metalloids, cyanides, phenols and other specific substances.

D. Monitoring networks

Water monitoring networks cover precipitation and surface water networks, including floating sediments, groundwater, seawater, and wastewater control and information systems. Each of the networks includes stations and / or water monitoring stations. The precipitation monitoring network covers the monitoring of precipitation from rain, sleet, snow, wet snow, hail, sleet, as well as delayed precipitation such as dew, frost, ice, frost, wet fog. The network consists of rain gauge stations, which measure the amount of precipitation for a certain time, its type and duration, as well as the level of snow cover. Additional observations and analyzes of the intensity of precipitation and the strength, direction and duration of the wind can be performed at the stations. The Black Sea Monitoring Network may include the Black Sea Monitoring Network, as well as the Wastewater Control and Information System. The monitoring network includes stations and points for monitoring the ecological and chemical status of river waters and sediments; points for monitoring the chemical status of territorial river waters; points for monitoring the river level, the direction and speed of the prevailing currents and the wave regime, structure and substrate of the bottom. The control and information system for wastewater covers the sites forming wastewater, including the treatment plants of the settlements, which discharge into surface waters and are subject to a permit regime under the Law, as well as those for which a complex permit is required by law. for environmental protection. The design of a surface water monitoring system for river basins aims to create a platform that includes a database on the state of various environmental parameters, water areas and coastal water areas that have environmental impact and are related to the protection and sustainable development of river basins. One of the main goals is to create a spatial data infrastructure (SDI) for real-time monitoring.

The integrated system includes the construction of technical infrastructure, consisting of stations for measuring water level and rainfall and sensors for measuring wind direction and speed, humidity, temperature, atmospheric pressure and more. The other main component is the water management information system, which aims to use modern preventive approaches in the field of disaster protection and reduce the difficulties of lack of accurate and timely information on flood risk.

III. THE STRUCTURE OF THE ELECTRONIC MONITORING SYSTEM

The electronic system consists of two separate independent photovoltaic modules in order to increase the level of security and continue the operation of

reporting and sending accurate, detected by two separate independent methods information about the level and quality of water in water bodies.

A wide-angle camera is installed next to the overflow of a metal chair, monitoring the overflow itself and the general condition of the whole dam. This allows continuous control over the access of unauthorized persons in the sanitary protection zone and the water cup of the dam. If there is a walkway, there will be an ultrasonic level meter installed and another camera, which will give an accurate picture of the precisely sized line mounted on the concrete base, reflecting the water level. The level meter and the picture from the camera, following the measured line, give accurate information about the water level by two separate independent methods (ultrasonic and visual).

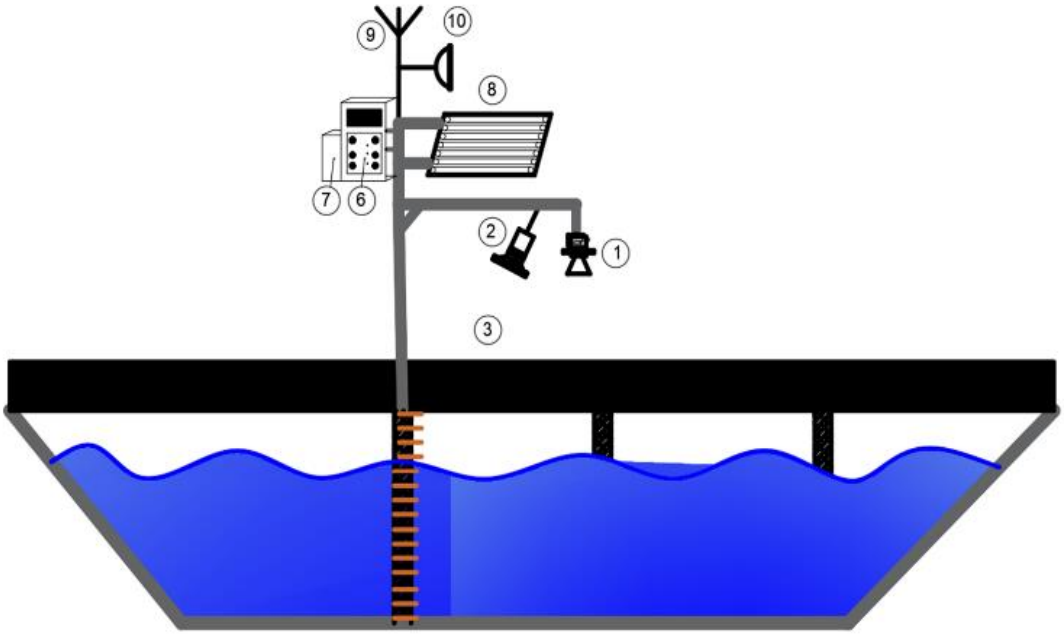

Figure 1. Electronic monitoring system

/ 1 / - Ultrasonic liquid level sensor;
/ 2 / - Video camera (monitoring the measuring line);
/ 3 / - Measuring line for level;
/ 4 / - Soil moisture sensor;
/ 5 / - Video camera (wide angle);
/ 6 / - meteorological station with built-in electronic unit;
/ 7 / - Power supply unit (7) including electronic solar controller and rechargeable batteries;
/ 8 / - Photovoltaic panels;
/ 9 / - GPRS (2G / 3G / 4G) modems for emergency data transmission;
/10/ - Directional antenna with radio module for data transmission.

Small meteorological station provides information on temperature, humidity, atmospheric pressure, rainfall per square meter. The data on the amount of precipitation from the meteorological station compared with the readings of the level meter for the water level in the dam will enable the software developed by us (based on artificial intelligence), taking into account all incoming data from the weather station in future heavy rainfall to predict rising water. This allows the necessary safe release of the required amounts of water or their transfer to areas with insufficient quantities. The release of the necessary amounts of water will be done before the onset of rainfall, which will avoid raising the level of rivers in which the dams are discharged, and this will lead to complete prevention of rivers from overflowing and puts an end to dangerous to people and property them flood. The system has the ability to install and integrate sensors to monitor the level and quality of water in rivers flowing nearby or through settlements in the area of the dam monitored by the system. During the construction of communication infrastructure, it is possible to install forest fires at a very early stage by installing thermal cameras and to notify the relevant authorities.

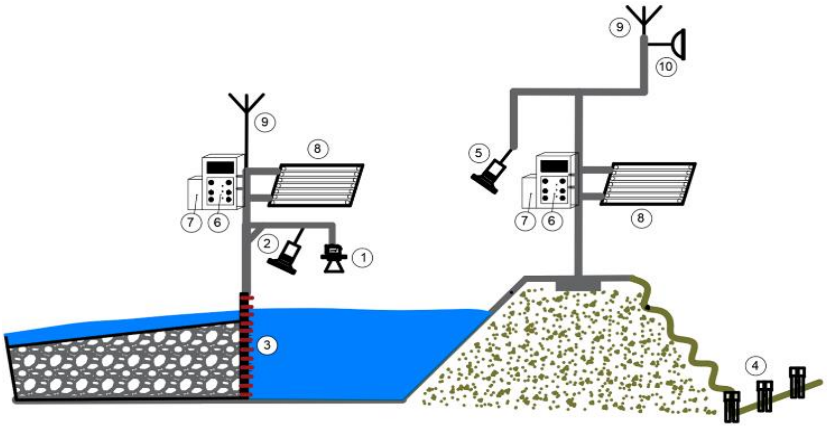

Figure 2. Monitoring and communication system.

The system allows to obtain information for measurement and monitoring of physical and chemical indicators of water quality.

The physical characteristics of water such as: temperature, amount of dissolved oxygen, pH of water, turbidity, etc. The chemical characteristics of water provide information on whether its use is safe for human health, as well as for plants and animals that live in and around watercourses.

Chemical assessment of water quality involves measurements of many elements and molecules dissolved or suspended in water. Chemical measurements can be used to detect contaminants and toxicity. A significant number of serious problems can arise as a result of chemical pollution of water resources. Water from sources that are considered to pose a significant risk of chemical or radiological contamination should be avoided. In order to obtain information on whether such a problem exists, a certain set of physicochemical parameters must be measured. The assessment of the acceptability of the chemical quality of drinking water relies on comparing the results of water quality analysis with reference values.

Where the pool is intended for the supply of drinking water, additional measurements, not limited to, inorganic substances (metals, basic ions, nutrients) may be included; organic substances (total organic carbon, hydrocarbons and pesticides). Analysis of chlorination by-products (CDBPs), trihalomethane (THMs), haloacetic acids (HAAs) and residual chlorine tests (free and total) can also be included in the water monitoring parameters. The provision of clean water to the users of the catchment area At each stage of treatment there are requests for the key parameters that must be monitored to ensure accurate and sustainable operation of the treatment process. / clean drinking water before entering the distribution network, the key parameters for detecting changes in quality during its distribution, the key parameters for monitoring changes in water quality related to the time spent in the distribution network and finally the key parameters for monitoring the quality of water in the water supply network of consumers is necessary and be determined in accordance with the characteristics of the water basin and national regulations for the provision of safe water.

The transmission of the collected information from all sensors and cameras is carried out via the Internet in two separate ways. Via wireless internet connection to digital transmission infrastructure in a nearby town. Additional security (in case of failure of the main Internet connection) is provided by a backup connection to the data transmission networks of two separate mobile operators.

One of the main advantages of the system is the ability to obtain information about the integrity of the dam wall (lack or presence of water leakage through the wall) through appropriate sensors.

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