III International Scientific Conference "**Sustainable and efficient use of energy, water and natural resources – SEWAN-2021**"

ECOLOGICAL FOUNDATIONS FOR THE FORMATION OF NETWORKS FOR AUTOMATIC MONITORING OF THE NEGATIVE IMPACT OF FOREST MANAGEMENT ON THE ECO-SYSTEMS OF THE RIVERS OF THE NORTHERN TAIGA OF THE EUROPEAN PART OF RUSSIA

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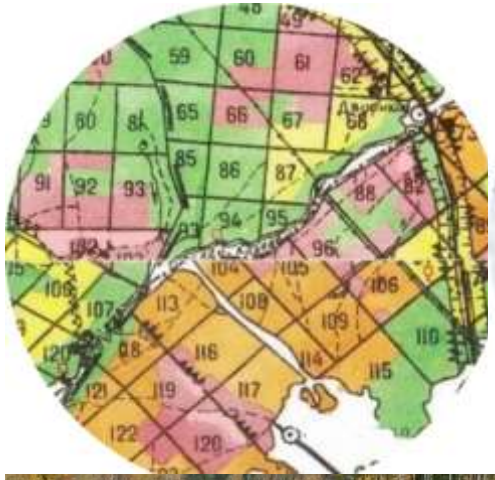

In order to preserve the valuable natural resources of the northern european taiga in conditions of active forest cuts, one of the most important issues is scientifically sound spatial planning of logging, aimed at the preserving of the natural ecological balance of valuable ecosystems.

Scientific information on the effects of logging on river ecosystems of the northern edge of the taiga zone is few and concerns mainly the biotic components of ecosystems.

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Response

Impact

The difficulty of assessing the impact of forest management upon ecosystems based on biodiversity monitoring data is due to the difficulty of organizing regular observation in outlying areas with far distance from roads, as well as the fact that biotic changes reflect already occurring ecosystem disruptions.

Regular monitoring of chemical water pollution from forest management is useful for early detection of adverse effects. Remote areas also prevent monitoring of water quality through regular sampling at stations.

An automated water quality monitoring system with remote monitoring data transmission is required for regular monitoring of river quality in forest areas.

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Automatic monitoring systems for water bodies are actively used in many countries, including in the southern regions of Russia.
It`s use in the northern areas is hampered by their maintenance costs, primarily the short life of sensors (on average no more than a year) and their high cost.

The use of a typical minimum configuration of one station equipped with 8 sensors of European or American production, stably represented on the market, ranges from 6000 to 10 000 EURO

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The purpose of this study is to develop a methodological approach to the formation of a low-budget effective network of automatic stations for the registration of hydrochemical changes dangerous to ecosystems in small rivers of the northern taiga in forest logging areas.

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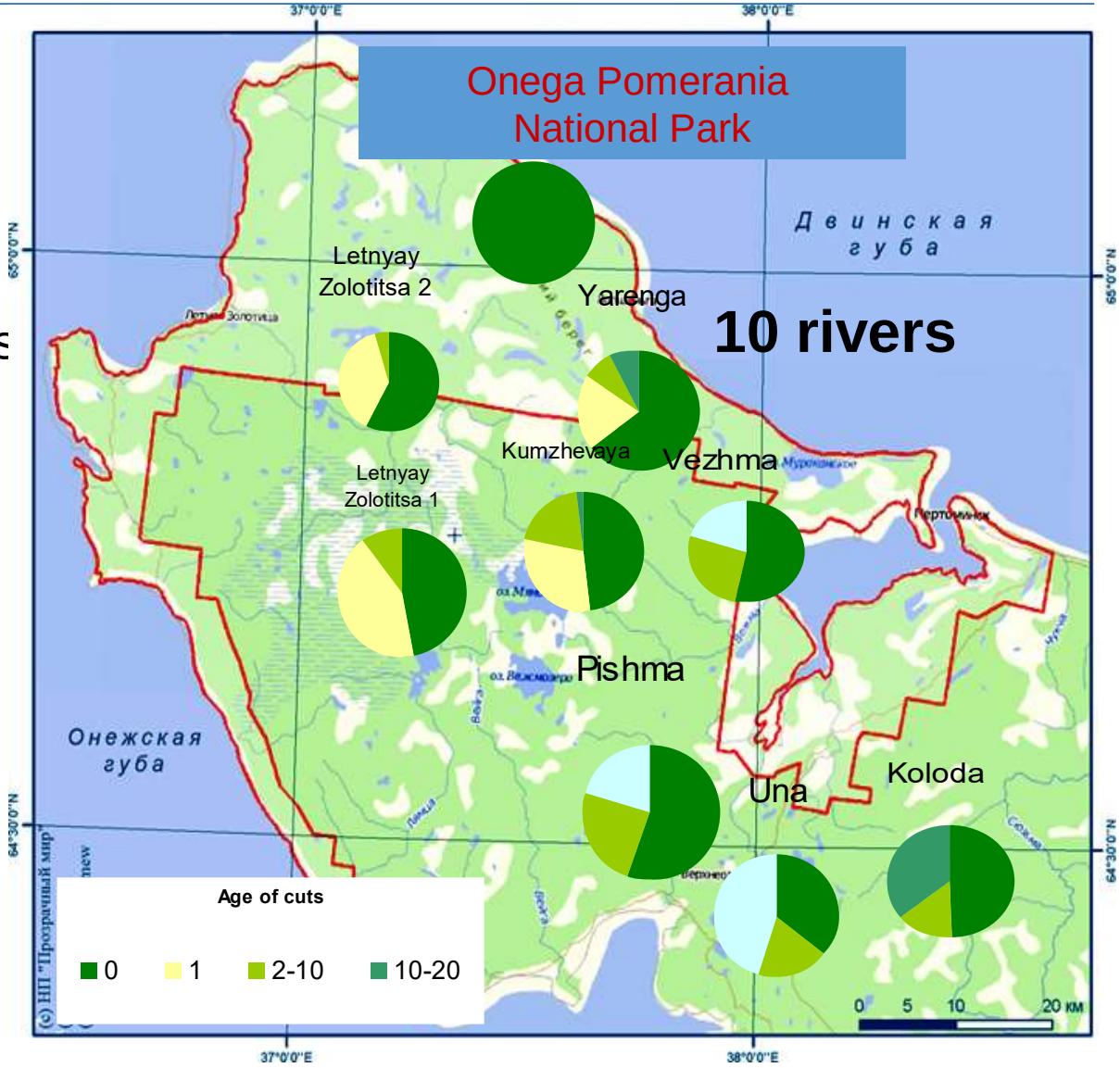
For the study, data on the state of hydrochemical parameters of the rivers of the Onega Peninsula in conditions of landscapes undisturbed by logging and in the zone of active logging were used, obtained as a result of laboratory studies of water samples collected by the expedition of the Onega Pomerania National Park on the Onega Peninsula in the summer of 2020.



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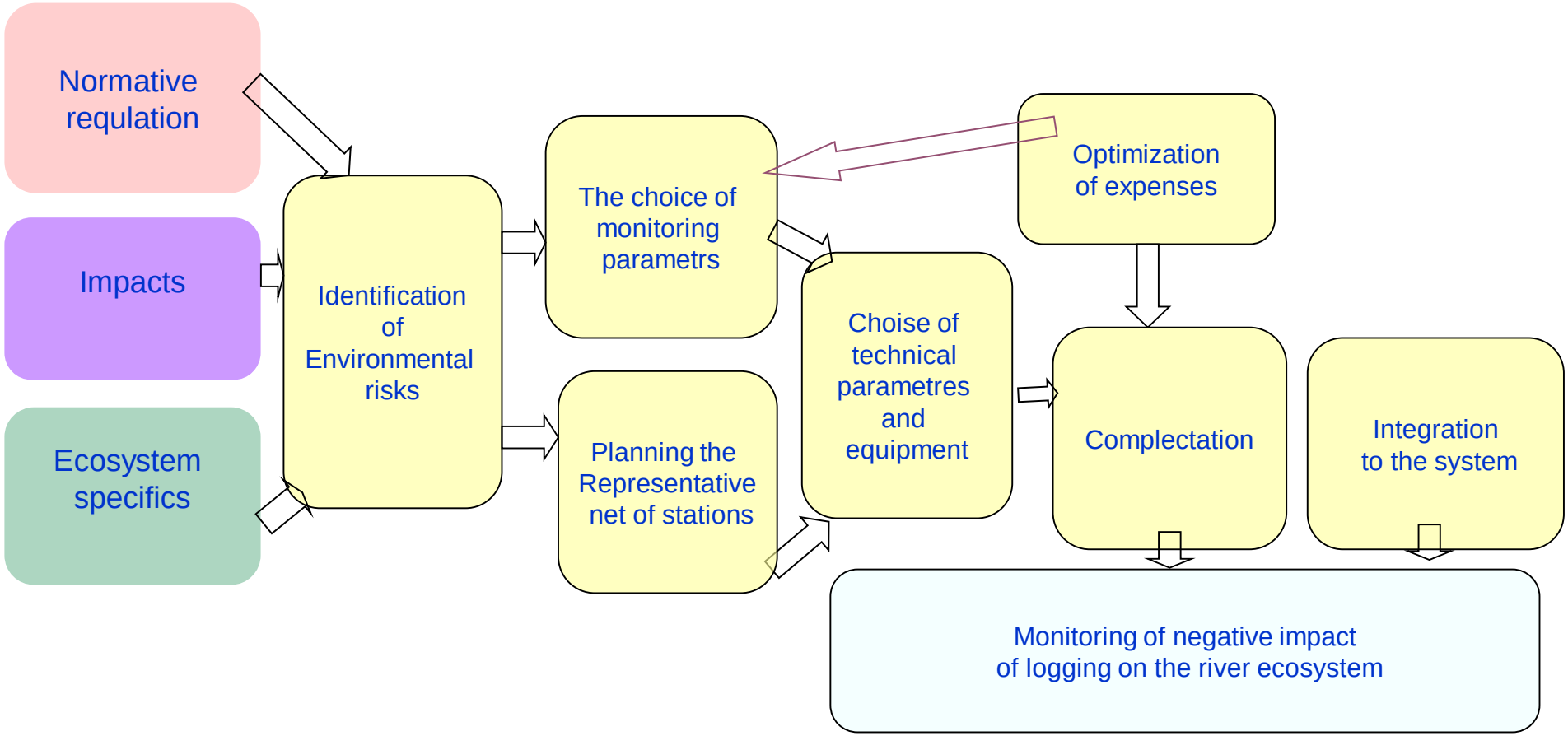
The methodological approach



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During laboratory studies using standard methods entered in the Federal Register, the main hydrochemical parameters of the water of 10 rivers of the Onega Peninsula were determined (electrical conductivity, pH, content of nitrates, nitrites, ammonium ion, phosphates, sulfates, carbonates, cationic composition of water, chemical oxygen consumption, chromaticity, turbidity, organoleptic indicators).

Indicators	**Methods**
pH	FR.1.31.2007.03794 3
Organoleptic indicators	GOST P 57164-2016
Chemical oxygen consumption	FR.1.31.2007.03794 3
NH_4 - ion	RD 52.24.394-95
NO_3-ion	RD 52.24.367-2010
NO_2-ion	PNDF 14.1:2:4.3-9
PO_4-ion	PNDF 14.1:2.112-97

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The places of the study and water sampling

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STEP 1 – Identification of key indicators of negative impact on river ecosystem

A study of these indicators and a correlation analysis have revealed river water parameters, which change significantly in logging areas and are indicators of negative changes in river ecosystems.

The result was confirmed by a parallel study of the macrophytobenthos material from these rivers, represented by species confined to eutrophic conditions.

The 2 of chemical indices have been identified, the increase of which above the standard values indicates the negative impact of logging on the investigated rivers.

It is an ammonium ion and nitrite ion and a "chemical oxygen consumption" indicator

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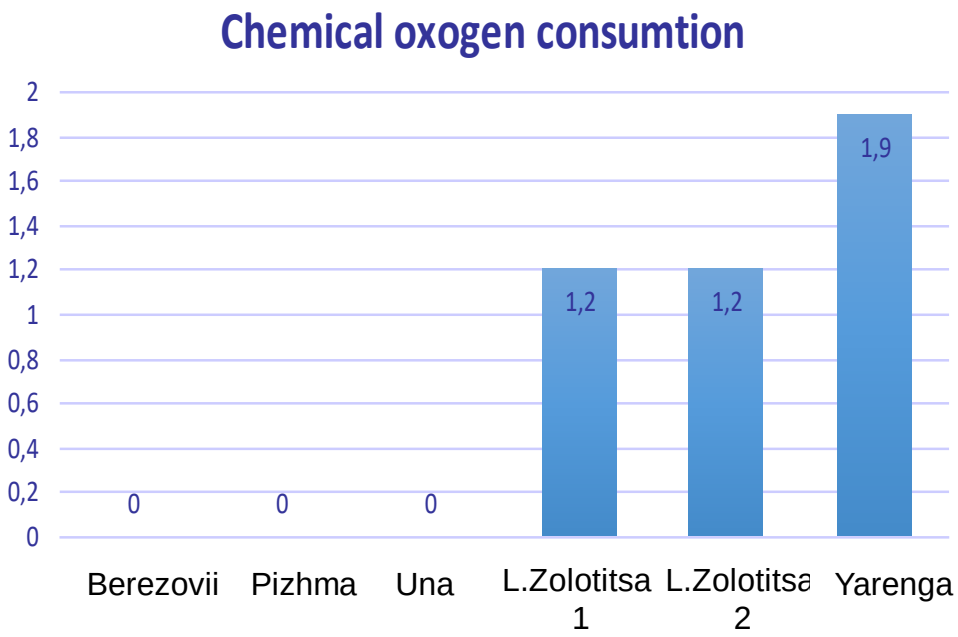
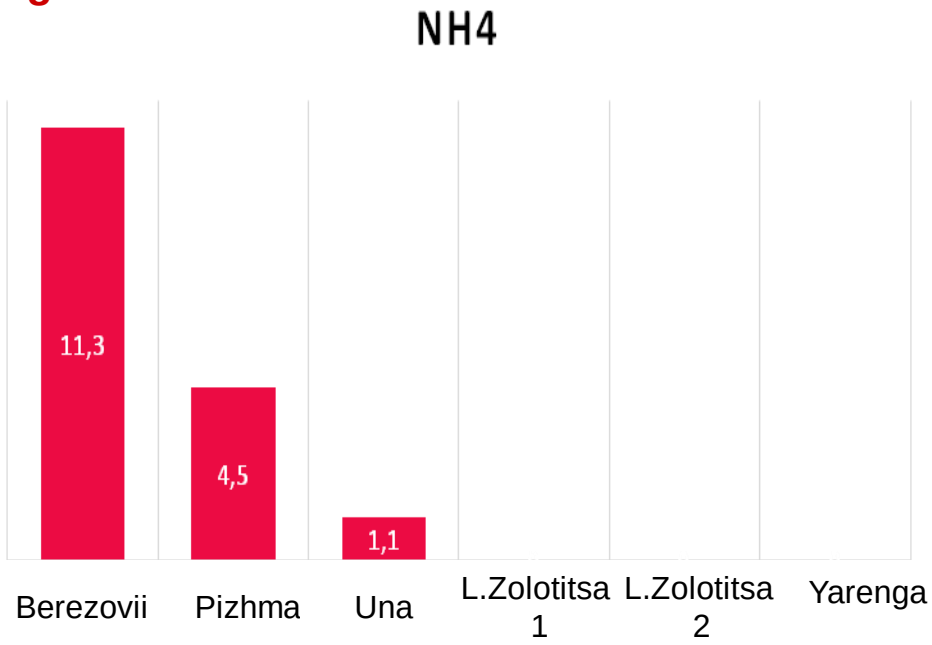
Indicator at the rivers with forest cuts of current year



Indicator at the rivers with forest cuts 3-10 years ago



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STEP 2 – Planning of the net of stations using sensors for key indicators of negative impact on river ecosystem

On the basis of the received results the plan of location of stations of monitoring of water quality of the rivers including 6 stations was developed, each of which is equipped with the sensors registering changes of 2 indicator. (ammonium ion or nitrite ion). At the same time, the annual cost of servicing such stations is no more than 2 thousand euros when using sensors of European or American production.

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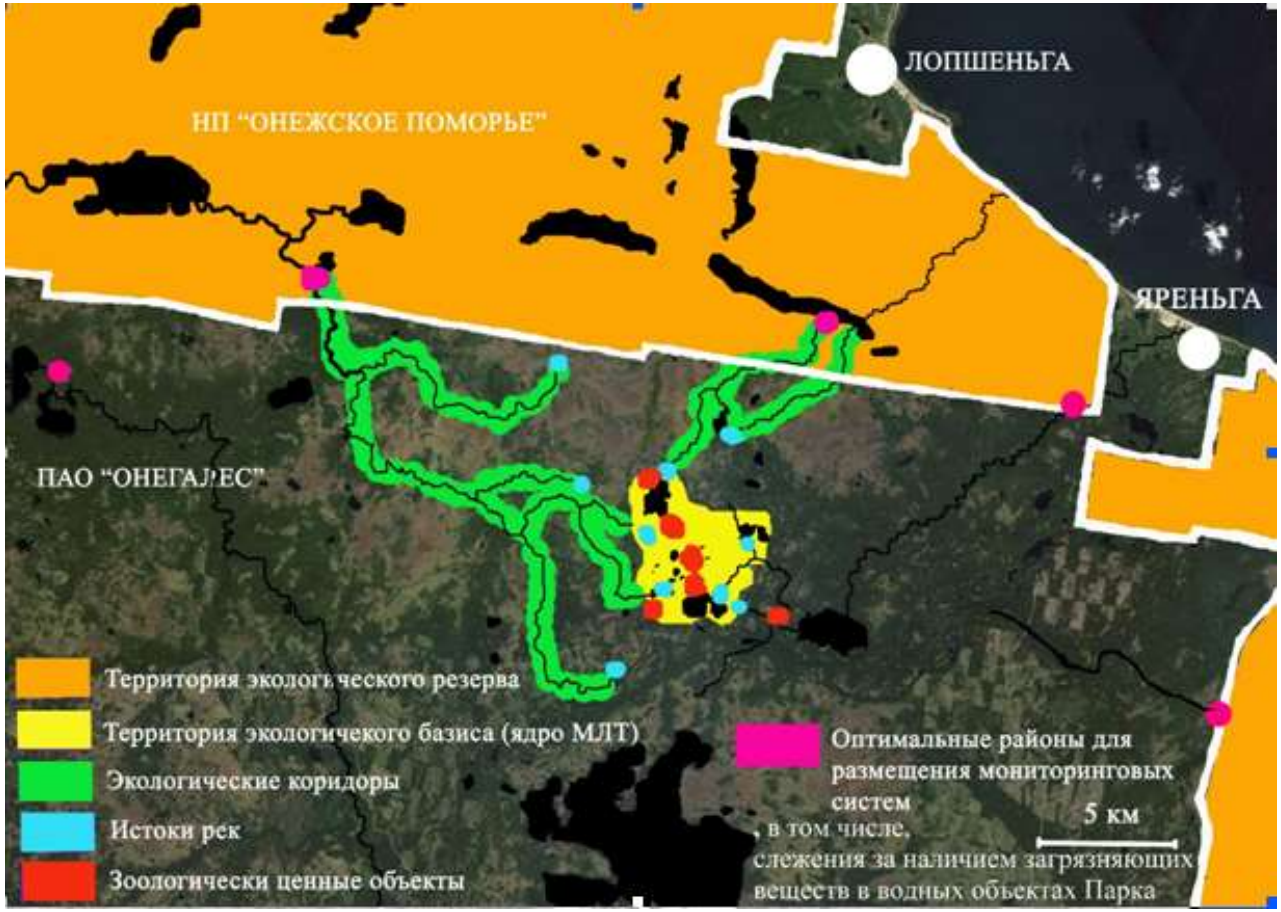
STEP 2 – Planning the representative net for river system^

-for each year of logging in the area in the water catchment basins

- taking into account all parts of hydrological system
- estimating technical possibilities of stations

Exapmle: Developed monitoring net for Una river on Onega Peninsula



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STEP 3 Complectation of automatic monitoring stations for monitorong of logging negative impact on water quality in the rivers

- Температура почвы / воды
- Проводимость
- Растворенный кислород
- pH
- Окислительно-восстановительный потенциал

- Аммоний (NH_4^+)
- Бромид (Br^-)
- Кальций (Ca^{2+})
- Хлорид (Cl^-)
- Медь (Cu^{2+})
- Фторид (F^-)
- Иодид (I^-)
- Литий (Li^+)
- Нитрат (NO_3^-)
- Нитрит (NO_2^-)
- Магний (Mg^{2+})
- Перхлорат (ClO_4^-)
- Калий (K^+)
- Серебро (Ag^+)
- Натрий (Na^+)
- pH
- Температура почвы / воды

- NH4
- Chemical oxygen Consumption

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Conclusion

- Introduction of sensor-based water quality monitoring systems in Russia is constrained by their high price and annual update costs
- The use of indicator-based monitoring significantly reduces the cost of maintaining the system
- The indicators of logging negative impact on small rivers ecosystems are studied at Onega Penninsula
- On the basis of the received results the plan of location of stations of monitoring of water quality of the rivers including 6 stations was developed, each of which is equipped with the sensors registering changes of 2 indicator (ammonium ion or nitrite ion). At the same time, the annual cost of servicing such stations is no more than 2000 EURO when using sensors of European or American production.