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PROPOSED METHODOLOGY FOR THE ASSESSMENT OF GROUNDWATER CHEMICAL AND QUANTITATIVE STATUS IN THE REPUBLIC OF BELARUS

(in accordance with the principles of the EU Water Framework Directive)

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PROPOSED METHODOLOGY FOR THE ASSESSMENT OF GROUNDWATER CHEMICAL AND QUANTITATIVE STATUS IN THE REPUBLIC OF BELARUS

(in accordance with the principles of the EU Water Framework Directive)

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On basis of the applicable regulatory legal acts of the Republic of Belarus, as well as taking into consideration the EU Water Framework Directive (WFD) requirements, for the first time for the territory of the Republic of Belarus, criteria have been proposed in order to develop a methodology for assessing the status of groundwater bodies (GWBs) in “good status”, “poor status” and “at risk” of failing to achieve good status.

Within this research work, the following tasks were undertaken:

- Inventory of the actual/current legal provisions and methodologies used in assessing GW quantity and quality in the Republic of Belarus;
- Comparison of the current methodologies used in assessing the quantitative and qualitative GW state in the Republic of Belarus with the principles of the WFD;
- Determination of criteria for assessing the quantitative and qualitative GWB status, as well as criteria for assessing risk;
- Proposal of a step-by-step methodology and its preliminary testing with real data;
- Compilation of a list of open questions that need to be solved in the future in order to improve the methodology for assessing the status of GWBs and the development of a GW monitoring system in the Republic of Belarus.

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LEGAL PROVISIONS SUMMARY

The water legislation of the Republic of Belarus is based on the Norms of the Constitution of the Republic of Belarus. Relevant laws and codes in the sphere of environmental protection are:

- Law of the Republic of Belarus as of November 26, 1992 No. 1982-XII "**On environmental protection**";
- Code of the Republic of Belarus as of April 30, 2014 No. 149-З "**Water Code of the Republic of Belarus**";
- "**Code of the Republic of Belarus on Subsurface**" as of July 14, 2008 No. 406-З and others.

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LEGAL PROVISIONS FOR GROUNDWATER MONITORING (NATURAL CONDITIONS)

The Resolution of the Council of Ministers of the Republic of Belarus as of April 28, 2004 No. 482 "On approval of provisions on the procedure for monitoring surface water, groundwater, atmospheric air, local environmental monitoring and use of these monitoring data as part of the National Environmental Monitoring System (NEMS) in the Republic of Belarus“ approved the Provisions on:

- the procedure for carrying out groundwater monitoring in the NEMS and using its data;
- the Information and Analytical Center for Groundwater Monitoring of the National Environmental Monitoring System in the Republic of Belarus, etc.

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LEGAL PROVISIONS FOR GROUNDWATER MONITORING (CONDITIONS DISTURBED BY OPERATION)

- On the basis of the Water Code of the Republic of Belarus (Article 12, clause 1.8), the Ministry of Natural Resources of the Republic of Belarus, together with the Ministry of Health of the Republic of Belarus, is responsible for maintaining the **State Water Cadastre**;
- Resolution of the Council of Ministers "Regulations on the procedure for maintaining the State Water Cadastre" as of March 12, 2010 No.345 approves the procedure for maintaining the GWC, which is systematized data on the quantity and quality of water, as well as their use;
- the Water Code of the Republic of Belarus (Article 30) defines the procedure for issuing permits for special water use (water intake from water resources or its reduction, etc.);
- the Subsoil Code (Article 33) defines the procedure for provision for a mining lease (a subsoil plot provided to a subsoil user for the extraction of minerals, etc.), etc.

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CURRENTLY USED METHODS FOR ASSESSING THE STATE OF THE HYDRODYNAMIC AND HYDROGEOCHEMICAL REGIMES OF GROUNDWATER IN BELARUS

The algorithm for sequential actions includes:

- sampling in order to determine the hydrogeochemical composition and measurement of levels to determine the hydrodynamic groundwater regime;
- collection, processing and transfer of primary information to the IAC MPV for its subsequent adding to the database "Groundwater of the Republic of Belarus";
- conclusions, findings, preparation of annual reports and editions, provision of the information received to the Ministry of Natural Resources of the Republic of Belarus and interested parties for making management decisions.

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BRIEF DESCRIPTION OF METHODS FOR ASSESSING CONDITION AND SUMMARIZING TEST RESULTS

- The applied approaches and methodologies of the EU WFD and the Republic of Belarus for groundwater monitoring have been considered;
- A comparative analysis of the approaches and methodologies of the EU WFD and the Republic of Belarus has been carried out;
- The differences and similarities in the groundwater monitoring approaches and methodologies of the EU WFD and the Republic of Belarus to have been identified;
- The consideration of certain EU approaches (e.g. “threshold value” and “starting point for trend reversal”) will be useful;
- Criteria for determining the quantitative and qualitative status of GWBs were established.

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PROPOSED CRITERIA AND METHODS FOR ASSESSING GROUNDWATER QUANTITATIVE AND CHEMICAL STATUS

CRITERIA FOR ASSESSING GWB QUANTITY STATUS

The assessment of the "**quantitative status**" of a groundwater body is based on a decrease in groundwater levels and a comparison of the actual decrease with the permissible one and on the percentage of monitoring sites within a GWB that are failing to achieve the criteria.

- For observation wells located in natural and disturbed (observation wells are located at the edges of the water intake and on the overlying aquifers) conditions, the main criterion for determining the GWB quantitative status is the decrease of the groundwater level by more than 1 m.
- For observation wells located in the center of the water intake, the criterion for the status assessment is the comparison of the actual decrease against the calculated permissible decrease.

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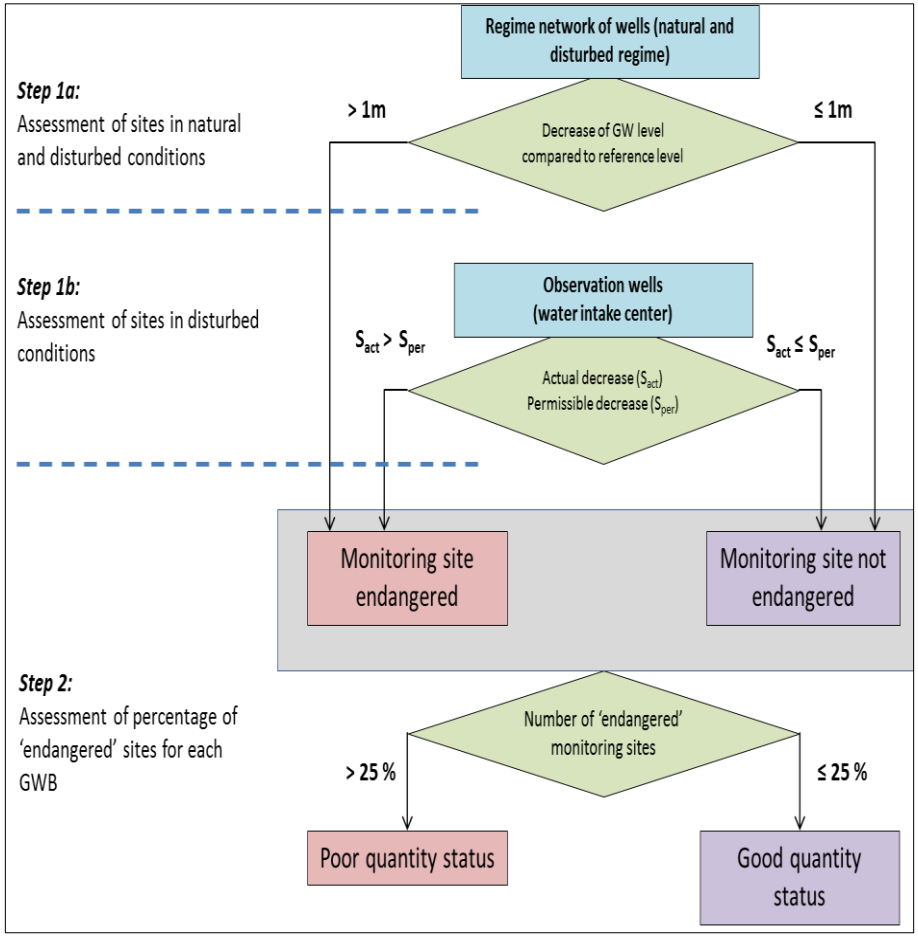
METHOD FOR ASSESSING GWB QUANTITY STATUS



Step 1a. For observation wells located in natural and disturbed conditions (observation wells located at the edges of the water intake and within the overlying aquifers), the main criterion is a decrease in the GW level. If the decrease is more than **1 m**, the monitoring site is called "**endangered**".

Step 1b. For observation wells located in the center of the water intake, the monitoring site is "**endangered**" when the actual decrease in $S_{(act)}$ exceeds the allowable decrease in $S_{(per)}$, which is established when the groundwater reserves are approved.

Step 2. The assessment of the overall quantitative status of a GWB compares the number of endangered sites with the total number of sites.

A groundwater body is of "**poor quantitative status**" when **more than 25%** of observation wells are "endangered".

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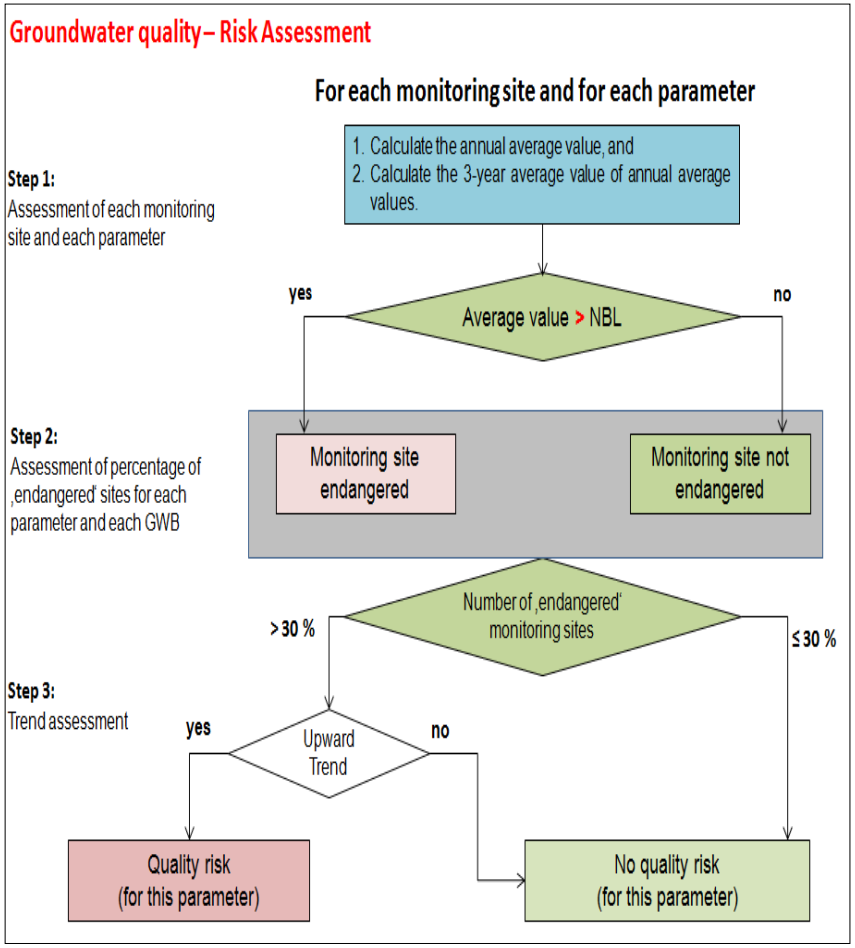
CRITERIA FOR ASSESSING THE RISK OF FAILING TO ACHIEVE GOOD GROUNDWATER QUALITY STATUS

Within the territory of the Republic of Belarus, the risk assessment of the hydrogeochemical regime of groundwater is based on comparing the actual hydrogeochemical data with natural background concentrations.

Therefore, the calculated background concentrations are the main criteria for determining the risk whether the good groundwater quality status of groundwater bodies in the Pripyat river basin cannot be achieved.

METHOD FOR ASSESSING THE GWB QUALITY RISK



Step 1. Generalization of hydrogeochemical data for monitoring wells in natural and disturbed conditions. Calculate the average value of each chemical component for each monitoring site based on data for three years.

The assessment of whether the monitored site is **"endangered"** is based on a comparison of the average value (over three years) with **the background value.**

Step 2. The assessment of the risk whether the good quality status of a GWB cannot be reached is to be done for each individual chemical component and based on a comparison of the number of endangered sites with the total number of sites.

- A GWB is **"at risk"** when **> 30%** of observation wells are "endangered" for a specific substance and exceed the background value.
- A GWB is "**not at risk"**, when **≤ 30%** of observation wells for a polluting component are not "endangered".

Step 3. In the case where **> 30%** of observation wells are "endangered", a trend assessment is necessary to identify the tendency of concentrations to increase.

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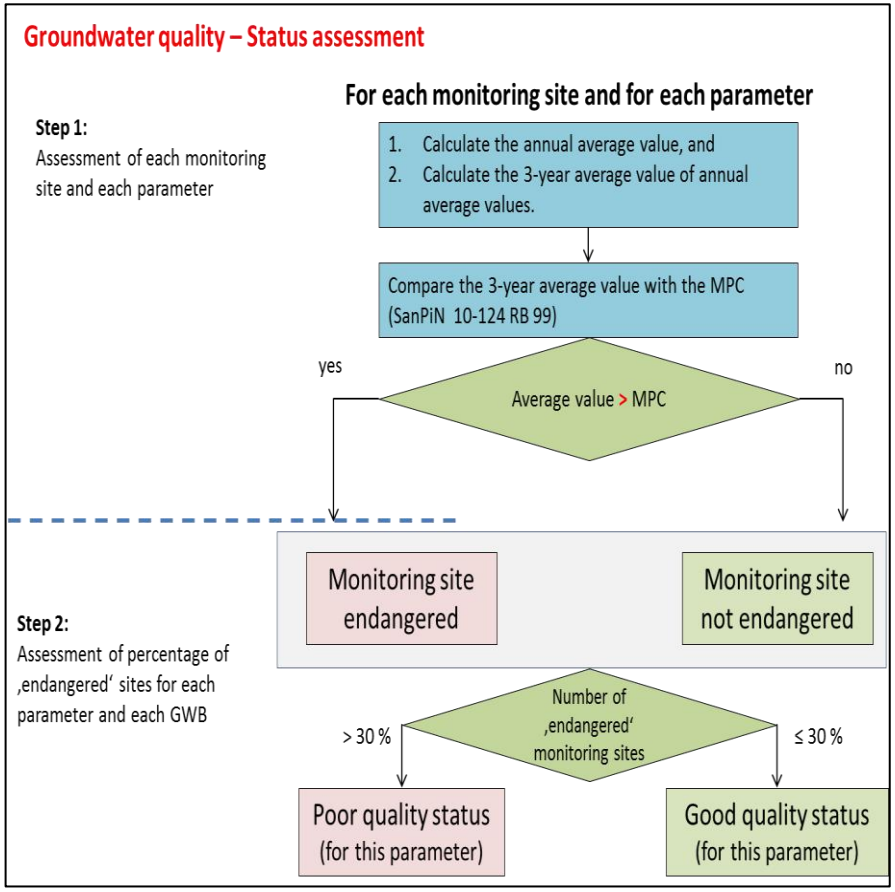
CRITERIA FOR ASSESSING GWB QUALITY STATUS

In the Republic of Belarus the assessment of the status of the hydrogeochemical regime of groundwater consists in comparing the actual hydrogeochemical data with the background and maximum permissible concentrations (established in SanPiN 10-124 RB 99).

That is why the calculated (background concentrations) and established (maximum permissible concentrations) values arethe main criteria for determining the quality status of GWBs in the Pripyat river basin.

METHOD FOR ASSESSING GWB QUALITY STATUS



Step 1. Generalization of hydrogeochemical data of all monitoring wells. For each monitoring site: Calculate the annual average values for each substance and then calculate the average value of a period of 3 years.

A monitoring site is called "**endangered**" when the 3-year average value exceeds the maximum permissible concentration (MPC) laid down in SanPiN 10-124 RB 99.

Step 2. The assessment of the overall quality status of a GWB compares the number of endangered sites with the total number of sites.

- A GWB is of **poor chemical status** when **> 30%** of observation wells are "**endangered**" and do not meet the requirements.
- A GWB has **good chemical status** of groundwater when **≤ 30%** of observation wells do not meet the requirements of SanPiN 10-124 RB 99.

TESTING OF THE PROPOSED METHODS
IN GROUNDWATER BODIES BYPRGW0002, BYPRGW0006

Groundwater quantitative status

The maximum GW level decrease in **GWB BYPRGW0002** reached 0.64m in natural conditions and 0.53 m under disturbed operating conditions, at the maximum water withdrawal in 2015.
The maximum depressions observed do not exceed 1 meter, therefore, the **quantitative status** of the GWB BYPRGW0002 is "**good**".

The maximum decrease in **GWB BYPRGW0006** reached 1 m (in 2 wells) in natural conditions. Under disturbed operating conditions, the maximum actual depressions were 2.45m and 6.49m, which did not exceed the permissible decrease of 55m and 37m, respectively, hence the **quantitative status** of the GWB BYPRGW0006 is "**good**".

TESTING OF THE PROPOSED METHODS
IN GROUNDWATER BODIES BYPRGW0002, BYPRGW0006

Groundwater quality status

The generalisation of monitoring data was performed for Nitrates. The 3-year average values of annual average values per monitoring well were calculated and compared with the Maximum Permissible Concentration.

For **BYPRGW0002** the **quality status** is "**good**" and it is "**not at risk**", since the percentage of monitoring sites exceeding the background values was ≤ 30% and no exceedance of MPC was revealed.

BYPRGW0006 is in **good quality status** and "**no at risk**" as well. The percentage of endangered sites in relation to the background and MPC was ≤30%.

CONCLUSIONS

The proposed methodological approach is the first attempt and needs to be thoroughly tested with the available groundwater monitoring data, both for groundwater bodies with dense monitoring networks and for groundwater bodies with limited groundwater monitoring.

Finally, this approach should be intensively discussed at national level before being implemented in national legislation.

Detailed information can be found in the technical report on the EUWI+ project homepage:

- Full Report

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