



LATVIJAS VIDES, ĢEOLOĢIJAS  
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# Transboundary monitoring strategy and monitoring points

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*Project WaterAct virtual seminar for experts*

April 7, 2022



**Interreg**  
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Joint actions for more efficient management  
of common groundwater resources

# Groundwater monitoring principles in Latvia and Estonia (1)

## Legislation defining the monitoring network:

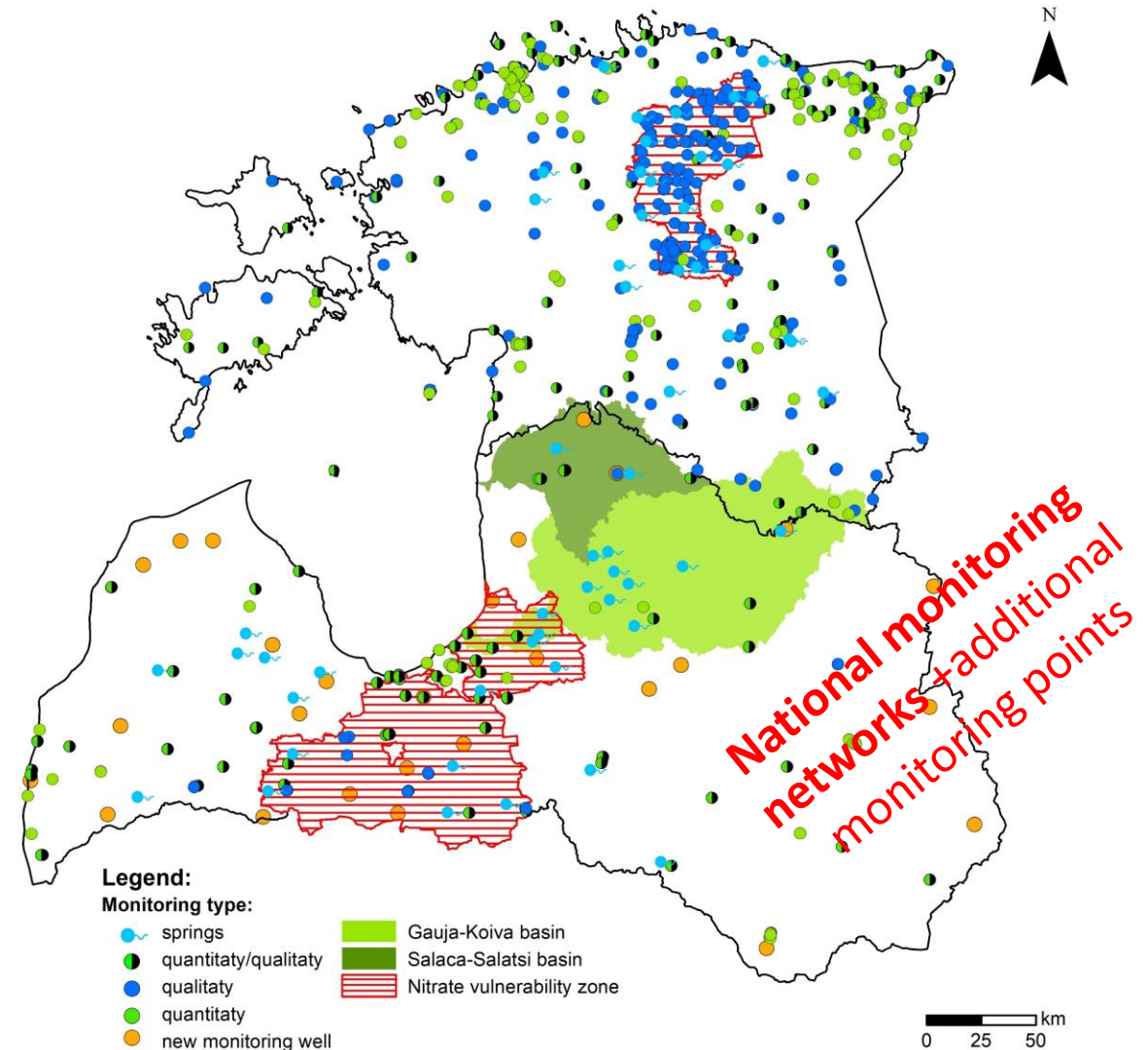
- ✓ Water Framework Directive 2000/60/EK Article 8, Paragraph 1;
- ✓ Groundwater directive 2006/118/EK;
- ✓ Nitrate directive 91/676/EK Article 5, Paragraph 6;
- ✓ Laws and regulations of each country;
- ✓ Guidance documents N<sup>o</sup>.15, N<sup>o</sup>.16, N<sup>o</sup>.26



## Groundwater monitoring principles in Latvia and Estonia (2)

### Groundwater observation purposes:

- ✓ assessment of quantitative and qualitative status;
- ✓ assessment of pressures and growth trends of pollutants;
- ✓ development of River Basin Management Plans;
- ✓ provides input for the development and evaluation of the effectiveness of groundwater protection measures.



## Groundwater monitoring principles in Latvia and Estonia (3)

- ✓ every 6 years, long-term GW monitoring programs are developed in both countries;
- ✓ each year annual monitoring plans are prepared;
- ✓ new long-term GW monitoring programme developed – in Estonia for 2022-2027, in Latvia for 2021-2026.

**Data analyses focused on new long-term program!**





# Principles of groundwater quality monitoring

## Sampling:

- ✓ GW samples are taken, transferred and analyzed in accordance with national methods, which are standardized. **GW sampling according to:** EVS EN ISO 5667-1, EVS EN ISO 5667-3, EVS EN ISO 5667-11, EVS EN ISO 5667-14.
- ✓ GW sampling are provided by well-trained specialists.



# Principles of groundwater quality monitoring (1)

## Sampling:

- ✓ After stabilization of the field parameters (pH, temperature, dissolved oxygen concentration and electrical conductivity), a water sample is taken, placed in a closed cold box and delivered to the laboratory;





# Principles of groundwater quality monitoring (3)

## Analysis:

- ✓ performed in accredited laboratories (NE ISO/IEC 17025)
- ✓ laboratory names (national accreditation number): **Estonian Environmental Research Centre (L008)** and **Latvian Environment, Geology and Meteorology Center (LATAK-T-105-34-97)**



# Principles of groundwater quality monitoring (4)

## Analysis:

- ✓ analyzed basic and additional parameters;
- ✓ minimal list of basic parameters (EC recommendations) - **Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, HCO<sub>3</sub><sup>-</sup>, NH<sub>4</sub><sup>+</sup>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, total organic carbon (TOC), P<sub>tot</sub> or PO<sub>4</sub><sup>3-</sup>** and **fieldwork parameters**;
- ✓ Groundwater Directive Annex II determines the minimal specific indicators list – **As, Cd, Pb, Hg, chemical pollutants (trichlorethylene, tetrachloroethylene)**;
- ✓ Groundwater Directive Annex I requires monitoring of **individual pesticides** and the **amount of total pesticides**.



# Principles of groundwater quality monitoring (5)

## Observed indicators of groundwater quality in Latvia and Estonia

Parameters	Latvia	Estonia
Major ions	Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>2+</sup> , Mg <sup>2+</sup> , Cl <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , HCO <sub>3</sub> <sup>-</sup> , total hardness (calculated), PO <sub>4</sub> <sup>3-</sup> , P <sub>tot</sub> , Fe <sub>tot</sub> <sup>*</sup> , <b>Mn</b>	Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>2+</sup> , Mg <sup>2+</sup> , Cl <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , HCO <sub>3</sub> <sup>-</sup> , total hardness, PO <sub>4</sub> <sup>3-</sup> , P <sub>tot</sub> <sup>*</sup> , Fe <sub>tot</sub> , <b>Dry residue</b>
Nitrogen compounds and their ionic forms	NH <sub>4</sub> <sup>+</sup> , NO <sub>2</sub> <sup>-</sup> , NO <sub>3</sub> <sup>-</sup> , N <sub>tot</sub> , <b>TOC, DOC, UV absorption, permanganate index</b>	NH <sub>4</sub> <sup>+</sup> , NO <sub>2</sub> <sup>-</sup> , NO <sub>3</sub> <sup>-</sup> , N <sub>tot</sub> <sup>*</sup> , <b>PHT, CO2 (calculated)</b>
Heavy metals	Cd, Pb, Hg, As, <b>Ni</b>	Cd, Pb, Hg, As, <b>Ba, Zn*, Cu*, Ni*</b>
Chemical pollutants	Trichlorethylene, tetrachloroethylene, 1,2-dichloroethane, <b>trichloromethane, BTEX</b> + <u>other parameters</u> (more information in Annex I)	Trichlorethylene, tetrachloroethylene, 1,2-dichloroethane + <u>other parameters</u> (more information in Annex I)
Pesticides	Atrazine, simazine, bentazone, MCPA, promethrin, propazine, 2,4-D, isoproturon, aclonifen, bifenox, aldrin, dieldrin, heptachlor, dimethoate, cypermethrin, trifluralin, tebuconazole*, epoxiconazole*, diflufenican*, metribazuzan*, metribazuran*, <b>MCPB, heptachlor epoxy, alpha-cypermethrin, pendimethalin*, azoxystrobin*, prochloraz*</b>	Atrazine, simazine, bentazone, MCPA, promethrin, propazine, 2,4-D, isoproturon, aclonifen, bifenox, aldrin, dieldrin, heptachlor, dimethoate, cypermethrin, trifluralin, tebuconazole, epoxiconazole, diflufenican, metribuzin, metazachlor + <u>other parameters</u> (more information in Annex I)

**Notes:** Basic parameters, Additional parameters, **Mn** – a parameter measured in only one country.

\* Components are included in the new monitoring program.

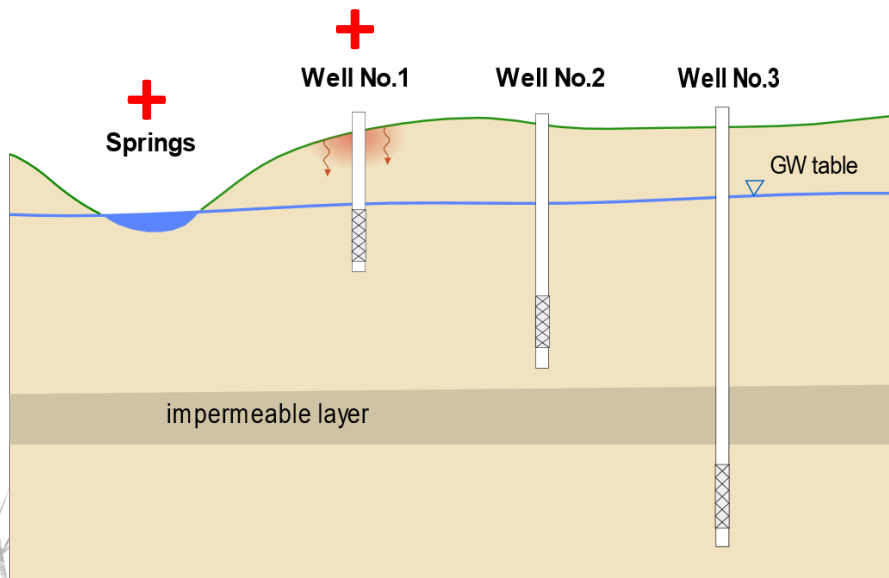
# Principles of groundwater quality monitoring (6)

**There are different principles for monitoring additional parameters!**

Latvia



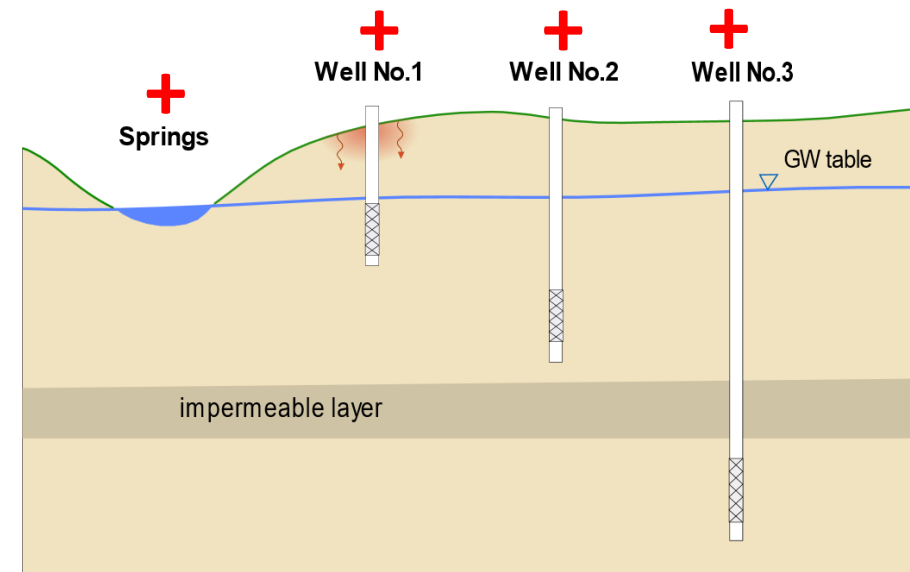
- ✓ only at points with the lowest protection
- ✓ determined according to the pressures



Estonia



- ✓ at all points, regardless of pressures
- ✓ exceptions are  $N_{tot}$ ,  $P_{tot}$ ,  $PO_4$ , Ba, Ni, Cu, Zn



# Principles of groundwater quality monitoring (7)



- ✓ methods mostly comparable
- ✓ Exemptions are pesticides and chemical pollutants

Parameter	Latvian method	Estonian method
Atrazine	EN ISO 10695:2000*	STJnrU63
Simazine	EN ISO 10695:2000*	STJnrU92
Propazine	EN ISO 10695:2000*	STJnrU63
Bentazone	US EPA Method 8151A:1996*	STJnrU92
MCPA	US EPA Method 8151A:1996*	STJnrU92
Aldrin	ISO 6468:1996	STJnrU63
Dieldrin	ISO 6468:1996	STJnrU63
Heptachlor	ISO 6468:1996	STJnrU63
2,4-D	BIOR-T-012-162-2015	STJnrU92
Isoproturon	BIOR-T-012-162-2015	STJnrU92
Aclonifen	BIOR-T-012-162-2015	STJnrU63
Biphenox	BIOR-T-012-162-2015	STJnrU63
Promethrin	BIOR-T-012-162-2015	STJnrU63
Dimethoate	BIOR-T-012-162-2015	STJnrU92
Cypermethrin	BIOR-T-012-162-2015	STJnrU63
Trifluralin	BIOR-T-012-162-2015	STJnrU63
Tebuconazole	BIOR-T-012-162-2015	STJnrU92
Epoxiconazole	BIOR-T-012-162-2015	STJnrU63
Diflufenican	BIOR-T-012-162-2015	STJnrU92
Metribuzin	BIOR-T-012-162-2015	STJnrU63
Metazachlor	BIOR-T-012-162-2015	STJnrU92
Trichlorethylene	ISO 10301:1997	ISO 20595
Tetrachlorethylene	ISO 10301:1997	ISO 20595
1,2-dichloroethane	ISO 10301:1997	ISO 20595

Parameter	Latvian method	Estonian method
Calcium (Ca)	LVS EN ISO 11885:2009	EVS-EN ISO 11885
	LVS EN ISO 7980:2000	ISO 6058
	-	SFS 3003
Magnesium (Mg)	LVS EN ISO 11885:2009	EVS-EN ISO 11885
	LVS EN ISO 7980:2000	ISO 6059
	-	EN ISO 14911
Sodium (Na)	LVS ISO 9964-3:1993	EVS-ISO 9964-3
	LVS EN ISO 11885:2009	EN ISO 14911
Potassium (K)	LVS ISO 9964-3:1993	EVS-ISO 9964-3
	LVS EN ISO 11885:2009	EN ISO 14911
Bicarbonates (HCO3)	SM 2320 B:2017	EVS-EN ISO 9963-1
Sulphates (SO4)	LVS EN ISO 10304-1:2009	EVS-EN ISO 10304-1
Chlorides (Cl)	LVS EN ISO 10304-1:2009	EVS-EN ISO 10304-1
Orthophosphate phosphorus andphosphates (PO4)	LVS EN ISO 6878:2005, 4.nod	EVS-EN ISO 6878
	-	ISO 15681-2
Total phosphorus (Ptot)	LVS EN ISO 6878:2005, 7.nod.	ISO 15681-2
Total nitrogen (Ntot)	LVS EN ISO 11905-1:1998	ISO 11905
	LVS EN 12260:2004	-
Ammonium (NH4)	LVS EN ISO 11732:2005	EVS-EN ISO 11732
	QuAAtro Method no. Q-080-06 Rev.2	SFS 3032
Nitrites (NO2)	LVS ISO 6777:1984	EVS-EN ISO 13395
Nitrates (NO3)	LVS EN ISO 13395:2004	EVS-EN ISO 13395
	-	EVS-EN ISO 10304-1
Total hardness	SM 2340 C:2017	SM 2340 C:2017
	-	ISO 6059
Total iron (Fetot)	-	SFS 3003
	LVS EN ISO 11885:2009	ISO 6332
Lead (Pb)	LVS EN ISO 11885:2009	EVS-EN ISO 11885
	-	EVS-EN ISO 17294-2
Nickel (Ni)	LVS EN ISO 11885:2009	EVS-EN ISO 11885
	-	EVS-EN ISO 17294-2
Cadmium (Cd)	LVS EN ISO 15586:2003	EVS-EN ISO 17294-2
	LVS EN ISO 11885:2009	EVS-EN ISO 11885
Mercury (Hg)	LVS EN ISO 17852:2008	EVS-EN ISO 17852
	-	EVS-EN ISO 12846
Arsenic (As)	LVS EN ISO 15586:2003	EVS-EN ISO 17294-2
	-	EVS-EN ISO 11885



## Principles of groundwater quality monitoring (8)

### Frequency of groundwater quality monitoring at monitoring points:

Country	Parameter	Survey frequency (from-to)	Sampling frequency (from-to)	Sampling points
Latvia	Basic	Once a year - once every 6 years	Once a year – 4 times a year	all points
	Additional	Once a year – 2 times in 6 years	Once a year – 4 times a year	only at points with the lowest protection or GWBs at risk
Estonia	Basic	Once a year – 3 times in 6 years	Once a year – 4 times a year (for nitrates in nitrate vulnerable stations)	all points
	Additional	Once a year – 1 time in 6 years	Once a year	all points, except in GWBs 1, 2, 3, 4 where samples are taken from half of the monitoring stations

**Additional parameters** – in Latvia indicated only in monitoring points with lower protection, in Estonia indicated in all monitoring points (exemptions - Ntot, Ptot, PO4, Ba, Ni, Cu, Zn)!

# Principles of groundwater quantity monitoring

## GW quantity indicator:

- ✓ water level

## Frequency of GW quantity observations at monitoring points:

Type/frequency of measurements		Latvia	Estonia
Manual measurements	Once a year	-	-
	4 times a year	7	-
	Once a month	70	105
	Twice a month	35	-
Automatic measurements	Twice a day	201	-
	8 times a day	-	151
<b>Total:</b>		<b>313</b>	<b>256</b>



## Summary about GW monitoring principles

Although there is a little different list of chemical parameters and monitoring frequency between countries, Estonia and Latvia carry out GW monitoring on a relatively similar basis following the WFD guidelines. This is a good foundation for harmonized TB monitoring network.





# Transboundary monitoring network (1)

- ✓ **Why** we need transboundary monitoring?
- ✓ **What** is the aim of GW monitoring?
- ✓ **What** is that we want to learn or accomplish?



# Transboundary monitoring network (2)

## Why?

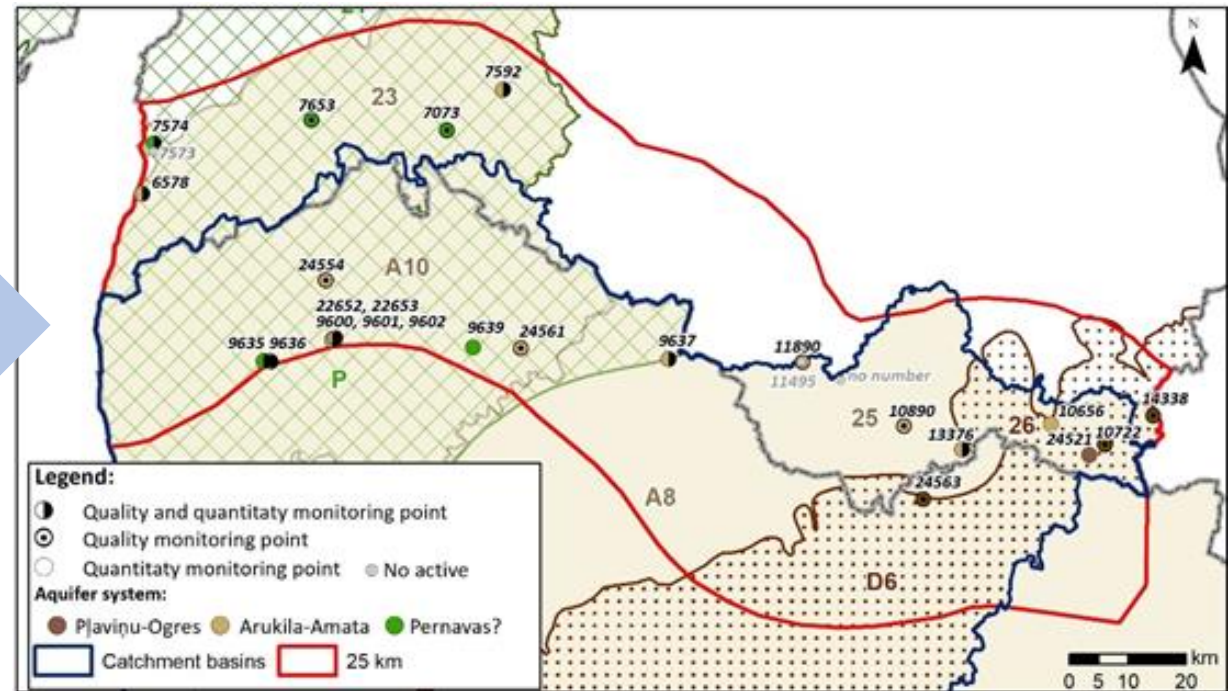
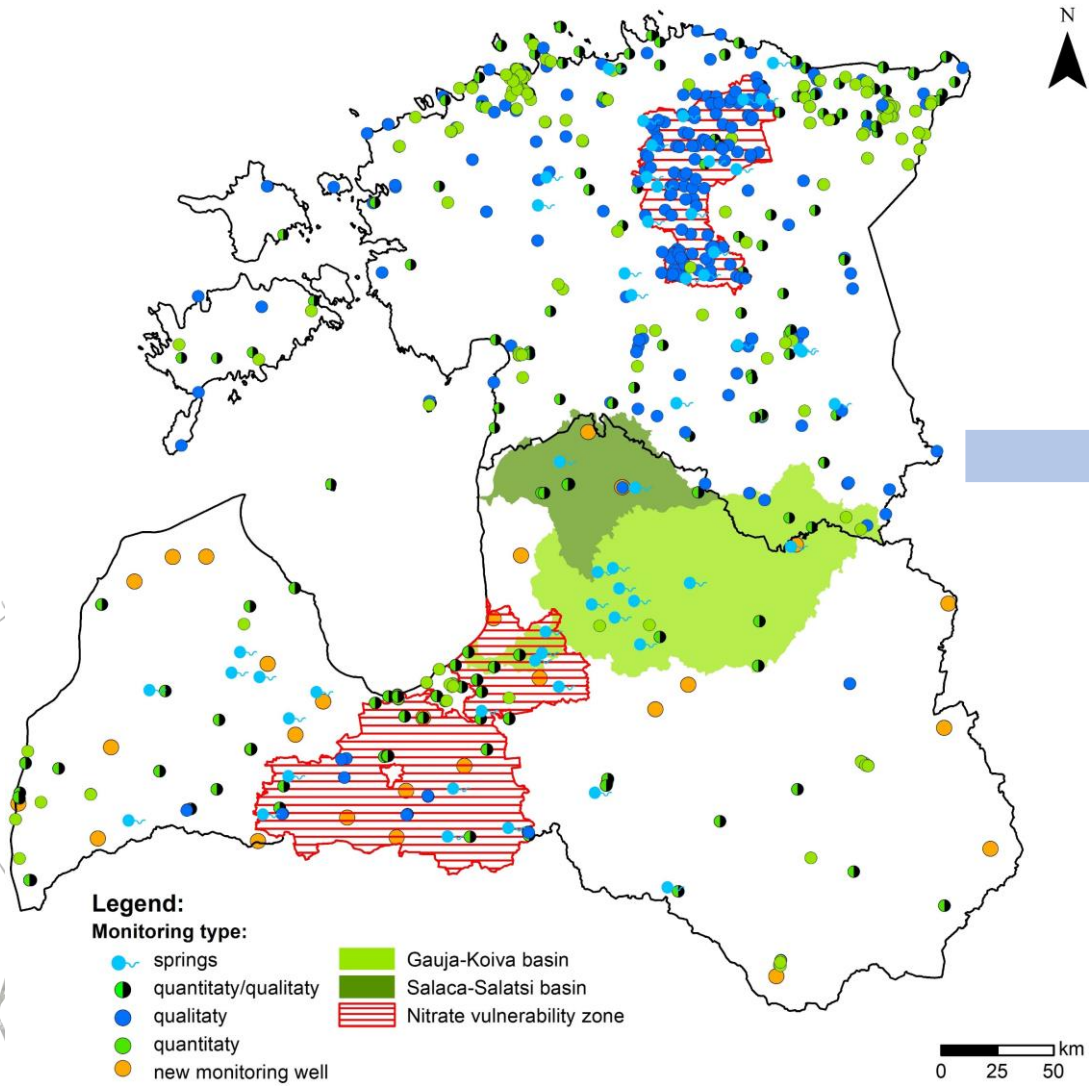
- ✓ shared groundwater resources
- ✓ identified 8 TGWBs (D26, A8, A10, P, 21, 23, 25, 26)

## What?

- ✓ determine the chemical and qualitative status of TGWBs at regional level;
- ✓ improve cooperation between countries



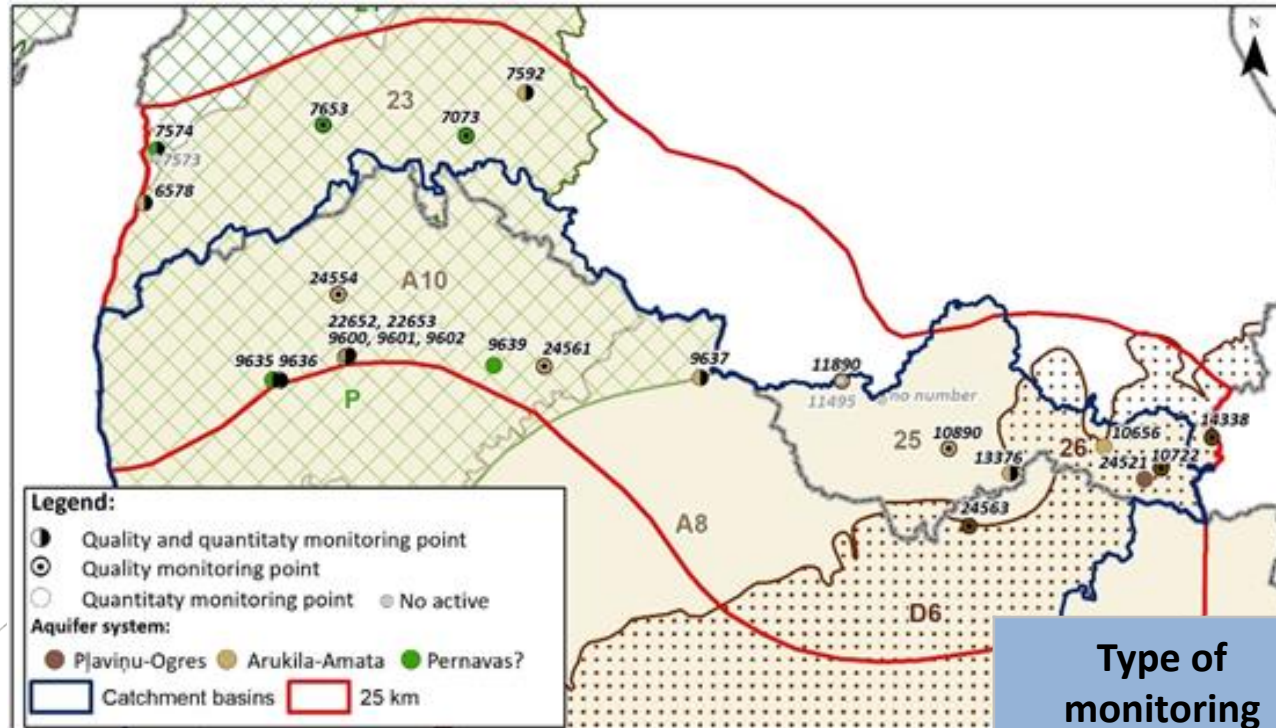
# Transboundary monitoring network (3)



It is recommended that the TM network also include monitoring points that characterize GWBs 22 and 24!



# Transboundary monitoring network (3)



- ✓ 79% quality monitoring,
- ✓ 58% quantitative monitoring,
- ✓ low density,
- ✓ recommended to focus on the development and harmonization of GW quality monitoring program.


 Only for low anthropogenic pressure!
 

Type of monitoring	GWB								Total number
	26	D6	23	25	A8	A10	21	P	
Quality	2	1	2	3	1	5	2	3	19
Quantity	1	0	2	2	1	5	1	2	14
Inactive	-	-	1	2	-	-	-	-	3
<b>Total number</b>	<b>3</b>	<b>1</b>	<b>3*</b>	<b>6</b>	<b>1</b>	<b>7</b>	<b>3</b>	<b>3</b>	<b>27</b>

## Long-term quality monitoring program

- ✓ need of data exchange,
- ✓ identified the initial list of transboundary monitoring points,
- ✓ increased attention should be paid for Gauja-Koiva river basin district



# Long-term quality monitoring program (2)

Parameters		Frequency
<b>Basic (universal) parameters</b>		
<b>Descriptive determinants (field parameters)</b>	Temperature, pH, Electrical conductivity, dissolved oxygen (O <sub>2</sub> )	<b>3 times in 6 years</b> (springs and wells which represent GWB 23, 25, 26, A8, A10 and D6); <b>2 times in 6 years</b> (wells which represent GWB 21, P)
<b>Major ions and nitrogen compounds</b>	Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>2+</sup> , Mg <sup>2+</sup> , Cl <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , HCO <sub>3</sub> <sup>-</sup> , total hardness, Fe <sub>tot</sub> , NH <sub>4</sub> <sup>+</sup> , NO <sub>2</sub> <sup>-</sup> , NO <sub>3</sub> <sup>-</sup>	
<b>Additional parameters</b>		
<b>Metals</b>	Cd, Pb, Hg, As	<b>1 time in 6 years</b> (in the all monitoring points)
<b>Chemical pollutants</b>	Trichlorethylene, Tetrachlorethylene, 1,2-dichloroethane	<b>1 time in 6 years</b> (only in the monitoring points, which parameters analyzed)
<b>Pesticides</b>	Atrazine, Simazine, Propazine, Bentazone, MCPA, Aldrin, Dieldrin, Heptachlor, 2,4-D, Isoproturon, Aclonifen, Biphenox, Promethrin, Dimethoate, Cypermethrin, Trifluralin, Tebuconazole, Epoxiconazole, Diflufenican, Metribuzin, Metazachlor	

**Initial list!!  
Could be changed!**

## Long-term quality monitoring program (3)

- ✓ agreement needed between LEGMC and EEA (in process)
- ✓ forwarding monitoring results in April-May each year?





# Thank you!

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