Status, problems and proposals for improving, planning and implementation of the monitoring for the 2nd RBMps

Workshop on monitoring

EUROPE-INBO 2013

November 13, 2013, Plovdiv, Bulgaria

Groundwater monitoring network for chemical status

- The Groundwater monitoring in the frame of the Ministry of Environment and Water existed from 1980
- The monitoring programs and networks for chemical status have been changed at 2006, 2007, 2010 and 2013 (sampling sites were addopted to GWBs).
- The number of monitoring sampling sites have been changed as folows:

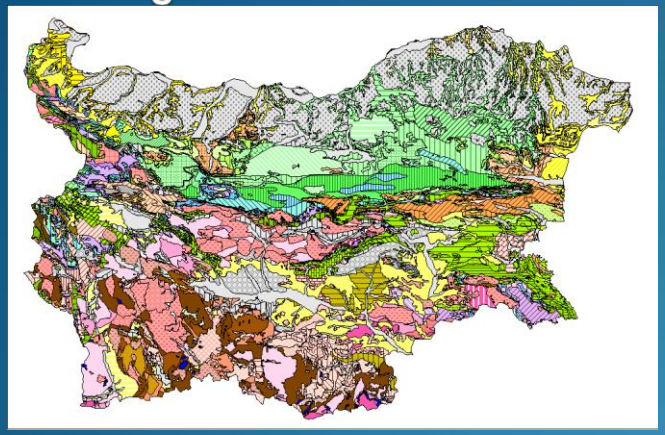
RBD	Real number of GW sampling sites - 2006 according to the Orders N-192/11.05.1998 r. and N - RD-593/4.8.2006	Real number of GW sampling sites - 2007 according to the Orders N- RD-593/4.8.2006 And N- RD 867/29.11.2007	Real number of GW sampling sites - 2008 according to the Order N- RD-867/29.11.2007	Real number of GW sampling sites - 2009 according to the Order N- RD-867/29.11.2007	Real number of GW sampling sites - according to the Order N-715/ 02.08.2010	Sampl. Points according to the Order N-182/ 26.02.2013
Danube RBD	100	68	93	97	99	99
Black Sea RBD	73	50	43	94	67	90
East Aegean RBD	191	141	98	98	97	112
West Aegean RBD	74	45	43	38	37	38
Total	438	304	277	327	300	339

GWB identification and delineation

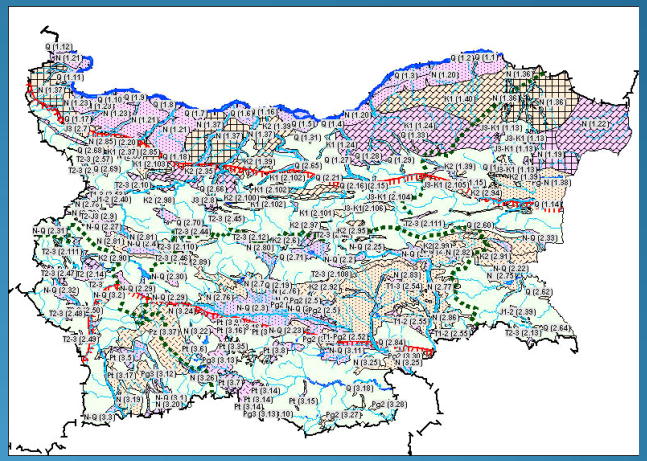
- The main unit for groundwater management and monitoring in compliance with WFD is groundwater body. “Body of groundwater” means a distinct volume of groundwater within an aquifer or aquifers.
- So identification of groundwater bodies and delineation in GIS were made initiallu at 2004 in ExEA (under implementation of Groundwater Netherland project)
- after a modifying by Working group in MoEW (by groundwater and GIS experts in MoEW, RBD and ExEA) were made. The identification of GWBs were made on the basis of the basis of hydrogeological and geological characteristics of the rocks and other hydraulic boundaries .
- In first variant of GWBs – “white spots” have been available – in the regions with low permeable rocks
- The last version of GWBs was finished at 2009

The starting point for identifying the geographical boundaries of a groundwater body should be geological boundaries to flow

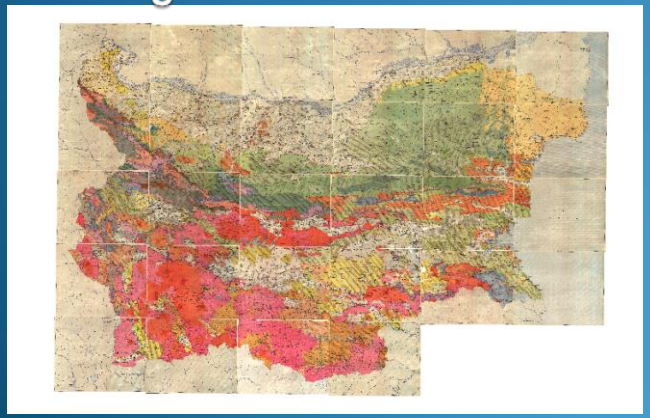
Vector geological map of Bulgaria in Scale 1:100 000



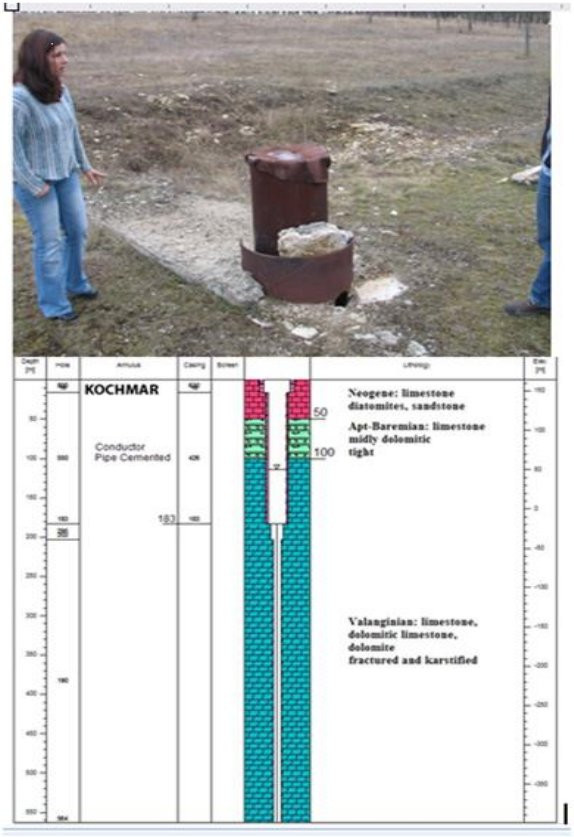
Vector hydrogeological map of Bulgaria in Scale 1:500 000



Raster hydrogeological map of Bulgaria in Scale 1:200 000



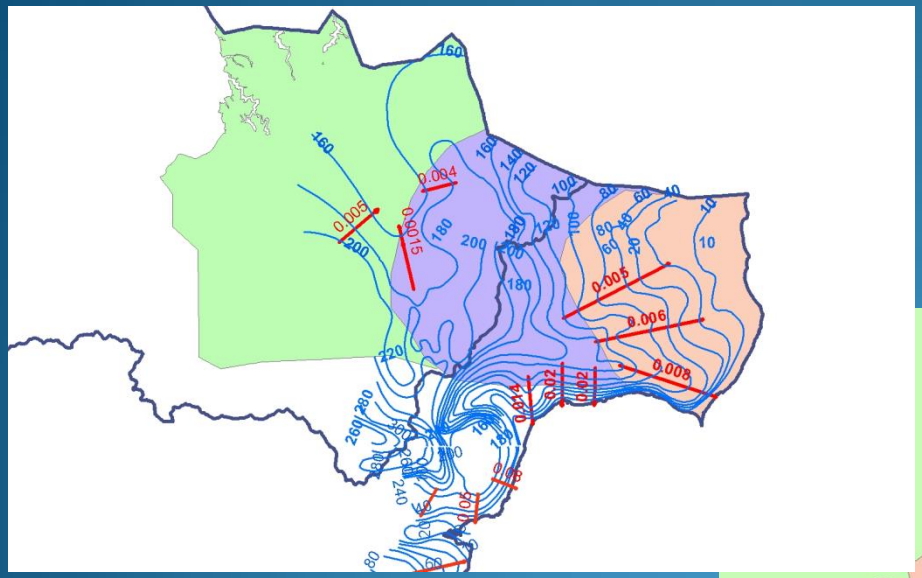
The available lithological data in boreholes, have been used – one example

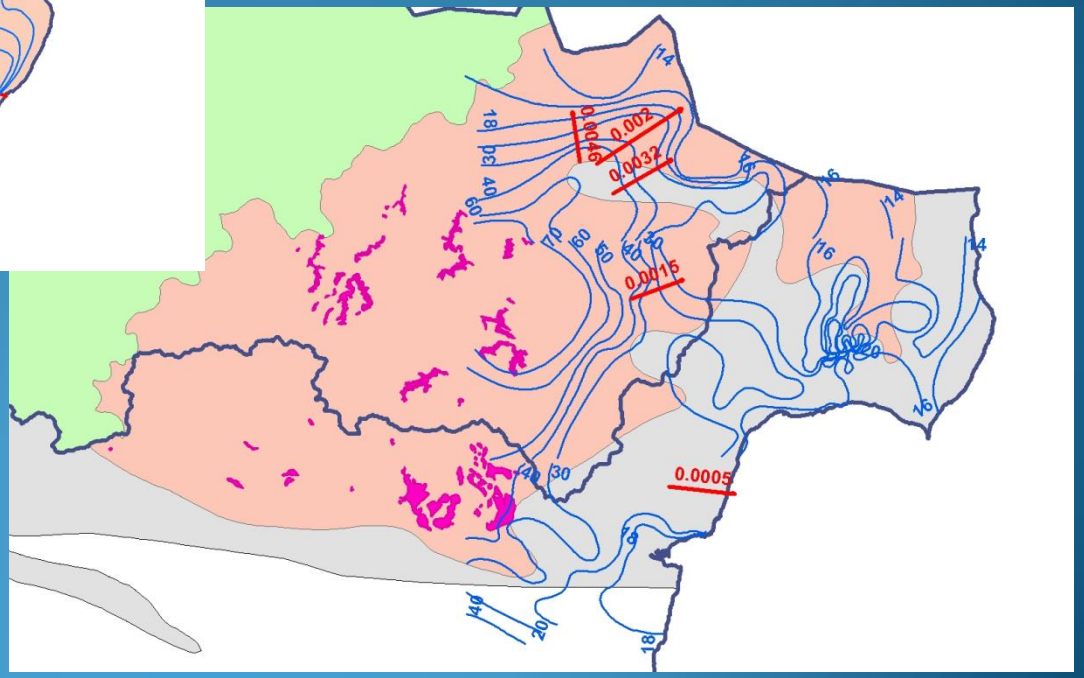


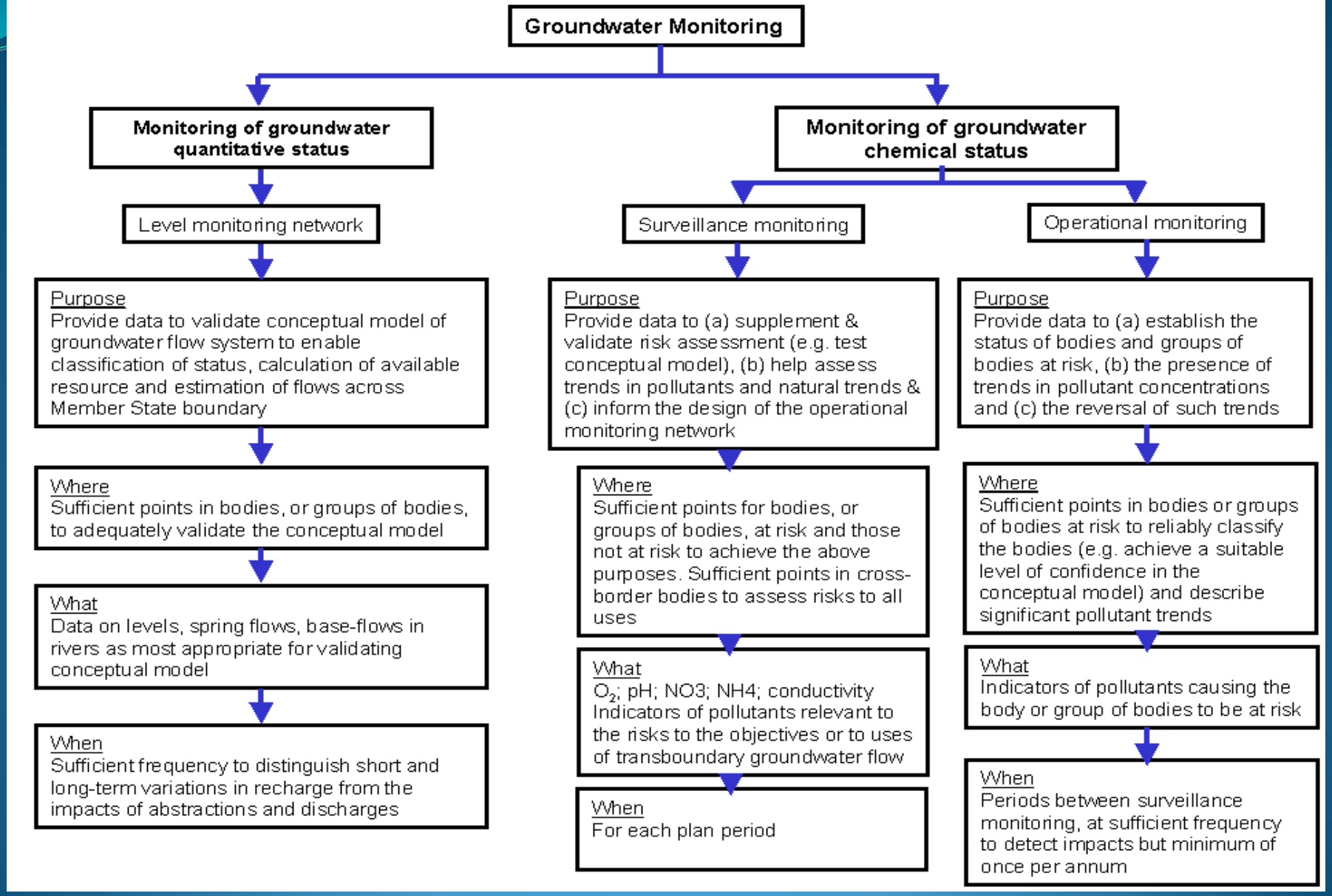
Well at Kochmar, 1km SE of village.

X=538426; Y=4837610

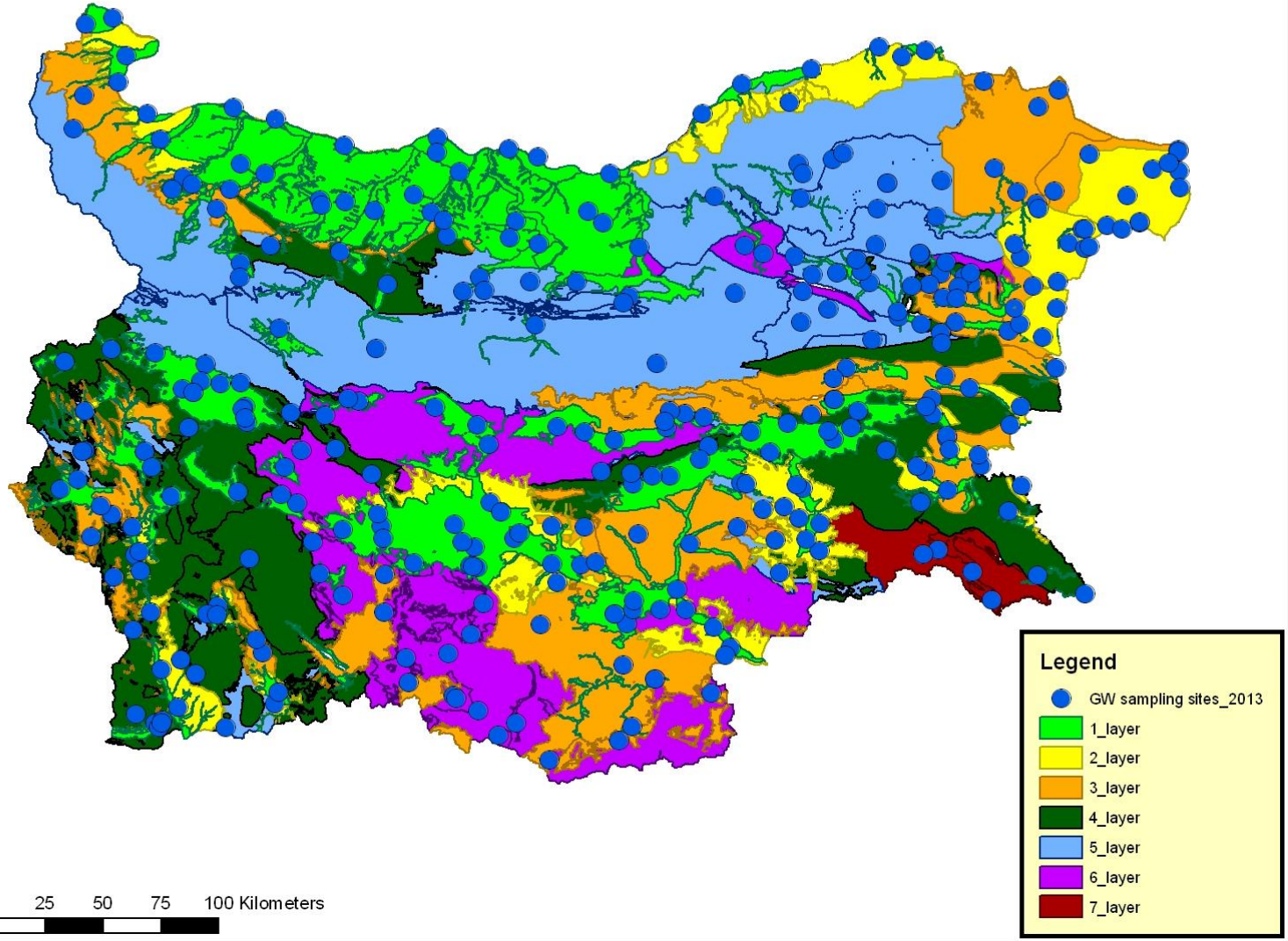
Other hydraulic boundaries - Sub-divisions of an aquifer or aquifers that cannot be based on geological boundaries should be based initially on groundwater highs or, where necessary, on groundwater flow lines






Groundwater Monitoring
Monitoring of groundwater quantitative status
Level monitoring network
Purpose
Provide data to validate conceptual model of groundwater flow system to enable classification of status, calculation of available resource and estimation of flows across Member State boundary
Where
Sufficient points in bodies, or groups of bodies, to adequately validate the conceptual model
What
Data on levels, spring flows, base-flows in rivers as most appropriate for validating conceptual model
When
Sufficient frequency to distinguish short and long-term variations in recharge from the impacts of abstractions and discharges
Monitoring of groundwater chemical status
Surveillance monitoring
Purpose
Provide data to (a) supplement & validate risk assessment (e.g. test conceptual model), (b) help assess trends in pollutants and natural trends & (c) inform the design of the operational monitoring network
Where
Sufficient points for bodies, or groups of bodies, at risk and those not at risk to achieve the above purposes. Sufficient points in cross-border bodies to assess risks to all uses
What
O_2; pH; NO3; NH4; conductivity
Indicators of pollutants relevant to the risks to the objectives or to uses of transboundary groundwater flow
When
For each plan period
Operational monitoring
Purpose
Provide data to (a) establish the status of bodies and groups of bodies at risk, (b) the presence of trends in pollutant concentrations and (c) the reversal of such trends
Where
Sufficient points in bodies or groups of bodies at risk to reliably classify the bodies (e.g. achieve a suitable level of confidence in the conceptual model) and describe significant pollutant trends
What
Indicators of pollutants causing the body or group of bodies to be at risk
When
Periods between surveillance monitoring, at sufficient frequency to detect impacts but minimum of once per annum

Groundwater monitoring sampling sites, according to the Order N-182/ 26.02.2013



The observed parameters are:

Phisico-chemical parameters – group I – Basic Phisico-chemical parameters - temperature, pH, Dissolved Oxygen, COD (Mn), Electrconductivity, Calcium, Magnesium, Sodium, Potassium, Hydrocarbonates, Carbonates, Chloride, Sulphate, Ammonium, Nitrates, Total Solids, Total Hardness – friquency - 4 or 2 times per year.

Phisico-chemical parameters – group II – Additional Phisico-chemical parameters – Total Iron, Manganese, Phosphates, Nitrites friquency - 4 or 2 times per year.

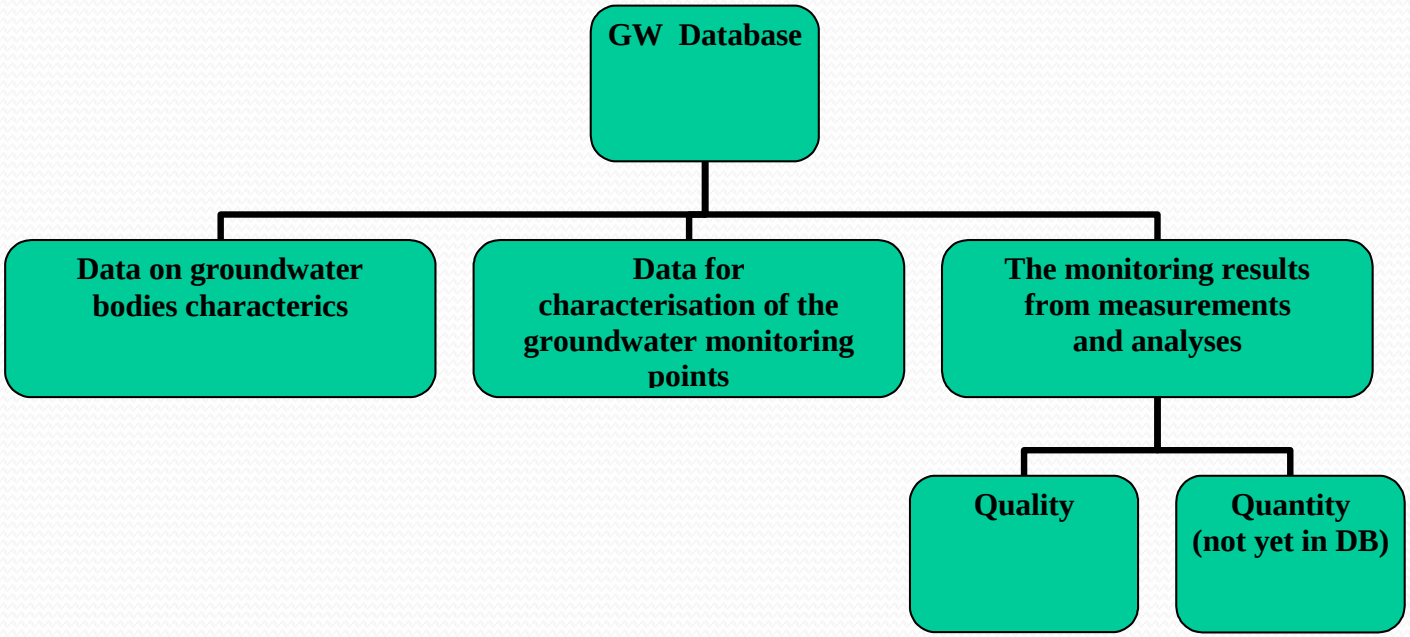
Specific polutants - group I – Metals – lead, cadmium, arsenic, mercury, copper, zinc, nickel, Chrome 3+, Chromium 6+, Strontium (natural background), Common α – Activity, Common β – activity, natural uranium and radium R226 - 1 time per year.

Specific pollutants Group II organic matter – 56 – Trichloroethylene, Tetrachlorethylene, aldrin, atrazine, DDT / DDD / DDE, dieldrin, Drines, endosulfan, endrin, methoxychlor, HCH – compounds, propazine, simazine, Heptahlor, chlordane, 2,4 D, acetochlor, pendimethalin, Flutriaflor, triadimenol, mancozeb, Tebuconazole, chlorpyrifos, Trifluoralin, alachlor, cypermethrin, chlorpyrifos- ethyl, imidacloprid, thiacloprid, flusilazole, famoxadon, cyproconazole, propiconazole, difenoconazole, metazachlor, S- Metolachlor, terbutylazine, florasulam, aminopyralid – potassium, thiamethoxam, carboxin, thiram, dithianon, amine salt, glyphosate, prokinazit, metsulfuron, imazamox, tribenuron, metalahlor, dimethoate, dimethomorph, metalaxyl M, napropamide, metribuzin and fluazifop -P –butyl. They are analysed in part of the sampling sites – 1 time per year

Groundawater quality monitoring procedures

- The groundwater quality monitoring is carried out by the Executive Environmental Agency and their 15 Regional Laboratories.
- The staff from the RL are taking groundwater samples, making on-site measurements and carrying out the physic-chemical laboratory analyses.
- The RLs input groundwater monitoring data in the regional data bases
- The data are finally collecting in the central groundwater database in the Executive Environment Agency.
- Groundwater Data are accessible by RBD trough WEB based interface

Structure of Data Base in ExEA



DRINKING WATER PROTECTED AREA MONITORING (1)

- From the total 339 stations for monitoring of chemical status of groundwater – 222 have been determined for monitoring of drinking water protected areas.
- They are distributed as follows:

- In the Danube RBD - 84 of 99 stations;
- In Black Sea RBD - 47 of 90 stations;
- In the East Aegean RBD - 74 from a total of 112 stations;
- In the West Aegean RBD - 17 out of 38 stations.

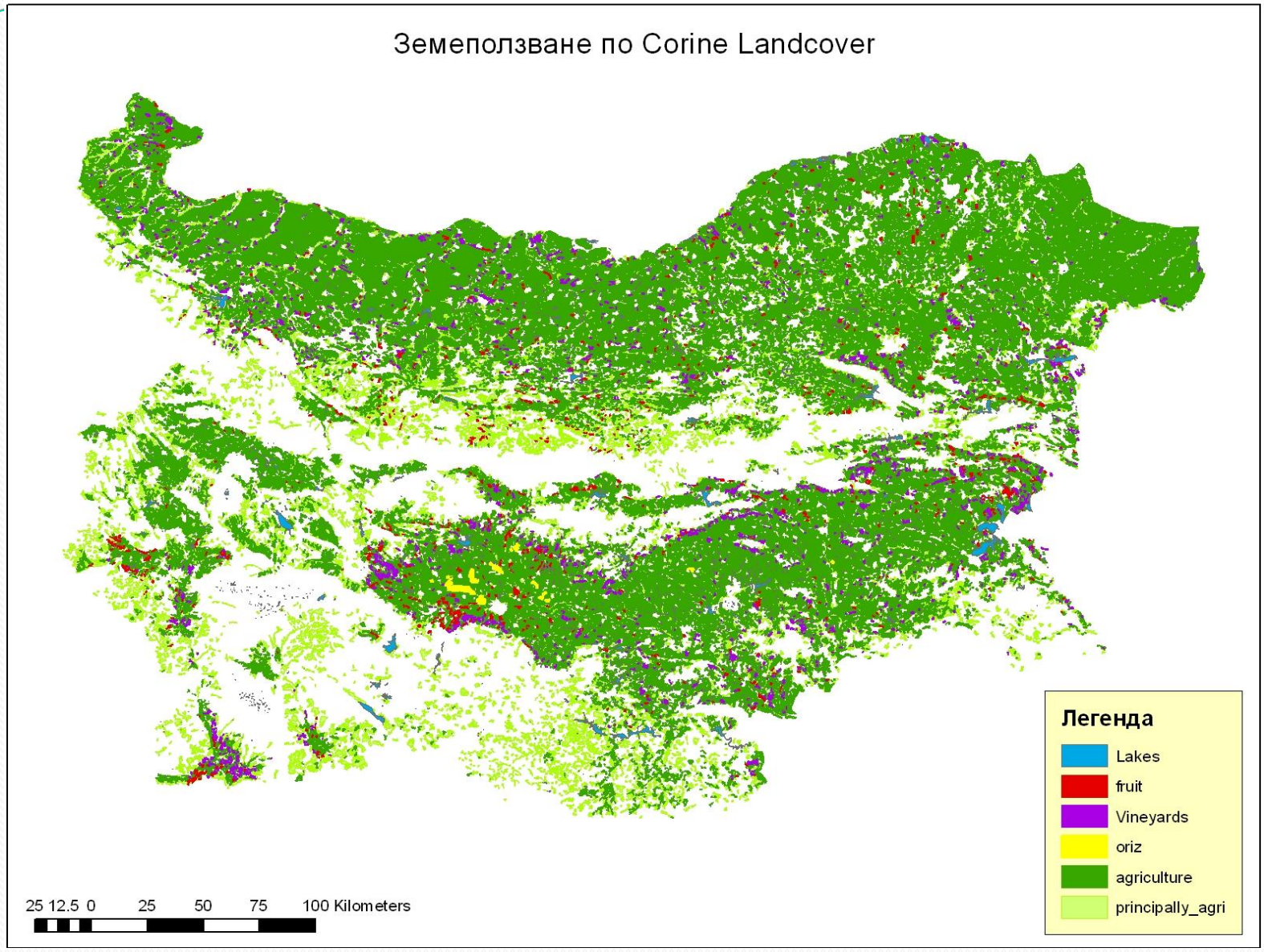
These stations are addopted to 148 GWB, as areas to protect drinking water (in the Danube RBD - 49 GWB; RBD in Black Sea - 32 GWB; in the East - 35 GWB; RBU and West Aegean RBD - 32 GWB). 92% of the areas for the drinking water protection are observing.

DRINKING WATER PROTECTED AREA MONITORING (2)

The Black Sea , East Aegean RBD and West Aegean RBD not required specific observations in the stations in DWPA, while Danube RBD provided 2 additional samplings during the year:
- A sampling analysis of additional indicators (iron , manganese, nitrates and phosphates and analyses for heavy metals / lead, cadmium, arsenic, mercury , copper, zinc , nickel, chromium 3+ and 6+, and in the specific points - Strontium natural origin / ; common α - activity , common β - activity , natural uranium, radium R226); and
- Second sampling - Analysis of basic physicochemical parameters (Dissolved oxygen , pH , El.conductivity , nitrate ions , ammonium ions, temperature , Mn , total hardness , calcium, magnesium , chloride, sodium, potassium, sulfates, hydrocarbons, carbonates and solids) and the additional phisico-chemical indicators and metals – above mentioned.

Groundwater monitoring network under 'NITRATES' DIRECTIVE (91/676/CEE)

- By the Order of the Minister of Environment and Water (№ RD - 635 of 13.8.2013) a new program for water monitoring in relation to assessments and protection against pollution caused by nitrates from agricultural sources has been established.
- The types of groundwater sampling points are: phreatic shallow, phreatic deep, captive and karstic groundwater.
- The new program for nitrate in groundwater has been developed by an assessment of each individual groundwater body and consider the types of land use on the surface of the GWB.
- To this end, GIS vector map with the GWBs has been imposed with the land use map (from Corine Lancover). Some type of land use are mainly considered - non-irrigated arable land, land occupied mainly by agriculture, but with significant areas of natural vegetation , fruit trees, vineyards and rice plantations .


Земеползване по Corine Landcover
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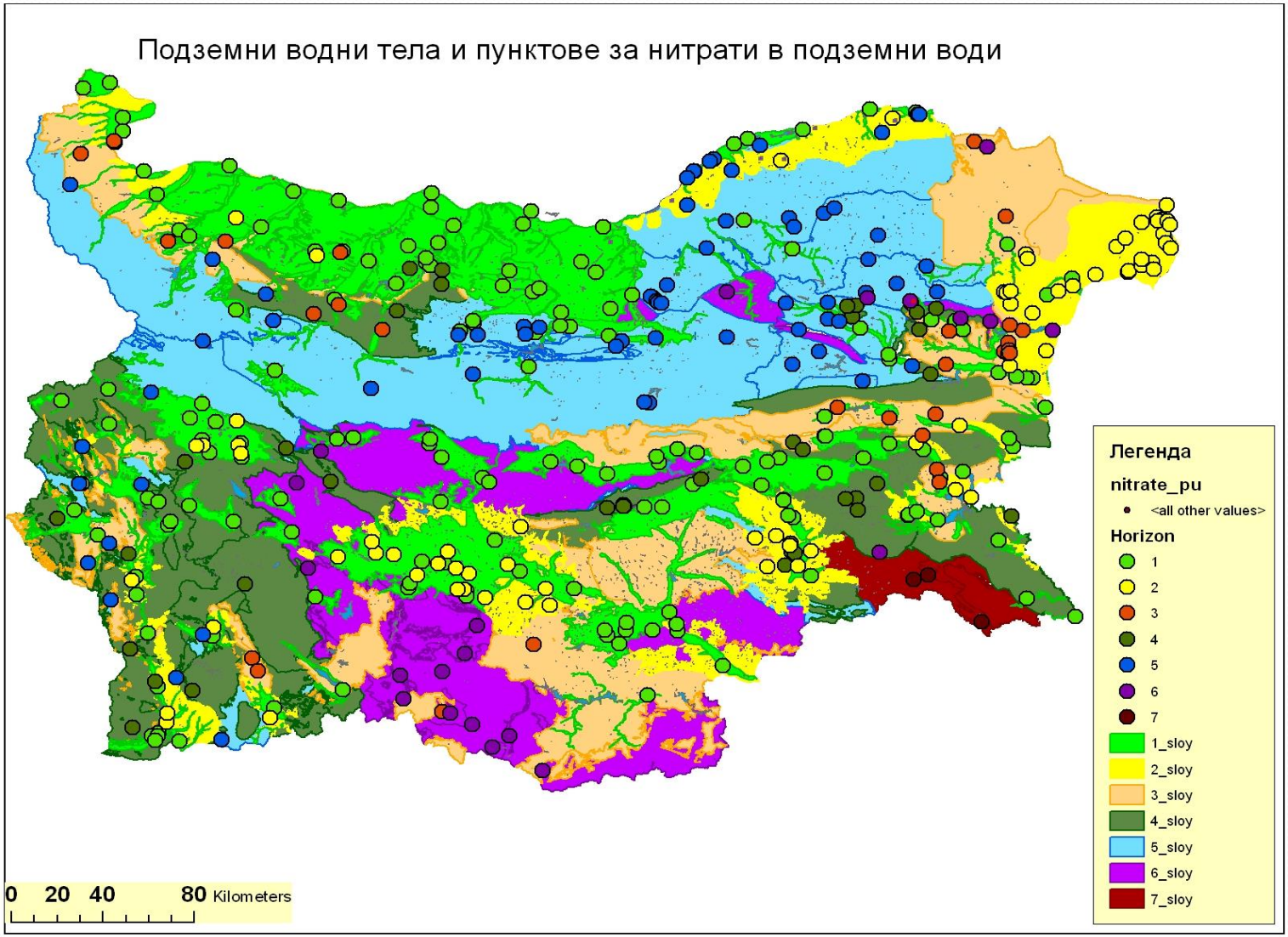
Подземни водни тела и пунктове за нитрати в подземни води
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5_sloy
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0 20 40 80 Kilometers

Groundwater monitoring network under 'NITRATES' DIRECTIVE (91/676/CEE)(2)

- After the imposing the Corine land use map on the maps with GWBs and map with the groundwater sampling sites (National network) the GWB are determined where not enough groundwater stations are available, but there are agricultural area with significant land use as arable land, fruits, vineyards etc. For these GWB, additional stations have been added where self-monitoring has been performed by the various water users, under the license issued to them and requires carring out research on nitrate .
- Overall improvement in the monitoring of nitrate in ground water by the extension of the network from 139 to 413 monitoring points, distributed as follows:

- For Danube RBD – 137 points in 49 GWB - nitrates are analyzing with a frequency of 4 times per year
- For Black RBD - 128 points in 36 groundwater bodies - nitrates are analyzing with a frequency of 4 times per year
- For East Aegean RBD – there are 121 points in 40 GWB- nitrates are analyzing with a frequency of 4 times per year
- For West Aegean RBD - There are 44 points in 31 GWB - nitrates are analyzing with a frequency of 4 times per year

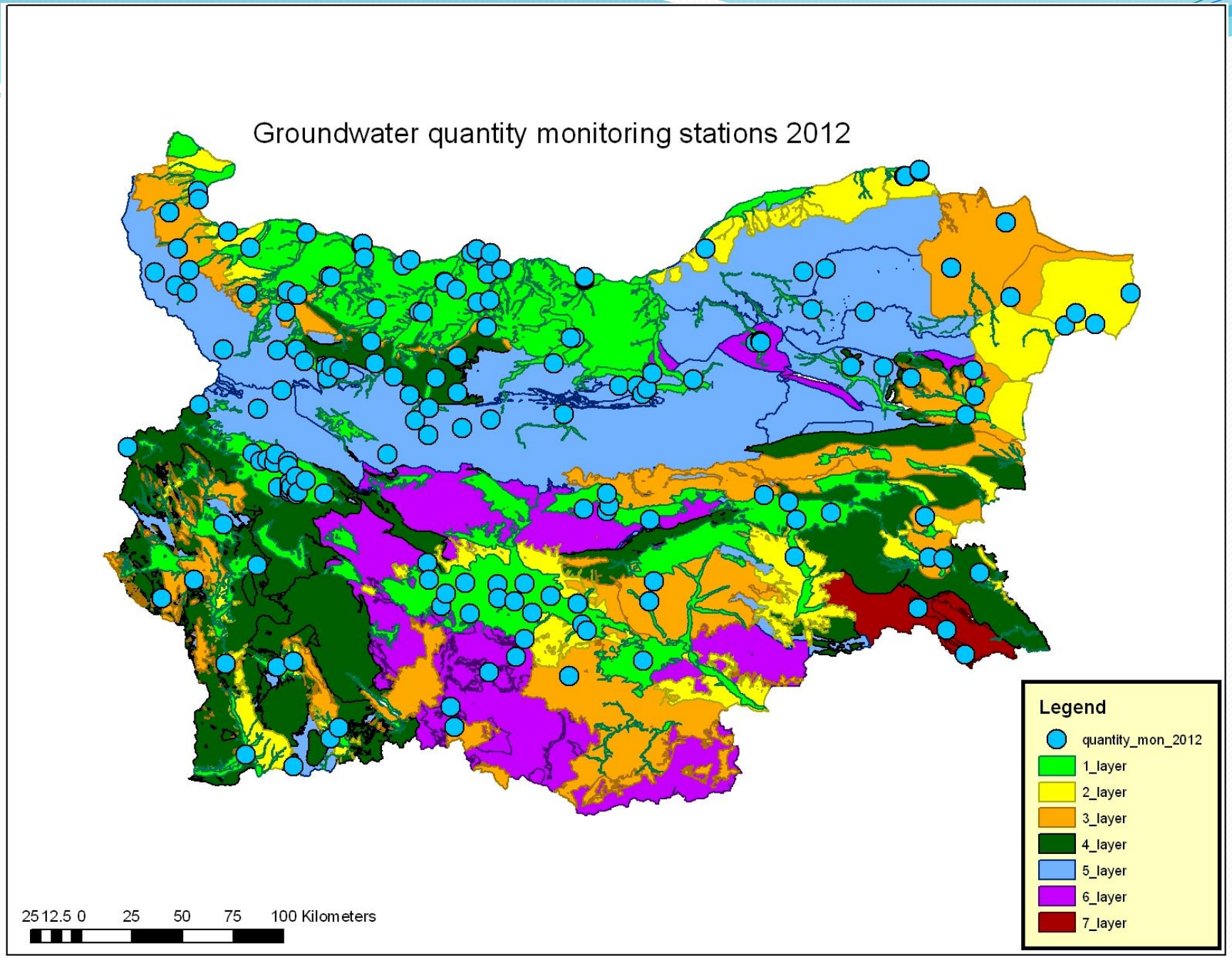
Groundwater quantity monitoring

- National Institute of Hydrology and Metheorology is responsible for groundwater quantitative monitoring, in compliance with Bulgarian Water legislation

- The regional structures of NIMH are responsible for measuring of GW levels and springs' recharges,

- They make maintenance of monitoring points and input data in data bases – on regional level.

- The central office is responsible for the central data base and quality assurance of data.
- RBD receive data from NIMH


Groundwater quantity monitoring stations 2012
Legend
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4_layer
5_layer
6_layer
7_layer
25 12.5 0 25 50 75 100 Kilometers

Groundwater monitoring data have used for:

WISE-SoE Reporting: Groundwater quality for European Environmental Agency

- Groundwater Body Characteristics and Pressures table
- Physical Characteristics of Groundwater Monitoring Stations table
- Nutrients in Groundwater - Aggregated Data table
- Nutrients, Organic Matter and General Physico-Chemical Determinands in Groundwater - Disaggregated Data table
- Hazardous Substances and Other Chemical Determinands in Groundwater - Disaggregated Data table
- Saltwater Intrusion table
- GIS tables
- Groundwater Body GIS Boundaries
- Saltwater Intrusion GIS Boundaries

WISE-SoE WQ Data Reporting

State and Quantity of Water Resources

There are reporting data for wells, whwre the level has been measured

Groundwater level (H) at selected wells

Groundwater monitoring data have used for:

River Basin Management Plans

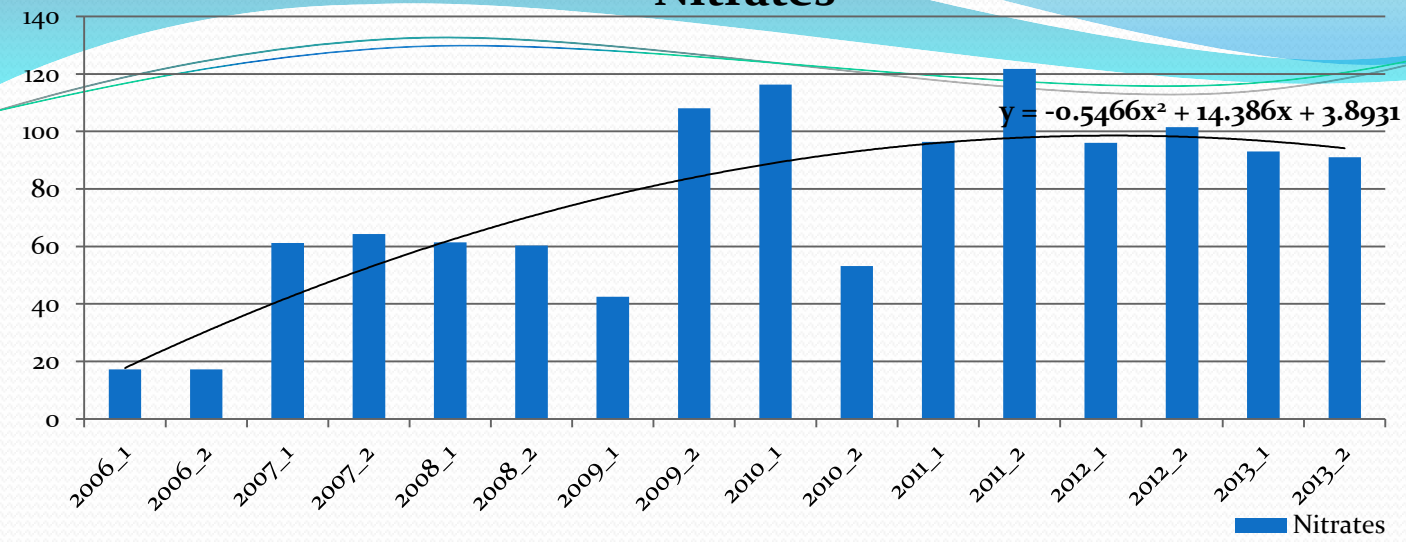
- Determination of Treshold values
- Status assessment

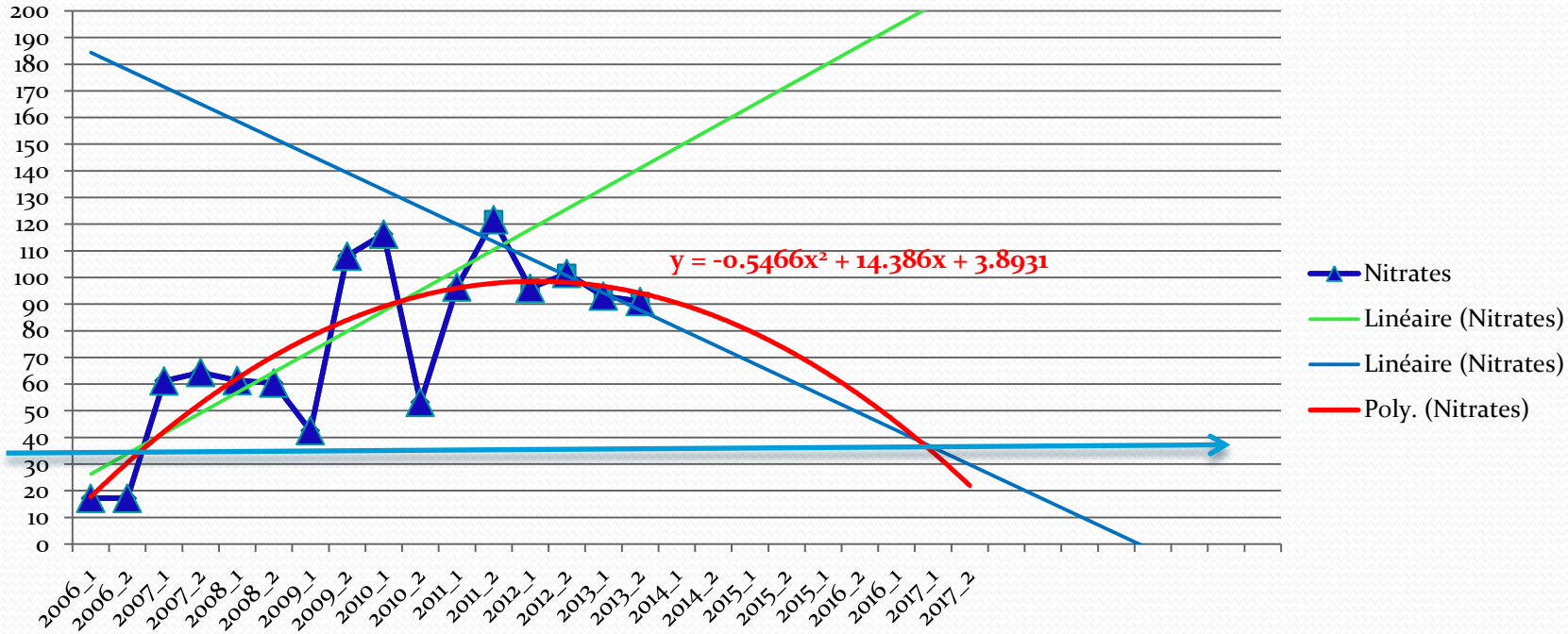
Member States shall ensure the establishment of programmes for the monitoring of water status in order to establish a coherent and comprehensive overview of water status within each river basin district:
for groundwaters such programmes shall cover monitoring of the chemical and quantitative status

- Identification of significant and sustained

upward trends and for the definition of starting points for trend reversals

Nitrates


y = -0.5466x² + 14.386x + 3.8931
Nitrates


y = -0.5466x² + 14.386x + 3.8931
Nitrates
Linéaire (Nitrates)
Linéaire (Nitrates)
Poly. (Nitrates)

Some problems in grondwater monitoring planning

- At present only 18 GWB (representing about 10% of the total) - located primarily in mountain and sparsely populated areas , which are subject to insignificant pressure - not provided surveillance monitoring for the chemical status of GWB.
- Networks for surveylance monitoring and for operational monitoring , including the part of their assessment of groundwater pollution caused by nitrates from agricultural sources are unbalanced . They are not included stations for contamination prevention and control , although in places on such points (used for self-monitoring) are taken into account in the GW status assessment.
- In all networks mainly wells and springs for drinking water supply are included as monitoring points.
- On one hand,this solves the problem of lack of financial resources and reduces the cost of monitoring, but on the other hand, leads to a dverestimated quality of groundwater, as these wells are located in areas where groundwater quality is good.
- The rest of the network stations for monitoring wells are used for the abstraction of water for irrigation or other purposes.
- Therefore in many cases monitoring the chemical status of groundwater is not tied to specific pressure and does not provide information about the potential impacts of identified pressures and spatial distribution of pollution

- Very similar are the problems in network for monitoring of groundwater quantity.
- About 86 GWB have no monitoring points and 30 GWBs there is only one monitoring station of the quantitative status .
- The existing network is not has been structured according to the requirements of the WFD and the necessary information to assess the available quantities of groundwater , respectively, to assess the water balance ,
- and the interaction between groundwater and surface water and direction of flow from and to the groundwater .
- There are missing points and stations providing data necessary to calculate the water flow to dependant from GW terrestrial ecosystems.