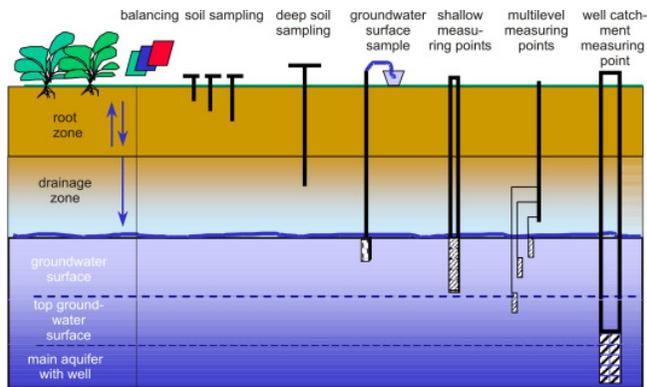


medium (soil or water) and the spatial and temporal references.

The analytical methods differ on two depth zones of application:

- Unsaturated zone (root and drainage zone)
- Saturated zone (shallow and deep groundwater)

The picture below reflects the variety of methods related to the different zones.



Instruments for efficiency control in soil and groundwater

### Analytical methods: soil and water sampling

In the unsaturated zone, soil mineral nitrogen sampling in autumn (to measure late fall mineral-nitrogen in the root zone) is very common and widespread. This method, originally developed for the loess soils, is now established state wide. Common standards are important, e.g. setting the appropriate date of sampling to avoid nitrate leaching and to ensure a comparable database on the state level.

In the saturated zone shallow or multilevel measuring points may be appropriate, depending on the specific question.

Besides the consideration of the saturated and unsaturated zone an integrated monitoring system

also includes taking samples from drainage systems and surface watercourses.

If there are ditches with drainage systems, it is possible to control parcel-specific emissions. Because of very different site conditions, feasible efficiency control should not only rely on a single instrument.

### Calculatory methods: nitrogen balances

Nitrogen balances are the appropriate tool to determine nutrient surpluses, e. g. at farm level. Within the project WAgriCo improved methods for the identification of an optimised nutrient management system on farm level, based on resilient nitrogen balances, was compiled. It is aimed to reward an optimised management of nutrient inputs (especially nitrogen). This valuable approach will be continued after the project end.

### For further information:

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## WAgriCo

Water Resources Management in Cooperation with Agriculture

A Water Framework Directive Project



Groundwater Monitoring and Methods of Efficiency Control



Niedersachsen

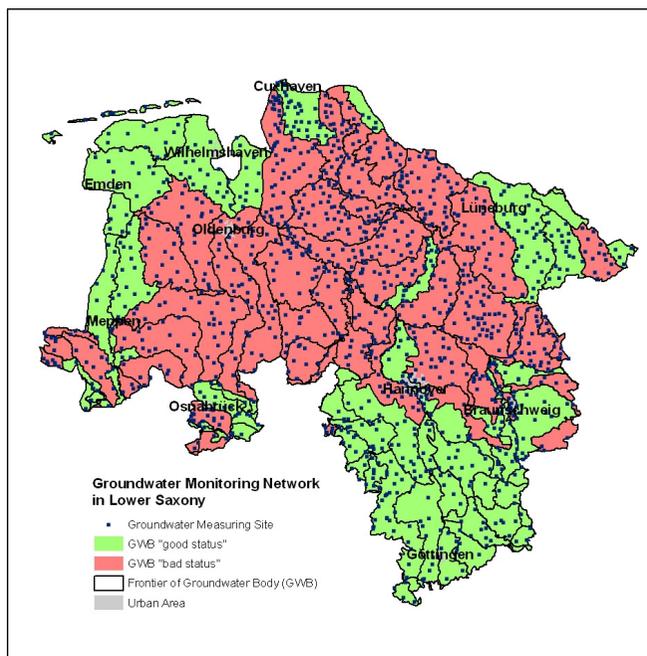
## Groundwater monitoring in

### Lower Saxony

The expected positive effects of groundwater protection activities are going to be verified by a monitoring programme according to the WFD. Within the project WAgriCo a state-wide monitoring concept was compiled, which is based on the already existing measuring networks and monitoring systems. Different spatial levels need to be considered (e.g. state- and farm-level).

### Monitoring on Federal State level

The monitoring on state level is focussed on groundwater bodies. On this level data from the WFD measuring points for general survey (yearly) and operative survey (twice a year) are collected.



Groundwater monitoring network in Lower Saxony (stand Dec. 2008)

### Groundwater measuring points

Due to the requirements of the WFD the monitoring network in Lower Saxony was reorganised. As shown in the map there is a high coverage of the groundwater bodies with measuring points. The majority of these measuring points is installed and maintained by the State of Lower Saxony. To ensure a monitoring of all groundwater bodies, measuring points especially of water supply companies and municipalities are integrated into the monitoring network additionally.



Groundwater measuring points within different depths at measuring point Bakede

This state wide measuring network for monitoring the groundwater quality and the groundwater level is supplemented with further information of state wide surveys and investigation programmes about nitrate inputs from agricultural use.

### Nitrogen-surplus survey

In addition to that state wide network there is the so-called basic level survey of emissions which is based on agricultural statistics and delineating a potential nitrate concentration in seepage water from nitrogen surplus to identify the trends of pollution.

### Soil observation sites

Further information for monitoring purposes is delivered by approximately 90 permanent soil observation sites on arable land, pasture and forest in Lower Saxony. These investigation sites are equipped with a lot of measuring tools, e.g. porous cups, shallow and deep groundwater measuring points.



Sampling of soil mineral nitrogen

### Monitoring on farm and parcel level

An important aspect in groundwater protection schemes is the implementation of site-specific measures. For the evaluation process on farm or parcel level an efficient set of instruments and methods is available. Primarily there are two ways of efficiency control:

- Analysis (e. g. Soil Mineral Nitrogen)
- Calculation (Nitrogen balances)

The selection of the appropriate methods depends on the site conditions and the specific question. In general every method is related to the examined