LEGISLATION AND DEFINITIONS
- A groundwater body (GWB) is an administrative compliance unit.
- The chemical status of the GWB is reported every 6th year in the river basin management plans.
- Guidance document on assessment of state and background values (BGV)

METODOLOGY
- The geological layers and aquifers in the National Groundwater Model (DK-Model)
- Are the basic units for delineation (Figure 1)
- Links between GWB units, borehole screens and aquifers were established through algorithms.
- Modelled aquifers were grouped into GWB units through automatic algorithms, updating is easy and transparent.
- The model provides an overview of groundwater - surface water contact.
- Improved coherence between groundwater mapping, monitoring and water plans

DATA ON GROUNDWATER QUALITY
- Data from all water work wells, monitoring wells, investigation wells etc. are public available in the national database JUPITER.
- The chemical water analysis in JUPITER were linked to GWB through links to the DK-model.
- Data from 2000-2013 were used to assess the chemical status of the groundwater bodies.
- 2,379,426 analysis of individual parameters processed to assess groundwater status and trend.
- The parameter “pesticides” was calculated as the highest concentration of a detected pesticide or relevant metabolite in a groundwater sample

CHEMICAL STATUS OF GROUNDWATER BODIES
- Distribution of parameters shows all relevant information (Figure 2)
- Ion exchange used to discriminate between natural salt and salt intrusion
- Good chemical status: Compliance with the quality standards and threshold values for >90% of monitoring points
- Poor chemical status: Non-compliance with the quality standards and threshold values
- Unknown status, no data (pesticides and nitrates have to be analysed)
- EU Groundwater quality standards for nitrates and pesticides
- Drinking water quality standards used for all other parameters

BACKGROUND VALUES
- Background values (BGV) were calculated in river basins grouped with similar hydrogeology
- Only nickel, arsenic, aluminium and NOx contribute to background values due to natural concentrations above the quality standard
- BGV > 90% of the concentrations in unpolllated monitoring points
- BGV discriminated by the redox state of groundwater if > 20 monitoring points

CONCLUSION
- All expert judgments were transformed to systematic algorithms.
- Calculations based on the DK-model guarantees a transparent decision making tool.
- Nitrates and pesticides were the most common reason for groundwater bodies to fail having good status.
- Background values of specific elements such as arsenic and nickel were found.
- Due to water abstraction or acidification elevated nickel concentrations were found

REFERENCES
5. The National Groundwater Model DK-model http://www.vanddata.dk

http://www.gu.dk/3Materiel01/denmark-management/Site/groundwater_forskning_fakta01.aspx

[Figure 1: Examples of delineation of GWB in two different geological layers in the groundwater model]

[Figure 2: Data from a groundwater body at individual monitoring point. The quality standard (red) and 95% of quality standard (red dashed) are highlighted in the actual grid. Values > 95% in blue and 85% effect is red. (light) are highlighted in the horizontal grid. A groundwater body that fail the test for good state at a specific attribute if more than 60% of the monitoring points are below the quality standard.]

[Figure 3: Natural background values for nickel in eastern Jylland and at Zealand where water abstraction causes nickel in medium concentrations due to nickel sulfoxidation. Red indicates groundwater. Background values (BGV) are automatically calculated for the layer in the relevant area. The anthropogenic impact at isolated bodies establishment at a BGV limit.]

Danish Groundwater Bodies and their chemical status

Lærke Thorling, Senior Scientist
ltl@geus.dk
Geological Survey of Denmark and Greenland (GEUS)
Groundwater and Quaternary Geology Mapping
Lyngby Alle 1, 8270 Høje Taastrup Denmark

Brian Sørensen, Geologist
bhs@geus.dk
Geological Survey of Denmark and Greenland (GEUS)
Groundwater and Quaternary Geology Mapping
Lyngby Alle 1, 8270 Høje Taastrup Denmark