Water Quality of the Nation’s Groundwater 1991-2010

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for
Association of Clean Water Administrators

U.S. Department of the Interior
U.S. Geological Survey
• What contaminants are in groundwater?
• What chemical processes are occurring in the aquifer?
• How can water-resource managers use this information?
Groundwater study wells — 1991-2010

Well located in:
- ... a part of an aquifer used for drinking water supply
- ... shallow groundwater underlying agricultural land
- ... shallow groundwater underlying urban land
• Geologic source
  – Manganese
  – Arsenic
  – Radon

• Manmade source
  – Nitrate
  – Pesticides
  – Solvents

Benchmark exceedances

Geologic Manmade
None

Geologic source

Human source

Percentage of wells with one or more contaminants at a concentration greater than a human-health benchmark
Ground-water quality

- Geology
- Climate
- Hydro-geology
- Contaminant source
- Geo-chemistry
Contaminant source
Climate
Climate
Geology

Glacial aquifer – northern U.S.

Volcanic-rock aquifer, Oahu

Upper Floridan aquifer
Hydrogeology

Recharge

Discharge
Hydrogeology

Discharge
Hydrogeology

Unconfined aquifer

Confined aquifer
Hydrogeology

- Confining layer
- Unconfined aquifer
- Confined aquifer
- Multi-aquifer well
Nitrate Concentration (mg/L as N)
Geology

Hydrogeology

Geochemistry

Public-supply well

Multi-aquifer well

Recharge

Water table
Potentiometric surface
Unconfined aquifer
Confining unit
Confined aquifer

Groundwater flow pathway

High Plains aquifer

USGS
Hydrogeology

Contaminant source

Geology

Excess nutrients and pesticides

Glacial aquifer system, northern U.S.
Glacial aquifer system, northern U.S.
Selenium-containing salts

Denver Basin aquifer system
Contaminant source

Geology

Hydrogeology

Geochemistry

Northern Atlantic Coastal Plain surficial aquifer system

Radium

Nitrogen-containing fertilizer

Ca$^{2+}$

Mg$^{2+}$

Ca$^{2+}$

Mg$^{2+}$

(weakly) acidic rainwater

Northern Atlantic Coastal Plain aquifer system
Radium in groundwater

Radium concentration in sampled wells

- **low**
- **medium**
- **high** (exceeds human-health benchmark)
Agricultural recharge

Urban recharge

Stream recharge

Agricultural recharge

Years

Oxic

Decades

Anoxic

Centuries

Predevelopment water
The next decade: What will the future bring?
http://water.usgs.gov/nawqa/pubs/prin_aq/