Water Quality of the Nation's Groundwater 1991-2010

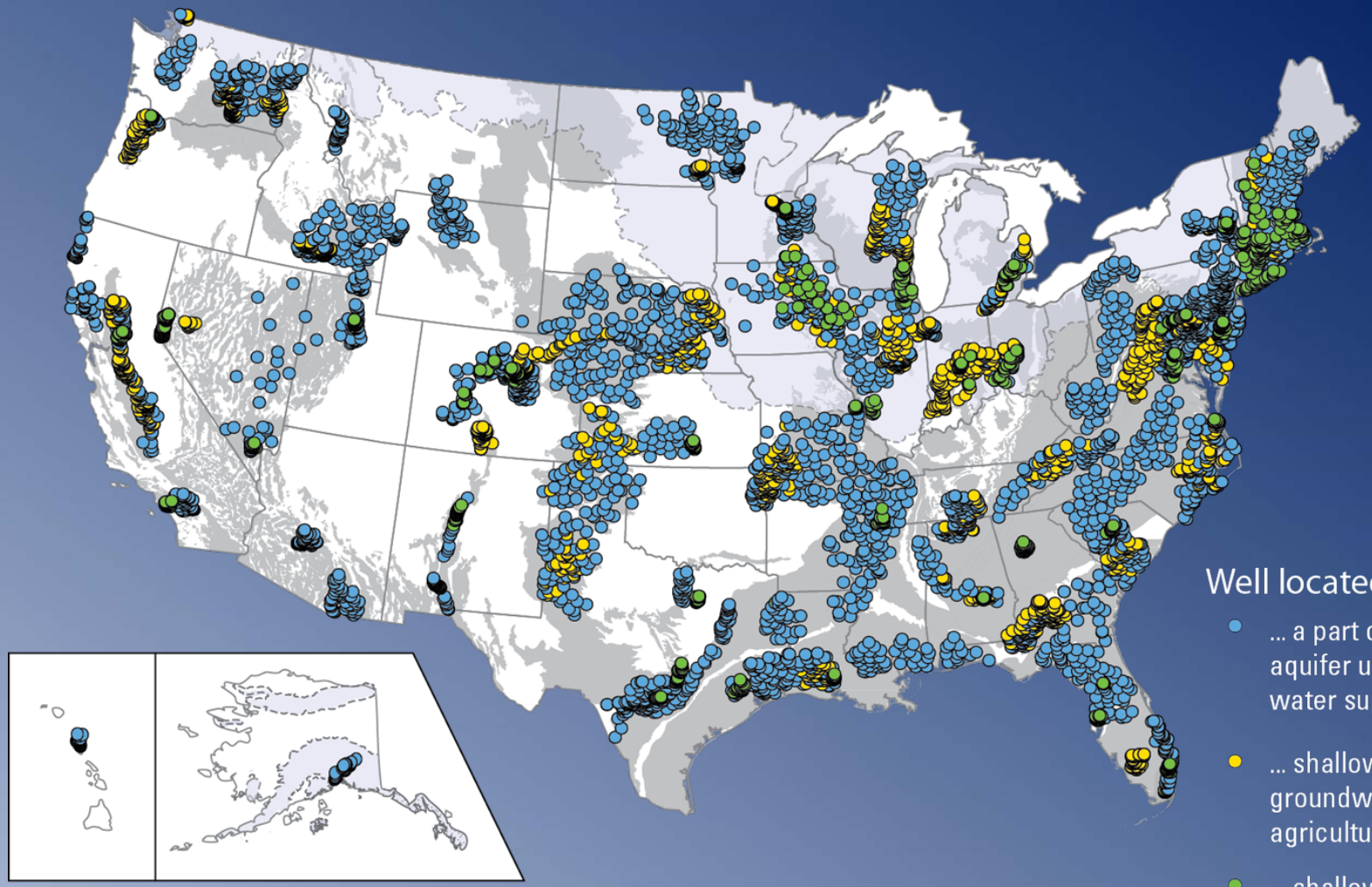
Barbara Mahler

6 March 2015

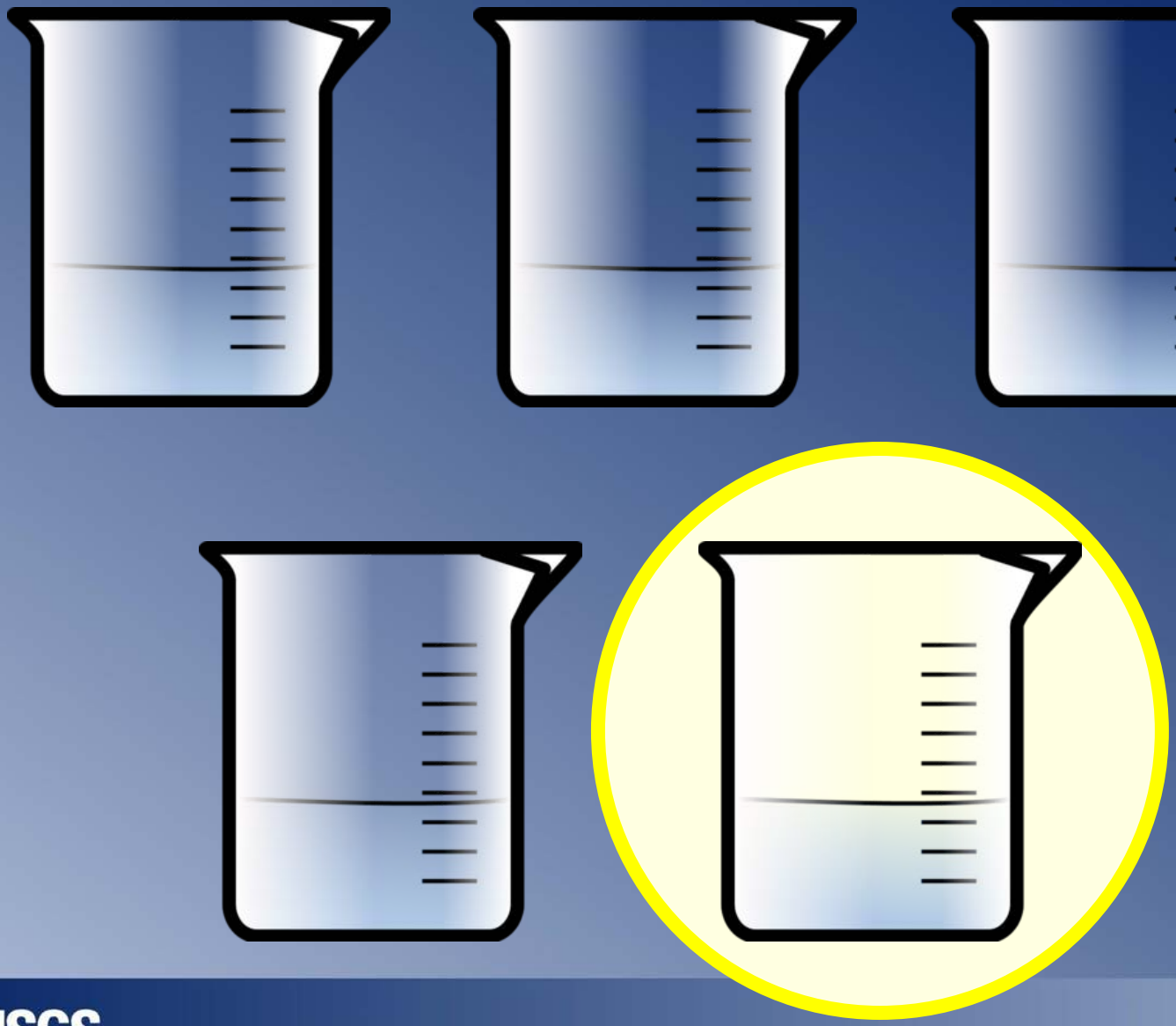
National Water-Quality Assessment Program
U.S. Department of the Interior
U.S. Geological Survey

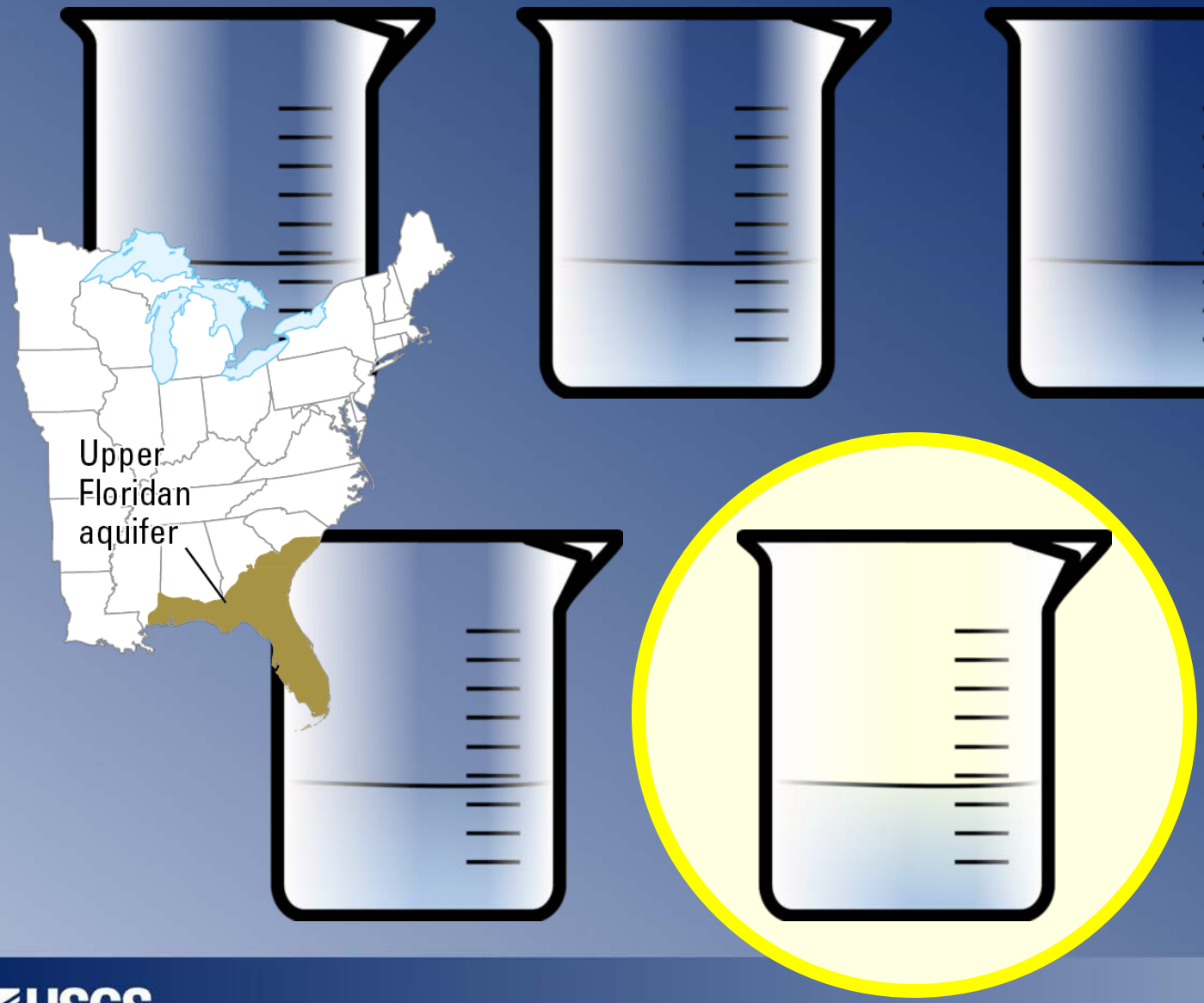
- What contaminants are in groundwater?
- What chemical processes are occurring in the aquifer?
- How can water-resource managers use this information?

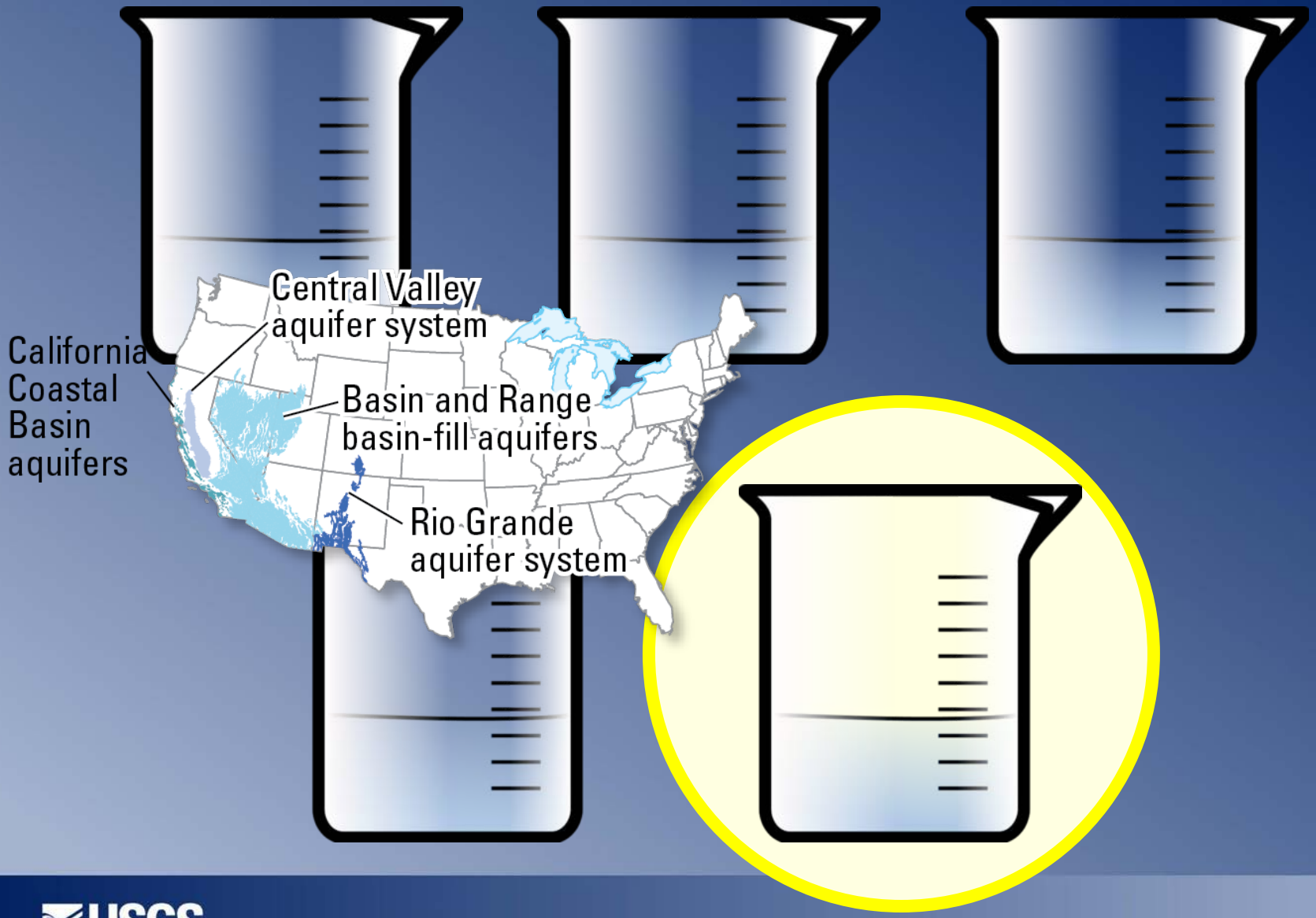
Groundwater study wells — 1991-2010



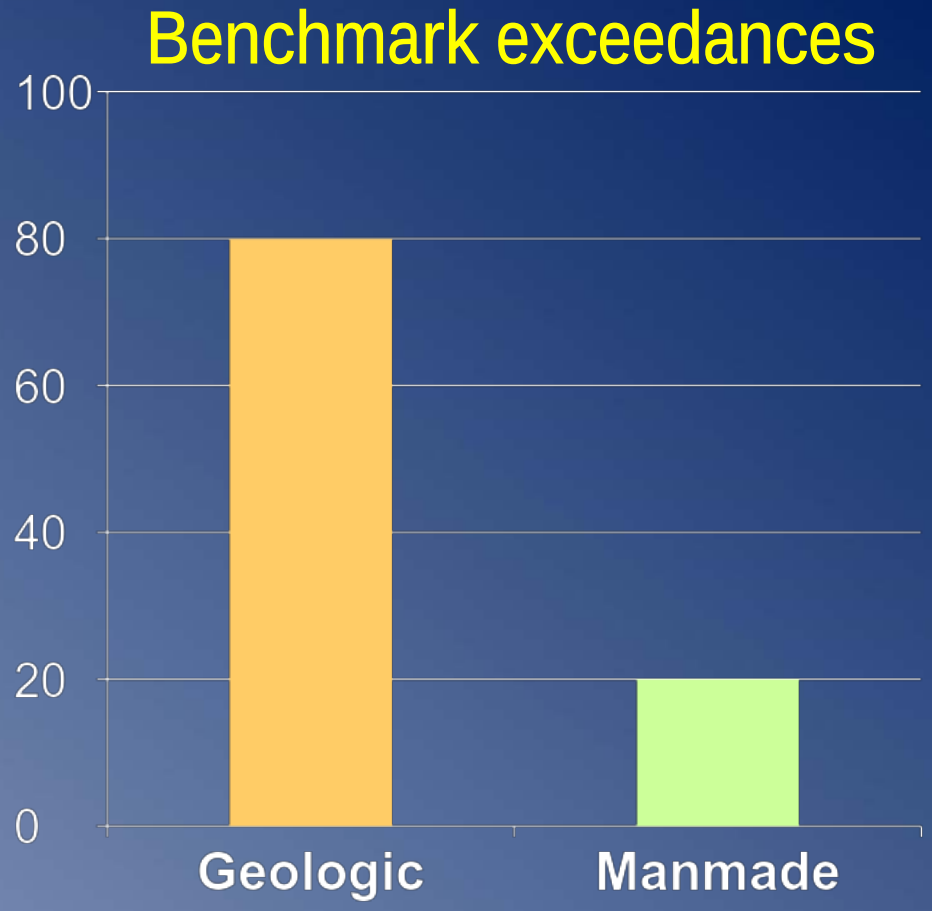
USGS



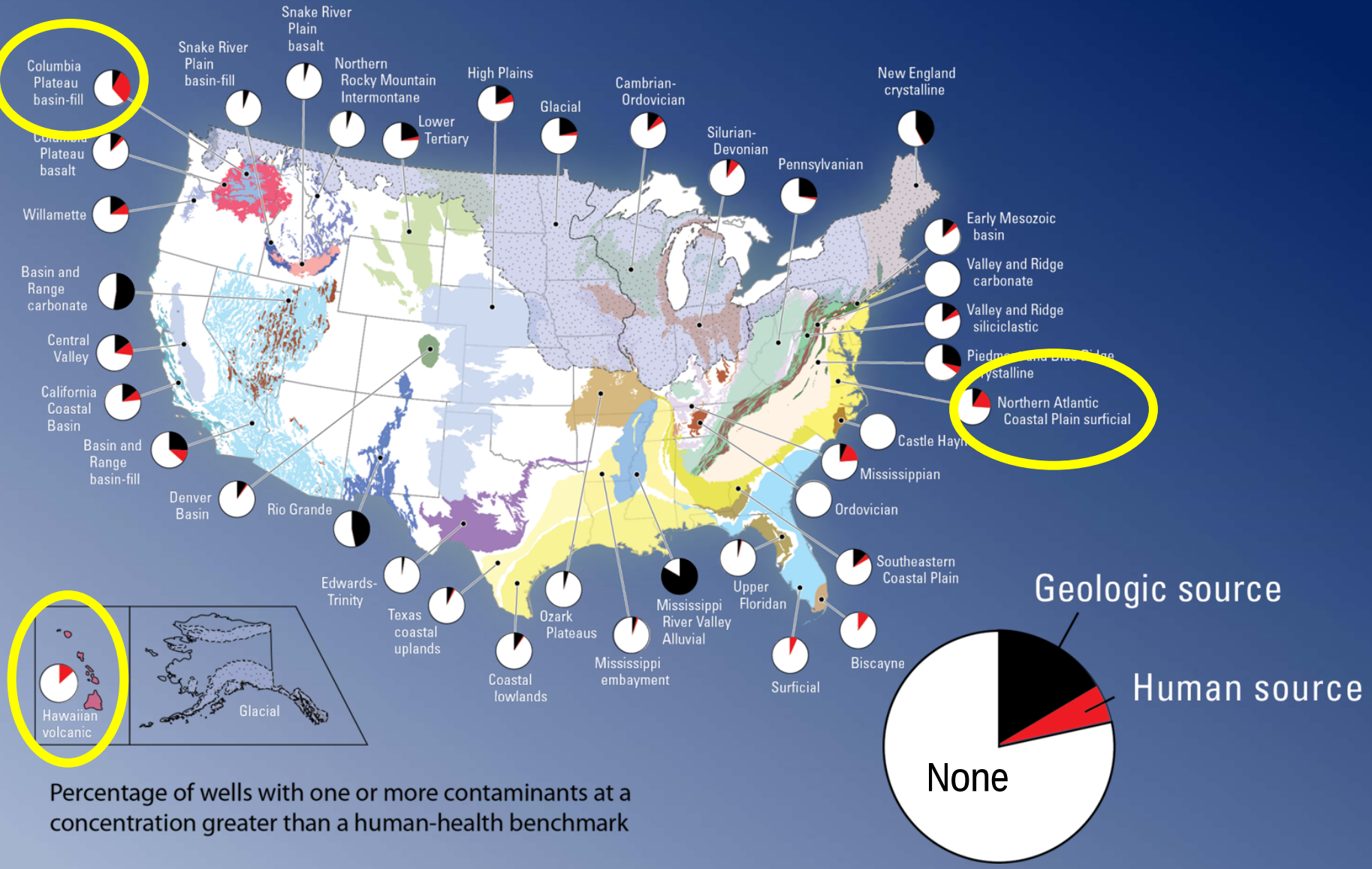

Upper
Floridan
aquifer

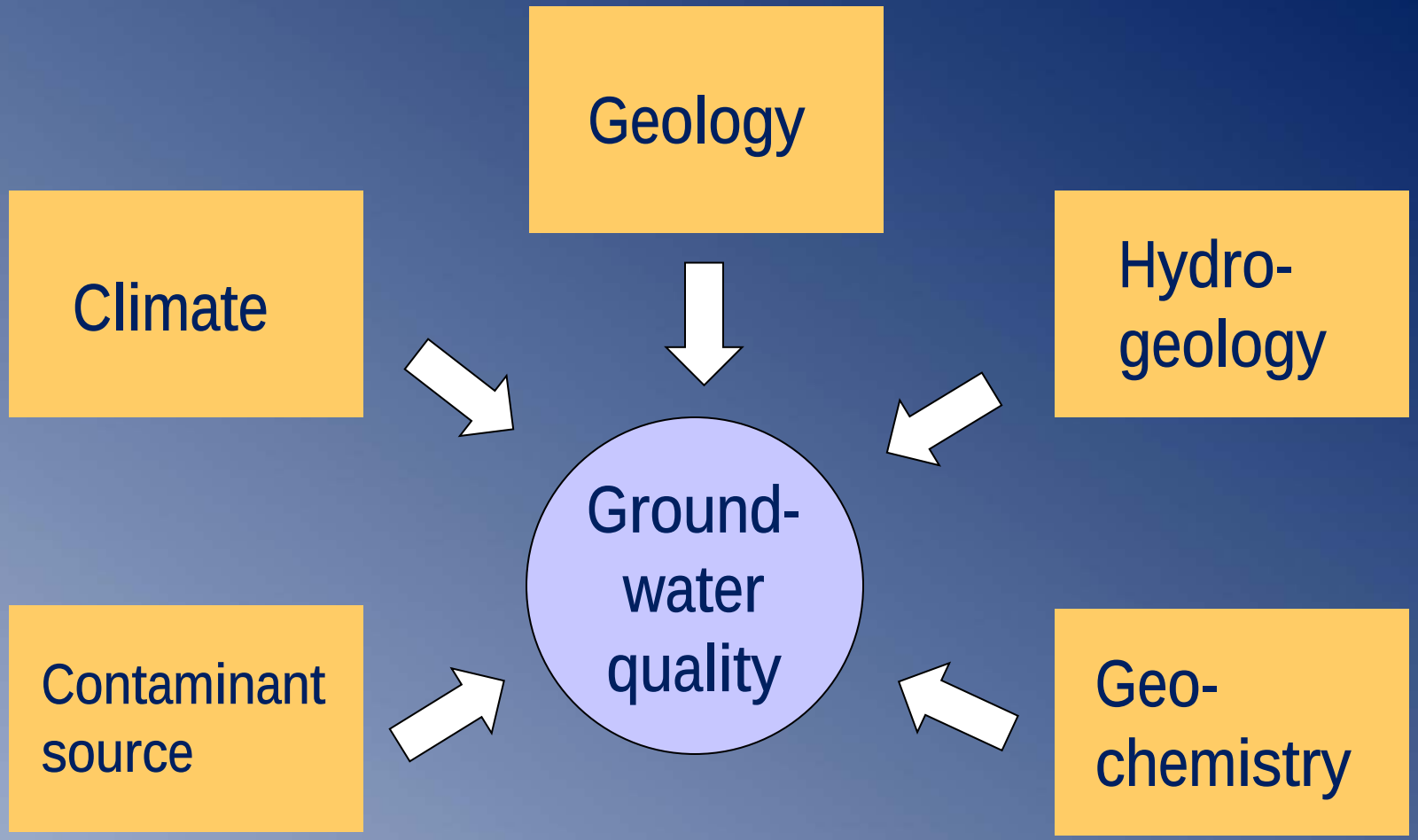

Central Valley
aquifer system
California
Coastal
Basin
aquifers
Basin and Range
basin-fill aquifers
Rio Grande
aquifer system

- Geologic source
  - Manganese
  - Arsenic
  - Radon
- Manmade source
  - Nitrate
  - Pesticides
  - Solvents



USGS


Columbia Plateau basin-fill
Columbia Plateau basalt
Willamette
Basin and Range carbonate
Central Valley
California Coastal Basin
Basin and Range basin-fill
Snake River Plain basin-fill
Snake River Plain basalt
Northern Rocky Mountain Intermontane
Lower Tertiary
High Plains
Glacial
Cambrian-Ordovician
Silurian-Devonian
Pennsylvanian
New England crystalline
Early Mesozoic basin
Valley and Ridge carbonate
Valley and Ridge siliciclastic
Piedmont and Blue Ridge crystalline
Northern Atlantic Coastal Plain surficial
Castle Hayne
Mississippian
Ordovician
Southeastern Coastal Plain
Upper Floridan
Biscayne
Surficial
Mississippi River Valley Alluvial
Mississippi embayment
Ozark Plateaus
Coastal lowlands
Texas coastal uplands
Edwards-Trinity
Rio Grande
Denver Basin
Hawaiian volcanic
Glacial
Geologic source
Human source
None
Percentage of wells with one or more contaminants at a concentration greater than a human-health benchmark


Geology
Climate
Hydro-
geology
Ground-
water
quality
Contaminant
source
Geo-
chemistry

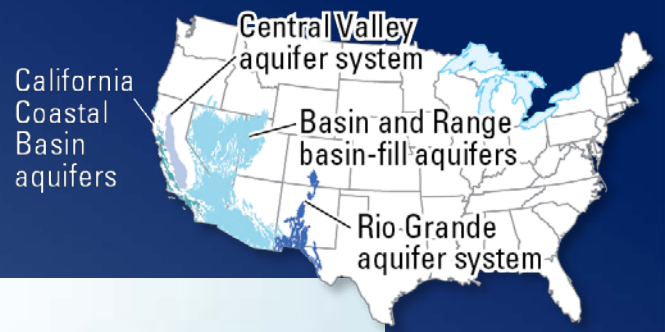
Contaminant source

Contaminant source

Climate

Climate

Climate



Southwest basin-fill aquifers

Climate

Geology

Glacial aquifer – northern U.S.

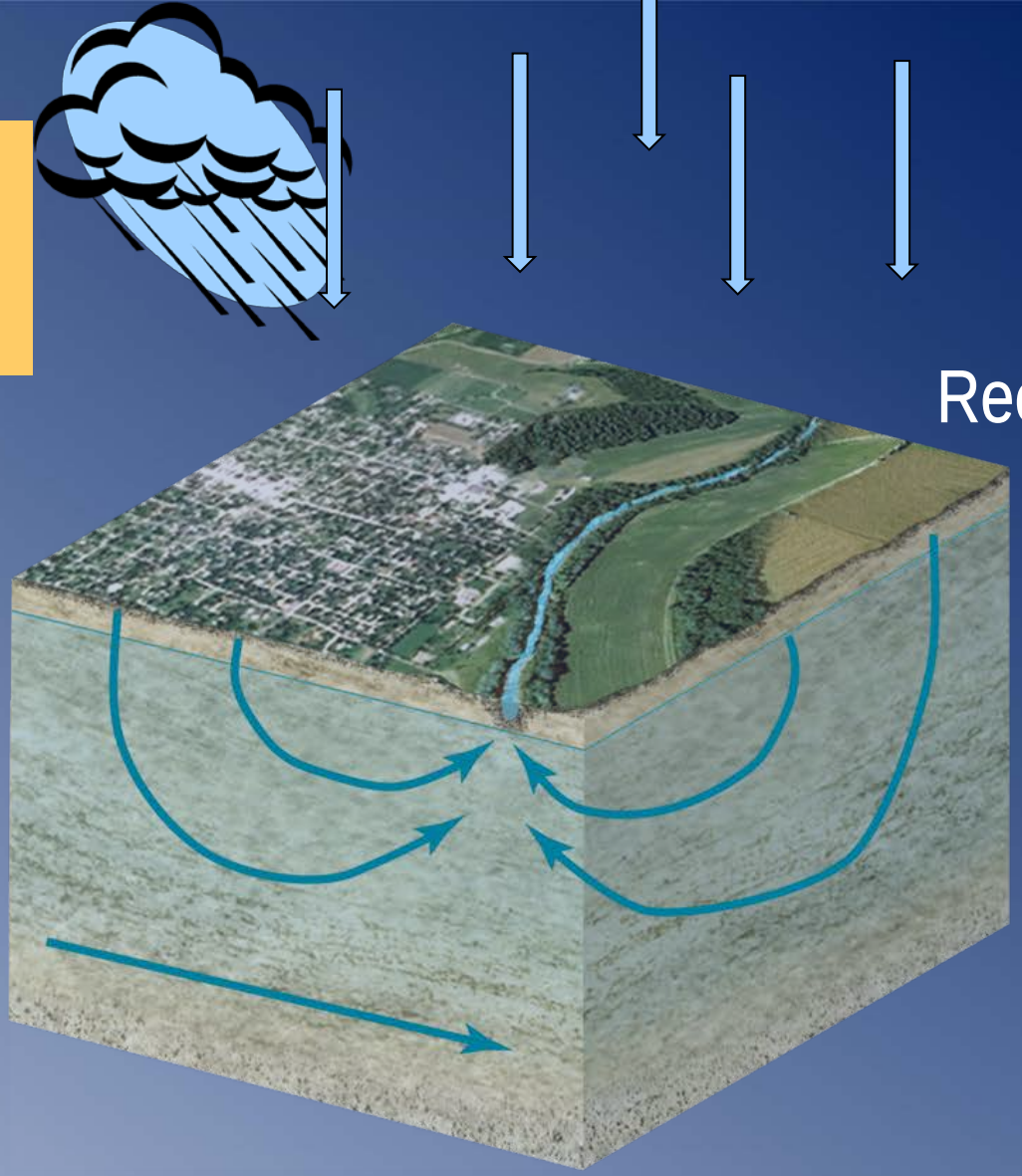
Geology

Volcanic-rock aquifer, Oahu

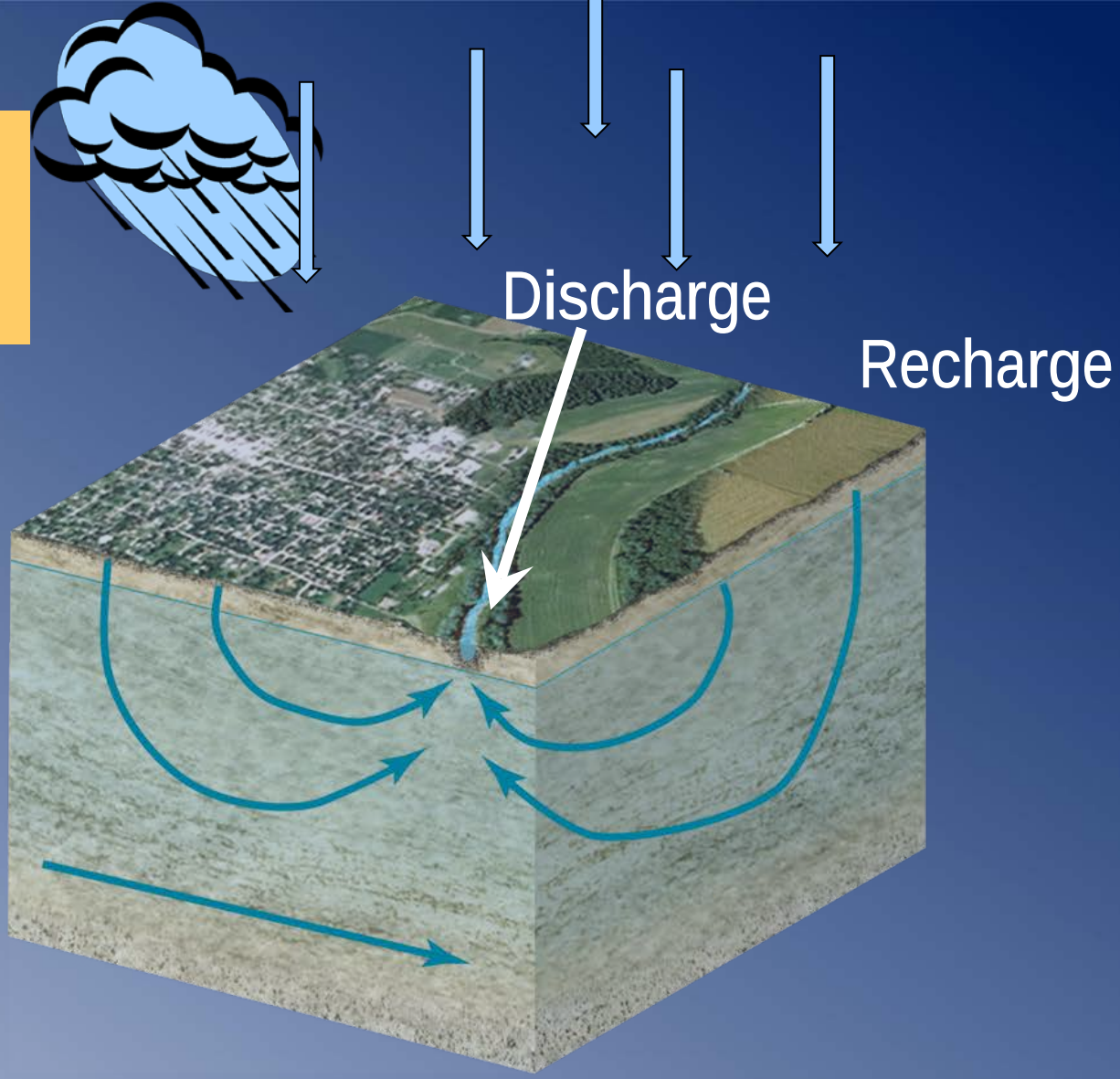
Geology

Upper Floridan aquifer

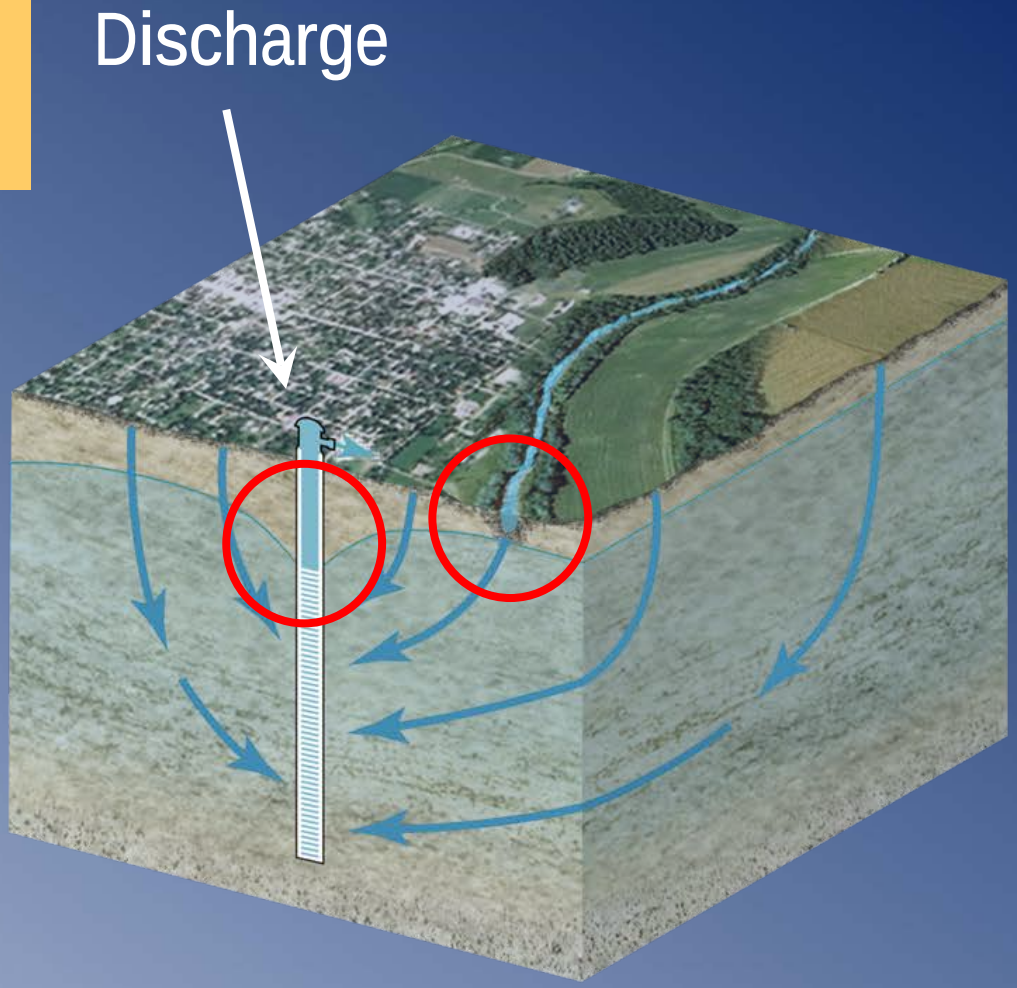
Hydro-geology



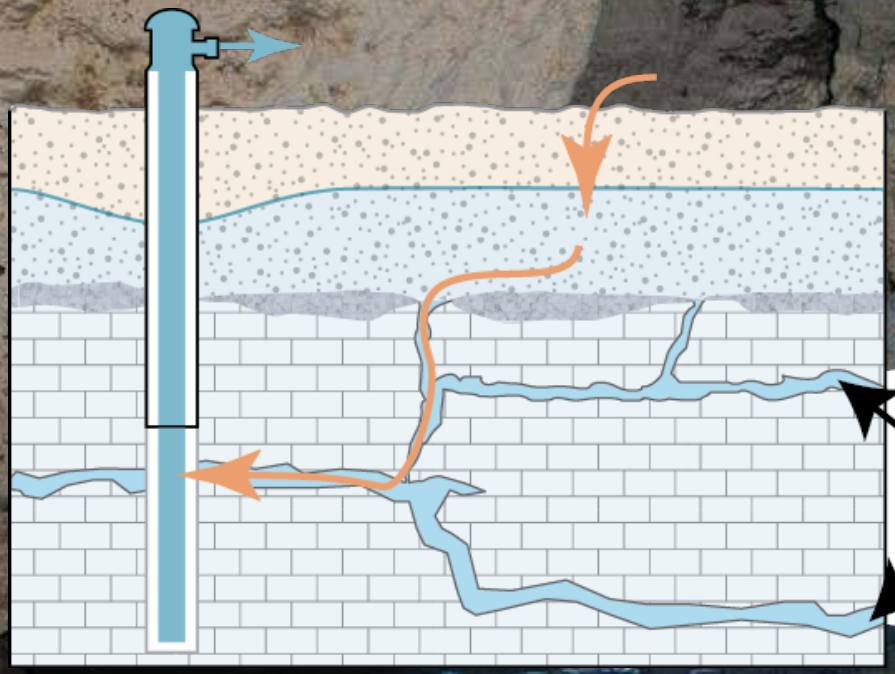
Hydro-geology



Hydro-geology

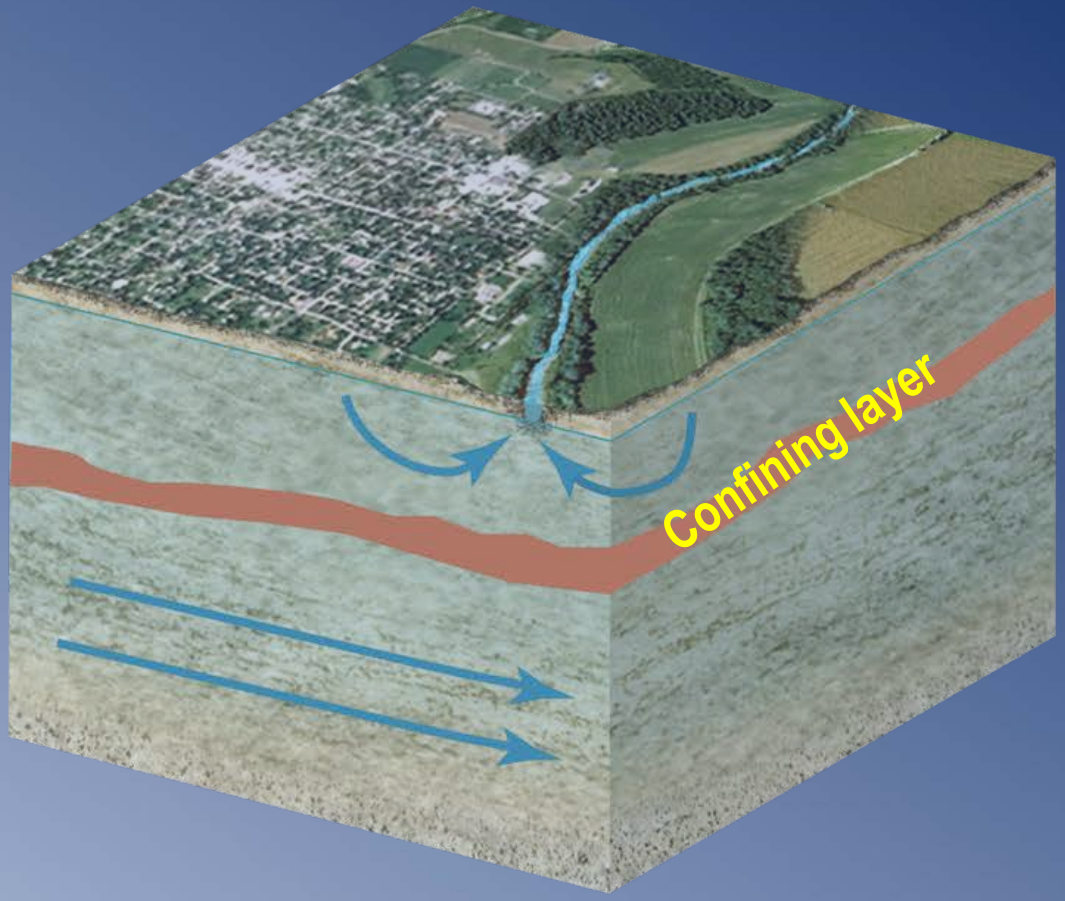


Hydro-geology



Preferential pathways

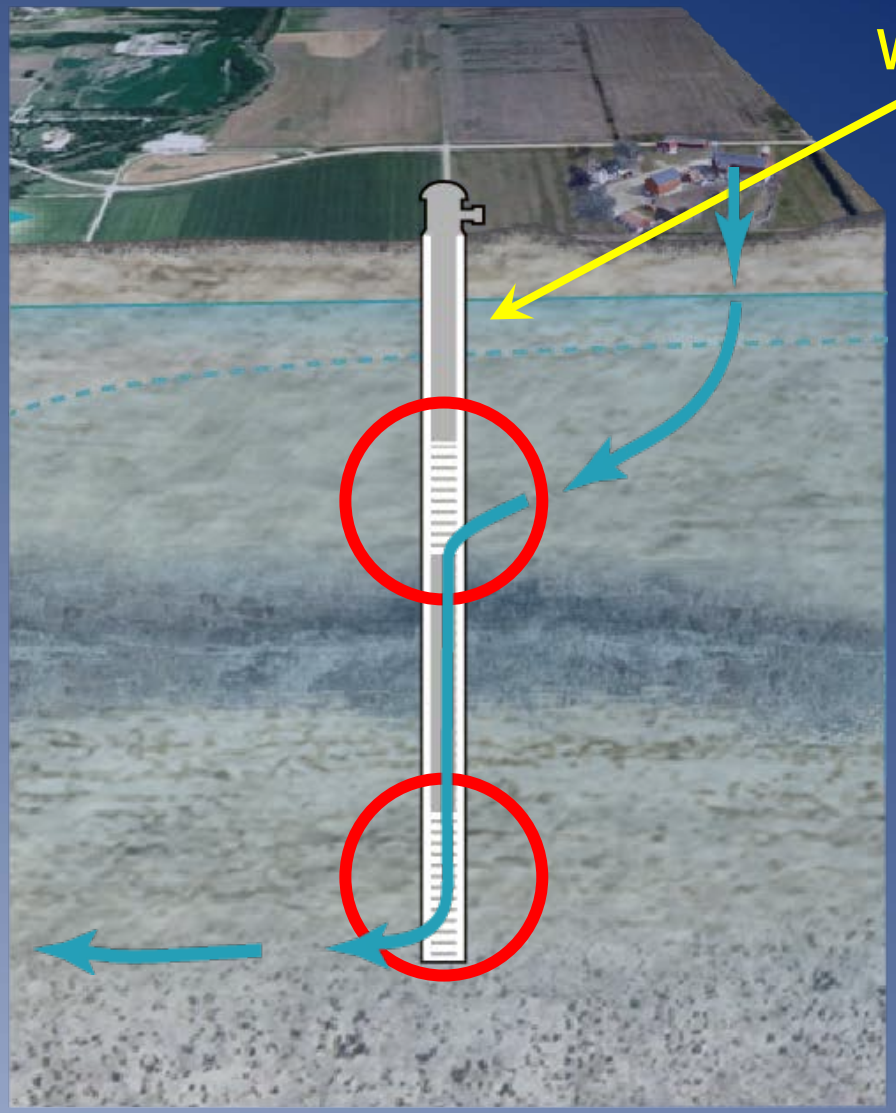
Hydro-geology



Unconfined aquifer

Confined aquifer

Hydro-geology



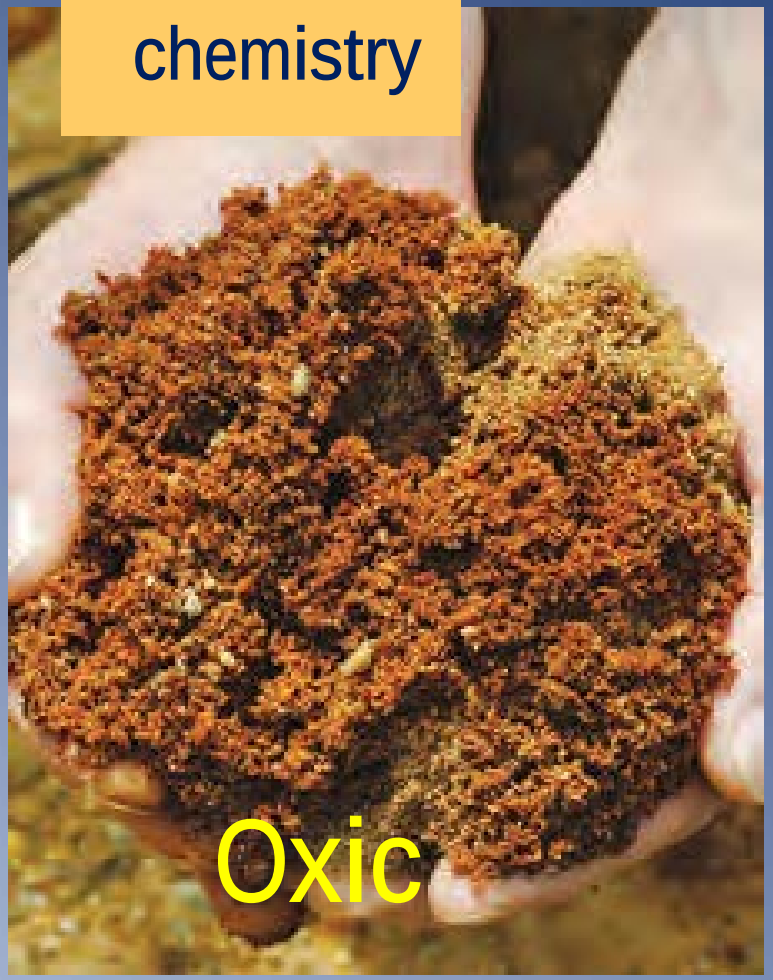
Multi-aquifer well

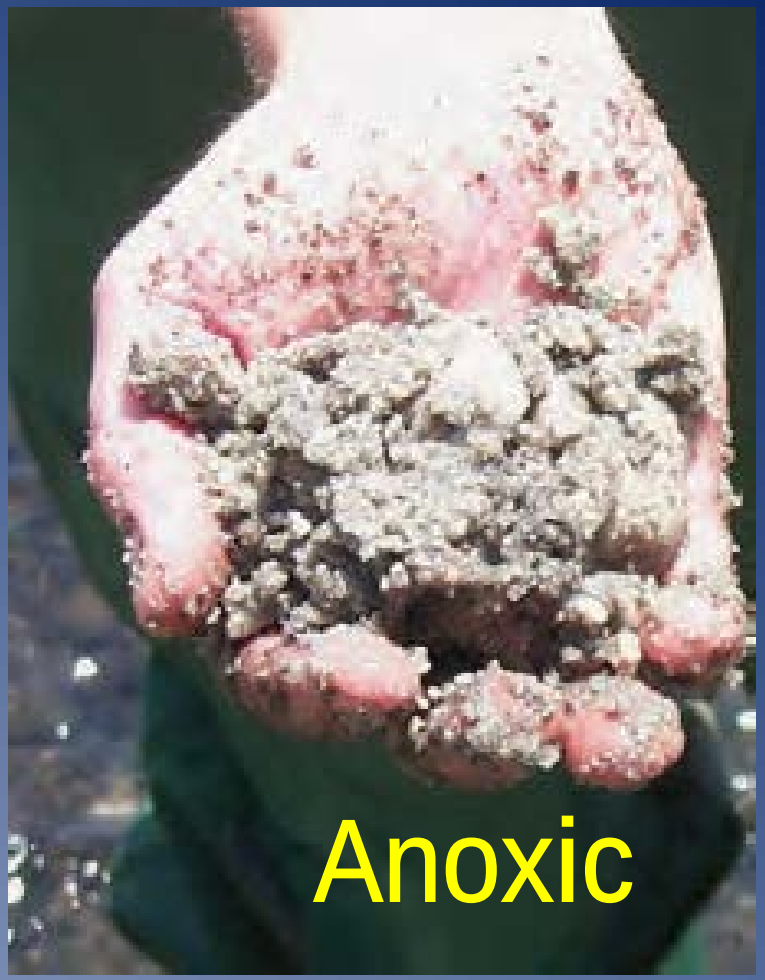
Unconfined aquifer

Confining layer

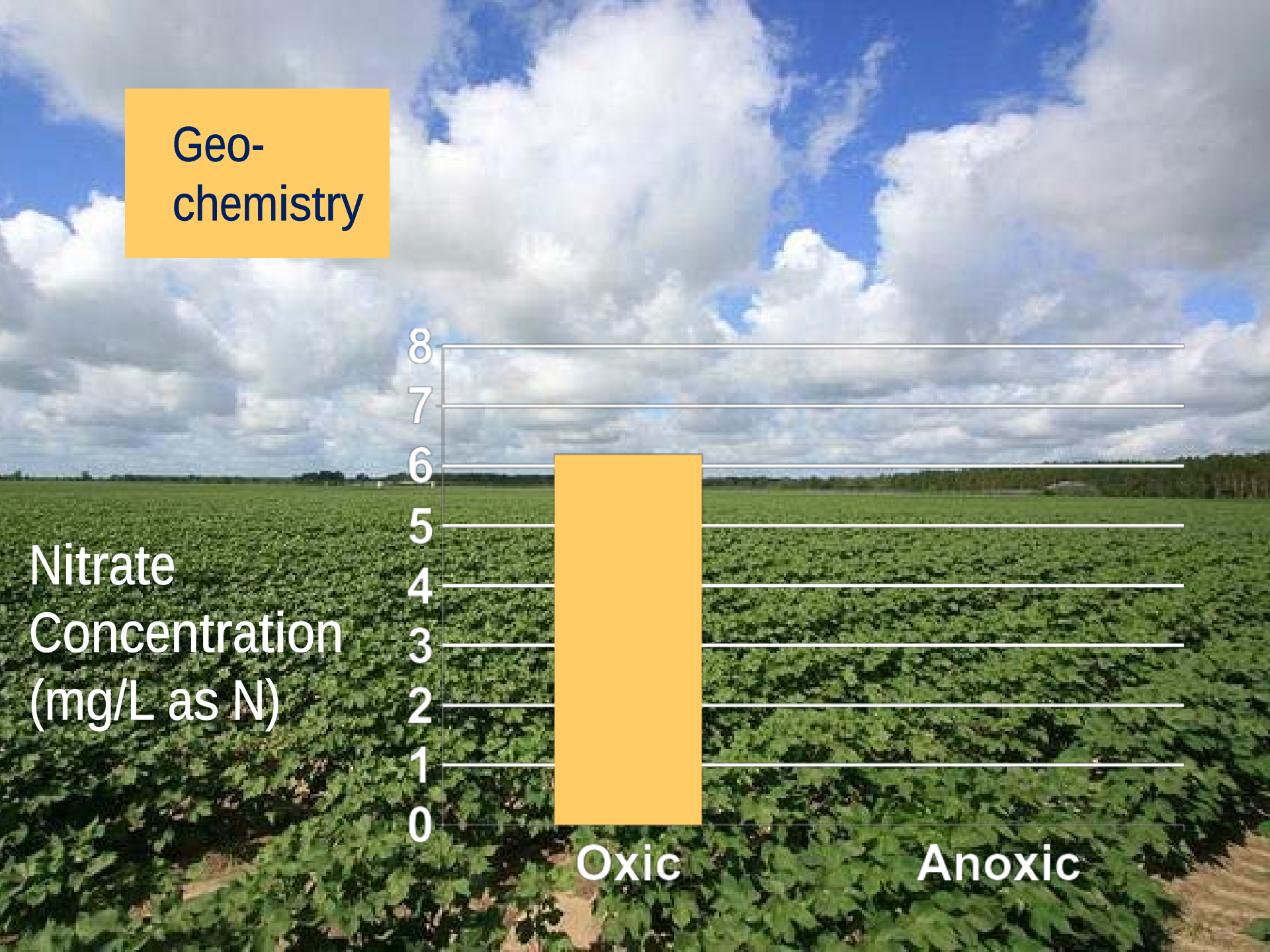
Confined aquifer

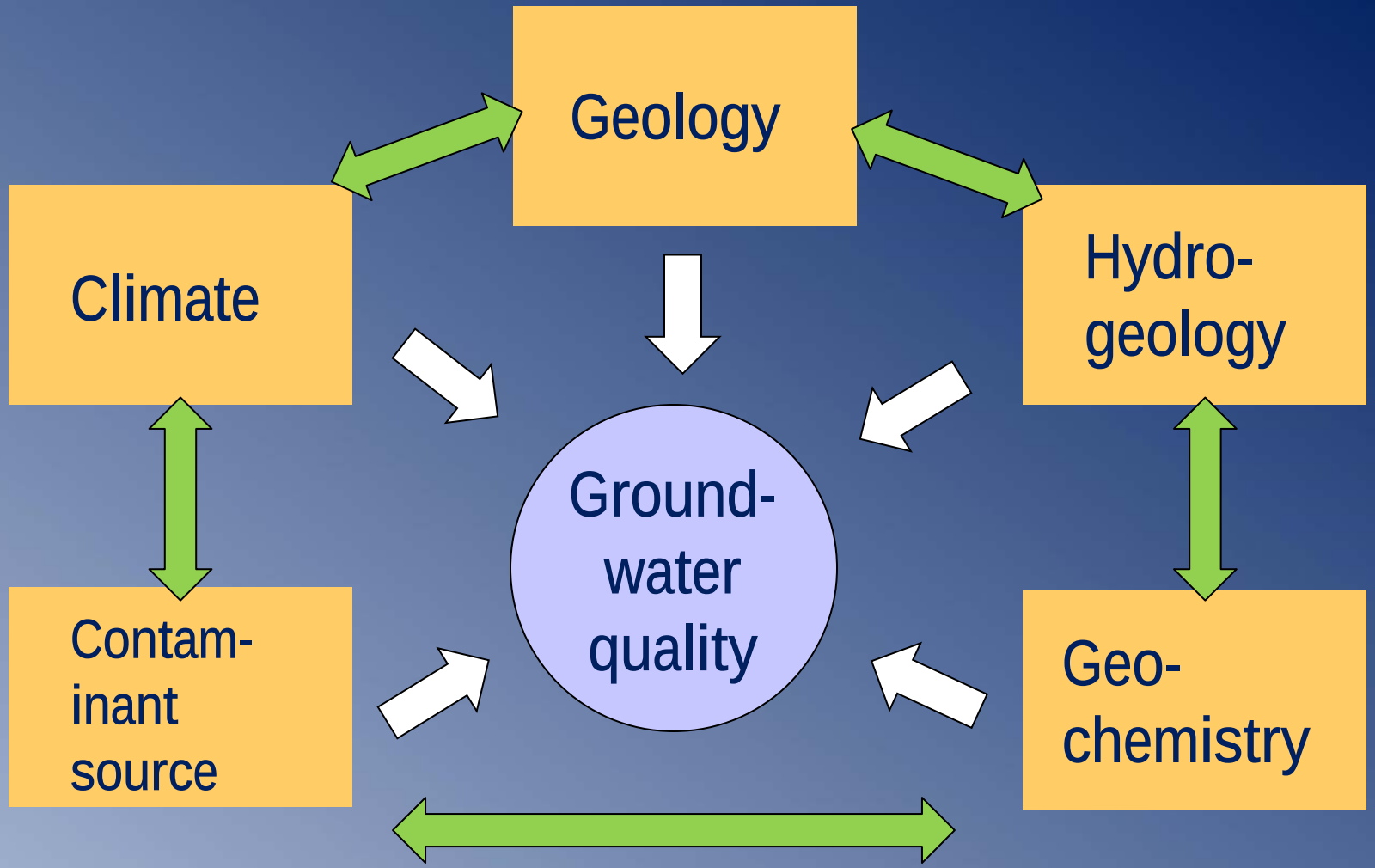
Geo-chemistry



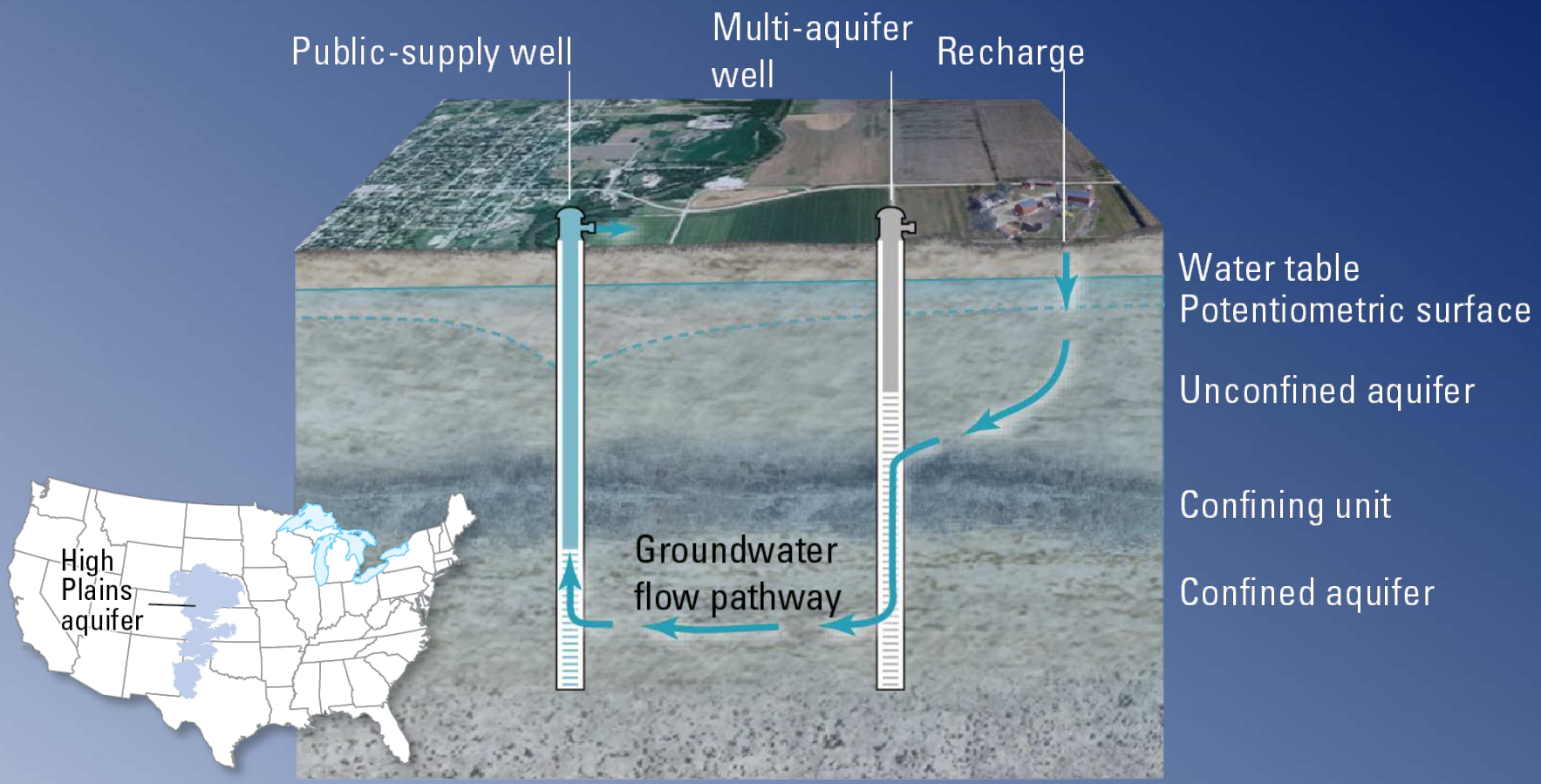


Geo-chemistry

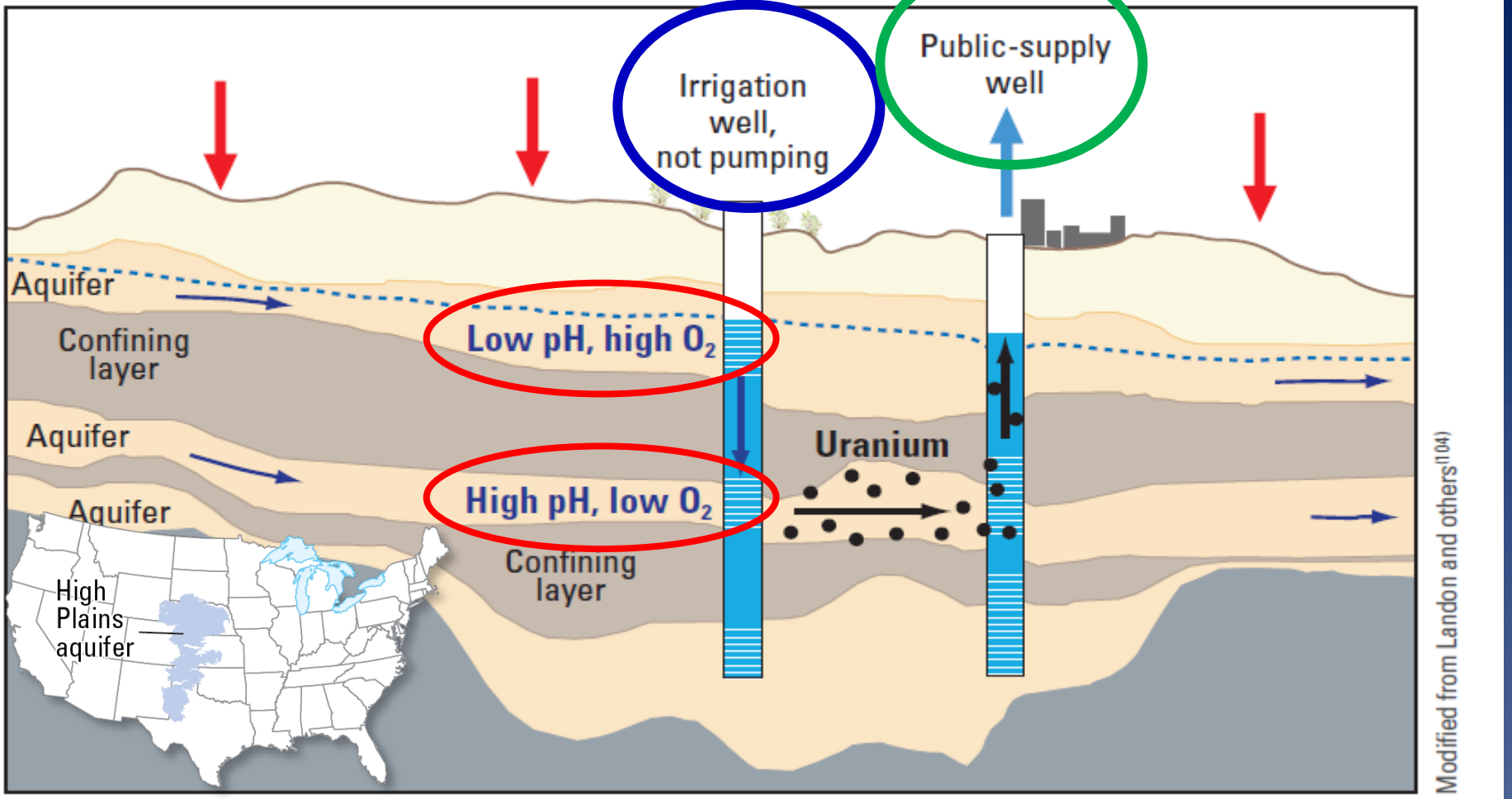



Geology
Climate
Hydro-
geology
Ground-
water
quality
Contam-
inant
source
Geo-
chemistry

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



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



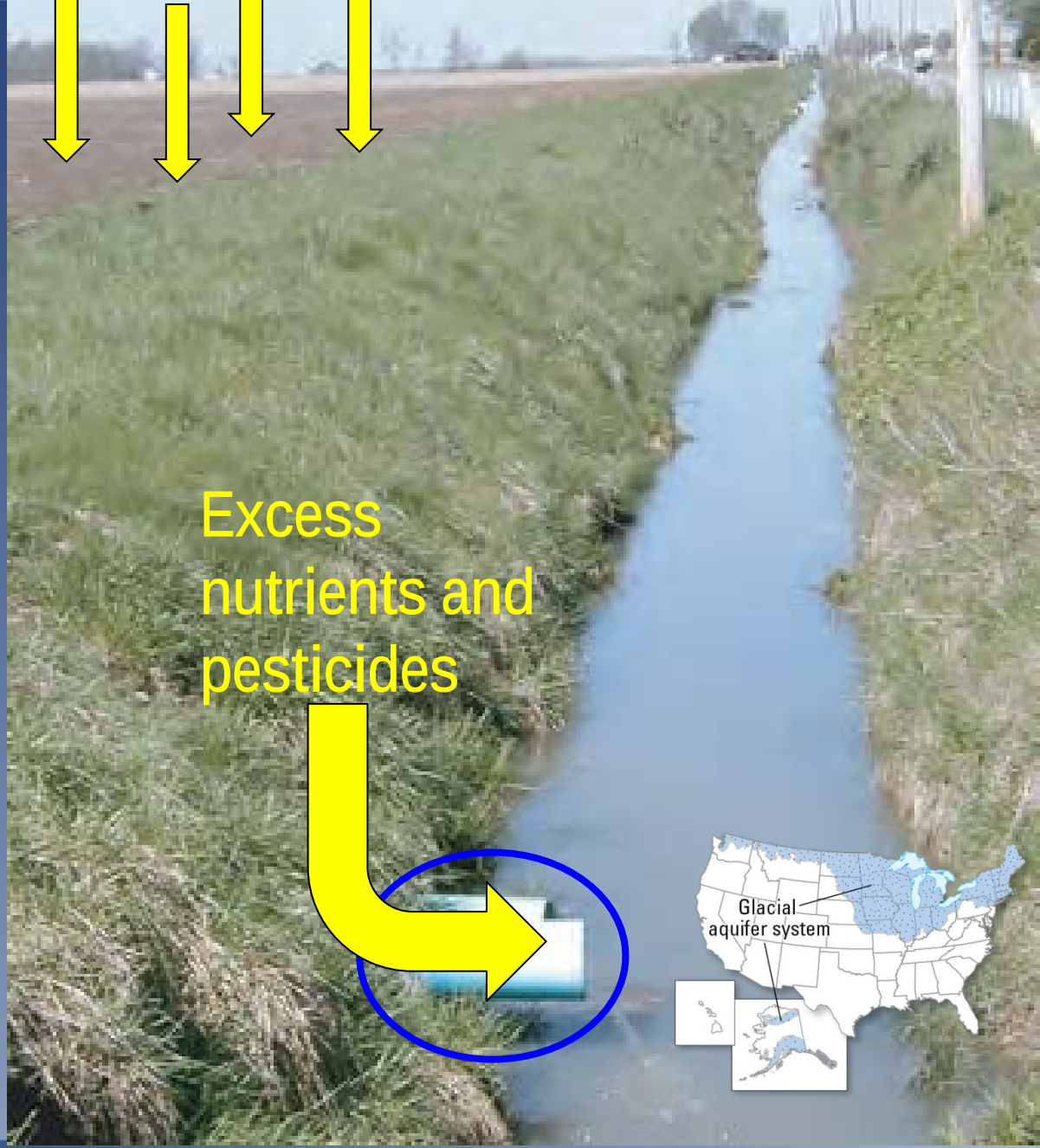
USGS

High Plains aquifer, central U.S.

Geology

Contaminant source

Hydro-geology

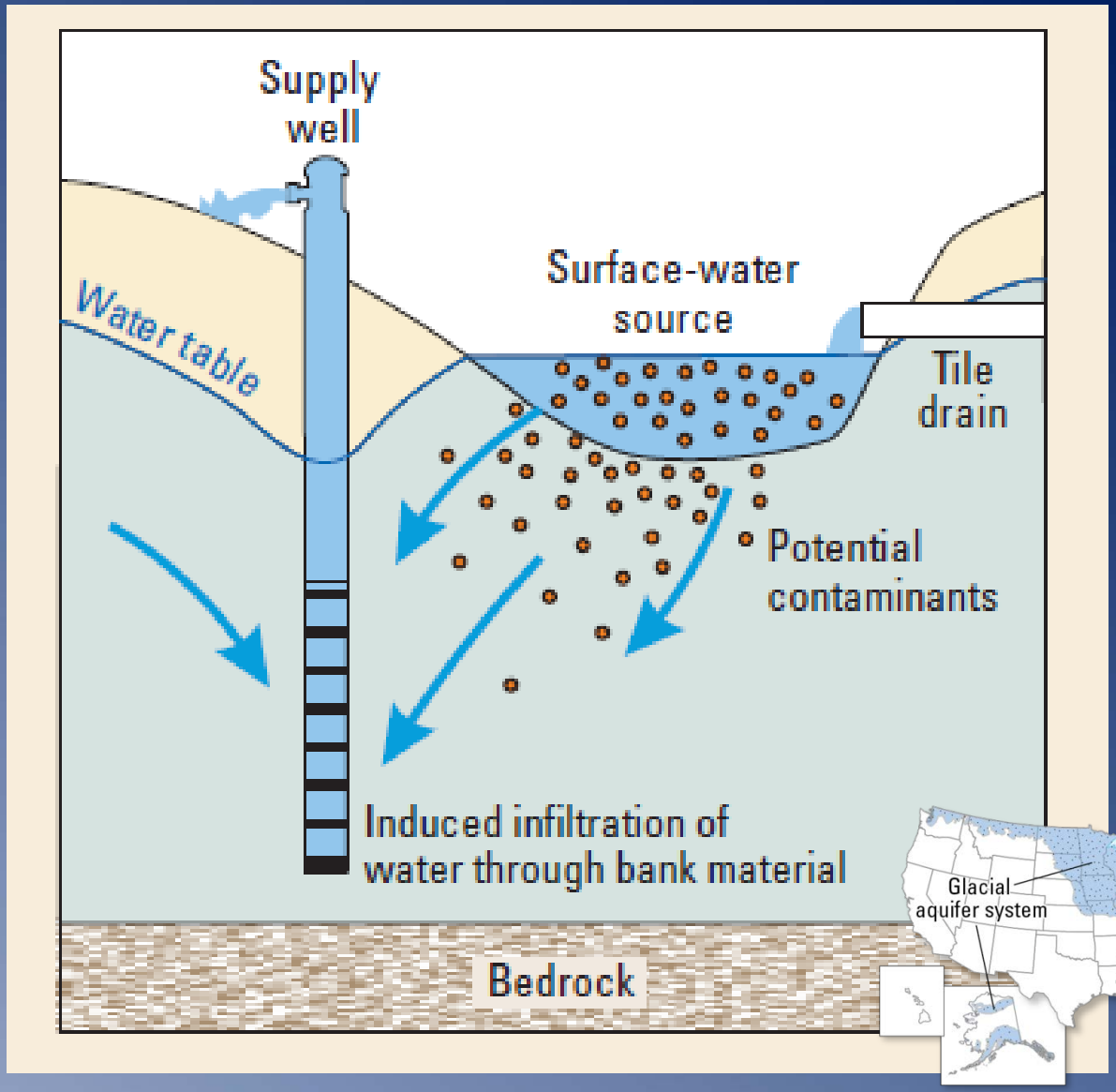


Glacial aquifer system, northern U.S.

Geology

Contaminant source

Hydro-geology



USGS

Glacial aquifer system, northern U.S.

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

Selenium-containing salts

Denver Basin aquifer system

Contaminant source

Geology

Hydro-geology

Geo-chemistry

Northern Atlantic Coastal Plain surficial aquifer system

Contaminant source

Geology

Hydro-geology

Geo-chemistry

Northern Atlantic Coastal Plain surficial aquifer system

Contaminant source

Geology

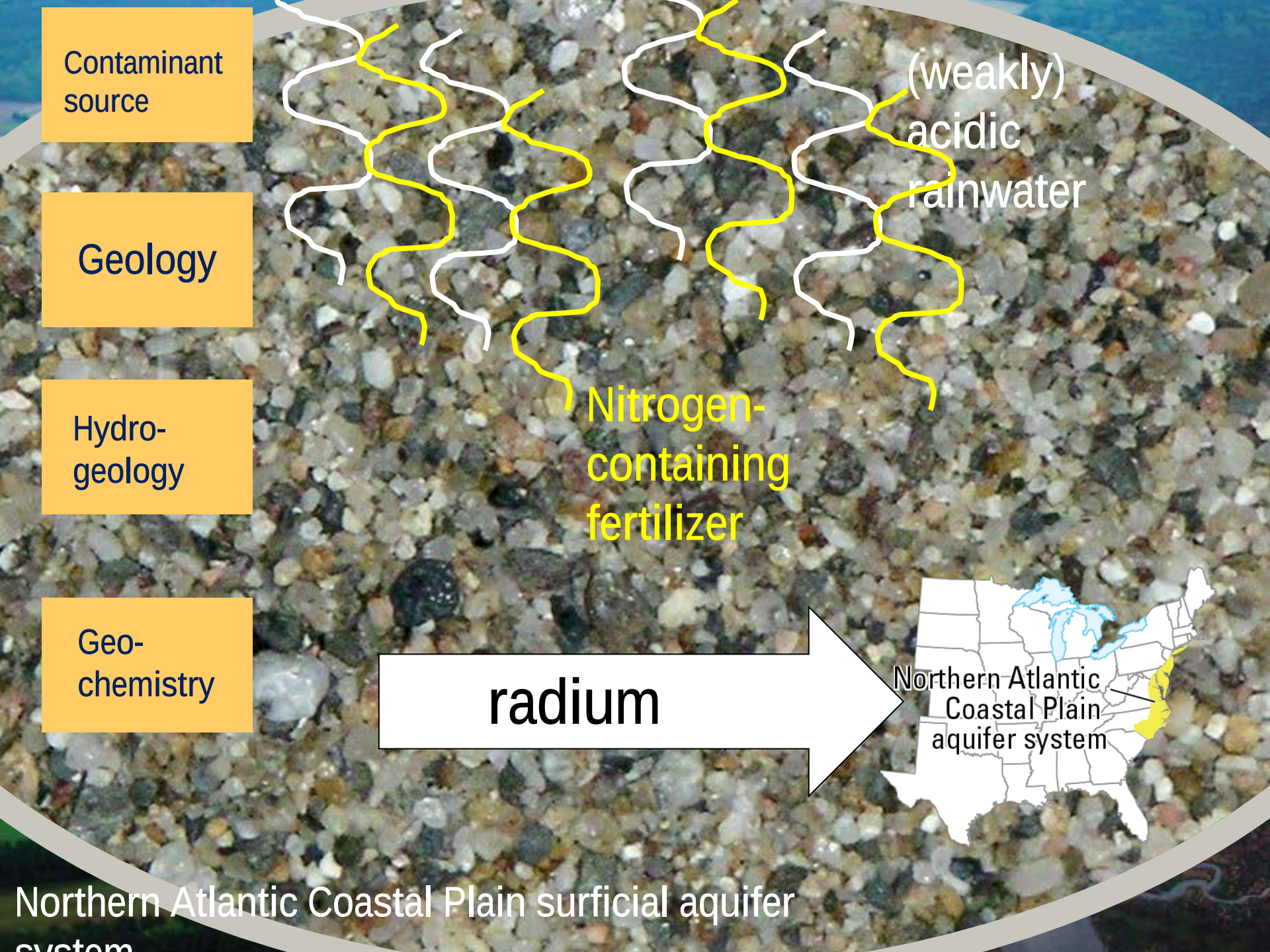
Hydro-geology

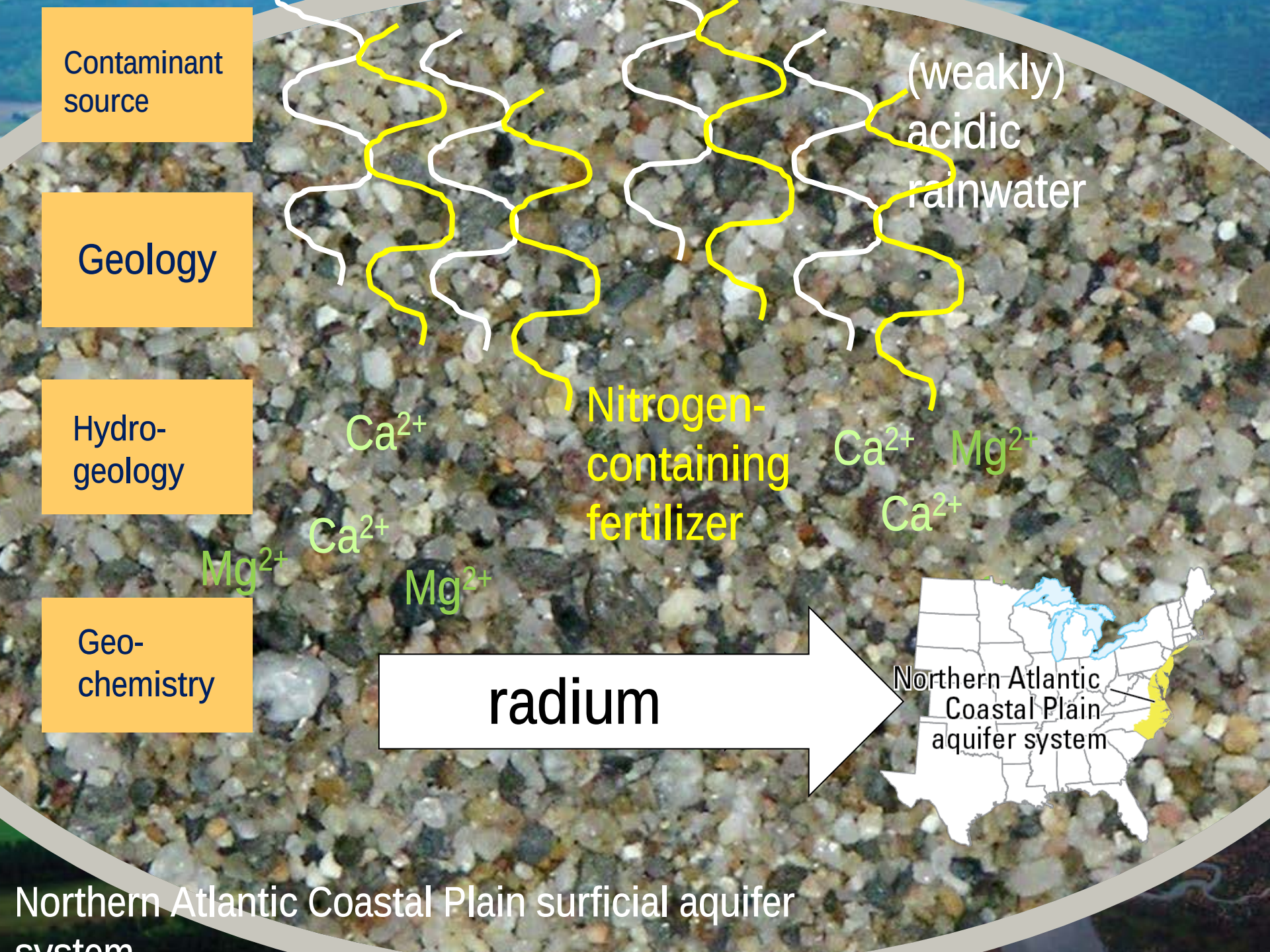
Geo-chemistry

(weakly) acidic rainwater

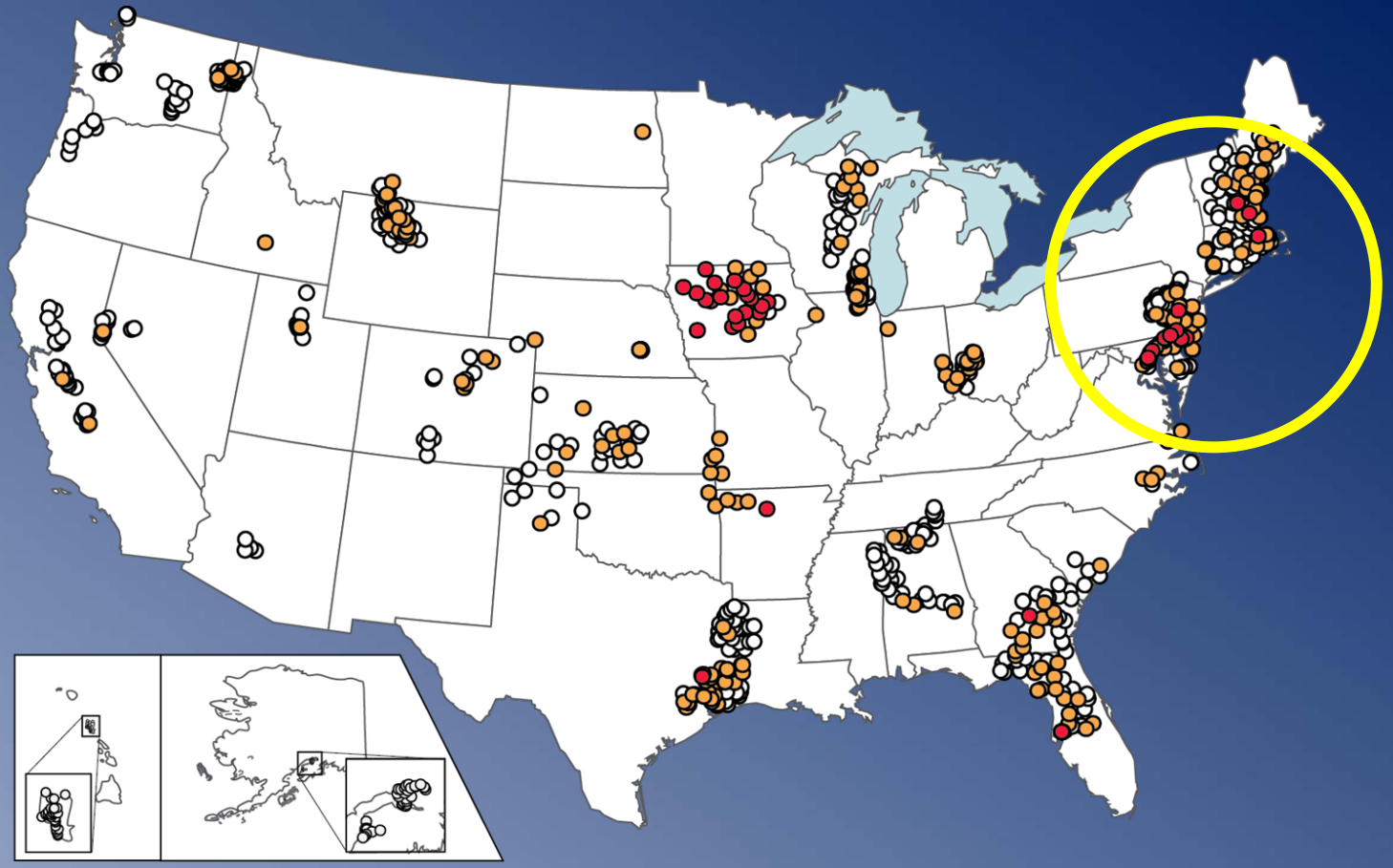
radium

Northern Atlantic Coastal Plain surficial aquifer system


Contaminant source
Geology
Hydro-geology
Geo-chemistry
(weakly) acidic rainwater
Nitrogen-containing fertilizer
radium
Northern Atlantic Coastal Plain aquifer system
Northern Atlantic Coastal Plain surficial aquifer system


Contaminant source
Geology
Hydro-geology
Geo-chemistry
(weakly) acidic rainwater
Nitrogen-containing fertilizer
Ca^{2+}
Mg^{2+}
Ca^{2+}
Mg^{2+}
Ca^{2+}
Ca^{2+}
Mg^{2+}
radium
Northern Atlantic Coastal Plain aquifer system
Northern Atlantic Coastal Plain surficial aquifer system

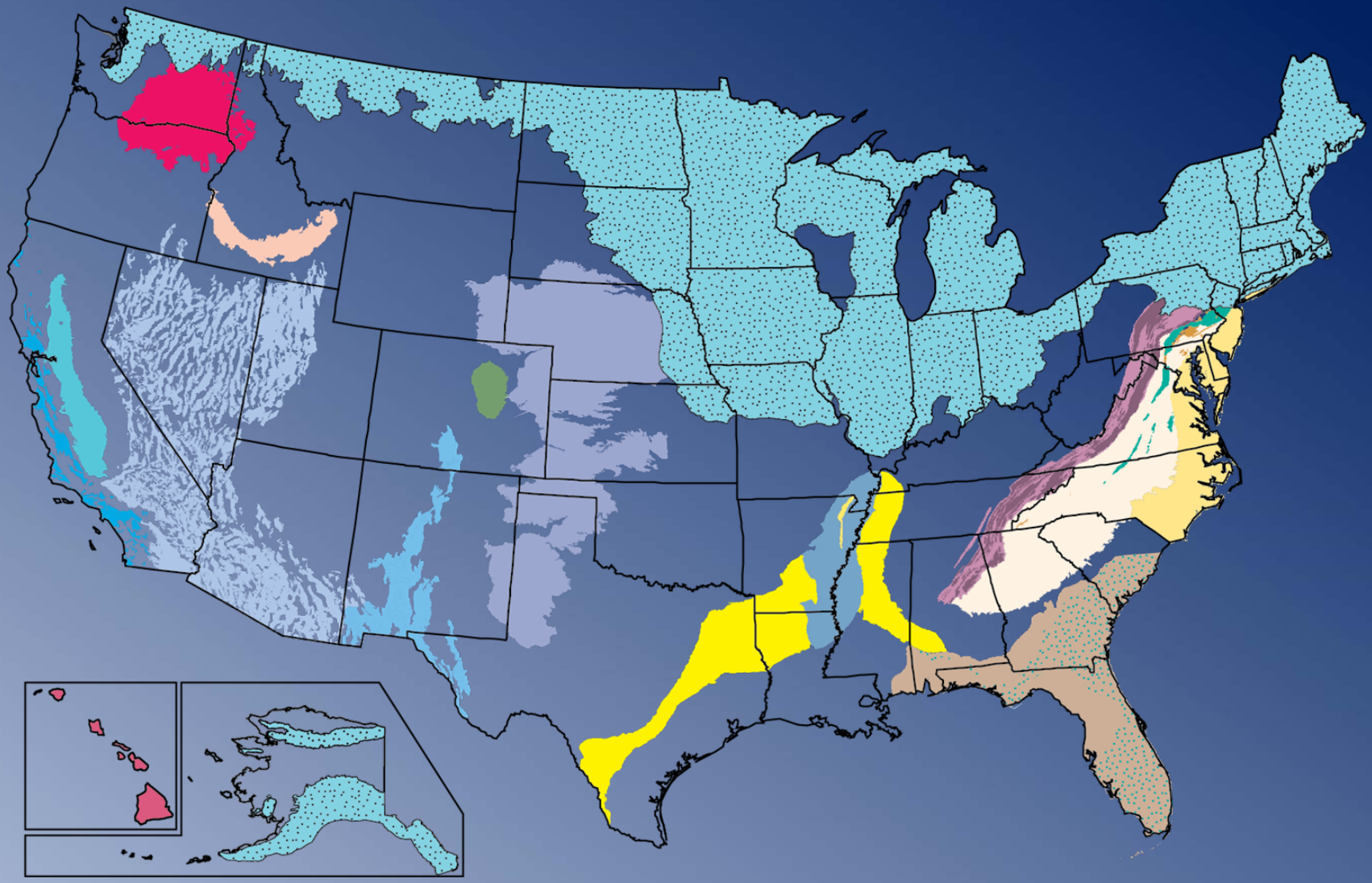
Radium in groundwater

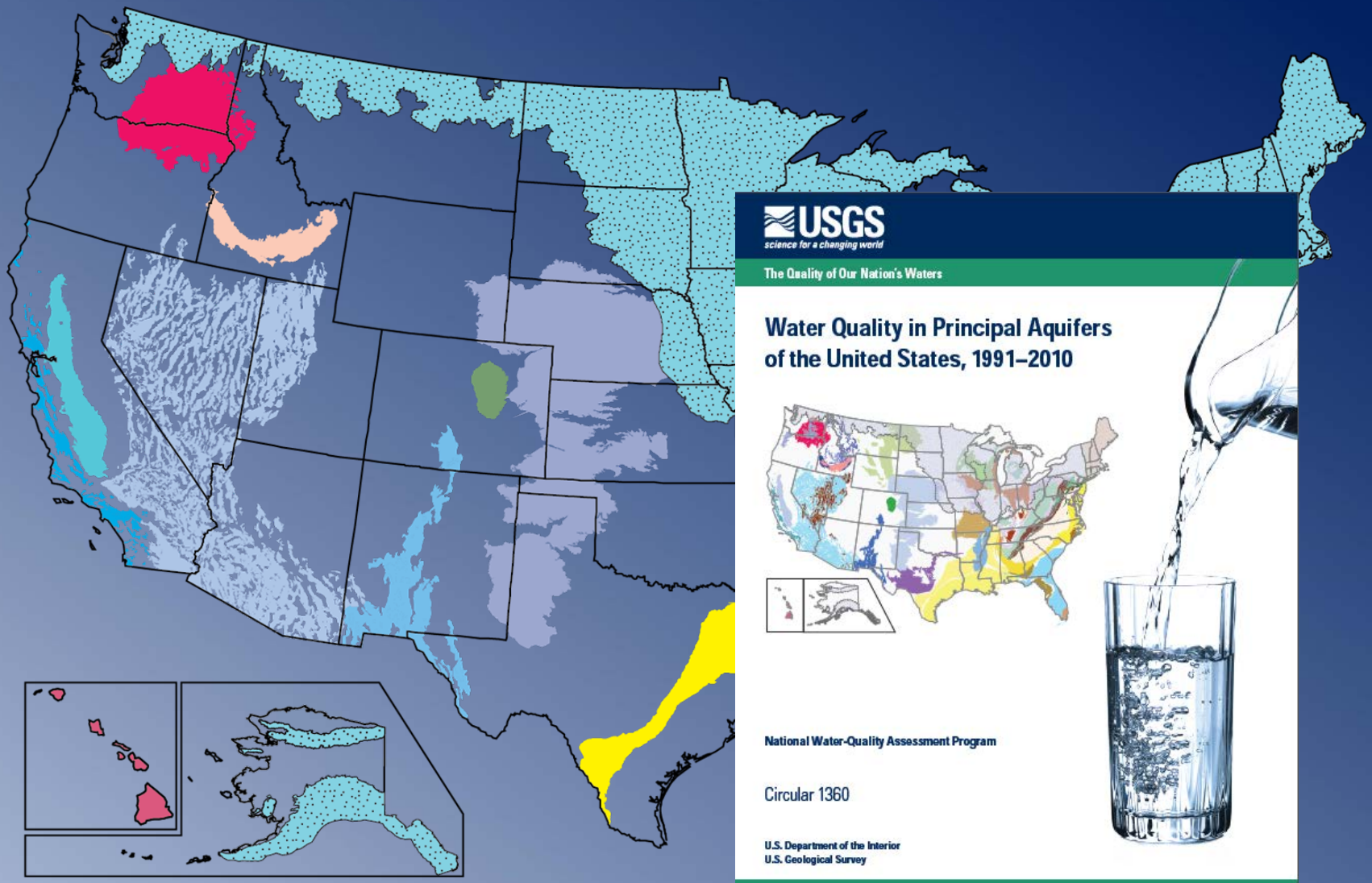


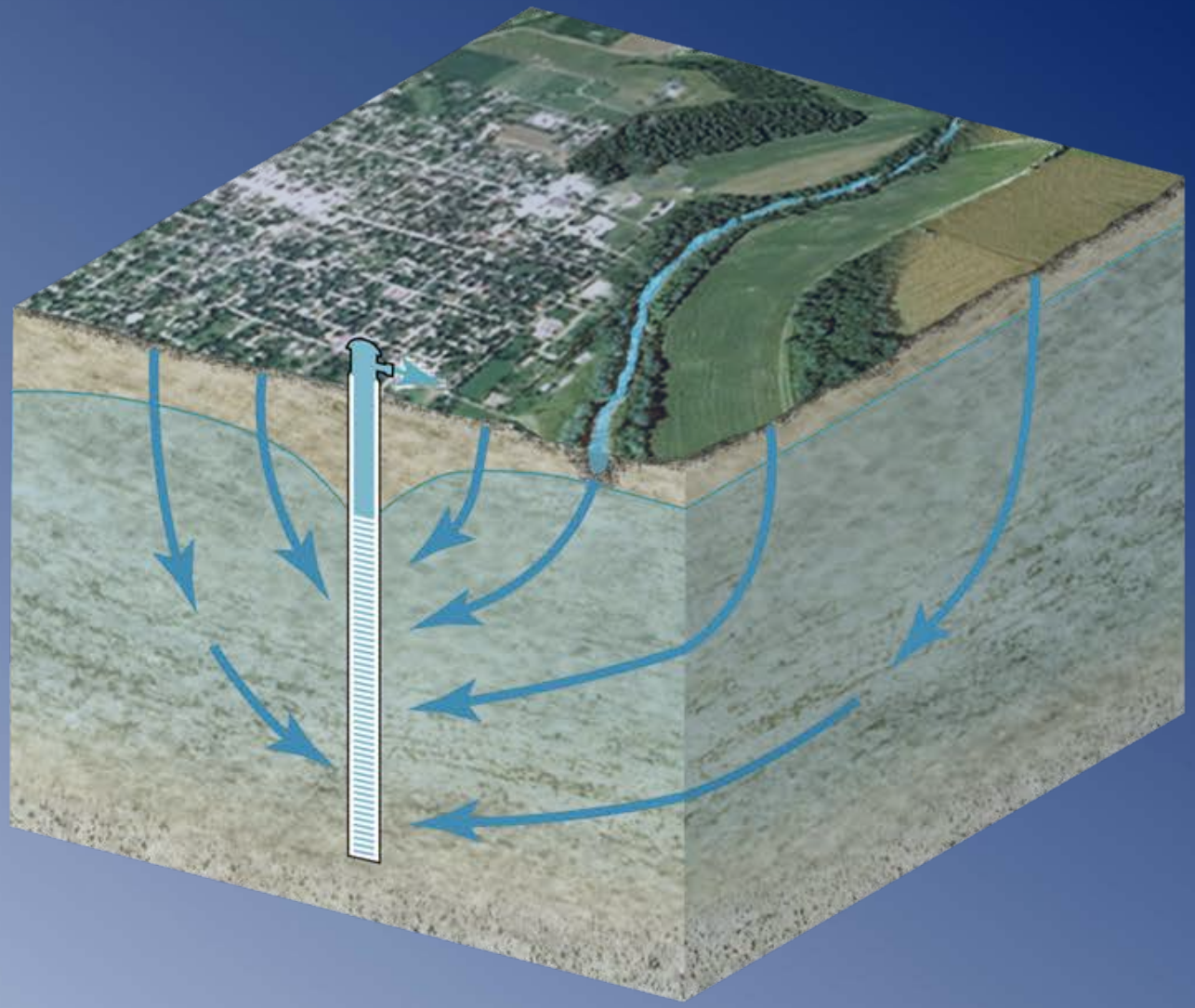
Radium concentration in sampled wells

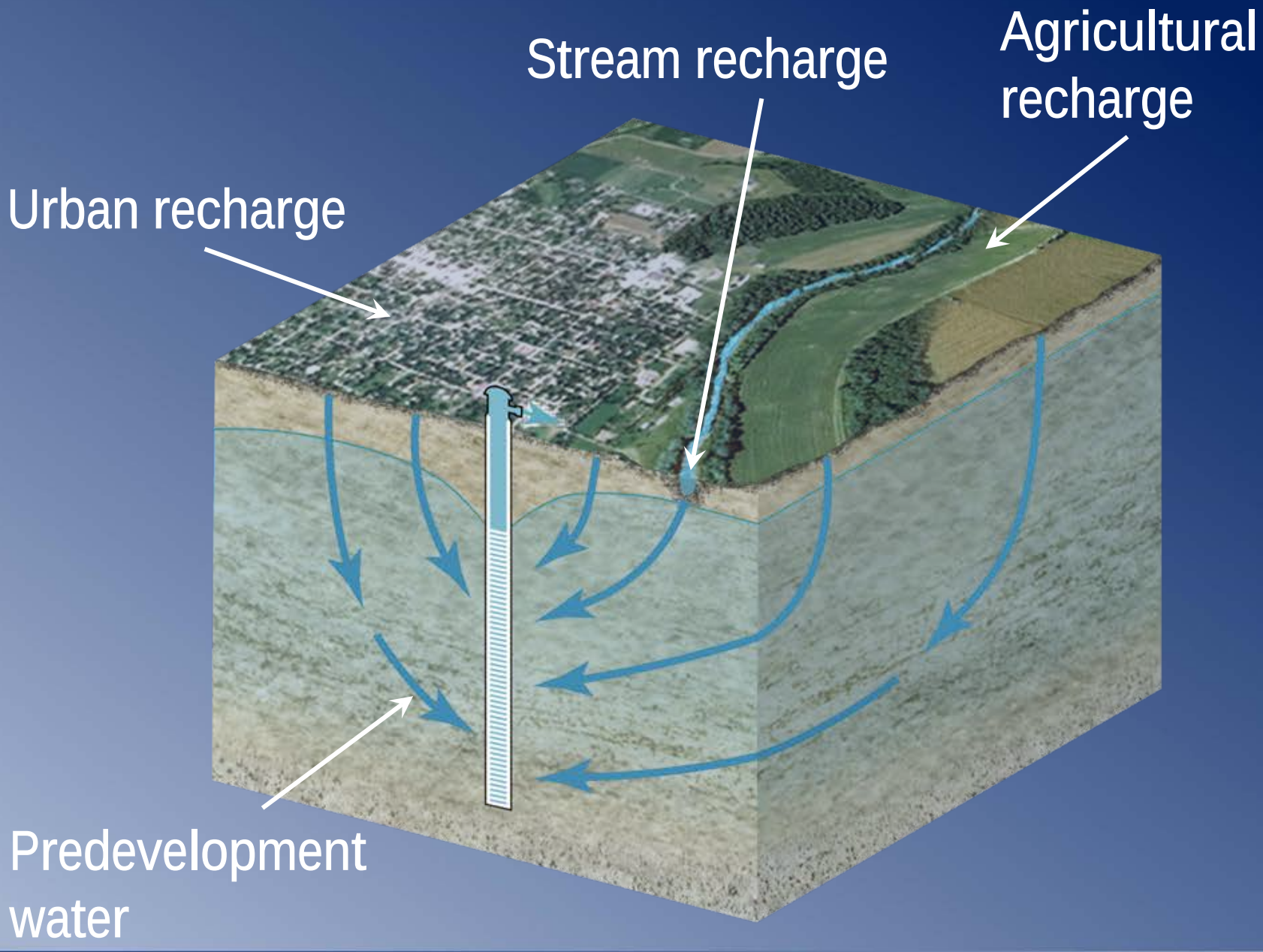
- low
- medium
- high (exceeds human-health benchmark)

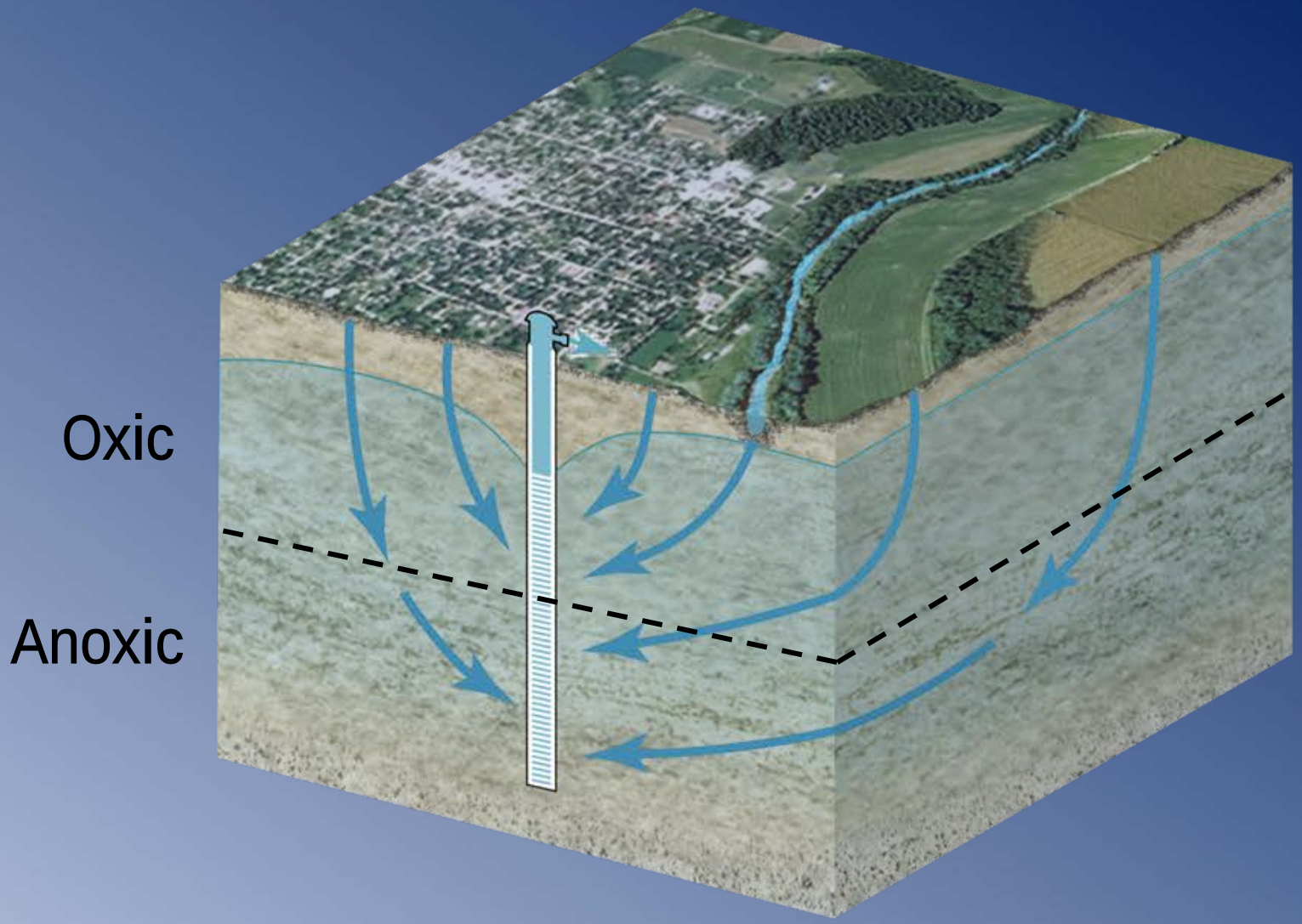
USGS




USGS
science for a changing world
The Quality of Our Nation's Waters
Water Quality in Principal Aquifers of the United States, 1991–2010
National Water-Quality Assessment Program
Circular 1360
U.S. Department of the Interior
U.S. Geological Survey



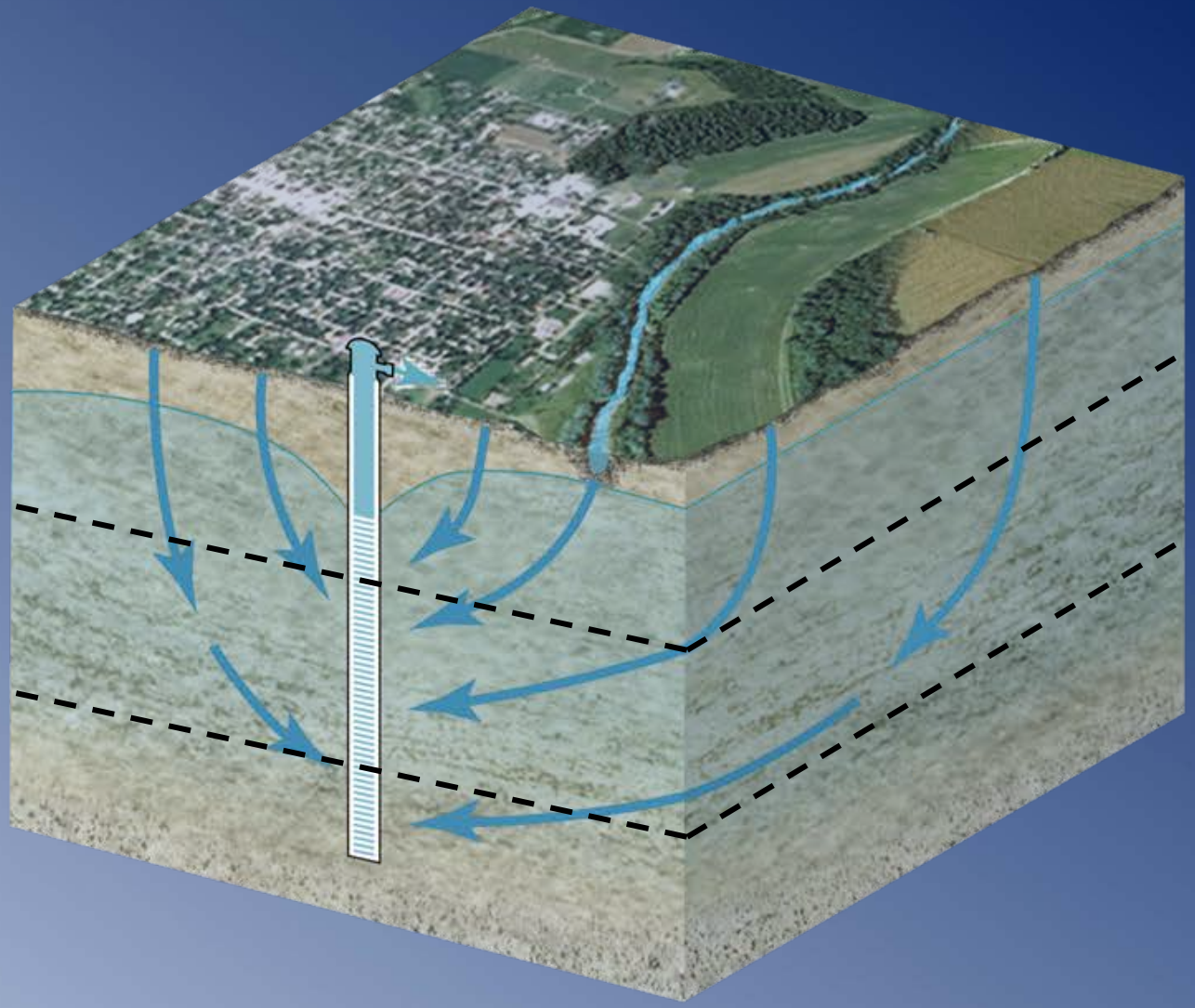

Agricultural recharge
Stream recharge
Urban recharge
Predevelopment water


Oxic
Anoxic

Years

Decades

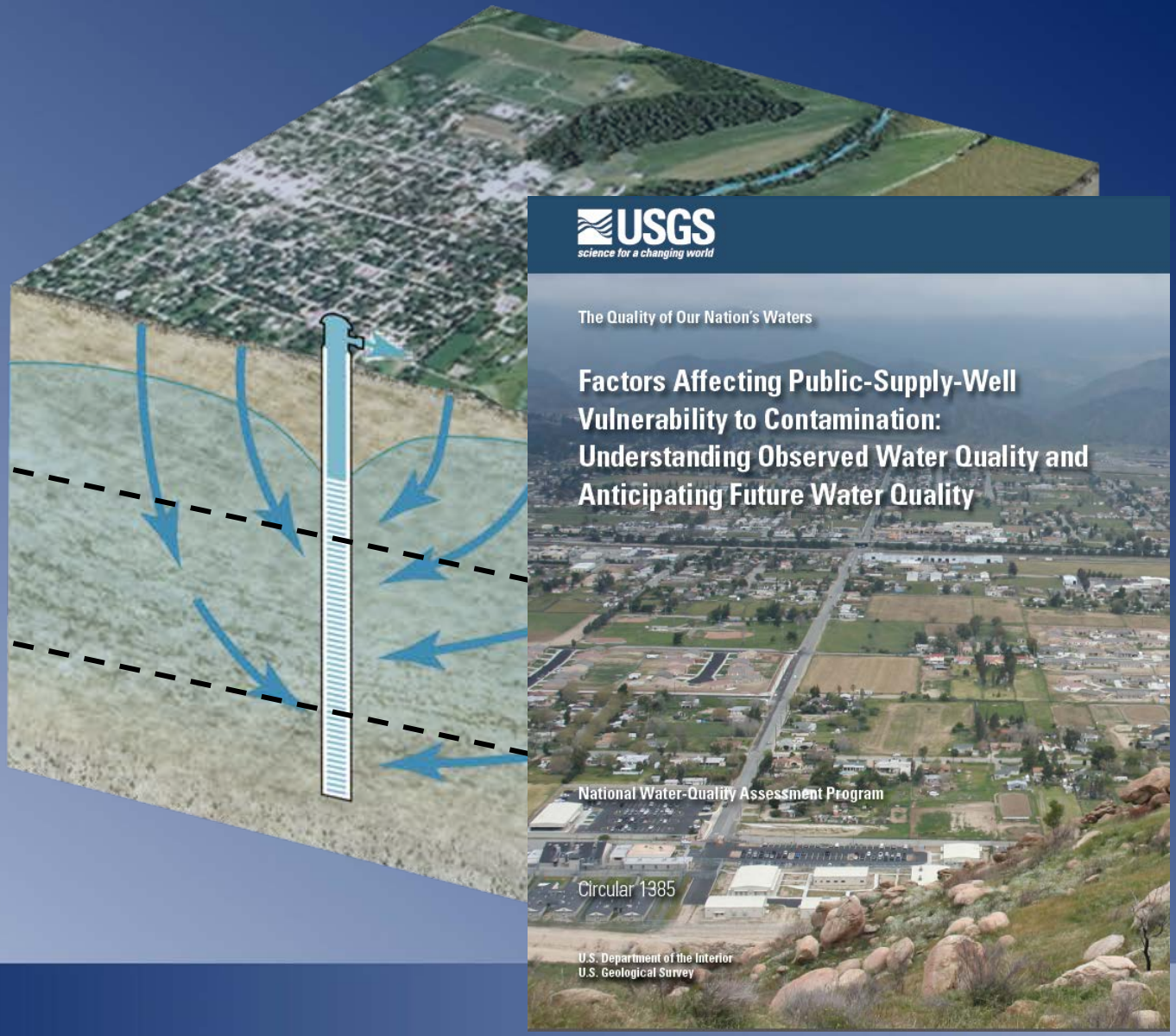
Centuries

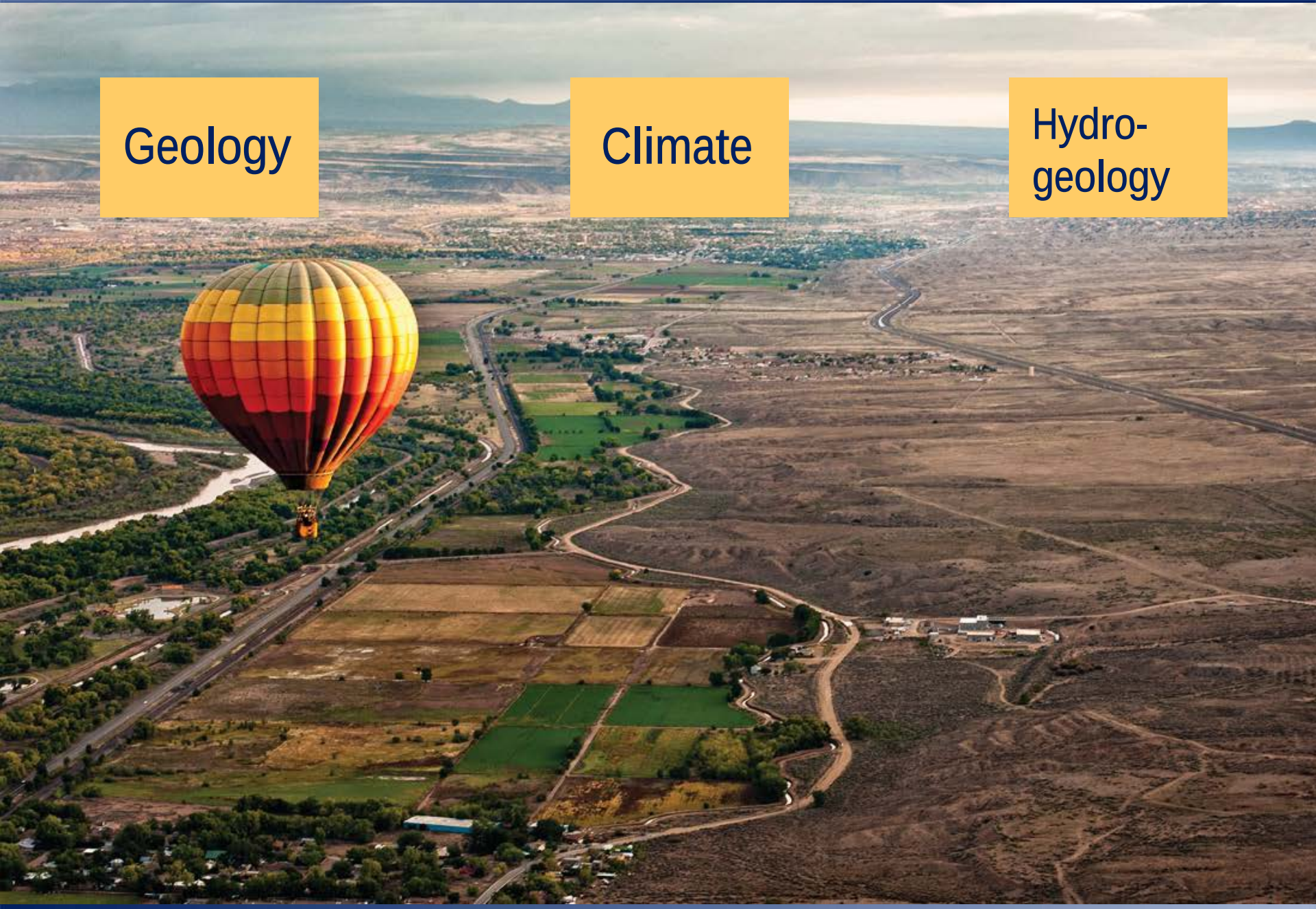


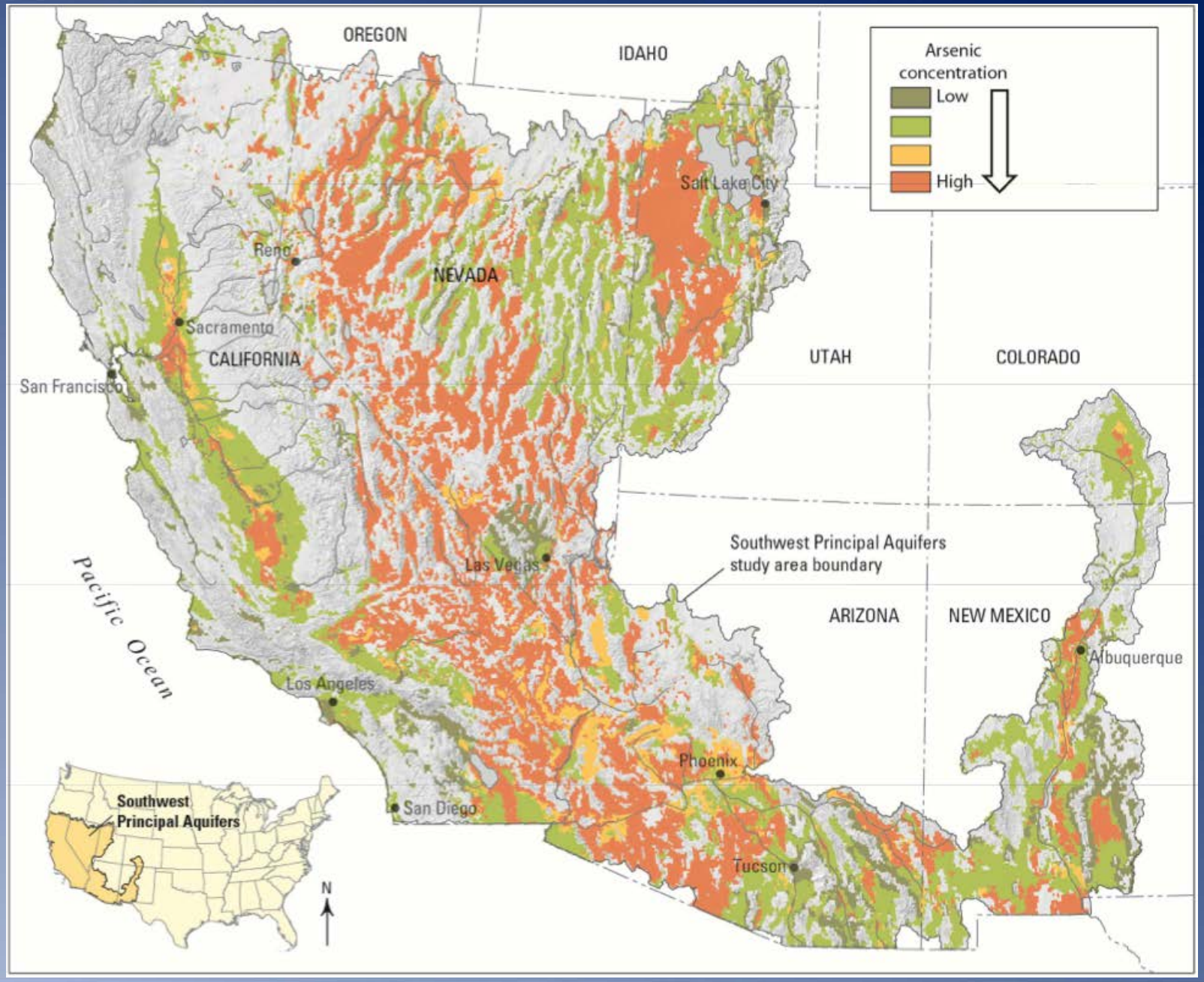
Years

Decades

Centuries




Geology
Climate
Hydro-
geology


OREGON
IDAHO
Arsenic concentration
Low
High
Salt Lake City
Reno
NEVADA
Sacramento
CALIFORNIA
San Francisco
UTAH
COLORADO
Southwest Principal Aquifers study area boundary
Las Vegas
Pacific Ocean
ARIZONA
NEW MEXICO
Albuquerque
Los Angeles
Phoenix
San Diego
Tucson
Southwest Principal Aquifers
N

USGS

The next decade: What will the future bring?