



EERC



U N I V E R S I T Y O F
NORTH DAKOTA



Critical Challenges. Practical Solutions.



Minnesota Senate Energy Committee

St. Paul, Minnesota

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**HIGH-BAY
TECHNOLOGY
DEMONSTRATION**

**FUEL
PROCESSING**

**MOBILE
LABORATORIES**

**WATER USE
MINIMIZATION
TECHNOLOGY**

FUELS OF THE FUTURE

**NATIONAL CENTER
FOR HYDROGEN
TECHNOLOGY**

CHEMICAL STORAGE

LABORATORIES

OFFICES

**IN-HOUSE
FABRICATION SHOP**

**TECHNOLOGY
DEMONSTRATION**

**DISCOVERY HALL
MEETING AREA**

OUR FACILITIES

254,000 SQ FT OF FACILITIES

CORE RESEARCH PRIORITIES

Coal Utilization & Emissions

Carbon Management

Oil & Gas

Alternative Fuels & Renewable Energy

Energy–Water

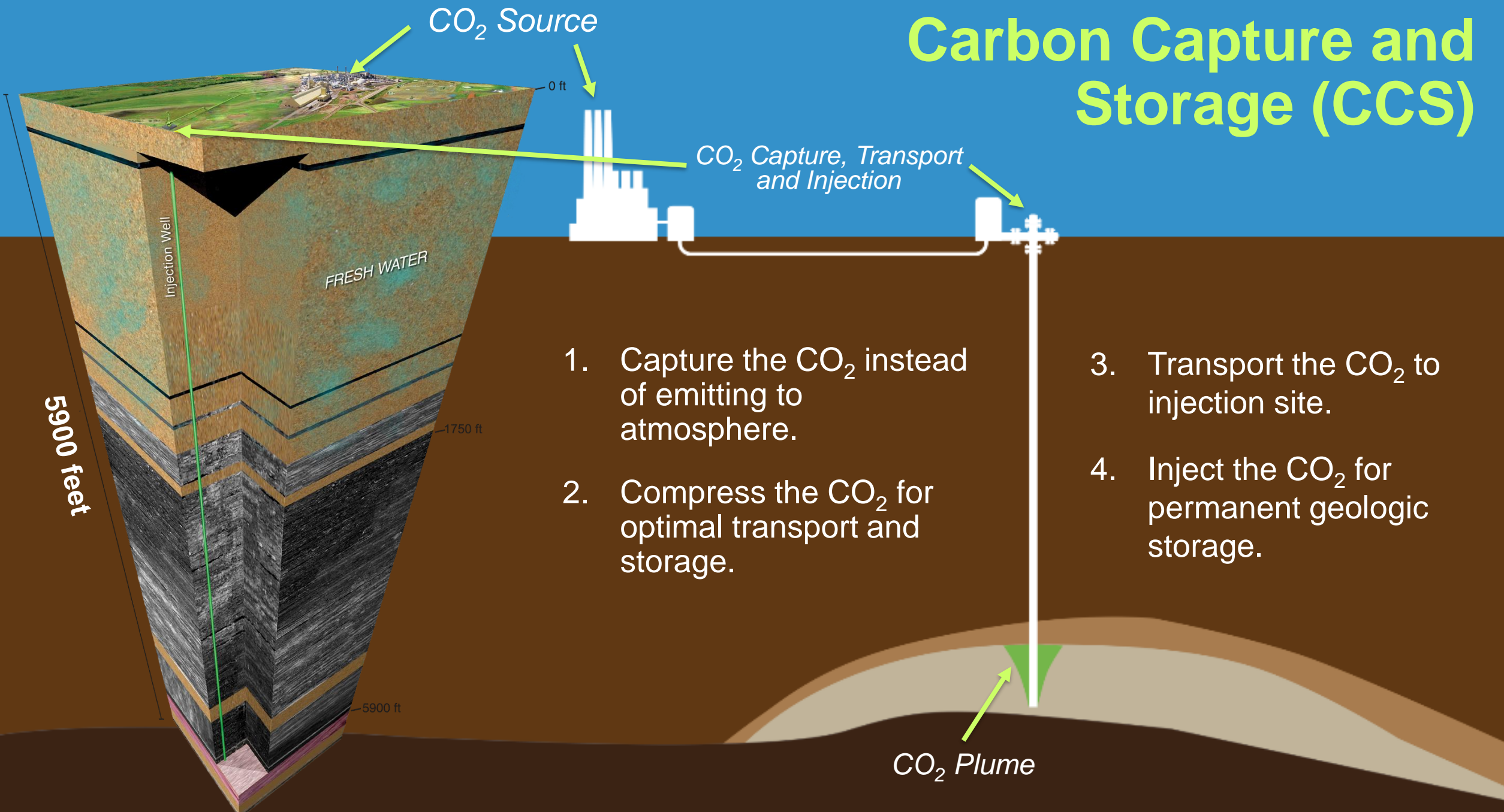


CARBON MANAGEMENT

Global leader in the area of CO₂ capture, utilization, reduction, and storage.
Experienced resource for industry and government in fossil fuels and biomass.



Carbon Capture and Storage (CCS)



CO₂ Source

0 ft

CO₂ Capture, Transport and Injection

Injection Well

FRESH WATER

1. Capture the CO₂ instead of emitting to atmosphere.
2. Compress the CO₂ for optimal transport and storage.

3. Transport the CO₂ to injection site.
4. Inject the CO₂ for permanent geologic storage.

CO₂ Plume

5900 feet

1750 ft

5900 ft

CRITICAL SUBSURFACE CHARACTERISTICS

- Depth
- Porosity/permeability
- Good cap rock
- Appropriate salinity
- No natural leakage pathways

Depth

- Below approximately 2600 ft, CO₂ becomes a supercritical fluid.
- CO₂ will behave like a liquid.
- High density of the CO₂ allows for more storage in a given volume.

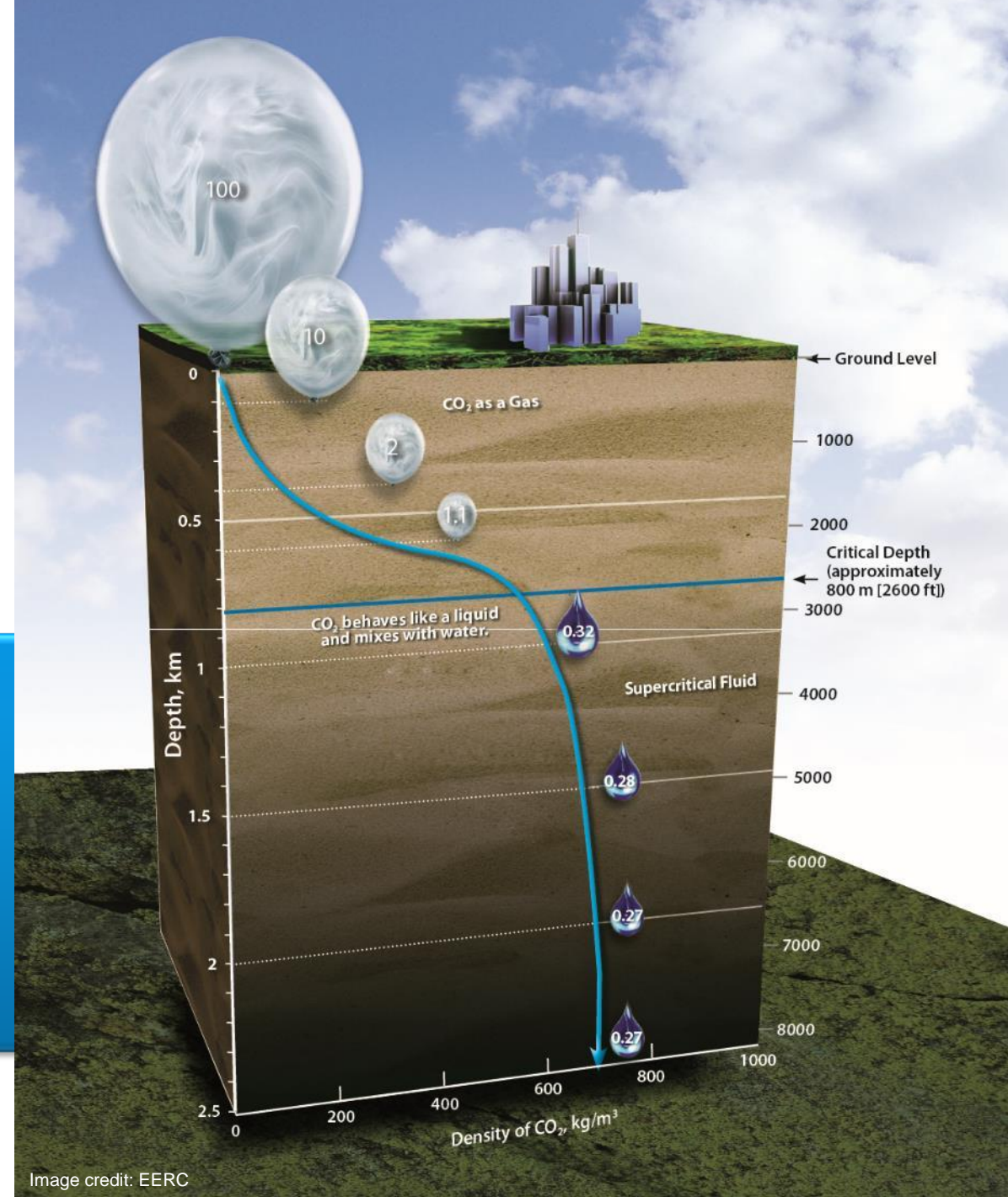


Image credit: EERC

POROSITY AND PERMEABILITY



A close-up photograph of a person's hands holding a large, rectangular, reddish-brown soil core sample. The soil has a porous, crumbly texture. The background is blurred, showing a person in a white lab coat. The text "GEOLOGIC STORAGE OF CARBON DIOXIDE" is overlaid in the bottom right corner.

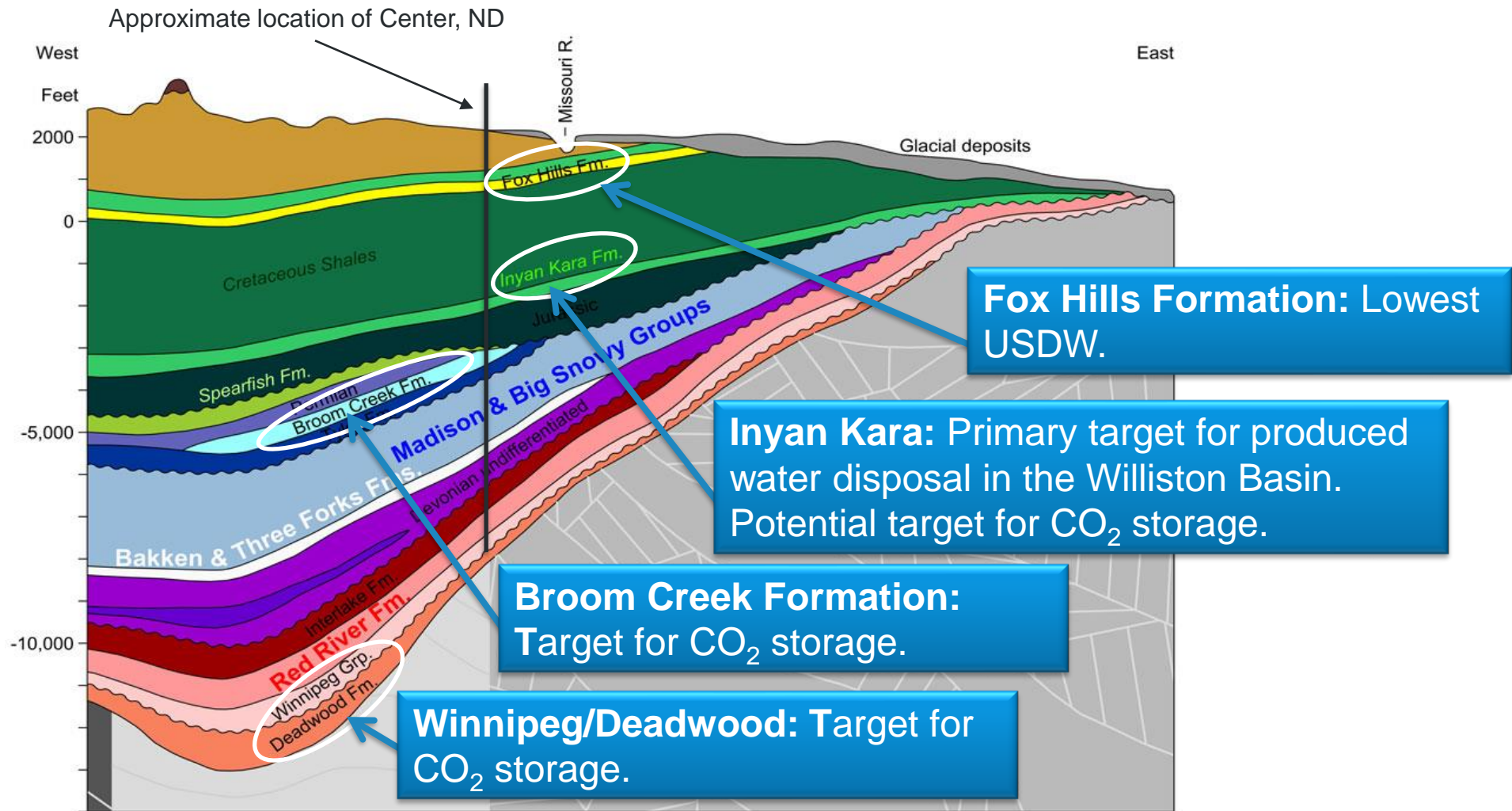
**GEOLOGIC
STORAGE OF
CARBON DIOXIDE**

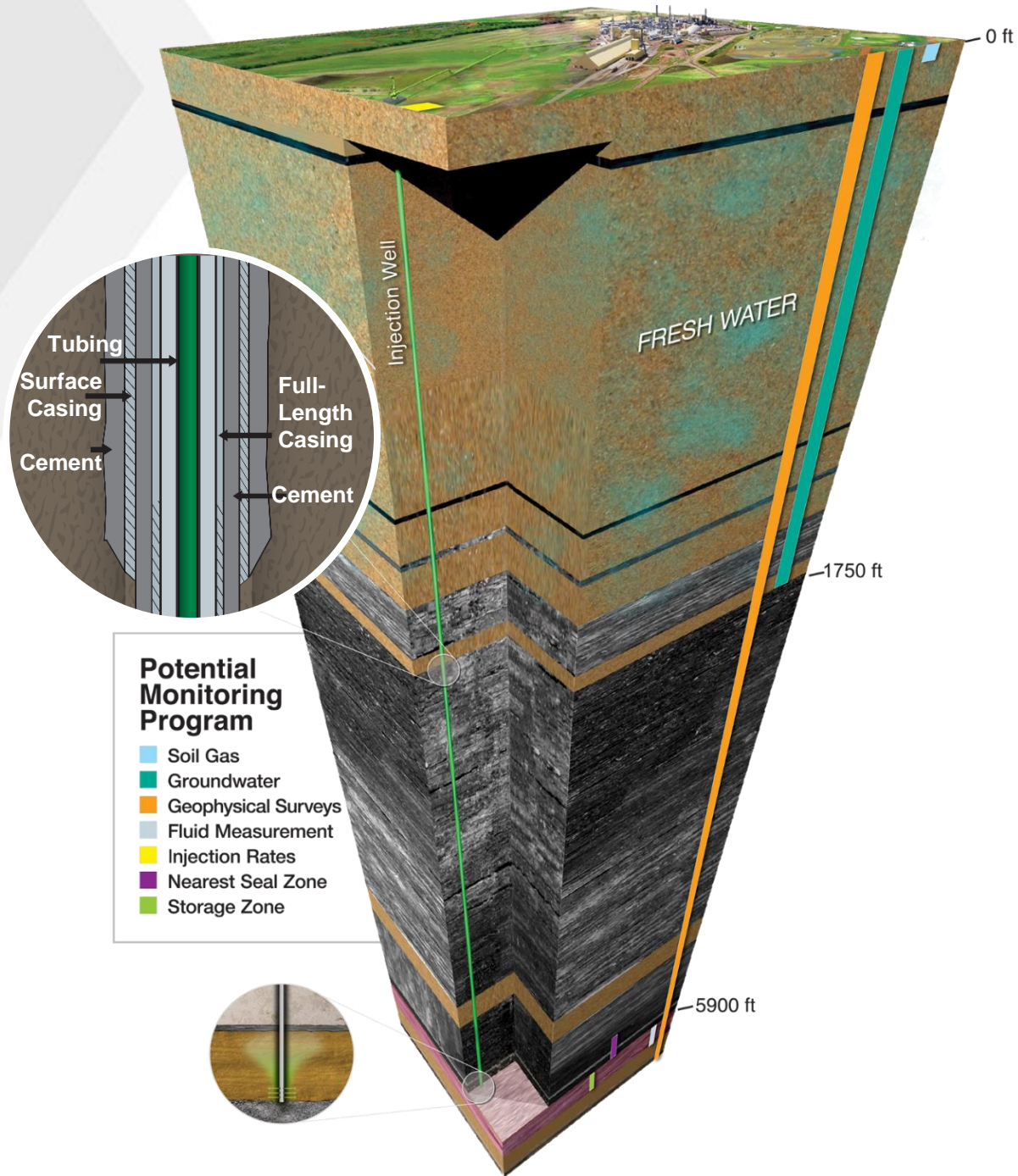


REGIONAL SOURCES AND SEDIMENTARY BASINS

Critical Challenges. Practical Solutions.

WILLISTON BASIN SALINE STORAGE OPPORTUNITIES

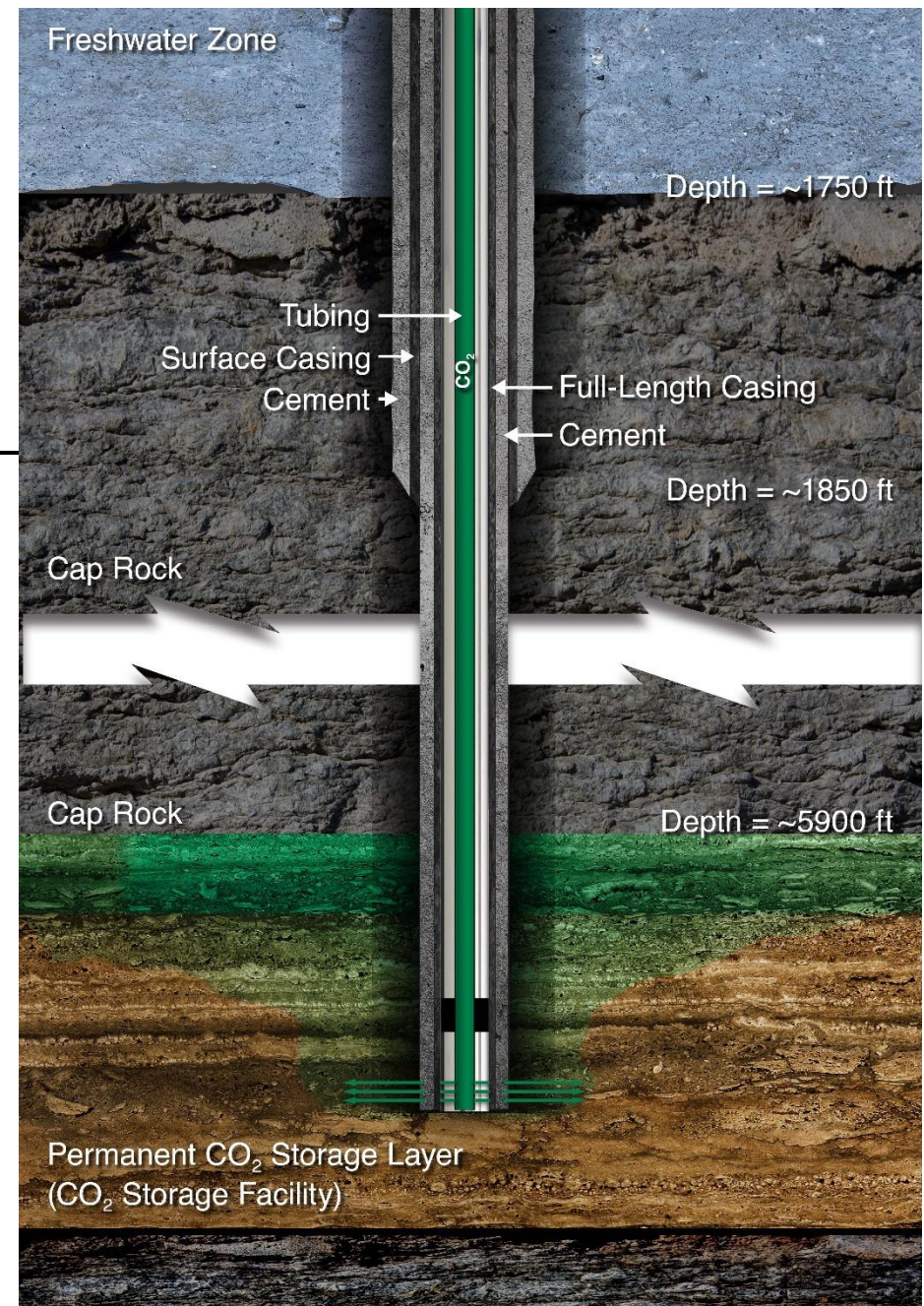




ENSURING HUMAN SAFETY AND PROTECTING THE ENVIRONMENT

DRINKING WATER PROTECTION

A layer of steel casing and a layer of durable, long-lasting cement isolate the freshwater aquifers, protecting them from drilling fluids and saltwater from deeper layers.



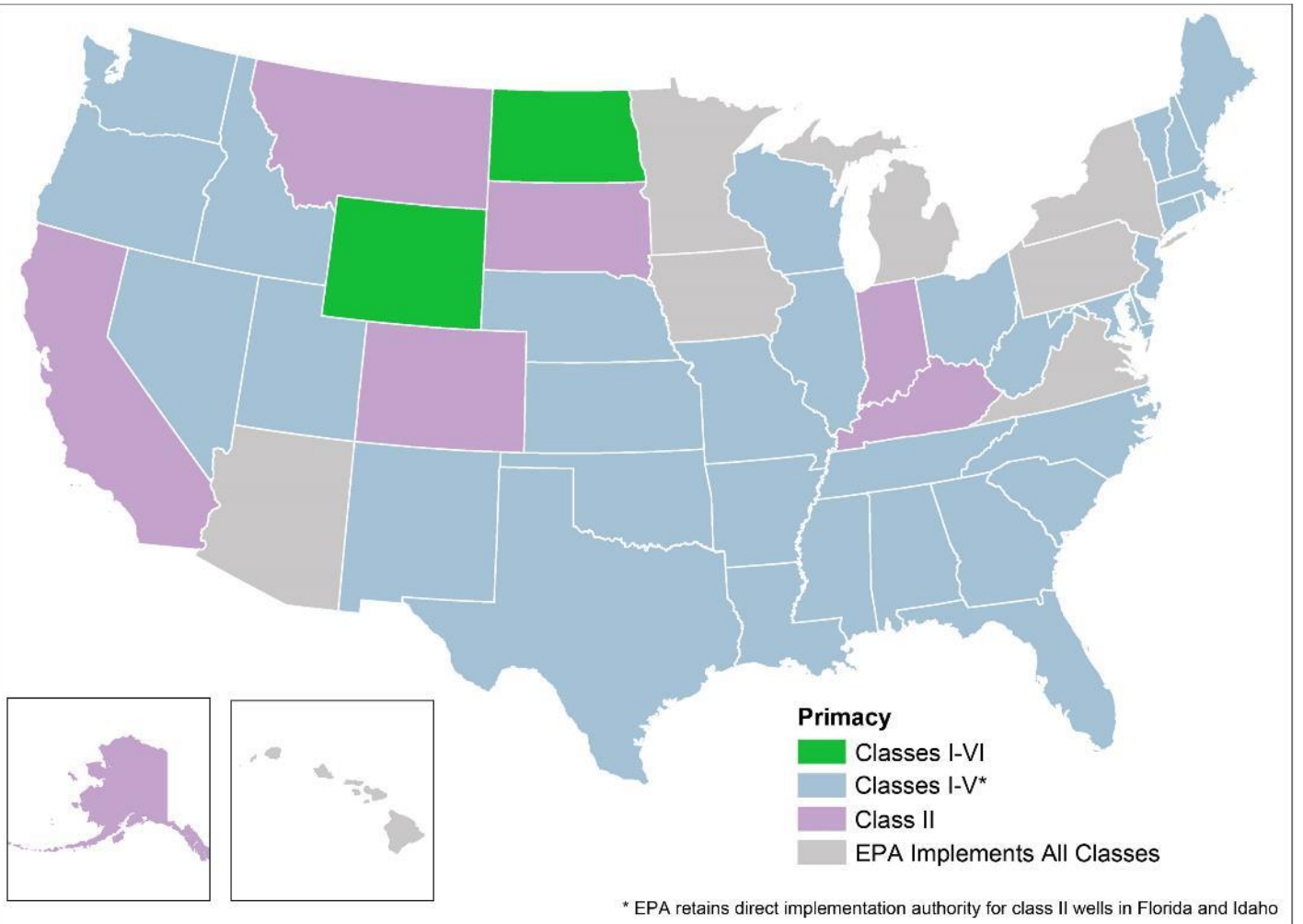
REGULATING GEOLOGIC STORAGE OF CARBON DIOXIDE



UNDERGROUND INJECTION CONTROL CLASS VI PRIMACY

UIC Program Standards:

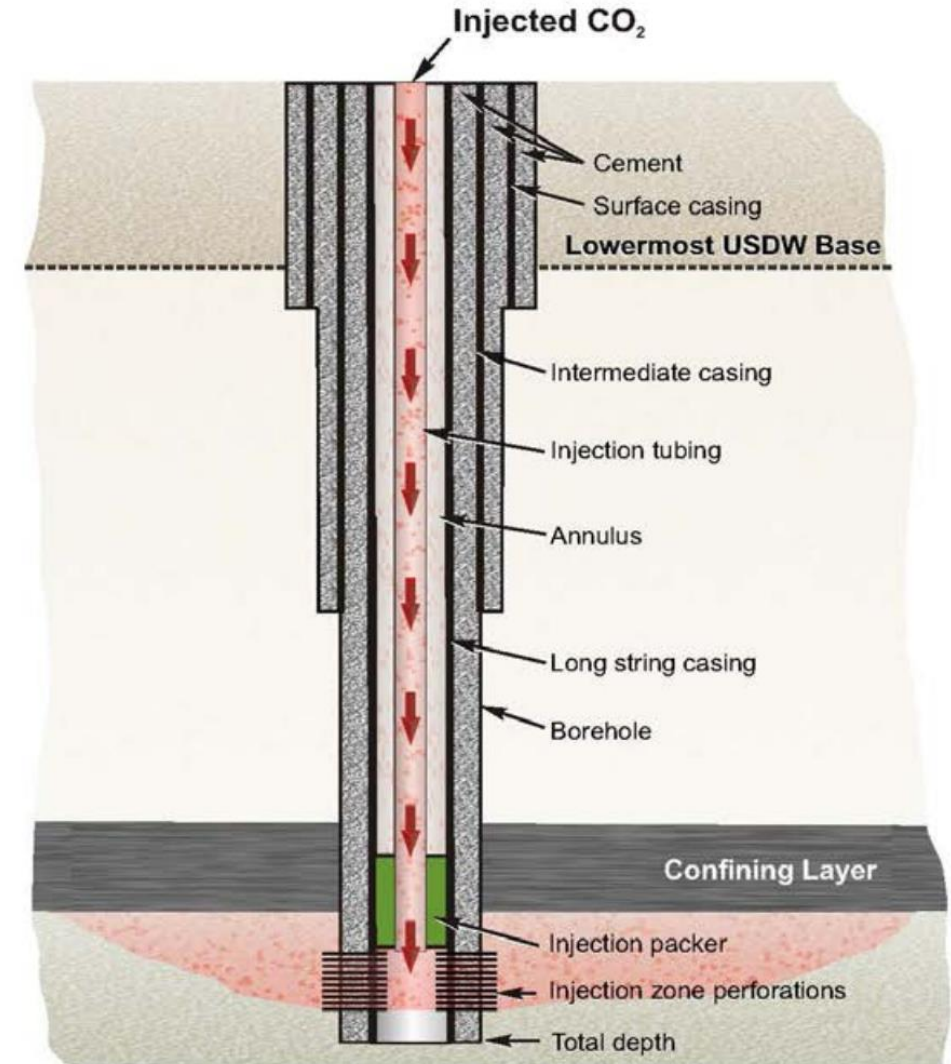
- 1) Protection of underground sources of drinking water (USDW)
- 2) Injection zone
- 3) Confining zones (upper and lower)
- 4) Area of review and corrective action
- 5) Wellbore integrity demonstration



Class I	Class II	Class III	Class IV	Class V	Class VI
Hazardous and nonhazardous fluids (industrial and municipal wastes).	Brines and other fluids associated with oil and gas production, including CO ₂ EOR.	Fluids associated with solution mining of minerals.	Hazardous or radioactive wastes. This class is banned by EPA.	Nonhazardous fluids into or above a USDW and are typically shallow.	Injection of CO ₂ for long-term storage.

CLASS VI INJECTION WELLS

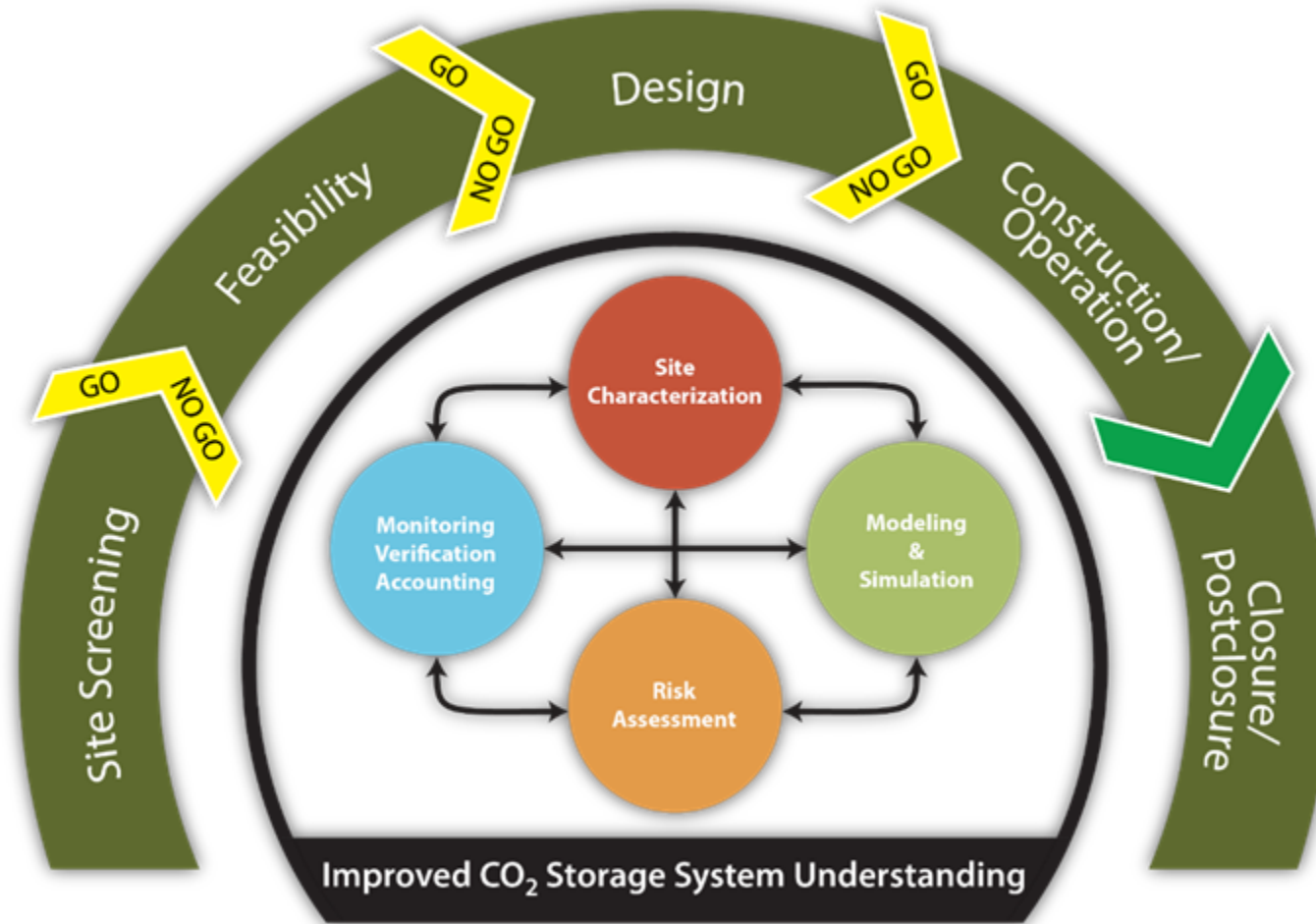
- Class designated for CO₂ injection wells as required by the U.S. Environmental Protection Agency (EPA) under the Safe Drinking Water Act.
- Material costs are increased over other well types (corrosion resistance, increased tensile/compressive strength, etc.).
- Injection target formation total dissolved solids (TDS) content cannot be less than 10,000 milligrams per liter.



CO₂ IS MONITORED EVERY STEP OF THE WAY



ADAPTIVE MANAGEMENT APPROACH





UND UNIVERSITY OF
NORTH DAKOTA.

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A wide-angle photograph of a university campus during sunset. The sun is low on the horizon, casting a warm glow over the scene. In the foreground, there are large trees with some yellowing leaves. In the background, several multi-story brick buildings and a parking lot with many cars are visible under a clear sky.

THANK YOU

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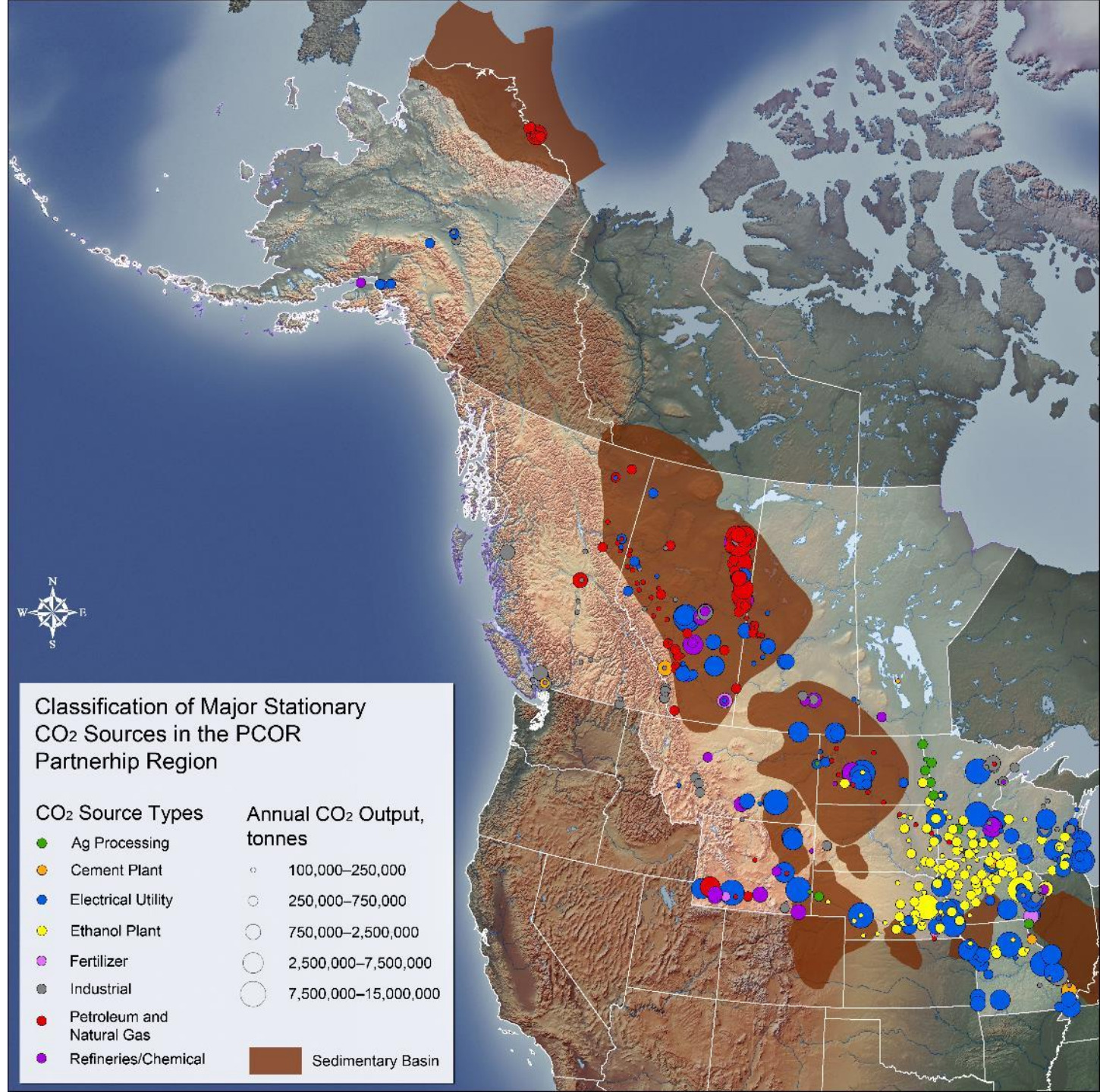


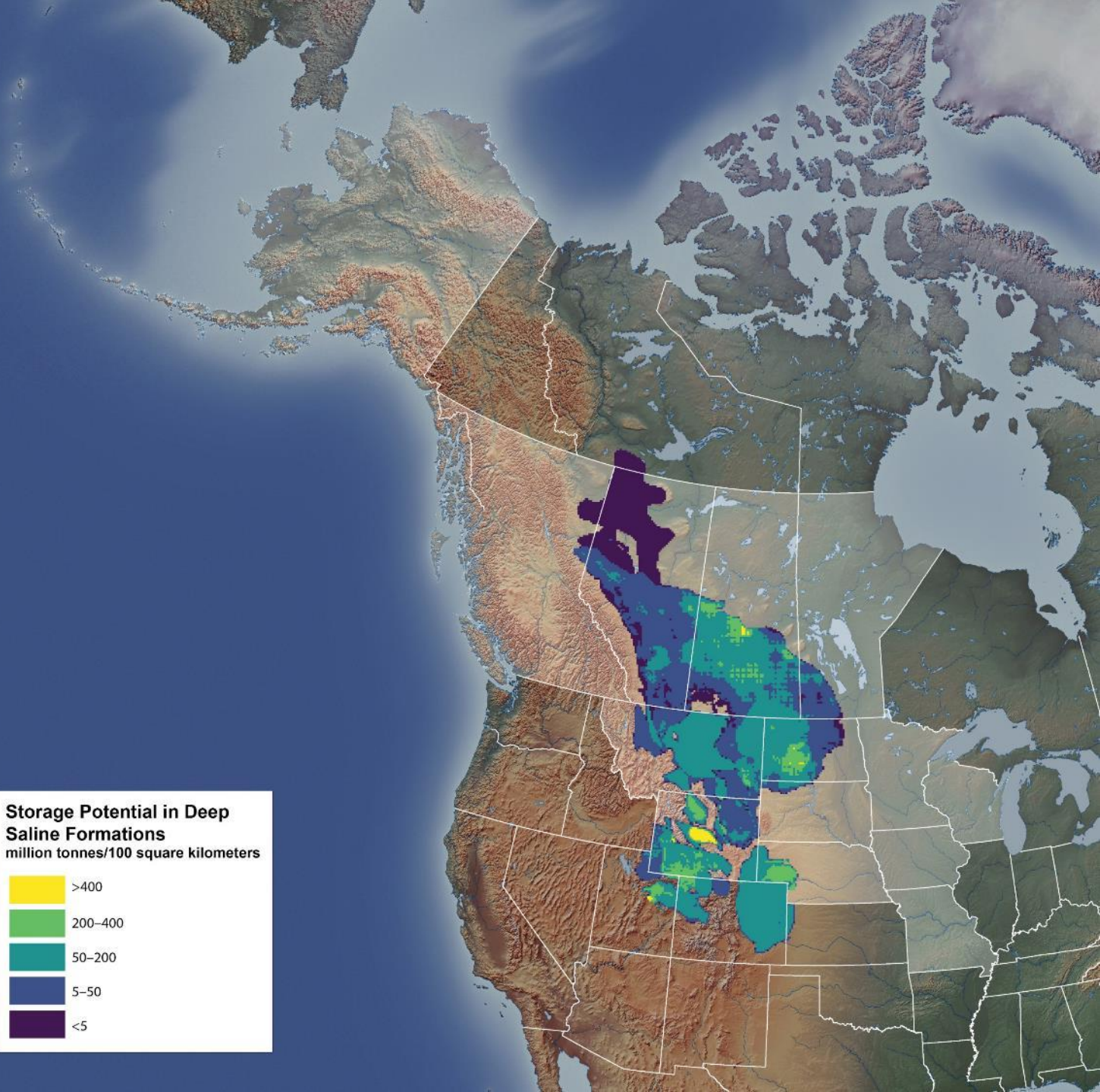
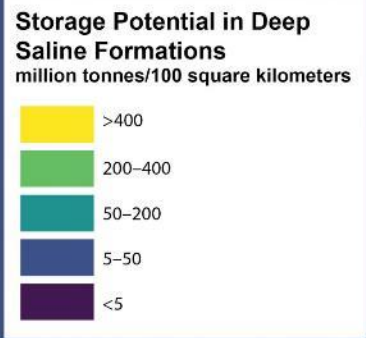
UNIVERSITY OF
NORTH DAKOTA



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REGIONAL SOURCES AND SEDIMENTARY BASINS



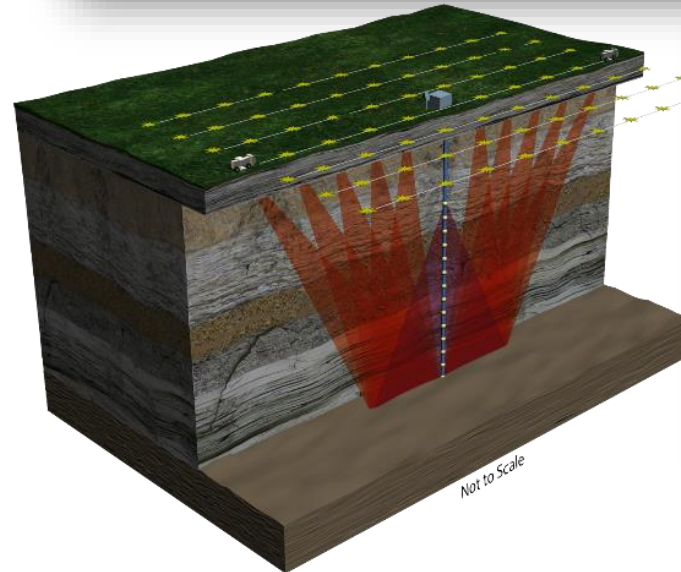
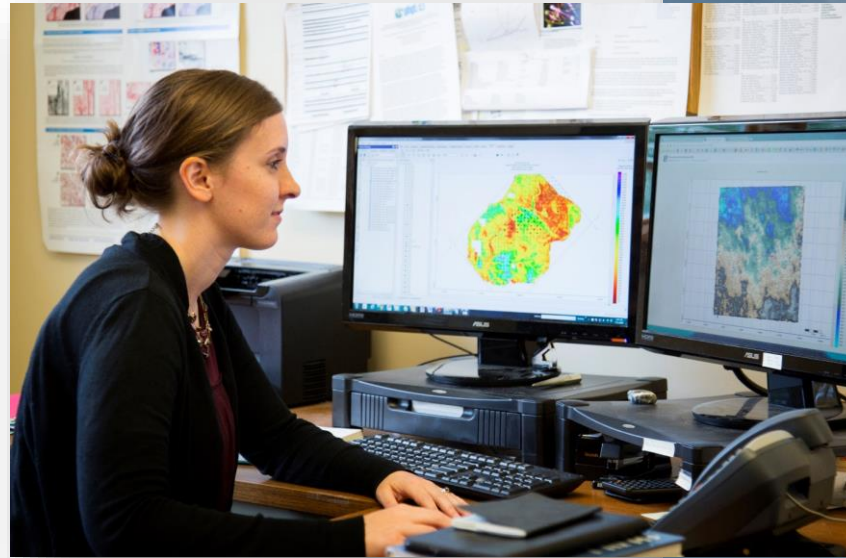


SALINE STORAGE POTENTIAL

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SUBSURFACE MONITORING IS DONE TO ENSURE CONTAINMENT

Regulations require
periodic subsurface
monitoring.



WATER MONITORING

Is done to confirm that current CO₂ levels match baselines taken before injection started.



SOIL GAS MONITORING

