

A map of the Appalachian region in Pennsylvania and West Virginia. The map shows major cities like Pittsburgh, Columbus, and Charleston, as well as rivers like the Allegheny and Ohio. The title is overlaid on the map.

# GEOLOGIC FINDINGS OF THE BENEDUM FOUNDATION'S APPALACHIAN STORAGE HUB STUDY

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# ACKNOWLEDGEMENTS

- **AONGRC co-authors** – Douglas Patchen, Jessica Moore, Mohammad Fakhari, Gary Daft, Philip Dinterman, Michael Solis, Robin Anthony, Katherine Schmid, Brian Dunst, Antonette Markowski and Stephen Shank
- **Benedum Foundation**
- **Industry Partners** – AEP, Antero Resources, Blue Racer, Charleston Area Alliance, Chevron, Dominion, EQT, First Energy/Team NEO, Mountaineer NGL Storage LLC, Noble Energy, Southwestern Energy, XTO Energy and the West Virginia Oil & Natural Gas Association
- **West Virginia University** – WVU Foundation, WVU Research Corporation, National Research Center for Coal and Energy and WVU Corporate Relations Office
- **Advisory Group**

# STUDY GOAL

- Complete a **geologic study** of all potential options for subsurface storage of NGLs along and adjacent to the Ohio River from southwestern Pennsylvania to eastern Kentucky, including a similar study along the Kanawha River in West Virginia
  - Stratigraphic correlation of key units
  - Mapping thickness and structure of key units
  - Reservoir characterization studies
  - Development and application of rating and ranking criteria



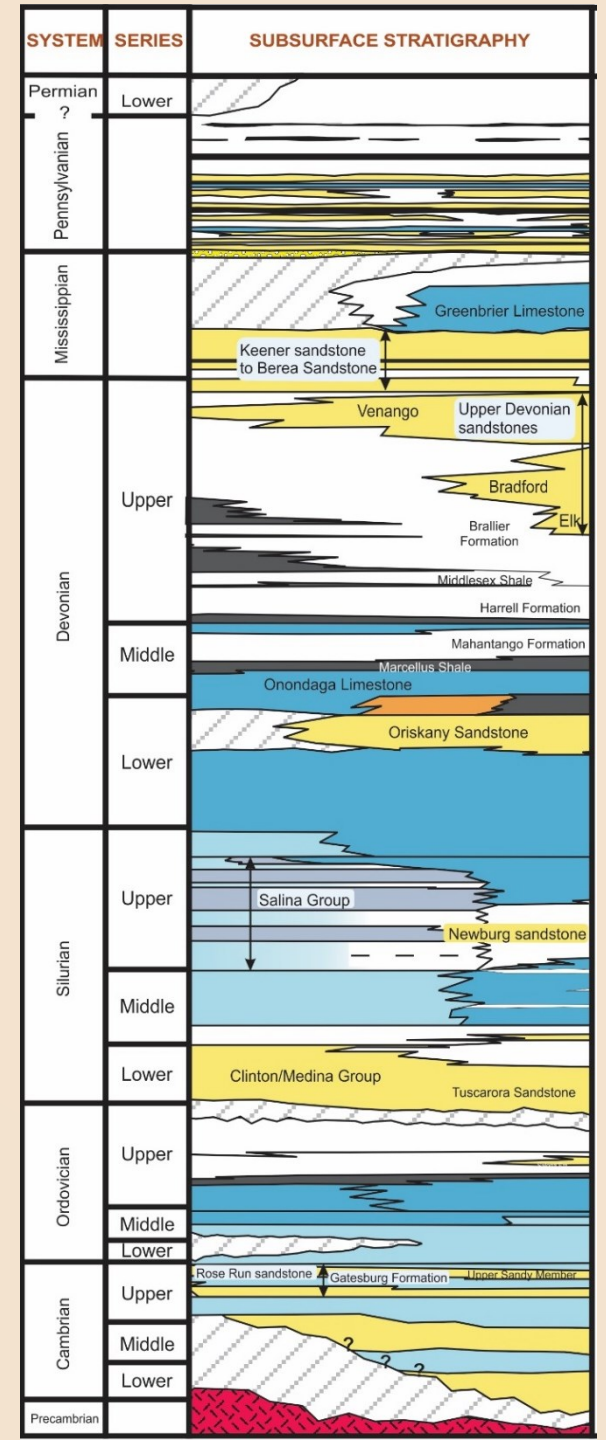
**Area of Interest (AOI)**

# GEOLOGIC INTERVALS OF INTEREST

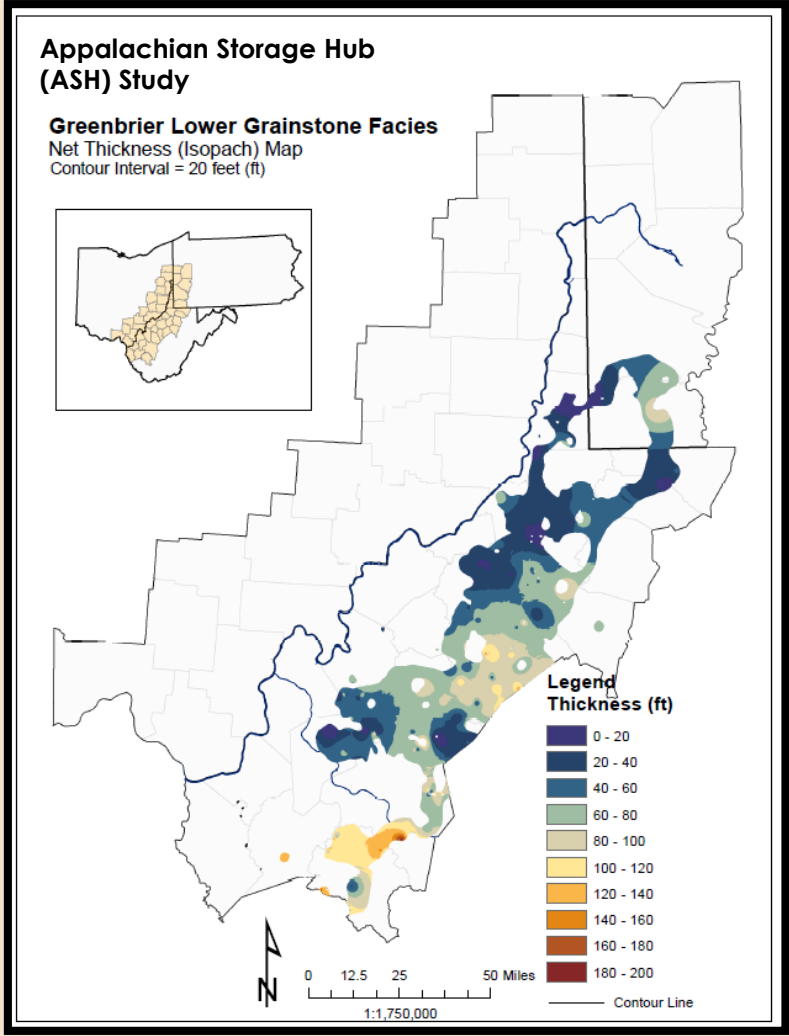
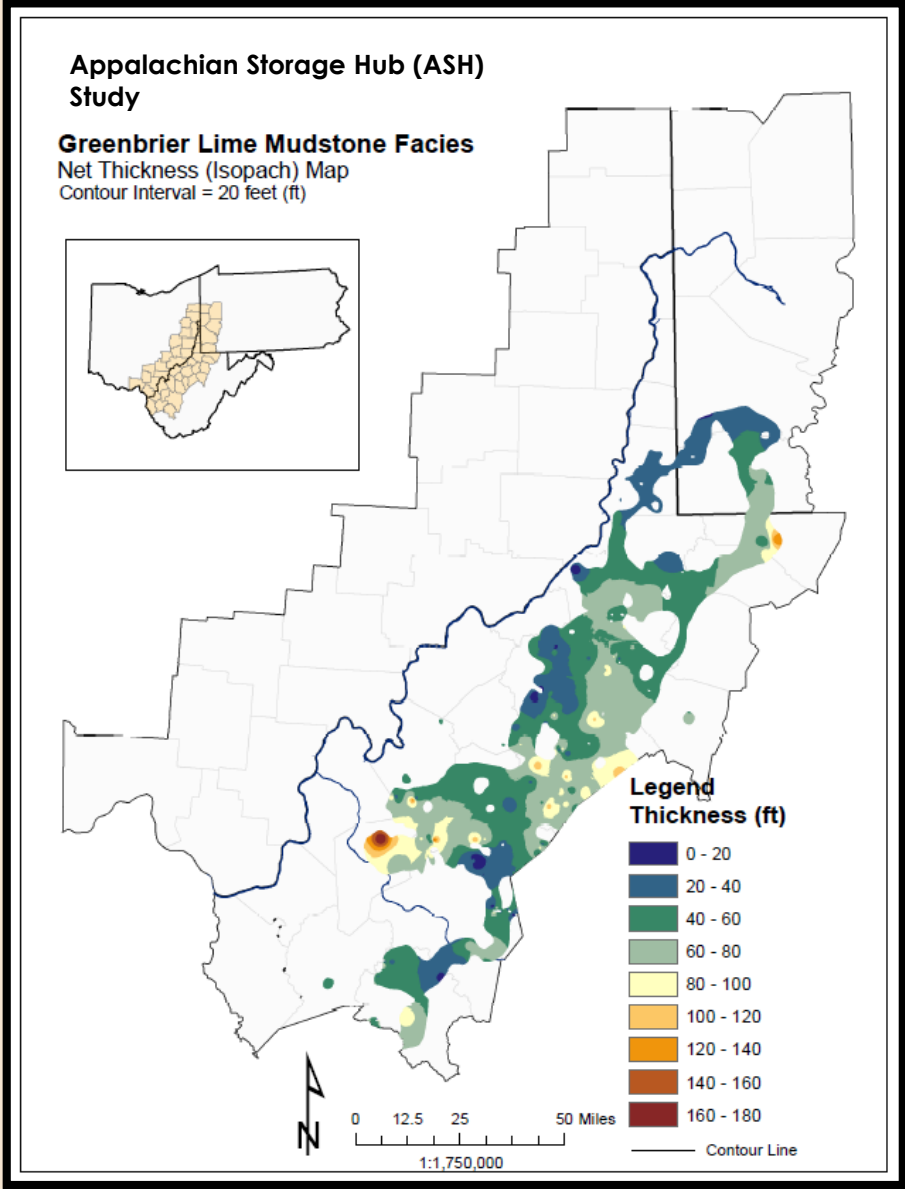
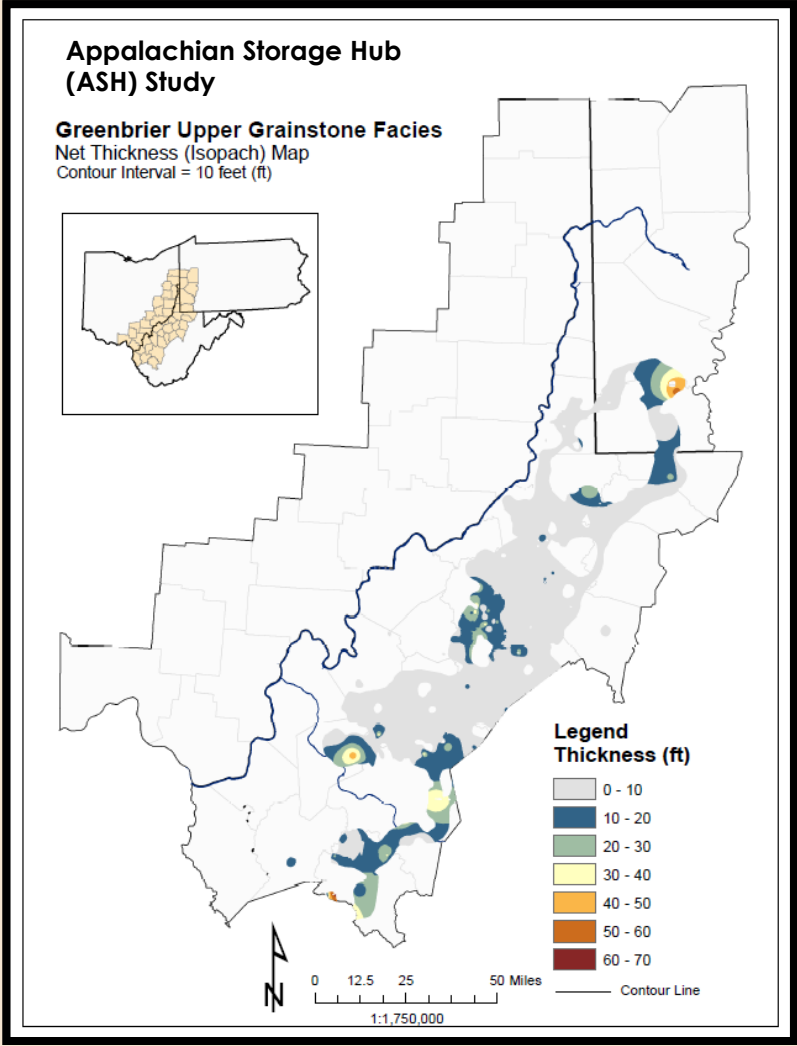
System/Age	Interval	Description	Storage Type
Mississippian	Greenbrier Limestone	Limestone comprised of multiple carbonate facies	Mined-rock cavern
Lower Mississippian-Devonian	Keener to Berea	Multiple sandstones of variable location, thickness and extent	Depleted gas reservoirs
Upper Devonian	Venango, Bradford and Elk groups	Multiple sandstones of variable location, thickness and extent	Depleted gas reservoirs
Lower Devonian	Oriskany Sandstone	Regionally persistent sandstone	Depleted gas reservoir
Upper Silurian	Salina Group	Bedded salt formations	Salt cavern
Upper Silurian	Newburg sandstone	Localized sandstone equivalent to Salina C interval	Depleted gas reservoir
Lower Silurian	Clinton/Medina Group	Multiple sandstones of variable location, thickness and extent	Depleted gas reservoirs
Lower Ordovician - Upper Cambrian	Rose Run-Gatesburg sandstones	Regionally persistent sandstone	Depleted gas reservoirs

# RESERVOIR CHARACTERIZATION EFFORTS

- Unique characterization efforts for each type of storage container
  - Depth – structure maps
  - Thickness – isopach maps
  - Extent – facies evaluation (Greenbrier) and clean vs. “dirty” salt intervals (Salina F4)
  - Preliminary assessment – screened field-level data for 2,700+ depleted gas reservoirs



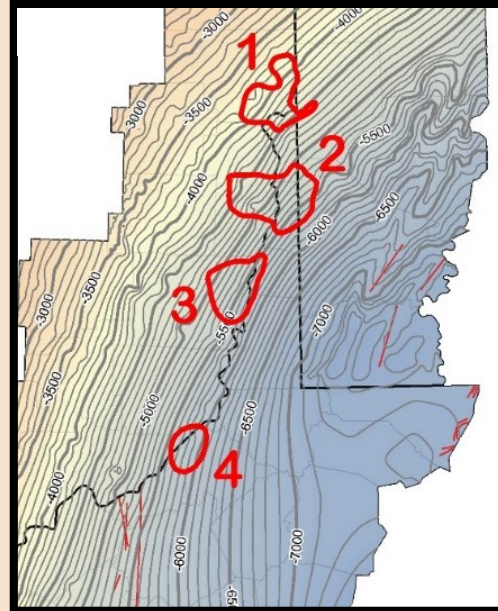
# GREENBRIER LIMESTONE – MINED-ROCK CAVERN



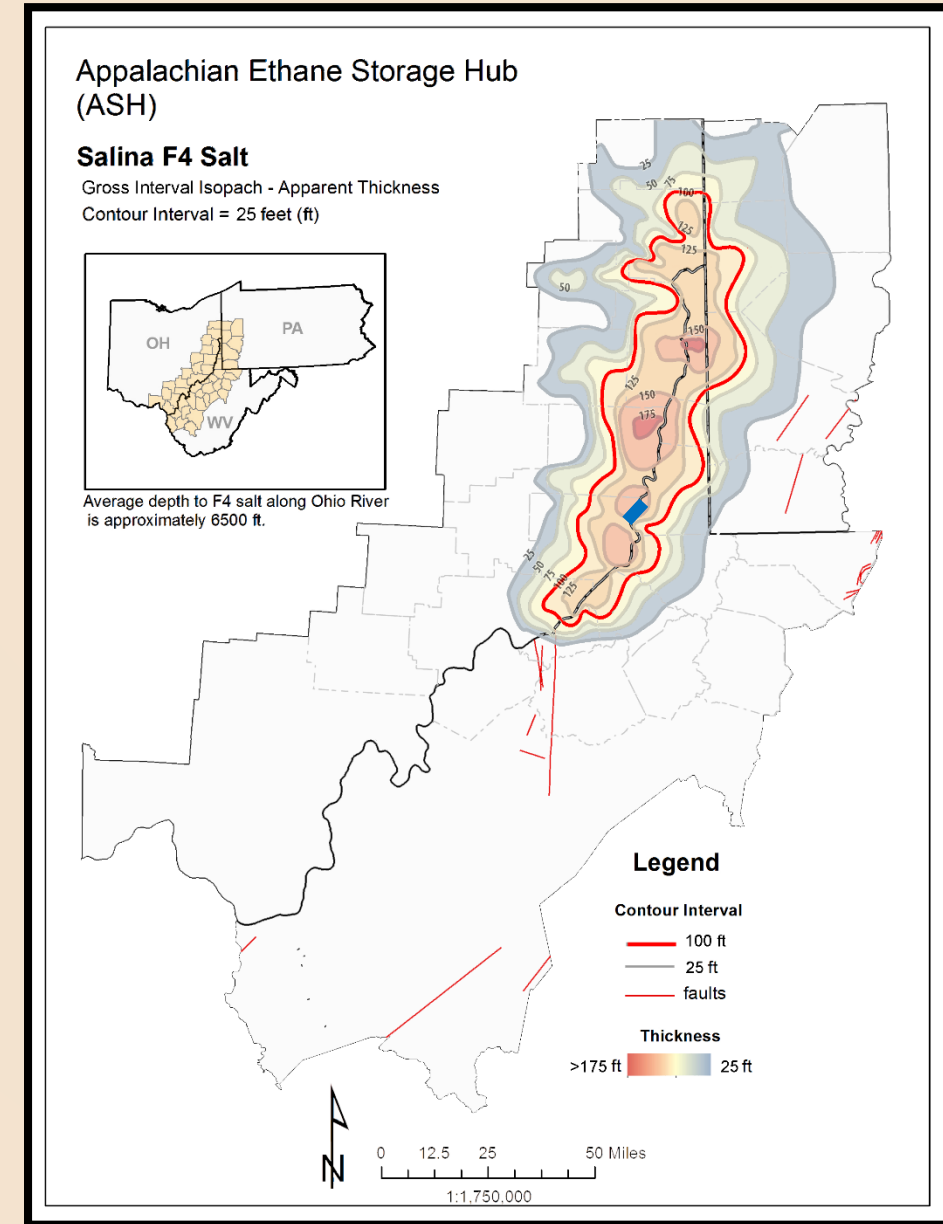


# SALINA F4 SALT – SALT CAVERN

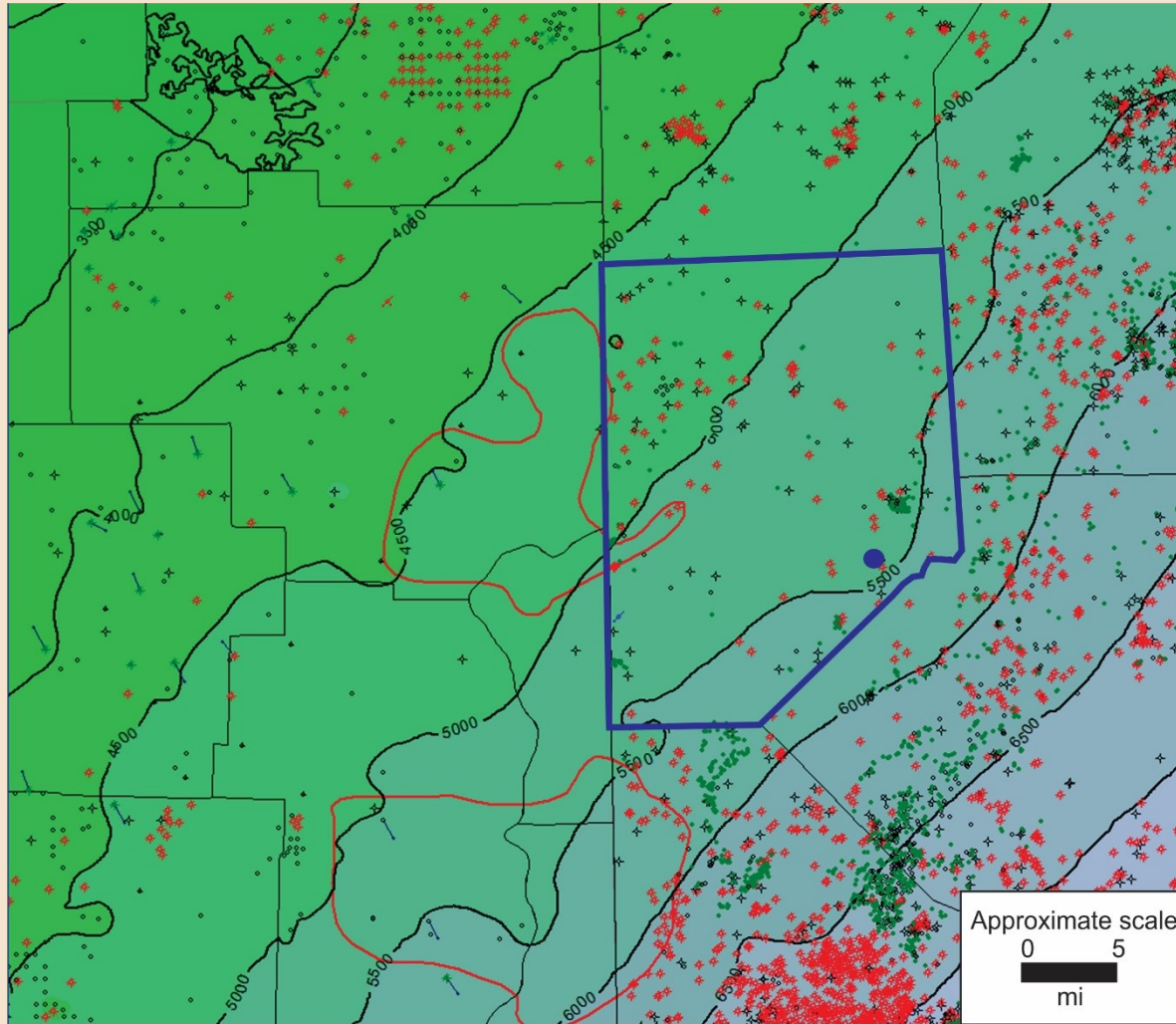
- Below deepest occurrence of fresh drinking water
- Not penetrated by many gas wells that could provide vertical migration routes
- Increase in salt plasticity limits lower cavern depths to <7,000 ft



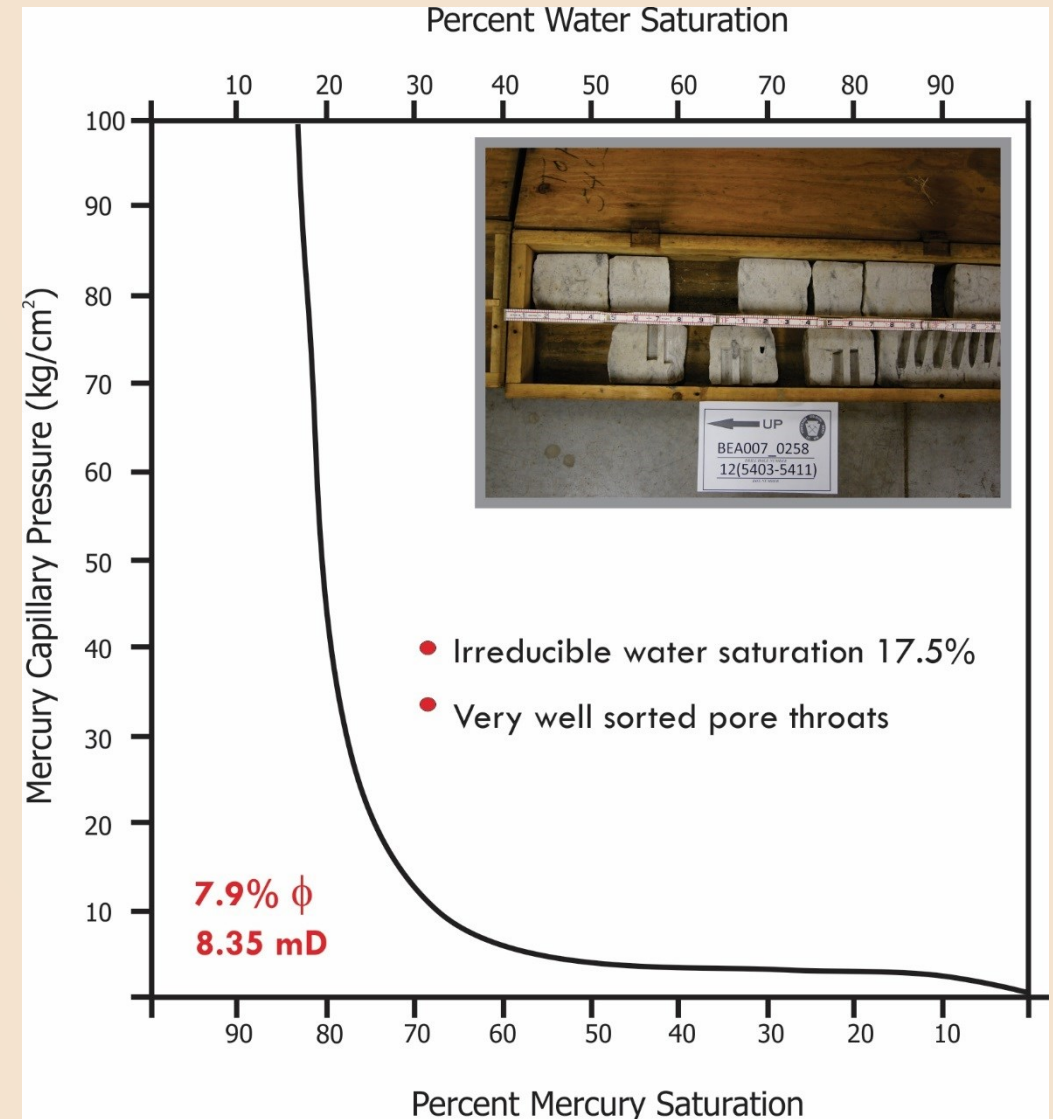
Area	1	2	3	4
Average Depth (ft)	5,300	6,200	6,650	6,600



# ORISKANY SANDSTONE – DEPLETED GAS RESERVOIR



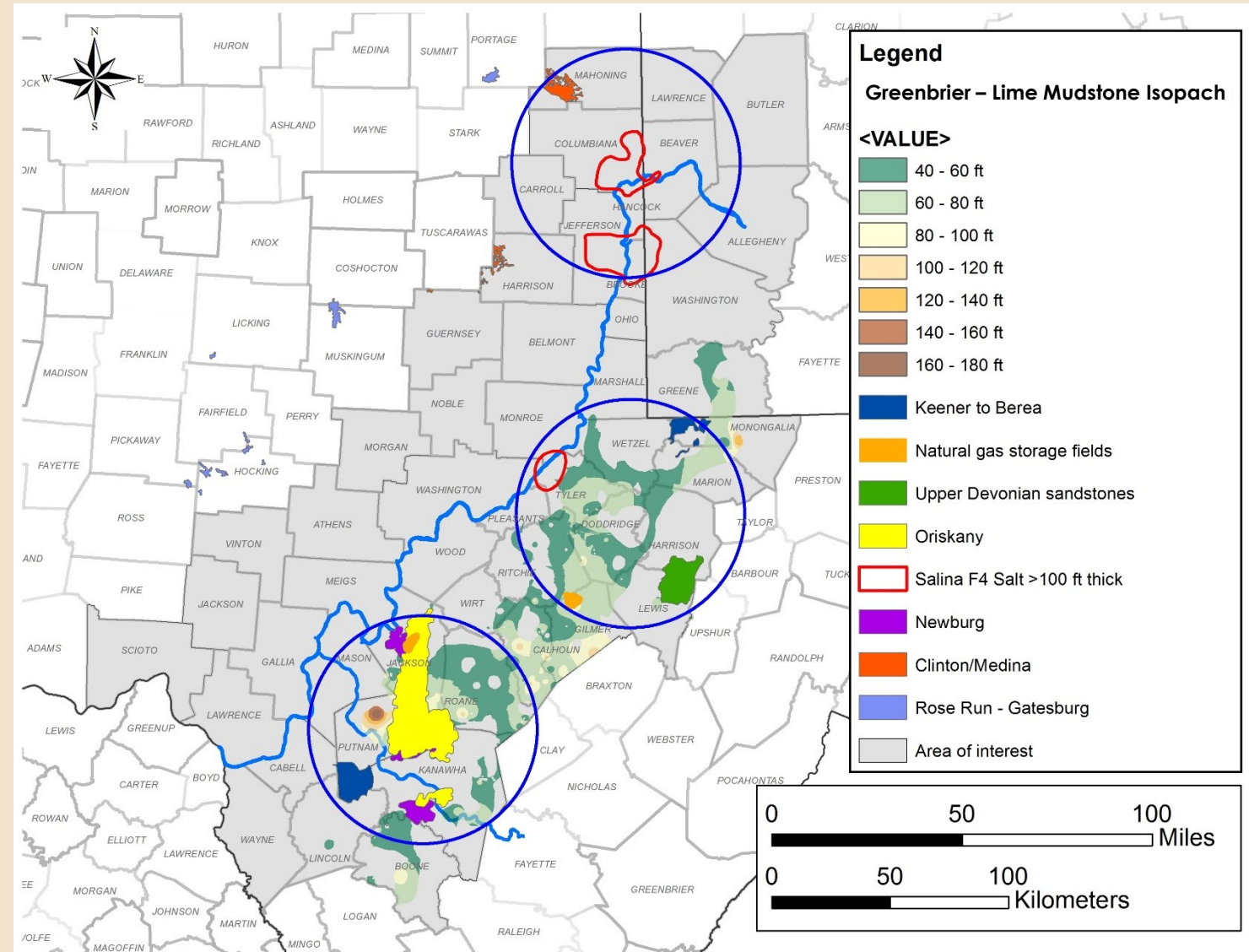
**Measured Depth Map  
(ft below ground surface)**





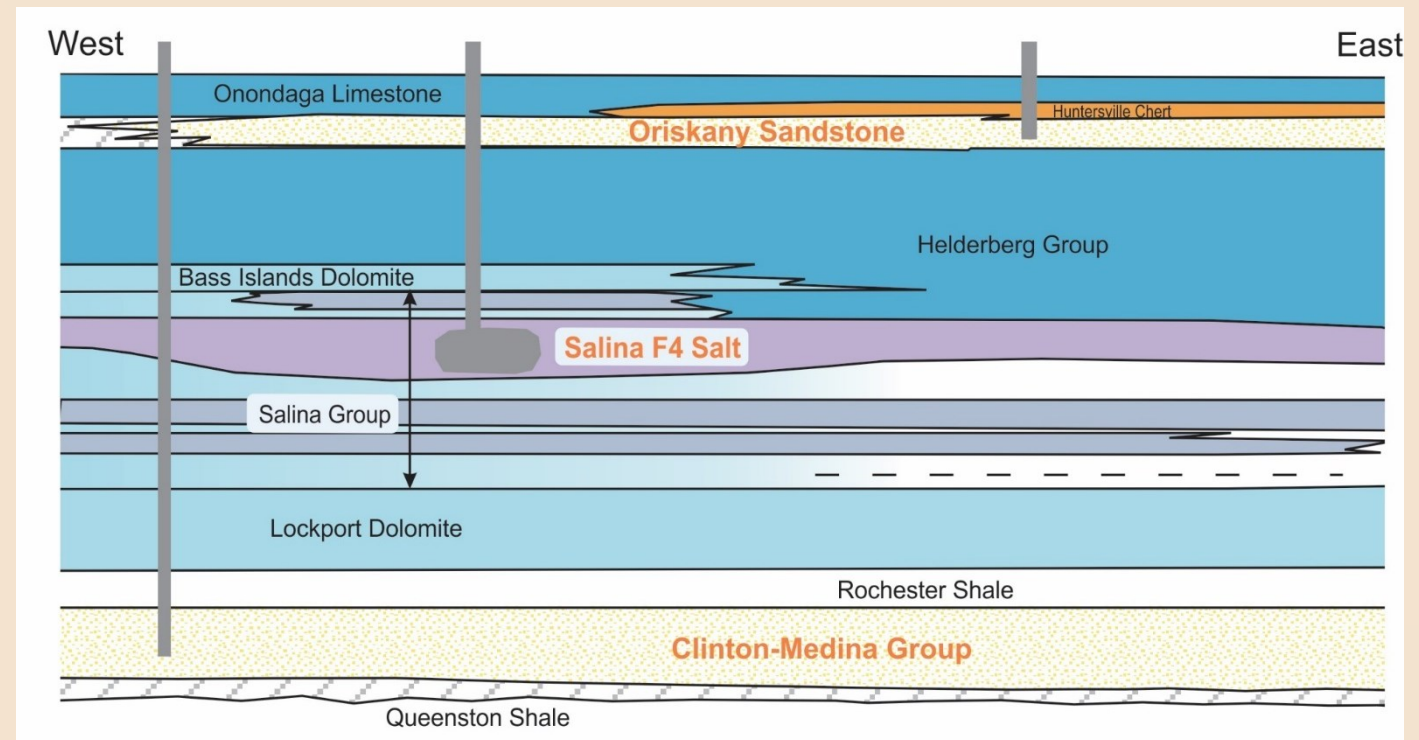
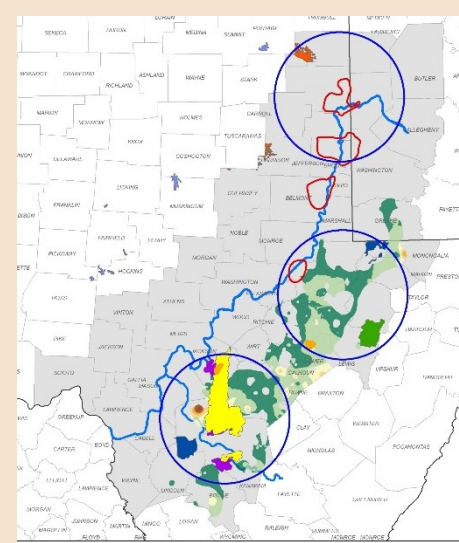
# THREE PROSPECTS FOR NGL STORAGE

- Demonstrate how this Study's regional and field-level geologic data can be applied to underground storage siting work
- Ascertain what site-level data might be necessary as part of a follow-on study
- Stacked storage plays an important role



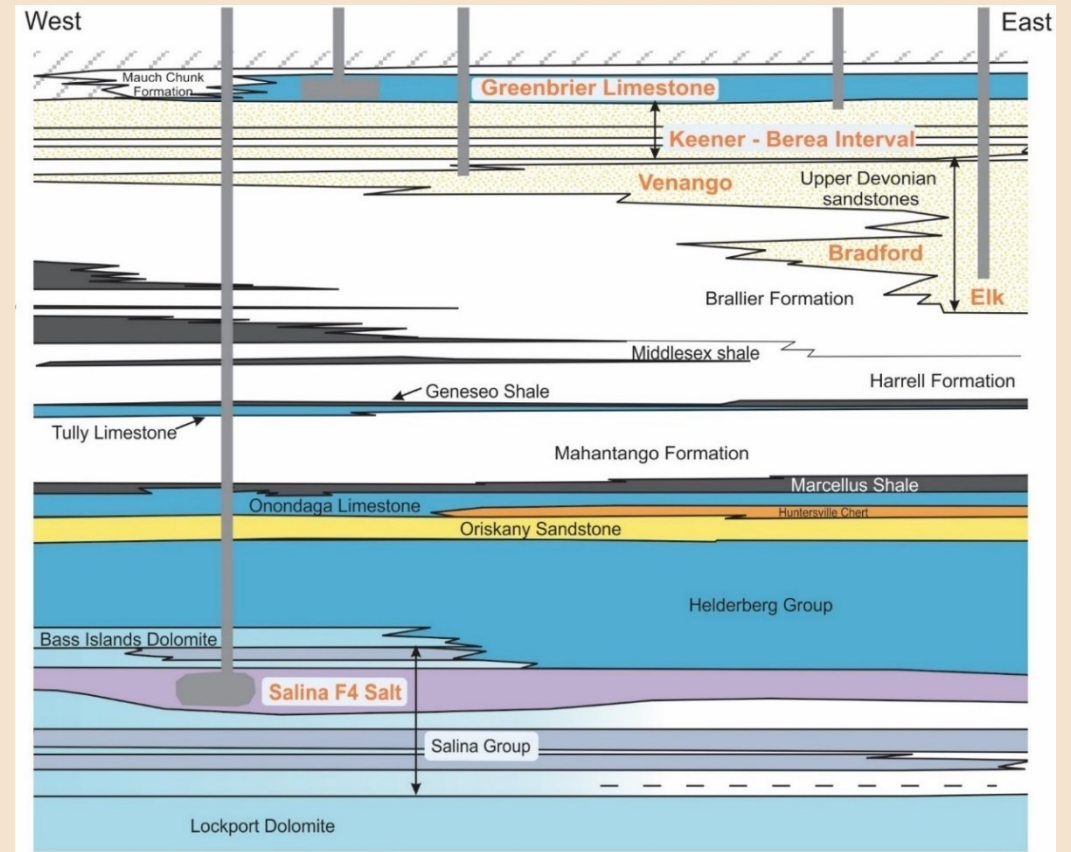
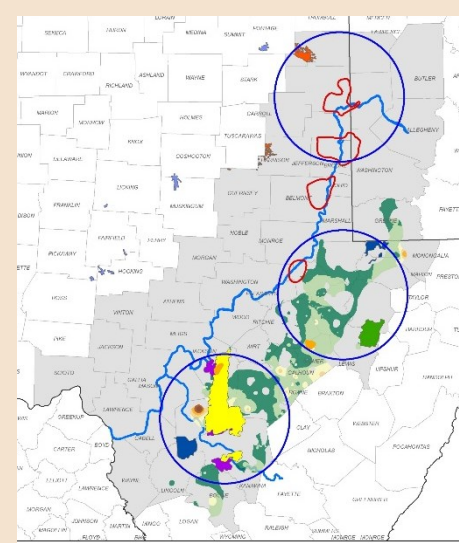
# NORTHERN PROSPECT AREA

- **Clinton/Medina** sandstones in Ohio's Ravenna-Best Consolidated Field
- Two **Salina F4 Salt** cavern opportunities on both sides of the Ohio River
- **Oriskany** core data indicates another opportunity; suggests stacked potential



# CENTRAL PROSPECT AREA

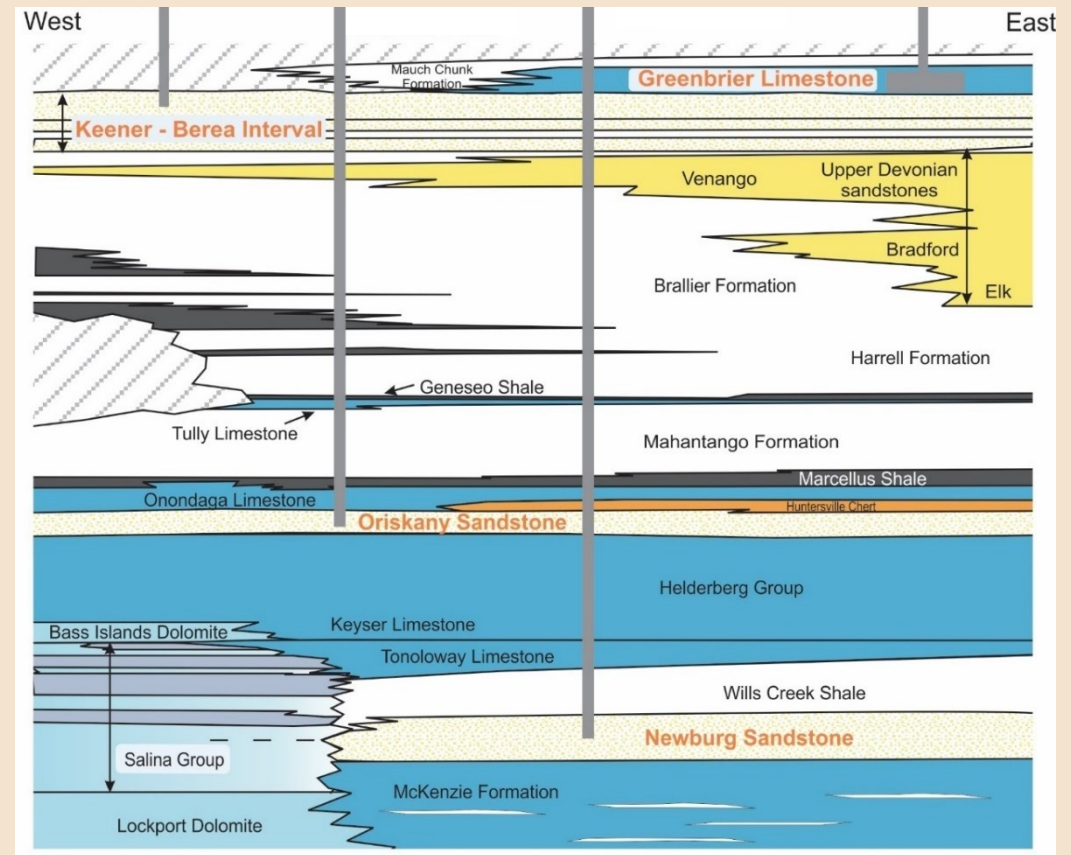
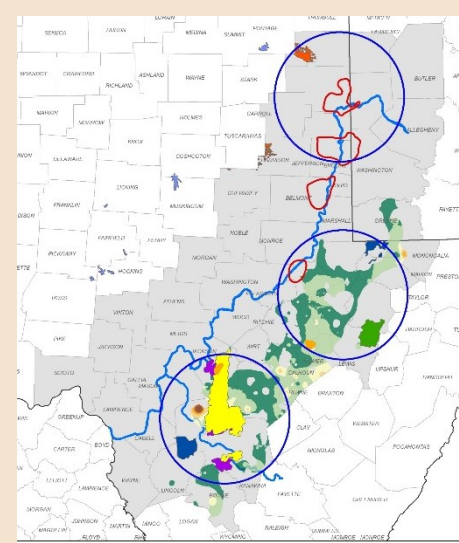
- **Greenbrier Limestone** mined-rock cavern opportunities
- **Keener to Berea** Interval depleted gas field
- **Venango Group** inactive gas storage field
- **Upper Devonian** depleted gas field to the east
- **Salina F4 Salt** – Ben's Run and vicinity





# SOUTHERN PROSPECT AREA

- **Greenbrier Limestone** mined-rock cavern opportunities
- Depleted gas fields in the **Keener to Berea** Interval
- **Oriskany Sandstone** (depleted gas and natural gas storage)
- **Newburg** fields (North Ripley, Rocky Fork, Cooper Creek and Kanawha Forest) are among the very best of all depleted gas fields





# SUMMARY AND CAVIATS

- Multiple options are present along the Ohio and Kanawha rivers where storage could be constructed in three different types of storage containers
- Storage capacity and deliverability will ultimately depend on the NGL product(s)
- Storage capacity and deliverability may require more than one facility and/or more than one geologic container per facility (stacked storage)
- We recommend a follow-on engineering and geologic site assessment at any potential site



# THANK YOU!

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