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*The Business of Innovation*



***Status of CO<sub>2</sub> Geologic Sequestration  
Field Tests in the Midwest Regional  
Carbon Sequestration Partnership***

*Phil Jagucki, David Ball, Neeraj Gupta - Battelle, Columbus, OH*

# MRCSP Phase II Partners Represent a Full Spectrum of Industrial and Research Entities



## *This Presentation is Based on Contributions from a Number of Researchers*

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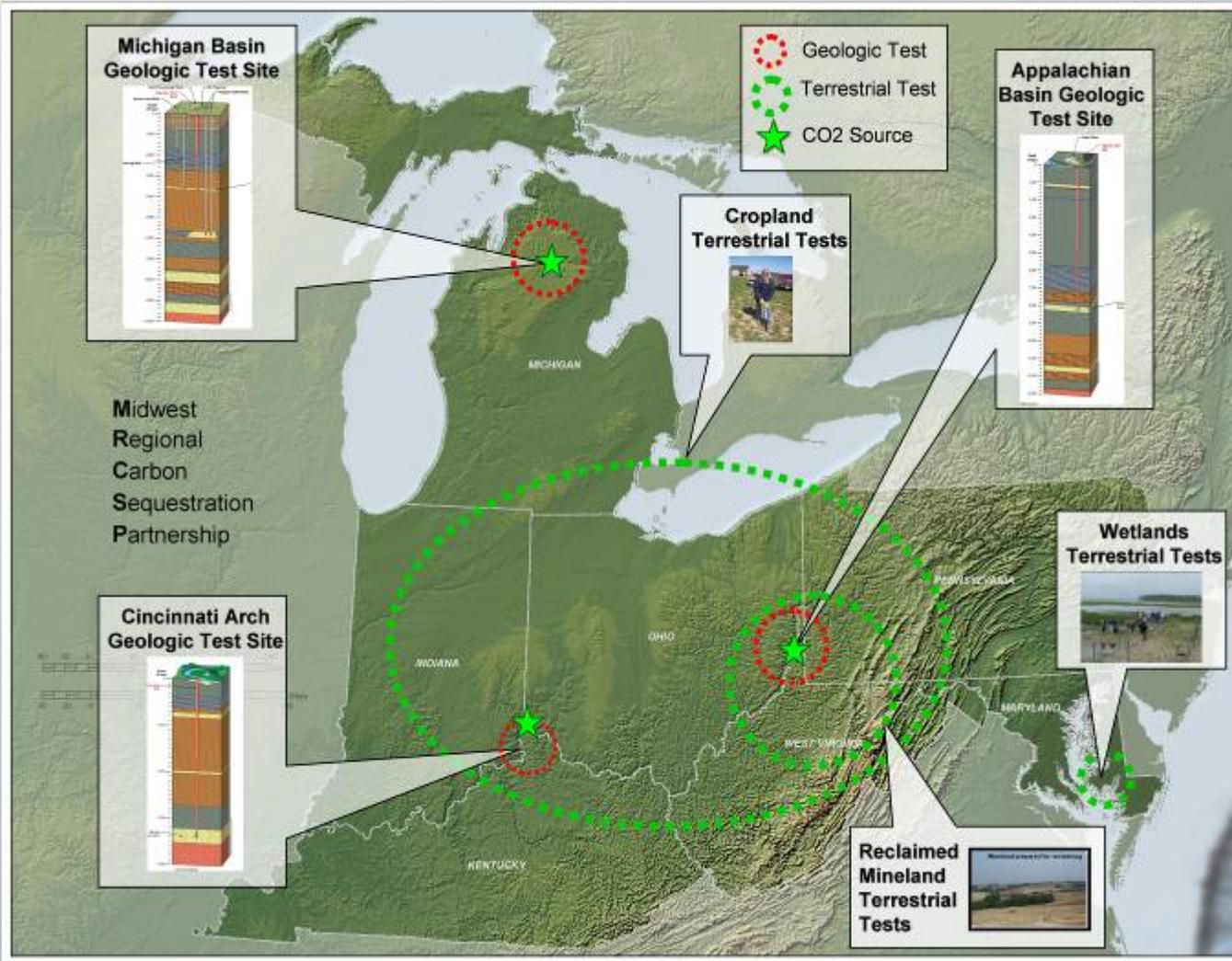
- Battelle – David Ball, Neeraj Gupta, Phil Jagucki, Joel Sminchak, Danielle Meggyesy, Bruce Sass, Jim Dooley, Bob Janosy, Diana Bacon, Judith Bradbury, Jerry Tompkins, Vic Saylor, and others
- Ohio Geological Survey - Larry Wickstrom, Mark Baranoski, and others
- Indiana Geological Survey - John Rupp, Wilfred Solano
- Kentucky Geological Survey - Steve Greb, Jim Drahovzal
- Pennsylvania Geological Survey - John Harper, Kris Carter
- West Virginia Geological Survey - Lee Avary, Michael Hohn
- Western Michigan University - Bill Harrison, Dave Barnes

# Geologic Research Participants

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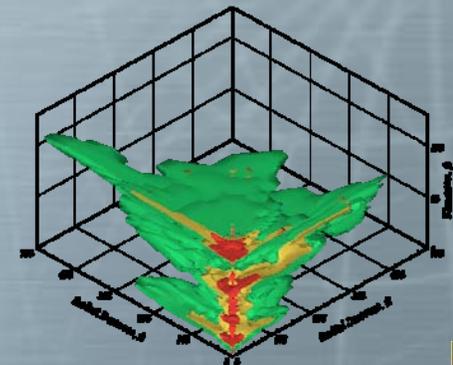
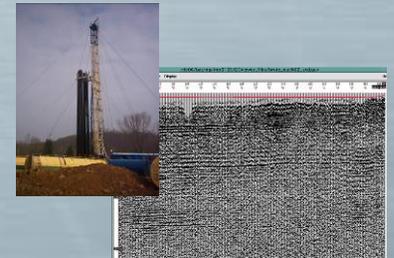
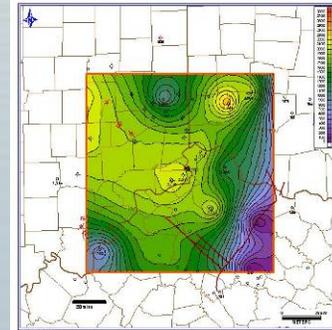
- Major contributions have been made by host site companies and other participants:
  - DTE Energy
  - FirstEnergy
  - Duke Energy
  - Core Energy LLC
  - Schlumberger
  - William Rike, Appalachian Geophysical, and other vendors

# MRCSP Field Tests

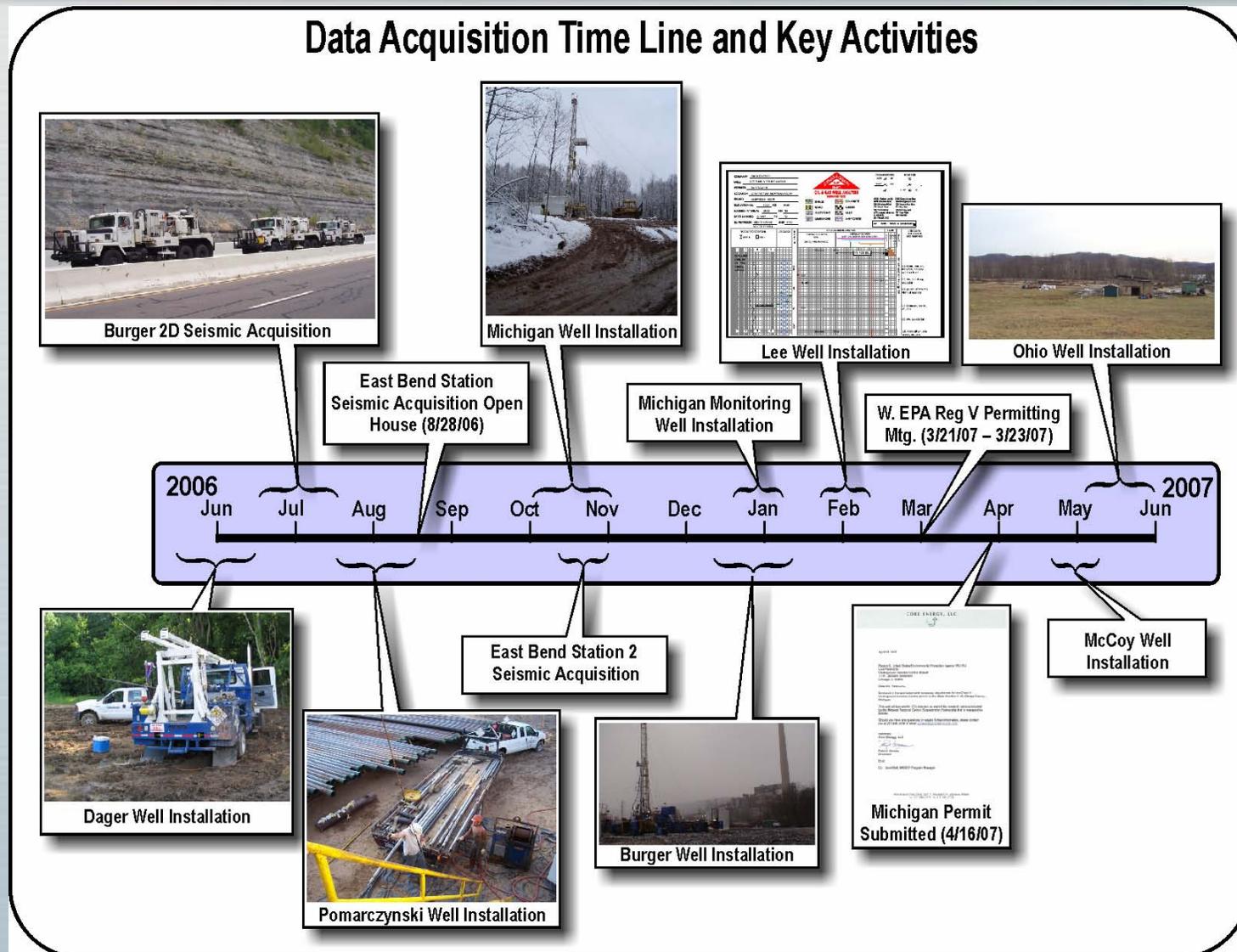


# Phase II: Geologic Field Test Activities

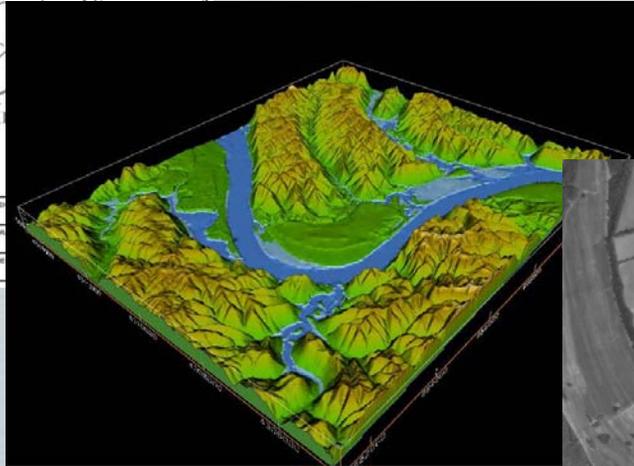
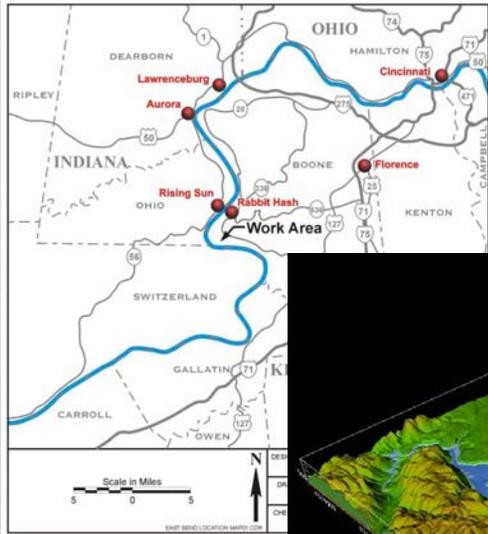
- Preliminary Geologic Assessment
  - Site specific assessment of target storage reservoirs and geologic setting performed jointly with state Geologic Surveys and support of regional data collection
- Site Characterization and Design
  - Seismic surveys, test-well drilling, reservoir tests, brine sampling, other field work at the demo sites
  - Site data used to design injection and monitoring programs
- CO<sub>2</sub> Injection Tests and Monitoring
  - Finalize CO<sub>2</sub> source and delivery
  - CO<sub>2</sub> injection testing and monitoring/verification
  - Objectives vary by location due to different storage targets, CO<sub>2</sub> sources, and system design



# The Last 12 Months Have Included Many Activities

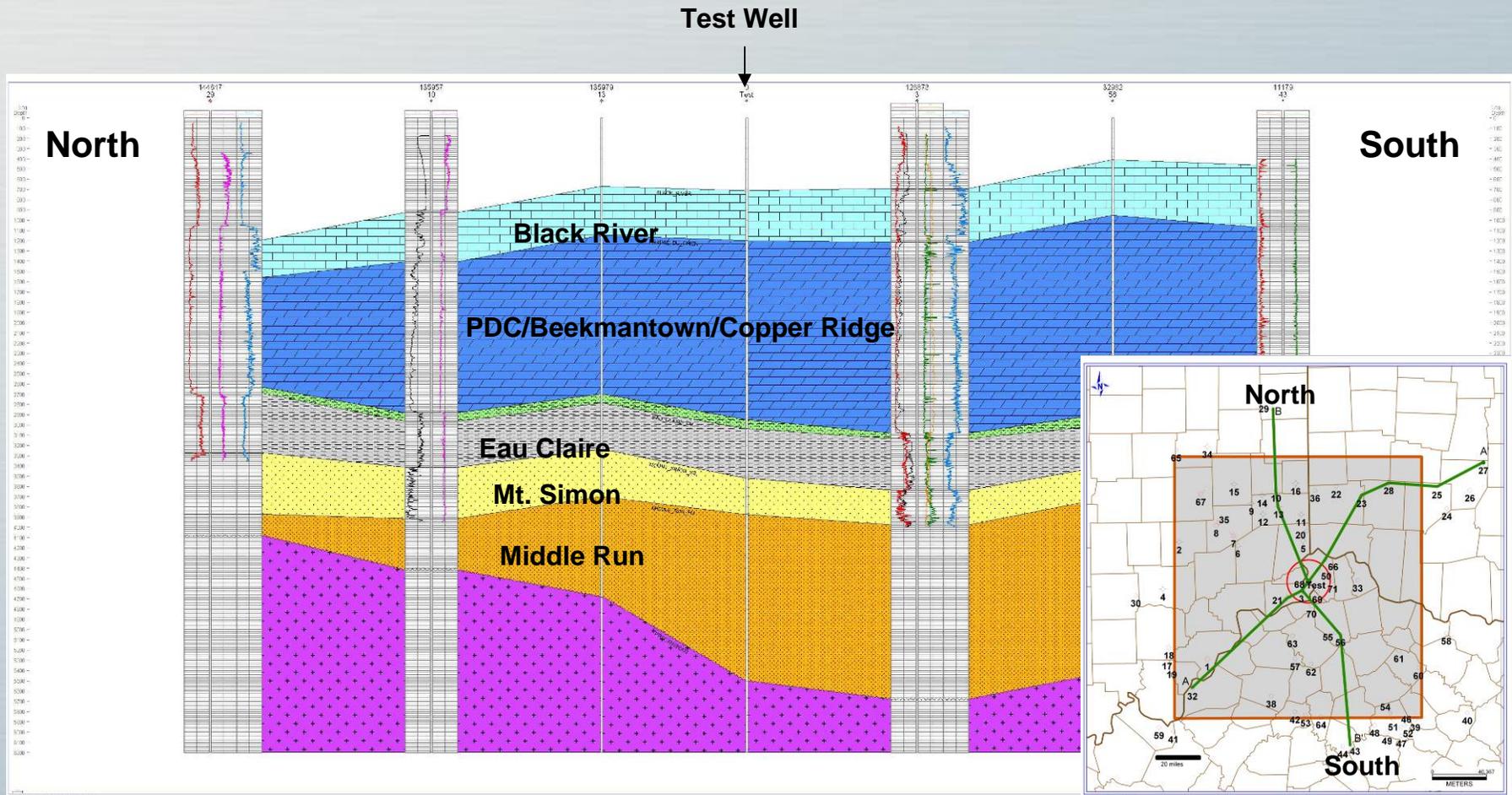


# East Bend Test Site



- Duke Energy East Bend facility
- 650 MW coal-burning power plant
- SOx and NOx control systems

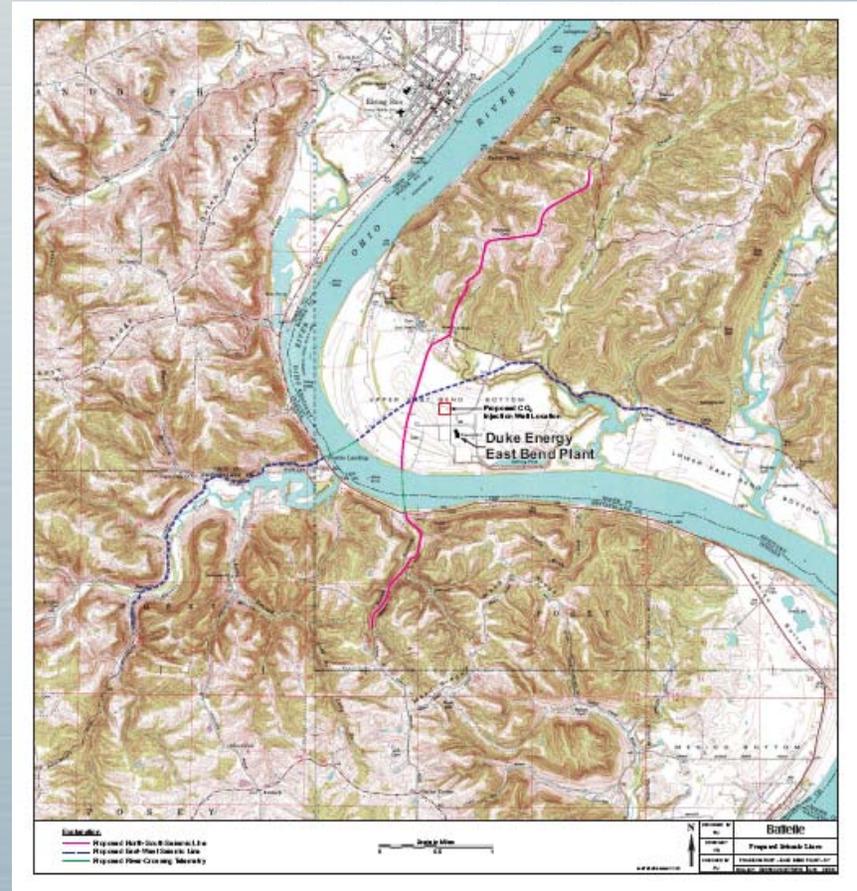
# Geologic Cross-Section Through Study Area



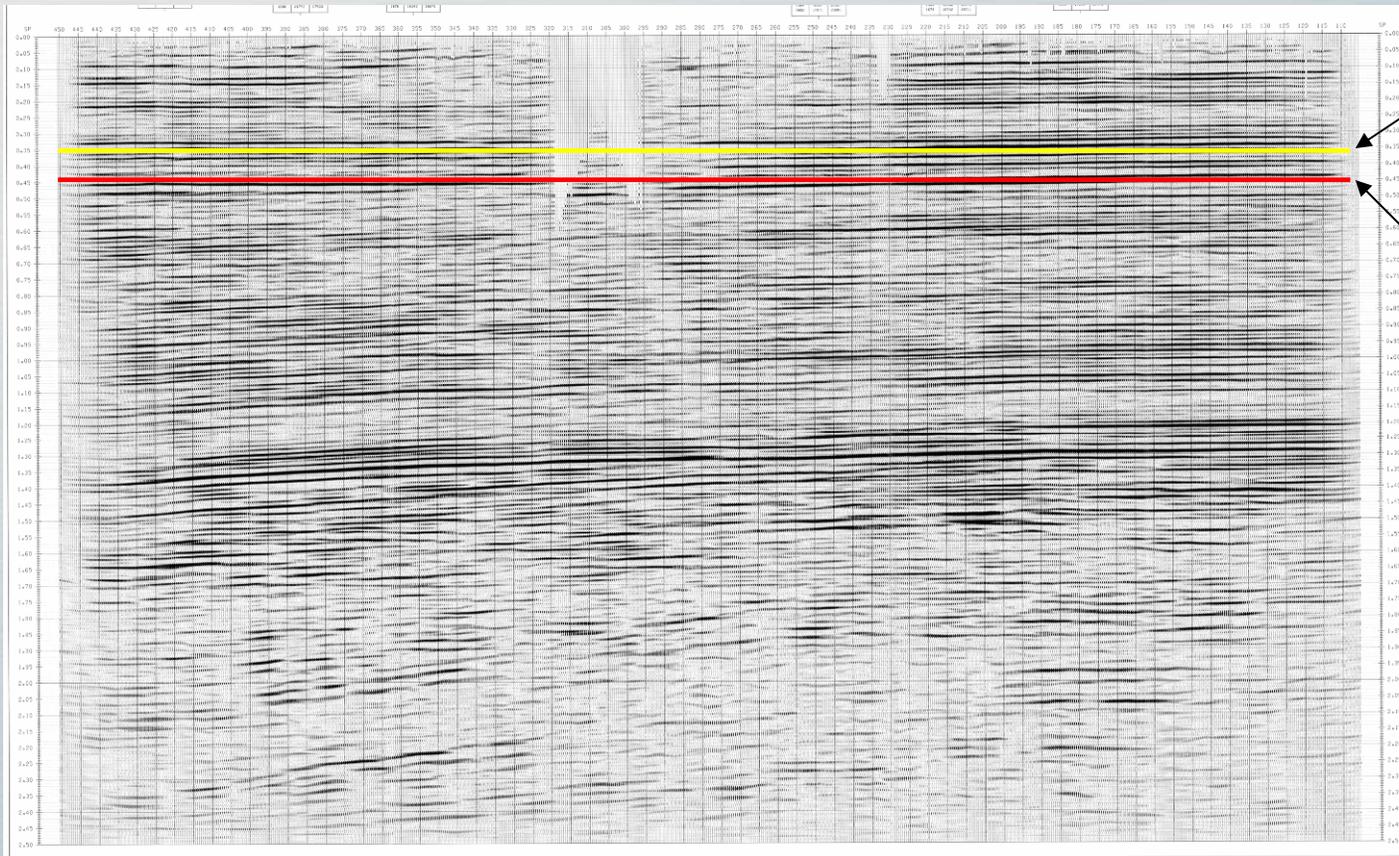
# Seismic Survey



- Held an open house at the East bend station to provide information on the survey to local residents.
- Met with local officials on both sides of the river
- 10-mile seismic survey completed in October-November 2006



# East Bend Seismic (S→N Line)



Eau Claire  
(0.32 seconds)

Pre-Cambrian  
(0.45 seconds)

PRELIMINARY RESULTS – DO NOT QUOTE

# East Bend Site Current Status

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- Continue review of seismic survey
- Review feasibility of undershooting the Ohio River at a closer geophone spacing to fill in data gap
- Focus on procurement for drilling. Planned for Fall 2007
  - Stratigraphic test well (will permit through State of Kentucky as a strat well and convert to injection well with US EPA Region IV)
  - Monitoring well (State permit)
  - Each about 4000 feet deep
- Continue with stakeholder outreach



# Michigan Basin Site - CO<sub>2</sub> Source

- CO<sub>2</sub> available from DTE gas processing plant
- Antrim Shale gas contains 15-30% CO<sub>2</sub> and is removed in amine based separation process
- Relatively pure CO<sub>2</sub> (99%) stream
- CO<sub>2</sub> periodically used for EOR floods in Niagaran Reef oil fields



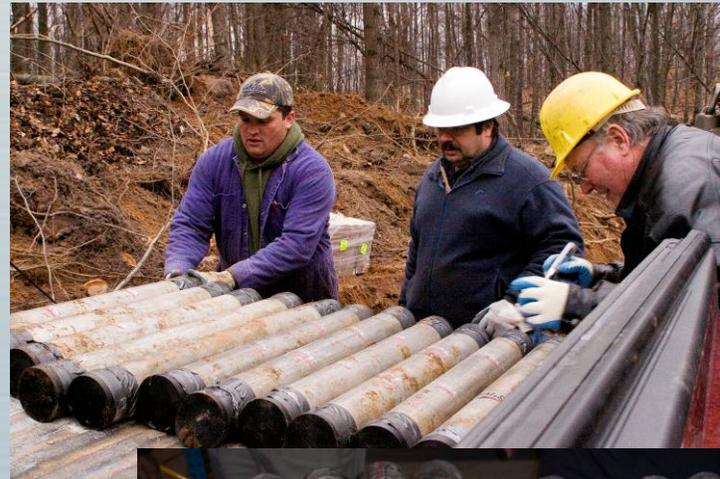
# Test Well Drilling

- Test well drilled October 30 – November 22, 2006



# Test Well Drilling

- 180 ft of full core collected.



# The Core was Transferred to WMU Laboratory....

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This is some of the most interesting Michigan core we have ever recovered



# ...And Studied in Great Detail

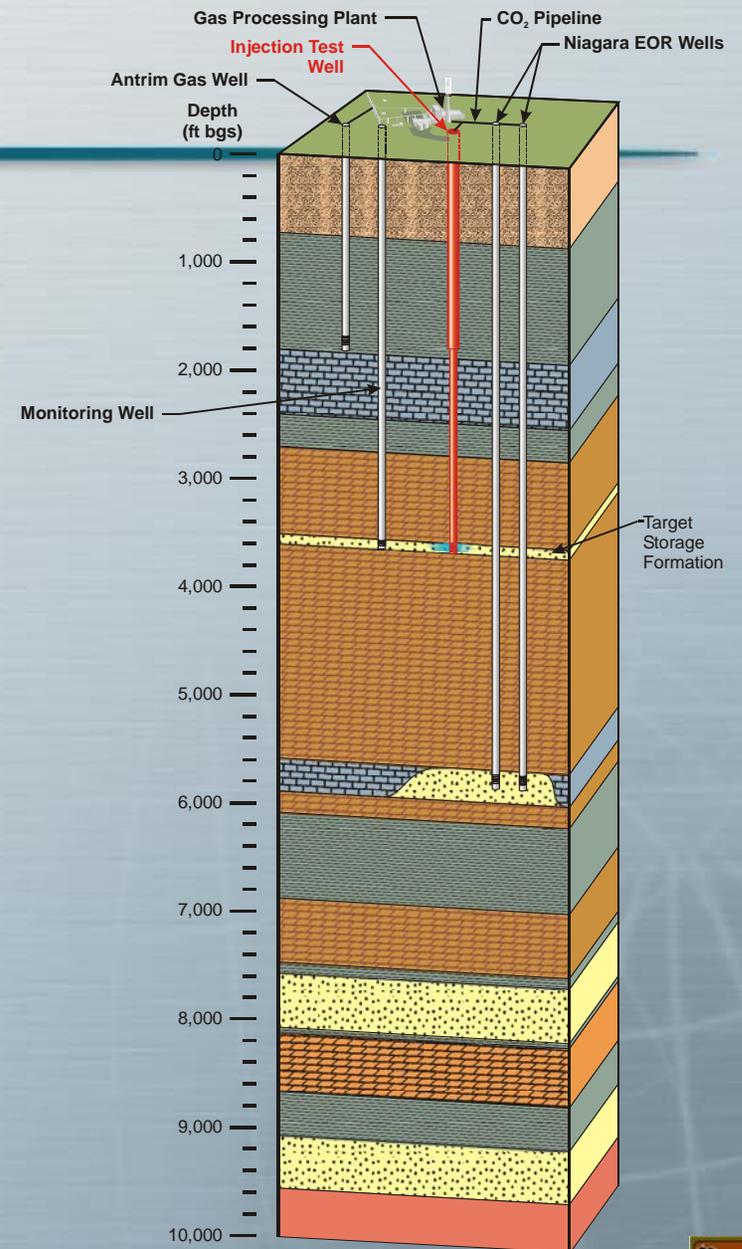
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# Current Status

- Injection well (not complete) in Bass Island dolomite - deep saline formation (Well No. Charlton 4-30)
- Detroit Group shale and salt layers provide containment
- Complete the retrofit of unused Niagaran well for monitoring (Charlton 2-30)
- UIC permit in review with Region V US EPA
- Detailed monitoring plans in progress

Plans for additional stakeholder outreach underway



# Upcoming Schedule for Michigan Test Site

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- **Permitting**

- Work closely with US EPA Region V and State of Michigan
- Expect public comment period during mid-Summer 2007
- Planning around a late summer (August) permit

- **Public Outreach**

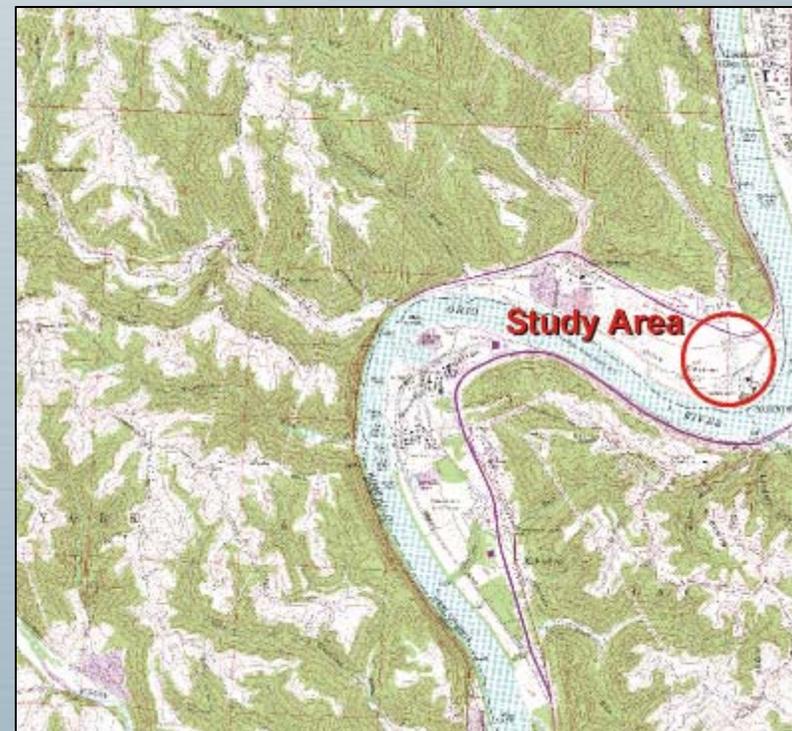
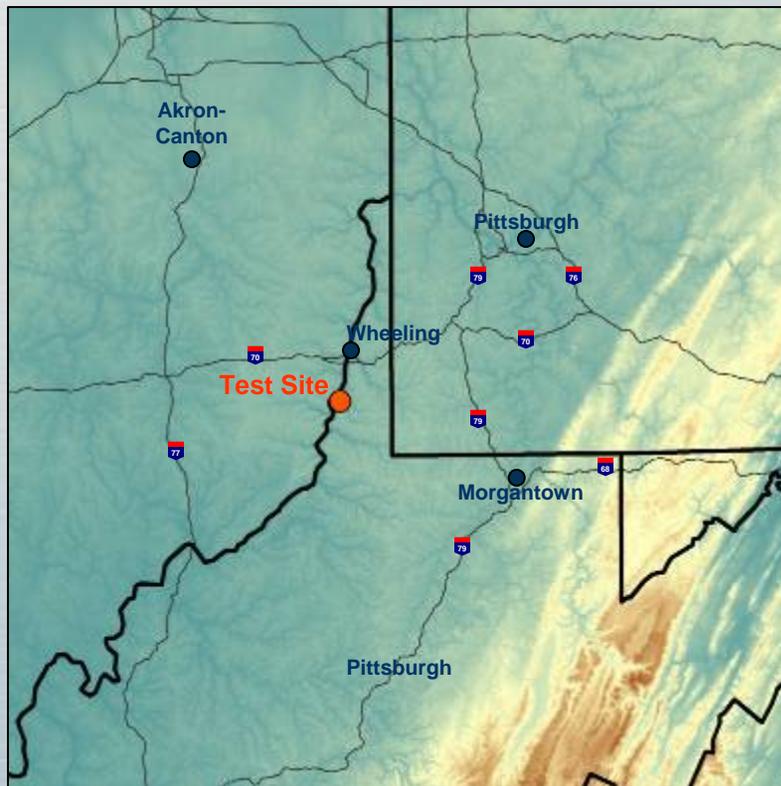
- Core Energy will personally contact residents and landowners within area of review
- Planning open house during public comment period
- Planning for an “on-site” event during injection

- **Injection**

- Procure services to compete well once permit is issued
- Permit and extend CO2 line to injection well

# Appalachian Basin- R.E. Burger Test Site

- FirstEnergy Plant outside of Shadyside, Ohio
- 20 miles southwest of Wheeling, West Virginia
- Near Maryland, Ohio, Pennsylvania, and West Virginia



# R.E. Burger Test Site

**FirstEnergy**



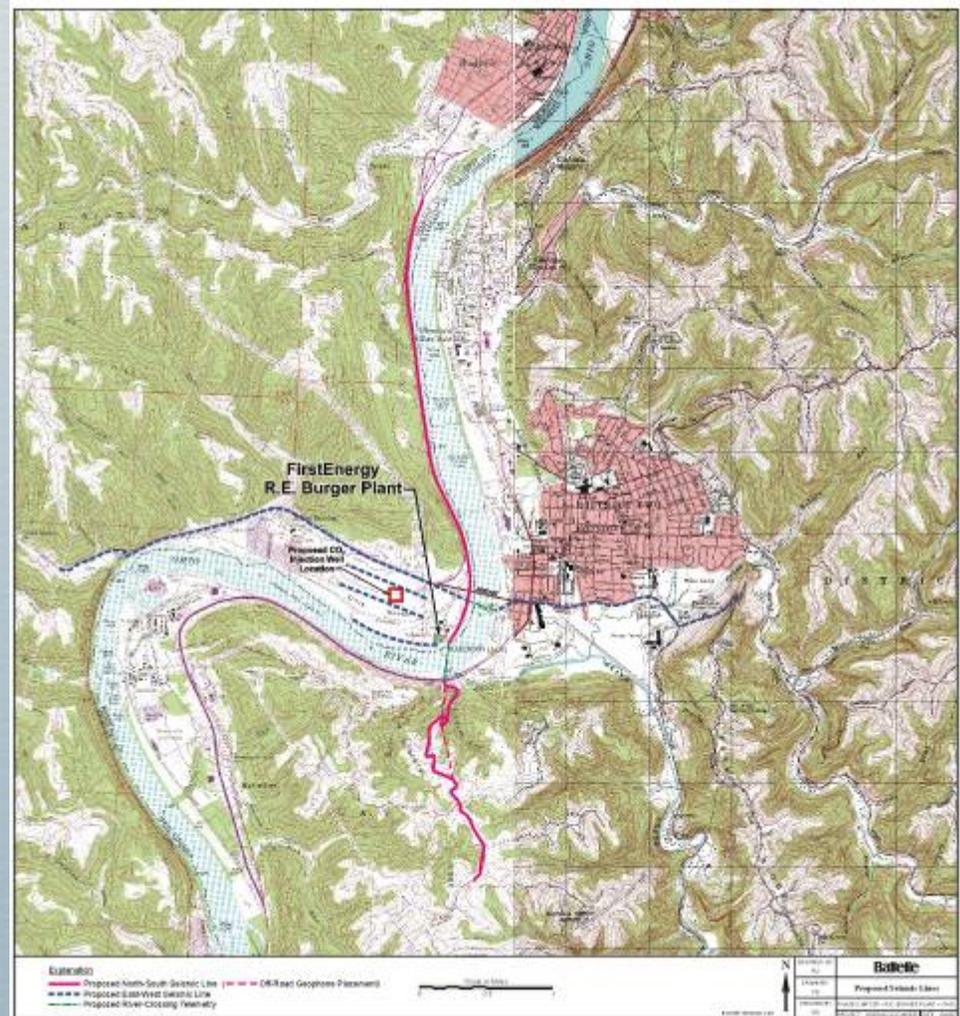
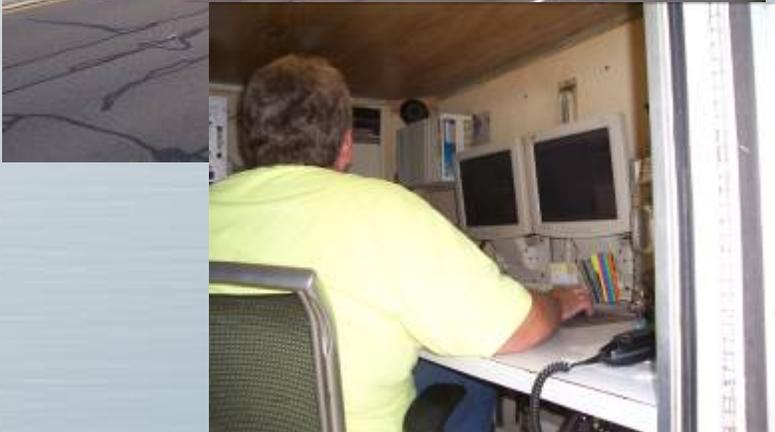
- FirstEnergy R.E. Burger facility
- 413 MW coal-burning power plant

- 100 acres on the floodplain along a bend in the Ohio River



# Seismic Survey

- 10-mile seismic survey completed in August 2006
- Additional 1-mile of “quasi-3D” to investigate reservoirs and 3D options



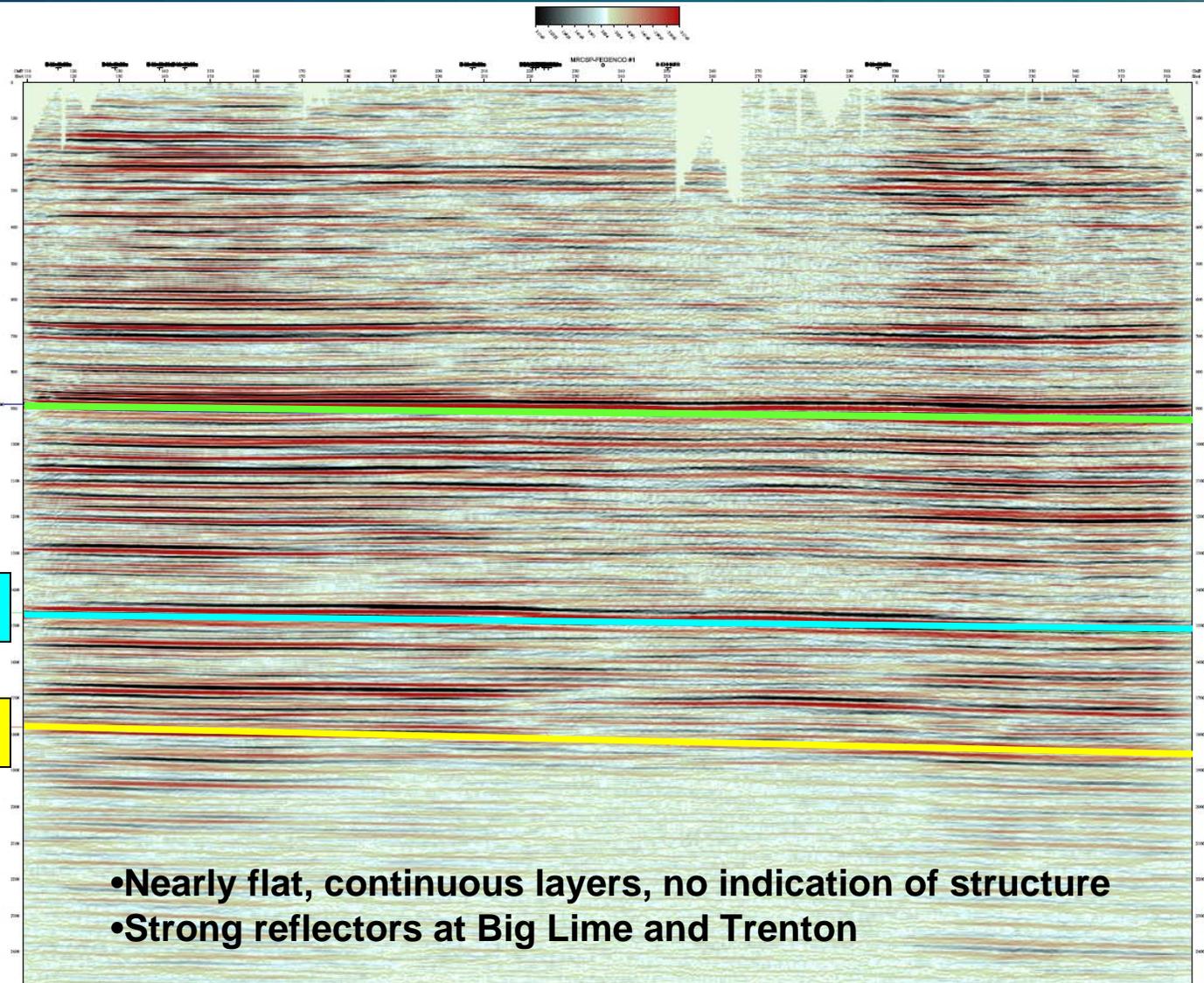
# Seismic Survey- Preliminary Data

## Burger Seismic – East-West Line

Big Lime

Trenton

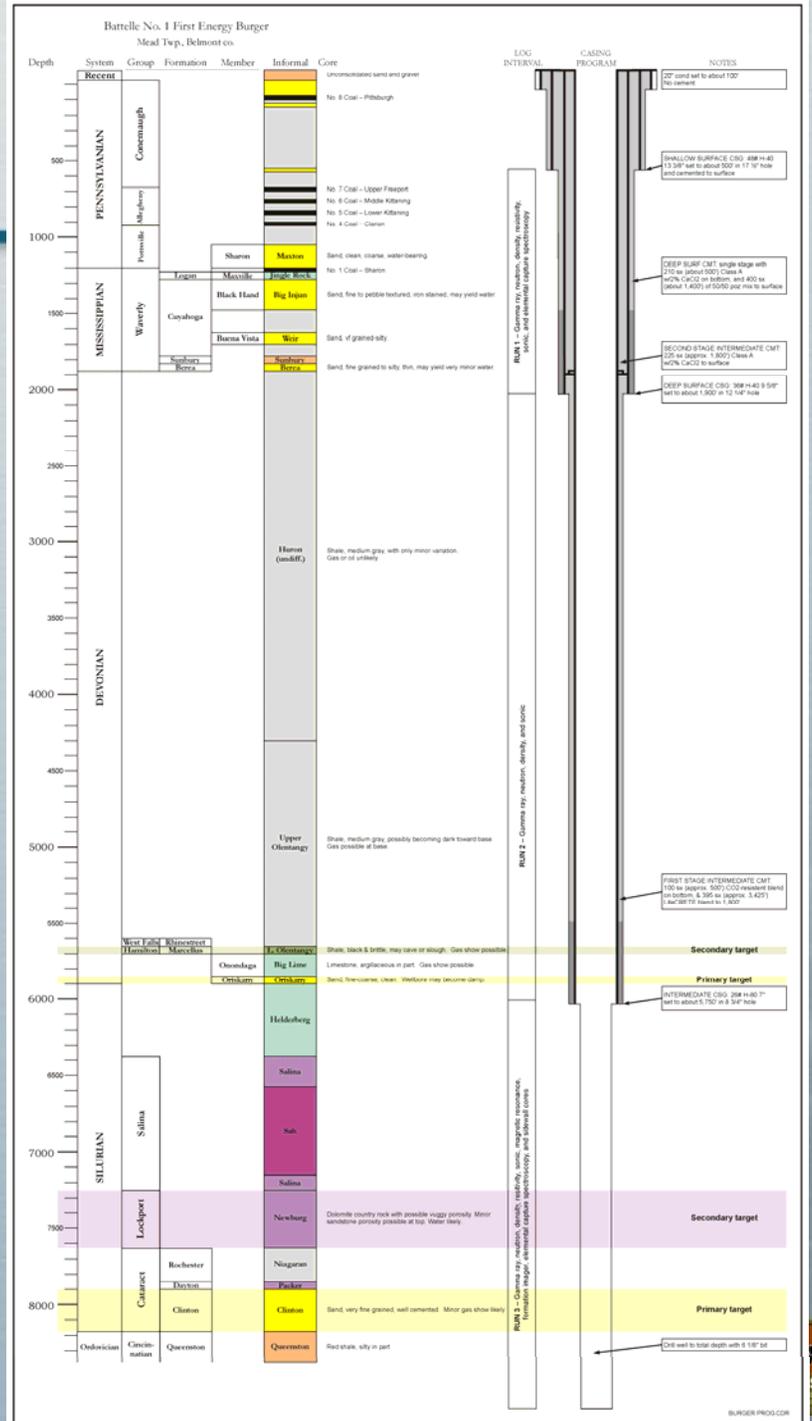
Pre-Cambrian



- Nearly flat, continuous layers, no indication of structure
- Strong reflectors at Big Lime and Trenton

# Test Well – Final Pre-drilling Design

- Iterative design process
- Ongoing discussion with FirstEnergy, Geologic experts, and regulators
- Drilling permitted as stratigraphic test well by Ohio Department of Natural Resources – Mineral Resources Management



# Site Preparation and Shallow Drilling – December 2006



# Drilling the Test Well – January 2007

- Numerous site visitors including
  - First Energy corporate and plant staff
  - DOE, FE, and Battelle management
  - Documentary film crew



# Burger Current Status

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- Continue review of site data
  - Seismic survey
  - Wireline data
  - Laboratory data from sidewall core samples
- Prepare detailed monitoring plan
- Prepare UIC permit application for Ohio EPA
- Continue stakeholder outreach

# Summary of Progress

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- During the first year of MRCSP, our team has made significant progress at all three geologic demonstration sites
- This includes planning, regulatory and outreach effort, procurement, site characterization, and design
- All of the project deliverables are on schedule
- Key challenges include field services demand, cost increases, and working within the continuing resolution for funding
- Field data combined with regional mapping and oil and gas data is helping us with key technical issues for CCS deployment across the region
- We hope to continue this progress towards an injection phase on schedule

# Thank You – To All of Those Who Support Our Field Efforts!

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