Utica Shale Energy and Environment Laboratory (USEEL)

Project Number DE-FE0024357

David R. Cole

The Ohio State University

U.S. Department of Energy

National Energy Technology Laboratory

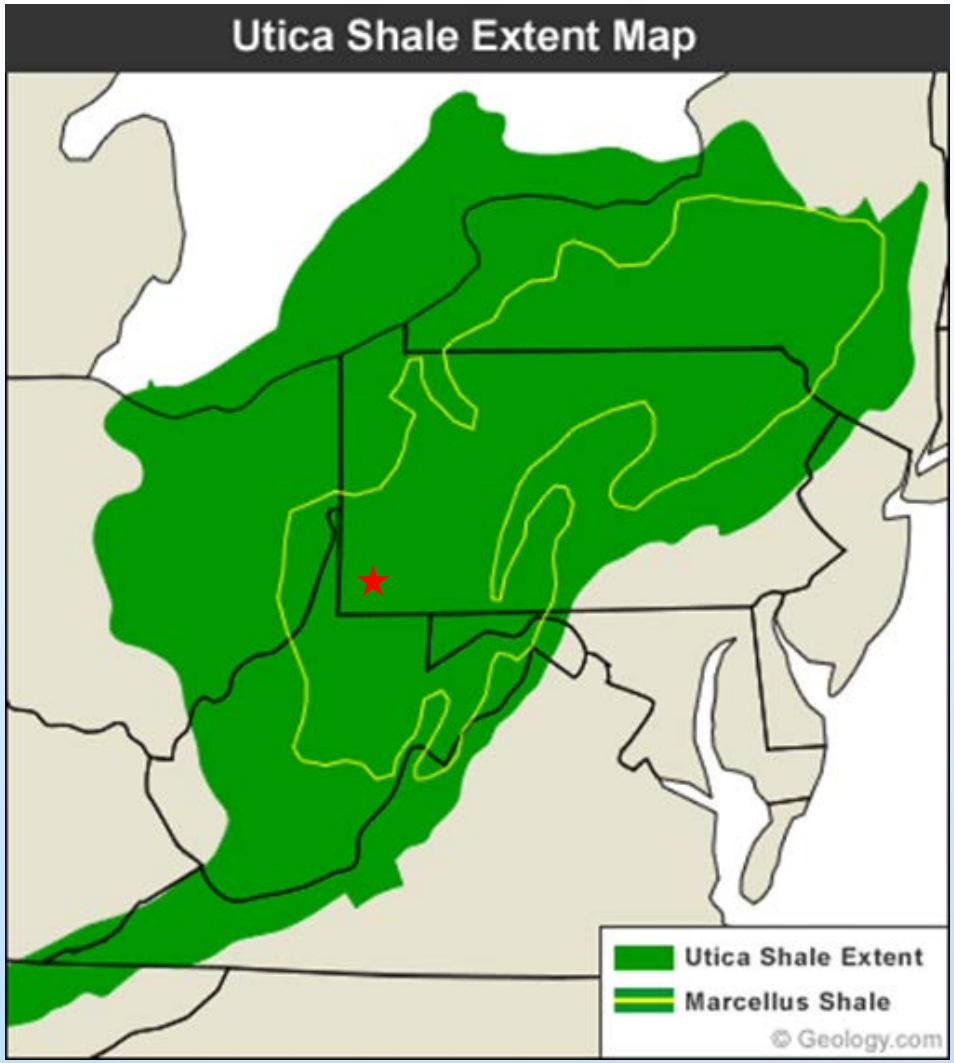
Mastering the Subsurface Through Technology Innovation, Partnerships and Collaboration:
Carbon Storage and Oil and Natural Gas Technologies Review Meeting

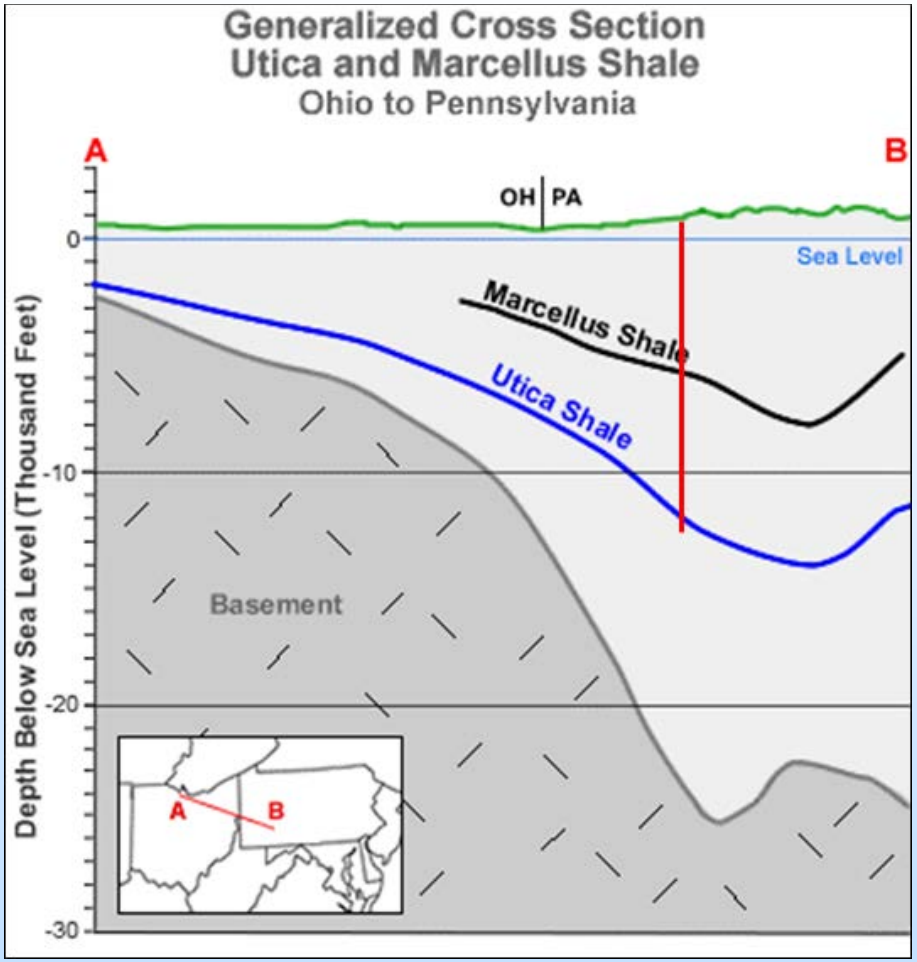
August 1-3, 2017

***Overarching Goal*:**

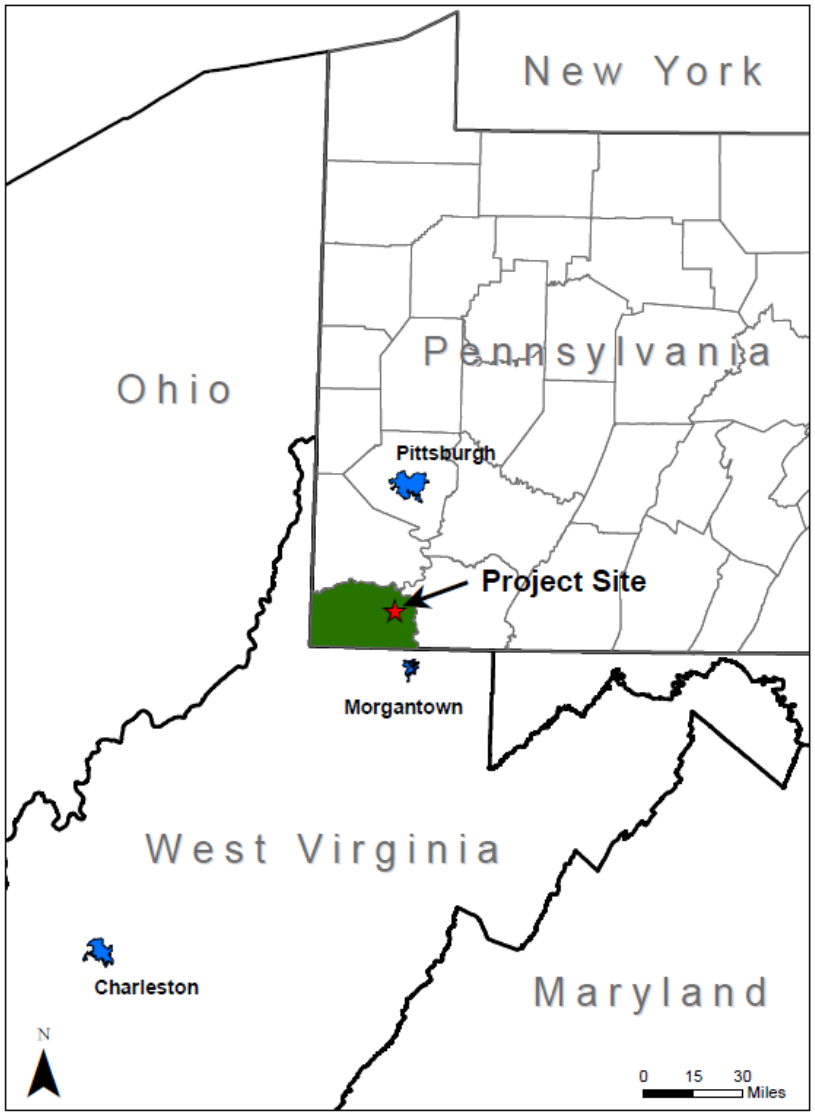
Establish a collaborative field site to develop and validate new knowledge and technology for improving recovery efficiency and minimizing environmental implications of deep Utica development

Aerial Extent and Simplified Cross Section

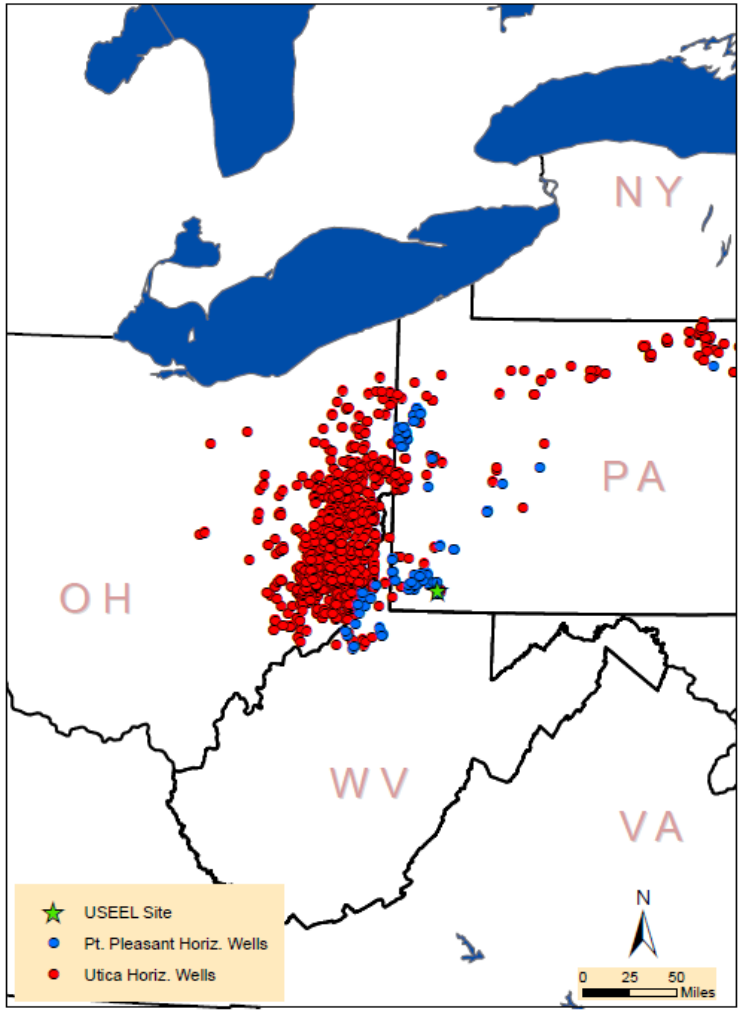




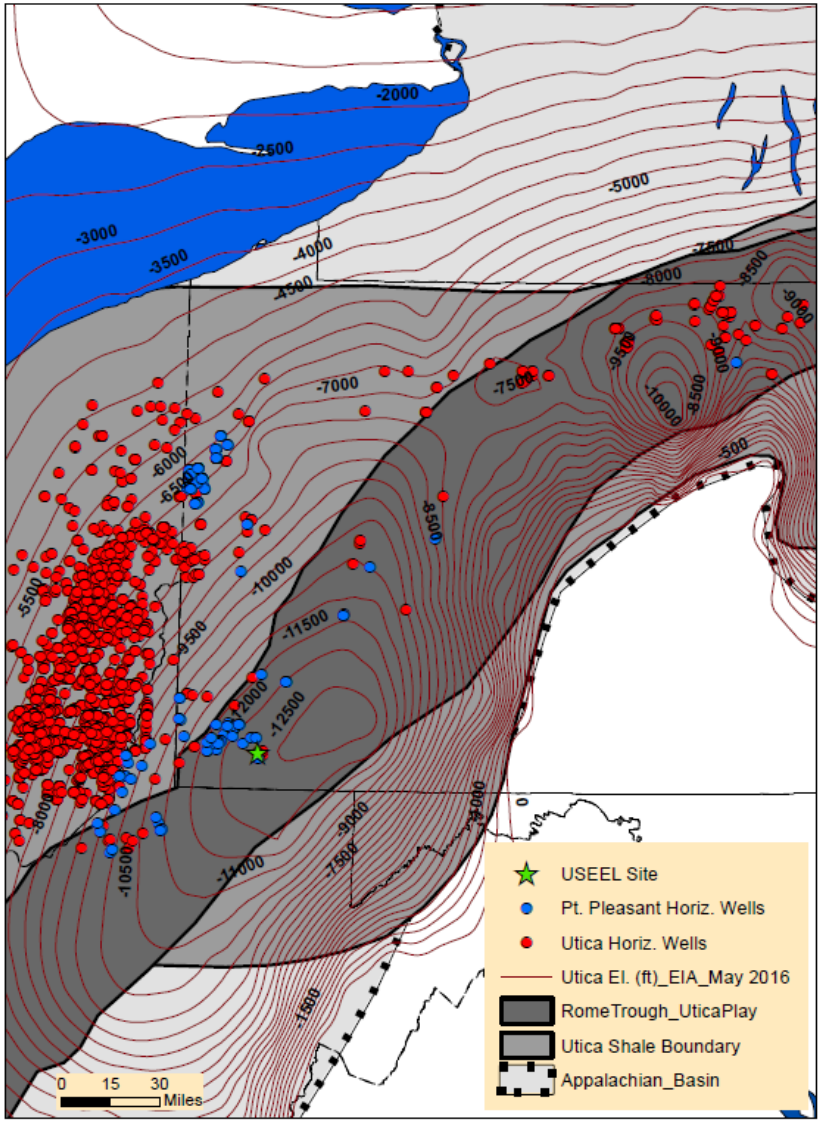
Greene County Pennsylvania



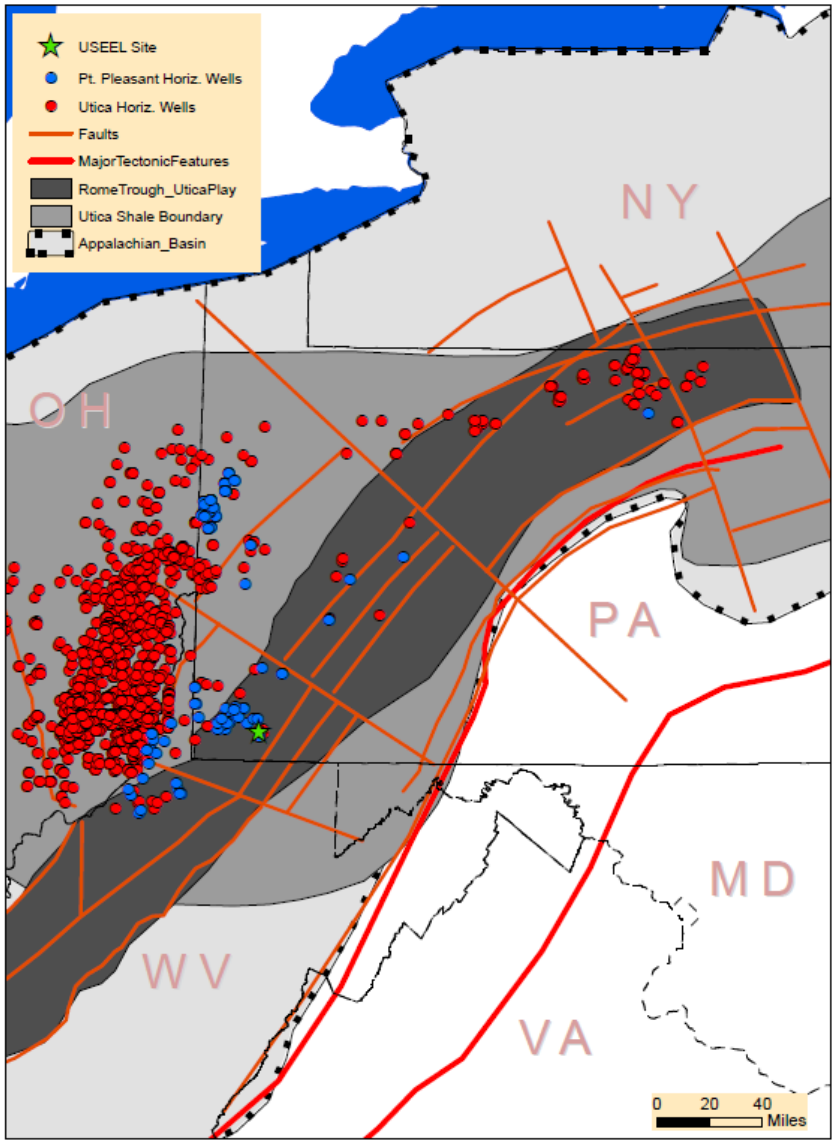
Active Utica & Pt Pleasant Horizontal Wells

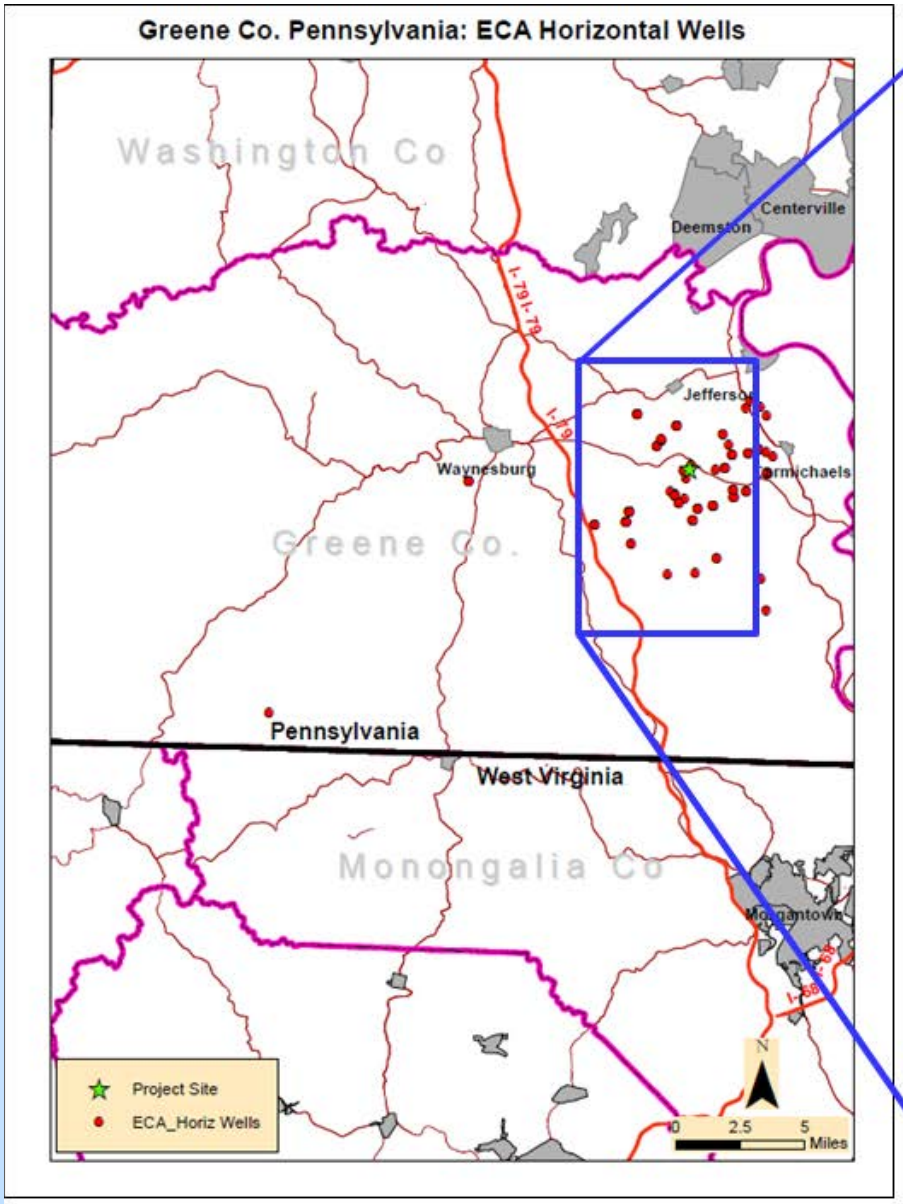


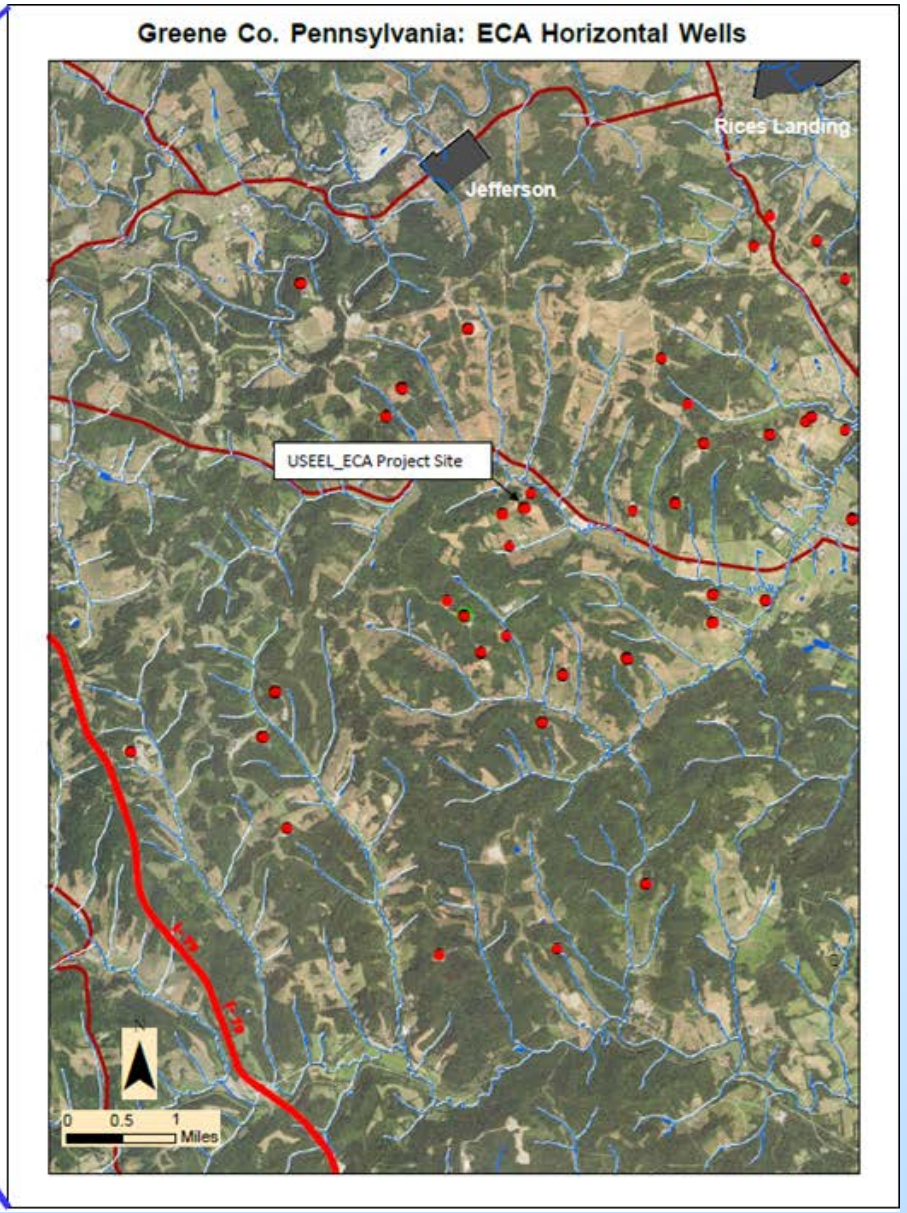
Appalachian Basin: Utica Top Elevation

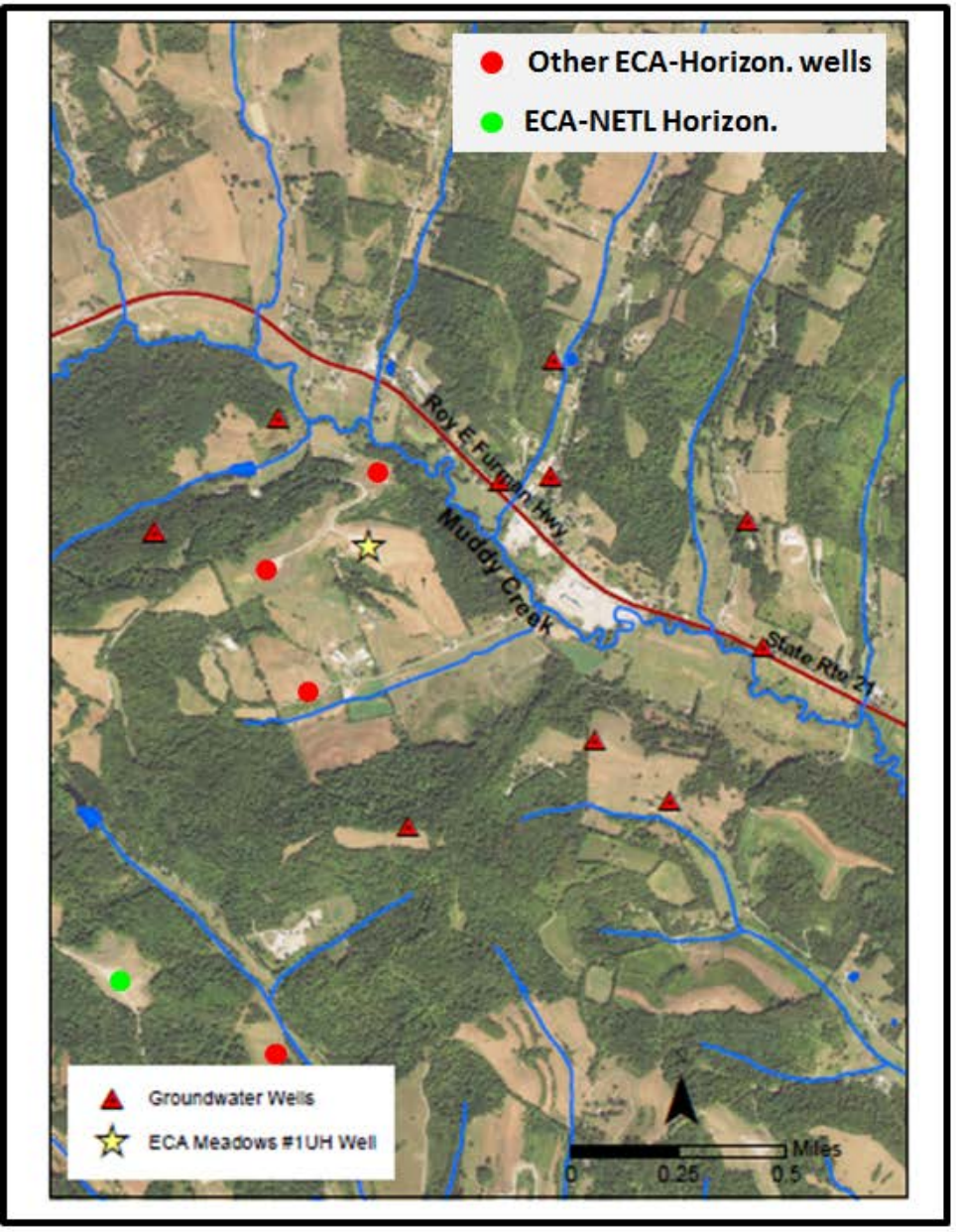


Appalachian Basin Structure




Greene Co. Pennsylvania: ECA Horizontal Wells
Washington Co
Centerville
Deemston
I-79
Jefferson
Waynesburg
Carmichaels
Greene Co.
Pennsylvania
West Virginia
Monongalia Co
Project Site
ECA_Horiz Wells
0 2.5 5
Miles


Greene Co. Pennsylvania: ECA Horizontal Wells
Rices Landing
Jefferson
USEEL_ECA Project Site
I-79
I-79
0 0.5 1
Miles



***Science Targets*:**

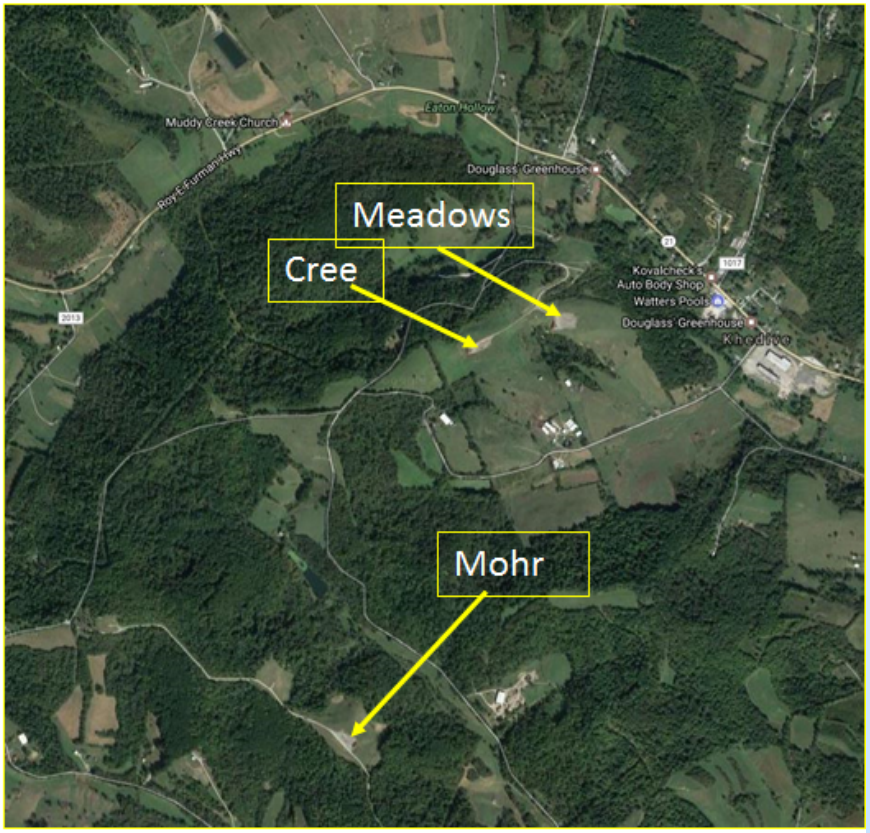
Environmental – pad retrofit
3-D seismic survey (completed)
Bore hole logging suite
Bore hole integrity
Microseismic (lateral)
Fiber optic (DTS, DAS) along lateral
Core, fluids, gas, cuttings analyses
Flowback chemistry monitoring

NETL Marcellus Research at ECA Locations in Greene Co., PA

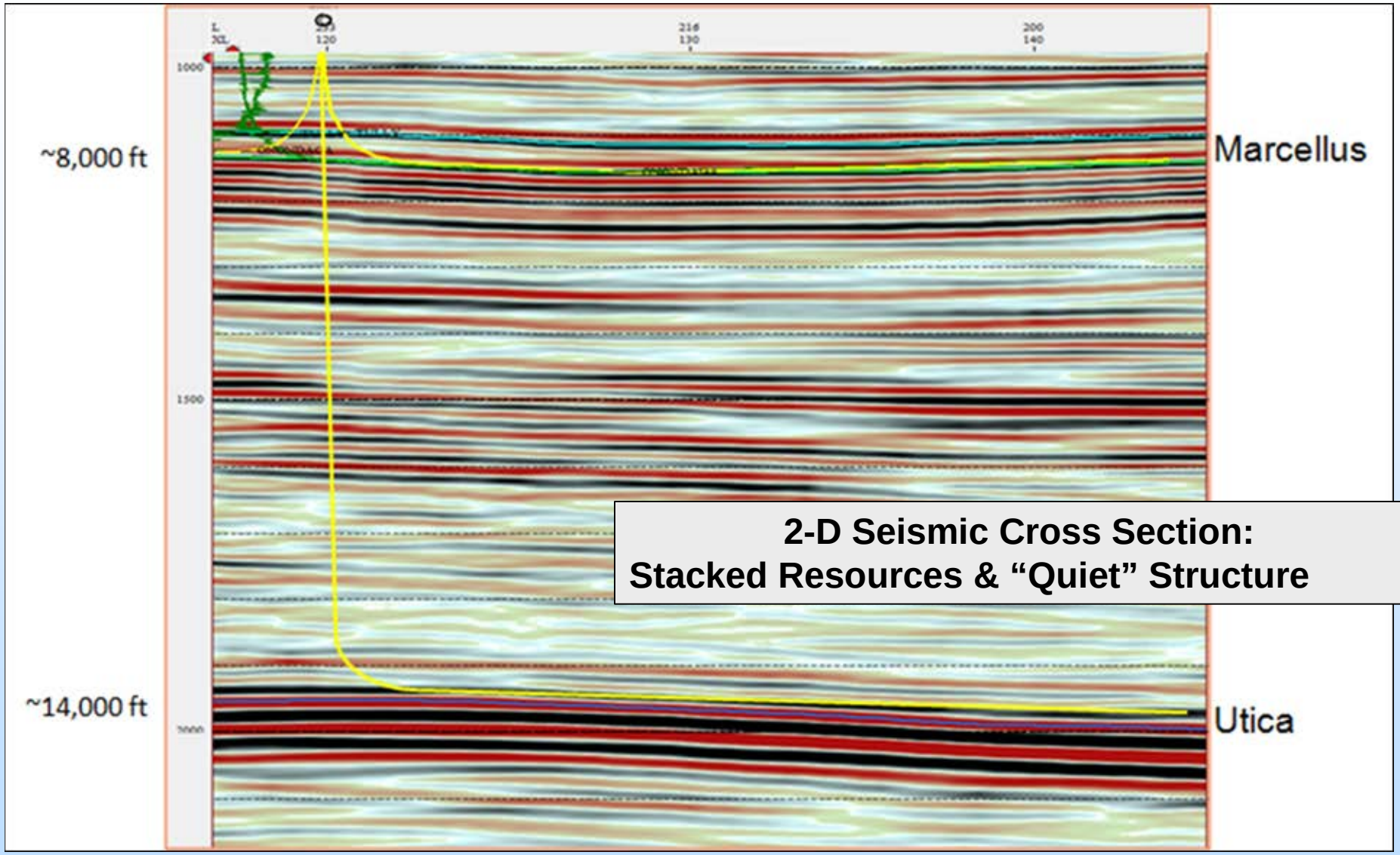
Meadows Pad - Marcellus
NETL and USGS collaborated on a long-term sampling of produced water from Marcellus wells. Microbial (metagenomic) and chemical analysis of produced water.

Cree Pad - Marcellus
NETL sampling of frac fluids and produced water. Microbial (metagenomic) and chemical analysis of produced water

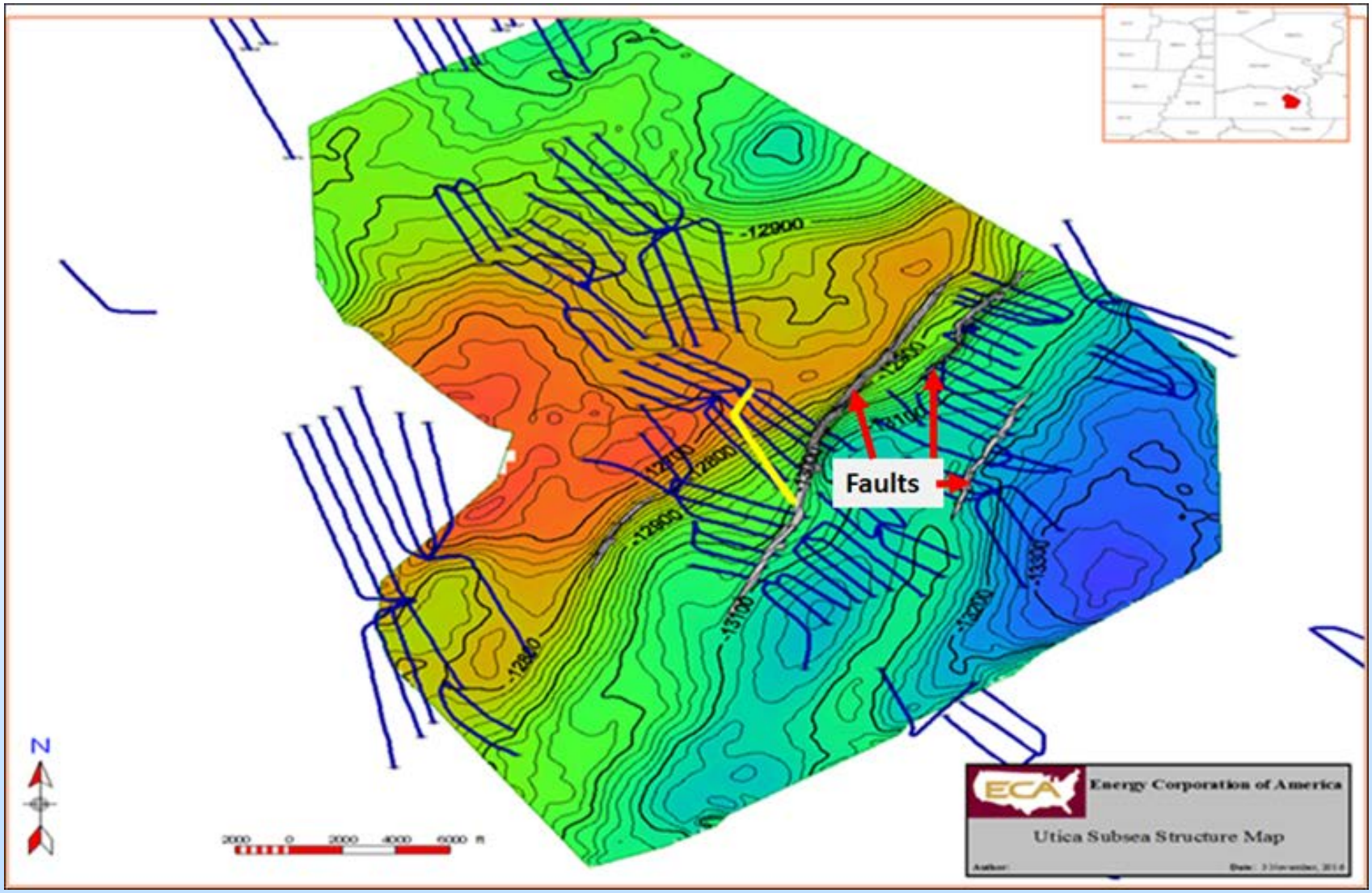
Mohr Pad - Marcellus
"Green County Site"
- Air Quality Monitoring
- Microseismic Monitoring of Fracture Growth
- Broadband Surface Seismic Monitoring
- Natural and Man-Made Tracers Studies



Develop background geological model based on 3D seismic; other data
Establish framework for understanding fracturing and microseismic behavior



Utica structure map: top of the Trenton



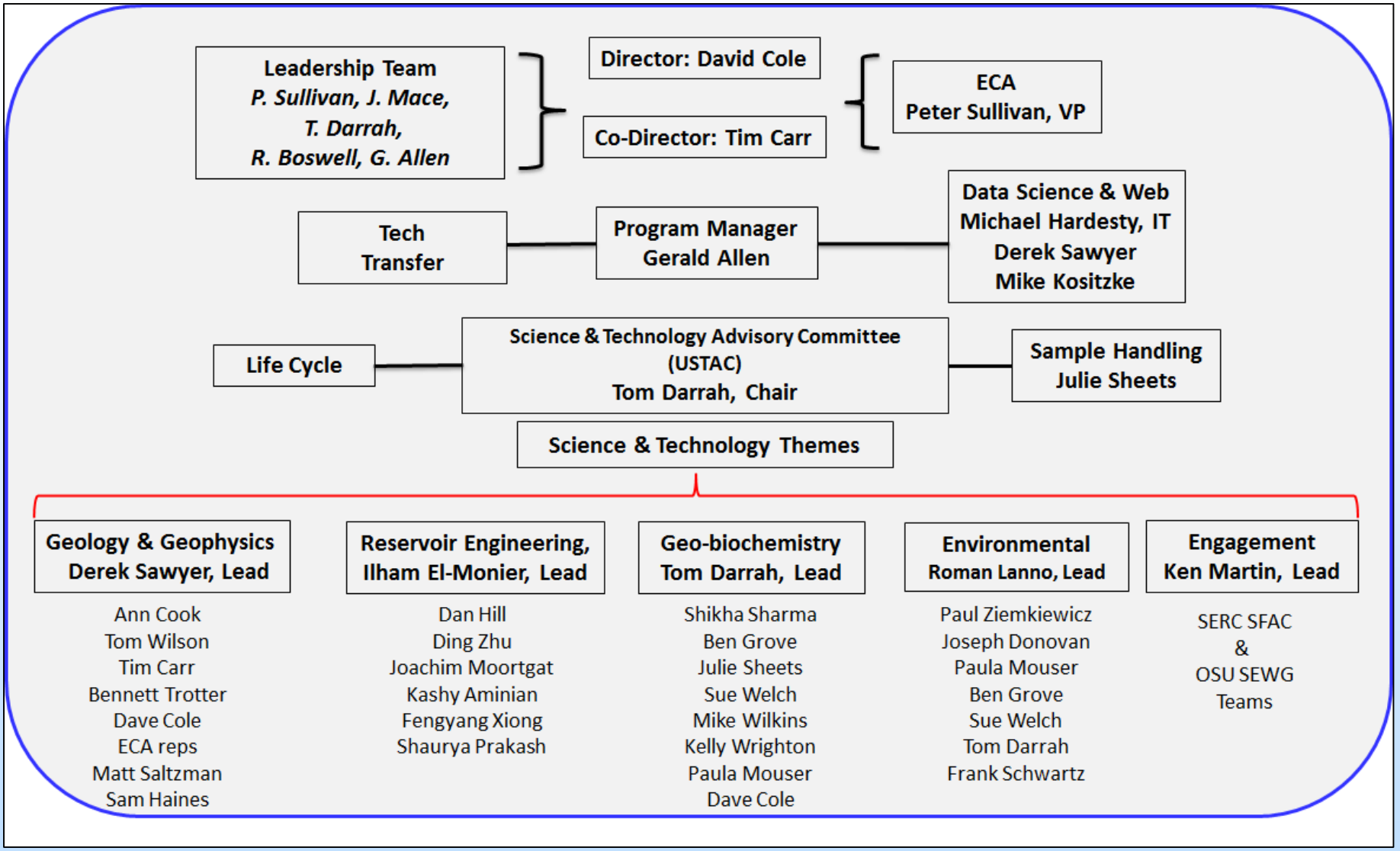
Lateral: 5000-5500 ft

Unique Attributes and Challenges of the USEEL Project

- **Develop a first-ever predictive geo-model and answer why this deep formation has such an extremely high pressure gradient of 0.95psi/ft.**
- **Determine the seal formation and sealing mechanisms that preserve such high gas pressures and enormous quantities of gas.**
- **Quantify the static state of stress and how this stress field affects induced fracture geometry – i.e., stimulated reservoir volume (SRV).**
- **Predict the optimum well spacing based on integration of 3-D and microseismic data with fiber optic and completion monitoring.**
- **Test for the first time the extent of fluid/gas communication between the metamorphosed basement and the Utica, and between the Utica and Marcellus.**

Unique Attributes and Challenges of the USEEL Project

- Constrain the mechanism(s) and physical locations for gas storage.
- Quantify reliable gas in place estimates, a largely unknown quantity.
- Delineate the permeability and hydrodynamic properties of an “over pressured” deep shale that control how gas will migrate during stimulation.
- Utilize the evolution of flowback and produced water chemistry and isotopes with time to quantify the volume of rock accessed by the frac fluid.
- Evaluate effect of pad expansion on the integrity of existing producing wells, ground disruption and slope stability, and ultimate efforts to conduct site reclamation.


Leadership Team
P. Sullivan, J. Mace,
T. Darrah,
R. Boswell, G. Allen
Director: David Cole
Co-Director: Tim Carr
ECA
Peter Sullivan, VP
Tech
Transfer
Program Manager
Gerald Allen
Data Science & Web
Michael Hardesty, IT
Derek Sawyer
Mike Kositzke
Life Cycle
Science & Technology Advisory Committee
(USTAC)
Tom Darrah, Chair
Sample Handling
Julie Sheets
Science & Technology Themes
Geology & Geophysics
Derek Sawyer, Lead
Ann Cook
Tom Wilson
Tim Carr
Bennett Trotter
Dave Cole
ECA reps
Matt Saltzman
Sam Haines
Reservoir Engineering,
Ilham El-Monier, Lead
Dan Hill
Ding Zhu
Joachim Moortgat
Kashy Aminian
Fengyang Xiong
Shaurya Prakash
Geo-biochemistry
Tom Darrah, Lead
Shikha Sharma
Ben Grove
Julie Sheets
Sue Welch
Mike Wilkins
Kelly Wrighton
Paula Mouser
Dave Cole
Environmental
Roman Lanno, Lead
Paul Ziemkiewicz
Joseph Donovan
Paula Mouser
Ben Grove
Sue Welch
Tom Darrah
Frank Schwartz
Engagement
Ken Martin, Lead
SERC SFAC
&
OSU SEWG
Teams

Simplified Work Flow
(Oct 1 2014 - July 31 2017)

Phase 1: Regional geologic assessment, Secure operator and site, Develop detailed work plan (Oct 2014 – Nov 2016)

Phase 2: Synthesis of existing local geo-data, Surface baseline environmental measurements, 3D seismic data analysis, Drilling plan and permitting; Establish web/data portal (4th quarter 2016 – 1st quarter 2017)

Simplified Work Flow
(Aug 1 2017- July 31 2019)

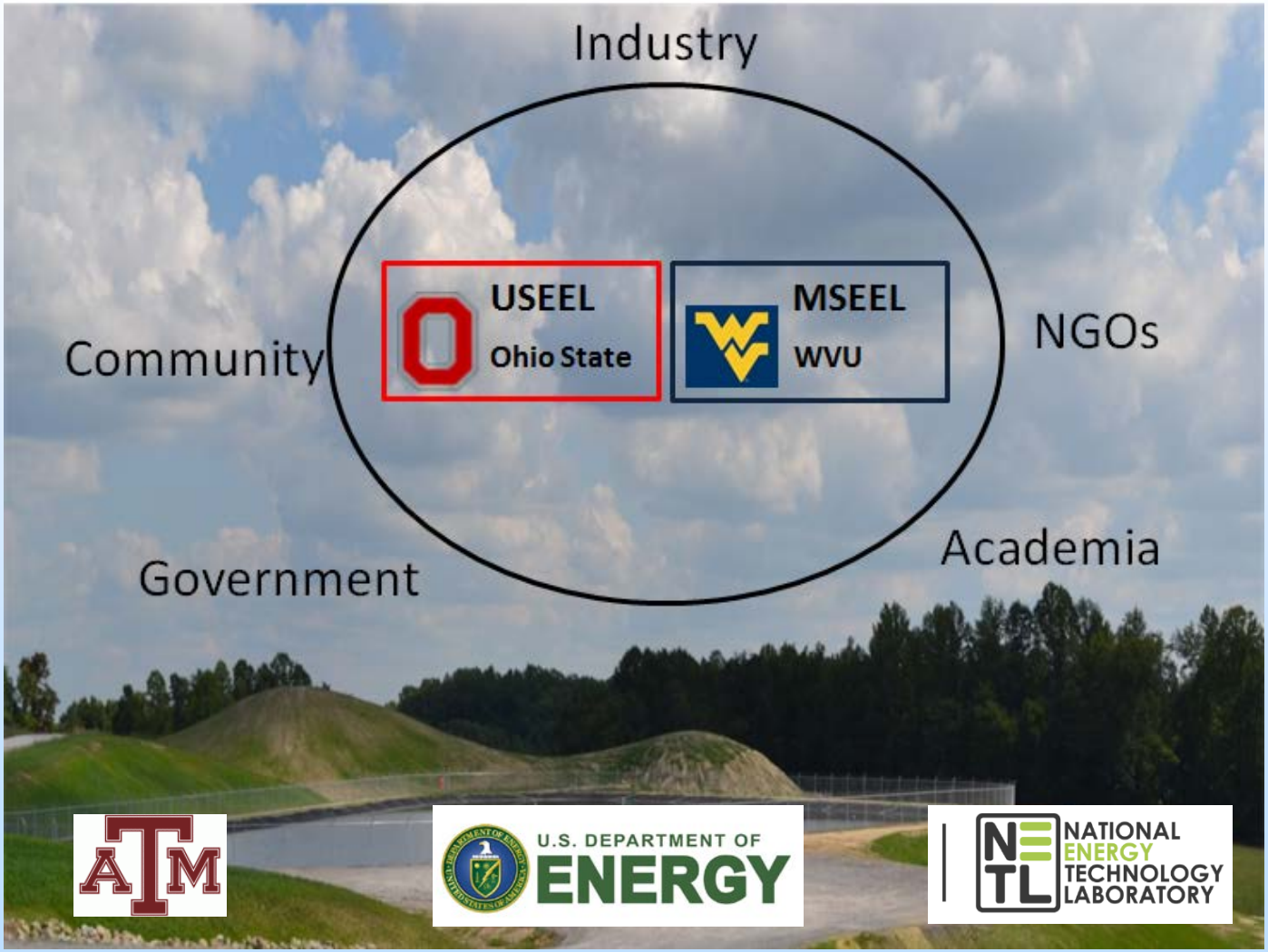
Phase 3a: Vertical drilling with logging, Core/side-wall core/cuttings acquisition and assessment, Fluid and gas sampling; Air and water monitoring (4th quarter 2017- 1st quarter 2018)

Phase 3b: Horizontal drill, logging and fracing, Fiber optic and microseismic monitoring, Stress tests, Tracer tests, Fluid and gas sampling, Continue surface monitoring (2nd - 3rd quarters 2018)

Phase 4: Post drilling laboratory, modeling, and computer analysis; On-going flowback fluid/gas and seismicity monitoring, Final report (3rd quarter 2018 - 3rd quarter 2019)

SEEL

Building Partnerships for Research, Education, and Outreach



The Team

Geology and Geophysics

Ann Cook

Geophysics/
Well
Logging

Tom Darrah
Geology

Matt Saltzman

Geology/Stratigraphy

Derek Sawyer
Geophysics/
Reflections seismic

Dave Cole
Geology/
Mineralogy

Peter Sullivan
Geology

Tim Carr
Geology/Structure

Tom Wilson
Microseismic

Reservoir Engineering

Joachim Moortgat
Reservoir modeling

Ilham El-Monier
Petroleum Engineering

Kashy Aminian
Reservoir Characterization

Dan Hill
Reservoir modeling

Ding **Zhu**
Reservoir characterization; modeling

Geo- & Biogeochemistry

Shikha Sharma
Biogeochemistry

Julie Sheets
Mineralogy/
Petrophysics

Dave Cole
Earth Materials/
Mineralogy

Tom Darrah
Isotope/gas
Geochemistry

Paula Mouser
Flowback chemistry

Kelly Wrighton
Geomicrobiology

Mike Wilkins
Geomicrobiology

Sue Welch
Water/isotope chemistry

Environment

Joe Donovan
Hydrogeology

Roman Lanno
Chemical bioavailability

Paul Ziemkiewcz
Water resources

Gerald Allen
Hydrologist

Sue Welch
Water-isotope chemistry
Flowback assessment

Frank Schwartz
Hydrogeologist

Tom Darrah
Isotope/gas
geochemistry

Paula Mouser
Flowback chemistry