



RANGE RESOURCES®

Marcellus Shale

May 2012

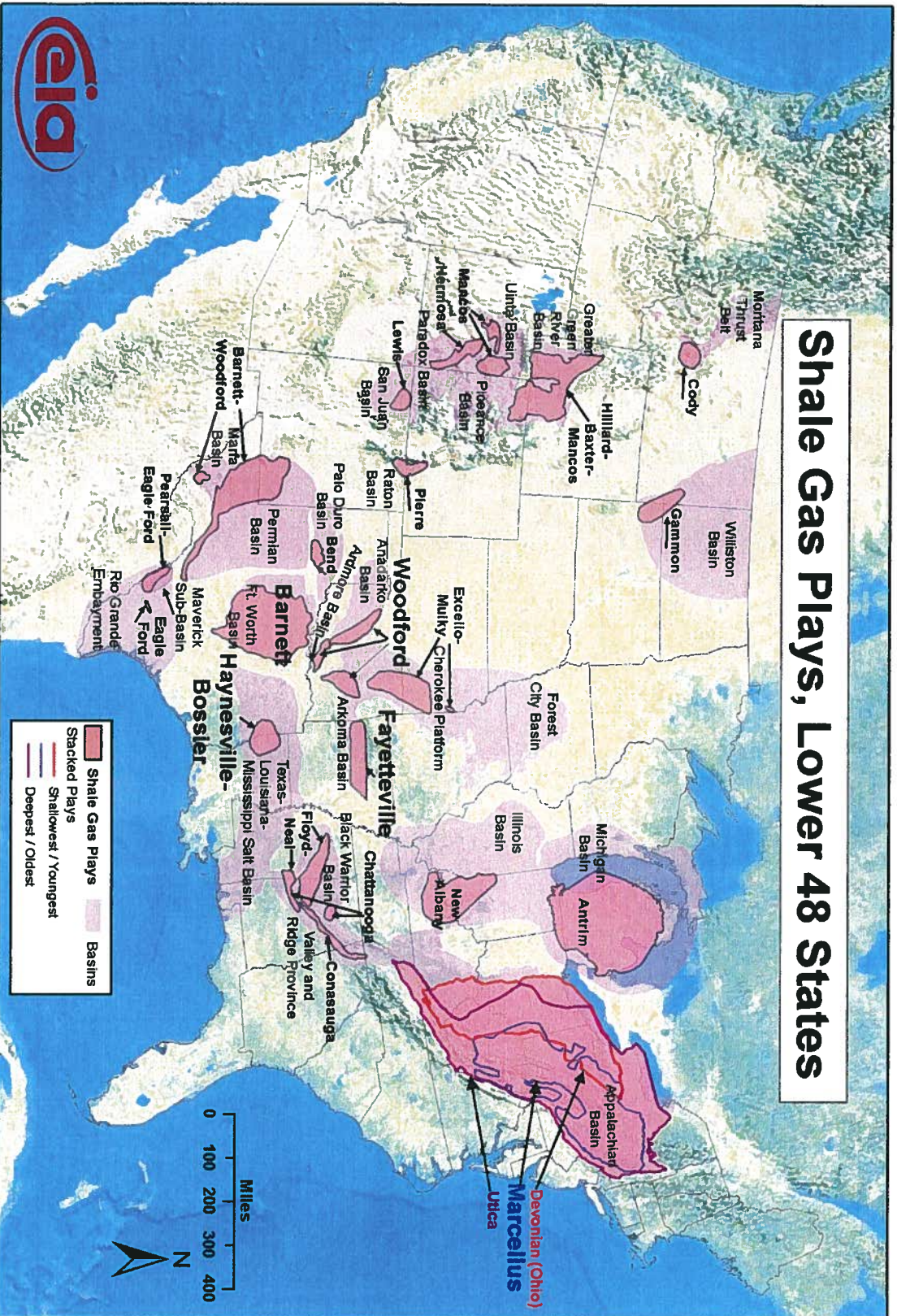
Range Resources

- Natural gas production company
- Included in S&P 500
- Regional Headquarters in Canonsburg, PA
- Operations in SW United States and Appalachian Basin
- Pioneered Marcellus Shale, 2004
- More than \$3 billion invested in Pennsylvania



American Shale Plays

Shale Gas Plays, Lower 48 States



Source: Energy Information Administration based on data from various published studies.
 Updated: March 10, 2010

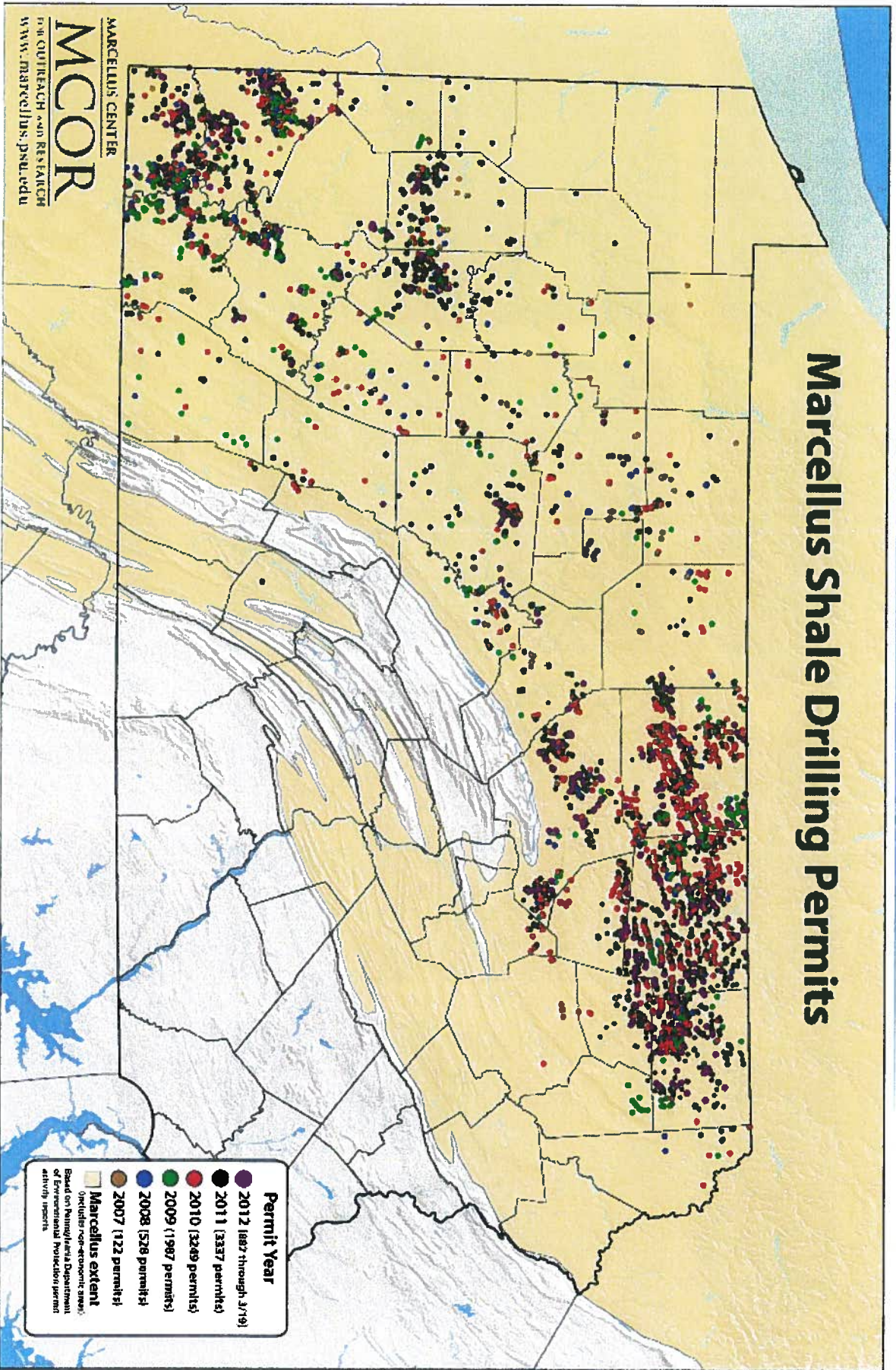
What is the Marcellus Shale?



- Large, natural gas rich, marine shale formation
- Spans across tens of million of acres
- Natural gas and hydrocarbons are trapped inside the solid shale

Marcellus Wells Drilled

Marcellus Shale Drilling Permits



MARCELLUS CENTER
MCCOR
THE OUTREACH AND RESEARCH
WWW.MARCELLUS.PSU.EDU

Marcellus Shale Development

State-of-the-art Technology - Proven Approach - Industry Expertise



Preparation

Drilling

Completion

Production

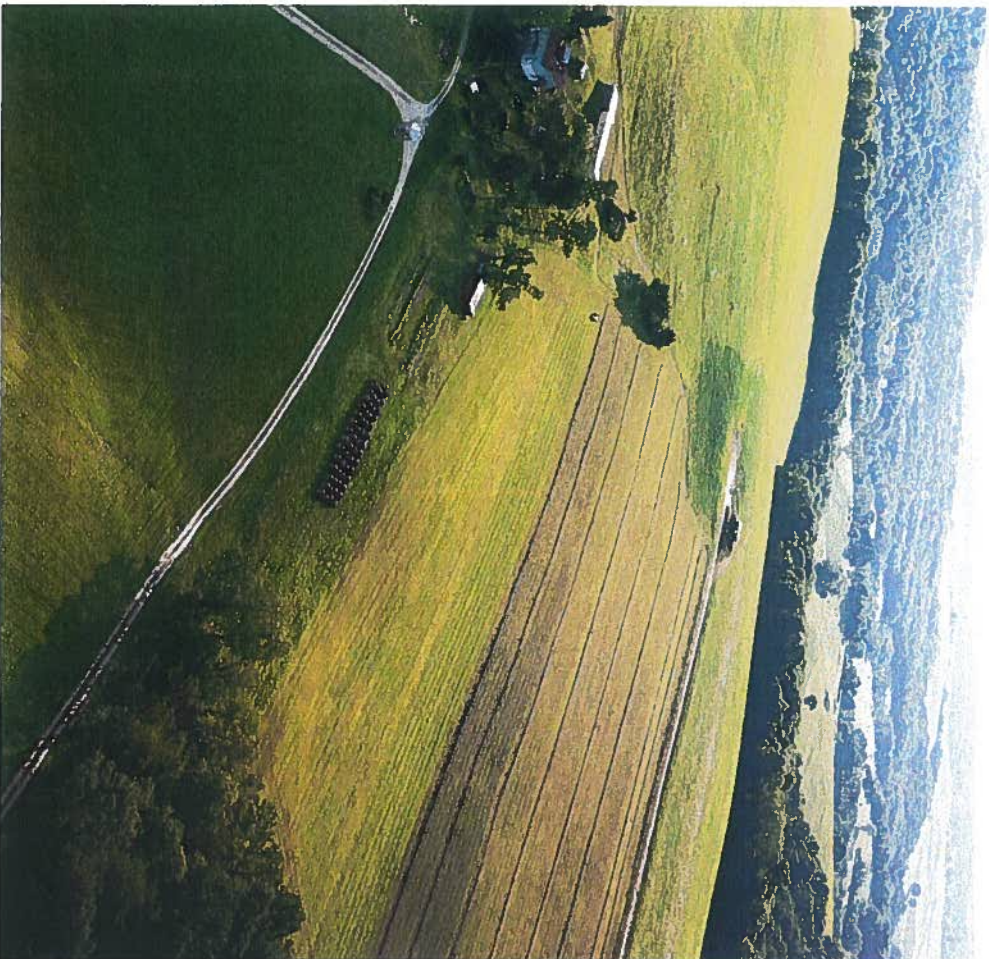
Preparation



Geoscientists determine drilling locations

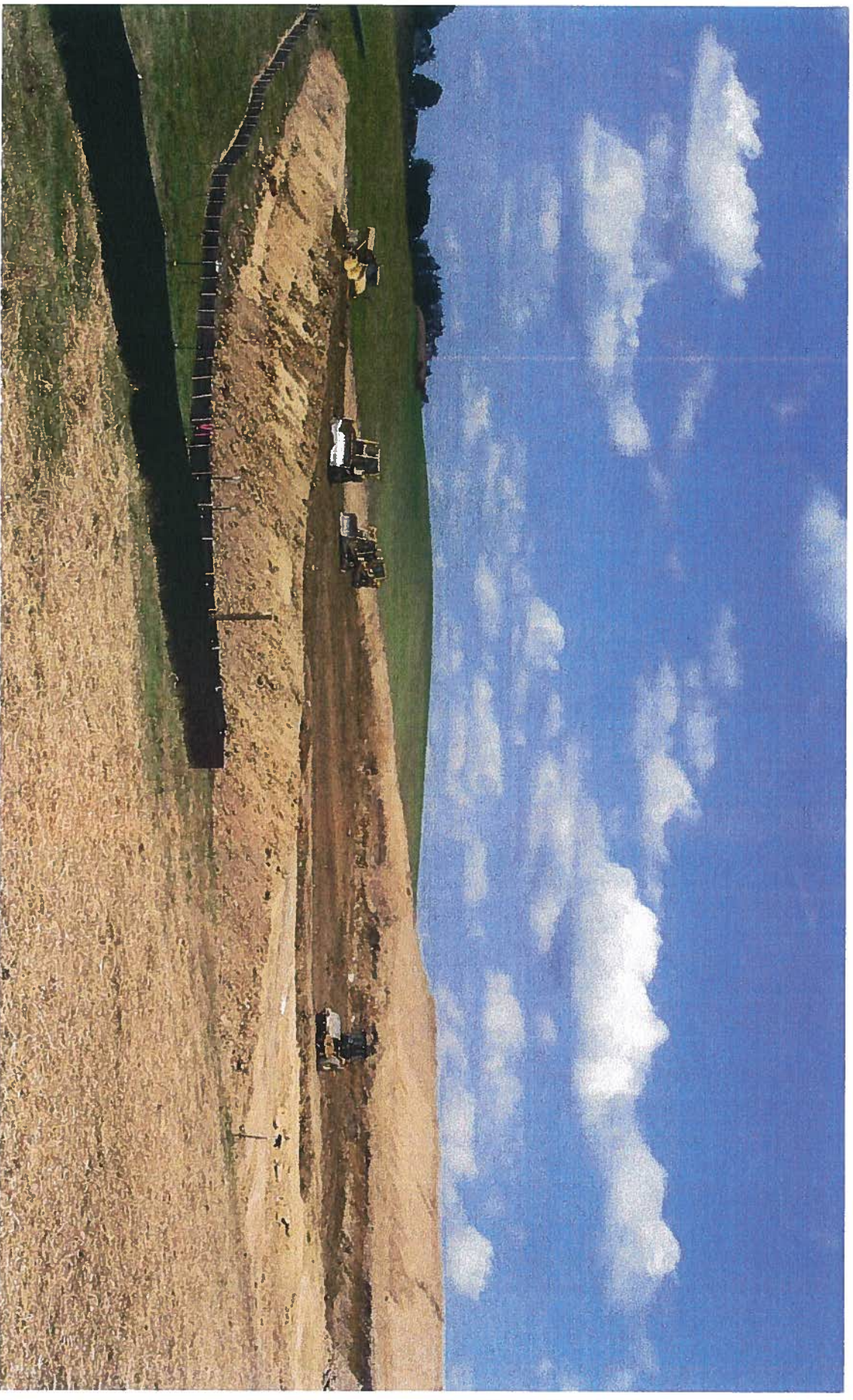
- 3-D seismic measurements
- Surface, sub-surface maps
- State-of-the-art Technology

Leases are Acquired



- Oil & gas owners (frequently the surface owner) are offered compensation for leasing rights to their property
- In addition to initial lease payment, oil & gas owners also receive royalties on natural gas sold from the wells in their unit

Site Preparation



Drilling

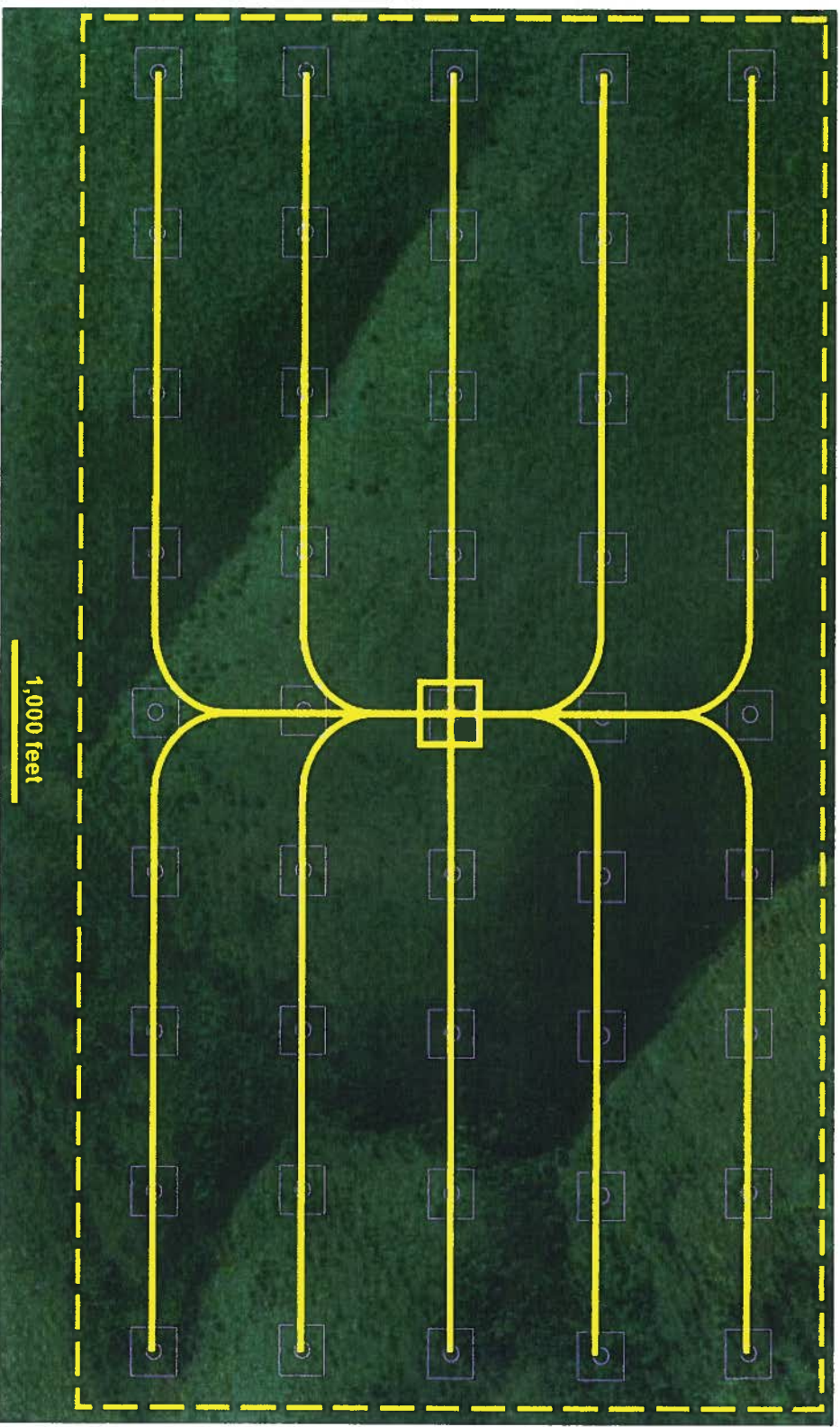


- State-of-the-art technology
- Multiple wells, single site
- Footprint is 4-6 acres
- Each well takes 3-4 weeks to drill on average

Utilize two rigs: Vertical and Horizontal



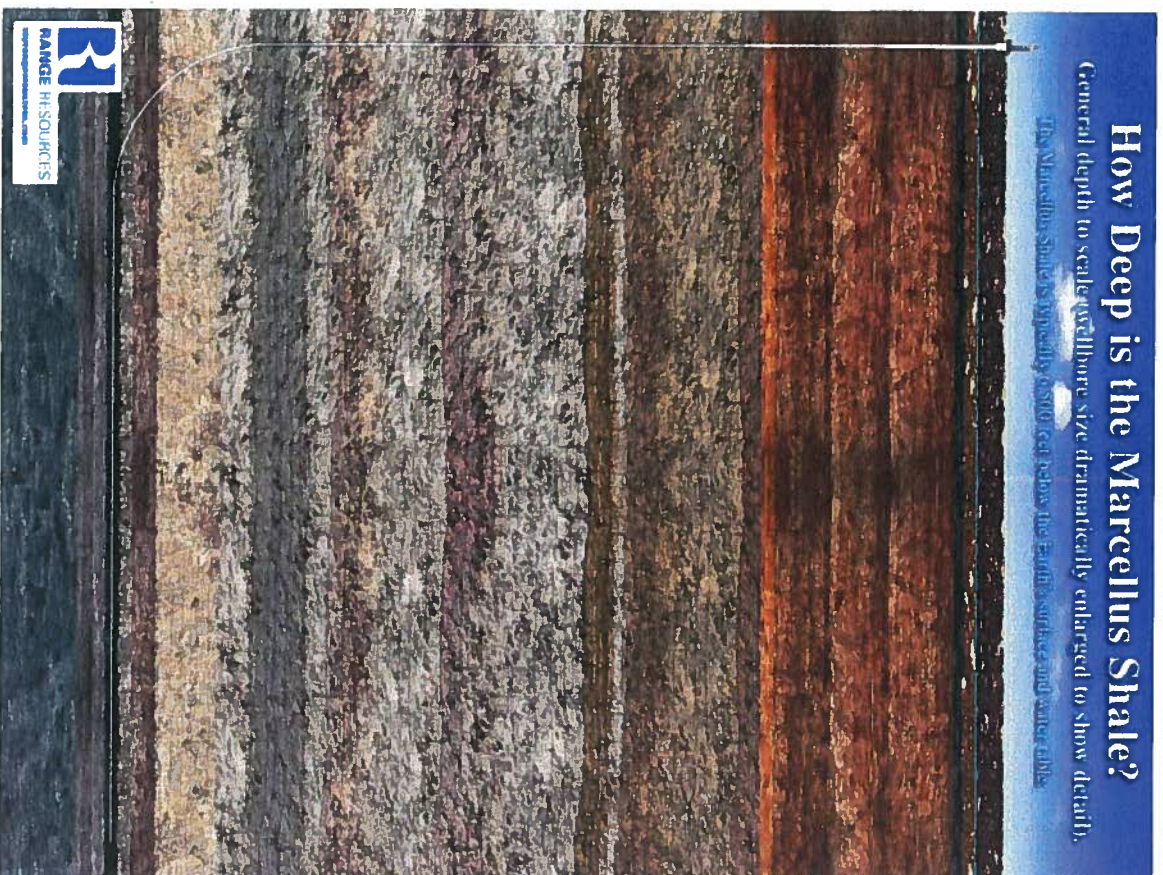
Horizontal Drilling



Total surface disturbance during drilling, including access road, drilling pad and required pipeline infrastructure:

- Horizontal (yellow) develop 640 acres per pad with less than 1% surface disturbance

Horizontal Technology



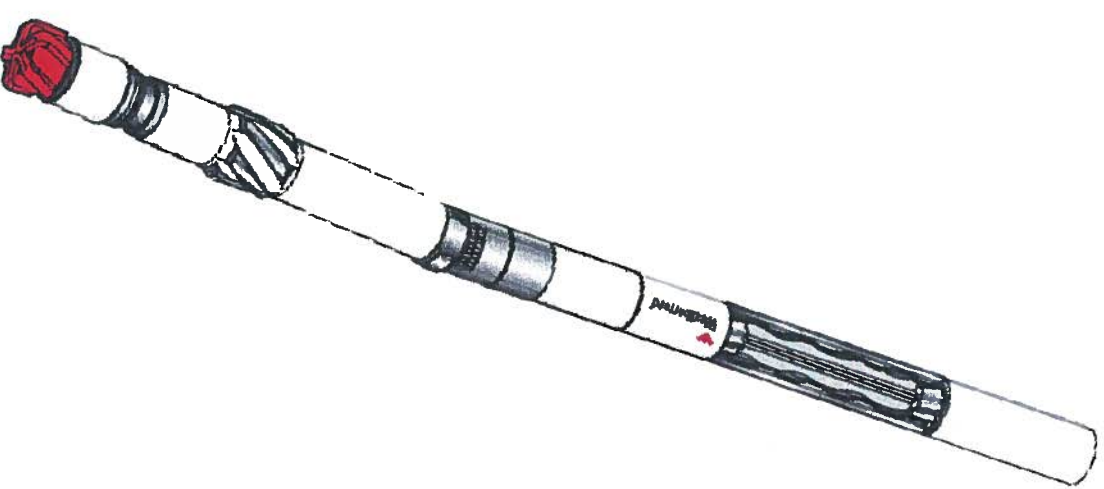
- Drill 5,000-8,000' vertical up to 3,000' horizontal
- Roughly 2 miles of drilling, spot-on accuracy
- Reduce surface disturbance, with less environmental impact

Building the Curve

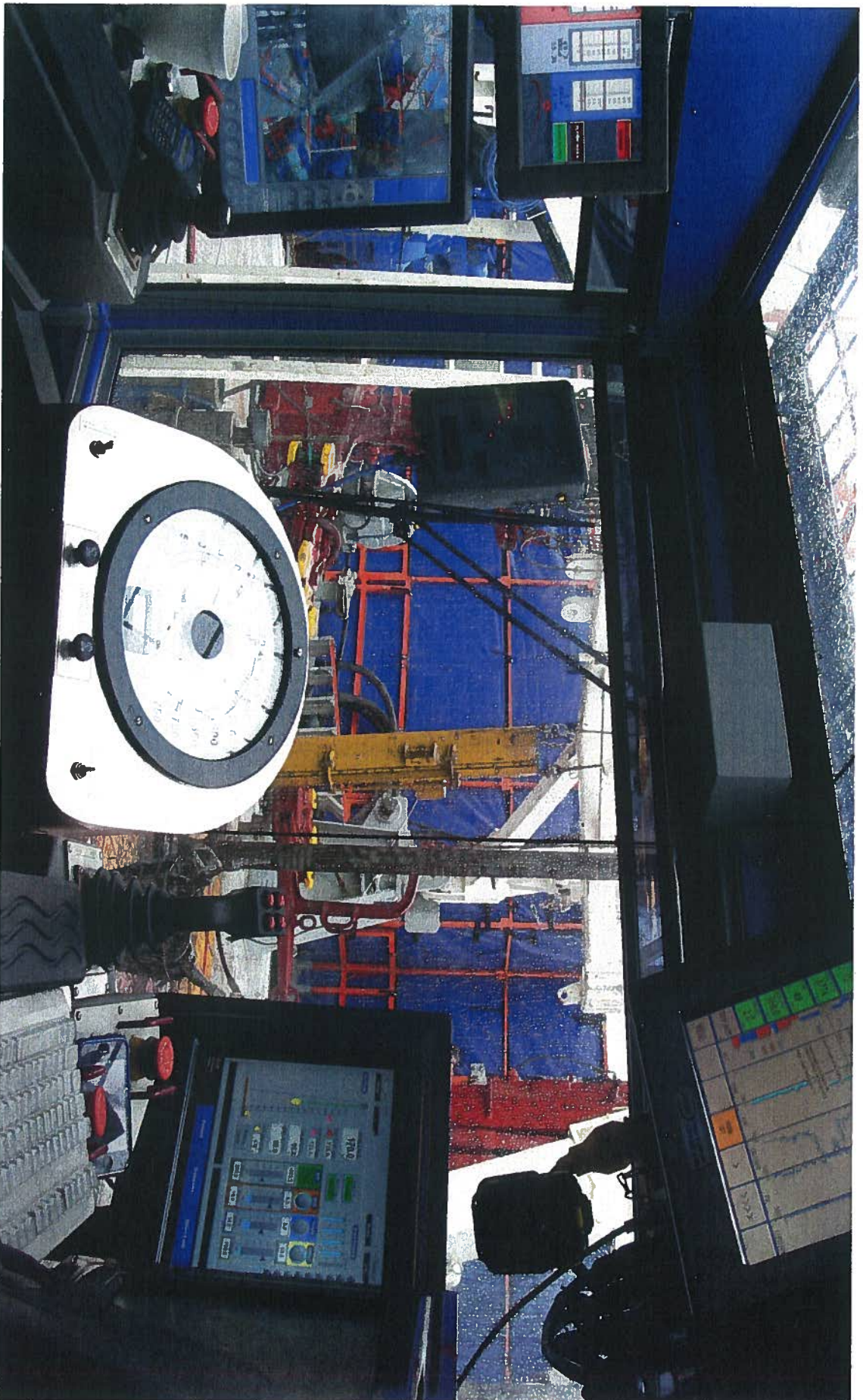
How Do You “Drill Horizontal”

Small bend in drilling motor assembly, roughly 1-2°, drills the curve over the course of 900', at a rate of 10° per 100' to achieve a 90° turn horizontally.

It's not abrupt, rather a gradual sweeping motion.



Doghhouse



Drilling Pad



Well Casing

General Casing Design for a Marcellus Shale Well

More than three million pounds of steel and concrete isolate the wellbore.
The Marcellus Shale is typically 6,500 feet below the Earth's surface and water table.



- A well is comprised of 5 strings of casing that gradually get smaller, like a telescope.
- Each string is fully cemented to the surface and allowed to set for at least 8 hours.
- Over 3 million pounds of U.S. steel and cement go into each well.

Completions



Hydraulic fracture stimulation or fracking is: the injection of fresh water and sand at high pressure, into the formation fracturing the rock and safely releasing the gas.

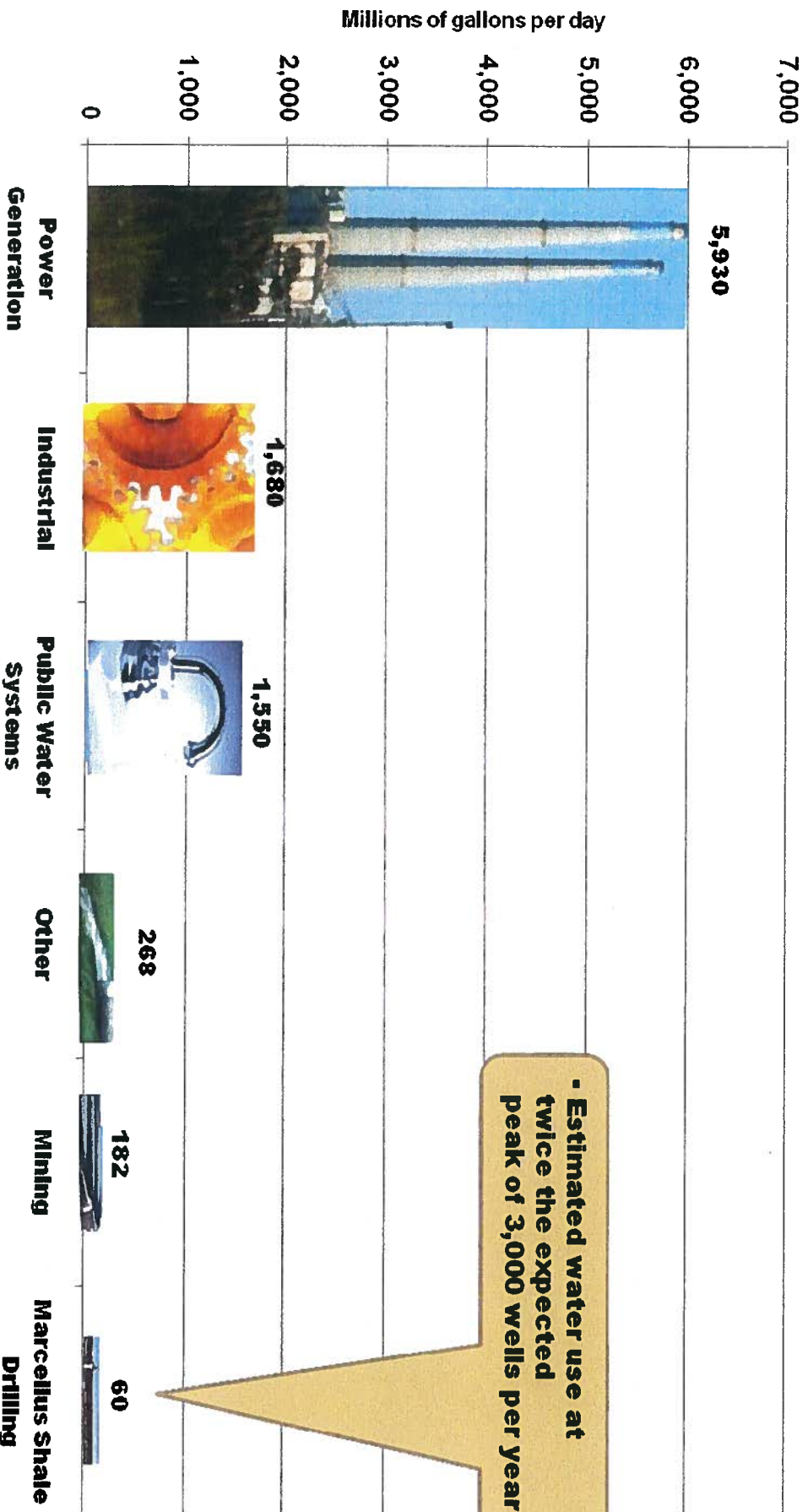
Each well is completed in stages starting at the toe of the wellbore and working out towards the heel.

A typical Marcellus frac job requires 3-4 million gallons of water per well.

Completions



Water Usage Comparison



Source: USGS, Pennsylvania Water Consumption

Water Use per Billion BTU of Energy

Energy Resource	Range of Water Used per MMBTU of Energy Produced (Gallons)	Fuel Source	Water Generated From Burning (Gal/Mbtu)
Deep Shale Gas	0.60 – 2.0	Methane	*10.8
Conventional Oil	8-20	Gasoline	7.4
Coal	13-32	Coal	2.5

*Based on 30% water recovery

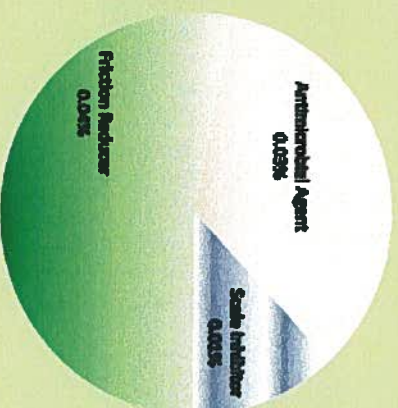
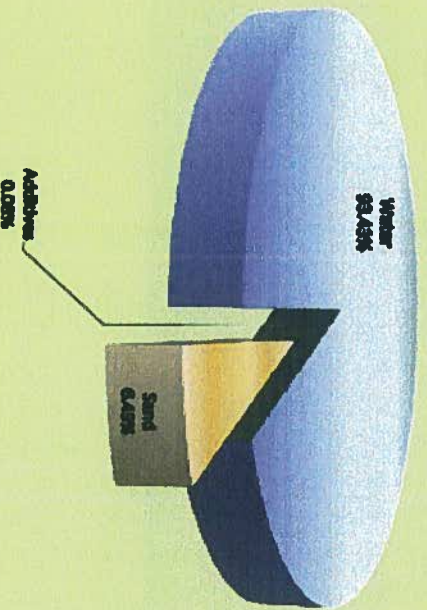
Hydraulic Fracturing Fluid

Yute Unit #4H
Well API: 37-003-21982

Completion Date: 11/29/10 - 12/7/10
Township: Frazier

% Composition of Hydraulic Fracture Fluid (by volume)						
Product Name	Additive	Purpose	Use and Dilution	Volume	Overall %	Common Uses
Water	Carrier Fluid	Creates fracture network in shale and carry proppant to the formation	Primary constituent	3,115,601 gal	93.427%	Water is the most abundant molecule on the Earth's surface
Sand	Sand	Allows fractures to remain open so gas can escape	Second most common constituent, making up almost 6% of the fluid	216,599 gal	6.495%	Drinking water filtration, play sand
FRW-200	Friction Reducer	Reduces friction between fluid and pipe	Diluted at one-half gallon per 1,000 gallons of water	1,377 gal	0.041%	Water treatment; soil conditioner; some children's toys
MC-B-895D/Bioban	Antimicrobial Agent	Eliminates bacteria in the water that produce corrosive byproducts	Diluted at one-half gallon per 1,000 gallons of water	0,903 gal	0.027%	Water treatment, disinfectant, sterilize medical and dental equipment and surfaces
MX 588-2	Scale Inhibitor	Prevents scaling in pipe	Diluted at one-tenth gallon per 1,000 gallons of water	313 gal	0.009%	Water treatment, household cleaners, de-icing agent

Composition of Hydraulic Fracture Fluid (by volume)



Water Sourcing

- Super Sources
- Municipal
- Surface Water



Water Impoundment



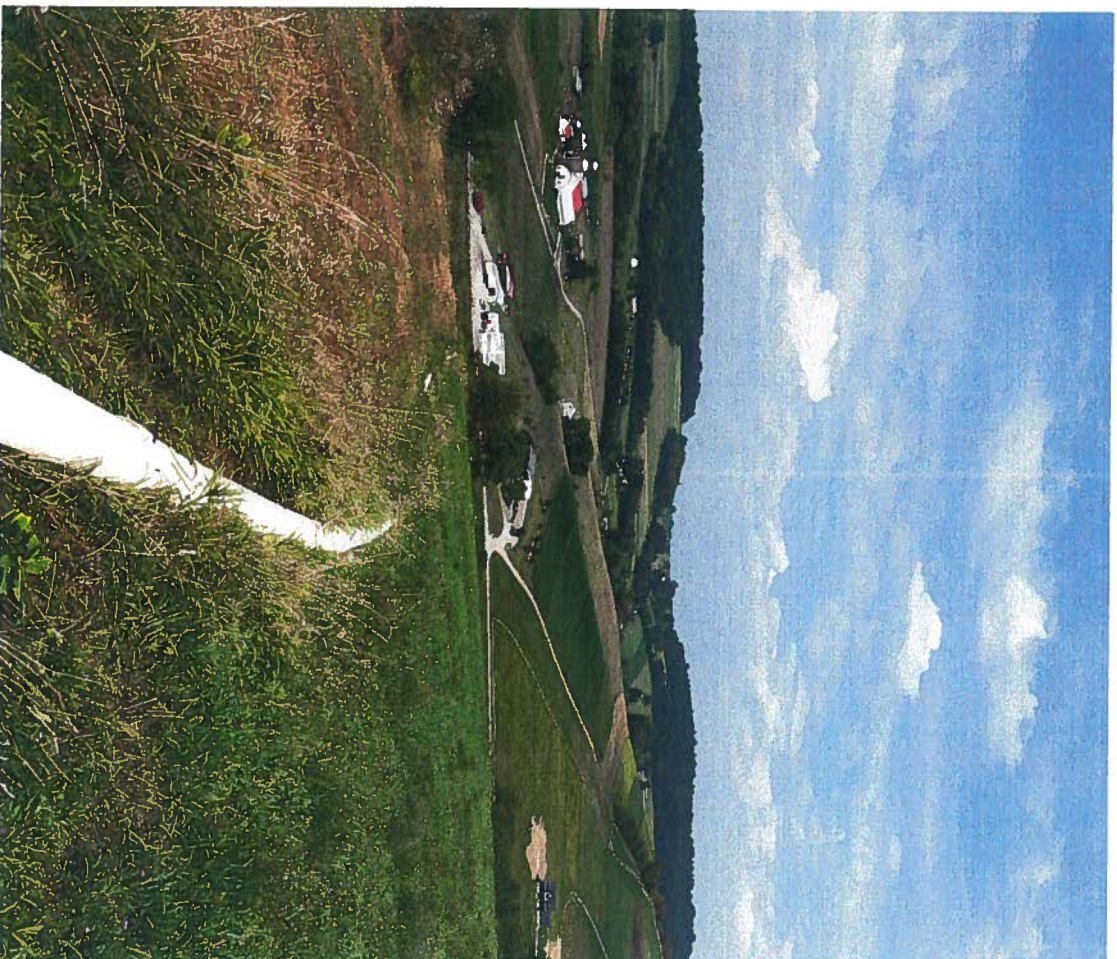
Water Impoundment



Water Transfer

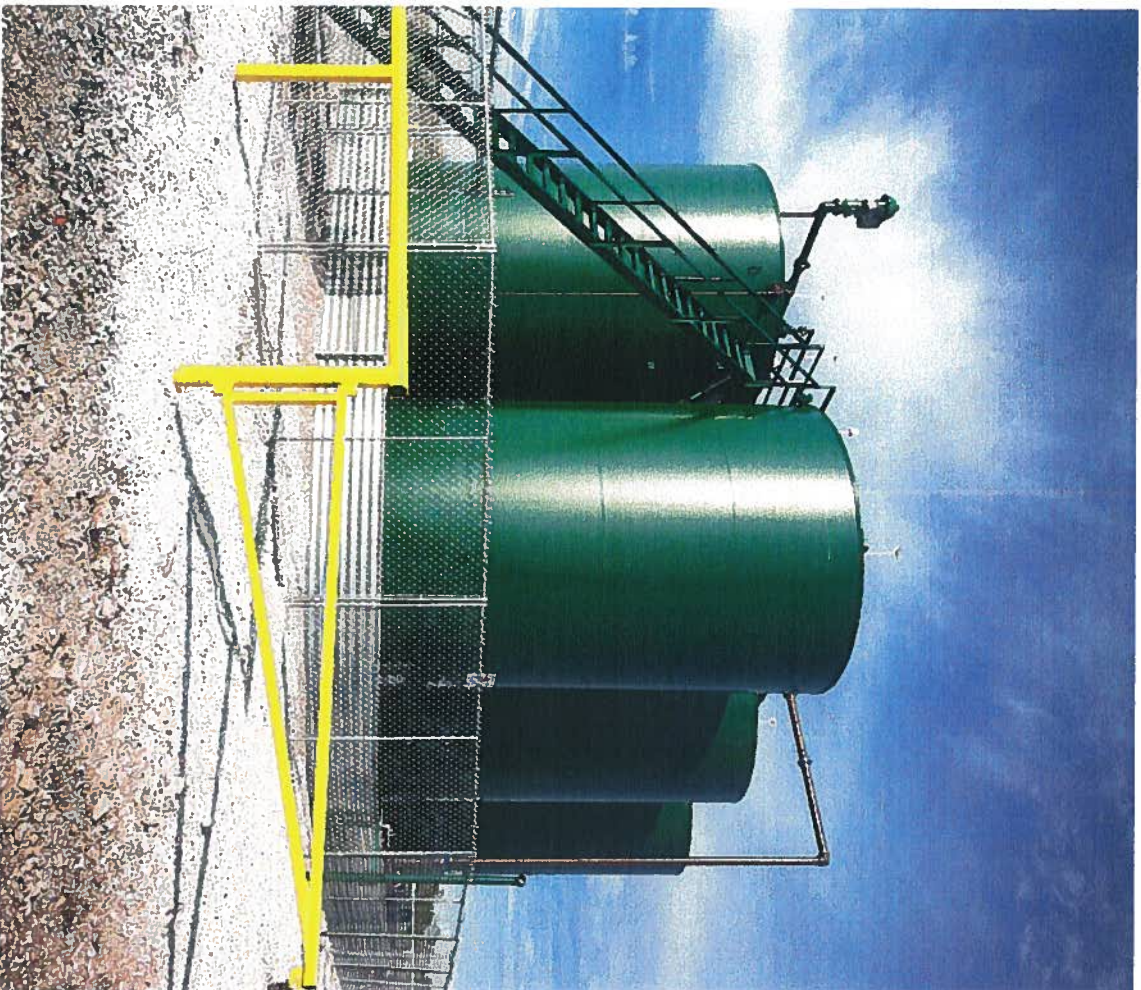


Water Transfer



- Saves thousands of truck trips
- Can pump water several miles from impoundment to location
- HD Polyethylene or PVC for pumping fresh and recycled water
- More permanent, buried lines currently being installed

Production



- Following fracing, water is flowed back and to clean out the wellbore
- Small footprint – wellhead, separators, production tanks

Production



Production



Environmental Regulations & Protections

State Review of Oil & Natural Gas

Environmental Regulations (STRONGER): state regulators, NGOs, EPA, DOE and others – “Pennsylvania regulations deserve ‘special merit’ and among best in nation.”

U.S. Secretary of Energy Advisory Board, directed by President Obama & lead by former U.S. Central Intelligence Administration director and assistant Secretary of Defense John Deutch said that *many of their national recommendations were based on Pennsylvania standards*

Pennsylvania
Hydraulic Fracturing
State Review

September, 2010



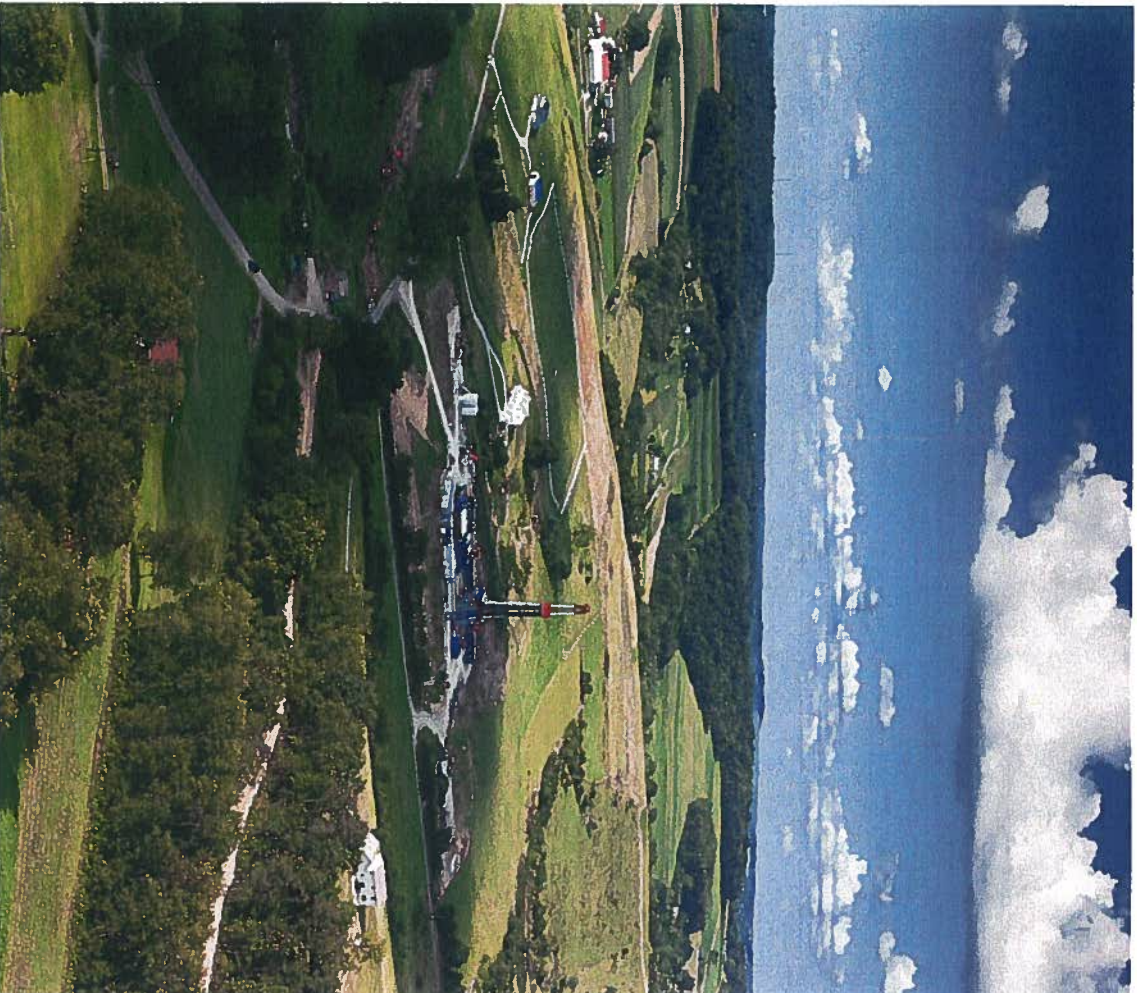
Activity



Inconveniences

- Dusty
- 24-hour operations
- Truck traffic
- Noise and lights
- Some road damages
- **Temporary**

Thank You



Additional Information:

www.myrangeresources.com

www.rangeresources.com

www.marcelluscoalition.org

