Chesapeake Energy

Shale Operations Overview

Chesapeake Energy Overview

- Founded in 1989
- Headquartered in Oklahoma City, OK
  - Office regionally located in Canton, OH, Uniontown, OH, Charleston, WV, Jane Lew, WV, Mt. Morris, PA, Canonsburg, PA
- Exclusive U.S. onshore focus
- Second-largest producer of U.S. natural gas and a Top 15 producer of U.S. liquids
  - 3Q'11 gas production of ~2.8 bcf/d
  - Liquids production of ~94 mbbls/d
- Nation's most active horizontal driller 1993-2010
  - #1 in the world in horizontal shale drilling over past 10 years; > 4,100 wells
- Exceptional drilling success rate – 99%

Chesapeake Energy Overview

- Most active driller in U.S. 1993-2011
  - 171 operated rigs currently
    - 7 rigs currently drilling in the Utica Shale area
    - ~30 rigs currently drilling in the Marcellus Shale area
- Consistent production growth
  - 21st consecutive year of sequential production growth
- Unparalleled inventory of U.S. onshore leasehold and 3-D seismic
  - 29 million acres of 3D seismic data
  - Lower risk of suboptimal return on capital
  - Higher production rates

Chesapeake Energy Overview

- ~ 15 mm net acres of U.S. onshore leasehold
  - 1.36 million acres acquired in Ohio
- Acreage position in gas shale plays:

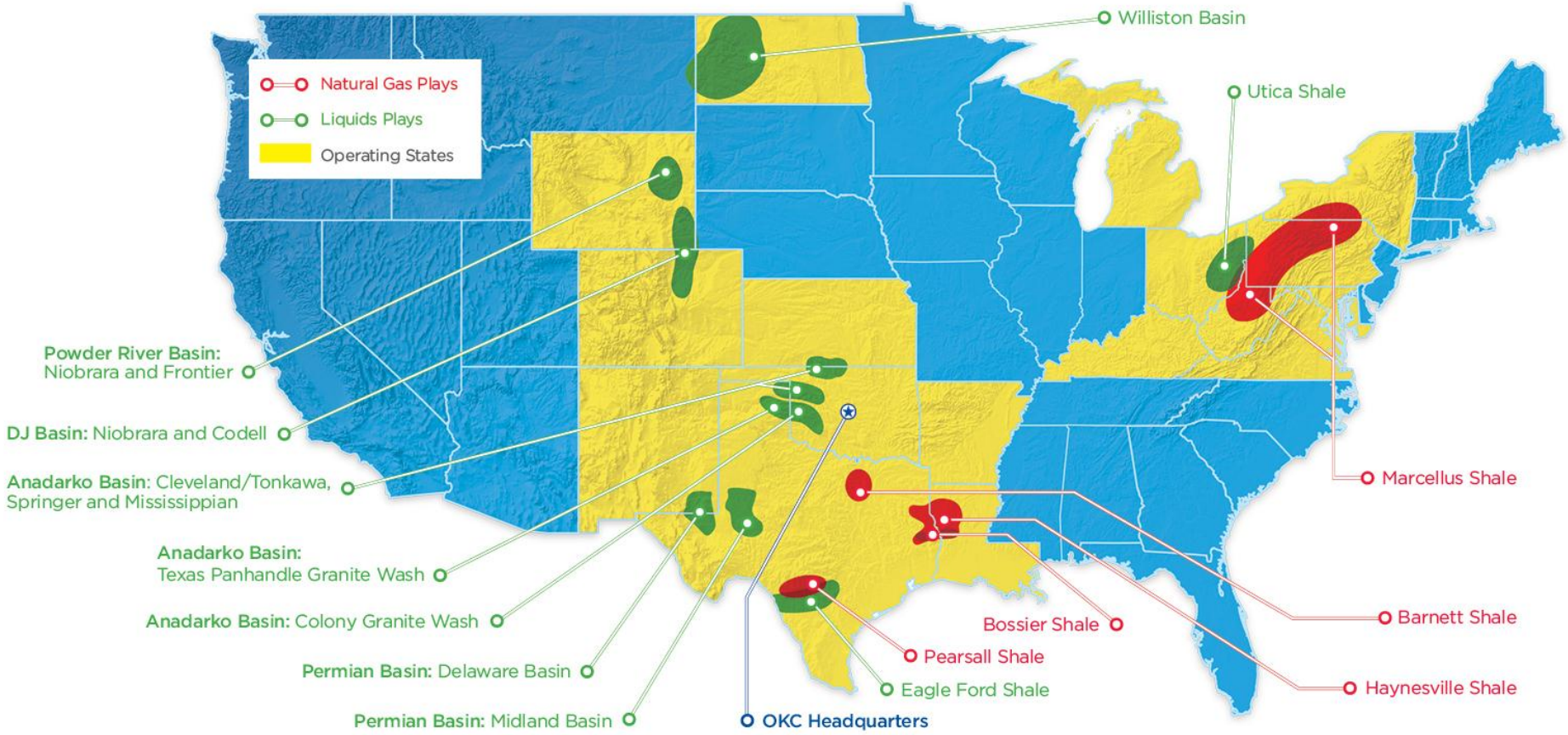
Barnett Shale	220,000
Haynesville Shale	495,000
Marcellus Shale	1,750,000

- Acreage position in unconventional oil plays

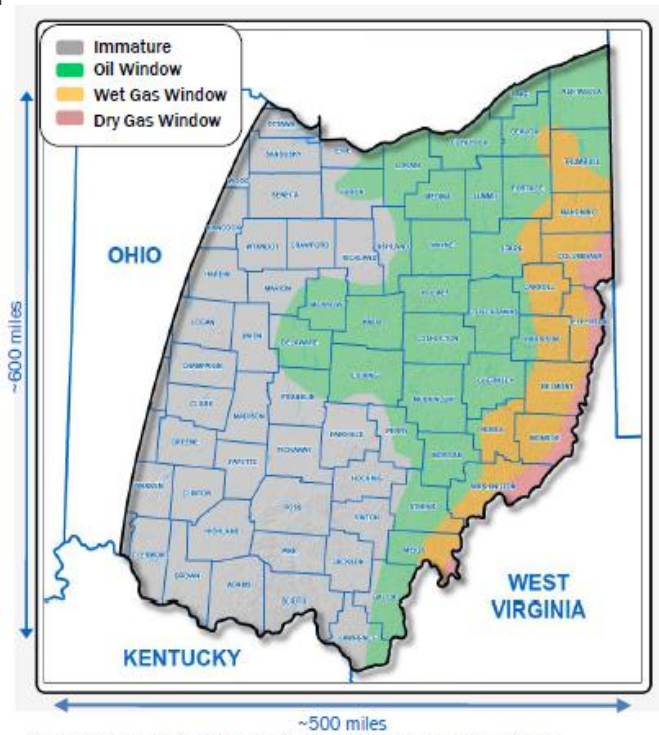
Anadarko Basin	2,035,000
Eagle Ford Shale	460,000
Permian Basin	835,000
Powder River and DJ Basin	595,000

- Advantageous joint venture arrangements and partnerships
  - StatoilHydro, Total, Plains Exploration and Production Company, CNOOC

Chesapeake's Key Operating Areas



Major Liquids Discovery- CHK's Ohio Utica Shale



Map source: Modified from Rowan, 2006, Geological Survey

» Began leasing in Ohio for Utica in mid-2010 now have:

- 1.36 mm net acres of leasehold, by far the largest position in the industry (~50% of the potentially drillable acres)
- Extensive well log and petrophysical data as well as 4,000 feet of proprietary core samples
- Spudded 19 horizontal wells to date, 8 being completed
- Strong initial drilling results from 7 horizontal wells
  - All from the dry and wet phase of the play
  - Early in the process of evaluating the oil phase

» CHK is currently operating 7 drilling rigs in the play

» Plan to increase operated rigs in the play up to 8 by YE'11, up to 20 by YE'12 and up to 30 by YE'14

» Believe the play is likely most analogous, but economically superior, to the Eagle Ford in South Texas

Utica Shale JV and Financial Investment Summary

» CHK has entered into letter of intent (LOI) with an undisclosed international major energy company

- JV partner will acquire an undivided 25% interest in ~570,000 net acres of CHK leasehold in the wet natural gas area of the Utica Shale play for consideration of $15,000 per net acre or ~$2.14 billion
- ~$640 million of the consideration will be paid in cash at closing (anticipated by mid-December 2011) and ~$1.5 billion will be paid in the form of a drilling and completion cost carry, which CHK anticipates fully receiving by YE 2014

» Completed sale to EIG Global Energy Partners ("EIG") of $500 million of perpetual preferred shares of a newly formed entity, CHK Utica, L.L.C.

- CHK expects to sell up to $750 million of additional CHK Utica, ("CHKU") preferred shares to other investors, including limited partners of EIG, by 11/30/11
- Chesapeake has retained all the common interests in CHKU and therefore the upside

Approximate potential net proceeds from transactions: $3.4 billion

Characteristics of Shale Formations

- Found in organic-rich sedimentary rocks (shales) that were originally deposited as muds within tidal flats and deep water basins
  - Shale formations can be found 1 mile or more underground
- Dense rock with low permeability
- Typically requires a combination of horizontal drilling and hydraulic fracturing for the natural resources to be recovered in economic quantities

The Production Process

» Five Basic Steps

- Site selection and well pad preparation
- Drilling the well
- Completing the well
- Marketing the resources
- Reclaiming the site

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Site Selection

» A number of factors are considered in selecting a drilling site:

- Favorable geology
- Topography
- Access Roads
- Routes for pipelines and utilities
- Proximity to schools or residential areas
- Environmental factors such as wetlands and sensitive wildlife habitat
- Available water source(s)

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Well Pad Preparation

- Well pads can be located in rural or urban areas
  - Pad preparation requires approximately 4-6 weeks
  - Typical horizontal well pad requires 3-5 acres to construct
  - Appropriate erosion and sediment controls are installed

Well Pad Preparation
Best Management Practices

» Erosion and sediment controls follow New York State Department of Environmental Conservation's *New York State Standards and Specification for Erosion and Sediment Control*, August 2005 and IPAA/API's Reasonable and Prudent Practices for stabilization (RAPPS) of Oil and Natural Gas Construction Sites

» All sites outfitted with

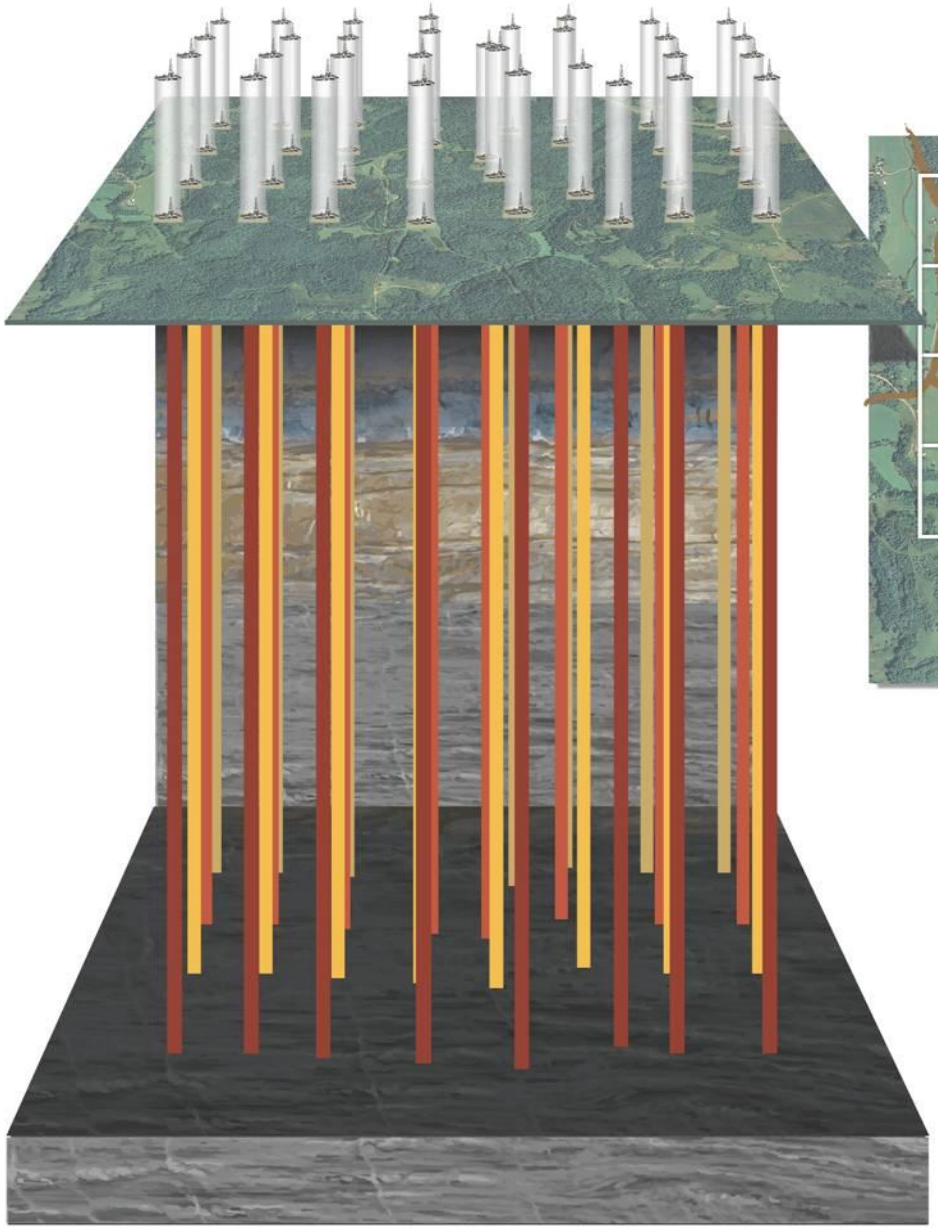
- 18"x24" berm
- 18"x18" trenching
- 0.5 to 1.0% grade toward sump

Pre-drill Testing

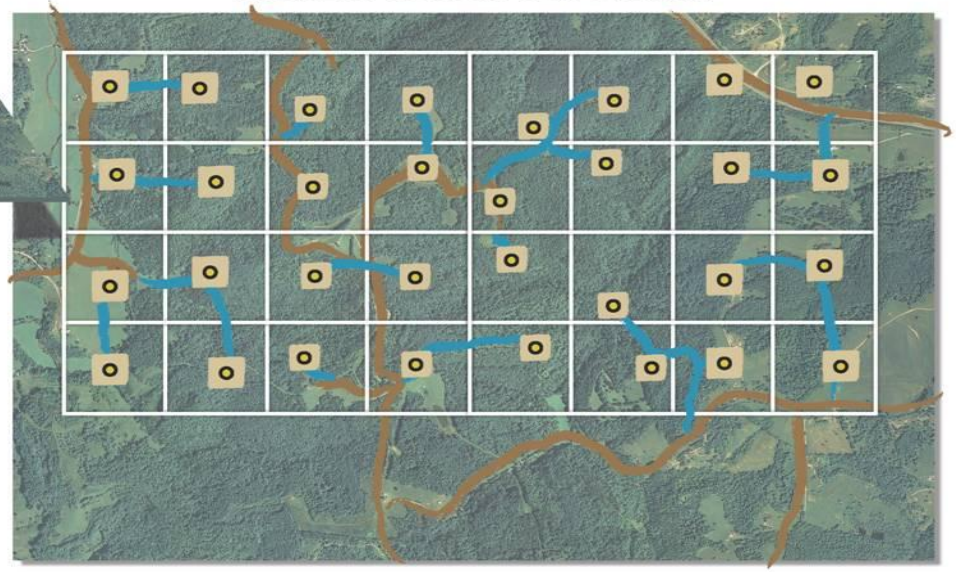
- Chesapeake Energy conducts pre-drill testing on water sources prior to conducting drilling operations in an area
  - Testing is done on water sources within 3,000 feet from the vertical portion of the well
    - Includes springs, wells, streams and ponds
  - The testing establishes a baseline of water quality conditions for both Chesapeake and the property owner
  - The testing is free for the property owner

- A representative from Chesapeake will collect a water sample
  - It is preferred that the property owner be present during the collection
  - Analysis is conducted by a state-certified analytical laboratory
  - The property owner receives a copy of the laboratory's analysis

Area shown is 1,280 acres



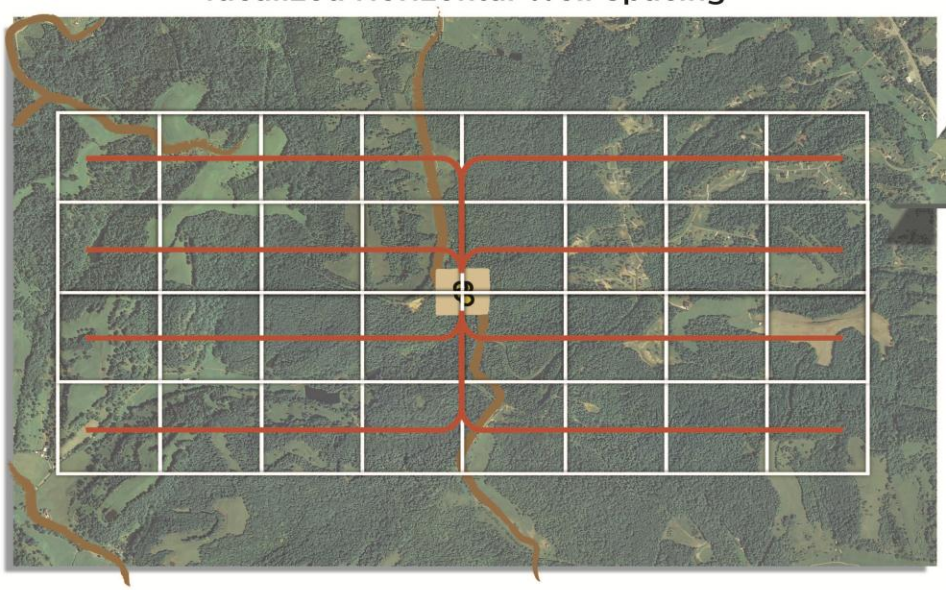
Idealized Vertical Well Spacing



Well spacing can vary due to a number of factors including state regulatory requirements, location and formation characteristics.

Area shown is 1,280 acres

Idealized Horizontal Well Spacing



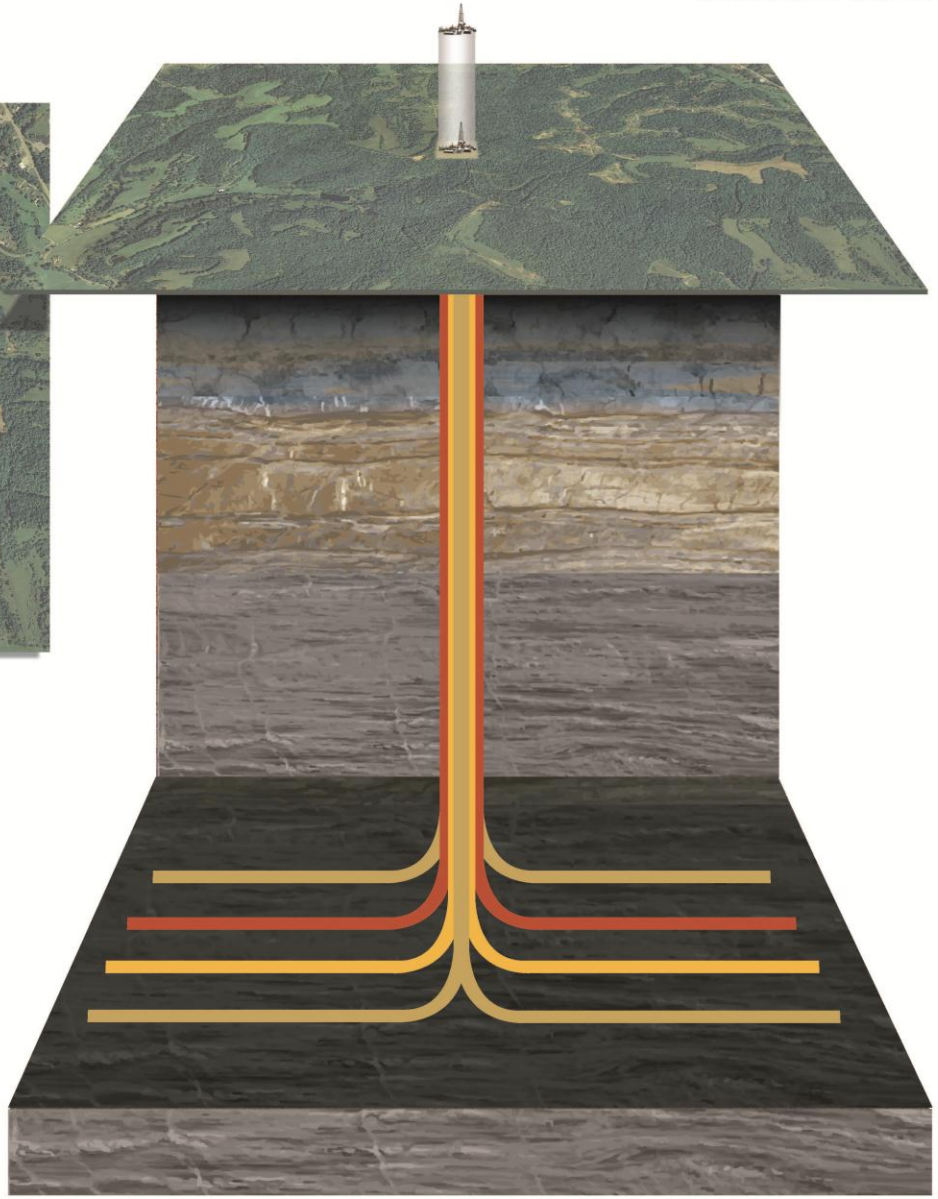
Existing Road

40 Acre Grid

Padsite

Gas Wells

Wellbore



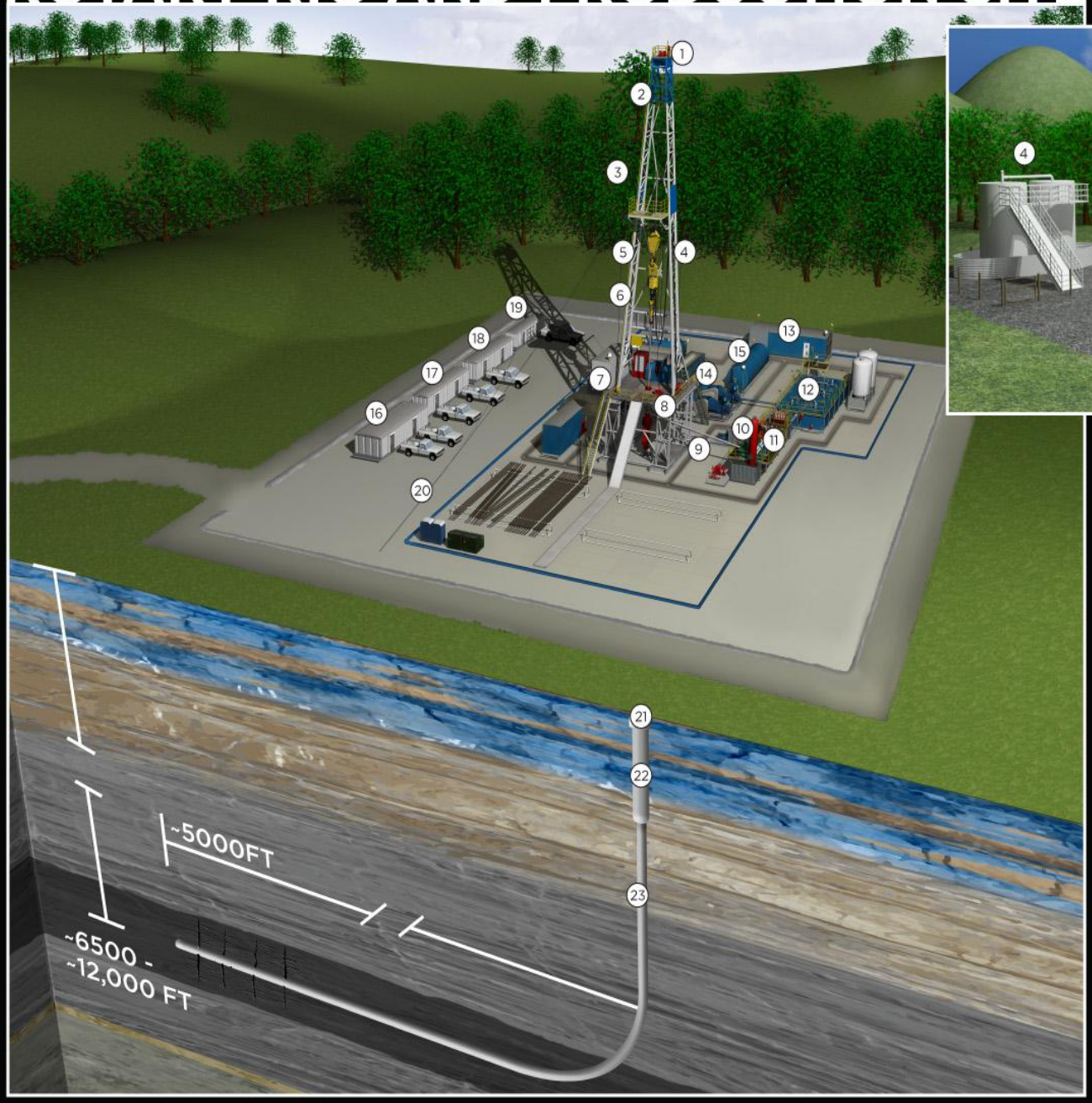
Well spacing can vary due to a number of factors including state regulatory requirements, location and formation characteristics.

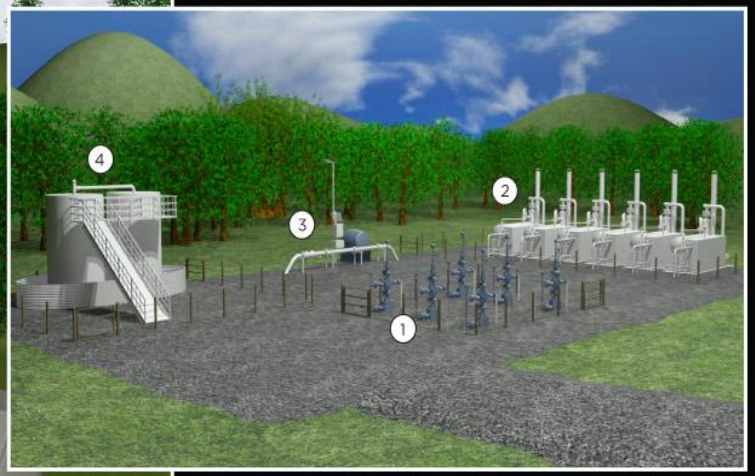
Drilling the Well Using Today's New Technology

- Wells are drilled and constructed to recover the natural resources while protecting the environment and providing for the safety of workers and area residents
- Drilling is a 24/7 operation
  - Reduces rig time on location
- The drilling phase is a temporary operation, typically lasting 3-4 weeks per wellbore
  - Multiple wells may be drilled in succession
- Chesapeake Energy utilizes a "closed-loop" drilling system
  - All drilling materials are contained
  - No materials collected in earthen pits

Drilling the Well Using Today's New Technology

ROTARY RIG AND PRODUCTION SITE





Rotary Rig Legend

1 Crown Block Assembly
2 Crown Platform/Watertable
3 Derrick Board/Monkey Board
4 Mast
5 Traveling Block
6 Top Drive/Power Swivel
7 Mouse Hole
8 Hydraulic/Air Hoists
9 Mud Return Line
10 Mud-Gas Separator
11 Shale Shakers
12 Mud Pits
13 Mud House
14 Mud Pumps
15 Diesel Tank
16 Company Man - Quarters
17 Toolpusher - Quarters
18 Direction Drillers - Quarters
19 Mud Workers - Quaters
20 Geronimo Line
21 Conductor Casing
22 Surface Casing
23 Production Casing

Production Site Legend

1 Production wellhead
2 Gas Processing units, with line heater
3 Departing Pipeline with chemical treatment tank
4 Brine water Production tanks, in secondary containment

Typically housed on a 300' x 400' padsite, rotary rigs are common to the oil and natural gas industry and can be used to drill multiple wells from a single site. Standing up to 186 feet high, these rigs can drill to a variety of depths and are manned 24 hours a day by rotating five-man crews. Crews live off-site, but report to the rig manager or toolpusher who lives on-site. Chesapeake employs an on-site drilling supervisor, often referred to as a company man, to oversee the complete operation.

Drilling Best Management Practices

- Pre-job meetings
  - Review safety, operational and environmental concerns
- Equipment staging
  - Staged to allow for visual inspection of potential leak points
  - Staged to take advantage of site construction measures
- Closed-loop drilling system
  - Solids/cuttings will be separated from the drilling fluid and maintained in steel tanks
  - Tanks hauled off and disposed of consistent with OEPA regulations
  - Fluids diverted back to mud tanks for reuse
- Use of air drilling through freshwater aquifers

Drilling Best Management Practices

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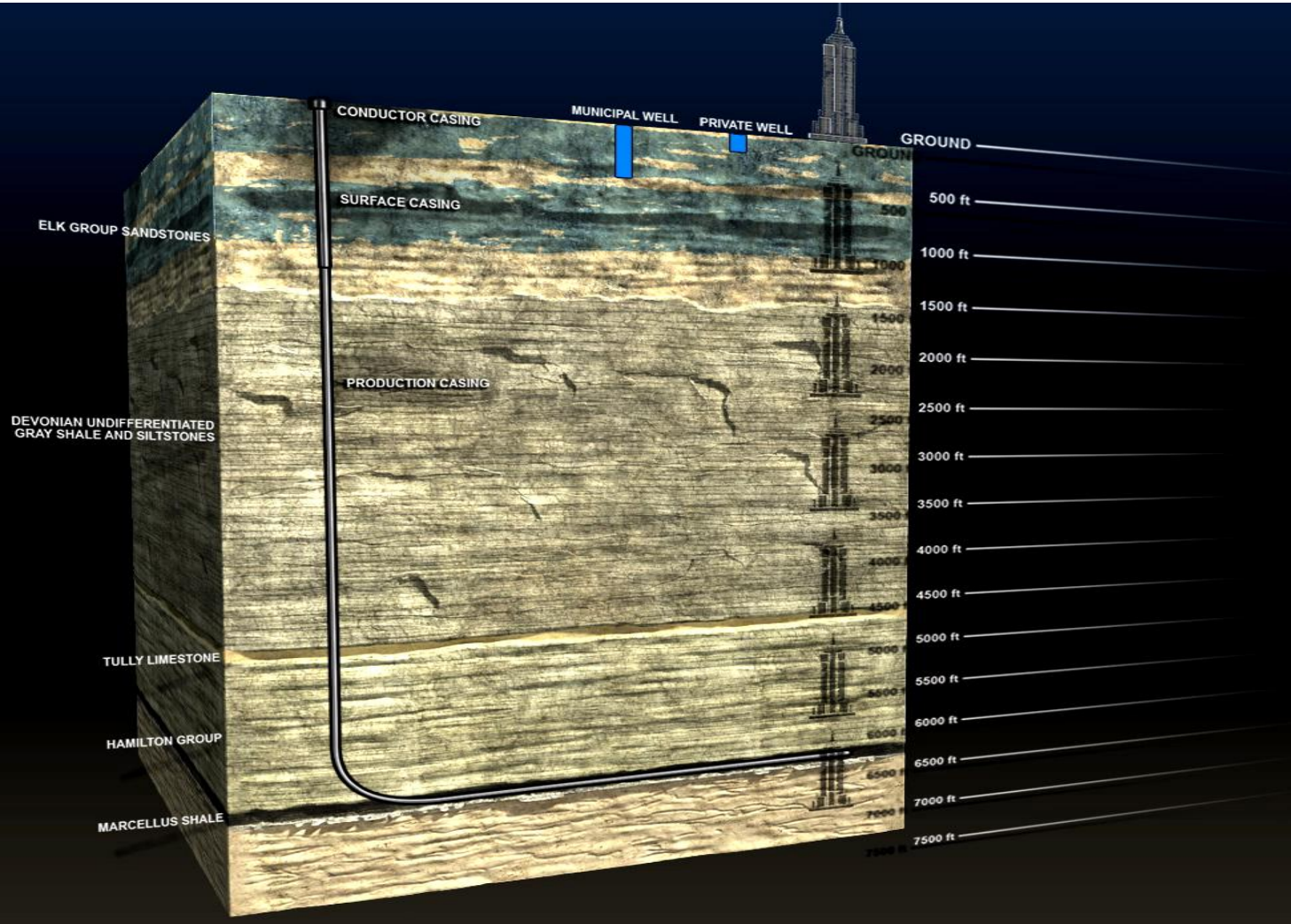
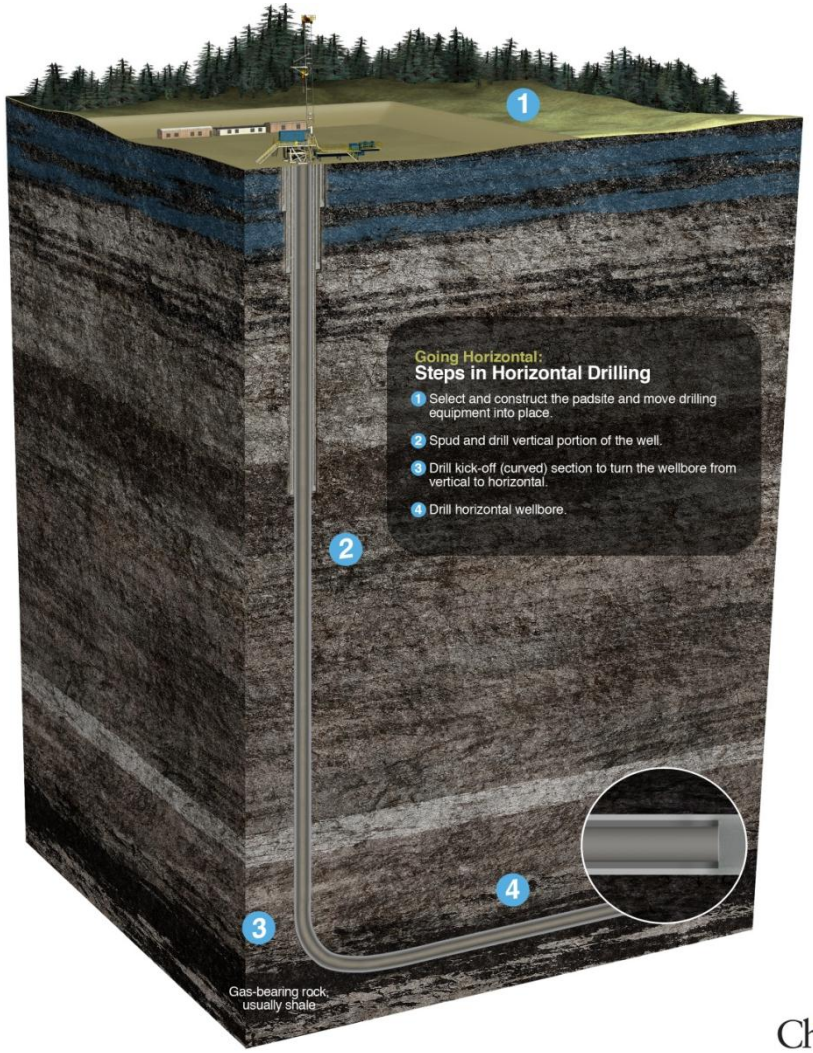
- Chemical containers, tanks and process vessels
  - Containers greater than 55-gallons placed inside lined secondary containment
    - Secondary containment may include temporary earthen berms with polyethylene underlining the entire contained area
    - Or, a portable containment area constructed of steel, PVC or other suitable material

- Hoses and fittings
  - Where practical, hoses will be run within secondary containment
  - Drip-pots or troughs placed under all hose connections in concentrated chemical transfer service outside of secondary containments

How Deep?


CONDUCTOR CASING
MUNICIPAL WELL
PRIVATE WELL
GROUND
SURFACE CASING
ELK GROUP SANDSTONES
PRODUCTION CASING
DEVONIAN UNDIFFERENTIATED GRAY SHALE AND SILTSTONES
TULLY LIMESTONE
HAMILTON GROUP
MARCELLUS SHALE
500 ft
1000 ft
1500 ft
2000 ft
2500 ft
3000 ft
3500 ft
4000 ft
4500 ft
5000 ft
5500 ft
6000 ft
6500 ft
7000 ft
7500 ft

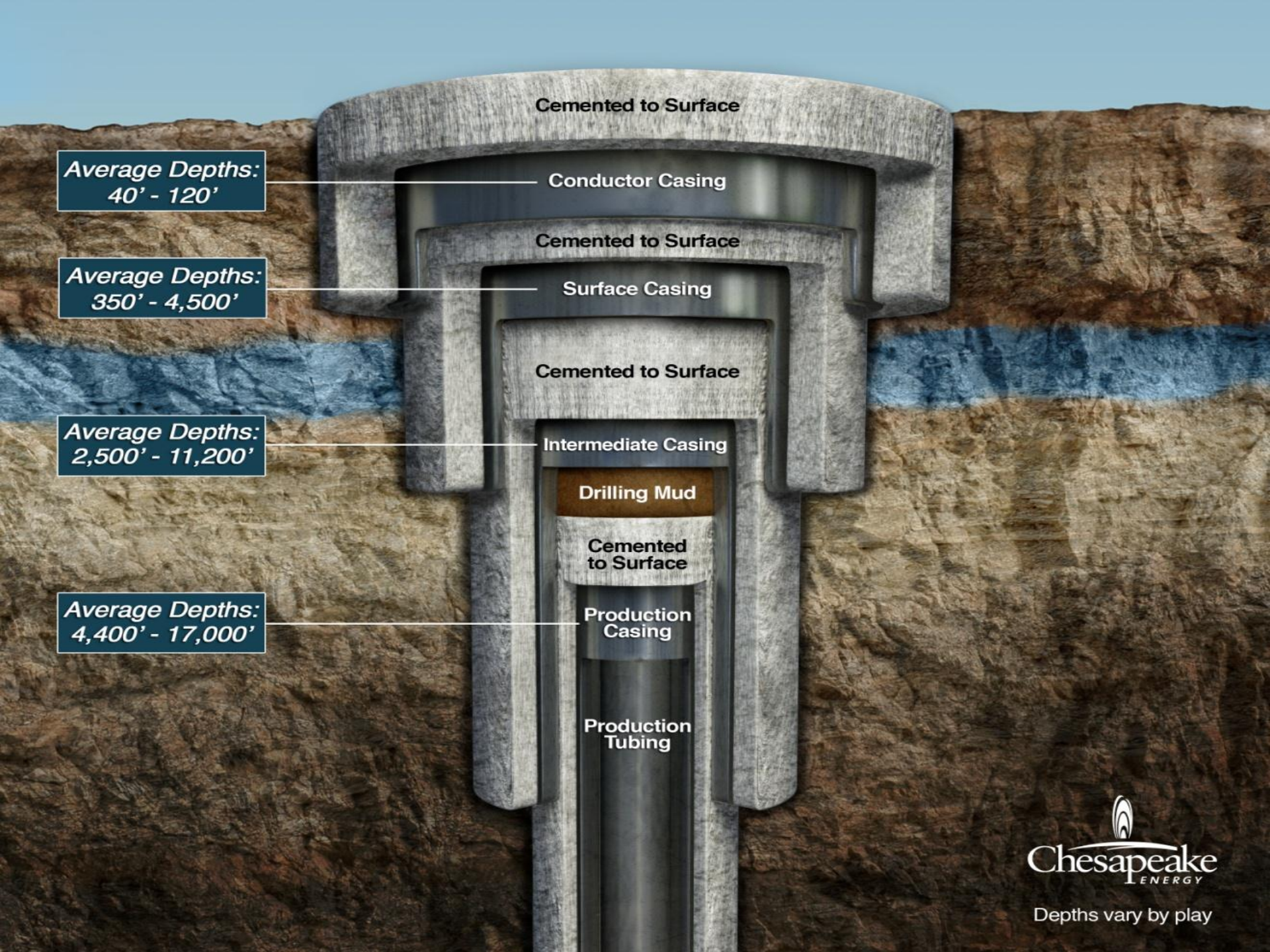
Drilling the Well- Groundwater Protection



» 4 or more layers of protection are installed in the well to isolate the well from the surrounding strata and protect groundwater supplies and the environment

- Multiple layers of steel casing and cement are utilized
- Casing set in place below freshwater aquifer zone
- FIT test performed and cement logs recorded to ensure proper seal

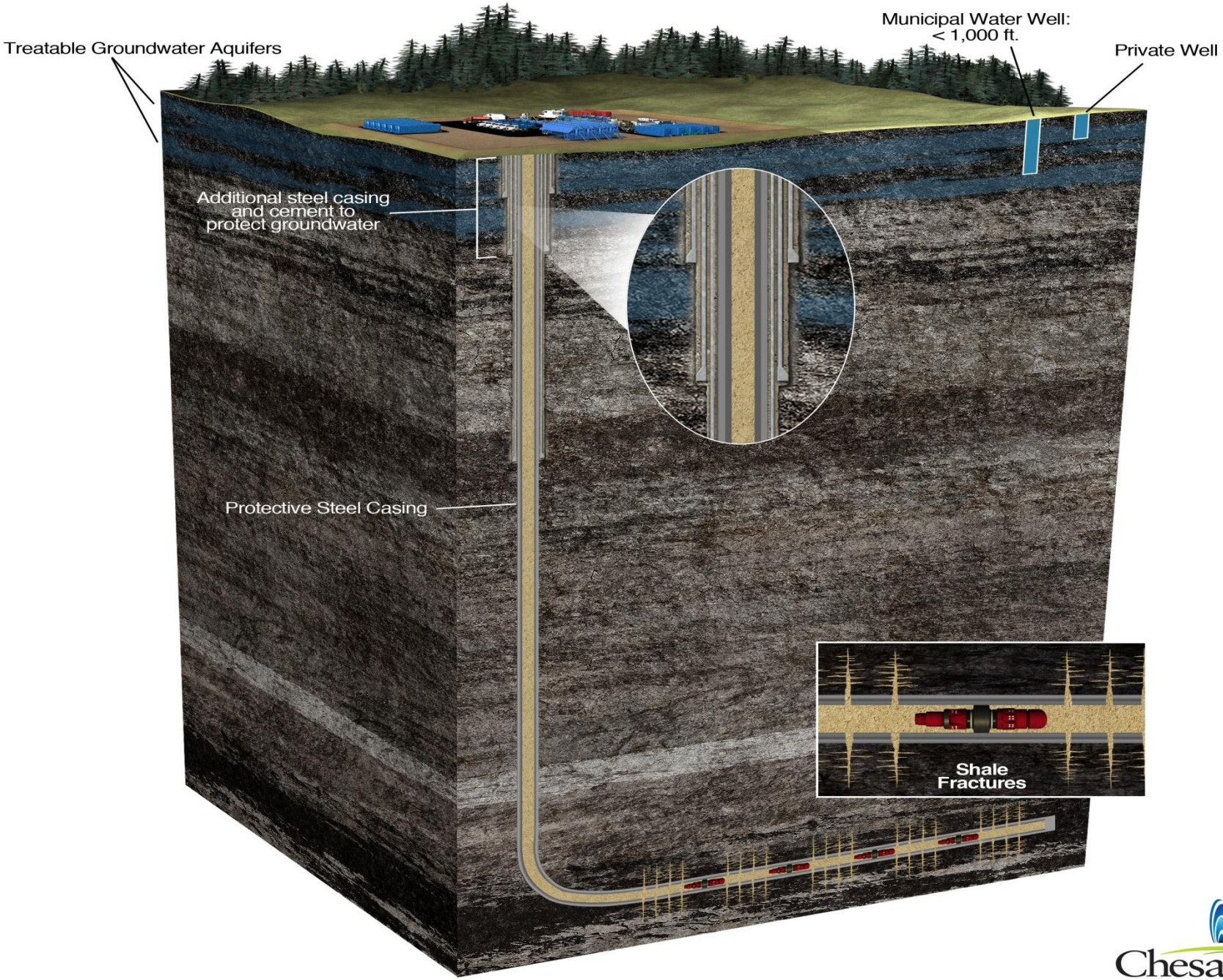
» ODNR must be notified prior to the installation and cementing of all casing strings


Cemented to Surface
Average Depths:
40' - 120'
Conductor Casing
Cemented to Surface
Average Depths:
350' - 4,500'
Surface Casing
Cemented to Surface
Average Depths:
2,500' - 11,200'
Intermediate Casing
Drilling Mud
Cemented
to Surface
Average Depths:
4,400' - 17,000'
Production
Casing
Production
Tubing
Chesapeake
ENERGY
Depths vary by play

Well Completion-Hydraulic Fracturing

- After the drilling rig is removed, hydraulic fracturing ("fracing") begins
  - Not new technology; has been in use since after World War II
  - ODNR estimates over 80,000 wells have been hydraulically fractured in Ohio
- Water is mixed with proppant (such as sand) and pumped into the shale reservoir under pressure
  - 99.5% of fracturing fluid is made up of water and sand
- Generally takes several days per wellbore

For more information on hydraulic fracturing, please visit AskChesapeake.com



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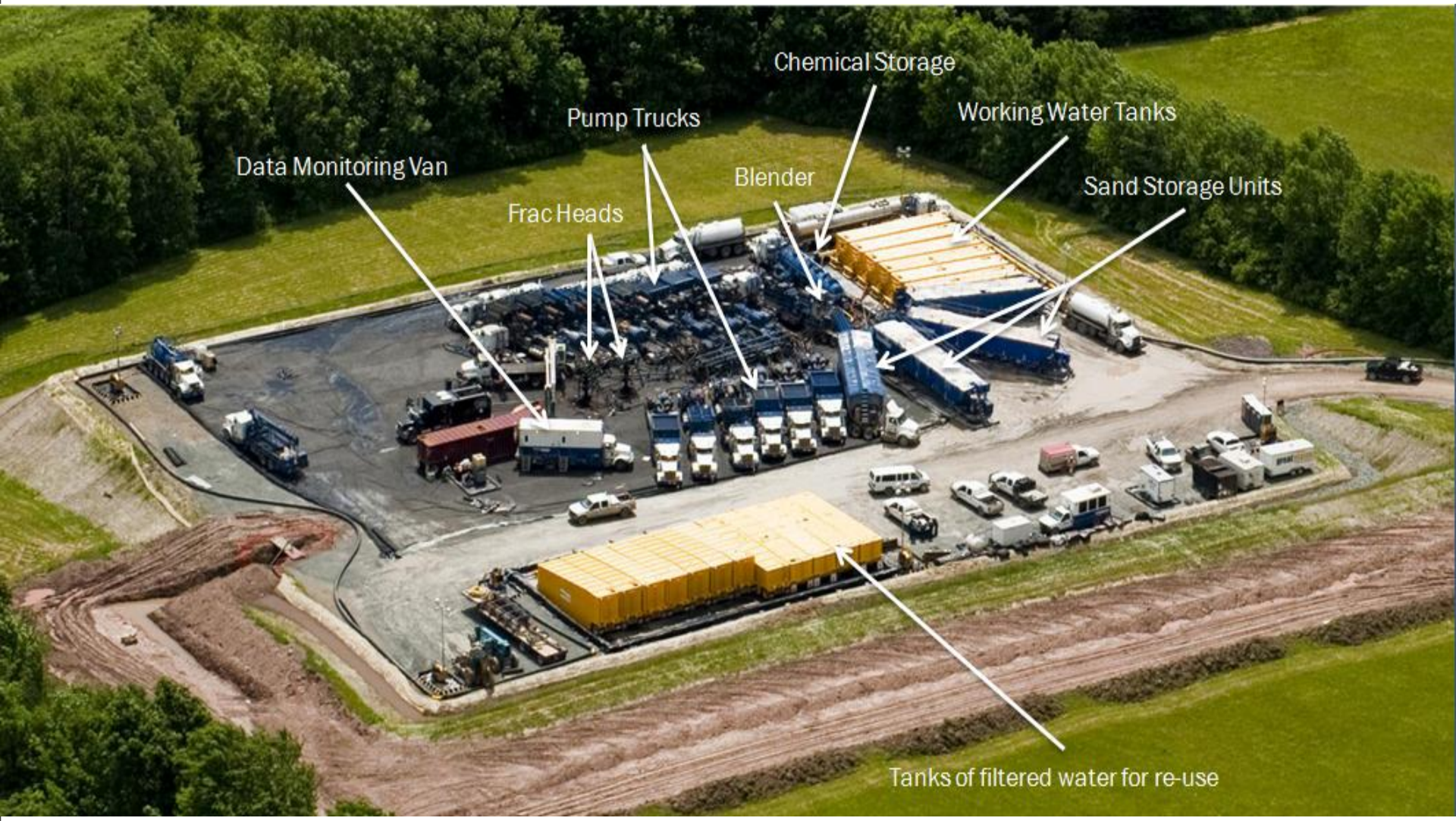
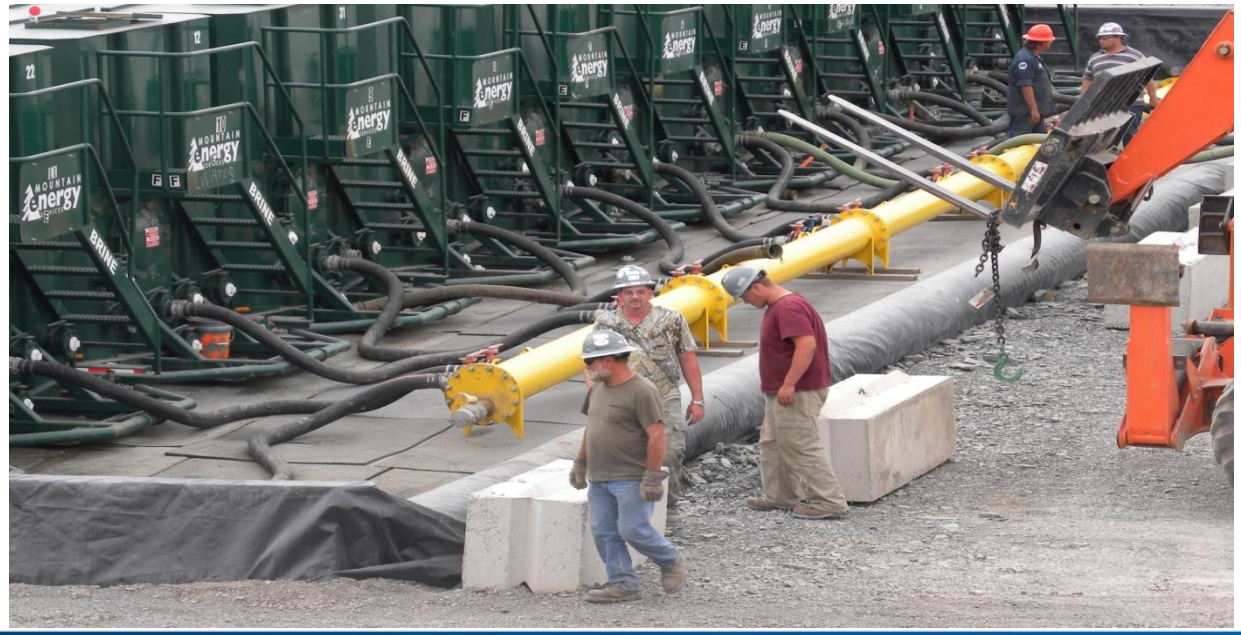
Hydraulic Fracturing Site Layout

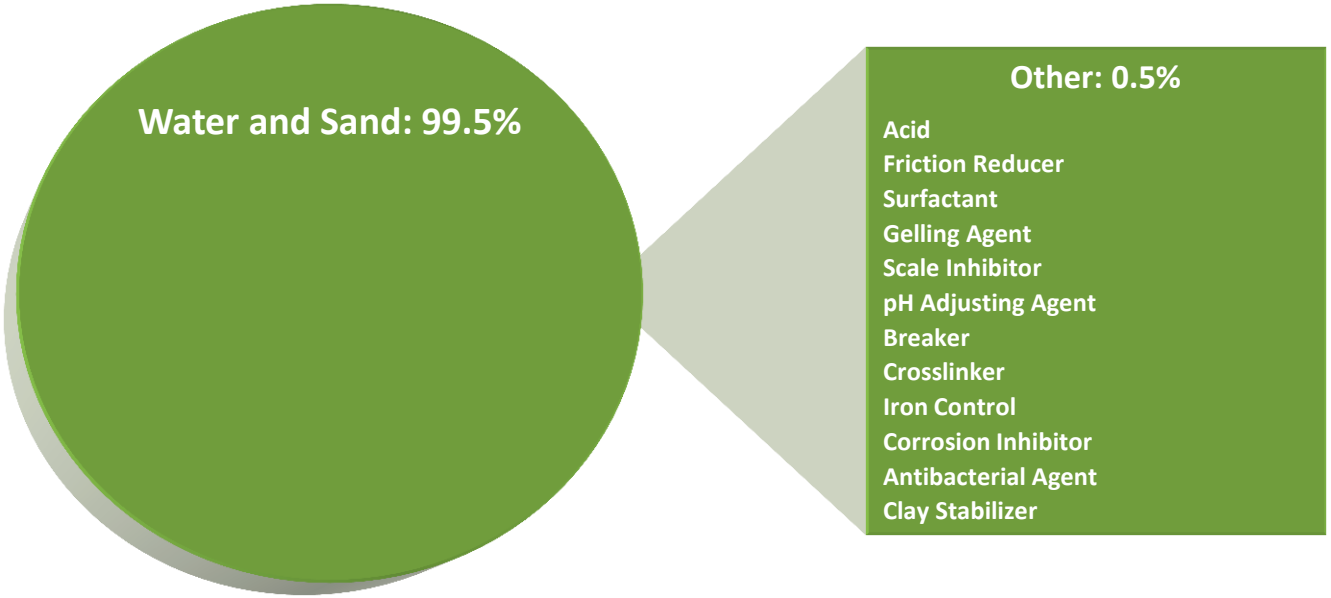


Well Completion Best Management Practices

- Containment
  - Chemical trailers, containers and raw chemical transfer equipment will be placed in secondary containment
  - Troughs and/or drip pots will be placed underneath hose connections in concentrated chemical service not located within secondary containment
- Use of freshwater impoundments only
- Aqua Renew Program



Typical Deep Shale Gas Fracturing Mixture



Fracturing Fluid Additives

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Product Category	Main Ingredient	Purpose	Other Common Uses
Water	99.5% Water & Sand	Expand fracture and deliver sand	Landscaping, manufacturing
Sand (Proppant)		Allows the fractures to remain open so the gas can escape	Drinking water filtration, play sand, concrete and brick mortar
Other	**~ 0.5%**		
Gel	Guar gum or Hydroexyethyl cellulose	Thickens the water in order to suspend the sand	Cosmetics, baked goods, ice cream, toothpaste, sauces, and salad dressings
Friction Reducer	Petroleum distillate	"Slicks" the water to minimize friction	Used in cosmetics including hair, make-up, nail and skin products
Acid	Hydrochloric acid or muriatic acid	Helps dissolve minerals and initiate cracks in the rock	Swimming pool chemical and cleaner
Anti-Bacterial Agents	Glutaraldehyde	Eliminates bacteria in the water that produces corrosive by-products	Disinfectant; sterilizer for medical and dental equipment
Scale inhibitor	Ethylene glycol	Prevents scale deposits in the pipe	Used in household cleansers, de-icer, paints, and caulk
Breaker	Ammonium Persulfate	Allows a delayed break down the gel	Used in hair coloring, as a disinfectant, and in the manufacture of common household plastics
Corrosion inhibitor	Formamide	Prevents corrosion of the well casing	Used in pharmaceuticals, acrylic fibers and plastics
Crosslinker	Borate Salts	Maintains fluid viscosity as temperature increases	Used in laundry detergents, hand soaps and cosmetics
Iron Control	Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice ~7% citric acid
Clay Stabilizer	Potassium Chloride	Creates a brine carrier fluid that prohibits fluid interaction with formation clays	Used in low-sodium table salt substitute, medicines, and IV fluids
pH adjusting agent	Sodium or potassium carbonate	Maintains the effectiveness of other components, such as crosslinkers	Used in laundry detergents, soap, water softener and dish washer detergents
Surfactant	Isopropanol	Used to reduce surface tension of the fracturing fluids to improve liquid recovery from the well after the frac	Used in glass cleaner, multi-surface cleansers, antiperspirant, deodorants and hair-color

Aqua Renew™
CHESAPEAKE ENERGY'S WATER RECYCLING INITIATIVE

Chesapeake ENERGY

» Process

- Currently recycling / reusing nearly 100% of produced water
- Produced water is collected and stored in holding tanks onsite
  - Then pumped from the tanks through 20–micron filter
  - Then pumped into a clean storage tank
  - Prior to reuse, the water is tested for chlorides and then blended accordingly with freshwater during the next fracturing job

» Benefits

- Reduces or eliminates need for water to be sent offsite for disposal
- Reduces impact on local supplies
- Reduces truck traffic, lower impact on roads, noise and air
- Reduces the cost of operations

Marketing / Reclaiming the Site

- Gas and liquids are separated by the "separator"
- Pipeline carries natural resources to market
- Produced water is retained on location in tanks until removed via truck
- Site is reclaimed and landscaped
  - Site is reduced to approximately 1 acre
  - Small access road will be retained
- Company returns regularly
  - Maintain equipment / monitor production rate

Use of Roads

- Chesapeake Energy prefers to use a Road Use Maintenance Agreement (RUMA) for dealing with potential effects on public roads
  - Has been used extensively for Chesapeake's operations are in PA
- Basics of the RUMA
  - "Operator agrees to reimburse (Township, County, other) for any additional costs incurred, associated with the maintenance of said roadway as a result of the Operator's activities during construction, drilling and completion of said wells"
  - "Operator agrees to maintain roads to a condition consistent with that prior to operations"
  - "Operator assumes all liability for subcontractors working on Operators behalf"
- Can be customized by both Operator and/or road owner depending on circumstances
  - Municipality can perform the road maintenance if preferred or Chesapeake will perform work to municipalities specifications

Who Shares In The Revenue

- Mineral Owners
  - Bonuses and royalties
- Local workers
  - Wages and benefits
- Local Business
  - Subcontractors and service companies
- Counties, Cities, School Districts
  - Ad valorem and other taxes
- Other Stakeholders
  - Charitable organizations
  - Chesapeake shareholders

Chesapeake ENERGY

10 Interesting Facts

- >$1 billion
  - Per day, how much the U.S. spends to buy energy or $2,000 per U.S. citizen, per year
- $2 billion
  - The amount invested by Chesapeake to date via lease bonus payments and acquisitions
- ~ $6-10 million
  - The amount to bring one Utica well into production
- ~ 5 million pounds
  - The amount of sand used to hydraulically fracture one Utica well
- 5,000 tons
  - The amount of aggregate used to construct one drilling pad
- $20 million
  - The amount spent on Ohio roads to date; $200 million has been spent in Pennsylvania
- 204,000
  - Number of projected jobs the Ohio oil and gas industry will generate by 2015
- 410 people across 150 different professions
  - The size and diversity of the workforce needed to bring one horizontal well into production
- $1 billion
  - The amount Chesapeake is investing in the development of CNG projects over the next 10 years
- 2015
  - The year CHK plans to have all of its 3,000+ fleet of vehicles converted or dedicated to CNG, thus saving $6 million/year

Questions?

For more information:

AskChesapeake.com

Information provided is subject to change based on multiple factors

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Chesapeake Energy Economic Impact A Look to the Future for Ohio?

- 23 rigs currently operating in Pennsylvania
- Over 1,100 employees PA
  - Less than 250 employees in January 2009
- Over $1.2 billion paid to landowners since 2008
- Over $350 million in contracts to vendors since 2009
- Over $1.5 million in community investment in 2009

- 8 Rigs currently operating in West Virginia
- 702 Chesapeake employees living in WV
- $57 million paid in severance tax in the past five years
- $46 million in contracts to WV vendors for WV operations in 2010
- Over the past five years, an $800 million dollar investment to WV entities was made by Chesapeake Energy

Pre-Drill Testing

» Each sample will be tested for:

- pH
- Specific conductance
- Turbidity
- Chloride, Sulfate
- Carbonate, Bicarbonate
- Total Dissolved Solids
- Total Suspended Solids
- Sodium, Calcium, Magnesium, Potassium
- Barium, Iron, Manganese
- BTEX
- MBAS (Surfactants)
- Light gas analysis (C1-C6) (includes methane, butane, ethane)
- RCRA 8 metals
- Oil and Grease (HEM)

Leading the Way on Increasing Natural Gas Demand

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» Clean Energy Fuels Corp. –LNG fueling infrastructure:

- CHK has agreed to invest $150 million in newly issued convertible debt of Clean Energy Fuels Corp. (Nasdaq:CLNE)
- Clean Energy will use CHK's $150 million investment to accelerate its build-out of LNG fueling infrastructure for heavy-duty trucks at truck stops across interstate highways in the U.S., thereby creating the foundation for "America's Natural Gas Highway System"
- This investment alone is projected to help underwrite approximately 150 LNG truck fueling stations, increasing by more than tenfold the number of publicly accessible LNG fueling stations and providing a foundational grid for heavy-duty trucks to have ready access to cleaner and more affordable American natural gas fuel along major interstate highway corridors
- CHK believes $1.5 -2.0 billion of LNG truck fueling stations puts entire heavy truck fuel demand market in reach for natural gas substitution

» Sundrop Fuels, Inc. –biobased "green gasoline" made from natural gas and cellulosic material:

- CHK has agreed to invest $155 million for a 50% ownership stake in Sundrop Fuels, Inc.
- The investment over the next two years will fund construction of the largest nonfood waste biomass-based "green gasoline" plant in the world, capable of annually producing more than 40 million gallons of ultra-clean liquid transportation fuel from natural gas and waste biomass. The plant will utilize Sundrop Fuels' proprietary gasification process coupled with proven methanol-to-gasoline process to produce gasoline, rather than the more expensive Fischer-Tropsch process producing a wide variety of hydrocarbons that require further refining or processing

1,000 BOE Per Day Wells in Multiple CHK Plays

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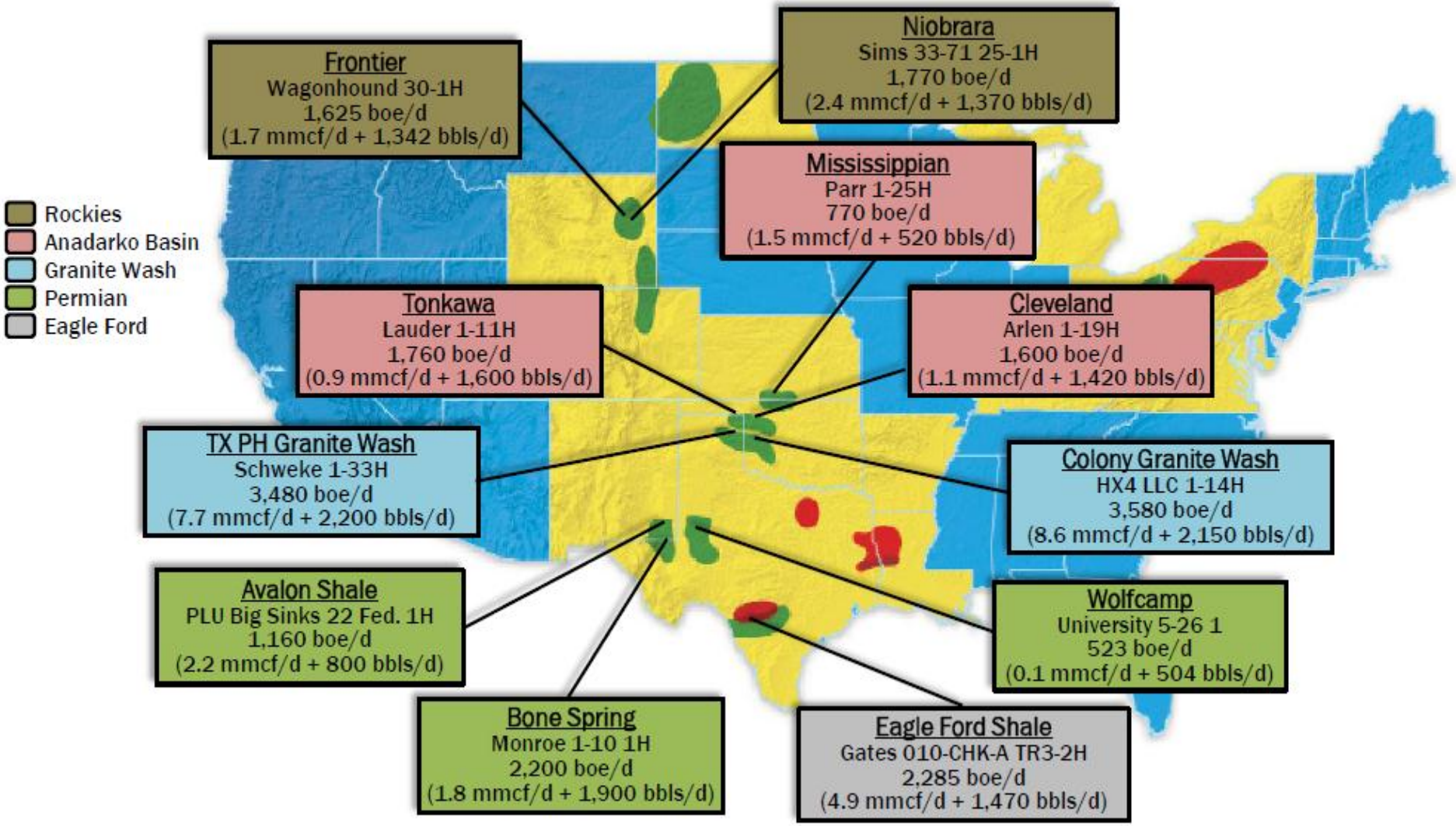


CHK is drilling big oil and liquid-rich wells in multiple developing plays

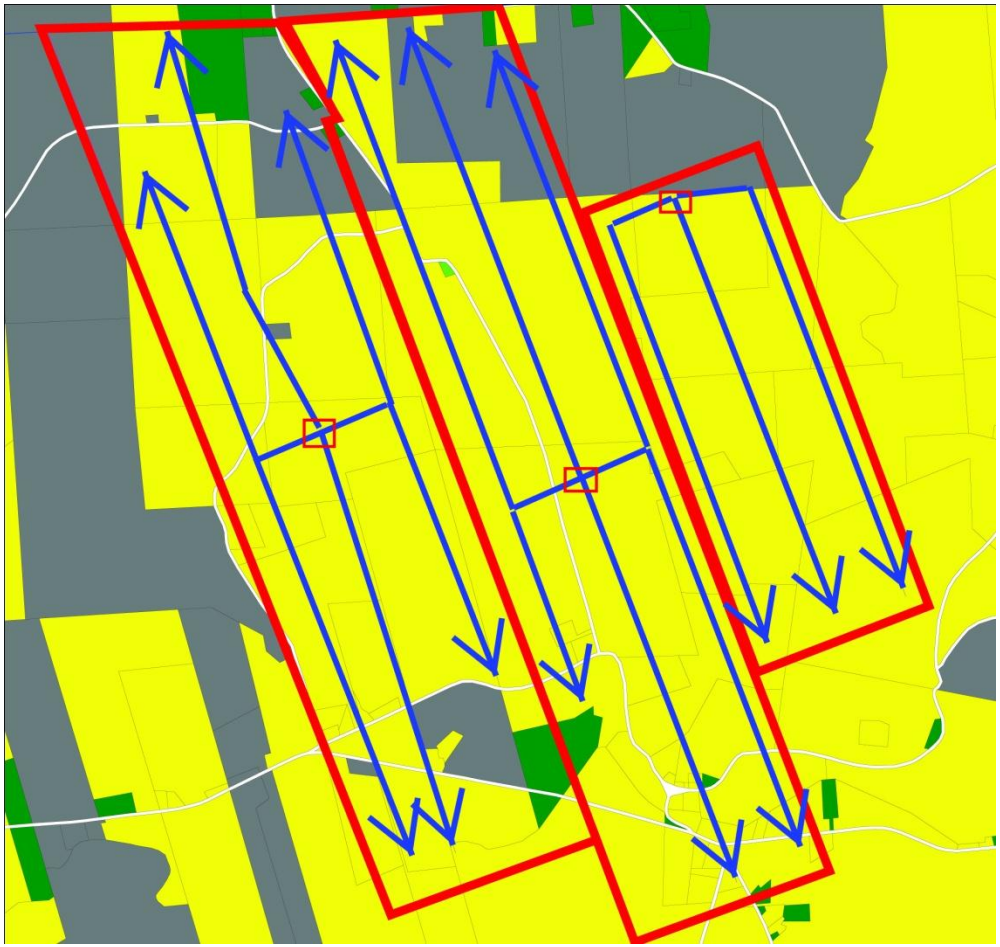
Chesapeake's Internal Auditing Program

- Commenced in September 2009 in the Marcellus play
  - Performed by a third party firm
  - 6 person team, conducting 40-50 audits per week
  - Sites are audited multiple times
- Types of sites audited:
  - Drilling
  - Completions
  - Water impoundments
  - Water intakes
  - Water transfer lines
  - Production sites
  - Temporarily inactive sites

Chesapeake's Internal Auditing Program

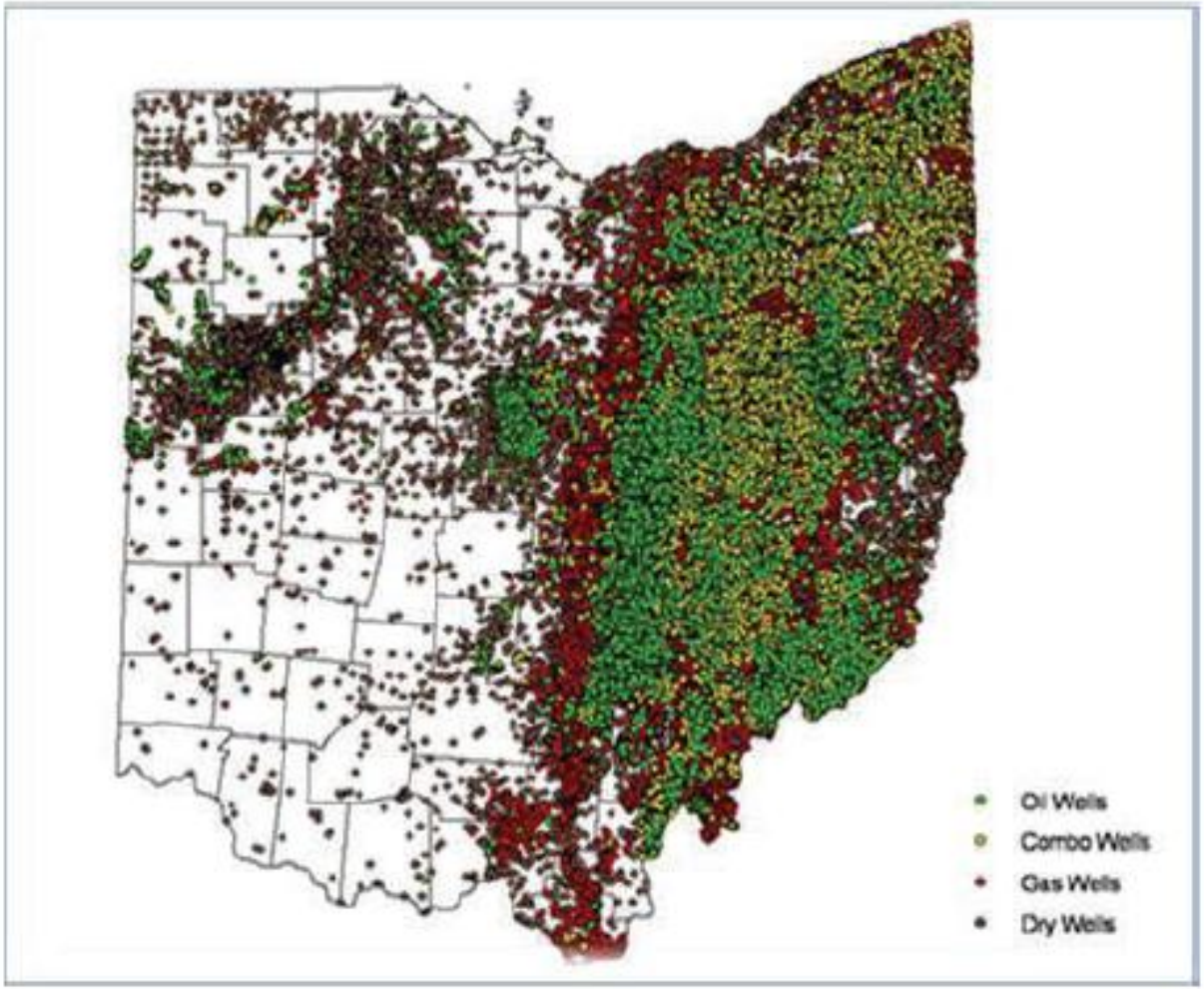
- Elements that are audited:
  - E&S controls
  - Containment
  - Spill prevention
  - Residual waste management
  - Stream crossings
- Each site is given a score, the lower the better
  - Up to 11 different elements are addressed, each containing 2-13 questions each
  - One unsatisfactory answer for any of the questions equals at least 1 point
    - Violations of CHK BMP's: 2 points
    - Violations that would warrant a DEP Notice of Violations: 3 points
- Evidence is photographed
- Scored on violations' frequency and severity
- Program is continuously updated

Drilling Units/Royalties



- ❖Drilling unit size and shape can vary depending on geology, topography, leasehold, drilling et. al. issues
- ❖Usually 640 acres or larger
- ❖Once drilling is complete – Division Order process begins
- ❖Royalty payments generally begin within 120 days of first sale and then continue monthly for the life of a well

Current Oil and Gas Activity in OH



- 273,000 wells drilled
  - Ranks 4th in the US behind TX, OK and PA
  - 64,000 wells currently in production
  - 80,000 wells estimated to have been hydraulically fractured
- Last year, Ohio produced 88 billion cubic feet of natural gas and 5.1 million barrels of crude oil
  - Enough to gas to heat over 1 million Ohio homes and business

Criticism of Oil and Natural Gas Water Use

- **Concerns of the so-called "permanent removal" of water from the effective hydrologic cycle**
  - Most water used in shale gas development either remains in the formation or returns as produced water
  - Argument that this is a different type of "consumption" than the evaporation of water from a power plant and other types of "consumption"

Natural Gas Combustion: Water Vapor Generation

- Balanced Methane Combustion Reaction: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
- Water Vapor Production Calculation Assumptions:
  1. Typical Natural Gas Makeup: ~ 95% Methane (remaining ~ 5% as Ethane, Propane, Butane, etc)
  2. Take conservative approach and only use methane to calculate water vapor *
  3. Assume normal temperature and pressure (68°F and 1 atm)
  4. Volume of 1 mole of CH4 at 68°F is 0.0026 mole/cu-ft
  5. Molecular weight of water is 18 lb/lb mole
  6. Liquid water density at 68°F is 8.33 lb/gallon
- Volume of Water Vapor Produced per Million Cubic Feet of Natural Gas
  - (1,000,000 cu-ft of CH_4) x (0.95) x (0.0026 lb mol CH_4 / cu-ft of CH_4) x (2 lb mol H_2O / 1 lb mol CH_4) x (18 lb H_2O / 1 lb mol H_2O) x (1 gal H_2O / 8.33 lb H_2O) = **10,675 gallons**
- Approx 10,675 gallons of water produced per MMCF of natural gas combusted
- This equates to approx 525 MMCF of natural gas needed to combust to produce an equivalent amount of water used in a Marcellus frac job
  - A typical Chesapeake Marcellus Shale well is projected to produce approx 5,200 MMCF of natural gas over its lifetime. Based on current data, it takes an average CHK Marcellus Well < 6 months to produce 525 MCF of natural Gas