



# *Microhole Coiled Tubing Drilling* Cost Effective Access For CO<sub>2</sub> Sequestration

- > **Regional Carbon Sequestration Partnerships Review Meeting**  
**Pittsburgh, PA**  
**October 3, 2006**

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**Gas Technology Institute**



# Topics

- > **Microhole Coiled Tubing Drilling**
- > **Applications to CO<sub>2</sub> Sequestration**
- > **Coiled Tubing Field Test Results – How They Might Apply to CO<sub>2</sub> Activities**

# Advanced Drilling Technologies Coiled Tubing Rig



## Rig Features

Handles 1" thru 2 5/8" Coiled Tubing

5000' Depth Capability

Zero Discharge Mud System

Handles 7 5/8" R3 Casing

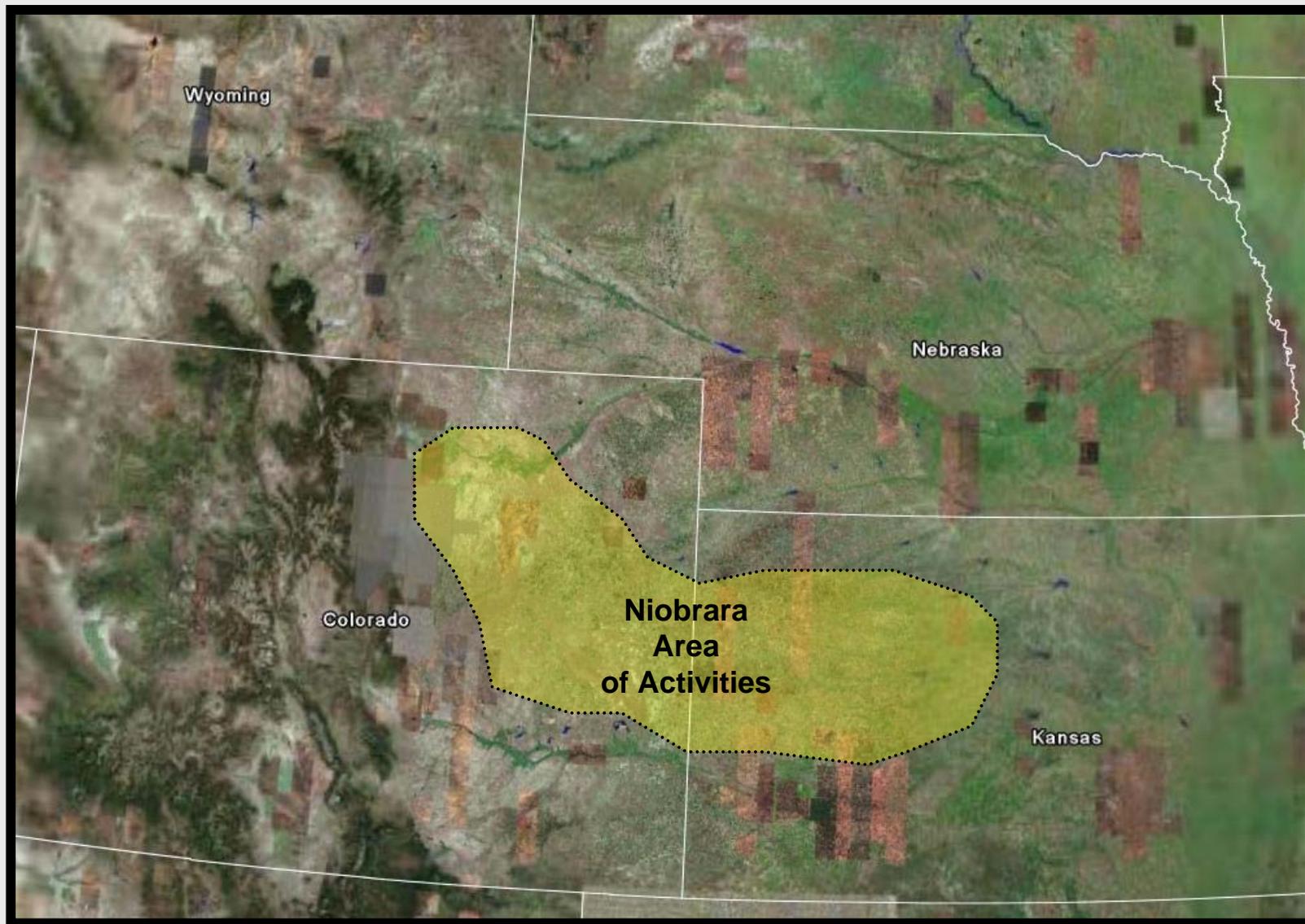
Supports Rotary & Top Drive

Trailer Mounted Rig – Meets USDOT Limitations

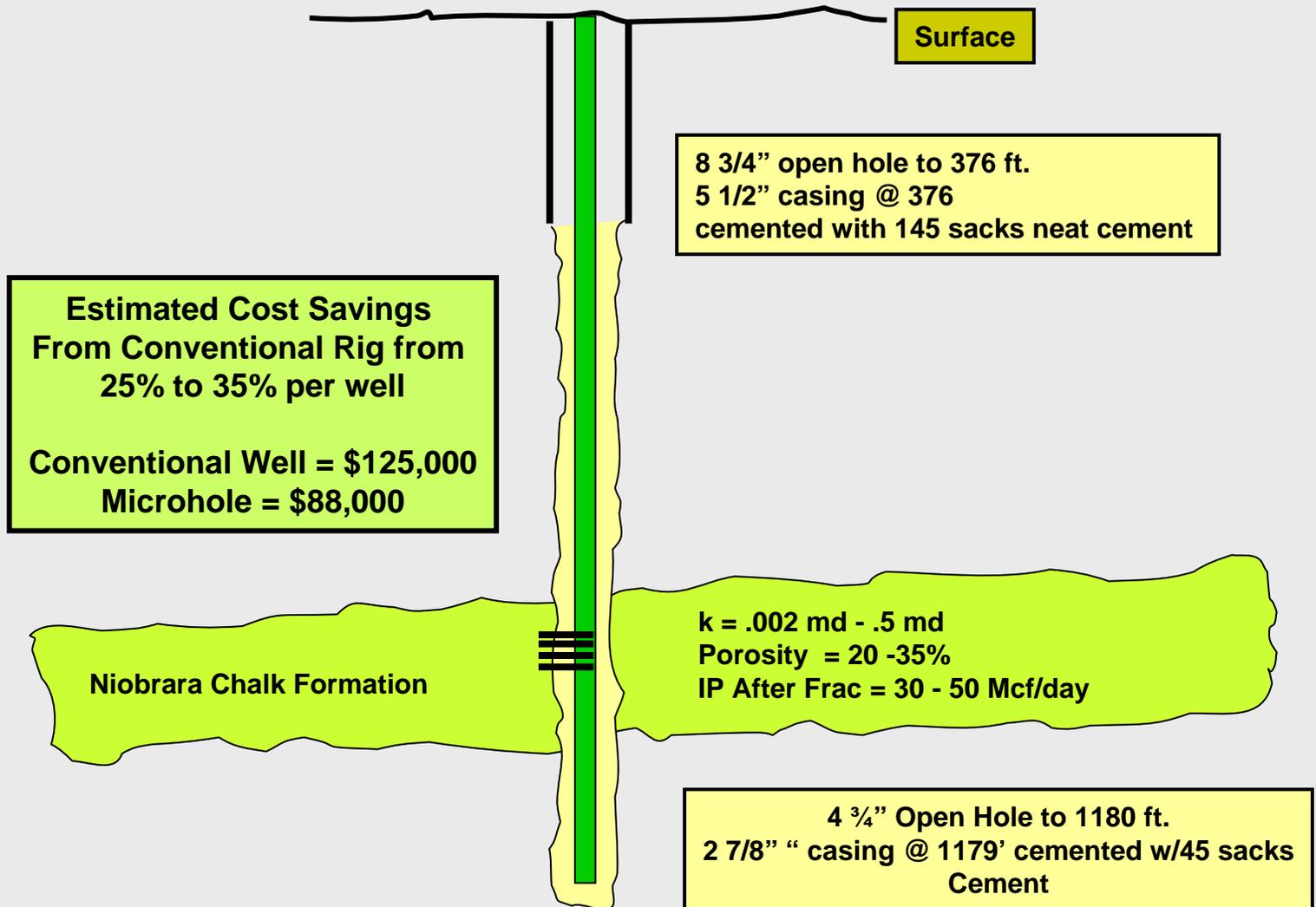
Moves w/4Loads

- Rig Drilled +220 Wells in 2005
- Drills 3000' Wells at Rate of One/Day

# Area of Drilling Activity



# Microhole Well Completion – Goodland, Kansas Niobrara

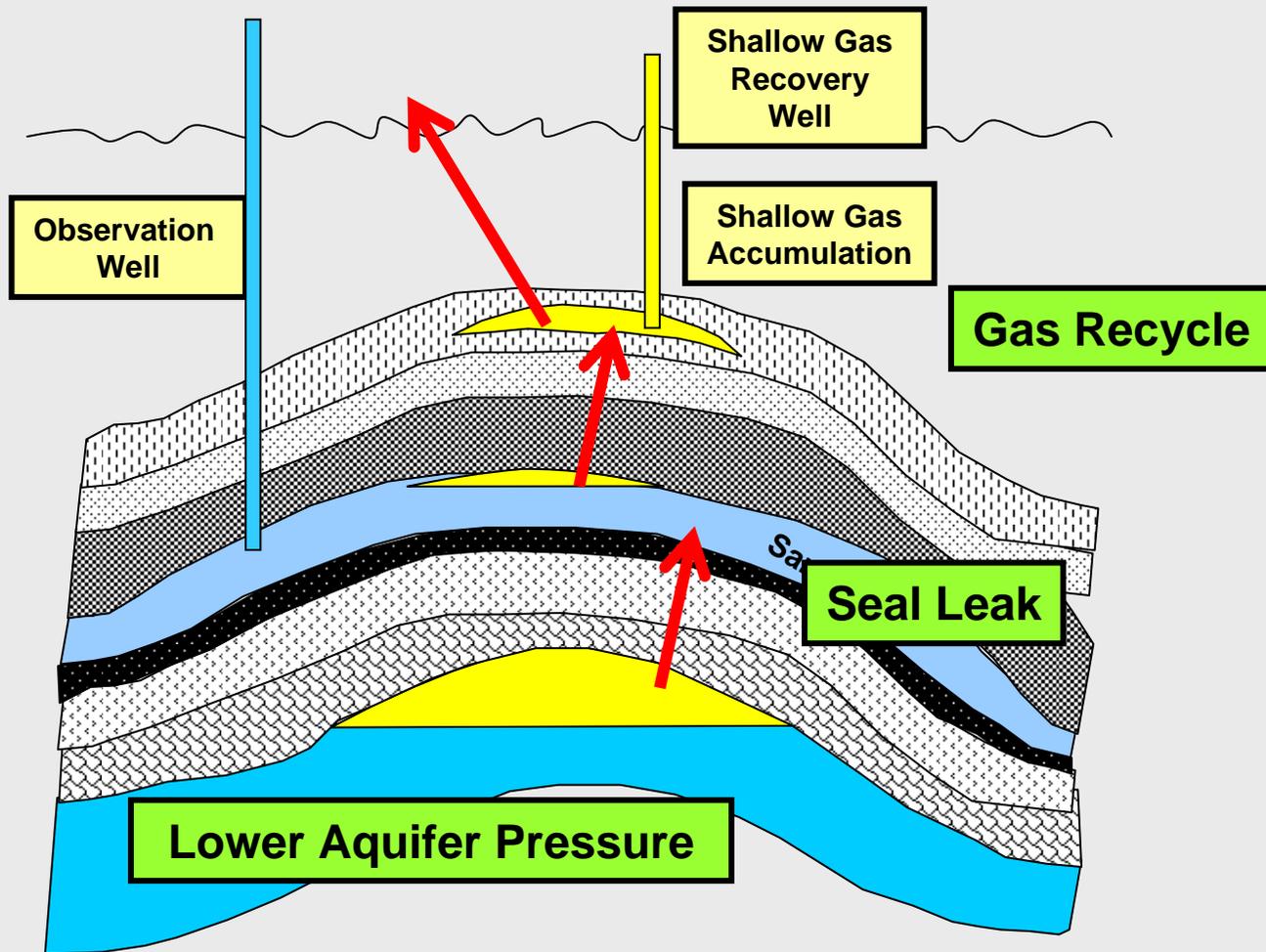


# Potential Applications to CO<sub>2</sub> Sequestration

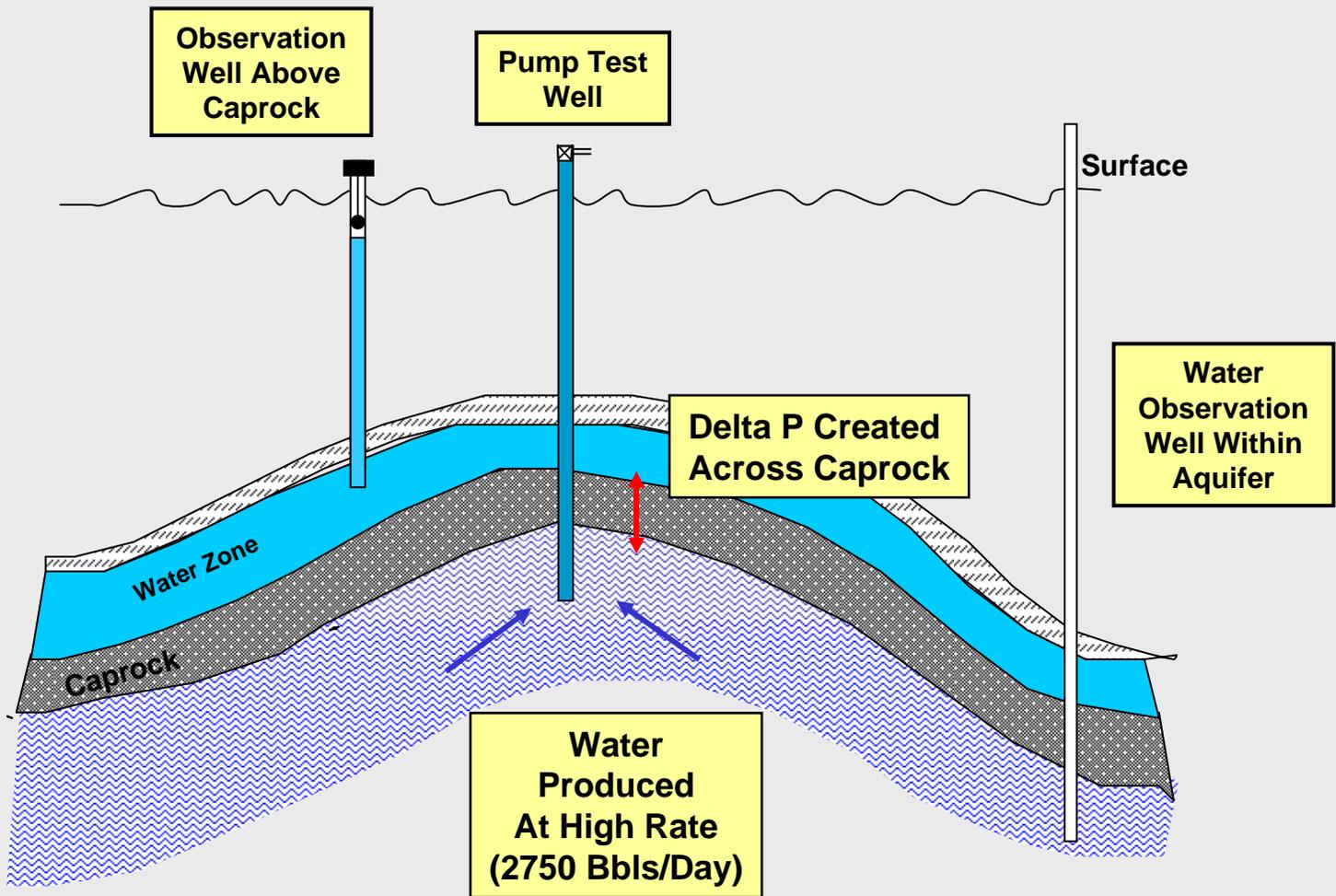
- > **Inventory Verification**
- > **Leak Mitigation**
- > **Reservoir (Caprock) Integrity Testing**
- > **Long Term Monitoring**
- > **Injection Wells**



# Leak Control Technology



# Reservoir Integrity Testing



## Field Results and Cost Savings



# Rig Mobilization



# Mobilization



Dog House



Mud Tanks

# Reduce Drilling Cost-Staff

**Number of staff: 4 to 6**

**Rig Up: 4**

**Drilling to target: 4**

**Running casing and cementing: 5**



# Bottom Hole Assembly (BHA)

**PDC Bit**

**Size: 4.75 inches**

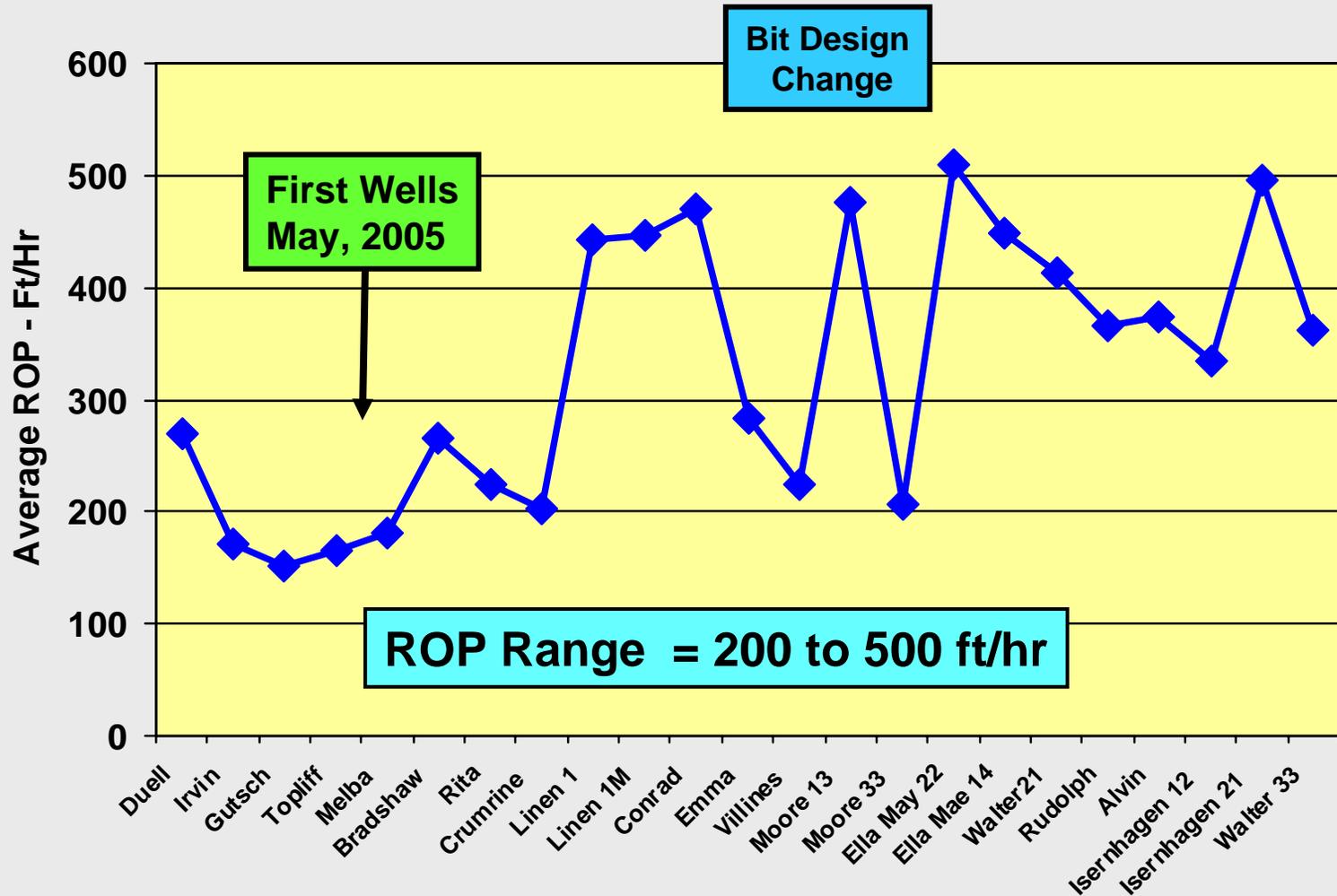
**Life: 30 to 40 Wells**

**Mud Motor**

**OD: 3.75 inches - 5/6 Lobe**



# Drilling Rate – Ft/Hr – 23 Project Wells - 4 3/4” Holes – Chronological Order



# Reduce Drilling Cost- Mud



# Decreased Environmental Impact



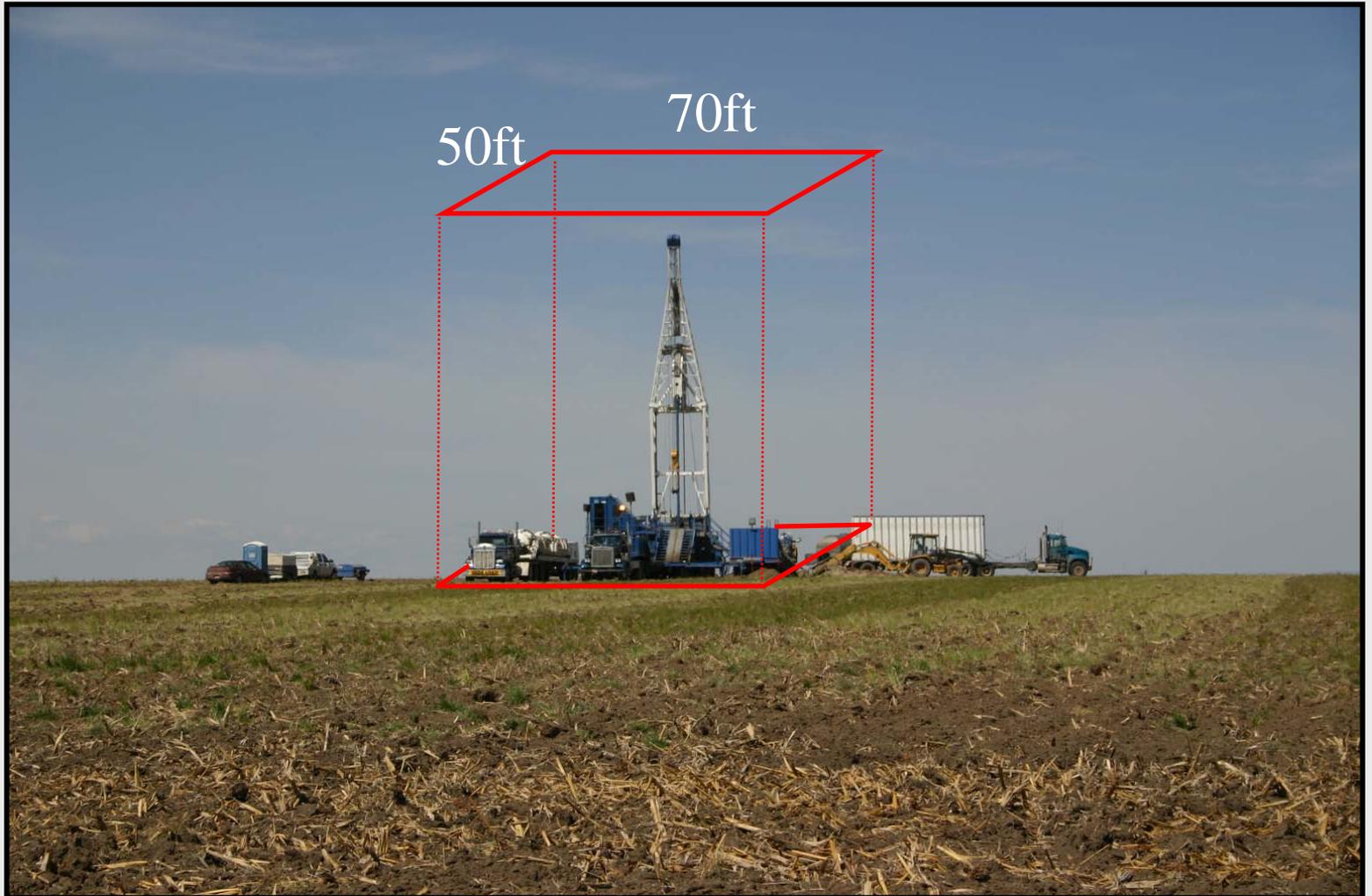
- **Small Drill Pads**
- **No Mud Pit**
- **Smaller Equipment Yields Fewer Air Emissions**
- **Smaller Wellbore - Less Drilling Mud**
- **Smaller Access Roads**
- **Minimum noise**

# Zero Discharge Mud System

- No Earthen Pits
- All Cuttings and Drilling Fluid Confined to Tanks
- Rig Up on Sealed/Booted Tarp For Any Overflow or Spill Containment
- Auger Hole for Conductor and Boot Around Conductor

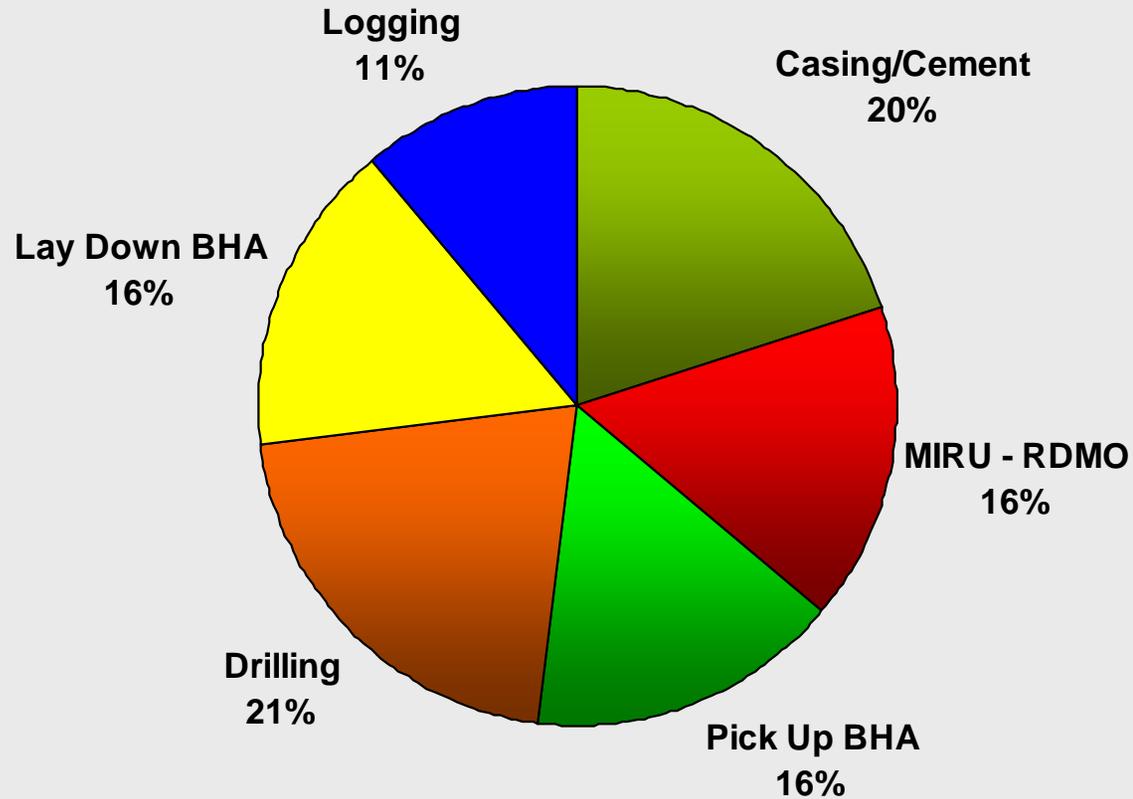


# Reduce Drilling Cost- Location



# Allocation of Rig Time – 3100' Well

Total Time = 19 Hours



# Benefits of Rig Utilization

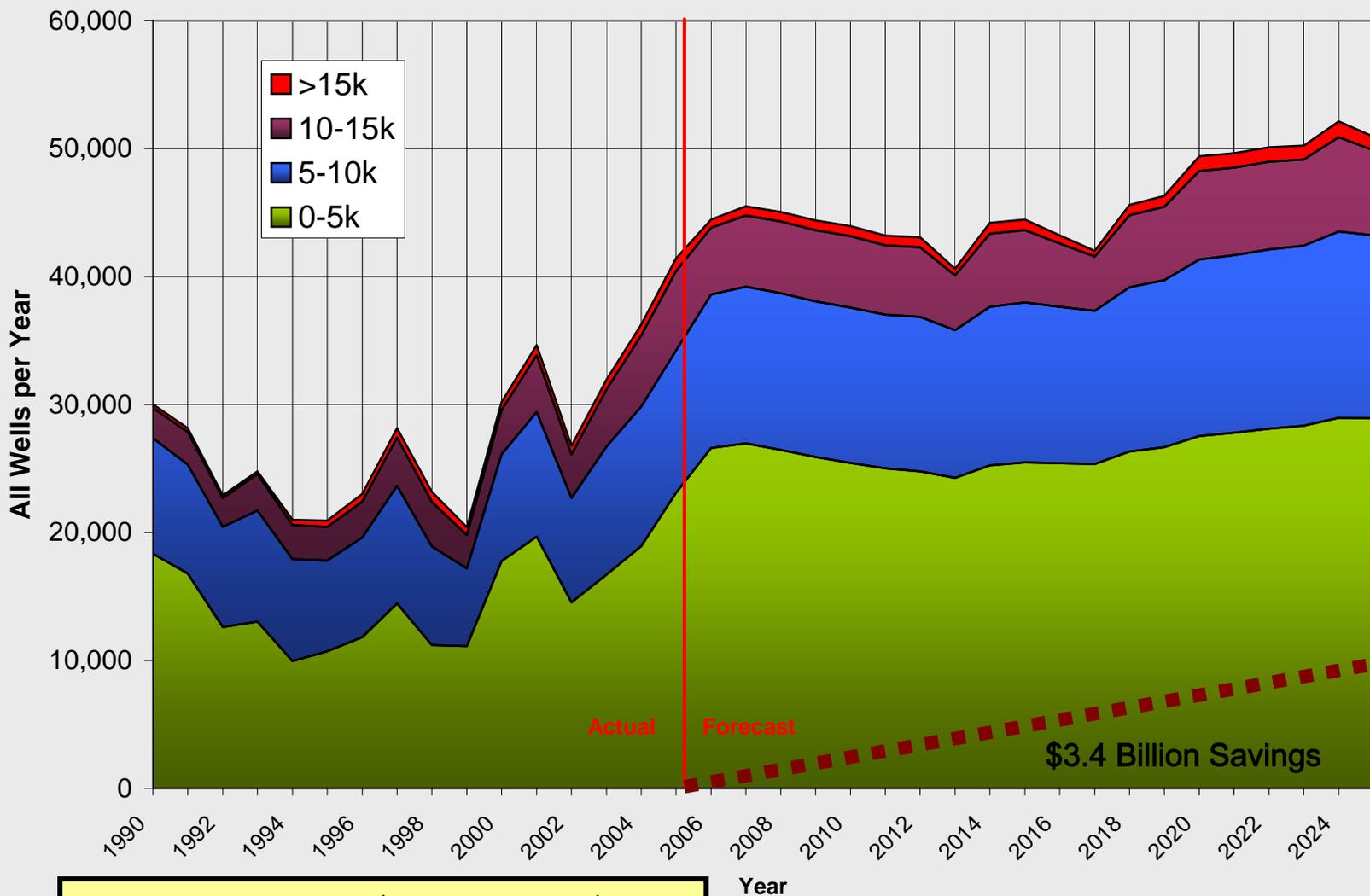
- > Efficient Rig Mobilization
- > Small Environmental Footprint
- > Rapid Drilling
- > Good Hole Quality and Cement
- > Rig Capable of Drilling, Running Casing, Tool Handling, Logging
- > Benefits of Continuous Tubing
- > Low Noise, Emissions
- > Mud Recycle, Minimum Cuttings and Zero Discharge if Required
- > Improved Safety

**Saves Money,  
Environment and  
Enables Marginal  
Resources**

# Barriers to Microhole Usage

- > **Production Engineers Have Long Term Concerns**
  - Ability to Rework Wells
  - Handling of Significant Fluids
  - Limited Space for Mechanical Equipment
  - Future Use of Wellbores
- > **Lack of Experience/Familiarity**
- > **Depth Limitation**
- > **Difficult Drilling Environments – Stuck Pipe**
- > **Issues with State of Colorado – Ability to Adequately Complete Wells, P&A**
- > **Hard Formations – Heavy Muds**

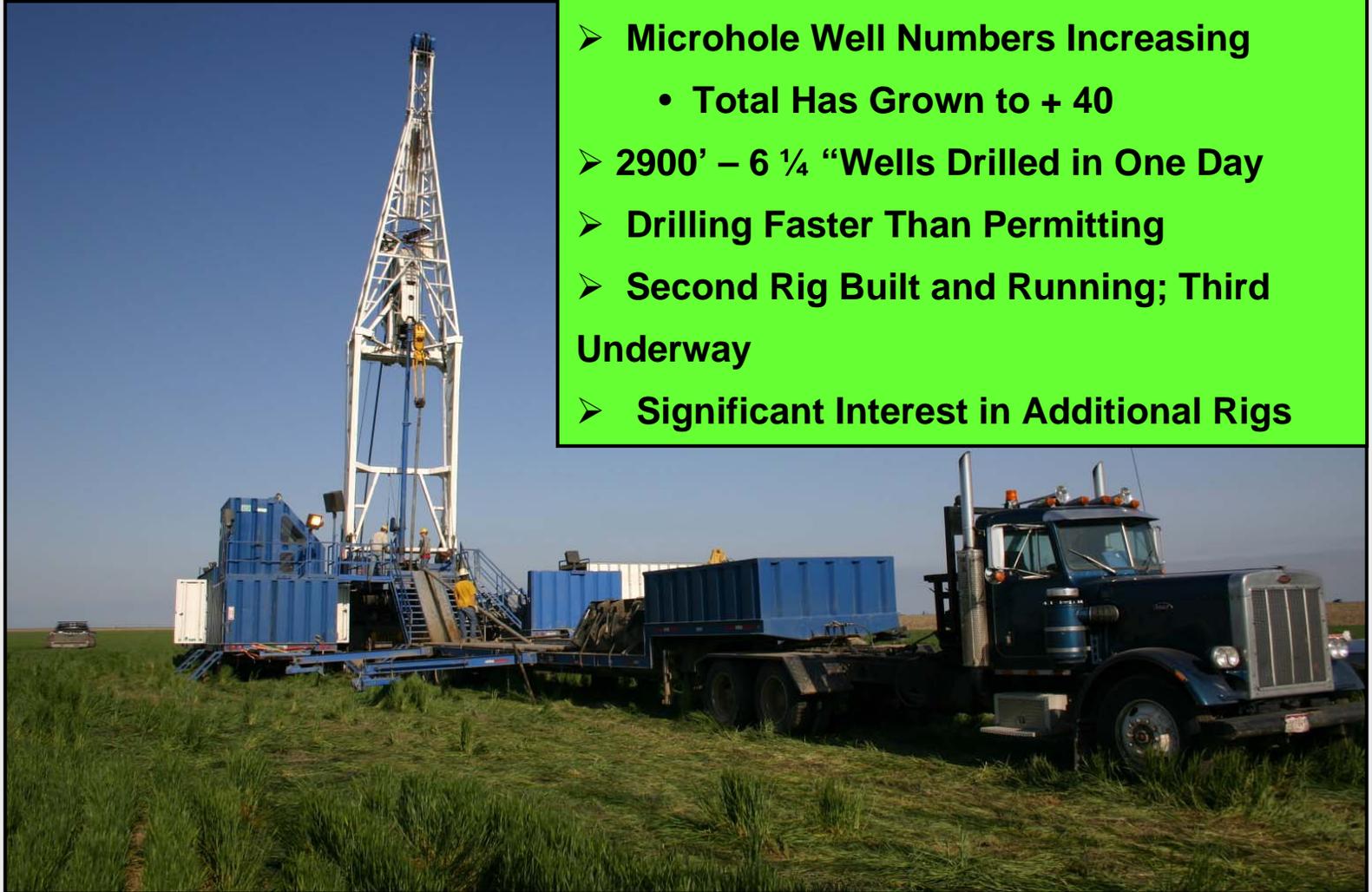
# U.S. Onshore Drilling By Depth Interval



Avg Day Rate 1999 = < \$6000; 2005 = > \$12,000

\$3.4 Billion Savings

# Activity Trend



- Rig Has Drilled + 300,000 Feet of Hole
  - Colorado – Kansas
- Microhole Well Numbers Increasing
  - Total Has Grown to + 40
- 2900' – 6 ¼ "Wells Drilled in One Day
- Drilling Faster Than Permitting
- Second Rig Built and Running; Third Underway
- Significant Interest in Additional Rigs

## Summary

- > **“Fit For Purpose” Microhole Coiled Tubing Drilling**
  - Less Impact on the Environment
  - Fast and Efficient
  - Enhances Safety
- > **Saves Money**
  - Enables the Development of Marginal Oil and Gas Resources
  - Can Enable Cost Effective CO<sub>2</sub> Sequestration
- > **Future Direction**
  - Smaller Holes, Horizontal Capabilities
  - DOE is Leading a Systems Approach Effort for Microhole Drilling