COAL BED NATURAL GAS BASINS AND PRODUCED WATER

Presented To –
Garfield County Energy Advisory Board
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Presented By -
Doug Dennison, Oil & Gas Liaison
Outline

- Goal of Presentation
- What is CBNG?
- CBNG Basins Background
- Comparison of Drilling & Production
- Produced Water Quality & Management
- Questions
Goal of Presentation

- Full-scale coal bed natural gas (CBNG) development is relatively new to Garfield County.
- CBNG development has been occurring in the San Juan, Raton and Powder River Basins for many years and people look to those areas as examples of what CBNG development will look like in Garfield County.
- The goal of this presentation is to contrast and compare these basins with the Piceance Basin so that residents can better understand potential impacts from CBNG development.
What is CBNG?

- Coal bed natural gas, or coal bed methane (CBM) is natural gas that is trapped in coal seams by hydraulic (water) pressure.
- In order to produce CBNG, the hydraulic pressure must be reduced to allow the gas to be released from cleats (fractures).
- In general, water production from CBNG wells declines as gas production increases with time.

*Figure 2. Typical production curves for a coal-bed methane well showing relative volumes of methane and water through time. Modified from Kuuskraa and Brandenberg (1989).*
CBNG Basins Background

**FIGURE 5** Source: Steve de Albuquerque, NRLC coalbed methane conference, April 4-5, 2002
CBNG Basins Background

- The San Juan Basin (SJB) occupies approximately 7,500 square miles in northwestern New Mexico and southwestern Colorado.
- CBNG has been developed in the SJB since the initial wells were drilled in the 1950s and appears to be declining.
CBNG Basins Background

- The Raton Basin (RB) occupies approximately 4,000 square miles in northeastern New Mexico and southeastern Colorado.
- CBNG has been developed in the RB since 1980.
The Powder River Basin (PRB) occupies approximately 12,000 square miles in northern Wyoming and southern Montana.

CBNG has been developed in the PRB for many years, but activity in the PRB increased substantially in the late 1990’s to present.
CBNG Basins Background (cont.)

- The Piceance Basin (PB) occupies approximately 6,000 square miles in northwestern Colorado.
- Full-scale development of CBNG is relatively new in the PB and viability of development in Garfield County is still being explored.
Comparison of CBNG Basins (cont.)

- Drilling, development, and production technologies, well spacing, and water-disposal options in each basin are dictated by several factors, including:
  - Depth of coals
  - Thickness of coals
  - Gas/coal content
  - Gas/water ratio
  - Cleats/fractures in coal
  - Quantity and quality of produced water
Comparison of CBNG Basins (cont.)

<table>
<thead>
<tr>
<th>Basin</th>
<th>Depth of Coals (ft)</th>
<th>Thickness of Coals (ft)</th>
<th>Gas/Coal (scf/ton)</th>
<th>Gas/Water Ratio¹</th>
<th>Typical TDS (mg/l)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJB</td>
<td>2,000 – 3,500</td>
<td>5 – 20</td>
<td>430</td>
<td>15.6</td>
<td>8,000</td>
</tr>
<tr>
<td>PRB</td>
<td>300 – 700</td>
<td>40 – 100+</td>
<td>60</td>
<td>0.5</td>
<td>500</td>
</tr>
<tr>
<td>RB</td>
<td>&lt;3,500</td>
<td>5-140</td>
<td>200-500</td>
<td>1.1</td>
<td>&lt;5,000</td>
</tr>
<tr>
<td>PB</td>
<td>4,000 +</td>
<td>20-30</td>
<td>TBD</td>
<td>TBD</td>
<td>20,000</td>
</tr>
</tbody>
</table>

SJB = San Juan Basin  
PRB = Powder River Basin  
RB = Raton Basin  
PB = Piceance Basin  

1. For SJB, PRB and RB ratio is based on data collected by B.C. Technologies.  
2. SJB and PRB data from Crystal Solutions, LLC; RB data from EPA; PB data from EnCana
Comparison of CBNG Basins (cont.)

- Drilling technologies used in the SJB, RB and PRB are significantly different than those used in the PB
  - Surface impact is less in SJB, RB and PRB due to use of smaller drill rigs
  - Reserve pits are often not used in the SJB, RB, and PRB (air drilling vs. mud drilling)
  - Access roads and well pads are commonly not constructed in PRB
Typical CBNG Drilling Site – Piceance Basin

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Typical CBNG Drilling Site – Powder River Basin
Comparison of CBNG Basins (cont.)

- Development and production technologies used in each basin are significantly different
  - Fracing is generally not required in the PRB
  - Other development methods (e.g., cavitation) are used in several of the basins
  - Methods for removing water vary by basin
    - PRB - Downhole electric pumps
    - SJB - Pump jacks or “dynalift” pumps
    - RB – Pump jacks
    - PB – Gas lift and downhole and surface electric pumps
Well Cavitation – Piceance Basin
Typical Well Site – Piceance Basin
Typical Pump Jack – San Juan Basin

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Typical Production Equipment – San Juan Basin 06.20.2003
Typical Well Site – Powder River Basin
Comparison of CBNG Basins (cont.)

- Water disposal/reuse options vary by basin and are largely dictated by water quality and geology
  - Due to relatively good water quality, surface discharge (permitted, irrigation, dust control); evaporation; use in stock/wildlife ponds; and other beneficial uses are employed in the RB and PRB
  - Due to high TDS, reinjection is the most commonly used method in the SJB
  - Due to high TDS, recycling and evaporation appears to be the preferred method in PB, however, reinjection is being evaluated
For More Information

- Garfield County Oil & Gas Liaison
  - Doug Dennison
  - Phone 970-625-5691
  - Fax 970-625-0908
  - Cell 970-309-5441
ddennison@garfield-county.com

- County Website
  - www.garfield-county.com
  - Click on “Oil & Gas” under “County Departments”