

# Monitoring the Quality of CBNG Produced Water Across the Powder River Basin, Wyoming

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## Introduction

- Exploratory drilling for Coalbed Natural Gas (CBNG) is at an all time high due to the global energy crisis. The states most effected are in the Rocky Mountain region. They include Wyoming, Colorado, Utah, Montana, and New Mexico.
- The Powder River Basin (PRB) is located in the Northeast corner of Wyoming and in the Southeastern Montana. Here in the PRB it is expected that 139,000 CBNG wells will be drilled by 2032 (U.S. BLM 2003).
- To recover CBNG the coal seam is fractured and water from the coal seam is pumped to the surface where it is separated from the dissolved CBNG. The produced water is then placed into disposal ponds.

## Study Justification and Rationale

- Concerns have been raised about the quality of the produced water at well head and in disposal ponds.
- Previous studies have shown that product water quality differs among watersheds in the PRB due to the depth of coal seam (McBeth et al. 2003ab, Patz et al 2003, Jackson and Reddy 2006).
- Produced water can move down in the soil profile and salt and trace metal concentrations are able to infiltrate into shallow aquifers.
- Trace metals are increasing as a function of time and watershed characteristics.



(USGS 2006)

## Objectives

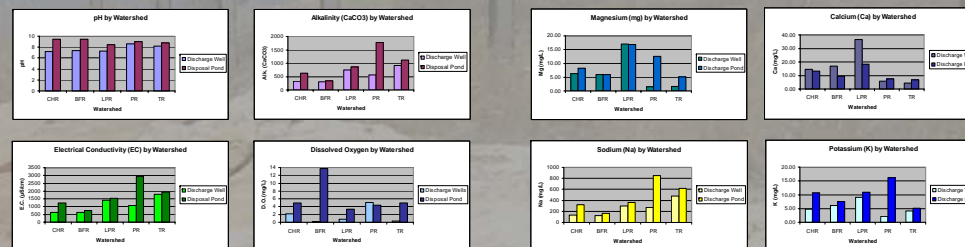
- Monitor water constituents (pH, dissolved oxygen, oxidation reduction potential, electrical conductivity, temperature, sodium adsorption ratio) and major cations, major anions, as well as trace metals in discharge wells and disposal ponds.
- Model water chemistry using MINTEQA2 to determine geochemical processes.

## First Year Sampling Results

## Methods

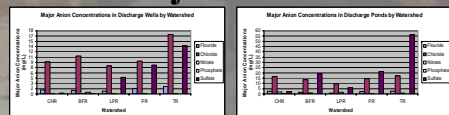
- In July 2006 water samples were taken in the PRB. The five watersheds that make up the PRB are the Cheyenne River (CHR), Belle Fourche (BFR), Little Powder River (LPR), Powder River (PR), and Tongue River (TR).
- Field measurements were taken of both discharge well and corresponding disposal pond.
- Water samples were taken according to QA/QC procedures from discharge well and corresponding disposal pond (WYDEQ 2004).
- Water samples were transported to University of Wyoming Water Quality Lab in coolers and filtered using a 0.45 micron filter.
- Water samples were then divided and one sample was acidified and the other left alone and analyzed using ICP-MS and IC.

## Field Measurements

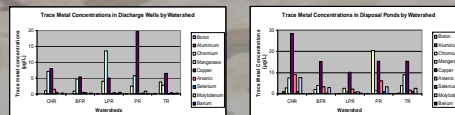


## Major Cations

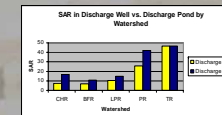
## Major Anions



## Trace Metals



## SAR



\*Aluminum, Barium, and Boron are in mg/L

## Conclusions

- pH in both discharge wells and disposal ponds ranges from 7 to 10.
- Sodium had the highest concentration of major cations. Due to these high concentrations the SAR values are also high.
- Alkalinity (CaCO<sub>3</sub>) is dominant in the water system when looking at major anions.
- Aluminum, barium, and boron had the highest concentrations of all trace metals analyzed.
- After another year of sampling, previous studies and data collected will be combined to determine beneficial uses for CBNG produced water.

## References

Jackson, Richard and Reddy, K.J.: 2006. Geochemistry of coalbed natural gas (CBNG) produced water in Powder River Basin, Wyoming: salinity and sodicity. Accepted 2006. Water, Air, and Soil Pollution. McBeth, I.H., K.J. Reddy, and Skinner, Q.D.: 2003a. Chemistry of coalbed methane product water in three Wyoming watersheds. Journal of American Water Resources Association. 39:575-585. McBeth, I.H., K.J. Reddy, and Skinner, Q.D.: 2003b. Chemistry of trace elements in coalbed methane product water. Journal of Water Research. 37:884-890. Patz, M.J., Reddy, K.J., and Skinner, Q.D.: 2006. Trace elements in coalbed methane produced water interacting with semi-arid ephemeral stream channels. Water, Air, and Soil Pollution 170:55-67. U.S. Bureau of Land Management (BLM): 2003. Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project. WY-070-02-065. Buffalo, WY. U.S. Geological Survey (USGS): 2006. Assessment of Aquatic Communities in Northeastern Wyoming and Southeastern Montana, 2005. Fact Sheet 2006-3047 U.S. Geological Survey. Wyoming Department of Environmental Quality/Water Quality Division: 2004. Manual of Standard Operating Procedures for Sample Collection and Analysis. Wyoming Department of Environmental Quality, Water Quality Division, Watershed Program, Cheyenne, WY.