

# USING AIRBORNE GEOPHYSICS TO IMPROVE THE MANAGEMENT OF PRODUCED WATER FROM COAL BED NATURAL GAS EXTRACTION IN THE POWDER RIVER BASIN<sup>1</sup>

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The Powder River Basin (PRB) of Wyoming and Montana has seen a boom in drilling for coalbed natural gas (CBNG), the natural gas contained in coal seams. Large quantities of water are coproduced during the extraction process. The water is currently managed by land application (irrigation), returned to shallow groundwater aquifers via infiltration basins, directly discharged to ephemeral or perennial streams, or injected into the deep subsurface via injection wells. At present, there are over 28,000 CBNG wells permitted or drilled in the PRB and it is estimated that another 50,000 to 100,000 new wells will be drilled in the future. Produced water management is a major challenge to the oil and gas industry as well as federal and state regulators.

The purpose of this study was to evaluate the use of airborne electromagnetic (AEM) methods for the large-scale mapping of vadose zone properties. The base maps derived from the AEM data show the location of conductive anomalies within the vadose zone. These conductive anomalies have been identified as conditions related to soil properties, geologic features, saturated areas, and seepage zones. In the PRB, the data can be used to identify suitable locations for constructing impoundments in areas that avoid highly conductive soils where infiltrating water may leach salts through the vadose zone and into shallow aquifers. Hydrologic changes within the vadose zone were evaluated by completing an AEM survey in 2003 and 2004 over two coincident spatial areas. The data were analyzed to determine statistical relationships between the data sets, in particular data outliers which may represent areas of significant change between each year. The outliers plot in areas of CBNG development. These areas may have been altered between 2003 and 2004 through land disturbance or the construction of water managements systems such as impoundments. Ultimately, it is hoped that the information from these surveys will identify cost effective treatment or disposal options for produced water that address both production and environmental issues.

Additional Key Words: electromagnetic conductivity, vadose zone mapping, conductive anomalies, leaking impoundments

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