

# CENTRAL REGION DOI LANDSCAPES INITIATIVE

## Project Proposal

**Project Title:** Multi-scale, Interdisciplinary Investigation of CBM Development in the Powder River Basin of Wyoming

**Project Coordinator:** Myron Brooks

**Partners/Collaborators and Affiliations:** Mike McKinley, Bruce West, U.S. Bureau of Land Management

**Total Funding Requested:** \$218,000 (FY '04), \$675,000 (3 year project)

**Proposal Submission Date:** 6 February 2004

**Problem:** Development of coalbed methane (CBM) in the Powder River Basin (PRB) has increased at a near-exponential rate over the last decade. A recent Environmental Impact Statement (EIS), prepared by the Wyoming office of the Bureau of Land Management (BLM), addresses the possible operation of nearly 50,000 wells in the Wyoming portion of the PRB by 2010. Production of this resource from the PRB is a relatively new phenomenon, and the level of anticipated development there is unprecedented. Department of the Interior (DOI) land managers, especially those in BLM, are under significant pressure to accelerate development to meet current administration goals for increased domestic energy production. They must accomplish this while ensuring protection of air, land, biological, and water resources under their care. The scope of existing and anticipated CBM development in the PRB has generated a wide range of environmental concerns. These include the potential for contamination of ground and surface waters, detrimental changes in habitat, introduction of invasive species, depletion of ground-water resources, and cumulative impacts from the widespread, dispersed nature of the development. Most, if not all, of the issues of concern involve multiple scales, both areal and temporal. For example, infrastructure (roads, power lines and pipelines) needed to establish and operate CBM wells can impact habitat of threatened or endangered species at the scale of a single well (<1 km<sup>2</sup>), and in aggregate, have impacts at the ecoregion scale (>10,000 km<sup>2</sup>). Similarly, ground water pumping and disposal associated with CBM production can impact local hydrologic flow systems near production wells and disposal points, whereas cumulative impacts of tens of thousands of production wells could perturb major regional hydrologic flow systems for hundreds of years. Integration of USGS interdisciplinary science capabilities across these various scales can provide science information that is directly relevant to BLM decision makers.

**Objectives and Scope:** The objectives of the project are to examine impacts of CBM development on the land surface, soils, plants, and energy and water resources of the PRB. The majority of the project's activities will occur within an area (roughly 200 km<sup>2</sup>) slated for a landscape change analysis. This area, to be selected in consultation with BLM, will be chosen to maximize opportunities for conducting investigations of current relevance to BLM science needs. It is certain that some project activities will occur outside of this area owing to site specific requirements of a particular investigation, needs for particular efforts to be conducted at a larger scale (perhaps basin-wide), and the possibility of new critical issues arising outside of the area. The project will incorporate some recently completed and ongoing USGS investigations related to CBM development. Examples of these investigations include studies of recharge and geochemical evolution of CBM production water being discharged into an ephemeral drainage (Burger Draw), ongoing monitoring of water quantity and quality in streams receiving CBM discharges, a gas resource evaluation and associated ground water quality

investigation being conducted in cooperation with BLM, and an evaluation of invasive plant species distribution in CBM development areas. The project will attempt to build on these studies by using their findings and interpretations to pose new research questions. Special emphasis will be placed upon questions where capabilities from more than one discipline have the potential to lead to enhanced understanding. For example, it has been observed that CBM discharges into ephemeral channels result in year-round streamflow accompanied by rapid and dramatic increases in plant growth along the stream channel. A possible contributing factor in this change is dissolved nitrogen in the CBM discharge water. This nitrogen, which is discharged at the land surface as dissolved ammonium ion, undergoes significant chemical transformations as it is transported along the stream channel. Understanding the complex processes associated with this phenomenon will call upon expertise in plant ecology, hydrology, soil science, aquatic geochemistry and microbial ecology applied at the stream reach scale. Further, understanding the extent and cumulative impact of this landscape response could employ sampling across multiple watersheds as well as remote sensing techniques applied to larger land areas. The project team will attempt to address several such interdisciplinary questions during the course of the project. A key component of the project will be to compile, analyze, and present existing and newly acquired spatial data (soils, vegetation, geology, hydrology, topography, CBM infrastructure, etc.) within the study area.

**Approach:** As our principal DOI partner, BLM will be actively engaged in project planning. The BLM, Buffalo Field Office (BFO) has primary responsibility for overseeing most of the CBM development with ties to federal lands and federal mineral rights in the Wyoming portion of the PRB. Recent activities in the PRB by all four USGS disciplines have established working relationships with BLM personnel (range managers, soil scientists, and hydrologists) from the BFO. As appropriate, BLM personnel from other offices (for example, the Wyoming State Office and National Science and Technology Center), and other DOI agency personnel will be kept informed of project plans and activities, and consulted on project directions. Funding from the Central Region Interdisciplinary Science Program (CRISP) was used to begin an interdisciplinary investigation of CBM water disposal practices at an infiltration reservoir (Skewed Reservoir) in fiscal year 2003. This project will continue to support activities at the Skewed Reservoir site as well as in an adjacent drainage (Burger Draw) that was the focus of a recently completed Director's Venture Capital project. USGS scientists will conduct site-specific, watershed-scale studies, as well as investigations covering larger areas, perhaps covering a large portion of the entire structural basin. Examples of anticipated investigations include quantification of recharge and vegetation changes resulting from surface disposal of CBM discharges into ephemeral channels, quantification of solute transport into the shallow subsurface from a CBM infiltration reservoir, geochemical modeling of interactions between CBM discharge water and various geologic materials (soils, stream sediments, unsaturated zone minerals, etc.), analysis of nitrogen loading into perennial streams from surface discharge of CBM production water, landscape change analysis of areas undergoing rapid CBM development, and characterization of soils and other geologic materials to better understand interactions between CBM discharge waters and those materials. An attempt will be made to extrapolate findings from specific sites and watersheds to similar settings in larger areas of the PRB so that study results can be more broadly applied by decision makers. An already developed database platform, the Powder River Information Science Access Site (PRISAS) will be used to serve spatial data, provide decision support tools, and provide web page information about the project.

**Benefits:** One benefit will be increased scientific understanding of environmental impacts of a relatively new, and increasingly prevalent, method of energy production. An interdisciplinary team of USGS scientists, integrating the agency's unique capabilities, should be able to develop a more complete view of the complex, interrelated impacts of CBM development on the energy, biologic and hydrologic resources of the PRB. An equally important benefit will be the development of data and interpretations that will have relevance for BLM land managers coping with the unprecedented pace and scope of CBM development in the PRB. Products and data from this project will also be of interest to current USGS customers such as the Wyoming Department of Environmental Quality, Wyoming State Engineer's Office, USEPA, USFWS, and to CBM producers, advocacy groups and private citizens. Because a portion of the CBM development in the PRB is occurring on and near public lands, environmentally sound CBM production is of benefit to all U.S. citizens. The Director's goals for integrated science will be advanced as the work at the site will provide opportunities for USGS scientists from all disciplines to work jointly within a common study area on scientific problems related to CBM development, an activity that is of significant interest to other DOI agencies.

**Outcome/Products:** It is expected that several peer-reviewed publications will be produced by project scientists during and following the three year funding period. In addition, project scientists will make presentations at regional and national technical meetings. It is anticipated that regular consultation and information exchange between USGS scientists and BLM personnel will support better-informed decision-making by BLM managers. Project activities, preliminary findings and publications will be publicly available at a project website. In addition, data such as spatial coverages and water quality time series will be served for use by USGS, BLM and other interested parties. At the conclusion of the project, if adequate funds can be obtained, a general interest publication describing key findings from the study will be produced.

**Budget:** Dollar amounts in the table below are in thousands, and all numbers are gross funds (includes all assessments). The table only shows DOI Landscapes Initiative funds. Additional funding, USGS program funding supporting project scientists' time, in-kind contributions of time and materials from BLM, and reimbursable funding from BLM will significantly leverage DOI Landscapes Initiative funds. For example, CRISP funding supplied \$50,000 to support work at the Skewed Reservoir site in FY 2003. Other USGS program funding provided an additional \$82,000, BLM provided \$38,000 of reimbursable funding, and an estimated \$10,000 of in-kind services (primarily field technician support at the site).

<b>DOI LANDSCAPES INITIATIVE FUNDS (year one totals, values are dollars / 1000)</b>					
	<b>BIOLOGY</b>	<b>GEOLOGY</b>	<b>GEOGRAPHY</b>	<b>WATER</b>	
<b>CATEGORY</b>					<b>TOTAL</b>
<b>Salary</b>	27	23	32	50	132
<b>Travel</b>	6	6	6	8	26
<b>Equipment/ Supplies</b>	2	3	19	4	28
<b>Services (Laboratory)</b>		9		9	18
<b>Services (Drilling)</b>		7		7	14
<b>TOTAL</b>	35	48	57	78	218