Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs

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United States Environmental Protection Agency
Office of Water
Office of Ground Water and Drinking Water
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List of Acronyms and Abbreviations

μg/g	*Micrograms per gram*
μg/L	*Micrograms per liter*
ADEM	*Alabama Department of Environmental Management*
Bbl/min	*Barrel per minute*
Bcf	*Billion cubic feet*
Bgs	*Below ground surface*
BHP	*Bottom hole pressure*
BLM	*Bureau of Land Management*
BTEX	*Benzene, toluene, ethylbenzene, xylenes*
Btu	*British thermal unit*
CBM	*Coalbed methane*
CDH	*Colorado Department of Health*
CCL	*Contaminant Candidate List*
CDWR	*Colorado Division of Water Resources*
CFR	*Code of Federal Regulations*
CMHPG	*Carboxymethylhydroxypropylguar*
COGCC	*Colorado Oil and Gas Conservation Commission*
DASC	*Data Access and Support Center*
DNR	*Department of Natural Resources*
DOE	*Department of Energy*
EPA	*Environmental Protection Agency*
g	*Gram*
g/mL	*Grams per milliliter*
GRI	*Gas Research Institute*
GTI	*Gas Technology Institute*
GSA	*Geological Survey of Alabama*
HCl	*Hydrochloric acid*

HEC	*Hydroxyethylcellulose*
HPG	*Hydroxypropylguar*
KCl	*Potassium chloride*
L	Liter
LEAF	*Legal Environmental Assistance Foundation*
Mcf	*Million cubic feet*
MCL	*Maximum contaminant level*
md	*Millidarcy*
mg/L	*Milligrams per liter*
mL	*Milliliter*
MOA	*Memorandum of Agreement*
MSDS	*Material Safety Data Sheet*
MTBE	*Methyl tert butyl ether*
NMOCD	*New Mexico Oil Conservation Division*
NPDEA	*National Pollution Discharge Elimination System*
OGB	*Oil and Gas Board*
OGWDW	*Office of Ground Water and Drinking Water*
P3D	*Pseudo 3 Dimensional*
PAH	*Polynuclear aromatic hydrocarbons*
POM	*Polycyclic organic matter*
ppm	*Parts per million*
PRBRC	*Powder River Basin Resource Council*
PRCMIC	*Powder River Coalbed Methane Information Council*
psi	*Pounds per square inch*
SDWA	*Safe Drinking Water Act*
SEO	*State Engineer's Office*
SJRA	*San Juan Regional Authority*
TBEG	*Texas Bureau of Economic Geology*

Tcf	*Trillion cubic feet*
TDS	*Total dissolved solids*
TGD	*Tennessee Geology Division*
UIC	*Underground Injection Control*
USBM	*United States Bureau of Mines*
USDW	*Underground Source of Drinking Water*
USGS	*United States Geological Survey*
VDMME	*Virginia Division of Oil and Gas, within the Department of Mines, Minerals and Energy*
wt.	*Weight*

Glossary

Adsorption *Adhesion of gas molecules, ions or molecules in solution to the surface of solid bodies with which they are in contact.*

Alluvial aquifer *A water-bearing deposit of unconsolidated material (e.g., sand and gravel) left behind by a river or other flowing water.*

Amphoteric *Having both basic and acidic properties.*

Anaerobic Bacteria *Bacteria that thrive in oxygen-poor environments.*

Anisotropic *Having some physical property that varies with direction from a given location.*

Annulus *The space between the casing (the material that is used to keep the well stable; typically this material is steel) in a well and the wall of the hole, or between two concentric strings of casing, or between casing and tubing.*

Anticline *A fold of layered, sedimentary rocks whose core contains stratigraphically older rocks, the shape of the fold is generally convex upward.*

Aureole *A ring surrounding a volcanic intrusion where the surrounding rock has been altered.*

Azimuth *The direction of a horizontal line as measured on an imaginary horizontal circle.*

Bedrock aquifer *An aquifer located in the solid rock underlying unconsolidated surface materials (i.e., sediment). Solid rock can bear water when it is fractured.*

Billion cubic feet *A unit typically used to define gas production volumes in the coalbed methane industry; 1 Bcf is roughly equivalent to the volume of gas required to heat approximately 12,000 households for one year (based on the Department of Energy's average household energy consumption statistic, 2001).*

Biogenic *A direct product of the physiological activities of organisms.*

Bituminous *From the base word bitumen, referring to a general term for various solid and semi-solid hydrocarbons that are able to join together and are soluble in carbon bisulfide (e.g., asphalts).*

Breaker *A fracturing fluid additive that is added to break down the viscosity of the fluid.*

Breccia *A coarse-grained clastic rock composed of angular broken rock fragments held together by a mineral cement or a fine-grained matrix.*

Brecciated *Consisting of angular fragments cemented together.*

Btu *British thermal unit; a unit of measure used to define energy.*

Butt Cleat *The coal cleat set that abuts into face cleats.*

Capture Zone *The portion of an aquifer that contributes water to a particular pumping well.*

Cavitation Cycling	*Also known as cavity completion, an alternative completion technique to hydraulic fracturing, in which a cavity is generated by alternately pumping in nitrogen and blowing down pressure.*
Cleats	*Natural fractures in coal that often occur in systematic sets, through which gas and water can flow.*
CMHPG	*Carboxymethyl hydroxypropylguar; a form of guar gel.*
Craton	*A part of the earth's crust that has attained stability and has been relatively undeformed for a long time; the term is restricted to continents, and includes both shield and platform.*
Crosslinker	*An additive that when added to a linear gel, will create a complex, high viscosity, pseduoplastic fracturing fluid.*
Crosslinked Gel	*A gel to which a crosslinker has been added (see crosslinker).*
Darcy	*A measure of the permeability of rock or sediment.*
Desorption	*Liberation of tightly held methane gas molecules previously bound to the solid surface of the coal.*
Epiclastic	*Formed from the fragments or particles broken away (by weathering and erosion) from pre-existing rocks to form an altogether new rock in a new place.*
Evapotranspiration	*The portion of precipitation returned to the air through evaporation and transpiration.*
Face Cleat	*A coal cleat set that is through-going and continuous.*
Flowback	*The process of causing fluid to flow back to the well out of a fracture after a hydraulic fracturing event is completed.*
Fracture Conductivity	*The capability of the fracture to conduct fluids under a given hydraulic head difference.*
Geophone	*A seismic detector, placed on or in the ground, that responds to ground motion at its point of location.*
Graben	*An elongate, down-dropped block that is bounded by nearly parallel faults on both sides.*
Guar	*Organic powder thickener, typically used to make viscous fracturing fluids, completely soluble in hot and cold water, insoluble in oils, grease and hydrocarbons.*
HCl	*Molecular formula for hydrochloric acid; can be used in diluted form in the hydraulic fracturing process to fracture limestone formations and to clean up perforations in coalbed methane fracturing treatments.*
HEC	*Hydroxyethylcellulose; a form of guar gel.*
Hydraulic Conductivity	*(see permeability)*
Injectate	*In relation to the coalbed methane industry, this is the fracturing fluid injected into a coalbed methane well.*
Isopach	*A line drawn on a map through points of equal true thickness of a designated stratigraphic unit or group of stratigraphic units.*

Isotopic	*Rocks formed in the same environment, i.e. in the same sedimentary basin or geologic province.*
Isotropic	*A medium, such as unconsolidated sediments or a rock formation, whose properties are the same in all directions.*
KCl	*Molecular formula for potassium chloride.*
Lacustrine	*Pertaining to, produced by, or formed in a lake or lakes.*
Laminar Flow	*Water flow in which the stream lines remain distinct and the flow direction at every point remains unchanged with time; non-turbulent flow.*
Leakoff	*The magnitude of pressure exerted on a formation that causes fluid to be forced into the formation. In common usage, leakoff is often considered the movement of fluid out of primary fractures and into a geologic formation, either through small existing permeable paths (connected pores and natural fracture networks) or through small pathways created or enlarged in the rock through the fracturing process.*
Lenticular	*Pertaining to a discontinuous, lens-shaped (saucer-shaped) stratigraphic body.*
Linear Gel	*A simple guar-based fracturing fluid usually formulated using guar and water with additives or guar with diesel fuel.*
Lithology	*The description of rocks based on mineralogic composition and texture.*
Millidarcy	*The customary unit of measurement of fluid permeability; equivalent to 0.001 Darcy.*
Mcf	*Million cubic feet; a unit typically used to define gas production volumes in the coalbed methane industry; 1 Mcf is roughly equivalent to the volume of gas required to heat approximately 12 households for one year (based on the Department of Energy's average household energy consumption statistic, 2001); Mcf can sometimes represent 1,000 cubic feet.*
mg/L	*Milligrams per liter; typically used to define concentrations of a dissolved compound in a fluid.*
Mined-through studies	*Mined-through studies are projects in which coalbeds have been actually mined through (i.e., the coal has been removed) so that remaining coal and surrounding rock can be inspected, after the coalbeds have been hydraulically fractured. These studies provide unique subsurface access to investigate coalbeds and surrounding rock after hydraulic fracturing.*
Moduli	*Plural of modulus (often referred to as bulk modulus), the ratio of stress to strain, abbreviated as "k". The bulk modulus is an elastic constant equal to the applied stress divided by the ratio of the change in volume to the original volume of a body.*
Overthrust	*A low-angle thrust fault of large scale, with total displacement (lateral or vertical) generally measured in kilometers.*
Pad	*An initial volume of fluid that is used to initiate and propagate a fracture before a proppant is placed.*
Paleochannels	*Old or ancient river channels preserved in the subsurface as lenticular sandstones.*

Permeability	*The capacity of a porous rock, sediment, or soil to transmit a fluid; it is a measure of the relative ease of fluid flow under equal pressure and from equal elevations.*
Physiographic	*A region of which all parts are similar in geologic structure and climate and which has had a unified geomorphic history; its relief features differ significantly from those of adjacent regions.*
Play	*A productive coalbed methane formation, or a productive oil or gas deposit.*
Potentiometric	*The total head of ground water, defined by the level to which water will rise in a well.*
ppm	*Parts per million; typically used to define concentrations of a dissolved compound in a fluid; equivalent to 1 mg/L.*
Primacy	*The right to self-establish, self-enforce and self-regulate environmental standards; this enforcement responsibility is granted by EPA to States and Indian Tribes.*
Primary porosity	*The porosity preserved from some time between sediment deposition and the final rock-forming process; (e.g., the spaces between grains of sediment).*
Proppant	*Granules of sand, ceramic or other minerals that are wedged within the fracture and act to "prop" it open after the fluid pressure from fracture injection has dissipated.*
psi	*Pounds per square inch; a unit of pressure.*
Rank	*The degree of metamorphism in coal; the basis of coal classification into a natural series from lignite to anthracite.*
Screen-out	*Term used to describe a fracturing job where proppant placement has failed.*
Secondary porosity	*The porosity created through alteration of rock, commonly by processes such as, dissolution and fracturing.*
Semianthracite	*Term used to identify coal rank; specifically representing coal that possesses a fixed-carbon content of 86% to 92%.*
Stratigraphy	*The study of rock strata; concerning all characteristics and attributes of rocks and their interpretation in terms of mode of origin and geologic history.*
Subbituminous	*A black coal, intermediate in rank between lignite and bituminous.*
Subgraywacke	*A sedimentary rock (sandstone) that contains less feldspar, and more and better-rounded quartz grains than graywacke; intermediate in composition between graywacke and orthoquartzite; it is lighter-colored and better-sorted, and has less matrix than greywacke.*
Surficial	*Pertaining to or lying in or on a surface; specific to the surface of the earth.*
Syncline	*A fold of layered, sedimentary rocks whose core contains stratigraphically younger rocks; shape of fold is generally concave upward.*
Tcf	*Trillion cubic feet; a unit typically used to define gas production volumes in the coalbed methane industry; 1 Tcf is roughly equivalent to the volume of gas required to heat approximately 12 million households for one year (based on the Department of Energy's average household energy consumption statistic, 2001).*

Thermogenic	*A direct product of high temperatures, (e.g. Thermogenic methane).*
Toughness	*The point at which enough stress intensity has been applied to a rock formation, so that a fracture initiates and propagates.*
Transmissivity	*A measure of the amount of water that can be transmitted horizontally through a unit width by the full saturated thickness of the aquifer under a hydraulic gradient of one.*
Up-warp	*The uplift of a region; usually a result of the release of isostatic pressure, e.g. the melting of an ice sheet.*
Viscosity	*The property of a substance to offer internal resistance to flow; internal friction.*
Volcaniclastic	*Composed of fragments or particles, and related to volcanic processes either by forming as the result of explosive processes or due to the weathering and erosion of volcanic rocks.*