ALASKA LEGISLATURE COMMITTEE FILES, 2003-2004 8672
10978 HOUSE RESOURCES

HB

531

(File 3 of 3)

HOUSE COMMITTEE REPORT

(7)

Date Referred to Committee: March 4, 2004

FURTHER REFERRALS: Resources
Finance

Date of Committee Action: April 1 2004

The HOUSE SPECIAL COMMITTEE ON OIL AND GAS considered: **HB 531**

HOUSE BILL NO. 531 **CONVENTIONAL & NONCONVENTIONAL GAS LEASES**

"An Act relating to natural gas exploration and development and to nonconventional gas, and amending the section under which shallow natural gas leases may be issued; and providing for an effective date."

Recommends it be replaced with [ ] HCS *or* [✓] CS for HB 531 (O&G)
For Senate Bills with new title: [ ] Technical Title [ ] New Title: HCR_____ [✓] Same Title [ ] New Title

[ ] attach amendments
[ ] add new referral to _____Committee
[ ] Letter of Intent_____Committee

List of Abbrev for Depts.:
ADM
CED
COR
CRT
EED
DEC
DFG
GOV
HSS
LEG
LAW
LWF
MVA
DNR
DPS
REV
DOT
UA

NEW **FISCAL NOTES** *Assigned by Chief Clerk's Office				
List by Dept(s):	*FN#	Fiscal	Indet.	Zero
DNR			✓	

PREVIOUS **FISCAL NOTES**				
List by Dept(s):	FN#	Fiscal	Indet.	Zero

Signing with recommendations	**Printed Last Name**	**DP**	**DNP**	**NR**	**AM**
	Holm				✓
Bryn Kerttula	Kerttula				✓
Reo McGuire	McGuire				✓
Vic Rokeberg	Rokeberg				✓
Harry Crawford	CRAWFORD				✓
Chris Heinze	HEINZE				✓
Chair: Kurt Kohring	Kohring				X
Chair:					

Alaska Oil and Gas Association

AOGA

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Judith Brady, Executive Director

April 22, 2004

Via Facsimile: (907)465-4822

The Honorable Beverly Masek
Alaska State House of Representatives
State Capitol, Room 403
Juneau, AK 99801-1182

AOGA Concerns on Shallow Gas Legislation
(CSHB 531 and CSHB 395)

Dear Representative Masek:

The Alaska Oil & Gas Association (AOGA) shares your interest in Alaska's shallow gas leasing/coalbed methane program and your concern for its future. We have been following the proposed legislation pertaining to the shallow gas program and the public meetings undertaken by the Department of Natural Resources (DNR). We note that the Department has just released the public draft review of the Coalbed Methane Development Standards.

AOGA supports repealing the present, separate shallow gas leasing/coalbed methane program and incorporating it into Alaska's competitive oil and gas system with its required Best Interest Finding as proposed in CSHB 531. Simply stated, we believe many of the issues raised in this proposed legislation could, and should, be addressed by a Best Interest Finding. AOGA also recommends that CSHB 531 and CSHB 395 be revised to incorporate the same surface protection rights, including payment of damages and bonding requirements for nonconventional gas and coalbed methane, as the state demands for its conventional oil and gas leasing program. Alaska's current bonding requirements are based on legal precedent, are legally defensible, protect the state's dominant subsurface interest in the oil and gas that belongs to all Alaskans while assuring the surface owner of the right to negotiate a fair agreement for surface damages, should there be any. Finally, we have made recommendations on other provisions of CSHB 531 and CSHB 395.

AOGA is a private, nonprofit trade association whose 19 member companies represent the majority of oil and gas operations in the state. Our interest, as an association, is the same as the State of Alaska's: oil and gas leasing programs that have clear standards that are legally defensible and environmentally and technically sound, and that respect the rights of the public, the lessees and individual property owners.

CORRECTION

THE FOLLOWING DOCUMENT(S)
HAVE BEEN REFILMED TO
ASSURE LEGIBILITY OR PAGINATION

Alaska Oil and Gas Association

AOGA

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AOGA is a private, nonprofit trade association whose 19 member companies represent the majority of oil and gas operations in the state. Our interest, as an association, is the same as the State of Alaska's: oil and gas leasing programs that have clear standards that are legally defensible and environmentally and technically sound, and that respect the rights of the public, the lessees and individual property owners.

We appreciate the willingness of policy makers to understand the complex legal and political challenges inherent in Alaska's "split estate" heritage. While Alaska's ownership of the subsurface mineral estate on state-selected oil and gas lands is the basis for the state's wealth and its Permanent Fund, this same ownership sometimes causes concerns with private surface owners and managers. Both CSHB 531 and CSHB 395 address unconventional gas leasing in those instances where the state owns the subsurface and a private individual owns the surface.

The historical record of split estate transactions, both in other states and in Alaska, shows that most transactions between companies and individual landowners involve mutual respect, accommodation and agreement. For those transactions for which no agreement can be reached, there is a history of court decisions, including those in Alaska, which lay the foundation for resolving any such disputes today.

In 1996 the shallow gas leasing/coalbed methane program was viewed as a positive opportunity for the people of the state. In a bi-partisan vote the Legislature established the shallow gas leasing program with a vote of 57 yeas and 3 nays. Governor Knowles signed it into law.

The support for the program was based on its potential to bring new sources of clean, efficient energy to the state as well as providing jobs and taxes for local economies, and that in light of the tightening gas market in the Cook Inlet area, this new source could provide much needed gas reserves. It was believed the state had regulations in place to assure it could be done in an environmentally safe manner while protecting the rights of surface owners.

AOGA believes that shallow gas leasing and coalbed methane development is still a positive opportunity. The state does have regulations in place to assure environmentally safe development of coalbed methane and the state has the legal means of protecting both the surface and subsurface owners.

However, it has become clear that there is a lack of understanding of Alaska's split estate heritage as well as a variety of homeowner concerns that must be addressed if the future of the program is to be assured.

Most, if not all, of the present concerns being expressed by homeowners would have been aired, discussed and addressed had the program included a Best Interest Finding in the beginning.

AOGA agrees with concerned legislators and the administration that it will be in the best interest of all parties for the state to have the same leasing, public notice requirements, environmental protections, Best Interest Finding requirements, and bonding and surface use protections for nonconventional gas as it does for conventional oil and gas.

Alaska's conventional oil and gas leasing program is comprehensive, timely and legally defensible. It meets the public criteria for fair notice, local involvement, environmental protection, bonding and damage requirements. A Best Interest Finding:

- provides extensive public notice;
- provides for public hearings;

- provides written responses to all concerns raised;
- provides the opportunity for experts from all agencies, the Departments of Environmental Conservation, Fish & Game and Natural Resources, as well as local governments, private organizations and individuals to provide input;
- provides a method for responding to special circumstances with special mitigation measures; and
- provides a legally defensible, comprehensive finding on which all parties can rely.

Recommendations for CSHB 531

1. AOGA supports repealing the present, separate shallow gas leasing/coalbed methane program and incorporating it into Alaska's competitive oil and gas system with its required Best Interest Finding as proposed in CSHB 531.

We believe that such an action will restore the faith of the public in these programs.

2. We support that provision of CSHB 531 that clearly identifies the role of the Alaska Oil & Gas Conservation Commission (AOGCC) in protecting water rights for nonconventional gas.(AS 31.05.030(j)).

This is the same role the Commission plays in conventional oil and gas leasing and therefore meets our recommendation that nonconventional oil and gas must be subject to the same environmental criteria as conventional oil and gas.

3. AOGA recommends that CSHB 531 be revised to incorporate the same surface protection rights, including payment of damages and bonding requirements for nonconventional gas and coalbed methane, as the state demands for its conventional oil and gas leasing program.

Alaska has strict surface damage requirements to protect the rights of surface owners.

Since Statehood there have been many cases of split estate negotiations in the Matanuska and the Kenai Boroughs. Only two cases have gone to DNR for resolution.

A straightforward approach would be to include a provision making it clear that existing state law governing damages and bonds also applies to gas only leases. Recommended language for CSHB 531(RES), Version V, is suggested below, along with language that clarifies the process. This language replaces the language included in Section 41, AS 38.05.180(ff)(3)(A) and (B):

> (3) the provisions of AS 38.05.130 apply to gas only leases and shall be implemented as follows:
>
> **(A) Damages and posting of bond.** A developer may not exercise a right of entry until the developer makes provision to pay the surface owner full payment for all damages sustained by the surface owner by reason of entering upon the land. If the surface owner, for any cause, refuses or

neglects to settle the damages, the developer may enter upon the land after posting a surety bond determined by the Department of Natural Resources using a procedure similar to the procedure used to administer AS 38.05.130, including notice and an opportunity to be heard. The bond must be sufficient as to form, amount, and security to secure the surface owner payment for damages. The surface owner may institute legal proceedings in a court where the land is located as may be necessary to determine the damages that the surface owner may suffer.

(B) Before the amount of the surety bond to be posted is determined by the director, the director, after notice and an opportunity to be heard, shall review the lessee's proposed Plan of Operations to determine if use of the surface is reasonably necessary to remove the minerals.

(C) If the lessee holds a statewide bond, the amount determined by the director may be imposed against such bond and no separate additional bond will be required.

4. AOGA is strongly advising that there be no added requirement, special to shallow gas leasing or coalbed methane, concerning bonding/damages. Both CSHB 531 and CSHB 395 propose that, if the land owner and the lessee do not come to an agreement on use of the land, the director, in determining the amount of surety bond, shall make a finding that the lessee "has no other reasonable means of entry than access and entry on the land of the owner". Further, that in addition to the coverage of actual damages a surface owner be paid "reasonable compensation ...for any loss by the owner of the owner's use and enjoyment of the property." (Proposed language in CSHB 531AS 38.05.180 (ff)(3); CSHB 395AS 38.05.177(k)(3)).

As to the requirement that there be a finding that the lessee has no other reasonable means of entry, the legislature's attorney, Jack Chenoweth, pointed out his concern in a March 30 memo that, insofar as the new bonding provisions in CSHB 531 and CSHB 395 limit access to the subsurface estate, they would therefore "call into question compliance with the statutory reservation" of the state's subsurface reservation of mineral rights.

The new bonding and damages proposals in CSHB 531 and in CSHB 395 raise serious legal and practical issues for all of Alaska's oil and gas leasing programs by making the dominant mineral estate into the subservient estate. Case law on surface estate is very clear that the mineral estate is the dominant estate, carrying with it the right to make such use of the surface as is reasonably necessary to remove the minerals.

Alaska's current bonding requirements are based on legal precedent, are legally defensible, protect the state's dominant subsurface interest in the oil and gas that belongs to all Alaskans while assuring the surface owner of the right to negotiate a fair agreement for surface damages, should there be any.

Alaska is not unique in having different owners of the surface and subsurface or mineral estate. Alaska is unique in that the state's mineral estate was deemed so important to the state's future that the Alaska Statehood Act imposed restrictions on the state's ability to alienate its mineral estate.

Under 6(i) of the Statehood Act, the state must reserve to itself the mineral rights of all lands granted to it and must continue to do so even when the state sells, grants, deeds or patents these lands to third parties. If the state does not do so, the state lands "shall be forfeited to the United States...".

This restriction has implications for what rights the state can and cannot grant to surface owners when the state owns the subsurface. Quite simply, the state cannot transfer to a private surface owner a right that is inherent in the mineral state.

The combination of long-standing legal precedent in the resolutions of rights between surface and subsurface owners along with the restrictions in 6(i) of the Statehood Act means that care must be taken in responding to the challenge of protecting rights.

With the changes proposed above, nonconventional gas (shallow gas and coalbed methane) would be subject to the same process, notice, environmental and surface protection requirements as the conventional oil and gas leasing program in Alaska.

Recommendations on CSHB 395

1. AOGA supports the direction to the AOGCC on the protection of water in the proposed amendment of AS 31.05.030(j). AOGCC's role should be the same for conventional and unconventional oil and gas leasing.

2. We question the purpose and workability of the proposed AOGCC public forum process for shallow gas proposed in the section on AS 31.05.098. If the shallow gas program is incorporated into a Best Interest Finding, which we believe is the most comprehensive answer to concerns being expressed, this section will not be necessary.

If, this section is retained in lieu of a Best Interest Finding, the following should be considered:

- Tighten up the language to reflect that only matters within AOGCC's jurisdiction will be addressed in the hearings. (See especially lines 28-30 on page 3.)
- Determine who can complain and in what time period. As written, anyone, anywhere, at any time can file a complaint and expect a public process 60 days later. Due process to the lessee is lost.
- This section also seems to be making the AOGCC the gatekeeper for all complaints to the Department of Environmental Conservation, the Department of Public Safety, the Department of Natural Resources. Is the intent to add a new layer of hearings on these departments based on complaints?

3. It is noted that in the proposed amendment for private, non-state lands, the state's "damages and posting of bond" is almost identical to that provided for conventional oil and gas leasing (Chapter 90 Mineral Interests: Sec. 34.90.020) and yet for nonconventional leasing, additional requirements are proposed. (AS 38.05.177 (k)(3). (See also Section 12.)

The first issue is whether the legislature wants to impose these requirements on private lands.

The second issue has to do with imposing additional bonding and damage requirements for nonconventional leases. We have expressed our concern with this approach in our comments on CSHB 531 (See comments 3 and 4.) AOGA believes that conventional and nonconventional oil and gas leasing programs should be bound by the same historic case law pertaining to damages and surface use. We believe these laws provide the protection that Alaskans expect. We recommend that the same language we've proposed in Section 41 of HB 531 be substituted in this legislation for the same reasons.

We emphasize that the proposed additional requirements for damages have serious implications both for the legal precedents that have governed split estate matters for years and for the implications to Alaska's conventional oil and gas leasing program. They are the single largest impediment in both CSHB 395 and CSHB 531.

4. Additional water testing, this time a requirement that each private water well within a quarter mile circle be tested by the lessee, is included in a new subsection, AS 38.05.177(f). It may be desirable to baseline test, but the size of area required to be tested is going to present some problems, aside from the obvious cost. It is our understanding that many Alaskans do not register their wells nor are all wells that are not registered logged. Further, some owners may not want them tested. There should be consideration given as to how a lessee could comply with this requirement.

5. The sections pertaining to appropriate setbacks and reasonable and appropriate noise mitigation would be more appropriately addressed in a Best Interest Finding, as would the lease abandonment requirement. All of these issues are commonly addressed in Best Interest Findings.

This concludes AOGA's comments. We hope they are helpful. We would be glad to work with you to ensure that the unconventional gas leasing program offers the same level of protection and assurance to the lessees, the public and the State as does Alaska's conventional oil and gas program.

Sincerely,

JUDITH BRADY
Executive Director

FISCAL NOTE

updated

STATE OF ALASKA
2004 LEGISLATIVE SESSION

Fiscal Note Number:
Bill Version: HB531CS(FIN)-DNR-O&G-0
() Publish Date:

Revision Date/Time (Note if correction): 4/29/2004
Dept. Affected: Natural Resources

Title: Conventional & Non-conventional Gas Leasing
RDU: Resource Development
Component: Oil and Gas Development
Sponsor: House Resources
Requester: House Rules
Component No.: 439

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

OPERATING EXPENDITURES	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
Personal Services	80.0					
Travel	4.0					
Contractual	165.5					
Supplies	3.1					
Equipment						
Land & Structures						
Grants & Claims						
Miscellaneous						
TOTAL OPERATING	252.6	0.0	0.0	0.0	0.0	0.0
CAPITAL EXPENDITURES						
CHANGE IN REVENUES ( )	**Indeterminate Amount **					

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts						
1003 GF Match						
1004 GF	252.6					
1005 GF/Program Receipts						
1037 GF/Mental Health						
Other (Specify Type--Do not abbreviate)						
TOTAL	252.6	0.0	0.0	0.0	0.0	0.0

Estimate of any current year (FY2004) cost: 0.0
Check this box (X) if funding for this bill is included in the Governor's FY 2005 budget proposal:

POSITIONS

Full-time						
Part-time						
Temporary	1					

ANALYSIS: *(Attach a separate page if necessary)*

This bill would eliminate the current over-the-counter shallow natural gas program. HB 531 would create a new gas only option under the competitive leasing and exploration licensing programs.

**Indeterminate positive revenue: Moving from an over-the-counter program to a competitive program will result in increased revenue to the state. The commissioner will be able to set minimum rentals and bonus bid amounts based on technical analysis of the potential resources and economics of the lease or license area. While a best interest finding process will cost more up front, that cost will be more than offset by the gains in going to a competitive process. Also, having a best interest finding process at the leasing and licensing stage will facilitate a more efficient progression to exploration and development and provide the state with royalties and other revenues from development sooner.

Prepared by: Mark D. Myers
Phone 269-8800
Division: Oil and Gas
Date/Time 4/29/04
Approved by: Thomas Irwin, Commissioner
Date 4/29/04
Agency: Natural Resources

(Revised 9/2003 OMB)

FISCAL NOTE

STATE OF ALASKA
2004 LEGISLATIVE SESSION

BILL NO. HB531CS(FIN)-DNR-O&G-0

ANALYSIS CONTINUATION

Section 60 would allow all pending shallow natural gas applicants a one-time opportunity to convert to a noncompetitive exploration license application upon payment of an application fee of $1 per acre and with a 3-year work commitment equal to $3 per acre. This section would also require DNR to conduct a best interest finding process prior to issuing the license.

In order to convert pending shallow natural gas applications to exploration licenses, DNR would need to simultaneously work on at least three additional best interest findings. In order to do so, it will be necessary to add one additional temporary best interest finding writer and contract out major portions of at least three findings. DNR anticipates after completing these findings that additional funding will not be needed.

DNR anticipates that there would be three separate best interest findings to cover conversion of the shallow natural gas applications to exploration licenses.

Expenditures:
Natural Resource Sp. III ($80,000 Personal Services, $4,300 Contractual, $3,000 Supplies).
Travel for public hearings: $4,000.
Outside Contracts for portions of three best interest findings: $150,000
Expenses Associated with public notice and printing best interest findings:
Printing findings: $1,400
Postage $1,600
Envelopes: $69
Public Notice (legal ads and display ads): $8,231
(The Anchorage Daily News has general circulation in all areas of the state. The cost for a legal notice in the Anchorage Daily News is $404 per day (weekday). 9 x $404 = $3,636. Publication cost in a local paper is estimated at $225. 9 x $225 = $2,025. Display ad in the Anchorage Daily News = $614.70 x 3 = $1,844.10. Display ad in a local paper = $242.00 x 3 = $726)

FISCAL NOTE

STATE OF ALASKA
2004 LEGISLATIVE SESSION

Fiscal Note Number:
Bill Version: HB531-DNR-O&G-03-12-04
() Publish Date:

Revision Date/Time (Note if correction):
Dept. Affected: Natural Resources
Title: Conventional & Non-conventional Gas Leasing
RDU: Resource Development
Component: Oil and Gas Development
Sponsor: House Resources
Requester: House Oil and Gas
Component No.: 439

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

OPERATING EXPENDITURES	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 201[illegible]
Personal Services						
Travel						
Contractual						
Supplies						
Equipment						
Land & Structures						
Grants & Claims						
Miscellaneous						
TOTAL OPERATING	0.0	0.0	0.0	0.0	0.0	0.0
CAPITAL EXPENDITURES						
CHANGE IN REVENUES (1004 GF) +	**Indeterminate Positive Amount**					

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts						
1003 GF Match						
1004 GF						
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1037 GF/Mental Health						
Other (Specify Type–Do not abbreviate)						
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0

Estimate of any current year (FY2004) cost: 0.0
Mark this box (X) If funding for this bill is included in the Governor's FY 2005 budget proposal:

POSITIONS

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Part-time						
Temporary						

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Prepared by: Mark D. Myers
Phone 269-8800
Division: Oil and Gas
Date/Time 3/11/04
Approved by: Thomas Irwin, Commissioner
Date 3/12/04
Agency: Natural Resources

(Revised 8/2003 OMB)

What is the UIC program?

Critical Initiatives

Classes of Injection Wells
- Class I
- Class II
- Class III
- Class IV
- Class V

State UIC Programs

Regulations & Guidance

Study of Potential Impacts of Hydraulic Fracturing of Coalbed Methane Wells on Underground Sources of Drinking Water

EPA is completing a study of the possible impacts of hydraulic fracturing on underground sources of drinking water (USDWs). The Agency prepared a draft report on the preliminary results of its investigation which focuses on hydraulic fracturing used specifically for enhancing coalbed methane production. That report was published in August 2002. EPA used existing sources of information, and consolidated pertinent data into a summary report to serve as the basis for the study. Based on an analysis of the information collected, EPA has preliminarily found that the potential threats to public health posed by hydraulic fracturing of coalbed methane wells appear to be small and do not justify additional study.

- Read the Federal Register Notice for directions on how to submit comments
- Executive Summary (PDF 6 MB) - this is the corrected version
- Read/Print The Complete Study Online

EPA received over 100 sets of comment from citizens, industry, and states. We have reviewed and addressed those comments. The final report will reflect changes resulting from public comment. Please check this site periodically for the final report.

BACKGROUND

Prior to 1997, EPA had not considered regulating hydraulic fracturing because the Agency believed that this well production stimulation process did not fall under the Underground Injection Control (UIC) program's purview, nor under the jurisdiction of the Safe Drinking Water Act (SDWA).

In 1994, the Legal Environmental Assistance Foundation (LEAF) challenged that interpretation because LEAF believed the State of Alabama should regulate hydraulic fracturing for coalbed methane development as underground injection. LEAF petitioned EPA to withdraw Alabama's SDWA Section 1425 UIC program. EPA rejected LEAF's petition, and LEAF litigated. In 1997, the 11th Circuit Court of Appeals ruled that hydraulic fracturing of coalbeds in Alabama should be regulated under the SDWA as underground injection (LEAF v. EPA, 118 F. 3d 1467). The State was required to modify its UIC program, and in December 1999, EPA

approved this revision.

Since the 11th Circuit Court's decision, EPA has contacted and been contacted by citizens who expressed concern that practices associated with methane gas production from coalbeds has resulted in contamination of USDWs. EPA has been asked to support legislation which would exempt hydraulic fracturing from SDWA.

For more information, contact: Leslie Cronkhite, Drinking Water Protection Division, Environmental Protection Agency, Mail Code 4606, Ariel Rios Building, 1200 Pennsylvania Avenue, NW., Washington, DC 20460; Phone: (202) 564-3878; E-Mail: cronkhite.leslie@epa.gov.

You will need Adobe Acrobat Reader to view the Adobe PDF files on this page. See EPA's PDF page for more information about getting and using the free Acrobat Reader.

Last updated on Wednesday, March 3rd, 2004
URL: http://www.epa.gov/safewater/uic/cbmstudy.html

Executive Summary

This report summarizes findings from the US Environmental Protection Agency's (EPA) hydraulic fracturing study. The goal of this first phase of the study was to determine if a threat to public health as a result of underground sources of drinking water (USDW) contamination from hydraulic fracturing of coalbed methane (CBM) wells (herein known as hydraulic fracturing) exists, and if so, is it high enough to warrant further study. Based on the information collected, the potential threats to USDWs posed by hydraulic fracturing of CBM wells appear to be low and do not justify additional study.

This study is the most thorough effort conducted to review any impacts to public health as a result of USDW contamination from hydraulic fracturing. If risks from hydraulic fracturing of CBM wells were significant, we would expect to find instances of water well contamination from the practice. Instead, thousands of CBM wells are fractured annually and yet EPA did not find persuasive evidence that any drinking water wells had been contaminated by CBM hydraulic fracturing.

EPA also evaluated the theoretical potential for hydraulic fracturing to impact drinking water wells. In some cases, constituents of concern (see section ES-7) are injected into USDWs during the course of normal fracturing operations. However, EPA's determination is that the threat of contamination of drinking water supplies is low because concentrations are diminished by the ground water production aspect of coalbed methane development. Studies have found no observed breach of confining layers from hydraulically created fractures, consistent with theoretical understanding of fracturing behavior.

Although the threat to public health from hydraulic fracturing appears to be low, it may be feasible and prudent for industry to remove any threat whatsoever from injection of fluids. The use of diesel fuel in fracturing fluids by some companies introduces the majority of constituents of concern to USDWs. Water-based alternatives exist and from an environmental perspective, these water-based products are preferable.

ES-1 How Does CBM Play a Role in the Nation's Energy Demands?

Coalbed methane mining began as a safety measure in underground coalmines to reduce the explosion hazard posed by methane gas (Elder and Deul, 1974). In 1980, the U.S. Congress enacted a tax credit for non-conventional fuels production, including coalbed methane production, as part of the Crude Oil Windfall Profit Act. In 1984, there were fewer than 100 coalbed wells in the U.S. By 1990, almost 8,000 coalbed wells had been drilled nationwide (Pashin and Hinkle, 1997). In 1996, coalbed methane production in 12 states totaled about 1,252 billion cubic feet, accounting for approximately seven percent of U.S. gas production (U.S. Department of Energy, 1999). According to the U.S. Department of Energy, natural gas demand is expected to increase at least 45% in the next 20 years (U.S. Department of Energy, 1999). The rate of coalbed methane production is also expected to increase in response to the growing demand.

EPA reviewed geology in eleven basins, illustrated in Figure ES-1, throughout the U.S. The most actively producing basins are highlighted in red on the map and include the Powder River Basin in Wyoming and Montana, the San Juan Basin in Colorado and New Mexico, and the Black Warrior Basin in Alabama. Hydraulic fracturing is or has been used to stimulate CBM wells in all basins, although not frequently in the Powder River Basin. Table ES-1 lists the estimated number of active producing wells, production volume of methane gas, and our understanding of hydraulic fracturing activity in each of the eleven basins reviewed.

ES-2 What Is Hydraulic Fracturing?

Figure ES-2 illustrates a typical hydraulic fracturing event within a coalbed methane well. This diagram shows the fracture creation and propagation, as well as the proppant placement and fracturing fluid recovery stages.

A hydraulically created fracture acts as a conduit in the rock or coal formation that allows the oil or coalbed methane (one source of natural gas) to travel more freely from the rock pores to the production well that can bring it to the surface.

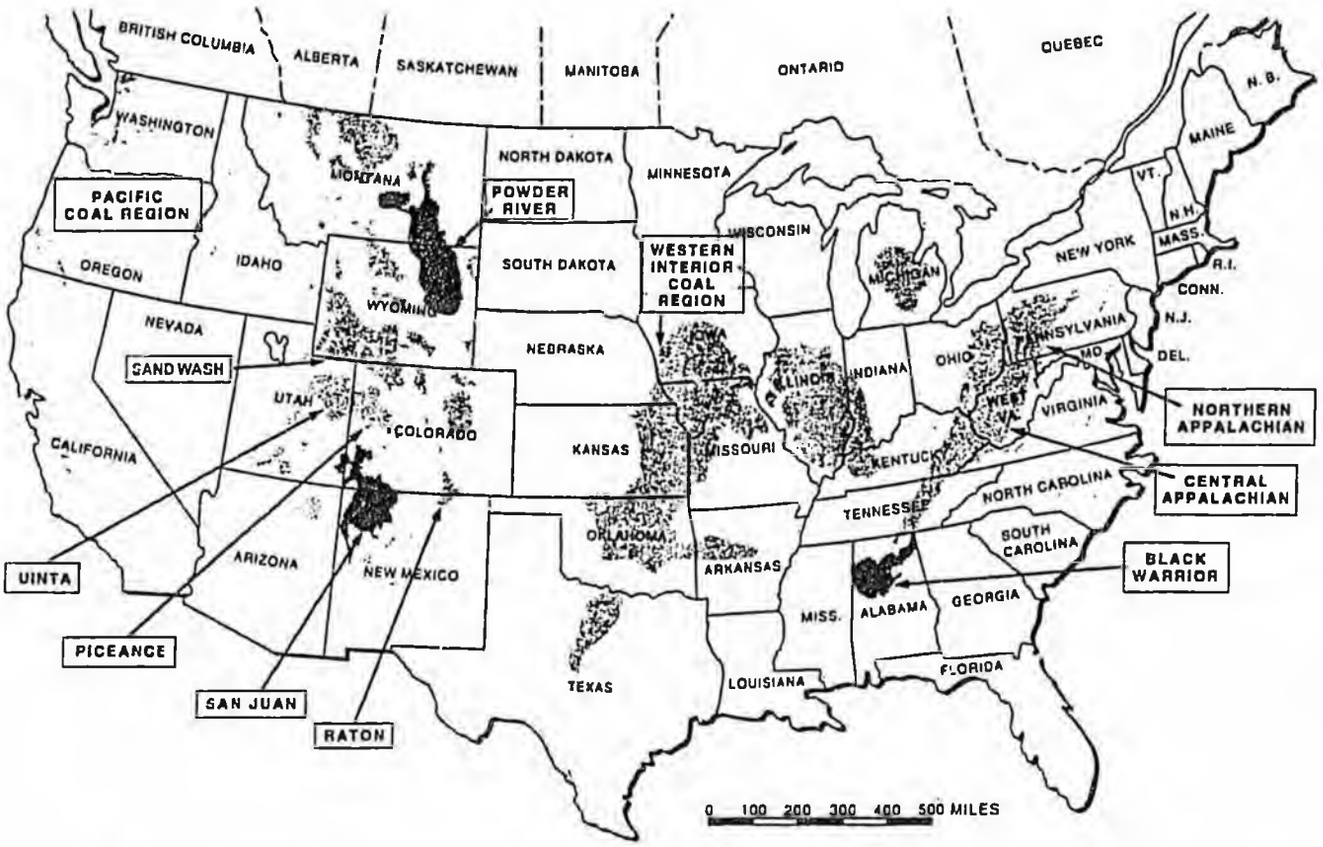
In the case of coalbed methane production, the gas is trapped in tiny, disconnected clusters of fractures (called "cleats") within a coal layer. The coal layer is typically sandwiched between

Table ES-1. U.S. Coal Basins Production Statistics and Activity Information

Basin	*Number of Producing Wells (Year 2000)	*Production of CBM in Billions of Cubic Feet (Year 2000)	Does Hydraulic Fracturing Occur?
San Juan	3,051	925	Yes
Black Warrior	3,086	112	Yes
Piceance	50	1.2	Yes
Uinta	494	75.7	Yes
Powder River	4,200	147	Yes (in the past)
Central Appalachian	1,924	52.9	Yes
Northern Appalachian	134	1.41	Yes
Western Interior	420	6.5	Yes
Raton Basin	614	30.8	Yes
Sand Wash	0	0	Yes (in the past)
Pacific Central	0	0	Yes (in the past)

*Data provided by GTI and EPA Region Offices

Figure ES-1. Locus Map of Major U.S. Coal Basins



layers of dense rock, such as shale, sandstone or limestone, which prevents the coalbed methane from migrating up and away from the coal. To extract the coalbed methane, a production well is drilled through the rock layers to intersect the coal seam containing the gas. Next, a fracture must be created in the coal seam to intersect the tiny, gas-bearing fractures and create a pipeline through which the coalbed methane can travel to the well so it can be brought to the surface.

To create such a fracture, a thick, water-based fluid is pumped into the coal seam at a gradually increasing rate. At a certain point, the coal seam will not be able to accommodate the fluid as quickly as it is being injected. When this occurs, the pressure is high enough that a fracture is created. A propping agent, usually sand (commonly known as "proppant"), is pumped into the fracture so that when the pumping pressure holding the fracture open is released, the fracture does not close completely because the proppant is "propping" it open. The resulting fracture filled with proppant is a conduit through which coalbed methane trapped in the formation can flow to the well.

Production begins when pumping of the well begins. Ground water is produced from the coal seam, decreasing the pressure and allowing methane to de-sorb from the coal matrix itself (Gray, 1987). Contrary to conventional gas production, the percentage of water produced declines with increasing coalbed methane production. In some basins, huge volumes of ground water are produced from the production well.

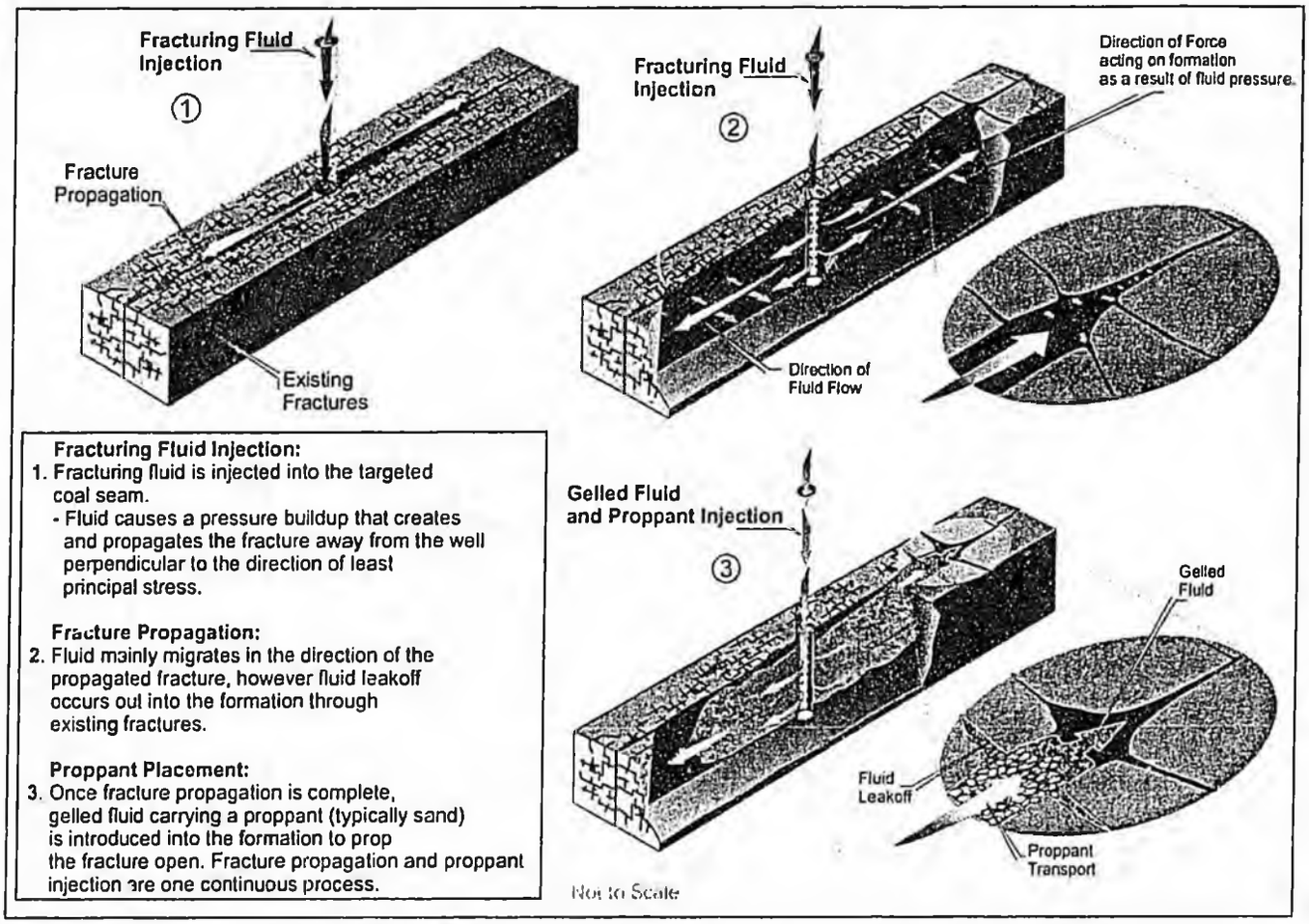
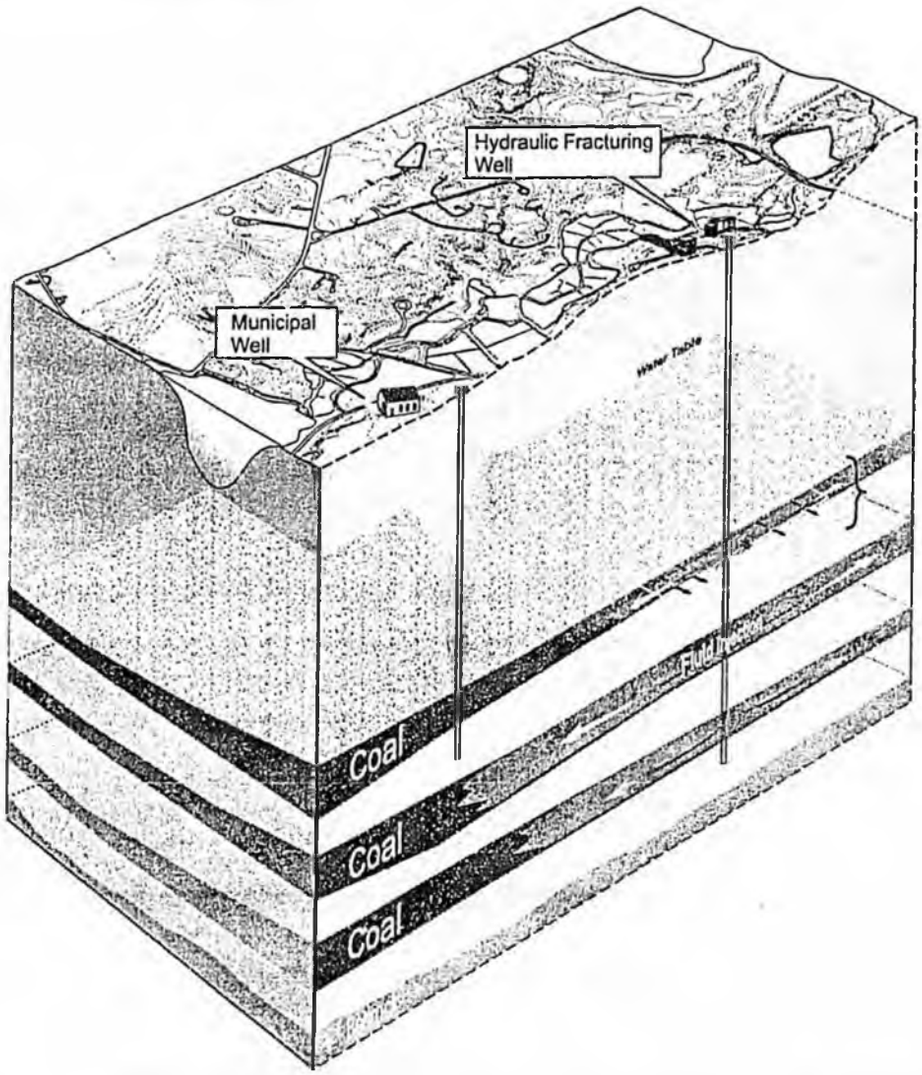
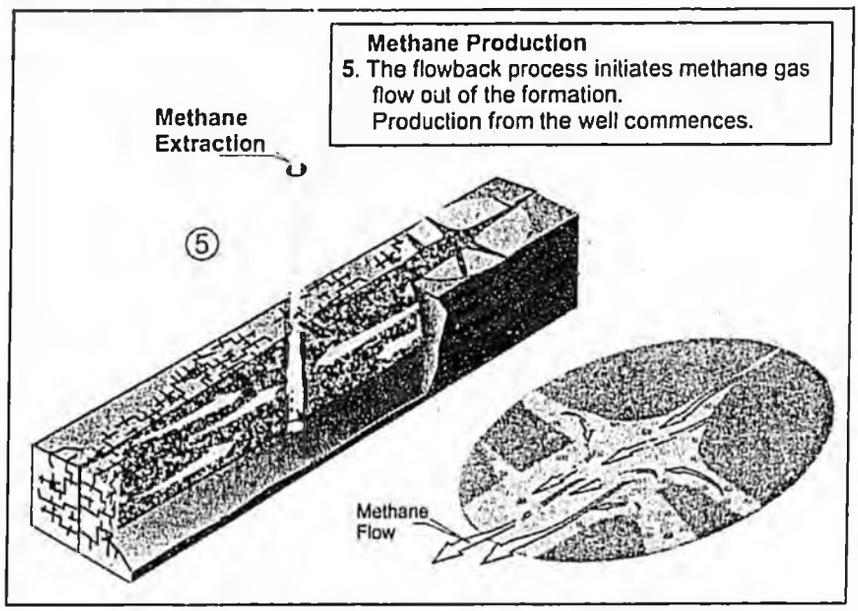


Figure ES-2. A Graphical Representation of the Hydraulic Fracturing Process in Coalbed Methane Wells


Hydraulic Fracturing Well
Municipal Well
Water Table
Fault
Coal
Coal
Coal


Methane Production
5. The flowback process initiates methane gas flow out of the formation. Production from the well commences.
Methane Extraction
⑤
Methane Flow

ES-3 Why Is EPA Evaluating Hydraulic Fracturing?

EPA's Underground Injection Control (UIC) Program is authorized by the Safe Drinking Water Act (SDWA) to protect public health from threats arising from contamination of USDWs resulting from underground injection activities. Underground injection is the subsurface emplacement of fluids through a well bore. However, SDWA does not authorize EPA to regulate oil and gas production practices.

A USDW is defined as an aquifer or it's portion that:

A.

1. supplies any public water system;

or

2. contains sufficient quantity of ground water to supply a public water system; and

i. currently supplies drinking water for human consumption; or

ii. contains fewer than 10,000 milligrams per liter (mg/L) total dissolved solids (TDS);

and

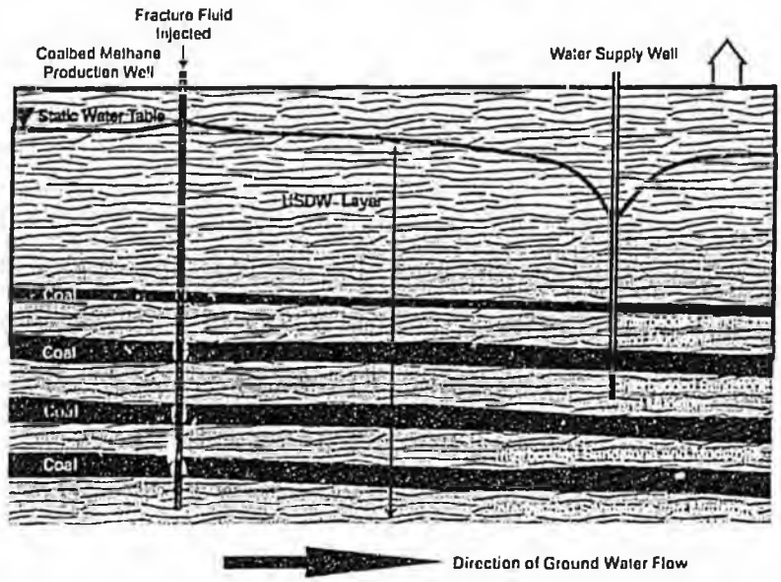
B. is not an exempted aquifer.

Although aquifers with greater than 500 mg/L TDS are rarely used for drinking water supplies, it is believed that imposing protection for waters with less than 10,000 mg/L TDS will ensure an adequate supply (through treatment) for present and future generations.

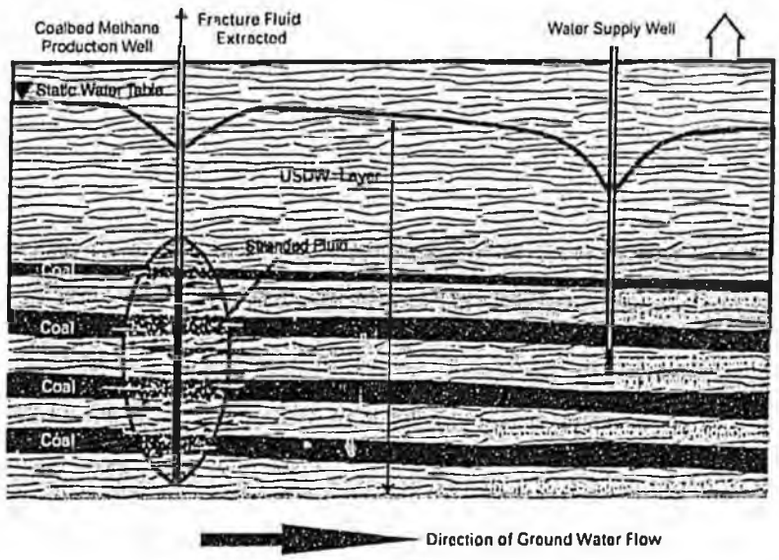
EPA initiated the hydraulic fracturing study in response to concerned citizens and the 11th Circuit Court's decision in LEAF v. EPA, 118F.3d 1467, which ruled that the State of Alabama must regulate hydraulic fracturing in order to retain authority of its State UIC Program. Members of Congress also wanted EPA to collect more information to evaluate any public health risks associated with hydraulic fracturing.

Figure ES-3. Direct Fluid Injection into a USDW (Coal within USDW)

Step 1:
Fracture Fluid is Injected into Coalbed Seams

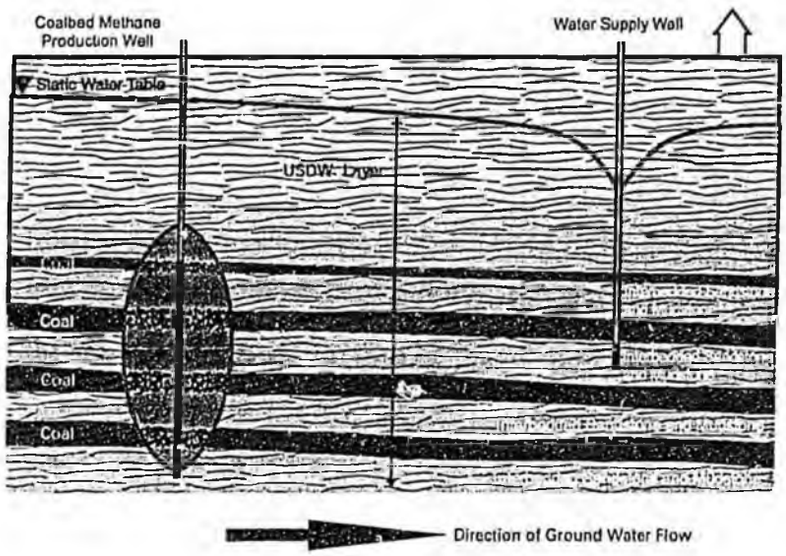


Step 3:
Fluid Stranded as Production Resumes

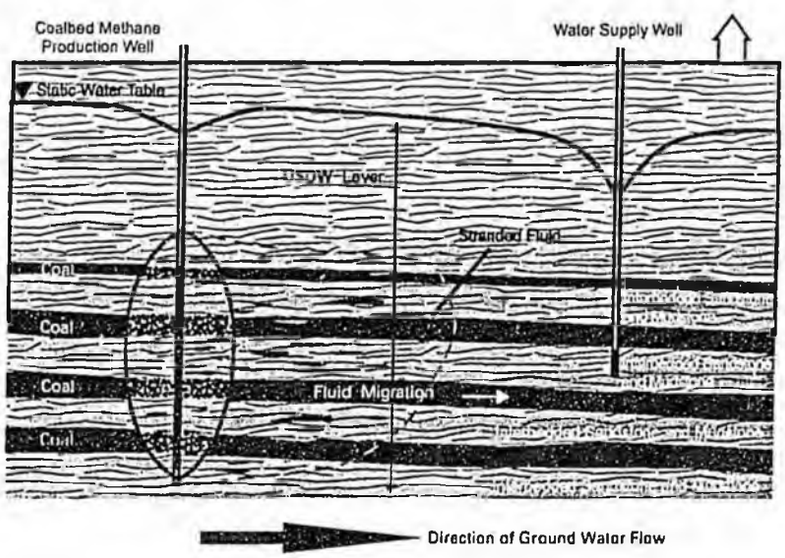


This study is narrowly focused to address hydraulic fracturing of CBM wells. It does not address all hydraulic fracturing practices, because (1) the 11th Circuit Court's decision was specific to CBM production; (2) CBM wells tend to be more shallow and closer to USDWs than conventional oil and gas production wells (1,000s of feet below ground surface [bgs] rather than 10,000s of feet bgs); and (3) EPA has not heard concerns from citizens regarding any other type of hydraulic fracturing. The study also does not address other concerns surrounding CBM production such as ground water removal or production water discharge

Step 2:
Fracture Created



Step 4:
Stranded Fluid Migration



ES-4 What Was EPA's Project Approach?

EPA designed the hydraulic fracturing study to have three possible phases, narrowing the focus from general to more specific as findings warrant. This report describes the findings from the Phase I efforts, a limited-scope assessment of potential threats posed from hydraulic fracturing using existing information.

The goal of EPA's hydraulic fracturing Phase I study is to determine if a threat to public health as a result of USDW contamination from hydraulic fracturing exists, and if so, is high enough to warrant further study. The threat to public health from USDW contamination was defined by the presence or absence of documented contamination cases stemming from hydraulic fracturing, or a clear immediate contamination threat to drinking water wells.

EPA's approach for evaluating the threat to public health was to review claimed incidents of drinking water well contamination as well as evaluate the theoretical potential for hydraulic fracturing to impact drinking water wells. We evaluated two potential mechanisms, illustrated in Figures ES-3 and ES-4, by which

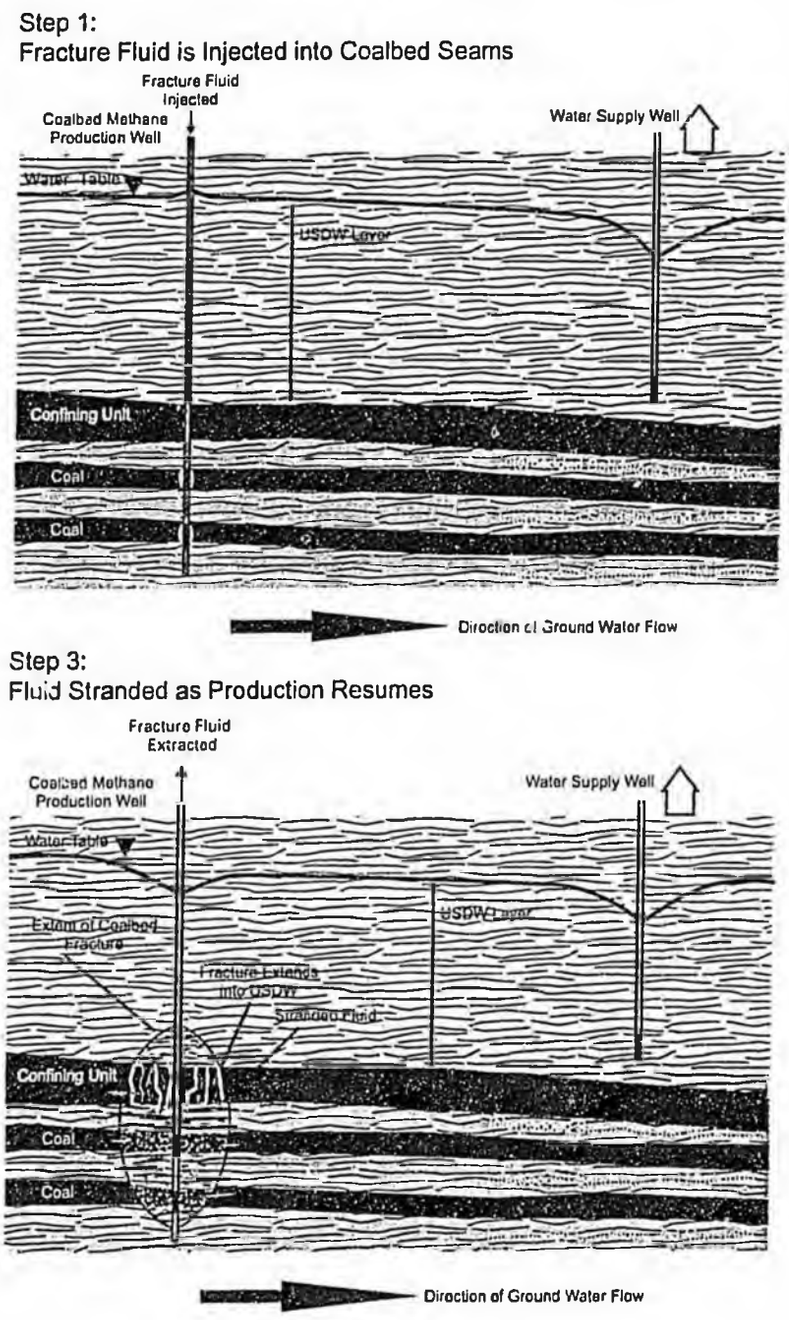
hydraulic fracturing may threaten USDWs: (1) the injection of fracturing fluids directly into a USDW, and (2) the creation of a hydraulic communication through a confining layer between the target coalbed formation and adjacent USDWs located either above or below.

ES-5 How Do Fractures Grow?

In many coalbed methane-producing regions, the target coalbeds occur within USDWs, and the fracturing process injects stimulation fluids directly into the USDWs. In other production regions, target coalbeds are adjacent to the USDWs that exist either higher or lower in the geologic section. Vertical fracture heights in coalbeds have been measured in excess of 500 feet and lengths can reportedly reach up to 1,500 feet. Fracture heights vary widely depending on the basin geology. For instance, in the Central Appalachian basin, fracture heights can be as small as two feet and lengths are typically in the range of 200 to 300 feet from the well bore (Halliburton, Inc., 2001). Hydraulic fracturing in coalbed methane formations in the Black Warrior basin can create fractures that are taller than they are long depending on the number of coal seams targeted and the strength of the intervening layers (Morales et al., 1990; Zuber et al., 1990; Holditch et al., 1989; Palmer et al., 1991, 1991a, 1993). The potential exists for fractures to extend from coalbeds into adjacent USDWs, which could increase communication between stratigraphic sections. Fractures generally will not penetrate confining layers separating coalbeds and overlying aquifers.

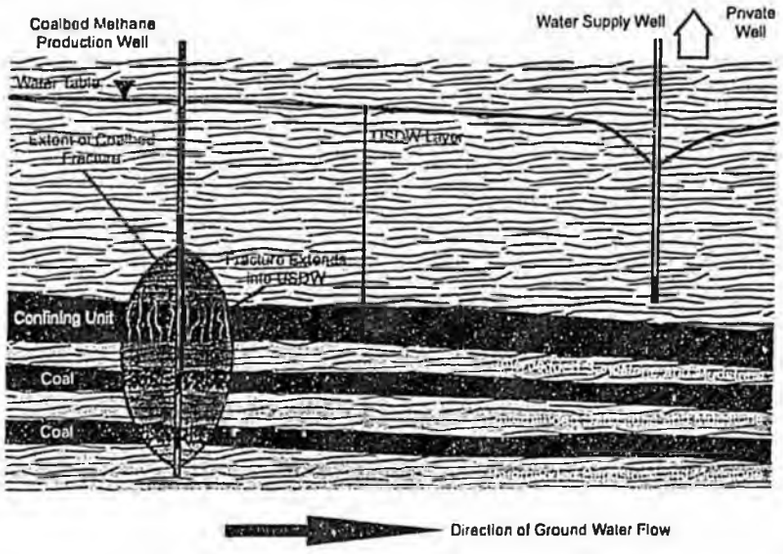
Once fracturing fluids are injected, either directly or indirectly, local geologic conditions may interfere with their

Figure ES-4. Fracture Creates Connection to USDW

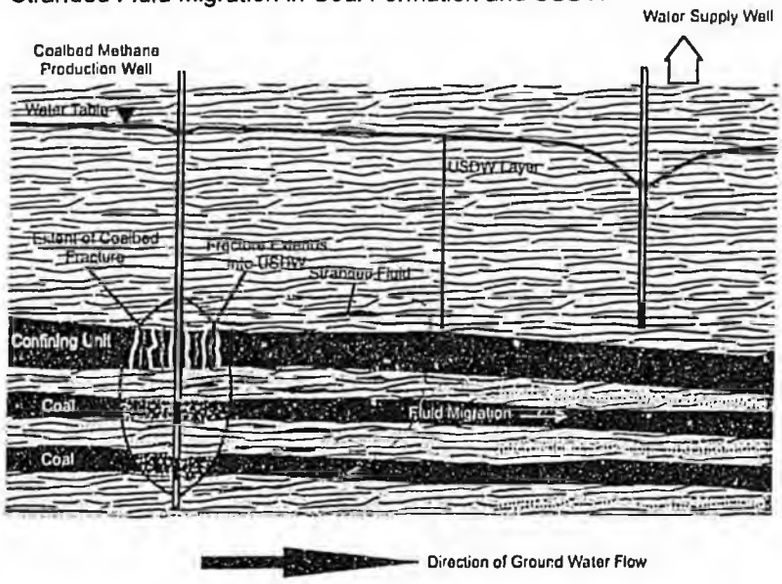


complete recovery. This may result in fracturing fluids being "stranded" in a USDW. Subsequent coalbed methane production creates a flow back regime that should contain ground water flow within the zone of influence surrounding the well. Any fluids not captured during production are presumably trapped due to low permeability within the formation. Low permeability limits ground water flow in both directions – toward the production well, which pulls ground water toward it and away from the production well.

Step 2:
Fracture Created (Breaking Through Confining Unit)



Step 4:
Stranded Fluid Migration in Coal Formation and USDW



The extent of a fracture is controlled by the characteristics of the geologic formation, the fracturing fluid type used, the pumping pressure, and the depth at which the fracturing is being performed. The fracture initiates from the well and extends out as two separate wings in opposite directions. Whether the fracture grows higher or longer is determined by the surrounding rock properties. A hydraulically created fracture will always take the path of least resistance through the coal seam and surrounding formations.

ES-6 What Is In Hydraulic Fracturing Fluids?

Fracturing fluids consist of primarily water or inert foam, such as nitrogen or carbon dioxide. Fluids also usually contain additives designed to improve performance of the fluid. Components of fracturing fluids are stored and mixed on site (Figures ES-5 and ES-6 show fluids stored in tanks at CBM well locations.) Table ES-2 lists additives available and any constituents of concern that may be in the additives. This information was obtained from material safety data sheets (MSDS) by EPA. Diesel fuel is the additive which contains most of the constituents of concern. It is used as an alternative to a water-based polymer gel. Much

more gel can be dissolved in diesel as compared to water, reducing the cost required to transport the fracturing fluids. Water and any additives are typically pumped from the storage tanks to a manifold system placed on the production wells where they are mixed and then injected into the coal formation (Figure ES-6). Coalbed fracture treatments typically use 50,000 to 350,000 gallons of various fracturing fluids, and from 75,000 to 320,000 pounds of sand as proppant (Holditch et al., 1988 and 1989; Jeu et al., 1988; Hinkel et al., 1991; Holditch, 1993; Palmer et al., 1991, 1993, and 1993a). The volumes of constituents of concern and the ultimate concentration at which they are injected into the ground vary, but chemical additives make up only a small fraction of the overall fluid mixture. EPA estimated the concentrations of chemicals of concern in fracturing fluids at the point of injection using mid-range volumes reported by service companies. Table ES-3 presents the estimated concentrations and compares them to drinking water or ground water standards.

Studies observed that for fracture stimulations in conventional production formations, 25 to 65 percent of fracturing fluids are recovered during flowback (Mukhergee et al. 1995; Samuel et al. 1997; Willberg et al. 1997 and 1998). In a study specific to coalbed methane production, Palmer et al. (1991a) reported a 61 percent recovery of fracturing fluids after 20 days of production and projected that 20 to 30 percent would remain in the formation. To inform our decision, EPA estimated the concentrations of constituents of concern at the edge of a fracture considering only dilution effects and assuming 60 percent of fluid was recovered. We estimated concentrations decreased to 30 times less than those at point of injection – a significant drop at a relatively short distance from the production well. Any constituent of concern would have to migrate long distances, both vertically and horizontally, before reaching an exposure point.

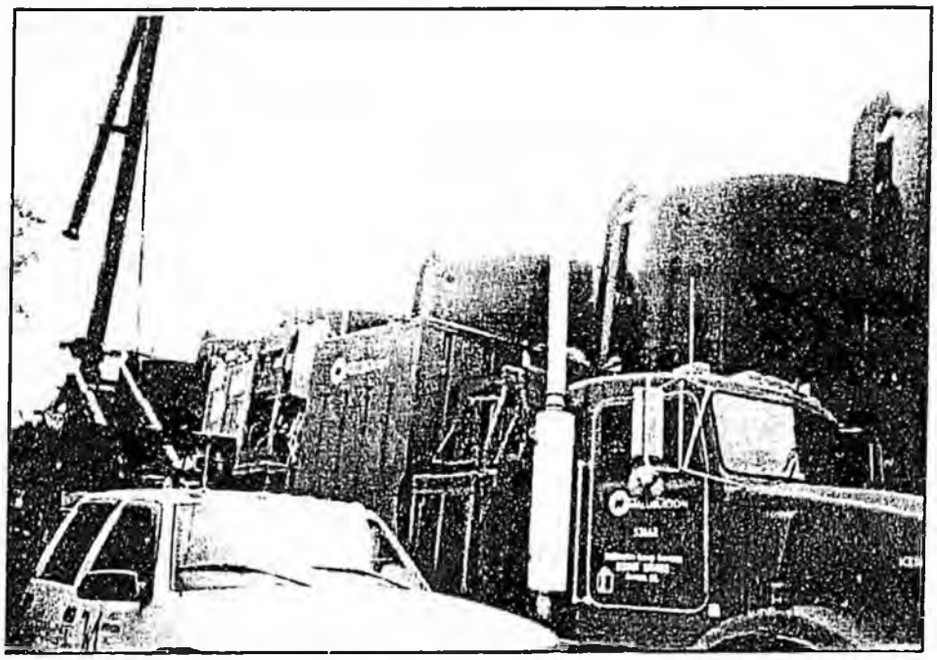


Figure ES-5. The fracturing fluids are stored on site in large, upright storage tanks and in truck-mounted tanks.

Methane production requires the removal of ground water; thus, in active coalbed methane wells the lowest pressure is typically in the CBM production well. Ground water will flow in the direction of the lowest pressure. This pressure dynamic should prevent un-recovered fracturing fluids from migrating beyond the influence of the CBM well.

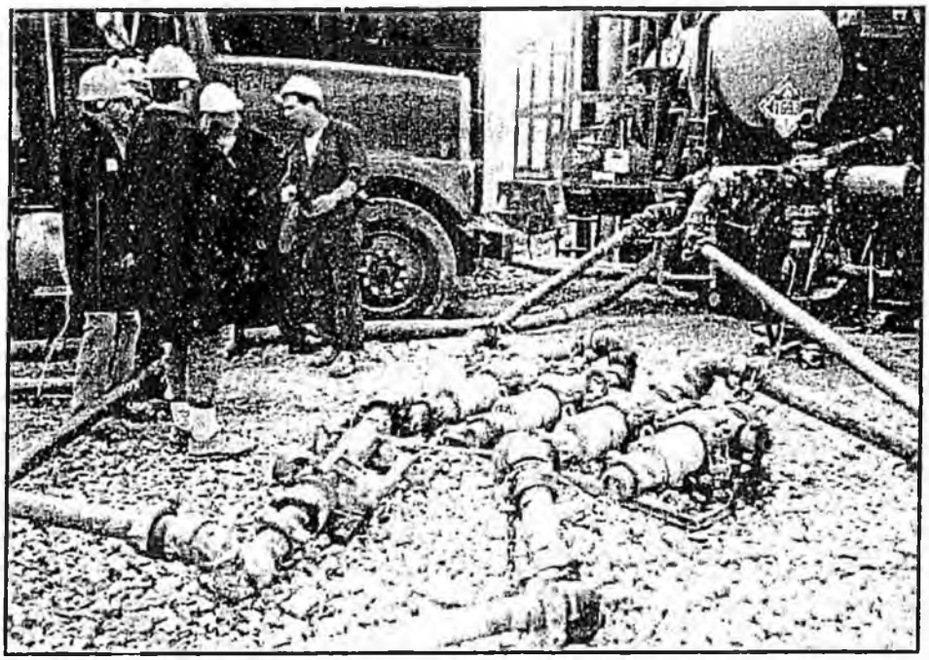


Figure ES-6. The fracturing fluids, additives, and proppant are pumped from the storage tanks to a manifold system placed on the wellhead where they are mixed just prior to injection.

ES-7 Are Coalbeds Located within USDWs?

EPA reviewed the geology of eleven basins to determine if coalbeds are co-located with USDWs and to understand the coalbed methane activity in the area. If coalbeds are located within USDWs, then any fracturing fluids injected into coalbeds have the potential to contaminate the USDW. As described previously, a USDW is not necessarily currently used for drinking water and may contain ground water not suitable for drinking without treatment. EPA found that ten of the eleven basins likely lie, at least in part, within USDWs. Table ES-4 identifies coalbed basin locations in relation to USDWs, and summarizes evidence used as the basis for the conclusions.

ES-8 Did EPA Find Any Cases of Contaminated Drinking Water Wells Caused by Hydraulic Fracturing in CBM Wells?

EPA reviewed studies and follow-up investigations conducted by State oil and gas agencies in response to citizen reports that CBM production resulted in water quality and quantity incidents. EPA found no confirmed cases of drinking water well contamination or water loss as the result of the hydraulic fracturing process.

EPA received reports of drinking water well problems associated with coalbed methane development (see Table ES-5) from:

- San Juan Basin (Colorado and New Mexico)
- Powder River Basin (Wyoming and Montana)
- Black Warrior Basin (Alabama)
- Central Appalachian Basin (Virginia and West Virginia).

Table ES-2. Summary of MSDSs[1] for Hydraulic Fracturing Fluid Additives

Product	Hazards Information	Toxicological Information	Ecological Information
Linear gel delivery system	-Harmful if swallowed -Combustible	- Chronic effects/Carcinogenicity - Contains diesel, a petroleum distillate (known carcinogen) - Causes eye, skin, respiratory irritation - Can cause skin disorders - Can be fatal if ingested	- Slowly biodegradable
Water gelling agent	- None	- May be mildly irritating to eyes	- Biodegradable
Linear gel polymer	- Flammable vapors	- Can cause eye, skin and respiratory tract irritation	- Not determined
Linear gel polymer slurry	- Causes irritation if swallowed - Flammable	- Carcinogenicity - Possible cancer hazard based on animal data; diesel is listed as a category 3 carcinogen in EC Annex 1 - May cause pain, redness, dermatitis	- Partially biodegradable
Crosslinker	-Harmful if swallowed -Combustible	-Chronic effects/Carcinogenicity D5 may cause liver, heart, brain reproductive system and kidney damage, birth defects (embryo and fetus toxicity) -Causes eye, skin, respiratory irritation -Can cause skin disorders and eye ailments	- Not determined
Crosslinker	- may be mildly irritating to eyes and skin - may be mildly irritating if swallowed	- May be mildly irritating	- Partially biodegradable - Low toxicity to fish
Foaming agent	- Harmful if swallowed - Highly flammable	- Chronic effects/Carcinogenicity - May cause liver and kidney effects - Causes eye, skin, respiratory irritation - Can cause skin disorders and eye ailments	- Not determined
Foaming agent	- Harmful if swallowed or absorbed through skin	- May cause nausea, headache, narcosis - May be mildly irritating	- Harmful to aquatic organisms
Acid treatment - hydrochloric acid	- May cause eye, skin and respiratory burns - Harmful if swallowed	- Chronic effects/Carcinogenicity - Prolonged exposure can cause erosion of teeth - Causes severe burns - Causes skin disorders	- Not determined
Acid treatment - formic acid	- May cause mouth, throat, stomach, skin and respiratory tract burns - May cause genetic changes	- May cause heritable genetic damage in humans - Causes severe burns - Causes tissue damage	- Not determined
Breaker Fluid	-May cause respiratory tract, eye or skin irritation - Harmful if swallowed	- May cause redness, discomfort, pain, coughing, dermatitis	- Not determined
Microbicide	- May cause eye and skin irritation	- Chronic effects/Carcinogenicity - Not determined - Can cause permanent eye damage, skin disorders, abdominal pain, nausea, and diarrhea if ingested	- Not determined
Biocide	- Causes severe burns - Harmful if swallowed - May cause skin irritation - May cause allergic reaction upon repeated skin exposure	-Harmful if swallowed; large amounts may cause illness - Irritant; may cause pain or discomfort to mouth, throat, stomach; may cause pain, redness, dermatitis	- Not determined
Acid corrosion inhibitor	- May cause eye and skin irritation, headache, dizziness, blindness and central nervous system effects - May be fatal if swallowed - Flammable	- Chronic effects/Carcinogenicity – may cause eye, blood, lung, liver, kidney, heart, central nervous system and spleen damage - Causes severe eye, skin, respiratory irritation - Can cause skin disorders	- Not determined
Acid corrosion inhibitor	- Cancer hazard (risk depends on duration and level of exposure) - Causes severe burns to respiratory tract, eyes, skin - Harmful if swallowed or absorbed through the skin	- Carcinogenicity – Thiourea is known to cause cancer in animals, and possibly causes cancer in humans - Corrosive - short exposure can injure lungs, throat, and mucous membranes; can cause burns, pain, redness swelling and tissue damage	- Toxic to aquatic organisms - Partially biodegradeable

[1] MSDS = Material Safety Data Sheets, lists of hazardous chemical constituents in industrial products.
They provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance.
MSDS's include information such as physical data (melting point, boiling point, flash point etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, andspill/leak procedures.

Table ES-3. Estimated Concentrations at the Point of Injection of Constituents of Concern in Hydraulic Fracturing Fluids

Product	Chemical Composition of Existing Products	Concentrations of Interest (ug/L)	
	Chemical Compound	Injection Concentration	MCL or RBC or MCP
Linear gel delivery system	guar gum derivative		
	diesel		
	benzene	313.20	5.00
	toluene	522.00	1,000.00
	ethylbenzene	522.00	700.00
	xylene	522.00	10,000.00
	napthalene	14,094.00	20.00
	1-methylnapthalene	71,340.00	20 / 6,000
	2-methylnapthalene	34,974.00	121.67
	dimethylnapthalenes	270,570.00	na
	trimethylnapthalenes	160,080.00	na
	fluorenes	31,320.00	2,190.00
	phenanthrenes	7,830.00	300 / 50
	aromatics	574,200.00	200 / 30,000
Water gelling agent	guar gum		
	water	495,049.50	na
	fumaric acid	132,337.87	na
Linear gel polymer	fumaric acid	529,351.49	na
	adipic acid	366,257.43	na
Gelling agents (BLM Lists)	benzene		5.00
	ethylbenzene		700.00
	methyl tert-butyl ether		2.64
	napthalene		20.00
	polynuclear aromatic hydrocarbons (PAHs)		na
	polycyclic organic matter (POM)		na
	sodium hydroxide		na
	toluene		1,000.00
	xylene		10,000.00
Crosslinker	boric acid	170,993.00	na
	ethylene glycol	285,788.42	73,000.00
	monoethanolamine	na	na
Crosslinker	sodium tetraborate decahydrate	na	na
Crosslinkers (BLM Lists)	ammonium chloride		na
	potassium hydroxide		na
	zirconium nitrate		na
	zirconium sulfate		na
Foaming agent	isopropanol	234,945.16	na
	salt of alkyl amines	na	na
	diethanolamine	na	na
Foaming agent	ethanol	236,081.75	na
	2-butoxyethanol	269,641.08	na
	ester salt	na	na
	polyglycol ether	na	na
	water		na
Foamers (BLM Lists)	glycol ethers		na
Acid treatment - hydrochloric acid	hydrochloric acid	na	na
Acid treatment - formic acid	formic acid	na	73,000.00
Breaker Fluid	diammonium peroxidisulphate	na	na
Breaker Fluids (BLM Lists)	ammonium persulfate		na
	ammonium sulphate		na
	copper compounds		1,460.00
	ethylene glycol		na
	glycol ethers		na
Microbicide	2-bromo-2nitro1,3-propanediol	na	na
Biocide	2, 2-dibromo-3-nitrilo propionamide	na	na
	2-bromo-3-nitrilopropionamide	na	na
Bactericides	polycyclic organic matter (POM)	na	na
	polynuclear aromatic hydrocarbons (PAHs)	na	na
Acid corrosion inhibitor	methanol	236,070,000.00	10,250.00
	propargyl alcohol	47,425,000.00	na
Acid corrosion inhibitor	pyridinium, 1-(phenylmethyl)-, ethyl methyl derivitives, ch	na	na
	thiourea	210,750,000.00	na
	propan-2-ol	39,275,000.00	na
	poly(oxy-1,2-ethanediyl)-nonylphenyl-hydroxy	na	na
	water		na

* 2 numbers given (1. Drinking water standard 2. Groundwater discharging to surface water standard)

* Exceeds regulatory standard

MCL = Maximum Contaminant Level - The highest level of a contaminant that is allowed in drinking water.

RBC = EPA's Risk Based Concentration Tables. www.epa.gov/reg3hwmd/risk/index.html, developed by Region 3 (serving: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia)

MCP = Massachusetts Contingency Plan - Risk-based ground water standards for drinking water protection - chosen because Massachusetts has developed standards for many constituents in diesel fuel.

Table ES-4. Evidence In Support Of Coal-USDW Co-Location In U.S. Coal Basins

Basin	Is coal found within the USDW?	Explanation and/or evidence
San Juan	Yes	A large area of the Fruitland system produces water containing less than 10,000 mg/L TDS, the water quality criteria for a USDW. Analyses taken from a selected coal well area show that the majority of wells (16 of 27 wells) produce water containing less than 10,000 mg/L TDS (Kaiser et al., 1994).
Black Warrior	Yes	Almost all waters of the Pottsville aquifer contain less than 10,000 mg/L TDS, and most waters in the Pottsville flow systems contain less than 3,000 mg/L TDS, even within the deeper, methane-target coal seams such as the Mary Lee beds (Pashin et al., 1991; Pashin and Hinkle, 1997).In the early 1990's, several authors reported fresh water production from coalbed wells at rates up to 30 gallons per minute (summarized in Pashin et al., 1991; Ellard et al., 1992).
Piceance	Unlikely	The stratigraphic separation between the coal gas bearing zone and the lower aquifer system in the Green River Formation is approximately 6,400 feet. The major coalbed methane target, the Cameo-Wheeler-Fairfield coal zone lies roughly 6,000 feet below the ground surface in a large portion of the basin (Tyler et al., 1998). A composite water quality sample taken from 4,637 to 5,430 feet deep within the Cameo Coal Group in the Williams Fork Formation exhibited a TDS level of 15,500 mg/L (Graham, CDWR, personal communication 2001). The produced water from coalbed methane extraction in the Piceance Basin is of such low quality that it must be disposed of in evaporation ponds or re-injected into the formation from which it came, or at even greater depths (Tessen, 2001)
Uinta	Likely	Production waters from coal seams at the higher elevation Castlegate Field within the Blackhawk Formation appear to have TDS levels of about 5,000 mg/L (Quarterly Review, 1993).
Powder River	Yes	A report prepared by the US Geological Survey showed that samples of water co-produced from 47 CBM wells in the Powder River Basin all had a TDS of less than 10,000 mg/L (Rice et al., 2000). The water produced by coalbed methane wells in the Powder River Coal Field commonly meets drinking water standards. In fact, production waters such as these have been proposed as a separate or supplemental source for municipal drinking water in some areas (DeBruin et al., 2000).
Central Appalachian	Likely	Depths of coal groups are coincident with fresh water in at least two of the states within the overall basin (Kelafant et al., 1988; Wilson, 2001; Foster, 1980; Hopkins, 1966 and USGS, 1973). Anecdotal information suggests that private wells in Virginia are screened within coal seams (Wilson, VDMME, 2001).
Northern Appalachian	Yes	The depth of each coal group within the basin is coincident with the depths of USDWs (Kelafant et al., 1988; Platt, 2001; Foster, 1980; Hopkins, 1966; USGS, 1973; Sedam and Stein, 1970; USGS, 1971; Duigon, 1985). Water quality data from eight historic Northern Appalachian Coal Basin projects show that TDS levels were below 10,000 mg/L (Zobrowitz et al., 1991)
Western Interior *Arkoma*	Yes (in Arkansas) Unlikely (in Oklahoma)	The depths of coal beds within the State of Arkansas are coincident with depths to fresh water (Andrews et al., 1998; Cordova, 1963; Friedman, 1982; Quarterly Review, 1993). Based on maps provided by the Oklahoma Corporation Commission (2001) as to the depths of the 10,000 mg/L of TDS ground water quality boundary in Oklahoma, the location of coalbed methane wells and USDWs would most likely not coincide in Oklahoma. This is based on depths to coals typically greater than 1,000 feet (Andrews et al. 1998) and depths to the base of the USDW typically shallower than 900 feet (OCC Depth to Base of Treatable Water Map Series, 2001).
Cherokee	Yes	The depths of coal beds within the State of Kansas are coincident with depths to fresh water (Quarterly Review, 1993; McFarlane, 2001; DASC, 2000).
Forest City	Unlikely	The shallow thickness of the aquifer suggests that there is significant separation from the deeper coalbeds within the basin (Bastic et al, 1993; DASC, 2001; Condra and Reed, 1959; Flowerday et al., 1998).
Raton Basin	Yes	Water quality results from coalbed methane wells in the Raton Basin demonstrate TDS content of less than 10,000 mg/L. Nearly all wells surveyed show a TDS of less than 2,500 mg/L, and more than half had TDS of less than 1,000 mg/L (Nat. Wat. Sum., 1984).
Sand Wash	Yes	Two gas companies produced water from coals that showed TDS levels below 10,000 mg/L. At Craig Dome in Moffat County, Cockrell Oil Corporation drilled 16 coalbed methane wells. The wells yielded large volumes of fresh water with TDS <1,000 mg/L (Colorado Oil and Gas Commission web site, 2001). Fuelco was operating 11 wells along Cherokee arch. Water pumped from the wells contained 1,800 mg/L of TDS and was discharged to the ground with a NPDES permit (Quarterly Review, 1993).
Pacific Central	Yes	Data demonstrating the co-location of a coal seam and a USDW was found for Pierce County. Water quality information from four gas test wells indicates TDS levels between 1330 and 1660 mg/L, well below 10,000 mg/L (Dion, 1984). Wells in the Basalts commonly yield 150 to 3,000 gallons per minute. Total dissolved solids in the water produced generally range from 250 to 500 mg/L (Dion, 1984).

Water quantity complaints are the most predominant cause for complaint by private well owners. EPA received reports from concerned citizens from each area with significant coalbed methane development. Taken on a case-by-case basis, investigations of water well contamination incidents conducted by the states do not provide evidence that hydraulic fracturing of CBM wells has impacted drinking water wells. Several other factors may contribute to ground water problems such as various aspects of resource development, naturally-occurring conditions, population growth and historical practices.

ES-9 What Are EPA's Conclusions and Recommendations?

EPA's approach for evaluating the threat to public health was an extensive information collection and review of empirical and theoretical data.

Based on the information collected, the threats posed by hydraulic fracturing of CBM wells to USDWs are low, and do not justify additional study. A Phase II effort would not likely provide any new information that would redirect the Phase I findings – those being a lack of contamination incidents and low potential for hydraulic fracturing to threaten human health through the contamination of USDWs. Therefore, the apparent risk to public health from hydraulic fracturing is not compelling enough to warrant expending resources on a Phase II effort.

Finally, it is important to note that States with primacy for their UIC programs enforce and have the authority to place controls on any injection activities that may threaten USDWs. With the expected increase in CBM production, additional data collection may become valuable in the future, if development leads to injection of fracturing fluids into USDWs that are simultaneously used as drinking water sources. The Agency is committed to working with states to collect relevant data to monitor this issue.

Table ES-5. Summary of Reported Incidents that Associate Water Quality/Quantity with Coalbed Methane (CBM) Activity

Basin	Water Contamination Associated with Methane	Water Contamination Associated with Fracturing Fluids
San Juan Basin (New Mexico, Colorado)	• Increased methane and hydrogen sulfide in water wells, pumphouses, and homes. • Claims of data showing methane concentrations in wells increased by 1000 ppm. • Improperly abandoned wells lead to methane migration from deep coal seams to shallow soils.	Information not available
Powder River (Wyoming, Montana)	• Methane causes drinking water to froth and bubble.	Information not available
Black Warrior (Alabama)	• Drinking water well was hissing due to a high concentration of methane gas. Water also had a strong, unpleasant odor.	• Citizen believes drinking water well became contaminated with a brown, slimy, petroleum-smelling fluid after recovered fracturing fluid drained from a CBM well site to an area near this homeowner's house.
Central Appalachian (Virginia, West Virginia)	• Well water contaminated by methane gas had bad taste and odor.	• Fish kills believed to be a result of fracturing fluid discharged into streams. • VA DMME states that soap bubbles in residential water fixtures are linked with production well drilling.

Water Contamination Reported Without Specific Mention of CBM Activity	Water Depletion or Loss Associated with CBM Activity	Non-Water Related Impacts Associated with CBM Activity
• Appearance of anaerobic bacteria in wells and transient appearance of particulates. • Black water believed to be due to pulverized coal. • Cloudy water with grayish sediment found 2 days after fracturing.	• Complaints of loss of water due to CBM development.	• Impacted vegetation.
Information not available	• Loss of water in wells from CBM development. • Aquifer dropped up to 200 feet in some areas.	• Discharged water creates artificial ponds and swamps not indigenous to region. • Coal ignites from lightning and creates underground fires that burn because of dewatered aquifer. This creates toxins and carcinogens that could contaminate water.
• Well water with milky white substance and strong odor. • Well water with black fines, globs of black jellied grease and smelled of petroleum. • Well water turned brown and had long, slimy tags of floating gunk.	Information not available	• Citizen believed recovered hydraulic fracturing fluid was allowed to run off-site. She noticed animal/plant life impacted.
• Private well contamination by oily films, soaps, iron oxides precipitates, black sediments, bad odor and taste, diesel fuel smells, and murky water. • Soap bubbles flowing from residential household fixtures. • Resident provided EPA with well water sample that was translucent with dark gray color and dark black sediments.	• Average of 10-12 complaints per year to Virginia Dept of Mines, Minerals, and Energy involve reports of water supplies diminishing or disappearing entirely. • Over 380 homes in Buchanan County without potable water as a result of CBM development.	• Residents develop rashes from showering. • Miner burned from acid that seeped into mine shaft.

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COAL BED METHANE

BEST MANAGEMENT PRACTICES

DRAFT HANDBOOK
3/19/04

("Clean Version" – changes not shown)

TABLE OF CONTENTS

I. INTRODUCTION AND OVERVIEW

A. Introduction

The development of this Handbook was initiated by the Western Governors' Association, (WGA) which believes that Coal Bed Methane (CBM) represents a key component of our nation's energy supply and accordingly should continue to be developed. WGA recognizes the importance of CBM and the need by private industry, and state, local and federal officials to develop this critical resource in an environmentally sound manner. The Western Governors therefore called for coordination and sharing of information that promotes the sound, efficient and environmentally responsible development of CBM. The Governors believe that many issues might be alleviated through sharing of information and active implementation of best management practices across the states and the private sector. The Governors called for the use of the Enlibra principles in addressing CBM conflicts. (See Appendix B). Based on the presentations and the facilitated discussion at a breakout session during the WGA and Council on Environmental Quality Environmental Summit on the West II, held in Salt Lake City in April 2002, a set of consensus recommendations were developed that WGA later incorporated into a policy resolution on CBM. [1]

With this guidance, the WGA sought funding to engage the CBM industry, all levels of government, and other stakeholders to build a Handbook of Best Management Practices (BMPs). The US Environmental Protection Agency (EPA), the William and Flora Hewlett Foundation, and the US Department of the Interior, Bureau of Land Management (BLM) provided the funding to bring together a diverse group of stakeholders with an interest in CBM to guide the development of the Handbook (the WGA Coal Bed Methane Advisory Committee). The members of the Committee are listed in Appendix C.

B. Purpose and Assumptions

The purpose of this Handbook is to share and encourage the use of best practices that will promote the sound, efficient, and environmentally appropriate development of coal bed methane

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[1] Western Governors' Association Policy Resolution 02-27 (June 2002). The WGA resolution also states that "Western Governors believe that state and federal government should work with the private sector and academia to determine the best way to pool existing natural gas research and data that may aid in the development of improved techniques and to identify what issues require further research. Establishing a central database for critical CBM research should be considered." The WGA CBM Advisory Committee heard a briefing on the Wyoming CBM Clearinghouse maintained by the University of Wyoming's William D. Ruckelshaus Institute and the School of Environment and Natural Resources. http://www.cbmclearinghouse.info/. The clearinghouse is a centralized Internet-based clearinghouse for textual, tabular, photographic, and spatially-referenced information pertaining to CBM resource development and related management issues in Wyoming. The ultimate goal of the CBM Clearinghouse is to create and maintain a single, up-to-date, and easy-to-use entry point for accessing data and information on all aspects of CBM-related issues in Wyoming. The WGA CBM Advisory Committee believes the CBM Clearinghouse at the University of Wyoming is a model that should be considered in the development of a central database for CBM across the region and that it might also be an appropriate location to co host the Best Practices Handbook.

resources. The document provides site specific considerations, tools, and practices that, when appropriately applied, encourage excellence in environmentally sound energy resource development in concert with economic realities. The audience for the Handbook is diverse, and includes operators, agencies, surface owners, mineral owners, and other land users.

It is hoped that by applying BMPs, we will reduce conflicts, encourage environmental stewardship, and provide for efficient resource development. Adoption of these practices may require more work early in CBM development; however, the expected benefits are reduced environmental and socio-economic impacts; improved relations between gas well operators and surface owners; less time invested in surface use negotiations and litigation; and increased economic efficiencies. Other benefits and opportunities arising from CBM development such as job creation, tax revenue, royalty payments, and physical improvements for landowners (e.g., installation of cattle guards, fence replacement, on-going road maintenance, etc.) were also noted.

CBM development can have both positive and negative effects on the environment and communities. Development will produce jobs and revenues and contribute to meeting the Nation's energy needs, but should not compromise a healthy environment. Adopting BMPs in CBM development promotes a healthy environment that also produces jobs, revenues, and benefits to society.

Key assumptions in constructing the Handbook are:

- It is not a regulatory document.[2]
- Use of one or more practices is voluntary.
- BMPs do not replace local, state, federal and Tribal requirements.
- The Handbook is a "living" document that can be updated and amended to reflect the results of monitoring implementation of BMPs as well as advances in technology that may lead to new BMPs.
- The Handbook is intended to be broadly applicable unless otherwise noted. Differences among geologic basins create different challenges, and some or all of the BMPs documented herein may or may not be suitable for some locations. The decision to adopt a particular BMP may be site specific.

C. Context

Coal bed methane (CBM) (natural gas derived from coal beds) is a valuable energy resource in the Western United States. The natural gas that results from CBM development is an important element of the national goal of a secure supply of energy.[3] CBM production has progressed rapidly from a few dozen wells in the 1980s to approximately 22,000 wells in the Rocky Mountain Region in 2003.

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[2] The Handbook is not intended to have legal consequences or to bind any participants or persons affected.

[3] Coal Bed Methane Development in the Intermountain West, Natural Resources Law Center, University of Colorado, p.1, July 2002. (add web addresses to footnotes)

CBM development entails the construction of new roads, pipelines, compressors, water impoundments, and other facilities and can change landscapes. The development of the CBM resources may cover extensive areas, and under certain geologic conditions requires the extraction of large amounts of water from coal seams before the gas can be collected. Planned and likely CBM development in the West (primarily New Mexico, Wyoming, Colorado, Montana, Utah, and North Dakota) is a matter of local, regional, and national interest.

Widely differing viewpoints on CBM development have polarized some of the communities where the development is occurring. Such difficulties may be exacerbated by split estate ownership, where the mineral resource is owned by one entity and the surface by another. Concerns that have provided impetus for development of the handbook include:

- Management of produced water
- Groundwater quantity and quality
- Surface water quality and quantity
- Visual impacts
- Effects of noise
- Impacts to air quality
- Fish, wildlife and wildlife habitat
- Changes to soil and vegetation
- Social and economic impacts on communities and states
- Surface owner issues, especially in split estate cases

Handbook topics reflect these issues by providing BMPs in the categories of planning, water, landowner relations, and infrastructure.

D. Best Management Practices (How Used, Definitions, Application, Suitability)

For purposes of this Handbook, a Best Management Practice (BMP) is a proven way of conducting CBM operations which eliminates or minimizes adverse impacts from CBM development to public health and the environment, land owners, and to natural resources; enhances the value of natural and land owner resources; and reduces conflict.

BMPs are dynamic, and intended to promote excellence in how CBM is developed while still maintaining efficiency, cost effectiveness and competitiveness in producing the CBM resource. Adopting BMPs can increase efficiency and/or effectiveness for producers and at times has actually lowered costs (which are necessary considerations for operators). BMPs in the context of this project are not minimum standards (i.e., baseline under statutes or rules) or "down the hole" engineering practices.

II. PLANNING

Introduction

Planning is essential to successful CBM development and provides significant environmental and economic benefits. Careful, objective CBM project planning that includes various interests in the planning process is essential to effectively address aspects of a project that could otherwise become challenging issues. Careful and inclusive planning provides opportunity for thorough implementation of development practices that will enhance environmental protection.

A. Development Plans

BMP: Prepare a development plan. A development plan identifies a specific area (e.g., leasehold or watershed) in which development is expected. It provides a comprehensive description of geographic and cultural characteristics of the area, along with the anticipated nature of CBM development. Planning needs may differ by basin and be applied in different ways, depending on such things as subsurface geology, terrain, and land use. As a result, development plans could be complex or simple depending upon the circumstances, and will need to be customized to fit the individual conditions within a CBM basin or project.

Discussion: The following items could be included in the plan:

- Identification of land ownership
- Identification of existing and expected surface uses (including number and spacing of wells, roads, pipelines, water disposal facilitaties, treatment facilities, compression facilities, gathering and transmission pipelines, etc.)
- Identification of existing and required infrastructure and utility corridors
- Map of the area with location of existing facilities (i.e., wells) and potential (optimal) locations for future facilities, including production facilities (wellsites, processing units, etc.), roads, flowlines, and utility corridors. The map can also include geographic features such as streams and other water bodies, and special ecosystems.
- Development strategy that addresses environmental and economic objectives
- Identification of opportunities to reduce adverse impacts
- Identification of regulatory requirements
- Water management plan (strategy) - See Section A in Chapter III
- Identification of strategies for interim and final reclamation of disturbed areas and for final abandonment
- Conflict resolution procedures
- Strategy for establishing a baseline and monitoring (surface and subsurface water quality, wildlife and fish, air quality, etc.) and steps to apply monitoring information to existing and future actions
- Steps to address public safety through participation with local emergency preparedness committees

The development plan is based on existing and expected surface use, geologic, engineering, and scientific information about the natural gas reservoir and the environment of the area. Collection

of baseline information on such things as surface uses and surface owner preferences, pre-development noise levels, air quality, surface and groundwater quality, and biological resources can assist in identifying critical data or information gaps. Thorough knowledge about existing information and information gaps is necessary for developing an effective monitoring strategy, while thoroughly understanding the commitment of resources that will be necessary to acquire baseline information.

Oil and gas operators, government agencies, elected officials, affected surface and mineral owners, community representatives, and other concerned citizens working together to plan for anticipated field development can produce development plans that reflect environmental responsibility, respect for the land, efficient energy resource development, and productive relationships among diverse interests while at the same time permitting extraction of CBM.

A development plan established during the early stages of anticipated development provides the framework for avoiding or minimizing surface disturbance, protecting other resources, mitigating environmental impacts, and alleviating or addressing concerns of landowners and communities. It serves as a tool for comprehensive, coordinated planning to guide strategic, development. It can also assist in meeting the requirements of the Clean Water Act, the Clean Air Act, the Endangered Species Act, and other applicable federal, state, and local laws.

B. Permitting

In order for a project to be approved and go forward, certain agreements and permits, along with valid oil and gas leases, need to be in place. It is imperative that an oil or gas company contact mineral and surface owners and permitting agencies early to minimize timeframe conflicts. Appendix D provides an example of a regulatory checklist (for Wyoming), including regulatory requirements of federal, tribal, state, and local jurisdictions.

BMP: Master Drilling Plan for Multiple Applications for Permit to Drill (Multiple APD Package): Master Drilling Plans involve multiple wells (two or more) in an identified area, and contain drilling and surface use procedures common to all wells in the package, and are used in the federal APD review and approval process.

Discussion: The Master Drilling Plan can encompass a planned cluster of wells and facilities in close proximity, sometimes referred to as a "pod", or can be prepared for multiple in-fill wells scattered throughout a field. Each well under a Master Drilling Plan must have a survey plat and an APD that references the Master Drilling Plan. Information contained in the Master Drilling Plan does not have to be repeated within the individual APDs that it covers. Differences in the drilling or surface use programs that may be unique to individual wells are clearly addressed and identified within the Master Drilling Plan and/or individual well APDs.

Multiple APD packages are suitable for areas that have known surface and subsurface characteristics that give an operator the technical certainty to propose multiple wells. Areas suitable for this practice typically have similar reservoir characteristics, subsurface geology, and producing zones.

A multiple APD package under a Master Drilling Plan within a specified area achieves more efficient permitting, provides for more effective protection of other resources, and is a valuable tool for future planning. It can result in reduced paperwork and cost for both the operator and permitting agency, improved development planning, and more comprehensive environmental review, especially with respect to identifying and analyzing cumulative effects.

C. Community and County Services

BMP: Proactive and early engagement with local governmental entities.

Discussion: Proactive and early engagement with local governmental entities is beneficial in gaining an understanding of applicable regulations as well as in establishing positive and important working relationships. State and local government rules and regulations may also have a significant impact on CBM development. Local issues related to air quality, noise abatement, traffic flow, etc. can be better addressed by early coordination with local government.

D. Other Resources

Proposed BMP: Review existing publications regarding information on CBM development.

Discussion: An overview document on coalbed methane is ALL Consulting's "Coal Bed Methane Primer", a US DOE Fossil Energy project addressing education and public relations for public meetings, coordination between developers and local stakeholders, and general orientation on this subject. The Primer is in the final revision stage but a draft can be found on http://www.all-llc.com/CBM/.

III. WATER

Introduction

Coal bed methane development can present complex water-related challenges as well as possible beneficial uses. Extracting CBM generally requires the withdrawal of groundwater to release the pressure within a coal seam thus allowing the methane gas to begin flowing. Because CBM production generally begins by withdrawing a high volume of water, this has raised significant issues, including the potential wasting of valued water resources; concerns about groundwater, specifically on the effects of lowering the water table, potential impacts on residential and agricultural wells, and possible contamination, and; produced water disposal or management, including downstream impacts on both water quantity and quality. In some cases, landowners are very interested in putting the water to beneficial use when appropriate and consider it an asset. Adoption of BMPs can help address these and other water related concerns, and potentially reduce conflicts with landowners, conservationists, anglers, and other land and water users, but must be customized to deal with a variety of considerations that vary by basin or project

Water Best Management Practices

A. Water Management Planning

BMP 1: Prepare a Water Management Plan. Water management plans must be specifically designed for the basin or project in which they are being used, and are typically applicable to surface discharge of CBM produced water. As part of preparation for the plan:

- **Consult surface owner(s)** (as well as downstream stakeholders and affected water users) early in the planning process and throughout the development of Water Management Plans (WMPs).

- **Understanding and Application of Laws, Regulations, and Policy.** Develop an understanding of the laws, regulations and policies that would apply to the development of the operation. These will vary by State and locality. For example, when considering underground injection, ensure that the components of the Underground Injection Control Program can be met whether the EPA is administering the program or an individual state has received primacy for the program. Certain design and operating requirements should be researched through the appropriate jurisdictional agency (either the EPA or the primacy state) to ensure a complete application for approval is submitted. (See the sample Regulatory Compliance Checklist in Appendix D).

- **Consider Planning on a Watershed Basis.** Watershed Planning in the CBM context is an emerging practice that involves coordinating with other companies, surface owners and permitting agencies within, and potentially downstream, of the watershed, and entails baseline monitoring and an assessment of quantity, quality, water rights, and downstream

landowners concerns. The State of Wyoming is in the process of developing a CBM watershed planning program which may eventually serve as a model for other locales.

- **Mitigation of Surface Water Discharge Effects**, i.e., headcuts, road crossing, impoundments, channel stability.

Discussion: Initial planning before a project begins and refinement of the water management variables in that plan during development of a CBM prospect are critical to the overall success of a project. To design an effective system for managing produced water, it is necessary to know the following: i) likely quality of produced water; ii) estimated water production rates at various phases of the project; iii) evaluation of the hydrologic relationship between ground and surface water; iv) nature and existing use of any proposed receiving waters, including seasonal flow rates flora, fauna and soils associated with surface discharge; v) current or proposed permitting and regulatory restrictions; and vi) the institutional framework governing groundwater within the project area. With the need to maintain flexibility and provide for contingencies, the initial plan may change as data is collected from actual operations.

BMP 2: Produced Water Options. Take the following factors into consideration when evaluating options for managing CBM produced water:

- Landowner preference and concerns
- Quantity and quality of water to be discharged
- Quality of the receiving water standards
- Environmental/ecological effects from surface discharge
- Downstream concerns
- Economic feasibility/cost effectiveness
- Beneficial use possibilities
- Proximity to streams/ponds/reservoirs/wetlands/lakes
- Proximity to clinker/scoria and gravel deposits
- Proximity to springs
- Long-term impacts to the environment
- Protection of groundwater

Discussion: There are a variety of options for managing produced water, including reinjection (either for disposal, or for storage and later retrieval), and surface discharge, which involves release of produced CBM water onto the earth's surface, either to surface water or surface soil. One way to group alternatives for surface discharge is into the following three general categories: i) discharge to surface water, ii) discharge to land surface with possible runoff, and iii) discharge to land surface with possible infiltration into subsurface aquifers and surface water.

Decisions and use of tools for managing produced water will also involve regulatory and technical considerations including geology, and economic and engineering factors as well as surface owner needs. Evaluation of water management options and produced water use alternatives will require planning, data gathering, and analysis. Planning should include a detailed understanding of water classifications, standards, water rights, and any other compacts or laws that may exist. Where CBM development is proposed adjacent to or near important fisheries habitat, hydrologic mapping and analysis, and other related research is essential to gain

a better understanding of ground and surface water interactions, and potential impacts of CBM development on water quality and quantity.

BMP 3: Understanding the Capacity of the Receiving Aquifer. When considering underground injection, ensure that the capacity of the receiving aquifer is adequate to handle the anticipated volume of water to be injected.

Discussion: Underground injection is a management option for produced water in some, but not all, places. It can be used for storage and retrieval (of high quality water), or for disposal. Injection is generally viewed as the emplacement of water into a zone or formation that is capable of receiving and storing water. Several important factors can influence the feasibility of injection including availability of an injection zone, depth of the injection zone, injection pressures, needs for transportation of water, the rate of injection, the quality of water being injected, the quality of water in the receiving formation, and the ultimate storage capacity of the receiving formation(s).

B. Beneficial Use

BMP: Information for landowners. When the landowner is interested in possibly using CBM produced water, provide information about options for beneficial use and about potential problems and liability.[4]

Discussion: Water extracted during CBM development presents challenges but may also offer opportunities for beneficial use of produced water. (See Appendix E for Beneficial Use Alternatives for CBM Produced Water.) However, the quality of the water extracted influences how this water can be managed and whether it can be used for beneficial purposes. The quality of water that is produced will vary from basin to basin, within a particular basin, and over the lifetime of a CBM well.[5] There are a variety of technologies existing and evolving that may be applied to improve the quality of the water and consequently the options available for use. (See Appendix F for a discussion of Water Treatment Technologies.)

Decisions about beneficial use also need to factor in the reality that the availability of CBM produced water is not sustained over time. The volume of produced water is typically very high for a short time after production starts and then drops off rapidly. For this reason, long-term reliance on produced water should not be encouraged. This also applies to the use of the produced water to enhance wildlife habitat. The Rocky Mountain west is characterized by semi-arid to arid conditions. It is not realistic to think that ecological conditions that are related to areas with significantly more water can be sustained in these arid areas.

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[4] It is very important that beneficial use of produced water is consistent and meets the requirements of water rights within a given state. In addition, the need to obtain a NPDES (National Pollutant Discharge Elimination System) permit may be necessary in some cases. These are important considerations that requires the ultimate user of the produced water to research all legal and regulatory aspects thoroughly in order to make informed decisions about beneficially using CBM produced water.

[5] As an example of the differences between basins, CBM produced water quality in the Colorado River drainage area of Utah is very poor compared to some other places, and consequently the only currently approved surface water options are: a) no discharge, or b) reverse osmosis type treatment.

C. Water Quality:

Land application of produced water can be of benefit to the surface owners in some cases, but also has the potential to produce negative long-term impacts to soil physical and chemical properties if not properly managed. Water quality can be also be affected by the construction and maintenance of ponds, impoundments and infiltration systems. These are generally an excavation or diked area that is can be used for a variety of water management options, including treatment, storage, evaporation leakage, or disposal of liquids, storage prior to another water management option including injection or irrigation; or for beneficial use such as a fishpond, livestock and wildlife watering ponds or a recreational pond, and can vary from less than one acre in size to several acres. Non-infiltration impoundments are usually constructed in low permeable soils, to prevent or decrease raw water loss due to subsurface infiltration or percolation. (See Appendix G for a description of impoundment options.)[6]

BMP 1: Establishing a Baseline. As mentioned elsewhere, it is important to establish a baseline for ground and surface water quality in the area where development will occur, relying as much as possible on existing information.

BMP 2: Monitoring Data. Provide assistance to landowners who want monitoring data, either by providing the data, or directing them to the appropriate source such as a regulatory agency that maintains the information.[7]

BMP 3: Distance from Outcrops. When drilling near outcrops of coal formations, understand the hydrology of the basin to determine a sufficient distance for well placement to avoid contamination of water wells and methane seepage at the outcrop of coal formations.

BMP 4: Fracturing Fluids. Discontinue the use of diesel fuel in hydraulic fracturing fluids injected directly into formations which contain underground sources of drinking water (USDW).

Discussion: Water-based alternatives exist and from an environmental perspective, these water-based products are preferable compared to diesel fuel. The EPA signed an agreement in December 2003 with three major companies that provide approximately 95 percent of the hydraulic fracturing services performed in the United States. The agreement calls for the voluntary removal of diesel fuel from hydraulic fracturing fluids injected directly into formations which contain USDWs during hydraulic fracturing for CBM production. Included in the agreement are assurances from the companies that fluids used to replace diesel fuel will not endanger USDWs. The Memorandum of Understanding is available at http://www.epa.gov/safewater/uic.html.

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[6] It was noted by some CBM Advisory Committee members that the beneficial use of water is perceived as a positive by many in Wyoming's Powder River Basin.

[7] Individual NPDES permits dictate what type of monitoring will be required.

D. Protection of Wetland/Riparian Areas

BMP 1: Location of Non-Linear Features. To protect the biological and hydrologic features of riparian areas, woody draws, wetlands, and floodplains, locate all well pads, compressors, and other non-linear facilities to the maximum extent possible outside of these areas.

BMP 2: Crossings by Linear Features. Avoid crossings of wetland/riparian areas by linear features, such as pipelines, roads, and power lines to the extent practicable. Where crossings cannot be avoided, impacts can be minimized through use of the following measures and others that may be consistent with the Corps of Engineers nationwide permit program.[8]

- Developing site-specific mitigation plans during the permit approval process for all proposed disturbance to wetland/riparian areas
- Constructing crossings perpendicular to wetland/riparian areas
- For power lines, using the minimum number of poles necessary to cross the area
- Scheduling construction in wetland areas to minimize the duration of construction activity within the wetland, and, if possible, to concentrate such activity during dry conditions (that is, during late summer or fall), or when the ground is frozen during the winter
- Not depositing waste material below high water lines in riparian areas, flood plains, or in natural drainage ways
- Locating the lower edge of soil or other material stockpiles outside the active floodplain
- Locating drilling mud pits outside of riparian areas, wetlands, and floodplains, where practical
- Re-shaping disturbed channels to their approximate original configuration or other geomorphological configuration and ensuring they are properly stabilized
- Beginning reclamation of disturbed wetland/riparian areas as soon as possible after project activities are complete
- Conducting stream channel monitoring for erosion, degradation, and riparian health

Resources

Handbook on Coal Bed Methane Produced Water: Management and Beneficial Use Alternatives Prepared by: ALL Consulting, Tulsa, OK for the Ground Water Protection Research Foundation, U.S. Department of Energy, National Petroleum Technology Office, and Bureau of Land Management. ***[Insert web address]***

[8] See 33 CFR Parts 330.1-330.6 including Appendix A Part 330-Nationwide permits and conditions.

IV. LANDOWNER AND OPERATOR RELATIONS

Introduction

Positive relations between landowners and CBM operators are an important aspect of successful development of the resource. As development expands in the Western states, there is increased interaction between the public, the CBM service industry, and local communities. While communities and states receive revenue from CBM development, this interaction can become sensitive in some split estate situations (where the surface and minerals are owned by different entities). Development of a strong relationship between the operator and landowner early in the process allows the operator to tailor operations to complement the landowner's uses. Adoption of BMPs is often helpful in addressing interaction challenges related to a range of land owner issues, including: location of wells, pipelines roads and facilities to accommodate surface uses; reclamation; topsoil preservation; privacy; noise; compensation for surface occupancy; effects and beneficial use of produced water; impacts from infrastructure development;; livestock issues; potential loss of groundwater wells; and safety concerns. These practices, combined with open communications and respect for the land and the rights and values of the involved parties, can promote cooperative relationships as well as responsive and responsible CBM development. Use of best surface use management practices is good business.

Landowner and Operator Relations Best Management Practices

A. Communication and Notification

It is critically important for operators to develop a relationship early with the surface owner and surface occupant. This relationship should be based on both parties respecting and accommodating each other's property rights and interests, with open and consistent communication. Both parties should negotiate in good faith.[9]

On-site visits by the operator for the purposes of planning the development of the oil and gas resources are an important opportunity for coordination and cooperation with surface owners, permitting agencies and other affected parties. The onsite visit provides the opportunity for representatives of the affected entities to discuss and evaluate the proposed activities as well as alternatives for improved operations that consider the needs and rights of everyone. Onsite visits with different representatives can be conducted at different times. For instance, site visits with company representatives and the surface owner can occur when the well sites and access road are being considered and staked. Other site visits can occur after the well sites and access roads have been staked.

BMP 1: The operator and the landowner should each establish a single point of contact.

[9] Oil and Gas at Your Door? A Landowner's Guide to Oil and Gas Development "http://www.ogap.org contains useful information.

Issue that was discussed but upon which there was not agreement:

The CBM Advisory Committee discussed whether, how, when, and by whom surface owners might be notified about a CBM lease under their property, but the group did not reach agreement. The following BMP was proposed: "Provide the surface owner with a copy of the mineral lease or other publicly filed documents within 180 days of acquiring the lease either through purchase or assignment".

The perspective of some CBM Advisory Committee members was that surface owners need to know when the mineral estate under their property is leased in order to make informed decisions about management of the surface. They acknowledged that lease information is publicly available, but said it is extremely difficult for individual landowners to find and track the information. At one point in the discussion it was suggested that county governments might be enlisted to assist in notifying surface owners of leasehold ownership changes.

The perspective of others was that landowners have access to this information as public record and therefore do not need additional notification. Furthermore they expressed a concern that the proposed BMP could infringe on proprietary information that could affect the competitiveness of an operator. They also pointed to the emphasis elsewhere in the Handbook on early and frequent communication with landowners, which in their view precludes the need for the proposed BMP.

There was a sense in the group that this important issue merits further discussion, and that finding a satisfactory resolution would contribute substantially to improving landowner operator relations.

B. Plans, Agreements, and Bonds

BMP 1: Surface Use Agreements (SUAs), (sometimes also called Surface Owner Agreements, SOAs). Once an operator decides to undertake operations under a valid lease, immediately notify the landowner so there is adequate time to understand the proposed operations. This would include notice to the surface owner of record based upon the last known address, which is found in county records, and a minimum set of details about anticipated operations within the notice (e.g., tentative well, road, pipeline and facilities) and a request that the landowner provide input regarding locations which reduce adverse impacts of surface use. Thereafter, the operator and landowner should proceed in good faith to develop a mutually agreeable SUA.[10]

Discussion: Operators and landowners could benefit by negotiating a mutually agreeable SUA. The SUA should address all relevant concerns, including such items as compensation for use of

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[10] It was suggested by some that a Master Surface Use Agreement might also be employed where the development involves a large ranch or related tracts (i.e. joint ventures or associations) and contains drilling and surface use procedures common to all wells, and where there is agreement on well and facility locations (or a procedure for determining locations), minimum footprints, reclamation criteria, and surface use compensation prior to drilling individual wells. It is believed by some that where numerous wells are contemplated, such Master Surface Use Agreements could significantly speed up well drilling, virtually eliminate well by well negotiations, mitigate adverse surface impacts, insure good reclamation practices, and reduce operator/surface owner conflicts.

the surface, damage payments, and development plans that address facility and road locations, timing of operations, construction and reclamation requirements, water management, and access to the property. See the WGA CBM website for sample SUAs.

BMP 2: Water Well Mitigation Agreements. During CBM planning, operators should determine who has appropriated water wells within the vicinity of its proposed operations. Operators should determine whether their operations could impair the capability of these water wells and take appropriate actions to mitigate such impacts when CBM development is occurring within the same aquifer. A Water Well Mitigation Agreement should be offered to owners of wells and springs that could potentially be affected by CBM operations. Such an Agreement provides a method to determine operator responsibility for any damage to wells or springs and provides an opportunity to an owner of a well or spring affected by CBM operations to obtain repair, replacement or compensation by the operator. Surface owners and the operator should inventory existing, water wells prior to the commencement of operations, to have baseline data on the quantity and quality of the applicable wells. See the WGA CBM website for a sample Water Well Mitigation Agreement.

C. Dispute Resolution

BMP 1: Dispute Resolution Services. Alternative Dispute Resolution services (ADR) should be considered to resolve disputes. An ADR process such as mediation that encourages good communication and development of working relationships, and that allows parties to retain control over the ultimate solution would be preferable.

BMP 2: Payment Mechanisms. Unless otherwise mutually agreed, the costs should usually initially be covered 50% by the Operator and 50% by the surface owner. Costs and attorney's/mediator's fees may be allocated as part of an agreement.

Resources

A Model Agreement Approach to Resolving Conflicts over CBM in the Powder River Basin" (Institute for Environmental Conflict Resolution), (March 2003).
http://www.ecr.gov/s_publications.htm

Wyoming Split Estate Initiative – Petroleum Association of WY, WY Stock Growers Association, WY Farm Bureau Federation, and WY Wool Growers Association.
http://www.wysei.com

Wyoming Agriculture and Natural Resource Mediation Program. To receive additional information on the program, or to receive a list of available mediators, contact: Mediation Coordinator, WY Dept. of Agriculture, 2219 Carey Ave., Cheyenne, WY 82002, 307-777-7323, or the WY Agriculture Mediation Board, Department of Agricultural Economics, University of WY, P.O. Box 3354, Laramie, WY 82071-3354, 307-766-5133.

V. INFRASTRUCTURE

Introduction

CBM development can impact the environment by affecting soils, land use, wildlife, aesthetics, and surface drainages as construction of roads, utility corridors, compressors, wells, and other facilities occur. When properly managed, CBM development may also enhance the use and value of a landowner's property. BMPs for this infrastructure can complement local regulations, influence how development proceeds, and can determine what will be impacted and the extent of the impacts. The impact on communities, the landscape, habitat, and air can be minimized through careful practices and infrastructure design considerations. These practices and design considerations can minimize surface disturbances, view shed impacts, noise levels, emissions, and erosion. This in turn has a direct bearing on the quality of life of the communities and can affect the success of the development project.

Infrastructure Best Management Practices

Guiding principles for infrastructure best practice operational standards can be summarized as follows:

- Use the means of operation that minimize adverse impacts while still maintaining efficient and cost effective operations.
- The surface owner, as a vested stakeholder should be consulted early on decisions regarding siting for wells, roads and other facilities.
- In general, there needs to be a heightened awareness of habitat fragmentation in sensitive areas where there are high levels of biodiversity, or sensitive, and critical habitats.
- During development, landowners should be kept informed of the ongoing schedule of activities to prevent serious use conflicts, and operators should communicate with each other regarding land use activities that could result in conflict.

The following BMPs are suggested as means to minimize impact of operations. It should be noted that some of the BMPs in other sections of the document also relate to infrastructure.

A. Roads and Transportation

BMP 1: Minimizing Road Development. Where it is operationally feasible and safe, encourage the use of two-track roads into well locations. Suitable locations for two-track roads typically have the following features: low "average daily traffic" for wells being drilled, wells equipped with remote monitoring/telemetry, low maintenance traffic during production; flat to gently rolling country; stable soils; road use primarily during dry conditions.

BMP 2: Siting. Utilize existing roads to gas facilities to the maximum extent possible. Locate new roads in areas that will optimize year-round, all-weather access, and minimize surface disturbance and environmental impacts. Road location should be selected in consultation with the surface owner, and should consider future development plans.

BMP 3: Inclement Weather and Wet Ground Conditions. If using unimproved two-track roads, limit use during inclement weather and wet ground conditions when severe rutting and other resource impacts might occur.

BMP 4: Road Construction and Reclamation. Plan, maintain and construct all roads in conformance with road standards established by the local jurisdictional agency (i.e., BLM or the County). In select cases such as major access roads to the general development area or in individual circumstances, a higher standard of road is necessary.[11] Practices that can enhance reclamation include:

- Reclaim and revegetate all disturbed surface that will not be used for oil and gas operations in a manner that restores topsoil and minimizes erosion.
- Following well plugging and abandonment, the access road should be left in the condition prescribed by the surface owner. If complete reclamation is required, the access road should be recontoured back to the original contour, topsoil replaced, and revegetated so that the reclaimed areas blend with the surrounding land and revegetation establishes either the agricultural crop desired by the surface owner or, over time migrates toward the local native plant community.
- Use only certified and state inspected seed that is free of noxious weeds for reclamation/revegetation.

BMP 5: Bypass Routes. When feasible, heavy equipment and trucks should use bypass routes to avoid municipalities, schools, rural residential or other sensitive areas.

BMP 6: Service Industry Traffic. Enter into discussions with surface owners, local and other government agencies for road maintenance and traffic about potential problems and solutions related to increased CBM service industry traffic to ensure safety and minimize problems such as with dust, compaction, and debris.

B. Pipelines and Power Lines (Gas, Water, and Power)

BMP 1: Corridors. Use existing disturbance corridors whenever possible (ideally following access routes or existing pipeline routes).

BMP 2: Trenches. Locate all lines (i.e. gas and water disposal) in the same trenches (or immediately parallel to), and at the same time, if possible.

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[11] Consider guidelines such as the "Gold Book" (Surface Use Standards for Oil and Gas Exploration and Development, which is available at http://www.blm.gov/nhp/300/wo310/O&G/Ops/GoldBook.pdf), the BLM Road Standards Manual 9113 for designing roads, applicable county or state design criteria, or similar high quality engineering standards.

BMP 3: Equipment. Use ditch witches or wheel trenchers (versus back hoes) wherever practical for installation of buried lines.

C. Habitat and Species Protection.

The following measures help protect habitat and sensitive species:

BMP 1: Whenever practical, bury utilities, particularly in grouse habitat and in and near areas of sensitive species critical habitat such as prairie dog towns. Minimize the disturbance footprint by burying utilities along the road to the extent possible rather than cross-country.[12]

BMP 2: Aerial power line should be designed, and existing power poles should be modified if possible, to prevent or minimize raptor perching and mortalities.

BMP 3: Reclaim and revegetate all disturbed surfaces as soon as possible after completion of pipelines or well abandonment pursuant to regulations and surface owner preference. Use native plants from local seed sources whenever possible.

BMP 4: Long Term Production Pits. Long term production pits should be netted and fenced to prevent entry by birds, wildlife, and livestock, in accordance with applicable regulations.

BMP 5: Impacts to Environmentally Sensitive Areas. To the extent possible, minimize traffic and disturbance in and near wildlife habitat, wetlands, winter range, birthing and rutting areas, and other environmentally sensitive areas. Examples of ways to accomplish this objective are to minimize access and to use telemetry to monitor wells.

Resources

Avian Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996. Edison Electric Institute/Raptor Research Foundation Washington, D.C. [Include website]

D. Wells

BMP 1: Surface Disturbance Minimization. The use of alternative techniques, for example, directional drilling, drilling multiple wells from the same pad, commingling, recompletion, using existing well pads, are encouraged to minimize surface impacts if technically feasible and not economically prohibitive. .

BMP 2: Equipment Removal. Remove all equipment not necessary for well operations.

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[12] It has been shown through research that utility poles cause great disturbance in grouse leks and wintering populations because prairie grouse avoid vertical structures (i.e., will abandon the lek or area) regardless of raptor protection placed on poles.

BMP 3: Landowner Involvement in Siting Decisions. Contact the surface owner before staking access routes and well facility sites.[13]

BMP 4: Siting and Construction Considerations. Where feasible, site and construct wells with the following considerations:

- Locate well sites in stable, non-erosive soil areas, with grass or brush cover and on relatively level areas that minimize pad construction. Choose sites that avoid steep slopes, unstable soils, stream bottoms, wetlands, and floodplains.
- Where no code exists, locate facilities and roads away from occupied dwellings.
- Locate in visually acceptable areas (avoid dwelling view sheds) and paint facilities colors that blend in with the natural environment.
- Locate where safe access can be maintained year round.
- Avoid sensitive wildlife habitat and migration corridors. Consultation with the State wildlife agency can help determine areas to avoid.

BMP 5: Reclamation. As soon as reasonably possible after drilling is completed, conduct interim reclamation to reduce the drill site to the minimum area required for production operations and to restore the disturbed areas to their pre-disturbance condition, or better, pursuant to landowner preference. Interim reclamation should include the following:

- Recontour disturbed areas to be compatible with existing grades, including for agricultural purposes.
- Depending on landowner preferences, replace topsoil to at least the depth and quality which existed prior to disturbance for final reclamation of the site upon abandonment of the well.
- Revegetate disturbed areas using a seed mixture to match native vegetation.
- Remove all chemicals, equipment, materials, and waste not necessary for sustaining production from the well pad.
- Use only certified and state inspected seed that is free of noxious weeds for reclamation.

BMP 6: Multiple Seam Completions. In areas where multiple seam completions are conducted, development plans should account for increased water production and the necessary disposal/management options and variations in water quality in the coal seams.[14]

E. Central Gas Gathering Treatment, Compression, and Metering Facilities.

BMP 1: Route Identification and Description. Contact the surface owner before staking routes and facility sites.[15] This provides an opportunity for mutual agreement about proposed locations and reclamation. Off lease gathering and transmission pipelines can often be located in existing utility or transportation corridors.

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[13] See also the Landowner and Operator Relations Chapter.

[14] It was noted that multiple seam wells should be, and are most often, drilled from the same well site or utilizing multiple completions in the same well. In the Powder River Basin, multiple seam wells are routinely enclosed in the same small winterized box.

[15] See also the Landowner and Operator Relations Chapter.

BMP 2: Co-locating Water and Gas Gathering Lines and Roads. Locate roads and water and gas gathering lines in the same easement along a route agreed to with the surface owner. In general, for smaller tracts of land (160 acres or less) and tracts which may be later subdivided, roads and gathering lines should be located in designated utility easements or along property boundary lines to avoid splitting off unuseable tracts.

BMP 3: Right of Way Width and Line Depth. Minimize the width of gathering line rights-of-way. Bury the top of each gathering line below the surface[16], unless local rock outcrops and terrain prohibit such burial, and the exception is agreed to by the surface owner.

BMP 4: Reclamation. Each gathering line should be double ditched and topsoil should be restored in each disturbed location to at least the depth and quality that existed prior to such disturbance. Pipeline trenches should be compacted during back-filling. After installation, repair or other surface disturbance, the operator should promptly reclaim the surface, re-contouring to conform to existing grade, revegetating with a seed mixture specified by the surface owner, and filling of any settled areas with comparable quality topsoil. Use only certified and state inspected seed free of noxious weeds for reclamation.

BMP 5: Pipeline Agreements. Pipeline agreements should routinely permit the overlap of pipeline rights-of-way. .[17]

BMP 6: Roads. Use the same standards/criteria as noted above for constructing roads to metering and compressor sites.

Resources

Coal Bed Natural Gas Well Application for Permit to Drill and Plan of Development Preparation Guide. Bureau of Land Management. Buffalo Field Office. May 9, 2003. [Insert website]

F. Pests and Noxious Weeds

BMP 1: Integrated Pest Management. Discuss proposed pest and weed management plans with the surface owner and permitting agency as part of the planning process. Application of and use of herbicides for weed control must follow applicable local and state regulations. Approved permits must be obtained before implementing plans as required.

BMP 2: Mulch. Mulch used for reclamation should be certified weed free.

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[16] There were two suggestions regarding depth: One was to bury the top of each gathering line "48 inches "below the surface" and the other was "below plow depth".

[17] There were three alternate suggestions regarding the placement of subsequent pipelines. The suggestions were that they should be placed: a) within ten feet or less of existing pipelines, b) "as close as possible to" existing pipelines, or c) pursuant to industry standards for installation.

BMP 3: Education. Review weed educational material during pre-construction on-site meetings with operators, subcontractors, and landowners.

BMP 4: Revegetaton. Moist soils near wetlands, streams, lakes, or springs in the project area should be promptly revegetated if construction activities impact the vegetation in these areas. Revegetation should be designed to avoid the establishment of noxious weeds. As noted with reclamation, use only certified and state inspected seed that is free of noxious weeds in any revegetation operation.

BMP 5: Pests. Waste handling, construction practices, and operations should take into consideration pests such as mosquitoes (which can potentially transmit West Nile Virus – of significant concern for sage grouse and other wildlife as well as humans), rodents (which can potentially transmit hantavirus), flies, and other pests that can cause problems. It was pointed out that at this time (Spring 2004) there is no proven connection between CBM development and these pests.[18]

BMP 6: Vehicles/Heavy Equipment. Vehicles and machinery contaminated with soil can be sources of non-native noxious weed seed, which can seriously degrade native habitats. When moving vehicles and machinery from areas containing populations of noxious weeds, consider washing vehicles prior to entering CBM development areas.

BMP 7: Long-term weed infestation issues. It is important for companies to plan for the condition of the surface lands after holding ponds no longer hold water. It is likely that the ponds will have changed the soils and habitat characteristics of that immediate land and when water is no longer there, non-native weed infestation is very likely. Reclamation plans should include post-pond weed and soil restoration considerations.

G. Visual Impacts

BMP 1: Minimize Footprint and Use Existing Facilities. Minimize the footprint of well locations, access roads, and utilities, and use existing well pads where feasible. Avoid creating large cut and fill slopes, minimize clearing, taking into consideration state well spacing requirements.

BMP 2: Color Selection and Screening. Use vegetative and topographic screening when siting well and facility locations, avoid highwall cuts, and reclaim all portions of the location not needed for production facilities. All well facilities should be painted a color which allows the facilities to blend with the background, typically a vegetated background.

BMP 3: Ridgelines. Avoid locating wells, equipment, and facilities on highly visible ridgelines.

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[18] The University of Montana is entering the second year of a three year study on the affects of West Nile Virus on Sage-grouse populations.

H. Noise Abatement

BMP 1: Noise Levels. Where CBM operations generate noise that can impact established receptors (for example residences, churches, schools, established campgrounds, or sensitive wildlife) control of noise is good practice.[19] If low frequency noise becomes an issue then it should be addressed in consultation with those being affected.

BMP 2: Distance. Provide the appropriate distance between a CBM facility and an existing noise-sensitive receptor (residences, schools, medical facilities, sensitive wildlife habitat areas, and recreational areas). [20]

BMP 3: Features. Consider utilizing obstacles as a noise abatement measure.

Discussion: Noise can be reduced by construction of obstacles in the direct path from the noise source to a receiver. These obstacles can be tightly spaced wood fences (no gaps in the wood panels), engineered noise barriers, concrete fences, earth berms, structures, straw bale "zig-zag" design structures, or naturally occurring hills. Care must be taken even with a tightly spaced wood fence. Even a small opening between the individual slats on a fence can allow a pathway for noise to propagate through the opening. In fact, the noise can actually be enhanced through a small opening because the noise energy is channeled through the opening. To mitigate this problem, wood fences are generally constructed with two faces with the slats on one face overlapping the adjacent face.

BMP 4: Compressor and Pumpjack Equipment Noise Abatement. The following measures can help abate compressor and pumpjack equipment noise:

- Utilize compression equipment which reduce or alleviate noise (e.g., properly selected hospital grade mufflers matched to the noise reduction sought);
- Use design retrofits to reduce or alleviate noise associated with older compression equipment;
- Locate equipment to take advantage of surface topography to aid in noise abatement, etc.

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[19] Two versions of additional specific noise reduction guidance were suggested. Version one: In the absence of local ordinances or state laws, a general guideline of 55 dBA for outdoor residential, farms, and outdoor areas where people spend significant amounts of time can be considered as published by the U.S. Environmental Protection Agency entitled "Information On Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety". Version two: Noise should be mitigated to the satisfaction of the receptor. Noise in excess of 50 decibals measured 200 feet from the equipment or at a property line or an established receptor (for example residences, churches, schools, established campgrounds or sensitive wildlife) is normally unacceptable. For residential areas, the BLM has established a maximum standard of 48.6 dB(A)Leq at any structure. CBM wells, facilities, and equipment can often be cost effectively quieted below these maximum standards using "hospital grade" mufflers (which may be buried), sound panels (or hay bales), sound insulated buildings, and other methods.

[20] There were two alternative suggestions regarding appropriate distance. Version one: Provide the appropriate distance... to comply with an Ldn of 55 dBa. In otherwise quiet rural areas, even low level sound can be heard for long distances. Version two: Provide the appropriate distance...to minimize noise impacts. Prescribing a specific noise standard may conflict with local ordinances and state laws.

- Install high grade mufflers on the exhaust of compressor engines, wellsite, and facility engines to reduce the exhaust noise.[21]
- Consider the use of multi-blade fan configuration on the cooling fan.
- Electric power should be utilized when possible (rather than diesel).
- Use progressive cavity pumps or other quiet running artificial lift equipment in place of conventional pumpjacks/rocker arms to reduce noise and visual impacts.

Discussion: Noise abatement measures are applicable in areas where grouse are present (as well as in areas of human concern) because data indicate that grouse avoid large areas around noise sources. [Cite research – Note if we don't get the cite in time for publication then this discussion will be moved into the "future considerations" document]

I. Air Quality

BMP 1: Reduce Emissions. Operators should strive to reduce total emissions in CBM operations.

Discussion: EPA has joined with companies across all sectors of the natural gas industry to reduce methane emissions through a voluntary partnership known as the EPA Natural Gas STAR Program. (See the Natural Gas STAR web site, http://www.epa.gov/gasstar/index.htm for further information.) For larger internal combustion engine, lean burn technology is recommended. [22]

BMP 2: Particulates. Emissions of particulate matter from construction and road use can be minimized with various techniques such as the application of water, gravel, or other dust suppressants, with at least 50 percent control efficiency. Companies should contact the counties to ascertain the procedures to be followed on county roads, and should post and obey speed limits set by local authorities.

BMP 3: Air Quality Management/Coordination with Local Stakeholders. In some jurisdictions, city, county and regional air quality oversight entities are now being established in addition to the State and Federal air quality regulatory agencies to deal with possible exceedances of air quality standards. Operators should contact the appropriate regulatory agency to ensure compliance and coordination of air quality requirements. Other BMP examples include: establishment of cooperative boards to ensure air quality performance which meet local, regional, state and national requirements; increased monitoring resources due to the involvement of a wider body of participants; need for effective coordination to avoid conflicting efforts or duplicative performance requirements for CBM operators.

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[21] It was noted that mufflers can be buried to further reduce noise levels.

[22] Catalytic converters were discussed as a proven measure for helping to reduce air emissions by up to 95% from CBM operations, but various members of the group differed on the advisability of suggesting their use as a BMP at this time.

J. Public Safety Around CBM Infrastucture

BMP 1: Operational Awareness and Signs. Unless otherwise required by state or federal requirements, provide operational information and post necessary signs to minimize accidents. Post telephone number for emergencies.

BMP 2: Site Security. In consideration of the landowner's land use, and as necessary in high-risk areas, minimize entrance by unauthorized personnel through effective site security or barriers.[23]

BMP 3: Flare Fire Prevention. In CBM basins where cavitation is used as a completion technique (instead of hydraulic fracturing) flaring can be a safety and fire hazard. In addition to complying with local regulations regarding fire prevention, specific precautions should be taken to prevent fires including wetting down areas and ensuring adequate berming of flares. Flare pits used in cavitation should not be constructed adjacent to public roadways.

BMP 4: Coal Fires. In the San Juan Basin, dewatering of Fruitland Coals may contribute to coal fires burning at the outcrop. While control of such coal fires has proven to be extremely difficult, during dry periods, areas near underground coal fires should be monitored for grass and forest fires.

BMP 5: Education. Educate schools and communities about the dangers of going near CBM activities

BMP 6: Emergency Management Plans. Residents should be made aware of emergency procedures and be supplied with emergency phone numbers for fire departments and operators. Each operator should have an emergency management plan in place that is shared with state and local emergency management authorities.

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[23] On private lands, landowners often prefer to lock property boundary gates which will increase site security. On public lands, limitation of non-gas field access on gas field roads will increase security and promote damage avoidance while mitigating adverse impacts on wildlife use and habitat.

COAL BED METHANE
BEST MANAGEMENT PRACTICES HANDBOOK

PROPOSED BMPS, ALTERNATIVE LANGUAGE AND ADDITIONAL INFORMATION FOR FUTURE CONSIDERATION (4/12/04)

These are proposed Best Management Practices (BMPs), alternative language for portions of the WGA Coal Bed Methane BMP Handbook, and other comments and additional ideas/sources of information that were suggested too late in the process for full group consideration. **They have not been discussed and were not agreed to by the full CBM Advisory Committee.** However, it is hoped that they will be reviewed and considered in the future.

INTRODUCTION AND OVERVIEW

Introduction

Proposed Alternative Language for the Introduction, Second Paragraph:
Current Language: "With this guidance, the WGA sought funding to engage the CBM industry, all levels of government, and other stakeholders to build a Handbook of Best Management Practices (BMPs)."
Proposed Language: "With this guidance, the WGA sought funding to engage members of the CBM industry..."

Purpose and Assumptions

Comment on Existing Handbook Language, Purpose and Assumptions, Second Paragraph: Omit the following sentence "Other benefits and opportunities arising from CBM development such as job creation, tax revenue, royalty payments, and physical improvements for landowners (e.g., installation of cattle guards, fence replacement, on-going road maintenance, etc.) were also noted." because it sounds like CBM industry self promotion rather than a BMP.

Proposed Alternative Language, Purpose and Assumptions, Third Paragraph, Second Sentence:
Existing Language: "Development will produce jobs and revenues and contribute to meeting the Nation's energy needs, but should not compromise a healthy environment."
Proposed Language "Development will produce reliable, affordable clean burning energy, jobs and revenues and contribute to meeting the Nation's energy needs, but should not compromise a healthy environment".

Best Management Practices: How Used, Definitions, Applications, and Suitability

Comment on Existing Handbook Language, BMP Definitions, First Sentence: The word "proven" seems a bit strong.

I. PLANNING

Development Plans

Comment on Existing Handbook Language in Development Plans, Discussion Bullet Regarding Baseline Monitoring: The Handbook discusses "Strategies for establishing a baseline and monitoring." The concept of "baseline monitoring" is a red herring. Some baseline monitoring programs are established by law (for example in other extractive industry regulations or certain environmental protection requirements) and mandate a minimum of one year's worth of monitoring data. Such a mandate may not exist in oil and gas law at the state or local government level. When it is required, many professionals cannot agree on what is adequate baseline monitoring. In the future, WGA might want to consider: a) substituting a term such as "scientific monitoring sufficient to understand pre-CBM activity conditions" for establishing a baseline or collecting baseline information, b) clarifying additional descriptions or criteria for baseline monitoring, or c) eliminating this part of the discussion entirely.

Proposed Alternative Language in Development Plans, Discussion Bullet Regarding Maps:
Existing Language: "The map can also include geographic features such as streams and other water bodies, and special ecosystems."
Proposed Language: "The map can also include geographic features such as streams and other water bodies, and special sensitive areas".

Proposed Alternative Language In Development Plans Discussion Bullet Regarding Baseline Information:
Existing Language: "Collection of baseline information on such things as surface uses and surface owner preferences, pre-development noise levels, air quality, surface and groundwater quality, and biological resources can assist in identifying critical data or information gaps."
Proposed Language: "Collection of baseline information on such things as surface uses and surface owner preferences, pre-development noise levels in sensitive areas, air quality, surface and groundwater quality where the groundwater is a used resource, and biological resources can assist in identifying critical data or information gaps."

Comment on Existing Handbook Language in Development Plan Discussion: Delete following sentence: "Oil and gas operators, government agencies, elected officials, affected surface and mineral owners, community representatives, and other concerned citizens working together to plan for anticipated field development can produce development plans that reflect environmental responsibility, respect for the land, efficient

energy resource development, and productive relationships among diverse interests while at the same time permitting extraction of CBM."

Proposed Additions for the Planning Chapter

Proposed BPM: ***Surface Use Standards.*** For each operational area, each gas well operator should develop and constantly improve its own BMPs.

Discussion: For each operational area gas well operators should strive to proactively implement good surface use practices adapted to the area and the requirements of its operations. For a comprehensive example of such practices see: Williams i) Standard Surface Use Plan, ii) Ten Point Plan for Drilling; and iii) Standard and Site Specific Mitigation Measures used in Garfield County, Colorado.

II. WATER

Introduction

Proposed Alternative Language in the Water Introduction:
Existing Language: "Because CBM production generally begins by withdrawing a high volume of water, this has raised significant issues, including the potential wasting of valued water resources; concerns about groundwater, specifically on the effects of lowering the water table, potential impacts on residential and agricultural wells, and possible contamination, and; produced water disposal or management, including downstream impacts on both water quantity and quality."
Proposed Language: "Because CBM production generally begins by withdrawing a high volume of water, this has raised significant issues, including the potential wasting of valued water resources; concerns about groundwater, specifically on the effects on residential and agricultural wells, and; produced water disposal or management, including downstream impacts on both water quantity and quality."

Water Management Planning

Proposed Alternative Language in the Water Management Planning Discussion, Point i):
Existing Language: "likely quality of produced water"
Proposed Language: "estimated quality of produced water"

Produced Water Options:

Proposed Alternative Language for Produced Water Option, Factors for Consideration Bullets:
Existing Language: "Long-term impacts to the environment"
Proposed Language: "Long-term effects to the environment"

Proposed Additions to the Water Chapter

Proposed BMP (somewhere in the Water Chapter or in the Infrastructure Chapter): ***Storm water management practices.*** Control runoff and minimize sediment production from disturbed areas (roads, pads, pipelines, etc.) due to storm runoff.

Proposed BMP: ***Gas Companies Have Primary Responsibility for Solving Problems Caused by Produced Water From CBM Wells.***

Discussion: Without the production of water from CBM wells the water problems discussed below would not exist. The apparent profitability of CBM development is driving a boom in gas well drilling. It is the responsibility of the parties who are profiting from and pressing for this rapid development to promptly solve and pay for the problems caused by that rapid development. In keeping with Enlibra Principle Seven, (see Appendix B in the Handbook) gas companies should not increase their profits by reaping the benefits of CBM development while imposing its adverse consequences and the costs of solutions on other stakeholders.

Proposed BMP: ***Water Injection.*** If satisfactory solutions to surface water disposal and water quality issues cannot be implemented in a timely way in a field or portion thereof, water should be injected into appropriate geologic reservoirs.

Discussion: At present, stakeholders are searching for effective solutions to water issues caused by current levels of produced water discharge from CBM wells in Wyoming. At the same time rapid drilling continues. Variations in conditions, particularly water quality and soil types may well result in identification of different Best Practices for specific areas. However, it is clear that the prompt identification and implementation of actual best practice solutions to these water issues is a pressing priority.

Proposed Additional Language: The role of State Engineers and applicable state water law should be included in the discussion of water management. In many western states the State Engineer's Office is the agency responsible for determining "beneficial use", and that role should be understood in any discussion of beneficial use related to CBM produced water.

III. LANDOWNER RELATIONS

Introduction

Proposed Alternative Language in the Landowner Relations Introduction:
Existing Language: "Adoption of BMPs is often helpful in addressing interaction challenges related to a range of land owner issues, including: ....compensation for surface occupancy..."
Proposed Language: "Adoption of BMPs...compensation for damages..."

Communication and Notification:

Proposed Alternative Language for the Communication and Notification Section:
Existing Language: "This relationship should be based on both parties respecting and accommodating each other's property rights and interests, with open and consistent communication".
Proposed Language: "This relationship should be based on all parties respecting and accommodating each other's property rights and interests, with open and consistent communication."

Comment on Existing Handbook Language in the Communication and Notification Section: The comments on encouraging early and frequent communication between operator and surface owner are sound practices. Early and frequent communication as necessary will help alleviate problems on split estate when both parties act in good faith. Heading B. Plans, Agreements and Bonds – BMP 1, is a good example of what open and respectful communication between surface and mineral operators could accomplish. Also, the discussion of this BMP references a sample Surface Use Agreement available on the WGA website. A model SUA could actually be a BMP in and of itself, providing that the conditions in such an agreement do not violate regulatory permitting and other legal requirements. WGA should be cautious to avoid BMPs that mandate specific operator responsibilities on split estate given the extensive legal precedent that currently accrues to mineral owners and operators.

Comment on Existing Handbook Language in Communication and Notification Section: Delete the discussion of notification.

Plans Agreements and Bonds

Comment on Existing Handbook Language in the Plans, Agreements and Bonds Introduction: Add property values and wildlife impacts to the sentence that reads: Adoption of BMPs is often helpful in addressing interaction challenges related to a range of land owner issues, including: location of wells…"

Comment on the Footnote regarding Master Surface Use Agreements: Delete the footnote and show a list of sites where to obtain such information.

Comments on Surface Use Agreements BMP:
First Comment: Use the term "Surface Owner Agreement" instead of "Surface Use Agreement".

Second Comment: Change the sentence that now reads: "This would include notice to the surface owner of record…" to "This would include a personal visit with the surface owner to discuss the preliminary plan. If the surface owner is not available for an initial face-to-face meeting, then the operator should send a notice to the surface owner of record …"

Third Comment: Change the sentence in the discussion that now reads: "The SUA should address all relevant concerns, including such items as compensation for use of the surface, damage payments, and development plans that address facility and road locations, timing of operations, construction and reclamation requirements, water management, and access to the property." to read "The SOA should address all relevant concerns, including such items as compensation for damages and development plans that address facility and road locations, timing of operations, construction and reclamation requirements, and water management."

Comments on the Water Well Mitigation Agreement BMP:

First Comment: Delete "when CBM development is occurring within the same aquifer" from the sentence that currently reads: "Operators should determine whether their operations could impair the capability of these water wells and take appropriate actions to mitigate such impacts when CBM development is occurring within the same aquifer".

Second Comment: Change the sentence that now reads "A Water Well Mitigation Agreement should be offered to owners of wells and springs that could potentially be affected by CBM operations." to "A Water Well Mitigation Agreement should be offered to appropriated owners of wells and springs..."

Third Comment: Add the following language to the Water Well Mitigation Agreement BMP: "The operator should promptly and voluntarily remedy any damage to water sources caused by its operations and any doubts should be resolved in favor of the landowner, at least where water is derived from or above the coal formation from which gas and water is being produced."

Proposed Additions for the Landowner and Operator Relations Chapter

Proposed BMP: ***Surface Owner Selection Of Reasonable Facility Locations*****:** The surface owner is best able to select wellsites and facility locations together with road and pipeline routes which will minimize adverse impacts on existing and proposed surface uses, and to preserve the value of the surface, (Third Restatement of the Law of Property, Servitudes §4.8 (2000)). Landowners should be informed of the reasonable needs and alternatives available to the gas well operator so that a reasonable location may be selected within the drilling window for required operations. The fact that CBM fields are extensive and that any locations in the drilling window will generally result in similar production of gas allows surface use considerations to control the siting of wells, roads, pipelines, and other facilities.

Proposed BMP: ***Landowner Indemnification Provisions.*** SUAs Should Contain Landowner Indemnification Provisions.

Discussion: A typical indemnification provision might read: "The gas well operator hereby covenants and agrees to indemnify, defend and hold the Surface Owner harmless against any and all loss, damage, claims, injury, demands and suits which Surface Owner

may suffer as a result of or related to the gas well operator's operations on the Subject Property, excluding any portion of such loss, damage or claim caused by the negligence or willful misconduct of the Surface Owner." The indemnity provision simply assures the surface owner that the gas well operator will be responsible for loss and damage resulting from gas well operations.

Proposed BMP: SUAs should specifically identify the well, road, pipeline and other agreed upon facilities on a detailed attached plat. Buried pipelines should be well and permanently marked. Within sixty days after completion of construction, the operator should provide to the surface owner and record an "as built" survey so that successors, the parties themselves, and surveyors and planners can accurately locate the facilities and understand the extent of the agreed use.

Discussion: SUAs which generally reference the area to be used and permit multiple unspecified wells, road use or pipelines, or do not utilize the minimum reasonable footprint, constitute over reaching by the gas well operator and, as an unreasonable use, constitute a trespass. *Gerrity v. Magness, 946P.2d 913 (Colo. 1997).*

IV. INFRASTRUCTURE

Introduction

Comment on Existing Handbook Language: In the Infrastructure Chapter Introduction delete the sentence that reads: "When properly managed, CBM development may also enhance the use and value of a landowner's property" because it seems like self promotion by the CBM industry.

Suggested as Additional Guiding Principles for Infrastructure Best Practice Operational Standards:

- Within identified drilling windows and on leases, the landowner should select reasonable sites wells, roads and other facilities which accommodate existing and anticipated surface uses to the maximum extent possible.

- Tight control of contractors and agents to insure that best surface use practices are followed, agreements are complied with, and good surface owner relations are maintained.

- In general, well and facility footprints should be minimized to the maximum extent possible consistent with safe operating practices.

- In general, reclamation, including recontouring, topsoil replacement, and revegetation, should occur as early as possible with interim reclamation of disturbed areas not actually used for production operations being reclaimed upon completion of construction. See e.g. Colorado Oil and Gas Conservation Commission Rule 1003.

Roads and Transportation

Proposed BMP: ***Anterial Roads.*** Existing ranch roads should generally be utilized as anterial roads to access two track well roads. Such roads should be adequately crowned, graveled, and drained by the operator to bear up under gas field traffic under adverse weather conditions, and the operator should maintain such roads in good and passable condition for the life of the field.

Proposed BMP: ***Limiting Road Use.*** Particularly on public lands in areas of sensitive wildlife habitat, birthing areas or winter range, etc., roads can be fenced and gated and closed to non-gas well personnel. Oil and gas traffic should be kept to a minimum and remote sensing and control systems utilized. Private lands are normally required to be gated and locked to preclude access to the general public. Reasonable landowner requests for gating and locking private lands should be complied with. Gas field traffic should stay on the roads at all times. On private lands, all road easements should be non-exclusive and limited to access to defined oil and gas facilities. The surface owner, rather than the gas company, has the right to grant access to the surface owner's property, including access roads.

Proposed Alternate Language for the Road Siting BMP in the Current Handbook.
Current Language: Utilize and improve existing roads to gas field requirements to the maximum extent possible. Locate roads in areas that will optimize year-round, all-weather access, and minimize surface disturbance and environmental impacts. Road location should be selected in consultation with the surface owner, and should consider future development plans.
Proposed Language: Locate roads where landowners want them, where they will serve both gas field and surface owner needs, and in areas that will optimize year-round, all-weather access, and minimize surface disturbance and environmental impacts. Road location should be reasonably selected by the surface owner.

Proposed Additional Language for the Service Industry Traffic BMP in the Current Handbook: It is the operator's responsibility to ensure service company compliance with surface use agreements and permit requirements.

Pipelines and Power Lines (Gas, Water, and Power)

Proposed Alternate Language for the Corridors BMP in the Current Handbook.
Current Language: Use existing disturbance corridors whenever possible (ideally following access routes or existing pipeline routes).
Proposed Language: Use existing disturbance corridors and utility corridors to the maximum extent possible (ideally following utility easements, utility access corridors or existing pipeline routes). Rights-of-way should overlap with pipelines placed as close as possible to other utilities in the corridor. On relatively level ground, gathering lines can often be placed within ten feet of each other (in Houston, major pipelines are sometimes placed in corridors within one foot of each other).

Proposed Discussion: Gathering pipelines can have a significant unnecessary adverse impact on the usefulness and value of the surface. If gathering lines crisscross each other, they may define significant areas of non-use and divide the real property in small pieces which are unuseable for many valued purposes, such as residential or commercial development and siting of agricultural structures.

Proposed Alternate Language for the Trenches BMP:
Current Language: Locate all lines (i.e. gas and water disposal) in the same trenches (or immediately parallel to), and at the same time, if possible.
Proposed Language: Locate all lines (i.e. gas and water disposal) in the same corridors (or immediately parallel to), and at the same time, if possible.

Proposed BMP: ***Location.*** Outside of existing utility corridors, pipelines should be located along routes selected by the surface owner which reasonably accomplish the purpose of the gas well operator. Pipelines located in road rights-of-way or under roads or within ten feet of property boundaries will minimize adverse surface impacts. To the maximum extent possible, pipelines should be buried at least 48 inches deep to get below plow depth and reduce the risk of inadvertent excavation.

Proposed BMP: ***Safety.*** Pipeline markers should include one-call notices and contact numbers. Surface owners and others grading and excavating on the property should make use of the one-call system to locate pipelines prior to any excavation in the area of the pipeline. Steel pipelines should be properly fitted with cathodic protection to reduce the risk of corrosion and related gas leakage.

Proposed BMP: ***Reclamation.*** Pipeline should be double ditched with soil compaction and restoration of topsoil to the surface. Subsidence should be anticipated and mitigated using compaction and mounding of topsoil. If the ground settles over the trench, fill should be topsoil of like quality and free of noxious weeds. Foreign soil (from other properties) should be introduced onto the property only with prior written permission of the surface owner. The refilled trench should be contoured to conform to the terrain and revegetated utilizing a seed mixture agreed to by the surface owner and, as necessary, mulch and fertilizer. On agricultural lands, rocks of two inches or more in diameter should be "picked" by the operator at least three times over the ensuing two years to reduce the damage to agricultural equipment working over the excavated pipeline.

<u>Habitat and Species Protection</u>

Proposed BMP: ***Survey areas for rare plants before building well pads.*** At a minimum operators should review BLM and Forest Service sensitive species lists prior to siting infrastructure (e.g., well pads), and avoid locations where sensitive species are found. G1 and G3 plants represent the groups of most imperiled species as ranked by the NatureService and the Heritage Program network

Wells

Proposed BMP: ***Footprint.*** The well footprint should be as small as possible. Use of a small well or facility footprint avoids trespass by unreasonable and unnecessary use.

Proposed alternative language to precede the bullets under Siting and Construction Considerations for Wells
Current Language: Where feasible, site and construct wells with the following considerations:
Proposed Language: Within the applicable drilling window, the Landowner should be permitted to select a reasonable well location which accommodates surface use. To the extent possible, construct wells as follows:

Proposed Additional Consideration under Siting and Construction Considerations for Wells:

- Choose and construct sites with reclamation in mind; i.e., if possible, avoid cutting trees and other long lived, slow growing vegetation, minimize cut and fill, and store topsoil and preserve it from erosion.

- Production facilities and equipment should be consolidated in as small an area as possible, a separate facilities location may be unnecessary or quite small for shallow CBM wells and is often 1,500 square feet or less for conventional wells. Production facilities should be bermed and fenced to preclude domestic and wild animals from entering the area. The wellhead is often fenced using a ten by ten pipe fence or, for Powder River CBM wells, may be winterized and enclosed is a steel container.

- Where no code exists, locate facilities and roads away from occupied dwellings. Add: (in addition to dwellings) agricultural and commercial buildings, schools, water sources, and other significant areas of surface use.

- Locate well sites no closer than one-half mile from homes and other domestic structures.

- Utilize closed-loop drilling systems to achieve pitless drilling and minimize truck traffic and water usage.

Proposed Alternative Language for the Reclamation BMP under Wells:
Current Language: ***Reclamation.*** As soon as reasonably possible after drilling is completed, conduct interim reclamation to reduce the drill site to the minimum area required for production operations and to restore the disturbed areas to their pre-disturbance condition, or better, pursuant to landowner preference. Interim reclamation should include the following:

- Recontour disturbed areas to be compatible with existing grades, including for agricultural purposes.

- Depending on landowner preferences, replace topsoil to at least the depth and quality which existed prior to disturbance for final reclamation of the site upon abandonment of the well.

- Revegetate disturbed areas using a seed mixture to match native vegetation.

- Remove all chemicals, equipment, materials, and waste not necessary for sustaining production from the well pad.

- Use only certified and state inspected seed that is free of noxious weeds for reclamation.

Proposed Language (Read in context of the proposed BMPs that follow below): ***Interim Reclamation.*** As soon as reasonably possible after drilling is completed, conduct interim reclamation to reduce the drill site to the minimum area required for production operations and to restore the disturbed areas to their pre-disturbance condition, or better. Interim reclamation should include the following:

- Remove all chemicals, foreign substances, pit liners, contaminated soil and trash, together with all equipment which is not required to sustain production from the well.

- Fill and compact any pits.

- Recontour disturbed areas to be compatible with existing grades, including for agricultural and irrigation purposes.

- Replace topsoil on the reclaimed area to at least the depth and quality which existed prior to disturbance .

- Revegetate the reclaimed area using a weed free seed mixture selected by the surface owner to establish the desired crop or match native vegetation. Use only certified and state inspected seed that is free of noxious weeds for reclamation.

- Remove all chemicals, equipment, materials, and waste not necessary for sustaining production from the well pad.

Proposed BMP: ***Final Reclamation:*** Plug and abandon the well in accordance with regulatory requirements and good and safe operating practices. Promptly remove all equipment to below plow depth and promptly reclaim the entire well pad and any other disturbed areas in accordance with the BMP above.

Proposed BMP: ***Equipment Removal.*** Remove all equipment not necessary for well operations.

Proposed BMP: ***Centralized Well Sites.*** Centralized well sites, in certain circumstances, can reduce capital and operating costs and at the same time reduce adverse surface impacts, including the well site footrprint, roads and pipelines. For example, the Colorado Oil and Gas Conservation Commission has determined that centralized well sites accomplish all of these savings with respect to drilling to the Williams Fork Formation in Mesa and Garfield Counties, Colorado. See COGCC website. However, centralized well sites should be expected to be impractical in shallow coalbeds until shallow, long reach directional drilling technology is proven. Some companies are working to develop the required techniques, which some expect to lower costs and improve production; but it will likely take some time.

Central Gas Gathering, Treatment, Compression, and Metering Facilities

Proposed BMP: ***Water Gathering Systems.*** Where produced water is not discharged or injected at the wellsite, particularly for typically closely spaced CBM wells, water should be gathered using water gathering pipelines co-located with gas gathering lines. Such a water gathering system is often less expensive over the life of the field than water hauling by truck, and avoids the significant road damage and community disruption that results from constant heavy truck traffic often necessary to move large volumes of CBM water by truck.

Proposed BMP: ***Gas Gathering Systems.*** Low pressure gas gathering systems constructed utilizing centralized compression and treating facilities should be used. CBM normally requires low bottom hole pressures to dewater and to flow at an economical rate from the CBM well. Without such low pressure, little or no CBN gas from the coal formation can be recovered. Centralizing compressor facilities efficiently increase the gas pressure from gathering line inlet pressure (perhaps 50 psig) up to long distance transmission line pressure (often greater than 1000 psig). Centralized compression, as opposed to a compressor at every well, will normally save capital and operating costs, dramatically reduce adverse surface impacts (i.e., noise and unnecessary use of more land) and reduce system down time while achieving low bottom hold pressures at wells connected to the system. Centralized compressors can normally be quieted more cost effectively (on a per mmbtu basis) than small wellsite compressors.

Proposed BMP: ***Centralized Treatment and Processing.*** Centralized treatment (removal of impurities) and processing (removal and sale of natural gas liquids or helium) should be used. CBM often requires treating to remove CO2, nitrogen, or other impurities, and CBM infrequently may contain sufficient NGLs to warrant processing. With respect to generally low volume CBN wells, centralized facilities will normally save capital and operating costs, dramatically reduce adverse surface impacts, and reduce system downtime. Centralized treatment and processing facilities are often placed on property purchased by the facility operator and are normally subject to county and state regulatory and land use processes.

Pests and Noxious Weeds

Proposed Additional Language for the Integrated Pest Management BMP: Each operator should have a pest and weed control procedure, and should be fully responsible for pest and weed control problems which result from or are aggregated by its operations. Control contractors should be supervised to ensure that control measures are effectively implemented, and at the optimum time.

Proposed Additional Language for the Revegetation BMP: Revegetation of disturbed areas not required for production should occur promptly following the completion of pipeline, road, well, and facility construction. This practice reduces erosion and establishes vegetation to hold topsoil. As compared to final reclamation, interim reclamation and revegetation provides a 30 to 50 year head start on plant growth, allows reestablishment of surface use, and normally ensures that a large portion of the reclamation will be completed by a responsible operator. (Toward the end of their productive life, gas wells may be transferred to "stripper" operators who may not adequately reclaim well and facilities sites.)

Visual Impacts

Proposed Additional Language for the Minimize Footprint BMP: Consolidate equipment in a compact area which may often be effectively screened by placement on the cut side of the pad. Excessive or unnecessary use of the surface constitutes trespass.

Noise Abatement

Proposed Additional Measure to Help Abate Compressor and Pumpjack Equipment Noise: Enclose compressors in sound insulated buildings with adequate ventilation to permit doors to be closed in the summer months.

For Possible Inclusion in a Future Handbook Version as Additional Research Data Becomes Available: Noise abatement measures may be applicable in areas where grouse are present (as well as in areas of human concern) because anecdotal information indicate that grouse avoid large areas around noise sources.

V. EMERGING TECHNOLOGIES

The technologies and practices described in this section offer potential, but have not yet been tested sufficiently or utilized broadly and successfully enough to be characterized as best management practices. They may, however, become BMPs in the future.

Microhole Drilling Technology: Microhole drilling technology allows the drilling of wells using smaller diameter drill holes than are generally used for oil and gas wells. A hole diameter of 2-3/8 inch is characteristic. The technology involves coiled tubing, which spools from the drilling unit into the drill hole. The relatively small and light

drilling unit can be hauled with a light truck. Accordingly, microhole drilling offers the potential of decreased drilling costs as well as restricting disturbed environments to a smaller area during drilling. Collateral benefits include reduced impacts due to lighter equipment moving on access roads. Current investigations are focusing on drilling to relatively shallow formations (less than approximately 5,000 ft depth), however DOE considers deeper drilling to be achievable.

APPENDIX A

ACRONYMS

ADR – Alternative Dispute Resolution

APD – Application for Permit to Drill

BLM – Bureau of Land Management

BMP – Best Management Practice

CBM – Coal Bed Methane

EPA – Environmental Protection Agency

NEPA – National Environmental Policy Act

NPDES – National Pollution Discharge Elimination System

RMP – Resource Management Plan

SOA – Surface Owner Agreement

SOP Agreement – Standard Operating Practices Agreement

SUA - Surface Use Agreement

SN – Sundry Notice

USDW – Underground Source of Drinking Water

USFS - United States Forest Service

USF&WS - United States Fish & Wildlife Service

WMP – Water Management Plan

APPENDIX B

ENLIBRA PRINCIPLES

WGA uses a set of principles to guide its work on complex environmental and natural resource issues. Based on successful problem solving experiences, the Enlibra principles were articulated and endorsed by the western governors to serve as a guide to policy development and decision-making in the West. Enlibra is a hybrid word with Latin roots created to mean balance and stewardship. Enlibra is based upon the following eight interdependent principles:

One: National Standards, Neighborhood Solutions - Assign Responsibilities at the Right Level

Two: Collaboration, Not Polarization - Use Collaborative Processes to Break Down Barriers and Find Solutions

Three: Reward Results, Not Programs - Move to a Performance-Based System

Four: Science For Facts, Process for Priorities - Separate Subjective Choices from Objective Data Gathering

Five: Markets Before Mandates - Pursue Economic Incentives Whenever Appropriate

Six: Change a Heart, Change a Nation - Environmental Understanding is Crucial

Seven: Recognition of Benefits and Costs - Make Sure All Decisions Affecting Infrastructure, Development and Environment are Fully Informed

Eight: Solutions Transcend Political Boundaries - Use Appropriate Geographic boundaries for Environmental Problems. [1]

[1] "Principles for Environmental Management in the West," WGA policy resolution 02-07 (June 2002).

APPENDIX C

WESTERN GOVERNOR'S ASSOCIATION COAL BED METHANE
CBM ADVISORY COMMITTEE MEMBERS

The CBM Best Practices Handbook represents a working collaboration between a number of individuals from federal, state, tribal, and local government. The Western Governors also consulted with and utilized input from a broader group of interested stakeholders and experts. The following individuals were participants in this process and receive tremendous thanks from WGA for lending their time and expertise.

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Larry Charach
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Frank Chavez
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Art Compton
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Ned Farquhar
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APPENDIX D

REGULATORY COMPLIANCE CHECKLIST - WYOMING EXAMPLE

Federal, State, and County Permits, Approvals, and Authorizing Actions - Wyoming Example

Agency	Permit, Approval or Action	Authority
U.S. Forest Service (USFS)	Decision Record for Proposed Action. Evaluate environmental impacts of Proposed Action	National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) Council on Environmental Quality, 40 CFR 1501, 1502
	Approval of Plan of Development for surface use of well pad	FSM 1950
	Concurrence with BLM's APD approval process on USFS administered land	FSM 1500
	Special Use Permit for access road ROW, road decommissioning, and pipeline	Forest Service Handbook (FSH) 1509.11
	Special Use Permit to utility company for installation and operation of powerline	Federal Register Notice 5-22-95
	Antiquities and cultural resource permits on USFS-administered land	Antiquities Act of 1906, as amended (16 U.S.C. 431-433); Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. Sections 470aa-470ll); Preservation of American Antiquities, as amended (43 CFR 3)
Bureau of Land Management (BLM)	Decision Record for Proposed Action. Evaluate environmental impacts of Proposed Action	National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) Council on Environmental Quality, 40 CFR 1501, 1502
	Permit to drill, deepen, or plug back on BLM-managed land or minerals (APD process)	Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.) Requirements for Operating Rights Owners and Operators, as amended (43 CFR 3162)

Agency	Permit, Approval or Action	Authority
	Rights-of-way grants and temporary use permits for pipelines and central tank battery on BLM-managed land	Mineral Leasing Act of 1920, as amended (30 U.S.C 185); 43 CFR 3180
	Rights-of-way grants for access roads on BLM-managed land	FLPMA (43 U.S.C. 1761-1771); 43 CFR 2800
	Authorization for flaring and venting of natural gas on BLM-managed land or minerals	Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.); Requirements for Operating Rights Owners and Operators, as amended (43 CFR 3162)
	Plugging and abandonment of a well on BLM-managed land or minerals	Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.); Requirements for Operating Rights Owners and Operators, as amended (43 CFR 3162)
	Antiquities and cultural resource permits on BLM-managed land	Antiquities Act of 1906 (16 U.S.C. Section 431-433); Archaeological Resources Public Protection Act of 1979 (16 U.S.C. Sections 470aa-47011); 43 CFR 3
	Approval to dispose of produced water on BLM-managed land	Mineral Leasing Act of 1920 (30 U.S.C. 181 et seq.); 43 CFR 3164; Onshore Oil and Gas Order No. 7
	Use only BLM Approved Formulations of Herbicides on BLM lands. Ensure that a Pesticide Use Proposal is submitted and approved by the proper BLM authority. Ensure that a Pesticide Application Record is completed within 24 hours after the completion of the herbicide application on BLM lands and submitted to the proper BLM Office.	Requirements by the BLM Vegetation Treatment on BLM Lands in the Thirteen Western Station Final Environmental Impact Statement 1991 and BLM Manual 9011 Chemical Pest Control, BLM Handbook H-9011-1 Chemical Pest Control, and BLM Manual 9015 Integrated Weed Management
Bureau of Indian Affairs (BIA) and/or Tribe	Approval of Utilization - Provide for efficient and timely development and production of tribal oil and gas leases	Indian Minerals Leasing Act of May 11, 1938, 25 U.S.C. 396a-396q, 25 CFR, Part 211. Act of March 3, 1909, 25 U.S.C. 396, 25 CFR, Part 212. Indian Mineral Development Act of December 22, 1982, 25 U.S.C. 21-02-2108, 25 CFR, Part 225

Agency	Permit, Approval or Action	Authority
	Rights of Way - Grant rights-of-way and issue temporary permits	Act of March 3, 1901, c.832 ss4.31.Stat.1084. Also 209DM8 Secretaries Order 3150 and 3177, as amended, 10 BIAM, bulletin 13, as amended, and Albuquerque Area Addendum Release 9401
	Archaeological Clearance - Issue antiquities or archaeological resource permits to remove or excavate archaeological resources on land administered by BIA	Antiquities Act of 1906, 16 USC Secs. 431-433; Archaeological Resources Protection Act of 1979 (16 USC Secs. 470a-47011), 43 CFR, Parts 3 and 7; National Historic Preservation Act, Section 106 and 36 CFR Part 800
	Air emissions inventory data - Accumulating emissions data	Clean Air Act
U.S. Army Corps of Engineers (COE)	Section 404 permits and coordination regarding placement of dredged or fill material in area waters and adjacent wetlands	Section 404 of the Clean Water Act of 1972, as amended (33 U.S.C. 1344); EPA-administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES), as amended (40 CFR 122); state program requirements (40 CFR 123); Section 404(b)(1) Guidelines for Specific Disposal Sites for Dredged or Filled Material, as amended (40 CFR 230)
U.S. Fish and Wildlife Service (USFWS)	Coordination, consultation, and impact review on federally listed threatened and endangered (T&E) species	Fish and Wildlife Coordination Act (16 U.S.C. 661-666c), Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1536); Bald Eagle Protection Act (16 U.S.C. 668-668dd)
	Migratory bird impact coordination	Migratory Bird Treaty Act (16 U.S.C. 704)
U.S. Department of Transportation (DOT)	Control pipeline maintenance and operation	Transportation of Natural and Other Gas by Pipeline, Annual Reports, Incident Reports, and Safety Related Condition Reports, as amended (49 CFR 191); Transportation of Natural

Agency	Permit, Approval or Action	Authority
		and Other Gases by Pipeline: Minimum Safety Standards, as amended (49 CFR 192)
U.S. Environmental Protection Agency (EPA)	Spill Prevention Control and Countermeasure Plans (SPCCPs)	40 CFR 112
	Regulation of hazardous waste treatment, storage, and/or disposal	Resource Conservation and Recovery Act (42 U.S.C. Section 6901)
	Produced-Water Disposal - Issue permit to allow for underground injection of produced water	Safe Drinking Water Act (42 U.S.C. 300F-300-9), 40 CFR Parts 144 and 147
Wyoming Department of Environmental Quality - Water Quality Division (WDEQ-WQD)	Permits to construct settling ponds and waste water treatment systems, including groundwater injection and disposal wells	Wyoming Environmental Quality Act, Article 3, Water Quality, as amended (W.S. 35-11-301 through 35-11-311)
	Regulate disposal of drilling fluids from abandoned reserve pits *[Should be under WY Oil & Gas]*	Wyoming Environmental Quality Act, Article 3, Water Quality, as amended (W.S. 35-11-301 through 35-11-311)
	NPDES permits for discharging produced water and stormwater runoff if greater than five acres of disturbance	WDEQ-WQD Rules and Regulations, Chapter 18; Wyoming Environmental Quality Act, Article 3, Water Quality, as amended (W.S. 35-11-301 through 35-11-311); Section 405 of the Federal Water Pollution Control Act (Clean Water Act) (codified at 33 U.S.C. 1345); EPA-administered Permit Programs: NPDES, as amended (40 CFR 122); State Program Requirements (40 CFR 123); EPA Water Program Procedures for Decision-making, as amended (40 CFR 124)
	Approval for discharge of hydrostatic test water *[This takes authorization under a general discharge permit]*	Wyoming Environmental Quality Act, Article 3, Water Quality, as amended (W.S. 35-11-301 through 35-11-311) .
Wyoming Department of Environmental Quality - Air Quality Division (WDEQ-AQD)	Permits to construct and permits to operate	Clean Air Act, as amended (42 U.S.C. 7401 et seq.); Wyoming Environmental Quality Act, Article 2, Air Quality, as amended (W.S.

Agency	Permit, Approval or Action	Authority
		35-11-201 through 35-11-212)
Wyoming Department of Environmental Quality - Land Quality Division (WDEQ-LQD)	Mine permits, mine impoundments, and drill hole plugging on state lands	Wyoming Environmental Quality Act, Article 4, Land Quality, as amended (W.S. 35-11-401 through 35-11-437)
Wyoming Department of Environmental Quality - Solid Waste Division (WDEQ-SWD)	Construction fill permits and industrial waste facility permits for solid waste disposal during construction and operations	Wyoming Environmental Quality Act, Article 5, Solid Waste Management, as amended (W.S. 35-11-501 through 35-11-520)
Wyoming Department of Transportation (WDOT)	Permits for oversize, overlength, and overweight loads	Chapters 17 and 20 of the Wyoming Highway Department Rules and Regulations
	Access permits to state highways	Chapter 13 of the Wyoming Highway Department Rules and Regulations
Wyoming Board of Land Commissioners/ Land and Farm Loan Office	Approval of oil and gas leases, ROWs for long-term or permanent off-lease/off-unit roads and pipelines, temporary use permits, and developments on state lands	Public Utilities, W.S. 37-1-101 et seq.
Wyoming Oil and Gas Conservation Commission (WOGCC)	Permit to drill, deepen, or plug back (APD process)	WOGCC Regulations, Chapter 3, Operational and Drilling Rules, Section 2 Location of Wells
	Permit to use earthen pit (reserve pits)	WOGCC Regulations, Chapter 4, Environmental Rules, Including Underground Injection Control Program Rules for Enhanced Recovery and Disposal Projects, Section 1, Pollution and Surface Damage (Forms 14A and 14B)
	Authorization for flaring or venting of gas	WOGCC Regulations, Chapter 3, Operational and Drilling Rules, Section 45 Authorization for Flaring or Venting of gas

Agency	Permit, Approval or Action	Authority
	Permit for Class II underground injection wells	Underground Injection Control Program: Criteria and Standards, as amended (40 CFR 146); state Underground Injection Control Programs, State-administered program - Class II Wells, as amended (40 C.F. R. 147.2551)
	Well plugging and abandonment	WOGCC Regulations, Chapter 3, Section 14, Reporting (Form 4); Section 15, Plugging of Wells, Stratigraphic Tests, Core, or Other Exploratory Holes (Form 4)
	Change in depletion plans	Wyoming Oil and Gas Act, as amended (Form W.S. 30-5-110)
Wyoming State Engineer's Office (WSEO)	Permits to appropriate groundwater (use, storage, wells, dewatering)	W.S. 41-3-901 through 41-3-938, as amended (Form U.W. 5)
	Permits to construct dams and reservoirs	W.S. 41-3-301 et seq., as amended (Forms SW3, SW4)
Wyoming State Historic Preservation Office (SHPO)	Cultural resource protection, programmatic agreements, consultation	Section 106 of National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.) and Advisory Council Regulations on the Protection of Historic and Cultural Properties, as amended (36 CFR 800)
County (representative)	Construction/use permits	County Code and Zoning Resolution
	Conditional use permits	County Code and Zoning Resolution
	Road use agreements/oversize trip permits	County Code
	County road crossing/access permits	County Code/Engineering Department
	Small wastewater permits	County Health Department
	Hazardous material recordation and storage	County Code
	Zone changes	Zoning Resolution
	Filing Fees	County Code
	Noxious weed control	County Code

APPENDIX E

BENEFICIAL USE ALTERNATIVES FOR CBM PRODUCED WATER

Produced water quality, applicable regulations, and cost will generally dictate potential beneficial use of produced water. In some cases, produced water can be treated to make it suitable for a particular use, and treatment technologies are discussed in the next section. However, in accordance with 40 CFR, Part 435, produced water must be put to some use for livestock, wildlife, or agriculture. Otherwise, it is not to be discharged to surface waters of the Nation.

Agricultural Uses

The water provided by CBM discharge is a temporary and potentially valuable resource for agriculture, particularly in arid regions. CBM produced water has the potential for beneficial use in agricultural livestock and irrigation applications, depending on the quality. Livestock benefits have been realized with increased cattle density, increased weight gain in cattle, and subsequent improvement in range use when water is made available in otherwise dry areas. New water sources may also increase aquatic habitat and provide new fisheries. However, water law and compact requirements vary between states, so a full understanding of water issues is critical.

Alternative 1 - Stock Watering

The layout of many CBM projects is particularly conducive to stock watering because CBM wells are spread out on 80 acre spacing, or greater. Stock watering may be handled in several ways, including discharge to reservoirs and stream drainages, or discharge to small containment vessels, such as tire tanks. In either case, overflow of water from the containment ponds or tanks can provide water to livestock over a distance. Water impounded at the head of a drainage, if allowed to overflow from a small tank or reservoir, distributes water over a larger linear distance, potentially up to several miles. The result is an improved distribution of the herd, and ultimately an improved utilization of the grazing lease or ranch. Loss of the water in this scenario is largely a function of infiltration through the streambed and consumption by plant species along the banks, rather than direct consumption by livestock and wildlife.

The overflow of water into streams constitutes a discharge to surface waters thus to discharge the water as described would in most cases require a NPDES permit. There is also the potential to impact soils by allowing the water to run along the surface, depending on the water quality and soil types.

Alternative 2 - Irrigation

CBM produced water can be used for irrigation purposes when water quality, soil type, crop type and irrigation method are conducive for irrigation. The appropriateness of irrigation with CBM water is dependent on the site specific conditions (water quality,