Montana Board of Oil and Gas Conservation

Environmental Assessment

For

Fidelity Exploration & Production Company

Tongue River – Coal Creek Project, Plan of Development (Amended 2005)

This site-specific analysis tiers to and incorporates by reference the information and analyses contained in the Final Statewide Oil and Gas Environmental Impact Statement - January 2003 (Final CBNG EIS) jointly prepared by the Bureau of Land Management (BLM), Montana Department of Environmental Quality (MDEQ), and the Montana Board of Oil and Gas Conservation (MBOGC) and adopted by the MBOGC on March 26, 2003. It also tiers to and incorporates by reference the Programmatic EIS on Oil and Gas Drilling In Montana (Programmatic EIS), prepared under the supervision of the Office of the Governor and adopted by the MBOGC on December 28, 1989. The scope of this analysis includes analysis specific to state lands managed by the Montana Department of Natural Resources and Conservation's (DNRC) Trust Land Management Division (TLMD) for this project. Authority to conduct operations on state lands requires a separate and independent decision by the TLMD and State Land Board. Additionally, authority to conduct operations on federal lands managed by the BLM requires a separate and independent decision by the BLM.

Proposed Action – Title: Fidelity Exploration & Production Company (Fidelity) Coal Creek, Amended Plan of Development (POD).

Location of Proposed Action

The POD proposes development of coal bed natural gas (CBNG) resources (as delineated on maps provided for the POD and available for review in the MBOGC offices) in Sections 9, 16-22, 27-34, Township 9 South, Range 41 East, and Sections 23-26, Township 9 South, Range 40 East, in the CX Field, Big Horn County, Montana. Surface ownership in the project area includes privately owned (fee) lands; lands owned by the State of Montana (state) and federally owned lands (federal). Mineral ownership includes fee, state and federal estates. Fidelity proposes to drill an additional 236 CBNG (43 fee, 20 state, 173 federal) wells in the POD area. The POD proposes developing CBNG from the Dietz, Monarch, and Carney coals, with potential exploration and production of the Smith and Wall coals, and possibly other deeper coals (e.g., Carlson, King, and Roberts). The proposed action is the drilling and production of 236 CBNG wells.

Minerals	Original POD	Amended POD	Total
Fee	62	43	105
State	16	20	36
Federal	132	173	305
Total	210	236	446

This Environmental Assessment (EA) analyzes the potential effects and impacts associated with proposed fee and state wells. It is anticipated that an additional assessment will be carried out by BLM to assess drilling and production of federal wells.

Purpose and Need

The proposed action involves the further development of CBNG resources known to exist within the current CX Field (Board Orders: 174-2000, 100-2003, 6-2004) and to increase well density on lands contained within the Coal Creek POD. The lands involved are state trust, fee and federal, all under oil and gas lease. Recovery of natural gas resources is a direct benefit to the mineral owners, both public and private, to state and local governments, and to public schools as recipients of both tax receipts and royalties from school trust land. Natural gas has become a fuel of choice for environmental reasons, and national demand, as well as the price received for this commodity, has increased substantially during recent years. This Environmental Assessment (EA) is the site-specific analysis for Fidelity's POD to determine, examine, and document the potential effects and impacts of the proposed action on the quality of the human and physical environment. This EA is prepared to ensure that CBNG development of leases occurs in an orderly, efficient, economically and environmentally responsible manner that provides measures to protect the environment and surface owner assets.

Description of the Proposed Action

On February 12, 2004, Fidelity submitted the Tongue River – Coal Creek POD. On February 1, 2005, the MBOGC completed an EA and issued a Finding of No Significant Impact related to the original POD. This action is a request to increase well density within the project, as described in the Tongue River – Coal Creek POD (Amended). Of the proposed new drilling, the 63 wells will be under the regulatory jurisdiction of the MBOGC.

The Proposed Action includes the use of existing infrastructure and facilities. Access to well sites, battery locations and other facilities is to occur on existing improved and existing/proposed two-track roads. Approximately 13.19 miles of existing access roads (8.2 miles existing 2-track and 4.99 miles existing improved/all-weather roads) and 5.39 miles of proposed 2-track roads are included in the proposed action. Approximately 11.1 miles of utility corridors with water, gas and power lines resulting in a surface disturbance of approximately 40.4 acres, and 2.43 miles of buried power cable outside a utility corridor will be utilized. A total of 5 existing central gathering and metering facilities are to be used for the amended POD, along with 1 existing compressor station. No new batteries and compressors are being proposed for this amendment. Two MDEQ discharge permits (i.e.,

MT 0030457 and MT 0030724) may be used for the management of water produced in association with development. Additionally, containment/storage ponds have been proposed (as needed) as water management tools. Wells will be typically drilled, one per coal bed, on shared sites with up to five wells located on a common well site (or pad), into the Dietz, Monarch and Carney coal seams and possibly additional coal seams (e.g., Smith, Wall, Carlson, King and Roberts). In some cases, multiple coal seams may be accessed from a single well.

Wells will be drilled with truck-mounted, water well-type rigs. This type of rig can be set up on uneven terrain; consequently, a pad site may not be constructed unless topography requires it. A pad will be constructed where terrain interferes with safe operation of vehicles and equipment. Approximately one acre of surface will be disturbed during drilling and completion operations. An estimated total of 20 acres may be disturbed during the drilling process on fee and state lands. Two mud pits at the pad locations may be constructed (6'Wx15'Dx15'L) to contain drilling fluids and water. Topsoil will be stripped and saved during any surface disturbing operations and used for reclamation of the disturbed area.

Well heads, compressors, and other surface facilities will be equipped with appropriate frost boxes painted an unobtrusive color and fenced to protect against damage by cattle. Electronic flow devices or chart recorders will measure natural gas and water production.

Fidelity has submitted a surface use plan, water management plan and reclamation plan for this POD, as required in the March 26, 2003, MBOGC Record of Decision (ROD) for the EIS. The initial and amended POD for this project includes a number of maps and exhibits available for public inspection at the MBOGC offices in Helena and Billings.

Hearing Process and Public Involvement

Fidelity presented its Coal Creek POD amendment to the MBOGC on December 8, 2005, as Docket No. 587-2005 to amend Board Order 7-2004 and provide for 2 wells per coal bed for each 160-acre governmental spacing unit. The Coal Creek POD (Amended) was approved by the MBOGC on December 8, 2005, by Order 507-2005. The MBOGC 2003 ROD and MBOGC Order 99-1999 apply to this proposed action. Order 99-1999 was established by the MBOGC to recognize the DNRC Controlled Ground Water Area for the Powder River Basin and to establish minimum requirements for information to be considered at a public hearing. The order also requires development and implementation of a groundwater monitoring plan, as part of establishing field spacing for CBNG development. Fidelity's amended POD complies with the requirements of both the EIS ROD and Order 99-1999.

Public Hearings were advertised in the statewide ***Helena Independent Record*** and the official newspaper of the county in which the proposed operations are to take place. In addition, notice of the public hearing was mailed to the MBOGC's mailing list and a notice was published on its Web site. Compliance with all applicable public notice requirements has been completed.

Other Regulatory Requirements

Table 1-1, Page 1-14, of the Final CBNG EIS identifies the applicable permits and reviews for CBNG activities and the agencies responsible for each. Table 1-2 of the same document identifies the permitting activities associated with CBNG development. Approval of PODs must be made by the BLM for federal interests and by the MBOGC for state and fee interests under the preferred alternative adopted by both agencies, as presented in the Final CBNG EIS. In this case, the 236 proposed wells are under both BLM and MBOGC permitting jurisdiction, located on fee, federal and state minerals and surface. Specifically, of the 236 proposed wells, 20 are located on state-managed lands and the TLMD procedures for CBNG development require separate approval by the state land board. Produced water discharge permits and stormwater discharge permits for state trust lands and fee lands are the responsibility of the MDEQ. In addition, the MDEQ will manage air quality permits for activities in the State of Montana. The BLM will manage permitting activities for wells on federal lands. This EA addresses fee and state wells.

Alternatives

Alternatives are presented to address the relevant major issues in the proposed action. A "No Action" alternative was considered in the 2003 Montana Statewide EIS. Under this alternative, no proposed wells in the Coal Creek POD would be drilled. However, taking no action on the current proposal would prohibit the lawful recovery of private property (i.e., CBNG) and would place the state trust mineral resources in jeopardy of drainage by wells on adjacent lands not under jurisdiction of the state. The 2003 Montana Statewide EIS considered other alternatives, including the Preferred Alternative, which is consistent with Fidelity's amended Coal Creek POD.

For this EA, Alternative A is the "No Action" Alternative. In this alternative, no approval would be issued for the POD and no additional wells would be drilled or produced. This alternative was included to provide the required basis for comparison with Alternative B, the "Proposed Alternative."

Alternative B is the operator's proposed action. Under this alternative, Fidelity's Coal Creek POD (Amended) would be approved, including drilling and production of the additional 63 state and fee wells, and construction of any additional associated infrastructure. This EA analyzes full implementation of Fidelity's proposal, while incorporating mitigating measures identified during project review that would avoid or reduce impacts to area resources. Alternative B is the agency's preferred alternative.

Table 1 presents a descriptive summary of the two alternatives.

Alternatives Considered but Eliminated from Detailed Analysis

The alternatives listed below were considered in order to resolve planning questions or issues, but were not analyzed in detail because of technical, legal or other constraints.

Injection of All Produced Water: This alternative was suggested as a means to reduce the amount of produced water requiring management by other means (e.g., treatment or surface discharge). However, the feasibility of injection of produced water is quite variable and site specific. The likelihood of successful injection has not been established in the Montana portion of the Powder River Basin. In fact, the variable geology, and limited porosity and permeability of the potential receiving units in the Powder River Basin, along with the very limited success of injection in Wyoming's portion of the Powder River Basin, indicate that injection is likely not feasible in the project area. While some limited injection may be feasible at selected sites, this alternative cannot be the basis for comprehensive water management program. Rock units below the level of the nearest perennial or intermittent stream are usually already saturated with water, and have very little available porosity in which to store additional water. Confined coal or sandstone units in the Fort Union formation are naturally under hydrostatic pressure, and the total volume of those units capable of storing injected water is very small, often less than 1% by volume. Re-injecting into former producing coal beds may not be possible within several miles of active gas fields, since this would re-pressurize the subject coal, eventually interfering with the production of natural gas in active fields or in different mineral estates.

Furthermore, the regulatory burden for injection into shallow, drinking water aquifers could require a lead time of one year or more before permit approval. For these reasons, injection of produced water is proposed, at most, as one of multiple methods for managing water produced in associated with development. During the development process, the operator may seek to evaluate potential injection zones for technical and economic feasibility. In the event that injection is proven to be feasible, where appropriate, injection of produced water will be utilized as one of the POD water management options.

Phased Development: Phased development is an alternative that was considered, but not analyzed in detail. As applied specifically to this project area, phased development of CBNG was not considered because of several important legal and regulatory issues, including the protection of correlative rights, prevention of waste, and the fact that the current permitting process, as a practical matter, results in phased development. Discussion of each of these issues is presented below:

- **Protection of Correlative Rights:** The MBOGC is required to protect correlative rights to minimize drainage of mineral resources by off-lease drilling and production. Drainage can be prevented by minimum setbacks from lease boundaries and mirror-image locations off-setting well location exceptions. Drainage is also prevented by the operator's freedom to drill any legal well locations. Where contiguous tracts exist, they must be equally drillable or drainage may occur by the first well to be drilled. If the offsetting well is delayed, such as by a phased development restriction on the number of CBNG wells per year, drainage could occur.

- **Prevention of Waste:** MCA Section 82-11-111(1) provides: "The board shall make such investigations as it considers proper to determine whether waste exists or is imminent or whether other facts exist which justify action by the board under the authority granted by this chapter with respect thereto." Waste is defined at 82-11-101(16) as follows:

  > (16) (a) "Waste" means:
  > (i) physical waste, as that term is generally understood in the oil and gas industry;
  > (ii) the inefficient, excessive, or improper use of, or the unnecessary dissipation of reservoir energy;
  > (iii) the location, spacing, drilling, equipping, operating, or producing of any oil or gas well or wells in a manner which causes or tends to cause reduction in the quantity of oil or gas ultimately recoverable from a pool under prudent and proper operations or which causes or tends to cause unnecessary or excessive surface loss or destruction of oil or gas; and
  > (iv) the inefficient storing of oil or gas. (The production of oil or gas from any pool or by any well to the full extent that the well or pool can be produced in accordance with methods designed to result in maximum ultimate recovery, as determined by the board, is not waste within the meaning of this definition.)
  > (b) The loss of gas to the atmosphere during coal mining operations is not waste within the meaning of this definition.

  The MBOGC's primary responsibility, as defined in the statutes quoted above, is to assure efficiency and prevent waste in the production of oil and gas resources, including CBNG. Requiring a particular operator or operators to phase production by deferring development in one or more areas creates the risk of waste. In the case of CBNG development, restricting an operator's number of wells could reduce the efficiency of an operator's depressurization of producing coal beds and thereby reduce ultimate CBNG recovery, wasting the CBNG resource. The MBOGC does not have the authority to impose such an order since it would violate MBOGC's responsibilities.

- **Implicit Phased Development:** The MBOGC, as well as other state and federal regulatory agencies, have numerous permitting mechanisms in place to address issues such as drilling and pit construction, produced water management, air emissions, and others that must be satisfied before CBNG development can occur. These permitting mechanisms require ongoing analysis to allow development to continue. Full-field development simply cannot occur under the current regulatory scheme. These permitting mechanisms have the practical effect of phased development of the resource. This implicit phasing of development, which comprises the Preferred Alternative, also achieves the objective of managing resource conservation and development.

Cumulative Effects

Cumulative effects are the result of impacts from other past, present or reasonably foreseeable future actions that would overlap in time and locale with the direct effects of the proposed action or alternatives, thus resulting in "cumulative effects" distinctly different (greater or less) than the direct effects of the proposed action. The actions listed below have been considered as potential contributors to cumulative effects:

- **Existing Montana CBNG Development**: According to MBOGC records , approximately 784 CBNG wells have been drilled in Big Horn, Custer, Powder River and Rosebud Counties. (See MBOGC web site.) Approximately 147 wells, or less than 20%, are identified as federal wells. The status of these wells varies, and includes wells that are drilled, shut-in, producing and plugged. Currently 605 CBNG wells, all but six in Big Horn County, are considered to be in production. The main development is found in the CX Field near Decker, Montana. The CX Field, which includes the existing, producing Badger Hills, Dry Creek, Coal Creek and Deer Creek North project areas, is a CBNG-producing field operated by Fidelity The field encompasses approximately 56 sections between the Montana-Wyoming state line and the Decker and Spring Creek coal mines. The CBNG wells in the CX Field are completed in the Dietz 1, Dietz 2, Dietz 3, Monarch and Carney coal seams. Currently, a number of commingled wells in the Deer Creek North project are being completed in the Carney and Wall coal seams. A portion of the produced water from the CX Field is discharged to the Tongue River under MPDES permits (MT0030457 and MT0030724). These discharges are analyzed in the surface water impact assessment prepared for the Fidelity Coal Creek POD project. Due to factors such as reliance on existing infrastructure, increased well density in the Coal Creek POD is not likely to have cumulative effects on the existing project areas.

- **CX Field (Deer Creek North Amended POD)**: Fidelity has proposed and received approval to amend the Deer Creek North POD. The Deer Creek North POD is similar to the amended Coal Creek POD. Both PODs proposed increasing well density within the project area. The Deer Creek North POD specifies drilling and producing an additional 184 CBNG wells (112 fee, 4 state, 68 federal) and constructing and operating associated infrastructure within the CX Field. The project area is immediately north and east of the Coal Creek project area. The relatively limited scope and nature of the Deer Creek North POD, as well as its proximity to the Coal Creek project, results in only minor potential for cumulative effects on resources in the project area.

- **CX Field (Pond Creek POD)**: Fidelity has proposed and received approval for the Pond Creek POD. The Pond Creek POD includes the drilling and producing 78 CBNG wells and construction and operation of associated infrastructure within the CX Field. The project area is immediately north and west of existing production in the CX Field. The relatively limited scope and nature of the Pond Creek POD, as well as its proximity to the Coal Creek project, results in only a

minor potential for cumulative effects on resources in the project area.

- **Coal Creek Field (Dietz POD)**: Pinnacle Gas Resources (Pinnacle) proposed and received approval for the Dietz POD. The Dietz POD includes the drilling and producing of 132 CBNG wells, along with construction and installation of associated infrastructure in the area of the Coal Creek Field and reclaiming disturbed areas. The project area is within the Coal Creek Field, north and northeast of the Coal Creek project area. The 132 wells will be drilled on 42 sites. These CBNG wells will be completed in the four Fort Union coal seams. The scope and nature of the Dietz POD, as well as its proximity to the Coal Creek project, results in only a minor potential for cumulative effects on resources in the project area.

- **Decker Coal Mine**: The Decker Mine is a surface coal mine operated by Decker Coal Company, a Kiewit subsidiary. The East Decker Mine is located northwest of the Fidelity Coal Creek project area. The mining method consists of open pit strip mining where overburden and interburden are removed by draglines, shovels, and trucks, front-end loaders and trucks or dozers. The permitted mine operations area is approximately 11,400 surface acres. The average annual coal production is 10 million short tons. Although located in close proximity to the Fidelity project, the scope and nature of the Decker Coal Mine results in only a minor potential for cumulative effects.

- **Spring Creek Coal Mine**: The Spring Creek Mine is a surface coal mine owned and operated by Spring Creek Coal Company. The mine is located approximately ten miles northwest of the Fidelity Coal Creek POD's northwest boundary. The mining method consists of open pit strip mining where overburden and interburden are removed by draglines, shovels and trucks, front-end loaders and trucks, or dozers. The permitted mine operations area is approximately 7,000 surface acres. The average annual coal production is 11 million short tons. The scope and nature of the Spring Creek Coal Mine, as well as its proximity to the Coal Creek project, results in only a minor potential for cumulative effects.

- **Existing Wyoming CBNG Development**: According to the Wyoming Oil and Gas Conservation Commission (WOGCC) Web site on June 1, 2005; 26,353 CBNG wells have been drilled in the state. These wells range from spudded, producing or abandoned wells. Generally, in Wyoming, CBNG development has occurred since the early 1990s, mostly in the Powder River Basin of north central/eastern Wyoming. The CBNG development is primarily located between the cities of Gillette and Sheridan. From 2002 to 2005, the Upper Tongue River Basin had 4,281 wells drilled and 63,630 acre-feet of produced water (2002, 2003, 2004, January to March 2005 (actual), and March to June 2005 (estimated)). The scope and nature of the Wyoming CBNG development, as well as its distance from the Fidelity project, would not likely create cumulative effects on resources in the Fidelity project area.

- **Coal Creek Field (Coal Creek POD)**: Pinnacle has proposed and received approval for the Coal Creek POD. Pinnacle's Coal Creek POD proposes drilling and producing 48 CBNG wells, along with the construction and installation of associated infrastructure in an area of the Coal Creek Field and reclaiming disturbed areas. The project area is within the Coal Creek Field, immediately north and west of the Pinnacle Dietz project and northwest of the Fidelity Coal Creek project area. The 48 wells will be drilled on 24 sites. These CBNG wells will be completed in the Wall and Flowers/Goodale coal seams. Due to the distance of this project from the Fidelity project area, the Pinnacle Coal Creek POD would not likely result in cumulative effects on resources in the Fidelity project area.

- **Gravel/Scoria Quarries**: Some gravel or scoria would be used to surface project roads and would come from permitted mineral material sites. Surface disturbance associated with gravel or scoria quarries would not exceed existing permit limits. The potential for cumulative effects from mineral material excavation is minimal.

- **Absaloka Coal Mine**: The Absaloka Mine, owned and operated by Westmoreland Resources, is a surface coal mine located adjacent to the Crow Reservation. The mine is located approximately forty five (45) miles northwest of the Coal Creek project area. The mining method consists of open pit strip mining of Crow Tribe mineral resources. The distance of the Absaloka Coal Mine from the Coal Creek project area makes it unlikely that there would be any cumulative effects on project area resources.

- **Castle Rock-Stevens POD**: Powder River Gas has submitted and received approval for the Castle Rock-Stevens POD. The POD proposes the development of 284 CBNG wells in Powder River County, including the construction and operation of associated infrastructure, and reclaiming disturbed areas. The project area is approximately forty-three (43) miles east-northeast of the Coal Creek project. The 284 wells will be drilled on 71 sites. These CBNG wells will be completed in the Cook/Otter, Pawnee, Sawyer Knobloch or Terret/Stag coal beds. Due to the distance of this project from the Coal Creek project area, the Castle Rock-Stevens POD would not likely create cumulative effects on resources in the project area.

- **Conventional Oil and Gas Development**: A total of 1,991 conventional oil and gas wells have been drilled in Big Horn and Rosebud counties, approximately 22% of which are federal or Indian wells. The conventional oil and gas wells within approximately twenty (20) miles of the Coal Creek project area have been abandoned. Cumulative effects from conventional oil and gas development are not likely.

- **Wolf Mountain Coal**: Wolf Mountain Coal, Inc. proposes to build a coal processing plant on private land for retail sales of coal in Lot 1, Section 18, T. 8 S., R. 40 E. BLM recently issued a right-of-way (MTM93074) for a power line

across Federal surface in the NE¼SE¼, Section 13, T. 8 S., R. 39 E., to provide power to the proposed site. Due to the distance of the Wolf Mountain plant from the Coal Creek project area this processing plant would likely not have cumulative effects on resources in the Coal Creek project area.

- **Tongue River Railroad**: The Surface Transportation Board has published a Draft Supplemental Environmental Impact Statement for the Tongue River Railroad Company's (TRRC) proposed rail line construction in Rosebud and Big Horn Counties, Montana. The document analyzes the proposed 17.3 mile "Western Alignment" route, which had been preceded by two related applications that were considered and approved by the Board in 1986 and 1996, respectively. The proposed Western Alignment is an alternative route for the southernmost portion of the 41-mile Ashland to Decker alignment; known as the Four Mile Creek Alternative. The proposed Western Alignment bypasses the Four Mile Creek alignment, which is generally located from the Birney Road (Hwy 566) and the Tongue River Canyon junction, running west to Hwy 314, then south to the Decker Mine. The Western Alignment would continue south along the Tongue River on the ridge, but paralleling the river and ending near the Spring Creek Mine area. If approved and constructed, this proposed route could approach within approximately three miles of the Fidelity Coal Creek project area. Because effects from the two actions would not occur in the same area and likely not at the same time, no cumulative effects are anticipated to occur from the TRR and the Coal Creek POD.

Affected Environment and Environmental Consequences

Fidelity's Coal Creek POD covers approximately 8,718 acres in southern Big Horn County, Montana. The area is in the northwestern portion of the Powder River Basin and lies in the upper Tongue River drainage basin. The project is located in the area approximately 1.5 miles south-southeast of the Tongue River Reservoir.

Air Quality

Ambient air quality in the project area is good. Coal mining operations in the area may cause localized elevation in suspended particulates or sulfur dioxide. The West Decker, East Decker, and the Spring Creek mines are south and west of the proposed project area.

Air pollution is regulated under the federal Clean Air Act (CAA) and under Montana statutes and regulations implemented by the MDEQ. The southern boundary of the Northern Cheyenne Reservation lies approximately 22 miles north of the proposed Coal Creek Project and is the closest PSD (Prevention of Significant Deterioration) Class I area; the project area is in a PSD Class II area, which allows for moderate, controlled air quality impacts.

Air quality could be impacted by suspended particulate matter generated during drilling and production primarily due to dust associated with travel on unimproved roads;

emissions from drilling rig engines, field and main compressor facilities, and venting natural gas during testing of wells prior to hookup. The produced natural gas in CX Field contains no Hydrogen Sulfide (H_2S), and is very nearly pure methane (CH_4).

Air quality regulations require certain new or existing modified air pollution emission sources (including CBNG compression facilities) to undergo a permitting review before construction can commence. The MDEQ has the primary authority to review and require permits and/or control devices prior to construction. A source emitting less than 25 tons of any regulated pollutant, excluding hazardous air pollutants (HAPs), without controls, does not require a permit. This amended POD, however, does not anticipate the installation of any new compressors to meet the anticipated compression requirements of the project. Therefore, at this level of compression, it does not appear that a Montana Air Quality Permit (MAQP) would be required. However, if additional compressors are needed, the operator may need to obtain a MAQP for applicable emissions.

Mitigation proposed by the operator includes implementation of speed limits on unpaved roads to reduce dust emissions, installation of telemetry equipment at wellheads to monitor well performance, thereby minimizing travel to individual well sites, and use of natural gas to fuel field and sales compressor engines. Gas venting is minimized by a MBOGC regulatory requirement prohibiting venting of commercial quantities of gas. Because substantial infrastructure already exists in the area of the CX Field, extensive well testing prior to pipeline hookup is not anticipated. Some gas emissions may occur from boreholes drilled as monitor wells, mineral exploration holes and other boreholes of unknown origin. The operator is required to plug such emission sources, and Fidelity has demonstrated its willingness to promptly report and plug these sources.

The drilling of CBNG wells, although a temporarily intense activity, is of relatively minor concern for air quality impacts since drilling actually occurs only for an extremely limited time during the life of the project. The water well rigs employed are smaller than those commonly used to drill conventional oil and gas wells in the state and do not have high horsepower engines. Typically, no more than 1-2 days are required to drill a well to the depths proposed. Air quality impacts are not expected to be significant and the operator's proposed mitigation measures are adequate. MDEQ permitting requirements mitigate longer-term impacts from point sources such as field and sales compressor engines.

Water Quality and Quantity

The Coal Creek Project is located in the upper Tongue River watershed in an area that receives an average of approximately 12 inches of annual precipitation. The project area is approximately 1.5 miles south-southeast of the Tongue River Reservoir. As required in the EIS ROD, a water management plan for the project has been prepared by WWC Engineering (WWC) and is incorporated into this EA by reference.

Based upon the production of existing wells in the area, Fidelity estimates the initial water production from the new wells proposed in this project will be approximately 6

gallons per minute (gpm), declining by approximately 30% per year,. The proposed 63 fee and state wells will initially produce a combined estimated total of 378 gpm of water. Fidelity proposes the following water management options for the Coal Creek project: storage and managed irrigation, industrial and stock water use, treatment prior to discharge to Tongue River, and direct discharge to Tongue River. Fidelity will utilize one or a combination of these options after water quality and quantity values have been established. Each option will be implemented in compliance with local, state, and federal regulatory guidelines, rules and regulations, and will take into account the preferences of the surface owner, as discussed below. Any new storage impoundments will be located in upland locations and sited in "off-channel" areas to avoid interfering with natural runoff and to avoid capture of water that would otherwise travel to downstream water rights holders. Any discharge of untreated and treated water will be in accordance with Montana Pollutant Discharge Elimination System (MPDES) discharge permits (MT 0030457 and MT 0030724, respectively).

Surface use agreements and water well mitigation agreements have been accepted by, or offered to, all private landowners within the project area. A total of eighteen water wells and one spring may be affected by the proposed action. A list of well owners is available for review within the POD submittal. Additionally, water well mitigation agreements have been offered to all owners of registered wells/springs within one mile of the project boundary.

The Hydrology and Groundwater section of the Final CBNG EIS discusses the Powder River Basin groundwater, surface water, and stratigraphy in detail. The stratigraphic section in the project area includes alluvial aquifers under and near stream channels, the coalbed aquifers, and the impermeable aquitards that impede or prevent vertical movement of water between coalbed aquifers. Monitoring reports document the effect of CBNG water withdrawal as well as the compartmentalized nature of the coalbed aquifers due to faulting in the Powder River Basin of Montana. Many faults are visible at the surface and have been mapped by geological researchers. These down-to-the-basin faults have been shown to retard or prevent the movement of water (and gas) across the fault boundary; as a result, drawdowns of water pressure in the coalbed aquifers are not uniform. Local groundwater chemistry is described in the referenced water management plan. Regional groundwater quality is characterized in the Final CBNG EIS.

The proposed water management plan relies on accepted methods of water management. The potential impacts of each are described in the Final CBNG EIS. Water well mitigation agreements effectively guarantee replacement of water if a legitimate well owner/water user is adversely impacted. The hydrogeology of the coalbed aquifers in the project area minimizes any potential impacts that water withdrawn from coal seams would have on users of shallow alluvial aquifers.

Produced water discharge is authorized by MDEQ, in compliance with the water quality standards in place at the time the permit is issued; MBOGC's authorization of the Fidelity Coal Creek Project does not constitute approval to either discharge produced waters to waters of the state or to discharge produced water in excess of the amount authorized by

MDEQ. Overall impacts to water quality due to discharge of CBNG water to the Tongue River were thoroughly discussed in the Final CBNG EIS. The Montana Board of Environmental Review (BER) has adopted numerical water quality standards for electrical conductivity (EC) and sodium adsorption ratio (SAR). The Final CBNG EIS analyzed a number of discharge scenarios incorporating the current EC and SAR standards. Any future discharge permits would be required to meet the EC and SAR standards. Approval of the proposed action is anticipated to have minimal effect on surface water quality in the Tongue River.

Soils, Vegetation, Land Use

Fort Union and Wasatch Formations are at the surface in the Coal Creek project area; the Fort Union is the older of these two Tertiary-aged formations and is composed of sandstone, siltstone, clay-shale, impure limestone, and coal. The Wasatch Formation is composed of light-colored massive sandstones, drab-colored shale, and lignite. Erosion in the project area has created a rugged, badland topography where the more resistant sandstone and scoria ("clinker") form hills and buttes. Increased precipitation during Modern and Pleistocene climate episodes increased surface water flows and created isolated alluvial terraces and gravel-capped benches.

Soils in the project area are described generally in the Soils Appendix of the Final CBNG EIS and in more detail in the POD. Soils consist primarily of shallow to very deep, well-drained soils formed in-situ of materials weathered from silty clay and silty shale bedrock. Due to the variability of topography and bedrock, soil groups vary throughout the project area. Soil K-factors for the project area indicate medium to high runoff and moderate to severe erosion potential for disturbed soils. Principle vegetation in the area includes grassland (approximately 70%), forest (approximately 20%), and shrub-land (approximately 10%).

Fidelity proposes the possibility of utilizing managed irrigation as part of its water management plan. Managed irrigation is not Land Application Disposal (LAD) and Fidelity does not consider LAD a means to manage the water being produced by Fidelity. Fidelity uses managed irrigation efforts and those efforts have been addressed by the study "Managed Irrigation for the Beneficial Use of Coalbed Natural Gas Produced Water: The Fidelity Experience" by Harvey, Kevin C. and Brown, Dina E., certified professional soil scientists of KC Harvey, LLC, Bozeman, MT. This document is available for review at the MBOGC offices. The MBOGC also asked ALL Consulting to develop a FAQ memorandum relevant to managed irrigation. That document is incorporated as Attachment A to this response.

The proposed CBNG development activity includes surface/shallow soil disturbances required to construct gas and water handling infrastructure, drill wells and construct access roads. Approximately 5.39 miles of new 2-track road will be constructed with an estimated land disturbance of 5.22 acres. The operator has located proposed construction activities to avoid steep slopes and surface disturbance that would require removal of trees. The operator is responsible for construction of erosion/sedimentation controls

during construction and production operations. Specific road locations, surfacing requirements, and interim and final reclamation of disturbed areas and roads on private surface are subject to consultation between Fidelity and the landowner. However, MBOGC rules require stockpiling of topsoil as well as prompt re-vegetation of disturbed areas. Reseeding of disturbed areas will be done with a seed mix acceptable to the surface owner. Without specific instructions from the surface owner, BLM or National Resource Conservation Service (NRCS)-recommended seed mixtures will be utilized. Part of the area included in the Coal Creek POD is managed by the TLMD. Site-specific stipulations and management requirements for this project will be discussed in TLMD's assessment and applicable decision. No significant cumulative or irreversible effects to existing land use or to soils are expected from the proposed action.

Health Hazards/Noise

CBNG produced in this area of Montana apparently does not contain H_2S or other contaminants that could affect public safety and health. The near pure methane produced from Powder River Basin CBNG wells is lighter than air and does not accumulate in low areas; therefore little or no exposure hazard exists for the general public. Closed buildings and frost-boxes around well-heads may allow accumulations of CBNG. However, these facilities are generally off-limits to the general public. CBNG operators have established strictly enforced no-smoking policies and other operating procedures to avoid fire or explosion hazards to their employees and authorized visitors. Tank batteries and compressor buildings are equipped with combustible gas detectors.

Exposure to noise from drilling CBNG wells is generally short-term in nature and consists of relatively low levels since the water-well type drilling rigs used are smaller and have smaller engines than conventional oil or gas drilling rigs. The 1989 Programmatic EIS describes typical drilling rigs used in Montana. CBNG drilling rigs commonly operate only during daylight hours. CBNG wells in the Montana portion of the Powder River Basin typically take only one to two days to drill. Field compressors are another source of noise, operating on a nearly continuous basis (i.e., except for occasional maintenance and repair/replacement). No new compressors are proposed in this POD.

In addition to human residents, noise could affect wildlife. The Final CBNG EIS and especially the Biological Opinion Appendix discuss potential effects to Threatened and Endangered Species from noise disturbance. The relatively short duration drilling operations and construction activities may result in noise levels that could impact noise-sensitive populations; however, ongoing CBNG production and associated maintenance activities will likely have little noise impact. Fidelity will locate batteries and field compressors to avoid identified sensitive habitat. The operator also agrees to avoid construction or drilling activities within a quarter-mile of active sage grouse or sharp tail grouse leks during the nesting season to protect these species from noise disturbance during this critical period.

Wildlife/Recreation

Hayden-Wing Associates prepared the Wildlife and Habitat Review of the Coal Creek POD area for Fidelity, which is available for review at the Helena and Billings offices of the MBOGC. The MBOGC does not have authority to implement any special wildlife stipulations, acquiesce to third party surveys, or to provide habitat for wildlife on private surface. However, the operator has completed a baseline survey that includes the entire Coal Creek project area, as stated above. Several greater sage-grouse leks have been recorded near the project area. Where suitable occupied nesting habitat is identified by a qualified wildlife biologist, Fidelity has voluntarily elected not to conduct any surface disturbing activity within such habitat from March 1 through June 15. Sharp-tailed grouse leks have been recorded within and near the POD boundary and mountain plover habitat may be present in the POD area. Wells, roads, and batteries will be located to avoid disturbing active sage grouse, sharp-tailed grouse, and mountain plover nesting sites in the project.

The Tongue River Reservoir, a state-managed recreational area, lies near the POD area. Dispersed recreation may occur in parts of the POD area during hunting season. Surface owners control access to most of the project area and one section is managed by the State TLMD. Any recreational opportunities that may exist are not anticipated be affected by this action.

Historical/Cultural/ Paleontological Resources

The MBOGC cannot require archeological/cultural surveys on fee surface property, since the underlying MBOGC regulations generally do not apply to private property. The Coal Creek project includes Fee and State-managed acreage. Cultural resources records were reviewed (Ethnoscience, Inc., 2004-2005), as part of the POD preparation process.

The Ethnographic Overview of Southeast Montana prepared by Peterson and Deaver (2002) for the Final CBNG EIS provides a current inventory of historical and cultural sites of the project area obtained from the Montana State Historical Preservation Office (SHPO) database. The area has seen limited archeological reconnaissance; three investigations were undertaken between 1973-1981, prior to CBNG development. Direct impacts to cultural sites can be avoided by carefully locating roads and other infrastructure facilities. For this amended POD, if cultural sites cannot be avoided, then suggestions for mitigation will need to be discussed with the surface owner, whether ranch owners or TLMD.

Social/Economic

Social and economic effects of CBNG development are discussed in the Final CBNG EIS and in the Socioeconomic Appendix. The proposed action involves increased well density in the existing CX Field. Additional demands on governmental services, impacts on county facilities, and significant relocation or population increases are not expected to result from implementation of the proposed action. The likely increase in natural gas

production from additional wells in the project will result in a significant increase in both state and county tax income. Royalty owners and the State School Trust will also benefit from natural gas production. Natural gas is expected to increase in value due to potential market shortfalls and increasing demand for natural gas as both a space heating fuel and as a fuel for generation of electricity. Implementation of the proposed action will increase gas reserves and production in Big Horn County.

On February 25, 2005, United States Magistrate Judge Richard Anderson issued a ruling that declared a portion of the analysis contained in the Montana Statewide Final CBNG EIS to be deficient, due to its failure to consider a reasonable range of alternatives. NPRC v. BLM, CV 03-69-BLG-RWA, consolidated with Northern Cheyenne Tribe v. Norton, CV 03-78-BLG-RWA. This case is currently on appeal to the Ninth Circuit Court of Appeals. The case was brought under federal law and pertains to federal lands in the project area, and has no bearing on this EA, which is limited in scope to state and fee mineral resources.

On November 18, 2005, the Montana Environmental Information Center (MEIC) filed a complaint against the MBOGC, challenging the MBOGC's Finding of No Significant Impact (February 2005) and EA for Fidelity's Coal Creek POD (January 2005). The MEIC alleges that the MBOGC violated the Montana Environmental Policy Act (MEPA), Montana Code Annotated § 75-1-101, *et seq.*, and the Montana Constitution.

The MBOGC developed the EA, in cooperation with the BLM Miles City Field Office and the MDEQ, in accordance with the requirements of MEPA, the Administrative Rules of Montana governing the operations of the MBOGC, and all other applicable laws. The Final CBNG EIS, to which the EA is tiered, contains a comprehensive programmatic analysis addressing potential environmental effects of CBNG production. By performing a site-specific analysis that tiers to and incorporates by reference the information contained in the Final CBNG EIS, the EA fully addresses the potential environmental impacts of the state action, and satisfies the mandates of MEPA.

To ensure informed decision-making, the MBOGC prepared an EA for the Coal Creek-Tongue River Project to meet the requirements set forth in § 75-1-201(b)(iv) of the Montana Code Annotated. No individual well permits or applications to conduct drilling, facility construction, or production operations were approved through the approval of the POD and issuance of Board Order 7-2004. Those activities require separate application and approval. The impacts on wildlife and its habitat were thoroughly addressed in the EA. Furthermore, an appropriate range of alternatives was addressed and presented in the EA. The MBOGC also conducted a comprehensive review and analysis of the direct, indirect, and cumulative impacts of the proposed action. In sum, the actions taken by the MBOGC complied with both the spirit and the letter of the law.

Remarks/Special Concerns

The proposed action includes drilling an additional 236 wells and construction of infrastructure needed to produce the wells within the existing Coal Creek project area.

Measurement of gas production and produced water, and reporting of gas and water production is required as part of the MBOGC's regulatory program. Wells in the Coal Creek POD area will be added to the monitoring requirements established for the CX Field. The project area is included in the groundwater monitoring program. Data will be collected from the new wells and compiled with existing information. The Technical Advisory Committee (TAC), established by DNRC's Controlled Groundwater Area for the Powder River Basin, reviews operator's groundwater monitoring plans and annual report(s).

Sections 82-11-172 MCA, through 82-11-174, MCA, known as the "Coal Bed Methane Production Offset Act", requires the MBOGC to issue drilling permits to protect mineral resources under its jurisdiction from drainage by wells permitted by other agencies not under its jurisdiction (BLM jurisdiction over federal mineral resources). Production from adjacent/offsetting wells, not under the jurisdiction of the MBOGC may drain gas from Montana State Trust leases and fee leases unless additional wells within the Coal Creek project are promptly permitted, drilled and produced.

Summary: Evaluation of Impacts and Cumulative Effects

The Final CBNGEIS identified and analyzed the cumulative effects of CBNG development in the Powder River Basin. The CX Field and its environs formed the analogue for the analysis used in the EIS, as it was the only source of CBNG project level data available in Montana. The EIS is directly applicable to the proposed action and accurately identifies impacts and mitigation appropriate to this EA. The following table summarizes impacts and mitigation applicable to the amended Coal Creek project.

Resource	Summary of Impacts and Mitigation	
	Alternative A – No Action	Alternative B – Proposed Action
Air Quality	No change from existing conditions	Minimal impact from well drilling operations due to short duration; air permit requirements mitigate impacts from significant point sources; voluntary speed limits, minimizing traffic to individual wells to mitigate fugitive dust impacts. This proposed action does not significantly increase air quality impacts.

Resource	Summary of Impacts and Mitigation	
	Alternative A – No Action	Alternative B – Proposed Action
Water Quality and Quantity	No change from existing conditions	Project does not increase surface discharge of produced water beyond that currently permitted. MDEQ has adopted numeric standards for discharge to protect downstream agricultural uses should any additional discharge be proposed in the future. New off-channel containment impoundments will be constructed as needed. Enlargement of existing impoundments may be required in the future. MBOGC inspectors will periodically monitor sites. Cumulative effects on groundwater quantity are limited to the coal zones being produced; water well mitigation agreements protect groundwater appropriators; DNRC Controlled Ground Water Area order outlines jurisdiction and procedures. Overall impacts to water quantity and quality are mitigated below the level of significance for the proposed action.
Soils, Vegetation, Land Use	No change from existing conditions	Short-term damage to vegetation and some disruption of existing land use is expected. The operator has proposed no new surfaced roads and the addition of 5.39 miles of 2-track roads disturbing an estimated 5.22 acres; MBOGC requirements for prompt re-vegetation of disturbed areas minimize overall and cumulative effects. Operator has negotiated surface use agreements with surface owners that protect land uses in the project area. No significant impact to these resources is expected.
Health Hazards/Noise	No change from existing conditions	Minimal long-term impacts are expected as a result of the operator's careful selection of sites to minimize potential effects. Short-term impacts related to noise levels during drilling and construction activities are less than those described in the 1989 Programmatic EIS. Operator has substantive programs intended to protect safety of workers and public.

Resource	Summary of Impacts and Mitigation	
	Alternative A – No Action	Alternative B – Proposed Action
Wildlife/ Recreation	No change from existing conditions	Operator has relocated proposed well sites and infrastructure to avoid active wildlife nesting/mating grounds. Operator will install devices to discourage raptor roosting on power poles within ¼ mile of active leks and will use raptor protective power line structure where underground utilities are not practical. Voluntary vehicle speed limits are also protective of wildlife. TLMD staff will perform site review and analysis of the state-managed mineral leases and surfaces in the project. With the voluntary mitigation, potential effects to wildlife due to approval of the proposed action are neither significant nor long term.
Historical/ Cultural/ Paleontological Resources	No change from existing conditions	Cultural and historical resource surveys have been conducted on nearby lands as part of the Final CBNG EIS. Although antiquities laws generally do not apply to private landowners, the operator has voluntarily agreed to consult with the surface owner and halt construction if resources are discovered on private land. TLMD will review the Coal Creek POD and will assess State Trust Lands. If cultural resource sites are identified in the area, then voluntary mitigation efforts will ensure no significant impact on these resources will occur from the proposed action.
Social/ Economic	No change from existing conditions	Some short-term impacts to private landowner/residents of the area are expected; relocation or population increases are not expected. Increases in state and county taxes are likely. Royalty owners will benefit from the proposed action. Most adverse impacts occur during drilling and infrastructure construction and are short term. No significant increase in demand for local government services or long-term adverse impacts is likely from this amended project.

Resource	Summary of Impacts and Mitigation	
	Alternative A – No Action	Alternative B – Proposed Action
Remarks/ Special Concerns	No change from existing conditions	Key wells in the Coal Creek POD area will be added to the groundwater monitoring program established for the CX Field. Data from the project area will be included in future annual groundwater monitoring reports. The operator has offered surface use agreements and water well mitigation agreements to all surface owners and water users in the project area. Production from wells on offsetting/nearby minerals not under the jurisdiction of the MBOGC (i.e., federal wells), may cause drainage from state and fee minerals unless offsetting "protective" wells are promptly permitted and drilled.

Fidelity has proposed voluntary mitigation efforts that are intended to reduce overall impacts of the proposed project. This voluntary mitigation accompanied by the regulatory programs enforced by state and federal agencies reduce the long term, cumulative effects of the proposed action below the level of significance; therefore, I conclude that the approval of the Coal Creek Plan of Development (Amended, 2005) does **not** constitute a major action of state government significantly affecting the quality of the human environment, and does **not** require the preparation of an environmental impact statement.

Approved by (MBOGC):

Original signed by

_____ Date: March 1, 2006

Thomas P. Richmond, Administrator

Contacts and References:

- Final Statewide Oil and Gas EIS, adopted March 2003 (MBOGC, MDEQ, BLM)
- Final Programmatic EIS, Adopted December 1989 (MBOGC)
- Montana 2002 and 2003 Baseline Wildlife Inventory (Hayden-Wing Associates)
- Plan of Development Coal Creek Project – February 2004
- Environmental Assessment Coal Creek Project – January 2005 (BLM)

Table 1. Fidelity Coal Creek POD (Amended)--Comparison of Alternatives

Project Component	Alternative A – No Action	Alternative B – Proposed Action with Additional Mitigation (preferred alternative)
Number and type of wells and drill sites	0 new State wells 0 new Fee wells	236 New Wells, 43 Fee and 20 State (proposed)
Drill site construction	No drill site construction	Well pad construction would be as described in the Coal Creek POD.
Drilling Operations	No drilling operations	63 new Fee and State wells would be drilled in the same manner as described in the Coal Creek POD.
Disposal of drilling and water treatment wastes	No waste would be generated	6 feet x 15 feet x 15 feet reserve pits for the disposal of drilling waste with reserve pits constructed as needed at each drill site with up to five wells drilled per site. Reserve pit closure occurs within 90 days of well completion. After evaporation of fluids, the pit is backfilled with soil and topsoil and compacted to prevent settling, as described in the Coal Creek POD. Garbage would be stored in containers at the well site and taken off site to an approved facility for disposal. Sewage is handled with portable toilets, as described in the Coal Creek POD. Any excess brine or reject water that is not recycled to other beneficial uses would be transported and injected into a licensed Class I deep disposal well in Wyoming.
Gas & Water Pipelines & Electrical Lines	None constructed	Approximately 12.7 acres of utility corridor will be built along existing 2-track roads and 13.4 acres of utility corridors will be built within new 2-track roads. Along existing improved/all-weather roads, 14.36 acres of utility corridors will be built. Total interim disturbance of utility corridors is projected to be approximately 40.4 acres. Buried high density polyethylene flow-

Project Component	Alternative A – No Action	Alternative B – Proposed Action with Additional Mitigation (preferred alternative)
		line to carry gas from the proposed wells to the central collection point. Produced water would be transported through buried, high density polyethylene flow-lines from each well site to the chosen water management option. If the treatment and discharge option is utilized, the water would be transported through buried, high density polyethylene and steel central pipeline to the treatment facility and to an existing discharge point adjacent at the Tongue River. Electricity would be brought to the new wells and facilities from existing major power lines in the Coal Creek project area. Electricity would be routed to drop points above ground on poles. At power drop points, electricity will be routed to buried underground cable placed in trenches dug to well sites. Multiple wells will be serviced from each power drop point.
Road maintenance and use	Road maintenance and use would remain in the current condition.	Access would be primarily by way of 8.2 miles of existing and 5.39 miles of new two-track roads to new fee wells, plus the use of 4.9 miles of existing all-weather county roads. Earthen materials would come from adjacent locations owned by local ranchers. Gravel/scoria from permitted pits would be used when necessary for surfacing material. Vehicle access will be negotiated with surface owners via a surface use agreement.
Discharge of Produced Water	No water would be produced or discharged	Water produced from the proposed state and fee wells will be stored for managed irrigation, treated and/or discharged into Tongue River (under MPDES Permits

Project Component	Alternative A – No Action	Alternative B – Proposed Action with Additional Mitigation (preferred alternative)
		MT 0030457 and MT 0030724), industrial and stock watering use and/or stored for future beneficial use.
Reclamation Measures	No reclamation needed	The disturbed surfaces will be reclaimed in accordance with the agreements with surface owners and TLMD. The disturbed areas would be seeded with a certified seed mix agreed to by the NRCS and the surface owner.
Reclamation Timeframes	No reclamation needed	Reclamation would take place as defined in the Coal Creek POD.
Air Quality Monitoring	No effects	Per MDEQ permit requirements.
Wildlife Monitoring	None required	Monitoring of specific wildlife species is not required on fee surface: The disturbed areas will be located to avoid disturbing sage grouse, sharp-tailed grouse, and mountain plover nesting sites. Drilling activities will be avoided during bald eagle nesting season. TLMD requirements will be applied for State Trust minerals.
Soils Monitoring	None required	Sites would be monitored by on-site visits during various stages of development and reclamation to ensure accelerated erosion is not occurring.
Water Quality Monitoring	None required	Per MPDES requirements.

Attachment A:

Frequently Asked Questions Technical Memorandum: Managed Irrigation

ALL Consulting
"Technology Integrators for Government and Industry"

Environmental
Oil & Gas
Data Management
Computer / Networks

Technical Memorandum

To: Tom Richmond/MBOGC

From: Brian Bohm, ALL
David Epperly, Ph.D., P.E., ALL
Dan Arthur, P.E., ALL

Date: 12/5/2005

Re: Talking Points on Managed Irrigation with CBNG Produced Water in the Powder River Basin.

Per your request, we have prepared the following discussion/talking points on the use of coal bed natural gas (CBNG) produced water for Managed Irrigation activities in the Powder River Basin. The following presents various questions and answers based on our direct experience obtained; published information; and information from researchers who are overseeing and researching managed irrigation of CBNG produced water in the PRB. This format was chosen as a means of addressing various common questions and concerns regarding this practice and as a compliment to other material on the subject. The information prepared is provided below:

What is coal bed natural gas produced water?

Coal bed natural gas (or CBNG) produced water is naturally occurring groundwater that is withdrawn from a coal seam to facilitate the production of natural gas from the coal seam. The presence of this groundwater in the coal seam acts to trap the natural gas within the coal; in order to allow this natural gas to be released (produced) from the coal seam some of the water must be removed from the coal seam. Prior to withdrawal the groundwater creates a pressure with the coal seam which acts to hold the natural gas in place. Once this pressure is removed (by withdrawing some of the groundwater) the natural gas is released from the coal and can migrate to the wellbore.

How is CBNG produced water different from surface water or other groundwaters?

All waters (surface or ground) have natural chemical variations that result from the interaction of these waters with the soils, minerals, and rocks present at the surface or in the subsurface environment from which they are in contact. Groundwater and surface waters are typically evaluated by hydrologists and hydrogeologists by the quantities of the most common four positively charged cations (calcium, sodium, magnesium, and potassium) and the most common four negatively charged anions (bicarbonate, carbonate, chloride and sulfate). CBNG produced water within the PRB typically exhibits a sodium/bicarbonate water signature, meaning that Sodium is most abundant cation, and bicarbonate is the most abundant anion. While shallow alluvial groundwaters can range from calcium/bicarbonate to sodium/sulfate, surface waters in the PRB range from calcium/bicarbonate to sodium/chloride-sulfates. Agronomists and soil scientist use another method of classifying waters, they evaluate the total dissolved solids (TDS) concentrations (as measure of the salinity) and the sodium adsorption ratio (SAR) which is a measure of the sodicity of the water, these two values are used to evaluate the irrigation quality of water.

What is the Sodium Adsorption Ratio and what does it tell us about water quality?

Sodium Adsorption Ratio (SAR) is a comparison of the relative concentration of Sodium cations to the relative concentrations of Calcium and Magnesium cations present in water. SAR is calculated using the following formula (all values are in meq/L):

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

The important thing to understand about SAR values is that this number is not a measure of the concentration of sodium but a measure of the relative concentration of sodium compared to the concentrations of calcium and magnesium. A groundwater with 500 mg/L sodium can have an SAR of 19 or an SAR of 5 depending on the relative quantities of calcium and magnesium. The SAR relationship is not linear, therefore in the example given an SAR of 19 which is nearly four times greater than an SAR 5 does not mean the relative concentrations of Ca and Mg is four times greater for the SAR 5 water. This difference in SAR equates to a difference in the calcium and magnesium concentrations present is 14.4 times greater in the SAR 5 water than the SAR 19 water. Waters which have a high SAR are described as Sodic, indicating these soils have a higher percentage of dissolved sodium than calcium and magnesium.

Why is Sodicity a concern for Irrigators?

Sodicity is a concern because of three primary affects sodic irrigation water can have on the physical properties of soil: dissolved sodium in irrigation water can cause dispersion of soils which reduces infiltration of water, reduces the hydraulic conductivity, and surface crusting in clay rich soils. Clay minerals in soils are negatively charged and consequently attract ions with a positive charge such as sodium, calcium and magnesium. When sodium comprises more than about 15% of the exchangeable ions in the soil, the clay minerals can begin to repel one another causing the soil structure to degrade (i.e., swell and disperse). The swelling of clay minerals and continued dispersion, and subsequent degradation of soil structure, can reduce the rate of water infiltrating the soil and the permeability of water through the soil. Put another way, certain clay minerals are more prone to "swelling" as a result of the incorporation of sodium ions (which are larger than calcium or magnesium ions) into the inter sheet layers of the clay mineral. As an example, imagine two sheets of construction paper (clay sheets) with several baseballs (calcium ions) sandwiched between the two sheets, if the baseballs were replaced by basketballs (sodium ions), the space occupied by the two sheets would increase by difference of the diameters of two types of balls. Now if a room was half full of baseball filled sheets (calcium rich clays) and all the baseballs were replaced the basketballs, the room would be now full of basketball filled sheets (sodium rich clays) and the amount of free space to move through the room would effectively be lost. The replacement of calcium ions by sodium ions in clay rich soils results in a similar loss of soil pore space and results in a "swelling" of the clay minerals. In general, soils with moderately high, to high, clay contents are at higher risk.

Additionally, as these salts accumulate in the area near the plant's root (or the soil root zone), the precipitated salts can impeded the movement of water or change the structure of soil. The cations present in salts affect the physical properties of some of soil particles, in particular clay particles are affected the most by certain cations. Clay particles are composed of negatively charge sheets with cations present along the surface, as more cations are present in the soil water the attraction between clay sheets increases resulting in the flocculation or binding of clay particles. The flocculation of clay particles results in decreased pore space between the particles decreasing the movement of soil water, this can have both a positive and negative impact in that flocculate soils are more stable and less likely to erode but flocculated soils also reduce the ability for water to migrate within the soil.

What is Total Dissolved Solids and what does it tell us about water quality?

Total dissolved solids (TDS) is a measure of the relative concentration of dissolved salts present in a water or a measure of the salinity of the water. It is important to realize that "salts" in this context refers to dissolved cations and anions which typically include: calcium, sodium, magnesium, potassium, carbonate, bicarbonate, chloride, and sulfate and is not just in reference to common "table salt" (NaCl). The Environmental Protection Agency defines potable drinking water as having a TDS of less than 500 mg/L, the USGS defines freshwater as having <1,000 mg/L TDS, and typical seawater has a TDS of approximately 35,000 mg/L. Salinity (or TDS) is often estimated by measuring the electrical conductivity (EC) of a water, TDS can be approximated from EC (expressed in units of dS/m or mmhos/cm) by multiplying the EC value by the conversion factor of 640 (Hem, 1992).

Why is Salinity a concern for Irrigators?

Salinity and salts affect plant growth over time because plants uptake water, but most crop plants typically do not uptake the salts, thus when saline water is present the plants are required to expend more energy to separate the water from the salt causing additional stress on the plants. Over time there can be an accumulation of salts near the plant roots if there is inadequate flushing of the soils which increases the amount of energy a plant must expend to obtain the water.

Plant species vary with respect to salt tolerance. Generally, most forage and field crops grown in southeastern Montana and northeastern Wyoming are semi-tolerant to tolerant for salt. For example, based on research presented in the Montana State University Extension Montguide #8382, the EC Tolerance of four common crops (wheat, oats, safflower, and corn) is between 4.0 and 10 dS/m (Montana State University Extension Salinity, Sodic Water and Soils FAQ, 2005). Other crops such as barley, sugar beet, and sunflower are tolerant to EC's higher than 10 dS/cm, while potatoes, field bean, peas, and lentils are less tolerant and can be affected by EC's < 4dS/cm.

Is CBNG Produced Water Saline or Sodic?

Coalbed natural gas produced water has been shown to vary considerably across the PRB and between the various coal seams in any area of the PRB. Generally, CBNG produced water increases in salinity and sodicity as you move north and west across the basin and with depth in a particular area of the PRB. The coal seam waters of the PRB vary from SAR values of < 5 to SAR values greater than 50, while TDS values range from less than 500 mg/L to more than 10,000 mg/L. The University of Wyoming calculated a median SAR for coal seams in the Fort Union Formation of the PRB of 9 (unitless) and a median TDS of 1,100 mg/L. These median values are under the U.S. Department of Agriculture's definitions of saline (E.C. of 3.0 dS/m or ~1,920 mg/L TDS) and sodic (SAR >12).

What are the relationships of Sodic (SAR) and Saline (EC) water when used with irrigation on soils?

Sodium and salinity are different issues. Sodium at high levels can affect soil permeability and infiltration. Sodium can exaggerate the shrink/swell character of a soil and can slow infiltration, thereby increasing runoff. Soils can have problems with sodium but not salinity. Soil hydraulic properties (ability to infiltrate water) improve with increasing salinity (that is, increasing EC), no matter the SAR. Put another way, for a given SAR, infiltration rates generally increase as salinity (measured by the EC) increases. Soil hydraulic properties degrade with increasing SAR, no matter the salinity. In the long run, soil EC and SAR will be determined by the EC and SAR of the irrigation water.

What is Managed Irrigation and how does it facilitate the use of saline or sodic waters for irrigation?

Managed irrigation has been defined as the application of soil science, water chemistry, and agronomic principles to manage the application of irrigation water in a beneficial manner to produced forage for livestock and wildlife while protecting soil physical and chemical properties (Harvey, 2004). Managed irrigation is designed, located, and operated in an agronomic manner to grow a forage crop, protect soil physical and chemical conditions, and to minimize any potential environmental impacts. Managed irrigation is one alternative out of several available for managing CBNG-produced water. Its suitability as a water management alternative depends on many factors, including produced water chemistry, site and soil characteristics, landowner objectives, and project economics. As such, its suitability can only be evaluated on a project- and site-specific basis.

What are the primary components of Managed Irrigation?

The primary components of the managed irrigation process are as follows (taken from Harvey and Brown, 2005):

- Irrigation Water Quality Suitability Assessment
- Soil Amendment Prescriptions
- Project Water Balance Estimates
- Site Selection
- Site Characterization
- Crop Selection
- Selection and Design of Irrigation Systems
- Soil Water Balance Modeling and Irrigation Scheduling
- Water, Soil, Crop, and Meteorological Monitoring
- Development of Irrigation and Crop Management Plans
- Site Closure Planning

Each of these components is discussed below.

Irrigation Water Quality Suitability Assessment

To assess the suitability of produced water for irrigation, four specific areas are addressed: salinity, sodicity, alkalinity, and specific ion toxicity using the criteria specified in Ayers and Westcot (1985) and Hanson et al. (1999). This is the first step in any managed irrigation project to determine overall project feasibility. Soil and/or water conditioning prescriptions are then developed (if necessary) based on the chemistry of the irrigation water to allow long-term irrigation with CBNG-produced water.

Soil Amendment Prescriptions

The naturally occurring sodicity of CBNG-produced water, as measured by the SAR, is the primary concern to be addressed before this water can be used for irrigation and forage production. The SAR formula presented above indicates that two general treatment methods would result in a reduction in SAR prior to irrigation: (1) removal of sodium, or (2) addition of calcium and/or magnesium. Salt removal water treatment systems (e.g., reverse osmosis, ion exchange, etc.) are technically feasible; however, due to operational and economic limitations and issues associated with concentrated reject waters, they are not usually used in conditioning water for managed irrigation projects. The process of calcium addition, however, is a common practice used today in the Powder River Basin.

The level of bicarbonate alkalinity limits the maximum amount of calcium that can be dissolved in produced water. The minimum SAR is achieved by maximizing the dissolved calcium concentrations in the soil-water system. This requires the addition of an acid to neutralize the bicarbonate alkalinity, control pH, and maintain the solubility of the added calcium. The most popular approach for managed

irrigation in the Powder River Basin involves the application of conventional agricultural soil amendments such as elemental sulfur and gypsum (calcium sulfate dihydrate) to the soil.

The added calcium effectively competes against sodium for the negatively charged exchange sites on soil clay particles. The positively charged divalent calcium ions (two positive charges) are more strongly attracted to clay particles in soil than are monovalent sodium ions (one positive charge), resulting in a stronger bond between the clay particles. Clay particles that are strongly bound by calcium ions are less likely to swell and disperse.

Geochemical equilibrium models such as PHREEQC and MINTEQA are used to calculate the amount of sulfur and gypsum amendments necessary to reduce the SAR of the applied CBNG-produced water to a suitable target level. The quantity of sulfur and gypsum amendments applied to a managed irrigation site depends on the chemistry of the water (i.e., the alkalinity and sodium levels) and the expected quantity of irrigation water necessary to grow the crop. Soil amendment rates for irrigation sites within the Powder River Basin typically range between 0.5 and 1.5 tons per acre per year for sulfur, and 2 and 6 tons per acre per year for gypsum. Soil amendment scheduling is site-specific. Typically, soil amendments are applied directly to the soil in the spring, prior to the initiation of irrigation for the season.

Project Water Balance Estimates

Development of irrigation plans for CBNG-produced water requires a detailed understanding of water production at CBNG project startup and throughout the estimated operational life of the well field. In other words, how much water will be available from CBNG operations and when will it be available? Estimates of the project water balance can be made using spreadsheet-based water balance models. These simulations guide initial irrigation planning, design, and operations.

Site Selection

Candidate irrigation sites are identified in the general area of the CBNG project by screening the soils using geographical information system (GIS) technology and published USDA-NRCS soil survey data. The GIS-based screening examines topography, soil texture, soil permeability, and soil depth to categorize the soils on maps as "very likely suitable," "possibly suitable," and "not likely suitable" for managed irrigation. Other site selection factors include vegetation presently growing on the site, surface hydrology and depth to groundwater, current land use, landowner preferences, and the overall improvement potential (e.g., can the site be improved as in the case of overgrazed upland areas). If the screening demonstrates that there is a high likelihood of suitable soils in the area, a more thorough site and soil evaluation would be required (see below).

Site Characterization

An on-site evaluation of the candidate irrigation site is necessary to determine the specific soil types present, current soil chemical and physical properties, and overall suitability of the site. The on-site evaluation is also necessary to collect soil data to assist in the design of the irrigation system, establish baseline (pre-irrigation) soil conditions, and to meet U.S. Bureau of Land Management (BLM) requirements for produced water management planning.

An Order 1 soil survey (as defined by the USDA-NRCS) is completed for all managed irrigation sites. This equates to approximately one soil profile description test pit per five to ten acres of area investigated (more for highly variable soils, less for more homogeneous soils). Test pits are excavated with a backhoe to a depth of 60 inches. At each test pit, a soil profile description is performed in accordance with USDA-NRCS protocols (Soil Survey Division Staff, 1993). Bulk samples are collected from each soil horizon and submitted to a contract laboratory for analysis of pH, EC, SAR, saturation percentage, ESP, percent lime, percent organic matter (surface horizon only), fertilizer requirements, bulk density, and soil texture (percent sand, silt and clay). In addition, baseline

soil infiltration rates are estimated by infiltrometer tests conducted near several of the test pit locations representing each soil-mapping unit.

Crop Selection

Crops typically grown under managed irrigation systems in the Powder River Basin are alfalfa and native forage grass mixes. Crop selection is based primarily on landowner preference, soil type, available equipment for harvesting, and the projected root zone salinity level resulting from the CBNG-produced water in equilibrium with the soil amendments. For alfalfa, the average root zone EC at which alfalfa is expected to begin to decline is 4.0 dS/m (Bridger Plant Materials Center, 1996). Alfalfa can tolerate much higher average root zone EC levels (i.e., up to 8.0 dS/m) before significant yield reductions or mortality occurs. Native forage grass species can typically tolerate much higher average root zone salinity levels than alfalfa. For example, tall wheatgrass can tolerate an average root zone soil EC level of 12 dS/m before yield begins to decline (Bridger Plant Materials Center, 1996).

Most managed irrigation projects are constructed on private land for a landowner who wants and can use the extra forage for livestock. Most of the sites utilized for managed irrigation in the recent past have been overgrazed, upland range areas that support little in the way of native plants. Typically, these sites are vegetated with sagebrush, introduced grass species, prickly pear cactus, and weedy species such as cheat grass. Managed irrigation projects have successfully rehabilitated these small areas into productive forage sources for both livestock and wildlife.

Selection and Design of Irrigation Systems

Several mechanized and non-mechanized irrigation systems are available for applying CBNG water to managed irrigation sites, including center pivot sprinklers, side roll/wheel line sprinklers, hand moved or fixed solid set sprinklers, big gun sprinklers, surface drip, subsurface drip, gated pipe flood, and ditch flood. One of the preferred systems is the center pivot sprinkler because the significant advantages in automation, overall control, runoff control, distribution of water, operation costs, and reliability outweigh the capital costs. The selection of a particular system is based on topography, soil conditions, landowner preferences, size of the site, crop type, post-irrigation land use, available labor, and project economics.

Soil Water Balance Modeling and Irrigation Scheduling

A spreadsheet-based soil-water balance model can be used to determine the amount and timing of irrigation required to produce a healthy forage crop and to ensure that sound agronomic leaching practices are followed. With a soil-water balance analysis, all water inputs to the soil and outputs from the soil are identified and balanced according to the following equation (Natural Resources Conservation Service, 2001):

Total Irrigation Water Applied = Crop Requirement + Leaching Fraction + Irrigation Losses – Precipitation – Change in Soil-Water Content.

For sprinkler irrigation systems, several assumptions, actual data, and calculations are used in developing the soil-water balance and resulting irrigation schedule. Typically, 25 to 30 inches of CBNG-produced water are applied per season to grow crops such as alfalfa and forage grasses in the Powder River Basin.

With irrigation, the EC of the CBNG-produced water by itself should not cause any serious increases in soil salinity. However, amendments applied to the soil to negate the possible effects of the sodicity (SAR) of the produced water will cause an increase in soil EC, requiring leaching with excess water. Salt removal through leaching with excess water is required to minimize the concentration of salts in the root zone. This is termed the "leaching requirement." In most cases, a leaching requirement (fraction) of 10 to 20 percent will result in a soil EC approximately equivalent to the EC resulting from

the equilibration of the produced water with the soil amendments. At the end of each irrigation season, actual (as opposed to projected) soil-water balances are prepared for each irrigation site with site-specific climatic data and total irrigation amounts. These soil-water balances will indicate whether the required leaching fraction has been achieved during the past irrigation season.

Following managed irrigation practices, which utilize the soil-water balance approach to irrigation scheduling, CBNG-produced water is applied in amounts that will be evaporated from the soil and transpired through the roots and out the plant leaves during crop growth. Under these conditions, little or no net movement of water occurs beneath the root zone. As discussed above, additional water is applied during the irrigation season to ensure that salts do not accumulate within the root zone. This leaching requirement typically equates to approximately 5 to 10 inches of additional water spread out over the entire year including precipitation. Therefore, this limited volume of water applied over an entire year is not expected to create saturated flow conditions beneath the root zone down to groundwater. This condition is especially true where irrigation areas are located on upland range sites having significant depth to groundwater.

Irrigation scheduling is critical in minimizing potential runoff and erosion from irrigation areas, and potential runoff/discharge into streams. If irrigation systems were not carefully controlled and monitored, the application rates would exceed the soil infiltration rate. Managed irrigation systems are designed and operated in a way that supplies enough water to meet the demands of the crop, provides for an adequate leaching requirement, and applies water at or below the infiltration rate of the soil.

Water, Soil, Crop, and Meteorological Monitoring

The purpose of the soil, water, crop, and meteorological monitoring plan is to ensure that the managed irrigation site is operated in a manner that (1) promotes the beneficial use of CBNG water to produce forage, (2) maintains soil productivity and sustainability, and (3) minimizes the possible impacts associated with saline and sodic water irrigation. The data collected from soil, water, crop and meteorological monitoring are used to determine the overall performance of the managed irrigation system as well as to make adjustments to irrigation scheduling and soil amendment application rates. Site monitoring documents how the managed irrigation system is performing and data collected during monitoring are utilized in the creation of annual operations and monitoring reports.

Development of Irrigation and Crop Management Plans

The annual irrigation and crop management plan addresses seasonal landowner and land use goals, crop selection, site preparation, seeding, irrigation system operations, harvesting/grazing plans, soil amendment application rates and scheduling, irrigation scheduling, leaching requirements, and monitoring. This document serves as the overall planning, operations, and monitoring guide. The irrigation and crop management plan is revised each winter based on the monitoring results and other input from the previous irrigation season, and the operational requirements for the upcoming irrigation season.

Site Closure Planning

A critical component of the managed irrigation planning process is site closure. Issues to be addressed during site closure planning are:

- What are the post-irrigation land use goals and landowner preferences?
- Will the site continue to be cropped or will it be put back into native vegetation?
- Will the irrigation equipment be removed or will it be left in place to be used by the landowner?
- If the irrigation equipment is to remain, what are the water sources available for continued irrigation?
- What do we expect in the way of post-irrigation soil physical and chemical conditions?

• Will the chemistry of the soil require adjustment to meet post-irrigation land use and landowner goals?
• What level of post-irrigation monitoring will be required to meet post-irrigation land use and landowner goals?

Some of the answers to these questions can be anticipated at project startup, while others can be answered only after conducting and evaluating the managed irrigation activities. In any event, the primary goal of site closure is to leave a physically and chemically stable site capable of moving towards a sustainable vegetative community that meets or exceeds landowner goals.

Has Managed Irrigation been successful using CBNG-produced water?

There have been several producers that have been very successful using CBNG water for irrigation. DeJoia (2002) reported on a feasibility study from the fall of 2001 and the 2002 operating year that demonstrated CBNG produced water irrigation can be managed effectively without causing soil degradation. The results of the project indicated that the use of soil applied amendments was successful at mitigating the high bicarbonate and sodium concentrations in CBNG produced water. The addition of gypsum and sulfur appeared to work the best out of all of the treatments applied. These amendments appeared to work best when a one-month application was applied versus the use of a three-month application. Gypsum alone also appears to be an option; however, because of the larger amounts required to treat this water with gypsum alone, the treatment costs are higher. Therefore the addition of sulfur was able to reduce the total amendment cost while not impacting the effectiveness of the amendments. No other treatments appeared to effectively control soil SAR at the site. The SAR of the soil ranged from 8.6 to 14.6 with an average SAR of 12.0. Although these levels were elevated they did not appear to impacting soil infiltration rates.

Several other CBNG producers have used Managed Irrigation with very positive results. One other example is the use of subsurface drip irrigation (SDI) by J.M. Huber at Prarriedog Creek, Wyoming. They are irrigating 115 acres of alfalfa using SDI and applying up to 60 inches of water per year. The water is being applied at or below the root zone with the salts mostly going below the root zone. The soils at the site have a high porosity and they perform some leaching. The yield of the alfalfa has increased with the use of SDI and there have not been any signs of significant impacts to plants or soils.

The Agronomic Monitoring and Protection Program (AMPP) is a soil and crop testing program developed by Fidelity to better understand the potential effects of CBNG production on the soil and crops in the Tongue River drainage area of southeastern Montana. Data collected through this program creates a baseline of information to determine what — if any — impacts occur from the discharge of water produced in association with CBNG development. The AMPP started collecting data on soils irrigated with CBNG in the fall of 2003 and finished this stage of data collection this last fall, with further data collection to follow. The final report has not been released, but the information to-date indicates discharge of unaltered groundwater into the Tongue River has not had and will not have a negative impact on irrigated lands.

What is the best type of irrigation system to use with CBNG produced water?

The main types of irrigation used with CBNG produced water are sprinkler (center pivot, side roll, big gun, solid set), flood, and subsurface drip irrigation. Each type of irrigation has its advantages and disadvantages depending on the crop, application rate, soil type, topography, and required labor. Therefore, there is not one system that is better than others and should be chosen based on these factors, cost and the landowner's input. All managed irrigation solutions are site specific. The design approach, amendment application rate, and water application equipment selected for a particular project are unique to the water and soil chemistry of the location.

What affect will Managed Irrigation have on groundwater?

In order for groundwater to be significantly influenced by managed irrigation systems, or any source of water applied to the surface, saturated flow must exist through the soil/unsaturated zone and into the groundwater. As defined above, managed irrigation is not a process whereby water is applied to the ground on a continual basis throughout the year. CBNG produced water is applied in an agronomic manner, in accordance with crop needs, soil water holding capacities, climatic characteristics, soil infiltration rates, and leaching requirements. Irrigating crops in a way that results in saturating the soil to the point where water is moving in a continuous wetting front under gravity to the groundwater table is not desirable or practical but rather detrimental to vegetation. A continuous wetting front flowing by gravity through soil and bedrock is termed "saturated flow." When the soil water content is less than saturation, water movement is termed "unsaturated flow." Water moving through the soil under unsaturated flow conditions moves from areas of higher water content to lower water content, which means water can move diffusely in almost any direction.

Will Managed Irrigation cause salt damage on the surface of the ground?

Where land is irrigated year round and not allowed to dry out, salts can migrate up. Seasonal precipitation flushes salts down through the soil, often to depths of 1-1.5 meters below the root zone of most crops. Wet years move the salts down deeper. Seasonal dry periods slow the ability of salt to migrate up into the root zone of plants.

What is PAM and does it help with soil infiltration?

Polyacrylamide (PAM) is a synthetic water-soluble polymer made from monomers of acrylamide. PAM binds soil particles together. Surface application of PAM in solution has been found to be very effective in decreasing seal formation, runoff, and erosion and have been known to benefit soil properties for a long time. DeJoia (2002) reported from their studies that use of soil PAM did not appear to control soil pH or sodicity, however, the infiltration did remain relatively high. The infiltration rate was actually as good as the gypsum and sulfur site. Therefore, it appears that the use of soil PAM could help to increase infiltration rates on soils that are adversely affected by low infiltration. They added that actual implementation of soil PAM for this practice was not evaluated so its actual place in managing CBM produced water is not known at this time.

What are some estimated costs for using Managed Irrigation with CBNG-produced water?

Costs for managed irrigation systems are influenced by water chemistry, soil chemistry, water volume, irrigation season limitations and land management practices. Paetz and Maloney (2002) gave an example of costs for a Managed Irrigation project in the Powder River Basin. Based on the evaluation of an actual managed irrigation site with a flow of 12,500 barrels per day (bbl/day), the lifetime cost of a 100-acre system was $0.005 to $0.01 per barrel for design and equipment; $0.04 to $0.06 per barrel for water amendments; and $0.02 to $0.04 per barrel for operation and monitoring for a total project cost of $0.06 to $0.11 per barrel.

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Montana Board of Oil and Gas Conservation

Finding of No Significant Impact and Notice of Decision

Fidelity Exploration and Production Company
Tongue River-Coal Creek CBM Project (Amended)
Township 9 South, Ranges 40 and 41 East

Proposed Action

Fidelity Exploration and Production Company (Fidelity) proposes to drill, complete and produce 236 new wells (43 Fee, 20 State, 173 Federal) in this Plan of Development (POD) amendment of the existing Coal Creek POD for the CX Ranch CBM Field. The Coal Creek POD amendment was approved by the Board of Oil and Gas Conservation on December 8, 2005 by Order 507-2005. The Board accepted the plan of development and approved it relative to Fee and State wells and subject to environmental assessment in said Order. An additional environmental assessment will need to be performed by the U.S. Bureau of Land Management (BLM) for the wells on Federal lands. The amendment is to increase density to 2 wells per 160 acre spacing units. The project area covers approximately 8,718 acres, and proposes to drill and produce the wells drilled to the Dietz, Monarch, and Carney coal zones with additional exploration of the Smith and Wall coals and possibly other deeper coals (e.g., Carlson, King and Roberts) at a well density of two wells per coal zone per quarter section (160 acre spacing).

Water produced by the Coal Creek POD is proposed to be (1) beneficially used for industrial uses (dust suppression) in the Spring Creek and Decker Coal Mines; (2) beneficially used by Fidelity for CBNG drilling, construction, and dust suppression; (3) beneficially used by livestock and wildlife; (4) discharged to the Tongue River using Fidelity's existing MDEQ direct discharge permit (MT0030457), including modifications; (5) treated via ion exchange and discharged to the Tongue River using Fidelity's MDEQ discharge permit for treated water (MT0030724); (6) stored in the existing off drainage impoundments; and (7) during the irrigation season, applied via managed irrigation. The ion exchange water treatment facility is to be located 2.5 miles south-southeast of Decker in Bighorn County. The project area lies on the east side of the Tongue River, in the Badger Creek drainage Township 9 South, Range 40 East, Sections 33 and 34. The Agency preferred alternative, assumes drilling and production of all proposed wells and the associated need to manage water produced from 100% of the proposed wells; at this time federal wells cannot be drilled pending results of current litigation and environmental assessment performed by BLM. Therefore, until such time that federal wells begin to produce, water management is expected to maximize use of existing facilities, including beneficial use, managed irrigation and untreated water discharge. For the purposes of this record of decision, the use of treated water discharge as a management option is assumed to be supplemental to existing management options on an as needed basis.

Any well(s) would be plugged and abandoned and surface restored if commercial quantities of gas are not discovered; partial reclamation of unused disturbed areas and

utilities/flow line disturbed areas would be required during the project life. The project area is comprised of private, federal and State owned minerals. Surface is managed by private owners, BLM, and Trust Land Management Division of DNRC.

Decision

The decision to approve the project plan of development includes adoption of the Environmental Analysis prepared by the Montana Board of Oil and Gas Conservation (MBOGC)- *Environmental Assessment for Fidelity Exploration & Production Company, Tongue River – Coal Creek Project, Plan of Development (Amended, 2005);* approval of the drilling, completion, and production of an additional 43 wells located on fee minerals, 20 wells located on State minerals; installation of roads, pipelines and associated infrastructure needed to produce the wells; and the location construction and operation of three field compressor sites. The decision is effective immediately; drilling permits (Form No. 22) will be approved in the ordinary course of business following this decision.

The Board of Oil and Gas Conservation's General Rules and Regulations, as well as the statutory requirements under which the Rules are adopted generally apply to the proposed action. Additional mitigation may be required by BLM for federal actions and Trust Land Management Division for State lands and the operator has agreed to implement other actions to mitigate any impacts of its activities. Those mitigating measures include implementation of lease road speed limits to reduce wildlife mortality and dust emissions, monitoring of the quantity of produced fluids and monitoring of any domestic wells or springs within the one-mile statutory radius as needed to determine potential impairment from the project. Monitoring of reclamation and potential noxious weed invasion are also required and agreed to by the operator. It is assumed that other agencies permitting requirements, mitigation requirements or monitoring are authorized by those agencies jurisdictional authorities; where program elements and associated requirements overlap, the MBOGC relies upon its own authority for this decision. Some mitigation imposed by BLM is beyond the scope of jurisdiction of the MBOGC, however. Cultural and paleontological resources are the property of the private surface owner and MBOGC does not assert any right to determine the disposition of any resources found; the operator however has agreed to notify and consult with the surface owner if any such resources are discovered during construction. The MBOGC cannot require the surface owner to manage private property for wildlife mitigation or to require the owner to provide access to those seeking to survey the property for cultural or wildlife resources. MBOGC defers to the surface owner for use of pesticides/herbicide on the property and does not regulate the use or possession of firearms on private property. Private owners retain the right to manage (or prohibit) general public access to the property.

Finding of No Significant Impact

Based upon a review of the Environmental Assessment prepared for the project relative to state and fee wells, the voluntary mitigation proposed by the operator, compliance with the requirements for monitoring and reporting associated MBOGC Order 99-1999, and considering the scope and effect of the MBOGC's statutory and regulatory requirements, I determine that approval of the proposed action does not constitute a major state action significantly affecting the quality of the human environment, and does not require the preparation of an environmental impact statement.

March 1, 2006

Thomas P. Richmond
Administrator, Board of Oil and Gas Conservation