FINDING OF NO SIGNIFICANT IMPACT & DECISION RECORD
FOR
Pennaco-Marathon
Knudson 9 Extension
ENVIRONMENTAL ASSESSMENT –WY-070-EA08-173

DECISION: Is to approve Alternative C as described in the attached Environmental Assessment (EA) and authorize Pennaco-Marathon's Knudson 9 Extension Coal Bed Natural Gas (CBNG) POD comprised of the following 10 Applications for Permit to Drill (APDs):

	Well Name	Well #	Qtr/Qtr	Sec	TWP	RNG	Lease #
1	KNUDSON 9 KNUDSON	6-9AW	SENW	9	52N	77W	WYW163521
2	KNUDSON 9 GGM	10-17AW	NWSE	17	52N	77W	WYW163521
3	KNUDSON 9 GGM	11-17AW	NESW	17	52N	77W	WYW163521
4	KNUDSON 9 GGM	4-17AW	NWNW	17	52N	77W	WYW163521
5	KNUDSON 9 GGM	6-17AW	SENW	17	52N	77W	WYW163521
6	KNUDSON 9 EK RANCH	10-18AW	NWSE	18	52N	77W	WYW163521
7	KNUDSON 9 EK RANCH	14-18AW	SESW	18	52N	77W	WYW163521
8	KNUDSON 9 EK RANCH	16-18AW	SESE	18	52N	77W	WYW163521
9	KNUDSON 9 EK RANCH	2-18AW	NWNE	18	52N	77W	WYW163521
10	KNUDSON 9 EK RANCH	8-18AW	SENE	18	52N	77W	WYW163521

***Note:** The 11-17AW APD is pending a 30-day public posting period ending October 8, 2008.

	IMPOUNDMENT Name / Number	Qtr/Qtr	Sec	TWP	RNG	Capacity (Acre Feet)	Surface Disturbance (Acres)	Lease #
1	JEWEL	SENW	7	52	77	19.64	3	FEE
2	PK9-17	NWNE	7	52	77	28.81	5	FEE
3	PK9-29	NWNW	8	52	77	8.22	2	WYW 155328
4	PK9-27	NWSW	8	52	77	73.88	8	WYW 155328
5	FORT'S VIEW	SWSE	17	52	77	14.1	4	WYW 159006
6	HEATSTROKE	SWSE	17	52	77	10.3	2	WYW 159006
7	FRESNO	SESE	18	52	77	28.15	4	WYW 159006

This approval is subject to adherence with all of the operating plans and mitigation measures contained in the Master Surface Use Plan of Operations, Drilling Plan, Water Management Plan, and information in individual APDs. This approval is also subject to operator compliance with all mitigation and monitoring requirements contained within the Powder River Oil and Gas Project Environmental Impact Statement and Resource Management Plan Amendment (PRB FEIS) approved April 30, 2003.

RATIONALE: The decision to authorize Alternative C, as described in the attached Environmental Assessment (EA), is based on the following:

1. The Operator, in their POD, has committed to:
    - Comply with all applicable Federal, State and Local laws and regulations.
    - Obtain the necessary permits from other agencies for the drilling, completion and production of these wells including water rights appropriations, the installation of

water management facilities, water discharge permits, and relevant air quality permits.
    - Offer water well agreements to the owners of record for permitted water wells within ½ mile of a federal CBNG producing well in the POD.
    - Provide water analysis from a designated reference well in each coal zone.
2. The Operator has certified that a Surface Use Agreement has been reached with the Landowners.
3. Alternative C will not result in any undue or unnecessary environmental degradation.
4. It is in the public interest to approve these wells, as the leases are being drained of federal gas, resulting in a loss of revenue for the government.
5. Mitigation measures applied by the BLM will alleviate or minimize environmental impacts.
6. Alternative C is the environmentally-preferred Alternative.
7. The proposed action is in conformance with the PRB FEIS and the Approved Resource Management Plan for the Public Lands Administered by the Bureau of Land Management (BLM), Buffalo Field Office, April 2001.

FINDING OF NO SIGNIFICANT IMPACT: Based on the analysis of the potential environmental impacts, I have determined that NO significant impacts are expected from the implementation of Alternative C and, therefore, an environmental impact statement is not required.

ADMINISTRATIVE REVIEW AND APPEAL: Under BLM regulations, this decision is subject to administrative review in accordance with 43 CFR 3165. Any request for administrative review of this decision must include information required under 43 CFR 3165.3(b) (State Director Review), including all supporting documentation. Such a request must be filed in writing with the State Director, Bureau of Land Management, P.O. Box 1828, Cheyenne, Wyoming 82003, no later than 20 business days after this Decision Record is received or considered to have been received.

Any party who is adversely affected by the State Director's decision may appeal that decision to the Interior Board of Land Appeals, as provided in 43 CFR 3165.4.

Field Manager:_____ Date: _____

BUREAU OF LAND MANAGEMENT
BUFFALO FIELD OFFICE
ENVIRONMENTAL ASSESSMENT (EA)
FOR
Pennaco-Marathon
Knudson 9 Extension
PLAN OF DEVELOPMENT
WY-070-EA08-173

INTRODUCTION

This site-specific analysis tiers into and incorporates by reference the information and analysis contained in the Powder River Basin Oil and Gas Project Environmental Impact Statement and Resource Management Plan Amendment (PRB FEIS), #WY-070-02-065 (approved April 30, 2003), pursuant to 40 CFR 1508.28 and 1502.21. This document is available for review at the Buffalo Field Office. This project EA addresses site-specific resources and impacts that were not covered within the PRB FEIS.

1. PURPOSE AND NEED

The purpose for the proposal is to produce coal bed natural gas (CBNG) on 1 federal oil and gas mineral lease issued to the applicant by the BLM.

1.1. Conformance with Applicable Land Use Plan and Other Environmental Assessments:

The proposed action is in conformance with the terms and the conditions of the Approved Resource Management Plan for the Public Lands Administered by the Bureau of Land Management, Buffalo Field Office (BFO), April 2001 and the PRB FEIS, as required by 43 CFR 1610.5

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1. Alternative A - No Action

A No Action Alternative was considered in the PRB FEIS, Volume 1, pages 2-54 through 2-62. This alternative would consist of no new federal wells. An oil and gas lease grants the lessee the "right and privilege to drill for, mine, extract, remove, and dispose of all oil and gas deposits" in the lease lands, "subject to the terms and conditions incorporated in the lease." Thus, under this alternative, the operator's proposal would be denied.

2.2. Alternative B Proposed Action

Proposed Action Title/Type: Pennaco-Marathon's Knudson 9 Plan of Development (POD) for coal bed natural gas well APD`s and associated infrastructure.

Proposed Well Information: There were 10 wells proposed within this POD; the wells are vertical bores proposed on an 80 acre spacing pattern with 1 well per location. Each well will produce from the Anderson and/or Wall coal seams. Exact determination of production zones will be decided after the drilling and logging of each well. There will be no well house used. Instead, Pennaco has their surface equipment 'skid' mounted and heat traced with an insulated blanket wrap. The approx. dimensions of this surface equipment are 2' x 6' x 2', with the control unit mounted on a post inside the fenced enclosure. Proposed wells are located as follows:

	Well Name	Well #	Qtr/Qtr	Sec	TWP	RNG	Lease #
1	KNUDSON 9 KNUDSON	6-9AW	SENW	9	52N	77W	WYW163521
2	KNUDSON 9 GGM	10-17AW	NWSE	17	52N	77W	WYW163521
3	KNUDSON 9 GGM	11-17AW	NESW	17	52N	77W	WYW163521
4	KNUDSON 9 GGM	4-17AW	NWNW	17	52N	77W	WYW163521
5	KNUDSON 9 GGM	6-17AW	SENW	17	52N	77W	WYW163521
6	KNUDSON 9 EK RANCH	10-18AW	NWSE	18	52N	77W	WYW163521
7	KNUDSON 9 EK RANCH	14-18AW	SESW	18	52N	77W	WYW163521
8	KNUDSON 9 EK RANCH	16-18AW	SESE	18	52N	77W	WYW163521
9	KNUDSON 9 EK RANCH	2-18AW	NWNE	18	52N	77W	WYW163521
10	KNUDSON 9 EK RANCH	8-18AW	SENE	18	52N	77W	WYW163521

Water Management Proposal: The following impoundments were proposed for use in association with the water management strategy for the POD.

	IMPOUNDMENT Name / Number	Qtr/Qtr	Sec	TWP	RNG	Capacity (Acre Feet)	Surface Disturbance (Acres)	Lease #
1	JEWEL	SENW	7	52	77	19.64	3	FEE
2	PK9-17	NWNE	7	52	77	28.81	5	FEE
3	PK9-29	NWNW	8	52	77	8.22	2	WYW 155328
4	PK9-27	NWSW	8	52	77	73.88	8	WYW 155328
5	FORT'S VIEW	SWSE	17	52	77	14.1	4	WYW 159006
6	HEATSTROKE	SWSE	17	52	77	10.3	2	WYW 159006
7	FRESNO	SESE	18	52	77	28.15	4	WYW 159006

County: Johnson

Applicant: Pennaco-Marathon

Surface Owners: Eddie Knudson, Carl Knudson, John Gammon III

Project Description:
The proposed action involves the following:

- Drilling of 10 total federal CBM wells in Anderson and Wall coal zones to depths of approximately 1000 and 1600 feet, respectively. Multiple seams will be produced by co-mingling production (a single well per location cable of producing from multiple coal seams).

- Drilling and construction activities are anticipated to be completed within two years, the term of an APD. Drilling and construction occurs year-round in the PRB. Weather may cause delays lasting several days but rarely do delays last multiple weeks. Timing limitations in the form of COAs and/or agreements with surface owners may impose longer temporal restrictions on portions of this POD, but rarely do these restrictions affect an entire POD.

Well metering shall be accomplished by central metering facility. Upon start up, wells will be visited daily over the first 7-10 days. As production is established, this will trail off to one visit every 7-10 days, which will work out to approximately 2-4 visits per month. The CDP (Central Distribution Point) will be

visited as necessary, once the 'new' wells are started and the gas sales lines are purged from the well to header. This is anticipated to be one to two times per week.

- A Water Management Plan (WMP) that involves the following infrastructure and strategy: 7 discharge points, 7 stock water reservoirs, 1 injection well, and approximately 106 acres of surface irrigation (LAD) within the Upper Powder River watershed. All water handling infrastructure, with the exception of piping from proposed wells, is existing.

- An unimproved and improved road network.

- No new above ground power line is proposed for this POD. Existing network has been constructed by a contractor.

- A buried gas, water and power line network, and a variable number of compression facilities. Big Horn Gas Gathering will be providing the compression facilities, and they use mobile systems to allow for the varying levels of gas production in coal bed methane fields. Once the level of production for this project is determined, the appropriate number of compressors will be brought in to the project area. As production then declines, compressors will be removed to other areas that require higher compressor capability. Location of Compressor facilities will be sundried in to the POD as needed.

For a detailed description of design features, construction practices and water management strategies associated with the proposed action, refer to the Master Surface Use Plan (MSUP), Drilling Plan and WMP in the POD and individual APDs. Also see the subject POD and/or APDs for maps showing the proposed well locations and associated facilities described above. More information on CBNG well drilling, production and standard practices is also available in the PRB FEIS, Volume 1, pages 2-9 through 2-40 (January 2003).

Implementation of committed mitigation measures contained in the MSUP, Drilling Program and WMP, in addition to the Standard COA contained in the PRB FEIS Record of Decision Appendix A, are incorporated and analyzed in this alternative.

Additionally, the Operator, in their POD, has committed to:

1. Comply with all applicable Federal, State and Local laws and regulations.
2. Obtain the necessary permits for the drilling, completion and production of these wells including water rights appropriations, the installation of water management facilities, water discharge permits, and relevant air quality permits.
3. Offer water well agreements to the owners of record for permitted water wells within ½ mile of a federal CBNG producing well in the POD
4. Provide water analysis from a designated reference well in each coal zone.

The Operator has certified that a Surface Use Agreement has been reached with the Landowners.

2.3. Alternative C – Environmentally Preferred

Alternative C represents a modification of Alternative B based on the operator and BLM working cooperatively to reduce environmental impacts. The description of Alternative C is the same as Alternative B with the addition of the project modifications identified by BLM and the operator following the initial project proposal (Alternative B). At the on-sites, all areas of proposed surface disturbance were inspected to insure that the project would meet BLM multiple use objectives to conserve natural resources while allowing for the extraction of Federal minerals. In some cases, access roads were re-routed, and

well locations, pipelines, discharge points and other water management control structures were moved, modified, mitigated or dropped from further consideration to alleviate environmental impacts. Alternatives to the different aspects of the proposed action are always considered and applied as pre-approval changes, site specific mitigation and/or Conditions of Approval (COAs), if they will alleviate environmental effects of the operator's proposal. The specific changes identified for the Knudson 9 POD are listed below under 2.3.1:

2.3.1. Changes as a result of the on-sites

1. 10-17 well: Pad corners on W edge of pad were pulled in to keep disturbance out of sandy hillside. The access road to the 10-17 well was moved slightly east, and will cross more of a headcut near the road. This portion of the headcut will be filled in. Additionally, a berm will be constructed on the uphill side of the road to divert water around the area, two diversion ditches will be built, and a culvert will be added.
2. 12-17 well: Well was dropped due to location in good sage grouse habitat. Alternate well location in saddle to the SE was discussed at the onsite. New well, the 11-17, will be added at this location. Additionally, the overhead power that was built to this proposed well location will be removed.
3. 8-18 well: Pad will be redesigned on SE corner to keep fill out of drainage. Also, pad will not disturb sandy knob on NW side of pad.

2.3.2. Programmatic mitigation measures identified in the PRB FEIS ROD

Programmatic mitigation measures are those, determined through analysis, which may be appropriate to apply at the time of APD approval if site specific conditions warrant. These mitigation measures can be applied by BLM, as determined necessary at the site-specific NEPA APD stage, as COAs and will be in addition to stipulations applied at the time of lease issuance and any standard COA.

2.3.2.1. Groundwater

In order to address the potential impacts from infiltration on shallow ground water, the Wyoming DEQ has developed and revised a guidance document, "Compliance Monitoring and siting Requirements for Unlined Impoundments Containing Coalbed Methane Produced Water" (September, 2006) which can be accessed on their website. For all WYPDES permits the BLM will require that operators comply with the latest DEQ standards and monitoring guidance.

2.3.2.2. Surface Water

1. Channel Crossings:
   a) Channel crossings by road and pipelines will be constructed perpendicular to flow. Culverts will be installed at appropriate locations for streams and channels crossed by roads as specified in the BLM Manual 9112-Bridges and Major Culverts and Manual 9113-Roads. Streams will be crossed perpendicular to flow, where possible, and all stream crossing structures will be designed to carry the 25-year discharge event or other capacities as directed by the BLM.
   b) Channel crossings by pipelines will be constructed so that the pipe is buried at least four feet below the channel bottom.
2. Low water crossings will be constructed at original streambed elevation in a manner that will prevent any blockage or restriction of the existing channel. Material removed will be stockpiled for use in reclamation of the crossings.

3. Concerns regarding the quality of the discharged CBNG water on downstream irrigation use may require operators to increase the amount of storage of CBNG water during the irrigation months and allow more surface discharge during the non-irrigation months.

2.3.2.3. Soils

1. The Companies, on a case by case basis depending upon water and soil characteristics, will test sediments deposited in impoundments before reclaiming the impoundments. Tests will include the standard suite of cations, ions, and nutrients that will be monitored in surface water testing and any trace metals found in the CBNG discharges at concentrations exceeding detectable limits.

2.3.2.4. Wetland/Riparian

1. Power line corridors will avoid wetlands, to the extent possible, in order to reduce the chance of waterfowl hitting the lines. Where avoidance can't occur, the minimum number of poles necessary to cross the area will be used.

2. Wetland areas will be disturbed only during dry conditions (that is, during late summer or fall), or when the ground is frozen during the winter.

3. No waste material will be deposited below high water lines in riparian areas, flood plains, or in natural drainage ways.

4. The lower edge of soil or other material stockpiles will be located outside the active floodplain.

5. Disturbed channels will be re-shaped to their approximate original configuration or stable geomorphologic configuration and properly stabilized.

6. Reclamation of disturbed wetland/riparian areas will begin immediately after project activities are complete.

2.3.2.5. Wildlife

1. For any surface-disturbing activities proposed in sagebrush shrublands, the Companies will conduct clearance surveys for sage grouse breeding activity during the sage grouse's breeding season before initiating the activities. The surveys must encompass all sagebrush shrublands within 0.5 mile of the proposed activities.

2. The Companies will locate facilities so that noise from the facilities at any nearby sage grouse or sharp-tailed grouse display grounds does not exceed 49 decibels (10 dBA above background noise) at the display ground.

3. All stock tanks shall include a ramp to enable trapped small birds and mammals to escape. See Idaho BLM Technical Bulletin 89-4 entitled Wildlife Watering and Escape Ramps on Livestock Water Developments: Suggestions and Recommendations.

2.3.2.6. Threatened, Endangered, or Sensitive Species

2.3.2.6.1. Bald Eagle

1. Special habitats for raptors, including wintering bald eagles, will be identified and considered during the review of Sundry Notices.

2. Additional mitigation measures may be necessary if the site-specific project is determined by a BLM biologist to have adverse effects to bald eagles or their habitat.

2.3.2.6.2. Ute Ladies'-tresses Orchid

1. Moist soils near wetlands, streams, lakes, or springs in the project area will be promptly revegetated if construction activities impact the vegetation in these areas. Revegetation will be designed to avoid the establishment of noxious weeds.

2.3.2.7. Visual Resources

1. The Companies will mount lights at compressor stations and other facilities on a pole or building and direct them downward to illuminate key areas within the facility while minimizing the amount of light projected outside the facility.

2.3.2.8. Noise

1. Noise mufflers will be installed on the exhaust of compressor engines to reduce the exhaust noise.

2. Where noise impacts to existing sensitive receptors are an issue, noise levels will be required to be no greater than 55 decibels measured at a distance of one-quarter mile from the appropriate booster (field) compressor. When background noise exceeds 55dBA, noise levels will be no greater than 5dBA above background. This may require the installation of electrical compressor motors at these locations.

2.3.2.9. Air Quality

1. During construction, emissions of particulate matter from well pad and resource road construction will be minimized by application of water, or other dust suppressants, with at least 50 percent control efficiency. Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced or otherwise stabilized to reduce the amount of fugitive dust generated by traffic or other activities, and dust inhibitors (surfacing materials, non-saline dust suppressants, and water) could be used as necessary on unpaved collector, local and resource roads that present a fugitive dust problem. The use of chemical dust suppressants on BLM surface will require prior approval from the BLM authorized officer.

2.3.3. Site specific mitigation measures

All changes made at the onsite will be followed. They have all been incorporated into the operator's POD.

Surface Use

1. 6-9 well: To protect sagebrush habitat, limit mowing radius to 75' around well stake.
2. Compressor locations will be addressed by sundry as needed.
3. A pre-construction field meeting shall be conducted prior to beginning any dirt work approved under this POD. The operator shall contact the BLM Authorized Officer Melanie Hunter @ 307 684-1138 at least 4-days prior to beginning operations so that the meeting can be scheduled. The operator is responsible for having all contractors present (dirt contractors, drilling contractor, pipeline contractor, project oversight personnel, etc.) including the overall field operations superintendent, and for providing all contractors copies of the approved POD, project map and BLM Conditions of Approval pertinent to the work that each will be doing.
4. Maintain a minimum 20-foot undisturbed vegetative border between toe-of-fill of pad and/or pit areas and the edge of adjacent drainages, unless otherwise directed by the BLM Authorized Officer.
5. All permanent above-ground structures (e.g., production equipment, tanks, etc.) not subject to safety requirements will be painted to blend with the natural color of the landscape. The paint used will be a color which simulates "Standard Environmental Colors." The color selected for the Knudson 9 POD is Covert Green.
6. The operator will drill seed on the contour to a depth of 0.5 inch, followed by cultipaction to compact the seedbed, preventing soil and seed losses. To maintain quality and purity, the current years tested,

Loamy Ecological Site Seed Mix		
Species	**% in Mix**	**Lbs PLS***
Western Wheatgrass (Pascopyrum smithii)/or ***Thickspike Wheatgrass*** (Elymus lanceolatus ssp. lanceolatus)	30	3.6
Bluebunch Wheatgrass (Pseudoroegneria spicata ssp. Spicata)	10	1.2
Green needlegrass (Nassella viridula)	25	3.0
Slender Wheatgrass (Elymus trachycaulus ssp. trachycaulus)	20	2.4
Prairie coneflower (Ratibida columnifera)	5	0.6
White or purple prairie clover (Dalea candidum, purpureum)	5	0.6
Rocky Mountain beeplant (Cleome serrulata)	5	0.6
Chapter 2 Totals	**100%**	**12 lbs/acre**

Wildlife

Bald Eagles

1. The following conditions will alleviate impacts to bald eagles:
   No project related actions shall occur within one mile of bald eagle habitat (Crazy Woman Creek and the Powder River) annually from November 1 through April 1 (CM9), or from February 1 through August 15 (CM8) prior to a nesting survey. This timing limitation will be in effect unless surveys determine the nest to be inactive. This affects the entire project area. **Due to the amount and frequency of bald eagles roosting along Crazy Woman Creek and the Powder River, no exception will be granted to winter roosting timing restrictions.**
   a. Surveys for winter roost sites will be conducted within suitable habitat by a biologist. If a roost is identified and construction has not been completed, a year-round disturbance-free buffer zone of 0.5 mile will be established for all bald eagle winter roost sites , and a seasonal minimum disturbance buffer zone of 1 mile will be established (November 1 - April 1). Additional measures such as remote monitoring and restricting maintenance visitation to between 9:00 AM and 3:00 PM may be necessary to prevent disturbance.
   b. If a nest is identified and construction has not been completed, a disturbance-free buffer zone of 0.5 mile (i.e., no surface occupancy) would be established year round for all bald eagle nests. A seasonal minimum disturbance buffer zone of 1 mile will be established for all bald eagle nest sites (February 1 - August 15).
   c. Additional mitigation measures may be necessary if the site-specific project is determined by a Bureau biologist to have an adverse affect to bald eagles or their habitat.

Burrowing Owls

1. The following conditions will alleviate impacts to burrowing owls:
   No surface disturbing activity shall occur within 0.25 miles of all identified prairie dog colonies from

April 15 to August 31, annually, prior to a burrowing owl nest occupancy survey for the current breeding season. A 0.25 mile buffer will be applied if a burrowing owl nest is identified. This condition will be implemented on an annual basis for the duration of surface disturbing activities within the prairie dog town(s). This timing limitation will be in effect unless surveys determine the nest(s) to be inactive. This timing limitation will affect the following

Township/Range	Section	Wells and Infrastructure
52/77	18	Well: 16-18-52-77AW All proposed access corridors in the SESE of this section.

Raptors

1. The following conditions will alleviate impacts to raptors:
    a. No surface disturbing activity shall occur within 0.5 mile of all identified raptor nests from February 1 through July 31, annually, prior to a raptor nest occupancy survey for the current breeding season. This timing limitation will affect the following

Township/Range	Section	Wells and Infrastructure
52/77	17	Wells: GGW Fed: 4-17-52-77AWP, 6-17-52-77AWP All proposed access / pipeline corridors in the NW of this section.
52/77	18	Wells: EK Ranch Fed: 2-18-52-77AW, 8-18-52-77AW, 10-18-52-77AW, 14-18-52-77AWP All proposed access / pipeline corridors in this entire section.

        1) Surveys to document nest occupancy shall be conducted by a biologist following BLM protocol, between April 15 and June 30. All survey results shall be submitted in writing to a Buffalo BLM biologist and approved prior to surface disturbing activities. Surveys outside this window may not depict nesting activity. If a survey identifies active raptor nests, a 0.5 mile timing buffer will be implemented. The timing buffer restricts surface disturbing activities within 0.5 mile of occupied raptor nests from February 1 to July 31.
        2) Nest productivity checks shall be completed annually continuing through the first five years following project completion. The productivity checks shall be conducted no earlier than June 1 or later than June 30 and any evidence of nesting success or production shall be recorded. Survey results will be submitted to a Buffalo BLM biologist in writing no later than July 31 of each survey year. This applies to the nests listed in Table 3.1 of this EA.
    b. If an undocumented raptor nest is located during project construction or operation, the Buffalo Field Office (307-684-1100) shall be notified within 24 hours.
    c. Well metering, maintenance and other site visits within 0.5 miles of raptor nests should be minimized as much as possible during the breeding season (February 1 – July 31).

Grouse

1. The following conditions will minimize the impacts to sage-grouse:
    a. A survey is required for sage-grouse between April 1 and May 7, annually, within the project area for the life of the project and results shall be submitted to a BLM biologist. The required sage grouse survey will be conducted by a biologist following the most current WGFD protocol. All survey results shall be submitted in writing to a Buffalo BLM biologist and approved prior to surface disturbing activities.
    b. If an active lek is identified during the survey, the 2 mile timing restriction (March 1-June 15) will be applied and surface disturbing activities will not be permitted until after the nesting

season. If surveys indicate that the identified lek is inactive during the current breeding season, surface disturbing activities may be permitted within the 2 mile buffer until the following breeding season (March 1).

c. Well metering, maintenance and other site visits within 0.5 miles of documented sage grouse lek sites shall be minimized as much as possible during the breeding season (March 1– June 15), and restricted to between 0900 and 1500 hours.

2. The following conditions will minimize impacts to sharp-tail-grouse:
   a. A survey is required for sharp-tailed grouse between April 1 and May 7, annually, within the project area for the life of the project and results shall be submitted to a BLM biologist.
      (1) If an active lek is identified during the survey, the 0.64 mile timing restriction (April 1 to May 31) will be applied and surface disturbing activities will not be permitted until after the nesting season. The required sharp-tailed grouse survey will be conducted by a biologist following WGFD protocol. All survey results shall be submitted in writing to a Buffalo BLM biologist and approved prior to surface disturbing activities.
      (2) If surveys indicate that the identified lek is inactive during the current breeding season, surface disturbing activities may be permitted within the 0.5 mile buffer until the following breeding season (April 1).

Water Management

1. The outfall into Fresno Reservoir will be repaired prior to discharge of water produced as a result of this federal action.

2.4. Alternatives considered but not analyzed in detail

The water management strategies considered in this plan were containment, injection, surface irrigation and subsurface drip irrigation (SDI). The only alternative rejected was SDI and no rationale was given.

2.5. Summary of Alternatives

A summary of the infrastructure currently existing within the POD area (Alternative A), the infrastructure originally proposed by the operator (Alternative B), and the infrastructure within the BLM/operator modified proposal (Alternative C) are presented in Table 2.5.

Table 2.5 Summary of the Alternatives

Facility	Alternative A (No Action) Existing Number or Miles	Alternative B (Original Proposal) Proposed Number or Miles	Alternative C (Environmental Alt.) Revised Number or Miles
Total CBNG Wells	51, includes shut-ins, (approx. 0.2 acre/ea)	10	
Total Locations		10	10
Nonconstructed Pads		4	4
Slotted Pads		0	0
Constructed Pads		6	6
Conventional Wells	1 (0.5 acre)	0	0
Gather/Metering Facilities	1	0	0
Compressors	See statement on P. 5 regarding	Refer to P. 5	Refer to P. 5

Facility	Alternative A (No Action) Existing Number or Miles	Alternative B (Original Proposal) Proposed Number or Miles	Alternative C (Environmental Alt.) Revised Number or Miles
	compressors		
Monitor Wells	1	0	0
Impoundments			
On-channel	7	0	0
Off-channel	0	0	0
Water Discharge Points			
	7	0	0
Treatment Facilities	0	0	0
Improved Roads	0		
No Corridor		0	0
With Corridor		9666’	9666’
2-Track Roads			
No Corridor	22107’	0	0
With Corridor	35473’	5925’	5289’
Buried Utilities	18056’		
No Corridor	5642’	1551’	1551’
With Corridor			
Overhead Powerlines	47451’	0	0
Communication Sites			
Staging/Storage Areas	3	3	3
Other Disturbance			
Acres of Disturbance	70.79	15.5 acres	15.21 acres

3. DESCRIPTION OF AFFECTED ENVIRONMENT

Applications to drill were received on 12/21/2007. Field inspections of the proposed Knudson 9 Extension CBNG project were conducted on 7/1 and 7/2/2008 by

NAME	TITLE	AGENCY
Jenny Morton	Wildlife Biologist	BLM
Ben Adams	Hydrologist	BLM
Scott Jawors	Wildlife Biologist	BLM
Wendy Sutton	Archaeologist	BLM
Melanie Hunter	Natural Resource Specialist	BLM
Brad Rogers	Wildlife Biologist	USFWS
Jeb Beacham	Regulatory Compliance Rep.	Pennaco
Annette Mathis	Regulatory Compliance Tech.	Pennaco
Jim Enochs	Project Manager	Marathon/Pennaco
John Ridenour	Construction	Marathon/Pennaco
Eric Kessner	Surveyor	WHS

NAME	TITLE	AGENCY
Harry Kessner	Civil Engineer	WHS
Eddie Knudson	Landowner	

This section describes the environment that would be affected by implementation of the Alternatives described in Section 2. Aspects of the affected environment described in this section focus on the relevant major issues. Certain critical environmental components require analysis under BLM policy. These items are presented below in Table 3.1.

Table 3.1 - Critical elements requiring mandatory evaluation are presented below.

Mandatory Item	Potentially Impacted	No Impact	Not Present On Site	BLM Evaluator
Threatened and Endangered Species	X			Jenny Morton
Floodplains	X			Ben Adams
Wilderness Values			X	Melanie Hunter
ACECs			X	Melanie Hunter
Water Resources	X			Ben Adams
Air Quality	X			Melanie Hunter
Cultural or Historical Values			X	Wendy Sutton
Prime or Unique Farmlands			X	Melanie Hunter
Wild & Scenic Rivers			X	Melanie Hunter
Wetland/Riparian	X			Ben Adams
Native American Religious Concerns			X	Wendy Sutton
Hazardous Wastes or Solids			X	Melanie Hunter
Invasive, Nonnative Species	X			Melanie Hunter
Environmental Justice			X	Melanie Hunter

3.1. Topographic Characteristics of Project Area

The Knudson 9 project area is located approximately 25 miles northeast of Buffalo, Wyoming, near the intersection of Tipperary and Lower Powder River roads. The northern portion of the project area, closer to Crazy Woman Creek, is open grasslands, with relatively flat topography and some gently rolling hills. The 2-18-5277, 4-17-5277, and 6-9-5277 wells are located in this area, although the 2-18 and 4-17 wells are borderline. The remainder of the project area is located in steeper, “breaks” type sagebrush country. Narrow ridgelines are cut with deep ephemeral drainages, with limited flat ground in the narrow valleys between ridgelines. Occasional rocky or sandy outcroppings are also found in steeper areas. The portion of the project area on Crazy Woman Creek as it approaches the Powder River is a broad, flat-bottomed floodplain with a well incised baseflow channel. There is a limited amount of development (barns, irrigation, CBNG wells and infrastructure, etc) within this floodplain.

3.2. Vegetation & Soils

Species typical of short grass prairie comprise the project area flora. Specific species observed throughout the project area include cheatgrass, western wheatgrass, and crested wheatgrass. Differences in dominant species within the project area vary with soil type, aspect and topography. The bottomlands near Crazy Woman Creek, including the 3 wells listed above, have been plowed and planted with grasses such as crested wheatgrass, although cheatgrass has become a major component. Plant diversity is low. This plant community is relatively stable, with the rhizomatous wheatgrasses being somewhat resistant to overgrazing, and the cheatgrass effectively competing against the establishment of perennial cool-season grasses.

An increase in bare ground reduces water infiltration and increases soil erosion. The watershed is usually functioning. The biotic integrity is reduced by the lack of diversity in the plant community.

The remaining seven wells in the project area are in a Mixed Sagebrush/Grass Plant Community. Historically, this plant community evolved under grazing by bison and a low fire frequency. Currently, it is found under moderate, season-long grazing by livestock in the absence of fire or brush control. Big sagebrush is a significant component of this plant community. Cool-season grasses make up the majority of the understory with the balance made up of short warm-season grasses, annual cool-season grass, and miscellaneous forbs.

Dominant grasses include rhizomatous wheatgrasses, and green needlegrass, although cheatgrass has invaded most of these sites. Forbs commonly found in this plant community include Louisiana sagewort (cudweed), plains wallflower, hairy goldaster, slimflower scurfpea, and scarlet globemallow. Sagebrush canopy ranges from 20% to 30%. Plains pricklypear is also present in this part of the project area. The overstory of sagebrush and understory of grass and forbs provide a diverse plant community, which will support domestic livestock and wildlife such as mule deer and antelope.

This state is stable and protected from excessive erosion. The biotic integrity of this plant community is intact, but can be at risk depending on how far a shift has occurred in plant composition toward blue grama, big sagebrush, and/or cheatgrass. The watershed is functioning, but it could become at risk if blue grama sod and/or bare ground increases.

The soils in the project area vary from loamy bottomland soils to clayey soils with sandy outcrops in the sagebrush, breaks country. Topsoil depths to be salvaged for reclamation range from 6-8 inches on ridges to greater than 10 inches in bottomland. Erosion potential varies from to depending on the soil type, vegetative cover and slope, but is severe for the most of the project area, excluding the 6-9-5277 well. The erosion potential for the soils where this well is located is slight. The reclamation potential of soils in the project area varies from fair, including the 2-18-5277, 8-18-5277, 10-18-5277, 14-18-5277, and 6-9-5277 wells, to poor, which includes the remainder of the wells in the project.

3.2.1. Wetlands/Riparian/Floodplains

Wetland and riparian areas are present all along Crazy Woman Creek through the project area. They are characterized by vegetation which is typically present along perennial streams. As Crazy Woman Creek approaches its confluence with the Powder River, it becomes a wide, broad-bottomed floodplain with an incised baseflow channel through it. The irrigation that takes place throughout stream systems typically occurs on these floodplains. Crazy Woman Creek is no exception.

3.2.2. Invasive Species

No state-listed noxious weeds and/or weed species of concern infestations were discovered by a search of inventory databases on the Wyoming Energy Resource Information Clearinghouse (WERIC) web site (www.weric.info).

The WERIC database was created cooperatively by the University of Wyoming, BLM and county Weed and Pest offices. The operator or BLM did not find any noxious weed species subsequent field investigations. Although not listed as noxious weed, cheatgrass infestation is prevalent in the project area.

The state-listed noxious weeds are listed in PRB FEIS Table 3-21 (p. 3-104) and the Weed Species of Concern are listed in Table 3-22 (p. 3-105.

3.3. Wildlife

Several resources were consulted to identify wildlife species that may occur in the proposed project area. Resources that were consulted include the wildlife database compiled and managed by the BLM Buffalo Field Office (BFO) wildlife biologists, the PRB FEIS, the Wyoming Game and Fish Department (WGFD) big game and sage-grouse maps, and the Wyoming Natural Diversity Database (WYNDD).

A habitat assessment and wildlife inventory surveys were performed by Jones & Stokes (J&S) (2006, 2007, 2008). J&S performed surveys for bald eagles, mountain plover, sharp-tailed grouse, greater sage-grouse, raptor nests, and prairie dog colonies according to Powder River Basin Interagency Working Group (PRBIWG) accepted protocol in 2006, 2007, and 2008. Surveys were conducted for Ute ladies'-tresses orchid habitat on August 17, 2006. PRB IWG accepted protocol is available on the CBM Clearinghouse website (www.cbmclearinghouse.info).

A BLM biologist conducted field visits on July 1, 2008. During this time, the biologist reviewed the wildlife survey information for accuracy, evaluated impacts to wildlife resources, and provided project modification recommendations where wildlife issues arose.

Wildlife species common to the habitat types present are identified in the PRB FEIS (pg. 3-114). Species that have been identified in the project area or that have been noted as being of special importance are described below.

3.3.1. Big Game

Big game species expected to be within the Knudson 9 Extension project area include pronghorn antelope, mule deer, and white-tailed deer. Small groups of pronghorn antelope were observed from several well locations during the onsite visit. The WGFD has determined that the project area contains yearlong range for pronghorn antelope and white-tailed deer, and winter-yearlong range for mule deer. The Fortification Creek elk herd is concentrated approximately 2.5 miles east of the project area. Despite this close proximity, no elk have been recorded within the project area. The Powder River may serve as a barrier between this project area and Fortification Creek elk habitats.

Winter-Yearlong use is when a population or a portion of a population of animals makes general use of the documented suitable habitat sites within this range on a year-round basis. During the winter months there is a significant influx of additional animals into the area from other seasonal ranges. **Yearlong** use is when a population of animals makes general use of suitable documented habitat sites within the range on a year round basis. Animals may leave the area under severe conditions. Populations of pronghorn antelope, mule deer, and white-tailed deer within their respective hunt areas are above WGFD objectives. Big game range maps are available in the PRB FEIS (3-119-143), the project file, and from the WGFD.

3.3.2. Aquatics

The Powder River and Crazy Woman Creek are the primary drainages in the area and flow north along the eastern margin of the project area and east through the middle of the project area. Smaller drainages, including Headgate, Coal, and Scroggins Draws in the north and several unnamed tributaries in the south, drain the majority of the project and empty into either Crazy Woman Creek or the Powder River. Fish that have been identified in the Powder River watershed are listed in the PRB FEIS (3-156-159).

The Powder River Basin is one of the last free-flowing prairie stream ecosystems left in the United States, with existing flows, turbidity, and water quality within historic ranges. The Powder River supports an intact native fish community including several rare or declining species. These species have evolved life history strategies that allow them to survive in extreme conditions (Hubert 1993). Native fish species include sauger, shovelnose sturgeon, goldeye, plains minnow, sand shiner, flathead chub, plains killifish, river carpsucker, sturgeon chub, western silvery minnow, channel catfish, fathead minnow, longnose

dace, mountain sucker, shorthead redhorse, longnose sucker, stonecat, white sucker and others. Six of these are designated by the WGFD as either Native Species Status (NSS) 1, 2, or 3 species. Species in these designations are considered to be species of concern, in need of more immediate management attention, and more likely to be petitioned for listing under the Endangered Species Act.

NSS1 species (sturgeon chub and western silvery minnow) are those that are physically isolated and/or exist at extremely low densities throughout their range, and habitat conditions are declining or vulnerable. NSS2 species (goldeye, shovelnose sturgeon, and sauger) are physically isolated and/or exist at extremely low densities throughout their range, and habitat conditions appear to be stable. NSS3 species (plains minnow) are widely distributed throughout their native range and appear stable; however, habitats are declining or vulnerable. For these species, the WGFD has been directed by the Wyoming Game and Fish Commission to recommend that no loss of habitat function occur. Some modification of the habitat may occur, provided that habitat function is maintained (i.e., the location, essential features, and species supported are unchanged).

The sturgeon chub was petitioned for listing under the Endangered Species Act in 2000. The sturgeon chub is a small minnow native to WY and is known to occur only in the Powder River and in one location on Crazy Woman Creek. The sturgeon chub requires large, free-flowing rivers characterized by swift flows, high variable flow regimes, braided channels, high turbidity, and sand/gravel substrates. On April 18, 2001, the U.S. Fish and Wildlife Service determined that the listing was not warranted, due to the sturgeon chub population being more abundant and better distributed throughout their range than previously believed.

Amphibian and reptile species occur throughout the Basin, but there is little recorded baseline information available about them. Confluence Consulting, Inc. identified the following species present within the Clear Creek and Powder River watersheds: Woodhouse's toad, Northern leopard frog, gopher snake, and garter snake (2004). Because sampling at the upper two sites on Clear Creek occurred late in the season, seasonality may have influenced the lack of reptiles and amphibians observed at these sites.

3.3.3. Migratory Birds

A wide variety of migratory birds may be found in the proposed project area at some point throughout the year. Migratory birds are those that migrate for the purpose of breeding and foraging at some point in the calendar year. Many species that are of high management concern use shrub-steppe and shortgrass prairie areas for their primary breeding habitats (Saab and Rich 1997). Migratory bird species of management concern that may occur in the project area are listed in the PRB FEIS (3-151). Species observed by J&S include ferruginous hawk and loggerhead shrike.

3.3.4. Raptors

Raptors species expected to occur in suitable habitats within the Powder River Basin include northern harrier, golden eagle, red-tailed hawk, Swainson's hawk, ferruginous hawk, American kestrel, prairie falcon, short-eared owl, great horned owl, bald eagle, rough-legged hawk, merlin, Cooper's hawk, northern goshawk, long-eared owl, and burrowing owl. Most raptor species nest in a variety of habitats including but not limited to; native and non-native grasslands, agricultural lands, live and dead trees, cliff faces, rock outcrops, and tree cavities.

Eleven raptor nest sites were identified by J&S (2006, 2007, 2008) and BLM within 0.5 mile of the project area, of these, one nest was active in 2008.

Table 3.1. Documented raptor nests within the Knudson 9 Extension project area.

BLM ID #	UTME	UTMN	Legal Location	Substrate	Year	Condition	Status	Species
3054	411480	4928219	T52N R77W S10	cottonwood, live	2008	good	active	golden eagle
					2007	good	inactive	
					2006	good	active	golden eagle
					2005	good	active	golden eagle
3055	411497	4926622	T52N R77W S15	cottonwood, live	2008	fair	inactive	
					2007	good	inactive	
					2006	good	inactive	
					2005	good	active	red-tailed hawk
3745	411277	4926486	T52N R77W S15	cottonwood, live	2008	good	inactive	
					2007	good	active	great-horned owl
					2006	excellent	inactive	
3766	411560	4927457	T52N R77W S10	cottonwood, live	2008	unknown	unknown	unknown
					2007	unknown	unknown	unknown
					2006	poor	inactive	
					2005	poor	inactive	
4307	407843	4927643	T52N R77W S8	cottonwood, live	2008	fair	inactive	
					2007	fair	inactive	
					2006	good	active	golden eagle
					2005	good	active	golden eagle
4308	408211	4927216	T52N R77W S8	cottonwood, live	2008	fair	inactive	
					2007	fair	inactive	
					2006	fair	inactive	
					2005	fair	inactive	
4309	406783	4926063	T52N R77W S18	cottonwood, live	2008	gone	inactive	
					2007	poor	inactive	
4310	406828	4926052	T52N R77W S18	rock cavity	2008	unknown	inactive	
					2007	unknown	inactive	
					2006	unknown	inactive	
5605	406364	4926760	T52N R77W S18	cottonwood, live	2008	good	inactive	
					2007	fair	active	red-tailed hawk
5606	408056	4927014	T50N, R77W S8	cottonwood, live	2008	poor	inactive	
					2007	fair	inactive	

3.3.5. Threatened and Endangered and Sensitive Species

3.3.5.1. Threatened and Endangered Species

Within the BLM Buffalo Field Office there are two species that are Threatened or Endangered under the Endangered Species Act.

3.3.5.1.1. Black-footed ferret

The USFWS listed the black-footed ferret as Endangered on March 11, 1967. Active reintroduction

efforts have reestablished populations in Mexico, Arizona, Colorado, Montana, South Dakota, Utah, and Wyoming. In 2004, the WGFD identified six prairie dog complexes (Arvada, Sheridan, Pleasantdale, Four Corners, Linch, Kaycee, and, Thunder Basin National Grasslands) partially or wholly within the BLM Buffalo Field Office administrative area as potential black-footed ferret reintroduction sites (Grenier et al. 2004).

This nocturnal predator is closely associated with prairie dogs, depending almost entirely upon them for its food. The ferret also uses old prairie dog burrows for dens. Current science indicates that a black-footed ferret population requires at least 1000 acres of black-tailed prairie dog colonies, separated by no more than 1.5km, for survival (USFWS 1989).

The WGFD believes the combined effects of poisoning and Sylvatic plague on black-tailed prairie dogs have greatly reduced the likelihood of a black-footed ferret population persisting east of the Big Horn Mountains (Grenier 2003). The U.S. Fish and Wildlife Service has also concluded that black-tailed prairie dog colonies within Wyoming are unlikely to be inhabited by black-footed ferrets (Kelly 2004).

Eleven black-tailed prairie dog colonies, totaling 204.9 acres, were identified from the BLM database to be within or extend into the project area (See Table 3.2 below). An additional 77 colonies, totaling 7748 acres are located within 1.5 km (0.9 mile) of the towns within the project area. The project area is located completely within the Arvada complex, a potential reintroduction area. Black-footed ferret habitat is present within the Knudson 9 Extension project area.

Table 3.2. Black-tailed prairie dog colonies within the Knudson 9 Extension project area.

Legal Location	Size (Acres)
SW S6 T52N, R77W	11.6
NENW S7 T52N, R77W	38.1
SWNW S7 T52N, R77W	30.0
W S8 T52N, R77W	91.9
SWSW S8 T52N, R77W	4.6
SWNE S9 T52N, R77W	1.8
NWNE S17 T52N, R77W	21.5
NENW S17 T52N, R77W	0.3
NENW S18 T52N, R77W	1.6
NWSE S18 T52N, R77W	0.5
SESE S18 T52N, R77W	3.0
Total	**204.9**

3.3.5.1.2. Ute Ladies'-Tresses Orchid

This orchid is listed as Threatened under the Endangered Species Act. It is extremely rare and occurs in moist, sub-irrigated or seasonally flooded soils at elevations between 1,780 and 6,800 feet above sea level. Habitat includes wet meadows, abandoned stream channels, valley bottoms, gravel bars, and near lakes or perennial streams that become inundated during large precipitation events. Wyoming Natural Diversity Database model predicts undocumented populations may be present particularly within southern Campbell and northern Converse Counties.

Prior to 2005, only four orchid populations had been documented within Wyoming. Five additional sites were located in 2005 and one in 2006 (Heidel pers. Comm.). The new locations were in the same drainages as the original populations, with two on the same tributary and within a few miles of an original location. Drainages with documented orchid populations include Antelope Creek in northern Converse County, Bear Creek in northern Laramie and southern Goshen Counties, Horse Creek in Laramie County,

and Niobrara River in Niobrara County. In Wyoming, *Spiranthes diluvialis* blooms from early August to early September, with fruits produced in mid August to September (Fertig 2000).

The Powder River and Crazy Woman Creek are the primary drainages in the area and flow north along the eastern margin of the project area and east through the middle of the project area. Smaller drainages, including Headgate, Coal and Scroggins Draws in the north and several unnamed tributaries in the south, drain the majority of the project and empty into either Crazy Woman Creek or the Powder River. During ground surveys in the spring of 2006, the Powder River and Crazy Woman Creek contained moderate flow throughout the project area and pools of standing water existed along portions of the unnamed drainage in central Section 18. Filled reservoirs were present in SWNE Section 9 and SWSE Section 17, and an empty reservoir was in SWSE Section 17. The Knudson 9 Extension project area provides non-existent orchid habitat, with one exception, in the form of uplands and dry ephemeral drainages lacking an historic water source of suitable duration. The single location that provided marginal habitat was discluded due to a fluctuating water table, sandy soil noted at the banks, the height and density of the vegetation and the slope of the banks (BKS Environmental Associates, Inc. 2007). This area was surveyed in 2007. No orchids were observed.

3.3.5.2. Sensitive Species

The USDI Bureau of Land Management (BLM) Wyoming has prepared a list of sensitive species to focus species management efforts towards maintaining habitats under a multiple use mandate. Two habitat types, prairie dog colonies and sagebrush ecosystems, specifically, are the most common among habitat types within the Powder River Basin and contain habitat components required in the life cycle of several sensitive species. These are described below in general terms. Those species within the Powder River Basin that were once listed or candidates for listing under the Endangered Species Act of 1973 and remain BLM Wyoming sensitive species are described in more detail. The authority for this policy and guidance comes from the Endangered Species Act of 1973, as amended; Title II of the Sikes Act, as amended; the Federal Land Policy and Management Act (FLPMA) of 1976; and the Department Manual 235.1.1A.

3.3.5.2.1. Prairie dog colony obligates

Prairie dog colonies create habitat for many species of wildlife (King 1955, Reading et al. 1989). Agnew (1986) found that bird species diversity and rodent abundance were higher on prairie dog towns than on mixed grass prairie sites. Several studies (Agnew 1986, Clark 1982, Campbell and Clark 1981 and Reading et al. 1989) suggest that species richness increases with colony size and regional colony density. Prairie dog colonies attract many insectivorous and carnivorous birds and mammals because of the concentration of prey species (Clark 1982, Agnew 1986, Agnew 1988).

In South Dakota, forty percent of the wildlife taxa (134 vertebrate species) are associated with prairie dog colonies (Agnew 1983, Apa 1985, McCracken et al. 1985, Agnew 1986, Uresk and Sharps 1986, Deisch et al. 1989). Of those species regularly associated with prairie dog colonies, six are on the Wyoming BLM sensitive species list: swift fox (*Vulpes velox*), mountain plover (*Charadrius montanus*), ferruginous hawk (*Buteo regalis*), burrowing owl (*Athene cunicularia*), loggerhead shrike (*Lanius ludovicianus*), and long-billed curlew (*Numenius americanus*). Species observed by J&S include ferruginous hawk and loggerhead shrike.

3.3.5.2.2. Sagebrush obligates

Sagebrush ecosystems support a variety of species. Sagebrush obligates are animals that cannot survive without sagebrush and its associated perennial grasses and forbs; in other words, species requiring sagebrush for some part of their life cycle. Sagebrush obligates within the Powder River Basin, listed as sensitive species by BLM Wyoming include greater sage-grouse, Brewer's sparrow, sage thrasher, and sage sparrow. Sage sparrows, Brewer’s sparrows, and sage thrashers all require sagebrush for nesting,

with nests typically located within or under the sagebrush canopy. Sage thrashers usually nest in tall dense clumps of sagebrush within areas having some bare ground for foraging. Sage sparrows prefer large continuous stands of sagebrush, and Brewer's sparrows are associated closely with sagebrush habitats having abundant scattered shrubs and short grass (Paige and Ritter 1999). Other sagebrush obligate species include sagebrush vole, pronghorn antelope, and sagebrush lizard. Species observed by the BLM biologists include pronghorn antelope.

3.3.5.2.3. Bald eagle

On February 14, 1978, the bald eagle was federally listed as Endangered. On August 8, 2007, the bald eagle was removed from the Endangered Species list. The bald eagle remains under the protection of the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. In order to avoid violation of these laws and uphold the BLM's commitment to avoid any future listing of this species, all conservation measures and terms and conditions identified in the Powder River Basin Oil and Gas Project Biological Opinion (WY07F0075) (USFWS 2007) shall continue to be complied with.

Bald eagle nesting habitat is generally found in areas that support large mature trees. Eagles typically will build their nests in the crown of mature trees that are close to a reliable prey source. This species feeds primarily on fish, waterfowl, and carrion. In more arid environments, such as the Powder River Basin, prairie dogs, ground squirrels, and lagomorphs can make up the primary prey base. The diets of wintering bald eagles are often more varied. In addition to prairie dogs, ground squirrels, and lagomorphs, carcasses of domestic sheep and big game may provide a significant food source in some areas. Historically, sheep carcasses from large domestic sheep ranches provided a reliable winter food source within the Powder River Basin (Patterson and Anderson 1985). Today, few large sheep operations remain in the Powder River Basin. Wintering bald eagles may congregate in roosting areas generally made up of several large trees clumped together in stands of large ponderosa pine, along wooded riparian corridors, or in isolated groups. Bald eagles often share these roost sites with golden eagles as well.

Suitable nesting and winter roosting habitat exists throughout the project area. Trees are abundant along Crazy Woman Creek and the Powder River and sparsely distributed throughout the remaining areas. Large stands (>100 individuals) of mature cottonwoods occur along the Powder River and nearly a continuous band occupies the length of Crazy Woman Creek. Additional cottonwoods, lone individuals or pairs, were documented in bottomlands and at the tops of draws throughout the project area, particularly in Scroggins and Headgate Draws, and the unnamed drainage in Section 18. Small stands of junipers also exist in the northern extents of Scroggins, Headgate, and Coal Draws, and scattered individuals occur on hillsides throughout the project area. Both Crazy Woman Creek and the Powder River are within the project boundaries. These two waterways have historically supported concentrations of bald eagles consistently throughout each winter (See Table 3.3 below).

Table 3.3. Bald eagle observations within and surrounding the Knudson 9 Extension project area.

Date	Total	Ad	Imm	Unk	UTMs	Habitat	Behavior	Legal Location
01/14/06	1	1	0	0	408795E 4924994N	Cottonwood riparian	Perched	S20 T52N R77W
12/13/06	2	2	0	0	411976E 4927873N	Cottonwood riparian	Perched	S10 T52N R77W
12/23/03	1	0	0	1	412587E 4928759N	Cottonwood riparian	Perched	S02 T52N R77W
01/15/05	2	2	0	0	409586E 4925499N	Cottonwood riparian	Perched	S16 T52N R77W
12/13/06	1	1	0	0	411458E 4926851N	Cottonwood riparian	Perched	S10 T52N R77W

Date	Total	Ad	Imm	Unk	UTMs	Habitat	Behavior	Legal Location
12/13/06	1	1	0	0	410589E 4926008N	Cottonwood riparian	Perched	S16 T52N R77W
12/13/06	2	2	0	0	409881E 4926296N	On heron nest in rookery	Perched	S16 T52N R77W
2/23/05	1	1	0	0	410342E 4926087N	Cottonwood riparian	Perched	S16 T52N R77W
12/16/05	1	1	0	0	409353E 4925770N	Cottonwood riparian	Perched	S16 T52N R77W
12/22/05	1	0	0	1	408598E 4924402N	Cottonwood riparian	Perched	S20 T52N R77W
12/22/05	1	0	0	1	409432E 4927059N	Cottonwood riparian	Perched	S09 T52N R77W
01/17/06	1	1	0	0	410141E 4926650N	Cottonwood riparian	Perched	S16 T52N R77W
12/06/06	1	1	0	0	409683E 4925965N			S16 T52N R77W
12/06/06	3	1	2	0	411568E 4928272N			S10 T52N R77W
01/16/07	2	2	0	0	409922E 4926317N	Cottonwood riparian	Perched	S16 T52N R77W
12/12/06	7	6	1	0	410272E 4926144N	Cottonwood riparian	Perched	S16 T52N R77W
12/27/06	1	0	1	0	408878E 4925234N	Cottonwood riparian	Perched	S17 T52N R77W
12/27/06	1	0	1	0	410151E 4927047N	Cottonwood riparian	Perched	S09 T52N R77W
12/27/06	1	1	0	0	410662E 4927746N	Cottonwood riparian	Perched	S09 T52N R77W
12/27/06	2	2	0	0	410889E 4928321N		Flying	S09 T52N R77W
12/27/06	1	0	1	0	410889E 4928321N	Cottonwood riparian	Perched	S09 T52N R77W
01/04/07	1	1	0	0	409881E 4926420N	Cottonwood riparian	Perched	S16 T52N R77W
01/05/07	1	1	0	0	411097E 4928489N			S03 T52N R77W
01/08/07	1	1	0	0	410033E 4926293N	Cottonwood riparian	Perched	S16 T52N R77W
01/08/07	1	1	0	0	410261E 4926335N	Ice edge at open water	Ground	S16 T52N R77W
01/08/07	3	2	1	0	410237E 4925912N	Cottonwood riparian	Perched	S16 T52N R77W
02/19/07	8	3	5	0	410740E 4926132N	Cottonwood riparian	Perched	S16 T52N R77W
01/29/07	6	4	2	0	410663E 4926038N	Cottonwood riparian	Perched	S16 T52N R77W

Date	Total	Ad	Imm	Unk	UTMs	Habitat	Behavior	Legal Location
02/13/07	1	1	0	0	411344E 4927615N	Cottonwood riparian	Perched	S10 T52N R77W
12/11/07	1	1	0	0	410185E 4924826N	Cottonwood riparian	Perched	S21 T52N R77W
1/16/08	10	6	4	0	410593E 4926077N	Cottonwood riparian	Perched	S16 T52N R77W
1/16/08	1	0	1	0	409073E 4923780N	Cottonwood riparian	Perched	S20 T52N R77W
2/12/08	2	2	0	0	409787E 4926332N	Cottonwood riparian	Perched	S16 T52N R77W
2/12/08	5	0	5	0	410593E 4926077N	Cottonwood riparian	Perched	S16 T52N R77W
2/12/08	1	0	1	0	410262E 4925784N	River bank	Perched	S16 T52N R77W

3.3.5.2.4. Black-tailed prairie dog

The black-tailed prairie dog was added to the list of Candidate species for federal listing on February 4, 2000 (USFWS 2000). On August 12, 2004, the U.S. Fish and Wildlife Service removed the black-tailed prairie dog's Candidate status. BLM Wyoming, considers prairie dogs as a sensitive species and continues to afford this species the protections described in the PRB FEIS. The black-tailed prairie dog is a diurnal rodent inhabiting prairie and desert grasslands of the Great Plains.

Due to human-caused factors, black-tailed prairie dog populations are now highly fragmented, and isolated (Miller 1994). Most colonies are small and subject to potential extirpation due to inbreeding, population fluctuations, and other problems, such as landowner poisoning and disease that affect long term population viability (Primack 1993, Meffe and Carroll 1994, Noss and Cooperrider 1994).

The black-tailed prairie dog is considered common in Wyoming, although its abundance fluctuates with activity levels of Sylvatic plague and the extent of control efforts by landowners. Comparisons with 1994 Digital Ortho Quads indicated that black-tailed prairie dog acreage remained stable from 1994 through 2001. However, aerial surveys conducted in 2003 to determine the status of known colonies indicated that a significant portion (approximately 47%) of the prairie dog acreage was impacted by Sylvatic plague and/or control efforts (Grenier 2004).

Eleven black-tailed prairie dog colonies, totaling approximately 204.9 acres were identified by the BLM database within the project area (See Table 3.2).

3.3.5.2.5. Burrowing owl

The burrowing owl is a small, long-legged owl found throughout open landscapes of North and South America. Burrowing owls can be found in grasslands, rangelands, agricultural areas, deserts, or any dry open area with low vegetation where abandoned burrows dug by mammals such as ground squirrels (*Spermophilus spp*.), prairie dogs (*Cynomys spp.),* and badgers (*Taxidea taxus*) are available. Black-tailed prairie dog colonies provide the primary habitat for burrowing owls (Klute et al. 2003).

The western burrowing owl has declined significantly throughout its North American range. Current population estimates for the United States are not well known but trend data suggest significant declines (McDonald et al. 2004). The last official population estimate placed them at less than 10,000 breeding pairs. The majority of the states within the owl's range have recognized that western burrowing owl populations are declining. It is listed as a sensitive species by the BLM throughout the west and by the

USDAFS. Primary threats across the North American range of the burrowing owl are habitat loss and fragmentation primarily due to intensive agricultural and urban development, and habitat degradation due to declines in populations of colonial burrowing mammals (Klute et al. 2003).

Burrowing owl nesting habitat consists of open areas with mammal burrows. Individual burrowing owls have moderate to high site fidelity to breeding areas and even to particular nest burrows (Klute et al. 2003). Burrow and nest sites are reused at a higher rate if the bird has reproduced successfully during the previous year. Favored nest burrows are those in relatively sandy sites (possibly for ease of modification and drainage), areas with low vegetation around the burrows (to facilitate the owl's view and hunting success), holes at the bottom of vertical cuts with a slight downward slope from the entrance, and slightly elevated locations. In Wyoming, egg laying begins in mid-April. Incubation is assumed to begin at the mid-point of the laying period and lasts for 26 days (Olenick 1990). Young permanently leave the primary nest burrow around 44 days from hatch (Landry 1979). Juveniles will continue to hunt with and associate with parents until migration (early September through early November) (Haug 1985).

The survey information provided by J&S indicated a burrowing owl nest within the Knudson 9 Extension project area in 2008. This nest, inactive in both 2007 and 2008, is located in NENW Section17, T52N, R77W (UTMs 408459E, 4926645N).

3.3.5.2.6. Grouse

3.3.5.2.6.1. Greater sage-grouse

The greater sage-grouse is listed as a sensitive species by BLM (Wyoming). In recent years, several petitions have been submitted to the USFWS to list greater sage-grouse as Threatened or Endangered. On January 12th, 2005, the USFWS issued a decision that the listing of the greater sage-grouse was "not warranted" following a Status Review. The decision document supporting this outcome noted the need to continue or expand all conservation efforts to conserve sage-grouse. In 2007, the U.S. District Court remanded that decision, stating that the USFWS' decision-making process was flawed and ordered the USFWS to conduct a new Status Review as a result of a lawsuit and questions surrounding the 2005 review (Winmill Decision Case No. CV-06-277-E-BLW, December 2007).

Greater sage-grouse are found in prairie, sagebrush shrublands, other shrublands, wet meadows, and agricultural areas; they depend upon substantial sagebrush stands for nesting and winter survival (BLM 2003). Suitable sage-grouse habitat is present throughout the project area. Wyoming big sagebrush occurs throughout the project area in a patchy mosaic of sparse to dense stands. Stands of sparse sagebrush averages 12 to 24 inches in height and exists on sloping and steep terrain throughout the project area. Moderately dense to dense patches exist in NE Section 18 and NW Section 17 and along Headgate Draw in Sections 5 and 8 and Coal Draw in SW Section 4 and NW Section 9 (Wilsey 2006). Sage-grouse habitat models indicate that the project area contains high quality sage-grouse nesting habitat within Sections 6, 8, 9, 17, and 18 and high quality sage-grouse wintering habitat within Sections 6, 8, and 9 (Walker et al. 2007). BLM records identified three sage-grouse leks within 4 miles of the project area. The 4-mile distance was recommended by the State wildlife agencies' ad hoc committee for consideration of oil and gas development effects to nesting habitat (WGFD 2008). These three lek sites are identified below (Table 3.4).

Table 3.4. **Sage-grouse leks surrounding the Knudson 9 Extension project area.**

LEK NAME	LEGAL LOCATION	OCCUPANCY STATUS	DISTANCE (MILES) FROM PROJECT AREA
Lake	NWNE Sec. 25 T53N, R78W	Occupied	2.3
Jewell Draw	NWSE Sec. 34 T53N, R78W	Occupied	2.6

LEK NAME	LEGAL LOCATION	OCCUPANCY STATUS	DISTANCE (MILES) FROM PROJECT AREA
Lake NW	SWNE Sec. 23 T53N, R78W	Occupied	3.4

3.3.5.2.6.2. Sharp-tailed grouse

Sharp-tailed grouse inhabit short and mixed-grass prairie, sagebrush shrublands, woodland edges, and river canyons. In Wyoming, this species is found where grasslands are intermixed with shrublands, especially wooded draws, shrubby riparian area, and wet meadows.

The Knudson 9 Extension project area has the potential to support sharp-tailed grouse during most of the year. The mosaic of grasslands and sagebrush-grasslands could provide habitat from April through October. Cottonwoods and junipers along drainages throughout the project area could provide buds and berries, respectively, to sustain grouse through the winter. However, the lack of more suitable berry producing shrub, such as snowberry, rose, and skunkbush sumac, may reduce the likelihood of the area to attract large numbers of wintering sharp-tailed grouse (Wilsey 2006). No sharp-tailed grouse leks were documented within or surrounding the project area.

3.3.5.2.7. Mountain plover

The mountain plover was proposed for listing in 1999 (USFWS). In 2003, the USFWS withdrew a proposal to list the Mountain Plover as a Threatened species, stating that the population was larger than had been thought and was no longer declining. Mountain plovers, which are a BLM sensitive species, are typically associated with high, dry, short grass prairies (BLM 2003). Mountain plover nesting habitat is often associated with heavily grazed areas such as prairie dog colonies and livestock pastures.

Stands of mature cottonwoods and other shrubs along the Powder River and Crazy Woman Creek render large portions of those bottomlands unsuitable for nesting plovers. Similarly, while vegetation characteristics in the prairie dog colonies along Crazy Woman Creek are adequate for nesting mountain plovers, these are unlikely to attract plovers due to the presence of trees and a steep bench along the creek. The most suitable habitat for nesting plovers occurs in haylands located in SE Section 9, W Section 10, and NNE Section 16. However, grass density and height detracts from the suitability of these areas. Marginal plover habitat exists in the remaining grasslands along the Powder River and Crazy Woman Creek, but these occur on sloping terrain and in proximity to sagebrush stands, steep ridges, or eroded drainages (Wilsey 2006). No mountain plovers were observed within the project area in 2006, 2007, or 2008.

3.4. West Nile Virus

West Nile virus (WNv) is a mosquito-borne disease that can cause encephalitis or brain infection. Mosquitoes spread this virus after they feed on infected birds and then bite people, other birds, and animals. WNv is not spread by person-to-person contact, and there is no evidence that people can get the virus by handling infected animals.

Since its discovery in 1999 in New York, WNv has become firmly established and spread across the United States. Birds are the natural vector host and serve not only to amplify the virus, but to spread it. Though less than 1% of mosquitoes are infected with WNv, they still are very effective in transmitting the virus to humans, horses, and wildlife. *Culex tarsalis* appears to be the most common mosquito to vector, WNv.

The human health issues related to WNv are well documented and continue to escalate. Historic data collected by the CDC and published by the USGS at www.westnilemaps.usgs.gov are summarized below.

Reported data from the Powder River Basin (PRB) includes Campbell, Sheridan and Johnson counties.

Table 3.4 Historical West Nile Virus Information

Year	Total WY Human Cases	Human Cases PRB	Veterinary Cases PRB	Bird Cases PRB
2001	0	0	0	0
2002	2	0	15	3
2003	392	85	46	25
2004	10	3	3	5
2005	12	4	6	3
2006	65	0	2	2
2007*	155	22	Unk	1

*Wyoming Department of Health Records September 12, 2007.

Human cases of WNv in Wyoming occur primarily in the late summer or early fall. There is some evidence that the incidence of WNv tapers off over several years after a peak following initial outbreak (Litzel and Mooney, personal conversations). If this is the case, occurrences in Wyoming are likely to increase over the next few years, followed by a gradual decline in the number of reported cases.

Although most of the attention has been focused on human health issues, WNv has had an impact on vertebrate wildlife populations. At a recent conference at the Smithsonian Environmental Research Center, scientists disclosed WNv had been detected in 157 bird species, horses, 16 other mammals, and alligators (Marra et al 2003). In the eastern US, avian populations have incurred very high mortality, particularly crows, jays and related species. Raptor species also appear to be highly susceptible to WNv. During 2003, 36 raptors were documented to have died from WNv in Wyoming including golden eagle, red-tailed hawk, ferruginous hawk, American kestrel, Cooper's hawk, northern goshawk, great-horned owl, prairie falcon, and Swainson's hawk (Cornish et al. 2003). Actual mortality is likely to be greater. Population impacts of WNv on raptors are unknown at present. The Wyoming State Vet Lab determined 22 sage-grouse in one study project (90% of the study birds), succumbed to WNv in the PRB in 2003. While birds infected with WNv have many of the same symptoms as infected humans, they appear to be more sensitive to the virus (Rinkes 2003).

Mosquitoes can potentially breed in any standing water that lasts more than four days. In the Powder River Basin, there is generally increased surface water availability associated with CBNG development. This increase in potential mosquito breeding habitat provides opportunities for mosquito populations to increase. Preliminary research conducted in the Powder River Basin indicates WNv mosquito vectors were notably more abundant on a developed CBNG site than two similar undeveloped sites (Walker et al. 2003). Reducing the population of mosquitoes, especially species that are apparently involved with bird-to-bird transmission of WNv, such as *Culex tarsalis*, can help to reduce or eliminate the presence of virus in a given geographical area (APHIS 2002). The most important step any property owner can take to control such mosquito populations is to remove all potential man-made sources of standing water in which mosquitoes might breed (APHIS 2002).

The most common pesticide treatment is to place larvicidal briquettes in small standing water pools along drainages or every 100 feet along the shoreline of reservoirs and ponds. It is generally accepted that it is not necessary to place the briquettes in the main water body because wave action prevents this environment from being optimum mosquito breeding habitat. Follow-up treatment of adult mosquitoes with malathion may be needed every 3 to 4 days to control adults following application of larvicide (Mooney, personal conversation). These treatment methods seem to be effective when focused on specific target areas, especially near communities, however they have not been applied over large areas

nor have they been used to treat a wide range of potential mosquito breeding habitat such as that associated with CBNG development.

The WDEQ and the Wyoming Department of Health sent a letter to CBNG operators on June 30, 2004. The letter encouraged people employed in occupations that require extended periods of outdoor labor, be provided educational material by their employers about WNv to reduce the risk of WNv transmission. The letter encouraged companies to contact either local Weed and Pest Districts or the Wyoming Department of Health for surface water treatment options.

3.5. Water Resources

The project is within the Upper Powder River drainage system. It straddles Crazy Woman Creek immediately upstream of its confluence with the Powder River.

3.5.1. Groundwater

Wyoming Department of Environmental Quality (WDEQ) water quality parameters for groundwater classifications (Chapter 8 – Quality Standards for Wyoming Groundwater) define the following limits for Total Dissolved Solids (TDS) and the classes of groundwater; 500 mg/l TDS for drinking water (Class I), 2000 mg/l for Agricultural Use (Class II)and 5000 mg/l for Livestock Use (Class III).

The PRB EIS Record of Decision includes a Monitoring, Mitigation and Reporting Plan (MMRP). The objective of the plan is to monitor those elements of the analysis where there was limited information available during the preparation of the EIS. The MMRP called for the use of adaptive management where changes could be made based on monitoring data collected during implementation. Specifically related to groundwater, the plan identified the following (PRB EIS ROD page E-4):

- The effects of infiltrating waters on the water quality of existing shallow groundwater aquifers were not well documented when the FEIS was approved
- Potential impacts will be highly variable depending upon local geologic and hydrologic conditions
- It may be necessary to conduct investigations at representative sites around the basin to quantify these impacts
- Provide site specific guidance on the placement and design of CBNG impoundments
- Shallow groundwater wells would be installed and monitored where necessary

As stated in the MMRP, an Interagency Working Group was established to implement an adaptive management approach. BLM is working with the WDEQ and the Interagency Working Group regarding the monitoring information being collected and assessed to determine if changes in mitigation are warranted.

The BLM installed shallow groundwater monitoring wells at five impoundment locations throughout the PRB to assess ground-water quality changes due to infiltration of CBNG produced water. The most intensively monitored site had a battery of nineteen wells which were installed and monitored jointly by the BLM and USGS starting in August of 2003. Water quality data has been sampled from these wells on a regular basis. That impoundment site, which has since been reclaimed, lies atop approximately 30 feet of unconsolidated deposits (silts and sands) which overlie non-uniform bedrock on a side ephemeral tributary to Beaver Creek and is approximately one and one-half miles from the Powder River. Baseline investigations showed water in two sand zones, the first was at a depth of 55 feet and the second was at a depth of 110 feet. The two water bearing zones were separated by a fifty-foot thick shale layer. The water quality of the two water bearing zones fell in the WDEQ Class III and Class I classifications respectively. Preliminary results from this sampling indicated increasing levels of TDS and other

inorganic constituents over a six month period resulting in changes from the initial WDEQ classifications.

The on-going shallow groundwater impoundment monitoring at four other impoundment locations are less intensive and consist of batteries of between 4 and 6 wells. Preliminary data from two of these other sites also are showing an increasing TDS level as water infiltrates while two other sites are not.

The WDEQ implemented requirements for monitoring shallow groundwater of Class III or better quality under unlined CBNG water impoundments effective August 1, 2004. The intent is to identify locations where the impoundment of water could potentially degrade any existing shallow groundwater aquifers. These investigations are conducted where discharged water will be detained in existing or proposed impoundments. If shallow groundwater is detected and the water quality is determined to fall within the Class III or better class of use (WDEQ Chapter 8 classifications for livestock use), operators are required to install batteries of 1 to 3 wells, develop a monitoring plan and monitor water levels and quality. The results of these investigations have yet to be analyzed and interpreted.

A search of the Wyoming State Engineer Office (WSEO) Ground Water Rights Database for this area showed 9 registered stock and domestic water wells within 1 mile of this proposed CBNG development producing with depths ranging from 200 to 1060 feet below ground level. For additional information on water, please refer to the PRB FEIS (January 2003), Chapter 3, Affected Environment pages 3-1 through 3-36 (groundwater).

3.5.2. Surface Water

The project area is within the Crazy Woman Creek and Upper Powder River watersheds. (The Crazy Woman Creek watershed is a tributary to and part of the Powder River watershed.) The bulk of the projected development lies in the lower reaches of Crazy Woman Creek immediately upstream of its confluence with the Powder River. One well lies within Coal Draw which is a direct tributary to the Powder River. Another well along with Heatstroke and Fort's View dams are on an unnamed tributary to the Powder River. The remainder of the development is proposed on various tributaries to Crazy Woman Creek. The floodplains of Crazy Woman Creek and the Powder River have been traditionally used as irrigated hay or pasture lands, using passive (spreader dikes, natural out-of-channel flows, etc) or active (flood or sprinkled with sideroll or center pivot systems) irrigation methods. The floodplain at Crazy Woman Creek's mouth is no exception.

Stockwater dams are common throughout ephemeral drainage systems in the arid Powder River Basin. In this area, there are a number of old stock dams as well as a number of new dams constructed to contain a combination of runoff and CBNG product water.

All of the drainages in the area are ephemeral (flowing only in response to a precipitation event or snow melt) except for Crazy Woman Creek and the Powder River, which are perennial (have flowing water year around – PRB FEIS Chapter 9 Glossary). The channels grade from steep, rapidly eroding gully systems to wide, broad-bottomed floodplain/delta features as they join either Crazy Woman Creek or the Powder River floodplain.

The PRB FEIS presents the historic mean Electrical Conductivity (EC, in μmhos/cm) and Sodium Adsorption Ratio (SAR) by watershed at selected United States Geological Survey (USGS) Gaging Stations in Table 3-11 (PRB FEIS page 3-49). These water quality parameters "…illustrate the variability in ambient EC and SAR in streams within the Project Area. The representative stream water quality is used in the impact analysis presented in Chapter 4 as the baseline for evaluating potential impacts to water quality and existing uses from future discharges of CBM produced water of varying chemical composition to surface drainages within the Project Area" (PRB FEIS page 3-48). For the Upper Powder River watershed, the EC ranges from 1797μmhos/cm at Maximum monthly flow to 3400 μmhos/cm at

Low monthly flow and the SAR ranges from 4.76 at Maximum monthly flow to 7.83 at Low monthly flow. These values were determined at the USGS station located on the Powder River at Arvada (PRB FEIS page 3-49).

For more information regarding surface water, please refer to the PRB FEIS Chapter 3 Affected Environment pages 3-36 through 3-56.

3.6. Cultural Resources

Class III cultural resource inventories were conducted for the Knudson 9 Extension POD project, following the Secretary of the Interior's Guidelines and Standards. A Class III inventory specifically for the project was conducted by Foothills Archaeological Consulting (BLM project no. 70080089). The inventory covered approximately 140 acres; no new sites or isolates were recorded as part of this inventory. Sites and isolates are defined as specified by the 2006 State Protocol Between the Wyoming Bureau of Land Management State Director and the Wyoming State Historic Preservation Officer. One additional Class III inventory within the project area was consulted during the review of the proposed action, BLM project no. 70040150. No cultural resources are located in or near the APE (area of potential effect).

3.7. Air Quality

Existing air quality throughout most of the Powder River Basin is in attainment with all ambient air quality standards. Although specific air quality monitoring is not conducted throughout most of the Powder River Basin, air quality conditions in rural areas are likely to be very good, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches) and good atmospheric dispersion conditions, resulting in relatively low air pollutant concentrations.

Existing air pollutant emission sources within the region include following:

- Exhaust emissions (primarily CO and nitrogen oxides [NOx]) from existing natural gas fired compressor engines used in production of natural gas and CBNG; and, gasoline and diesel vehicle tailpipe emissions of combustion pollutants;
- Dust (particulate matter) generated by vehicle travel on unpaved roads, windblown dust from neighboring areas and road sanding during the winter months;
- Transport of air pollutants from emission sources located outside the region;
- Dust (particulate matter) from coal mines;
- NOx, particulate matter, and other emissions from diesel trains and,
- SO2 and NOx from power plants.

For a complete description of the existing air quality conditions in the Powder River Basin, please refer to the PRB Final EIS Volume 1, Chapter 3, pages 3-291 through 3-299.

4. ENVIRONMENTAL CONSEQUENCES

The changes to the proposed action (Alternative B) resulted in development of Alternative C as the preferred alternative. The changes have reduced impacts to the environment which will result from this action. The environmental consequences of Alternative C are described below.

4.1. Vegetation & Soils Direct and Indirect Effects

Impacts to vegetation and soils from surface disturbance will be reduced, by following the operator's plans and BLM applied mitigation. Of the 10 proposed well locations, 4 can be drilled without a well pad being constructed and 6 will require a constructed (cut & fill) well pad. Surface disturbance associated

with the drilling of the 4 wells without constructed pads would involve digging-out of rig wheel wells (for leveling drill rig on minor slopes), reserve pit construction (2 pits, estimated approximate size of 15' x 15' each), and compaction (from vehicles driving/parking at the drill site). Estimated disturbance associated with these wells would involve approximately 0.1 acre/well for 0.4 total acres. The other 6 wells requiring cut & fill pad construction vary in size somewhat, but pad size average is approximately 100' x 150'. Disturbance associate with these wells will be approximately 0.35 acres/well pad for a total of 2.1 acres. The total estimated disturbance for all wells would be 2.5 acres.

Approximately 9666' of improved roads would be constructed to provide access to various well locations. Approximately 5289' of new two-track trails would be utilized to access well sites. The majority of proposed pipelines (gas and water) have been located in "disturbance corridors." Disturbance corridors involve the combining of 2 or more utility lines (water, gas, power) in a common trench, usually along access routes. This practice results in less surface disturbance and overall environmental impacts. Approximately 1551' of pipeline would be constructed outside of corridors. Expedient reclamation of disturbed land with stockpiled topsoil, proper seedbed preparation techniques, and appropriate seed mixes, along with utilization of erosion control measures (e.g., waterbars, water wings, culverts, rip-rap, gabions etc.) would ensure land productivity/stability is regained and maximized.

Proposed stream crossings, including culverts and fords (low water crossings) are shown on the MSUP and the WMP maps (see the POD). These structures would be constructed in accordance with sound, engineering practices and BLM standards.

The PRB FEIS made predictions regarding the potential impact of produced water to the various soil types found throughout the Basin, in addition to physical disturbance effects. "Government soil experts state that SAR values of 13 or more cause potentially irreversible changes to soil structure, especially in clayey soil types, that reduce permeability for infiltration of rainfall and surface water flows, restrict root growth, limit permeability of gases and moisture, and make tillage difficult." (PRB FEIS page 4-144).

Table 4.1 summarizes the proposed surface disturbance.

Table 4.1 - SUMMARY OF DISTURBANCE

Facility	Number or Miles	Factor	Acreage of Disturbance	Duration of Disturbance
Nonconstructed Pad	4	0.1/acre	0.4	Long Term
Constructed Pad	6	0.35/acre	2.1	
Gather/Metering Facilities		Site Specific		Long Term
Screw Compressors		Site Specific		Long Term
Monitor Wells	0	0.1/acre		Long Term
Impoundments				Long Term
On-channel	0	Site Specific	0.0	
Off-channel	0	Site Specific	0.0	
Water Discharge Points	0	Site Specific or 0.01 ac/WDP	0.0	
Channel Disturbance				
Headcut Mitigation*	0	Site Specific	0.0	
Channel Modification	0	Site Specific	0.0	

Facility	Number or Miles	Factor	Acreage of Disturbance	Duration of Disturbance
Improved Roads				Long Term
No Corridor	0			
With Corridor	9666’	40’ Width	8.8	
2-Track Roads				Long Term
No Corridor	0			
With Corridor	5289’	28’ Width	3.4	
Pipelines				Short Term
No Corridor	1551’	25’ Width	0.9	
With Corridor	0’			
Buried Power Cable No Corridor	0	12’ Width or Site Specific		Short Term
Overhead Powerlines	0.0	15’ Width		Long Term
Additional Disturbance Staging Areas	3	50’ x 100’	0.34	

The designation of the duration of disturbance is defined in the PRB FEIS (pg 4-1 and 4-151). “For this EIS, short-term effects are defined as occurring during the construction and drilling/completion phases. Long-term effects are caused by construction and operations that would remain longer”.

4.1.1. Wetland/Riparian/Floodplains

The PRB FEIS assumes that 15% of the impounded water will re-surface as channel flow (PRB FEIS pg 4-74). Re-surfacing water from the impoundments will potentially allow for wetland-riparian species establishment. “Continuous high stream flows into wetlands and riparian areas would change the composition of species and dynamics of the food web. The shallow groundwater table would rise closer to the surface with increased and continuous stream flows augmented by produced water discharges. Vegetation in riparian areas, such as cottonwood trees, that cannot tolerate year-round inundated root zones would die and would not be replaced. Other plant species in riparian areas and wetland edges that favor inundated root zones would flourish, thus changing the plant community composition and the associated animal species. A rise in the shallow ground groundwater table would also influence the hydrology of wetlands by reducing or eliminating the seasonal drying periods that affect recruitment of plant species and species composition of benthic and water column invertebrates. These changes to the aquatic food web base would affect the higher trophic levels of fish and waterfowl abundance and species richness for wetlands and riparian areas.” (PRB FEIS Page 4-175).

The PRB FEIS identified effects to gallery forests of mature cottonwood trees stating that “(they) may be lost by bank undercutting caused by the increased surface water flows in channels.” Included in the ROD is programmatic mitigation “which may be appropriate to apply at the time of APD approval if site specific conditions warrant.”(ROD page A-30). One of the conditions included in that section addresses the impact to trees in A.5.8-2: “To reduce adverse effects on existing wetlands and riparian areas, water discharge should not be allowed if increased discharge volumes or subsequent recharge of shallow aquifers will inundate and kill woody species, such as willows or cottonwoods.”(ROD Page A-32).

4.1.2. Invasive Species

No noxious weeds were found during the investigations performed during the POD planning process, but the operator has committed to the control of noxious weeds and species of concern. Pennaco will use the

following measures, as described in the Integrated Pest Management Plan (IPMP) included in the proposal:

1. Control Methods: In disturbed areas, disking, mowing, or the application of biological control agents will be used as necessary, based on the type and extent of the infestation.
2. Preventive practices: Certified weed-free mulches, road surfacing, and other earthen materials will be used. Vehicles will be washed prior to mobilization into new activity areas. Disturbed areas will be re-seeded as soon as possible with certified weed-free seed.
3. Education: In collaboration with Campbell County Weed and Pest, Pennaco will ensure that its contractors and other field personnel can identify noxious weeds. Education efforts will also include creating an awareness of the impacts that noxious weeds have on the environment.

Cheatgrass or downy brome (*Bromus tectorum*) and to a lesser extent, Japanese brome (*B. japonicus*) are known to exist in the affected environment. These two species are found in such high densities and numerous locations throughout NE Wyoming that a control program is not considered feasible at this time.

The use of existing facilities along with the surface disturbance associated with construction of proposed access roads, pipelines, water management infrastructure, produced water discharge points and related facilities would present opportunities for weed invasion and spread. Produced CBNG water would likely continue to modify existing soil moisture and soil chemistry regimes in the areas of water release and storage. The activities related to the performance of the proposed project would create a favorable environment for the establishment and spread of noxious weeds/invasive plants such as salt cedar, Canada thistle and perennial pepperweed. However, mitigation as required by BLM applied COAs will reduce potential impacts from noxious weeds and invasive plants.

4.1.3. Cumulative Effects

The PRB FEIS stated that cumulative impacts to soils could occur due to sedimentation from water erosion that could change water quality and fluvial characteristics of streams and rivers in the sub-watersheds of the Project Area. SAR in water in the sub-watersheds could be altered by saline soils because disturbed soils with a conductivity of 16 mmhos/cm could release as much as 0.8 tons/acre/year of sodium (BLM 1999c). Soils in floodplains and streambeds may also be affected by produced water high in SAR and TDS. (PRB FEIS page 4-151).

As referenced above, the PRB FEIS did disclose that cumulative impacts may occur to soils and vegetation as a result of discharged produced CBNG water. The cumulative effects on vegetation and soils are within the analysis parameters and impacts described in the PRB FEIS for the following reasons:

- They are proportional to the actual amount of cumulatively produced water in the Upper Powder River drainage and the total amount that was predicted in the PRB FEIS, which is approximately 19% of that total (see section 4.4.2.1). Water produced to date in the Crazy Woman Creek watershed is only 0.9% of the total predicted.
- The WDEQ enforcement of the terms and conditions of the WYPDES permit that are designed to protect irrigation downstream.
- The WMP for the Knudson 9 Extension proposes that produced water will not contribute significantly to flows downstream.
- The commitment by the operator to monitor the volume of water flowing into Crazy Woman Creek and the Powder River and prevent significant volumes of water from flowing into the Upper Powder River Watershed.

Additional mitigation measures may become necessary as this and other PODs are developed in the Crazy

Woman Creek Watershed.

4.2. Wildlife

4.2.1. Big Game Direct and Indirect Effects

Under the environmentally preferred alternative, Yearlong range for pronghorn antelope and white-tailed deer and Winter-Yearlong range for mule deer would be directly disturbed with the construction of wells, reservoirs, pipelines and roads. Table 4.1 summarized the proposed activities; items identified as long term disturbance would be direct habitat loss. Short-term disturbances also result in direct habitat loss; however, they should provide some habitat value as these areas are reclaimed and native vegetation becomes established.

In addition to the direct habitat loss, big game would likely be displaced from the project area during drilling and construction. A study in central Wyoming reported that mineral drilling activities displaced mule deer by more than 0.5 miles (Hiatt and Baker 1981). The WGFD indicates a well density of eight wells per section creates a high level of impact for big game and that avoidance zones around mineral facilities overlap creating contiguous avoidance areas (WGFD 2004). A multi-year study on the Pinedale Anticline suggests not only do mule deer avoid mineral activities, but after three years of drilling activity the deer have not become accustomed to the disturbance (Madson 2005).

Big game animals are expected to return to the project area following construction; however, populations will likely be lower than prior to project implementation as the human activities associated with operation and maintenance continue to displace big game. Mule deer are more sensitive to operation and maintenance activities than pronghorn, and, as the Pinedale Anticline study suggests, mule deer do not readily habituate. A study in North Dakota stated "Although the population (mule deer) had over seven years to habituate to oil and gas activities, avoidance of roads and facilities was determined to be long term and chronic" (Lustig 2003). Deer have even been documented to avoid dirt roads that were used only by 4-wheel drive vehicles, trail bikes, and hikers (Jalkotzy et al. 1997).

Winter big game diets are sub-maintenance, meaning they lose weight and body condition as the winter progresses. Survival below the maintenance level requires behavior that emphasizes energy conservation. Canfield et al. (1999) pointed out that forced activity caused by human disturbance exacts an energetic disadvantage, while inactivity provides an energetic advantage for animals. Geist (1978) further defined effects of human disturbance in terms of increased metabolism, which could result in illness, decreased reproduction, and even death.

Reclamation and other CBNG activities that occur within big game habitats during the spring will likely displace does and fawns due to the human presence in the area. This may cause reduced survival rate of does and fawns that must expend increased energies to avoid such activities.

4.2.1.1. Big Game Cumulative effects

The cumulative effects associated with Alternative C are within the analysis parameters and impacts described in the PRB FEIS. For details on expected cumulative impacts, please refer to the referenced PRB FEIS, Volume 2, Chapter 4, page 4-211.

4.2.2. Aquatics Direct and Indirect Effects

Produced water is to be discharged to seven existing impoundments within the project area. If a reservoir were to discharge, it is likely that the produced water will reach a fish-bearing stream, but unlikely that downstream species would be affected as this small amount of water would have little effect on either Crazy Woman Creek or the Powder River.

4.2.2.1. Aquatics Cumulative effects

The cumulative effects associated with Alternative C are within the analysis parameters and impacts described in the PRB FEIS. For details on expected cumulative impacts, please refer to the referenced PRB FEIS, Volume 2, Chapter 4, page 4-247. No additional mitigation measures are required.

4.2.3. Migratory Birds Direct and Indirect Effects

Disturbance of the habitat types within the project area is likely to impact migratory birds. Native habitats are being lost directly with the construction of wells, roads, and pipelines. Prompt re-vegetation of short-term disturbance areas should reduce habitat loss impacts. Human activities likely displace migratory birds farther than simply the physical habitat disturbance. Drilling and construction noise can be troublesome for songbirds by interfering with the males' ability to attract mates and defend territory, and the ability to recognize calls from conspecifics (BLM 2003).

Habitat fragmentation results in more than just a quantitative loss in the total area of habitat available; the remaining habitat area is also qualitatively altered (Temple and Wilcox 1986). Ingelfinger (2004) identified that the density of breeding Brewer's sparrows declined by 36% and breeding sage sparrows declined by 57% within 100 m of dirt roads within a natural gas field. Effects occurred along roads with light traffic volume (<12 vehicles per day). The increasing density of roads constructed in developing natural gas fields exacerbated the problem creating substantial areas of impact where indirect habitat losses (displacement) were much greater than the direct physical habitat losses.

Reclamation and other CBNG activities that occur in the spring may be detrimental to migratory bird survival. Those species that are edge-sensitive will be displaced further away from vegetative edges due to increased human activity, causing otherwise suitable habitat to be abandoned. If the interior habitat is at carrying capacity, then birds displaced from the edges will have no place to relocate. One consequences of habitat fragmentation is a geometric increase in the proportion of the remaining habitat that is near edges (Temple 1986). In severely fragmented habitats, all of the remaining habitat may be so close to edges that no interior habitat remains (Temple and Cary 1988). Over time, this will lead to a loss of interior habitat species in favor of edge habitat species. Other migratory bird species that utilize the disturbed areas for nesting may be disrupted by the human activity and nests may be destroyed by equipment.

Overhead power lines may affect migratory birds in several ways. Power poles provide raptors with perch sites and may increase predation on migratory birds. Power lines placed in flight corridors may result in collision mortalities. Some species may avoid suitable habitat near power lines in an effort to avoid predation.

Migratory bird species within the Powder River Basin nest in the spring and early summer and are vulnerable to the same affects as sage-grouse and raptor species. Though no timing restrictions are typically applied specifically to protect migratory bird breeding or nesting, where sage-grouse or raptor nesting timing limitations are applied, nesting migratory birds are also protected. Where these timing limitations are not applied and migratory bird species are nesting, migratory birds remain vulnerable. Additional direct and indirect effects to migratory birds are discussed in the PRB FEIS (4-231-235).

4.2.3.1. Migratory Birds Cumulative effects

The cumulative effects associated with Alternative C are within the analysis parameters and impacts described in the PRB FEIS. For details on expected cumulative impacts, please refer to the referenced PRB FEIS, Volume 2, Chapter 4, Page 4-235. No additional mitigation measures are required.

4.2.4. Raptors Direct and Indirect Effects

Human activities in close proximity to active raptor nests may interfere with nest productivity. Romin

and Muck (1999) indicate that activities within 0.5 miles of a nest are prone to cause adverse impacts to nesting raptors. If mineral activities occur during nesting, they could be sufficient to cause adult birds to remain away from the nest and their chicks for the duration of the activities. This absence can lead to overheating or chilling of eggs or chicks. Prolonged disturbance can also lead to the abandonment of the nest by the adults. Both actions can result in egg or chick mortality. In addition, routine human activities near these nests can draw increased predator activity to the area and increase nest predation.

The presence of overhead power lines may impact foraging raptors. Raptors forage opportunistically throughout the Powder River Basin. Power poles provide attractive perch sites in areas where mature trees and other natural perches are lacking. From May 2003, through December 28, 2006, Service Law Enforcement salvage records for northeast Wyoming identified that 156 raptors, including 1 bald eagle, 93 golden eagles, 1 unidentified eagle, 27 hawks, 30 owls and 4 unidentified raptors were electrocuted on power poles within the Powder River Basin Oil and Gas Project area (USFWS 2006a). Of the 156 raptors electrocuted 31 were at power poles that are considered new construction (post 1996 construction standards). Additionally, two golden eagles and a Cooper's hawk were killed in apparent mid span collisions with powerlines (USFWS 2006a). Power lines not constructed to APLIC suggestions pose an electrocution hazard for eagles and other raptors perching on them; the Service has developed additional specifications improving upon the APLIC suggestions. Constructing power lines to the APLIC suggestions and Service standards minimizes but does not eliminate electrocution risk.

To reduce the risk of decreased productivity or nest failure, the BLM BFO requires a one-half mile radius timing limitation during the breeding season around active raptor nests and recommends all infrastructure requiring human visitation to be located greater than one-quarter mile from occupied raptor nests. No attempts were made at the onsite visit to move any infrastructure to reduce impacts to raptor nests.

The EK Ranch Fed 10-18-52-77AW well is located approximately 0.21 mile from 3 nests (6263- red-tailed hawk, 4309 – unknown species, 4310 – unknown species). No suitable alternative location was available that would remove this well from line of-sight of these three nests. The combination of existing and proposed infrastructure surrounding these nests may disturb the nesting pairs, possibly causing nest abandonment. The remaining nesting pairs in the table above will likely be impacted by the additional infrastructure as foraging habitat will be impacted.

Table 5. Infrastructure within close proximity (0.5 mile) to documented raptor nests within the Knudson 9 project area.

BLM ID#	**AMOUNT AND TYPE OF INFRASTRUCTURE**	
	Within 0.25 mile	*Within 0.25 to 0.5 mile*
4309	1 well (EK Ranch Fed 10-18-52-77 AW), 2 access / pipeline corridors	3 wells (EK Ranch Fed: 2-18-52-77AW, 8-18-52-77AW, 14-18-52-77AWP), 4 access pipeline corridors
4310	1 well (EK Ranch Fed 10-18-52-77 AW), 2 access / pipeline corridors	3 wells (EK Ranch Fed: 2-18-52-77AW, 8-18-52-77AW, 14-18-52-77AWP), 4 access pipeline corridors
6263	1 well (EK Ranch Fed 10-18-52-77 AW), 2 access / pipeline corridors	3 wells (EK Ranch Fed: 2-18-52-77AW, 8-18-52-77AW, 14-18-52-77AWP), 4 access pipeline corridors
5605		1 well (EK Ranch Fed 2-18-52-77AW), 2 access / pipeline corridors
4308		1 well (GGM Fed 4-17-52-77AWP), 1 access / pipeline corridor

BLM ID#	AMOUNT AND TYPE OF INFRASTRUCTURE	
	Within 0.25 mile	*Within 0.25 to 0.5 mile*
5606		2 wells (GGM Fed: 4-17-52-77AWP, 6-17-52-77AWP), 1 access / pipeline corridor

Additional direct and indirect impacts to raptors, from oil and gas development, are analyzed in the PRB FEIS (4-216-221).

4.2.4.1. Raptors Cumulative effects

The cumulative effects associated with Alternative C are within the analysis parameters and impacts described in the PRB FEIS. For details on expected cumulative impacts, please refer to the referenced PRB FEIS, Volume 2, Chapter 4, page 4-221.

4.2.5. Threatened and Endangered and Sensitive Species

Potential project effects on Threatened and Endangered Species were analyzed and a summary is provided in Table 4.2.5.1. Threatened and Endangered Species potentially affected by the proposed project area are further discussed following the table.

4.2.5.1. Threatened and Endangered Species

Table 4.2 Summary of Threatened and Endangered Species Habitat and Project Effects.

Common Name (scientific name)	Habitat	Presence	Project Effects	Rationale
Endangered				
Black-footed ferret (*Mustela nigripes*)	Black-tailed prairie dog colonies or complexes > 1,000 acres.	NS	NLAA	Suitable habitat will be affected.
Threatened				
Ute ladies'-tresses orchid (*Spiranthes diluvialis*)	Riparian areas with permanent water	NP	NE	No suitable habitat present.

Presence
K Known, documented observation within project area.
S Habitat suitable and species suspected, to occur within the project area.
NS Habitat suitable but species is not suspected to occur within the project area.
NP Habitat not present and species unlikely to occur within the project area.

Project Effects
LAA Likely to adversely affect
NE No Effect.
NLAA May Affect, not likely to adversely effect individuals or habitat.

4.2.5.1.1. Black-Footed Ferret Direct and Indirect Effects

Suitable habitat is of sufficient size to support a black-footed ferret population and the project area is adjacent to the Arvada complex. No surveys for ferrets were required or conducted. It is extremely unlikely that any black-footed ferret is present in the project area. However, if any become present, the proposed action will most likely make portions of the project area unsuitable for ferret inhabitance. Implementation of the proposed development ***"may affect, but is not likely to adversely affect"*** the black-footed ferret.

4.2.5.1.2. Ute Ladies'-Tresses Orchid Direct and Indirect Effects

Suitable habitat is present within the Knudson 9 project area. No project activities are proposed within suitable habitat. Implementation of the proposed coal bed natural gas project will have '***no effect***" on the Ute ladies'- tresses orchid.

4.2.5.2. Sensitive Species Direct and Indirect Effects

BLM will take necessary actions to meet the policies set forth in sensitive species policy (BLM Manual 6840). BLM Manual 6840.22Astates: "The BLM should obtain and use the best available information deemed necessary to evaluate the status of special status species in areas affected by land use plans or other proposed actions and to develop sound conservation practices. Implementation-level planning should consider all site-specific methods and procedures which are needed to bring the species and their habitats to the condition under which the provisions of the ESA are not necessary, current listings under special status species categories are no longer necessary, and future listings under special status species categories would not be necessary."

4.2.5.2.1. Prairie dog colony obligates

Wells, roads, pipelines and other infrastructure associated with energy development constructed within prairie dog colonies will directly remove habitat for prairie dog colony obligate species. Activities that disturb these species could lead to temporary or even long-term or permanent abandonment. Direct loss of species may also occur from vehicle traffic. Continued loss of prairie dog habitat and active prairie dog towns will result in the decline of numerous sensitive species in the short grass prairie ecosystem.

4.2.5.2.2. Sagebrush obligates

Shrubland and grassland birds are declining faster than any other group of species in North America (Knick et al. 2003). In Wyoming, existing oil and gas wells are located primarily in landscapes dominated by sagebrush, causing direct loss of this habitat. Associated road networks, pipelines, and powerline transmission corridors also influence vegetation dynamics by fragmenting habitats or by creating soil conditions facilitating the spread of invasive species (Braun 1998, Gelbard and Belnap 2003). Density of sagebrush-obligate birds within 100 m of roads constructed for natural gas development in Wyoming was 50% lower than at greater distances (Ingelfinger 2001). Increased numbers of corvids and raptors associated with powerlines (Steenhof et al. 1993, Knight and Kawashima 1993, Vander Haegen et al. 2002) increases the potential predation impact on sage-grouse and other sagebrush-breeding birds (Knick et al. 2003)

Fragmentation of shrubsteppe habitat is a major disruption that has consequences for sagebrush-obligate species (Braun et al. 1976; Rotenberry & Wiens 1980a). In fragmented habitats, suitable habitat area remains only as a remnants surrounded by unusable environments (Urban and Shugart 1984; Fahrig & Paloheimo 1988). Populations of sagebrush-obligate species decline because areas of suitable habitat decrease (Temple & Cary 1988), because of lower reproduction, and/or because of higher mortality in remaining habitats (Robinson 1992; Porneluzi et al. 1993). Fragmentation of shrubsteppe has the further potential to affect the conservation of shrub-obligate species because of the permanence of disturbance (Knick and Rotenberry 1995). Several decades are required to reestablish ecologically functioning mature sagebrush communities. Due to this, sagebrush obligate species may not return until after habitat reestablishment.

Table 4.3 Summary of Sensitive Species Habitat and Project Effects.

Common Name (scientific name)	Habitat	Presence	Project Effects	Rationale
Amphibians				
Northern leopard frog (*Rana pipiens*)	Beaver ponds, permanent water in plains and foothills	S	MIIH	Additional water will affect existing waterways.
Spotted frog (*Ranus pretiosa*)	Ponds, sloughs, small streams	NP	NI	Prairie not mountain habitat.
Birds				
Baird's sparrow (*Ammodramus bairdii*)	Grasslands, weedy fields	S	MIIH	Sagebrush cover will be affected.
Bald eagle (*Haliaeetus leucocephalus*)	Mature forest cover often within one mile of large water body.	K	MIIH	Occupied habitat will be impacted.
Brewer's sparrow (*Spizella breweri*)	Basin-prairie shrub	S	MIIH	Sagebrush cover will be affected.
Burrowing owl (*Athene cunicularia*)	Grasslands, basin-prairie shrub	K	MIIH	Prairie dog colony present.
Ferruginous hawk (*Buteo regalis*)	Basin-prairie shrub, grasslands, rock outcrops	K	MIIH	Basin-prairie shrub will be affected.
Greater sage-grouse (*Centrocercus urophasianus*)	Basin-prairie shrub, mountain-foothill shrub	K	WIPV	Sagebrush cover will be affected.
Loggerhead shrike (*Lanius ludovicianus*)	Basin-prairie shrub, mountain-foothill shrub	K	MIIH	Sagebrush cover will be affected.
Long-billed curlew (*Numenius americanus*)	Grasslands, plains, foothills, wet meadows	NP	NI	Habitat not present.
Mountain plover (*Charadrius montanus*)	Short-grass prairie with slopes < 5%	NP	NI	Habitat not will not be impacted.
Northern goshawk (*Accipiter gentilis*)	Conifer and deciduous forests	NP	NI	No forest habitat present.
Peregrine falcon (*Falco peregrinus*)	cliffs	NP	NI	No nesting habitat present.

Common Name (scientific name)	Habitat	Presence	Project Effects	Rationale
Sage sparrow (*Amphispiza billneata*)	Basin-prairie shrub, mountain-foothill shrub	NS	MIIH	No known records within the project area.
Sage thrasher (*Oreoscoptes montanus*)	Basin-prairie shrub, mountain-foothill shrub	S	MIIH	Sagebrush cover will be affected.
Trumpeter swan (*Cygnus buccinator*)	Lakes, ponds, rivers	S	MIIH	Reservoirs may provide migratory habitat.
White-faced ibis (*Plegadis chihi*)	Marshes, wet meadows	NP	NI	Permanently wet meadows not present.
Yellow-billed cuckoo (*Coccyzus americanus*)	Open woodlands, streamside willow and alder groves	NP	NI	Streamside habitats not present
Fish				
Yellowstone cutthroat trout (*Oncoryhynchus clarki bouvieri*)	Mountain streams and rivers in Tongue River drainage	NP	NI	Outside species range.
Mammals				
Black-tailed prairie dog (*Cynomys ludovicianus*)	Prairie habitats with deep, firm soils and slopes less than 10 degrees.	K	MIIH	Prairie dog towns will be affected.
Fringed myotis (*Myotis thysanodes*)	Conifer forests, woodland chaparral, caves and mines	NP	NI	Habitat not present.
Long-eared myotis (*Myotis evotis*)	Conifer and deciduous forest, caves and mines	NP	NI	Habitat not present.
Spotted bat (*Euderma maculatum*)	Cliffs over perennial water.	NP	NI	Cliffs & perennial water not present.
Swift fox (*Vulpes velox*)	Grasslands	NP	NI	Habitat not present.
Townsend's big-eared bat (*Corynorhinus townsendii*)	Caves and mines.	NP	NI	Habitat not present.

Common Name (scientific name)	Habitat	Presence	Project Effects	Rationale
Plants				
Porter's sagebrush (*Artemisia porteri*)	Sparsely vegetated badlands of ashy or tufaceous mudstone and clay slopes 5300-6500 ft.	NP	NI	Habitat not present.
William's wafer parsnip (*Cymopterus williamsii*)	Open ridgetops and upper slopes with exposed limestone outcrops or rockslides, 6000-8300 ft.	NP	NI	Habitat not present.

Presence
K Known, documented observation within project area.
S Habitat suitable and species suspected, to occur within the project area.
NS Habitat suitable but species is not suspected to occur within the project area.
NP Habitat not present and species unlikely to occur within the project area.

Project Effects
NI No Impact.
MIIH May Impact Individuals or Habitat, but will not likely contribute to a trend towards Federal listing or a loss of viability to the population or species.
WIPV Will Impact Individuals or Habitat with a consequence that the action may contribute to a trend towards Federal listing or cause a loss of viability to the population or species.
BI Beneficial Impact

4.2.5.2.1. Bald eagle Direct and Indirect Effects

The entire project area is proposed within 1 mile of occupied bald eagle habitat. To reduce the risk of decreased productivity or nest failure, BLM BFO requires a 0.5 mile no surface occupancy radius and a one mile radius timing limitation of all activity during the breeding season around active bald eagle nests. To reduce the risk of disruption to the winter roosting activities of bald eagles, the BLM BFO requires a 0.5 mile no surface occupancy radius and a one mile radius timing limitation of all winter roosts (either communal or consistent use). Due to the amount and frequency of bald eagle roosting along Crazy Woman Creek and the Powder River, the BLM and representatives from Pennaco agreed that exceptions for construction during the bald eagle winter roosting season will not be requested.

There are 9 miles of existing overhead three-phase distribution lines within the project area. The wire spacing is likely in compliance with the Avian Power Line Interaction Committee's (1996) suggested practices and with the Service's standards (USFWS 2002); however other features may not be in compliance. Pennaco is not proposing any additional overhead three-phase distribution lines. Pennaco contracted PRECorp to install overhead powerlines to the fee development throughout the project area. One section of overhead powerline (approximately 5 poles) was installed to the proposed GGM Fed 12-17-52-77AWP well. This well was not recommended for approval due to concerns for sage-grouse habitat. The BLM recommended that this section of powerline be removed. Pennaco agreed to remove this unauthorized powerline segment. There are currently no improved roads within the project area, with 1.8 miles proposed.

The presence of overhead power lines may impact foraging bald eagles. Bald eagles forage opportunistically throughout the Powder River Basin particularly during the winter when migrant eagles join the small number of resident eagles. Power poles provide attractive perch sites in areas where mature trees and other natural perches are lacking. From May 2003, through December 28, 2006, Service Law Enforcement salvage records for northeast Wyoming identified that 156 raptors, including 1 bald eagle, 93 golden eagles, 1 unidentified eagle, 27 hawks, 30 owls and 4 unidentified raptors were electrocuted on power poles within the Powder River Basin Oil and Gas Project area (USFWS 2006a). Of the 156 raptors electrocuted 31 were at power poles that are considered new construction (post 1996 construction standards). Additionally, two golden eagles and a Cooper's hawk were killed in apparent mid span collisions with powerlines (USFWS 2006a). Power lines not constructed to APLIC suggestions pose an electrocution hazard for eagles and other raptors perching on them; the Service has developed additional specifications improving upon the APLIC suggestions. Constructing power lines to the APLIC suggestions and Service standards minimizes but does not eliminate electrocution risk.

Typically two-tracks and improved project roads pose minimal collision risk. In one year of monitoring road-side carcasses the BLM Buffalo Field Office reported 439 carcasses, 226 along Interstates (51%), 193 along paved highways (44%), 19 along gravel county roads (4%), and 1 along an improved CBNG road (<1%) (Bills 2004). No road-killed eagles were reported; eagles (bald and golden) were observed feeding on 16 of the reported road-side carcasses (<4%). The risk of big-game vehicle-related mortality along CBNG project roads is so insignificant or discountable that when combined with the lack of bald eagle mortalities associated with highway foraging leads to the conclusion that CBNG project roads do not affect bald eagles.

4.2.5.2.2. Black-tailed prairie dog Direct and Indirect Effects

The EK Ranch Fed 16-18-52-77AW well and the access / pipeline corridor to it are proposed along the edge of the small prairie dog colony in SE Section 18.

Individuals that survive the excavation process but whose burrows were destroyed will be displaced. As the prairie dog town grows in size, prairie dogs move from an area of high population density to an area of low population density. Male prairie dogs resort to either long-distance dispersal to new colonies

(mostly as yearlings, rarely as adults) or short distance within the home colony. Female prairie dogs disperse over long distances to other colonies (as either yearlings or adults). Short-distance dispersal of females within the home colony almost never occurs (Hoogland 1995). Dispersal of prairie dogs occurs as single individuals. Both male and female prairie dogs prefer to move into an existing colony or one that has been abandoned rather than start a completely new colony. Coterie (small family group within the colony) members resist attempted invasions by conspecifics including immigrants. Dispersing prairie dogs have increased stress levels, higher exposure to predators, and are unlikely to be accepted by other colonies if they even encounter one. Both males and females actively protect their coterie territories from invading males and females (Hoogland 1995).

Well houses and power poles may provide habitats for mammal and avian predators increasing prairie dog predation. Mineral related traffic on the adjacent roads may result in prairie dog road mortalities. During construction of these facilities, there is the possibility that prairie dogs within these colonies may be killed as a direct result of the earth moving equipment. Constant noise and movement of equipment and the destruction of burrows puts considerable stress on the animals and will cause an increase in prairie dog mortalities. During the construction of these facilities individuals are exposed more frequently to predators and have less protective cover.

4.2.5.2.3. Burrowing owl Direct and Indirect Effects

See Black-tailed prairie dog Direct and Indirect Effects for impacts to burrowing owl habitat within the project area. The previously recorded burrowing owl nest is located within a prairie dog colony that will not be impacted by the project.

The dramatic reduction of prairie habitat in the United States has been linked to reduction of burrowing owl populations (Klute et al. 2003). Use of roads and pipeline corridors may increase owl vulnerability to vehicle collision. Overhead power lines provide perch sites for larger raptors that could potentially result in increased burrowing owl predation. CBNG infrastructure such as roads, pipe line corridors, and nearby metering facilities may provide shelter and den sites for ground predators such as skunks and foxes.

The USDAFS Thunder Basin National Grasslands in Campbell County, WY, whom cooperated with the BLM in the creation of the 2003 PRB EIS, recommends a 0.25 mile timing restriction buffer zone for burrowing nest locations during their nesting season (April 15 to August 31). Instruction Memorandum No. 2006-197, directs the field offices to "use the least restrictive stipulations that effectively accomplish the resource objectives or uses." Alteration of the general raptor nest timing limitation (Feb 1 to July 31) to a more specific burrowing owl nesting season timing limitation will effectively reduce the vulnerability of owls to collision while shortening the timing restriction period to four and one half months (See Chapter 3 for breeding, nesting, and migration chronology) from six and one half months and from 0.5 mile to 0.25 mile.

4.2.5.2.4. Grouse

4.2.5.2.4.1. Greater sage-grouse Direct and Indirect Effects

Three sage-grouse leks are located within four miles of the project area. The proposed action will adversely impact nesting, brood rearing, late summer, and winter habitat. Proposed project elements that are anticipated to negatively impact grouse are approximately: 10 CBNG wells on 10 locations, 1.8 miles of new roads, 0.3 mile of new pipelines, and increased vehicle traffic on established roads and increased noise from compressor stations. Using 0.6 miles as a distance for impacts (Holloran et al. 2007, Aldridge and Boyce 2007), effective sage-grouse habitat loss will be 657 acres of winter habitat and 1418 acres of nesting habitat from roads and well locations. In an effort to reduce impacts to sage-grouse habitat, the GGM Fed 12-17-52-77AWP well, proposed within a draw containing a large patch of habitat, was moved to the 11-17-52-77 location, out of this draw. The operator did not submit any proposal or voluntarily modify the project in an effort to minimize impacts to sage-grouse habitat.

Based on the best available science, which is summarized below, the proposed action will most likely affect the local grouse population and contribute to the subsequent abandonment of the three leks within four miles of the project.

4.2.5.2.4.1.1. Greater sage-grouse Cumulative Effects

In addition to the direct impacts to sage-grouse habitat that will be created by the federal wells and associated infrastructure the project area does contain existing fee, state, and federal fluid mineral development. The sage-grouse cumulative impact assessment area for this project encompasses a four mile radius from the Lake, Lake NW, and Jewell Draw sage-grouse leks. As of September 2, 2008, there are approximately 140 existing wells and associated infrastructure within four miles of the 3 leks - an area of 73 square miles. The existing well density is approximately 1.9 wells/section. Due to this level of development there is potential that the population(s) breeding at these leks may be impacted without the federal development.

There are 47 proposed wells (2 are the wells from this project) within four miles of the 3 leks. With the addition of the 45 proposed wells that are not associated with this proposed action, the well density within four miles of the 3 leks increases to 2.5 wells/section. With approval of alternative C (10 proposed well locations, 2 within 4 miles of the 3 leks) the well density increases to 2.6 wells/section.

CBNG is a recent development, with the first well drilled in 1987 (Braun et al. 2002). In February 1998 there were 420 producing wells primarily restricted to eastern Campbell County (BFO 1999). By May 2003 there were 26,718 CBNG wells permitted within the BFO area (WGFD 2004). The PRB FEIS estimated 51,000 additional CBNG wells to be drilled over a ten year period beginning in 2003 (BFO 2003).

The Powder River Basin Oil and Gas Project FEIS (BLM 2003) concluded that "Activities associated with the proposed project would affect sage-grouse in several ways. These effects may include: (1) increased direct mortality (including legal hunting, poaching, and collision with power lines and vehicles); (2) the introduction of new perches for raptors and thus the potential change in rate of predation; (3) direct loss or degradation of habitats; (4) indirect disturbance resulting from human activity (including harassment, displacement, and noise); (5) habitat fragmentation (particularly through construction of roads); and (6) changes in population (pg. 4-257)." The FEIS goes on to state that "implementation of several mitigation measures would reduce the extent of each impact addressed by those measures. Despite these measures, the synergistic effect of several impacts would likely result in a downward trend for the sage-grouse population, and may contribute to the array of cumulative effects that may lead to its federal listing. Local populations may be extirpated in areas of concentrated development, but viability across the Project Area (Powder River Basin) or the entire range of the species is not likely to be compromised (pg. 4-270)."

The Powder River Basin Oil and Gas Project Record of Decision (BLM 2003) included a Mitigation Monitoring and Reporting Plan (MMRP). The uncertainties as to where and at what level development was to proceed as well as the uncertainties associated with the assumptions that were used to predict impacts suggests that one-time determination of impacts that is included in the EIS may not occur as projected. The MMRP helps to continually assess the effects of the project and the adequacy of the mitigation. Such a plan/process provides a mechanism to continuously modify management practices in order to allow development while continuing to protect the environment (E-1)." In other words, development pace and patterns may not occur as predicted, and so the BLM may use the adaptive management process provided for in the BFO RMP.

Impacts from CBNG development are likely to be significant and additive to the long-term impacts afflicting the sage-grouse population (WGFD 2004). Greater sage-grouse habitat is being directly lost with the addition of well sites, roads, pipelines, powerlines, reservoirs and other infrastructure in the Powder River Basin (WGFD 2005, WGFD 2004). Sage-grouse avoidance of CBNG infrastructure results in even greater indirect habitat loss. In southwestern Wyoming, yearling female greater sage-grouse avoid nesting in areas within 0.6 miles of producing well pads (Holloran et al. 2007), and in southern Alberta, brood-rearing females avoid areas within 0.6 miles of producing wells (Aldridge and Boyce 2007). Doherty et al. (2008) demonstrated that sage-grouse in the Powder River Basin avoided otherwise suitable wintering habitats once they have been developed for energy production, even after timing and lek buffer stipulations had been applied. The WGFD feels a well density of eight wells per section creates a high level of impact for sage-grouse and that sage-grouse avoidance zones around mineral facilities overlap creating contiguous avoidance areas (WGFD 2004). As interpreted by coordinated effort with state fish and wildlife agencies from Montana, Colorado, Utah, South Dakota, North Dakota and Wyoming, (State wildlife agencies' ad hoc committee for sage-grouse and oil and gas development 2008), research indicates that oil or gas development exceeding approximately 1 well pad per square mile with the associated infrastructure, results in calculable impacts on breeding populations, as measured by the number of male sage-grouse attending leks (Holloran 2005, Walker et al. 2007)

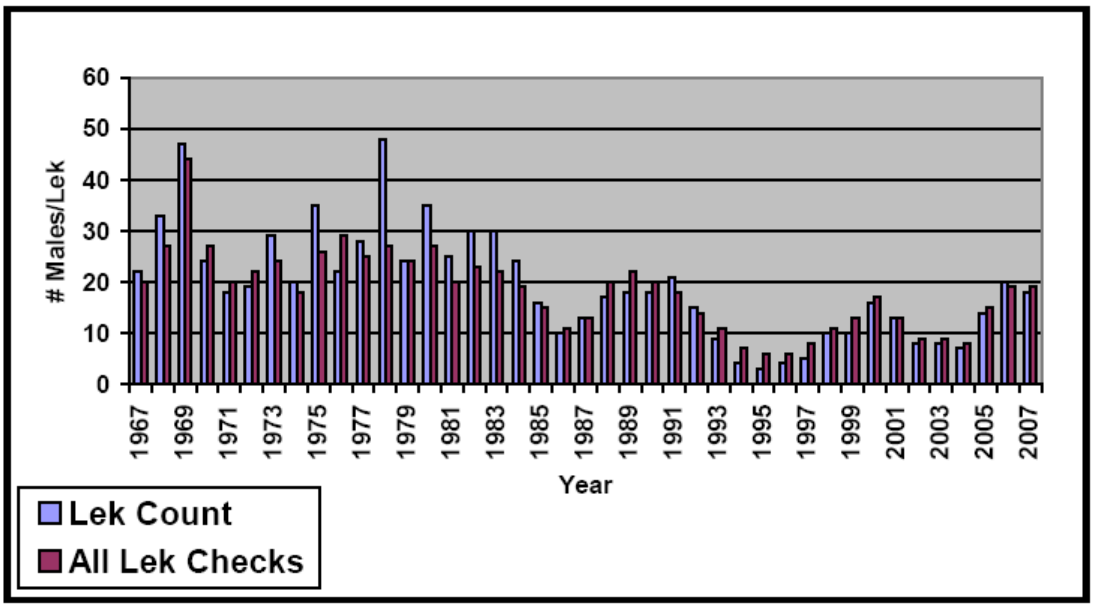
Noise can affect sage-grouse by preventing vocalizations that influence reproduction and other behaviors (WGFD 2003). In a study of greater sage-grouse population response to natural gas field development in western Wyoming, Holloran (2005) concluded that increased noise intensity, associated with active drilling rigs within 5 km (3.1 miles) of leks, negatively influenced male lek attendance. In 2002, Braun et al. documented approximately 200 CBNG facilities within one mile of sage-grouse leks. Sage-grouse numbers were found to be consistently lower for these leks than for leks without this disturbance. Direct habitat losses from the facilities themselves, roads and traffic, and the associated noise were found to be the likely reason for this finding.

Vegetation communities within the Powder River Basin are naturally fragmented, as they represent a transition between the intermountain basin sagebrush communities to the west and the prairie communities to the east. The Powder River Basin is also near the eastern edge of greater sage-grouse range. A sagebrush cover assessment within Wyoming basins estimated sagebrush coverage within the Powder River Basin to be 35% with an average patch size less than 300 acres (Rowland et al. 2005). The Powder River Basin patch size has decreased by more than 63% in the past forty years, from 820 acre patches and an overall coverage of 41% in 1964 (Rowland et al. 2005). The existing development within the cumulative impacts assessment area has further fragmented the sage-grouse habitat. Disturbance created by this project will contribute to additional fragmentation.

Another concern with CBNG development is that reservoirs created for water disposal provide habitat for mosquitoes associated with West Nile virus (WGFD 2004). West Nile virus represents a significant new stressor, which in 2003 reduced late summer survival of sage-grouse an average of 25% within four populations including the Powder River Basin (Naugle et al. 2004). In northeastern Wyoming and southeastern Montana, West Nile virus-related mortality during the summer resulted in an average decline in annual female survival of 5% from 2003 to 2006 (Walker et al. 2007). Powder River Basin sage-grouse losses during 2004 and 2005 were not as severe. Summer 2003 was warm and dry, more conducive to West Nile virus replication and transmission than the cooler summers of 2004 and 2005 (Cornish pers. comm.).

The sage-grouse population within northeast Wyoming is exhibiting a steady long term downward trend (Figure 1) (WGFD 2005). The figure illustrates a ten-year cycle of periodic highs and lows. Each subsequent population peak is lower than the previous peak. Long-term harvest trends are similar to that of lek attendance (WGFD 2005).

Figure 1. Male sage-grouse lek attendance within northeastern Wyoming, 1967-2007.



The BFO Resource Management Plan (BLM 2001) and the Powder River Basin Oil and Gas Project Record of Decision (BLM 2003) include a two-mile timing limitation within sage-grouse nesting habitat. The two-mile measure originated with the Western Association of Fish and Wildlife Agencies (WAFWA) (BLM 2004). BLM Wyoming adopted the two-mile recommendation in 1990 (BLM 1990). The two-mile recommendation was based on early research which indicated between 59 and 87 percent of sage-grouse nests were located within two miles of a lek (BLM 2004). These studies were conducted within prime, contiguous sage-grouse habitat such as Idaho's Snake River plain.

Additional studies, across more of the sage-grouse's range, indicate that many populations nest much farther than two miles from the breeding lek (BLM 2004). Holloran and Anderson (2005), in their Upper Green River Basin study area, reported only 45% of their sage-grouse hens nested within 3 km (1.86 mi) of the capture lek. Moynahan and Lindberg (2004) found only 36% of their grouse nesting within 3 km of the capture lek. Moynahan's study area was north-central Montana in an area of mixed-grass prairie and sagebrush steppe, with Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) being the dominant shrub species (Moynahan et al. 2007). Habitat conditions and sage-grouse biology within the Buffalo Field Office are more similar to Moynahan's north-central Montana study area than the Upper Green River area.

A two-mile timing limitation, given the long-term population decline and that less than 50% of sage-grouse are expected to nest within the limitation area, is insufficient to reverse the population decline. Moynahan and Lindberg (2004) like WAFWA (Connelly et al. 2000), recommend increasing the protective distance around sage-grouse leks. The BLM and University of Montana are currently researching nest location and other sage-grouse questions and relationships between grouse and coalbed natural gas development. Thus far, this research suggests that impacts to leks from energy development are discernable out to a minimum of four miles, and that some leks within this radius have been extirpated as a direct result of energy development (State wildlife agencies' ad hoc committee for sage-grouse and oil and gas development 2008). Even with a timing limitation on construction activities, sage-grouse may avoid nesting within CBNG fields because of the activities associated with operation and production. In a typical landscape in the Powder River Basin, energy development within two miles of leks is projected to reduce the average probability of lek persistence from 87% to 5% percent (Walker et al. 2007).

Walker et al, 2007 indicates the size of a no-development buffer sufficient to protect leks would depend on the amount of suitable habitat around the lek and the population impact deemed acceptable. Also, rather than limiting mitigation to only timing restrictions, research suggests more effective mitigation strategies include, at a minimum, burying power lines (Connelly et al. 2000 b); minimizing road and well pad construction, vehicle traffic, and industrial noise (Lyon and Anderson 2003, Holloran 2005); and managing produced water to prevent the spread of mosquitoes with the potential to vector West Nile Virus in sage grouse habitat (Walker et al 2007).

The multi-state recommendations presented to the WGFD for identification of core sage grouse areas acknowledges there may be times when development in important sage grouse breeding, summer, and winter habitats cannot be avoided. In those instances they recommend, "…infrastructure should be minimized and the area should be managed in a manner that effectively conserves sagebrush habitats (State wildlife agencies' ad hoc committee for sage-grouse and oil and gas development 2008).

4.2.5.2.4.2. Sharp-tailed grouse Direct and Indirect Effects

Effects similar to sage-grouse.

4.2.5.2.5. Mountain plover Direct and Indirect Effects

Suitable mountain plover habitat is present within the project area, but no project related activities are proposed within suitable habitat. The project should not impact mountain plovers.

4.2.5.3. Sensitive Species Cumulative effects

The cumulative effects associated with Alternative C are within the analysis parameters and impacts described in the PRB FEIS. For details on expected cumulative impacts, please refer to the referenced PRB FEIS, Volume 2, Chapter 4, page 4-271.

4.3. West Nile Virus Direct and Indirect Effects

This project is likely to result in standing surface water which may potentially increase mosquito breeding habitat. BLM has consulted with applicable state agencies, County Weed and Pest and the State Health Department, per above mitigation in the PRB ROD page 18, regarding the disease and the need to treat. BLM has also consulted with the researchers that are studying the dynamics of WNv species and its effects in Wyoming.

There is no evidence that treatment, either through the use of larvicides or malithion, on a site specific or basin-wide scale will have any effect on the overall spread of the disease. The State agencies have not instituted state-wide treatment for mosquitoes due to WNv, nor are they requiring any mitigation specific to permitting for CBM operations.

Cumulatively, there are many sources of standing water, beyond CBM discharge, throughout the PRB that would add to the potential for mosquito habitat. Sources include; natural flows, livestock watering facilities, coal mining operations, and outdoor water use and features in and around communities.

BLM will keep monitoring this issue by continuing to consult with the State agencies and the researchers working in the area in order to stay abreast of the most current developments and any need to apply mitigation.

4.4. Water Resources

The operator has submitted a comprehensive WMP for this project. It is incorporated-by-reference into this EA pursuant to 40 CFR 1502.21. The WMP incorporates sound water management practices, monitoring of downstream impacts within the Upper Powder River watershed and commitments to

comply with Wyoming State water laws/regulations. It also addresses potential impacts to the environment and landowner concerns. Qualified hydrologists developed the water management plan. Adherence with the plan, in addition to BLM applied mitigation (in the form of COAs), would reduce project area and downstream impacts from proposed water management strategies.

The WDEQ has assumed primacy from United States Environmental Protection Agency for maintaining the water quality in the waters of the state. The WSEO has authority for regulating water rights issues and permitting impoundments for the containment of surface waters of the state.

The maximum water production is predicted to be 31 gpm per well or 310.0 gpm (0.7 cfs or 500 acre-feet per year) for this POD. The PRB FEIS projected the total amount of water that was anticipated to be produced from CBNG development per year (Table 2-8 Projected Amount of Water Produced from CBM Wells Under Alternatives 1, 2A and 2B pg 2-26). For the Upper Powder River drainage, the projected volume produced within the watershed area was 147,481 acre-feet in 2008 (maximum production was predicted to occur in 2006 with 171,423 acre-feet). As such, the volume of water resulting from the production of these wells is 0.3% of the total volume projected for 2008. This volume of produced water is also within the predicted parameters of the PRB FEIS.

4.4.1. Groundwater

The PRB FEIS predicts an infiltration rate of 40% to groundwater aquifers and coal zones in the Upper Powder River drainage area (PRB FEIS pg 4-5). For this action, it may be assumed that a maximum of 124 gpm will infiltrate at or near the discharge points and impoundments (0.3 cfs or 200 acre-feet per year). This water will saturate the near surface alluvium and deeper formations prior to mixing with the groundwater used for stock and domestic purposes. According to the PRB FEIS, "…the increased volume of water recharging the underlying aquifers of the Wasatch and Fort Union Formations would be chemically similar to alluvial groundwater." (PRB FEIS pg 4-54). However, there is potential for infiltration of produced water to influence the quality of the antecedent groundwater. The WDEQ requires that operators determine initial groundwater quality below impoundments to be used for CBNG produced water storage. If high quality water is detected (Class 3 or better) the operator is required to establish a groundwater monitoring program at those impoundments.

In order to address the potential impacts from infiltration on shallow ground water, the Wyoming DEQ has developed a guidance document, "Compliance Monitoring for Ground Water Protection Beneath Unlined Coalbed Methane Produced Water Impoundments" (June 14, 2004) which can be accessed on their website. This guidance document became effective August 1, 2004, and was revised as the "Compliance Monitoring and Siting Requirements for Unlined Coalbed Methane Produced Water Impoundments" which was approved in June, 2006. The Wyoming DEQ established an Impoundment Task Force which drafted an "Impoundment Monitoring Plan" to investigate the potential for existing impoundments to have impacted shallow groundwater. Drilling at selected existing impoundments began in the spring of 2006.

As of April of 2008, approximately 1774 impoundment sites have been investigated with over 1988 borings. Of these impoundments, 259 met the criteria to require "compliance monitoring" if constructed and used for CBNG water containment. Only 109 impoundments requiring monitoring are presently being used. As of the first quarter of 2008, only 16 of those monitored impoundments caused a change in the "Class of Use" of the underlying aquifer water.

The PRB FEIS predicts that one of the environmental consequences of coal bed natural gas production is possible impacts to the groundwater. "The effects of development of CBM on groundwater resources would be seen as a drop in the water level (drawdown) in nearby wells completed in the developed coal aquifers and underlying or overlying sand aquifers." (PRB FEIS page 4-1). In the process of dewatering

the coal zone to increase natural gas recovery rates, this project may have some effect on the static water level of water wells in the area. The permitted water wells in the area produce from water bearing zones ranging in depth from 200 to 1060 feet below the ground surface. The targeted coal zones range from 2009 to 2177 feet below ground surface. As mitigation, the operator has committed to offer water well agreements to holders of properly permitted domestic and stock wells within the circle of influence of the proposed wells.

Recovery of the coal bed aquifer was predicted in the PRB FEIS to "…resaturate and repressurize the areas that were partially depressurized during operations. The amount of groundwater storage within the coals and sands units above and below the coals is enormous. Almost 750 million acre-feet of recoverable groundwater are stored within the Wasatch - Tongue River sand and coals (PRB FEIS Table 3-5). Redistribution is projected to result in a rapid initial recovery of water levels in the coal. The model projects that this initial recovery period would occur over 25 years." (PRB FEIS page 4-38).

Adherence to the drilling plan, the setting of casing at appropriate depths, following safe remedial procedures in the event of casing failure, and utilizing proper cementing procedures will protect any potential fresh water aquifers above the target coal zone. This will ensure that ground water will not be adversely impacted by well drilling and completion operations.

In order to determine the actual water quality of the producing formations in this POD, and to verify the water analyses submitted for the pre-approval evaluation, the operator has committed to designate a reference well within the POD boundary. The well will be capable of being sampled at the wellhead. A sample will be collected at the wellhead for analysis within sixty days of initial production. A copy of the water analysis will be submitted to the BLM Authorizing Officer.

4.4.1.1. Groundwater Cumulative Effects:

As stated in the PRB FEIS, "The aerial extent and magnitude of drawdown effects on coal zone aquifers and overlying and underlying sand units in the Wasatch Formation also would be limited by the discontinuous nature of the different coal zones within the Fort Union Formation and sandstone layers within the Wasatch Formation." (PRB FEIS page 4-64).

Development of CBNG through 2018 (and coal mining through 2033) would remove 4 million acre-feet of groundwater from the coal zone aquifer (PRB FEIS page 4-65). This volume of water "…cumulatively represents 0.5 percent of the recoverable groundwater stored in the Wasatch – Tongue River sands and coals (nearly 750 million acre-feet, from Table 3-5). All of the groundwater projected to be removed during reasonably foreseeable CBNG development and coal mining would represent less than 0.3 percent of the total recoverable groundwater in the Wasatch and Fort Union Formations within the PRB (nearly 1.4 billion acre-feet, from Table 3-5)." (PRB FEIS page 4-65). No additional mitigation is necessary.

4.4.2. Surface Water

The following table shows Wyoming proposed numeric limits for the watershed for SAR, and EC, the average value measured at selected USGS gauging stations at high and low monthly flows, and Wyoming groundwater quality standards for TDS and SAR for Class I to Class III water. It also shows pollutant limits for TDS, SAR and EC detailed in the WDEQ's WYPDES permit, and the levels found in the POD's representative water sample.

Table 4.5 Comparison of Regulated Water Quality Parameters to Predicted Water Quality

Predicted Values	**TDS, mg/l**	**SAR**	**EC,** μmhos/cm
Most Restrictive Proposed Limit –		2	1000
Least Restrictive Proposed Limit		10	3200

Predicted Values	**TDS, mg/l**	**SAR**	**EC,** μmhos/cm
Powder River at Arvada, WY			
Historic Data Average at Maximum Flow		4.76	1797
Historic Data Average at Minimum Flow		7.83	3400
WDEQ Quality Standards for Wyoming Groundwater (Chapter 8)			
Drinking Water (Class I)	500		
Agricultural Use (Class II)	2,000	8	
Livestock Use (Class III)	5,000		
WDEQ Water Quality Requirement for WYPDES Permit # WY0054429			
At discharge point	NS**	NS**	7500
WDEQ Water Quality Requirement for WYPDES Permit # WY0051951			
At discharge point	NS**	NS**	7500
Predicted Produced Water Quality			
Co-mingled Anderson & Wall	1420	32	2310

**Not Stated

Based on the analysis performed in the PRB FEIS, the primary beneficial use of the surface water in the Powder River Basin is the irrigation of crops (PRB FEIS pg 4-69). The water quality projected for this POD is 1420 mg/l TDS which is within the WDEQ criteria for agricultural use (2000 mg/l TDS). Direct surface land application is included in this proposal.

The quality for the co-mingled water produced from the Anderson and Wall coal zones is predicted to be similar to the quality of the representative sample collected from a location near the POD. A maximum of 31 gallons per minute (gpm) is projected is to be produced from these 10 wells, for a total of 310.0 gpm for the POD. See Table 4.5.

For more information, please refer to the WMP included in this POD.

There are 7 existing discharge points proposed for use with this project. They have been appropriately sited and utilize appropriate water erosion dissipation designs. However, at the time of the onsite, the discharge chute into Fresno Reservoir required extensive repair work and all weirs required maintenance and modification to function properly. Existing water management facilities were evaluated for compliance with best management practices during the onsite.

To manage the produced water, the operator proposes to use 7 existing on-channel impoundments (183 acre-feet of storage) which have disturbed approximately 28 surface acres. The operator also proposes to use one existing injection well and approximately 103 acres of surface irrigated land. Existing impoundments have been upgraded and appear to meet the requirements of the WSEO, WDEQ and the needs of the operator and the landowner. All water management facilities were evaluated for compliance with best management practices during the onsite.

The PRB FEIS assumes that 15% of the impounded water will re-surface as channel flow (PRB FEIS pg 4-74). Consequently, the volume of water produced from these wells may result in the addition of 0.1 cfs below the lowest reservoir (after infiltration and evapotranspiration losses) if all water were discharged to the impoundments. The operator has committed to monitor the condition of channels and address any problems resulting from discharge. Discharge from the impoundments would potentially allow for streambed enhancement through wetland-riparian species establishment. Sedimentation will occur in the

impoundments, but would be controlled through a concerted monitoring and maintenance program. Phased reclamation plans for the impoundments will be submitted and approved on a site-specific, case-by-case basis as they are no longer needed for disposal of CBNG water, as required by BLM applied COAs.

Alternative (2A), the approved alternative in the Record of Decision for the PRB FEIS, stated that the peak production of water discharged to the surface would occur in 2006 with a total contribution to the mainstem of the Upper Powder River of 68 cfs (PRB FEIS pg 4-86). The predicted maximum discharge rate from these 10 wells is anticipated to be a total of 310.0 gpm or 0.69 cfs to impoundments, deep injection and irrigation. Using an assumed conveyance loss of 20% (PRB FEIS pg 4-74) and full containment, the produced water re-surfacing in Crazy Woman Creek and the Powder River (treated as one channel for this exercise) from this action (0.1 cfs) may add a maximum 0.08 cfs to the Upper Powder River flows, or 0.1% of the predicted total CBNG produced water contribution. This incremental flow rate is statistically below the measurement capabilities for the flow rate in either Crazy Woman Creek or the Powder River without the use of highly specialized flow measurement techniques and equipment (refer to Statistical Methods in Water Resources U.S. Geological Survey, Techniques of Water-Resources Investigations Book 4, Chapter A3 2002, D.R. Helsel and R.M. Hirsch authors). For more information regarding the maximum predicted water impacts resulting from the discharge of produced water, see Table 4-6 (PRB-FEIS pg 4-85).

The operator did not provide an analysis of the potential development in the watershed above the project area. Based on the area of the Crazy Woman and Powder River watersheds above the POD, there could be considerable development and subsequent contribution of CBNG produced water to both stream systems in the future. The BLM has stated that this is not likely to occur because:

1. Some of these wells have already been drilled and are producing.
2. New wells will be phased in over several years, and
3. A decline in well discharge generally occurs after several months of operation.

The proposed method for surface discharge provides passive treatment through the aeration supplied by the energy dissipation configuration at each discharge point outfall. Aeration adds dissolved oxygen to the produced water which can oxidize susceptible ions, which may then precipitate. This is particularly true for dissolved iron. Because iron is one of the key parameters for monitoring water quality, the precipitation of iron oxide near the discharge point will improve water quality at downstream locations.

The operator has obtained a Wyoming Pollutant Discharge Elimination System (WYPDES) permit for the discharge of water produced from this project from the WDEQ.

Permit effluent limits were set at (WY0054429 Part I page 2):

pH	6.5 to 9.0
Specific Conductance	7500 mg/l max
Dissolved iron	1000 µg/l max
Chlorides	2000 mg/l

Permit effluent limits were set at (WY0051951 Part I page 2):

pH	6.5 to 9.0
Specific Conductance	7500 mg/l max
Dissolved iron	1000 µg/l max
Chlorides	230 mg/l
Total Recoverable Arsenic	150 µg/l max

The WYPDES permits also addresses existing downstream concerns, such as irrigation use, in the COAs

for the permits. Flow monitoring stations have been established downstream of the reservoirs to be used for storage "…to ensure that effluent from the reservoirs does not flow downstream except in the event of a 50-year/24-hour storm event or greater."

In order to determine the actual water quality of the producing formations in this POD and to verify the water analysis submitted for the pre-approval evaluation, the operator has committed to designate a reference well within the POD boundary. The reference well will be sampled at the wellhead for analysis within sixty days of initial production. A copy of the water analysis will be submitted to the BLM Authorized Officer.

As stated previously, the operator has committed to offer water well agreements to properly permitted domestic and stock water wells within the circle of influence of the proposed CBNG wells.

The development of coal bed natural gas and the production and discharge of water in the area surrounding the existing natural spring may affect the flow rate or water quality of the spring.

In-channel downstream impacts are addressed in the WMP for the Knudson 9 Extension POD prepared for Marathon Oil Company by ARCADIS U.S., Inc.

4.4.2.1. Surface Water Cumulative Effects

The analysis in this section includes cumulative data from Fee, State and Federal CBNG development in the Upper Powder River watershed. These data were obtained from the Wyoming Oil and Gas Conservation Commission (WOGCC).

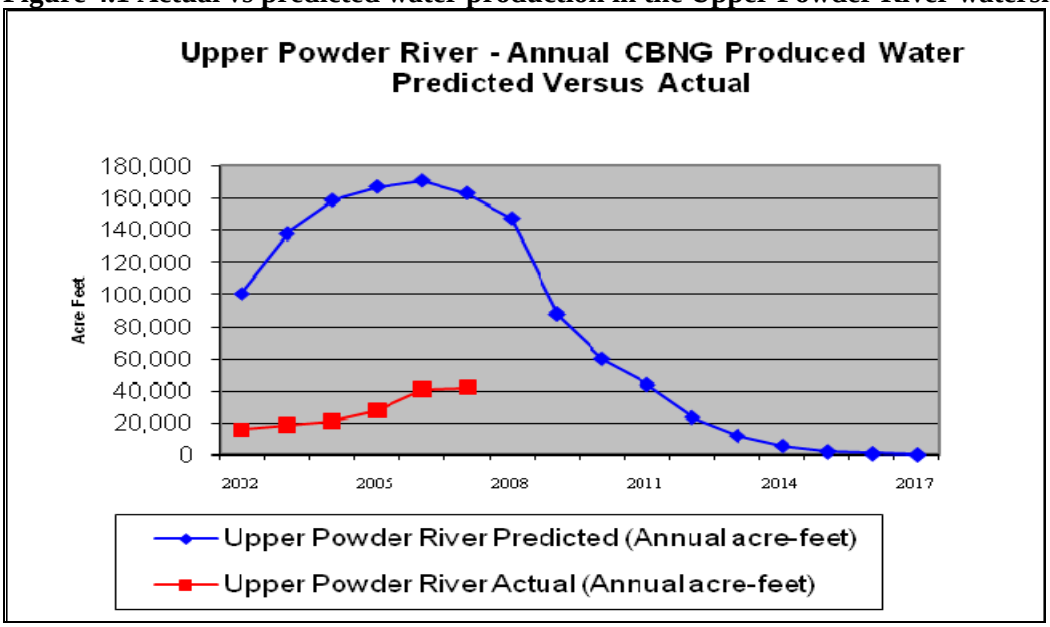
As of December 2007, all producing CBNG wells in the Upper Powder River watershed have discharged a cumulative volume of 166,096 acre-ft of water compared to the predicted 900,040 acre-ft disclosed in the PRB FEIS (Table 2-8 page 2-26). These figures are presented graphically in Figure 4.1 and Table 4.6 following. This volume is 19 % of the total predicted produced water analyzed in the PRB FEIS for the Upper Powder River watershed.

Table 4.6 Actual vs predicted water production in the Upper Powder River watershed *2007 Data Update 3-08-08*

Year	Upper Powder River Predicted (Annual acre-feet)	Upper Powder River Predicted (Cumulative acre-feet from 2002)	Upper Powder River Actual (Annual acre-feet)		Upper Powder River Actual (Cumulative acre-feet from 2002)	
			A-ft	% of Predicted	A-Ft	% of Predicted
2002	100,512	100,512	15,846	15.8	15,846	15.8
2003	137,942	238,454	18,578	13.5	34,424	14.4
2004	159,034	397,488	20,991	13.2	55,414	13.9
2005	167,608	565,096	27,640	16.5	83,054	14.7
2006	171,423	736,519	40,930	23.9	123,984	16.8
2007	163,521	900,040	42,112	25.8	166,096	18.5
2008	147,481	1,047,521				
2009	88,046	1,135,567				
2010	60,319	1,195,886				

Year	Upper Powder River Predicted (Annual acre-feet)	Upper Powder River Predicted (Cumulative acre-feet from 2002)	Upper Powder River Actual (Annual acre-feet)		Upper Powder River Actual (Cumulative acre-feet from 2002)	
			A-ft	% of Predicted	A-Ft	% of Predicted
2011	44,169	1,240,055				
2012	23,697	1,263,752				
2013	12,169	1,275,921				
2014	5,672	1,281,593				
2015	2,242	1,283,835				
2016	1,032	1,284,867				
2017	366	1,285,233				
Total	**1,285,233**		**166,096**			

Figure 4.1 Actual vs predicted water production in the Upper Powder River watershed

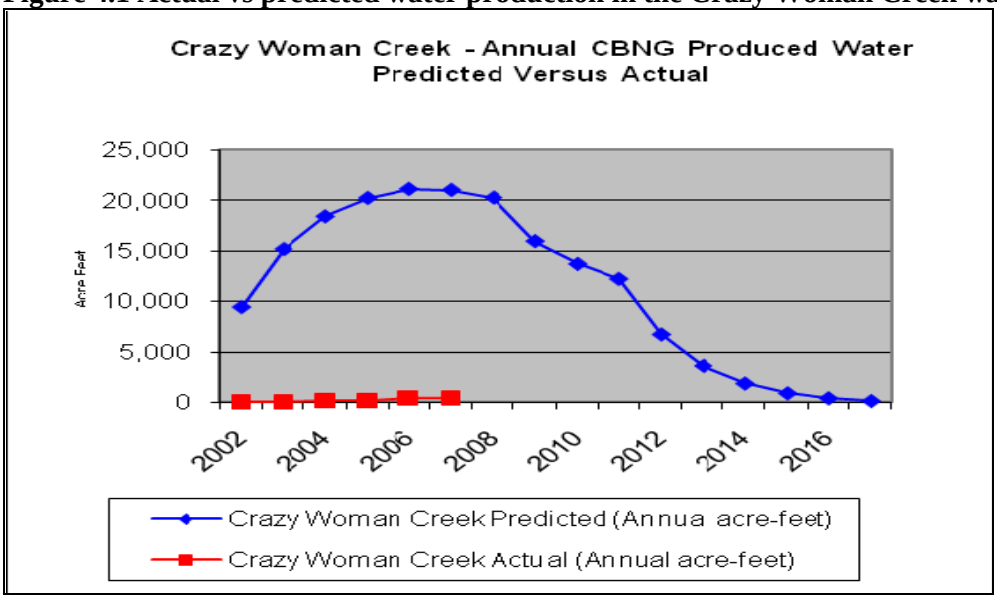


As of December 2007, all producing CBNG wells in the Crazy Woman Creek watershed have discharged a cumulative volume of 984 acre-ft of water compared to the predicted 105,463 acre-ft disclosed in the PRB FEIS (Table 2-8 page 2-26). These figures are presented graphically in Figure 4.1 and Table 4.6 following. This volume is 0.9 % of the total predicted produced water analyzed in the PRB FEIS for the Crazy Woman Creek watershed.

Table 4.6 Actual vs predicted water production in the Crazy Woman Creek watershed *2007 Data Update 3-08-08*

Year	Crazy Woman Creek Predicted (Annual acre-feet)	Crazy Woman Creek Predicted (Cumulative acre-feet from 2002)	Crazy Woman Creek Actual (Annual acre-feet)		Crazy Woman Creek Actual (Cumulative acre-feet from 2002)	
			Actual Ac-ft	% of Predicted	Cum Ac-ft	% of Predicted
2002	9,449	9,449	4	0.0	4	0.0
2003	15,185	24,634	1	0.0	5	0.0
2004	18,418	43,052	126	0.7	130	0.3
2005	20,240	63,292	113	0.6	243	0.4
2006	21,135	84,427	392	1.9	635	0.8
2007	21,036	105,463	349	1.7	984	0.9
2008	20,279	125,742				
2009	15,962	141,704				
2010	13,716	155,420				
2011	12,240	167,660				
2012	6,731	174,391				
2013	3,629	178,020				
2014	1,881	179,901				
2015	910	180,811				
2016	422	181,233				
2017	150	181,383				
Total	**181,383**		**984**			

Figure 4.1 Actual vs predicted water production in the Crazy Woman Creek watershed



The PRB FEIS identified downstream irrigation water quality as the primary issue for CBNG produced water. Electrical Conductivity (EC) and SAR are the parameters of concern for suitability of irrigation water. The water quality analysis in the PRB FEIS was conducted using produced water quality data, where available, from existing wells within each of the ten primary watersheds in the Powder River Basin. These predictions of EC and SAR can only be reevaluated when additional water quality sampling is available.

The PRB FEIS states that "Cumulative effects to the suitability for irrigation of the Powder River would be minimized through the interim MOC (Memorandum of Cooperation) that the two DEQs (Wyoming and Montana Departments of Environmental Quality) have signed. This MOC was developed to ensure that designated uses downstream in Montana would be protected while CBM development in both states continued. As the two states develop a better understanding of the effects of CBM discharges through the enhanced monitoring required by the MOC, they can adjust the permitting approaches to allow more or less discharges to the Powder River drainage. Thus, through the implementation of instream monitoring and adaptive management, water quality standards and interstate agreements can be met." (PRB FEIS page 4-117) However, this MOC expired and has not been renewed. The EPA has approved the Montana Surface Water Standards for EC and SAR. Therefore the Wyoming DEQ is responsible for ensuring that the Montana standards are met at the state line under the Clean Water Act (CWA). Litigation between Wyoming and Montana which was entered into after issuing the PRB FEIS ROD will now determine the water quality and quantity parameters which will be applied to CBNG produced water disposal into waters flowing from Wyoming into Montana.

As referenced above, the PRB FEIS did disclose that cumulative impacts may occur as a result of discharged produced CBNG water. The cumulative effects relative to this project are within the analysis parameters and impacts described in the PRB FEIS for the following reasons:

1. They are proportional to the actual amount of cumulatively produced water in the Upper Powder River drainage and the total amount that was predicted in the PRB FEIS, which is approximately 19% of that total (see section 4.4.2.1). Water produced to date in the Crazy Woman Creek watershed is only 0.9% of the total predicted.
2. The WDEQ enforcement of the terms and conditions of the WYPDES permit that are designed to protect irrigation downstream.
3. The commitment by the operator to monitor the volume of water discharged into reservoirs in Crazy Woman Creek and the Powder River tributaries.

No additional mitigation measures are required.

Refer to the PRB FEIS, Volume 2, page 4-115 – 117 and table 4-13 for cumulative effects relative to the Upper Powder River watershed and page 117 for cumulative effects common to all sub-watersheds.

4.5. Cultural Resources

BLM review, conducted by Wendy Sutton, has determined no sites lie within the APE for the proposed project. Following the Wyoming State Protocol, Section VI(A)(1) the Bureau of Land Management electronically notified the Wyoming State Historic Preservation Officer (SHPO) on 9/16/2008 that the proposed project would result in no effect (DBU_WY_2008_2148).

If any cultural values [sites, artifacts, human remains (Appendix L PRB FEIS)] are observed during operation of this lease/permit/right-of-way, they will be left intact and the Buffalo Field Manager notified. Further discovery procedures are explained in the Standard COA (General)(A)(1).

4.6. Air Quality

In the project area, air quality impacts would occur during construction (due to surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well testing, as well as drilling rig and vehicle engine exhaust) and production (including non-CBM well production equipment, booster and pipeline compression engine exhaust). The amount of air pollutant emissions during construction would be controlled by watering disturbed soils, and by air pollutant emission limitations imposed by applicable air quality regulatory agencies. Air quality impacts modeled in the PRB FEIS concluded that projected oil & gas development would not violate any local, state, tribal or federal air quality standards.

5. CONSULTATION/COORDINATION

Contact	Title	Organization	Present at Onsite
Jeb Beacham	Regulatory Compliance Rep.	Pennaco	Yes

6. OTHER PERMITS REQUIRED

A number of other permits are required from Wyoming State and other Federal agencies. These permits are identified in Table A-1 in the PRB FEIS Record of Decision.

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