Chapter 4
Environmental Consequences

4.1 INTRODUCTION

The PAPA DEIS (BLM, 1999a) was released for public review and comment in 1999. The existing environment in 1999 was very different from the one present in 2006 and described in Chapter 3 of this Draft SEIS. In 1999, much was unknown about the future of natural gas development in the PAPA. Consequently, impacts described in the PAPA DEIS were generic and the document recognized that level and significance of actual impact to each resource would depend on the level of development, as it would ultimately progress in the future.

Of necessity, environmental impacts disclosed in the PAPA DEIS (BLM, 1999a) were based on assumptions associated with the anticipated levels of development. Some effects to various resources by natural gas development in the PAPA are now known, at least for the level of development that has evolved since the PAPA ROD (BLM, 2000b) was issued in July 2000. Documentation of the effects is incorporated into the appropriate sections of Chapter 3 and when applicable, known effects are addressed in this chapter.

The alternatives for future development in the PAPA considered in this Draft SEIS are quantitatively and qualitatively different from the alternatives analyzed in the PAPA DEIS (BLM, 1999a). In 1999, three exploration and development scenarios were incorporated within each of three alternatives, which at that time were titled “Mitigation Alternatives.” The three exploration and development scenarios were developed to address the uncertainty of the future spatial (geographic) distribution and intensity of natural gas development. The exploration and development scenarios in the PAPA DEIS are as follows:

1. The *Project Wide Exploration/Development Scenario* assumed that development would generally occur throughout the entire PAPA. Two potential levels of development were analyzed; 500 and 700 producing well pads. The scenario assumed that to reach the 700 well pad development level, 900 well pads would be constructed and drilled and that 200 of the well pads would be reclaimed because the wells would be non-productive, dry holes. Similarly, it was assumed that 650 well pads would be constructed to achieve the 500 producing well pad development level (150 well pads would be reclaimed).
2. The *Anticline Crest Exploration/Development Scenario* assumed that approximately 70 percent of the well pads would be located within 1 mile of the Anticline Crest and 30 percent of the well pads would be located in the three hot spots away from the Anticline Crest. An equal number of well pads would be developed in each hot spot. The two potential levels of development (500 and 700 producing well pads) as discussed above were evaluated under this scenario for each of the alternatives described below.
3. The *No Action Exploration/Development Scenario,* required by CEQ guidelines, was included to describe the impacts of no further development in the PAPA while recognizing that BLM could not impose the scenario because federal minerals were leased and BLM made the commitment to allow development of natural gas. The No Action scenario provided a benchmark against which to compare the impacts of the other anticipated levels of development.

The three exploration/development scenarios were analyzed within the framework of three "Mitigation Alternatives," constructed to incorporate different levels of mitigation requirements across the landscape during future implementation of one scenario or another. The three alternatives analyzed in the PAPA DEIS (BLM, 1999a) are:

- The *Standard Stipulations Alternative* assumed that either 500 or 700 producing well pads would be developed entirely under BLM's Standard Mitigation Guidelines (Appendix A of the DEIS) and lease stipulations. Impact analysis was based on an average of up to eight drilling rigs operating within the PAPA year-round. Unless required by lease stipulations, the *Standard Stipulations Alternative* generally did not limit the density of development (the number of potential well pad locations per section) within any of the SRMZs. In most cases, the alternative addressed impact from locating up to 16 well pads per section in each of the SRMZs.
- The *Resource Protection (RP) Alternative on Federal Lands and Minerals* analyzed the impacts of implementing the RP Alternative on only federal lands and minerals. This alternative assumed that either 500 or 700 producing well pads would be developed using BLM's Standard Mitigation Guidelines and lease stipulations. It disclosed the types of impacts that would remain even if BLM implemented additional controls to reduce undue impacts. It evaluated the benefits of slower paced development by limiting the number of rigs operating annually in the PAPA to five. This RP Alternative considered pad drilling as an option for reducing surface disturbance and human presence in the PAPA. Pad drilling refers to the practice of directionally drilling multiple wells, each with different bottom-hole locations, from a single well pad. The RP Alternative included the use of centralized production facilities to reduce storage of condensate and produced water on each well pad, collecting them at central locations for removal, thereby reducing truck traffic needed for liquids removal.
- The *Resource Protection (RP) Alternative on All Lands and Minerals* analyzed the impacts of implementing the RP Alternative throughout the PAPA (on all lands and minerals). This alternative assumed that either 500 or 700 producing well pads would be developed using BLM's Standard Mitigation Guidelines and lease stipulations. This alternative evaluated implementation of mitigation measures (pad drilling and centralized production facilities) on all lands and minerals. However, the alternative recognized that adoption of the additional mitigation measures on private and state lands and minerals would be strictly voluntary by operators and probably would not occur.

The PAPA ROD (BLM, 2000b) ultimately authorized the *Resource Protection Alternative on Federal Lands and Minerals* with expected implementation of the *Project Wide Exploration/Development Scenario* because it would include all of the PAPA and would be less restrictive should future exploration warrant development beyond the Anticline Crest. As analyzed in the PAPA DEIS (BLM, 1999a), the *Resource Protection Alternative on Federal Lands and Minerals* would have limited the pace of development by allowing no more than five drilling rigs operating in the PAPA at any one time. Only two drilling rigs on new locations north of the New Fork River would have been allowed on federal lands and minerals. This limitation was not carried forward in the PAPA ROD (see PAPA ROD: Management Considerations, page 36) using the following rationale:

> *"BLM has concluded that to limit the number of rigs working in the PAPA at any one time (on Federal and non-Federal lands and minerals combined) would be extremely difficult administratively. However of greater consequence and importance is the fact that the Operators are already seasonally restricted over a significant portion of the PAPA, leaving a relatively small window within which to complete field development activities*

(i.e., May 1 through July 1 restriction in many areas due to sage grouse nesting, mountain plover nesting, bald eagle nesting; July 1 through November 15 no restriction). The EIS proposed action and analysis inherently provides for a control on the pace of development. Many factors enter into this including availability of rigs, availability of workers, market price of natural gas, budgetary constraints, etc. Therefore, the BLM will place no restrictions on the number of rigs drilling within the PAPA at any one time. The Operator must be able to take advantage of the drilling window available."

4.1.1 Impact Analysis Related to the PAPA DEIS

The brief synopsis, above, of the three alternatives analyzed in the PAPA DEIS (BLM, 1999a), emphasizes the uncertainty of the anticipated future intensity and spatial (geographic) extent of natural gas development in the PAPA at the time. As BLM explained in the PAPA DEIS:

"At this point in time, insufficient information is available to understand exactly how the Pinedale Anticline should ultimately be developed (i.e., it is not currently possible to predict where the actual productive zones are located and what well density will be necessary to drain the reservoir(s) or adequately estimate ultimate production). However, the operators believe that at least 8 and as many as 16 bottom holes per section may be required to adequately drain productive zones which may be discovered in the future……Because so little of the PAPA has been explored and much remains to be understood about the ability of the anticline to economically produce natural gas, the operators have been unable to develop a detailed proposed action that specifies locations of wells and associated facilities (e.g., roads, gathering pipelines, etc.). The lack of available information to quantify development potential requires this EIS to consider a wide range of exploration/development scenarios and potential levels of development. This range includes considering the impacts from wide spread development across the full extent of the PAPA to no further additional exploration or development."

Even with that acknowledgement, there were assumptions specified in the PAPA DEIS (BLM, 1999a) that were applied to impact evaluations in the document, particularly evaluations of surface disturbance related to future wellfield development. The assumptions, included in Table 4.1-1, are the maximum of any analyzed in the PAPA DEIS. They were developed in the *700 Productive Well Pad Level of Development Scenario* under the *Standard Stipulations Alternative*. Assumptions applicable to surface disturbance analyzed for each of the RP Alternatives would have resulted in less short-term and long-term disturbance than for the *Standard Stipulations Alternative* in Table 4.1-1.

Over the 10 to 15 year period of development anticipated in the PAPA DEIS (BLM, 1999a), the wellfield components identified in Table 4.1-1 would have disturbed a total of 6,153 acres in the short-term (initial disturbance) and 1,909 acres in the long-term (LOP) under the *Standard Stipulations Alternative*.

Although such disturbance is not static, a best estimate for total wellfield disturbance since the PAPA ROD (BLM, 2000b) was issued is 4,118 acres through 2005. The Operators provided development plans for 2006 and this projected disturbance totals 381 acres. That total of 4,499 acres is in addition to 561 acres that had already been disturbed prior to July 2000. Some of the surface disturbance, before and after issuance of the PAPA ROD, has been revegetated, particularly within pipeline corridors, but the amount of reclaimed disturbance changes constantly as new pipelines are placed in existing, revegetated corridors or as roads and well pads are expanded.

Compared to the maximum surface disturbance estimate of 6,153 acres short-term and 1,909 acres long-term over 10 to 15 years of development analyzed in the PAPA DEIS (BLM, 1999a), the total amount disturbed by wellfield development is 4,499 acres within the 6 years following issuance of the PAPA ROD (BLM, 2000b). Although the total disturbance has not exceeded the disturbance analyzed in the PAPA DEIS (BLM, 1999a), the pace of development has exceeded the pace of development analyzed in the PAPA DEIS.

Table 4.1-1
Assumptions Utilized in the PAPA DEIS for Analyzing Impact[1]

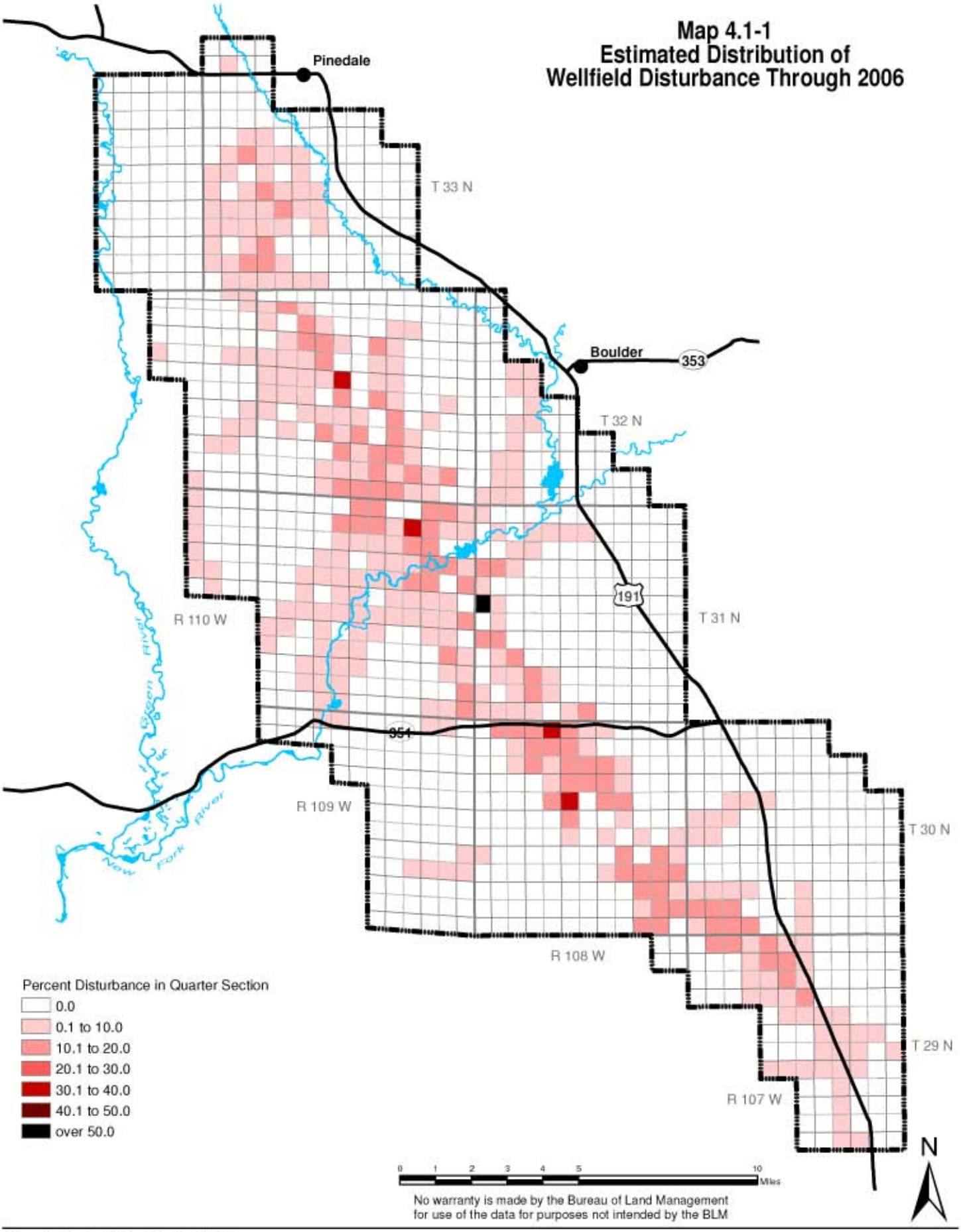
Wellfield Component	Maximum Number For Any Alternative	Short-Term Disturbance per Unit	Long-Term Disturbance per Unit	Maximum Short-Term Disturbance Analyzed	Maximum Long-Term Disturbance Analyzed
Period of Development	10 to 15 years	N/A	N/A	N/A	N/A
Number of Wells Drilled	60 to 90 wells/year	N/A	N/A	N/A	N/A
Number of Rigs Operating at a Time	average of 8 rigs, year-round	N/A	N/A	N/A	N/A
Producing Well Pads	700 pads	3.7 acres/well	1.5 acres/well	2,590 acres	1,050 acres
Dry Hole Well Pads[2]	200 pads	3.7 acres/well	0 acres/ well	740 acres	0 acres
Collector Roads	6 miles	6.3 acres/mile	4.4 acres/mile	38 acres	26 acres
Local and Resource Roads with Adjacent Gathering Pipelines	280 miles	8.5 acres/mile	2.9 acres/mile	2,380 acres	812 acres
Resource Roads to Dry Holes	80 miles	4.8 acres/mile	0 acres/mile	384 acres	0 acres
Compressor Sites	3 sites	7 acres/site	7 acres/site	21 acres	21 acres
			TOTAL	**6,153 acres**	**1,909 acres**

[1] Impact analysis for implementation of the 700 Productive Well Pad Level of Development Scenario under the Standard Stipulations Alternative.
[2] As of December 2005, 266 well pads were constructed since the issuance of the PAPA ROD and five of those contained a single non-producing well.

4.1.2 Spatial Analysis of Future Surface Disturbance

The inventory of wellfield disturbance through 2005 and the Operators' projections for 2006 form the baseline for all future natural gas development in the PAPA for all alternatives. The Operators provided their plans for both 2006 and for future long-term development in the PAPA; however, specific locations were not provided. To allow for spatial analysis, a model was developed to estimate the surface disturbance in each quarter section in 2006 and into the future for development under the No Action Alternative and the Proposed Action Alternative. A description of the distribution model is provided in Appendix L. Development information provided by the Operators for the Proposed Action Alternative was used to model disturbance for Alternative C through 2023. Although the geographic distribution of initial ground-disturbing actions might change, the amount of disturbance and general area of initial disturbance are assumed to be representative of long-term development.

The spatial (geographic) distribution and density of all existing wellfield disturbance is shown on Map 4.1-1, which is based on all development seen on the ground in satellite imagery for 2005 and new development projected by the Operators in 2006. The map displays the distribution and density of wellfield development through 2006 as a percentage of the area (within each quarter section) that is disturbed. The areas of initial surface disturbance have not been adjusted for reclamation efforts because it is impossible to predict when and where reclamation would occur over the landscape by the end of 2006. Likewise, there have been no attempts to


Map 4.1-1
Estimated Distribution of
Wellfield Disturbance Through 2006
Pinedale
Boulder
353
191
351
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
R 110 W
R 109 W
R 108 W
R 107 W
Green River
New Fork River
Percent Disturbance in Quarter Section
0.0
0.1 to 10.0
10.1 to 20.0
20.1 to 30.0
30.1 to 40.0
40.1 to 50.0
over 50.0
0 1 2 3 4 5 10
Miles
N
No warranty is made by the Bureau of Land Management
for use of the data for purposes not intended by the BLM

model how reclamation would offset initial wellfield surface disturbance in the future for each of the alternatives analyzed, below. The future distribution of wellfield development by any alternative is uncertain and therefore, differences should not be viewed as absolute. The Proposed Action Alternative and Alternative C through 2011 have more disturbance than the No Action Alternative. This is because winter restrictions would not apply in certain areas under the Proposed Action Alternative and Alternative C, essentially increasing the pace of development over the No Action Alternative. Distribution of surface disturbance between all alternatives through 2011 would be different; however, the distribution of surface disturbance for the Proposed Action Alternative and Alternative C through 2023 would be similar.

4.1.2.1 Alternative A (No Action Alternative)

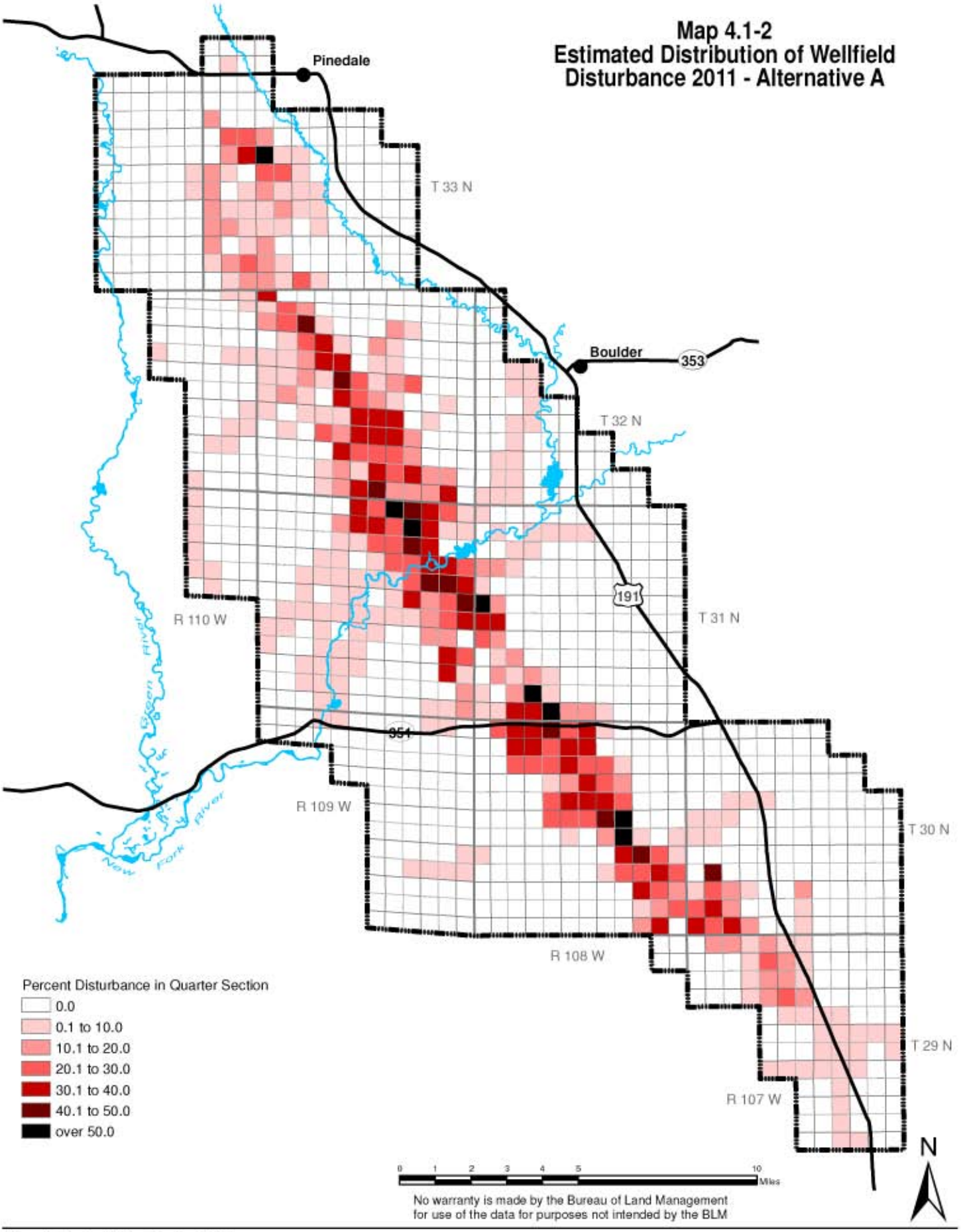
A projected distribution at the end of 2011 of one possible outcome of development under the No Action Alternative is shown on Map 4.1-2. Future wellfield development under the No Action Alternative would follow guidance in the PAPA ROD (BLM, 2000b). Specifically, numbers of new well pads projected by each Operator within each MA would be limited by the MA thresholds for total producing well pads established in the PAPA ROD. It is projected that the threshold of 212 producing well pads in MA 5 would be reached in 2009. The estimated distribution and density of wellfield disturbance accounting for the threshold is shown on Map 4.1-2. The distribution of disturbance includes disturbance as a result of new well pads, access roads to newly constructed well pads, gas gathering pipelines to new well pads, additional liquids gathering pipelines (to connect existing liquids gathering pipelines), and all trunk pipelines and ancillary facilities identified in Table 2.4-5.

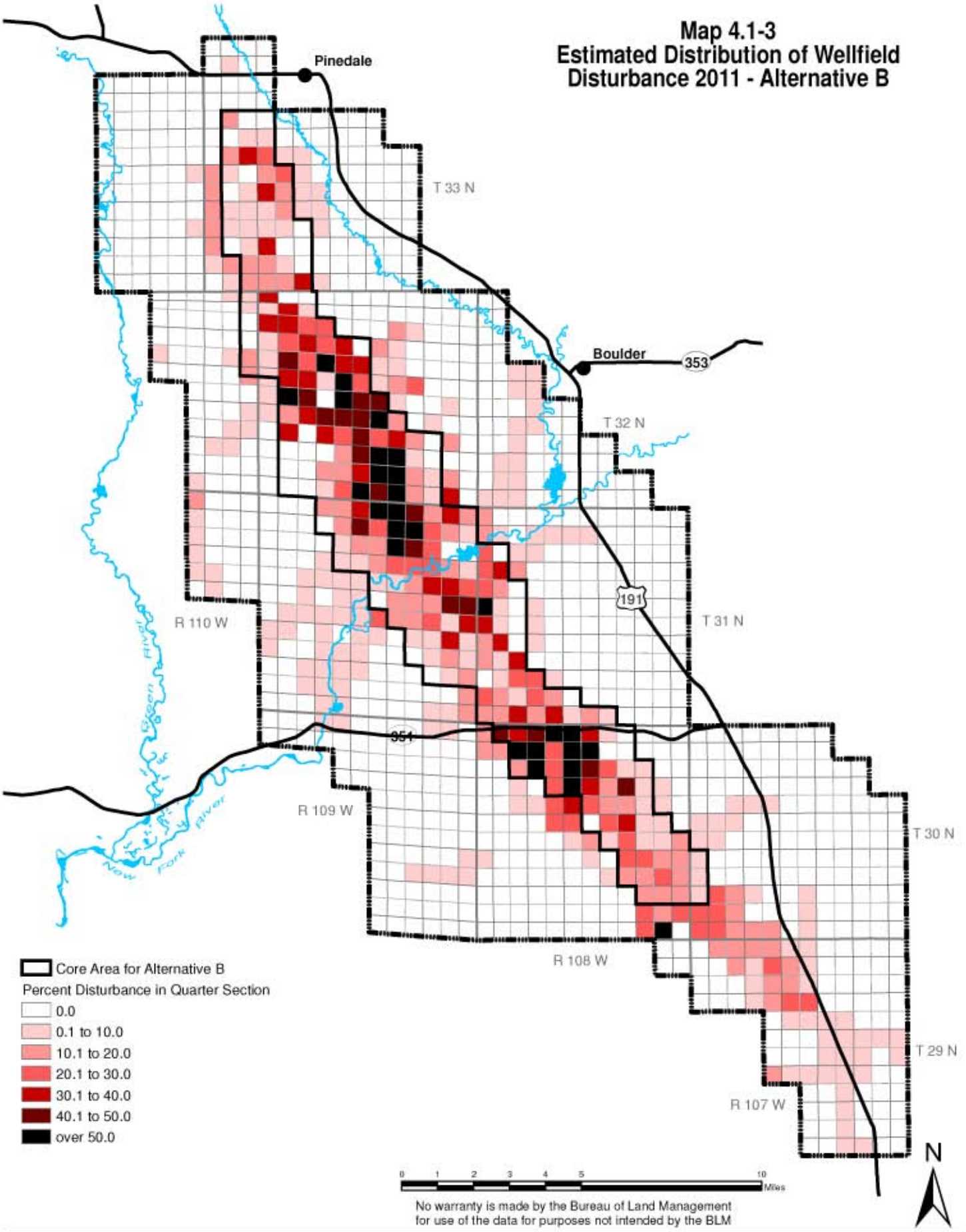
4.1.2.2 Alternative B (Proposed Action)

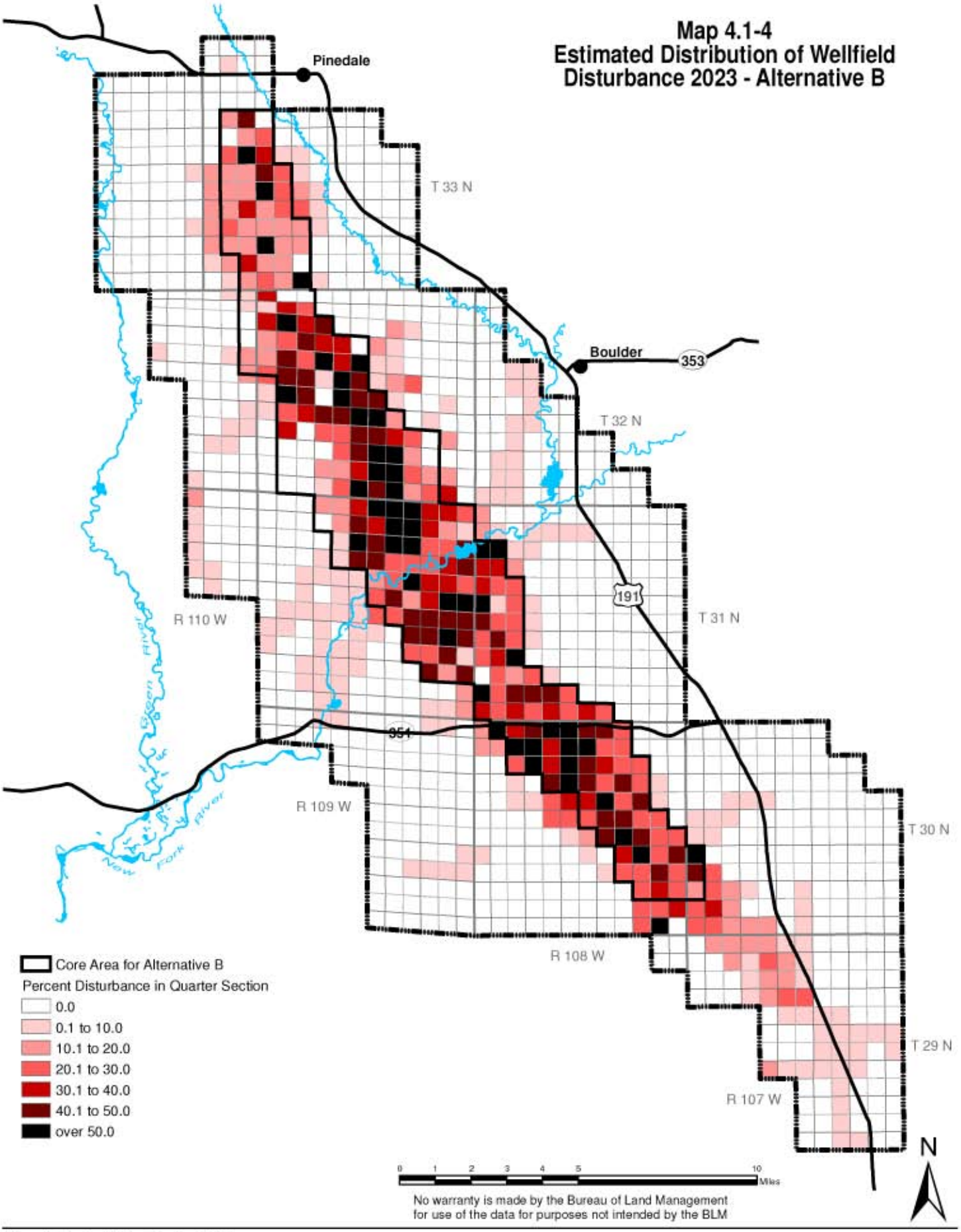
One possible scenario of distribution and density of wellfield disturbance at the end of 2011 under the Proposed Action Alternative is shown on Map 4.1-3. The Operators specified general locations of new and expanded well pads for years 2007 through 2011. Under the Proposed Action Alternative, year-round drilling would occur within each of three CDAs (see Chapter 2). The distribution of disturbance through 2011 and 2023, shown on Maps 4.1-3 and 4.1-4, respectively, includes newly constructed well pads, expansion of existing well pads, access roads to newly constructed well pads, and natural gas gathering pipelines to new well pads. Under this alternative, the distribution of disturbance includes the liquids gathering system proposed for the central and southern portions of the PAPA, and all pipelines and ancillary facilities identified in Table 2.4-8 (through 2011) and Table 2.4-9 (through 2023).

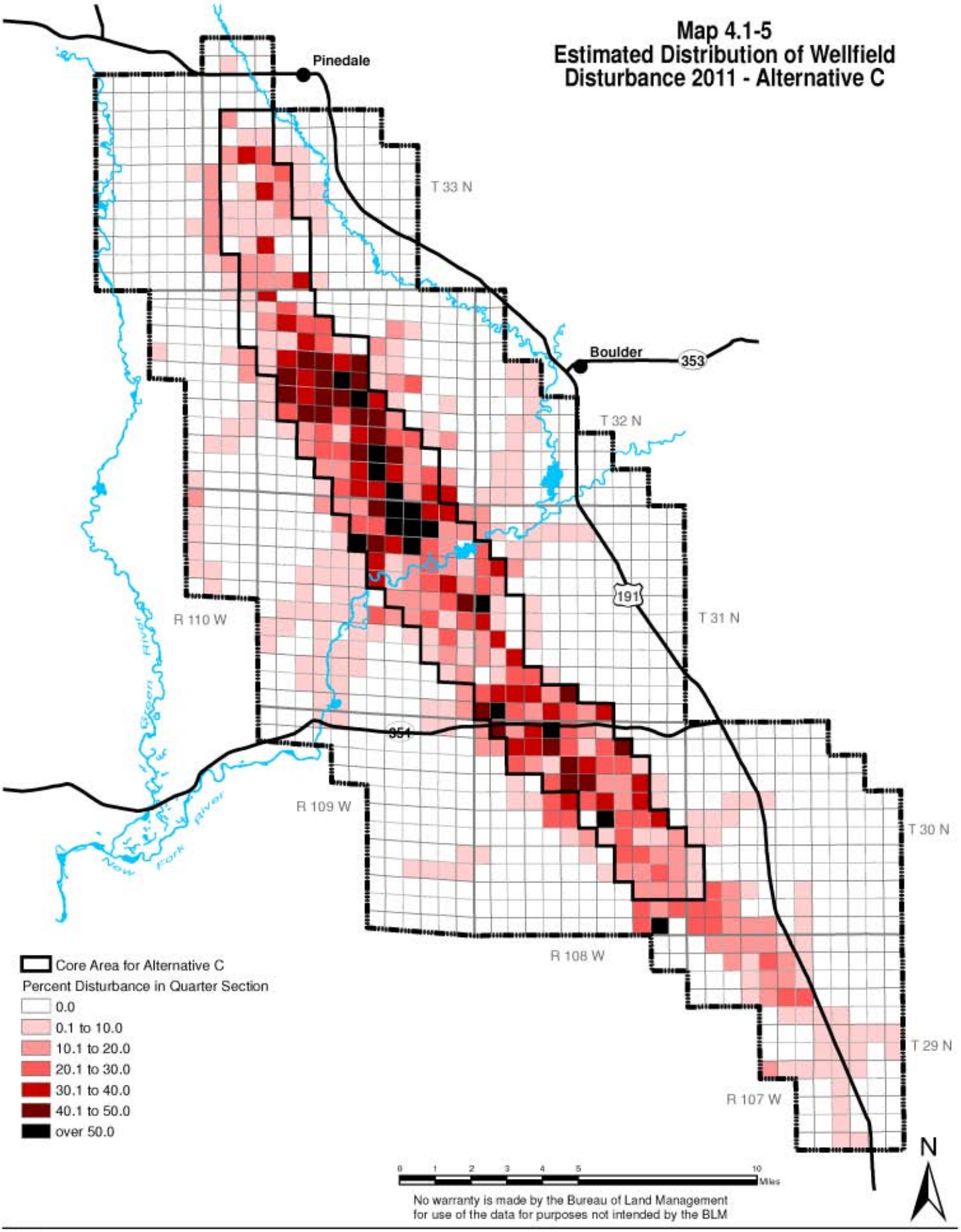
4.1.2.3 Alternative C

As with each of the other alternatives, the result of spatially modeling Alternative C through 2011 (Map 4.1-5) is one possibility of many outcomes. The spatial distribution of surface disturbance in the PAPA reflects that Alternative C focuses initial development within the south end of DA-1 and within DA-2 and DA-4. There are few additional surface disturbances in the northern portion of DA-1 and within DA-3. New disturbances these areas, and in DA-5, are due to new and/or expanded delineation pads, similar to disturbance by delineation pads under the Proposed Action Alternative. By 2023, surface disturbance associated with Alternative C (Map 4.1-6) would be similar to the spatial distribution of disturbance under the Proposed Action Alternative (Map 4.1-4). Disturbance shown include new well pads, expansion of existing well pads, access roads to newly constructed well pads, natural gas gathering pipelines to new pads, and the liquids gathering system similar to Alternative B. All of the trunk pipelines and ancillary facilities identified in Table 2.4-11 through 2011 and in Table 2.4-12 through 2023 are included in Map 4.1-5 and Map 4.1-6, respectively.


Map 4.1-2
Estimated Distribution of Wellfield Disturbance 2011 - Alternative A
Pinedale
T 33 N
Boulder
353
T 32 N
191
R 110 W
T 31 N
Green River
351
R 109 W
New Fork River
T 30 N
R 108 W
T 29 N
R 107 W
Percent Disturbance in Quarter Section
0.0
0.1 to 10.0
10.1 to 20.0
20.1 to 30.0
30.1 to 40.0
40.1 to 50.0
over 50.0
0 1 2 3 4 5 10
Miles
N
No warranty is made by the Bureau of Land Management
for use of the data for purposes not intended by the BLM


Map 4.1-3
Estimated Distribution of Wellfield Disturbance 2011 - Alternative B
Pinedale
Boulder
353
191
351
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
R 110 W
R 109 W
R 108 W
R 107 W
Green River
New Fork River
Core Area for Alternative B
Percent Disturbance in Quarter Section
0.0
0.1 to 10.0
10.1 to 20.0
20.1 to 30.0
30.1 to 40.0
40.1 to 50.0
over 50.0
0 1 2 3 4 5 10
Miles
N
No warranty is made by the Bureau of Land Management
for use of the data for purposes not intended by the BLM


Map 4.1-4
Estimated Distribution of Wellfield Disturbance 2023 - Alternative B
Pinedale
T 33 N
Boulder
353
T 32 N
191
R 110 W
T 31 N
351
R 109 W
T 30 N
R 108 W
T 29 N
R 107 W
Green River
New Fork River
Core Area for Alternative B
Percent Disturbance in Quarter Section
0.0
0.1 to 10.0
10.1 to 20.0
20.1 to 30.0
30.1 to 40.0
40.1 to 50.0
over 50.0
0 1 2 3 4 5 10
Miles
N
No warranty is made by the Bureau of Land Management
for use of the data for purposes not intended by the BLM


Map 4.1-5
Estimated Distribution of Wellfield Disturbance 2011 - Alternative C
Pinedale
Boulder
353
191
351
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
R 110 W
R 109 W
R 108 W
R 107 W
Green River
New Fork River
Core Area for Alternative C
Percent Disturbance in Quarter Section
0.0
0.1 to 10.0
10.1 to 20.0
20.1 to 30.0
30.1 to 40.0
40.1 to 50.0
over 50.0
0 1 2 3 4 5 10
Miles
N
No warranty is made by the Bureau of Land Management
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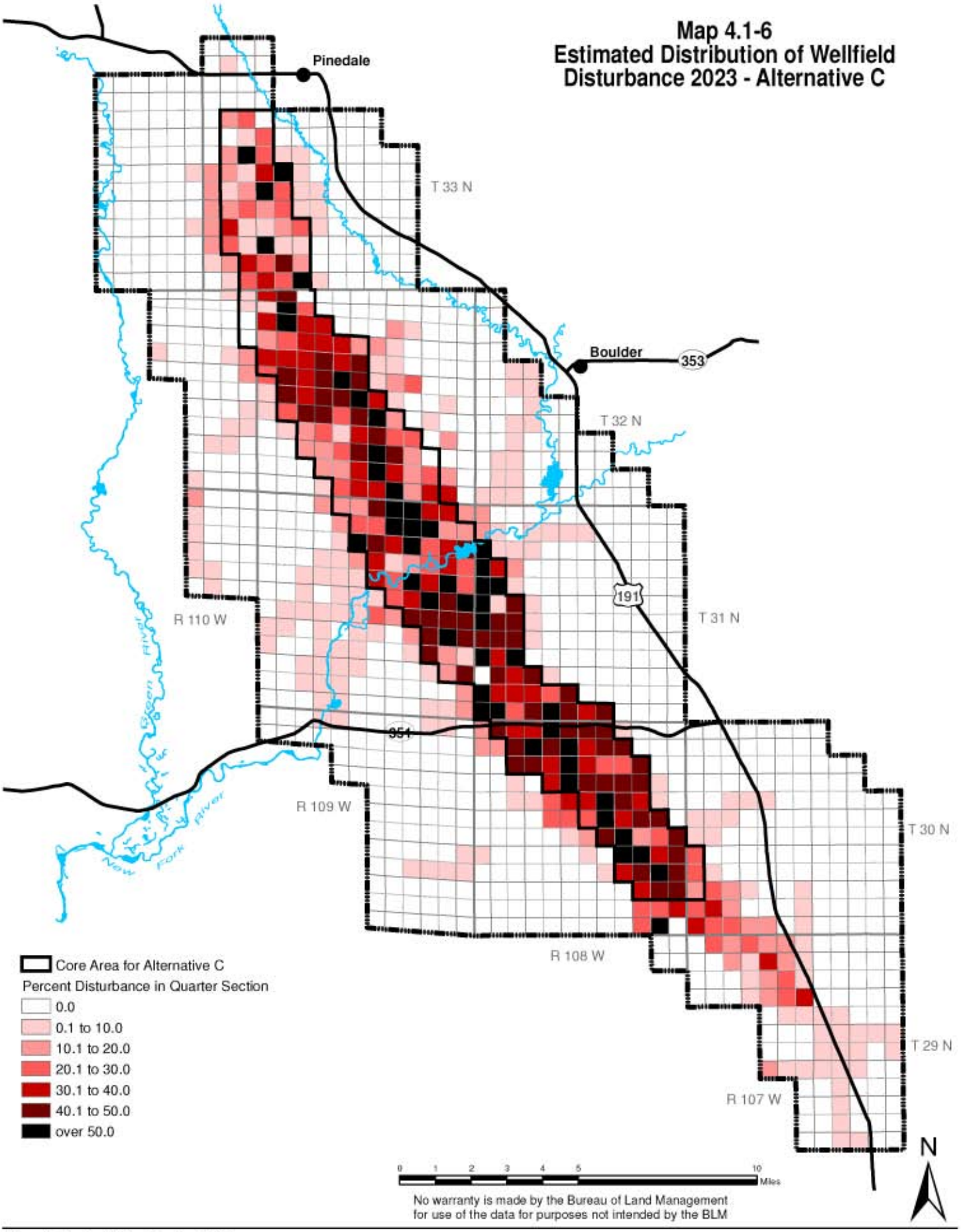
Map 4.1-6
Estimated Distribution of Wellfield Disturbance 2023 - Alternative C
Pinedale
T 33 N
Boulder
353
T 32 N
191
R 110 W
T 31 N
351
R 109 W
T 30 N
R 108 W
T 29 N
R 107 W
Green River
New Fork River
Core Area for Alternative C
Percent Disturbance in Quarter Section
0.0
0.1 to 10.0
10.1 to 20.0
20.1 to 30.0
30.1 to 40.0
40.1 to 50.0
over 50.0
0 1 2 3 4 5 10
Miles
N
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4.1.3 Relationship of Spatial Disturbance to Impact Assessment

The modeled distribution of wellfield disturbance in the PAPA under each alternative is the basis for evaluating impact. In the sections below, the actual acreage of total wellfield disturbance has been overlaid with the geographic distribution of each resource (i.e., soils, vegetation, wetlands, etc.).

As an example, the distribution of surface disturbance by quarter section in 2006 was overlaid with the Surface and Mineral Ownership GIS coverage (see Map 3.2-1).

Table 4.1-2 provides the amount (acres) of wellfield disturbance within each ownership category, estimated for each alternative through 2011, and for the Proposed Action Alternative and Alternative C through 2023. As expected (because of the slower pace of development due to winter drilling restrictions), implementation of the No Action Alternative through 2011 results in less disturbance to lands in the Federal Surface/Federal Minerals category and less disturbance within the PAPA overall, compared to the other two alternatives through 2011. Disturbance under the Proposed Action Alternative and Alternative C through 2023 would be similar, in each category and overall.

The pattern of surface disturbance is different within the ownership categories (Table 4.1-2) as wellfield development, by the Proposed Action Alternative and Alternative C, progresses through 2011. For example, there would be less initial surface disturbance on lands in the Private Surface/Private Minerals category by the Proposed Action Alternative compared to initial disturbances produced by Alternative C in 2011. The distinction is reversed by 2023 so that there would be more disturbance by the Proposed Action Alternative than by Alternative C on lands in that ownership category (Table 4.1-2). The reason for the reversal is related to the geographic and timing sequences of wellfield development by the two alternatives. When development is complete in 2023, the distribution and amount of surface disturbance would be similar for the Proposed Action Alternative and Alternative C. Adjustments have not been made for reclamation of initial surface disturbance in this table or any other table in this chapter.

Table 4.1-2
Surface Disturbance in Relation to Land and Mineral Ownership by Alternative

Ownership Category	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Federal Surface/Federal Minerals	3,980.9	3,788.4	5,950.8	5,724.8	10,708.5	10,828.0
Federal Surface/State Minerals	0.0	0.0	0.0	0.0	0.0	0.0
State Surface/State Minerals	507.7	153.9	278.6	339.6	370.6	426.6
Private Surface/Private Minerals	235.3	153.9	188.1	233.5	420.0	365.0
Private Surface/State Minerals	0.0	0.0	0.0	0.0	0.0	0.0
Private Surface/Federal Minerals	335.5	388.3	427.5	558.7	779.3	652.0
Total	**5,059.4**	**4,484.5**	**6,845.0**	**6,856.6**	**12,278.4**	**12,271.6**

Anticipated direct and indirect impacts to each resource are discussed in the sections below. Direct impacts include all effects caused by the action/alternatives that would occur at the same

time and place as the action/alternatives (40 CFR §1508.8). Indirect impacts are also caused or induced by the action/alternative but usually involve an intermediate step or process. Consequently, indirect impacts occur later in time or are farther removed in distance from the source of impact, but are still reasonably foreseeable (40 CFR §1508.8).

Cumulative impact analyses within the PAPA applied to the categories in this chapter are the sum of all surface disturbance by "*past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions*" (40 CFR § 1508.7). The analyses include all past and present wellfield disturbance and all existing, non-wellfield disturbance that has been measured within the PAPA. The existing non-wellfield surface disturbance includes agricultural areas, residential areas, industrial sites, Wenz Field (airport), Rendezvous Meadows Golf Course, municipal water treatment facility, gravel pits, stock watering facilities, various residential streets, and arterial highways.

The cumulative impact of surface disturbance in Table 4.1-3 from past and present actions has been added to surface disturbance estimated for each of the alternatives in the reasonably foreseeable future. Included are 426 acres of surface disturbance within the PAPA for new pipelines (R6 and PBC pipelines) for each land and mineral ownership category. Sections of this chapter discussing spatially oriented resources include comparative analyses of surface disturbance impacts associated with each alternative.

Table 4.1-3
Cumulative Surface Disturbance in Relation to Land and Mineral Ownership by Alternative

Ownership Category	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Federal Surface/Federal Minerals	428.0	3,980.9	8,574.8	10,737.2	10,511.2	15,494.9	15,614.4
Federal Surface/State Minerals	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State Surface/State Minerals	23.2	507.7	684.8	809.5	870.5	901.5	957.5
Private Surface/Private Minerals	5,621.5	235.3	6,035.6	6,069.8	6,115.2	6,301.7	6,246.7
Private Surface/State Minerals	4.2	0.0	4.2	4.2	4.2	4.2	4.2
Private Surface/Federal Minerals	1,390.0	335.5	2,137.7	2,176.9	2,308.1	2,528.7	2,401.4
Total	**7,466.9**	**5,059.4**	**17,437.1**	**19,797.6**	**19,809.2**	**25,231.0**	**25,224.2**

4.1.4 Scoping Issues

Issues pertinent to each resource identified through the public scoping process are included in the introductory impact analysis sections. However, several issues did not fall within a particular resource's domain. The following eight concerns pertain to continued and future development in the PAPA:

1. The pace of development is a concern.
2. A decision should be delayed until BLM has fully evaluated the consequences of previously approved winter drilling projects.

3. BLM should implement adaptive management as a means of determining adequacy of existing research and monitoring programs and determine how management of development would be changed (in addition to applying waivers, modifications or exceptions) once impacts are detected.
4. Current and future operators should be held to commitments and responsibilities through effective monitoring and enforcement.
5. BLM should require all mitigation (directional drilling, gathering system, reduced surface disturbance) and application of improved technology (drilling and casing techniques to prevent blowouts) without removing seasonal stipulations.
6. There is concern over existing compliance with regulatory standards for air quality and water quality, including residential water sources.
7. BLM should consider at least one conservation alternative.
8. An alternative should be considered that protects wildlife habitat in portions of the PAPA while allowing development in other portions.

4.2 ENVIRONMENTAL JUSTICE

Chapter 4 of the PAPA DEIS (BLM, 1999a) provides a discussion of the basis for Environmental Justice, and it is not repeated here. The PAPA DEIS referred to the Bureau of Census 1990 population and determined that the racial composition of Sublette County was predominantly white (approximately 97 percent). There are no Indian Tribes in the area affected by any of the alternatives.

Table 3.4-1 provides data from the Bureau of Census 2000 Racial Composition. The data indicate that the racial composition of the three-county area (Sublette, Lincoln and Sweetwater) is still predominantly white (greater than 90 percent overall and greater than 97 percent in Sublette County and Lincoln County). Therefore, the racial composition has not changed since the PAPA DEIS (BLM, 1999a). Table 3.4-1 shows that in all three counties, less than 10 percent of the population is below the poverty line compared to more than 11 percent in Wyoming and more than 12 percent in the United States.

The BLM has determined that none of the alternatives would result in a disproportionately high and adverse human health or environmental impact on minority populations, low-income populations, or Indian Tribes.

4.3 SOCIOECONOMIC RESOURCES

4.3.1 Scoping Issues

Concerns about impacts to socioeconomic resources received during scoping focused on economic stability and the related issues of stable employment, housing, safety, and the human environment. Concerns related to socioeconomic resources are:

1. Though the proposal will provide jobs and economic stability for Sublette County citizens, there is concern for a potential economic “bust”, once development ends.
2. Maintaining winter restrictions would affect seasonal employment, housing, safety, and the human environment in Pinedale and surrounding communities.

4.3.2 Impacts Considered in the PAPA DEIS

Given that little was known about the potential of the PAPA to produce economically recoverable natural gas at the time the PAPA DEIS (BLM, 1999a) was prepared, it was impossible to predict ultimate gas recovery. Without such an estimate, overall revenues from the PAPA were impossible to predict. However, many individuals believed there was potential

for positive revenue impacts during scoping in 1999. The following were key assumptions made in the PAPA DEIS about future impact to socioeconomic resources:

- the positive impact to county-wide employment was not expected to be significant, as most employment would result from drilling and completion activities, which were not expected to rely heavily upon local hires;
- a few new residents could be expected in Pinedale;
- increased direct and indirect local employment was expected to be negligible;
- continued exploration and development was not expected to increase housing demand above that presently available;
- some workers might decide to occupy motels in Pinedale, particularly in the winter when rates and occupancy would be low;
- with the exception of ambulance service, increases in demand for local government facilities and services were not expected to exceed capacity; and
- adequate revenues would have been generated by the project to cover any additional costs incurred by local governments.

The PAPA DEIS (BLM, 1999a) considered that the following would be significant impacts, positive and negative, to socioeconomic resources by implementation of any of the alternatives evaluated in the PAPA DEIS (BLM, 1999a), except for the *No Action Exploration/Development Scenario*:

- increased demand for housing resulting from project activities which exceed supply;
- short- or long-term increases in demand for local government facilities or services which exceed existing capacity and are not offset by adequate revenues from continued exploration and development; and
- a 10 percent change in county government revenues or in county-wide employment.

In the PAPA DEIS (BLM, 1999a), based on the criteria above, all alternatives were expected to have a negligible impact on housing demand. In the time since the PAPA DEIS (BLM, 1999a), however, the permanent population of Sublette County grew 17 percent, Lincoln County grew 10 percent, and Sweetwater County grew less than 1 percent. Furthermore, for the period 2006 through 2020, population of the three-county region is forecasted to grow an estimated 10 percent (Table 3.5-7). Housing demand in the three-county region has exceeded supply and the trend is expected to continue (assuming significant recoverable reserves continue to be located and developed in the PAPA).

In the PAPA DEIS (BLM, 1999a), all alternatives, except the *No Action Exploration/Development Scenario*, were expected to have, and have had, a significant positive impact on Sublette County government revenues, due to location and development of significant recoverable reserves in the PAPA. All alternatives were expected to have a negligible effect on employment. Employment, however, has increased significantly (52.5 percent in Sublette County and 17.7 percent in Sweetwater County), as shown in Table 3.5-12. An estimated 14.7 percent of workers employed in the three-county region are employed in jobs associated with exploration and development in the PAPA (see Table 3.5-4).

Several of the key assumptions made in the PAPA DEIS (BLM, 1999a) have been challenged by development in the PAPA occurring from 1999 through 2006. Drilling and completion activities were not expected to rely heavily upon locally hired workers, yet 40 percent of those employed in the PAPA reside in the three-county region. The three-county region was not

expected to have many new residents, yet there are 2,794 new residents (2005 estimate, U.S. Census Bureau – see Table 3.5-6), a population growth rate for the three-county region of 5 percent over 5 years.

In the PAPA DEIS (BLM, 1999a), housing demand was not expected to exceed existing vacancies, yet from 2000 to 2004, the change in the number of housing units was 10.8 percent in Lincoln County, 8.6 percent in Sublette County, and 1 percent in Sweetwater County. Though workers were only expected to stay in Pinedale motels in the winter, demand for motel rooms year-round exceeded supply from 1999 to 2006.

4.3.3 Alternative Impacts

Economic impacts are presented in terms of real and nominal impact. A real discount rate was used to adjust and to eliminate the effect of expected inflation to determine the discounted constant-dollar (present value or "real value") of benefits and costs. The real discount factor is calculated as $1/(1+i)^t$ where i is the interest rate and t is the project year (Office of Management and Budget, 2006). The present value is the value of the activities after the real discount rate has been applied over time. As presented herein, the nominal value of project activities is the simple calculation of dollars with no adjustment (here, in 2003 dollars). The discount rate used for this analysis is 7 percent.

4.3.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Activities Within the PAPA

Local infrastructure, facilities, and services (including ambulance service) have grown to meet increased demand. Tax and royalty revenues from the PAPA have helped local governments to meet these additional costs. There is increased drug and alcohol abuse and diversity of school populations which stretch the affected communities and which impose both fiscal and non-pecuniary costs.

In addition to the market costs and benefits associated with oil and gas drilling and production in the PAPA, non-market economic values are being affected by development, i.e., economic values associated with amenities such as clean air, clean water, open space, and preservation of crucial wildlife habitat that are not bought or sold directly. These amenities have non-market values associated with both use and non-use. For example, it may be worth something to stakeholders to know that open space exists in the PAPA whether or not they visit the PAPA. Though not quantified here, these non-market economic values are affected by all alternatives analyzed in this Draft SEIS.

Although there is evidence of increased demand for housing, increased employment, increased local government revenues, and the accompanying demand for local infrastructure and amenities, the character of the economic growth occurring in the three-county region appears to differ from "booms" that occurred in the region in the 1980s. Sixty percent of the oil and gas workers are non-local (Jacquet, 2006). This non-local workforce is composed of different people cycling through the three-county region, and contract workers who come and go. Accordingly, while these non-local workers make direct, indirect, and induced contributions to economic activity in the three-county region, in some cases they exert less demand on the rental housing market, and population statistics reflect their presence less than would otherwise be seen in a boom involving more local workers.

Housing Demand. From 2000 to 2005, a majority of PAPA workers were based in Pinedale, Boulder, Marbleton, La Barge, and Big Piney. In southwestern Wyoming, local motels and RV parks often experienced year-round full occupancy, rental housing costs increased, and the rental market was tight (see Table 3.5-14 through Table 3.5-17). In Pinedale, 161

motel rooms have been added since 1999 (Sublette County Chamber of Commerce, 2006). A growing number of PAPA workers may be relocating permanently to Sublette County. BLM is analyzing the potential for additional remote housing for workers.

In late 2005, a casual survey was conducted of 524 natural gas industry workers for the PAPA and Jonah Field Project Area. Almost half of the respondents (212) considered themselves non-residents, and 64 percent of these non-residents (136 individuals or families) said they were at least considering permanently relocating to the area. Respondents were more interested in moving to Sublette County (especially Pinedale and Boulder) than Sweetwater County (Sublette SE, 2006). As long as employment in the PAPA is strong and demand for housing exceeds supply, market pressure on housing costs would contribute to a higher cost of living and higher inflation rates.

Demand for Services and Facilities. Potentially impacted services include schools, rural fire departments, emergency medical services, and law enforcement. Three of the five school districts in the three-county region are experiencing increased enrollments. The two Sublette CSDs and the Sweetwater ISD #1 are planning to add schools to accommodate increasing student numbers, particularly in the elementary schools (see Table 3.5-18). Both the Pinedale Volunteer Fire Department and the Sublette Rural Health Care District have added equipment and personnel during the period 1999 to 2006 and are adequately meeting demands (Mitchell, 2006 and McGinnis, 2006). Law enforcement agencies in the three-county region report increasing demand for services and some stress on existing resources, but also that local governments are being responsive to their resource requests and their concerns (Hanson, 2006a, McConkie, 2006 and Kessler, 2006).

Boom-Bust Characteristics. To date, in the three-county region, there has been only limited cyclical activity in employment and earnings associated with activity in the PAPA. Under all alternatives, employment is strongest during the development phase (well drilling and completion), and then drops when the field is in the production phase only. Production makes less difference than drilling in employment and earnings trends associated with activity in the PAPA. Because drilling extends for a longer period under the Proposed Action Alternative and Alternative C than under the No Action Alternative, total earnings from oil and gas production would drop more sharply and sooner under the No Action Alternative. Furthermore, total nominal earnings in each year are greater under the Proposed Action Alternative and Alternative C than under the No Action Alternative.

Economic Benefits. Table 4.3-1 shows the direct, indirect, and induced economic effects to the local economy (Lincoln, Sublette, and Sweetwater counties) from natural gas drilling in the PAPA on a per-well basis. Impact from drilling was analyzed using estimates of economic activity for the three-county region generated using the IMPLAN model, a community impact assessment modeling system using input-output analysis (Minnesota IMPLAN Group, 2006). Each well drilled puts $4,715,100 directly into the local economy (local earnings plus wages to employees). Indirect contributions, associated with secondary economic goods and services attributed to industrial purchases in conjunction with PAPA drilling, amount to $497,776. Induced contributions, associated with household purchases by the employees involved in direct and indirect economic activities in the PAPA, amount to $322,985. The Operators currently estimate that 40 percent of the workers drilling a typical well in the PAPA reside locally. It is estimated that 47.4 total jobs are associated with a typical well in the PAPA. The direct economic employment is 38 workers in the PAPA to drill a typical well. An additional 5.3 workers are employed in activities that have an indirect economic impact. Finally, 10.2 workers are employed in activities that have an induced economic impact. Average annual earnings per drilling job are $51,291 for 2007 through 2011. An annual job equivalent is one job for 12 months, two jobs for 6 months or three jobs for 4 months. This exceeds the average earnings per job in Lincoln County ($30,438), in Sublette County ($31,715) and in Sweetwater County ($38,698), thus employment in the PAPA would contribute to raising wage levels in the three-county region for the period 2007 through 2011.

Table 4.3-1
Economic Impact of PAPA Drilling[1]

Output	Dollars Per Well 40 Percent Local Workers
Direct	4,715,100
Indirect	497,776
Induced	322,985
Total	5,535,861
Employment, Number of Workers:	
Direct (local 40%)	15.2
Indirect (non-local 60%)	22.8
Indirect	5.3
Induced	4.1
Total	47.4
Worker Earnings:	
Direct	$2,187,536
Indirect	$152,073
Induced	$90,570
Total Worker Earnings	$2,430,179
Average Earnings Per Job	$51,291

[1] In 2003 Dollars.

The estimates of oil and gas production in the PAPA assume that the life of an average well is 40 years, and that it produces 5,000 MMCF (million cubic feet) of natural gas and 35,000 barrels of condensate. Accordingly, average annual natural gas production is 125 MMCF of natural gas and 875 barrels of condensate. This is an annual average and does not imply that a single well produces this level each year. Production rates are typically highest when a well is first drilled, declines rapidly, and then levels off for the life of the well (Figure 4.3-1).

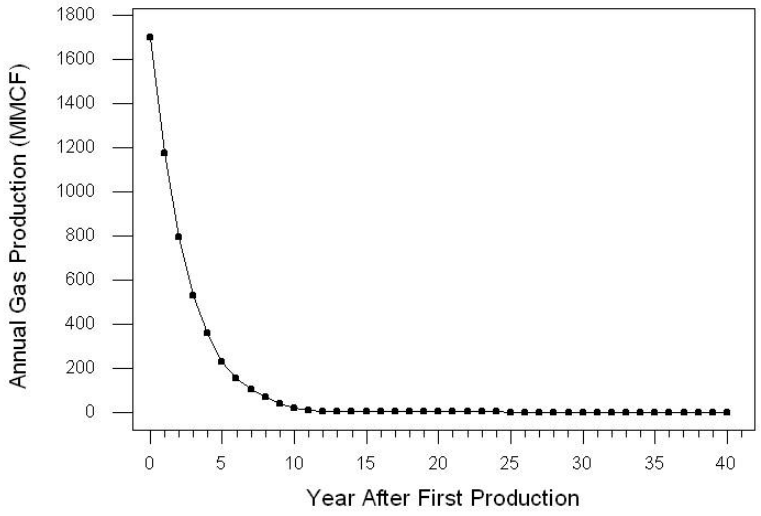

Figure 4.3-1
Estimated Average Well Production Profile

Table 4.3-2 assumes that all workers employed in production in the PAPA reside in the three-county region. For each MMCF of natural gas produced, activity in the PAPA generates $5,020.00 in direct economic impacts (i.e., local earnings plus wages paid to those employed in the PAPA), $158.08 in indirect economic impacts (i.e., secondary economic activity due to industrial purchases), and $32.54 in induced economic impacts (i.e., household expenditures by PAPA employees). The total economic impact generated by one MMCF of PAPA natural gas from drilling is $5,210.62. There is one direct job in oil and gas extraction per 996 MMCF of natural gas produced in the PAPA. The average annual earnings per job for a worker involved in natural gas production in the PAPA are $52,243.

Table 4.3-2
Economic Impact of PAPA Production[1]

Output	Per MMCF Produced	Per Average Well, Per Year
Direct	$5,020.00	$627,500
Indirect	$158.08	$19,760
Induced	$32.54	$4,067.50
Total	$5,210.62	$651,327.50
Employment:		
Direct	0.001004	0.1255
Indirect	0.000502	0.06275
Induced	0.000502	0.06275
Total	0.002008	0.251
Earnings:		
Direct	$66.74	$8,342.50
Indirect	$29.04	$3,630.00
Induced	$9.12	$1,140.00
Total	**$104.90**	**$13,112.50**

[1] In 2003 Dollars.

Figure 4.3-1 shows the profile of annual natural gas production for an average well in the PAPA. This profile is used in forecasting production earnings over time in the PAPA .

Government Revenues. The potential for development of the PAPA to provide significant economic benefit to federal, state, and local governments can be demonstrated by considering the revenues generated by the PAPA since the PAPA DEIS (BLM, 1999a) (see Tables 3.5-19, 3.5-20, and 3.5-21).

Table 4.3-3 provides the royalty and tax revenues generated by a PAPA well in 2006. The estimates of oil and gas production for an average PAPA well assume that the life of a well is 40 years, and that it produces 5,000 MMCF of natural gas and 35,000 barrels of condensate. Accordingly, average annual natural gas production is 125 MMCF and average annual condensate production is 875 barrels.

Table 4.3-3
Royalties and Tax Revenues for a Typical Natural Gas Well in the PAPA in 2006[1]

Tax and Royalty Revenues	$/MMCF	$/Well/Year
Federal mineral royalty – U.S. Government	500.00	64,976
Severance tax – State of Wyoming	304.70	39,597
Ad valorem (production) – Sublette County	320.00	41,585
TOTAL	**1124.70**	**146,158**

[1] Represents the total federal mineral royalties for natural gas production and gas plant products in Wyoming divided by the natural gas production sales volume for Wyoming in 2005.
Source: Mineral Management Services, 2006.

Royalties are paid on net revenues (gross revenues minus operating expenses). State severance tax and ad valorem taxes are paid after royalties are deducted. Approximately 78 percent of the existing well pads in the PAPA have been drilled on federal leases; the federal royalty is 12.5 percent of production revenues (after operating costs). Wells on state owned minerals incur royalties to the State of Wyoming (16.7 percent of production revenues, after operating costs) and royalties on privately owned minerals are paid to the owner of the mineral rights. A typical PAPA well to generated $500 per MMCF in federal mineral royalty payments in 2005. Half of the federal mineral royalty was returned to the State of Wyoming ($250 per MMCF). The State of Wyoming distributes the returned portion of the federal mineral royalty from a typical PAPA well as shown in Table 4.3-4.

Table 4.3-4
State of Wyoming Distribution of Federal Mineral Royalty for a Typical Gas Well in the PAPA in 2005

Percent Allocation of State Share	Percent
Cities and towns	3.0
University of Wyoming	2.1
Foundation funds	35.7
Capital facility revenue boards	1.0
Highway fund	9.6
Highway fund – state roads	0.7
Cities, counties and special district capital construction	1.2
School district grants	0.9
General fund – 1 percent	0.3
Budget reserve account	45.5
Total	**100.0**

Ad valorem taxes (i.e., property taxes) from the PAPA are paid to Sublette County. The total ad valorem taxes collected in Sublette County during 2005 were $164 million (Montgomery, 2006). Ninety four percent of the total ad valorem taxes collected were from mineral production (compared with 75 percent in 1998). As the value of the mineral production in the county increases, the mil levy tends to decrease, creating a situation in which all other taxpayers (residential, commercial, industrial, and agricultural) pay lower taxes. If economically recoverable PAPA reserves continue to be developed and/or if production from the PAPA increases, then the percentage of total property taxes paid by non-mineral taxpayers would continue to decrease.

The distribution of ad valorem taxes (using the 2005 mil levy structure) is shown in Table 4.3-5. The calculations assume that, on average, a PAPA well produces 125 MMCF of natural gas and 875 barrels of condensate per year over the 40-year life of the well.

Table 4.3-5
Distribution of Ad Valorem Tax Collected by Sublette County from a Typical PAPA Well during Production in 2005

Entities Receiving Ad Valorem Tax Shares	Percent	Dollars per MMCF	Dollars per well
Total ad valorem tax collected on production		320.00	41,585
Allocated as Follows:			
State of Wyoming Schools (12 mils)	20.6	65.96	8,571
Sublette County Schools (32 mils)	55.0	175.88	22,857
Total Tax Retained by Sublette County			
County General Fund (10.82 mils)	18.6	59.47	7,728
Fair (0.083 mils)	0.1	0.46	59
Airport (0.103 mils)	0.2	0.57	74
Library (0.219 mils)	0.4	1.20	156
Museum (0.136 mils)	0.2	0.75	97
Recreation (0.241 mils)	0.4	1.32	172
Fire (0.399 mils)	0.7	2.19	285
Rural Health (2.0 mils)	3.4	10.99	1,429
Weed & Pest (0.17 mils)	0.3	0.93	121
Upper Green Cemetery (0.049 mils)	0.1	0.27	35
Source: Montgomery, 2006 Note: School funding does not consider recapture by the state.			

Approximately 20 percent of the total property tax collected by Sublette County would be sent to the State of Wyoming School Foundation ($8,571 per well). In some years, additional ad valorem tax revenue could go to State School Funding, subject to recapture provisions that are determined by the Wyoming legislature. The remaining tax (approximately $33,014 per well) would stay in Sublette County and would be distributed as shown in Table 4.3-5.

Pipeline Corridors and Gas Sales Pipelines

Effects on socioeconomic conditions from the establishment of the transportation corridors and construction of gas sales pipelines would be generally less than 1 year. A peak workforce of 200 to 300 workers for construction of an individual pipeline is projected for 3 to 5 months. Both qualified local workers and non-local workers would make up the workforce for each pipeline project. These jobs are mostly temporary in nature and therefore, non-local workers would be likely to make up a majority of the workforce. For similar pipeline projects in the region, it has been typical for non-local workers to make up 50 to 80 percent of the workforce (Northwest Pipeline Corporation, 2005). An estimated 30 percent of non-local workers would bring their own temporary housing (i.e., recreational vehicles or tents) (Entrega, 2004). A temporary increase in demand for housing is expected in communities near the proposed pipeline alignments during a period when temporary housing markets are already being strained by demand. There would be increased demand for a limited range of community services,

including emergency response, medical services, and law enforcement. Construction of pipelines would generate additional economic benefits of employment and income and subsequent expenditures by workers for goods and services in the affected counties (Sublette, Sweetwater, Lincoln and Uinta). Additional public sector revenues for federal, state, and local government entities would be generated. Once constructed, a relatively small number of workers (i.e., five to ten professionals) would be required to operate and maintain the pipelines.

There would be a potential for accidents and fires, including those along transportation/access routes, along pipeline rights-of-way, and at work sites. Accidents or fires would require emergency response (fire suppression and/or ambulance) and law enforcement services.

4.3.3.2 Alternative A (No Action Alternative)

Table 4.3-6 shows the employment and nominal earnings associated with drilling in the PAPA under the No Action Alternative. The IMPLAN model (Minnesota IMPLAN Group, 2006) was used to analyze estimates of economic activity for the three-county region under all alternatives.

Table 4.3-6
Employment and Nominal Earnings associated with
Drilling under the No Action Alternative (2007 through 2011)[1,2]

Year	Total Wells	Total Employment 47.4 workers/well	Total Earnings $2,430,179/well
2007	231	10,945	$561,371,257
2008	235	11,134	$571,091,971
2009	236	11,182	$573,522,150
2010	217	10,281	$527,348,756
2011	220	10,424	$534,639,292
Total	1,139	53,966	$2,767,973,426
Average	228	10,793	$553,594,685
Net Present Value, 2007-2011			$2,275,127,060

[1] In 2003 dollars.
[2] Assumes 40 percent of workers are local.

Under the No Action Alternative, the net present value of the stream of earnings from drilling is $2,275,127,060. Table 4.3-7 shows the employment and nominal earnings associated with production in the PAPA under the No Action Alternative.

Table 4.3-7
Employment and Nominal Earnings associated with
Production under the No Action Alternative (2007 through 2051)[1]

Year	Number of Production Workers	Total Earnings
2007	972	$50,762,813
2008	1,209	$63,176,566
2009	1,405	$73,401,367
2010	1,510	$78,881,786
2011	1,571	$82,087,680
2012	1,581	$82,592,124
2013	1,081	$56,498,122
2014	741	$38,716,229
2015	509	$26,585,613
2016	350	$18,299,698
2017	242	$12,631,437

Year	Number of Production Workers	Total Earnings
2018	167	$8,747,026
2019	116	$6,079,566
2020	81	$4,243,377
2021	57	$2,975,866
2022	40	$2,098,078
2023	28	$1,487,930
2024	20	$1,062,025
2025	15	$763,310
2026	11	$552,683
2027	8	$403,290
2028	6	$296,646
2029	4	$219,987
2030	3	$164,472
2031	2	$123,958
2032	2	$94,151
2033	1	$72,044
2034	1	$55,513
2035	1	$43,052
2036	1	$33,586
2037	1	$26,342
2038	0	$20,759
2039	0	$16,429
2040	0	$13,050
2041	0	$10,398
2042	0	$8,269
2043	0	$6,563
2044	0	$5,189
2045	0	$4,046
2046	0	$3,134
2047	0	$2,315
2048	0	$1,630
2049	0	$1,074
2050	0	$624
2051	0	$281
Net Present Value, 2007-2051		$435,068,074

[1] In 2003 dollars.

The net present value of the stream of earnings from production in the PAPA under the No Action Alternative, 2007 through 2051 is $435,068,074. Under the No Action Alternative, production in the PAPA would continue through 2051, generating federal, state, and local tax revenues, as described in Table 4.3-8.

Table 4.3-8
Nominal Tax Revenues associated with Drilling (through 2011) and Production (through 2051) under the No Action Alternative[1]

Year	Total FMR ($500 per MMCF)	FMR-Wyoming ($250 per MMCF)	Severance Tax ($304.70 per MMCF)	Ad Valorem Production ($320 per MMCF)
2007	$219,049,562	$109,524,781	$133,488,803	$140,191,719
2008	$272,611,265	$136,305,633	$166,129,305	$174,471,210
2009	$316,734,274	$158,367,137	$193,017,867	$202,709,936
2010	$340,379,177	$170,189,589	$207,427,071	$217,842,673
2011	$359,183,241	$179,591,620	$218,886,267	$229,877,274
2012	$246,678,246	$123,339,123	$150,325,723	$157,874,077
2013	$169,232,530	$84,616,265	$103,130,304	$108,308,819
2014	$116,362,836	$58,181,418	$70,911,512	$74,472,215

Year	Total FMR ($500 per MMCF)	FMR-Wyoming ($250 per MMCF)	Severance Tax ($304.70 per MMCF)	Ad Valorem Production ($320 per MMCF)
2015	$80,219,878	$40,109,939	$48,885,994	$51,340,722
2016	$55,470,992	$27,735,496	$33,804,023	$35,501,435
2017	$38,491,429	$19,245,714	$23,456,677	$24,634,515
2018	$26,815,866	$13,407,933	$16,341,589	$17,162,154
2019	$18,766,351	$9,383,175	$11,436,214	$12,010,465
2020	$13,199,859	$6,599,929	$8,043,994	$8,447,910
2021	$9,336,974	$4,668,487	$5,689,952	$5,975,664
2022	$6,645,588	$3,322,794	$4,049,822	$4,253,177
2023	$4,761,917	$2,380,959	$2,901,912	$3,047,627
2024	$3,436,842	$1,718,421	$2,094,412	$2,199,579
2025	$2,499,435	$1,249,718	$1,523,156	$1,599,639
2026	$1,832,151	$916,075	$1,116,513	$1,172,576
2027	$1,353,940	$676,970	$825,091	$866,522
2028	$1,008,748	$504,374	$614,731	$645,599
2029	$757,669	$378,835	$461,724	$484,908
2030	$573,593	$286,797	$349,548	$367,100
2031	$437,541	$218,770	$266,637	$280,026
2032	$336,159	$168,079	$204,855	$215,142
2033	$259,999	$130,000	$158,444	$166,400
2034	$202,334	$101,167	$123,302	$129,494
2035	$158,340	$79,170	$96,492	$101,337
2036	$124,535	$62,267	$75,892	$79,702
2037	$98,386	$49,193	$59,956	$62,967
2038	$78,033	$39,017	$47,554	$49,941
2039	$62,105	$31,052	$37,847	$39,747
2040	$49,576	$24,788	$30,211	$31,728
2041	$39,665	$19,833	$24,172	$25,386
2042	$31,653	$15,826	$19,289	$20,258
2043	$25,197	$12,598	$15,355	$16,126
2044	$19,966	$9,983	$12,167	$12,778
2045	$15,600	$7,800	$9,506	$9,984
2046	$12,094	$6,047	$7,370	$7,740
2047	$8,939	$4,469	$5,447	$5,721
2048	$6,293	$3,146	$3,835	$4,027
2049	$4,142	$2,071	$2,524	$2,651
2050	$2,402	$1,201	$1,464	$1,537
2051	$1,070	$535	$652	$684
Total, 2007-2051	**$2,307,376,391**	**$1,153,688,195**	**$1,406,115,173**	**$1,476,720,890**
Average, 2007-2051	$51,275,031	$25,637,515	$31,247,004	$32,816,020
Net Present Value, 2007-2051	$1,680,010,301	$840,005,150	$1,023,798,277	$1,075,206,592
2007-2011	$1,507,957,519	$753,978,760	$918,949,312	$965,092,812
Average for 2007-2011	$301,591,504	$150,795,752	$183,789,862	$193,018,562
Net Present Value, 2007-2011	$1,217,144,300	$608,572,150	$741,727,736	$778,972,352

[1] In 2003 dollars (assumes 2005 prices, taxes, and conversions).

The estimated employment in the three-county region would peak in 2009 at 12,587 drilling and production workers, of which the majority would be employed in drilling. With the end of drilling in 2011, the number of total workers in the three-county area would drop by 10,414. At peak employment in 2009, 12,587 drilling and production workers and some of their families would be exerting pressure on the housing market (temporary and permanent) and would be demanding

local services and infrastructure. After 2011, however, an estimated 10,414 drilling and production workers would be unemployed. If current trends continue, then approximately 40 percent of this workforce (4,166 drilling and production workers) would be local. They would be competing in a tight job market or would be unemployed. Approximately 60 percent (6,248 drilling and production workers) would be leaving the three-county region, thus creating a glut in the local temporary housing market and increasing the vacancies in local motels.

Beginning in 2009, unemployment in the region would be expected to increase and the average earnings per job would decrease, as drilling and production jobs in the PAPA decline. Local governments might experience difficulty providing amenities and infrastructure (including support to local schools), as the share of tax levies generated from oil and gas production begins to decline in 2012.

4.3.3.3 Alternative B (Proposed Action Alternative) and Alternative C

Alternatives B and C through 2011

The economic impacts of the Proposed Action Alternative and Alternative C are similar because both alternatives include the same number of wells drilled per year and the same number of drilling rigs operating in the PAPA and thus, the same pace of production. Table 4.3-9 shows the employment and nominal earnings associated with drilling in the PAPA under the Proposed Action Alternative and Alternative C from 2007 to 2011.

Table 4.3-9
Employment and Nominal Earnings associated with Drilling under the Proposed Action Alternative and Alternative C[1,2]

Year	Total Wells	Total Employment (47.4 workers per well)	Total Earnings ($2,430,179 per well)
2007	268	12,698	$651,287,865
2008	299	14,167	$726,623,401
2009	305	14,451	$741,204,473
2010	291	13,788	$707,181,973
2011	290	13,740	$704,751,794
Total	**1,453**	**68,844**	**$3,531,049,506**
Average	291	13,769	$706,209,901
Net Present Value, 2007-2011			$2,890,368,935

[1] Expressed in 2003 dollars
[2] Assumes 40 percent of workers are local.

Under the Proposed Action Alternative and Alternative C, the net present value of the stream of earnings for 2007 through 2011 is $2,890,368,935.

Alternatives B and C through 2023

Table 4.3-10 shows employment and nominal earnings associated with drilling under the Proposed Action Alternative and Alternative C from 2007 through 2025. Economic impacts associated with drilling were projected through 2025 rather than 2023 because drilling extends through 2025.

Table 4.3-10
Employment and Nominal Earnings associated with Drilling under the Proposed Action Alternative and Alternative C[1,2]

Year	Total Wells	Total Employment (47.4 workers per well)	Total Earnings ($2,430,179 per well)
2007	268	12,698	$651,287,865
2008	299	14,167	$726,623,401
2009	305	14,451	$741,204,473
2010	291	13,788	$707,181,973
2011	290	13,740	$704,751,794
2012	289	13,693	$702,321,615
2013	288	13,645	$699,891,437
2014	287	13,598	$697,461,258
2015	287	13,598	$697,461,258
2016	286	13,551	$695,031,080
2017	282	13,361	$685,310,365
2018	279	13,219	$678,019,829
2019	213	10,092	$517,628,042
2020	187	8,860	$454,443,398
2021	177	8,386	$430,141,612
2022	143	6,775	$347,515,540
2023	112	5,307	$272,180,003
2024	107	5,070	$272,180,003
2025	9	426	$21,871,607
Total	**4,399**	**208,425**	**$10,690,355,661**
Average	232	10,970	$562,650,298
Net Present Value, 2007-2025			$6,393,270,699

[1] In 2003 dollars.
[2] Assumes 40 percent of workers are local.

Under the Proposed Action Alternative and under Alternative C, the net present value of the stream of earnings associated with drilling from 2007 through 2025 is $6,393,270,699.

Table 4.3-11 shows the employment and total earnings associated with production in the PAPA under the Proposed Action Alternative and Alternative C. These figures include local revenues from the sale of oil and gas, local wages, and indirect and induced economic activity.

Table 4.3-11
Employment and Nominal Earnings associated with Production under the Proposed Action Alternative and Alternative C[1]

Year	Total Employment	Total Earnings
2007	1,063	$55,540,092
2008	1,429	$74,672,039
2009	1,704	$89,014,077
2010	1,910	$99,770,677
2011	2,094	$109,402,328
2012	2,191	$114,486,756
2013	2,184	$114,122,025
2014	2,134	$111,482,777

Year	Total Employment	Total Earnings
2015	2,097	$109,537,845
2016	2,073	$108,278,857
2017	2,094	$109,405,600
2018	2,095	$109,424,702
2019	1,956	$102,181,143
2020	1,724	$90,086,049
2021	1,520	$79,422,614
2022	1,364	$71,244,305
2023	1,231	$64,323,192
2024	1,116	$58,278,380
2025	1,013	$52,912,967
2026	920	$48,084,908
2027	837	$43,725,805
2028	762	$39,792,821
2029	694	$36,244,575
2030	632	$33,037,219
2031	577	$30,137,632
2032	527	$27,512,917
2033	481	$25,135,859
2034	440	$22,979,466
2035	402	$21,018,950
2036	368	$19,240,510
2037	337	$17,626,180
2038	309	$16,156,050
2039	284	$14,816,223
2040	260	$13,594,505
2041	240	$12,514,152
2042	220	$11,502,284
2043	203	$10,600,790
2044	187	$9,769,891
2045	172	$8,988,644
2046	153	$8,009,345
2047	134	$6,977,462
2048	113	$5,916,266
2049	96	$5,008,289
2050	82	$4,292,440
2051	72	$3,768,062
2052	63	$3,287,462
2053	55	$2,889,998
2054	52	$2,714,017
2055	49	$2,563,653
2056	46	$2,424,319
2057	44	$2,294,973
2058	42	$2,174,685
2059	39	$2,062,628
2060	37	$1,958,062
2061	36	$1,860,325
2062	34	$1,768,828
2063	32	$1,683,040
2064	31	$1,602,489
2065	29	$1,526,747
Net Present Value, 2007 - 2065		$1,037,642,883

[1] In 2003 dollars.

The net present value of the stream of earnings for 2007 through 2065 under the Proposed Action Alternative and Alternative C is $1,037,642,883. Table 4.3-12 shows the nominal tax revenues associated with drilling through 2007 and production through 2065 under the Proposed Action Alternative and Alternative C.

Table 4.3-12
Nominal Tax Revenues associated with Drilling (through 2025) and Production (through 2065) under the Proposed Action Alternative and Alternative C[1]

Year	Total FMR ($500 per MMCF)	FMR-Wyoming ($250 per MMCF)	Severance Tax ($304.70 per MMCF)	Ad Valorem Production ($320 per MMCF)
2007	$239,654,568	$119,827,284	$146,045,494	$153,378,924
2008	$322,194,535	$161,097,268	$196,345,350	$206,204,502
2009	$384,085,992	$192,042,996	$234,062,004	$245,815,035
2010	$430,504,084	$215,252,042	$262,349,189	$275,522,614
2011	$472,060,958	$236,030,479	$287,673,948	$302,119,013
2012	$493,997,247	$246,998,623	$301,041,922	$316,158,238
2013	$492,415,213	$246,207,607	$300,077,831	$315,145,736
2014	$481,009,600	$240,504,800	$293,127,250	$307,846,144
2015	$472,603,619	$236,301,810	$288,004,645	$302,466,316
2016	$467,161,689	$233,580,844	$284,688,333	$298,983,481
2017	$472,011,522	$236,005,761	$287,643,822	$302,087,374
2018	$472,087,538	$236,043,769	$287,690,146	$302,136,024
2019	$440,847,122	$220,423,561	$268,652,236	$282,142,158
2020	$388,669,776	$194,334,888	$236,855,361	$248,748,657
2021	$342,664,758	$171,332,379	$208,819,904	$219,305,445
2022	$307,382,996	$153,691,498	$187,319,198	$196,725,118
2023	$277,525,261	$138,762,631	$169,123,894	$177,616,167
2024	$251,447,913	$125,723,956	$153,232,358	$160,926,664
2025	$228,301,342	$114,150,671	$139,126,838	$146,112,859
2026	$207,472,687	$103,736,343	$126,433,855	$132,782,519
2027	$188,666,903	$94,333,451	$114,973,611	$120,746,818
2028	$171,699,247	$85,849,624	$104,633,521	$109,887,518
2029	$156,391,233	$78,195,616	$95,304,817	$100,090,389
2030	$142,553,717	$71,276,859	$86,872,235	$91,234,379
2031	$130,043,854	$65,021,927	$79,248,725	$83,228,067
2032	$118,719,747	$59,359,874	$72,347,814	$75,980,638
2033	$108,464,002	$54,232,001	$66,097,963	$69,416,961
2034	$99,160,166	$49,580,083	$60,428,205	$63,462,507
2035	$90,701,317	$45,350,658	$55,273,383	$58,048,843
2036	$83,027,955	$41,513,978	$50,597,236	$53,137,891
2037	$76,062,588	$38,031,294	$46,352,541	$48,680,056
2038	$69,719,318	$34,859,659	$42,486,952	$44,620,363
2039	$63,938,185	$31,969,093	$38,963,930	$40,920,438
2040	$58,666,601	$29,333,301	$35,751,427	$37,546,625
2041	$54,005,027	$27,002,513	$32,910,663	$34,563,217
2042	$49,638,792	$24,819,396	$30,249,880	$31,768,827
2043	$45,748,849	$22,874,424	$27,879,349	$29,279,263
2044	$42,163,422	$21,081,711	$25,694,389	$26,984,590
2045	$38,792,231	$19,396,116	$23,639,986	$24,827,028
2046	$34,566,223	$17,283,111	$21,064,656	$22,122,382
2047	$30,113,219	$15,056,610	$18,350,996	$19,272,460
2048	$25,533,659	$12,766,829	$15,560,212	$16,341,542
2049	$21,615,323	$10,807,661	$13,172,378	$13,833,807
2050	$18,526,132	$9,263,066	$11,289,825	$11,856,725
2051	$16,263,247	$8,131,623	$9,910,823	$10,408,478
2052	$14,189,263	$7,094,631	$8,646,937	$9,081,128

Year	Total FMR ($500 per MMCF)	FMR-Wyoming ($250 per MMCF)	Severance Tax ($304.70 per MMCF)	Ad Valorem Production ($320 per MMCF)
2053	$12,474,038	$6,237,019	$7,601,679	$7,983,384
2054	$11,714,656	$5,857,328	$7,138,911	$7,497,380
2055	$11,065,801	$5,532,900	$6,743,499	$7,082,113
2056	$10,464,533	$5,232,266	$6,377,086	$6,697,301
2057	$9,906,351	$4,953,176	$6,036,931	$6,340,065
2058	$9,387,250	$4,693,625	$5,720,590	$6,007,840
2059	$8,903,653	$4,451,827	$5,425,886	$5,698,338
2060	$8,452,374	$4,226,187	$5,150,877	$5,409,519
2061	$8,030,562	$4,015,281	$4,893,824	$5,139,559
2062	$7,635,668	$3,817,834	$4,653,176	$4,886,827
2063	$7,265,410	$3,632,705	$4,427,541	$4,649,863
2064	$6,917,743	$3,458,871	$4,215,672	$4,427,355
2065	$6,590,828	$3,295,414	$4,016,451	$4,218,130
Total	**$9,711,877,507**	**$4,855,938,754**	**$5,918,418,153**	**$6,215,601,605**
Average	$164,608,093	$82,304,047	$100,312,172	$105,349,180
Net Present Value, 2007-2065	$4,476,921,330	$2,238,460,665	$2,728,235,859	$2,865,229,651
2007-2011	$1,848,500,138	$924,250,069	$1,126,475,984	$1,183,040,088
Average for 2007-2011	$369,700,028	$184,850,014	$225,295,197	$236,608,018
Net Present Value, 2007-2011	$1,483,924,440	$741,962,220	$904,303,554	$949,711,642

[1] In 2003 dollars (assumes 2005 prices, taxes, and conversions).

The average number of PAPA drilling and production workers in the three-county region for the period 2007 to 2018 would be 15,548. During this period, on average, 15,548 workers and their families would be exerting pressure on the housing market (both temporary and permanent) and would be demanding local services and infrastructure. If current trends continue, approximately 40 percent of this workforce would be local, thus 60 percent of these individuals and families (9,329 workers) would be continuing to exert pressure on a tight rental housing and motel room market from 2007 through 2018. However, it is likely that the market would accommodate ongoing demand pressure for temporary housing. There may be a market for housing (as second homes) when oil and gas workers depart, depending upon the quality of the permanent and temporary housing that is constructed.

The demand for drilling and production workers under the Proposed Action Alternative and Alternative C would taper more gradually than under the No Action Alternative. Under the Proposed Action Alternative and Alternative C, the decline in the demand for drilling and production workers would begin in 2019, when an estimated 60 percent of 3,266 workers (1,960 workers) would be likely to leave the region. A glut in the temporary housing and motel room markets would follow. An estimated 1,306 workers would be unemployed and entering the job market in 2019. Under the Proposed Action Alternative and Alternative C, the largest drop in demand for drilling and production workers would occur in 2025, the year drilling ends, when 4,746 workers would be unemployed, of whom 2,948 would leave the region, adding to the surplus in the temporary housing and motel room market. Additionally, 1,898 workers would be looking for work in the three-county region.

Average earnings per job in the three-county region would be expected to fall as employment in the PAPA declines. The average earnings per job for those employed in drilling (2007 through 2025) would be $51,291, and for production (2007 through 2065), it would be $52,243. This exceeds the average earnings per job in Lincoln County ($30,438), in Sublette County

($31,715), and in Sweetwater County ($38,698). Therefore, employment in the PAPA would raise wage levels in the three-county region from 2007 through 2065, and in particular, in the years when drilling occurs (2007-2025).

Leading up to 2065, local government revenues from PAPA production would drop, shifting the tax burden away from the oil and gas industry and toward Sublette County residents for provision of infrastructure and amenities. From 2007 through 2065, increased revenues from PAPA taxes and royalties to the City of Pinedale and Sublette County would allow greater local government provision of amenities and infrastructure (including schools). Because the percentage of Sublette County property taxes that is contributed to local governments from oil and gas production is high, the mil levy for property taxes paid by residents would be proportionally smaller than it would without development in the PAPA.

4.3.4 Cumulative Impacts

Lincoln, Sublette, and Sweetwater counties comprise the CIAA for socioeconomics. This three-county region depends upon the oil and gas industry for a portion of their economic activity and tax base (see Table 3.5-2 and Table 3.5-8). Ongoing development of the PAPA, along with other oil and gas development, is correlated with increased employment opportunities, higher paying employment opportunities, expanded tax base, and support for the ability of local government to maintain and increase services and infrastructure. Wells developed in the PAPA add proportionately to the economic benefits in the three-county region.

Increases in regional oil and gas development activity over a short period can cause notable changes in employment and income, including the boom/bust cycles mentioned during scoping. Changes in employment and income trigger impacts on community services, social structures, and lifestyles. Wyoming, particularly the three-county region, is highly dependent on mineral revenues, and the revenue from natural gas development in the PAPA would add to these revenues.

4.3.5 Alternative Impact Mitigation

The PAPA DEIS (BLM, 1999a) identified several mitigation measures that would offset the impact to Socioeconomic Resources. However, BLM and the cooperating agencies lack jurisdiction to impose many of the identified measures and none were carried forward into the PAPA ROD (BLM, 2000b). Any mitigation to offset impacts to Socioeconomic Resources would be strictly voluntary by the Operators.

4.4 TRANSPORTATION

4.4.1 Scoping Issues

Increased traffic volume and associated safety risks were concerns received during scoping including:

1. Evaluate further efforts to reduce traffic by busing, stockpiling, or convoys.
2. Concern over increased safety risks on local and county roads with winter drilling and increased winter traffic.

4.4.2 Impacts Considered in the PAPA DEIS

In 1999, the PAPA DEIS (BLM, 1999a) stated that potential impacts from all of the alternatives, except the *No Action Exploration/Development Scenario*, could include the following:

- increased traffic volume on area highways and roads;

- accelerated deterioration of road surfaces;
- increased road maintenance requirements because of increased traffic;
- increased off-road vehicle use, use of two-tracks, and access to sensitive areas;
- increased likelihood of traffic accidents, vehicle-person, and vehicle-animal collisions;
- increased access to sensitive areas during winter months while big game is abundant and potentially stressed; and
- increased speeding.

The PAPA DEIS (BLM, 1999a) specified that impacts under the alternatives would be significant if the following occurred:

- increased traffic levels on U.S. Highway 191 or State Highway 351 cause a decrease in level of service as defined by the Wyoming Department of Transportation;
- project related traffic conflicts with existing residential use; or
- project related traffic would accelerate the deterioration and related maintenance costs of area roads beyond those scheduled by the responsible agency.

The PAPA DEIS (BLM, 1999a) recognized potential conflict between extensive development in the north end of the PAPA near Pinedale and project related traffic and dust adjacent to the Pinedale South and Mesa roads. The project related traffic could cause significant impacts to residents and recreation use. Subdivisions and subdivided lands are located adjacent to these roads. Residential streets through the Town of Pinedale provide easy access to the Pinedale South Road. Local residents use areas along roads near and west of the New Fork River for recreation (i.e., walking, jogging, bicycling, etc).

Many of the roads in the PAPA were not designed for the loads they currently support. Increased development traffic would result in further and accelerated deterioration of these roads. Accelerated deterioration of county road surfaces is expected to cause significant impacts.

Based on the significance criteria in the PAPA DEIS (BLM, 1999a), there have been significant negative impacts to Transportation Resources by existing development in and near the PAPA. Increased traffic levels on U.S. Highway 191 caused a decrease in the Level of Service (see Section 3.6.1.1). Project related traffic has conflicted with existing residential use and has accelerated the deterioration and related maintenance costs of area roads.

4.4.3 Alternative Impacts

4.4.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Each of the alternatives would require additional construction of local and resource roads to access new well pads and other wellfield components. Arterial and collector roads are assumed to remain constant during future development in the PAPA.

Direct impact to Transportation Resources includes increased traffic in the PAPA. Each of the alternatives would require additional traffic throughout the year during construction of new well pads, drilling, completions, and production. Estimates of projected daily traffic volumes in the

PAPA under the No Action Alternative and Proposed Action Alternative were provided by the Operators for summer 2009 (Table 4.4-1) and winter 2009 (Table 4.4-2). Traffic estimates under Alternative C are assumed to be similar to traffic estimates for the Proposed Action

Table 4.4-1
Projected Traffic Volume in the PAPA (vehicles per day)
During Development for all Alternatives in Summer 2009[1]

Wellfield Development	No Action Alternative			Proposed Action Alternative and Alternative C		
	Light Vehicles	Heavy Vehicles	Total Vehicles	Light Vehicles	Heavy Vehicles	Total Vehicles
Well Pad Construction [2]	65	97	162	49	73	122
Road Construction [3]	17	26	43	12	18	30
Gathering Pipeline Construction [4]	59	89	148	40	61	101
Rig Moves [5, 6]	7	20	27	2	6	8
Drilling [7, 8]	410	273	683	251	251	502
Completion [9, 10]	342	228	570	100	150	250
Production Activities [11, 12]	1,059	0	1,059	168	0	168
Liquids Removal [13, 14]	0	301	301	0	36	36
Total	1,959	1,034	2,993	622	595	1,217

[1] Assumes 183 days of summer construction.
[2] Assumes 400 vehicles per pad, 160 light vehicles and 240 heavy vehicles. In 2009, there are 54 new pads and 20 expanded pads (74 pads total) by the No Action Alternative and 37 new pads and 19 expanded pads (56 pads total) by the Proposed Action (and Alternative C).
[3] Assumes 88 heavy vehicles and 58 light vehicles per new pad constructed. In 2009, assumes 54 new pads by the No Action Alternative and 37 new pads by the Proposed Action (and Alternative C).
[4] Assumes 300 heavy vehicles and 200 light vehicles per new pad constructed.
[5] Assumes 8.8 light vehicles and 26.3 heavy vehicles per well drilled. In summer 2009, assumes 139 wells drilled by the No Action Alternative over 183 days.
[6] Assumes 2.2 light vehicles and 6.6 heavy vehicles per well drilled. Assumes 305 wells drilled over 365 days in 2009 by the Proposed Action and Alternative C.
[7] Assumes 360 heavy vehicles and 540 light vehicles per well drilled. In summer 2009, assumes 139 wells drilled by the No Action Alternative over 183 days.
[8] Assumes 300 heavy vehicles and 300 light vehicles per well drilled. Assumes 305 wells drilled over 365 days in 2009 by the Proposed Action and Alternative C.
[9] Assumes 300 heavy vehicles and 450 light vehicles per well completed. Assume 139 wells drilled by the No Action Alternative over 183 days.
[10] Assumes 180 heavy vehicles and 120 light vehicles per well completed. Assumes 305 wells drilled over 365 days in 2009 by the Proposed Action and Alternative C.
[11] Assumes 1,246 producing wells at mid year 2009. Assumes 0.85 light vehicles per day per well by the No Action Alternative.
[12] Assumes 1,342 producing wells at mid year 2009. Assumes 0.125 light vehicles per day per well by the Proposed Action and Alternative C.
[13] Assumes 10,755,765 bbl water removed in 2009 and 4,639,513 bbl oil removed (Shell and Ultra only plus 5 percent added for other operators). Assumes one heavy vehicle per 140 bbls of water removed and one heavy vehicle per 140 bbls of oil removed by the No Action Alternative.
[14] Assumes 10 percent of water and oil is trucked. Assumes one heavy vehicle per 140 bbls of water removed and one heavy vehicle per 140 bbls of oil removed by the Proposed Action and Alternative C.

Table 4.4-2
Projected Traffic Volume in the PAPA (vehicles per day)
during Development for all Alternatives in Winter 2009[1]

Wellfield Development	No Action Alternative			Proposed Action Alternative and Alternative C		
	Light Vehicles	Heavy Vehicles	Total Vehicles	Light Vehicles	Heavy Vehicles	Total Vehicles
Well Pad Construction	N/A	N/A	N/A	N/A	N/A	N/A
Road Construction	N/A	N/A	N/A	N/A	N/A	N/A
Gathering Pipeline Construction	N/A	N/A	N/A	N/A	N/A	N/A
Rig Moves [2, 3]	5	14	19	2	6	6
Drilling [4, 5]	286	191	477	251	251	502
Completion [6, 7]	239	159	398	100	150	250
Production Activities [8, 9]	1,059	0	1,059	168	0	168
Liquids Removal [10, 11]	0	301	301	0	36	36
Total	1,589	665	2,254	521	443	964

[1] Assumes 183 days of winter.
[2] Assumes 8.8 light vehicles and 26.3 heavy vehicles per well drilled. In winter 2009, assumes 97 wells drilled by the No Action Alternative over 183 days.
[3] Assumes 2.2 light vehicles and 6.6 heavy vehicles per well drilled. Assumes 305 wells drilled over 365 days in 2009 by the Proposed Action and Alternative C.
[4] Assumes 360 heavy vehicles and 540 light vehicles per well drilled. In winter 2009, assumes 97 wells drilled by the No Action Alternative over 183 days.
[5] Assumes 300 heavy vehicles and 300 light vehicles per well drilled. Assumes 305 wells drilled over 365 days in 2009 by the Proposed Action and Alternative C.
[6] Assumes 300 heavy vehicles and 450 light vehicles per well completed. Assumes 97 wells drilled by the No Action Alternative over 183 days.
[7] Assumes 180 heavy vehicles and 120 light vehicles per well completed. Assumes 305 wells drilled over 365 days in 2009 by the Proposed Action and Alternative C.
[8] Assumes 1,246 producing wells at mid year 2009. Assumes 0.85 light vehicles per day per well by the No Action Alternative.
[9] Assumes 1,342 producing wells at mid year 2009. Assumes 0.125 light vehicles per day per well by the Proposed Action and Alternative C.
[10] Assumes 10,755,765 bbl water removed in 2009 and 4,639,513 bbl oil removed (Shell and Ultra only plus 5 percent added for other operators). Assumes 1 heavy vehicle per 140 bbls of water removed and 1 heavy vehicle per 140 bbls of oil removed by the No Action Alternative.
[11] Assumes 10 percent of water and oil is trucked. Assumes 1 heavy vehicle per 140 bbls of water removed and 1 heavy vehicle per 140 bbls of oil removed by the Proposed Action and Alternative C.

Alternative. Assumptions for estimating traffic are based on projected number of well pads, wells drilled, producing wells, and production of condensate and water.

There would be a reduction in wellfield traffic once all wells have been drilled and are in production. Installation of a liquids gathering system in the northern portion of the PAPA has reduced daily traffic to producing wells. Under the Proposed Action and Alternative C, a liquids gathering system would be installed in the central and southern portions of the PAPA, thereby further reducing production related traffic. However, the level of traffic related to drilling far exceeds any reduction realized by installation and use of liquids gathering systems in big game crucial ranges in winter and during all seasons. The liquids gathering system in the central and southern portions of the PAPA would not be installed under the No Action Alternative.

Increased rates of vehicular accidents on roads adjacent to the PAPA (direct impact by wellfield development) have increased with increased traffic volumes (see Chapter 3 – Transportation).

Assuming that increased traffic volume contributes to the possibility of vehicular accidents, higher accident rates are expected with implementation of any of the alternatives, although higher accident rates would continue longer under the Proposed Action Alternative and Alternative C through 2011 than under the No Action Alternative. Increased traffic volume would be similar under the Proposed Action Alternative and Alternative C through 2023.

As discussed in Chapter 3, highway maintenances costs borne by WDOT have increased and in September 2006, the U.S. Department of Transportation cut more than $27 million in highway funds for Wyoming that had already been appropriated (Neary, 2006). Reduced federal funding would limit highway maintenance opportunities on roads used to access the PAPA. Increased traffic in the PAPA would accelerate deterioration of area roads beyond the maintenance capabilities of the responsible agency.

The significant impacts to transportation that have already been realized are expected to continue to occur under all of the alternatives through 2023 during wellfield development. Once all wells are producing and development is complete, impacts would be reduced.

Pipeline Corridors and Gas Sales Pipelines

Construction of the proposed pipelines (estimated 3 to 5 months duration) would result in increases in traffic, both heavy and light vehicles, on federal and state highways and county and BLM/BOR roads. There is a potential for corresponding short-term increase in accidents along the highways and roads providing access to the pipeline construction locations. However, observance of highway safety rules, regulations, and practices would reduce this potential. Pipeline construction would comply with permit requirements from state, county, and BLM/BOR to ensure that roads are repaired after construction and that there is adequate traffic control to protect the traveling public. Detour (shoe-fly) roads would be constructed and temporarily maintained at existing road crossings to prevent disruption of use. Traffic associated with pipeline operations would be minimal.

4.4.3.2 Alternative A (No Action Alternative)

There would be an estimated 108 miles of roads constructed in the PAPA, through 2011, under the No Action Alternative. The Operators expect to construct 245 new well pads and expand 92 existing pads by 3 to 16 acres each. New roads are not required for expansion pads.

After 2006, under the terms of BLM's 2004 Decision Record (BLM, 2004a), there is a limitation of two additional well pads allowed within the mostly single Operator contiguous leasehold in the northern portion of the PAPA (currently operated by Questar). The limitation on new well pad construction is included in the No Action Alternative. Consequently, most new wellfield roads under the No Action Alternative would be constructed in the central and southern portions of the PAPA. Winter drilling would be allowed within the mostly single Operator contiguous leasehold in the northern portion of the PAPA (November 15 though April 30) in mule deer crucial winter range with up to six drilling rigs, two rigs per well pad, each year through 2011. Liquids gathering systems have been installed within this leasehold and would continue to be installed under the No Action Alternative. Traffic to producing wells within this leasehold is estimated to be 0.7 vehicle per day per producing well (see Table 3.6-5), based on winter 2005-2006 data. Traffic related to winter drilling would probably exceed 66 vehicles per day to each pad location.

No development related traffic would occur on big game crucial winter ranges in the central and southern portions of the PAPA between November 15 and April 30, however, production related traffic would continue through each winter. The No Action Alternative does not include construction of additional liquids gathering systems in the central and southern portions of the PAPA. Without a gathering system, estimated traffic to producing wells would be approximately 1.6 vehicles per day per producing well (see Table 3.6-5), based on winter 2005-2006 data.

Operators with leaseholds outside of big game crucial winter ranges could continue year-round drilling with traffic similar to the estimate made for the mostly single Operator contiguous leaseholds in the northern portion of the PAPA. Impacts associated with increases in traffic volume, accident rates, road surface deterioration, and maintenance costs would continue under the No Action Alternative.

4.4.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Under the Proposed Action Alternative, 2007 through 2011, there would be an estimated 89 miles of roads, nearly 20 miles less than under the No Action Alternative. Under the Proposed Action Alternative, Operators expect to construct 179 new well pads rather than 245 well pads under the No Action Alternative, resulting in fewer road miles. Under the Proposed Action Alternative, 116 existing well pads would be expanded by the end of 2011; however, new access roads are not required for expansion pads.

Under the Proposed Action Alternative, well drilling on all new pads and expanded pads within a CDA (Map 4.1-3) would occur year-round even on pads within big game crucial winter ranges. Consequently, vehicular traffic related to drilling and completions during winter would be substantially greater through 2011 under the Proposed Action Alternative compared to traffic under the No Action Alternative.

Under the Proposed Action Alternative, a liquids gathering system would be installed in the central and southern portions of the PAPA within 2 years of the issuance of the ROD. Use of liquids gathering systems and increased use of computer assisted remote monitoring would reduce daily traffic to producing wells in winter as well as in other seasons. The amount of traffic reduced during winter months by use of the liquids gathering system would not compensate for traffic generated by development (drilling and completions) during winter. Consequently, impacts associated with traffic volume, accident rates, road surface deterioration, and maintenance costs would increase, particularly during winter, under the Proposed Action Alternative.

Proposed Action Alternative Through 2023

Through 2023, the Proposed Action Alternative would require an estimated total of 121 miles of new roads. Under this alternative, 250 new well pads would be constructed through 2017 and therefore, no new roads would be constructed after 2017. In addition to new pads, 264 existing well pads would be expanded through 2023. New access roads are not required for expansion of existing pads.

Under the Proposed Action, well drilling within the Operators' collective CDAs would continue on a year-round basis even within big game crucial winter ranges. Winter drilling would continue, although on fewer and fewer well pads each year, through 2023. Winter traffic in the PAPA would similarly decline, most noticeably after 2017. Impacts associated with traffic volume, accident rates, road surface deterioration, and maintenance costs would increase through 2017. These impacts would gradually decrease after 2017 and through 2023 with the steady decline in winter traffic and development related traffic in general.

4.4.3.4 Alternative C

Alternative C Through 2011

Under Alternative C, through 2011, the number of new well pads, existing pads expanded, and miles of new roads would be the same as under the Proposed Action Alternative through 2011. In 2011, the distribution of new roads constructed under Alternative C would differ from the

distribution of new roads constructed under the Proposed Action Alternative. Under Alternative C, new road construction would be concentrated in the southern 2 miles of DA-1, within DA-2, and throughout DA-4 (Map 4.1-4). Access to those development areas during winter would be from the south, along Paradise Road and the North Anticline Road, similar to access under the No Action and Proposed Action alternatives.

No new roads are likely to be constructed in DA-3 through 2011 under Alternative C or until development is complete in DA-2. Consequently, winter traffic would be production related. A liquids gathering system would be installed to each producing well in DA-3 within 2 years of issuance of the ROD, further reducing winter traffic. Increased use of computer assisted remote monitoring would reduce traffic during all seasons. Access during winter could be limited to either the Boulder South Road or South Anticline Road. Access to year-round drilling in DA-4 would probably be from Highway 351 and the Jonah North Road. Under Alternative C, impacts associated with increasing traffic volume, including accident rates, road surface deterioration, and maintenance costs would be more restricted, particularly during winter under Alternative C than under the Proposed Action Alternative.

Alternative C Through 2023

Similar to the Proposed Action Alternative 250 new well pads and 121 miles of new roads would be constructed through 2017, the year the last new well pad would be constructed under Alternative C. Like the Proposed Action Alternative, 264 existing well pads would be expanded, although no new roads would be constructed for expansion pads.

As development in the southern portion of DA-1 is completed, development would move to the north within the mostly single Operator contiguous leasehold. By 2017, development in DA-1 would be concentrated on the north end of DA-1. By 2017 and through 2023, winter drilling on big game crucial winter range would be limited to the north end of DA-1. Access to wellfield development during winter on the north end would be from the north, rather than from the south along the North Anticline Road. Development of a transportation plan for access from the north is pending. BLM is currently working with Sublette County, WGFD, and local landowners in identifying an access route from the north. Production activity in all crucial winter range would use access closest to any paved road from producing wells so that the limited traffic required to access producing wells in the southern end of DA-1 would be from the south.

Once all year-round drilling and wellfield development has been completed within DA-2, wellfield development would commence in DA-3. With no additional winter drilling allowed in DA-2, access into DA-2 would be related to production. Liquids gathering systems would be in place so the production related traffic volumes to DA-2 would be minimal, at rates that would be expected to continue through the life of the project. Access would be from the Boulder South Road.

Once development moves into DA-3, traffic would increase substantially due to year-round drilling. The traffic may be limited to entering the area from Highway 351 and the South Anticline Road rather than from the Boulder South Road which would be closed during winter to limit traffic within big game crucial winter ranges.

Development would probably continue in DA-4 and extend into DA-5. Once there, however, Operators would be restricted by seasonal limitations on drilling between March 1 and July 15 (BLM, 2004c) to protect greater sage-grouse leks and nesting habitats. In DA-5, traffic volume resulting from implementation of Alternative C would be similar to traffic associated with the Proposed Action Alternative. With the steady decline in winter traffic and development related traffic after 2017, impacts associated with traffic volume, including accident rates, road surface

deterioration and maintenance costs would gradually decrease through 2023 under Alternative C, similar to declines under the Proposed Action.

4.4.4 Cumulative Impacts

Cumulative impact from project related traffic is considered in combination with other regional development within the CIAA. The CIAA includes secondary roads and major highways within and adjacent to the PAPA. Any additional traffic would increase the disturbance of wildlife, potential for accidents, and the needs for maintenance and dust control. Installation of liquids gathering systems in the central and southern portions of the PAPA, under the Proposed Action Alternative and Alternative C, would reduce liquid haulage traffic compared to the No Action Alternative, but this is a small impact compared to the overall drilling and development traffic.

Costs of road maintenance would be partly supported by county taxes from Operators, and partly from state revenues. Increasing maintenance costs, uncertain funding, and increased traffic by any of the alternatives and other developments in the region are likely to put more responsibility for maintenance of drilling access roads on Operators, and could lead to deterioration of main roads.

While some cumulative impact on transportation may be positive (increased availability of roads and improved road conditions in the PAPA), the overall cumulative impact is likely to be negative for the reasons noted.

4.4.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to Transportation Resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.5 LAND USE AND RESIDENTIAL AREAS

4.5.1 Scoping Issues

The following concerns related to land uses in the PAPA were received during scoping:

1. Address impacts to ranchers and private property owners from wildlife displaced to their lands by development.
2. Concern that multiple use objectives on BLM land are being overlooked.
3. Concern that operators are industrializing nonfederal lands to avoid restrictions on BLM land.

4.5.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS (BLM, 1999a), BLM recognized with new development in the PAPA, land use would change because oil and gas activities would become the dominant land use under full development and would preclude or interfere with other land uses. It recognized that the PAPA

was valued for its open space and as a place of solitude. Some of the area was inaccessible by vehicles, and in some areas it was difficult to find evidence of human activity. In 1999, the views from most of the PAPA, particularly the Mesa, were exceptional with the Wind River Range to the east and the Wyoming Range to the west. The views were compared to current views available from the adjacent Jonah II Field:

> *"While the views are equally as dramatic in the Jonah II Field, the sense of openness and solitude have been lost. In that portion of the Jonah II Field currently being developed, one is constantly aware that extensive development activities are ongoing. This is not a criticism of oil and gas development but rather a recognition of the difference in the feeling of open space and solitude between the two areas."*

Because it was impossible to predict where economically recoverable of oil and gas reserves occur in the PAPA, it was not possible to predict where the changes in open space and solitude would occur. The PAPA DEIS (BLM, 1999a) concluded, wherever development would occur, those characteristics of the landscape would be lost.

The PAPA DEIS (BLM, 1999a) specified that significant impacts to land use would result from project related activities if those activities:

- were incompatible with land use ordinances, plans, regulations or controls;
- adversely affected other existing and legitimate land uses; or
- adversely affected the use, enjoyment or value of adjacent property or introduce safety and health risks or a nuisance or annoyance to an area where such risks, nuisance, or annoyance did not previously exist.

The PAPA DEIS (BLM, 1999a) predicted significant impacts to land use from all of the alternatives except the *No Action Exploration/Development Scenario*. The significant impacts to land use in the PAPA that were predicted in 1999 have occurred.

In addition to values of open space and solitude, the PAPA DEIS (BLM, 1999a) considered that extensive development on many of the private parcels of land in the PAPA would not be compatible with their zoned use as established by the Sublette County Zoning and Development Regulations. Conflicts were expected to occur between wellfield development and residential uses. The *Resource Protection Alternative on Federal Lands and Minerals* specified that placement of well pads on federal lands and minerals within 0.25 mile of occupied dwellings would be avoided, according to BLM Mitigation Guidelines. On private and state lands and minerals, well pads could be placed as close as 350 feet from occupied dwellings. BLM expanded the 0.25-mile buffer to include areas zoned for residential use by Sublette County and subdivisions and subdivided lands, thus avoiding placement of well pads within the entire Residential Area SRMZ.

4.5.3 Alternative Impacts

4.5.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Impacts to land use and residential areas, similar to those predicted in the PAPA DEIS (BLM, 1999a), have occurred during wellfield development since issuance of the PAPA ROD (BLM, 2000b). While the PAPA had been valued for its open space and as a place of solitude, the view within the Anticline Crest more resembles the Jonah II Field in 1999. Land uses associated with open space, principally recreation, livestock grazing, and wildlife habitat have changed to an industrial landscape.

A comparison of potential surface disturbance by land use/land cover type by 2011 under the alternatives show differences in the affected areas (Table 4.5-1). Total disturbance by 2011 would be greater under the Proposed Action Alternative and Alternative C than under the No Action Alternative. However, surface disturbance under the No Action Alternative may be randomly spread across the Anticline Crest while both the Proposed Action Alternative and Alternative C include concentrated development and restrictions on where disturbance could occur, at least in winter. By 2023, the land use/land cover types affected would be similar under the Proposed Action Alternative and Alternative C.

Table 4.5-1
Surface Disturbance in Relation to Land Use/Land Cover Types by Alternative

Land Use/Land Cover Type	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Cropland and Pasture	142.1	161.0	198.1	307.1	387.4	319.9
Forested Wetlands	25.2	30.3	45.2	45.1	185.3	166.9
Herbaceous Rangeland	13.9	0.4	0.4	0.4	9.3	1.9
Industrial	10.0	5.1	6.3	4.3	10.0	12.5
Mixed Rangeland	81.1	120.1	178.9	103.6	264.3	212.4
Nonforested Wetlands	111.6	126.8	106.8	125.6	239.3	215.2
Reservoirs	0.0	0.0	0.0	0.0	0.0	0.0
Residential	3.4	0.6	0.0	0.0	0.0	0.0
Sandy Areas other than Beaches	6.1	0.0	0.2	0.2	0.2	0.7
Shrub and Brush Rangeland	4,661.6	4,040.2	6,308.7	6,269.9	11,182.2	11,341.7
Mines, Quarries and Gravel Pits	0.6	0.0	0.4	0.4	0.4	0.4
Transitional Areas	0.6	0.0	0.0	0.0	0.0	0.0
Transportation, Communication, Utilities	3.2	0.0	0.0	0.0	0.0	0.0
Total	**5,059.4**	**4,484.5**	**6,845.0**	**6,856.6**	**12,278.4**	**12,271.6**

Implementation of any of the alternatives would continue to change the characteristics of most land use/land cover types (see Table 4.5-1) to a landscape where "*one is constantly aware that extensive development activities are ongoing*." As stated above, the potential significant impacts to land use predicted in the PAPA DEIS (BLM, 1999a) have occurred and would continue to occur under all of the alternatives.

Table 4.5-2 shows that wellfield development under any of the alternatives would have minimal impact to lands zoned as Residential by Sublette County. However, there would be disturbance within the Residential SRMZ by each alternative including new wellfield disturbance expected within the 0.25-mile buffer surrounding residences (Table 4.5-2). This occurs because many residences, and therefore the 0.25-mile buffer, are outside of the areas zoned Residential by Sublette County.

All alternatives are expected to result in substantial additional surface disturbance on lands zoned as both Agriculture and Resource Conservation by Sublette County (Table 4.5-2). While the county's zoning districts include federally administered lands, the county has no jurisdiction on these lands.

Table 4.5-2
Surface Disturbance in Relation to Sublette County
Zoning Districts and the Residential SRMZ by Alternative

Sublette County Zoning District	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Agricultural	1,119.7	934.1	1,147.2	1,313.1	2,454.2	2,233.8
Highway Commercial	0.5	0.0	0.0	0.0	0.0	0.0
Heavy Industrial	0.0	0.0	0.0	0.0	0.0	0.0
Light Industrial	6.6	0.0	0.0	0.0	0.0	0.0
Rural Residential	11.9	0.0	0.0	0.0	0.0	0.0
Rural Residential 10	5.6	0.0	0.0	0.0	0.0	0.0
Rural Residential 20	0.7	0.0	0.0	0.0	0.0	0.0
Rural Residential 5	2.2	0.0	0.1	0.1	0.1	0.1
Rural Residential Mobile/Manufactured Home 10	0.0	0.0	0.0	0.0	0.0	0.0
Resource Conservation	3,912.2	3,550.4	5,697.7	5,543.4	9,824.1	10,037.7
Rural Mixed	0.0	0.0	0.0	0.0	0.0	0.0
Total in Zoning Districts	**5,059.4**	**4,484.5**	**6,845.0**	**6,856.6**	**12,278.4**	**12,271.6**
0.25-mile Residence Buffer	123.6	54.3	109.9	184.8	249.1	202.8
Residential SRMZ	145.5	103.1	154.7	229.6	294.2	247.8

Pipeline Corridors and Gas Sales Pipelines

The principal land uses along the proposed corridor/pipeline alignments are livestock grazing, wildlife habitat and oil and gas development. Establishment of the proposed corridors and construction and operation of pipelines within the corridors would not preclude the current land uses. The proposed corridors represent a proposed expansion of either adjacent or nearby pipeline corridors that connect the PAPA and the Jonah Field Project Area with gas plants in southwestern Wyoming. Designation of the corridors would be consistent with past, current, and continued uses of the lands. No changes in land use or conflicts with county zoning regulations are expected as a result of either designation of the corridors or construction and operation of the proposed pipelines.

4.5.3.2 Alternative A (No Action Alternative)

Implementation of the No Action Alternative would affect Resource Conservation and Agricultural zoning districts with an expected disturbance of approximately 3,550 acres and 934 acres, respectively (Table 4.5-2). Wellfield development under the No Action Alternative would increase surface disturbance inside the Residential SRMZ and 0.25-mile residential buffer by more than 100 acres, primarily near residences along the New Fork River.

Although development under the No Action Alternative would be compatible with county zoning in the several rural residential categories, the development would be in conflict with the intended use of lands zoned as Resource Conservation in which protection and conservation of

environmentally sensitive areas must be limited to prevent degradation (Sublette County, 2002). It is unknown if planned development under the No Action Alternative, within the Residential SRMZ and 0.25-mile residential buffer, would adversely affect the use, enjoyment or value of adjacent property or introduce safety and health risks or a nuisance or annoyance to the areas.

4.5.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Compared to the No Action Alternative, implementation of the Proposed Action Alternative through 2011 would result in more overall disturbance (6,845 acres) than the No Action Alternative. Map 4.1-3 shows that wellfield development under the Proposed Action Alternative through 2011 would be concentrated on the Anticline Crest rather than distributed throughout the PAPA. Wellfield development by the Proposed Action Alternative through 2011 would affect the Residential SRMZ more than the No Action Alternative, but less than Alternative C by 2011.

Proposed Action Alternative Through 2023

By 2023, the Proposed Action Alternative is expected to increase existing surface disturbance by nearly 12,300 acres. Of that, more than 11,000 acres of surface disturbance would be in Shrub and Brush Rangeland (Table 4.5-1). Depending on how successful future revegetation efforts would be during the 17-year period of wellfield development, the PAPA (Anticline Crest) might or might not appear as an industrialized landscape, such as it is in 2006.

By 2023, the Proposed Action Alternative would likely increase existing surface disturbances within the Resource Conservation zoning district by more than 9,800 acres. Wellfield development under the Proposed Action Alternative is expected to affect the Residential SRMZ by less than 300 acres in 2023, and would be similar to that disturbed by Alternative C by 2023.

4.5.3.4 Alternative C

Alternative C Through 2011

Implementation of Alternative C through 2011 would result in about the same level of disturbance (6,856 acres) as the Proposed Action Alternative through 2011; however, the level of disturbance under both alternatives would be greater than under the No Action Alternative. Most new wellfield development under Alternative C would be within Shrub and Brush Rangeland by 2011 (Table 4.5-1). Map 4.1-4 shows that future development under Alternative C through 2011 would be concentrated on the Anticline Crest rather than distributed throughout the PAPA.

Unlike the No Action Alternative and the Proposed Action Alternative, initially, there would not be any new surface disturbance within the northern portion of DA-1 and within DA-3 in winter. Initially, there would be considerably more surface disturbance in the southern portion of DA-1 and in DA-2 than under the Proposed Action Alternative because of the restricted development in DA-1 and DA-3 under Alternative C. The differential is evident in Table 4.5-1 by more disturbance in the Cropland and Pasture land use/land cover category and in Table 4.5-2 by more disturbance within lands zoned as Agricultural under Alternative C through 2011 than under the Proposed Action through 2011.

Wellfield development under Alternative C is expected to affect the Residential SRMZ slightly more under Alternative C through 2011 than under the No Action Alternative, but more than the Proposed Action Alternative by 2011.

Alternative C Through 2023

By 2023, Alternative C is expected to increase existing surface disturbance by nearly 12,300 acres, similar to the Proposed Action Alternative (Table 4.5-1).

Alternative C specifies that wellfield development would progress from south to north in D-1 and from DA-2 to DA-3, during winter. With wellfield development completed in development areas before new areas could be developed (at least during winter), there is the potential for not just interim reclamation, but final reclamation in these areas. That possibility does not exist under the Proposed Action Alternative because the CDAs would be allowed to move north and south within the core area.

Similar to the Proposed Action Alternative by 2023, wellfield development under Alternative C by 2023 would increase existing surface disturbance within the Resource Conservation zoning district by 10,037 acres. Wellfield development by Alternative C through 2023 is expected to affect the Residential SRMZ by approximately 250 acres, similar to the Proposed Action Alternative through 2023.

4.5.4 Cumulative Impacts

The CIAA for land use/residential areas is confined to the PAPA. Land use within Sublette County was changing before 1999 from an area of open spaces associated with agriculture, wildlife habitat, dispersed recreation, and overall low densities of development – including residential, urban, and natural resource extraction by oil, natural gas, and mining industries (McLeod et al., 1998). Prior to issuance of the PAPA ROD (BLM, 2000b), most of the native landscape in the PAPA had been changed by agricultural use.

The cumulative surface disturbance to land use/land cover types by alternative (Table 4.5-3) was calculated by adding the existing non-wellfield disturbance, the existing wellfield disturbance and the projected surface disturbance by each alternative. The portion of the surface disturbance in the PAPA projected for the gas sales pipelines is also included in Table 4.5-3 under each alternative.

Total cumulative surface disturbance by the Proposed Action Alternative and Alternative C through 2011 exceeds cumulative effects by the No Action Alternative. The difference in level of cumulative impact among the alternatives is most apparent in the effects to Shrub and Brush Rangeland. Although cumulative effects to Cropland and Pasture appear substantial by each alternative in Table 4.5-3, it is only a reflection of the existing agricultural development.

Cumulative impact to Sublette County Zoning Districts is based on past, present, and future levels of surface disturbance (Table 4.5-4) for which the vast majority of impact is within the Resource Conservation zoning district. There would be cumulative impact to the Agricultural Zoning District by each alternative as well, but 5,458 acres of that is due to agricultural land use in that district, the reason for the lands being zoned Agricultural by Sublette County. Even so, there is existing wellfield development (1,120 acres) and future development that would transform the district to some degree from current zoning.

Table 4.5-3
Cumulative Surface Disturbance in Relation to Land Use/Land Cover Types by Alternative

Land Use/Land Cover Type	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Cropland and Pasture	4,111.8	142.1	4,421.8	4,458.9	4,567.9	4,648.2	4,580.7
Forested Wetlands	5.8	25.2	64.9	79.8	79.7	219.9	201.5
Herbaceous Rangeland	589.7	13.9	604.0	604.0	604.0	612.9	605.5
Industrial	0.0	10.0	16.5	17.7	15.7	21.4	23.9
Mixed Rangeland	23.6	81.1	231.0	289.8	214.5	375.2	323.3
Nonforested Wetlands	598.1	111.6	851.9	831.9	850.7	964.4	940.3
Reservoirs	12.2	0.0	12.2	12.2	12.2	12.2	12.2
Residential	97.8	3.4	101.8	101.2	101.2	101.2	101.2
Sandy Areas Other than Beaches	0.0	6.1	6.1	6.3	6.3	6.3	6.8
Shrub and Brush Rangeland	1,896.6	4,661.6	10,991.2	13,259.7	13,220.9	18,133.2	18,292.7
Mines, Quarries and Gravel Pits	0.0	0.6	0.0	0.4	0.4	0.4	0.4
Transitional Areas	0.0	0.6	0.6	0.6	0.6	0.6	0.6
Transportation, Communication, Utilities	131.3	3.2	134.5	134.5	134.5	134.5	134.5
Total	**7,466.9**	**5,059.4**	**17,437.1**	**19,797.6**	**19,809.2**	**25,231.0**	**25,224.2**

While existing, non-wellfield disturbance has generated only a minor amount of disturbance within the Resource Conservation zoning district in the PAPA, the majority of existing wellfield development has been concentrated in the Resource Conservation zoning district and development by all of the alternatives is expected there as well. Compared to the No Action Alternative, there would be far more cumulative impact to the Resource Conservation zoning district by the Proposed Action Alternative and Alternative C through 2011 (Table 4.5-4). Under the Proposed Action through 2023, cumulative impact to the Resource Conservation zoning district would be similar to Alternative C.

Existing non-wellfield surface disturbance within the Residential SRMZ and 0.25-mile residence buffer in Table 4.5-4 are from residences and associated infrastructure, mostly roads that were originally used to define the two land use components in the PAPA DEIS (BLM, 1999a). While the impact to each one by present and future wellfield development in the PAPA is not small, the relatively large amount of surface disturbance by each alternative is the result of including existing residential land uses in the cumulative area of surface disturbance for each alternative. Under the No Action Alternative, cumulative impact to the Residential SRMZ and 0.25-mile buffer would be less than under the Proposed Action Alternative and Alternative C through 2011. Cumulative impact to the Residential SRMZ and 0.25-mile residential buffer would be similar under the Proposed Action Alternative and Alternative C through 2023.

Table 4.5-4
Cumulative Surface Disturbance in Relation to
Sublette County Zoning Districts and the Residential SRMZ by Alternative

Sublette County Zoning District	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Agricultural	5,458.2	1,119.7	7,616.1	7,829.2	7,995.1	9,136.2	8,915.8
Highway Commercial	14.1	0.5	14.6	14.6	14.6	14.6	14.6
Heavy Industrial	36.8	0.0	36.8	36.8	36.8	36.8	36.8
Light Industrial	259.4	6.6	266.0	266.0	266.0	266.0	265.9
Rural Residential	1,024.6	11.9	1,036.5	1,036.5	1,036.5	1,036.5	1,036.5
Rural Residential 10	129.0	5.6	134.6	134.6	134.6	134.6	134.6
Rural Residential 20	142.7	0.7	143.4	143.4	143.4	143.4	143.4
Rural Residential 5	6.4	2.2	8.6	8.7	8.7	8.7	8.7
Rural Residential Mobile/Manufactured Home 10	33.7	0.0	33.7	33.7	33.7	33.7	33.7
Resource Conservation	345.8	3,912.2	8,130.6	10,277.9	10,123.6	14,404.3	14,618.0
Rural Mixed	16.2	0.0	16.2	16.2	16.2	16.2	16.2
Total in Zoning Districts	**7,466.9**	**5,059.4**	**17,437.1**	**19,797.6**	**19,809.2**	**25,231.0**	**25,224.2**
0.25-mile Residence Buffer	2,330.3	123.6	2,508.2	2,563.8	2,638.7	2,703.0	2,656.7
Residential SRMZ	3,739.9	145.5	3,988.5	4,040.1	4,115.0	4,179.6	4,133.2

4.5.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to land use and residential areas would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.6 RECREATION RESOURCES

4.6.1 Scoping Issues

Concerns regarding potential impacts to recreation received during public scoping include:

1. Concern that hunting has been affected because wildlife populations have declined.
2. Removal of winter restrictions on drilling will impact the hunting and fishing communities.

4.6.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS (BLM, 1999a), BLM assumed that there would be a negligible increase in recreational use of the PAPA because wellfield workers typically do not recreate near project sites and generally leave the area when they are not working. BLM acknowledged the potential for immigrant workers to impact recreation resources by parking overnight and camping or setting up residence at recreation sites. Typically, these types of problems are generated when adequate housing is not available though it was assumed that illegal camping on public lands or at public recreation facilities would be isolated cases. The following is a list of potential impact to Recreational Resources anticipated in the PAPA DEIS:

- project development and operation would affect the visual and aesthetic quality associated with dispersed recreational experiences (e.g. hunting, fishing, mountain biking, etc.) by increasing traffic, producing noise and dust and by adding production facilities and other disturbances to the landscape which would cause a loss of open space and solitude.
- impacts would be most severe on the north end of the PAPA near Pinedale where residents use the area regularly. However, other areas within the PAPA that are used for dispersed recreation could also be impacted by project development.
- hunters may find it unsafe to use some areas because of the density of development or they may have a less rewarding experience if project activities affect wildlife populations in the area.
- people fishing or floating on the Green or New Fork rivers in the project area may be discouraged by project activities adjacent to these rivers which could impact their recreational experience.
- individuals visiting the Lander Trail in the PAPA to experience the historic setting of the area may also be affected by the industrial change in the landscape from development.

BLM defined several specific areas where future development in the PAPA would conflict with recreation use as it existed in 1999. BLM considered the following impacts associated with these conflicts significant if:

- project related activities result in long-term elimination or reduction of recreation use in any of these areas; or
- any of the alternatives result in a level of development incompatible with the stated objectives of special recreation management areas.

Based on these criteria, significant impact to dispersed recreation use was anticipated for all alternatives, except the *No Action Exploration/Development Scenario*, in the area immediately south of Pinedale (along the Pinedale South Road) if project development became extensive and use of the Pinedale South or Mesa roads by wellfield traffic increased. A significant impact was predicted to a very small portion of the Wind River Front Special Recreation Management Area (SRMA) under the *Project Wide and Anticline Crest* development scenarios in the PAPA DEIS (BLM, 1999a). Because there are no specific measures of recreation use in the PAPA, it is not possible to determine whether significant impact, based on the criteria in the PAPA DEIS, has occurred.

4.6.3 Alternative Impacts

4.6.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Impact to Recreation Resources, specifically public recreation areas that have been delineated in the PAPA, has occurred, primarily through surface disturbance associated with wellfield development. Approximately 27 acres of the Wind River Front SRMA will have been impacted by wellfield development by the end of 2006 and an additional 0.3 acre in the SRMA would be affected under the Proposed Action and Alternative C (Table 4.6-1). Potential new surface disturbance within other Public Recreation Areas in the PAPA associated with each alternative is included in Table 4.6-1.

By the end of 2006, surface disturbance by wellfield development will have disturbed an estimated 5,059 acres across the landscape, 4,225 acres within the public recreation areas in Table 4.6-1. Implementation of the alternatives would continue to change the characteristics of most of the PAPA to a landscape where "*one is constantly aware that extensive development activities are ongoing*." Though not quantified, one may assume that the development and operation of natural gas resources in the PAPA affected the visual and aesthetic quality associated with dispersed recreational experiences, one of several impacts anticipated in the PAPA DEIS (BLM, 1999a) (also see Visual Resources, Section 4.7, below). Impacts as a result of any of the alternatives may not be significant but dispersed recreational use of the PAPA would not be enhanced.

Table 4.6-1
Surface Disturbance in Relation to Public Recreation Areas by Alternative

Public Recreation Area	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Mount Airy OHV Open Use Area	195.8	304.3	197.6	197.6	702.0	546.3
Area of OHV Use Limited to Existing Roads and Trails	1,612.3	1,211.4	2,940.1	2,759.1	3,944.6	3,653.5
Desert General OHV Open Use Area	2,390.7	2,294.2	2,975.3	2,947.6	5,881.5	6,576.9
Wind River Front SRMA	26.6	0.0	0.3	0.3	0.3	0.3
Total	**4,225.4**	**3,809.9**	**6,113.3**	**5,904.6**	**10,528.4**	**10,777.0**

Pipeline Corridors and Gas Sales Pipelines

The proposed corridor/pipeline alignments would not directly affect existing dispersed recreational opportunities in the project area. Corridor designation would not affect current land uses or overall management direction by federal, state, and private land managers.

Actual disturbance or displacement of the affected area's characteristic, dispersed recreational activity may occur near pipeline construction activities; however, this impact would be limited in both extent and duration as the construction activity would migrate across the landscape and would not be concentrated at a single location for an extended period. Construction of specific pipelines would occur sequentially within a corridor, within a construction season and over a

period of years. Consequently, the area of disturbance and the impact on recreational travel (use of roads) would be minor.

Depending on timing of pipeline construction activities, overall minor conflicts with hunting opportunities could result in localized interruption of activities for a given area. The conflict would be temporary, a matter of a few days, and limited to an area immediately surrounding pipeline construction. Temporary displacement of game animals caused by construction activity and noise may occur. Impacts to recreational use of the rivers would be temporary and would be limited pipeline construction across the rivers. Conflicts with recreational uses of the Green River would be temporary and would be minimized because the Green River would be crossed by HDD construction techniques.

4.6.3.2 Alternative A (No Action Alternative)

Wellfield development has affected the Desert General OHV Open Use Area south of the New Fork River (Table 4.6-1). Continued development, through 2011, under the No Action Alternative, would affect 2,294 additional acres in the Desert General OHV Open Use Area. The No Action Alternative would generate no new disturbance in the Wind River Front SRMA. Disturbance by existing wellfield development within recreation areas on the Mesa would nearly double by 2011, affecting the Mount Airy OHV Open Use Area and other areas of existing roads and trails on the Mesa. Current restrictions on recreational travel across the Mesa and Mount Airy OHV Open Use Area to protect deer and antelope on winter range would continue under the No Action Alternative, if needed. Vehicular access during winter in the recreation areas would be limited to production related traffic and traffic associated with drilling in the mostly single operated contiguous leaseholds in the northern portion of the PAPA (BLM, 2004a).

4.6.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Through 2011, wellfield development under the Proposed Action Alternative is expected to affect more surface within the Desert General OHV Open Use Area than the No Action Alternative. There would be more surface disturbance under the Proposed Action Alternative than under the No Action Alternative in the Area of OHV Use Limited to Existing Roads and Trails although surface disturbance would be less in the Mount Airy OHV Open Use Area. Current restrictions on recreational travel across the Mesa and Mount Airy OHV Open Use Area during the winter to protect deer and antelope on winter ranges might continue under the Proposed Action Alternative, if needed. However, extensive vehicular traffic during winter is expected in recreation areas with year-round drilling through 2011 under the Proposed Action Alternative.

Proposed Action Alternative Through 2023

After 2017, there would be a steady decline in winter traffic through 2023 under the Proposed Action Alternative. Production related traffic would be reduced by installation of a liquids gathering system in the central and southern portions of the PAPA and increased use of computer assisted remote monitoring. At some point, restrictions on recreational travel across the Mesa and Mount Airy OHV Open Use Area during the winter might effectively protect deer and antelope on winter ranges, if needed.

4.6.3.4 Alternative C

Alternative C Through 2011

Through 2011, Alternative C is expected to affect more surface disturbance within the Desert General OHV Open Use Area and the Area of OHV Use Limited to Existing Roads and Trails

than is the No Action Alternative. However, surface disturbance in the Mount Airy OHV Open Use Area is expected to be less under Alternative C through 2011 than the No Action Alternative. Disturbance by Alternative C through 2011 is expected to be comparable to those generated by the Proposed Action Alternative. Current restrictions on recreational travel across the Mesa and Mount Airy OHV Open Use Area during winter to protect deer and antelope on winter ranges might continue under Alternative C, if needed. However, extensive vehicular traffic during winter would be expected in recreation areas with year-round drilling through 2011, especially in the southern portion of DA-1 and in all of DA-2. Restrictions on winter recreational traffic, if applied, are expected to be most effective within the Mount Airy OHV Open Use Area.

Alternative C Through 2023

By 2023, Alternative C is likely to result in similar distribution of surface disturbance as the Proposed Action Alternative among the three public recreation areas. Table 4.6-1 shows differences in surface disturbance between the two alternatives, however, the difference is based on modeled outcomes for projection of disturbance. Therefore, it is more realistic to look at a range of disturbance between the two alternatives. In the end, surface disturbance within recreation areas would be similar under the two alternatives. After 2017, there would be a steady decline in winter traffic through 2023 under Alternative C. Production related traffic would be reduced by installation of a liquids gathering system in the central and southern portions of the PAPA and increased use of computer assisted remote monitoring. At some point, restrictions on recreational travel across the Mesa and Mount Airy OHV Open Use Area during the winter might effectively protect deer and antelope on winter ranges, if needed.

4.6.4 Cumulative Impacts

The CIAA for Recreation is the PAPA. Residents of Sublette County placed high value on recreational opportunities and people who moved there cited recreation as one reason for choosing to live there (McLeod et al., 1998). In the past, use of the PAPA included OHV-oriented recreation. OHV use within Sublette County has increased annually from 2002 through 2005 (based on numbers of OHV permits issued) though not as much as in other Wyoming counties, due in part to the relatively small population (Foulke et al., 2006b).

Before issuance of the PAPA ROD (BLM, 2000b), most of the OHV use in the PAPA was in three assigned areas; Mount Airy OHV Open Use Area, Area of OHV Use Limited to Existing Roads and Trails, and the Desert General OHV Open Use Area. Past disturbance unassociated with wellfield development in the PAPA (Table 4.6-2) occurred within each of the OHV-use areas, mainly by a variety of roads (arterials, collectors), livestock facilities and a few gravel quarries. All past disturbances to OHV-oriented recreational areas in the PAPA totaled approximately 460 acres (Table 4.6-2).

Currently, surface disturbance associated with wellfield development within the OHV-oriented recreational areas is nearly ten times the disturbance unassociated with wellfield development, amounting to 4,225 acres (Table 4.6-2). Reasonably foreseeable development in the PAPA is focused on the disturbance associated with each of the alternatives.

The cumulative impact to public recreation areas in the PAPA (Table 4.6-2) is based solely on estimates of surface disturbance within the areas by wellfield development projected by each alternative. Total cumulative impact by the Proposed Action Alternative and Alternative C exceed cumulative effects by the No Action Alternative for all public recreation areas except the Wind River Front SRMA. The difference in levels of cumulative impact among the alternatives is most apparent in the effects to Area of OHV Use Limited to Existing Roads and Trails. All alternatives would generate the most cumulative impact within the Desert General OHV Open Use Area, more by the Proposed Action Alternative and Alternative C in 2011 than by the No

Action Alternative and even more by the two alternatives in 2023 than by the No Action Alternative in 2011.

Table 4.6-2
Cumulative Surface Disturbance in Relation to Public Recreation Areas by Alternative

Public Recreation Area	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Mount Airy OHV Open Use Area	77.2	195.8	577.3	470.6	470.6	975.0	819.3
Area of OHV Use Limited to Existing Roads and Trails	151.2	1,612.3	2,984.1	4,712.8	4,531.8	5,717.3	5,426.2
Desert General OHV Open Use Area	231.3	2,390.7	5,265.3	5,946.4	5,918.7	8,852.6	9,548.0
Wind River Front SRMA	0.0	26.6	26.6	26.9	26.9	26.9	26.9
Total	**459.7**	**4,225.4**	**8,853.3**	**11,156.7**	**10,948.0**	**15,571.8**	**15,820.4**

4.6.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to recreation resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.7 VISUAL RESOURCES

4.7.1 Scoping Issues

There were no public scoping concerns related to visual resources.

4.7.2 Impacts Considered in the PAPA DEIS

The Mesa "breaks," foothills and sandstone ridges form the background west of U.S. Highway 191. The management objective of VRM Class II is to retain the existing character of the landscape, the level of change to the character of the landscape should be low, and management activities should not attract the attention of the casual observer. Management of visual resources in Class III areas allows for moderate change in the character of the landscape while Class IV areas allow for major modification of the landscape.

Visibility analysis conducted for the PAPA DEIS (BLM, 1999a) determined that a portion of the PAPA would be visible from sensitive viewpoints near Pinedale. Wellfield development, shown on Map 3.9-2 and identified as the Sensitive Viewshed SRMZ, would be noticeable as visual resource impacts because the impacted area would be seen from many points in the Town of

Pinedale, residential areas, and along U.S. Highway 191. In particular, night lighting effects within the Sensitive Viewshed SRMZ during drilling would be visible from all of the sensitive viewpoints. BLM noted that night lighting in general can impact areas far from the drilling activity and areas outside of the PAPA.

The PAPA DEIS (BLM, 1999a) considered a significant impact to visual resources on federal lands and minerals would occur if project related development did not meet BLM's VRM class objectives for an area: Significant visual impacts would occur if:

- oil and gas development becomes the dominant feature in the landscape where objectives for that land are to maintain the existing character of the landscape; or
- there is an apparent change, to the casual observer, from a natural landscape to an "industrialized appearing" landscape in areas visible from U.S. Highway 191, residential areas, and the Town of Pinedale.

Based on the significance criteria, the PAPA DEIS (BLM, 1999a) stated that significant impacts to visual resources in the PAPA could occur for all alternatives except the *No Action Exploration/ Development Scenario*. Visual resources in localized areas have been significantly impacted, according to impact significance defined in the PAPA DEIS. Some areas that are visible from U.S. Highway 191 and some residential areas have changed from a natural landscape to an "industrialized appearing" landscape since 2000. Significant impact has occurred to visual resources in these locations, according to the significance criteria in the PAPA DEIS.

4.7.3 Alternative Impacts

4.7.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Each of the alternatives is expected to disturb additional areas within VRM II by the end of 2011. The most affected VRM II land in the PAPA is along the New Fork River near Pinedale and in riparian zones in the central portion of the PAPA. As stated above, there are localized areas that have been significantly impacted and would be further impacted by each alternative through 2011 and by the Proposed Action Alternative and Alternative C through 2023 (Table 4.7-1).

Table 4.7-1
Surface Disturbance in Relation to VRMs and the Sensitive Viewshed SRMZ by Alternative

VRM Classes	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
VRM II	354.8	258.9	285.9	341.1	855.9	748.0
VRM III	1,093.8	959.0	1,075.8	1,251.7	2,182.6	1,960.3
VRM IV	3,610.8	3,266.6	5,483.3	5,263.8	9,239.9	9,563.3
Total in VRM Classes	**5,059.4**	**4,484.5**	**6,845.0**	**6,856.6**	**12,278.4**	**12,271.6**
Sensitive Viewshed SRMZ	406.2	319.6	242.7	242.7	1,022.2	912.0

The Sensitive Viewshed SRMZ has similarly been affected by wellfield development in the PAPA through 2006 (Table 4.7-1). Additional disturbance by all alternatives within the SRMZ would result from construction of the 7.5-mile long, 30-inch gas pipeline from the Stewart Point Area to the 4-way area along existing rights-of-way and the 22.8-mile long, 10-inch water line from the Stewart Point area to Highway 351 (see Section 2.4.2.1).

Most disturbance, by any alternative, would be within land classified as VRM IV. However, substantial portions of the VRM III class would be affected by all alternatives, primarily within the northern end of the PAPA and along the New Fork River. Some development in VRM Class III lands on the west side of U.S. Highway 191 has occurred in the southern end of the PAPA and additional development is expected under all alternatives. Wellfield development could disturb about 2,000 acres in VRM Class III by the Proposed Action Alternative and Alternative C by 2023 (Table 4.7-1). This level of development would exceed BLM's management objective for the VRM III class, which allows for only moderate change in the character of the landscape. Visual resources in the localized areas of VRM II and VRM III have been significantly impacted (according to impact significance defined in the PAPA DEIS) and would be further impacted under all alternatives. Depending on the success of future revegetation efforts, the PAPA may not appear as an industrialized landscape such as it is in 2006 and effects to VRM II and VRM III lands, particularly within DA-2, may be substantially diminished. According to the significance criteria in the PAPA DEIS, impact to visual resources would continue by implementation of any of the alternatives.

Pipeline Corridors and Gas Sales Pipelines

Establishment of the proposed pipeline corridors would result in new pipeline construction in lands classified as VRM classes II, III, and IV. Pipeline construction would involve the removal of vegetative cover and blading, excavation, backfilling, and re-spreading of soil materials which would likely create visual contrasts with the surrounding landscape. With selective placement of surface ancillary facilities and successful reclamation and reestablishment of protective vegetative cover, pipeline construction would be consistent with the BLM's VRM objectives.

The proposed corridor/pipeline alignments would cross approximately 11 miles of VRM Class II lands at the New Fork River and Green River. The objectives of VRM Class II criteria would be maintained at all three river crossings because they would be crossed by HDD. Reclamation of the disturbed construction rights-of-way for each pipeline would allow for overall retention of the landscape's existing character. Within a short period of time (3 years), apparent changes in landscape character within the construction rights-of-way should not be readily noticeable to a casual observer.

Approximately 13 miles of the proposed corridor/pipeline alignments would cross areas designated as VRM Class III. These areas are on either side of the river crossings bordering and extending beyond the VRM Class II areas. The existing character of these lands would be retained following reclamation of the affected rights-of-way. Pipeline construction and operation in VRM Class III lands would be consistent with the class objectives to partially retain the existing character of the landscape. The remaining 126 miles of proposed corridor/pipeline alignments would cross VRM Class IV landscapes that allow for major modifications of the existing character. Consistent application of reclamation procedures would meet and exceed these objectives.

4.7.3.2 Alternative A (No Action Alternative)

Continuation of wellfield development under the No Action Alternative would affect more than 3,200 acres in VRM Class IV (Table 4.7-1). The No Action Alternative is expected to affect more than 250 additional acres in VRM Class II and 960 additional acres in VRM Class III. The

No Action Alternative is likely to increase the disturbance within the Sensitive Viewshed SRMZ more than effects by the other two alternatives by 2011 (Table 4.7-1). This is because the No Action Alternative does not allow for any concentrated development as do the other alternatives.

4.7.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Implementation of the Proposed Action Alternative would result in slightly more levels of disturbance than the No Action Alternative but less than Alternative C to VRM II and VRM III lands (Table 4.7-1) by 2011. The Proposed Action would likely affect less of the Sensitive Viewshed SRMZ than the No Action Alternative by 2011.

Proposed Action Alternative Through 2023

Under the Proposed Action Alternative, disturbance in VRM Class II lands would be about 800 acres which would be more than double the disturbance in 2006. About 1,000 acres of the Sensitive Viewshed SRMZ would be disturbed under the Proposed Action Alternative through 2023.

4.7.3.4 Alternative C

Alternative C Through 2011

Implementation of Alternative C would result in more disturbance than either the No Action Alternative or the Proposed Action Alternative to VRM II and VRM III lands (Table 4.7-1) by 2011. Effects to the Sensitive Viewshed SRMZ by Alternative C would be less than effects by the No Action Alternative by 2011.

Unlike the Proposed Action Alternative, there would be no new disturbance within the northern portion of DA-1 and within DA-3 until development is complete in the southern portion of DA-1 and in DA-2. VRM classes II and III would be more affected by Alternative C through 2011 than they would be the Proposed Action Alternative through 2011.

Alternative C Through 2023

By 2023, effects to VRM classes II and III would be similar to that under the Proposed Action Alternative through 2023. Effects to the Sensitive Viewshed SRMZ under Alternative C through 2023 would be similar to the Proposed Action Alternative through 2023.

There is more opportunity for focal points of final reclamation under Alternative C than under the Proposed Action Alternative as development moves north from the southern portion of DA-1 and as development moves from DA-2 to DA-3.

4.7.4 Cumulative Impacts

Residents of Sublette County placed high value on the surrounding scenery and people who moved there cited scenery associated with the Wind River Range to the east and the Wyoming Range to the west as one reason for choosing to live there (McLeod et al., 1998). Reflecting on and reinforcing the scenic values held by residents of Sublette County, BLM established management objectives in portions of the PAPA that would retain the visual characteristics of some landscapes.

Prior to natural gas development that followed the PAPA ROD in July 2000, most surface disturbance within VRM II and VRM III lands in the PAPA had been by agriculture with some disturbance by roads and residences. This disturbance contributes to the existing non-wellfield surface disturbance listed in Table 4.7-2. Most, if not all, of this disturbance was present when BLM classified the VRM II and VRM III lands in the Pinedale RMP (BLM, 1988b). Similar

existing non-wellfield disturbance occurred within the Sensitive Viewshed SRMZ that was identified for the area's visual qualities in the PAPA DEIS (BLM, 1999a).

The cumulative impact to VRM Classes in the PAPA (Table 4.7-2) is based on estimates of surface disturbance by wellfield development projected into the future (2011 and 2023) by each alternative. Total cumulative impact by the Proposed Action Alternative and Alternative C exceeds cumulative effects by the No Action Alternative for all VRM classes although effects to VRM II lands in 2011 would be nearly the same for all alternatives. Likewise, cumulative surface disturbance within the Sensitive Viewshed SRMZ in 2011 is roughly equivalent among alternatives. The difference in level of cumulative impact among the alternatives is most apparent in the effects to VRM IV lands. There is more effect within all VRM classes and the Sensitive Viewshed SRMZ by the Proposed Action Alternative and Alternative C in 2011 than by the No Action Alternative, and certainly more under these two alternatives by 2023.

Table 4.7-2
Cumulative Surface Disturbance in Relation to
VRMs and the Sensitive Viewshed SRMZ by Alternative

VRM Classes	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
VRM II	3,976.5	354.8	4,617.9	4,644.9	4,700.1	5,214.9	5,107.0
VRM III	3,173.7	1,093.8	5,289.8	5,406.6	5,582.5	6,513.4	6,291.1
VRM IV	316.7	3,610.8	7,529.4	9,746.1	9,526.6	13,502.7	13,826.1
Total in VRM Classes	**7,466.9**	**5,059.4**	**17,437.1**	**19,797.6**	**19,809.2**	**25,231.0**	**25,224.2**
Sensitive Viewshed SRMZ	4,786.8	406.2	5,512.6	5,435.7	5,435.7	6,215.2	6,105.0

4.7.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to visual resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.8 CULTURAL AND HISTORIC RESOURCES

4.8.1 Scoping Issues

There were no project scoping comments related to cultural and historic resources.

4.8.2 Impacts Considered in the PAPA DEIS

Because of the requirement for compliance with Section 106 of the National Historic Preservation Act (NHPA) and with the Archeological Resources Protection Act (ARPA), all areas on federal lands and minerals proposed for surface disturbance would be surveyed for cultural resources. Procedures for identifying and protecting cultural resources on private or State of Wyoming lands are not in place. Only if a project involves a federal permit or authorization (e.g., a pipeline crossing on both BLM and private land), would federal historic preservation requirements apply. On federal lands, any undertaking by Operators would follow the BLM National Programmatic Agreement Process, as identified in BLM's State Protocol Agreement between BLM and the Wyoming SHPO (Appendix G), prior to any surface disturbing activity and would either avoid or protect cultural resource properties and sacred sites.

As stated in the PAPA DEIS (BLM, 1999a), the preferred strategy for treating potential adverse effects on cultural properties is "avoidance." That strategy has been used in some circumstances during wellfield development through 2006 (see Section 3.8). If avoidance was imprudent or unfeasible, appropriate mitigation has included excavation (data recovery), stabilization, monitoring, protection barriers and signs, Native American consultation, archival or ethnographic studies, or other physical and administrative measures. Traditional tribal elders have been consulted regarding the importance of specific features identified, and for their recommendations on appropriate avoidance distances. Distances were established through consultation with the Shoshone Tribe and tribal guidelines for buffer zones for development near Native American sites as described in Chapter 3 (Section 3.8).

The PAPA DEIS (BLM, 1999a) recognized that a significant impact to cultural or historical resources, as defined by 36 CFR 800.5 (July, 1999 version) would include:

- An undertaking that alters, directly or indirectly, characteristics of a historic property that qualify the property for inclusion in the National Register (of Historic Places) in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register.
- Adverse effects on historic properties include, but are not limited to: (i) physical destruction of or damage to all or part of the property; (ii) alteration of a property, including restoration, rehabilitation, repair, maintenance, and stabilization; (iii) removal of the property from its historic location; (iv) change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance; and (v) introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features.

Significant impacts based on one or more of the criteria above has occurred. Complete documentation of all occurrences of significant impacts is not available.

4.8.3 Alternative Impacts

4.8.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Additional disturbance within the 0.25-mile Lander Trail buffer, Lander Trail SRMZ, and Lander Trail viewshed are expected by each Alternative in 2011 (Table 4.8-1). With full development through 2023, the Proposed Action Alternative and Alternative C are expected to disturb substantial areas within the Lander Trail SRMZ (Table 4.8-2). Disturbance would probably change of the character of the Lander Trail's use and of physical features within the Trail's

setting that contribute to its historic significance, a significant impact according to criteria defined by 36 CFR 800.5, above.

Table 4.8-1
Surface Disturbance in Relation to the Lander Trail SMRZ and 0.25-Mile Buffer by Alternative

Lander Trail SRMZ Category	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Lander Trail 0.25-mile Buffer	67.3	23.0	67.8	74.5	122.1	212.1
Lander Trail SRMZ (PAPA DEIS)	532.8	520.5	800.7	702.5	1,588.8	1,670.5
Lander Trail Viewshed (PAPA ROD)	388.1	332.4	444.6	520.0	1,138.5	1,304.4

Impact to cultural resources would most likely be direct, resulting from any of the adverse effects stated above. Indirect impacts are likely if historic properties and other cultural resources are adversely affected because of increased human access and subsequent vandalism.

Pipeline Corridors and Gas Sales Pipelines

Specific Class III cultural resource inventories have not been completed in the proposed pipeline corridors. Information compiled from inventories completed adjacent to proposed corridors indicate that impacts to cultural and historical resources would likely result from pipeline construction. An estimated 35 cultural resource sites recommended as eligible for nomination to the NRHP could be affected by construction of the two pipelines in the BCC and the single pipelines in BFGC and OPC. An estimated 11 crossings of eligible historic trails/roads would result from construction of the proposed R6, PBC, and Opal Loop III pipelines.

The impacts anticipated at each of the historic trail crossings are discussed by trail below. The setting for all trail segments at the proposed pipeline crossings are compromised by past and/or ongoing disturbances.

Lander Cutoff. The proposed BCC and proposed R6 and PBC pipeline alignments cross the Lander Cutoff in Section 29, T. 31 N., R. 108 W on BLM administered lands. The proposed and R6 (staked) and PBC pipelines would be located on the west side of the existing pipeline corridor at the trail crossing. The area where the historic trail would be crossed by the proposed pipelines would be fenced to prohibit construction damages to the trail ruts. For each pipeline, the fences would extend a minimum of 50 feet each side of the trail center point for a total of 100 feet. A permitted archaeologist would determine the position of the fence. A bore under the historic trail from outside the fenced areas would eliminate new impacts to the historic ruts; however, the crossing method for this trail would be decided at a later date in consultation with the PFO archaeologist.

Oregon Trail. The proposed BCC and R6 Pipeline would cross the Oregon Trail in two locations. The southernmost crossing of the Oregon Trail occurs in Section 28, T. 19 N., R. 111 W. on land owned by Anadarko Land Corporation. The area has been disturbed. The proposed R6 Pipeline is staked on the west side of the existing pipeline corridor at the historic trail crossing. The trail would be crossed by HDD and the HDD would include the crossings of the

Union Pacific Mainline Railroad, Highway 375, and the Blacks Fork River. The proposed HDD would be 1,000 feet in length. The second crossing of the Oregon Trail/Pony Express Route occurs in Section 33, T. 20 N., R. 111 W., on land owned by Uinta Development. The area has been disturbed. The proposed pipeline is staked on the east side of the existing pipeline corridor at the historic trail crossing. The pipeline would be installed using conventional ditching methods and would parallel the east edge of the existing pipeline rights-of-way. No fencing is proposed at either of the trail crossing sites. Construction would be contained within previous disturbance.

The East Bank Kinney Cutoff. The proposed BCC and R6 Pipeline would cross the East Bank Kinney Cutoff in Section 9, T. 23 N., R. 111 W., on land administered by BOR. The proposed R6 Pipeline is staked on the east side of the existing pipeline corridor at the crossing of the trail. The area where the historic trail is crossed would be fenced to prohibit construction damages to the trail ruts. The fences would extend a minimum of 50 feet on each side of the trail center point for a total of 100 feet. A permitted archaeologist would determine the location of the fencing. The trail crossing would be bored from outside the fenced areas, eliminating new impacts to the historic ruts.

The proposed OPC and Opal Loop III Pipeline would cross the East Bank Kinney Cutoff. The proposed pipeline is yet not staked, and therefore, specific methods of pipeline crossing have not been determined. However, approved discovery plans would be followed to minimize or avoid impacts to the historic trail.

The Baker Davis Road/Slate Creek Cutoff. The proposed BBC and R6 Pipeline would cross the Baker Davis Road/Slate Creek Cutoff in Section 34, T. 24 N., R. 111 W., on land administered by the BOR. The proposed R6 Pipeline is staked on the east side of the existing pipeline corridor at the trail crossing. The area where the historic trail would be crossed would be fenced to prohibit construction damage to the trail ruts. The fences would extend a minimum of 50 feet on each side of the trail center point for a total of 100 feet. A permitted archaeologist would determine the position of the fence. A bore under the historic trail from outside the fenced areas would eliminate new impacts to the historic ruts.

The proposed OPC and Opal Loop III Pipeline would cross the Baker Davis Road/Slate Creek Cutoff. The proposed pipeline is not yet staked and specific methods of pipeline crossing have not been determined. However, approved discovery plans would be followed to minimize or avoid impacts to the historic trail.

Sublette Cutoff. The proposed pipeline would cross the Sublette Cutoff in Section 9, T. 26 N., R. 111 W., on land administered by the BLM. The proposed R6 Pipeline is staked on the east side of the existing pipeline corridor at the trail crossing, east of the County Line Road. The area where the historic trail is crossed by the proposed pipeline would be fenced to prohibit construction damages to the trail ruts. The fences would extend a minimum of 50 feet on each side of the trail center point for a total of 100 feet. A permitted archaeologist would determine the position of the fence. A bore under the historic trail from outside the fenced areas would eliminate new impacts to the historic ruts.

4.8.3.2 Alternative A (No Action Alternative)

Wellfield development within the PAPA under the No Action Alternative would generate an estimated 4,485 acres of additional surface disturbance, which includes new well pads, pipelines and roads. Because surface disturbing activities are directly associated with impacts to cultural resources, it is likely that these resources, especially archaeological artifacts, would continue to be impacted in much the same way and at similar rates as they have since the issuance of the PAPA ROD. Currently, and as continued under the No Action Alternative,

winter drilling is isolated to a few locations. The absence of winter drilling would continue to allow resource managers to effectively mitigate unexpected discoveries during construction.

Major finds in areas such as those at the sandy bluffs on the north side of the New Fork River and on the north and south ends of the anticline would continue to be impacted under the No Action Alternative. Wellfield disturbance in quarter-sections in these areas are projected to increase by between 10 to 40 percent, which would invariably result in more discoveries. Additionally, the potential for nearly 47 miles of new roads under the No Action Alternative raises potential for more finds and unexpected discoveries.

The No Action Alternative would have the least impact of all alternatives to the Lander Trail 0.25-mile buffer and SRMZ (Table 4.8-1). Potentially 23 additional acres would be disturbed within the 0.25-mile buffer zone, approximately 520 acres would be disturbed within the 22,893-acre Lander Trail SRMZ and 332 acres would be disturbed within the trail viewshed under the No Action Alternative. This alternative continues a trend of minimal new surface disturbance along the Lander Trail although it would continue to alter the Trail's historically significant setting through 2011.

Further, the Sensitive Viewshed and Mesa Breaks management areas (MA 4 and MA 2, respectively) near Stewart Point in the northern portion of the PAPA would remain protected under the No Action Alternative. This region of the PAPA has been documented as having potential for archaeological discoveries (see discussion in Chapter 3). Although winter drilling would continue near these areas, there would be no additional well pads allowed under BLM's 2004 Decision Record (BLM, 2004a), and further surface disturbance would be limited to expansion of existing well pads.

4.8.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

The Proposed Action Alternative through 2011 could result in a much higher probability of resource destruction and unexpected discoveries than the No Action Alternative. An estimate of more than 6,845 additional acres of surface disturbance by 2011 could place significant strain on the cultural and historical resources in the PAPA. The potential exists for 2,200 more acres of surface disturbance under the Proposed Action Alternative than for the No Action Alternative through 2011. Most of this would be in the form of 179 new and expanded well pads and new access roads. Some pads could be expanded by up to 30 acres and this is a concern for cultural resource managers. Unexpected discoveries and subsequent resource damage could significantly increase in areas of large, concentrated surface disturbances (Vlcek, 2006).

Development under the Proposed Action Alternative could cause an estimated 68 additional acres of surface disturbance in the Lander Trail 0.25-mile buffer, about twice what currently exists. Approximately 800 additional acres of disturbance is expected within the Lander Trail SRMZ (Table 4.8-1), which is nearly 280 acres more than under the No Action Alternative. There would be less disturbance to the Lander Trail viewshed (445 acres) through 2011 than would be expected under Alternative C, mainly due to focused development just north of State Highway 351 by that alternative.

In addition to surface disturbance issues, year-round drilling poses the potential for significant impacts to the resource. Mitigation, most commonly done through salvage excavations, cannot take place during the winter months when the ground is frozen and often snow-covered. Under law, construction activities could be halted because of resource discoveries in the winter months, if mitigation techniques cannot take place during those times. Not only does this threaten to adversely impact the resource by prolonged exposure to extreme weather and

potential vandalism or theft, it may cause significant additional expense to the Operator (Vlcek, 2006).

While the surface disturbance elements of the Proposed Action Alternative through 2011 would threaten cultural resources, aspects of that alternative could result in resource protection. For example, two areas located in Section 11, T. 31 N., R. 109 W. are adjacent to major find sites on the sandy bluffs just north of the New Fork River. The Proposed Action Alternative would possibly generate less surface disturbance proximate to those sites due to confined year-round development within the core area and CDA-2 that would not include those archaeologically significant areas.

Proposed Action Alternative Through 2023

Full development through 2023 under the Proposed Action Alternative is expected to bring substantial surface disturbance within the Lander Trail SRMZ and trail viewshed. This alternative could disturb nearly 1,600 acres with the SRMZ and more than 120 acres within the Trail's 0.25-mile buffer. Potential surface disturbance by this alternative in the Lander Trail SRMZ is enumerated in Table 4.8-1. This level of development could adversely impact the Trail's setting and historical significance.

Increased probability of unexpected discoveries and the potential resource damage that accompanies them continues in this phase of the Proposed Action Alternative. With more than 10,700 total acres likely to be disturbed 2023, it is anticipated that resource discovery and damage trends would continue, although exact figures are impossible to determine.

Further, with extensive surface disturbance (disturbance in many quarter section exceeding 50 percent) throughout the PAPA, it is likely that more major finds would be discovered under the Proposed Action Alternative through 2023. Currently, there are nearly 4,000 acres of wellfield surface disturbance on federal lands and minerals within the PAPA, with about three major finds. By 2023, surface disturbance on federal lands within the PAPA could result in not only several more discoveries in areas of existing development, but also discoveries in areas not known for significant archaeological resources.

Potentially, large numbers of unexpected discoveries could slow the pace of development through increased mitigation. Currently, most mitigation occurs as excavations supervised by permitted archeologists. If several excavations are necessary within a given quarter-section, operators may be forced to postpone construction and drilling activities.

Well drilling would continue during the winter months, although it would be on fewer well pads each year through 2023. As with the Proposed Alternative through 2011, year-round drilling can cause significant adverse impacts. Mitigation in the form of excavations is often impossible during the winter months when the ground is frozen and snow-covered. If extensive need for winter mitigation arises, alternative methods of resource protection could need to be researched and implemented.

4.8.3.4 Alternative C

Alternative C Through 2011

Alternative C is likely to result in about 100 acres less surface disturbance to the Lander Trail SRMZ than the Proposed Action Alternative by 2011. Within the Trail's 0.25-mile buffer, only about 7 fewer acres would be disturbed than by the Proposed Action through 2011 (Table 4.8-1).

Development under Alternative C through 2011 is projected to concentrate surface disturbance in portions of the PAPA differently than the Proposed Action. Focal areas of disturbance would

be in the southern part of DA-1, all of DA-2, and throughout DA-4, the larger expanse of development within the core area under the Proposed Action. For cultural resources, this means significant surface disturbance would continue in much the same way north of the New Fork River within the PAPA, but potentially would be more limited directly south of the New Fork River in DA-3 than by the Proposed Action Alternative. Potential areas of major finds along the sandy bluffs north of the New Fork River would likely be impacted more with the levels of concentrated development in DA-2 through 2011. Development within DA-4 north of State Highway 351 would generate more surface disturbance within the Lander Trail viewshed by 2011 than would the Proposed Action Alternative.

Alternative C Through 2023

With full development through 2023, Alternative C is expected to generate about the same amount of surface disturbance throughout the PAPA as the Proposed Action Alternative (Table 4.8-1). Full development under Alternative C could result in more than 200 acres of additional surface disturbance in the Lander Trail 0.25-mile buffer. This is considerably higher than the estimated 67 acres currently disturbed there. The potential surface disturbance would probably significantly alter the setting and use of the Lander Trail within the PAPA.

4.8.4 Cumulative Impacts

The cumulative impact analysis area for cultural and historic resources in the PAPA DEIS (BLM, 1999a) was an approximate 330,740-acre area which included the PAPA and a surrounding 2-mile buffer. The buffer was based on the assumption that roads could be constructed anywhere within the PAPA, and 2 miles past its boundaries would provide a reasonable limit to the distance thieves and vandals could wonder from roads in search of cultural or historic artifacts. Because development in the PAPA since 2000 has provided resource managers with more insight on cultural resources within the region, and the natural gas development patterns are more predictable, the CIAA in this section is confined to the PAPA. As of 2006, the majority of development and subsequent surface disturbance and roads have occurred along the Anticline Crest region. It is projected under all alternatives that this would continue to be the case through full field development.

In the PAPA, surface disturbance is the major factor determining adverse impacts for cultural and historic resources. Estimated cumulative surface disturbance within the Lander Trail SMRZ and trail viewshed is summarized in Table 4.8-2. It is projected that cumulative impacts to the Lander Trail would result in significant degradation to its setting and use under both the Proposed Action Alternative and Alternative C. Further, under all project development alternatives, cumulative impacts would increase with increased surface disturbance and human activity, and significant cumulative effects to cultural resources could occur if undocumented and unrecognized NRHP-eligible sites are impacted and unmitigated. Because of the unpredictable nature of archaeological discoveries made during construction in the PAPA, adverse effects could occur on sites not identified by customary inventory and evaluation work.

However, inventory, recording, and data recovery projects triggered by surface disturbance would continue to increase the cultural resource database, likely improving future cultural resource management decisions. In the last few years, several major new archeological discoveries have been documented, greatly increasing knowledge of the prehistoric period of the PAPA and Upper Green River Basin. Generally, the greater the increase in permitted activity, the greater the data acquisition of cultural resource information will be.

Table 4.8-2
Cumulative Surface Disturbance in Relation to
the Lander Trail SMRZ and 0.25-Mile Buffer Alternative

Lander Trail SRMZ Category	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Lander Trail 0.25-mile Buffer	6.6	67.3	665.1	709.9	716.6	764.2	854.2
Lander Trail SRMZ (PAPA DEIS)	93.7	532.8	692.3	972.5	874.3	1,760.6	1,842.3
Lander Trail Viewshed (PAPA ROD)	77.5	388.1	798.0	910.2	985.6	1,604.1	1,770.0

4.8.5 Alternative Impact Mitigation

Mitigation for impacts to Cultural Resources is discussed in Chapter 3 (Section 3.10.1.5) and in Chapter 4 (Section 4.7.3). A segment of the Lander Trail is currently managed under a PA between BLM, the Wyoming SHPO, the Advisory Council on Historic Preservation, Shell, and Ultra to maintain the integrity of the trail (see Appendix H). The PA does not include other Operators developing near the Lander Trail. They would be responsible for creating their own individual mitigation or management plans. In addition to the PA, the Wyoming Protocol Agreement (see Appendix G), is a document that describes the consultation process between the Wyoming SHPO and BLM regarding cultural resource management (though not specific to the PAPA). Both documents describe how archeological resource management would be implemented under any of the alternatives.

The proposed corridor/pipeline alignments cross historic trails at points considered as contributing to their eligibility nomination for the NRHP. All surface disturbing activity within 200 feet of the East Bank Kinney Cutoff, the Baker Davis Road/Slate Creek Cutoff, the Sublette Cutoff, and the Lander Cutoff would be monitored by an archaeologist who meets or exceeds the qualification standards recommended by the Secretary of the Interior. With the application of mitigation measures described above and those to be developed and documented in discovery plans following completion of Class III inventories of the proposed corridor/pipeline alignments, there should be no significant impacts to any historic properties.

4.9 AIR QUALITY

4.9.1 Scoping Issues

Air quality related concerns have increased in the Upper Green River Basin, including Pinedale, as natural gas development continues in the PAPA and in the Jonah Field. Because of this awareness, a number of comments were received during scoping. They are summarized below:

1. There should be a detailed air quality analysis including a cumulative analysis for southwestern Wyoming.
2. Utilize most recent modeled and monitored ozone concentrations in the Pinedale area to address regional haze and to determine compliance with National Ambient Air Quality Standards.
3. Model and disclose impacts to PSD Class I and sensitive PSD Class II areas by winter drilling, completions, and flaring in the PAPA and in the cumulative impact analysis area.

4. Compare emissions estimated from the original PAPA EIS to those from the proposed action.
5. Address cumulative impacts to high mountain lakes and downstream impact to trout and water users.
6. Provide evaluations of how effective the ASU Year-Round Drilling Demonstration Project emission mitigation has been and effectiveness of the Naughton Power Plant Unit 3 retrofit on regional air quality.
7. Concern regarding emissions from flaring operations.
8. Discuss use of low emission drilling rigs, best available technology, and other mitigation measures to comply with Wyoming Department of Environmental Quality regulations.
9. Address trade-offs between directional drilling and increased air quality impact.
10. Increase air quality monitoring.

4.9.2 Impacts Considered in the PAPA DEIS

An Air Quality Assessment Protocol was developed for the PAPA DEIS (BLM, 1999a). The Protocol specified the methodologies for quantifying potential air quality impacts from the project and surrounding development. The protocol was prepared with input and review from the BLM, State of Wyoming, USFS, EPA Region VIII, NPS and the operators, thereby ensuring that the assessment methodology would be acceptable to the federal land managers. The criteria for evaluating the significance of the potential air quality impacts were also addressed. The PAPA DEIS stated significant impacts to air quality would result from project related activities if:

- PSD increments for Class I and Class II areas have been exceeded;
- National Ambient Air Quality Standards (NAAQS) or Wyoming Ambient Air Quality Standards (WAAQS) have been exceeded;
- increased toxin concentrations are above designated thresholds;
- lifetime incremental increase in cancer risk of one additional person in 1 million from the most likely exposure scenario is exceeded;
- visibility impacts to sensitive areas are above the designated 0.5 and 1.0 dv (deciview) change thresholds; or
- change in sensitive lake acid neutralizing capacity (ANC) is above the designated 10 percent level of acceptable change (LAC).

4.9.3 Alternative Impacts

4.9.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Direct, indirect, and cumulative air quality impacts were analyzed to predict maximum potential near-field (surrounding the PAPA) and far-field (PSD Class I and sensitive PSD Class II areas) ambient air pollutant concentrations, as well as maximum impacts to visibility (regional haze), and atmospheric deposition (acid rain) impacts. Analyses were also performed to predict maximum in-field (within the PAPA) pollutant concentrations and maximum mid-field (regional communities of Boulder, Cora, and Pinedale) visibility impacts.

Air quality impacts from the project would occur from pollutants emitted during construction (due to potential surface disturbance by earthmoving equipment, vehicle traffic fugitive dust, well completion and testing, and drilling rig and vehicle engine exhaust) and production (production equipment, compressor engine exhausts, vehicle traffic engine exhausts, and fugitive dust).

Pollutants emitted from these activities include NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$, VOCs, and HAPs.

Ozone may develop from NO_x and VOC emissions. The EPA screening methodology (Scheffe, 1998) for ozone analysis was planned for inclusion in this Draft SEIS. However, BLM, with the agreement of the Air Quality Stakeholder Group, has determined that the CALGRID model for ozone impact analysis is the most appropriate method for estimating ozone impact from the PAPA. Results from the CALGRID modeling analysis will be released as a supplement to the Air Quality TSD for this Draft SEIS.

In the PAPA, greenhouse gases are emitted from three main sources: internal combustion engines, combustion of fuel or waste gases, and vented gases. Carbon dioxide is the main emission from internal combustion engines (diesel, gasoline, natural gas), the combustion of fuel gas in various production process burners/heaters, and the combustion of waste gases for safety or WDEQ-AQD requirements. Currently, WDEQ-AQD does not have specific rules regulating greenhouse gas emissions, and although greenhouse gas emissions are a concern they were not analyzed in this Draft SEIS.

This air quality impact assessment is based on the operations and engineering data and assumptions available at the time of the analysis, the best available meteorology data, and currently accepted dispersion modeling procedures, as well as professional and scientific judgment. Assumptions representing most likely operating conditions were incorporated into the analysis whenever possible. For example, compression in the field was assumed to operate at 90 percent of fully permitted capacity, and drilling rig engines were assumed to operate at an average of 42 percent of maximum capacity. In cases where operating projections were not provided by the Operators, parameters were assumed to occur at maximum proposed levels. For example, impact assessments assume that all proposed wells would be productive (no dry holes).

Regulatory Authority. Air pollution impacts are limited by state and federal regulations, standards, and implementation plans established under the Clean Air Act and administered by the applicable air quality regulatory agency (WDEQ/AQD and EPA). The states of Utah, Colorado, and Idaho have similar jurisdiction over potential air pollutant emissions sources in those states, which can have a cumulative impact when combined with WDEQ/AQD regulated sources. The applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees, and control devices prior to construction and/or operation. The U.S. Congress (through the Clean Air Act Section 116) also authorizes local, state, and tribal air quality regulatory agencies to establish air pollution control requirements of equal or greater stringency than federal requirements. Proposed emission sources are required to undergo a permit review by applicable air quality regulatory agencies (including state, tribal, and/or EPA) before construction can begin. The agencies review the proposed air pollutant emission sources and, depending upon the magnitude of emissions and other factors, the air quality regulatory agencies may require additional site-specific air quality analysis and/or additional emission control measures. The measures may include a Best Available Control Technology (BACT) analysis and determination to ensure protection of air quality.

Although WDEQ has the regulatory authority for air quality in Wyoming, BLM also has responsibility in regard to air quality. For example, under the Federal Land Policy Management Act (FLPMA) and the Clean Air Act, BLM cannot authorize activities that do not conform to all applicable local, state, tribal, and federal air quality laws, statutes, regulations, standards, and implementation plans. An extensive air quality impact assessment technical support document was prepared to analyze potential impacts from the development alternatives, as well as other

reasonably foreseeable emission sources. Additional detail regarding this air quality evaluation is provided in the Air Quality TSD.

The significance criteria for potential air quality impacts include state and federally enforced legal requirements to ensure that air pollutant concentrations remain within specific allowable levels. Legal requirements include the NAAQS and WAAQS, which set maximum limits for several air pollutants, and PSD increments, which limit the incremental increase of certain air pollutants (including NO_2, PM_{10}, and SO_2) above legally defined baseline concentration levels. These standards and increments are presented in Table 3.11-1.

Where legal limits have not been established, the BLM uses best available scientific information to identify thresholds of significant adverse impacts. Thresholds or levels of concern are identified for hazardous air pollutant (HAP) exposure, incremental cancer risks, a "just noticeable change" in potential visibility impacts, and potential atmospheric deposition impacts. These thresholds or levels of concern are described later in this chapter.

Impact Analysis. The assessment of direct project impacts includes near-field analyses and far-field analyses which were completed separately for the No Action Alternative (Alternative A), Proposed Action Alternative (Alternative B), and Alternative C. Alternative C is similar to the Proposed Action Alternative; however, it includes mitigation options to reduce air quality impacts. All near-field analyses used the AERMOD model; the far-field analyses used the CALPUFF model. In-field modeling (within the PAPA) and mid-field modeling (regional community locations) were part of the far-field analyses. Detailed information regarding the modeling methodologies used in the near-field and far-field analyses is provided in the Air Quality TSD.

When reviewing predicted near-field impacts, it is important to understand that results reported reflect the maximum pollutant emission rates calculated for the field. The resulting concentrations are combined with monitored background ambient pollutant concentrations. Maximum monitored background air pollutant concentrations were assumed to occur throughout the LOP at all locations in the region year-round. In addition, the maximum predicted air quality impacts from project emission sources would occur near the PAPA. Because impacts typically lessen with distance from an emissions source, impacts at locations more distant from the PAPA would be less than the predicted maximum concentrations. Finally, total air pollutant concentrations for comparison to WAAQS and NAAQS were assumed to be the sum of the maximum modeled concentration and the maximum background concentration. This methodology is used for both long-term and short-term averaging periods. For short-term averaging periods, the maximum concentrations may occur under very different meteorological conditions and may not occur simultaneously.

Near-Field Analysis. The near-field analysis includes impact assessments for comparison to applicable ambient air quality standards and for comparison to PSD increments. It also includes assessments of HAP impacts for comparison to applicable health-based levels for non-cancer compounds and cancer risks for carcinogens. The EPA guideline dispersion model, AERMOD was used to assess near-field impacts of NO_2, CO, SO_2, PM_{10}, and $PM_{2.5}$ and to estimate short-term and long-term HAP impacts. AERMOD was applied using 1 year of meteorological data that was collected during 1999 and 2000 in the Jonah Field.

Ambient Air Quality Standards. Impacts were assessed from the phases of well pad construction or field production that produce the highest emissions. Near-field analyses for NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$ focused on localized impacts from construction, drilling and field compression. Maximum predicted concentrations of all criteria pollutants were added to the ambient background pollutant concentrations for comparison to WAAQS and NAAQS and are

provided in Section 4.9.3.2 and in Appendix M. Results in Appendix M are also presented as the maximum impacts expressed as a percentage of the NAAQS and WAAQS.

Comparison to PSD Increments. The near-field analyses include impact assessments for comparison to PSD increments. Ambient background concentrations were not added to modeled concentrations for comparison to PSD Class II increments. These comparisons are shown in Section 4.9.3.2 and in Appendix M.

HAP Analysis. The near-field analysis also includes assessments of HAP impacts for comparison to applicable health-based levels for non-cancer compounds and cancer risks for carcinogens. The near-field analysis assesses direct impacts in the immediate vicinity of project activities resulting from a single phase and multiple phases of construction or production reflective of maximum emissions. Maximum acute (short-term), long-term (chronic) health-based, and long-term (chronic) cancer risk impacts were modeled. The model used project alternative field-wide HAP emissions and nearest residence locations within and near the PAPA. Modeled HAP impacts representative of all project alternatives is provided in Section 4.9.3.2 and in Appendix M.

Potential maximum acute (short-term; 1-hour) HAP concentrations were compared with the acute Reference Exposure Levels (RELs) (EPA, 2006a). RELs are defined as concentrations at or below which no adverse health effects are expected. RELs are not available for ethylbenzene and n-hexane; instead, the available Immediately Dangerous to Life or Health divided by 10 (IDLH/10) values were used. The IDLH values are determined by the National Institute for Occupational Safety and Health (NIOSH) and were obtained from EPA's Air Toxics Database (EPA, 2006a).

Potential long-term (annual) HAP concentrations were compared to non-carcinogenic Reference Concentrations for Chronic Inhalation (RfCs) (EPA, 2006a). An RfC is defined by EPA as the daily inhalation concentration at which no long-term adverse health effects are expected.

Long-term exposures to emissions of suspected carcinogens (benzene and formaldehyde), were evaluated based on estimates of the increased latent cancer risk over a 70-year lifetime. This analysis presents the potential incremental risk from these pollutants and does not represent a total risk analysis. The cancer risks were calculated using the maximum predicted annual concentrations and EPA's chronic inhalation unit risk factors (URF) for carcinogenic constituents (EPA, 2006a). Estimated cancer risks were evaluated based on the Superfund National Oil and Hazardous Substances Pollution Contingency Plan (EPA, 1990b), where a cancer risk range of 1 to 100 x 10^{-6} is generally acceptable. Two estimates of cancer risk were made; one that corresponds to a most-likely-exposure (MLE) over a national residency average of 9 years with some time spent away from home, and one reflective of the maximally-exposed-individual (MEI) residing at one location for a lifetime with no time spent away from home. The MEI estimate is adjusted for the expected 60 year LOP. For each constituent, the cancer risk is computed by multiplying the maximum predicted annual concentration by the URF and by the overall exposure adjustment factor. The cancer risks for both constituents are then summed to provide an estimate of the total inhalation cancer risk.

Far Field Analysis. The far-field analysis utilized the EPA CALMET/CALPUFF modeling system to predict maximum potential air quality impacts at mandatory federal PSD Class I and other sensitive PSD Class II areas, as well as designated acid-sensitive lakes. This analysis includes assessments of ambient air quality standards, PSD increments, visibility and acid deposition. The far-field analysis includes in-field (within the PAPA) analyses which are additional near-field impact assessments of field-wide source emissions for comparison to applicable ambient air quality standards and to PSD increments, and a mid-field (regional community) visibility impact assessment. This mid-field visibility assessment includes the regional communities of Boulder,

Cora, and Pinedale. Although these communities are classified as sensitive PSD Class II areas, no visibility protection exists under local, state, or federal law.

PSD Class I areas and sensitive PSD Class II areas analyzed in the far-field analyses include the following:

- Bridger Wilderness Area (Class I),
- Fitzpatrick Wilderness Area (Class I),
- North Absaroka Wilderness Area (Class I),
- Teton Wilderness Area (Class I),
- Washakie Wilderness Area (Class I),
- Grand Teton National Park (Class I).
- Yellowstone National Park (Class I),
- Gros Ventre Wilderness Area (Class II),
- Popo Agie Wilderness Area (Class II),
- Wind River Roadless Area (Class II).

Seven lakes within the PSD Class I and sensitive PSD Class II areas were identified as being sensitive to acid deposition. These lakes are those for which the most recent and complete data are available and include the following:

- Black Joe Lake in the Bridger Wilderness Area,
- Deep Lake in the Bridger Wilderness Area,
- Hobbs Lake in the Bridger Wilderness Area,
- Lazy Boy Lake in the Bridger Wilderness Area,
- Upper Frozen Lake in the Bridger Wilderness Area,
- Ross Lake in the Fitzpatrick Wilderness Area, and
- Lower Saddlebag Lake in the Popo Agie Wilderness Area.

The far-field analysis uses 3 years (2001, 2002, and 2003) of hourly windfields which were developed with the CALMET meteorological model for the modeling domain (Map 3.11-1). The CALPUFF dispersion model was used to model project alternative NO_x, SO_2, PM_{10}, and $PM_{2.5}$ emissions for each year of meteorology to estimate maximum potential air quality impacts. Detailed information regarding the modeling methodologies used in the analysis is provided in the Air Quality TSD.

Project emissions inventories were developed for the No Action Alternative and the Proposed Action Alternative. Annual emissions estimates were determined for each year over the LOP for both the No Action and Proposed Action alternatives based on estimates of field development provided by the Operators. Modeling scenarios were developed for each project alternative for the year with the maximum emissions. The maximum emissions scenarios include both construction and production activities. The maximum emissions year under the No Action Alternative is year 2007 and for the Proposed Action the maximum emissions are expected to occur in year 2009. For comparison purposes, an analysis of the PAPA in full production, after all construction activities have ceased (Year-2026), is also presented for the Proposed Action Alternative. The air emissions modeled for project sources in the far-field analysis are presented in Table 4.9-1 and a complete emissions inventories are provided in the Air Quality TSD (appendices F and G).

Table 4.9-1
Project and Non-Project Emissions (tpy) included in Far-field Analysis

Source Category	NO_X	SO_2	PM_{10}	$PM_{2.5}$
Project Sources				
No Action Alternative	6,253.2	70.8	1,567.0	521.0
Proposed Action Alternative	5,885.1	79.3	1,158.3	469.0
Proposed Action Alternative – Maximum Field Production	2,424.9	2.5	1,149.2	391.4
Non-Project Sources				
RFD[1]	6,465.3	406.1	2,923.9	802.8
State-permitted and RFFA[1]	-2,574.6	110.7	476.4	476.4

[1] Reasonably foreseeable development (RFD) and reasonably foreseeable future actions (RFFA) are described in Section 4.9.3.

Comparison to Ambient Air Quality Standards and PSD Increments. The far-field analyses include impact assessments for comparison to applicable ambient air quality standards and for comparison to PSD increments. Predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Ambient background concentrations were not added to modeled concentrations for comparison to PSD Class I and II increments. These comparisons are shown in Section 4.9.3.2 and in Appendix M.

Visibility. Far-field analyses assess potential change to regional haze at PSD Class I and sensitive PSD Class II areas. Regional haze is caused by light scattering and light absorption by fine particles and gases. Potential changes to regional haze were calculated in terms of a perceptible "just noticeable change in visibility" when compared to background conditions, expressed in deciviews (dv). The BLM considers a 1.0 dv change to be a significance threshold for visibility impairment, although there are no applicable local, state, tribal, or federal regulatory visibility standards. Other federal agencies use a 0.5 dv change as a screening threshold for significance. The USFS and NPS compare direct project impacts to the 0.5 dv level, and those comparisons are included in the Air Quality TSD.

Predicted changes in regional haze at PSD Class I and sensitive PSD Class II areas were estimated by comparing CALPUFF modeled concentration impacts to background visibility conditions representative of each PSD Class I or sensitive PSD Class II area. At the request of the BLM, WDEQ, and USFS, three separate visibility calculation methods were performed. Two additional visibility calculation methods were also performed (VISTAS, 2006). These methods follow recent CALPUFF modeling guidance for Best Available Retrofit Technology (BART) analyses developed for the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) Regional Planning Organization (RPO). The BLM and USFS requested methods that use visibility values provided in the FLAG Report for each PSD Class I area to represent natural background visibility. The WDEQ-AQD requested a method that uses representative monitoring data, for the quarterly average of the 20 percent best visibility days, collected from the IMPROVE network for the time period (2000 to 2004). This coincides with the time period that will be used to establish "baseline conditions" under the EPA Regional Haze Rule (EPA, 2003a). The two BART methods use background visibility conditions representative of each PSD Class I area as provided in the Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule (EPA, 2003b). Visibility impacts for the calculation method requested by BLM are presented in Section 4.9.3.2 and in Appendix M. These are compared to a 1.0 dv change, BLM's significance threshold for visibility impairment. All other visibility calculation methods and comparisons are detailed and presented in the Air Quality TSD.

Acid Deposition. Far-field analyses assess potential change to acid deposition and potential increase in acidification of acid sensitive lakes within the PSD Class I and sensitive PSD Class II areas. The USFS (Fox et al.,1989) has defined thresholds below which no adverse impacts

from acid deposition are likely; however, the USFS has concerns that these deposition thresholds are set too high (Svalberg, 2006). These thresholds (herein referred to as levels of concern), defined as 3 kilograms per hectare per year (kg/ha-yr) for nitrogen and 5 kg/ha-yr for sulfur, are used for comparison of potential impacts from direct project impacts combined with background deposition values. CALPUFF predicted nitrogen and sulfur deposition impacts combined with background deposition values were compared to LOCs and are provided in Section 4.9.3.2 and in Appendix M. The NPS (2001) has identified Deposition Analysis Threshold (DAT) for total nitrogen and sulfur deposition in the western U.S. as 0.005 (kg/ha-year) for both nitrogen and sulfur. The DAT is used as an analysis threshold for evaluating potential impacts from project-related emissions. Comparisons of deposition impacts to the DAT are provided in the Air Quality TSD.

The USFS Rocky Mountain Region has developed a screening method (USFS, 2000) that identifies a LAC in lake chemistry. The LACs are 1) no more than a 10 percent change in ANC for lakes with an existing ANC greater than 25 microequivalents per liter (µeq/l) and 2) no more than a 1-µeq/l change for extremely acid-sensitive lakes where the existing ANC is less than or equal to 25 µeq/l. Of the seven lakes identified by the USFS as acid-sensitive, Upper Frozen and Lazy Boy lakes are considered extremely acid-sensitive. Predicted nitrogen and sulfur deposition values at acid sensitive lakes were used to estimate change in ANC for comparison to LAC and are provided in Section 4.9.3.2 and in Appendix M.

In-field Modeling. In-field analyses are additional near-field impact assessments of field-wide source emissions for comparison to applicable ambient air quality standards and to PSD increments and are provided in Section 4.9.3.2 and in Appendix M.

Mid-Field Modeling. Predicted changes to regional haze resulting from project source emissions were estimated for the regional community locations (Boulder, Cora, and Pinedale). Model predicted concentration impacts and recent (year 2005-2006) background visibility data collected at Boulder were used to estimate potential visibility impairment in these residential locations. Predicted visibility impacts were compared to the BLM 1.0 dv threshold and are provided in Section 4.9.3.2 and in Appendix M.

Pipeline Corridors and Rendezvous Pipeline

Construction of the proposed gas sales pipelines would result in intermittent and short-term emissions from the operation of diesel-fired heavy construction equipment.

While air emissions from fugitive dust and diesel combustion could occur at increased levels at locations adjacent to construction and development areas of these linear projects, potential impacts would be temporary and occur in isolation, and would not cause or significantly contribute to a violation of any applicable ambient air quality standard, or significantly impact AQRVs.

4.9.3.2 Alternative A (No Action Alternative)

Near-field Impacts. As shown in Appendix M (Tables M-1 through M-5), predicted near-field pollutant concentrations from the No Action Alternative sources are below the applicable WAAQS and NAAQS. Model predicted NO_2 concentrations are above the PSD Class II increment. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

The predicted acute and chronic (long-term) impacts are below applicable health-based levels for non-cancer compounds (Table M-5). Under both the MLE and MEI scenarios, the estimated incremental and combined cancer risk associated with long-term exposure to benzene and formaldehyde fall at the lower end of the 1 to 100 x 10^{-6} cancer risk range (Table M-7).

Far-field Impacts. Pollutant concentrations under the No Action alternative are below applicable ambient air quality standards (Tables M-8 through M-11).

Predicted impacts are below the applicable PSD increments (Tables M-12 through M-14).

Visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from No Action Alternative source emissions (Table M-16) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 62 days
- Fitzpatrick Wilderness Area 8 days
- Grand Teton National Park 2 days
- Gros Ventre Wilderness Area 6 days
- Popo Agie Wilderness Area 12 days
- Teton Wilderness Area 1 day
- Washakie Wilderness Area 2 days
- Wind River Roadless Area 9 days

There are no predicted impacts above the 1.0 dv threshold at any of the other analyzed sensitive areas.

Predicted maximum deposition impacts from the No Action Alternative (Tables M-18 and Table M-19) are well below the 3 kg/ha-yr (nitrogen)and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. The No Action Alternative source emissions do not result in a predicted increase in ANC above any LAC at acid-sensitive lakes (Table M-20).

In-field Impacts. Project related impacts are below applicable ambient air quality standards (Table M-15). Annual NO_2 concentrations are above the applicable PSD Class II increment. Modeled PM_{10} impacts are above the 24-hour PM_{10} increment and below the annual increment. Predicted SO_2 concentrations are below the applicable SO_2 increments. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

Mid-field Impacts. Visibility impacts at mid-field regional community locations from the No Action Alternative source emissions (Table M-17) were predicted to be above the 1.0 dv threshold for up to 126 days at Boulder, 89 days at Pinedale, and 58 days at Cora.

4.9.3.3 Alternative B (Proposed Action Alternative)

Near-field Impacts. As shown in Appendix M (Tables M-1 through M-5), predicted near-field pollutant concentrations from the Proposed Action Alternative sources are below the applicable WAAQS and NAAQS. Model predicted NO_2 concentrations are above the PSD Class II increment. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

Tables M-6 and M-7 summarize modeled HAP impacts based on emissions representative of the Proposed Action Alternative. The predicted acute and chronic (long-term) impacts are below applicable health-based levels for non-cancer compounds. Under both the MLE and MEI scenarios, the estimated incremental and combined cancer risk associated with long-term exposure to benzene and formaldehyde fall at the lower end of the 1 to 100 x 10^{-6} cancer risk range.

Far-field Impacts. Pollutant concentrations under the Proposed Action Alternative are below applicable ambient air quality standards (Tables M-8 through M-11).

Predicted impacts are below the applicable PSD increments (Tables M-12 through M-14).

Modeled visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Proposed Action Alternative source emissions (Table M-16) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 67 days
- Fitzpatrick Wilderness Area 10 days
- Grand Teton National Park 3 days
- Gros Ventre Wilderness Area 8 days
- Popo Agie Wilderness Area 14 days
- Teton Wilderness Area 1 day
- Washakie Wilderness Area 2 days
- Wind River Roadless Area 10 days

There are no predicted impacts above the 1.0 dv threshold at any of the other analyzed sensitive areas.

Predicted maximum deposition impacts from the Proposed Action Alternative (Tables M-18 M-19) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. The Proposed Action Alternative source emissions are not predicted to result in an increase in ANC above any LAC at acid-sensitive lakes (Table M-20).

In-field Impacts. Project related impacts are below applicable ambient air quality standards (Table M-15). Predicted annual NO_2 concentrations are above the applicable PSD Class II increment. Modeled SO_2 and PM_{10} concentrations are below the applicable PSD increments. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

Mid-field Impacts. Visibility impacts at mid-field regional community locations from Proposed Action Alternative source emissions are predicted to be above the 1.0 dv threshold for up to 138 days at Boulder, 91 days at Pinedale, and 62 days at Cora (Table M-17).

4.9.3.4 Alternative C

Air quality impacts associated with Alternative C are similar to those for the Proposed Action Alternative; however, Alternative C includes two additional air quality modeling analyses that include mitigation to reduce visibility impacts:

- Phase I Mitigation is based on Year-2005 actual project emissions and the source locations of PAPA development activities that occurred during 2005. The analysis assumes Year-2005 actual emissions levels combined with the estimated PAPA source locations for Year-2009.
- Phase II Mitigation includes Year-2005 actual emissions levels with an additional 80 percent reduction in drilling rig emissions combined with the estimated source locations for Year-2009.

A discussion of the mitigation options is provided in Section 4.9.5. The results for these two model analyses are summarized below.

Near-field Impacts. Near-field impacts from Alternative C would be similar to the Proposed Action Alternative results shown in Appendix M (Tables M-1 through M-5).

Far-field Impacts. Pollutant concentrations under Alternative C are below applicable ambient air quality standards (Tables M-8 through M-11).

Predicted impacts are below the applicable PSD increments (Tables M-12 through M-14).

Modeled visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative C Phase I mitigation (Table M-16) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 40 days
- Fitzpatrick Wilderness Area 5 days
- Grand Teton National Park 1 day
- Gros Ventre Wilderness Area 2 days
- Popo Agie Wilderness Area 6 days
- Wind River Roadless Area 5 days

Predicted impacts are less than the 1.0 dv threshold at any of the other analyzed sensitive areas.

Modeled visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative C Phase II Mitigation (Table M-16) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 10 days
- Fitzpatrick Wilderness Area 1 day
- Gros Ventre Wilderness Area 1 day
- Wind River Roadless Area 1 day

Predicted impacts are less than the 1.0 dv threshold at any of the other analyzed sensitive areas.

Predicted maximum deposition impacts from the Alterative C with mitigation (Tables M-18 M-19) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. Alternative C source emissions are not predicted to result in an increase in ANC above any LAC at acid sensitive lakes (Table M-20).

In-field Impacts. Table M-15 compares the maximum impacts from Alternative C (includes mitigation) to ambient air quality standards. Project related impacts are below applicable ambient air quality standards. Predicted annual NO_2 concentrations are above the applicable PSD Class II increment for the Alternative C Phase I Mitigation and are below the PSD increment for Alternative C Phase II Mitigation. Modeled SO_2 and PM_{10} concentrations are below the applicable PSD increments for Alternative C Phase I Mitigation and Alternative C Phase II Mitigation.

Mid-field Impacts. Visibility impacts at mid-field regional community locations from Alternative C Phase I Mitigation (Table M-17) are predicted to be above the 1.0 dv threshold for up to 107 days at Boulder, 70 days at Pinedale, and 47 days at Cora. Under Alternative C Phase II Mitigation, there are up to 45 days at Boulder, 25 days at Pinedale, and 12 days at Cora.

4.9.4 Cumulative Impacts

The CALPUFF model was used to quantify the impacts of NO_x, SO_2, PM_{10}, and $PM_{2.5}$ resulting from cumulative emission sources associated with the project alternatives, state-permitted projects, reasonable foreseeable future actions (RFFA), and reasonably foreseeable development (RFD) located within the model domain (see Map 3.11-1). Project source emissions and other regional emissions included in the cumulative study are shown in Table 4.9-1. The cumulative study considers 2005 as a baseline year for emissions from non-project sources due to the availability of background air quality data for 2005 measured within and

nearby the PAPA. The cumulative analysis assesses potential impacts to air quality that could occur beyond 2005 levels.

State-permitted projects include NO_x, SO_2 and/or $PM_{10}/PM_{2.5}$ sources that began operation after January 1, 2005, and were permitted before February 1, 2006. Projects permitted within the 18 months prior to January 1, 2005, but not yet operating were included as RFFA. RFD is defined as the undeveloped portion of 1) an approved NEPA project or 2) a proposed NEPA project for which quantified air emissions data were available at the time of the analysis. State-permitted projects, RFFA, and RFD emissions modeled in the cumulative analysis are quantified in Table 4.9-1. RFD projects included in the cumulative analysis are listed in Appendix M, Table M-21. RFD projects were analyzed utilizing the quantified proposed action emissions scenarios available in NEPA documents or the maximum production scenario identified for each project. Emissions from field development (the construction phase) of RFD were not analyzed for all projects because estimates were not available. The development phases of individual RFD projects have the potential to cause or contribute to higher localized ambient air impacts than those demonstrated in this analysis. RFD project development rates and schedules vary for each project and are difficult to define with certainty. Therefore, it was determined that emission sources operating at maximum production rates were the most reasonable representation of cumulative impacts occurring in the future, when based on RFD information available at the time of analysis.

While there may be additional gas processing and/or transmission requirements due to development within the PAPA and other natural gas projects regionally and nationally, the potential effects of these developments are not quantified herein because these developments are speculative and would require additional WDEQ/AQD permitting if they eventually are proposed. A portion of the Powder River Basin Oil and Gas Development Project (PRBP), located more than 200 kilometers east-northeast of the PAPA, is located within the far-field modeling domain defined in Map 3.11-1. A ratio of total PRBP field development equal to the geographical portion within the PAPA far-field modeling domain was included as RFD in this analysis. The PRBP identified significant project-specific and cumulative impacts in the Bridger Wilderness Area and other sensitive areas analyzed for this project. The air quality impacts associated with the PRBP have been described by BLM (2002b).

4.9.4.1 Alternative A (No Action Alternative)

As shown in Appendix M (Tables M-22 through M-28), cumulative pollutant concentrations from the No Action Alternative and regional source emissions are predicted to be below applicable ambient air quality standards and PSD increments at all analyzed PSD Class I and sensitive PSD Class II areas. Predicted cumulative impacts are below applicable ambient air quality standards at in-field locations (Table M-29).

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from the No Action Alternative and regional source emissions (Table M-30) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 75 days
- Fitzpatrick Wilderness Area 13 days
- Grand Teton National Park 4 days
- Gros Ventre Wilderness Area 12 days
- North Absaroka Wilderness Area 1 day
- Popo Agie Wilderness Area 21 days
- Teton Wilderness Area 2 days

- Washakie Wilderness Area 2 days
- Wind River Roadless Area 12 days
- Yellowstone National Park 1 day

There are no predicted impacts above the 1.0 dv threshold at any of the other analyzed sensitive areas.

Cumulative visibility impacts at mid-field regional community locations for the No Action Alternative and regional source emissions (Table M-31) are predicted to be above the 1.0 dv threshold for up to 141 days at Boulder, 94 days at Pinedale, and 65 days at Cora.

Predicted maximum cumulative deposition impacts from the No Action Alternative (Table M-32 and Table M-33) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. Cumulative emissions from the No Action Alternative and regional sources would not result in an increase in ANC above any LAC at acid-sensitive lakes (Table M-34).

4.9.4.2 Alternative B (Proposed Action Alternative)

As shown in Appendix M (Tables M-22 through M-28), predicted cumulative pollutant concentrations from the Proposed Action Alternative and regional source emissions are below applicable ambient air quality standards and PSD increments at all analyzed PSD Class I and sensitive PSD Class II areas. Predicted cumulative impacts are below applicable ambient air quality standards at in-field locations (Table M-29).

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from the Proposed Action Alternative and regional source emissions (Table M-30) are predicted to be above the 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 77 days
- Fitzpatrick Wilderness Area 15 days
- Grand Teton National Park 5 days
- Gros Ventre Wilderness Area 12 days
- North Absaroka Wilderness Area 1 day
- Popo Agie Wilderness Area 25 days
- Teton Wilderness Area 2 days
- Washakie Wilderness Area 3 days
- Wind River Roadless Area 19 days
- Yellowstone National Park 1 day

There are no predicted impacts above the 1.0-dv threshold at any of the other analyzed sensitive areas.

Cumulative visibility impacts at mid-field regional community locations from the Proposed Action Alternative and regional source emissions (Table M-31) are predicted to be above the 1.0 dv threshold for up to 153 days at Boulder, 96 days at Pinedale, and 68 days at Cora.

Predicted maximum cumulative deposition impacts from the Proposed Action Alternative (Table M-32 and Table M-33) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all sensitive PSD Class I and sensitive PSD Class II areas. Cumulative emissions from the Proposed Action Alternative and regional sources would not result in an increase in ANC above any LAC at acid-sensitive lakes (Table M-34).

4.9.4.3 Alternative C

As shown in Appendix M (Tables M-22 through M-28), predicted cumulative pollutant concentrations from the Alternative C Phase I Mitigation and Alternative C Phase II Mitigation, both with regional source emissions, are below applicable ambient air quality standards and PSD increments at all analyzed PSD Class I and sensitive PSD Class II areas. Predicted cumulative impacts are below are below applicable ambient air quality standards at in-field locations (Table M-29).

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative C Phase I Mitigation and regional source emissions (Table M-30) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 56 days
- Fitzpatrick Wilderness Area 7 days
- Grand Teton National Park 2 day
- Gros Ventre Wilderness Area 8 days
- Popo Agie Wilderness Area 14 days
- Teton Wilderness Area 1 day
- Washakie Wilderness Area 2 days
- Wind River Roadless Area 10 days
- Yellowstone National Park 1 day

Predicted impacts are less than the 1.0 dv threshold at any of the other analyzed sensitive areas.

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative C Phase II Mitigation and regional source emissions (Table M-30) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 25 days
- Fitzpatrick Wilderness Area 4 days
- Grand Teton National Park 1 day
- Gros Ventre Wilderness Area 2 days
- Popo Agie Wilderness Area 6 days
- Wind River Roadless Area 6 days

Predicted impacts are less than the 1.0 dv threshold at any of the other analyzed sensitive areas.

Cumulative visibility impacts at mid-field regional community locations from Alternative C Phase I Mitigation and regional source emissions (Table M-31) are predicted to be above the 1.0 dv threshold for up to 118 days at Boulder, 79 days at Pinedale, and 60 days at Cora. For Alternative C Phase II Mitigation and regional source emissions, cumulative visibility impacts at mid-field regional community locations are predicted to be 69 days at Boulder, 45 days at Pinedale, and 25 days at Cora.

Predicted maximum cumulative deposition impacts from Alternative C Phases I and II Mitigation and regional sources (Table M-32 and Table M-33) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all sensitive PSD Class I and sensitive PSD Class II areas. Cumulative emissions from Alternative C Phases I and II Mitigation and regional sources would not result in an increase in ANC above any LAC at acid-sensitive lakes (Table M-34).

4.9.5 Alternative Impact Mitigation

Air quality impact assessment modeling was conducted for existing conditions in the PAPA and the results are summarized in Chapter 3. The modeling analysis was based on Year-2005 actual emissions. Impact modeling results show 45 days of visibility impairment over 1.0 dv at Bridger Wilderness Area (see Appendix I).

Year-2009 (the maximum emissions year) for the Proposed Action Alternative was modeled for visibility impacts. Impact modeling results predict 67 days of visibility impairment over 1.0 dv at Bridger Wilderness Area.

Alternative C Phase I Mitigation would begin immediately after issuance of the ROD. Within 1 year of issuance of the ROD, Operators would be required to show a reduction in modeled visibility impacts to 2005 actual impact levels. This modeling would be based on modeling of Year-2009 Proposed Action emissions mitigated to 2005 actual emissions levels – a prediction of 40 days of visibility impairment over 1.0 dv at Bridger Wilderness Area. Modeled reductions are based on future year models, which include expanded development activities and development areas beyond what occurred during Year-2005. Therefore, modeling emissions levels that are reduced to 2005 levels shows modeling results (40 days over 1.0 dv) that are different from what was modeled for the PAPA during year 2005 (45 days over 1.0 dv). The reduction of modeled air quality impacts to 2005 levels would effectively mitigate the potential increase in visibility impacts for the Proposed Action Alternative. This reduction would be the starting point for further mitigation of the modeled visibility impacts of development that occurred in the PAPA since issuance of the PAPA ROD (BLM, 2000b) through 2005.

The objective for Alternative C Phase II Mitigation would be to achieve minimal days of predicted visibility impairment over 1.0 dv at Bridger Wilderness Area, with a goal of 0 days. Operators would be required to reduce visibility impact levels associated with modeling 20 percent drilling rig emissions reductions each year for the next 4 years after 2005 impact levels are achieved, within 1 year of issuance of the ROD. Modeling results using the BLM FLAG test for the Bridger Wilderness Area show that in Year 1, with 20 percent mitigation, impacts would be reduced to 35 days of visibility impairment over 1.0 dv. Further emissions reductions of 20 percent per year for the next 3 years would result in 23, 17, and 10 days, respectively, of modeled visibility impairment over 1.0 dv at Bridger Wilderness Area. The predicted impact levels are a result of reducing only drilling rig emissions by 20, 40, 60, and 80 percent, respectively. Reductions in compression and fugitive (well site, including well completions, and traffic) emissions as well as drilling rig emissions would further reduce predicted visibility impacts, however, there are limitations to obtain reductions in compression and fugitive emissions. Existing compression in the PAPA is BACT (best available control technology) as permitted through WDEQ-AQD. Most of the engines used in portable equipment during well completions have Tier 2 equivalent emissions. BLM modeled future emissions with the assumption that future compression would also use BACT. However, in order to achieve the goal of 0 days of visibility impairment, further emission reductions in these and other areas, in addition to the drilling rig emission reductions, may be required.

Predicted impact reduction by modeling is based on a reduction in drilling rig emissions, however, Operators would be able to reduce emissions from any source. The objective for mitigation is based on impact reduction (reduction in predicted visibility impairment) rather than reduction in specific emissions, such as NO_x. Implementation of one or more of the following examples would result in reduction of predicted visibility impact:

- natural gas-fired drilling rig engines;
- fuel additives;
- gas turbines rather than internal combustion engines for compressors;

- reduction in the number of drilling rigs;
- Tier 2 equivalent emissions drilling rig engines;
- selective catalytic reduction on drilling rig engines;
- electric drilling rigs;
- electric compression;
- centralization of gathering facilities to reduce truck traffic;
- cleaner technologies on completion activities, and other ancillary sources; and
- advancements in drilling technology.

The Operators should continue to innovate by demonstrating and using new techniques for controlling emissions to reduce potential visibility impact. Within 5 years after issuance of the ROD, the Operators must demonstrate annually through modeling that their plan to further reduce visibility impairment at the Bridger Wilderness Area is effective. If the goal of 0 days over 1.0 dv of modeled visibility impairment at the Bridger Wilderness Area cannot be demonstrated, the Operators, BLM, EPA, and WDEQ would jointly agree to a mitigation plan that complies with the goal, using any and all available means.

The method by which the Operators would determine project visibility impact would be determined by BLM in consultation with WDEQ, EPA, USFS, and NPS. BLM would rely on the Operators to determine how they would attain the reduction in visibility impacts from the PAPA.

At any time, BLM and/or the Operators may run air dispersion models to reassess air quality impacts. BLM would use the results of the model to assess whether the air quality impact objective and goal described in this Draft SEIS have been achieved.

4.10 NOISE

4.10.1 Scoping Issues

The following concern related to noise was submitted during scoping:

Use noise mitigation in crucial winter range.

4.10.2 Impacts Considered in the PAPA DEIS

Two noise sources were analyzed in the PAPA DEIS (BLM, 1999a) for potential impacts in the PAPA, a drilling rig and a compressor station. A background noise level of 39 dBA was assumed within the PAPA in 1999. Based on sound attenuation from the two sources, noise impact would become significant (greater than 49 dBA) when:

- a rig is located closer than about 800 feet to a receptor; and
- a compressor station is located closer than about 2,500 feet to a receptor.

With all of the potential compressor station sites farther than 2,500 feet from a residence, the PAPA DEIS (BLM, 1999a) concluded there would be no significant potential noise impacts to residences from compressor stations. There were potential well sites closer than 800 feet from a residence and significant noise impacts would be expected to occur at these locations. Noise from well flaring is very loud and occurs during the initial testing of the well, also periodically during well operation.

The PAPA DEIS (BLM, 1999a) considered noise impacts to greater sage-grouse leks from well drilling and operation but concluded noise would not be significant because well locations would be at least 1,320 feet (0.25 mile) from greater sage-grouse leks. However, compressor facilities located closer than 2,500 feet to a greater sage-grouse lek could significantly affect greater

sage-grouse lek use. From these considerations, the BLM determined that significant impacts by noise would result from project related activities if noise levels are increased more than 10 dBA at any noise sensitive area (residences and greater sage-grouse leks). According to the significance criteria in the PAPA DEIS, significant impacts have most likely occurred.

4.10.3 Alternative Impacts

4.10.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Noise sensitive areas identified in the PAPA DEIS (BLM, 1999a) included greater sage-grouse leks, crucial big game habitat during crucial periods; residences within and adjacent to the PAPA; areas adjacent to the Lander Trail; ranches along both the New Fork and Green rivers; raptor nest sites when occupied; and recreation areas. The PAPA ROD (BLM, 2000b) set noise limits of new wellfield development so that distance to a dwelling or a greater sage-grouse lek would be sufficient to result in no noise level increase from operating facilities at the dwelling. It would not result in an increase greater than 10 dBA above background at the edge of a greater sage-grouse lek. In the PAPA DEIS, only wellfield traffic was considered as a potential noise source 0.25 mile away from greater sage-grouse leks because timing and geographic limitations on drilling were assumed to be enforced within 2 miles of greater sage-grouse leks from March 15 through July 15 (BLM, 2004c).

Noise associated with winter drilling was studied in 2006. The assumption was applied that noise generated by one drilling rig engine on a well pad would attenuate by 6 dBA for every doubling of distance from the source. With that assumption, distances at which engine noise would approximate background noise (with an assumed background of 39 dBA) would range from 1,717 feet to 8,944 feet (see Table 3.12-2). With the same assumptions, distances at which drilling engine noise would attenuate to 49 dBA (10 dBA above background) at noise sensitive sites (dwellings, greater sage-grouse leks) defined in the PAPA ROD ranged from 543 feet to 2,828 feet.

Leks attended by male greater sage-grouse near and within the PAPA have been intensively monitored from 1999 through 2005 (see Wildlife and Aquatic Resources, Section 4.20.3). The investigation indicated that male counts on leks that were heavily impacted by gas wells declined 51 percent from 1 year prior to well development in 1999 through 2004 (Holloran, 2005). Generally, the number of strutting males on leks decreased as distance to drilling rigs decreased. Numbers of strutting male also decreased with increased traffic volumes within 1.86 miles of the leks and increased noise intensity estimated at leks (Holloran, 2005).

Attenuation of noise from drilling rigs can exceed the 10 dBA limit above background noise at greater sage-grouse leks that was specified in the PAPA DEIS (BLM, 1999a) and carried through the PAPA ROD (BLM, 2000b) as an Administrative Requirement and Condition of Approval. Further, results of the long-term study on effects of wellfield development to greater sage-grouse lek attendance indicate that the 0.25-mile buffer surrounding leks, within which surface disturbance would be avoided (PAPA ROD), is insufficient to maintain function of lek habitats due to wellfield activities (road use, drilling) and associated noise (Holloran, 2005 and Ecosystem Research Group, 2006).

The PAPA DEIS (BLM, 1999a) established 800 feet as the distance at which noise between a sensitive receptor and drilling rig attenuate to 49 dBA (~10 dBA above ambient levels) and classified as a significant impact. However, noise studies in the PAPA (see Table 3.12-2) indicate that drilling noise may attenuate to 49 dBA up to 0.5 mile away from a drilling rig.

Therefore, significant impact could occur over 3.5 times the distance used to define impact significance in the PAPA DEIS.

Pipeline Corridors and Gas Sales Pipelines

Project related vehicles and construction equipment would generate noise while in operation during the construction of the gas sales pipelines. The noise would occur only during daylight hours, except for some highway vehicles which may be traveling over public roads in the minutes or hours preceding dawn and following dusk as workers return to work or lodging. The operation of the pipeline is not expected to generate noise, except for the regular small vehicle traffic associated with facility inspections.

4.10.3.2 Alternative A (No Action Alternative)

Under the No Action Alternative, restrictions would be retained on wellfield development within big game crucial winter ranges between November 15 and April 30. Consequently, noise generated by wellfield development would be limited to that associated with production (winter traffic) and compressors. The drilling of new wells would continue to be prohibited within 0.25-mile buffers surrounding residences and greater sage-grouse leks to minimize noise at those noise sensitive sites. Impact from noise to sensitive resources would continue at current levels.

4.10.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Implementation of the Proposed Action Alternative would allow drilling during winter within big game crucial winter ranges. Seasonal protection of greater sage-grouse leks and nesting habitats that fall within areas subject to winter drilling under the Proposed Action Alternative would be subject to increased noise. The protections include:

- avoidance within a 2-mile radius of active leks from March 15 through July 15 (BLM, 2004c) to protect greater sage-grouse nesting habitat; avoidance of drilling; and
- avoidance of construction activities during the greater sage-grouse strutting period (March 1 through May 15) on areas within 1 mile of active leks as specified by the PAPA ROD (BLM, 2000b).

Noise within big game crucial winter ranges would increase overall under the Proposed Action Alternative through 2011. Noise at residences would increase within and adjacent to the PAPA during winter.

Proposed Action Alternative Through 2023

Increased noise during winter would continue through 2023 within big game crucial winter ranges and potentially near enough to other noise sensitive sites to cause significant impact.

4.10.3.4 Alternative C

Alternative C Through 2011

Under Alternative C, noise generated during winter would be concentrated within the southern 2 miles of DA-1 and within DA-2 and DA-4. Noise would exceed levels generated by the No Action Alternative in these locations. Unlike the Proposed Action Alternative, there would not initially be any new disturbances within the northern portion of DA-1 and within DA-3 in the winter. Noise at sensitive noise receptors (greater sage-grouse leks, big game crucial winter ranges, residences) in these areas would likely be at or near background levels except for noise associated with production activities.

Alternative C Through 2023

Wellfield development would progress from south to north within DA-1 within the mostly single Operator contiguous leaseholds. By 2017, wellfield development would be concentrated on the north end of DA-1. By that time and through 2023, winter drilling on big game crucial winter range would be limited to the north end of the PAPA within DA-1. Noise generated by winter drilling would be redistributed from south to north, affecting noise sensitive receptors (greater sage-grouse leks, big game crucial winter ranges, residences) at different locations until winter drilling has been completed. In areas where wellfield development is complete, noise during winter would only be associated with production activities.

Once all year-round drilling and wellfield development is complete within DA-2, development would commence in DA-3. With no additional winter drilling allowed, noise within DA-2 would be related to production. All liquids gathering systems would be in place so traffic related noise within DA-2 would be minimal.

Traffic and drilling in DA-3 would increase noise levels substantially during winter. Development would probably continue in DA-4 and extend into DA-5. Once there, however, Operators would be restricted by seasonal limitations on drilling between March 15 through July 15 (BLM, 2004c) to protect greater sage-grouse leks and nesting habitats.

4.10.4 Cumulative Impacts

The CIAA for noise extends outside the PAPA to some range, active rigs sometimes being audible for up to 20 miles (BLM, 2006a). This does not constitute a human health risk, but it would disturb wildlife to some extent, and does impact perceptions of the quality of the outdoor experience ("peace and quiet"). Traffic also contributes transient noise.

Noise is an unavoidable impact of development. There would be only small differences in overall noise in the PAPA between the alternatives though 2011, after which drilling would cease under the No Action Alternative. More noise would be generated during winter especially from drilling and well completions, by the Proposed Action Alternative and Alternative C. The Proposed Action Alternative and Alternative C extend drilling activity through 2023, although the number of rigs decreases through that period. The impacts of noise would depend not only on the number of drilling rigs operating, but also on their location relative to residences (particularly at night) or to recreational areas.

4.10.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate noise impact would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.11 GEOLOGY AND GEOLOGIC HAZARDS

4.11.1 Scoping Issues

The following concern related to Geology and Geologic Hazards was submitted during scoping:

Companies should be required to get more gas out of their existing wells before drilling additional wells.

4.11.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS, impact considered to Geology and Geologic Hazards by development in the PAPA included:

- seismic hazards, including direct hazards such as ground shaking and surface faulting and indirect hazards such as ground failure and liquefaction of water-saturated deposits such as sandy soils, alluvium and artificial fill, that would result in substantial damage to operating equipment; and
- landslides and/or slope failures resulting from wellfield development because of 1) inherent weakness in the composition or structure of rock or soils; 2) variation in the weather, such as heavy rain and snowmelt; and 3) human activity.

The PAPA DEIS concluded that implementation of BLM's Mitigation Guidelines would avoid development on slopes greater than 25 percent, and landslides or slumps should not result from project activities.

4.11.3 Alternative Impacts

4.11.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

In 2006, the PAPA is not a pristine area and current activities include active drilling, road, pad and pipeline construction, and traffic. Potential impacts to geology (geomorphology) include erosion and destabilizing slopes. To date, the control of erosion and sediment transport has consisted of adherence to stormwater management plans (SWPPPs), and berms and culverts where appropriate.

Tight gas sands such as the target formations in the PAPA require a high density of drilling to manage production, to not leave large blocks of the resource untapped and more difficult to access. In the last decade, drilling practices have developed so that a high density of drilling can be achieved from fewer pads, optimizing production while minimizing surface disturbance.

Production of the gas resource does deplete a non-renewable resource. BLM and the State of Wyoming management objectives associated with mineral resources are to enhance opportunities for their development, while protecting other resource values. There would be no interference with any other resource such as sand and gravel under any of the alternatives.

Pipeline Corridors and Gas Sales Pipelines

Pipeline construction within the proposed pipeline corridors would result in disturbance of underlying bedrock beneath deep to shallow soils. The disturbance would occur by excavation of softer and/or fractured bedrock and by blasting followed by excavation of harder, consolidated bedrock. The rock would be excavated and removed from the trench and it would be returned to the trench after the pipeline is placed in the open trench and is padded with protective finer grained sandy material. Construction activities should not cause slides due to

the absence of active faults or slide surfaces in the immediate vicinity of the corridors. There would be only minor excavation into bedrock.

The terrain crossed by much of the proposed corridor system does not have steep slopes predisposed to mass movement. Areas with some susceptibility to mass movement of exposed soils and/or geologic substrate include the Blue Rim Area just south of the New Fork River. The R6 and PBC pipelines would cross the New Fork River at this location, but the potential for instability of geologic materials in such areas of steep slopes would be minimized by post-construction stabilizing measures and features, such as appropriately designed and constructed water bars and surface preparation.

Access to locatable or salable minerals would not be limited by corridor designation or pipeline construction due to the absence of such minerals and/or lack of proposed development of these resources near the proposed pipeline corridors. Access to preferred locations for oil and gas well development/drill locations could be compromised by pipeline construction and operation; however, there is flexibility in both the proposed well location and the pipeline alignment to a limited extent.

4.11.4 Cumulative Impacts

The CIAA for geology and geologic hazards is the PAPA. Cumulative impacts would be the same as those described for the proposed project under any of the alternatives.

4.11.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to geology and geologic hazards would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.12 PALEONTOLOGICAL RESOURCES

4.12.1 Scoping Issues

There were no project scoping comments related to Paleontological Resources.

4.12.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS (BLM, 1999a), BLM stated that a significant impact to paleontological resources would occur if important fossils, which could substantially add to scientific understanding of paleontological resources, are destroyed. BLM concluded that all of the alternatives, except the *No Action Exploration/Development Scenario*, had the potential for uncovering or disturbing paleontological resources during construction and excavation of the project facilities. Further, improved access and increased visibility may cause fossils to be damaged or destroyed due to unauthorized collection and vandalism. It is not known if paleontological resources have been significantly impacted by existing development within the PAPA.

4.12.3 Alternative Impacts

4.12.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Since the PAPA DEIS (BLM, 1999a) was written, all paleontological discoveries within the PAPA have been made in the badlands and outcrops associated with Blue Rim and Ross Butte. Consequently, analyses of potential effects by each alternative focus on surface disturbances within the Blue Rim Area of the Sensitive Soils SRMZ, discussed below in Soil Resources, Section 4.15, and enumerated in Table 4.15-1 where future paleontological discoveries and potential for impact would probably occur. The potential for significant impact would increase as additional development is implemented under each of the alternatives.

Pipeline Corridors and Gas Sales Pipelines

Construction of the gas sales pipelines would likely disturb unconsolidated and, to a lesser extent, consolidated bedrock by trenching in areas of moderately deep to shallow soils. Such disturbance of bedrock would have the potential to damage undiscovered, scientifically-significant fossils. Such disturbance could also result in the exposure and discovery of fossils that may add to the understanding of the area's paleontological resources.

Discovery of fossils during construction would result in the suspension of construction activities to prevent further disturbance and/or damage to the fossil resource. The discovery would result in the immediate reporting of the find to the BLM's AO for a determination of significance and possible recommendation for recovery or avoidance

4.12.3.2 Alternative A (No Action Alternative)

Continued development in the PAPA under the No Action Alternative would likely nearly double the amount of existing wellfield disturbance within the Blue Rim Area of the Sensitive Soils SRMZ by increasing the current level of disturbance from 590 acres to potentially more than 1,100 acres (see Table 4.15-1). Such disturbance could lead to increased impact and/or paleontological discoveries.

4.12.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Continued development in the PAPA under the Proposed Action Alternative through 2011 would lead to considerably more surface disturbance, possibly 1,000 acres, within the Blue Rim Area of the Sensitive Soils SRMZ compared to project disturbance under the No Action Alternative (Table 4.15-1). This amount of disturbance could lead to increased impact and/or discovery of paleontological resources.

Proposed Action Alternative Through 2023

Under the Proposed Action Alternative through 2023, surface disturbance expected in the Blue Rim Area would nearly triple the existing amount of disturbance in 2006. Consequently, there is the potential for significant impact to paleontological resources by the Proposed Action Alternative.

4.12.3.4 Alternative C

Alternative C Through 2011

Development in the PAPA under Alternative C through 2011 is expected to increase existing disturbance by more than 700 acres within the Blue Rim Area of the Sensitive Soils SRMZ (Table 4.15-1). However, potential disturbance could be 200 acres less than disturbance by the

Proposed Action in 2011. As with the Proposed Action Alternative, the increase in disturbance could lead to increased impact and/or discovery of paleontological resources.

Alternative C Through 2023

Disturbance under Alternative C through 2023 would be similar to the Proposed Action through 2023. Like the Proposed Action Alternative, disturbance in the Blue Rim Area would nearly triple the existing amount of disturbance in 2006 (Table 4.15-1). Consequently, there is the potential for significant impact to paleontological resources by Alternative C.

4.12.4 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to paleontological resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.12.5 Cumulative Impacts

The CIAA for paleontological resources is the PAPA. Cumulative impacts would be the same as those described for the Blue Rim Area of Sensitive Soils in Table 4.15-2, below. While there had been limited surface disturbances by non-wellfield disturbance in the Blue Rim Area, existing and projected surface disturbance under all alternatives is likely to disturb between 1,000 and 2,000 acres and increase the likelihood of cumulative impact to paleontological resources.

4.13 GROUNDWATER RESOURCES

4.13.1 Scoping Issues

The following comment addressing Groundwater Resources was received during scoping:

Concern about aquifer contamination by drilling and fracturing, BLM should provide methods to prevent, mitigate, and monitor impact to groundwater.

4.13.2 Impacts Considered in the PAPA DEIS

The PAPA DEIS (BLM, 1999a) considered various potential impacts to Groundwater Resources during future wellfield development in the PAPA. Those impacts include:

- the subsurface could be affected by groundwater withdrawals and wastewater injection;
- anticipated impacts consist of drawdown in aquifers from which water is extracted for drilling;
- there could also be loading of deeper receiving zones by wastewater injection;
- there is the potential for contamination of aquifers during drilling, completion, and production of the gas wells through drilling/fracturing fluids and/or produced water;

- there is the potential for shallow aquifers to be contaminated by leakage from the reserve pit and by onsite water wells with alkaline pH's; and
- drilling and completion techniques of water wells needs to be changed to correct the alkalinity problem.

The PAPA DEIS (BLM, 1999a) addressed injection of produced water, however, there currently are no injection wells within the PAPA and there are none included in any of the alternatives. However, Operators and others are currently investigating permitting wells for deep injection of produced water in the PAPA. In the PAPA DEIS, BLM considered potential impacts from an injection well to be insignificant because the well must be permitted with the WOGCC. The agency's rules and regulations require that the Operator demonstrate that the proposed disposal operation would not endanger fresh water sources. The disposal well must be cased and cemented in such a manner that damage would not be caused to oil, gas, or fresh water sources. The Operator must also demonstrate mechanical integrity of the well at least every 5 years and, if tests fail, the well must be repaired, shut-in, or operated at a reduced injection pressure.

Similarly, BLM cited adequate regulations were in place to protect shallow aquifers:

- Significant impact to the aquifer from drilling and completion fluids and produced water are not likely because all production wells would be cased and cemented to protect subsurface mineral and freshwater zones according to WOGCC rules and regulations.
- Wells that are no longer productive would be plugged and abandoned according to procedures outlined in the WOGCC's rules and regulations.
- Contamination of shallow aquifers from reserve pits is unlikely because the reserve pits would be lined and would be constructed in cut areas or in compacted and stabilized fill in accordance with WOGCC rules.
- If the quality of groundwater becomes unacceptable for any purpose, other water supply sources would be investigated and permitted through the appropriate agency.

In the PAPA DEIS (BLM, 1999a), BLM considered that impacts to groundwater supplies or springs would be significant if:

- the natural flow of water to local springs is interrupted;
- new water supply wells that are first tested with a neutral pH (about 7.0) later become significantly alkaline (pH 8.0 to 10) after pumping;
- groundwater quality is degraded so that it can no longer be classified for its current use; or
- the water table is lowered, as a result of drilling water withdrawals, to a level that would require replacement or deepening of other groundwater wells in the project area.

Based on the significance criteria stated above, significant impacts to groundwater have not occurred.

4.13.3 Alternative Impacts

4.13.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Potential impacts to groundwater quality include accidental spills of petroleum products or other pollutants and cross-aquifer mixing. Potential impacts to groundwater quantity are those resulting from withdrawals of groundwater from the Wasatch aquifer and include:

- lowering water levels in aquifers used by domestic and stock wells;
- depletion of Wasatch aquifer (drilling water supply source);
- depletion of groundwater discharge to surface waters; and
- cross contamination of aquifers.

Groundwater quality could be impacted by leaky well seals allowing cross-aquifer contamination, or by leaks and spills from trucks or other equipment on the well location. Ensuring good well seals across aquifer boundaries would prevent cross-aquifer contamination. Detection of water quality impacts would require notification of WDEQ-WQD and appropriate remedial action. Potential for leak and spill impacts and appropriate responses would be addressed in the Operator's individual Spill Prevention Countermeasure and Control (SPCC) Plans.

Lowering of water levels and cross-contamination of aquifers are preventable by sound well construction practices required by permits to drill, which state that isolation of aquifers will be maintained by ensuring good cement seals in gas production wells. All gas production wells have the annulus cemented to surface, and cement bond logs are run to confirm the cement integrity across formation contacts. The PAPA ROD (BLM, 2000a) required that open intervals of water wells be at least 200 ft deeper than any domestic or stock well within one-half mile. These provisions are meant to prevent communication between shallow and Wasatch aquifers. Temporary depletion of the Wasatch aquifer is a consequence of groundwater extractions for drilling water through water supply wells. The projected annual usage is a fraction of the annual recharge through infiltration, and less than 1 percent of the storage of the Wasatch. Water level recovery in the Wasatch should therefore be rapid when pumping ceases in any area. There are only a few domestic wells completed in the Wasatch.

A model is provided in Appendix N of likely impacts to the Wasatch aquifer due to a dense cluster of drilling rigs and associated water supply wells. The model is based on typical Wasatch hydraulic properties and a typical configuration of wells. The model suggests that up to 10 feet drawdown may be expected up to 3 miles from such a concentration of activity. No more than 30 feet drawdown is expected in the Wasatch within 1.5 miles of any drilling rig.

Recovery of water levels in the Wasatch after drilling and groundwater extraction cease should be rapid. Numerical modeling in the Jonah Field indicated full recovery in the case of the most aggressive development within 6 years. This estimation is particularly sensitive to recharge from above and within the Wasatch. Groundwater use under any of the alternatives is a fraction of the average vertical recharge (see Section 3.15).

WDEQ-Water Quality Division (2005b) voiced concern that the current Groundwater Monitoring Program conducted by SCCD does not attempt to map or distinguish various aquifers within the Wasatch, which rendered monitoring of an inconsistent target very uncertain.

Much of the variability in the Wasatch aquifer results from its being composed of many stacked and discontinuous sands, deposits of wandering early Tertiary rivers, so that water supply wells encounter and draw water from different units in different locations. Sands are so variable they can rarely be interpolated between holes on quarter-section spacing. This means that it is not practical to map individual water producing sand units, and it is practical only to monitor the Wasatch as a heterogeneous aquifer in an average sense.

The Operators, in cooperation with BLM and WDEQ-WQD, are drafting a revised groundwater monitoring plan to ensure detection of impacts to Wasatch or shallow alluvial groundwater. This would refer to, but not include, SPPC Plans and SWPPPs. The proposal for the revised monitoring plan is provided in Appendix O.

The Wasatch aquifer both recharges and discharges in the PAPA, that is, it receives some infiltration from precipitation and some of its groundwater enters surface water in the tributaries of the Green River. Depletion of the Wasatch could decrease this local contribution to streamflow. This potential could be addressed by the installation of a number of alluvial monitoring wells in watercourses in the PAPA above the influence of the Green and New Fork rivers. Water levels would be measured on a monthly basis for 1 year to assess the seasonal and baseflow components of alluvial flow coming off the PAPA. Groundwater seepage typically supplies a minimum baseflow (surface water and or alluvial groundwater) throughout the year, and local flow generated by seasonal precipitation superimposes a local variable but cyclic component. When baseflow has been established, impacts due to depletion of the Wasatch should be discernible in the monitoring wells. Mitigation of baseflow depletion would consist of augmenting the streamflow by pumping groundwater to infiltration basins in an affected watercourse. Alluvial wells would also monitor for any increase in salinity in discharge to surface water.

Various drilling and production scenarios are well specified under the alternatives, but hydraulic characteristics of the aquifers are not, and so comparisons of impacts to groundwater resources cannot be precise. Impacts to the Wasatch with greater drilling activity would be greater than the current scenario, but these impacts should not affect stock and domestic wells if effective well seals are maintained. Operators are increasing the re-use of produced water and therefore, there is the potential for groundwater withdrawals to decrease under each of the alternatives over time. Relative impacts to groundwater can be gauged by a comparison of total water usage by each alternative as discussed below. Based on the significance criteria in the PAPA DEIS, it is not expected that significant impacts to groundwater would occur under any of the alternatives.

Pipeline Corridors and Gas Sales Pipelines

The establishment of the proposed corridors and subsequent construction and operation of pipelines is not expected to result in any impacts to groundwater resources. The depth to groundwater would preclude adverse effects from pipeline construction and operation. No toxic substances are proposed for use during pipeline construction. The pipelines would be hydrostatically tested for any leaks prior to entering service to ensure the absence of any leakage of natural gas. Any spills of fuel, lubricants, and solvents during pipeline/facility construction would be contained and cleaned up in accordance with SPCC Plan requirements.

4.13.3.2 Alternative A (No Action Alternative)

Under the No Action Alternative, it is estimated that an additional 1,139 wells would be drilled in the PAPA through 2011. This would require approximately 2,280 acre-feet of water for drilling and completions.

4.13.3.3 Alternative B (Proposed Action Alternative)

Under the Proposed Action, it is estimated that an additional 1,453 wells would be drilled through 2011 requiring 2,900 acre-feet of water. This represents 27 percent more water under the Proposed Action Alternative than for the No Action Alternative. By 2023, an additional 4,399 wells would be drilled requiring 8,800 acre-feet of water.

4.13.3.4 Alternative C

Groundwater withdrawals for drilling and completion would be the same as those described above for the Proposed Action Alternative.

4.13.4 Cumulative Impacts

The CIAA for groundwater is the PAPA. Drawdown in the Wasatch should be less than 1 foot at any time on the perimeter of the PAPA. Therefore, it is not likely that groundwater resources would be affected outside the PAPA as a result of the groundwater uses within the PAPA. Cumulative impacts to groundwater would be the same as those described for each of the alternatives.

4.13.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to groundwater would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, the Operators provided the measures included in Attachments 1 through 4 in Appendix C.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.14 SURFACE WATER

4.14.1 Scoping Issues

The public expressed two concerns about surface water during scoping. They were that BLM should:

1. Evaluate potential for impacts to downstream water users including heavy metals in produced waters.
2. Ensure that reclamation is timely, successful, and appropriate to benefit wildlife.

4.14.2 Impacts Considered in the PAPA DEIS

Because the New Fork and Green rivers flow through the PAPA, the PAPA DEIS (BLM, 1999a) recognized that potentially significant impacts could occur to water quality from increased erosion and sedimentation from construction related runoff (i.e., non-point source pollutants). BLM also noted the potential impact (increased sedimentation) to water quality from discharge of hydrostatic test water during pipeline testing. Hydrostatic test water, though, was not expected to produce significant impacts because it would be short-term in nature and the Operators would be required to comply with WDEQ/WQD regulations. There could be water quality impacts from accidental spills. Depending on where such a spill occurred, the impacts could be significant.

Impacts from sedimentation would not be significant if the Operators strictly comply with BLM's Mitigation Guidelines, apply relevant stormwater Best Management Practices (BMPs), and implement appropriate mitigation measures described in the PAPA DEIS. If significant impacts to area waters from sedimentation are to be avoided, attention to control of non-point sources of sediment will be necessary. In the PAPA DEIS, impacts produced by the alternatives would be considered significant should any of the following occur:

- Construction related erosion and runoff into intermittent drainages and subsequently into perennial streams, altering the physical characteristics of streambeds;

- Construction related erosion and leaching of exposed subsoils, releasing increased flux of salts into perennial streams and degrading the quality of water;
- accidental spill of fuels or liquids associated with drilling, construction, or production activities affects the quality of surface water; or
- an increase in sediment loading causes any of the rivers or streams to be identified as a water which does not support its designated use.

Based on these significance criteria, it is not known if significant impact has occurred to surface water.

4.14.3 Alternative Impacts

4.14.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Surface Water Withdrawals. Table 4.14-1 shows the amount of surface withdrawal required within the PAPA under each of the alternatives for the life of the project. Direct impacts to Colorado River endangered fish species could occur as a result of surface water withdrawal in the PAPA. A discussion of the Recovery and Implementation Program (RIP) for Endangered Fish Species in the Upper Colorado River Basin is provided in Section 4.19.3.1. Surface water would be withdrawn from the New Fork River for hydrostatic testing of trunk pipelines, gas and liquid gathering pipelines, and for dust control during pipeline construction.

Table 4.14-1
Estimated Surface Water Withdrawals from the
New Fork River for Life of Project within the PAPA by Alternative

Water Use	Surface Water Withdrawal (acre-feet)				
	No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Pipeline Hydrostatic Testing					
Gas gathering	2.51	2.21	2.06	2.82	2.79
Liquid gathering	0.06	2.49	2.50	3.12	3.12
30-inch Mesa loop	8.51	8.51	8.51	8.51	8.51
10-inch water trunk line	1.51	1.51	1.51	1.51	1.51
12-inch gas line	0.74	0.74	0.74	0.74	0.74
Liquid gathering trunk lines	0.00	0.19	0.19	0.19	0.19
Water redistribution lines	0.00	0.14	0.14	0.14	0.14
Pipeline interconnection	0.00	0.40	0.40	0.40	0.40
Dust Control During Pipeline Construction	12.08	30.63	30.21	37.13	37.05
Total	**25.41**	**46.82**	**46.26**	**54.56**	**54.45**

Surface Water Discharges. Produced water is managed in several ways within the PAPA. Mostly, produced water is piped or trucked to the Anticline Disposal facility or other water treatment facility. Some is re-used in well completions (drill-out of the production zone, or fracturing). Produced water used for drilling is only used after isolation casing has been

installed through the fresh water zone. After treatment, some produced water is re-used for dust control. These uses are increasing, and re-use of the water reduces the demand on the Wasatch water supply. Some produced water and treatment plant reject is disposed of in permitted deep injection wells, none of which is in the PAPA. However, Operators and others are currently investigating possibilities for deep injection within the PAPA. Currently, produced water is not discharged within the PAPA; however, Anticline Disposal has a permit to discharge (up to 1 cfs) water that is treated to WDEQ standards. The discharge would be to the New Fork River and is planned to begin in 2007.

Gray water is treated on site by a third-party and is disposed of by sprinkler (WDEQ permit has been acquired for the discharge). Impacts to surface water could occur if the discharge were allowed to reach surface water, which is not allowed under the permit. Flows are limited under the permit to prevent erosion.

Impacts Resulting from Disturbance. Potential direct impacts to surface water include increased salinity, turbidity, and sedimentation in surface waters as a result of surface disturbance. These impacts are a result of runoff and erosion, leaching of soil salts, or by increased salinity in groundwater discharging to streams. Increased salinity in surface water is a concern in regard to the Colorado River Basin Salinity Control Act (see Section 3.16.1.1).

Implementation of each alternative is expected to concentrate additional surface disturbance within New Fork River-Alkali Creek, Mack Reservoir and Sand Draw-Alkali Creek sub-watersheds by the end of 2011; in some cases, an alternative could potentially more than double or nearly triple the existing surface disturbed by 2011 (Table 4.14-2). Continued development through 2023 by either the Proposed Action Alternative or Alternative C could increase disturbed areas in the New Fork River-Alkali Creek and Mack Reservoir sub-watersheds by more than 300 percent of existing disturbance levels (Table 4.14-3).

Table 4.14-2
Surface Disturbance in Relation to Sub-Watersheds by Alternative

Sub-Watershed and Hydrologic Unit Code	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Green River-Tyler Draw 140401010403	21.7	45.0	45.0	45.0	45.1	45.0
Green River-The Mesa 140401010404	10.1	7.5	7.5	7.5	7.5	7.5
Sand Draw-Alkali Creek 140401010701	502.2	519.0	427.1	444.7	1,076.8	1,277.1
Granite Wash 140401010704	0.0	0.0	0.0	0.0	0.0	0.0
North Alkali Draw 140401010705	116.5	150.9	98.6	133.6	231.6	275.7
New Fork River-Duck Creek 140401020102	92.4	141.1	38.6	38.6	181.0	114.7
Hay Gulch 140401020105	3.9	0.0	0.0	0.0	0.0	0.0
Lower Pine Creek 140401020203	3.7	0.0	0.0	0.0	0.0	0.0
New Fork River-Stewart Point 140401020301	361.9	191.3	207.6	207.6	934.3	878.6
East Fork River 140401020302	12.0	0.0	0.0	0.0	0.0	0.0

Sub-Watershed and Hydrologic Unit Code	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
New Fork River-Alkali Creek 140401020303	2,353.6	2,230.4	3,885.8	4,230.1	6,189.1	6,040.4
Sand Springs Draw 140401020304	81.3	5.2	93.3	102.4	240.4	336.4
New Fork River- Blue Ridge 140401020305	228.8	136.3	251.0	217.8	533.5	505.3
Mack Reservoir 140401020306	850.3	938.5	1,593.7	1,232.5	2,642.3	2,499.7
Lower Pole Creek 140401020403	0.9	0.0	0.0	0.0	0.0	0.0
South Muddy Creek 140401020602	0.0	0.0	0.0	0.0	0.0	0.0
Lower Muddy Creek-New Fork 140401020603	0.0	7.0	7.0	7.0	7.0	7.0
Big Sandy River-Waterhole Draw 140401040105	1.5	2.7	0.3	0.3	0.3	0.3
Big Sandy River-Bull Draw 140401040106	74.2	10.9	34.5	34.5	34.5	34.5
Mud Hole Draw 140401040107	344.4	98.7	155.0	155.0	155.0	249.4
Long Draw 140401040109	0.0	0.0	0.0	0.0	0.0	0.0
Total	**5,059.4**	**4,484.5**	**6,845.0**	**6,856.6**	**12,278.4**	**12,271.6**

Table 4.14-3
Modeled Average Annual Sediment Yields of Sub-Watersheds by Alternative

Sub-Watershed and Hydrologic Unit Code	Sediment Loss (kg/ha)				
	Pristine No Disturbance	Current Conditions 2006	No Action Alternative 2011	Proposed Action and Alternative C 2011	Proposed Action and Alternative C 2023
Green River-Tyler Draw 140401010403	1.55	1.55	1.57	1.57	1.57
Green River-The Mesa 140401010404	1.46	1.46	1.46	1.46	1.46
Sand Draw-Alkali Creek 140401010701	0.16	0.19	0.21	0.20	0.24
Granite Wash 140401010704	N/A-	N/A	N/A	N/A	N/A
North Alkali Draw 140401010705	1.65	2.05	2.49	2.62	2.70
New Fork River-Duck Creek 140401020102	0.04	0.04	0.04	0.04	0.04
Hay Gulch 140401020105	N/A-	N/A	N/A	N/A	N/A
Lower Pine Creek 140401020203	0.01	0.01	0.01	0.01	0.01
New Fork River-Stewart Point 140401020301	0.25	0.33	0.35	0.34	0.47

Sub-Watershed and Hydrologic Unit Code	Sediment Loss (kg/ha)				
	Pristine No Disturbance	Current Conditions 2006	No Action Alternative 2011	Proposed Action and Alternative C 2011	Proposed Action and Alternative C 2023
East Fork River 140401020302	0.74	0.74	0.74	0.74	0.74
New Fork River-Alkali Creek 140401020303	0.51	0.67	0.95	0.99	1.16
Sand Springs Draw 140401020304	0.02	0.02	0.02	0.02	0.02
New Fork River- Blue Ridge 140401020305	1.13	1.13	1.16	1.14	1.28
Mack Reservoir 140401020306	0.39	0.44	0.71	0.56	0.89
Lower Pole Creek 140401020403	N/A-	N/A	N/A	N/A	N/A
South Muddy Creek 140401020602	N/A-	N/A	N/A	N/A	N/A
Lower Muddy Creek-New Fork 140401020603	N/A-	N/A	N/A	N/A	N/A
Big Sandy River-Waterhole Draw 140401040105	0.14	0.15	0.15	0.15	0.15
Big Sandy River-Bull Draw 140401040106	0.68	0.70	0.70	0.70	0.70
Mud Hole Draw 140401040107	0.33	0.39	0.40	0.41	0.41
Long Draw 140401040109	N/A-	N/A	N/A	N/A	N/A
N/A= not analyzed-due to minimal disturbance					

Modeling was conducted by HydroGeo, Inc. for sediment loss in the PAPA and transport (load) to the PAPA boundary for all sub-watersheds in the PAPA. *The Erosion Modeling, Sediment Transport Modeling and Salt Loading Technical Report, Pinedale Anticline Project Sublette County, Wyoming* is provided in Appendix J. The watersheds were modeled for individual storms of varying size, with the amount of erosion proportional to the size of the storm, for seven scenarios:

- a pristine case (no disturbance or development in the PAPA);
- current conditions in the PAPA;
- No Action Alternative 2011;
- Proposed Action 2011;
- Proposed Action 2023;
- Alternative C 2011; and
- Alternative C 2023.

Modeled impacts for each scenario were assessed for new disturbance above and beyond that of the current condition. Disturbance was assumed to accumulate and not be reclaimed in this model, so it represents a worst case.

The greatest erosion impacts occur on the Anticline Crest under all alternatives. Mack Reservoir and New Fork River-Alkali Creek sub-watersheds show the largest increase in annual erosion over the current conditions. Erosion is increased as well in Sand Draw-Alkali Creek sub-watershed for large storms. Modeled average annual sediment yields in the PAPA sub-

watersheds are provided in Table 4.14-3 and the percent increases of sediment yield for each of the alternatives is provided in Table 4.14-4.

Table 4.14-4
Average Annual Sediment Yield Increase (%)
above Current Conditions for Sub-Watersheds by Alternative

Sub-Watershed and Hydrologic Unit Code	Percent of PAPA Area	No Action Alternative 2011	Proposed Action and Alternative C 2011	Proposed Action and Alternative C 2023
Green River-Tyler Draw 140401010403	4.46	1.29	1.29	1.29
Green River-The Mesa 140401010404	3.68	0.00	0.00	0.00
Sand Draw-Alkali Creek 140401010701	4.55	10.53	5.26	26.32
Granite Wash 140401010704	0.55	N/A	N/A	N/A
North Alkali Draw 140401010705	5.03	21.46	27.80	31.71
New Fork River-Duck Creek 140401020102	2.79	0.00	0.00	0.00
Hay Gulch 140401020105	0.12	N/A	N/A	N/A
Lower Pine Creek 140401020203	0.64	0.00	0.00	0.00
New Fork River-Stewart Point 140401020301	8.69	6.06	3.03	42.42
East Fork River 140401020302	2.47	0.00	0.00	0.00
New Fork River-Alkali Creek 140401020303	25.01	41.79	47.76	73.17
Sand Springs Draw 140401020304	6.67	0.00	0.00	0.00
New Fork River- Blue Ridge 140401020305	12.58	2.65	0.88	13.27
Mack Reservoir 140401020306	7.75	61.36	27.27	102.27
Lower Pole Creek 140401020403	0.89	N/A	N/A	N/A
South Muddy Creek 140401020602	2.08	N/A	N/A	N/A
Lower Muddy Creek-New Fork 140401020603	0.75	N/A	N/A	N/A
Big Sandy River-Waterhole Draw 140401040105	1.69	0.00	0.00	0.00
Big Sandy River-Bull Draw 140401040106	2.91	0.00	0.00	0.00
Mud Hole Draw 140401040107	6.53	2.56	5.13	5.13
Long Draw 140401040109	0.16	N/A	N/A	N/A
N/A= not analyzed-due to minimal disturbance				

Rates of erosion and sediment transport in the PAPA are currently low, because relatively gentle slopes predominate, and runoff from much of the PAPA occurs only during large storm events. Measurable increases in sediment in the New Fork River are predicted only for 25-year or larger storms (a 25-year storm is of a magnitude that occurs on average every 25 years).

Smaller storms mobilize significant sediment on disturbed land, but it tends to be redeposited in lower watercourses before leaving the PAPA. Increased disturbance causes higher sediment yield in all scenarios in large storms.

Reclamation would significantly reduce these estimates of sediment yield. Instituting best management practices for erosion and sediment transport control would further diminish impacts.

The reason that some watersheds show greater erosion and sediment yield under the No Action Alternative than under the Proposed Action Alternative (for instance the Mack Reservoir) is that development in the particular watershed in the No Action Alternative is concentrated on higher slopes, whereas it is spread out and on lower slopes in the Proposed Action Alternative.

According to the significance criteria in the PAPA DEIS, significant impact to surface water resources is not expected under any of the alternatives.

Pipeline Corridors and Gas Sales Pipelines

Potential impacts to surface water resources from pipeline construction could include short-term increased turbidity, salinity, and sedimentation of surface waters. This would occur during seasonal flows or precipitation events due to increased runoff and accelerated erosion from disturbed upland areas, and depletion of Green River tributary waters for hydrostatic testing. Clearing and blading followed by construction vehicle travel across ephemeral stream channels could break down stream banks, cause or accelerate erosion, increase sediment loads, and destabilize the channels. However, vehicle access to the pipeline rights-of-way would be confined to existing access roads and to the construction rights-of-way (for the duration of construction activities). No new roads would be constructed. Vehicles would also not operate when soils are saturated to avoid rutting and associated excessive soil compaction and enhanced conditions for accelerated erosion. Implementation of approved reclamation measures that extend to ephemeral stream banks and bottoms would also enhance bank stability and limit excessive channel erosion and sedimentation when stream flows again.

No toxic substances are proposed for use during pipeline construction. The pipelines would be hydrostatically tested for any leaks prior to being placed in service. Any spills of fuel, lubricants, and solvents during pipeline/facility construction in the corridors that could be entrained by surface soils materials and/or enter into surface waters or drainages would be contained and cleaned up in accordance with SPCC Plan requirements.

Direct impacts to perennial waterbodies would be minimized by crossing using HDD construction methods. In HDD construction, disturbance is set back away from the river edges and typically above any flood plains that may be present. Increased contributions of sediment to the rivers from affected ephemeral tributaries would be mitigated by measures implemented at ephemeral stream crossings and in compliance with an approved reclamation plan.

Accidental leaks from the proposed natural gas pipelines would likely have negligible impact on surface water quality due to the minor amount of liquids present in the pipelines. Other pipelines in the corridors may carry more hydrocarbon liquids or possibly product. Those future pipelines could have more of an adverse impact on water quality should they leak. The principal risks of pipeline operations that could lead to leaks/releases include excessive pressure, physical damage during flood events and from accelerated soil erosion and pipe corrosion. Pipeline failures due to excess pressure would be prevented by proper engineering design and incorporation of pressure relief valves. The pipeline would be monitored through periodic leakage surveys and patrols to anticipate and correct problems before failures occur.

Approximately 33.4, 43.0, and 29.3 acre-feet of water would be withdrawn from the New Fork, Green, and Blacks Fork rivers, respectively, for hydrostatic testing of the proposed R6, PBC, and Opal Loop III pipelines. Permits and/or license agreements for water withdrawal would be obtained from the State of Wyoming. The terms of the permits/agreements would ensure that the quantity used for testing would not harm other uses. Discharge operations would also be permitted by the state, and permit requirements would ensure the discharged water would not damage soils or surface waters at the point of discharge. The test waters would be tested and treated, if necessary, to ensure compliance with federal and state water quality standards and permit conditions prior to release.

4.14.3.2 Alternative A (No Action Alternative)

Under the No Action Alternative, an additional 4,485 acres would be disturbed with a LOP disturbance of 1,315 acres. Disturbance would not occur all at once but would increase as development progresses. Sediment loss would be increased by an average of nearly 10 percent over the current conditions under this alternative, without reclamation.

4.14.3.3 Alternative B (Proposed Action Alternative)

The Proposed Action would result in a total disturbance of 6,845 acres, an increase of 53 percent over the No Action Alternative through 2011. LOP disturbance under the Proposed Action would be 2,066 acres, a 57 percent increase over the No Action Alternative in 2011. Sediment loss would be increased by an average of nearly 8 percent in 2011 and 20 percent in 2023 over the current conditions under this alternative, without reclamation.

4.14.3.4 Alternative C

Estimates of initial and LOP disturbance would be similar for Alternative C as for the Proposed Action Alternative. In 2011, although the amount of disturbance would be similar, the distribution of disturbance would be different for Alternative C than it would be for the No Action or for the Proposed Action. By 2023, the patterns of disturbance would be similar for both the Proposed Action Alternative and Alternative C. Sediment loss under this alternative would be similar to that stated above for the Proposed Action Alternative – an average of nearly 8 percent in 2011 and 20 percent in 2023, without reclamation.

4.14.4 Cumulative Impacts

The CIAA for surface water resources is the PAPA which is the same CIAA as for soils and vegetation. Watersheds that drain the PAPA are not expected to be directly impacted outside of the PAPA except for those associated with construction of the gas sales pipelines. The extent of indirect impacts would depend primarily on the effectiveness of erosion control and reclamation within the PAPA. Table 4.14-5 shows the cumulative disturbance impacts for each of the alternatives. The cumulative disturbance for all alternatives includes disturbance associated with non-wellfield disturbance in the PAPA, existing wellfield disturbance in the PAPA and that portion of disturbance associated with the gas sales pipelines that is within the PAPA. Under each of the alternatives, the New Fork River-Alkali Creek sub-watershed would have the most disturbance with nearly 10,000 acres under the Proposed Action Alternative and Alternative C in 2023. Total cumulative disturbance within the PAPA is more than 25,000 acres under each of the alternative in 2023, which represents almost 13 percent of the PAPA.

Table 4.14-5
Cumulative Surface Disturbance in Relation to Sub-Watersheds by Alternative

Sub-Watershed and Hydrologic Unit Code	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Green River-Tyler Draw 140401010403	50.0	21.7	116.7	116.7	116.7	116.8	116.7
Green River-The Mesa 140401010404	23.5	10.1	41.1	41.1	41.1	41.1	41.1
Sand Draw-Alkali Creek 140401010701	5.0	502.2	1,046.1	954.2	971.8	1,603.9	1,804.2
Granite Wash 140401010704	0.8	0.0	8.1	8.1	8.1	8.1	8.1
North Alkali Draw 140401010705	13.0	116.5	377.7	325.4	360.4	458.4	502.5
New Fork River-Duck Creek 140401020102	527.5	92.4	761.0	658.5	658.5	800.9	734.6
Hay Gulch 140401020105	19.1	3.9	23.0	23.0	23.0	23.0	23.0
Lower Pine Creek 140401020203	804.2	3.7	807.9	807.9	807.9	807.9	807.9
New Fork River-Stewart Point 140401020301	2,736.8	361.9	3,290.0	3,306.3	3,306.3	4,033.0	3,977.3
East Fork River 140401020302	23.3	12.0	35.3	35.3	35.3	35.3	35.3
New Fork River-Alkali Creek 140401020303	1,183.7	2,353.6	5,901.3	7,556.7	7,901.0	9,860.0	9,711.3
Sand Springs Draw 140401020304	49.8	81.3	136.3	224.4	233.5	371.5	467.5
New Fork River-Blue Ridge 140401020305	162.6	228.8	549.6	664.3	631.1	946.8	918.6
Mack Reservoir 140401020306	34.3	850.3	1,969.4	2,624.6	2,263.4	3,673.2	3,530.6
Lower Pole Creek 140401020403	1,740.4	0.9	1,741.3	1,741.3	1,741.3	1,741.3	1,741.3
South Muddy Creek 140401020602	20.6	0.0	20.6	20.6	20.6	20.6	20.6
Lower Muddy Creek-New Fork 140401020603	0.0	0.0	7.0	7.0	7.0	7.0	7.0
Big Sandy River-Waterhole Draw 140401040105	1.9	1.5	6.1	3.7	3.7	3.7	3.7
Big Sandy River-Bull Draw 140401040106	22.0	74.2	107.1	130.7	130.7	130.7	130.7
Mud Hole Draw 140401040107	48.4	344.4	491.5	547.8	547.8	547.8	642.2
Long Draw 140401040109	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**7,466.9**	**5,059.4**	**17,437.1**	**19,797.6**	**19,809.2**	**25,231.0**	**25,224.2**

4.14.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to surface water resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).

- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.15 SOIL RESOURCES

4.15.1 Scoping Issues

There were no project scoping comments related to soil resources.

4.15.2 Impacts Considered in the PAPA DEIS

The PAPA DEIS described potential impacts to soils that include:

- increased wind and water erosion;
- loss of topsoil;
- decreased soil and vegetation productivity; and
- introduction and invasion of noxious weeds.

Removal of vegetation and the exposure of soils during construction of well pads, roads and pipelines, along with the alteration and compaction of soils during construction, can increase runoff and wind and water erosion. Topsoil, in particular, is a valuable resource in semi-arid areas such as the PAPA, particularly during reclamation as well as the following considerations:

- topsoil development is slow;
- it provides a crucial plant-growth medium that is essential to establish successful revegetation;
- it is higher in organic matter, fertility and biologic activity than subsoil materials;
- loss or dilution of the topsoil during construction by burial or mixing with subsoil horizons would reduce soil productivity and could hinder successful revegetation; and
- topsoil is generally much darker than subsoil materials and its reapplication during reclamation would help to minimize visual impacts by reducing contrasts on reclaimed sites.

Impacts from erosion would be greatest after initial soil disturbance and would decrease naturally in the short-term due to natural stabilization through particle aggregation and armoring (i.e., formation of soil crusts and pavements). In general, most sediment in the PAPA is from exposed areas (i.e., stream channels and banks, badlands and bare escarpment slopes). The primary factors affecting sediment delivery or movement includes slope gradient, soil particle size, roughness of soil and vegetation cover (see Appendix J - *The Erosion Modeling, Sediment Transport Modeling and Salt Loading Technical Report*).

BLM considered implementation of alternatives in the PAPA DEIS would cause significant impacts to soils if:

- disturbed areas are not adequately stabilized to reduce soil erosion and potential impacts to water quality; or
- there is increased erosion or reduced soil productivity to a level which prevents reestablishment of vegetative cover within 5 years.

Based on these criteria, significant impacts to soils has not been documented. However, as pointed out in Chapter 3 and the sections below, there is considerable surface disturbance in soils that are considered sensitive.

4.15.3 Alternative Impacts

4.15.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

One of the primary concerns related to soil resources is the potential for sedimentation to cause significant adverse impacts to area waters as discussed in Section 4.14. Alteration of soil physical and chemical characteristics (e.g., compaction), dilution of topsoil (i.e., mixing of soil horizons) or the addition of contaminants from spilled materials decrease soil productivity. Sensitive soils (e.g., steep slopes, soils with high erosion potential, saline and/or sodic soils, shallow soils, soils with low reclamation potential or with high water tables) are more susceptible to impacts due to their limiting characteristics. For example, construction activities on steep slopes (greater than 15 percent) would require larger disturbed areas. They would also require longer and steeper cut and fill slopes which are difficult to successfully revegetate and stabilize, and in turn, have a greater erosion potential. These slopes can be difficult to return to their original contour during final reclamation.

By the end of 2006, approximately 590 acres will have been disturbed within the Blue Rim Area of sensitive soils. Some of that disturbance will also be on slopes greater than 15 percent, increasing the likelihood of soil erosion. Implementation of each alternative is expected to increase surface disturbance in both sensitive soils categories by the end of 2011 (Table 4.15-1). The Proposed Action Alternative may disturb less surface area with sensitive soils than the other two alternatives by 2011. Development of the Proposed Action Alternative through 2023 is expected to be similar to Alternative C through 2023 (Table 4.15-1).

Table 4.15-1
Surface Disturbance in Relation to Sensitive Soils SMRZ by Alternative

Sensitive Soils Category	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alterative C 2011	Proposed Action 2023	Alternative C 2023
Blue Rim Area Sensitive Soils	589.9	538.2	978.5	731.4	1,488.4	1,415.6
Soils on slopes ≥ 15%	266.9	179.9	454.3	412.0	753.7	702.9
Sensitive Soils SRMZ[1]	786.9	663.9	1,273.8	1,051.8	2,019.2	1,924.6

[1] Areas within Sensitive Soils SRMZ are not the combined total of the Blue Rim Area soils and soils on slopes greater than 15 percent because some soils are in both categories – see Map 3.17-1.

Pipeline Corridors and Gas Sales Pipelines

Construction of the proposed pipelines would disturb approximately 2,900 acres. Soil impacts are expected to be temporary (less than 1 year) to short-term (1 to 3 years) in duration. During a period of stabilization and reestablishment of protective vegetative cover, there would be some accelerated erosion and loss of soil material from disturbed areas due to exposure and physical degradation of soil materials during construction activities. Potential for accelerated

erosion and soil loss would be greatest in areas with steeper and longer slopes. The largest extent of these steeper and longer slopes is in the Blue Rim Area south of the New Fork River crossing and northwest of the Jonah Field.

Potential for accelerated erosion would be increased during pipeline construction after protective vegetative cover is cleared and topsoil materials are bladed into windrowed stockpiles within the construction rights-of-way. Windrowed topsoil and exposed subsoil would be exposed to accelerated water and wind erosion due to the loss of protective vegetative cover, loss of aggregation, lower infiltration rates, higher runoff rates, and more direct exposure to wind. The exposed subsoils that form the working surface within the construction rights-of-way would also receive rubber-tired and track vehicle traffic which would result in soil compaction. Such compaction could result in reduced soil productivity due to loss of soil structure, increased erodibility, and decreased infiltration and waste storage capacity. Accelerated soil erosion could potentially increase delivery of sediment and salinity to drainages.

Site stabilization and reclamation measures would limit potential impacts to soils in duration, extent, and magnitude. Trench spoil would be backfilled into the trench above the installed pipe and subsoil and topsoil would be redistributed over the construction rights-of-way. Erosion control features would be installed as necessary. Approved seed mix(es) would be applied. All equipment and vehicular access would be confined to existing roads and the established rights-of-way thereby avoiding soil compaction on undisturbed areas. Vehicle travel during saturated soil conditions would be avoided to prevent rutting, to minimize soil compaction, and to reduce potentials for accelerated soil erosion.

4.15.3.2 Alternative A (No Action Alternative)

Continued development in the PAPA under the No Action Alternative through 2011 would likely nearly double the amount of surface disturbances within the Blue Rim Sensitive Soils area and increase surface disturbances by 180 acres within sites on slopes greater or equal to 15 percent (Table 4.15-1). An estimated 660 acres within the Sensitive Soils SRMZ are expected to be affected by development through 2011.

4.15.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Continued development in the PAPA under the Proposed Action Alternative through 2011 would likely lead to considerably more surface disturbances within the Blue Rim Sensitive Soils area and within sites on slopes greater or equal to 15 percent compared to project disturbance under the No Action Alternative (Table 4.15-1). More than 1,200 acres within the entire Sensitive Soils SRMZ are expected to be affected by developments under the Proposed Action through 2011.

Proposed Action Alternative Through 2023

Under the Proposed Action Alternative through 2023, approximately 2,000 acres would be disturbed in the Sensitive Soils SRMZ. Most of the disturbance (approximately 1,500 acres) would be in sensitive soils within the Blue Rim Area.

4.15.3.4 Alternative C

Alternative C Through 2011

Development in the PAPA under Alternative C through 2011 is expected to more than double the amount of surface disturbances within the Blue Rim Sensitive Soils area and within sites on slopes greater or equal to 15 percent (Table 4.15-1). More than 1,000 acres within the entire Sensitive Soils SRMZ are expected to be affected by developments under Alternative C through 2011.

Alternative C Through 2023

Disturbance to the Sensitive Soils SRMZ and sensitive soils within the Blue Rim Area under Alternative C through 2023 is expected to be similar to the Proposed Action Alternative through 2023.

4.15.4 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to soil resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.15.5 Cumulative Impacts

Cumulative impact analysis to soil resources in the PAPA is based on past, present, and future levels of surface disturbance in Table 4.15-2. There has been only minor disturbance to the Blue Rim sensitive soils and soils on slopes of 15 percent by existing non-wellfield developments. Most of the existing sources were livestock watering facilities and roads. Existing wellfield development in the PAPA has affected sensitive soils by the amounts shown in Table 4.15-2. There would be cumulative impact to sensitive soils by each alternative as well, at least until reclamation has been successfully implemented.

Table 4.15-2
Cumulative Surface Disturbance in Relation to Sensitive Soils SMRZ by Alternative

Sensitive Soils Category	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Blue Rim Area Sensitive Soils	32.8	589.9	918.6	1,358.9	1,111.8	1,868.8	1,796.0
Soils on slopes ≥ 15%	26.7	266.9	813.1	1,087.5	1,045.2	1,386.9	1,336.1
Sensitive Soils SRMZ[1]	55.3	786.9	1,506.1	2,116.0	1,894.0	2,861.4	2,766.8

[1] Areas within Sensitive Soils SRMZ are not the combined total of the Blue Rim Area soils and soils on slopes greater than 15 percent because some soils are in both categories – see Map 3.17-1.

4.16 VEGETATION RESOURCES

4.16.1 Scoping Issues

1. Multiple wells drilled from one well pad should be standard practice to minimize surface disturbance.
2. Operators should coordinate activities with livestock producers who utilize the Mesa.

3. BLM should ensure reclamation is timely, successful, and appropriate to benefit wildlife.

4.16.2 Impacts Considered in the PAPA DEIS

Potential impacts to vegetation from all project alternatives considered in the PAPA DEIS include:

- removal of native vegetation during construction of well pads, roads, and pipelines;
- sagebrush, the predominant shrub within the PAPA, may take 10 to 20 years to become reestablished;
- surface disturbance to sagebrush steppe vegetation may adversely affect wildlife species that depend on sagebrush for some life history function;
- undisturbed ground is covered by microphytic crusts (growths of lichens, algae, mosses, fungi or bacteria on the soil surfaces) which are readily destroyed by vehicles and trampling, thereby increasing erosion potential and suitability for invasions by nonnative species;
- cheatgrass and halogeton are exotic species that have invaded, halogeton is poisonous to livestock; and
- introduction of other noxious weeds following removal of native vegetation is a potential impact that would further limit reestablishment of native species.

BLM considered that impacts to vegetation produced by the alternatives in the DEIS would be significant if:

- within 5 years, reclaimed areas do not attain adequate vegetation cover and species composition to stabilize the site and to support predisturbance land uses including livestock forage, wildlife habitat, and big game population objectives; or
- there is invasion and establishment of noxious nonnative weeds that contribute to unsuccessful revegetation.

It is not know whether vegetation resources have been significantly impacted by existing development in the PAPA, based on the significance criteria, above.

4.16.3 Alternative Impacts

4.16.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

In general, the extent of impacts by removal of vegetation would be influenced by precipitation and soil characteristics. Areas with shallow or exposed subsoils and areas where soils are highly alkaline would be difficult to revegetate. In 1999, mean annual precipitation in the PAPA was approximately 10 inches. Beginning in 2000 and continuing through 2003, precipitation in the PAPA was consistently below the 30-year average. This is in part because snowfall (October through April) was below the 30-year average of 58 inches since 1987, except during winter 2003-2004 (see Table 3.3-1). With the possibility that drought could continue, the future of successful revegetation in the PAPA could be at risk.

Wellfield development directly impacts vegetation, primarily by its removal. Indirect impact to vegetation may occur if wellfield development displaces native and domestic herbivores, causing excessive browsing and/or grazing on vegetation resources that would otherwise not occur. Indirect impact to native vegetation can also occur if invasive non-native species become established and limit or prohibit growth of native species. Sagebrush-dominated

vegetation is the most extensive of all vegetation categories in the PAPA. By the end of 2006, most surface disturbance is projected to occur in the sagebrush steppe vegetation type, nearly 3,900 acres (Table 4.16-1). Continued direct impact to sagebrush and other native vegetation types is expected under each alternative. The potential for significant impact would increase as additional development is implemented under any of the alternatives.

While black henbane and scentless chamomile have been declared as noxious weeds by Sublette County, large areas of the county have been infiltrated by Canada thistle and perennial pepperweed and to lesser extents by hoary cress and Russian knapweed. Because noxious weeds are often able to establish in areas following surface disturbance, primarily along roads, areas of oil and gas development, and in heavily grazed areas (BLM, 2005d), the potential for increased infestation and profusion of weeds is very likely under all of the alternatives.

Table 4.16-1
Surface Disturbance in Relation to Vegetation Types by Alternative

Vegetation Category	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Sagebrush Steppe	3,864.1	3,313.6	4,874.3	4,986.9	8,865.2	9,112.9
Mixed Grass Prairie	409.1	380.6	760.6	646.5	1,126.1	1,001.0
Greasewood Flats	46.9	84.2	79.3	71.2	234.7	226.0
Desert Shrub	286.5	261.3	596.1	453.1	938.0	978.7
Riparian Forest and Shrub	70.4	74.7	58.9	84.8	278.0	269.3
Other limited types	3.6	1.4	1.4	1.4	9.1	6.8
Barren Ground	45.8	37.8	87.6	66.8	109.8	88.5
Irrigated Cropland	310.9	329.1	386.8	545.9	717.5	588.4
Human Settlement	22.1	1.8	0.0	0.0	0.0	0.0
Total	**5,059.4**	**4,484.5**	**6,845.0**	**6,856.6**	**12,278.4**	**12,271.6**

Pipeline Corridors and Gas Sales Pipelines

Construction of pipelines within the proposed corridors would directly impact and possibly indirectly impact vegetation by the mechanisms discussed, above. The extent of active disturbance to the vegetative cover is expected to be limited to the construction rights-of-way approved for each pipeline. Incremental disturbance and subsequent reclamation of the corridors is anticipated with each pipeline installation.

Construction of the proposed R6 and the PBC and Opal Loop III pipelines would disturb approximately 2,813 acres of mostly native shrubs and grasses. Construction activities would result in either the direct removal of vegetation by blading, excavation/trenching or damage from vehicular traffic and placement of equipment and materials where some vegetation may be left in place within the rights-of-way. Removed vegetative debris would be windrowed to one side of the construction rights-of-way, usually in combination with salvaged topsoil materials, for later redistribution across the disturbed rights-of-way as part of reclamation.

Invasive, noxious weed species could establish in cleared, disturbed areas resulting in infestations that may limit success of native and/or desirable species. Weed seeds or cuttings

of some species could be transported naturally or accidentally to the disturbed areas. Weed seeds may be present in the native soil materials and the removal of vegetative cover and soil disturbance may promote weed establishment at the expense of desirable species.

To replace protective cover, to limit weed infestation, and to restore vegetative productivity of desirable species, all areas disturbed for pipeline construction would be reclaimed and revegetated after construction is complete. Revegetation would be conducted with landowner approved seed mixtures to promote establishment of grasses in the short-term while the shrubs would become established over a longer period of time. On federal lands, different seed mixtures may be applied to different areas at the direction of the BLM/BOR. Grasses could require 2 to 3 years for successful re-establishment in arid environments. Shrub components may require more than 20 years for recovery to predisturbance levels after reseeding and reclamation. Although some weed infestation may be anticipated on the pipeline construction rights-of-ways, the application of weed control measures would minimize impacts from weed species. Overall, long-term impacts to vegetative resources should be minimal.

4.16.3.2 Alternative A (No Action Alternative)

Under the No Action Alternative, more than 3,300 acres of sagebrush steppe vegetation would be disturbed with over 4,000 acres disturbed overall.

4.16.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Implementation of the Proposed Action would result in removal of almost 5,000 acres of sagebrush steppe vegetation through 2011 (Table 4.16-1). In almost all vegetation types, particularly mixed grass prairie and desert shrub, disturbance would exceed disturbance in those types by the No Action Alternative.

Proposed Action Alternative Through 2023

Through 2023, the Proposed Action Alternative would remove almost 9,000 acres of sagebrush steppe vegetation (Table 4.16-1). Most other disturbance would be in the Mixed Grass Prairie and Desert Shrub vegetation types.

4.16.3.4 Alternative C

Alternative C Through 2011

Implementation of Alternative C could result in long-term removal of nearly 5,000 acres of sagebrush steppe in 2011 (Table 4.16-1), approximately the same amount as projected for the Proposed Action Alternative. Effects to some other vegetation types, particularly irrigated cropland, mixed grass prairie and desert shrub, would likely exceed disturbance in those types by the No Action Alternative though in other vegetation categories, disturbances would probably be almost equivalent by the end of 2011.

Alternative C Through 2023

By 2023, Alternative C is expected to increase existing surface disturbances by about 9,000 acres within sagebrush steppe, which is similar to the disturbance under the Proposed Action Alternative through 2023.

Under Alternative C, because development would be complete in the southern area of DA-1 before moving north and development in DA-2 would be complete before moving to DA-3, the potential exists for focal points of final reclamation rather than just interim reclamation. Under Alternative C, final reclamation must begin, once an area is fully developed. Depending on how successful future revegetation efforts would be during the 17-year period of wellfield

development, there may be some reestablishment of native vegetation within the PAPA, though not to pre-disturbance levels. Disturbed areas within sagebrush steppe would most likely be converted to some other vegetation type.

4.16.4 Cumulative Impacts

The CIAA for vegetation is the PAPA. Cumulative impact analysis to vegetation resources in the PAPA is based on past, present, and future levels of surface disturbances in Table 4.16-2 for which the vast majority of impact is and would be within sagebrush steppe. There would be cumulative impact to irrigated cropland by each alternative as well. Over 5,000 acres of irrigated cropland is due to agricultural use. Even so, there is existing wellfield development (311 acres) and future development that would convert cropland to a non-vegetated status, at least until reclamation has been successfully implemented. Likewise, the human settlement category in Table 4.16-2 is composed of residences, roads, and urban infrastructure in the PAPA.

Table 4.16-2
Cumulative Surface Disturbance to Vegetation Types by Alternative

Vegetation Category	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Sagebrush Steppe	963.5	3,864.1	8,435.3	9,996.0	10,108.6	13,986.9	14,234.6
Mixed Grass Prairie	35.3	409.1	859.4	1,239.4	1,125.3	1,604.9	1,479.8
Greasewood Flats	18.2	46.9	149.3	144.4	136.3	299.8	291.1
Desert Shrub	27.4	286.5	639.5	974.3	831.3	1,316.2	1,356.9
Riparian Forest and Shrub	31.9	70.4	184.3	168.5	194.4	387.6	378.9
Other limited types	0.0	3.6	5.0	5.0	5.0	12.7	10.4
Barren Ground	3.6	45.8	87.4	137.2	116.4	159.4	138.1
Irrigated Cropland	5,688.4	310.9	6,354.4	6,412.1	6,571.2	6,742.8	6,613.7
Human Settlement	698.6	22.1	722.5	720.7	720.7	720.7	720.7
Total	**7,466.9**	**5,059.4**	**17,437.1**	**19,797.6**	**19,809.2**	**25,231.0**	**25,224.2**

While existing, non-wellfield disturbance has generated a minor amount of disturbance compared to existing and future wellfield disturbance, the majority of existing wellfield disturbance has been concentrated in sagebrush steppe and future disturbances by any alternative are expected in sagebrush steppe as well. Compared to the No Action Alternative, there would be far more cumulative impact by the Proposed Action Alternative and Alternative C to sagebrush steppe through 2011 and certainly by 2023 (Table 4.16-2). The same is true, though not to the same level, for cumulative effects to other vegetation in the PAPA by the alternatives.

4.16.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to vegetation resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.17 GRAZING RESOURCES

4.17.1 Scoping Issues

The following concerns related to livestock and grazing resources were raised during the scoping process:

1. BLM should evaluate how effects to wintering mule deer on the Mesa would affect private lands and consider off-site mitigation for affected landowners.
2. BLM should evaluate how offsite mitigation benefiting wildlife would reduce livestock AUMs on and off the Mesa.
3. Operators should coordinate activities with livestock producers who utilize the Mesa.

4.17.2 Impacts Considered in the PAPA DEIS

BLM analyzed potential impact to grazing resources from wellfield development in the PAPA DEIS (BLM, 1999a). BLM considered the primary impact to grazing resources would be the loss of forage associated with construction and production related disturbance. Loss of forage associated with construction was anticipated to be temporary (short-term), lasting until areas became revegetated, approximately 3 to 5 years after reclamation. However, production related disturbance, such as portions of well pads and road surfaces, would convert rangeland to an industrial use for the life of the project. Other impacts to grazing considered in the PAPA DEIS include:

- displacement of livestock from preferred grazing areas and stock watering facilities or ponds;
- disruption of livestock trailing by surface pipelines (typically greater than 6 inches in diameter), and new roads that run perpendicular to cattle drive trails, or large surface pipelines laid across two-track roads which impede vehicles and cause annoying and sometimes long detours;
- damage to range improvements including fences, cattleguards, water wells, and water impoundments;
- the spread of noxious weeds; and
- increased injury or loss of livestock from vehicle-livestock collisions or other incidents associated with oil and gas operations.

Section 4.13 describes the potential impacts of water supply wells in the PAPA could have on the existing stock water wells. BLM considered impacts produced by the project alternatives would be significant if:

- animal unit months (AUM) in any single grazing allotment declined by 5 percent or more through clearing or disturbance of vegetation; or
- project activities result in long-term disruption of grazing management, such as changes in livestock use patterns, which result in increased resource conflicts or changes in ranching operations, livestock trailing, watering, fencing, and feeding.

More than 5 percent of some grazing allotments in the PAPA have been subject to surface disturbance as of 2006. Assuming that grazing capacities (AUMs) in any allotment are directly related to the amount of vegetation present, those allotments have been significantly impacted by current wellfield developments, under the significance criteria in the PAPA DEIS (BLM, 1999a).

4.17.3 Alternative Impacts

4.17.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Wellfield development directly impacts grazing resources, primarily by removal of vegetation. Indirect impact to grazing resources may occur if wellfield development displaces native herbivores and livestock, causing them to graze unaffected areas. Displacement and concentration of animals could cause excessive grazing pressure on vegetation that would otherwise not occur. Indirect impact to native vegetation, and consequently grazing, can also occur if invasive nonnative species become established and limit or prohibit growth of native vegetation. Nonnative invasive species may be less palatable than native vegetation and some may be toxic to livestock.

Of the 16 grazing allotments in the PAPA, the ones most affected by wellfield development and those that would continue to be affected are on the Anticline Crest. The amount of surface disturbance that has been reclaimed in allotments is unknown and there is no evaluation of successful revegetation that could offset the impact to AUMs by surface disturbance.

Though no estimate has been made of changes in AUMs within either allotment, the amount of surface disturbance suggests that significant impacts to grazing resources (more than 5 percent of the total allotment areas) in two allotments have already occurred according to the impact significance criteria established in the PAPA DEIS (BLM, 1999a). The amount of forage lost to livestock grazing within any single allotment during future development by any of the alternatives cannot be predicted since because revegetation of disturbed surfaces would compensate for forage lost through development. Future wellfield development under any alternative is expected to generate significant impact according to the significance criteria in the PAPA DEIS (Table 4.17-1). Such impacts are expected to be reduced to levels below impact significance once surface disturbance has been fully reclaimed.

Black henbane and scentless chamomile are declared weeds in Sublette County. Relatively large areas of the county have been infiltrated by Canada thistle and perennial pepperweed and to lesser extents by hoary cress and Russian knapweed. Noxious weeds are often able to establish in areas following surface disturbance, primarily along roads, areas of oil and gas development, and in heavily grazed areas (BLM, 2005d), and therefore, the potential for increased infestation and profusion of weeds is very likely under any of the alternatives. Canada thistle and perennial pepper weed are especially aggressive and difficult to control once established. Hoary cress can be controlled with herbicides but is very competitive with other plants if established and Russian knapweed readily colonizes pastures, roadsides and other disturbed sites.

Table 4.17-1
Surface Disturbance in Relation to Grazing Allotments by Alternative

Allotment and Number	Estimated Existing Wellfield (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Blue Rim Individual (2173)	1,401.9	1,582.8	2,182.1	2,196.9	4,335.1	4,742.6
Circle 9 Individual (2124)	0.0	0.0	0.0	0.0	0.0	0.0
Clark-Bloom Common (2053)	40.0	117.6	25.6	25.6	149.2	91.6
Blue Rim Desert (2029)	15.5	0.0	1.7	1.7	1.7	1.7
Fremont Butte Common (2009)	81.4	2.9	79.1	79.1	248.1	284.2
Luman Individual (2124)	11.4	0.0	8.9	8.9	9.6	8.9
Marincic Mesa Individual (2132)	0.2	0.0	0.0	0.0	0.0	0.0
Mesa Common (2031)	1,425.4	1,086.1	2,748.2	2,637.9	3,378.3	2,970.2
Mount Airy Common (2049)	378.7	343.4	346.2	336.5	1,194.8	1,207.7
New Fork Individual (2113)	320.8	371.4	312.2	241.9	696.1	753.2
Burch (2050)	7.9	0.0	20.6	20.8	80.0	31.6
Northwest Square Top Individual (2123)	122.6	200.9	154.8	156.9	521.2	517.3
Square Top Common (2051)	62.1	18.3	14.9	14.9	14.9	15.5
Stud Horse Common (2008)	508.0	266.2	351.6	351.6	396.8	555.8
Boundary/Poston (13005)	54.2	0.0	2.2	2.2	2.2	2.2
Sand Draw (2156)	0.0	0.0	0.0	0.0	0.0	0.0
Total	**4,430.1**	**3,989.6**	**6,248.1**	**6,074.9**	**11,028.0**	**11,182.5**

Pipeline Corridors and Gas Sales Pipelines

Establishment of the three proposed pipeline corridors would have no immediate impact on lands within those portions of the corridors used for livestock grazing. However, pipeline construction within the proposed corridors would result in short-term loss of available forage and potential temporary impacts on animal movement and well-being.

Based on an average stocking ratio of 11.5 acres per AUM for the area (BLM, 2006a), the construction of the proposed pipelines would affect 252 AUMs (2,900 acres/11.5 acres per AUM). That estimate includes federal, state, and private lands and assumes all lands within the corridors are open to grazing. These affected AUMs would be restored in the short-term as re-seeded vegetation reestablishes and restores vegetative productivity in the construction rights-of-ways over a 1 to 3 year period.

To minimize impacts to animal movement and overall well being, soft plugs would be constructed and left in the open trenchline every 0.25 mile to allow for livestock and wildlife crossings and if necessary escape from the trench should an animal fall into the open trench.

Long-term loss of forage would be negligible because of the minimal amount of life of project disturbance (less than 1 acre for each pipeline) required for ancillary surface facilities.

4.17.3.2 Alternative A (No Action Alternative)

Assuming that revegetation on surfaces disturbed by wellfield development would not have reestablished livestock grazing capacities within affected allotments by 2011, significant impacts (using BLM's criteria in the PAPA DEIS) would occur within the Blue Rim Individual, Mesa Common, and Northwest Square Top Individual allotments by 2011. In these allotments, the amount of grazing capacity affected would be more than 5 percent of the total allotment.

Continued wellfield development though 2011 under the No Action Alternative would further impact grazing resources on the New Fork Individual and Stud Horse Common allotments. The No Action Alternative is likely to affect the New Fork Individual allotment more than the other two alternatives by 2011 (Table 4.17-1).

4.17.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Significant impact to grazing capacities within several allotments is expected under the Proposed Action Alternative through 2011. More surface disturbance than would have been generated under the No Action Alternative is likely in the New Fork Individual and Stud Horse Common allotments in 2011, but those had already been significantly impacted by 2006 according to BLM's impact significance criteria in the PAPA DEIS (see Section 4.17.3). More surface disturbance is expected in the Blue Rim Individual and Mesa Common allotments by 2011 than by the No Action Alternative. More than 5 percent of the grazing capacity (AUMs) is likely to be lost in these two allotments by 2011, assuming direct relationship between surface disturbance to vegetation and AUMs.

Proposed Action Alternative Through 2023

By the end of 2023, the Proposed Action Alternative potentially would have generated more than 11,000 acres of new disturbance within all grazing allotments in the PAPA, combined. Depending on how successful future revegetation efforts would be during the 17-year period of wellfield development, grazing capacity may or may not become reestablished to levels below 5 percent in allotments where substantial areas have been disturbed. Many existing well pads and pipeline corridors are likely to be re-disturbed in the future during well pad expansions and construction of new gathering pipelines, potentially within existing corridors.

4.17.3.4 Alternative C

Alternative C Through 2011

Similar to the Proposed Action Alternative, significant impact to grazing capacities within several allotments is expected under Alternative C through 2011. Less surface disturbance than would have been generated under the No Action Alternative would be likely in the New Fork Individual allotment but more disturbance would be likely in Stud Horse Common allotment in 2011. More surface disturbance is expected in the Blue Rim Individual and Mesa Common allotments by 2011 than by the No Action Alternative. More than 5 percent of the grazing capacity is likely to be affected in these two allotments by 2011.

Alternative C Through 2023

By the end of 2023, Alternative C would have disturbed more than 11,000 acres within all gazing allotments in the PAPA, combined. This is similar to the amount of surface disturbance that would be generated by the Proposed Action Alternative.

With wellfield development completed in specific areas before new areas would be developed, the potential for focal points of final reclamation rather than interim reclamation is possible under

Alternative C. That possibility does not exist under the Proposed Action Alternative. Depending on how successful future revegetation efforts would be during the 17-year period of wellfield development, grazing capacity may or may not become reestablished to levels below 5 percent in allotments where substantial areas have been disturbed.

4.17.4 Cumulative Impacts

The CIAA for grazing resources is the PAPA. Even though employment in agriculture within Sublette County decreased from 2001 to 2004 (see Section 3.5), livestock grazing in the PAPA remains an important use of lands within BLM grazing allotments by livestock producers (see scoping comments in Section 4.17-1, above). Cumulative impact analysis to grazing resources in the PAPA is based on past, present, and future levels of surface disturbances in Table 4.17-2.

Table 4.17-2
Cumulative Surface Disturbance in Relation to Grazing Allotments by Alternative

Allotment and Number	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Blue Rim Individual (2173)	44.7	1,401.9	3,348.4	3,947.7	3,962.5	6,100.7	6,508.2
Circle 9 Individual (2124)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clark-Bloom Common (2053)	104.1	40.0	261.7	169.7	169.7	293.3	235.7
Blue Rim Desert (2029)	55.3	15.5	70.8	72.5	72.5	72.5	72.5
Fremont Butte Common (2009)	0.0	81.4	84.3	160.5	160.5	329.5	365.6
Luman Individual (2124)	18.5	11.4	29.9	38.8	38.8	39.5	38.8
Marincic Mesa Individual (2132)	0.0	0.2	0.2	0.2	0.2	0.2	0.2
Mesa Common (2031)	143.5	1,425.4	2,664.6	4,326.7	4,216.4	4,956.8	4,548.7
Mount Airy Common (2049)	1.5	378.7	723.6	726.4	716.7	1,575.0	1,587.9
New Fork Individual (2113)	0.0	320.8	741.2	682.0	611.7	1,065.9	1,123.0
Burch (2050)	5.2	7.9	13.1	33.7	33.9	93.1	44.7
Northwest Square Top Individual (2123)	6.3	122.6	329.8	283.7	285.8	650.1	646.2
Square Top Common (2051)	22.6	62.1	103.0	99.6	99.6	99.6	100.2
Stud Horse Common (2008)	18.5	508.0	792.7	878.1	878.1	923.3	1,082.3
Boundary/Poston (13005)	25.4	54.2	79.6	81.8	81.8	81.8	81.8
Sand Draw (2156)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**445.6**	**4,430.1**	**9,242.9**	**11,501.4**	**11,328.2**	**16,281.3**	**16,435.8**

Existing, non-wellfield disturbance has generated a minor amount of disturbance in grazing allotments in the PAPA. Since 2000, wellfield disturbance is about ten 10 times the area (4,430 acres) that had been disturbed by non-wellfield actions (446 acres). Compared to the No Action Alternative, there would be far more cumulative impact by the Proposed Action Alternative and Alternative C to grazing allotments through 2011 (Table 4.17-2).

By 2023, cumulative disturbance under the Proposed Action Alternative and Alternative C would be approximately 10 percent of all grazing lands in the PAPA, but that cumulative effect would not be distributed among all allotments. Focal areas of cumulative disturbance in 2023 would be in the New Fork Individual allotment with 43 percent of the total land within the PAPA disturbed, the Mount Airy Common (17 percent disturbed in the PAPA), Blue Rim Individual (16 percent disturbed in the PAPA), the Stud Horse Common (9 percent disturbed), and Mesa Common allotment (9 percent disturbed).

4.17.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to grazing resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.18 WETLANDS, RIPARIAN RESOURCES AND FLOOD PLAINS

4.18.1 Scoping

There were no comments related to wetlands, riparian resources or flood plains from project scoping.

4.18.2 Impacts Considered in the PAPA DEIS

Jurisdictional wetlands considered in the PAPA DEIS (BLM, 1999a), and continue to be, primarily associated with the Green River and New Fork River flood plains that support wet meadow, aquatic bed, riparian scrub shrub, and riverine wetland types. Stock ponds fall within another wetland category. To minimize impact to wetlands, BLM considered the following actions:

- locations of new well pads would be avoided within 500 feet of perennial streams, riparian areas, or wetlands on federal lands and minerals (96 percent of all wetlands in the PAPA are located on private and state lands and minerals);
- avoid placement of well pads within 100-year flood plains; and
- some impacts to intermittent streams by road and pipeline crossings would be unavoidable.

By adhering to conditions in permits issued by COE for pipeline and road construction, no significant impacts to those "waters of the U.S" were expected. Section 404 of the Clean Water Act requires that a permit be issued to insure that no discharge of dredged material or fill material is allowed to enter waters of the U.S. if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. To obtain a Section 404 permit from COE, the applicant must demonstrate that three steps have been accomplished: wetland impacts have been avoided, where practicable; potential impacts to wetlands have been minimized; and, compensation has been provided for any remaining unavoidable impacts through activities to restore or create wetlands.

In the PAPA DEIS, BLM determined that impacts by the project alternatives would be significant if:

- there is a loss of wetlands or wetland function in the project area; or
- there is any violation of the requirements for Section 404 permits.

BLM concluded that significant impacts to wetlands would likely occur from implementation of the alternatives considered in the PAPA DEIS (BLM, 1999a) by the following:

- loss of wetlands or wetland function could occur from authorization under general permits without mitigation as a requirement; and
- although the COE usually requires restoration or creation of similar wetland types as mitigation for projects that impact more than 0.33 acre of wetland, it takes several years for a wetland created as mitigation to develop functions that are typical of natural wetlands, especially scrub-shrub and forested wetlands.

Therefore, the loss of wetlands without mitigation would be significant long-term impacts and when mitigation is required, there would be significant short-term impacts due to the temporary loss of important wetland functions. It is not known if wetlands (including riparian zones and flood plains) have been significantly impacted (based on the significance criteria, above) by existing development within the PAPA.

4.18.3 Alternative Impacts

4.18.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Wellfield disturbance has occurred within wetlands, within the Wetland SRMZ, and the 100-year flood plain of the New Fork River. Direct impacts to those resources were described in Chapter 3 and are summarized in Table 4.18-1. Continued development in the PAPA by the alternatives would disturb additional acreages within wetlands, riparian zones, and 100-year flood plains. Most, if not all disturbance to wetlands, the riparian zone of the New Fork River, and the 100-year flood plain has been and would continue to be on nonfederal lands and minerals. Consequently, BLM does not have an inventory of wellfield development effects to specific wetlands or other features. It is not known if Operators have been issued specific COE Section 404 permits. All existing and future surface disturbance to wetlands is potentially unmitigated, and if so, would be judged to be significant impacts to wetlands, riparian zones and 100-year flood plains under the significance criteria in the PAPA DEIS.

Ninety-six percent of wetlands in the PAPA occur on private and state lands and minerals, and therefore, past efforts to avoid disturbance within wetlands are unknown. Future disturbance within wetlands and the 100-year flood plain should be subject to COE Section 404 permit conditions. The amounts of additional surface disturbances shown in Table 4.18-1 do not take into account any efforts to avoid impact to wetlands as consequences of Section 404 permits issued by COE. The potential for significant impact would increase as additional development is implemented under any of the alternatives, according to the significance criteria in the PAPA DEIS (BLM, 1999a).

Table 4.18-1
Surface Disturbance in Relation to Wetlands, the Wetland SRMZ, and Flood Plain SRMZ by Alternative

Sensitive Resource	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Wetlands	149.7	167.5	184.4	222.6	466.7	430.7
Wetland SRMZ	275.1	227.9	357.5	378.2	740.9	692.6
100-Year Flood Plain and Flood Plain SRMZ	182.0	197.5	246.7	297.3	612.4	589.5

Pipeline Corridors and Gas Sales Pipelines

Potential impacts to wetlands may occur as a result of pipeline construction within the proposed pipeline corridor system. These impacts would likely occur as a result of ground disturbance within the proposed BCC pipeline corridors and at the crossings of the New Fork River flood plain by the R6 and PBC pipelines. Impacts to the river, wetlands within the flood plain, and riparian habitats would be minimized by the use of HDD construction technique at river crossings. However, due to spatial requirements of HDD temporary use areas, minor short-term impacts to wetlands within the flood plain may occur. Construction techniques within wetlands would include segregation of hydric topsoil from spoil during construction. Reclamation is expected to be successful due replacement of hydric soils, the existing moisture regime, and the anaerobic conditions that are favorable to hydrophytic vegetation. Seed sources for wetland species are likely present within and adjacent to the proposed rights-of-way and existing plant material and seeds in the soil would likely contribute to successful revegetation of disturbed areas within 1 to 3 years.

Wetland vegetation is only present along the riverbanks, immediately adjacent to the Green and Blacks Fork rivers. These areas consist of small strips of hydrophytic vegetation present only at the waters edge. Due to the use of HDD crossing techniques, these limited wetland areas would not be disturbed by pipeline construction. No other wetlands are present within the proposed pipeline corridors.

4.18.3.2 Alternative A (No Action Alternative)

The No Action Alternative is expected to increase surface disturbance within wetlands and within the 100-year flood plain by 2011. Included within the 228 acres affected by the No Action Alternative in the Wetland SRMZ (Table 4.18-1) are 75 acres of disturbance to riparian forest and riparian shrub vegetation (see Table 4. 16-1).

4.18.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

The Proposed Action Alternative through 2011 is expected to further increase surface disturbances within wetlands and the 100-year flood plain than under the No Action Alternative. Included within the 358 acres affected by the Proposed Action Alternative in the Wetland SRMZ (Table 4.18-1) are 59 acres of disturbance to riparian forest and riparian shrub vegetation (see Table 4. 16-1).

Proposed Action Alternative Through 2023

By 2023, the Proposed Action Alternative would disturb more than 700 acres within the Wetland SRMZ (Table 4.18-1). Included within that disturbance would be 278 acres of riparian forest and shrub vegetation (Table 4.16-1).

4.18.3.4 Alternative C

Alternative C Through 2011

Wellfield developments through 2011 would be focused within DA-2 under Alternative C. Therefore, more surface disturbance within wetlands and within the 100-year flood plain north of the New Fork River are expected through 2011 than by disturbances generated under the No Action and Proposed Action alternatives (Table 4.18-1). Alternative C through 2011 would affect 85 acres of riparian forest and shrub vegetation (Table 4.16-1) which is included in the 378 acres affected in the Wetland SRMZ.

Alternative C Through 2023

By 2023, disturbance to wetlands and within the 100-year flood plain under Alternative C would be similar to the Proposed Action Alternative. Included within the estimate of more than 690 acres affected within the Wetland SRMZ by Alternative C are 269 acres of riparian forest and shrub vegetation (Table 4.16-1).

4.18.4 Cumulative Impacts

Cumulative impact analysis to wetlands, the Wetland SRMZ, and Flood Plain SRMZ in the PAPA (the CIAA) is based on past, present, and future levels of surface disturbances in Table 4.18-2. Existing non-wellfield disturbance in wetlands and the Wetland SRMZ appears substantial but is mainly due to irrigated and non-irrigated croplands in those areas of the PAPA while only minor non-wellfield disturbance has occurred in the 100-year flood plain, primarily from roads and residences. By 2006, disturbances to each of the three areas by existing wellfield development are relatively minor.

Implementation of any of the three alternatives would generate considerable cumulative disturbances to wetlands, the Wetland SRMZ, and Flood Plain SRMZ as shown in Table 4.18-2. Through 2011, each of the three alternatives would cumulatively affect somewhat similar areas though slightly more overall by Alternative C. Compared to the No Action Alternative however, there would be far more cumulative impact by the Proposed Action Alternative and Alternative C to wetlands, the Wetland SRMZ, and Flood Plain SRMZ by 2023 (Table 4.18-2).

Table 4.18-2
Cumulative Surface Disturbance in Relation to Wetlands, the Wetland SRMZ, and Flood Plain SRMZ by Alternative

Sensitive Resource	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Wetlands	1,631.0	149.7	1,965.6	1,982.5	2,020.7	2,264.8	2,228.8
Wetland SRMZ	2,444.7	275.1	2,968.5	3,098.1	3,118.8	3,481.5	3,433.2
100-Year Flood Plain and Flood Plain SRMZ	46.3	182.0	444.7	493.9	544.5	859.6	836.7

4.18.5 Alternative Impact Analysis

Potential measures appropriate to mitigate impact to wetland, riparian resources and flood plains would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.19 THREATENED AND ENDANGERED SPECIES AND SPECIAL STATUS SPECIES

4.19.1 Scoping

There were no comments received during project scoping related to threatened and endangered species or special status species.

4.19.2 Impacts Considered in the PAPA DEIS

Section 7(a) of the ESA requires BLM to ensure that actions which they authorize or permit are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat for such species. Such action could result in "take" of a listed species. As defined in the ESA, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 U.S.C. §1532(19)). This broad definition includes "harm," a term subject to debate. FWS defined "harm" as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 C.F.R. § 17.3 (1994)), an interpretation that has been upheld by the U.S. Supreme Court. Even though an action may "harm" a listed species, the ESA, as amended, recognizes that incidental take (50 C.F.R. § 402.02) can occur in "carrying out an otherwise lawful activity conducted by the federal agency or applicant."

Following the definitions of "take" and "harm," the PAPA DEIS (BLM, 1999a) examined impacts to federally listed endangered or threatened species by potential development in the PAPA. Impacts were considered and evaluated if a species potentially occurred near the PAPA or if any of the criteria listed below were met:

- direct mortality of individuals (fish, wildlife, or plants);
- long-term or permanent loss or alteration of existing or potential fish or wildlife habitat supporting significant life history functions (e.g., breeding, wintering, or migration); or
- temporary alteration or disturbance of habitat that may result in avoidance by listed fish or wildlife species, and increased mortality or lowered reproductive success.

BLM (2002) updated their *Sensitive Species Policy and List* in Wyoming in 2002 with the following stated goals:

- maintain vulnerable species and habitat components in functional BLM ecosystems;

- ensure sensitive species are considered in land management decisions;
- prevent a need for species listing under the Endangered Species Act; and
- prioritize needed conservation work with an emphasis on habitat.

In the PAPA DEIS (BLM, 1999a), BLM declared that impacts to federally listed threatened and endangered species, species proposed for listing, candidate species, and species with special status recognized by FWS, BLM, and WGFD would be considered significant if any of the following occurs:

- the death of any individuals due to project related activities, which would jeopardize the continued existence of a species;
- reduced recruitment and/or survival of individuals that would impede species' recovery;
- loss of federally designated critical habitats; or
- contributing causes to warrant an unlisted species to be proposed for listing as threatened or endangered under the Endangered Species Act (ESA).

The PAPA DEIS (BLM, 1999a) determined that implementation of any of the alternative development scenarios would not be likely to adversely affect species listed under the ESA. The FWS concurred with that determination in their Biological Opinion (see Appendix F in the PAPA ROD).

4.19.3 Alternative Impacts

4.19.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Federally Listed Species. The only species listed under the ESA that has been documented within the PAPA is the bald eagle, listed as threatened. In addition to protection under ESA, bald eagles are protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. Incidental take of bald eagles, whether from direct or indirect impact, could occur under any of the alternatives.

Other species listed under ESA considered in this document include the black-footed ferret (endangered), Kendall Warm Springs dace (endangered), grizzly bear (threatened), Canada lynx (threatened), Ute ladies'-tresses orchid (threatened), and gray wolf (experimental population). Incidental take is not expected for any of the other federally listed species, by any of the alternatives.

Bald Eagle. Bald eagles nest in the PAPA and feed on fish, waterfowl, and big game carrion. They inhabit forest-dominated riparian zones along the Green and New Fork rivers for perching during the breeding season and during winter. Most of the existing surface disturbance, in forested-dominated riparian vegetation, is on private land. Bald eagle nests in the PAPA are also on private land.

FWS could consider wellfield disturbances on private lands within the PAPA as interrelated and interdependent to disturbances authorized by BLM on federal lands and minerals under the ESA. Wellfield development on private lands may require access roads and pipelines across federally managed lands that have been authorized by BLM. To address potential conflicts between wellfield developments on private lands and bald eagles, Ultra, Shell, Questar, and JGGC consulted with FWS for conservation approaches to minimize impact to bald eagle habitats along the New Fork River. The FWS recommended BMPs on private lands that are to be used voluntarily by the Operators, with technical assistance from BLM. The BMPs apply to

other raptor species as well as bald eagles and were designed to minimize adverse effects during development. The FWS recommended the following spatial and timing constraints:

- avoid activities within 1 mile of active bald eagle nests from courtship (February 1) through fledging (August 15);
- avoid activities within 1 mile of roosts used during winter, November 1 through April 1; and
- strive to conserve potential nesting, roosting, and foraging habitats of mature and old growth trees, particularly within 0.5 mile of water.

Ultra, Shell, Questar, and JGGC proposed several measures to minimize disturbance to bald eagles when development would be within the spatial buffers during periods when habitats may be used by bald eagles. Those measures include:

1. *"During night operations and only when worker's safety is not reduced, direct lighting toward the pad to avoid light disturbances to surrounding areas;*
2. *Reduce unnecessary traffic and encourage travel times to be during daylight hours between 9 a.m. and 3 p.m.;*
3. *In areas within 1 mile of active nests where there is line of sight from active nests to the activity, pipeline installation equipment shall be shielded from the affected area with camouflage netting; and*
4. *Avoid potentially disruptive activities or permanent aboveground structures in the bald eagles' direct flight path between their nest and roost sites and important foraging areas."*

With these measures, FWS cautioned that they would not support activities within recommended protective buffers. This could result in adverse effects to bald eagles and/or other raptors. Application of any of the above measures within protective buffers should be used with caution. "Take" could occur and would be a violation of the ESA, Section 9, and other legislation protecting bald eagles.

BLM uses the spatial and temporal buffers recommended by FWS as standard practices. BLM considers activities within 1 mile of forested-dominated riparian vegetation as potentially disruptive to bald eagle use of those habitats during winter. Surface disturbance within 1 mile of the New Fork River riparian zone would occur under each of the alternatives by 2011, but minimal new surface disturbances are likely within 1 mile of existing nest sites (Table 4.19-1). Implementation of the Proposed Action Alternative and Alternative C would likely increase disturbances within the 1-mile nest site buffer and certainly increase surface disturbances within 1 mile of riparian zones by 2023.

Table 4.19-1
Surface Disturbance in Relation to 1-Mile Buffer of Bald Eagle Habitats by Alternative

Bald Eagle Habitat Component	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
1 mile of Active Bald Eagle Nests	48.7	1.5	2.3	2.3	39.7	10.8
1 mile of New Fork River Riparian Zone	828.1	740.1	862.3	984.5	2,083.1	1,833.3
Forest-Dominated Riparian Vegetation	64.9	74.7	59.0	84.9	278.1	269.4

Bald eagles may have established communal winter roosts within forest-dominated riparian vegetation in or near the PAPA, although locations of communal roosts have not yet been firmly established. Depending on their locations, wellfield development during winter could be within the 1-mile forest-dominated riparian vegetation buffer during winter, November 1 through April 1, and constitute a "take" situation.

There are no records of bald eagles killed in the PAPA. Bald eagles have been killed by vehicles in the region during winter and at other times as they feed on roadside carrion (FWS, 1999). Some level of risk and direct impact to bald eagles may occur by winter traffic that would otherwise be absent with no winter drilling.

Black-footed Ferret. The FWS (2004a) determined that approximately 64 square miles of the PAPA (all or portions of Townships 29 North through 31 North, and Ranges 109 West through 111 West) are within the Big Piney Prairie Dog Complex in which surveys for black-footed ferrets are recommended. The remainder of the PAPA has been cleared for any further need to conduct surveys for black-footed ferrets (FWS, 2004a).

FWS concurred with BLM's determination for the PAPA DEIS (BLM, 1999a) that project activities were not likely to adversely affect black-footed ferrets. That concurrence was based on mitigating measures provided in the PAPA ROD (BLM, 2000b) including:

- examining construction sites prior to surface disturbance for presence of prairie dog colonies;
- avoiding disturbance to prairie dog colonies that meet criteria as suitable habitat for black-footed ferrets;
- if colonies can not be avoided, conducting surveys for black-footed ferrets; and
- if black-footed ferrets or signs are detected during surveys, immediately stopping all actions that may affect black-footed ferrets and reinitiating Section 7 review with FWS.

Vehicles have killed black-footed ferrets (records in Kinter and Martin, 1992). The North Anticline Road is within 0.5 mile of white-tailed prairie dog colonies that have not been exempted by FWS (Township 31 North, Range 109 West) from recommended surveys for black-footed ferrets (FWS, 2004a). Until surveys have been conducted, the colonies remain as potential habitat for black-footed ferrets. There is no evidence to suggest black-footed ferrets are or have been present in the colonies. If black-footed ferrets are present in the PAPA, there would be some risk of vehicle related mortality associated with all alternatives due to increased traffic above current levels. However, the risk of vehicle mortality or other sources to harm black-footed ferrets by any alternative is extremely minute, and probably non-existent.

Kendall Warm Springs Dace. This species is limited to habitat in the Bridger-Teton National Forest, approximately 30 miles north of Pinedale, and would not be affected by any of the alternatives.

Grizzly Bear. Suitable habitat is not present within the PAPA, and grizzly bears are not likely to occur in the area. Further, WGFD's policy is to limit grizzly bear occurrence outside of the occupancy area boundary established in the Wyoming Grizzly Bear Management Plan. The PAPA is not within the occupancy area boundary. None of the alternatives would affect grizzly bears.

Canada Lynx. Absence of montane, forested habitat precludes Canada lynx from occurring within the PAPA. Canada lynx would not be affected by any of the alternatives.

Ute Ladies'-tresses Orchid. This species has not been detected within the PAPA and available information indicates it is not present (Fertig, 2000). Further, there are no records of this

species' presence in southwest Wyoming. The species would not be affected by any of the alternatives.

Gray Wolf. Though occupied ranges of wolves introduced to Yellowstone National Park has expanded to include the region north and east of the PAPA, their presence in the PAPA is not expected. Wolves tend to avoid areas where human related activities occur (Paradiso and Nowak, 1982), although they have preyed on domestic livestock as well as elk at winter feedgrounds in the region. Wolves depredating on livestock in the PAPA would likely be subject to control actions (FWS et al., 2006). There is a remote possibility that wolves might prey on mule deer or pronghorn wintering in the PAPA. It is impossible to predict if wolves would pursue elk or other big game wintering in the PAPA. The gray wolf would not be affected by any of the alternatives.

Colorado River Fish. The FWS has determined that any withdrawal of water from the Colorado River System will jeopardize the following listed species: Colorado pikeminnow, humpback chub, bonytail, and razorback sucker, all of which may inhabit the Colorado River System downstream from the PAPA in the Green River, below Flaming Gorge dam.

Primary threats to the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker are stream flow regulation and habitat modification, including coldwater dam releases, habitat loss, and blocked migration corridors, as well as competition from nonnative fish species, pesticides, and pollution (FWS, 2002a, 2002b, and 2002c). Flow recommendations have been developed for some waters in the Upper Colorado River Basin. The recommendations were designed to enhance habitat complexity (i.e., suitable spawning areas and inundation of flood plain areas), and to restore and maintain ecological processes (i.e., sediment transport and food production) that are believed to be important for the life history and subsequent recovery of the endangered pikeminnow (FWS, 2002a, 2002b, and 2002c).

The Recovery and Implementation Program (RIP) for Endangered Fish Species in the Upper Colorado River Basin was established in 1988 to mitigate for water depletion impacts. Under the RIP, water depletions from tributary waters within the Colorado River Basin are considered to jeopardize the continued existence of these fish species. The provisions for the RIP were based upon appropriate legal protection of the in-stream flow needs of the endangered Colorado River fishes. To ensure the survival and recovery of listed fish species, any single incremental withdrawal of 100 acre-feet (annual average) or more would require the water user to make a payment to the RIP. The current depletion fee (as of October 2005) is $16.67/acre-foot. The fee would be applied to the average annual depletion from the Colorado River System, averaged over the life of the action. Water use and depletion includes evaporative loss and consumption of surface and groundwater within the Green River Basin.

For development within the PAPA, water would be withdrawn from the New Fork River for hydrostatic testing of trunk pipelines, gas and liquids gathering systems, and for dust control during pipeline construction. Groundwater supply wells provide drilling water on certain well locations; however, groundwater use in the PAPA is declining due to water re-use. The total water withdrawal and average annual depletion for each alternative is provided below, in Table 4.19-2. This water would be subject to the RIP for Endangered Colorado River fish and depletion fees may apply. Produced water from the PAPA, if surface discharged, would be returned to the Colorado River Basin. Although it would not be subject to depletion fees as it is produced, it may be considered as a contribution, and if so, there would be no net depletion associated with the project. The determination of effect to the Colorado River Fish species will be addressed in BLM's Biological Assessment for the project and by their Biological Opinion which will be prepared at the conclusion of consultation with BLM. It will be determined at that time if the project would be subject to the depletion fee.

Table 4.19-2
Estimated Surface and Groundwater Withdrawals in the PAPA subject to the Recovery and Implementation Program for Endangered Fish Species by Alternative

Water Use	Surface Water Withdrawal (acre-feet)				
	No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Surface Water Withdrawal Pipeline Hydrostatic Testing					
Gas gathering	2.5	2.2	2.16	2.8	2.89
Liquid gathering	0.16	2.5	2.5	3.1	3.1
30-inch Mesa loop	8.5	8.5	8.5	8.5	8.5
10-inch water trunk line	1.5	1.5	1.5	1.5	1.5
12-inch gas line	0.7	0.7	0.7	0.7	0.7
Liquid gathering trunk lines	0.0	0.20	0.20	0.20	0.20
Water redistribution lines	0.0	0.1	0.1	0.1	0.1
Pipeline interconnection	0.0	0.4	0.4	0.4	0.4
Surface Water Withdrawal Dust Control During Pipeline Construction	12.1	30.6	30.2	37.1	37.1
Groundwater Withdrawal	2,280	2,900	8,800	2,900	8,800
Total Depletion	2,292.1	2,930.6	2,930.6	8,830.2	8,830.2
Average Annual Depletion[1]	458.4	586.1	586.1	519.4	519.4
Average Annual Contribution[2]	705.7	705.7	705.7	705.7	705.7

[1] Average annual depletion based on 5 year development period for No Action Alternative and Proposed Action Alternative and Alternative C through 2011. Average annual depletion based on 17 year development period for Proposed Action Alternative and Alternative C through 2023.
[2] Based on 630,000 gallons per day (1.93 acre-feet per day) of surface discharge at Anticline Disposal Facility. This represents the permitted maximum allowable discharge. Discharge would begin in 2007.

Special Status Wildlife Species. Under all alternatives, additional surface disturbances within areas currently covered by native vegetation (especially the large areas of sagebrush steppe, desert shrub, and mixed grass prairie) are expected to indirectly impact some BLM Sensitive Species. Those species probably include: ferruginous hawks, mountain plovers, long-billed curlew, burrowing owls, sage thrasher, loggerhead shrike, grasshopper sparrow, Brewers sparrow, sage sparrow, pygmy rabbits, white-tailed prairie dogs, and spotted bats. These species have either been documented in the PAPA or their presence was judged to be possible in Chapter 3 (see Table 3.21-2). Merlins, fringed myotis, and long-eared myotis have either been documented as inhabitants or possibly inhabit forest-dominated riparian vegetation in the PAPA, and could be indirectly impacted by project related activities within the habitat. Likewise, surface disturbances in wetlands (and possibly irrigated croplands) could affect northern leopard frogs, western boreal toads, snowy egrets, white-faced ibis, and trumpeter swans. Adverse effects to surface water quality could indirectly impact roundtail chubs, bluehead suckers, and flannelmouth suckers, all of which are included as BLM Sensitive Species. Many of these species have special status as determined by WGFD (see Table 3.21-2). A comparison of the disturbance of habitats used by special status species by alternative is provided in Table 4.19-3.

Table 4.19-3
Surface Disturbance in Relation to Habitats used by
Special Status Wildlife Species by Alternative

Special Status Wildlife Species Habitat Component	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Sagebrush steppe	3,864.1	3,313.6	4,874.3	4,986.9	8,865.2	9,112.9
Mixed grass prairie	409.1	380.6	760.6	646.5	1,126.1	1,001.0
Greasewood flats	46.9	84.2	79.3	71.2	234.7	226.0
Desert shrub	286.5	261.3	596.1	453.1	938.0	978.7
Forest-dominated riparian	64.9	74.7	59.0	84.9	278.1	269.4
Wetland SRMZ	275.1	227.9	357.5	378.2	740.9	692.6
Hydrologic sub-watersheds	5,059.4	4,484.5	6,845.0	6,856.6	12,278.4	12,271.6

Pygmy rabbits inhabit the PAPA. They are active during winter, feeding almost entirely on sagebrush (Green and Flinders, 1980), and apparently have small home ranges (Green and Flinders, 1979). There is no information to indicate how the species responds to winter drilling but diminished habitat function is expected to occur within some distance from edges created by well pads, roads, pipelines, and other wellfield components within sagebrush habitats in the PAPA.

Vehicles have killed pygmy rabbits in the PAPA. The potential for such direct impact to pygmy rabbits by any of the alternatives is unknown but is expected to increase as traffic volumes increase under the Proposed Action Alternative and Alternative C.

The status of some of these special status wildlife species has been recently evaluated from data collected during annual wildlife monitoring studies prior to 2001. The area evaluated, termed the Pinedale Anticline Wildlife Study Area (PAWSA), included the PAPA and a 2-mile buffer beyond the PAPA boundary (Ecosystem Research Group, 2006).

There were 11,622 acres of prairie dog colonies within the PAWSA, mostly within sagebrush steppe, desert shrub and mixed grass prairie vegetation types. The majority of prairie dog colony areas (69 percent) in the PAWSA was found to be farther than 0.5 mile from the closest natural gas well (Ecosystem Research Group, 2006). However, 78 percent of the PAWSA was farther than 0.5 mile from the closest well and the data do not indicate that prairie dogs avoided wells, at least not within 0.5 mile.

Ferruginous hawks nest in the PAPA and within the PAWSA. Available data collected from 2003 through 2005 indicate that distance of active nests to wells varies from 1,179 feet to 17,958 feet, with an average distance of 5,873 feet. Similar analyses of distances from active burrowing owl nests to wells ranged from 379 feet to more than 27,300 feet, averaging 6,356 feet (Ecosystem Research Group, 2006). Because there are no data on nesting distributions for either species prior to wellfield development, the analysis of monitoring data developed for the PAWSA could not lead to any conclusions about effects of development on these special status species (Ecosystem Research Group, 2006). Tentative conclusions were that current NSO buffers surrounding nest sites that are stipulated by BLM on APDs extend far enough so that only the most tolerant individuals of each species nest within the current buffer distances from

well pads. Nest abandonment due to wellfield development by less tolerant individuals would be a direct impact to raptors.

Special Status Plant Species. Suitable habitat for BLM sensitive plant species would be identified prior to construction of new wellfield components. Surveys would be conducted to locate sensitive plant populations, and they would be avoided during construction or otherwise conserved. Special status plant species include meadow pussytoes, Trelease's racemose milkvetch, Cedar Rim thistle, large-fruited bladderpod, Beaver Rim phlox, and tufted twinpod. Of these species, large-fruited bladderpod has been documented in the Ross Butte and Blue Rim areas of the PAPA (Fertig, 1998), within portions of the Sensitive Soils SRMZ and desert shrub vegetation. In 1998, OHV use and surface disturbing activities (road construction) were judged to be the main threats to local sensitive plant populations. Within the Blue Rim Area of sensitive soils, 590 acres potentially will have been disturbed by wellfield development by the end of 2006, though effects by those disturbances to large-fruited bladderpod are unknown.

Pipeline Corridors and Gas Sales Pipelines

Federally Listed Species. Potential impacts to threatened and endangered species from pipeline construction would be similar to impacts from wellfield development within the PAPA.

Bald Eagle. Suitable habitats for bald eagle are present along the proposed pipeline corridors. Known nesting locations and potential roost sites are present near the BFGC and OPC pipeline corridors in forest-dominated riparian vegetation habitats along the Green River. Bald eagle surveys would be conducted prior to commencement of construction activities within suitable habitats. Increased traffic along the pipeline corridors during construction activities has the potential to cause direct mortality from vehicle collisions although pipeline construction is not expected to impact bald eagles.

Black-footed Ferret. Potentially suitable habitat for black-footed ferrets is present within and adjacent to the proposed pipeline corridors. Short-term disturbance to prairie dog colonies in the Moxa Prairie Dog Complex would likely occur as a result of pipeline construction activities. Direct loss of prairie dogs, the principal prey of black-footed ferrets, would likely result from blading, grading, and trenching activities. Despite potential impacts to prairie dogs and suitable habitats for black-footed ferrets, impacts to black-footed ferrets are not expected because recent surveys in the project area failed to locate black-footed ferrets. Furthermore, additional black-footed ferret surveys would be conducted in suitable habitats prior to construction activities. If black-footed ferrets are located within 0.5 mile of proposed activities, BLM would consult with FWS to determine necessary conservation measures. These measures would ensure that pipeline construction would not adversely affect black-footed ferrets.

Kendall Warm Springs Dace. This species is limited to habitat in the Bridger-Teton National Forest, approximately 30 miles north of Pinedale, and would not be affected by construction of the pipelines.

Grizzly Bear. Grizzly bears are not likely to occur in the area of the proposed corridors. Pipeline construction would not affect grizzly bears.

Canada Lynx. Absence of montane, forested habitat precludes Canada lynx from occurring within the pipeline corridors. Canada lynx would not be affected by construction of the pipelines.

Ute Ladies'-tresses Orchid. This species has not been detected within the proposed pipeline corridors or within southwest Wyoming. Impacts to wetland habitats would be mostly avoided because rivers would be crossed by HDD construction techniques. Ute ladies'-tresses orchid are not expected to be impacted by pipeline construction.

Colorado River Fish. Water withdrawals required for hydrostatic testing and dust control during construction would be subject to the RIP for Endangered Colorado River fish. Approximately 132.1 acre-feet would be required during construction of the R6 pipeline, and approximately 113.0 acre-feet would be required during construction of the PBC and Opal Loop III pipelines (see Appendix D for specifics on water withdrawals associated with gas sales pipeline construction). The hydrostatic test water would be discharged within the Colorado River Basin, and therefore, actual depletion would be minor. The determination of effect to the Colorado River Fish species will be addressed in BLM's Biological Assessment for the project, and after consultation with the FWS, the FWS will issue a Biological Opinion. It will be determined at that time if the project would be subject to the depletion fee.

Special Status Wildlife Species. Potential impacts to BLM Sensitive Species from pipeline construction would be similar to impacts from wellfield development within the PAPA. The following sensitive species, or suitable habitats for these species, have been identified within or adjacent to the proposed pipeline corridors: ferruginous hawk, mountain plover, long-billed curlew, burrowing owl, sage thrasher, loggerhead shrike, grasshopper sparrow, Brewers sparrow, sage sparrow, pygmy rabbit, and white-tailed prairie dog. Long-billed curlew, sage thrasher, loggerhead shrike, grasshopper sparrow, Brewers sparrow, and sage sparrow are addressed under migratory birds in Section 4.20.3.1.

Pygmy rabbits and suitable habitats are present within and along much of the proposed pipeline corridors. Construction activities within these habitats would likely displace individuals. Ground disturbing activities have the potential to cause direct mortality of individuals but would not be likely to directly impact pygmy rabbit populations.

Prairie dog colonies associated with the Moxa Prairie Dog Complex are present within and adjacent to the proposed pipeline corridors. The species is known to colonize disturbed areas and has demonstrated an affinity towards the existing adjacent pipeline corridors. Impacts to prairie dogs from pipeline construction would likely include direct mortality of individuals, short-term disturbance and removal of habitat, and short-term reduction in forage for the species. These adverse impacts are anticipated to be short-term. Potentially beneficial long-term impacts may result from pipeline construction activities. These beneficial impacts would include improvements to forage from transitioning vegetative species composition from shrub dominance to reclamation grasses, and facilitating easier burrow development along the reclaimed pipeline right-of-way and other disturbed areas. Adverse impacts to prairie dogs would be minor and short-term.

Mountain plover habitat is present along the proposed pipeline corridors. Construction activities in these areas would be avoided during the plover nesting season between May 1 and July 15. Pipeline construction outside of this period is not likely to have adverse impacts on mountain plover due to the species' preference for disturbed ground and low vegetation.

Potential impacts to ferruginous hawk and burrowing owls are discussed above, in Section 4.19.3.1 (see discussion under Natural Gas Development within the PAPA).

Special Status Plant Species. Potential impacts to BLM sensitive plant species from pipeline construction would be similar to impacts from wellfield development within the PAPA. None of the special status plant species identified in Chapter 3 (see Table 3.21-4) are expected along any of the proposed corridor/pipeline alignments. Though unlikely, Nelson's milkvetch could occur within alkaline clay flats, shale bluffs and gullies, pebbly slopes, sparsely vegetated sagebrush and would be associated with cushion plant communities. Also, persistent sepal yellowcress, a species generally associated with sandy, muddy stream banks, stockponds, and reservoirs, could be directly impacted during pipeline construction. Once surveys for these and other special status plant species are complete, BLM would determine if any would be affected.

4.19.3.2 Alternative A (No Action Alternative)

Federally Listed Species. The only federally listed species likely to be affected by the No Action Alternative is the bald eagle. Under this alternative, an additional 1.5 acres of disturbance is expected within 1 mile of an existing (as of 2006) active bald eagle nest (Table 4.19-1). Approximately 740 acres of disturbance is expected within the 1-mile buffer of the New Fork River riparian zone, of which approximately 75 acres would be within forest-dominated riparian vegetation (Table 4.19-1).

It is estimated that 2,292.08 acre-feet of water subject to the RIP for Endangered Fish Species in the Colorado River Basin would be used for hydrostatic testing, drilling and completions, and dust control over the 5-year development period under the No Action Alternative (Table 4.19-2). This results in an average annual depletion of 458.42 acre-feet of water over the 5-year development period.

Special Status Wildlife Species. The No Action Alternative would disturb a variety of habitats utilized by BLM sensitive species (BLM, 2002) that were described above under Special Status Wildlife Species in Section 4.19.3.1 – Summary of Impacts Common to All Alternatives. Expected area disturbance in habitats used by these species is shown above in Table 4.19-3.

Special Status Plant Species. The No Action Alternative is likely to affect 538 additional acres within the Blue Rim Area of sensitive soils, some of which may provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

4.19.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Federally-Listed Species. Similar to the No Action Alternative, the only federally listed species likely to be affected by the Proposed Action Alternative through 2011 is the bald eagle. Only 2 acres of new surface disturbance are expected within 1 mile of an existing (in 2006) active bald eagle nest (Table 4.19-1). Approximately 860 acres of new disturbance is expected within the 1-mile buffer of the New Fork River riparian zone, of which approximately 124 acres would be within forest-dominated riparian vegetation (Table 4.19-1).

It is estimated that 2,930.6 acre-feet of water subject to the RIP for Endangered Fish Species in the Colorado River Basin would be used for hydrostatic testing, drilling and completions, and dust control over the 5-year development period under the Proposed Action Alternative through 2011 (Table 4.19-2). This results in an average annual depletion of 586.1 acre-feet of water over the 5-year development period.

Special Status Wildlife Species. The Proposed Action Alternative through 2011 would disturb a variety of habitats utilized by BLM sensitive species (BLM, 2002) that were described above under Special Status Wildlife Species in Section 4.19.3.1 – Summary of Impacts Common to All Alternatives. Expected area disturbance in habitats used by these species is shown above in Table 4.19-3.

Special Status Plant Species. The Proposed Action Alternative through 2011 is likely to affect nearly 1,000 additional acres within the Blue Rim Area of sensitive soils (Table 4.15-1), some of which is likely to provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

Proposed Action Alternative Through 2023

Federally-Listed Species. By 2023, the conclusion of wellfield developments under the Proposed Action Alternative, 40 acres of new surface disturbances are expected within 1 mile of any existing (in 2006) active bald eagle nest (Table 4.19-1). Approximately 2,100 acres of new

disturbance is expected within 1 mile of the New Fork River riparian zone, of which approximately 340 acres would be within forest-dominated riparian vegetation.

It is estimated that 8,830.2 acre-feet of water subject to the RIP for Endangered Fish Species in the Colorado River Basin would be used for hydrostatic testing, drilling and completions, and dust control over the 17-year development period under the Proposed Action Alternative through 2011 (Table 4.19-2). This results in an average annual depletion of 519.4 acre-feet of water over the 17-year development period.

Special Status Wildlife Species. The Proposed Action Alternative through 2011 would disturb a variety of habitats utilized by BLM sensitive species (BLM, 2002) that were described above under Special Status Wildlife Species in Section 4.19.3.1 – Summary of Impacts Common to All Alternatives. Expected area disturbance in habitats used by these species is shown above in Table 4.19-3.

Special Status Plant Species. By 2023, the Proposed Action Alternative is likely to have affected nearly 1,500 acres total since 2006 within the Blue Rim Area of sensitive soils (Table 4-15-1), some of which may provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

4.19.3.4 Alternative C

Alternative C Through 2011

Federally-Listed Species. Similar to the No Action and Proposed Action alternatives, the only federally listed species likely to be affected by Alternative C through 2011 is the bald eagle. Only 2 acres of new surface disturbances are expected within 1 mile of any existing (as of 2006) active bald eagle nest (Table 4.19-1). Approximately 980 acres of new disturbance is expected within the 1-mile buffer of the New Fork River riparian zone (Table 4.19-1), of which 150 acres would be forest-dominated riparian vegetation.

It is estimated that 2,930.6 acre-feet of water subject to the RIP for Endangered Fish Species in the Colorado River Basin would be used for hydrostatic testing, drilling and completions, and dust control over the 5-year development period under Alternative C through 2011 (Table 4.19-2). This results in an average annual depletion of 586.1 acre-feet of water over the 5-year development period.

Special Status Wildlife Species. The Proposed Action Alternative through 2011 would disturb a variety of habitats utilized by BLM sensitive species (BLM, 2002) that were described above under Special Status Wildlife Species in Section 4.19.3.1 – Summary of Impacts Common to All Alternatives. Expected area disturbance in habitats used by these species is shown above in Table 4.19-3.

Special Status Plant Species. Alternative C is likely to affect more than 700 additional acres within the Blue Rim Area of sensitive soils (Table 4.15-1), some of which is likely to provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

Alternative C Through 2023

Federally-Listed Species. By 2023 and the conclusion of wellfield developments under Alternative C, 11 acres of new surface disturbances are expected within 1 mile of any existing (in 2006) active bald eagle nest (Table 4.19-1). Approximately 1,800 acres of new disturbance is expected within the 1-mile buffer of the New Fork River riparian zone (Table 4.19-1), of which 330 acres is expected to be forest-dominated riparian vegetation (Table 4.19-1).

It is estimated that 8,830.2 acre-feet of water subject to the RIP for Endangered Fish Species in the Colorado River Basin would be used for hydrostatic testing, drilling and completions, and dust control over the 17-year development period under Alternative C through 2023 (Table 4.19-2). This results in an average annual depletion of 519.4 acre-feet of water over the 17-year development period.

Special Status Wildlife Species. The Proposed Action Alternative through 2011 would disturb a variety of habitats utilized by BLM sensitive species (BLM, 2002) that were described above under Special Status Wildlife Species in Section 4.19.3.1 – Summary of Impacts Common to All Alternatives. Expected area disturbance in habitats used by these species is shown above in Table 4.19-3.

Special Status Plant Species. By 2023, Alternative C is likely to have affected more than 1,400 acres total since 2006 within the Blue Rim Area of sensitive soils (Table 4.15-1), some of which is likely to provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

4.19.4 Cumulative Impacts

Federally Listed Species. The only federally listed species likely to be affected by cumulative impacts due to past, present and foreseeable future wellfield development in the PAPA is the bald eagle. The CIAA related to bald eagles includes the area administered by the BLM's PFO. Throughout the species' range in the conterminous United States, bald eagles have been adversely affected by human related direct mortality (shooting, poisoning including by pesticide residues, electrocution, collisions with vehicles, wind turbines, and powerlines), and human disturbances that interrupt reproduction and survival of young (FWS, 1999). Within the area managed by the BLM PFO, principal threats to bald eagle nesting habitat were judged to be from recreation and livestock grazing. Likewise, livestock grazing had been the principal land use near potential wintering habitats along the New Fork and Green rivers The river corridors supported concentrated foraging habitats and, though mostly on private lands, livestock grazing was the predominant land use (BLM, 2003d).

Cumulative impact analysis to bald eagle habitats in the PAPA is based on past, present, and future levels of surface disturbances shown in Table 4.19-4. Existing non-wellfield disturbance within 1 mile of existing bald eagle nest sites and within 1 mile of the New Fork River riparian zone appear substantial, but are mainly due to irrigated and non-irrigated croplands in those areas of the PAPA. Roads, residential developments, and some urban infrastructure (e.g., Wenz Field) have contributed to past disturbances within those bald eagle habitats. Only minor non-wellfield disturbance has occurred in forest-dominated riparian vegetation, primarily from construction of roads and residences. By the end of 2006, disturbances to each of the three areas by existing wellfield developments are relatively minor. However, surface disturbances within the 1-mile buffer of the New Fork River riparian zone has been subject to the most wellfield development of the three areas (Table 4.19-4).

Implementation of any of the alternatives would generate considerable cumulative disturbances to bald eagle habitats, even if existing non-wellfield disturbance is ignored, as shown in Table 4.19-4. Through 2011, each of the alternatives would cumulatively affect somewhat similar areas within 1 mile of nests, 1 mile of the New Fork River riparian zone, and within forested-dominated riparian vegetation. Compared to the No Action Alternative through 2011, there would be more cumulative impact by the Proposed Action Alternative and Alternative C to bald eagle habitats by 2023 (Table 4.19-4). Cumulative impact to bald eagle habitats under the Proposed Action Alternative through 2023 would be similar to that under Alternative C through 2023.

Table 4.19-4
Cumulative Surface Disturbance in Relation to 1-Mile Buffer of Bald Eagle Habitats by Alternative

Bald Eagle Habitat Component	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
1 mile of Active Bald Eagle Nests	921.5	48.7	971.7	972.5	972.5	1,009.9	981.0
1 mile of New Fork River Riparian Zone	4,589.7	828.1	6,238.7	6,360.9	6,483.1	7,581.7	7,331.9
Forest Dominated Riparian Vegetation	15.4	64.9	162.3	146.6	172.5	365.7	357.0

Water withdrawals from the Colorado River Basin by other projects have contributed and will continue to contribute cumulative impacts to endangered Colorado River fish species. As noted above, withdrawals of 100 acre-feet or more from any project would be subject to payments under the RIP for Endangered Colorado River fish.

Special Status Wildlife Species. Implementation of any of the alternatives would result in cumulative disturbance to a variety of habitats utilized by BLM sensitive species (Table 4.19-5). These were described above under Special Status Wildlife Species in Section 4.19.3.1 – Summary of Impacts Common to All Alternatives. Existing non-wellfield disturbances to those habitats were addressed in earlier sections of this chapter.

Table 4.19-5
Cumulative Disturbance in Relation to Habitats
used by Special Status Wildlife Species by Alternative

Special Status Wildlife Species Habitat Component	Existing Non Wellfield Disturbance (acres)	Estimated Existing Wellfield Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Sagebrush steppe	963.5	3,864.1	8,435.3	9,996.0	10,108.6	13,986.9	14,234.6
Mixed grass prairie	35.3	409.1	859.4	1,239.4	1,125.3	1,604.9	1,479.8
Greasewood flats	18.2	46.9	149.3	144.4	136.3	299.8	291.1
Desert Shrub	27.4	286.5	639.5	974.3	831.3	1,316.2	1,356.9
Forest-dominated riparian	15.4	64.9	162.3	146.6	172.5	365.7	357.0
Wetland SRMZ	2,444.7	275.1	2,968.5	3,098.1	3,118.8	3,481.5	3,433.2
Hydrologic sub-watersheds	**7,466.9**	**5,059.4**	**17,437.1**	**19,797.6**	**19,809.2**	**25,231.0**	**25,224.2**

Through 2011, each of the alternatives would cumulatively affect similar areas within most habitats utilized by special status species. However, cumulative impact to sagebrush steppe and mixed grass prairie by the Proposed Action Alternative and Alternative C would exceed cumulative disturbance by the No Action Alternative. Compared to the No Action Alternative

however, there would be far more cumulative impact by the Proposed Action and Alternative C to all sensitive species' habitats by 2023.

Special Status Plant Species. Cumulative impacts by the Proposed Action and Alternative C are likely to affect areas than the No Action Alternative within the Blue Rim Area of sensitive soils by 2011 (see Table 4.15-2). Compared to the No Action Alternative however, there would be more cumulative impact by the Proposed Action and Alternative C to habitats in the Blue Rim Area by 2023, some of which may provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

4.19.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to threatened, endangered, and special status species would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.20 WILDLIFE AND AQUATIC RESOURCES

4.20.1 Scoping Issues

The following concerns related to wildlife and aquatic resources were received during public scoping:

1. Document how the operators' proposal, including removal of seasonal stipulations, would provide compensation and/or protection for mule deer, pronghorn, and greater sage-grouse at least equal to enforcing those stipulations.
2. Concern that winter drilling will contribute to declines in mule deer, pronghorn, and greater sage-grouse populations as a result of lost habitat, ineffective habitat, roadkills, and/or disease.
3. Continue and/or expand existing wildlife studies while making data and study results available to the public.
4. BLM should consider short-term impacts (5 to 20 years) to wildlife (mule deer, pronghorn and greater sage-grouse) and their habitats as well as long-term impacts.
5. Address any deviations from the Wyoming Game and Fish Department's "*Minimum Recommendations for Development of Oil and Gas Resources Within Crucial and Important Wildlife Habitats on BLM Lands*."
6. BLM should consider off-site mitigation strategies in the region, beyond the agency's administrative boundaries (including reducing impact on big game summer range and restricting development on undeveloped or suspended oil and gas leases), to offset impact to wildlife in the PAPA and potential conflicts with people and other wildlife by off-site mitigation.
7. BLM should ensure that some portion of the PAPA remains unfragmented and undisturbed.

8. BLM should monitor the implementation and effectiveness of applicant-committed mitigation measures and effects of current development over the long-term to allow for better management of continued and future development.

4.20.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS (BLM, 1999a), BLM considered direct and indirect impacts to wildlife as explicitly related to wellfield development in the PAPA. Direct impacts include:

- mortality from wildlife-vehicle collisions on or off the PAPA;
- mortality during road, pipeline and well pad construction and other surface-disturbing actions;
- mortality due to consumption of, or exposure to, toxic compounds; and
- interruption or interference with life history functions including courtship, nesting and parturition, migration, and winter survival.

Potential indirect impacts to wildlife considered in the PAPA DEIS included:

- fragmentation of connected habitats;
- removal of vegetation and other features, such as rock outcrops, that provide habitat;
- degradation of terrestrial habitats from erosion and introduction of nonnative vegetation;
- degradation of aquatic habitats due to altering stream banks, siltation, and decreased water quality;
- loss of forage for herbivores; and
- diminished animal use of habitats due to effects of noise, dust, emissions, and human presence.

Anticipated direct and/or primary impacts to wildlife include all effects directly related to the alternatives (Anderson, 1985 and Comer, 1982). Primary impacts can result from disturbance and/or wildlife mortality and/or disturbance that interferes with requisite life-history functions (e.g., feeding, reproduction) during wellfield development and operation.

Indirect impacts may also be primary impacts because they are related to, but removed from, an action by an intermediate step or process. For wildlife, indirect impacts are often associated with alteration, elimination, or degradation of habitats. Indirect effects may result from induced changes to wildlife habitats, principally by conversion of one vegetation cover type to another or by fragmentation of existing wildlife habitats. Indirect impact to habitats decreases their functional capacity to support wildlife populations at non-impacted levels.

Alternatively, indirect impact may be a secondary, rather than primary, effect of the project or alternative. Secondary impacts of a project on wildlife most commonly follow an increased human population base and increased access, either as a result of the requirements of the action itself (the workforce needed to construct or operate the project) or as a consequence of the action (need for ancillary goods, services, or opportunities resulting from the project). Potential secondary effects of a project often are associated with increased recreation demand including hunting or OHV use, habitat degradation by human encroachment, and increased illegal harvest (Anderson, 1985; Comer, 1982).

For some species direct impacts are expected to be interrelated, such as the effects of habitat fragmentation on interference with life history functions. There will probably be indirect or secondary impacts that ensue with increased human presence and/or increased human use

(access) of an area. Direct impacts could occur during the project and after, but are functionally related to secondary impacts. Secondary impacts would not occur without the project. Once initiated though, secondary impacts may continue well beyond the project and may further develop independently of the project. While the effects of secondary impacts on wildlife may be the same as primary, direct impacts, BLM identified that potential sources of those impacts vary and include:

- increased recreation, especially off-highway vehicles;
- increased habitat conversion, especially urban/suburban sprawl;
- habitat degradation by human encroachment;
- increased noise, air, and water pollution;
- increased game poaching;
- increased wildlife road kills; and
- increased harassment of wildlife by uncontrolled pets, especially dogs.

BLM considered that impacts to wildlife would be significant if any of the following occurred as a direct or indirect result of development in the PAPA:

- increased mortality and/or decreased survival of native wildlife species considered as Vital, High, or Moderate by the WGFD Mitigation Policy;
- loss of habitat function and/or habitat value for habitats classified as Vital or High by the WGFD Mitigation Policy; or
- net loss of habitat value with alterations in habitat function for habitats classified as Moderate by the WGFD Mitigation Policy.

Based on these criteria, significant impacts were predicted for a number of wildlife species by the PAPA DEIS (BLM, 1999a). Evidence collected since the PAPA DEIS has shown that the functions of some wildlife habitats, those classified as “vital” or “high value” by WGFD, have declined as wellfield developments have progressed. Such evidence has been based on species’ use of habitats before and after development. In other cases, species’ use of habitats proximate to disturbance has declined whereas use of habitats farther away from disturbance has not. Diminished habitat function is a significant indirect impact that may ultimately directly affect wildlife populations through increased mortality and/or decreased births (fecundity). Such direct impact though, has not yet been conclusively demonstrated.

4.20.3 Alternative Impacts

4.20.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development within the PAPA

Since issuance of the PAPA DEIS (BLM, 1999a), many of the impacts to wildlife that were predicted have been substantiated by wildlife studies conducted cooperatively by the Operators, BLM, WGFD, and the University of Wyoming. Impacts resulting from removal of vegetation are discussed in other sections in this chapter, including Surface Water (Section 4.14), Vegetation (Section 4.16), and Wetlands (Section 4.18).

Habitat Fragmentation and Effectiveness. Fragmentation of connected habitats by wellfield development was predicted in the PAPA DEIS (BLM, 1999a) and concern about fragmented habitat in the PAPA was indicated during public scoping for this Draft SEIS. Fragmentation refers to breaking up contiguous areas of vegetation/habitat into smaller patches that become

progressively smaller and isolated over time (Forman, 1995). Among other effects, fragmentation of habitat allows predator access to breeding sites used by birds along newly created corridors and through edges of habitats that were previously continuous. Habitat fragmentation contributes to higher rates of nest predation in grasslands (Burger et al., 1994; Vickery et al., 1994) and at habitat edges (Gates and Gysel, 1978; Marini et al., 1995).

Measures of habitat fragmentation projected by the end of 2006, and estimated for each of the alternatives, are provided in Table 4.20-1. Well pad numbers provide some indication of the number of disturbed patches within otherwise contiguous vegetation or habitat; more disturbed patches indicate more fragmentation. By this measure (the number of well pads), the No Action Alternative would create more fragmentation than the other alternatives by 2011 with a total of 245 new well pads. Under the Proposed Action Alternative and Alternative C through 2011, 179 new well pads would be constructed. Habitat fragmentation would be similar under the Proposed Action Alternative and Alternative C through 2011. By 2023, the Proposed Action Alternative and Alternative C would each have 250 new well pads (Table 4.20-1). Therefore, habitat fragmentation would be similar under these two alternatives by 2023.

Each well pad could be considered as a patch of altered or unusable wildlife habitat. In 2006, the average size of well pads was approximately 7 acres (Table 4.20-1). Due to increased size of new well pads and expansion of existing pads, the average patch area would increase to 8 acres for pads developed under the No Action Alternative and to 11 acres for pads developed through 2011 under the Proposed Action and Alternative C. Additional construction of new pads and further expansion of existing pads through 2023 under the Proposed Action and Alternative C would lead to average well pad patches of nearly 18 acres (Table 4.20-1). Fragmentation due to the patchiness of altered or unusable wildlife habitat within undisturbed vegetation would be most extensive under the Proposed Action Alternative and Alternative C by 2023.

Another measure of fragmentation is the amount of edge created by wellfield development. In the context of habitat fragmentation, edge is the portion of habitat (or ecosystem on a larger scale) "*near its perimeter, where influences of the surroundings prevent development of interior environmental conditions*" (Forman, 1995). An estimate of the perimeter of each existing pad, new pad, and expansion pad was derived from the pad areas. Well pad perimeters were computed as the average of a circular well pad (circumference) and a square (a conservative estimate because most pads are rectangular and perimeters of rectangles can greatly exceed those of circles and squares with the same areas). The estimated total perimeter for the 348 existing well pads projected by the end of 2006 is 134 miles. Roads and pipelines also create edges when constructed through undisturbed habitat. An indication of fragmentation is the total length of wellfield roads and pipelines in Table 4.20-1, a measure that does not include each side of a road or pipeline corridor nor does it include possible co-locations of multiple pipeline corridors or pipelines located directly adjacent to roads. There is no way to anticipate future contiguity of these linear elements. By the end of 2006, a total of 369 miles of edge from roads and pipelines, combined is expected within the PAPA. When added to total well pad perimeters, there would be an estimated 503 miles of edge in the PAPA by the end of 2006 (Table 4.20-1).

The amount of edge length would increase under each of the alternatives. There is less total edge length for the No Action Alternative than under either of the other two alternatives by 2011. This is because the liquids gathering system included in the Proposed Action Alternative for the central and southern portions of the PAPA would not be installed under the No Action Alternative. Substantial edge length would be associated with the proposed liquids gathering system. The amount of edge length created under Alternative C would be similar to the edge length created under the Proposed Action Alternative by 2011 and through 2023.

Table 4.20-1
Potential Edge Length Indicative of Fragmentation by Alternative

Wellfield Component	Well Pads and Estimated Existing Edge Length by the end of 2006	Additional Well Pads and Potential Edge Length (miles) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Total Well Pad Number	348	245	179	179	250	250
Well Pad Size (acres)	7.0	8.4	11.1	11.1	17.6	17.6
Well Pad Perimeter (miles)	133.6	104.3	111.3	111.9	221.7	222.5
Road Length[1] (miles)	215.2	108.0	88.7	89.3	120.8	120.8
Pipeline Length [2] (miles)	154.2	149.7	382.7	383.8	474.0	472.9
Total Edge Length (miles)	**503.0**	**362.0**	**582.7**	**585.0**	**816.5**	**816.2**

[1] Includes all new roads (local and resource) in the PAPA.
[2] Includes all new pipelines (gas gathering, liquids gathering, and trunk pipelines) in the PAPA.

Habitat Function. Since the PAPA DEIS, WGFD (2004b) developed guidance relevant to current and future natural gas development in the PAPA, *Recommendations for Development of Oil and Gas Resources Within Crucial and Important Wildlife Habitats*, in which evaluation of impact by varying levels of oil and gas development is related to the function of wildlife habitats. Habitat function is defined (WGFD, 2004b) as "*the arrangement of habitat features, and the features' capability to sustain species, populations, and diversity of wildlife over time*." Impacts that decrease habitat function render the habitat less effective. As the effectiveness and ultimately the function of the habitat is diminished, a species' or population's use of the habitat is expected to diminish as a direct or indirect result of the impact.

WGFD (see 2004b) identified vital wildlife habitats for which they recommend no loss of habitat function, although, "*some modification of habitat characteristic can take place*." The vital wildlife habitats include big game crucial winter ranges, greater sage-grouse habitats (leks, nesting and brood-rearing complexes, winter habitat), raptor nesting habitats, and habitats used by native species with NSS1 and NSS2 status (Table 3.21-2).

All of the vital habitats for big game, greater sage-grouse, raptors, and a few high priority native species are in the PAPA. WGFD also defined high value habitats (big game parturition areas, riparian habitats, habitats of NSS3 species) for which WGFD recommends no loss of habitat function within the biological community that encompasses the project impact site. Impact to high value habitat can be mitigated within the affected biological community (WGFD, 2004b). Though no specific big game parturition areas have been identified in the PAPA, other high value habitats are present including riparian habitats and habitats utilized by NSS3 species (for example pygmy rabbits, ferruginous hawks, white-tailed prairie dogs, and merlins). As discussed below under specific wildlife species, the function of some vital and high value habitats in the PAPA has diminished as wellfield development has progressed.

Big Game.

Pronghorn. Wellfield development in the PAPA has led to surface disturbance within pronghorn seasonal habitats, including crucial winter ranges (Table 4.20-2). Surface disturbance in crucial

pronghorn winter range would increase under each of the alternatives (Table 4.20-2). Compared to the No Action Alternative, the Proposed Action Alternative and Alternative C would result in more disturbance to pronghorn crucial winter range through 2011, although disturbance would be similar under the two alternatives. Surface disturbance under the Proposed Action Alternative and Alternative C would be similar through 2023. Effects to noncrucial pronghorn spring/summer/fall ranges in the PAPA have been substantial and would continue with increased disturbance under all of the alternatives by 2011 and through 2023.

Table 4.20-2
Surface Disturbance in Relation to Pronghorn Seasonal Ranges by Alternative

Pronghorn Seasonal Ranges	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Crucial Winter Range SRMZ	1,619.0	1,534.1	2,460.1	2,611.9	4,371.1	4,179.2
Spring/Summer/Fall Range	3,440.5	2,950.4	4,384.9	4,244.7	7,907.3	8,092.4
Winter Range	0.0	0.0	0.0	0.0	0.0	0.0
Total	**5,059.4**	**4,484.5**	**6,845.0**	**6,856.6**	**12,278.4**	**12,271.6**

There has been direct impact (area of lost habitat) to pronghorn habitats, at least until revegetation of disturbed surface is successful. Also, pronghorn utilizing crucial winter range generally avoid areas where wellfield development is concentrated (Berger et al., 2006), an example of decreased habitat function even though vegetation has not been physically removed. The ongoing study, by Berger et al. (2006), included the PAPA and the Jonah Field Project Area. After the first year of the study, none of the study animals utilized the Jonah Field Project Area. Analyses of preliminary results indicate that habitat patches of less than about 600 acres are under-utilized or abandoned by wintering pronghorn (Berger et al., 2006). If future study results are similar, increased surface disturbance on crucial winter range that lead to habitat patchiness would likely contribute to diminished effectiveness and lost function of pronghorn habitats in the PAPA under all of the alternatives. Lost habitat and diminishing habitat function may eventually lead to population declines but such demographic response to impact is most likely after some time has elapsed.

Under the Proposed Action Alternative and Alternative C, a liquid gathering system would be installed in the central and southern portions of the PAPA, connecting most producing wells with 2 years of issuance of the ROD. The liquids gathering system would not be installed under the No Action Alternative. Liquids gathering systems reduce daily traffic to producing wells year-round. Decreased traffic as a result of the liquids gathering system would benefit wintering big game, including pronghorn, but is not expected to compensate for traffic associated with wellfield development (drilling and completions) and specifically, traffic during winter with year-round drilling. Once wellfield development is complete and traffic is only related to production, there would be a large decrease in wellfield traffic. Wellfield development during winter would reduce habitat effectiveness under all alternatives.

Mule Deer. Mule deer habitat in the PAPA has been directly impacted by surface disturbance. Approximately 58 percent of existing disturbance in the PAPA is within crucial mule deer winter range (Table 4.20-3). Year-round drilling would be allowed in crucial winter range under the

Proposed Action Alternative and Alternative C, whereas it would not occur in crucial winter range under the No Action Alternative. The estimated surface disturbance to crucial winter range under the Proposed Action Alternative and Alternative C. through 2011 will likely increase existing disturbance by more than 2,000 acres, roughly twice the estimated surface disturbance anticipated under the No Action Alternative (Table 4.20-3). By 2023, existing disturbance within mule deer crucial winter range is expected to increase by about 3,500 acres under the Proposed Action Alternative and Alternative C.

Mule deer in the Sublette Herd Unit, including those inhabiting winter ranges in the PAPA, have been intensively studied since 1998. Phase II of the Sublette Mule Deer Study has been in progress since 2002, continuing as wellfield development progresses. Available information, since 2002, indicates that the mule deer population on the Pinedale Mesa steadily declined from more than 5,000 animals in 2002 to less than 3,000 animals in 2004-2005 (Sawyer et al., 2005a). Mule deer abundance during winter 2005-2006 was nearly the same as for the previous winter (Sawyer, 2006). Mule deer abundance in the Pinedale Front control area showed no similar trend.

Table 4.20-3
Surface Disturbance in Relation to Mule Deer Seasonal Ranges by Alternative

Mule Deer Seasonal Ranges	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Crucial Winter Range SRMZ	1,518.8	1,090.5	2,213.7	2,097.7	3,587.8	3,411.4
Spring/Summer/Fall Range	59.6	0.0	0.0	0.0	0.0	0.0
Winter Range	1,011.6	1,093.8	1,669.2	1,823.9	2,818.2	2,323.8
Winter/Yearlong Range	27.7	0.0	0.0	0.0	0.0	0.0
Total	**2,617.7**	**2,184.3**	**3,882.9**	**3,921.6**	**6,406.0**	**5,735.2**

Since issuance of the PAPA ROD (BLM, 2000b), direct loss of habitat has increased annually within mule deer crucial and noncrucial winter ranges in the PAPA and would continue under each alternative (Table 4.20-3). Another aspect of the Sublette Mule Deer Study has focused on distribution of wintering mule deer prior to and since wellfield development on the Mesa. Only 60 percent of mule deer habitats that were classified as high-use areas before development in 2000 were classified as high-use areas in the first year since the PAPA ROD. In the second year of development, only 49 percent of the predevelopment high-use areas were classified as high-use. By the third year of development, only 37 percent of initial high-use areas were classified as high-use areas (Sawyer et al., 2006).

Winter 2003-2004, the fourth year of the study, was more severe than the previous three winters. Although mule deer abundance further declined on the Mesa, the remaining deer inhabiting the PAPA during winter 2003-2004 were closer to wellfield development than in the previous 3 years. Seventy-seven percent of the predevelopment high-use areas were highly used, though by fewer deer (Sawyer et al., 2005a). It appears that mule deer utilizing winter range in 2003-2004 may have been more tolerant of wellfield development, at least when severe winter conditions rendered habitats near wellfield development apparently more suitable than habitats farther away. Winter conditions in 2004-2005 were mild and mule deer once again

were distributed farther from well pads and roads than during the previous severe winter, highly used mule deer habitats included only 52 percent of predevelopment high-use areas (Madson, 2006). The study has shown that crucial winter ranges in the PAPA are less effective than they were before wellfield development and some level of habitat function has been lost. Further loss of habitat effectiveness and habitat function may continue as more development occurs under each of the alternatives.

Mule deer in the PAPA avoid roads with different levels of traffic. During winter 2005-2006, deer distances from roads with very high traffic volumes (263 to 350 vehicles/day) averaged about 4 miles. Distances of deer from roads with high volumes (77 to 152 vehicles/day) averaged 2.9 miles; distances from roads with medium volume (19 to 30 vehicles/day) averaged 1 mile; and distances from closed or low use roads (0 to 12 vehicles/day) averaged 0.5 mile. Deer distances to well pads with liquids gathering systems averaged 1.5 miles, while distances to pads without a liquids gathering system averaged more than 3 miles (Sawyer, 2006). These data show the negative effects of traffic on wintering mule deer distribution but also the benefits of a liquid gathering system. Under the Proposed Action Alternative and Alternative C through 2011, winter traffic would increase above existing levels with year-round drilling. Even though both of these alternatives would have a liquid gathering system and the No Action Alternative would not, winter traffic would still be increased over levels for the No Action Alternative due to the increase in traffic related to drilling and completions.

Mule deer avoidance of roads with very high and high traffic volume would likely become more extensive throughout the crucial winter range as roads with higher traffic volumes proliferate. Mule deer would avoid habitats adjacent to roads with higher traffic volumes by up to 3 or 4 miles under all alternatives. Crucial winter habitat in all areas adjacent to wellfield development, especially habitats proximate to well drilling locations and roads with high traffic volume, would remain ineffective as mule deer habitat for the duration of wellfield development. Once all wells are productive, traffic volumes year-round would be relatively low due to the use of liquids gathering systems under the Proposed Action Alternative and Alternative C. This would not be the case under the No Action Alternative.

Over-winter mule deer fawn and adult survival is a function of demographic response to habitat quality and quantity. Over-winter fawn survival on the Mesa (impacted study area) and on the Pinedale Front (unimpacted control area) has been similar each year until winter 2005-2006 when the mortality rate was significantly higher in the control area (Wildlife Technical Report, Appendix K), though the reason for the difference is not clear. The fawn mortality rate observed on the Mesa following winter 2005-2006 was within range of the expected rate given winter snowfall, precipitation during the two previous growing season, and temperature at the onset of winter. The fawn mortality rate on the Pinedale Front was significantly higher than expected, based on measured winter conditions. Because a smaller proportion of mule deer utilize the Mesa crucial winter range complex than in the past, over-winter mortality on other crucial winter ranges (e.g., the Pinedale Front Complex) would become proportionately more significant to the entire population, regardless of the cause of mortality there. The results emphasize the importance of all crucial winter ranges to the population.

There is a growing body of research that indicates time lags between landscape changes and population, or demographic, responses to the changes (Nagelkerke et al., 2002). Examples of time lag responses have been reported for roads. As roads through previously unaffected wildlife habitat proliferate resulting in lost habitat, reduced habitat quality (or habitat effectiveness), increased vehicle-related mortality, and increased fragmentation (decreased habitat connectivity), declining populations follow but some time after the initial impact of road construction (Forman et al., 2003).

For mule deer in the Sublette Herd Unit, there has not been a demographic response related to over-winter survival. There is potential for a declining population, given a time lag between lost habitat effectiveness and function and a population-level response. Current understanding is insufficient to predict how such a demographic response would be manifested, but decreased mule deer survival on or off winter range is one possibility. Other demographic responses that may be observed in the future include overcrowding and over-utilization of unaffected habitats within increased intraspecific competition, increased prevalence of disease, predation, physiological stress response, and decreased birth rates, all of which could occur in some combination and at varying levels as the extent of wellfield development increases under any of the alternatives. Any demographic response to wellfield development would be a significant impact.

Moose and Elk. Approximately 252 acres of moose crucial winter/yearlong range would be disturbed by wellfield development by the end of 2006. Additional surface disturbance in moose crucial winter/yearlong range is expected under each alternative (Table 4.20-4). Moose response to roads and traffic in crucial winter/yearlong range has not been documented. No new disturbance is likely in the portion of elk winter range coinciding with the PAPA.

Table 4.20-4
Surface Disturbance to Moose and Elk Seasonal Ranges by Alternative

Seasonal Range	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Moose Crucial Winter/Yearlong Range	252.5	248.8	244.2	290.5	756.5	642.9
Elk Winter Range	14.2	0.0	0.0	0.0	0.0	0.0

Upland Game Birds. Abundance of greater sage-grouse breeding in the PAPA has decreased since issuance of the PAPA ROD (BLM, 2000b). However, male attendance at leks in and outside the PAPA increased in 2005 and 2006, presumably due to heightened juvenile recruitment following 2004, a year of relatively high precipitation accompanied by beneficial sagebrush growth.

As distances between greater sage-grouse leks and drilling rigs, producing wells, and main roads have declined with the increased level of development since 2001, attendance of male greater sage-grouse at leks has declined (Holloran, 2005). The investigation by Holloran (2005) indicates that male counts on heavily impacted leks declined 51 percent, from 1 year prior to well development, through 2004. Numbers of strutting males decreased with increased traffic volumes within 1.86 miles of leks and increased noise intensity at leks (Holloran, 2005).

There are similar observations in the Powder River Basin (PRB) of northeastern Wyoming where greater sage-grouse populations on leks, subject to disturbances by coal-bed methane development, have substantially declined, relative to populations on undisturbed leks (Naugle et al., 2006). Results from studies in the PAPA and PRB indicate declining greater sage-grouse populations resulting from loss of habitat, disturbance from roads, and noise during breeding (Braun et al., 2002). Results from the PRB study indicate a time lag effect (discussed above for

impact to mule deer) between the onset of wellfield development and decreasing breeding populations. For example, wellfield development in the PRB gradually increased since 1987 and greater sage-grouse attendance at leks in impacted areas dropped precipitously seven years later (Braun et al., 2002) and have further declined in the past several years (Naugle et al., 2006). Declining attendance at leks proximate to wellfield development is attributed to avoidance of the leks by yearling male greater sage-grouse (Kaiser, 2006). With low or no recruitment of yearling males, leks would eventually disappear. Once a lek has been abandoned, that vital habitat is no longer functional and has been significantly impacted.

Noise from drilling rigs can exceed 10 dBA above background noise, even if drilling is farther than 0.25 mile from noise sensitive sites such as a greater sage-grouse lek (see Section 3.12 – Noise). The 10 dBA above background limit was specified in the PAPA ROD (BLM, 2000b) as an Administrative Requirement and Condition of Approval. The PAPA DEIS (BLM, 1999a) assumed that a 0.25-mile buffer around leks was sufficient to limit noise from wellfield traffic to 10 dBA above background levels. Holloran (2005) indicates that the 0.25-mile buffer surrounding leks may be insufficient to maintain function of lek habitats due to wellfield development and associated noise.

Greater sage-grouse nesting and brood-rearing habitats have been affected by wellfield development in the PAPA. Females avoid nesting in areas of high well densities and females with broods of chick avoid well pads with producing wells (Holloran, 2005). The accumulated evidence on the effects of wellfield development on greater sage-grouse use of habitats indicate that once-functional, non-impacted habitats are less effective, given the level of development though 2005. This is because greater sage-grouse use them less over time. Function of greater sage-grouse habitat in and outside of the PAPA also appears to be affected by climatological conditions, specifically by drought. Whether the combination of effects to greater sage-grouse by wellfield disturbance and drought is synergistic or additive has not been demonstrated. However, the negative effects of one do not diminish the negative effects of the other.

Continued loss of habitat function is likely with levels of development under all of the alternatives through 2011 and under the Proposed Action and Alternative C through 2023 (Table 4.20-5). Under all alternatives, effectiveness of greater sage-grouse breeding (leks), nesting, and brood-rearing habitats would continue to decline, as they have through 2006. Declining habitat use would likely be exacerbated by continued drought. With the declines in greater sage-grouse use of the PAPA, expected through 2011, it is uncertain if habitats would still provide some function to greater sage-grouse by 2023. Habitats may not provide function even if development activities are restricted within 2-mile buffers of leks, between March 15 and July 15 (BLM, 2004c), to protect greater sage-grouse nesting habitat. Noise, traffic, and habitat elimination would all contribute to diminished effectiveness of habitats used by greater sage-grouse during winter, during breeding, nesting, and brood-rearing, through 2023. Highly impacted leks, those still active by 2006, are very likely to follow the Mesa Springs and Lovatt Draw Reservoir leks to total abandonment (as observed in 2006) even if development activities are restricted within the 2-mile buffers between March 15 and July 14 (BLM, 2004c). However, buffers of some leks would be impacted more than others. Extinction of leks would inevitably follow if yearling males do not replace aging adults at highly impacted leks. New leks may become established following extinction of former leks, such the establishment of Lovatt West and Dukes Triangle leks in 2005. Longevity of the newly established leks and their effectiveness (in terms of breeding populations), relative to extinct leks, is unknown.

Table 4.20-5
Surface Disturbances to Greater Sage-Grouse Lek Buffers by Alternative

Greater Sage-Grouse Lek Buffer	Estimated Existing Wellfield Disturbance (acres)	Potential Additional Surface Disturbance (acres) by Alternative				
		No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
0.25-Mile Buffer	56.8	26.0	95.5	91.6	204.3	198.3
2-Mile Buffer and Sage Grouse SRMZ	3,907.1	3,290.2	4,995.4	5,136.8	9,372.5	9,660.4

Other upland game birds, including mourning doves, are expected to occur in all habitats within the PAPA (see Table 3.22-15). Ruffed grouse could occur in the PAPA although they are mostly associated with aspen groves and there are only about 2 acres of aspen in the PAPA. Mourning doves may nest on the ground and surface disturbing activities could destroy nests. Increased fragmentation by road and pipeline corridors could increase nest predation, especially predation of ground nests.

Small Game and Furbearing Mammals. Diminished function in habitats utilized by cottontails is expected to occur some distance from edges created by wellfield development within sagebrush and other vegetation types. All small game mammals, furbearers, and nongame mammals are susceptible to mortality on roads. The risk of vehicle mortality of small and medium-sized mammals is expected to increase with increased traffic volumes under all alternatives, especially with increased winter traffic volumes associated with the Proposed Action Alternative and Alternative C because most of the small mammals are active during winter.

Migratory Birds. There have been concomitant declines of sagebrush-dependent migratory passerine bird species with loss of sagebrush steppe vegetation and increased fragmentation in remaining sagebrush-dominated habitats in Wyoming (Knick and Rotenberry, 1995; Knick et al., 2003). A study on the effects of wellfield roads on densities of Brewer's sparrow and sage sparrow, as well as other species dependent on sagebrush for nesting habitat, found that the density of the species was markedly reduced within 300 feet of a road compared to the density beyond that distance (Ingelfinger, 2001). Traffic accounted for some of the reduced density effects while the presence of an edge (change in vegetative type) in otherwise continuous stands of sagebrush may have had an influence. A similar reduction in sage sparrow density was observed along a pipeline alignment (Inglefinger, 2001).

As discussed earlier, edges are one component of habitat fragmentation. Fragmentation and the amount of edge between disturbed surfaces and wildlife habitat has been considerable through 2006, particularly due to wellfield roads (Table 4.20-1). A study of migratory bird populations (sagebrush obligate species) includes effects by wellfield development in the Jonah Field Project Area (King and Holmes, 2005). Results of effects of fragmentation on populations are not yet available. Amounts of fragmentation would continue to increase in the PAPA under each alternative. Declines in populations of species associated with sagebrush habitats is expected (Knick et al., 2003). Effects of fragmentation to migratory breeding birds and other wildlife (small game, furbearers, and small mammals) would increase considerably from 2006.

Raptors nesting in the PAPA are migratory birds. In addition to ferruginous hawks, merlins and burrowing owls discussed above in Section 4.19.3.1, golden eagles and other raptors nest in the PAPA and within the PAWSA (see Section 4.19, above). Monitoring data collected from 2003 through 2005 indicate that the distance of active golden eagle nests to the nearest well location varied from 895 feet to 16,582 feet with an average distance of 7,327 feet (Ecosystem Research Group, 2006). Except for short-eared owls (there is very limited data), other raptor nests in the PAPA are concentrated within forest-dominated riparian vegetation along the New Fork and Green rivers. Similar analyses of distances from active nests of other raptor species to well locations ranged from 314 feet to more than 28,500 feet, averaging 9,175 feet (Ecosystem Research Group, 2006). The large average distance between raptor nests and well locations probably is a reflection of relatively low levels of wellfield development within forest-dominated riparian zones rather than displacement of raptors away from high wellfield development (see Table 4.19-1).

Implementation of each alternative would increase disturbance within forested-dominated riparian vegetation through 2011. By 2023, increased disturbance within forested-dominated riparian vegetation would be similar under the Proposed Action Alternative and Alternative C (Table 4.19-1). Although monitoring data collected for annual raptor nesting activities has not indicated specific conflicts between wellfield development and raptor nesting success, increased disturbance within nesting habitats in the PAPA could affect at least some nests of some species, by decreasing habitat effectiveness.

Aquatic Resources. The New Fork and Green rivers support coldwater fisheries; principally rainbow trout, Snake River cutthroat trout, brown trout, and mountain whitefish. They also support limited kokanee salmon, brook trout, and lake trout. Snake River cutthroat trout and rainbow trout spawn in the spring while mountain whitefish, brook trout and brown trout are fall spawners (Baxter and Stone, 1995). In lower portions of watersheds, such as the reaches of the New Fork and Green rivers in the PAPA, high sediment loads can limit reproduction of rainbow and cutthroat trout. Sediments are mobilized during runoff from snowmelt and spring precipitation, which in the PAPA is highest during May. Increased sedimentation in the New Fork and Green rivers following spring precipitation and runoff would be most detrimental to reproduction of rainbow trout and Snake River cutthroat trout by covering spawning sites (redds) with silt, suffocating eggs, and inducing mortality of embryos developing within intergravel spaces and/or fry. Therefore, populations of fall spawning nonnative salmonids (brook and brown trout) would increase at the expense of native species (Behnke, 1992).

Surface disturbing activities that remove riparian vegetation and cause erosion and sediment transport on slopes are sources of sediment that promote degradation of aquatic environments (Reid, 1993). Surface disturbance within the forest-dominated riparian zone of the New Fork River would generate sediment into surface waters even though the amount is small compared to the estimates of new disturbance in all sub-watersheds under all alternatives (Table 4.14-1). The potential for sedimentation in aquatic habitats increases as a direct function of surface disturbance (see Section 4.14.3.1). Consequently, implementation of alternatives would increase existing surface disturbance in several sub-watersheds in the PAPA. The greatest erosion impacts occur on the Anticline Crest under all alternatives. Mack Reservoir and New Fork Alkali Creek basins show the largest increase in annual erosion over the current conditions. Erosion is increased as well in Sand Draw-Alkali Creek Basin for large storms (4.14-3). By 2023, increased surface disturbance associated with either the Proposed Action Alternative or Alternative C is expected to increase annual sediment yields to surface waters by up to 20 percent above current conditions. Depending on specific conditions in any given year, especially precipitation and runoff during spring, surface disturbance could potentially indirectly impact spawning by native salmonids.

Pipeline Corridors and Gas Sales Pipelines

Potential impacts to wildlife species from pipeline construction would be similar to impacts resulting from development within the PAPA.

Big Game. Loss of habitat function and disturbance to big game activities would occur as direct and indirect results of pipeline construction. These impacts would be limited to short-term loss of forage and short-term displacement of individuals near the construction right-of-way. Most of the pipeline construction would occur adjacent to existing pipelines and therefore, these impacts would be minimal. Long-term impacts to big game forage would not occur because the pipeline right-of-way would be reclaimed within one growing season after construction. Right-of-way maintenance would include control of noxious weeds and invasive nonnative species.

Upland Game Birds. Several greater sage-grouse leks have been identified within 2 miles of the proposed pipeline corridors. Ground disturbing activities would be avoided from March 15 through July 15 (BLM, 2004) within a 2-mile buffer of identified leks. No surface facilities would be constructed within 0.25 mile of leks. Impacts to greater sage-grouse from pipeline construction would include loss of habitat and increased habitat fragmentation. Short-term disturbance to the species and displacement of individuals could occur because of construction activities and increased human presence. These impacts are likely to reduce greater sage-grouse reproductive success and survival rates near the pipeline corridors until reclamation of shrub habitats is successful. These impacts would be localized and are not anticipated to lead to the decline of the species.

Migratory Birds. Potential impacts to migratory birds such as loss of sagebrush habitats and increased habitat fragmentation would be greater in areas of cross-country pipeline construction where the pipeline right-of-way does not parallel existing pipeline rights-of-way. One possible indirect impact would be reduced breeding success due to increased human presence. There could be direct impacts to nests and mortality to individuals as a result of construction activities. The availability of similar habitats near the proposed pipeline corridors would lessen the potential impacts to these species.

BLM imposes temporal and spatial limitations for pipeline construction activities around active raptor nest sites. Pipeline construction would not occur within 0.5 mile of active raptor nests or within 1 mile of active bald eagle or ferruginous hawk nests between February 1 and July 31. These temporal and spatial buffers may be adjusted, based on site-specific conditions. Raptor surveys would be conducted prior to commencement of construction activities from February 1 to July 31 in the nesting season. No impacts to nesting raptors are anticipated as a result of pipeline construction.

Due to the avoidance of occupied raptor and mountain plover habitats during the nesting season, migratory bird species occupying the habitats would be protected. Potential impacts to migratory birds within the proposed pipeline corridors would be localized and minor.

Aquatic Resources. Impacts to fisheries are not expected as a result of pipeline construction. The only perennial waterbodies crossed by the proposed corridor/pipeline alignments are the New Fork, Green, and Blacks Fork rivers. All of these rivers would be crossed by horizontal directional drill (HDD) construction methods. Any potential impacts to the rivers would be avoided by HDD because the pipeline would be placed beneath the rivers by drilling away from the stream banks and stream channel. There would be no excavation in the rivers or any other in-stream work.

4.20.3.2 Alternative A (No Action Alternative)

After 2006, only four new well pads would be allowed in the mostly contiguous leaseholds in the northern portion of the PAPA (currently operated by Questar) under a BLM Decision Record (BLM, 2004a). The limitation is included in the No Action Alternative. Consequently, most new wellfield roads under the No Action Alternative would be constructed in the central and southern portions of the PAPA. Under the same Decision Record, winter drilling would be allowed to continue (November 15 though April 30) on mule deer crucial winter range with up to six drilling rigs, two rigs per well pad, each year through 2011 in the mostly contiguous leaseholds. These leaseholds have, and would continue to have, a liquids gathering system servicing most producing wells. With the liquids gathering system in place, traffic in the northern leaseholds is estimated to be 0.7 vehicle/day to each producing well (see Table 3.6-5). Winter drilling traffic would exceed 66 vehicles per day to each drilling location.

Under the No Action Alternative, in the mostly contiguous leaseholds in the northern portion of the PAPA, traffic through mule deer crucial winter range would be about the same as traffic evaluated during winter 2005-2006. Mule deer avoidance of roads with very high, high, medium and low traffic volume would be similar to observed avoidance in winter 2005-2006. Mule deer would continue to avoid habitats adjacent to roads with higher traffic volumes resulting from drilling (North Anticline Road, local roads, and resource roads) by up to 3 or 4 miles.

Almost all of the mostly contiguous leasehold in the northern portion of the PAPA is within mule deer crucial winter range, and therefore, the limits on additional well pads placed by BLM (2004a) are reflected in the estimated surface disturbance in crucial winter range under the No Action Alternative. By 2011, there would be 1,090 acres of new disturbance in mule deer crucial winter range under the No Action Alternative (Table 4.20-3).

In the central and southern portions of the PAPA, no development related traffic would occur within crucial winter ranges between November 15 and April 30 under the No Action Alternative. The Operators with leaseholds in these areas would not install liquids gathering systems under the No Action Alternative, although production related traffic would continue. Estimated traffic to producing wells in crucial winter range, where there is no liquids gathering system, is 1.6 vehicles per day per producing well (see Table 3.6-5).

Although there would be no drilling related traffic in the central and southern portions of the PAPA within pronghorn crucial winter ranges during winter, the No Action Alternative would likely disturb an additional 1,500 acres of pronghorn crucial winter range (Table 4.20-2), north and south of the New Fork River. Similarly, about 250 acres of new disturbance would be within moose crucial winter/yearlong range along the New Fork River (Table 4.20-4). New producing wells in crucial winter ranges without a liquids gathering system would increase winter traffic overall.

Under the No Action Alternative, there would be 3,290 acres of surface disturbance within 2-mile buffers of greater sage-grouse leks. There are 134,283 acres in the PAPA within 2-mile buffers of all leks, and therefore, more than 5 percent of the total area within 2-mile buffers would be disturbed if disturbance is spread uniformly across the landscape.

Habitat fragmentation would increase under the No Action Alternative. Wellfield development under the No Action Alternative would generate 362 miles of new edge length (Table 4.20-1). Most new fragmentation would be within sagebrush steppe vegetation in which 3,314 acres of additional surface disturbance is projected under the No Action Alternative (Table 4.16-1).

Raptors nesting in the forested-dominated riparian zone of the New Fork River would be potentially affected by 75 acres of new disturbance under the No Action Alternative (Table 4.16-1).

4.20.3.3 Alternative B (Proposed Action Alternative)

Proposed Action Alternative Through 2011

Within the first 5 years of development, through 2011, there would be an estimated 89 miles of additional roads constructed in the PAPA. Miles of new roads estimated for the Proposed Action Alternative through 2011 are nearly 20 fewer miles than for the No Action Alternative because the Operators expect to construct 179 new pads under the Proposed Action Alternative rather than 245 new pads under the No Action Alternative. In addition, 116 existing well pads would be expanded by the end of 2011. New access roads would not be required for expansion pads.

Under the Proposed Action Alternative, well drilling and completion within the CDAs (Map 4.1-3) would occur year-round within big game crucial winter ranges. Consequently, vehicular traffic during winter would be substantially greater through 2011 under the Proposed Action Alternative compared to traffic expected under the No Action Alternative.

Under the Proposed Action Alternative through 2011, there would be more than 2,200 acres of new disturbance in mule deer crucial winter range, over twice the amount disturbed by the No Action Alternative (Table 4.20-3). Under the Proposed Action Alternative, an estimated 2,400 acres and 244 acres would be disturbed in pronghorn crucial winter range (Table 4.20-2) and moose crucial winter/yearlong range(Table 4.20-4), respectively.

Declines of greater sage-grouse are expected to be more rapid and more extensive under the Proposed Action Alternative than by the No Action Alternative because winter drilling would generate noise and considerably more traffic (due to drilling and completions). This would occur even if development activities are restricted within 2-mile buffers around leks between March 15 and July 15 (BLM, 2004c). By 2011, the Proposed Action Alternative would add almost 5,000 acres of surface disturbance within 2-mile buffers of greater sage-grouse leks (Table 4.20-5). This would increase the amount of surface within 2 miles of all leks in the PAPA by more than 6.6 percent.

Habitat fragmentation (edge length) would increase with the Proposed Action Alternative through 2011, though less than with the No Action Alternative. Wellfield development under the Proposed Action Alternative is expected to generate an estimated 583 miles of new edge length (Table 4.20-1). Most new fragmentation would be within sagebrush steppe vegetation in which 4,870 acres of additional surface disturbance is projected through 2011 (Table 4.16-1).

Raptors nesting in the forest-dominated riparian zone of the New Fork River would be potentially affected by 59 acres of new disturbances by the Proposed Action Alternative through 2011, less disturbance than by the No Action Alternative.

Proposed Action Alternative Through 2023

Through 2023, the Proposed Action Alternative would require an estimated total of 121 miles of new roads to access new well pads. Under this alternative, 250 new well pads would be constructed through 2017 and therefore, no new roads would be constructed after 2017. In addition to new pads, 264 existing well pads would be expanded after 2012. New access roads are not required for expansion of existing pads.

Under the Proposed Action Alternative, drilling and completions within CDAs would continue to occur year-round within big game crucial winter ranges. However, the Operators have not defined CDAs through 2023. Year-round drilling could occur anywhere within the core area as defined for the Proposed Action Alternative (Map 4.1-5). Consequently, vehicular traffic related to drilling and completions during winter would continue to be substantial as long as year-round drilling continues.

Under the Proposed Action Alternative, by 2023, nearly 3,600 acres of surface disturbance in mule deer crucial winter range and more than 2,800 acres of disturbance in noncrucial winter range are expected (Table 4.20-3). Nearly 4,400 acres would likely be disturbed in pronghorn crucial winter range (Table 4.20-2) and more than 750 acres disturbed in moose crucial winter/yearlong range (Table 4.20-4) by the Proposed Action Alternative. Operators plan to have most existing producing wells connected to a liquids gathering system within 2 years of issuance of the ROD, under the Proposed Action Alternative.

By 2023, the Proposed Action Alternative would add 9,372 acres of disturbance within 2-mile buffers of greater sage-grouse leks (Table 4.20-5), increasing the amount of surface disturbance within the 2-mile buffer of all leks in the PAPA by more than 10 percent. Noise, traffic, and habitat elimination would all contribute to diminished effectiveness of habitats used by greater sage-grouse during winter, during breeding, nesting and brood rearing and would be similar to that by Alternative C through 2023.

Habitat fragmentation would increase with the Proposed Action Alternative through 2023 and would be similar to Alternative C. Wellfield development under the Proposed Action is expected to generate more than 800 miles of new edge length (Table 4.20-1). Most new fragmentation would be within sagebrush steppe vegetation in which 8,865 acres of additional surface disturbance is projected through 2023 (Table 4.16-1).

Raptors nesting in the forested-dominated riparian zone of the New Fork River would be potentially affected by 278 acres of new disturbances by the Proposed Action Alternative through 2023.

4.20.3.4 Alternative C

Alternative C Through 2011

Within the first 5 years of development, 2007 through 2011, the numbers of new pads and existing pads expanded would be the same as under the Proposed Action Alternative. About 89 miles of new road would be constructed in the PAPA through 2011 under Alternative C (Table 4.20-1). In 2011, the distribution of new roads under Alternative C would differ from locations of roads constructed under the Proposed Action Alternative. New road construction would be concentrated in the southern 2 miles of DA-1, within DA-2, and throughout DA-4 (Map 4.1-4). Access to these development areas during winter would be from the south, along Paradise Road and the North Anticline Road, similar to access under the No Action and Proposed Action alternatives.

No new roads are expected to be constructed during the winter in DA-3 until development in DA-2 is complete, under Alternative C. Consequently, winter traffic would be limited to production activities. Most producing wells would be connected to a liquids gathering system in DA-3 within 2 years of issuance of the ROD, further reducing winter traffic. Access to DA-3 during winter would most likely be limited to either the Boulder South Road or South Anticline Road. Access to year-round drilling in DA-4 would probably be from Highway 351 and the Jonah North Road.

Under Alternative C, drilling would occur year-round within big game crucial winter ranges on the southern end of DA-1 (mule deer crucial winter range) and in all of DA-2 (pronghorn crucial winter range). Consequently, vehicular traffic related to drilling and completions during winter would be reduced through 2011 under Alternative C on mule deer crucial winter range in the northern portion of DA-1 and on pronghorn crucial winter range in DA-3 (Map 4.1-4). Winter traffic in those winter ranges would be substantially less than traffic expected under the Proposed Action and No Action alternatives. Crucial winter habitat effectiveness in areas adjacent to wellfield activities under Alternative C, especially habitats proximate to well drilling

locations in the southern end of DA-1, is expected to be considerably less than under the No Action Alternative through 2011. However, habitat effectiveness in the central and northern portions of DA-1 is expected to exceed effectiveness under the No Action Alternative because the liquids gathering system would reduce winter traffic to producing wells.

By 2011, nearly 2,100 acres of new disturbance in mule deer crucial winter range is expected under Alternative C, about twice the amount disturbed by the No Action Alternative (Table 4.20-3). Likewise, more than 2,600 acres are likely to be disturbed in pronghorn crucial winter range (Table 4.20-2) and Alternative C is expected to disturb 290 additional acres in moose crucial winter/yearlong range (Table 4.20-4). Drilling restrictions within portions of DA-1 and all of DA-3 through at least 2011 would provide some areas of lesser impact for those species. Consequently, big game crucial winter habitats within portions of DA-1 and all of DA-3 are expected to be substantially more effective and functional, at least through 2011, than under the Proposed Action Alternative.

Effectiveness of greater sage-grouse breeding (leks), nesting, and brood-rearing habitats would continue to decline through 2011 under Alternative C similar to the Proposed Action Alternative. Declines may be more rapid and more extensive under Alternative C than by the No Action Alternative because winter drilling would generate noise and considerably more wellfield traffic in the southern end of DA-1, in all of DA-2 and in DA-4. New wellfield activities would be restricted within 2-mile buffers around greater sage-grouse leks between March 15 and July 15 (BLM, 2004c) to protect leks and nesting habitats in DA-5 (Map 4.1-4). By 2011, Alternative C would add more than 5,100 acres of disturbance within 2-mile buffers of leks (Table 4.20-5), increasing the amount of surface disturbance within 2-mile buffers of all leks in the PAPA by more than 6.7 percent. Noise, traffic, and habitat elimination would all contribute to diminished effectiveness of habitats used by greater sage-grouse during winter, during breeding, nesting and brood-rearing more than by the No Action Alternative.

Levels of habitat fragmentation would increase under Alternative C similar to the Proposed Alternative through 2011. Wellfield development under Alternative C is expected to generate an estimated 585 miles of new edge length (Table 4.20-1). Most new fragmentation would be within sagebrush steppe vegetation in which 4,987 acres of additional surface disturbance is projected through 2011 (Table 4.16-1).

Raptors nesting in the forested-dominated riparian zone of the New Fork River would be potentially affected by 85 acres of new disturbances to forest-dominated riparian habitat in 2011 by Alternative C, more disturbance than by No Action Alternative.

Alternative C Through 2023

As development is completed in the southern portion of DA-1, development in DA-1 would move to the north. By 2017, new pads and expansion pads would be concentrated in the north end of DA-1. By that time, and through 2023, winter drilling on big game crucial winter range would be limited to the north end of the PAPA within DA-1. Access to winter drilling operations on the north end of DA-1 would be from the north, rather than from the south along the North Anticline Road. Development of a transportation plan for access from the north is pending. BLM is currently working with Sublette County, WGFD, and local landowners in identifying an access route. Production activity in all crucial winter range would use access closest to any paved road from producing wells so that the limited traffic required to access producing wells in the southern end of DA-1 would be from the south.

Once all year-round drilling and wellfield development is complete within DA-2, some time after 2011, wellfield development would commence within DA-3. With no additional winter drilling

allowed, winter traffic within DA-2 would be production related only. Liquid gathering systems would be in place so traffic-related disturbance within DA-2 would be minimal.

Under Alternative C, well drilling and completion would occur year-round within big game crucial winter ranges in the northern end of DA-1 (mule deer crucial winter range) and in all of DA-3 (pronghorn crucial winter range). Consequently, vehicular traffic related to drilling and completions during winter would be reduced through 2023 on mule deer crucial winter range in the southern portion of DA-1 and on pronghorn crucial winter range in DA-2 (Map 4.1-6). Winter traffic in crucial winter ranges would be substantially less than traffic expected under the Proposed Action and No Action alternatives.

By 2023, more than 3,400 acres of total new disturbance in mule deer crucial winter range are expected under Alternative C (Table 4.20-3). More than 4,100 acres are likely to be disturbed in pronghorn crucial winter range (Table 4.20-2), and 650 additional acres of disturbance is expected in moose crucial winter/yearlong range under Alternative C (Table 4.20-4).

Alternative C does not specify that new surface disturbance would occur, from south to north in DA-1 and from DA-2 to DA-3, before reclamation in those areas would be initiated. However, with all development completed in specific areas before new areas can be developed, the potential for focal points of reclamation is possible under Alternative C. That possibility does not exist under the Proposed Action Alternative. Depending on how successful future revegetation efforts would be on well pads, road and pipeline corridors during the 17-year period of wellfield development, habitat effectiveness may or may not become reestablished to levels that would increase function within big game crucial winter ranges. Winter drilling restrictions within portions of DA-1 and all of DA-2 through 2023 would provide some areas of lesser impact for those species. Consequently, big game crucial winter habitats in these areas are expected to be somewhat more effective and functional in under Alternative C than under the Proposed Action Alternative through 2023.

Winter traffic and drilling and completions in DA-3 would increase substantially once year-round drilling is complete in DA-2. Pronghorn on crucial winter ranges would be affected similarly to the effect in DA-2 during year-round drilling. Development would probably continue in DA-4 and extend into DA-5. Once there, however, Operators would be restricted by seasonal limitations on drilling between March 1 and July 15 (BLM, 2004c) to protect greater sage-grouse leks and nesting habitats.

Effectiveness of greater sage-grouse breeding (leks), nesting, and brood-rearing habitats would continue to decline through 2023 under Alternative C. Winter drilling would generate noise and development related traffic in the northern end of DA-1, in all of DA-3 and in DA-4. Wellfield development would be restricted within 2-mile buffers around leks between March 15 and July 15 (BLM, 2004c) in DA-2 and in all of DA-5 (Map 4.1-4). Alternative C is designed to protect greater sage-grouse habitats in DA-5 sufficiently to retain functional habitats through 2023. Whether that objective would be successful or not remains to be seen. By 2023, Alternative C would add 9,660 acres of disturbance within 2-mile buffers of greater sage-grouse leks (Table 4.20-5), increasing the amount of surface disturbance within the 2-mile buffer of all leks in the PAPA by more than 10 percent. Noise, traffic, and habitat elimination would all contribute to diminished effectiveness of habitats used by greater sage-grouse during winter, during breeding, nesting and brood rearing and would be similar to that by the Proposed Action Alternative through 2023.

Habitat fragmentation would increase with Alternative C at the same level as the Proposed Action Alternative, through 2023. Wellfield development under Alternative C is expected to generate more than 800 miles of new edge length (Table 4.20-1). Most new fragmentation

would be within sagebrush steppe vegetation in which 9,113 acres of additional surface disturbance is projected through 2023 (Table 4.16-1).

Raptors nesting in the forested-dominated riparian zone of the New Fork River would be potentially affected by 269 acres of new disturbances to this type of nesting habitat in 2023 by Alternative C.

4.20.4 Cumulative Impacts

The CIAAs that are applicable to wildlife vary by species. The CIAA for pronghorn includes the northern portion of the Sublette Herd Unit while the CIAA for moose and mule deer are the respective species' herd units in their entireties. The CIAA applicable to greater sage-grouse includes the area encompassed by SUGMAs 3 and 7. The CIAA for all other wildlife and aquatic species is the PAPA.

Changes in land use in the region surrounding the PAPA affected wildlife and their habitats. Livestock grazing was the predominant traditional land use and is compatible with wildlife use, where appropriately managed. However, other changes in land use have occurred that affected the function of some wildlife habitats. For example, fragmentation of wildlife habitat by various developments include proliferation of roads associated with mineral resource developments (Weller et al., 2002) and subdivision of former agricultural private lands (Coupal et al., 2004 and Taylor, 2003). This fragmentation changed the landscape by removing habitat and leaving remnant areas of native habitat less functional, physically and biologically (Saunders, et al., 1991).

Fragmentation in the PAPA occurs due to human actions regardless of wellfield development. Approximately 75 miles of roads were constructed within the PAPA prior to wellfield development (Table 4.20-6). These roads include major arterial highways and a variety of collector, local, and resource roads mostly utilized by livestock operators and recreation users. Wellfield development will have increased the total edge length in the PAPA by more than an estimated 500 miles by the end of 2006. Implementation of the alternatives would substantially increase habitat edge. The estimated cumulative edge length within the PAPA would be more than 900 miles under the No Action Alternative and more than 1,100 miles under the Proposed Action Alternative and Alternative C by the end of 2011 (Table 4.20-6). By 2023, implementation of the Proposed Action Alternative and Alternative C would further increase edge length to almost 1,400 miles.

Table 4.20-6
Cumulative Existing and Potential Additional Edge Length Indicative of Fragmentation by Alternative

Component	Existing Non Wellfield Edge Length (miles)	Estimated Existing Wellfield Edge Length (miles)	Estimated Cumulative Edge Length (miles) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Well Pad Perimeter	0.0	133.6	237.9	244.9	245.5	355.3	356.1
Road Length	75.1	215.2	398.3	379.0	379.6	411.1	411.1
Pipeline Length	0.0	154.2	303.9	536.9	538.0	628.2	627.1
Total Edge Length	**75.1**	**503.0**	**940.1**	**1,160.8**	**1,163.1**	**1,394.6**	**1,394.3**

In addition to the effects of fragmentation, wildlife habitats associated with native vegetation have been altered by land uses in the PAPA (see Section 4.16.3.5). These habitats would be physically eliminated through implementation of alternatives until surface disturbances have been reclaimed. However, revegetation of surface disturbances within native vegetation will alter wildlife habitats for the life of the project, especially habitats defined by shrub and tree species.

Big Game. Pronghorn in the region surrounding the PAPA have been affected by a variety of land uses including livestock grazing, fences constructed to manage livestock, developments by mineral industries, roads, right-of-way fences, and other human developments (Lee et al., 1998; Sheldon, 2005). In the region, fences, constructed along highways (Sheldon, 2005) and associated with housing developments (Sawyer et al., 2005b), have affected pronghorn access to habitats and impede migrations between seasonally used ranges.

In addition to fragmentation and migration impediments, both of which cumulatively impact pronghorn in the Sublette Herd Unit, human developments have affected seasonal habitats utilized by pronghorn in the PAPA (Table 4.20-7). Nearly 7,500 acres of pronghorn habitats are affected by disturbances associated with non-wellfield developments including agriculture, residences, roads, urban infrastructure, and livestock facilities. Wellfield related developments in the PAPA have disturbed more than 5,000 acres. Implementation of future natural gas development in the PAPA under the alternatives is expected to increase the cumulative loss of pronghorn habitats by several thousand acres. The cumulative habitat loss, through 2011, is estimated to be more than 17,000 acres under the No Action Alternative and almost 20,000 acres under the Proposed Action Alternative and Alternative C. By 2023, it is estimated that cumulative habitat loss would be more than 25,000 acres under the Proposed Action Alternative and Alternative C (Table 4.20-7).

Table 4.20-7
Cumulative Surface Disturbance in Relation to Pronghorn Seasonal Ranges by Alternative

Pronghorn Seasonal Ranges	Existing Non Wellfield Disturbance (acres)	Estimated Total Existing Surface Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Crucial Winter Range SRMZ	1,592.9	1,619.0	4,882.6	5,808.6	5,960.4	7,719.6	7,527.7
Spring/Summer/Fall Range	5,829.7	3,440.5	11,510.3	12,944.8	12,804.6	16,467.2	16,652.3
Winter Range	44.3	0.0	44.3	44.3	44.3	44.3	44.3
Total	**7,466.9**	**5,059.4**	**17,437.1**	**19,797.6**	**19,809.2**	**25,231.0**	**25,224.2**

Mule deer habitats in the region have been affected by various past management practices and changes in land use including fire suppression, livestock grazing, residential proliferation, and barriers to migration and habitat access (Lutz et al., 2003). Similar to effects on pronghorn, human developments within the Sublette Herd Unit have affected mule deer migrations and access to seasonally used ranges, including seasonal ranges in the PAPA (Sawyer et al., 2005b).

Development not associated with wellfield activities have affected seasonal habitats utilized by mule deer in the PAPA (Table 4.20-8). More than 7,200 acres of pronghorn habitats have been affected by disturbances associated with agriculture, residences, roads, urban infrastructure,

and livestock facilities. Wellfield related developments in the PAPA have disturbed an additional 2,600 acres in mule deer seasonal habitats. Implementation of any of the alternatives is expected to increase the cumulative loss of pronghorn habitats by several thousand acres. By 2011, cumulative loss of mule deer habitat associated with the No Action Alternative is estimated at more than 12,000 acres and at almost 14,000 acres under the Proposed Action Alternative and Alternative C. Estimated cumulative loss of habitat is approximately 16,000 acres under the Proposed Action Alternative and Alternative C, by 2023 (Table 4.20-8).

Table 4.20-8
Cumulative Surface Disturbance in Relation to Mule Deer Seasonal Ranges by Alternative

Mule Deer Seasonal Ranges	Existing Non Wellfield Disturbance (acres)	Estimated Total Existing Surface Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
Crucial Winter Range SRMZ	1,397.4	1,518.8	4,006.7	5,129.9	5,013.9	6,504.0	6,327.6
Spring/Summer/Fall Range	4,326.6	59.6	4,386.2	4,386.2	4,386.2	4,386.2	4,386.2
Winter Range	846.7	1,011.6	3,028.6	3,604.0	3,758.7	4,753.0	4,258.6
Winter/Yearlong Range	667.5	27.7	695.2	695.2	695.2	695.2	695.2
Total	**7,238.2**	**2,617.7**	**12,116.7**	**13,815.3**	**13,854.0**	**16,338.4**	**15,667.6**

Crucial winter/yearlong ranges in the PAPA utilized by moose in the Sublette Herd Unit are affected by 1,195 acres of surface disturbance, mostly associated with agriculture, residences, and roads unassociated with wellfield development. Existing wellfield development disturbed another 252 acres of crucial moose habitat. Cumulative effects by each alternative would increase surface disturbances to about 1,700 acres in 2011, but implementation of the Proposed Action Alternative and Alternative C would affect more than 2,100 acres of moose crucial winter/yearlong range by 2023.

Upland Game Birds. Throughout their range, greater sage-grouse have been adversely affected by habitat loss due to agriculture, energy development, rural and urban housing, and roads, as well as by habitat fragmentation from fences and powerlines (Braun, 1998). Oil and gas development, and associated infrastructure, have affected large expanses of sagebrush vegetation that supported greater sage-grouse populations (Braun et al., 2002). Changes in land uses have affected sagebrush steppe vegetation in the sage-grouse CIAA and in the PAPA. Cumulative impact to sagebrush by the alternatives is expected to be substantial (see Section 4.16.3.5).

Past human-related activities in the PAPA, unassociated with wellfield development, within various distances to greater sage-grouse leks have been relatively modest. Only 5.3 acres have been disturbed within 0.25 mile of all leks, combined and approximately 760 acres within the PAPA had been disturbed within 2 miles of all leks (Table 4.20-9). There is considerable surface disturbance associated with existing wellfield development in the PAPA, especially within 2 miles of leks (Table 4.20-9). Surface disturbance and wellfield development activities contributed to declines of greater sage-grouse in the PAPA and are discussed in Section 4.20.3.1. Cumulative surface disturbance within 0.25 mile and 2- mile buffers of greater sage-grouse leks would increase substantially with implementation of the alternatives (Table 4.20-9).

The Proposed Action Alternative and Alternative C would affect more areas within those radii than the No Action Alternative by 2011 and considerably more in 2023.

Table 4.20-9
Cumulative Surface Disturbance to Greater Sage-Grouse Lek Buffers by Alternative

Greater Sage-Grouse Lek Buffer	Existing Non Wellfield Disturbance (acres)	Estimated Total Existing Surface Disturbance (acres)	Estimated Cumulative Surface Disturbance (acres) by Alternative				
			No Action 2011	Proposed Action 2011	Alternative C 2011	Proposed Action 2023	Alternative C 2023
0.25-Mile Buffer	5.3	56.8	88.1	157.6	153.7	266.4	260.4
2-Mile Buffer and Sage Grouse SRMZ	758.9	3,907.1	8,252.9	9,958.1	10,099.5	14,335.2	14,623.1

Other Wildlife. Cumulative actions described in this section affect migratory birds (including raptors), small game mammals, furbearers, and nongame wildlife. Although monitoring efforts focused on some of these wildlife species have not revealed any effects by current wellfield development, there are no predevelopment data to compare against the monitoring data. Species' populations in the PAPA are expected to decline, with fewer unaffected habitats available, based on projected levels of development for each alternative.

Aquatic Resources. No data is available to address the potential impacts to fisheries in the New Fork and Green rivers due to surface disturbance activities that remove riparian vegetation or cause erosion and sediment transport on slopes. Existing disturbance within riparian zones, unassociated with wellfield development, is primarily associated with agriculture that limits erosion as sediment transport into aquatic habitats. Bare ground from unreclaimed wellfield development does not prevent such erosion. Increased surface disturbance caused by wellfield development in the PAPA would increase cumulative sedimentation and may adversely affect fisheries in both rivers (see Section 4.14.3.5, above).

4.20.5 Alternative Impact Mitigation

Potential measures appropriate to mitigate impact to wildlife and aquatic resources would vary by alternative as noted below:

- Under all alternatives, BLM would require the appropriate BMPs described in the Gold Book (see Section 2.4.2.1).
- Under the No Action Alternative, mitigation measures would include the appropriate sections from Appendix A in the PAPA ROD (BLM, 2000b).
- Under the Proposed Action Alternative, mitigation measures provided by the Operators in Attachments 1 through 4 in Appendix C would apply.
- Under Alternative C, BLM's Performance-Based Objectives would apply (see Section 2.4.2.4 and Appendix E).

4.21 HAZARDOUS MATERIALS

4.21.1 Scoping Issues

There are no scoping concerns related to hazardous materials.

4.21.2 Impacts Considered in the PAPA DEIS

The PAPA DEIS (BLM, 1999a) did not address hazardous materials.

4.21.3 Alternative Impacts

The same hazardous materials are expected to be present in the PAPA under each of the alternatives. Hazardous materials that have been identified by the Operators and which are expected in the PAPA some time during the life of the project are provided in Appendix C. There are requirements for reporting quantities under 40 CFR Part 355 - Emergency Planning and Notification under the Comprehensive Environmental Response, Compensation and Liability Act (CERLA) of 1980. In particular, acrylamide is listed as an Extremely Hazardous Substance utilized in drilling materials, cementing and plugging materials. Appendix A to 40 CFR Part 355 requires that users must report 5,000 pounds of acrylamide (1,000 pounds the minimum threshold planning quantity) to state/federal officials. Acrylamide is primarily used to synthesize polyacrylamide, water-soluble thickeners such as those used in drilling materials. There is evidence that exposure to large doses can cause damage to the male reproductive glands. Direct exposure to pure acrylamide by inhalation, skin absorption, or eye contact irritates the exposed mucous membranes. In addition, the acrylamide monomer is a potent neurotoxin (Merck, 2001).

4.21.4 Cumulative Impacts

Impacts from hazardous materials could result from accidental spills of hazardous materials, pipeline ruptures, and/or exposure to hazardous materials but events would be localized. Proper containment of oil and fuel in storage areas, containment of fluids in reserve pits, appropriate pipeline design and construction, proper well casing and cementing, and location of wells away from drainages would prevent potential surface water and groundwater contamination.

All existing, proposed, and future development projects in the PAPA and similar projects elsewhere in the regions would apply mandatory mitigation measures similar to those described in Appendix C (Attachment 3) to prevent pollution and exposure to hazardous materials and cumulative impacts are not expected to be significant.

4.21.5 Alternative Impact Mitigation

Project operations would comply with all relevant federal and state laws regarding hazardous materials with the directives specified in Appendix C (Attachment 3).