CHAPTER 4 — ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

The potential positive and adverse impacts of construction, drilling, completion, operation, maintenance, and reclamation of the proposed project are disclosed for each affected resource under each alternative. An environmental consequence or impact is defined as a modification to the existing environment brought about by development activities. Impacts can be beneficial or adverse, can be a primary result of an action (direct impacts) or a secondary result (indirect impacts), and can be permanent or long-lasting (long-term impacts--more than 5 years) or temporary and short duration (short-term--5-years or less). Impacts can vary in degree from a slightly discernable change to a dramatic change in the environment.

Impacts are quantified whenever possible. Potential significant impacts (as defined in CEQ guidelines 40 C.F.R. 1500-1508--effects that are most substantial and therefore should receive the greatest attention in decision-making) are identified. The use of adjectives (e.g., “moderate,” “low,” “negligible”) has been avoided because this EIS is an analytical document. The magnitude of an impact (i.e., its significance) is based on RMP and state and local land use planning objectives, regulatory standards, scientific and environmental documentation, and professional judgment. Impacts are considered adverse unless identified as beneficial.

Significance criteria were developed to measure the degree to which an impact would affect (positively or negatively) the human and natural environment. Developing significance criteria is difficult for a number of reasons. First, although used extensively throughout the Act, NEPA does not identify what is meant by significant on a resource-by-resource basis. Second, it is often difficult to quantify impacts for some resources. In these cases, significance criteria must be subjective and often rely on the professional opinion of the persons preparing and reviewing the impact analysis. Finally, for the reader, the significance of an impact is often framed in terms of personal experience. For instance, persons who benefit directly from the positive economic impacts of the project are more likely to consider that positive impact more significant than someone who will not receive financial gain. Similarly, someone who recreates in the JIDPA is likely to find conflicts with project-related activities much more severe than someone who recreates elsewhere. Although this document does not predict "worst-case" impacts, it may overestimate impacts from the project. For purposes of this analysis, it is assumed that development would occur throughout the JIDPA. Overestimation is unavoidable for complete disclosure of potential or reasonable foreseeable impacts from the project.

Each resource discussed in this chapter includes a description of the following:

- Impact Significance Criteria. Current resource management goals/objectives are summarized from BLM RMP RODs (BLM 1988b, 1997b), the State of Wyoming land use plan (Wyoming State Land Use Commission [WSLUC] 1979) and the Sublette County comprehensive plan (SCBC and SCPC 2003). In general, the ability of management agencies to achieve or maintain these goals/objectives determines significance (i.e., if plan goals/objectives can no longer be met on the JIDPA or for the planning area, then the potential for a significant impact exists).

For some resources, additional impact significance criteria are provided (e.g., for air resources, various legally mandated thresholds/limits are identified).

- Impacts. The level and duration of impacts anticipated to occur as a result of the No Action Alternative, the Proposed Action, Alternatives A-G, and the Preferred Alternative are described. It is assumed that BLM-identified and Operator-committed practices would be implemented to avoid or minimize adverse impacts (see Chapter 2, and Appendices A and B).
- Cumulative Impacts. These are impacts that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable actions, regardless of who is responsible for such actions. CIAAs for each resource are identified in Table 3.2 and existing disturbance/conditions in these areas are discussed in Chapter 3. Cumulative impact assessment includes past, present, and reasonably foreseeable development (RFD). RFD for this project includes development that has been analyzed and approved under NEPA, including past development in Jonah Field, existing and approved developments in the Pinedale Anticline, and others, as appropriate, as well as other likely surface disturbance (e.g., South Piney Project).
- Unavoidable Adverse Impacts. These are impacts that cannot be completely mitigated.

Mitigation and other environmental protection measures are identified across alternatives in Chapter 2. Detailed descriptions of these measures are provided in Appendix A (BLM Standards), and Appendix B (Operator-committed practices). It is assumed that the application of identified mitigation and protection measures would reduce impact levels; however, the efficacy of many mitigations is unknown. Therefore, no quantitative variation in impact levels based upon the application of variable mitigations is provided.

Alternative-specific mitigation and monitoring measures for the Preferred Alternative are identified in Section 2.14. It is assumed that these measures would impart some level of impact reduction to various resources.

Irreversible and irretrievable commitment of resources and short-term use of the environment versus long-term productivity are discussed in separate sections following the discussions of specific resources (Sections 4.8 and 4.9, respectively).

Considerable natural gas development has already occurred within the JIDPA as approved in past NEPA documents (BLM 1998b, 2000b), and impacts from this past development would continue for approximately 63 years without any further development authorizations. Most impacts associated with this project, therefore, would involve increases in the magnitude and/or duration of impacts previously described in past NEPA documents (BLM 1997a, 2000a). Additionally, preliminary research and monitoring results indicate significant adverse impacts to many area resources have already occurred with existing development and mitigation requirements. Therefore, BLM is proposing to increase on-site mitigation efforts with a particular focus on reclamation, and recommend initiation of CM as appropriate and consistent with BLM policy. All CM efforts would be voluntarily developed and proposed by the Operator, and following approval and authorization by BLM, would become commitments of the Operator.

For most resources, the quicker the project is implemented, the shorter the duration of impacts; therefore, pace of development may have the greatest effect on area resources. For example, the faster the gas is recovered, the sooner the area can be reclaimed.

4.1 PHYSICAL RESOURCES

4.1.1 Climate

An assessment of project impacts to climate is beyond the scope of this analysis and is therefore not discussed further in this EIS.

4.1.2 Air Quality

Direct, indirect, and cumulative air quality impacts were analyzed to predict maximum potential near-field ambient air pollutant concentrations, as well as to determine maximum far-field ambient air pollutant concentrations, visibility (regional haze), and atmospheric deposition (acid rain) impacts. Maximum mid-field (regional community) visibility impacts were also determined, as were maximum in-field (within the JIDPA) concentration impacts.

This air quality impact assessment is based on the best available engineering data and assumptions, meteorology data, and 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% of fully permitted capacity. Other parameters for which no reliable most likely operating projections were available were assumed to occur at maximum proposed levels. For example, impact assessments for both the Proposed Action and alternatives assume that all proposed wells would be productive (no dry holes).

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--specifically, the WDEQ/AQD and the 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. Any proposed emissions source is 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 specific air pollutant emission sources proposed 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 (including a Best Available Control Technology [BACT] analysis and determination) to ensure protection of air quality.

Under FLPMA and the *Clean Air Act*, BLM cannot authorize any activity that does 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. The *Jonah Infill Natural Gas Project Air Quality*

Technical Support Document (TRC Environmental Corporation [TRC EC] 2004) provides additional detail on this air quality evaluation and is available for review at the PFO.

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) prescribe the following management goals/objectives associated with air quality:

- to maintain and, where possible, enhance air quality levels;
- to protect public health and safety and sensitive natural resources;
- to within authority minimize emissions which may add to acid rain, cause violations of air quality standards, or reduce visibility;
- to ensure that industries adhere to federal and state air quality standards; and
- to consider the frequency of atmospheric inversions, meteorology, topography, present ambient air quality, significant deterioration limits, and applicable local, state, and federal laws when evaluating land use proposals and development issues.

The significance criteria for potential air quality impacts include state and federally enforced legal requirements to ensure that air pollutant concentrations will remain within specific allowable levels, as well as adherence to the aforementioned RMP and land use plan goals and objectives. 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 have been presented in Table 3.7.

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 have been identified for Hazardous Air Pollution (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.

Air quality impacts from the project would occur from pollutants emitted during construction (due to potential surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well completion and testing, and drilling rig and vehicle engine exhaust) and production (natural gas well-site production equipment, reciprocating pipeline compression engine exhausts, vehicle traffic engine exhausts, and fugitive dust). Pollutants emitted from these activities include PM_{10}, $PM_{2.5}$, NO_X, CO, SO_2, VOC, and HAPs. O_3 may develop from NO_x and VOC emissions. Some amount of unquantified HAPs may also occur from water treatment. The amount of air pollutant emissions during construction and production may, in part, be controlled using the mitigation methods outlined in Section 2.14 and Appendices A and B. Impacts for the Preferred Alternative have been qualitatively estimated. Model runs to quantify the impacts of the Preferred Alternative will be conducted during the DEIS public comment period, and results will be reported in the FEIS. Actual air quality impacts from air pollutants would depend on the amount, duration, location, and emission characteristics of potential emissions sources, as well as meteorological conditions (e.g., wind speed and direction, precipitation, relative humidity).

The assessment of direct project impacts includes a near-field analysis and a far-field analysis, which were completed separately for selected project Alternatives. A summary of near-field and far-field impacts across alternatives is provided in Table 4.1. The near-field analysis assesses direct impacts in the immediate vicinity of project activities resulting from a single phase of construction or production reflective of maximum emissions. The far-field analysis assesses direct impacts from field-wide project emissions at in-field locations within the JIDPA, mid-field locations defined as Class II areas (Wyoming regional communities of Big Piney, Big Sandy, Boulder, Bronx, Cora, Daniel, Farson, LaBarge, Merna, and Pinedale), and at far-field locations (i.e., sensitive Class I and Class II areas) (see Map 3.1). The far-field analysis also assesses regional emission sources located within the model domain illustrated in Map 3.1 to predict cumulative impacts at in-field, mid-field, and far-field locations. While there may be additional gas processing and/or transmission requests due to development of this and other natural gas projects regionally and nationally, the potential effects of these developments are not quantified since they are speculative in nature and would likely require additional WDEQ/AQD permitting if eventually proposed.

Near-field Analysis

The near-field analysis utilized air pollutant emission rates calculated for all phases of construction and production based on WDEQ/AQD guidance in place at the time of the analysis. Impacts were assessed from the phase of single-well pad construction or field production that produced the highest emissions. Near-field analysis for PM_{10}, $PM_{2.5}$, and SO_2 focused on localized impacts from construction and drilling activity at a single well pad and analyzed direct project impacts within the JIDPA using three different well pad configurations to predict maximum impacts that could result from a single pad. A 3.8-acre single-well pad configuration, a 7-acre (two wells per pad) configuration, and a 10.0-acre (10 wells per pad) configuration were analyzed. These three scenarios reflect a range of wells per pad that may be developed under the alternatives. Direct project NO_X, CO, and HAPs impacts were modeled for 3,100- and 1,250-well developments to reflect the maximum range of wells in production under any alternatives. NO_2 and CO impacts analyses included project emissions combined with existing JIDPA wells and non-project existing and proposed compression to better approximate a NAAQS analysis under WDEQ/AQD requirements. Detailed information regarding the modeling methodologies used in the near-field analysis is provided in the *Jonah Infill Natural Gas Project Air Quality Technical Support Document* (TRC EC 2004).

O_3 is formed through a chemical reaction between NO_x, VOCs and ultraviolet light (sunlight) within the atmosphere. The EPA O_3 formation screening methodology (Scheffe 1988) was used to estimate maximum ozone impacts from NO_x and VOC emissions generated from the project. A representative 128-well section with a compressor station was used for this analysis. The maximum quantity of O_3 that could be formed from this project in combination with other existing projects and potential future developments is expected to be less than NAAQS. Further detail on O_3 is provided in the Air Quality Technical Support Document (TRC EC 2004).

Acute (short-term) HAP impacts were modeled by assuming a person would not persistently remain at a location closer than 100 m (328 ft) from a well pad or a compressor station due to site operations safety considerations. Long-term (chronic) health-based HAP impacts and long-term (chronic) cancer risk were modeled using the realistic estimate of long-term exposure, which assumes a person would not be closer than the nearest residence on the New Fork River, located 8 miles from a well pad or compressor site, when averaged over a lifetime. Two estimates of

Table 4.1 Summary of Primary Additional Air Quality Impacts Across Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

IMPACT	NO ACTION	PROPOSED ACTION (3,100 Wells/16,200 Acres Disturbance)	ALTERNATIVE A (3,100 Wells And Pads)	ALTERNATIVE B (3,100 Wells/No New Pads)	ALTERNATIVE C (1,250 Wells And Pads)	ALTERNATIVE D (2,220 Wells And Pads)	ALTERNATIVE E (266 New Pads; 16 Total Pads/Section)	ALTERNATIVE F (1,028 New Pads; 32 Total Pads/Section)	ALTERNATIVE G (2,553 New Pads; 64 Total Pads/Section)	PREFERRED ALTERNATIVE (Specific Maximum Disturbance Allowances, Mitigation/Monitoring)
AIR QUALITY										
Increased concentrations of criteria pollutants and Hazardous Air Pollutants (HAPs)	No impact above existing levels; no new developments	Potential near-field concentrations would be in compliance with applicable National Ambient Air Quality Standards (NAAQS) and Wyoming Ambient Air Quality Standards (WAAQS); potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable Prevention of Significant Deterioration (PSD) increments	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable PSD increments	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable PSD increments	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable PSD increments	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable PSD increments	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable PSD increments	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable PSD increments	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable PSD increments	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below applicable PSD increments
Visibility (regional haze) at Class I and Sensitive Class II areas (far-field)	No impact above existing levels; no new developments	Potential project impacts would be greater than 1.0 deciview (dv) for a maximum of 10 days per year; impairment at Bridger Wilderness only	Potential project impacts would be greater than 1.0 dv for a maximum of 10 days per year; impairment at Bridger Wilderness only	Potential project impacts would be greater than 1.0 dv for a maximum of 11 days per year; impairment at Bridger Wilderness only	Potential project impacts would be greater than 1.0 dv for a maximum of 8 days per year; impairment at Bridger Wilderness only	Potential project impacts would be greater than for Alternative C and less than for Alternative A	Potential project impacts would be similar to Alternative B	Potential project impacts would be greater than 1.0 dv for a maximum of 10 days per year; impairment at Bridger Wilderness only	Potential project impacts would be greater than for Alternative A and less than for Alternative F	Potential project impacts would be similar to Alternative G
Visibility (regional haze) (mid-field communities)	No impact above existing levels; no new developments	Maximum of 23 days per year >1.0 dv	Maximum of 23 days per year >1.0 dv	Maximum of 26 days per year >1.0 dv	Maximum of 17 days per year >1.0 dv	Impacts greater than Alternative C but less than Alternative A	Impacts similar to Alternative B	Maximum of 24 days per year >1.0 dv	Impacts greater than Alternative A but less than Alternative F	Impacts similar to Alternative G
Atmospheric/terrestrial deposition	No impact above existing levels; no new developments	Potential project impacts from sulfur deposition would be less than Deposition Analysis Threshold (DAT) at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT (i.e., 0.005 kg/ha/yr) at Bridger Wilderness (0.035 kg/ha/yr), Popo Agie Wilderness (0.017 kg/ha/yr), and Wind River Roadless Area (0.010 kg/ha/yr), and less than DAT at all other analyzed areas	Potential project impacts from sulfur deposition would be less than DAT at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT (i.e., 0.005 kg/ha/yr) at Bridger Wilderness (0.035 kg/ha/yr), Popo Agie Wilderness (0.017 kg/ha/yr), and Wind River Roadless Area (0.010 kg/ha/yr), and less than DAT at all other analyzed areas	Potential project impacts from sulfur deposition would be less than DAT at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT (i.e., 0.005 kg/ha/yr) at Bridger Wilderness (0.040 kg/ha/yr), Popo Agie Wilderness (0.019 kg/ha/yr), and Wind River Roadless Area (0.011 kg/ha/yr), and less than DAT at all other analyzed areas	Potential project impacts from sulfur deposition would be less than DAT at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT (i.e., 0.005 kg/ha/yr) at Bridger Wilderness (0.032 kg/ha/yr), Popo Agie Wilderness (0.015 kg/ha/yr), and Wind River Roadless Area (0.009 kg/ha/yr), and less than DAT at all other analyzed areas	Potential project impacts from sulfur deposition would be less than DAT (i.e., 0.005 kg/ha/yr) at all analyzed areas; potential project impacts from nitrogen deposition would be greater than for Alternative C but less than for Alternative A	Potential project impacts would be similar to Alternative B	Potential project impacts from sulfur deposition would be less than DAT (i.e., 0.005 kg/ha/yr) at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT at Bridger Wilderness (0.036 kg/ha/yr), Popo Agie Wilderness (0.017 kg/ha/yr), and Wind River Roadless Area (0.010 kg/ha/yr), and less than DAT at all other analyzed areas	Potential project impacts from sulfur deposition would be less than DAT (i.e., 0.005 kg/ha/yr) at all analyzed areas; potential project impacts from nitrogen deposition would be greater than for Alternative A but less than for Alternative F	Potential project impacts would be similar to Alternative G
Sensitive lake acid neutralization capacity (ANC)	No impact above existing levels; no new developments	Potential project impacts would be less than Level of Acceptable Change (LAC); potential cumulative impacts would be less than LAC	Potential project impacts would be less than LAC; potential cumulative impacts would be less than LAC	Potential project impacts would be less than LAC; potential cumulative impacts would be less than LAC	Potential project impacts would be less than LAC; potential cumulative impacts would be less than LAC	Potential project impacts would be less than LAC; potential cumulative impacts would be less than LAC	Potential project impacts would be less than LAC; potential cumulative impacts would be less than LAC	Potential project impacts would be less than LAC; potential cumulative impacts would be less than LAC	Potential project impacts would be less than LAC; potential cumulative impacts would be less than LAC	Potential project impacts would be less than LAC; potential cumulative impacts were less than LAC

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 estimated cancer risks were calculated based on EPA (1997) unit risk factors for carcinogenic constituents.

Near-field Impacts Summary

The near-field modeling results for the range of project alternatives are provided in Appendix F, Tables F-1 through F-8. A discussion of these results by alternative is presented in later sections. Maximum predicted concentrations of all criteria pollutants were added to the ambient background pollutant concentrations for comparison to WAAQS and NAAQS. Predicted impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. These tables also present the maximum impacts expressed as a percentage of the NAAQS and WAAQS. Predicted impacts from all project alternatives are less than the applicable WAAQS and NAAQS. Table F-2 also presents a comparison of the maximum predicted NO2 impacts resulting from production activities to the PSD Class II increment for NO_2. Background NO2 concentrations are not added to modeled concentrations for comparison to the PSD Class II Increment for NO_2. Predicted NO_2 impacts from all project alternatives are less than the applicable PSD increment. A comparison of the maximum modeled PM_{10} and SO_2 impacts to PSD Class II increments is not presented since these maximum impacts are associated with emissions from temporary construction activities and as such they do not consume PSD Class II increment (EPA 1990; WDEQ 1993). Production-related emissions of SO_2 and PM_{10} that would be subject to PSD regulations were not modeled for this project. These impacts however, would be required by Wyoming and Federal regulations to be within the applicable PSD increment thresholds. All NEPA analysis comparisons to the PSD Class II increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD Increment Consumption Analysis.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts representative of all project alternatives. For all alternatives, the predicted acute and chronic (long-term) impacts would be below applicable health-based levels for non-cancer compounds. In addition, calculated cancer risks from formaldehyde and benzene are less than the level of acceptable cancer risk of 1×10^{-6} (one in one million) for both the MLE and MEI scenarios except for MEI benzene scenario, which falls at the lower end of the 1×10^{-4} to 1×10^{-6} cancer risk range.

When reviewing predicted near-field impacts, it is important to understand that results reported reflect the maximum pollutant emission rates calculated for the field and 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 JIDPA emission sources would occur in the vicinity of the JIDPA. Because impacts typically lessen with distance from an emissions source, impacts at locations more distant from the JIDPA 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, these maximum concentrations may occur under very different meteorological conditions and may not occur simultaneously.

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 within these areas. The analysis also included an assessment of maximum mid-field (regional community) visibility impacts and air quality impacts at in-field locations within the JIDPA.

The air emissions modeled for project and non-project sources in the far-field analysis are presented in Appendix F Table F-9. Modeling scenarios were developed to approximate a range of project development including the Proposed Action, Alternative A, Alternative B, Alternative C, and Alternative F. These modeling scenarios assumed maximum field emissions that could potentially occur concurrently: during the final year of construction representing the maximum annual construction activity rate combined with nearly full-field production. For comparison purposes, an analysis of the JIDPA in full production, after all construction activities have ceased, is also presented for all alternatives with 3,100 producing wells. Maximum emissions scenarios include production emissions (producing well sites and ancillary equipment) and construction emissions (drilling rigs and pit flaring operations), both occurring continuously over the year. Three well development rates were analyzed--250 wells/year (WDR250), 150 wells/year (WDR150), and 75 wells/year (WDR75). The WDR250 assumes simultaneous operation of 20 drilling rigs and 3 pit flares, WDR150 assumes simultaneous operation of 12 drilling rigs and 2 pit flares, and WDR75 assumes simultaneous operation of 6 drilling rigs and 1 pit flare. Development rates considered both straight and directional drilling operations generally consistent with the various proposed project alternatives. The Proposed Action, Alternative A, and Alternative C scenarios assumed all straight-hole drilling. The Alternative B scenario assumed all directional drilling, and the Alternative F scenario assumes a combination of 50% straight hole drilling and 50% directional drilling operations. The WDR250 scenario model approximates Alternative A and WDR250 approximates the Proposed Action. Details on modeling methodology are presented in the Air Quality Technical Support Document (TRC EC 2004).

Predicted pollutant concentrations were compared to applicable ambient air quality standards and to PSD Class I and Class II increments, and were used to assess potential impacts to AQRVs--visibility (regional haze) and acid deposition--at sensitive PSD Class I and II areas. Ambient background concentrations were added to modeled concentrations for comparison to ambient air quality standards. No ambient background was added to modeled concentrations for comparison to PSD Class I and II Increments. PSD Class I areas and sensitive Class II areas analyzed in the far-field analyses include the following:

- Bridger Wilderness Area (Class I),
- Fitzpatrick Wilderness Area (Class I),
- Popo Agie Wilderness Area (Class II),
- Wind River Roadless Area (Class II),
- Grand Teton National Park (Class I),
- Teton Wilderness Area (Class I) ,

- Yellowstone National Park (Class I), and
- Washakie Wilderness Area (Class I).

Because emissions sources under the Proposed Action and alternatives consist of many small sources spread out over a large area, discrete visible plumes are not likely to impact distant sensitive areas. However, visible plumes may be noticeable within the JIDPA from nearby travel routes and at nearby towns on occasion, especially during flaring upset conditions. Nonetheless, the potential for cumulative visibility impacts (increased regional haze) is a concern.

Regional haze is caused by light scattering and light absorption by fine particles and gases. Potential changes to regional haze are 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 reasonably foreseeable significant adverse impact, 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 Technical Support Document (TRC EC 2004).

The NPS, USFS, and USFWS have published the *Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report* (FLAG 2000) that prescribes a process for assessing impacts of new and existing sources on AQRVs, including visibility. The FLAG Report describes a cumulative impacts analysis of new growth sources (defined as PSD increment-consuming sources) on visibility. If predicted visibility impacts are above a visibility threshold of 1.0 dv for all days, factors such as magnitude of dv change, frequency, seasonal variations, and meteorological conditions may be considered when assessing the significance of predicted impacts.

Potential changes in regional haze at PSD Class I and sensitive PSD Class II areas were estimated by comparing CALPUFF modeled impacts to background visibility conditions in Class I or sensitive Class II area. This comparison was performed using two different representations of background visibility conditions. One method used visibility values provided in the FLAG Report for each Class I area to represent natural background visibility. The second method used estimated background visibility values from an analysis of recent long-term monitored data (1988–2002) from the IMPROVE program. This analysis consisted of estimating visibility parameters for representative Class I areas corresponding to the monitoring period of record quarterly average of the 20% best visibility days.

Potential changes to regional haze resulting from project source emissions were also estimated for nearby communities located in PSD Class II areas (mid-field). Model-predicted concentration impacts within these communities were used to estimate potential impacts to visibility. Background visibility data monitored at the Class I Bridger Wilderness Area, an area more pristine than populated residential areas, were used to estimate potential visibility impairment in these residential areas. These data were used because no visibility monitoring has been conducted in populated areas of the region. Since visibility impacts are calculated as percent increases of modeled concentrations above background values, the use of a more pristine background results in an overestimate of potential visibility impacts.

Seven lakes within the sensitive PSD Class I and Class II Wilderness 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:

- Deep Lake in the Bridger Wilderness Area,
- Black Joe 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 NPS (2001) has identified Deposition Analysis Thresholds (DATs) for total nitrogen (N) and sulfur (S) deposition in the western U.S. as 0.005 kilograms per hectare per year (kg/ha-year) for both N and S. The DAT is used as an analysis threshold for evaluating potential impacts from project-related emissions. 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. These thresholds (herein referred to as levels of concern), defined as 5 kg/ha-yr for S and 3 kg/ha-yr for N, are used for comparison of potential impacts from cumulative source emissions. The USFS Rocky Mountain Region has also developed a screening method (USFS 2000) that identifies a Limit of Acceptable Change (LAC) in lake chemistry. The LACs are 1) no more than a 10% change in acid-neutralizing capacity (ANC) for lakes with an existing ANC of 25 microequivalents per liter (µeq/l) or greater and 2) no more than a 1-µeq/l change for extremely acid-sensitive lakes where the existing ANC is below 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.

Far-field Impacts Summary

An overall summary of maximum direct project far-field impacts by alternative is provided in Table 4.1. Pollutant concentrations under all project alternatives would be below applicable ambient air quality standards and PSD increments (see Appendix F, Tables F-10 through F-16). Direct project NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area for various development alternatives, but would be below the SILs at all other sensitive areas.

Direct project visibility impacts from all alternatives were predicted to be above "just noticeable visibility changes" (1.0-dv) threshold at the Bridger Wilderness Area, using both the FLAG and IMPROVE background visibility data (see Appendix F, Tables F-17 and F-18). There were no predicted direct project impacts above the 1.0-dv threshold at any other analyzed sensitive area.

Direct project source emissions under all project alternatives would not result in an increase in ANC above any LAC at the acid-sensitive lakes (see Appendix F, Tables F-19 through F-21). The predicted maximum S deposition impacts from all alternatives are below the 0.005 kg/ha-yr

DAT at all sensitive PSD Class I and Class II areas. Under various alternatives, the maximum predicted N impacts are above the 0.005 kg/ha-yr DAT at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and are below the DAT at all other sensitive areas.

The number of days of direct project visibility impacts within the mid-field (Wyoming regional communities) were predicted to be above the "just noticeable visibility change" (1.0-dv) threshold as shown in Appendix F, Tables F-22 and F-23.

Estimated direct project impacts at in-field locations are below the applicable ambient air quality standards (see Appendix F, Table 2-24).

A presentation of the aforementioned results for each alternative and for cumulative source impacts is presented below.

4.1.2.1 No Action Alternative

Near-field Impacts

No project-related near-field impacts beyond currently approved levels would occur in the JIDPA under the No Action Alternative. As a result, near-field air quality impacts would reflect those analyzed in the Jonah Field II EIS (BLM 1997a, 1998a), and air quality would remain similar to existing levels.

Far-field Impacts

No new project-related development would occur under the No Action Alternative; therefore, no far-field impacts would occur beyond those analyzed in the Jonah Field II EIS (BLM 1997a, 1998a). Air quality would remain similar to existing levels.

4.1.2.2 Proposed Action

Near-field Impacts

The construction or production phase of the Proposed Action that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of the Proposed Action modeled were: PM_{10} and $PM_{2.5}$ using a 3.8-acre pad; SO_2 using straight hole drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 128 wells per section (5.0-acre surface well spacing). These configurations result in the maximum predicted impacts for the Proposed Action.

The maximum predicted impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparison of these impacts to WAAQS and NAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Table F-2 also presents a comparison of maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Proposed Action source emissions are less than the applicable WAAQS and NAAQS and PSD increments.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts based on emissions representative of the Proposed Action.

Far-field Impacts

Direct impacts from the Proposed Action maximum emissions scenario (the last year of field construction and the full field in production) were modeled as set forth in the *Jonah Infill Natural Gas Project Air Quality Technical Support Document* (TRC EC 2004). The emissions modeled are provided in Appendix F, Table F-1. Appendix F Tables F-10, F-11, F-12, and F-13 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix F Tables F-14, F-15, and F-16 present the maximum modeled Proposed Action impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from Proposed Action source emissions would be below the applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from the Proposed Action were predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area, using both the FLAG and IMPROVE background visibility data. The visibility impacts resulting from direct project source emissions are provided in Appendix F Table F-17 for the FLAG background visibility data, and in Table F-18 for the IMPROVE background visibility data. Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions from the Proposed Action would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). The predicted maximum S deposition impacts (Appendix F Table F-20) from the Proposed Action are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. For the maximum emissions scenario, maximum N impacts (Appendix F Table F-21) are predicted to be above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and below the DAT at all other sensitive areas. The maximum predicted N deposition impacts from the full field in production emissions scenario are above the DAT at the Bridger Wilderness Area and below the DAT at all other sensitive areas. The exceedances of this threshold trigger a management concern but are not necessarily indicative of an adverse impact (NPS 2004).

Mid-field Impacts

Maximum visibility impacts and the estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at nearby Wyoming communities from the Proposed Action source emissions scenarios are shown in Appendix F Table F-22 for the FLAG visibility data and Table F-23 for the IMPROVE visibility data.

In-field Impacts

Appendix F Table F-24 presents the maximum impacts from all Proposed Action source emissions compared to ambient air quality standards estimated to occur within the JIDPA. These project-related impacts are below applicable ambient air quality standards.

4.1.2.3 Alternative A

Near-field Impacts

The construction or production phase of the Alternative A scenarios that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of Alternative A modeled were: PM_{10} and $PM_{2.5}$ using a 3.8-acre pad; SO_2 using straight hole drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 128 wells per section (5.0-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative A.

The predicted impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparisons of these impacts to WAAQS and NAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Table F-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative A source emissions are less than the applicable WAAQS and NAAQS and PSD increments.

Appendix F Table F-8 and F-9 summarize modeled HAP impacts based on emissions from Alternative A sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ from Alternative A were estimated at each of the eight Class I and sensitive Class II areas. The emissions modeled for Alternative A scenarios are provided in Appendix F Table F-9. Appendix F Tables F-10, F-11, F-12, and F-13 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix F Tables F-14, F-15, and F-16 present the maximum modeled Alternative A concentration impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from Alternative A source emissions scenarios are less than the applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative A source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each of the three development rate alternatives, using both the FLAG and IMPROVE background visibility data. The visibility impacts resulting from direct project source emissions are provided in Appendix F Table F-17 for the FLAG background visibility data and in Table F-18 for the IMPROVE background visibility data.

Direct project source emissions from Alternative A would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). The predicted maximum S deposition impacts (Appendix F Table F-20) from Alternative A sources are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. For the development rates WDR250 and WDR150, the predicted N impacts (Appendix F Table F-21) are above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and below the DAT at all other sensitive areas. N impacts from the WDR75

development rate are above the DAT at the Bridger Wilderness and Popo Agie Wilderness and below the DAT at all other sensitive areas.

Mid-field Impacts

The maximum visibility impacts (dv) and estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at nearby Wyoming towns for Alternative A scenarios are shown in Appendix F Tables F-22 for the FLAG visibility data and F-23 for the IMPROVE visibility data.

In-field Impacts

Model predicted concentrations of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$, resulting from Alternative A source emissions at locations within the JIDPA are shown in Appendix F Table F-24. The estimated project-related impacts are less than applicable ambient air quality standards.

4.1.2.4 Alternative B

Near-field Impacts

The construction or production phase of Alternative B scenarios that would produce maximum emissions were identified by pollutant and analyzed. The maximum emissions configurations representative of Alternative B modeled were: PM_{10} and $PM_{2.5}$ using a 10.0-acre pad; SO_2 using directional drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 16 well pads per section (40-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative B.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparison of these impacts to WAAQS and NAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Table F-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative B source emissions are less than applicable WAAQS and NAAQS and PSD increments.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts based on emissions from Alternative B sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ were estimated at each of the eight Class I and sensitive Class II areas. The emissions modeled for Alternative B scenarios are provided in Appendix F Table F-9. Appendix F Tables F-10, F-11, F-12, and F-13 present the maximum predicted concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix F Tables F-14, F-15, and F-16 present the maximum modeled Alternative B impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from all Alternative B source emissions scenarios would be below applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative B source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. A summary of these impacts is provided in Appendix F Tables F-17 (FLAG) and F-18 (IMPROVE). Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions from Alternative B would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). Predicted maximum S deposition impacts (Appendix F Table F-20) from Alternative B sources are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. For the well development rates WDR250 and WDR150, the predicted N impacts (Appendix F Table F-21) are above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and below the DAT at all other sensitive areas. N impacts from the WDR75 development rate are above the DAT at the Bridger Wilderness and Popo Agie Wilderness and below the DAT at all other sensitive areas.

Mid-field Impacts

The maximum visibility impacts (dv) and estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at nearby Wyoming towns from Alternative B scenarios are shown in Appendix F Table F-22 (FLAG) and F-23 (IMPROVE).

In-field Impacts

Model predicted concentrations of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ resulting from Alternative B source emissions at locations within the JIDPA are shown in Appendix F Table F-24. The estimated project-related impacts are below applicable ambient air quality standards.

4.1.2.5 Alternative C

Near-field Impacts

The construction or production phase of the Alternative C scenarios that would produce maximum emissions were identified by pollutant and analyzed. The maximum emissions configurations representative of Alternative C modeled were: PM_{10} and $PM_{2.5}$ using a 3.8-acre pad; SO_2 using straight drilling; and NO_2, CO, and HAP using 1,250 wells developed in the field at 32 well pads per section (20.0-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative C.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparison of these impacts to WAAQS and NAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Table F-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative C source emissions are less than the applicable WAAQS and NAAQS standards and PSD increments.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts based on emissions from Alternative C sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ were estimated at each of the eight Class I and sensitive Class II areas. The emissions modeled for Alternative C scenarios are provided in Appendix F Table F-9. Appendix F Tables F-10, F-11, F-12, and F-13 present the maximum predicted impacts of NO_2, SO_2, PM_{10} and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix F Table F-14, F-15, and F-16 present the maximum modeled Alternative C impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from all Alternative C source emissions scenarios would be below applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative C source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. A summary of these impacts is provided in Appendix F Tables F-17 (FLAG) and F-18 (IMPROVE). Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). The predicted maximum S deposition impacts (Appendix F Table F-20) from Alternative C sources are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. For the well development rates WDR250 and WDR150, the predicted N impacts (Appendix F Table F-21) are above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and below the DAT at all other sensitive areas. N impacts from the WDR75 development rate are above the DAT at the Bridger Wilderness and Popo Agie Wilderness and below the DAT at all other sensitive areas.

Mid-field Impacts

The maximum visibility impacts (dv) and estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at nearby Wyoming towns from Alternative C scenarios are shown in Appendix F Tables F-22 (FLAG) and F-23 (IMPROVE).

In-field Impacts

Model predicted concentrations of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ resulting from Alternative C source emissions at locations within the JIDPA are shown in Appendix F Table F-24. The estimated project-related impacts are below applicable ambient air quality standards.

4.1.2.6 Alternative D

Near-field Impacts

The construction or production phase of the Alternative D scenarios that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of Alternative D modeled were: PM_{10} and $PM_{2.5}$ using a 3.8-acre

pad; SO_2 using straight hole drilling; and NO_2, CO, and HAP using 2,200 wells developed in the field at 64 well pads per section (10.0-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative D.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparison of these impacts to WAAQS and NAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Table F-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative D source emissions are less than the applicable WAAQS and NAAQS and PSD increments.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts based on emissions from Alternative D sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ would be comparable to those estimated for Alternative A and Alternative C (see Sections 4.1.2.3 and 4.1.2.5, respectively, and Appendix F Tables F-10 through F-16). The estimated project-related impacts at the Class I and sensitive Class II areas are below the applicable ambient air quality standards and PSD increments. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative D source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. Estimated impacts would be slightly less than those presented for Alternative A scenarios but above the impacts presented for Alternative C scenarios (Appendix F Table F-17 and F-18). Visibility impacts at all other sensitive areas are predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). The predicted maximum S deposition impacts (Appendix F Table F-20) from Alternative D sources would be below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. The predicted N deposition impacts (Appendix F Table F-21) would be similar to those presented for Alternative A and Alternative C scenarios (see Sections 4.1.2.3 and 4.1.2.5, respectively), which predict impacts would be above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area.

Mid-field Impacts

Maximum visibility impacts at nearby Wyoming towns from Alternative D scenarios are predicted to be slightly less than those of Alternative A scenarios but above those presented for Alternative C scenarios, (see Sections 4.1.2.3 and 4.1.2.5, respectively, and Appendix F Tables F-22 and F-23).

In-field Impacts

Predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from Alternative D source emissions at locations within the JIDPA would be between those presented for Alternative A and Alternative C (see Sections 4.1.2.3 and 4.1.2.5, respectively, and Appendix F Table F-24). Estimated project-related impacts from Alternative D sources are predicted to be below applicable ambient air quality standards.

4.1.2.7 Alternative E

Near-field Impacts

The construction or production phase of Alternative E scenarios that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of Alternative E modeled were: PM_{10} and $PM_{2.5}$ using a 10.0-acre pad; SO_2 using directional drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 40 well pads per section (16-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative E.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparison of these impacts to WAAQS and NAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Table F-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative E source emissions are less than the applicable WAAQS and NAAQS and PSD increments.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts based on emissions from Alternative E sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ would be comparable to those estimated for Alternative B (see Section 4.1.2.4, and Appendix F Tables F-10-F-16). Estimated project-related impacts at the Class I and sensitive Class II areas are below the applicable ambient air quality standards and PSD increments. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative E source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. Estimated impacts would be slightly less than those presented for Alternative B scenarios (Appendix F Tables F-17 and F-18). Visibility impacts at all other sensitive areas are predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). The predicted maximum S deposition impacts (Appendix F Table F-20) from Alternative E sources would be below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. Predicted N deposition impacts (Appendix F Table F-21) would be similar to those presented for Alternative B (see Section 4.1.2.4), which predict

impacts would be above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area.

Mid-field Impacts

Maximum visibility impacts at nearby Wyoming towns from Alternative E scenarios are predicted to be slightly lower than those of Alternative B scenarios (see Section 4.1.2.4 and Appendix F Table F-22 and F-23).

In-field Impacts

Predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from Alternative E source emissions at locations within the JIDPA would be similar to those presented for Alternative B (see Section 4.1.2.4 and Appendix F Table F-24). The estimated project-related impacts from Alternative E sources are predicted to be below applicable ambient air quality standards.

4.1.2.8 Alternative F

Near-field Impacts

The construction or production phase of Alternative F scenarios that would produce maximum emissions was identified by pollutant and analyzed. The maximum emission configurations representative of Alternative F modeled were: PM_{10} and $PM_{2.5}$ using a 7.0-acre pad; SO_2 using directional drilling; and NO_2, CO, and HAP using 3,100 well pads developed in the field at 32 well pads per section (20.0-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative F.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and a comparison of these impacts to WAAQS and NAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Table F-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative F source emissions would be below the applicable WAAQS and NAAQS and PSD increments.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts based on emissions from Alternative F sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ were estimated at each of the eight Class I and sensitive Class II areas. The emissions modeled for Alternative F scenarios are provided in Appendix F Table F-9. Appendix F Tables F-10, F-11, F-12, and F-13 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix F Table F-14, F-15, and F-16 present the maximum modeled Alternative F impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from all Alternative F source emissions scenarios would be below applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative F source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. A summary of these impacts is provided in Appendix F Tables F-17 (FLAG) and F-18 (IMPROVE). Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions from Alternative F would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). Predicted maximum S deposition impacts (Appendix F Table F-20) from Alternative F sources are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. For well development rates WDR250 and WDR150, predicted N impacts (Appendix F Table F-21) are above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and below the DAT at all other sensitive areas. N impacts from the WDR75 development rate are above the DAT at the Bridger Wilderness and Popo Agie Wilderness and below the DAT at all other sensitive areas.

Mid-field Impacts

Maximum visibility impacts (dv) and the estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at nearby Wyoming towns from Alternative F scenarios are shown in Appendix F Table F-22 (FLAG) and Table F-23 (IMPROVE).

In-field Impacts

Model predicted concentrations of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ resulting from Alternative F source emissions at locations within the JIDPA are shown in Appendix F Table F-24. The estimated project-related impacts are below applicable ambient air quality standards.

4.1.2.9 Alternative G

Near-field Impacts

The construction or production phase of the Alternative G scenarios that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of Alternative G modeled were: PM_{10} and $PM_{2.5}$ using a 3.8-acre pad; SO_2 using directional drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 64 well pads per section (10.0-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative G.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparison of these impacts to WAAQS and NAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Table F-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative G source emissions are less than the applicable WAAQS and NAAQS and PSD increments.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts based on emissions from Alternative G sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ would be comparable to those estimated for Alternative A and Alternative C (see Sections 4.1.2.3 and 4.1.2.5, respectively, and Appendix F Tables F-10-F-16). The estimated project-related impacts at Class I and sensitive Class II areas are well below the applicable ambient air quality standards and PSD increments. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative G source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. Estimated impacts would be slightly less than those presented for Alternative A scenarios but above the impacts presented for Alternative C scenarios (Appendix F Table F-17 and F-18). Visibility impacts at all other sensitive areas are predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). Predicted maximum S deposition impacts (Appendix F Table F-20) from Alternative G sources would be below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. Predicted N deposition impacts (Appendix F Table F-21) would be similar to those presented for Alternative A and Alternative F scenarios (see Sections 4.1.2.3 and 4.1.2.8, respectively), which predict impacts would be above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area.

Mid-field Impacts

Maximum visibility impacts at nearby Wyoming towns from Alternative G scenarios are predicted to be greater than those of Alternative A scenarios, but less than those presented for Alternative F scenarios, (see Sections 4.1.2.3 and 4.1.2.8, respectively, and Appendix F Tables F-22 and F-23).

In-field Impacts

Predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from Alternative G source emissions at locations within the JIDPA would be between those presented for Alternative A and Alternative F (see Sections 4.1.2.3 and 4.1.2.8, respectively, and Appendix F Table F-24). Estimated project-related impacts from Alternative G sources are predicted to be below applicable ambient air quality standards.

4.1.2.10 BLM Preferred Alternative

Near-field Impacts

The construction or production phase of the Preferred Alternative scenarios that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of the Preferred Alternative modeled were: PM_{10} and $PM_{2.5}$ using a 7.0-acre pad; SO_2 using directional drilling; and NO_2, CO, and HAP using 3,100 wells developed

in the field at 16 well pads per section (40.0-acre surface well spacing). These configurations result in the maximum predicted impacts for the Preferred Alternative.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and a comparison of those impacts to NAAQS and WAAQS are presented in Appendix F Tables F-1, F-2, F-3, F-4, F-5, and F-6, respectively. Appendix F Tables F-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from the Preferred Alternative source emissions would be below the applicable WAAQS and NAAQS and PSD increments.

Appendix F Tables F-7 and F-8 summarize modeled HAP impacts based on emissions from Preferred Alternative sources.

Far-field Impacts

Direct project impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ would be comparable to those estimated for Alternative G (Section 4.1.2.9, and Appendix F Tables F-10 through F-16). The estimated project-related impacts at the Class I and sensitive Class II areas are below applicable ambient air quality standards and PSD increments. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Preferred Alternative source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. Estimated impacts would be comparable to those presented for Alternative G scenarios (Appendix F Tables F-17 and F-18). Visibility impacts at all other sensitive areas are predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix F Table F-19). Predicted maximum S deposition impacts (Appendix F Table F-20) from Preferred Alternative sources would be below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. Predicted N deposition impacts (Appendix F Table F-21) would be similar to those presented for Alternative G scenarios (see Section 4.1.2.9), which predict impacts would be above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area.

Mid-field Impacts

Maximum visibility impacts at nearby Wyoming towns from Preferred Alternative scenarios are predicted to be similar to those of Alternative G scenarios (see Section 4.1.2.9 and Appendix F Tables F-22 and F-23).

In-field Impacts

Predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from Preferred Alternative source emissions at locations within the JIDPA would be similar to those presented for Alternative G (see Section 4.1.2.9, and Appendix F Table F-24). Estimated project-related impacts from Preferred Alternative sources are predicted to be below applicable ambient air quality standards.

Preferred Alternative Air Quality Mitigation Measures

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14).

4.1.2.11 Cumulative Impacts

The CALPUFF model was used to quantify the impacts of NO_X, SO_2, PM_{10}, and $PM_{2.5}$ resulting from project sources, state-permitted sources, RFFA, and RFD located within the model domain (see Map 3.1). Project source emissions are described in Section 4.1.2 and quantified in Appendix F Table F-9. State-permitted sources include NO_X, SO_2 and/or $PM_{10}/PM_{2.5}$ sources that began operation after January 1, 2001, and were permitted before June 20, 2003. Sources permitted within the 18 months prior to January 1, 2001, but not yet operating were included as RFFA. RFD was 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, RFFA, and RFD emissions modeled in the cumulative analysis are quantified in Appendix F Table F-9. RFD projects included in the cumulative analysis are listed in Appendix F Table F-25. RFD projects were analyzed utilizing the maximum production scenario identified for each project. Emissions from field development (the construction phase) of RFD were not analyzed; rather, the combined emissions of all RFD operating at maximum production levels simultaneously was considered a conservative representation of domain-wide emissions. 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. However, because RFD project development rates and schedules vary for each project and are difficult to define with certainty, it was determined that all emission sources operating at maximum production rates was 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 of this and other natural gas projects regionally and nationally, the potential effects of these developments are not quantified herein since these developments are speculative and would likely require additional WDEQ/AQD permitting if they eventually are proposed. A portion of the Powder River Basin Oil and Gas Development project, located more than 185 miles (>300 km) east-northeast of the JIDPA, is located within the far-field modeling domain defined in Map 3.1. A ratio of total Powder River Basin project field development equal to the geographical portion within the JIDPA far-field modeling domain was included as RFD in this analysis. The Powder River Basin project identified significant project-specific and cumulative impacts in the Bridger Wilderness and other sensitive areas analyzed for this project. Further information on air quality impacts associated with the PRBP may be found in the BLM (2002b).

Recent estimation of NO_X emissions in the Pinedale Anticline Project Area has shown that NO_X emissions are greater than assumed in the Pinedale Anticline EIS (BLM 2004d). Since a quantitative relationship between air emissions and the subsequent potential cumulative impacts to air quality is complex and time consuming, it was not possible to quantify potential impacts of these increased NO_X emissions in this DEIS.

Cumulative impacts were analyzed at each of the eight Class I and sensitive Class II areas, and at mid-field (regional communities) and in-field locations within the JIDPA. Ambient concentrations were estimated at each Class I and sensitive Class II area and at locations within the JIDPA. Acid deposition calculations were performed for each Class I and sensitive Class II

area and at acid-sensitive lakes within these areas. Visibility impacts were computed for each Class I and sensitive Class II area and at mid-field (regional communities) locations.

Impacts Summary. The cumulative far-field modeling results for the range of project alternatives are provided in Appendix F Tables F-26 through F-40. These tables present the estimated cumulative impacts resulting from project and regional source emissions. A discussion of the cumulative modeling results for each alternative is presented below.

Appendix F Tables F-26, F-27, F-28, and F-29 present the maximum predicted cumulative impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. These maximum predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Appendix F Tables F-30, F-31, and F-32 present the maximum modeled direct project and cumulative source impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to applicable PSD increments. As shown in these tables, cumulative pollutant concentrations from all project alternatives would be below applicable ambient air quality standards and PSD increments.

Estimated cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from project and regional source emissions are provided in Appendix F Table F-33 for the FLAG background visibility data, and in Appendix F Table F-34 for the IMPROVE background visibility data. As shown in these tables, cumulative visibility impacts from project alternatives were predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area and Wind River Roadless Area using the FLAG background data and at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Areas using the IMPROVE background visibility data. There were no predicted impacts above the 1.0-dv threshold at any of the other analyzed sensitive areas.

Appendix F Table F-35 provides a summary of the maximum potential change in ANC at each of the analyzed sensitive lakes for each project alternative. Maximum modeled cumulative deposition impacts are provided in Appendix F Table F-36 (S) and Table F-37 (N). Cumulative emissions from any of the project alternative sources combined with regional sources would not result in an increase in ANC above any LAC at the acid-sensitive lakes. In addition, predicted maximum cumulative S and N deposition impacts from all alternatives are well below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern at all sensitive PSD Class I and Class II areas. Further detail on cumulative S and N deposition impacts is provided in the air quality technical support document (TRC EC 2004).

Modeled cumulative visibility impacts at mid-field Wyoming regional community locations from project and regional source emissions are provided in Appendix F Table F-38 for the FLAG background visibility data and in Table F-39 for the IMPROVE background visibility data. The number of days cumulative visibility impacts were predicted to be above the "just noticeable visibility change" (1.0-dv) threshold are shown in these tables for each project alternative scenario.

Appendix F Table F-40 presents the maximum predicted cumulative impacts for each project alternative at in-field location compared to ambient air quality standards after adding monitored background concentrations. These estimated cumulative impacts are below applicable ambient air quality standards.

No Action Far-field Cumulative Impacts. Modeling was performed for the No Action Alternative to estimate cumulative impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ from non-project related source emissions consisting of RFD, RFFA, and state-permitted sources. Appendix F Tables F-26, F-27,

F-28, and F-29 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. These maximum predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Appendix F Tables F-30, F-31, and F-32 present the maximum modeled cumulative No Action impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to applicable PSD increments. As shown in these tables, pollutant concentrations from No Action Alternative source emissions scenarios would be well below the applicable ambient air quality standards and PSD increments.

The visibility impacts resulting from cumulative No Action source emissions are provided in Appendix F Table F-33 for the FLAG background visibility data and in Table F-34 for the IMPROVE background visibility data. Impacts are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area using both the FLAG and IMPROVE background visibility data. Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days. Current regional visibility trends are shown in Figures 3.2 through 3.4.

Cumulative acid deposition impacts at the seven sensitive lakes (Appendix F Table F-35) are below the ANC change LACs. In addition, cumulative total N (Appendix F Table F-36) and S deposition (Appendix F Table F-37) are below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern.

No Action Mid-field Cumulative Impacts. The maximum visibility impacts at nearby Wyoming towns are shown in Appendix F Table F-38 (FLAG) and Table F-39 (IMPROVE). The estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold and the maximum dv change are shown.

No Action In-field Cumulative Impacts. Model predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from No Action cumulative source emissions at locations within the JIDPA are shown in Appendix F Table F-24. The maximum impacts shown are compared to ambient air quality standards after adding monitored background concentrations. The estimated non-project impacts are below applicable ambient air quality standards.

Proposed Action Far-field Cumulative Impacts. Modeling was performed for the Proposed Action to estimate cumulative impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ from project and non-project related source emissions, consisting of RFD, RFFA, and state-permitted sources. Appendix F Tables F-26, F-27, F-28, and F-29 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. These maximum predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Appendix F Tables F-30, F-31, and F-32 present the maximum modeled cumulative impacts of NO_2, SO_2, and PM_{10}, respectively, from Proposed Action and regional sources for comparison to applicable PSD increments. As shown in these tables, pollutant concentrations from Proposed Action and regional source emissions scenarios would be below applicable ambient air quality standards and PSD increments.

The cumulative visibility impacts for the Proposed Action are provided in Appendix F Table F-33 (FLAG) and in Table F-34 (IMPROVE). Visibility impacts are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area and Wind River Roadless Area using both the FLAG and IMPROVE background visibility data. Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Cumulative acid deposition impacts at the seven sensitive lakes (Appendix F Table F-35) are below the ANC change LACs. In addition, cumulative total N (Appendix F Table F-36) and S deposition (Appendix F Table F-37) are well below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern.

Proposed Action Mid-field Cumulative Impacts. The maximum visibility impacts at nearby Wyoming towns are shown in Appendix F Table F-38 (FLAG) and Table F-39 (IMPROVE). The estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold and the maximum dv change are shown.

Proposed Action In-field Cumulative Impacts. Model predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from Proposed Action and regional source emissions at locations within the JIDPA are shown in Appendix F Table F-24. The maximum impacts shown are compared to ambient air quality standards after adding monitored background concentrations.

Cumulative Impacts for Other Project Alternatives. The predicted cumulative impacts from all other project alternatives are well below the applicable ambient air quality standards and PSD Class I increments. Estimated acid deposition impacts at the seven sensitive lakes are below the ANC change LACs. In addition, cumulative total N and S depositions are well below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern. Visibility impacts from the other project alternatives that include increased directional drilling activities have the potential to slightly increase the estimated number of days of visibility impairment. The cumulative far-field modeling results for all project alternatives are summarized in Appendix F Tables F-26 through F-40.

4.1.2.12 Unavoidable Adverse Impacts

Some increase in air pollutant emissions would occur as a result of the Proposed Action and alternatives. Near-field impacts from these emissions are predicted to be below applicable significance thresholds. However, there is a potential for direct and cumulative visibility impacts to exceed visibility levels of concern within PSD Class I Bridger Wilderness Area and deposition thresholds within Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area.

4.1.3 Topography

Impacts to topography would be considered significant if disturbance permanently inhibited or substantially altered surface drainage patterns (e.g., new head-cutting and/or gully formation inhibiting surface runoff to areas where wetlands or riparian areas depend on it, changes that substantially redirect surface runoff). Project impacts to topography are assumed to be proportional to the volume of surface disturbance (i.e., increased surface disturbance would correspond to an increase in the potential for altered surface drainage patterns). Specific impacts would include changes to the landscape due to cut-and-fill (surface-leveling) activities used to construct well pads, access roads, and other facilities; road and pipeline crossings of channels; and slope and drainage alterations. The landscape and surface drainage alterations associated with this project would require specific mitigation as identified in Appendices A, B, and G.

4.1.3.1 No Action Alternative

Under the No Action Alternative, impacts to topography would be limited to the existing developments for 497 well pads and associated facilities--4,209 acres initially and 1,409 acres for the LOP (see Table 2.3). No significant impacts are anticipated. The duration of impacts would be approximately 63 years (see Table 2.2) and until areas are adequately reclaimed (see Appendix G).

4.1.3.2 The Proposed Action

An estimated maximum of 20,409 acres of disturbance would occur under the Proposed Action (see Table 2.4), 14,369 acres of which would be short-term, because surface disturbance areas not needed for operations would be recontoured and reseeded within 2 to 4 years after disturbance (e.g., portions of well pads and road ROWs and entire pipeline ROW areas). Long-term LOP disturbance is estimated at 6,040 acres and is anticipated to last for 76 years (250 wells developed per year) and until successful reclamation is achieved (see Table 2.2). An approximate 285% increase in new disturbance and 229% increase in LOP disturbance above the No Action would occur under the Proposed Action, impact duration would be extended at least an additional 13 years (76-year LOP), and significant impacts are anticipated.

4.1.3.3 Alternative A

The types of impacts to topography under Alternative A would be similar to that described for the No Action but there would be an additional 16,200 acres of initial disturbance. Impacts may be further amplified if BLM standard stipulations (particularly those regarding steep slopes and drainage channels) are excepted (see Appendix A). Additionally, impacts would occur in some areas that would be avoided under the Proposed Action (i.e., greater sage-grouse lek, raptor nest, and Sand Draw buffers) and, depending upon the rate of development, impacts could last for an additional 29 or more years (75 wells developed per year) plus the time needed for successful reclamation (see Table 2.2). Significant impacts are anticipated.

4.1.3.4 Alternative B

Impacts to topography under Alternative B would be similar to those of the No Action Alternative except that total new initial disturbance would be 3,297 acres more than that required for the No Action Alternative (see Table 2.5). LOP disturbance would be 1,213 acres more than No Action LOP disturbance, and most surface disturbance would occur as expansions at existing disturbance areas. No significant impacts are anticipated. Depending upon the rate of development, the duration of impacts could be 76 (250 new wells per year) to a 105 years (75 new wells per year) plus the time needed for successful reclamation (see Table 2.2).

4.1.3.5 Alternative C

Under Alternative C, impacts to topography would be similar to those of the No Action Alternative, except that Alternative C would result in 6,705 acres of disturbance, 1,990 acres of additional LOP disturbance (see Table 2.6). Impact duration would range from 68 years (250 wells/year) to 80 years (75 wells/year) plus the time needed for successful reclamation (see Table 2.2), and significant impacts are anticipated.

4.1.3.6 Alternative D

Under Alternative D, impacts to topography would be similar to those of the No Action Alternative except that Alternative D would result in 11,581 acres more disturbance, and 3,346 acres of additional LOP disturbance (see Table 2.7). Impact duration would range from 72 years (250 wells/year) to 93 years (75 wells/year) plus the time needed for successful reclamation (see Table 2.2), and significant impacts are anticipated.

4.1.3.7 Alternative E

Under Alternative E, impacts to topography would be similar to those of the No Action Alternative except that Alternative E would result in 6,386 acres additional disturbance and 2,188 acres of additional LOP disturbance compared to the No Action Alternative (see Table 2.8). Impact duration would range from 76 to 105 years plus the time needed for successful reclamation (see Table 2.2). No significant impacts are anticipated.

4.1.3.8 Alternative F

Under Alternative F, impacts to topography would be similar to those of the No Action Alternative except that Alternative F would result in 10,446 acres of additional disturbance and 2,588 acres more LOP disturbance (see Table 2.9). Impact duration would range from 76 to 105 years plus the time needed for successful reclamation (see Table 2.2), and significant impacts are anticipated.

4.1.3.9 Alternative G

Under Alternative G, impacts to topography would be similar to those of the No Action Alternative except that Alternative G would result in 13,989 acres disturbance, 3,999 acres more LOP disturbance (see Table 2.10). Impact duration would range from 76 to 105 years plus the time needed for successful reclamation (see Table 2.2), and significant impacts are anticipated.

4.1.3.10 BLM Preferred Alternative

Under the Preferred Alternative, impacts to topography would be similar to those of the No Action Alternative except that the Preferred Alternative would result in 8,316 acres of additional disturbance and 2,438 acres more LOP disturbance (see Table 2.11). In terms of the amount of disturbance over-and-above that expected for the No Action Alternative, the Preferred Alternative ranks sixth (out of the nine development alternatives), and thus, would result in less potential impacts than for the Proposed Action and Alternatives A, D, F, and G. In terms of duration of impact, the Preferred Alternative is comparable to most of the other alternatives under the 250 well/year development scenario (76-year LOP) since a development rate of 250 wells/year is assumed. Only No Action and Alternatives C and D could result in shorter impact duration (see Table 2.2).

Under the BLM Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources

(see Section 2.14). Even with the application of these measures, significant impacts may occur to topography for the LOP.

4.1.3.11 Cumulative Impacts

The CIAA for topography includes the combined 10 watersheds that drain the JIDPA, which encompass approximately 210,300 acres. Approximately 1.6% of the CIAA (3,355 acres), has previously been disturbed (see Table 3.11).

RFD (total new initial surface disturbance) for the CIAA outside the JIDPA is estimated at 594 acres, primarily from gas-related development in the Pinedale Anticline Natural Gas Field (see Section 4.1.7). Approximately 38% (228 acres) of the RFD would occur in the Expanded Sand Draw-Alkali Creek Watershed. RFD for the North Alkali Draw watershed is estimated at 168 acres; Southeast New Fork River is estimated at 126 acres; the Big Sandy river is estimated at 54 acres; and the Upper Eighteenmile is estimated at 18 acres.

Maximum cumulative disturbance (i.e., the combined existing, proposed [new initial under Proposed Action and Alternative A], and RFD disturbance) would be 22,953 acres (10.9%) in the combined watersheds. Maximum cumulative disturbance would be greatest in the Expanded Sand Draw-Alkali Creek watershed, and would be primarily attributable to gas development (see Section 4.1.7). The Long Draw watershed that drains 16% of the JIDPA would experience the second greatest amount of cumulative disturbance. The closed basin watersheds--Jonah Gulch and 140401040603--would likely only experience a small increase in cumulative disturbance. Significant cumulative impacts to topography are anticipated under the Proposed Action and Alternatives A, C, D, F, and G.

4.1.3.12 Unavoidable Adverse Impacts

Unavoidable adverse impacts to topography would include long-term changes in landform throughout the JIDPA. Since reclamation activities would be performed such that the reclaimed landscape emulates pre-disturbance conditions, no notable permanent changes (post-LOP) in topography are anticipated. Minor differences from the pre-disturbance condition would be present, but the overall integrity to pre-existing topography would be retained.

4.1.4 Mineral Resources

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and the land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with mineral resources:

- to maintain or enhance opportunities for mineral exploration and development, while protecting other resource values;

- to provide for oil and gas leasing, exploration, and development while protecting other values;

- to provide saleable mineral materials (e.g., sand, gravel) in convenient locations for users, while protecting other resources;
- to consider the conservation and enhancement of natural resources with the economic benefits of resource development;
- to coordinate land use decisions with economic factors and needs;
- to plan land use consistent with the orderly development, use, and conservation of resources while preserving environmental quality; and
- to plan uses that encourage energy conservation.

The primary project impact to mineral resources would be from the depletion of recoverable gas and oil reserves from the Lance Pool and possibly other formations underlying the JIDPA (Table 4.2), and significant impacts are anticipated under most alternatives since these are non-renewable resources. The economic impacts from natural gas and oil recovery are described in Section 4.4.

Since the project (under any alternative) is not anticipated to interfere with the recovery of other minerals (i.e., sand and gravel), these resources would remain available for recovery. Therefore, no impacts to other minerals are anticipated and they are not further discussed.

4.1.4.1 No Action Alternative

Under the No Action Alternative, an estimated 3,366 BCF of natural gas and 31.98 million barrels of oil (MBO) would be recovered. Compared to the Proposed Action, this would leave approximately 4,581 BCF of gas and 43.52 MBO unrecovered.

The No Action Alternative could result in substantial volumes of unrecovered resource. Since large volumes of the resources would remain in place and could be potentially extracted at a future date, no significant impacts are anticipated.

4.1.4.2 The Proposed Action

Implementation of the Proposed Action would result in an estimated total production of natural gas and condensates (oil) from the field of 7,947 BCF and 75.50 MBO, respectively. These amounts represent 4,581 BCF more gas and 43.52 MBO more oil than would be recovered under the No Action Alternative. Since these extracted mineral resources would no longer be available, significant effects to mineral resources would occur.

4.1.4.3 Alternative A

Under Alternative A, impacts to oil and gas reserves would be the recovery of 8,191 BCF of gas and 77.81 MBO (see Table 4.2). These amounts represent an increase in 4,825 BCF of gas and

Table 4.2 Anticipated Gas and Condensate Recovery Volumes for Each Alternative, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Alternative	Approximate Natural Gas Recovered[1] (billion cubic feet [BCF])	Approximate Condensate (Oil) Recovered[1] (MBO)	Recovery Volumes Compared to Proposed Action	
			Gas (BCF)	Oil (MBO)
No Action	3,366	31.98	(4,581)	(43.52)
Proposed Action[2]	7,947	75.50	0	0
Alternative A	8,191	77.81	+244	+2.31
Alternative B[2]	6,124	58.18	(1,823)	(17.32)
Alternative C	6,657	63.24	(1,290)	(12.26)
Alternative D	7,554	71.76	(393)	(3.74)
Alternative E[2]	6,302	59.87	(1,645)	(15.63)
Alternative F[2]	7,186	68.27	(761)	(7.23)
Alternative G[2]	7,876	74.82	(71)	(0.68)
Preferred Alternative[2]	7,876	74.82	(71)	(0.68)

[1] Assumes approximately 10,500 BCF of natural gas and 99.75 MBO of condensate are present beneath the JIDPA.

[2] Does not fully account for losses/unrecovered resources associated with undeveloped wells (assumed to be uneconomic).

45.83 MBO of oil that would be recovered under the No Action Alternative. Since the extracted mineral resources would no longer be available, significant effects to mineral resources and future consumers would occur.

4.1.4.4 Alternative B

Under Alternative B, 6,124 BCF of natural gas and 58.18 MBO would be produced--approximately 2,758 BCF of gas and 26.20 MBO more than would be recovered under the No Action Alternative. Alternative B would leave approximately 1,823 BCF of gas and 17.32 MBO unrecovered. Since considerable unrecovered reserves would remain available and could be potentially extracted at a future date, no significant impacts are anticipated.

4.1.4.5 Alternative C

Under Alternative C, 6,657 BCF of natural gas and 63.24 MBO would be produced--approximately 3,291 BCF of gas and 31.26 MBO of oil more than for the No Action Alternative. Alternative C would leave approximately 1,290 BCF of gas and 12.26 MBO unrecovered. Since considerable unrecovered reserves would remain available and could be potentially extracted at a future date, no significant impacts are anticipated.

4.1.4.6 Alternative D

Under Alternative D, 7,554 BCF of natural gas and 71.76 MBO would be produced--approximately 4,188 BCF of gas and 39.78 MBO of oil more than would be recovered under the No Action Alternative. Alternative D would leave approximately 393 BCF of gas and 3.74 MBO unrecovered. Since considerable unrecovered reserves would remain available and could be potentially extracted at a future date, no significant impacts are anticipated.

4.1.4.7 Alternative E

Under Alternative E, 6,302 BCF of natural gas and 59.87 MBO would be produced--approximately 2,936 BCF of gas and 27.89 MBO of oil more than for the Proposed Action. Alternative E would leave approximately 1,645 BCF of gas and 15.63 MBO unrecovered. Since considerable unrecovered reserves would remain available and could be potentially extracted at a future date, no significant impacts are anticipated.

4.1.4.8 Alternative F

Under Alternative F, 7,186 BCF of natural gas and 68.27 MBO would be produced, approximately 3,820 BCF of gas and 36.29 MBO of oil more than would be produced under the No Action Alternative. Alternative F would leave approximately 761 BCF of gas and 7.23 MBO unrecovered. Since considerable unrecovered reserves would remain available and could be potentially extracted at a future date, no significant impacts are anticipated.

4.1.4.9 Alternative G

Under Alternative G, impacts to oil and gas reserves would approximate those of the Proposed Action (i.e., 7,876 BCF of gas and 74.82 MBO of oil would be produced)--4,510 BCF more gas and 42.84 MBO more oil than for the No Action Alternative. Since these extracted mineral resources would no longer be available, significant effects to mineral resources would occur.

4.1.4.10 BLM Preferred Alternative

Under the Preferred Alternative, impacts to oil and gas reserves would approximate those of Alternative G (i.e., 7,876 BCF of gas and 74.82 MBO of oil would be produced)--4,510 BCF more gas and 42.84 MBO more oil than for the No Action Alternative. Since these extracted mineral resources would no longer be available, significant effects to mineral resources would occur.

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14); however, since most natural gas resources would be recovered and would no longer be available, significant effects would occur.

4.1.4.11 Cumulative Impacts

The CIAA for mineral resources is the composite Jonah Field, which includes the original Jonah Prospect field, the Jonah II project area, and the JIDPA (see Map 3.4). This project is proposed in part to maximize natural gas and condensate recovery from the known reserves in this area. Since no additional development beyond that described herein is anticipated in the CIAA, cumulative impacts to mineral resources would be the same as described for the No Action, Proposed Action, Alternatives A through G, and the BLM Preferred Action.

4.1.4.12 Unavoidable Adverse Impacts

Under the No Action Alternative and Alternatives B through F, there would be less-than-complete recovery of resources, which would either: 1) necessitate developing similar resources elsewhere with possible adverse effects; 2) delay the recovery of these resources until some unknown time in the future; or 3) result in the complete loss of non-recovered energy resources and the associated royalties.

4.1.5 Geologic Hazards

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with geologic hazards:

- to protect the health and safety of the public and the well-being of sensitive natural resources,
- to minimize the loss of life and property from natural hazards, and
- to generate and provide data on development limitations.

Any impacts that would lead to the inability of management agencies to achieve these goals/objectives would be considered a significant impact.

Potential impacts associated with geologic hazards include impacts associated with subsidence, earthquakes, and landslides. The depth of gas reserves in the JIDPA and the lack of underground mines in the area negate the potential for subsidence. There are no known active faults within the JIDPA, and although earthquakes may occur infrequently, all facilities would be designed to withstand the effects of moderate earthquakes. No known landslides occur in the JIDPA, so none of the alternatives would be affected by landslides. With the application of mitigations (see Appendices A and B), impacts are anticipated to be less than significant under all alternatives, and no further alternative-specific impact analyses are discussed.

Under the BLM Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14).

The CIAA area for geologic hazards includes the composite Jonah field, including the original Jonah Prospect field, the Jonah Field II project area, and the JIDPA (see Map 3.5), and no further development beyond this proposed project is planned for the area. Development in this area is not likely to affect or be affected by geologic hazards. Therefore, cumulative impacts would be the same as described above for the proposed project.

No unavoidable adverse impacts would occur due to geologic hazards.

4.1.6 Paleontological Resources

The PFO and RSFO RMP (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with paleontologic resources:

- to expand the opportunities for scientific study and educational and interpretive uses of paleontologic resources,
- to protect and preserve important paleontologic resources and/or their historic record for future generations, and
- to resolve conflicts between paleontologic resources and other resource uses.

Under all alternatives, direct impacts to paleontological resources would include damage or destruction of fossils and associated data due to field development/surface disturbance for well pads, roads, pipelines, ancillary facilities, etc. For the purpose of this analysis, it is assumed that increases in surface disturbance correspond to an increase in the potential for impacts to paleontological resources. Indirect impacts would include loss from unauthorized collection or vandalism which, in turn, would result in a loss of the opportunity to expand scientific study and educational and interpretive uses of these resources. However, surface-disturbing activities could uncover fossils of significant scientific importance that otherwise would have remained buried and unavailable for scientific study.

The important fossil record of the Green River Basin is well known (Grande 1984; BLM 1992) (see also Table 3.9). The recent discovery of Pleistocene horse bones (tentative identification) during well pad construction in the JIDPA affects potential future paleontological mitigation procedures for the area since Pleistocene paleontologic materials were previously unknown for the JIDPA. Significant fossils likely occur in the JIDPA. To lessen impacts, mitigation measures including avoidance, survey, monitoring, and collection would be used under all alternatives (see also Appendices A and B). In areas of paleontological sensitivity, a determination would be made by the BLM as to whether a survey by a qualified paleontologist is necessary prior to the disturbance.

4.1.6.1 No Action Alternative

Under the No Action Alternative, potential impacts to paleontological resources would be primarily associated with existing surface disturbances (4,209 acres) related to currently approved field development activities. Indirect impacts associated with unauthorized collection or vandalism would continue for the LOP.

4.1.6.2 The Proposed Action

Direct impacts under the Proposed Action would be increased from those of the No Action Alternative since up to 20,409 acres of disturbance would occur--16,200 acres more than for the No Action Alternative. There would be an increase in human activity and it would occur for a longer duration, resulting in more potential for both vandalism and discovery.

4.1.6.3 Alternative A

Potential direct impacts to paleontological resources under Alternative A would be similar to those described for the Proposed Action except that under Alternative A, some disturbance would occur in areas such as along Sand Draw that would be avoided under the Proposed Action. Indirect impacts would be increased from the No Action Alternative due to the increase in human activity, and these indirect impacts would occur for a longer duration, resulting in more potential for both vandalism and discovery (see Table 2.2).

4.1.6.4 Alternative B

Direct and indirect impacts to paleontological resources under Alternative B would be increased from those of the No Action Alternative due to the increase in total surface disturbance of 3,297 acres and the increased human presence. Duration of the impacts would be up to 42 years longer, resulting in more potential for both vandalism and discovery.

4.1.6.5 Alternative C

Under Alternative C, direct impacts to paleontological resources would be increased from those of the No Action Alternative due to the 6,705 acres of additional surface disturbance. Duration of the impacts would be dependent upon the rate of development, but could be up to 17 years longer than for the No Action Alternative. Indirect impacts would be increased from the No Action Alternative due to increased human presence during project development and production.

4.1.6.6 Alternative D

Under Alternative D, direct impacts to paleontological resources would be increased from those of the No Action Alternative due to the 11,581 acres of additional surface disturbance. Duration of the impacts would be dependent upon the rate of development. Indirect impacts would occur for up to 42 years longer than the No Action Alternative, resulting in the potential for increased vandalism and discovery.

4.1.6.7 Alternative E

Under Alternative E, direct impacts to paleontological resources would be increased from those of the No Action Alternative due to the 6,386 acres of additional surface disturbance. Duration of the impacts would be dependent upon the rate of development, and could be up to 42 years longer. Indirect impacts would be increased from the No Action Alternative due to increased human presence during development and production.

4.1.6.8 Alternative F

Under Alternative F, direct impacts to paleontological resources would be increased from those of the No Action Alternative due to the 10,446 acres of additional surface disturbance. Duration of the impacts would be dependent upon the rate of development (see Table 2.2), and could be up to 42 years longer than the No Action Alternative. Indirect impacts would be increased from the No Action Alternative due to increased human presence during development and production.

4.1.6.9 Alternative G

Under Alternative G, impacts to paleontological resources would be increased from those of the No Action Alternative due to the 13,989 acres of additional surface disturbance. Duration of the impacts would be dependent upon the rate of development, and could be up to 42 years longer than the No Action Alternative. Indirect impacts would be increased from the No Action Alternative due to increased human presence during development and production.

4.1.6.10 BLM Preferred Alternative

Under the Preferred Alternative, impacts to paleontologic resources would be increased from those of the No Action Alternative. The Preferred Alternative would result in 8,316 acres of additional surface disturbance and 2,438 acres more LOP disturbance. The Preferred Alternative would have a direct impact duration of approximately 13 years (250 wells/year) longer than the No Action Alternative. In terms of the amount of disturbance over-and-above that expected for the No Action Alternative, the Preferred Alternative ranks sixth out of the nine potential development alternatives and, thus would result in a lower potential for inadvertent loss than the Proposed Action and Alternatives A, D, F, and G. In terms of duration of development (and thus exposure to potential indirect impacts such as vandalism, and, conversely, beneficial discoveries), the Preferred Alternative is comparable to most of the other alternatives under the 250 well/year development scenario; the Preferred Alternative would result in a 4- to 29-year shorter duration of impacts compared to all of the slower development scenarios. Only Alternatives C and D could result in a shorter duration of impact (4 to 8 years). Additionally, the application of alternative-specific management objectives and associated mitigation and monitoring protocol could further reduce impacts.

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14).

4.1.6.11 Cumulative Impacts

The CIAA for paleontological resources is a 484.4-square mile area (310,000 acres) surrounding the JIDPA (see Map 3.5). Approximately 1.1% of the CIAA (3,331 acres) has previously been disturbed, much of which is from natural gas well pads, roads, and pipelines in the JIDPA (i.e., currently approved oil and gas development activities). Other activities include oil and gas development in the Pinedale Anticline Field, livestock grazing, and recreation. Livestock grazing and recreation have minimal impacts on paleontological resources, other than the possibility of increasing opportunities for illegal collecting and/or vandalism.

RFD (new surface disturbance) for the portion of the CIAA outside the JIDPA is estimated at 594 acres, primarily from gas-related development in the Pinedale Anticline Natural Gas Field. Maximum cumulative disturbance (i.e., the combined existing, proposed [Proposed Action and Alternative A], and RFD disturbance) would be 20,121 acres (6.4% of the CIAA); other action alternatives would have less surface disturbance and activity and would therefore have a reduced potential for cumulative impacts. Cumulative impacts to paleontological resources would be of the same type as those described for the action alternatives; however, the potential for significant cumulative impacts is unknown since little paleontological inventory or evaluation has been conducted in the JIDPA.

4.1.6.12 Unavoidable Adverse Impacts

Unavoidable adverse impacts to paleontological resources include the fossil resources that may be inadvertently damaged or destroyed by surface-disturbing activities and those potentially lost through illegal collecting and/or vandalism.

4.1.7 Soils

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with soils:

- to stabilize and conserve soils;
- to increase vegetative production;
- to maintain or improve surface and ground water quality;
- to protect, maintain, or improve wetlands, floodplains, and riparian areas;
- to minimize topsoil erosion;
- to maintain or increase highly diverse native plant communities; and
- to consider the suitability of soil composition in all land use decisions.

Impacts to soils would be considered significant if a reduction in soil productivity and/or increased erosion would prevent successful reclamation and/or if disturbance or other activities resulted in a violation of the aforementioned land use objectives. Impacts to soils are assumed to be proportional to the amount of new initial surface disturbance for all alternatives (i.e., increased disturbance would result in a proportionally increased potential for adverse impacts to soils). Under the various alternatives, Operators would implement various management requirements/mitigation measures (see Appendices A and B); therefore, impacts to soils would also be dependent on the effectiveness of this mitigation. Significant impacts to soils are anticipated under all project alternatives.

Direct impacts to soils would include removal of vegetation, exposure of the soil, mixing of soil horizons, loss of topsoil productivity, soil compaction, and increased susceptibility to wind and water erosion. These impacts could, in turn, result in increased runoff, erosion, and sedimentation. Increased surface runoff and erosion would occur primarily in the short-term and would decline in time due to natural stabilization through particle aggregation, soil structure development, and armoring. Short-term control of surface runoff would be dependent on the success and implementation of reclamation and revegetation efforts described in Reclamation Plan and Surface Use Plans and Plans of Development prepared for each APD and/or ROW application, and Storm Water Pollution Prevention Plans (SWPPPs) (see also Appendix G). Following application of reclamation and revegetation procedures, the susceptibility of disturbed areas to soil erosion would be minimized for both the short term and for the LOP. Since the extent of erosion in the JIDPA under any alternative is undefined, the BLM has determined that modeling will be performed to identify potential soil losses. The results of this modeling will be available in the Final EIS.

The potential for contamination of soils due to the accidental discharge would be limited by appropriate project implementation procedures and the remedial measures applied as specified in SPCCPs (see Appendix G).

Most soils in the JIDPA have a naturally high erosion potential and generally have limited rehabilitation potential because of one or more characteristics including thin soils, shallow depth to bedrock, excess salts, excess sand and/or small stones, clayey textures, and excess lime.

Concentrating development actions at larger well pads would have increased site-specific effects on overland flow patterns, ground water infiltration (reduced on compacted areas), and runoff volumes (increased rates and potential erosion and sedimentation). Additionally, if surface disturbance is concentrated in any one watershed, increased potential erosion and runoff-related effects may occur, possibly requiring the need for special treatments to be specified in APD approvals. Estimates of potential new and LOP disturbance associated with the various project alternatives within each project-affected watershed are presented in Tables 4.3 and 4.4 and are discussed under each alternative.

The following analyses show that the Proposed Action and alternatives generally are compatible with existing management goals/objectives; however, significant impacts to soils are anticipated in the short term in and down-channel from the JIDPA. Mitigation measures (see Appendices A and B) would be required under all project alternatives to minimize impacts to soil resources.

4.1.7.1 No Action Alternative

Under the No Action Alternative, there would be no additional activities that would potentially affect soil resources other than those previously approved for the area (BLM 1998b, 2000b)--4,209 acres of new (short-term) and 1,409 acres of LOP disturbance or 13.8% and 4.6% of the JIDPA, respectively. The duration of impacts would be approximately 63 years and until areas are adequately reclaimed.

4.1.7.2 The Proposed Action Alternative

A total of 4,209 acres of new (short-term) and 1,409 acres of LOP disturbance are currently approved (see Table 4.3) and would occur under the No Action Alternative. The Proposed Action would result in an estimated increase of 16,200 acres of new initial disturbance, for a total disturbance of 20,126 acres in the JIDPA (66.0% of the JIDPA), and an additional 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total project-specific existing (i.e. No Action Alternative) and new initial disturbance under the Proposed Action would be 20,409 acres (see Table 4.3). Approximately 70.4% (14,369 acres) of this disturbance would be reclaimed and reseeded as soon as practical after disturbance (see Appendix G). Disturbance would not occur all at once, but would increase as development occurs (for approximately 12 years. Simultaneously, disturbance would decrease in some areas as some disturbed lands are reclaimed. The magnitude of impacts to soil resources would depend on how much disturbance is present at any one time and the rate of reclamation. Approximately 6,040 acres would be disturbed for the LOP--approximately 76 years and until successful reclamation is achieved.

The Expanded Sand Draw-Alkali Creek watershed, which drains 45% of the JIDPA, could experience the greatest level of impacts to soil resources from project-related activities. Under the Proposed Action, potential new disturbance to this watershed could increase from that of the

Table 4.3 Cumulative Acreage of Disturbance in each CIAA Watershed and Including RFD, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Watershed/ Major River Drainage	Total Acreage of Watershed	Acres of Watershed Within JIDPA	Existing Disturbance In CIAA but Outside JIDPA	RFD	No Action[1]			Proposed Action and Alternative A[2] (3,100 Wells/Pads)			Alternative B[3] (3,100 Wells/497 Pads)		
					New	LOP	Cumulative[10]	New	LOP	Cumulative[10]	New	LOP	Cumulative[10]
Green River/New Fork River													
Expanded Sand Draw-Alkali Creek	22,931	13,725	327	228	1,800	607	2,355	9,057	2,682	9,612	3,250	1,143	3,805
Granite Wash	12,212	1,312	36	0	172	58	208	866	256	902	311	109	347
Reduced Upper Alkali Creek-Green River	26,797	3,782	239	0	496	167	735	2,496	739	2,735	896	315	1,135
Upper Eighteenmile Canyon	35,212	1,958	477	18	257	87	752	1,292	386	1,787	464	163	959
Southeast New Fork River-Blue Rim	11,746	0	23	126	0	0	149	0	0	149	0	0	149
North Alkali Draw	15,911	0	101	168	0	0	269	0	0	269	0	0	269
Subtotal	124,809	20,777	1,203	540	2,725	919	4,469	13,710	4,059	15,453	4,920	1,731	6,663
Big Sandy River													
Big Sandy River-Bull Draw	19,760	3,630	217	54	476	160	747	2,395	709	2,666	860	302	1,131
Long Draw	18,521	5,028	281	0	660	222	941	3,318	982	3,599	1,191	419	1,472
Subtotal	38,281	8,658	498	54	1,136	382	1,688	5,713	1,692	6,265	2,050	721	2,603
Closed Basins													
Jonah Gulch	22,652	318	127	0	42	14	169	210	62	337	75	26	202
[illegible]	24,558	747	122	0	98	33	220	493	146	615	177	62	299
140401040603	47,210	1,065	249	0	140	47	389	703	208	952	252	89	501
Subtotal	210,300	30,500	1,950	594	4,001	1,348	6,545	20,126	5,959	22,670	7,223	2,541	9,767
Total													
Additional associated disturbance[12]					208	61	208	283	81	283	283	81	283
Grand Total[11]			--	--	4,209	1,409	6,753	20,409	6,040	22,953	7,506	2,622	10,050
Percent disturbance of entire CIAA			0.9	0.3	1.9	0.6	3.2	9.6	2.9	10.9	3.4	1.2	4.8

Table 4.3 (continued)

Watershed/ Major River Drainage	Alternative C[4] (1,250 Wells and Pads)			Alternative D[5] (2,220 Wells and Pads)			Alternative E[6] (3,100 Wells/266 New Pads)		
	New	LOP	Cumulative[10]	New	LOP	Cumulative[10]	New	LOP	Cumulative[10]
Green River/New Fork River									
Expanded Sand Draw-Alkali Creek	4,784	1,493	5,339	6,978	2,103	7,533	4,640	1,582	5,195
Granite Wash	457	143	493	667	201	703	444	151	480
Reduced Upper Alkali Creek-Green River	1,318	411	1,557	1,923	580	2,162	1,279	436	1,518
Upper Eighteenmile Canyon	682	213	1,177	995	300	1,490	662	226	1,157
Southeast New Fork River-Blue Rim	0	0	149	0	0	176	0	0	149
North Alkali Draw	0	0	269	0	0	281	0	0	269
Subtotal	7,242	2,260	8,985	10,564	3,184	12,307	7,025	2,395	8,768
Big Sandy River									
Big Sandy River-Bull Draw	1,265	395	1,536	1,846	556	2,117	1,227	418	1,498
Long Draw	1,753	547	2,034	2,556	771	2,837	1,700	580	1,981
Subtotal	3,018	942	3,570	4,402	1,327	4,954	2,927	998	3,479
Closed Basins									
Jonah Gulch	111	35	238	162	49	289	108	37	235
14040104603	260	81	382	380	114	502	253	86	375
Subtotal	371	116	620	541	163	790	360	123	610
Total[11]	10,631	3,318	13,175	15,507	4,674	18,051	10,312	3,516	12,857
Additional associated disturbance[12]	283	81	283	283	81	283	283	81	283
Grand Total[11]	10,914	3,399	13,458	15,790	4,755	18,334	10,595	3,597	13,139
Percent disturbance of entire CIAA	5.1	1.6	6.3	7.4	2.2	8.7	4.9	1.7	6.2

Table 4.3 (continued)

6th Order Watershed/ Major River Drainage	Alternative F[7] (3,100 Wells/ 1,028 New Pads)			Alternative G[8] (3,100 Wells/ 2,553 New Pads)			Preferred Alternative[9] (3,100 Wells/Pads)		
	New	LOP	Cumulative[10]	New	LOP	Cumulative[10]	New	LOP	Cumulative[10]
Green River/New Fork River									
Expanded Sand Draw-Alkali Creek	6,467	1,762	7,022	8,062	2,397	8,617	5,509	1,695	6,064
Granite Wash	618	168	654	771	229	807	527	162	563
Reduced Upper Alkali Creek-Green River	1,782	486	2,021	2,221	661	2,460	1,518	467	1,757
Upper Eighteenmile Canyon	923	251	1,418	1,150	342	1,645	786	242	1,281
Southeast New Fork River-Blue Rim	0	0	149	0	0	149	0	0	149
North Alkali Draw	0	0	269	0	0	269	0	0	269
Subtotal	9,790	2,668	11,533	12,204	3,629	13,947	8,340	2,567	10,083
Big Sandy River									
Big Sandy River-Bull Draw	1,711	466	1,982	2,132	634	2,403	1,458	448	1,729
Long Draw	2,369	646	2,650	2,953	878	3,234	2,018	620	2,299
Subtotal	4,080	1,112	4,632	5,086	1,512	5,638	3,476	1,068	4,028
Closed Basins									
Jonah Gulch	150	41	277	187	56	314	127	39	254
140401040603	352	96	474	439	130	561	299	92	421
Subtotal	502	137	751	626	186	875	426	131	675
Total[11]	14,372	3,916	16,916	17,915	5,327	20,459	12,242	3,766	14,786
Additional associated disturbance[11]	283	81	283	283	81	283	283	81	283
Grand Total [11]	14,655	3,997	17,199	18,198	5,408	20,742	12,525	3,847	15,069
Percent disturbance of entire CIAA	6.8	1.9	8.2	8.5	2.5	9.9	6.0	1.8	7.2

Table 4.3 (continued)

[1] Assumes new and LOP disturbance as currently authorized.
[2] Assumes 20,126 acres of new initial and 5,956 acres of LOP disturbance in the JIDPA.
[3] Assumes 7,223 acres of new initial and 2,541 acres of LOP disturbance in the JIDPA.
[4] Assumes 10,631 acres of new initial and 3,318 acres of LOP disturbance in the JIDPA.
[5] Assumes 15,507 acres of new initial and 4,674 acres of LOP disturbance in the JIDPA.
[6] Assumes 10,312 acres of new initial and 3,516acres of LOP disturbance in the JIDPA.
[7] Assumes 14,372 acres of new initial and 3,916 acres of LOP disturbance in the JIDPA.
[8] Assumes 17,915 acres of new initial and 5,327 acres of LOP disturbance in the JIDPA.
[9] Assumes 12,242 acres of new initial and 3,766 acres of LOP disturbance in the JIDPA.
[10] Cumulative disturbance = New + existing + RFD.
[11] Columns may not total due to rounding error.
[12] Assumes new initial and LOP disturbance associated with selected ancillary facilities which may be constructed outside the JIDPA (e.g. Burma Road upgrade).

Table 4.4 Percent of Watersheds Affected, Including Existing Disturbance, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.[1]

Watershed/ Major River Drainage[2]	Total Acreage of Watershed	Percent of Watershed in JIDPA	Percent of Entire Watershed Currently Disturbed[2]	No Action			Proposed Action and Alternative A (3,100 Wells/ Pads)			Alternative B (3,100 Wells/ 497 Pads)			Alternative C (1,250 Wells and Pads)		
				New[3]	LOP[3]	Cumulative	New[3]	LOP[3]	Cumulative	New[3]	LOP[3]	Cumulative	New[3]	LOP[3]	Cumulative
Green River/New Fork River															
Expanded Sand Draw-Alkali Creek	22,931	59.9	4.2	7.8	2.6	10.3	39.5	11.7	41.9	14.2	5.0	16.6	20.9	6.5	23.3
Granite Wash	12,212	10.7	0.3	1.4	0.5	1.7	7.1	2.1	7.4	2.5	0.9	2.8	3.7	1.2	4.0
Reduced Upper Alkali Creek-Green River	26,797	14.1	1.3	1.9	0.6	2.7	9.3	2.8	10.2	3.3	1.2	4.2	4.9	1.5	5.8
Upper Eighteenmile Canyon	35,212	5.6	1.7	0.7	0.2	2.1	3.7	1.1	5.1	1.3	0.5	2.7	1.9	0.6	3.3
Southeast New Fork River-Blue Rim	11,746	0.0	0.2	--	--	1.3	--	--	1.3	--	--	1.3	--	--	1.3
North Alkali Draw	15,911	0.0	0.6	--	--	1.7	--	--	1.7	--	--	1.7	--	--	1.7
Big Sandy River															
Big Sandy River-Bull Draw	19,760	18.4	1.1	2.4	0.8	3.8	12.1	3.6	13.5	4	1.5	5.7	6.4	2.0	7.8
Long Draw	18,521	27.1	0.7	3.6	1.2	5.1	17.9	5.3	19.5	6.4	2.3	7.9	9.5	3.0	11.0
Closed basins															
Jonah Gulch	22,652	1.4	1.0	0.2	0.1	0.7	0.9	0.3	1.5	0.3	0.1	0.9	0.5	0.2	1.1
140401040603	24,558	3.0	0.7	0.4	0.1	0.9	2.0	0.6	2.5	0.7	0.3	1.2	1.1	0.3	1.6

Table 4.4 (continued)

Watershed/ Major River Drainage[2]	Alternative D (2,220 Wells and Pads)			Alternative E (3,100 Wells/ 266 Pads)			Alternative F (3,100 Wells/ 1,028 New Pads)			Alternative G (3,100 Wells/ 2,553 Pads)			Preferred Alternative (3,100 Wells/ Pads)		
	New[3]	LOP[3]	Cumulative	New[3]	LOP[3]	Cumulative	New[3]	LOP[3]	Cumulative	New[3]	LOP[3]	Cumulative	New[3]	LOP[3]	Cumulative
Green River/New Fork River															
Expanded Sand Draw-Alkali Creek	30.4	9.2	32.9	20.2	6.9	22.7	28.2	7.7	30.6	35.2	10.5	37.6	24.0	7.4	26.4
Granite Wash	5.5	1.7	5.8	3.6	1.2	3.9	5.1	1.4	5.4	6.3	1.9	6.6	4.3	1.3	4.6
Reduced Upper Alkali Creek-Green River	7.2	2.2	8.1	4.8	1.6	5.7	6.6	1.8	7.5	8.3	2.5	9.2	5.6	1.7	6.6
Upper Eighteenmile Canyon	2.8	0.9	4.2	1.9	0.6	3.3	2.6	0.7	4.0	3.3	1.0	4.7	2.2	0.7	3.6
Southeast New Fork River-Blue Rim	--	--	1.3	--	--	1.3	--	--	1.3	--	--	1.3	--	--	1.3
North Alkali Draw	--	--	1.7	--	--	1.7	--	--	1.7	--	--	1.7	--	--	1.7
Big Sandy River															
Big Sandy River-Bull Draw	9.3	2.8	10.7	6.2	2.1	7.6	8.7	2.4	10.0	10.8	3.2	12.2	7.3	2.2	8.7
Long Draw	13.8	4.2	15.5	9.2	3.1	10.7	12.8	3.5	14.3	15.9	4.7	17.5	10.4	3.2	12.4
Closed basins															
Jonah Gulch	0.7	0.2	1.3	0.5	0.2	1.0	0.7	0.2	1.2	0.8	0.2	1.4	0.6	0.2	1.1
140401040603	1.5	0.5	2.0	1.0	0.4	1.5	1.4	0.4	1.9	1.8	0.5	2.3	1.2	0.4	1.7

[1] Percent of watershed affected is calculated using potential acreage affected (refer to Table 4.3) divided by the total watershed acreage multiplied by 100.
[2] As described in Table 3.12.
[3] Provides percent of the watershed within the JIDPA that would be disturbed.

No Action Alternative to 39.5% (see Tables 4.3 and 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from the Proposed Action would be 2,682 acres (11.7% of the watershed).

No formal estimates of disturbance to the 17 soil map units defined for the JIDPA (see Map 3.6) are provided herein due to the variability and unknown locations for much of the proposed development. Estimates of the types of soils most likely to be disturbed are based on the coarse-scale soil map units (see Map 3.6). The SU05 soil map unit that occurs on 67.2% of the JIDPA (see Table 3.10 and Map 3.6) is anticipated to experience the greatest amount of disturbance--13,525 acres of new disturbance as a result of the Proposed Action. The SU03 unit that occupies 32.5% of the JIDPA could experience 6,541 acres of disturbance. The remaining 60 acres of disturbance could occur in the SU07 soil map unit type.

4.1.7.3 Alternative A

Implementation of Alternative A is anticipated to result in the same types and acreage of impacts and surface disturbance as the Proposed Action (see Tables 4.3 and 4.4) and would result in increased soil impacts and disturbance from these of the No Action Alternative. However, since selected Operator-committed and BLM-required practices would not be implemented (e.g., avoidance of steep slopes and drainage buffers), significant impacts are more likely to occur under this alternative. Development of natural gas resources in these areas could result in significant impacts to soil resources, particularly in the Expanded Sand Draw-Alkali Creek watershed, due to increased erosion and/or sedimentation. As with the Proposed Action, not all areas would be disturbed at the same time, rather, disturbance would accumulate as development occurs. Since the rate of development may vary under Alternative A (i.e., 75, 150, or 250 wells developed/year) the duration of impacts could be extended from the No Action Alternative by an additional 42 years (75 wells/year development rate) and until areas are reclaimed.

4.1.7.4 Alternative B

Implementation of Alternative B would result in an increase of 3,297 acres of new initial surface disturbance from that of the No Action Alternative. Impact potential would increase as development occurs from approximately 5 to 17 years; all surface disturbance would not be present at any one time. The duration of impacts could be extended from the No Action Alternative by 42 years (75 wells/year development rate).

Under Alternative B, there would be a total of 7,506 acres new disturbance--7,223 acres would occur in the JIDPA (i.e., 23.7% of the JIDPA). Of this total, 4,884 would be short-term and 2,622 acres would be LOP disturbance. Under Alternative B, LOP disturbance to soils within the JIDPA would increase from the No Action Alternative of 4.6% (1,409 acres) to 8.3% (2,541 acres) of the JIDPA.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to soil resources from project-related activities. Potential new disturbance to this watershed under Alternative B could increase from that of the No Action to 14.2% of the watershed (see Tables 4.3 and 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative B would be 1,143 acres (5.0% of the watershed).

It is anticipated that soil map unit SU05 would experience the greatest amount of disturbance (5,044 acres) under this alternative. The SU03 unit could experience 2,439 acres of disturbance. The remaining 23 acres of disturbance could occur in the SU07 soil map unit type.

4.1.7.5 Alternative C

Implementation of Alternative C would result an increase of 6,705 acres of new initial surface disturbance from that of the No Action Alternative. Impact potential would increase as development occurs; therefore, all surface disturbance would not be present at any one time. The duration of impacts to soils could be extended from the No Action Alternative from 5 to 17 years plus the time needed for successful reclamation.

Under Alternative C, total new surface disturbance in the JIDPA would be 10,631 acres (7,313 and 3,318 acres for short-term and LOP disturbance, respectively) (34.9% of the JIDPA). An additional 283 acres of initial disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore total new disturbance under Alternative C would be 10,914 acres (see Table 4.3). Approximately 68.9% (7,515 acres) of total disturbance would be short-term (i.e., reclaimed and reseeded as soon as practical after disturbance); the remaining 3,399 acres would be disturbed for the LOP. Under Alternative C, LOP disturbance to soils within the JIDPA would increase from the No Action Alternative of 4.6% to 10.9% of the JIDPA.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to soil resources from project-related activities. Potential new disturbance to this watershed under Alternative C could increase from that of the No Action Alternative to 20.9%of the watershed (see Tables 4.3 and 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative C would be 1,493 acres (6.5% of the watershed).

The SU05 soil map unit is anticipated to have approximately 7,144 acres of new disturbance. The SU03 unit could experience 3,455 acres of disturbance. The remaining 32 acres of new disturbance could occur in the SU07 soil map unit type.

4.1.7.6 Alternative D

Implementation of Alternative D would result in an increase of 11,581 acres of new initial surface disturbance from that of the No Action Alternative. Impact potential would increase as development occurs from approximately 9 to 30 years; therefore, all surface disturbance would not occur at once. Depending in the rate of development, impact duration would be approximately 72 to 93 years, the duration of impacts to soils could be extended from the No Action Alternative by approximately 9 to 30 years plus the time needed for successful reclamation.

Under Alternative D, total new surface disturbance in the JIDPA would be 15,507 acres (10,833 and 4,674 acres for short-term and LOP disturbance, respectively) (50.8% of the JIDPA). An additional 283 acres of new disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under this alternative would be 15,790 acres (see Table 4.3). Approximately 69.9% (11,035 acres) of total disturbance would be short-term (i.e., reclaimed and reseeded as soon as practical after disturbance); the remaining 4,755 acres would be disturbed for the LOP. Under Alternative D, LOP disturbance to soils within the JIDPA would increase from the No Action Alternative of 4.6% to 15.3% of the JIDPA.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to soil resources from project-related activities. Potential new disturbance to this watershed under Alternative D could increase from that of the No Action Alternative to 30.4% of the watershed (Tables 4.3 and 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative D would be 2,103 acres (9.2% of the watershed).

The SU05 soil map unit is anticipated to have approximately 10,421 acres of new disturbance. The SU03 unit could experience 5,040 acres of disturbance. The remaining 46 acres of disturbance could occur in the SU07 soil map unit type.

4.1.7.7 Alternative E

Implementation of Alternative E would result in an increase of 6,386 acres of new initial surface disturbance from that of the No Action Alternative. Impact potential would increase as development progresses, from 12 to 42 years. Depending on the rate of development, impact duration would be approximately 76 to 105 years and could be extended from that of the No Action Alternative by approximately 13 to 42 years plus the time needed for successful reclamation.

Under Alternative E, total surface disturbance in the JIDPA would be 10,312 acres (6,796 and 3,516 acres for short-term and LOP disturbance, respectively) (33.8% of the JIDPA). An additional 283 acres of new disturbance and 81 acres LOP disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new initial disturbance under Alternative E would be 10,595 acres, and 3,597 acres of disturbance would occur for the LOP (see Table 4.3). Under Alternative E, LOP disturbance to soils within the JIDPA would increase from the No Action Alternative of 4.6% to 11.5% of the JIDPA.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to soil resources from project-related activities. Potential new disturbance to this watershed from Alternative E could increase from that of the No Action Alternative to 20.3% of the watershed (see Tables 4.3 and 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative E would be 1,582 acres (6.9% of the watershed).

The SU05 soil map unit is anticipated to have approximately 6,930 acres of new disturbance. The SU03 unit could experience 3,354 acres of disturbance. The remaining 28 acres of new disturbance could occur in the SU07 soil map unit type.

4.1.7.8 Alternative F

Implementation of Alternative F would result in an increase of 10,446 acres of new initial surface disturbance from that of the No Action Alternative. Impact potential would increase as development progresses from 12 to 42 years. Depending on the rate of development, impact duration would be approximately 76 to 105 years and could be extended from that of the No Action Alternative by approximately 42 years plus the time needed for successful reclamation.

Under Alternative F, total surface disturbance in the JIDPA would be 14,372 acres (10,456 and 3,916 acres for short-term and LOP disturbance, respectively) (47.1% of the JIDPA). An additional 283 acres of new disturbance and 81 acres LOP disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under Alternative F would be 14,655 acres, and 3,997 acres of disturbance would occur for the

LOP (see Table 4.3). Under Alternative F, LOP disturbance to soils would increase from the No Action Alternative of 4.6% to 12.8% of the JIDPA.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to soil resources from project-related activities. Potential new disturbance to this watershed from Alternative F could increase from that of the No Action Alternative to 28.2% of the watershed (see Tables 4.3 and 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative F would be 1,762 acres (7.7% of the watershed).

The SU05 soil map unit is anticipated to have approximately 9,658 acres of new disturbance. The SU03 unit could experience 4,671 acres of disturbance. The remaining 43 acres of new disturbance could occur in the SU07 soil map unit type.

4.1.7.9 Alternative G

Implementation of Alternative G would result in an increase of 13,989 acres of new initial surface disturbance from that of the No Action Alternative. Impact potential would increase as development progresses from 12 to 42 years. Depending on the rate of development, impact duration would be approximately 76 to 105 years and could be extended from that of the No Action Alternative by approximately 13 to 42 years plus the time needed for successful reclamation.

Under Alternative G, total surface disturbance in the JIDPA would be 17,915 acres (12,588 and 5,327 acres for short-term and LOP disturbance, respectively) (58.7% of the JIDPA). An additional 283 acres of new disturbance and 81 acres LOP disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under Alternative G would be 18,198 acres, and 5,408 acres of disturbance would occur for the LOP (see Table 4.3). Under Alternative G, LOP disturbance to soils from would increase from that of the No Action Alternative of 4.6% to 17.5% of the JIDPA.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to soil resources from project-related activities. Potential new disturbance to this watershed under Alternative G could increase from that of the No Action Alternative of 4.2% to 35.2% of the watershed (see Tables 4.3 and 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative G would be 2,397 acres (10.5% of the watershed.

The SU05 soil map unit is anticipated to have approximately 12,039 acres of new disturbance. The SU03 unit could experience 5,822 acres of disturbance. The remaining 54 acres of new disturbance could occur in the SU07 soil map unit type.

4.1.7.10 BLM Preferred Alternative

Impacts to soils under the Preferred Alternative would be similar to those described for all other alternatives. Implementation of the Preferred Alternative would result in an estimated 8,316 acres of additional surface disturbance above that of the No Action Alternative, subsequently resulting in an assumed increase in soil impacts. Impact potential would increase as development occurs (for approximately 12 years); therefore, all surface disturbance would not be present at any one time.

Under the Preferred Action Alternative, total new surface disturbance in the JIDPA would be 12,242 acres. An additional 283 acres of initial disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, a total of 12,525 acres would be disturbed under this alternative (see Table 4.3). Approximately 69.2% (8,678 acres) of total disturbance would be short-term (i.e., reclaimed and reseeded as soon as practical after disturbance); the remaining 3,847 acres would be disturbed for the LOP. Under the Preferred Action Alternative, LOP disturbance to soils within the JIDPA would increase from the No Action Alternative of 4.6% to 12.6% of the JIDPA.

Impacts to soil resources resulting from surface disturbance under the Preferred Alternative would be less than those from the Proposed Action and Alternatives A, D, F, and G, where total disturbance is estimated at 20,409 acres, 20,409 acres, 15,790 acres, 14,655 acres, and 18,198 acres, respectively. Additionally, it is anticipated that impacts to soil resources resulting from surface disturbance under the Preferred Alternative would be greater than those from Alternatives B, C, and G, where new disturbance is estimated at 7,506 acres, 10,914 acres, and 10,595 acres, respectively.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to soil resources from project-related surface disturbance. Potential new disturbance to this watershed from the Preferred Alternative could increase from the No Action Alternative to 24.0% of the watershed (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from the Preferred Alternative would increase from 607 acres or 2.6% of the watershed (under the No Action Alternative) to 1,696 acres (7.4% of watershed) (see Tables 4.3 and 4.4).

Due to the variability and unknown locations for much of the proposed development disturbance, estimates of the types of soils most likely to be disturbed are based on the larger soil map units (see Map 3.6). Under this Alternative, it is anticipated that soil map unit SU05 would experience the greatest amount of disturbance--8,226 acres of new disturbance as a result of this alternative. The SU03 unit could experience 3,978 acres of disturbance. The remaining 38 acres of disturbance could occur in the SU07 soil map unit type.

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14).

4.1.7.11 Cumulative Impacts

The CIAA for soil resources is the 10 watersheds that drain the JIDPA, which encompass approximately 210,300 acres. Areas west of Big Sandy River, occurring within the Big Sandy River-Bull Draw watershed are included in the CIAA; however, no project impacts (cumulative or otherwise) would occur in this area. Approximately 1.6% of the CIAA (3,355 acres) has been disturbed by well pads, agricultural lands (i.e., hay meadows), reservoirs, pipelines, roads, and residential areas (i.e., ranches) (see Table 3.11). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance (992 acres or 4.2% of the watershed), most of which is from existing natural gas development in the Jonah Field.

RFD (total surface disturbance) for the portion of the soil resources CIAA outside the JIDPA is estimated at 594 acres (see Table 4.3), primarily from gas-related development in the Pinedale Anticline Natural Gas Field. Approximately 38% (228 acres) of the RFD would occur in the

Expanded Sand Draw-Alkali Creek Watershed. RFD for the North Alkali Draw watershed is estimated at 168 acres, Southeast New Fork River is estimated at 126 acres, the Big Sandy River-Bull Draw is estimated at 54 acres, and Upper Eighteenmile Canyon is estimated at 18 acres. Maximum cumulative disturbance for the No Action Alternative (i.e., the combined existing and RFD disturbance) would be 6,753 acres (3.2%) in the combined watersheds. The maximum cumulative disturbance for the Proposed Action (i.e., the combined existing, proposed [Proposed Action and Alternative A], and RFD disturbance) would be 22,953 acres (10.9%) in the combined watersheds (see Table 4.3). Under Alternative B, maximum cumulative disturbance would be increased from the No Action to 10,050 acres, 4.8% of the combined watersheds. Under Alternatives C and D, maximum cumulative disturbance would be 13,458 acres and 18,334 acres or 6.3% and 8.7% of the CIAA, respectively. Under Alternative E, maximum cumulative disturbance would be 13,139 acres (6.2%). Under Alternative F, maximum cumulative disturbance would be 17,199 acres or 8.2% of the combined watersheds. Under Alternative G, maximum cumulative disturbance would be 20,742 acres or 9.9% of the combined watersheds. Under the Preferred Alternative, maximum cumulative disturbance would be 15,069 acres (7.2% of the combined watershed)--an increase of 8,316 acres above the No Action Alternative.

Maximum cumulative disturbance would be greatest in the combined watersheds that drain into the Green River, and disturbance would be greatest in the Expanded Sand Draw-Alkali Creek watershed (see Tables 4.3 and 4.4). Gas development would continue to be the primary component of this disturbance. Maximum cumulative disturbance as a result of the No Action Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 2,355 acres (10.3% of the watershed). Maximum cumulative disturbance as a result of the Proposed Action and Alternative A in the Expanded Sand Draw-Alkali Creek watershed is estimated at 9,612 acres (41.9% of the watershed). Maximum cumulative disturbance as a result of the Preferred Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 6,064 acres (26.4% of the watershed). Under other alternatives, maximum cumulative disturbance in the Expanded Sand Draw-Alkali Creek watershed is estimated to range from 3,805 acres (16.6%) under Alternative B to 8,617 acres (37.6%) under Alternative G. The Long Draw watershed that drains 16% of the JIDPA would experience the next greatest amount of cumulative disturbance. The closed basin watersheds--Jonah Gulch and 140401040603--would likely only experience a small percentage of cumulative disturbance to soils.

4.1.7.12 Unavoidable Adverse Impacts

Productivity of some disturbed soils would be reduced due to removal of vegetation, increased soil exposure, mixing of soil horizons, and increased susceptibility to wind and water erosion. Some increased soil loss through erosion would be unavoidable under all of the alternatives.

4.1.8 Surface Water and Ground Water

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with water resources:

- to maintain, improve, and/or protect surface and ground water quality;
- to maintain or improve channel stability and overall watershed conditions;

- to protect, maintain, or improve wetlands, floodplains, riparian areas, and other water resources;
- to conserve water and relate water resources and development to desired land use;
- to support and encourage water quality monitoring programs;
- to establish more watering systems on all grazing lands for livestock, wildlife, and game/non-game birds;
- to encourage strategies that utilize Wyoming's appropriated share of Colorado River waters for beneficial uses;
- to consider potential effects on surface and ground water quality/resources when land uses are planned or proposed, particularly near water courses and lakes;
- to ensure land uses and developments do not accelerate long-term ground water depletion; and
- to comply with water quality standards (e.g., salinity) set forth by the *Colorado River Basin Salinity Control Act.*

Impacts to surface or ground waters would be significant 1) if water quality declined (e.g., from sedimentation, accidental spills, or cross-aquifer mixing) such that existing WDEQ water quality classes (WDEQ 1990) would be downgraded; 2) if water quantities were depleted such that the water rights of ground water or downstream users would be violated; 3) if project-related erosion and runoff into intermittent drainages and subsequently into perennial waters altered the physical characteristics of these waters; 4) if project activities resulted in a violation of RMP objectives within or downstream of the JIDPA; and/or 5) if project activities resulted in a violation of Colorado river Water Quality standards for salinity (723 mg/L salinity below Hoover Dam [Colorado River Basin Salinity Control Forum 2002]).

There would be no depletion of surface waters associated with the project. With successful reclamation (including interim reclamation occurring during the LOP [Appendix G]) and the construction of sediment retention/catchment areas where needed, only minor amounts of project-related runoff sediments are anticipated to reach perennial surface waters. In the absence of successful reclamation and during periods of high runoff, significant sediment loads in runoff waters could potentially occur. No impacts to and/or from flooding are anticipated because areas adjacent to drainages would be avoided.

Potential impacts to surface and/or ground water resulting from the project include increased turbidity, salinity, and sedimentation of surface waters due to runoff and erosion from disturbed areas; accidental spills of petroleum products or other pollutants; discharge of unsuitable quality produced water and/or pipeline test water; and cross-aquifer mixing. Impacts to surface water from development generally would result from increased runoff from disturbed areas, and it is assumed that with increased surface disturbance acreage, there would be a corresponding decrease in water quality (increased sediment loads in runoff waters) and increased runoff rates. Since the sediment and salt loads are unknown under any project alternative, the BLM has determined that modeling will be performed to identify these volumes. The results of this

modeling will be available in the Final EIS. Rates of wind and water erosion would increase above natural rates until successful reclamation of disturbed areas is achieved. Short-term control of surface runoff would be dependent on the success of reclamation and revegetation efforts described in site-specific reclamation plans, Surface Use Plans, or Plans of Development prepared for each APD and/or ROW application, and SWPPPs.

Concentrating development actions at larger well pads would have increased site-specific effects on overland flow patterns, ground water infiltration (reduced on compacted areas) and runoff volumes (increased rates and potential erosion and sedimentation). Additionally, if surface disturbance is concentrated in any one watershed, increased potential erosion and runoff-related effects may occur, possibly requiring the need for special treatments to be specified in APD approvals. Estimates of potential new initial and LOP disturbance associated with the Proposed Action and each of the alternatives within each project-affected watershed are presented in Tables 4.3 and 4.4 and discussed under each alternative. Development activities in the JIDPA such as roads and well pads could affect natural overland flow patterns and ground water infiltration. Compacted areas (e.g., roads and well pads) could reduce ground water infiltration and potentially could increase the erosive potential of runoff events by creating a shorter period of runoff and an increased volume of runoff water and contained sediments. While increased sedimentation and salinity volumes are unknown, potential impacts could occur if increases result in the loss of channel stability and a decrease in overall watershed condition. While proper design, construction, and maintenance of proposed facilities would reduce erosion potential, these actions may not entirely compensate for anticipated increased flows.

As noted in Section 3.1.6.2, ground water greater than approximately 2,300 ft below ground surface is relatively fresh, and the aquifer is extensive. Proposed ground water consumption of fresh water would result in the temporary partial depletion of this aquifer. An estimated maximum of 4.9 acre-ft of new ground water would be required to drill and complete each well (Table 4.5), and this water would be obtained from approximately 41 (25 existing, 16 new) water wells drilled to the top 600 ft of the aquifer.

Water wells pumping water out of an aquifer create a cone of depression, where ground water levels are lowered near the pumping wells. The ground water model MODFLOW was used to simulate the cone of depression created by pumping of all Proposed ground water from the existing 25 water wells and to determine the approximate time to full recovery of the aquifer after pumping stops (full recovery is defined as the point in time when drawdown is 1.6 ft or less) (HydroGeo, Inc. 2004). Three development rates were modeled: development of 75 wells per year over 41.3 years, 150 wells per year over 20.7 years, and 250 wells per year over 12.4 years (Table 4.5).

Ground water modeling results (Map 4.1) showed that the cone of depression would extend only about 1.0 mile beyond the boundary of the JIDPA, even for the most rapid rate of maximum development (250 wells per year over 12.4 years) and that drawdown would be no greater than about 10 ft in the JIDPA (HydroGeo, Inc. 2004). The results also showed that the aquifer would fully recover within 1 to 6 years following the cessation of pumping (Table 4.6). Outside the JIDPA, no notable impacts to surface or ground water would occur. Ground water quality would not be impacted as a result of freshwater pumping, since the freshwater aquifers from which proposed waters would be obtained appear to be isolated from deeper, poorer quality waters. None of the alternatives would result in significant aquifer drawdown, and this impact is not discussed further, except to note that rate of development would impact rate of aquifer recovery.

Table 4.5 Summary of Ground Water Pumping Scenarios (3,100 total wells), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Gas Wells/ Year	Water Need per Gas Well (acre-ft/yr)	Water Need for All Gas Wells (acre-ft/yr)	Length of Drilling Program (years)	Number of Pumping Water Wells	Water per Pumping Well (acre-ft/yr)	Water per Pumping Well (gpm)
75	4.9	367.5	41.3	25	14.7	9.1
150	4.9	735.0	20.7	25	29.4	18.2
250	4.9	1,225.0	12.4	25	49.0	30.4

Potential for contamination of the freshwater aquifer is low because the well drilling and casing practices used by the Operators and required by BLM and the WOGCC limit the potential for movement of any materials outside the well casing and across aquifers. Accidental contamination is possible but would be mitigated through a groundwater clean-up program, the scope of which would be determined by the EPA should a reportable incident occur (see Appendix G).

Gas wells are expected to produce 0.5-10.0 bbls of water per day, which would be disposed of as described in Appendix G. The brackish water aquifer(s) that is the source of the produced water is thought to be isolated from the freshwater aquifer described above; thus, water production is not likely to impact the quantity or quality of fresh ground water. Furthermore, because it apparently is isolated, production and disposal or reuse of this water for the project is not likely to impact surface water resources within or outside of the JIDPA.

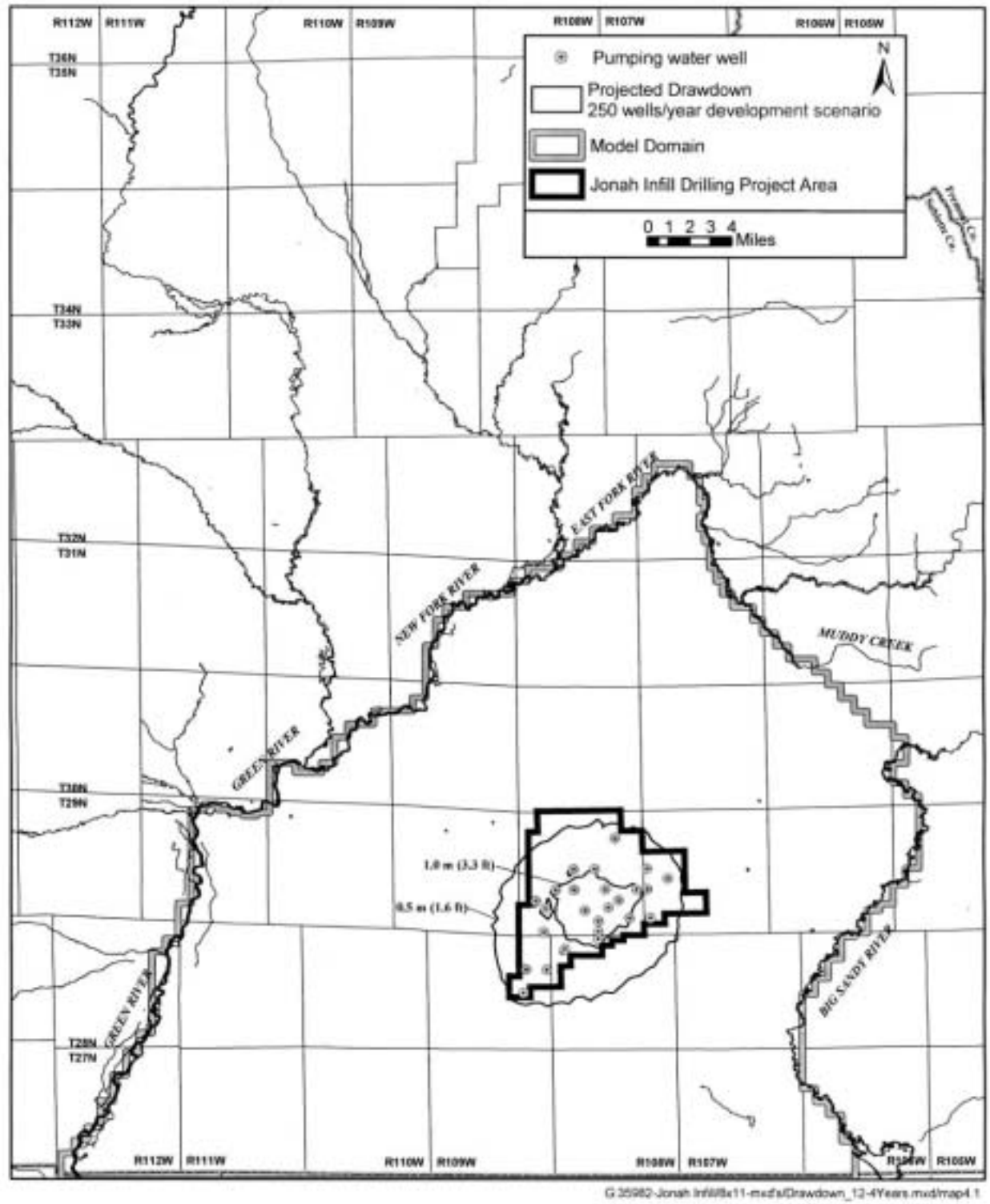
Hydrostatic pipeline testing water that does not meet applicable state and federal surface or ground water standards would not be released on the ground surface. This water may require treatment in a lined treatment pond prior to discharge or may be transported away from well locations to lined evaporation ponds or injector wells for disposal. All disposal and/or reuse of produced and test water would be in accordance with WDEQ rules and regulations and BLM *Onshore Oil and Gas Order No. 7*. Considerable volumes of produced water would be purified and reused for the project (see Appendix G).

Impacts to surface water resources could be significant under any project alternative. Under all alternatives, Operators would be required to implement management requirements and mitigation measures (see Appendices A and B); therefore, impacts to surface water also would be relative to the effectiveness of these additional requirements.

No significant impacts to ground water resources are anticipated under any alternative.

4.1.8.1 No Action Alternative

Under the No Action Alternative, there would be no additional activities that would potentially affect water resources other than those previously approved for the area (BLM 1998b, 2000b)--4,209 acres of new (short-term) and 1,409 acres of LOP disturbance (see Table 2.3) or 13.8% and 4.6% of the JIDPA, respectively. Some ephemeral drainages would remain prone to flooding



Map 4.1 Modeled Cone of Depression for Development of 250 Wells per Year Over 12.4 Years (3,100 total wells), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Table 4.6 Ground Water Recovery Time (3,100 wells), Jonah Infill Drilling Project, 2005.

No. Gas Wells/Year	Years of Pumping	Years to Full Recovery After Pumping Ends	Total Years to Full Recovery
75	41.3	0.5	41.8
150	20.7	4.0	24.7
250	12.4	6.0	18.4

after storm events, and their channels would continue to be subject to erosion at existing rates. The duration of impacts to surface water would be approximately 63 years (see Table 2.2) and until areas are adequately reclaimed. Further ground water pumping would not be conducted, and aquifers would begin recharging immediately. Prior decisions found that the existing project would be unlikely to significantly impact surface or ground water resources (BLM 1998b, 2000b).

4.1.8.2 The Proposed Action

A total of 4,209 acres of new (short-term) and 1,409 acres of LOP disturbance currently is approved in the JIDPA (see Table 4.3). The Proposed Action would result in an estimated additional 16,200 acres of new initial disturbance, for a total of 20,126 acres in the JIDPA (66.0% of the JIDPA) and an additional 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under the Proposed Action would be 20,409 acres (see Table 4.3). Approximately 70.4% (14,369 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would increase as development occurs (for approximately 13 years). The magnitude of surface disturbance would depend on the amount of disturbance present at any one time and the rate of reclamation. The remaining 6,040 acres would be disturbed for the LOP (approximately 76 years and until successful reclamation is achieved); thus, surface water impacts would last 13 years longer than under the No Action Alternative.

Estimates of potential new initial and LOP disturbance acreages associated with the Proposed Action and each of the alternatives within each project-affected watershed are presented in Tables 4.3 and 4.4. The Expanded Sand Draw-Alkali Creek watershed, which drains 45.0% of the JIDPA, would experience the greatest level of impacts to surface water resources from project-related activities. Potential new initial disturbance to this watershed from implementation of the Proposed Action could increase from that of the No Action Alternative to 39.5% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from the Proposed Action would increase from 607 acres or 2.6% of the watershed (under the No Action Alternative) to 2,682 acres (11.7% of the watershed).

Under the Proposed Action, types of impacts to ground water would be similar to those described for the No Action Alternative and, with effective mitigation, it is anticipated that the potential for adverse impacts also would be similar. However, more fresh ground water would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Under the Proposed Action Alternative, the duration of ground water impacts would be 13 years longer than under the No Action Alternative (i.e., the development phase [see Table 2.2]) plus 6 years required to recharge the aquifer (see Table 4.6).

4.1.8.3 Alternative A

Implementation of Alternative A is anticipated to result in the same types and volumes of water resource impacts as described for the Proposed Action (see Section 4.1.8.2 and Tables 4.3 and 4.4). However, since selected Operator-committed and BLM-required practices (e.g., avoidance of drainage buffers) would not be implemented, significant impacts are more likely to occur under this alternative. Because development of natural gas resources in these areas would not require the use of directional drilling, impacts to surface water resources, particularly sedimentation into Sand Draw, likely would be greater than under the Proposed Action. As with the Proposed Action, areas would not all be disturbed at the same time; rather, disturbance would accumulate as development occurs. Impacts to surface water would depend on the rate of development and would occur throughout the LOP (approximately 76 to 105 years and until successful reclamation is achieved); thus, impacts would last 13 to 42 years longer than under the No Action Alternative.

Implementation of Alternative A is anticipated to result in the same types of impacts to ground water as described for the No Action Alternative (see Tables 4.3 and 4.4); however, more fresh ground water would be consumed and more poor-quality water would be produced because more gas wells would be drilled. The ground water aquifer recovery rate would depend on the rate of development. Because the rate of development may vary under Alternative A (i.e., 75, 150, or 250 wells developed/year), the duration of ground water impacts would range from 13 to 42 years longer than the No Action Alternative (i.e., the development period) plus up to 6 years required to recharge the aquifer (see Table 4.6).

4.1.8.4 Alternative B

Implementation of Alternative B would result in an estimated additional 3,297 acres of new initial disturbance above that of the No Action Alternative for a total of 7,223 acres in the JIDPA (23.7% of the JIDPA) and 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under Alternative B would be 7,506 acres (see Table 4.3). Approximately 65.1% (4,884 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would accumulate as development occurs (for approximately 13 to 42 years). The remaining 2,622 acres would be disturbed for the LOP (approximately 76 to 105 years and until successful reclamation is achieved); thus, surface water impacts would last 13 to 42 years longer than under the No Action Alternative, depending on the rate of development.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to surface water resources from project-related activities. Potential new disturbance to this watershed from implementation of Alternative B could increase from that of the No Action Alternative to 14.2% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative B would increase from 607 acres or 2.6% of the watershed (under the No Action Alternative) to 1,143 acres (5.0% of the watershed) (see Tables 4.3 and 4.4).

Implementation of Alternative B would result in the same types of impacts to ground water as the No Action Alternative; however, more fresh ground water would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Because the rate of development may vary under Alternative B, the duration of ground water impacts would range

from 13 to 42 years longer than the No Action Alternative (i.e., the development period) plus 1 to 6 years required to recharge the aquifer.

4.1.8.5 Alternative C

Implementation of Alternative C would result in an estimated additional 6,705 acres of new initial disturbance above that of the No Action Alternative, for a total of 10,631 acres in the JIDPA (34.9% of the JIDPA) and 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under Alternative C would be 10,914 acres (see Table 4.3). Approximately 68.9% (7,515 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would accumulate as development occurs (for approximately 13 to 42 years). The remaining 3,399 acres would be disturbed for the LOP (i.e., approximately 68 to 80 years and until successful reclamation is achieved); thus, surface water impacts would last 5 to 17 years longer than under the No Action Alternative, depending on the rate of development.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to surface water resources from project-related activities. Potential new disturbance to this watershed from implementation of Alternative C could increase from that of the No Action Alternative to 20.9% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative C would increase from 607 acres or 2.6% of the watershed (under the No Action Alternative) to 1,493 acres (6.5% of the watershed) (see Tables 4.3 and 4.4).

Implementation of Alternative C would result in the same types of impacts to ground water as the No Action Alternative; however, more fresh ground water would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Because the rate of development may vary under Alternative C, the duration of ground water impacts would range from 5 to 17 years longer than the No Action Alternative (i.e., the development period) plus an undetermined number of years (<6) required to recharge the aquifer.

4.1.8.6 Alternative D

Implementation of Alternative D would result in an estimated additional 11,581 acres of new initial disturbance above that of the No Action Alternative, for a total of 15,507 acres in the JIDPA (50.8% of the JIDPA) and 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under Alternative D would be 15,790 acres (see Table 4.3). Approximately 69.9% (11,035 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would accumulate as development occurs (for approximately 9 to 30 years). The remaining 4,755 acres would be disturbed for the LOP (i.e., approximately 72 to 93 years and until successful reclamation is achieved); thus, surface water impacts would last 9 to 30 years longer than under the No Action Alternative, depending on the rate of development.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to surface water resources from project-related activities. Potential new disturbance to this watershed from implementation of Alternative D could increase from that of the No Action Alternative to 30.4% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative D would increase from 607 acres or 2.6% of the

watershed (under the No Action Alternative) to 2,103 acres (9.2% of the watershed) (see Tables 4.3 and 4.4).

Implementation of Alternative D would result in the same types of impacts to ground water as the No Action Alternative; however, more fresh ground water would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Because the rate of development may vary under Alternative D, the duration of ground water impacts would range from 9 to 30 years longer than the No Action Alternative (i.e., the development period) plus an undetermined number of years (<6) required to recharge the aquifer.

4.1.8.7 Alternative E

Implementation of Alternative E would result in an estimated additional 6,386 acres of new initial disturbance above that of the No Action Alternative, for a total of 10,312 acres in the JIDPA (33.8% of the JIDPA) and 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under Alternative E would be 10,595 acres (see Table 4.3). Approximately 66.0% (6,998 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would accumulate as development occurs (for approximately 13 to 42 years). The remaining 3,597 acres would be disturbed for the LOP (i.e., approximately 76 to 105 years and until successful reclamation is achieved); thus, surface water impacts would last 13 to 42 years longer than under the No Action Alternative, depending on the rate of development.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to surface water resources from project-related activities. Potential new disturbance to this watershed from implementation of Alternative E could increase from that of the No Action Alternative to 20.2% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative E would increase from 607 acres or 2.6% of the watershed (under the No Action Alternative) to 1,582 acres (6.9% of the watershed) (see Tables 4.3 and 4.4).

Implementation of Alternative E would result in the same types of impacts to ground water as the No Action Alternative; however, more fresh ground water would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Because the rate of development may vary under Alternative E, the duration of ground water impacts would range from 13 to 42 years (i.e., the development period) longer than the No Action Alternative plus up to 6 years required to recharge the aquifer.

4.1.8.8 Alternative F

Implementation of Alternative F would result in an estimated additional 10,446 acres of new initial disturbance above that of the No Action Alternative, for a total of 14,372 acres in the JIDPA (47.1% of the JIDPA) and 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under Alternative F would be 14,655 acres (see Table 4.3). Approximately 72.7% (10,658 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would accumulate as development occurs (for approximately 13 to 42 years). The remaining 3,997 acres would be disturbed for the LOP (i.e., approximately 76 to 105 years and until successful reclamation is achieved); thus, surface water impacts would last 13 to 42 years longer than under the No Action Alternative, depending on the rate of development.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to surface water resources from project-related activities. Potential new disturbance to this watershed from implementation of Alternative F could increase from that of the No Action Alternative to 28.2% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative F would increase from 607 acres or 2.6% of the watershed (under the No Action Alternative) to 1,762 acres (7.7% of the watershed) (see Tables 4.3 and 4.4).

Implementation of Alternative F would result in the same types of impacts to ground water as the No Action Alternative; however, more fresh ground water would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Slightly larger volumes of fresh water would be needed to drill directional wells than would be needed under the Proposed Action. Because the rate of development may vary under Alternative F, the duration of ground water impacts would range from 13 to 42 years (i.e., the development period) longer than the No Action Alternative plus up to 6 years required to recharge the aquifer.

4.1.8.9 Alternative G

Implementation of Alternative G would result in an estimated additional 13,989 acres of new initial disturbance above that of the No Action Alternative, for a total of 17,915 acres in the JIDPA (58.7% of the JIDPA) and 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under Alternative G would be 18,198 acres (see Table 4.3). Approximately 70.3% (12,790 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would accumulate as development occurs (for approximately 13 to 42 years). The remaining 5,408 acres would be disturbed for the LOP (i.e., approximately 76 to 105 years and until successful reclamation is achieved); thus, surface water impacts would last 13 to 42 years longer than under the No Action Alternative, depending on the rate of development.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to surface water resources from project-related activities. Potential new disturbance to this watershed from implementation of Alternative G could increase from that of the No Action Alternative to 35.2% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from Alternative G would increase from 607 acres or 2.6% of the watershed (under the No Action Alternative) to 2,397 acres (10.5% of the watershed) (see Tables 4.3 and 4.4).

Implementation of Alternative G would result in the same types of impacts to ground water as the No Action Alternative; however, more fresh ground water would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Because the rate of development may vary under Alternative G, the duration of ground water impacts would range from 13 to 42 years (i.e., the development period) longer than the No Action Alternative plus up to 6 years required to recharge the aquifer.

4.1.8.10 BLM Preferred Alternative

Implementation of the Preferred Alternative would result in an estimated additional 8,316 acres of new initial disturbance above that of the No Action Alternative, for a total of 12,242 acres in the JIDPA (38.5% of the JIDPA) and 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under the Preferred Alternative would be 12,525 acres (see

Table 4.3). Approximately 69.2% (8,678 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would accumulate as development occurs (for approximately 13 years). The remaining 3,847 acres would be disturbed for the LOP (i.e., approximately 76 years and until successful reclamation is achieved); thus, surface water impacts would last 13 years longer than under the No Action Alternative.

Impacts to surface water resources under the Preferred Alternative would be similar to those described under the Proposed Action and the other alternatives; however, impacts are expected to be proportional the amount of new initial surface disturbance. Potential impacts to surface water from the Preferred Alternative (12,525 acres of new initial disturbance) would likely be less than the Proposed Action and Alternatives A, D, F, and G, where initial disturbance is estimated at 20,409 acres, 20,409 acres, 15,790 acres, 14,655 acres, and 18,198 acres, respectively. Additionally, it is anticipated that potential impacts to surface water under the Preferred Alternative would be greater than impacts to surface water resources as a result of Alternatives B, C, and G, where new disturbance is estimated at 7,506 acres, 10,914 acres, and 10,595 acres, respectively. Impacts are anticipated to be greatest in areas developed with the highest well pad densities (i.e., 48 wells/section).

The Expanded Sand Draw-Alkali Creek watershed would likely experience the greatest level of impacts to surface water resources from project-related activities. Potential new disturbance to this watershed from implementation of the Preferred Alternative could increase from that of the No Action Alternative to 24.0% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from the Preferred Alternative would increase from 607 acres or 2.6% of the watershed (under the No Action Alternative) to 1,695 acres (7.4% of the watershed) (see Tables 4.3 and 4.4).

Implementation of the Preferred Alternative would result in the same types of impacts to ground water as the No Action Alternative. Larger volumes of fresh water would be needed to drill directional wells and more wells would be drilled, so ground water consumption would be greater than for the No Action Alternative and comparable to the Proposed Action and Alternatives A, B, E, F, and G (all with up to 3,100 new wells). Alternatives C and D (1,250 and 2,200 new wells, respectively) would result in less ground water consumption than the Preferred Alternative because fewer wells would be drilled. The duration of ground water impacts would be 13 years (i.e., the development period) longer than the No Action Alternative plus 6 years required to recharge the aquifer.

Under the Preferred Alternative additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14).

4.1.8.11 Cumulative Impacts

The CIAA for surface water resources is the 10 watersheds that drain the JIDPA, which encompass approximately 210,300 acres. The overall stability of these watersheds is not anticipated to be significantly affected within the CIAA under any project alternative. Areas west of Big Sandy-occurring within the Bull Draw watershed are included in the CIAA; however, no project impacts would occur in this area. This is the same CIAA for soils and vegetation. Approximately 1.6% of the CIAA (3,355 acres) has been disturbed by well pads, agricultural lands (i.e., hay meadows), reservoirs, pipelines, roads, and residential areas (i.e., ranches) (see

Table 3.11). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance (992 acres or 4.2% of the watershed), most of which is from existing natural gas development in the Jonah Field.

RFD for the portion of the surface water CIAA outside the JIDPA is estimated at 594 acres, primarily from gas-related development in the Pinedale Anticline Natural Gas Field (see Table 4.3). Approximately 38% (228 acres) of the RFD would occur in the Expanded Sand Draw-Alkali Creek watershed. RFD for the North Alkali Draw watershed is estimated at 168 acres; for the Southeast New Fork River-Blue Rim watershed it is estimated at 126 acres; for the Big Sandy River-Bull Draw watershed it is estimated at 54 acres; and for the Upper Eighteenmile Canyon watershed it is estimated at 18 acres.

Maximum cumulative disturbance for each alternative (i.e., the combined existing, alternative-specific, and RFD disturbance) is shown in Table 4.3. Cumulative impacts would be as described for all alternatives, but increased in volume and duration.

Maximum cumulative disturbance would be greatest in the combined watersheds that drain into the Green River, and disturbance would be greatest in the Expanded Sand Draw-Alkali Creek watershed (see Tables 4.3 and 4.4). Gas development would continue to be the primary component of the disturbance. Maximum cumulative disturbance as a result of the No Action Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 2,355 acres (10.3% of the watershed). Maximum cumulative disturbance as a result of the Proposed Action and Alternative A in the Expanded Sand Draw-Alkali Creek watershed is estimated at 9,612 acres (41.9% of the watershed). Maximum cumulative disturbance as a result of the Preferred Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 6,064 acres (26.4% of the watershed). Under the other alternatives, maximum cumulative disturbance in the Expanded Sand Draw-Alkali Creek watershed is estimated to range from 3,805 acres (16.6%) under Alternative B to 8,617 acres (37.6%) under Alternative G. The Long Draw watershed that drains 16.5% of the JIDPA would experience the next greatest amount of cumulative disturbance. The closed basin watersheds--Jonah Gulch and 140401040603--would likely only experience a small percentage of cumulative disturbance to surface waters.

The CIAA for ground water includes the JIDPA and adjacent drawdown areas (see Map 4.1). Since no actions other than those proposed for this project are anticipated in the area, cumulative impacts to ground water would be of the same type and extent as those described for the No Action and action alternatives.

4.1.8.12 Unavoidable Adverse Impacts

There would be an unavoidable increase in surface disturbance in watersheds within the JIDPA for the LOP that could reduce water quality in ephemeral drainages during runoff events.

Project development would require a maximum of approximately 15,200 acre-ft of fresh water from shallow ground water aquifers.

4.1.9 Noise and Odor

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) do not specify any management goals/objectives specifically associated with noise and odor. However, the BLM's general goal of preserving and maintaining the quality of the environment while coordinating multiple use objectives remains applicable for noise and odor.

Impacts from noise and odor would be considered significant if they resulted in displacement of area residents, the loss of important wildlife features (e.g., greater sage-grouse leks, raptor nests, pronghorn migration corridors), and/or if BLM's goals of preserving and maintaining the quality of the environment could not be met.

Additional noise sources above and beyond current levels (i.e., the No Action Alternative) would include scraping, grading, and construction of new well pads; drilling, completion, and operation of new wells; Burma Road upgrade activities and associated increases in traffic; construction, maintenance, and traffic associated with new resource roads, gathering pipelines and collector/resource roads; construction/upgrade of ancillary facilities (i.e., water disposal, storage, and compressor station facilities); and exploration activities. Additional odor sources would be associated primarily with wells and exhaust from increased vehicular traffic.

Drilling and flaring operations would produce temporary noise levels of up to 115 dBA at the source, with noise levels of 55 dBA at 3,500 ft from the source (see Section 3.1.7). These activities are expected to be the loudest proposed noise-producing operations and would continue 24 hrs/day at well sites during development periods (see Appendix G). Increased noise levels associated with construction equipment (e.g., scrapers, dozers, trucks, graders, loaders) are expected to be between 70 and 90 dBA at about 50 ft from the source and would attenuate at a rate of approximately 6 dBA with each doubling of distance from the source (Table 4.7). Noise levels associated with production at each well pad would be minimal because no pumping is required. Noise levels associated with compressor stations (between 64 and 86 dBA at compressor stations, between 58 and 75 dBA at approximately 1.0 mile away) would continue at current levels for the LOP. Further noise level data are provided in Section 3.1.7, Figure 3.13, and Table 3.15.

Project noise may be heard 20 or more miles from the area, and although this noise would be barely audible at such distance, it could affect resident and recreating visitor perceptions of solitude. Some area residents have indicated that project noise (especially at night) is pervasive and disruptive and does affect their quality of life.

Under most weather conditions, it is anticipated that project odors would disperse rapidly and would not affect area users greater than 1.0 mile from sources; however, during temperature inversions and at other windless times, odors could be detected at distances greater than 1.0 mile from the JIDPA. This impact would be considered significant and could occur under all project alternatives.

Table 4.7 Estimated Noise Attenuation with Distance from Construction Equipment, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Distance from Source (ft)				
50	100	200	400	800
70 (busy traffic)	64 (conversation)	58 (conversation)	52 (quiet)	46 (library)
90 (endangers hearing)	84 (noisy, factory)	78 (noisy, factory)	72 (busy traffic)	66 (busy traffic, conversation)

It is likely that noise already has contributed to the apparent decrease in wildlife use on and adjacent to the JIDPA (see Section 4.2.2), with observed decreases in raptor nesting activity and productivity, male greater sage-grouse lek attendance and sage-grouse nesting within the JIDPA having been reported over the past several years (TRC Mariah 1999, 2001a, 2001b, 2002, 2004a). Data also suggest that noise may contribute to disturbance and/or departure of greater sage-grouse from area leks (TRC Mariah 2001d, 2003a).

Although project-related noise and odor are not anticipated to pose a human health hazard to persons in the area, they likely would be noticeable to recreationists and other visitors on and in the vicinity of the JIDPA (see Section 4.5.3) and might cause decreased use or diminished enjoyment of the area.

Significant impacts from noise and odor are anticipated within the JIDPA and vicinity under all alternatives.

4.1.9.1 No Action Alternative

Under the No Action Alternative, impacts due to noise and odor would be as identified and approved for existing Jonah Field developments (see Section 3.1.7). Prior decisions found existing project noise and odor impacts to be less than significant (BLM 1998b, 2000b). However, monitoring data collected since those decisions were made indicate that noise associated with existing activities may be contributing to documented decreases in wildlife use on and adjacent to the JIDPA (i.e., may be significant) (TRC Mariah 1999, 2001a, 2001b, 2001d, 2002, 2003a, 2004a).

Once all approved wells are drilled and developed, noise levels would be limited to those needed for production (primarily traffic), compressor stations, and reclamation (farm equipment), and would continue for an estimated 63 years and until all reclamation activities are completed.

4.1.9.2 The Proposed Action

Under the Proposed Action, the nature of impacts due to noise and odor would be similar to those of the No Action Alternative, but levels would be substantially increased as a result of the new

wells, well pads, and other proposed project facilities. Increased noise levels associated with construction of new well pads; drilling and completion of new wells; upgrade and/or construction of roads; and other project construction activities would be short-term at any given location but would continue throughout the field development period--12 to 13 years. Noise levels from field traffic and well maintenance actions (which might include some flaring) would occur for an estimated 76 years and until all reclamation activities are completed (i.e., 13 years longer than the No Action Alternative).

Odors present periodically at well and ancillary facility locations and along roadways could offend area users in the vicinity of emission sources. However, odors would be dispersed by wind and are not anticipated to adversely affect the majority of area users.

4.1.9.3 Alternative A

Under Alternative A, noise and odor levels would be similar to those of the Proposed Action. However, potential noise-related impacts to wildlife would be amplified in areas that would have been avoided under the Proposed Action (i.e., greater sage-grouse lek and raptor nest buffers [see Section 4.2.2]), increasing the potential for significant impacts. Odor impacts would be the same as described for the Proposed Action. Since the rate of development may vary under Alternative A (i.e., 75, 150, or 250 wells developed/year), the noise and odor impacts would occur for an estimated 76 to 105 years and until all reclamation activities are completed (i.e., 13 to 42 years longer than under the No Action Alternative).

4.1.9.4 Alternative B

Impacts due to noise and odor under Alternative B would be similar to those described for the Proposed Action except that elevated noise levels during development would be concentrated at the existing 497 wells pads and noise associated with construction of new well pads would not occur. Use of directional drilling would increase the site-specific (per well pad) duration of the noise impacts due to the additional time necessary to drill directional wells and the increased number of wells drilled per pad. Duration of field-wide impacts would be dependent upon the rate of development (76 to 105 years plus the time required to complete reclamation activities, or 13 to 42 years longer than under the No Action Alternative).

4.1.9.5 Alternative C

Under Alternative C, impacts due to increased noise levels and odor would be substantially higher than those for the No Action Alternative but lower than those described for the Proposed Action because 60% fewer well pads would be constructed and 60% fewer wells would be drilled. The duration of elevated noise levels associated with drilling would last from 5 to 17 years depending on the rate of development. Impacts due to odors also would be commensurately reduced from the Proposed Action because fewer wells would be drilled. Duration of field-wide noise and odor impacts would be dependent upon the rate of development (68 to 80 years plus the time required to complete reclamation activities, or 5 to 17 years longer than under the No Action Alternative).

4.1.9.6 Alternative D

Under Alternative D, impacts due to increased noise and odor levels would be substantially higher than those under the No Action Alternative but lower than those under the Proposed

Action because 29% fewer well pads would be constructed and 29% fewer wells would be drilled. The duration of elevated noise levels associated with drilling would last from 12 to 29 years depending on the rate of development. Impacts due to odors also would be commensurately reduced because fewer wells would be drilled. Duration of field-wide noise and odor impacts would be dependent upon the rate of development (72 to 93 years plus the time required to complete reclamation activities, or 9 to 30 years longer than under the No Action Alternative).

4.1.9.7 Alternative E

Impacts due to noise under Alternative E would be substantially higher than those described for the No Action Alternative but lower than those described for the Proposed Action, because elevated noise and odor levels during development would be concentrated at the 497 existing well pads and at 266 new well pads. Use of directional drilling would increase the site-specific (per well pad) duration of the noise impacts due to the additional time necessary to drill directional wells, as well as the increased number of wells per pad. Duration of the field-wide noise and odor impacts would be dependent on the rate of development (76 to 105 years plus the time required to complete reclamation activities, or 13 to 42 years longer than under the No Action Alternative).

4.1.9.8 Alternative F

Impacts due to noise and odor under Alternative F would be substantially higher than those described for the No Action Alternative but slightly lower than those under the Proposed Action because elevated noise and odor levels during development would be concentrated at the existing 497 well pads and at 1,028 new well pads. Use of directional drilling would increase the site-specific (per well pad) duration of the noise impacts due to the additional time necessary to drill directional wells, as well as the increased number of wells per pad. Duration of field-wide noise and odor impacts would be dependent on the rate of development (76 to 105 years plus the time required to complete reclamation work, or 13 to 42 years longer than under the No Action Alternative).

4.1.9.9 Alternative G

Impacts due to noise and odor under Alternative G would be substantially higher than those described under the No Action Alternative but lower than described for the Proposed Action because elevated noise and odor levels would be concentrated at the existing 497 well pads and at 2,553 new well pads. Use of directional drilling would increase the site-specific (per well pad) duration of the noise impacts due to the additional time necessary to drill directional wells, as well as the increased number of wells per pad. Duration of field-wide noise and odor impacts would be dependent on the rate of development (76 to 105 years plus the time required to complete reclamation work, or 13 to 42 years longer than under the No Action Alternative).

4.1.9.10 BLM Preferred Alternative

Impacts due to noise and odor under the Preferred Alternative would be substantially higher than those described under the No Action Alternative but lower than described for other action alternatives because this alternative requires implementation of additional mitigation and monitoring measures/management requirements (see Section 2.14). Implementation of these measures would decrease noise and odor impacts from those described for other action alternatives but impacts associated with noise would still be considered significant within the JIDPA.

Duration of field-wide noise and odor impacts would be dependent on the rate of development (76 years plus the time required to complete reclamation work, or 13 years longer than under the No Action Alternative).

4.1.9.11 Cumulative Impacts

The CIAA area for noise includes the JIDPA plus a 20-mile buffer, whereas the CIAA for odor is the JIDPA and a 2.0-mile buffer. Odors would not likely be detected more than 1.0 mile from the JIDPA and, in most cases, would be confined to the JIDPA because of dispersion. Noise impacts from the project in combination with other existing and proposed noises (most notably those from development in the Pinedale Anticline area) may be heard throughout the CIAA for the LOP. These noise levels could affect the use of some habitat features proximal to the JIDPA by wildlife (see Section 4.2.2) and may affect some recreationists and other visitors through a reduction in the perceived quality of experience throughout the CIAA. In no instance is it anticipated that cumulative noise levels would pose a human health hazard. As with the project alternatives, significant impacts associated with noise and odor are possible and would vary across alternatives depending upon the pace and extent of development. Cumulative impacts are anticipated to be greatest under the Proposed Action and Alternative A and least under the No Action Alternative.

4.1.9.12 Unavoidable Adverse Impacts

All of the action alternatives would result in some additional noise and odors within the JIDPA and in surrounding areas.

4.2 BIOLOGICAL RESOURCES

4.2.1 Vegetation

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with vegetation:

- to maintain or enhance vegetation community health, composition, and diversity to meet watershed, wild horse, and wildlife resource management objectives,
- to provide for plant diversity (desired plant communities) to meet livestock management, watershed, wild horse, and wildlife objectives, and
- to reduce the number and spread of invasive species.

Impacts to plant communities (including wetlands) would be significant if there was a long-term reduction in vegetation productivity, a permanent change in species composition, an increase in invasive non-native species (including noxious weeds), a net loss of wetlands, or a vegetation loss that resulted in a violation of BLM RMP or other land use plan objectives within or outside the JIDPA. Impacts to vegetation and wetland resources are assumed to be proportional to the amount of new initial surface disturbance for all alternatives (i.e., increased surface disturbance would result in a corresponding increase to vegetation impacts).

Impacts to wetlands, waters of the U.S. and riparian areas would be significant if there would be a violation of Section 404 of the *Clean Water Act* or *EOs* 11988 or 11990 and/or if BLM RMP or

other land use planning objectives could not be achieved. Since these areas would generally be avoided, there are no perennial streams on the JIDPA, and the project would be developed in compliance with the *Clean Water Act*, no significant impacts to wetlands, waters of the U.S, or riparian areas are anticipated under any alternative.

At the end of the LOP, most, if not all, disturbed areas including roads would be reclaimed and revegetated; however, BLM system roads (e.g., Burma and Luman Roads) would likely remain in an upgraded status.

All potentially disturbed vegetation types are common throughout the JIDPA and on surrounding lands. No uncommon or unique vegetation types would be removed by the project. The estimated disturbance volumes to each of the vegetation type in the JIDPA are provided in Table 4.8.

Impacts associated with the removal of vegetation include loss of wildlife habitat, a reduction in vegetation diversity, potential for increased soil erosion, potential invasion of undesirable plant species (non-native and/or noxious), and loss of livestock forage. Because it would take many years for reclaimed areas to develop the structure and function of self-sustaining vegetation communities (i.e., sagebrush), impacts would persist for an undetermined number of years following reclamation. Reclaimed areas would produce less forage for several years until revegetation is successful, at which time grasses and possibly forbs would likely become more dominant than the existing condition, providing increased forage for some wildlife and livestock (see Section 4.5.2). Shrubs may take 30 to 100 years or longer to reach predisturbance productivity levels and wildlife habitat structures (see also Section 4.2.2). The duration of impacts to vegetation communities would depend on the rate of development (i.e., 75, 150, or 250 wells per year) and the duration of time needed for reclaimed area to reach pre-disturbance conditions.

The following analyses show that the project under all alternatives is generally compatible with BLM management goals/objectives; however, significant impacts are anticipated to vegetation in the JIDPA through loss of habitat, forage, and soil protection, and increased potential for invasive, non-native species invasion under any alternative. For the PFO and RSFO areas as a whole, these significant impacts would not affect BLM's capability to manage vegetation resources pursuant to RMP objectives field-wide. Under all alternatives, specific management requirements and mitigation measures would be implemented; therefore, impacts to vegetation would also be relative to the effectiveness of these additional measures.

4.2.1.1 No Action Alternative

Under the No Action Alternative, there would be no additional activities that would potentially affect vegetation resources other than those previously approved for the area--4,209 acres of new (short-term) and 1,409 acres of LOP disturbance or 13.8% and 4.6% of the JIDPA, respectively. The duration of impacts would be approximately 63 years and until areas are adequately reclaimed. Prior decisions found that the existing project would not be likely to significantly impact vegetation resources (BLM 1998b, 2000b) (see also Section 3.2.1).

4.2.1.2 The Proposed Action

The Proposed Action would result in an estimated increase of 16,200 acres of new initial disturbance. Therefore, total disturbance under the Proposed Action, including existing

Table 4.8 Vegetation Type Disturbance Across Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Alternative and Disturbance Type	Dense sagebrush	Moderate Density Sagebrush	Scattered/No Sagebrush	Basin Big Sagebrush	Unknown Type (Unmapped Area)	Total (Acres of New Disturbance)
No Action						
New Initial	3,671	375	112	7	44	4,209
LOP	1,229	126	37	2	15	1,409
Proposed Action and Alternative A						
New Initial	14,129	1,445	431	25	170	16,200
LOP	4,039	413	123	7	49	4,631
Alternative B						
New Initial	2,876	294	88	4	35	3,297
LOP	1,058	108	32	2	13	1,213
Alternative C						
New Initial	5,848	598	178	11	70	6,705
LOP	1,736	178	53	2	21	1,990
Alternative D						
New Initial	10,101	1,033	308	17	122	11,581
LOP	2,918	299	89	5	35	3,346
Alternative E						
New Initial	5,570	570	170	9	67	6,386
LOP	1,908	195	58	4	23	2,188
Alternative F						
New Initial	9,111	932	278	15	110	10,446
LOP	2,257	231	69	4	27	2,588
Alternative G						
New Initial	12,201	1,248	372	21	147	13,989
LOP	3,448	357	106	6	42	3,999
Preferred Alternative						
New Initial	7,253	742	221	13	87	8,316
LOP	2,127	218	65	3	25	2,436
Total Acreage in JIDPA	26,601	2,721	811	47	320	30,500

disturbance, would be 20,409 acres (see Table 4.3). Of these 20,409 acres, 14,369 acres (70.4%) would be reclaimed and revegetated as soon as possible after disturbance. Not all disturbance would occur at one time but would accumulate as development occurs (for approximately 12 years). The magnitude of surface disturbance would depend on how much disturbance is present at any one time, as well as the rate of reclamation. Approximately 6,040 acres of vegetation would be removed for the LOP (i.e., 76 years and until adequate reclamation is achieved).

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to vegetation resources from project-related activities. Potential new disturbance to this watershed from the Proposed Action could increase from the existing 4.2% to 39.5% (see Table 4.4). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from the Proposed Action could increase to 2,682 acres (11.7% of the watershed).

Habitat suitable to the invasion of noxious weeds and other undesirable plant species would be created as a result of removal of existing vegetation.

Direct impacts to wetlands and waters of the U.S. would occur temporarily only as a result of road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 ft of wetlands or open water or within 100 ft of ephemeral or intermittent channels. Indirect impacts to wetlands, waters of the U.S, and/or riparian areas would occur as a result of increased sediment deposition in these areas.

4.2.1.3 Alternative A

Implementation of Alternative A is anticipated to result in the same types and volumes of vegetation impacts as the Proposed Action Alternative and would result in an increase in vegetation impacts from the No Action Alternative. However, under this Alternative, selected Operator-committed and BLM-required practices would not be implemented (i.e., avoidance of various buffers); therefore, impacts to vegetation, including wetlands, and waters of the U.S. particularly in the Sand Draw area would likely be greater than under the Proposed Action. Depending upon the rate of development (i.e., 75, 150, or 250 wells developed per year), the duration of vegetation impacts could be extended by an additional 42 years from that of the No Action Alternative (75 wells/year).

4.2.1.4 Alternative B

Implementation of Alternative B would result in an increase of 3,297 acres of new surface disturbance from that of the No Action Alternative, thereby increasing the potential of impacts to vegetation. There would be a total of 7,506 acres new disturbance (4,884 and 2,622 acres of short-term and LOP disturbance, respectively) under Alternative B. Approximately 65% (4,879 acres) of this disturbance would be reclaimed and reseeded as soon as practical after disturbance. An estimated 2,622 acres of total LOP disturbance, of which 2,541 acres would occur in the JIDPA, would be required for Alternative B. LOP disturbance to vegetation from this Alternative would increase from the No Action Alternative to 8.3% of the JIDPA. Disturbance acreages and percentages within affected watersheds are provided in Tables 4.3 and 4.4, respectively. Depending upon the rate of development (i.e., 75, 150, or 250 wells developed per year), the duration of vegetation impacts could be extended by an additional 42 years from that of the No Action Alternative (75 wells/year).

Habitat suitable to the invasion of noxious weeds and other undesirable plant species would be created as a result of removal of existing vegetation.

Direct impacts to wetlands, and waters of the U.S. would occur temporarily only as a result of road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 ft of wetlands or open water or within 100 ft of ephemeral or intermittent channels. Indirect impacts to wetlands and waters of the U.S. would occur as a result of increased sediment deposition in these areas.

4.2.1.5 Alternative C

Implementation of Alternative C would result in an increase of 6,705 acres of new surface disturbance from that of the No Action Alternative, thereby increasing potential impacts to vegetation resources. The duration of impacts to vegetation would depend on the rate of development, and the rate of reclamation, which could be from 68 years (250 wells/year) to 80 years (75 wells/year) plus the time needed for successful reclamation.

Under Alternative C, total new surface disturbance in the JIDPA would be 10,631 acres (7,313 acres and 3,318 acres for short-term and LOP disturbance, respectively). An additional 283 acres of new disturbance (81 acres for the LOP) would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under Alternative C would be 10,914 acres (see Table 4.3). Approximately 69% (7,515 acres) of this disturbance would be reclaimed and reseeded as soon as practical after disturbance; the remaining 3,399 acres would be disturbed for the LOP. LOP disturbance to vegetation from this alternative would increase from the No Action Alternative to 10.9% of the JIDPA. Disturbance acreages and percentages within affected watersheds are provided in Tables 4.3 and 4.4, respectively.

Habitat suitable to the invasion of noxious weeds and other undesirable plant species would be created as a result of removal of existing vegetation.

Direct impacts to wetlands and waters of the U.S. would occur temporarily only as a result of road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 ft of wetlands or open water or within 100 ft of ephemeral or intermittent channels. Indirect impacts to wetlands and waters of the U.S. would occur as a result of increased sediment deposition in these areas.

4.2.1.6 Alternative D

Implementation of Alternative D would result in an increase of 11,581 acres of new surface disturbance from that of the No Action Alternative, thereby increasing impacts to vegetation resources. Surface disturbance would accumulate as development occurs from 12 to 29 years. The duration of impacts to vegetation would depend on the rate of development and the rate of reclamation, which could be from 72 years (250 wells/year) to 93 years (75 wells/year) plus the time needed for successful reclamation.

Under Alternative D, total new surface disturbance in the JIDPA would be 15,507 acres (10,833 acres and 4,674 acres for short-term and LOP disturbance, respectively). An additional 283 acres of new initial disturbance (81 acres for the LOP) would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under this Alternative would be 15,790 acres (see Table 4.3). Approximately 70% (11,035 acres) of total disturbance

would be short-term (i.e., reclaimed and reseeded as soon as practical after disturbance); the remaining 4,755 acres would be disturbed for the LOP. LOP disturbance to vegetation from Alternative D would increase from the No Action Alternative to 15.3% of the JIDPA. Disturbance acreages and percentages within affected watersheds are provided in Tables 4.3 and 4.4, respectively.

Habitat suitable to the invasion of noxious weeds and other undesirable plant species would be created as a result of removal of existing vegetation.

Direct impacts to wetlands, waters of the U.S, and/or riparian areas would occur temporarily only as a result of road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 ft of wetlands or open water or within 100 ft of ephemeral or intermittent channels. Indirect impacts to wetlands and waters of the U.S. would occur as a result of increased sediment deposition in these areas.

4.2.1.7 Alternative E

Implementation of Alternative E would result in an increase of 6,386 acres of new surface disturbance from that of the No Action Alternative, thereby increasing impacts to vegetation as more well pads (estimated at 266 new well pads) and roads would be constructed. Surface disturbance would accumulate as development occurs from 12 to 42 years. The duration of impacts to vegetation would depend on the rate of development and the rate of reclamation, which could be from 76 years (250 wells/year) to 105 years (75 wells/year) plus the time needed for successful reclamation.

Under Alternative E, total surface disturbance in the JIDPA would be 10,312 acres (6,796 acres and 3,516 acres for short-term and LOP disturbance, respectively). An additional 283 acres of new disturbance and 81 acres LOP disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under Alternative E would be 10,595 acres (see Table 4.3). LOP disturbance to vegetation from Alternative E would increase from the No Action Alternative to 11.5% of the JIDPA. Disturbance acreages and percentages within affected watersheds are provided in Tables 4.3 and 4.4, respectively.
Habitat suitable to the invasion of noxious weeds and other undesirable plant species would be created as a result of removal of existing vegetation.

Direct impacts to wetlands and waters of the U.S. would occur temporarily only as a result of road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 ft of wetlands or open water or within 100 ft of ephemeral or intermittent channels. Indirect impacts to wetlands and waters of the U.S. would occur as a result of increased sediment deposition in these areas.

4.2.1.8 Alternative F

Implementation of Alternative F would result in an increase of 10,446 acres of new surface disturbance from that of the No Action Alternative; thereby increasing impacts to vegetation as more well pads (estimated at 1,028 new pads) and roads would be built. Surface disturbance would accumulate as development occurs from 12 to 42 years. The duration of impacts to vegetation would depend on the rate of development and the rate of reclamation, which could be from 76 years (250 wells/year) to 105 years (75 wells/year) plus the time needed for successful reclamation.

Under Alternative F, total surface disturbance in the JIDPA would be 14,372 acres (10,456 acres and 3,916 acres for short-term and LOP disturbance, respectively). An additional 283 acres of new disturbance and 81 acres LOP disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under Alternative F would be 14,655 acres (see Table 4.3). LOP disturbance to vegetation from Alternative F would increase from the No Action Alternative to 12.8% of the JIDPA. Disturbance acreages and percentages within affected watersheds are provided in Tables 4.3 and 4.4, respectively.

Habitat suitable to the invasion of noxious weeds and other undesirable plant species would be created as a result of removal of existing vegetation.

Direct impacts to wetlands and waters of the U.S. would occur temporarily only as a result of road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 ft of wetlands or open water or within 100 ft of ephemeral or intermittent channels. Indirect impacts to wetlands and waters of the U.S. would occur as a result of increased sediment deposition in these areas.

4.2.1.9 Alternative G

Implementation of Alternative G would result in an increase of 13,989 acres of new surface disturbance from that of the No Action Alternative; thereby increasing impacts to vegetation since more well pads (estimated at 2,553 new pads) and roads would be built. Surface disturbance would accumulate as development occurs from 12 to 42 years. The duration of impacts to vegetation would depend on the rate of development and rate of reclamation, which could be from 76 years (250 wells/year) to 105 years (75 wells/year) plus the time needed for successful reclamation.

Under Alternative G, total surface disturbance in the JIDPA would be 17,915 acres (12,588 acres and 5,327 acres for short-term and LOP disturbance, respectively). An additional 283 acres of new disturbance and 81 acres LOP disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under Alternative G would be 18,198 acres (see Table 4.3). LOP disturbance to vegetation from Alternative G would increase from the No Action Alternative to 17.5% of the JIDPA. Disturbance acreages and percentages within affected watersheds are provided in Tables 4.3 and 4.4, respectively.

Habitat suitable to the invasion of noxious weeds and other undesirable plant species would be created as a result of removal of existing vegetation.

Direct impacts to wetlands and waters of the U.S. would occur temporarily only as a result of road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 ft of wetlands or open water or within 100 ft of ephemeral or intermittent channels. Indirect impacts to wetlands and waters of the U.S. would occur as a result of increased sediment deposition in these areas.

4.2.1.10 BLM Preferred Alternative

Implementation of the Preferred Alternative would result an increase of an estimated 8,316 acres of surface disturbance from that of the No Action Alternative, resulting in an assumed increase in

vegetation impacts. Surface disturbance would accumulate as development occurs (for approximately 12 years).

Under the Preferred Alternative, total new initial surface disturbance in the JIDPA would be 12,242 acres. An additional 283 acres of initial disturbance would be required for ancillary facilities that may be constructed outside the JIDPA; therefore, total new disturbance under this Alternative would be 12,525 acres (see Table 4.3). Approximately 69.2% (8,678 acres) of total disturbance would be short-term (i.e., reclaimed and reseeded as soon as practical after disturbance); the remaining 3,847 acres would be disturbed for the LOP. New initial disturbance to vegetation in the JIDPA under this Alternative would increase from No Action to 12,242 acres (40.1% of the JIDPA). LOP disturbance to vegetation from the Preferred Alternative would increase from the No Action Alternative to 12.6 % of the JIDPA.

Habitat suitable to the invasion of noxious weeds and other undesirable plant species would be created as a result of removal of existing vegetation.

Direct impacts to wetlands and waters of the U.S. would occur temporarily only as a result of road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 ft of wetlands or open water or within 100 ft of ephemeral or intermittent channels. Indirect impacts to wetlands and waters of the U.S. would occur as a result of increased sediment deposition in these areas.

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14).

4.2.1.11 Cumulative Impacts

The CIAA for vegetation including wetlands and waters of the U.S. are the 10 watersheds that drain the JIDPA which encompass approximately 210,300 acres. Areas west of Big Sandy River occurring within the Big Sandy River-Bull Draw watershed are included in the CIAA; however, no project impacts would occur in this area. Approximately 1.6% of the CIAA (3,355 acres) has had native vegetation removed primarily as a result of well pads, agricultural lands (i.e., hay meadows), reservoirs, pipelines, roads, and residential areas (i.e., ranches). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance, of which most is from existing natural gas development in the Jonah Natural Gas Field.

RFD (vegetation disturbance) for the portion of the vegetation CIAA outside the JIDPA is estimated at 594 acres (see Table 4.3), primarily from gas-related development in the Pinedale Anticline Natural Gas Field. Approximately 38% (228 acres) of the RFD would occur in the Expanded Sand Draw-Alkali Creek Watershed. RFD for the North Alkali Draw watershed is estimated at 168 acres; for the Southeast New Fork River is estimated at 126 acres; for the Big Sandy River-Bull Draw is estimated at 54 acres; and for the Upper Eighteenmile Canyon is estimated at 18 acres.

Maximum cumulative disturbance for the No Action Alternative (i.e., the combined existing and RFD disturbance) would be 6,753 acres (3.2%) in the combined watersheds (see Table 4.3). The maximum cumulative disturbance for the Proposed Action (i.e., the combined existing, proposed

[Proposed Action and Alternative A], and RFD disturbance) would be 22,953 acres (10.9%) in the combined watersheds (see Table 4.3). Under Alternative B, maximum cumulative disturbance would be increased from the No Action to 10,050 acres, 4.8% of the combined watersheds. Under Alternatives C and D, maximum cumulative disturbance would be 13,458 acres and 18,334 acres or 6.3% and 8.7% of the CIAA, respectively. Under Alternative E, maximum cumulative disturbance would be 13,139 acres (6.2%). Under Alternative F, maximum cumulative disturbance would be 17,199 acres or 8.2% of the combined watersheds. Under Alternative G, maximum cumulative disturbance would be 20,742 acres or 9.9% of the combined watersheds. Under the Preferred Alternative, maximum cumulative disturbance would be 15,069 acres (7.2% of the combined watershed), an increase of 8,316 acres above the No Action Alternative.

Maximum cumulative disturbance would be greatest in the combined watersheds that drain into the Green River, and disturbance would be greatest in the Expanded Sand Draw-Alkali Creek watershed (see Tables 4.3 and 4.4).

The Wyoming sagebrush vegetation type, the primary vegetation type in the JIDPA and CIAA (see Tables 3.16 and 3.17 and Maps 3.11 and 3.12), would experience the greatest amount of cumulative disturbance regardless of development alternative. Disturbance to Wyoming sagebrush vegetation communities would remain greatest in the Expanded Sand Draw-Alkali Creek watershed, where gas development would continue to be the primary component of the disturbance. Maximum cumulative disturbance to vegetation as a result of the No Action Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 2,355 acres (10.3% of the watershed). Maximum cumulative disturbance to vegetation as a result of the Proposed Action and Alternative A in the Expanded Sand Draw-Alkali Creek watershed is estimated at 9,612 acres (41.9% of the watershed). Maximum cumulative disturbance to vegetation as a result of the Preferred Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 6,064 acres (26.4% of the watershed). Under other Alternatives, maximum cumulative disturbance in the Expanded Sand Draw-Alkali Creek watershed is estimated to range from 3,805 acres (16.6%) under Alternative B to 8,617 acres (37.6%) under Alternative G. The Long Draw watershed that drains 16% of the JIDPA would experience the next greatest amount of maximum cumulative disturbance. The closed basin watersheds--Jonah Gulch and 140401040603 would likely only experience a small percentage of cumulative disturbance to vegetation resources.

Within the CIAA, riparian and wetland habitats are primarily found along drainages and dispersed at ponds and reservoirs. Existing adverse impacts include some roads within these habitats, livestock grazing, and recreational use. Wetlands, waters of the U.S., and riparian areas would be avoided where possible by this and most other proposed projects in the area, so there are not anticipated to be any significant direct impacts to these resources. Indirect impacts to wetland and riparian areas would be limited to increased sediment deposition (see Section 4.1.8). A beneficial impact to riparian habitat would occur with planned improvements in grazing management. No permanent cumulative impacts are anticipated since all future development activities would comply with Section 404 of the *Clean Water Act* and EO 11990.

4.2.1.12 Unavoidable Adverse Impacts

The proposed project would temporarily remove from 13.8% (No Action, 4,209 acres) to 66.0% (Proposed Action and Alternative A, 20,409 acres) of the vegetation and would provide areas conducive to the invasion of noxious weeds and invasive species.

Since wetlands, WUS, and riparian areas would generally be avoided and any disturbance of these areas would be promptly reclaimed, no long-term unavoidable adverse impacts to these resources are anticipated.

4.2.2 Wildlife and Fisheries

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with wildlife and fisheries:

- to maintain, improve, or enhance the biological diversity of all plant and wildlife species while ensuring healthy ecosystems;
- to restore disturbed or altered habitat with the objective to attain desired native plant communities, while providing for wildlife needs and soil stability;
- to conserve and develop recreational resources for the benefit of present and future generations;
- to consider wildlife migration corridors, crucial winter ranges, and other important habitats when evaluating land use proposals;
- to support and maintain healthy wildlife populations as an appropriate and desired land use;
- to establish more watering systems on all grazing lands for livestock, wildlife, and game/non-game birds; and
- to minimize conflicts between wildlife and domestic pets.

Impacts to wildlife and fisheries would be considered significant if any project action would compromise the ability to meet the above management objectives, and significant impacts to most wildlife species on the JIDPA are anticipated under all project alternatives. Specific impacts which would be considered significant include, but would not be limited to, the physical loss or the abandonment of important wildlife features (e.g., greater sage-grouse leks, greater sage-grouse winter concentration areas, raptor nests and nesting and foraging territories, pronghorn migration corridors), diminished wildlife diversity in the JIDPA, and degradation of crucial winter ranges and/or other important wildlife habitats. For the PFO and RSFO areas as a whole, significant impacts to wildlife on and adjacent to the JIDPA would not be to such a degree that they would affect BLM's capability to manage these resources pursuant to RMP objectives field officewide.

In general, impacts to wildlife would result from 1) the direct loss of habitat due to removal of vegetation; 2) displacement of wildlife due to disturbance and/or noise from project-related activities including construction, drilling, traffic, and human presence (indirect habitat loss); 3) habitat fragmentation; 4) direct mortality due to construction activities and/or animal/vehicle collisions; 5) potential increased poaching and harassment as a result of increased access and

human presence; 6) impediments to pronghorn antelope migration; 7) loss of habitat function (most notably for greater sage-grouse breeding, nesting, brood-rearing, and wintering); 8) loss of suitable raptor nesting areas and/or existing territories; and 9) a decrease in species diversity. No impacts to fisheries in the Big Sandy, New Fork, and Green Rivers are anticipated under any alternative due to the distance of the project from live surface waters, the absence of surface water depletion, and the application of appropriate mitigation. Thus, impacts to fisheries are not discussed further in this section.

Exploration and development activities may cause severely fragmented habitats, and habitat treatments may not be an effective mitigation to offset the impacts of initial and long-term disturbance or loss of habitat function. When sagebrush habitats are degraded, vegetation reestablishment may take many years. Wyoming big sagebrush may require between 30 and 40 years to become established and may take 90 to 110 years to achieve desirable habitat characteristics (e.g., canopy height, coverage, and area). Therefore, habitat functionality, particularly for nesting species, on disturbed areas may not be achieved for 90 to 110 years. However, with successful reclamation, a mosaic of sagebrush successional stages, which is desirable for most sagebrush obligate species would be available in the JIDPA within a shorter time frame.

The Wilderness Society (2002) defines habitat fragmentation by quoting Noss and Csuti (1994); "Fragmentation of habitat can be defined as the decrease in the size of habitat patches and interior habitat and the increase in distance between patches." When large blocks of habitat are separated into small patches, the resulting fragmentation of the habitat may limit the ability of some animals to move, resulting in the use of inferior or unsuitable habitat. The Wilderness Society (2002) suggests that landscape analysis is a proven way to identify habitat fragmentation.

This EIS quantifies habitat fragmentation using GIS technology to draw buffers of various widths around roads, pipeline ROWs, well pads, and other project-related disturbance. The areas outside those buffers (i.e., those greater than a designated distance from project features and/or activities) are considered core areas. Core areas, by their definition, are the habitat patches most removed from project disturbances and, in general, they are likely to have a higher comparative value to wildlife species in the JIDPA than non-core areas, all other factors being equal. By producing habitat fragmentation models of the JIDPA using various buffers (i.e., 0.5 mile, 0.25 mile, 0.125 mile, and 0.063 mile) from existing and/or proposed project disturbance at various well densities (16, 32, and 64 wells per 640-acre section), an estimated total acreage and the number and average size of core areas within the JIDPA under a variety of development scenarios has been analyzed. The modeling results are provided in Tables 4.9 and 4.10 and Maps 4.2 through 4.5. Although it is suspected that some species in the area (e.g., greater sage-grouse, pronghorn antelope) are sensitive to varying degrees of fragmentation, insufficient scientific research has been conducted to determine what level of fragmentation is critical for individual populations or species.

Impacts specific to species or groups of species are described in the following sections. Significant impacts are anticipated under all alternatives (including the No Action Alternative), but would vary in degree as discussed in Sections 4.2.2.1 through 4.2.2.11. Existing and BLM-proposed mitigations for many wildlife species may be inadequate to reduce impacts to less than significant levels in the JIDPA.

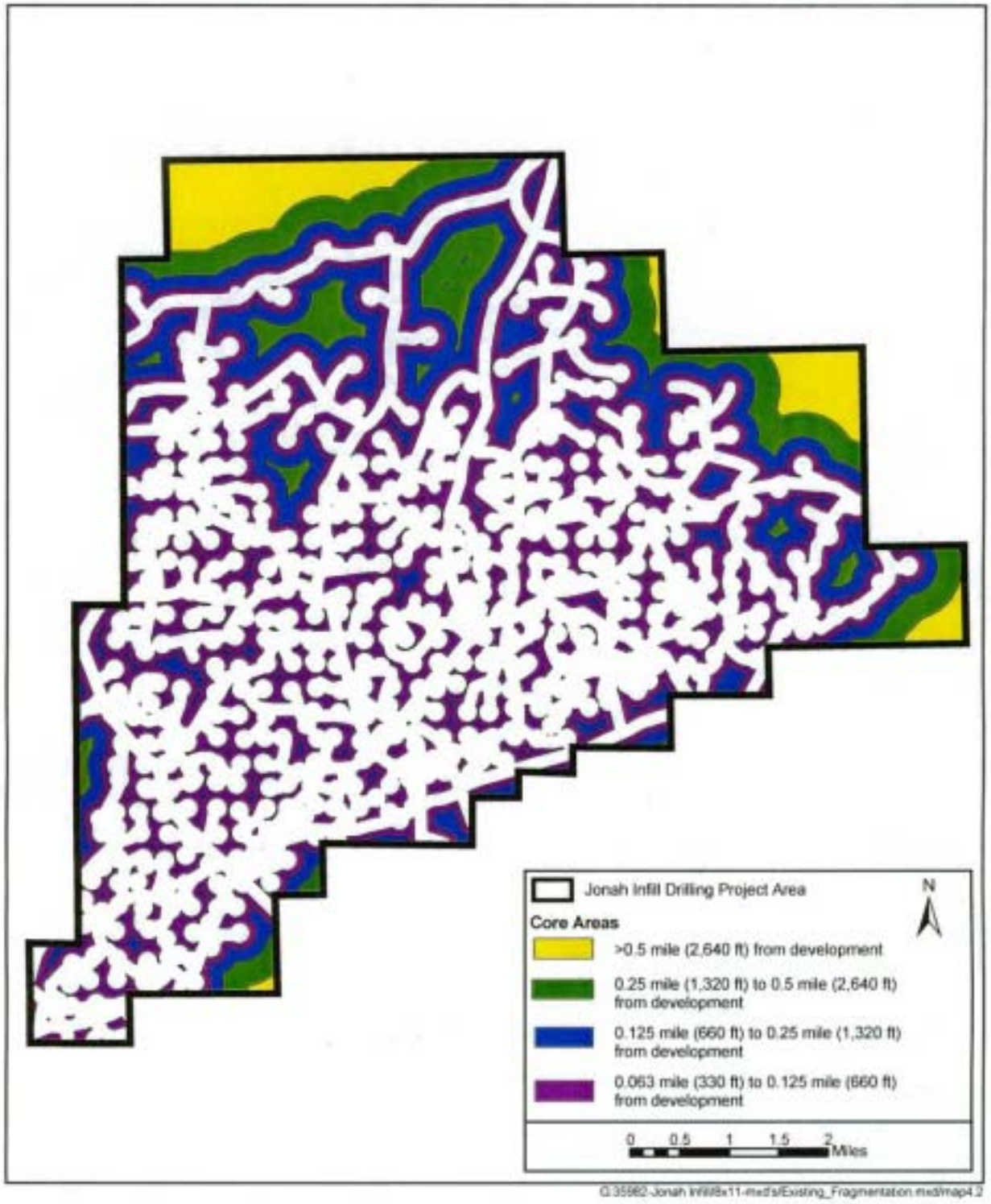
Table 4.9 Percent of the JIDPA Contained Within Core Areas for Existing Conditions and Selected Action Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.[1]

	Percent of JIDPA in Core Areas (%)			
Disturbance Buffer	Existing Conditions (No Action)	16 Wells/Section (Alternative E)	32 Wells/Section (Alternative F)	64 Wells/Section (Alternative G)
0.063 mile	45.3	28.6	10.1	2.1
0.125 mile	24.3	2.7	1.0	0.8
0.25 mile	12.6	0.2	0.04	0.02
0.5 mile	5.2	0	0	0

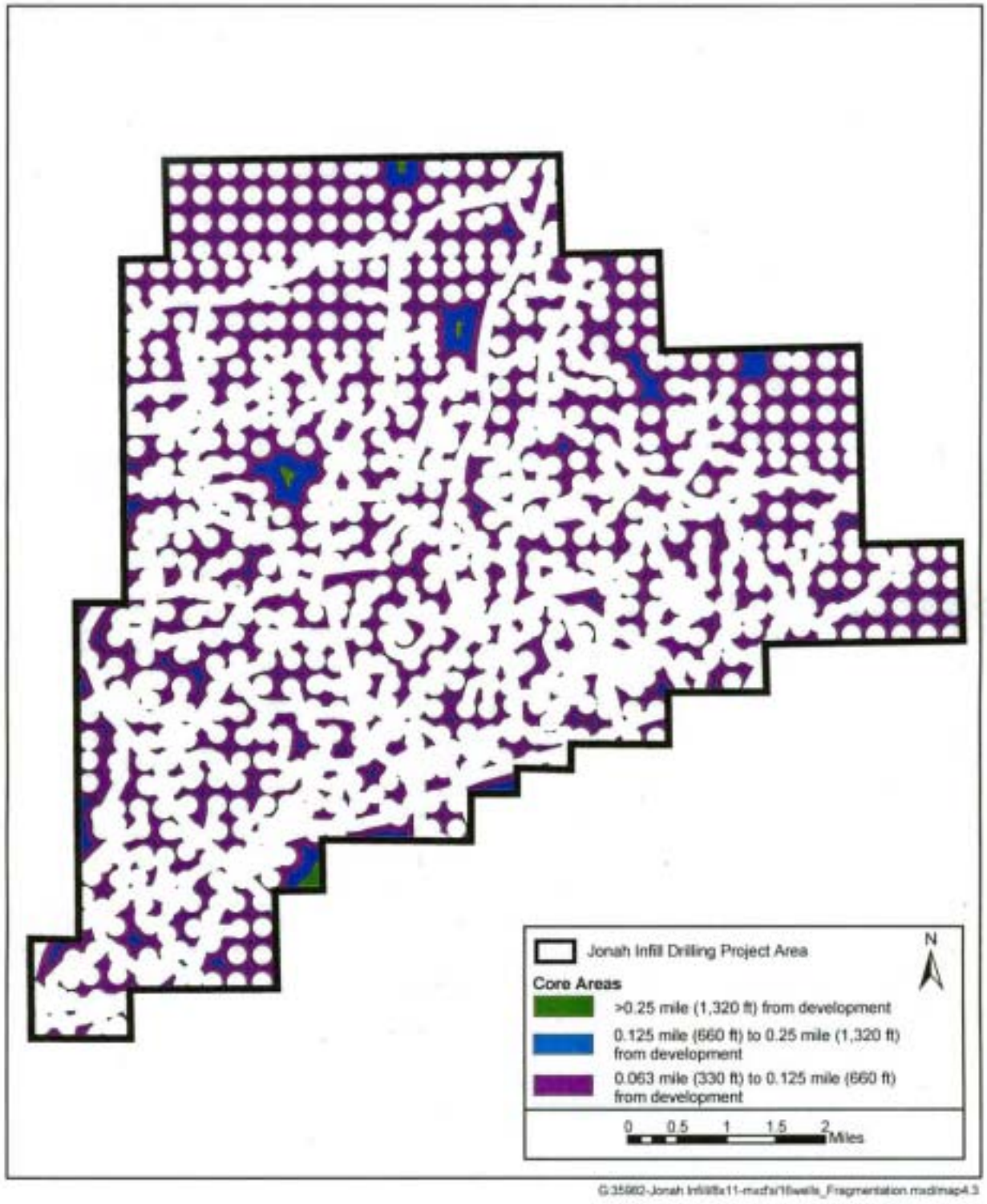
[1] Core areas are those areas within the JIDPA and outside the disturbance buffer (i.e., greater than a designated distance from Project-related disturbance).

Table 4.10 Number and Mean Size of Core Areas in the JIDPA for Existing Conditions and Selected Action Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

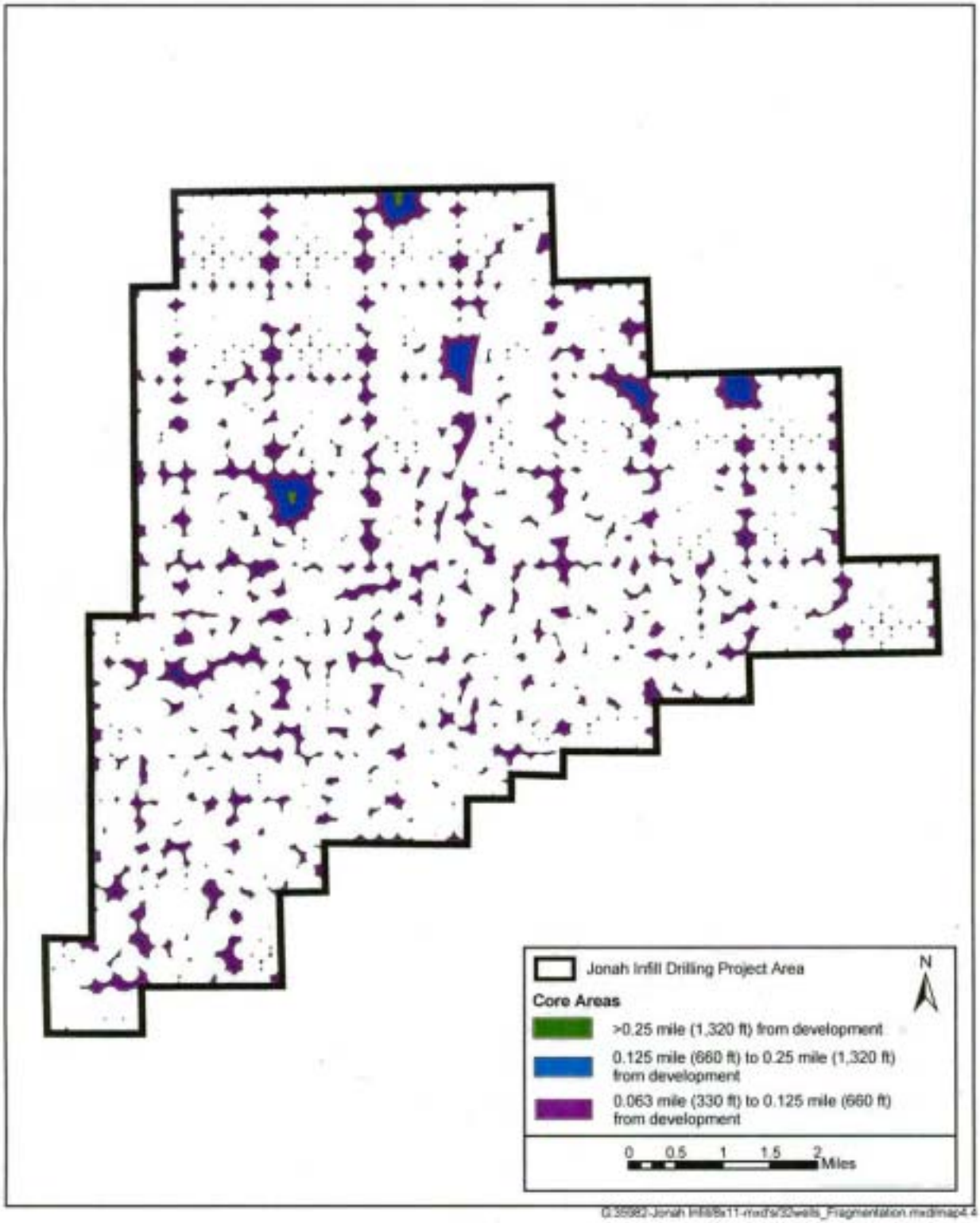
	Number/Mean Size of Core Areas (acres)			
Disturbance Buffer	Existing Conditions (No Action)	16 Wells/Section (Alternative E)	32 Wells/Section (Alternative F)	64 Wells/Section (Alternative G)
0.063 mile	164/84	205/42	616/5	93/7
0.125 mile	119/62	237/3	64/5	7/33
0.25 mile	18/214	6/10	3/5	2/3
0.5 mile	7/226	0	0	0



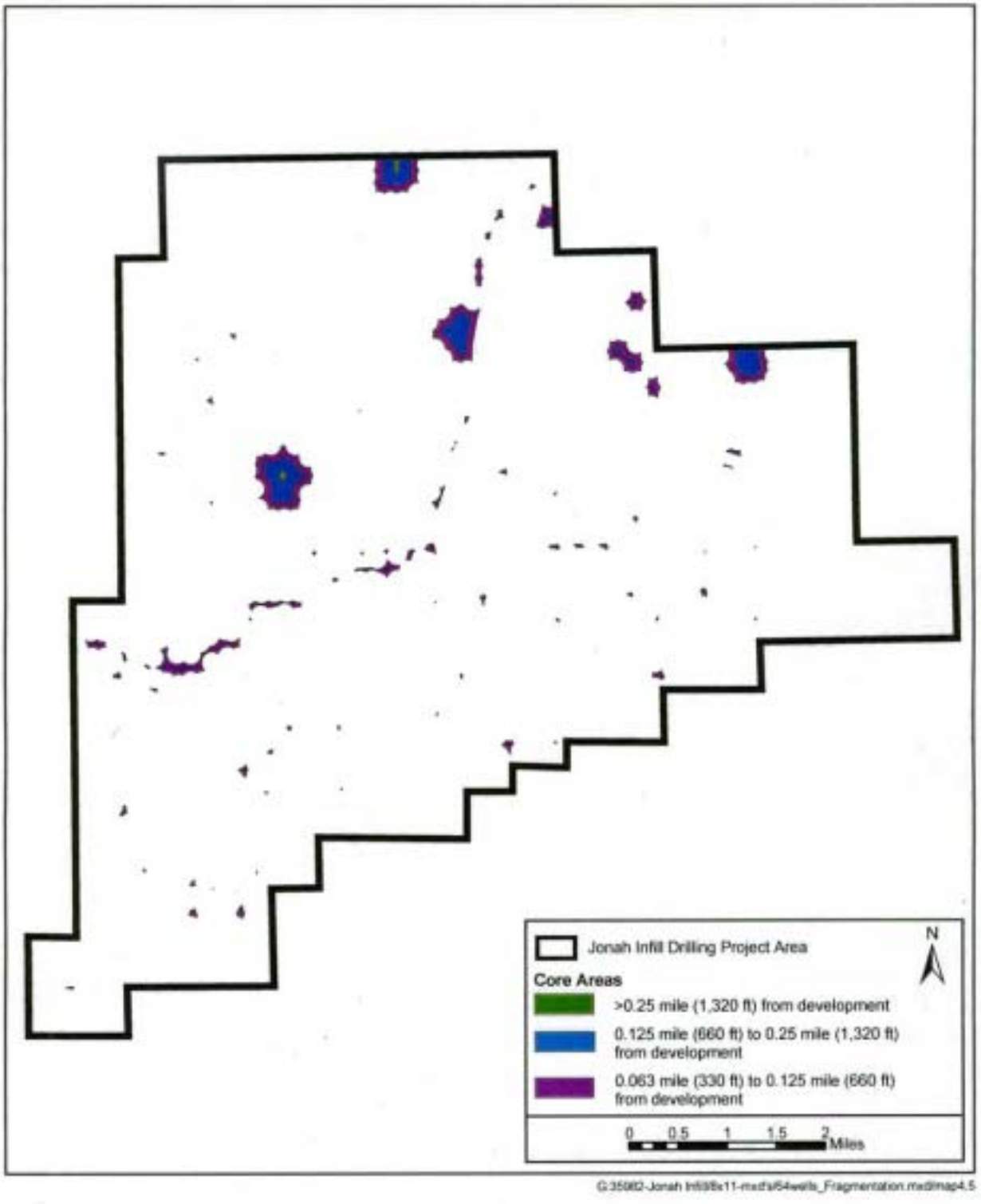
Map 4.2 Existing Wildlife Habitat Fragmentation (No Action), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.



Map 4.3 Wildlife Habitat Fragmentation Expected Under Development at 16 Wells per Section (Alternative E), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.



Map 4.4 Wildlife Habitat Fragmentation Expected Under Development at 32 Wells per Section (Alternative F), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.



Map 4.5 Wildlife Habitat Fragmentation Expected Under Development at 64 Wells per Section (Alternative G), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Pronghorn Antelope

Surface disturbance (both short-term and LOP) would result in a direct loss of spring/summer/fall pronghorn habitat within the Sublette Herd Unit. This represents up to 0.7% of the 4,697 square miles of spring/summer/fall habitat for the herd and up to 0.4% of the total acreage of the 7,938 square miles of occupied habitat (the amount would depend on the alternative). No crucial pronghorn habitats would be disturbed as a result of the proposed project. Approximately 65-73% (depending on the alternative) of the disturbed areas would be reclaimed and revegetated shortly after disturbance. This short-term disturbance would occur within spring/summer/fall habitat and would be spread over the development period and scattered throughout the JIDPA. The remaining 27-35% of the disturbance would result in the removal of spring/summer/fall habitat on the Sublette Herd for the LOP and until successful reclamation and revegetation is achieved. Reclaimed and revegetated areas would produce less forage for a period of years until revegetation is successful, at which time grasses and possibly forbs would become more dominant. Shrubs likely would take 30 to 40 years or more to become established but may take 90 to 110 years to reach predisturbance productivity and structure levels. In the interim, habitat function for sagebrush obligate species such as pronghorn would be compromised to varying degrees.

In addition to the direct loss of habitat, disturbance from drilling activities (including noise, increased traffic volume, and human presence) would affect utilization of habitats adjacent to development areas. Displacement likely would be about 0.5 mile (Gusey 1986; Guenzel 1987; Easterly et al. 1991). However, as noise and human presence are reduced, pronghorn likely would increase their use of these areas (e.g., during production operations), although probably not to the same extent as prior to disturbance. Although methodologies for documenting animal displacement or changes in distribution are fairly straightforward, those for documenting population-level impacts (i.e., survival, reproduction) are extremely complex. Thus, little information is available concerning how human-related disturbances impact reproduction and survival of ungulates (Western EcoSystems Technology Inc. [West] 2003).

Because the Jonah Infill Project would disturb pronghorn spring/summer/fall range, it is reasonable to assume that the project would have some adverse impacts to pronghorn populations as a result of direct habitat removal and a reduction in habitat function on areas adjacent to development activities. However, specific quantitative estimates of such impacts are not possible because the requisite research has not been done. Lindzey (2002), commenting on impacts to big game from oil and gas development, said:

> Changes resulting from energy development, undoubtedly, will influence wildlife populations, yet little [research] is available to support inferences about the degree of population-level effects or the best way to address possible impacts. Understanding the population-level effects of disturbances, such as those realized during energy exploration and development require more than the short-term, observational studies biologists now have to rely on.

Reeve (1984) found that pronghorn habituated to increased traffic volumes and heavy machinery as long as traffic moved in a predictable manner. Reaction of pronghorn to roads is not well understood; however, pronghorn are often seen adjacent to road ROWs, including busy interstate highways. It is likely that pronghorn movement is more affected by fences along ROWs than by the activity (traffic) on the ROW. However, increased mortality from vehicle/animal collisions is a potential direct impact that may occur due to increased traffic on the JIDPA for the LOP, and

the provision of access to big game range may increase legal and illegal pronghorn harvest. On the other hand, some people may be deterred from poaching because of the increased number of vehicles and humans in the area and the subsequent likelihood of being observed by other area visitors.

Pronghorn are known to move through the JIDPA on their way to and from crucial habitats (see Map 3.13), and some of these movements are likely to be hindered under most, if not all, of the development alternatives. The existing migration corridor between U.S. Highway 191 and the JIDPA boundary is at least 1.0 mile wide and would remain undisturbed (excluding the existing and unfenced Luman, Jonah North, and Rim Roads).

Furbearers, Small Game, and Other Mammals

Impacts to furbearers, small game, and other mammals would include the direct loss of habitat due to surface disturbance. Total proposed surface disturbance represents up to 67% of the JIDPA (depending on the alternative), and some unknown portion of the undisturbed habitat likely would suffer a reduction in use because of its proximity to human activity (noise, traffic, etc.). The degree of loss of habitat function would, to some extent, depend on each species' ability to adapt to disturbance. In addition, some smaller, less mobile animals like mice, voles, and ground squirrels are likely to be killed during construction operations.

Some additional poaching and increased mortality from animal/vehicle collisions is likely due to the increased road and traffic volume associated with project activities. The ability of the lands within the JIDPA to support furbearers, small game, and other mammals likely would decrease from current levels due to habitat loss and human disturbance. Increased human activity would displace some species from areas near project features which, when coupled with direct habitat loss, would further fragment habitats. Populations would continue to fluctuate and impacts would be masked by natural variations in weather, incidence of disease, and other natural factors. project-related disturbance to rare habitats (e.g., wetlands) would be avoided where practical (no other rare habitats are currently known to occur on the JIDPA).

Raptors

Existing seasonal and spatial restrictions at active raptor nests are intended to prevent adverse impacts (e.g., frightened adults, overexposure of eggs or young to heat or cold, missed feedings, premature fledging, and increased predation) to breeding, nesting, and brood-rearing raptors. However, no restrictions are in place to prevent development within the seasonal buffer zone outside of the nesting season except for the 825-ft or 1,000-ft no surface occupancy (NSO) buffers, and project facilities and roads constructed outside of the nesting season could result in disturbance to nesting activities in subsequent years. Tolerance to disturbance varies among raptor species and among individuals of the same species. In general, ferruginous hawks are among the most sensitive species to human disturbance. In some instances, raptor nest disturbance and the associated decrease in reproductive success may be avoided if project facilities are located outside of the line-of-sight of active raptor nests and/or if other raptor protection measures are effective. However, if suitable nesting habitat as identified during pre-development surveys is determined to be unoccupied by raptors, development may be allowed in these areas potentially precluding the future use of these areas by nesting raptors. The potential for adverse impacts to raptors would be greatest during project development, when human activity levels are highest; it is anticipated that impacts would decrease somewhat during the production phase of the project.

Reduction in raptor prey species also is likely to occur as a result of the surface disturbance of up to two-thirds of the JIDPA (the amount of disturbance would depend on the alternative). This habitat loss and the associated decrease in available prey base would reduce the quality of raptor foraging habitat within the JIDPA and may increase the size of foraging territory necessary to support an individual and/or decrease the number of foraging raptors the area can support.

Throughout the LOP, it is likely that raptor productivity (especially that of ferruginous hawks) would be negatively impacted by project-related activities. Increased human activity associated with the proposed project is likely to result in fewer nest initiations, increased nest site abandonment and/or reproductive failure, and decreased productivity of successful nests.

Game Birds

Continued disturbance of breeding, nesting, brood-rearing, and wintering greater sage-grouse and their habitats would occur and would increase from that currently occurring in the JIDPA as a result of increased habitat removal and noise and disturbance from traffic and human presence. The currently identified 0.25-mile active lek buffer and other seasonal avoidance measures may be inadequate to protect breeding, nesting, brood-rearing, and wintering grouse from noise or other impacts within the JIDPA (e.g., individuals flushed from leks, failure of females to breed, lek and nest abandonment, avoidance of all habitat areas), which could result in reduced breeding initiation, reproductive success, and survival. The locations of known leks (see Map 3.19) on and adjacent to the JIDPA are assumed to represent optimal lek habitat. Impacts to leks and other important habitats (nesting, winter) may be serious enough to cause abandonment of the area. Even if alternate lek sites are established or existing leks at alternate locations are used, it is assumed that less than optimal conditions would prevail, resulting in decreased breeding success. Furthermore, the loss of nesting, brood-rearing, and wintering areas may be equally, if not more, important to grouse survival. As with raptor nests, site-specific situations vary, and the success in reducing impacts using standard mitigation measures (e.g., NSO buffers and seasonal timing restrictions) is variable.

Most impacts to greater sage-grouse in the JIDPA have likely already occurred due to existing developments, and the area may no longer be suitable for sage-grouse use. Further habitat loss and disturbance would occur under all action alternatives. Recovery of habitat functionality for greater sage-grouse may take over 100 years. However, it is anticipated that a mosaic of sagebrush habitat age classes would be available on the JIDPA within a shorter time frame.

In areas where 40% of greater sage-grouse nesting, early brood-rearing, and/or winter habitat has been lost or severely degraded within the range of a population, Connelly et al. (2000) suggest that the management emphasis should focus on protecting any remaining sagebrush that is in any way suitable for these functions. Disturbance to remaining suitable greater sage-grouse nesting, early brood-rearing, and winter habitats should be avoided to prevent further fragmentation of those habitats. Within comparatively intact sagebrush ecosystems, treating up to 20% of degraded nesting and early brood-rearing habitats and 30% of the winter habitat may improve habitat conditions. Treatments may consist of restoring herbaceous understory, creating open patches of herbaceous vegetation, thinning dense sagebrush canopies exceeding 30% cover, creating openings within dense sagebrush, regenerating the shrub component by setting back succession, or enhancing herbaceous understory by reducing herbivory. However, at some point, it becomes difficult to mitigate habitat loss by treating vegetation because the temporary loss of habitat as a result of the treatment, combined with the habitat loss that is being mitigated, creates an unacceptable level of impacts to greater sage-grouse (Connelly et al. 2000). These impacts

include loss of nesting and roosting habitat and decreased food availability. Optimal food availability allows sage-grouse to minimize brood movement during foraging, thereby lowering predator exposure and energetic costs of foraging (Lyon 2000). With decreasing availability of forbs and grasses, broods move longer distances and expend more energy to find forage. This increased movement, in addition to decreased vegetative cover, may expose chicks to greater risk of predation (Lyon 2000).

A study on coal mining activities and oil field development in North Park, Colorado, found that greater sage-grouse populations in areas experiencing disturbance decreased in relation to surrounding undisturbed populations (Braun 1986, 1987). Adult male greater sage-grouse establish fidelity to specific leks. Braun (1986) hypothesized that mining activity and large-scale habitat loss occurring adjacent to leks may contribute to a reduction in the number of yearling male recruits to those areas and that the increased road construction associated with such development also may impact greater sage-grouse populations. Road construction results in permanent travel routes, improved public access, increased long-term traffic-related disturbance to previously inaccessible regions, indirect noise impacts to leks, and direct mortality (Braun 1998). Roads also provide a clear pathway for predators to move unimpeded by vegetation or other obstructions (Lyon 2000). The road-effect distance, or the distance from a road at which a population density decrease is detected, is positively correlated with increased traffic density and speed and is more critical in years when wildlife populations are low (Forman and Alexander 1998). Studies conducted in Montana, Wyoming, and Colorado suggest that some recovery of greater sage-grouse populations may occur after a site has been developed and subsequently reclaimed following energy development, road construction, and other human disturbances (Braun 1998). However, there has been no evidence that populations attain their pre-disturbance levels.

Female greater sage-grouse also demonstrate site fidelity to nesting areas surrounding a lek (Schroeder et al. 1999; Lyon 2000). Female yearlings nest in the same area in which they hatched (Lyon 2000). Even in areas of high disturbance, females continue to maintain their site fidelity, though not without some behavioral modifications. The results from a study conducted by Lyon (2000) indicate that hens captured on disturbed leks demonstrate lower nest initiation rates, travel twice as far to nest sites, and select higher total shrub canopy cover and live sagebrush canopy cover than hens captured near undisturbed leks. The average distances between nests and the nearest lek varies from 0.7 to 3.9 miles; however, one female nested more than 12.4 miles from the nearest lek. Lyon (2000) found 74% of the hens captured from disturbed leks nested more than 1.9 miles from the lek, while 91% of the hens from undisturbed leks nested within 1.9 miles of the lek. Females that nest >2.0 miles from a lek are less likely to be protected under current BLM stipulations. Maintaining large, continuous tracts of suitable habitat protected from disturbance is critical to the sustainability of greater sage-grouse populations.

Field development also could reduce the value of some greater sage-grouse winter habitat, although some grouse winter habitat would remain on and adjacent to the JIDPA (especially within the Sand Draw buffer).

Further definition of potential greater sage-grouse impacts would be provided during annual inventory and monitoring (TRC Mariah 2004a), and additional protection measures may be applied in the JIDPA as directed by BLM.

Mourning doves are seasonal (summer) visitors in the JIDPA and populations likely would not be impacted by the Proposed Action because of their relatively high tolerance to human activity and presence, their inherent mobility, and the availability of suitable habitat on adjacent lands.

Other Birds

Non-game birds would be adversely affected by increased human activity in the JIDPA. Primary impacts to any given species would occur in direct proportion to the amount of suitable habitat removed (up to 67% of the JIDPA, depending on the alternative) plus any additional habitat avoided by the birds (and thus, at least temporarily lost) because of human disturbance. Approximately 65-73% of initial disturbance (depending on the alternative) would be reclaimed and revegetated during the LOP; however, in sagebrush communities (the dominant predisturbance vegetation type in the JIDPA), it may take decades to recover the functional value of the habitat. Wyoming big sagebrush may require 30 to 40 years to become established and may take 90 to 110 years to achieve desirable habitat characteristics (e.g., canopy height, coverage, and area). Thus, impacts, particularly for sagebrush-obligate bird species, could persist for decades after the LOP. Some increased mortality also is likely to occur due to vehicle/bird collisions resulting from increased traffic.

Amphibians and Reptiles

Direct impacts to amphibians and reptiles would occur in direct proportion to the amount of their habitats disturbed. Total surface disturbance in the JIDPA would be up to 67% of the area (depending on the alternative). However, 65-73% of that disturbance would be short-term, and wetlands and waters of the U.S. generally would be avoided. An increase in mortality due to increased traffic is also anticipated as a result of the proposed project.

All Species

Impacts to most wildlife resources would be proportional to the amount of direct (see Section 4.2.1) and indirect habitat lost and the duration of this loss. While a variety of mitigation/protection measures would be applied across alternatives (see Chapter 2 and Appendices A and B), significant adverse impacts to some wildlife resources are anticipated under all alternatives including the No Action Alternative. These impacts have been identified in the JIDPA during annual wildlife monitoring of the area (e.g., TRC Mariah 2004a). Impacts noted during annual wildlife monitoring include non-attendance or decreased attendance by greater sage-grouse on some known leks, absence/decline in known greater sage-grouse nesting, brood-rearing, and wintering in the area, and inactivity and nest failure of some raptor nests and/or territories (particularly for ferruginous hawks). These existing impacts would be exacerbated with the implementation of the proposed project and the accompanying direct and indirect disturbances to wildlife species and their habitats.

The degree of habitat fragmentation within the JIDPA at current levels is high, with 87.40% of the lands in the JIDPA being within 0.25 mile (1,320 ft) of project-related disturbance and 75.70% of the lands being within 0.125 mile (660 ft) (see Table 4.9). With the implementation of the proposed project, up to 99.98% of the JIDPA would be within 0.25 mile (1,320 ft) of project-related disturbance, and up to 99.20% would be within 0.125 mile (660 ft). Furthermore, patch sizes for areas greater than 0.25 mile from project-related disturbance would be reduced from the current average of 214 acres to as small as 3 acres (depending on the alternative) (see Table 4.10). Although, as recognized above, insufficient scientific research has been conducted to determine

what level of fragmentation is critical for individual populations or species, this level of disturbance is very likely a significant impact under all alternatives for at least some of the species of wildlife that inhabit the JIDPA.

The aforementioned impacts are significant within the JIDPA and on adjacent lands under any alternative.

Wildlife impacts due to increased mortality from construction, traffic, and poaching are not anticipated to be significant on either a local or a management area level under any alternative.

Based on existing research data and observations of pronghorn reactions to oil and gas development, impacts on pronghorn populations in the Sublette Herd Unit resulting from development of the JIDPA, including habitat fragmentation and a reduction in habitat function, are anticipated to be less than significant on both a local and a management area level. No loss of pronghorn migration routes is anticipated, although pronghorn may alter their migration routes to avoid project disturbances.

4.2.2.1 No Action Alternative

Direct wildlife habitat loss through 4,209 acres of short-term and 1,409 acres of LOP disturbance is currently approved within the JIDPA (BLM 1998b, 2000b) for ongoing natural gas development and production. Under the No Action Alternative, no additional impacts to wildlife species from natural gas development would occur in the JIDPA as a result of the proposed project because no additional habitat disturbance would be approved, nor would indirect impacts change. Mortality rates due to construction would not occur; however, the potential for vehicle/wildlife collisions would remain. No further habitat fragmentation or displacement would occur beyond current levels (see Map 4.2 and Tables 4.9 and 4.10); however, considerable habitat fragmentation already exists in the JIDPA, and the area may no longer be suitable for many wildlife species. Impact duration would be approximately 63 years plus the time needed for adequate reclamation.

4.2.2.2 The Proposed Action

The Proposed Action would result in an estimated increase (over the No Action Alternative) of 16,200 acres of new initial disturbance, for a total of 20,409 acres of project-related surface disturbance. All of the new initial disturbance would be within pronghorn Sublette Herd Unit spring/summer/fall habitat. This represents 0.68% of the 4,697 square miles of spring/summer/ fall habitat for the herd and 0.40% of the total acreage of the 7,938 square miles of occupied habitat. Approximately 70.4% of the total disturbance (14,369 acres) would be reclaimed and reseeded as soon as practical after disturbance (i.e., short-term disturbance). The remaining 29.6% (6,040 acres) would remain disturbed for the LOP. In addition to the direct loss of habitat, disturbance from drilling and production activities (including noise, increased traffic volume, and human presence) would affect utilization of habitats adjacent to development areas. Impact duration would be approximately 76 years plus the time needed for adequate reclamation, or 13 years longer than the No Action Alternative.

4.2.2.3 Alternative A

Implementation of Alternative A would result in the same types and acreages of impacts to wildlife species as the Proposed Action (i.e., an increase of 16,200 acres [11,569 acres of short-term disturbance and 4,361 acres of LOP disturbance] over the No Action Alternative). However, under Alternative A, selected Operator-committed and BLM-required practices for the avoidance of sensitive areas (e.g., avoidance of the Sand Draw drainage [300-ft buffer either side], greater sage-grouse leks, and raptor nests) would not occur. This likely would result in increased impacts to greater sage-grouse, raptors, and other wildlife species. Habitat fragmentation under this alternative would result in all areas within the JIDPA being within 330 ft of project disturbance. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

4.2.2.4 Alternative B

Alternative B would result in an estimated increase (over the No Action Alternative) of 3,297 acres of new initial disturbance, for a total of 7,506 acres of project-related surface disturbance in the area. Approximately 65% (4,884 acres) of the total disturbance would be short-term, and the remaining 35% (2,622 acres) would remain disturbed for the LOP. Areas of the JIDPA that currently lack well pads would have minimal new surface disturbance because this alternative does not allow for construction of new well pads and, as a result, disturbance for new roads and pipelines required in those areas also would be minimal. Habitat fragmentation would be similar to that of the No Action Alternative (see Map 4.2). Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

4.2.2.5 Alternative C

Alternative C would result in an estimated increase (over the No Action Alternative) of 6,705 acres of new initial disturbance, for a total of 10,914 acres of project-related surface disturbance in the area. Approximately 68.9% (7,515 acres) of the total disturbance would be short-term, and the remaining 31.1% (3,399 acres) would remain disturbed for the LOP. Since the location of new well pads is unknown, new habitat fragmentation conditions are not identified but likely would be similar to that shown on Map 4.4 (32 pads/section). Depending on the rate of development, impact duration would be approximately 68 to 80 years plus the time needed for adequate reclamation, or 5 to 17 years longer than the No Action Alternative .

4.2.2.6 Alternative D

Alternative D would result in an estimated increase (over the No Action Alternative) of 11,571 acres of new initial disturbance, for a total of 15,790 acres of project-related surface disturbance. Approximately 69.9% (11,037 acres) of the total disturbance would be short-term, and the remaining 30.1% (4,753 acres) would remain disturbed for the LOP. Since the location of new well pads is unknown, new habitat fragmentation conditions are not identified but likely would be intermediate to that shown on Maps 4.4 (32 pads/section) and 4.5 (64 pads/section). Depending on the rate of development, impact duration would be approximately 72 to 93 years plus the time needed for adequate reclamation, or 9 to 30 years longer than the No Action Alternative.

4.2.2.7 Alternative E

Alternative E would result in an estimated increase (over the No Action Alternative) of 6,386 acres of new initial disturbance, for a total of 10,595 acres of project-related surface disturbance. Approximately 66.1% (6,998 acres) of the total disturbance would be short-term, and the remaining 33.9% (3,597 acres) would remain disturbed for the LOP. Habitat fragmentation conditions would be as shown on Map 4.3. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

4.2.2.8 Alternative F

Alternative F would result in an estimated increase (over the No Action Alternative) of 10,446 acres of new initial disturbance, for a total of 14,655 acres of project-related surface disturbance. Approximately 72.7% (10,658 acres) of the total disturbance would be short-term, and the remaining 27.3% (3,997 acres) would remain disturbed for the LOP. Habitat fragmentation conditions would be as shown on Map 4.4. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

4.2.2.9 Alternative G

Alternative G would result in an estimated increase (over the No Action Alternative) of 13,989 acres of new initial disturbance, for a total of 18,198 acres of project-related surface disturbance. Approximately 70.3% (12,790 acres) of the total disturbance would be short-term, and the remaining 29.7% (5,408 acres) would remain disturbed for the LOP. Habitat fragmentation conditions would be as shown on Figure 4.5. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

4.2.2.10 BLM Preferred Alternative

The Preferred Alternative would result in an estimated increase (over the No Action Alternative) of 7,804 acres of new initial disturbance, for a total of 12,013 acres of project-related surface disturbance. Approximately 69.2% (8,309 acres) of the total disturbance would be short-term, and the remaining 30.8% (3,704 acres) would remain disturbed for the LOP. Since the location of new well pads is unknown, new habitat fragmentation conditions are not identified but likely would be similar to that shown on Map 4.4 (32 pads/section). Impact duration would be approximately 76 years plus the time needed for adequate reclamation, or 13 years longer than the No Action Alternative.

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14). These measures would moderate, to some extent, anticipated impacts to wildlife species.

4.2.2.11 Cumulative Impacts

CIAAs for wildlife and fisheries vary by resource. While the principle focus of the following analysis is cumulative impacts from oil and gas development, other actions in each CIAA have affected and will continue to affect wildlife. These actions include, but are not limited to, urbanization, the proliferation of roads (in addition to those for oil and gas development), WGFD species management and associated hunter harvests, livestock grazing, and recreation.

For the following cumulative impacts discussion, impacts under the 10 alternatives discussed herein can be ranked based on new initial and LOP disturbance acreages, with the following caveats.

- Although new initial and LOP disturbance under the Proposed Action and Alternative A are the same, impacts would be greater under Alternative A because selected Operator-committed practices and BLM development guidelines and stipulations would not be implemented.

- Under the Preferred Alternative, impacts may be lower than implied by disturbance acreage alone, because BLM management and monitoring requirements designed to protect resources and minimize impacts while meeting field development objectives would be implemented.

That said, Alternative A and the Proposed Action would result in the largest surface disturbance within the JIDPA (i.e., 20,409 acres new initial disturbance and 6,040 acres LOP disturbance). The next highest disturbance would be Alternative G (18,198 acres new initial and 5,408 acres LOP disturbance), followed by Alternative D (15,790 acres and 4,753 acres), Alternative F (14,655 acres and 3,997 acres), the Preferred Alternative (12,525 acres and 3,847 acres), Alternative E (10,595 acres and 3,597 acres), and Alternative C (10,914 acres and 3,399 acres). Alternative B has the lowest proposed disturbance acreage of any of the action alternatives, with 7,506 acres of new initial disturbance and 2,622 acres of LOP disturbance. Under the No Action Alternative, disturbance would be limited to that already approved—4,209 acres of new initial disturbance and 1,409 acres of LOP disturbance.

Pronghorn Antelope

The CIAA for pronghorn is the Sublette Herd Unit (see Map 3.13). The impacts of oil and gas development on pronghorn in the herd unit are largely unknown, but the WGFD indicates that pronghorn have been and will continue to be redistributed, and mortality may increase due to habitat loss (WGFD 2001). Avoiding a loss of habitat function on crucial winter range is especially important to maintaining pronghorn populations at a desired level. In addition, there are several migratory "bottlenecks" through which some Sublette Herd Unit pronghorn move (to and from winter range). These bottlenecks are created by natural topography and/or human activity and are crucial to the continued survival of portions of the Sublette Herd. Efforts have been initiated to mitigate the impacts to pronghorn movement through these bottlenecks. Fences, particularly those along highways, also restrict pronghorn movements and hinder use of seasonal ranges. New highway and other area fencing may further restrict pronghorn movement and further fragment habitat. The proposed project would not affect any known pronghorn crucial winter range or bottlenecks; therefore, it would not contribute to cumulative impacts to these habitat features.

Under the Preferred Alternative, approximately 0.40% (initial disturbance) and approximately 0.12% (LOP disturbance) of spring/summer/fall range in the Sublette Herd Unit would be disturbed and habitat function on an unknown amount of adjacent habitat would be reduced. Maximum disturbance to spring/summer/fall range within the Herd Unit would occur under the Proposed Action and Alternative A development scenarios—approximately 0.68% initial disturbance and 0.20% LOP disturbance. Therefore, the proposed project is not anticipated to measurably add to cumulative impacts to the Sublette Herd Unit. RFD for the Sublette Herd Unit includes 1,591 wells, additional roads, and other related development disturbing more than 12,000 acres, bringing the maximum cumulative development (existing disturbance, disturbance from the proposed project, and disturbance from RFD) within the Herd Unit to 97,000-113,200 acres, or approximately 1.4-1.7% of the area (Table 4.11). Indirect habitat loss affecting habitat function would occur on an additional but unknown amount of land. The magnitude of impacts from such development on the Sublette Herd Unit are unknown (WGFD 2001); however, they are not anticipated to be cumulatively significant.

Furbearers, Small Game, and Other Mammals

The CIAA for furbearers, small game, and other mammals for the JIDPA is depicted in Map 3.14 and is otherwise known as the Jonah wildlife study area.

RFD for the CIAA includes 1,014 acres primarily associated with oil and natural gas development in the Pinedale Anticline Project area (see Table 4.11). Cumulative impacts resulting from development are anticipated to be similar in kind to those described for the proposed project but would include the additional developments for the Pinedale Anticline Project. Developments would result in additional cumulative impacts to small mammals due to direct and indirect habitat loss, habitat fragmentation, increased traffic volumes, and increased vehicle/small mammal collisions. Recreational hunter harvest of small game and shooting of prairie dogs and other small non-game mammals are also anticipated to increase as a result of increased access to the area. The increased mortality experienced by small mammal populations also would have a cumulative impact on the predator species that depend on small mammal populations for prey (e.g., raptors, foxes, coyotes, badgers, etc.). Cumulative disturbance within the CIAA (i.e., Jonah wildlife study area) would range from 4.2% to 12.8% of the area, with 8.6% disturbance under the Preferred Alternative (see Table 4.11). Impacts generally would be in proportion to the amount of direct habitat loss and are anticipated to be less than significant.

Raptors

The CIAA for raptors is depicted in Map 3.16.

RFD disturbance in the CIAA includes 2,862 acres (see Table 4.11) and is primarily associated with natural gas development described for the Pinedale Anticline Project. With the implementation of the proposed project, between 10.1 and 11.5% of the CIAA would be surface disturbed—10.8% would be disturbed under the Preferred Alternative (see Table 4.11).

All raptor nests in the Pinedale Anticline Project Area are protected by No Surface Occupancy buffers year-round and active nests are protected during the nesting season by timing restrictions and seasonal buffers. Monitoring of raptor nests in the Pinedale Anticline and Jonah Field wildlife study areas is conducted annually (TRC Mariah 2004a, 2004b). The results of these investigations have led to the application of additional mitigation (artificial nest structure placement) and likely would continue to identify expanded mitigation opportunities.

Table 4.11 Potentially Disturbed Acreage in Each Wildlife CIAA, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Cumulative Impact Analysis Area (CIAA) Percent of CIAA	Total Acreage of CIAA	Existing Disturbance In CIAA, Outside JIDPA	RFD	Disturbance											
				No Action			Proposed Action and Alternative A			Alternative B			Alternative C		
				New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]
Sublette Antelope Herd Unit	6,727,270	80,791	12,000	4,209	1,409	97,000	20,409	6,040	113,200	7,390	2,561	100,181	10,914	3,399	103,705
Percent of entire CIAA		0.01				1.4			1.7			1.5			1.5
Jonah Wildlife Study Area	188,888	2,729	1,014	4,209	1,409	7,952	20,409	6,040	24,152	7,390	2,561	11,133	10,914	3,399	14,657
Percent of entire CIAA		1.4				4.2			12.8			5.9			7.8
Raptors	1,184,443	113,092	2,862	4,209	1,409	120,153	20,409	6,040	136,363	7,390	2,561	123,344	10,914	3,399	126,868
Percent of entire CIAA		9.5				10.1			11.5			10.4			10.7
Greater Sage-grouse	1,061,805	28,767	1,716	4,209	1,409	34,692	20,409	6,040	50,892	7,390	2,561	37,873	10,914	3,399	41,397
Percent of entire CIAA		2.71							4.8						3.9

3.2 3.6

Cumulative Impact Analysis Area (CIAA) Percent of CIAA	Disturbance														
	Alternative D			Alternative E			Alternative F			Alternavtive G			Preferred Alternative		
	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[2]	New	LOP	Cumulative[1]
Sublette Antelope Herd Unit	15,790	4,755	108,581	10,595	3,597	103,386	14,655	3,997	107,446	18,198	5,408	110,989	12,525	3,847	105,316
Percent of entire CIAA			1.6			1.5			1.6			1.6			1.6
Jonah Wildlife Study Area	15,790	4,755	19,533	10,595	3,597	14,338	14,655	3,997	18,398	18,198	5,408	21,941	12,525	3,847	105,316
Percent of entire CIAA			10.3			7.6			9.7			11.6			8.6
Raptors	15,790	4,755	131,744	10,595	3,597	126,549	14,655	3,997	130,609	18,198	5,408	134,152	12,525	3,847	105,316
Percent of entire CIAA			11.1			10.7			11.0			11.3			10.9
Greater Sage-grouse	15,790	4,755	46,273	10,595	3,597	41,078	14,655	3,997	45,138	18,198	5,408	48,681	12,525	3,847	105,316
Percent of entire CIAA			4.4			3.9			4.3			4.6			4.1

[1] Cumulative disturbance = new + existing + RFD.

Raptors using the JIDPA and CIAA for nesting and foraging would experience continued adverse effects within nesting and foraging territories, which would likely lead to reductions in the regional reproductive success of raptors in the CIAA. These adverse effects are anticipated to be cumulatively significant.

Game Birds

The CIAA for greater sage-grouse is depicted in Map 3.18. There are approximately 52 known leks in the CIAA, with the highest percentage of those occurring east of Highway 191.

RFD in the CIAA includes 1,716 acres and is primarily associated with oil and gas development (see Table 4.11). With the implementation of the proposed project, disturbance within the CIAA would range from 3.2-4.8% of the area—disturbance under the Preferred Alternative would be 4.1%.

The proposed project and RFD likely would result in some disturbance of nesting, brood-rearing, wintering, and possibly breeding greater sage-grouse, and although the magnitude of impact resulting from that disturbance is unknown, it is anticipated that cumulative effects on the continued apparent decline in regional greater sage-grouse populations would be significant.

The CIAA for mourning dove is the Jonah Field wildlife study area (see Map 3.14). No significant cumulative impacts to mourning doves are anticipated.

Other Birds

The CIAA for other birds is the Jonah Field wildlife study area (see Map 3.14). Little additional project-related disturbance is anticipated in wildlife study area outside the JIDPA, other than that for the Burma Road upgrade and impacts occurring for the Pinedale Anticline Project. Impacts generally would be in proportion to the amount of direct habitat loss and are anticipated to be less than significant.

Amphibians and Reptiles

The CIAA for amphibians and reptiles is the Jonah Field wildlife study area (see Map 3.14). Little additional project-related disturbance is anticipated in the wildlife study area outside the JIDPA, other than the Burma Road upgrade that would disturb the area adjacent to existing disturbance, and impacts occurring for the Pinedale Anticline Project. Impacts would generally be in proportion to the amount of direct habitat loss and are anticipated to be less than significant.

Fisheries

The CIAA for fisheries includes all 10 project-affected watersheds (see Map 3.9), the same CIAA as for soils, surface waters, and vegetation. Affected drainages include Expanded Sand Draw-Alkali Creek, Granite Wash, Reduced Upper Alkali Creek-Green River, Big Sandy River-Bull Draw, Long Draw, Upper Eighteen Mile Canyon, Jonah Gulch, 140401040603, North Alkali Draw, and Southeast New Fork River-Blue Rim. Project-affected drainages do not support fish; therefore, cumulative impacts on fisheries would not be significant as a result of the proposed project. See Section 4.1.8.11 and Table 4.3 for further information regarding cumulative disturbance within these watersheds.

4.2.2.12 Unavoidable Adverse Impacts

Unavoidable impacts to wildlife would include reductions in available habitat and habitat effectiveness due to both direct surface disturbance/vegetation removal and project-related activities such as increased traffic, noise, and human presence. Some direct wildlife mortality to small mammals during construction and from project traffic/vehicle collisions is also likely to occur.

4.2.3 Threatened, Endangered, Proposed, and Candidate and BLM Wyoming Sensitive Species

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with wildlife and fisheries which are also relevant for TEP&C and BWS species:

- to maintain, improve, or enhance the biological diversity of all plant and wildlife species while ensuring healthy ecosystems;
- to restore disturbed or altered habitat with the objective to attain desired native plant communities, while providing for wildlife needs and soil stability; and
- to conserve and develop recreational resources for the benefit of present and future generations;
- to consider wildlife migration corridors, crucial winter ranges, and other important habitats when evaluating land use proposals;
- to support and maintain healthy wildlife populations as an appropriate and desired land use;
- to establish more watering systems on all grazing lands for livestock, wildlife, and game/non-game birds; and
- to minimize conflicts between wildlife and domestic pets.

Impacts to TEP&C species would be considered significant if any project action would adversely affect or jeopardize federal TEP&C species or their critical habitat and/or any recovery program. Impacts to BWS species would be significant if project activities would cause any BWS species to become federally listed.

Black-footed ferrets are not known to occur, nor are they likely to occur, within the JIDPA, and the JIDPA and vicinity have been block-cleared for ferrets by the USFWS (i.e., surveys for ferrets are not required in the area because USFWS has concluded that their presence in the area is unlikely) (USFWS 2004). However, should ferrets be discovered in the JIDPA, consultation would be initiated with the USFWS to ensure their protection and management.

No bald eagle nests or winter roosts are known to occur on the JIDPA; however, they do use the Green and New Fork River corridors north of the JIDPA for nesting and migration and may occasionally forage in the JIDPA. It is anticipated that bald eagles would avoid the JIDPA for the LOP and would move to other suitable foraging areas in the region.

Since no withdrawals or depletions of surface water nor increased turbidity or sedimentation of surface waters are expected to occur as a result of development of the JIDPA, no adverse affects to the four species of endangered fish present in the Green and Colorado Rivers below Flaming Gorge Dam are anticipated to occur.

Ute ladies'-tresses habitat is not known to occur nor is the species likely to occur within the JIDPA.

A biological assessment (BA) with USFWS concurrence of effects determinations for the above federally listed TEP&C species would be obtained prior to project authorization.

The best habitat areas for the BWS pygmy rabbit (e.g., basin big sagebrush communities) occur along Sand Draw, and pygmy rabbits do occur in this area both on and adjacent to the JIDPA (TRC Mariah 2004a). Idaho pocket gophers may occur within the JIDPA in areas of shallow, stony soils. White-tailed prairie dog towns have been recorded within the JIDPA, and populations routinely utilize habitats on or close to surface disturbance; thus, to some degree, prairie dogs may adapt to the human presence/disturbance associated with the proposed project. The ability of habitats in the JIDPA to support these mammals likely would decrease due to continued habitat disturbance, habitat fragmentation, and direct mortality.

Mountain plovers nest and forage in areas of low, sparse vegetation (often associated with prairie dog towns), and plovers have been observed in the vicinity of the JIDPA during wildlife monitoring efforts (e.g., TRC Mariah 2002, 2004a). Burrowing owls and ferruginous hawks nest and forage in the vicinity of the JIDPA; however, their use of the area appears to be declining in recent years (TRC Mariah 1999, 2001a, 2001b, 2002, 2004a). Similarly, greater sage-grouse forage, lek, nest, and winter in the vicinity of the JIDPA, but male lek attendance is declining on some leks on and adjacent to the JIDPA and a decrease in the use of the JIDPA for nesting, brood-rearing, and wintering also appears to be occurring (TRC Mariah 1999, 2001a, 2001b, 2002, 2004a). These declines likely are, in part, associated with increased human activity and disturbance associated with oil and gas activities in the area.

Species which are sagebrush obligates (i.e., sage thrasher, Brewer's sparrow, and sage sparrow) likely would be adversely affected due to habitat loss/disturbance, which could have negative impacts on these populations regionally, and this impact is anticipated to be significant under all alternatives. Ingelfinger (2001) reported a 50-60% reduction in sagebrush obligates within 100 m of roads in the Pinedale Anticline Project area, likely due to traffic, increased horned lark abundance, and avoidance of habitat edges created by roads. The author suggested that oil and gas development likely would result in a decline in populations of sagebrush obligates and an increase in populations of horned larks, as well as additional nesting opportunities for common ravens on structures associated with gas extraction. Ravens prey on sagebrush-obligate nestlings (Martin and Carlson 1998). Nicholoff (2003) recommends that, for Brewer's sparrow, sage sparrow, and sage thrasher, road construction and other developments that would reduce sagebrush habitat patch size to less than 50 acres be avoided where practical. For loggerhead

shrike, another BWS species which occurs within the vicinity of the JIDPA, Nicholoff (2003) recommends minimizing conversion of sagebrush and other shrublands and woodlands to non-native grasslands or croplands.

Populations of long-billed curlew have been declining due to loss of suitable habitat as grasslands are converted to cropland or urban development (Nicholoff 2003). No cropland conversion or urban development is proposed; however, some unknown amount of disturbance and habitat fragmentation could result if suitable habitat is disturbed.

Impacts to TEP&C and BWS animal species generally would be as described for wildlife (see Section 4.2.2), whereas impacts to TEP&C and BWS plant species generally would be as described for vegetation (see Section 4.2.1). Vegetation/habitat recovery to approximate predisturbance productivity could take 30 to over 100 years in sagebrush habitats (Braun 1998; Slater 2003). Impacts include 1) the direct loss of habitat due to the removal of vegetation and possible increased weed infestations; 2) displacement (wildlife only) due to disturbance from project-related activities, and increased public access to the JIDPA (indirect habitat loss); 3) habitat fragmentation; 4) direct mortality due to construction activities and animal/vehicle collisions; and 5) potential increased mortality due to poaching and harassment.

This project is unlikely to adversely affect TEP&C species occurring or potentially occurring on or adjacent to project-affected areas due primarily to the absence of these species on the area and the implementation of appropriate mitigation measures (see Chapter 2 and Appendices A and B). Therefore, the project is not anticipated to significantly impact TEC&P species under any alternative. Significant impacts to BWS species are anticipated within the JIDPA under all alternatives (most notably to sagebrush-obligate species). However, these impacts are not anticipated to result in the need to federally list any BWS species.

4.2.3.1 No Action Alternative

Currently, a total of 4,209 acres of short-term and 1,409 acres of LOP disturbance are approved within the JIDPA (BLM 1998b, 2000b). Under the No Action Alternative, no additional impacts to TEP&C and BWS species from oil and gas development would occur in the JIDPA. Impact duration would be approximately 63 years plus the time needed for adequate reclamation.

4.2.3.2 The Proposed Action

The Proposed Action would result in an estimated increase (over the No Action Alternative) of 16,200 acres of new initial disturbance, for a total of 20,409 acres of project-related surface disturbance. Most of the disturbance would occur in habitats used by BWS species. Approximately 70.4% of the total disturbance (14,369 acres) would be reclaimed and reseeded as soon as practical after disturbance (i.e., short-term disturbance). The remaining 29.6% (6,040 acres) would remain disturbed for the LOP. Impact duration would be approximately 76 years plus the time needed for adequate reclamation, or 13 years longer than the No Action Alternative.

Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.3 Alternative A

Implementation of Alternative A would result in the same types and acreages of impacts to TEP&C and BWS species as the Proposed Action (i.e., an increase of 16,200 acres [11,569 acres of short-term disturbance and 4,361 acres of LOP disturbance] over the No Action Alternative). However, under Alternative A, selected Operator-committed and BLM-required practices (e.g., avoidance of Sand Draw buffer) would not occur; thus, additional impacts to BWS species and their habitats (e.g., pygmy rabbit, ferruginous hawk, burrowing owl, sagebrush-obligate species) would likely occur. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.4 Alternative B

Alternative B would result in an estimated increase over the No Action Alternative of 3,297 acres of new initial disturbance, for a total of 7,506 acres of project-related surface disturbance in the area. Most of the disturbance would occur in habitats used by BWS species. Approximately 65% (4,884 acres) of the total disturbance would be short-term, and the remaining 35% (2,622 acres) would remain disturbed for the LOP. Areas of the JIDPA that currently lack well pads would have minimal new surface disturbance because the alternative does not allow for construction of new well pads and, as a result, disturbance for new roads and pipelines required in those areas also would be minimal. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.5 Alternative C

Alternative C would result in an estimated increase over the No Action Alternative of 6,705 acres of new initial disturbance, for a total of 10,914 acres of project-related surface disturbance in the area. Most of the disturbance would occur in habitats used by BWS species. Approximately 68.9% (7,515 acres) of the total disturbance would be short-term, and the remaining 31.1% (3,399 acres) would remain disturbed for the LOP. Depending on the rate of development, impact duration would be approximately 68 to 80 years plus the time needed for adequate reclamation, or 5 to 17 years longer than the No Action Alternative.

Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.6 Alternative D

Alternative D would result in an estimated increase over the No Action Alternative of 11,571 acres of new initial disturbance, for a total of 15,790 acres of project-related surface disturbance. Most of the disturbance would occur in habitats used by BWS species. Approximately 69.9% (11,037 acres) of the total disturbance would be short-term, and the remaining 30.1% (4,753 acres) would remain disturbed for the LOP. Depending on the rate of development, impact duration would be approximately 72 to 93 years plus the time needed for adequate reclamation, or 9 to 30 years longer than the No Action Alternative.

Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.7 Alternative E

Alternative E would result in an estimated increase over the No Action Alternative of 6,386 acres of new initial disturbance, for a total of 10,595 acres of project-related surface disturbance. Most of the disturbance would occur in habitats used by BWS species. Approximately 66.1% (6,998 acres) of the total disturbance would be short-term, and the remaining 33.9% (3,597 acres) would remain disturbed for the LOP. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.8 Alternative F

Alternative F would result in an estimated increase over the No Action Alternative of 10,446 acres of new initial disturbance, for a total of 14,655 acres of project-related surface disturbance. Most of the disturbance would occur in habitats used by BWS species. Approximately 72.7% (10,658 acres) of the total disturbance would be short-term, and the remaining 27.3% (3,997 acres) would remain disturbed for the LOP. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.9 Alternative G

Alternative G would result in an estimated increase over the No Action Alternative of 13,989 acres of new initial disturbance, for a total of 18,198 acres of project-related surface disturbance. Most of the disturbance would occur in habitats used by BWS species. Approximately 70.3% (12,790 acres) of the total disturbance would be short-term, and the remaining 29.7% (5,408 acres) would remain disturbed for the LOP. Depending on the rate of development, impact duration would be approximately 76 to 105 years plus the time needed for adequate reclamation, or 13 to 42 years longer than the No Action Alternative.

Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.10 BLM Preferred Alternative

The Preferred Alternative would result in an estimated increase over the No Action Alternative of 7,804 acres of new initial disturbance, for a total of 12,013 acres of project-related surface disturbance. Most of the disturbance would occur in habitats used by BWS species. Approximately 69.2% (8,309 acres) of the total disturbance would be short-term, and the remaining 30.8% (3,704 acres) would remain disturbed for the LOP. Depending on the rate of development, impact duration would be approximately 76 years plus the time needed for adequate reclamation, or 13 years longer than the No Action Alternative.

The additional Preferred Alternative-specific mitigation and monitoring measures listed for vegetation and wildlife (see Section 2.14) would moderate, to some extent, any impacts to TEP&C and BWS species. Impacts still would occur at potentially significant levels for most, if not all BWS species identified as occurring in the JIDPA. Impacts to TEP&C species and their habitat would be minimal because of their infrequent use of the area.

4.2.3.11 Cumulative Impacts

The CIAA for TEP&C and BWS species includes the entire range of each potentially affected species, with an emphasis for BWS species, on the BLM PFO area. With regard to federally listed TEP&C species, the proposed project would not likely contribute to cumulative impacts to the black-footed ferret or Ute ladies'-tresses, because these species are not known to occur on the JIDPA nor are they likely to be affected by the project. Because no bald eagle nests or winter roosts are known to occur within 1 mile of the JIDPA and alternate foraging areas exist within relatively close proximity to the JIDPA, it is unlikely that the project would have any cumulative impact on the bald eagle. The proposed project would not add to cumulative impacts (surface water depletions) for the four Colorado River endangered fish species.

Project-related impacts to BWS species would add to impacts from other disturbance in the CIAA, including existing roads and traffic, oil and gas development, grazing and any other activity that would result in direct mortality, habitat fragmentation, or loss of habitat/habitat function. However, there is no evidence that any of the species would be proposed for listing as threatened or endangered as a result of cumulative impacts under any of the project alternatives. Site-specific projects requiring surface disturbance on BLM lands would require additional permitting which, in turn, may include mitigation measures for BWS similar to those for this project (see Appendices A and B).

4.2.3.12 Unavoidable Adverse Impacts

Habitat loss (direct and indirect) would occur due to construction, and human presence would further reduce habitat functionality in some of the remaining undisturbed or minimally disturbed areas. This would result in decreased populations of some BWS species on the JIDPA. Some direct mortality, especially to small mammals, likely would occur during construction and from project-related traffic.

4.2.4 Wild Horses

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979), and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with wild horses:

- to protect, maintain, and control viable, healthy herds of wild horses while retaining their free roaming nature;
- to provide adequate habitat for free-roaming wild horses through management consistent with environmental protection; and
- to provide opportunity for the public to view wild horses.

Impacts to wild horses would be significant if there would be a reduction in AUMs of a magnitude that would require modification to the management of wild horses in the LCHMA, or other actions that would prevent the realization of herd objectives, or if project disturbance resulted in a violation of RMP wild horse objectives.

There would be an increase in wild horse displacement, including movement of wild horses off the RSFO LCHMA onto PFO portion of the JIDPA (through potentially damaged fences or gates left open), and potential injury as a result of encounters with project facilities (e.g., cattle guards, traffic). Project impacts would occur primarily from vegetation loss (i.e., AUM loss); however, some impact to wild horse viewing is also anticipated under all alternatives since the quality of views (i.e., set with an oil and gas development background) would be reduced. With the revegetation and reclamation measures proposed to ensure successful revegetation (see Appendix G) and other practices identified in Appendices A and B, no significant impacts to wild horses are anticipated under any alternative.

4.2.4.1 No Action Alternative

Under the No Action Alternative, there would be no additional activities that would potentially affect wild horse populations other than those currently approved for the area (BLM 1998b, 2000b). Approximately 16 AUMs would be lost within the LCHMA for the LOP. The duration of impacts would be approximately 63 years and until areas are adequately reclaimed.

4.2.4.2 The Proposed Action

The Proposed Action would result in the direct removal of forage from approximately 2,415 acres (242 AUMs) initially, and 715 acres (72 AUMs) for the LOP within the 519,541-acre LCHMA. Impact duration is anticipated to be approximately 76 years and until adequate reclamation is achieved.

4.2.4.3 Alternative A

Implementation of Alternative A would result in the same types of impacts as all other development alternatives; however, impacts would be increased in areas that would otherwise have been avoided (e.g., steep slopes, drainage buffers). Alternative A would result in the direct removal of forage from approximately 2,415 acres (242 AUMs) initially, and 715 acres

(72 AUMs) for the LOP within the 519,541-acre LCHMA. Impact duration would be dependent upon the rate of development (from 76 to 105 years) plus the time required for adequate reclamation.

4.2.4.4 Alternative B

Under implementation of Alternative B, there would be forage losses on approximately 867 acres (87 AUMs) initially and 306 acres (31 AUMs) for the LOP in the LCHMA. Impact duration would be dependent upon the rate of development (from 76 to 105 years) plus the time required for adequate reclamation.

4.2.4.5 Alternative C

Under implementation of Alternative C, there would be forage losses on approximately 1,276 acres (128 AUMs) initially and 398 acres (40 AUMs) for the LOP in the LCHMA. Impact duration would be dependent upon the rate of development (from 68 to 80 years) plus the time required for adequate reclamation.

4.2.4.6 Alternative D

Under implementation of Alternative D, there would be forage losses on approximately 1,861 acres (186 AUMs) initially and 561 acres (56 AUMs) for the LOP in the LCHMA. Impact duration would be dependent upon the rate of development (from 72 to 93 years) plus the time required for adequate reclamation.

4.2.4.7 Alternative E

Under implementation of Alternative E, there would be forage losses on approximately 1,237 acres (124 AUMs) initially and 422 acres (42 AUMs) for the LOP in the LCHMA. Impact duration would be dependent upon the rate of development (from 76 to 105 years) plus the time required for adequate reclamation.

4.2.4.8 Alternative F

Under implementation of Alternative F, there would be forage losses on approximately 1,725 acres (172 AUMs) initially and 470 acres (47 AUMs) for the LOP in the LCHMA. Impact duration would be dependent upon the rate of development (from 76 to 105 years) plus the time required for adequate reclamation.

4.2.4.9 Alternative G

Under implementation of Alternative G, there would be forage losses on approximately 2,150 acres (215 AUMs) initially and 639 acres (64 AUMs) for the LOP in the LCHMA. Impact duration would be dependent upon the rate of development (from 76 to 105 years) plus the time required for adequate reclamation.

4.2.4.10 BLM Preferred Alternative

Under implementation of the Preferred Alternative, there would be forage losses on approximately 1,469 acres (147 AUMs) initially and 452 acres (45 AUMs) for the LOP in the LCHMA. Impact duration is anticipated to be approximately 76 years and until adequate reclamation is achieved.

Under the Preferred Alternative, additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14).

4.2.4.11 Cumulative Impacts

The CIAA for wild horses is the entire LCHMA (see Map 3.20). Other existing developments in the LCHMA area are generally limited to secondary roads and natural gas development. Existing, proposed, and RFD (surface disturbance) activities are unlikely to reduce the carrying capacity of the Little Colorado Herd Management Unit although shifts in distribution may occur. Undo time expenditure and unnecessary hazing of wild horses back onto the RSFO LCHMA from the PFO portion of the JIDPA may occur due to increased area use for natural gas development and the failure to close field office boundary gates. The primary factor limiting the distribution of wild horses in the LCHMA is the availability of water, which is not anticipated to be affected cumulatively under any alternative except possibly the Preferred Alternative, if new water sources are provided. Cumulative impacts to wild horses are anticipated to be less than significant since wild horse population objectives are currently being met or exceeded in the LCMHA, and the reclamation activities that would be implemented under all alternatives have the potential to provide increased forage for wild horses. The aesthetic values associated with wild horse viewing would continue to decline where horses are observed in areas of development. This would occur cumulatively under all alternatives.

4.2.4.12 Unavoidable Adverse Impacts

Other than the temporary short-term and LOP loss of forage, no unavoidable adverse impacts to wild horses are anticipated.

4.3 CULTURAL AND HISTORICAL RESOURCES

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) prescribe the following management goals/objectives associated with cultural resources:

- to design cultural resource management actions to maintain the value of cultural resources;
- to expand the opportunities for scientific study and educational and interpretive uses of cultural resources;
- to protect and preserve important cultural resources or their historic record for future generations;

- to resolve conflicts between cultural resources and other resource uses; and conserve and develop historic resources for the benefit of present and future generations.

Because of the requirement for compliance with Section 106 of the NHPA and with the ARPA on federal lands, all areas on federal lands (surface or mineral estate) proposed for surface disturbance would be surveyed for cultural resources. These inventories would serve to protect most cultural properties from significant damage and would increase the site database and further our understanding of history and prehistory. Impacts to cultural and historic resources would be considered significant if they resulted in non-mitigated impacts to National Register-eligible historic properties, loss of scientifically important data or artifacts, a violation of the NHPA and/or ARPA, or disturbed Native American sensitive sites, or if they were inconsistent with the goals/objectives listed above. Adverse impacts to NRHP-eligible properties, or properties considered important to Native American groups, would be significant if they cannot be satisfactorily mitigated as determined through consultation with SHPO, ACHP, and other interested parties.

Impacts to cultural resources identified in a discovery situation (archaeological features found during and not prior to surface disturbing activities) could be greater and more significant than impacts to resources that were previously identified because damage to discovery sites would occur prior to their recordation and evaluation, thereby complicating mitigation procedures. The most significant and time-consuming mitigation of discoveries would likely be for sites with structural remains in San Arcacio soil contexts along Sand Draw and when subsurface components containing extensive or abundant artifact assemblages are located during large disturbances. Mitigation of impacts to discoveries could often be accomplished through data recovery excavations, which would increase our understanding of prehistory to varying degrees, depending on the nature and extent of the discovery. Significant impacts can occur in situations where undocumented NRHP-eligible archaeological sites are impacted but not recognized (and therefore not treated as discoveries and appropriately mitigated).

The Site 48SU4000 complex is highly sensitive and currently at risk. Extant and potential field developments pose a risk of direct threats to the site complex, and these threats would continue as the number of individuals familiar with and accessing the area increases due to ancillary adverse effects resulting from vandalism. To begin addressing these issues, the BLM and one of the Operators have negotiated a long-term site monitoring plan that includes a detailed inventory and recording of the entire District, as well as photographic monitoring and evaluation of looting. Miner (2001) has recommended pre-emptive mitigative excavations of rockshelters in highly visible locations and at significant locations in the vicinity of any proposed well pads and related facilities. Area-specific plans and procedures would continue to be promulgated and implemented to protect the resources in this area.

Impacts would primarily occur in direct proportion to the volume of new surface disturbance (i.e., more acres of disturbance generally would result in more discoveries, excavation, chances for illegal artifact collection and/or vandalism, and/or impacts to sites, locales, and places considered sacred, sensitive, or of importance to modern-day Native Americans [especially the Shoshone People]). Vandalism and illegal collection impacts would occur in proportion to the amount of human use on the area. Vandalism may be minimized through law enforcement, site monitoring

activities, and educational programs. Application of various mitigation protocol (see Appendices A and B), would reduce impacts to cultural resources under all alternatives; however, in the absence of a Programmatic Agreement and Cultural Resource Management Plan, potential significant impacts to cultural resources could occur under any alternative.

Because of the requirement for cultural resource inventories in new disturbance areas, a large number of cultural properties would be found and added to the cultural resource database under all development alternatives. In addition, a large number of site mitigations (e.g., excavations) would be likely to occur, as avoidance of some NRHP-eligible sites likely would not be possible. Data recovery excavations would serve to increase our understanding of the prehistory of the region.

Procedures for identifying and protecting cultural resources on State of Wyoming lands are not in place. Generally, BLM requires inventory on State of Wyoming lands as a connected action for the first access; however, once federal access via a ROW or other federal permit to these lands is obtained, uninventoried future construction and project developments and associated unmitigated site disturbance may occur. Only with the implementation of a Programmatic Agreement that addresses State of Wyoming land development protocol could the avoidance of significant adverse impacts to cultural resources on these lands be assured.

Vandalism to cultural properties and illegal artifact collection would continue to be an issue in the JIDPA. Construction of new roads for well field expansion would provide access to additional areas, increasing the potential for vandalism. The increase in development under all development alternatives would increase traffic and human presence in the area, leading to additional artifact collecting and "pot hunting." Potential impacts associated with vandalism and illegal artifact collection are assumed to be proportional to the level of human activity (i.e., with a higher human presence there would be increased impact potential). Therefore, these potential impacts would likely be greatest during the development period, but would continue for the LOP.

Subsurface prehistoric discoveries resulting from construction are common in portions of the JIDPA, and more of these discoveries are likely to occur with continued development. Discoveries usually occur on the toes of small but discreet upland hillocks and rises flanked by intermittent drainages and on the terraces and valley slopes adjacent to Sand Draw. Sediments along Sand Draw are particularly sensitive; these are primarily San Arcacio soils known to contain intact Early Archaic period sites, including those with housepits. These soils extend as much as 0.5 mile from each side of the drainage channel. Impacts to cultural resources discovered during construction activities would be minimized by relocating further proposed surface disturbances or through appropriate mitigation. Any cultural resources discovered during project construction would be treated in accordance with 36 C.F.R. 800 and the State-wide protocol.

While avoidance of eligible sites would likely remain the primary tool to minimize potential adverse effects to cultural resources, there is a high degree of new development proposed for the JIDPA, with much of this development likely to occur in geomorphologically sensitive areas with high discovery potential, and project-by-project avoidance would prove to be increasingly difficult and time-consuming. Since substantial new ground disturbance is proposed within the JIDPA under all development alternatives, it would not only be much more difficult to avoid identified cultural resources, but there would likely be an increase in unanticipated discoveries. Such unexpected discoveries are currently being handled on a case-by-case basis under the

general direction of 36 C.F.R. 800.13. Consultation involves the Operators, BLM, Wyoming SHPO, Advisory Council on Historic Preservation, and other interested parties. Under all project development alternatives, a greater number of construction projects would be delayed due to discoveries and subsequent consultation requirements. Because of the frequently complex nature of such discoveries, the need for development of case-by-case treatment plans, the exposed nature of the discovery, and the availability of archaeologists to evaluate the discovery, delays are common. Implementation of Programmatic Agreements and treatment or discovery plans that identify standard treatments, procedures, and management alternatives would lessen the impacts unexpected discoveries have on specific development projects. Duplication of paperwork is reduced, time frames for decision-making are greatly condensed, more "hands-on" management of an already damaged resource can occur, and overall management efficiencies are increased. A reduction in delay to Operators also results in a savings in construction costs and lessened shut-down impediments. Development and implementation of these plans would be beneficial to all parties, given the substantial increase in proposed ground disturbance within culturally sensitive areas. Programmatic approaches in the JIDPA could also benefit data synthesis and provide useful information to scholars and the general public.

Past consultation with Native American Tribes has determined that the 48SU4000 Archaeological District is sensitive to Native Americans, as are several rock alignment sites along the edge of Yellow Point Ridge. Any increase in ground-disturbing activities has an increased potential of impacting significant sites, locales, and places considered sacred, sensitive, or of importance to modern-day Native Americans (especially the Shoshone People).

4.3.1 No Action Alternative

Under the No Action Alternative, there would be no additional surface disturbance other than that already approved by the BLM (1998b, 2000b). Prior NEPA documents concluded that there would be no significant adverse impacts to cultural resources as a result of the project; however, these conclusions assumed implementation of a Programmatic Agreement among BLM, SHPO, and Operators. Since this Programmatic Agreement expired, significant impacts have occurred, and while most cultural resource impacts have already happened, potentially significant impacts could still occur. Few new cultural resource inventories would be conducted, and no new sites would be recorded and added to the cultural resource database. Vandalism and illegal artifact collecting may continue for the LOP. In the absence of new ground disturbance, no additional unanticipated discoveries are likely to occur. Cultural resource impacts would continue for an estimated 63 years under the No Action Alternative. No new impacts to Native American religious or culturally significant sites are anticipated beyond current levels.

4.3.2 The Proposed Action

Under the Proposed Action, an estimated 20,409 acres (67% of the JIDPA) would be directly impacted by surface-disturbing activities. This equates to an average disturbance of 429 acres per 640-acre section. Impacts to cultural resources would be increased due primarily to new surface disturbance (16,200 acres). Vandalism and illegal artifact collection would likely be greatest during development (13 years), but would continue for approximately 76 years and until project personnel are no longer required.

4.3.3 Alternative A

Under Alternative A, impacts to cultural resources would be increased from those of the No Action Alternative, be the same as those of the Proposed Action, but be increased in areas such as Sand Draw that would be avoided under other alternatives. Vandalism and illegal artifact collection would likely be greatest during development (13 to 42 years) but the duration of these impacts would continue for the LOP (from 76 to 105 years).

4.3.4 Alternative B

Under Alternative B, approximately 7,298 acres of the JIDPA would be directly impacted by surface-disturbing activities, and an additional 283 acres of disturbance would occur at locations outside the JIDPA (e.g., Burma Road upgrade). This would result in an increase to potential impacts to cultural resources from that of the No Action Alternative. Cultural property avoidance may be more difficult under Alternative B as compared with the other development alternatives (i.e., existing pads would be increased in size) since pad locations are fixed. Vandalism and artifact collection would likely be greatest during development (13 to 42 years) but duration of these impacts would continue for the LOP (from 76 to 105 years).

4.3.5 Alternative C

Under Alternative C, approximately 10,631 acres of the JIDPA would be directly impacted by surface-disturbing activities, and an additional 283 acres of disturbance would occur outside the JIDPA. This would result in an increase to potential impacts to cultural resources from that of the No Action Alternative. Vandalism and illegal artifact collection would likely be greatest during development (5 to 17 years) but would continue for the LOP (68 to 80 years).

4.3.6 Alternative D

Under Alternative D, approximately 15,507 acres of the JIDPA would be impacted, and an additional 283 acres of disturbance would occur outside the JIDPA. This would result in an increase to potential impacts to cultural resources from that of the No Action Alternative. Vandalism and illegal artifact collection would likely be greatest during development (9 to 30 years) but would continue for the LOP (72 to 93 years).

4.3.7 Alternative E

Under Alternative E, approximately 10,312 acres of the JIDPA would be impacted, and an additional 283 acres of disturbance would occur outside the JIDPA. This would result in an increase to potential impacts to cultural resources from that of the No Action Alternative. Vandalism and illegal artifact collection would likely be greatest during development (13 to 42 years) but would continue for the LOP (76 to 105 years).

4.3.8 Alternative F

Under Alternative F, approximately 14,372 acres of the JIDPA would be impacted, and an additional 283 acres of disturbance would occur outside the JIDPA. This would result in an increase to potential impacts to cultural resources from that of No Action Alternative. Vandalism

and illegal artifact collection would likely be greatest during development (13 to 42 years) but would continue for the LOP (76 to 105 years).

4.3.9 Alternative G

Under Alternative G, approximately 17,915 acres of the JIDPA would be impacted, and an additional 283 acres of disturbance would occur outside the JIDPA. This would result in an increase to potential impacts to cultural resources from that of the No Action Alternative. Vandalism and illegal artifact collection would likely be greatest during development (13 to 42 years) but would continue for the LOP (76 to 105 years).

4.3.10 BLM Preferred Alternative

Under the Preferred Alternative, approximately 11,730 acres of the JIDPA (38%) would be directly impacted by surface-disturbing activities, and an additional 283 acres of disturbance would occur outside the JIDPA. An average disturbance of 243 acres per 640-acre section would occur in the JIDPA. Impacts to cultural resources would be increased from that of the No Action Alternative due primarily to new surface disturbance (7,804 acres more than No Action). Vandalism and illegal artifact collection would likely be greatest during development (13 years) but would continue for the LOP (76 years).

Under the Preferred Alternative, additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14). Any measure that reduces the volume of surface disturbance or the level of human presence has the potential to reduce impacts to cultural resources.

4.3.11 Cumulative Impacts

Cumulative impacts to cultural resources within their CIAA (see Map 3.5) would include those detailed in past NEPA documents (BLM 1997a, 1998a, 2000a) and would generally be as described for this project, but would occur over the larger CIAA and as a result of additional non-project-related ground-disturbing and vandalism/illegal collection activities primarily associated with energy developments in the Pinedale Anticline area. Additional direct impacts to cultural resources in the CIAA and outside the JIDPA have resulted primarily from development of the Pinedale Anticline Gas Field to the north of the JIDPA.

The great increase in the human presence in the JIDPA and surrounding areas over the last 8 years has tremendously increased vandalism and artifact collection (personal communication, September 2004, with Dave Vlcek, Cultural Resource Specialist, PFO). Numerous contacts among regulatory agency personnel and consultants have noted considerable illegal artifact collection in the area. The cumulative effect of this activity has been adverse. Illegal artifact removal has made the evaluation of surficial archaeological sites quite difficult due to the absence of diagnostic artifacts, tools (which aid in the determination of site function), and the dislocation of the tools of the archaeologist.

Unmitigated loss of cultural resources in discovery and undocumented site situations associated with ground-disturbing actions would accumulate. Inventory, recordation, and data recovery projects triggered by ground-disturbing actions would continue to increase the cultural resource database, likely improving future cultural resource management decisions. Generally, the greater the increase in permitted activity, the greater the data acquisition of cultural resource information

will be. Already in 2004, several major new archaeological discoveries have been made and documented, greatly increasing our knowledge of the prehistory of the area. The recovery of a 7,300-year-old human burial is one such example and the data recovery efforts at Site 48SU4479 are beginning to rewrite the prehistory of the Upper Green River Basin. Cumulatively, archaeological investigations in the JIDPA have made notable positive impacts upon our knowledge of the archeology of the region.

Data recovery excavations remove all or a portion of in situ cultural materials at sites, thereby resulting in potential future data loss if new data recovery and analysis techniques are developed. These impacts would accumulate as additional sites are excavated.

With the implementation of the cultural resource mitigation actions identified in Appendices A and B, cumulative impacts to cultural resources would be minimized or offset.

Increased surface-disturbing activities and human presence primarily resulting from expanded energy development activities in the CIAA would result in increased cumulative adverse effects, and because many of these impacts are indirect (pot hunting), they are difficult to minimize or mitigate. Under any project development alternative, 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.

4.3.12 Unavoidable Adverse Impacts

Because of the requirement for compliance with Section 106 of the NHPA and with the ARPA on federal lands, adverse impacts are generally avoided or mitigated with the exception of situations where undocumented NRHP-eligible sites are impacted but not recognized, thereby occurring without mitigation. This type of unavoidable adverse impact may occur under all alternatives.

Unmitigated adverse effects to eligible sites could also occur on State of Wyoming lands because fewer protections are afforded to cultural resources on lands falling outside BLM jurisdiction. Unexpected discoveries on state lands have occurred, and procedures for mitigative treatment of these finds are not in place. Therefore, unavoidable adverse impacts to discovery sites would continue until or unless formal procedures for protecting cultural resources on State of Wyoming lands are implemented.

4.4 SOCIOECONOMICS

The PFO and RSFO RMP RODs (BLM 1988b, 1997b, 2004b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with socioeconomics:

- to coordinate land use decisions with economic factors and needs;
- to mitigate economic, social, and environmental impacts on communities caused by rapid or large-scale growth and development;
- to plan for the provision of public facilities and services, including safe and efficient transportation and utility systems, in coordination with local land use policies, goals, and objectives; and
- to provide adequate, suitable land to meet housing needs of all residents.

BLM (2004b) criteria stipulate that impacts to socioeconomic resources would be considered potentially significant if any of the following were to occur:

- changes in total employment in Lincoln, Sublette, and Sweetwater Counties exceed an increase or decrease of 1% of the trend or

- changes in local tax revenues exceed an increase or decrease of 15% of the trend.

The SCBC and SCPC (2003) emphasize the following values specific to the social traditions and socioeconomic base of Sublette County.

- Sublette County's unique local culture should be preserved and enriched, a culture characterized by a rural Wyoming flavor, a thriving private business community, an atmosphere friendly to working families, and the security of friendly crime-free communities.

- There should be an abundance of economic freedom and diverse opportunities for residents old and new to pursue prosperity and happiness--complemented and sustained by a business-friendly atmosphere, reasonable taxation, a low cost of living, limited regulation, wise development of its natural resources, and a strong tradition of a good work ethic.

Unless otherwise cited, the socioeconomic information that follows has been summarized from the *Socioeconomic Analysis Technical Support Document for the Jonah Infill Drilling and South Piney Projects Environmental Impact Statements* (BLM 2005), which is available from the BLM PFO. Please refer to that document for more detailed socioeconomic information and analysis. Additional information has been taken from the socioeconomic profile (BLM 2003b) prepared for inclusion in the Pinedale RMP.

BLM defines a significant change as any change that would result in a 15% or greater change of any affected factor. The following analyses show that the project under all alternatives is compatible with BLM management objectives. Socioeconomic impacts are anticipated as a result of increased local taxes and revenues. Under the No Action Alternative, the affects of increased employment, economic activity, and substantial federal, state, local, and county revenues would not occur; which could result in impacts on socioeconomics. Cumulative economic impacts are likely to occur.

In the long-term, all alternatives would likely result in economic impacts; however, while population is not likely to be affected over the LOP as a direct result of this project, there may be short-term (development phase) population impacts as a result of cumulative impacts from in-migration associated with this project in combination with other regional projects (e.g., Pinedale Anticline).

Depending upon the number of wells (1,250, 2,200, or 3,100) and the number of wells developed per year (75, 150, or 250), project construction, drilling, completion, and production would require from 43 to 82 years to complete (the LOP). The fewer the number of wells and/or the faster the pace of development, the shorter the LOP. The estimated number of years to complete the project under each alternative is shown in Table 2.2. Production for the LOP could range from 3,366 billion cubic feet (BCF) under the No Action Alternative (no new development) to

8,191 BCF under the Alternative A (3,100 new wells and new well pads). The anticipated gas and condensate recovery volumes are shown in Table 4.2.

The economic impact of the Proposed Action, alternatives, and cumulative impacts on the study-area economy were analyzed in two phases using the methods developed for the Southwest Regional Economic Evaluation (SWREE) (UWAED 1997) and the Jack Morrow Hills Coordinated Action Plan (JMHCAP) (UWAED 2003; BLM 2003a). Phase I was the development phase, which considered the economic impacts associated with drilling and completion of infill wells in the JIDPA. Due to the large price fluctuations in natural gas prices, the economic impacts of production were estimated based on cost of production rather than total output. Phase II considered the economic impact of natural gas and condensate production as a result of the production from the wells completed under Phase I.

Assumptions and Methods

Assumptions and methods are detailed in BLM (2005). Economic impacts are presented in terms of real and nominal impact. A real discount rate has been used to adjust and to eliminate the effect of expected inflation to determined discounted constant-dollar (present value or "real value") of benefits and costs. Pursuant to OMB Circular No. A-94, the real discount factor is calculated as $1/(1+i)^t$ where i is the interest rate and t is the project year (OMB 2004). The present value is the value of those 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 adjustments. Natural gas economic activity will depend upon three primary factors: 1) total number of wells, 2) total number of pads on which wells can be placed, and 3) rate of development. Total recovery will depend upon the number of wells (1,250, 2,200, or 3,100) and the number of pads they are placed on. Some combinations of conventional/directional drilling may make full recovery uneconomical. An estimated 10,500 BCF of natural gas and 99.85 million barrels of Jonah Field condensate (oil) are present beneath the JIDPA (see Table 4.2). No alternative anticipates total recovery of all natural gas or condensate resources present in the field. Total annual per well operation cost is presented in Table 4.12.

Labor

An estimated 7,011-16,863 worker-years of direct employment would be provided by the Proposed Action during the LOP (see Appendix G). Jobs indirectly created or induced as a result of development and operations are presented in terms of annual job equivalents (AJEs). An AJE represents 12 months of employment. For example, one AJE could represent one job for 12 months or two jobs for 6 months or three jobs for 4 months. For the purposes of this analysis, a job is defined as 260 worker-days or 1 worker year, a person-year is 365 days; therefore, there are approximately 1.4 worker years per person year. An AJE would not necessarily result in a new job; it may simply represent the continuation of an existing job that would otherwise have been terminated had the development not occurred. Average annual starting wages per job would not necessarily be the earnings for each job created/maintained. Actual wages are determined on an individual basis by employers as influenced by market forces.

Table 4.12 Annual Cost of Natural Gas Production, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.[1]

Annual Production Operating Costs	Annual Cost per Well
Annual Production (million cubic feet [MCF])	717,232
Direct Labor and Overhead	$16,831
Nonlabor Annual Costs	
Fuel, Chemicals, and Disposal	9,850
Surface Maintenance	5,847
Subsurface Maintenance	5,979
Electricity	--
Gas Compression Costs	--
Gas Transportation Costs	191,041
Total Annual Costs	$229,548
Nonlabor Annual Costs	$212,717
Total Annual Cost Per MCF	$0.32
Nonlabor Cost Per MCF	$0.30

[1] Source: Operators. Assumes natural gas recovery costs include recovery of condensate.

Economic Activity from Development and Production

An in-depth discussion of expected economic activity is presented in BLM (2005). A summary of expected economic activity from one conventional and one directionally drilled well is presented in Table 4.13. AJEs represent secondary jobs and do not include proposed jobs presented in Appendix G. Expenditures made to drill and complete one conventional well would generate economic activity (direct and secondary) of $2,719,091 and would generate 16.7 AJEs. Expenditures made to drill and complete one directionally drilled well would generate economic activity (direct and secondary) of $3,051,586 (includes $621,292 of secondary labor earnings) and would generate 19.4 AJEs. This activity is assumed to remain constant across all alternatives on a per well basis. The timing of economic activity will depend on the approved number of wells and the rate of development.

The value of natural gas production is based on revenues less cost of operation. Table 4.14 shows that production from one BCF of natural gas would generate total economic activity (direct and secondary) of $3,632,083 (includes $132,083 of secondary labor earnings) and would create 3.92 AJEs. One MBO is assumed to generate total economic activity (direct and secondary) of $21,792,498 (includes $792,498 of secondary labor earnings) and would create 23.52 AJEs. The economic activity associated with condensate production is likely conservatively underestimated because condensate from the Jonah Field is of particularly high quality and generally sells for a price higher than the price of crude oil. Assumed production rates, decline curves, and discounting tables are presented in BLM (2005: Appendix A).

Table 4.13 Economic Activity from Gas Drilling Per Well, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Estimated Impacts	Conventional Well	Directionally Drilled Well
Direct Expenditures[1,2]		
Drilling ($)	$653,574	$897,184
Completion ($)	$1,533,110	$1,533,110
Total Direct Expenditures ($)	$2,186,684	$2,430,294
Secondary Labor Earning		
Drilling ($)	$239,402	$328,287
Completion ($)	$293,005	$293,005
Total Secondary Labor Earnings ($)	$532,407	$621,292
Total Economic Activity Impact per Well	$2,719,091	$3,051,586
Annual Job Equivalents (AJEs)		
Drilling	7.3	3.3
Completion	9.4	1.2
Total AJEs per Well[3]	16.7	19.4
Average Earnings Per Created Job ($)[4]	$31,881	$32,025

1 Includes proposed labor costs.
2 Completion includes the cost of completion and setting of production equipment.
3 AJEs are jobs indirectly created as a result of the activity. They do not include the direct labor jobs (proposed) presented in Appendix G.
4 This estimated average annual starting wage per job would not necessarily be the actual wage paid for each created job. Actual wages are determined on an individual basis by employers as influenced by market forces.

Table 4.14 Economic Activity Gas Production from One BCF of Natural Gas and One MBO, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Resource	Economic Activity
Natural Gas	**Activity per BCF**
Revenue[1]	$3,500,000
Secondary Labor Earnings	$132,083
Total Economic Activities	$3,632,083
AJEs	3.92
Condensate	**Activity per Million Barrels**
Revenue[2]	$21,000,000
Secondary Labor Earnings	$792,498
Total Economic Activities	$21,792,498
AJEs	23.52

1 Price is $3.50/MCF based on CREG (2004). The value of production is based on revenues less cost of operation.
2 Price is $21/bbl based on CREG (2004). Assumes natural gas recovery costs include recovery of condensate.

Government Revenues

Under all alternatives (including No Action), the project would generate substantial revenues for state, county, and local governments, as well as area school districts, through state sales tax, federal income tax, ad valorem taxes, severance taxes, federal minerals royalties, and other taxes on facilities and production. Assumptions regarding the analysis of project effects on government revenues are detailed in BLM (2005).

The estimated revenues and taxes resulting from the project, as well as their present value, for the LOP are presented in detail in BLM (2005), including the likely distribution of those funds to the U.S., Wyoming, and affected counties, cities, and towns based on current statutes and distribution trends. For the purposes of this analysis, the rate of development and an average decline curve for individual well production (BLM 2005: Appendix A) was used to estimate total annual field production; well life was assumed to be 40 years. Increases in taxes and revenues would have the effect of providing counties and communities with more discretionary dollars to develop infrastructure and provide for the needs of low-income residents; thus, the dependence on federal or state grant monies would be reduced.

All counties in the study area would benefit from increased revenues from federal royalties, severance taxes, sales taxes, and presumably use and lodging taxes, although the latter are not discussed further herein.

Because development and production would occur within Sublette County, directly related increases in ad valorem production and property taxes would impact only Sublette County and its communities. Ad valorem taxes on production were estimated herein; however, real property values are likely to change if population fluctuates due to cumulative non-project-related factors, which could result in fluctuating receipts from ad valorem taxes on property. Real property value changes are beyond the scope of this analysis and are not addressed further.

Recreation

Economic losses could result if recreationists were displaced from the JIDPA and moved their activities out of the study area. Losses would be proportional to the number of displaced recreationists. For the purposes of this analysis, it is assumed that all recreation would be lost from the JIDPA for the LOP. (It is likely that most of this loss has already occurred due to extant development effects.)

Direct impacts from displaced nonconsumptive recreationists (per visitor day) could result in a loss of $29.62 (including $6.80 of labor income) and 0.000518 AJEs each (Table 4.15). If all 3,396 RVDs (see Section 3.4) were lost (regardless of the alternative), there would be a loss of direct expenditures of $100,590 (including $23,093 labor earnings) and a loss of 1.8 AJEs annually for the LOP (BLM 2005).

However, it is likely that any recreationists discouraged from engaging in activities in the JIDPA as a result of natural gas development would relocate their activities to other locations in the vicinity that would provide similar recreational opportunities unique to the PFO area; thus, no actual economic loss is likely to result from loss of recreation due to the proposed project. Individuals may experience some impacts in terms of lessened enjoyment and satisfaction from relocated recreational activities.

Table 4.15 Economic Activity per RVD from Nonconsumptive Recreation, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Item	Economic Activity per RVD
Direct Expenditures	$22.82
Secondary Labor Earnings	$6.80
Total Economic Activity per RVD	$29.62
AJES per RVD	0.000518

Economic activity from hunting could be reduced if hunters were displaced from the JIDPA and moved their activities out of the study area. Losses would be proportional to the number of displaced hunters. Under the Proposed Action and alternatives, populations of pronghorn antelope and/or greater sage-grouse, which are the two principle species hunted on the JIDPA, would likely be displaced to such an extent that recreational hunting on the JIDPA may no longer occur. Cottontail rabbits are also hunted on the JIDPA, but are unlikely to be displaced by project activities. However, it is likely that hunters already avoid the area due to extant development. Lands adjacent to the JIDPA may absorb displaced hunting pressure since displaced wildlife (most notably pronghorn antelope and greater sage-grouse) may also move to adjacent lands; thus, no economic loss may result from loss of hunting due to the project. However, for the purposes of this economic analysis, it is conservatively assumed that all hunting on the JIDPA would be lost for the LOP.

Only cottontail, greater sage-grouse, and pronghorn are likely to be hunted on the JIDPA. WGFD does not collect resident versus nonresident information for cottontail and greater sage-grouse hunting; therefore, it will be conservatively assumed for the purposes of this analysis that all hunters are nonresident. Direct impacts from displaced pronghorn hunters (61.0 hunter days per year attributable to JIDPA) could result in a loss of $536.46/hunter day (including $155.16 of labor income) and 0.012087 AJEs each (Table 4.16). Direct impacts from displaced cottontail hunters (26.4 hunter days per year) could result in a loss of $243.48/hunter day (including $70.42 of labor income) and 0.005486 AJEs each. Direct impacts from displaced greater sage-grouse hunters (16.3 hunter days per year) could result in a loss of $183.32 (including $53.02 of labor income) and 0.004131 AJEs each. If all hunters relocate their activities away from the JIDPA could result in a loss of $42,140 ($12,188 of labor income) and 0.95 AJEs of annual economic activity (BLM 2005).

It is likely that any hunters discouraged from engaging in activities in the JIDPA as a result of natural gas development would relocate their activities to other locations in the vicinity; thus, no economic loss is likely to result from loss of hunting due to the proposed project.

Grazing

There would be a reduction in available forage on grazing allotments within the JIDPA due to road, pipeline, and well pad construction (see Section 4.5.2). For the purposes of this analysis, it is conservatively assumed that, based on the reduction in forage, BLM would reduce the number

Table 4.16 Economic Activity per Hunter Day, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

	Economic Activity per Hunter Day			
Item	Pronghorn	Cottontail	Greater Sage-grouse	Total
Direct Expenditures	$381.30	$173.06	$130.30	$684.66
Secondary Labor Earnings	$155.16	$70.42	$53.02	$278.60
Total Secondary Activity per Hunter Day	$536.46	$243.48	$183.32	$963.26
AJEs per Hunter Day	0.012087	0.005486	0.004131	0.021704

of permitted AUMs during initial disturbance and for the LOP; these estimated reductions are presented in BLM (2005). The economic activity from these AUMs is presented in Table 4.17. The assumed reduction in AUMs does not take into consideration the possibility that areas reclaimed shortly after initial disturbance--areas not needed for the LOP--would provide more forage (primarily grass) for livestock than the previously undisturbed range. Total economic impact per AUM lost is estimated at $114.99 (including $18.46 labor earnings) and 0.000709 AJEs annually and (Table 4.17). Additionally, fees paid to the BLM by permittees ($1.35/AUM) would not be realized if the number of permitted AUMs were reduced.

For the purposes of this economic analysis, it is conservatively assumed that all affected AUMs (cumulative plus RFD) would be lost under each action alternative for the LOP (BLM 2005). Total losses would depend on the length of the LOP, which depends on the number of wells and rate of development ultimately approved. Some AUMs would return to productivity during the LOP as reclamation proceeds and forage production increases. Removal and subsequent reinstatement of any permitted AUMs would be at the discretion of the BLM.

Social Impacts

Social impacts are discussed in more detail in BLM (2005).

The project could result in some increases in population in Sublette, Lincoln, and Sweetwater Counties, as a result of job seekers from other areas moving to the area in search of employment; although existing industry expertise and services in the three counties is generally adequate to service additional oil and gas development. Some limited degree in-migration of labor is anticipated as a result of the project; without adequate planning at the local level, increases in population would likely have some effect on communities in the study area.

Personal per capita income in the study area ranged from $16,140 to $28,037 in 2000. Estimated annual starting wages per job created as a result of the project would be from 50-58% higher than the personal per capita income reported in 2000. Thus, there would likely be impacts from increased income to local families and reduced poverty as a result of the Proposed Actions and alternatives. These impacts would not be realized under the No Action Alternative.

Table 4.17 Economic Activity from Grazing per AUM, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Item/AUM	Economic Activity per AUM
Value of Production	$35.29
Indirect Economic Activity (not labor)	$61.24
Secondary Labor Earnings	$18.46
Total Economic Activity per AUM	$114.99
AJEs per AUM	0.000709

It is not anticipated that the project would result in an in-migration of workers to the study area. With an estimated 1,713 available workers available in the study area and 12,000 available workers in Wyoming, the estimated number of laborers that would be directly employed as a result of the project would be readily available. The project would directly provide 166-401 jobs annually (assuming a 43-year LOP) and would indirectly generate 1,690 to 5,256 AJEs annually. Some of these jobs would be existing jobs that would continue to occur as a result of continued development and operations that would otherwise have been lost; some jobs would be newly created parallel or transitional jobs. These jobs would likely reduce or prevent an increase in unemployment in the study area and the state. The project would result in impacts resulting from increased local employment--both to the workforce directly involved in oil and gas development and to the general service economy--especially during construction and drilling. However, the existing labor shortage reported by Mast (2004) may be incrementally increased by the project (personal communication, December 2004, with Roy Allen, Economist, BLM Wyoming State Office, Cheyenne and with Marilyn Filkins, Sublette County Attorney, Pinedale).

Increased revenues, incomes, and population in the study area would likely result in increased entropy in the study area society. Crime could increase in the study area as a result of greater affluence among the residents of the study area. However, the population in the study area is not anticipated to increase in the long-term as a result of this project; therefore, no project-specific increase in crime is anticipated. However, because of the demographics of the laborers attracted to oil and gas development and production, the existing crime situation, which is already affecting the CIAA, may be incrementally increased by the project.

Increased affluence in the study area could attract additional health-care providers to the area or encourage existing health care providers to remain in the area. However, impacts already being experienced by the healthcare community may be incrementally increased by the project as a result of increases in population by individuals attracted to potential new opportunities.

While it is possible that there may be some increase in the study area population as a result of job-seekers coming to the area, such an increase in population would not place an undue burden on existing infrastructure. For instance, nearly 32% of the housing in Sublette County is vacant, although the habitability of this vacant housing is unknown. No housing shortages are anticipated. However, if there were an increase in the population, increased demand would likely cause an increase in housing prices (rental costs and home sale prices). Additionally, increased affluence in the study area is likely to cause an increase in the demand for higher-quality housing. This would result in increased ad valorem tax revenues to local governments. It could also make

it more difficult for some individuals to obtain satisfactory housing within affordable price ranges, which would have an effect on those individuals. Impacts to housing already being experienced by the affected communities may be incrementally increased by the project as a result of increases in population. A motel is being planned for construction in Pinedale and several mancamps are also under discussion by area operators not involved with this project, to help alleviate pressures on housing. Additionally, several multi-unit housing developments are under discussion (personal communication, December 2004, with Roy Allen, Economist, BLM Wyoming State Office, Cheyenne and Cyd Goodrich, Realtor, Pinedale Properties).

Increased cost of living and inflation already being experienced by the affected communities also may be incrementally increased by the project.

Increased revenues to schools as a result of increased ad valorem and other taxes and revenues would be an impact to the school systems, thereby allowing the purchase of higher quality teaching materials and potentially increasing the wages of teachers, which could attract teachers with higher credentials than would otherwise have been attracted to positions within the study area. Any increases in population would likely aid in offsetting the current trend toward school closures/consolidations in some communities. Additionally, increased funding would provide schools with more options to improve education and raise Wyoming Comprehensive Assessment System scores, thus increasing the overall education rate and improving the quality of the overall work force in the study area. Increases in population may help reduce impacts already being experienced by schools in affected communities that have resulted in school closures. All area schools have plenty of capacity for expansion of enrollment (Blevins et al 2004).

4.4.1 No Action Alternative

See BLM (2005) for a detailed analysis of socioeconomic impacts related to production, recreation, and grazing, as well as social impacts. Under the No Action Alternative, no additional development would occur. This would reduce the number of rigs, crews, and associated services currently operating in the area. Currently, one oilfield service operator employs over 300 people and employs local contractors from over 30 companies within the town of Rock Springs (Schlumberger Oil Field Services Companies 2003). It is approximated that between 1996 and 2002, 59.3% of all exploration and production oilfield service fees paid in the state were spent on services in the Jonah Field (Schlumberger Oil Field Services Companies 2003). These services and associated jobs would likely be reduced or eliminated under the No Action Alternative. No additional economic activity from development would occur under this alternative--no additional secondary labor earnings or jobs would be created, and no additional taxes or revenues from development would be realized.

Under the No Action Alternative, the least amount of change in economic activity from current conditions would be expected when compared to all other alternatives. Because no additional development would occur, no economic activity from development would occur (Table 4.18). Production would be limited to the life of currently producing wells, therefore, only up to 3,366 BCF of gas and 31.98 MBO would be recovered under this alternative. Over the LOP, the No Action Alternative would generate up to $9,275.7 million present value, including $1,753.7 million present value in taxes/royalties. Based on a population of 6,024 (year 2002), this would be nominally equivalent to the county receiving funds of $123,144 (approximately $3,079 annually) for each person in the county (see BLM 2005).

Table 4.18 Summary of Total Economic Activity Resulting from Natural Gas Development and Production Over the Life of Field, Jonah Infill Drilling Project, Sublette County, 2005.

	Economic Activity Resulting from Development (LOF)									
Economic Effect	No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Preferred Alternative
Total Anticipated Natural Gas Recovery over the LOF (BCF)	3,366	7,947	8,191	6,124	6,657	7,554	6,302	7,186	7,876	
Total Anticipated Condensate Recovery over the LOF (million bbls)	31.98	75.50	77.81	58.18	63.24	71.76	59.87	68.27	74.82	
Potential Range of Change in Employment										
Secondary Development Employment (AJEs)	--	52,930 to 53,342	52,187.5 to 52,605.0	60,625 to 61,110	21,617 to 22,119	38,466 to 38,474	59,848 to 60,316	57,823 to 99,071	53,740 to 54,193	
Average Earnings Per Job	--	$31,881 to $32,025	$31,881 to $32,025	$31,881 to $32,025	$31,881 to $32,025	$31,881 to $32,025	$31,881 to $32,025	$31,881 to $32,025	$31,881 to $32,025	
Secondary Production Employment (AJEs)	13,947	32,928	33,939	25,374	27,583	31,299	26,112	29,775	32,634	
Average Earnings Per Job	$47,173	$47,173	$47,173	$47,173	$47,173	$47,173	$47,173	$47,173	$47,173	
Recreation AJEs	--	-92.4 to -144.2	-92.4 to -144.3	-92.4 to -144.4	-79.2 to -100.3	-86.2 to -123.1	-92.4 to -144.4	-92.4 to -144.4	-92.4 to -144.4	
Hunting AJEs	--	-49.9 to -77.9	-49.9 to -77.9	-49.9 to -77.9	-42.8 to -54.2	-46.6 to -66.5	-49.9 to -77.9	-49.9 to -77.9	-49.9 to -77.9	
Grazing AJEs	--	-65.7 to -102.7	-65.7 to -102.7	-24.4 to -38.1	-30.5 to -38.6	-47.6 to -68.0	-34.5 to -53.9	-47.4 to -74.1	-58.7 to -91.7	
Potential Range of Change in Employment	13,947	85,110.0 to 85,945.2	85,918.5 to 86,219.1	85,832.3 to 86,223.6	59,047.5 to 49,508.9	69,584.6 to 69,515.4	85,732.2 to 86,151.8	87,408.3 to 128,549.0	86,173.0 to 86,513.0	Approximately the same as Alternative G
NOMINAL VALUE OF ECONOMIC ACTIVITY										
75 Wells Per Year Development Rate										
Value of Development[1] (millions of $)	0.0	8,655.9	8,565.1	9,612.5	3,568.6	6,227.7	9,514.7	9,263.4	8,760.6	
Value of Production[1,2] (millions of $)	12,922.5	30,509.5	31,446.1	23,510.8	25,556.9	29,000.6	24,194.1	27,587.9	30,236.8	
Taxes/royalties from proposed project (millions of $)	2,334.9	6,076.0	6,239.1	4,881.4	4,850.7	5,646.0	4,997.8	5,592.7	6,034.8	
Recreation (millions of $)	0.0	-8.2	-8.2	-8.2	-5.7	-7.0	-8.2	-8.2	-8.2	
Hunting (millions of $)	0.0	-3.5	-3.5	-3.5	-2.4	-2.9	-3.5	-3.5	-3.5	
Grazing (millions of $)	-1.5	-14.2	-14.2	-5.3	-5.3	-9.4	-7.8	-10.2	-12.0	
Total Nominal Economic Activity (millions of $)	15,255.9	45,215.5	46,224.5	37,987.7	33,962.7	40,854.9	38,687.2	42,422.1	45,008.6	
150 Wells Per Year Development Rate										
Value of Development[1] (millions of $)	0.0	8,655.9	8,565.1	9,612.5	3,796.5	6,227.7	9,507.8	15,678.7	8,760.6	
Value of Production[1,2] (millions of $)	12,922.5	30,509.5	31,446.1	23,510.8	25,556.9	29,000.6	24,194.1	27,587.9	30,236.8	
Taxes/royalties (millions of $)	2,334.9	6,076.5	6,239.1	4,881.4	4,865.7	5,646.0	4,997.3	6,015.6	6,034.8	
Recreation (millions of $)	0.0	-6.1	-6.1	-6.1	-4.9	-5.5	-6.1	-6.1	-6.1	
Hunting (millions of $)	0.0	-2.6	-2.6	-2.6	-2.1	-2.3	-2.6	-2.6	-2.6	
Grazing (millions of $)	-1.5	-10.5	-10.5	-3.9	-4.6	-7.4	-5.8	-7.6	-8.9	
Total Nominal Economic Activity (millions of $)	15,255.9	45,222.7	46,231.1	37,992.0	34,207.5	40,859.0	38,684.7	49,265.9	45,014.7	Approximately the same as Alternative G
250 Wells Per Year Development Rate										
Value of Development[1] (millions of $)	0.0	8,588.6	8,497.2	9,536.2	3,490.3	6,228.7	9,440.6	9,191.2	8,688.3	
Value of Production[1,2] (millions of $)	12,922.5	30,509.5	31,446.1	23,510.8	25,556.9	29,000.6	24,194.1	27,587.9	30,236.8	
Taxes/royalties (millions of $)	2,334.9	6,072.1	6,234.7	4,876.4	4,845.5	5,646.1	4,992.9	5,588.0	6,030.1	
Recreation (millions of $)	0.0	-5.3	-5.3	-5.3	-4.5	-4.9	-5.3	-5.3	-5.3	
Hunting (millions of $)	0.0	-2.2	-2.2	-2.2	-1.9	-2.1	-2.2	-2.2	-2.2	
Grazing (millions of $)	-1.5	-9.1	-9.1	-3.4	-4.2	-6.6	-5.0	-6.5	-7.7	
Total Nominal Economic Activity (millions of $)	15,255.9	45,153.7	46,161.4	37,912.5	33,882.1	40,861.8	38,615.2	42,353.2	44,940.1	

Table 4.18 (Continued)

Economic Effect	No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G	Preferred Alternative
	Economic Activity Resulting from Development (LOF)									
	PRESENT VALUE OF ECONOMIC ACTIVITY[3]									
75 Wells Per Year Development Rate										
Value of Development[2] (millions of $)	0.0	4,496.4	4,452.8	4,997.3	2,655.7	3,818.0	4,946.5	4,815.8	4,554.5	
Value of Production[2] (millions of $)	9,275.7	12,101.0	12,144.6	9,325.1	14,130.0	13,208.8	9,596.1	10,942.1	11,992.8	
Taxes/royalties (millions of $)	1,753.7	2,557.3	2,561.7	2,108.2	2,733.2	2,665.9	2,151.9	2,378.2	2,542.8	
Recreation (millions of $)	0.0	-2.7	-2.7	-2.7	-2.5	-2.6	-2.7	-2.7	-2.7	
Hunting (millions of $)	0.0	-1.1	-1.1	-1.1	-1.0	-1.1	-1.1	-1.1	-1.1	
Grazing (millions of $)	-0.9	-5.4	-5.4	-2.0	-2.7	-4.1	-3.0	-3.9	-4.6	
Total Present Value of Economic Activity (millions of $)	11,028.5	19,145.4	19,149.8	16,424.7	19,512.7	19,684.9	16,687.6	18,128.4	19,081.6	
150 Wells Per Year Development Rate										Approximately the same as Alternative G
Value of Development[2] (millions of $)	0.0	6,058.3	5,994.8	6,727.8	3,209.1	4,781.8	6,654.5	10,973.6	6,131.6	
Value of Production[2] (millions of $)	9,275.7	15,864.2	16,349.9	12,225.0	16,049.7	16,543.1	12,580.4	14,345.1	15,722.5	
Taxes/royalties (millions of $)	1,753.7	3,156.6	3,239.5	2,543.2	3,073.1	3,217.8	2,602.8	3,061.5	3,134.5	
Recreation (millions of $)	0.0	-2.5	-2.5	-2.5	-2.3	-2.4	-2.5	-2.5	-2.5	
Hunting (millions of $)	0.0	-1.1	-1.1	-1.1	-1.0	-1.0	-1.1	-1.1	-1.1	
Grazing (millions of $)	-0.9	-5.1	-5.1	-1.9	-2.4	-3.8	-2.8	-3.7	-4.3	
Total Present Value of Economic Activity (millions of $)	11,028.5	25,070.4	25,575.5	21,490.6	22,326.1	24,535.3	21,831.3	28,372.9	24,980.7	
250 Wells Per Year Development Rate										
Value of Development[2] (millions of $)	0.0	6,631.8	6,561.2	7,363.5	3,151.8	5,265.1	7,289.7	7,097.1	6,708.8	
Value of Production[2] (millions of $)	9,275.7	17,963.8	18,511.2	13,842.7	17,145.3	18,212.2	14,245.2	16,243.3	17,803.0	
Taxes/royalties (millions of $)	1,753.7	3,474.7	3,574.9	2,725.2	3,242.5	3,483.9	2,798.3	3,165.4	3,446.6	
Recreation (millions of $)	0.0	-2.4	-2.4	-2.4	-2.3	-2.3	-2.4	-2.4	-2.4	
Hunting (millions of $)	0.0	-1.0	-1.0	-1.0	-0.9	-1.0	-1.0	-1.0	-1.0	
Grazing (millions of $)	-0.9	-6.6	-6.6	-2.5	-2.5	-3.7	-3.6	-4.7	-5.6	
Total Present Value of Economic Activity (millions of $)	11,028.5	28,060.4	28,637.3	23,925.5	23,533.9	26,954.2	24,326.2	26,497.8	27,949.5	

[1] Includes nonproject labor earnings resulting from secondary economic activity induced by project activities. These earnings do not include project labor earnings.

[2] Natural gas plus condensate; Proposed Action and Alternatives A-G include wells currently in production (i.e., No Action Alternative wells); natural gas price is $3.50/mcf and condensate is $21/bbl.

[3] Variable development rates porvided for each alternative; well life is assumed to be 40 years; see TRC Mariah (2004c) for a discussion of discounting. The discount rate used for this analysis was 3.5%. Conservatively assumes revenues are received as a lump sum at year end.

Grazing could be reduced by up to $0.9 million present value. No effect would be expected to occur on recreation or hunting resources. The least total economic activity would occur under the No Action Alternative of all alternatives and this alternative would create the least number of AJEs.

4.4.2 Proposed Action

See BLM (2005) for a detailed analysis of impacts related to this alternative. Because no new development would occur under the No Action Alternative, development impacts would be greater under the Proposed Action which provides that up to 3,100 new (assumed at 2,825 conventional, 275 directional) wells would be developed (see Table 4.18). The economic activity under the 250 wells/year development rate (12.5 years) would be $4,496.4 million present value and 52,930.0 AJEs for the LOP (BLM 2005). The Proposed Action would have more economic activity in terms of production than the No Action Alternative because of the higher level of resource recovery. The number of AJEs that would be created in the study area would be up to 85,945.2 with an average wage ranging from $31,881 to $47,173.

Over an LOP of 52.5 years (12.5 years to develop), economic activity would be $28,060.4 million present value, including $3,474.7 million present value in taxes/royalties (see Table 4.18). Based on a population of 6,024 (year 2002), this would be nominally equivalent to the county receiving funds of $305,292 (approximately $5,815 annually) for each person in the county (BLM 2005). BLM (2005) presents speculative examples of what budgets for Big Piney, Pinedale, and Sublette County may be in year 10 of development under the Proposed Action. Under the Proposed Action, local area government operating budgets would likely expand and increase the amount of services and infrastructure provided to community residents. These impacts would be higher under the Proposed Action than under the No Action Alternative.

The Proposed Action could result in a present value loss of economic activity from recreation of $2.4 million, hunting of $1.0 million, and grazing of $6.6 million over the LOP. Impacts to recreation, hunting, and grazing would be greater than for the No Action Alternative due to increased disturbance and longer project duration. Under the Proposed Action, if it is assumed that all 3,396 RVDs are relocated for the LOP, reduced recreation economic activity would amount to $2.4 million present value and up to 92.4 AJEs. These impacts would be higher than under the No Action Alternative. Under the Proposed Action, if it is assumed that all 103.7 hunter days per year are relocated for the LOP, reduction in economic activity from hunting expenditures would amount to $1.0 million present value and up to 49.9 AJEs. These impacts would be higher than under the No Action Alternative. Under the Proposed Action, if it is assumed that 1,761 AUMs would be lost for the LOP, reduction in economic activity would amount to $6.6 million present value and up to 65.5 AJEs.

4.4.3 Alternative A

See BLM (2005) for a detailed analysis of impacts related to this alternative. Under Alternative A, change in economic activity from current conditions would be expected from the development of up to 3,100 wells and the recovery of up to 8,191 BCF of gas and 77.81 MBO (see Table 4.18). Economic activity from Alternative A would be less than that expected from the Proposed Action due to the removal of directional drilling, but greater than expected under the No Action Alternative. This alternative would have more nominal economic activity in terms of production than the Proposed Action or the No Action Alternative because of the higher level of resource recovery.

Economic activity could range from $19,149.8 million present value (including $2,561.7 million in taxes and revenues) to $28,637.3 million present value (including $3,574.9 million in taxes and revenues) (see Table 4.18). Based on a population of 6,024 (year 2002), this would be nominally equivalent to Sublette County receiving funds of $314,077 (approximately $5,982 annually) for each person in the county (BLM 2005). Property tax revenues would likely be higher under this alternative than under the No Action Alternative or Proposed Action due to the greater amount of construction involved with development, which would result in an increased tax base resulting from capital improvements in the JIDPA. Because Alternative A maximizes resource recovery, benefits to consumers and local, state, and national economies would likely be higher than under the Proposed Action. While, conceptually, changes in production for this field could impact pricing of natural gas for consumers, given the size of the market it is not likely that a measurable change in market price would be associated with this alternative due to the length of the LOP. Local area government operating budgets would likely increase but more under this alternative than under the No Action Alternative, but less than under the Proposed Action due to reduced development expenditures. Alternative A would generate the most overall taxes and revenues and the most funds for the school capital account over the LOP compared to all others alternatives (BLM 2005).

The number of AJEs that would be created in the study area could range from 85,918.5-86,219.1 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would be higher than under the No Action Alternative and would likely be similar to but reduced from that described for the Proposed Action because fewer AJEs would be created to attract new workers (BLM 2005). The potential for population changes from secondary employment would likely be lowest under Alternative A when compared to all other alternatives that contain a development component.

This alternative could result in a loss of economic activity from recreation ranging from $2.4 million present value to $2.7 million present value, hunting ranging from $1.0 million present value to $1.1 million present value, and grazing ranging from $6.6 million present value to $5.1 million present value over the LOP. The loss of economic activity from recreation, hunting, and grazing would be increased under Alternative A as compared to the No Action Alternative and longer development periods under the 75 and 150 wells/year development rates would result in greater reductions in economic activity from these resources than under the Proposed Action. The greatest loss in grazing from all alternatives would occur under Alternative A 75 wells/year development rate.

4.4.4 Alternative B

See BLM (2005) for a detailed analysis of impacts related to this alternative. Under Alternative B, change in economic activity from current conditions would be expected from the development of up to 3,100 wells and the recovery of up to 6,124 BCF of gas and 58.18 MBO (see Table 4.18).

Economic activity from Alternative B would be more than that expected from the Proposed Action and the No Action Alternative due to the increased amount of directional drilling from the development activities. The least economic activity would occur under Alternative B when compared to all alternatives except for the No Action Alternative, both in nominal and real terms as well as numbers of jobs. This alternative would have less nominal economic activity in terms of production than the Proposed Action because of the lower level of resource recovery.

Economic activity could range from $16,424.7 million present value (including $2,108.2 million present value in taxes and revenues to $23,925.5 million present value including $2,725.2 million present value in taxes and revenues (see Table 4.18). Based on a population of 6,024 (year 2002), this would be nominally equivalent to Sublette County receiving funds of $240,050 (approximately $5,334 annually) for each person in the county (BLM 2005). Under Alternative B, property tax revenues would increase due to the increased tax base resulting from capital improvements in the JIDPA, but at a lower amount than under the Proposed Action due to the decreased number of well pads. However, this alternative would result in a lower recovery of resources and a lower supply of natural gas over the long-term than under the Proposed Action and may result in higher consumer prices and increased dependence on foreign supplies. While, conceptually, changes in production for this field could impact pricing of natural gas for consumers, given the size of the market it is not likely that a measurable change in market price would be associated with this alternative due to the length of the LOP. Local area government operating budgets would likely increase under this alternative when compared to the No Action Alternative, but less than under the Proposed Action due to reduced development expenditures and lower recovery of resources.

The number of AJEs that would be created in the study area could range from 85,832.3-86,223.6 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would likely be similar to but increased from that described for the Proposed Action because more AJEs would be created to attract new workers (BLM 2005).

Under Alternative B, losses to economic activity for recreation, hunting, and grazing would be the same as those described for Alternative A (BLM 2005).

4.4.5 Alternative C

See BLM (2005) for a detailed analysis of impacts related to this alternative. Under Alternative C, change in economic activity from current conditions would be expected from the development of up to 1,250 wells and the recovery of up to 6,657 BCF of gas and 63.24 MBO (see Table 4.18).

Impacts to economic activity from Alternative C would be greater than for the No Action Alternative, but would be less than half that expected from the Proposed Action due to the reduced number of wells to be developed (BLM 2005). This alternative would also have less nominal economic activity in terms of production than the Proposed Action because of the lower level of resource recovery.

Economic activity could range from $23,533.9 million present value (including $3,242.5 million present value in taxes and revenues) to $19,512.7 million present value (including $2,733.2 million present value in taxes and revenues) (see Table 4.18). Based on a population of 6,024 (year 2002), this would be nominally equivalent to Sublette County receiving funds of $249,465 (approximately $5,091 annually) for each person in the county (BLM 2005). Impacts to taxes and revenues would be greater than that expected for the No Action Alternative, but less than that described for the Proposed Action. This alternative would result in more tax and revenue economic activity than the No Action Alternative; however, due to lower recovery of resources and a lower supply of natural gas over the long-term than under the Proposed Action, it may result in higher consumer prices and increased dependence on foreign supplies. While, conceptually, changes in production for this field could impact pricing of natural gas for consumers, given the size of the market it is not likely that a measurable change in market price

would be associated with this alternative due to the length of the LOP. Local area government operating budgets would likely increase but less under this alternative than under the Proposed Action due to lower recovery of resources.

Alternative C would produce the least economic activity in terms of both dollars and jobs (except for the No Action alternative) when compared to the other alternatives.

The number of AJEs that would be created in the study area under Alternative C could range from 59,047.5-49,508.9 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would be greater than that described for the No Action Alternative, but likely be less than that described for the Proposed Action due to the creation of fewer AJEs as a result of fewer wells being developed (BLM 2005).

This alternative could result in a loss of economic activity from recreation ranging from $2.3 million present value to $2.5 million present value, hunting ranging from $0.9 million present value to $1.0 million present value, and grazing ranging from $2.4 million present value to $2.7 million present value over the LOP. Impacts to these resources would be greater under Alternative C than under the No Action Alternative, but would be less than for the Proposed Action due to reduced disturbance over the LOP.

4.4.6 Alternative D

See BLM (2005) for a detailed analysis of impacts related to this alternative. Under Alternative D, change in economic activity from current conditions would be expected from the development of up to 2,200 wells and the recovery of up to 7,554 BCF of gas and 71.76 MBO (see Table 4.18). Economic activity from development under Alternative D would be greater than that expected from the No Action Alternative, but less than that expected from the Proposed Action due to the reduced number of wells to be developed. This alternative would have less nominal economic activity in terms of production than the Proposed Action because of the lower level of resource recovery.

Economic activity could range from $26,954.2 million present value (including $3,483.9 million present value in taxes and revenues) to $19,684.9 million present value (including $2,665.9 million present value in taxes and revenues (see Table 4.18). Based on a population of 6,024 (year 2002), this would be nominally equivalent to Sublette County receiving funds of $286,915 (approximately $5,855 annually) for each person in the county (BLM 2005). Impacts to taxes and revenues would be greater than that expected for the No Action Alternative, but less than that described for the Proposed Action. This alternative would result in more tax and revenue economic activity than the No Action Alternative; however, due to lower recovery of resources and a lower supply of natural gas over the long-term than under the Proposed Action, it may result in higher consumer prices and increased dependence on foreign supplies. While, conceptually, changes in production for this field could impact pricing of natural gas for consumers, given the size of the market it is not likely that a measurable change in market price would be associated with this alternative due to the length of the LOP. Local area government operating budgets would likely increase but less under this alternative than under the Proposed Action due to lower recovery of resources.

The number of AJEs that would be created in the study area could range from 69,584.6-69,515.4 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would be higher than that expected for the No Action Alternative, but would likely

be similar to but decreased from that described for the Proposed Action due to fewer numbers of AJEs being created as a result of fewer wells being developed (BLM 2005).

This alternative could result in a loss of economic activity from recreation ranging from $2.3 million present value to $2.6 million present value, hunting ranging from $1.0 million present value to $1.1 million present value, and grazing ranging from $3.7 million present value to $4.1 million present value over the LOP. Impacts to recreation, hunting, and grazing would be higher than that expected for the No Action Alternative but would be less than for the Proposed Action due to reduced disturbance over the LOP.

4.4.7 Alternative E

See BLM (2005) for a detailed analysis of impacts related to this alternative. Under Alternative E, change in economic activity from current conditions would be expected from the development of up to 3,100 wells and the recovery of up to 6,302 BCF of gas and 59.87 MBO (see Table 4.18). Economic activity from development Alternative E would be more than that expected from the No Action Alternative or the Proposed Action due to the increased number of directionally drilled wells to be developed. This alternative would have less nominal economic activity in terms of production than the Proposed Action because of the lower level of resource recovery, but more than under the No Action Alternative.

Economic activity could range from $24,326.2 million present value (including $2,798.3 million present value in taxes and revenues) to $16,687.6 million present value (including $2,151.9 million present value in taxes and revenues (see Table 4.18). Based on a population of 6,024 (year 2002), this would be nominally equivalent to Sublette County receiving funds of $246,416 (approximately $4,694 annually) for each person in the county (BLM 2005). Under Alternative E, property tax revenues would increase from that expected under the No Action Alternative due to the increased tax base resulting from capital improvements in the JIDPA, but at a lower amount than under the Proposed Action due to the decreased number of well pads. Impacts to taxes and revenues would be greater than that expected for the No Action Alternative, but less than that described for the Proposed Action. This alternative would result in more tax and revenue economic activity than the No Action Alternative; however, due to lower recovery of resources and a lower supply of natural gas over the long-term than under the Proposed Action, it may result in higher consumer prices and increased dependence on foreign supplies. While, conceptually, changes in production for this field could impact pricing of natural gas for consumers, given the size of the market it is not likely that a measurable change in market price would be associated with this alternative due to the length of the LOP. Local area government operating budgets would likely increase but less under this alternative than under the Proposed Action due to lower recovery of resources.

The number of AJEs that would be created in the study area could range from 85,732.2-86,151.8 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would be higher than for the No Action Alternative and would likely be similar to but somewhat higher than that described for the Proposed Action due to the increased number of AJEs created because of the higher level of directional drilling (BLM 2005).

Alternative E could result in a loss of economic activity from recreation ranging from $2.4 million present value to $2.7 million present value, hunting ranging from $1.0 million present value to $1.1 million present value, and grazing ranging from $2.8 million present value to $3.6 million present value over the LOP. Under Alternative E, changes to economic activity

for recreation, hunting, and grazing would be the same as those described for Alternative A (BLM 2005).

4.4.8 Alternative F

See BLM (2005) for a detailed analysis of impacts related to this alternative. Under Alternative F, change in economic activity from current conditions would be expected from the development of up to 3,100 wells and the recovery of up to 7,186 BCF of gas and 68.27 MBO (see Table 4.18). Economic activity from Alternative F would be more than that expected from the either No Action Alternative or the Proposed Action due to the increased number of directionally drilled wells to be developed. This alternative would have less nominal economic activity in terms of production than the Proposed Action because of the lower level of resource recovery, but more than under the No Action Alternative.

Economic activity could range from $26,497.8 million present value (including $3,165.4 million present value in taxes and revenues) to $18,128.4 million present value (including $2,378.2 million present value in taxes and revenues (see Table 4.18). Based on a population of 6,024 (year 2002), this would be nominally equivalent to Sublette County receiving funds of $278,376 (approximately $5,302 annually) for each person in the county (BLM 2005). Under Alternative F, property tax revenues would increase from that described for the No Action Alternative due to the increased tax base resulting from capital improvements in the JIDPA, but at a lower amount than under the Proposed Action due to the decreased number of well pads. However, this alternative would result in a lower recovery of resources and a lower supply of natural gas over the long-term than under the Proposed Action and may result in higher consumer prices and increased dependence on foreign supplies. While, conceptually, changes in production for this field could impact pricing of natural gas for consumers, given the size of the market it is not likely that a measurable change in market price would be associated with this alternative due to the length of the LOP. Local area government operating budgets would likely increase but less under this alternative than under the Proposed Action due to lower recovery of resources.

The number of AJEs that would be created in the study area could range from 87,408.3-128,549.0 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would likely be higher than that described for either the No Action Alternative or the Proposed Action. The potential for population changes from secondary employment would likely be highest under Alternative F when compared to all other alternatives.

This alternative could result in a loss of economic activity from recreation ranging from $2.4 million present value to $2.7 million present value, hunting ranging from $1.0 million present value to $1.1 million present value, and grazing ranging from $4.3 million present value to $5.6 million present value over the LOP. Impacts would likely be similar to those described under Alternative A.

The greatest total economic activity in terms of dollars and jobs would occur under the Alternative F under the 150 wells/year development rate (see Table 4.57).

4.4.9 Alternative G

See BLM (2005) for a detailed analysis of impacts related to this alternative. Under Alternative G, change in economic activity from current conditions would be expected from the development of up to 3,100 wells and the recovery of up to 7,876 BCF of gas and 74.82 MBO (see Table 4.18).

Economic activity from Alternative G would similar to but slightly higher than that described for the Proposed Action due to the slightly increased number of directionally drilled wells to be developed and would be higher than that expected for the No Action Alternative. This alternative would have less nominal economic activity in terms of production than the Proposed Action because of the lower level of resource recovery, but more than under the No Action Alternative.

Economic activity could range from $27,949.5 million present value (including $3,446.6 million present value in taxes and revenues) to $19,081.6 million present value (including $2,542.8 million present value in taxes and revenues (see Table 4.18). Based on a population of 6,024 (year 2002), this would be nominally equivalent to Sublette County receiving funds of $302,847 (approximately $5,769 annually) for each person in the county (BLM 2005). Under Alternative G, property tax revenues would increase over that described for the No Action Alternative due to the increased tax base resulting from capital improvements in the JIDPA, but at a lower amount than under the Proposed Action due to the decreased number of well pads. However, this alternative would result in a lower recovery of resources and a lower supply of natural gas over the long-term than under the Proposed Action and may result in higher consumer prices and increased dependence on foreign supplies. While, conceptually, changes in production for this field could impact pricing of natural gas for consumers, given the size of the market it is not likely that a measurable change in market price would be associated with this alternative due to the length of the LOP. Local area government operating budgets would likely increase but less under this alternative than under the Proposed Action due to lower recovery of resources.

The number of AJEs that would be created in the study area could range from 86,173-86,513 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would likely be similar to but somewhat higher than that described for the Proposed Action due to the increased number of AJEs created as a result of the higher number of directionally drilled wells (BLM 2005).

This alternative could result in a loss of economic activity from recreation ranging from $2.4 million present value to $2.7 million present value, hunting ranging from $1.0 million present value to $1.1 million present value, and grazing ranging from $4.3 million present value to $5.6 million present value over the LOP. Under Alternative G, changes to economic activity from recreation and hunting would be the same as those described for Alternative A (BLM 2005). Impacts would be less than for the Proposed Action due to reduced disturbance over the LOP.

4.4.10 BLM Preferred Alternative

See BLM (2005) for a detailed analysis of impacts related to this alternative. Under the Preferred Alternative, change in economic activity from current conditions would be expected from the development of up to 3,100 wells. Economic activity would be greater than that described under the No Action Alternative and similar to that described under Alternative G (see Section 4.4.9). This alternative would have less nominal economic activity in terms of production than the Proposed Action because of the lower level of resource recovery, but more than under the No Action Alternative.

4.4.11 Cumulative Impacts

The CIAA for socioeconomics includes Sublette, Lincoln, and Sweetwater Counties. All of these counties depend upon the oil and gas industry for a portion of their economic activity and tax base (refer to Section 3.4), and the project, along with other oil and gas development, would increase employment opportunities, expand the tax base, and improve the abilities for the counties to maintain and increase services and infrastructure to their residents. When considering employment, tax base/revenues, and general economic health, increased oil and gas development produces impacts. Wells developed as part of this project would add proportionately to the economic potential to be realized in the area. Local communities would experience economic impacts from an increase in consumption of local goods and services and increased sales tax revenues. For instance, construction of well pads and roads is usually contracted to local construction companies, and it is likely that many employees would spend some of their payroll in these communities. Actual impacts would depend on the rate of development and the number of wells.

Increases in regional oil and gas development activity in a short period of time can cause notable changes in employment and income. These variables can in turn cause changes in population trends, which could have detrimental effects on community services, social structures and lifestyles. Increased oil and gas development is expected under all alternatives except No Action, and would cause an increase in taxes and revenues to all governments in the study area proportional to the volume of gas produced and associated development levels. Increases to ad valorem taxes would be expected to occur in Sublette County. Conversely, under the No Action Alternative, these increases would not be realized, which could result in negative impacts to local government. Additional revenues would accrue to the U.S. in the form of personal and corporate income taxes. Wyoming, and especially Sublette, Sweetwater, and Lincoln Counties are highly dependent on mineral revenues, and the revenue anticipated from the Proposed Action would add to those revenues.

Where the surface is in private ownership and the minerals are in federal ownership, a lease holder has the right of ingress and egress on the private surface and the right to disturb whatever is reasonably necessary to recover the minerals. This does not prevent the private owner and the lease holder from entering into mutually acceptable terms regarding surface use to facilitate the process. When both the surface and minerals are in private ownership, negotiations for a lease--including financial considerations--are between the private owner and the potential lessee, and the terms of the lease--financial and otherwise--are negotiated by the two parties. It is usual for the private mineral owner to share in the profits from the recovery of the mineral resource.

However, some portion of the resident population, as well as many non-residents, prioritize preserving the naturalness of the area above all else and are not in favor of the high level of oil and gas development proposed in JIDPA. These individuals may be affected on a personal aesthetic and moral level by the Proposed Action and alternatives.

4.4.12 Unavoidable Adverse Impacts

There would be avoidable adverse impacts to socioeconomics as a result of the proposed project. Impacts could be reduced by implementation of suggested mitigation measures.

4.4.13 Environmental Justice

EO 12898 directs BLM to assess whether an action would have disproportionately high and adverse human health or environmental impacts on minority and/or low-income communities. The EO has three goals:

- to focus federal agency attention on the environment and human health conditions in minority communities and low-income communities;
- to promote non-discrimination in federal programs that substantially affect human health and the environment; and
- to provide minority communities and low-income communities greater access to information on, and opportunities for public participation in, matters relating to human health and the environment.

Sublette County is neither a minority community nor a low-income community (see Section 3.4.12), and no impact associated with environmental justice would occur.

4.5 LAND USE

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with land use (including status/ownership, livestock/grazing management, recreation, and transportation):

- to manage public lands to support the goals and objectives of other resource programs;
- to respond to public demand for land use authorizations;
- to acquire administrative and public access, where necessary;
- to maintain or improve the quality of land resources in the state;
- to coordinate land use decisions with economic factors and needs;
- to provide for a cooperative process of local land use planning with other governmental agencies;
- to plan for continuing use of agricultural-rural lands and for potential changes in use of these lands;

- to plan land use consistent with the orderly development, use, and conservation of renewable and nonrenewable natural resources;
- to plan for the provision of public facilities and services, including safe and efficient transportation and utility systems, in coordination with local land use policies, goals, and objectives;
- to minimize conflicts among utility corridor needs, competing land uses, and local land use plans;
- to consider the conservation and enhancement of natural resources with the economic benefit of resource development;
- to consider site-specific environmental features (e.g., soil types, wetlands, riparian areas, topography, drainage patterns) as part of land use planning decisions and in the review of development proposals;
- to plan land use in a manner that minimizes environmental pollution and disruption of natural resources;
- to establish more watering systems on all grazing lands for livestock, wildlife, and game/non-game birds;
- to support/encourage multiple-use policy implementation on federal and state lands;
- to ensure the continued availability of outdoor recreational opportunities sought by the public while protecting other resources;
- to prevent resource degradation resulting from recreation and other uses and to provide for the anticipated increase in recreational uses on BLM-administered lands;
- to conserve and develop scenic resources for the benefit of present and future generation; and
- to encourage recreational enterprise while preserving natural values.

Impacts to land use would be significant if project activities precluded other current uses of the JIDPA for the long term, if there would be a reduction in AUMs of a magnitude that would require modification in grazing allotments or other actions that would prevent the realization of grazing management goals, or if project activities resulted in a violation of BLM RMP or other land use plan goals/objectives. Impacts to land use are assumed to be proportional to the amount of new initial and/or LOP disturbance for all alternatives. Impacts would primarily result from surface disturbing activities and/or the presence of oil and gas developments. Impacts to land use, specifically, grazing and recreation would be significant in the short-term under all project alternatives (see Sections 4.5.2 and 4.5.3, respectively).

4.5.1 Status/Ownership

The current JIDPA land uses of livestock grazing (see Section 4.5.2), natural gas production (see Section 4.1.3), wildlife habitat (see Section 4.2.2), and recreation--primarily hunting (see Section 4.5.3)—are anticipated to continue for the LOP under all alternatives. Further development of the JIDPA primarily for natural gas extraction would alter the historic land use pattern for the LOP. There is the potential for some impacts to existing roads on the area if these roads are not adequately upgraded prior to their use for the project. Natural gas recovery would continue to be the dominant use of the JIDPA and would maintain the changed character of the landscape from a relatively undisturbed area (prior to about 1996) to one with industrial development; however, other existing uses are not anticipated to be excluded as defined in Section 103(1) of FLPMA. After the LOP, land use likely would revert back to primarily livestock grazing, wildlife habitat, and recreation under all alternatives.

Ownership of surface and mineral estates in the JIDPA are anticipated to be unchanged under all alternatives; therefore, no significant impacts to land status/ownership are anticipated from the project.

4.5.1.1 No Action Alternative

Under the No Action Alternative, there would be no additional activities that would potentially affect land status or ownership, as previously identified for the area and including oil and gas development on 4,209 acres of new (short-term) and 1,409 acres of LOP (BLM 1998b, 2000b). Natural gas production is currently the dominant use of the JIDPA and would continue to be the dominant use for approximately 63 years.

4.5.1.2 The Proposed Action

Under the Proposed Action, the ownership of surface and mineral estates in the JIDPA are anticipated to be unchanged. There would be increased natural gas development and production operations from that of the No Action Alternative under the Proposed Action; there would be an increase of approximately 16,200 acres of new initial surface disturbance. New and LOP surface disturbance would be 20,409 acres and 6,040 acres, respectively. The duration of the project under the Proposed Action would be approximately 76 years.

4.5.1.3 Alternative A

Implementation of Alternative A would result in the same types of impacts and surface disturbance as the Proposed Action (see Section 4.5.1.2). However, natural gas development would occur in areas that would have been avoided under other action alternatives. Project duration would be dependent upon the rate of development (from 76 to 105 years).

4.5.1.4 Alternative B

Implementation of Alternative B would result in the same types of impacts as the No Action Alternative but would result in an increase of 3,297 acres of new initial surface disturbance from that of the No Action Alternative. Total new and LOP disturbance under Alternative B would be 7,506 acres and 2,622 acres, respectively. Project duration would be dependent upon the rate of development (from 76 to 105 years).

4.5.1.5 Alternative C

Implementation of Alternative C would result in the same types of impacts as the No Action Alternative but would result in an increase of 6,705 acres of new initial surface disturbance from that of the No Action Alternative. Total new and LOP disturbance under Alternative C would be 10,914 acres and 3,399 acres, respectively. Project duration would be dependent upon the rate of development (from 68 to 80 years).

4.5.1.6 Alternative D

Implementation of Alternative D would result in the same types of impacts as the No Action Alternative but would result in an increase of 11,581 acres of new initial surface disturbance from that of the No Action Alternative. Total new and LOP disturbance under Alternative D would be 15,790 acres and 4,755 acres, respectively. Project duration would be dependent upon the rate of development (from 72 to 93 years).

4.5.1.7 Alternative E

Implementation of Alternative E would result in the same types of impacts as the No Action Alternative but would result in an increase of 6,386 acres of new initial surface disturbance from that of the No Action Alternative. Total new and LOP disturbance under Alternative E would be 10,595 acres and 3,597 acres, respectively. Project duration would be dependent upon the rate of development (from 76 to 105 years).

4.5.1.8 Alternative F

Implementation of Alternative F would result in the same types of impacts as the No Action Alternative but would result in an increase of 10,446 acres of new initial surface disturbance from the No Action Alternative. Total new and LOP disturbance under Alternative F would be 14,655 acres and 3,997 acres, respectively. Project duration would be dependent upon the rate of development (from 76 to 105 years).

4.5.1.9 Alternative G

Implementation of Alternative G would result in the same types of impacts as the No Action Alternative but would result in an increase of 13,989 acres of new initial surface disturbance from that of the No Action. Total new and LOP disturbance under Alternative G would be 18,198 acres and 5,408 acres, respectively. Project duration would be dependent upon the rate of development (from 76 to 105 years).

4.5.1.10 BLM Preferred Alternative

Implementation of the Preferred Alternative would result in the same types of impacts as the No Action Alternative but would result in an increase of an estimated 8,316 acres of new initial surface disturbance from that of the No Action Alternative. Total new and LOP disturbance under the Preferred Alternative would be 12,525 acres and 3,847 acres, respectively. Project duration is anticipated to be approximately 76 years.

Under the Preferred Alternative, additional mitigation and monitoring measures would be implemented to ensure achievement of specific management objectives and to minimize

project-related impacts (see Section 2.14). No specific measures are identified for land status/ownership. However, many of the measures identified for other resources (e.g., vegetation, wildlife, livestock, recreation) would mitigate, to some extent, impacts to land status.

4.5.1.11 Cumulative Impacts

The CIAA for land status/ownership is the JIDPA and the leases that extend beyond the project area; therefore, cumulative impacts would be the same as the impacts described for each of the alternatives above. Landownership would not change, and natural gas recovery would continue to be a dominant use but not to the exclusion of other existing uses. After the LOP, land use would revert back to livestock grazing, wildlife habitat, and recreation.

4.5.1.12 Unavoidable Adverse Impacts

There would be no unavoidable adverse impacts to land status/ownership.

4.5.2 Livestock/Grazing Management

Impacts to grazing would be significant if there would be a reduction in AUMs of a magnitude that would require modification in grazing allotments (e.g., changes in ranching operations, livestock trailing, watering, fencing, and feeding), other actions that would prevent the realization of grazing goals, or if project activities resulted in a violation of RMP or other land use plan grazing objectives. Impacts to grazing are assumed to be proportional to the amount of new initial and/or LOP disturbance for all alternatives. Impacts would primarily result from surface disturbing activities and/or the presence of oil and gas developments and associated disturbance to livestock. Significant impacts could occur under any of the project development alternatives if AUM reductions require grazing allotment modifications; this action would be most likely to occur in the Sand Draw and Stud Horse Common Allotments under the Proposed Action and Alternatives A, D, F, and G. Impacts to grazing are anticipated to be significant in the short-term under all alternatives, even with the implementation of identified reclamation practices (see Appendix G) and mitigations (see Appendices A and B).

The principal impact to livestock/grazing management would be the direct impact resulting from the removal of forage due to proposed surface disturbance. Livestock operations (primarily animal movement, forage availability [i.e., AUMs], and distribution) would be significantly adversely affected under each of the development alternatives in the short-term due to the increased number and density of well pads, noise, and other project-related activities. Economic impacts to livestock/grazing management are described in Section 4.4. Short-term removal of vegetative cover would remove rangeland from production until revegetation is successful. Disturbance would be greatest in the Sand Draw allotment and less in each of the remaining three allotments (Table 4.19). The actual loss of production on lands subjected to short-term disturbance would be dependent on the success of reclamation efforts. As with short-term disturbance, LOP disturbance would be greatest in the Sand Draw allotment.

The construction of additional roads and associated reclamation efforts could affect the pattern of livestock forage utilization on the JIDPA and could concentrate animals along roads and on

Table 4.19 Acreage, AUMs, and Percent of AUMs Potentially Affected by Grazing Allotment, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Allotment	Total Acres in Allotment	Total AUMs	Average Federal Acres per AUM	AUMs in JIDPA	Percent of JIDPA Occurring in Allotment	No Action[1]		Proposed Action and Alternative A[2]		Alternative B[3]		Alternative C[4]		Alternative D[5]		Alternative E[6]		Alternative F[7]		Alternative G[8]		Preferred Alternative[9]		RFD[10] (acres)
						New[11]	LOP	New[11]	LOP	New[11]	LOP	New[11]	LOP	New[11]	LOP	New[11]	LOP	New[11]	LOP	New[11]	LOP	New[11]	LOP	
Potentially Affected Acres (Includes Existing Project-required Disturbance)[12, 13]																								
Stud Horse Common	15,590	1,730	8.2	670	18.0	720	243	3,623	1,073	1,300	457	1,914	597	2,791	841	1,856	633	2,587	705	3,225	959	2,203	677	252
Sand Draw	31,740	2,324	13.2	1,571	68.0	2,721	917	13,686	4,052	4,912	1,728	7,229	2,256	10,545	3,178	7,012	2,391	9,773	2,663	12,182	3,622	8,325	2,562	0
Boundary	31,994	2,996	10.0	363	12.0	480	162	2,415	715	867	306	1,276	398	1,861	561	1,237	422	1,725	470	2,150	639	1,469	452	24
Blue Rim Desert	41,273	2,826	14.6	--	0.0	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--	--	120
No Allotment	640	0	--	--	2.0	80	27	403	119	144	51	213	66	310	93	206	70	287	78	358	107	245	75	--
Total	120,597	9,876		2,604	100.0	4,001	1,348	20,126	5,959	7,223	2,541	10,631	3,318	15,507	4,674	10,312	3,516	14,372	3,916	17,915	5,327	12,242	3,766	396
Change from No Action	--	--	--	--	--	--	--	16,125	4,611	3,222	1,193	6,630	1,970	11,506	3,326	6,311	2,168	10,371	2,568	13,914	3,979	8,241	2,418	--
Potentially Affected AUMs (Includes Existing Project-required Disturbance)[14]																								
Stud Horse Common	15,590	1,730	8.2	670	18.0	88	30	442	130	159	56	233	73	340	103	226	77	315	86	393	117	269	83	31
Sand Draw	31,740	2,324	13.2	1,571	68.0	206	70	1,036	307	372	131	548	171	799	241	531	181	740	202	923	274	631	194	0
Boundary	31,994	2,996	10.0	363	12.0	48	16	242	72	87	31	128	40	186	56	124	42	172	47	215	64	147	45	2
Blue Rim Desert	41,273	2,826	14.6	--	0.0	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
No Allotment	640	0	--	--	2.0	--	--	--	--	--		--	--	--	--	--	--	--	--	--	--	--	--	--
Total	120,597	9,876		2,604	100.0	342	116	1,720	509	618	218	909	284	1,325	400	881	300	1,227	335	1,531	455	1,047	322	41
Change from No Action	--	--	--	--	--	--	--	1,378	393	276	102	567	168	983	284	539	184	885	219	1,189	339	705	206	--
Percent of Potentially Affected AUMs Within the JIDPA (Includes Existing Project-required Disturbance)[15]																								
Stud Horse Common	15,590	1,730	8.2	670	18.0	5.1	1.7	25.5	7.5	9.2	3.2	13.5	4.2	19.7	5.9	13.1	4.5	18.2	5.0	22.7	6.8	15.5	4.8	n/a
Sand Draw	31,740	2,324	13.2	1,571	68.0	8.8	3.3	44.6	13.2	16.0	5.6	23.6	7.4	34.4	10.4	22.9	7.8	31.9	8.7	39.7	11.8	27.1	8.3	n/a
Boundary	31,994	2,996	10.0	363	12.0	1.6	0.5	8.1	2.9	2.9	1.0	4.3	1.3	6.2	1.9	4.1	1.4	5.8	1.6	7.2	2.1	4.9	1.5	n/a
Blue Rim Desert	41,273	2,826	14.6	--	0.0	--	--	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	n/a
No Allotment	640	0	--	--	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	n/a
Total[16]	120,597	9,876		2,604	100.0			--																

1 Existing project-required disturbance.
2 Proposed Action and Alternative A assume 20,126 acres of new initial and 6,020 acres of LOP disturbance in the JIDPA.
3 Alternative B assumes 7,223 acres of new initial and 2,541 acres LOP disturbance in the JIDPA.
4 Alternative C assumes 10,631 acres of new initial and 3,318 acres of LOP disturbance in the JIDPA.
5 Alternative D assumes 15,507 acres of new initial and 4,674 acres of LOP disturbance in the JIDPA.
6 Alternative E assumes 10,312 acres of new initial and 3,516acres of LOP disturbance in the JIDPA.
7 Alternative F assumes 14,372 acres of new initial and 3,916 acres of LOP disturbance in the JIDPA.
8 Alternative G assumes 17,915 acres of new initial and 5,327 acres of LOP disturbance in the JIDPA.
9 Preferred Alternative assumes 12,242 acres of new initial and 3,766 acres of LOP disturbance in the JIDPA.
10 RFD = reasonable foreseeable development; n/a = not applicable.
11 Excludes 283 acres of new initial and 81 acres of LOP disturbance associated with selected ancillary facilities which may be constructed outside the JIDPA.
12 Excludes 208 acres (short-term) and 61 acres LOP disturbance outside JIDPA.
13 Assumes percent JIDPA occurring in each allotment multiplied by proposed new initial and LOP disturbance.
14 Assumes number of potentially affected acres divided by average federal acres/AUM.
15 Assumes number of potentially affected AUMs divided by total number of AUMs permitted in each allotment multiplied by 100.
16 Percentages are not additive.

reclaimed areas, thus increasing the chances of vehicle/livestock collisions. Construction and drilling activities could contribute to livestock movement off uplands and concentration in lowlands and reclamation areas. Proposed increased road/well densities would cause an increase in the amount of fugitive dust and its accumulation on forage and in the air, thereby increasing the potential for "dust pneumonia" in cattle. Project hazards to livestock in addition to increased traffic include pipeline trenches and unprotected water sources, and potential impacts from these hazards would increase proportionally to the number of new developments under all project alternatives.

4.5.2.1 No Action Alternative

Under the No Action Alternative, there would be no additional impacts to livestock/grazing management other than those already approved for the area, which include 4,001 acres of new initial and 1,348 acres of LOP disturbance (excludes minor disturbances outside the JIDPA) in the JIDPA (see Table 4.58) (BLM 1998b, 2000b). An estimated 342 AUMs initially and 116 AUMs for the LOP would be affected under the No Action Alternative. Project duration is anticipated to be approximately 63 years and until areas are adequately reclaimed.

4.5.2.2 The Proposed Action

The JIDPA contains a total of approximately 2,604 AUMs or 26% of the total 9,876 permitted AUMs distributed among three grazing allotments. Under the Proposed Action, LOP AUM loss would increase from the No Action Alternative by approximately 393 AUMs. Some additional minor and unquantified AUM loss would occur to the Blue Rim Desert allotment, primarily associated with the Burma Road upgrade. Implementation of the Proposed Action would affect a total of approximately 1,720 AUMs in the short term and 509 AUMs for the LOP (see Table 4.19). Under the Proposed Action, approximately 70% (1,204 AUMs) of all disturbance would be reclaimed as soon as practical after disturbance and reclamation on these areas would likely provide forage within an estimated 5 to 10 years after disturbance; therefore, all 1,720 AUMs would not be out of production at any one time. AUM losses would accumulate as development occurs for approximately 12 years but would occur for the entire 76-year LOP and until areas are adequately reclaimed. LOP losses are those associated with disturbances that would not be reclaimed until project abandonment.

4.5.2.3 Alternative A

Implementation of Alternative A would result in the same types and acreage of impacts as the Proposed Action (see Section 4.5.2.2). However, under this alternative, selected Operator-committed and BLM-required practices (i.e., avoidance of selected area buffers) would not be implemented. Therefore, impacts to forage resources in these areas (most notably along Sand Draw and other drainage channels) would be greater than that of other project alternatives. The duration of surface disturbance and hence forage loss would depend on the rate of development and the rate of reclamation; losses would accumulate during development (13 to 42 years) and would continue for the LOP (76 to 105 years).

4.5.2.4 Alternative B

Implementation of Alternative B would result in the same types of impacts as the No Action Alternative; however, LOP forage loss would increase by approximately 102 AUMs (see Table 4.19). Implementation of Alternative B would affect approximately 618 AUMs in the short

term and 218 AUMs for the LOP. Under Alternative B, approximately 65% (400 AUMs) of all disturbance would be reclaimed as soon as practical after disturbance; therefore, all 618 AUMs would not be out of production at the same time. AUM losses would accumulate as development occurs (13 to 42 years) but would also occur for the LOP (76 to 105 years) and until areas are adequately reclaimed.

4.5.2.5 Alternative C

Implementation of Alternative C would result in the same types of impacts as the No Action Alternative, however, LOP forage loss would increase by approximately 168 AUMs (see Table 4.19). Implementation of Alternative C would affect a total of approximately 909 AUMs in the short term and 284 AUMs for the LOP. Under Alternative C, approximately 69% (625 AUMs) of all disturbance would be reclaimed as soon as practical after disturbance; therefore, all 909 AUMs would not be out of production at the same time. AUM loss would accumulate as development occurs (5 to 17 years) but would also occur for the LOP (68 to 80 years) and until areas are adequately reclaimed.

4.5.2.6 Alternative D

Implementation of Alternative D would result in the same types of impacts as the No Action Alternative; however, LOP forage loss would increase by approximately 284 AUMs (see Table 4.19). Implementation of Alternative D would affect a total of approximately 1,325 AUMs in the short term and 400 AUMs for the LOP. Under Alternative D, approximately 70% (925 AUMs) of all disturbance would be reclaimed as soon as practical after disturbance; therefore, all 1,325 AUMs would not be out of production at the same time. AUM loss would accumulate as development occurs (9 to 30 years) but would also occur for the LOP (72 to 93 years) and until areas are adequately reclaimed.

4.5.2.7 Alternative E

Implementation of Alternative E would result in the same types of impacts as the No Alternative; however, LOP forage loss would increase by approximately 184 AUMs (see Table 4.19). Implementation of Alternative E would affect a total of approximately 881 AUMs in the short term and 300 AUMs for the LOP. Under Alternative E, approximately 66% (581 AUMs) of all disturbance would be reclaimed as soon as practical after disturbance; therefore, all 881 AUMs would not be out of production at the same time. AUM loss would accumulate as development occurs (13 to 42 years) but would also occur for the LOP (76 to 105 years) and until areas are adequately reclaimed.

4.5.2.8 Alternative F

Implementation of Alternative F would result in the same types of impacts as the No Action Alternative; however, LOP forage loss would increase by approximately 219 AUMs (see Table 4.19). Implementation of Alternative F would affect a total of approximately 1,227 AUMs in the short term and 335 AUMs for the LOP. Under Alternative F, approximately 73% (892 AUMs) of disturbance would be reclaimed as soon as practical after disturbance; therefore, all 1,227 AUMs would not be out of production at the same time. AUM loss would accumulate as development occurs (13 to 42 years) but would also occur for the LOP (76 to 105 years) and until areas are adequately reclaimed.

4.5.2.9 Alternative G

Implementation of Alternative G would result in the same types of impacts as the No Action Alternative; however, LOP forage loss would increase by approximately 339 AUMs (see Table 4.19). Implementation of Alternative G would affect a total of approximately 1,531 AUMs in the short term and 455 AUMs for the LOP. Under Alternative G, approximately 71% (1,076 AUMs) of disturbance loss would be reclaimed as soon as practical after disturbance; therefore, all 1,531 AUMs would not be out of production at the same time. AUM loss would accumulate as development occurs (13 to 42 years) but would also occur for the LOP (76 to 105 years) and until areas are adequately reclaimed.

4.5.2.10 BLM Preferred Alternative

Implementation of the Preferred Alternative would result in the same types of impacts as the No Action Alternative, however, LOP forage loss would increase by approximately 206 AUMs (see Table 4.58). Implementation of the Preferred Alternative would affect approximately 1,047 AUMs in the short term and 322 AUMs for the LOP. Under the Preferred Alternative, approximately 69% (722 AUMs) of disturbance would be reclaimed as soon as practical after disturbance; therefore, all 1,047 AUMs would not be out of production at the same time. AUM loss would accumulate as development occurs (13 to 42 years) but would also occur for the LOP (76 to 105 years) and until areas are adequately reclaimed.

Under the Preferred Alternative, additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14). Any measure that reduces the volume of surface disturbance has the potential to reduce impacts to livestock grazing.

4.5.2.11 Cumulative Impacts

The CIAA for livestock/grazing includes all of the four grazing allotments (Stud Horse Common, Sand Draw, Blue Rim Desert, and Boundary) that may be affected by the proposed development. These four allotments cover 120,597 acres and contain a total of 9,876 AUMs (see Table 4.19). RFD surface disturbance in these allotments is estimated to be approximately 396 acres (46 AUMs) in the long term and would be associated with development for the Pinedale Anticline Project. Therefore, maximum cumulative short-term impact (i.e., the combined existing, proposed, and RFD disturbance) would result in the loss of approximately 1,766 AUMs or 17.9% of the combined allotments. Maximum long-term cumulative AUM loss within all allotments is estimated to be less than 550 AUMs. Cumulative impacts to livestock/grazing across alternatives would be proportional to the extent of surface disturbance and development features/human activity.

4.5.2.12 Unavoidable Adverse Impacts

The project would result in the temporary and potentially long-term loss of livestock forage and available AUMs.

4.5.3 Recreation

Impacts to recreation would be considered significant if project development changes the recreational use of the JIDPA or would result in a violation of BLM RMP or other land use plan

recreation objectives. Impacts to recreation are assumed to be proportional to the amount of development for all alternatives. Dispersed recreation opportunities would be lost from the JIDPA for the LOP under all project alternatives including the No Action Alternative, resulting in significant impacts for the LOP under all alternatives.

No developed recreation sites or facilities are present in or immediately adjacent to the JIDPA; therefore, no significant impacts to sites or facilities are anticipated. Project-improved roads may promote some increased recreational use (e.g., driving for pleasure, sightseeing, desire to view a natural gas field). However, long-term displacement or elimination of existing dispersed recreation due to increased levels of gas field development activity is anticipated. In addition, some potential recreational visitors would likely avoid the JIDPA because of a perceived reduction in the quality of the recreational experience.

Outdoor recreation is important both in terms of the satisfaction it provides residents of the region and for the activity it generates in the region's economy as a result of expenditures by nonresident visitors; the economic impacts associated with project-affected recreation are described in Section 4.4. Hunting pressure for any species on the JIDPA is likely to be directly related to wildlife population size, structure, and availability. Under all alternatives, populations of pronghorn and greater sage-grouse, which are the two primary hunted species on the JIDPA, would likely be displaced to such an extent that recreational hunting on the JIDPA may no longer occur (see also Section 4.2.2). However, lands adjacent to the JIDPA could, and likely would, absorb displaced hunting pressure since displaced wildlife would in part also likely move to adjacent lands. It is anticipated that not all wildlife would move to alternate locations, and that their breeding, nesting, brood-rearing, and foraging opportunities would in part be jeopardized; therefore, the wildlife populations currently found on the JIDPA are anticipated to decline. This would result in the loss of potential recreational opportunities associated with wildlife (e.g., hunting, wildlife viewing and photography, etc.), and associated recreational opportunities and revenues from these activities would also be lost.

4.5.3.1 No Action Alternative

Under the No Action Alternative, there would be no additional impacts to recreation other than those which have occurred as a result of approved development in the Jonah Field (i.e., loss of dispersed recreation and hunting for the 63-year LOP and until areas are adequately reclaimed). Past NEPA documents concluded that there would be no significant adverse impacts to recreation as a result of the project (BLM 1998b, 2000b).

4.5.3.2 The Proposed Action

Under the Proposed Action, impacts to recreational opportunities are anticipated to increase from levels under the No Action Alternative as 3,100 new well pads and associated roads would be constructed. Duration of impacts would be for the 76-year LOP and until areas are adequately reclaimed.

4.5.3.3 Alternative A

Impacts to recreation under Alternative A would be the same as those of the Proposed Action. However, under this alternative, selected Operator-committed and BLM-required area-avoidance practices would not be implemented; therefore, increased impacts to greater sage-grouse, raptors,

and other wildlife are anticipated due to disturbance in habitat buffers, this would likely result in decreased wildlife populations and subsequent reductions in hunting and wildlife viewing opportunities. Duration of impacts would be for the LOP and until areas are adequately reclaimed (i.e., from 76 to 105 years).

4.5.3.4 Alternative B

Implementation of Alternative B would result in the same types of impacts to recreation as No Action but would likely occur at increased levels due to expanded development. Impacts would likely be reduced from those of the Proposed Action due to the absence of disturbance in portions of the JIDPA. Duration of impacts would be for the LOP and until areas are adequately reclaimed (i.e., 76 to 105 years).

4.5.3.5 Alternative C

Implementation of Alternative C would result in the same types of impacts to recreation as the No Action Alternative but impacts would be increased as more well pads and roads would be constructed. However, Alternative C provides for fewer areas of surface disturbance than the Proposed Action, Alternatives D, E, F, G, and the Preferred Alternative, and this decreased disturbance would likely result in reduced impact levels, including human presence, traffic, and noise. Duration of impacts would be for the LOP and until areas are adequately reclaimed (i.e., 68 to 80 years).

4.5.3.6 Alternative D

Implementation of Alternative D would result in the same types of impacts to recreation as the No Action Alternative but impacts would be increased as more well pads and roads would be constructed. However, Alternative D provides for fewer areas of surface disturbance than the Proposed Action, Alternative G, and the Preferred Alternative, and this decreased disturbance would likely result in reduced impact levels, including human presence, traffic, and noise. Duration of impacts would be for the LOP and until areas are adequately reclaimed (i.e., 72 to 93 years).

4.5.3.7 Alternatives E, F, and G

Alternative E (16 total pads/section), Alternative F (32 total pads/section), and Alternative G (64 total pads/section) would produce the same types of impacts as the No Action Alternative, and it is assumed that impacts to recreation would likely be proportional to the different volumes and densities of surface disturbance (as well as other disturbances [e.g., human presence, noise, traffic, dust]). Given that any increased level of project-related human presence or disturbance has the potential to adversely affect the perceived quality of the recreational experience, then it follows that the greater the disturbance, the greater the likelihood that recreational opportunities would be negatively impacted. Duration of impacts would be for the LOP and until areas are adequately reclaimed (i.e., 76 to 105 years).

4.5.3.8 BLM Preferred Alternative

Under the Preferred Alternative impacts to recreational opportunities are anticipated to be of the same type as all other alternatives and would be increased from levels under the No Action

Alternative as additional development would occur. Duration of impacts would be for the LOP and until areas are adequately reclaimed.

While no recreation-specific mitigations for reducing impacts to recreation are proposed under the Preferred Alternative, any measure that reduces the volume of surface disturbance and human presence as well as those measures that minimize adverse effects to wildlife has the potential to reduce impacts to recreation (see Section 2.14).

4.5.3.9 Cumulative Impacts

The CIAA for recreation is shown on Map 3.23. Existing disturbance in the CIAA is 84,352 acres, and RFD surface disturbance includes 7,014 acres primarily associated with natural gas development. The extent of development throughout the CIAA has and will continue to result in displaced recreational use from the area.

Maximum cumulative disturbance (i.e., the combined alternative-specific and RFD disturbance) in the recreation CIAA for all alternatives is presented in (Table 4.20). Cumulative impacts to recreation are anticipated to be similar under all development alternatives.

Since it is assumed that the majority of workers employed for this project would be hired from the local workforce, there would be little increase in local populations and subsequent demand for recreation associated specifically with this project. However, regional populations are increasing in part from natural gas development projects, and this increase is creating an additional demand for recreation facilities and public access areas. Within the CIAA, traditional dispersed recreation has been and will continue to be directed away from areas with increased road and well development for the long term due to a reduction in the quality of the recreational experience on the part of some users. Some individuals may no longer recreate in the area at all. Current users of recipient areas may be adversely affected by increased use, over-crowding, and/or a feeling that the quality of the recreation experience of solitude has been decreased.

It is anticipated that the upgraded conditions on the Burma and Luman Roads would be retained after project completion allowing for increased recreational use of the area. This additional non-paved road development for oil and gas projects opens new areas for recreational use and raises the awareness of the recreational opportunity in these newly open areas for nontraditional use and new users. This new access and increased awareness of opportunities could encourage existing and new recreational use of previously primitive or semi-primitive areas, displacing those traditional recreational users with more new users and different uses (i.e., OHV) that may put new stresses on resources in these areas.

4.5.3.10 Unavoidable Adverse Impacts

Some level of unavoidable adverse impact to recreation is anticipated under all alternatives due to the likely avoidance of the JIDPA by recreational visitors.

4.5.4 Transportation

Impacts due to traffic volume would be considered significant if the proposed project resulted in the inability of the BLM, the State of Wyoming, and/or Sublette County to achieve land use planning objectives for transportation. Since the design of new and upgraded roads in the JIDPA would be in compliance with the BLM road standard guidelines (BLM 1985, 1991a), the

Table 4.20 Cumulative Acreage of Disturbance in the Recreation CIAA, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Cumulative Impact Analysis Area (CIAA)	Total Acreage of CIAA	Existing Disturbance In CIAA, Outside JIDPA	RFD	Disturbance					
				No Action			Proposed Action and Alternative A		
				New	LOP	Cumulative[1]	New	LOP	Cumulative[1]
Recreation	1,557,558	84,352	7,014	4,209	1,409	95,575	20,409	6,040	111,775
Percent of entire CIAA									7.2

Cumulative Impact Analysis Area (CIAA)	Disturbance											
	Alternative B			Alternative C			Alternative D			Alternative E		
	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]
Recreation	7,390	2,561	98,756	10,914	3,399	102,280	15,790	4,755	107,156	10,595	3,597	101,961
Percent of entire CIAA			6.3			6.6			6.9			

Cumulative Impact Analysis Area (CIAA)	Disturbance								
	Alternative F			Alternative G			Preferred Alternative		
	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]
Recreation	14,655	3,997	106,021	18,198	5,408	109,564	12,525	3,847	103,891
Percent of entire CIAA			6.8						6.7

[1] Cumulative disturbance = new + existing + RFD.

Transportation Plan for this project (Appendix G), individually approved APD and ROW road specifications, and continued Sublette County and WDOT consultation would occur, no significant transportation impacts are anticipated under any alternative. Furthermore, the project would be implemented with mitigation as identified in Appendices A and B. Further detail on transportation planning and effects is provided in the project Transportation Plan (Appendix G).

From 199 to 672 miles of new roads would be required for this project (Table 4.21). Impacts to existing, upgraded, and newly constructed roads could result from inadequate road maintenance resulting in road failure. While maintenance agreements would be established by Operators, adverse weather conditions coupled with increased traffic may result in roads being temporally impassable (i.e., stuck vehicles, vehicles driving off roads). Increased traffic volumes are anticipated under all Alternatives except the No Action Alternative. For the LOP and especially during development, traffic increases may cause congestion and road damage and an increased potential for vehicle collisions.

For impact analysis, it is assumed that transportation impacts would be greatest during development and would be proportional to the rate of development (i.e., the faster the development pace, the greater the impact to transportation).

4.5.4.1 No Action Alternative

The current estimate of existing and/or proposed in the JIDPA is approximately 199 miles (see Table 4.21). Under No Action, transportation impacts would continue at existing approved levels, the Burma Road would not be upgraded, and the duration of impacts would be approximately 63 years. A total of approximately 1,063,900 round trips, which could occur to and from any location in the JIDPA, or approximately 73 round trips per day is anticipated under the No Action Alternative for the LOP (Appendix G). Prior decisions found that the existing Jonah Field developments would be unlikely to have significant transportation impacts (BLM 1998b, 2000b).

4.5.4.2 The Proposed Action

Under the Proposed Action, approximately 664 miles of resource roads, 8 miles of new collector/local roads, and 12 miles of Burma Road improvement would be required for field development (see Table 4.21). A total of approximately 8,698,600 round trips or approximately 496 round trips per day is anticipated under the Proposed Action for the LOP (Appendix G). This is an increase of 473 new miles of road and 7,634,700 round trips when compared to the No Action Alternative. The length of the Proposed Action and therefore increased traffic volumes is estimated to be 76 years.

4.5.4.3 Alternative A

Under Alternative A, impacts would be the same as for the Proposed Action Alternative; however, some new roads would be built in areas that would be avoided under other project alternatives, and the duration of impacts could be extended by an additional 29 years (at a development rate of 75 wells/year) beyond the Proposed Action Alternative depending upon the rate of development.

Table 4.21 Miles of New Roads, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Alternative	Miles of New Resource Roads[1]	Miles of New In-Field Collector Roads	Miles of Burma Road Upgrade
No Action Alternative[1]	199	0	0
Proposed Action[2]	664	8	12
Alternative A[2]	664	8	12
Alternative B[1]	199	0	12
Alternative C[2]	387	8	12
Alternative D[2]	529	8	12
Alternative E[2]	239	8	12
Alternative F[2]	353	8	12
Alternative G[2]	652	8	12
Preferred Alternative[2,3]	353	8	12

[1] Based on 0.4 mile per well pad.
[2] Based on 0.15 mile per well pad and includes existing (No Action) road miles.
[3] Assumed to be similar to Alternative F.

4.5.4.4 Alternative B

Under Alternative B, impacts would be similar to the No Action Alternative in that no new well pads or roads would be built (see Table 4.21). Impacts would increase from the No Action Alternative due to new development and would increase from the Proposed Action during development due to the increased time necessary to drill the additional directional wells; however, during production, impacts would be decreased from the Proposed Action and all other development alternatives since traffic would occur only to the existing pads. The Burma Road would be upgraded. A total of approximately 8,202,300 round trips or approximately 468 round trips per day is anticipated under Alternative B for the LOP (Appendix G). This is an increase of 7,138,400 round trips when compared to the No Action Alternative. Duration of impacts would be from 76 (250 wells/year) to 105 years (75 wells/year), depending upon the rate of development.

4.5.4.5 Alternative C

Under Alternative C, impacts would be increased from the No Action Alternative due to the increase in the number of new well pads and access roads. Approximately 387 total miles of resource roads, 8 miles of new in-field collector roads, and 12 miles of Burma Road improvement would be developed (see Table 4.21). A total of approximately 3,507,600 round trips or approximately 200 round trips per day is anticipated under Alternative C for the LOP (Appendix G). This is an increase of 196 new miles of road and 2,443,700 round trips when compared to the No Action Alternative. Duration of impacts could be from 68 years (250 wells/year) to 80 years (75 wells/year), depending upon the rate of development.

4.5.4.6 Alternative D

Under Alternative D, impacts would be increased from the No Action Alternative due to the increase in the number of new well pads and access roads. Approximately 529 total miles of resource roads, 8 miles of new in-field collector roads, and 12 miles of Burma Road improvement would be developed (see Table 4.21). A total of approximately 6,232,600 round trips or approximately 356 round trips per day is anticipated under Alternative D for the LOP (Appendix G). This is an increase of 338 new miles of road and 5,168,700 round trips when compared to the No Action Alternative. Duration of impacts could be from 72 years (250 wells/year) to 93 years (75 wells/year), depending upon the rate of development.

4.5.4.7 Alternative E

Under Alternative E, impacts would be increased from the No Action Alternative due to the increase in the number of new well pads and access roads. Approximately 239 total miles of resource roads, 8 miles of new in-field collector roads, and 12 miles of Burma Road improvement would be developed (see Table 4.21). A total of approximately 8,342,500 round trips or approximately 476 round trips per day is anticipated under Alternative E for the LOP (Appendix G). This is an increase of 48 new miles of road and 7,278,600 round trips when compared to the No Action Alternative. Duration of impacts could be from 76 years (250 wells/year) to 105 years (75 wells/year), depending upon the rate of development.

4.5.4.8 Alternative F

Under Alternative F, impacts would be increased from the No Action Alternative due to the increase in the number of new well pads and access roads. Approximately 353 total miles of resource roads, 8 miles of new in-field collector roads, and 12 miles of Burma Road improvement would be developed (see Table 4.21). A total of approximately 8,744,000 round trips or approximately 499 round trips per day is anticipated under Alternative F for the LOP (Appendix G). This is an increase of 162 new miles of road and 7,680,100 round trips when compared to the No Action Alternative. Duration of impacts could be from 76 years (250 wells/year) to 105 years (75 wells/year), depending upon the rate of development.

4.5.4.9 Alternative G

Under Alternative G, impacts would be increased from the No Action Alternative due to the increase in the number of new well pads and access roads. Approximately 652 total miles of resource roads, 8 miles of in-field collector roads, and 12 miles of Burma Road improvement would be developed (see Table 4.21). A total of approximately 8,691,600 round trips or approximately 496 round trips per day is anticipated under Alternative G (Appendix G). This is an increase of 461 new miles of road and 7,627,700 round trips when compared to the No Action Alternative. Duration of impacts could be from 76 years (250 wells/year) to 105 years (75 wells/year), depending upon the rate of development.

4.5.4.10 BLM Preferred Alternative

Under the Preferred Alternative, impacts would be increased from the No Action Alternative due to the increase in the number of new well pads and access roads. Approximately 353 miles of resource roads, 8 miles of new collector/local roads, and 12 miles of Burma Road improvement would be required for field development (see Table 4.21). A total of approximately 8,744,600

round trips or approximately 499 round trips per day is anticipated under the Preferred Action for the LOP. This is an increase of 162 new miles of road and 7,680,100 round trips when compared to the No Action Alternative. Duration of impacts could be from 76 years (250 wells/year) to 105 years (75 wells/year) depending upon the rate of development.

Under the Preferred Alternative additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14). Any measure that reduces the volume of human presence or centralizes development actions has the potential to reduce impacts to transportation. Furthermore, those measures associated with the JIWG also could reduce impacts to transportation through appropriate planning.

4.5.4.11 Cumulative Impacts

Cumulative impacts from traffic resulting from the project in combination with other regional projects and overall regional growth could be significant. The project would be the major contributor to increased traffic on secondary roads within the JIDPA. Field development would result in increased traffic volumes on major highways (especially on U.S. Highway 191, a major tourist corridor) and on county and local roads. Increased traffic would result in an increased potential for public traffic hazards and other safety and road maintenance concerns. However, the magnitude of the increase would depend on alternative-specific development levels and development rates (i.e., 75, 150, or 250 new wells developed per year). Existing major highways and county roads are adequate to handle anticipated increased traffic (Appendix G). The costs of maintaining county and local roads would be borne, to some extent, by Operators primarily through tax payments. Cumulative impacts on transportation are anticipated to be slightly beneficial for the long term as an increase in available roads, improved road conditions, and increased revenues for state-sponsored road improvements occur. It is anticipated that the upgraded conditions on the Burma and Luman Roads would be retained after project completion allowing for increased recreational use of the area under all alternatives.

4.5.4.12 Unavoidable Adverse Impacts

Unavoidable adverse impacts to transportation would occur for the LOP primarily as a result of increased traffic and the expanded road network.

4.6 VISUAL RESOURCES

The BLM PFO and RSFO RMP RODs (BLM 1988b,1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with visual resources:

- to maintain or improve scenic values and visual quality and to establish priorities for managing the visual resources in conjunction with other resource values; and
- to conserve and develop scenic resources for the benefit of present and future generations.

The BLM defines a significant impact to visual resources, on federal lands and minerals, as project-related development that would not meet VRM class objectives for an area. A significant impact would occur if oil and gas development becomes the dominant feature in the landscape

where the objectives for that land are to maintain the existing character of the landscape. Impacts to visual resources are assumed to be proportional to the amount of new initial and LOP development. A significant impact to the visual resources on non-federal lands and minerals is also defined as 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. Due to the presence of natural gas development as a dominant visual feature throughout the JIDPA, as well as project effects such as haze, nighttime lighting, increased traffic, and short-term visible smoke plume events, significant visual resource impacts are anticipated under all alternatives for the LOP and until areas are adequately reclaimed. These significant visual resource impacts would not occur within the JIDPA specifically since the entire JIDPA is considered a Class IV VRM area and the project under all alternatives is generally consistent with Class IV objectives, but would occur at locations where the JIDPA and/or project effects (e.g., light sources, haze, smoke plumes) are visible. These non-JIDPA areas include VRM Class II and III areas, sections of U.S. Highway 191, and other locations including wilderness and wilderness study areas.

4.6.1 No Action Alternative

Under the No Action Alternative, there would be no new impacts to visual resources beyond those already approved for Jonah Field developments. The duration of impacts would be approximately 63 years and until areas are adequately reclaimed. While past NEPA decisions for the project identified no significant impacts to visual resources (BLM 1998b, 2000b), significant visual resource impacts from the existing developments have since been identified as described above.

4.6.2 The Proposed Action

Implementation of the Proposed Action would result in a continuation of the existing long-term visual characteristics of the JIDPA as a developed natural gas field with increased impacts to visual resources from that of the No Action Alternative due to increased development and prolonged development life. Increased natural gas field developments would include greater well pad densities, more miles of roads and associated traffic, and more ancillary facilities. Impact duration is anticipated to be approximately 76 years and until areas are adequately reclaimed.

4.6.3 Alternative A

Implementation of Alternative A would result in the same types and volumes of visual resource impacts as the Proposed Action; however, there would be increased visual resource impacts in the resource buffer areas that would have otherwise been avoided under the other project alternatives. Duration of impacts would be dependent upon the rate of development plus the time needed for adequate reclamation (i.e., from 76 to 105 years).

4.6.4 Alternative B

Implementation of Alternative B would result in the same types of impacts as No Action but would be increased due to expanded development. Impacts would be reduced from the other project alternatives since no new well pads or roads would be built. Duration of impacts would be dependent upon the rate of development plus the time needed for adequate reclamation (i.e., from 76 to 105 years).

4.6.5 Alternative C

Implementation of Alternative C would result in the same types of visual resource impacts as No Action, but impacts would be increased since more well pads and roads would be constructed. Reductions in visual resource impacts from those of the Proposed Action are anticipated as development would be concentrated on fewer well pads. Duration of impacts would be dependent upon the rate of development plus the time needed for adequate reclamation (i.e., from 68 to 80 years).

4.6.6 Alternative D

Implementation of Alternative D would result in the same types of visual resource impacts as No Action, but impacts would be increased since more well pads and roads would be constructed. Reductions in visual resource impacts from those of the Proposed Action are anticipated as development would be concentrated on fewer well pads. Duration of impacts would be dependent upon the rate of development plus the time needed for adequate reclamation (i.e., from 72 to 93 years).

4.6.7 Alternative E

Implementation of Alternative E would result in the same types of visual resource impacts as No Action, but impacts would be increased since more well pads and roads would be constructed. Reductions in visual resource impacts from those of the Proposed Action (3,100 wells/pads) are anticipated as development would be concentrated on fewer well pads. Duration of impacts would be dependent upon the rate of development plus the time needed for adequate reclamation (i.e., from 76 to 105 years).

4.6.8 Alternative F

Implementation of Alternative F would result in the same types of visual resource impacts as No Action, but impacts would be increased since more well pads and roads would be constructed. Under this alternative, visual resource impacts are anticipated to be similar to those of the Proposed Action but reduced since the 3,100 proposed wells would be concentrated on only 1,028 well pads. Duration of impacts would be dependent upon the rate of development plus the time needed for adequate reclamation (i.e., from 76 to 105 years).

4.6.9 Alternative G

Implementation of Alternative G (64 total pads/section) would result in the same types of visual resource impacts as No Action, but impacts would be increased since more well pads and roads would be constructed. Under this alternative, visual resource impacts are anticipated to be similar to those of the Proposed Action but reduced since the 3,100 proposed wells would be concentrated on only 2,553 well pads. Duration of impacts would be dependent upon the rate of development plus the time needed for adequate reclamation (i.e., from 76 to 105 years).

4.6.10 BLM Preferred Alternative

Implementation of the Preferred Alternative would result in the same types of visual resource impacts as No Action, but impacts would be increased since more well pads and roads would be

constructed. Under this alternative, visual resource impacts are anticipated to be similar to those of the Proposed Action (3,100 wells/pads), but slightly less as the Operators would implement unique development procedures and additional mitigation requirements. Duration of impacts would be approximately 76 years.

Under the Preferred Alternative, additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14). Any measure that reduces regional haze or smoke plumes, the volume of surface disturbance, human presence, and/or traffic, as well as those measures that minimize adverse effects vegetation or facilitate enhanced reclamation have the potential to reduce impacts to visual resource.

4.6.11 Cumulative Impacts

Total surface disturbance resulting from the Proposed Action and Alternative A would be 20,409 acres (the most disturbance of all potential alternatives), all of which would occur on areas designated as VRM Class IV. RFD (disturbance) in the visual resource CIAA (see Map 3.24) includes 7,302 acres of existing disturbance primarily from natural gas developments in the Jonah, Pinedale Anticline, Fontenelle, Moxa, and Stagecoach Draw project areas (Table 4.22). Maximum cumulative disturbance for the visual resources CIAA (i.e., the combined existing, proposed [Proposed Action and Alternative A], and RFD disturbance) is 166,452 acres, or 8.0% of the CIAA.

Most of the visual resource CIAA is designated as VRM Class IV (see Map 3.24). Class IV areas allow for management activities that require major modifications to the existing character of the landscape. Although the activities may dominate the view of the casual observer and the relative change to the landscape may be high, all management activities must be conducted to minimize the impact to the visual quality of the area. Under all project alternatives, the JIDPA and its incumbent developments coupled with other regional developments are visible and may dominate the viewscape from VRM Class II and III areas, some sections of U.S. Highway 191, and nearby wilderness and wilderness study areas within the CIAA; therefore, significant cumulative impacts to regional visual resources would occur at these sites.

4.6.12 Unavoidable Adverse Impacts

The expansion of gas development facilities, and various development effects (e.g., haze, smoke plumes, nighttime lighting effects on regional star-gazing) and associated roads would be an unavoidable adverse impact to visual resources on the JIDPA and at locations where it is visible outside the JIDPA. This impact would occur throughout the LOP and for some additional time necessary for reclaimed areas to acquire predisturbance visual characteristics.

4.7 HAZARDOUS MATERIALS

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with hazardous materials:

- to protect public and environmental health and safety on BLM-administered public lands;

Table 4.22 Cumulative Acreage of Disturbance in the Visual Resources CIAA, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Cumulative Impact Analysis Area (CIAA)	Total Acreage of CIAA	Existing Disturbance In CIAA, Outside JIDPA	RFD	Disturbance					
				No Action			Proposed Action and Alternative A		
				New	LOP	Cumulative[1]	New	LOP	Cumulative[1]
Visual Resources	2,089,363	138,740	7,302	4,209	1,409	150,252	20,409	6,040	166,452
Percent of entire CIAA									8.0

Cumulative Impact Analysis Area (CIAA)	Disturbance											
	Alternative B			Alternative C			Alternative D			Alternative E		
	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]
Visual Resources	7,390	2,561	153,433	10,914	3,399	156,957	15,790	4,755	161,833	10,595	3,597	157,002
Percent of entire CIAA			7.3			7.5			7.8			

Cumulative Impact Analysis Area (CIAA)	Disturbance								
	Alternative F			Alternative G			Preferred Alternative		
	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]	New	LOP	Cumulative[1]
Visual Resources	14,655	3,997	160,698	18,198	5,408	164,241	12,525	3,847	158,567
Percent of entire CIAA			7.7						7.6

[1] Cumulative disturbance = new + existing + RFD.

- to comply with applicable federal and state laws;
- to prevent waste contamination due to any BLM-authorized action;
- to minimize federal exposure to the liabilities associated with waste management on public lands; and
- to integrate hazardous materials and waste management policies and controls into all BLM programs.

Impacts associated with hazardous materials would be considered significant if project activities resulted in violations of the aforementioned goals/objectives and/or local, state, and federal laws. Impacts to soils, surface and ground water resources, and wildlife could result from accidental hazardous materials spills, pipeline ruptures, and/or exposure to hazardous materials. It is likely that only small amounts of soil potentially would be contaminated and, should this occur, the affected area would be cleaned up in an appropriate and timely manner (Appendix G). 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 (all but Alternative A) would prevent potential surface and ground water contamination. Project operations would comply with all relevant federal and state laws regarding hazardous materials and with directives identified in the Hazardous Materials Summary for this project (Appendix G) and existing SPCCPs.

With the implementation of the aforementioned procedures plus the additional mitigations and practices identified in Appendices A, B, and G, no significant impacts are anticipated under any project alternative.

4.7.1 No Action Alternative

Under the No Action Alternative, there would be no new developments and associated opportunities for material spills, pipeline ruptures, and/or exposure to hazardous materials above present levels and as previously approved for the JIDPA. Prior NEPA documents concluded that there would be no significant adverse impacts involving hazardous materials (BLM 1998b, 2000b). The duration for potential impacts would be for the LOP which is anticipated to be approximately 63 years and until all potentially contaminated sites are remediated.

4.7.2 The Proposed Action

Under the Proposed Action Alternative there would be an approximate six-fold increase (from 533 approved wells to 3,100 new wells) in the potential for material spills, pipeline ruptures, and/or exposure to hazardous materials above current approved levels. The duration for potential impacts would be for the LOP which is anticipated to be approximately 76 years and until all potentially contaminated sites are remediated.

4.7.3 Alternative A

Implementation of Alternative A would have the same potential for hazardous material impacts as the Proposed Action Alternative. However, potential impacts to wildlife and surface waters would be increased in some areas since selected wildlife and drainage buffers would not be avoided. The duration for potential impacts would be for the LOP which would be dependent

upon the approved rate of development (i.e., from 76 to 105 years) and until all potentially contaminated sites are remediated.

4.7.4 Alternative B

Implementation of Alternative B would have the same potential types of hazardous material impacts as the No Action Alternative; however, impacts would be increased due to the addition of new wells, pipelines, and produced materials. Potential impacts and impact areas would be limited to the existing well pads and roads since no new pads or roads would be constructed. The duration for potential impacts would be dependent upon the rate of development (i.e., from 76 to 105 years) and until all potentially contaminated sites are remediated.

4.7.5 Alternative C

Under Alternative C, the types of potential impacts would be the same as under the No Action Alternative, but there would be an approximately two-fold increase (from 533 [No Action] to 1,250 new wells) in the potential for impacts. Potential impacts would be increased from those of the No Action Alternative due to the addition of new wells, pipelines, and produced materials. The duration of the impacts would be dependent upon the rate of development (i.e., from 68 to 80 years) and until all potentially contaminated sites are remediated.

4.7.6 Alternative D

Under Alternative D, the types of potential impacts would be the same as under the No Action Alternative, but there would be an approximately four-fold increase (from 533 [No Action] to 2,200 new wells) in the potential for impacts. Potential impacts would be increased from those of the No Action Alternative due to the addition of new wells, pipelines, and produced materials. The duration of the impacts would be dependent upon the rate of development (i.e., from 72 to 93 years) and until all potentially contaminated sites are remediated.

4.7.7 Alternative E

Under Alternative E, the types of potential impacts would be the same as under the No Action Alternative, but there would be an approximate six-fold increase in the potential for material spills, pipeline ruptures, and/or exposure to hazardous materials above current approved levels (from 533 wells [No Action] to 3,100 new wells). The duration of the impacts would be dependent upon the rate of development (i.e., from 76 to 105 years) and until all potentially contaminated sites are remediated.

4.7.8 Alternative F

Under Alternative F, the types of potential impacts would be the same as under the No Action Alternative, but there would be an approximate six-fold increase in the potential for material spills, pipeline ruptures, and/or exposure to hazardous materials above current approved levels (from 533 wells [No Action] to 3,100 new wells). The duration of the impacts would be dependent upon the rate of development (i.e., from 76 to 105 years) and until all potentially contaminated sites are remediated.

4.7.9 Alternative G

Under Alternative G, the types of potential impacts would be the same as under the No Action Alternative, but there would be an approximate six-fold increase in the potential for material spills, pipeline ruptures, and/or exposure to hazardous materials above current approved levels (from 533 wells [No Action] to 3,100 new wells). The duration of the impacts would be dependent upon the rate of development (i.e., from 76 to 105 years) and until all potentially contaminated sites are remediated.

4.7.10 BLM Preferred Alternative

Under the Preferred Alternative, the types of potential impacts would be the same as under the No Action Alternative, but there would be an approximate six-fold increase in the potential for material spills, pipeline ruptures, and/or exposure to hazardous materials above current approved levels (from 533 wells [No Action] to 3,100 new wells). The duration of the impacts would be approximately 76 years and until all potentially contaminated sites are remediated.

Under the Preferred Alternative, additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.14). Any measure that reduces the overall level of development, the number of proposed facilities or facility locations, and/or traffic, as well as any actions that facilitate enhanced reclamation have the potential to reduce potential hazardous material impacts.

4.7.11 Cumulative Impacts

All existing, proposed, and future development projects would use mitigation measures similar to those described for this project (Appendix G) to prevent soil contamination, surface and ground water pollution, and wildlife exposure; therefore cumulative impacts from hazardous materials are expected to be as described above for the various project alternatives and are not anticipated to be significant. There would, however, be some increased potential for hazardous material impacts associated with expanded regional developments associated with other oil and gas projects.

4.7.12 Unavoidable Adverse Impacts

With strict adherence to identified hazardous material management requirements (Appendix G), no unavoidable adverse impacts are anticipated.

4.8 COMPENSATORY MITIGATION

Preliminary research and monitoring results, as well as the impact results reported here, indicate that existing surface disturbance activity especially when combined with certain project alternatives considered in this EIS may be appropriate for CM.

Mitigation measures fall within the actions the Secretary of the Interior can direct to prevent unnecessary or undue degradation of the public lands and protect surface resources in the approval of surface use plans. These measures, as part of the Proposed Action, are analyzed as part of BLM's compliance with the National Environmental Policy Act (NEPA). Mitigation, as

defined by the Council on Environmental Quality (CEQ) in 40 CFR 1608.20, may include one or more of the following:

> (1) Avoiding the impact altogether by not taking a certain action or parts of an action;
> (2) Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
> (3) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
> (4) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
> (5) **Compensating** for the impact by replacing, or providing substitute resources or environments. [emphasis added]

As a general guideline, CM may be considered after other forms of on-site mitigation, including best management practices, have been analyzed. In other words, while on-site mitigation is the first priority when mitigating significant impacts, CM is an available tool for enhancing mitigation when impacts to BLM resources cannot be adequately mitigated on the site where the impacts are occurring.

It is assumed that any BLM-approved CM project would reduce impacts to the same or similar resources impacted by Jonah Infill activities, or would substitute resources for those impacted by Jonah Infill activities. However, any quantitative analysis of beneficial effects of CM cannot be identified until specific projects are proposed and it is known what specific impacts that project is intended to mitigate. The BLM may include other affected Federal agencies and the State of Wyoming in discussions regarding selection of specific CM projects, and may provide opportunity for public input.

A partial list of CM project ideas is provided in Section 5.2. Included with each idea is an estimated cost, where available, and the resources whose impacts might be mitigated by that type of project. There is no implied prioritization in that list.

4.8.1 Operator-proposed CM

The Operators have committed to funding a Cumulative Impacts Mitigation Fund (CIMF) to offset impacts of their proposed Jonah Infill development. While details are emerging, one form of financing the fund could be to deposit a particular dollar amount for every acre of new initial surface disturbance in the JIDPA above a certain acreage threshold. For example, Operators have suggested a hypothetical amount of $850.00 for every acre of new initial surface disturbance authorized in the JIDPA, above a threshold of 11,000 acres. The CIMF could be administered by an independent Advisory Board.

The hypothetical dollar amounts that the Operators would commit to the CIMF by alternative, based on the acres of surface disturbance each alternative would approve if selected, are shown below and summarized in Table 2.12.

No Action:

> No new initial surface disturbance approved for authorization
> = No money committed to the CIMF

Proposed Action:

16,200 acres new initial surface disturbance approved for authorization
- 11,000 acres new initial surface disturbance authorization threshold
5,200 acres x $850/acre of authorized new initial surface disturbance
= $4,420,000 potentially available to finance CIMF

Alternative A:

16,200 acres new initial surface disturbance approved for authorization
- 11,000 acres new initial surface disturbance authorization threshold
5,200 acres x $850/acre of authorized new initial surface disturbance
= $4,420,000 potentially available to finance CIMF

Alternative B:

3,297 acres new initial surface disturbance approved for authorization
11,000 acres new initial surface disturbance authorization threshold
= No money committed to the CIMF

Alternative C:

6,705 acres new initial surface disturbance approved for authorization
11,000 acres new initial surface disturbance authorization threshold
= No money committed to the CIMF

Alternative D:

11,581 acres new initial surface disturbance approved for authorization
- 11,000 acres new initial surface disturbance authorization threshold
581 acres x $850/acre of authorized new initial surface disturbance
= $493,850 potentially available to finance CIMF

Alternative E:

6,386 acres new initial surface disturbance approved for authorization
11,000 acres new initial surface disturbance authorization threshold
= No money committed to the CIMF

Alternative F:

10,446 acres new initial surface disturbance approved for authorization
11,000 acres new initial surface disturbance threshold
= No money committed to the CIMF

Alternative G:

13,989 acres new initial surface disturbance approved for authorization
- 11,000 acres new initial surface disturbance authorization threshold
2,989 acres x $850/acre of authorized new initial surface disturbance
= $2,540,650 potentially available to finance CIMF

BLM Preferred Alternative:

8,316 acres new initial surface disturbance approved for authorization
11,000 acres new initial surface disturbance authorization threshold
= No money committed to the CIMF

4.8.2 BLM Preferred Alternative CM

In lieu of the proposed CIMF, the Operators could voluntarily develop proposals, submit those proposals to BLM for approval, and fund and implement the BLM-approved CM projects.

4.9 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible and irretrievable commitment of resources is defined as a permanent reduction of resources that, once lost, cannot be regained. The degree of loss would be dependent upon the alternative implemented. The primary irreversible and irretrievable commitment of resources for this project would result from the recovery of the natural gas and condensate reserves from the Lance Pool (see Section 4.1.4). These recovered reserves would no longer be available; however, some reserves would remain and could be recovered in the future with improved technology. Other permanent irreversible and irretrievable commitments of resources would include soils lost through water or wind erosion (see Section 4.1.7); accidental or inadvertent destruction and/or vandalism of cultural (see Section 4.3) or paleontological (see Section 4.1.6) resources; loss of wildlife due to direct mortality (see Section 4.2.2); and the labor, materials, and energy expended during project-related activities (see Appendix G).

4.10 SHORT-TERM USE OF THE ENVIRONMENT VS. LONG-TERM PRODUCTIVITY

For the purposes of this discussion, short-term use of the environment is that use during the LOP, whereas long-term productivity refers to the period after the project is completed and the area is adequately reclaimed. Short-term use of the JIDPA for natural gas recovery for the LOP would not affect the long-term productivity of the area. LOP commitments of resources would include loss of vegetation productivity (see Section 4.2.1), wildlife habitat/habitat function (see Section 4.2.2), and livestock forage (see Section 4.5.2) on lands devoted to project activities (e.g., well pads, roads) until these areas are adequately reclaimed. After the project is completed and disturbed areas are reclaimed, the same resources that were present prior to project activities would be available, except for the natural gas and oil resources (see Section 4.1.4). It may take 20 years or more after the LOP for some of the reclaimed areas to revegetate to predisturbance levels; however, reclamation would eventually provide conditions to support wildlife, livestock, and recreation. Use of the JIDPA during the LOP would not preclude the subsequent long-term use of the area for any purpose for which it was suited prior to the project.