CHAPTER 4

ANALYSIS OF ENVIRONMENTAL CONSEQUENCES

4.0 INTRODUCTION

This chapter of the environmental impact statement (EIS) provides an analysis of the potential environmental consequences that would result from implementation of the Cave Gulch/Bullfrog/Waltman Natural Gas Development project and/or alternatives, including the project components (access roads, drill sites, well drilling, completion and production operations, and reclamation). Certain measures that would avoid or reduce impacts under the Proposed Action have been included in Chapter 2. Additional information concerning reclamation guidelines is contained in Appendix B. The following impact assessment takes these measures into consideration. Additional opportunities to mitigate impacts beyond the measures proposed in Chapter 2 are presented in this chapter under Mitigation Summary for each resource discipline. A detailed discussion of cumulative impacts that would result with implementation of the Proposed Action or alternatives is provided in Chapter 5, Cumulative Impacts.

As noted in previous sections of this document, an environmental impact or consequence is defined as a modification or change in the existing environment brought about by the action taken. Impacts can be direct or indirect in nature, and can be permanent (long-term) or temporary (short-term). Impacts can vary in degree ranging from only a slight discernable change to a drastic change in the environment. Short-term impacts are impacts that occur during and immediately after facility construction, well drilling, testing, and production and last from two to five years. For purposes of this EIS, short-term impacts are defined as lasting five years or less. Long-term impacts are impacts imposed by construction and operations that remain longer than five years and extend for the life of the project and beyond.

The description of the environmental consequences for each resource section in this chapter includes the following subsections:

Introduction - A description of the type and range of potential impacts that could occur as a result of implementation of the alternatives.

Resource Management Objectives and Impact Significance Criteria - A narrative of management objectives for the resource area and the threshold or magnitude at which an impact would be considered significant, thus warranting special attention such as special mitigation. These criteria are based on government regulatory standards, available scientific documentation, previously prepared environmental documents, and the professional judgement of resource specialists.

Direct and Indirect Impacts - An area-specific and site-specific impact assessment relative to the natural gas development alternatives. This section indicates which impacts are significant relative to the impact significance criteria.

Impacts Summary - A narrative comparison of direct and indirect impacts that would occur under each alternative and between alternatives.

Mitigation Summary - A summary of measures that could be applied to avoid or reduce impacts. Mitigation items specified in the Mitigation Summary are *assumed to be* applicable to impacts on all lands, regardless of ownership. However, the Operators will coordinate with State and private land managers to determine which measures would be applied, to what degree, and where. The measures identified under this section would be considered for application to all Bureau of Land Management- (BLM) administered lands.

Residual Impacts - A summary of impacts that are unavoidable and cannot be reduced or eliminated through the application of available and reasonable mitigation and, therefore, would remain throughout the duration of the project and to some point beyond.

The following impact assessment assumes all applicable standards, procedures, and mitigation measures would be applied over all lands. Mitigation cannot be required by the BLM on state surface over state or private minerals, or on private surface over private or state minerals. The land owner/manager will specify such measures. The degree of implementation of these measures on non-federal lands cannot be predicted or evaluated at this level of analysis. Not implementing the mitigation measures on these lands could result in increased severity and magnitude of impacts beyond those assessed in this chapter. Some discussion is provided in regard to differential application of mitigation and resultant impacts under each resource discipline section.

4.1 GEOLOGY/MINERALS/PALEONTOLOGY

4.1.1 Introduction

4.1.1.1 Geology

Impacts could occur to the geologic environment caused by project construction and operation (e.g., alteration of existing topography, initiation of landslides and mass failures), or impacts could occur to project facilities as a result of inherent geologic hazards.

4.1.1.2 Mineral Resources

With the exception of petroleum reserves, there are no major mineral resources that would be significantly impacted by implementation of the project. Implementation of the proposed project could beneficially affect mineral resources in the project area. The proposed project would allow recovery of the federal natural gas resources per 43 CFR 3162(a) and would allow for effective management of the resource to minimize draining of the federal reserves from non-federal lands.

4.1.1.3 Paleontology

Literature review of paleontologic resources in the Cave Gulch/Bullfrog/Waltman project area documented the presence of sedimentary deposits of late Cretaceous, Paleocene and early Eocene age known to contain fossils of scientific interest and significance (Appendix C). Field survey led to the identification of fossil localities in deposits of the Wind River and Lance Formations, but only those in the Wind River Formation were considered to be scientifically significant. Technical analysis of paleontologic resources for this report has been conducted to

conform to procedures for paleontology detailed in Wyoming BLM guidelines (Washington Office Instructional Memorandums WO-95-51 and WO-96-67).

4.1.2 Impact Significance Criteria

Impacts would be considered significant if the following were to occur:

Geology

- Project facilities were damaged due to seismic events, landslides, subsidence, or flooding.
- Project activities resulted in landslides, subsidence, or increased flooding

Mineral Resources

- Attainment of maximum ultimate recovery of oil/gas resources were unnecessarily precluded from existing leases (43 CFR Subpart 3161, Para. 3161.2).

Paleontology

Adverse impacts to fossil resources occur when fossils are damaged or destroyed as the result of surface disturbance. Significant impacts occur when scientifically significant nonrenewable fossil resources are lost forever and not available for scientific study. Although all fossils contain some scientific information, few paleontologists consider all fossils to have scientific significance. The scientific significance of fossils can only be evaluated by a qualified paleontologist. There is no precise definition of what constitutes a significant fossil or fossil resource, even among paleontologists. BLM guidelines consider all vertebrate fossils to be of scientific interest and other types of fossils may be placed in this category.

Professional paleontologists generally recognize fossils and their containing deposits to be of scientific value or significance if they provide taphonomic, taxonomic, phylogenetic, ecologic, or stratigraphic information. Paleontologic resources are considered to be older than recorded history and/or greater than 10,000 years old. Remains of animals currently inhabiting an area under consideration are usually excluded from being considered fossil, unless it can be clearly demonstrated by geologic or other scientific information that such remains are older than Recent. Recent remains should not be collected and treated as fossils.

According to the above guidelines, significant impacts occur when scientifically significant remains of plants and animals or their traces that are older than Recent in age are damaged or destroyed as a result of project implementation.

4.1.3 Direct and Indirect Impacts

Geology

The inherent geologic hazards in the project area do not pose significant danger or public safety hazard. As a result, impacts related to natural geologic hazards would not likely occur due to topographic alteration resulting from drill site, access road, and pipeline construction. As discussed

in Chapter 3, no major landslides have been mapped within the project area. Construction activities would not incite landslides, mudslides, debris flows, or slumps. Seismic activity is low, so the potential for damage of project facilities would be minimal.

Mineral Resources

Inventory of geologic resources revealed no major mineral resources that would be impacted by implementation of the Cave Gulch/Bullfrog/Waltman project other than oil and natural gas reserves. As discussed in Chapter 2, Project wide Mitigation Measures, the mitigation measures presented in the Soils and Water Resources sections would avoid or reduce potential impacts to the surface geologic environment to non-threshold levels. Implementation of these measures and adherence to Federal and State rules and regulation regarding drilling, testing and completion procedures would avoid or reduce potential impacts to the subsurface geologic environment to non-threshold levels.

Paleontology

Construction excavation associated with the development of well pads, access roads, pipelines and other production facilities could directly result in the exposure and damage or destruction of scientifically significant fossil resources. Fossils may also be destroyed in the subsurface by drilling activities, but this is thought to be a rare occurrence and insignificant when compared to the potential for destruction of fossils from surface activities. Adverse impacts indirectly associated with construction are of additional concern. For example, fossils may be subject to damage or destruction by erosion that is accelerated by construction disturbance. In addition, improved access and increased visibility , as the result of construction and on-going production activity, may lead to fossils being damaged or destroyed by unauthorized collection or vandalism.

Implementation of the Proposed Action and Alternatives A and B involve the development of similar surface and subsurface facilities and as a result have the potential for the same direct and indirect impacts to fossil resources. The nature of ground disturbance associated with implementation of the project and its alternatives is described in Chapter 2. The potential magnitude of impact to fossil resources of the alternatives varies proportionally with the total area of surface development in areas of high paleontologic potential as specified under each alternative. Alternative C, which would allow additional APDs and ROW action on a case by case basis could also have potential direct and indirect, adverse and beneficial impacts to fossil resources. The types of potential adverse direct and indirect impacts are identical for this alternative as for the others. The magnitude of impacts for this alternative is unknown at present and depends on the specific action taken and the specific area involved.

Project-related adverse impacts to fossil resources in the project area are most likely and could be significant at known fossil localities, or in places underlain at or very near the surface by geological deposits with a high paleontologic potential. Impacts to fossil resources are unlikely to be significant in areas underlain at the surface or near surface by geologic deposits with a low paleontologic potential. Beneficial and significant positive construction impacts, including the unanticipated discovery of scientifically significant fossils, are possible anywhere in the project area, but most likely in areas underlain by geologic deposits with high paleontologic potential.

4.1.4 Impacts Summary

4.1.4.1 Proposed Action, Alternatives A, B, and C

Geology and Mineral Resources

No impacts to the geologic or mineral resources are anticipated under the Proposed Action or Alternatives A, B, or C. The difference in the total number of wells that would be allowed under each of these alternatives will influence the amount of reserves that could be recovered. Under the Proposed Action, and Alternatives B and C, maximum ultimate recovery of the oil and gas reserves should be attainable. Under Alternative A, an estimated 54.9 bcf of gas could not be recovered from within the raptor nest buffer areas because those areas could not be drained by existing or new Alternative A wells. The economic impacts of not recovering these reserves are considered in Section 4.11, Socioeconomics.

Paleontology

Construction of well pads, access roads and production facilities and excavation of pipeline trenches could result in the exposure and possible destruction of fossil resources along with the loss of associated geologic information. Direct damage or destruction of fossils preserved at known, or as yet undiscovered localities as a result of project implementation is of primary concern as an adverse impact of the project to paleontology. Adverse impacts indirectly associated with construction, such as accelerated erosion and improved access, that could affect fossil resources are of additional concern. Construction related disturbances could have beneficial impacts if fossils are recovered from known localities prior to destruction or if new fossil localities are discovered. The discovery of fossils of scientific importance is in itself not a beneficial impact, however. To have beneficial impact such newly discovered fossils must be properly collected and catalogued into the retrievable collections of a repository so that associated geologic data is preserved and the fossils are available for scientific study.

The magnitude of adverse impacts can be reduced and beneficial impacts can be fostered by the implementation of paleontologic resource mitigation measures described in section 4.1.6.3.

4.1.5 Mitigation Summary

4.1.5.1 Geology

Mitigation measures presented in the Soils and Water Resources sections would avoid or minimize many of the potential impacts to the surface geologic environment.

4.1.5.2 Mineral Resources

Since adverse impacts to mineral resources are not anticipated, no mitigation is required.

4.1.5.3 Paleontology

The following mitigation measures would avoid or reduce potential impacts to paleontologic resources to non-threshold levels and foster beneficial impacts:

General Mitigation Measures

- **Worker Instruction.** Information on known and potential fossil resources and proper procedures for treatment of discovered fossils within the project area will be conveyed to construction personnel.

- **Discovery Contingency.** Contingency will be made in the event that significant fossils are discovered in areas not monitored during construction. Usually in the case of a discovery, construction activities which could adversely affect fossils are redirected until a qualified paleontologist has been consulted and made and implemented recommendations regarding further mitigation, if any are warranted.

Specific Mitigation Measures

A Paleontologic Field survey has been completed on the Cave Gulch area. A paleontologic Resources report documenting the survey is provided in Appendix C-2. The report describes the survey methods, results of survey, and follow-up recommendations. These measures are summarized as follows:

- Preconstruction Sampling. In areas determined to have high paleontologic potential as shown on Figure 3-1, where surface disturbance is unavoidable, a representative sample of fossil remains will be collected from the surface and from anthills prior to construction disturbance. Anthill material will be screened, bagged, and sorted under a binocular microscope by a qualified paleontologist to retrieve microfossil vertebrate remains.

- Curation. Fossils collected as a result of preconstruction sampling or during treatment of an unanticipated discovery will be curated into the collections of the University of Wyoming. Curation will include identifying the remains and cataloging them into the vertebrate paleontology collections of the Department of Geology and Geophysics at the University of Wyoming, Laramie, WY.

- Reporting. A letter report describing the results of paleontologic mitigation efforts and documenting the curation of specimens into the University of Wyoming collections will be prepared. The scientific significance of recovered fossils will be discussed in the report. Copies of the report will be provided to the BLM and project proponents.

4.1.6 Residual Impacts

Geology

Alternatives A, B, and C would have no residual impacts.

Mineral Resources

Alternatives A, B, and C would have no residual impacts.

Paleontology

If mitigation measures are applied consistently for all lands, there would be no residual impacts to paleontologic resources. If all measures are not applied on all lands, impacts would be of a greater magnitude than indicated in this EIS.

4.2 AIR QUALITY

4.2.1 Introduction

Air pollution impacts are limited by regulations, standards and implementation plans established under the Federal Clean Air Act and administered by WDEQ/AQD. Under FLPMA and the Clean Air Act, the BLM can not conduct or authorize any activity which does not conform to all applicable local, state or Federal air quality laws, statues, regulations, standards or implementation plans. Therefore, before any air pollutant emitting activity can occur, WDEQ/AQD requires air quality permits which would examine expected emissions from compressor engines and gas plants prior to their construction. Additional site specific air quality analysis would be performed, and additional emission control measures may be required, to ensure protection of air quality resources. Individual well sites would be permitted following a 180-day start-up period. An extensive air quality impact assessment was prepared (as detailed in "Cave Gulch-Bullfrog-Waltman Air Quality Technical Support Document: Cumulative Air Quality Impact Analysis.") A copy of the detailed report may be obtained from the BLM, Casper District Office, and is incorporated by reference (TRC 1997).

This analysis was based on conservative "worst case" assumptions regarding the: (1) amount of development; (2) equipment necessary to produce the resource to its maximum capacity; (3) well spacing; and (4) source locations.

This "worst case" emission scenario represents an upper bound which would not be exceeded. For example, review of current production activities in the area suggests that this level of air emissions and impacts would not be reached. Thus the impacts projected in this report should be viewed as a conservative "upper bound" estimate of potential air quality effects that are not likely to occur.

It is also important to note that before development could occur, the WDEQ/AQD would require very specific air quality pre-construction permits which must examine project specific air quality effects (per requirements of Wyoming and Federal air quality standards and regulations). Thus, as development occurs, additional site specific air quality analysis must be performed to ensure protection of air quality resources.

4.2.2 Impact Significance Criteria

The significance criteria for air quality include state and federally enforced legal requirements to ensure that ambient air pollutant concentrations remain below specified levels. These include the Wyoming and National Ambient Air Quality Standards, and the Prevention of Significant Deterioration (PSD) increments that limit the amount of pollutant concentration increase that is allowed in specific areas, shown in Table 3-3.

4.2.3 Direct and Indirect Impacts

4.2.3.1 Proposed Action, Alternatives A, B, and C

Near field potential air quality impact modeling was used to predict maximum potential concentrations in the vicinity of the emission sources for comparison with applicable air quality standards. This modeling was performed to quantify potential "worst-case" impacts from particulate and SO2 emissions during construction, and CO, NO2, VOC (Ozone), and HAP emissions during production.

Using the Cave Gulch well site design, minimum well site spacing, and proposed compression, a representative well field "patch" was used to determine a realistic geometric layout. This "patch" included eight wells, a 12,000 hp compressor station, and an individual 3,000 hp compressor engine. The ISCST3 dispersion model was used with meteorological data collected at Casper, Wyoming, during 1991. Proposed compressors and well site heaters were modeled as point sources, and well site separators and dehydrators were modeled as volume sources.

Potential TSP and PM10 emissions from traffic on the unimproved lease road, resource road, and well pad construction, were used to determine the maximum 24-hour TSP and PM10 concentrations and the annual average PM10 concentration. These emissions are temporary (occur over a 6-day period) during construction and would occur in isolation, without significantly affecting neighboring well sites.

The total maximum potential concentrations at the public access receptors (including representative background values) would be nearly 66 $\mu g/m^3$ (PM10 24-hour), 24 $\mu g/m^3$ (PM10 annual), and 130 $\mu g/m^3$ (TSP 24-hour). Therefore, both predicted short- and long-term particulate matter concentrations comply with all applicable Ambient Air Quality Standards; defined as 150 $\mu g/m^3$ (PM10 24-hour), 50 $\mu g/m^3$ (PM10 annual), and 150 $\mu g/m^3$ (TSP 24-hour).

The predicted maximum 24-hour concentrations shown are likely to overestimate actual expected concentrations because they assume the maximum modeled concentration would coincide with the maximum measured background concentration. However, these two events would occur under very different meteorological conditions, and are not be expected to coincide.

In computing particulate emissions from well pad and resource road construction, it is assumed that water and/or chemical dust suppressants would be applied in order to minimize TSP and PM10 fugitive dust emissions. A 50 percent control efficiency would be achieved by watering (and/or dust suppressant use) at an assumed application rate of 0.02 gallons per square yard.

The maximum short-term (3- and 24-hour) and long-term (annual average) SO2 emissions are those from the drilling engines used for the 25-day rig-up and drilling campaign. Although these emissions would be temporary, occurring over a 25-day period during drilling, SO2 concentrations were predicted for all applicable time periods. The total maximum modeled concentrations (including representative background values) would be nearly 164 $\mu g/m^3$ (3-hour), 52 $\mu g/m^3$ (24-hour), and 8 $\mu g/m^3$ (annual). Therefore, both predicted short- and long-term SO2 concentrations comply with all applicable Wyoming Ambient Air Quality Standards; defined as 1300 $\mu g/m^3$ (3-hour), 260 $\mu g/m^3$ (24-hour), and 60 $\mu g/m^3$ (annual). The Federal standards are less restrictive.

The maximum direct CO impacts predicted to occur from the compressor engines during production are nearly 634 µg/m^3 (1-hour) and 318 µg/m^3 (8-hour), indicating that no concentrations exceed EPA "significant" levels (2,000 µg/m^3 1-hour, and 500 µg/m^3 8-hour). Therefore, by definition, there would be no significant air quality impact overlap between compressors. When these values are added to the assumed background concentrations, total maximum CO impacts become nearly 4,134 µg/m^3 (1-hour) and 1,818 µg/m^3 (8-hour), demonstrating compliance with the applicable CO standards of 40,000 µg/m^3 (1-hour) and 10,000 µg/m^3 (8-hour).

Potential maximum modeled NO2 concentrations (production phase) were determined by multiplying maximum NOx concentrations by 0.75, in accordance with standard EPA methodology (FR 60:153, p. 40469, dated Aug 9, 1995). A realistic "worst case" geometric layout of eight wells, a 12,000 hp compressor station, and a 3,000 hp compressor station were modeled to determine the potential for interaction of emissions. The maximum potential NO2 impacts are those associated with the compressor station. The total maximum predicted NO2 impact (including background) was nearly 24 µg/m^3, well below both the Wyoming and Federal NO2 ambient air quality standards of 100 µg/m^3.

In developing the NOx emission inventory, it was assumed that each compressor engine would reflect at least 75 percent control with an emission rate of 2 g/hp-hr (uncontrolled emissions are 9-25 g/hp-hr). This reflects the current WDEQ/AQD Best Available Control Technology (BACT) requirements. The air quality impact assessment evaluated potential NOx emissions control measures for natural gas fired, internal combustion compressor engines. The evaluation did not rank or identify which technology is most applicable for the proposed compressors; the appropriate level of control would be determined as part of the air quality preconstruction permitting process required by the WDEQ/AQD.

Alternate NOx emission control measures include:

- Nonselective Catalytic Reduction. This control technology is applicable to relatively new engines, and requires the installation of catalysts in the engine exhaust. The catalyst removes between 80 to 90 percent of the uncontrolled NOx emissions, for an operating emission rate of 1-5 g/hp-hr. Costs are approximately $110-180/ton removed.

- Lean Combustion. This technology involves the increase of the air-to-fuel ratio to lower the peak combustion temperature, thus reducing the formation of NOx (new engines and retrofit applications). The controls are between 80 to 90 percent efficient, for an operating emission rate of 1.5-4 g/hp-hr. Costs are $490-690/ton removed.

- Selective Catalytic Reduction. This is a post combustion control technology which is only applicable to exhaust streams with significant oxygen content (a lean burn engine). The controls are between 80 to 90 percent efficient, for an operating emission rate of 1-2.5 g/hp-hr. Costs are $750-9600/ton removed.

Ozone is formed as a result of photochemical reactions involving ambient concentrations of VOC and NOx. Because of the complicated photochemical reactions involved with the formation of ozone, a nomograph developed from the Reactive Plume Model (RPM) was used to predict maximum potential ozone impacts (Scheffe, 1988). This involves computing a potential VOC to NOx emission ratio, and comparing this ratio (plus potential VOC emissions) to the nomograph.

At the predicted ratio (1.6), the nomograph estimated maximum potential ozone concentrations of less than 0.02 parts per million (37 $\mu g/m^3$). Therefore, the total predicted ozone impact (including background) of 147 $\mu g/m^3$ would be below the Wyoming Ambient Air Quality Standard of 160 $\mu g/m^3$. The Federal standard is less restrictive. This predicted impact is conservative since the nomograph was developed using meteorological conditions more conducive for forming ozone than would occur in the Cumulative Impact Study Area.

In addition, the potential emissions rates of several Hazardous Air Pollutants (HAP) from compression and well production were evaluated, including formaldehyde (approximately 13.9 tons per year) from the compression station, and n-hexane (0.85 tons per year), benzene (0.12 tons per year), toluene (0.55 tons per year), ethyl benzene (0.12 tons per year), and xylene (0.50 tons per year) from the individual well dehydrator, separator and storage tank. Potential HAP impacts were predicted using the ISCST3 model and an 8-hour averaging time, then compared to a range of State Acceptable Ambient Concentration Levels (AACLs). These data and standards are summarized in Table 4-1.

Table 4-1. Potential HAP Concentrations and Comparable State Acceptable Ambient Concentration Levels.

Pollutant	Concentration ($\mu g/m^3$)	Range of State AACLs ($\mu g/m^3$)
Formaldehyde	13.7	4.5 - 71
n-Hexane	72.5	1800 - 4290
Benzene	10.4	30 - 714
Ethyl benzene	10.4	4340 - 43500
Toluene	46.6	1870 - 8930
Xylene	42.7	2170 - 4400

Note: These maximum predicted concentrations occur at the compressor station fence line and within 50 meters of individual well sites. As the distance from the fence line increases, the predicted concentrations decrease rapidly.

Long-term (70-year) exposures to suspected carcinogens (benzene and formaldehyde) emissions were calculated to estimate the latent cancer risk. These were calculated from EPA unit risk factors for carcinogenic constituents (EPA, 1997). Two estimates of cancer risk were made; one that corresponds to a Most Likely Exposure (MLE) scenario, and one reflective of the Maximally Exposed Individual (MEI). The estimated cancer risks were adjusted to account for duration of exposure and time spent at home. In addition, there would be no cumulative risk, since no residence would be affected by more than one well or compressor. Under the MLE scenario, the estimated cancer risks associated with long-term exposure to benzene and formaldehyde concentrations are 5e-08 and 4e-07, which are both below the 1e-06 threshold. The estimated total MLE cancer risk for the inhalation pathway (4e-07) is also less than 1e-06. Under the MEI scenario, both the individual cancer risks for benzene and formaldehyde (2e-07 and 1e-06) are less than or equal to 1e-06, and the total cancer risk for the inhalation pathway is 1e-06. The total risk is considered acceptable since it falls on the lower end of the 1e-06 to 1e-04 range. In addition,

given the conservative nature of the MEI analysis, these calculated exposures overstate what any individual would experience.

Under Alternative C (No Action), development would occur at the same or higher level as the Proposed Action, although analyzed on an individual, case-by-case basis. Because specific development actions are unknown, potential impacts can not be evaluated at this time. However, under FLPMA and the Clean Air Act, the Bureau of Land Management can not conduct or authorize any activity which does not conform to all applicable local, state or Federal air quality laws, statutes, regulations, standards or implementation plans. Therefore, no violation of Wyoming or Federal standards would occur.

4.2.4 Impacts Summary

No violations of applicable Wyoming or Federal air quality regulations or standards are expected to occur as a result of direct, indirect or cumulative project emissions (including construction and operation.) The maximum potential air pollutant concentrations would occur close to, and between, well locations, even with the densest assumed well spacing. That is, the maximum ground level concentrations occurred so close to each well that adding additional wells in the field would not increase the overall maximum concentration.

Potential air quality impacts would be below applicable significance criteria for atmospheric deposition at the Cloud Peak Class II Wilderness Area.

Given the inherent conservatism in the analysis, operation emissions would not result in any perceptible visibility impact on the cleanest days at the Cloud Peak Class II Wilderness Area. This conclusion is based on an extremely clean assumed background standard visual range (374 km) and very conservative Interagency Workgroup on Air Quality Modeling (IWAQM) Preliminary Screening Analysis.

In reviewing these predicted impacts it is important to understand the assumptions that have been made regarding resource development. The development of this analysis includes a great deal of uncertainty in the projection of specific plans (i.e. number of wells, equipment to be used, and specific locations) for resource development 10 years in the future. All of these factors affect air emissions as well as predicted air quality impacts.

4.2.5 Mitigation Summary

The air quality impact assessment assumed water and/or chemical dust suppressants would be applied in order to achieve a 50 percent control efficiency (at an assumed application rate of 0.02 gallons per square yard) in order to minimize TSP and PM10 fugitive dust emissions. In addition, roads constructed on soils susceptible to wind erosion could be graveled, or dust inhibitors could be periodically used on unpaved local, collector or arterial roads which present a fugitive dust problem. Project operators could also establish and enforce speed limits for all non-surfaced roads (identified in the transportation plan.) No further mitigation or monitoring measures are proposed.

4.2.6 Residual Impacts

Other than the impacts described and quantified in Section 4.2.3 there will be no other residual impacts.

4.3 SOILS

4.3.1 Introduction

Impacts resulting from natural gas field development could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. Many of these impacts could result in difficult reclamation challenges due to soils with poor or very poor reclamation potential. Project activities that could cause these types of impacts include construction and operation of drill/well sites, access roads, gas pipelines, and ancillary facilities as described in detail in Chapter 2. Direct and indirect impacts of the proposed project would occur in addition to existing impacts in the project area causing cumulative impacts. Cumulative impacts are discussed in Chapter 5. More detail on the impact analysis is presented in the Soils, Water, and Vegetation Resources Technical Report (ECOTONE 1997).

4.3.2 Impact Significance Criteria

- Non-compliance with the RMP (USDI-BLM 1984b). The following management directives pertinent to the soils environment are presented in the RMP (also see water resource directives):

    - The Cave Gulch watershed will be evaluated by the BLM to determine the need for intensive management. Intensive management may include requirements for a watershed plan, implementation of various protective measures, and placement of various structures as may be necessary (Watershed Plans - SWA1).

    - Surface development is not permitted from December 30 to June 1 in the South Fork Powder River drainage. Seasonal limitations do not apply to maintenance of existing facilities and may be waived in writing by the District Manager or BLM authorized officer (AO) (Soil Protection - SWA3).

    - No occupancy or other surface disturbance is allowed on slopes of more than 25 percent without written permission from the BLM AO. When development is proposed on slopes of more than 15 percent, engineered drawings for construction, drainage design, and final contours proposed after rehabilitation will be required (Slope Restrictions - SWA4).

    - Construction will not be allowed without written permission from the AO when soils are frozen or during periods when the soil material is saturated or when watershed damage is likely to occur.

- Increased soil erosion that cannot be reduced by 50 percent after 1 year and by 75 percent after 5 years of soil disturbance;
- Failure to have successful revegetation within 3 to 5 years of implementation;
- A reduction in soil productivity such that the lowered productivity minimizes or prevents the disturbed area from obtaining predisturbance productivity levels;
- Location and construction of project facilities on sensitive soils (soils having one or more of the following characteristics: difficult reclamation potential, high erosion hazard, slope gradients greater than 25 percent, and moderate to high stability hazard); and
- The proposed project would increase the total cumulative soil disturbance within the project area to more than a total of 10 percent of a given watershed intersected by the project area.

4.3.3 Direct and Indirect Impacts

4.3.3.1 Proposed Action

The project activities listed above and as described in Chapter 2 could result in adverse impacts to soils including the removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. These impacts could increase runoff, erosion, and off-site sedimentation and subsequently increase the loss of the base natural resource. To access the natural gas reservoir in a feasible manner, project facilities would likely be located in areas of sensitive soils, soils with poor and very poor reclamation potential, and areas containing slopes in excess of 25 percent. The probability for significant impacts would be high in these areas. Prime farmland soils and farmland soils of state and local importance do not occur in the project area and therefore, would not be adversely affected by the project.

Construction of the Proposed Action would variously disturb approximately 788.39 acres of soils or 3.1 percent of the 25,093-acre project area in the short term. This total would include 313.45 acres for drill sites, 72.06 acres for roads without associated pipelines, 183.94 acres for the gas gathering pipelines not associated with roads, 183.94 acres of combined access road and pipeline construction, and 35.0 acres for ancillary facility sites. These disturbance areas are summarized in the following tables. Table 4-2 summarizes the area of disturbance that would occur under the Proposed Action by sensitive and non-sensitive soils type defined in Chapter 3. Of the total disturbance of 788.39 acres, 549.08 acres, or 70 percent of the disturbance, would occur in areas containing sensitive soils. The balance, 239.31 acres or 30 percent of the disturbance, would occur in areas containing non-sensitive soils. This suggests that the likelihood of causing significant impacts is high compared to areas that do not contain sensitive soils. As discussed in Chapter 3, Section 3.3.2, a soil map unit may be identified as sensitive; however, a large portion of that map unit may be comprised of non-sensitive soil series where actual impacts may be low. Soils with poor or very poor reclamation potentials comprise approximately 55 percent or 302.70 acres of the area of sensitive soils that would be impacted under the Proposed Action, or approximately 38 percent of the total area of disturbance. Thus, disturbance in these areas of poor or very poor reclamation potential could pose substantial reclamation difficulties such that significant impacts could occur. Only site-specific analysis in the field could determine the actual magnitude of impact

of disturbance on soils. As indicated, significant soil impacts could occur in sensitive soils areas and such areas should be avoided to the maximum extent practicable. Careful review of project facilities sites in the field during the APD process should include identifying facility locations and alignments that avoid sensitive soils and/or sensitive soil features. Where they cannot be avoided, special construction techniques and mitigation measures (see Section 4.3.6) would need to be developed and approved by the BLM AO before authorization and construction of project facilities in sensitive soil areas could occur.

Even with poor to very poor reclamation potentials, most disturbances in the project area could be effectively revegetated and reclaimed. Revegetation effectiveness and success in the project area on existing natural gas pipelines (e.g., CIG pipeline) and other reclaimed disturbances were observed to be adequate in regard to erosion control, protective groundcover of beneficial vegetation, and species composition; even in areas of sensitive soils with poor and very poor reclamation potentials.

Table 4-2. Summary of Construction Disturbance Impacts by Soil Type for the Proposed Action.

Proposed Action									
Area (ac)		Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	Area (ac)						
Sensitive	16,279	78	228.50	52.26	134.16	134.16	0.0	549.08	3.4
Non-sensitive	8,814	29	84.95	19.80	49.78	49.78	35.00	239.31	2.7
TOTAL	**25,093**	**107**	**313.45**	**72.06**	**183.94**	**183.94**	**35.00**	**788.39**	**3.1**

Project development would not occur uniformly over the project area. Reservoir development would require location of development facilities at topographic positions conducive to gas recovery. The BLM has determined potential locations for well sites under the Proposed Action as described in Chapter 2. The following analysis is based on these well site locations. Potential road and pipeline alignments were not located on maps. To determine the disturbance impacts due to roads and pipelines, the unit disturbance assumptions made in Chapter 2 were applied to each well and such associated disturbance was assumed to occur in the same soil map unit and watershed as the well site. Table 4-3 summarizes the total disturbance under the proposed action according to slope class. Most of the proposed disturbance, 434.71 acres, would occur in the 6 to 10 percent slope class. However, 58.95 acres would occur in the 16 to 25 percent slope class and 14.74 acres would occur in the 26 to 50 percent slope class where the potential for significant impacts would be high. As indicated previously, all slopes in excess of 15 percent should be avoided during project design and the site-specific APD authorization process. Siting of project facilities on slopes in excess of 25 percent would constitute a significant impact and such areas should be avoided.

As project development would not occur uniformly over the project area, the distribution of disturbances relative to watersheds intersected by the project area can provide an indication of the importance and significance of impacts. Figure 3-4 shows the location of the watersheds. The project area is situated at headwater positions along the divide of these watersheds. Table 4-3

summarizes total disturbance associated with the proposed action by watershed. The Main Branch of Cave Gulch and the South Branch of Cave Gulch would sustain the most of the 788.39 acres of disturbance (415.32 acres or 53 percent of the total disturbance), including 225.30 acres or 29 percent, and 190.02 acres or 24 percent of the total disturbance, respectively. On a watershed basis, this would equate to 7.5 percent of the Main Branch of Cave Gulch and 7.0 percent of the South Branch of Cave Gulch. Although these percentages are less than the threshold value of 10 percent presented in Section 4.3.2, they approach this threshold. The 10 percent threshold is important because at this level of disturbance, watersheds begin to show obvious adverse signs of instability and adjustment (i.e., excessive erosion, slope instability, channel instability, and sedimentation). Disturbance in the other watersheds range from 0 percent to 4.7 percent. As discussed in greater detail in Section 5.3 in Chapter 5, short-term construction disturbance combined with the total existing disturbance produces a total disturbance impact level that exceeds 10 percent in the Main Branch of Cave Gulch (13.5 percent) and Waltman Draw (11.1 percent).

There would be an increased susceptibility to erosion in newly disturbed areas. Soil compaction caused by equipment traffic or by increased raindrop impact after loss of surface cover may decrease infiltration and water storage capacity, increase runoff, and reduce soil productivity. Increased surface runoff and erosion would occur primarily in the short term and would decline in time due to natural stabilization. Increases in surface runoff would also depend on the success of reclamation and other mitigation measures.

If handled incorrectly, the removal of topsoil for revegetation purposes could reduce the natural fertility of the soil or cause coarse fragments from the subsoil to be mixed into the topsoil, decreasing its reclamation potential. This in turn could inhibit reclamation success such that successful reclamation may not be completed in 3 to 5 years. Thus, special handling of topsoil would be required to minimize such adverse impacts.

As discussed in Section 3.3 of Chapter 3, many of the soils in the project area are relatively coarse-textured with high infiltration and permeability rates. High infiltration and permeability rates restrict the soil's suitability for unlined reserve and evaporative pits. Soils with high permeability rates can lead to pit seepage and possible contamination of surface and groundwater if such pits are unlined.

Surface soil textures may not reflect the texture of subsoils and parent materials. This is particularly true for the soils derived from wind-blown sand that overlies shale bedrock. Although the operators initially proposed to only line reserve pits in areas where leakage was anticipated to be a problem, there is sufficient information known on the character of soils and the sensitivity of the hydrologic environment to require that all pits be lined, whether reserve or evaporative. In general, impermeable pit liners should always be used to minimize potential leakage given the relatively high permeability rates of soils in the project area.

Indirect impacts from off-road use of vehicles include vegetal cover destruction and rutting and compaction of the soil. Given the sensitivity of the soils, unauthorized off-road vehicle use should be restricted. Similarly, geophysical exploration within the project area would add to this dispersed disturbance. Such disturbance involves crushing of vegetation and compaction of soils. In general, disturbed vegetation and soils effectively recovers assuming that the linear disturbances are not subsequently used by off-road vehicles.

Table 4-3. Summary of Construction Disturbance Impacts by Slope Class for All Alternatives.

Slope Class	Proposed Action		Alternative A		Alternative B	
	# Wells	Total Disturbance (ac)	# Wells	Total Disturbance (ac)	# Wells	Total Disturbance (ac)
0-5%	7	51.8	5	33.84	6	40.46
6-10%	59	434.71	63	426.37	67	451.78
11-15%	31	228.41	24	162.43	29	195.55
16-25%	8	58.95	7	47.37	10	67.43
26-50%	2	14.74	0	0.0	2	13.49
>50%	0	0.0	0	0.0	0	0.0
TOTAL	**107**	**788.39**	**99**	**670.01**	**114**	**768.71**

Table 4-4. Summary of Construction Disturbance Impacts by Watershed for the Proposed Action.

Watershed	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	acres						
Alkalai Creek	1801	0	0	0	0	0	0	0	0
Poison Creek	4198	9	26.37	6.08	15.48	15.48	0	63.41	1.5
North Branch Cave Gulch	3455	23	67.39	15.51	39.56	39.56	0	162.02	4.7
Main Branch Cave Gulch	3012	32	93.76	21.56	54.99	54.99	0	225.30	7.5
South Branch Cave Gulch	2735	27	79.05	18.19	46.39	46.39	0	190.02	7.0
Waltman Draw	4209	16	46.88	10.72	27.52	27.52	35.00	147.64	3.5
Upper Sand Draw	3074	0	0	0	0	0	0	0	0
Sand Draw Tributary	2027	0	0	0	0	0	0	0	0
Keg Springs Draw	582	0	0	0	0	0	0	0	0
TOTAL	**25,093**	**107**	**313.45**	**72.06**	**183.94**	**183.94**	**35.0**	**788.39**	**3.1**

These potential adverse impacts of the proposed project could reduce soil productivity, impair successful revegetation, and result in increased erosion potential. Successful revegetation through applied surface runoff, erosion, and sediment control measures, and effective revegetation efforts would reduce the potential for soil productivity loss. Soil erosion is likely to be a primary adverse impact of these project effects.

Based on professional judgement and experience with soil erosion in Wyoming, soil loss tolerance (i.e., approximates the rate of soil development) within the general area of the project is approximately 2 tons/acre/year (t/ac/yr). Losses exceeding this amount would significantly reduce topsoil quantities and lower soil productivity. In regard to general soil erosion, most sediment is generated from exposed areas that cover only a small portion of the project area. Sediment delivery in the project area is approximately 1.0 ac-ft per square mile. The majority of sediment delivery at some point along a channel originates from erosion and degradation of stream channels as opposed to soil erosion away from channels. In other words, only a small portion of soil erosion is transported to stream channels to be included in the sediment delivery term. As discussed in Chapter 3, existing erosion within the project area was estimated to be approximately 1.5 t/ac/yr. At this rate, however, current soil loss within the project area including erosion from existing disturbances (approximately 1,041 acres) may exceed the threshold of 2 t/ac/yr.

Given the potential importance of soil erosion, the Modified Soil Loss Equation (MSLE) as originally developed by Wischmeir and Smith (1965), as discussed specifically for roads by Israelsen et al. (1980) and as applied to land management practices (USDA-FS 1980), was applied to the project area. Methods used and assumptions made are summarized in the Soils, Water, and Vegetation Resources Technical Report (ECOTONE 1997). Natural baseline erosion was estimated to be approximately 1.5 t/ac/yr. This is an environmentally conservative (i.e., worse case) estimate, and the true natural baseline erosion rates are likely less than the value presented here. Therefore, increased erosion caused by livestock grazing and other dispersed disturbances have been captured in this environmentally conservative estimate. Most of the eroded soil is contained on-site and is not transported off-site to streams.

Applying the same technique to newly disturbed soils, the average unmitigated erosion rate could be as high as 14 t/ac/yr for drill pads, 74 t/ac/yr for pipelines, and 6 t/ac/yr for roads as summarized in table 4-4. New project facilities would be constructed with surface runoff, erosion, and sedimentation controls in place that would reduce erosion rates. The effect of applying control measures to reduce erosion was investigated by Grah (1989) through the use of the MSLE to demonstrate the feasibility of erosion reduction. Applying the procedures described by Grah (1989), control measures and assuming a reasonable success rate, erosion from newly disturbed areas could be reduced to 1.5, 1.8, and 2.3 t/ac/yr in the first year for drill sites, pipelines, and roads, respectively. This represents a reduction in erosion rates of greater than 50 percent in the first year after construction. As discussed previously, erosion would continue to decrease due to natural stabilization and a maturing vegetal cover. By the fifth year after construction, erosion would likely reduce to 0.2, 0.5, and 0.5 t/ac/yr for wells, pipelines, and roads, respectively, assuming best management practices are implemented. This represents an average reduction in erosion rate of approximately 95 percent over five years with the application of best management practices. Erosion reductions for well sites, roads, and ancillary facilities would not decrease as much as for pipelines since exposed earth material that comprise the surface of these features would continue to be exposed to erosion. These calculations suggest that soil erosion could be reduced to non-significant levels with the application of best management practices.

Table 4-4 summarizes total erosion that could occur under this alternative with and without erosion control measures. Without the application of erosion control measures, total erosion from the proposed action would be approximately 19,860 tons per year after the first year of construction and 4,482 tons after the fifth year. With the application of erosion control measures including effective revegetation, total erosion from the proposed action would be approximately 1,443 tons per year after the first year of construction and 290 tons per year after the fifth year. These estimates are in addition to baseline erosion and assume that all construction would occur in the first year of project authorization. Total erosion would be distributed according to the watershed the disturbance occurs in. Thus, the majority of erosion and sedimentation that would occur from soil disturbance would occur in the North (21 percent), South (24 percent), and Main (29 percent) Branches of Cave Gulch and Waltman Draw (19 percent).

Wind erosion could also be an adverse affect of project development. However, wind erosion is not expected to be a widespread problem across the project area. Chronic and severe wind erosion could occur in limited areas where roads and/or pipelines traverse extremely sandy soils. Special erosion control and soil stabilization measures should be applied in these sandy soils.

The previous discussion discussed the construction phase or short-term disturbance associated with the proposed project. The total area of disturbance at any one time would be less than these totals due to 1) staggered production as described in Chapter 2, and 2) contemporaneous reclamation of the portion of disturbances not needed for the production phase. Once a well goes into production, the size of the drill pad can be reduced. The unused portion of the drill pad and cut and fill slopes would be reclaimed as described in Chapter 2. There would be a reduction in disturbance associated with drill pads of from 313.45 acres during construction, drilling, and completion to 231.0 acres during the production phase. Similarly, all of the 40-foot wide gathering pipelines unassociated with roads (183.94 acres) would be reclaimed during the production phase. Road disturbance outside of drainage ditches would also be reclaimed during production, reducing road disturbance from 40 feet to approximately 16 to 20 feet, depending on the service level of the road. This would result in an approximate reduction in total disturbance from 72.06 acres to 36.03 acres. A similar reduction in disturbance would occur for combined roads and pipelines from 183.94 acres to 91.98 acres. The ancillary facilities (35 acres) would not be reclaimed during operations since such sites would be totally occupied for operational activities. Thus, during the production phase, the disturbance area would be reduced from 788.39 acres to a residual disturbance of 394.07 acres, or 394.38 acres of the total disturbance would be reclaimed. This residual production phase disturbance area (i.e., the disturbance area left unreclaimed during the production phase) would represent approximately 1.6 percent of the 25,093-acre project area.

Table 4-6 summarizes the disturbance area left unreclaimed during the production phase by watershed. The South and Main Branches of Cave Gulch would be subjected to approximately 107.4 acres (3.6 percent) and 90.57 acres (3.3 percent) of disturbance during the production phase, respectively.

As discussed in greater detail in Section 5.3 of Chapter 5, the residual project disturbance area of 394.01 acres would be combined with the unreclaimed existing disturbance (452 acres) to produce approximately 846.21 acres of unreclaimed disturbance, or 3.4 percent of the 25,093-acre project area. Cumulative long-term disturbance would be approximately 6.4 percent for the Main Branch of Cave Gulch, 5.1 percent for Waltman Draw, and 4.7 percent for the South Branch of Cave

Table 4-5. Summary of Erosion Estimates Due to Construction for the Proposed Action.

Project Facility	Acres	Year 1				Year 5			
		Without BMP[a]		With BMP		Without BMP		With BMP	
		t/ac/yr[b]	t/yr[c]	t/ac/yr	t/yr	t/ac/yr	t/yr	t/ac/yr	t/yr
Well Pads	313.45	13.8	4,326	1.5	470	3.1	972	0.2	63
Roads unassociated with pipelines	72.06	5.8	418	2.3	166	1.5	108	0.5	36
Gathering Pipes unassociated with roads	183.94	73.7	13,566	1.8	331	16.4	3,017	0.5	92
Combined Roads and Pipelines	183.94	5.8	1,067	2.3	423	1.5	276	0.5	92
Ancillary Facilities	35.00	13.8	483	1.5	53	3.1	109	0.2	7
TOTAL Construction	**788.39**	---	**19,860**	---	**1,443**	---	**4,482**	---	**290**

[a] - BMP- Best Management Practices (BMP).
[b] - t/ac/yr - tons/acres/year.
[c] - t/yr - tons/year.

Gulch. Other watersheds would sustain less than 4 percent cumulative disturbance in the long term. Thus, in the long term, total disturbance would not exceed the impact significance criteria of 10 percent identified above.

Assuming sensitive soils and slopes greater than 25 percent could be avoided to the maximum extent practicable and carefully designed surface runoff, erosion, sedimentation control, and revegetation plans would be developed for these sites that cannot avoid sensitive soils, implementation of this alternative could occur without causing significant impacts on soil resources. Given the above impacts analysis and the mitigation items identified in Section 4.3.6, this alternative could be implemented in compliance with RMP directives.

4.3.3.2 Alternative A

Under Alternative A, the density of surface well pads and production facilities would be decreased below the Proposed Action level. As discussed in greater detail in Chapter 2, this alternative was developed to reduce adverse impacts on raptors. In general, the potential adverse impacts of this alternative would be similar to the Proposed Action, but of reduced magnitude. The same types of impacts would occur as previously described for the Proposed Action.

Construction of this alternative would variously disturb approximately 670.01 acres of soils or 2.7 percent of the 25,093-acre project area. This total would include 268.35 acres for drill sites, 60.00

Table 4-6. Summary of Production Disturbance Impacts by Watershed for the Proposed Action.

Watershed	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	acres						
Alkalai Creek	1801	0	0.0	0.0	0.0	0.0	0.0	0	0
Poison Creek	4198	9	19.43	3.04	0.0	7.74	0.0	30.21	0.7
North Branch Cave Gulch	3455	23	49.66	7.77	0.0	19.78	0.0	77.21	2.2
Main Branch Cave Gulch	3012	32	69.10	10.80	0.0	27.50	0.0	107.40	3.6
South Branch Cave Gulch	2735	27	58.26	9.11	0.0	23.20	0.0	90.57	3.3
Waltman Draw	4209	16	34.55	5.37	0.0	13.76	35.00	88.68	2.1
Upper Sand Draw	3074	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sand Draw Tributary	2027	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keg Springs Draw	582	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**25,093**	**107**	**231.00**	**36.09**	**0.0**	**91.98**	**35.0**	**394.07**	**1.6**

acres for roads without associated pipelines, 153.33 acres for the gas gathering pipelines not associated with roads, 153.33 acres of combined access road and pipeline construction, and 35.0 acres for ancillary facility sites. Table 4-7 summarizes the area of disturbance that would occur under Alternative A by sensitive and non-sensitive soils type. Of the total disturbance of 670.01 acres, 461.82 acres, or 69 percent of the disturbance, would occur in areas containing sensitive soils. The balance, 208.19 acres or 31 percent of the disturbance, would occur in areas containing non-sensitive soils. This suggests that the likelihood of causing significant impacts is high compared to areas that do not contain sensitive soils.

Soils with poor or very poor reclamation potentials comprise approximately 49 percent or 274.37 acres of the area of sensitive soils that would be impacted under Alternative A, or approximately 36 percent of the total area of disturbance. Thus, disturbance in these areas of poor or very poor reclamation potential could pose substantial reclamation difficulties such that significant impacts could occur. As discussed previously under the Proposed Action, only site-specific analysis in the field could determine the actual magnitude of impact of disturbance on soils.

The BLM has determined potential locations for well sites under Alternative A as described in Chapter 2. The following analysis is based on these well site locations. Potential road and pipeline alignments were not located on maps. To determine the disturbance impacts due to roads and pipelines, the unit disturbance assumptions made in Chapter 2 were applied to each well and such associated disturbance was assumed to occur in the same soil map unit and watershed as the well site. Table 4-3 summarizes the total disturbance under Alternative A according to slope class. Most of the proposed disturbance, 426.37 acres, would occur in the 6 to 10 percent slope class. However, 47.37 acres would occur in the 16 to 25 percent slope class and no disturbance would

occur in the 26 to 50 percent slope class where the potential for significant impacts would be high. As indicated previously, all slopes in excess of 15 percent should be avoided during project design and the site-specific APD authorization process.

Table 4-7. Summary of Construction Disturbance Impacts by Soil Type for Alternative A.

Alternative A									
Soil Class	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	Area (ac)						
Sensitive	16,279	72	195.16	43.64	111.51	111.51	0.0	461.82	2.8
Non-sensitive	8,814	27	73.19	16.36	41.82	41.82	35.00	208.19	2.4
TOTAL	**25,093**	**99**	**268.35**	**60.00**	**153.33**	**153.33**	**35.00**	**670.01**	**2.7**

Table 4-8 summarizes total disturbance associated with Alternative A by watershed. The North Branch, Main Branch, and the South Branch of Cave Gulch would sustain most of the 788.39 acres of disturbance (506.71 acres or 76 percent of the total disturbance), including 179.62 acres or 27 percent, 192.39 acres or 29 percent, and 134.70 acres or 20 percent of the construction disturbance, respectively. On a watershed basis, this would equate to 6.4 percent of the Main Branch of Cave Gulch, 5.2 percent for the North Branch of Cave Gulch, and 4.9 percent of the South Branch of Cave Gulch. Although these percentages are less than the threshold value of 10 percent presented in Section 4.3.2, they approach this threshold. The significance of the 10 percent threshold was previously discussed under the Proposed Action. Disturbance in the other watersheds range from 0 percent to 2.7 percent. As discussed in greater detail in Section 5.3 in Chapter 5, short-term construction disturbance combined with the total existing disturbance produces a total disturbance impact level that exceeds 10 percent in the Main Branch of Cave Gulch (12.4 percent) and Waltman Draw (10.2 percent). The same erosion calculations were applied to this alternative as described for the Proposed Action. The average unmitigated erosion rate could be as high as 14 t/ac/yr for drill pads, 74 t/ac/yr for pipelines, and 6 t/ac/yr for roads as summarized in Table 4-9. New project facilities would be constructed with surface runoff, erosion, and sedimentation controls in place that would reduce erosion rates. As described under the Proposed Action, erosion from newly disturbed areas could be reduced by more than 50 percent after the first year of construction and 95 percent by the fifth year of construction. These calculations suggest that soil erosion could be reduced to non-significant levels with the application of best management practices.

Table 4-8 summarizes total erosion that could occur under this alternative with and without erosion control measures. Without the application of erosion control measures, total erosion from Alternative A would be approximately 16,723 tons per year after the first year of construction and 3,776 tons after the fifth year. With the application of erosion control measures including effective revegetation, total erosion from Alternative A would be approximately 1,223 tons per year after the

Table 4-8. Summary of Construction Disturbance Impacts by Watershed for Alternative A.

Watershed	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	acres						
Alkalai Creek	1801	0	0	0	0	0	0.0	0	0
Poison Creek	4198	5	13.55	3.03	7.75	7.75	0.0	32.08	0.8
North Branch Cave Gulch	3455	28	75.91	16.97	43.37	43.37	0.0	179.62	5.2
Main Branch Cave Gulch	3012	30	81.33	18.18	46.44	46.44	0.0	192.39	6.4
South Branch Cave Gulch	2735	21	56.91	12.73	32.53	46.39	0.0	134.70	4.9
Waltman Draw	4209	12	32.52	7.27	18.59	18.59	35.0	111.97	2.7
Upper Sand Draw	3074	2	5.42	1.21	3.10	3.10	0	12.83	0.4
Sand Draw Tributary	2027	1	2.71	0.61	1.55	1.55	0	6.42	0.3
Keg Springs Draw	582	0	0	0	0	0	0	0	0
TOTAL	**25,093**	**99**	**268.35**	**60.00**	**153.33**	**153.33**	**35.0**	**670.01**	**2.7**

Table 4-9. Summary of Erosion Estimates Due to Construction for Alternative A.

Project Facility	Acres	Year 1				Year 5			
		Without BMP[a]		With BMP		Without BMP		With BMP	
		t/ac/yr[b]	t/yr[c]	t/ac/yr	t/yr	t/ac/yr	t/yr	t/ac/yr	t/yr
Well Pads	268.35	13.8	3,703	1.5	403	3.1	832	0.2	54
Roads unassociated with pipelines	60.00	5.8	348	2.3	138	1.5	90	0.5	30
Gathering Pipes unassociated with roads	153.33	73.7	11,300	1.8	276	16.4	2,515	0.5	77
Combined Roads and Pipelines	153.33	5.8	889	2.3	353	1.5	230	0.5	77
Ancillary Facilities	35.00	13.8	483	1.5	53	3.1	109	0.2	7
TOTAL Construction	670.01	---	16,723	---	1,223	---	3,776	---	245

[a] - BMP- Best Management Practices (BMP).
[b] - t/ac/yr - tons/acres/year.
[c] - t/yr - tons/year.

first year of construction and 245 tons per year after the fifth year. These estimates are in addition to baseline erosion and assume that all construction would occur in the first year of project authorization. Total erosion would be distributed according to the watershed the disturbance occurs in. Thus, the majority of erosion and sedimentation that would occur from soil disturbance would occur in the North (27 percent), South (20 percent), and Main (29 percent) Branches of Cave Gulch and Waltman Draw (17 percent).

In the long term during the production phase, there would be a reduction in disturbance associated with drill pads of from 268.35 acres during construction, drilling, and completion to 160.10 acres during the production phase. Similarly, all of the 40-foot wide gathering pipelines unassociated with roads (153.33 acres) would be reclaimed during the production phase. Road disturbance outside of drainage ditches would also be reclaimed during production, reducing road disturbance from 40 feet to approximately 16 to 20 feet, depending on the service level of the road. This would result in an approximate reduction in total disturbance from 60.00 acres to 32.26 acres. A similar reduction in disturbance would occur for combined roads and pipelines from 153.33 acres to 79.69 acres. The ancillary facilities (35 acres) would not be reclaimed during operations since such sites would be totally occupied for operational activities. Thus, during the production phase, the disturbance area would be reduced from 670.01 acres to a residual disturbance of 307.04 acres, or 362.97 acres of the total disturbance would be reclaimed. This residual production phase disturbance area would represent approximately 1.2 percent of the 25,093-acre project area. Table 4-10 summarizes the disturbance area left unreclaimed during the production phase by watershed. The South, North, and Main Branches of Cave Gulch would be subjected to approximately 56.58 acres (2.1 percent), 75.46 acres (2.2 percent), and 80.82 acres (2.7 percent) of disturbance during the production phase, respectively.

Table 4-10. Summary of Production Disturbance Impacts by Watershed for Alternative A.

Watershed	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	acres						
Alkalai Creek	1801	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poison Creek	4198	5	8.08	1.52	0.0	3.88	0.0	13.48	0.3
North Branch Cave Gulch	3455	28	45.29	8.48	0.0	21.69	0.0	75.46	2.2
Main Branch Cave Gulch	3012	30	48.52	9.08	0.0	23.22	0.0	80.82	2.7
South Branch Cave Gulch	2735	21	33.95	6.36	0.0	16.27	0.0	56.58	2.1
Waltman Draw	4209	12	19.40	3.64	0.0	9.30	35.0	67.34	1.6
Upper Sand Draw	3074	2	3.23	0.61	0.0	1.55	0.0	5.39	0.2
Sand Draw Tributary	2027	1	1.62	0.31	0.0	0.78	0.0	2.71	0.1
Keg Springs Draw	582	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	25,093	99	160.09	32.26	0.0	79.69	35.0	307.04	1.2

As discussed in greater detail in Section 5.3 of Chapter 5, the residual project disturbance area of 307.04 acres would be combined with the unreclaimed existing disturbance (452 acres) to produce approximately 759.24 acres of unreclaimed disturbance, or 3.0 percent of the 25,093-acre project area. Cumulative long-term disturbance would be approximately 5.5 percent for the Main Branch of Cave Gulch, 4.6 percent for Waltman Draw, 3.4 percent for the North Branch of Cave Gulch, and 3.4 percent for the South Branch of Cave Gulch. Other watersheds would sustain less than 3 percent cumulative disturbance in the long term. Thus, in the long term, total disturbance would not exceed the impact significance criteria of 10 percent identified above.

Assuming sensitive soils and slopes greater than 25 percent could be avoided to the maximum extent practicable and carefully designed surface runoff, erosion, sedimentation control, and revegetation plans would be developed for these sites that cannot avoid sensitive soils, implementation of this alternative could occur without causing significant impacts on soil resources. Given the above impacts analysis and the mitigation items identified in Section 4.3.6, this alternative could be implemented in compliance with RMP directives.

4.3.3.3 Alternative B

Under Alternative B, the density of surface well pads and production facilities would be decreased below the Proposed Action level, but would be greater than for Alternative A. As discussed in greater detail in Chapter 2, this alternative was developed to reduce adverse impacts on raptors. In general, the potential adverse impacts of this alternative would be similar to the Proposed Action, but of reduced magnitude. A larger proportion of this alternative would be reclaimed during the production phase when compared to the Proposed Action and Alternative A. The same types of impacts would occur as previously described for the Proposed Action and Alternative A.

Construction of this alternative would variously disturb approximately 768.71 acres of soils or 3.1 percent of the 25,093-acre project area. This total would include 313.50 acres for drill sites, 68.75 acres for roads without associated pipelines, 175.73 acres for the gas gathering pipelines not associated with roads, 175.73 acres of combined access road and pipeline construction, and 35.0 acres for ancillary facility sites. Table 4-11 summarizes the area of disturbance that would occur under Alternative B by sensitive and non-sensitive soils type. Of the total disturbance of 768.71 acres, 559.94 acres, or 73 percent of the disturbance, would occur in areas containing sensitive soils. The balance, 208.77 acres or 27 percent of the disturbance, would occur in areas containing non-sensitive soils. This suggests that the likelihood of causing significant impacts is high compared to areas that do not contain sensitive soils.

Soils with poor or very poor reclamation potentials comprise approximately 58 percent or 324.77 acres of the area of sensitive soils that would be impacted under Alternative B, or approximately 42 percent of the total area of disturbance. Thus, disturbance in these areas of poor or very poor reclamation potential could pose substantial reclamation difficulties such that significant impacts could occur. As discussed previously under the Proposed Action, only site-specific analysis in the field could determine the actual magnitude of impact of disturbance on soils.

The BLM has determined potential locations for well sites under Alternative B as described in Chapter 2. The following analysis is based on these well site locations. Potential road and pipeline alignments were not located on maps. To determine the disturbance impacts due to roads and pipelines, the unit disturbance assumptions made in Chapter 2 were applied to each well and such

associated disturbance was assumed to occur in the same soil map unit and watershed as the well site. Table 4-3 summarizes the total disturbance under Alternative B according to slope class. Most of the proposed disturbance, 451.78 acres, would occur in the 6 to 10 percent slope class. However, 67.43 acres would occur in the 16 to 25 percent slope class and 13.49 acres of disturbance would occur in the 26 to 50 percent slope class where the potential for significant impacts would be high. As indicated previously, all slopes in excess of 15 percent should be avoided during project design and the site-specific APD authorization process.

Table 4-12 summarizes total disturbance associated with Alternative B by watershed. The North Branch, Main Branch, and the South Branch of Cave Gulch would sustain most of the 768.71 acres of disturbance (604.98 acres or 79 percent of the total disturbance), including 180.24 acres or 24 percent, 238.10 acres or 31 percent, and 186.64 acres or 24 percent of the construction disturbance, respectively. On a watershed basis, this would equate to 7.9 percent of the Main Branch of Cave Gulch, 5.2 percent for the North Branch of Cave Gulch, and 6.8 percent of the South Branch of Cave Gulch. Although these percentages are less than the threshold value of 10 percent presented in Section 4.3.2, they approach this threshold. The significance of the 10 percent threshold was previously discussed under the Proposed Action. Disturbance in the other watersheds range from 0 percent to 2.7 percent. As discussed in greater detail in Section 5.3 in Chapter 5, short-term construction disturbance combined with the total existing disturbance produces a total disturbance impact level that exceeds 10 percent in the Main Branch of Cave Gulch (13.9 percent) and Waltman Draw (10.2 percent), while total disturbance approaches 10 percent in the South Branch of Cave Gulch (9.6 percent).

Table 4-11. Summary of Construction Disturbance Impacts by Soil Type for Alternative B.

Alternative B									
Soil Class	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	Area (ac)						
Sensitive	16,279	87	239.25	52.47	134.11	134.11	0.0	559.94	3.4
Non-sensitive	8,814	27	74.25	16,28	41.62	41.62	35.00	208.77	2.4
TOTAL	**25,093**	**114**	**313.50**	**68.75**	**175.73**	**175.73**	**35.00**	**768.71**	**3.1**

The same erosion calculations were applied to this alternative as described for the Proposed Action. The average unmitigated erosion rate could be as high as 14 t/ac/yr for drill pads, 74 t/ac/yr for pipelines, and 6 t/ac/yr for roads as summarized in Table 4-12. New project facilities would be constructed with surface runoff, erosion, and sedimentation controls in place that would reduce erosion rates. As described under the Proposed Action, erosion from newly disturbed areas could be reduced by more than 50 percent after the first year of construction and 95 percent by the fifth year of construction. These calculations suggest that soil erosion could be reduced to non-significant levels with the application of best management practices.

Table 4-12. Summary of Construction Disturbance Impacts by Watershed for Alternative B.

Watershed	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	acres						
Alkalai Creek	1801	0	0	0	0	0	0.0	0	0
Poison Creek	4198	5	13.75	3.02	7.71	7.71	0.0	32.19	0.8
North Branch Cave Gulch	3455	28	77.00	16.88	43.18	43.18	0.0	180.24	5.2
Main Branch Cave Gulch	3012	37	101.75	22.31	57.02	57.02	0.0	238.10	7.9
South Branch Cave Gulch	2735	29	79.75	17.49	44.70	44.70	0.0	186.64	6.8
Waltman Draw	4209	12	33.00	7.24	18.50	18.50	35.0	112.24	2.7
Upper Sand Draw	3074	2	5.50	1.21	3.08	3.08	0	12.87	0.4
Sand Draw Tributary	2027	1	2.75	0.60	1.54	1.54	0	6.43	0.3
Keg Springs Draw	582	0	0	0	0	0	0	0	0
TOTAL	25,093	114	313.50	68.75	175.73	175.73	35.0	768.71	3.1

Table 4-13 summarizes total erosion that could occur under this alternative with and without erosion control measures. Without the application of erosion control measures, total erosion from Alternative A would be approximately 19,178 tons per year after the first year of construction and 4,330 tons after the fifth year. With the application of erosion control measures including effective revegetation, total erosion from Alternative B would be approximately 1,401 tons per year after the first year of construction and 280 tons per year after the fifth year. These estimates are in addition to baseline erosion and assume that all construction would occur in the first year of project authorization. Total erosion would be distributed according to the watershed the disturbance occurs in. Thus, the majority of erosion and sedimentation that would occur from soil disturbance would occur in the North (24 percent), South (24 percent), and Main (31 percent) Branches of Cave Gulch.

In the long term during the production phase, there would be a reduction in disturbance associated with drill pads of from 313.50 acres during construction, drilling, and completion to 185.50 acres during the production phase. Similarly, all of the 40-foot wide gathering pipelines unassociated with roads (175.73 acres) would be reclaimed during the production phase. Road disturbance outside of drainage ditches would also be reclaimed during production, reducing road disturbance from 40 feet to approximately 16 to 20 feet, depending on the service level of the road. This would result in an approximate reduction in total disturbance from 68.75 acres to 37.05 acres. A similar reduction in disturbance would occur for combined roads and pipelines from 175.73 acres to 90.87 acres. The ancillary facilities (35 acres) would not be reclaimed during operations since such sites would be totally occupied for operational activities. Thus, during the production phase, the disturbance area would be reduced from 768.71 acres to a residual disturbance of 348.43 acres, or 420.28 acres of the total disturbance would be reclaimed. This residual production phase disturbance area would represent approximately 1.4 percent of the 25,093-acre project area. Table 4-14 summarizes the disturbance area left unreclaimed during the production phase by watershed.

The South, North, and Main Branches of Cave Gulch would be subjected to approximately 78.29 acres (2.9 percent), 75.59 acres (2.2 percent), and 99.88 acres (3.3 percent) of disturbance during the production phase, respectively.

Table 4-13. Summary of Erosion Estimates Due to Construction for Alternative B.

Project Facility	Acres	Year 1				Year 5			
		Without BMP[a]		With BMP		Without BMP		With BMP	
		t/ac/yr[b]	t/yr[c]	t/ac/yr	t/yr	t/ac/yr	t/yr	t/ac/yr	t/yr
Well Pads	313.50	13.8	4,326	1.5	470	3.1	972	0.2	63
Roads unassociated with pipelines	68.75	5.8	399	2.3	158	1.5	103	0.5	34
Gathering Pipes unassociated with roads	175.73	73.7	12,951	1.8	316	16.4	2,882	0.5	88
Combined Roads and Pipelines	175.73	5.8	1,019	2.3	404	1.5	264	0.5	88
Ancillary Facilities	35.00	13.8	483	1.5	53	3.1	109	0.2	7
TOTAL Construction	768.71	—	19,178	—	1,401	—	4,330	—	280

[a] - BMP- Best Management Practices (BMP).
[b] - t/ac/yr - tons/acres/year.
[c] - t/yr - tons/year.

Table 4-14. Summary of Production Disturbance Impacts by Watershed for Alternative B.

Watershed	Area (ac)	Well Pads		Road (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	acres						
Alkalai Creek	1801	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poison Creek	4198	5	8.14	1.51	0.0	3.86	0.0	13.51	0.3
North Branch Cave Gulch	3455	28	45.56	8.44	0.0	21.59	0.0	75.59	2.2
Main Branch Cave Gulch	3012	37	60.21	11.16	0.0	28.51	0.0	99.88	3.3
South Branch Cave Gulch	2735	29	47.19	8.75	0.0	22.35	0.0	78.29	2.9
Waltman Draw	4209	12	19.53	3.62	0.0	9.25	35.0	67.40	1.6
Upper Sand Draw	3074	2	3.25	0.61	0.0	1.54	0.0	5.40	0.2
Sand Draw Tributary	2027	1	1.63	0.30	0.0	0.77	0.0	2.7	0.1
Keg Springs Draw	582	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	25,093	114	185.51	37.05	0.0	90.87	35.0	348.43	1.4

As discussed in greater detail in Section 5.3 of Chapter 5, the residual project disturbance area of 348.43 acres would be combined with the unreclaimed existing disturbance (452 acres) to produce approximately 800.63 acres of unreclaimed disturbance, or 3.2 percent of the 25,093-acre project area. Cumulative long-term disturbance would be approximately 6.1 percent for the Main Branch of Cave Gulch, 4.6 percent for Waltman Draw, 3.4 percent for the North Branch of Cave Gulch, 4.2 percent for the South Branch of Cave Gulch, and 4.6 percent for Waltman Draw. Other watersheds would sustain less than 3 percent cumulative disturbance in the long term. Thus, in the long term, total disturbance would not exceed the impact significance criteria of 10 percent identified above.

Assuming sensitive soils and slopes greater than 25 percent could be avoided to the maximum extent practicable and carefully designed surface runoff, erosion, sedimentation control, and revegetation plans would be developed for these sites that cannot avoid sensitive soils, implementation of this alternative could occur without causing significant impacts on soil resources. Given the above impacts analysis and the mitigation items identified in Section 4.3.6, this alternative could be implemented in compliance with RMP directives.

4.3.3.4 Alternative C - No Action

Under the No Action Alternative, soils would continue to be impacted as additional individual APDs were granted by the BLM. Soils impacts would be similar to those described above. In terms of magnitude, such impacts would likely be similar to the Proposed Action and other action alternatives. There would be an increased probability of occurrence of unexpected adverse impacts since overall field development would not happen in a well-planned out manner.

4.3.4 Impacts Summary

Impacts resulting from drill pad, access road, and pipeline ROW construction could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion.

Implementation of the Proposed Action would result in a total of 788.39 acres of disturbance. Assuming avoidance of sensitive soils to the maximum extent practicable, effective surface runoff, erosion, and sedimentation control combined with effective revegetation would reduce the severity of adverse impacts to non-significant levels. Alternative A would involve a reduced level of disturbance from the Proposed Action and would involve 670.01 acres of disturbance. Alternative B would involve a reduced level of disturbance from the Proposed Action, but greater than Alternative A, and would involve 768.71 acres of disturbance. Alternative C, No Action, under which individual APDs could continue to be approved by the BLM, would result in impacts approaching the magnitude of the action alternatives. However, there would be an increased probability of occurrence of unexpected adverse impacts since overall field development would not happen in a well-planned out manner.

Alternative B (559.94 acres) would involve more disturbance in sensitive soils than the Proposed Action (549.08) and Alternative A (468.82 acres). Similarly, Alternative B (321.80 acres) would involve more disturbance in soils with a poor or very poor reclamation potential than the Proposed Action (302.70) and Alternative A (321.80 acres). Thus, Alternative B would potentially be the more damaging of the action alternatives in this regard.

Both the Proposed Action and Alternative B would involve siting of project facilities in areas of slope gradients greater than 25 percent. This could lead to significant impacts in regard to increased surface runoff, erosion, and sedimentation, as well as reclamation problems.

In regard to the amount of construction disturbance located in each of the nine watersheds, the Main Branch of Cave Gulch would sustain the most development pressure under each alternative. The Proposed Action and Alternative B would involve an increased level of disturbance in the South Branch of Cave Gulch. Significant cumulative impacts could occur in the Waltman Draw and Main Branch of Cave Gulch watersheds in the short term during construction, but total disturbance would be below the 10 percent threshold in the long-term production phase. Erosion impacts would follow a similar trend of magnitude commensurate with the area of disturbance associated with each alternative.

The analysis of direct and indirect impacts indicates that significant impacts could occur under each of the action alternatives as well as the No Action alternative. Mitigation would be required to avoid such significant impacts as itemized in the next section.

4.3.5 Mitigation Summary

In addition to measures proposed by the operators and prescribed by existing management directions, implementation of the following mitigation measures would ensure important impacts would not occur:

- Reduce all soil disturbance to the absolute minimum area required for feasible construction and operation.

- During the site-specific planning process, avoid to the maximum extent possible sensitive soil areas, areas with poor and very poor reclamation, and slopes in excess of 15 percent. There is a good chance the avoidance of these areas would be feasible in most cases based on site-specific field review during the APD process. Where these areas cannot be avoided, special construction techniques and mitigation measures would need to be developed and approved by the BLM AO before authorization and construction of project facilities in such areas could occur. The specific construction measures developed for project facilities that absolutely cannot avoid such areas would have to be based on site-specific field analysis during the APD process.

- Salvage and selectively handle the upper 6 to 12 inches of the soil and use the salvage topsoil in revegetating soil disturbances. Every effort should be taken to minimize mixing of subsoil with topsoil as well as mixing course fragments with finer-textured topsoil.

- Implement effective surface runoff and sediment control structures to minimize erosion and off-site sedimentation.

- All disturbances should be mulched, with mulch crimped or hydromulched, if left exposed for more than one month. All disturbances regraded and topsoiled should be protected with weed-free mulch. Effective protection of sandy soils would be required to minimize the potential of wind erosion.

- Disturbed areas should be stabilized with appropriate treatments (topsoiled, mulched, erosion control, etc.) immediately following project facility construction until the areas can be seeded with site-specific mix(es) during the next appropriate planting period (spring or fall).

- Per BLM Wyoming State Reclamation policy (USDI-BLM 1990) and Executive Order 11987, site specific seed mixes should be developed that primarily include native species. Introduced species should be avoided where practicable. Such seed mixes should include a variety of grasses, forbs (including nitrogen-fixers), and shrubs where appropriate. Appendix B presents recommended guidelines for reclaiming project disturbances.

- Limit construction activities to periods when soil materials are dry and not frozen or wet. The RMP states that no construction will be allowed from December 30 through June 1 in the South Fork of the Powder River which includes the majority of the areas proposed for facilities locations.

- Design cut and fill slopes in a manner that will allow retention of topsoil and subsequent revegetation and mulching.

- Although the operators initially proposed to only line reserve pits in areas where leakage was anticipated to be a problem, there is sufficient information known on the character of soils and the sensitivity of the hydrologic environment to require that all pits be lined, whether reserve or evaporative. Therefore, all pits should be lined with impermeable membrane liners having a permeability of less than 10^{-7} centimeters/second.

- Include in road design adequate drainage control devices and measures (e.g., road berms and drainage ditches, diversion ditches, cross drains, culverts, out-sloping, and energy dissipators) at sufficient intervals and intensities to adequately control and direct surface runoff above, below, and within the road environment to avoid erosive concentrated flows. In conjunction with surface runoff or drainage control measures, use erosion control devices and measures such as temporary barriers, ditch blocks, water bars erosion stops, mats, mulches, and vegetative covers. Implement a timely revegetation program as soon as possible to re-establish the soil protection afforded by a vegetal cover.

- The RMP specifies that a watershed management plan be developed for the Cave Gulch drainage if the level of disturbance becomes important. The Cave Gulch watershed will be evaluated by the BLM to determine the need for intensive management. Intensive management may include requirements for a watershed plan, implementation of various protective measures, and placement of various structures as may be necessary.

4.3.6 Residual Impacts

No significant residual impacts would result from project implementation provided that all environmental protection strategies identified in the mitigation section above, Chapter 2, and in Appendices A and B are implemented successfully.

4.4 WATER RESOURCES

4.4.1 Introduction

Potential impacts that could occur due to the proposed project include increased surface water runoff and off-site sedimentation due to soil disturbance (see the Soils Section 4.3); increased salt loading and water quality impairment of surface waters; and channel morphology changes due to road and pipeline crossings. The magnitudes of impacts to water resources would depend on the proximity of the disturbance to the drainage channel, slope aspect and gradient, degree and area of soil disturbance, soil character, duration of time within which construction activities would occur, and the timely implementation and success/failure of mitigation measures. Impacts would likely be greatest shortly after the start of construction activities and would likely decrease in time due to natural stabilization, reclamation, and revegetation efforts. Construction activities would occur over a relatively short period; therefore, the majority of the disturbance would be intense but short-lived. Petroleum products and other chemicals could be accidentally spilled resulting in surface and groundwater contamination. Similarly, reserve and evaporative pits could leak and degrade surface and groundwater if liners were punctured or no liners installed. Authorization of the proposed project would require full compliance with RMP management directives that relate to surface and groundwater protection, Executive Order 11990 (floodplains protection), and the Federal Clean Water Act (CWA) in regard to protection of water quality and compliance with Section 404.

4.4.2 Impact Significance Criteria

- Non-compliance with the RMP (USDI-BLM 1984b). The following management directives pertinent to the water environment are presented in the RMP (see also soils directives):
    - surface development would be prohibited in the following areas:
        - within 500 feet of live streams, lakes, reservoirs, and canals and associated riparian habitat;
        - within 500 feet of water wells;
        - within 660 feet of springs or artesian and flowing wells; and
        - within 200 feet of intermittent and ephemeral streams.
- Compliance with Executive Order 11990, Protection of Floodplains;
- Degradation of water quality such that state standards outlined in the Rules and Regulations of the Water Quality Division of the Wyoming Department of Environmental Quality are not met;
- Degradation of groundwater quality in any freshwater aquifers regardless of use or non-use;
- Alteration of channel geometry or gradients that produce undesirable effects such as aggradation, degradation, or side-cutting;

- Modification of the quantity and quality of streamflows such that it affects established users; and

- Non-compliance with the CWA in regard to water quality and Section 404 permits.

4.4.3 Direct and Indirect Impacts

4.4.3.1 Proposed Action

The proposed project activities listed above could result in adverse impacts to water resources including the removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. These impacts could increase runoff, erosion, and off-site sedimentation which could cause channel instability and degradation of surface water quality. As described previously under Soils, project construction disturbances would be approximately 788.39 acres. These disturbance areas would represent approximately 3.1 percent of the total 25,093-acre project area. This total would include 313.45 acres for drill sites, 72.06 acres for roads without associated pipelines, 183.94 acres for the gas gathering pipelines not associated with roads, 183.94 acres of combined access road and pipeline construction, and 35.0 acres for ancillary facility sites. These disturbance areas were summarized in Tables 4-2 through 4-6 of the Soils section (4.3). The construction disturbance would not be uniformly distributed across the project area. Rather, project facilities would be located where the efficiency and feasibility of extracting the natural gas would be the highest as discussed in Chapter 2.

The following analysis is based on well site locations identified by the BLM. Potential road and pipeline alignments were not located on maps. Disturbance impacts due to roads and pipelines were determined as described in Section 4.3.3. Construction disturbance was allocated according to the watersheds the disturbance occurred in. Of the total disturbance of 788.39 acres, 549.08 acres, or 70 percent of the disturbance, would occur in areas containing sensitive soils as summarized in Table 4-2. Sensitive soils include physical characteristics that relate to watershed stability, runoff potential, erosion potential, and surface runoff rates. The balance, 239.31 acres or 30 percent of the disturbance, would occur in areas containing non-sensitive soils. This suggests that the likelihood of causing significant impacts is high compared to areas that do not contain sensitive soils.

Table 4-3 summarized the total disturbance under the Proposed Action according to slope class. This is important information because the slope of the landform determines to a large degree the rate of surface runoff and the potential for erosion and off-site sedimentation. Most of the proposed disturbance, 434.71 acres, would occur in the 6 to 10 percent slope class. However, 58.95 acres would occur in the 16 to 25 percent slope class and 14.74 acres would occur in the 26 to 50 percent slope class where the potential for significant impacts relating to excessive surface runoff would be high. Siting of project facilities on slopes in excess of 25 percent would constitute a significant impact and such areas should be avoided.

The construction disturbance associated with the Proposed Action can also be distributed by the watersheds shown in Figure 3-5. Table 4-4 summarizes the disturbance by watershed. As discussed in section 4.3.3, the Main Branch of Cave Gulch and the South Branch of Cave Gulch would sustain most of the 788.39 acres of disturbance (415.32 acres or 53 percent of the total

disturbance), including 225.30 acres or 29 percent, and 190.02 acres or 24 percent of the total disturbance, respectively. On a watershed basis, this would equate to 7.5 percent of the Main Branch of Cave Gulch and 7.0 percent of the South Branch of Cave Gulch. Although these percentages are less than the threshold value of 10 percent discussed in Section 4.3.3, they approach this threshold. The 10 percent threshold is important because at this level of disturbance, watersheds begin to show obvious adverse signs of instability and adjustment (i.e., excessive erosion, slope instability, channel instability, and sedimentation). Disturbance in the other watersheds range from 0 percent to 4.7 percent. As discussed in greater detail in Section 5.3 and 5.4 in Chapter 5, short-term construction disturbance combined with the total existing disturbance (1,041 acres) produces a total disturbance impact level that exceeds 10 percent in the Main Branch of Cave Gulch (13.5 percent) and Waltman Draw (11.1 percent).

As discussed in the Soils section 4.3.3) and as presented in the Soils, Water, and Vegetation Resources Technical Report (ECOTONE 1997), approximately 19,860 t/yr of soil erosion could occur from soil disturbances without erosion control or 1,443 t/yr with erosion control after the first year of construction as summarized in Table 4-5. These estimates are for total soil detached and entrained in place and do not include sediment transport over the ground surface. The vast majority of the soil detached and entrained is transported and deposited in very close proximity to the source and very little sediment is transported successfully to stream channels. The primary factors of sediment delivery efficiency include slope gradient, roughness of soil and vegetation, and overland distance of transport. Most drainage channels occur in valley bottom locations with sideslope gradients less than 10 percent. Undisturbed vegetation is relatively dense ranging from 50 to 80 percent. As indicated, the vast majority of soil disturbance would be well away from stream channels as required by RMP management directives identified in Section 4.4.2 (within 500 feet of live streams, lakes, reservoirs, canals and associated riparian habitat, and water wells; within 660 feet of springs or artesian and flowing wells; and within 200 feet of intermittent and ephemeral streams). Given these conditions, sediment delivery efficiency is likely to be well below 10 percent. Using this efficiency (i.e., 10 percent), approximately 1,986 t/yr without erosion control and 144 t/yr with erosion control could be transported to stream channels after the first year of construction. In regard to an increase in sediment delivery, these sediment delivery values would equate to an increase in sediment yield in streams of less than 0.0001 ac-ft/mi^2/yr as compared to current sediment yield of 1.0 ac-ft/mi^2/yr. Thus, adverse sedimentation is not expected to occur, in general, as a result of implementation of the Proposed Action. As discussed in Chapter 3, most of the yield originates from channel erosion and degradation due to infrequent high intensity thunderstorm events.

As indicated previously, compliance with the RMP management directives and Executive Order 11990 would be required for project authorization. Both regulations require avoidance of stream channels to the maximum practicable extent. Where total avoidance is not practicable, then minimization of impacts to streams and associated floodplains/floodways must be implemented. Where streams and floodplains cannot be avoided, the Operators would be required to show the BLM AO why such resources cannot be totally avoided and how impacts would be minimized.

As described in Section 3.4 of Chapter 3, many of the ephemeral and intermittent stream channels show signs of channel degradation and downcutting. Often these adverse channel processes are in response to disturbance in the watersheds or are the result of very sensitive watersheds. Even though the above analysis indicated that sediment transport to a channel would likely be very small, this sediment input combined with potential minor increases in surface runoff could increase the

rate of channel degradation and downcutting which would also increase sedimentation. Therefore, even with the predicted small quantity of sediment transport, such sediment must be managed in these sensitive watersheds by restricting all sediment to the site of erosion through the implementation of best management practices and mitigation.

As described in Chapter 2, water would be required in most aspects of project construction including road construction, drill site construction, and well drilling. Water for use in facilities construction could be as high as 1,000 gallons per acre of disturbance. This would equate to approximately 2.2 ac-ft of water. Water used in the well-drilling process could be as high as 462,000 gallons, or 1.4 ac-ft, per well for a total of 224 ac-ft (for 160 wells). Assuming one set of pipelines per well pad (single or multiple wells), and all pipelines associated with 107 well pads (520,080 feet of pipeline) would be hydrostatically tested at once and therefore water would not be re-used, approximately 4.2 ac-ft, of water would be required for hydrostatic testing of pipelines. Therefore, total water demand with hydrostatic testing for this alternative would be approximately 230.4 ac-ft. Water would be obtained from State of Wyoming approved sources. This water demand is relatively small and would not adversely affect existing surface or groundwater sources or rights. This total quantity of water would not be withdrawn from a source of water at one time; rather, this amount would be distributed over the construction phase that could be staggered over several years as discussed in Chapter 2. As described in Chapter 3, there are only a few groundwater rights filed in the project area. Two of the 18 permits are adjudicated, three are abandoned, six are canceled, and seven have unknown status. There are 16 surface water right permits on file that occur within the project area. Six of the permits are unadjudicated, five are adjudicated, four are good standing, and one is expired. These surface water rights are all located on various drainage channels in the project area. Most of the rights are associated with livestock watering facilities (i.e., stock ponds); however, two rights are associated with domestic use. The water demand identified above would not likely adversely affect the surface water or groundwater rights in the project area provided full coordination is implemented with the Wyoming State Engineer's Office (SEO), BLM, and the surface water right holders prior to project implementation. The total demand of 230 ac-ft by the project would be spread out over several years. Thus, water diversion and/or extraction would not cause significant adverse impacts on surface or groundwater supply in the project area.

Handling and management of hydrostatic test water, if used by the applicant, would need to be accomplished in a manner that does not adversely affect soils, streams channels, and surface water and groundwater quality. A large portion of the hydrostatic test water would be re-used for other aspects of the construction, drilling, completion, and/or production processes. However, if such water is not re-used it must be disposed of in a manner where soil scouring and water quality impairment would not result. Used water from hydrostatic testing is expected to have relatively good water quality. Hydrostatic test water should be evaluated for compliance with State water quality standards. No test water should be discharged unless such water meets these standards. Further, use and disposal of hydrostatic test water must comply with the mandatory ROW stipulation for hydrostatic testing as well as the CWA and the National Pollutant Discharge Elimination System (NPDES) permit that would be required for the proposed project.

Reserve pits would be utilized to contain drilling cuttings and waste water from the well drilling operations. Although the operators initially proposed to only line reserve pits in areas where leakage was anticipated to be a problem, there is sufficient information known on the character of soils and the sensitivity of the hydrologic environment to require that all pits be lined, whether

reserve or evaporative. In general, all reserve pits should have an impermeable liner placed given the relatively coarse textured soils of the project area and their high permeability and potential for leakage. As discussed in Section 4.3 of Chapter 4, many of the soils in the project area are relatively coarse-textured with high infiltration and permeability rates. High infiltration and permeability rates restrict the soil's suitability for unlined reserve pits. Soils with high permeability rates can lead to reserve pit seepage and possible contamination of surface and groundwater if such pits are unlined. Further, given that the project area occurs in an important groundwater recharge area (Powder River Basin-Wind River Basin divide), adverse impacts of potential leakage from unlined pits would be particularly severe and significant. Therefore, all pits should be lined with impermeable membrane liners having a permeability of less than 10^{-7} centimeters/second. Leakage of pit fluids would be minimal from lined reserve pits unless the liners were installed incorrectly or the liners were damaged during drilling operations. Thus, adverse impacts from leaks in lined reserve pits would likely not occur.

As discussed in Chapter 2, some deep wells may require the use of oil based muds. Oil based muds could have the potential to further degrade groundwater quality. However, such muds would be required to be in compliance with EPA standards on hazardous wastes. If used, such oil based mud should be fully isolated from surface and groundwater systems. The operators would be required to provide specific plans on how such oil-based mud systems would be applied and how containment of potential hazardous substances would be managed and ensured.

It is unlikely that seeps or springs would be adversely affected by the proposed action as very few of these water features occur within the project area nor are they likely to occur near proposed project facilities. Figures 3-4 and 3-5 show areas that may contain seeps and springs. However, locations of such surface water expressions of groundwater would be evaluated during the site-specific analysis conducted for all project components at the APD stage. All construction activities and storage of petroleum products would be kept well away from seeps and springs (a minimum distance of 200 to 600 feet depending on type of spring). Therefore, contamination of seeps and springs and groundwater would be unlikely.

Well drilling and completion should not have an adverse effect on groundwater quality if the project is in compliance with "On-shore Oil and Gas Order No. 2". However, poor drilling and completion techniques could result in degradation of groundwater due to the mixing of variable quality water from different aquifers. Groundwater at various depths usually occurs under pressure due to confining beds. Once pierced, groundwater can migrate vertically up and down the well bore and mix with groundwater a different depths. Depending on the quality of waters that mix, this could result in a reduction in groundwater quality. The magnitude of mixing, if any, would be relatively small during drilling due to the relatively short period of time drilling is accomplished and the state-of-art drilling and completion techniques proposed by the operators. Therefore, the opportunity for significant degradation of groundwater quality in aquifers would be low.

Well completion must be accomplished in compliance with "On-Shore Oil and Gas Order No. 2." These guidelines specify the following:

> "...proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones, potentially productive zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. Any isolating medium other than cement shall receive approval prior to use."

Usable water is defined as groundwater with a TDS of 10,000 ppm or less encountered at any depth. To comply with the order, wells must be completed such that either usable water is isolated from "unusable" water, or that unusable water is isolated from usable water through the use of cementing and other proven technologies. Assuming compliance with this order, no contamination of usable groundwater would likely occur. Well drilling and completion as proposed in Chapter 2 appears to comply with the on-shore order.
As discussed in Chapter 3, the SEO records identify approximately eighteen groundwater permits in the project area. Two of the 18 permits are adjudicated, three are abandoned, six are canceled, and seven have unknown status. This, combined with the improbable degradation of groundwater quality would essentially eliminate the potential occurrence of adverse impacts to water right holders in the project area.

There is a remote chance that road and pipeline construction across established channels could adversely modify flow hydraulics. However, with correct design of channel crossings including design for 25- to 50-year runoff events, no adverse impacts are expected. (Note: most Interstate highway features are only designed to handle a 50-year event). As discussed in Chapter 3, most drainage channels in the project area have ephemeral flow class (277,465 feet) and few channels exhibit intermittent flow (59,870 feet). Intermittent and perennial stream reaches occur well down-stream and out of the project area. Therefore, it is unlikely that increased sedimentation would adversely affect water quality of surface waters. However, some increase in sediment discharge into the existing detention ponds (i.e., stock ponds) within the project area could occur. This could result in sedimentation and loss of storage capacity of the ponds. The erosion analysis indicates that with successful implementation of control measures, no significant increase in channel sedimentation should occur. Thus, the storage capacity of the ponds should not be adversely impacted. There is a greater chance that a pond would be filled in with sediment due to natural channel erosion processes and to separate out natural processes from human-induced would be impossible within the scope of this EIS. If it were determined that the project causes loss of storage capacity or reduction in water quality, the operators would be required to compensate the water right holders by excavating the collected sediment in the pond and/or provide better quality water during the occurrence of the adverse impact. Most of the project could be constructed without adverse affect on water resources except in areas where project facilities cannot avoid sensitive soils areas as discussed in the Soils section.

It is likely that field production would result in produced water from many or most wells. Some of this water could be used during the construction phase, but only if there are wells to be drilled and facilities to construct after producing wells yield such water. Water is produced from existing Chevron wells within the Cave Gulch and Waltman field areas. Such water is injected into Chevron Waltman No. 15 well without adverse effects. Such injection is permitted by the Wyoming Oil and Gas Conservation Commission. Similar procedures may need to be implemented for the Proposed Action depending on the amount of water produced. Produced water should be evaluated for compliance with State water quality standards. No produced water should be discharged unless such water meets these standards.

As identified previously, authorization of the proposed project would require full compliance with RMP management directives that relate to surface and groundwater protection, Executive Order 11990 (floodplains protection), and the CWA in regard to protection of water quality and compliance with Section 404. These regulations require that certain permits/authorizations be obtained for project authorization including a NPDES permit; development of a surface runoff, erosion, and

sedimentation control plan; oil spill containment and contingency plan; as well as CWA Section 404 permits. Most of the ephemeral and intermittent drainage channels identified on Figures 3-4 and 3-5 are classified as waters of the U.S. and are often associated with jurisdictional wetlands. Crossings of these channels and associated wetlands would require authorization from the U.S. Army Corps of Engineers (COE) through the CWA Section 404 permitting process. However, these channel crossings would likely receive expedited authorization from the COE through Nationwide Permit No. 12 (buried utility lines) and/or No. 14 (minor road crossing fills). Other project facilities such as well sites and/or facilities sites could not be located in waters of the U.S., and therefore, Section 404 permitting would not be necessary for such facilities. Each individual channel crossing would be reviewed during the APD/ROW permitting process for specific permit requirements under Section 404 of the CWA. No significant impacts would likely result given the assumptions and compliance with management direction identified previously, as well as the mitigation measures listed under Mitigation.

4.4.3.2 Alternative A

The same types of adverse impacts discussed under the Proposed Action could occur under this alternative; however, the magnitude of such impacts would be less. Project disturbances under this alternative would be approximately 670.01 acres. These disturbance areas would represent approximately 2.7 percent of the total 25,093-acre project area. This total would include 268.35 acres for drill sites, 60.00 acres for roads without associated pipelines, 153.33 acres for the gas gathering pipelines not associated with roads, 153.33 acres of combined access road and pipeline construction, and 35.0 acres for ancillary facility sites. Of the total disturbance, 461.82 acres, or 69 percent of the disturbance, would occur in areas containing sensitive soils as summarized in Table 4-6. Sensitive soils include physical characteristics that relate to watershed stability, runoff potential, erosion potential, and surface runoff rates. The balance, 208.19 acres or 31 percent of the disturbance, would occur in areas containing non-sensitive soils. This suggests that the likelihood of causing significant impacts is high compared to areas that do not contain sensitive soils.

Table 4-3 summarized the total disturbance under Alternative A according to slope class. Most of the proposed disturbance, 426.37 acres, would occur in the 6 to 10 percent slope class. However, 47.37 acres would occur in the 16 to 25 percent slope class and no disturbance would occur in the 26 to 50 percent slope class.

The construction disturbance associated with Alternative A can also be distributed by the watersheds shown in Figure 3-4. Table 4-8 summarizes the disturbance by watershed. As discussed in Section 4.3.3, the Main Branch of Cave Gulch, the South Branch of Cave Gulch, and the North Branch of Cave Gulch would sustain most of the 670.01 acres of disturbance (506.71 acres or 76 percent of the total disturbance), including 192.39 acres or 29 percent, 134.70 acres or 20 percent, and 179.62 acres or 27 percent of the total disturbance, respectively. On a watershed basis, this would equate to 6.4 percent of the Main Branch of Cave Gulch, 5.2 percent of the North Branch, and 4.9 percent of the South Branch of Cave Gulch. Although these percentages are less than the threshold value of 10 percent discussed in Section 4.3.3, they approach this threshold. Disturbance in the other watersheds range from 0 percent to 2.7 percent. As discussed in greater detail in Section 5.3 and 5.4 in Chapter 5, short-term construction disturbance combined with the total existing disturbance (1,041 acres) produces a total disturbance

impact level that exceeds 10 percent in the Main Branch of Cave Gulch (12.4 percent) and Waltman Draw (10.2 percent).

As discussed in the Soils section 4.3.3) and as presented in the Soils, Water, and Vegetation Resources Technical Report (ECOTONE 1997), approximately 16,723 t/yr of soil erosion could occur from soil disturbances without erosion control or 1,223 t/yr with erosion control after the first year of construction as summarized in Table 4-9. Using a 10 percent transport efficiency as discussed previously for the Proposed Action (Section 4.4.3.1), approximately 1,672 t/yr without erosion control and 122 t/yr with erosion control could be transported to stream channels after the first year of construction. In regard to an increase in sediment delivery, these sediment delivery values would equate to an increase in sediment yield in streams of less than 0.0001 ac-ft/mi^2/yr as compared to current sediment yield of 1.0 ac-ft/mi^2/yr. Thus, adverse sedimentation is not expected to occur, in general, as a result of implementation of Alternative A.

Water for use in facilities construction could be as high as 1,000 gallons per acre of disturbance. This would equate to approximately 1.8 ac-ft of water. Water used in the well-drilling process could be as high as 462,000 gallons, or 1.4 ac-ft, per well for a total of 224 ac-ft (for 160 wells). Assuming one set of pipelines per well pad (single or multiple wells), and all pipelines associated with 99 new well pads (481,195 feet of pipeline) would be hydrostatically tested at once and therefore water would not be re-used, approximately 3.9 ac-ft, of water would be required for hydrostatic testing of pipelines. Therefore, total water demand with hydrostatic testing for this alternative would be approximately 229.7 ac-ft. Water would be obtained from State of Wyoming approved sources. This water demand is relatively small and would not adversely affect existing surface or groundwater sources or rights. The total demand of 229.7 ac-ft by the project would be spread out over several years. Thus, water diversion and/or extraction would not cause significant adverse impacts on surface or groundwater supply in the project area.

The analysis and discussion presented under the Proposed Action, Section 4.4.3.2, in regard to the discharge of hydrostatic test water, lining of reserve and evaporative pits, use of oil-based drilling muds, potential impacts on seeps and springs, compliance with "On-Shore Order No. 2", contamination of groundwater, impairment of surface water quality, destabilization of channels, and the management of produced water are applicable to this alternative.

4.4.3.3 Alternative B

The same types of adverse impacts discussed under the Proposed Action could occur under this alternative; however, the magnitude of such impacts would be slightly less. Project disturbances under this alternative would be approximately 768.71 acres. These disturbance areas would represent approximately 3.1 percent of the total 25,093-acre project area. This total would include 313.50 acres for drill sites, 68.75 acres for roads without associated pipelines, 175.73 acres for the gas gathering pipelines not associated with roads, 175.73 acres of combined access road and pipeline construction, and 35.0 acres for ancillary facility sites. Of the total disturbance, 559.94 acres, or 73 percent of the disturbance, would occur in areas containing sensitive soils as summarized in Table 4-11. Sensitive soils include physical characteristics that relate to watershed stability, runoff potential, erosion potential, and surface runoff rates. The balance, 208.77 acres or 27 percent of the disturbance, would occur in areas containing non-sensitive soils. This suggests that the likelihood of causing significant impacts is high compared to areas that do not contain sensitive soils.

Table 4-2 summarized the total disturbance under Alternative B according to slope class. Most of the proposed disturbance, 451.78 acres, would occur in the 6 to 10 percent slope class. However, 67.43 acres would occur in the 16 to 25 percent slope class and 13.49 acres of disturbance would occur in the 26 to 50 percent slope class. Location of project facilities in areas of slopes exceeding 25 percent could cause significant impacts.

The construction disturbance associated with Alternative A can also be distributed by the watersheds shown in Figure 3-4. Table 4-12 summarizes the disturbance by watershed. As discussed in Section 4.3.3, the Main Branch of Cave Gulch, the South Branch of Cave Gulch, and the North Branch of Cave Gulch would sustain most of the 768.71 acres of disturbance (604.98 acres or 79 percent of the total disturbance), including 238.10 acres or 31 percent, 186.64 acres or 24 percent, and 180.24 acres or 24 percent of the total disturbance, respectively. On a watershed basis, this would equate to 7.9 percent of the Main Branch of Cave Gulch, 5.2 percent of the North Branch, and 6.8 percent of the South Branch of Cave Gulch. Although these percentages are less than the threshold value of 10 percent discussed in Section 4.3.3, they approach this threshold. Disturbance in the other watersheds range from 0 percent to 2.7 percent. As discussed in greater detail in Section 5.3 and 5.4 in Chapter 5, short-term construction disturbance combined with the total existing disturbance (1,041 acres) produces a total construction disturbance impact level that exceeds 10 percent in the Main Branch of Cave Gulch (13.9 percent) and Waltman Draw (10.2 percent). Total disturbance in the South Branch of Cave Gulch (9.6 percent) very closely approaches 10 percent.

Approximately 19,178 t/yr of soil erosion could occur from soil disturbances without erosion control or 1,401 t/yr with erosion control after the first year of construction as summarized in Table 4-13. Using a 10 percent transport efficiency as discussed previously for the Proposed Action (Section 4.4.3.1), approximately 1,918 t/yr without erosion control and 140 t/yr with erosion control could be transported to stream channels after the first year of construction. In regard to an increase in sediment delivery, these sediment delivery values would equate to an increase in sediment yield in streams of less than 0.0001 ac-ft/mi^2/yr as compared to current sediment yield of 1.0 ac-ft/mi^2/yr. Thus, adverse sedimentation is not expected to occur, in general, as a result of implementation of Alternative B.

Water for use in facilities construction could be as high as 1,000 gallons per acre of disturbance. This would equate to approximately 2.1 ac-ft of water. Water used in the well-drilling process could be as high as 462,000 gallons, or 1.4 ac-ft, per well for a total of 224 ac-ft (for 160 wells). Assuming one set of pipelines per well pad (single or multiple wells), and all pipelines associated with 114 new well pads (554,103 feet of pipeline) would be hydrostatically tested at once and therefore water would not be re-used, approximately 4.5 ac-ft, of water would be required for hydrostatic testing of pipelines. Therefore, total water demand with hydrostatic testing for this alternative would be approximately 230.6 ac-ft. This water demand is relatively small and would not adversely affect existing surface or groundwater sources or rights. The total demand of 230.6 ac-ft by the project would be spread out over several years. Thus, water diversion and/or extraction would not cause significant adverse impacts on surface or groundwater supply in the project area.

The analysis and discussion presented under the Proposed Action, Section 4.4.3.2, in regard to the discharge of hydrostatic test water, lining of reserve and evaporative pits, use of oil-based drilling muds, potential impacts on seeps and springs, compliance with "On-Shore Order No. 2",

contamination of groundwater, impairment of surface water quality, destabilization of channels, and the management of produced water are applicable to this alternative.

4.4.3.4 Alternative C - No Action

Under the No Action Alternative, water resources would continue to be impacted as additional individual APDs are granted by the BLM. Water resource impacts would be similar to those described above. In terms of magnitude, such impacts would likely be slightly less than for the Proposed Action. However, there would be an increased probability of occurrence of unexpected adverse impacts since overall field development would not happen in a well-planned out manner.

4.4.4 Impacts Summary

Most adverse impacts to water resources could be avoided or reduced through implementation of control measures identified in Chapter 2, mitigation listed in this section, Appendix A, and Appendix B. The Proposed Action would result in the greatest area of disturbance 788.39 acres, followed by Alternative B, 768.71 acres, with Alternative A causing the least disturbance, 670.01 acres. Alternative C, No Action, under which individual APDs could continue to be approved by the BLM, would result in impacts approaching the magnitude of the action alternatives. However, there would be an increased probability of occurrence of unexpected adverse impacts since overall field development would not happen in a well-planned out manner.

Alternative B (559.94 acres) would involve more disturbance in sensitive soils than the Proposed Action (549.08) and Alternative A (468.82 acres) where impacts to water resources could be significant. Both the Proposed Action and Alternative B would involve siting of project facilities in areas of slope gradients greater than 25 percent. This could lead to significant impacts in regard to increased surface runoff, erosion, and sedimentation, as well as reclamation problems. As discussed in Section 4.3.3, the Main Branch of Cave Gulch would sustain the most development pressure under each alternative. The Proposed Action and Alternative B would involve an increased level of disturbance in the South Branch of Cave Gulch. Significant cumulative impacts could occur in the Waltman Draw and Main Branch of Cave Gulch watersheds in the short term during construction, but total disturbance would be below the 10 percent threshold in the long term production phase. Erosion impacts would follow a similar trend of magnitude commensurate with the area of disturbance associated with each alternative. Most other types of adverse impacts would be essentially the same for each of the action alternatives. The analysis of direct and indirect impacts indicates that significant impacts could occur under each of the action alternatives as well as the No Action alternative. Mitigation would be required to avoid such significant impacts as itemized in the next section.

4.4.5 Mitigation Summary

- The mitigation measures presented in Section 4.3.4 also apply to this section.
- Limit construction of drainage crossings to no-flow periods or low-flow periods.
- Minimize the area of disturbance within ephemeral and intermittent drainage channel environments.

- Well sites, access roads, and pipelines should not be constructed within 200 feet of ephemeral and intermittent drainage channels; within 500 feet of live streams, lakes, reservoirs, canals and associated riparian habitat, and water wells; and within 660 feet of springs or artesian and flowing wells. Exceptions to this should be approved by the BLM based on an environmental analysis and site specific mitigation plans.

- Channel crossings should be designed to minimize changes in channel geometry and subsequent changes in flow hydraulics.

- Maintain vegetation barriers occurring between construction activities and ephemeral and intermittent channels.

- The project must comply with Executive Order 11990 (floodplains protection) and RMP management directives that relate to protection of water resources identified in Section 4.4.2. These regulations require avoidance of stream channels to the maximum practicable extent. Where total avoidance is not practicable, then minimization of impacts to streams and associated floodplains/floodways must be implemented. Where streams and floodplains cannot be avoided, the Operators would be required to show the BLM AO why such resources cannot be totally avoided and how impacts would be minimized during the APD process.

- The Operators must coordinate with the COE to determine the specific CWA Section 404 permit requirements and conditions (including the potential requirement of compensatory mitigation) for each facility that occurs in waters of the U.S. to prevent the occurrence of significant impact to such waters.

- Design and construct effective surface runoff, erosion, and sediment control measures at all sites of disturbances. Such measures include but are not limited to interception ditches, sediment traps/silt fences, water bars, silt fences and revegetation and soil stabilization measures.

- Construct channel crossings by pipelines such that the pipe is buried well below the maximum scour depth or a minimum of four feet below the channel bottom.

- Regrade disturbed channel beds to the original geometric configuration and replace bed material with the same or very similar channel bed material.

- Ensure reserve, produced water, and evaporation pits are not in danger of overflowing; the maximum containment level should not exceed two feet of freeboard. Shut down drilling operations until the problem is corrected if leakage is found outside the pit.

- Although the operators initially proposed to only line reserve pits in acres where leakage was anticipated to be a problem, there is sufficient information known on the character of soils and the sensitivity of the hydrologic environment to require that all pits be lined, whether reserve or evaporative. Therefore, all pits should be lined with impermeable membrane liners having a permeability of less than 10^{-7} centimeters/second.

- Discharge all concentrated water from surface runoff within access roads and hydrostatic test waters in a manner as not to result in increased or accelerated erosion. In certain applications, energy dissipators (e.g., riprapped aprons and discharge points) should be utilized. All discharged water should be directed into undisturbed vegetation. Use and discharge of hydrostatic test water must comply with the right of way stipulation on hydrostatic testing.

- The project must comply with all aspects of the CWA. A NPDES permit will be required for the project. The permit will require the operators to develop surface runoff, erosion, and sedimentation control plans; oil spill containment and contingency plan; as well as other environmental protection plans to ensure that the opportunity or probability of water pollution is minimized.

- The RMP specifies that a watershed management plan be developed for the Cave Gulch drainage if the level of disturbance becomes important. The Cave Gulch watershed will be evaluated by the BLM to determine the need for intensive management. Intensive management may include requirements for a watershed plan, implementation of various protective measures, and placement of various structures as may be necessary.

4.4.6 Residual Impacts

No significant residual impacts would result from project implementation provided that all environmental protection strategies identified in the mitigation section above, Chapter 2, and in Appendices A and B are implemented.

4.5 VEGETATION AND WETLANDS

4.5.1 Introduction

Direct impacts would include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect adverse impacts would include the short-term and long-term increased potential for weed invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition and/or changes in vegetative density away from a more desirable condition (e.g., native communities); a loss of natural biodiversity; reduction of wildlife habitat; and changes in visual aesthetics.

4.5.2 Impact Significance Criteria

The management plan (USDI-BLM 1984b) for the resource management unit in which the project area occurs (RMU 14, remaining Platte River Resource Area) indicates the following specific management directives for vegetation resources:

- The overall objective of grazing management is "to prevent overgrazing and downward trends and to improve forage conditions... with no adverse impact to wildlife and watershed values" (p. 133);

- Control measures for noxious weeds would conform to the procedures outlined in the EA for noxious weed control (USDI-BLM 1982) (p. 135); and

- The effects of implementing decisions outlined in the Platte RMP will be monitored and evaluated over the life of this plan (p. 138).

For this analysis, the following specific threshold criteria were used to determine the importance of impacts on vegetation resources:

- Non-compliance with management directives and objectives as stated in the RMP (USDI-BLM 1984);

- Removal of vegetation such that following reclamation, the disturbed area(s) would not have adequate cover (density) and species composition (diversity) to support pre-existing land uses, including wildlife habitat and grazing, within a period of five years for general vegetation types or within two years for riparian and wetland areas;

- Unauthorized discharge of dredged and/or fill materials into, or excavation of, waters of the U.S., including special aquatic sites, wetlands, and other areas subject to Executive Orders 11988 (floodplains) and 11990 (wetlands and riparian zones);

- Reclamation is not accomplished in compliance with Executive Order 11987 (reclamation);

- Introduction and establishment of noxious or other undesirable weedy species to the degree that such establishment results in listed weedy species occupying more than 20 percent of a specific vegetation type or hampering successful revegetation of desirable species in disturbed areas;

- Removal or disturbance, directly or indirectly, of individual special status plant species or habitat used by such species to the extent that the impact would threaten the viability of the local population and/or induce an upgrade in the federal, state, or resource area status; and/or

- Cumulative removal of more than 10 percent of any vegetation cover type within the project area and/or the cumulative impact analysis area.

4.5.3 Direct and Indirect Impacts

4.5.3.1 Proposed Action

Construction and installation of well sites, access roads, and ancillary facilities (including pipelines) would directly reduce the areal cover of vegetation cover types. Over the five-year drilling period, the Proposed Action would involve clearing a total of 788.39 acres, most of which would occur in the mixed desert shrub cover type as itemized in Table 4-15. The areas of clearing in each cover type was determined based on well site locations identified by the BLM. Potential road and pipeline alignments that service the assumed well sites were not located on maps. To determine the disturbance impacts due to roads and pipelines, the unit disturbance assumptions made in Chapter

2 were applied to each well and such associated disturbance was assumed to occur in the same vegetation cover type as the well site. Of the total construction disturbance, approximately 580.45 acres of mixed desert scrub, 197.24 acres of badlands, 5.35 acres of alkali bottomlands, and 5.35 acres of aquatic habitats would be impacted. Construction impacts on alkali bottomlands and aquatic habitats caused by linear facilities were assumed to be approximately 2.0 percent of the impact to mixed desert scrub since specific alignments were unknown for this analysis. During the site-specific planning of project facilities, most or all aquatic habitat areas would be avoided to the maximum extent practicable in compliance with the federal Clean Water Act (CWA), Executive Order 11990, and BLM management direction. Similarly, impacts on alkali bottomlands would be minimized since such habitats are closely associated with stream channels where the RMP requires setbacks from 200 to 660 feet. The area of disturbance in the badland cover type should be less than itemized here because this cover type is considered to be a sensitive soil area and avoidance would be required by the BLM to the maximum extent practicable as discussed in Section 4.3. Total construction disturbance in each vegetation cover type would not exceed the 10 percent significance threshold; thus, significant impacts would not occur due to the disturbance of these cover types identified in Table 4-15. Section 5.5 of Chapter 5 discusses the cumulative impact of impacts due to the proposed project when combined with existing disturbance and disturbance associated with reasonably foreseeable future projects.

During the production phase, unused portions of the well sites and roads as well as all portions of the pipelines would be reclaimed; however, no reclamation would occur at the compressor stations. Thus, under the Proposed Action total vegetation disturbance would be reduced from 788.39 acres to 394.07 acres. This reduction of 394.38 acres would be comprised of the proportional amount of each cover type subjected to construction disturbance as identified in Table 4-15.

Table 4-15. Summary of Vegetation Impacts (acres) with Construction of the Proposed Action.

Cover Type	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	ac						
Mixed Desert Scrub	21,204	79	231.41	51.04	131.50	131.50	35.00	580.45	2.7
Alkali Bottomlands	248	0	0.0	1.07	2.14	2.14	0.0	5.35	2.2
Badlands	3,383	28	82.04	18.88	48.16	48.16	0.0	197.24	5.8
Aquatic Habitats	258	0	0.0	1.07	2.14	2.14	0.0	5.35	2.1
TOTAL	**25,093**	**107**	**313.45**	**72.06**	**183.94**	**183.94**	**35.00**	**788.39**	**3.1**

The duration of impacts to vegetation would depend, in part, on the success of mitigation and revegetation efforts and the time needed for natural succession to return revegetated areas to predisturbance conditions. This may be on the order of 20 to 30 years for mixed desert shrub cover type. Revegetation success would depend on the amount and quality of topsoil salvaged, stockpiled, and respread over disturbed areas.

Based on the specific location of well sites as identified in Chapter 2, no impacts are anticipated for the aquatic cover types. However, roads and pipelines would invariably cross dry channels that carry ephemeral and some intermittent flow and associated aquatic habitats identified in Figures 3-4 and 3-5. These features are considered waters of the U.S. and any activity that involves the excavation of or the discharge of dredge/fill into waters of the U.S. would require prior authorization from the COE through the Section 404 permit program. Such programs would likely include Nationwide Permit No. 12 (buried utility lines), No. 14 (minor road crossing fills), No. 18 (minor discharges less than 25 cubic feet), and/or No. 26 (minor discharges into isolated waters and/or headwaters). Impacts associated with such crossings would not be substantial given the measures incorporated into the Mitigation section (Section 4.5.6) for this resource; the measures presented in the Soils and Water Resources sections; and compliance with the CWA, RMP management directives, and Executive Orders 11990 and 11989. Thus, the probability of impacting wetlands and other waters of the U.S. is low and the total construction impact on such areas would be less than the 5.35 acres assessed in this EIS.

Surface disturbance activities could affect special status plants directly and indirectly by destroying individuals or their habitat, increasing the amount of fugitive dust, and introducing weeds. Weedy species often out-compete more desirable species, rendering an area less productive as a source of forage for livestock and wildlife, adversely impacts visual aesthetics, as well as causing reduced effectiveness of the vegetal cover as a protective soil cover. Based on existing information presented in Chapter 3, habitat for all of the six special status plants does not likely occur in the project area. Suitable habitat is only possible in the analysis for the smooth goosefoot, many-stemmed spider-flower, and the devil's gate twinpod. There is not enough known about the occurrence and/or distribution of these special status plants and/or their preferred habitat in combination with the lack of specific locations of project facilities to determine specific impacts caused by the Proposed Action. With implementation of site-specific surveys prior to earth-surface disturbance and possible relocation of facilities if these plants were found, the Proposed Action would not likely have a direct or indirect effect on special status plants.

Effective reclamation of project disturbances would be accomplished following the measures identified in Chapter 2, Appendix B, and the Soils, Water, and Vegetation Resources Technical Report (ECOTONE 1997). The reclamation recommendations presented in Appendix B were designed to keep the proposed project in compliance with Executive Order 11987. These guidelines were developed based on the physical and biological conditions in the project area as well as on observations of successful reclamation efforts on associated resource development projects. Therefore, assuming these measures are effectively applied, significant impacts that relate to reclamation success are not likely to occur. In regard to the invasion and establishment of weeds (noxious and other unwanted weed species), the potential for increased weed occurrence as a result of the proposed project is very high. Weeds are effectively transported into a project area on heavy equipment and work vehicles that are not cleaned off prior to transport into the new project area. Further, weeds that are already established in the project area can be easily transported on equipment and work vehicles that are exposed to weeds in the project area. In order to minimize the potential for a significant impact due to weed invasion, monitoring for weed invasion would be necessary, and if found control and eradication measures would be implemented. Further, construction contractors would be required to clean vehicles and equipment of weed seed prior to traveling into the project area. It is unlikely that weed invasion and establishment would exceed the 20 percent cover threshold if these measures were effectively

implemented. Given the analysis presented above, significant impacts to vegetation resources would not occur under the Proposed Action.

4.5.3.2 Alternative A

Construction and installation of well sites, access roads, and ancillary facilities (including pipelines) would directly reduce the areal cover of vegetation cover types. Over the five-year drilling period, Alternative A would involve clearing a total of 670.01 acres, most of which would occur in the mixed desert shrub cover type as itemized in Table 4-15. Of the total construction disturbance, approximately 504.19 acres of mixed desert scrub, 160.29 acres of badlands, 2.74 acres of alkali bottomlands, and 2.74 acres of aquatic habitats would be impacted. This construction disturbance represents less than 10 percent of the total area of each cover type in the project area. During the site-specific planning of project facilities, most or all aquatic habitat areas would be avoided to the maximum extent practicable in compliance with the CWA, Executive Order 11990, and BLM management direction. Similarly, impacts on alkali bottomlands would be minimized since such habitats are closely associated with stream channels where the RMP requires setbacks from 200 to 660 feet. The area of disturbance in the badland cover type should be less than itemized here because this cover type is considered to be a sensitive soil area and avoidance would be required by the BLM to the maximum extent practicable. Total construction disturbance in each vegetation cover type would not exceed the 10 percent significance threshold; thus, significant impacts would not occur due to the disturbance of these cover types identified in Table 4-16.

Under this alternative, total vegetation disturbance would be reduced from 670.01 acres to 307.04 acres during production phase reclamation. This reduction of 362.97 acres would likely be comprised of the proportional amount of each cover type subjected to construction disturbance as identified in table 4-16. The discussion presented under the Proposed Action on duration of impacts, aquatic habitat and stream channel impacts, CWA Section 404 permitting, special status plants, and weeds applies to this alternative. The same type of impacts could occur under this alternative, but of slightly lower magnitude than the Proposed Action. Given the analysis presented above, significant impacts to vegetation resources would not occur under the Alternative A.

Table 4-16. Summary of Vegetation Impacts (acres) with Construction of Alternative A.

Cover Type	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	ac						
Mixed Desert Scrub	21,204	74	200.58	43.95	112.33	112.33	35.00	504.19	2.4
Alkali Bottomlands	248	0	0.0	0.44	1.15	1.15	0.0	2.74	1.1
Badlands	3,383	25	67.77	15.12	38.70	38.70	0.0	160.29	4.7
Aquatic Habitats	258	0	0.0	0.44	1.15	1.15	0.0	2.74	1.1
TOTAL	**25,093**	**99**	**268.35**	**60.00**	**153.33**	**153.33**	**35.00**	670.00	2.7

4.5.3.3 Alternative B

Construction and installation of well sites, access roads, and ancillary facilities (including pipelines) would directly reduce the areal cover of vegetation cover types. Over the five-year drilling period, Alternative B would involve clearing a total of 768.71 acres, most of which would occur in the mixed desert shrub cover type as itemized in Table 4-16. Of the total construction disturbance, approximately 532.69 acres of mixed desert scrub, 225.30 acres of badlands, 5.36 acres of alkali bottomlands, and 5.36 acres of aquatic habitats would be impacted. This construction disturbance represents less than 10 percent of the total area of each cover type in the project area. During the site-specific planning of project facilities, most or all aquatic habitat areas would be avoided to the maximum extent practicable in compliance with the CWA, Executive Order 11990, and BLM management direction. Similarly, impacts on alkali bottomlands would be minimized since such habitats are closely associated with stream channels where the RMP requires setbacks from 200 to 660 feet. The area of disturbance in the badland cover type should be less than itemized here because this cover type is considered to be a sensitive soil area and avoidance would be required by the BLM to the maximum extent practicable. Total construction disturbance in each vegetation cover type would not exceed the 10 percent significance threshold; thus, significant impacts would not occur due to the disturbance of these cover types identified in Table 4-17.

Table 4-17. Summary of Vegetation Impacts (acres) with Construction of Alternative B.

Cover Type	Area (ac)	Well Pads		Roads (ac)	Pipelines (ac)	Roads and Pipelines (ac)	Facilities (ac)	Total (ac)	%
		#	ac						
Mixed Desert Scrub	21,204	79	217.25	46.68	116.88	116.88	35.00	532.69	2.5
Alkali Bottomlands	248	0	0.0	0.48	2.44	2.44	0.0	5.36	2.2
Badlands	3,383	35	96.25	21.11	53.97	53.97	0.0	225.30	6.7
Aquatic Habitats	258	0	0.0	0.48	2.44	2.44	0.0	5.36	2.1
TOTAL	**25,093**	**114**	**313.50**	**68.75**	**175.73**	**175.73**	**35.00**	**768.71**	**3.1**

Under this alternative, total vegetation disturbance would be reduced from 768.71 acres to 348.43 acres during production phase reclamation. This reduction of 420.28 acres would likely be comprised of the proportional amount of each cover type subjected to construction disturbance as identified in Table 4-16. The discussion presented under the Proposed Action on duration of impacts, aquatic habitat and stream channel impacts, CWA Section 404 permitting, special status plants, and weeds applies to this alternative. The same type of impacts could occur under this

alternative, but of slightly lower magnitude than the Proposed Action, except for the area of disturbance in the badland cover type would be greater under this alternative. Given the analysis presented above, significant impacts to vegetation resources would not occur under the Alternative B.

4.5.3.4 Alternative C - No Action

Under the No Action Alternative, vegetation would continue to be impacted as additional individual APDs were granted by the BLM. Loss of upland cover types would not be significant. If present, impacts to wetlands and other aquatic habitat types would be assessed on a case-by-case basis similar to the Proposed Action and would be mitigated as appropriate during the permitting process. However, there would be an increased probability of occurrence of unexpected adverse impacts under this alternative since overall field development would not happen in a well-planned out manner.

4.5.4 Impacts Summary

Impacts to vegetation include removal of cover types and the potential for noxious weed invasion. Except for waters of the U.S. (including wetlands) and special status plant species and their habitat, disturbance of vegetation cover types would not be important because upland types are common, have high frequencies of occurrence, cover large areas, and have wide distribution. However, construction in badland areas could have serious erosion and site stabilization consequences as discussed under Soils. Any construction activities that result in placing fill or removing material from wetlands areas or other waters of the U.S. would be important. Measures imposed by the Section 404 permitting process would reduce or avoid impacts to jurisdictional wetlands and remove the potential for significant impacts. In spite of the sandy nature of the soils in many locations, the technology exists to return disturbed areas to predisturbance conditions. Due to the poor reclamation potential, impacts in badland areas should be avoided. If impacts cannot be avoided, site-specific design and/or relocation of the proposed well sites could reduce the potential for negative impacts to this cover type. No significant impacts would occur to special status plant species or their habitat with avoidance and mitigation measures implemented as determined appropriate by the BLM.

4.5.5 Mitigation Summary

In addition to measures proposed by the operators and prescribed by existing management directions, implementation of the following mitigation measures would ensure minimal adverse effects to vegetation, wetlands, and rare plants.

- Effective reclamation of project disturbances should be accomplished following the measures identified in Chapter 2, Appendix B, and the Soils, Water, and Vegetation Resources Technical Report (ECOTONE 1997). The reclamation recommendations presented in Appendix B were designed to keep the proposed project in compliance with Executive Order 11987. These guidelines were developed based on the physical and biological conditions in the project area as well as on observations of successful reclamation efforts on associated resource development projects.

- The recommended measures for Soils and Water Resources should be implemented. Because such areas are difficult to restabilize once disturbed, impacts in the Badlands cover type and on sparsely vegetated areas should be avoided or minimized.

- Disturbed areas should be stabilized with appropriate treatments immediately following project facility construction until the areas can be seeded with site-specific mix(es) during the next appropriate planting period (spring or fall).

- Weed monitoring should occur for species identified by the State of Wyoming as well as for additional species specified by Natrona County during a given year. Such species comprise the official list of weeds for which a county may cost-share funding for control and removal efforts. Should such species be found during monitoring, control and eradication efforts should be implemented following County control procedures. Further, construction contractors should be required to clean vehicles and equipment of weed seed prior to travelling into the project area.

- Site-specific surveys should be performed for special status plants and their habitat **prior** to earth-surface disturbance at a facility location. If found, impacts to special status plants should be minimized and monitored. Minor adjustments could be made to the location of project facilities to avoid species and/or their habitat.

- Shifts in the proposed location of facility sites as addressed in this EIS should be evaluated relative to the occurrence and distribution of waters of the U.S. If such sensitive areas are found, the facility should be relocated to avoid impacts. Where avoidance is not practicable, impacts should be minimized through modification and minor relocations. Activities that involve dredge, fill, or excavation of wetlands must be coordinated with the U.S. Army Corps of Engineers (COE).

4.5.6 Residual Impacts

Assuming a large portion of additional impacts due to the proposed project are reclaimed and that the identified mitigation measures are implemented in addition to directives contained in the RMP, no significant residual impacts to vegetation resources would occur. Successful revegetation within three to five years would be difficult for areas of badland, alkali scrub, and mixed desert shrub cover types. Revegetation to predisturbance conditions would require 30 years or more; however, this lag would not be significant provided substantial erosion or other important environmental impacts would not occur during this long-term period.

4.6 RANGE RESOURCES AND OTHER LAND USES

4.6.1 Introduction

Livestock grazing would continue within the project area during all phases of the natural gas development project. There would be some reduction in forage availability in those areas having natural gas development activities (e.g. well pad, access road, and pipeline construction), and possibly some disruption of livestock management activities on grazing allotments in the project area.

4.6.2 Impact Significance Criteria

Impacts to the range resource would be significant if the following occurred:

- Non-compliance with management directives and objectives as stated in the Platte River Resource Area (PRRA) Resource Management Plan (RMP)(USDI-BLM 1985) that pertain to Range Resources in the Cave Gulch-Bullfrog-Waltman Natural Gas Development proposal.

4.6.3 Direct and Indirect Impacts

4.6.3.1 Proposed Action

With the construction of 107 new well pads and the expansion of 24 existing well pads to accommodate twinning, 314 acres would be disturbed with implementation of the Proposed Action (Table 2-8). This disturbance, combined with new road and pipeline construction (440 acres), and ancillary facility construction (35 acres) would result in an estimated total disturbance of 789 acres of forage production during the initial stages of the project. Stocking rates are estimated to vary between 8 and 21 acres per animal unit month (AUM) between the various allotments within the Cave Gulch-Bullfrog-Waltman Project Area, with an average stocking rate of about 8-9 acres per AUM. Depending on the actual locations of the well sites with respect to forage productivity, lost forage during drilling, access road, and pipeline construction would vary between 98.63 and 37.6 AUMs, with an average of 92.8 AUMs (short-term loss of forage). Following reclamation and re-establishment of suitable range forage, approximately 394 acres (46.35 AUMs) of forage production would continue to be removed from livestock use (long-term loss of forage). This would be a reduction of about 1.57 percent of the current livestock forage use in the project area. Overall, this level of reduction should not affect the livestock use in the project area, or create an economic hardship for the permittee, unless the well sites and associated facilities are located predominately on a select few permittees and/or are located on areas where forage production is greater than average in the project area.

In addition to partial reclamation of well sites and access roads and total reclamation of pipelines, as older production wells in the Cave Gulch-Bullfrog-Waltman Project Area are abandoned and reclaimed, additional land would become available for forage production. Actual amounts of additional forage available for livestock use following reclamation would be contingent on the success/failure of revegetation efforts.

The increased activity associated with drilling and production has the potential for disrupting livestock operations, particularly during the construction phase of development. Opportunities for vehicle-livestock collisions would increase. Also, the opportunity for livestock theft would likely increase as roads provide additional access into the allotments. However, additional roads in the Cave Gulch-Bullfrog-Waltman Project Area may allow livestock operators improved access into the area, thus potentially providing them with greater ease of livestock management operations such as herding. Surface pipelines may present some disruption of livestock management in the project area. Disruption of livestock movement in the areas of surface pipelines is dependent upon the size (diameter) of pipelines, their height above the ground surface, the number of exposed valves, and the size of the livestock involved (cattle, sheep, horses). A pipeline or combination of pipelines (pipelines side by side) could discourage livestock from moving from one side of the pipeline to the

other. This is especially true if livestock are being trailed through or handled in the area. Depending upon such factors as pipe size, height, and the number of exposed valves, livestock are also inclined to rub and scratch on the exposed facilities. While this activity usually does not injure livestock, it could increase the possibility of damage to surface pipeline facilities.

The potential for problems would decrease once the wells were producing and the traffic volume declined. Drilling may also result in the development of additional water wells which could be converted for livestock use. This would improve the ability of livestock to make efficient use of rangeland within the project area.

Construction activities could provide for introduction of undesirable and noxious weed species into the project area. These plants often out-compete the more desirable species, rendering an area less productive as a source of forage for livestock and wildlife. Appendix B (Reclamation Guidelines) contains recommendations regarding noxious weed monitoring and eradication on disturbed areas in the project area.

Given the actions and measures proposed by the operators (Chapter 2) and stipulations contained in the Platte River Resource Area RMP (USDI-BLM 1985), no significant impacts would occur to the range resources under the Proposed Action.

4.6.3.2 Alternative A

With the construction of 97 new well pads and the expansion of 2 existing well pads to accommodate twinning, the forage area disturbed under Alternative A would be approximately 670.01 acres (78.82 AUMs) in the short-term (initial construction and production phases)(Table 2-8). Following reclamation, approximately 307.04 acres (36.12 AUMs) would remain out of forage production. This represents a loss in stocking levels of about 1.22 percent throughout the Cave Gulch-Bullfrog-Waltman Project Area in the long-term. Overall, this level of reduction should not affect the livestock use in the project area, or create an economic hardship for the permittee, unless the well sites and associated facilities are located predominately on a select few permittees and/or are located on areas where forage production is greater than average in the project area.

The potential for livestock loss from theft and vehicular collision, the potential for disruption of trailing due to surface pipelines, and the introduction of weed species also exists as discussed under the Proposed Action, but to a lesser degree due to the reduced acreage of roads and pipelines. The potential for enhancing livestock operations (water developments and better allotment access) also exists with this alternative.

4.6.3.3 Alternative B

With the construction of 114 new well pads, the forage area disturbed under Alternative B would be approximately 768.71 acres (90.44 AUMs) in the short-term (initial construction and production phases)(Table 2-8). Following reclamation, approximately 348.43 acres (40.99 AUMs) would remain out of forage production. This represents a loss in stocking levels of about 1.39 percent throughout the Cave Gulch-Bullfrog-Waltman Project Area in the long-term. Overall, this level of reduction should not affect the livestock use in the project area, or create an economic hardship for the permittee, unless the well sites and associated facilities are located predominately on a

select few permittees and/or are located on areas where forage production is greater than average in the project area.

The potential for livestock loss from theft and vehicular collision, the potential for disruption of trailing due to surface pipelines, and the introduction of weed species is slightly less than that discussed under the Proposed Action, due to the slightly reduced acreage of roads and pipelines. The potential for enhancing livestock operations (water developments and better allotment access) also exists with this alternative.

4.6.4 Impacts Summary

Impacts to the range resource would involve disturbance of livestock forage, potential for livestock loss through theft or vehicular collision, potential disruption of trailing due to surface pipelines, and potential introduction of weed species. However, with implementation of the mitigation measures proposed by the operators (Chapter 2), which would include measures pertaining to soils and vegetation, and stipulations in the RMP, impacts to range resources can be avoided or reduced to acceptable levels.

4.6.5 Mitigation Summary

Monitoring of surface pipelines for formation of livestock trails parallel to the pipelines should be performed by the operators and grazing lessees. No additional mitigation beyond this and those measures incorporated into Chapter 2 and the RMP would be necessary.

4.6.6 Residual Impacts

Livestock may react to surface pipelines as they do to fences, and will walk alongside the pipelines. This creates trails parallel to the pipeline, which may promote some minor soil loss within pipeline corridors. There would be no additional residual impacts to range resources or other land uses as a result of implementation of the Proposed Action or alternatives.

4.7 WILDLIFE

4.7.1 Introduction

The principal wildlife impacts likely to be associated with project construction and operation include: (1) the displacement of some individuals of some wildlife species, (2) loss of certain wildlife habitats due to the development of drilling and production operations, (3) an increase in the potential for collisions between wildlife and motor vehicles, and (4) an increase in the potential for illegal kill and harassment of wildlife. The magnitude of impacts to wildlife resources would depend on a number of factors including the type and duration of disturbance, the species of wildlife present, time of year, and implementation of recommended and required mitigative measures.

4.7.2 Impact Threshold Criteria

Impacts related to this project would be considered significant if any of the following were to occur:

- Non-compliance with existing BLM, FWS, or WGFD management objectives for wildlife, or BLM wildlife stipulations for surface occupancy criteria on oil and gas developments.
- A substantial increase in direct mortality of wildlife due to: road kill, poaching, harassment, or other causes.
- The abandonment of crucial habitat by big game during an important use period.
- The permanent reduction in size, elimination, or otherwise rendering unsuitable for wildlife an officially designated crucial habitat.
- Any effect, whether direct or indirect, that results in long-term decreases in recruitment and/or survival of individuals in a wildlife population.
- Disruption of grouse or raptor breeding or nesting activities to the extent that reproductive success of the population of any species is decreased, threatened or damaged.

Impacts to species of special concern including listed threatened and endangered species, species proposed for listing, FWS or state sensitive species and federal candidate species would be considered significant if any of the following were to occur:

- The loss (death) of any individual from direct or indirect project-related causes including, but not limited to, recruitment rate reductions to viable populations.
- Project related impacts that jeopardize or substantially decelerate the recovery program for any species of concern.

4.7.3 Direct and Indirect Impacts

4.7.3.1 Proposed Action

The Proposed Action would provide an optimum development scenario of ~~160 production wells on~~ 107 newly constructed well pads the expansion of 24 existing well pads to accommodate twinning, and related facilities over the next ten-year planning period. The precise number of wells and their specific locations, however, would be directed by the success of developmental drilling and production technology, and economic considerations such as the cost of development of leases of marginal profitability. For planning purposes, however, the project area was divided into four geologic boundaries which helped to more clearly define projections for well locations and spacing (see Figure 2-1). The geologic boundaries used for the Proposed Action are based on a draft RMG report and are not the same as the boundaries used in Alternatives A and B. By combining this information, along with existing well locations and current spacing limitations within the project area, the analysis of impacts to wildlife for the proposed action was based on reasonably foreseeable spacing and drilling projections into areas within the project boundary where the planned production and development activities would occur.

Under the Proposed Action, surface disturbances resulting from gas development would be greater than Alternatives A and B, but less than under the No Action Alternative. Implementation of the proposed 160 well program would result in the direct disturbance of 788 acres of general wildlife habitat over the next 10-year planning period. This includes a total of 313 acres associated with well pad construction, 256 acres for access roads, 184 acres for pipelines, and 35 acres for ancillary facilities. During the production phase, the unused portions of well sites and roads, as well as pipelines (a total of 364 acres) would be reclaimed. Following completion of production operations, the well field and ancillary facilities would be reclaimed and abandoned. Well pads would be removed and the areas revegetated with seed mixes approved by the BLM, some of which are specifically oriented to enhance wildlife use. The duration of impacts to vegetation would depend, in part, on the success of mitigation and reclamation efforts and the time needed for natural succession to return revegetated areas to predisturbance conditions. Grasses and forbs are expected to become established within the first several years following reclamation, however an estimated 8 to 20 years would be required for shrub establishment and production of useable forage (Plummer et al. 1968, Environmental Studies Board 1974, Fisser 1981, Wasser and Shoemaker 1982). Consequently, the disturbance of badlands and mixed desert scrub habitats within the project area would represent a long-term loss to those species that depend on such vegetation for forage or shelter.

In addition to the direct loss of habitat due to construction of well pads and associated roads and pipelines, disturbances from human activity and traffic would lower the utilization of habitat immediately adjacent to these areas. Habitat effectiveness of these areas would be lowest during the construction and production phases when human activities are more chronic and localized. During the production phase of operations, however, many animals will likely become accustomed to equipment and facilities and once again use habitats immediately adjacent to these areas.

4.7.3.1.1 General Wildlife

The direct disturbance of 788 acres of wildlife habitat associated with the construction and production of gas wells and associated facilities under the proposed action will reduce habitat availability and effectiveness for a variety of common small mammals and birds and their predators. The major small nongame songbirds that would be affected by the reduction in habitat would be horned larks, Brewer's sparrows, sage sparrows, and vesper sparrows. Although there is no way to accurately quantify these changes, the impact is likely to be moderate in the short term and be reduced over time as reclaimed areas produce suitable habitats. Because of the high reproductive potential of these species they would rapidly repopulate reclaimed areas as habitats become suitable. Birds are highly mobile and would disperse into surrounding areas and utilize suitable habitats to the extent that they are available.

The principal small mammals found on the project area include but are not limited to, deer mice, least chipmunks, Wyoming and thirteen-lined ground squirrels, desert cottontails, and white-tailed jackrabbits. The initial phases of surface disturbance would result in some direct mortality and displacement of small mammals from construction sites. In addition, a slight increase in mortality from increased vehicle use of roads in the project area is expected. Quantification of these losses is not possible because population data are lacking; however, small mammal populations would likely rebound to pre-disturbance levels following reclamation of pipelines, unused portions of roads, well pads, and wells that are no longer productive.

Fencing of both reserve pits and produced water pits will be done, either around the pit itself or the entire location, to prevent access by cattle and wildlife. Any hydrocarbons floating on the surface of reserve pits would be removed as soon as possible after drilling operations are completed. If any oil is on the pit(s) and is not immediately removed after drilling and completion operations cease, the pit containing the oil or other adverse substance(s) will be flagged overhead or covered with wire or plastic mesh to protect migratory birds. Produced water pits will have incidental hydrocarbon build up on the surface as water is deposited. Since large volumes will inhibit evaporation, the hydrocarbons would be periodically vaced off. However, since large quantities are not required to have an impact on migratory birds, these pits should be designed to include flagging overhead or covering with wire or plastic mesh.

4.7.3.1.2 Big Game

Pronghorn Antelope. An estimated 98 of the 107 proposed wells (92 percent) would be drilled within antelope year-long range limited almost exclusively to the North Natrona herd unit. The development of these wells along with associated road and pipeline installation would initially result in the disturbance of 725 acres of year-long badlands and mixed desert scrub habitats within the project area. The remaining wells (9) would be drilled within winter/yearlong range in the Badwater and Beaver Rim herd units; and total well, road, and pipeline installation would initially result in the disturbance of approximately 63 acres of this range. Following construction, reclamation will reduce disturbed areas to 394 acres. No adverse impacts to antelope are expected as a result of direct habitat disturbance under this alternative because no designated crucial habitats will be affected, a relatively small total area is involved, and habitats similar to those impacted are readily available in surrounding areas. Pits or well locations would be fenced if necessary, but there would be no extensive fencing that would inhibit movement of pronghorn through the area.

Activities associated with the construction phase of the project are likely to temporarily displace pronghorn from adjacent habitats, lowering the overall habitat effectiveness of these areas. These zones are not likely to be completely abandoned by pronghorn, but the effective use of these areas could be reduced depending on a number of factors such as time of year, social structure of the individual herd, and whether populations are resident or migratory. However, once the facilities are put into operation and human activity levels reduced, pronghorn are likely to habituate and to return to pre-disturbance activity patterns. Segerstrom (1982) found that deviation from the ordinary caused antelope displacement, but Reeve (1984) found that pronghorn acclimated to increased traffic volumes and heavy machinery as long as the traffic and machines moved in a predictable manner. The displacement of pronghorn is considered a short-term non-significant impact because of the temporary nature of the displacement and the availability of comparable habitats in adjacent areas.

The potential for vehicle collisions with pronghorn during spring, summer, and fall months would be increased by the creation of 66 miles of new access roads and would continue (although at a much reduced rate) throughout all phases of the well operations. Therefore, the potential for an increase in the incidence of pronghorn-vehicle encounters exists and mitigative measures to avoid and/or reduce such incidents should be taken.

The short-term influx of temporary construction workers and the long-term increase in the use of the area by gas field employees will increase the potential for poaching and general harassment

of antelope. Although such activities are not likely to reach significant proportions, it is possible, and steps to eliminate and/or minimize them should be taken.

Public vehicle use on roads built to access gas wells can have a similar, additive, or possibly a synergistic influence on reducing pronghorn use of adjacent habitats, as well as causing additional impacts. Public access to isolated road systems in the project area increases the potential for poaching and general harassment of antelope. Closure of new and some existing roads to public vehicle use would be one of the most effective mitigation measures that could be implemented to offset this impact. This would reduce the number of vehicles disturbing antelope as well as reducing the potential for direct harassment of pronghorn by humans.

Mule Deer. The project area supports a year-round resident population of mule deer. However, only 46 percent of the analysis area is classified as mule deer range, and of this area, approximately 12,686 acres are classified as winter/year-long range for mule deer. Under this alternative, an estimated 97 of the 107 proposed wells (91 percent) would be drilled within winter/year-long mule deer range located entirely within the North Natrona herd unit. The development of these wells along with associated road and pipeline installation would initially disturb an estimated 717 acres of habitat within the project area. The remainder of the proposed wells are not in designated mule deer range. Following construction, reclamation will reduce disturbed areas to 358.5 acres. No habitats designated as crucial would be affected. Displacement of the deer from winter/year-long range is not expected to result in a significant loss because of the relatively small area involved and the small number of deer using the area. For the same reasons, vehicle collision and poaching/harassment impacts to mule deer are expected to be minimal and non-significant. No adverse impacts to mule deer are expected as a result of direct habitat disturbance under this alternative because no designated crucial habitats will be affected, a relatively small total area is involved, and habitats similar to those impacted are readily available in surrounding areas.

4.7.3.1.3 Upland Game Birds

Mourning Dove. Since mourning doves are found on the project area it is likely that at least some breeding and nesting activity occurs there. Therefore, there is a possibility that mourning dove nests occur within the 783 acres of habitat that will be disturbed by the proposed construction. Because of the low density of doves in the area and the availability of comparable habitats in the area, the disturbance of 783 acres of possible dove habitat would not be a significant impact.

Sage Grouse. No sage grouse leks are known to occur in the project area, nor is any part of the project area known to be within the ¼-mile buffer zone of a lek. In addition, there is no known nesting habitat (i.e. the area within a 2-mile radius of an active lek [Braun et al. 1977]) that occurs within the project area. Records from the Wildlife Observation System of the Wyoming Game and Fish Department (WOS) (WGFD 1996e) and personal observations of HWA biologists do suggest, however, that sage grouse use some habitats within the project area during late summer and early fall.

Although most of the available habitat within the project area is marginal for sage grouse breeding and nesting, it is possible that one or more leks occur on or proximal to the project area; however, no formal surveys were conducted for sage grouse and much of the existing information contained in the WOS on lek locations and status is anecdotal and dated. Therefore, formal sage grouse lek

surveys should be conducted in the spring of 1997 to search for possible undocumented leks and provide needed information on the current activity status of leks on and adjacent to the project area. In the event that an active sage grouse lek is identified during formal surveys in the spring, surface disturbing activities would be restricted within a ¼-mile radius of each lek through a Controlled Surface Use restriction, and an additional 1¾-mile radius of each lek is protected from construction activities from March 1 through June 15. Given the implementation of these measures, impacts to sage grouse from the Proposed Action would be expected to be negligible.

4.7.3.1.4 Raptors

The principal potential impacts of the Proposed Action on raptors are: (1) nest desertions and/or reproductive failure caused by project related disturbance, (2) increased public access and subsequent human disturbance resulting from new road construction, and (3) temporary reductions in prey populations. Based on aerial and ground inventories conducted in the spring and summer of 1995 and 1996, 52 raptor nests were identified within the project area. The locations of individual nests are depicted in Figure 3-11 and individual nest site characteristics are described in Table 3-18.

Observations and field data collected in 1995 and 1996, show that five species of raptors tended or activated nests on the project area and that a total of 15 nests were either tended or active during these years. Because raptor pairs were observed to tend more than one nest within their territory, the total number of tended nests was more than the actual numbers of pairs tending them. Data collected are not detailed enough to accurately determine the number of raptor pairs using the project area, but estimates based on the field observations and data indicate that during years of good prey base availability there is adequate room for the territories of approximately twelve pairs of birds of mixed species. During poor prey base years it is likely that the project area may support only four pairs of raptors. The identification numbers of nests which were tended or active during 1995 and 1996 include: ferruginous hawk - 3&4, 15, 25&26, 33, and 72; red-tailed hawk - 14, 43, and 68, golden eagle - 2&20 and 5, prairie falcon - 73, and great horned owl - 20b. Although the northern harrier was observed on the project area during 1995 and 1996 the status of nesting is unknown. Suitable nest habitat for this species exists on the project area and it is possible that it nests there.

Nesting Related Impacts. When or if human activities occur within the zone of influence of raptor nests during the breeding/nesting season, stress from increased human activity and increased noise levels may result in nest abandonment, lowered productivity levels, or abandonment of the entire area. Potential effects that human disturbance can have on nesting raptors include nest desertion, damage to eggs or young caused by frightened adults, overexposure of eggs or young to heat or cold, missed feedings, premature fledging of young, and possible increased predation (Fyfe and Olendorff 1976). The nest construction and egg laying phases in *Buteo* nesting cycles are considered to be a very sensitive time for disturbance. Later in the nesting cycle, however, tolerance to humans is much greater (Call 1978). The potential for these impacts would be greatest during the construction phase (first 10 years) when human activity levels are highest, and would generally decrease during production (10 to 40 years).

Table 4-18. Estimated Numbers of Breeding Pairs of Raptors Displaced by the Proposed Action and Alternatives A, B, and C.

Prey Base Availability	Without the use of Artificial Nesting Structures							
	Proposed Action		Alternative A		Alternative B		Alternative C	
	Short-term[a]	Long-term[b]	Short-term	Long-term	Short-term	Long-term	Short-term	Long-term
Poor	3[c]	3[c]	0	0	3[c]	3[c]	3[c]	3[c]
Good	7[e]	4[d]	3[f]	0	7[e]	4[d]	7[e]	4[d]
Prey Base Availability	**With the use of Artificial Nesting Structures[g]**							
	Proposed Action		**Alternative A**		**Alternative B**		**Alternative C**	
	Short-term	**Long-term**	**Short-term**	**Long-term**	**Short-term**	**Long-term**	**Short-term**	**Long-term**
Poor	0	0	0	0	0	0	0	0
Good	0	0	0	0	0	0	0	0

[a] Short-term = 1 - 10 years (construction and drilling).
[b] Long-term = 11 - 40 years (production and maintenance).
[c] Ferruginous hawk nests 3 & 4 and 25 & 26; golden eagle nests 2 & 20.
[d] Ferruginous hawk nests 3 & 4, 12 & 15, and 25 & 26; golden eagle nests 2 & 20.
[e] Ferruginous hawk nests 3 & 4, 12 & 15, and 25 & 26; golden eagle nests 2 & 20; red-tailed hawk nests 14, 43, and 68.
[f] Red-tailed hawk nests 14, 43, and 68.
[g] Assumes that suitable locations are found and long-term legal arrangements for these locations are made.

Short and Long-Term Impacts As shown in Table 4-1, an estimated 3 to 7 potential territories will be impacted over the short-term by the proposed action during the intensive drilling and construction phase of the project, unless artificial nesting structures (ANSs) are employed. The number of displacements will be determined by the rate of development, proximity to potential nest sites, tolerance level of individual pairs, and density of prey base. More territories will be impacted during good prey base years than during poor ones because the project area is capable of supporting more pairs during good years. As intensive development gives way to the less intensive production and maintenance phase, some raptor pairs are likely to re-use the project area. The rate of recolonization will depend on many factors such as levels of human activities, density of prey base, availability of nest sites, species of raptor, and tolerance level of individual pairs to human activities. Species like the red-tailed hawk, however, are very tolerant of human activities and are likely to resume nesting on the project area during the production phase. Although the disturbance potential is reduced during production, more sensitive species of wildlife like the ferruginous hawk may continue to avoid the areas of greatest concentration of facilities. The ferruginous hawk is more sensitive to human disturbances and abandons its nests more readily than any other *Buteo* species (Snow 1974, Smith and Murphy 1978, Roth and Marzluff 1989, White and Thurow 1985). During the long term production phase, it is estimated that from 3 to 4 potential territories will be impacted. These territories include one golden eagle and 2 to 3 ferruginous hawks. The great horned owl is so tolerant of human activities that it will probably continue to nest in the project area even during the construction and drilling phase.

Buffer Zones. Under the Proposed Action, all nests in the project area would be subject to seasonal restrictions and would be protected until their use for nesting that season was determined. The shapes of buffer zones for active nests are irregular in shape and vary in width from ¼- to ½-mile. Shapes of zones will be determined on a site specific basis based on the degree of visual screening associated with each nest. Where there is no visual screening, zone widths are at the ½-mile maximum; where visual obscurity is provided by topography, zone widths are reduced to the ¼-mile minimum. For golden eagles, the exclusionary time window for nesting activities would extend from February 1 through July 31 and, for other raptor species from March 1 through July 31. If no nesting activity is observed by some later date, determined by the BLM AO to be past the viable nesting period for conditions prevailing during a given year, it can be concluded that it is almost certain that the given nest will not be used during the current nesting season and the BLM AO could authorize construction activities to proceed at such sites.

Buffers around active raptor nests provide insulation from facilities, human activity, and altered habitat. Buffer size and dates may vary, however, as determined by the BLM AO, depending on the status of current use, species involved, and the arrangement and size of natural topographic barriers. The application of these spatial and temporal buffer zones to raptor nests under the Proposed Action will provide insulation from facilities, human activity, and altered habitat on a season by season basis, but will not provide long term protection. An inherent problem with the seasonal buffer zone concept is that it only protects nesting raptors during the nesting season prior to or during the construction phase(s) of the project. Continuous protection of raptor nests and nesting habitat is not provided, since facilities may be constructed near formerly productive nests outside of the exclusionary period. Once facilities are established in an area, raptors may be deterred from using these nest sites again during subsequent breeding seasons. As adjacent habitats become increasingly fragmented due to concentrated well densities in portions of the project area, the availability of alternative nest sites could become limited. For these reasons, the implementation of temporal and spatial buffer zones alone, may not be enough to sufficiently offset

impacts to local raptor populations under the Proposed Action, and impacts could reach significant levels without implementation of additional mitigative measures.

Artificial Nesting Structures. Although a wide variety and large number of natural nest sites exist in the project area, few tree and cliff nest sites are available and nesting opportunities are mostly limited to the badland habitat that trends northwest-southeast through the central portion of the project area. The concentration of proposed drilling activities in the northern end of these badlands and elsewhere over the project area will result in a reduction of nest sites that is likely to constitute a significant impact in the absence of effective mitigation efforts. For this reason, efforts to alleviate the effects of the reduction of useable raptor nest sites should be directed towards the establishment of alternative nesting opportunities for raptors within the project area and the greater area within which the project area occurs. Reduction of nest sites can be effectively offset or mitigated by constructing new nesting structures in areas which are sufficiently far removed from proposed well sites and on-going human activities to allow undisturbed nesting opportunities. The provision of enough constructed nesting structures to insure that raptor productivity will continue at levels comparable to or greater than those that existed prior to project development would result in the avoidance of significant impacts, and none of the raptor pairs from the project area would lack nesting opportunity (Table 4-18). As demonstrated in previous studies (Call 1994, Apple 1994), the provision of constructed nesting structures in locales that have limited nesting opportunities, can effectively translocate nesting pairs away from planned or existing developments and increase the density of nesting raptors. Olendorff et al. (1980) documents numerous studies where the low availability of nest sites has been shown to be the limiting factor in the utilization of some habitats by raptors.

Ferruginous hawks are likely to make immediate use of ANSs within the greater area surrounding the project area and, if adequate structures are erected, maintain levels of production at or higher than those originally found on the project area and surrounding area. Golden eagle production, from the territory containing the number 2&20 nests, is likely to remain suppressed for several years or more since this species normally requires a longer period for adjusting to and accepting ANSs than the ferruginous hawk. Ferruginous hawks and golden eagles may not return to the portions of the field with the highest well densities during the life of the field and are most likely to remain in the ANSs within the greater area surrounding the project area. Given the demonstrated success of ANSs and the demonstrated ability of raptors to change nesting locations, long-term impacts within the greater area, within which the project area occurs, are likely to be negligible or even positive if a minimum of 14 ANSs are erected and maintained on suitable locations on and adjacent to the project area. However, ANS locations have not been specifically identified, and their potential to be effective cannot be analyzed without specific locations.

ANS Limitations

Although the successful use of ANSs is well documented, the achievement of success is dependent upon the accomplishment of several requirements that will need careful planning and considerable efforts to achieve. These requirements include:

- the structures must be located far enough away from human activities to provide security to the nesting pair. For most raptor species this requires that the structure be 1/4 to 1/2-mile (depending upon visual screening) away from human activities.

- some party must assume the responsibility for the construction, maintenance, and monitoring of the structures for the life of the field in order for ANSs to be successful.

- potential impacts to existing oil and gas and other rights needs to be considered and allowed for so that certainty of long-term (life of project) security can be assured.

- a sufficient number of structures must be erected to offer options to nesting raptors and to insure that the number of displaced pairs will be compensated for. A ratio of 2 nesting structures per displaced pair would be desirable.

Because of the high density of proposed wells over most of the project area there are relatively few sites on individual leases or units that provide locations far enough removed from human activities to be suitable for placement of an adequate number of ANSs to compensate for displaced pairs, particularly during good prey base years (14 structures). In order to provide an adequate number of sites it is likely that some ANSs will need to be erected off-leases or off-units.

Use of ANSs for moving raptors from certain problem areas. Another potential use of ANSs would be for moving nesting birds out of the path of operations when these birds choose to erect nests on existing man-made structures. In portions of Wyoming, golden eagles and ferruginous hawks have been known to perch, roost, and nest on condensate tanks and separators next to active pump jacks (Postovit and Postovit 1987, Apple 1994). However, not all pairs are this tolerant of human activities. To avoid potential disturbance to birds which have built nests on existing facilities, an ANS could be constructed in a nearby location that would not be disturbed, and the nest on the tank or other facility would be removed during the non-nesting season, after consultation and approval from the FWS and WGFD. Apple (1994) and Call (1994) have reported the success of this approach in other areas in Wyoming.

Adherence to the mitigation and avoidance actions described herein and in Sections 4.7.5 and 2.2.2.11 of this document, would help to minimize and eliminate potential long-term impacts of the Proposed Action. However, ANS locations have not been specifically identified, and their potential to be effective cannot be analyzed without specific locations.

Prey Related Impacts. The development of proposed well pads and associated roads and pipelines would initially disturb an estimated 788 acres of potential habitat for several species of small mammals that serve as prey items for raptors. This short-term moderate impact would affect approximately 3.1 percent of the project area and is not likely to be the determining factor in the level of use the project area receives by raptors because the small amount of short-term change in prey base populations created by the construction associated with the proposed action is minimal in comparison to the overall status of the rodent and lagomorph cycles which is controlled over the region and state by natural forces. While prey populations on the project area would likely sustain some stress during the initial phase of the project, prey numbers would be expected to soon rebound to pre-disturbance levels following reclamation of approximately 50 percent of the total initial disturbance area involving pipelines, unused portions of well pads and roads, and wells that are no longer productive. Once reclaimed, these areas will likely promote an increased density and biomass of small mammals that is comparable to those of undisturbed areas (Hingten and Clark 1984). For these reasons, implementation of the Proposed Action is not expected to produce any appreciable long-term negative changes to the raptor prey base within the project area.

Other Impacts. The creation of new roads outlined in the Proposed Action would increase public access to areas within the project area. As use of the project area by both workers and recreationists increases, the potential for encounters between raptors and humans would increase and could result in increased disturbance to nests and foraging areas, vehicle collisions, and shooting incidences. Closure of new and some existing roads to public vehicle use would be one of the most effective mitigation measures that could be implemented to offset this potential impact.

New powerlines used to serve facilities and wells can pose an electrocution hazard to raptors. Electrocution is a well documented source of mortality for raptors and the vast majority of electrocutions involve electric distribution lines rather than high voltage transmission lines (Olendorff et al. 1981). This impact can be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Powerlines: the State of the Art in 1981* (Olendorff et al. 1981).

4.7.3.1.5 Special Status Wildlife Species

The FWS has determined that one species listed as endangered under the ESA (black-footed ferret), and two species designated as Category C1 wildlife species (swift fox and mountain plover) have the potential for occurrence on or in the vicinity of the project area (USDI-FWS 1996; Appendix F).

Black-Footed Ferret. No prairie dogs or prairie dog colonies were observed within the project area during three years (1994-1996) of field surveys of raptor nests and one prey base survey of rodents and lagomorphs in 1996. In addition, no black footed ferret sightings within or proximal to the project area have been reported in the WOS, WYNDD, or the records of the FWS. For these reasons, the implementation of the proposed alternative is not likely to cause impacts to this species.

Swift Fox. Although there are no documentations of swift fox sightings on the project area contained in either the WOS or the WYNDD, data from Woolley et al. (1995) suggest that they are present in the region and that they are much more widely distributed than previously thought. One "probable", but unconfirmed sighting was made in the Waltman area. In consideration of this information and the fact that the project area lies near the western edge of historic swift fox range (Long 1965), it is likely that the swift fox is found within or near the project area.

The direct disturbance of 738 acres of mixed desert shrub and badlands habitats associated with the construction and production of gas wells under the proposed action would reduce habitat availability and effectiveness for swift fox if present. The magnitude of this impact is undetermined because distributional ranges and population data are lacking. For this reason, a formal swift fox survey should be conducted during the spring and summer of 1997 to determine the presence and distribution of swift fox on and adjacent to the project area. In the event that swift fox are observed within the study area during formal surveys in the spring, consultation and coordination with the FWS would be required to ensure that no adverse impacts to this species result from the Proposed Action.

Mountain Plover. No mountain plover were seen within the project area during three years (1994-1996) of field surveys of raptor nests and one prey base survey of rodents and lagomorphs in 1996. In addition, there are no documented sightings within the project area reported in either

the WOS or WYNDD. Also, suitable habitat for the mountain plover (i.e. shortgrass prairie dominated by blue grama and buffalo grass) does not occur within the project area. In consideration of the lack of evidence of occurrence and lack of preferred habitat, no adverse impacts to this species are expected as result of the implementation of the Proposed Action.

4.7.3.2 Alternative A - (Raptor Management Alternative)

Alternative A would provide a minimum development scenario of 97 newly constructed well pads the expansion of 2 existing well pads to accommodate twinning, and related facilities over the next ten-year planning period. Surface disturbances resulting from gas development under Alternative A would be the least of all alternatives considered. Field development at this level would result in the direct disturbance of approximately 670 acres of wildlife habitat over the next ten-year planning period. This includes a total of 268 acres associated with well pad construction, 224 acres for access roads, 143 acres for pipelines, and 35 acres for ancillary facilities. Following reclamation efforts, disturbed acreage would be reduced to an estimated 307 acres on which on-going project activities remain throughout the 30-year life of production. Vegetation would become re-established along the pipelines and access roads beginning the first fall after wells start producing and would continue with the subsequent reclamation of abandoned well sites that are no longer productive.

4.7.3.2.1 General Wildlife

The proposed disturbance of 670 acres of wildlife habitat associated with the construction of production wells under this alternative is 118 acres less than would be disturbed under the Proposed Action. Low levels of impact would likely result to various species of non-game songbirds and small mammals in the short-term. As with the Proposed Action, these impacts are not expected to adversely affect populations of these species because of their high reproductive potential and the availability of other suitable habitats within the Project Area.

4.7.3.2.2 Big Game

Pronghorn Antelope. Approximately 90 of the 99 proposed well sites (91 percent) would be placed within antelope yearlong range limited almost exclusively to the North Natrona herd unit. The development of these wells along with associated road and pipeline installation would initially result in the disturbance of 610 acres of yearlong badlands and mixed desert scrub habitats within the project area. The remaining well sites (9) would be placed within winter/yearlong range in the Badwater and Beaver Rim herd units; and total well, road, and pipeline installation would initially result in the disturbance of approximately 60 acres of this range. Following construction, reclamation will reduce disturbed areas of pronghorn habitat to 307 acres. As with the Proposed Action, no adverse impacts to antelope are expected as a result of direct habitat loss under this alternative, since no designated crucial habitats would be affected, a relatively small total area is involved, and habitats similar to those impacted are readily available in surrounding areas.

The analysis of potential impacts to pronghorn due to displacement, vehicle collisions, and poaching/harassment are identical to those presented under the Proposed Action (4.7.3.1.2) except for the fact that the potential for impacts under Alternative A is proportionately less than the Proposed Action because of 19 fewer miles of new road disturbance.

Mule Deer. Approximately 89 of the 99 proposed well sites (90 percent) would be placed within winter/year-long mule deer range located entirely within the North Natrona herd unit. The development of these well sites along with associated road and pipeline installation would initially disturb an estimated 603 acres of habitat within the project area. Following construction, reclamation will reduce disturbed areas of mule deer habitat to 276 acres. The remainder of the proposed well sites would be in areas designated as non-mule deer range. As with the Proposed Action, no adverse impacts to mule deer are expected under this alternative because of the relatively small area involved, the small number of deer using the area, and the fact that no habitats designated as crucial would be affected. For the same reasons, vehicle collision and poaching/harassment impacts to mule deer are expected to be minimal and non-significant.

4.7.3.2.3 Upland Game Birds

Mourning Dove. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.3).

Sage Grouse. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.3).

4.7.3.2.4 Raptors

The types of potential nesting related impacts of Alternative A on raptors are the same as those described for the Proposed Action except that the potential for impacts to ferruginous hawks and golden eagle nest numbers 2/20 under this alternative is much lower than for the Proposed Action. As described in Chapter 2, this alternative would provide continuous protection to selected raptor nests and nesting habitat rather than protecting nesting raptors only during the nesting season. Under Alternative A, current BLM raptor stipulations specifying a seasonal ¼- to ½-mile buffer would be expanded to a year-round ¼- to ½-mile buffer (mapped specifically) for selected nests (Figure 2-12). These nests include ferruginous hawk nest numbers 3/4, 12/15, 25/26, 33, and 72, and golden eagle nests 2/20 and 5 which represent the territories of five ferruginous hawk pairs and two golden eagle pairs. Criteria used in selecting these nests include: species of raptor, past activity status, condition of the nest and the potential for use in the future. This alternative is intended to set aside specific areas for raptors that provide secure, long-term nesting opportunities. In addition to the year-round exclusionary period for these selected nests, the implementation of Alternative A would include expanding the seasonal ¼- to ½-mile buffer zone to a seasonal 1-mile buffer zone for all ferruginous hawk nests. The remainder of the nests in the project area would be subject to the existing RMP stipulation.

According to the radius applied on the eleven nests identified for analysis under this alternative, approximately 1,961 acres of the project area would be excluded from future development, and casual use (e.g. location/route surveying and staking; cultural resource inventories) and extensive maintenance activities (e.g. work-over operations) on existing facilities would be managed in these areas during the February 1 through July 31 nesting season, provided raptors are occupying the area. An additional 6,412 acres of the project area could be subject to seasonal restrictions as a result of the expanded 1-mile buffer zone for ferruginous hawks under this alternative. This would variously affect an estimated 67 of the 99 proposed well site locations (68%) within the project area.

It is estimated that short-term impacts to 3 potential territories of the red-tailed hawk (nests 14, 43, and 68) will occur under Alternative A during years of good prey base availability, unless ANSs are employed (Table 4-1). Because of the consolidation of facilities and the permanent buffer zones, the need for ANSs on this alternative is less than for the Proposed Action. Except for the short-term displacement of red-tailed hawks where no ANSs are employed, no other displacements are expected to occur (Table 4-1). With the incorporation of mitigative measures stated herein, there should be no significant impact to raptor nesting success within the project area as a result of the implementation of Alternative A.

With regard to opportunities for raptors to hunt, potential impacts resulting from Alternative A would be slightly less than described for the Proposed Action in that the amount of habitat affected is 118 acres less. For the same reasons as described under the Proposed Action, implementation of this alternative is not expected to appreciably affect populations of small mammals that serve as prey for raptors within the project area.

The analysis of potential impacts to raptors due to increased public access and potential for electrocution are identical to those presented under the Proposed Action (4.7.3.2.1) except for the fact that the potential for impacts under Alternative A is proportionately lower than for the Proposed Action, because there are 8 fewer newly constructed well pads, 22 fewer expanded existing well pads, 19 fewer miles of roads, and 118 fewer acres of overall disturbance.

4.7.3.2.5 Special Status Wildlife Species

Black-footed Ferret. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.5).

Swift Fox. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.5).

Mountain Plover. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.5).

4.7.3.3 Alternative B - (Key Raptor Area Alternative)

This alternative would provide a development scenario of 114 newly constructed well pads and related facilities over the next ten-year planning period. Surface disturbances resulting from gas development under Alternative B would be only 19 acres less than under the Proposed Action and 99 acres greater than for Alternative A. Field development at this level would result in the direct disturbance of approximately 769 acres of wildlife habitat over the next ten-year planning period. This includes a total of 314 acres associated with well pad construction, 257 acres for access roads, 163 acres for pipelines, and 35 acres for ancillary facilities. Following initial reclamation efforts, disturbed acreage would be reduced to an estimated 348 acres on which on-going project activities remain throughout the 30-year life of production. Vegetation would become re-established along the pipelines and access roads beginning the first fall after wells start producing and would continue with the subsequent reclamation of abandoned well sites that are no longer productive.

4.7.3.3.1 General Wildlife

The proposed disturbance of 769 acres of wildlife habitat associated with the construction of production wells and associated facilities under this alternative would produce low levels of impact to various species of non-game songbirds and small mammals in the short-term. As with the Proposed Action, these impacts are not expected to adversely affect populations of these species because of their high reproductive potential and the availability of suitable habitats within the project area.

4.7.3.3.2 Big Game

Pronghorn Antelope. Under Alternative B, approximately 105 of the 114 proposed well pads (92 percent) would be placed within antelope yearlong range limited almost exclusively to the North Natrona herd unit. The development of these wells along with associated road and pipeline installation would initially result in the disturbance of 707 acres of yearlong badlands and mixed desert scrub habitats within the project area. The remaining well pads (9) would be placed within winter/year-long range in the Badwater and Beaver Rim herd units; and total well, road, and pipeline installation would initially result in the disturbance of approximately 62 acres of this range. Following construction, reclamation will reduce disturbed areas to 348 acres. As with the Proposed Action, no adverse impacts to antelope are expected as a result of direct habitat loss under this alternative, since no designated crucial habitats will be affected, a relatively small total area is involved, and habitats similar to those impacted are readily available in surrounding areas.

The analysis of potential impacts to pronghorn due to displacement, vehicle collisions, and poaching/harassment are identical to those presented under the Proposed Action (4.7.3.1.2).

Mule Deer. Under this alternative, approximately 99 of the 114 proposed well sites (87 percent) would be placed within winter/year-long mule deer range located entirely within the North Natrona herd unit. The development of these wells along with associated road and pipeline installation would initially disturb an estimated 669 acres of habitat within the project area. Following construction, reclamation will reduce disturbed areas of mule deer habitat to 303 acres. The remainder of the proposed well sites would be in areas designated as non-mule deer range. As with the Proposed Action, no adverse impacts to mule deer are expected under this alternative because of the relatively small area involved, the small number of deer using the area, and the fact that no habitats designated as crucial would be affected. For the same reasons, vehicle collision and poaching/harassment impacts to mule deer are expected to be minimal and non-significant.

4.7.3.3.3 Upland Game Birds

Mourning Dove. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.3).

Sage Grouse. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.3).

4.7.3.3.4 Raptors

The types of potential nesting related impacts of Alternative B on raptors are the same as those described for the Proposed Action and Alternative A, except that this alternative includes a provision for off-site mitigation within a key raptor management area. As described in Chapter 2, the main provision of this alternative is to set aside a federal mineral and surface estate adjacent to the project area for special management of raptor habitat. The area, which encompasses approximately 6,252 acres, would be designated the Powder River Draw Key Raptor Area (KRA). The boundary of the KRA and its location relative to the project area is shown in Figure 2-13.

Within the KRA, surface development of existing oil and gas leases within ¼- to ½-mile of raptor nests would be subject to seasonal restrictions unless or until field development is proposed. Future oil and gas leases would be subject to No Surface Occupancy (NSO) and the KRA would be identified as an avoidance area for development of salable minerals. Within the project area, all developmental activities proposed within ¼- to ½-mile of occupied raptor nests would be subject to existing RMP seasonal restrictions.

Data on the location and status of raptor nest sites within the KRA were obtained as part of a larger survey conducted during the spring of 1996 (HWA 1996) which included an area of approximately 273 sq. miles (see Section 3.7.2.3 and Chapter 5 - Cumulative Impacts). Data from the survey revealed a total of 24 raptor nest sites identified within the KRA. Of these, 22 (91.7%) were those of ferruginous hawks, one was that of a golden eagle, and one was that of an unknown buteo. Of the 24 nests identified, only 1 was occupied by ferruginous hawks during the 1996 nesting season.

The general premise behind Alternative B is that any potential impacts created as a result of the development of 114 well pads and associated facilities within the project area, would be off-set by the long-term benefit of the KRA which would protect critical nesting habitat for the long-term. However, as suggested previously under the Proposed Action, seasonal buffer zones only protect nesting raptors during the nesting season. Continuous protection of raptor nests and nesting habitat is not provided, since facilities may be constructed near formerly productive nests outside of the exclusionary period. Once facilities are established in an area, raptors may be deterred from using these nest sites again during subsequent breeding seasons. As adjacent habitats become increasingly fragmented due to concentrated well densities in portions of the project area, the availability of alternative nest sites could become limited. As a result, raptors may be displaced from portions of the project area and effectively forced to move to other suitable habitats in surrounding areas, including those within the KRA. This may result in a situation of overcrowding and increased competition among birds in the KRA. The displacement and increased competition may result in an ultimate decrease in local populations of raptors. This notion is supported by the fact that the average density of nests within the KRA is 2.8 nests per sq. mile, which is over twice that of 1.3 nests per sq. mile for the project area. Although better habitat conditions are likely represented in the KRA because of the increased density of nests there, the ability of the KRA to support additional raptor territories is in question. Therefore, for the same reasons described under the Proposed Action, the implementation of temporal and spatial buffer zones alone, may not be enough to sufficiently offset impacts to local raptor populations under the proposed alternative, and impacts to raptors could reach significant levels without implementation of additional mitigative measures.

As described with the Proposed Action, the effects created by the loss of nest-site alternatives can be offset or mitigated by constructing ANSs in areas which are the farthest removed from proposed well sites and on-going human activities. As shown in Table 4-1, both the short-term and long-term displacement of raptor pairs from territories on the project area will be the same as those described for the Proposed Action, with or without the use of ANSs.

Although the KRA will not mitigate the loss of raptor production on the Project Area, it will help to compensate by serving as a long-term nucleus area that will help to protect and stabilize the on-going production of raptors in the greater area and region and help to minimize cumulative impacts. With the provision of ANSs and implementation of mitigative measures stated herein there should be no adverse impacts to raptor nesting success within the project area as a result of Alternative B.

The analysis of potential impacts to raptors due to decreased prey density, increased public access, and potential for electrocution are identical to those presented under the Proposed Action (4.7.3.2.1) except for the fact that the potential for impacts under Alternative B is slightly lower than the Proposed Action, because there are 19 fewer acres of overall disturbance.

4.7.3.3.5 Special Status Wildlife Species

Black-footed Ferret. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.5).

Swift Fox. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.5).

Mountain Plover. The analysis for this alternative is identical to that presented under the Proposed Action (4.7.3.1.5).

4.7.3.4 Alternative C - No Action

Under the No-Action Alternative the consideration of individual APDs on public lands on a case by case basis would be allowed through site-specific environmental analysis. Additional gas development could occur on State and private mineral estate within the project area under APDs approved by the WOGCC. Therefore, essentially the same levels of development as described under the Proposed Action and Alternative B would be allowed under the No Action Alternative and impacts would be comparable to these alternatives (Table 4-18).

4.7.4 Impacts Summary

4.7.4.1 Big Game, Upland Game Birds, Special Status and General Wildlife

The implementation of the Proposed Action, Alternative A, or Alternative B would result in direct losses of habitat from surface disturbance associated with the construction of well pads and related access roads and pipelines. In addition, some wildlife species would be indirectly impacted by displacement from habitats in the vicinity of the project area due to the presence of human activities associated with the construction and operation of wells. The potential for collisions between wildlife and motor vehicles would also increase due to the construction of new roads and increased traffic

levels on existing roads. The severity of these impacts would be expected to decrease with the completion of the construction phase and with the onset of reclamation efforts on many of the disturbed areas.

The acreages of wildlife habitats disturbed for the Proposed Action and Alternatives A and B are 788, 670, and 769, respectively, and the nature of impacts to wildlife is identical. The application of prescribed avoidance and mitigation measures (Section 4.7.5) as well as additional measures described in Section 2.2.4.1 would reduce the impact potential and allow for any of the action alternatives to be performed without significant impacts to wildlife.

No impacts to the black-footed ferret or mountain plover are expected due to the lack of suitable habitats for theses species on the project area. Adoption of mitigation procedures described in Sections 4.7.3.1.5 and 4.7.5.1.2 will ensure that adverse impacts to the swift fox, should it be found to occur on the project area, are avoided.

4.7.4.2 Raptors

The principal potential impacts of the Proposed Action, Alternative A, and Alternative B on raptors are: (1) nest desertions and/or reproductive failure caused by project related disturbance, (2) increased public access and subsequent human disturbance resulting from new road construction, and (3) temporary reductions in prey populations.

Although the nature of prescribed avoidance and mitigation measures varies considerably between the Proposed Action and alternatives, the application of these measures (Section 4.7.5), as well as additional measures described in Section 2.2.4.1, would reduce impact potentials and allow for any of the action alternatives to be performed without significant impacts to raptors.

Under the Proposed Action, golden eagle production from the territory containing the #2 & #20 nests is likely to remain suppressed for several years or more. The long-term impacts within the greater area (raptor cumulative impact analysis area), within which the project area occurs, are likely to be negligible or even positive if a minimum of 14 ANSs are erected on suitable locations on and adjacent to the project area.

Under Alternative A, because of the consolidation of facilities and the permanent buffer zones, the need for ANSs is less than under the Proposed Action or Alternative B. Except for the short-term displacement of red-tailed hawks if no ANSs are employed, no other displacements are expected to occur.

Under Alternative B, both the short-term and long-term displacement of raptor pairs from territories on the project area will be the same as those described for the Proposed Action, with or without the use of ANSs.

Under Alternative C, essentially the same levels of development as described under the Proposed Action and Alternative B would be allowed, and impacts would be comparable to these alternatives.

Under the Proposed Action as well as the two alternatives, prey populations would sustain some habitat disturbance and stress during the initial phase of the project, but effective revegetation of pipelines and unused portions of well pads and roads would restrict impacts to the short-term. The

areas of disturbed habitat would be 788, 670, and 769 acres, respectively, for the Proposed Action, Alternative A, and Alternative B.

Other potential impacts to raptors resulting from increased new roads and subsequent increases in public access would be lower under Alternatives A and B than the Proposed Action. The implementation of Alternatives A and B would result in 19 and 13 fewer miles of roads, respectively, than the Proposed Action.

4.7.5 Mitigation Summary

4.7.5.1 Big Game, Upland Game Birds, Special Status and General Wildlife

- To avoid injury and mortality to migratory birds, hydrocarbons floating on the surface of the reserve pits will be removed as soon as possible after drilling operations are completed. If any oil is on the pits and is not removed within one week after drilling operations cease, the pits will be flagged overhead or covered with netting. Fencing of both reserve pits and produced water pits will be done, either around the pit itself or the entire location, to prevent access by cattle and wildlife.

- Following construction, reclaim access road and pipelines, unused portions of well pads, and wells that are not productive and incorporate forage and shrub species into the reclamation seed mix that include staple forage and browse plants for pronghorn and mule deer.

- A sage grouse lek survey should be conducted in the spring of 1997 to search for possible undocumented leks and provide information on the current activity status of leks on and adjacent to the project area. If active leks are found, surface disturbing activities would be restricted within ¼-mile radius from each lek through a Controlled Surface Use restriction and an additional 1¾-mile radius from each lek will be protected from construction activities from March 1 through June 15.

- In order to reduce incidents of illegal kill and harassment of wildlife, all project workers should be instructed on local wildlife regulations and state wildlife laws and regulations should be posted in conspicuous places at the job sites. Personnel should also be instructed about the nature of the wildlife species that occur on the work site, potential impacts to these species, and measures that could be taken to avoid or minimize impacts.

- A formal swift fox survey should be conducted during the spring and summer of 1997 to determine the presence and distribution of swift fox on and adjacent to the project area. In the event that swift fox are observed within the study area during formal surveys in the spring, consultation and coordination with the FWS would be required to ensure that no adverse impacts to the swift fox result from the implementation of the proposed project.

4.7.5.2 Raptors

Inventory and Monitoring

- Because the status of nests may change from year to year, activity status and location must be current to allow for the planning of mitigation and impact avoidance. Therefore, raptor surveys which commenced in 1995 should continue annually into 1997 and beyond.

- Project proponents should coordinate with the BLM, WGFD, and USFWS to develop a raptor monitoring plan that documents the effectiveness of ANSs and other mitigation measures.

Avoidance and Mitigation

- Where the construction of well pads, roads, pipelines, and drilling activities within the impact zone of raptor nest sites are likely to impact active raptor nests, such activities should be excluded between February 1 and July 31 for golden eagles, and between March 15 and July 31 (or when young are fledged) for Ferruginous hawks, or as determined by the BLM AO.

- Place ANSs in strategic locations within and adjacent to the Project Area and the greater raptor survey area (273 square miles) to offset losses in raptor production resulting from displacement by development.

- To mitigate the functional loss of nest sites in raptor territories where permanent facilities are established and to maximize nest site alternatives, construct new nesting structures in areas which are the farthest removed from proposed well sites and on-going human activities.

- If above-ground powerlines are installed, power pole cross arms should be configured according to specifications described in *Suggested Practices for Raptor Protection on Powerlines: the State of the Art in 1981* (Olendorff et al. 1981) so as to the eliminate the potential for raptor electrocution.

4.7.6 Residual Impacts

4.7.6.1 Big Game, Upland Game Birds, and General Wildlife

With implementation of prescribed mitigation measures, there would be no residual impacts to wildlife resources under the Proposed Action or Alternatives A and B.

4.7.6.2 Raptors

Although it is likely that the avoidance and mitigation strategies, presented in the Mitigation Summary of this EIS, will reduce potential impacts to nesting raptors to non-significant levels, effects need to be monitored over time and appropriate adjustments made when or if residual impacts become evident.

4.8 RECREATION

4.8.1 Introduction

Well drilling, testing and production operations, ancillary facilities and associated site preparation and construction activities such as those proposed within the project area have the potential to cause some major alterations to the recreation setting and recreation opportunities available to persons using and passing through the area. Recreationists could be temporarily or permanently displaced from using certain locations associated with drilling and production activities. Displacement of recreationists could also result from changes in the numbers or distribution patterns of wildlife that attract hunters and wildlife observers to the area.

The presence of construction and drilling equipment and associated increased evidence of human industrial activities in the project area could reduce opportunities for recreationists seeking to experience isolation from human activity. They will also adversely impact the visual resource and detract from the recreation experience of passive recreationists. An increase in drilling and production facilities would also cause a safety hazard to those recreationists who continue to hunt in their traditional hunting areas. Such changes could also result in displacement or redistribution of recreationists who would choose to avoid such conditions, as well as reduced satisfaction among others who might continue to engage in recreation activities in the project area.

4.8.2 Impact Significance Criteria

The following criteria were used to evaluate the potential significance of recreation impacts:

- Levels or patterns of project equipment and vehicle use that would result in displacement of recreation activities for more than one season of use and,

- Increased evidence of human activity that would reduce recreationists perceived levels of isolation and solitude.

4.8.3 Direct and Indirect Impacts

4.8.3.1 Proposed Action

Short term impacts associated with drilling and construction would include noise, dust, truck traffic and high levels of visual contrast. Most of the drilling and construction would occur in the first 5 to 10 years. It is anticipated that this level of activity over a 5-year period would displace most hunters, particularly during the Pronghorn season. These hunters would be forced to relocate to other hunting areas near the project area. Participation in wildlife observation, geologic observation, and nature photography would also likely decline in the short term. The high levels of visual contrast during construction may discourage some from traveling the backcountry byway. High levels of contrast detract from the experience of all users. High volumes of truck traffic are also known to discourage travel, particularly by tourists. Overall, these short term impacts would be significant because they would continue at an intense level for 3 years or more.

In the long term, the presence of 107 well sites with associated roads, pipelines, and ancillary facilities, would significantly alter the recreational resource. The landscape would become both

physically and visually fragmented into an unnatural appearance. The high density of wells and support facilities in all proposed planning areas, particularly Sections 30, 31, and 32, and Areas 3 and 4, would likely displace hunters and hikers from the project area for the 30 to 40 year life of the project. Similarly a decline in use of the area by those interested in wildlife or geologic observation and photography would be expected. Although the project area did not provide users with a high level of isolation and solitude, what little it did offer would be eliminated under the Proposed Action.

It is expected that most recreationists currently using the project area would be displaced to other areas within the region. They would seek out similar resources with lower levels of cultural modification. Displaced hunters could incur additional costs in driving to more distant areas and scouting these areas for hunting opportunities. Miles of new roads will be constructed in the project area. These roads may be used by some recreationists to explore areas previously inaccessible by vehicle. As noted in Chapter 3, similar areas are not uncommon in the region. No camping was accommodated on the project area. The Proposed Action could generate an increase in demand for camping outside the study area. Camping, particularly in the Grave Springs area could increase during the construction phase. However, the long term impacts of the Proposed Action would be significant because both Significance Criteria would be exceeded.

4.8.3.2 Alternative A

The nature of both the short term and long term impacts to the recreation resource associated with Alternative A would be similar to those described for the Proposed Action. The level of impact would however, be reduced somewhat because 8 fewer well pads (99 total) are proposed. A similar small decrease in access roads, pipelines, and other support facilities would also be expected. Less construction could equate to less visual contrast depending upon the location of the 99 well sites that would be drilled. Wells drilled in seldom seen locations, while they may affect on-site users, would not affect Backcountry Byway travelers. A reduced drilling program could also equate to a shortened construction period. Short-term impacts would be considered significant because recreationists would be displaced for more than one season. However, these impacts could be shorter in duration than the Proposed Action depending, upon the final drilling schedule. Long-term impacts would be considered significant for the reasons previously described for the Proposed Action.

4.8.3.3 Alternative B

Both the short term and long term impacts for Alternative B would be the same as those described for the Proposed Action, but of a higher magnitude due to a greater number of planned drill pads (114 total) and associated production facilities.

4.8.3.4 Alternative C

The nature of short-term impacts would be the same for Alternative C as those described for the Proposed Action and Alternatives A and B. Specific impacts would be similar to those described for the Proposed Action and Alternatives A and B, even though fewer wells would be drilled initially and fewer support facilities constructed at any one time. However, over time as the project area fills incrementally, it could approach well densities recommended in Alternative A or the Proposed Action or even exceed proposed levels. Development in the project area would be more hap-

hazard in character than the Proposed Action or Alternatives A or B. As densities approach or exceed these levels they would be considered significant for reasons described for the Proposed Action and Alternatives A and B.

4.8.4 Impact Summary

The Proposed Action and Alternatives A and B would have significant short-term and long-term adverse impacts on the recreational resources of the project area. Both Impact Significant Criteria would be exceeded. Alternative C could produce impacts as significant and potentially more adverse than the Proposed Action or Alternative A or B depending upon the number of single wells permitted and their locations.

4.8.5 Mitigation Summary

In addition to the Project Wide Mitigation Measures outlined in Chapter 2, the following additional mitigation measures are proposed:

- Redesign the interpretative exhibit in the project area explaining the geologic, cultural, and paleontological features of the project site. The exhibit would emphasize the oil and gas resource and the importance of developing these resources on BLM land in Wyoming and the U.S. Reconstruct the South Bighorn/Redwall Backcountry Byway interpretive exhibit outside the project area. The specific location of the exhibit would be determined by BLM recreation specialists and landscape architects.

- Construct a new interpretive exhibit to replace the existing one located inside the project near the badland breaks. The new exhibit should be located outside the project area in a more scenic location to be determined by the BLM landscape architect. Redesign the existing exhibit at the above location to interpret the project sites geology as described in the Visual Resources section.

- Construction of an interpretative exhibit at an appropriate location on BLM land north of the project site that would emphasize plants and wildlife that can be seen along the Backcountry Byway. This would partially mitigate for wildlife and plant observation opportunities lost to the Proposed Action.

4.8.6 Residual Impacts

Well pads, roads, pipelines, and ancillary facilities will remain on the site for the life of the project. Truck traffic and resultant fugitive dust will also persist. The visible presence of these residual activities would continue to detract from the recreational experience of those traveling the Backcountry Byway and the few that may continue to recreate in the project area.

4.9 VISUAL RESOURCES

4.9.1 Introduction

Both short-term and long-term impacts to the visual resource will occur where patterns of area, line, form, color, and texture in the characteristic landscape would be contrasted by drilling equipment, production facilities, and/or construction related damage to vegetation, topography or other visible features. The severity of impact depends upon the scenic quality, sensitivity level, and distance zone of the affected environment; the reclamation potential of the landscape disturbed; and the level of disturbance to the visual resource created by the Proposed Action and alternatives. In general, impacts would be most severe on sites where mitigation would be difficult and where visual contrasts would be highly visible to potentially large numbers of viewers.

4.9.2 Impact Significance Criteria

A visual impact would be considered significant if the level of contrast produced by the Proposed Action and/or alternatives would:

- exceed the level of contrast permitted in a VRM Class and could not be returned to an acceptable level following production reclamation;

- create change in overall character from Human Influenced to Human Dominated (in conjunction with other present actions, proposed future actions, and potential actions permitted under management direction).

4.9.3 Direct and Indirect Impacts

4.9.3.1 Proposed Action

Short-term impacts to the visual resource under the Proposed Action would include contrast in line, form, color, texture, and scale associated with drilling rigs, construction equipment, service equipment, trailers, and the general industrial character of drilling and field development. Construction operations also produce fugitive dust, which adds to the level of contrast. Long- term impacts would include contrasts in line, form, color, texture and scale associated with fixed structures (well heads, production facilities, access roads, powerlines, and other ancillary facilities) that would remain once well drilling was completed and additional disturbed landscape yet unreclaimed.

The severity of impact depends upon scenic quality, sensitivity level, and distance zones of the affected environment, as well as, the reclamation potential of soil and the level of disturbance to the visual resource. In general, impacts would be most severe on sites where Scenic Quality is high, where reclamation would be difficult, and where visual contrasts would be visible to potentially large numbers of viewers.

As mentioned in Chapter 3 (Affected Environment), the project area is not pristine; existing oil and gas roads and facilities, powerlines, a substation, a junk yard, ranch out-buildings, and a railroad grade are all visible to motorists and recreationists. These existing cultural modifications are considered when assessing the potential impact of the Proposed Action and alternatives.

Planning Areas 1 and 2

In Planning Areas 1 and 2 (Figure 2-1), an estimated 22 well pads and support facilities would be visible from State Highway 20/26. In addition, all the well sites in Planning Area 1 and most of the well sites in Area 2 would also be visible from Natrona County Road 104. Area 1 is the most sensitive area of the project site because the greatest number of viewers that could observe the site are traveling Highway 20/26. All Area 1 well pads and support facilities would be highly visible because the topography is sloping toward the viewer and all wells are in the foreground/middleground of the viewshed. Each graded well pad would produce a contrast in form, color, and texture. Surface disturbance associated with 40-foot wide roads, pipelines, and powerlines would introduce miles of contrasting lines. Fugitive dust generated by service traffic to production facilities would increase road related contrasts. The combined contrasts in line, form, color, and texture created by 22 wellpads and support facilities on 160-acre spacing would dominate the landscape.

Short- term impacts would not repeat the form, line, texture of the characteristic landscape as required in a Class 4 zone. These impacts would not be considered significant because they would be short-term. Long-term impacts associated with fixed facilities would dominate the viewshed. They would not, however, be considered significant because compliance with recommended mitigation would reduce contrasts to levels permitted in a Class 4 zone.

Planning Areas 3 and 4

Twenty-four sites (excluding Sections 30, 31, and 32) would be drilled in Area 3 on 40-acre spacing. It is estimated that 8 of these wells would be drilled in areas that are seldom seen with 2 or 3 wells located in areas identified as Class A or B Scenic Quality. The remaining 16 well sites would be visible from County Road 104. The impacts to the visual resource would be similar to, but less severe than those described above. Impacts would be less severe because 30% of the well pads and support facilities would not be visible and the topography is flat to gently sloping which would reduce surface disturbance by grading.

Most of the 16 wells drilled in Area 4 (excluding Sections 30, 31, and 32) would be located in areas that are seldom seen but all would be in areas identified either as Class A or B Scenic Quality. Impacts would be similar to those described for Sections 30, 31, and 32. However, unlike development in Sections 30, 31, and 32, they would be seldom seen by motorists.

Short- term impacts in Planning Areas 3 and 4 would be similar to those described for Planning Areas 1 and 2, but of less magnitude since the Areas 3 and 4 would not be as visible from Highway 20/26 and County Road 104. Short- term impacts would not repeat the form, line, texture of the characteristic landscape as required in a Class 4 zone. These impacts would not be considered significant because they would be short-term. Long-term impacts associated with fixed facilities would dominate the viewshed. They would not, however, be considered significant because compliance with recommended mitigation would reduce contrasts to levels permitted in a Class 4 zone.

Sections 30, 31, and 32

Development in Planning Areas 3 and 4 would include construction of 48 well pads in Sections 30, 31, and 32. These wells would be drilled from 46 new pads concentrated in the most visible areas of these sections. Steep topography in much of Sections 30, 31, and 32 would require substantial grading for well pads, roads, and pipelines. High well pad density (20/40 acre spacing) and extensive surface disturbance would result in high levels of contrast in line, form, color, and texture. As noted in Chapter 3, Planning Areas 3 and 4, including portions of Sections 30, 31, and 32, have the highest Scenic Quality in the project area. The level of contrast associated with implementation of the Proposed Action would have a significant adverse impact on Scenic Quality; seriously compromising the most scenic section of the project area.

Liquids Recovery Plant

A liquids recovery plant requiring a surface area of 10 acres is tentatively proposed at a site located approximately 0.25 miles north of the high point along the first 9-mile section of County Road 104. A 10-acre facility in a prominent location would visually dominate the adjacent landscape. It would be a major detraction from the view of the southern Bighorns. The plant would also be a dominant element in views looking south from the southern Bighorns. The impact of the recovery plant would be considered significant because it would exceed Class 4 standards. It would be impractical to construct the plant in a "manner that they [it] might be seen to have been a natural occurrence." VRM(USDI-BLM, 1980) The plant would introduce a highly industrial character to the landscape. The 2 new meter stations in the same locale as the gas plant would add to the industrial character.

In summary, the Proposed Action would introduce significant impacts associated with the liquids recovery plant and substantial adverse visual impacts would occur in Sections 30, 31 and 32. The remainder of the Proposed Action would dominate the landscape but successful implementation of recommended mitigation would bring the level of contrast into compliance with Class 4 standards.

4.9.3.2 Alternative A

The nature of both the short term and long term impacts would be the same as those described for the Proposed Action. However, in Alternative A, the level of contrast in line, form, color, texture, and scale would be slightly higher even though 7 fewer well pads are proposed. The impacts are slightly higher for several reasons. Four more well pads would be visible from Highway 20/26. In addition, 8 well sites would be visible in Sections 19, 20 and 25 from Arminto and County Road 104. Significant impacts would be associated with the liquids recovery plant for reasons previously presented. The remainder of the development proposed in Alternative A would comply with Class 4 standards given successful implementation of recommended mitigation.

4.9.3.3 Alternative B

Both the short term and long term impacts associated with Alternative B would be similar to those described for Alternative A. The well locations are similar; more wells are in visible locations than the Proposed Action.

4.9.3.4 Alternative C

The nature of short term impacts would be the same for Alternative C as those previously described. They would, however, likely be spread out over a longer period of time. Specific short-term impacts would be similar to those described for the Proposed Action or Alternatives A and/or B even though fewer wells would be drilled and support facilities constructed at any one time. These short term impacts would exceed levels of contrast permitted in a Class 4 zone. Short term impacts would not however, be considered significant because of their short duration. Over time as the project area fills incrementally it could approach well densities proposed in Alternative A or the Proposed Action or even exceed proposed levels. Development in the project area would be more hap-hazard in character than the Proposed Action or Alternative A or B. As densities approach or exceed these levels, impacts would be the same as those described for the Proposed Action.

4.9.4 Impact Summary

The Class 4 VRM classification for the entire project site is the most permissive VRM Class in terms of visual contrast permitted. Neither the Proposed Action or the alternatives would exceed the level of contrast allowed in a Class 4 zone. The only site specific exception would be the liquids recovery plant included in the Proposed Action and Alternatives A and B, which would produce significant impacts.

The area of highest Scenic Quality within the project area would be seriously compromised by the Proposed Action and alternatives. Contrasts in line, form, color, and texture would dominate the badland breaks. In addition the aesthetic experience of those traveling the Backcountry Byway would be substantially diminished by the Proposed Action and alternatives. The first 9 miles of the County Road 104, the South Bighorn/Redwall National Backcountry Byway, would no longer be an attractive southern gateway to the Bighorns. The Proposal Action and all alternatives would also diminish the recreation experience of those few who may continue to recreate on-site as described in the Recreation section.

Alternative A would be the least impacting of all alternatives for reasons previously discussed. The degree to which impacts would be reduced would depend upon where the fewer well sites were eliminated.

4.9.5 Mitigation Summary

In addition to the Project Wide Mitigation Measures outline in Chapter 2, the following additional mitigation measures are proposed:

- Upon completion of construction activities recontour topography to approximate pre-existing contours by reducing disturbance to the smallest areas required for safe operation of: well sites, roads, pipelines, and other facilities sites. Revegetate recontoured areas with native grasses and forbs.

- Recontour dry hole pads and related access roads to pre-existing contours and revegetate with native grasses and forbs.

- Recontour all development related disturbances to pre-existing contours and revegetate with native grasses and forbs once the project life has terminated.

- Eradicate sweet clover and noxious weeds from roadcuts, pipeline corridors and other surface disturbances.

- Construct a new interpretive exhibit to replace the existing one located inside the project near the badland breaks. The new exhibit should be located outside the project area in a more scenic location to be determined by the BLM landscape architect. Redesign the existing exhibit at the above location to interpret the project sites geology as described in the Recreation section.

4.9.6 Residual Impacts

Well pads, roads, pipelines, and ancillary facilities would remain on the site for the life of the project. Truck traffic and resultant fugitive dust would also persist. The visible presence of these residuals would continue to detract from the recreational experience of those traveling the Backcountry Byway and the few that may continue to recreate in the project area.

4.10 CULTURAL RESOURCES

4.10.1 Introduction

Cultural resources on public land, including archaeological sites and historic properties, are protected by various laws and regulations. The National Historic Preservation Act of 1966 (NHPA), the Native American Graves Protection and Repatriation Act (NAGPRA) and 36 CFR 800 are examples of particular pertinence. The specific directives can be found in "Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines" (Federal Register 1983). Laws and regulations concerning cultural resources stipulate that a proposed undertaking must take into consideration the effects of the action on significant cultural resources. This requires that cultural resources within the proposed area of potential effect (APE) be identified and evaluated. Measures can then be taken to mitigate or minimize the adverse effects to those resources that are considered to be significant.

4.10.2. Impact Significance Criteria

4.10.2.1 Assessment of Site Significance

Mitigation of adverse effects is afforded to properties considered to be eligible for nomination to, or listed on the National Register of Historic Places. The National Register criteria (36 CFR 60.4) define four categories with which to measure significance based on: "the quality of significance in American history, architecture, archeology, and culture present in districts, sites, buildings, structures and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association; and that:

a. are associated with events that have made a significant contribution to the broad patterns of our history; or

b. are associated with the lives of persons significant in our past; or

c. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d. have yielded, or may be likely to yield information important in prehistory or history."

For cultural resources present in the project area, both prehistoric and historic, significance is primarily based on a site's potential to yield information important in prehistory or history. For these sites, significance is based on information content and how that information will contribute to addressing local and regional research questions or problems.

The Advisory Council on Historic Preservation has developed guidelines for determining adverse impacts for sites on or eligible to the National Register [36 CFR 800.9 (b)(1),(2),(3)]. Significant impacts to cultural resource consist of the following:

1. Destruction or alteration of all or part of a property.

2. Isolation of a cultural resource from, or alteration of, its surrounding environment.

3. Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting.

4. Neglect and subsequent deterioration.

4.10.3 Direct and Indirect Impacts

4.10.3.1 Proposed Action

Adverse effects to cultural resources under the Proposed Action could be in the form of direct, indirect, or cumulative impacts. Potential direct impacts to the sites considered eligible to the National Register of Historic Places (NRHP) would primarily result from construction-related activities and from erosion of soils off the construction site. Impacts would be significant if any information was lost that impeded efforts to reconstruct the prehistory or history of the region. Activities that are considered to have the greatest effect on cultural resources include the blading of well pad and associated facilities, construction of roads, and product transportation facilities. Sites that are located outside the APE would not be directly affected by construction-related activity. Additionally, if a portion of an eligible site which does not contribute to the overall eligibility is crossed by earth disturbing activity, the project is judged to have no adverse effect on the site. Mitigative data recovery would occur at eligible sites located within the APE and scheduled for disturbance. This mitigation usually would occur prior to the disturbance.

Indirect impacts would not immediately result in the physical alteration of the property. Indirect impacts to prehistoric sites primarily include unauthorized surface collecting of artifacts and casual use activities such as surveying which physically alters the site assemblage. With regard to historic sites, indirect impacts would result from surface artifact collecting and alteration of the surrounding

environment by introducing visual impacts. These effects could be considered cumulative if they persisted through time and resulted in incremental deterioration of a property.

4.10.3.2 Alternative A

Impacts associated with Alternative A would be similar, but of less magnitude, than those described for the Proposed Action because of less overall anticipated site disturbance associated with implementation of Alternative A.

4.10.3.3 Alternative B

Impacts associated with Alternative B would be similar, but of more magnitude, than those described for the Proposed Action because of more overall anticipated site disturbance associated with implementation of Alternative B

4.10.3.4 Alternative C

Under Alternative C, impacts to cultural resources within the project area would continue to occur as construction activities are authorized, but of an unknown magnitude since the actual level of development would be unknown.

4.10.4 Impacts Summary

Gauging the effect of any impact on a specific cultural property depends on the level of information available for that particular property provided by inventory and/or testing data. If cultural resources on or eligible for the National Register are to be adversely impacted by a proposed undertaking, then the applicant, in consultation with the surface-managing agency and SHPO, shall develop a mitigation plan. Typically, construction does not proceed until terms of the mitigation plan are satisfied.

Potential impacts to specific eligible or unevaluated properties are unknown at this time. Given the Cave Gulch/Bullfrog/Waltman proposal is in an area of high to moderate site density, development would be likely to encounter significant cultural resources.

In general, the project area has a moderate to high site density, and therefore, high archaeological sensitivity. Certain geomorphic situations have a greater archaeological potential than other areas especially in terms of significant cultural resources. These situations include eolian deposits (sand dunes, sand shadows and sand sheets) and alluvial deposits along major drainages.

Although the project area has a high degree of archaeological sensitivity, impacts to known cultural properties would not be significant. Potential impacts to known and anticipated cultural resources can be alleviated through appropriate mitigation measures.

4.10.5 Mitigation Summary

If a site is considered eligible for nomination to, or is on the National Register, and if that site will be impacted, then mitigative procedures must be implemented. Avoidance is the preferred method for the mitigation of adverse effects to an eligible property. Avoidance is accomplished through

project redesign to totally eliminate or minimize impacts. The total avoidance of significant cultural resources is not always possible or prudent given other management considerations. The total avoidance of some properties, (e.g., historic trails), may be considered not to be the preferred option if the avoidance would lead to greater overall land disturbance or would result in significant impacts to other resources such as wildlife, hydrology, soil, or range. Mitigation of adverse effects to properties that can not be avoided would be accomplished by the documentation of the physical remains. For historic sites consisting of standing structures this could include detailed drawings and photographs following regulatory standards. For archaeological properties the documentation of physical remains would consist of data recovery.

Additional mitigation would include cultural resource values awareness training of the Cave Gulch-Bullfrog-Waltman operators' personnel and contractors to avoid vandalism or cultural site damage.

If at any time during construction cultural resources are found, all construction activities in that vicinity will halt and the appropriate BLM personnel will be notified. Work will not proceed until the cultural materials are handled properly by qualified archaeologists and notification is received from the BLM.

4.10.6 Residual Impacts

By avoiding known cultural and historical sites during drilling facility layout (drill sites, access roads, and pipeline corridors), and by implementing Class III inventory on the proposed project elements (drill sites, access roads, and pipeline corridors) the potential for adverse impacts to cultural resources in the project area is minimized. With implementation of these measures, there would be no avoidable impacts to known cultural resources and minimal impacts to newly discovered cultural resources in the project area.

4.11 SOCIOECONOMICS

4.11.1 Introduction

The existing local (Natrona County) oil and gas service industry is well developed and mature. The local labor pool is sufficient to provide any additional employees which may be required to conduct the well field development activities associated with the Proposed Action. Therefore, implementation of the Proposed Action would result in the following socioeconomic effects: (1) increased economic opportunities for local drilling and service firms, (2) increased employment opportunities for local oil industry workers, (3) secondary economic benefits in other sectors of the local economy resulting from spending by companies and workers associated with the Proposed Action, and (4) additional tax revenue for federal, state and local governments.

The proposed action would also result in localized increases in demand for Natrona County road maintenance and law enforcement services in the area near the project site. However, the Proposed Action-related tax revenues to Natrona County should be adequate to fund increased service demands.

Incremental Proposed Action-related demand for housing and other local government facilities and services would be minimal given that Proposed Action-related employment demand is anticipated

to be filled by existing Natrona County employed, under-employed and unemployed oil field workers. To the extent that non-local contractors may perform work on Proposed Action-related activities, temporary housing resources and local government facilities and services are adequate to accommodate the increased demand.

4.11.2 Resource Management Objectives and Impact Significance Criteria

No specific RMP directions are available for this discipline. The following criteria are used to determine whether socioeconomic impacts of the Proposed Action would be significant:

- demographic impacts involving a greater than ten percent annual increase in a local area population. This criteria is based on the assumption that such growth would strain the ability of affected communities to provide housing and services or otherwise adapt to growth-related social and economic changes;

- an aggregate change in revenue and expenditure flows likely to result in an inability on the part of affected units of government to maintain public services and facilities at established service level standards; and

- any permanent displacement of residents or users of affected areas that would result due to major project-induced changes in or conflicts with existing ways of life.

- levels of project-induced dissatisfaction likely to generate organizational response and conflict.

4.11.3 Direct and Indirect Impacts

4.11.3.1 Proposed Action

The Operators estimate that an annual average of approximately 172 full-time equivalent workers would be required for the various phases of Proposed Action-related drilling and completion activities over the life of the project (Fact Sheet 1996). Barrett Resources, Chevron and the other operators plan to drill up to 160 wells over a ten year period. Four or more drilling rigs could be used at one time during the drilling phase. Completion activities would commence as soon as the well drilling rigs are moved off location.

4.11.3.1.1 Local Economy

As described in Section 3.11.4.3, despite declines in employment since the early 1980s and recent diversification, the Natrona County oil and gas industry remains a major employer in the County and has some capacity for expansion. The level of drilling associated with the Proposed Action (16 wells per year) is well within the range of drilling activity in Natrona County in recent years (46 wells per year on average during 1991 through 1995), therefore, it is anticipated that the existing local oil and gas industry would be able to accommodate the level of activity associated with the Proposed Action.

The development and production activity associated with the Proposed Action may help slow the recent declining trend in local oil and gas industry activity (Robitaile 1996). Further decline in the local oil and gas sector would decrease basic employment in Natrona County. Decreases in basic

employment would lead to further reductions in non-basic employment as the employment multiplier effect reverses, eliminating more retail, service and other non-basic jobs in the economy.

4.11.3.1.2 Employment, Unemployment, and Labor Force

The Proposed Action is anticipated to provide direct employment for as many as 172 full-time equivalent (FTE) jobs per year over the ten-year development phase of the project (Chevron 1996). Proposed Action-related direct employment opportunities are expected to primarily result in continued employment for existing workers rather than jobs for new workers. If individual contractors require additional employees to meet Proposed Action-related demand, the local labor pool should be able to provide qualified drilling and service workers.

The impact of spending by Proposed Action-related companies and direct employees is expected to generate additional employment in other sectors (particularly retail and service) of the local economy. According to the U.S. Bureau of Economic Analysis, the total employment impact of each FTE job in the oil and gas sector in Wyoming is about 2.4 (Regional Multipliers 1992). Consequently, for each job in the oil and gas sector, as many as 1.4 additional jobs may be created in other sectors of the State's economy. Not all of this additional employment would be experienced in the local economy, some would occur elsewhere in the State. However, it is reasonable to assume that between 50 and 100 percent of the secondary employment effects would occur in the local economy. Based on this assumption, the estimated 172 direct FTEs associated with the Proposed Action would result in an additional 120 to 241 secondary jobs in Natrona County. As with oil and gas industry employment, it is likely that most of these jobs would represent continued employment for currently employed workers. To the extent that new employment opportunities occur, they will likely be filled from the substantial pool of unemployed workers in the County.

Unemployment in Natrona County remains above the Statewide rate. Any new direct or indirect employment resulting from the Proposed Action should have the effect of decreasing the County unemployment rate, all other factors remaining constant.

Based on the foregoing, the Proposed Action is expected to generate minimal worker in-migration for Natrona County. Conversely, without the oil and gas industry employment associated with the Proposed Action, the labor force in this sector could diminish as the unemployed leave the area to seek employment elsewhere, continuing the downward trend in Natrona County mining sector employment depicted in Figure 3-16.

It is possible that the seasonal occupancy restrictions during the raptor nesting season may result in corresponding seasonal unemployment in the Natrona County oil and gas sector. This may occur if the most desirable well pad locations are in restricted areas. It may also occur in later years when most of the wells outside the restricted areas have been drilled.

4.11.3.1.3 Earnings

The estimated 172 full-time equivalent jobs during the drilling phase of the Proposed Action will generate an estimated annual payroll of $7 million (Chevron 1996). This direct income represents 3.4 percent of the 1994 total earnings in the mining sector in Natrona County. The average weekly wage for all workers covered by unemployment insurance in Natrona County was $22,621 in 1995

(Wyoming Department of Employment 1996). The average annual income for the 172 full-time equivalent workers associated with the Proposed Action is estimated to be $40,697, almost eighty percent higher than the average annual wage in Natrona County.

Direct employee spending will increase total earnings in the State economy through a multiplier effect. Based on the Wyoming earnings multiplier (Regional Multipliers 1992), the total Proposed Action-related annual income effect in Wyoming would be an estimated $12,446,000. The total estimated direct and indirect income impact in Wyoming resulting from ten years of drilling would be about $124,460,000 (in uninflated 1996 dollars).

4.11.3.1.4 Potential Economic Effects to Business on the U.S. 20/26 Corridor

Recent (1994 and 1995) mineral development activity has resulted in an increase in workers in the area of the Proposed Action. The increase in workers has, in turn, generated a substantial increase in business activity at the stores and restaurants in the communities of Waltman and Hell's Half Acre (CGIDEIS 1996). The increase in business activity has allowed the Hell's Half Acre Restaurant to increase its staff (Smith). The gas station, convenience store, and bar in Powder River have been reopened and the restaurant may reopen in the near future (Benthusen 1997). Continuing mineral development activity could result in additional commercial development along the US 20/26 corridor.

It is possible that the seasonal occupancy restrictions during the raptor nesting season may result in an annual boom and bust cycle for the businesses along the US 20/26 corridor. Responding to this cycle may present challenges for certain businesses and may also affect business expansion decisions.

4.11.3.1.5 Underemployment and Multiple Job Holding

To the extent that local or non-local drilling and service contractors performing activities associated with the Proposed Action hire additional workers from the local labor pool, under- and unemployment in Natrona County will be reduced. Additionally, the development and production employment associated with the Proposed Action may slow the declining trend in Natrona County oil and gas employment and thereby reduce the potential future increases in underemployment.

Given the relatively high average wages associated with the proposed action (described in Section 4.11.3.1.3. above), workers who are employed on Proposed Action-related jobs will be less likely to require additional employment to provide adequate household income.

4.11.3.1.6 Population

Both the direct and in-direct employment opportunities associated with the Proposed Action are likely to result in continued employment for workers already employed by oil and gas drilling and service firms and by retail and service firms in Natrona County. To the extent that contractors performing Proposed Action-related activities need to hire additional workers, it is anticipated that the local labor force in Natrona County will be sufficient to meet the majority of labor demands. Consequently, little if any Proposed Action-related population in-migration is anticipated.

4.11.3.1.7 Housing

Based on the conclusion that the local labor force in Natrona County will be able to supply most of the labor for the direct and indirect employment needs associated with the proposed action and the minimal in-migrant population expected, little impact on the local housing market is expected. As indicated in Section 3.11.6, substantial housing resources are available in Casper. If non-local contractors are employed on Proposed Action-related activities, the effect on the housing market would be to utilize housing resources which are currently vacant, generating income for owners of rental housing.

4.11.3.1.8 Poverty and Social Services

Because most Proposed Action-related jobs are anticipated to be taken by existing Natrona County workers or come from the existing Natrona County labor pool, increases in demand for social service programs are not anticipated. Conversely, the direct and indirect employment opportunities associated with the Proposed Action may prevent or reduce a certain amount of under- and unemployment in Natrona County. This may have the effect of reducing some families' dependence on public assistance in Natrona County.

4.11.3.1.9 Local Government Facilities and Services

Based on the observation that little population in-migration is anticipated, the impact of the Proposed Action on most local government facilities and services is expected to be minimal. Conversely, local governments in the study area will receive significant revenues from the Proposed Action, which could be used to fund any incremental Proposed Action-related local government facility and service demand.

The increased traffic and development activity in the project area and along the Highway 20/26 corridor is likely to increase the need for additional road maintenance and for a additional law enforcement services.

4.11.3.1.10 Natrona County Schools

Due to the minimal in-migrant population expected to be associated with the Proposed Action and to the excess capacity of the Natrona County School District's facilities, no adverse impact is anticipated. Conversely, the District will receive significant revenues from the Proposed Action, which could be used to fund any incremental service demands. Estimated revenues to the District are identified in Section 4.11.3.1.11 below.

4.11.3.1.11 Local Government Fiscal Conditions

Proposed Action-related tax revenue projections in this section are presented in constant 1996 dollars.

Sales and Use Tax .

Operators and contractors would pay sales and use taxes on purchases of non-exempt equipment, materials and supplies used for drilling and for construction of pipelines, roads and production

facilities. This analysis assumes that sales and use tax revenues associated with the Proposed Action would accrue to the State of Wyoming, Natrona County and its municipalities.

The State of Wyoming collects a 4 per cent sales and use tax on the purchase and use of tangible goods. The State returns 28 per cent of the 4 per cent sales and use tax to the county in which purchases are made or used. The portion returned is distributed to the county and to the incorporated cities and towns within the county based on ratios derived from the 1990 census. Revenues from Wyoming's optional 1 per cent county sales and use tax (which Natrona County has in place) are distributed among the county and the incorporated cities and towns in the same manner. The distribution rates for Natrona County are illustrated in Table 4-19 (Wyoming Department of Revenue 1993).

The Wyoming sales and use tax is applied to the tangible cost for equipment associated with the drilling of each well and associated pipeline (an average of 0.30 miles of pipeline per well). Construction of surface facilities and the liquids recovery plant would generate sales and use tax revenue as well. Based on estimates of tangible well costs provided by the operators, drilling 160 wells over ten years would generate about $2.9 million in state and local sales and use tax revenue. Of this total, about $1.2 million would be distributed to Natrona County and its municipalities. The State share of sales and use tax revenue over ten years would be about $1.7 million.

Table 4-19. Direct Local Project-Related Sales and Use Tax Revenues Over the Ten Year Drilling Program.

Local Government	Distribution Percentage	Estimated Project Sales & Use Revenue
Natrona County	16.23%	201,967
Bar Nunn	1.36%	16,983
Casper	76.34%	950,688
Edgerton	0.40%	5,024
Evansville	2.29%	28,536
Mills	2.57%	32,014
Midwest	0.81%	10,068
Total Natrona County	100.00%	1,245,279

Source: Wyoming Department of Revenue, PIC Estimates

Indirect Sales and Use Tax.

Workers employed by the Proposed Action would spend a portion of their income on sales and use taxable goods and services. With an estimated annual payroll of $7 million, assuming that 32.4 percent of this income would be spent on taxable items and that two thirds of this amount would be spent in Natrona County, about $76,000 in additional sales and use tax revenue would be generated for state and local governments per year.

State Severance Tax.
The state of Wyoming collects a six percent severance tax on gross revenues from gas production. Any state, tribal or federal mineral royalties paid and some transportation expenses may be deducted from gross revenues before applying the severance tax. The total state severance tax revenues generated by the Proposed Action over the ten year drilling program are estimated to be about $26.35 million. The estimated total state severance tax for the life of the project is estimated by the operators to be about $63 million.

Annual estimates for the ten year drilling program for state severance tax, state mineral royalties and federal mineral royalties are provided in Table 4-20. Of the state severance taxes collected in 1995, 6.56 percent was distributed to cities and towns and 2.19 percent was distributed to counties on the basis of population. State severance tax revenues also provide funding for state highways, water development, the School Foundation Program, community colleges and general state government.

Table 4-20. State of Wyoming Severance Tax, State Mineral Royalty and Federal Mineral Royalty Revenues.

Year	Wyoming Severance Tax	State Mineral Royalties	Federal Mineral Royalties
1997	1,757,189	206,046	3,978,847
1998	2,595,243	304,315	5,876,473
1999	3,132,679	367,334	7,093,403
2000	3,508,884	411,447	7,945,254
2001	3,320,656	389,376	7,519,045
2002	2,872,796	336,861	6,504,945
2003	2,559,295	300,100	5,795,075
2004	2,339,843	274,367	5,298,166
2005	2,186,227	256,354	4,950,329
2006	2,078,696	243,745	4,706,844
10-year Totals	26,351,508	3,089,945	59,668,381

Source: PIC Estimates (1996 dollars, totals may not add due to rounding)

Mineral Royalties.
The federal government and the state of Wyoming require payment of royalties for production of oil and gas on federally- and state-owned lands. The federal and state royalties for gas production are generally 12.5 percent and 16.67 percent of gross revenues, respectively. Approximately 78 per cent of the mineral estate within the project area is under federal ownership and about 3 percent is state land. Estimated annual state and federal natural gas royalties are illustrated in Table 4-Xb. These projections are based on the same price and production assumptions as the

severance tax projections, provided by the operators. Over the ten-year drilling program, the Proposed Action is estimated to generate a total of $59.7 million in federal mineral royalties and $3.1 million in state mineral royalties. Total federal mineral royalties and state royalties over the life of the project are estimated to be $152 million and $6 million, respectively.

About fifty percent of the federal mineral royalties collected within Wyoming are returned to the state. Of the amount received, 9.375 per cent is distributed to cities and towns on the basis of population and 0.625 per cent is distributed to counties based on population. An additional 4.5 per cent of the state's share of federal mineral royalties are distributed to counties for construction and maintenance of county roads.

County Ad Valorem Property Taxes on Facilities.
Natrona County would levy property taxes on surface facilities and on the value of gas produced by the Proposed Action. The revenues presented in this section are projected on the basis of 1995 mill levies. The project area is located in Natrona County School District #1 which levied a total levy of 72.000 mills in 1995. (Wyoming Taxpayers Association, 1995).

Industrial property is assessed as of February 1. All surface facilities such as compressors, well head equipment, tank batteries, pipelines and the proposed liquids recovery plant would be assessed as industrial property at 11.5 per cent of actual value. Taxable property associated with the Proposed Action would include surface facilities associated with 128 wells (assuming 80 percent of the 160 wells drilled will be producing wells). The average assessed values for well head equipment, tank batteries, compressors and pipelines are based on figures provided by the operators.

Ad valorem property taxes on facilities from the Proposed Action would begin to flow in 1998 and continue throughout the life of the project. Over the ten year drilling program, estimated ad valorem tax revenues to all taxing entities in Natrona County would total about $855,402; the Natrona County general fund would receive an estimated $123,677 from Proposed Action-related surface facilities and pipelines.

County Ad Valorem Property Taxes on Production.
For property tax purposes, the value of gas production is the sales price of gas sold in the previous calendar year minus state and federal royalties paid. Property taxes on production will begin in 1998 and continue throughout the life of the project. Over the ten-year drilling program, the total ad valorem revenues from Proposed-Action-related production to all taxing entities in Natrona County (including the School Foundation Program) are estimated to be about $37.8 million. The Natrona County General Fund would receive an estimated total of approximately $5.5 million over the ten-year period. Projected county General Fund ad valorem tax revenues are presented in Table 4-21. The project area is located in portions of Natrona County property tax districts 0102 and 0105.

Table 4-21. Annual Ad Valorem Property and Production Taxes (County General Fund Revenues Only).

	Natrona County General Fund	
Year	Production	Facilities
1998	205,114	926
1999	381,090	12,580
2000	562,843	12,877
2001	679,400	13,159
2002	760,989	13,427
2003	720,167	13,682
2004	623,038	13,923
2005	555,047	14,153
2006	507,454	14,371
2007	474,138	14,579
10-year Totals	5,469,280	123,677

Source: PIC estimates based on 1995 mill levies and 1996 dollars. Facilities are not depreciated.

Table 4-22. Annual Ad Valorem Property and Production Taxes (Total Ad Valorem Revenues, All Taxing Entities).

	All Taxing Entities in Natrona County	
Year	Production	Facilities
1998	1,418,657	6,404
1999	2,635,784	87,008
2000	3,892,864	89,062
2001	4,699,018	91,013
2002	5,263,326	92,867
2003	4,980,984	94,627
2004	4,309,195	96,300
2005	3,838,942	97,889
2006	3,509,765	99,399
2007	3,279,341	100,833
10-year Totals	37,827,876	855,402

Source: PIC estimates based on 1995 mill levies and 1996 dollars. Facilities are not depreciated.

The total ad valorem property and production taxes projected for all taxing entities in Natrona County are shown in Table 4-22. Based on the assumptions outlined above, the Proposed Action would generate a total of about $37.8 million in production ad valorem taxes and $855,402 in facilities ad valorem taxes to all taxing entities over the 10-year drilling program. The Operators total estimated ad valorem property and production tax revenue for the life of the project is about $76 million. Table 4-23 presents estimates of ad valorem tax revenues for appropriate Natrona County taxing entities. The total ad valorem revenues to all taxing entities over the ten year drilling program would be about $38.7 million.

Table 4-23. Total Project Ad Valorem Revenues by Taxing Entity (10-Year Drilling Program).

Taxing Entity	1995 Mill Levy	Total Project Revenue
Natrona County	10.410	5,592,978
School Foundation Program	12.000	6,447,237
School District #1	39.500	21,222,156
County Library	1.110	596,369
County Fair	0.480	257,889
Community College	7.000	3,760,888
Weed & Pest Control	1.500	805,905
Total Natrona County	72.000	38,683,422

Source: PIC estimates; Wyoming Taxpayers Association. PIC estimates based on 1995 mill levies and 1996 dollars. Facilities are not depreciated.

Ad valorem property tax revenues from the Proposed Action for Natrona County School District and the Wyoming School Foundation Program will be substantial as illustrated in Table 4Xe. The additional ad valorem tax revenues for the School District in 1998 represents a 8.4 percent increase and in 1999 a 15.5 percent increase from 1996 ad valorem revenues. However, due to a recent Wyoming Supreme Court ruling, the Wyoming Legislature is in the process of revising the funding program for public schools. As long as either the local school district or the State Foundation Program levies ad valorem taxes, the contribution of the Proposed Action to education funding would be substantial.

Natrona County and its municipalities will receive substantial revenues from the Proposed Action. The additional ad valorem revenues generated by the Proposed Action in 1998 would represent a 7.7 percent increase over 1996 Natrona County general fund ad valorem revenues and a 14.8 percent increase in 1999. The ad valorem revenue increases would be more significant in later years as more wells are drilled and are brought into production.

Revenue Impacts Summary

The Proposed Action would generate substantial revenues for the Federal Government, the State of Wyoming, and for Natrona County and its municipalities. Total revenues to all of these entities over the life of the project are estimated to be about $297 million.

4.11.4 Alternative A

Socioeconomic effects of Alternative A are described in terms of differences between effects associated with Alternative A and those associated with the Proposed Action. Implementation of Alternative A would result 8 fewer well pads than would be developed under the Proposed Action. Also access to and surface occupancy of a larger portion of the project area could be restricted during the February 1 through July 31 raptor nesting season. The proposed 1-mile restriction for occupied ferruginous hawk nests could restrict surface occupancy of an additional 6,412 acres (in addition to the area potentially restricted under the Proposed Action) and could affect 67 of the 99 proposed well locations. Restricted access to an additional 6,412 acres of the project area during the raptor nesting season would limit drilling activities during February through July.

One difference between the socioeconomic effects associated with Alternative A and those associated with the Proposed Action is that socioeconomic effects would be clustered or concentrated during the period in which drilling and field development activities are allowed. It is likely that the additional access restrictions would result in seasonal unemployment for some portion of the estimated 172 FTEs associated with Alternative A during the raptor nesting season. This would have the effect of increasing seasonal unemployment in the Natrona county oil and gas sector and possibly in the nonbasic sectors in response to the loss in basic income.

It is also possible that local businesses along the US 20/26 corridor would be affected by the seasonal boom and bust. Some businesses may find it difficult to respond to the seasonal fluctuations. As more of the development activity would be compressed into the August through January time period, the demand for law enforcement and road maintenance services would also be concentrated in this period.

Under Alternative A, economically recoverable reserves would be left in place in some portions of the nest buffer areas because wells outside the buffer areas would not be able to drain the gas (Figure 4-1 and Table 4-24 (Unrecoverable Reserves)). Alternative A could result in $68,624,500 less gross revenue to the operators, including $8,578,063 less federal royalty revenue, than could be realized by maximum recovery of the natural gas reservoir under the Proposed Action (Table 4-4). Half of the loss in federal mineral royalty revenue would be the loss in Wyoming's share, $4,289,031. Over the life of the project, the unrecoverable reserves under Alternative A would result in a loss of about $3,602,816 in severance taxes to the State of Wyoming and those entities receiving a portion of these revenues. Project ad valorem tax revenues to the taxing entities in Natrona County would be reduced by about $4,323,379 under this Alternative.

Figure 4-1 illustrates the areas of restricted access and unrecoverable reserves (URR) resulting from the no surface occupancy restrictions (NSO) for the proposed raptor nest buffer areas of Alternative A. The original gas in place (OGIP), 78.428 bcf, in Figure 4-1 and column 2 of Table 4-24 represents the total estimated gas reserves that will not be produced with well locations proposed for Alternative A due to the NSO restriction. The BLM Reservoir Management Group has estimated that only about 70 percent of the original gas in place in the areas would be recoverable. Thus, the reduction in gas production due to the NSO restriction in the raptor nest buffer areas depicted in Figure 4-1 under Alternative A would be 70 percent of the OGIP. The unrecoverable reserves that would not be produced because of the NSO restriction in the raptor nest buffer areas is indicated in column 3 of Table 4-24, 54.900 bcf. The following estimates of reductions in

revenues associated with Alternative A are based on the portion of unrecoverable gas reserves that would likely be recovered without the NSO restriction, as under the Proposed Action (54.900 bcf).

Table 4-24. Alternative A - Raptor Nest Buffer Areas (NSO) - Unrecoverable Reserves.

Nest Buffer	URR @ OGIP (bcf)	URR @ 70% RF (bcf)	Total Value @ $1.25/mcf	Royalty Value @ 12.5%
1	10.482	7.337	9,171,750	1,146,469
2	12.706	8.894	11,117,750	1,389,719
3	9.230	6.461	8,076,250	1,009,531
4	45.746	32.022	40,027,750	5,003,469
5	0.264	0.185	231,000	28,875
6	0.000	0.000	0	0
TOTALS	**78.428**	**54.900**	**68,624,500**	**8,578,063**

- 54.9 bcf in recoverable reserves will not be recovered from within the raptor nest buffer areas, due to the NSO.
- Unrecoverable reserves (URR) were determined by calculating the original gas in place (OGIP) and using a 70% recovery factor (RF).
- The areas of URR can not be drained by existing or proposed "Alternative A" wells.
- These conclusions were based on the "Final Geologic, Well Spacing, and Reserve Evaluation Report" by the BLM-RMG dated June 3, 1996.

It is estimated that Alternative A would generate approximately $280,637,740 in revenues for federal, state and local governments over the life of the project. This represents a reduction of about $16,504,258 compared to the proposed action. It is also possible that some additional reduction in state and local sales and use tax and production tax revenues and royalties would result if the operators chose not to drill some wells proposed for less than optimal locations under this Alternative.

4.11.5 Alternative B

Socioeconomic effects of Alternative B are described in terms of differences between effects associated with Alternative B and those associated with the Proposed Action.

The analysis of Alternative B assumes the same number of wells would be drilled as under the Proposed Action. The seasonal surface occupancy restrictions for this Alternative are the same as those for the Proposed Action. However, this alternative includes development of a Key Raptor Area adjacent to the project area.

As long as the wells drilled are equally productive, tax revenues for Federal, State and local governments would be very similar to those estimated for the Proposed Action. It is likely that a

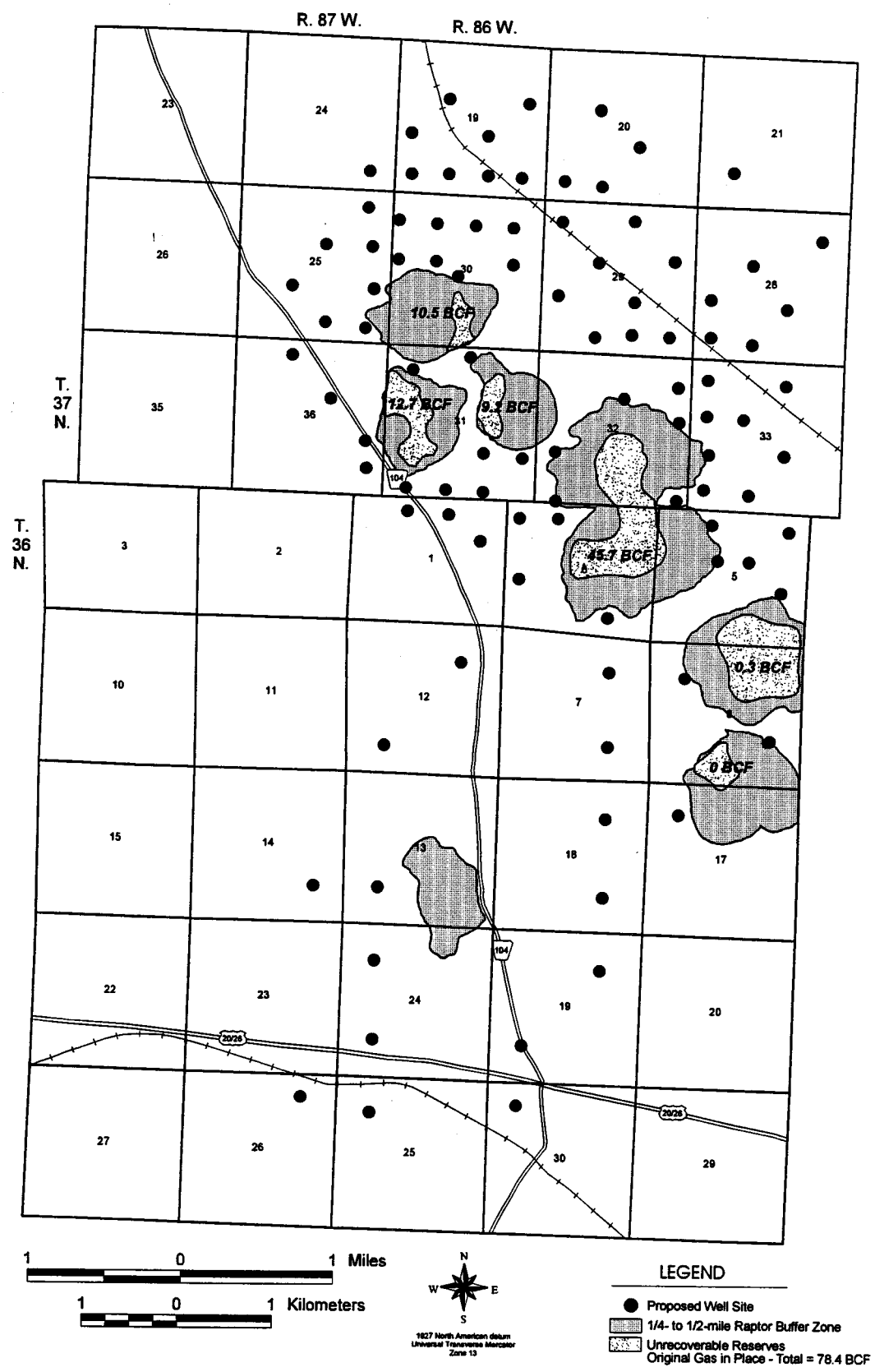

Figure 4-1. Unrecoverable Gas Reserves Associated with Proposed Raptor Buffer Zones as a Result of the Implementation of Alternative A.

slight increase in facility ad valorem taxes would be experienced due to the increase in the number of well pads used and the associated increase in surface facilities.

Under Alternative B, the loss of revenue from oil and gas lease bids and rentals could total $43,580 over the next ten years (Table 4-25 (Federal Oil and Gas Lease Sale Data)). Because there is low potential for federal oil and gas development in the Key Raptor Area (WRMG 1996), and since exploration and development of existing oil and gas leases is allowed and could occur in the Key

Table 4-25. Alternative B - Powder River Draw Key Raptor Area - Federal Oil & Gas Lease Sale Data.

Lease	Location	Acres	Bonus Bid		Issue Date
			$/Acre	$	
W137147	18, T36N, R85W	120	2.00	240.00	Aug-95
W133797	18, 19, T36N, R85W	800	1.50	1,200.00	Oct-94
W137146	18, 30, T36N, R85W	240	16.00	3,840.00	Aug-95
W134944	29, T36N, R85W	160	5.00	800.00	Dec-94
W140265	29, T36N, R85W	40	2.00	80.00	Oct-96
W134943	29, 32, T36N, R85W	280	5.00	1,400.00	Dec-94
W134730	32, T36N, R85W	80	1.50	120.00	Oct-94
W136196	3, T36N, R86W	40	2.00	80.00	Jun-95
W127432	4, 9, T36N, R86W	1,220	1.50	1,830.00	Aug-93
W136699	10, T36N, R86W	160	120.00	19,200.00	Jun-95
W131000	10, T36N, R86W	240	1.50	360.00	Feb-94
W136697	10, T36N, R86W	80	2.00	160.00	Jun-95
PRIVATE	10, T36N, R86W	40	--	0.00	--
W133909	11, 13, 14, T36N, R86W	1,520	1.50	2,280.00	Oct-94
W132290	15, 23, 24, T36N, R86W	1,000	2.00	2,000.00	Apr-94
W118807	24, T36N, R86W	320	1.50	480.00	Oct-90
TOTALS		**6,340**	**5.37**	**34,070.00**	
Average Bonus Bid = $5.37			**Total Yearly Rentals = $9,610.00**		

- As leases expire over the next 10 years, $34,070 in bonus bids and $9,510 in yearly rentals would not be realized.
- Based on published geologic data, this area has little potential for oil and gas development ("Mesaverde Formation and Alternative Raptor Nesting Site Area Evaluation", BLM-RMG report, 4/4/96).
- A dollar amount for potential reserves was not determined.
- The lease acres are based on idealized sections.
- Total summed acres are greater than actual area within the KRA (6,252 acres).

Raptor Area until leases expire, the total revenue and federal royalty and tax revenue which might not be realized were not estimated. However, considering the low potential, the reservoir revenue value is anticipated to be considerably lower than the value of the reserves that could be realized under the Proposed Action or Alternative A.

4.11.6 Alternative C - No Action

For the No-Action Alternative, it is assumed that the Operators would submit new proposals for the development of their leases. Consequently, the socioeconomic effects of the No-Action Alternative cannot be estimated because the details of the proposals are not currently known. The short-, mid-, and long-term economic, employment, and fiscal (tax revenues) effects of this Alternative could be greater than, less than, or about the same as those associated with the Proposed Action, depending on the timing and level of development contained in future proposals.

4.11.7 Impacts Summary

Given the relatively few annual number of wells to be drilled under the Proposed Action, and the fact that anticipated drilling levels are well within the range of recent drilling levels in the area, the socioeconomic effects of the Proposed Action would be largely positive. The increases in income associated with the Proposed Action and alternatives A and B would be substantial. The Proposed Action and alternatives A and B would provide continued and increased employment opportunities for some local residents . Anticipated tax revenues associated with the Proposed Action would also be substantial. Local government service impacts would be limited to localized increased demand for road maintenance and law enforcement services. Negative impacts would not be significant according to the thresholds used for this analysis.

4.11.8 Mitigation Summary

Following are several socioeconomic mitigation measures which could maximize the economic, employment and fiscal benefits of the project and minimize potential negative effects.

1. Natrona County may encourage all contractors working in the project area to obtain a Natrona County sales and use tax license to maximize revenues for Natrona County and its municipalities. These revenues could be used to offset any increased demand for local government facilities and services.

2. Natrona County may encourage contractors to hire qualified local workers for any Proposed Action-related jobs. This would help reduce Natrona County under- and unemployment and ensure that population in-migration and the associated demand for local government facilities and services would be minimal.

4.11.9 Residual Impacts

A potential residual socioeconomic impact associated with the Proposed Action and development Alternatives A and B is the potential seasonal unemployment resulting from the seasonal occupancy restrictions.

4.12 TRANSPORTATION

4.12.1 Introduction

Transportation effects of the Proposed Action and alternatives would occur primarily on US Highway 20/26 and Arminto Road. These public roads provide access to the project area from Casper and other nearby communities. Secondary transportation effects would occur on operator-maintained roads within the project area.

4.12.2 Resource Management Objectives and Impact Significance Criteria

No specific RMP directions are available for this discipline. The following criteria are used to determine whether transportation impacts of the Proposed Action would be significant:

- Increases in traffic levels on the local public highway network that will cause the level of service on large segments of those public highways to fall below acceptable levels as defined by the responsible government agency.

- Measurable increases in accident rates on the local public highway network above the average accident rate for similar roadways which would increase the risk to highway users.

4.12.3 Direct and Indirect Impacts

4.12.3.1 Proposed Action

The proposed action would generate increases in traffic volumes on highways providing access to the project area and on County and operator-maintained roads within the project area. These increases would result from the movement of project-related workers, equipment and materials to and from the project area to perform drilling, field development, well service, field operations and reclamation activities.

Existing roads would be utilized to the extent practical to access the wellfield development area associated with the Proposed Action, however some new access roads would be required. It is estimated that an average of 0.4 miles of new road would be developed for each new well pad with 20 or 40 acre spacing, 0.75 miles of new road would be developed for each new well pad on 160 acre spacing and 0.5 miles of new road would be developed for each new well pad on 320 or 640 acre spacing. This would result in development of an estimated total of 66 miles of new access roads.

Table 2-3 in Chapter 2 shows the estimated average number of trips associated with various wellfield activities. Table 4-26 displays the estimated traffic increases related to the Proposed Action on highways providing access to the project area. The traffic increases in Table 4-26 are based on the assumption that all of the trips identified in Table 2-3 will be allocated to US 20/26 and Arminto Road. Note that the drilling and wellfield development traffic associated with the Proposed Action will replace drilling and field development traffic included in the 1995 base traffic counts, when a total of 11 wells were drilled in the project area. Consequently, a portion of the estimated increases in ADT shown in Table 4-26 will replace existing traffic.

The highways identified in Table 4-26 and 3-26 already experience substantial drilling and field service traffic. The 1995 accident rates for the highways providing access to the project area are listed in Table 3-26. The existing traffic on these highway has resulted in accident rates similar to other rural highways in the State. The relatively small increase in traffic volumes associated with the Proposed Action is not anticipated to result in measurable increases in accident rates on highways within the analysis area. Given the 50 mile per hour speed limit on Arminto Road, the relatively small increases in traffic volumes identified in Table 4-26 are not expected to have a noticeable effect on highway safety.

Table 4-26. Current Traffic Information and Estimated ADT Impacts - Proposed Action.

Highway Segment (mileposts)	1995 ADT All Vehicles Weighted	Estimated Increase in ADT	Estimated Percentage Increase in ADT
US Highway 20/26 Mills to Waltman (mp 4.64 - 50.69)	3314	70	2.11%
Natrona County 104 Arminto Road	n/a	70	n/a

Source: Wyoming Department of Transportation(3), PIC

Arminto Road and the operator-maintained roads in the project area currently serve primarily well field development and operations-related traffic and some local and recreational traffic. The small additional volume of traffic is not anticipated to negatively affect levels of service or accident rates on internal roads. However, Proposed Action-related activities would generate additional trips on internal roads and may increase the functional classification of some of these roads. To maintain traveller safety, those internal roads moving from local to collector or from resource to local classification should be improved according to BLM Road Standards Manual Section 9113 Standards. The need for road maintenance would increase on the most travelled roads within the project area. Proposed Action-related tax revenues would be available to off-set additional maintenance costs for the Natrona County Road and Bridge Department.

Given the small traffic increases associated with the Proposed Action and the excess capacity of the highways providing access to the project area, decreases in levels of service are not anticipated, nor are increases in accident rates. As a result, the transportation impacts of the Proposed Action would be minimal and below the significance thresholds established for this analysis.

4.12.4 Alternative A

Implementation of Alternative A would involve fewer well pads (a maximum of 99 versus 107 for the Proposed Action). Due to the reduction in the number of new well pads, only about 47 miles of new road would be constructed.

Alternative A involves a similar area of seasonal restriction for raptors as the Proposed Action, with the exception of ferruginous hawks. The potential increase in area with seasonal occupancy restriction for ferruginous hawks is 6,412 acres and could potentially affect 67 of the 99 well locations under this Alternative. This substantial increase in surface occupancy restriction could have the effect of condensing the drilling season to approximately half of the year in some years. This would effectively double the ADT impacts presented in Table 4-x. The increase in ADT could be as high as 140 for Highway 20/26 and Arminto Road and the percentage increase in traffic on 20/26 could be as much as 4.22 percent.

As with the Proposed Action, the relatively small traffic increases associated with Alternative A would not result in decreases in levels of service, given the excess capacity of the highways providing access to the project area. Similarly, measurable increases in accident rates are not anticipated. As a result, the transportation impacts of Alternative A would be minimal and below the significance thresholds established for this analysis.

4.12.5 Alternative B

Implementation of Alternative B would involve more well pads with 20/40 acre-spacing and fewer wells with 160 acre-spacing. A maximum of 114 new well pads would be constructed versus 107 for the Proposed Action. Due to the increase in the number of 20/40 acre-spaced well pads and the reduction in 160 acre-spaced well pads, about 53 miles of new road would be constructed. Under this alternative a special raptor habitat management area would be set aside adjacent to the project area.

The seasonal surface occupancy restrictions for Alternative B are the same as those for the Proposed Action. However, this alternative includes development of a Key Raptor Area adjacent to the project area. As long as the number of wells to be drilled remains the same, the traffic impacts can be expected to be the same or very nearly the same as those listed under the Proposed Action.

Given the small traffic increases associated with this Alternative and the excess capacity of the highways providing access to the project area, decreases in levels of service are not anticipated, nor are increases in accident rates. As a result, the transportation impacts of this Alternative would be minimal and below the significance thresholds established for this analysis.

4.12.6 Alternative C

For the No-Action Alternative, it is assumed that the Operators would submit new proposals for the development of their leases. Consequently, the transportation effects of the No-Action Alternative cannot be estimated because the details of the proposals are not currently known. The short-, mid-, and long-term transportation effects of this Alternative could be greater than, less than, or about the same as those associated with the Proposed Action, depending on the timing and level of development in future proposals.

4.12.7 Impacts Summary

The Proposed Action would result in levels of truck traffic on US Highway 20/26 and Natrona County Road 104 (Arminto Road) slightly higher than recent (1995 and 1996) levels when 11 and 10 wells were drilled, respectively.

The increases in traffic associated with the Proposed Action and Alternatives A and B would create direct impacts from the construction of new roads and traffic associated with development and production activities. These impacts would occur steadily over the ten-year drilling program, although traffic impacts may be more concentrated under Alternative A. Due to the low increases in traffic volumes associated with the Proposed Action and Alternatives A and B, and due to the existing condition and excess capacity on affected highways, these impacts are not considered significant.

4.12.8 Mitigation Summary

Existing roads should be used as collectors and local roads whenever possible to minimize the amount of surface disturbance within the area. Standards for road design should be consistent with BLM Road Standards Manual Section 9113.

Permits are required from Natrona County for road access to or across a county road or for any pipeline crossing of a county road. These permits should be acquired prior to construction of additional roads.

All wellfield development roads on public lands which are not required for operation and maintenance of field production should be permanently blocked, re-contoured and reseeded. Roads on private lands should be treated similarly depending on the desires of the land owner.

The operators of the field will be responsible for preventive and corrective maintenance of roads in the project area throughout the duration of the project. This may include blading, cleaning ditches and drainage facilities, dust abatement, noxious weed control, or other requirements as directed by the BLM or the Natrona County Road, Bridge and Parks Department.

The Operators and the BLM should coordinate with the Wyoming Department of Transportation regarding the installation of signs to alert motorists of the increase in truck traffic entering US 20/26 during peak periods of development each year.

4.12.9 Residual Impacts

Minor increases in traffic associated with production, well and pipeline service and reclamation activities would continue throughout the life of the project.

4.13 HEALTH AND SAFETY

4.13.1 Introduction

The Proposed Action and Project Alternatives A , B, and C do not differ in the expected occurrence of the following health and safety impacts. Overall, implementation of the Proposed Action and project alternatives is not expected to produce any detectable increase in cumulative health and safety impacts. Mitigation measures are proposed to ensure that this does not occur.

4.13.2 Resource Management Objectives and Impact Significance Criteria

No specific health and safety standards were identified in the Platte River Resource Area RMP. The following criteria were used to determine the degree of impacts relative to health and safety aspects of the natural gas production proposal.

- Increased risk to the public caused by project implementation.

4.13.3 Direct and Indirect Impacts

4.13.3.1 Proposed Action

4.13.3.1.1 Sanitation

As described in chapter two, service trailers located on the well pad would be self-contained and would not require a septic system. Portable toilets would be available at construction sites. The liquids recovery plant would have its own septic and potable water system. Potable water would be trucked to other project sites as needed. Garbage would be stored in closed containers. Sewage and solid waste would be hauled off-site to sites permitted by a State Department of Environmental Quality. For these reasons no sanitation-related impacts are expected to occur.

4.13.3.1.2 Firearms Accidents

The posting of signs informing the public that they are entering an area of intensive natural gas development would discourage hunting and recreation use in the area, subsequently reducing a potential source of firearms accidents. Increased development would lead to increased surveillance of the field by production personnel and personnel manning the liquids recovery plant. This would help to discourage the improper use of firearms in the vicinity of drilling and production equipment. It is possible, however, that increased development activity would increase the number of firearms brought into the project area by project-related workers.

4.13.3.1.3 Criminal Activities

Increased activity and well-site monitoring in the project area would help to discourage property crimes and vandalism. A minor increase in theft from construction or drilling sites could occur.

4.13.3.1.4 Fire

The risk of fire in the project area will increase under the Proposed Action or project alternatives. This is an unavoidable impact associated with the presence of fuels, condensate storage tanks, natural gas pipelines and gas processing equipment. However, this risk will be contained by the placement of facilities on pads and locations that are graded and devoid of vegetation which could lead to wildfires. In the event of a fire, property damage most likely would be limited to construction or production related equipment. There would be a heightened risk of wildfire where construction activities place welding or other equipment in close proximity to native vegetation. It is possible that some project personnel or responder from local or volunteer fire departments may be unfamiliar with appropriate measures for responding to a fire in a natural gas field and suffer injury as a result. To address these impacts, mitigation measures are suggested. Some operators may already be implementing some of these and other measures.

4.13.3.1.5 Occupational Hazards

An increased potential for work-related injuries, especially during drilling and construction, will be unavoidable. Emergency response times may suffer if project personnel or local emergency responders are unfamiliar with the area. Drilling and construction-related occupational hazards would decline as the project enters the production-maintenance stage.

4.13.3.1.6 Well Blowout

The risk of this accident is already minimized by implementation of BLM requirements (e.g., blowout preventers) discussed in chapter three. Based on historical data discussed in chapter three, which showed 2 well blowouts in a sample of 12,000 wells drilled in the State of Wyoming, the probability of a blowout on any single well during implementation of the Proposed Action or project alternatives is estimated to be less than 0.00017. Blowouts caused by damage to well heads can be avoided with the implementation of relatively simple measures suggested below.

4.13.3.1.7 Hydrogen Sulfide

Given that no hydrogen sulfide has been associated with exploration or production activities, there is little risk of this health and safety impact occurring.

4.13.3.1.8 Pipeline Failure

Increasing the miles of gathering line within the project area would increase the chance of a pipeline failure. Extrapolating from available data which found the risk of a pipeline leak or rupture to be approximately 1-2 incidents per 1,000 miles of pipeline per year, the estimated annual risk for the Proposed Action is 0.168 to 0.336 per 168 miles of proposed pipeline per year. However, the likelihood of an incident will be reduced by the proposed implementation of cathodic protection (to reduce corrosion-caused failure) and more advanced pipeline coatings. Signing of pipeline rights-of-way could reduce the likelihood of pipeline ruptures caused by excavation equipment--particularly in the vicinity of road crossings or areas likely to be disturbed by road maintenance activities.

4.13.3.1.9 Hazardous Materials

A review of materials typically found at drilling and construction sites (see Appendix C) found no materials incorporating a component listed as extremely hazardous. Ignitability and fine mineral fibers are the two hazards most commonly associated with the types of chemicals likely to be used at project sites. Potential impacts associated with hazardous materials will be reduced as the operators have agreed to design their operations to severely limit or eliminate the need for substances designated by the EPA as designated extremely hazardous. Furthermore, the operators have agreed to the goal of minimizing the creation of hazardous wastes (as currently defined by Resource Conservation and Recovery Act--RCRA). Transportation of hazardous wastes would meet the requirements of the (RCRA). BLM would not necessarily require a right-of-way grant prior to the transporting of hazardous materials used in conjunction with lease development. But, if a ROW were needed and would involve transportation of hazardous materials, it would be subject to strict liability stipulations. Implementation of Spill Prevention Control and Countermeasure (SPCC) Plans by the operators would further reduce the potential for a health and safety impact.

4.13.3.2 Alternatives A and B

Impacts from road, drill site, and pipeline construction; drilling operations; production operations; and project traffic would be similar to those describe under the Proposed Action.

4.13.3.3 Alternative C

Under Alternative C, Health and Safety impacts within the project area would continue to occur as constructed activities are authorized, but of an unknown magnitude since the actual level of development would be unknown.

4.13.4 Impacts Summary

Hazards associated with the drilling and development activities, including construction and operation, are the ones normally associated with heavy construction and industrial work. There would be a minor increased risk to the public caused by project implementation resulting from additional drilling and production related traffic in the project area. None of these impacts occur at significant levels.

4.13.5 Mitigation Summary

The posting of signs informing the public that they are entering an area of intensive natural gas development would discourage hunting and recreation use in the area, subsequently reducing a potential source of firearms accidents. Fire suppression equipment, a no smoking policy, shutdown devices or other safety measures typically incorporated into gas drilling and production activities would help to minimize the risk of fire. Institution of a hazardous materials communication program for project workers would help to reduce health and safety impacts associated with improper handling or disposal of hazardous materials. In addition, for any hazardous material brought onto a project site, workers would have access to a Material Safety Data Sheet (MSDS) which describes the hazards, proper handling and emergency response for that material. Reports of chemical and hazardous materials, where required by the Superfund Amendments and

Reauthorization Act (SARA) Title III (40 CFR 335), would alert state and local emergency responders to potentially hazardous situations. As no other potentially significant impacts would occur, there is no need for additional health and safety mitigation measures beyond those presented above and in Chapter 2.

4.13.6 Residual Impacts

No residual impacts to public health and safety are expected to result with implementation of the Proposed Action or Alternatives A, B, and C.

4.14 NOISE

4.14.1 Introduction

In general, noise impacts would take two forms: (1) a generalized increase in background noise levels; and, (2) noise in excess of 55 dBA at noise sensitive locations. The potential for these two impacts is discussed in terms of the Proposed Action and project alternatives. Impacts specific to each alternative, mitigation measures, and unavoidable impacts are addressed.

4.14.2 Impact Threshold Criteria

The following criteria was used to assess the significance of noise impacts related to this project:

- Long-term activities that would exceed federal 55 dBA maximum standards for noise at either residences or other sensitive locations as identified by the BLM.

4.14.3 Direct and Indirect Impacts

4.14.3.1 Proposed Action

Noise associated with construction and natural gas production operations can create a disturbance that affects human safety (at extreme levels) or comfort as well as modifies animal behavior. Determining activities that exceed the maximum standards is not a simple issue since perception of sound varies with intensity and pitch of the source, air density, humidity, wind direction, screening/focusing by topography or vegetation, and distance to the observer. Noise levels in excess of the 55 dBA maximum standards can occur at construction and production operations. Under typical conditions, excess levels decline below the level of significance (55 dBA) at 3,500 feet from the source (BLM 1991). Construction-related impacts would be short-term, lasting as long as construction activities were ongoing at well sites, access roads, pipelines, and other ancillary facilities such as compressor sites. Noise would be created over a longer term at the individual well sites as a resulting of drilling activities.

Noise sensitive locations typically include residences and raptor nests. In this analysis, the primary noise sensitive location would be an occupied raptor nest. In general, it has been found that mammals and birds will consistently escape from noises that exceed 75-85 dBA (Golden *et al.*, 1980). Below that level, noise sensitivity will vary by species. Under the Proposed Action, when an `active' raptor nest is within 0.25 to 0.50 miles (depending on species and line of sight) of a

proposed well site, drilling and construction activities would be scheduled to occur outside of the critical nesting season for that species. Based on estimates of noise impacts, as discussed below, it appears that a buffer area of 0.5 miles or less would be adequate to protect the existing background level around a noise sensitive area. If the intent is to meet the 55 dBA standard, a displacement away from noise sensitive areas of about 500 feet would be adequate.

A person's sensitivity to noise would depend, in part, upon background noise levels, physiology, frequency and the intended activity. For example, non-motorized recreation users tend to be more sensitive to noise impacts than most other resource users. However, current recreation use of the project area is very low and is unlikely to change. Noise sensitivity of wildlife populations and the potential for displacement has been described in more detail in the Wildlife section. In brief, studies have found that big game move away from frequently traveled roads. A study of the Birch Creek area of the BLM Rock Springs District found that displacement of big game animals away from drilling rigs occurs but that animals quickly return to the area once drilling has been completed--despite some increase in maintenance-related traffic (Reeve, 1995).

In portions of the project area that are undergoing more intensive development (i.e., wells at 20-40 acre spacing), a combination of ambient conditions (e.g., wind), traffic, construction equipment and proposed drilling and production could result in a daytime, average noise level that exceeds 50 dBA. This is the noise level found in a typical suburban neighborhood and has been found in developing gas fields elsewhere in Wyoming. Noise levels would decrease at night. Over the long-term, traffic and construction-related noise impacts would decline as the project moves from the drilling and development stage into the maintenance stage.

Under the Proposed Action and project alternatives, drilling activities would produce short-term increases in ambient noise levels. The radius of this impact would vary with topography, vegetation, type and size of rig employed, the use of mufflers, wind speed, and other factors. Using actual field measurements from wells drilled elsewhere in Wyoming, Kruger (1981) found that noise impacts from diesel electric rigs with three engines would recede below 64 dBA at about 400 feet and below 35 dBA in less than 2,000 feet (3/8 mile). Other, more generalized estimates of the noise from a wide range of drilling rigs show that the 55 dBA level is reached at 500 feet but 35 dBA is not reached until 4,000 feet (3/4 mile) from the well site--depending upon the type of rig and engines used (Montana Board of Oil and Gas Conservation, 1989, *Programmatic Environmental Impact Statement*; p. 126). Installation of mufflers on engines could substantially reduce the noise impact radius. Kruger (1981, p. 24), for example, noted that mufflers on drill rig engines could be capable of up to a 30 dBA reduction in noise levels at certain frequencies. Van Houton (1997) described a situation in which drilling activities in Huntington Beach, California have proceeded in a residential area within 100 feet of a residence--but with the implementation of unusually extensive noise-control measures.

Under the Proposed Action and project alternatives, once drilling and reclamation activities have been completed at a well site, no impacts would be associated with the well head itself because no pumpjacks are proposed. Depending upon availability and operating conditions, electricity could be used to drive small compressors such as those used on vapor recovery units. The main sources of noise impacts associated with drilling and production activities in the project area would be traffic, construction equipment, the liquids recovery plant and field compressors.

Traffic and construction equipment. As defined by BLM, resource roads which serve well sites are designed for vehicle speeds of 15 to 30 miles an hour. Local roads serve as the internal access network within a field and are designed for vehicle speeds from 20-50 mph. Heavy truck traffic on these roads tends to produce very short-term spikes in noise levels (about 105 dBA at the edge of the road) that quickly recedes to background levels. Under such conditions, measurements taken in field situations show that average noise levels tend to approach background noise levels (30 dBA) at about 100 feet from such roads (Kruger, 1981). However, on a calm day, depending upon operating conditions such as load weight and the use of engine brakes, intermittent noise (95 dBA) from heavy trucks might be noticeable up to 1.5 miles away--assuming a background level of 35 dBA (Montana Board of Oil and Gas Conservation, 1989, Programmatic EIS).

However, noise from heavy trucks and construction equipment should be less in light of current federal regulations. For example, federal standards for heavy trucks (more than 10,000 pounds gross vehicle weight) manufactured between 1979 and 1988 require that they produce no more than 83 dBA in a low speed test. Trucks manufactured after January 1, 1988 must meet an 80 dBA standard. It is illegal under federal regulations to remove (other than for maintenance purposes) a noise control device which has been incorporated into a vehicle in compliance with the Noise Control Act of 1972. It is also illegal to operate such a vehicle. Assuming these standards, and if a background level of 40 dBA is assumed--which is typical of partially developed rural areas, then the impact zone for truck traffic should be reduced. Under the Proposed Action, the operators have already agreed to muffle and maintain all motorized equipment according to manufacturers' specifications.

Field compressors and liquids recovery plant. During operations, noise impacts would primarily occur in the vicinity of compressors sites or the liquids recovery plant. Principal sources would be noise from exhaust pipes and engine casing. Secondary noise sources include cooling fans. Actual noise levels could be reduced by the installation of mufflers and housing of compressor engines within buildings. Noise from blow down stacks and relief valves would be infrequent but would produce a temporary spike in ambient noise levels.

Noise from field compressors and the liquids plant would depend upon the actual size and configuration of the engines used. However, based on noise data for engines much larger than those typically used in field situations (see chapter three), it is expected that the disturbance zone (i.e., 55 dBA) created by a field compressor or the liquids plant would be less than 500 feet (Montana Board of Oil and Gas Conservation, 1989). It is difficult to predict the point at which noise from this equipment would approach background. However, based on other situations (e.g., drill rigs and compressor stations with multiple engines), this probably would occur within 2,000 feet (3/8 mile) and almost certainly would occur within 4,000 feet (0.75 mile) from the facility. The use of mufflers and other mitigation measures could reduce these distances.

4.14.3.2 Alternative A

This alternative would reduce the potential for noise impacts by reducing the number of wells and thus associated drilling, traffic and construction-related impacts. Implementation of a year-round buffer area, versus a seasonal buffer, would not reduce impacts to a noise sensitive location but could reduce overall noise impacts by reducing the number of wells and production locations. A noise sensitive location requires a receptor and a fixed geographic point--here defined as an

occupied raptor nest or a residence. Implementation of a one mile buffer area would not be necessary to protect a noise sensitive location from noise impacts. Assuming noise sources, such as drilling locations and compressors are located about 3/8 to 0.5 miles from a noise sensitive area, it is estimated that background noise at a noise sensitive location would be unchanged. Facilities could be placed even closer to a noise sensitive location and still protect background levels if additional noise control measures were implemented. However, the expense of mitigating sudden, unexpected noise sources from a relief valve or blow down, for example, could also discourage this. Under this alternative, noise at some compression facilities would increase if centralized, larger compressor units or multiple compressors were to be concentrated at a location. This could increase the zone of noise impact around such a facility. However, use of fewer but larger compression facilities would reduce noise from smaller, more widely scattered field compressors.

4.14.3.3 Alternative B

The noise impacts of this alternative are essentially the same as those associated with the Proposed Action as the number of drilling and production locations and associated traffic-related impacts within the project area would be similar. Ambient noise levels within the adjacent Key Raptor Area are less likely to change under this alternative as development activities would be restricted.

4.14.3.4 Alternative C

Noise impacts from existing operations and activities on state and private lands would continue. Some temporary increase in noise impacts associated with new drilling operations, construction activities and associated traffic would be avoided. Noise associated with additional field compressors and the liquid recovery plant would be avoided. However, when compared to the Proposed Action, implementation of this alternative would not substantially increase the protection of noise sensitive areas, such as occupied raptor nests. Standard timing restrictions already applied in the Platte River Resource Area have placed restrictions on activities within 0.5 miles of an active raptor nest. As described above, noise from proposed activities would seldom exceed background level outside a 0.5 mile radius.

4.14.4 Impacts Summary

In summary, using the EPA standard of 55 dBA, no impact to noise sensitive areas is likely to occur outside of a 500-foot radius from a drill rig. Noise levels from drill rigs would recede to 35 dBA within about 4,000 feet (0.75 mile) from a well site regardless of the type of rig used. However, if diesel-electric rigs similar to those analyzed in Kruger (1981) are used--and especially if mufflers are installed on rig engines--noise levels are expected to recede to less than 30 dBA within about a 2,000 foot (3/8 mile) radius of the well site. As set by federal regulation (see Chapter 3), noise levels on the drill rig itself--especially in proximity to engines--would require the use of hearing protection by shift workers.

A temporary increase in noise levels from drilling and associated field development traffic would be unavoidable. Workers on drill rigs would be exposed to high levels of noise requiring hearing protection. Even with the implementation of noise control technologies, some long-term increase in noise levels in the vicinity of field compressors and the liquids recovery plant would be unavoidable. However, the magnitude of this impact would drop markedly outside a 500-foot

radius. Noise from blow down stacks and relief valves would be infrequent but would be unavoidable and necessary.

4.14.5 Mitigation Summary

Measures to mitigate noise impacts would include the following:

- Mufflers should be installed on drill rig engines.
- Mufflers should be installed on all internal combustion engines installed at compressor sites, tank batteries and the liquids recovery plant.
- All medium and heavy weight vehicles (i.e., 10,000 pound gross vehicle weight or more) and construction equipment manufactured after 1978 should have properly installed mufflers that meet federal noise control standards.
- Contractors should be informed that mufflers will be required on all internal combustion engines in accordance with manufacturers specifications and in compliance with applicable federal regulations.
- Wherever feasible, and if available, diesel-electric drill rigs should be used if activities would occur 0.5 miles or less from a noise sensitive location.
- Before a drilling location, compressor or liquids recovery plant is placed 0.5 miles or less from a noise sensitive location, a description of equipment-specific and location-specific noise mitigation measures should be incorporated into the applicable permit application to BLM.
- Before a central compression facility with multiple engines is constructed, a description of equipment-specific and location-specific noise mitigation measures should be incorporated into the applicable permit application to BLM. A central compressor facility should incorporate sound control measures such as mufflers and a building around compressor engines.

4.14.6 Residual Impacts

Implementation of mitigation measures as proposed should fully mitigate or reduce all noise impacts to levels not considered significant.