RILEY RIDGE
NATURAL GAS PROJECT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

MAY 1983

DEPARTMENT OF INTERIOR
BUREAU OF LAND MANAGEMENT
DEPARTMENT OF AGRICULTURE
FOREST SERVICE

March 3, 1849

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
State Office
P. O. Box 1828
Cheyenne, Wyoming 82001

May 20, 1983

IN REPLY
REFER TO:
1792 (934)
Riley Ridge

Dear Reviewer:

This draft environmental impact statment (DEIS) on the proposed Riley Ridge sour gas development project is provided for your review and comment. This DEIS assesses the impacts of sour gas development proposals made by Exxon Company, American Quasar Petroleum Company, Williams Exploration Company, Northwest Pipeline Corporation, and Mobil Oil Corporation. It has been developed under joint lead by the USDA Forest Service and the Bureau of Land Management (BLM) with the BLM serving as administrative lead.

We welcome your comments on this DEIS. Those comments addressing the adequacy of the scope of this DEIS or the impact analysis will be responded to in the final EIS. Specific comments are the most useful. These include suggestions for alternative data sources or impact analysis methodologies. All comments will be considered in the decisionmaking process.

Please keep this copy of the DEIS as an abbreviated final EIS may be issued in accord with the Council on Environmental Quality (CEQ) regulations. A copy of the FEIS will be sent to all those on the DEIS mailing list and anyone requesting a copy.

In accord with the CEQ regulations, this draft incorporates a number of other documents by reference. The supporting technical reports for this EIS can be obtained from the address shown below.

All written comments should be received no later than July 19, 1983, and should be sent to:

Mrs. Janis VanWyhe
Riley Ridge Project Leader
Bureau of Land Management
Division of Environmental Impact
  Statement Services
555 Zang Street
First Floor, East
Denver, Colorado 80228

As indicated elsewhere in the EIS, a series of public hearings will be held to receive oral/written comments.

Sincerely yours,

Maxwell T. Lieurance
Maxwell T. Lieurance
BLM Wyoming
State Director

T. A. Roederer
for J.S. Tixier
Regional Forester
Intermountain Region
USDA Forest Service

DEPARTMENT OF THE INTERIOR

AND DEPARTMENT OF AGRICULTURE

DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE RILEY RIDGE NATURAL GAS PROJECT SUBLETTE, LINCOLN, AND SWEETWATER COUNTIES, WYOMING

Prepared by

BUREAU OF LAND MANAGEMENT, FOREST SERVICE, AND ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

May 1983

Maxwell T. Lieurance

Director, Wyoming State Office, Bureau of Land Management

J. C. Roederer

Regional Forester, Intermountain Region, Forest Service

COVER SHEET

Riley Ridge Natural Gas Project Environmental Impact Statement

(X) DRAFT ( ) FINAL

Joint Lead Agencies	U.S. Department of the Interior Bureau of Land Management Wyoming State Office, Cheyenne, Wyoming U.S. Department of Agriculture Forest Service Intermountain Region, Ogden, Utah
Cooperating Agencies	U.S. Department of the Interior, Fish and Wildlife Service U.S. Department of Energy, Federal Energy Regulatory Commission U.S. Department of the Army, Corps of Engineers U.S. Environmental Protection Agency
Counties That Could Be Directly Affected	Sublette, Lincoln, and Sweetwater Counties, Wyoming

Abstract

American Quasar Petroleum Company; Exxon Company, USA; Northwest Pipeline Corporation; Mobil Oil Corporation; and Williams Exploration Company propose to develop, produce, treat, and transport natural gas from a new deep gas well field in western Wyoming.

This Draft Environmental Impact Statement analyzes the environmental effects of the proposed well field development and the construction, operation, and abandonment of four low-Btu natural gas treatment plants in Sublette, Lincoln, and Sweetwater Counties, Wyoming. The facilities are designed to process a total of 2.8 billion cubic feet per day of natural gas.

This EIS analyzes the impacts of the Proposed Action and three siting alternatives: the Buckhorn, Shute Creek, and Northern Alternatives. The No Action Alternative is also analyzed. Individual component alternatives are analyzed for sulfur transport, power supply, and employee housing.

Based on the issues and concerns identified during the scoping process, the EIS focuses on the impacts to socioeconomics, wildlife, health and safety, and air quality. Key issues include effects to communities and people in the study area; effects to wildlife and wildlife habitat; effects to human health and safety from the release of hydrogen sulfide gas; and potential reductions in air quality and visibility.

EIS Contact

Comments on this EIS should be directed to:

Ms. Janis VanWyhe
Bureau of Land Management
Division of EIS Services
555 Zang Street, First Floor East
Denver, Colorado 80228
(303) 234-6737

Date by Which Comments Must Be Received: July 19, 1983

PUBLIC HEARINGS INFORMATION

Public hearings on the Riley Ridge Project Draft Environment Impact Statement will be held in the following locations:

Monday June 27
Pinedale Middle School
Carmichael Media Center
227 East Hennick
Pinedale, WY

Tuesday June 28
Big Piney High School Auditorium
650 Piney Drive
Big Piney, WY

Wednesday June 29
Kemmerer Junior High School Auditorium
1525 Third West Avenue
Kemmerer, WY

Thursday June 30
Holiday Inn
1675 Sunset Drive
Rock Springs, WY

All hearings will begin at 7:00 p.m.

The hearings will be held pursuant to the objectives of the National Environmental Policy Act (PL9-1190; 83 Stat. 852,853) to receive comments (testimony) on the scope of the EIS and the adequacy of the impact analysis. Testimony presented at these hearings will be considered in the preparation of the final environmental impact statement.

The public hearings will be conducted by a Bureau of Land Management (BLM) official who will be accompanied by other BLM, FS, and other federal and state personnel involved in preparing this draft environmental impact statement. The panel members may ask questions of the witness to clarify points in the testimony. All hearing proceedings will be recorded.

Before giving testimony at the public hearing, participants are requested to complete a hearing registration from. A REGISTRATION FORM IS INCORPORATED AS THE LAST PAGE OF THIS VOLUME. Additional forms may be obtained from the address shown on the registration form. Registration forms must be returned to that address no later than June 20, 1983. Participants may also register at the registration desk at each hearing.

Times preferences for presentation of oral statements will be honored whenever possible. A tentative listing of speakers, in the order they will be called, will be available at the registration desk at each hearing.

After the last witness has been heard, the hearings administrator will consider the requests of other persons present who wish to testify. Only one witness will be allowed to present the viewpoint of a single organization at any one hearing. However, any witness will be permitted to give relevant testimony if it is offered as the opinion of a private citizen.

Persons wishing to give oral testimony will be limited to 10 minutes. Written submissions may also be presented at the hearing.

PREFACE

This Environmental Impact Statement (EIS) presents facts pertaining to the construction, operation, and abandonment of the Riley Ridge Natural Gas Project and its alternatives and analyzes the environmental effects of the project. This EIS provides pertinent information in sufficient detail for the public to understand the project and for the decisionmakers to make a knowledgeable decision.

The EIS has been prepared according to the requirements of the National Environmental Policy Act of 1969 (NEPA) and the Council on Environmental Quality's regulations for implementing NEPA, effective July 30, 1979.

In addition to the four chapters and the appendices in the EIS, there are separate technical reports which support the EIS. Technical reports were prepared on the following topics:

- Description of the Proposed Action
- Socioeconomics
- Wildlife and Fisheries
- Health and Safety
- Air Resources
- Soils, Vegetation, and Reclamation
- Cultural Resources

The technical reports can be obtained from the Bureau of Land Management, Division of EIS Services, 555 Zang Street, First Floor East, Denver, Colorado 80228. They are also available for review at BLM offices in Rock Springs, Pinedale, and Kemmerer, Wyoming, and FS offices in Big Piney, Pinedale, and Jackson, Wyoming, and Ogden, Utah.

During the course of preparing this EIS, Secretarial Order Number 3087 (dated December 6, 1982) transferred the onshore responsibilities of the Minerals Management Service (MMS) to the Bureau of Land Management (BLM). Consequently, the functions of MMS covered by this EIS are now part of the BLM. Internal organization for these functions has not yet been worked out, however, throughout this document MMS has been replaced with BLM (except where studies are cited that were performed by MMS personnel prior to the merger).

SUMMARY

INTRODUCTION

The Riley Ridge Project is a natural gas development project which includes the construction, operation, and abandonment of a deep gas well field in western Wyoming, gathering lines for the transportation of sour gas within the well field, trunk lines for shipment of sour gas from the well field gathering lines terminus to the treatment plants, the treatment plants, sales gas pipelines for delivery of sales gas to existing gas transmission pipelines, and facilities for the handling and transportation of by-products (sulfur and carbon dioxide) to markets. The project represents three individual projects proposed by Northwest Pipeline Corporation, Mobil Oil Corporation, Exxon Company, U.S.A., American Quasar Petroleum Company, and Williams Exploration Company.

Major project actions and components consist of the following: (1) exploration, development, and abandonment of a 159,928-acre, low-Btu gas well field; (2) construction, operation, maintenance, and abandonment of four sour gas treatment plants with a total processing capacity of 2.8 billion cubic feet per day (cfd) and producing 576 cfd of methane; (3) construction, operation, maintenance, and abandonment of associated rights-of-way for gathering lines, trunk lines, railroads, access roads, transmission lines, and other ancillary facilities; and (4) processing and transportation of products and by-products.

The applicants have applied to the U.S. Department of the Interior (DOI), Bureau of Land Management (BLM) for right-of-way permits to cross federal land managed by the BLM and Forest Service (FS). This draft environmental impact statement (DEIS) was prepared jointly by BLM and FS. The BLM has assumed the administrative lead and is responsible for filing the DEIS with the Environmental Protection Agency.

In addition to the proposed project, numerous component alternatives and siting alternatives have been evaluated. These include the sulfur transport alternative, power supply alternative, and employee housing alternative; and the Buckhorn, Shute Creek, and Northern sour gas treatment plant siting alternatives; as well as the No Action Alternative.

AREAS OF CONTROVERSY

Several concerns about the Riley Ridge Project were raised during the public scoping meetings held in Cheyenne, Kemmerer, Pinedale, and Big Piney, Wyoming on November 2, 3, 4, and 5, 1981, respectively, and through the mail-in comments in July of 1982. The results of these comments are summarized in a document entitled *Public Concerns and Scope of EIS,* which is available from BLM Division of EIS Services, 555 Zang Street, First Floor East, Denver, Colorado 80228, and BLM offices in Cheyenne, Kemmerer, Rock Springs, and Pinedale, Wyoming. The most significant issues raised were socioeconomics, wildlife, air quality, and health and safety.

Under socioeconomics, the effects to communities and the people within the study area from project activities (construction personnel, etc.) was identified as a significant issue and concern. The area has experienced boom-type growth in the past from energy development and is thus sensitive to any similar future developments.

Under wildlife, effects to wildlife and wildlife habitat (especially within the well field) are a major concern to the FS, BLM, Fish and Wildlife Service (FWS), Wyoming Department of Game and Fish, and the general public. Hunting is an important recreational activity in Wyoming. The well field lies in an area which is critical range (i.e., wintering areas, calving areas, etc.) for elk, deer, pronghorn (antelope), and moose. Development of all types has reduced the amount of winter range for big game. Feedgrounds have been utilized to compensate for lost habitat; however, the quantity and quality of big game herds has been affected. This well field area encompases one of the last natural wintering areas in the Upper Green River Valley for elk.

Under air quality, concerns were expressed by the BLM, FS, National Park Service, Environmental Protection Agency, and general public. The project area is located in a region of western Wyoming where air quality is good and relatively unaffected by industrial development. The major exception to this is in the trona mining area near Green River, Wyoming. Concerns were generally related to reductions in air quality in national parks and wilderness areas (Class I) and in the general project area (Class II), reductions in visibility in national parks and wilderness areas, and effects of acid rain on high mountain lakes in the Bridger Wilderness and other areas to the east of the proposed gas treatment plants.

Under health and safety, effects to human health and safety from the release of hydrogen sulfide (H_2S) gas is an issue to the general public and the BLM. The natural gas, as taken from the wells, contains a small percentage of hydrogen sulfide (H_2S) which is toxic. Potential areas where hazards from H_2S are possible are wells, pipelines, and at the plants.

MAJOR IMPACT CONCLUSIONS

Western Wyoming is currently undergoing a change from an area characterized by rangeland and wilderness to one experiencing industrial growth and active exploration and development of oil and gas reserves. This trend is having many beneficial and adverse effects on the human and natural environments of the area.

The major unmitigated environmental impacts of the Riley Ridge Project are detailed in Chapter 4 of this EIS and are compared in Chapter 2. (Mitigation measures are included near the end of Chapter 4). However, there are several major issues and impacts associated with the Proposed Action which need to be stressed. Major issues and impacts associated with the project are summarized below.

SOCIOECONOMICS

The construction of the Riley Ridge Project would create significant, potentially adverse impacts in the short-term and beneficial impacts in the long-term. The direct employment for nearly 3000 workers in 1985 would contribute to a strong regional economy in Lincoln, Sublette, and Sweetwater Counties, but place demands on local governments, particularly Sublette County, that would far exceed their current service capacity and fiscal capability. In the long term the revenues accruing to affected jurisdictions could provide substantial local benefits and opportunities for enhancing the quality of life. While these prospects are attractive, the short-term problems could create substantial hardships for newcomers and residents alike, due to crowding and service shortfalls.

WILDLIFE AND FISHERIES

Several aspects of the Riley Ridge Project would result in significant adverse impacts to wildlife within the study area. A serious impact would result from the increase in human population and accompanying human disturbance to wildlife in the form of increased hunting and fishing pressure. Increased game violations, harassment, and road kills would also result from the project. Another significant impact would be the disturbance of critical ranges during their season of use and loss of critical ranges through project construction activities.

The project presents the possibility of adversely affecting streams in the well field area. Increased long-term siltation coupled with increased fishing pressure, altered stream flows, and a few accidental spills could create sufficient stress on the existing fishery to significantly reduce its future value. Special concern is held for the native Colorado River cutthroat trout.

HEALTH AND SAFETY

The probability of a well blowout or a pipeline rupture is critical in determining the effects to humans from the presence of H_2S gas. Because the gas is extremely toxic, the frequency of an accident and dispersion of the gas is critical. Analysis for the project has indicated that there would be a potential for 2.8 well blowouts associated with drilling and production operation during the lifetime of this project. Individuals within one-half mile of a well blowout could be subjected to lethal levels of at least 1,000 parts/million H_2S. Individuals within 1 to 2 miles could be subject to significant doses of H_2S, i.e., doses that would cause human discomfort.

Based on the pipeline rupture analysis, it was concluded that in any year there is about a 7 percent chance that ruptures would occur in the gathering system, but there is only about a 1 percent chance that a trunk line would rupture. The size of the ruptured pipeline would determine the potential impact on humans. The rupture of a 4-inch pipeline would not result in lethal H_2S doses to people in towns or traveling established routes, while the rupture of a 12-inch pipeline or an 18 to 26-inch pipeline could cause lethal doses to individuals within 1 to 3 miles, respectively.

Based on the quantitative risk assessment for towns in the study area, it was concluded that only Calpet would be at risk of exposure to lethal levels from a trunk line rupture. Calpet's annual individual risk is roughly equivalent to the annual risk of death from an automobile accident. The towns of Calpet, LaBarge, and Big Piney would have a small risk of exposure to significant levels of H_2S, risks roughly equivalent to the annual risk of death from fires.

WATER RESOURCES

Impacts to water resources are difficult to assess because of data gaps concerning characteristics of the surface and groundwater systems, the frequency of events (leaks, ruptures, other failures) affecting water resources, and engineering details on the applicant's waste water disposal systems. While quantification is not possible, significant impacts on water resources are expected to occur during the life of the project. In order to reduce potential impacts, mitigation measures have been developed but additional environmental analysis and monitoring will be required. The project will also have to comply with the permit requirements of the State of Wyoming.

AIR QUALITY

Significant air quality impacts would result from the operation of the Riley Ridge Project. American Quasar's plant at the East Dry Basin site would violate the Prevention of Significant Deterioration (PSD) Class II increment for sulfur dioxide (SO_2). Quasar's plant at the East Dry Basin and Buckhorn sites would also violate the Wyoming Ambient Air Quality Standard (WAAQS) for hydrogen sulfide (H_2S). There would be no significant exceedances of the PSD significance criteria in Class I areas. Significant odor impacts resulting from releases of small amounts of H_2S would occur near the East Dry Basin, West Dry Basin, Big Mesa, and Buckhorn plant sites but would not affect populated areas.

SOILS AND VEGETATION

The Riley Ridge Project would disturb approximately 12,852 acres of soils and vegetation during construction. Of this, 641 acres would remain in roads and railroads and would not be reclaimed at the end of the project life. In assessing significant impacts, it has been assumed that the Erosion Control, Revegetation, and Reclamation Program would be successfully implemented and that soils would be stabilized within 5 years following construction or abandonment. No significant impacts to soils are anticipated. About 63 acres of riparian vegetation would be disturbed, and this is considered a significant impact.

VISUAL RESOURCES

The project as proposed would substantially alter the visual character of much of the project area and contribute to a continued progression from a predominantly natural landscape to one that is man-dominated. Most affected would be the well field and lands crossed by the sulfur pipeline.

CULTURAL RESOURCES

Construction and operation of the Riley Ridge Project would cause both direct and indirect impacts to cultural resources in the study area. A Class III (100 percent) survey of each area to be disturbed will be conducted prior to construction to determine the actual resources present and the potential impacts to those resources. Less than 5 percent of the study area has been previously surveyed.

RECREATION

During the years 1985 and 1986 when the construction work force would be at its peak, the quality of recreation experiences available in the area would be significantly impacted. The long-term prospects, however, would be much more favorable and all affected groups, newcomers, long-time residents, and temporary visitors, should be able to enjoy the area's many recreation opportunities.

WILDERNESS

Both short-term and long-term significant impacts to wilderness-related values would occur to the following areas: Bridger Wilderness, Scab Creek Instant Study Area, Lake Mountain Wilderness Study Area, and high density use corridors of the Popo Agie Primitive Area and Teton Wilderness. Impacts would be primarily attributed to anticipated increases in visitation. The ability of the wilderness resources to absorb social, physical, and biological impacts would likely exceed carrying capacity threshold levels. Wilderness related values could be significantly impaired by severely diminishing the quality of user experiences through increased visitation.

AGRICULTURE/GRAZING

Impacts to agriculture and grazing are generally insignificant. Significant impacts due to loss of forage, however, would occur in 5 small grazing allotments during construction. Unquantifiable but significant impacts could also occur to those ranchers using the Slate Creek sheep trail. There would be no impacts to prime farm land.

TIMBER

Impacts to timber would be generally favorable due to project construction of new access roads that would reduce the costs of timber harvesting in otherwise remote and previously inaccessible areas.

TRANSPORTATION

In the summers of 1985 and 1986, construction activities plus anticipated recreational travel would create traffic volumes that would lead to traffic congestion and traffic slowing in and around Kemmerer, Opal, LaBarge, Big Piney, and Marbleton during peak commute hours. While these would not be so severe as to disrupt emergency services (police, fire, and ambulance) they could be annoying to the resident public and perceived as a degradation in the quality of life in the area. These impacts would only be temporary, however. Once construction is completed, traffic volumes due to the proposed project would decrease substantially.

LAND USE

The principal land use conflicts of the proposed project are with the planning objectives of the federal land management agencies. Except for conflicts with Sublette County zoning which would probably be dealt with administratively, for many areas affected by the project, existing land use plans encourage the type of development that is proposed.

NOISE

Noise impacts would be localized but significant during construction due to heavy truck traffic. Residences and businesses within one-half mile of U.S. 189, U.S. 30, and S.R. 240 would be most affected.

ISSUES TO BE RESOLVED

Implementation of the proposed project would be dependent upon resolution of issues in three resource areas: socioeconomics, air quality, and water resources. These issues would be resolved in the permitting processes of the Wyoming Industrial Siting Council, the Wyoming Oil and Gas Commission, and the Wyoming Department of Environmental Quality. The issues and the dates by which resolution is expected are discussed below.

SOCIOECONOMICS

The Proposed Action would have significant adverse impacts on housing and local public services. Additional housing units and public services would be needed as a result of the increased population to the study area. A schedule and definite plan for meeting these project-generated needs would be required by the Wyoming Industrial Siting Council as part of its permit process. Permission to proceed with project construction would be dependent upon acceptance of a required mitigation plan. Given the Siting Council review process, it could be expected that this plan would have been developed by year-end 1983 or early 1984, if the companies retain their current schedules.

AIR QUALITY

The potential problem for the Proposed Action associated with Quasar's predicted violation of the SO_2 24-hour average PSD Class II increment (based on use of off-site meteorological data) would have to be resolved during the PSD permitting process. Resolution of this problem is potentially a two step process. The first step would be to remodel Quasar's SO_2 impacts with on-site meteorological data. (This simultaneously resolves the problem of results based on off-site meteorological data.) If violations are still predicted, the second step would be for Quasar to install additional in-plant sulfur controls or other options they may develop.

Quasar's plant for the Proposed Action and all alternatives shows predicted violations of the Wyoming half-hour H_2S standards. Resolution of this problem is identical to that for SO_2.

The Exxon and Northwest plants would have to resolve the problem of results based on off-site meteorological data. In their respective PSD permits to the Wyoming Department of Environmental Quality, use of on-site meteorological data in the modeling would resolve current uncertainties.

Resolution of these issues must be achieved for granting of the PSD permit and approval to begin project construction.

WATER RESOURCES

The effects on groundwater of deep well reinjection of waste water from the sour gas treatment plants and well field dehydrators have not been fully analyzed due to lack of information on the applicant's injection engineering plans and specific water resources data. Prior to allowing this activity on or off the proposed plant sites, the BLM will require further analysis of impacts. In addition, the Wyoming Oil and Gas Commission, Wyoming Department of Environmental Quality, and BLM-Minerals Division must review and approve the applicants' disposal plans. The necessary permits or approvals would be required before the applicants could begin drilling new reinjection wells or injecting in old oil or gas wells.

AGENCY PREFERRED ALTERNATIVE

The BLM and FS have jointly identified the Agency Preferred Alternative to be the Shute Creek Alternative, subject to the mitigation identified in Chapter 4 - Committed Measures Section; Required Federal Measures and Applicants' Standard Operating Procedures Designed to Reduce Environmental Impacts (Appendix B); and Sour Gas Trunk Line Mititgation Measures (Appendix C.6). This alternative was selected based on the comparative analysis presented in Chapter 2 and the ultimate impacts which would result from the implementation of this alternative with all applicable mitigation. The Shute Creek Alternative, as analyzed and mitigated, would have fewer overall negative impacts to resources than the other alternatives which were considered.

The health and safety considerations for this alternative were significant since the unmitigated impacts as identified in Chapter 2 (Table 2-1) were higher than the other alternatives. Additional mitigation (Chapter 4 - Committed Measures Section and Appendix C.6) indicates that implementation of the Shute Creek Alternative would reduce the lethal hazard for H_2S exposure to a level which is equivalent to the Proposed Action or the Buckhorn Alternative. This hazard would be very small.

The agencies have also identified the preferred Component Alternatives (sulfur transport, power supply, and employee housing) for the project. The applicants' proposals for sulfur transport for the Shute Creek Alternative are preferred; the applicants' power supply route selection is preferred; and all applicants would be required to provide construction camps for housing at all plant site locations.

It is also the agencies' preference to allow the applicants to vent carbon dioxide (CO_2) until an economic market is jointly identified by the BLM and MMS. At that time, the CO_2 must either be sold or compensatory royalty will be assessed for the marketable volume. In addition, the helium will be allowed to be vented until such time as the Bureau of Mines makes a final determination regarding its disposition.

The Agency Preferred Alternative is the first step in the decision-making process based on the comparative analysis and mitigation presented. It is meant to solicit public opinion which will be considered prior to a final decision being made. The final decision will be published in the Record of Decision following the Final EIS.

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CHAPTER 1

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

INTRODUCTION

American Quasar Petroleum Company (Quasar), Williams Exploration Company (Williams), Exxon Company, USA (Exxon), Northwest Pipeline Corporation (Northwest), and Mobil Oil Corporation (Mobil) propose to develop, produce, treat, and transport natural gas from a new deep gas well field in western Wyoming. The planned production is from previously explored but undeveloped reservoirs below 14,000 feet. The project participants are proposing to produce a significant supply of low-Btu natural gas and process it to pipeline quality. The gas (called sour gas) contains methane (CH_4), carbon dioxide (CO_2), hydrogen sulfide (H_2S), nitrogen (N_2), helium (He) and other inert gases when extracted from the well field. The sour gas would be transported by pipelines from the well field to treatment plants where the impurities and by-products would be removed and the natural (sales) gas would be prepared for shipment to available markets by sales gas pipelines. Large amounts of nitrogen and CO_2 and small amounts sulfur dioxide (SO_2) and He would be vented to the atmosphere. Certain by-products (CO_2, He, and sulfur) are of commercial value if markets can be identified during the life of the project and may be transported by pipeline, truck, or rail to potential markets (see Figure 1-1).

To undertake the Riley Ridge Project, the applicants will each be required to obtain right-of-way grants to occupy and utilize public lands in Wyoming. Various components of the proposed project would be within or cross lands managed by the Bureau of Land Management (BLM), Forest Service (FS), Bureau of Reclamation (BuRec), State of Wyoming, and private lands. In addition, various streams would be crossed. Before authorization to cross or utilize any public lands can be given, the environmental impacts of the proposed project must be assessed.

This EIS will assess impacts from the development of the Riley Ridge well field, through the delivery of sour gas to treatment plants, treatment of the gas, and delivery of sweet gas and by-products to existing transportation systems. All phases of the project including the exploration, development, operation, and abandonment of the applicants' facilities are addressed in the EIS. Existing production and on-going development of sweet gas and oil in the Big Piney/LaBarge area is included as part of the baseline condition against which impacts from the Riley Ridge Project are analyzed.

As with any project, uncertainties exist relative to the timing of project implementation and ultimate size. For the projects included in the Riley Ridge EIS, there is significant potential for delay in project implementation. This potential for delay in construction and drilling activity is primarily attributable to uncertainties as to gas pricing and demand in the 1986-1990 time frame and the limited availability of capital for investment in the near term for facilities of the size contemplated.

Although these delays cannot be quantified at this time, it is very probable that several of the proposed plants and the field development in support of those plants could be delayed for a period of up to five years.

The Riley Ridge EIS Proposed Action is a worst-case analysis for all projects defined by the applicants in their individual rights-of-way applications. If one or more of the proposed plants currently analyzed under the Proposed Action is delayed, the resulting impacts are anticipated to be less than those presented. Since the probable delays cannot be quantified at this time, the reduction of impacts also cannot be quantified. However, the scope of analysis in the EIS is such that decisions and authorizations relative to individual rights-of-way applications can be made independently for each applicant. Prior to granting of any of the requested federal actions, the cumulative impacts will be reevaluated to determine if they fall within the parameters discussed in this EIS.

Mitigation measures to alleviate potential impacts will be applied to individual rights-of-way grants as stipulations at the time the grants are developed. In the event of changed schedules, such mitigation measures will be reviewed by the agencies at the time of grant development to ensure their applicability and to ensure that all appropriate and necessary mitigation measures are applied as stipulations. This will prevent impacts from exceeding the worst-case analyzed and mitigated in this EIS. Implementation of such stipulations will be in a timely manner based on the companies schedule of development activities.

Approximately 1.876 cubic feet/day (cfd) of CO_2 gas is proposed to be vented from this project. A final determination must be made by the agencies concerning the disposition of the CO_2. A decision will be made following the public hearings, but prior to the issuance of the FEIS. The alternatives for the disposition of this gas are to either require sales or allow

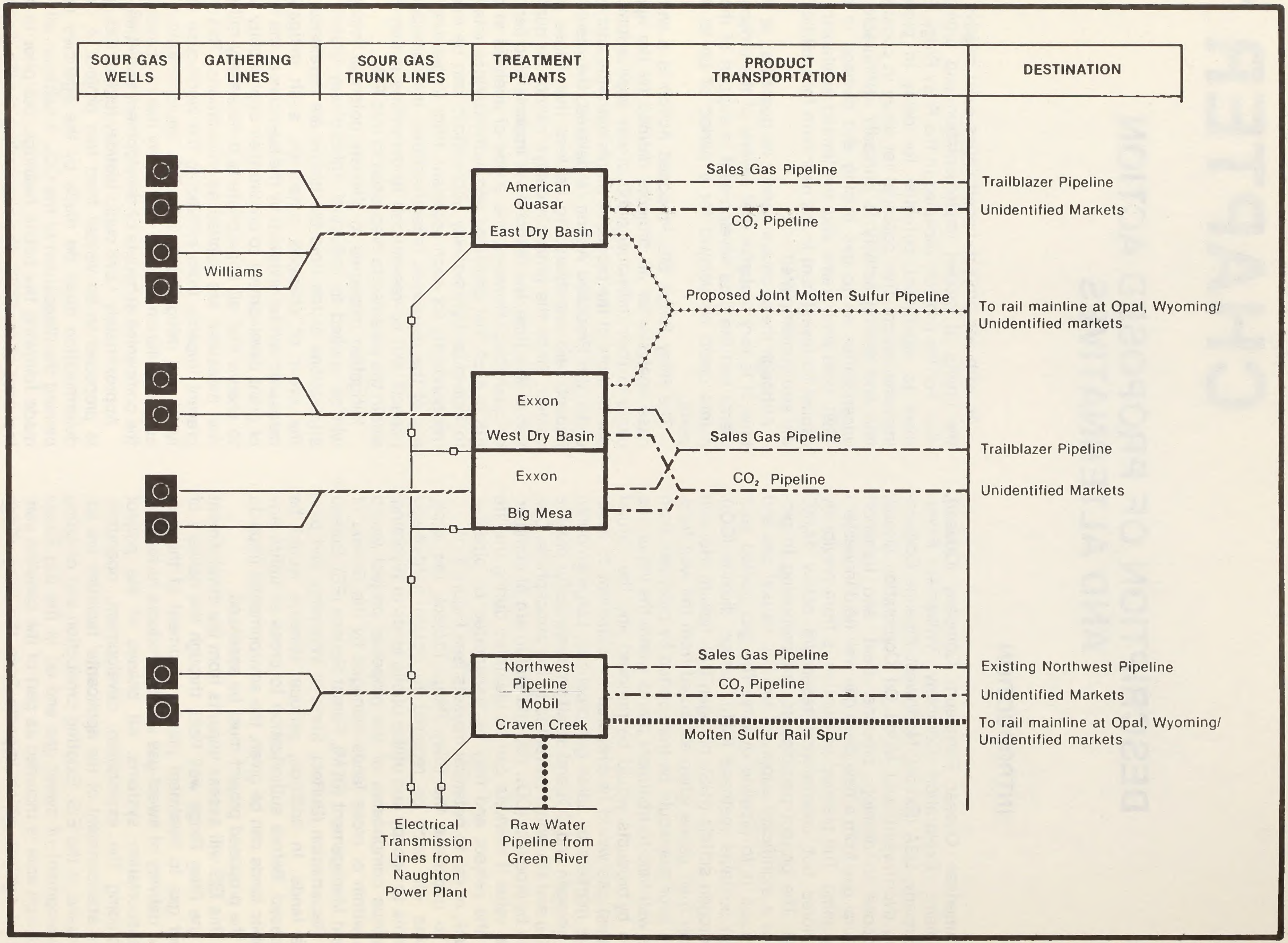


FIGURE 1-1 SCHEMATIC OF RILEY RIDGE PROJECT COMPONENTS

venting. The decision of what royalties may be due to the U.S. government and under what conditions they may be due must also be resolved.

PURPOSE AND NEED FOR PROJECT

The applicants have proposed the Riley Ridge Project for the purpose of developing low-BTU natural gas reserves and providing the necessary processing for that natural gas. Processing is necessary to remove high levels (approximately 67 percent) of CO_2 and low levels (approximately 4 percent) of H_2S and inerts, so that satisfactory (high-Btu) sales gas can be obtained. The proposed treatment facilities would process a total gas volume of 2.8 billion cfd with production of 580 million cfd of sales gas. In addition to the methane content of the gas, some of the by-products (CO_2, He, and sulfur) recovered as a result of the upgrading process would be of economic value if markets can be developed during the life of the project. CO_2 can be used for enhancing oil recovery in older oil fields and as a transporting medium in coal slurry pipelines, while sulfur is used in the manufacture of phosphate fertilizers.

The recession in late 1981 and 1982 and the record drilling activity and discoveries in 1981 have resulted in current, producible natural gas reserves which exceed current demand. However, this surplus is expected to be temporary. Data on U.S. natural gas production show that production has been declining since 1973, when it peaked at 22 trillion cubic feet per year (DOE 1980). This decline is expected to continue; by the year 2000 production is expected to drop to 13 trillion cubic feet per year. Based on estimates of projected demand, approximately 30 percent of domestic natural gas production in 1990, and nearly 50 percent in 2000, must come from reserves yet to be discovered (Exxon 1982). Development of the Riley Ridge Project reserves would provide a major domestic source of natural gas over the 40-year life of the project.

Present data indicate the proven reserves in the "lower 48" states amount to 161 trillion cubic feet as of the latter part of 1981 (Northwest Pipeline and Mobil 1982). At current consumption rates of 20 trillion cubic feet per year, these proven reserves would last about eight years, so investigating and developing supplementary sources such as the Riley Ridge Project is necessary to ensure a reliable supply of natural gas.

Comparing current consumption with domestic production, there would be a net shortfall in gas production that would have to be made up by imported gas or other sources of energy. The proposed project would provide a means to enhance domestic energy supplies by developing a source of natural gas that is somewhat lower in quality than has been exploited in the past; the commercial technology is available to upgrade this low-Btu gas into a usable resource (American Quasar 1982). Based on current consumption and estimated production, the Riley Ridge Project could produce approximately 1 percent of the nation's annual demand for natural gas.

GENERAL LOCATION OF PROJECT

The proposed Riley Ridge Project area is located in southwestern Wyoming in Sublette, Lincoln, and Sweetwater Counties as shown on Map 1-1. Major physiographic features of the region include the Wyoming Range extending in a north-south direction west of the proposed project, the Wind River Range east of the project area, and the Green River approximately 13 miles east of the proposed well field. Numerous creeks drain the area and flow eastward to the Green River. Nearby towns include Big Piney, Marbleton, and LaBarge, all of which are located east of the well field along U.S. Highway 189, and Opal and Kemmerer which are located southwest of the proposed southern treatment plant sites. Portions of the proposed well field are located in the Bridger-Teton National Forest and the BLM Rock Springs District, while the balance of the project is located on BuRec-managed, state, and privately owned land.

AUTHORIZING ACTIONS

Overview

The federal, state, county, and local actions that would be required to implement any of the applicants' proposed projects would generally be the same regardless of the type of project or its location. These actions are listed in Tables 1-1 through 1-3 (federal actions, state actions, county and local actions).

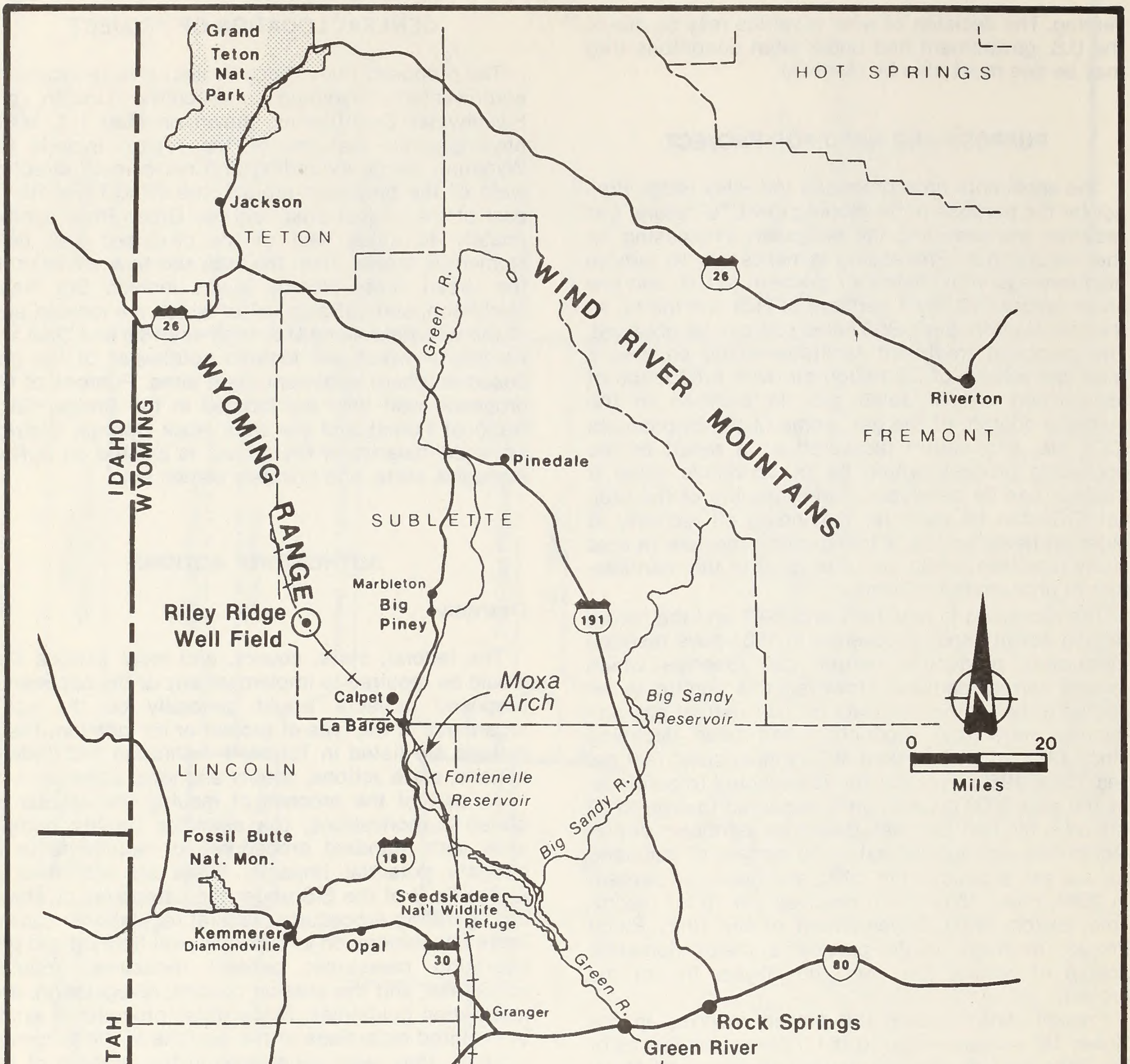
As part of the process of issuing the various required authorizations, the agencies require compliance with standard procedures or requirements to mitigate potential impacts; these are identified in Appendix B of the EIS under the categories of standard operating procedures; federal regulations; current lease stipulations on occupancy; well field oil and gas operating measures; general measures; roading guidelines; and the erosion control, revegetation, and restoration guidelines. Since these procedures would be required regardless of the designs of the proposed projects, they were considered in the analysis of the impacts.

Prior to issuance of various permits to the applicants, requirements beyond those covered by the EIS must be met. Examples of such permits would be permits to drill, rights-of-way grants, Wyoming Industrial Siting permits, and Prevention of Significant Deterioration (PSD) permits.

Application for a Permit to Drill

Federal applications for permit to drill (APD), which are issued by the BLM, would utilize this EIS as part of the decision-making process. The following explains the process for issuing APDs and their relationship to the EIS.

Obtaining approval to drill an oil/gas well on a federal oil/gas lease is achieved in two phases: (1) submission of request for Preliminary Environmental



MAP 1-1 REGIONAL LOCATION MAP

TABLE 1-1
KEY FEDERAL AUTHORIZING ACTIONS
(*denotes well field related authorization)

Agency	Nature of Action	Authority	Project Feature
DEPARTMENT OF THE INTERIOR			
Bureau of Land Management (Rock Springs District)	Grant rights-of-way (contingent upon lease or unit boundary)	Title V of Federal Land Policy and Management Act of 1976, 43 U.S.C. Section 1761-1771; CFR Part 28; Section 28 of the Mineral Leasing Act; 30 U.S.C. Section 185; 43 CFR Part 2800, 2880, and 3100	Corridor facilities; access roads, power transmission lines, water supply lines, gas pipelines, construction camp, treatment plant
	Issue temporary use permits	Title V of Federal Land Policy and Management Act of 1976; Section 28 of the Mineral Leasing Act of 1920	Temporary construction activities construction camp, treatment plant
	Issue non-competitive mineral materials sales contract	Materials Act of July 31, 1947, as amended, 30 U.S.C. 601, 602, 43 CFR 3600	Aggregate for well pad construction, road construction
	*Approval of applications for permit to drill, completions, work-overs, and well repair, and hydrogen sulfide contingency plans	Mineral Leasing Act of 1920, 30 CFR Part 221, U.S.C. 30	Well pad (access roads and pipelines not requiring rights-of-way), subsurface drilling and production actions
	*Approval to flare or vent gas	Mineral Leasing Act of 1920, 30 CFR 221, U.S.C.; NTL-4A;	Well field
	*Approval to dispose of produced water	Mineral Leasing Act of 1920; 30 CFR 221, U.S.C.; NTL-2B-Disposal of produced water	Well field
	*Approval of any off-lease measurement or comingling of oil or gas production	Mineral leasing Act of 1920, 30 CFR Part 221, 30 U.S.C.	Pipeline and lease production
Bureau of Reclamation	Issue special land use license or easement	Reclamation Projects Act of August 4, 1939, 53 Stat. 1189, Section 10	Pipelines, access roads, etc.
	Issue special land use permit	Reclamation Projects Act of August 4, 1939, 53 Stat. 1189, Section 10	Pipelines, access roads, etc.
National Park Service Office of the Departmental Consulting Archaeologist	*Issue antiquities permits and permit to excavate or remove archaeological resources on Public Lands	Antiquities Act of 1906, 16 U.S.C. Section 431-433; Archaeological Resource Protection Act of 1979, 16 U.S.C. Sections 470aa-47011; 43 CFR Part 3 National Historic Preservation Act (amended 1980) P.L. 95-515, 36 CFR 60	All project features

TABLE 1-1 (continued)
KEY FEDERAL AUTHORIZING ACTIONS
(*denotes well field related authorization)

Agency	Nature of Action	Authority	Project Feature
Bureau of Mines	Approval for recovery of federally owned helium from natural gas	Minerals Lands Leasing Act of 1920, as amended, (30 U.S.C. 181); Helium Act Amendments of 1960 (50 U.S.C. 167)	Natural gas extraction
U.S. Fish and Wildlife Service	*Review impact on threatened or endangered species of fish, wildlife, or plants	Section 7 of Endangered Species Act of 1973, 16 U.S.C. Section 1536; 50 CFR part 402	All project features
	Grant of right-of-way	PL 89-669 Mineral Leasing Act Section 28, National Wildlife Refuge System, Oil & Gas pipelines.	Linear facilities across Seedskadee National Wildlife Refuge
DEPARTMENT OF AGRICULTURE			
U.S. Forest Service (Bridger-Teton National Forest)	Issue special use permit for constructing rights-of-way and facilities outside unit boundaries	Title V of Federal Land Policy and Management Act of 1976; 43 U.S.C. Sections 1761-1771; Section 28 of the Minerals Leasing Act; 30 U.S.C. Section 185	Construction of access roads, gas pipelines, power transmission lines, etc. outside of lease or unit boundaries
	*Issue permit for borrow material	Materials Act; 30 U.S.C. Section 601, 602; 30 CFR Section 251.4	Aggregate for well pad construction, road construction, plant sites
	*Issue antiquities permits and permit to excavate and remove archaeological resources on National Forest System Lands	Antiquities Act of 1906, 16 U.S.C. Sections 431-433; Archaeological Resource Protection Act of 1979, 16 U.S.C. Sections 470aa-47011; 43 CFR Part 3; National Historic Preservation Act (amended 1980) P.L. 95-515, 36 CFR 60	All project features
	Issue timber sales contracts	Act of July 31, 1947, 61 statute 681 as amended 30 U.S.C. Section 601-604, 43 CFR Group 5400	Removal of commercial timber on National Forest System Lands
DEPARTMENT OF THE ARMY			
U.S. Army Corps of Engineers	Issue (Section 404) individual permit(s) for placement of dredged or fill material in waters of the United States or their adjacent wetlands	Section 404 of Federal Water Pollution Control Act Amendment of 1972, 33 U.S.C. Section 1344; 33 CFR Parts 323, 325	River or stream crossing for access roads, water supply pipelines, product pipelines, etc.
	Issue (Section 10) permit(s) for structures or work in or affecting navigable waters of the United States	Section 10 of the Rivers and Harbor Act of 1899; 33 U.S.C. Section 403; 33 CFR Parts 320-322, 329	Water diversion facilities, dams, wells and construction resulting in alterations to water course
FEDERAL COMMUNICATIONS COMMISSION	License to operate industrial radio service	Section 303 of Communications Act of 1934, 47 U.S.C. Section 303; 47 CFR Parts 90, 94	Communications

TABLE 1-1 (continued)
KEY FEDERAL AUTHORIZING ACTIONS
(*denotes well field related authorization)

Agency	Nature of Action	Authority	Project Feature
FEDERAL ENERGY REGULATORY COMMISSION	Certificate of Public Convenience and Necessity	Section 7(c) of the Natural Gas Policy Act of 1978; 18 CFR Section 2.102; Section 110 of the Natural Gas Policy Act of 1978; FERC Order No. 94	Recovery of the costs for treatment plant
DEPARTMENT OF TRANSPORTATION			
Federal Highway Administration	Issue (permit(s) to cross Federal-aid highways	23 U.S.C. Sections 116, 123, 315; 23 CFR Part 645 Subpart B	Water pipelines, gas pipelines, access roads
Federal Aviation Administration	Issue air space permit for air-related air space determination and air space obstruction clearance for project facilities	Section 1101 of the Federal Aviation Act of 1958, 49 U.S.C. Section 1501; 14 CFR Part 77	Stacks at treatment plant and other facilities; well sites; microwave towers; and other facilities
Research and Special Programs Administration Office of Pipeline Safety Operations	Regulates safe construction and operation of gas pipelines	18 U.S.C. Section 834; 49 U.S.C. Section 1655; 49 CFR Part 195	Pipelines
DEPARTMENT OF LABOR			
Occupational Safety and Health Administration	*Inspect and approve surface construction for worker safety	Occupational Safety and Health Act of 1970, 29 U.S.C. Sections 651 et seq.; 29 CFR Part 2200	Construction at the well site, treatment plant, and ancillary facilities
ENVIRONMENTAL PROTECTION AGENCY	Issue Resource Conservation and Recovery Permit for treatment, storage, or disposal of hazardous waste	Section 3005 of Resource Conservation and Recovery Act of 1976, 42 U.S.C. Section 6925; 40 CFR Parts 122, 124, 260-267	Hazardous waste disposal
	Register generators of hazardous waste	Section 3002 of Resource Conservation and Recovery Act of 1976, 42 U.S.C. Section 6922, 40 CFR Parts 122, 262	Hazardous waste generation

TABLE 1-2
KEY STATE AUTHORIZING ACTIONS
(*denotes well field related authorization)

Agency	Nature of Action	Authority	Project Feature
WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY			
Solid Waste Management	*Permits for solid waste disposal	Wyoming Environmental Quality Act, Article 5, W.S. 35-502-42 through 35-502-44 (Cumulative Supplement 1973)	Disposal of solid wastes in a sanitary landfill
Air Quality Division	Issue air quality construction and operation permit	Wyoming Environmental Quality Act, W.S. 35-502-101 through 35-502-1207	Treatment plant emissions
	Issue prevention of significant deterioration permit for generating station stack emissions	Clean Air Act of 1977, as amended (43 U.S.C. 1701; 40 CFR 42.21)	Treatment plant emissions
Water Quality Division	Issue National Pollution Discharge Elimination System (NPDES) permit for plant site runoff	Wyoming Environmental Quality Act, W.S. 35-11-301	Treatment plants
	Issue NPDES permit for construction runoff at railroad spur	Wyoming Environmental Quality Act, W.S. 35-11-301	Railroad line and spur
	Approval of wastewater evaporation pond	Wyoming Environmental Quality Act, W.S. 35-11-301	Treatment plants
	Approval of plant site runoff retention pond	Wyoming Environmental Quality Act, W.S. 35-11-301	Treatment plants
	Approval of sewage treatment plant (ground water pollution control permit)	Wyoming Environmental Quality Act, W.S. 35-11-301	Treatment plants
	Approval of water supply for plant personnel	Wyoming Environmental Quality Act, W.S. 35-11-301 (a)(v) and 35-11-302	Treatment plants
	Approval of spill prevention control and countermeasure plan	Wyoming Environmental Quality Act, W.S. 35-11-301	Treatment plants
WYOMING STATE ENGINEER'S OFFICE	Approval for construction or enlargement of reservoir	Wyoming Industrial Development Information and Siting Act, W.S. 35-12-107	Treatment plants
	Approval of change of use and point of diversion - inundated rights	Wyoming Industrial Development Information and Siting Act, W.S. 35-12-107	Treatment plants

TABLE 1-2 (continued)
KEY STATE AUTHORIZING ACTIONS
(*denotes well field related authorization)

Agency	Nature of Action	Authority	Project Feature
	Review of water supply and water yield analysis	Wyoming Industrial Development Information and Siting Act, W.S. 35-12-107	Treatment plants
	Issue permits to appropriate ground water, statement of completion and description of well including produced water for beneficial use	"	Treatment plants
	Approval of water pipeline	"	Treatment plants
	Issue reservoir permit - raw water holding pond	"	Treatment plants
	Issue reservoir permit - wastewater evaporation pond	"	Treatment plants
	Issue reservoir permit - plant site runoff retention pond	"	Treatment plants
	Issue temporary water rights for construction permits to appropriate surface water	"	Treatment plants
WYOMING OIL AND GAS COMMISSION	*Authority to allow or prohibit flaring or venting of gas	Wyoming Oil and Gas Act, W.S. 30-5-102	Well Field
	*Approval of wastewater disposal	Wyoming Oil and Gas Act, W.S. 30-5-102	Well Field
	*Set gas oil ratio of wells	Wyoming Oil and Gas Act, W.S. 30-5-104	Well Field
	*Regulate drilling and plugging of wells	Wyoming Oil and Gas Act, W.S. 30-5-104	Well Field
	*Directional drilling	Wyoming Oil and Gas Act, W.S. 30-5-104	Well Field
	*Rules and regulations governing drilling units	Wyoming Oil and Gas Act, W.S. 30-5-109	Well Field
	*Agreements for enhanced recovery	Wyoming Oil and Gas Act, W.S. 30-5-110	Well Field
	*Permits to drill and blowout prevention	Wyoming Oil and Gas Act, W.S. 30-5-115	Well Field
	*Waste of natural gas	Wyoming Oil and Gas Act, W.S. 30-5-121	Well Field
	*Ratable take of oil	Wyoming Oil and Gas Act, W.S. 30-5-104	Well Field
	*Ratable take of gas	Wyoming Oil and Gas Act, W.S. 30-5-104	Well Field

TABLE 1-2 (continued)
KEY STATE AUTHORIZING ACTIONS
(*denotes well field related authorization)

Agency	Nature of Action	Authority	Project Feature
WYOMING STATE HIGHWAY DEPARTMENT	Permits for oversize and overweight loads	Chapters 17 and 20 of the Wyoming Department of Highways Rules and Regulations; Wyoming Statute (1977 as amended) Section 31-5-1001 through 31-5-1006	Construction material and equipment utilizing State highways
	Encroachment permits	Chapter 12 of the Wyoming Department of Highways Rules and Regulations	Pipelines, transmission lines, and access roads crossing State highways
WYOMING INDUSTRIAL SITING ADMINISTRATION	Issue Industrial Facility Siting permit	Wyoming Industrial Development and Siting Act W.S. 35-12-101 through 35-12-121; Wyoming 1975 Session Laws, Chapter 169, as amended 1977, and 1981.	Treatment plants and appurtenant components
	Issue a ten-year plan for industrial facility applicants	Wyoming Industrial Development and Siting Act W.S. 35-12-101 through 35-12-121; Wyoming 1975 Session Laws, Chapter 169, as amended 1977, and 1981.	Treatment plants and appurtenant components
	Information application	Wyoming Industrial Development and Siting Act W.S. 35-12-101 through 35-12-121; Wyoming 1975 Session Laws, Chapter 169, as amended 1977, and 1981.	Treatment plants and appurtenant components
	Issue certificate of insufficient jurisdiction	Wyoming Industrial Development and Siting Act W.S. 35-12-101 through 35-12-121; Wyoming 1975 Session Laws, Chapter 169, as amended 1977, and 1981.	Treatment plants and appurtenant components
WYOMING STATE LAND BOARD	Issue easements to cross state lands		Pipelines, transmission lines, access roads, etc.
WYOMING PUBLIC SERVICE COMMISSION	Certificate of Public Convenience and Necessity	Wyoming Statutes 1977 and Wyoming Administrative Procedure Act, W.S. 37-1-101, 37-1-102, 37-1-116, 37-2-117, 37-2-119, 37-2-120, 37-2-122, 37-2-205 through 207, 37-2-210 through 212, 37-3-114, 37-6-101 through 107	Railroad spur, transmission lines
WYOMING STATE HISTORIC PRESERVATION OFFICE	*Cultural clearance		All project features

TABLE 1-3
KEY COUNTY AND LOCAL AUTHORIZING ACTIONS
(*denotes well field related authorization)

Agency	Nature of Action	Authority	Project Feature
SUBLETTE COUNTY	*Zoning amendment	Sublette County Zoning and Development Regulations Resolution, December 13, 1978; as amended	Well Field
	*Zoning of Development Permits	Sublette County Zoning and Development Regulations Resolution, December 13, 1978; as amended	Well Field
	Access permits	Sublette County Road Standards; May 19, 1980	Crossing of county roads
LINCOLN COUNTY	*Issue industrial permit (oil and gas development permit)	State Development and Permit Resolution, July 8, 1981; Fees October 7, 1981	Treatment plants, wells, and loading facilities
	Issue Development Permit	State Development and Permit Resolution, July 8, 1981; Fees October 7, 1981	Man camps, pipeline, and railroad rights-of-way
	Agreement for county road use	State Development and Permit Resolution, July 8, 1981; Fees October 7, 1981	Use or cross county roads
SWEETWATER COUNTY	Approval of applications to county roads	County Commission by resolution	Railroad
	Zoning permits (construction or alteration permit, and conditional use permit)	W.S. 18-5-201 through 18-5-207; Wyoming Statutes Annotated 1977, republished edition	Railroad and any structure over 96 square feet
	Temporary work camp permit	County Commission by resolution	Man camps

Review and (2) submission of the subsurface and surface use operations plans. The operator submits a written request to the appropriate BLM or FS field office. The BLM or FS reviews the proposal to identify any major resource conflicts (i.e., cultural resources, threatened and endangered species, critical wildlife habitats, etc.) and notifies the operator of any major problems. If no problems exist, approval to stake is given within 15 days. If the operator does not receive notification within 15 days, he may then submit a complete APD with the subsurface and surface use plans to the appropriate BLM district office for review. If the APD is complete, a copy is forwarded to the appropriate BLM or FS field office to review the plan. The BLM schedules an on-site field inspection with the operator, BLM or FS, excavation contractor, and any other interested parties. The BLM then prepares the appropriate environmental documentation [Categorical Exclusion, Environmental Assessment (EA), or, in this case, an EIS] to assess the impacts of the proposal.

Following completion of the EIS, the majority of APDs will be processed via the categorical exclusions process as provided for by Department of the Interior regulations. The EIS will provide guidance for siting of well sites and access roads, and mitigation for various resource conflicts. Using the EIS mitigation, agency personnel at the on-site inspection can determine appropriate mitigation for each site. Only very difficult locations, such as possible sites on the proposed Darby Mountain Unit, may require preparation of an EA to develop the appropriate site-specific mitigation. The use of the categorical exclusion process would be maximized following EIS completion for all APDs within the project area. The BLM or FS field office would then develop site-specific mitigating measures and forward them with a letter of concurrence to the BLM district office prior to APD approval. When concurrence is received from the BLM or FS and all deficiencies have been corrected, the APD is approved and construction and drilling may begin.

Application for Rights-of-Way

The process for meeting requirements for federal rights-of-way is outlined below.

1. Following completion of the Final EIS and a decision by the agencies on the Proposed Action or preferred alternative, the companies would each revise their applications for rights-of-way grants.
2. A Construction and Use Plan (CU Plan) would be prepared by each of the companies. Approval of this plan is required prior to construction. The CU Plan would include the following sections:
   - Detailed construction schedule,
   - Access requirements (construction and use),
   - Engineering details (ground profiles, centerline, cross sections, staging areas, specific techniques and equipment),
   - Construction materials (amounts, sources, waste disposal),
   - Site preparation,
   - Erosion Control, Revegetation, and Restoration Guidelines (Appendix B)
   - Maintenance and Monitoring,
   - Fire protection,
   - Threatened and endangered plant and animal species studies and mitigation (including a wildlife mitigation plan developed jointly by the Wyoming Game and Fish Department, BLM, Fish and Wildlife Service, and the companies),
   - Cultural and paleontological resources,
   - Construction clearing,
   - Improvements,
   - Visual resources,
   - Water quality,
   - Transportation,
   - Communications,
   - Blasting,
   - Pesticide use, and
   - Health and Safety, waste disposal (all forms), emergency response, transportation, contingency plans (H_2S etc).
3. The BLM Rock Springs District and the FS Big Piney District would work closely with the companies in developing these plans. Part of BLM and FS participation may include:
   - A team of BLM and FS resource and realty specialists would be involved during the companies surveying the right-of-way for the centerline to help in avoiding sensitive environmental areas.
   - The companies would contract for site-specific resource surveys. BLM and FS would assist the companies in deciding which surveys should be completed. At a minimum, a Class III survey would be performed for cultural resources and, as determined necessary by the Fish and Wildlife Service, a survey would be performed for threatened or endangered species. Surveys may also be required for any wildlife clearances (e.g., for sage grouse leks and nesting concentrations associated with pipeline rights-of-way and other species which may be considered sensitive).
4. Following completion of the CU Plans, the BLM and FS would review each plan and the BLM would provide comments to each company which would include:
   - Ways to improve the plan,
   - Any additional requirements (other environmental surveys) needed prior to construction and operation,
   - A detailed list of site-specific mitigation measures (stipulations) to which the company must adhere during construction, operation, and maintenance. These stipulations may include site-specific reclamation and revegetation procedures, seasonal restrictions on

construction activities, and other measures both included in the EIS and determined as a result of review of the plan and further environmental analysis. Measures from the EIS include the Committed Mitigation from Chapter 4, and the Required Federal Measures in Appendix B.

- A list of temporary use permits which must be applied for by the company (either separately or in conjunction with their application for a right-of-way grant).

5. The BLM and FS would also determine (from the CU Plan) whether this EIS covers all potential site-specific impacts of the project. If impacts from specific activities (such as borrow pit locations, construction staging areas and access needs, or temporary use permits) are not covered in enough detail in the EIS, the BLM and FS would prepare minor site-specific environmental analyses to assess these impacts.
6. A right-of-way grant or APD would be issued to the companies containing site-specific mitigation measures (determined during preparation and review of the CU Plan and from the EIS or minor EAs).
7. The companies would review the right-of-way grant or APD with the attached general, legal, and site-specific mitigation measures for agreement with the terms.
8. A pre-construction conference would be held between the companies and the agencies prior to any ground disturbance to insure requirements are understood and being met and all required surveys are complete. The right-of-way grant would contain provisions to allow the agencies to stop any work if requirements are not being met.

Application to the Wyoming Office Of Industrial Siting

Under the Wyoming Industrial Development and Siting Act (W.S. 35-12-101 through 35-12-121) application must be made to the Office of Industrial Siting Administration (ISA) for permission to construct and operate any plant designed to process H_2S gas that has an estimated construction cost in excess of approximately $88 million. Under proposed revisions to this act, one or more sites can be permitted on a regional or resource basis and the applicant can be a single company or a group of companies. These revisions are intended to expedite permitting of oil and gas facilities and to encourage an early partnership between companies and local government in developing a socioeconomic mitigation program which accounts for all activities necessary to develop the identified reserve. Therefore, in addition to the EIS, the applicants for this project must either individually or collectively submit an application to the ISA that identifies anticipated social, economic, and environmental impacts and plans and programs for alleviating these impacts. In the area of socioeconomics, the regulations stress that the application contain a mitigation plan committed to by the applicants that was developed jointly by the applicants and local government. The mitigation plan must be in sufficient detail that it sets forth a time schedule for implementation that is tied to construction milestones. Funding for the mitigation program is not the sole responsibility of the applicants but rather can come from a variety of sources including federal and state governments, city and county governments, as well as fees to residents and businesses expected to benefit from the proposed project. Responsibility for implementation of the plan lies with the applicants.

Prevention of Significant Deterioration (PSD) Permit

Each sour gas treatment plant would also require a PSD permit from the Wyoming Department of Environmental Quality (DEQ) prior to on-site groundbreaking. The information, data, and analysis that must be supplied by each applicant to satisfy the DEQ completeness requirements are as follows:

- A detailed project description including plot plans, description of the unit operations, and block flow diagrams of the operations. The project description should be based on the latest engineering design parameters and should indicate which aspects are subject to change and why.
- An air pollution control technology review which demonstrates that the control measures proposed represent Best Available Control Technology considering the capability of the technology, environmental impact, energy consumption, and capital and operating costs.
- An air quality review of the impacts of the project emissions (similar to that performed for this EIS but utilizing on-site meteorological data) which includes a description of existing air, quality, a characterization of the climatology and dispersion meteorology, a dispersion modeling assessment of the project emissions, and a comparison of pollutant concentrations to applicable PSD increments and ambient air quality standards. The air quality assessment also includes secondary impacts due to population growth, and impacts to local vegetation and visibility.
- A review of the impacts to Air Quality Related Values (AQRVs) in PSD Class I areas. The AQRV's can vary from area to area but typically include visibility, soils, water quality, odor, flora and fauna. The FS is particularly interested in acid deposition impacts on sensitive watersheds in the Bridger and Fitzpatrick Wildernesses.

HISTORY AND BACKGROUND

Since initial development began in the late 1940s, an estimated 25 million barrels of oil and 632 billion cubic feet of sweet gas have been produced in the Riley Ridge well field (Wyoming Oil and Gas Conservation Commission 1982). Exploration for deep, low-BTU gas in the well field has been ongoing since 1979; previous oil and gas development was relatively shallow, down to about 8,000 feet. In 1981, approximately 683,000 barrels of oil and 19 billion cubic feet of sweet gas were produced from the units which make up the well field.

Quasar, Williams, Exxon, and Northwest/Mobil have each submitted right-of-way applications for use of public lands to develop, produce, treat, and transport natural gas from this well field. On September 21, 1981, the BLM received an application from Northwest for the occupancy and use of public lands for the Riley Ridge Project; this application was revised on March 31, 1982. On or about March 25, 1982, applications were also received from Exxon and Quasar. Williams submitted a right-of-way application on April 2, 1982. Development of the well field is proposed to begin following issuance of the necessary permits in mid-1984.

On March 12, 1981, the Minerals Management Service (MMS), formerly part of the U.S. Geological Survey but now under BLM, identified the need to prepare an EIS on development of the well field. In September 1981, the BLM, MMS, and FS signed a Memorandum of Understanding to prepare an EIS for the Riley Ridge Project. BLM published a Notice of Intent to prepare an EIS in the Federal Register on October 8, 1981. During the EIS scoping process, issues associated with both the exploration and development of the well field and construction and operation of four natural gas treatment plants and associated linear facilities were determined to be significant by the public, and local, state, and federal agencies.

LEASES, UNITS, AND CONSTRAINTS

The well field for the Riley Ridge Project and its component units are shown on Map 1-2 (see map pocket), and associated acreages are displayed in Table 1-4. A unit is defined by BLM as a combination of leases designed to provide unified development and operation of an entire geologic prospect in the most efficient and economical manner under the administration of one operator. Nearly all of the land within the well field has been leased or is under application for lease for oil and gas development. The lessees have the right to develop these resources subject to various lease stipulations. Leases which restrict development to various degrees are specifically identified in Appendix B. In general, these and other stipulations applied to these leases are designed to protect surface resources such as soils, water, and wildlife by restricting periods of activity and location of disturbance.

The unitization agreement for Quasar's Riley Ridge Unit was approved February 27, 1982. The remaining acreage in Quasar's proposed action consists of the proposed North Riley Ridge and Darby Mountain Units, which are proposed units and have not been approved. Unit boundaries for the proposed North Riley Ridge and Darby Mountain Units are provided only as a target area for the EIS purposes.

Mountain Fuel Supply Company received formal approval of the Dry Piney Unit in July 1957; however, Exxon is the current operator. Since then, 27 wells have been drilled into 3 separate formations. Thirteen of these wells currently produce sweet gas, six produce oil, and eight are either shut-in or abandoned. The leases in the Dry Piney Annex have not been formally unitized but are being considered as part of the Dry Piney Unit for analysis in this EIS. Exxon would be the operator of the one sour gas well in the Annex. Formal approval of the Fogarty Creek Unit was received on May 28, 1975. Exxon is the current operator of this unit and owns a 62 percent working interest. This unit contains 11 sweet gas wells drilled to a depth of approximately 8,000 feet. Exxon received approval from BLM on January 10, 1983, to drill a sour gas well in Fogarty Creek Unit. The purpose of this well will be to delineate the geologic strata in this unit and test productivity of the formation.

The Graphite Unit was unitized on July 25, 1980. Exxon was named the operator with an 80 percent working interest. No sweet gas or oil wells have been drilled in this unit. The Lake Ridge Unit was formally approved on October 21, 1980, and Exxon was named the operator with a 57 percent working interest. No sweet gas or oil wells have been drilled in this unit.

Mobil's unitization agreement for the Tip Top Unit was approved November 1, 1947. The unit currently has 10 oil wells and 73 sweet gas wells; this includes some shut-in wells. The unitization agreement for the Hogsback Unit was approved November 1, 1954. The unit currently has 9 oil wells and 61 sweet gas wells; this includes some shut-in wells.

On August 28, 1982, the Sawmill Unit operated by Williams was terminated. However, all 17,226 acres of the former unit, now being called the Sawmill Area, are being included in the EIS. Williams will still represent the lease holders in this area. No sweet gas or oil wells have been drilled in the Sawmill Area.

EXPLORATION DONE TO DATE

To date, Quasar has drilled five sour gas wells into the Madison Formation. Four of these wells are within the Riley Ridge Unit, and one is within the proposed North Riley Ridge Unit.

Exxon has drilled three deep wells into the sour gas-producing Madison Formation. These wells are located in the Fogarty Creek, Graphite, and Lake Ridge Units and were drilled between October 1980 and August 1982. As exploratory wells, they were designed to test the production potential of the sour gas reservoir. The wells have tested at a production

TABLE 1-4
WELL FIELD ACREAGE AND PROPOSED NUMBER OF WELLS BY UNIT

	Acres	Wells
Quasar		
Riley Ridge Unit	16,018	26
North Riley Ridge Unit (Proposed)	18,880	18
Darby Mountain Unit (Proposed)	16,960	26
Exxon		
Lake Ridge Unit	20,990	34
Fogarty Creek Unit	15,861	26
Graphite Unit	3,640	4
Dry Piney Unit (includes Dry Piney Annex)	7,281	11
Mobil		
Tip Top Unit	31,840	51
Hogsback Unit	11,232	16
Williams		
Sawmill Area	17,226	24[1] 2[2]
TOTAL	159,928	238

[1] Wells to be drilled by Williams.

[2] Wells to be drilled by Quasar.

rate ranging between 4 and 10 million cfd with a methane content ranging between 20 and 29 percent. No sour gas wells have been drilled in the Dry Piney Unit.

As of August 1982 Mobil had drilled five wells into the Madison Formation in the Tip Top Unit. One well was plugged back and completed in a shallower zone, two wells have been perforated and tested, and two wells have not yet been tested. No sour gas wells have been drilled in the Hogsback Unit.

Williams has not yet drilled any sour gas wells in the Sawmill Area.

GEOLOGIC RESERVE EVALUATION

The following section outlines for the reader the characteristics of the Riley Ridge natural gas reserve. These characteristics, such as depth and gas composition, are important in understanding the methods proposed by the applicants for developing this resource.

The Riley Ridge area is situated on the east flank of a geological structure known as the Moxa Arch anticline, just to the east of the Overthrust Belt, which extends more than 160 miles to the south. Field development along the Moxa Arch makes it one of the largest oil and gas producing structures in southwestern Wyoming. The hydrocarbon reserves in shallower formations of the Moxa Arch have been extensively drilled and produced to the south of the Riley Ridge area.

From the crest of the Moxa Arch (Map 1-1), the anticline dips eastward on basement rock surface. Near the Tip Top Unit (Map 1-2), the basement rises to 9,600 feet below the surface. During Precambrian time, erosion of the surface of the basement rock on which sediments were deposited occurred prior to uplift of the western margin of the region. The subsequent uplift formed a trough in which thousands of feet of sediments were deposited. Faulting of the earliest formations and basement rocks occurred with the increase of overburden. Later in geologic time faulting brought source rocks (organic-rich rocks where the hydrocarbons are produced) into contact with reservoir rocks (permeable formations like the Madison where the hydrocarbons can migrate laterally). High energy environments of deposition during structural development improved reservoir quality and enhanced potential for commercial reserves of hydrocarbons and CO_2 gas.

The Riley Ridge Project area is conservatively estimated to contain 17.5 trillion cubic feet of recoverable natural gas, of which 3.5 trillion cubic feet would be methane (MMS 1982). The sour, low-Btu gas would be produced from the Madison Formation at depths exceeding 14,000 feet. The gas has the following approximate composition based on analyses presently available:

Component	Percent
CO_2	67
CH_4	20
N_2 plus inerts	8
H_2S	4
He	1

The following figures illustrate the estimated in-place and recoverable reserves credited to each of the federal units within the Riley Ridge Project area, plus limited adjacent non-unitized lands.

Unit	Billion Cubic Feet[1]	Billion Cubic Feet[2]
Dry Piney (includes Dry Piney Annex)	1,140	912
Fogarty Creek	2,480	1,984
Graphite	570	456
Hogsback	1,755	1,404
Lake Ridge	3,280	2,624
Riley Ridge	2,500	2,000
Tip Top	4,975	3,980
Adjacent non-unitized lands (Proposed North Riley Ridge and Darby Mountain Units and Sawmill Area)	8,290	6,632
	24,990	19,992

Source: MMS 1982

[1] These calculations assume the overall project area would average 100 billion cubic feet of gas per section (640 acres).

[2] 80 percent recovery factor.

Based on the above figure of 19,992 billion cubic feet of recoverable gas and the analysis previously cited, the following amounts of components would be recoverable:

Component	Billion Cubic Feet
CO_2	13,395
CH_4	3,998
N_2 plus inerts	1,600
H_2S	800
He	200

OVERVIEW OF PROPOSED ACTION AND ALTERNATIVES

The Riley Ridge Project would consist of the construction, operation, and abandonment of the following components:

- well field;
- gathering pipelines for the transportation of sour gas within the well field;
- trunk lines for the shipment of sour gas from the terminus of the well field gathering systems to the proposed treatment plants;
- treatment plants;
- sales gas pipelines for shipment of sweet gas to existing main pipelines;
- facilities for the handling and transportation to proposed markets of by-products (sulfur and CO_2) removed during the treatment process, if markets are developed during the life of the project; venting of CO_2 would occur until markets are found; and
- ancillary facilities.

Table 1-5 summarizes the Riley Ridge Project and identifies the associated participating companies. Table 1-6 shows the acreages associated with well pad disturbance and right-of-way width requirements. A schedule extending over the expected 40-year life of the project is shown on Figure 1-2.

In addition to the Proposed Action, three project siting alternatives were analyzed for the Riley Ridge Project. The Buckhorn, Shute Creek, and Northern Alternatives differ from the Proposed Action primarily in the location of certain plant sites and associated corridors. These alternatives change some aspects of the Proposed Action while keeping other aspects unchanged. Component alternatives are options dealing with small changes in the Proposed Action or siting alternatives (e.g., location of a transmission line) designed to respond to specific concerns.

The locations of the corridors and major project components discussed in the description of the Proposed Action are shown on Map 1-3 (see map pocket). Maps 1-5 through 1-7 in the map pocket illustrate the location of project components for the Buckhorn, Shute Creek, and Northern Alternatives. The component alternatives are shown on Map 1-4. Data summary tables are included at the end of this chapter.

PROPOSED ACTION

CONSTRUCTION, OPERATION, AND ABANDONMENT

The land requirements (by federal, state, and private ownership) for the major components of the Riley Ridge Project for each applicant are shown in Table 1-7 (see Maps 1-2 and 1-3). The number of acres disturbed by component during the construction, operation, and abandonment phases of the Proposed Action are summarized in Table 1-8.

Construction

General construction procedures which would apply to all participating companies are described in the following section. A more detailed discussion which shows differences in company methods is contained in the Proposed Action Technical Report. The required federal measures in Appendix B provide conditions for granting the various rights-of-way and permits for which the authorizing agency(s) will require that certain terms and conditions be met. A listing of the applicants' standard construction and operation procedures is also presented in Appendix B. Specific reclamation measures are described in Appendix B in the Erosion Control, Revegetation, and Reclamation Guidelines.

TABLE 1-5
RILEY RIDGE PROJECT COMPONENTS

	Participants					
	American Quasar	Williams Exploration	Exxon Corporation	Mobil Oil	Northwest Pipeline	Totals
Well Field						
Units	Riley Ridge, Proposed North Riley Ridge, & Proposed Darby Mountain (supplying Quasar plant)	Sawmill Area (supplying Quasar plant)	Lake Ridge, Fogarty Creek, Graphite, Dry Piney, & Dry Piney Annex (supplying Exxon plants)	Tip Top & Hogsback (supplying Northwest plant)	0	11
Total Proposed Wells	72	24	75	67	0	238
Permitted Drilling, or Completed Wells	5	0	3	5	0	13
Well Field Facilities	-Gathering pipelines -Wellhead facilities including drilling sump pit, -Access roads -Communications & transmission lines	-Gathering pipelines -Wellhead facilities including drilling sump pit, dehydration facilities -Access roads -Communications & transmission lines	-Gathering pipelines -Wellhead facilities including drilling sump pit, dehydration facilities -Access roads -Communications & transmission lines	-Wellhead facilities including drilling sump pit, -Access roads -Communications & transmission lines	-Gathering pipelines Dehydration facilities -Transmission lines	
Plants						
Proposed Site	East Dry Basin	Will use Quasar's	West Dry Basin & Big Mesa	Will use Northwest's	Craven Creek	4
Alternative Sites	Buckhorn	None	West Dry Basin & East Dry Basin; Shute Creek	None	East Dry Basin	
Capacity	1.2 billion cfd	None	1.2 billion cfd (two plants)	None	400 million cfd	2.8 billion cfd
Product (methane)	240 million cfd	None	252 million cfd	None	84 million cfd	576 million cfc
By-Products	1,960 TPD[1] sulfur 600-700 million cfd CO_2 He	None	2,240 TPD[1] sulfur 660 million cfd CO_2 N_2 He	None	757 TPD[1] sulfur 260 million cfd CO_2 N_2 He	4,957 TPD[1] sulfur 1,520-1,620 million cfd CO_2
Plant Facilities	-Above-ground heated sulfur pipeline to Opal[2] -Sour gas line to plant -Access roads, transmission lines, communication lines, water wells -Plant -Sales gas line to Trailblazer Pipeline -CO_2 pipeline		-Above-ground heated sulfur pipeline to Opal -Sour gas line to plant -Access roads, transmission lines, communication lines, water wells -Plant -Sales gas line to Trailblazer Pipeline -CO_2 pipeline	None	-Railroad for sulfur transport to Opal -Sour gas line to plant -Access roads, transmission lines, communication lines, water wells -Plant -Sales gas line to Trailblazer Pipeline -CO_2 pipeline	None

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[1] Tons per day

[2] Proposed common pipeline with Exxon

TABLE 1-6
SITE SIZES AND RIGHT-OF-WAY WIDTHS USED FOR DISTURBANCE CALCULATIONS[1]

	Quasar	Williams	Exxon	Northwest	Mobil
			In Acres		
Well Sites	3.7	3.7	6.7	NA	3.7
Plant Sites	640	NA	1,280	640	NA
			In Feet		
Gathering System	50	50	100	50	NA
Plant Access Roads	30	NA	50	50	NA
Well Field Access Roads	30	35	50	NA	50
Sour Gas Trunk Lines	75	75	100	75	NA
Transmission Line[2]	100	NA	100	100	NA
Sales Gas Pipeline	50	NA	100	50	NA
CO_2 Pipeline	50	NA	100	75	NA
Sulfur Pipeline	with Exxon	NA	75	NA	NA
Railroad Spur[2]	NA	NA	100	100	NA
Raw Water Pipeline	NA	NA	NA	60	NA

Source: Companies' Right-of-Way Applications.

NA = Not Applicable

[1] The size of permanent legal right-of-way would vary according to component and agency stipulations. For disturbance calculations, these widths are average, assuming some narrow and wider areas of disturbance depending upon topography.

[2] ERT assumption.

Well Sites

Gas well drilling would begin by staking the location of the drill pad selected for the drilling rig. Wells would be constructed outside of riparian areas to avoid interruption of operation or damage resulting from potential seasonal high water fluctuations. Table 1-6 indicates well pad disturbance acres for each applicant. Preparation would generally involve the following earthwork: an access road would be constructed (according to agency specifications, see Appendix B) so that equipment could be brought to the site, the land would be leveled, and a reserve pit would be excavated. Figure 1-3 is representative of a drill rig layout, and Figure 1-4 is a photograph of a drill rig in a flat area of the Riley Ridge well field. Mud tanks and unlined reserve pits would contain all fluids used during the drilling operation. The drilling mud, composed basically of water and bentonitic clay, would be mixed in steel mud tanks at the well site.

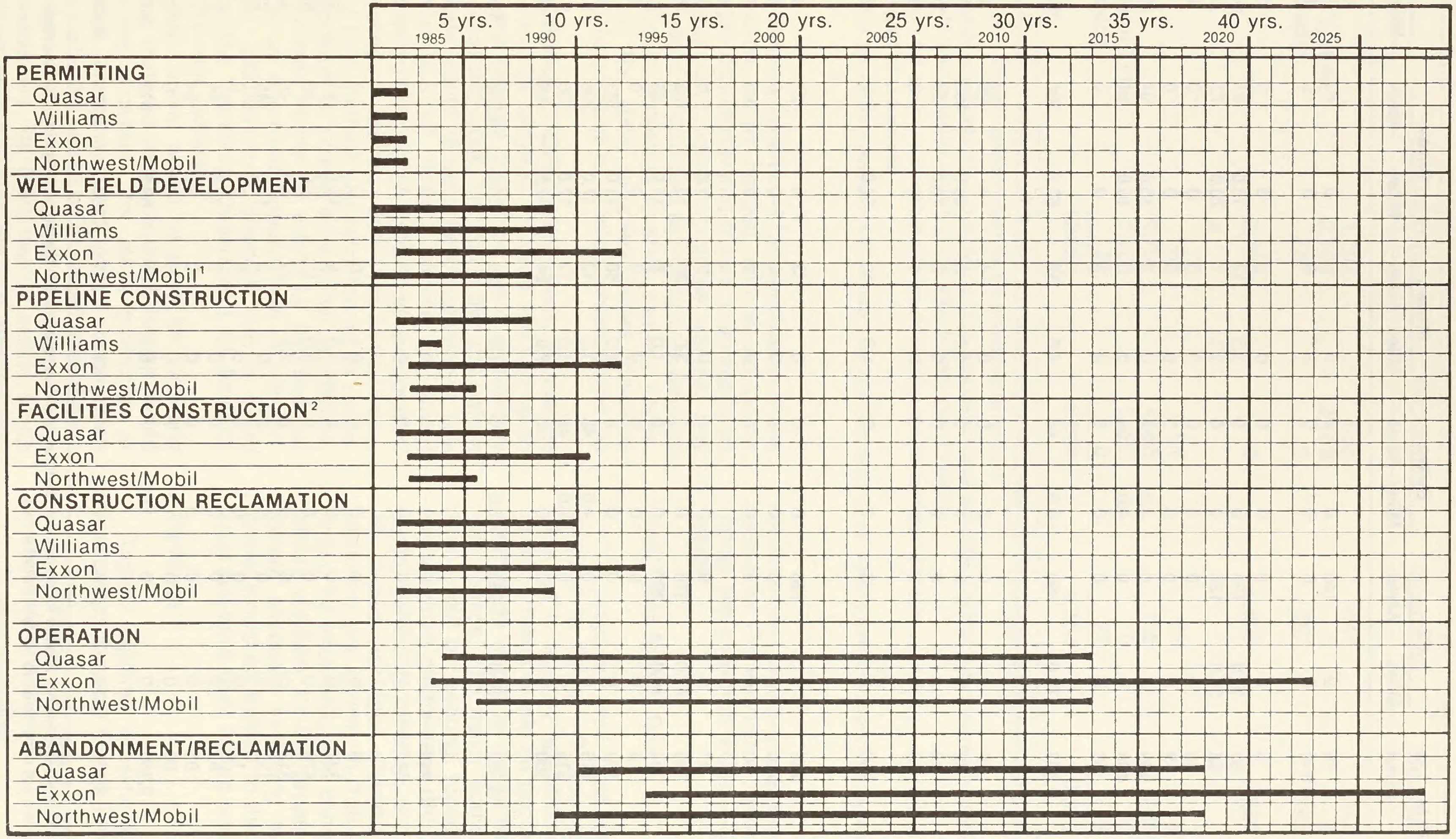
Following well site preparation, a drilling rig would be moved on location and drilling would commence. Upon completion of the drilling operation, an inhibitor fluid would be placed in the well bore to prevent corrosion of the casing. The remaining drilling mud removed from the well would be discarded into the reserve pit. The well would be acidized with hydrochloric acid (approximately 10,000 gallons of 15 percent hydrochloric acid per well) to provide efficient communication of gas from the producing formation to the well bore. Upon well completion, the rig would be removed and the drill site cleared and reclaimed except for the area needed for gas production. The well would then be connected to the gathering system and placed on line. The time required for the entire well installation would be about 240 days (including 60 days for completion).

Safety. Drilling and completion operations would involve potentially hazardous equipment and processes. By following safety procedures and using equipment designed specifically for drilling operations, it should be possible to avoid most hazardous situations. Drillers, equipment operators, and other contractors, as well as company personnel, would be familiar with all safety procedures and equipment. Each applicant would prepare an H_2S contingency plan which must be approved by the BLM and adhered to during the well drilling.

The primary hazard to human life would be the danger of toxic gas (H_2S) releases from the well during drilling. Precautions by the drilling crew would be necessary to avoid potential risks both from slow gas seepage from the well and from well blowouts. Blowout preventers would be installed on all wells prior to drilling out the surface casing and would be inspected at least daily and pressure tested monthly.

Other safety problems on the site could result from open excavations and fire. Fire hazards would be reduced by following precautionary procedures and by installing the necessary equipment on site. Fire hand tools would be made available to site personnel. Traffic hazards resulting from travel to and from the site would be reduced through precautionary measures.

Waste Disposal. Solid wastes generated during drilling operations and testing would be incinerated as approved by the regulatory agencies or trucked to



[1] Mobil's drilling program would extend to 2009; however, in 1989 the completed 20 wells would be supplying the plant with a maximum 400 million cfd.

[2] Including plants, roads, transmission lines, and railroads.

FIGURE 1-2. RILEY RIDGE PROJECT SCHEDULE

TABLE 1-7
LAND REQUIREMENTS FOR THE PROPOSED ACTION[1]

	BLM		FS		BuRec		State		Private		Total	
	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres
Quasar												
Well Sites	0	75	0	148	0	0	0	0	0	40	0	263
Plant Site	0	640	0	0	0	0	0	0	0	0	0	640
Plant Access Roads	2.5	9	0	0	0	0	0	0	0	0	2.5	9
Gathering System	14.0	85	32.0	194	0	0	2.0	12	15.0	91	63.0	382
Well Access Roads	18.5	68	38.0	138	0	0	2.0	7	20.0	73	78.5	286
Trunk Line	6.5	60	0	0	0	0	0	0	0	0	6.5	60
Transmission Lines	1.0	12	0	0	0	0	0	0	0	0	1.0	12
Sales Pipeline	67.5	409	0	0	4.0	24	0	0	15.0	91	86.5	524
CO$_2$ Pipeline	67.5	409	0	0	4.0	24	0	0	15.0	91	86.5	524
Sulfur Pipeline	4.0	36	0	0	0	0	0	0	0	0	4.0	36
Subtotal	181.5	1,803	70.0	480	8.0	48	4.0	19	65.0	386	382.5	2,736
Williams												
Well Sites	0	59	0	0	0	0	0	4	0	26	0	89
Gathering System	7.0	42	0	0	0	0	1.0	6	25.0	152	33	200
Well Access Roads	21.0	89	0	0	0	0	0	0	8.0	34	29	123
Trunk Line	6.5	60	0	0	0	0	0	0	0	0	6.5	60
Subtotal	34.5	250	0	0	0	0	1.0	10	33.0	212	68.5	472
Exxon												
Well Sites	0	234	0	228	0	0	0	13	0	27	0	502
Plant Site	0	1,280	0	0	0	0	0	0	0	0	0	1,280
Sulfur Loadout	0	80	0	0	0	0	0	0	0	160	0	240
Plant Access Roads	4.5	27	0	0	0	0	0	0	1.0	6	5.5	33
Gathering System	28.0	339	47.0	570	0	0	3.0	36	13.0	158	91.0	1,103
Well Access Roads	37.0	224	49.0	297	0	0	1.0	6	14.0	85	101.0	612
Trunk Line	0.5	6	0	0	0	0	0	0	0	0	0.5	6
Transmission Lines	58.5	709	0	0	0	0	4.0	48	11.0	133	73.5	890
Sales Pipeline	75.5	915	0	0	4.0	48	1.0	12	17.0	206	97.5	1,181
CO$_2$ Pipeline	75.5	915	0	0	4.0	48	1.0	12	17.0	206	97.5	1,181
Sulfur Pipeline	39.5	360	0	0	0	0	7.0	64	7.5	68	54.0	492
Subtotal	319.0	5,089	96.0	1,095	8.0	96	17.0	191	80.5	1,049	520.5	7,520
Mobil/Northwest												
Well Sites	0	248	0	0	0	0	0	0	0	0	0	248
Plant Site	0	640	0	0	0	0	0	0	0	0	0	640
Plant Access Roads	1.0	6	0	0	0	0	0	0	0	0	1.0	6
Gathering System	54.0	327	0	0	0	0	1.0	6	15.0	91	70.0	424
Well Access Roads	79.0	479	0	0	0	0	2.0	12	8.0	48	89.0	539
Trunk Line	35.0	318	0	0	0	0	2.5	23	4.5	40	42.0	381
Transmission Lines	11.0	133	0	0	0	0	0	0	12.0	145	23.0	278
Sales Pipeline	2.0	12	0	0	0	0	0	0	0	0	2.0	12
CO$_2$ Pipeline	9.0	82	0	0	0	0	0	0	18.0	164	27.0	246
Railroad Spur	5.0	61	0	0	0	0	0	0	2.0	24	7.0	85
Water Pipeline	11.0	80	0	0	1.0	7	0	0	0	0	12.0	87
Subtotal	207.0	2,386	0	0	1.0	7	5.5	41	59.5	512	273.0	2,946
Total	742.0	9,528	166.0	1,575	17.0	151	27.5	261	238.0	2,159	1,190.5	13,674

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[1] Land required for facility construction. Disturbed areas not needed for permanent facilities would be reclaimed following construction. Existing roads which would be upgraded for well field or plant access are not considered to be new disturbances.

TABLE 1-8
NUMBER OF ACRES DISTURBED BY COMPONENT FOR THE PROPOSED ACTION

	Construction	Reclaimed	Operation	Reclaimed	Abandonment[1]
Well Field					
Well Sites	1,102	658	444	444	0
Gathering System	2,109	2,109	0	0	0
Access Roads[2]	757	0	757	151	606
Plant Sites	2,800	0	2,800	2,800	0
Corridors					
Railroad[3]	85	64	21	8	13
Pipelines[4]	4,790	4,685	105	105	0
Transmission Line	1,182	1,182	0	0	0
Access Roads	27	0	27	5	22
Total	12,852	8,698	4,154	3,513	641

[1] Represents the number of acres of disturbance that would not be reclaimed after the project is abandoned. Included here are facilities that would continue in use after project abandonment, or are infeasible to reclaim.

[2] Many existing roads would only require upgrading; thus, new disturbance would be less than total land requirement. It is assumed that 80 percent of the project road system would remain in use after project abandonment.

[3] It is assumed that the operational right-of-way would be 25 feet wide and that a 15-foot wide portion of the right-of-way would be infeasible to reclaim upon project abandonment.

[4] It is assumed that the sulfur pipeline would require a 15-foot wide strip for an access trail during project operation.

an approved sanitary landfill. At the conclusion of the drilling operation, or as needed, ash would be removed from the incinerator and placed in an approved sanitary landfill with non-combustible wastes. Any scrap metal would be sold to a recycling firm. Sewage would be handled according to state sanitary codes. Table 1-20 in the data summary tables indicates the approximate amount of wastes which would be generated.

At the conclusion of drilling operations, all sewage and waste would be removed from the site and taken to an approved sewage treatment plant or sanitary landfill. No materials would be left on the site unless those materials would be used for completion or production activities. The fenced reserve pit would remain uncovered until the water had evaporated, leaving only solids in the base of the pit. At that point, the pit would be backfilled and recontoured as necessary. If evaporation is slowed by weather conditions, the liquid contents of the pit would be pumped out and hauled to an approved disposal site. A new, privately owned, 290,000-barrel disposal site is being permitted by the Wyoming Department of Environmental Quality near LaBarge.

Gravel/Riprap. Gravel would be used for road and site surfacing material when required. Riprap would be used, where necessary, for slope protection at culverts, creek crossings, and other construction sites. These materials would be obtained from the access road right-of-way, from local commercial suppliers or landowners, or from nearby public lands where permitted by the federal surface management agency or the landowner. Suitable materials found in construction excavations would be used whenever possible. The estimated requirements for gravel and riprap are shown in Table 1-22 in the data summary tables.

Well Field Access Roads

The proposed well field roadway system is summarized in Table 1-9. Access roads would be constructed to agency specifications to each well site; existing roads would be upgraded wherever possible. New roads would be designed for minimal additional disturbance. The major activities for road construction would be clearing, topsoil stripping, excavation, construction of drainage ditches and drainage structures, surfacing, cleanup, and restoration of cut and fill slopes. Acreages disturbed by access road construction are shown in Table 1-7. The right-of-way would be excavated and compacted until a suitable, stable roadway of the proper width is constructed. Where adequate surfacing material is not present, gravel would be applied to the roadway to prevent the road sub-base from failing under heavy loads.

Pipelines

Typical pipeline construction activities are schematically shown on Figure 1-5 and would include:

- right-of-way clearing and grading,
- trenching,
- pipe stringing,
- pipe bending,

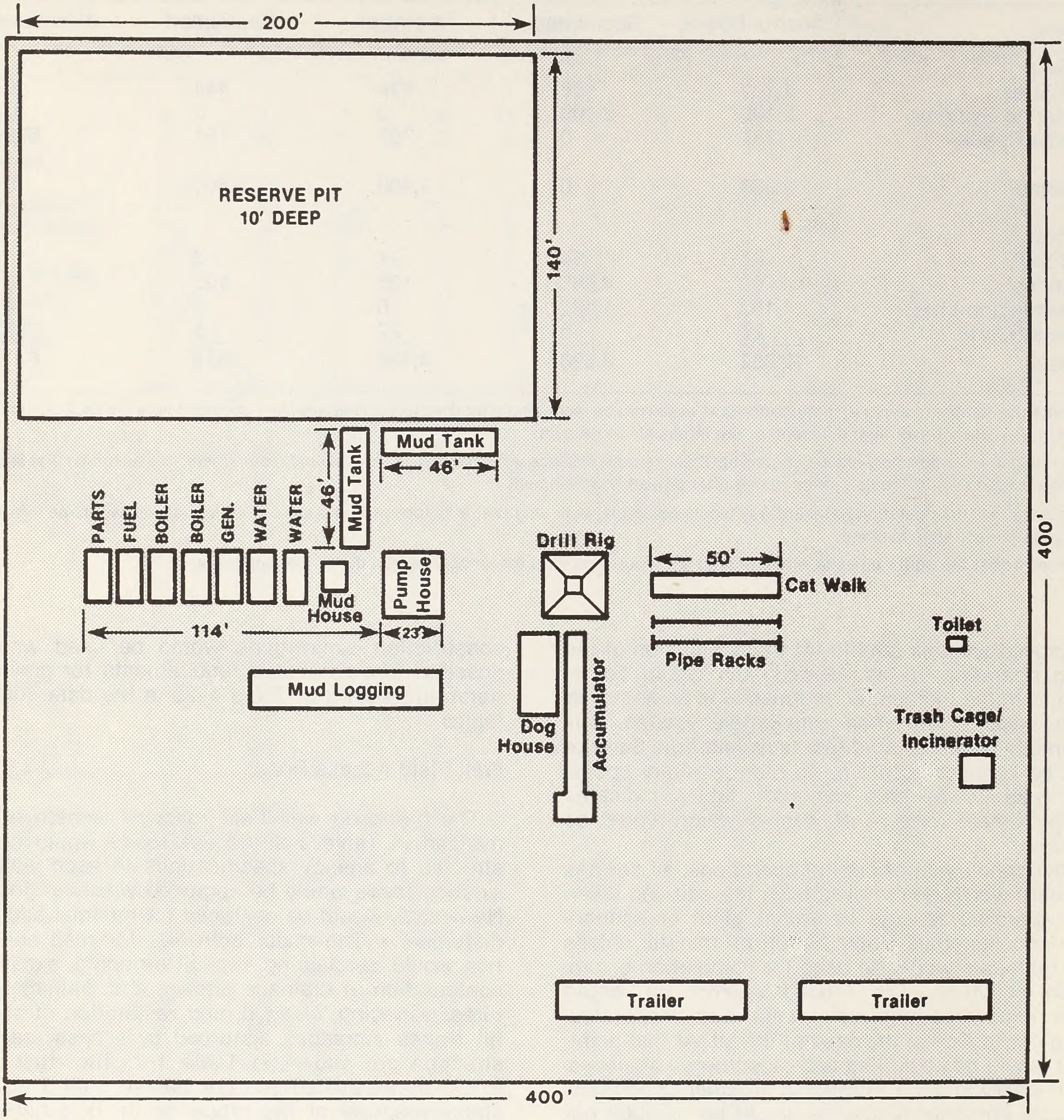

FIGURE 1-3 SCHEMATIC OF WELL SITE DURING DRILLING ACTIVITIES

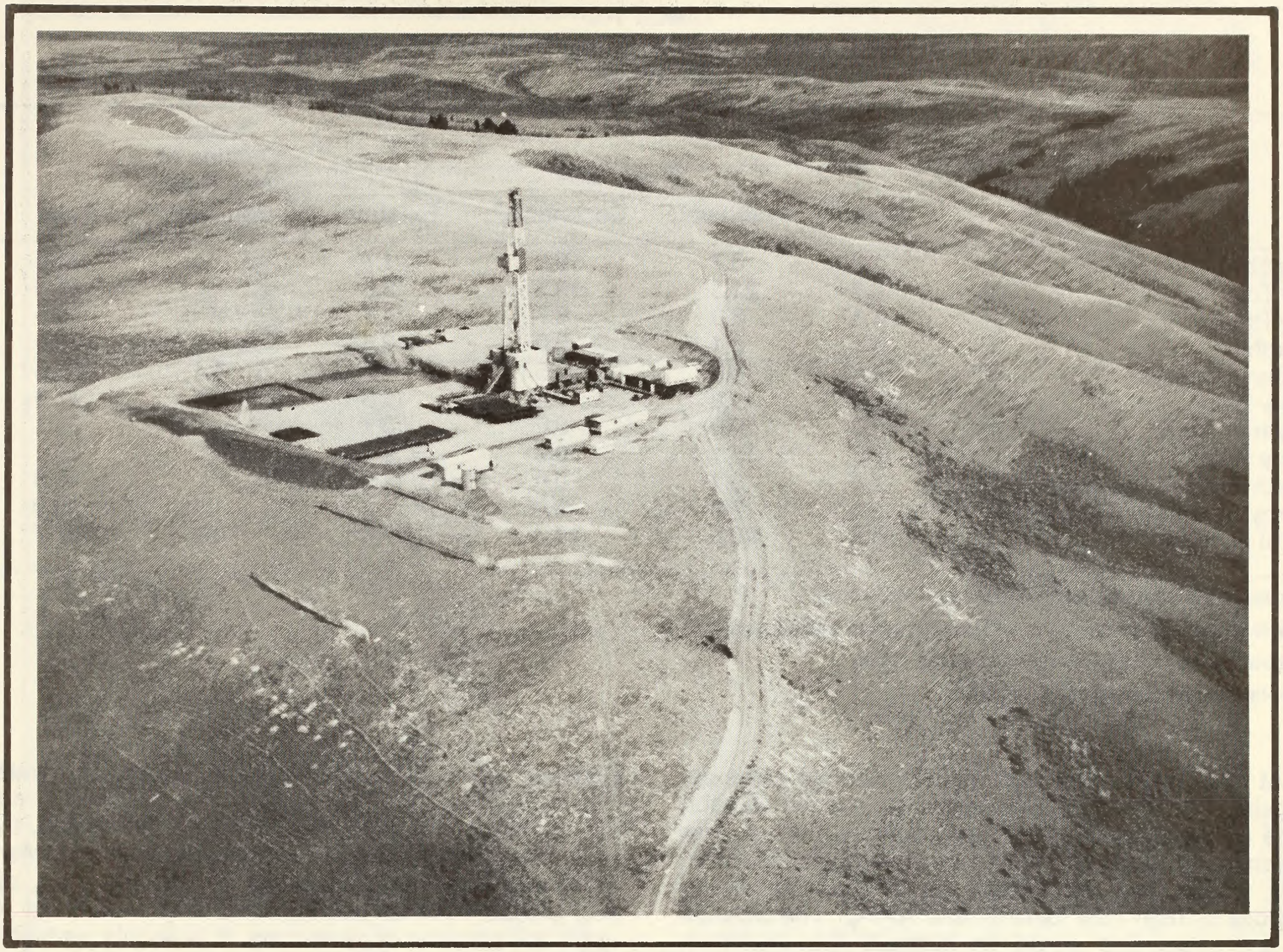

FIGURE 1-4 PHOTOGRAPH OF DRILL SITE IN THE RILEY RIDGE WELL FIELD

- pipe welding,
- pipe coating,
- lowering in of pipeline sections,
- backfilling of the trench,
- hydrostatic testing, and
- right-of-way clean-up and restoration.

Pipe sizes used in the gathering systems would range from 4 to 26 inches in diameter; trunk lines could range from 28 to 36 inches in diameter.

Construction activities would be confined to the construction right-of-way (see Table 1-6) along the length of the gathering lines, trunk lines, and sales gas and CO_2 lines. Only those portions of the right-of-way needed for construction would be cleared of obstacles and debris. Construction in steep terrain such as the well field would require side hill cuts and cut-and-fill excavation in order to maintain grade. These activities would be similar for all of the buried pipelines (gathering pipelines, sour gas trunk lines, sales gas pipelines, and CO_2 pipelines) required for the Riley Ridge Project. The construction techniques which would be used for the above-ground molten sulfur pipeline are described separately.

Construction activities would require clearing above-ground vegetation and obstacles to allow for safe and efficient operation of the construction equipment. Blading of the right-of-way would only be done as necessary for access for machinery and equipment, or for the trenching required for the installation of pipe. To further ensure vehicle safety, it may be necessary to construct temporary bridges or culverts across creeks and gullies on the working side of the right-of-way. Excavation and grading may be necessary to decrease the gradient and increase the stability of unstable slopes, especially in the steep terrain found in the well field.

Once the right-of-way is prepared, trenching operations would begin. A ditch, 18 to 48 inches wide and 36 to 66 inches deep, would be centered on a line about 15 feet from one edge of the right-of-way, thus providing about 35 feet of working space and an area in which to place ditch-excavated materials. The ditch would be excavated mechanically with ditching equipment. The ditch of each construction spread would be open no more than 7 miles and for no more than 14 days at a time. Where necessary for wildlife or livestock crossing, dirt plugs would be left in the ditch or other measures would be employed.

TABLE 1-9
PROPOSED WELL FIELD ACCESS ROADWAY SYSTEM
(IN MILES)

Well Field Unit	Road Type				Roads Outside of Well Field Boundary	Total
	New[1]	Primitive[2]	Secondary[3]	Existing[4]		
Hogsback	1.0	6.7	12.2	1.7	--	21.6
Tip Top	8.3	21.3	19.2	18.5	--	67.3
Dry Piney	1.1	2.0	8.7	4.7	--	16.5
Graphite	1.1	2.1	0.0	2.6	--	5.8
Fogarty Creek	11.6	8.5	2.5	5.3	3.4	31.3
Lake Ridge	16.9	11.8	1.1	12.5	5.1	47.4
Sawmill Area	11.0	10.0	0.0	8.1	--	29.1
Riley Ridge	10.0	13.1	0.0	5.9	--	29
North Riley Ridge (Proposed)	8.4	9.4	0.0	11.0	--	28.8
Darby Mountain (Proposed)	6.4	5.9	0.0	7.1	1.5	20.9
Total All Units	75.8	90.8	43.7	77.4	10.0	297.7

[1] Access roads constructed where none currently exist.

[2] Single-lane roads (or two-track trails) upgraded to access roads.

[3] Lane-and-a-half roads upgraded to access roads.

[4] Two-lane roads not requiring upgrading.

At major river crossings, cleared working areas approximately 100 by 350 feet would be needed on each side of the crossing. Normally, construction of river crossings (Figure 1-6) would be accomplished within two weeks and would not be undertaken during periods of high flow (usually late spring). The pipeline in the streambed would be beneath the maximum scour depth. The minimum cover would be 4 feet, or 20 percent of the distance of maximum scour (whichever is greater), beneath the maximum scour depth. During construction of river crossings, the drainage or storm runoff from riverbank staging areas would be controlled via detention basins, evaporation pits, or straw bale filters to ensure that levels of suspended solids, grease, or oil would not exceed receiving water standards.

Stringing, bending, welding, coating, lowering, and backfilling are the usual steps that follow trenching (Figure 1-5). The pipe would be placed along the right-of-way, bent where necessary, and welded. It would then be coated with protective materials for protection from external corrosion and lowered directly into the ditch. Once it is placed in the ditch, the pipe would be padded with soil or, where necessary, rock shield may be used in place of padding to protect the pipe coating during backfill operations.

After backfilling is completed, a hydrostatic test would be conducted to detect leaks or weaknesses in the pipeline. Water for testing would most likely come from surface water such as the Green River. A permit to use this water must be obtained from the State Engineer to ensure protection of water rights. Testing would be scheduled to occur during warm months. To conserve water and lessen environmental impacts during the disposal of hydrostatic test water, the pipeline would be tested in sections, and the water would be moved from one section to the next. Since the interior of the pipelines would not be coated, the test water would contain iron oxide as well as stream sediments and small amounts of welding slag, oil, and grease. Normal testing conditions would not require the addition of chemicals. If schedule problems cause testing to be conducted under freezing conditions, an antifreeze would be added to the test water as necessary.

After completion of hydrostatic testing, the test water would be removed from the pipe, filtered, and released as specified by the Wyoming Department of Environmental Quality (DEQ). DEQ usually requires that test water be discharged into pits where the water evaporates or percolates into the soil (these pits must be reclaimed); however, DEQ may allow test water to be discharged into dry stream beds or gullies where the water would not come in contact with live streams. Energy dissipators are used to minimize bank cutting and excessive erosion. Specific measures to protect water quality, stream life, and downstream uses are specified by DEQ when permission to discharge is granted (Wagner 1982, personal communication).

Once hydrostatic testing has been completed, the right-of-way and other disturbed areas would be cleared of trash, brush, and other debris to prevent fire hazards. Some brush would be used to assist in stabilization and rehabilitation of the right-of-way. The right-of-way would be graded where needed, and all disturbed surfaces would be restored approximately to the preconstruction grade, as outlined in the Erosion Control, Revegetation, and Reclamation Guidelines in Appendix B. Temporary access roads would be returned as nearly as practicable to the original

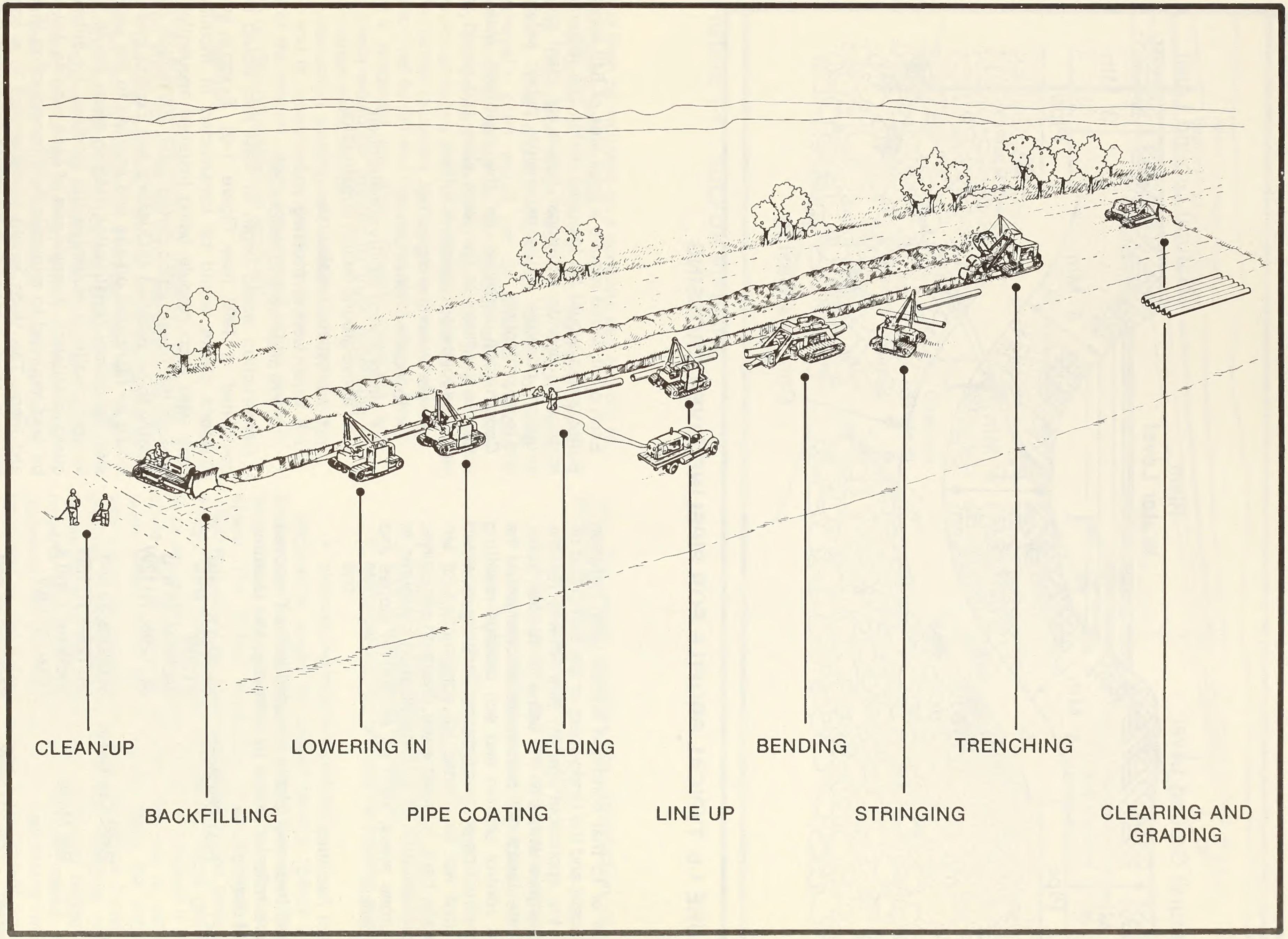

FIGURE 1-5 TYPICAL PIPELINE CONSTRUCTION SPREAD

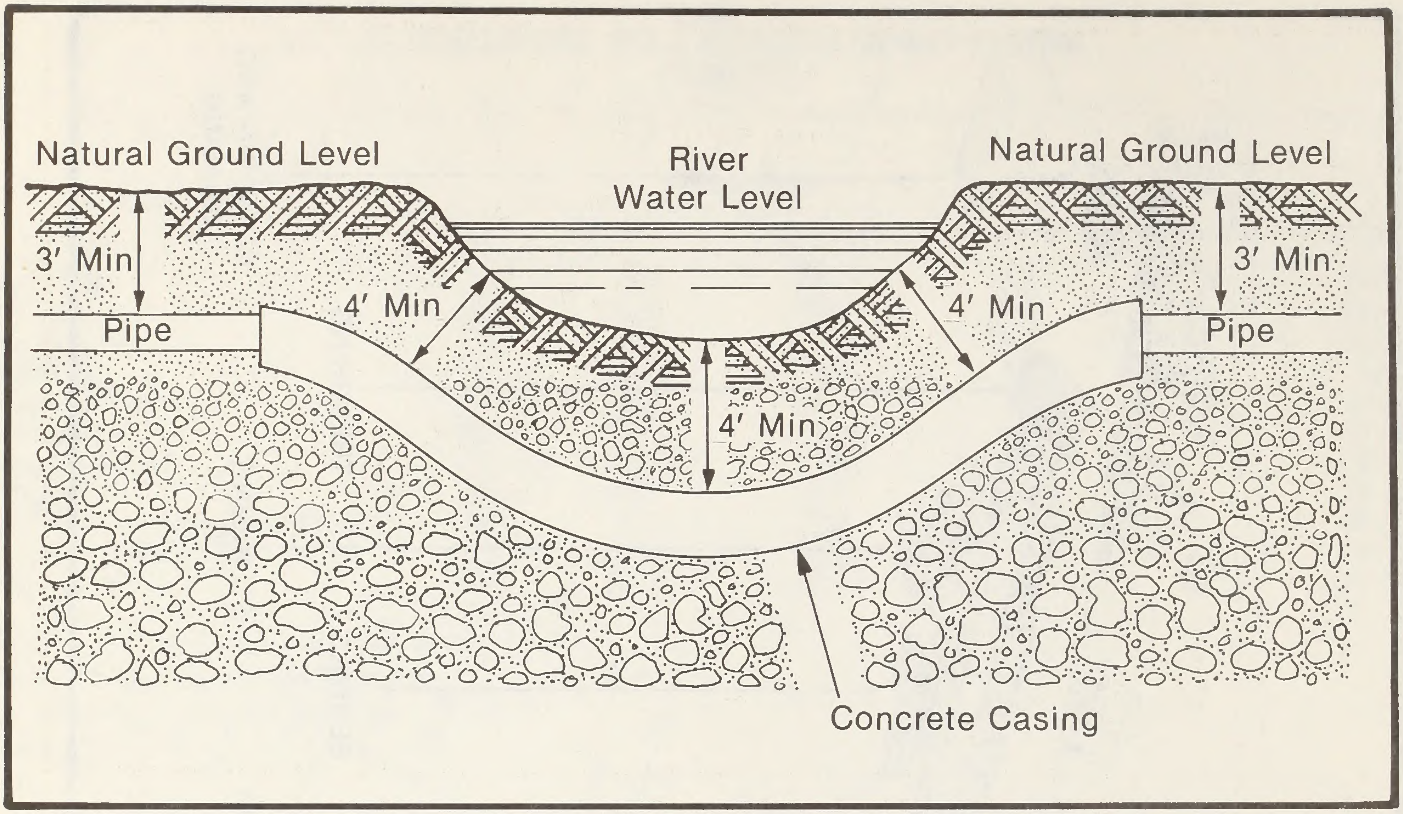

FIGURE 1-6 TYPICAL PROFILE FOR PIPELINE RIVER CROSSING

condition or to that condition agreed upon between the applicant and the landowners or the authorized officer of the applicable agency. Right-of-way restoration techniques would be the same for federal, state, and private lands. All reasonable efforts would be made to control erosion and soil damage resulting from construction or maintenance. Techniques would include (but not be limited to) construction of terraces, water bars, or other water diversion structures, and implementation of soil stabilization measures in erosion-prone areas, such as cut-and-fill slopes and stream banks.

Treatment Facilities

The gas treatment plants included in the Proposed Action are indicated below by company, site location, and legal description.

Quasar	East Dry Basin	Section 5, T28N, R112W Sections 33 and 34, T29N, R112W
Exxon	West Dry Basin	Sections 33 and 34, T29N, R113W
	Big Mesa	Sections 3 and 4, T27N, R113W
Northwest	Craven Creek	Sections 28 and 29, T22N, R113W

Each plant would require a total area of 640 acres. Buffer zones would be included within the required acreage to provide additional space for plant construction, possible future expansion, public safety, and legal protection.

Construction activities for the treatment plants would be confined to the plant sites and would include the following general activities:

- site clearing and grading;
- foundation construction;
- underground facility construction;
- above-ground facility construction;
- equipment installation;
- finish work and testing; and
- site clean-up and restoration.

Construction would begin in 1984 and would be completed in 1993 (see Figure 1-2). Exxon's and Quasar's plants would be constructed in modular form with each module being installed sequentially through the construction period. Each 200-million cfd module to be installed at Quasar's and Exxon's plants would be fabricated off-site and shipped to the plant site. Temporary construction staging areas would be located on-site to assemble the modules for subsequent installation. A major part of each module would be skid mounted to minimize field construction time and labor. The skids would be fabricated in a contractor's shop, transported by rail to Opal, and then trucked from the Opal rail terminal to the site. They

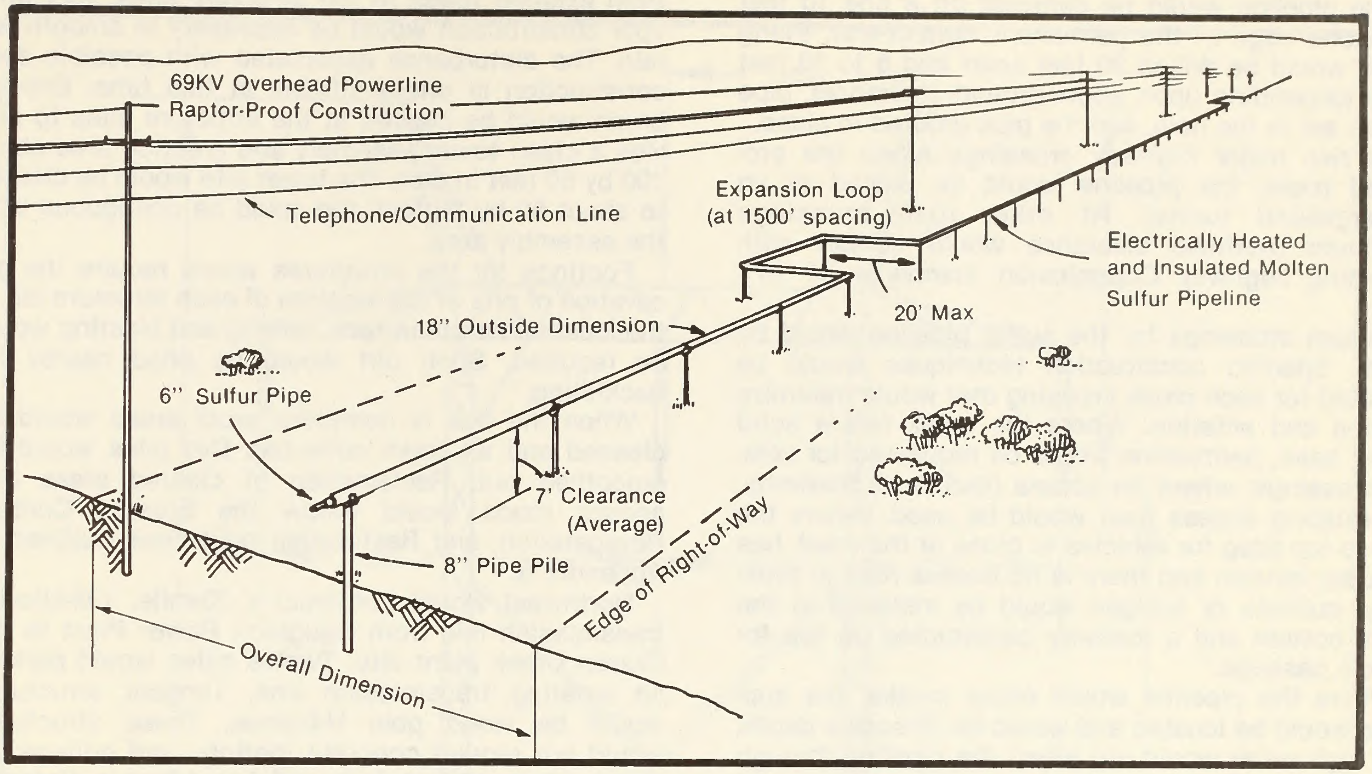

FIGURE 1-7 SULFUR PIPELINE

would then be mounted on a concrete pad and the required piping tie-ins made.

Construction of Northwest's gas treatment would involve the same steps required for Exxon's and Quasar's. One distinct difference would be that Northwest's plant would not be modular. Various plant facilities would be constructed on-site, while many components would be fabricated off-site and transported to the site for installation. Large or heavy construction materials and equipment would be shipped to Opal by rail and then to the plant site via Northwest's proposed rail spur. Smaller materials and equipment would be shipped by truck depending on the location of its source.

Construction employment would also vary through time and is presented in detail in Table 1-19 at the end of the chapter. Peak employment would occur in 1985 or 1986 depending on applicant.

Sulfur Pipeline

Exxon and Quasar plan to transport sulfur as a molten liquid in a 54-mile long, electrically heated, 6-inch diameter pipeline from the treatment plants to a loadout facility located on a railroad spur near Opal, Wyoming (see Map 1-3 in the map pocket). This pipeline is proposed to be constructed jointly and would be located above ground on 8-inch diameter pipe piles (see Figure 1-7). The average clearance height would be 7 feet. A 69-kilovolt electric transmission line would be constructed within the pipeline right-of-way. The major activities for construction of the pipeline would be:

- cleaning and grading of site;
- drilling, setting, and grouting of pipe pilings;
- stringing, welding, and radiographic examination of pipe;
- raising and setting pipe on pilings;
- installing heater cables;
- insulating and covering field joints of pipe;
- hydrostatic testing of pipeline;
- electrical testing of pipeline heating system; and
- cleanup and restoration of site.

Vegetation would be cleared from a 10-foot wide area under the sulfur pipeline and about a 50-foot wide area in wooded areas for vehicle travel and work space. The 20-foot expansion loops located every 1,500 feet could be accommodated on the proposed 75-foot wide construction right-of-way. Trees growing in or along the right-of-way would be removed if they could fall across the elevated pipeline. In remote areas where there are no access roads, the right-of-way would be the primary path of surface travel for pipeline construction. In order that vehicles might safely traverse the right-of-way, temporary bridges or culverts would be constructed across creeks and gullies on the working side of the right-of-way (where permitted by the federal surface management agency or the landowner).

The pipeline would be centered on a line 10 feet from one edge of the permanent right-of-way. Piling holes would be drilled 30 feet apart and 5 to 10 feet deep (depending upon above-ground clearance), pipe length set in the hole, and the pipe grouted in place.

At two major highway crossings along the proposed route, the pipeline would be placed in an underground tunnel. At other road crossings minimum overhead clearance would comply with Wyoming Highway Commission standards of 16.5 feet.

Stream crossings for the sulfur pipeline would be aerial. Specific construction techniques would be selected for each creek crossing that would minimize erosion and siltation. Where the creek has a solid gravel base, permission would be requested for vehicle crossings; where an access road is in proximity, the existing access road would be used. Where the flow is too deep for vehicles to cross or the creek has a muddy bottom and there is no access road in proximity, culverts or bridges would be installed in the creek bottom and a roadway constructed on top for vehicle passage.

Where the pipeline would cross creeks, the supports would be located and would be of such a depth, that high water would not affect the pipeline through scour action. Construction of creek crossings would be made in a manner that minimizes the effects of construction on water flow. The gradient of the stream would be maintained by removing all spoil from the creek bed upon completion of construction, and the creek banks would be restored.

Transmission Lines

A 345-kilovolt electric transmission line originating near the Naughton Power Plant would provide power to the Quasar and Exxon treatment plants. This line would be a total of 75 miles in length, of which 9 miles would parallel an existing transmission line. Tangent structures would be lattice steel H-frames (see Figure 1-8); spans would be approximately 1,000 feet in open terrain.

The phases of development following right-of-way acquisition and surveying would be:

- access development and clearing of structure sites;
- excavation;
- grillage and form work;
- concrete work;
- stringing and tensioning; and
- cleanup and reclamation.

If trees interfere with the transmission line survey, some centerline trimming or clearing may be needed to obtain line of sight; however, clearing is not normally required in sagebrush country.

Erection of tall structures would require that excavating equipment, concrete trucks, supply trucks, and a crane be able to reach each structure site. In rough terrain it could be necessary to construct spurs from existing roads to the structure sites; very little spur construction would be necessary in smooth terrain. The disturbance associated with possible spur construction is unquantifiable at this time. Enough brush would be cleared at the structure sites to provide a clean tower assembly and erection area about 100 by 50 feet in size. The tower site would be cleared to about 50 by 20 feet and could be contiguous with the assembly area.

Footings for the structures would require the excavation of pits at the location of each structure leg. If the local substrate is rock, drilling and blasting would be required. Spoil dirt would be piled nearby for backfilling.

When the line is complete, work areas would be cleaned and all trash collected. Dirt piles would be smoothed out. Reclamation of cleared areas and access roads would follow the Erosion Control, Revegetation, and Restoration guidelines outlined in Appendix B.

Northwest would construct a 23-mile, 138-kilovolt transmission line from Naughton Power Plant to the Craven Creek plant site. Twelve miles would parallel an existing transmission line. Tangent structures would be wood pole H-frames. These structures would not require concrete footings and grillage; instead, a hole 10-feet deep and 3 to 4 feet in diameter would be dug for each of the two legs. After the legs are placed in the holes, the remaining space would be packed with soil.

Railroad

A 7-mile railroad spur for plant construction and transportation of sulfur from Northwest's Craven Creek treatment plant would be constructed. It would be built according to American Railway Engineers Association specifications and be consistent with Union Pacific practices. Right-of-way width on relatively flat ground would only need to be 50 feet. If wide areas are needed for cut-and-fill, the width may extend to 200 feet. If required, a railroad overpass at U.S. Highway 30 would require 200 feet of right-of-way. Until more detail is known, the average right-of-way disturbance width is assumed to be 100 feet.

Earth work for the railroad bed could be done in about 90 days using standard earth-moving equipment. The road bed would be 34 feet wide at grade with an adjacent and parallel 8-foot wide construction access road. Following the completion of earth work, cut-and-fill slopes would be revegetated in a manner similar to that used for cut-and-fill slopes along pipeline rights-of-way (see Appendix B).

Track building would begin with construction of the main switch at Union Pacific's main line. All heavy construction equipment used would be on-track equipment which would ride on the rails as they are laid. Working access would also be via the adjacent access road. Cross ties and track would be laid first and connected. Track can be laid at the rate of 3,000 feet/day under good conditions. The laying of track would be immediately followed by ballast dumping and tamping which would take 90 days.

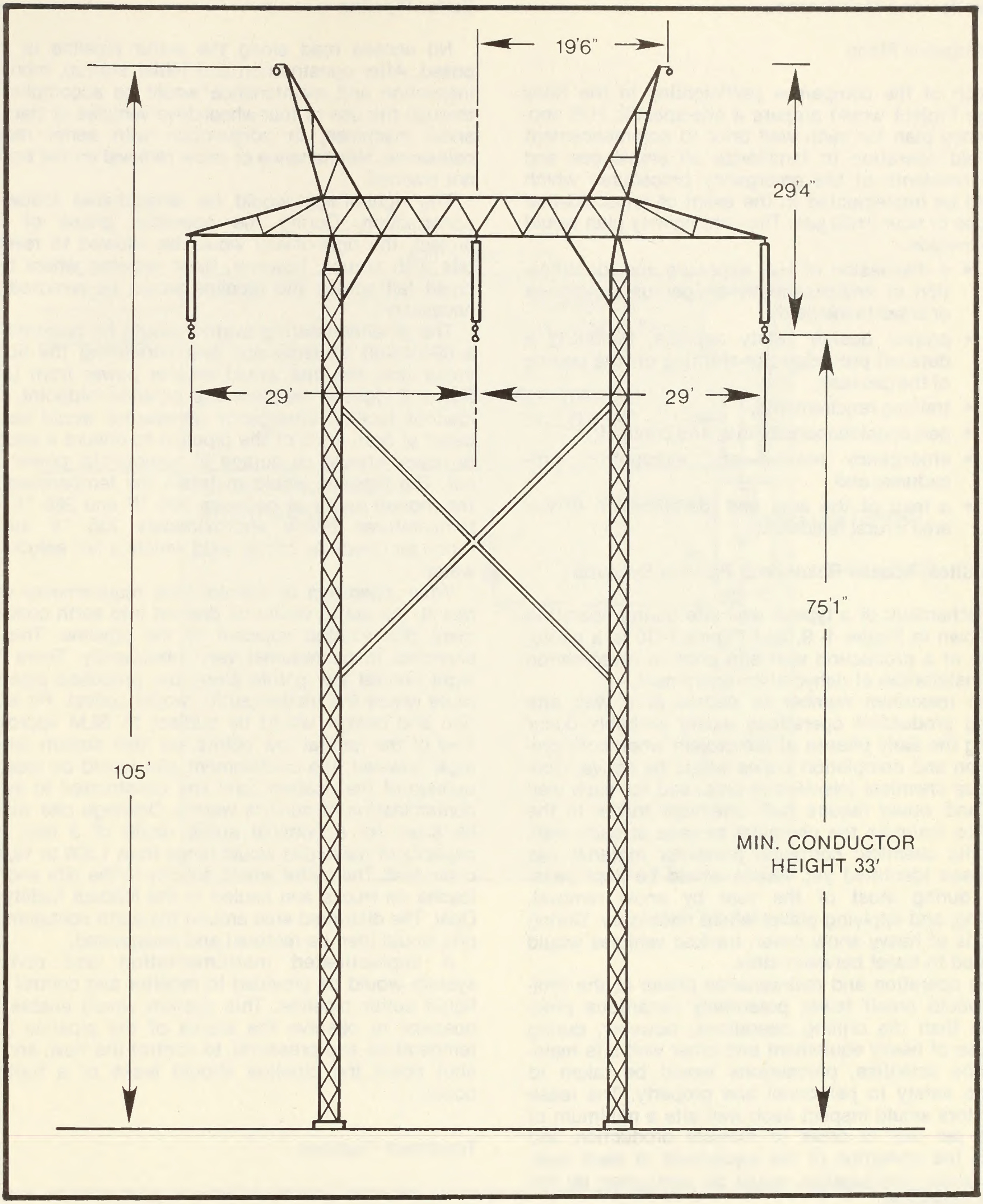

FIGURE 1-8 TYPICAL H-FRAME TANGENT STRUCTURE

Operation and Maintenance

Contingency Plans

Each of the companies participating in the Riley Ridge Project would prepare a site-specific H_2S contingency plan for each well prior to commencement of field operation to familiarize all employees and area residents of the emergency procedures which would be implemented in the event of an accidental release of sour (H_2S) gas. The contingency plan would also include:

- a discussion of H_2S exposure and identification of any potentially dangerous conditions or areas in the field;
- project design safety aspects, including a detailed procedure for shutting off the source of the gas leak;
- training requirements;
- personnel responsibilities and conduct;
- emergency rescue and evacuation procedures; and
- a map of the area and identification of the area's rural residents.

Well Sites, Access Roads, and Pipeline Systems

A schematic of a typical well site during operation is shown in Figure 1- 9, and Figure 1-10 is a photograph of a production well site prior to revegetation and installation of dehydration equipment.

The maximum number of people at a well site during production operations would probably occur during the early phases of the project when both production and completion crews would be active. Continuous chemical injection is proposed for each well site and would require bulk chemical trucks in the field to maintain the chemical storage at each well. Specific chemical corrosion preventer material has not been identified yet. Roads would be kept passable during most of the year by snow removal, grading, and applying gravel where necessary. During periods of heavy snow cover, tracked vehicles would be used to travel between sites.

The operation and maintenance phase of the project would entail fewer potentially hazardous processes than the drilling operations; however, during the use of heavy equipment and other well site maintenance activities, precautions would be taken to assure safety to personnel and property. The lease operators would inspect each well site a minimum of twice per day in order to monitor production and check the operation of the equipment at each well. Any minor maintenance would be performed by the lease operators.

Automatic safety block valves would be located at appropriate intervals along the pipeline alignments. The block values are sensitive to pressure loss (indicative of line rupture), and any significant change in pressure would cause the valves to close. Any power loss would also initiate automatic closing.

Sulfur Pipeline

No access road along the sulfur pipeline is proposed. After construction and initial startup, monthly inspection and maintenance would be accomplished through the use of four-wheel-drive vehicles or tracked snow machines, in conjunction with aerial reconnaissance. Maintenance or snow removal on the trail is not planned.

The right-of-way would be rehabilitated following construction. During the operation phase of the project, the right-of-way would be allowed to revegetate with shrubs; however, trees growing where they could fall across the pipeline would be removed as necessary.

The pipeline heating system would be powered by a 69-kilovolt transmission line paralleling the liquid sulfur line; the line would receive power from Utah Power & Light at the plant site, pipeline midpoint, and loadout facility. Emergency generators would be located at both ends of the pipeline to ensure a source of power should an outage of commercial power occur. The pipeline would maintain the temperature of the molten sulfur at between 265 °F and 285 °F. At temperatures below approximately 235 °F sulfur forms an odorless, brittle solid which is not soluble in water.

When operation or maintenance requirements warrant it, the sulfur would be drained into earth containment pits located adjacent to the pipeline. This is expected to be required very infrequently. There are eight natural low points along the proposed pipeline route where the molten sulfur would collect. Pit location and design would be subject to BLM approval. Five of the natural low points are near stream crossings; however, the containment pits would be located outside of the riparian zone and constructed to avoid contamination of surface waters. Drainage pits would be sized for a nominal sulfur depth of 3 feet; the capacity of these pits would range from 1,300 to 19,000 cubic feet. The sulfur would solidify in the pits and be loaded on trucks and hauled to the loadout facility at Opal. The disturbed area around the earth containment pits would then be restored and revegetated.

A sophisticated instrumentation and control system would be provided to monitor and control the liquid sulfur pipeline. This system would enable an operator to observe the status of the pipeline (i.e., temperature and pressure), to control the flow, and to shut down the pipeline should leaks or a rupture occur.

Treatment Facilties

Quasar and Exxon's treatment process would consist of three primary steps which occur in the treatment modules (see Figure 1-11):

- gas separation,
- nitrogen rejection, and
- sulfur recovery.

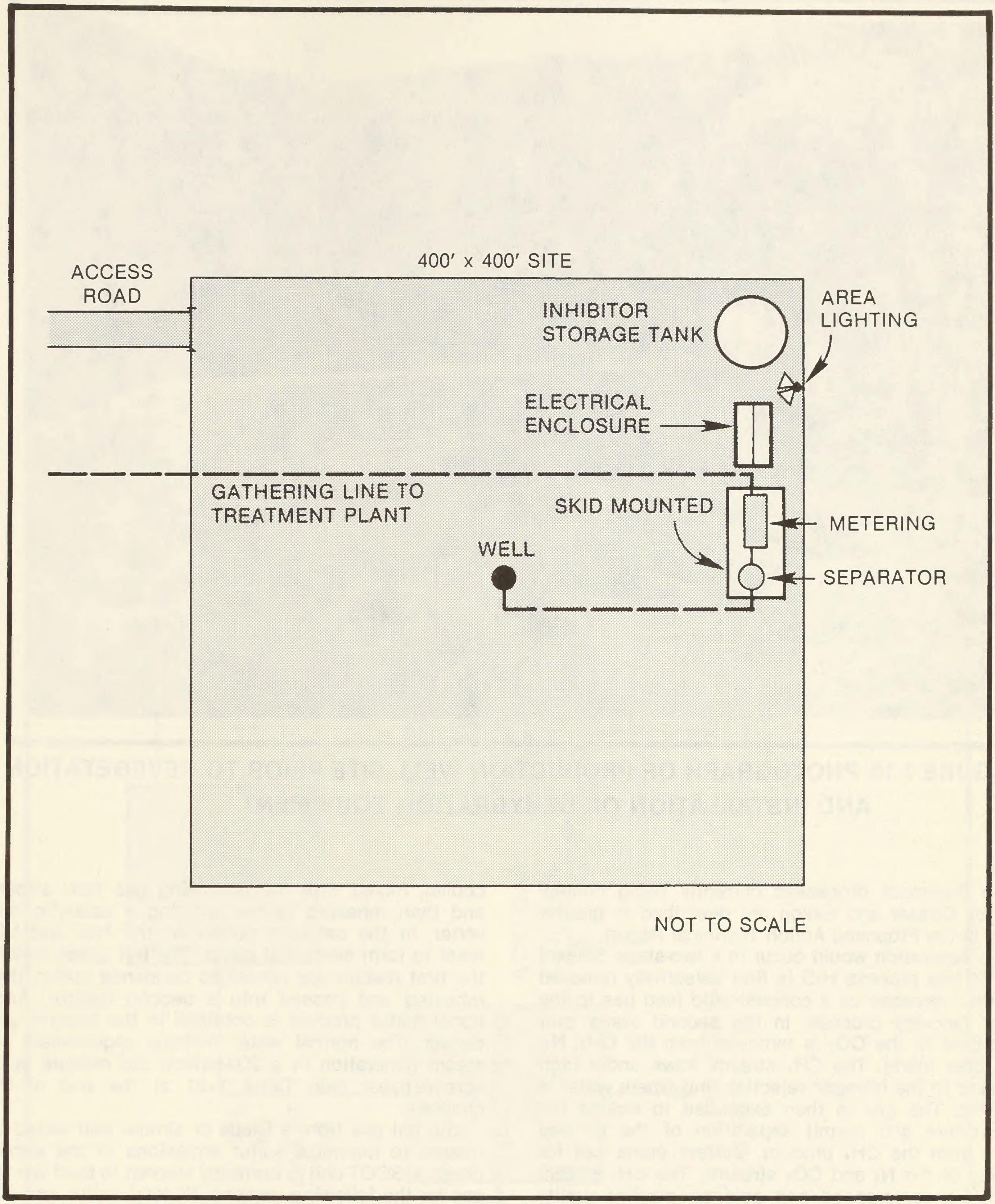

FIGURE 1-9 TYPICAL WELL SITE DURING OPERATION

FIGURE 1-10 PHOTOGRAPH OF PRODUCTION WELL SITE PRIOR TO REVEGETATION AND INSTALLATION OF DEHYDRATION EQUIPMENT

The treatment processes currently being considered by Quasar and Exxon are described in greater detail in the Proposed Action Technical Report.

Gas separation would occur in a two-stage Selexol unit. In this process H_2S is first selectively removed and then released as a concentrated feed gas to the sulfur recovery process. In the second stage over 90 percent of the CO_2 is removed from the CH_4, N_2, and other inerts. The CH_4 stream flows under high pressure to the nitrogen rejection unit where water is removed. The gas is then expanded to reduce the temperature and permit separation of the N_2 and inerts from the CH_4 product. Current plans call for venting of the N_2 and CO_2 streams. The CH_4 stream would be compressed and sold as pipeline-quality natural gas.

In the sulfur recovery process, a Claus unit or a similar type of process would be used to convert the H_2S in the Selexol stripped off-gas into sulfur. In a typical Claus process, part of the feed gas flow is diverted and reacted with air to form SO_2. This gas is cooled, mixed with the remaining gas flow stream, and then reheated before entering a catalytic converter. In the catalytic converter, the H_2S and SO_2 react to form elemental sulfur. The hot gases leaving the first reactor are cooled to condense sulfur, then reheated and passed into a second reactor. Additional sulfur product is obtained in the second condenser. The normal water makeup requirement for steam generation in a 200-million cfd module is 32 acre-feet/year (see Table 1-21 at the end of the chapter).

The tail gas from a Claus or similar unit would be treated to minimize sulfur emissions to the atmosphere. A SCOT unit is currently favored to treat the tail gas for the following reasons: (1) total sulfur recovery of 99.8 percent, (2) low sensitivity to Claus plant upsets, and (3) cost competitive with other high recovery (99.8 percent) processes.

In the SCOT tail gas recovery unit, Claus tail gas is combined with hydrogen (H_2) gas and passed over a cobalt-molybdenum catalyst to convert SO_2 to H_2S.

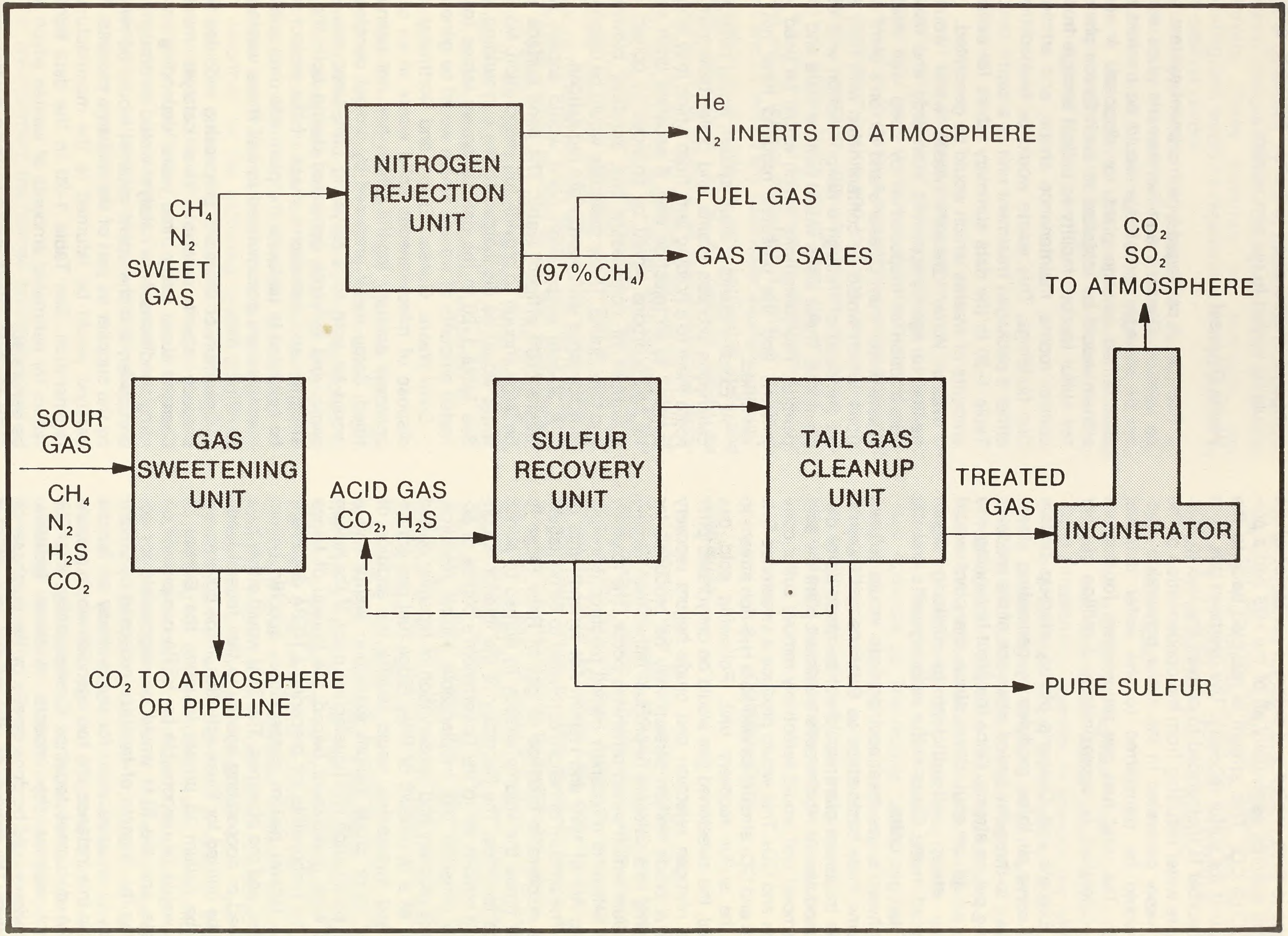

FIGURE 1-11 REPRESENTATIVE DIAGRAM FOR RILEY RIDGE TREATMENT PLANTS

The gas is then cooled and enters a contactor where material absorbs essentially all of the H_2S and a portion of the CO_2. This stream is recycled back to the Claus unit for sulfur recovery. The overhead gas from the absorber is incinerated to convert the H_2S to SO_2.

Waste water resulting from the condensation of the water vapor generated in the sulfur conversion reaction would be transferred to the water disposal system. The total fuel gas requirement for burners and incinerators is approximately 3 million cfd per module.

At Exxon's and Quasar's plants, start-up boilers would serve all three modules by generating steam for a two to three-day period when one of the modules is being put on stream. Once the plant is running, the boiler would be shut down since the plant would become steam self-sufficient by utilizing steam generated in the Claus sulfur recovery units and the SCOT tail gas units.

Northwest's gas treatment process would follows the same three basic steps as Quasar's and Exxon's, but the treatment plant would not be made up of discrete modules. At Northwest's treatment plant the acid gas removal unit would selectively remove sulfur compounds and CO_2. This would produce a sweetened CH_4 stream and CO_2 stream, as well as a H_2S-rich stream to feed the sulfur recovery unit. Following acid gas removal, the sweetened gas would be dehydrated prior to the nitrogen rejection and crude helium recovery steps. A crude helium stream may be produced for upgrading to a saleable by-product rather than venting the helium which would otherwise occur. The majority of the helium is a federally owned resource (Minerals Leasing Act of 1920 and Helium Act Amendments of 1960). The amount of helium estimated to be contained in the recoverable reserves of gas at Riley Ridge is several times the volume already in Bureau of Mines storage facilities. The Secretary of the Interior is considering options as to the Government's course of action to conserve this irreplaceable natural resource. Possible recovery and conservation of federally owned helium as a by-product of Riley Ridge fuel gas enrichment and sweetening would require the addition of one or more crude helium extraction plants and a helium purification and liquefaction plant. If the helium plants were government owned, the Bureau of Mines would be responsible for preparing a NEPA document on the federal helium conservation, specific helium facilities, and the pipelines. The BLM would either be a joint lead or cooperating agency in that federal lands would be utilized for these activities. If the government sells the helium to private industry, the Bureau of Mines would be responsible for NEPA compliance on the sale, and the BLM would be responsible for addressing the impacts of facilities proposed by private industry in an application for rights-of-way on federal lands. In this instance, the two agencies would prepare a NEPA document together. Consequently, this EIS will not address the impacts of these facilities. Purification would be done on-site by the purchaser of the helium. The removal of nitrogen and recovery of a raw helium stream would be accomplished using a cryogenic fractionation scheme. Nitrogen and CO_2 would be vented to the atmosphere.

Waste Disposal

Sewage. A packaged-type treatment system would be used at Quasar's and Northwest's plant sites to handle sewage, and sludge would be trucked to an unidentified sewage plant for disposal. A sewage system would be installed at each Exxon plant and the sulfur loadout facility to collect sewage from the control rooms, maintenance shops, and administration buildings. This waste would be treated through either a packaged treatment unit or a septic tank. See Table 1-20 in the data summary tables for estimated amounts of wastes which would be generated.

Waste Water. Quasar's waste water would be treated to agency-approved standards and used for construction or disposed of by deep well injection. Waste water from Quasar's and Exxon's plant operations, which would be contaminated with H_2S, would be disposed of through a deep injection well on the plant site. These wells would require state and federal permits. The formations which would be used for injections and the pressure required have not been identified.

At Exxon's plants a drain system would collect miscellaneous process drains and boiler blowdown, and route them to a holding tank from which they would be pumped to an injection well. A separate drain system for hydrocarbons would be provided to collect small quantities of compressor oils, scrubber blowdowns, and tank drains. These materials would be disposed of in accordance with appropriate regulations.

A 30-acre evaporation pond would accept Northwest's plant effluent water. The pond surface would be large enough to provide full evaporation. No waste water would be discharged to the surrounding areas. See Table 1-20 in the data summary tables for estimated amounts of wastes which would be generated.

Solid Waste. Quasar, Exxon, and Northwest would dispose of miscellaneous solid waste in an off-site approved sanitary landfill which has not been identified. Scrap metal produced by project construction would be sold to a recycling firm. Used oils, lubricants, and solvents generated during both the construction and operations phase of the project would be collected in tanks on the plant site until sufficient quantities are accumulated to sell these wastes to a re-refining firm.

Operation of Quasar's processing modules would produce spent catalyst. This catalyst must be changed about every three years, depending on operating conditions. New catalyst would be brought in by a supplier, and the spent catalyst would be removed by the supplier as part of the recharge process. Spent catalyst would be returned to the manufacturer for regeneration. See Table 1-20 in the data summary tables for estimated amounts of wastes which would be generated.

Northwest's plant would have no continuous solid waste discharge other than the trash and human waste generated by the operating personnel. Spent catalyst charges must be changed at three to five-year intervals. These materials are non-toxic, non-polluting, and would be regenerated or disposed of by the catalyst vendor.

Hazardous Waste. No hazardous wastes are anticipated by the companies at this time. Should any hazardous wastes be identified during the life of the project, the storage, use, and disposal of these materials would be according to Environmental Protection Agency regulations.

Abandonment

Well Sites

A well that stopped producing or was found to be dry upon completion of drilling would be plugged and abandoned. The first stage in the abandonment process would be to install a cement plug at the bottom of the production casing and to force cement into the adjacent formations through perforations in the casing. The tubing string would then be removed, and cement plugs would be placed at designated depths in the well to prevent migration of water or hydrocarbons and to protect any freshwater aquifers from contamination in accordance with applicable state and federal regulations. Since all casings would be cemented in the borehole, no casing would be recovered from the well. The wellhead and casing would be cut off below ground level, capped with cement, and a dry hole marker erected as outlined in Appendix B.

All above-ground facilities, foundations, and salvageable materials would be removed. Soil material would be restored over the well and the site returned to its original contour as soon as the well abandonment was completed. Each completed well site would be reseeded by the next growing season using techniques and methods described in the Erosion Control, Revegetation, and Reclamation Guidelines (Appendix B).

Pipelines

At abandonment, all well field pipelines would be purged of sour gas or other contaminants. Underground pipelines would be sealed and abandoned in place. Unsalvageable materials would be disposed of at an authorized disposal site. The construction and erosion control and restoration procedures for sales gas and CO_2 pipelines would be the same as that described for the gathering system and trunk pipelines. The sulfur pipeline would be abandoned and reclaimed in the same manner as all of Exxon's above-ground facilities. That is, the pipeline would be drained and dismantled, foundations would be demolished to below ground level, and the disturbed area would be revegetated.

Railroad

Upon abandonment, the railroad would be reclaimed according to land management agency (BLM or State of Wyoming) or private owner stipulations. In general, the rails and ties would be removed and sold for salvage. The roadbed would be disturbed as little as possible in order to facilitate revegetation. Ballast would not be removed from the roadbed.

Treatment Plants

At the end of the facilities' useful life (30 to 40 years), the companies would obtain authorization from jurisdictional agencies to abandon the facilities. All plant facilities would be purged of sour gas or other contaminants. All above-ground facilities, foundations, and salvageable material would be removed. Unsalvageable materials would be disposed of at authorized disposal sites. The plant sites would be regraded and revegetated according to the Erosion Control, Revegetation, and Reclamation Guidelines (see Appendix B). The federal, state, or other land-managing or jurisdictional agencies may place reasonable conditions upon abandonment as needed. In addition, abandoned rights-of-way would be returned to the private landowner's or agency's control.

COMPONENTS

Well Sites

Quasar's Riley Ridge, proposed North Riley Ridge, and proposed Darby Mountain Units (see Map 1-2, map pocket) would consist of 72 wells, including 2 wells in the Sawmill Area. A total of nine wells in the proposed Darby Mountain Unit are proposed to be directionally drilled in order to avoid severe access and surface disturbance problems; two wells would be drilled at each of seven well sites, and three wells would be drilled at one well site. Thus, for a total of 72 wells, Quasar would only have 63 well sites. The area prepared at each single well site would be approximately 400 by 400 feet (3.7 acres), while the area prepared at each multiwell directional site would be approximately 7.4 acres.

Quasar's facilities at a typical production well would include a wellhead, a gas/water separator, a metering system, an electrical system and injection system, a storage tank for corrosion inhibitor chemicals, and a gathering line leading to the production network (Figure 1-9). Individual wellhead production facilities would perform four basic functions: (1) injection of a corrosion inhibitor into the well; (2) separation of water from the production stream; (3) metering of the production; and (4) recombining the water with metered production downstream of the wellhead measurement facility. Gathering lines would transport the water-production mixture from the well site to the treatment plant where all water would be separated from the gas and disposed. Each wellhead facility would be served by an electrical system for powering corrosion inhibitor injection pumps, area lighting, well control systems, and measurement data systems. Any necessary power cables would be buried coincident with the gathering lines. There would be no water requirements at the well sites during operation.

Quasar's production wells would not generate significant quantities of waste. Water entrained in the production stream would not be collected at the well site, but would be separated and collected at the treatment plant. Any wastes that are generated during normal maintenance of the well sites would be removed from the site and taken to an approved landfill.

Williams' application for the Riley Ridge Project covers only well drilling and sour gas production and transportation. Williams plans to drill 24 wells in the Sawmill Area (see Map 1-2, Map Pocket), each requiring 3.7 acres. Operation size would also be 3.7 acres. Williams would transport its gas to Quasar's East Dry Basin treatment plant where it would be purchased by Quasar.

Williams would construct a maintenance base camp and office for use by company field personnel during the drilling, completion, and production operations. The unit would need a 0.5-mile electrical transmission line, which would require no more than ten power poles, from an existing mainline. A 50 gallon/minute water supply well would provide water for drilling and field office use. A septic system would be constructed at the office site.

Williams proposes to use a wellhead dehydration system, but the type of system has not yet been determined. During wellhead operation, water produced from the dehydration units would be stored in fiberglass storage tanks on site, and trucks would haul the water to a disposal site. Electric power lines to the well sites would not be required.

Exxon plans to drill 75 wells. Each drill site would be approximately 540 by 540 feet (6.7 acres) and would have a reserve pit with a capacity of approximately 7.2 acre-feet. An operational well site would consist of approximately 1.9 acres of cleared area around the wellhead for production facilities. Exxon would utilize triethylene glycol (TEG) dehydration systems in the well field to remove water from the gas and minimize corrosion in the gathering system pipelines. The gas would be piped underground to the nearest dehydrator site for water removal. The dehydration systems would be sized to process at least 20 million cfd. Where feasible, larger dehydration units would be provided to serve up to three or four wells, thus reducing the surface facilities and associated land requirements at each well site. Exxon's wellhead dehydration equipment would be constructed on skid-mounted modules at a remote location and shipped to the field sites for erection. Storage tanks (15 feet in diameter and 15 feet high) for glycol and stripped water would be required. Electrically driven compressors would be installed upstream of the dehydration units to maintain adequate supply pressure at the treatment plants as the reservoir pressure declines. Water produced during wellhead dehydration would contain approximately 366 parts/million of H_2S and would be disposed of by underground injection. These wells would require state and federal permits. The formation into which the waste water would be injected and the required pressure have not been identified at this time.

Overhead electric power lines on single wood poles would follow the gas gathering system or access road rights-of-way where possible and would originate from the substations at the treatment plants. Water required for drilling would be supplied by water wells drilled near the well sites.

Mobil has lease holdings in the gas field and would drill wells and produce the sour gas. Mobil's drilling program includes 67 wells which would disturb approximately 3.7 acres each. For Mobil's drilling operation, water would be hauled to the drill site in tank trucks (see Table 1-21 at the end of the chapter). After the well is in operation, each wellhead facility would require about one acre. Northwest would purchase the gas at the wellhead and transport it to the proposed Craven Creek treatment plant.

Northwest would own and operate facilities at each production wellhead including free water knockout, dehydrators, meters, water storage, flare, fuel tank, and a control system which includes a remote shut-in valve and H_2S detector and warning system. Electric power would be obtained by expanding the existing network that services the sweet gas and oil field. Gas from the well would contain both free-state and vapor-state water. Gas would be dehydrated at Mobil's wellheads using calcium chloride dehydration. The area for the calcium chloride dehydration system would be a minimum of 200 by 200 feet enclosed by a barbed wire fence to keep large animals from the equipment. A building approximately 800 square feet in size would house metering equipment, free water knockout and possibly the gas-to-gas heat exchanger. Water from the dehydration process would be held in buried tanks. The tanks would periodically be pumped into a disposal system and ultimately into a disposal well. Approximately 32,000 pounds/well/month of spent calcium chloride (in brine form) would be disposed of by underground injection. The required pressure and injection formation have not been identified. A flare of undetermined height would also be on the site.

Treatment Facilities

The treatment plants included in the Proposed Action are shown below by company, location, and processing capacity.

Quasar	East Dry Basin	1.2 billion cfd
Exxon	West Dry Basin	.6 billion cfd
	Big Mesa	.6 billion cfd
Northwest	Craven Creek	.4 billion cfd
	TOTAL	2.8 billion cfd

Figure 1-12 is a photograph of a sour gas treatment plant with a designed capacity of 270 million cfd. A conceptual layout for a treatment plant is shown in Figure 1-13. Each treatment plant would consist of the following components:

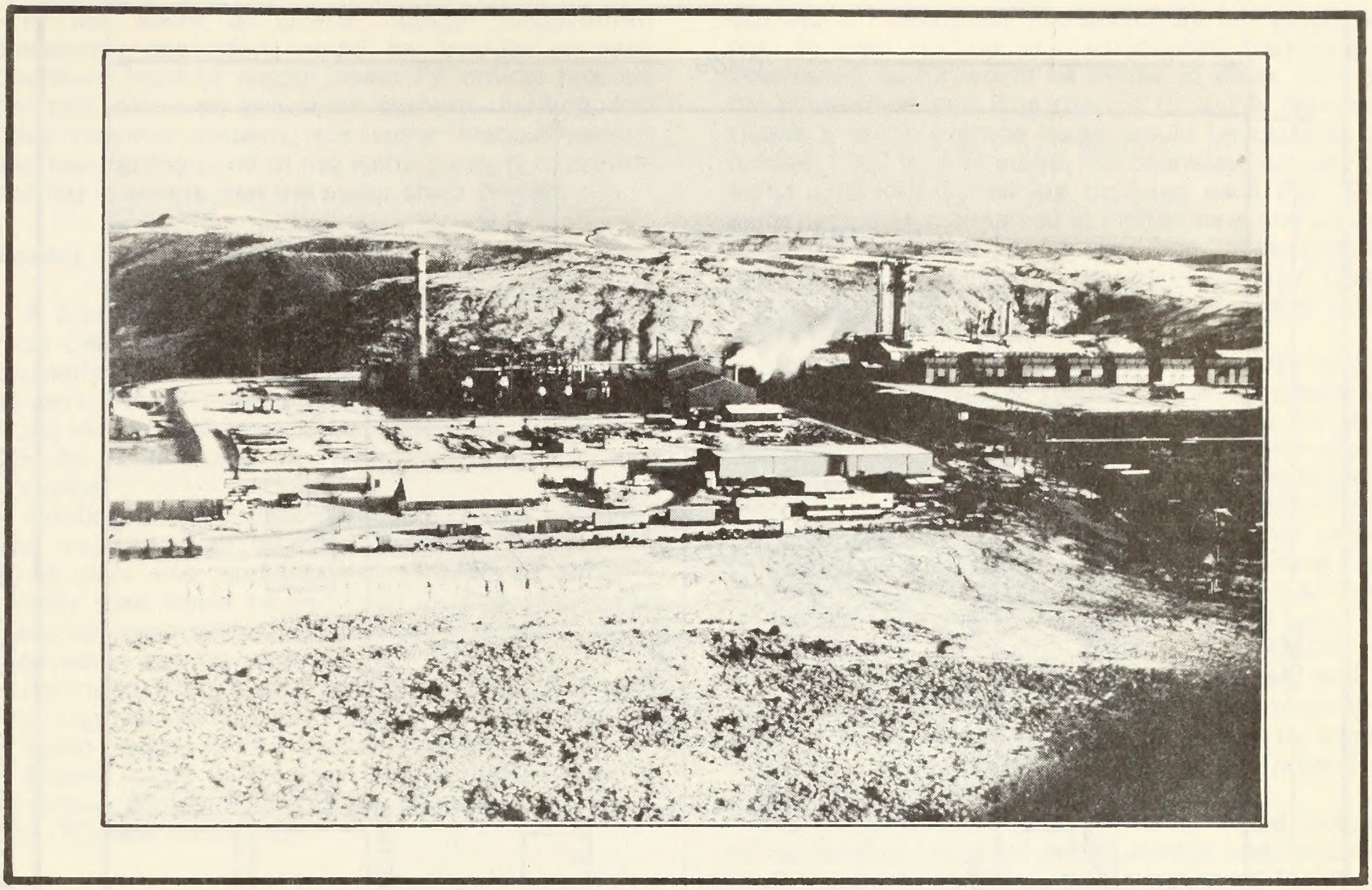

FIGURE 1-12 PHOTOGRAPH OF A SOUR GAS TREATMENT PLANT WITH DESIGNED CAPACITY OF 270 MILLION CFD

- treatment plant modules or treatment facilities,
- electrical distribution system,
- water supply system,
- waste disposal system,
- sulfur block storage area, and
- ancillary plant facilities.

Quasar's plant site at East Dry Basin would include a maximum of six unitized gas treatment modules, each capable of processing 200 million cfd of sour gas. A single module would occupy approximately 37 acres, and a total of 222 acres would be needed for all six modules. An additional 40 acres would be used for sulfur storage and 378 acres for a buffer zone. The total amount of land proposed to be leased for the plant site would be 640 acres.

Exxon currently plans to construct two 600-million cfd plants, one at each West Dry Basin and Big Mesa. Each treatment plant would consist of three identical 200-million cfd modules. The total area required for each plant would be approximately 160 acres with a 480-acre buffer zone, for a total of 1,280 acres.

Northwest's treatment plant at Craven Creek would be designed to process 400 million cfd of sour gas. The plant would occupy approximately 55 acres, the evaporation pond approximately 30 acres, and the sulfur storage area would be 80 acres. The overall area of the plant site would also be 640 acres.

Natural gas and CO_2 (when a market is identified) produced at Exxon's and Quasar's plants would be transported in parallel pipelines to a proposed terminus in the vicinity of the Trailblazer Pipeline approximately 5 miles southwest of Rock Springs, Wyoming. A 16-inch sales gas pipeline would be built connecting Northwest's treatment plant at Craven Creek with Northwest's existing 16-inch line 3 miles to the west. Approximately 27 miles of 16-inch CO_2 pipeline would be constructed from Northwest's plant to the vicinity of the MAPCO pipeline in the event a market is secured. Pending approval of BLM, all applicants would vent CO_2 until a market is identified. At that time, the proposed CO_2 pipelines would be constructed along the indicated rights-of-way and on to the ultimate purchaser.

Primary support facilities for each treatment plant and Exxon's sulfur loadout facility would consist of steam boilers, electrical distribution systems, fire water systems, potable and raw water systems, drain systems, waste water and solid waste disposal, sewage systems, vent stacks, storage tanks, and sulfur storage areas.

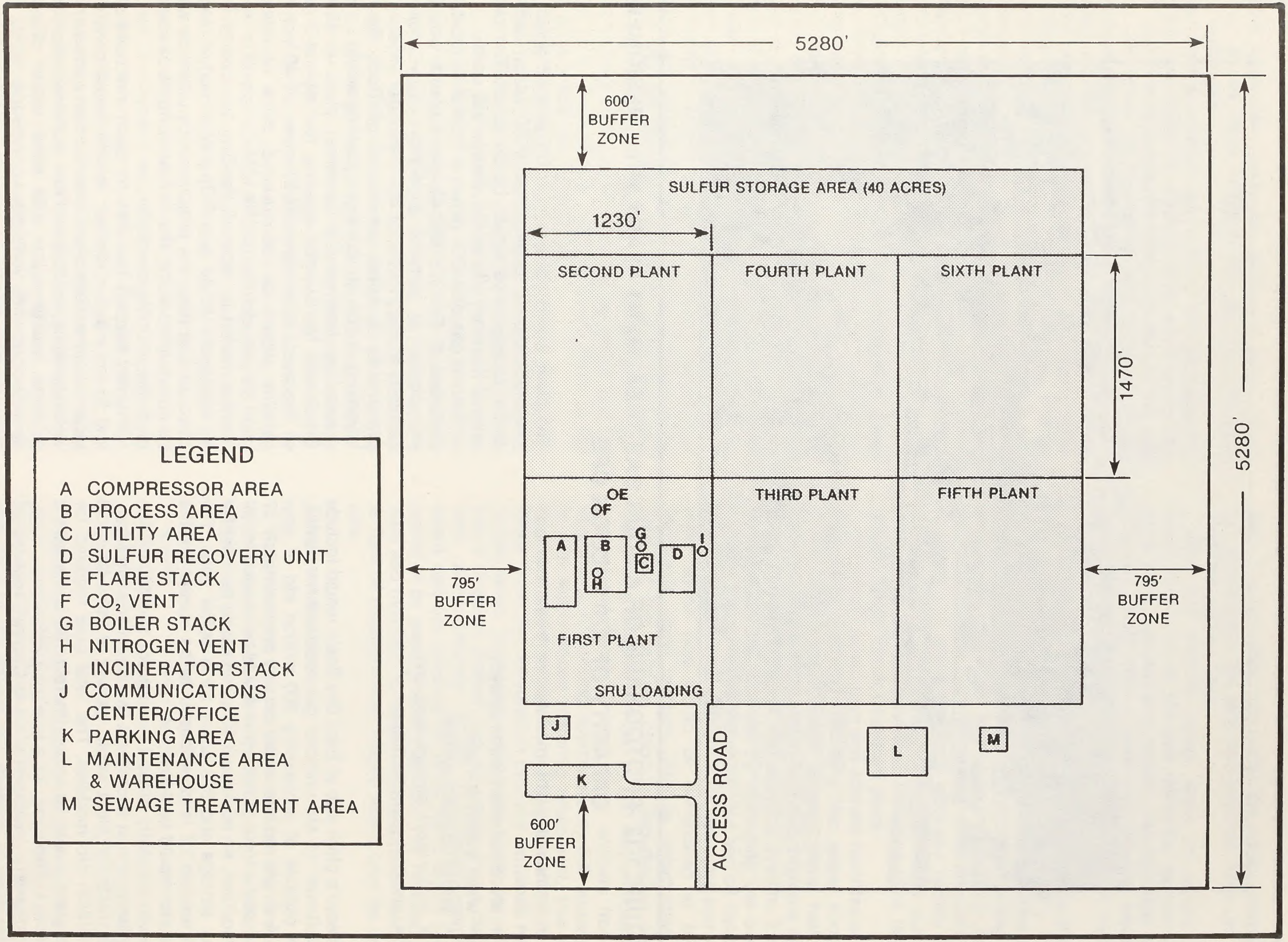

FIGURE 1-13 CONCEPTUAL SITE PLAN FOR A 1.2 BILLION CFD GAS TREATMENT PLANT

In the event of power outage, diesel-driven emergency generators would be provided at each treatment plant to supply power for critical process controls, detection and alarm systems, lighting, and other required systems; the sulfur loadout facility; and the starting point of the sulfur pipeline to provide heating to ensure that the sulfur stays molten.

Access Roads

A 2.3-mile paved access road would be required from Calpet Road (Sublette County Road 23-134) to Quasar's treatment plant at East Dry Basin. For Exxon's West Dry Basin plant site, a turnout at Calpet Road and an access road would be constructed. The 0.5-mile road would be paved to the plant site entrance.

Existing gravel-surfaced roads would be upgraded and maintained to provide access to Exxon's Big Mesa plant site. Approximately 2 miles of Sublette County road would be improved in accordance with plans approved by the county. An additional 3 miles of road would also be improved.

Northwest's plant site access road would extend from Highway 240 directly east to the treatment plant. It would be paved and 1.4 miles in length.

Access roads to all plant sites would be built to American Association of State Highway Transportation Officials standards.

Transmission Lines

Quasar and Exxon plan to purchase electrical power from Utah Power & Light Company. Electrical power for operation of their treatment plants would require construction of a 75-mile, 345-kilovolt transmission line from near the Naughton Power Plant to the plant sites. Approximately 7 miles of the total distance would parallel an existing transmission line. Tangent structures would be lattice steel H-frames (see Figure 1-8); spans would be approximately 1,000 feet. A lower voltage distribution system would be constructed to supply each plant area. The gas field electrical distribution system would also originate from these substations.

Power for Northwest's treatment plant would also be obtained from Utah Power & Light Company's Naughton Power Plant south of Kemmerer. A 138-kilovolt transmission line would extend southeast from Naughton paralleling an existing transmission line for approximately 12 miles, then turn northeast and continue to where it intersects the proposed railroad spur. The power line would then parallel the railroad spur to the plant site for a total distance of approximately 23 miles. Tangent structures would be wood pole H-frames.

Sulfur Pipeline and Loadout Facility

Elemental sulfur is a by-product of H_2S processing in the treatment plants. Sulfur would be sold as markets are developed. If markets are not identified prior to plant start-up, or if established markets are interrupted, sulfur would be stored in block form at the plant sites until it is needed to supply demand. Quasar's sulfur storage tanks would be capable of holding 1,960 tons of sulfur, the equivalent amount of sulfur produced by all six modules each day. The sulfur would be maintained in molten form and potentially transported in a 54-mile long, above-ground molten sulfur pipeline to the terminus near Opal, Wyoming. This pipeline would be a proposed common pipeline with Exxon.

Approximately 2,240 tons of sulfur per day would be produced when Exxon's two plants are operating at design capacity (Exxon's sulfur recovery process would be more efficient than Quasar's). Exxon plans to transport sulfur as a molten liquid in an electrically heated, 6-inch diameter, above-ground pipeline from the treatment plants to a loadout facility that would be located on a railroad spur near Opal, Wyoming (see Figures 1-7 and 1-14). The sulfur pipeline would have an average clearance of 7 feet above ground level. To date an electrically heated molten sulfur pipeline of this length has not been built and operated. Sulfur produced at the initial 200-million cfd gas treatment module at the West Dry Basin plant may be transported by trucks prior to startup of the proposed pipeline.

The 240-acre sulfur loadout facility would include railcar loading facilities, sulfur storage and handling facilities, boiler facilities, water treatment facilities, and an operations/maintenance building. Product storage would be provided in the event of transport or market interruptions. Approximately 1 mile of railroad spur would be constructed, and 0.5 mile of existing unimproved road would be upgraded to provide access. Twenty-four 100-ton railroad cars would be loaded per day for full-scale plant operations.

An access road would be constructed to the sulfur loadout facility which would be located approximately 2.5 miles east of Opal. An exit or turning lane, built to and approved by Wyoming State Highway Department standards, would be constructed at U.S. Highway 30, and a road to the facilities would be constructed as for the West Dry Basin treatment plant.

At Northwest's treatment plant, sulfur would be recovered and kept in a molten state, stored in an adjacent underground storage tank, and pumped from the tank directly to rail cars. Sulfur would be diverted to block storage only when necessary. In the event of mechanical problems, or should the sulfur sales market deteriorate, a large area would be needed for block sulfur storage. Forty acres would be provided at the east side of the lease to accommodate 20 years of production. A 10-acre evaporation pond about 13 feet deep would adjoin the sulfur block to collect, contain, and evaporate precipitation runoff from the sulfur block. The pond would be lined with expanding clay or a synthetic material to prevent seepage and would conform to agency requirements. Sulfur is not soluble in water, and when stored as solid blocks would not be subject to wind and/or water erosion.

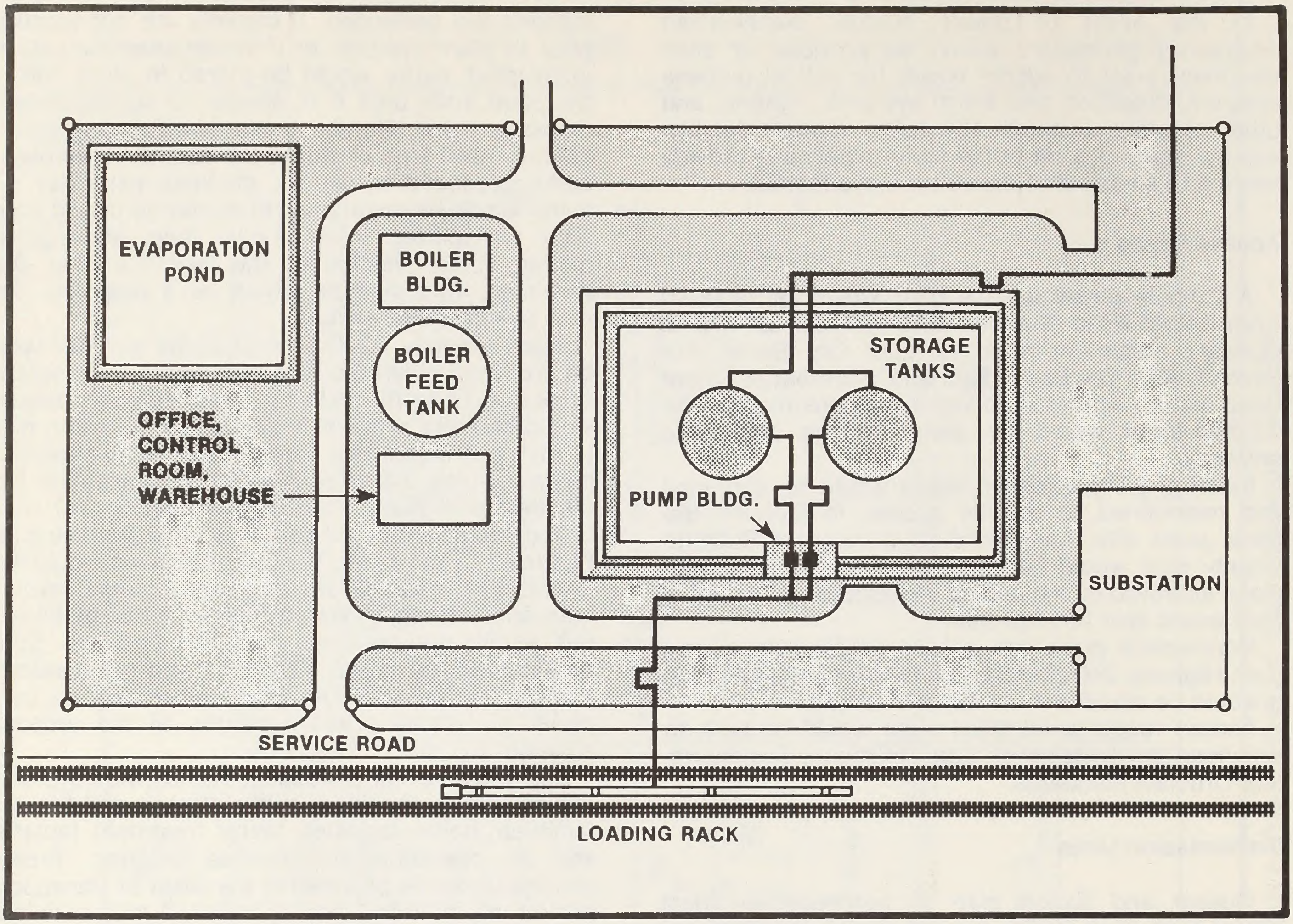

FIGURE 1-14 SULFUR LOADOUT FACILITY

Rail Spur

Northwest would build a railroad spur from the Union Pacific mainline to the treatment plant. The spur would extend from a point about 3 miles east of Opal in a northerly direction to the west lease boundary, a distance of about 7 miles. Northwest's plans are for a molten sulfur production rate of 757 tons per day. Sulfur rail cars have a nominal capacity of 100 tons and, therefore, about 53 rail cars per week would be loaded. Union Pacific would pick up a string of cars two to five times a week. Sufficient rail siding would be included to accommodate up to 40 cars.

Water Supply

Water requirements for all applicants (by activity) are presented in Table 1-21. Quasar's potable and process water needs during plant construction would be taken from an on-site groundwater well. Treated water from the sewage treatment plant would be used for construction needs.

A potable water system for personnel use and a raw water system for boiler makeup and other uses would be required at each of Exxon's treatment plants and the sulfur loadout facility. These systems would consist of water wells and associated equipment and electrical power. At Exxon's sulfur loadout facility and each treatment plant site approximately one and three water wells, respectively, would be drilled into the Wasatch Formation to depths of less than 500 feet. It is expected that each well would have a maximum yield of 50 gallons/minute (80 acre-feet/year).

Northwest's treatment plant water requirements would be supplied from the Green River. A raw water pipeline would extend from a reinforced concrete intake structure on the Green River below the Fontenelle Dam to the plant site. The approximate distance would be 12 miles using 8-inch pipe, buried to a depth of 8 feet. Raw water would be stored in a large tank and serve as plant makeup water storage and fire water storage.

Ancillary Plant Facilities

Quasar's facilities would include structures such as office and communica tion buildings, and the maintenance base. The maintenance base would be located at the plant site and would be used by well field personnel during drilling, well completion, and production operations.

Exxon would use a key telephone system to provide access to lines serving the plants from any telephone set; probably either Wyoming Telephone Company or Mountain Bell Telephone Company would provide and install the telephone lines. The closest trunk facility to the plants is at Calpet, Wyoming, and would require approximately 11 miles and 5 miles of buried cable to the West Dry Basin plant and Big Mesa plant, respectively. Separate two-way radio systems would also be used.

Communications from Northwest's plant to the well field would be by microwave. Microwave facilities would be installed at each wellhead facility for monitoring purposes and to shut in any number of wells in case of an emergency. The plant would also use microwave to tie in to the Mountain Bell telephone system. A land line for teletype communication with Union Pacific Railroad may be necessary.

A construction camp is proposed to be built adjacent to Northwest's plant site and within the 640-acre leased area. The 45-acre camp area would consist of housing units and infrastructure to accommodate a peak capacity of 1,500 persons including direct hire craftsmen, subcontractors, and camp operating personnel; recreational vehicle park and infrastructure for 200 units; kitchen and dining facilities; recreation room, warehouse, and operations building; infirmary; staff housing; parking; water and waste water treatment; and power generation equipment.

COMPONENT ALTERNATIVES

Component alternatives to the Proposed Action and the three siting alternatives have been submitted by the applicants and agencies as optional ways to accomplish various aspects of the project. The component alternatives deal with sulfur transport, power supply, and employee housing. Figure 1-15 illustrates the possible application of the component alternatives to the Proposed Action or the siting alternatives. These alternatives deal only with single components of an applicant's proposal or alternative and, thus, are being considered separately from the siting alternatives. The land requirements associated with the component alternatives are in Table 1-10 and the acreage which would be disturbed by the component alternatives is shown in Table 1-11. Standard Operating Procedures associated with the component alternatives are presented in Appendix B.

SULFUR TRANSPORT

An alternative to a molten sulfur pipeline for transportation of the sulfur produced at Exxon's and Quasar's treatment plants would be a railroad spur extended to the West Dry Basin site. This component alternative could be applied to the Proposed Action, Buckhorn Alternative, or Northern Alternative (see Figure 1-15). A spur could be constructed to the West Dry Basin site from either an existing spur or from the Union Pacific Railroad main line. Construction of a railroad to the plant site would require approximately 91.5 miles of railroad spur to connect the plant site with Stauffer Chemical Company's spur for their trona mine and chemical plant northwest of Green River, Wyoming (see Map 1-4, map pocket). The 100-foot wide right-of-way would require approximately 1,109 acres. Railroad construction would be the same as described in the Proposed Action.

The molten sulfur produced at the plants would be collected in on-site tanks designed for five-day capacity. The railroad spur would be located adjacent to the storage tank at the West Dry Basin site so loading of railcars could be completed through a short pipeline. The loading equipment and procedure would be the same as discussed for the Proposed Action. A short, electrically heated, molten sulfur pipeline (approximately 7 miles long) would be constructed from the Big Mesa plant site to the West Dry Basin loadout facility. This pipeline would require approximately 54 acres. The pipeline would be of similar construction as described in the Proposed Action.

Construction of a railroad spur to the Shute Creek alternative plant site for transporting molten sulfur would require approximately 8.5 miles of railroad spur. The spur would originate from Northwest's rail spur to the Craven Creek plant site, and follow the proposed sulfur pipeline route to the Shute Creek plant site. This railroad spur would require 102 acres for construction along a 100-foot right-of-way.

POWER SUPPLY

Two power supply alternatives to the applicants' proposed system have been submitted. The total lengths of these three systems for all alternatives are summarized in Table 1-12. Utah Power & Light Company (UP&L) has submitted to BLM alternative routes for electric transmission lines to service the Riley Ridge Project. These optional routes are shown on Map 1-4 (see map pocket). In addition, UP&L has located a new substation south of Big Piney which would service the northern plant sites. Voltage levels for the transmission lines (between 138 and 345 kilovolts) would be selected to adequately supply the final load centers. Construction and operation of transmission lines along UP&L's alternative routes would be the same as described for the Proposed Action.

The BLM has also developed an alternative transmission line system which utilizes parts of the applicants' and UP&L's systems (see Map 1-4 map pocket). The BLM's rationale for needing an additional alternative was that neither of the other two transmission line systems follow existing linear corridors to a significant degree. BLM policy is to encourage use of existing corridors wherever possible. As a result of recent scoping meetings in the BLM Rock Springs District, the BLM area managers are

Component Alternative	Siting Alternative			
	Proposed Action	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Sulfur Transport				
Railroad to West Dry Basin	●	●		●
Railroad to Shute Creek			●	
Power Supply				
UP&L System				
Proposed Action	●			
Buckhorn Alternative		●		
Shute Creek Alternative			●	
Northern Alternative				●
Power Supply				
BLM System				
Proposed Action	●			
Buckhorn Alternative		●		
Shute Creek Alternative			●	
Northern Alternative				●
Employee Housing				
East Dry Basin Camp	●			
West Dry Basin Camp	●	●		
Big Mesa Camp	●			●
Buckhorn Camp			●	
Shute Creek Camp			●	

FIGURE 1-15 COMPONENT ALTERNATIVES AS APPLICABLE TO SITING ALTERNATIVES

TABLE 1-10
LAND REQUIREMENTS FOR THE COMPONENT ALTERNATIVES

	BLM		FS		BuRec		State		Private		Total	
	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres
Sulfur Transport												
Railroad to West Dry Basin[1]	57.5	697	0	0	12.0	145	4.0	49	18.0	218	91.5	1,109
Railroad to Shute Creek	8.5	103	0	0	0	0	0	0	0	0	8.5	103
Power Supply												
UP&L System												
Proposed Action	68.5	830	0	0	1.0	12	5.5	67	20.0	243	95.0	1,152
Buckhorn Alternative	70.0	848	0	0	1.0	12	5.5	67	21.0	255	97.5	1,182
Shute Creek Alternative	76.0	921	0	0	1.0	12	5.5	67	21.5	261	104.0	1,261
Northern Alternative	63.0	764	0	0	1.0	12	6.5	79	9.5	115	80.0	970
BLM System												
Proposed Action	81.0	982	0	0	0	0	3.0	36	15.5	188	99.5	1,206
Buckhorn Alternative	82.5	1,000	0	0	0	0	3.0	36	16.5	200	102.0	1,236
Shute Creek Alternative	83.5	1,012	0	0	0	0	3.0	36	16.5	200	103.0	1,248
Northern Alternative	66.5	806	0	0	0	0	3.5	42	12.0	146	82.0	994
Employee Housing												
East Dry Basin Camp	0	320	0	0	0	0	0	0	0	0	0	320
West Dry Basin Camp	0	320	0	0	0	0	0	0	0	0	0	320
Big Mesa Camp	0	320	0	0	0	0	0	0	0	0	0	320
Buckhorn Camp	0	320	0	0	0	0	0	0	0	0	0	320
Shute Creek Camp	0	320	0	0	0	0	0	0	0	0	0	320

[1] Exxon's railroad to West Dry Basin would cross approximately 4 miles of Seedkadee National Wildlife Refuge and disturb approximately 48 acres of land. While the refuge is managed by the Fish and Wildlife Service, the land within the refuge boundaries is owned by federal, state, and private entities. Affected land would break down as follow: State - 1.5 miles, 18 acres; Private - 2.5 miles, 30 acres.

also aware of public concern on the multiplying of corridors. The BLM transmission line alternative was developed to maximize the amount of shared corridor utilized by the proposed transmission lines for the Riley Ridge Project. A comparison of shared corridor lengths is also presented in Table 1-12.

EMPLOYEE HOUSING

Both Exxon and Quasar have proposed construction camps as options to housing construction employees in local communities. Camp sites have been identified for the Proposed Action and the siting alternatives. A detailed description of the type and layout of the various components in the camps has not been developed at this time. The actual design of a camp would be coordinated with the involved agencies to assure that all concerns were met.

Two construction camps for Exxon's facilities would be located on public land administered by the BLM. The first campsite would be located near Hogsback Ridge in Sections 8 and 17, T27N, R113W. A camp at this site would be about 8 miles south of the West Dry Basin site and 1 mile southwest the Big Mesa site (see Map 1-4, map pocket). The camp would house up to 900 workers assigned to construct the dehydration facilities, treatment plant, gathering system, sulfur pipeline, and associated facilities. The second construction camp would be located at East Dry Basin between County Road 235 and South Piney Creek in Sections 19 and 20, T29N, R112W. A camp at this site would be 2.5 miles from the West Dry Basin plant site.

An existing electrical transmission line could be used to supply 3 megawatts of 220-volt power to the camp. Water requirements for each camp would be approximately 47 gallons/minute (75 acre-feet/year) and would come from three wells drilled on the site. Sewage from the construction camp would be treated in septic tanks or wastewater systems using a drain field. The raw sewage rate from the camp would be approximately 47 gallons/minute (75 acre-feet/year).

Component alternatives for the Shute Creek Alternative would include a construction camp located near Exxon's treatment plant site in Section 26, T22N, R112W. This camp would house up to 900 workers. A camp at this site would be 2 miles south of the plant site. Potable water for the camp would come from wells drilled at the site. Water and sewage treatment requirements would be the same as described for the West Dry Basin and Big Mesa camps. Electrical

TABLE 1-11
NUMBER OF ACRES AFFECTED BY EACH COMPONENT ALTERNATIVE

	Construction	Reclaimed	Operation	Reclaimed	Abandonment[1]
Sulfur Transport[2]					
Railroad to West Dry Basin[1]	1,109	832	277	111	166
Railroad to Shute Creek	103	77	26	11	15
Power Supply					
UP&L System					
Proposed Action	1,152	1,152	0	0	0
Buckhorn Alternative	1,182	1,182	0	0	0
Shute Creek Alternative	1,261	1,261	0	0	0
Northern Alternative	970	970	0	0	0
Power Supply					
BLM System					
Proposed Action	1,206	1,206	0	0	0
Buckhorn Alternative	1,236	1,236	0	0	0
Shute Creek Alternative	1,248	1,248	0	0	0
Northern Alternative	994	994	0	0	0
Employee Housing					
East Dry Basin Camp	320	320	0	0	0
West Dry Basin Camp	320	320	0	0	0
Big Mesa Camp	320	320	0	0	0
Buckhorn Camp	320	320	0	0	0
Shute Creek Camp	320	320	0	0	0

[1] Represents the number of acres of disturbance that would not be reclaimed after the project is abandoned. Included here are facilities that would continue in use after project abandonment, or are infeasible to reclaim.

[2] It is assumed that the operational right-of-way would be 25 feet wide and that a 15-foot wide portion of the right-of-way would be infeasible to reclaim upon project abandonment.

power would be obtained by extending a power line from the plant construction site.

The temporary right-of-way for any of these camps would be 320 acres. This would include space for living quarters, parking, runoff water, waste water facilities, and storage areas. Access would be on existing roads.

After the gas treatment plant, sulfur pipeline, and gas field systems are completed, the construction camp would no longer be required. All structures would be salvaged. Pipelines would be capped and abandoned in place. Electrical lines and poles would be removed. All foundations would be demolished. All unsalvageable materials would be disposed of in a waste area arranged with a landowner or other authorizing official, in conformance with the Wyoming DEQ regulations.

Quasar's construction camp would be located in the south one-half of Section 24, T29N, R112W, approximately 2 miles northeast of the East Dry Basin plant site. Details on camp construction, operation, and abandonment have not been developed at this time. However, it is assumed that 50 percent of Quasar's work force (up to 500 workers) would be housed in the construction camp and that camp size, facilities, and abandonment procedures would be similar to Exxon's camps.

The construction camp alternative for Quasar's Buckhorn site would be located in the west one-half of Section 29, T28N, R110W. All facilities at the Buckhorn construction camp would be the same as the East Dry Basin construction camp.

SITING ALTERNATIVES

Three project siting alternatives, the Buckhorn, Shute Creek, and Northern Alternatives, were analyzed for the Riley Ridge Project. The siting alternatives differ from the Proposed Action primarily in the location of certain plant sites and associated corridors. These alternatives change some aspect of the Proposed Action while keeping other aspects unchanged.

TABLE 1-12
LENGTH OF ALTERNATIVE TRANSMISSION LINE SYSTEMS AND SHARED CORRIDORS (IN MILES)

	Proposed Action	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Applicants' System	97.5 (21)[1]	101.5 (21)	104.0 (21)	84.0 (9.5)
UP&L System	95.0 (17.5)	97.5 (17.5)	104.0 (17.5)	80.0 (11)
BLM System	99.5 (56.5)	102.0 (56.5)	103.0 (56.5)	82.0 (46.5)

[1]( ) indicates miles of shared corridor.

BUCKHORN ALTERNATIVE

The Buckhorn Alternative would be the same as the Proposed Action except that Quasar's plant would be located at the Buckhorn site (Sections 16 and 21, T28N, R110W) and Exxon's second plant would be located at East Dry Basin (Sections 33 and 34, T29N, R112W) rather than Big Mesa. The total alternative is summarized below.

Applicant	Site	Treatment Capacity (billion cfd)
Quasar	Buckhorn	1.2
Exxon	West Dry Basin	.6
	East Dry Basin	.6
Northwest/Mobil	Craven Creek	.4

Total gas treatment capacity would remain the same as the Proposed Action, 2.8 billion cfd.

The Buckhorn Alternative (and each other alternative) will be analyzed as a total unit for all resource elements. However, in order to avoid duplication of descriptive information presented under the Proposed Action, only a discussion of the Buckhorn and East Dry Basin site facilities will be presented in this section. All other aspects of the alternative would be the same as the Proposed Action.

The Buckhorn site is located about 13 miles southeast of Big Piney, Wyoming, on the east side of the Green River (see Map 1-5, map pocket). The site is relatively level, ranging in elevation from about 7,200 to 7,260 feet and has no prominent landmarks.

The East Dry Basin site is located about 6 miles southwest of Big Piney. The site is relatively flat with an elevation of approximately 7,000 feet.

Quasar and Exxon propose no significant differences in the facilities or layout of the treatment plants at the Buckhorn and East Dry Basin sites as compared to the Proposed Action. Therefore, the major differences between the Proposed Action and the Buckhorn Alternative would be the location and length of the linear facilities, such as the pipelines and transmission lines associated with the plants. The linear facilities associated with the Buckhorn Alternative are shown on Map 1-5 (map pocket).

Some changes in the northern portions of the sales gas pipelines, CO_2 pipelines, and transmission line routes would be required due to the different site locations. The transmission line to the Buckhorn site would cross the Green River near Reardon Draw. The molten sulfur pipeline would originate at the Buckhorn site, descend Reardon Draw, cross the Green River via an aerial crossing, join the proposed route about 10 miles south of Big Piney, and continue on to the rail loadout near Opal. Quasar's sour gas trunk line would be upsized to 36 inches in diameter, while William's trunk line would remain at 26 inches in diameter. These pipelines would cross the Green River in a buried crossing and would also use Reardon Draw to reach the Buckhorn site. The land requirements associated with the Buckhorn Alternative are shown in Table 1-13 and the acreage disturbed during construction, operation, and abandonment for the site and linear facilities are summarized in Table 1-14.

SHUTE CREEK ALTERNATIVE

The Shute Creek Alternative would locate all sour gas treatment facilities outside of the Dry Basin area. This alternative is summarized below.

Applicant	Site	Treatment Capacity (billion cfd)
Quasar	Buckhorn	1.2
Exxon	Shute Creek	1.2
Northwest/Mobil	Craven Creek	.4

The Buckhorn site and the Craven Creek site have been discussed under the previous alternative and the Proposed Action, respectively, and will not be repeated here. The Shute Creek site and modified linear facilities are discussed in the following paragraphs.

TABLE 1-13
LAND REQUIREMENTS FOR THE BUCKHORN ALTERNATIVE[1]

	BLM		FS		BuRec		State		Private		Total	
	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres
Quasar												
Well Sites	0	75	0	148	0	0	0	0	0	40	0	263
Plant Site	0	320	0	0	0	0	0	320	0	0	0	640
Plant Access Roads	9.5	34	0	0	0	0	1.0	4	3.0	11	13.5	49
Gathering System	14.0	85	32.0	194	0	0	2.0	12	15.0	91	63.0	382
Well Access Roads	18.5	68	38.0	138	0	0	2.0	7	20.0	73	78.5	286
Trunk Line	17.0	155	0	0	0	0	1.0	9	2.5	23	20.5	187
Transmission Lines	6.5	79	0	0	0	0	1.0	12	2.0	24	9.5	115
Sales Pipeline	56.0	339	0	0	4.0	24	0	0	14.0	85	74.0	448
CO_2 Pipeline	56.0	339	0	0	4.0	24	0	0	14.0	85	74.0	448
Sulfur Pipeline	6.0	55	0	0	0	0	1.0	9	2.0	18	9.0	82
Subtotal	183.5	1,549	70.0	480	8.0	48	8.0	373	72.5	450	342.0	2,900
Williams												
Well Sites	0	59	0	0	0	0	0	4	0	26	0	89
Gathering System	7.0	42	0	0	0	0	1.0	6	25.0	152	33	200
Well Access Roads	21.0	89	0	0	0	0	0	0	8.0	34	29	123
Trunk Line	17.0	155	0	0	0	0	1.0	9	2.5	23	20.5	187
Subtotal	45.0	345	0	0	0	0	2.0	19	35.5	235	82.5	599
Exxon												
Well Site	0	234	0	228	0	0	0	13	0	27	0	502
Plant Sites	0	1,280	0	0	0	0	0	0	0	0	0	1,280
Sulfur Loadout	0	80	0	0	0	0	0	0	0	160	0	240
Plant Access Roads	3.0	18	0	0	0	0	0	0	0	0	3.0	18
Gathering System	28.0	339	47.0	570	0	0	3.0	36	13.0	158	91.0	1,103
Well Access Roads	37.0	224	49.0	297	0	0	1.0	6	14.0	85	101.0	612
Trunk Line	4.5	55	0	0	0	0	0	0	0	0	4.5	55
Transmission Lines	54.0	654	0	0	0	0	4.0	48	11.0	133	69.0	835
Sales Pipeline	72.0	873	0	0	4.0	48	0	0	15.0	182	91.0	1,103
CO_2 Pipeline	72.0	873	0	0	4.0	48	0	0	15.0	182	91.0	1,103
Sulfur Pipeline	43.5	396	0	0	0	0	7.5	68	9.0	82	60.0	546
Subtotal	314.0	5,026	96.0	1,095	8.0	96	15.5	171	77.0	1,009	510.5	7,397
Mobil/Northwest												
Well Sites	0	248	0	0	0	0	0	0	0	0	0	248
Plant Site	0	640	0	0	0	0	0	0	0	0	0	640
Plant Access Roads	1.0	6	0	0	0	0	0	0	0	0	1.0	6
Gathering System	54.0	327	0	0	0	0	1.0	6	15.0	91	70.0	424
Well Access Roads	79.0	479	0	0	0	0	2.0	12	8.0	48	89.0	539
Trunk Line	35.0	318	0	0	0	0	2.5	23	4.5	40	42.0	381
Transmission Lines	11.0	133	0	0	0	0	0	0	12.0	145	23.0	278
Sales Pipeline	2.0	12	0	0	0	0	0	0	0	0	2.0	12
CO_2 Pipeline	9.0	82	0	0	0	0	0	0	18.0	164	27.0	246
Railroad Spur	5.0	61	0	0	0	0	0	0	2.0	24	7.0	85
Water Pipeline	11.0	80	0	0	1.0	7	0	0	0	0	12.0	87
Subtotal	207.0	2,386	0	0	1.0	7	5.5	41	59.5	512	273.0	2,946
Total	749.5	9,306	166.0	1,575	17.0	151	31.0	604	244.5	2,206	1,208.0	13,842

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[1] Land required for facility construction. Disturbed areas not needed for permanent facilities would be reclaimed following construction. Existing roads which would be upgraded for well field or plant access are not considered to be new disturbances.

TABLE 1-14
NUMBER OF ACRES DISTURBED BY COMPONENT FOR THE BUCKHORN ALTERNATIVE

	Construction	Reclaimed	Operation	Reclaimed	Abandonment[1]
Well Field					
Well Sites	1,102	658	444	444	0
Gathering System	2,109	2,109	0	0	0
Access Roads[2]	757	0	757	151	606
Plant Sites	2,800	0	2,800	2,800	0
Corridors					
Railroad[3]	85	64	21	8	13
Pipelines[4]	4,885	4,760	125	125	0
Transmission Line	1,228	1,228	0	0	0
Access Roads	17	0	17	3	14
Total	12,983	8,819	4,164	3,531	633

[1] Represents the number of acres of disturbance that would not be reclaimed after the project is abandoned. Included here are facilities that would continue in use after project abandonment, or are infeasible to reclaim.

[2] Many existing roads would only require upgrading; thus, new disturbance would be less than total land requirement. It is assumed that 80 percent of the project road system would remain in use after project abandonment.

[3] It is assumed that the operational right-of-way would be 25 feet wide and that a 15-foot wide portion of the right-of-way would be infeasible to reclaim upon project abandonment.

[4] It is assumed that the sulfur pipeline would require a 15-foot wide strip for an access trail during project operation.

Exxon's Shute Creek Alternative plant site (Section 14, T22N, R112W) is located approximately 43 miles south of the West Dry Basin site and 9 miles east of Northwest's Craven Creek site (see Map 1-6, map pocket). The site is 14 miles northeast of Opal and 6 miles south of Fontenelle. The elevation of the site is approximately 6,450 feet. An oil and gas field is located in the vicinity of the plant site, and numerous well sites, production facilities, pipelines, and roads have been constructed. A BuRec electrical transmission line passes from Fontenelle Dam south to Flaming Gorge Reservoir and an access road, which would provide access to the plant site, follows this power line through the site.

As with the Buckhorn Alternative, the main differences between the Shute Creek Alternative and the Proposed Action would be the relocation of facilities. The physical description and operating characteristics of the facilities in the gas treatment plant and associated pipelines and transmission lines would be the same as presented for the Proposed Action.

The Shute Creek treatment plant site would be designed for the entire 1.2-billion cfd gas capacity, built as six modules. Each module would contain the components described under the Proposed Action, and the entire site development would be similar to, but larger than, the proposed 0.6-billion cfd plants at West Dry Basin and Big Mesa.

The plant site would be located on 640 acres of land administered by the BLM. Access to the plant site would be from Wyoming State Highways 372 and 240, and U.S. Highway 30. A total of 27.5 miles of existing primitive road would be upgraded. Nine miles of this road pass through private land, while the remaining 18.5 miles are located on the land administered by the BLM.

The land requirements associated with the Shute Creek Alternative are shown in Table 1-15 and acreage requirements for the site and linear facilities during construction, operation, and abandonment are shown in Table 1-16. The demand for power at the Buckhorn site and well field would still necessitate the construction of a transmission line from the Naughton Power Plant to the LaBarge area.

NORTHERN ALTERNATIVE

The Northern Alternative would locate all gas treatment facilities in the northern half of the project area, near Big Piney, and is summarized below.

Applicant	**Site**	**Treatment Capacity (billion cfd)**
Quasar	Buckhorn	1.2
Exxon	West Dry Basin	.6
	Big Mesa	.6
Northwest/Mobil	East Dry Basin	.4

The plant sites and linear facilities for the Northern Alternative are presented on Map 1-7 (map pocket). All of these sites have been discussed under the Proposed Action or a previous alternative. Linear facilities, except for those to service Northwest's

TABLE 1-15
LAND REQUIREMENTS FOR THE SHUTE CREEK ALTERNATIVE[1]

	BLM		FS		BuRec		State		Private		Total	
	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres
Quasar												
Well Sites	0	75	0	148	0	0	0	0	0	40	0	263
Plant Site	0	640	0	0	0	0	0	0	0	0	0	640
Plant Access Roads	9.5	34	0	0	0	0	1.0	4	3.0	11	13.5	49
Gathering System	14.0	85	32.0	194	0	0	2.0	12	15.0	91	63.0	382
Well Access Roads	18.5	68	38.0	138	0	0	2.0	7	20.0	73	78.5	286
Trunk Line	17.0	155	0	0	0	0	1.0	9	2.5	23	20.5	187
Transmission Lines	49.0	594	0	0	0	0	5.0	61	12.5	152	66.5	807
Sales Pipeline	56.0	339	0	0	4.0	24	0	0	14.0	85	74.0	448
CO_2 Pipeline	56.0	339	0	0	4.0	24	0	0	14.0	85	74.0	448
Sulfur Pipeline	42.0	382	0	0	0	0	8.5	78	10.5	95	61.0	555
Subtotal	262.0	2,711	70.0	480	8.0	48	19.5	171	91.5	655	451.0	4,065
Williams												
Well Sites	0	59	0	0	0	0	0	4	0	26	0	89
Gathering System	7.0	42	0	0	0	0	1.0	6	25.0	152	33	200
Well Access Roads	21.0	89	0	0	0	0	0	0	8.0	34	29	123
Trunk Line	17.0	155	0	0	0	0	1.0	9	2.5	23	20.5	187
Subtotal	45.0	345	0	0	0	0	2.0	19	35.5	235	82.5	599
Exxon												
Well Site	0	234	0	228	0	0	0	13	0	27	0	502
Plant Site	0	1,280	0	0	0	0	0	0	0	0	0	1,280
Sulfur Loadout	0	80	0	0	0	0	0	0	0	160	0	240
Plant Access Roads	18.5	112	0	0	0	0	0	0	9.0	55	27.5	167
Gathering System	28.0	339	47.0	570	0	0	3.0	36	13.0	158	91.0	1,103
Well Access Roads	37.0	224	49.0	297	0	0	1.0	6	14.0	85	101.0	612
Trunk Line	34.5	418	0	0	0	0	1.5	18	5.0	61	41.0	497
Transmission Lines	14.0	170	0	0	0	0	0	0	0.5	6	14.5	176
Sales Pipeline[2]	21.5	261	0	0	3.5	42	1.0	12	31.0	376	57.0	691
CO_2 Pipeline[2]	21.5	261	0	0	3.5	42	1.0	12	31.0	376	57.0	691
Sulfur Pipeline	10.5	96	0	0	0	0	0	0	1.0	9	11.5	105
Subtotal	185.5	3,475	96.0	1,095	7.0	84	7.5	97	104.5	1,313	400.5	6,064
Mobil/Northwest												
Well Sites	0	248	0	0	0	0	0	0	0	0	0	248
Plant Site	0	640	0	0	0	0	0	0	0	0	0	640
Plant Access Roads	1.0	6	0	0	0	0	0	0	0	0	1.0	6
Gathering System	54.0	327	0	0	0	0	1.0	6	15.0	91	70.0	424
Well Access Roads	79.0	479	0	0	0	0	2.0	12	8.0	48	89.0	539
Trunk Line	35.0	318	0	0	0	0	2.5	23	4.5	40	42.0	381
Transmission Lines	11.0	133	0	0	0	0	0	0	12.0	145	23.0	278
Sales Pipeline	2.0	12	0	0	0	0	0	0	0	0	2.0	12
CO_2 Pipeline	9.0	82	0	0	0	0	0	0	18.0	164	27.0	246
Railroad Spur	5.0	61	0	0	0	0	0	0	2.0	24	7.0	85
Water Pipeline	11.0	80	0	0	1.0	7	0	0	0	0	12.0	87
Subtotal	207.0	2,386	0	0	1.0	7	5.5	41	59.5	512	273.0	2,946
Total	699.5	8,886	166.0	1,575	16.0	139	34.5	328	291.0	2,709	1,207.0	13,637

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[1] Land required for facility construction. Disturbed areas not needed for permanent facilities would be reclaimed following construction. Existing roads which would be upgraded for well field or plant access are not considered to be new disturbances.

[2] Exxon's sales gas and CO_2 pipelines would cross approximately 2 miles of Seedskadee National Wildlife Refuge and disturb approximately 48 acres of land. While the refuge is managed by the Fish and Wildlife Service, the land within the refuge boundaries is owned by federal, state, and private entities. Affected land would break down as follows: State - 1 mile, 24 acres; Private - 1 mile, 24 acres.

TABLE 1-16
NUMBER OF ACRES DISTURBED BY COMPONENT FOR THE SHUTE CREEK ALTERNATIVE

	Construction	Reclaimed	Operation	Reclaimed	Abandonment[1]
Well Field					
Well Sites	1,102	658	444	444	0
Gathering System	2,109	2,109	0	0	0
Access Roads[2]	757	0	757	151	606
Plant Sites	2,160	0	2,160	2,160	0
Corridors					
Railroads[3]	85	64	21	8	13
Pipelines[4]	4,535	4,403	132	132	0
Transmission Line	1,261	1,261	0	0	0
Access Roads	106	0	106	21	85
Total	12,115	8,495	3,620	2,916	704

[1] Represents the number of acres of disturbance that would not be reclaimed after the project is abandoned. Included here are facilities that would continue in use after project abandonment, or are infeasible to reclaim.

[2] Many existing roads would only require upgrading; thus, new disturbance would be less than total land requirement. It is assumed that 80 percent of the project road system would remain in use after project abandonment.

[3] It is assumed that the operational right-of-way would be 25 feet wide and that a 15-foot wide portion of the right-of-way would be infeasible to reclaim upon project abandonment.

[4] It is assumed that the sulfur pipeline would require a 15-foot wide strip for an access trail during project operation.

plant at East Dry Basin, have also been discussed previously. Northwest's sour gas trunk pipeline and sales gas pipeline would be located in corridors utilized by other applicants. For analysis purposes, it has been assumed that Northwest's CO_2 pipeline would parallel Exxon's to the Trailblazer Pipeline and that Northwest would utilize Exxon's molten sulfur pipeline to transport their sulfur by-product to the sulfur loadout near Opal.

Specific aspects of treatment plant and linear facility construction would be the same as described for the Proposed Action. The land requirements by applicant for the Northern Alternative are shown in Table 1-17, and a summary of the acreage requirements for the site and linear facilities during construction, operation, and abandonment is presented in Table 1-18.

NO ACTION ALTERNATIVES

The purpose of this alternative is to analyze impacts which would occur if the Proposed Action or any of its alternatives were not implemented. The "Questions and Answers About the NEPA Regulations" (published in the *Federal Register*, Vol. 46, No. 55), provide guidelines to agencies for preparing the No Action Alternative (page 18027. Essentially, these guidelines state that agencies should consider a No Action Alternative even if it is outside the legal jurisdiction of an agency or the scope of what Congress has approved or funded. In addition, the guidelines state that if disapproving a proposed action or alternatives creates the need for another action in place of it, the No Action Alternative must analyze the effects of that action.

The Riley Ridge Project is composed of two categories of authorizing actions, one being the consideration of well field activities as a cumulative total to help facilitate the approval or disapproval of APD actions for approved federal gas leasees, and the other the consideration of granting rights-of-way permits for proposed sour gas treatment plants and their ancillary facilities. The low-Btu (sour) gas that is drilled for must be processed to be marketable to the consumer, thus the two authorizing actions are interdependent. In addition, wells would probably not be drilled on a large scale if processing facilities were not readily available.

No Action would constitute BLM and FS denial of each of the rights-of-way applications submitted by the companies. This would mean that none of the gas treatment plants and ancillary facilities would be built and no action would be allowed in the well field as applied for in the project rights-of-way applications. Some wells could still be drilled by operators later submitting individual APDs and the agencies preparing individual environmental assessments for each APD.

Thus, No Action would create three possible alternatives: (1) denial of entire project, (2) denial of treatment plants, and (3) denial of one or more of the proposed treatment plants. These are discussed in more detail following.

TABLE 1-17
LAND REQUIREMENTS FOR THE NORTHERN ALTERNATIVE[1]

	BLM		FS		BuRec		State		Private		Total	
	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles	Acres
Quasar												
Well Sites	0	75	0	148	0	0	0	0	0	40	0	263
Plant Site	0	640	0	0	0	0	0	0	0	0	0	640
Plant Access Roads	9.5	34	0	0	0	0	1.0	4	3.0	11	13.5	49
Gathering System	14.0	85	32.0	194	0	0	2.0	12	15.0	91	63.0	382
Well Access Roads	18.5	68	38.0	138	0	0	2.0	7	20.0	73	78.5	286
Trunk Line	17.0	155	0	0	0	0	1.0	9	2.5	23	20.5	187
Transmission Lines	6.5	79	0	0	0	0	1.0	12	2.0	24	9.5	115
Sales Pipeline	56.0	339	0	0	4.0	24	0	0	14.0	85	74.0	448
CO_2 Pipeline	56.0	339	0	0	4.0	24	0	0	14.0	85	74.0	448
Sulfur Pipeline	13.5	123	0	0	0	0	1.0	9	3.0	27	17.5	159
Subtotal	191.0	1,937	70.0	480	8.0	48	8.0	53	73.5	459	350.5	2,977
Williams												
Well Sites	0	59	0	0	0	0	0	4	0	26	0	89
Gathering System	7.0	42	0	0	0	0	1.0	6	25.0	152	33	200
Well Access Roads	21.0	89	0	0	0	0	0	0	8.0	34	29	123
Trunk Line	17.0	155	0	0	0	0	1.0	9	2.5	23	20.5	187
Subtotal	45.0	345	0	0	0	0	2.0	19	35.5	235	82.5	599
Exxon												
Well Site	0	234	0	228	0	0	0	13	0	27	0	502
Plant Site	0	1,280	0	0	0	0	0	0	0	0	0	1,280
Sulfur Loadout	0	80	0	0	0	0	0	0	0	160	0	240
Plant Access Roads	4.5	27	0	0	0	0	0	0	1.0	6	5.5	33
Gathering System	28.0	339	47.0	570	0	0	3.0	36	13.0	158	91.0	1,103
Well Access Roads	37.0	224	49.0	297	0	0	1.0	6	14.0	85	101.0	612
Trunk Line	0.5	6	0	0	0	0	0	0	0	0	0.5	6
Transmission Lines	58.0	703	0	0	0	0	4.0	48	11.5	140	73.5	891
Sales Pipeline	75.5	915	0	0	4.0	48	1.0	12	17.0	206	97.5	1,181
CO_2 Pipeline	75.5	915	0	0	4.0	48	1.0	12	17.0	206	97.5	1,181
Sulfur Pipeline	39.5	360	0	0	0	0	7.0	64	7.5	68	54.0	492
Subtotal	318.5	5,083	96.0	1,095	8.0	96	17.0	191	81.0	1,056	520.5	7,521
Mobil/Northwest												
Well Sites	0	248	0	0	0	0	0	0	0	0	0	248
Plant Site	0	640	0	0	0	0	0	0	0	0	0	640
Plant Access Roads	2.5	6	0	0	0	0	0	0	0	0	2.5	15
Gathering System	54.0	327	0	0	0	0	1.0	6	15.0	91	70.0	424
Well Access Roads	79.0	479	0	0	0	0	2.0	12	8.0	48	89.0	539
Trunk Line	4.5	41	0	0	0	0	0	0	0	0	4.5	41
Transmission Lines	1.0	12	0	0	0	0	0	0	0	0	1.0	12
Sales Pipeline	17.0	103	0	0	0	0	1.0	6	2.0	12	20.0	121
CO_2 Pipeline	67.5	614	0	0	4.0	36	0	0	15.0	136	86.5	786
Water Pipeline	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	225.5	2,479	0	0	4.0	36	4.0	24	40.0	287	273.0	2,826
Total	780.0	9,844	166.0	1,575	20.0	180	31.0	287	230.0	2,037	1,227.0	13,923

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[1] Land required for facility construction. Disturbed areas not needed for permanent facilities would be reclaimed following construction. Existing roads which would be upgraded for well field or plant access are not considered to be new disturbances.

TABLE 1-18
NUMBER OF ACRES DISTURBED BY COMPONENT FOR THE NORTHERN ALTERNATIVE

	Construction	Reclaimed	Operation	Reclaimed	Abandonment[1]
Well Field					
Well Sites	1,102	658	444	444	0
Gathering System	2,109	2,109	0	0	0
Access Roads[2]	757	0	757	151	606
Plant Sites	2,800	0	2,800	2,800	0
Corridors					
Pipelines[3]	5,237	5,237	0	0	0
Transmission Line	1,018	1,018	0	0	0
Access Roads	27	0	27	5	22
Total	13,050	9,022	4,028	3,400	628

[1] Represents the number of acres of disturbance that would not be reclaimed after the project is abandoned. Included here are facilities that would continue in use after project abandonment, or are infeasible to reclaim.

[2] Many existing roads would only require upgrading; thus, new disturbance would be less than total land requirement. It is assumed that 80 percent of the project road system would remain in use after project abandonment.

[3] It is assumed that the sulfur pipeline would require a 15-foot wide strip for an access trail during project operation.

DENIAL OF ENTIRE PROJECT

The blanket denial of the entire project, treatment plants, ancillary facilities, and well field activities, would prevent project proponents from constructing gas treatment facilities and from developing their lease rights (as stated in the Minerals Leasing Act of 1920, as amended). Effects from this alternative, including jurisdictional and legislative implications, are discussed in Chapter 4; the affected environment for this alternative is described in Chapter 3.

DENIAL OF TREATMENT PLANTS

Denial of the treatment plants, as applied for, may still allow for some low-Btu gas to be drilled for on an individual APD/environmental assessment basis as currently occurs, including application of standard agency stipulations and specific mitigation developed in the environmental assessment.

Upon denial of treatment plant rights-of-way applications, the companies might have the following options, among possibly others.

1. Find other possible plant site locations in the regional vicinity which might be more acceptable;
2. transport sour gas out of the project region for treatment;
3. transport sour gas to the Carter Creek or Whitney Canyon plants.

These possibilities were investigated and the following conclusions were drawn. The first option is a real option which could be analyzed in the event of new rights-of-way applications. The second option appears to be impractical for several reasons, including high costs of long distance transport of gas, no known plants which have capacity to treat this kind of gas, and hazards and lack of technology of long distance sour gas transport. The third option is not possible because the Carter Creek and Whitney Canyon gas treatment facilities do not have the necessary equipment and treatment processes to remove the amount of CO_2 found in the Riley Ridge sour gas. In addition, they currently lack sufficient capacity.

Consequently, the above options will not be addressed further in the EIS.

Another possible scenario under the "denial of treatment plants" would be the denial of one or more of the proposed plants or the alternative plant sites. This is a real possibility which could occur if there were adverse environmental or social impacts which could be avoided by such a denial.

The Proposed Action constitutes a worst-case analysis of various companies' proposals. Denial of specific plant proposals would result in fewer total impacts. The EIS addresses impacts of the various proposed projects which make up the Proposed Action.

Because the various portions of the Proposed Action are analyzed separately, selection of parts and denial of parts of the Proposed Action is analyzed sufficiently in the EIS, and no further analysis of this scenario is necessary.

ALTERNATIVES CONSIDERED BUT ELIMINATED

TREATMENT PLANT SITING SCENARIOS

As part of their applications to the BLM, Quasar, Exxon, and Northwest/Mobil each presented a proposed treatment plant site and two alternative sites as shown below.

Various combinations of these sites would yield over 30 possible development scenarios, each processing 2.8 billion cfd of sour gas. Since it was not practical to analyze each of these scenarios in detail, certain alternatives were identified by the agencies and applicants which would provide a comprehensive analysis of potential impacts.

The results of initial air quality modeling conducted by ERT indicated that Quasar's production capacity of 1.2 billion cfd at the East or West Dry Basin sites would violate air quality standards (PSD for SO_2). Since the intent of alternatives is to reduce various impacts identified for the Proposed Action, an alternative which violated air quality standards was not deemed appropriate. Thus, in addition to the Proposed Action (Quasar at East Dry Basin) only alternatives which located Quasar at the Buckhorn site were considered. The Buckhorn Alternative locates Quasar and Exxon at their first alternative sites.

Potential significant impacts to big game winter range were predicted for development in the Dry Basin area. Thus, an alternative which located all plant sites outside of the Dry Basin area was desired. The Shute Creek Alternative not only satisfies this objective, but also allows analysis of maximum development in the southern part of the project area.

Finally, an alternative which located all development in the northern portions of the project area (near Big Piney) was deemed necessary to give a wide range of alternatives for analysis. The Northern Alternative was identified so that this combination of potential impacts could be assessed.

Other combinations of plant sites were reviewed and eliminated from detailed study because it was felt that they would duplicate situations which would be analyzed as part of the Proposed Action or three primary alternatives. For example, Northwest's plant at the Buckhorn site was not analyzed specifically because impacts of a plant at this site were covered by the analysis conducted for Quasar.

	Proposed Site	Alternative 1	Alternative 2
Quasar	East Dry Basin	Buckhorn	West Dry Basin
Exxon	West Dry Basin/ Big Mesa	West Dry Basin/ East Dry Basin	Shute Creek
Northwest/Mobil	Craven Creek	East Dry Basin	Buckhorn

MULTIWELL DIRECTIONAL DRILLING

As an alternative to development of the well field using vertical wells drilled from single sites, Exxon has proposed to evaluate development of the field using multi-well sites, locating up to four wellheads at a well site and drilling directional holes to reach the producing zone at the appro priate depth and spacing location. In some areas individual vertical wells would still be drilled because of geological constraints, unit boundary locations, or directional drilling limitations. It may not be economically feasible to drill directional wells in the Riley Ridge area. In order to fully evaluate the feasibility of directional drilling, Exxon plans to drill several test wells in the near future. The directional drilling program would then be evaluated, and a decision made regarding its use.

Geological constraints have a substantial impact on whether wells can be directionally drilled. Directional wells would only be possible where the formation bedding planes do not dip more than approximately 5 degrees. Horizontal displacement is also a constraint to directional drilling. At this time, the maximum horizontal displacement is assumed to be about 3,800 feet. The technical feasibility of directional drilling in the Riley Ridge area has not been demonstrated. While it may be practical at certain locations in the well field, too little information is avilable to apply directional drilling on a project-wide basis. Based on the feasibility of directional drilling and conflicts identified in the sensitivity analysis, this alternative will be imposed as mitigation by the authorized offices, where necessary.

PHASED DEVELOPMENT

The development schedule for the proposed project has been compiled from the individual company rights-of-way applications. As these schedules are independent of each other, they represent a worst-case scenario for socioeconomic impacts. Phased development that would spread employment demands out over time was considered as an alternative but eliminated from detailed analysis because significant socioeconomic impacts that are expected to result from the Riley Ridge Project could be mitigated by less restrictive mitigation measures. The appropriateness of and need for phased development as a means of mitigating socioeconomic impacts would be considered when development plans are more definite and could be required by the Wyoming Industrial Siting Commission.

PROJECT COMPONENT OR PROCESS ALTERNATIVES

In developing the Proposed Action, the applicants reviewed many alternatives for project components and processes. Those which have not been presented as part of the Proposed Action or an alternative were dropped from detailed considerations. These alternatives and the reasons for eliminating them are summarized below.

Treatment Plant Sites

- A site adjacent to the Opal Gasoline Plant was rejected by Northwest prior to filing its application because of topography and the fact that the plants would not be compatible.

Sour Gas Treatment

- Gas separation alternatives. Exxon evaluated five chemical solvents, two physical solvents, one hybrid solvent, and two physical processes. All were rejected by Exxon prior to filing its application for process reasons.
- Tail gas cleanup alternatives. An Amoco CBA sulfur recovery unit was evaluated and rejected by Exxon prior to filing its application because it can only achieve a 98.6 percent recovery of sulfur in the tail gas.

Water Supply

- Big Sandy Salinity Project (all applicants). Water would not be available in time to supply the developing gas treatment plants. Plant operation would begin in late 1985 to early 1986, while Big Sandy water would not be available until about 1989.
- Groundwater for Craven Creek plant (Northwest). Sufficient yield for the plant would be uncertain.
- Hams Fork water for Craven Creek plant (Northwest). Sufficient water rights not available.

Sulfur Transport

- Sulfur pipeline from Craven Creek plant. A pipeline was rejected by Northwest prior to filing its application due to the proximity of the site to an existing railroad.
- Long-term truck transport over haul road. Rejected by Exxon prior to filing its application due to inefficiencies.
- Sulfur stockpile on plant site. Rejected by Exxon prior to filing its application due to commercial value of sulfur and space needed for stockpile.

CO_2 Disposition

- Five alternatives concerning the disposition of CO_2 from the project were considered by the agencies. The No Action Alternative for CO_2 is discussed in conjunction with the No Action Alternative discussed previously in this chapter. The alternative of surface CO_2 storage was dismissed as infeasible from an engineering and economic standpoint. The potential of reinjecting the CO_2 into the Madison Formation or other formations was also rejected for similar reasons. The alternatives of venting or selling the CO_2 are addressed in Chapter 4.

INTERRELATIONSHIPS WITH OTHER PLANNED OR PROPOSED PROJECTS

Several projects which are being planned for southwestern Wyoming were examined to determine if their environmental effects would be interrelated with the effects from the Riley Ridge Project. These projects are identified in Table 1-19 and the locations of the projects are shown on Map 1-8.

Projects may be interrelated in various ways. For example, projects which are constructed during the same time period may compete for the same labor force. Additionally, socioeconomic effects on local services and infrastructure could be increased. Projects which go into operation during the same period of time could jointly add to the degradation of air quality. Projects could also have cumulative effects on surface resources such as wildlife habitat.

All potentially interrelated projects were reviewed to see if their location, time schedule, employment levels, air emissions, water demands, or surface disturbance would cause them to contribute to cumulative impacts. Projects which have a reasonable likelihood of going forward, which would begin constuction in 1984 or later, and which have the potential for related effects were considered to be interrelated. Those projects that were determined to be interrelated will be considered in the cumulative impact analysis and are summarized in Table 1-19.

All applicants on the Riley Ridge Project were questioned as to their plans for future sweet gas and oil development within the well field. All but Quasar replied that they had no plans for additional drilling and development of these resources within their leases. However, other lease holders are expected to conduct additional drilling for sweet gas and oil. Using MMS records for the past six years, it is projected that 70 wells per year will be drilled in Sublette and northern Lincoln Counties. Approximately 30 percent (21 wells per year) of this drilling is expected to take

TABLE 1-19
INTERRELATED PROJECTS

Project	Description	Location	Peak Construction Work Force	Operation Work Force	Operation Water Requirements	Acres Required
Bureau of Reclamation						
Big Sandy Salinity Project	Construct a well field and pipeline to divert saline water before it enters the Big Sandy River. Up to 8,000 acre-feet/yr would be sold to the Chevron Fertilizer Plant. Other markets are being investigated.	About 40 miles north of Rock Springs, Sweetwater County	Approximately 25 (1987)	Very Small	25,000 ac-ft/yr	Approximately 300 for well field; 250 for pipeline
Chevron Chemical Phosphate Project	Construct a fertilizer plant and 98-mile slurry pipeline from phosphate mine in northern Utah. Plant would produce phosphate and ammonium phosphate fertilizers.	4 miles south of Rock Springs, Sweetwater County	1,100 (1986)	386 (1988 on)	25,000 ac-ft/yr (from Fontenelle Reservoir)	Approximately 1,500 for all facilities
Exxon Road Hollow Gas treatment Plant	Construct a sour gas treatment plant with a capacity of 80 million cfd. The plant would be constructed off-site and shipped to the site as modules. Project life would be 20 years.	23 miles south of Kemmer, Lincoln County	175 (1984)	36 (1986)	32 ac-ft/yr	40
Cumberland Coal Company South Haystack Coal Mine	Proposed surface coal mine located on federal, state, and private land. Anticipated annual production of 2.5 - 3.5 million tons. Need federal approval of mining reclamation plan and rights-of-way for facilities including conveyor.	25 miles southwest of Kemmerer, Unita County	200 (1985)	313 (1988-1991)	126 to 176 ac-ft/yr	8,200 (1,745 disturbed).

TABLE 1-19 (continued)
INTERRELATED PROJECTS

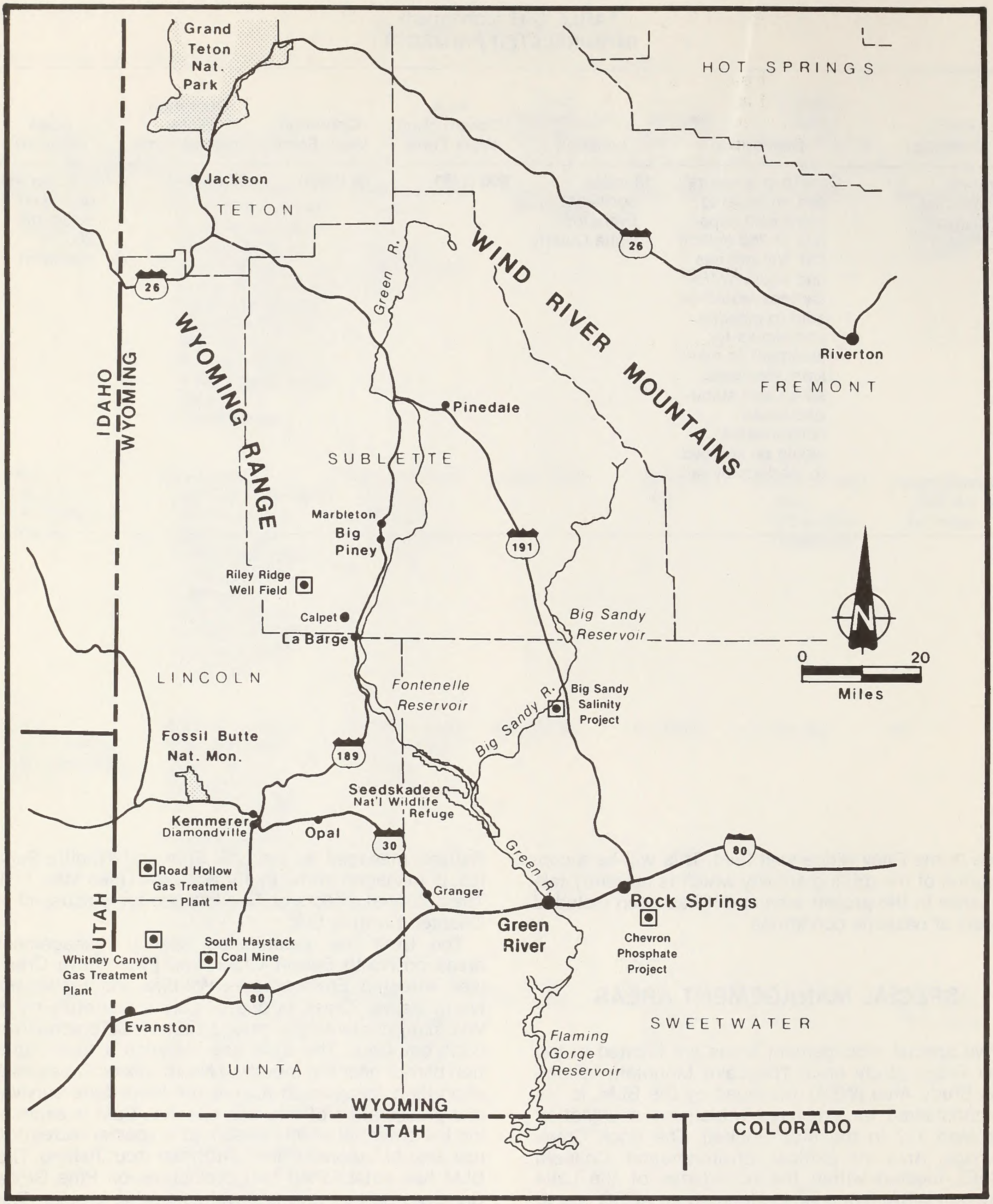
Project	Description	Location	Peak Construction Work Force	Operation Work Force	Operation Water Requirements	Acres Required
Amoco Whitney Canyon Project	Construct a natural gas processing plant with capacity of 250 million cfd. Natural gas and liquid hydrocarbons would be sold to pipeline companies for shipment to markets; elemental sulfur and stabilized liquid condensates would be shipped to markets by rail.	18 miles northeast of Evanston, Unita County	600 (1981)	69 (1982)	97 ac-ft/yr	515 disturbed during construction; 266 for operation

place in the Riley Ridge well field. This will be a continuation of the drilling activity which is currently taking place in the project area and it has been included as part of baseline conditions.

SPECIAL MANAGEMENT AREAS

Five special management areas are located in the Riley Ridge study area. The Lake Mountain Wilderness Study Area (WSA), managed by the BLM, is being considered for proposed wilderness designation (see Map 1-2 in the Map Pocket). The Rock Creek Drainage Area of Critical Environmental Concern (ACEC), located within the boundaries of the Lake Mountain WSA, has been designated an ACEC due to the high value of the Colorado River cutthroat trout habitat and habitat for elk and other sensitive wildlife species. These two special management areas are located in the northwestern portion of the study area. The 14,376-acre Seedskadee National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service, is managed primarily for waterfowl (see Map 1-1). The potential effects on Seedskadee are discussed in Chapter 4 of this EIS.

The BLM has established special management areas on North Beaver Creek and Pine Grove Creek (see Affected Environment—Wildlife and Fisheries). North Beaver Creek is one of only a few streams in Wyoming containing a pure strain of Colorado River cutthroat trout. The BLM has installed a fish migration barrier near the mouth of North Beaver Creek as a short-term measure to ensure the immediate survival and preservation of this fish species. BLM is examining the potential of this stream as a special recreation use area of Colorado River cutthroat trout fishing. The BLM has established two exclosures on Pine Grove Creek as part of a stream rehabilitation project. The purpose of the study is to determine the improvement potential and the degree of stream habitat recovery possible through intensive multiple use management (BLM 1978a). The potential effects on these two special management areas are discussed in Chapter 4.



MAP 1-8 INTERRELATED PROJECTS

DATA SUMMARY TABLES

Tables 1-20 through 1-24 provide a data summary of the Proposed Action and alternatives. Information provided in the data summary tables includes the average annual employment projections; solid wastes, sanitary wastes, and wastewater generated; an emissions summary; and project resource requirements (water, gravel, and riprap). Since the alternatives differ primarily in plant site location and not in major components, resource requirements are expected to be similar for all alternatives.

The reader will note that there are differences among project components and resource requirements for the five applicants; examples are right-of-way requirements, manpower requirements, and water requirements. These differences do not represent discrepancies or inconsistencies among the applicants but rather reflect differences in estimating assumptions, facility design, process technology, operating practices, and engineering philosophy among the companies. All available data were reviewed and differences were discussed with the applicants to ensure that an accurate picture of the Proposed Action was presented for each.

TABLE 1-20
AVERAGE ANNUAL EMPLOYMENT PROJECTIONS

Location	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995-2000
Quasar													
Well Field Drilling	0	94	220	220	220	220	220	40	0	0	0	0	0
Well Field Operation	0	0	5	26	28	28	28	28	28	28	28	28	28
Linear Facilities Construction	0	239	437	49	49	49	49	49	0	0	0	0	0
Linear Facilities Operation	0	0	5	26	28	28	28	28	28	28	28	28	28
Plant Construction	0	100	425	213	213	213	213	16	0	0	0	0	0
Plant Operation	0	0	16	75	125	138	150	150	150	150	150	150	150
Williams													
Well Field Drilling	0	44	40	40	40	40	40	30	0	0	0	0	0
Well Field Operation	0	9	15	16	17	18	19	29	47	47	47	47	47
Linear Facilities Construction	0	0	0	95	0	0	0	0	0	0	0	0	0
Linear Facilities Operation	0	3	5	8	10	13	14	15	15	15	15	15	15
Exxon													
Well Field Drilling	0	60	120	120	120	120	120	120	120	120	120	120	102
Well Field Operation	0	0	5	13	20	23	33	43	53	60	60	60	60
Linear Facilities Construction	0	23	501	355	0	133	0	0	0	0	0	0	0
Linear Facilities Operation	0	0	7	35	35	35	36	40	43	45	45	45	45
Plant Construction	0	281	535	390	369	406	450	406	344	150	91	0	0
Plant Operation	0	0	33	94	150	169	244	319	394	450	450	450	450
Mobil													
Well Field Drilling	25	25	25	25	25	25	25	25	25	25	37	37	37
Well Field Operation	14	14	14	15	15	15	15	15	15	16	16	16	16
Northwest													
Linear Facilities Construction	0	22	20	240	20	0	0	0	0	0	0	0	0
Linear Facilities Operation	0	0	0	9	30	30	30	30	30	30	30	30	30
Plant Construction	0	77	542	972	108	0	0	0	0	0	0	0	0
Plant Operation	0	0	5	82	82	82	82	82	82	82	82	82	82
Total	39	991	2,975	3,118	1,704	1,655	1,929	1,465	1,374	1,246	1,199	1,108	1,108

Note: Linear Facilities include pipelines, electric transmission lines, access roads, and railroads.

TABLE 1-21
SOLID WASTES, SANITARY WASTES, AND WASTE WATER GENERATED

	Quasar	Williams	Exxon	Mobil/ Northwest	Total
Solid Wastes (in yd^3/yr)					
Construction	16,000	4,000[1]	20,000	20,000	60,000
Operation	2,500	500[1]	6,500	2,500[1]	12,000
Sanitary Wastes (in ac-ft/yr)					
Operation	1.8	1.4[1]	10	40	53.2
Waste Water (in ac-ft/yr)					
Dehydration[2]	Included below	110	120	200[4]	430
Plant Operation[3]	725	NA	725	60[5]	1,510

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[1] Estimated value for analysis purposes.

[2] Projected chemical quality of effluent from wellhead dehydration is 193 milligrams/liter (mg/l) of CO_2, 366 mg/l of H_2S, and 2,000 mg/l of total dissolved solids (Exxon 1982).

[3] Projected chemical quality of treatment plant effluent is 600 parts/million (ppm) H_2S, 730 ppm of total reduced sulfur, 2,200 ppm chemical oxygen demand, and less than 0.1 ppm of chromium, lead, nickel, copper, zinc, mercury, and arsenic (Exxon 1982).

[3] Assumes 3 acre-feet/well/year.

[5] Assumes 75 percent of the annual water requirement is discharged.

TABLE 1-22
WATER REQUIREMENTS BY SOURCE FOR LIFE OF PROJECT (IN ACRE-FEET)

	Quasar		Williams		Exxon		Mobil/Northwest		Total	
Activity	Green River[1]	Groundwater[2]	Green River[1]	Groundwater[2]	Green River[1]	Groundwater[2]	Green River[1]	Groundwater[2]	Green River[1]	Groundwater[2]
Well Drilling	778	NA	NA	286	NA	670	268	NA	1,046	956
Hydrostatic Testing	28	NA	4	NA	19	NA	30[3]	NA	81	NA
Plant Construction	NA	211	NA	NA	NA	124	160	NA	160	335
Plant Operation	NA	2,010	NA	NA	NA	11,040	2,430	NA	2,430	13,050
Sulfur Loadout										
Construction	NA	see Exxon	NA	NA	NA	1	NA	NA	NA	1
Operation	NA		NA	NA	NA	22/yr	NA	NA	NA	22/yr

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[1] Or other nearby surface water source.

[2] Aquifers which would be tapped for groundwater have not been identified.

[3] Estimate.

TABLE 1-23
ESTIMATED GRAVEL AND RIPRAP REQUIREMENTS FOR CONSTRUCTION (IN CUBIC YARDS)

	Quasar	Williams	Exxon	Mobil/Northwest	Total
Well Field Development					
Gravel	452,100	150,000 (est.)	350,000	5,500	957,600
Riprap	90,000	30,000 (est.)	19,000	None	139,000
Plant Construction					
Sand/Gravel	238,900	NA	180,000	96,000	514,900
Riprap	100,000	NA	None	None	100,000
Asphalt (access roads)	300	NA	130	180	610
Railroad Construction					
Sand/Gravel	NA	NA	NA	23,000	23,000
TOTAL	881,300	180,000	549,130	124,680	1,735,110

---

[1] Borrow material would be obtained from local approved sources which may be subject to further environmental analysis at the time these sources are identified.

[2] Exxon's sulfur transport railroad (Component Alternative) would require 225,000 cubic yards of sand/gravel.

TABLE 1-24
EMISSIONS SUMMARY[1]
(IN TONS/YEAR)

	Quasar	Exxon	Northwest/ Mobil	Total
Plant				
Capacity (billion cfd)	1.2	1.2[2]	0.4	2.8
CO	458	264	6,145	6,867
COS[3]	4,126	4,126	52	8,304
CO_2[4]	17,613,000	17,007,000	5,587,000	40,207,000
He	10,722	10,722	3,854	25,298
H_2S	170	106	97	373
N_2	4,144,000	4,618,000	909,779	9,671,779
NO_x	2,104	1,249	323	3,676
SO_2	6,745	5,579	3,509	15,833
TSP[5]	156	92	25	273
VOC[6]	194	112	33	339

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[1] Includes temporary emissions during well drilling, plant start-up, testing, and upset conditions, as well as emissions during routine operation.

[2] Includes both of Exxon's plants at West Dry Basin and Big Mesa.

[3] COS is carbonyl sulfide.

[4] Assumes that all CO_2 is vented.

[5] TSP is total suspended particulates.

[6] VOC is non-methane volatile organic compounds.

CHAPTER 2

COMPARATIVE ANALYSIS OF PROPOSED ACTION AND ALTERNATIVES

COMPARISON OF ENVIRONMENTAL IMPACTS

SITING ALTERNATIVES

A comparison of significant environmental impacts for the Proposed Action and the siting alternatives is presented in Table 2-1. The comparative analysis was developed using information included in Chapter 4. The table presents impacts for each siting alternative based on a complete scenario for developing the well field, processing sour gas, and transporting sales gas and by-products to market. The reader is reminded that the impacts presented in Table 2-1 are unmitigated with respect to the application of the measures described in Chapter 4 and Appendix C.6.

The numbers presented in the tables represent the worst unmitigated impacts that can be expected for each alternative during construction (some of which are short term) as well as impacts that can be expected during operation (most of which are long term). For example, under population increase, the largest change would occur during construction. Communities would experience smaller population increases, many of which also exceed the impact significance criteria, during project operation.

There are several environmental impacts that, although they are significant, do not vary among the alternatives; therefore, the evaluation of these impacts does not enable comparison of the various siting alternatives. Many of these impacts would occur in the well field, which is common to all alternatives. The impacts which are the same for all siting alternatives are listed below by environmental resource.

Wildlife and Fisheries:

- Impacts to federal T&E wildlife species.
- Increased sedimentation of trout streams located in the well field.
- Impacts from possible leaks or spills.

Health & Safety:

- Frequency of well blowouts and gathering system leaks or ruptures.

Water Resources:

- Construction of the sulfur loadout facility within the 100-year floodplain of the Hams Fork.
- Sedimentation of surface streams from construction runoff.
- Possible contamination of surface water from leaks or spills.
- Degradation of groundwater aquifers.
- Water demand.

Soils and Vegetation:

- Acres of aspen lost.

Visual Resources:

- Site-specific and combined visual change impacts within the well field.

Recreation:

- Increase in regional recreation demand.
- Decrease in quality of hunting and fishing.
- Number of recreation areas affected.

Wilderness:

- Increase in recreation demand on wilderness areas.

Agriculture/Grazing:

- Number of grazing allotments losing more than 5 percent of their AUMs.
- Loss in hay production.

Timber:

- Acres of timber cleared.
- Increased access to areas of proposed timber sales.

Noise:

- Increased noise along highways from increased trunk traffic.

In addition to the information presented in Table 2-1, the following paragraphs briefly summarize the major differences among the siting alternatives. Many of the differences are not quantitative, so they do not appear in the table. However, the impacts represent qualitative differences among alternatives which may be of interest to decision makers and the public.

TABLE 2-1
COMPARISON OF UNMITIGATED SIGNIFICANT IMPACTS FOR RILEY RIDGE PROJECT SITING ALTERNATIVES[1]

	Proposed Action	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Socioeconomics				
Percentage Change in Population (%)				
Lincoln County				
Construction	37	37 (0)	42 (+5)	28 (-9)
Operation	8	8 (0)	15 (+7)	7 (-1)
Kemmerer				
Construction	58	58 (0)	72 (+4)	32 (-26)
Operation	9	9 (0)	24 (+15)	6 (-3)
Diamondville				
Construction	108	108 (0)	136 (+28)	55 (-53)
Operation	15	15 (0)	45 (+30)	10 (-5)
LaBarge				
Construction	345	345 (0)	265 (-80)	472 (+127)
Operation	142	142 (0)	106 (-36)	142 (0)
Sublette County				
Construction	66	66 (0)	49 (-17)	89 (+23)
Operation	36	36 (0)	20 (-16)	39 (+3)
Big Piney				
Construction	149	149 (0)	109 (-40)	201 (+52)
Operation	82	82 (0)	44 (-38)	89 (+7)
Marbleton				
Construction	136	136 (0)	99 (-37)	183 (+47)
Operation	75	75 (0)	40 (-35)	81 (+6)
Pinedale				
Construction	14	14 (0)	11 (-3)	18 (+4)
Operation	8	8 (0)	4 (-4)	8 (0)
Sweetwater County				
Construction	3	3 (0)	4 (+1)	2 (-1)
Operation	0	0 (0)	0 (0)	0 (0)
Granger				
Construction	61	61 (0)	76 (+15)	39 (-22)
Operation	3	3 (0)	5 (+2)	2 (-1)
Housing Shortfall (Units)				
Lincoln County				
Construction	2,270	2,270 (0)	2,529 (+259)	1,298 (-972)
Operation	447	447 (0)	801 (+354)	381 (-66)
Kemmerer				
Construction	885	885 (0)	1,098 (+213)	393 (-492)
Operation	141	141 (0)	418 (+277)	91 (-50)
Diamondville				
Construction	452	452 (0)	571 (+119)	207 (-245)
Operation	72	72 (0)	219 (-147)	43 (-29)
LaBarge				
Construction	468	468 (0)	363 (-105)	539 (+71)
Operation	226	226 (0)	170 (-56)	190 (-36)
Sublette County				
Construction	1,259	1,259 (0)	925 (-334)	2,208 (+949)
Operation	695	695 (0)	379 (-316)	761 (+66)
Big Piney				
Construction	351	351 (0)	255 (-96)	449 (+98)
Operation	197	197 (0)	107 (-90)	200 (+3)
Marbleton				
Construction	256	256 (0)	187 (-69)	413 (+157)
Operation	143	143 (0)	78 (-65)	185 (+42)
Pinedale				
Construction	62	62 (0)	49 (-13)	82 (+20)
Operation	33	33 (0)	20 (-13)	37 (+4)
Granger				
Construction	46	46 (0)	56 (+10)	28 (-18)
Operation	2	2 (0)	14 (+12)	2 (0)

TABLE 2-1 (continued)
COMPARISON OF UNMITIGATED SIGNIFICANT IMPACTS FOR RILEY RIDGE PROJECT SITING ALTERNATIVES

	Proposed Action	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Personal Income (Percent above Baseline)				
Lincoln County				
Construction	74	74 (0)	83 (+9)	56 (-18)
Operation	13	13 (0)	22 (+9)	11 (-2)
Sublette County				
Construction	152	152 (0)	113 (-39)	202 (+50)
Operation	72	72 (0)	42 (-30)	77 (+5)
Sweetwater County				
Construction	5	5 (0)	6 (+1)	4 (-1)
Operation	0	0 (0)	0 (0)	0 (0)
Wildlife and Fisheries				
Acres of Critical Range Disturbed				
Elk Calving Range				
Construction	1,107	1,107 (0)	1,107 (0)	1,107 (0)
Operation	1,107	1,107 (0)	1,107 (0)	1,107 (0)
Elk Winter Range				
Construction	1,479	1,479 (0)	1,685 (+206)	1,355 (-124)
Operation	1,019	1,019 (0)	1,019 (0)	1,019 (0)
Moose Winter Range				
Construction	586	447 (-139)	452 (-134)	595 (+9)
Operation	287	287 (0)	287 (0)	287 (0)
Mule Deer Winter Range				
Construction	2,957	2,579 (-378)	1,610 (-1,347)	3,020 (+63)
Operation	1,172	782 (-390)	142 (-1,030)	1,202 (+30)
Pronghorn Winter Range				
Construction	2,281	2,379 (+98)	1,342 (-939)	2,344 (+63)
Operation	640	640 (0)	0 (-640)	640 (0)
Pronghorn Summer Range				
Construction	1,891	1,897 (+6)	1,687 (-204)	1,135 (-756)
Operation	840	840 (0)	900 (+60)	200 (-640)
Prairie Dog Towns				
Construction	579	721 (+142)	1,064 (+486)	540 (-39)
Operation	191	191 (0)	163 (-28)	123 (-68)
Total Number of Perennial Stream Crossings	100	101 (+1)	102 (+2)	103 (+3)
Sour Gas Trunk Line Perennial Stream Crossings	5	6 (+1)	4 (-1)	2 (-3)
Health and Safety				
Miles of Sour Gas Trunk Line	54	68 (+14)	111 (+57)	33 (-21)
Number of Trunk Line Ruptures Expected During Life of Project	0.33	0.41 (+0.08)	0.67 (+0.34)	0.20 (-0.13)
Number of People at Risk of Lethal H_2S Exposure in 1990 (Trunk Line Rupture)	54	54 (0)	904 (864)	0 (-54)
Individual Annual Risk of Lethal Exposure				
LaBarge	negligible	negligible	0.000068	negligible
Big Piney	negligible	negligible	negligible	negligible
Marbleton	negligible	negligible	negligible	negligible
Calpet	0.00023	0.00023	0.00048	negligible
Fontenelle Recreation Area	negligible	negligible	negligible	negligible

TABLE 2-1 (continued)
COMPARISON OF UNMITIGATED SIGNIFICANT IMPACTS FOR RILEY RIDGE PROJECT SITING ALTERNATIVES[1]

	Proposed Action	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Air Quality				
Ambient Air Impacts from Emissions Exceed Applicable Standards				
SO_2 (PSD Class II, 24-hour, 91 $\mu g/m^3$)	124 at East Dry Basin	no exceedance	no exceedance	no exceedance
H_2S (WAAQS, 1/2-hour, 40 $\mu g/m^3$)	237 at East Dry Basin	65 at Buckhorn	65 at Buckhorn	65 at Buckhorn
Ambient Air Impacts from Emissions Exceed Odor Significance Level (6.5 $\mu g/m^3$)	East Dry Basin 237 West Dry Basin 12 Big Mesa 7	East Dry Basin 7 West Dry Basin 12 Buckhorn 65	Buckhorn 65	East Dry Basin 9 West Dry Basin 12 Big Mesa 7 Buckhorn 65
Ambient Air Impacts from Emissions Compared to Class I Standards (PSD, 24-hour, 5 $\mu g/m^3$)[2]				
Maximum Concentration	4.7 at Scab Creek[3]	5.9 (+1.2) at Scab Creek[3]	5.3 (+0.6) at Fossil Butte[3]	6.5 (+1.8) at Scab Creek[3]
Highest Second-Highest Concentration	NA	4.3	4.3	4.7
Soils and Vegetation				
Total Acres Disturbed				
Construction	12,852	12,983 (+131)	12,115 (-737)	13,050 (+198)
Operation	4,154	4,164 (+64)	3,620 (+534)	4,028 (+126)
Total Miles of Linear Facilities (Outside Well Field)	636.0	653.5 (+17.5)	652.5 (+16.5)	672.5 (+36.0)
Acres of Riparian Vegetation Disturbed				
Construction	249	252 (+3)	236 (-13)	257 (+8)
Operation	63	63 (0)	63 (0)	63 (0)
Acres of Sensitive Rehabilitation Unit Disturbed	3,969	3,492 (-477)	4,130 (+161)	3,190 (-779)
Acres not Reclaimed at Abandonment	641	633 (-8)	704 (+63)	628 (+13)
Visual Resources				
Miles of Significant Impact	103	103 (0)	93 (-10)	91 (-12)
Miles of Highly Significant Impact	26	26 (0)	26 (0)	26 (0)
Number of Plant Sites with Significant Impacts	3	3 (0)	2 (-1)	2 (-1)
Number of Plant Sites with Highly Significant Impacts	1	0 (-1)	0 (-1)	1 (0)
Cultural Resources				
Number of Cultural Sites Impacted	128	130 (+2)	168 (+40)	94 (-34)
Agriculture/Grazing				
Number of AUMs Lost				
Construction	690	664 (-26)	585 (-105)	657 (-33)
Operation	223	213 (-10)	175 (-48)	203 (-20)
Number of Crossings of Slate Creek Sheep Trail				
Construction	4	4 (0)	6 (+2)	2 (-2)
Operation	1	1 (0)	2 (+1)	1 (0)

TABLE 2-1 (continued)
COMPARISON OF UNMITIGATED SIGNIFICANT IMPACTS FOR RILEY RIDGE PROJECT SITING ALTERNATIVES[1]

	Proposed Action	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Transportation				
Percent Above Service Volume C Operating Standard for Significantly Impacted Road Segments				
Construction				
U.S. 189, LaBarge to County Road 23-134	10	10 (0)	0 (-10)	98 (+88)
U.S. 189 at Big Piney	54	54 (0)	0 (-54)	137 (+83)
U.S. 191 West of Pinedale				
U.S. 30, Kemmerer to Opal	156	156 (0)	189 (+33)	11 (-145)
U.S. 30 East of Opal	86	86 (0)	86 (0)	50 (-36)
S.R. 240 North of Opal	43	43 (0)	67 (+24)	0 (-43)
Operation				
U.S. 189 at Big Piney	3	3 (0)	0 (-3)	9 (+6)
U.S. 191 West of Pinedale	8	8 (0)	0 (-8)	0 (-8)
U.S. 30, Kemmerer to Opal	17	17 (0)	42 (-25)	12 (-5)
U.S. 30, East of Opal	55	55 (0)	53 (-2)	0 (-55)
Increase in Number of Traffic Accidents				
Construction	135	135 (0)	145 (+10)	190 (+55)
Operation	45	45 (0)	48 (+3)	62 (+17)
Land Use Plans, Controls, and Constraints				
Conflicts with Existing Land Use Plans				
BLM Management Framework Plan (miles of transmission line)	76.0	80.5 (+4.5)	83.0 (+7.0)	72.0 (-4.0)
Seedskadee National Wildlife Refuge (miles of pipeline)	0	0 (0)	2 (+2)	0 (0)
Sublette County Zoning (plant sites)	East Dry Basin, West Dry Basin, Big Mesa	East Dry Basin, West Dry Basin, Buckhorn	Buckhorn	East Dry Basin, West Dry Basin, Big Mesa, Buckhorn

Note: Numbers in parentheses ( ) indicate the difference from the Proposed Action.

[1] The reader is reminded that the impacts presented in this table are unmitigated with respect to the application of the measures described in Chapter 4 and Appendix C.6. For example, under Health and Safety, were the measures described in Appendix C.6 applied to the sour gas trunk lines of the Shute Creek Alternative, the 904 people at risk of lethal H_2S exposure would be reduced to 54, the same number of people (Calpet residences) as indicated for the Proposed Action and Buckhorn Alterative.

[2] Short-term standards in Class I areas allow one exceedance per year. This is important because it means the maximum value can be ignored at each receptor and instead, the highest remaining value (termed the highest second-highest) is compared to the increment or standard. This highest second-highest value must exceed the limit for the impacts to be deemed significant.

[3] These are BLM and NPS units not currently classified as Class I areas.

Socioeconomics

Differences among the alternatives are primarily a function of the location of the plant sites. The Proposed Action and Buckhorn Alternative would have the same impacts on Lincoln and Sublette Counties. The impacts of the Shute Creek Alternative would be concentrated in Lincoln County which is the strongest of the two counties in terms of fiscal condition. The impacts of the Northern Alternative, on the other hand, would be concentrated in Sublette County which is not as well prepared, from the standpoint of finances or services, to deal with the growth that would be associated with project development.

Wildlife and Fisheries

The majority of significant impacts to big game critical range and high quality trout fisheries would occur as a result of the development of the well field.

Thus, there would be small differences among alternatives for these impacts. Short and long-term impacts to wildlife caused by critical range disturbances would vary among alternatives off the well field (Table 2-1). Overall, the Shute Creek Alternative would result in the least long-term disturbance to important critical ranges. Human population related impacts, such as legal and illegal hunting and fishing, wildlife harassment, road kills, and unintentional disturbance, would also vary among alternatives. Impacts from the Proposed Action and the Buckhorn Alternative would be very similar. Impacts from the Northern Alternative would be greatest due to the concentration of population in the northern part of the study area, closest to important big game habitat and trout streams. Impacts from the Shute Creek Alternative would be the least because of the more even distribution of increased population in the study area and the smallest population increase in the Big Piney area, near the critical big game range and sensitive trout fisheries.

All alternatives except the Proposed Action would have sour gas trunk lines crossing the Green River. This could significantly affect fisheries in the event of a leak or rupture.

Health and Safety

Differential impacts to health and safety resulting from potential releases of H_2S would be caused by differences in the location and length of the sour gas trunk lines. The Northern Alternative would have the fewest miles of trunk lines, which would also be located furthest away from population centers, so it would pose the smallest risk of lethal exposure. On the other hand, the Shute Creek Alternative would have the most miles of trunk line, which would pass near Calpet and LaBarge, and would pose the greatest risk of lethal exposure. The risk of lethal exposure associated with sour gas trunk lines for the Proposed Action and the Buckhorn Alternative would be intermediate between the Northern and Shute Creek Alternatives.

The number of people at risk of exposure to discomfort levels of H_2S would also be highest for the Shute Creek Alternative; however, it would be lowest for the Proposed Action. Sour gas trunk lines to the Buckhorn plant site (part of the Buckhorn, Shute Creek, and Northern Alternatives) would pass south of the Big Piney/Marbleton area, which is the largest population concentration near a trunk line. Trunk lines associated with the Proposed Action would be further away and pose a smaller risk.

Water Resources

Only minor differences in impacts to water resources among the four siting alternatives have been identified. Since most impacts would occur from well drilling and construction of access roads and pipelines in the well field, these impacts would be common to all alternatives. One difference that would not constitute a change in significant impacts would occur with the Northern Alternative. Under this alternative, Northwest would utilize groundwater for its plant water requirements rather than surface water from the Green River, as under the other alternatives.

Air Quality

No Class I air quality standards would be violated for any alternative. PSD Class II standards for SO_2 would be violated only for the Proposed Action by Quasar at East Dry Basin. WAAQS standards for H_2S would be violated by Quasar for all alternatives. Combined air quality effects for SO_2 would be greatest for the Northern Alternative where all four plants would be located in the northern part of the study area, and emissions from all four plants could contribute to combined annual average SO_2 impacts. However, these impacts would not be signficant. Combined SO_2 impacts would be the least for the Shute Creek Alternative. Odor impacts from H_2S would be the greatest for the Northern Alternative and least for the Shute Creek Alternative.

Soils and Vegetation

The four siting alternatives differ very slightly in their impacts to soils and vegetation. The total number of acres disturbed varies by less than 6 percent among alternatives. The greatest difference is found in the number of acres of sensitive rehabilitation units disturbed. The Northern Alternative would disturb the least, while the Shute Creek Alternative would disturb the most. The difference between these two alternatives is nearly 23 percent.

Visual Resources

The Proposed Action would be the most visually disruptive of the siting alternatives; this alternative includes four plant sites, one of which would cause highly significant impacts to visual resources. The Shute Creek Alternative, because of the use of only three sites, one of which is insignificant in its visual impacts, would be the least visually disruptive. The sulfur pipeline for each alternative would be the single most disruptive component as it would create long-term significant impacts along 26 of the proposed 54 miles of corridor.

Cultural Resources

The differences in impacts of the siting alternatives are based on the number of cultural resources identified during previous surveys of the study area. The numbers range from 94 resources for the Northern Alternative to 168 for the Shute Creek Alternative. A total of 128 and 130 sites have been identified for the Proposed Action and the Buckhorn Alternative, respectively. Less than 5 percent of the study area for the siting alternatives has been surveyed; therefore, a survey of the proposed area of disturbance will determine the actual number of sites to be impacted.

Recreation

Due to the regional nature of recreation use patterns, the differences in impacts by alternative cannot be quantified. It is expected that the differences among alternatives would be small; however, alternatives which concentrate population in the Big Piney area would be expected to have the greatest impacts on recreation. Thus, the Northern Alternative would have the greatest impacts while the Shute Creek Alternative would have the least.

Wilderness

Impacts to wilderness are a function of the area-wide population increase and potential air quality degradation. This does not vary significantly by alternative, hence the impacts to wilderness are common to all of the siting and component alternatives. Potential impacts to certain air quality related values (AQRV), specifically acid deposition in high mountain lakes, vegetation injury, visibility, and odor, have been determined to be insignificant.

Agriculture/Grazing

Impacts to agriculture in terms of AUMs lost would be somewhat greater under the Proposed Action than the other siting alternatives. In total, the impacts for each alternative would be insignificant though losses would be significant to five allotments regardless of the choice of plant site.

Timber

Almost all impacts to timber resources are the result of well field activities. There would be no differences in impacts for the siting or component alternatives.

Transportation

The Northern Alternative would generate the greatest number of vehicle miles traveled, and therefore, would have the greatest accident potential. The impact from this alternative would be concentrated along U.S. 189 whereas the impacts from the other three siting alternatives would be greatest on U.S. 30 and State Route 240.

Land Use Plans, Controls, and Constraints

The most significant land use conflict would result from Exxon's CO_2 and sales gas proposed pipeline (Shute Creek Alternative) and railroad (Component Alternative) corridors that would cross the Seedskadee National Wildlife Refuge. A railroad would be much more disruptive of Refuge management plans than would pipelines.

Other land use conflicts would result from the siting of corridors and conflicts with land management agency objectives that encourage sharing of corridors. Plant sites that are currently not permitted under Sublette County zoning would require local administrative action to permit construction.

Noise

Significant noise impacts result mostly from construction-related truck traffic. These would be significant within one-half mile of U.S. 189 from Big Piney to LaBarge and south to Kemmerer and east on U.S. 30 from Kemmerer to Opal and Granger. As the frequency of travel on these roads varies by alternative, noise impacts would be relatively greater on U.S. 189 under the Northern Alternative and relatively greater on U.S. 30 under the other three siting options.

SIGNIFICANT IMPACT SUMMARY

In order to facilitate review, the following sections summarize the significant beneficial and adverse impacts (based on the significance criteria presented in Chapter 4) for each siting alternative. Please refer to Table 2-1 or specific sections in Chapter 4 for quantification and details.

Proposed Action

Socioeconomics:

- Shortfall in housing units (see Table 2-1).
- Shortfall in revenue for capital facilities in Diamondville, LaBarge, Big Piney, Marbleton, and Granger.
- Shortfall in revenue for personnel in LaBarge, Sublette County, Big Piney, Marbleton, and Granger.

Wildlife and Fisheries:

- Disturbance of critical wildlife range (see Table 2-1).
- Increased poaching, harassment, and road kills.
- Possible adverse effects on the black-footed ferret.
- Increase sedimentation of trout streams located in the well field.
- Increased fishing pressure, particularly on the Colorado River cutthroat trout.
- Impacts from possible leaks or spills.

Health & Safety:

- Potential for 2.8 well blowouts during the life of the project.
- Potential for 2.74 gathering system leaks or ruptures during the life of the project.
- Potential for 0.33 trunk line ruptures during the life of the project.

- Risk of lethal exposure to H_2S from trunk line ruptures in Calpet.
- Risk of discomfort exposure to H_2S from trunk line rupture in LaBarge, Big Piney, Calpet, and Fontenelle Recreation Area.

Water Resources:

- Location of sulfur loadout within 100-year floodplain of Hams Fork.
- Several potential impacts to surface and groundwater. Probability and extent unknown due to data gaps.

Air Quality:

- Violation of PSD Class II 24-hour SO_2 concentrations from East Dry Basin plant.
- Violation of WAAQS half-hour H_2S concentrations from the East Dry Basin plant.
- Violation of significance criteria for odor from H_2S from the East Dry Basin, West Dry Basin, and Big Mesa plants.

Soils and Vegetation:

- Disturbance of 249 acres of riparian vegetation during construction.
- Long-term loss of 63 acres of riparian vegetation during operation.

Visual Resources:

- Combined visual change impacts (significant and highly significant) to 44 residences and 129 miles of road.

Cultural Resources:

- Potential impact to 128 cultural sites.

Recreation:

- Increased overall recreation demand (27 percent in 1986).
- Increased hunting (26 percent) and fishing (64 percent) demand.

Wilderness:

- Significant social, physical, and biological impacts due to increased visitor use, particularly in the Bridger Wilderness.

Agriculture/Grazing:

- Number of AUMs in 5 grazing allotments reduced by more than 5 percent.

Timber Resources:

- Significant beneficial impact due to the construction of additional access roads near future timber sales.

Transportation:

- The Level of Service C traffic volume would be exceeded on U.S. 189, U.S. 191, U.S. 30, and State Route 240.
- An additional 130 to 140 traffic accidents would be expected each year during construction.
- Accelerated roadway deterioration would be expected on U.S. 189.

Land Use Plans, Controls, and Constraints:

- BLM Management Framework Plan goals for shared corridors would be violated (see Table 2-1).
- Plant sites in Sublette County would violate current zoning regulations (see Table 2-1).

Noise:

- Residences within one-half mile of U.S. 189 and U.S. 30 would experience increased noise from project-related truck traffic.

Buckhorn Alternative

Socioeconomics:

- Shortfall in housing units (see Table 2-1).
- Shortfall in revenue for capital facilities in Diamondville, LaBarge, Big Piney, Marbleton, and Granger.
- Shortfall in revenue for personnel in LaBarge, Sublette County, Big Piney, Marbleton, and Granger.

Wildlife and Fisheries:

- Disturbance of critical wildlife range (see Table 2-1).
- Increased poaching, harassment, and road kills.
- Possible adverse effects on the black-footed ferret.
- Increase sedimentation of trout streams located in the well field.
- Increased fishing pressure, particularly on the Colorado River cutthroat trout.
- Impacts from possible leaks or spills.

Health & Safety:

- Potential for 2.8 well blowouts during the life of the project.
- Potential for 2.74 gathering system leaks or ruptures during the life of the project.

- Potential for 0.41 trunk line ruptures during the life of the project.
- Risk of lethal exposure to H_2S from trunk line ruptures in Calpet.
- Risk of discomfort exposure to H_2S from trunk line rupture in LaBarge, Big Piney, Calpet, and Fontenelle Recreation Area.

Water Resources:

- Location of sulfur loadout within 100-year floodplain of Hams Fork.
- Several potential impacts to surface and groundwater. Probability and extent unknown due to data gaps.

Air Quality:

- Violation of WAAQS half-hour H_2S concentrations from the Buckhorn plant.
- Violation of significance criteria for odor from H_2S from the East Dry Basin, West Dry Basin, and Buckhorn plants.

Soils and Vegetation:

- Disturbance of 252 acres of riparian vegetation during construction.
- Long-term loss of 63 acres of riparian vegetation during operation.

Visual Resources:

- Combined visual change impacts (significant and highly significant) to 47 residences and 129 miles of road.

Cultural Resources:

- Potential impact to 130 cultural sites.

Recreation:

- Increased overall recreation demand (27 percent in 1986).
- Increased hunting (26 percent) and fishing (64 percent) demand.

Wilderness:

- Significant social, physical, and biological impacts due to increased visitor use, particularly in the Bridger Wilderness.

Agriculture/Grazing:

- Number of AUMs in 5 grazing allotments reduced by more than 5 percent.

Timber Resources:

- Significant beneficial impact due to the construction of additional access roads near future timber sales.

Transportation:

- The Level of Service C traffic volume would be exceeded on U.S. 189, U.S. 191, U.S. 30, and State Route 240.
- An additional 130 to 140 traffic accidents would be expected each year during construction.
- Accelerated roadway deterioration would be expected on U.S. 189.

Land Use Plans, Controls, and Constraints:

- BLM Management Framework Plan goals for shared corridors would be violated (see Table 2-1).
- Plant sites in Sublette County would violate current zoning regulations (see Table 2-1).

Noise:

- Residences within one-half mile of U.S. 189 and U.S. 30 would experience increased noise from project-related truck traffic.

Shute Creek Alternative:

Socioeconomics:

- Shortfall in housing units (see Table 2-1).
- Shortfall in revenue for capital facilities in Diamondville, LaBarge, Big Piney, Marbleton, and Granger.
- Shortfall in revenue for personnel in LaBarge, Sublette County, Big Piney, Marbleton, and Granger.

Wildlife and Fisheries:

- Disturbance of critical wildlife range (see Table 2-1).
- Increased poaching, harassment, and road kills.
- Possible adverse effects on the black-footed ferret.
- Increase sedimentation of trout streams located in the well field.
- Increased fishing pressure, particularly on the Colorado River cutthroat trout.
- Impacts from possible leaks or spills.

Health & Safety:

- Potential for 2.8 well blowouts during the life of the project.
- Potential for 2.74 gathering system leaks or ruptures during the life of the project.

- Potential for 0.67 trunk line ruptures during the life of the project.
- Risk of lethal exposure to H_2S from trunk line ruptures in Calpet and LaBarge.
- Risk of discomfort exposure to H_2S from trunk line rupture in LaBarge, Big Piney, Calpet, and Fontenelle Recreation Area.

Water Resources:

- Location of sulfur loadout within 100-year floodplain of Hams Fork.
- Several potential impacts to surface and groundwater. Probability and extent unknown due to data gaps.

Air Quality:

- Violation of WAAQS half-hour H_2S concentrations from the Buckhorn plant.
- Violation of significance criteria for odor from H_2S from the Buckhorn plant.

Soils and Vegetation:

- Disturbance of 236 acres of riparian vegetation during construction.
- Long-term loss of 63 acres of riparian vegetation during operation.

Visual Resources:

- Combined visual change impacts (significant and highly significant) to 47 residences and 119 miles of road.

Cultural Resources:

- Potential impact to 168 cultural sites.

Recreation:

- Increased overall recreation demand (27 percent in 1986).
- Increased hunting (26 percent) and fishing (64 percent) demand.

Wilderness:

- Significant social, physical, and biological impacts due to increased visitor use, particularly in the Bridger Wilderness.

Agriculture/Grazing:

- Number of AUMs in 5 grazing allotments reduced by more than 5 percent.

Timber Resources:

- Significant beneficial impact due to the construction of additional access roads near future timber sales.

Transportation:

- The Level of Service C traffic volume would be exceeded on U.S. 30 and State Route 240.
- An additional 145 traffic accidents would be expected each year during construction.
- Accelerated roadway deterioration would be expected on U.S. 189.

Land Use Plans, Controls, and Constraints:

- BLM Management Framework Plan goals for shared corridors would be violated (see Table 2-1).
- Plant sites in Sublette County would violate current zoning regulations (see Table 2-1).
- Exxon's sales gas and CO_2 pipeline would conflict with FWS management plans for the Seedskadee National Wildlife Refuge.

Noise:

- Residences within one-half mile of U.S. 189 and U.S. 30 would experience increased noise from project-related truck traffic.

Northern Alternative:

Socioeconomics:

- Shortfall in housing units (see Table 2-1).
- Shortfall in revenue for capital facilities in Diamondville, LaBarge, Big Piney, Marbleton, and Granger.
- Shortfall in revenue for personnel in LaBarge, Sublette County, Big Piney, Marbleton, and Granger.

Wildlife and Fisheries:

- Disturbance of critical wildlife range (see Table 2-1).
- Increased poaching, harassment, and road kills.
- Possible adverse effects on the black-footed ferret.
- Increase sedimentation of trout streams located in the well field.
- Increased fishing pressure, particularly on the Colorado River cutthroat trout.
- Impacts from possible leaks or spills.

Health & Safety:

- Potential for 2.8 well blowouts during the life of the project.

- Potential for 2.74 gathering system leaks or ruptures during the life of the project.
- Potential for 0.20 trunk line ruptures during the life of the project.
- Risk of discomfort exposure to H_2S from trunk line rupture in LaBarge and Big Piney.

Water Resources:

- Location of sulfur loadout within 100-year floodplain of Hams Fork.
- Several potential impacts to surface and groundwater. Probability and extent unknown due to data gaps.

Air Quality:

- Violation of WAAQS half-hour H_2S concentrations from the Buckhorn plant.
- Violation of significance criteria for odor from H_2S from the East Dry Basin, West Dry Basin, Big Mesa, and Buckhorn plants.

Soils and Vegetation:

- Disturbance of 257 acres of riparian vegetation during construction.
- Long-term loss of 63 acres of riparian vegetation during operation.

Visual Resources:

- Combined visual change impacts (significant and highly significant) to 47 residences and 117 miles of road.

Cultural Resources:

- Potential impact to 94 cultural sites.

Recreation:

- Increased overall recreation demand (27 percent in 1986).
- Increased hunting (26 percent) and fishing (64 percent) demand.

Wilderness:

- Significant social, physical, and biological impacts due to increased visitor use, particularly in the Bridger Wilderness.

Agriculture/Grazing:

- Number of AUMs in 5 grazing allotments reduced by more than 5 percent.

Timber Resources:

- Significant beneficial impact due to the construction of additional access roads near future timber sales.

Transportation:

- The Level of Service C traffic volume would be exceeded on U.S. 189 and U.S. 30.
- An additional 190 traffic accidents would be expected each year during construction.
- Accelerated roadway deterioration would be expected on U.S. 189.

Land Use Plans, Controls, and Constraints:

- BLM Management Framework Plan goals for shared corridors would be violated (see Table 2-1).
- Plant sites in Sublette County would violate current zoning regulations (see Table 2-1).

Noise:

- Residences within one-half mile of U.S. 189 and U.S. 30 would experience increased noise from project-related truck traffic.

COMPONENT ALTERNATIVES

Quantitative differences in impacts associated with the component alternatives are summarized in Tables 2-2 through 2-4. Only a few significant impacts would be caused by these component alternatives. Most component alternatives would cause no change in the impacts identified for a given siting alternative, while some would reduce these impacts. Significant adverse and beneficial effects of the component alternatives are noted below.

Sulfur Transport:

- Various increases and decreases in the disturbance of critical wildlife range would occur if a railroad from West Dry Basin or Shute Creek were constructed (see Table 2-2).
- The sulfur transport railroad from West Dry Basin would cross 4 miles of Seedskadee National Wildlife Refuge. This would interfere with refuge management plans and would be a significant impact.
- The sulfur transport alternative would cause some sedimentation of streams at crossing locations during construction. This would be particularly impoartant for the railroad crossing of the Green River.
- A rail spur from West Dry Basin would disturb additional riparian vegetation and sensitive rehabilitation units.
- A rail spur from West Dry Basin would reduce the miles of significant visual impact.

TABLE 2-2
COMPARISON OF IMPACTS FOR COMPONENT ALTERNATIVES
SULFUR TRANSPORT[1]

	Sulfur Pipeline from West Dry Basin (Proposed Action)	Railroad from West Dry Basin	Sulfur Pipeline from Shute Creek (Shute Creek Alternative)	Railroad from Shute Creek
Wildlife and Fisheries				
Acres of Critical Range Disturbed[2]				
Elk Calving Range	0	0 (0)	0	0 (0)
Elk Winter Range	206	0 (-206)	0	0 (0)
Moose Winter Range	48	39 (-9)	0	0 (0)
Mule Deer Winter Range	339	170 (-169)	0	0 (0)
Pronghorn Winter Range	182	400 (+218)	0	0 (0)
Pronghorn Summer Range	158	121 (-37)	73	24 (-49)
Prairie Dog Towns	61	150 (+89)	12	16 (+4)
Total Number of Streams Crossed	6	6 (0)	0	0(0)
Soils and Vegetation				
Acres Disturbed During Construction	528	1,115 (+587)	105	103 (-2)
Acres Disturbed During Operation	105	279 (+174)	21	26 (+5)
Acres Not Reclaimed at Abandonment	0	167 (+167)	0	15 (+15)
Total Miles of Linear Facilities	58	91.5 (+33.5)	10.5	8.5 (-2.0)
Acres of Riparian Vegetation Disturbed				
Construction	5	22 (+17)	0	0 (0)
Operation	2	6 (+4)	0	0 (0)
Acres of Sensitive Rehabilitation Units Disturbed	158	235 (+77)	89	69 (-20)
Visual Resources				
Miles of Significant Impact	11.50	2 (-9.5)	0	0 (0)
Miles of Highly Significant Impact	14.25	4 (-10.25)	0	0 (0)
Cultural Resources				
Number of Cultural Sites Disturbed	13	12 (-1)	3	2 (-1)
Agriculture/Grazing				
Number of Crossings of Slate Creek Sheep Trail	1	0 (-1)	0	0 (0)
Land Use Conflicts				
Miles of Conflict with Seedskadee National Wildlife Refuge Management Objectives	0	4 (+4)	0	0 (0)

Note: Numbers in parentheses ( ) indicate the difference from the Proposed Action or Shute Creek Alternative.

[1] The reader is reminded that the impacts presented in this table are unmitigated with respect to the application of the measures described in Chapter 4 and Appendix C.6.

[2] Disturbance of wildlife critical ranges would occur during construction and are considered to be short-term for the sulfur pipelines; operational disturbance (long-term) along the railroads is expected to be 50 percent of the construction disturbance.

TABLE 2-3
COMPARISON OF IMPACTS FOR COMPONENT ALTERNATIVES
POWER SUPPLY[1]

	Proposed Action	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Wildlife and Fisheries[2]				
Acres of Critical Range Disturbed				
Elk Calving Range				
Applicants' System	0	0	0	0
UP&L System	0 (0)	0 (0)	0 (0)	0 (0)
BLM System	0 (0)	0 (0)	0 (0)	0 (0)
Elk Winter Range				
Applicants' System	194	194	194	194
UP&L System	170 (-24)	170 (-24)	194 (0)	170 (-24)
BLM System	158 (-36)	158 (-36)	158 (-36)	158 (-36)
Moose Winter Range				
Applicants' System	48	61	48	61
UP&L System	48 (0)	61 (0)	61 (+13)	61 (0)
BLM System	65 (+17)	77 (+16)	77 (+29)	48 (-13)
Mule Deer Winter Range				
Applicants' System	570	570	448	618
UP&L System	630 (+60)	606 (+36)	545 (+97)	691 (+73)
BLM System	558 (-12)	533 (-37)	448 (0)	630 (+12)
Pronghorn Winter Range				
Applicants' System	218	267	242	279
UP&L System	218 (0)	267 (0)	230 (-12)	279 (0)
BLM System	339 (+121)	388 (+121)	351 (+109)	400 (+121)
Pronghorn Summer Range				
Applicants' System	327	327	388	279
UP&L System	182 (-145)	182 (-145)	218 (-170)	182 (-97)
BLM System	218 (-109)	218 (-109)	240 (-148)	194 (-85)
Prairie Dog Towns				
Applicants' System	73	73	97	85
UP&L System	NA	NA	NA	NA
BLM System	NA	NA	NA	NA
Total Number of Streams Crossed				
Applicants' System	6	7	7	7
UP&L System	8 (+2)	8 (+1)	7 (0)	8 (+1)
BLM System	6 (0)	6 (-1)	6 (-1)	7 (0)
Soils and Vegetation[2]				
Total Acres Disturbed				
Applicants' System	1,182	1,228	1,261	1,018
UP&L System	1,152 (-30)	1,182 (-46)	1,261 (0)	970 (-48)
BLM System	1,206 (+24)	1,236 (+8)	1,248 (-13)	994 (-24)
Acres of Riparian Vegetation Disturbed				
Applicants' System	10	14	14	10
UP&L System	13 (+3)	15 (+1)	15 (+1)	13 (+3)
BLM System	12 (+2)	15 (+1)	15 (+1)	10 (0)
Acres of Sensitive Rehabilitation Units Disturbed				
Applicants' System	459	445	414	326
UP&L System	680 (+221)	680 (+235)	640 (+226)	753 (+427)
BLM System	701 (+242)	703 (+258)	733 (+319)	549 (+223)
Visual Resources[3]				
Miles of Significant Impact				
Applicants' System	0	0	0	0
UP&L System	0.75 (+0.75)	0.75 (+0.75)	0.75 (+0.75)	0.75 (+0.75)
BLM System	0 (0)	0 (0)	0 (0)	0 (0)
Miles of Highly Significant Impact				
Applicants' System	10.50	10.50	10.50	12.00
UP&L System	12.75 (+2.25)	10.25 (-0.25)	10.25 (-0.25)	15.50 (+3.50)
BLM System	13.50 (+3.00)	11.00 (+0.50)	11.00 (+0.50)	16.25 (+4.25)

TABLE 2-3 (continued)
COMPARISON OF IMPACTS FOR COMPONENT ALTERNATIVES
POWER SUPPLY[1]

	Proposed Action	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Cultural Resources[2]				
Number of Cultural Sites Impacted				
Applicants' System	21	24	26	19
UP&L System	31 (+10)	32 (+8)	41 (+15)	30 (+11)
BLM System	N S	N S	N S	N S
Agriculture/Grazing[2]				
Number of Crossings of Slate Creek Sheep Trail				
Applicants' System	1	1	1	1
UP&L System	0 (-1)	0 (-1)	1 (0)	0 (-1)
BLM System	1 (0)	1 (0)	1 (0)	1 (0)
Land Use Plans, Controls, and Constraints[3]				
Conflicts with Existing Land Use Plans				
Applicants' System	76.5	80.5	83.0	74.5
UP&L System	77.5 (+1.5)	80.0 (-0.5)	86.5 (+3.5)	69.0 (-5.5)
BLM System	43.0 (-33.5)	45.5 (-35.0)	46.5 (-36.5)	35.5 (-39.0)

N A = Not applicable. These corridors were not sampled for prairie dog towns.

N S = Not Surveyed.

() = Change from the Applicant's System.

[1] The reader is reminded that the impacts presented in this table are unmitigated with respect to the application of the measures described in Chapter 4 and Appendix C.6.

[2] Impacts to Wildlife and Fisheries, Soils and Vegetation, Cultural Resources, and Agriculture/Grazing would occur during construction.

[3] Impacts to Visual Resources and Land Use would occur during construction and operation.

Power Supply:

- Changes in disturbance of critical wildlife range among transmission systems varies with species (see Table 2-3). No significant difference from the Applicant's System has been identified.
- The UP&L and BLM Systems would disturb significantly more acres of sensitive rehabilitation units than the Applicant's System.
- The UP&L transmission system would disturb up to 58 percent more cultural sites than the Applicant's System.
- The BLM transmission system would have significantly less conflict with BLM's Management Framework Plan than the Applicant's System.

Employee Housing:

- The employee housing construction camp alternatives would reduce impacts on housing.
- Construction camps would disturb critical wildlife range as shown in Table 2-4. Only the West Dry Basin and Buckhorn camps would disturb no critical range. Constructions camps in close association with critical wildlife range would cause the potential for increase harassment and poaching.
- Each construction camp would require 75 acre-feet/year of groundwater for domestic supplies. This amount of groundwater is expected to be available from aquifers beneath the camp sites.
- Only the West Dry Basin camp site would have significant impacts on visual resources.
- A partial inventory for cultural resources has been conducted on the Shute Creek camp site. Four NRHP eligible sites were found. No inventories have been conducted on the other camp sites.
- The construction camp alternatives would reduce the amount of traffic on area roadways and thus the incidence of traffic accidents.
- The East Dry Basin, West Dry Basin, Big Mesa, and Buckhorn camp sites would not comply with Sublette County zoning regulations.

TABLE 2-4
COMPARISON OF IMPACTS FOR COMPONENT ALTERNATIVES
EMPLOYEE HOUSING

	East Dry Basin Camp	West Dry Basin Camp	Big Mesa Camp	Buckhorn Camp	Shute Creek Camp
Wildlife and Fisheries					
Acres of Critical Range Disturbed[1]					
Mule Deer Winter Range	0	0	80	0	0
Pronghorn Winter Range	320	0	0	0	0
Pronghorn Summer Range	0	0	0	0	320
Soils and Vegetation					
Acres of Sensitive Rehabilitation Units Disturbed	0	30	0	0	60
Visual Resources					
Significance of Impact	Insignificant	Significant	Insignificant	Insignificant	Insignificant
Cultural Resources					
Number of Cultural Sites Disturbed	0	0	0	0	4
Agriculture/Grazing					
Affected Allotment	North LaBarge Common	North LaBarge Common	North LaBarge Common	Desert Canyon	Slate Creek
Land Use Plans, Controls, and Constraints					
Conflicts with County Zoning	Yes	Yes	Yes	Yes	No

[1] Impacts to wildlife critical ranges are considered to be of 20 years duration (5 years of construction and operation, 15 years to reclaim to critical range characteristics) for all construction camps.

Alternatives to the single construction camp that is part of Northwest's proposed action are the addition of other construction camps, up to a total of four. Impacts to area housing would depend on the siting alternative and the number and location of the camps. Because details on the camps have not been specified, these impacts cannot be quantified. It can be predicted, however, that the greatest reductions in housing demand would be in towns farthest from the plant sites and that the construction camps would not eliminate the significant housing impacts in Big Piney, Marbleton, and LaBarge. Housing in these towns is limited and the housing demand associated with the project would be substantially above the existing supply as well as the response capability of the housing market to provide new units.

ENERGY

Table 2-5 summarizes the energy demand for the proposed Riley Ridge Project. Since the alternatives to the Proposed Action differ primarily in the location of the treatment plant sites, there would be very little difference in the energy requirements of the four alternatives. Thus, the information contained in Table 2-5 can be applied to all alternatives.

The only component alternative which would have an important energy consumption consideration would be the sulfur transport alternative. At this point in time, insufficient data on the energy requirements of the molten sulfur pipeline and the alternative railroad have been developed to allow comparison of these alternatives.

TABLE 2-5
FUEL AND ELECTRICAL ENERGY REQUIREMENTS

	Quasar			Williams			Exxon			Mobil/Northwest			Total		
	Natural Gas[1]	Electricity (Megawatts)	Fuel[2]	Natural Gas[1]	Electricity	Fuel[2]	Natural Gas[1]	Electricity	Fuel[2]	Natural Gas[1]	Electricity	Fuel[2]	Natural Gas[1]	Electricity	Fuel[2]
Well Drilling	NA	NA	25,920	NA	NA	8,640	NA	NA	18,000	NA	NA	16,683	NA	NA	69,243
Well Operation	NA	0.7	NA	NA	0.2	NA	NA	80 (dehydration)	NA	0.02	0.6	NA	NA	81.5	NA
Plant Construction	NA	2.4	390	NA	NA	NA	NA	12	70	NA	2.5	50	NA	16.9	510
Plant Operation	2.9	175	30	NA	NA	NA	17	218	2,400	1.1	65	300	21	458	2,730
Sulfur Pipeline and Loadout															
Operation	NA	NA	NA	NA	NA	NA	NA	6	11,600	NA	NA	NA	NA	6	11,600
Construction	NA	NA	NA	NA	NA	NA	NA	NA	33	NA	NA	NA	NA	NA	NA
TOTAL	2.9	178.1	26,340	NA	0.2	8,640	17	316	32,103	1.1	68.1	17,033	21	562.4	84,083

[1] Million cubic feet/day.

[2] Thousands of gallons.

CHAPTER 3

AFFECTED ENVIRONMENT

INTRODUCTION

This EIS analyzes the environment which would be affected by the Riley Ridge Project. Data projections are based on environmental conditions without the development of the Riley Ridge Project; however, existing production and on-going development of sweet gas and oil in the Big Piney/LaBarge area is included as part of the baseline condition against which impacts from the Riley Ridge Project are analyzed. Baseline data were collected on each resource covering a surface area or along a linear corridor to a distance at which impacts could no longer be identified. The study area varies with different resources. For some resources, such as vegetation and soils, the affected area would be confined to the immediate area of disturbance. The affected environment for these land-based resources examined the components of the Proposed Action, the component alternatives, and each of the siting alternatives. For other resources, such as air resources and socioeconomics, a regional study area was delineated; these resources treated the affected environment in a regional context. A 1-mile wide corridor was used for the analysis of the corridors in the study area. The area of influence is included in the description of the affected environment for each resource.

Resources and other environmental categories which would not be significantly affected by implementation of the Proposed Action, component alternatives, or siting alternatives, and resources related to issues which were not raised in the public scoping process are not discussed in detail. The criteria for determining the significance of impacts and the assumptions for the analysis for each resource are described in Chapter 4.

Individual resource technical reports were prepared to support the baseline descriptions and impact analyses summarized in the Riley Ridge Project EIS. This chapter describes the significant elements of the environment which could be affected by the Riley Ridge Project. Detailed descriptions of each resource are included in the respective technical report. The following is a list of the resources for which technical reports were prepared:

- Socioeconomics
- Wildlife and Fisheries
- Health and Safety
- Air Resources
- Soils, Vegetation, and Reclamation
- Cultural Resources
- Description of the Proposed Action

Figure 3-1 shows which environmental resources are discussed in this chapter and in Chapter 4, and for which resources the affected environment of an alternative would be the same as for the Proposed Action. When the affected environment of the alternative is the same as the Proposed Action, no description is provided for that component alternative or siting alternative.

PROPOSED ACTION

SOCIOECONOMICS

Information in this section has been summarized from the Riley Ridge Socioeconomics Technical Report (WRC 1982).

The areas where project-related workers would reside and where in-migrating workers would settle overlap for the well field, treatment plants, and linear facility components of the proposed project. Because of this overlap, discussion of the affected socioeconomics environment is not disaggregated by component. The characteristics of the workers, which would vary by skill and by project component, are accounted for in the analysis of service needs. The analysis assumes that Evanston would continue as the major service center for oil and gas activities in western Wyoming. Hence, the area most likely affected in terms of socioeconomic conditions has been identified as Lincoln County and the communities of Kemmerer, Diamondville, LaBarge, and Opal; Lincoln County School District #1; Sublette County and the communities of Big Piney, Marbleton, and Pinedale; Sublette County School District #9; and in Sweetwater County, only the Town of Granger (Map 1-1). Teton, Jackson, and Fremont Counties, including the Wind River Indian Reservation, are sufficiently removed from the project site, either in absolute distance or highway travel time, that they are outside the two hours travel time assumed for daily commuting. Because of these distances, these areas would neither be a source of workers nor places where inmigrating workers would settle. While travel conditions in the area are often made difficult due to road closures from snow, the two-hour daily commuting range is based on experience in other, similar areas (Electric Power Research Institute 1982). Further, the most intense construction activities would not occur during the winter months so worker decisions on residential location would be influenced by the average weather conditions, and hence average travel time, that could be anticipated.

Resources	Proposed Action			Component Alternatives			Buckhorn Alternative			Shute Creek Alternative			Northern Alternative			No Action Alternative
	Well Field	Plant Sites	Linear Facilities	Sulfur Transport	Power Supply	Employee Housing	Well Field	Plant Sites	Linear Facilities	Well Field	Plant Sites	Linear Facilities	Well Field	Plant Sites	Linear Facilities	
Socioeconomics	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	●
Wildlife and Fisheries	■	■	■	■	■	■	●	■	■	●	■	■	●	■	■	●
Water Resources	■	■	■	■	●	●	●	●	■	●	●	■	●	●	■	●
Air Quality	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	●
Soils and Vegetation	■	■	■	■	■	■	●	■	■	●	■	■	●	■	■	●
Visual Resources	■	■	■	■	■	■	●	■	■	●	■	■	●	■	■	●
Cultural Resources	■	■	■	■	■	■	●	■	■	●	■	■	●	■	■	●
Recreation Resources	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	●
Wilderness	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	●
Agriculture/Grazing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	●
Timber Resources	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	●
Transportation Networks	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	●
Land Use Plans, Controls, and Constraints	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	●

■ Included in Text
● Same as Proposed Action
• Regional Description

FIGURE 3-1. KEY TO RESOURCE DISCUSSION OF AFFECTED ENVIRONMENT

TABLE 3-1
PROJECTED TOTAL ANNUAL AVERAGE LABOR FORCE, NUMBER EMPLOYED, AND UNEMPLOYMENT RATES FOR LINCOLN, SUBLETTE, AND SWEETWATER COUNTIES FOR THE BASELINE FROM 1970 TO 2000

County	1970[1]	1980[1]	1985[2]	1986[2]	1990[2]	2000[2]
Lincoln County						
Labor Force	4,240	5,020	5,787	5,855	6,135	6,856
Number Employed	3,940	4,695	5,412	5,475	5,739	6,412
Unemployment Rate (%)	7.1	6.5	6.5	6.5	6.5	6.5
Sublette County						
Labor Force	1,770	2,145	2,260	2,276	2,241	2,292
Number Employed	1,750	2,080	2,186	2,201	2,177	2,216
Unemployment Rate (%)	1.1	3.0	3.3	3.3	2.9	3.3
Sweetwater County						
Labor Force	7,800	21,018	22,292	22,646	24,121	30,448
Number Employed	7,400	20,280	21,316	21,675	23,328	29,683
Unemployment Rate (%)	5.1	3.5	4.4	4.3	3.3	2.5

Source: Western Research Corporation 1982

[1] Wyoming Employment Security Commission.

[2] Western Research Corporation projections.

Employment

Average annual labor force, number employed, and unemployment rates for Lincoln, Sublette, and Sweetwater Counties for the period 1970 to 2000 are shown in Table 3-1. Apparent from this data is the much greater recent growth in employment in Sweetwater County than in Lincoln and Sublette Counties. This reflects the increases in coal, oil, gas, and trona production that have occurred in Sweetwater County in the period from 1970 to 1980.

The unemployment rate in Lincoln County has historically been above the state unemployment rate, while the opposite has been true in Sublette County. As of March 1982, Sublette County continued to have the lowest unemployment rate in the state, while Lincoln County continued to have the highest. Preliminary estimates for June showed these rates to be at a ten-year high for both counties (Wyoming Employment Security Commission 1982). Without the proposed Riley Ridge Project, future unemployment rates are projected to remain very near those levels experienced during the late 1970s with lower rates occurring in the first part of the 1980s as a result of continuing oil and gas exploration and development in Lincoln and Sublette Counties.

The importance of the agricultural sector in terms of employment opportunities in Lincoln and Sublette Counties is shown by Table 3-2. In 1980, approximately 13 and 19 percent of all employment opportunities in Lincoln and Sublette Counties, respectively, were found in the agricultural sector. This is compared to less than 1 percent for Sweetwater County and 6 percent for all of Wyoming.

Historically the mining sector has been of only minor importance in terms of supplying employment opportunities in Lincoln and Sublette Counties, while the economy in Sweetwater County has long been dominated by the mining industry. In the ten-year period from 1970 to 1980 Sweetwater County experienced an increase in mining employment opportunities of approximately 343 percent. The majority of this occurred between 1970 and 1975 as a result of the development of the trona industry. By 1980, the mining sector accounted for nearly 30 percent of all jobs in the county, over twice the state level.

Future employment opportunities in Lincoln County are expected to follow very much the same general trend that was observed during the 1970s, the primary difference being the rates of change. The mining sector is expected to continue to lead the county in terms of job growth while agricultural employment opportunities will continue to decline as a percentage of total available jobs. Projected employment opportunities in mining in Sublette County will continue to increase during the early 1980s, peaking in 1985 and declining thereafter. Agricultural employment will continue to dominate the economy in this county and still account for 20 percent of all employment by the year 2000.

Population

Table 3-3 presents baseline population for the three-county study area for the years 1970 to 2000. As a result of the rapid growth in mineral and energy development and related activities, Sweetwater County was the second fastest growing county in the state in

TABLE 3-2
ANNUAL EMPLOYMENT OPPORTUNITIES BY SECTOR BY COUNTY FOR THE BASELINE FROM 1970 TO 2000

County/Sector	1970	1980	1985	1986	1990	2000
Lincoln County						
Agriculture	820	809	829	834	850	894
Mining	279	1,353	1,540	1,566	1,681	1,951
Construction	638	539	591	598	626	697
Manufacturing	289	444	690	692	698	713
Transportation, Cumminications, and Public Utilities	303	482	546	551	573	634
Retail and Wholesale Trade	594	838	933	942	983	1,084
Finance, Insurance, and Real Estate	72	163	199	202	217	256
Services	451	577	633	638	662	721
Government	749	925	1,005	1,022	1,092	1,288
Miscellaneous	19	37	44	45	48	55
Total Employment	4,214	6,167	7,101	7,090	7,429	8,293
Sublette County						
Agriculture	476	467	479	481	491	516
Mining	127	274	298	299	227	115
Construction	165	336	370	376	402	486
Manufacturing	46	41	41	41	41	41
Transportation, Cumminications, and Public Utilities	184	137	139	140	139	139
Retail and Wholesale Trade	286	361	371	373	377	395
Finance, Insurance, and Real Estate	40	49	51	51	50	50
Services	244	285	292	294	298	313
Government	371	423	438	442	454	488
Miscellaneous	17	35	38	39	41	46
Total Employment	1,956	2,408	2,517	2,536	2,520	2,589
Sweetwater County						
Agriculture	347	235	241	242	247	260
Mining	1,612	7,142	7,411	7,421	7,459	7,582
Construction	515	3,141	1,786	1,801	1,859	2,109
Manufacturing	216	475	668	673	695	779
Transportation, Cumminications, and Public Utilities	863	1,933	2,356	2,369	2,427	2,652
Retail and Wholesale Trade	1,533	4,224	4,426	4,494	4,799	5,864
Finance, Insurance, and Real Estate	188	445	452	457	479	564
Services	1,525	2,847	2,895	2,923	3,056	3,556
Government	1,538	3,067	4,195	4,466	5,737	10,733
Miscellaneous	17	54	55	55	58	69
Total Employment	8,354	23,545	24,485	24,901	26,816	34,168

Source: Western Research Corporation 1982.

Note: Columns may not total due to rounding.

TABLE 3-3
BASELINE POPULATION WITHIN THE RILEY RIDGE STUDY AREA

County/Community	1970	1980	1985	1986	1990	2000
Lincoln County[1]	8,640	12,177	14,168	14,333	15,025	16,748
Afton	1,290	1,481	1,721	1,741	1,825	2,039
Thayne	195	256	300	303	318	355
Diamondville	485	1,000	1,164	1,177	1,234	1,378
Kemmerer	2.292	3,273	3,811	3,856	4,042	4,515
LaBarge	NA	302	350	354	371	415
Cokeville	440	515	597	604	633	707
Rural	3,938	5,350	6,226	6,298	6,602	7,375
Frontier	NA	146	170	172	180	201
Opal	NA	99	116	117	123	137
Sublette County	3,755	4,548	4,809	4,844	4,768	4,876
Big Piney	570	530	561	565	556	569
Marbleton	223	537	567	571	562	575
Pinedale	948	1,066	1,127	1,135	1,117	1,143
Rural	2,014	2,415	2,555	2,573	2,533	2,590
Calpet	NA	25	26	27	26	27
Daniel	NA	150	158	160	157	161
Sweetwater County	18,391	41,723	44,583	45,292	48,242	60,896
Granger	131	177	189	192	204	258
Green River	4,196	12,807	13,676	13,894	14,799	18,680
Rock Springs	11,657	19,458	20,781	21,111	22,487	28,385
South Superior	197	586	621	631	672	849
Wamsutter	139	681	739	751	800	1,009
Rural	2,065	8,014	8,577	8,713	9,281	11,715

Source: Western Research Corporation 1982

NA: Not Available

[1] The county population is the sum of the town populations plus the rural total.

total population between 1970 and 1980. While construction of the Jim Bridger Power Plant contributed to the growth in the County, the population distribution was affected more by the trona development west of Green River.

During the 1980s, population growth in the three counties is expected to be much less than it was during the 1970s. County populations are expected to increase by approximately 23 and 16 percent in Lincoln and Sweetwater Counties, respectively, between 1980 and 1990. Almost no change in total population is expected in Sublette County during the same period. The percentage of county population residing in the various cities and towns within the three counties is not expected to vary from the distributions observed in 1980. Similarly, the age (Table 3-4) and sex distributions of the population in Lincoln and Sublette Counties are expected to remain essentially unchanged through the 1980s.

Personal Earnings

Total annual personal earnings (in constant 1980 dollars) projected for Lincoln, Sublette, and Sweetwater Counties for the period of 1970 to 2000 are shown in Table 3-5. Total personal earnings (average annual wages multiplied by employment, exluding any accounting of fringe benefits and other adjustments made for total income determinations) are expected to increase from approximately $102.3 million in 1983 to approximately $112.0 million in 1990 in Lincoln County. This 9 percent increase is greater than the expected increase in total employment opportunities in the county and occurs as a result of the continued expansion in energy development activities planned for the region and the proportionately high level of wages paid in the mining and construction sectors (Table 3-6). Employment opportunities in these sectors are expected to increase by nearly 24 percent from 1982 to 1990 (Wyoming Employment Security Commission 1981).

Housing

Tables 3-7 and 3-8 indicate the existing and projected mix of housing in Lincoln and Sublette Counties and the towns in the three-county study area that are expected to attract project-related population. While single-family dwellings are the dominant type of housing in the counties in total, mobile homes are a relatively larger part of the housing stock in Diamondville, LaBarge, Marbleton, and Granger. Multi-family

TABLE 3-4
PROJECTED BASELINE POPULATION DEMOGRAPHICS WITHIN THE RILEY RIDGE STUDY AREA

County	1970	1980	1985	1986	1990	2000
Lincoln County						
0 to 4 Years	806	1,595	1,856	1,878	1,968	2,199
5 to 19 Years	2,912	3,423	3,981	4,028	4,222	4,716
20 to 34 Years	1,330	3,002	3,499	3,540	3,711	4,146
35 to 54 Years	1,901	2,183	2,536	2,566	2,689	3,004
55 Years and Older	1,691	1,974	2,295	2,322	2,434	2,719
Total Population	8,640	12,177	14,167	14,334	15,024	16,784
Sublette County						
0 to 4 Years	328	408	433	436	429	439
5 to 19 Years	1,211	1,211	1,279	1,289	1,268	1,297
20 to 34 Years	739	1,152	1,217	1,226	1,206	1,234
35 to 54 Years	915	1,014	1,072	1,080	1,063	1,087
55 Years and Older	562	763	808	814	801	819
Total Population	3,755	4,548	4,809	4,845	4,767	4,876

Source: Western Research Corporation 1982

TABLE 3-5
TOTAL ANNUAL PERSONAL EARNINGS IN 1980 DOLLARS BY COUNTY (1,000s)

County	1970	1980	1985	1986	1990	2000
Lincoln	$26,333	$ 91,111	$104,813	$106,177	$112,034	$126,729
Sublette	$11,767	$ 32,591	$ 34,273	$ 34,514	$ 33,406	$ 32,892
Sweetwater	$54,792	$466,234	$474,758	$480,611	$507,309	$609,939

Source: Western Research Corporation 1982

TABLE 3-6
1982 AVERAGE WEEKLY WAGES BY SECTOR BY COUNTY

Employment Sector	Lincoln County	Sublette County
Mining	$520.94	$419.85
Construction	415.29	352.97
Manufacturing	268.21	238.93
Transportation and Public Utilities	484.13	466.66
Trade, Wholesale	255.70	282.74
Trade, Retail	137.91	125.34
Finance	264.05	245.02
Services	293.18	256.84
Government	249.65	302.45
Average	346.39	303.42

Source: Wyoming Employment Securities Commission, Research and Analysis Section, State and County Summary of Covered Employment and Total Payroll by Industry, 2nd Quarter 1982

units provide a relatively smaller portion of the housing stock in these same towns and in the counties overall. Only Kemmerer and Pinedale have an appreciable number of temporary units such as efficiency apartments or motel units.

Housing supply in Lincoln County increased at a rate of 4.25 percent annually, or 52 percent, from 1970 to 1980 while population in the county grew at 41 percent. The average household size dropped from 3.4 in 1970 to 3.15 by 1980 accounting for the higher growth in the housing stock than in population. In 1980, 8 percent of the total county housing stock was classified as seasonal and was located primarily in the northern areas of the county. These units are considered unavailable to meet the housing needs of an inmigrating work force. The average cost of housing in Lincoln County as reflected by surveys in Kemmerer was $640 per month for mortgage payments and $350 per month for an apartment. Mobile home lot rents in the county averaged $115 per month. The housing stock in Diamondville and Kemmerer grew slightly faster than in the county as a whole, while housing in

TABLE 3-7
HISTORIC HOUSING SUPPLY[1] AND BASELINE HOUSING DEMAND[2] FOR LINCOLN COUNTY, KEMMERER, DIAMONDVILLE AND LABARGE

County	1970	1980	1985	1986	1990	2000
Lincoln						
Single Family	2,359	3,201	3,352	3,375	3,508	3,919
Mobile Home	274	653	743	761	828	925
Multi-Family	121	329	326	325	328	366
Other	95	138	162	166	182	203
TOTAL	2,849	4,321	4,583	4,627	4,846	5,413
Kemmerer						
Single Family	NA	819	953	964	1,021	1,138
Mobile Home	NA	213	248	250	265	297
Multi-Family	NA	157	183	185	194	219
Other	NA	110	130	131	138	153
TOTAL	794	1,299	1,514	1,530	1,618	1,807
Diamondville						
Single Family	NA	160	186	187	198	221
Mobile Home	NA	178	207	209	220	245
Multi-Family	NA	17	20	20	21	23
Other	NA	2	3	3	3	4
TOTAL	195	357	416	419	442	493
LaBarge						
Single Family	NA	66	76	77	81	91
Mobile Home	NA	44	51	52	54	61
Multi-Family	NA	8	10	9	10	11
Other	NA	0	0	0	0	0
TOTAL	87	118	137	138	145	163

Source: Western Research Corporation 1982

[1] 1970 and 1980 housing supply (U.S. Census).

[2] 1985 to 2000 housing demand projections (WRC).

NA: Not available.

LaBarge grew at about the county rate. Land is presently available within and adjacent to Kemmerer, Diamondville, and LaBarge to support future development. While actual 1982 vacancy rates are unavailable, the 1981 vacancy rate in Lincoln County was estimated at about 3.5 percent by the Wyoming Housing Monitoring System, Department of Economic Planning and Development.

In Sublette County, the year-round housing stock grew at an average annual rate of 3.36 percent or 39 percent from 1970 to 1980. The county average household size dropped from 3.2 in 1970 to 2.86 in 1980. Seasonal housing units made up 33 percent of the total housing stock in Sublette County in 1980 reflecting the recreational influence within the county. According to the County Master Plan, 38 percent of the subdivision lots are owned by out-of-state residents, 33 percent by Sweetwater County residents, 5 percent by other Wyoming residents, and only 24 percent by Sublette County residents. While Big Piney and Marbleton have 4 percent or less of their housing stock in the seasonal category, Pinedale has almost 7 percent seasonal dwellings. Housing supply in Big Piney and Pinedale grew at less than the county average annual rate, while growth in Marbleton was substantially higher. The county average 1981 housing costs are based on costs in Pinedale and are $625 for monthly mortgage payments, $240 per month for apartments, and $65 per month for mobile home spaces. Vacancy rates throughout the county are estimated by local residents to be extremely low, approaching 1 percent or lower. There is developable land in or adjacent to Pinedale and Marbleton to meet future growth. Big Piney has relatively little developable land within its present boundaries.

TABLE 3-8
HISTORIC HOUSING SUPPLY[1] AND BASELINE HOUSING DEMAND[2] FOR SUBLETTE COUNTY, BIG PINEY, MARBLETON, PINEDALE, AND GRANGER

County/Community	1970	1980	1985	1986	1990	2000
Sublette County						
Single Family	1,013	1,156	1,199	1,208	1,191	1,218
Mobile Home	203	353	383	385	372	380
Multi-Family	75	254	274	276	276	282
Other	0	33	38	38	37	38
TOTAL	1,291	1,796	1,894	1,907	1,876	1,918
Big Piney						
Single Family	NA	142	152	152	150	154
Mobile Home	NA	58	62	62	61	62
Multi-Family	NA	22	22	22	22	22
Other	NA	1	1	1	1	1
TOTAL	193	223	237	237	234	239
Marbleton						
Single Family	NA	87	92	93	91	93
Mobile Home	NA	83	88	89	87	89
Multi-Family	NA	9	10	10	10	10
Other	NA	0	0	0	0	0
TOTAL	64	179	190	192	188	192
Pinedale						
Single Family	NA	374	345	347	342	350
Mobile Home	NA	36	33	33	33	34
Multi-Family	NA	48	44	45	44	45
Other	NA	27	25	25	25	25
TOTAL	383	485	447	450	444	454
Sweetwater County Granger						
Single Family	NA	39	41	42	45	57
Mobile Home	NA	29	30	31	33	42
Multi-Family	NA	2	2	2	2	2
Other	NA	0	0	0	0	0
TOTAL	50	70	73	75	80	101

Source: Western Research Corporation 1982

[1] 1970 and 1980 housing supply (U.S. Census).

[2] 1983 to 2000 housing demand projections (WRC).

NA: Not Available.

Education

Table 3-9 shows the baseline projections for enrollment, classrooms, and staff needs for Lincoln County School District #1, Sublette County School District #9, and Granger Elementary School. Lincoln County School District #1 serves the south and southeastern portions of Lincoln County and includes the communities of Kemmerer, Diamondville, and Opal. LaBarge, although in Lincoln County is served by Sublette County School District #9. Because the grade schools, Kindergarten-6 (K-6), are at 92 percent of capacity, a new school that would add space for 450 students is planned for Kemmerer; construction is scheduled to begin in 1984. Between 1982 and 1991 enrollment is projected to increase a total of 17 percent. Existing facilities and those planned for construction should accomodate this growth but additional teaching and support staff will be required. Sublette County School District #9 includes the high

TABLE 3-9
EDUCATION: BASELINE ENROLLMENT AND SERVICE PROJECTIONS FOR LINCOLN COUNTY SCHOOL DISTRICT #1 AND SUBLETTE COUNTY SCHOOL DISTRICT #9

Category	Current	1985[1]	1986	1987	1990	2000
Lincoln County School District #1 Enrollment						
K-6	739	756	766	744	802	894
7-12	398	402	406	412	426	475
Total Enrollments	1,137	1,158	1,172	1,186	1,228	1,369
Classroom[2]						
K-6	30	31	31	31	33	36
7-12	33	34	34	34	36	40
Total	63	65	65	65	69	76
Teacher[2]						
K-6	30	31	31	31	33	36
7-12	30	30	31	31	32	36
Total	60	61	62	62	65	72
Support Staff[2]	2	2	2	2	2	2
Sublette County School District #9 Enrollment						
K-6	352	351	354	357	351	365
7-12	162	162	164	165	162	168
9-12	182	183	184	185	181	189
Total Enrollments	696	696	702	707	694	722
Teacher and Classroom Needs						
K-6	21	21	21	22	21	22
6-12	10	10	10	10	10	10
9-12	23	23	23	23	23	24
Total	54	54	54	55	54	56

Source: Western Research Corporation 1982

[1] Indicates academic year; e.g., 1985 = 1984-1985.

[2] Projections are based on the enrollment projections in the previous table, as well as the following assumed ratios: 24.6 elementary students per room; 12 secondary students per room; one teacher per every 24.6 elementary students; one teacher per every 13.27 secondary students; and 1.76 support staff per 1,000 students.

school and middle school in Big Piney, and the elementary schools in Big Piney and LaBarge. In 1982, each school had the capacity to handle at least 50 additional students with space for an additional 100 in the Pinedale Middle School. Modest enrollment increases that are projected for the period 1982-1990 can be accommodated by existing facilities and staff.

Current enrollment at Granger Elementary School is 70 students. Recommended capacity is 100 and maximum capacity is 125; expansion potential is limited. At present the school has four teachers. Facilities are limited to five classrooms plus a gym and auditorium.

Public Facilities

The range of public services offered in the counties and communities of the Riley Ridge Project area varies in terms of responsibility and services provided. Some towns share responsibility for service provision, other towns receive services from the county and in yet other cases, the town is sufficiently small that it has not taken on responsibility for provision of the service and the need is filled by the private sector. In the tables that accompany the discussion of public services and facilities, only those services now provided by a town are addressed. Also, a service is shown only for the

TABLE 3-10
PUBLIC FACILITIES: CURRENT CAPABILITY AND PROJECTED PERSONNEL AND FACILITY NEEDS
LINCOLN COUNTY

Services	Current	1985	1990	2000
General Administration	28	28	30	34
Sherrif's Department				
Sworn Officers	12	14	15	17
Support Personnel	19	19	20	23
Road & Bridge (South County only)	7.5	7.5	8	9
Library	11	12	13	14
Facilities				
County Sheriff Number of Vehicles	10	10	11	13
Library Volumes	33,500	33,500	35,000	39,000
Waste Disposal - Acres	67.0	29.3	40.3	64.2

Source: Western Research Corporation 1982

town which has responsibility for service provision, not for the town that through contract or other arrangement shares the service. Hence, the absence of a service listing under a town does not mean that that need is not met in that area. Where projected facility and service needs are less than current capacity, this indicates that current service levels are adequate to meet anticipated future service demands.

Lincoln County

Lincoln County's current and projected personnel and public service facility needs are given in Table 3-10. Additional personnel requirements for the county's administrative, sheriff, and road and bridge staffs are expected to be low, with the staffs expanding slightly to accommodate projected baseline populations. Administrative and law enforcement facilities are relatively new or presently under construction, and are adequate to meet future needs. Library facilities and staffing in the county are currently inadequate. A new facility that will include a meeting room, is being completed this year in Kemmerer. This will reduce, but not eliminate, the system's shortage of space and number of volumes. The road and bridge department has requested 20 acres of land from the BLM to construct a new lot and facility outside Diamondville in order to meet anticipated needs.

Projections of community personnel and facilities in Lincoln County are given in Table 3-11. With the exception of Kemmerer, towns within the county (Diamondville, LaBarge, and Opal) are small communities, offering only minimal administrative, law enforcement, fire, and maintenance services. These small communities are expected to meet anticipated baseline service needs with minimal additional personnel and with no major construction of facilities.

The Town of Kemmerer anticipates the need for a new city hall by 1985. In addition, the police, fire, and street departments have identified major new equipment and facility requirements to meet present and projected baseline service needs. However, projections of personnel requirements do not show the need for major expansions of staff.

The water and sewer systems for Kemmerer and Diamondville are shared facilities. Kemmerer is presently making significant additions to storage and treatment facilities, and Diamondville has installed the equipment necessary to connect to the Kemmerer system. Capacity of the water and sewer systems will be adequate to meet projected baseline needs through 1990. However, Kemmerer anticipates the need for additional water rights by the late 1980s.

Kemmerer has annexed 1,000 acres of BLM land and requested 250 of these acres be set aside for a summer park. If the BLM approves the request, Kemmerer will have ample park land available to meet future need.

Lincoln County maintains two landfill sites, one in the northern part of the county and one in the southern portion. The south Lincoln County site is approximately 44 acres and is estimated to have a remaining life of 10 years. The north Lincoln County site consists of approximately 23 acres but less than 5 percent of this area has been utilized. In Kemmerer, the city provides for solid waste collection but the county has taken over operation of the landfill site where Kemmerer disposes of its wastes. In Diamondville, collection is provided by a private service that uses the county landfill site for dumping. In LaBarge and Opal, collection and disposal are handled by a private contractor.

TABLE 3-11
PUBLIC FACILITIES: CURRENT CAPABILITY AND PROJECTED PERSONNEL AND FACILITY NEEDS LINCOLN COUNTY COMMUNITIES

Community/Service		Current	1985	1990	2000
TOWN OF KEMMER					
Town Administration		6.5	6.5	7.5	8
Police	Sworn Officers	9	8	8	9
	Staff	2	3	3	4
Fire Department	Chief (part time)	1	1	1	1
	Volunteers	24	24	26	29
Street Department		12	12	13	14
Solid Waste Disposal		3	3	3	4
Parks & Recreation	full time	3	3	3	4
	part time	10	10	10	12
Facilities					
Police Department Number of Vehicles		3	3	3	3
Water System - mgd		5.00	1.00	1.06	1.18
Sewer System - mgd		1.45	0.65	0.69	0.77
Street Department			2-8 yard dump trucks w/snowplows 1-street sweeper		
Parks & Recreation (Acres)[1]		229	38	40	45
TOWN OF DIAMONDVILLE					
Town Administration		5	5	5	6
Police Department		2	2	2	3
Street Department		2	2	2	2
Facilities					
Police Department Number of Vehicles		1	1	1	1
Street Department			1-dumptrucks w/snowplow		
Parks & Recreation (Acres)[1]		6.4	7.2	7.7	8.5
TOWN OF LABARGE					
Town Administration		1	1	1	1
Police Department	full time	1	1	1	1
	part time	1	1	1	1
Fire Protection	volunteers	10	10	11	12
Facilities					
Police Department Number of Vehicles		1	1	1	1
Municipal Water System - mgd		0.123	0.070	0.074	0.083
TOWN OF OPAL					
Town Administration		1	1	1	1

Source: Western Research Corporation 1982

Note: mgd = million gallons/day.

[1] Recreation facilities also include an outdoor pool and tennis courts, a golf course, and Little League fields. Total acres comprised of 4 acres at Archie Neil Park and 225 acres that the town has applied to the BLM for under the Recreation and Public Purpose Act.

TABLE 3-12
PUBLIC FACILITIES: CURRENT CAPABILITY AND PROJECTED PERSONNEL AND FACILITY NEEDS
SUBLETTE COUNTY

Services	Current	1985	1990	2000
General Administration	14	14	14	14
Sherrif's Department				
Sworn Officers	9	9	9	9
Staff	6	6	6	6
Road & Bridge Department	11	11	11	11
Library				
Librarians	2	3	3	3
Clerks	3	1	1	1
Facilities				
Road and Bridge Department Number of Vehicles	30	30	30	31
Library Volumes	25,000	15,000	15,000	15,000
Recreation Acres	0	29.8	29.6	30.2

Source: Western Research Corporation 1982

Sublette County

Current and projected public facilities for Sublette County are given in Table 3-12. Anticipated population growth will require some additional staff for each of the major service areas, but is not expected to require additional capital expansion.

Services for the Towns of Big Piney and Marbleton are given in Table 3-13. Big Piney's greatest service need is for expanded police services to provide 24-hour protection; however, at existing levels of service, no needs for additional staff or facilities are anticipated. A similar situation exists for Marbleton. In both towns, 24-hour police coverage would require five sworn officers and a half-time support staff person.

Within Sublette County there are four county or municipal landfill sites. The county maintains one landfill at Daniel and another at Boulder. The Daniel site encompasses a total of 40 acres with a total of 4.5 acres used since the site was opened in 1971. The Boulder site contains 20 acres of which about 0.25 has been used since it was opened in 1980. At the current rate of utilization, the remaining 55.5 acres would be sufficient to meet the needs of the county for the projected 30-year life of the landfill sites. The Pinedale Municipal landfill is located on a 17-acre site. Because it is projected that this site will be filled by 1984, the town has applied to the BLM for additional acreage. Big Piney operates a landfill on a 40-acre site which has been in operation about 9 years. Approximately 12 acres have been used. The remaining 28 acres are adequate for anticipated population needs. Marbleton does not have its own municipal landfill but contracts with Big Piney for services.

Town of Granger

Public facilities for the Town of Granger in Sweetwater County are also shown in Table 3-13. Presently the town is planning a new community facilities center to accommodate current and anticipated space needs. This center will answer existing problems of crowding, particularly in the police department. In addition, the fire hall will require upgrading to meet future baseline needs.

The town's water and sewer systems were recently upgraded and are presently adequate to meet future needs. The town does require a new solid waste disposal site, since the present site is a privately owned open dump which is not in compliance with state regulations.

Human Services

Lincoln County

Most health and welfare needs are met at the county level by state and county agencies. Agencies for Lincoln County are shown in Table 3-14. The county's most pressing staffing needs are for physicians, dentists, and nurses. In addition, the county needs to provide nursing home beds to meet needs of senior citizens.

TABLE 3-13
PUBLIC FACILITIES: CURRENT CAPABILITY AND PROJECTED PERSONNEL AND FACILITY NEEDS FOR SUBLETTE COUNTY COMMUNITIES AND GRANGER

Community/Service		Current	1985	1990	2000
TOWN OF BIG PINEY					
Town Administration		1	1	1	1
Police	Chief	1	1	1	1
	Officers	2	2	2	2
Fire Protection	Volunteers	20	20	20	20
Street Department		1	1	1	1
Facilities					
Police Department Number of Vehicles		2	2	2	2
Fire Department Number of Vehicles		6	6	6	6
Parks and Recreation (Acres)		0	3.5	3.5	3.5
Water System - mgd		0.20	0.112	0.111	0.114
Sewer System - mgd		0.36	0.073	0.072	0.074
TOWN OF MARBLETON					
Town Administration		1	1	1	1
Police Department	Chief	1	1	1	1
(less than 24 hour)	Officers	2	2	2	2
Facilities					
Police Department Number of Vehicles		2	2	2	2
Water System - mgd		0.2	0.113	0.112	0.110
Sewer System - mgd		0.11	0.074	0.073	0.075
Parks & Recreation (Acres)		2.5	3.5	3.5	3.5
TOWN OF GRANGER (Sweetwater County)					
Town Administration		1	1	1	1
Police Department	Chief	1	1	1	1
	Officers	1	1	1	1
Fire Protection	Chief	1	1	1	1
	Volunteers	12	14	14	17
Facilities					
Police Department Number of Vehicles		1	1	1	1
Water System - mgd		0.14	0.038	0.041	0.052
Sanitary Sewer System - mgd		0.060	0.025	0.027	0.034

Source: Western Research Corporation 1982

Note: mgd = million gallons/day.

Sublette County

As shown in Table 3-15, the county's most pressing need is for physicians, dentists, and professional nurses. Most serious cases presently are referred to medical facilities in Salt Lake City, since only primary care is available in the county. The present medical staff is below projected needs based on state-wide averages of health care coverage.

Public Finance

The baseline projections of revenues and expenditures for Lincoln County, Sublette County, Granger, and selected jurisdictions within the two counties are shown in Table 3-16 and 3-17. Revenues for Lincoln County have been projected assuming continuation of the optional 1 percent sales tax; Sublette County has not adopted the optional tax. Excluded from the

TABLE 3-14
HUMAN SERVICES: CURRENT CAPABILITY AND PROJECTED PERSONNEL AND FACILITY NEEDS (LINCOLN COUNTY)

Services	Current	1985	1990	2000
Health Care				
Physicians	7	11	11	13
Dentists	5	7	7	8
Nurses (RN)	21	63	67	75
Nurses (Public Health)	1	2	3	3
Mental Health				
South Lincoln Community Counseling Center (Kemmer) prof	2	2	2	2
support	1	1	1	1
Lincoln Mental Health Center (Afton) prof	2	2	2	2
support	1	1	1	1
Welfare & Social Services				
Wyoming Department of Public Assistance and Social Services	5	5	5	5
Employment Services				
Wyoming State Employment Service	4	4	4	4
Senior Services Full time	3	3	3	3
Part time	4	4	4	4
Facilities				
Health Care				
Nursing Home Beds	0	11	12	13
Hospital Beds	35	29	31	34

Source: Western Research Corporation 1982

TABLE 3-15
HUMAN SERVICES: CURRENT CAPABILITY AND PROJECTED PERSONNEL AND FACILITY NEEDS (SUBLETTE COUNTY)

Community/Services	Current	1985	1990	2000
Health Care[1]				
Physicians	2	4	4	4
Dentists	2	2	2	2
Nurses (RN)	9	21	21	22
Nurses (Public Health)	2	1	1	1
Wyoming Department of Public Assistance and Social Services	1	1	1	1
Faciliities				
Health Care				
Nursing Home Beds	34	4	4	4
Hospital Beds	2	1	1	1

Source: Western Research Corporation 1982

[1] Availability of health care services are measured by the numbers of physicians, dentists, and nurses as there are existing service standards for these professions. Such standards are not available to measure the services provided by physician assistants, emergency medical technicians, and other paramedical personnel.

revenue projections for both counties were funds from interest, revenue sharing, and sale of equipment. Their continuation was too uncertain to warrant estimation. Similarly, the costs for known needed capital facilities and equipment are not included in expenditure projections. Decisions have not been made on how to fund most of these items. Further, in the case of municipalities, Wyoming law limits the ability to incur debt.

As the financial projections indicate, the position of the counties is currently favorable and continues to improve throughout the period shown as increases in assessed valuation due to increased mineral production grow at a faster rate than population and the associated increases in required services.

The financial position of the towns is less favorable. Unlike the counties, the communities do not enjoy the increases in taxes associated with mineral production. In the absence of any needed additions to public services, Marbleton and Granger will be in a deficit position throughout much of the 1980 time period. In Kemmerer, the town administrator has identified a capital improvement program including items for water, streets, fire, and civic center that, if implemented, would cost in excess of $5.5 million. The operating revenues surplus for Kemmerer is projected to total approximately $2.0 million from 1983 to 1990. Thus, even under baseline conditions the city anticipates the need to improve public facilities but will have to seed additional revenue sources or find new financing mechanisms to pay for them.

Like the counties, the school districts are in favorable and increasingly strong financial position due to the taxes generated by increased mineral production.

Social Conditions

Social conditions, while difficult to measure directly, can be inferred from a variety of secondary indicators. In case studies that included Wheatland and Douglas, Wyoming, and oil and gas-generated effects in Rangely, Colorado, it has been found that changes in such economic indicators as rate of population growth, per capita income, and general level of unemployment, as well as such social indicators as rates of crime, divorce, and infant mortality can be used to describe generally changes in area social conditions.

TABLE 3-16
REVENUES AND EXPENDITURES: LINCOLN COUNTY AND AFFECTED COMMUNITIES (THOUSANDS OF DOLLARS)

Jurisdiction/Fiscal Year	1983	1985	1986	1990	2000
Lincoln County					
Revenues	6,566.1	5,657.5	6,254.0	7,427.2	7,899.8
Expenditures	5,647.2	5,088.6	5,144.7	5,380.0	5,978.2
Surplus (deficit)	918.9	568.9	1,109.3	2,047.2	1,921.6
Kemmerer					
Revenues	2,346.4	2,435.5	2,479.8	2,624.0	3,121.1
Expenditures	2,174.4	2,212.8	2,233.1	2,317.0	2,530.3
Surplus (deficit)	172.0	222.7	246.7	307.0	590.8
Diamondville					
Revenues	560.1	568.4	579.7	614.6	743.5
Expenditures	497.2	379.7	383.7	401.3	445.8
Surplus (deficit)	62.9	188.7	196.0	213.3	297.7
LaBarge					
Revenues	967.5	170.2	173.7	182.5	219.8
Expenditures	969.6	6.2	167.6	173.6	189.2
Surplus (deficit)	(2.1)	4.0	6.1	8.9	30.6
School District #1					
Revenues	7,412.8	6,862.1	7,850.9	9,733.2	9,931.6
Expenditures	4,639.2	3,807.5	3,853.5	4,037.7	4,501.3
Surplus (deficit)	2,773.6	3,054.6	3,997.4	5,695.5	5,430.3

Source: Western Research Corporation 1982

Lincoln County

Lincoln County grew in population by approximately 50 percent during the 1970s and experienced a slow but definite change in its economy. Whereas agriculture was the dominant sector in 1970, mining was the dominant sector by 1980. Accompanying this was a dramatic change in per capita income, most of which was enjoyed more by newcomers to the mining sector rather than by established resident ranchers and farmers. In 1980, per capita personal income in Lincoln County was $9,414, continuing to be below the state average as it had throughout the last half of the 1970s. Unemployment has tended to fluctuate but has consistently been above the state rate between 1970 and 1980. Rates for crime, divorce, and infant mortality are at or below the state average. In 1980 these rates per 1,000 population were 27.6 and 5.7 for crime and divorce, respectively, versus 47.9 and 8.5 for the state. Infant mortality in the county was at a rate of 0.010 per live birth which was the same as the level throughout the state. Lincoln County, therefore, despite rapid growth and the change in economic base, appears to have accomodated this growth well, but with indications that additional growth may not be accommodated without increasing signs of social stress.

Sublette County

Sublette County as a whole grew relatively little during the 1970s, but of the growth that did occur, 25 percent was in the mining sector and 33 percent in the construction sector. Agriculture continued to dominate the county's economy and the majority of the population still resides in rural or unincorporated areas of the county. Per capita income has been increasing and in 1980 was at a level of $11,436, well above the state average of $10,875. The county's unemployment rate, however, has been below the state average. Rates of divorce, crime, and infant mortality for the county are either at or below the state average. The county appears, therefore, to have accomodated to the growth it has experienced, maintaining the standard of living of long-time residents and meeting the needs of newcomers.

TABLE 3-18
ACRES OF WILDLIFE HABITATS WITHIN THE WELL FIELD STUDY AREA

	Well Field Units and Areas										
Wildlife Habitat Type	Proposed Darby Mountain	Proposed N. Riley Ridge	Riley Ridge	Lake Ridge	Fogarty Creek	Dry Piney	Graphite	Sawmill Area	Tip Top	Hogsback	Total
Conifer	11,788	7,609	3,155	11,997	4,813	1,018	1,522	102	89	666	42,759 26%[1]
Clearcut	1,235	134	448	326	45	6	352	–	–	–	2,546 2%
Aspen	134	2,803	1,139	973	1,395	672	429	1,203	358	26	9,132 6%
Sagebrush	986	4,712	8,857	5,524	7,772	5,207	774	10,608	27,718	9,017	81,175 51%
Mountain shrub	538	–	–	–	–	–	–	–	634	538	1,710 1%
Bunchgrass/Forb	1,370	2,400	1,427	1,274	1,408	115	550	269	896	806	10,515 7%
Greasewood	–	–	–	–	–	–	–	–	256	–	256 <1%
Saltbush	–	–	–	–	–	–	–	–	–	–	– –
Pasture/Hayfield	–	198	435	–	166	26	–	3,712	1,210	–	5,747 3%
Riparian	442	1,024	557	896	262	237	–	1,332	679	179	5,608 3%
Aquatic	70	–	–	–	–	–	–	–	–	–	70 <1%
Mixed desert shrub	–	–	–	–	–	–	–	–	–	–	– –
Barren/Disturbed	397	–	–	–	–	–	13	–	–	–	410 <1%
TOTAL	16,960	18,880	16,018	20,990	15,861	7,281	3,640	17,226	31,840	11,232	159,928

[1]Percent of total within the well field.

moose in the Sublette Herd Unit (Mercier 1983, personal communication).

Thirty-five bighorn sheep were transplanted in 1981 onto Fish Creek Mountain in the proposed Darby Mountain Unit, an area of historical bighorn sheep range. The population has been doing well and is estimated at approximately 50 animals (Johnson 1982, personal communication; Thornton 1982, personal communication). Pronghorn use the extreme eastern portion of the well field as summer range. Pronghorn are discussed further under Plant Sites.

Black bear and mountain lion are two important trophy game species inhabiting higher elevations on the well field area. Approximately 50 black bear inhabit the well field area (Johnson 1982, personal communication; Thornton 1982, personal communication). The more uncommon mountain lion occurs in association with mule deer winter concentration areas.

Endangered species occasionally using the well field include the whooping crane and bald eagle, and possibly the peregrine falcon. Potential black-footed ferret habitat was found in the well field. For purposes of analysis, this 71-acre inactive prairie dog town was considered associated with only the West Dry Basin plant site in further discussions. Use of the well field by these species is extremely limited, and critical habitats or important use areas have not been identified in the well field.

IMPORTANT WILDLIFE AREAS

PROJECT COMPONENTS		Elk Critical Winter Range	Elk Calving Area	Moose Critical Winter Range	Mule Deer Critical Winter Range	Bighorn Sheep Critical Range	Pronghorn Critical Winter Range	Pronghorn Critical Summer Range	Sage Grouse Strutting Ground	Sage Grouse Critical Range	Bald Eagle Wintering Concentration Area	Potential Black-footed Ferret Habitat (Prairie Dog Towns)	Golden Eagle Nest	Raptor Nest	National Wildlife Refuge
WELL FIELD	Hogsback Unit	●		●	●								●		
	Graphite Unit	●													
	Dry Piney Unit			●											
	Fogarty Creek Unit	●	●	●						●					
	Lake Ridge Unit	●	●												
	Tip Top Unit	●	●	●	●				●	●		●	●	●	
	Riley Ridge Unit	●	●	●					●	●					
	Sawmill Area	●	●	●					●	●					
	Proposed Darby Mtn. Unit		●			●								●	
	Proposed N. Riley Ridge Unit	●	●	●											
PLANT SITES	West Dry Basin									●		●			
	East Dry Basin				●		●					●			
	Big Mesa				●										
	Craven Creek							●				●			
	Buckhorn Alternative														
	Shute Creek Alternative											●			

FIGURE 3-2. IMPORTANT WILDLIFE AREAS IN RELATION TO RILEY RIDGE PROJECT COMPONENTS

Fisheries

Habitat. Streams that may be affected by well field development are illustrated in Map 3-1 and listed in Table 3-19. These include Middle Piney Creek, South Piney Creek, Dry Piney Creek, and their tributaries. Well field streams range between 7,000 and 10,000 feet in elevation and have low to moderate gradients, beaver ponds, and meanders in middle and lower elevations. Riparian vegetation generally consists of low growing willows and/or grasses. Streams in the Beaver and Dry Piney Creek drainages become turbid during moderate and heavy runoff and occasionally stop flowing. Grazing occurs along most of these streams. Streams in the South and Middle Piney Creek drainages range in size from small headwater rivulets to fairly large creeks 10 to 20 feet wide.

Water quality is generally favorable for fish production; however, irrigation, timber cutting, mining, oil and gas exploration, and livestock grazing have increased water temperatures and siltation (Remmick 1981). Low flows resulting from irrigation withdrawals and droughts limit fish production in some areas. During low flow periods, beaver ponds become very important habitat for fish populations (Remmick 1981).

Habitat Quality Index (HQI) scores taken in September 1982 predict a high standing crop of trout (>30 pounds/acre) in South Piney Creek, Fish Creek, Porcupine Creek, and Beaver Creek. Streams with low standing crops (<20 pounds/acre) were Fogarty Creek, Pine Grove Creek, and South Beaver Creek. Flows were unusually high during 1982 in the Riley Ridge well field; therefore, HQI scores and standing crop estimates are probably higher than scores would be for an average water year. Instream flow conditions for four life stages of cutthroat trout in streams within the Riley Ridge study area were described in terms of weighted usable habitat area using the Fish and Wildlife Service's incremental flow methodology. Results have been interpreted conservatively because only one flow measurement was obtained. Upper South Piney Creek and Porcupine Creek apparently have the most area available for all stages of cutthroat trout. Additional detail on data limitations and flows that would provide optimal cutthroat trout habitat conditions for various life stages and spawning are presented in the Wildlife and Fisheries Technical Report.

The benthic macroinvertebrate communities of the study area streams appear healthy, diverse, and relatively free from stress. Major aquatic insect groups, including mayflies, stoneflies, caddisflies, beetles, and true flies were present at each sampling station. Macroinvertebrates are also sufficiently abundant to provide an adequate food base for existing fish populations.

The BLM has one aquatic habitat management plan covering the east side of the Wyoming Range. This plan includes streams in the well field (BLM 1978a).

Fish Species. Thirty fish species, of which half are recreationally important, have ranges within the Green River drainage in the project area (see the Wildlife and Fisheries Technical Report). Of the game fish species, rainbow trout, brown trout, brook trout, and mountain whitefish are most numerous. Some streams contain isolated populations of Colorado River cutthroat trout, the only trout indigenous to the Green River drainage. This species is considered sensitive by the WGF, BLM, and FS (Binns 1977; BLM 1978a). Distribution of these trout species is presented on Map 3-1.

The indigenous Colorado River cutthroat trout has declined in Wyoming because of hybridization and competition with introduced trout species, as well as man-caused changes in its habitat. In the well field, Colorado River cutthroat of varying genetic purity are found in Black Canyon Creek, Fogarty Creek, Pine Grove Creek, South Beaver Creek, Middle Beaver Creek, North Beaver Creek, Coal Creek, Trail Ridge Creek, South Piney Creek, Fish Creek, Porcupine Creek, and Spring Creek (Map 3-1). Rock Creek (just southwest of the well field) also contains a pure strain of the Colorado River cutthroat trout. Fish barriers installed by the BLM on Beaver and North Beaver Creeks prevent upstream migration of other trout species. The Colorado River cutthroat trout in North Beaver Creek comprises the only pure strain population in the well field (Binns 1977).

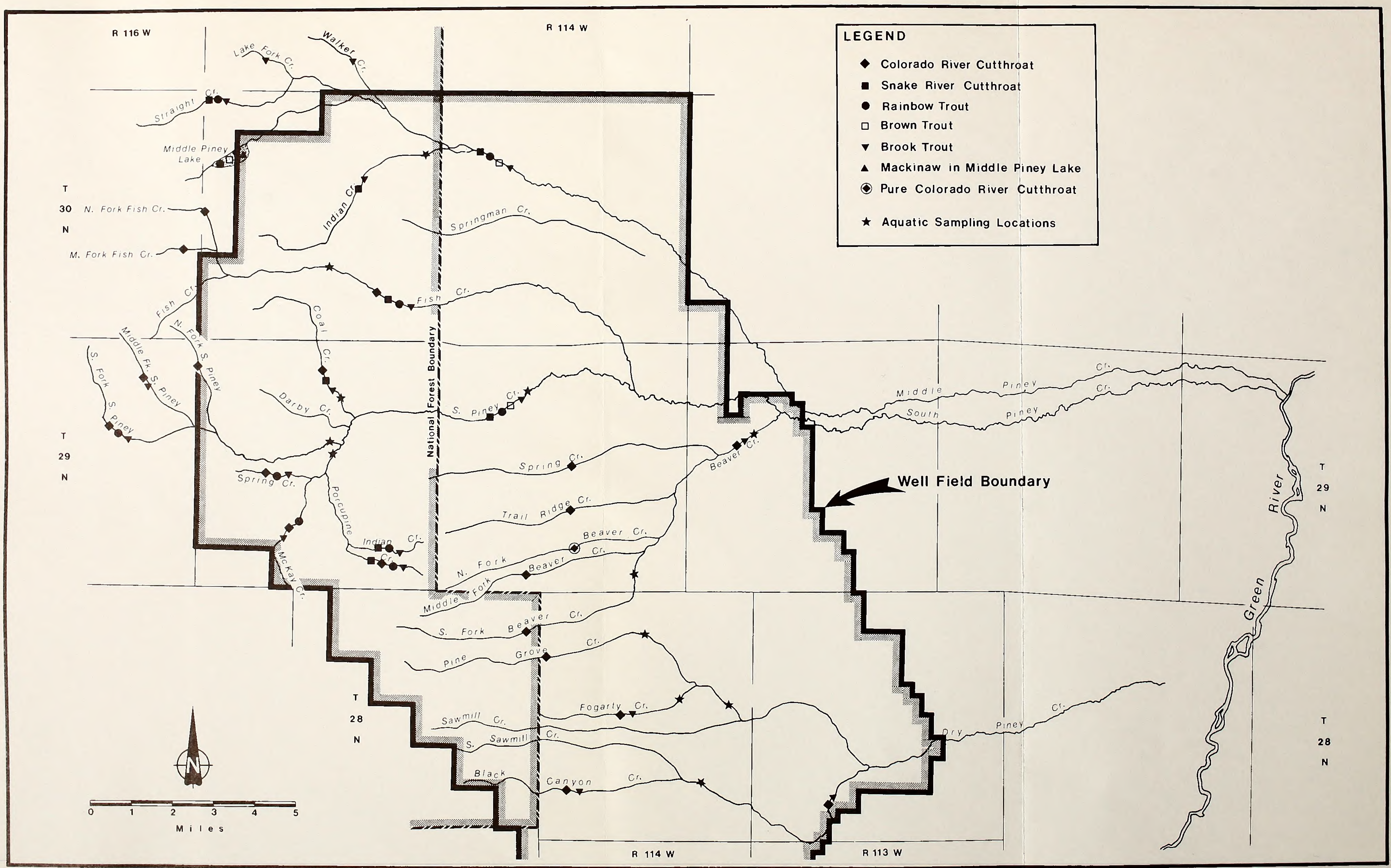
Within the well field streams, the majority of Colorado River cutthroat spawning activity occurs in the streams' upper reaches. Hatching of eggs usually occurs during August; fry emerge from the gravel during late August and into September (Quinlan 1980). During the winter, both adults and young-of-the-year rely on stream pools and beaver ponds that are deep enough and have sufficient current and water quality to prevent winter kill (BLM 1980).

Plant Sites

Wildlife

Wildlife habitat within the plant sites and other non-linear facility sites are presented on Table 3-20. All four plant sites occur predominantly in the sagebrush habitat, though the Big Mesa site includes 108 acres of bunchgrass/forb and 26 acres of mountain shrub, and the East Dry Basin site includes 157 acres of saltbush.

Important wildlife areas occurring within the various plant sites are presented in Figure 3-3. The West Dry Basin site coincides with sage grouse critical range (within 2 miles of a strutting ground) and contains a small prairie dog town of 71 acres. In addition, it is important mule deer winter range and the general area is used for mule deer migration (Johnson 1982, personal communication). The East Dry Basin site falls within mule deer critical winter range, pronghorn critical winter range, and coincides with about 22 acres of prairie dog town. The Big Mesa site also falls within mule deer critical winter range and lies immediately adjacent to moose critical winter range. All three of these plant sites are within elk winter range



MAP 3-1 AQUATIC SAMPLING LOCATIONS AND DISTRIBUTION OF TROUT SPECIES

TABLE 3-19
STREAMS (CREEKS) AFFECTED BY WELL PADS AND CROSSINGS IN THE WELL FIELD PROPOSED ACTION

	Facilities			
Streams	Well Pads[1]	Raod Crossings[2]	Pipeline Crossings[3]	Total Crossings
Middle Piney Drainage				
Walker	0	0	0	0
Lake Fork	0	0	0	0
Straight	0	0	0	0
Indian	0	3	1	4
Middle Piney (U)[4]	0	0	0	0
Middle Piney (L)	0	1	2	3
Total	0	4	3	7
Springman	0	0	0	0
Total	0	0	0	0
South Piney Drainage				
North Fork Fish	0	0	0	0
Middle Fork Fish	0	0	0	0
Fish (U)	4	1	1	2
Fish (L)	2	2	4	6
North Fork South Piney	0	0	0	0
Middle Fork South Piney	0	0	0	0
South Fork South Piney	0	0	0	0
Coal	0	2	1	3
Darby	0	0	1	1
Spring	0	1	2	3
McKay	0	1	1	2
Indian	0	0	0	0
Porcupine	0	0	0	0
South Piney (U)	1	4	5	9
South Piney (L)	3	1	2	3
Spring	0	1	5	6
Trail Ridge	1	1	2	3
North Fork Beaver	1	1	1	2
Middle Fork Beaver	0	1	1	2
South Fork Beaver	1	1	1	2
Beaver	1	0	5	5
Total	14	17	32	49
Dry Piney Drainage				
Pine Grove	0	2	2	4
Fogarty	1	1	1	2
Sawmill	0	2	2	4
South Sawmill	0	1	2	3
Black Canyon	0	0	1	1
Dry Piney	0	0	1	1
Total	1	6	9	15
GRAND TOTAL	15	27	44	71

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[1] Well pads within 1,000 feet of stream.

[2] Roads that would disturb streams (maximum 30-foot width).

[3] Pipelines that would be buried in streams (maximum 100-foot width).

[4] Upper and Lower refers to above or below National Forest Boundary in well field.

TABLE 3-20
ACRES OF WILDLIFE HABITATS WITHIN THE PLANT SITE STUDY AREAS AND OTHER NON-LINEAR FACILITIES

	Non-Linear Facilities				
Habitat Type	East Dry Basin (AQ)	West Dry Basin (Ex)	Big Mesa (Ex)	Craven Creek (NWP)	Sulfur Loadout (Ex)
Conifer	-	-	-	-	-
Clearcut	-	-	-	-	-
Aspen	-	-	-	-	-
Sagebrush	483	635	506	496	22
Mountain Shrub	-	-	26	-	-
Bunchgrass/Forb	-	5	108	-	-
Greasewood	-	-	-	-	-
Saltbush	157	-	-	-	125
Pasture/Hayfield	-	-	-	-	-
Riparian	-	-	-	-	34
Aquatic	-	-	-	-	-
Mixed Desert Shrub	-	-	-	144	-
Barren/Disturbed[1]	-	-	-	-	59
TOTAL	640	640	640	640	240

[1] Barren - high altitude talus slopes with little or no vegetation

Disturbed - abandoned gravel pit.

(Maps 3-2 and 3-3 in the Map Pocket). The Craven Creek site contains 68 acres of prairie dog town and falls within an area mapped as pronghorn critical summer range by WGF. Critical summer range is an area where pronghorn concentrate during the hottest, dryest weather, primarily because of water availability. Like critical winter range, critical summer range can also limit population size.

Pronghorn are abundant in the Riley Ridge area. Winter range occurs east of the well field in blocks on either side of the Green River and occurs within the East Dry Basin plant site. Approximately 600 pronghorn winter between Big Piney and LaBarge west of the Green River, and an additional 2,400 pronghorn winter between Big Piney and LaBarge east of the river. There are 13,500 pronghorn in the Sublette Herd Unit (Mercier 1983, personal communication). Wild horses also occur in areas which include the plant sites. Approximately 470 horses occupy the five Wild Horse Management Areas affected by the Riley Ridge Project.

Threatened or endangered species are not known to use any plant site habitats. Prairie dog towns, a potential black-footed ferret habitat, occur on the East Dry Basin, West Dry Basin, and Craven Creek plant sites where further studies would be required prior to development.

Fisheries

Perennial streams do not occur at or near the proposed plant sites. Northwest's Craven Creek plant site is crossed by some intermittent tributaries to Craven Creek. Craven Creek has limited fish habitat because of intermittent flows, high water temperatures, high alkalinity, and silt-sand substrates. Craven Creek does not support a game fishery.

Linear Facilities

Wildlife

The affected environment of linear facilities' corridors pertinent to the Proposed Action are identified in Figure 3-3. Many categories of important wildlife areas occur within the transportation corridors; most important among these are mule deer critical winter range and pronghorn critical winter range (Maps 3-2 and 3-3 in the Map Pocket). In addition, elk critical winter range would be crossed by electrical transmission lines, sour gas trunk lines, and the sulfur pipeline. Moose critical winter range, sage grouse critical range, and other important areas also occur along the 1-mile wide study corridors. Prairie dog towns, a potential habitat for the black-footed ferret, occur within virtually all facilities corridors. The water pipeline to Northwest's Craven Creek plant site begins at the Green River south of Fontenelle Dam within an area where wintering bald eagles concentrate.

Fisheries

Corridors associated with the Proposed Action would cross quality trout streams as well as streams that contain only non-game fish or no fish at all. The corridors that would accommodate the transmission line from Naughton Power Plant to East Dry Basin, the sour gas trunk line from the well field to Craven Creek, and the sulfur pipeline from West Dry Basin to the sulfur loadout all cross LaBarge, Fontenelle, and

PROPOSED ACTION		Elk Critical Winter Range	Elk Calving Area	Moose Critical Winter Range	Mule Deer Critical Winter Range	Bighorn Sheep Critical Range	Pronghorn Critical Winter Range	Pronghorn Critical Summer Range	Sage Grouse Strutting Ground*	Sage Grouse Critical Range	Bald Eagle Wintering Concentration Area	Potential Black-footed Ferret Habitat (Prairie Dog Towns)	Golden Eagle Nest*	Raptor Nest*	National Wildlife Refuge
PLANT SITES	East Dry Basin				●		●					●			
	West Dry Basin									●		●			
	Big Mesa				●										
	Craven Creek							●				●			
LINEAR FACILITIES	Transmission Lines	●		●	●		●	●	●	●		●	●	●	
	Sour Gas Trunk Lines	●		●	●		●	●		●		●			
	Sales Gas & CO_2 Pipelines			●	●		●	●		●		●	●		
	Sulfur Pipelines	●		●	●		●	●	●	●		●			
	Water Pipeline							●			●	●			
	Access Roads			●	●			●				●			
	Railroad Spur							●				●			

IMPORTANT WILDLIFE AREAS

*Within 1-mile wide study corridor.

FIGURE 3-3 IMPORTANT WILDLIFE AREAS IN RELATION TO PLANT SITES AND LINEAR FACILITIES OF THE PROPOSED ACTION

Slate Creeks which contain trout in the affected reaches. The remainder of the streams potentially affected by corridor crossings either do not contain game fish or contain marginal trout populations (e.g., Dry Piney Creek). The combined sales gas and CO_2 pipeline corridor from West Dry Basin to Trailblazer would cross Dry Piney Creek, the Green River south of Big Piney, and the Big Sandy River below Farson. The Green River contains a good brown and rainbow trout fishery, whereas the Big Sandy River near the proposed crossing contains a seasonal trout fishery. The remaining transmission line branches, sour gas trunk lines, and sales gas/CO_2 branch pipelines would cross streams with no significant aquatic resources. Northwest's proposed water supply pipeline from the Green River just below Fontenelle Dam to the Craven Creek plant would not cross streams with significant fisheries resources. The Wildlife and Fisheries Technical Report provides more detail on corridor stream crossings.

WATER RESOURCES

Water resources in the study area are diverse and include tributary streams to the Upper Green River (in the well field), the mainstem of the Green River to Fontenelle Reservoir, and several intermediate tributaries to the Green River like Fontenelle, LaBarge, Muddy, and Slate Creeks. The Big Sandy River, a tributary to the Lower Green River, was also included since it would be crossed by sales gas and CO_2 pipelines.

In addition high mountain wilderness lakes in the Bridger Wilderness were evaluated for potential effects of acid precipitation resulting from gas treatment plant emissions. The lakes in this area occur at 9,000 to 11,000 feet, have substrates derived from granitic materials, and are primarily fed by snowmelt. The pH of the lakes is slightly less than neutral, and the capability of the water in the lakes to resist the effects of acid input (buffering capacity) is small. Many of these lakes support significant populations of game fish.

Groundwater resources occur throughout the study area, especially in the well field where numerous springs and seeps are present. Groundwater of excellent quality occurs in the Madison and Wasatch Formations throughout the area and provides domestic and municipal water for several communities.

Well Field

Surface Water

Drainage Description. The well field is drained by a system of intermittent streams which flow from the western divide eastward to the Green River. The area is bounded on the north by North Piney Creek and on the south by LaBarge Creek. Major streams are Middle Piney Creek, South Piney Creek, and Dry Piney Creek. Table 3-19 summarizes the number of crossings and streams crossed. Many of the higher tributaries normally flow throughout the year, but may be dry during drought periods. Most of the lower reaches are subject to periods of zero flow resulting from additive effects of seasonal low flows and irrigation diversions. Numerous springs and seeps are evident. Certain springs seem to maintain normal discharge even during extremely dry periods, indicating that they are supplied by formation water and are, therefore, independent of the near-surface recharge system.

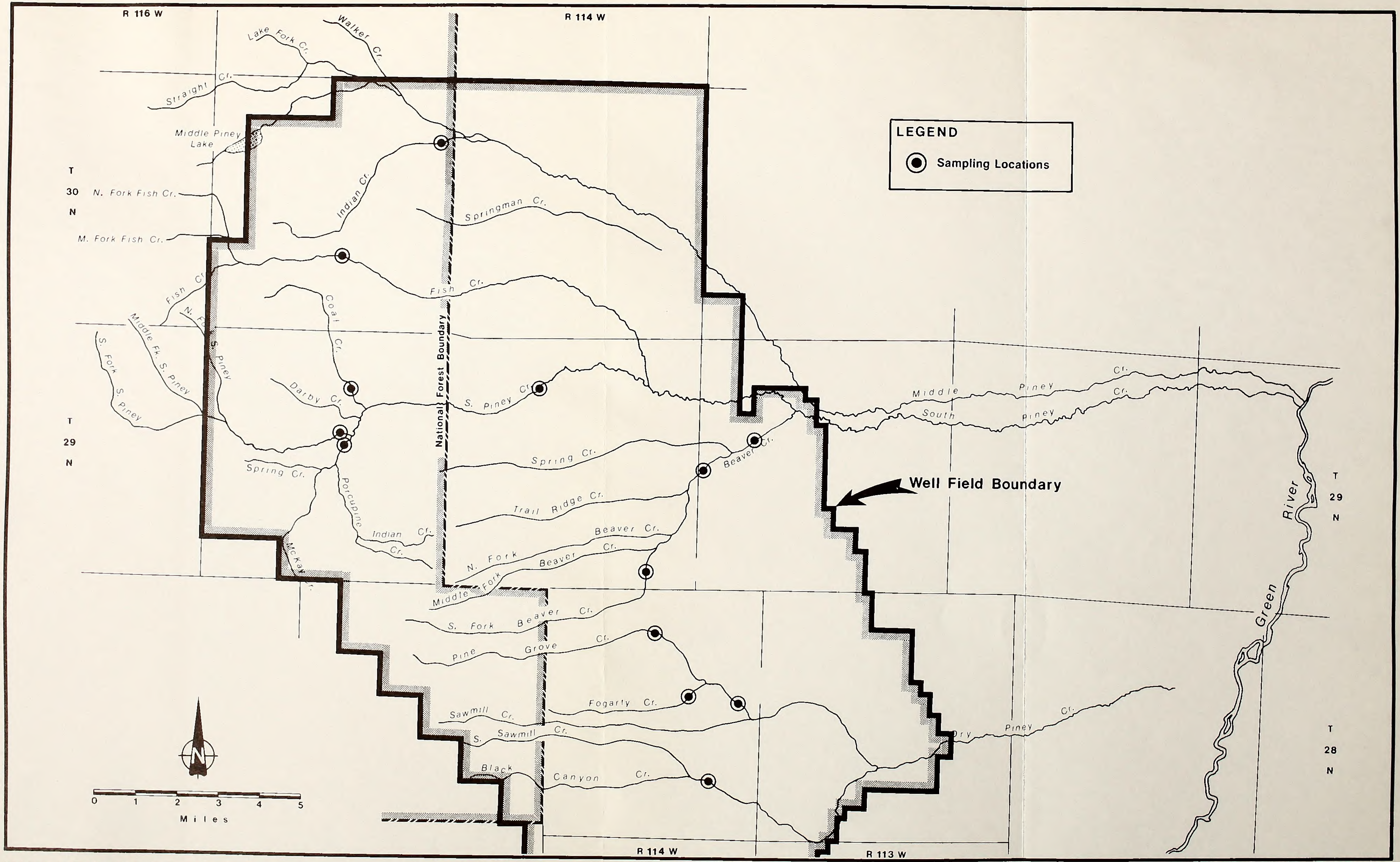
Water Quality. Water quality in the well field is generally high with few limitations on potential water use. Preliminary results from the baseline monitoring program (see Map 3-4) on well field streams indicate that surface waters are bicarbonate, with major cations being calcium and magnesium. Values for pH range from 8.2 to 8.6. Values for total dissolved solids range from 120 to 275 milligrams/liter. Conductivity values range from 320 to 860 micromhos/centimeter.

Sediment. Quantitative data to support sediment yield analyses are limited. Records from a discontinued U.S. Geological Survey (USGS) station on Dry Piney Creek indicate that total suspended solids concentrations are high during runoff events and low during baseflow periods (USGS 1972). Recent low flow data (Fall 1982) indicate suspended sediment concentrations of 4 to 10 milligrams/liter in representative stream reaches. High flow data for the Spring of 1983 will be available for the Final EIS. Since soils in the well field appear to be relatively erodible and slopes relatively steep, it is possible that natural sediment loads during high runoff approach the transport capacities of the streams.

Groundwater

Groundwater in the well field and surrounding area supplies water for both domestic and agricultural use. There are over 200 wells averaging from 2 to 200 gallons/minute as well as over 200 springs of varying yields within the well field. Occurrence of groundwater in the area is highly variable because of complex folding and faulting which has taken place in the geologic past. Where water is found, the quantity and quality are also highly variable. Wells may be flowing (confined water table) or require pumping; both situations may occur in proximity (Yose 1982).

In general, aquifers in limestone and dolomite yield the greatest quantities of water with relatively low dissolved solids compared to other aquifers in the well field. These aquifers are present in Madison limestone, Darby formation, and Bighorn dolomite. The formations are found in Hogsback Ridge, Cretaceous Mountain, Deadline Ridge, and Mount Darby. Although these formations may yield large (greater than 100 gallons/minute) quantities of water, there are also large volumes of rock with low permeability (Lines and Glass 1975). The primary bedrock aquifer for the remainder of the area is the Wasatch Formation. The LaBarge member of the Wasatch Formation contains sandstone aquifers which may yield small



MAP 3-4 STREAM FLOW AND WATER QUALITY SAMPLING LOCATIONS

(less than 100 gallons/minute) quantities to wells. The conglomerate member of the Wasatch Formation is also capable of yielding small amounts of water, and moderate amounts are possible where the conglomerate is well sorted. Water associated with these aquifers commonly contains 500 to 1,000 milligrams/liter of dissolved solids (Welder 1968; Lines and Glass 1975).

The alluvium along drainages may yield large quantities (about 100 to 500 gallons/minute) of water to wells; the variation is dependent on the permeability, storage, and saturated thickness of the alluvium. There are a number of shallow wells along Middle Piney Creek. The water may contain 200 to 500 milligrams/liter of dissolved solids.

Plant Sites

Surface Water

The proposed plant sites occupy relatively small areas relative to the drainage basin and are located either on high ground or in well-drained basin areas (see well field discussion). No perennial streams are present in the vicinity of the proposed plant sites. Northwest proposes to divert 81 acre feet/year of water by pipeline from the Green River for plant operation. At the USGS gaging station 1.7 miles upstream from Fontenelle Reservoir on the Green River, the average discharge is 1,636 cubic feet/second or 1,185,000 acre-feet/year. The water quality records for water year 1979 show the water to be a bicarbonate type with pH values which range from 7.4 to 8.4. Total disolved solids concentrations range from 140 to 289 milligrams/liter; total suspended solids concentrations are generally less than 10 milligrams/liter.

The sulfur loadout facility would be located approximately 2 miles northeast of Opal, Wyoming on the north side of the Hams Fork (see Map 1-3). The southern end of the 240-acre site would be within the 100-year floodplain of the river. Highest flows in the Hams Fork characteristically occur in May and June from snowmelt runoff and after summer thunderstorms.

Groundwater

The primary water-bearing structure beneath the plant sites is the Wasatch Formation which is discussed under the well field. Groundwater resources in the Wasatch Formation would likely supply water for plant construction and operation, and construction camp requirements.

Linear Facilities

Surface Water

All of the linear facilities in the Proposed Action are located within the Green River drainage basin. The area is characterized by few lakes and reservoirs, limited perennial rivers and streams, and numerous marginally intermittent streams. Weathered sedimentary rocks have produced highly erodible soils with high mineral content. Leaching of these soils has created waters with relatively high total dissolved solids. Due to highly erodible soils and stream channels, suspended sediment concentrations become very high with increased stream flows and surface runoff.

Topography changes in an upstream direction from level to rolling sagebrush-covered hills and valleys. The perennial river and stream channels are meandering with low bed gradients. Channel substrate is composed predominantly of sand and gravel with cobble in the riffles. Numerous channel reaches exhibit limited stability with moderate to heavy erosion along the banks. A large number of irrigation diversions and irrigated meadows are evident along perennial rivers and streams.

The marginally intermittent streams are characterized by sparse vegetation, meandering unstable channels, low bed gradients, and sand/gravel substrate. The streams are generally dry from mid-summer through the winter, and often flow only during spring snowmelt runoff or in direct response to precipitation events.

Major perennial rivers and streams crossed by project facilities include the Green River, Fontenelle Creek, LaBarge Creek, Dry Piney Creek, the Big Sandy River, and Hams Fork.

The railroads, transmission lines, pipelines, and access roads included in the Proposed Action often run parallel and in proximity to the streams. The Proposed Action would involve 22 crossings of 11 perennial streams and 54 crossings of 28 intermittent streams as summarized below.

- Pipelines: 15 perennial, 33 intermittent.
- Transmission lines: 7 perennial, 20 intermittent.
- Railroad spur: 0 perennial, 1 intermittent.
- Access roads: None.

AIR QUALITY

Climatological and Meteorological Characteristics

The Riley Ridge Project area is located in the northern portion of the Sublette Air Basin in southwestern Wyoming. The air quality study area is bounded by the Wyoming-Utah border to the south, the Wyoming Range and Bear River Divide to the west, and the Wind River Range and the Great Divide Basin to the north through east. Wind flow in the area is predominantly from the west and southwest; however, these general wind patterns may be modified by the blocking effects of the mountains. In general, the atmospheric dispersion characteristics of the area are quite good because of the prevailing high wind speeds. During the day, atmospheric dispersion is enhanced by strong surface heating providing for surface based instability. At night, however, surface drainage flows and stable atmospheric conditions may reduce dispersive capacity.

Modified Pacific air frequently covers the state;

cold air masses from Canada are less likely, and warm, moist air masses from the Gulf of Mexico are least likely to occur. Precipitation most often occurs with a low pressure center near the southern portion of Wyoming. This condition results in warm, moist Pacific air aloft and cooler air near the surface. Frequent low pressure systems, originating from the Alberta area of Canada, tend to move southeasterly over the northern plains states, often causing strong, gusty winds over the area but little precipitation. Precipitation amounts vary considerably from one location to another. The period of maximum precipitation for most of the area is the late spring season. During the summer months, showers and thunderstorms are quite frequent, but generally light. Occasionally, heavy rains associated with thunderstorms occur locally within the area.

Because of its 6,000 to 8,000-foot elevation, the climate of the Sublette Air Basin is relatively cool, but with large seasonal and diurnal temperature changes. Summer nights are often cool, even though daytime maximum temperatures may reach 90 °F. During the winter, cold frontal passages may give rise to rapid and frequent changes between warm and cold temperatures. Although temperatures are generally cooler in the mountains than the valleys, it is not unusual for the Green River Valley to be colder than the surrounding mountains. This results from the sheltering effect of the mountains and cold air drainage at night.

Winds

Wind speed and direction information is critical in estimating atmospheric transport and dispersion. It is preferable to have on-site measurements of wind speed and direction to enhance the accuracy of the transport and dispersion estimates, and the Riley Ridge Project applicants are currently conducting such monitoring at each of the proposed plant sites for use in the State of Wyoming industrial siting application processes. These data are not expected to be available until late 1983. In the absence of on-site meteorological data, other meteorological data sets generally available in the region have been reviewed for dispersion modeling use and representativeness. These data sources include: the Fort Bridger Civil Aeronautics Administration's 60-foot tower; the Kemmerer Coal 10-meter tower; the National Weather Service's Rock Springs station; FMC Corporation's Green River site; and Utah Power & Light Company's Naughton Power Plant site, among others. These sites are shown on Map 3-5. A detailed discussion of these data sources is contained in the Air Resources Technical Report. Wind roses for the area indicate that winds with strong westerly components are most frequent. In addition, all data sources demonstrate that the highest wind speeds are generally associated with westerly winds.

The Fort Bridger meteorological data appear to be the most representative of the available sources for characterizing long-term wind patterns. At Fort Bridger, measurements of wind direction, wind speed, and atmospheric stability were taken from a 60-foot tower for the period 1950-1954. A wind rose for Fort Bridger is presented in Figure 3-4. A multi-year joint frequency distribution of these parameters has been constructed. This is considered the best choice for annual average dispersion modeling because: 1) it represents a multi-year record,(2) local terrain features surrounding Fort Bridger are reasonably similar to the project sites,(3) the elevation and site exposure at Fort Bridger are similar to conditions in the Riley Ridge study area, and(4) even though the Fort Bridger data are older than other data sets, they are still considered representative in a climatic sense because the Fort Bridger wind roses are very similar to more recent wind roses available from other sites in the area.

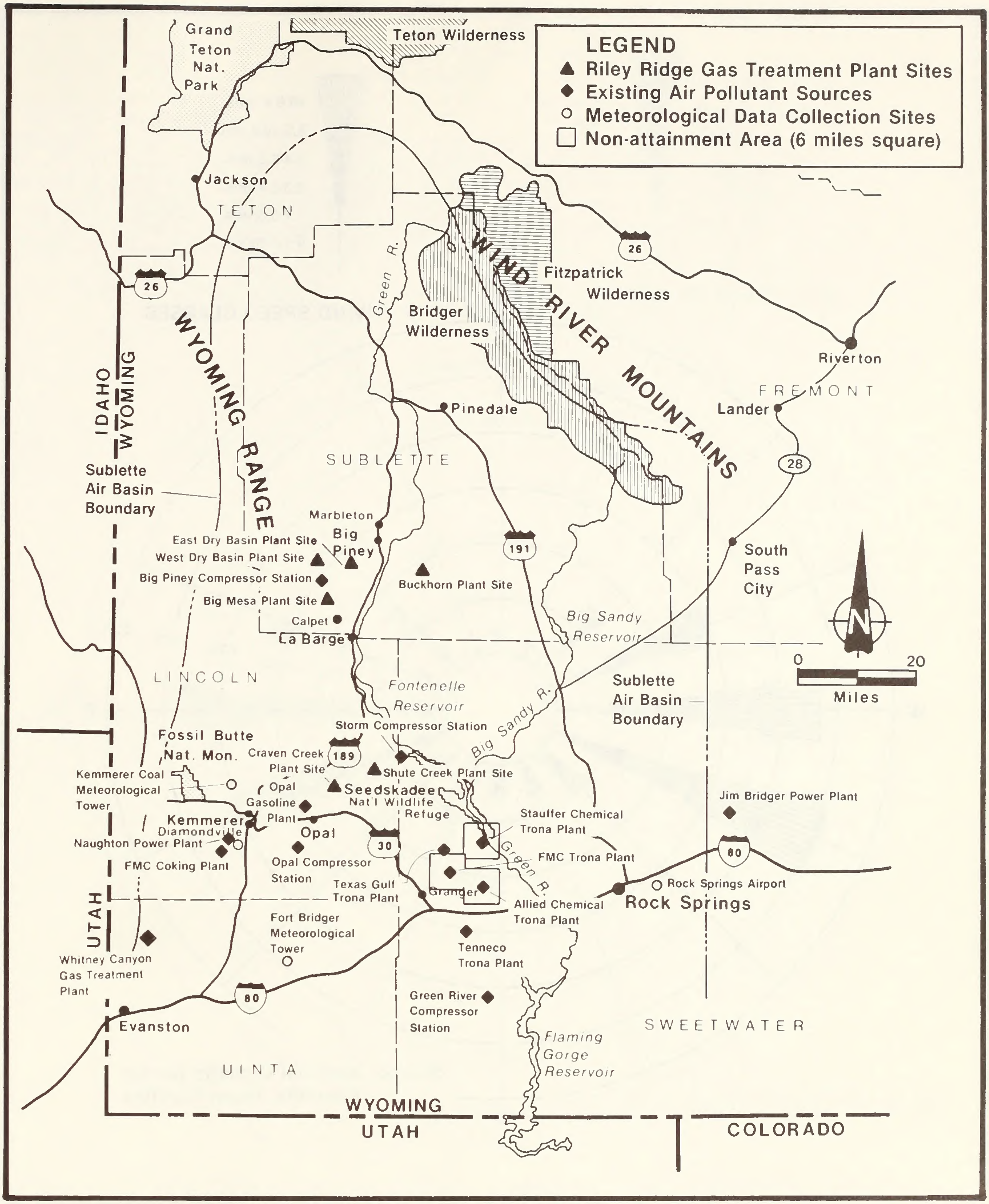
The Kemmerer Coal Company meteorological data from their mine about 5 miles north-northwest of Kemmerer include hourly measurements of 10-meter wind direction and speed for the one-year period November 1979 through October 1980. A wind rose for this data set is presented in Figure 3-5. Hourly stability class was estimated using the Kemmerer Coal wind direction fluctuation data following Slade (1968). This hourly sequential data base is considered the best presently available for refining short-term dispersion modeling assessments based on assumed worst-case conditions.

Precipitation

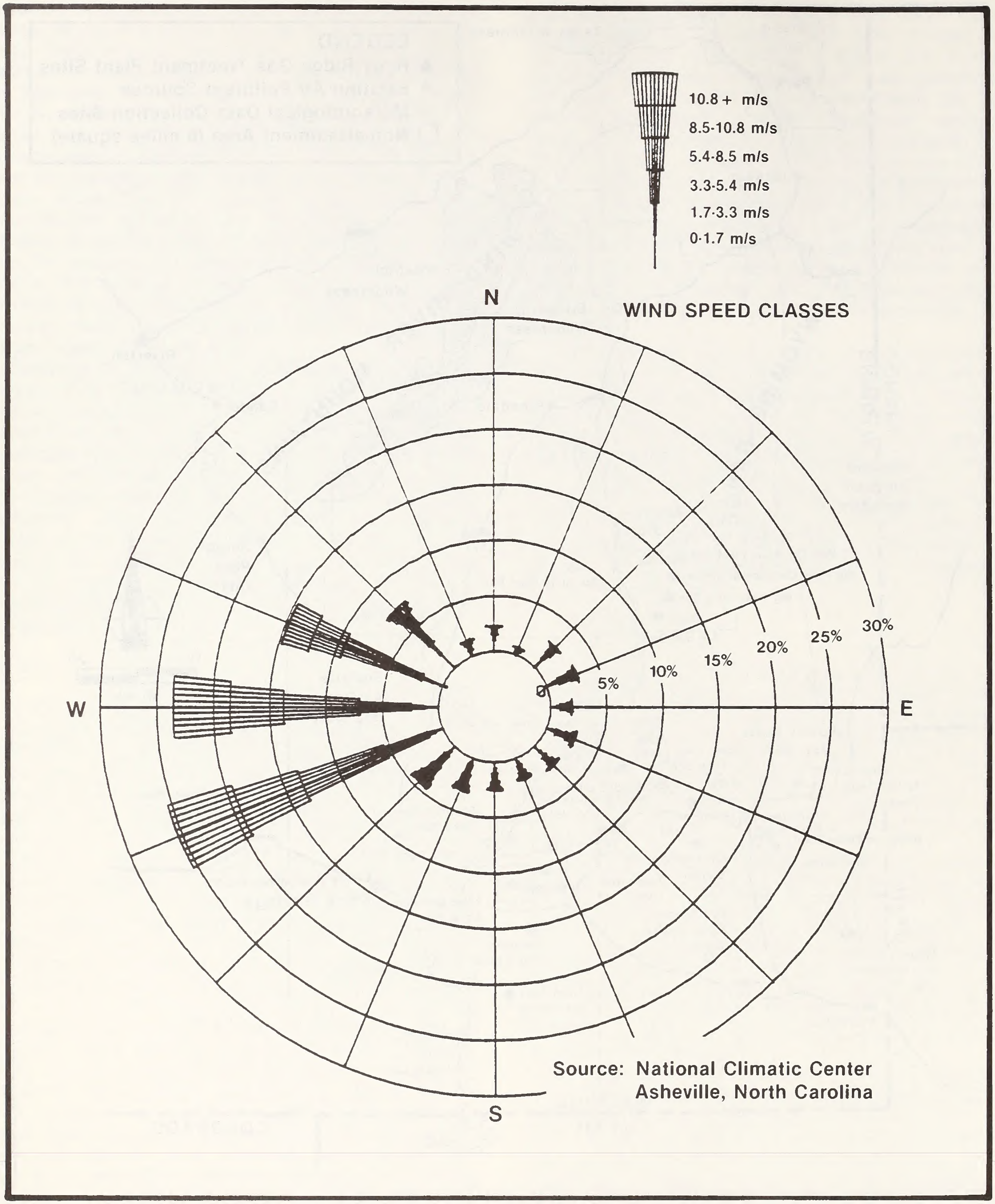
Precipitation is an important element in acid deposition assessments and affects average fugitive dust emissions during construction. Seasonal and annual precipitation amounts are considered more important in predicting total acid deposition and fugitive dust effects from Riley Ridge emissions than short-term precipitation intensities. For this reason, the discussion focuses mainly on total precipitation amounts.

Table 3-21 presents average monthly precipitation for lower altitude sites in the Riley Ridge Project area. At these sites, precipitation is greatest in the late spring and early summer months. Excluding the Lander site (located on the east side of the Wind River Range), the total annual average precipitation for the sites increases with increasing elevation, as expected. Snowfall in the region varies considerably by location, and may be very different from one year to the next at the same site.

The data presented in Table 3-21 are applicable only to the "lower" elevation areas, about 6,000 to 8,000 feet. Annual precipitation amounts in the areas most sensitive to acid deposition, such as headwater lakes in the Bridger Wilderness, are expected to be significantly greater than those in the Sublette Air Basin. Snow cover in the vicinity of the Bridger Wilderness is typically in the 100 to 130-centimeter (40 to 50-inch) range, with an associated 25 to 51 centimeters (10 to 20 inches) of water equivalent. At the three high lakes selected for the acid deposition analysis, the mean annual precipitation in water equivalent is approximately 114 centimeters (45 inches) at

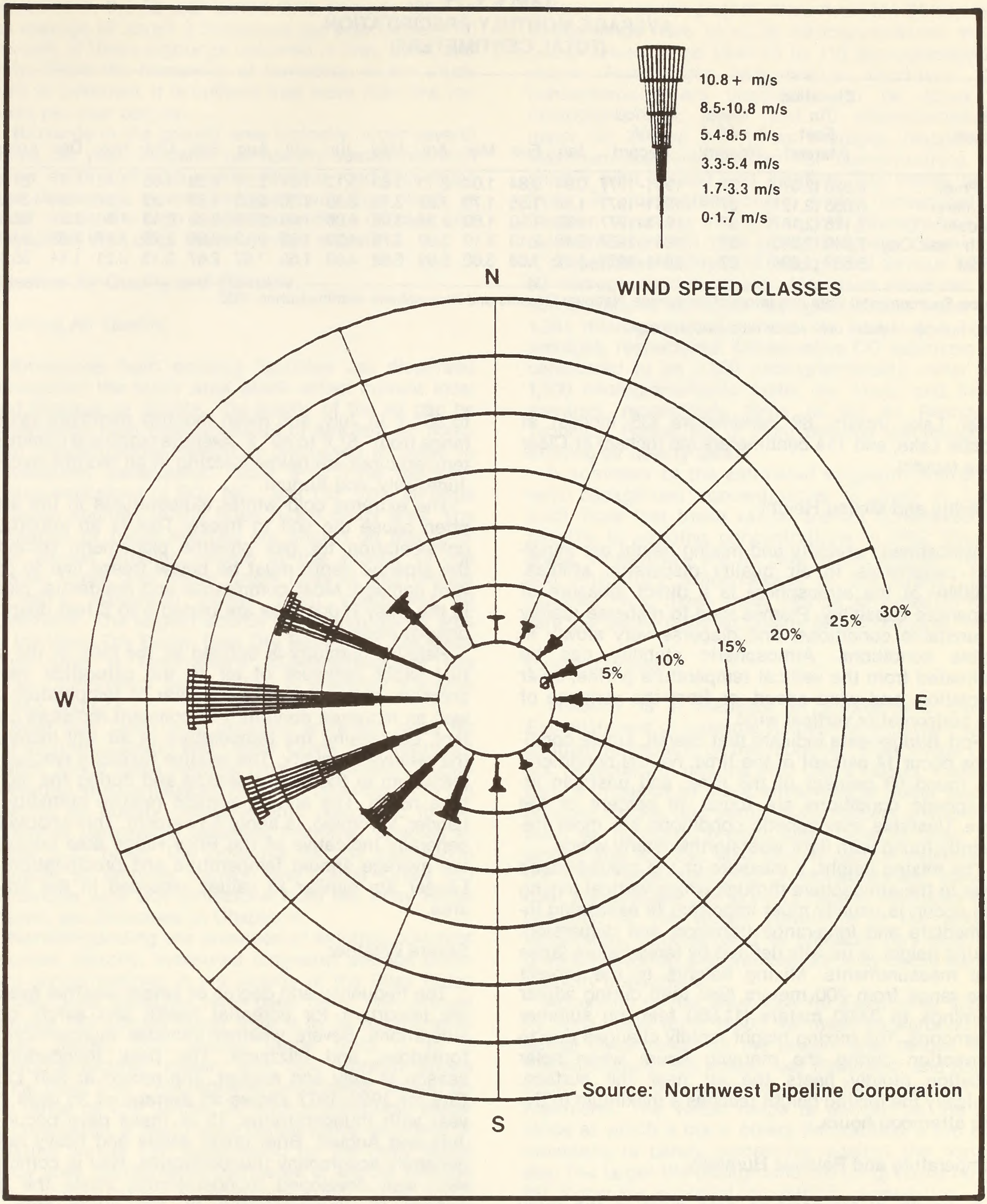


MAP 3-5 EXISTING EMISSIONS SOURCES AND PROPOSED PLANT SITES IN THE RILEY RIDGE AREA



Source: National Climatic Center
Asheville, North Carolina

FIGURE 3-4 FORT BRIDGER WIND ROSE (1950-1954)



Source: Northwest Pipeline Corporation

FIGURE 3-5 KEMMERER WIND ROSE (NOV. 1979-OCT. 1980)

TABLE 3-21
AVERAGE MONTHLY PRECIPITATION
(TOTAL CENTIMETERS)

Station	Elevation in Feet (Meters)	Years of Record[1]	Period of Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Big Piney	6,820 (2,079)	37	1941-1977	0.94	0.84	1.04	2.13	3.33	3.12	1.91	2.31	2.29	1.65	1.12	1.17	21.84
Kemmerer	6,958 (2,121)	37	1941-1977	1.68	1.55	1.70	1.83	3.12	0.36	1.30	2.08	1.85	1.88	1.80	1.80	24.21
Pinedale	7,175 (2,187)	37	1941-1977	1.85	1.50	1.60	2.34	3.99	4.06	1.96	2.59	2.39	2.13	1.80	2.31	28.52
South Pass City	7,840 (2,390)	37	1941-1977	3.18	2.13	3.10	3.99	3.76	4.32	1.55	2.13	2.36	2.79	2.77	2.79	34.87
Lander	5,557 (1,694)	37	1941-1977	1.22	1.68	3.00	5.99	6.58	4.90	1.55	1.07	2.67	3.15	2.21	1.14	35.15

Source: Environmental Data and Information Service, National Oceanic and Atmospheric Administration 1980.

[1] Total number of years over which data was averaged.

Clear Lake (north), 89 centimeters (35 inches) at Hobbs Lake, and 114 centimeters (45 inches) at Clear Lake (south).

Stability and Mixing Height

Atmospheric stability and mixing height are important parameters in air quality dispersion studies. Stability of the atmosphere is a direct measure of dispersive capability. Plumes tend to disperse rapidly in unstable conditions, and disperse very slowly in stable conditions. Atmospheric stability can be estimated from the vertical temperature profile, solar insolation, and wind speed, or from the variance of the horizontal or vertical wind.

Fort Bridger data indicate that overall, stable conditions occur 14 percent of the time, neutral conditions are found 68 percent of the time, and unstable atmospheric conditions are found 18 percent of the time. Unstable atmospheric conditions are most frequently found with light west-northwesterly winds.

The mixing height, a measure of the ground-based layer in the atmosphere through which vertical mixing can occur, is usually most important in assessing intermediate and long-range transport and dispersion. Mixing height is usually defined by temperature lapse rate measurements. Mixing heights in the project area range from 300 meters (980 feet) during winter mornings to 3,600 meters (11,800 feet) on summer afternoons. The mixing height rapidly changes due to convection during the morning hours when solar radiation rapidly heats the air near the surface. Typically the mixing height reaches a maximum in the late afternoon hours.

Temperature and Relative Humidity

A wealth of temperature data exist in the Riley Ridge area. Data at Kemmerer show slightly higher temperatures than those at Big Piney. The Big Piney data show that average temperatures are below freezing from November through March. Mean monthly maximum temperatures range from 25° F in January to 80° F in July, and mean monthly minimum values range from -5° F to 40° F. Average nighttime minimum temperatures are below freezing in all months except June, July, and August.

The extreme cold winter temperatures in the area often cause the soil to freeze. This is an important consideration for gas pipeline placement, because the pipeline depth must be below freeze line to prevent damage. Most commercial and residential pipes in the Riley Ridge area are buried 6 to 8 feet deep to prevent freezing.

Relative humidity is defined as the ratio of the actual vapor pressure of air to the saturation vapor pressure of air, and is a function of temperature as well as moisture content. For constant moisture content, decreasing the temperature of air will increase the relative humidity. The relative humidity reaches a maximum in the winter season and during the nighttime hours. The annual average relative humidity at Lander, Wyoming, is about 53 percent. This should be generally indicative of the Riley Ridge area because the average annual temperature and precipitation at Lander are similar to values recorded in the study area.

Severe Weather

The frequency and degree of severe weather events are important for potential health and safety considerations. Severe weather includes thunderstorms, tornadoes, and blizzards. The peak thunderstorm season is July and August. The record at Salt Lake City for 1929-1977 shows an average of 35 days per year with thunderstorms; 15 of these days occur in July and August. Brief gusty winds and heavy rains generally accompany thunderstorms. Hail is common with well developed thunderstorms. While the frequency of thunderstorms in the study area is unknown, the frequency reported at Salt Lake City should be a reasonable approximation.

Tornadoes are associated with the most severe thunderstorms and also with squall lines in fast-moving cold fronts. In Wyoming, 165 tornadoes were observed in the 52-year period 1916 through 1967, or an average of about 3 tornadoes per year. Almost 90 percent of these sightings occurred in May, June, and July. While the frequency of tornadoes in the study area is unknown, it is unlikely that more than one tornado per year occurs.

Blizzards in the project area typically occur several times per year. Blizzards are usually associated with snow drifts and high winds causing road blockages and damage to power and communication lines. In most cases, the high winds cause more damage and disruption than does the amount of snowfall.

Baseline Air Quality and Visibility

Existing Air Quality

Emissions from existing facilities are dispersed throughout the study area which affect current local and regional air quality. The quality of the air can be determined from measurements of ambient air pollutant concentrations, which is discussed in detail in subsequent paragraphs. Table 3-22 lists the estimated emissions of SO_2, NO_x, and TSP from all large existing sources in the Riley Ridge study area. The locations of these sources are shown on Map 3-5. The largest existing source in the vicinity of the Craven Creek and Shute Creek sites is Utah Power & Light's Naughton power plant southwest of Kemmerer. The largest source in the immediate area of the West Dry Basin, East Dry Basin, and Big Mesa plant sites is Northwest's 12,000-horsepower Big Piney Compressor Station. This is primarily a source of NO_x and CO.

Note that Table 3-22 contains emission rates for the Whitney Canyon and Carter Creek gas treatment plants. Since these sources have only recently begun operation, their emissions have not contributed to the historic air quality measurements discussed in the following paragraphs (whereas the other sources in Table 3-22 have). The potential for the cumulative impacts of Whitney Canyon and Carter Creek SO emissions with SO_2 emissions from the Riley Ridge Project are discussed in Chapter 4.

Notwithstanding the presence of existing pollutant sources, historic, measured long-term average pollutant concentrations in the vicinity of the Riley Ridge Project area generally have been quite low. Annual average TSP values range from 9 to 34 micrograms/cubic meter; NO_2 values range from 3 to 9 micrograms/cubic meter; and SO_2 concentrations range from 1 to 3 micrograms/cubic meter. Based on the range of TSP values, 30 micrograms/cubic meter is considered a reasonably conservative estimate of existing annual TSP background for the Riley Ridge study area. Conservative estimates of annual average SO_2 background are 3 micrograms/cubic meter, and 9 micrograms/cubic meter for NO_2.

Maximum measured short-term air pollutant concentrations are higher than average annual measurements. Since the measurement sites are relatively far removed from the Riley Ridge Project sites, it is difficult to estimate representative background short-term concentrations at the project sites. Available 24-hour SO_2 values range from 14 to 26 micrograms/cubic meter; 3-hour values range from 68 to 115 micrograms/cubic meter. Reasonably conservative short-term SO_2 concentrations are considered to be about 15 micrograms/cubic meter and 70 micrograms/cubic meter for 24-hour and 3-hour averages, respectively. Maximum measured 24-hour TSP concentrations vary sharply with season and location. The values range from 39 micrograms/cubic meter (measured in Boulder, Wyoming in 1980) to 218 micrograms/cubic meter (measured in 1980 at the Kemmerer Coal Mine). A conservative estimate of background 24-hour TSP is 60 micrograms/cubic meter. Maximum measured CO concentrations are 3,336 micrograms/cubic meter and 1,381 micrograms/cubic meter for 1-hour and 8-hour averages, respectively. Conservative CO estimates are considered to be 3,500 micrograms/cubic meter and 1,500 micrograms/cubic meter for 1-hour and 8-hour averages, respectively. Refer to the Air Resources Technical Report for a more detailed discussion of existing air quality data.

A summary of the estimated long-term and short-term background concentrations is given in Table 3-23. Note that these values are not considered applicable to existing concentrations in PSD Class I areas. While there are no data in the Bridger, Teton, and Fitzpatrick Wildernesses or the Grand Teton National Park, these areas can be assumed to have very low background air quality concentrations.

Existing Visibility

Visibility is a measure of atmospheric clarity. Establishment of baseline visibility is important when estimating impacts of the proposed Riley Ridge Project, especially in pristine PSD Class I areas. Visibility can be impaired by stack emissions of sulfur oxides, nitrogen oxides, and particulates. Natural phenomena such as humidity, precipitation, blowing dust, and smoke and fog can also greatly reduce visibility. In the Riley Ridge area, fog, precipitation, and blowing dust are probably the primary natural restrictions to visibility. At the higher elevations in the Bridger Wilderness, blowing dust is probably very rare, but ground-based fog and precipitation may cause natural visibility impairment.

According to the *Workbook for Estimating Visibility Impairment* (EPA 1980), the mean background (existing) visual range for the project area ranges from 170 kilometers (105 miles) near Kemmerer and points south, to 110 kilometers (68 miles) for points north of Kemmerer. The visual range is defined as the distance at which a black object (in practice, a top of a mountain) is barely perceptible against the horizon sky. The larger the background (existing) visual range, the higher the potential for visibility degradation.

The National Park Service currently maintains visibility sites equipped with manual telephotometers and cameras in the Grand Teton and Yellowstone National Parks. The data from both sites are similar and indicate the mean background visual range is approximately 150 kilometers (93 miles). The FS has

TABLE 3-22
EMISSIONS FOR EXISTING SOURCES IN THE STUDY AREA (POUNDS/HOUR)

Emissions Source	Emissions SO_2	NO_x	TSP
Naughton Power Plant (Allowable)[2]	5,894	5,018	1,517
Opal Gasoline Plant	0	150	0
Opal Compressor Station	0	16	0
Green River Compressor Station	0	153	0
PEPL Storm Compressor Station	0	16	0
FMC Coking Plant	NA[1]	NA[1]	139
Kemmerer Coal (Allowable)[2]	0	0	269
Jim Bridger Power Plant (Allowable)[2]	5,522	14,056	2,438
Big Piney Compressor Station	NA[1]	259	NA[1]
Miscellaneous Big Piney Field Compressor Units and Dehydrators	NA[1]	65	NA[1]
Allied Chemical Trona Plant	1,052	848	225
FMC Trona Plant	806	820	330
Texas Gulf Trona Plant	203	381	240
Stauffer Trona Plant	20	153	175
Tenneco Trona Plant	226	791	NA[1]
Whitney Canyon Gas[3] Treatment Plant	3,117	0	0
Carter Creek Gas[3] Treatment Plant	34	0	0

[1] No data available.

[2] Allowable emissions refer to the maximum emission rate permitted by regulation. Actual plant emissions are generally below these levels.

[3] These sources have only recently begun operation. Their emissions, therefore, have not contributed to historic air quality measurements. Because of its emission levels, Whitney Canyon is included in Table 1-19 and air quality cumulative analysis in Chapter 4.

TABLE 3-23
ESTIMATES OF REPRESENTATIVE BACKGROUND (EXISTING) POLLUTANT LEVELS IN THE STUDY AREA[1] (MICROGRAMS/CUBIC METER)

Pollutant	Averaging Time	Background Concentration	WAAQS[3]	NAAQS[2] Primary	Secondary
SO_2	3-Hour	70	1,300	-	1,300
	24-Hour	15	260	365	-
	Annual	3	60	80	-
NO_2	Annual	9	100	100	100
TSP	24-Hour	60	150	260	150
	Annual	30	60	75	60
CO	1-Hour	3,500	40,000	40,000	40,000
	8-Hour	1,500	10,000	10,000	10,000

[1] Background pollutant levels estimated from available data sources. Sources include WDEQ monitors at Kemmerer, Grover, and Boulder; Amoco monitors at Ryckman Creek; Utah Power & Light monitors at the Naughton Power Plant; and monitors operated by Kemmerer Coal Company. The Air Resources Technical Report contains a detailed discussion of the data available at each station.

[2] National Ambient Air Quality Standards.

[3] Wyoming Ambient Air Quality Standards.

also taken photographs of various views in the Bridger Wilderness. However, these data have yet to be analyzed by the FS.

SOILS AND VEGETATION

Soils investigations for the well field were conducted by ERT, Biowest, and the FS. ERT has correlated the three different surveys to prepare a unified data base for the 159,928-acre well field. Additional detail on the different soils surveys is presented in the Soils, Vegetation, and Reclamation Technical Report.

Well Field

Soils and Geomorphology

Soils within the well field vary in physical and chemical characteristics as determined primarily by geologic, topographic, vegetative, and climatic factors. The geologic nature of the area is dominated by uplifted fault blocks which form the major ridges, and relatively flat-lying clay shales and siltstones forming the intervening valleys and side ridges (slopes). The major ridges, such as the Hogsback and Deadline Ridge, generally trend north and south. They are composed of limestones, dolomites, and quartzites of Paleozoic and older Mesozoic age. Side ridges and valleys are formed by the Wasatch Formation, primarily of Eocene age (Lines and Glass 1975). Very gravelly colluvium and alluvium mantle most of the area.

Geomorphic surfaces within the well field are composed of steep, high-elevation major ridges, lower side ridges that extend laterally from the axis of the high ridges, alluvial fans, and alluvial terraces along stream drainages. Elevations range from about 7,000 feet in the extreme southeastern portion of the well field to over 10,600 feet at Mount Darby in the northwest. Elevational changes of 1,000 to 2,000 feet are common within horizontal distances of 2 or 3 miles, especially in the vicinities of the Hogsback, Cretaceous Mountain, Deadline Ridge, and Mount Darby. These areas typify the major high-elevation ridges within the well field; generally elevations are over 8,500 feet.

The soils occurring at the crests and shoulder slopes of these ridges are typically shallow over hard bedrock such as quartzite, limestone, or dolomite. These soils have textures ranging from very gravelly to very cobbly sandy loams or loams. Starman and Starley soils are examples. They are well drained to somewhat excessively drained. These textural, depth, and drainage characteristics limit the amount of water that these soils can hold and make available for plant growth. The soils on adjacent sideslopes have similar internal drainage and textural characteristics, but are deep over bedrock. Farlow, Pishkun, and Hobacker soils are examples. Some soils in the Deadline Ridge to Mount Darby area have similar drainage and position, but textures are clay to very gravelly clay. The Bead soil is an example.

The soils on these high ridges occur under a cold and moist climate, with mean annual air temperatures ranging from 32° to 34° F., and mean annual precipitation ranges of about 17 to over 30 inches, depending on location (SCS no date). Climatic data reported for soils were taken from Soil Conservation Service information which is more applicable to growing season and revegetation than regional meteorological data reported in the Air Quality section of this chapter. Slopes on the high ridges range from moderately steep (10 percent) on the shoulders and crests to very steep (50 percent) on the sideslopes. Site rehabilitation potential on these soils is limited by cold temperatures, steep slopes, very gravelly or very cobbly soil textures, and areas of shallow to outcropping nonrippable bedrock.

A system of side ridges extends eastward across much of the well field from the higher north-south trending uplifts. Johnson Ridge, Riley Ridge, and Pine Grove Ridge are examples. These geomorphic surfaces are mantled by 4 to 15 feet of very gravelly or very cobbly colluvium and alluvium, primarily overlying clay shales of the Wasatch Formation. The soils in these areas are typically deep and well drained. Granile, Nutras, Rooset, and Jerry soils are examples. These soils have textures ranging from very gravelly or very cobbly sandy loams to clays. Generally, they have dark-colored surface layers under shrub communities and thick, bleached surface layers under coniferous forest. Slopes range from undulating (5 percent) on the flatter bench-like ridge tops to very steep (50 percent) along the sideslopes where these ridges are bounded by deep, narrow valleys. These soils also occur in a cold and moist climate, receiving 15 to 19 inches of annual precipitation; the mean annual air temperature is 32° to 37° F. Site rehabilitation potential varies from fair on the flatter surfaces to poor on the steeper soils. Stoniness and slope are limiting factors.

Side ridges near the Hogsback and Cretaceous Mountain are comprised of undulating to steep convex slopes and crests, underlain by the Wasatch Formation. In these areas, the very gravelly or very cobbly mantle is thin or absent. Soils are moderately deep and reflect the loamy or clayey textural characteristics of interbedded sandstones, siltstones, and shales. These soils, of which Delphill and the Glassner variant are examples, are well drained, cool, and dry. They receive 10 to 14 inches of precipitation annually, with a mean annual air temperature of 37° to 40° F. These soils generally have poor site rehabilitation potential because of slope, depth to rock, and clayey textures. Their potential improves somewhat on the flatter slopes.

Alluvial fans occur over small, nearly level to gently sloping areas scattered throughout the eastern part of the well field. West of Cretaceous Mountain, soils on alluvial fans are deep and well drained. They have dark-colored surface layers and profile textures of very gravelly or very cobbly loams to heavy clay loams. Jerry and Hoodle soils are examples. These soils are well drained and occasionally have stratified sand, gravel, and cobble at depth. These soils have fair potential for use in site rehabilitation; they are limited primarily by rock content. In the vicinity of Cretaceous Mountain and to the south and east towards Calpet, alluvial fans are comprised of finer grained materials derived from the Wasatch Formation. The soils in these positions have sandy clay loam, loam, and clay loam textures. Typically they are deep and well drained, and have few limitations to use in site rehabilitation efforts. Patent and Kremlin soils are examples.

Streamlain alluvial terraces and floodplains occur throughout the well field. Typically the soils are dark colored, deep, and moderately well to somewhat poorly drained. Textures are sandy loams, loams, and clay loams, with occasional very gravelly or very cobbly textures at depth. Most of these soils occur in areas with level or gentle slopes with riparian vegetation, but large areas along Middle Piney and South Piney Creeks are used agriculturally for hay and pasture. The Silas, Tine, and Foxcreek soils are typical examples. These soils are well suited to site rehabilitation, though care should be taken to avoid disturbance or handling of soil resources during the wettest times of the year. Major limitations to site rehabilitation in these areas relate to sensitive vegetation and wildlife habitat resources.

All soils occurring within the well field and corridor areas have been grouped into rehabilitation units, based on similarities of climate, slope, geomorphic position, and other soil factors (see Methodology Appendix C). Out of a total of 3,968 acres proposed for disturbance in the well field, about 1,467 acres (37 percent) have been characterized as sensitive rehabilitation units (Table 3-24). Sensitive rehabilitation units are soils exhibiting special constraints with regard to revegetation. For more detailed descriptions of the soils occurring on the well field and their use and management capabilities, refer to the Soils, Vegetation, and Reclamation Technical Report.

Vegetation

Forest communities, consisting principally of coniferous species, dominate elevations above 8,000 feet in the well field. Shrubland communities, composed of several sagebrush species, occupy ridges and basins at lower elevations. Mountain shrub communities occur occasionally along ridges with steep slopes. Shrub willows and wet meadows are interspersed along flood plains of major streams. Ranchers have diverted water from streams forming irrigated haylands along Middle Piney Creek and other streams.

Coniferous forest communities cover about 27 percent of the well field (Table 3-25). Conifer forests occupy all slope aspects at higher elevations and occur on steep north-facing slopes at the lower extensions of their range. Dominance by various conifer species varies with elevation and past disturbance. Whitebark pine forms open stands on the slopes of the highest ridges (Mount Darby, Wyoming Peak, and Deadline Ridge) on the western boundary of the well field. The majority of the conifer forest consists of mixed stands of subalpine fir and lodgepole pine. Lodgepole pine and aspen, representing an early stage of succession, frequently form stands on areas that have been logged or burned. Subalpine fir and Engelmann spruce, the climax species, become established in the understory of lodgepole and aspen stands and gradually assume dominance. Douglas-fir occupies steep, north-facing slopes at lower elevations, commonly mixes with subalpine fir and lodgepole pine communities, and forms small isolated stands on favorable sites. The shrub understory of all conifer stands is sparse (less than 25 percent cover), consisting of gooseberry currant, buffaloberry, Oregon grape, and mountain lover. Herbaceous understory is also sparse, commonly consisting of elk sedge and heartleaf arnica.

Yield capability for the conifer types ranges from 50 to 60 cubic feet/acre/year and is considered low to moderate (Steele et al. 1979). District timber volume estimates range from 14 to 20 thousand board feet/acre (Paroz 1982, personal communication). Types and uses of timber are described in the Timber section of this chapter.

Aspen communities cover about 6 percent of the well field. Aspen stands occupy similar slope aspects as conifers. Aspen is the principal overstory species. The most productive aspen stands contain an extensive herbaceous understory composed of a mixture of forbs, such as geranium, fleabane, and western yarrow, and grasses such as blue wildrye, mountain brome, and Kentucky bluegrass. The low (less than 3 feet) shrub stratum is dominated by snowberry. Mountain big sagebrush often intergrades with the aspen shrub stratum on gently sloping sites. The understory of aspen stands is extensively utilized by both big game and livestock. Estimates of average understory productivity on the most productive sites was 1,180 pounds/acre (Youngblood and Mueggler 1981).

Sagebrush-dominated areas cover about 51 percent of the well field. In general, big sagebrush stands occupy sites where clayey subsoils are deeper than those found under black or alkali sagebrush communities. The principal big sagebrush subspecies found in the area include subalpine big sagebrush, mountain big sagebrush, and Wyoming big sagebrush. Basin big sagebrush occurs in small isolated patches on deep soils on alluvial fans and road sides below 7,500 feet. Subalpine big sagebrush is found at the highest elevations, generally above 9,500 feet; mountain big sagebrush occupies the basins and lower slopes of the well field, generally below 7,500 feet. The understory of big sagebrush stands consists of a variety of grasses and forbs. Sandberg bluegrass and Hood phlox are commonly associated with Wyoming big sagebrush; Letterman needlegrass, Great Basin wildrye, and spike fescue are commonly associated with mountain big sagebrush; and mountain brome is an important understory constituent in subalpine big sagebrush stands. Average annual understory production is about 1,200 pounds/acre in Wyoming sagebrush and ranges from 1,400 to 2,000 pounds/acre in some mountain big sagebrush communities (SCS 1977a).

TABLE 3-24
SENSITIVE SOIL REHABILITATION UNITS (ACRES) IN THE WELL FIELD[1]

Unit	Soils	Units and Area											Rehabilitation Consideration
		Hogsback	Dry Piney	Graphite	Fogarty Creek	Lake Ridge	Tip Top	Riley Ridge	North Riley Ridge	Sawmill	Darby Mtn	Total	
A2	Deep and moderately deep, saline-alkaline soils formed in alluvium on dry drainageways and stream terraces. Includes small areas of geographically associated sand dunes. Corridor Soil Associations 102, 104, 105, 107							10				10	High salts, compaction, drouthiness
B3	Shallow to moderately deep soils on ridgeslopes, hillsides, folded and faulted lands. Corridor Soil Associations 309, 301. ERT Well Field Soil Units 82,84, 86. Includes minor areas of deep soils in ERT Well Field Units 81E, 81F. Bio/West Units 1, 14, 34, 35, 36.	37	23		2		234	19	7	30		352	Drouthiness, depth to bedrock, high probability of extensive cuts and fills, avoid moist slopes to minimize surface erosion and slumping.
C2	Drouthy, shallow and deep, gravelly soils on ridge crests and sideslopes. ERT Well Field Soil Units 50E, 50F, 51E, 51F, 52, 53, 54, 64, 97. Bio/West Units 7, 13, 21	124					31	7	5	2		169	Depth to hard bedrock, stoniness, slope, drouthiness.
C4	Deep, gravelly soils steep ridgeslopes. Well Field Soil Units 66E, 66F, 77E, 77F, 82, 85, 91. Bio/West Units 12, 20, 22.		39		50	6	6	27	21	73		222	Slope, stoniness, moist slopes surface erode or slump, need for extensive cuts and fills.
D4	Deep, nongravelly and gravelly soils on steep to extremely steep ridges and mountain sideslopes. USFS Units 154D, 200D, 220D, 221D, 255C, 360D, 391, 650D, 660D, 675D, 702D, 710, 711D.					127		9	2		5	143	Slope, shortness of growing season, erosion hazard, need for extensive cuts and fills.
D5	Deep and shallow, gravelly soils with rock outcrop on steep mountain sideslopes. ERT Well Field Units 55, 93F, 96, 98. USFS Units 203D, 355, 492D, 502, 701, 712B, 713, 714, 715. Bio/West Unit 10.		26	19	61	339		75	25		26	571	Slope, shortness of growing season, erosion hazard, stoniness depth to hard bedrock, need for extensive cuts and fills.
	TOTAL ACRES	161	88	19	113	472	281	137	60	105	31	1,467	

Note: See Table C.3, Rehabilitation Units in Appendix C for an expanded discussion of rehabilitation unit characteristics.

Other important sagebrush species in the well field include black sagebrush, which is most abundant on soils derived from limestones, and alkali sagebrush which predominates on sites with a shallow subsoil layer at middle elevations in the well field. These "low" sagebrush species form a mosaic with big sagebrush communities over large areas. Understory species commonly associated with these two sagebrush species include bluebunch wheatgrass, bottlebrush squirreltail, and Indian ricegrass. Estimated annual production in black and alkali sagebrush stands ranges from 600 to 1,200 pounds/acre (SCS 1977a).

The bunchgrass type covers about 7 percent of the well field. This type occurs on windswept ridges on shallow, gravelly soils. Common species include

TABLE 3-25
VEGETATION TYPES (ACRES) IN THE WELL FIELD

	Units and Area											
Vegetation Type	Tip Top	Hogs-back	Riley Ridge	North Riley Ridge	Darby Mtn.	Dry Piney	Lake Ridge	Graphite	Fogarty Creek	Sawmill Area	Total	(Percent)
Mixed Pine	-	-	1,395	3,571	9,624	979	7,933	1,464	1,248	-	26,214	(16.4)
Spruce/Subalpine Fir	19	-	538	2,784	1,210	26	2,874	13	2,707	102	10,273	(6.4)
Douglas-Fir	70	666	1,222	1,254	954	13	1,190	45	858	-	6,272	(3.9)
Aspen	358	26	1,139	2,803	134	672	973	429	1,395	1,203	9,132	(5.7)
Big Sagebrush	8,960	6	3,443	4,712	896	557	5,338	646	6,217	8,874	39,649	(24.8)
Sagebrush Complex	18,758	9,011	5,414	-	90	4,650	186	128	1,555	1,734	41,526	(25.9)
Mountain Shrub	634	538	-	-	538	-	-	-	-	-	1,710	(1.1)
Greasewood	256	-	-	-	-	-	-	-	-	-	256	(0.2)
Bunchgrass	896	806	1,427	2,400	1,370	115	1,274	550	1,408	269	10,515	(6.6)
Willow	525	·	557	1,024	365	45	672	-	262	1,306	4,756	(3.0)
Meadow	154	179	-	-	77	192	224	-	-	26	852	(0.5)
Pasture/Hayfield	1,210	-	435	198	-	26	-	-	166	3,712	5,747	(3.6)
Clearcut	-	-	448	134	1,235	6	326	352	45	-	2,546	(1.6)
Barren	-	-	-	-	397	-	-	13	-	-	410	(0.3)
Lake	-	-	-	-	70	-	-	-	-	-	70	(<.1)
TOTAL	31,840	11,232	16,018	18,880	16,960	7,281	20,990	3,640	15,861	17,226	159,928	(100.0)

bluebunch wheatgrass, spike fescue, phlox, and fringed sagebrush. Estimated annual production ranges from 600 to 2,000 pounds/acre (SCS 1977a).

The willow and meadow types (riparian communities) occupy saturated soils along major drainages covering about 4 percent of the well field. The willow type includes a shrub stratum dominated by Booth willow and Wolf willow. Both are shrub willows that range from 1.5 feet to 6 feet in height. Important understory shrub species include shrubby cinquefoil and silver sagebrush. Sedges and Kentucky bluegrass are important herbaceous species in both the meadow and willow types. Estimated annual production ranges from 2,500 to 6,000 pounds/acre for the meadow and willow type (SCS 1977a). The willow and meadow types provide extremely important forage and cover for wildlife and livestock. Beaver are an important influence on the distribution of willows in the well field area. Beaver dams widen the riparian zone, offering additional sites favorable for willow growth.

A mountain shrub type occupies about 1 percent of the well field as small linear bands on steep slopes at lower elevations. The type is characterized by overstory dominance by true mountain mahogany, serviceberry, and rabbitbrush. Ground species include Indian ricegrass, slender wheatgrass, and bluebunch wheatgrass. Estimated annual production is 900 to 1,400 pounds/acre (SCS 1977a).

The greasewood type occurs along drainage bottoms and basin floors in the extreme eastern portions of the well field at low elevations. It occurs on less than 1 percent of the well field. Soils underlying greasewood stands are typically deep and loamy to clayey, with high sodium and/or calcium salt content and high pH. The type is characterized by dominance of greasewood shrubs. Understory species include several annual species and perennial grasses such as thickspike wheatgrass and inland saltgrass. Estimated herbaceous annual production ranges from 300 to 600 pounds/acre (SCS 1977a).

One rare plant species, Payson milkvetch (*Astragalus paysonii*), is known in the well field area and frequently occurs in clearcuts (Wyoming Natural Heritage Program 1982). See Soils, Vegetation, and Reclamation Technical Report for more detail on rare species. No federally listed species are known to occur in the well field.

Plant Sites

Soils

Soils investigations at plant sites and along corridors were conducted by ERT. For more information regarding these surveys and the soil characteristics occurring in these areas, refer to the Soils, Vegetation, and Reclamation Technical Report.

Soils occurring at proposed plant sites are generally dry and cool. About 65 percent (1,831 acres) of the total acreage involved is composed of moderately deep and deep, loamy soils formed in mixed alluvium or residuum. Typically these soils are poorly developed and calcareous. They occur under big sagebrush and grass communities. The remaining 35 percent (969 acres) of the potentially disturbed acreage is composed of saline/alkaline or steep soils formed from shale. Along stream drainages, somewhat poorly to poorly drained soils on bottomlands have loamy textures over coarse sand and gravel at a depth of 2 to 6 feet. About 34 acres of these soils occur at the proposed sulfur loadout facility near Opal. On somewhat higher alluvial surfaces, the soils are moderately deep and deep, strongly saline/alkaline, and have loamy to clayey textures. These soils occur most extensively at the East Dry Basin and Craven Creek plant sites. Steep, eroding soils occur along ridges, mesa sideslopes, and escarpments. About 120 acres of the Big Mesa site occur on these shallow to moderately deep soils, which are derived from both sandstone and shale. In addition, about 40 acres of these soils occur at West Dry Basin, 30 acres at East Dry Basin, and 25 acres at the sulfur loadout facility.

Typically, the soils on proposed plant sites near the well field receive 10 to 14 inches of precipitation annually; the Craven Creek site receive 7 to 9 inches of precipitation. Mean annual air temperature is about 36° to 40° F., and the growing season is about 85 to 100 days.

Vegetation

East Dry Basin, West Dry Basin, Big Mesa, and part of the Craven Creek site (or over 75 percent of the area occupied by the plant sites) consists of big sagebrush-dominated communities, principally an association of Wyoming big sagebrush and Sandberg bluegrass. Other important constituents of this sagebrush type include winterfat on highly calcareous soils on basin floors, and Gardner saltbush and shadscale in areas of transition between sagebrush-dominated uplands and saltbush-dominated basin floors and sideslopes. Thickspike wheatgrass is a common associate with sagebrush on clayey, deeper soils. Squirreltail dominates disturbed and intensively grazed areas. Needlegrasses represent a minor component on most sites. Vegetation canopy cover ranges from 20 to 30 percent. Shrub species contribute the majority of the cover. Estimated annual production is 500 to 2,000 pounds/acre (SCS 1977a).

The mixed desert shrub type covers 5 percent of the total plant site acreage primarily at Craven Creek. The type consists of scattered low dunes, deeply overlying medium to fine-textured alkaline soils on basin floors and on wide, gently sloping drainages. The dunes are dominated by gray horsebrush, spiny hopsage, rubber rabbitbrush, Wyoming big sagebrush, and Indian ricegrass. The basin floors are dominated by Gardner saltbush and thickspike wheatgrass. Average canopy cover in this type ranges from 15 percent in the saltbush component to 30 percent on the shrub-dominated dunes. Estimated annual production is 350 to 700 pounds/acre (SCS 1977a).

The saltbush vegetation type covers 10 percent of the plant sites, primarily at East Dry Basin and the sulfur loadout facility. This type occupies basin floors and erosive sideslopes. The type is dominated by Gardner saltbush. Minor constituents include thickspike wheatgrass, Sandberg bluegrass, and big sagebrush. Average canopy cover in this type averages 15 to 20 percent, and annual production is estimated to be 350 to 1,200 pounds/acre (SCS 1977a).

Riparian vegetation type covers less than 1 percent of the plant sites, primarily at the sulfur loadout facility. This type consists of streamside vegetation along small diversions. Species composition includes willows, rose, sedges, rushes, and inland saltgrass. Estimated annual production is 2,000 to 3,800 pounds/acre (SCS 1977a).

Other minor constituent types (less than 1 percent) include the bunchgrass and mountain shrub vegetation types that were described previously under the well field. No listed threatened or endangered plant species are known to occur at the plant sites.

Linear Facilities

Soils

Soils occurring on the proposed corridors are similar to those at the plant sites. Approximately 1,533 acres (25 percent) of the 6,084 acres of proposed corridors occur on sensitive rehabilitation units. About 812 acres are characterized by steep ridge slopes and eroding basins; the remaining 791 acres occur as highly saline/alkaline lands on alluvial fans and higher stream terraces.

Vegetation

Vegetation along the proposed railroad, transmission line, pipeline, and access road corridors consists of approximately 86 percent big sagebrush communities. Other constituent types in descending order of importance include saltbush, greasewood, bunchgrass, and mixed desert shrub. Saltbush and greasewood occur along drainages, while bunchgrass occurs on ridge lines and plateaus, and mixed desert shrub in basins and dune communities. No listed threatened or endangered plant species are known to occur in the corridors. Wet areas with riparian vegetation are considered sensitive because of their value to wildlife and because they need special considerations in revegetation.

For more detailed descriptions of the soils and vegetation in the well field, plant sites, and corridors, refer to the Soils, Vegetation, and Reclamation Technical Report and Maps.

VISUAL RESOURCES

Introduction

Process

The areas in which project components would be located were evaluated for visual resources using the BLM Visual Resource Management (VRM) system (BLM 1978c) except for lands managed by the FS. Lands managed by the FS were evaluated using the Visual Management System (FS 1974).

The visual inventory processes of these two agencies are conceptually similar, but differ in minor ways regarding specific component criteria. Each system considers two basic inventory factors. The first is scenic quality (Scenic Quality, BLM; Variety Class, FS), which is a measure of the scenic values inherent in the landscape. The second is consideration of the viewer including numbers, location, distance, attitudes and duration (Visual Sensitivity, BLM and FS). These inventory components are then combined to determine the overall visual resource value of the inventoried lands (Management Classes, BLM; Visual Quality Levels, FS). One of five levels of resource value is designated, each with specific guidelines for maintaining visual quality, i.e., the highest value lands must be retained in their existing condition, while subsequently lower value designations permit greater degrees of visual modification.

In addition to the standard BLM and FS inventory, a landscape character inventory was conducted. The purpose of this inventory was to gain a broader perspective regarding the overall condition of the lands in the project area. This evaluation is important to understanding and assessing the effects of landscape modifications that would take place with a project of this magnitude. For this purpose, generalized viewpoints were identified, such as major viewing segments of highways, roads, rural towns, and residential areas. The landscape visible from these viewpoints was described noting overall character condition and notable man-made or natural features. Based upon this description, one of the following conditions was designated: Natural Dominated-Scenic, Natural Dominated-Common, Man-Natural Mix, and Man-Dominated. Figures 3-6 through 3-9 show examples of these conditions.

The inventory procedures are presented in detail in Appendix C, Visual Resource Inventory and Analysis Process. Results of the inventory and analysis, including map overlays, are available for review in BLM and FS field offices.

Regional Inventory

The scenic quality study was conducted within the perspective of the physiographic province. Physiographic provinces are large regional landscape units made up of a characteristic set of landform and vegetation features. The study area includes two major physiographic provinces or generalized landscape types: the Wyoming Basin and the Central Rocky Mountains (Fenneman 1931).

The majority of the study area is contained within the Wyoming Basin Province. This area is characterized by flat to rolling sage-covered lands with a few distinguishing characteristics. Notable exceptions in this continuous, open landscape include: the Green River, which runs from north to south through the central portion of the study area, with a generally well developed riparian zone and often adjacent colorful bluffs (high scenic quality); major tributaries of the Green River; various escarpments and badland formations; and the Wyoming Range foothills (all rated as moderate scenic quality).

The Middle Rocky Mountain Landscape Province is located in the northwestern portion of the study area and accounts for only about 2 percent of the study area. Scenic quality ratings for areas in this province are generally in the moderate and high categories. Moderate ratings were usually given to the steep conifer, aspen, and sage-covered upper foothills of the Wyoming Range, while high scenic quality ratings were given to areas of high vertical relief, diverse vegetative patterns, stream valleys, and alpine meadows.

Viewers in the study area tend to be concentrated in urban areas, major highways, recreation areas, and rural residential areas (primarily farms and ranches). The majority of the study area is seen by a relatively low number of people, or for all practical purposes, not seen at all. This is especially true of the extensive rolling sage country in the central and eastern portions of the study area. The urban viewpoints such as Rock Springs and Kemmerer account for significant numbers of observers, but are set in locations already heavily influenced by man-made features. Major roads also account for significant numbers of viewers, but they are located in areas where scenic quality is low and is not the reason for viewers driving the road. In addition, there are scattered residences in the Green River, the Hams Fork River, and Fontenelle Creek river valleys. These viewers are fixed in position, in a relatively scenic setting, and have an affinity for the visual condition of their surroundings.

Viewers in the northwestern portion of the study area, which has higher recreation and scenic value, tend to be more recreation oriented. In addition, two of the Oregon Trail routes traverse this area, and the ruts and artifacts such as graves can be seen by and have been interpreted for the public. Highway 189 is a primary route to Yellowstone and Teton National Parks and, therefore, carries a greater percent of recreation oriented and scenery conscious travelers. Two primary routes into the Wyoming Range cross into and through the study area. These are Middle Piney and South Piney Creek Roads, the latter of which follows the Lander Cutoff of the Oregon Trail. There are also concentrations of farms and ranches in the Piney and LaBarge Creek valleys which presently look out onto the natural dominated scenic landscape of the Wyoming Range.

Towns include Marbleton, Big Piney, LaBarge, and Calpet. All towns are relatively small and easily influenced by the visual character of the surrounding lands. The Marbleton/Big Piney area generally has a natural character. LaBarge is next to the Green River and adjacent bluffs, but the area to the west through Calpet is already heavily influenced by existing oil and gas development.

The Wyoming Basin (the central and eastern portions of the study area) rated low in overall resource value due to a combination of low scenic values and relatively low viewer conditions. The most notable exception in this area is the Green River corridor, which rated high in visual resource value due to the combination of high scenic quality and high user concern.

Moving west from the Green River in the northern portion of the study area, visual resource values

FIGURE 3-6 NATURAL DOMINATED-COMMON LANDSCAPE CLASS

FIGURE 3-7 NATURAL DOMINATED-SCENIC LANDSCAPE CLASS

FIGURE 3-8 MAN-NATURAL MIX LANDSCAPE CLASS

FIGURE 3-9 MAN-DOMINATED LANDSCAPE CLASS

steadily increase due to landscapes of higher scenic quality combined with higher viewer conditions.

Well Field

Visual resource values in the well field range from low in the southeast portion to high in the west and northern portions. The low resource values occur in the Hogsback and Cretaceous Mountain areas due to a combination of lower scenic quality and the presence of existing oil and gas development. Viewer conditions in this area are generally low, since most viewers are associated with well field-related traffic. However, more distant views of this area are afforded from Highway 189 and the town of LaBarge, which are sensitive viewpoints.

Visual resource values generally increase in the northern and western portions of the well field due to increased scenic quality in and adjacent to the Wyoming Range in the Fish Creek Mountain, Mount Darby, and Snider Basin areas. Major recreation access routes into these areas follow scenic valley bottoms along Middle and South Piney Creeks. Consequently, viewer conditions are high, particularly along South Piney Creek. One road follows the Lander Cutoff of the Oregon Trail, which is identified with various interpretive markers.

Extensive portions of the well field along Deadline Ridge generally are not seen, or seen only as background from long distances. This sloping, elevated ridge is a complex of sage and conifer/aspen vegetation. It is of moderate scenic quality and, therefore, designated as a mix of moderate to low resource value.

Plant Sites

The visual resource values for three of the four proposed plant sites and sulfur loadout facility are low. The East and West Dry Basin plant sites are in a flat sage landscape partially enclosed by plateau and badland formations. Due to the proximity of the Calpet Road, these sites have a high degree of visibility, although the road is used primarily by well field traffic. This area is already influenced by existing oil and gas development. The Craven Creek plant site is located in an area of flat to rolling sage, but without enclosing landforms or the influence of existing development. This site is exposed to view from the Opal Cutoff and Highway 189, which are highways with moderate to high volume and low scenic concern.

The sulfur loadout site is also in an area of low scenic quality. It is adjacent to Highway 30 and has a high degree of visibility, but low viewer concern.

The fourth plant site, Big Mesa, has a moderate visual resource value. It is located in an elevated plateau landscape setting with moderate scenic value and is visible from a wide area, including Highway 189. Existing surface disturbance is present on top of the mesa, but is not visible from Highway 189.

Linear Facilities

Corridor areas of moderate to high visual resource value are generally concentrated west of the Green River and are associated with areas where there is some coincidence of moderate to high scenic quality and moderate to high viewer conditions. The only such area east of the Green River is the White Mountain escarpment north and west of Rock Springs. This prominent landscape feature of moderate scenic quality is exposed to a high number of viewers from urban, highway, and rural residential viewpoints.

Throughout the study area, the Green River is of both high scenic quality and high viewer conditions (concern and volume). Major tributaries to the Green River, including Fontenelle Creek, LaBarge Creek, Hams Fork, and the Piney Creeks, are of generally high visual resource value due to moderate scenic quality and high viewer conditions (from roads and ranches scattered throughout these creek bottoms).

The Names Hill-Muddy Creek-Holden Hill area is of moderate to high resource value primarily due to the high viewer concern for the historic significance of well preserved Oregon Trail artifacts in this area. Much of this area is of low to moderate scenic quality, generally natural in character.

In addition, the badlands and bluffs along the Green River from LaBarge northward, are of high visual resource value. This is due to moderate scenic quality and high exposure to view by large numbers of people from Highway 189, LaBarge, and numerous ranches.

CULTURAL RESOURCES

The documentation for the EIS includes an overview of the region's cultural history and an inventory of known cultural resource sites recorded by previous investigation in the areas of the well field, plant sites, and the linear facility rights-of-way encompassing a mile-wide study corridor. Additional information concerning the location of historic trails supplements the site-specific archaeological data. For the purpose of description and analysis, a distinction is made between prehistoric and historic resources. Prehistoric resources refer to physical evidence of human activity provided by individual sites that occurred prior to written records, or for events prior 1825 A.D. within the project area. Historic resources span the years 1825 to 1930 and include structures, historic archaeological sites, and historic transportation features including trails or roads and railways.

Regional Overview

Previous research in the Overthrust Belt and surrounding areas indicates that records of human occupation extend back for approximately 12,000 years. The earliest positively identified evidence of habitation involve the Paleo-Indians, who occupied western Wyoming from approximately 10,000 to 5,000 B.C. The

Paleo-Indian period was succeeded by the Early Archaic (5,000 to 3,000 B.C.), Middle Archaic (3,000 to 1,000 B.C.), and the Late Archaic (1,000 to 500 A.D.) periods. The Late Prehistoric period (500 A.D. to approximately 1825 A.D.) includes the period when indigenous Native Americans occupied the project area, principally Shoshonean people.

The subsistence lifestyles of the prehistoric people of the area focused on the hunting of game and collecting of wild edible plants. The movement of small groups was largely determined by the seasonal availability of food resources. The arid, high plains environment of most of the project area made the availability of water, landscape, and elevation among the most important factors that directly affected the choice of indigenous settlement areas. These circumstances are reflected in the distribution of prehistoric archeological sites recorded during previous investigations. Although each of the groups that occupied the project area possessed complex social systems involving a variety of religious and social practices, only limited remains of their economic activities exist today as archeological sites.

For most of the past 12,000 years, the indigenous populations that inhabitated the project area lived in small, self-sufficient family groups that traveled by foot to a number of different locations to engage in seasonal subsistence activities. The locations of communal antelope or rabbit hunts that reflect these activities are among the largest prehistoric sites. Semi-permanent settlements developed along major watercourses, where vegetation and small game could support groups of families for several months. As a result, the distribution of prehistoric archeological occupation areas reflects the pattern of spatially dispersed natural resources used by transient groups at different times of the year.

The documented historic exploration and settlement of the project area began with the William Ashley expedition up the Green River in 1823, although a few American and British fur traders had passed through western Wyoming in the previous decade. When Ashley traveled through the region, he established a route which later became the Overland Trail. In the next few years an influx of fur trappers and traders arrived, often establishing the first posts of forts along the principally traveled routes. The place names of many of the region's streams recall the names of early "mountain men": Lucien Fontenelle, Joseph LaBarge, and Zacharias Ham. William Sublette, a member of the Ashley party, explored the southern routes across the western Wyoming ranges and is among the first to have established a major trail, later known as the Sublette Cutoff of the Oregon Trail. In 1834, the first missionaries entered the region followed in 1841 by the first overland emigrants.

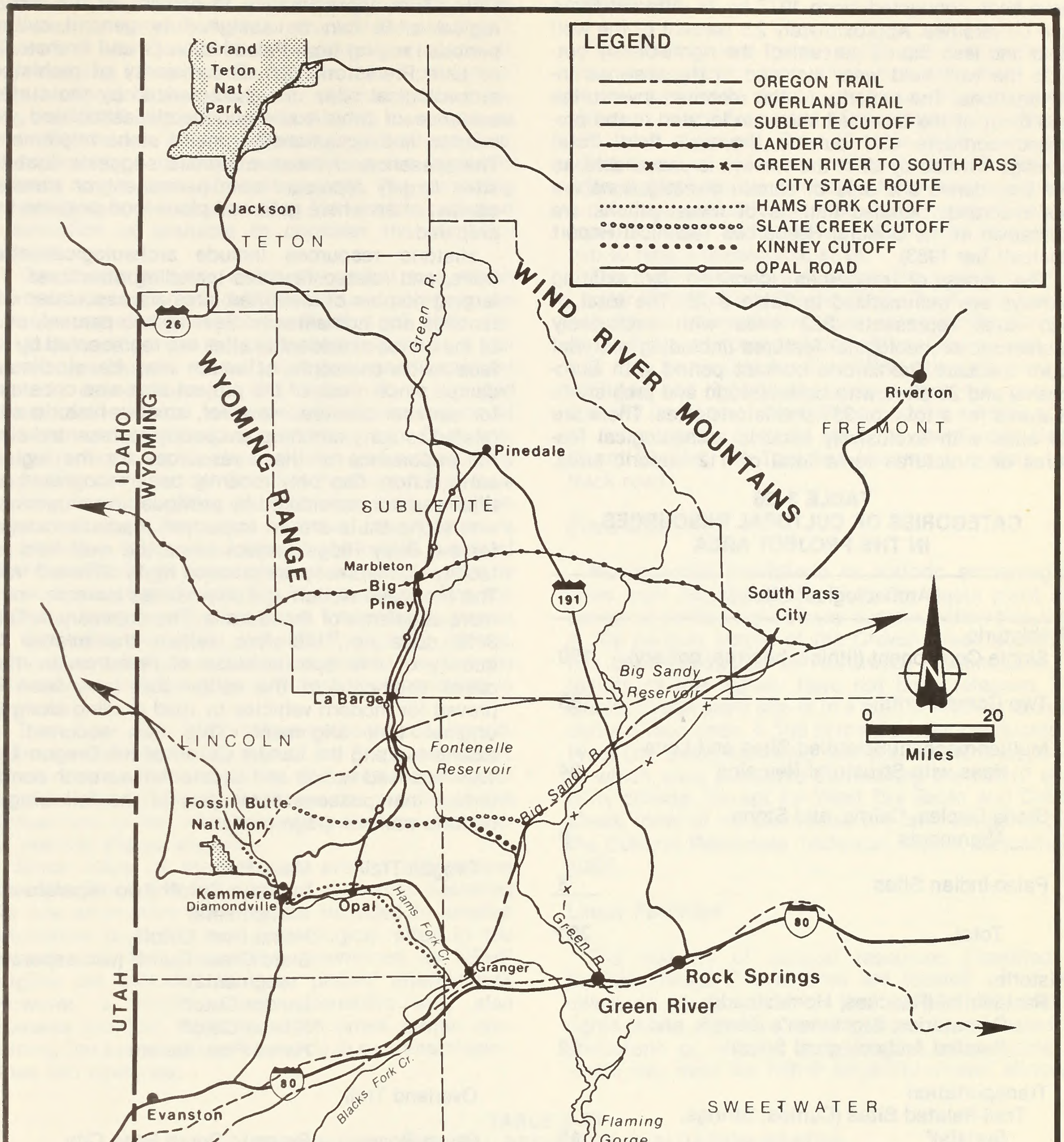
In an effort to learn more about the western territories, the U.S. Government sent John C. Fremont to survey the Green River basin in the years 1842 to 1843. The intensive trapping of the previous decades had significantly reduced the supply of furs, causing some veteran trappers like Jim Bridger to open trading posts along the Oregon Trail. The movement of emigrants over the major trails rapidly increased in the late 1840s, especially as word of the mining successes in California reached the eastern states. By 1849, several ferry crossings existed on the Green River, operated by early Mormon settlers. West of the Green River, many of the splinter trails originating in the Red Desert to the east converged onto several main routes. The Sublette Cutoff of the Oregon Trail became popular because it reduced overland travel time through the region by up to four days. The Kinney, Slate Creek, and Hams Fork Cuttoffs became additional transportation routes. Finally, in 1858, Frederick Lander led a construction party of the U.S. Army to upgrade and improve overland travel through western Wyoming. The resulting Lander Cutoff, which traversed the project well field, established a major overland mail service and shipment of freight to the West Coast.

As the region became more populated, stage roads developed between major settlements, among which were routes connecting Opal, Bryan, South Pass City, and Green River. The Riley Ridge Project would traverse each of the major trails as well as many of the minor historic transportation routes (see Map 3-6). In addition, emigrant camp sites and ferry crossings are within or adjacent to the project area.

The construction of the Union Pacific Railroad through the region in 1868 provided improved access to eastern cities and to southern markets via the Mississippi River. Cattle and sheep ranchers no longer had to drive their animals overland to the Platte River, but instead could ship them at different rail points. The open range cattle operations thus prospered in the following decades. The major settlements of the southwestern counties which occurred during this period followed the pattern of the earlier historic settlement. Small settlements along the major transportation routes, especially adjacent to the railroad, grew as more ranches in the surrounding range became settled by homesteaders. The individual ranches expanded, acquiring adjacent land for irrigated fields or stock raising. As the number and size of the ranches grew, a ranching network of commerce and communication developed. U.S. Post Offices were established at ranches along major stage routes and roads. The peak in rural settlement was reached in the 1920s, followed by the consolidation of ranches into larger operations. During the same period, the first important oil discoveries were made, producing the early petro-boomtowns of LaBarge (first called Tulsa) and Marbleton (see the Cultural Resources Technical Report, Metcalf-Zier 1983).

Project Area Resources

A total of 435 cultural resource surveys has been completed in the project area; most of the surveys were of 40-acre well pads and 50 or 100-foot rights-of way for roads, transmission lines, and pipelines. Only four surveys have considered areas of more than 1,000 contiguous acres. Most of the previous investigations



MAP 3-6 HISTORIC TRAILS

have been conducted since 1977 by 24 different firms and universities. Approximately 2.5 percent of the well field and less than 5 percent of the rights-of-way outside the well field were included in the previous investigations. The majority of the recorded inventories and most of the recorded sites are located in the proposed corridors and outside the well field. Total acreage covered by all of the surveys is unavailable, as the boundaries and area of certain investigations are not recorded. Detailed listings of investigations are contained in the Cultural Resources Technical Report (Metcalf-Zier 1983).

The types of resources identified by existing surveys are summarized in Table 3-26. The total of 435 sites represents 323 sites with exclusively prehistoric archeological features (including material from the Late Prehistoric contact period with Europeans) and 28 sites with both historic and prehistoric features for a total of 351 prehistoric sites. There are 84 sites with exclusively historic archeological features or structures for a total of 112 historic sites.

TABLE 3-26
CATEGORIES OF CULTURAL RESOURCES IN THE PROJECT AREA

Archeological Sites	
Prehistoric	
Single Component (lithics, hearths, pottery)	150
Two Components	155
Multicomponent/Stratified Sites and Locations with Structural Remains	34
Stone Circles, Cairns, and Stone Alignments	9
Paleo-Indian Sites	3
Total	351[1]
Historic	
Residential (Ranches, Homesteads, Cemetaries, Stockmen's Camps, and Related Archeological Sites)	62
Transportation	
Trail-Related Sites (Camps, Strings, Burials)[2]	15
Railroad-Associated Resources (Stations, Bridges, Tunnels, and Stockyards)	2
Industrial (Coal Mines and Prospects, Sawmills, and Wood Processing)	11
Unidentified Structures and Sites	22
Total	112[1]

[1] Includes 28 sites having prehistoric and historic components.

[2] Excludes portions of 11 trails which traverse the Riley Ridge Project area.

Only 47, or approximately 13 percent, of the archeological sites can be assigned to general cultural periods ranging from Paleo-Indian (3) and Archaic (23) to Late Prehistoric (21). The majority of prehistoric archeological sites are characterized by the surface evidence of lithic tools and debris associated with hearths and occasionally ground stone implements. The presence of these materials suggests that the sites largely represent semi-permanent or transient camps, often where gathered plant food or game was prepared.

Historic resources include archeological sites, trails, and related features including structures. The largest number of identified sites are associated with ranches and homesteads. Seventy-two percent, or 48 of the historic residential sites are represented by surface evidence, some of which may be stockmen's camps since much of the project area was once used for summer pasture. However, smaller historic sites related to early ranching are poorly represented since the importance of these resources for the region's early history has only recently been recognized and thus was not considered by previous investigations.

Historic trails are an important resource category for the Riley Ridge Project since the well field and facility rights-of-way are crossed by 11 different trails. The Proposed Action and alternatives traverse one or more segments of these trails. The summary in Table 3-26 does not, therefore, reflect the relative frequency of this special class of resource. In many cases segments of the earlier trail have been improved for modern vehicles by road grading along the original trail alignment. This has occurred, for example, along the Lander Cutoff of the Oregon Trail. The Proposed Action and all alternatives each contain terrain that possess some part of the following 11 historic trails or stage roads:

Oregon Trail - Main Trail
Sublette Cutoff (two separate segments)
Hams Fork Cutoff
Slate Creek Cutoff (two separate segments)
Lander Cutoff
Kinney Cutoff
Hams Fork Variant

Overland Trail

Stage Roads - Bryan to South Pass City
Green River to South Pass City
Opal to Pinedale

Resource Evaluation

The National Register of Historic Places (NRHP) criteria for eligibility is the basis for evaluating resources in the Riley Ridge Project area. The documentation for the previously identified resources provides sufficient data to allow an evaluation of only 62 percent of these resources or 271 sites. No sites, structures, or resources within the Riley Ridge Project area are currently listed on the NRHP. Less than 1 percent of all recorded sites (two resource locations), representing investigations of less that 5 percent of the total project area, have been determined as meeting the NRHP eligibility criteria. Among the resources identified to date for the different project alternatives, the percentage of sites not meeting the eligibility criteria ranges from 37 to 61 percent. The remaining resources are unevaluated sites for which insufficient information is available to consider the eligibility criteria.

The 11 historic trails within the project area, which compose an important cultural resource category, are largely unevaluated since verification of their terrestrial condition was not performed. In general, a trail would have historic value if: (1) it possessed important historic associations for the region, (2) it included related archeological features or structures that could provide useful historic information, and (3) it possessed integrity in its physical form and setting. Only segments of the Lander Cutoff of the Oregon Trail have undergone investigation to determine their condition (see the Cultural Resources Technical Report for more detail). As a major route through the region, much of the Cutoff's length was improved for modern vehicle travel by mechanical grading, thereby eliminating the physical integrity of the resource. Presently, segments of the trails may meet the NRHP eligiblity criteria, although a definitive evaluation of each of the 11 trails will only be feasible once sufficient documentation is available.

There have been 324 previous archeological investigations conducted in the area of the Proposed Action. These surveys have identified 235 prehistoric and/or historic sites. Table 3-27 shows the results of the evaluations of the sites regarding National Register of Historic Places eligibility.

Since many of the separate project alternatives share facilities and rights-of-way, resources specified for one alternative may also be included in another alternative (e.g., the two archeological sites in the project area that have been determined as NRHP eligible are included in three project alternatives). However, a single project alternative may also possess multiple facilities which cross terrain containing the same cultural resource (e.g., transmission lines and pipelines).

Well Field

The southeastern margin of the well field is the portion of the project area which has been most intensively surveyed during previous investigations, although only 2.5 percent of the total well field area has been surveyed. Only 30 sites have been identified, some of which may meet the NRHP eligibility criteria. Most are insufficiently documented to enable a definitive evaluation of their significance. Resource totals for each of the 10 well field units range from two to nine archeological sites.

The major historic trail within the well field is the Lander Cutoff of the Oregon Trail. The Forest Service has placed interpretative signs along visible portions of the trails adjacent to South Piney Creek Road. The trail may be eligible for the NRHP, although previous well pad and right-of-way surveys have not recorded specific portions of the trail beyond the existing road. In some areas, such as west of the Snider Basin Guard Station, the Trail has become a modern two-track road.

Plant Sites

No recorded prehistoric or historic archeological sites were located at the East Dry Basin plant site based on limited right-of-way surveys within this area. A 100 percent survey of the Craven Creek plant site has been conducted by Northwest Pipeline, but the results of this survey have not been released. The Craven Creek plant site is in a high sensitivity area for cultural resources. A 100 percent survey conducted at West Dry Basin identified four prehistoric sites, none of which were evaluated as meeting the NRHP eligibility criteria. Except for West Dry Basin and Craven Creek, most of the plant sites are uninvestigated (see the Cultural Resources Technical Report, Metcalf-Zier 1983).

Linear Facilities

The majority of cultural resources identified in the Riley Ridge Project area are located within the mile-wide study corridors that parallel the facility rights-of-way. Previous investigations have located 98 prehistoric or historic archeological sites, some of which may meet the NRHP eligibility criteria, although

TABLE 3-27
RILEY RIDGE CULTURAL RESOURCE EVALUATION STATUS
PROPOSED ACTION

	Resource Evaluation Status				
Project Alternative	Sites Determined NRHP Eligible (%)	Sites Potentially NRHP Eligible (%)	Sites Not Evaluated (%)	Total Possible NRHP Eligible Sites	Sites Not Eligible (%)
Proposed Action	2 (1%)	36 (15%)	90 (38%)	128 (54%)	107 (46%)

most of the sites remain unevaluated. Portions of 11 historic trails and stage coach roads intersect or run parallel to the Proposed Action rights-of-way, particularly in the vicinity of the Green River and Fontenelle Reservoir, 4 to 11 miles south of LaBarge. Here, the Sublette Cutoff of the Oregon Trail crosses the Green River near LaBarge Creek and intersects with the Opal Stage Road. It is also an area which includes the corridors of the sour gas pipeline, transmission line, and sales pipeline. A complete description of all areas possessing segments of historic trails within the corridors of the Proposed Action is included in the Cultural Resources Technical Report (Metcalf-Zier 1983).

RECREATION RESOURCES

The recreation study area is shown in Map 3-7. This area includes those lands that would be disturbed by project construction and operation activities and the recreation resources that would attract project-related population. The area is dominated by federal lands and opportunities for dispersed recreation activities. The Pinedale, Big Sandy, and Kemmerer Resource Areas managed by the BLM, and the Big Piney, Kemmerer, and Pinedale Ranger Districts of the FS, which together cover more than 5,813,841 acres, provide opportunities for hunting, fishing, hiking, and motorcycling. Within the well field, approximately one-half of the 159,928 acres would be considered roaded natural under the FS system for defining types of recreation opportunities. Another 27 percent would be semi-primitive and 20 percent considered rural. There are no areas that would be classed as primitive, nor are there any that would be considered urban (FS 1980). In addition, the area has a limited number of developed recreation facilities that are administered by both federal and state agencies (Table 3-28). Public access to these facilities and the vast acreages of undeveloped land is primarily by a system of graded gravel roads, unimproved roads, 4-wheel drive trails, and hiking trails. Most of the roads were originally developed to facilitate timber sales or to gain access to oil and gas development and do not receive any regular maintenance.

Visitor Use

Recreational use in the study area has fluctuated over the last five years, both in terms of total use and in the types of activities undertaken. While there are few estimates available of total recreation use, the Wyoming Recreation Commission (WRC) calculated that in 1979, outdoor recreation use in Region 7 (Lincoln, Sublette, Sweetwater, and Uinta Counties) was more than 4,302,621 participation days (Wyoming Recreation Commission 1980). Forty-six percent of this use was attributed to non-resident visitors. In a more recent study it was estimated that in 1981, resident and non-resident travelers spent over $114 million in Lincoln, Sublette, and Sweetwater Counties (Wyoming Travel Commission 1982).

Recreation use in the Kemmerer, Big Piney, and Pinedale Ranger Districts of the Bridger-Teton National Forest totaled 841,000 visitor days in 1981. This represents a 15 percent decline from the peak use that was experienced in 1979, but a 21 percent increase over visitor use in 1980.

On the basis of data collected by WGF and the Wyoming State Highway Department, it appears that the recent growth in recreation use has been due to increased use by area residents, while non-resident use has stabilized after a period of decline. As might be expected, visitor use is most intense during the summer months of June, July, and August (Wyoming Travel Commission 1982). Fall hunting accounted for 25 percent of total 1977 recreation use in the Pinedale Resource Area (BLM 1978b). Winter sports activities are limited to area resident snowmobiling and cross-country skiing. The distribution between weekend and weekday activities, while difficult to estimate, has been found to be relatively evenly distributed at area campgrounds (FS 1982d).

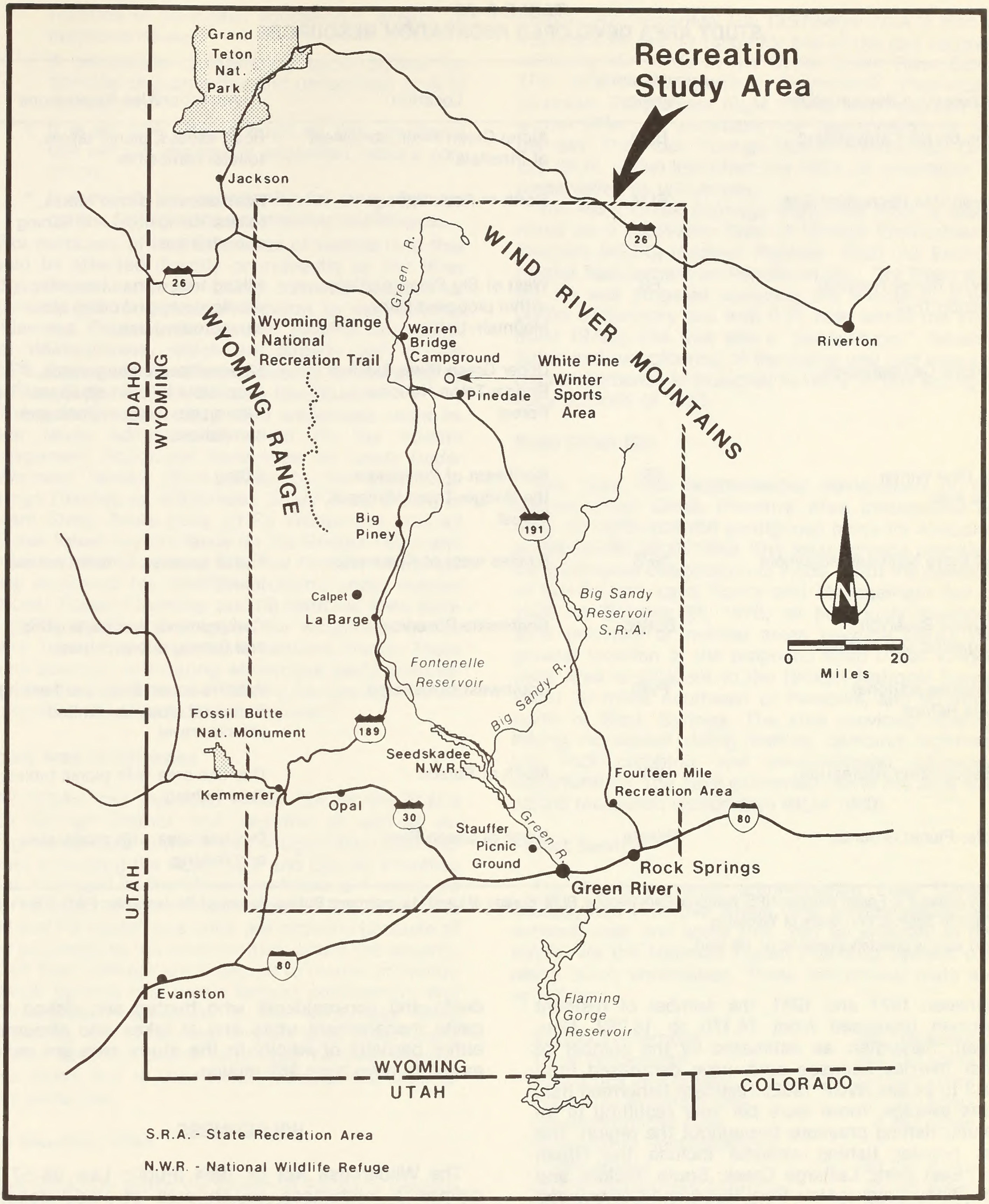
Dispersed types of recreational activities account for the majority of all use in the study area. Only 21 percent of use occurs at developed sites throughout the Bridger-Teton National Forest, while 79 percent is dispersed. About 75 percent of dispersed use is generated by local users (within 100 miles), while 75 percent of use at developed sites comes from regional (within 100 to 250 miles) and national users (FS 1982a).

Hunting and Fishing

Two of the most important recreational pursuits in the study area are the dispersed activities of hunting and fishing. The study area's vast, relatively undeveloped natural resources provide hunting opportunities for big game (elk, moose, deer, and pronghorn), upland birds (grouse), and waterfowl (geese and ducks), as well as small game animals. Streams and lakes within the upper Green River drainage have excellent water for game fish species such as rainbow, brown, and cutthroat trout, and grayling.

The taking of game animals and fish is controlled by WGF through the issuance of permits and licenses and development of harvest quotas. Depending on the supply of animals and user demand, the types of licenses offered and harvest quotas vary in different parts of the study area. In 1982, a total of 2,721 pronghorn, 767 deer, 586 elk, and 140 moose were harvested in hunting areas within the study area. Success rates varied from 90 percent for antelope to 17 percent for elk (WGF 1982). Applications for some hunting permits, such as elk, exceed supply by a considerable amount.

Hunting for grouse, geese and ducks accounted for 39,721 hunter days in Sublette, Sweetwater, and Lincoln Counties in 1981 (WGF 1982). Small game hunting, which is done primarily by local residents, had an estimated 13,247 hunter days in the three-county area in 1981 (WGF 1982).



MAP 3-7 REGIONAL RECREATION RESOURCES

TABLE 3-28
STUDY AREA DEVELOPED RECREATION RESOURCES

Recreation Resource/Site	Administering[1] Agency	Location	Attraction/Use Restrictions
Warren Bridge Campground	BLM	Along Green River, northwest of Pinedale	Road access, picnic tables, toilets, campsites.
Fourteen-Mile Recreation Site	BLM	North of Rock Springs	Road access, picnic tables, toilets, campsites, and fishing opportunities.
Wyoming Range National Recreation Trail	FS	West of Big Piney, partially within proposed Darby Mountain Unit	Hiking trail with outstanding scenic views and camp site. No motorized use.
Developed Campgrounds	FS	Upper Green River Basin in Bridger-Teton National Forest	12 developed campgrounds, accessible by road equipped with picnic tables, toilets and campsites.
White Pine Winter Sports Area	FS[2]	Northeast of Pinedale in the Bridger-Teton National Forest	Skiing.
Fossil Butte National Monument	NPS	8 miles west of Kemmerer	Fossil quarries. Limited vehicle travel.
Fontenelle Reservoir Campground and Marina	BuRec	Fontenelle Reservoir	Campground, marina, boating, and fishing opportunities.
Seedskadee National Wildlife Refuge	FWS	Southwest of LaBarge	Wildlife observation and hunting. Seasonal closures, limited vehicle travel.
Big Sandy State Recreation Area	WY	North of Farson	Day use area with picnic tables. Poor fishing.
Stauffer Picnic Grounds	Private	North of Green River	Day use area with picnic area and fishing.

[1] Agency codes: FS- Forest Service; NPS- National Park Service; BLM- Bureau of Land Management; BuRec- Bureau of Reclamation; FWS- U.S. Fish and Wildlife Service; WY- State of Wyoming.

[2] The ski area is privately operated on FS land.

Between 1977 and 1981, the number of resident fishermen increased from 14,170 to 18,282. Non-resident fishermen, as estimated by the number of tourist five-day licenses sold, have decreased from 41,913 to 24,444 (WGF 1982). Resident fishermen fish, on the average, more days per year resulting in increasing fishing pressure throughout the region. The most popular fishing streams include the Green River; East Fork; LaBarge Creek; South, Middle, and North Piney Creeks; New Fork River; and Cottonwood Creek. In 1981 it is estimated that between the Big Piney, Pinedale, and Kemmerer Ranger Districts and the Pinedale Resource Area, over 71,600 days were spent fishing for trout and other cold water species. Total expenditures within Wyoming in 1981 by residents and non-residents who hunted and fished in game management units and at lakes and streams either partially or wholly in the study area are estimated to have been $65 million.

WILDERNESS

The Wilderness Act of 1964 (Public Law 88-577) defines a wilderness as an area of undeveloped federal land, designated by Congress, that has the following characteristics:

- It is affected primarily by the forces of nature, where man is a visitor who does not remain. It may contain ecological, geological, or other features of scientific, educational, scenic, or historical value;

- It possesses outstanding opportunities for solitude or a primitive and unconfined type of recreation;
- It is an area large enough so that continued use will not change its unspoiled, natural condition;
- It provides the opportunity for (and often requires) self-reliance and meeting challenges.

For purposes of this EIS, areas of federal land that would be affected directly or indirectly by the Riley Ridge Project and are being formally studied or recommended for potential addition to the National Wilderness Preservation System (NWPS) are identified. Wildernesses, which are already part of the NWPS, that would be affected directly or indirectly by the Riley Ridge Project, are also identified.

The potential and designated wilderness units include lands administered under (1) the *Interim Management Policy and Guidelines for Lands Under Wilderness Review* (BLM 1979a) by the BLM Rock Springs District, as Wilderness Study Areas (WSA) or Instant Study Areas (ISA); (2) FS Wilderness, and all national forest system lands on the Bridger-Teton and portions of the Shoshone National Forests which are being evaluated for NWPS inclusions under current National Forest Planning; and (3) National Park Service (NPS) areas recommended for wilderness in the Grand Teton and Yellowstone National Parks. There are no potential or existing wilderness lands administered by the U.S. Fish and Wildlife Service that would be significantly affected by this project.

Impact Area of Influence

All WSAs and the Scab Creek ISA in the BLM's Rock Springs District, and potential, as well as existing, wilderness units in the Bridger-Teton National Forest (including the Popo Agie and Glacier Primitive Areas managed by the Shoshone National Forest) are also included in the impact area of influence. The BLM and FS wilderness units are included because of their proximity to the communities where the majority of well field workers are expected to reside, proximity to Rock Springs (the area's largest community), and the recognized attraction of the wilderness units themselves. The wilderness impact area of influence includes both the Grand Teton and Yellowstone National Parks due to their noted national and international attraction.

Lake Mountain WSA

This WSA lies within the Wyoming Range in western Wyoming (see Map 1-2 in the Map Pocket) and contains an irregular series of steep-sided ridges ranging in elevation from 7,400 feet to over 9,600 feet. Of four main drainages, Rock Creek in the central part of the WSA contains a pure strain population of Colorado River cutthroat trout (see Affected Environment - Wildlife and Fisheries). The 13,970-acre WSA is also an important elk winter range for one of the last naturally wintering elk herds in the Upper Green River Basin. The BLM's Management Framework Plan—Lake Mountain Supplement (BLM 1981a) recommended the entire WSA as unsuitable for preservation as wilderness. The Rock Springs District Wilderness Draft EIS (BLM 1983a) identified the WSA as unsuitable for preservation as wilderness.

The Rock Creek drainage within the WSA is designated as a 5,264-acre Area of Critical Environmental Concern (ACEC) (*Federal Register* 1982). An Environmental Assessment on Petroleum, Inc., Dry Piney Well (#1-26) was prepared analyzing the effects of a proposed exploratory gas well 0.25 mile within the WSA (BLM 1979b). The well was a "nonproducer". Rehabilitation and recontouring of the 2-acre well pad area and road disturbance is expected to occur in late spring or early summer of 1983.

Scab Creek ISA

The BLM has recommended designation of the present Scab Creek Primitive Area (designated on June 17, 1975) and 956 contiguous acres for inclusion in the NWPS (BLM 1980). The total acreage proposed for wilderness designation is 7,636. (With the passage of the Federal Land Policy and Management Act of 1976 on October 21, 1976, all previously managed BLM primitive or natural areas become ISAs.) The general location of the proposed Scab Creek Wilderness Area is adjacent to the Bridger National Forest about 20 miles southeast of Pinedale, and 90 miles north of Rock Springs. The area provides hunting, hiking, horseback riding, fishing, camping, sightseeing, rock climbing, and environmental education opportunities. The 1978 estimated use in the area was 10,000 recreation visitor days (BLM 1980).

Forest Service

The FS is currently administering three Wildernesses, two Primitive Areas, one recommended wilderness area, and areas that may be included in the NWPS via the National Forest Planning System currently being undertaken. These wilderness units are as follows:

Bridger Wilderness	392,169 acres
Teton Wilderness	557,312 acres
Fitzpatrick Wilderness	192,341 acres
Popo Agie Primitive Area	81,820 acres
Glacier Primitive Area	6,497 acres
Gros Ventre Recommended Wilderness	282,231 acres
Bridger Wilderness Additions	75,925 acres
Teton Wilderness Additions	27,751 acres

In October 1982, the U.S. Court of Appeals for the Ninth Circuit affirmed a lower court decision that the second RARE II environmental statement was inadequate. Subsequent to the courts ruling, the FS has decided to reevaluate all National Forest system lands (including those former roadless units identified under RARE II) for potential wilderness or non-wilderness recommendations as part of the land and resource management plans.

Under the Clean Air Act and its 1977 amendments, 42 U.S.C 7401-7642, the FS has an affirmative responsibility to protect air quality-related values in Class I airsheds. The FS has identified the following Air Quality Related Values (AQRV) for the wildernesses and primitive areas under its jurisdiction:

Flora (plant)
Fauna (animals)
Soil
Water
Visibility
Cultural - Archeological (i.e., structures, petroglyphs)
Geologic (i.e., fossils)
Odor.

The FS has authority to prevent damage to these values, including damage that is, or could be, caused by air pollutants. Each of these wilderness values are considered due to potential effects caused by changes in air quality. The FS is currently developing an action plan to identify and monitor sensitive receptors, if any, for each AQRV. This plan will be included in Appendix E of the FEIS.

Bridger Wilderness

The Bridger Wilderness extends about 80 miles along the Continental Divide on the west slope of the Wind River Range and is approximately 20 miles east of Pinedale, Wyoming. Elevations range from 7,500 feet above Fremont Lake to 13,804 feet at the summit of Gannett Peak, the highest in Wyoming. The Bridger Wilderness is an area which provides outstanding opportunities for wilderness experience. The extensive evidence of past glaciation, exposed geology, more than 1,300 lakes (many of which offer outstanding fishing opportunities), variety of vegetative zones, and active glaciers provide excellent opportunities for scientific study and wilderness recreation experiences. The area is also rich in historical significance having been visited by many famous fur trappers and explorers. Visitation to the Bridger Wilderness increased dramatically from the mid 1960s to the mid-1970s and is increasing once again. The average annual long-term increase in visitation has been 6 percent.

The Popo Agie Primitive Area, Gros Ventre recommended Wilderness, and Glacier Primitive Area are in the Wyoming Wilderness Act of 1983 for inclusion in the NWPS. On April 13, 1983, the U.S. Senate passed Senate Bill 543 by voice vote. The concurring legislation in the U.S. House of Representatives (H.R. 1568) is currently pending before the House Interior and Insular Affairs Subcommittee on Public Lands and National Parks. Major differences between the Senate and House versions of the Wyoming Wilderness Act of 1983 will need to be resolved in Conference Committee, if and when the bill progresses to this point.

The Southern Wyoming Range (formerly recommended as a non-wilderness unit under RARE II, #04110NW) would be overlaid by the proposed Darby Mountain well field unit.

National Park Services (NPS)

The NPS has recommended wilderness designation for portions of both Grand Teton and Yellowstone National Parks. Grand Teton National Park is recommending 122,604 acres of federal park land for wilderness, and an additional 20,850 acres of potential, non-federal land for wilderness designation (NPS 1972, Gardner 1982).

Yellowstone National Park is recommending 2,032,721 acres of federal park land for wilderness, and no additional potential, non-federal land for wilderness designation (NPS 1972, Gardner 1982).

AGRICULTURE/GRAZING

The dominant agricultural activity in the three-county area (Lincoln, Sublette, Sweetwater) affected by the Proposed Action is livestock production. The area's principal crop, hay, provides feed for cattle during the winter, while extensive acreages of federal, state, and private grazing land provide spring, summer, and fall forage. Because of the short growing season and soil types, there is no land classified as prime farm land in the study area (Lewis 1982, personal communication).

Federal rangelands have been divided into grazing allotments, each with specifications on the number of cattle or sheep that can be grazed and the grazing period. Some allotments also have detailed management plans that specify, among other things, the movements of livestock between pastures. Table 3-29 shows the federal grazing allotments found in the well field and along proposed right-of-way corridors. More than 36,000 federal animal unit months (AUMs) are contained in allotments within the well field, and allotments containing 200,000 federal AUMs are crossed by proposed corridors (FS 1982, BLM 1982). The last range survey and adjustments in allotment management of BLM land in the well field was completed in 1964. Since that time, oil and gas development has reduced the amount of available rangeland. These changes have not been analyzed by the BLM, and therefore, there is no data on whether allotments are currently at capacity or are being under- or over-utilized (Laster 1982, personal communication).

Hay production dominates area cropping patterns and is the only crop that would be affected by the proposed project. Critical to this production is irrigated land which accounted for 96 percent of the hay produced in Sublette County in 1978. The 5,747 acres of irrigated land in the well field represented 3.8 percent of the total amount of irrigated land in the county. (U.S. Bureau of the Census 1982). While this is a

TABLE 3-29
LIVESTOCK USE ON FEDERAL GRAZING ALLOTMENTS CROSSED BY PROJECT COMPONENTS

Agency/Allotment	AUMs
Well Field	
FS - Big Piney District	
Indian-Springman	606
Fish Creek	840
Snider Basin	1,562
South Piney S&G[1]	0
Mt. Darby S&G[1]	0
LaBarge Creek	2,589
LaBarge Roundup	1,200
BLM - Pinedale Resource Area	
Springman Creek	150
Budd Fish Creek	150
West Fish Creek	1,597
North LaBarge Common	14,501
LaBarge Ind.	337
Upper North LaBarge	1,985
South LaBarge Common	10,076
LaBarge Creek Ranch	42
Jory	50
Yose Ind.	150
Dry Piney	30
LaBarge Unit Ind.	140
Beaver Creek Ind.	129
South Piney Ind.	82
Beaver Meadows	5
Johnson Ridge	165
Star Coral	62
Piney Unit Fenced	19
West Unit Ind.	525
Subtotal - Well Field	36,992
Linear Facilities	
BLM - Pinedale Resource Area	
Reardon Canyon	1,121
Bondurant Ind.	10
Eubank South LaBarge	80
BLM - Big Sandy Resource Area	
Figure Four	7,630
Eighteen Mile	19,433
Lombard	6,643
Highway	5,030
Rock Springs Common	99,890
BLM - Kemmerer Resource Area	
Slate Creek	10,780
Cow Hollow	537
Robinson Creek	143
Coyote Springs	199
Cumberland - Uinta	36,570
Carter Lease	12,791
Subtotal - Linear Facilities	200,857
TOTAL - Well Field and Linear Facilities	237,849

Source: FS 1982b; BLM 1982

AUM - Animal Unit Month, the amount of forage needed to support a cow and a calf for one month.

S&G - Designation for domestic sheep and goats.

[1] These allotments have been withdrawn from domestic livestock use; forage is reserved for bighorn sheep.

relatively small percentage compared to the total, a loss of irrigated land could be important to any individual rancher because of the high productivity of the land.

TIMBER RESOURCES

Commercially valuable timber stands are limited to areas within the well field. Douglas-fir, lodgepole pine, Engelmann spruce, and subalpine fir are the most commonly found tree species. Productivity per acre varies with the type and maturity of the timber. For example, in the Big Piney Ranger District the timber volume average for lodgepole pine is 14 thousand board feet/acre, spruce fir is 18 and Douglas-fir is 20 (Paroz 1982, personal communication). The time period required for a seedling to reach maturity is about 100 years for all species forest-wide; thinning and other forms of timber management can reduce this period to around 75 years (Eggers 1982).

Timber resources are managed by the FS and BLM, and extensive inventories have been completed. Each agency uses several feasibility criteria, such as the stand's composition and age, proximity to road access, and its value as wildlife habitat, to determine when, or if, a particular stand of timber should be cut.

On the Big Piney Ranger District the annual average volume of timber harvested over the last five years has been about 5 million board feet/year, or about 17 percent of the total harvest for the Bridger-Teton National Forest (Eggers 1982). Timber value varies with home construction demands and other factors; during the period 1971-1981 a forest-wide average value was $52/thousand board feet. Current bid value is down to around $40/thousand board feet because of the slow economy and low demand for lumber (Eggers 1982). Multiplying the average annual harvest for the past five years by the estimate of $52/thousand board feet mbf for the Big Piney Ranger District gives an approximate value for timber harvested of $260,000/year.

Timber harvested in the Big Piney Ranger District has historically been trucked to Afton for milling into dimensional lumber. However, this mill and many other lumber mills are currently closed and probably will not reopen until the economy improves.

The BLM Pinedale Resource Area has much smaller timber acreage and its annual harvest is correspondingly smaller. Over the last five years, total annual harvest has averaged 500 to 600 thousand board feet, with individual sales averaging about 250 thousand board feet (Lanning 1982). Timber usually goes to several small mills in Pinedale where it is milled into rough cut lumber and house logs. An additional 80 to 100 thousand board feet is harvested annually by local residents for fuelwood (Lanning 1983).

Future timber harvest plans on FS land in the well field are contained in a Five-Year Timber Harvest Plan (FS 1982c). The 1982 map shows that within the well field there are three sales totaling 3.0 million board feet in 1984, one sale of 1.5 million board feet in 1986, and one sale of 2.0 million board feet in 1987. In order to achieve this projected harvest, an improvement in national housing construction and timber demand is necessary.

The Pinedale Resource Area has postponed future timber harvest plans until after the Riley Ridge EIS is complete, because stands which were previously inaccessible may have roads constructed nearby. Road access has been particularly critical in harvest planning because timber sales are normally so small that major road building costs cannot be recovered (Lanning 1982).

TRANSPORTATION NETWORKS

Roadway System Infrastructure

The existing system of roadways in southwestern Wyoming is oriented toward through traffic movement and access between the few existing population centers. Considering the geographic orientation of the Riley Ridge Project components, expected employee home origins, and product transportation corridors, an analysis area for the roadway system evaluation was defined that was bounded by U.S. 191 between Pinedale and Rock Springs on the east, Interstate 80 from Rock Springs to Evanston on the south, U.S. 189 and the Bridger-Teton National Forest on the west, and U.S. 191 between Daniel and Pinedale on the north. The roadway network analyzed is shown on Map 3-8 and encompasses portions of a four-county region including Sublette, Lincoln, Uinta, and Sweetwater Counties.

The major highway serving the region is Interstate 80, a limited access highway running east-west across the southern part of the state and interchanging with the primary north-south highways in the study area. Interstate 80 is classified as a principal arterial by the Wyoming State Highway Department (WSHD). North-south travel within the eastern portion of the study area is accommodated by U.S. 191, a two-lane minor arterial. In the western portion of the study area, north-south traffic movement is provided by U.S. 189, a two-lane minor arterial extending from Evanston in the south, through Kemmerer, to Daniel in the north. U.S. 189 is the primary regional roadway servicing the Riley Ridge well field.

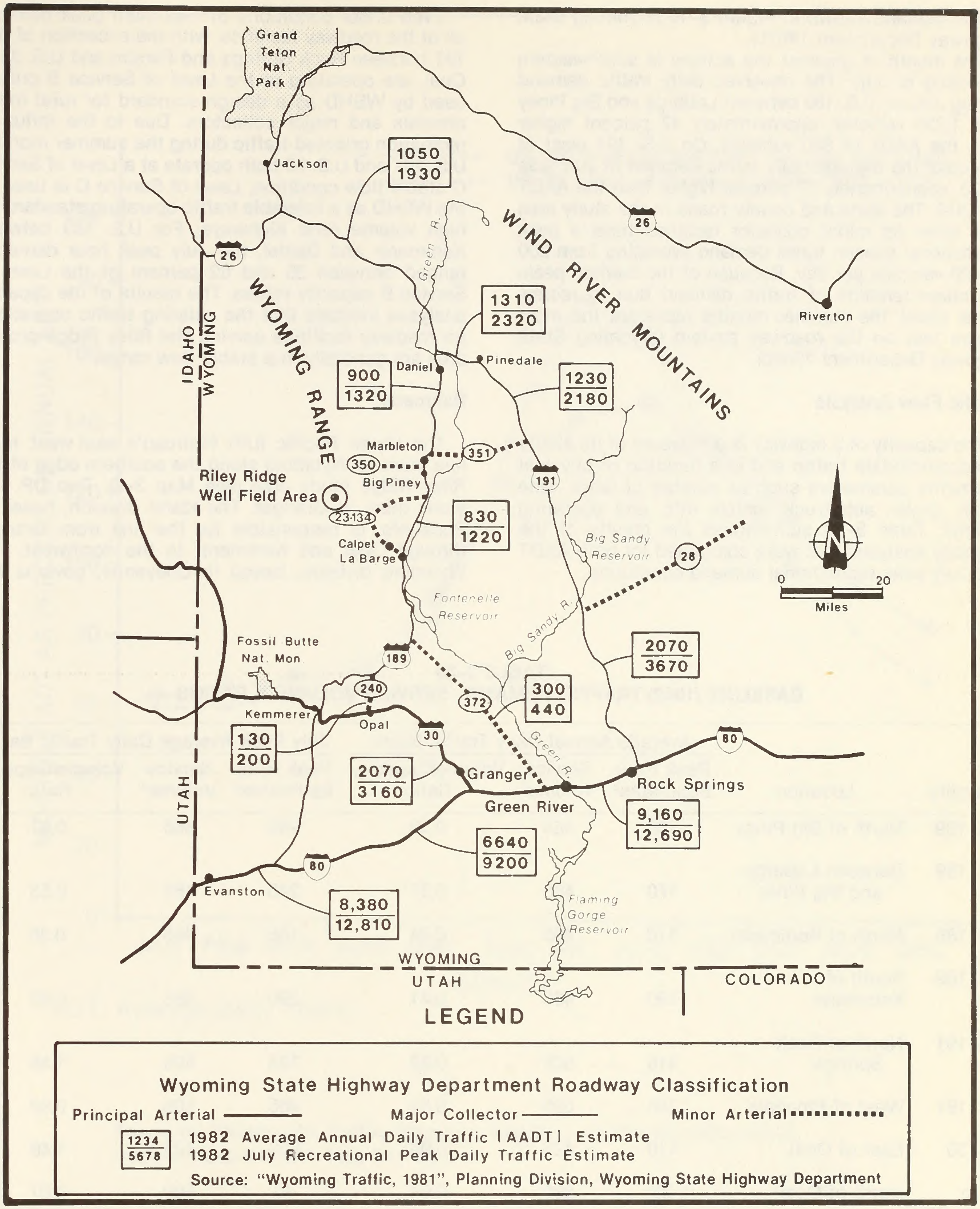
U.S. 30, a two-lane principal arterial, connects Interstate 80 just west of Green River with U.S. 189 in Kemmerer. Several two-lane state highways serve as major collector type facilities within the study area. Principal among these are State Route 350 which provides partial access between Big Piney and the Bridger-Teton National Forest, State Route 351 connecting U.S. 191 with U.S. 189 at Marbleton, State Route 372 connecting Interstate 80 at Green River with U.S. 189, and State Route 240 (the Opal Cutoff) connecting U.S. 30 at Opal with U.S. 189.

Existing roadways providing access between U.S. 189 and the area to the east of the well field consist of a number of county roads varying in width between 16 and 20 feet. County Road 23-134 (Calpet Road), a two-lane major collector, connects U.S. 189 just south of Big Piney with LaBarge. The remaining county roads intersecting U.S. 189 between Marbleton and LaBarge are classified as minor collectors by the WSHD.

The existing system of roadways within the well field consists of local access facilities ranging in width from 10 to 14 feet with packed dirt surfaces. Access roadways within the Bridger-Teton National Forest have been developed based on the needs of gas and oil production, timber industry activity permitted by the Forest Service, recreation vehicles, and livestock grazing. Vehicle accessibility is restricted in the upper elevations within the well field for a period generally extending from November to May due to snow. Snow removal is complicated due to exposure to wind, restricted lateral clearances on many roadway sections, and the need to control the interface of vehicle activity with wildlife grazing habitat and winter feeding areas.

Base-Year Traffic Operations

The 1982 average annual daily traffic (AADT) and peak recreational period travel demand for the area roadways are shown in Map 3-8. For U.S. 191 and U.S. 189, which serve as the primary north-south roadways connecting Interstate 80 with the recreational facilities within the region, peak summer season traffic demand is substantially higher than the AADT. The cumulative impact of recreational travel on these facilities is illustrated by the monthly variations in



Source: "Wyoming Traffic, 1981", Planning Division, Wyoming State Highway Department

MAP 3-8 REGIONAL HIGHWAY SYSTEM

traffic demand shown in Figure 3-10 (Wyoming State Highway Department 1982b).

The month of greatest trip activity in southwestern Wyoming is July. The observed daily traffic demand during July on U.S. 189 between LaBarge and Big Piney was 1,220 vehicles, approximately 47 percent higher than the AADT of 830 vehicles. On U.S. 191 west of Pinedale, the average daily traffic demand in July was 2,320, approximately 77 percent higher than the AADT of 1,310. The state and county roads in the study area that serve as minor collector facilities have a peak recreational season travel demand averaging from 200 to 400 vehicles per day. Because of the marked peaking characteristics of traffic demand due to recreational travel, the summer months represent the most severe test on the roadway system (Wyoming State Highway Department 1982b).

Traffic Flow Analysis

The capacity of a highway is a measure of its ability to accommodate traffic and is a function of physical geometric parameters such as number of lanes, lane width, grade, auto-truck vehicle mix, and operating speeds. Table 3-30 summarizes the results of the capacity analyses that were completed for both AADT and July peak recreational demand conditions.

Even under conditions of maximum peak demand, all of the roadway facilities, with the exception of U.S. 191 between Rock Springs and Farson and U.S. 30 at Opal, are operating at the Level of Service B criteria used by WSHD as a design standard for rural minor arterials and major collectors. Due to the influx of recreation oriented traffic during the summer months, U.S. 191 and U.S. 30 both operate at a Level of Service C stable flow condition. Level of Service C is used by the WSHD as a tolerable traffic operating standard for high volume rural highways. For U.S. 189 between Kemmerer and Daniel, the July peak hour demands ranged between 35 and 62 percent of the Level of Service B capacity values. The results of the capacity analyses indicate that the existing traffic operations on roadway facilities serving the Riley Ridge project area are generally in a stable flow range.

Railroads

The Union Pacific (UP) Railroad's east-west main line crosses Wyoming along the southern edge of the Riley Ridge study area (see Map 3-9). Two UP divisions meet at Granger. The Idaho division, based in Pocatello, is responsible for the line from Granger through Opal and Kemmerer to the northwest. The Wyoming division, based in Cheyenne, governs the

TABLE 3-30
BASELINE (1982) TRAFFIC DEMAND - SERVICE VOLUME B RATIOS

		Average Annual Daily Traffic Basis			July Peak Average Daily Traffic Basis[1]		
Facility	Location	Peak Hour Estimates[2]	Service Volume[3]	Volume/Capacity Ratio	Peak Hour Estimates[2]	Service Volume[3]	Volume/Capacity Ratio
U.S. 189	North of Big Piney	180	465	0.39	265	465	0.57
U.S. 189	Between LaBarge and Big Piney	170	465	0.37	245	465	0.53
U.S. 189	North of Kemmerer	110	465	0.24	165	465	0.35
U.S. 189	South of Kemmerer	190	465	0.41	290	465	0.62
U.S. 191	North of Rock Springs	415	505	0.82	735	505	1.46
U.S. 191	West of Pinedale	265	505	0.52	465	505	0.92
U.S. 30	East of Opal	410	425	0.96	630	425	1.48
State Route 240	North of Opal	25	590	0.04	40	590	0.07

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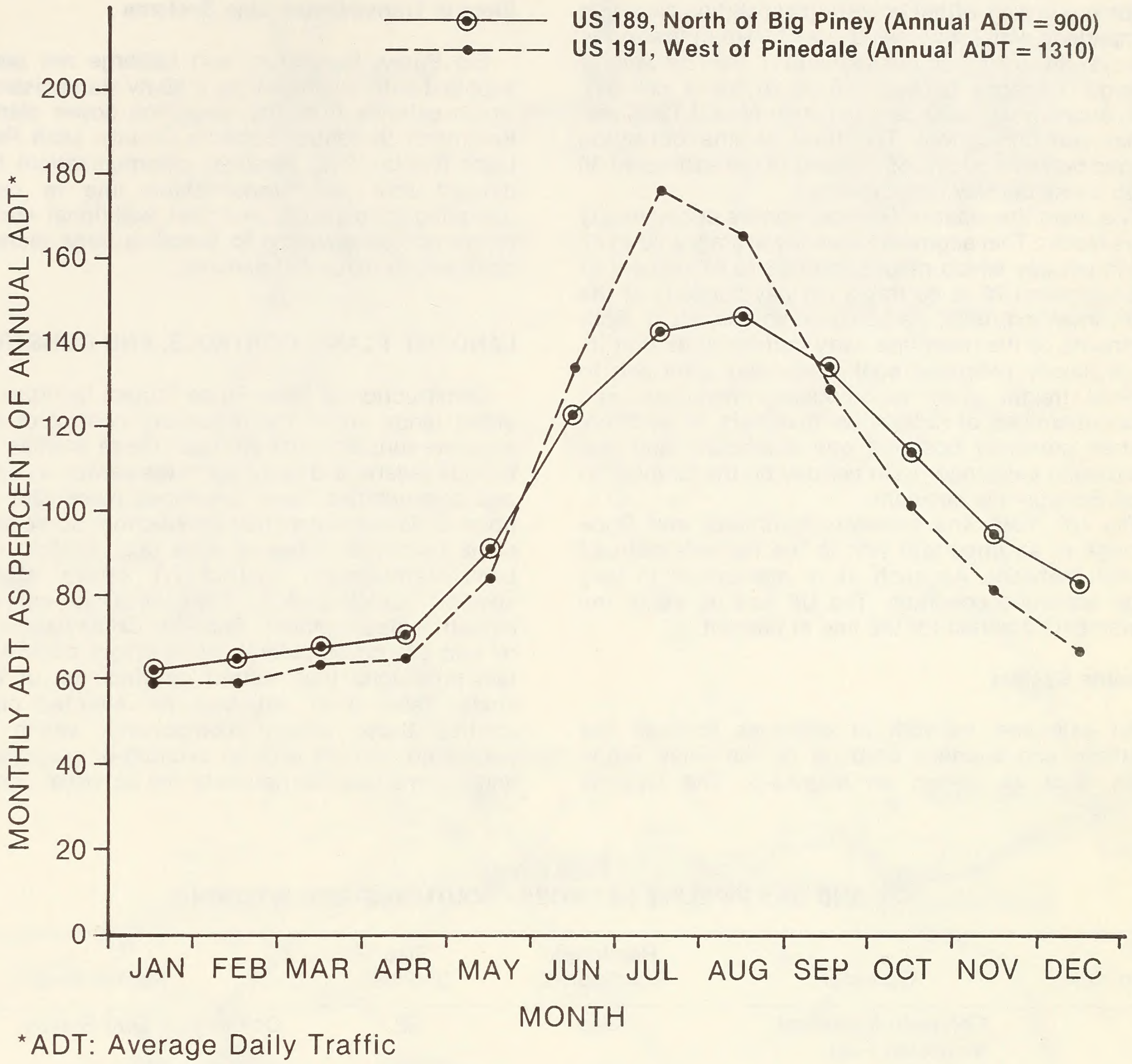
[1] July peak recreational season traffic represents maximum demand observed on area roadways.

[2] Peak hour estimates computed from traffic counts tabulated in "Wyoming Traffic - 1981", Planning Division of the Wyoming State Highway Department and data compiled in "Automatic Traffic Recorder Report - 1981", Wyoming State Highway Department.

[3] Service volumes are for Level of Service B which is used by Wyoming State Highway Department as a design standard for rural highway facilities. Service volumes shown for highway sections analyzed were provided by the Planning Division, Wyoming State Highway Department.



Based on "Automatic Traffic Recorder Report — 1981"; Wyoming State Highway Department, May 31, 1982.

FIGURE 3-10 MONTHLY VARIATIONS IN TRAFFIC DEMAND

line east through Green River and Rock Springs and the line southwest from Granger through Evanston. The rail traffic generated by the Riley Ridge Project is expected to use both the Idaho and Wyoming division lines.

Current traffic on the UP rail lines in southwestern Wyoming is well within operating capacities based on comparison with historical levels of train utilization of the system. Traffic on the segment of the line west of Granger averages between 16 to 20 trains per day, with approximately 80 cars per train (Wood 1982, personal communication). The level of line utilization ranges between 50 and 65 percent of the estimated 30 to 35 trains per day line capacity.

The main line east of Granger carries substantially more traffic. This segment presently averages 30 to 47 trains per day which ranges from 38 to 67 percent of the estimated 70 to 80 trains per day capacity of the line (Anderson 1982, personal communication). Both segments of the main line carry commodities that include locally produced coal, coke, and soda ash to general freight, mail, automobiles, chemicals, and small quantities of radioactive materials. In addition, Amtrak presently operates one eastbound and one westbound passenger train per day on the Granger to Rock Springs line segment.

The UP main line between Kemmerer and Rock Springs is an important link in the nation's railroad system network. As such, it is maintained in very good operating condition. The UP has no major improvements planned for the line at present.

Pipeline System

An extensive network of pipelines crosses the southern and western portions of the Riley Ridge study area as shown on Map 3-9. The pipeline network has been developed primarily to transport the extensive oil and gas resources of southwest Wyoming to markets in the west, midwest, and south. The key characteristics of the major lines in the network are presented in Table 3-31.

Electric Transmission Line Systems

Big Piney, Marbleton, and LaBarge are presently supplied with electricity by a 69-Kv transmission line which extends from the Naughton power plant near Kemmerer to central Sublette County. Utah Power & Light (Wells 1982, personal communication) has indicated that this transmission line is currently operating at capacity and that additional electricity would not be available to supply a large increase in domestic or industrial demand.

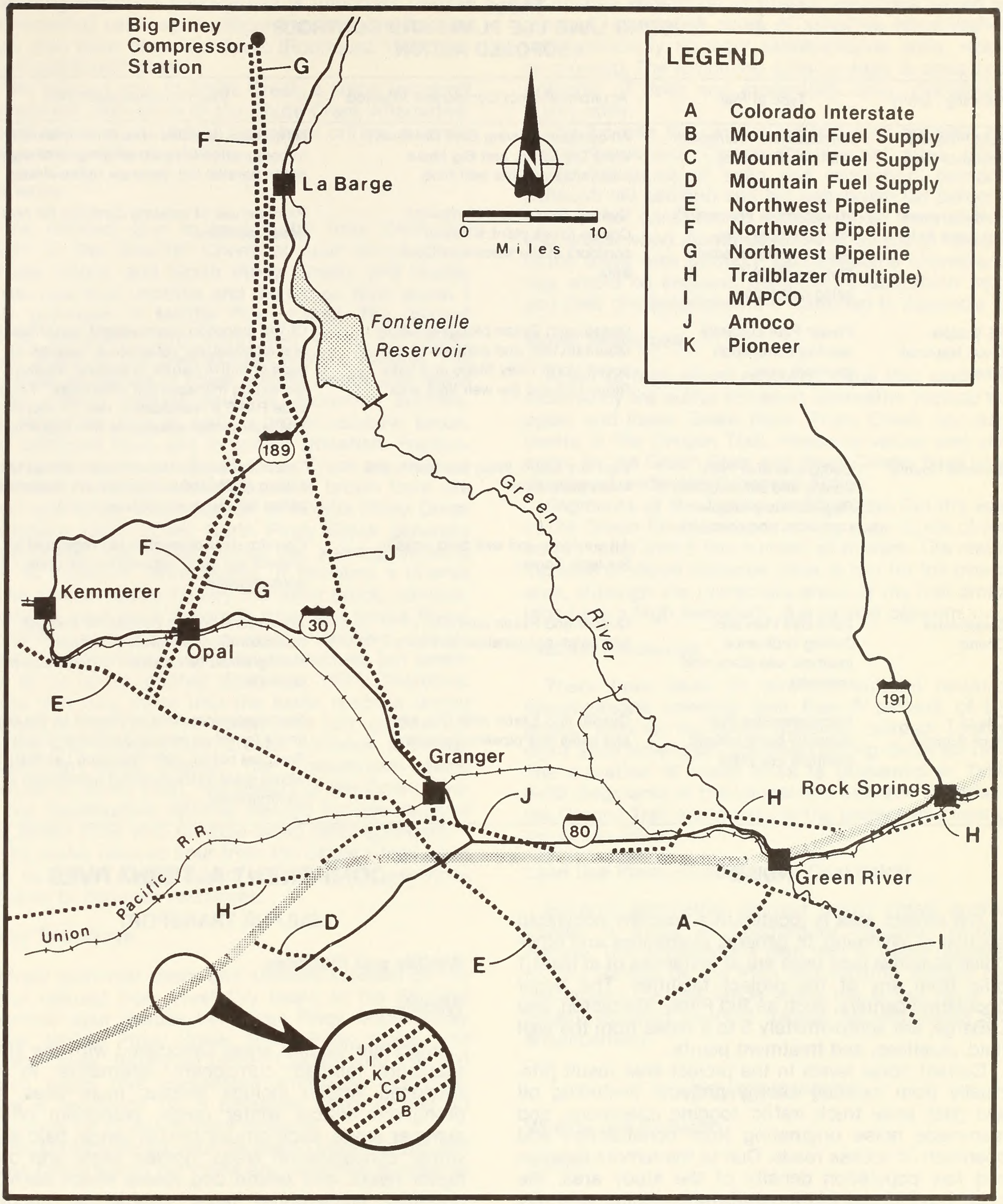
LAND USE PLANS, CONTROLS, AND CONSTRAINTS

Construction of Riley Ridge Project facilities would affect lands under the regulatory control of several separate jurisdictional entities. These entities, which include federal and state agencies as well as counties and communities, have developed plans and regulations for lands under their jurisdiction. Some of these plans permit all types of uses (e.g., Lincoln County Land Development District IV), others encourage specific activities (e.g., Town of Opal encourages industrial development, Sublette County encourages oil and gas development), while others currently contain provisions that restrict development of various kinds. Table 3-32 indicates for affected planning entities those project components which would potentially conflict with an existing or proposed plan and summarizes the nature of the potential conflict.

TABLE 3-31
OIL AND GAS PIPELINE NETWORK · SOUTHWESTERN WYOMING

Map Key	Operator	Resources Transported	Size (Inches)	Market Area
A	Colorado Interstate	Gas	22	Colorado & Gulf States
B	Mountain Fuel Supply	Gas	20	Utah & West Coast
C	Mountain Fuel Supply	Gas	18	Utah & West Coast
D	Mountain Fuel Supply	Gas	18	Utah & West Coast
E	Northwest Pipeline	Gas	22	West Coast/Gulf States
F	Northwest Pipeline	Gas	30	West Coast/Gulf States
G	Northwest Pipeline	Gas	16	West Coast/Gulf States
H	Trailblazer (multiple)	Gas	36	Midwest
I	MAPCON	GL	10	Midwest & Gulf States
J	Amoco	Oil	8	Utah, West Coast & Midwest
K	Pioneer	Products	8	Utah & Colorado

Source: Geological Survey of Wyoming. 1980. Energy resources map of Wyoming. Prepared in cooperation with the Wyoming Department of Economic Planning and Development, Minerals Division. (Scale 1:500,000).



MAP 3-9 EXISTING PIPELINES AND RAILROADS

TABLE 3-32
EXISTING LAND USE PLANS AND CONTROLS
PROPOSED ACTION

Planning Entity	Type of Plan	Applicant/Project Component Affected	Plan Directive/Restriction
BLM Pinedale Resource Area	Management Framework Plan (multiple use)	All corridors serving East Dry Basin, West Dry Basin, and Big Mesa plant sites and the well field	New linear facilities should be developed in conjunction with existing rights-of-way, not in parallel but separate rights-of-way.
BLM Kemmerer Resource Area	Management Framework Plan (multiple use), Resource Management Plan currently being developed	Quasar, Exxon, and Northwest Craven Creek plant sites; all corridors in the Kemmerer-Opal area.	Promote use of existing corridors for new linear facilities.
FS Bridger-Teton National Forest	Forest Plan currently nearing completion (multiple use)	Quasar and Exxon proposed Darby Mountain Unit and portions of proposed North Riley Ridge and Lake Ridge Units of the well field area	Of the proposed management classifications, one emphasizes "retaining a roadless or semi-primitive nature to support roadless recreation management objectives." Forest-wide RARE II reevaluation may or may not add substantial acreage to this classification.
Sublette County	Comprehensive Plan; Zoning and Development Regulations (multiple use plans and controls)	East Dry Basin, West Dry Basin, and Mesa plant sites	Treatment plants require heavy industrial zoning (proposed plant sites are presently zoned RC Resource Conservation).
		All corridors and well field units in Sublette County	Corridor development is not regulated at present but such regulations are under consideration.
Sweetwater County	Land Use Plan and Zoning Ordinance (multiple use plans and controls)	Quasar and Exxon joint CO_2 and sales gas pipeline corridors	Agricultural zoning permits oil and gas transportation facilities; industrial zoning would be required for large pumping stations.
City of Rock Springs	Comprehensive Plan currently being revised (multiple use plan)	Quasar and Exxon joint CO_2 and and sales gas pipeline corridors	Plan designates area northwest of the city limits for future residential development. Proposal before 1983 Wyoming Legislature would grant extraterritorial jurisdiction to communities.

NOISE

The project area is located in a sparsely populated section of Wyoming. In general, residences and other noise-sensitive land uses are at distances of at least 1 mile from any of the project facilities. The larger population centers, such as Big Piney, Marbleton, and LaBarge, are approximately 3 to 5 miles from the well field, pipelines, and treatment plants.

Current noise levels in the project area result principally from existing energy projects (including oil and gas), local truck traffic, logging operations, and man-made noise originating from construction and operation of access roads. Due to the remote location and low population density of the study area, the noise level throughout most of the project area is very near the ambient level found in nature where there is an absence man or machines. Natural noise sources consist of wind, rain, thunder, insects, birds, and other wildlife. Noise levels vary considerably in such remote areas but typically do not exceed 45 dbA (EPA 1971a).

COMPONENT ALTERNATIVES

SULFUR TRANSPORT

Wildlife and Fisheries

Wildlife

Important wildlife areas associated with the sulfur transport railroad component alternative to the Proposed Action include moose, mule deer, and pronghorn critical winter range, pronghorn critical summer range, sage grouse critical range, bald eagle winter concentration areas, golden eagle and other raptor nests, and prairie dog towns which serve as potential black-footed ferret habitat. In addition, this railroad would pass through approximately 4 miles of the Seedskadee National Wildlife Refuge. The Seedskadee is a 14,376-acre refuge established for mitigation of wetland habitat removed during development of Fontenelle and Flaming Gorge Reservoirs. Seedskadee supports many breeding and migrating waterbird species and is important habitat for wintering bald eagles. Migrating peregrine falcons have also been observed there. (Rodriquez 1982, personal communication).

The railroad spur to Shute Creek, a sulfur transport component alternative to the Shute Creek Alternative, would occur in an area of pronghorn critical summer range and prairie dog towns.

Fisheries

The railroad spur to haul sulfur from West Dry Basin to the Stauffer Chemical spur would cross Middle, South, and North Piney Creeks and Muddy Creek near their mouths and the Green River about 1 mile upstream of Middle Piney Creek. The railroad would eventually turn south and cross the Green River again in the Seedskadee Wildlife Refuge. The fisheries resources of lower Middle, South, and North Piney Creeks include sculpins, mountain suckers, and longnose dace as well as brown, rainbow, brook, and cutthroat trout and mountain whitefish. Predominant game species in South Piney Creek are rainbow trout and mountain whitefish, while brown trout are dominant in the lower portion of Middle Piney Creek (Remmick 1981). Lower North Piney Creek generally experiences low flows during the summer months due to irrigation. Nonetheless, it contains a diverse game and non-game fishery including brook, rainbow, cutthroat trout (both Colorado River and Snake River), whitefish, sculpins, and mountain suckers. Muddy Creek is intermittent in its lower reaches, but perennial in its upper reaches (Remmick 1981). Therefore, some fish may move into the lower reaches during periods of high flow. The Green River just upstream of Middle and South Piney Creeks contains a similar fishery to those creeks. The predominant game species is brown trout. The fishery of the Green River in the Seedskadee Wildlife Refuge include rainbow and brown trout with rainbow being most abundant.

The sulfur railroad spur from the Shute Creek plant site to Craven Creek would not affect any perennial streams or fisheries resources.

Water Resources

Major perennial rivers and streams crossed by the sulfur railroad from West Dry Basin to the Stauffer Chemical spur include the Green River, South Piney Creek, Middle Piney Creek, North Piney Creek, and Muddy Creek. Based on USGS 1:24,000 and 1:67,500 series maps, this component alternative would involve 6 crossings on 5 perennial streams and 13 crossings on 12 intermittent streams.

The sulfur railroad spur between Craven Creek and Shute Creek would not cross any perennial drainages.

Soils and Vegetation

The 92-mile long sulfur railroad corridor from Exxon's West Dry Basin site and the Stauffer Chemical spur near Rock Springs would cross 1,109 acres of soils and vegetation. Eighty percent of the route crosses big sagebrush communities. About 22 acres of riparian vegetation at stream crossings would be crossed. About 235 acres of sensitive rehabilitation units, primarily strongly saline/alkaline soils, would be crossed. The remaining soils acreage is comprised primarily of deep and moderately deep, calcareous, loamy soils.

The 8.5-mile long sulfur railroad spur between the Shute Creek and Craven Creek plant sites would cross 103 acres of soils and vegetation, primarily saltbush (40 percent) and big sagebrush (38 percent), other minor constituents include mixed desert shrub and greasewood. About 69 acres of sensitive rehabilitation units with strongly saline/alkaline characteristics would be crossed. Sensitive rehabilitation units and their characteristics are identified in Appendix C.

Visual Resources

Areas of high visual resource value that would be crossed by the sulfur transport alternative include the upper and lower Green River, Piney Creek, and segments of the Oregon Trail. Resource values and concerns for the Green River and Piney Creeks have been discussed under the Proposed Action.

Segments of the Lander and Sublette Cutoffs east of the Green River are open rolling sage lands of low scenic value with a low number of viewers. The resulting level of visual resource value is low for the overall area, although the immediate areas of the trail crossings have a high sensitivity due to user concern.

Cultural Resources

There have been 30 previous cultural resource investigations covering less than 5 percent of the project area for the sulfur transport railroad. Twenty-eight sites have been identified during these surveys. The elevation of these sites is presented in Table 3-33. Segments of the Lander and Sublette Cutoffs to the Oregon Trail are located in the project area east of the Green River.

Land Use Plans, Controls, and Constraints

Exxon's alternative railroad would cross approximately 4 miles of Seedskadee National Wildlife Refuge. The development plan that is being prepared for the Refuge by the Fish and Wildlife Service has designated the low lands along the Green River for gravity irrigated wetland habitat reconstruction and enhancement.

POWER SUPPLY

Wildlife and Fisheries

Wildlife

Important wildlife areas within the affected environment of the UP&L and BLM power supply component alternatives are similar to those of Proposed Action and alternative transmission lines. Both component alternatives would also occur within areas of elk, moose, mule deer, and pronghorn critical winter range, pronghorn critical summer range, sage grouse

TABLE 3-33
RILEY RIDGE CULTURAL RESOURCE EVALUATION STATUS COMPONENT ALTERNATIVES

	Resource Evaluation Status									
Project Alternative	Sites Determined NRHP Eligible	(%)	Sites Potentially NRHP Eligible	(%)	Sites Not Evaluated	(%)	Total Possible NRHP Eligible	Sites	Sites Not Eligible	(%)
Component Alternatives	1	(1%)	24	(15%)	39	(24%)	64	(39%)	98	(46%)
Sulfur Transport	0	(0%)	4	(14%)	11	(40%)	15	(54%)	13	(46%)
Power Supply (UP&L)[1]	1	(1%)	20	(15%)	24	(9%)	45	(35%)	85	(65%)
Employee Housing	0	(0%)	0	(0%)	4	(100%)	4	(100%)	0	(0%)

Source: WRC 1983

[1] No information is currently available for the BLM power supply component alternative.

strutting grounds and critical range, prairie dog towns, and raptor nests.

Fisheries

The UP&L alternative transmission line power system would cross the following perennial streams supporting fisheries; the Upper Hams Fork, Hams Fork near Opal, Willow Creek, Slate Creek, Fontenelle Creek, Muddy Creek, LaBarge Creek, and the Upper Green River near Big Piney. Depending on the siting alternative, the transmission line would affect different streams.

Fisheries in these streams are primarily comprised of rainbow, brown, brook, and some cutthroat trout. The Green River contains the most valuable fisheries.

The BLM alternative transmission line power system would cross the same streams as the UP&L alternative with the exception of avoiding both crossings of the Hams Fork and Willow Creek.

Water Resources

The UP&L system would cross seven or eight different streams depending on the siting alternative. These streams, the Upper Hams Fork, Willow Creek, Fontenelle Creek, and the Green River near Big Piney, are considered Class II waters by Wyoming Game and Fish. Water quality is generally good.

The BLM power supply system would cross six or seven different streams depending on the siting alternative. The Hams Fork below Kemmerer, Fontenelle Creek, LaBarge Creek, and the Green River near Big Piney would be affected. Water quality is generally good.

Soils and Vegetation

The UP&L power transmission line system would cross 1,152 acres of vegetation if substituted for the proposed power supply system to the Proposed Action. It would cross 1,182 acres if substituted for the Buckhorn Alternative system, 1,261 acres if substituted for the Shute Creek Alternative system, and 970 acres of vegetation if substituted for the Northern Alternative system. Sagebrush communities (both big sagebrush and sagebrush complex) would be the majority of vegetation types crossed (over 85 percent of each alternative). Between 13 and 15 acres of riparian vegetation would also be traversed at perennial stream crossings for all alternatives. About 680 acres of sensitive rehabilitation units would be crossed by substitution to the Proposed Action. Similarly, 680 acres of sensitive rehabilitation units would be affected by UP&L substitution to the Buckhorn Alternative. About 640 and 753 acres of sensitive areas would be crossed for the Shute Creek and Northern Alternatives, respectively. The sensitive rehabilitation units affected are dominantly steep, shaly areas (60 to 70 percent for each alternative) with the remainder comprised of strongly saline/alkaline soils. Sensitive rehabilitation units and their characteristics are identified in Appendix C.

The power transmission line system, proposed as an alternative by the BLM, would cross 1,206 acres of vegetation if substituted for the proposed power supply system to the Proposed Action. It would cross 1,236 acres of vegetation if substituted to the Buckhorn Alternative, 1,248 acres if substituted to the Shute Creek Alternative, and 994 acres if substituted for the proposed system to the Northern Alternative. Between 10 and 15 acres of riparian vegetation would be crossed at perennial stream crossings for all alternatives. Of remaining vegetation communities, 75 to 85 percent of each alternative would cross the sagebrush type. About 701 acres of sensitive rehabilitation units would be crossed under the proposed BLM substitution for the Proposed Action. About 703 acres of sensitive rehabilitation units would be crossed for the

Buckhorn Alternative under the proposed BLM transmission line system. About 733 acres and 549 acres of sensitive areas would be crossed for the Shute Creek and Northern Alternatives, respectively. Generally, 40 to 45 percent of the sensitive acreage is comprised of strongly saline/alkaline soils, while the remainder is comprised of steep, shaly areas.

Visual Resources

The UP&L transmission line would cross a wide variety of landscape types and viewing conditions. Sensitive areas include crossings of the upper (north of Kemmerer) and lower (south of Kemmerer) Hams Fork River, a mile of ridge top bluff along Highway 30 near Opal, crossings of Fontenelle and LaBarge Creeks, the Green River, Reardon Draw, and a long ridge top escarpment extending to the east from Big Mesa in view of Highway 189.

The BLM transmission line would maximize use of existing utility corridors, including UP&L's 69-kilovolt kv line between Round Mountain and the Reardon Draw area. This route parallels Highway 189 and is visible from the highway for much of its distance. Along this route, it would cross visually sensitive artifact areas on the Oregon Trail in the Holden Hill-Names Hill area. Other sensitive areas along this route would be common to the UP&L transmission alternative and are discussed above.

Cultural Resources

There have been 84 previous cultural resource investigations covering less than 5 percent of the project area for the power supply alternatives. During these surveys, 130 sites were identified for the UP&L system of which 1 site has been determined to be eligible to the NRHP, and 20 sites have been determined to be potentially eligible (see Table 3-33). The documentation is incomplete for 24 of the sites. No information is available for the BLM system; however, this system would be surveyed according to the specifications of the BLM and the Wyoming SHPO if selected for utilization.

EMPLOYEE HOUSING

Wildlife and Fisheries

Wildlife

The East Dry Basin construction camp would be located on 320 acres of sagebrush habitat and contains pronghorn critical winter range and sage grouse critical range. The West Dry Basin camp does not occur within any important wildlife areas. The Big Mesa camp would be located on about 80 acres of mule deer critical winter range in sagebrush habitat. The Buckhorn camp would also be a sagebrush habitat and would not occur within any important wildlife areas. The Shute Creek construction camp would occur in mixed desert shrub habitat on 320 acres of pronghorn critical summer range.

Fisheries

Construction camp component alternatives would not influence perennial streams or fisheries resources. The proposed camp at West Dry Basin could influence a small intermittent tributary to South Piney Creek which contains no fisheries.

Water Resources

The construction camps would not influence any perennial streams. Groundwater wells would supply water (probably from the Wasatch Formation) for domestic use to the camp sites. Specific well locations, numbers, or design are currently not available.

Soils and Vegetation

The construction camp sites would each cover 320 acres of soils and vegetation. East Dry Basin, West Dry Basin, and Buckhorn proposed camps are dominated (75 to 100 percent) by big sagebrush communities. The mixed desert shrub community dominates the proposed Shute Creek camp site, whereas the big sagebrush community and the sagebrush complex occupy all of the Big Mesa site. These vegetation types are similar to those described under the Proposed Action.

The construction camp sites would disturb a total of 90 acres of sensitive rehabilitation units, all comprised of strongly saline/alkaline soils. Thirty acres of this sensitive rehabilitation unit occur at West Dry Basin, and 60 acres occur at the proposed Shute Creek camp.

Visual Resources

The employee housing sites are all in low scenic quality landscapes. Additionally, the Exxon site near the Hogsback is in an area already heavily influenced by oil and gas development. Visibility varies significantly among these sites. The Buckhorn site is not visible from any major viewpoints. The other three are readily visible from the Calpet Road, which carries primarily oil and gas-related traffic. The Exxon site north of Dry Basin is the only site which is seen from viewpoints considered highly sensitive. These are the Piney Creek Road and a number of ranches below the site in the Piney Creek valley.

Cultural Resources

A small percentage (less than 5 percent) of the employee housing alternatives have been surveyed during five previous cultural resource investigations. No sites have been identified for the East Dry Basin, West Dry Basin, Big Mesa, or Buckhorn construction camps. Four sites have been identified for the Shute Creek camp. The documentation for all of these sites is incomplete; therefore, no determination of NRHP eligibility has been made for these sites (see Table 3-33).

SITING ALTERNATIVES

BUCKHORN ALTERNATIVE

Wildlife and Fisheries

Plant Sites

Important wildlife areas occurring within the Buckhorn, West Dry Basin, East Dry Basin, and Craven Creek plant sites are presented in Figure 3-11. Only the Buckhorn site differs from the Proposed Action. It occurs on sagebrush habitat and does not occur within or contain any important wildlife areas.

Perennial streams and fisheries resources would not be influenced by plant site construction.

Linear Facilities

The affected environment of linear facilities corridors associated with the Buckhorn Alternative is provided on Figure 3-11. The majority of these corridors are the same as the Proposed Action (compare Map 1-3 and 1-5 in Map Pocket). Many important wildlife areas occur within the transportation corridors; most important among these are mule deer critical winter range and pronghorn critical winter range (Maps 3-2 and 3-3 in Map Pocket). Some corridors associated with the Buckhorn Alternative would cross the Green River riparian habitat east of the well field, an area of bald eagle winter use.

Streams crossed by road and pipeline corridors in the well field would be the same as the Proposed Action. Outside of the well field, transmission lines, the sour gas pipeline, and the sulfur pipeline would cross LaBarge, Muddy, Fontenelle, and Slate Creeks. LaBarge, Fontenelle, and Slater Creeks contain trout. A transmission line, two sour gas pipelines, and the sulfur pipeline from Buckhorn plant site would cross the Green River about 7 miles downstream of the South Piney Creek confluence. The Green River sustains a good brown trout fishery in this area. Forage fish, such as shiners and minnows also occupy this reach of the river.

Water Resources

Linear Facilities

Major perennial rivers and streams crossed by the Buckhorn Alternative corridors include the Green River, Hams Fork, Fontenelle Creek, LaBarge Creek, Dry Piney Creek, and the Big Sandy River. According to USGS 1:24,000 and 1:62,500 series maps, the Buckhorn Alternative would involve 23 perennial and 58 intermittent stream crossings. Since the railroads, transmission lines, pipelines and access roads included in the Buckhorn Alternative often run parallel and in close proximity within the alignments, the actual numbers of different streams crossed are 10 perennial and 28 intermittent (see Table 3-34).

Soils and Vegetation

Plant Sites

The Buckhorn Alternative would cross 12,983 acres of vegetation and soils. Sagebrush communities dominate the site. Well field resources are the same as those described under the Proposed Action. Soils on the Buckhorn Alternative plant sites are similar to those discussed for plant sites under the Proposed Action, except that Quasar's plant would be located at Buckhorn instead of East Dry Basin. The Buckhorn site itself has no sensitive soils. Overall, about 349 acres of sensitive soils (12 percent) are present on the 2,800 acres of plant sites for this alternative, of which 254 acres are strongly saline/alkaline. About 95 acres of the sites would occur on steep soils formed from interbedded shales and sandstones. In addition to these sensitive rehabilitation acreages, about 34 acres of somewhat poorly to poorly drained soils supporting sensitive riparian vegetation occur at the proposed sulfur loadout facility.

Over 86 percent of the area occupied by the Buckhorn Alternative plant sites is dominated by big sagebrush communities, principally an association of Wyoming big sagebrush and Sandberg bluegrass. Also included are saltbush, mixed desert shrub, bunchgrass, and riparian communities described previously under the Proposed Action.

Linear Facilities

Soils and vegetation on the Buckhorn Alternative corridors are similar to those discussed under the Proposed Action corridors and plant sites. Approximately 1,676 acres of sensitive soils would be crossed. This acreage represents 27 percent of the 6,215 acres potentially disturbed for this alternative. About 879 acres of highly saline/alkaline soils occur along ephemeral drainages and associated alluvial fans. About 797 acres of rock outcrop and steep soils formed from shale occur along ridges and eroding basins.

Visual Resources

Plant Sites

The Buckhorn plant site is in an area of rolling sage land of low scenic quality. In addition, this site is seen by low numbers of people who are there for purposes other than scenery-related activities. This site is, in fact, not seen from any major viewpoint at any distance. The visual resource values in this area are correspondingly low.

BUCKHORN ALTERNATIVE	IMPORTANT WILDLIFE AREAS	Elk Critical Winter Range	Elk Calving Area	Moose Critical Winter Range	Mule Deer Critical Winter Range	Bighorn Sheep Critical Range	Pronghorn Critical Winter Range	Pronghorn Critical Summer Range	Sage Grouse Strutting Ground*	Sage Grouse Critical Range	Bald Eagle Wintering Concentration Area	Potential Black-footed Ferret Habitat (Prairie Dog Towns)	Golden Eagle Nest*	Raptor Nest*	National Wildlife Refuge
PLANT SITES	Buckhorn														
	West Dry Basin									●		●			
	East Dry Basin				●		●					●			
	Craven Creek							●				●			
LINEAR FACILITIES	Transmission Lines	●		●	●		●	●	●	●		●	●		
	Sour Gas Trunk Lines	●		●	●		●	●		●		●			
	Sales Gas & CO_2 Pipelines			●	●		●	●		●		●	●		
	Sulfur Pipelines	●		●	●		●	●	●	●		●			
	Water Pipeline							●			●	●			
	Access Roads							●				●			
	Railroad Spur							●				●			

*Within 1-mile wide study corridor.

FIGURE 3-11 IMPORTANT WILDLIFE AREAS IN RELATION TO PLANT SITES AND LINEAR FACILITIES OF THE BUCKHORN ALTERNATIVE

TABLE 3-34
NUMBER OF LINEAR FACILITY CROSSINGS OF MAJOR STREAMS FOR THE SITING ALTERNATIVES

	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Railroads			
Perennial	0	0	0
Intermittent	1	1	0
Total	1	1	0
Transmission Lines			
Perennial	8	7	7
Intermittent	19	18	18
Total	27	25	25
Pipelines			
Perennial	14	16	17
Intermittent	38	44	36
Total	52	60	53
Access Roads			
Perennial	1	1	1
Intermittent	0	6	0
Total	1	7	1
Total Perennial Stream Crossings	23	24	25
Total Intermittent Stream Crossings	58	69	54
Total Stream Crossings	81	93	79
Total Different Perennial Streams Crossed	10	9	11
Total Different Intermittent Streams Crossed	28	31	30
Total Different Streams Crossed	38	40	41

Linear Facilities

Areas of moderate to high resource value that would be crossed by corridors include the Green River, Highway 189 north of LaBarge, and the Reardon Draw bluff complex. The sensitivity of the Green River has been discussed under the Proposed Action. The Reardon Draw bluff complex east of the Green River is a moderately scenic area of cliffs with interesting and colorful erosional features. The majority of this cliff complex is unseen from sensitive viewpoints and, therefore, was rated a moderate visual resource value. Portions seen from Highway 189 were given a high resource value.

The visible area north of LaBarge along Highway 189 contains a mix of highly scenic features including the Green River and adjacent bluffs. The highway itself is located along a flat sage terrace that contains a variety of man-introduced features including scattered residences and distribution lines. Visual resource values along this highway corridor, therefore, range from high to low.

Cultural Resources

Previous investigations, primarily along rights-of-ways for proposed transmission lines and pipelines, that considered less than 5 percent of the Buckhorn Alternative's facility areas identified 229 resources, two of which were determined as NRHP eligible (see Table 3-35). A total of 99 sites were determined to be ineligible for the NRHP. The remaining 128 sites (56 percent of the surveyed sites) are incompletely documented, some of which may meet the NRHP eligibility criteria.

Agriculture/Grazing

The Buckhorn Alternative would cross 38 federal grazing allotments. These are the same allotments as crossed by the Proposed Action except for Dry Piney, South Piney Ind., and LaBarge Unit which would be unaffected by the Buckhorn Alternative, and Desert Common which is affected by the Proposed Action. Together these units contain 246,934 active AUMs, of which 9,337 are on Desert Common.

TABLE 3-35
RILEY RIDGE CULTURAL RESOURCE INVESTIGATIONS, RESOURCES, AND EVALUATION STATUS SITING ALTERNATIVES

			Resource Evaluation Status				
Project Alternative	Number of Investigations	Identified Resources	Sites Determined NRHP Eligible (%)	Sites Potentially NRHP Eligible (%)	Sites Not Evaluated (%)	Total Possible NRHP Eligible Sites	Sites Not Eligible (%)
Buckhorn Alternative	271	229	2 (1%)	41 (18%)	87 (38%)	130 (57%)	99 (43%)
Shute Creek Alternative	316	287	2 (2%)	41 (44%)	125 (44%)	169 (59%)	119 (41%)
Northern Alternative	325	149	1 (1%)	29 (19%)	64 (43%)	94 (63%)	55 (37%)

SHUTE CREEK ALTERNATIVE

Wildlife and Fisheries

Plant Sites

Important wildlife areas occurring within the Buckhorn, Craven Creek, and Shute Creek plant sites are presented in Figure 3-12. The Buckhorn and Craven Creek plant sites were discussed previously. Buckhorn does not occur within any important wildlife areas. Craven Creek contains a prairie dog town and pronghorn critical summer range. The Shute Creek site contains about 65 acres of prairie dog town, a potential black-footed ferret habitat, and also occurs within an area mapped as pronghorn critical summer range. The vegetation types at the Shute Creek site include 463 acres of bunchgrass/forb and 177 acres of mixed desert shrub.

A few ephemeral tributaries to Shute Creek would be influenced by the Shute Creek plant site. No perennial streams or fisheries resources would be crossed.

Linear Facilities

The affected environment of linear facilities corridors associated with the Shute Creek Alternative is provided in Figure 3-12. Many corridors are the same as the Proposed Action (compare Maps 1-3 and 1-6, see Map Pocket). Many categories of important wildlife areas occur within the transportation corridors; most important among these are mule deer critical winter range and pronghorn critical winter range. The CO_2 and sales gas pipelines from the Shute Creek plant would pass through approximately 2.5 miles of the Seedskadee Wildlife Refuge.

Streams crossed by road and pipeline corridors in the well field would be the same as the Proposed Action. Outside the well field transmission lines from Naughton Power Plant, Northwest's sour gas pipeline, and the sulfur pipeline would cross LaBarge, Fontenelle, and Slate Creeks (same as the Proposed Action). These creeks contain a trout fishery. In addition, the sales gas and CO_2 pipelines from the Shute Creek plant site would cross the Green River in the Seedskadee Wildlife Refuge. This reach of the Green River contains a valuable trout fishery consisting of brown trout and rainbow trout, with rainbow trout dominating.

Water Resources

Linear Facilities

Major perennial rivers and streams crossed by the Shute Creek Alternative include the Green River, Hams Fork, Fontenelle Creek, LaBarge Creek, and the Big Sandy River. According to USGS 1:24,000 and 1:62,500 series maps, the Shute Creek Alternative would involve 24 perennial and 69 intermittent stream crossings. Since the railroads, transmission lines, pipelines and access roads included in the Shute Creek Alternative often run parallel and in close proximity within the alignments, the actual number of different streams crossed are 9 perennial and 31 intermittent (see Table 3-34).

Soils and Vegetation

The Shute Creek Alternative would cross 12,115 acres of soils and vegetation. Primarily, this alternative affects sagebrush-dominated vegetation communities. Well field resources are the same as those described for the Proposed Action.

Plant Sites

Soils on the Shute Creek Alternative plant sites are similar to those discussed under the Proposed Action. The Shute Creek Alternative would occupy 2,160 acres at plant sites. The most widespread type of limited rehabilitation potential consists of 824 acres (38 percent) of strongly saline/alkaline soils on alluvial

SHUTE CREEK ALTERNATIVE	IMPORTANT WILDLIFE AREAS	Elk Critical Winter Range	Elk Calving Area	Moose Critical Winter Range	Mule Deer Critical Winter Range	Bighorn Sheep Critical Range	Pronghorn Critical Winter Range	Pronghorn Critical Summer Range	Sage Grouse Strutting Ground*	Sage Grouse Critical Range	Bald Eagle Wintering Concentration Area	Potential Black-footed Ferret Habitat (Prairie Dog Towns)	Golden Eagle Nest*	Raptor Nest*	National Wildlife Refuge
PLANT SITES	Buckhorn														
	Shute Creek							●				●			
	Craven Creek							●				●			
LINEAR FACILITIES	Transmission Lines	●		●	●		●	●	●	●		●			
	Sour Gas Trunk Lines	●		●	●		●	●		●		●			
	Sales Gas & CO_2 Pipelines						●	●		●		●	●		●
	Sulfur Pipelines	●		●	●		●	●	●	●		●			
	Water Pipeline							●			●	●			
	Access Roads						●	●				●			
	Railroad Spur							●				●			

*Within 1-mile wide study corridor.

FIGURE 3-12 IMPORTANT WILDLIFE AREAS IN RELATION TO PLANT SITES AND LINEAR FACILITIES OF THE SHUTE CREEK ALTERNATIVE fans and high stream terraces. These soils occur over all of the Shute Creek plant site and on a portion of the Craven Creek site. Additional sensitive areas (25 acres) occur on steep, eroding lands at the proposed sulfur loadout facility.

Over 50 percent of the area occupied by the Shute Creek Alternative plant sites is dominated by Wyoming big sagebrush communities. The bunchgrass type covers 21 percent of the plant sites, and mixed desert shrub types cover 15 percent. Other minor constituent types include saltbush and riparian. About 34 acres of riparian vegetation occurs at the sulfur loadout facility.

Linear Facilities

Soils on the Shute Creek Alternative corridors are similar to those discussed for the Proposed Action. Linear facilities for the Shute Creek Alternative would cross 5,987 acres. About 1,814 acres of sensitive rehabilitation units (30 percent) occur within the corridor alternatives. Strongly saline/alkaline soils are the most widespread sensitive soils within the corridors, occupying 1,170 acres. They occur on alluvial fans and along drainages. The remaining 644 acres are comprised of steep, shaly soils.

Over 78 percent of the Shute Creek Alternative corridors are occupied by big sagebrush communities; saltbush and mixed desert shrub cover 10 and 4 percent, respectively. Other minor constituents include bunchgrass, greasewood, pasture/hayfield, and riparian. About 67 acres of riparian vegetation would be crossed at perennial stream crossings.

Visual Resources

The Shute Creek plant site is in a low quality natural sage landscape and is seen only at great distances (9 to 11 miles) from a portion of Highway 189 and the Opal Cutoff. The Shute Creek plant site, therefore, is rated as low visual resource value area.

The affected environment associated with the Shute Creek Alternative corridors has been described previously under the Proposed Action and the Buckhorn Alternative.

Cultural Resources

Previous investigations identified 287 resources on less than 5 percent of the Shute Creek Alternative project facility areas (see Table 3-35). Two sites were determined NRHP eligible, and an additional 168 sites (57 percent of the total number of sites) are incompletely documented, some of which may meet the NRHP eligibility criteria. The 5 percent of the study area previously surveyed included a transmission line right-of-way and rights-of-way for four pipelines.

Agriculture/Grazing

The Shute Creek Alternative would affect the same 38 grazing allotments as would be affected by the Buckhorn alternative.

Land Use Plans, Controls, and Constraints

The proposed corridor for the parallel CO_2 and sales gas pipelines serving the Shute Creek plant site would cross approximately 2.5 miles of the Seedskadee National Wildlife Refuge. A development plan for the area is being prepared that stresses recreation and wildlife habitat enhancement to replace the loss of wetlands caused by construction of the Fontenelle Reservoir.

NORTHERN ALTERNATIVE

Wildlife and Fisheries

Plant Sites

Important wildlife areas occurring within the Buckhorn, West Dry Basin, East Dry Basin, and Big Mesa plant sites are presented in Figure 3-13. These represent no new sites from those previously discussed. The Big Mesa and East Dry Basin sites occur within mule deer critical winter range and the West Dry Basin site is important winter range and an area of general deer migration. The East Dry Basin site is also pronghorn critical winter range. Prairie dog towns, a potential black-footed ferret habitat, occur in both the East and West Dry Basin sites.

No perennial streams or fisheries resources would be influenced by plant site construction.

Linear Facilities

The affected environment of linear facilities corridors associated with the Northern Alternative is provided in Figure 3-13, some of which are the same as the Proposed Action (compare Maps 1-3 and 1-7, see Map Pocket). Many categories of important wildlife areas occur within the transportation corridors; most important are mule deer critical winter range and pronghorn critical winter range.

Streams crossed by road and pipeline corridors in the well field would be the same as the Proposed Action. Transmission lines from Naughton Power plant would cross the Hams Fork, Slate Creek, Fontenelle, Muddy, LaBarge, and Dry Piney Creeks. The Hams Fork supports a non-game fishery (suckers and minnows). Slate Creek, Fontenelle, and LaBarge Creek have trout while Muddy Creek supports primarily non-game fish. Lower Dry Piney Creek does not support a fishery where the transmission line crosses.

A transmission line, two sour gas pipelines, and the sulfur pipeline from Buckhorn plant site would cross the Green River about 7 miles downstream of the South Piney Creek confluence. The Green River sustains a good brown trout fishery in this area. Forage fish, such as shiners and minnows also occupy this reach of the river. Sales gas and CO_2 lines would cross the Big Sandy River and Alkali Creek. The Big Sandy supports some trout while Alkali Creek has no game fish but may support suckers and minnows.

NORTHERN ALTERNATIVE

IMPORTANT WILDLIFE AREAS

		Elk Critical Winter Range	Elk Calving Area	Moose Critical Winter Range	Mule Deer Critical Winter Range	Bighorn Sheep Critical Range	Pronghorn Critical Winter Range	Pronghorn Critical Summer Range	Sage Grouse Strutting Ground*	Sage Grouse Critical Range	Bald Eagle Wintering Concentration Area	Potential Black-footed Ferret Habitat (Prairie Dog Towns)	Golden Eagle Nest*	Raptor Nest*	National Wildlife Refuge
PLANT SITES	Buckhorn														
	West Dry Basin									●		●			
	Big Mesa				●										
	East Dry Basin				●		●					●			
LINEAR FACILITIES	Transmission Lines	●		●	●		●	●	●	●		●	●	●	
	Sour Gas Trunk lines			●	●		●			●		●			
	Sales Gas & CO_2 Pipelines			●	●		●	●		●		●	●		
	Sulfur Pipelines	●		●	●		●	●	●	●		●			
	Access Roads														

*Within 1-mile wide study corridor.

FIGURE 3-13 IMPORTANT WILDLIFE AREAS IN RELATION TO PLANT SITES AND LINEAR FACILITIES OF THE NORTHERN ALTERNATIVE

Water Resources

Corridors

Major perennial rivers and streams crossed by the Northern Alternative include the Green River, Fontenelle Creek, LaBarge Creek, Dry Piney Creek, the Big Sandy River, Fogarty Creek, and Hams Fork. According to USGS 1:24,000 and 1:62,500 series maps, the Northern Alternative would involve 25 perennial and 54 intermittent stream crossings. Since the transmission lines and pipelines included in the Northern Alternative often run parallel and in close proximity within the alignments, the actual numbers of different streams crossed are 11 perennial and 30 intermittent (see Table 3-34).

Soils and Vegetation

The Northern Alternative would occupy 13,050 acres of soils and vegetation. Primarily, this alternative occurs on sagebrush-dominated vegetation communities. Well field resources are the same as described for the Proposed Action.

Plant Sites

Soils occurring at the Northern Alternative plant sites are similar to those discussed under the Proposed Action. Sensitive rehabilitation units characterized by steep, eroding soils over shale or sandstone occur over about 145 acres distributed among the West Dry Basin, Big Mesa, and the sulfur loadout sites. Strongly saline/alkaline soils on alluvial fans and remnant terraces occur at 640 acres at the East Dry Basin and sulfur loadout sites. Somewhat poorly to poorly drained soils would also be occupied at the sulfur loadout facility.

About 82 percent of the area occupied by the Northern Alternative plant sites is dominated by Wyoming big sagebrush communities; saltbush type covers 10 percent of the area. Other communities include mountain shrub, bunchgrass, and riparian. About 34 acres of riparian vegetation occurs at the sulfur loadout facility.

Linear Facilities

Soils on the Northern Alternative corridors are similar to those discussed for plant sites under the Proposed Action. Linear facilities for the Northern Alternative would potentially cross 6,282 acres. A total of about 1,398 acres of sensitive rehabilitation units (22 percent) occur within the corridors. These include strongly saline/alkaline soils along drainages and alluvial fans (693 acres), and steep eroding soils on ridges and faulted lands (705 acres).

About 89 percent of the Northern Alternative corridors are occupied by big sagebrush communities; saltbush type covers about 4 percent. Also included are greasewood, bunchgrass, pasture/hayfield, riparian, and mixed desert shrub communities. About 88 acres of riparian vegetation would be affected at perennial stream crossings.

Visual Resources

The affected environment for visual resources associated with the Northern Alternative plant sites and corridors has been described previously for the Proposed Action and the Buckhorn Alternative.

Cultural Resources

Previous investigations were conducted for proposed transmission line and pipeline corridors covering less than 5 percent of the Northern Alternative project area. These surveys identified 149 resource locations (see Table 3-35). One site was determined NRHP eligible and an additional 64 sites (62 percent of the total sites) are incompletely documented, some of which may meet NRHP eligibility criteria.

Agriculture/Grazing

The Northern Alternative would affect 39 federal grazing allotments containing a total of 246,844 active AUMs. All units are the same as those for the Proposed Action except for Coyote Springs and Robinson Creek which would be unaffected and Desert Common which would be affected by the Northern Alternative.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

Environmental consequences are the impacts which would result from implementation of the Riley Ridge Project. The analysis of environmental consequences was conducted on two levels: (1) analysis of impacts from the Riley Ridge Project alone, and (2) a cumulative impact analysis, including all anticipated projects in the area of influence with impacts which would interrelate with the applicants' projects. Descriptions of the Proposed Action, alternatives, and interrelated projects included in the cumulative impact analysis are discussed in Chapter 1.

The impact analysis takes into consideration the standard operating procedures and agency requirements to mitigate potential impacts; these are identified in Appendix B of the EIS under the categories of applicants' standard operating procedures; federal regulations; current lease stipulations on occupancy; well field oil and gas operating measures; general measures; roading guidelines for exploration and development in the well field; and the erosion, revegetation, and restoration guidelines. Since these procedures would be required regardless of the designs of the proposed projects, they were considered in the analysis of the impacts. Committed mitigation measures for all resources are included at the end of Chapter 4.

The impact analyses were conducted for types of project components (well field, plant sites, and linear facilities) and different development phases (construction, operation, and abandonment). Impacts that are common or generally applicable to all alternatives are discussed under the Proposed Action. Impacts unique to individual alternatives or components are discussed separately by environmental resource.

This chapter of the EIS summarizes the significant impacts of the Riley Ridge Project. As described in Chapter 3, individual resource technical reports were prepared in support of this EIS. More detailed information on the results of the impact analyses are included in the respective technical report for several environmental resources.

The description of the environmental consequences for each resource in this chapter includes a discussion of the assumptions used in the impact analysis, the signficance criteria, cumulative impacts, and a summary of the significant impacts.

PROPOSED ACTION

SOCIOECONOMICS

Significance Criteria

Socioeconomic impacts would be considered significant under the following conditions:

1. The change in area population is 10 percent or more in any one year, or the change in population composition (race, age, sex, or ethnicity) is greater than 10 percent for a period of two or more years.
2. Shifts in the contribution among sectors to total regional or local employment are 10 percent or more for any given sector.
3. Increases in unemployment in the region exceed similar increases for the state as a whole.
4. Increases in median or per capita income for the county or community exceed similar increases for the state as a whole.
5. A projected shortage in housing within any year that would result in a vacancy rate of 3.5 percent or less.
6. The demands on public and human services is 25 percent or greater than under baseline conditions.
7. Changes in indicators of social well being exceed comparable state figures for the same period.

Significant socioeconomic impacts would occur in Lincoln and Sublette Counties and the Town of Granger due to construction of the gas treatment plants. Minor, more dispered impacts would result from construction of the well field and linear facilities. Impacts due to operation would be less than those occurring during construction and could be accommodated by service levels established to meet construction-generated needs. Significant impacts occur in population, employment, and housing. Negative impacts to county and community services are largely offset by positive fiscal impacts in Lincoln County whereas Sublette County jurisdictions and Granger do not have the fiscal capacity to provide all needed services even considering project-related revenues.

Employment

Employment impacts related to project development would be significant in Lincoln and Sublette Counties in terms of increased numbers employed as well as the changes in relative importance of the industrial sectors. The greatest absolute change occurs in Lincoln County while the greatest percentage change occurs in Sublette County (Table 4-1). By industrial sector, new employment opportunities provided directly by the Riley Ridge Project would be concentrated in the mining, construction, manufacturing and transportation, communications, and public utilities sectors. The greatest impact in Lincoln County would occur in 1986 when 2,831 additional jobs would be project-related and in Sublette County in 1985 when 1,543 new jobs would be project-related. In the three-county area the project would create a maximum of 4,934 jobs (Table 4-2).

Indirect employment effects are expected to be sizeable in both Lincoln and Sublette Counties. Increases in construction employment as well as increases in various service sectors would account for the main indirect employment effects. Many of the new jobs created by the project would be taken by local residents. As a result, area-wide unemployment would be relatively low, especially in Sublette County.

These projected increases in employment opportunities would cause increased in-migration and demand for public facilities and services. At the same time, these increases in employment opportunities would lead to increased diversification of the economy, decreased unemployment, increased personal earnings, and increased tax base for the political jurisdictions (both property and sales tax).

Population

Table 4-3 shows the population projections associated with construction and operation of the proposed project. Significant project-related population change in excess of 10 percent would occur during construction and would be concentrated in Lincoln and Sublette Counties, particularly in the Towns of Diamondville, Kemmerer, LaBarge, Big Piney, and Marbleton. Pinedale is not anticipated to experience significant population impacts. After 1990, the project-related population would decrease steadily until 1995 when a stable operation work force would be in place. Thereafter, population impacts would be relatively constant and less significant. Except for a slight increase (2 percent) during the period of peak construction in the relative concentration of individuals age 20 to 34 years old, the age and sex characteristics of the population in each of the counties would

TABLE 4-1
PROJECTED INCREASE IN ANNUAL AVERAGE LABOR FORCE[1], AND EMPLOYMENT[2], AND CHANGE IN UNEMPLOYMENT RATES PROPOSED ACTION

Category/County	1985	1986	1990	2000
Labor Force				
Lincoln	1,909	2,161	752	567
Sublette	1,502	1,332	1,110	833
Sweetwater	651	703	191	53
Total	4,062	4,196	2,053	1,453
Employment				
Lincoln	1,912	2,161	705	530
Sublette	1,469	1,288	1,064	806
Sweetwater	634	674	117	51
Total	4,015	4,123	1,886	1,387
Change in Annual Average Unemployment Rate Relative to the Baseline - %				
Lincoln	–1.7	1.7	0.0	0.0
Sublette	0.0	0.0	0.4	0.0
Sweetwater	0.0	0.0	0.3	0.0

Source: Western Research Corporation 1982

[1] Labor force is all persons 16 years of age or older who either are currently employed or who if unemployed are looking for work and available to accept a job.

[2] Employment is the number of persons who were paid for work they did or who worked 15 hours or more as unpaid workers on a family farm or in a family business.

TABLE 4-2
PROJECT-RELATED ANNUAL EMPLOYMENT OPPORTUNITIES
PROPOSED ACTION

County/Category	1985	1986	1990	2000
LINCOLN COUNTY				
Direct Employment				
Mining	134	143	98	93
Construction	1,115	1,148	146	0
Manufacturing	17	117	192	225
Transportation, Communications, and Public Utilities	9	43	52	57
Total Direct Employment	1,275	1,451	488	375
Total Indirect Employment	1,239	1,380	420	301
Total Employment Opportunities	2,514	2,831	908	676
SUBLETTE COUNTY				
Direct Employment				
Mining	274	292	204	182
Construction	899	615	285	0
Manufacturing	37	131	358	456
Transportation, Communications, and Public Utilities	8	35	50	50
Total Direct Employment	1,218	1,073	897	688
Total Indirect Employment	325	279	216	153
Total Employment Opportunities	1,543	1,352	1,113	841
SWEETWATER COUNTY				
Direct Employment				
Mining	35	38	25	26
struction	346	364	41	0
Manufacturing	0	3	3	3
Transportation, Communications, and Public Utilities	0	1	2	2
Total Direct Employment	381	406	71	31
Total Indirect Employment	324	345	59	25
Total Employment Opportunities	705	751	130	56
REGION				
Total Direct Employment	2,874	2,930	1,456	1,094
Total Indirect Employment	1,888	2,004	695	479
Total Employment Opportunities	4,762	4,934	2,151	1,573

Source: Western Research Corporation 1982

be essentially unchanged by the proposed project. Single status households currently account for approximately 20 percent of the area households. On the basis of experience in counties undergoing rapid energy development elsewhere in Wyoming, this level is expected to remain relatively constant throughout the construction of the project.

In Sweetwater County, the population increase would not meet the 10 percent significance criterion for inclusion in the socioeconomic analysis. Of the municipalities in Sweetwater County listed in Table 4-3, only Granger would be impacted by a 10 percent or greater population growth related to the Proposed Action.

Personal Earnings

The net impact on personal earnings for residents of Lincoln and Sublette Counties for the period 1982 to 1990 are shown in Table 4-4. Due to the new employment opportunities for local residents that would result from the proposed project, impacts are significant both in the short-term during construction and in the long-term during operation. More sizeable changes occur in Sublette County where the peak increase is 152 percent over projected baseline earnings and a change of 72 percent from baseline to operating levels of employment.

The effect of these projected increases in personal earnings would be increased per capita earnings, increased sales tax revenue, and an increased property tax base. In communities undergoing rapid development, newcomers often enjoy a disproportionate share of the economic benefits. Caution should be used in interpreting the data concerning per capita earnings to account for differential distributions among population groups.

TABLE 4-3
PROJECTED POPULATION INCREASE WITHIN THE RILEY RIDGE STUDY AREA
PROPOSED ACTION

County/Community[1]	1985	1986	1990	2000
Lincoln County	4,656	5,290	1,841	1,388
Afton	19	20	9	7
Thayne	6	6	4	3
Diamondville	1,001	1,267	244	202
Kemmerer	1,794	2,228	488	394
LaBarge	1,206	1,064	835	588
Cokeville	57	62	26	19
Rural	573	643	235	176
Frontier	99	100	50	38
Opal	68	68	34	26
Construction Camp	102	165	0	0
Sublette County	3,197	2,831	2,361	1,773
Big Piney	836	737	621	466
Marbleton	771	681	572	429
Pinedale	160	146	114	86
Rural	1,430	1,267	1,054	792
Calpet	38	33	28	21
Daniel	23	20	16	12
Sweetwater County	1,302	1,407	383	104
Granger	102	118	24	7
Green River	510	555	148	40
Rock Springs	426	454	130	35
South Superior	32	33	10	3
Wamsutter	15	15	5	1
Rural	217	233	65	18

Source: Western Research Corporation 1982

[1] The county population is the sum of the town populations plus the rural total.

Housing

Potentially the single most significant socioeconomic impact expected to occur as a result of development of the Riley Ridge Project involves the demand for housing in the affected area. Tables 4-5 and 4-6 summarize the significant housing impacts for the Proposed Action. Construction worker households were assumed to prefer and be able to secure 21 percent single-family housing, 53 percent mobile home, 10 percent multi-family, and 16 percent other types of dwelling units such as bachelor quarters, motel efficiency apartments, or recreational vehicles. All family status households were assumed to locate within the current boundaries of, or adjacent to, incorporated towns. This assumption reflects the service, trade, housing supply, and governmental infrastructure presently available to support growth in these areas. Northwest's proposed construction camp was assumed to be comprised of single status employees, located in the rural area of Lincoln County on the plant site, and made up of facilities similar to other construction camps in or planned for Wyoming.

TABLE 4-4
PROJECTED INCREASE IN TOTAL ANNUAL PERSONAL EARNINGS[1] PROPOSED ACTION

County	1985	1986	1990	2000
Lincoln County	$70,260	$78,571	$25,133	$16,177
Sublette County	52,136	44,937	34,603	23,662
Sweetwater County	21,565	24,623	4,566	1,502

Source: Western Research Corporation 1982

[1] In thousands of constant 1980 dollars.

TABLE 4-5
PROJECTED INCREASE IN HOUSING DEMAND FOR LINCOLN COUNTY, KEMMERER, DIAMONDVILLE, AND LABARGE
PROPOSED ACTION

Location/ Housing Type	1985	1986	1990	2000
Lincoln County[1]				
Single Family	783	980	371	280
Mobile Home	354	267	142	107
Multi-Family	106	103	45	34
Other	608	920	35	26
Total	1,851	2,270	593	447
Kemmerer				
Single Family	445	543	108	85
Mobile Home	118	152	30	23
Multi-Family	88	116	26	19
Other	60	74	16	14
Total	711	885	180	141
Diamondville				
Single Family	160	199	38	31
Mobile Home	179	230	45	37
Multi-Family	17	21	4	4
Other	1	2	0	0
Total	357	452	87	72
LaBarge				
Single Family	261	229	180	126
Mobile Home	175	154	120	84
Multi-Family	32	28	22	16
Other	0	0	0	0
Total	468	411	322	226

Source: Western Research Corporation 1982

[1] Total housing units in the county includes units in the towns listed as well as units in the unincorporated, rural areas.

TABLE 4-6
PROJECTED INCREASE IN HOUSING DEMAND FOR SUBLETTE COUNTY, BIG PINEY, MARBLETON, PINEDALE, AND GRANGER PROPOSED ACTION

Location/ Housing Type	1985	1986	1990	2000
Sublette County[1]				
Single Family	423	440	467	350
Mobile Home	548	432	281	210
Multi-Family	144	136	123	92
Other	144	107	57	43
Total	1,259	1,115	928	695
Big Piney				
Single Family	225	200	168	126
Mobile Home	91	80	68	51
Multi-Family	33	30	26	19
Other	2	1	1	1
Total	351	311	263	197
Marbleton				
Single Family	124	110	93	70
Mobile Home	119	106	88	66
Multi-Family	13	12	10	7
Other	0	0	0	0
Total	256	228	191	143
Pinedale				
Single Family	21	23	23	17
Mobile Home	27	22	14	10
Multi-Family	7	7	6	4
Other	7	6	3	2
Total	62	58	46	33
Sweetwater County				
Granger				
Single Family	16	18	5	1
Mobile Home	18	21	3	1
Multi-Family	3	4	0	0
Other	3	3	0	0
Total	40	46	8	2

Source: Western Research Corporation 1982

[1] Total housing units in the county includes units in the towns listed as well as units in the unincorporated, rural areas.

Lincoln County

The impacts of the project on Lincoln County housing are significant. As shown in Table 4-5, housing demand with the Proposed Action is projected to rise to a maximum of about 2,270 units above that expected without the project in 1986. Within Lincoln County, this represents a 49 percent increase from the baseline. Eighteen percent of this increase could be satisfied by the 825 average annual occupancy of the construction camp. The housing demand associated with both direct and indirect employment other than that residing in the construction camp is projected to represent a 31 percent (1,445 units) increase above the baseline in 1986. This portion of the total peak demand is more than twice the increase in demand expected one year later in 1987.

It is assumed that the level of housing demand projected for 1990 following major project construction represents the effective demand developers are willing to supply through their investment. The dynamics and locational considerations of projected housing demand indicate a further need for temporary housing in Lincoln County from 1985 through 1989. Local county builders may find it difficult to secure financing, labor, and sufficient developable land to meet this level of demand in such a short period. However, regional or national builders operating in Wyoming may be able to overcome limitations faced by smaller developers. The additional demand for temporary units by 1986 is supplied in part by the proposed construction camp. Actual occupancy may vary depending upon the family status of temporary workers. If these workers are accompanied by their families, the demand for mobile homes and apartments may create difficulties even for combinations of regional and local county developers.

Housing demand is expected to double in Diamondville during 1986 and be 19 percent above the baseline in 1990 as a result of the Proposed Action. The housing demand in Kemmerer during 1986 is projected to be a 58 percent increase over the demand without the Proposed Action. Within LaBarge, the 1985 peak housing demand is expected to be about 3.4 times the demand projected under the baseline. Unlike Diamondville and Kemmerer, the growth in LaBarge is also expected to be about 2.2 times the baseline projections in 1990. The more stable growth in housing demand in LaBarge indicates a potential need for over twice the existing permanent units to be added between 1982 and 1990, in addition to also adding a stock of temporary units in 1985 equivalent to the existing 1982 housing.

Land is presently available within and adjacent to Kemmerer, Diamondville, and LaBarge to support required future development.

Sublette County

The Proposed Action is projected to result in a peak housing demand during 1985 of 1,259 units that is in addition to the 1,894 units demanded without the project (Table 4-6). The 1985 peak increase of 66 percent declines to an increase of 49 percent by 1990.

Within the affected towns in Sublette County, Big Piney would be expected to have a significant increase of 148 percent above baseline forecasts in 1985; Marbleton's peak project-related increase would be about 135 percent in the same year. The project-related increase in 1985 housing demand in Pinedale is expected to be 62 units or 14 percent above the baseline projections. By 1990, Big Piney and Marbleton are expected to double in size. Developable land in or adjacent to Marbleton is available to meet future growth. Big Piney has relatively little developable land within its corporate boundaries. The Mayor of Big Piney feels that the town may be limited in its ability to expand by annexation.

Town of Granger, Sweetwater County

The effects of the Riley Ridge Project on the Town of Granger are significant and such that in 1986, the increase due to the Proposed Action is about 61 percent of the housing demand without the project. After construction activity declines, the increase by 1990 is projected to be about 10 percent of the demand projected under the baseline (Table 4-6).

Education

The proposed project would have short-term but significant impacts on Lincoln County School District #1, Sublette County School District #9, and the Granger Elementary School. Completion of the new grade school in Kemmerer in 1984 will bring the classroom capacity in grades kindergarten - sixth (K-6) in Lincoln County School District #1 to approximately 1,250 students. Enrollment capacity in grades 7-12 will be 700. Adding anticipated Riley Ridge enrollment (Table 4-7) to projected baseline enrollment (Table 3-9) would result in the grade schools being 124 students above capacity and the high schools 127 students above capacity during the 1986-1987 school years. At the same time, additional teaching staff would be required. The district owns three temporary classrooms which could be used to meet these capacity deficits. In all other years, the school district should be able to accommodate anticipated project-related growth by just the addition of teachers and staff.

Significant impacts to Sublette County School District #9 would occur one year earlier in 1985-1986. To accommodate project-related growth, the district would need an additional 39 teachers and 39 classrooms (Table 4-7).

For Granger Elementary School, peak impacts would occur in 1986-1987 when enrollment would increase to 123, 23 above recommended capacity and 2

TABLE 4-7
PROJECTED IMPACT ON LINCOLN COUNTY SCHOOL DISTRICT #9
AND SUBLETTE COUNTY SCHOOL DISTRICT #9
PROPOSED ACTION

	1985[1]	1986	1987	1990	2000
Lincoln County School District #1					
Enrollment Increase					
K-6	83	486	600	185	109
7-12	58	337	415	128	76
Total	141	823	1,015	313	185
Sublette County School District #9					
Enrollment Increase					
K-5	222	522	461	443	280
6-8	92	217	191	184	116
9-12	116	273	241	232	147
Total	430	1,012	893	859	543
Number of Classrooms Needed					
K-5	8	21	18	18	11
6-8	3	9	8	7	5
9-12	4	9	8	8	5
Total	15	39	34	33	21
Number of Teachers Needed					
K-5	9	21	18	18	11
6-8	4	9	8	7	5
9-12	4	9	8	8	5
Total	17	39	34	33	21

Source: Western Research Corporation 1982

[1] Year indicates school year, i.e., 1985 is the 1984-85 school year.

short of maximum capacity. Based on the present student/teacher ratio of 17.5 and the student/classroom ratio of 20, this enrollment could require 3 additional teachers and at least one additional classroom. In subsequent years, projected impacts are much smaller and enrollment increases would remain near recommended capacity.

Public Services

Lincoln County

The Riley Ridge Project would increase demands for facilities and personnel in most public service areas in the County and affected communities. Those services for which potential deficiencies can be quantified are shown in Tables 4-8 and 4-9. Such deficiencies would result in significant short-term impacts. Except for LaBarge, long-term impacts are insignificant.

The current service system in LaBarge is relatively undeveloped. Many services that in other towns are provided by the municipality are taken care of on a private basis in LaBarge. Increased population due to the project could have mixed effects on the service structure. For those services already provided by the town, project-related population increases would require increases in personnel and facilities to meet expected service demands. For services not now publicly provided, the increased population could have the effect of creating a demand level where it would be cost-effective for the town to provide the service. Whether or not this would occur and what effect it would have on the service cost to town residents cannot be predicted.

Sublette County

Personnel and facility needs that would result from the Riley Ridge Project are summarized in Table 4-10. In all cases, the impacts as judged against current conditions are significant in the short-term during construction and in the long-term during operation.

Both Lincoln and Sublette Counties and their respective municipalities have landfill capacity sufficient to meet the needs of anticipated population growth related to the Proposed Action. These sites have a useable life of 20 to 30 years assuming that they are used for disposal of residential wastes which are largely paper, bottles, and cans. Using them for disposal of industrial wastes which are larger and possibly toxic would reduce their effective life for residential use. Depending on depth, the existing sites may be totally inadequate for proposed industrial dumping. Further, not all sites are equipped with spreaders and machines capable of handling large amounts of waste products.

Significant impacts to the Town of Granger from the Proposed Action would be the need for 0.08 additional acres for solid waste disposal as well as added fire department personnel. Since Granger currently lacks a state-approved landfill site, the need for a suitable landfill would be increased by the Proposed Action. Under the Proposed Action, the Granger Fire Department would need an additional 8 volunteers in 1986. Existing equipment deficiencies would be exacerbated by population growth due to the Proposed Action, and a new fire truck would be needed.

TABLE 4-8
PROJECTED INCREASE IN LINCOLN COUNTY PUBLIC SERVICE PERSONNEL NEEDS PROPOSED ACTION

Jurisdiction/Service	1986	1990	2000
Lincoln County			
General Administration	11	4	4
Sheriff's Department	12	5	5
Road and Bridge	3	1	1
Library	4	2	2
Kemmerer			
General Administration	4	1	1
Police Department	6	1	1
Fire Department	14	3	3
Street Department	7	2	2
Solid Waste	2	0	0
Diamondville			
General Administration	6	1	1
Police Department	4	0	0
Street Department	2	0	0
LaBarge	(1985)		
General Administration	3	2	2
Police Department	3	3	1
Fire Department	35	24	17

Source: Western Research Corporation 1982.

Human Services

Lincoln County

The Lincoln County human service agencies expected to be significantly impacted by the Proposed Action are the Mental Health Center and the Department of Public Assistance and Social Services (Table 4-11). Both of these agencies are projected to need additional personnel because of the Proposed Action and they represent particular funding problems since their operating funds come from a variety of sources. Because of this, it may be difficult for the agencies to add staff during the impact period.

Significant numbers of health care professionals would also be needed in response to increased population growth related to the Proposed Action. Doctors and nurses would be particularly important. During the peak construction year, 4 additional physicians and 22 additional nurses would be needed to maintain service levels at the average state level. Recruitment of health care professionals to the area would be necessary to adequately meet expected increases in population

TABLE 4-9
PROJECTED INCREASE IN LINCOLN COUNTY PUBLIC SERVICE FACILITY REQUIREMENTS
PROPOSED ACTION

Jurisdiction/Service	1986	1990	2000
Lincoln County			
Sheriff's Department Number of Vehicles	4	1	1
Library Number of Volumes	10,500	3,700	3,700
Kemmerer			
Police Department Number of Vehicles	1	0	0
Water System Capacity (mg/d)	0.70	0.15	0.12
Sewer System Capacity (mg/d)	0.45	0.10	0.12
Diamondville			
Police Department Number of Vehicles	1	0	0
Parks Number of Acres	8.0		
LaBarge			
Police Department Number of Vehicles	1	1	0
Water System Capacity (mg/d)	0.241	0.167	0.117

Source: Western Research Corporation 1982.

demand. Hospital services in the County would be capable of handling project-related demands.

Sublette County

Mental Health and Department of Public Assistance and Social Services are the human service agencies expected to be significantly impacted by the Proposed Action in Sublette County. Both of these agencies are projected to need slight increases in personnel to handle anticipated growth. The increased personnel needs for these agencies begin in the peak construction year and extend through the life of the project. Special funding problems exist for both of these agencies since their revenue is obtained from a variety of sources.

Needs for health care professionals would also increase significantly in relation to the Proposed Action. Of particular importance are doctors and nurses. It is projected that 2 additional doctors and 15 additional nurses would be needed during the peak construction year. Recruitment of these additional professionals would have to be undertaken. Project-related emergencies would be cared for by existing personnel, but cases requiring hospitalization could not be cared for locally.

Fiscal Analysis

Lincoln County

Table 4-12 summarizes the revenue surplus or deficit, indicated by parentheses, projected for Lincoln County, Kemmerer, Diamondville, LaBarge, and School District #1. As can be noted from the table, Lincoln County would have a deficit in the early years of the project, but is expected to have sizeable surpluses in later years. The revenue and expenditure analysis includes incremental operating cost increases associated with population growth as well as increases in revenue related to population growth and energy development. Lincoln County would be in good fiscal condition because the County has an optional 1 percent sales tax which allows the County and municipalities to receive the state impact assistance tax. Revenue surpluses (deficits) reported in the summary table reflect both increased expenditures and revenue associated with population growth and energy development. Though Lincoln County and Kemmerer are significantly impacted by the Proposed Action, revenue surpluses should be sufficient to accommodate previously identified service and facility needs.

Table 4-12 shows Diamondville with a revenue surplus throughout the project period. This revenue surplus, while sufficient to addresss increased operating costs, would be insufficient to fund future capital facility needs. As indicated previously, a new city hall, park land, and water system would be needed in the future. Current bonding capacity would be inadequate to fund these capital improvements.

The Town of LaBarge would be significantly impacted by the Proposed Action. As indicated by Table 4-12, a deficit would be produced during the period of analysis, fiscal year 1985 to fiscal year 2000. This deficit situation would be likely to prevail throughout the life of the project as well. Revenue sources would be inadequate to cover projected personnel and capital facility needs. Of main concern is LaBarge's municipal water system as demand for water would exceed supply from 1984 through the life of the project (Table 3-11 and Table 4-9).

The significant impacts of the Proposed Action on Lincoln County School District #1 would occur in 1986 and 1987. Additional classrooms as well as teachers would be needed in these years. Additional teachers would be needed in each year that increases

TABLE 4-10
PROJECTED INCREASE IN SUBLETTE COUNTY PUBLIC SERVICE PERSONNEL AND FACILITY REQUIREMENTS
PROPOSED ACTION

Jurisdiction/Service	1985	1990	2000
Personnel			
Sublette County			
General Administration	9	7	5
Sheriff's Department	4	3	3
Road and Bridge	7	5	4
Library	2	2	2
Big Piney			
General Administration	2	1	1
Police Department	3	1	1
Fire Department	30	22	17
Street Department	2	1	1
Marbleton			
General Administration	1	1	1
Police Department	3	1	1
Street Department	2	2	2
Facilities			
Sublette County			
Sheriff's Department Number of Vehicles	2	1	1
Parks Number of Acres	19.8	14.6	11.0
Big Piney			
Police Department Number of Vehicles	1	0	0
Parks Number of Acres	5.2	3.9	2.9
Marbleton			
Police Department Number of Vehicles	1	0	0
Water System Capacity (mg/d)	0.15	0.11	0.9
Recreation Number of Acres	4.8	3.5	2.7

Source: Western Research Corporation 1982.

in enrollment occur. Table 4-12 indicates that the school district is expected to have sufficient resources to meet any capital facility needs related to the Proposed Action. Increases in operating costs associated with instruction are included in the revenue and expenditure analysis, thus the total projected revenue surplus would be available for meeting capital facility needs and unanticipated needs.

Sublette County

Table 4-13 summarizes revenue surpluses or deficits for Sublette County, Big Piney, Marbleton, School District #9, and the Town of Granger in Sweetwater County. As can be noted earlier, Sublette County is projected to need a new courthouse or additional office space and a hospital or a clinic. Bonding capacity of the County is sufficient to addresss these needs.

Sublette County does not have the optional one cent sales tax. Under state law, the County and municipalities are unable to receive the Impact Assistance Tax without the optional sales tax. Thus, Sublette County and its municipalities cannot maximize tax benefits from the Proposed Action.

Table 4-13 indicates significant fiscal impacts to Big Piney which would run substantial deficits throughout the project period. Town revenue would be unable to fund both the increased personnel and facility needs associated with the Proposed Action.

Sublette County School District #9 would be significantly impacted by the Proposed Action. Deficits are projected for the school district during FY85 and FY86, when there would be increased demand for teachers and classrooms. While increased personnel needs can be handled with increased revenue, capital facility needs would have to be met using the district's bonding capacity.

TABLE 4-11
PROJECTED INCREASE IN PERSONNEL NEEDS AND HUMAN SERVICES IN LINCOLN AND SUBLETTE COUNTIES
PROPOSED ACTION

	Lincoln			Sublette		
	1986	1990	2000	1985	1990	2000
Personnel						
Medical Services						
Physicians	4	2	2	2	2	1
Dentists	2	1	1	2	1	1
Nurses	22	8	8	15	11	8
Mental Health Staff	1	0	0	1	1	1
Welfare (D-PASS)[1] Staff	1	1	1	1	1	1
Facilities						
Nursing home beds	3	1	1	2	2	1
Hospital beds	9	4	4	0	0	0
Ambulances	0	0	0	1	1	0

Source: Western Research Corporation 1982

[1] D-PASS = Department of Public Assistance and Social Services.

TABLE 4-12
PROJECTED INCREASE IN REVENUES AND EXPENDITURES IN LINCOLN COUNTY AND JURISDICTIONS[1]
PROPOSED ACTION

Jurisdiction	1985	1990	2000
Lincoln County			
Revenues	792.2	918.2	926.0
Expenditures	1,583.4	626.1	472.0
Surplus (Deficit)[2]	(791.2)	292.1	454.0
Kemmerer			
Revenues	1,239.8	343.3	423.1
Expenditures	808.7	220.1	177.3
Surplus (Deficit)	431.1	123.2	245.9
Diamondville			
Revenues	313.2	96.3	123.0
Expenditures	309.3	75.4	62.4
Surplus (Deficit)	3.9	20.9	60.6
La Barge			
Revenues	397.9	181.9	143.7
Expenditures	427.9	296.0	208.4
Surplus (Deficit)	(30.0)	(114.1)	(64.8)
School District #1			
Revenues	95.5	1,121.7	1,088.1
Expenditures	463.6	1,029.1	608.3
Surplus (Deficit)	(368.2)	92.6	479.8

Source: Western Research Corporation 1982

[1] In thousands of dollars.

[2] Numbers in parenthesis indicate a deficit.

TABLE 4-13
PROJECTED INCREASE IN REVENUES AND EXPENDITURES IN SUBLETTE COUNTY, SUBLETTE COUNTY COMMUNITIES, AND GRANGER[1]
PROPOSED ACTION

Jurisdiction	1985	1990	2000
Sublette County			
Revenues	1,128.1	4,670.3	4,096.2
Expenditures	1,101.0	813.1	610.6
Surplus (Deficit)[2]	27.1	3,857.2	3,485.6
Big Piney			
Revenues	569.1	477.6	285.4
Expenditures	702.6	521.9	391.7
Surplus (Deficit)	(133.5)	(44.3)	(106.3)
Marbleton			
Revenues	200.4	338.2	161.5
Expenditures	158.3	317.6	204.8
Surplus (Deficit)	42.1	20.6	(43.3)
School District #9			
Revenues	373.0	12,711.1	12,717.1
Expenditures	2,436.3	4,861.3	3,076.6
Surplus (Deficit)	(2,063.3)	7,849.8	9,640.5
Granger			
Revenues	131.8	10.8	13.4
Expenditures	111.7	29.3	11.2
Surplus (Deficit)	20.1	(18.5)	2.2

Source: Western Research Corporation 1982

[1] In thousands of dollars.

[2] Numbers in parenthesis indicate a deficit.

Granger is the only municipality in Sweetwater County that would be significantly impacted by the Proposed Action. As indicated by Table 4-13, Granger is expected to encounter fiscal deficits during the latter years of the construction phase of the Proposed Action. Because revenue would be inadequate to compensate for increased expenditures related to the Proposed Action, Granger would be unable to afford the needed capital facilities identified previously.

Social Conditions

The Riley Ridge Project would result in a number of short-term and long-term changes in population, employment, and personal earnings in Lincoln and Sublette Counties. While there may be individual, personal benefits associated with these changes, there is also the potential for adverse social effects, but it is not anticipated that the impacts would be significant.

The results of the population analysis indicated that even during periods of peak employment, the project would not result in major demographic changes in Lincoln and Sublette Counties. Specifically, the distribution of the population with respect to age and sex would not change significantly. Given the absence of this kind of change, there is no basis for concluding that the counties would experience significant changes in such indicators of quality of life as divorce rate, crime rate, or infant mortality that would be project related. The number of such occurrences of any single event may increase due to increased numbers of people, but the relative incidence of such events, or the number of incidents per 1,000 population is not expected to change due to the project.

In terms of ability to deal with potential social problems, Lincoln and Sublette Counties are not without resources. Both counties have a relatively high level of monetary resources with which to meet the needs that would result from the Proposed Action. Both counties have relatively high assessed valuations because of the oil and gas properties present. Thus, the two counties could generate adequate levels of revenue to meet needs which would occur. While some municipalities within the counties would not have sufficient revenue because of the particular tax structure for municipalities in Wyoming, several mechanisms exist whereby municipal needs could be partially met from revenue available to the host county.

In addition to monetary resources, an important community resource is the prior experience of the community with development. Lincoln County has had extensive experience with energy development in the last five years. Thus, community members have a good idea of what to expect during a period of rapid growth and have developed many of the tools for managing growth such as municipal zoning ordinances. Their professional administrators have experienced a number of the activities which have to be undertaken to successfully manage growth. Sublette County, on the other hand, has not been subjected to extensive growth during the recent past. The State of Wyoming, however, has had extensive experience with energy-related growth, and much of this information and knowledge has filtered down to local communities. Further, state agencies which are charged with assisting counties and municipalities in managing growth have had experience with growth in other regions of the of the state. The state itself is in good financial condition and has a variety of mechanisms for providing communities impacted by energy development with direct financial assistance and other forms of assistance such as staffing in public service agencies.

In relative terms, the communities in Lincoln and Sublette Counties potentially affected by the Riley Ridge Project have an above-average level of resources available to them to properly manage growth. Depending on the degree of existing cooperation and coordination as well as applicant participation, the communities should be able to manage the expected growth in a positive manner.

Social conditions in Sweetwater County, in general, would be unaffected by the project. Granger would experience some of the same population-related social effects as would the smaller towns in Lincoln and Sublette Counties. Sweetwater County, however, has an established social service system ready to provide needed counseling, referral, and other types of services. Residents of Granger would have to drive to other towns to receive assistance but the nearby availability of such services would be sufficient to maintain the quality of life during the period of significant population changes.

Cumulative Impacts

Employment

Development of the interrelated projects plus anticipated expansion above baseline levels for existing projects would result in increased employment in Lincoln, Sublette, and Sweetwater Counties. As Table 4-14 shows, most of this development affects Sweetwater County.

The cumulative effects on labor force, employment, and unemployment rates in Lincoln, Sublette, and Sweetwater Counties are shown in Table 4-15. The concurrent development of the Proposed Action and the interrelated projects would result in significant impacts by increasing the peak county labor force above the baseline by 43 percent in Lincoln (1986), 70 percent in Sublette (1985), and 11 percent in Sweetwater (1985). By 1995 the labor force is projected to stabilize at 14 percent above the baseline in Lincoln County, 38 percent above baseline in Sublette County, and 4 percent above baseline in Sweetwater County.

Unemployment is expected to decline below the baseline rates in each county except for the periods following completion of major construction projects such as the Chevron Chemical Phosphate Project in Sweetwater County and the Proposed Action in Lincoln and Sublette Counties.

The cumulative basic employment opportunies identified in Table 4-16 includes the additional basic employment opportunities shown in Table 4-14 and those related to the Proposed Action.

TABLE 4-14
INTERRELATED BASIC EMPLOYMENT BY SECTOR

County	Sector	1983	1984	1985	1986	1987	1988	1989	1990	1995	2000
Lincoln	Mining	150	179	192	233	256	271	285	222	179	179
	Construction	0	0	0	0	0	0	0	0	0	0
	Manufacturing	0	0	0	0	70	70	70	70	70	70
	T.C. & P.U.[1]	0	0	0	0	0	0	0	0	0	0
	Total	150	179	192	233	326	341	355	292	249	249
Sublette	Mining	0	0	88	49	6	0	0	0	0	0
	Construction	0	0	0	0	0	0	0	0	0	0
	Manufacturing	0	0	0	0	0	0	0	0	0	0
	T.C. & P.U.[1]	0	0	0	0	0	0	0	0	0	0
	Total	0	0	88	49	6	0	0	0	0	0
Sweetwater	Mining	72	71	104	178	219	211	205	196	196	196
	Construction	432	1,056	1,403	487	112	182	112	61	61	61
	Manufacturing	30	30	180	416	416	416	416	416	416	416
	T.C. & P.U.[1]	47	57	92	106	127	127	127	136	136	136
	Total	581	1,214	1,779	1,187	874	936	860	809	809	809

Source: Western Research Corporation 1982

[1] Transportation, Communications, and Public Utilities.

TABLE 4-15
CUMULATIVE PROJECTED TOTAL ANNUAL AVERAGE LABOR FORCE, TOTAL EMPLOYMENT, AND CHANGE IN UNEMPLOYMENT RATES FOR LINCOLN, SUBLETTE, AND SWEETWATER COUNTIES

Category/County	1985	1986	1990	2000
Labor Force				
Lincoln	2,186	2,504	1,171	921
Sublette	1,580	1,390	1,110	833
Sweetwater	2,501	2,361	1,556	1,189
Total	6,267	6,255	3,837	2,993
Employment				
Lincoln	2,177	2,482	1,094	860
Sublette	1,569	1,344	1,064	806
Sweetwater	2,856	2,235	1,224	1,157
Total	6,602	6,061	3,382	2,823
Unemployment Rate (%)				
Lincoln	–1.7	–1.7	0	0
Sublette	–1.1	0.0	0.4	0
Sweetwater	–1.9	0.1	1.1	0

Source: Western Research Corporation 1982

During the peak construction for the Proposed Action (1986), Lincoln County would have a cumulative total of 1,685 jobs in the basic sectors of the economy. The increase in basic economic activity in the peak year (1985) in Sublette and Sweetwater Counties would increase jobs in Sublette to a cumulative total of 1,306 and in Sweetwater to 2,160 jobs.

The large construction effort associated with the potential Chevron Chemical Phosphate Project near Rock Springs is primarily responsible for the difference in basic jobs in Sweetwater County. Cumulative construction jobs would reach 1,749 of which the Proposed Action would account for 346 jobs in Sweetwater County in 1985.

When the indirect jobs are included, the cumulative job opportunities in Lincoln County are expected to be 3,235 jobs above the baseline in 1986. In Sublette County there would be 1,647 more jobs than in the baseline in 1985, while in that same year an additional 3,455 jobs above baseline projections would be available in Sweetwater County.

During the operation of the Proposed Action from 1990 through 2000, the total (direct and indirect) cumulative effects on employment opportunities are projected to be significantly above the baseline with Lincoln County having over 1,000 jobs, Sublette over 800 jobs, and Sweetwater over 1,300 jobs.

Population

The projected cumulative population is shown in Table 4-17. Lincoln County is projected to increase by 6,130 (838 interrelated and 5,292 Proposed Action) residents above the baseline population (14,333) in 1986. Lincoln County's cumulative population growth is steadier from 1982 to the 1986 peak and the subsequent decline from 1987 through 2000 is not as drastic as under the Proposed Action alone. Throughout this latter period, the County's cumulative population

TABLE 4-16
PROJECTED CUMULATIVE INCREASE IN ANNUAL EMPLOYMENT OPPORTUNITIES IN LINCOLN, SUBLETTE, AND SWEETWATER COUNTIES

LINCOLN COUNTY				
Basic Employment				
Mining	327	377	321	273
Construction	1,115	1,148	146	0
Manufacturing	17	117	262	295
Transportation, Communications, and Public Facilities	9	43	52	57
Total Basic Employment	1,468	1,685	781	625
Total Indirect Employment	1,379	1,550	608	457
Total Employment Opportunities	2,847	3,235	1,389	1,082
SUBLETTE COUNTY				
Basic Employment				
Mining	362	341	204	181
Construction	899	615	285	0
Manufacturing	37	131	358	456
Transportation, Communications, and Public Facilities	8	35	50	51
Total Basic Employment	1,306	1,122	897	688
Total Indirect Employment	341	288	216	153
Total Employment Opportunities	1,647	1,410	1,113	841
SWEETWATER COUNTY				
Basic Employment				
Mining	139	216	221	222
Construction	1,749	851	102	61
Manufacturing	180	419	419	419
Transportation, Communications, and Public Facilities	92	107	138	138
Total Basic Employment	2,160	1,593	880	840
Total Indirect Employment	1,295	983	494	460
Total Employment Opportunities	3,455	2,576	1,374	1,300

Source: Western Research Corporation 1982

impacts would be about 1,000 people or from 48 to 62 percent above the Proposed Action impacts. The decrease in population for the peak construction year (1986) to 1987 is expected to be 55 percent under the Proposed Action versus 45 percent when cumulative effects are considered. This smoothing effect is more pronounced between these years in Diamondville, Kemmerer, and LaBarge.

Sublette County is expected to grow by 3,362 (165 interrelated and 3,197 Proposed Action) people above the 4,809 baseline population projected for 1985. The cumulative effects on Sublette County population are significant in 1985, 1986, and 1987. In all other years, differences with the Proposed Action are not expected. The limited impacts of the interrelated projects will add slightly to the Proposed Action population expected for Big Piney, Marbleton, and Pinedale in these three years.

The largest population changes when cumulative effects are considered occur in Sweetwater County where the Proposed Action impacts are small compared to significant impacts that would result from other potential developments in the County. In the peak construction year of 1986, cumulative population impacts in Sweetwater County are 4,723 (3,316 interrelated and 1,407 Proposed Action) above the baseline population of 45,292. Granger, the only significantly impacted town in the County, is projected to increase its 1986 population by 397 (279 interrelated and 118 Proposed Action).

Housing

Housing demand would increase and potential housing shortages throughout the three-county area would be intensified when cumulative effects are considered. However, since the expected population growth is less volatile from year to year, the private housing market may be more attractive for developers than it would have been under the Proposed Action.

Public Services and Facilities

The cumulative impacts on public services and

TABLE 4-17
PROJECTED CUMULATIVE POPULATION

County/Community[1]	1985	1986	1990	2000
Lincoln County	5,349	6,130	2,859	2,252
Afton	22	24	14	11
Thayne	7	7	6	4
Diamondville	1,149	1,468	379	327
Kemmerer	2,061	2,581	758	639
LaBarge	1,386	1,233	1,297	954
Cokeville	66	72	40	31
Rural	658	745	365	286
Frontier	118	123	78	61
Opal	80	83	53	42
Construction Camp	102	165	0	0
Sublette County	3,362	2,955	2,361	1,773
Big Piney	879	769	621	466
Marbletown	811	711	572	429
Pinedale	168	152	114	86
Rural	1,503	1,323	1,054	792
Calpet	40	35	28	21
Daniel	24	21	16	12
Sweetwater County	5,003	4,723	3,113	2,377
Granger	392	397	196	154
Green River	1,960	1,862	1,200	918
Rock Springs	1,638	1,524	1,058	804
South Superior	122	109	85	64
Wamsutter	58	50	44	33
Rural	834	781	530	403

Source: Western Research Corporation 1982

[1] The county population is the sum of the town populations plus the rural total.

facilities under the Proposed Action would closely parallel the population impacts discussed above. In Lincoln and Sublette Counties, the majority of the impacts on public services and facilities are expected to occur as a result of development of the Riley Ridge Project. In Sweetwater County, the impacts of development of the Proposed Action are slight both in comparison to the existing service capacities in the area and the expected effects of other development in the area.

In Lincoln County, cumulative service and facility impacts would be similar to those discussed for the Proposed Action. The net effect of the cumulative impacts would be to accelerate the changes in demand for public services and facilities. That is, the changes in public service capacity expected with development of the Proposed Action would need to occur one year earlier to accommodate cumulative impacts.

Cumulative impacts on public services facilities in Sublette County are expected to be almost identical to those for the Proposed Action because development of the Riley Ridge Project constitutes almost all of the expected growth in the County. No changes in the overall magnitude or timing of service and facility impacts are projected.

Impacts on public services and facilities in Sweetwater County are transitory under the Proposed Action. They occur primarily during the peak construction period in 1985 and 1986. The interrelated projects are expected to cause the vast majority of the impacts in the County. While the public service impacts associated with the Riley Ridge Project may temporarily aggravate problems which may occur in 1985 and 1986, the overall effect of the Proposed Action is a minor part of the cumulative impacts.

Summary of Cumulative Impacts

The effects of the cumulative development of the Riley Ridge Project and the interrelated projects would aggravate already identified significant impacts in Lincoln and Sublette Counties but would not create additional significant impacts in these counties. The cumulative impacts in Sweetwater County are at the threshold of being significant and are attributable to the interrelated projects and the development schedule that has been assumed for these projects.

TABLE 4-18
SUMMARY OF CAPITAL FACILITY NEEDS FOR POLITICAL ENTITIES WITHIN LINCOLN COUNTY PROPOSED ACTION

Jurisdiction	Needed With Baseline	Needed With Proposed Action	Revenue Sufficient To Meet Need
Lincoln County			
Courthouse/ Office Space	X	X	Yes
Kemmerer			
Park Land	X	X	Yes
Diamondville			
City Hall	X	X	No
Park Land	X	X	No
Water System	X	X	No
LaBarge			
Water System (Expansion)		X	No
Lincoln County School District #1			
Additional Classrooms		X	Yes

Source: Western Research Corporation 1982

TABLE 4-19
SUMMARY OF CAPITAL FACILITY NEEDS FOR POLITICAL ENTITIES WITHIN SUBLETTE COUNTY AND GRANGER PROPOSED ACTION

Jurisdiction	Needed With Baseline	Needed With Proposed Action	Revenue Sufficient To Meet Need
Sublette County			
Courthouse/ Office Space	X	X	Yes
Hospital/ Clinic		X	Yes
Big Piney			
Police Facility/ Vehicles		X	No
Park Land	X	X	No
Marbleton			
Water System (Expansion)		X	No
Park Land	X	X	No
Sublette County School District #9			
Schools		X	Yes
Granger			
Town Hall		X	No
Water Line		X	No
Fire Station/ Truck		X	No
Solid Waste Site		X	No

Source: Western Research Corporation 1982

TABLE 4-20
SUMMARY OF NET IMPACTS ON PERSONNEL REQUIREMENTS AND FISCAL CONDITION OF POLITICAL ENTITIES WITHIN LINCOLN COUNTY PROPOSED ACTION

Jurisdiction	Net Impact During Peak Impact Year	Revenue Sufficiency For Increased Costs
Lincoln County[1]		
General Administration	11	
Sheriff's Department	12	Sufficient
Road and Bridge Department	3	
Library	4	
Kemmerer[1]		
General Administration	4	
Police Department	6	
Fire Department (Volunteers)	14	Sufficient
Street Department	7	
Solid Waste	2	
Parks and Recreation	8	
Diamondville[1]		
General Administration	6	
Police Department	4	Sufficient
Street Department	2	
LaBarge[2]		
General Administration	3	
Police Department	3	Insufficient
Fire Department (Volunteers)	35	
Lincoln County School District #1[1]		
Enrollments	1,015	
Teachers	56	Sufficient

Source: Western Research Corporation 1982

[1] Peak impact occurs in 1986.

[2] Peak impact occurs in 1985.

Summary

Implementation of the Proposed Action would cause significant population, employment, and income impacts that would result in signficant impacts to housing, public services and facilities, human services and facilities, and local area revenues and expenditures. In many cases, the revenues generated by the project are sufficient to cover the increased cost of public services, though there are some short-term mismatches between local area need and project generated revenues. Tables 4-18 through 4-21 summarize the relationship between maximum impacts generated by the project and revenue sufficiency. In Lincoln County, revenues would be sufficient to offset service needs except in LaBarge and Diamondville. In Sublette County, revenues would be generally insufficient to meet all service needs simultaneously, except in Sublette County School District #9. The area most severely affected by the proposed project would be Granger where all service needs are associated with the Proposed Action and project-related revenues fall far short of the project-related expenditures. Similar impacts would be expected in the various unincorporated areas where, because minimal services exist, it has been impossible to measure the current level of service and project service needs and local area fiscal status.

TABLE 4-21
SUMMARY OF NET IMPACTS ON PERSONNEL REQUIREMENTS AND FISCAL CONDITION OF POLITICAL ENTITIES WITHIN THE AREA OF SITE INFLUENCE
PROPOSED ACTION

Jurisdiction	Net Impact During Peak Impact Year	Revenue Sufficiency For Increased Costs
Sublette County[1]		
General Administration	9	
Sheriff's Department	4	Insufficient
Road and Bridge Department	7	
Library	2	
Big Piney[1]		
General Administration	2	
Police Department	3	
Fire Department (Volunteers)	30	Insufficient
Street Department	2	
Sublette County School District #9[1]		
Enrollments	1,012	
Teachers	39	Sufficient
Granger[2]		
Fire Department (Volunteers)	8	Insufficient

Source: Western Research Corporation 1982

[1] Peak impact occurs in 1986.

[2] Peak impact occurs in 1985.

WILDLIFE AND FISHERIES

Impacts to wildlife and fisheries would be considered significant under the following conditions.

Wildlife Significance Criteria

1. Impacts to wildlife are considered significant if critical ranges (wintering areas, calving grounds, strutting grounds) are affected during season of use, or if critical range disturbance within the well field is determined to be greater than 1 percent of that habitat within the affected geographic region (generally a big game herd unit).
2. Impacts to elk and elk spring-summer-fall habitats are considered significant if there is a relative decrease in "habitat effectiveness" of greater than 20 percent as determined by application of Forest Service (FS) forage/cover habitat evaluation methodologies. The 20 percent relative decrease figure for significance is based upon the professional judgment of FS wildlife biologists and relates to Bridger-Teton National Forest objectives for managing wildlife habitat.
3. Indirect impacts caused by human population increases are considered to be significant if the estimated increases in poaching, wanton killing, and harassment would exceed 15 percent over expected baseline levels. At present, no research data have been established regarding significant increases in these secondary impacts caused from population increases of energy development projects. Therefore, the 15 percent figure is based on professional judgment. Additionally, this same criteria has been used in previous EISs.
4. Impacts to threatened or endangered species are considered significant if the Biological Assessment required under Section 7 of the Endangered Species Act determines that the species are in a "may affect" category. The Biological Assessment is being prepared by the FS, BLM, and the Fish and Wildlife Service will respond with a biological opinion which will be included as part of the final EIS, and appended to the Wildlife and Fisheries Technical Report.
5. Impacts to riparian habitat are considered significant if more than 1 percent of this habitat occurring within the well field is disturbed during project construction. The 1 percent figure was determined independently by FS and BLM wildlife biologists and plant ecologists with input from WGF. It is based on professional judgment and the importance to wildlife and relative scarcity of this habitat within the project area.
6. Impacts to aspen habitat are considered significant if more than 1 percent of this habitat occurring within the well field suffers a loss of regenerative capacity (through loss of parent rootstock) during project construction (assumes 0 percent regenerative capacity on well pad disturbances, 25 percent on road disturbances and 100 percent on gathering system disturbances).

Several aspects of the Riley Ridge Project would result in significant adverse impacts to wildlife within the project area including primary impacts of big game critical habitat disturbance and disturbance of important vegetation and the secondary impacts of increased human population and the accompanying human disturbance to wildlife in the form of increased hunting and fishing pressure, game violations, poaching, wanton killing, harassment, road usage, oversnow vehicle use, vehicle-animal collisions, and unintentional disturbance. These significant impacts have been quantified to the extent possible and are presented throughout the following text.

Fisheries Significance Criteria

7. Impacts to fisheries resulting from accidental spills of chemicals are considered significant if changes in water quality exceed Wyoming Department of Environmental Quality (WDEQ) water quality criteria or exceed toxic levels for aquatic life. These criteria were developed to protect aquatic life and were developed from the

EPA 1976 Quality Criteria for Water. For example, a sour gas line break resulting in H_2S concentrations greater than 2 μg/liter in affected streams is considered significant.

8. Impacts to fisheries are considered significant if critical habitats (for example, spawning areas) are affected by increased sedimentation during critical months of fish use; April to June for cutthroat trout and rainbow trout and September to November for brook trout and brown trout.
9. Impacts to fisheries are considered significant if beaver ponds would be removed or lost; beaver ponds provide important habitat to fish during low flow periods and drought years.
10. Impacts to fisheries are considered significant if culverts at road crossings create barriers to fish movement; barriers can prevent normal movement of both adult and larval fish, increase predation, limit habitat availability and reproductive success; and ultimately decrease population numbers.
11. Impacts to streams currently under special WGF and/or BLM management for Colorado cutthroat trout are considered significant. Disturbance to and near these streams could degrade existing habitat conditions, increase the risk of illegal fishing pressure and threaten efforts to establish a natural reproducing population of pure Colorado cutthroat.
12. Indirect impacts caused by human population increases are considered significant if the estimated increases in illegal fishing would be greater than or equal to 15 percent over expected baseline conditions. This significance criterion has been used in previous EISs (BLM 1983b) and this increase is also considered significant by WGF biologists since any increase in fishing pressure both legal and illegal would tax the existing enforcement and stocking capabilities of WGF.

Well Field

Construction.

Wildlife. Wildlife habitat losses within the well field resulting from development of the Proposed Action are presented in Table 4-22. Habitat losses associated with construction of all facilities comprising the Proposed Action total 12,852 acres of which 3,968 acres would be in the well field (see Vegetation Section). The sagebrush habitat would be the most affected habitat and represents over 48 percent of the total disturbed well field acreages followed by conifer (27 percent), and bunchgrass/forb (9 percent).

Disturbances to riparian and aspen habitats would affect 135 and 190 acres, respectively (Table 4-22). For riparian, this would constitute 2.4 percent of the 5,608 acres of riparian habitat within the well field, a significant impact. Disturbances to aspen habitat would result in the loss of regenerative capacity through the destruction of parent rootstock on 75 of the 190 acres (see Significance Criteria 6), or 0.8 percent of the 9,132 acres of aspen habitat within the well field. This would not exceed the significance critieria of 1 percent.

On-going sweet gas and oil development within the well field between 1983 and 1990 was considered in determining significance of disturbance impacts to riparian and aspen habitats and big game critical ranges. This analysis did not reveal any differences in percent disturbance.

Removal of habitat would result in the direct destruction of small, less mobile species such as small mammals, bird nestlings, reptiles, and amphibians, and the displacement of larger more mobile species such as fledged birds, small game, predatory mammals, and big game. Animals that would primarily be impacted are those utilizing sagebrush habitats. These species include sage grouse, pronghorn, white-tailed jack rabbit, small mammals, and a variety of songbirds. Noise produced along roads and on well pads or other facilities would affect animal distributions to a certain extent.

The greatest impact of habitat removal and disturbance to other wildlife would be the loss of nesting or breeding habitat. For roads and permanent facilities where reclamation would not occur within the life of the project, this loss of habitat would be long-term. Assuming surrounding suitable habitats are at carrying capacity, displaced animals may not be successful in establishing territories in areas suitable for survival and reproduction. This would result in a reduction in local populations.

Habitat removal is particularly detrimental when it involves loss of critical habitats used for wintering or breeding. Critical habitats are often the limiting factor in maintaining wildlife populations; thus even small losses of critical habitats may result in wildlife population reductions.

Approximately 1,019 acres of elk critical winter range would be disturbed during well field construction activities (Table 4-23, Map 3-2, see Map Pocket). This represents a long-term loss of 1.9 percent of the 55,000 acres of critical winter range in the Piney Elk Herd Unit. This would exceed the significance criterion of 1 percent and constitute a significant impact to elk populations in the Riley Ridge Project area.

Assuming a direct, linear relationship between critical winter range and population size, and a zone of influence which reflects a species behavioral reaction to human activity and noise, the elk population within the well field would be reduced by 63 animals for the 40-year duration of well field construction and operation and result in a productivity loss of 632 elk during that period. (See the Wildlife and Fisheries Technical Report for more information regarding the zone of influence and other assumptions used in estimating population impacts.)

Elk calving areas would also be affected (Table 4-23, Maps 3-2 and 3-3, see Map Pocket) resulting in disturbance of 1,107 acres (1.1 percent) of the 102,400 acres of elk calving grounds within the herd unit, just over the significance criterion threshold of 1 percent.

TABLE 4-22
ACRES OF WILDLIFE HABITAT PRESENT, DISTURBED, AND PERCENT DISTURBED WITHIN THE WELL FIELD AREA

Wildlife Habitat Type	WELL FIELD UNITS										
	Darby Mountain[1]	N. Riley Ridge[1]	Riley Ridge	Lake Ridge	Fogarty Creek	Dry Piney	Graphite	Sawmill[2]	Tip Top	Hogsback	Total
Conifer											
Present	11,788	7,609	3,155	11,997	4,813	1,018	1,522	102	89	666	42,759
Disturbed	181	70	49	494	156	44	60	3	2	13	1,072
%Disturbed	1.5%	0.9%	1.6%	4.1%	3.2%	4.3%	3.9%	2.9%	2.2%	2.0%	2.5%
Clearcut											
Present	1,235	134	448	326	45	6	352	0	0	0	2,546
Disturbed	11	2	17	20	3	0	12	0	0	0	65
%Disturbed	0.1%	1.5%	3.8%	6.1%	6.7%	0 %	3.4%	0 %	0 %	0 %	2.6%
Aspen											
Present	134	2,803	1,139	973	1,395	672	429	1,203	358	26	9,132
Disturbed	1	21	34	30	44	12	20	18	9	1	190
%Disturbed	0.7%	0.7%	3.0%	3.1%	3.2%	1.8%	4.7%	1.5%	2.5%	3.8%	2.1%
Sagebrush											
Present	986	4,712	8,857	5,524	7,772	5,207	774	10,608	27,718	9,017	81,175
Disturbed	21	94	178	244	291	177	3	215	555	156	1,934
%Disturbed	2.1%	2.0%	2.0%	4.4%	3.7%	3.4%	0.4%	2.0%	2.0%	1.7%	2.4%
Mountain shrub											
Present	538	0	0	0	0	0	0	0	634	538	1,710
Disturbed	0	0	0	0	0	0	0	0	20	1	21
%Disturbed	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	3.2%	0.2%	1.2%
Bunchgrass/Forb											
Present	1,370	2,400	1,427	1,274	1,408	115	550	269	896	806	10,515
Disturbed	0	15	18	120	148	0	11	5	9	41	367
%Disturbed	0 %	0.6%	1.3%	9.4%	10.5%	0 %	2.0%	1.9%	1.0%	5.1%	3.5%
Greasewood											
Present	0	0	0	0	0	0	0	0	256	0	256
Disturbed	0	0	0	0	0	0	0	0	10	0	0
%Disturbed	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	3.9%	0 %	3.9%
Pasture/Hayfield											
Present	0	198	435	0	166	26	0	3,372	1,210	0	5,747
Disturbed	0	7	3	0	1	2	0	94	67	0	174
%Disturbed	0 %	3.5%	0.7%	0 %	0.6%	7.7%	0 %	2.5%	5.5%	0 %	3.0%
Riparian											
Present	442	1,024	557	896	262	237	0	1,332	679	179	5,608
Disturbed	15	8	18	38	0	10	0	24	20	2	135
%Disturbed	3.4%	0.8%	3.2%	4.2%	0 %	4.2%	0 %	1.8%	2.9%	1.1%	2.4%
Barren/Disturbed											
Present	397	0	0	0	0	0	13	0	0	0	410
Disturbed	0	0	0	0	0	0	0	0	0	0	0
%Disturbed	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Aquatic											
Present	70	0	0	0	0	0	0	0	0	0	70
Disturbed	0	0	0	0	0	0	0	0	0	0	0
%Disturbed	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
TOTAL											
Present	16,960	18,880	16,018	20,990	15,861	7,281	3,640	17,226	31,840	11,232	159,928
Disturbed	229	217	317	946	643	245	106	359	692	214	3,968
%Disturbed	1.4%	1.1%	2.0%	4.5%	4.1%	3.4%	2.9%	2.0%	2.2%	1.9%	2.5%

Note: Present habitats determined from 1982 aerial photography.

[1]Proposed Unit

[2]Former Unit

TABLE 4-23
ACRES OF WILDLIFE CRITICAL RANGES[1] DISTURBED
PROPOSED ACTION

	Well Field	Plant Sites[2]	Corridors	Total
Elk Critical Winter Range	1,019	0	460	1,479
Elk Critical Calving Range	1,107	0	0	1,107
Mule Deer Critical Winter Range	142	1,060	1,755	2,957
Moose Critical Winter Range	287	0	299	586
Pronghorn Critical Winter Range	0	640	1,641	2,281
Pronghorn Critical Summer Range	0	840	1,051	1,891
Prairie Dog Towns	0	191	388	579

[1] Critical ranges may overlap between species.

[2] Includes sulfur loadout facility.

Impacts of increased road access, traffic, and associated human disturbance in elk calving areas have an even greater potential for affecting elk calving success and would likely result in a unquantifiable reduction of elk calves joining the population annually.

Increased vehicular traffic on the roads and increased maintenance of roads to allow year-round use would cause an unquantifiable increase in the amount of disturbance to elk proportionate to well field traffic (see Environmental Consequences-Transportation Section). Roads normally closed from snow during the critical calving period would be open, allowing harassment of elk year-round (Hinschberger 1982, personal communication). Harassment during periods of stress, such as calving or wintering, may result in a decrease in productivity and survival, and an unquantified decrease in the size of the population.

A technical analysis of elk spring-summer-fall habitat within the Riley Ridge well field was also performed. Increased human access to the northwestern portions of the well field would greatly reduce the quality of that habitat. Increased human access to other portions of the well field would result in similar but less severe reductions of elk spring-summer-fall habitat quality. Throughout the entire well field there would be an estimated 17 percent reduction in elk habitat effectiveness, (a range of 0 to 100 percent reduction in elk habitat effectiveness was recorded for six individual habitat units analyzed). This is below the significance criterion of 20 percent and is therefore not a significant impact. The Wildlife and Fisheries Technical Report provides a further detailed discussion of this analysis.

Elk, and other big game, population impacts are intended to provide rough estimates or relative impacts and represent the best estimates at our current level of knowledge. Actual impacts may differ from these estimates. For example, although estimates show only a reduction in elk population, elk may react to well field development by abandoning the entire range. This abandonment may occur for only a few weeks or months during concentrated development or may extend over years, causing conflicts within other wildlife management units or feedgrounds.

Mule deer critical winter range losses as a result of well field development were determined to be 142 acres (Table 4-23). This would constitute less than 0.1 percent of the 468,000 acres of mule deer critical winter range within the herd unit, well below significance criteria. Well field habitat losses and human disturbance influences would result in an estimated mule deer population reduction of 29 animals in the well field and a productivity loss of 350 mule deer during construction and operation.

Approximately 287 acres of moose critical winter range would also be disturbed (Table 4-23) or less than 0.1 percent of the 312,000 acres of moose critical winter range within the herd unit. As a result, the moose population would be reduced by 6 animals and productivity losses would amount to 62 animals during construction and operation.

Bighorn sheep use of the well field is limited to the extreme northwestern portion of the area, primarily the tops and steep slopes of Mount Darby and Fish Creek Mountain. Well field development in the area would be very limited. Significant impacts to bighorn sheep are not expected.

Impacts to well field and plant site critical ranges are considered to be long-term (i.e., for the life of the project and longer). Habitats associated with critical ranges such as sagebrush, mountain shrub, or willow would require 10 to 50 years to reestablish following rehabilitation of disturbed areas. Within the well field, many of these revegetated areas would still not be used by big game species because of their behavioral response to human activity and noise. Other less sensitive species, such as song birds and small mammals, would use successfully reclaimed areas as a modified habitat of grasses, forbs, and developing shrubs (see Vegetation Section for more discussion on acreages of habitats disturbed, lost, and reclaimed).

Big game population reductions and productivity losses discussed above were estimated from several assumptions on animal densities, sensitivity to human activity, reproductive potential, and duration of impact and are intended to provide rough estimates or relative indices to impacts and represent the best estimates at the current level of knowledge (see the Wildlife and Fisheries Technical Report for methods used).

Other significant impacts would result from the increase in human population and the accompanying human disturbance to wildlife in the form of increased hunting and fishing pressure, game violations, poaching and wanton killing, and vehicle-animal collisions which would directly impact wildife through population reductions as a result of killing and lower reproductivity. This is an impact which would be greatest during well field, plant site, and linear facility construction and continue at reduced intensity for all components throughout operation and abandonment.

Increases in human disturbance to wildlife (poaching and wanton killing) are assumed to be directly related to increases in human population. Therefore, they are predicted to increase by 66 (3,197/4,809), 37 (5,292/14,333), and 3 (1,407/45,292) percent in Sublette, Lincoln, and Sweetwater Counties, respectively, as a result of the Proposed Action for peak project-related population and gradually decreasing in subsequent years from 1984 to 1989 (see Environmental Consequences-Socioeconomic Section). This represents a significant impact in Sublette and Lincoln Counties, well over the significance criterion of 15 percent.

These figures may be conservative because transient construction workers may tend to have a greater impact on the area's wildlife than permanent residents (see Environmental Consequences-Recreation Section). Observations of the outdoor use patterns of construction workers in the Kemmerer area show much greater outdoor use than local residents especially as related to hunting, fishing, and camping (Kominski 1982, personal communication). The Evanston area has experienced a significant increase in poaching and game violations as a result of an influx of construction workers (Smith 1982, personal communication).

The impact of poaching and wanton killing on game populations is very difficult to estimate. Assumptions on detection rates of poaching violations vary widely (from 2 percent on certain poaching simulation studies to up to 20 percent for certain game law enforcement personnel), so any estimate would represent only order-of-magnitude accuracy. Based on limited existing information and predicted human population increases, about 100 to 1,000 big game animals would be lost annually through project construction to poaching and wanton killing as a result of the Riley Ridge Project.

Projected increases in hunting demand due to the Riley Ridge Project would result in greater hunting pressure and ultimately in increased harvest of game species. This can be either positive or negative depending upon WGF strategic plans at the time increased harvest occurs. Based on current plans and expected hunting pressure increases, it is likely that increased harvests would be considered a negative impact (see Environmental Consequences-Recreation Section).

Vehicle-wildlife collisions may be numerous in areas of high wildlife use and high human activity. Increased vehicular use of the area would increase the likelihood of collisions. Big game species are of high concern because of their economic and aesthetic importance, and their ability to cause severe damage to vehicles and injure or kill people. Their crepuscular (dawn and dusk) habits also increase the possibility of collisions during periods of poor visibility and peak traffic for commuting workers. Smaller wildlife such as rabbits and grouse would also experience higher mortality from vehicle-wildlife collisions, but this is not expected to affect local population levels.

Counts of big game road kills on Highway 189 between Big Piney and Fontenelle Reservoir were recorded by the Wyoming Highway Department for the winter of 1981–1982. From these numbers there is an estimated 105 mule deer and 15 pronghorn killed each year on that stretch of highway (Johnson 1983, personal communication). Assuming a direct, linear relationship between average annual traffic volume and road kills, 1986 baseline mortality would be 125 deer and 18 pronghorn. With the Proposed Action, estimated additional mortality would be 90 mule deer and 13 pronghorn during 1986, a 72 percent increase over baseline. This represents the peak impact, though impacts of this magnitude would occur throughout the construction phase. Road kill data is unavailable for other highway segments within the project area. This section of Highway 189 may represent the most heavily impacted road section within the project area based on projected increases in traffic volume and the occurrence of big game winter range. These estimates represent a large portion, but only a portion of total vehicle-wildlife collision mortality that would occur as a result of the Proposed Action.

With increased traffic there is a proportionately increased chance of a vehicle striking the endangered black-footed ferret should they be found to inhabit the project area. Increased traffic and resulting road kills would also increase the chance of vehicles striking and killing wintering bald eagles and other raptors feeding on roadside carrion. Peregrine falcons would not be expected to be impacted, nor would whooping cranes because of their sporatic use of the area and small amount of habitat affected (35 acres of meadows would be disturbed in the well field).

Well field traffic (see Environmental Consequences-Transportation Section) would pass through many categories of critical winter range resulting in an unquantified number of road kills annually.

Fisheries. Potential impacts to fish (primarily trout) and other aquatic life during well field construction include (1) direct removal of habitat and habitat degradation from sedimentation generated by pipeline and road stream crossings, (2) altered spawning activity and changes in natural movement patterns because of barriers created by culverts, (3) loss, or premature siltation, of pools and beaver ponds, (4) increased sedimentation and habitat degradation from clearing of natural plant communities, (5) loss of habitat and fish from accidental spills or pipeline ruptures of toxic substances, (6) increased harvest and demand for recreational fishing, (7) loss of fish to illegal harvest associated with projected increases in human population, and (8) loss of critical habitat and reduced survival of fish from reduced flows.

Well field streams and their fisheries resources are described in Chapter 3 and illustrated on Map 3-1. All well field streams support trout in their upper reaches. Pine Grove Creek, Middle Fork, North Fork Beaver Creek, and Trail Ridge Creek support abundant native Colorado River cutthroat trout which are generally more sensitive to habitat degradation and fishing pressure than other trout species. The best trout streams in the well field are the mainstem of South Piney Creek, Fish Creek, and Beaver Creek based on fish abundance and habitat conditions.

Map 4-1 shows the locations of pipeline stream crossings, access road corridors (including new and upgraded roads) and the locations of well pad sites that are near (within 1,000 feet) riparian zones.

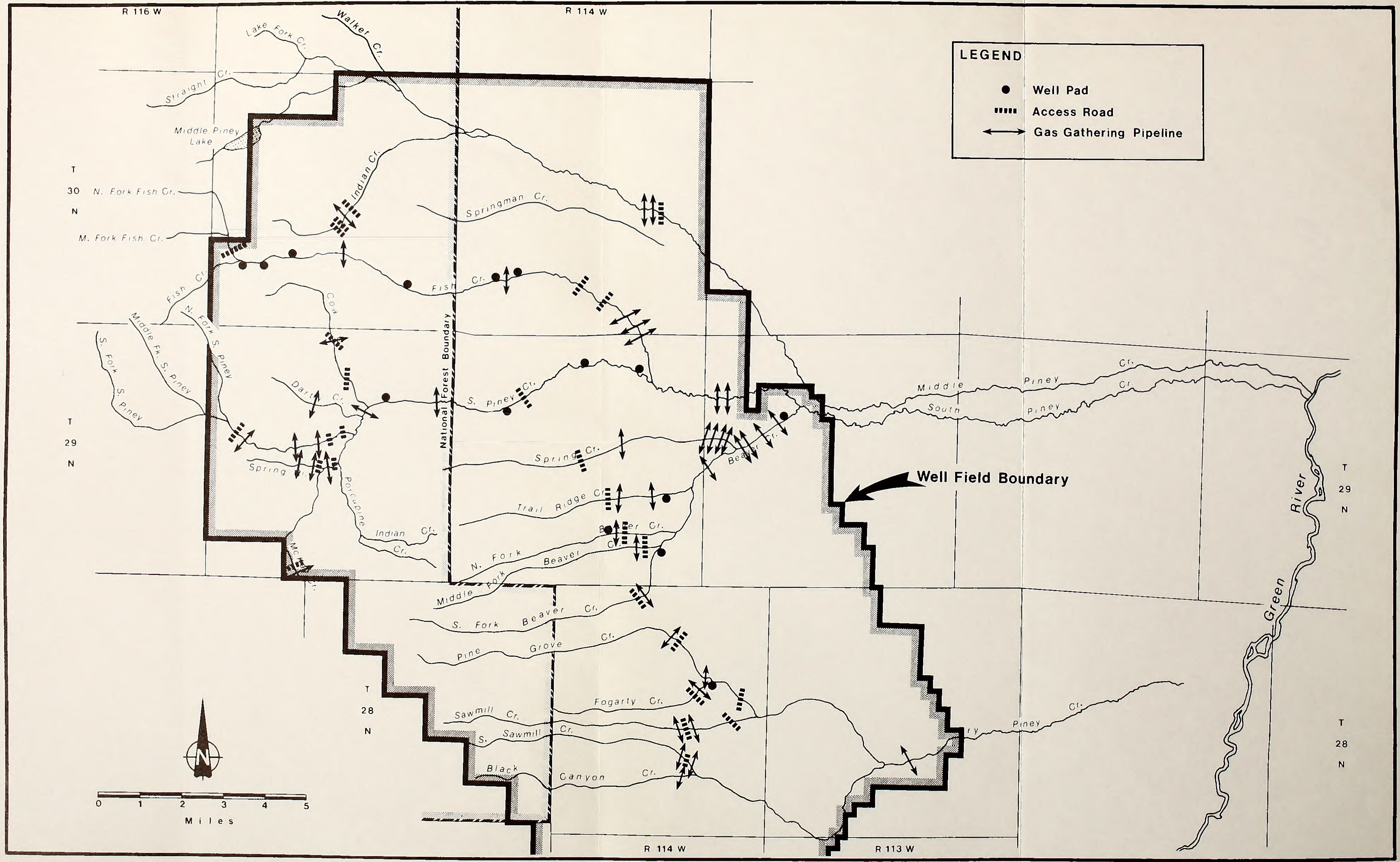
Forty-four pipeline and 27 road crossings would affect stream habitat and fish in 22 streams draining the well field (65 percent of the streams in the well field) (Table 3-19). Most of the crossings would occur in the South Piney drainage (49 crossings or 69 percent of the total crossings in the well field), affecting primarily South Piney Creek and its major tributaries. Stream crossings would generally occur during low flow (August to September) and would occur throughout the 40-year project life as different parts of the well field were developed and new roads and pipelines were constructed. In-stream construction time would be limited and would vary with stream size. Maximum construction time would be two weeks. Trenching and backfilling in the stream bed would remove stream substrates, redistribute stream sediments, and increase turbidity and suspended solids downstream. Sedimentation downstream could fill in spawning gravel, temporarily reducing available spawning habitat and limiting fish production until the next high runoff could "flush" the streams. In certain streams, construction could also prevent brook trout, and possibly brown trout, from reaching spawning habitat, or blanket gravels and subsequently smother eggs or newly hatched larval cutthroat trout, thus reducing local population abundance that season. However, given that construction would be restricted to the low flow season, occur over a wide area, be of short duration (two weeks), utilize stream protection measures, occur sporadically over an extended period of time, and affect a small total area of stream, (about 2.0 acres over the 40-year project life, assuming a disturbance of 100 feet and an average stream width of 15 feet), impacts from this activity would be short-term, localized, and insignificant.

Beaver ponds and pools are important to fish during periods of low flow, especially in drought years. Trout overwinter in the deeper pools and beaver ponds in well field streams. Reserve pit failures or accidental spills from service trucks, while unlikely could contaminate beaver pond habitat. This could affect management of well field fisheries by increasing dependence on stocking and would be considered a significant impact.

Increased sedimentation to well field streams would result from increased surface disturbance and clearing of natural plant communities for well pads, roads, pipelines, and transmission lines. Increased erosion from the 3,968 acres of disturbance would increase the amount of eroded material available to the stream. The amount of available eroded material and its effects on the stream are difficult to quantify. Adequate data are currently not available to evaluate the well field stream's capacity to transport additional sediment, but are expected to be available for the Final EIS. In addition, construction would occur continually over the project life in an unpredictable pattern; and mechanical erosion control and revegetation would be used to stabilize eroding soils (see Environmental Consequences-Soils and Vegetation Section).

In order to evaluate the potential impacts to streams and fisheries from surface disturbance, a worst-case analysis was conducted for North Beaver Creek, a typical stream with steep slopes, sensitive aquatic resources, and extensive new surface disturbance planned in its drainage. Please refer to the Affected Environment - Water Resources Section for a more detailed discussion of this analysis. Additional eroded material, deposited sediment, and suspended sediment attributable to the project would be 838 cubic feet/year, 612 cubic feet/year (0.07 inches deposited), and 226 cubic feet/year (2.9 parts/million), respectively, for the first year following construction. Over the next few years the numbers would decrease by about 8 percent each year. This appears to be a small amount of material and given that erosion control measures as described in Appendix B.7 would be implemented, actual numbers would likely be less (see Appendix C.4 for a discussion of erosion rates). However, it is not possible to predict the *impact* of this degree of sedimentation because the baseline levels of sedimentation are not known at this time. If this amount represents a small increment relative to existing quantities being transported and deposited, impacts to spawning gravels would probably be minimal. However, if the increment represents an increase in the existing sediment quantities being transported and deposited, deposition of sediment, changes in channel configurations, and filling in of spawning gravels are possible over time.

If this were the case, impacts to fisheries could be significant. Stream habitat could potentially be affected by siltation of spawning gravel, premature siltation of natural pools and beaver ponds, and reductions in productivity and available food sources. Certain smaller streams in parts of the well field which are bordered by steep slopes and sagebrush cover (like those in the southern well field) would be more susceptible to sedimentation since sagebrush does not trap or hold eroding soils as well as forested or grassland communities. About 51 percent, or 81,175 acres, of the well field is covered by sagebrush. Some streams, like Pine Grove Creek, have



MAP 4-1 LOCATION OF PROPOSED ACCESS ROADS AND GAS GATHERING PIPELINE STREAM CROSSINGS, AND WELL PADS NEAR RIPARIAN ZONES

already been adversely affected by surface disturbance (primarily grazing and oil and gas development) in their drainages. Biologists in the region have noted marked changes in habitats and fisheries in these streams (Remmick 1982). Pine Grove Creek currently supports a hybrid Colorado River cutthroat trout fishery and is currently under BLM management for habitat improvement (BLM 1978a).

A potential exists for toxic materials to enter streams through accidental spills from truck accidents or reserve pit failures during construction and operation. Diesel fuel, oil, drilling muds, and gasoline can be toxic to aquatic life. A gasoline spill in a stream in South Dakota caused the immediate death of most of the benthic organisms and numerous fish, many of which were native trout (Bugbee and Walter 1973). For the Riley Ridge Project, the probability of an accidental spill cannot be quantified, but is probably low. However, the resultant effects of a spill would be significant if it occurred in a stream containing Colorado River cutthroat trout since these trout are a unique resource in the region. In 1972 Pine Grove Creek was contaminated by an uncontrolled salt water flow encountered during the drilling of an oil well; as a result most of the 1,150 cutthroat trout stocked in the river were killed (Remmick 1981). Loss of a native population could be replaced by stocking, but not with similar genetic stock. Accidental introduction of drilling muds may or may not cause adverse effects depending on the quantity introduced. At low concentrations (1 to 1,000 microliters/liter), drilling fluids attract whitefish and rainbow trout. Whether the fluids (up to lethal concentrations of 25,000 microliters/liter for whitefish; 75,000 microliters/liter for rainbow trout) would continue to attract the fish is unknown; however, a spill with concentrations above 75,000 microliters/liter would result in a fish kill (Ferrante 1981).

Reserve pit failures could result in toxic chemicals being accidentally released into well field streams. In the past this has occurred when pits were inadequately designed to accommodate storm event runoff volumes. In 1978 Pine Grove Creek and Fogarty Creek experienced severe adverse impacts to aquatic habitats when a reserve pit failed during a thunderstorm and introduced large volumes of sediment and chemicals to the stream. Stream habitat was affected for about 2 to 3 miles, and pools and gravels were filled in with sediment, changing the stream's value as trout habitat. Fogarty Creek currently contains only a marginal trout fishery. Two hundred thirty eight wells will be drilled for the Riley Ridge Project; fifteen of these wells would be located near streams (within 1,000 feet). Although the probability of a reserve pit breaking cannot be quantified, the consequences of the event, if it occurred, would be significant.

Shallow freshwater aquifers feeding surface water streams could be contaminated by water from other aquifers with poorer water quality or toxic materials used in drilling if casing fails or is not properly installed. Contaminated streams would be less valuable as fish habitat. If toxic levels were high enough to kill food organisms or affect fish, local populations in affected stream reaches would be reduced. Current regulations require that drill hole casing be cemented in place to a depth of at least 2,000 feet in the Riley Ridge area, to prevent mixing of aquifers and contamination by toxic material, therefore, the risk of contamination should be significantly reduced.

Water for hydrostatic testing of gathering, trunk line, and sales gas pipelines and water for drilling make-up water would come from permitted nearby surface water sources. Test water would not be discharged to flowing streams, therefore, fisheries and aquatic life would not be affected. If water is withdrawn from well field streams, fish could be affected. However, since water in the well field is appropriated and regulated by the State Engineer, water for testing will likely come from irrigation water rights. Water would likely be taken from canals and trucked to the test site and existing fisheries would not be affected.

Another significant impact resulting from construction would be an increase in fishing pressure and poaching resulting from the increased human population and new access to previously unaccessible reaches of streams. In order to evaluate increases in illegal fishing, it is assumed that the increased human population will result in increased legal and illegal fishing in a linear relationship. In other words, a 10 percent increase in population would result in a 10 percent increase of legal and illegal fishing. A peak population increase of 66 percent is expected in Sublette County and 37 percent in Lincoln County. Assuming increases in population can be directly related to increases in illegal and legal fishing, a 66 percent increase in fishing pressure would result. Based on the significance criteria, a 15 percent or greater increase would have significant impacts. This would deplete fish stocks in smaller streams such as Black Canyon, Fogarty, Pine Grove, North Fork Beaver, and Coal Creeks to a point where natural recruitment would fail and stocking efforts would be necessary to maintain the fishery. Most of the above streams contain Colorado River cutthroat trout of varying genetic purity. North Beaver Creek contains one of a few populations of the pure strain in Wyoming; Rock Creek (a tributary to LaBarge Creek) contains another pure population. Rock Creek is just southwest of the well field in the Lake Mountain WSA. If current stocking and regulation enforcement are ineffective in preventing further decline, the Colorado River cutthroat trout could become classified as threatened or endangered in Wyoming.

Increased fishing pressure and poaching in Middle Piney, South Piney, Fish, Beaver, and Porcupine Creeks could result in a need for modifying management plans, such as increasing stocking rates of rainbow trout in South Piney Creek and Colorado River cutthroat in Fish Creek. Currently, natural recruitment is not maintaining existing trout populations in South Piney Creek, Dry Piney Creek, and their tributaries. Wyoming Game and Fish is augmenting the population by stocking catchable rainbows and fingerling

Colorado River cutthroat trout. Increased population and harvest will tax the ability of the state hatchery system to supply increased recreational demand, especially since several federal hatcheries have been closed. In addition to increased fishing pressure, increased abuse of the WGF 10-inch or larger keep regulation for Colorado River cutthroat would result in loss of natural recruitment of this species, create a demand for increased stocking, and limit the chances for establishing a natural reproducing population, the main objective of the WGF 10-inch rule.

Operation

Wildlife. Reclamation of areas temporarily disturbed by construction (road edges, well pad perimeters, and gathering system) would begin after construction of each facility. Areas occupied by roads and other life-of-project facilities would remove habitats from wildlife production for the life of the project and longer. Because of continued human presence and activity in the well field, population reductions and productivity losses discussed under well field construction would continue during the operation phase. Reclaimed area would gradually reestablish into wildlife habitat (see Vegetation Section) used by smaller, less sensitive species. Winter access to well sites and other facilities would continue to disturb animals already stressed by winter conditions. It is thought that elk using Finnegan Feedground on the northern half of the well field would gradually acclimate to well field activity, however, this is unknown.

Impacts of poaching, vehicle-wildlife collisions, and other human disturbance causes would continue through operation but gradually decrease as temporary construction workers are replaced with long-term oil company and contractor employees. By 1995, project-related population would decrease to 38, 9, and less than 1 percent over baseline in Sublette, Lincoln, and Sweetwater Counties, respectively (see Environmental Consequences-Socioeconomics Section). Human disturbance impacts would decrease accordingly.

Traffic volumes on Highway 189 would also be lower than construction levels. An estimated 30 mule deer and 5 pronghorn would be killed by project-related traffic during operation each year on Highway 189 between Big Piney and Fontenelle Reservoir.

Fisheries. Siltation would continue to occur during operation, but to a lesser extent because of cessation of dirt moving, and implementation of revegetation and erosion control measures (see Table C.4 in Appendix C). A constant flow of maintenance traffic to the well sites could degrade roads, creating potential for siltation to streams and spillage of toxic wastes or materials into streams. Breakage of sour gas gathering lines at a stream crossing and breakage of lines carrying toxic H_2S-laden water from the dehydration process and introduction of toxic wastes from reserve pit failures could also result in loss of fish and other aquatic organisms causing significant impacts in affected stream reaches. The probability of such a rupture would be very low; effects of pipeline ruptures are discussed under Linear Facilities.

Installation of culverts and removal of beaver ponds could significantly impact well field fisheries. Culverts that are not level with the stream bed gradient often cause channel headcutting, increased currents, and create "stair-steps" which limit movements of both adult and juvenile fish. Improperly installed culverts could prevent trout from reaching spawning habitat, resulting in reduced populations in affected streams. Given the 27 road crossings on 18 different streams, this could be a significant impact. If culverts, bridges, or open bottom culverts are installed properly, no impact would be expected.

Abandonment

Wildlife. At the end of the project, during abandonment, disturbed areas would be reclaimed and revegetated according to agency stipulations. Some habitats would be reestablished within 5 years, but critical ranges relying on shrub habitats such as sagebrush, mountain shrub, or willow would take from 10 to 50 years to become established.

Assuming that human access and activity in the well field would be at near pre-development levels and that critical ranges would take 15 years to reestablish, project impacts during well field abandonment would be a population reduction of 13 elk, 10 mule deer, and 1 moose. Productivity losses of these big game species are estimated to be 49 elk, 44 mule deer, and 5 moose in addition to those lost during construction and operation.

Fisheries. Assuming that abandoned areas are reclaimed according to stipulations and buried pipelines at stream crossings would not be removed, aquatic habitats should not be affected by abandonment.

Plant Sites

Construction

Wildlife. Construction at the plant sites and sulfur loadout facilities for the Proposed Action would remove 2,800 acres of wildlife habitat from production (see Vegetation Section). Critical ranges within these areas would be affected with the disturbance of 1,060 acres of mule deer critical winter range, (640 acres at East Dry Basin, 420 acres at Big Mesa) 640 acres of pronghorn critical winter range (East Dry Basin), and 840 acres of pronghorn critical summer range (640 acres at Craven Creek, 100 acres at sulfur loadout facility) (Table 4-23, Maps 3-2 and 3-3, see Map Pocket). The loss of mule deer critical winter range would result in a population reduction of 145 mule deer during plant site construction. This would result in a productivity loss of 1,523 deer for the 35-year duration of treatment plant construction and operation. The loss of pronghorn critical winter range would result in a population reduction of 28 pronghorn and a productivity loss of 482. The loss of pronghorn critical summer range cannot be reliably correlated to population reductions or productivity losses.

Access roads and worker traffic to and from the plant sites would pass through many categories of important wildlife areas (Maps 3-2 and 3-3, see Map Pocket) and result in many road kills annually. Plant site access through critical ranges would also increase the opportunity of human disturbance impacts of poaching, wanton killing, and harassment as discussed under well field construction.

Plant site construction would remove 191 acres of prairie dog towns, a potential black-footed ferret habitat. Because of the acreages of prairie dog towns potentially affected by the Riley Ridge Project (including corridor impacts), the FS and BLM have has issued a "may affect" decision in their biological assessment to the Fish and Wildlife Service. Therefore, this EIS recognizes a significant impact to the black-footed ferret (see Significance Criteria). Black-footed ferret surveys would be required in prairie dog towns to be removed or disturbed prior to construction. The FS and BLM are currently evaluating impacts to the other endangered species.

Fisheries. Aquatic habitats would not be affected by East Dry Basin, West Dry Basin, and Big Mesa plant site construction because of their general remoteness from flowing streams. Construction at the Craven Creek plant site would affect minor ephemeral tributaries to Craven Creek. These effects would be insignificant because of the limited value of aquatic resources of Craven Creek. Storm water runoff from construction of the sulfur loadout facility near Opal could result in a small increase in sediment delivered to the Hams Fork. Impacts would be minimal and insignificant since erosion control measures would be used.

Operation

Wildlife. Plant operation would not disturb additional wildlife habitat. Wildlife population reductions and productivity losses discussed under construction would continue throughout the operation phase. Many human disturbance impacts discussed previously would decline as construction stabilizes into operation.

Plant operation wastewater (contaminated with H_2S, reduced sulfur, and trace metals, see Chapter 1) would be disposed of through permitted deep well injection at American Quasar and Exxon plant sites. Northwest would dispose of its wastewater in a 30-acre evaporation pond at the Craven Creek site. The pond would be attractive to waterfowl, waterbirds, and other wildlife species in the area because of the scarcity of water throughout the region. The water in the pond would be highly toxic to any animals which ingest it, potentially killing an unquantified number of waterfowl, waterbirds, songbirds, small mammals, and big game species (pronghorn or deer) depending upon the proximity of the pond to industrial activity.

Employees traveling to and from work would continue to negatively impact wildlife through disturbance and collision.

Fisheries. Northwest proposes to divert 81 acre-feet per year of surface water from the Green River for operation of its Craven Creek plant; all other applicants would depend on pumping groundwater from the Wasatch Formation to supply their plants. The Green River diversion would result in a reduction of less than 0.24 percent during the winter low-flow period and therefore would have insignificant impacts on aquatic resources. The intake structure could impinge or entrain fish, potentially reducing local populations. Assuming groundwater pumping would be too deep to affect surface water flow, aquatic habitats would not be affected by plant operation.

Wastewater (contaminated with low concentrations of H_2S) would be disposed of in deep wells or in evaporation ponds. No impacts to aquatic stream life are expected from wastewater disposal at the plant sites.

The effects of acid deposition from SO_2 and NO_x emissions from the treatment plants on three representative susceptible lakes in the Bridger Wilderness were evaluated. Using very conservative modeling, it was determined that the greatest depression in pH that may occur would be 0.15 pH units in Clear Lake (South) in the Big Sandy Creek drainage. This pH reduction would result in a pH of 6.3, which would not significantly impact the fishery or aquatic resources of this lake. Depression of pH in the other lakes studied would be less than 0.03 pH units; thus, no significant impact on aquatic ecology or trout of these lakes would be expected since the pH would be within the tolerance level for fish species in the Bridger Wilderness as defined by the Significance Criterion (pH of 6.0). This significance criterion is based on field data summarized by Haines and Schofield (1980) and reflects the pH at which reproductive failure can occur.

While significant impacts, to fish populations are not expected due directly to the predicted pH changes, the loss of fish populations is one of the last aquatic biological effects of acidification. In the ultra-oligotrophic waters of the Bridger Wilderness, vegetative species diversity may decline as the pH decreases. However, productivity may remain unaffected. Given the lack of data regarding the types of vegetation species in high altitude Bridger Wilderness lakes as well as how the vegetative species could be impacted as pH declines, or how changes in vegetation could affect habitat quality for other species (i.e., fish or food organisms), it is unknown whether significant impacts to aquatic vegetation could occur for the pH changes predicted in this assessment. See the Environmental Consequences-Air Quality Section.

Abandonment

Wildlife. At the end of the project when buildings are dismantled and removed and reclamation and revegetation is complete, wildlife habitat would gradually regenerate. Assuming that big game critical range habitats on the plant sites would take 15 years to reestablish following successful revegetation, project impacts during plant site abandonment would be a population reduction of 73 mule deer and 14 pronghorn as compared to pre-development conditions and a corresponding productivity loss of 326 mule deer and 103 pronghorn.

Fisheries. Aquatic habitats and fisheries resources would not be significantly affected by plant site abandonment since perennial streams are not present at the plant sites.

Linear Facilities

Construction

Wildlife. Construction of roads, pipelines, transmission lines, and other linear facilities off the well field would disturb 6,084 acres of wildlife habitat or 47 percent of the total 12,852 disturbed acres occupied by the Proposed Action (see Environmental Consequences-Vegetation Section). Disturbance to critical ranges would include 1,755 acres of mule deer critical winter range, 1,641 acres of pronghorn critical winter range, 1,051 acres of pronghorn critical summer range, 460 acres of elk critical winter range, and 299 acres of moose critical winter range (Table 4-23). Construction of these linear facilities would take place over several years so not all of these acreages would be disturbed at any one time. Open trenches will be provided with fill areas so as not to impede animal movements. Corridor disturbances would be reclaimed and revegetated following disturbance and a modified wildlife habitat would exist once revegetation is complete (less than 5 years). Because of the short-term nature of the impact and the fact that there would be little human disturbance along the corridors once construction is completed, big game population reductions and productivity losses are not expected. Similarly, impacts to wild horses would not be significant.

There would be 388 acres of prairie dog towns disturbed during corridor construction resulting in the FS and BLM "may affect" decision regarding impacts to the endangered black-footed ferret as discussed earlier, a significant impact. The sales gas and CO_2 pipeline from East and West Dry Basin (Maps 3-2 and 3-3, see Map Pocket) would cross the Green River which is used by wintering bald eagles, but construction would be of short duration and impacts are not expected.

The transmission line from Naughton Power Plant and the sulfur pipeline would pass near (within ¼ mile) a known sage grouse strutting ground west of the Craven Creek plant site, potentially disrupting strutting (reproductive) activity if construction occurs during March through May.

Fisheries. Construction of linear facilities outside of the well field (power transmission lines, sales gas pipelines, CO_2 pipelines, sour gas trunk lines, the water supply pipeline, and the sulfur pipeline) would affect aquatic resources and fisheries in Middle Piney Creek, South Piney Creek, Dry Piney Creek, the Green River near Big Piney and LaBarge, and the Green River's southern tributaries; LaBarge Creek, Fontenelle Creek, Muddy Creek, Slate Creek, and Hams Fork River (Table 4-24).

Transmission line stream crossings would have a minimal and temporary effect on streams. Construction and operation traffic would cross stream beds on existing bridges, except in very remote areas where crossings would be infrequent resulting in slight disturbance to the stream bed. Impacts to aquatic resources would be short-term, localized, and insignificant.

Pipeline construction impacts would be similar for all pipelines buried at stream crossings including sales gas, CO_2, and sour gas pipelines. Impacts include removal of bank-side vegetation and stream bottom habitats, and increased suspended solids, turbidity, and downstream siltation. Pipeline stream crossing construction could alter fish movement for the 2-week construction period. Since construction would occur at low flow, brook and brown trout moving to spawning areas upstream could be temporarily blocked. However, given the short construction period (2 weeks) spawning would not be significantly affected. Sediment deposited in bottom habitats may temporarily alter food base organisms for fish. Sediment would remain until scoured by the next major runoff event, either a storm or seasonal cycle. Given the small area affected and the timing of construction, impacts would be short-term and insignificant.

Hydrostatic test water would be withdrawn from existing surface water. Withdrawal would be permitted by the State Engineer. Water would likely come from existing irrigation water rights and withdrawal should not affect existing fisheries resources. Test water would not be discharged to flowing streams; therefore, fisheries would not be affected. In extremely dry years, when large volumes of water are involved, the State Engineer may require test water to be returned to the stream. In this case, water would be treated prior to discharge to protect aquatic life. No impacts from testing are anticipated.

Construction of the water supply pipeline to Craven Creek would not affect any perennial streams or aquatic resources. Construction of the water intake structure on the Green River near Fontenelle would result in a small area of habitat loss, and increased suspended solids and turbidity. Impacts to fish would be short-term and minimal.

The sulfur pipeline would be suspended over Fogarty Creek, Dry Piney Creek, LaBarge Creek, Fontenelle Creek, and Slate Creek. All of these creeks support trout fisheries. No significant impacts to fisheries resources from construction of the sulfur pipeline are anticipated. Construction of the suspension structures may disturb some riparian vegetation (see Vegetation Section). Construction equipment would use existing roads; permission would be requested to cross creeks with solid gravel bases if roads are not present. Where streams are too deep to cross or have muddy bottoms, culverts would be installed. Drain pits for maintenance of the sulfur pipeline would be

TABLE 4-24
STREAMS AND FISHERY RESOURCES AFFECTED BY LINEAR FACILITIES
PROPOSED ACTION

Streams	Sulfur Pipeline	Transmission Lines	Sour Gas Pipeline	Sales Gas & CO_2 Pipeline
North Piney Creek[1]				
Middle Piney Creek[1]				
South Piney Creek(1)				
Dry Piney Creek[2]	X	X	X	X
LaBarge Creek(1)	X	X	X	
Muddy Creek(3)	X	X	X	
Fontenelle Creek(1)	X	X	X	
Slate Creek(3)	X	X	X	
Hams Fork (Opal)[3]	X			
Willow Creek[1]				
Alkali Creek[4]	X			
Bitter Creek[4]	X			
Jensen Wash(3)	X			
Big Sandy River[1]	X			
Blacks Fork[1]	X			

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[1] These streams are Class II cold water game fish streams that generally contain rainbow, brown, brook and cutthroat trout. Parentheses ( ) indicate stream is not officially classified as this class stream but support similar fishery resources.

[2] Dry Piney Creek near crossing supports a marginal trout population.

[3] These streams are Class III streams that support primarily nongame fish species such as suckers and minnows. Parenthesis ( ) indicate stream is not officially classified as this class stream but supports similar fishery resources.

[4] These streams may support marginal non-game fisheries or are classified Class IV streams (incapable of supporting fish).

located out of riparian areas and water ways. Instream construction of culverts for vehicle passage would eliminate a small area of stream bottom habitat and increase suspended solids, turbidity, and downstream siltation. Impacts to aquatic resources would be short term and localized.

Operation

Wildlife. Following construction, many of the corridors (pipeline, transmission line) would be reclaimed. After rights-of-way are stabilized and revegetated (within 2 to 5 years of construction, see Erosion Control Appendix), conditions would favor species adapted to disturbed or transitional vegetative communities and would result in local changes in abundance and distribution of the smaller animal species.

Transmission line operation may impact whooping cranes, bald eagles, and other birds which may strike transmission wires associated with the project resulting in death or injury (FWS 1978). These birds would be most susceptible to collision when transmission lines cross major drainages or large riparian areas. For the Proposed Action, transmission lines would not cross the Green River, however they would cross Fontenelle Creek and LaBarge Creek. Collisions are most likely to occur during periods of low light levels and poor visibility due to weather, and during periods of migration (Malcolm 1982). Electrocution hazards would be avoided by the H-frame configuration and conductor and ground wire spacing of the transmission towers. The above-ground sulfur pipeline would not physically impede animal movements, but certain species (elk, mule deer, pronghorn) or individuals may react behaviorally by not crossing under the line which could affect big game distribution.

Potential impacts of sour gas ruptures or leaks on wildlife are related to analyses performed for human health and safety (Health and Safety Section). Potential for a rupture or leak along any particular segment of the gathering lines or trunk lines is very small. Because of the mobility of wildlife populations, the probability of effects to wildlife cannot be assessed. If a rupture occurred within a wildlife concentration area during a period of year and time of day when wildlife were concentrated near the rupture, and rupture and meteorological conditions were both the worst possible case, many (but an unknown number of) animals could be lost. Such a possibility does exist, but probabilities are extremely low (see Environmental Consequences-Health and Safety Section) and wildlife impacts are not considered significant.

Fisheries. The major potential impacts from pipeline operation would result from a sour gas pipeline rupture or leak or a molten sulfur pipeline break. A sour gas pipeline rupture at a stream crossing could release highly poisonous and soluble H_2S to Dry Piney, Muddy, LaBarge, Fontenelle, or Slate Creeks. H_2S has a maximum solubility of 4,000 milligrams/liter in water. Concentrations of H_2S greater than 2 micrograms/liter (.0002 milligrams/liter) would be hazardous to aquatic life (EPA 1976). Since H_2S is very toxic to aquatic life, a

H_2S pipeline rupture would result in an immediate fish kill. Automatic safety block valves would prevent a continuous H_2S release. The probability of a sour gas line leak is low (0.002 spills/mile/year) (see Environmental Consequences-Health and Safety Section). Given this probability and the small number of miles of stream crossing (less than 1 mile), a spill during the 40-year life of the project is not expected. However, a leak or break in the sour gas trunkline at Fontenelle Creek or La Barge Creek could have significant effects downstream and potentially could affect Fontenelle Reservoir. Insufficient data are available to predict the impact of such an event. Several variables including the size of rupture or leak, volumes released, season, and stream flow could affect the magnitude and significance of a rupture or leak event. Aquatic resources, including benthic organisms (food chain organisms) and fish, several miles downstream from a spill could be killed, resulting in lowered population numbers in the affected stream reach.

Improperly installed culverts at stream crossings along the sulfur pipeline could create barriers to fish movement. Impacts could be significant if fish are unable to reach spawning areas. Reductions in local populations would be expected. Properly installed culverts would not impact fisheries during operation.

A spill of molten sulfur would not be toxic to aquatic life, but would heat the water, causing temperature stress in aquatic organisms, primarily immobile benthic invertebrates, immediately below the pipeline. In addition, the sulfur would crystallize and coat the stream bottom below the spill modifying stream bottom habitat. Benthic communities and fish habitat would be lost in a small localized area by the sulfur coating and adult fish would probably migrate out of the area. Assuming the probability of a sulfur pipeline rupture is the same as other pipelines (.002 spills/mile/year), a break or rupture in the sulfur pipeline at a stream crossing is not probable in the life of the project.

A break or leak in a sales gas (CH_4) or CO_2 pipeline would not have significant toxic effects on the affected streams aquatic biota. Fish may avoid the immediate area of a break and dissolved CH_4 could create a temporary barrier to fish movement. Impacts would be very short-term (minutes to hours) and insignificant. In the event of a pipeline rupture at a stream crossing, repair of the pipeline could require excavation and replacement of the pipe. Impacts would be similar to construction impacts.

Abandonment

Wildlife. Abandonment would cause some localized disturbance on some portions of the transportation corridors as surface facilities are removed; underground facilities would be left in place. Once abandonment is completed and locally disturbed areas are revegetated, wildlife habitats would continue to regenerate. No significant impacts are expected.

Fisheries. Pipelines buried at stream crossings would remain in place after use resulting in no impacts to aquatic resources. Assuming all transmission lines and 80 percent of the plant site access roads would also remain in use, impacts to fisheries (from sedimentation) would be minimal.

Cumulative Impacts

Wildlife

Potential cumulative impacts of the Riley Ridge Project and other interrelated projects would be minimal. The Chevron Chemical Phosphate Project would result in disturbance of 341 acres of prairie dog towns (with a long-term loss of 198 of those acres) approximately 4 miles southeast of Rock Springs. This, and prairie dog town losses from the Riley Ridge Project, would constitute a cumulative impact of potential habitat reduction for the endangered black-footed ferret. In addition, human population increases (Table 4-17) from the Phosphate Project and the Bureau of Reclamation's Big Sandy Salinity Project in Sweetwater County, and Exxon's Road Hollow Gas Treatment Plant in Lincoln County would result in cumulative impacts to wildlife through increased poaching, wanton killing, vehicle-wildlife collisions, and harassment.

Fisheries

Cumulative impacts to fisheries resources would result from the additional surface water requirements of other interrelated projects. In addition to the 81 acre-feet/year of water that would be diverted from the Green River for operation of the Craven Creek plant site; the Chevron Phosphate Project would divert another 22,500 acre-feet/year from Fontenelle Reservoir. This represents a 0.49 percent annual reduction in flow of the Green River. This consumptive use would increase salinity at Imperial Dam by 1 milligram/liter (BLM 1983). By itself the Riley Ridge Project would reduce flow in the Green River by 0.24 percent (during low flow). Cumulative impacts of other developments downstream would also increase depletions and salinity in the Green River (BLM 1983b).

Summary

Wildlife

Impacts of the Proposed Action to wildlife critical ranges have been summarized in Table 4-23. Significant impacts would include disturbance to elk critical winter range and calving grounds within the well field, disturbance to riparian habitat within the well field, and indirect impacts caused by increased human population within the project area.

Critical winter range disturbances in the well field and plant sites are expected to result in population reductions of 63 elk, 174 mule deer, 6 moose, and 28 pronghorn during construction and operation, and decrease of 13 elk, 83 mule deer, 1 moose, and 14 pronghorn during abandonment. Productivity losses (animals not born and growing to maturity) over the life of the project as a result of the above population reductions would be 681 elk, 2,243 mule deer, 67 moose, and 585 pronghorn. Critical range disturbances along the corridors are not expected to result in population effects because of the short-term nature of the disturbance. Wild horses and bighorn sheep would not experience significant impacts.

In addition, an unquantified number (more than 100 but less than 1,000) of big game animals would be killed annually by poaching and wanton destruction. A similar number would be killed by vehicle-animal collisions due to traffic associated with the Proposed Action. This impact would be greatest during construction and decrease during operation and abandonment.

The FS and BLM have issued a "may affect" decision on potential impacts to the black-footed ferret as a result of predicted disturbances to white-tailed prairie dog towns (potential ferret habitat), a significant impact.

Peregrine falcons would not be expected to be impacted because of their sporadic use of the area and wide-ranging habits. Whooping cranes would not be expected to be impacted because of the small amount of crane habitat loss. Only 35 acres of meadows would be removed from the well field, and other areas of crane habitat should not be seriously affected. The small number of cranes using the area and the sporadic nature of their use would enable whooping cranes to adjust to using other available habitat. However, there is a possibility that cranes may strike transmission lines. Project activities would not significantly affect bald eagles because concentrations of eagles occur along the Green River during winter. River crossings are not planned in the Proposed Action. However, there is a possibility that eagles may also strike transmission lines. The FS and BLM are currently evaluating impacts to these species.

Overall, implementation of the Riley Ridge Project would result in significant impacts to wildlife. Mule deer, pronghorn, and moose herd size in the area would decrease as a result of critical range disturbances, and increasing human populations would increase annual big game mortality. Elk herd size would probably be similarly impacted with the possibility that portions of the well field now used as a natural wintering areas would be abandoned for an unknown time period. Cumulatively, this project would contribute to big game herd size decreases in this part of Wyoming and increase the potential for impacts to endangered species.

Fisheries

The significant impacts to the Colorado River cutthroat trout and other game fish resources from the proposed activities of the Riley Ridge Project would result from (1) increased beaver pond siltation resulting from land and stream bed disturbances, and (2) reduction of fish population due to increased fishing pressure. Less probable or unquantifiable events that could impact fisheries are (1) sour gas pipeline ruptures which could release highly toxic H_2S into streams, (2) failure of reserve pits, (3) molten sulfur pipeline ruptures, and (4) increased stream sedimentation eliminating spawning gravels.

Because of planned construction, operation, and abandonment procedures and government stipulations, potential significant impacts would be substantially reduced. Regardless of mitigation measures, however, stream and beaver pond siltation as well as fishing pressure would be expected to increase. The effects of siltation would not be acute, but would occur slowly over a long period of time. This chronic phenomenon could contribute to increased habitat degradation especially in streams already experiencing sedimentation problems (those in the southern portion of the well field). This may render some marginal streams incapable of supporting trout. Increased fishing pressure and abuse of the 10-inch keep regulation for Colorado River cutthroat trout could reduce population densities and age structure to severely limiting natural recruitment, resulting in an increased demand for fish stocking.

The streams affected by corridor crossings would be impacted for a short time (less than one year) with no long-term detrimental effects. Accidental release of H_2S, however, would have a severe, acute, and significant impact on fisheries, with fish kills of major proportions possible.

Overall, the project presents the possibility of adversely affecting streams in the well field area as well as the Green River, LaBarge, Fontenelle, and Slate Creeks. Increased long-term siltation coupled with increased fishing pressure, a sour gas pipeline rupture, and a few accidental spills of drilling muds could create sufficient stress on the existing fishery to significantly reduce its future value.

HEALTH AND SAFETY

Significance Criterion

1. Exposure to an H_2S concentration that would cause discomfort and that *might be* lethal to certain sensitive individuals, e.g., to the very old, very young, or infirm (instantaneous concentrations of 500 parts/million or a 15-minute average concentration of 100 parts/million). Concentrations at significant levels would cause eye irritation, loss of smell, and possible coughing. Exposure to an instantaneous concentration of 1,000 parts/million (almost always lethal to all individuals).

Well Field

Historic information on blowouts in well fields from drilling and production operations was obtained from various sources. Based upon historical data for sour gas well drilling in Alberta, Canada during 1970–1980, it was found that during sour gas drilling, 1 blowout can be expected for every 630 wells drilled (Layton 1982, personal communication). During production the historical blowout rate is 1 per 3,000 well-years. These data provided an indication of the approximate probability of a well blowout during drilling and production operations. Analysis results for the Riley Ridge Project show that for an individual well, the probability of blowout during drilling is 0.0016 (or 0.16 percent) and the probability of blowout during a producing year is 0.00033 (or 0.033 percent). It is expected that 2.8 blowouts would occur during the drilling and producing lifetime of the project (30 to 40 years). One blowout has already occurred in the project area.

To minimize potenital impacts to the general public, all drilling operations would be required to conform to an approved H_2S contingency plan. The plan would include: H_2S well controls, restricted public access, evacuation plans, safety areas, emergency fire and breathing equipment, warning devices, flaring of an uncontrolled blowout, and allied measures.

In the event of a blowout, flaring would be initiated. If the raw gas stream would not burn otherwise, sufficient fuel gas would be introduced into the flare stack stream to initiate and maintain combustion. Fuel gas should be stored on-site for this purpose.

A modeling analysis was undertaken in order to estimate the health impacts that could occur as a consequence of a blowout. For this purpose, a generic blowout was postulated from information provided by the applicants. The results, which are described in detail in the Health and Safety Technical Report, show that the H_2S levels from a blowout are highly sensitive to the prevailing meteorological conditions and the assumed height of the release. Conservative assumptions regarding these variables show that, depending on the H_2S content of the gas, any persons within 1 to 2 miles from the well could be exposed to H_2S levels of at least 100 parts/million for 15 minutes; this exposure meets the significance criteria presented above. Individuals within one-quarter to one-half mile from the well could be subjected to lethal levels of at least 1,000 parts/million.

The exposure risk to a person standing both downwind and within these distances during drilling is estimated to be less than 0.0003 (or 0.03 percent), a risk that is roughly equivalent to the United States 1978 automobile death rate. During production the exposure risk per year is estimated to be less than 0.00002 (or 0.002 percent). a risk that is roughly equivalent to the United States 1978 fire and burns death rate.

Plant Sites

Each of the proposed gas treatment plants would have an emergency flare to combust toxic H_2S gas streams under plant upset conditions. The duration of a flaring event is estimated at one-half hour to one hour, and the annual frequency of upset conditions requiring flaring is estimated to range from 1 to 12 events per year, according to information provided by the applicants. The likelihood of pipeline ruptures within the gas treatment plants is considerably smaller than ruptures to the trunk lines, and public access to the hazardous areas of the plants would be severely restricted. Thus, significant impacts to the general public are not anticipated.

Linear Facilities

A pipeline rupture could occur in the Riley Ridge area. Historical data describing past pipeline rupture statistics were used to quantify this probability. As discussed in the Health and Safety Technical Report, historical data on sour gas lines in Alberta, Canada and on sweet gas lines in the United States support a rupture probability estimate of 0.0002 (or 0.02 percent) ruptures per pipeline mile-year (or 1 rupture per 5,000 mile-years). Historical data also suggest that ruptures occur more frequently in smaller pipes and in older pipes; however, the data are insufficent to quantify these effects.

Based on a rupture probability of 0.0002 (0.02 percent) ruptures per mile-year and the number of miles of gathering pipelines and trunk lines proposed by each applicant, the probability of ruptures was estimated for the Proposed Action. These probabilities are shown in Table 4-25. There is a greater likelihood of a rupture in the gathering pipeline system than in the trunk lines simply because there are more miles of pipeline in the gathering system. In any year there is a total probability of 0.074, or about a 7 percent chance that one or more ruptures would occur in the gathering system, but there is a total probability of 0.0086, or only about a 1 percent chance, that a trunk line would rupture.

There are numerous differences between gathering pipeline systems and trunk lines. Gathering pipeline systems would generally be located in sparsely populated areas whereas trunk lines would pass closer to local communities. Gathering systems would generally be constructed of smaller diameter pipes, and the block valve spacing for gathering lines is usually less than for trunk lines. Therefore, if a rupture were to occur, the mass of gas released would be less from a gathering pipeline than from a trunk line. For these reasons, the consequences of gathering line and trunk line ruptures are described separately below.

Gathering Pipelines

Air quality modeling was conducted to evaluate the consequences of a gathering pipeline rupture. Because the effects of a gathering line rupture are relatively local and the gathering systems would not be in the immediate vicinities of designated population areas, the analysis was made in a generic manner, that is, not tied to a specific location for a gathering line rupture. The analysis revealed that the predicted concentrations are highly sensitive to the assumptions made about the initial rise of the released gas. The results are also sensitive to variations in the applicants' block valve spacing, pipeline diameters, pressures, and assumed H_2S gas content. In particular, the results vary significantly with mass flow rates and

TABLE 4-25
PROBABILITY OF GATHERING PIPELINE AND TRUNK LINE RUPTURES
PROPOSED ACTION

	Miles of Pipeline or Trunk Line	Probability of One or More Ruptures in a Year	Mile-Years[1]	Probability of One or More Ruptures During Project Lifetime	Expected Number of Ruptures During Project Lifetime
Gathering Pipelines					
Quasar	72	1.4%	2,160	35%	0.43
Williams	27	0.5%	810	15%	0.16
Northwest	75	1.5%	2,250	36%	0.45
Exxon	213	4.2%	8,520	82%	1.70
Total	387[2]	7.4%	13,740	94%	2.74
Trunk Lines					
Quasar					
East Dry Basin	11	0.2%	330	6.4%	0.07
Williams[3]					
Exxon[3]					
Northwest					
Craven Creek	43	0.86%	1,290	22.7%	0.26

[1] Exxon proposes a 40-year project lifetime. The remaining applicants propose a 30-year project lifetime.

[2] Greater than right-of-way mileage due to parallel pipelines in the same right-of-way.

[3] Williams's pipeline to East Dry Basin and Exxon's pipelines to the West Dry Basin and Big Mesa sites would be less than 30 inches in diameter and are considered as part of the gathering system.

therefore with pipeline sizes, which range from 4 inches to 26 inches in diameter for the Proposed Action. To experience a significant (or greater) risk a person would have to be situated downwind at the time of the rupture. The critical distance from the rupture is dependent upon the prevailing meteorological conditions. The greatest distance at which concentrations could be significant would occur during low wind speed, stable atmospheric conditions. These conditions are estimated to occur about 30 percent of the time.

However, in general, the following conclusions can be drawn.

- A rupture of a 4-inch pipeline is not likely to result in lethal H_2S doses even if an individual were standing near the pipeline. However, an individual located within about 0.1 mile (600 feet) might experience eye irritation or a loss of smell (a significant impact).
- A rupture of a 6-inch pipeline could result in lethal doses to persons located within a few hundred feet. People within about 0.5 mile of the rupture could experience discomfort (a significant impact).
- A 12-inch pipe, if ruptured, could cause lethal dose to a distance of one-fourth to 1 mile, depending on the prevailing weather conditions, specific pipeline design, and H_2S content of the gas. Significant impacts, those which may not be lethal but would cause discomfort, could be experienced to a distance of 2 miles.
- Larger pipes in the gathering system (18 to 26 inches) would have the greatest areal extent of impact if ruptured. Lethal doses might be experienced to a distance of 3 to 4 miles, and discomfort (significant impacts) might be experienced to 6 miles if prevailing meteorological conditions were adverse.

Trunk Pipelines

Quasar's 11-mile trunk line to the East Dry Basin plant site, and Northwest's 43-mile trunk line to the Craven Creek plant site are the only sour gas trunk lines in the Proposed Action. Exxon's pipelines would be smaller than 30 inches in diameter and were considered as part of the gathering system. Quasar proposes a 10-mile block valve spacing for its trunk line;

Northwest proposes a 5-mile block valve spacing in rural areas and a 2.5-mile block valve spacing where the line passes populated areas.

The distribution of H_2S from a rupture was estimated for three meteorological conditions: low wind speed stable conditions typical of clear nights (worst-case); a moderate wind speed neutral condition typical of average conditions in the area; and a low wind speed unstable condition representative of summer afternoons.

Table 4-26 shows the modeling results expressed in terms of the distances from the trunk lines beyond which a person would not be exposed to lethal, or to significant, H_2S concentrations. As shown during unstable atmospheric conditions (typical of summer afternoons), a person located downwind and within about 0.7 mile of a trunk line rupture would be likely to experience a significant dose. During stable atmospheric conditions (most likely to occur during the evening and early morning hours), a person might be exposed to a lethal dose within 2 to 3 miles of a trunk line rupture and experience a significant dose (discomfort) out to downwind distances of about 5 to 7 miles.

A quantitative risk assessment for the Proposed Action was undertaken to assess the risk of H_2S exposure in the populated areas of LaBarge, Big Piney/Marbleton, Calpet, and the Fontenelle Recreation Area. The results are shown in Table 4-27. It was found that Calpet would be at risk of exposure to lethal levels if Northwest's trunk line were ruptured. By comparison with Table 4-28 Calpet's annual individual risk of lethal exposure is roughly equivalent to the annual risk of death from an automobile accident. Risk of death in a traffic accident in Sublette County is approximately 0.00066. The remaining populated areas would be at risk of experiencing discomfort, and then only during light wind stable meteorological conditions. They are not at risk of exposure to lethal doses. Taking into account both the individual annual risks and estimated total populations for each of the population areas, it may be estimated that there is less than 1 chance in 100 that even 1 person (and only at Calpet) would be at risk of lethal exposure from trunk line rupture in any year. Correspondingly, there is slightly less than 1 chance out of 2 that even one person from the general population would be at risk of discomfort level exposure in any year.

Cumulative Impacts

The only interrelated project that would involve sour gas is Exxon's Road Hollow project. Because of the geographic location of this project (23 miles south of Kemmerer), no cumulative health and safety impacts are anticipated.

Summary

Significant impacts to human health and safety could result from the release of sour gas (H_2S) during well drilling (blowouts), or pipeline leaks or ruptures. During the life of the project (30 to 40 years), 2.8 well blowouts would be expected to occur. Within one-quarter to one-half mile of the well a person would receive a lethal dose of H_2S, while within 1 to 2 miles of the well a person would receive a dose causing discomfort.

During the life of the project, approximately 2.74 leaks or ruptures of gathering pipelines would be expected to occur. Releases of H_2S could be lethal at distances up to 4 miles and could cause discomfort at a distance of 6 miles, depending on the size of the pipeline that ruptured and the volume of gas released.

The rupture of a sour gas trunk line is much less likely to occur due to the fewer miles of line. Approximately 0.33 ruptures would be expected during the life of the project. Lethal doses of H_2S could occur out to 3 miles while doses causing discomfort could occur out to 7 miles from the point of rupture, depending on meteorological conditions.

TABLE 4-26
DOWNWIND DISTANCES FOR SIGNIFICANT H_2S CONCENTRATIONS FROM RUPTURES OF TRUNK LINES

Applicant	Trunk Line Diameter (inches)	Block Value Spacing (miles)	Downwind Distance for Lethal Dose (miles)		
			Stable Atmosphere	Neutral Atmosphere	Unstable Atmosphere
Quasar	30	10	2.5	0.9	0.4
Northwest	30	5[1]	2.9	1.0	0.5
	30	2.5	2.2	0.9	0.4
			Downwind distance for Significant Dose (miles)		
Quasar	30	10	6.8	1.4	0.7
Northwest	30	5[1]	5.6	1.7	0.7
	30	2.5	3.4	1.5	0.6

[1] Based on 5-mile block valve spacing for rural areas; 2.5-mile spacing for populated areas.

TABLE 4-27
ANNUAL RISK TO POPULATED AREAS
PROPOSED ACTION

Populated Area	Individual Annual Risk of Lethal Exposure[1]	Individual Annual Risk of Significant Impact[2]	Approximate Number of People (in 1990)[3]
LaBarge	negligible[4]	0.00013	1,206
Big Piney	negligible	0.00008	1,177
Marbleton	negligible	negligible	1,134
Calpet	0.00023	0.00037	54
Fontenelle Recreation Area	negligible	0.00018	1,210

[1] Risk values shown in this table, such as 0.00013, mean 13 chances per 100,000.

[2] Significant exposures are those that would cause eye irritation, coughing, loss of smell, or other discomfort.

[3] Includes people in incorporated and unincorporated areas.

[4] Negligible means that the modeling analysis indicates **no** risk.

TABLE 4-28
RISKS FROM VARIOUS ACCIDENTS AND NATURAL DISASTERS

Risk-Producing Activity	Risk (Deaths/ Population/Year)
• Smoking (20 Cigarettes/Day)	0.005
• Automobile	0.00025
• Industrial	0.00017
• Falls	0.000077
• Airplane Crashes	0.0000077
• Lightning	0.0000005
• Tornadoes	0.00000044

Source: L. D. Atwell and W. B. Andrews. 1979. Risk assessment for sour gas facilities, Energy Resource Conservation Board, Calgory, Alberta, Canada.

The number of people potentially exposed to H_2S would depend on the location of a blowout or rupture. With the exception of drilling crews, exposure to significant levels of H_2S would most likely occur in Calpet, LaBarge, Big Piney/Marbleton, or Fontenelle Recreation Area, which are near the sour gas trunk line. A total of 0.01 person would be at risk of lethal exposure from trunk line rupture each year, while 0.49 people would be at risk of discomfort level exposure.

WATER RESOURCES

Significance Criteria

The impacts discussed for water resources are classified as significant or insignificant based on the degree of impact as measured against scientific and social (or human) criteria. The criteria that follow are derived from regulatory standards, research standards and/or standards based on best professional judgement of resource specialists. The water resource criteria are tied to water users including agricultural, domestic, industrial, natural systems, and recreational. Impacts to surface water would be considered significant if:

1. The quantity or quality of discharges from streams were modified by water withdrawals, accidental contamination (e.g., drilling mud) to the extent that water use by established users is measurably reduced, critical aquatic habitats no longer support fish populations, or the water quality is in violation with Wyoming Department of Environmental Quality (DEQ) water quality criteria.
2. Channel geometrics or gradients were altered sufficiently to produce undesirable effects such as aggradation, degradation, or sidecutting.
3. Any permanent facilities were constructed within the 100-year flood plain.
4. Changes in the pH of wilderness lakes by acid precipitation to the extent that productivity and

health of aquatic ecosystems were reduced, i.e., below 6.0.

Impacts to groundwater resources would be considered significant if:

5. Potentiometric heads and/or gradients of aquifers were altered enough to adversely affect established water uses. The magnitudes of changes required to produce adverse effects would vary with specific aquifers and water users.
6. Water quality within any given zone was degraded by introduction of foreign substances (e.g., drilling fluids) or by causing communication with a zone containing water of poorer quality. The degree of degradation required to produce a significant impact would depend upon established uses of the affected aquifer.

Well Field

Construction

Surface Water. Potential significant impacts of well field development on surface waters are increased sediment yield from disturbed areas, contamination of water courses from reserve pits which fail, modified discharge rates and increased consumptive water use, localized channel aggradation/degradation, and contamination of baseflow by upward migration of deep formation water along well casings.

Construction within the well field would create the potential for soil erosion and the subsequent increase of sediment loads in surface waters. Table 3-19 summarizes the streams potentially affected by the well field construction. Increased sedimentation would result from clearing 3,968 acres of natural plant communities for well pads, roads, pipelines, and transmission lines. The quantity and distribution of eroded materials and subsequent sedimentation impacts are difficult to predict. Site-specific information for stream discharge and current sediment loading is not available.

In order to evaluate the potential impacts to streams and fisheries from surface disturbances, a sedimentation analysis was conducted for North Beaver Creek, a typical stream with steep slopes, sensitive aquatic resources, and extensive new surface disturbance planned in its drainage area. The method developed by Leaf (1974) was used to calculate potential eroded material made available to the stream (see Appendix C.4). It should be noted that the subject drainage area is largely dry timber and mixed sage while the Leaf method is based on investigations of surface disturbance in forested communities in Idaho. Assuming that (1) all potential eroded material would reach the stream (no erosion control), (2) 73 percent of the available sediment would be deposited, and (3) 27 percent of the sediment would be suspended, the following estimates were made. About 838 cubic feet of additional eroded material would reach the stream in the first year following construction, with 612 cubic feet (0.07 inches) deposited and 226 cubic feet (2.9 parts/million) suspended. These volumes would decrease by about 8 percent per year over the next few years. This appears to be a small amount of material, and given that erosion control measures as described in Appendix B.7 would be implemented, actual numbers would likely be less. The impacts on water quality and substrates for aquatic organisms would likely be small. However, because the current sediment loads and hydrologic characteristics for specific streams are unknown, a quantitative sedimentation impact assessment cannot be completed. If the incremental increase of sediment loads is small relative to current loads, the impacts would likely be minimal. If the incremental increase of sediment loads is large relative to current loads, the resulting sedimentation could significantly damage fisheries habitat, change stream channel configuration, and degrade water quality. Additional analysis will be contained in the Final EIS.

Surface water could be contaminated by accidental failure of reserve pits or spills from trucks transporting materials to well sites. The greatest potential hazard would be an accidental spill of drilling muds into a flowing stream. Depending on the quantity and toxicity of the contaminant and the flow characteristics in the stream, a significant impact on downstream water users and aquatic populations could occur, but it is not possible to quantify this potential impact.

Stream discharge rates could be modified by the withdrawal of water for well drilling and hydrostatic testing, creating localized effects on stream flow and resulting in adverse effects on fisheries resources and on the availability of water for other users. However, all consumptive uses of surface water are controlled by the State Engineer through the appropriation of water rights. Water currently apportioned for irrigation would likely be sold for use during project construction. Thus, no changes in surface water consumption is expected. Hydrostatic test water is not routinely returned to water courses following use; however, in extremely dry years, the State Engineer may require test water to be treated to meet water quality standards and discharged to a stream. This would minimize any localized impacts on fisheries resources. Therefore, no significant impact from hydrostatic testing and well drilling water use would be anticipated.

All streams would be crossed in a manner to maintain stream integrity and not cause impacts of aggradation, degradation, or sidecutting. It is possible that some local (100 to 1,000 feet) reach of stream would be affected for a short period (less than one year) by pipeline and road construction. Well pads would not be constructed in riparian zones near water courses.

The quality of surface waters could be affected by the discharge of groundwaters contaminated by the drilling activities. Springs and seeps which presently discharge high quality water could become contaminated with drilling fluids and lower quality groundwater migrating through well bores. Some evidence of surface water contamination due to drilling activities is evident in the older portions of the existing sweet gas well field. The impacts on surface waters caused by the contamination of groundwater during well field development would depend on the extent of the groundwater contamination and the quantities of contaminated groundwater which reach surface waters.

Groundwater. Degradation of the groundwater could occur primarily as a result of drilling activities. Drilling wells through water and oil-bearing formations can cause contamination of fresh water by introducing oil and high concentrations of dissolved salts. Oil and gas-bearing formations at depth are often trapped under very high pressures between other impervious layers. The oil or gas is also frequently accompanied by a much larger volume of saline water. When the high pressure zone is pierced during drilling, problems may arise in controlling the pressure. The saline water may then migrate up the outside casing or along bedding planes to a zone of less pressure which contains fresh water. The degree of freshwater aquifer contamination can not be quantified but is expected to be small given current well drilling regulations.

Drilling muds and additives used in the well drilling operations could contaminate shallow alluvial aquifers if the reserve pits leak. The impact would depend on the extent of the intrusion in the aquifers, the nature of the drilling fluids, and the characteristics and uses of the aquifer. The probability of this impact would depend on design and construction of reserve pits and the type of compounds used in the drilling fluids.

Potentially significant impacts on the groundwater resources could occur from these activities. It is not possible to quantify these impacts based on the limited information available on the aquifers in the well field area. This lack of information has been identified as a data gap.

Operation

Surface Water. Major surface hydrologic impacts would occur as a consequence of well field construction. Additional impacts related to sedimentation incurred after construction are considered insignificant due to the applications of the Erosion Control, Revegetation and Restoration Guidelines presented in Appendix B. A small, unquantifiable amount of sedimentation would continue as a result of access raod maintenance, but this is also not expected to be significant.

Groundwater. Potential impacts from well field operation would result from the migration of poor quality water along the well bore to aquifers containing water of higher quality or from leakage of oil, gas, and saline water through poorly cemented or corroded well casings. Inadequate information is available on the failure rates (leakage) or oil and gas wells and on groundwater characteristics to evaluate this type of impact.

Abandonment

Surface Water. There would be few additional effects to surface water from abandonment of the well field. Culverts across abandoned access roads could eventually wash out causing a temporary increase in stream sedimentation. Given the sediment load carried by streams during flood events, significant impacts to water quality are not expected. Well abandonment would require approval of the Wyoming Oil and Gas Conservation Commission and, on federal leases, of the BLM.

Groundwater. Similar impacts could occur as those from operation of the well field. The annular space around the well casing as well as corroded and leaking casing left in the well bore could provide a conduit for oil, gas, and saline water to reach aquifers containing good quality water, a significant impact.

Plant Sites

Construction

Surface water. No significant impacts are anticipated from gas treatment plant construction, since no flowing water courses are crossed and construction area runoff would be properly handled to minimize erosion. However, approximately 34 acres of the 240-acre site for the sulfur loadout would be located within the 100-year floodplain of the Hams Fork. Based on the significance criteria, this would be a significant impact. The design of the loadout and the size of the floodplain at this location indicate that there would be little or no constriction of flood flows and no significant damming effect and rise in flood stage. Flood flows could, however, temporarily interrupt the loading of rail cars. Construction would temporarily increase sediment yield to the Hams Fork, but this would be an unquantifiable, short-term effect.

Groundwater. No impacts would result from plant construction, assuming deep injection wells used for water disposal would be properly cased and sealed to prevent impacts to groundwater aquifers. All wells would be permitted by WDEQ regulations in Chapter 9 of the Water Quality Rules and Regulations.

Operation

Surface Water. Plant facilities would be located on high ground or on relatively flat areas near ephemeral drainages. Impacts to surface water are not expected for Quasar's or Exxon's plants.

Northwest has proposed the use of a 30-acre evaporation pond to dispose of their plant wastewater stream. Calculations indicate that about 90 acre-feet of water per year could be evaporated assuming no oils or films form on the pond surface (Kohler 1959). Approximately 60 acre-feet/year would be disposed of in this pond. Standard design and operation procedures of the pond to maintain evaporative losses and provide storage for seasonal fluctuations in evaporation rates should prevent pond overflow. However, if operational problems caused the pond to overflow, intermittent tributaries to Craven Creek could be contaminated depending on the size of the discharge. This would be a significant impact.

The Craven Creek plant would require 81 acre-feet/year during operation. Water would be diverted from the Green River near Fontenelle and piped to the plant site. Diversion of 81 acre-feet/year represents 0.24 percent of the Green River's flow at low flow. Since the diversion would occur below Fontenelle Reservoir, which is regulated and permitted by the State Engineer, no effects on water quantity or quality of the Green River is expected.

Acid deposition caused by SO_2 and NO_x emissions has the potential to cause pH changes in surface waters in the Bridger Wilderness. The effects of acid deposition are discussed in detail in the Air Resources Section. No significant impacts to the pH in the lakes studied in the wilderness have been identified.

Groundwater. Wastewater disposal would consist of an unknown number of deep injection wells at the plant sites (Quasar and Exxon) to dispose of 1,880 acre-feet of wastewater per year and a single wastewater evaporation pond at the Craven Creek plant site (Northwest) to dispose of 60 acre-feet/year. The wastewaters would contain high concentrations of H_2S and total dissolved solids along with other contaminants (see Table 1-21).

Groundwater under Northwest's evaporation pond would be contaminated with waste water if the pond liner developed a leak. Aquifer characteristics under the evaporation pond have not been determined and are considered a data gap.

Disposal wells could be oil and gas wells which are found to be dry or which stop producing. Contamination of fresh water aquifers could occur if the well casing leaks to allow wastewater into the aquifers. Leakage of the casing could be caused by improper construction or by corrosion of the casing material. Inadequate information is available on the frequency of failures (leakage) of injection wells, the number of wells, location of wells, injection formations, and aquifer characteristics to complete an impact assessment. This is a data gap.

During operation of the gas treatment plants, groundwater sources would be used to supply approximately 67 acre-feet/year to the East Dry Basin plant (Quasar), 138 acre-feet/year for the West Dry Basin plant (Exxon), and 138 acre-feet/year for the Big Mesa plant (Exxon). Water for the plants would likely come from wells drilled into the Wasatch Formation. Inadequate data is available to quantify the impacts of using groundwater resources at these sites. However, existing production capacities of these groundwater systems indicate that adequate groundwater quantities are probably available to supply the plant sites. Interference with existing water users near the plant site could occur, and would be significant if water tables were lowered to the point that wells needed to be deepened. The possibility of such effects is unknown and is considered a data gap.

Abandonment

Surface Water. A significant impact could occur if the evaporation pond at Craven Creek were not properly reclaimed. Accumulated pollutants in the pond could contaminate streams should the pond berms be erroded or breached. This potential impact would be avoided by proper removal, treatment, and disposal of accumulated wastes from the pond. No significant impacts are anticipated from the dismantling and disposal of above ground structures.

Groundwater. Potential significant impacts could occur from the abandonment of wastewater injection wells similar to those resulting from the abandonment of the gas production wells. The well bore could act as a conduit for the migration of poor quality water to aquifers which contain good quality water. Requirements on the abandonment of these wells would be covered by WDEQ Chapter 9 Water Quality Rules and Regulations, by the Wyoming Oil and Gas Commission Rules and Regulations and by BLM regulations for wells on federal leases. Impacts can be minimized by properly cementing the entire cross sectional area of the well bore to isolate the zones containing the injected waste water and any aquifers present. Current regulations would require this type of abandonment procedures.

Linear Facilities

Construction

Construction impacts resulting from perennial stream crossings include direct removal of substrate during excavation, disruption of downstream substrate as a result of siltation from excavation and fill activities, and increases in turbidity levels. Degradation of water quality would be limited to the two-week construction period. Quantitative data to support sediment deposition analyses are limited; however given the short construction period and the restriction of construction to periods of low flow, impacts are expected to be insignificant.

The sulfur pipeline would cross Fogarty Creek, Dry Piney Creek, LaBarge Creek, Fontenelle Creek, and Slate Creek by an aerial crossing. All of these creeks support trout fisheries. Construction of the suspension structure piling may disturb some riparian vegetation (see Vegetation Section) and cause short-term increases in suspended solids and turbidity. Construction equipment would use existing roads and no in-stream construction is planned. Drain pits for maintenance of the sulfur pipeline would be located out of riparian areas and water ways. Thus, no significant impacts to water resources from construction of the sulfur pipeline are anticipated.

Operation

No impacts to water resources are expected from the operation of the railroad, transmission lines, and access roads. Major and minor leaks in sour gas pipelines at river or stream crossings would degrade water quality. Variables such as size of the leak, stream flow, stream velocities and pH of the water would all influence the areal extent of impact and rate of H_2S gas dissolution and dispersion. Instream concentrations of H_2S greater than 2 micrograms/liter would be hazardous to aquatic life (EPA 1976). A leak or rupture of a sour gas pipeline at a stream crossing would easily cause concentrations of H_2S to exceed this level in waters which contact the escaping gas, (see Fisheries Section for discussion of environmental consequences). Contaminated water could not be used for domestic or municipal use until toxic levels are reduced by dispersion or dilution. Loss of water to current use would be considered a signficant impact. Given the probability of a pipeline leak or rupture (0.002/mile/year) and the small mileage of streams affected by sour gas crossings (less than 1 mile), a rupture is not expected during the life of the project (see Health and Safety Section of this chapter).

A break in the sulfur pipeline discharging molten sulfur into one of the creeks mentioned above would not create a physical water quality problem. The temperature of the water would be temporarily elevated, but the molten sulfur is not reactive and is not toxic. The molten sulfur would solidify and drop to the bottom of the stream where it would eventually be transported downstream similar to sediment.

Abandonment

Since the transmission lines, buried pipelines, and most access roads would be left in place after project completion, no impacts to water resources are anticipated from corridor abandonment.

Cumulative Impacts

Cumulative impacts to water resources would result from the additional surface water requirements of other interrelated projects. In addition to the 81 acre-feet/year of water that would be diverted from the Green River for operation of the Craven Creek plant, the Chevron Phosphate Project would divert another 22,500 acre-feet/year from Fontenelle Reservoir. This alone represents a 0.49 percent reduction in flow along the Green River as measured at Green River, Utah. This consumptive use would increase salinty at Imperial Dam (on the Colorado River on the Arizona-California border) by 1 milligram/liter (BLM 1983b). By itself, the Riley Ridge Project would reduce flow in the Green River by 0.024 percent (during low flow). Cumulative impacts of other developments downstream would also increase depletions and salinity in the Green River (BLM 1983b).

Summary

Surface Water

Significant impacts to surface waters from the Proposed Action would include the location of the sulfur loadout facility at Opal, in the 100-year floodplain of the Hams Fork River. Potential significant impacts could include (1) degradation of surface water quality and fisheries habitat from increased sedimentation due to well field construction, (2) contamination of surface waters from the failure of reserve pits and the accidental release of drilling muds, (3) contamination of surface waters from the accidental release of materials from Northwest's wastewater evaporation pond, (4) the release of highly toxic H_2S into streams from leaking or ruptured sour gas trunklines at stream crossings, and (5) the degradation of streambase flow through the discharge of springs and seeps contaminated from well drilling and wastewater injection activities.

Groundwater

Potential significant impacts from the Proposed Action could include (1) the contamination of fresh water aquifers from drilling fluids, (2) contamination of fresh water aquifers from the migration of saline water, oil, gas, or injected waste water through well bores, and (3) contamination of shallow groundwater resources from the migration of contaminants from leaking reserve pits or Northwest's waste water evaporation ponds.

Because of planned construction, operation, and abandonment procedures and government stipulations, the likelihood of many of the potential significant impacts would be greatly reduced. Because of inadequate data on surface and groundwater characteristics and probabilities of the occurrence of contamination events, quantifications of these potential significant impacts cannot be made at this time.

AIR QUALITY

Significance Criteria

Impacts to air quality would be considered significant if:

1. Emissions exceed Class I (in designated areas) or Class II Prevention of Significant Deterioration (PSD) increments, National Ambient Air Quality Standards (NAAQS), or Wyoming Ambient Air Quality Standards (WAAQS) as shown in Tables 4-29 and 4-30. Note that most short-term standards allow one exceedance per year. This is important because it means the maximum value can be ignored at each receptor and instead, the highest remaining value (termed the highest second-highest) is compared to the increment or standard. This highest second-highest value must exceed the limit for the impacts to be deemed significant.
2. Emissions of carbon dioxide (CO_2) exceed suggested health protection standards, 5,000 parts/million annual average (ACGIH 1980).
3. Emissions of carbonyl sulfide (COS) exceed the multimedia environmental goal (MEG) (EPA

TABLE 4-29
PREVENTION OF SIGNIFICANT DETERIORATION INCREMENTS[1] (MICROGRAMS/CUBIC METER)

Averaging Period	Class I[2]	Class II[3]
SO_2		
Annual	2	20
24-Hour[4]	5	91
3-Hour[4]	25	512
Total Suspended Particulates		
Annual	5	19
24-Hour[4]	10	37

[1] PSD increments apply only to permanent sources. Temporary emissions (such as construction or well drilling) are not regulated by PSD.

[2] Class I areas include the Bridger, Fitzpatrick, Teton Wilderness, and Grand Teton National Park. Scab Creek, Glacier, and Popo Agie Primitive Areas and Fossil Butte National Monument are proposed Class I areas, but currently regulated by Class II increments. The Class I PSD increments can be waived if it is demonstrated to the satisfaction of federal land manager that the air quality related values (AQRV) of the Class I areas are not adversely impacted. On the other hand, a PSD permit may be denied if AQRV are adversely impacted, even if Class I increments are met.

[3] Areas surrounding the Riley Ridge Project are Class II.

[4] All 24- and 3-hour values may be exceeded once per year.

1977) of 800 micrograms/cubic meter annual average, or 20 parts/million 8-hour average (ACGIH 1980).

4. Emissions of helium (He) exceed 30,000 parts/million (ACGIH 1980).
5. Hydrogen sulfide (H_2S) concentrations exceed 6.5 micrograms/cubic meter (odor significance criterion).

   While the Wyoming half-hour average H_2S standards of 40 and 70 micrograms/cubic meter were orginally designed to help ensure that H_2S odors would not be a nuisance, a literature review of H_2S odor thresholds indicates that, depending on the individual, odors from H_2S can be detected at concentrations from about 0.7 micrograms/cubic meter to about 70 micrograms/cubic meter, a range spanning two orders of magnitude. Since the Wyoming H_2S standards are at the upper end of the documented odor threshold range, for the purposes of this EIS the more conservative value, 6.5 micrograms/cubic meter, was selected because it lies in the middle of the documented range.
6. Sulfur dioxide (SO_2), oxides of nitrogen (NO_x), and total suspended particulate (TSP) emissions result in visibility impairment according to Environmental Protection Agency (EPA) parameters as discussed in the Air Resources Technical Report.
7. SO_2 and NO_x emissions result in a pH change down to 6.0 in high altitude, low-buffered lakes (acid deposition significance criterion).
8. Particulate emissions, particularly from fugitive dust during construction activities, result in TSP concentrations above the EPA significant impact level of 1 microgram/cubic meter annual average in the trona industrial nonattainment area.
9. Sulfur dioxide (SO_2) emissions exceed PSD Class I increments in proposed and existing Class I areas. While these increments have been discussed above, they are also a valid benchmark for determining whether significant SO_2 impacts to sensitive vegetation (i.e., lichens) could occur, as discussed in more detail in the Air Resources Technical Report.

In addition to these significant air quality impact criteria discussed above the FS has identified eight Air Quality Related Values (AQRV) for the wilderness and primitive areas under its jurisdiction. While quantitative significance criteria are yet to be identified by the FS to determine whether significant impacts could occur to the AQRV, the FS has identified physical parameters for each AQRV whose changes can ultimately be used to judge whether significant impacts could occur as a result of changes in air quality. These parameters for each AQRV include:

- AQRV - Flora and Fauna. Changes in the parameters:
  - Growth
  - Mortality
  - Reproduction
  - Diversity
  - Visible injury
  - Succession
  - Productivity
- AQRV - Soil. Changes in the parameters:
  - Cation exchange capacity
  - Base saturation percent
  - pH
  - Structure
  - Metals concentration
- AQRV - Water. Changes in the parameters:
  - pH
  - Structure
  - Metals concentration
  - Total alkalinity
- AQRV - Visibility. Changes in the parameters:
  - Contrast
  - Coloration
  - Visual range
- AQRV - Odor. Changes in the parameters:
  - Odor
- AQRV - Cultural/Archeological. Changes in the parameters:
  - Deposition
  - Decomposition
- AQRV - Geologic. Changes in the parameters:
  - Deposition
  - Decomposition

TABLE 4-30
WYOMING AND NATIONAL AMBIENT AIR QUALITY STANDARDS[1]

Contaminants	Wyoming Standards (µg/m³)	National Standards (µg/m³)	
		Primary	Secondary
TSP			
24-Hour[2]	150	260	150
Annual[3]	60	75	60
SO_2			
3-Hour[2]	1,300	–	1,300
24-Hour[2]	260	65	–
Annual[4]	60	80	–
NO_2			
Annual[4]	100	100	100
CO			
1-Hour[2]	40,000	40,000	40,000
8-Hour[2]	10,000	10,000	10,000
H_2S[5]			
0.5-Hour[6]	70	–	–
0.5-Hour[7]	40	–	–
HF[5]			
24-Hour	0.8	–	–
Photochemical Oxidants (O_3)			
1-Hour	160	235	235
VOC (Nonmethane)[8]			
3-Hour[2]	160	–	–
Lead			
3-Month	1.5	1.5	1.5

[1] Temporary construction-related emissions as well as the more permanent operations-related impacts are subject to NAAQS and WAAQS. However, emissions resulting from emergency upsets and start-up and shut-down activities are exempted from NAAQS and WAAQS compliance.

[2] Not to be exceeded more than once per year.

[3] Annual geometric mean, never to be exceeded.

[4] Annual arithmetic mean, never to be exceeded.

[5] Wyoming ambient standard only.

[6] Not to be exceeded more than twice per year.

[7] Not to be exceeded more than twice in any five consecutive days.

[8] Wyoming ambient standard. Federal hydrocarbon standard was repealed by EPA on January 5, 1983.

The Riley Ridge Project would consist of numerous construction activities and well field, plant, and pipeline operations which would emit various air pollutants, including SO_2, NO_x, particulates, carbon monoxide (CO), nonmethane hydrocarbons, H_2S, He, COS, and CO_2. Air quality impacts of these pollutants can be judged as "significant" or "insignificant" based on comparison with the air quality significance criteria described above.

Table 4-31 summarizes the predicted air quality impacts for the Proposed Action for all pollutants except SO_2, which is summarized in Table 4-32. Significant impacts are predicted for SO_2 and H_2S. As indicated in Table 4-31, concentrations of all other pollutants would not exceed significance criteria. Readers interested in details for pollutants for which there are no significant impacts (NO_2, TSP, COS, CO_2, CO, and He) should consult the Air Quality Technical Report.

Sulfur Dioxide

The incinerators that combust tail gas from the sulfur recovery units at the treatment plants would emit relatively large quantities of SO_2 (see Table 1-23). A comparison of the maximum SO_2 concentrations

TABLE 4-31
SUMMARY OF TOTAL MAXIMUM CONCENTRATIONS[1] FROM CONSTRUCTION AND OPERATING ACTIVITIES PROPOSED ACTION

Pollutant	Averaging Time	Type of Significance Criterion	Significance Criterion	Proposed Action Max. Conc.	Proposed Action Percent Criterion
NO_2[2]	Annual	NAAQS/WAAQS	100	66	66
NO_2[3]	Annual	NAAQS/WAAQS	100	10	10
TSP[2]	Annual	NAAQS/WAAQS	60	48	80
TSP[4]	Annual	NAAQS/WAAQS	60	47	78
H_2S[3]	Half-hour	WAAQS	40	237[5]	593
H_2S	Instantaneous	Odor	6.5	HT[6]	N/A
COS[3]	Annual	MEG[7]	800	19	2
COS[3]	8-Hour	Toxicological[8]	60,000	623	1
CO_2[3]	Annual	TLV[9]	$11 g/m^3$	$0.5 g/m^3$	5
CO[3]	1-Hour	NAAQS/WAAQS	40,000	3,906	10
CO[3]	8-Hour	NAAQS/WAAQS	10,000	1,805	18
He	Instantaneous	Asphyxiant	30,000ppm	<30,000ppm	N/A

[1] All concentrations are based on modeling with actual off-site meteorological data. All numbers shown are micrograms/cubic meter unless otherwise noted. Values underscored are above applicable significance criteria.

[2] From well drilling operations.

[3] From operation of the gas treatment plants.

[4] From construction activities.

[5] From the American Quasar gas treatment plant at East Dry Basin.

[6] The significance criterion is exceeded in high terrain areas surrounding the Big Mesa, West Dry Basin, and East Dry Basin facilities.

[7] Threshold Limit Value.

[8] Poisonous.

[9] Multimedia Environmental Goal.

and applicable significance criteria in Table 4-32 show that the PSD increments are the limiting criteria rather than the NAAQS or WAAQS. The maximum modeled SO_2 concentrations from the tail gas incinerators occurred in high terrain, i.e., terrain above stack top. Maximum short-term impacts in Class II areas would be due to individual plants, because combined impacts of plumes from multiple facilities do not produce higher concentrations. This is primarily because of differences in plume centerline heights between the facilities. The plumes must grow in the vertical significantly (with corresponding plume dilution), which occurs at fairly large distances downwind before the plumes become mixed together. The plumes are so diluted at these distances that ground level concentrations are relatively small. The maximum modeled short-term concentrations that occurred in high terrain were generally for stable atmospheric conditions with low wind speeds. Predicted concentrations during unstable and neutral conditions were not as high as impacts under stable conditions. Because of more rapid plume transport to the surface, impacts under unstable conditions were generally greater than impacts under the more prevalent neutral atmospheric conditions.

The maximum short-term impacts from each facility occurred relatively close to each facility. The maximum predicted 3-hour and 24-hour SO_2 concentrations from Exxon's Big Mesa facility occurred about 4 kilometers (2.4 miles) to the west-southwest of the plant, and a little over 2 kilometers (1.2 miles) to the west-southwest of Exxon's West Dry Basin plant. The maximum predicted 3-hour SO_2 concentration from Quasar's East Dry Basin plant occurred about 4 kilometers (2.4 miles) to the southwest of the plant while the maximum predicted 24-hour SO_2 concentration occurred a little more than 1 kilometer (0.6 miles) to the southeast of the plant. Northwest's maximum predicted 3-hour SO_2 concentration occurred a little more than 2 kilometers (1.2 miles) to the south-southeast of the Craven Creek plant site, and the maximum 24-hour SO_2 concentration was predicted at a distance of a little greater than 2 kilometers (1.2 miles) to the southwest of the plant.

Table 4-33 displays the applicable PSD increments and the maximum modeled SO_2 impacts in PSD Class II areas from the individual treatment plant operations. SO_2 concentrations were predicted using two sets of meteorological data: (1) assumed worst-case conditions, and (2) actual measured off-site data.

TABLE 4-32
SUMMARY OF TOTAL MAXIMUM SO$_2$ CONCENTRATIONS[1] FROM CONSTRUCTION AND OPERATING ACTIVITIES
PROPOSED ACTION

			Proposed Action	
Type of Criterion	Averaging Time	Criterion	Max. Conc.	Percent Criterion
NAAQS/WAAQS[2]	Annual	80	21	26
NAAQS/WAAQS[3]	Annual	80	18	23
	24-Hour	365	139	38
	3-Hour	1,300	564	43
PSD Class II[3]	Annual	20	15	75
	24-Hour	91	124[4]	136
	3-Hour	512	49	96
PSD Class I[3]	Annual	2	0.7	35
	24-Hour	5	4.7	94
	3-Hour	25	16.6	66

[1] All concentrations are based on modeling with actual off-site meteorological data. All numbers shown are micrograms/cubic meter. Concentrations underscored are above applicable significance criteria.

[2] From well drilling operations.

[3] From operation of the gas treatment plants.

[4] From the American Quasar gas treatment plant at East Dry Basin.

Results for the actual off-site data are believed to be more representative and are used in this analysis. Actual off-site data are considered more representative because the terrain features where the data were collected (Kemmerer Coal, see Map 3-5) are similar to the terrain features at the Riley Ridge Project sites. Furthermore, assumed worst-case meteorology has somewhat arbitrarily assumed values for the persistence of wind direction, wind speed, and atmospheric stability. Actual off-site data do not require such persistence assumptions. Predicted concentrations above the PSD increments are underscored. Results show that maximum 3-hour, 24-hour, and annual averages for all facilities are below the applicable Class II increments, except for Quasar's treatment plant at East Dry Basin. These concentrations exceed the 24-hour SO$_2$ increment of 91 micrograms/cubic meter on eight days based on the actual off-site meteorology. A maximum of 124 micrograms/cubic meter was predicted. Therefore, significant impacts are expected with Quasar's treatment plant at East Dry Basin, but no significant Class II SO$_2$ impacts are expected from the plants sited at Big Mesa, West Dry Basin, and Craven Creek because SO$_2$ concentrations do not exceed PSD Class II increments.

As stated previously, short-term Class II SO$_2$ impacts, maximum combined impacts would be nowhere greater than individual plant impacts. However, this is not the case for annual impacts. In that situation, multiple plume trajectories do allow for combined impact from different plants at most receptors. The maximum annual average predicted in Class II areas is 15 micrograms/cubic meter, which was predicted at a distance a little greater than 1 kilometer to the southeast of Quasar's East Dry Basin plant site. This concentration is higher than the annual averages from individual plants, but still insignificant because it does not exceed the 20 micrograms/cubic meter significance criterion.

Because Class I areas are relatively far away from the project sites, combined SO$_2$ impacts for all time averages are greater than maximum individual plant impacts due to the interaction of multiple plant plumes at those distances. Table 4-34 displays the maximum combined SO$_2$ impacts in existing and proposed Class I areas. The combined impacts from the four gas treatment plants would have insignificant SO$_2$ impacts in proposed or existing Class I areas because total concentrations do not exceed PSD Class I increments. As noted in Table 4-29, impacts to air quality related values (AQRV) could conceivably be significant even if maximum predicted SO$_2$ concentrations are below applicable PSD increments. However, impacts to the AQRV specifically analyzed in this study, i.e., visibility, odor, vegetation (from SO$_2$, NO$_2$, and particulate), and sensitive trout (from acid deposition) were determined to be insignificant.

The locations of the maximum 3-hour, 24-hour, and annual impacts in the Bridger Wilderness are all about 67 kilometers (40.2 miles) to the northeast of the East Dry Basin plant site; in the Teton Wilderness the location of the maximum SO$_2$ impacts (all time averages) is about 156 kilometers (93.6 miles) to the north of the East Dry Basin plant site; and in Teton

TABLE 4-33
INDIVIDUAL GAS TREATMENT PLANT SO_2 IMPACTS IN CLASS II AREAS
PROPOSED ACTION

			Maximum SO_2 Concentrations/SO_2 Increments (micrograms/cubic meter)					
			3-Hour		24-Hour		Annual	
Company	Plant Site	Capacity (Million CFD)	Maximum Concentration	PSD Increment[2]	Maximum Concentration	PSD Increment[2]	Maximum Concentration	PSD Increment
Exxon	Big Mesa	600	141	512	30	91	2	20
Exxon	West Dry Basin	600	278	512	62	91	6	20
Quasar	East Dry Basin	1,200	494	512	$\underline{124}$[1]	91	14	20
Northwest	Craven Creek	400	159	512	50	91	4	20

[1] Underscore represents exceedance of increment.

[2] Not to be exceeded more than once per year.

TABLE 4-34
COMBINED SO_2 IMPACTS IN EXISTING AND PROPOSED PSD CLASS I AREAS
PROPOSED ACTION
(MICROGRAMS/CUBIC METER)

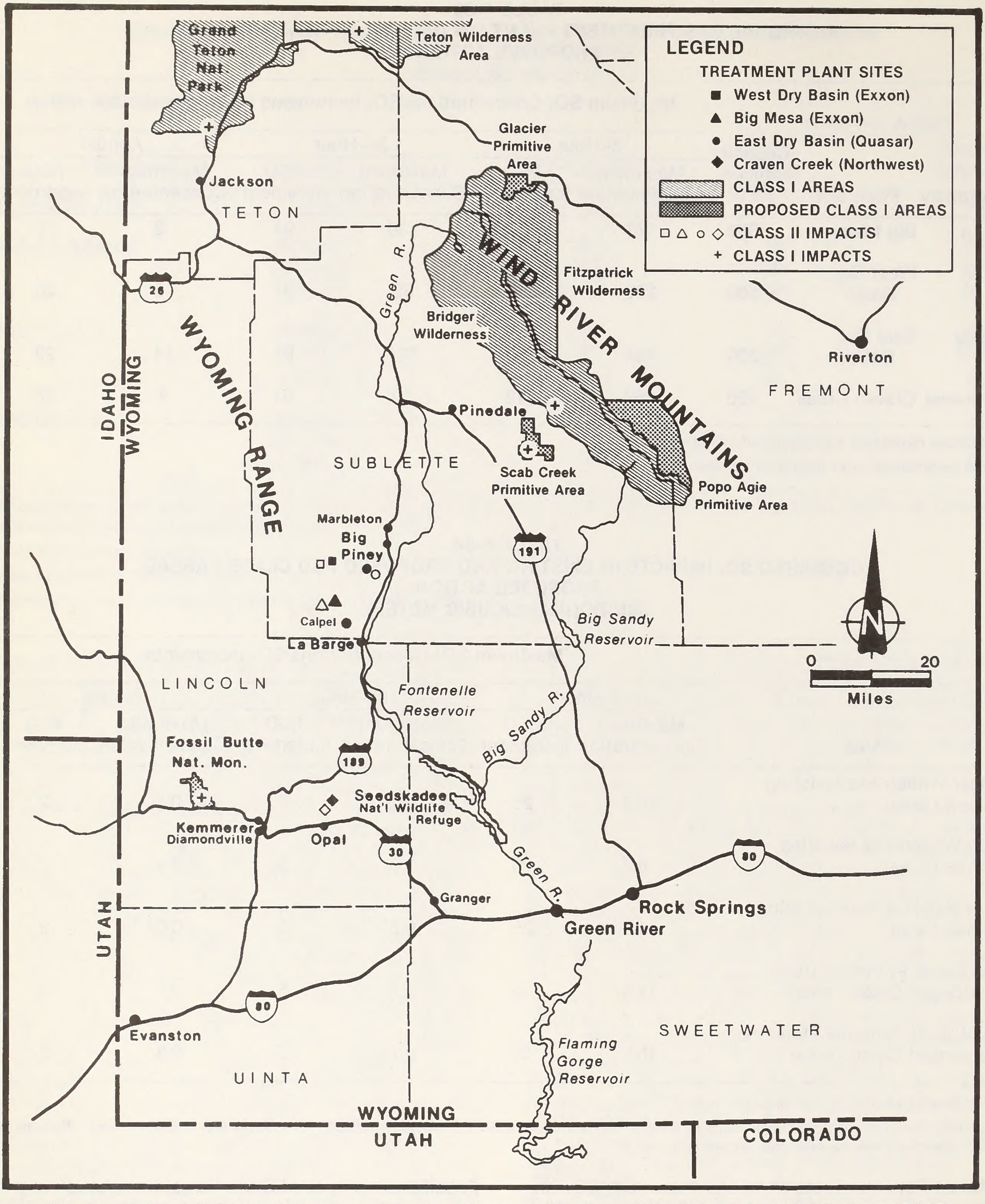
	Maximum SO_2 Concentrations/SO_2 Increments					
	3-Hour		24-Hour		Annual	
Area	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment
Bridger Wilderness (existing Class I area)	15.2	25	4.1	5	0.4	2
Teton Wilderness (existing Class I area)	6.2	25	1.0	5	0.1	2
Teton National Park (existing Class I area)	4.9	25	0.7	5	0.04	2
Scab Creek Primitive Area[2] (proposed Class I area)	12.3	25	4.7	5	0.7	2
Fossil Butte National Monument (proposed Class I area)	16.6	25	3.7	5	0.3	2

[1] Not to be exceeded more than once per year.

[2] Elsewhere in the EIS the Scab Creek Primitive Area is referred to as the Scab Creek Instant Study Area (see Affected Environment - Wilderness) and includes the Primitive Area plus additional acreage.

National Park the location of the maximum SO_2 impacts (all time averages) is about 139 kilometers (83.4 miles) to the north-northwest of the East Dry Basin plant site. In the Scab Creek proposed Class I area the location of the maximum 3-hour, 24-hour, and annual average SO_2 impact is about 62 kilometers (37.2 miles) to the northeast of the East Dry Basin plant site. In the Fossil Butte proposed Class I area, the location of the maximum SO_2 impacts (all time averages) is about 80 kilometers (48 miles) to the southwest of the East Dry Basin plant site.

Map 4-2 shows the locations of the maximum predicted 24-hour SO_2 concentrations in Class II areas and in proposed and existing Class I areas. The



MAP 4-2 LOCATIONS OF MAXIMUM 24-HOUR AVERAGE SO_2 CONCENTRATIONS IN PSD CLASS I AND CLASS II AREAS FOR THE PROPOSED ACTION

locations of maximum 24-hour SO_2 impacts from each gas treatment plant are shown in Class II areas. The locations of maximum combined 24-hour SO_2 impact considering all gas treatment plants are shown in proposed and existing Class I areas.

All previous discussions of SO_2 impacts from the Proposed Action have focused on the SO_2 emissions from the sulfur recovery tail gas incinerators. These are by far the largest sources of SO_2. There would also be SO_2 emissions above EPA's PSD de minimis levels due to emergency flaring of the feed gas to the treatment plants. The raw feed gas is primarily CO_2 and therefore would not combust without the addition of product gas or other fuel gas. Such gases would be available to allow the raw feed gas to ignite and burn. However, impacts from emergency flaring are exempt from compliance with PSD increments and ambient air standards. It is anticipated that emergency upset flaring operations would result in relatively high short-term SO_2 concentrations. However, these upsets, if they occur at all, are expected to be very short in duration (one hour or less). Therefore, concentrations would generally decrease rapidly with distance downwind and with time. For this reason SO_2 emissions from emergency plant flaring should not result in or contribute to signficant SO_2 impacts.

Oxidation of carbonyl sulfide (COS) in the atmosphere can ultimately form SO_2. The rates of the various reactions are not well known at this time; however, an estimate of the global mean lifetime for COS is 200 days (Logan et al. 1979). Since this lifetime is very long, emissions of COS are not expected to noticeably increase the total SO_2 burdens in the area, especially for maximum short-term concentrations.

Hydrogen Sulfide

The American Quasar gas treatment plant has two separate sources of H_2S, the carbon dioxide and nitrogen vents. The situation is slightly different at the Exxon facilities: the carbon dioxide and nitrogen vent streams are combined, resulting in one source of H_2S. At the Northwest facility, the carbon dioxide vent is the only source of H_2S. The maximum predicted one-half hour H_2S concentrations for each plant site are listed in Table 4-35. Concentrations greater than the significant levels are noted for Quasar's East Dry Basin plant. Quasar's impacts are much higher than the other plants primarily because the plume is less buoyant and Quasar's H_2S emissions are higher.

The H_2S significance criteria include the WAAQS. These standards allow H_2S impacts to exceed the 40 micrograms/cubic meter WAAQS no more than twice in five days, and the 70 micrograms/cubic meter WAAQS no more than twice in one year. Predicted impacts for the East Dry Basin plant exceed these standards. The maximum predicted H_2S concentration from the Quasar facility is 237 micrograms/cubic meter at the high terrain about 2 kilometers (1.2 miles) southeast of the East Dry Basin site. It was found that Quasar's H_2S impacts exceed the 40 micrograms/cubic meter standard more than twice in any five consecutive days and the 70 micrograms/cubic meter standard would be exceeded more than twice per year. Therefore, significant H_2S impacts are expected from East Dry Basin, but not from other plant sites.

Potential odor impacts from H_2S emissions were also evaluated. Near Exxon's West Dry Basin and Big Mesa sites and Quasar's East Dry Basin site, H_2S concentrations were predicted to exceed the 6.5 micrograms/cubic meter odor threshold in localized high terrain areas (Table 4-35). The high terrain significantly impacted is about 3 kilometers (1.8 miles) to the west-southwest of West Dry Basin, about 4 kilometers (2.4 miles) to the southwest of Big Mesa, and about 2 kilometers (1.2 miles) to the southeast of East Dry Basin. For Northwest at Craven Creek, this significance level would not be exceeded at any locations. At Big Piney and Opal, the nearest population centers, maximum H_2S concentrations would be below the odor significance level. At all proposed and existing Class I areas, H_2S impacts would be negligible and not significant.

Carbon Dioxide

The gas treatment plants would release relatively large quantities of CO_2 to the atmosphere (1.87 billion cubic feet/day) unless the CO_2 is purified and sold. Venting the CO_2 would only minimally increase the atmospheric loading of that species in the Sublette Air Basin. Therefore, it is not anticipated that the Riley Ridge CO_2 emissions above would cause any noticeable increase in average atmospheric temperatures due to the "greenhouse effect", although considerable uncertainty exists on a global scale whether increased atmospheric burdens of CO_2 result in climatic warming trends.

Acid Deposition in Class I Areas

This section addresses potential acidification of sensitive high mountain lakes in the Bridger Wilderness caused by SO_2 and NO_x emissions from the Riley Ridge Project. The greatest potential for acidification would occur during the spring and summer runoff of the accumulated snowpack. Acidic compounds which are deposited or which form in the snowpack would be released over the two to three-month snowpack runoff period and may cause "acid shock" to lakes in the area.

In addition to SO_2 and NO_x emissions from the Riley Ridge Project, emissions of H_2S, COS, and CO_2 could also contribute to lake acidification. However, the atmospheric reaction rates of COS and H_2S to SO_2 (the sulfate precursor) are extremely slow. When these reaction rates are considered with the magnitude of H_2S and COS emissions from the project, the contribution of H_2S and COS to lake acidification is considered negligible in comparison with SO_2 and NO_x emissions. However, CO_2 emissions from the project are much higher than SO_2 and NO_x emissions. Even so, the potential increase in lake acidification from CO_2 is also considered negligible because CO_2 in aqueous solution forms a weak carbonic acid. When compared to nitric and sulfuric acid (from NO_x

TABLE 4-35
MAXIMUM MODELED H_2S POLLUTANT IMPACTS
PROPOSED ACTION

Pollutant	Averaging Time	Plant Site	Maximum Concentration ($\mu g/m^3$)[1]	WAAQS Significance Level ($\mu g/m^3$)	Odor Significance Level ($\mu g/m^3$)
H_2S	0.5 Hour	West Dry Basin	12	40[2], 70[3]	6.5
		Big Mesa	7	40[2], 70[3]	6.5
		East Dry Basin	237	40[2], 70[3]	6.5
		Craven Creek	3	40[2], 70[3]	6.5

[1] Impacts (in micrograms/cubic meter) predicted using actual off-site meteorology. Underscore represents exceedance of increment.

[2] WAAQS. Two exceedances allowed every five days.

[3] WAAQS. Two exceedances allowed per year.

and SO_2 emissions), the potential lowering of lake pH from carbonic acid is considered negligible (notwithstanding the relatively large CO_2 emission rate). For these reasons, the acid deposition analysis is focused on SO_2 and NO_x emissions.

The high mountain lakes in the Bridger Wilderness are known to be inhabited by various species of trout (golden, rainbow, brook, and cutthroat), as well as other fish. Substantial reduction of pH in these waters could adversely impact the fish habitat and spawning grounds. Many of these lakes are believed to have little capacity for neutralization of acidic runoff and may, therefore, be extremely sensitive to acid deposition increases. High mountain lakes in other Class I areas, such as the Teton Wilderness and Teton National Park, also contain various trout species which are susceptible to changes in lake pH. However, these Class I areas are expected to undergo smaller pH changes than are anticipated in the Bridger Wilderness (see Air Resources Technical Report for further detail).

Coherent plumes are not expected to surmount the mountains of the Wind River Range because of the very large elevation differential (over 5,000 feet) between the mountain tops and plume heights. Surmounting such a large elevation differential and the potential energy associated with it during stable conditions would require the coherent plumes and the lower level air mass they are in to have a greater amount of kinetic energy. The wind speeds associated with such kinetic energies are expected to be so great as to not be observed normally in the study area. While it may be possible (albeit unlikely) that Riley Ridge pollutants in neutral or unstable air masses (e.g., in thunderstorm updrafts) might surmount the Wind River Range, the degree of dilution and dispersion under such conditions is so great that resultant concentrations of acid species are expected to be negligible in the Fitzpatrick Wilderness and Popo Agie Primitive Area. Therefore, insignificant impact from acid deposition is expected in these two areas.

Three lakes in the Bridger Wilderness that would likely experience the largest pH changes associated with acid deposition were selected by the Forest Service for gathering pertinent baseline data for the EIS. These lakes were also modeled for potential acid deposition impacts. They are Clear Lake (north), Hobbs Lake, and Clear Lake (south). For each lake modeled a range of results is given based on assumed acid input values from the snowpack runoff of from 100 to 50 percent. One hundred percent acid input represents the worst-case condition, and assumes no acid neutralization in the runoff as well as total conversion of SO_2 and NO_x to acid in the snowpack. The 50 percent neutralization value represents the mid-range of possible values (0 to 100 percent neutralization) and appears to be a reasonable, yet conservative estimate. This factor assumes one-half of the maximum possible acid is "lost" through a combination of ammonia and calcium neutralization and incomplete conversion of SO_2 and NO_x to acid in the snowpack.

Changes in stream pH have not been explicitly modeled in this assessment due primarily to a lack of adequate data, e.g., discharge rate. Changes in pH in streams immediately below the lakes should approximate the changes in the lakes above them. For streams feeding the lakes, insufficient data exist to adequately assess potential pH changes. The precise data needs are itemized in the recommendations contained in Appendix E.

Short-Term Effects

The short-term effects of acid deposition for the three lakes in the Bridger Wilderness from the Proposed Action are presented in Table 4-36. The maximum pH change is predicted to occur at Clear Lake (south). Without accounting for the effects of the freezing point depression of acidic snow or the SO_2 emissions from flaring operations (these are addressed in subsequent paragraphs), potential acid input at Clear Lake (south) results in pH values of from 6.38 to 6.30 (corresponding to a pH decrease of 0.07 to 0.15) depending on how much of the acid runoff is assumed to be neutralized. Clear Lake (south) is most sensitive

TABLE 4-36
ESTIMATED EFFECTS ON WATER CHEMISTRY OF THREE LAKES IN THE BRIDGER WILDERNESS PROPOSED ACTION

	Clear Lake (north)	Hobbs Lake	Clear Lake (south)
Baseline pH[1]	6.60	6.50	6.45
Resulting pH	6.59 - 6.59	6.48 - 6.47	6.38 - 6.30
Change in pH	0.01	0.02 - 0.03	0.07 - 0.15
After accounting for the potential effect of the freezing point depression of acidic snow:			
Resulting pH	6.55 - 6.55	6.48 - 6.47	6.38 - 6.30
Change in pH	0.05	0.02 - 0.02	0.07 - 0.15
After accounting for the potential effect of plant flaring:			
Resulting pH	6.55 - 6.55	6.48 - 6.47	6.36 - 6.28
Change in pH	0.05	0.02 - 0.02	0.09 - 0.17

[1] Measurements taken by ERT in August 1982.

because it has the lowest baseline pH (6.45, indicative of less alkalinity), and because it is predicted to experience the greatest SO_2 and NO_x deposition (primarily attributable to a high frequency of winds to the lake from the project site). This pH is above the significance criterion of 6.0 presented earlier.

Past studies (e.g., Seip 1980; Foster 1978; Overrein et al. 1980) have shown that acid concentrations are highest during early stages of snowpack runoff. This has been attributed to the freezing point depression of acidic snow; the acidic-laden snow material melts first, thus concentrating in the early stages of the runoff. For Hobbs Lake and Clear Lake (south), the long recharge period suggests this phenomenon would not be a significant factor. The early snowmelt at these two lakes cannot totally recharge the lake, and the increased acidic input would be diluted accordingly. Only at Clear Lake (north) is the recharge rate short enough to allow the freezing point depression to be a potential factor. Assuming the early runoff at Clear Lake (north) has an acid concentration five times higher than normal, the resulting pH would be 6.55 or a net decrease of 0.05 (compared to a pH of 6.59 without accounting for the freezing point depression). A pH of 6.55 is still well above the significance criterion of pH 6.0.

Treatment plant upset conditions such as flaring can produce large quantities of SO_2 for short time periods. When flaring emissions from all facilities are included (assuming they could all occur during the same year), the resulting pH levels at the worst-case lake (Clear Lake south) change from 6.30 to 6.28. This decrease in resulting pH is still well above the significance criterion of pH 6.0.

The resultant pH for all lakes is expected to be well within the tolerance level of known fish species in the Bridger Wilderness as defined by the significance criterion (pH of 6.0). This significance criterion is based on field data summarized by Haines and Schofield (1980) and reflects the pH at which reproductive failure can occur. Therefore, no significant short-term impact to fish populations is anticipated as a result of these pH levels.

While significant impacts to fish populations are not expected due directly to the predicted pH changes, the loss of fish populations is one of the last aquatic biological effects of acidification. In the ultra-oligotrophic waters of the Bridger Wilderness, vegetative species diversity may decline as the pH decreases. However, productivity may remain unaffected. Given the lack of data regarding the types of vegetative species in high altitude Bridger Wilderness lakes, as well as how the vegetative species could be impacted as pH declines, or how changes in vegetation would affect habitat quality for other species (i.e., fish or food organisms), it is unknown whether significant impacts to aquatic vegetation could occur for the pH changes predicted in this assessment.

Long-Term Effects

Although the long-term effects of acid deposition in the Bridger Wilderness Area cannot be estimated at this time with high confidence, based on existing knowledge these impacts are not expected to exceed the acute seasonal impacts discussed previously. The acidic input to sensitive lakes in the area from the Riley Ridge Project is small enough to be neutralized by the calculated carbonate and bicarbonate alkalinity levels attributable to equilibrium with atmospheric CO_2. This is only a fraction of the measured baseline total lake alkalinity. On a long-term basis (the life of the gas treatment plants) of consumed alkalinity as well as new biologic activity, the weathering of rocks might cause some replacement. The long-term rate at which alkalinity is replaced is poorly understood and requires substantial study. These data would help to establish whether long-term impacts are indeed important.

Visibility Impairment in PSD Class I Areas

Three separate visibility impairment cases were modeled based on the proximity of the nearest proposed and existing Class I areas to the Riley Ridge Project using conservative EPA screening procedures (see Air Resources Technical Report):

- Case 1 - the potential impact on visibility in the Bridger Wilderness.
- Case 2 - the potential impact at the Scab Creek Primitive Area.
- Case 3 - the potential visibility impairment at Fossil Buttes National Monument.

The results for these three cases show that the physical parameters, contrast degradation, changes in coloration, and visual range reduction, at all proposed and existing Class I areas are less than the empirical significance criterion of 0.1. Therefore, for the Proposed Action, significant visibility impairment would not occur at the Bridger Wilderness, Scab Creek Primitive Area, or Fossil Buttes National Monument. From these results it can also be concluded that the other more distant Class I areas, i.e., the Teton Wilderness and Teton National Park, would not have significant visibility impairment from the Proposed Action.

Vegetation Impacts in PSD Class I Areas

Because maximum predicted SO_2 concentrations would be below applicable PSD Class I increments in all proposed and existing Class I areas, SO_2 impacts to sensitive vegetative species are expected to be insignificant. As discussed in more detail in the Air Resources Technical Report, particulate emissions are not expected to result in significant impact to sensitive vegetation either.

Secondary Growth Impacts

The population increases which would be expected in southwestern Wyoming as a result of the Riley Ridge Project have been described in the Environmental Consequences-Socioeconomics section. The largest local population increases would occur in the Kemmerer-Diamondville area in 1986. These two communities would experience a projected population increase of about 3,500 people. The air quality impacts of such a population increase would be due primarily to residential space heating, refuse burning, and vehicular exhaust.

The air quality impact of regional population growth is shown in Table 4-37. The modeled concentrations include existing background concentrations. When compared to applicable NAAQS/WAAQS, none of the pollutant concentrations from secondary growth are significant.

Though concentrations were calculated only for the Kemmerer-Diamondville area in 1986, the results for other communities and during other years would be even less since the population increases would be less. These impacts would not be significant.

Cumulative Impacts

As noted in the Chapter 3 subsection, *Baseline Air Quality and Visibility*, SO_2 emissions from the Whitney Canyon and Carter Creek gas treatment plants (see Map 3-5) have not been accounted for in the baseline air quality. This is because the facilities have come on-line after the dates associated with the measured air quality data used in this study to determine baseline air quality. Based on the very low magnitude of the SO_2 emissions from the Carter Creek facility (about 34 pounds/hour) and its distance from the nearest Riley Ridge gas treatment plant site (Northwest's Craven Creek plant at about 60 kilometers or 36 miles), it is not expected that the Carter Creek SO_2 emissions would result in significant cumulative impacts with the Riley Ridge gas treatment plants. However, the Whitney Canyon gas treatment plant is a relatively large source of SO_2 (about 3,117 pounds/hour, see Table 3-22) but is also relatively far from the nearest Riley Ridge gas treatment plant site (Northwest's Craven Creek plant at about 65 kilometers or 39 miles). While cumulative SO_2 impacts of the Whitney Canyon emissions with the Craven Creek emissions are not expected for 3-hour and 24-hour time periods due to this large distance, annual average cumulative impacts are expected. However, it is not expected that these annual average cumulative concentrations would exceed about 5 micrograms/cubic meter of SO_2 based on the individual plant impacts of Craven Creek modeled in this study and the predicted Whitney Canyon SO_2 impacts in the PSD permit on file with the Wyoming DEQ. The 5 microgram/cubic meter maximum cumulative concentration is 25 percent of the applicable Class II PSD increment of 20 micrograms/cubic meter. Therefore, insignificant cumulative SO_2 impact is expected from the Whitney Canyon and Northwest's Craven Creek gas treatment plants. Because the other Riley Ridge gas treatment plants would be even further from the Whitney Canyon plant,

TABLE 4-37
AIR QUALITY IMPACT OF SECONDARY GROWTH ON THE KEMMERER-DIAMONDVILLE AREA PROPOSED ACTION

	Total Maximum Concentrations/NAAQS/WAAQS (micrograms/cubic meter)									
	1-Hour		3-Hour		8-Hour		24-Hour		Annual	
Pollutant	Conc.	Std.	Conc.	Std.	Conc.	Std.	Conc.	Std.	Conc.	Std.
TSP	--	--	--	--	--	--	62.4[5]	150	30.6[7]	60
SO_2	--	--	70.4[2]	1,300	--	--	15.1[6]	365	3.03[8]	80
NO_x	--	--	--	--	--	--	--	--	9.3[9]	100
CO	3,623[1]	40,000	--	--	1,593[4]	10,000	--	--	--	--
HC	--	--	8.3[3]	160	--	--	--	--	--	--

[1] Includes a background concentration of 3,500 micrograms/cubic meter.

[2] Includes a background concentration of 70 micrograms/cubic meter.

[3] Does not include a background concentration. Background is unknown but probably very low.

[4] Includes a background concentration of 1,500 micrograms/cubic meter.

[5] Includes a background concentration of 60 micrograms/cubic meter.

[6] Includes a background concentration of 15 micrograms/cubic meter.

[7] Includes a background concentration of 30 micrograms/cubic meter.

[8] Includes a background concentration of 3 micrograms/cubic meter.

[9] Includes a background concentration of 9 micrograms/cubic meter.

insignificant cumulative SO_2 impacts are expected with them as well.

Air Quality Related Values Impacts

As noted in the significance criteria, the FS has identified eight AQRV that include: flora, fauna, water, odor, soil, visibility, cultural/archeological, and geologic. For a number of reasons impact analyses cannot be performed at the present time on all AQRV. However, impacts to some of these AQRV have been analyzed in this study and were determined to be insignificant according to the identified significance criteria. As discussed in previous sections these include insignificant impacts to odor, visibility, vegetation (due directly from SO_2 and particulate), and acid deposition effects on sensitive fish in sensitive high altitude lakes (due directly from lake pH changes).

Summary

Operation of the Proposed Action is expected to result in insignificant air quality impacts except for the following:

- Twenty-four hour SO_2 concentrations for Quasar's East Dry Basin plant. The concentrations for this plant exceed the 24-hour PSD increment of 91 micrograms/cubic meter more frequently than allowed. The maximum predicted concentration is 124 micrograms/cubic meter. While the 3-hour SO_2 PSD increment is not predicted to be exceeded (and therefore the impact is insignificant), the maximum predicted 3-hour average from Quasar's East Dry Basin facility is 96 percent of the 3-hour Class II increment.
- Half-hour H_2S concentrations at plant boundaries and beyond from Quasar's East Dry Basin plant exceed the Wyoming one-half hour standard of 40 micrograms/cubic meter more frequently than allowed, i.e., more than twice in any five consecutive days. The 70 micrograms/cubic meter standard would also be exceeded more than allowed, i.e., more than twice per year. The area where these significant H_2S impacts are predicted is the high terrain about 2 kilometers (1.2 miles) to the southeast of Quasar's East Dry Basin site. The maximum predicted H_2S concentration from the Quasar facility is 237 micrograms/cubic meter.
- Odor impacts of H_2S are expected to be signficant in localized high terrain areas around the Exxon West Dry Basin and Big Mesa plants as well as around Quasar's East Dry Basin plant because the maximum predicted concentrations from these facilities are 12, 7, and 237 micrograms/cubic meter, respectively, which exceed the 6.5 microgram/cubic meter odor threshold.

SOILS AND VEGETATION

Impacts to soils and vegetation would be considered significant under the following conditions.

Significance Criteria

1. Impacts to soils were considered significant if increased erosion rates or reduction of soil productivity resulting from project activities would prevent successful rehabilitation (the process of

applying mechanical and revegetation techniques to limit soil loss to preconstruction levels on disturbed sites) and eventual vegetation regeneration (reestablishment of pre-existing vegetation composition, density, and cover).

Evaluations of successful rehabilitation were based on whether soils having severe rehabilitation constraints would stabilize to near preconstruction conditions within five years following application of proposed revegetation plans and compliance with federal stipulations for erosion control and revegetation (see Appendix B).

2. Impacts to vegetative productivity and wildlife habitat were considered significant if rehabilitated areas would not (1) have adequate vegetative ground cover to control soil erosion at preconstruction levels and, (2) have adequate vegetative ground cover consisting of plant species which have a utility in the post-disturbance land use within five years following initial revegetation.
3. Impacts were considered significant if any federally listed threatened or endangered plant species were affected, since loss of these species would contribute to a decline of an irretrievable resource.
4. Impacts to vegetation resulting from operational emissions were considered significant if emissions exceed known injury thresholds for sensitive vegetation (such as Douglas-fir) from chronic exposure to SO_2 and NO_x. Chronic exposure and injury from SO_2 and NO_x could reduce vigor in sensitive species making them more susceptible to injury from disease.
5. Impacts were considered significant if construction of roads, well pads, and plant sites disturbed areas with poorly drained soils occupied by riparian vegetation. Long-term productivity would be reduced in these areas because the composition and addition of fill would alter soils-water relations in this zone permanently, preventing reestablishment of riparian communities. Riparian areas are scarce in western environments, provide valuable wildlife habitat, and contribute to watershed maintenance.

Well Field

Construction

Implementation of the Proposed Action would result in the potential disturbance of 12,852 acres of soil and vegetation; 3,968 acres would be disturbed within the 159,928-acre well field (Table 4-38). Map 1-2 in the map pocket illustrates well field boundaries and proposed facilities. Disturbance would result from clearing for construction of roads, well pads, pipelines, plant sites, railroads, and transmission lines.

Of the 13 vegetation types affected (not including clearcuts or previously disturbed lands), 1,934 acres (49 percent) of the disturbance would occur in sagebrush-dominated types. The next most disturbed type (1,072 acres or 27 percent) would be in coniferous forest (mixed pine, spruce fir, and Douglas-fir). All soils potentially disturbed by project activities were classified into rehabilitation units (see Appendix C, Table C.3); however, only soils exhibiting severe revegetation constraints (sensitive units) are discussed in Chapter 4 (Table 4-39). These sensitive soils have revegetation constraints due to slope, depth, high erosion potential, or chemical nature. Table 3-24 presents rehabilitation considerations for these units; additional detail is provided in the Soils, Vegetation, and Reclamation Technical Report. Rehabilitation units containing somewhat poorly and poorly drained soils were not classified as sensitive, since reclamation should be readily accomplished in such areas. However, the riparian vegetation communities occurring within these units are considered sensitive due to their value to wildlife, livestock, and watershed management. Rehabilitation considerations for these areas are presented in the Soils, Vegetation, and Reclamation Technical Report.

Of the 3,968 potentially disturbed acres within the well field, approximately 1,467 acres (37 percent) of potential disturbance would occur on soils classified as sensitive rehabilitation units (Table 4-39). These sensitive rehabilitation units in the well field are characterized by very gravelly and very cobbly soils occurring on steeply sloping ridge crests and sideslopes. Depth to bedrock ranges from less than 20 inches to over 40 inches. Hard, non-rippable quartzites, limestones, and dolomites outcrop in some rehabilitation units. In addition, a small area (10 acres) of strongly saline-alkaline soils occurs in the eastern portion of the well field.

Impacts resulting from clearing vegetation would include loss of forage and timber, increased wind and water erosion, soil compaction, damage to vegetation from off-road vehicle (ORV) traffic, increased risk of fire, and reduced potential productivity resulting from weed invasion on disturbed sites.

Loss of forage and timber would be an insignificant impact (less than 1 percent) when compared to the abundant regional resource (see Timber and Agriculture/Grazing). Secondary impacts related to increased "risks" such as risk of fire, risk of weed invasion, and indiscriminate ORV use are also considered insignificant since federal land management and the applicants' standard operating procedures have controlled and minimized these impacts in the past.

Since the applicants would comply with the reclamation measures and government requirements (see Appendix B), erosion, soil compaction, and loss of vegetative productivity would be short term (one to two years) and insignificant for the majority of the well field. The potential for greater impact to soils is present in areas with less favorable soil and climatic conditions, since they are more susceptible to erosion hazards and have lower vegetative productivity. However, reclamation measures would adequately protect soil resources from degradation and establish preconstruction ground cover (grass and forbs) within five years after implementation of these measures on

TABLE 4-38
POTENTIAL CONSTRUCTION DISTURBANCE BY VEGETATION TYPE
PROPOSED ACTION
(ACRES)

	Vegetation Types[1]															
	BS	SC	MS	MDS	Sa	G	MP	SF	D	A	C	R	P/H	Gr	Di	Total
Well Field																
Roads	208	196	4	0	0	70	124	29	18	34	9	29	36	0	0	757
Wells	294	284	7	0	0	90	245	48	18	49	18	0	49	0	0	1,102
Gathering System	549	403	10	0	0	207	452	106	32	107	38	106	89	10	0	2,109
Total	1,051	883	21	0	0	367	821	183	68	190	65	135	174	10	0	3,968
Plant Sites																
East Dry Basin	483	0	0	0	157	0	0	0	0	0	0	0	0	0	0	640
West Dry Basin	605	30	0	0	0	5	0	0	0	0	0	0	0	0	0	640
Big Mesa	506	0	26	0	0	108	0	0	0	0	0	0	0	0	0	640
Craven Creek	496	0	0	144	0	0	0	0	0	0	0	0	0	0	0	640
Sulfur Loadout	22	0	0	0	125	0	0	0	0	0	0	34	0	0	59	240
Total	2,112	30	26	144	282	113	0	0	0	0	0	34	0	0	59	2,800
Linear Facilities																
Railroads	22	0	0	31	18	0	0	0	0	0	0	2	0	8	4	85
Transmission Lines	916	0	0	31	117	56	0	0	0	0	0	10	37	15	0	1,182
Pipelines	3,738	131	0	31	121	42	0	0	0	0	0	63	13	123	0	4,262
Sulfur Pipeline	372	46	0	8	49	12	0	0	0	0	0	5	27	9	0	528
Access Roads	20	4	0	0	3	0	0	0	0	0	0	0	0	0	0	27
Total	5,068	181	0	101	308	110	0	0	0	0	0	80	77	155	4	6,084
Grand Total	8,231	1,094	47	245	590	590	821	183	68	190	65	249	251	165	63	12,852

[1] BS = Big Sagebrush
SC = Sagebrush Complex
MS = Mountain Shrub
MDS = Mixed Desert Shrub
Sa = Saltbush
G = Grassland
MP = Mixed Pine
SF = Spruce Fir
D = Douglas-fir
A = Aspen
C = Clearcut
R = Riparian
P/H = Pasture/Hayfield
Gr = Greasewood
Di = Disturbed

sites receiving more than 9 inches of annual precipitation (BLM 1979c). On sites receiving less than 9 inches of annual precipitation, site stabilization is expected to occur within five years of implementing reclamation efforts, but the risk of early failures and repeated maintenance is likely. Approximately 7,600 acres (59 percent) of the overall disturbance under the Proposed Action would occur on areas receiving less than 9 inches of rainfall. This total includes the well field, plant sites, and linear facilities. Some unquantifiable soil loss resulting from accelerated wind and water erosion would occur until rehabilitation measures were implemented. Regeneration of woody species requires varying lengths of time depending upon the size of mature shrubs or trees, annual precipitation, growing season, and soil fertility. It is estimated that tree species in coniferous communities at higher elevations (whitebark pine, spruce-fir, mixed pine, Douglas-fir) require more than 100 years to reach maturity (Alexander 1974). Aspen trees may be expected to reach maturity in 80 to 100 years (Schier 1975). Shrub species in shrub-dominated vegetation types (big sagebrush, sagebrush complex, mountain shrub, willow) require 15 to 30 years to grow to predisturbance height and density (Johnson 1969 and Wright et al. 1979). Regeneration of communities

TABLE 4-39
AREAS (ACRES) OF POTENTIAL CONSTRUCTION DISTURBANCE ON SENSITIVE REHABILITATION UNITS[1]
PROPOSED ACTION

	A2	A4	B3	C2	C4	D4	D5	Total
Well Field (Overall Potential Disturbance: 3,968 acres)								
Roads	0	0	113	50	66	32	125	386
Wells	0	0	84	64	63	38	145	394
Gathering System	10	0	155	55	93	73	301	687
Subtotal	10	0	352	169	222	143	571	1,467
Plant Sites (Overall Potential Disturbance: 2,800 acres)								
East Dry Basin (Quasar)	600	0	0	0	0	0	0	600
West Dry Basin (Exxon)	0	40	0	0	0	0	0	40
Big Mesa (Exxon)	0	120	0	0	0	0	0	120
Craven Creek (Northwest)	144	0	0	0	0	0	0	144
Sulfur Loadout (Exxon)	40	25	0	0	0	0	0	65
Subtotal	784	185	0	0	0	0	0	969
Linear Facilities (Overall Potential Disturbance: 6,084 acres)								
Railroads	58	0	0	0	0	0	0	58
Transmission Line	189	157	113	0	0	0	0	459
Pipeline	405	448	0	0	0	0	0	853
Sulfur Pipeline	138	20	0	0	0	0	0	158
Access Roads	1	4	0	0	0	0	0	5
Subtotal	791	699	113					1,533
Total	1,585	814	465	169	222	143	571	3,969

[1] Sensitive Rehabilitation Units are identified in Appendix C (Table C.3).

dominated by grasses and forbs depends upon the availability of nearby seed sources. It is estimated that many of the understory species would reinvade the meadow type within 5 to 10 years; a longer time period (10 to 15 years) would be required for the bunchgrass type where soil moisture is more limiting on plant establishment and growth.

The degree of potential impacts within the well field would depend on the types of disturbance necessary to construct facilities. Three major types of land disturbance would be associated with the well field: gathering system pipelines, well pads, and roads. Construction of these project components would result in direct removal of vegetation, reduced vegetative productivity from sidecasting of earth materials, soil compaction, losses of soil and rock in areas of steep sidehill cuts, and alteration or removal of topsoil resources. Such disturbances would increase surface water runoff and accelerate erosion losses.

Gathering pipelines would be constructed throughout the life of the well field as needed to serve producing wells. The gathering system would account for 53 percent of the disturbance (2,109 acres) in the well field. Excavation of pipeline trenches would alter soil profiles; however, construction would not require extensive cuts-and-fills since the system would generally follow gentle slopes or traverse steep inclines. Installation of the gathering system would incorporate erosion control and revegetation measures within the first year after disturbance. Accelerated erosion and vegetative productivity losses would be short-term impacts until pipeline rights-of-way are stabilized (2-5 years).

Construction of well pads, which accounts for 28 percent of the disturbance (1,102 acres), would potentially have more intensive impacts. Well pads would preferably be located on more gently sloping surfaces where erosion potential is less. However, on steeper slopes where cuts-and-fills are necessary to construct the pad, impacts to soil and vegetation would be increased. Sidehill cuts-and-fills on slopes exceeding 30 percent would create extensive sidewall cuts that may cause slope instability, and would also involve side-casting of large volumes of earth materials onto otherwise undisturbed areas. Such impacts would limit the effectiveness of re-grading in cut areas, and would create difficult and expensive conditions for site rehabilitation. Construction or disturbance of steep slopes such as these should be avoided. Successful application of intensive revegetation and mechanical erosion control techniques would stabilize such areas within five years.

New road construction, which would cause 19 percent (757 acres) of the proposed disturbance, would have the greatest potential for impacts to soil and vegetation resources. Continued erosion losses would occur along roads. This impact would be most serious where sidehill cuts are constructed, as previously described for well pads. In addition, access roads could be used for off-road vehicle (ORV) activities, which would increase the problem of controlling off-road land disturbance. The use of unsurfaced roads during wet weather would subject them to rutting. This would increase the hazard of concentrated runoff and resultant gully erosion.

The risk of significant soil and vegetation impacts would be higher in areas of limited rehabilitation potential (see Table 4-39). Soils occurring within the project area have been grouped into rehabilitation units according to climatic regime, slope, and other factors (see Appendix C and the glossary). Sensitive rehabilitation units, as identified in the table, would be more susceptible to impacts should the proposed activities be located on such areas. These sensitive rehabilitation areas would require more intensive construction design, mechanical erosion control measures, and revegetation practices in order to minimize impacts to soils and vegetation (see the Soils, Vegetation, and Reclamation Technical Report).

In order to quantify the potential magnitude of increased erosion losses and the effectiveness of the erosion control measures, the Universal Soil Loss Equation (USLE) was applied to four representative soils within the well field (see Appendix C). Based on these calculations, good construction engineering practices and rehabilitation techniques would limit erosion losses to within tolerance limits established for Bridger-Teton National Forest lands and BLM lands.

Some small, unquantifiable soil losses would occur prior to rehabilitation efforts during the construction phase if unforeseen adverse climatic conditions occur prior to or during rehabilitation efforts. In addition, a few small sensitive areas would require follow-up rehabilitation efforts until stabilized.

Impacts to soils would generally be insignificant because the implementation of applicable erosion control and revegetation practices (see Appendix B) will minimize erosion and productivity losses. However, impacts to soils would be significant if applicable rehabilitation measures were not properly implemented due to lack of compliance with approved erosion control plans and stipulations, or if atypical climatic conditions (abnormal periods of drought or extremely severe precipitation) occur during the stabilization period.

Well pads would not be constructed in riparian areas, and pipeline rights-of-way in riparian areas would stabilize quickly (two to five years). However, addition of fill for road construction would permanently alter soils-water relations in the riparian zone, reducing the potential for regeneration of similar vegetation. A total of 29 acres of riparian vegetation would be lost to construction of access roads in the well field, resulting in a long-term loss of vegetative productivity. An additional 106 acres of riparian vegetation would be temporarily affected by pipeline construction. No other wetland communities would be affected in the well field. The loss of 29 acres of riparian vegetation to roads would be a significant impact based on the significance criteria.

No known populations of federally listed threatened or endangered species would be affected by construction activity in the well field. Additional detail on rare plants occurring in the well field is provided in the Soils, Vegetation, and Reclamation Technical Report.

Operation

Based on the applicants' plans to reclaim rights-of-way and well pads after construction, 1,201 acres (Table 1-8) would remain in use for the operating life of the project (40 years). Operation of the well field would have no significant impacts on soil or vegetation resources. Most of the disturbance would occur during construction and disturbed sites would be stabilized, revegetated, or occupied during operation. Expected SO_2 and NO_x emissions from well field sources would be below the threshold required to cause acute or chronic damage to native vegetation. Damage to vegetation could occur in the event of an H_2S pipeline rupture; however, given the low probability of a rupture (see Health and Safety Section), impacts to vegetation are not considered significant.

Abandonment

Abandonment of the well field would generally not involve significant impacts to soil or vegetation resources. Erosion control and reclamation techniques would be used during abandonment to minimize erosion and ensure revegetation. Roads would likely remain in use for other oil and gas development, secondary or tertiary recovery, timber harvest, or use as public roads. Assuming 80 percent of the roads in the well field would remain in use following abandonment, a total of 606 acres would be unreclaimed at completion of the project (Table 1-8). This unreclaimed acreage represents a long-term impact in terms of losses in vegetative productivity.

Plant Sites

Construction

Construction on the four proposed plant sites and sulfur loadout would remove 2,800 acres of vegetation (Table 4-38) and would affect 969 acres of sensitive rehabilitation units (Table 4-39) which consist of steep, shaly areas and saline/alkaline soils. Although these soils possess revegetation limitations, they generally are less productive or valuable than soils without chemical or physical constraints. A total of 34 acres of vegetation in riparian areas would be affected by construction of the sulfur loadout facility representing a significant long-term loss of vegetative productivity. With this exception, impacts resulting from site clearing, compaction, and increased erosion are expected be short term (less than 2 years) and insignificant with implementation of erosion control and revegetation measures which would be applied.

Operation

Based on the applicants' reclamation and operation plans specified in the rights-of-way applications, all the area disturbed for plant sites during construction would remain in use through the 30 to 40-year project operating life. Expected SO_2 and NO_x emissions from the treatment plants would be below threshold levels (2 parts/million for SO_2 and 6 parts/million for NO_x for 6 hours) which could cause acute or long-term (1 part/million for SO_2 and 1 part/million for NO_x for many hours) damage to native herbaceous and woody species of vegetation. This conclusion is based on a comparison of expected treatment plant emissions and air pollution damage susceptibility of vegetation. Additional detail on air pollution damage and vegetation susceptibility is provided in the Soils, Vegetation, and Reclamation Technical Report.

Abandonment

Based on applicants' operation plans, all disturbed areas would be reclaimed upon project abandonment using the reclamation measures described in Chapter 1 and the general measures described in Appendix A. No significant impacts from plant site construction, operation, or abandonment are projected for either vegetation or soils.

Linear Facilities

Construction

Construction of linear facilities outside of the well field, including plant site access roads, gas pipelines, the sulfur pipeline, power transmission lines, water pipeline, and railroad spur would affect 6,084 acres of soil and vegetation (Table 4-38). Of this, 86 percent (5,249 acres) of disturbance would occur in sagebrush-dominated types. Nearly 80 percent (4,790 acres) of the disturbance would result from clearing for pipeline construction. About 1,533 acres of disturbance would occur in soils classified as sensitive rehabilitation units (Table 4-39). Many of these soils are strongly saline or alkaline and require special attention to ensure successful revegetation. About 245 acres of mixed desert shrub communities, which characteristically occupy somewhat stabilized sand dunes, would be affected. Disturbing these areas may result in the loss of the entire dune since these areas are only marginally stable at present.

Impacts to soil and vegetation would be similar to those resulting from well field construction, including loss of forage, increased erosion, damage from ORV use, and increased risk of fire and weed invasion. Side-hill cut construction for roads, pipelines, and railroads could adversely affect soils. Cuts on slopes exceeding 30 percent could cause unstable soil and bedrock conditions, increase erosion losses of soil, and make rehabilitation difficult. However, impacts are expected to be localized, short term and insignificant with implementation of effective erosion control and revegetation measures. Loss of 80 acres of riparian vegetation associated with road construction would be significant. No known populations of federally listed threatened or endangered plant species would be affected.

Operation

A total of 153 acres would remain disturbed during operation. The sulfur pipeline would require a 15-foot wide access trail (105 acres) which would be traversed once a month by a 4-wheel drive vehicle or snowmobile. Use of the trail would crush vegetation along its 54-mile length, compact soil, and increase soil erosion potential. Unauthorized use of the access trail would cause significantly more disturbance of soils and vegetation than normal inspection and maintenance.

Eight sulfur pits for draining the sulfur pipeline would affect a small area (about 0.5 acre total) of vegetation and soil immediately under the drain points of the pipeline. Pits would not be constructed in riparian or sensitive communities and would be used only if necessary to service or repair the pipeline. If it were necessary to drain the pipeline, disturbance would be limited to the right-of-way and disturbed areas would be revegetated after the solidified sulfur was removed. The pits would then be left for the next emergency. The largest pit could potentially affect 6,333 square feet of soil and vegetation.

Northwest's railroad spur at Opal would require a 25-foot operational right-of-way and all roads would remain in use. These facilities would require 21 and 27 acres, respectively. Operation of the underground pipelines would have no significant impact on soils or vegetation based on the significance criteria.

Abandonment

A total of 35 acres (access roads and railroad right-of-way) would remain in use following abandonment. Thirteen acres for the railroad spur would be abandoned and not reclaimed; major regrading and removal of rock ballast on about 15 feet of the railbed to facilitate revegetation is assumed to be impractical and disruptive. Eight percent or 22 acres of road would also be in use beyond the project life. These 35 acres not reclaimed represent a long-term impact.

Cumulative Impacts

Cumulative impacts to vegetation and soils would result from the Riley Ridge Project and the Chevron Phosphate Project (slurry pipeline). Construction of the Chevron pipeline would disturb 1,516 additional acres of vegetation and soil, primarily in sagebrush/grass communities. Of this total, the slurry pipeline would disturb 24 acres of riparian vegetation on the Green River; 7 acres would be removed for the life of the project. After abandonment the Riley Ridge and the Chevron Phosphate Projects would cumulatively remove 1,381 acres of vegetation, including 70 acres of riparian vegetation, from the Green River drainage, a long-term impact.

Summary

Construction and operation of the Proposed Action would affect 12,852 acres of vegetation and soils (Table 4-38). No significant impacts are anticipated for soils, assuming compliance with the recommended soil protection measures. Approximately 249 acres of riparian vegetation would be removed of this total; a reduction in long-term vegetative productivity on 63 acres supporting riparian vegetation is anticipated. This significant impact would result from construction of access roads in the well field, the railroad spur to Opal, and the sulfur loadout facility. In addition, 606 acres of well field access roads would remain in use and unreclaimed as well as 13 acres of the railroad route and 22 acres of plant site access roads (Table 1-8). Of the 12,852 acres disturbed, a total of 641 acres would be removed beyond the life of the project. These land use conversions constitute a reduction in the rangeland or forest land resource, and represent an insignificant (less than 1 percent) reduction in the total regional resource (see Environmental Consequences-Timber, Agriculture, and Grazing). No known populations of threatened or endangered plant species would be affected.

VISUAL RESOURCES

Significance Criteria

Impacts to visual resources caused by individual project facilities would be considered significant:

1. Where a proposed facility could not meet existing Visual Resource Management (VRM) Class objectives (BLM) or Visual Quality Objectives (FS) for an area. In addition, impacts would be judged highly significant where a proposed facility would be the dominant feature (BLM Class IV or V; FS levels of Modification, Maximum Modification, or Unacceptable Modification) in a landscape with objectives for maintaining a natural dominated character (BLM Classes I, II, or III; FS areas of Preservation, Retention, or Partial Retention).

Impacts to visual resources caused by the combined effects of the project would be considered significant:

2. Where the visible area would change in overall character from: (1) Man-Natural Mix to Man Dominated, or (2) from Scenic Natural to Man-Natural Mix, or (3) from Common Natural to Man Dominated, or (4) from Common Natural to Man-Natural Mix (as seen from fixed viewpoints).
3. Impacts would be considered highly significant where the visible areas would change in character from (1) Scenic Natural to Man Dominated, or (2) from Scenic Natural to Man-Natural Mix (as seen from fixed viewpoints).

Study Process

Because of the extent and complexity of the project, the visual impact assessment process used for the Riley Ridge study is of two types with separate objectives.

The first type is the facility impact assessment which is used to identify the degree of visual impact that may be created by individual project facilities. The process involves a consideration of differences in the physical disturbance that may result from a proposed facility, such as a buried pipeline, in each of the various types of landscapes that occur in the study area. The process then involves an identification of how these changes would be seen from various viewpoints, such as specific houses, recreation areas, and highways. The degree of predicted visual contrast is then compared to the visual management guidelines (as determined by the inventoried level of resource value) to determine the degree of impact.

The second type of impact assessment is the combined visual change assessment, which evaluates the combined visual effect of all facilities. The combined extent and types of proposed facilities that would be visible from these viewpoints is identified and their overall effect on the existing landscape character considered. The resulting landscape character is then identified as Man Dominated, Natural Dominated Common, Natural Dominated Scenic, or Man-Natural Mix (see Figures 3-8 and 3-9 for examples). The level and type of change between the existing and the resulting visual character, as seen from these viewpoints, determine the level of impact.

Well Field

Construction

Of the 238 (Table 1-4) of proposed well sites, 6 would result in significant impacts and 75 would result in highly significant impacts. Highly significant impacts would result where wells are proposed in areas of high and moderate resource value (Figure 4-1), while significant adverse impacts would result for well sites in areas of low visual resource value. Construction of the well facilties would involve a significant degree of alteration to the existing landform, vegetation, and natural character conditions.

Landform and vegetation contrasts would vary from location to location, based in part on existing disturbance, but would be primarily related to the inherent landform and vegetation conditions present.

Contrasts would generally increase for landform with increased slope, and where the vegetation type is more dense and more uniform. These contrasts are modified by viewer conditions and would increase or decrease in response to such variables as viewer proximity, sensitivity, relative topographic position, and screening.

The degree of change created by the introduction of large drilling structures would be generally high, except in the eastern half of the Hogsback Unit and the southeastern portion of the Tip Top Unit. Oil and gas-related structures are already common at these locations.

Map 4-3 in the map pocket shows the locations of proposed wells which would result in significant and highly significant visual impacts. Many of these wells would be adjacent to or very near roads through recreation areas and would be highly visible in a scenic, or otherwise natural setting.

Construction-related impacts due to the gas gathering pipelines are primarily associated with the visual alteration of landform and vegetation, and are generally greater on steep slopes or areas of uniform vegetation. The proposed network would result in 15 miles of significant impacts and 6.75 miles of highly significant impacts.

Viewer orientations which provide views down the pipeline right-of-way were rated significantly more visible than orientations that would provide only views across the right-of-way. This is true in all vegetation types from sage to conifer timber, since even short vegetation types offer a degree of visual screening to these ground level modifications.

Access roads in the proposed well field would result in 4.5 miles of significant impacts and 10 miles of highly significant impacts. Construction-related access road impacts would result from the same vegetative modifications as described for pipelines above. Landform modifications associated with cuts, fills, and switchbacks, particularly in steep areas of low vegetative cover, were also important factors in determining level of impact. Areas of significant and highly significant visual impact from access roads would be in the same areas as those of gathering pipelines.

The Williams maintenance facility proposed along South Piney Creek would result in a highly significant visual impact due largely to the structure's contrast to a scenic, high resource value area without the presence of similar structures. This location would be a focal point to viewers traveling west on the South Piney Creek Road due to road orientation and elevated viewer position. Facility impacts are shown on Map 4-3 (see Map Pocket) and summarized in Table 4-40.

Operation

The number of wells causing significant and highly significant impacts during the operations phase would be 1 and 59, respectively. Well site operational impacts would be the result of contrasts among landform, vegetation, and structures. All sites would have a significant reduction in structure contrasts from the construction phase. All sites, except those in the Sawmill area, would have a noticeable reduction in the extent of landform and vegetation contrast during operation, due to a reduction in the well pad size and reclamation of the adjacent construction-related disturbance. Wells sites in the Sawmill area would remain at construction size and, therefore, contrast impacts would remain at construction levels.

Gathering pipeline rights-of-way would be revegetated following construction. Recovery needed to reduce visual contrasts to an acceptable level is expected to require 5 to 10 years. This is half the full recovery period anticipated, but would be sufficient in most cases to allow enough recovery of the herbaceous vegetation and shrub species to create a similar visual appearance in color and texture as adjacent areas. This time period would be significantly longer in areas of adverse soil conditions or on steep or arid slopes (see Environmental Consequences-Soils and Vegetation Section for more detail). In timbered areas the right-of-way cut, if oriented toward the viewer, would remain evident since trees would be cleared from the right-of-way during operation.

Access road contrasts would be reduced by revegetation of the cut-and-fill slopes. Since the roads would be kept open throughout the operation of the project, impacts would generally remain at construction levels.

The Williams maintenence facility would result in high visual impacts throughout the operation phase due to the structures.

Abandonment

No additional disturbance would be created by abandonment of the well sites or the Williams maintentance facility. Structure and landform contrasts would be eliminated immediately. Herbaceous cover would return within 1 to 2 years; shrub cover would not return completely for 10 to 20 years, but would return adequately within 5 to 10 years to reduce visual contrasts to an acceptable level.

No additional surface disturbance would be required in the abandonment of the gathering pipelines except at the location of surface controls. Access roads would be regraded and revegetated when abandoned. Landform contrasts would be eliminated immediately, and vegetation contrasts would be reduced to an acceptable level in most areas within 5 to 10 years. In heavily forested areas where views are afforded down the right-of-way, pipeline and access road contrasts would remain moderate to high for 25 to 75 years.

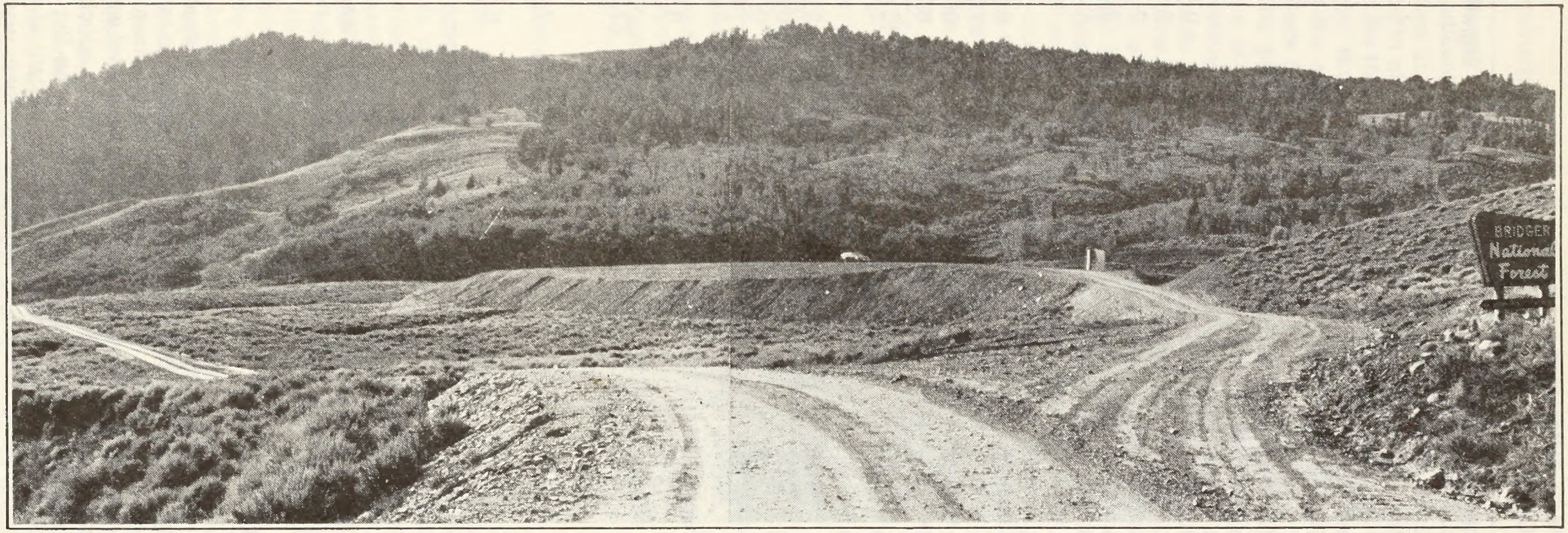
Plant Sites

Construction

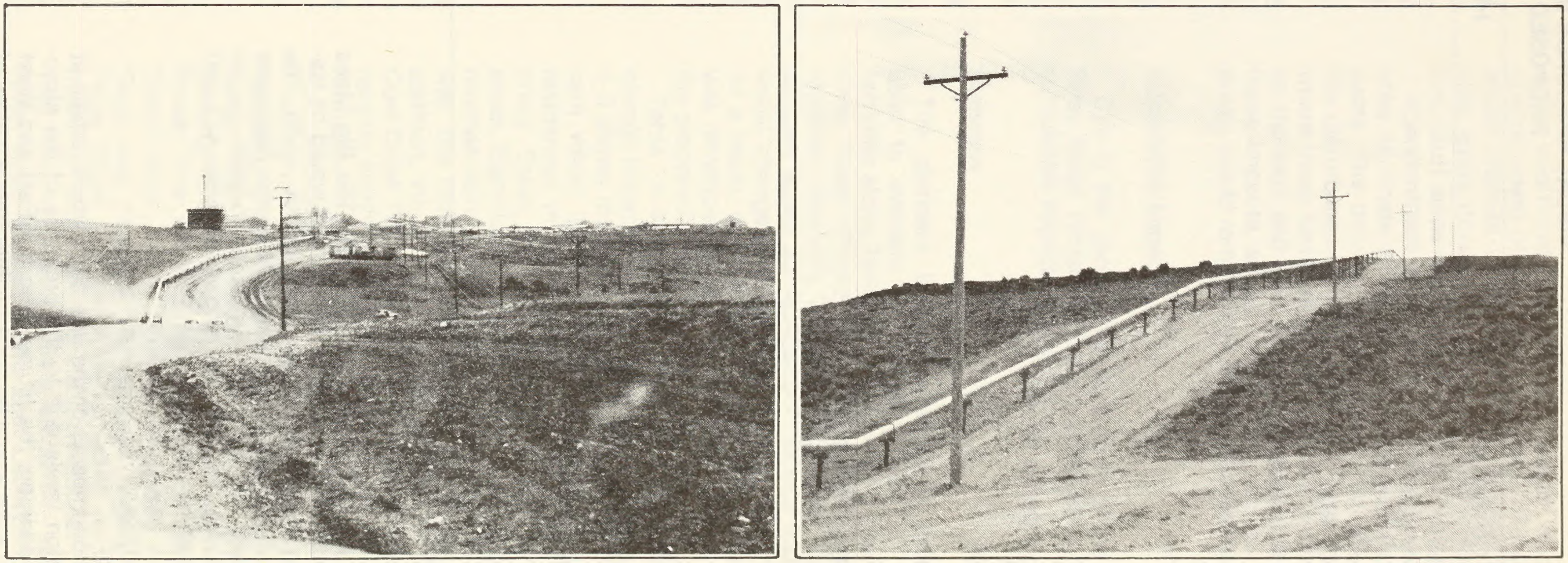
Due to their size, character, and visibility, the proposed plants at East Dry Basin, West Dry Basin, and Craven Creek would result in significant impacts, while the impact of the plant on Big Mesa would be highly significant (due to higher resource values).

Visual impacts of the plants would be due primarily to the structure's contrast. Even though extensive areas would be cleared during construction, the scale of the proposed structures would make the landform and vegetation contrasts insignificant in comparison (Figure 4-1).

Because of enclosing landforms, the visual contrast of the East and West Dry Basin sites would be generally confined to the Basin itself. The only viewing point in this area is County Road 23-134 (Calpet Road). The Craven Creek site would be more open to view, and would be seen from a portion of Highway



A. Well Site Development



B. Treatment Plant

C. Sulfur Pipeline

FIGURE 4-1 EXAMPLES OF SIGNIFICANT VISUAL IMPACTS

TABLE 4-40
VISUAL RESOURCE IMPACT SUMMARY
PROPOSED ACTION

Component	Highly Significant[1]	Significant[1]
Plant Sites		
East Dry Basin		X
West Dry Basin		X
Big Mesa	X	
Craven Creek		X
Williams Maintenance Facility	X	
Well Sites (#s)		
Quasar	23	0
Williams	16	2
Exxon	27	2
Mobil	9	2
	75	6
Gathering Pipeline (Miles)		
Quasar	5.75	6.50
Williams	0	7.75
Exxon	1.00	0
Mobil	0	0.75
	6.75	15.00
Access Roads (Miles)		
Quasar	5.25	3.25
Williams	2.00	0.50
Exxon	2.75	0.75
	10.00	4.50
Transmission Line (Miles)	11.00	0.
Sulfur Pipeline (Miles)	7.25	22.25
CO_2/Sales Gas Pipeline (Miles)	0.25	7.75
Water Pipeline	0	0.50

[1] See Significance Criteria.

189 and Route 240 (the Opal Cutoff). The Big Mesa plant would be high atop a plateau and would be visible from the Piney Creek area in the north, the LaBarge Creek area in the south, the Green River area on the east, and the Wyoming Range foothills on the west. Facility impacts are shown on Map 4-3 and summarized in Table 4-40.

Operation

Operation impacts of the four sites would remain at construction levels due to the presence of the structures. In addition, the plume from the East and West Dry Basin sites would be highly visible from a variety of sensitive viewpoints, including Marbleton/Big Piney, Highway 189, and Piney Creek Road and ranches, even though the plant structures would generally not be visible.

Abandonment

After completion of the project the plant structures would be eliminated. Landform and vegetative rehabilitation would be initiated and vegetation visual contrasts would be reduced to an acceptable level within 5 to 10 years due to herbaceous and shrub species revegetation. Because the ground level of the Big Mesa plant site is not visible except from distant elevated lands, the landform and vegetative contrasts would be considered low immediately following abandonment.

Linear Facilities

Construction

Buried pipelines would result in 7.75 miles of significant impact and 0.25 mile of highly significant impact as a result of landform and vegetation disturbance in steep or visually prominent locations. These include the Chapel Canyon entrance, crossings of the Green River, LaBarge Creek and Fontenelle Creek, and the steep slopes adjacent to Highway 191 north of Rock Springs.

The proposed sulfur pipeline would create 22.25 miles of significant impact and 7.25 miles of highly significant impact. Significant or highly significant impacts would occur in all locations where the sulfur pipeline would be visible due to structure contrasts alone, while landform and vegetation caused impacts would be limited to crossings of steep prominent landscape features (Figure 4-1). These impacts would be down the west side of the Big Mesa escarpment, at the crossings of Fontenelle and LaBarge Creeks, and along most of the route to the south where it would be visible from Highway 189 and various residences.

The proposed transmission line would create 11 miles of highly significant adverse impacts. As with the sulfur pipeline, visual contrasts would be the result of a combination of landform, vegetation, and structure contrasts, with structures being by far the major contributing factor. Areas impacted would include the east side of Big Mesa escarpment as seen from Highway 189, at two points along the Hams Fork River, and at the LaBarge, Fontenelle, and Muddy Creek crossings, where it would be visible from various combinations of highway, road, and residence viewpoints.

Locations of these facility impacts are shown on Map 4-3 and summarized in Table 4-40.

Operation

The buried pipeline impacts created in the construction phase would remain high into the early years of operation. Within 5 to 10 years, the visual contrasts of the disturbed vegetation would diminish to acceptable levels through partial reestablishment of the shrub species. The areas of exception would be the badland escarpment crossings east and west of the Green River where vegetative cover is very sparse. Evidence of surface disturbance would remain in these areas indefinitely.

Landform and vegetation contrasts associated with the sulfur pipeline would follow the pattern identified for buried pipelines above. Structure contrasts would be the major contributing factor to the significant adverse impacts associated with the sulfur pipeline, and impact levels would remain high throughout project operation. For the same reason, transmission line impacts would remain high throughout the operational life of the project.

Abandonment

No additional disturbances would occur during abandonment of the buried pipelines. At this time, all visual impacts would have been reduced to acceptable levels through revegetation, except for the badland bluff areas where impacts would remain evident.

Abandonment of the sulfur pipeline would immediately eliminate all structure-related contrasts and impacts. The only remaining visual impacts would be the disturbances initially created during construction where these facilities would cross escarpments, such as the east and west side of Big Mesa. The level of these impacts, as with the buried pipeline in similar areas, would remain high into the foreseeable future.

Cumulative Impacts

Due to the geographic separation of the proposed Riley Ridge Project and the interrelated projects, no cumulative impacts would occur.

Summary

The standard impact assessment process was used to evaluate the visual impacts of individual facilities alone. However, because of the extent of the Riley Ridge Project and the number of different facilities proposed, the standard impact assessment process would not adequately respond to the overall visual change anticipated to result from the project. As a result, the combined visual change assessment was developed to assess the overall visual effects of the proposed project.

Table 4-41 summarizes the combined visual change impacts of the project on the study area. Map 4-3 shows the extent of these impacts. Highly significant visual impacts would result for a total of 34 residences in the Fontenelle Creek, LaBarge Creek, Piney Creek, Beaver Creek, and Dry Piney Creek areas. Significant visual impacts would occur for 10 ranches along Slate Creek, LaBarge Creek, and Highway 189 between LaBarge and Dry Piney Creek. In addition, views from along 26 miles of the Indian/Coal Creek Road and South Piney Creek Road would receive highly significant impacts due to the transformation of a scenic natural landscape to one that is man dominated.

Views from an additional 103 miles of road in the following areas would receive significant visual impacts: the Opal Cutoff, Fontenelle Creek Road, LaBarge Creek Road, Calpet Road north of Fogarty Creek, Pine Grove Ridge Road, upper Beaver Dam Creek Road, Middle Piney Creek Road, Fish Creek Road, and Highway 189 between LaBarge and Dry Piney Creek. Similar impacts would occur along 2 miles of the Wyoming Range National Recreation Trail, and at three ranches along the upper Green River, three ranches along East LaBarge Creek, and one ranch along Slate Creek.

TABLE 4-41
COMBINED VISUAL CHANGE
PROPOSED ACTION

Viewer Location	Combined Visual Change[1]	Combined Visual Change Significance Level[2]	Miles/ Residences
Opal Cutoff (Hwy.240)	C-N to M-D	Significant	12 Miles
Slate Creek Ranch	C-N to M-N fixed vpt.	Significant	1 Ranch
Fontenelle Creek Road	S-N to M-N mix	Significant	12 Miles
Fontenelle Creek Ranches	S-N to M-N fixed vpt	Highly Significant	6 Ranches
East LaBarge Creek Road	M-N mix to M-D	Significant	6 Miles
East LaBarge Creek Ranches	M-N mix to M-D	Significant	6 Ranches
Hwy. 189 - LaBarge Creek to Dry Piney Creek	M-N mix to M-D	Significant	16 Miles
Ranches along 189 - LaBarge to Dry Piney Creek	M-N mix to M-D	Significant	3 Ranches
Residences along 189 - South of Dry Piney Creek	S-N to M-N mix fixed vpt.	Highly Significant	2 Residences
Calpet Road - North of Fogarty Creek to 189	M-N mix to M-D	Significant	10 Miles
Pine Grove Ridge Road	M-N mix to M-D	Significant	12 Miles
Upper Beaver Dam Creek Road	S-N to M-N mix	Significant	4 Miles
Middle Piney Road	S-N to M-N mix	Significant	26 Miles
Indian/Coal Creek Road	S-N to M-D	Highly Significant	10 Miles
South Piney Road	S-N to M-D	Highly Significant	16 Miles
Fish Creek Road	S-N to M-N mix	Significant	3 Miles
Wyoming Trail	S-N to M-N mix	Significant	2 Miles
Beaver Creek Ranches	S-N to M-N fixed vpt.	Highly Significant	2 Ranches
Piney Creek Ranches	S-N to M-N mix fixed vpt.	Highly Significant	24 Ranches

[1] S-N = Scenic Natural, C-N = Common Natural, M-N = Man-Natural Mix,
M-D = Man Dominated, VPT = Viewpoint

[2] See Significance Criteria.

The combined visual impact of the project would be to change the character of the northwest portion of the study area significantly. The present oil and gas activity around the Calpet area would be magnified and extended toward the Wyoming Range and throughout the various creek valleys of the region. These are scenic, recreational, and residential areas, so the degree of impact would be very high. Appreciated now for their natural and scenic features, these areas would become a combination of man-natural mix and man-dominated landscapes.

CULTURAL RESOURCES

Significance Criteria

1. The criteria for evaluating cultural resources are the eligibility criteria of the National Register of Historic Places, 36 CFR 60.4 (revised November, 1981). The criteria apply to resources (historic and prehistoric sites) significant at the national, regional, state, and local levels. Guidelines prepared by the BLM Wyoming State Office and the Wyoming State Historic Preservation Office provide information on the application of the criteria to different classes or types of resources. Effects on resources that produce direct or indirect impacts (36 CFR 800.3) are considered for sites listed on the National Register of Historic Places or which meet the criteria of eligibility.

Direct impacts to cultural resources would occur as a result of construction activities involving facility excavation or site preparation where terrain is physically modified. Indirect impacts would occur to resources in proximity to construction or as a result of operation and abandonment activities. Whereas direct impacts typically occur at a single time when a resource is altered, removed, or eliminated, indirect impacts tend to occur over a longer period and can be cumulative in effect. Access to previously remote sites and the growth in population would increase the likelihood of cumulative indirect impacts.

Separate categories of resources would be impacted in different ways. Prehistoric and historic archeological sites would be directly impacted as a result of the construction involved in drill pad preparation, access road grading, plant site clearing, and pipeline excavation or powerline placement. Since many of the region's archeological sites are characterized by only surface and shallow subsurface materials, activities involving vehicle access and machinery movement within construction areas and on terrain immediately adjacent to project facilities could produce both direct and indirect impacts. Historic structures, and particularly the historically important materials they contain, could be directly impacted by the construction that would remove them. The relatively high commercial and collector value associated with historic materials at certain sites makes them especially vulnerable to damage or removal as access to their locations is increased by new roads.

Historic trails are a special category of historic resource that is vulnerable to destruction or alteration. Road grading directly eliminates most evidence of their location, whereas traffic by modern vehicles, especially four-wheel drive cars and heavy trucks, can severely deform or damage the remaining evidence of 100-year-old trails.

Approximately 4,000 acres of previously undisturbed terrain within the well field would be disturbed by the Proposed Action for the well pads, the gathering system, and access roads (see Table 1-8 for exact facility acreages). This represents less than 2.5 percent of the total well field area. The plant sites would require 2,800 acres of new terrain, and the corridors for pipelines, railroad, transmission line, and access roads would require an additional 6,000 acres. Within the approximately 13,000 acres of new terrain plus already disturbed land, a total of 128 prehistoric or historic archeological sites have been identified that might meet the NRHP eligibility criteria and that could be directly or indirectly impacted by the Proposed Action. Of these sites, 15 would be directly impacted by the Proposed Action, 90 would be indirectly impacted, and the potential impact on the remaining 23 sites has not been determined. The potentially impacted resources identified by previous surveys represent an inventory area of less than 2.5 percent of the well field and less than 5 percent outside the well field for the Proposed Action.

Since a number of the proposed rights-of-way follow existing access roads, a significant number of the previously conducted cultural resource investigations are located in these areas. As a result, certain sections of the study corridors possess more inventory data than others. The sites that have been previously identified, therefore, mostly represent non-well field facilities, since only 30 sites identified by the previous surveys remain unevaluated within the well field.

Although the Proposed Action impact analysis suggests a relatively high number of potentially impacted resources based on less than 5 percent inventory coverage, the actual number of impacted sites would be substantially less since the corridor study area includes terrain a half-mile on either side of the proposed rights-of-way. The actual rights-of-way for the Proposed Action roads, pipelines, transmission lines, and railroad would typically not exceed 100 feet or 2 percent of the 10,012-acre corridor study area (see Table 1-7). However, since many of the surface facilities share adjacent rights-of-way, multiple impacts would occur to those significant resources (NRHP eligible) that would be either directly or indirectly impacted. The historic trails are a category of resource which would be subject to such multiple impacts. The Sublette Cutoff of the Oregon Trail, for example, would be traversed by several facility rights-of-way south of the well field.

Historic trails are one of the dominant historic resources that would be impacted by the Proposed Action and alternatives. The Lander Cutoff of the Oregon Trail passes through the proposed Darby Mountain, Lake Ridge, Riley Ridge, and Sawmill Area well field units. Certain segments are currently used as contemporary roads, although portions of the original trail may be adjacent to the most recent upgraded areas. Most of the other 10 historic trails and stage roads that could be impacted by the project facilities are located south of the well field, in the vicinity of the project rights-of-way. The facility centerlines cross these trails in 53 sections, sometimes more than once in the same section. A total of 85 sections of the study corridors contain segments of the Oregon Trail, Overland Trail, and portions of the Sublette, Hams Fork, Slate Creek, and Kinney Cutoffs. Although portions or the entire lengths of these trails may qualify as NRHP eligible, verification of their condition and proximity to related resources through terrestrial reconnaissance will be necessary to determine their historic significance and to completely evaluate potential project impacts.

The total number of possible NRHP eligible resources for the project alternatives each include the same 30 archeological sites within the well field. The difference in the resource totals, e.g., 98 for the Proposed Action, are almost entirely sites identified within the corridor study areas for each alternative's rights-of-way. A 100 percent survey of the West Dry Basin plant site identified four resources which were found to be not NRHP eligible. The Craven Creek plant site was surveyed, but the survey results have not been released by Northwest Pipeline. The other facility sites (including the sulfur loadout site) remain incompletely surveyed and evaluated for cultural resources. The impact summaries presented for the project alternatives should therefore be interpreted in terms of the relative potential impact on cultural resources within the study corridors.

The BLM will develop a formal compliance plan for the mitigation of potential impacts to cultural resources for all aspects of the Proposed Action. This plan will include the identification of cultural resources that may be impacted by the Riley Ridge Project; submittal of information on potentially significant resources to the SHPO for evaluation of significance; consultation with the Advisory Council on Historic Preservation on the effects of the project on significant resources; and implementation of a cultural resources mitigation program. The compliance plan will include a plan for additional surveys and data collection for all proposed areas of disturbance.

Cumulative Impacts

The historic sites identified for the Riley Ridge Project, particularly the 11 historic trails, would also be subjected to cumulative impacts from the interrelated projects, especially the Chevron Phosphate Project. The cumulative impacts would result from the increased population in the region, thus increasing the potential for indirect impacts to cultural resources.

Summary

A total of 128 sites could potentially be impacted by the Proposed Action. Of these sites, 15 are subject to direct impact, 90 are subject to indirect impact, and the potential impact on the remaining 23 resources has not been determined. The sulfur pipeline would impact 13 identified sites, and the applicants' transmission line would impact 21 identified sites. This impact analysis is based on previous surveys of approximately 2.5 percent of the well field and less than 5 percent of the non-well field area. Therefore, the number of impacted sites for the Proposed Action and the alternatives can only be evaluated in terms of the relative potential impact on cultural resources.

RECREATION

Significance Criteria

Impacts to recreation would be significant if any of the following criteria were met:

1. Total recreation demand in the recreation study area increases by 10 percent or more over baseline conditions.
2. Developed recreational facilities or state and national parks have 10 percent or more of their land use or visually sensitive areas permanently altered.
3. The quality of hunting and fishing is decreased due to reductions in game animal populations and/or increased hunter/fisherman demand.
4. Significant impacts would occur if there were a 10 percent or greater change in the amount of primitive type land within a recreation area.

Significant impacts to recreation resources would occur in the recreation study area due to decreased wildlife populations, increased regional human population, and a corresponding rise in recreational use. Crowding at dispersed and developed recreation sites, decreased hunting opportunities, and decreased fishing opportunities would be significant in the Upper Green River Basin during both construction and operation. The only specially managed recreation area directly affected by proposed activities would be the Wyoming Range National Recreation Trail. Construction of new roads and gathering pipelines would disturb approximately 0.5 mile of the trail along the Middle Fork of South Piney Creek and about 0.6 mile of the pack trail following the North Fork. The project would have no impacts on those sections of the Green River that have been investigated for Wild and Scenic designation.

The Recreation Opportunity Spectrum (ROS) developed by the FS provides a methodology for classifying an area's land base into six types of recreation classes (FS 1980). These classes range from primitive, which is defined as hiking and camping in wilderness settings, to urban, which is defined as organized activities in an urbanized environment. This disaggregation of recreation resources summarizes the unique natural resource capabilities and existing use characteristics of an area. The system can also be used to analyze potential changes in recreation opportunities by comparing existing conditions to resource changes associated with future development.

Applying the FS ROS system to the whole of the well field indicates that significant impacts would occur because large areas of semi-primitive, motorized terrain (SPM) would be converted to roaded natural lands (RN) due to project activities that would improve road access and decrease the area's natural character. The urban class would increase 256 percent and the SPM class would decrease 86 percent (Table 4-42). SPM lands within the Bridger-Teton National Forest are already in relatively short supply, and the Draft Forest Plan projects that by 2010 demand for these lands will exceed supply. The Riley Ridge Project would accelerate this loss and associated shortage relative to demand.

Visitor Use

Table 4-43 shows the projected increases in population and recreation demand in the study area to 1990. The project is expected to produce a peak increase of 27 percent over baseline conditions in 1986 with increases that are significant as well throughout the period 1984 to 1990. The majority of this increase is expected to be in dispersed types of use such as camping, hiking, fishing, horseback riding, and hunting and be concentrated in the Upper Green River Basin. Recreation use along streams with good road access, such as LaBarge Creek, South and Middle Piney Creeks, Hams Fork, and Greys, Big Sandy and New Fork Rivers would show large increases. If past usage patterns for dispersed activities continue, the Big Piney and Kemmerer Ranger Districts and the Pinedale Resource Area can expect significant increased use and impacts.

TABLE 4-42
ACREAGE BY CLASS IN THE WELL FIELD

Recreation Class	Baseline	With Proposed Action	Percent Change
Primitive	0	0	0
Semi-Primitive Non-Motorized	5,086	4,628	-9
Semi-Primitive Motorized	37,787	5,364	− 86
Roaded Natural	84,680	109,024	+ 29
Rural	32,130	40,040	+ 25
Urban	245	872	+ 256
Total Acreage	159,928	159,928	-

Source: FS 1980

Primitive	- Unmodified natural environment to remain free from evidence of human-induced restrictions where motorized use is not permitted.
Semi-primitive Non-Motorized	- Predominantly natural environment with some evidence of other users but managed so as to minimize on-site controls. - Motorized use not permitted.
Semi-primitive Motorized	- Same conditions as semi-primitive, non-motorized except that motorized use is permitted.
Roaded natural	- Predominantly natural-appearing environment with moderate evidence of human activity where conventional motorized use is provided for in construction standards and facility design.
Rural	- Area has substantial modified natural environment with facilities designed for use by a large number of people. Facilities for intensified motorized use are available.
Urban	- Substantial urban environment though background may have natural appearing elements. Mass transit often available to carry people throughout the site.

TABLE 4-43
PROJECTION OF FUTURE RECREATION DEMAND IN THE STUDY AREA[1]

	1983	1984	1985	1986	1987	1988	1989	1990
Population								
Baseline	62,097	65,926	63,560	64,469	65,386	66,228	67,040	68,035
Project Related	38	2,810	9,155	9,530	5,291	5,152	5,501	4,585
Total	62,135	68,736	72,715	73,999	70,677	71,380	72,541	72,620
Recreation Demand[1]								
Baseline	1,044	1,083	1,110	1,131	1,144	1,167	1,191	1,218
Project Related	<1	139	288	301	220	225	239	220
Total	1,044	1,222	1,398	1,432	1,364	1,392	1,430	1,438
% Change	<1	13	26	27	19	19	20	18

[1] Recreation demand presented in thousands of visitor days.

Hunting and Fishing Use

Impacts to recreational hunting and fishing would be significant. Table 4-44 shows the projected increases in demand for pronghorn, deer, elk, and moose hunting from the Riley Ridge project in 1985. There would be an estimated 13,682 hunter days spent by the project-related population, or a 26 percent increase over baseline 1985 use levels within the recreation study area. Elk hunting is expected to experience the largest increase in demand (30 percent), followed by deer hunting (25 percent). Historically, the greatest variety and concentration of animals have been on FS and BLM lands in the central and northern parts of the recreation study area and these are expected to realize the largest increases in future big game hunting demand.

Demand for trout fishing in the study area would also increase significantly. A total regional demand of 54,899 days of fishing is projected for 1985. These demands would be centered on the same FS and BLM lands that would also experience increased hunting pressure. Streams in the vicinity of Big Piney, LaBarge, and Kemmerer would receive a disproportionately greater increase in use than the regional average because of proximity to these fast growing communities, the abundance of nearby streams, and good road access.

TABLE 4-44
PEAK PROJECT-RELATED HUNTING AND FISHING DEMAND, RILEY RIDGE STUDY AREA 1986

Activity	1981 Participation Days	1985 Baseline Participation Days	1985 Project-Related Participation Days	Percent Project-Related Increase 1985
Big Game Hunting				
Antelope	6,728	7,067	1,363	19
Deer	21,574	23,026	5,831	25
Elk	19,926	21,506	6,359	30
Moose	2,002	2,034	129	6
Total	50,230	53,633	13,682	26
Fishing	71,600	85,261	54,899	64

Loss of habitat coupled with significant increases in hunting demand could result in WGF issuing limited quota hunting licenses as it has done in other energy impact areas (Harju 1982, personal communication). Given the projected levels of increased fishing demand, the capability of many of the fishing resources to sustain native populations would be overwhelmed and could result in WGF instituting a larger stocking program and/or more severe restrictions on fishing. For the fisherman, the effects would be seen as a shift to small hatchery trout instead of wild trout, and more crowding at all sites.

The degree of significance of these hunting and fishing impacts would vary with the affected party. For newcomers, the impact may be less severe, depending on previously experienced hunting and fishing quality. For the long-time local resident, effects would be clearly evident and may be felt as a change in their quality of life. Hunting and fishing guides who service non-residents and other businessmen who make a living directly from hunting and fishing activities would probably see these changes as threats to their livelihood.

Cumulative Impacts

Due to the regional nature of recreation activities, the cumulative effects of increased population from interrelated projects on recreation would further aggravate the significant impacts attributable to the Riley Ridge Project. Assuming that recreation patterns for the populations associated with the interrelated projects are the same as the study area's current population, the most noticeable cumulative impacts would be on hunting and fishing, crowding at managed recreation facilities, and increased presence of hikers and campers in otherwise uninhabited, natural areas.

Summary

Impacts to recreation due to the project would be significant and aggravated by cumulative development in the study area. Anticipated increased hunting and fishing would lead to reduced success rates and alteration of the recreation experience. Managed recreation facilities, already in short supply, would similarly experience crowding and afford an altered recreation experience from what currently exists.

WILDERNESS

Significance Criteria

Impacts would be considered significant if any of the following criteria were met:

1. If total recreation demand exceeded the Wilderness Opportunity Spectrum (WOS) supply (zones: transitional, semi-primitive, primitive, pristine), thereby exceeding the social carrying capacity.
2. If well field activity in the Lake Mountain Wilderness Study Area is permanent, substantially noticeable, and consists of permanent man-made fixtures so as to permanently impair the Wilderness Study Area's suitability for preservation as wilderness.
3. If indirect impacts such as the deterioration of air quality permanently alter or cause adverse effects upon wilderness-related values (i.e., naturalness, opportunities for primitive and unconfined forms of recreation, solitude) within the regional wilderness resource base (including proposed as well as existing wilderness units). Permanent alteration of wilderness-related values such as the degradation of flora and fauna, deterioration of visibility standards, adverse effects upon aquatic habitat and species, deterioration of soils, cultural resource values, and wildlife, or odor problems would constitute significant, adverse indirect impacts upon the wilderness resource.

Impacts to wilderness resources and quality of experience are based upon consideration of social, physical, and biological carrying capacities and changes in the quality of the wilderness experience. Based on previous research results (FS 1978; Baxter 1982, personal communication), this analysis assumes that 10 percent of the project-related newcomers (including support personnel) would utilize the available wilderness resource base within the wilderness impact area of influence.

Significant adverse effects to the wilderness resource base, resource values, and quality of the wilderness experience are expected to occur in the Bridger Wilderness, Scab Creek Instant Study Area, Lake Mountain Wilderness Study Area, and high density use corridors (transitional zones) of the Popo Agie Primitive Area and Teton Wilderness (see Maps 4-2 and 2-1). All other wilderness units are expected to have an unquantificable increase in user visitation due to project-induced growth; however, social, physical, and biological, carrying capacity levels are not predicted to be exceeded. This would be primarily due to current low use and the ability of the resource to absorb an increase in use without significantly impairing wilderness-related values.

Public use of the Bridger Wilderness is currently far in excess of acceptable levels. Demand exceeds supply for each of the four wilderness opportunity zones (transitional, semi-primitive, primitive, and pristine). Deterioration of soil stability and vegetative cover along lake shore lines and trails has already occurred. There has been a proliferation of fire rings at camping areas, especially those located near lakes. Available downed, dead wood for camp fires is at a premium at several locations within the Bridger Wilderness. Vandalism and other depreciative behaviorial acts have increased due to increases in use and lack of funding for educational programs and ranger-user contacts. Opportunities for solitude and primitive and unconfined forms of recreation have decreased. Therefore, due to the current situation in the Bridger Wilderness, any project-related newcomer's use of the area would further deteriorate the wilderness resource and quality of wilderness experience (Dailey 1982, personal communication), at a minimum, at least 10 percent of the project-related newcomers can be expected to visit the Bridger Wilderness (Baxter 1982).

The Scab Creek Instant Study Area, although not as heavily used as the Bridger Wilderness, would also be expected to have its social, physical, and biological carrying capacity levels exceeded with the anticipated increase in use by the project-related newcomers. Solitude experience and the naturalness of the area would undoubtedly decline (Bogle 1982, personal communication).

The Lake Mountain Wilderness Study Area (WSA) would also be expected to have a major increase in visitation, especially during hunting season. With well field activity in the Graphite Unit adjacent to, and within a portion of, the WSA, the incidences of poaching and wanton killing of wildlife (elk and other wildlife species), and the illegal use of off-road vehicles (ORV) would likely occur. Naturalness of the WSA through the proliferation of new ORV jeep trails would be compromised, as would the opportunities for primitive and unconfined forms of recreation.

Of greater environmental consequence would be direct impact upon the naturalness of the WSA by two proposed wells, their access roads, and a buried pipeline gathering system which could possibly be in conflict with the "non-impairment criteria". Section 603(c) of the Federal Land Policy and Management Act provides guidence to the BLM on how to manage lands under wilderness review.

> "During the period of review of such areas and until Congress has determined otherwise the Secretary shall continue to manage such lands according to his authority under this Act and other applicable law on a manner so as not to impair the suitability of such areas for preservation as wilderness . . . ."

The proposed two wells, access roads, and buried pipeline gathering system within the WSA would require individual site-specific environmental assessment(s) to determine the significance of the impacts upon the naturalness and other wilderness-related values. These environmental assessment(s) would be necessary prior to any decisions regarding the approval process for APDs within Exxon's Graphite Unit which overlays the WSA.

Increased use of high density transitional corridors in the Popo Agie Primitive Area and Teton Wilderness would affect the social, physical, and biological carrying capacity levels of these areas. Use of the Big Sandy trail within the Popo Agie Primitive Area to the Cirque of the Towers, and trails leading to Bridger Lake, Pacific Creek, and the Upper Yellowstone River reaches in the Teton Wilderness by the projected-related population would likely exceed the carrying capacities of these trails. This would adversely affect the solitude and naturalness of these corridors (Dailey 1982, personal communication; Perkins 1982, personal communication).

Based on the recent FS decision (February 1983) to reevaluate national forest system lands for potential wilderness or non-wilderness recommendations (refer to the Affected Environment - Wilderness section) the possible effects on wilderness values which could influence the potential for wilderness recommendation will need to be considered in the approval process for APDs and any other proposed well field permits on FS-administered lands within the well field. Indirect impacts such as an increase in illegal off-road vehicle use creating new roads or trails, and poaching on FS-administered lands by project-related newcomers, along with effects to air quality related values on FS-administered lands will also have to be evaluated.

Impacts to the backcountry areas recommended for wilderness designation in the Grand Teton and Yellowstone National Parks would not be significant due to the backcounty permit system used by the National Park Service. This system controls visitation by helping to preserve solitude and natural experiences for the users in those areas recommended for wilderness designation.

Cumulative Impacts

Cumulative impacts on wilderness resources are expected to be significant for those areas of current popularity and those areas either adjacent to or part of proposed well field development. Population growth from interrelated projects in the three-county region (Lincoln, Sublette, and Sweetwater) would increase visitation to all wilderness areas in the project study area and be most noticeable in the Bridger Wilderness, Scab Creek Instant Study Area, and Popo Agie Primitive Area. Well field units which are administered by the Forest Service and being reevaluated for potential wilderness designation and portions of the BLM Lake Mountain Wilderness Study Area would also experience cumulative impacts. These cumulative impacts would include the following: (1) increased visitation by the public causing an overall decline in the quality of the wilderness experience, (2) an increase of user conflicts, and (3) a potential for new off-road vehicle trails established on lands currently under study or reevaluation for wilderness designation; (4) an increase in user-wildlife contacts, harassment of wildlife, and poaching incidences; and (5) a unquantified low potential for deletorious air quality effects on wilderness-related values, including a possible decline in visibility and possible increased acidity in some wilderness lakes and streams which could affect future fishing opportunities and fishing quality.

Summary

Impacts to wilderness resources would be significant and due primarily to increased use of affected areas. Development of other projects in the study area would create additional social, physical, and biological impacts and impairment of the user's wilderness experience.

AGRICULTURE/GRAZING

Significance Criteria

Impacts to agricultural lands would be considered significant if:

1. The number of AUMs on any grazing allotment was reduced by 5 percent or more.
2. There is a disruption of critical ranching operations (calving, permanent modification of livestock trailing, permanent change in stock watering source).

Construction

A total of 7,311 acres of grazing land with an associated 690 AUMs within federal allotments would be disturbed during project construction (Table 4-45). This impact in total is insignificant as it represents a less than 1 percent decrease in the total number of AUMs of all affected allotments. Five of the 40 affected allotments, all relatively small and located in or adjacent to the well field area, however, would experience significant impacts due to decrease in AUMs of 5 percent or more. These significantly impacted BLM allotments are the South Piney Individual (6 percent decrease in AUMs), Piney Unit Fenced (21 percent), Beaver Creek Individual (5 percent), Beaver Meadows (100 percent), and LaBarge Individual (9 percent). Disturbance of 58 acres in the Beaver Meadows allotment would result in the loss of the allotment's 5 AUMS. No FS allotments would experience AUM decreases of 5 percent or more. Portions of two FS allotments (South Piney and Mt. Darby) within the well field, which are not stocked with domestic livestock because of the reintroduction of bighorn sheep, would be affected. The South Piney Sheep and Goat and the Mt. Darby Sheep and Goat allotments would lose a total of 1 and 8 AUMs, respectively, due to project construction. This is a less than 5 percent reduction in the number of available AUMs on these allotments and is therefore considered insignificant.

Approximately 77 acres of irrigated hayland would be disturbed during construction. This would result in a 1 percent decrease in the well field's total irrigated land during construction, a level which is not considered significant.

Within the Slate Creek allotment, the Slate Creek sheep trail runs east and west from north of Kemmerer to Seedskadee National Wildlife Refuge. Approximately 12,000 to 15,000 sheep are moved across this trail in groups of 1,000 (one day apart) during spring (April, May) and fall (October). Perpendicular to this trail are Northwest's proposed sour gas trunk line and water pipeline, the Exxon sulfur pipeline, and the American Quasar/Exxon transmission line. While the impacts from construction of these facilities are difficult to estimate in terms of the number of animals lost, if construction and herding occur simultaneously, it can be anticipated that the impacts would be significant. Any disruption of herding, particularly in the spring when the ewes are pregnant and must be moved to the lambing areas on schedule, would create significant impacts. The presence of construction crews and open pipeline trenches would delay the herding schedule and result in significant impacts that could include ewes giving birth prematurely and newborn lambs being lost.

Operation

The operation phase would affect a reduced area. Two allotments, South Piney Individual and Beaver Creek Individual, would experience losses in AUMs that fall below the 5 percent significance level. Because of maintained access roads, the other three allotments remain impacted as they were during construction. The height of the proposed sulfur pipeline is such that it should not impede the movement of sheep.

TABLE 4-45
TOTAL ACREAGE DISTURBED AND AUMs LOST DURING CONSTRUCTION BY GRAZING ALLOTMENT

Allotment	Acres AUMs	Disturbed[1]	AUMs Lost[2]	Percent Reduction in AUMS[3]
Slate Creek	10,780	-898	43	0.4
Highway	5,030	109	7	0.1
Coyote Springs	199	16	1	0.5
Cumberland-Unita	36,570	18	2	0.005
Cow Hollow	537	176	18	0.03
Robinson Creek	143	6	1	0.7
Reardon Canyon	1,121	22	1	0.09
18 Mile	19,433	172	14	0.07
Lombard	6,643	51	4	0.06
Figure Four	7,630	113	8	0.1
Rock Springs Common	99,890	246	14	0.01
North LaBarge Common	14,501	3,345	304	2.10
South LaBarge Common	10,076	56	5	0.05
Eubank South LaBarge	80	10	1	1.25
Bondurant Ind.	10	<1	<1	--
Dry Piney	30	24	1	3.33
South Piney Ind.	82	46	5	6.10
LaBarge Unit Ind.	140	26	5	3.57
LaBarge Creek Ranch	42	9	1	2.38
Indian Springman	606	97	12	1.98
South Piney S&G	0	11	1	--
Mt. Darby S&G	0	62	8	--
Fish Creek	840	107	13	1.55
Snider Basin	1,562	507	63	0.04
LaBarge Creek	2,589	102	13	0.50
LaBarge Roundup	1,200	413	52	4.33
West Unit Ind.	525	5	1	0.19
Piney Unit Fenced	19	33	4	21.05
Johnson Ridge	165	17	4	2.42
Star Coral	62	7	1	1.61
Springman Creek	150	18	2	1.33
Budd Fish Creek	150	23	2	1.33
W. Fish Creek	1,597	42	5	0.31
Beaver Creek Ind.	129	78	7	5.43
Beaver Meadows	5	58	7[4]	100.00[4]
LaBarge Ind.	337	-54	30	8.90
Jory	50	9	1	2.00
Yose Ind.	150	8	1	0.67
Upper North LaBarge	1,985	198	25	1.26
Carter Lease	12,791	18	2	0.02
TOTAL	237,849	7,311	690	

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[1] Total acreage includes losses from the well field roads, gathering lines, and well pads, as well as from all corridors and plant sites.

[2] Lost AUMs (Animal Unit Months) were calculated by applying ROW widths to component mileages and determining acres disturbed; acres disturbed was then divided by the average number of acres per AUM for each allotment. If no data were available, 8 acres was used for high elevation allotments and 15 acres for lower areas.

[3] An underline indicates a significant reduction in AUMS.

[4] Calculations of the AUMs lost is based on the number of acres disturbed, hence, the percentage lost can exceed 100.

Perhaps more critical than the estimated losses in AUMs, but impossible to quantify, are the potential effects on livestock due to the increased presence of human activity, and the economic impacts on ranching operations brought about by increased prices for land and labor. Incidences of livestock harassment and rustling, water pipelines being cut, and silting of reservoirs have increased in parts of Wyoming where energy development has resulted in population growth. Similar conditions could be expected from the Riley Ridge Project (Peterson 1982, personal communication).

Economic impacts to individual ranchers could be both positive and negative. Operators of large ranches who are dependent on hired workers may need to offer higher wages and increased fringe benefits in order to retain workers or increase mechanization to reduce labor needs. Operators of small farms who need additional income could take advantage of new project-related job opportunities.

Cumulative Impacts

Grazing allotments that would be affected by the Riley Ridge Project would not be affected by any of the interrelated projects or their alternatives. Since no cropland exists in the vicinity of those areas of Sweetwater County where cumulative population increases would occur, there would not be significant cumulative impacts to farming from land conversion related to urban development.

Summary

In total, impacts to agriculture would be insignificant. Only a limited number (five) of grazing allotments would experience a reduction in AUMs in excess of 5 percent. No prime farmland is affected by the project and impacts to cropland, in particular hay, are insignificant.

TIMBER RESOURCES

Significance Criteria

Impacts to timber resources would be considered significant if:

1. New roads are constructed within one-half mile of any proposed future timber sales. It is assumed that a road within one-half mile of the future timber sale could affect the economics (positive or negative) of a timber sale unit.

Well Field

Construction

Impacts to timber resources would be limited to western portions of the well field as these are the only areas directly affected by the Riley Ridge Project which are forested. Well field development would have both beneficial and adverse effects on timber resources. Beneficial impacts would include construction of access roads to timber stands which were previously inaccessible and the replacement of old, decadent timber by young, vigorous seedlings, possibly of a more desirable species. Adverse impacts would result from the long-term removal of forested tracts from timber production. Additional impacts would result from the regional influx of people associated with the Riley Ridge Project. Specifically, more demand would be placed on the forested areas for products like fuel wood, posts and poles, and Christmas trees. Increased trespass for harvesting of these same products would also be anticipated.

Construction or improvement of access roads in the well field to areas which are proposed, or which have the potential, for future timber harvest would reduce the costs of commercial logging operations on these tracts. New roads are planned to be built into the 1984 South Piney, 1986 Coal Creek, and 1987 South Fork of South Piney timber sales in the Big Piney Ranger District. Due to the relatively high cost of road construction and the small size of some timber sales, well field road construction would result in a significant cost savings to the lumber industry for commercial timber harvesting in these areas. There is no information available on planned BLM timber sales.

Road, well pad, and gathering line construction in the well field would remove timber resources. It is estimated that 779 acres of mixed pine, 188 acres of spruce/fir, and 68 acres of Douglas-fir would be removed, for a total of 1,057 acres (Table 4-38). Using the Big Piney Ranger District 1982 average of board feet per acre for these three forest types results in an estimated harvest of approximately 15.8 million board feet on FS and BLM land in the well field. Assuming that all timber removed would be recovered and utilized for lumber, these changes to forest resources would not result in significant adverse impacts to forest economics. If local loggers are given the clearing work, then the local timber industry would receive a beneficial effect. At the average value of $52 per thousand board feet, 15.8 million board feet would generate revenue of $821,600 to the federal government from the sale of standing timber.

Long-term productivity, however, would be reduced by the semi-permanent nature of well field operations in forested areas. Reclamation of well pads and right-of-way corridors from construction to operational widths would help mitigate this long term effect, but it would still take between 75 and 100 years for trees to attain harvestable size in the reclaimed area.

Cumulative Impacts

The forested areas of the Riley Ridge Project are separate from the areas of the interrelated projects; hence, there are no cumulative impacts to timber resources.

Summary

Both beneficial and adverse impacts would result from the project. The only significant impact is the beneficial effect of new roads being constructed in areas where future timber sales of 6.5 million board-feet are planned so that road construction costs during logging would be reduced. The principal adverse effect would be a reduction in the long- term productivity of 1,057 acres of forest lands, resulting from their conversion to well pads, roads and pipeline corridors, for the life of the project, plus recovery time for forested stands to reach harvestable size. There should be no adverse effects on the local logging industry, but there may be positive impacts if local contractors are utilized for right-of-way clearing.

TRANSPORTATION

Significance Criteria

Impacts to transportation would be considered significant if:

1. The roadway volume-to-capacity relationship results in the traffic operating Level of Service falling below a stable flow condition represented by Level of Service C.
2. The vehicle miles of travel (VMT) increase generated by the project action results in a vehicle accident probability that exceeds the state average.
3. The projected roadway impacts would require upgrading of roadway facilities and capital expenditure to mitigate vehicle flow and/or safety deficiencies that are beyond the fiscal capabilities of the responsible agency.
4. The addition of project-generated auto and truck demand would accelerate the deterioration and related maintenance costs of area roadways beyond those schedules by the responsible agency.
5. Rail-highway at-grade crossings would generate travel time delays of more than 5 minutes per hour.

Three analysis years that correspond to the construction, operation, and abandonment phases of the project were selected for evaluating impacts to the transportation network. Peak total construction and operation employment generated by the project is represented by 1986. Stable operational employment levels representing natural gas production, processing, and transport are addressed in the analysis of 1996. The abandonment and reclamation phase of the project is represented by analysis of the year 2015. The results of the analyses indicated that no significant transportation-related impacts would be generated during the abandonment and reclamation phase of the project, whereas due to project-related traffic volumes, significant impacts to selected segments of the roadway network occur in both the 1986 and 1996 time periods. Additional significant impacts occur in the well field because of extensive new roadway construction.

Roadway Network

Construction

In 1986, during peak summer construction, Riley Ridge Project activities would generate a total of 7,540 automobile and truck trips daily. Table 4-46 summarizes the distribution of vehicle trips by project component. Average daily traffic (ADT) estimates for 1986 that result from the assignment of the Riley Ridge-related traffic to the regional highway network are shown in Map 4-4. The ADT estimates are representative of combined peak summer recreational travel and peak project demand conditions.

The Wyoming State Highway Department (WSHD) has a preferred maximum traffic volume for rural arterial and collector roadways corresponding to a Level of Service B operating condition. At Level of Service B, traffic is in a stable flow condition with operating speeds and vehicle maneuverability starting to become affected by traffic conditions. A reduction in operations below a Level of Service C stable flow conditions on high volume rural highways is indicative of significant roadway impacts and is used by the WSHD to identify locations requiring either physical or traffic management improvements. Table 4-47 summarizes the relationship of the projected peak-hour traffic demand to the Level of Service B preferred volume standard and the Level of Service C "tolerable" volume standard for area roadways that are impacted by Riley Ridge traffic generation. The major areas of concern with respect to highway facility capacity are U.S. 189 between LaBarge and Big Piney, U.S. 30 between Kemmerer and the proposed sulfur loadout facility east of Opal, and State Route 240 north of Opal. For these highway segments, the concentration of Riley Ridge auto and truck traffic, combined with projected baseline hourly demands for recreational season travel, would result in significant impacts because of traffic loadings in excess of the Level of Service C stable flow volume criteria. The projected total peak hour demand could result in unstable traffic flow conditions with operating speeds reduced to the range of 30 to 35 miles/hour. The intersections of U.S. 30 with State Route 240 and U.S. 189 with County Road 23-134 could experience periods of vehicle congestion due to high volume turning movements of project commuter traffic. For those roadway segments where traffic volumes would be significant, the resulting Level of Service would be the following: U.S. 189 between LaBarge and County Road 23-134, Level of Service D: U.S. 189 at Big Piney, E; U.S. 30 between Kemmerer and Opal, F; U.S. 30 east of Opal, E; and State Route 240 north of Opal, E. At Level of Service D, traffic is approaching unstable flow conditions where low but tolerable speeds would be experienced; at E traffic flow is unstable and speeds are greatly reduced; and at F there would be forced flow conditions with extreme congestion and frequent intervals of vehicle delay.

Because of the increased vehicle miles of travel on regional highways due to the Riley Ridge Project, it is

TABLE 4-46
RILEY RIDGE PROJECT VEHICLE TRIP GENERATION
1986 SUMMER PEAK

	Daily Vehicle Trip Generation[1]			
Project Component	Inbound	Outbound	Total Both Directions	Percent of Project Total
Well Field	400	400	800	11
Treatment Plants[2]	2,660	2,660	5,320	70
Linear Facilities[3]	710	710	1,420	19
Total Project	3,770	3,770	7,540	100

Source: ERT.

[1] Trucks are estimated to comprise approximately 15 percent of the project generated vehicle trip activity.

[2] Includes 30 trucks required to transport sulfur until pipelines completed.

[3] Includes pipeline, railroad, and transmission line construction activity.

predicted that the number of accidents would increase. The observed accident rate on regional highways is 1.25 accidents/million vehicle miles of travel (MVMT) on I-80, 1.39 accidents per MVMT on State Route 240, 2.31 accidents per MVMT on U.S. 30, and 3.39 accidents per MVMT on U.S. 189. Applying these rates to the vehicle miles of travel attributable to Riley Ridge employee and truck travel, it is estimated that approximately 130 to 140 more accidents per year could occur in the study area due to project travel in 1986 and throughout the construction period. Locations shown in Table 4-48 where peak hour demand exceeds Level of Service C volumes (U.S. 189 between LaBarge and Big Piney, U.S. 30 between Kemmerer and Opal, and State Route 240) would have a higher potential for increased accident occurrence.

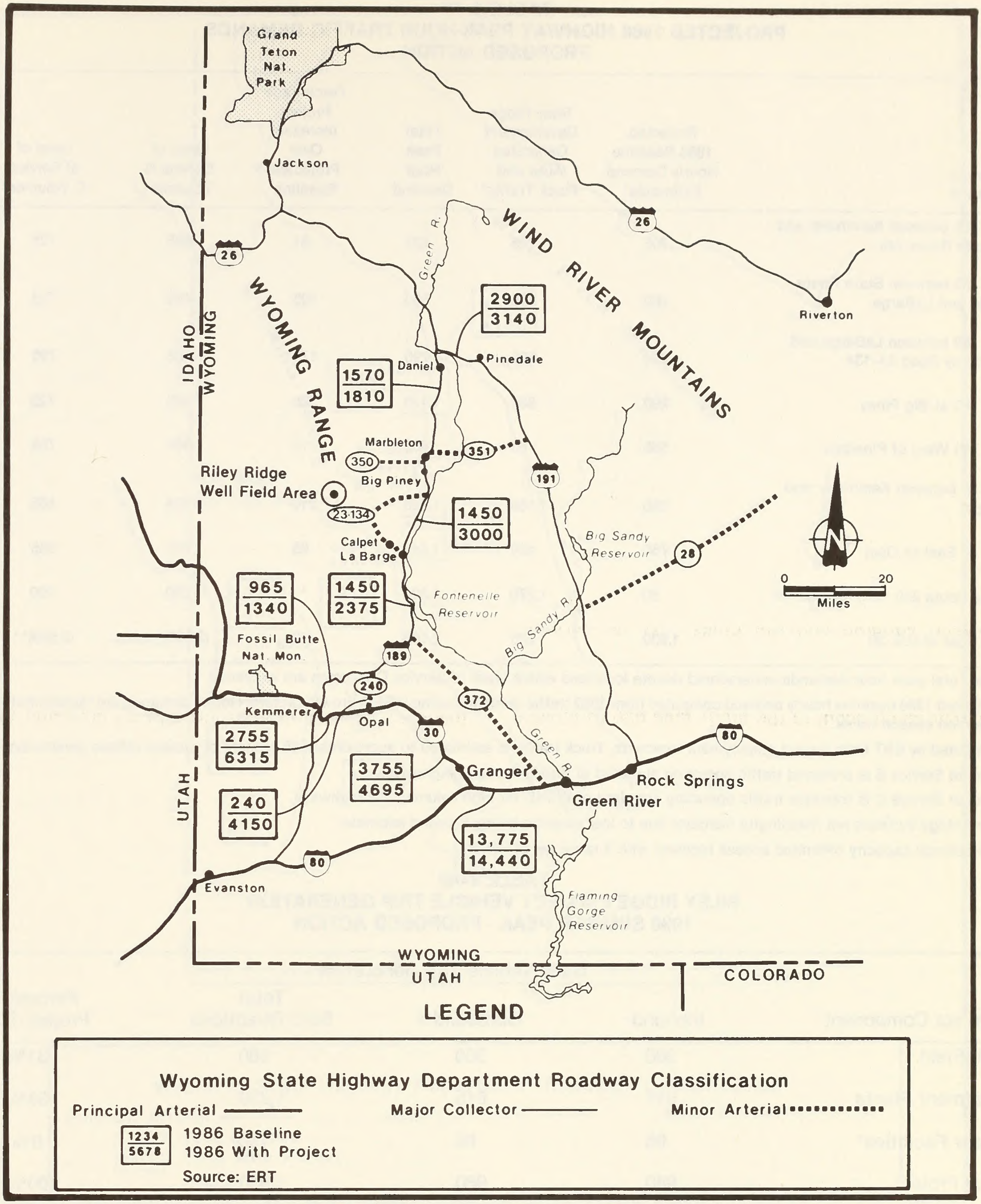
The rate of deterioration of the physical quality and structural soundness of highway pavement is proportional to the number of heavy load applications (Highway Research Board 1967). The addition of truck traffic generated by the project to the regional highway network would contribute to an accelerated rate of deterioration on heavily utilized highway sections such as U.S. 189 between Kemmerer and Big Piney, U.S. 30 between Kemmerer and Opal, and State Route 240 between Opal and the Craven Creek plant site. Pavement conditions on sections of U.S. 189 between Kemmerer and Big Piney are below WSHD standards and are therefore more susceptible to deterioration due to heavy truck loadings. Truck loads in excess of state size and weight limitations would require application to the WSHD for an oversize/overweight permit.

Traffic in the well field, which consists of drilling and operations vehicles for both the Riley Ridge Project sour gas activity and sweet gas development projected for the area, would result in significant impacts. The combined natural gas development would generate an estimated 445 employee vehicles and 410 trucks on a daily basis. Vehicle traffic of this magnitude would result in significant impacts because of the scale of the required access roadway system hierarchy and resulting land disturbance. Access to the well sites would require approximately 297.7 miles of roads (Table 1-9). The potential for well field access road operational and safety impacts is dependent upon the roadway cross section and layout (horizontal and vertical curvature). If built in accordance with WSHD standards and good engineering practice, these impacts would not be significant (see roading guidelines in Appendix B.6). By providing year-round access at the higher elevations potentially unquantifiable impacts would result from vehicle intrusion on winter elk feeding areas.

Operation

In 1996, Riley Ridge Project activity would generate a total of 1960 vehicle trips daily (see Table 4-48). Vehicle trip activity in 1996 is approximately 26 percent of the 1986 projected levels due to the completion of the construction of the processing plants, pipeline systems, railroad spurs, transmission lines, and the majority of the well sites. Traffic forecasts for 1996 are presented in Map 4-5.

The relationship of the projected 1996 peak-hour demands to WSHD operating standards is summarized in Table 4-49. The only section of U.S. 189 that would be significantly impacted due to traffic volumes exceeding the Level of Service C "tolerable" standard is the section between County Road 23-134 and Big Piney. The projected peak hour demand for this section of U.S. 189 exceeds the level of Service C volume by 25 vehicles, or 3.4 percent. The peak hour demand on U.S. 191 is projected to exceed the Level of Service C volume standard due to the continued growth in recreation traffic using the facility. The Riley Ridge Project impact on the section of U.S. 191 between U.S. 189 and Pinedale would be an additional 35 vehicles during the peak hour. Traffic volume on U.S. 30 exceeds the Level of Service C standard due primarily to the projected growth in baseline traffic



MAP 4-4 1986 AVERAGE DAILY TRAFFIC ESTIMATES - PROPOSED ACTION (PEAK RECREATIONAL SEASON DEMAND)

TABLE 4-47
PROJECTED 1986 HIGHWAY PEAK-HOUR TRAFFIC DEMANDS
PROPOSED ACTION

Highway Location	Projected 1986 Baseline Hourly Demand Estimates[1]	Riley Ridge Development Generated Auto and Truck Traffic[2]	Total Peak Hour Demand	Percentage Project Increase Over Projected Baseline	Level of Service B Volumes[3]	Level of of Service C Volumes[4]
U.S. 189 between Kemmerer and State Route 240	205	125	330	61	465	725
U.S. 189 between State Route 240 and LaBarge	290	305	595	105	465	725
U.S. 189 between LaBarge and County Road 23-134	290	505	795	174	465	725
U.S. 189 at Big Piney	290	830	1,120	286	465	725
U.S. 191 West of Pinedale	580	85	665	15	505	785
U.S. 30 between Kemmerer and Opal	550	1,155	1,705	210	425	665
U.S. 30 East of Opal	750	490	1,240	65	425	665
State Route 240 north of Opal	50	1,270	1,320	*	590	920
I-80 East of U.S. 30	1,930	235	2,165	12	(2,000)**	(2,500)**

Note: Total peak hour demands underscored denote locations where Level of Service C volumes are exceeded.

[1] Projected 1986 baseline hourly demand computed from 1982 traffic demands using WSHD growth factors. Hourly demands are representative of recreation season travel.

[2] Computed by ERT from project employment forecasts. Truck traffic is estimated to approximate 15 percent of project vehicle generation.

[3] Level of Service B is preferred traffic operating standard of WSHD for rural highways.

[4] Level of Service C is tolerable traffic operating standard of WSHD for high volume rural highways.

*Percentage increase not meaningful indicator due to low baseline hourly demand estimate.

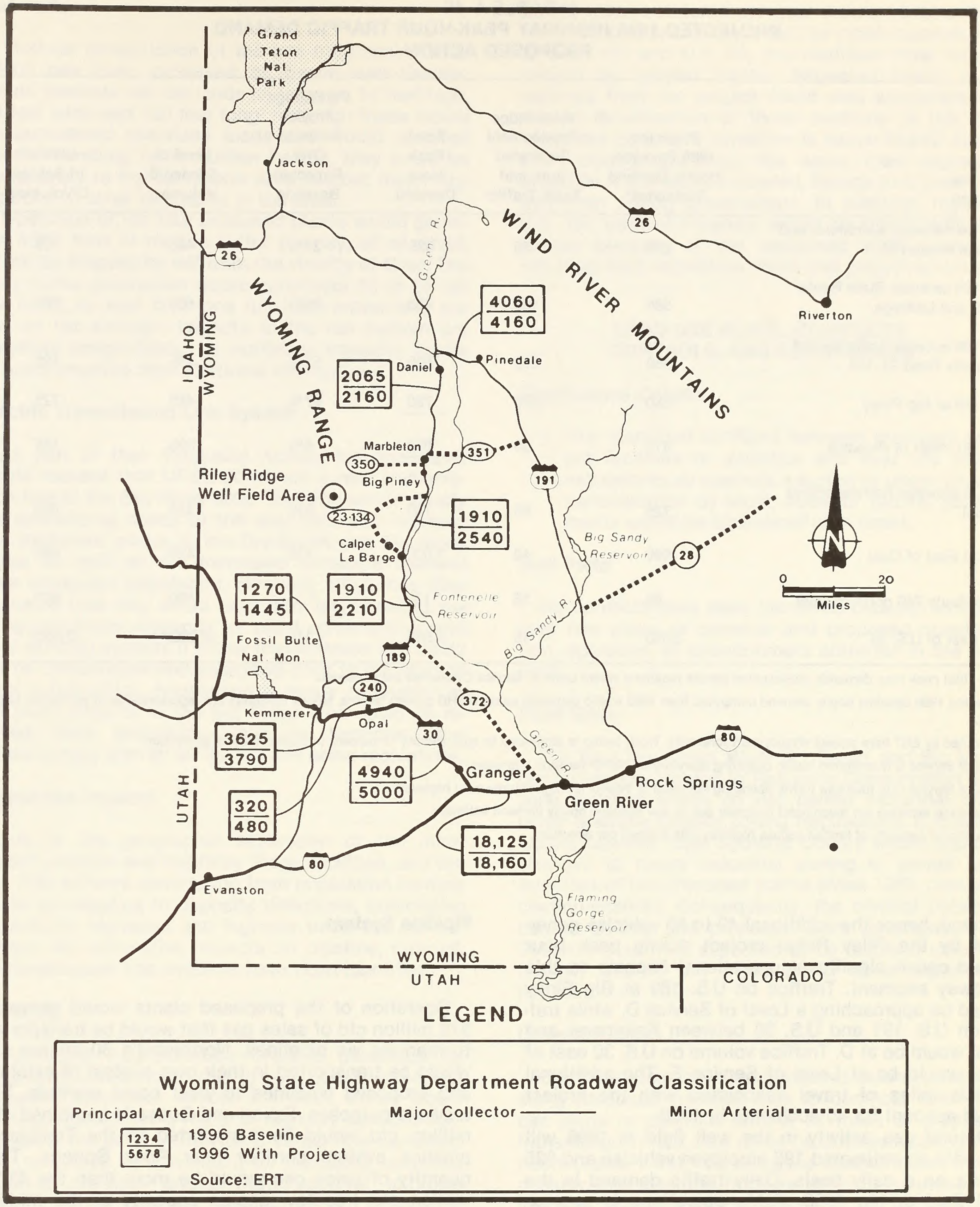
**Directional capacity of limited access highway with 2 lanes per direction.

TABLE 4-48
RILEY RIDGE PROJECT VEHICLE TRIP GENERATION
1996 SUMMER PEAK - PROPOSED ACTION

	Daily Vehicle Trip Generation			
Project Component	Inbound	Outbound	Total Both Directions	Percent of Project Total
Well Field	300	300	600	31%
Treatment Plants	615	615	1,230	63%
Linear Facilities[1]	65	65	130	6%
Total Project	980	980	1,960	100%

Source: ERT.

[1] Includes pipeline operations and maintenance.



MAP 4-5 1996 AVERAGE DAILY TRAFFIC ESTIMATES · PROPOSED ACTION

TABLE 4-49
PROJECTED 1996 HIGHWAY PEAK-HOUR TRAFFIC DEMAND
PROPOSED ACTION

Highway Location	Projected 1986 Baseline Hourly Demand Estimates[1]	Riley Ridge Development Generated Auto and Truck Traffic[2]	Total Peak Hour Demand	Percentage Project Increase Over Projected Baseline	Level of Service B Volumes[3]	Level of of Service C Volumes[4]
U.S. 189 between Kemmerer and State Route 240	270	65	335	24%	465	725
U.S. 189 between State Route 240 and LaBarge	380	105	485	28%	465	725
U.S. 189 between LaBarge and County Road 23-134	380	215	595	57%	465	725
U.S. 189 at Big Piney	380	370	750	97%	465	725
U.S. 191 West of Pinedale	815	35	850	4%	505	785
U.S. 30 between Kemmerer and Opal	725	55	780	8%	425	665
U.S. 30 East of Opal	990	40	1,030	4%	425	665
State Route 240 north of Opal	65	55	120	*	590	920
I-80 East of U.S. 30	2,540	15	2,555	1%	(2,000)**	(2,500)**

Note: Total peak hour demands underscored denote locations where Level of Service C volumes are exceeded.

[1] Projected 1986 baseline hourly demand computed from 1982 traffic demands using WSHD growth factors. Hourly demands are representative of recreation season travel.

[2] Computed by ERT from project employment forecasts. Truck traffic is estimated to approximate 15 percent of project vehicle generation.

[3] Level of Service B is preferred traffic operating standard of WSHD for rural highways.

[4] Level of Service C is tolerable traffic operating standard of WSHD for high volume rural highways.

*Percentage increase not meaningful indicator due to low baseline hourly demand estimate.

**Directional capacity of limited access highway with 2 lanes per direction.

demand, hence the additional 40 to 55 vehicles generated by the Riley Ridge project during peak hour would cause significant operational impacts to this roadway segment. Traffice on U.S. 189 at Big Piney would be approaching a Level of Service D, while traffic on U.S. 191 and U.S. 30 between Kemmerer and Opal would be at D. Traffice volume on U.S. 30 east of Opal would be at Level of Service E. The additional vehicle miles of travel associated with the project could account for 45 accidents in 1996.

Natural gas activity in the well field in 1996 will generate an estimated 195 employee vehicles and 325 trucks on a daily basis. Daily traffic demand in the well field during 1996 stable operations is approximately 61 percent of the level projected for 1986 peak construction and is not expected to be significant because of the changes required to deal with demand in 1986. If such changes are not made, the 1996 traffic demand would create significant capacity and safety impacts.

Pipeline System

Operation of the proposed plants would generate 572 million cfd of sales gas that would be transported to markets via pipelines. Northwest's 80 million cfd would be transported in their own system of existing and proposed pipelines to west coast markets. For analysis purposes, Exxon and Quasar's combined 492 million cfd would be transported to the Trailblazer pipeline system corridor near Rock Springs. This quantity of sales gas would be more than the 437.6 million cfd free-flow design capacity of the middle segment of Trailblazer running east from Rock Springs. The capacity of the middle segment can be increased to 665 million cfd by adding compression. Additional environmental assessments would have to be prepared for any new facilities added to the Trailblazer system.

Railroads

Modular construction of the gas treatment plants, which has been proposed by Exxon and Quasar, would generate rail car loads as large as 14 feet high, 14 feet wide and 120 feet long. Although these would be considered oversized loads and would required special handling by the Union Pacific, they could be transported to the Kemmerer area without major disruptions of other rail traffic in the area.

Operation of the four proposed plants would generate 4,957 tons of molten sulfur per day, all of which would be shipped by rail from the vicinity of Opal. The daily sulfur production would constitute 50 to 55 rail car loads, or less than one full train movement, per day on the average. Impacts to the rail system are therefore insignificant, as sufficient capacity exists to accommodate this additional demand.

Electric Transmission Line System

As part of their Proposed Action, the applicants would request that UP&L construct a new transmission line to the Big Piney area. This line would supply the operational needs of the well field and the sour gas treatment plants in the Dry Basin and Big Mesa areas, as well as the increased domestic demand from increased population. However, UP&L has also indicated that they could have difficulty meeting the initial electricity demands for plant construction with their existing system. If a new transmission line could not be constructed and energized prior to the start of plant construction, supplemental power generation at the plant sites or in the Big Piney area could be required. Such generation would be temporary and would comply with all air quality and noise regulations.

Cumulative Impacts

Due to the geographic separation of the interrelated projects and the Riley Ridge facilities, and the fact that workers commuting from population centers would be traveling in opposite directions, cumulative impacts on highways and highway travel are not expected. No cumulative impacts on pipeline, railroad, or transmission line systems have been identified.

Summary

Significant transportation impacts generated by the project would occur during both construction and operation. Employee vehicle and truck traffic would result in the following regional highway sections falling below the Level of Service C stable flow condition used by WSHD as a standard for indicating locations requiring physical and/or traffic control improvements: U.S. 189 between LaBarge and Big Piney; U.S. 30 between Kemmerer and Opal; and State Route 240 north of Opal. Project traffic requiring access to well sites would necessitate development of a roadway system of arterial, collector, and local facilities within the well field. The increase in vehicle miles of travel due to the project would generate approximately 130 to 140 more accidents per year during construction. The additional accidents would be most concentrated on U.S. 189 and U.S. 30, the facilities most heavily utilized by project traffic. Repeated heavy truck loadings from the project could also accelerate the rate of deterioration of those sections of U.S. 189 where the pavement condition is below WSHD standards. During operation, the same road segments would be signficantly impacted, though to a lesser extent than during construction. In addition, highway U.S. 191 west of Pinedale would be significantly impacted because of the combined traffic volumes resulting from recreation travel and project activities.

LAND USE PLANS, CONFLICTS, CONTROLS, AND CONSTRAINTS

Significance Criteria

1. Any identified conflicts between proposed project facilities or activities and land use plans, regulations, or controls adopted or under official consideration by local, state, or federal governments would be considered significant.

Well Field

No conflicts have been identified between existing land use plans or controls and proposed construction, operation, or abandonment activities in the well field.

Plant Sites

The East Dry Basin, West Dry Basin, and Big Mesa plant sites are located in Resource Conservation (RC) zone districts which do not permit industrial uses under Sublette County Zoning Regulations. It is anticipated, however, that Sublette County would approve changes to heavy industrial zoning to permit construction of the proposed plants (Wise 1982, personal communication). Consequently, the conflict between current zoning and proposed plant development in Sublette County is expected to be resolved administratively and is not expected to be a significant impact.

Linear Facilities

Significant impacts would occur at several locations along proposed corridors due to conflicts with land use plans or controls. Of the 97 miles of proposed transmission lines, 76.5 miles lie outside existing corridors (Table 1-11). The proposed Quasar/Exxon transmission line diverges from an existing transmission line and pipeline corridor for most of its length. In addition, the proposed alignment establishes two new corridors within 5 miles on either side of existing pipeline and transmission line corridors between the Opal area and the LaBarge area. Similarly, the Quasar/Exxon sulfur pipeline diverges from existing corridors for most of its length between the existing Big Piney compressor station and the proposed sulfur loadout facility near Opal. Both of these proposals would conflict with the BLM Kemmerer Resource Area Management Framework Plan which encourages use of existing corridors wherever possible (see Map 1-3 in the Map Pocket). This would be a significant impact.

The proposed Quasar/Exxon sales and CO_2 gas pipelines cross an area that is planned for future residential development on the northwest side of Rock Springs (Horton 1982, personal communication). Although permitted by city zoning regulations in residential zones, the right-of-way required by the pipeline could hamper good land planning practice for the area in the future. This is not expected to be a significant impact.

A decision by the federal government to implement the Proposed Action or alternatives would be a decision to alter the existing federal land use planning decision. Nonconformance with federal agency plans would be resolved through amendments to the specific plan or to the Proposed Action. proponents. In the case where the restriction derives from a state, county, or community plan or regulation, application for a change (i.e., zoning) or special exception would have to be made to the responsible agency.

Cumulative Impacts

Lands affected by the interrelated projects are distinct from those potentially affected by the Riley Ridge Project. There are no cumulative impacts that would be different from the Proposed Action in Lincoln and Sublette Counties. Zoning in Sweetwater County permits the proposed activities of the Riley Ridge Project and the interrelated projects.

Summary

Proposed transmission line and sulfur pipeline corridors would be in conflict with BLM MFP guidelines encouraging development of new linear facilities in existing corridors. The sales and CO_2 gas pipeline corridor along the west edge of Rock Springs would conflict with city plans for residential development in the area. Development of plants on proposed sites in Sublette County would be in conflict with existing county zoning regulations although this conflict is expected to be resolved by a change in zoning.

NOISE

Significance Criteria

1. The U.S. Environmental Protection Agency (EPA 1974) has established guidelines for noise levels requisite for the protection of public health and welfare. Long-term outdoor noise levels not exceeding 55 dBA are felt to provide for an adequate margin of safety. Noise in excess of this level would have significant impacts on the affected population.

Construction

The major noise-generating elements associated with the Riley Ridge Project during construction would be due to well drilling operations; sulfur, CO_2, sour gas, and sales gas pipeline construction; construction of the treatment plants and rail and highway traffic in the project area. For purposes of the noise analysis, a pipeline construction spread was considered to be a series of short segments of relatively noisy operations separated by distances of 1 mile or more where little or no activity exists. The rate of pipeline construction is generally such that noise exposure for area residents at any point near the right-of-way would be limited to about 3 or 4 days. Construction of roadways and other linear facilities would be similar to that of the pipelines. Experience with pipeline projects indicates that beyond 2,500 feet from construction activity, noise impacts would be insignficant because average noise levels would be less than 55 dBA (Northern Tier Pipeline 1979). Hence, for any residences within 2,500 feet of linear facility right-of-ways, noise impacts would be significant. The

TABLE 4-50
EQUIVALENT SOUND LEVELS FOR CONSTRUCTION ACTIVITIES (dBA)

	Distance from Source to Sound Contour (Feet)				
Construction Activity	2,390	3,420	4,800	6,600	9,120
Excavation	55	50	45	40	35
Concrete Pouring	51	46	41	36	31
Steel Erection	55	50	45	40	35
Mechanical Operations	50	45	40	35	30
Clean-Up	45	40	35	30	25

Source: Teplitsky and Wood 1978.

population centers such as Big Piney, Marbleton, and LaBarge are farther away than 2,500 feet and so would not experience significant impacts.

Construction-generated noise would also result from the erection of drilling rigs, treatment plants, and the sulfur loadout facility. Table 4-50 shows noise level data, based upon a generic analysis of large scale electric power generating stations, which in terms of construction practice and scale are assumed to be similar to the construction of the above Riley Ridge Project components. This table indicates that during excavation and earth moving activities, noise impacts would be insignificant because sound levels would not exceed 55 dBA 2,500 feet from these activities. Noise levels during other facility construction activities are similarly insignificant as they are less than 55 dBA at distances of 2,500 feet.

Noise levels in the area immediately adjacent to a well site have not been quantified but would exceed 55 dBA. These would create impacts for well site workers for whom conditions are regulated by OSHA. Potential impacts to wildlife are addressed in the Wildlife section of this EIS.

During construction, heavy trucks and other equipment would travel on access roadways to and from the project site. Diesel trucks typically generate noise levels of 86 dBA at 50 feet and less than 55 dBA at distances of 1,800 feet from a single truck (EPA 1971b). For individual residences or commercial activities located within approximately one-half mile of the roadways identified in the transportation analysis as the ones used during project construction, noise impacts would be significant.

Operation

At the gas treatment plants, noise would be produced by the operation of compressors, processing equipment operations, and vehicular access to the site.

The generation of noise at the treatment plants and other facilities during operation would be less than during construction. This is due to the fact that during operations, much of the equipment would be enclosed and equipment that would emit noise would be designed to meet Occupational Health and Safety Administration (OSHA) noise requirements. For these reasons, it is expected that noise levels during operation would not exceed construction levels and therefore, would be less than 55 dBA at 0.5 mile from these plants. As noted previously, residential and other noise sensitive land uses are generally located 2 to 3 miles or more from the major project components. Since project operational noise levels would be well below the 55 dBA guideline at noise sensitive receptors, no significant noise impacts associated with the project are expected.

Increased noise would be expected from the operation of trains serving the sulfur loadout facility. An additional three trains per week would operate over the existing rail line. This increased activity in the vicinity of Opal is not expected to create noise levels that would significantly impact area residents.

Abandonment

Noise impacts related to project abandonment would result only from truck activity along the regional highway system. These impacts would be transitory and significant within one-half mile of selected road segments.

Cumulative Impacts

Due to geographic separation from other proposed projects there would be no cumulative noise impacts.

Summary

Noise impacts to the population centers from well field, facility and pipeline construction, and operation would be insignificant. Noise related to project vehicle activity, however, would be significant within one-half mile of U.S. 189 in the vicinity of Big Piney and U.S. 30 in the vicinity of Opal.

COMPONENT ALTERNATIVES

The environmental consequences of the component alternatives associated with the Proposed Action and siting alternatives are presented in the following sections. Not all environmental disciplines would be affected by the component alternatives. For example, air quality would not be affected by the location of an electric transmission line under the power supply alternative. Effects on other disciplines, such as power supply effects on recreation, would be the same as described for the Proposed Action. Therefore, only those disciplines which would be significantly affected or affected differently from the Proposed Action are discussed.

Table 4-51 on the following page provides the reader with a guide to which resources have been analyzed for the component alternatives.

SULFUR TRANSPORT

Wildlife and Fisheries

Wildlife

Exxon's railroad component alternative to transport sulfur from the northern plant sites would disturb several categories of big game critical range (Table 4-52, Maps 3-2 and 3-3, see Map Pocket). Acreage disturbances would account for a population reduction of less than 1 moose, about 12 mule deer, and about 9 pronghorn. Population reductions applied over a 35-year railroad life would result in a productivity loss of 1 to 2 moose, 122 mule deer, and 150 pronghorn. In addition, though train traffic is expected to be less than one per day (see Environmental Consequences-Transportation Section), there would likely be an unquantified loss of mule deer and pronghorn due to train collisions.

TABLE 4-51
SUMMARY OF ENVIRONMENTAL DISCIPLINES AFFECTED BY THE COMPONENT ALTERNATIVES

Resource	Sulfur Transport (railroads)	Power Supply (UP&L and BLM)	Employee Housing (construction camps)
Socioeconomic	same	same	yes
Wildlife and Fisheries	yes	yes	yes
Health and Safety	no	no	no
Water Resources	yes	yes	yes
Air Quality	no	no	no
Soils and Vegetation	yes	yes	yes
Visual Resources	yes	yes	yes
Cultural Resources	yes	yes	yes
Recreation Resources	same	same	same
Wilderness	no	no	same
Agriculture/Grazing	yes	same	yes
Timber	no	no	no
Transportation	yes	same	yes
Land Use	yes	yes	yes
Noise	yes	same	same

Yes - Effects analyzed in following sections.
No - No significant effect on resource.
Same - Effects the same as discussed under Proposed Action.

Railroad construction would also disturb 150 acres of prairie dog towns, affecting potential black-footed ferret habitat (Table 4-52). The railroad would pass through approximately 4 miles of the Seedskadee National Wildlife Refuge and would interfere with Refuge goals. Construction and operation of a railroad through the Refuge would cause impacts to wildlife and to Refuge land use plans (see Environmental Consequences-Land Use Section). Goals of the Refuge include development of man-made wetlands and maintenance of existing wetlands. Seedskadee was created as a mitigation measure for development of Fontenelle and Flaming Gorge Reservoirs and is managed for migrating waterfowl and waterbirds. Construction and operation activities would be disruptive to wildlife species (including bald eagles which concentrate on the Seedskadee during winter) and would result in wildlife avoidance of the railroad vicinity.

The railroad spur to Shute Creek would disturb 24 acres of pronghorn critical summer range (Table 4-52). Population reductions are not expected. In addition, 16 acres of prairie dog towns would also be disturbed.

Fisheries

Exxon's sulfur transport railroad would cross Middle, North, and South Piney Creeks and Muddy Creek near their mouths, and the Green River about 1 mile upstream of Middle Piney Creek and again in the Seedskadee Wildlife Refuge (see Table 4-53). Middle, North, and South Piney Creeks contain good brown and rainbow trout fisheries, respectively, as well as diverse sucker/minnow populations. The Green River contains a good brown and rainbow trout fishery at both crossings.

This alternative would require construction of railroad bridges over North Piney Creek, Middle Piney Creek, South Piney Creek, Muddy Creek, and the Green River. Placement of bridge abutments and foundations would result in a small area of habitat loss and increased suspended solids which could temporarily block fish movements. Construction would be completed in a few weeks, so impacts are expected to be short-term, localized, and insignificant.

The sulfur railroad spur from Craven Creek to Shute Creek would not affect perennial streams or fishery resources.

Water Resources

Railroad construction would require bridges over the Green River, South Piney Creek, Middle Piney Creek, North Piney Creek, and Muddy Creek. Placement of fill and bridge abutment structures would result in short-term increases in suspended solids, turbidity, and sedimentation downstream. Effects should be short-term, and impacts to water users would be insignificant.

The rail spur to the Shute Creek plant site would cross no perennial streams, therefore no impacts to water resources are expected.

TABLE 4-52
ACRES OF WILDLIFE CRITICAL RANGE[1] POTENTIALLY DISTURBED BY COMPONENT ALTERNATIVES

	Elk Critical Calving Range	Elk Critical Winter Range	Moose Critical Winter Range	Mule Deer Critical Winter Range	Pronghorn Critical Winter Range	Pronghorn Critical Summer Range	Prairie Dog Towns
Sulfur Transport							
Railroad from West Dry Basin Plant Site	0	0	39	170	400	121	150
Railroad from Shute Creek Plant Site	0	0	0	0	0	24	16
Power Supply							
UP&L							
Proposed Action	0	170	48	630	218	182	NA
Buckhorn Alt.	0	170	61	606	267	182	NA
Shute Cr. Alt.	0	194	61	545	230	218	NA
Northern Alt.	0	170	61	691	279	182	NA
BLM							
Proposed Action	0	158	65	558	339	218	NA
Buckhorn Alt.	0	158	77	533	388	218	NA
Shute Cr. Alt.	0	158	77	448	351	240	NA
Northern Alt.	0	158	48	630	400	194	NA
Employee Housing							
West Dry Basin Camp	0	0	0	0	0	0	0
East Dry Basin Camp	0	0	0	0	320	0	0
Buckhorn Camp	0	0	0	0	0	0	0
Big Mesa Camp	0	0	0	80	0	0	0
Shute Creek Camp	0	0	0	0	0	320	0

NA = Not Applicable—These corridors were not sampled for prairie dog towns.

[1] Critical ranges may overlap between species.

Soils and Vegetation

The 92-mile Exxon railroad alternative from West Dry Basin to the Stauffer Chemical spur would disturb a total of 1,109 acres, of which 80 percent consists of sagebrush, 11 percent saltbush, 2 percent grassland, 2 percent riparian, 2 percent greasewood, 2 percent pasture/hayland, and 1 percent mixed desert shrub communities (Table 4-54). Construction of the railroad would affect approximately 235 acres of sensitive rehabilitation units, of which 216 acres are comprised of strongly saline-alkaline soils. About 19 acres of the proposed route cross shaly areas. Accelerated erosion could occur on these areas unless applicable and effective rehabilitation techniques are successfully employed. Twenty-two acres of riparian vegetation would be lost, a significant impact. A long-term loss of vegetative productivity on 166 acres of unreclaimed railroad right-of-way would remain after abandonment, a long-term impact. Impacts to soils are not considered significant based on the applicants' revegetation and erosion control commitments.

The 8.5-mile sulfur transport rail spur between Shute Creek and Craven Creek would disturb 103 acres of vegetation and soils dominated by saltbush (48 percent), big sagebrush (38 percent), mixed desert shrub (8 percent), and greasewood (6 percent). About 69 acres of sensitive rehabilitation units with saline characteristics would be affected (see Table 4-55). Fifteen acres would be abandoned and unreclaimed at the end of the project, assuming 15 feet of the railroad right-of-way containing rock for ballast would not be reclaimed. This would be a long-term loss of vegetation.

Impacts for both railroads would include loss of forage and increased erosion. An increased risk of range fires from train-generated sparks would exist during operation. However, given the applicants' standard operating procedures and the abundant regional resource, impacts resulting from either of these component alternatives would be insignificant, except for the loss of 22 acres of riparian vegetation. No known populations of threatened or endangered plant species would be affected.

TABLE 4-53
STREAMS AND FISHERY RESOURCES AFFECTED BY LINEAR FACILITIES COMPONENT ALTERNATIVES

Streams	Sulfur Transport		UP&L Transmission Lines				BLM Transmission Lines			
	WDB	SC	PA	BH	SC	NA	PA	BH	SC	NA
Muddy Creek[1],[2]	X									
North Piney Creek[1]	X									
Middle Piney Creek[1]	X									
South Piney Creek[1]	X									
Dry Piney Creek[3]			X		X	X	X		X	X
Upper Green River[1]	X			X		X		X		X
LaBarge Creek[1]			X	X	X	X	X	X	X	X
Muddy Creek[4]			X	X	X	X	X	X	X	X
Fontenelle Creek[1]			X	X	X	X	X	X	X	X
Slate Creek[5]			X	X	X	X	X	X	X	X
Green River (Seedskadee)[1]	X	X								
Upper Hams Fork[1]			X	X	X	X				
Hams Fork (Opal)[5]			X	X						
Lower Hams Fork[1]							X	X	X	X
Willow Creek[1]			X	X	X	X				

Note: WDB = West Dry Basin, SC = Shute Creek, PA = Proposed Action
BH = Buckhorn, NA = Northern Alternative.

[1] These streams are Class II cold water game fish streams that generally contain rainbow, brown, brook and cutthroat trout.

[2] Muddy Creek north of North Piney Creek.

[3] Does not support a fishery where transmission line crosses.

[4] Muddy Creek between LaBarge and Fontenelle Creeks.

[5] These streams support primarily nongame fish (suckers and minnows) populations.

Visual Resources

The sulfur transport railroad to West Dry Basin would result in 2 miles of significant impact and 4 miles of highly significant impact (Table 4-56). Visual impacts of the railroad would be related to vegetation and structure contrasts primarily along Highway 189 and the Green River. There are no significant visual impacts associated with the railroad to Shute Creek.

The combined visual change would increase with this alternative. Forty-three ranches would be subject to highly significant impacts and 8 would be subject to significant impacts.

Cultural Resources

Based on previous cultural resource surveys of segments of the railroad right-of-way, the railroad to West Dry Basin would indirectly impact 11 identified cultural resources and have an undetermined impact on 1 additional site (see Table 4-57). These 12 sites are possibly eligible for nomination to the NRHP. The railroad from Craven Creek to Shute Creek would indirectly impact 2 previously identified sites which are possibly NRHP eligible. In addition, the railroad to the sulfur loadout facility would cross the Hams Fork Cutoff of the Oregon Trail.

Agriculture/Grazing

Construction and operation of the railroad to transport sulfur from the West Dry Basin plant site would result in a 254-acre increase in the total numbers of acres disturbed. This increase would not be a significant loss of grazing land within any single allotment. Without provisions of an adequate number of fenced underpasses that would allow livestock movement from one part of an allotment to another, an unquantifiable increase in livestock deaths would occur.

Transportation

Development of the railroad alternative for sulfur transport would provide rail access to the Big Piney-Marbleton area. During operation of the Riley Ridge Project, this alternative would ship 4,670 tons of sulfur per day, or approximately three train loads per week, from the Big Piney area to the Union Pacific main line via the existing Stauffer spur. Given the unused rail capacity on this main line segment, development of this alternative would not have significant impacts on regional rail traffic.

Rail-related impacts in the Big Piney-Marbleton area would also be insignificant. The delays to local

TABLE 4-54
POTENTIAL CONSTRUCTION DISTURBANCE BY VEGETATION TYPE COMPONENT ALTERNATIVES (ACRES)

	Vegetation Types[1]															
	BS	SC	MS	MDS	Sa	G	MP	SF	D	A	C	R	P/H	Gr	Di	Total
Sulfur Transport																
Railroad to West Dry Basin	885	0	0	14	124	22	0	0	0	0	0	22	21	21	0	1,109
Railroad to Shute Creek	39	0	0	8	50	0	0	0	0	0	0	0	0	6	0	103
Power Supply																
UP&L -Proposed Action	1,028	0	20	0	29	26	0	0	0	0	0	13	28	8	0	1,152
Buckhorn	1,042	0	16	0	40	26	0	0	0	0	0	15	33	10	0	1,182
Shute Creek	1,105	0	16	0	54	26	0	0	0	0	0	15	33	12	0	1,261
Northern	846	0	20	0	34	21	0	0	0	0	0	13	28	8	0	970
BLM -Proposed Action	991	0	28	25	53	59	0	0	0	0	0	12	24	14	0	1,206
Buckhorn	1,004	0	24	25	64	59	0	0	0	0	0	15	29	16	0	1,236
Shute Creek	957	0	24	34	113	59	0	0	0	0	0	15	29	17	0	1,248
Northern	846	0	21	0	39	42	0	0	0	0	0	10	29	7	0	994
Employee Housing																
East Dry Basin Camp	320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	320
West Dry Basin Camp	320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	320
Big Mesa Camp	220	100	0	0	0	0	0	0	0	0	0	0	0	0	0	320
Buckhorn Camp	320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	320
Shute Creek Camp	0	0	0	320	0	0	0	0	0	0	0	0	0	0	0	320

[1] BS = Big Sagebrush
SC = Sagebrush Complex
MS = Mountain Shrub
MDS = Mixed Desert Shrub
Sa = Saltbush
G = Grassland
MP = Mixed Pine
SF = Spruce Fir
D = Douglas-fir
A = Aspen
C = Clearcut
R = Riparian
P/H = Pasture/Hayfield
Gr = Greasewood
Di = Disturbed

traffic that would occur at the at-grade crossing of U.S. 189 near Big Piney would average less than 5 minutes per day. Due to the visibility of the train traffic and the location of the crossing with respect to the population center, the expected increase in rail-auto accidents is approximately zero.

Land Use

Exxon's railroad option for sulfur transport from Shute Creek to Craven Creek, as currently routed, would require 4 miles of right-of-way across the Seedskadee National Wildlife Refuge. Portions of the right-of-way would directly conflict with U.S. Fish and Wildlife Service plans for development and restoration of wetland habitat for wildlife. This conflict would be particularly serious because of the scarcity of wetlands in this arid region and because the Refuge was established to mitigate the loss of natural wetlands that occurred when Fontenelle Reservoir was built. Operation of the railroad would not further conflict with planning for the Seedskadee Refuge.

Noise

Noise due to rail movement of sulfur would be relatively low and infrequent. The reduced train speeds that would be required on the rail segment near Big Piney would generate noise levels that would be less than 55 dBA. These insignificant levels would last no more than 15 minutes 3 times a week.

POWER SUPPLY

Wildlife and Fisheries

Wildlife

The UP&L component alternative transmission line would result in impacts similar to those of the transmission lines for the Proposed Action and alternatives. Temporary, short-term disturbance would occur to elk critical winter range, moose critical winter range, mule deer critical winter range, pronghorn critical winter range, and pronghorn critical summer range (Table 4-52). Big game population reductions or productivity losses are not expected. This route has not been surveyed for prairie dog towns. Potential impacts of wire-strikes for whooping cranes, bald eagles, or other birds are similar to the Proposed Action.

The BLM component alternative transmission line would also result in impacts similar to those of the Proposed Action and alternatives. Acreages of disturbance are presented on Table 4-52. The BLM component alternative would parallel an existing

TABLE 4-55
AREAS (ACRES) OF POTENTIAL CONSTRUCTION DISTURBANCE ON SENSITIVE REHABILITATION UNITS[1]
COMPONENT ALTERNATIVES

	A2	A4	B3	C2	C4	D4	D5	Total
Sulfur Transport								
Railroad to West Dry Basin	216	19	0	0	0	0	0	235
Railroad to Shute Creek	69	0	0	0	0	0	0	69
Power Supply								
UP&L - Proposed Action	254	426	0	0	0	0	0	680
UP&L - Buckhorn	274	406	0	0	0	0	0	680
UP&L - Shute Creek	243	397	0	0	0	0	0	640
UP&L - Northern	283	470	0	0	0	0	0	753
BLM - Proposed Action	287	414	0	0	0	0	0	701
BLM - Buckhorn	308	395	0	0	0	0	0	703
BLM - Shute Creek	347	386	0	0	0	0	0	733
BLM - Northern	253	296	0	0	0	0	0	549
Employee Housing								
East Dry Basin Camp	0	0	0	0	0	0	0	0
West Dry Basin Camp	30	0	0	0	0	0	0	30
Big Mesa Camp	0	0	0	0	0	0	0	0
Buckhorn Camp	0	0	0	0	0	0	0	0
Shute Creek Camp	60	0	0	0	0	0	0	60

[1] Sensitive Rehabilitation Units are identified in Appendix C.

TABLE 4-56
VISUAL RESOURCE IMPACT SUMMARY
COMPONENT ALTERNATIVES

	Proposed Action		Buckhorn		Shute Creek		Northern	
	Highly Significant[1]	Significant[1]	Highly Significant[1]	Significant[1]	Highly Significant[1]	Significant[1]	Highly Significant[1]	Significant[1]
Sulfur Transport								
Railroad (Miles)	4.00	2.00	4.00	2.00	4.00	2.00	4.00	2.00
Employee Housing								
West Dry Basin Construction Camp		X		X				X
Power Supply (Miles)								
UP&L	12.75	0.75	10.25	0.75	10.25	0.75	15.50	0.75
BLM	13.50	0	11.00	0	11.00	0	16.25	0

[1] See Significance Criteria.

69-kilovolt line, so the potential for avian wire strikes would be relatively high (McKenna and Allard 1976).

Fisheries

Construction of the UP&L power supply system would affect seven or eight different stream reaches depending on the alternative (Table 4-53). Five streams, the Upper Hams Fork, Willow Creek, Fontenelle Creek, LaBarge Creek, and the Green River near Big Piney are considered Class II cold water fisheries by WGF and support rainbow, brown, brook, and cutthroat trout fisheries. Construction and operation impacts would be similar to those described for the Proposed Action, and would be short-term, localized, and insignificant.

Construction of the BLM power sypply system would affect six or seven different stream reaches,

TABLE 4-57
IMPACTS TO KNOWN CULTURAL RESOURCES IN THE RILEY RIDGE PROJECT AREA

Project Alternatives	Total Number of Possible NRHP Eligible Resources[1]	Impact Direct	Impact Indirect	Impact Undetermined
Sulfur Transport				
RR to West Dry Basin	12	0	11	1
RR from Craven Creek to Shute Creek	2	0	2	0
Power Supply (UP&L System)				
Proposed Action	31	3	19	9
Buckhorn Alternative	32	3	21	8
Shute Creek Alternative	41	3	29	9
Northern Alternative	30	2	19	9
Employee Housing				
West Dry Basin	0	0	0	0
East Dry Basin	0	0	0	0
Big Mesa	0	0	0	0
Buckhorn	0	0	0	0
Shute Creek	4	3	0	1

[1] Includes resources that have been determined eligible and potentially eligible for NRHP, or resources not evaluated; resources determined as not meeting NRHP eligibility criteria are omitted.

depending on the alternative (Table 4-53). Four streams, the Hams Fork below Kemmerer, Fontenelle Creek, LaBarge Creek and the Green River near Big Piney support rainbow, brown, brook, and cutthroat trout. Impacts would be similar to those described for the Proposed Action and would be short-term, localized, and insignificant.

Water Resources

Stream crossings for construction of transmission lines would be infrequent and limited to the crossing of streams by construction vehicles. Existing bridges would be used whenever possible. The number of stream crossings for the UP&L system would vary between seven and eight, and for the BLM system between six and seven depending on the siting alternative (i.e., combination of plant sites) under consideration.

Soils and Vegetation

The UP&L power transmission line system would potentially disturb 1,152 acres for the Proposed Action, 1,182 acres for the Buckhorn Alternative, 1,261 acres for the Shute Creek Alternative, and 970 acres for the Northern Alternative (Table 4-54). Of this disturbance, over 85 percent would occur in the big sagebrush community for any alternative. See Table 4-54 for other communities potentially disturbed. Impacts would be similar to those described for linear facilities in the Proposed Action. Between 13 and 15 acres of riparian vegetation could be affected by this component alternative. Since no permanent service roads are planned, impacts would be short-term (less than 2 years) and insignificant.

The BLM power transmission line system would potentially distrub 1,206 acres for the Proposed Action, 1,236 acres for the Buckhorn Alternative, 1,248 acres for the Shute Creek Alternative, and 994 acres for the Northern Alternative (Table 4-54). Of this disturbance, between 75 and 85 percent would occur in the big sagebrush community. See Table 4-54 for other communities potentially disturbed. Impacts would be similar to those described for linear facilities in the Proposed Action. Between 10 and 15 acres of riparian vegetation could be affected by this component alternative. Since no permanent service roads are planned, impacts would be short-term (less than 2 years) and insignificant.

Visual Resources

The UP&L transmission line would result in 12.75 miles of highly significant impacts and 0.75-mile of significant impacts (see Table 4-56). These impacts would occur at crossings of the upper and lower Hams Fork River, the Green River, Reardon Draw, LaBarge Creek, and Fontenelle Creek. In addition, the line would be prominently skylined along a ridgetop just west of Opal as seen from Highway 30, and along an extensive escarpment extending east from Big Mesa as seen from Highway 189.

The BLM transmission line would result in 13.5

miles of highly significant impacts. These occur in a variety of locations, many of which correspond to those identified for the UP&L transmission line. Even though this route maximizes use of existing transmission line corridors, they contain much smaller lines than that proposed (woodpole 69-kilovolt versus 345-kilovolt steel lattice). Further, these corridors are located near highways and use areas from which the large towers would be highly visible. This alternative would also cause highly significant visual impacts to sensitive Oregon Trail artifacts in the Holden Hill/Names Hill area which is now largely without the influence of outside visual modifications.

Cultural Resources

The UP&L transmission line system for the Proposed Action would impact 31 previously identified cultural resources (see Table 4-57). The UP&L system for the Buckhorn Alternative would impact 32 cultural resources. The UP&L system for the Shute Creek Alternative would impact 41 cultural resources. The UP&L System for the Northern Alternative would impact 30 cultural resources. All of these resources were recorded during surveys of less than 5 percent of the corridor study areas, and they are possibly eligible for nomination to the NRHP. The alignment of the UP&L transmission lines would cross a majority of the historic trails and stage roads in the region. No information is presently available on the BLM power supply system.

Land Use

The transmission line corridor for the Proposed Action and the UP&L alternative would conflict with the BLM Management Framework Plans joint corridor guidelines. Table 1-12 presents a comparison between the applicant's, UP&L's, and BLM's transmission line systems with the miles of each that are within shared corridors.

The applicants' system would fall within existing corridors 20 to 21 percent of the miles for the Proposed Action, Buckhorn, and Shute Creek Alternative, and 11 percent of the miles for the Northern Alternative.

The UP&L system would share existing corridors 17 to 18 percent of the miles for the Proposed Action, Buckhorn, and Shute Creek Alternative, and 14 percent of the miles for the Northern Alternative.

The BLM system would share existing corridors 55 to 57 percent of the miles for the Proposed Action and all Alternatives.

EMPLOYEE HOUSING

Socioeconomics

Local housing markets are projected to experience increasing demands from 1982 through 1990 in all jurisdictions within Lincoln, Sublette, and Sweetwater Counties. The increased housing demand associated with the Proposed Action creates a need for employee housing in Lincoln County in or near the towns of Kemmerer and Diamondville in addition to the proposed construction camp. Employee housing which meets the needs of both married and single project employees will reduce the impacts on the local housing market and allow it to meet the housing needs of induced employment accompanying the project development.

The requirement for direct employee housing is significant in the Towns of Big Piney and Marbleton in Sublette County and the Town of LaBarge in Lincoln County. Projected housing demand in each of these three towns is beyond the response capability of the housing market currently existing in these towns. Since these towns are within 21 miles of each other and are within commuting distance of the Sublette County project sites, provision of housing for temporary employees would allow permanent project-related employees to settle closer to their work site and reduce the housing demand in more distant towns.

Without specific plans for the construction camps, it is impossible to quantify the impacts that they would have on local housing markets throughout Lincoln and Sublette Counties. The financial incentives to live in the camps as well as the facilities that they provide would determine how many single-status employees or employees with families would live there. It can be predicted, however, that as these camps are used, the effects would be noticed first in the towns farthest from the plant site. Given workers' desires to be near the work site and locate in towns providing the most services, a camp at West Dry Basin, for example, would not be likely to reduce housing demands in Big Piney and Marbleton.

Wildlife and Fisheries

Wildlife

The use of construction camps for employee housing at West Dry Basin and Buckhorn would not affect any big game critical ranges. A construction camp at Big Mesa would remove approximately 80 acres of mule deer critical winter range from production for an estimated 5 years. Similarly, the East Dry Basin camp would disturb 320 acres of pronghorn critical winter range, and the Shute Creek camp would disturb 320 acres of pronghorn critical summer range (Table 4-52).

Mule deer critical winter range disturbance and human presence at the Big Mesa camp would result in a mule deer population reduction of 11 mule deer for the 5-year construction camp life. Once the camp is dismantled and reclamation and revegetation are accomplished, the mule deer population reduction would be expected to be 5 deer until critical range shrub habitats regenerate to adequate productivity levels in 15 years. Mule deer productivity losses during camp construction, operation, and abandonment would total 40 deer. Similarly, pronghorn critical winter range disturbance would reduce populations by 14 animals during construction and operation and

7 animals during abandonment. Total pronghorn productivity losses would be 86 animals. Disturbance to pronghorn critical summer range at the Shute Creek camp would not be expected to result in pronghorn population reductions or productivity losses.

Additionally, when construction camps are within or in close association to critical wildlife ranges, the potential for poaching or harassment would be increased by an unquantified amount. This impact may be partially compensated for by the associated decrease in workers commuting and reduction in vehicle-wildlife collisions.

Fisheries

No perennial streams or aquatic resources are present at the proposed construction camp sites. Therefore, construction camps would not impact fisheries resources. Operation of the camps may concentrate fishing pressure in well field streams, especially near the West Dry Basin site which is about 1 mile from South Piney Creek. Impacts associated with increases in legal and illegal fishing pressure are discussed under well field impacts for the Proposed Action.

Water Resources

Domestic water supply requirements for each construction camp would be approximately 75 acre-feet/year for the West Dry Basin, East Dry Basin, Big Mesa, Shute Creek, and Buckhorn camp sites. Water would be supplied by ground water wells for about 5 years. Insufficient data is available to evaluate impacts on ground water or surface water quantity or quality potentially affected by these new wells; however, experience with existing wells in the Marbleton area indicate that sufficient ground water would be available.

Soils and Vegetation

The five construction camp sites would each disturb 320 acres of soils and vegetation (Table 4-54). Map 1-4 illustrates the various construction camp locations. Impacts to vegetation and soils from camp construction would include loss of forage and increased potential for erosion. Impacts would be localized and short-term, since the entire site would be revegetated following plant construction. No known populations of threatened or endangered plant species or riparian vegetation would be affected. Impacts to soils and vegetation would be insignificant given the small area affected relative to the regional resource, temporary nature of construction camp operation (about 5 years), and required revegetation measures (see Appendix B).

Visual Resources

Of the construction camp sites, only Exxon's camp site north of West Dry Basin would result in significant impacts (see Table 4-56). In this elevated open sage landscape, structure contrasts from a camp of the extent proposed would be readily visible from the Piney Creek Road, numerous ranches in the Piney Creek area, and the Calpet Road. It would also contribute to the combined visual change as seen from the Piney Creek Road and ranches. The visual impact associated with all other employee housing alternatives is insignificant.

Cultural Resources

A partial inventory of the Shute Creek construction camp indicates that 4 sites are present which may meet the NRHP eligibility criteria and which would be impacted by this component alternative (see Table 4-57). No information is available for the other camp locations since no investigations have been conducted in those areas.

Agriculture/Grazing

The 320-acre disturbance associated with construction of the Buckhorn construction camp within the Desert Canyon allotment would result in a less than 5 percent loss of AUMs on this unit.

Construction of the East Dry Basin, West Dry Basin, and Big Mesa camps would disturb 960 acres and remove approximately 87 AUMs from the North LaBarge Common allotment. This would be less than a 5 percent loss in AUMs for this allotment.

A construction camp at the Shute Creek plant site would disturb 320 acres and result in the loss of 18 AUMs in the Slate Creek allotment. This would not alter the significance of the impact to grazing from the Shute Creek Alternative.

Transportation

Temporary employee housing at the sites proposed would affect employee vehicle traffic on U.S. 189. Provision of housing for approximately one-half of the construction workers required at the American Quasar and Exxon treatment plants would result in peak hour traffic demands on U.S. 189 below the Level of Service C volume of 725. Below this level traffic impacts are insignificant. Traffic volumes on U.S. 30 and State Route 240 would continue to exceed Level of Service C. They would be significant and the same as decribed under the Proposed Action.

Land Use Plans, Controls, and Constraints

Proposed employee housing sites in Sublette County (Big Mesa, West Dry Basin, East Dry Basin, and Buckhorn) are not permitted uses in the Resource Conservation (RC) zone districts. Consequently, zone changes would be required for these sites. The standard Sublette County administrative, planning commission, and county commissioner review and approval process would have to be followed to obtain the necessary zone changes.

Housing is a permitted use in Lincoln County Development District VII where Exxon's Shute Creek employee housing site would be located.

SITING ALTERNATIVES

BUCKHORN ALTERNATIVE

For the following environmental resources, implementation of the Buckhorn Alternative would result in impacts the same as those described for the Proposed Action.

- Socioeconomics
- Water Resources
- Recreation
- Timber
- Wilderness
- Noise

The following discussions focus on those disciplines for which the effects would differ by implementing the Buckhorn Alternative.

Wildlife and Fisheries

Well Field

The wildlife and fisheries impacts of construction, operation, and abandonment of the well field as presented for the Proposed Action would also apply to all alternatives.

Plant Sites

Construction at the East Dry Basin, West Dry Basin, Buckhorn, and Craven Creek plant sites and sulfur loadout facility would remove 2,800 acres of wildlife habitat from production (see Environmental Consequences-Vegetation Section). Critical ranges in these areas would be affected with the disturbance of 640 acres of mule deer critical winter range (East Dry Basin), 640 acres of pronghorn critical winter range (East Dry Basin), and 840 acres of pronghorn critical summer range (640 acres at Craven Creek, 200 acres at the sulfur loadout facility) (Table 4-58, Maps 3-2 and 3-3, see Map Pocket).

These critical range disturbances would result in a population reduction of 88 mule deer during plant site construction and operation. This reduction would cause a productivity loss of 919 deer for the 35-year plant life. After abandonment, the deer population reduction would drop to 44 with an additional productivity loss of 197. In a similar manner, pronghorn critical winter range disturbances would reduce the pronghorn population by 28 during construction and operation and 14 during abandonment, and cause productivity losses of 482 pronghorn during construction and operation and 103 during abandonment. The loss of pronghorn critical summer range cannot be reliably correlated to population reductions or productivity losses. Plant site construction would remove 191 acres of prairie dog towns, the same acreage as for the Proposed Action.

Because plant sites would be located in roughly the same geographical areas as the Proposed Action, human population increases would also be expected to occur in the same towns and counties and in the same numbers. Thus, human disturbance impacts to wildlife (poaching, wanton killing, harassment) would also be expected to be similar to the Proposed Action, increasing, 66 (3,197/4,809), 37 (5,292/14,333), and 3 (1,407/45,292) percent in Sublette, Lincoln, and Sweetwater Counties, respectively during peak construction (see Environmental Consequences-Socioeconomics Section). This would constitute a significant impact in both Sublette and Lincoln Counties (see Significance Criteria). The impacts of project-related traffic on wildlife would be the same as those presented for the Proposed Action.

The Buckhorn Alternative plant sites would not impact perennial streams or aquatic resources during construction, operation, or abandonment. Impacts associated with construction of the plant sites would be similar to those described for the Proposed Action including increased legal and illegal fishing pressure associated with increases in human population. Significant increases in legal and illegal fishing would occur in Sublette and Lincoln Counties (66 and 37 percent, respectively).

Linear Facilities

The construction of roads, pipelines, transmission lines, and other linear facilities off the well field would disturb 6,215 acres of wildlife habitat or 48 percent of the total 12,983 disturbed acres in the Buckhorn Alternative (see Environmental Consequences-Vegetation Section). Corridor disturbance to critical range would include 1,797 acres of mule deer critical winter range, 1,739 acres of pronghorn critical winter range, 1,057 acres of pronghorn critical summer range, 460 acres of elk critical winter range, and 160 acres of moose critical winter range (Table 4-58).

As in the Proposed Action, construction of these linear facilities would take place over several years so that not all of these acreages would be disturbed at any one time. Big game population reductions and productivity losses are not expected.

There would be 530 acres of prairie dog towns disturbed during corridor construction resulting in a significant impact as discussed under the Proposed Action.

Potential wildlife impacts from transmission lines would be similar to those discussed for the Proposed Action. The potential for bird wire-strike incidents would be relatively high where the transmission line crosses the Green River in the Buckhorn Alternative in addition to the sensitive areas of Fontenelle Creek and LaBarge Creek discussed for the Proposed Action.

Two sour gas pipelines and a sulfur pipeline crossing the Green River east of the well field would disturb riparian habitat, but significant impacts are not anticipated. All corridors in the Buckhorn Alternative would disturb 83 acres of riparian habitat for a short period assuming reclamation success in 3-5 years (see Vegetation Section).

A transmission line, sulfur pipeline, and 36-inch and 26-inch sour gas trunk lines would cross the

TABLE 4-58
ACRES OF WILDLIFE CRITICAL RANGE[1] DISTURBED BY SITING ALTERNATIVES

	Buckhorn Alternative	Shute Creek Alternative	Northern Alternative
Elk Critical Winter Range			
Well Field	1,019	1,019	1,019
Plant Sites[2]	0	0	0
Corridors	460	666	336
Total	1,479	1,685	1,355
Elk Critical Calving Range			
Well Field	1,107	1,107	1,107
Plant Sites[2]	0	0	0
Corridors	0	0	0
Total	1,107	1,107	1,107
Mule Deer Critical Winter Range			
Well Field	142	142	142
Plant Sites[2]	640	0	1,060
Corridors	1,797	1,468	1,818
Total	2,579	1,610	3,020
Moose Critical Winter Range			
Well Field	287	287	287
Plant Sites[2]	0	0	0
Corridors	160	165	308
Total	447	452	595
Pronghorn Critical Winter Range			
Well Field	0	0	0
Plant Sites[2]	640	0	640
Corridors	1,739	1,342	1,704
Total	2,379	1,342	2,344
Pronghorn Critical Summer Range			
Well Field	0	0	0
Plant Sites[2]	840	900	200
Corridors	1,057	778	935
Total	1,897	1,678	1,135
Prairie Dog Towns			
Well Field	0	0	0
Plant Sites[2]	191	163	123
Corridors	530	901	417
Total	721	1,064	540

[1] Critical ranges may overlap (e.g., mule deer critical winter range and elk critical winter range may occur together).

[2] Includes sulfur loadout.

Green River below South Piney Creek (Table 4-59). Increased sedimentation to the Green River because of staging, trenching, and filling activities would block fish movement and disturb stream bottom habitat. Impacts would be localized, temporary (less than 1 year), and create no long-term significant impacts on the existing fishery. Impacts from construction of other linear facilities associated with this alternative would be similar to those described for the Proposed Action.

Leakage or rupture of the sour gas trunk line crossing the Green River could have serious toxic effects on the downstream fisheries resources. A rupture or leak in the pipeline would result in an immediate fish kill, a significant impact. The extent of downstream effect cannot be quantified with existing data and would be dependent on several factors including stream flow, pH, temperature, and concentration of H_2S at the site.

A molten sulfur pipeline breakage would coat

TABLE 4-59
STREAMS AND FISHERY RESOURCES AFFECTED BY LINEAR FACILITIES FOR THE BUCKHORN ALTERNATIVE

Streams	Sulfur Pipeline	Transmission Lines	Sour Gas Pipeline	Sales Gas & CO_2 Pipeline
North Piney Creek[1]				
Middle Piney Creek[1]				
South Piney Creek(1)				
Dry Piney Creek[2]	X		X	X
Upper Green River[1]	X	X	X	X
LaBarge Creek(1)	X	X	X	
Muddy Creek(3)	X	X	X	
Fontenelle Creek(1)	X	X	X	
Slate Creek(3)	X	X	X	
Green River (Seedskadee)[1]				X
Hams Fork (Opal)[3]		X		
Willow Creek[1]				
Alkali Creek[4]		X		
Bitter Creek[4]				X
Jensen Wash(3)				X
Big Sandy River[1]				X
Blacks Fork[1]				X

[1] These streams are Class II cold water game fish streams that generally contain rainbow, brown, brook and cutthroat trout. Parentheses () indicate stream is not officially classified but supports a fishery similar to that indicated by the footnote number.

[2] Dry Piney near crossing supports a marginal trout population.

[3] These streams are Class III that support primarily nongame fish (suckers and minnows) population.

[4] These streams support marginal non-game fisheries or are Class IV streams (incapable of supporting fish).

stream bottom habitats in a small localized area of the Green River and cause localized water heating. Since elemental sulfur is not toxic to aquatic life and fish would avoid areas of increased water temperature, impacts would not be considered significant. Given the low probability of a pipeline rupture and the few miles of stream crossed by pipelines, a pipeline rupture is not expected in the life of the project.

Health and Safety

The Buckhorn Alternative includes two major sour gas trunk lines: Quasar's 36-inch, 25-mile trunk line to the Buckhorn plant site and Northwest's 30-inch, 43-mile trunk line to Craven Creek. Exxon's and William's lines would be less than 30 inches in diameter and were considered as part of the gathering system. Quasar proposes a 10-mile block valve spacing for its trunk line; Northwest proposes a 5-mile block valve spacing in rural areas and a 2.5-mile block valve spacing where the line passes populated areas.

The probability of ruptures for Northwest's trunk line to Craven Creek was estimated for the Proposed Action. The estimated probability of ruptures for Quasar's trunk line to the Buckhorn plant site appears below. (See the Health and Safety Technical Report for a more detailed discussion of the trunk line sensitivity analysis.)

Miles of Trunk Line	Probability of One or More Ruptures In a Year	Mile-Years	Probability of One or More Ruptures During Life of Project	Expected Number of Ruptures During Project Lifetime
25	0.5%	750	13.9%	0.15

The modeling analysis was conducted as described for the Proposed Action, and a corresponding risk assessment for the Buckhorn Alternative was performed to assess the risk of H_2S exposure in the populated areas of LaBarge, Big Piney, Marbleton, Calpet, and the Fontenelle Recreation Area. The results are shown in Table 4-60. It was found that only Calpet would risk exposure to lethal levels from a trunk line rupture. The remaining populated areas are at risk of discomfort only during light wind stable meteorological conditions. Taking into account both the individual annual risks and estimated total populations for each of the population areas, it may be estimated that 0.01 person (and only at Calpet) would be at risk of lethal exposure from trunk line rupture each year. Correspondingly, it is likely that 0.87 persons from the general population would be at risk of discomfort level exposure each year.

Air Quality

Air quality impacts for the Buckhorn Alternative are summarized in Table 4-61 for all pollutants except SO_2, which is summarized in Table 4-62. Significant air quality impacts are indicated for H_2S. Concentrations of all other pollutants are below significance levels. Readers interested in details for pollutants for which no significant impacts are noted should consult the Air Resources Technical Report.

Sulfur Dioxide

Predicted SO_2 impacts in Class II areas from individual plant operations and the applicable PSD increments are displayed in Table 4-63. Results show that all impacts are below the significance levels. For the 3- and 24-hour impacts, maximum combined concentrations do not exceed the individual impacts displayed. The maximum predicted 3-hour SO_2 concentrations from Exxon's East Dry Basin facility occurred about 4 kilometers (2.4 miles) in high terrain to the southwest of the plant. The maximum 24-hour SO_2 was predicted a little more than 1 kilometer (0.6 miles) to the southeast of Exxon's plant in high terrain. The maximum predicted 3-hour average SO_2 concentration from the Buckhorn plant occurred about 24 kilometers (14.4 miles) to the west of the Buckhorn site in high terrain. The maximum 24-hour average was predicted to occur at a distance a little greater than 11 kilometers (6.6 miles) to the west-southwest of the plant. The locations of the maximum predicted 3-hour and 24-hour SO_2 concentrations for Northwest's Craven Creek plant and Exxon's West Dry Basin plant are the same as described in the Proposed Action.

For annual averages, multiple plume interaction can occur producing higher combined impacts. For the Buckhorn Alternative, the combined annual average SO_2 impact is predicted to be 7.8 micrograms/cubic meter at a distance of a little more than 15 kilometers (9 miles) to the west of the Buckhorn site.

Table 4-64 shows the combined SO_2 impacts at proposed and existing Class I areas. Insignificant impacts are predicted for all existing Class I areas but SO_2 impacts at Scab Creek Primitive Area (a proposed Class I area) are predicted to exceed the Class I PSD increment for a 24-hour average (5.9 versus 5.0 micrograms/cubic meter). However, at Scab Creek Primitive Area, the highest second-highest 24-hour value is 4.3 micrograms/cubic meter. Since this value, used to determine compliance with the PSD increment, is below the increment, no significant impacts in Class I areas are expected (refer to Significance Criterion Number (1).

For the Buckhorn Alternative, the locations of the maximum 3-hour, 24-hour, and annual SO_2 impacts in all proposed and existing Class I areas are the same as those described in the Proposed Action.

The locations of the predicted maximum 24-hour SO_2 impacts in Class II areas, and in the proposed and existing Class I areas, are presented in Map 4-6. Since

TABLE 4-60
ANNUAL RISK TO POPULATED AREAS FROM BUCKHORN ALTERNATIVE

Populated Area	Individual Annual Risk of Lethal Exposure[1]	Individual Annual Risk of Significant Impact[2]	Approximate Number of People (in 1990)[3]
LaBarge	negligible[4]	0.00013	1,206
Big Piney	negligible	0.00008	1,177
Marbleton	negligible	negligible	1,134
Calpet	0.00023	0.00037	54
Fontenelle Recreation Area	negligible	0.00018	1,210

[1] Risk values shown in this table, such as 0.00013, mean 13 chances per 100,000.

[2] Significant exposures are those that would cause eye irritation, coughing, loss of smell, or other discomfort.

[3] Includes people in incorporated and unincorporated areas.

[4] Negligible means that the modeling analysis indicates no risk.

TABLE 4-61
SUMMARY OF TOTAL MAXIMUM CONCENTRATIONS[1] FROM CONSTRUCTION AND OPERATING ACTIVITIES BUCKHORN ALTERNATIVE

Pollutant	Averaging Time	Type of Significance Criterion	Significance Criterion	Buckhorn Alternative	
				Max Conc	Percent Criterion
NO_2[2]	Annual	NAAQS/WAAQS	100	66	66
NO_2[3]	Annual	NAAQS/WAAQS	100	10	10
TSP[2]	Annual	NAAQS/WAAQS	60	48	80
TSP[4]	Annual	NAAQS/WAAQS	60	47	78
H_2S[3]	Half-hour	WAAQS	40	65	163
H_2S	Instantaneous	Odor	6.5	HT & 3.7 mi.[5]	N/A
COS[3]	Annual	MEG	800	10	1
COS[3]	8-Hour	Toxicological	60,000	225	<1
CO_2[3]	Annual	TLV	11g/m^3	0.2	2
CO[3]	1-Hour	NAAQS/WAAQS	40,000	3,906	10
CO[3]	8-Hour	NAAQS/WAAQS	10,000	1,805	18
He	Instantaneous	Asphyxiant	30,000 ppm	<30,000 ppm	N/A

[1] All concentrations are based on modeling with actual offsite meteorological data. All numbers shown are micrograms/cubic meter unless otherwise noted. Values underscored are above applicable significance criteria.

[2] From well drilling operations.

[3] From operation of the gas treatment plants.

[4] From construction activities.

[5] The odor significance criterion is exceeded in high terrain areas surrounding Big Mesa and West Dry Basin, and out to 3.7 mi. from the Buckhorn facility.

TABLE 4-62
SUMMARY OF TOTAL MAXIMUM SO_2 CONCENTRATIONS[1] FROM CONSTRUCTION AND OPERATING ACTIVITIES BUCKHORN ALTERNATIVE

Type of Criterion	Averaging Time	Criterion	Buckhorn Alternative	
			Max Conc	Percent Criterion
NAAQS/WAAQS[2]	Annual	80	21	26
NAAQS/WAAQS[3]	Annual	80	10	13
	24-Hour	365	77	21
	3-Hour	1,300	348	27
PSD Class II[3]	Annual	20	8	40
	24-Hour	91	62	68
	3-Hour	512	278	54
PSD Class I[3]	Annual	2	0.7	35
	24-Hour	5	5.9[4]	118
	3-Hour	25	19.5	78

[1] All concentrations are based on modeling with actual off-site meteorological data. All numbers shown are micrograms/cubic meter. Concentrations underscored are above applicable significance criteria.

[2] From well drilling operations.

[3] From operation of the gas treatment plants.

[4] This concentration would result from combined plant SO_2 emissions. Even though the maximum concentration exceeds the significance criterion, the highest second highest concentration does not, therefore SO_2 impacts are not considered significant. The highest second highest value is 4.3 micrograms per cubic meter.

TABLE 4-63
INDIVIDUAL GAS TREATMENT PLANT SO_2 IMPACTS IN CLASS II AREAS
BUCKHORN ALTERNATIVE

			Maximum SO_2 Concentrations/SO_2 Increments (micrograms/cubic meter)					
			3-Hour		24-Hour		Annual	
Company	Plant Site	Capacity (Million CFD)	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment
Exxon	East Dry Basin	600	130	512	33	91	4	20
Exxon	West Dry Basin	600	278	512	62	91	6	20
Quasar	Buckhorn	1,200	37	512	14	91	7	20
Northwest	Craven Creek	400	159	512	50	91	4	20

[1] Increments can be exceeded once per year.

TABLE 4-64
COMBINED SO_2 IMPACTS IN EXISTING AND PROPOSED PSD CLASS I AREAS
BUCKHORN ALTERNATIVE
(MICROGRAMS/CUBIC METER)

	Maximum SO_2 Concentrations/SO_2 Increments					
	3-Hour		24-Hour		Annual	
Area	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment
Bridger Wilderness (existing Class I area)	19.0	25	4.8	5	0.5	2
Teton Wilderness (existing Class I area)	6.5	25	1.0	5	0.1	2
Teton National Park (existing Class I area)	5.0	25	1.0	5	0.05	2
Scab Creek Primitive (proposed Class I area)	19.5	25	$\underline{5.9}$[2]	5	0.7	2
Fossil Butte National Monument (proposed Class I area)	13.5	25	3.6	5	0.2	2

[1] Increments can be exceeded once per year. Underscore represents exceedance of PSD Class I increment.

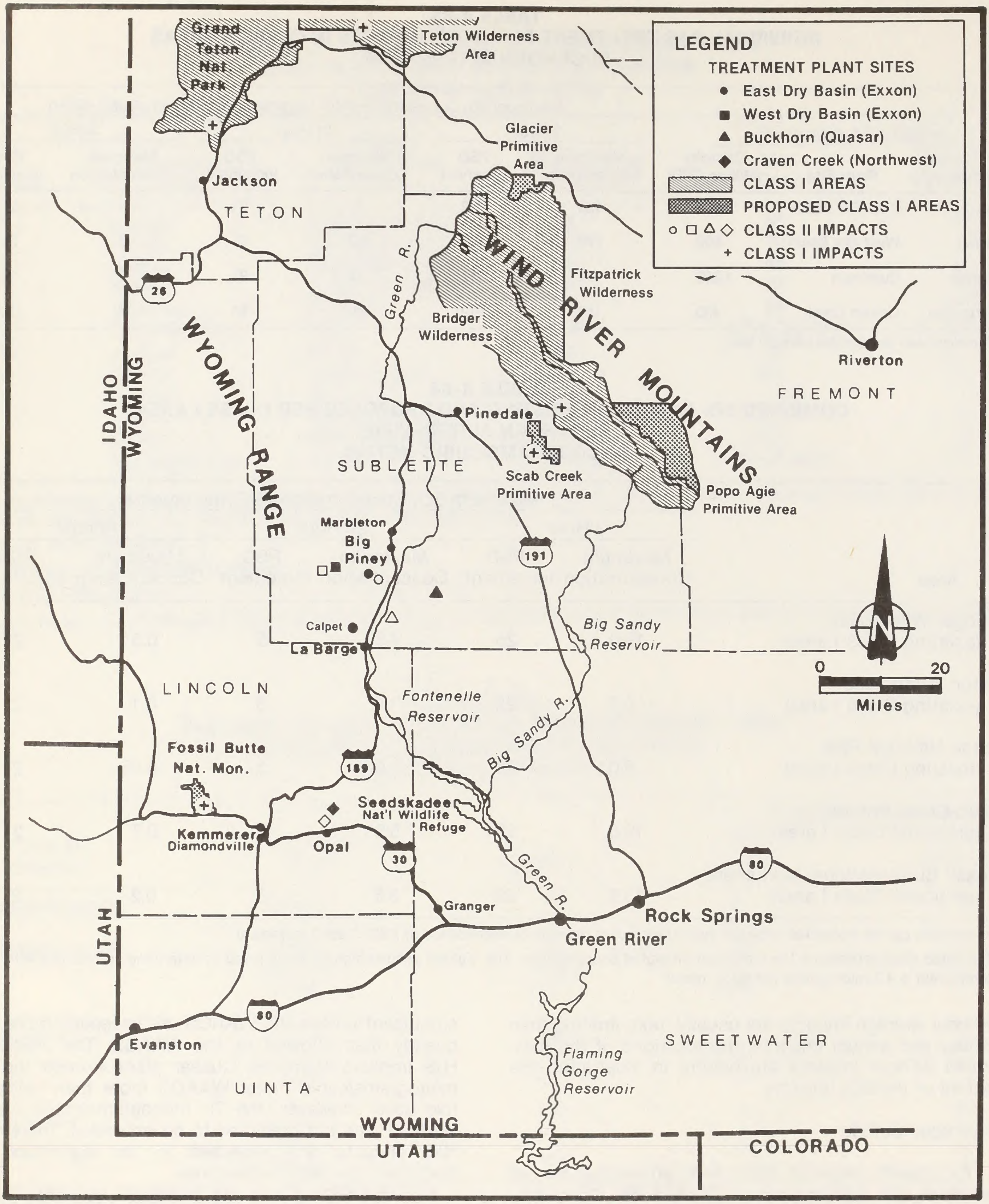
[2] The listed value represents the maximum predicted concentration. The highest second-highest value (used to determine compliance with PSD increments) is 4.3 micrograms per cubic meter.

24-hour average impacts are usually more limiting than 3-hour and annual impacts, the locations of the maximum 24-hour impacts are helpful in illustrating the extent of the SO_2 impacts.

Hydrogen Sulfide

Air quality impacts from H_2S emissions for all facilities are summarized in Table 4-65. Concentrations above the WAAQS significant impact level are predicted for Quasar at Buckhorn but not for the Exxon or Northwest plants. This can be attributed to the lower buoyancy of the Quasar plumes when compared to the Exxon and Northwest plumes, as well as the fact that Quasar emits more H_2S. H_2S impacts are not deemed significant unless the WAAQS are exceeded more frequently than allowed by the WAAQS. The predicted H_2S impacts from the Quasar plant exceed the 40 micrograms/cubic meter WAAQS more than twice in five days. However, the 70 micrograms/cubic meter WAAQS was not predicted to be exceeded. Therefore, H_2S impacts are expected to be significant at Buckhorn, but not at other sites.

H_2S emissions also are predicted to exceed the 6.5 micrograms/cubic meter odor threshold in a 6-kilometer (3.6-mile) area surrounding Buckhorn. For East and West Dry Basin, this limit would be exceeded in local high terrain areas surrounding each facility. The high terrain significantly impacted is about 3 kilometers (1.8 miles) to the west-southwest of West



MAP 4-6 LOCATIONS OF MAXIMUM 24-HOUR AVERAGE SO_2 CONCENTRATIONS IN PSD CLASS I AND CLASS II AREAS FOR THE BUCKHORN ALTERNATIVE

TABLE 4-65
MAXIMUM MODELED H_2S POLLUTANT IMPACTS
BUCKHORN ALTERNATIVE

Pollutant	Averaging Time	Plant Site	Maximum Concentration ($\mu g/m^3$)[1]	WAAQS Significance Level ($\mu g/m^3$)	Odor Significance Level ($\mu g/m^3$)
Hydrogen Sulfide	0.5 Hour	West Dry Basin	12	40[2] 70[3]	6.5
		East Dry Basin	7	40[2] 70[3]	6.5
		Buckhorn	65	40[2] 70[3]	6.5
		Craven Creek	3	40[2] 70[3]	6.5

[1] Impacts predicted using actual off-site meteorology. Underscore represents exceedance of WAAQS.

[2] WAAQS. Two exceedances allowed every five days.

[3] WAAQS. Two exceedances allowed per year.

Dry Basin and about 4 kilometers (2.4 miles) to the southwest of Big Mesa. No odor impacts are predicted for Craven Creek. Therefore, significant odor impacts are expected for the East and West Dry Basin and Buckhorn plants. H_2S impacts are predicted to be below the odor threshold and therefore insignificant at the towns of Big Piney, Marbleton, LaBarge, Calpet, and Opal. At all proposed and existing Class I areas, H_2S impacts would be negligible and not significant.

Carbon Dioxide

Emissions of CO_2 are not expected to cause a general climatic warming, although considerable uncertainty exists regarding the potential for the "greenhouse effect".

Acid Deposition in Class I Areas

Impacts in Class I areas to sensitive fish in sensitive high altitude lakes from acid deposition would be insignificant and the same as described for the Proposed Action (see Table 4-36).

Visibility Impairment in Class I Areas

Calculation of contrast parameters at all Class I areas indicate the significance criterion of 0.1 would not be exceeded. Therefore, no significant visibility impacts are expected from this alternative.

Vegetation Impacts in PSD Class I Areas

Impacts in Class I areas to sensitive vegetation from SO_2 and particulate would be insignificant and the same as described for the Proposed Action.

Secondary Growth Impacts

The predicted pollutant concentrations resulting from secondary growth emissions would be the same as described for the Proposed Action (see Table 4-37).

Air Quality Related Values Impacts

As discussed above, impacts to the AQRV flora, odor, visibility (due, directly from SO_2 and particulate), and acid deposition effects on sensitive fish (due directly from pH changes) in sensitive high altitude lakes are expected to be insignificant. However, it is unknown whether impacts to the other AQRV, i.e., flora (e.g., from acid deposition), fauna (other than sensitive fish), water, soil, cultural/archaeological, and geologic would be significant.

Summary

In summary, operation of the Buckhorn Alternative is expected to result in insignificant air quality impacts except for the following:

- Half-hour H_2S concentrations at plant boundaries and beyond from the Quasar site at Buckhorn. These concentrations exceed the Wyoming half-hour standard of 40 micrograms/cubic meter more frequently than allowed, i.e., more than twice in any five consecutive days, but not the 70 micrograms/cubic meter WAAQS. The maximum predicted H_2S concentration from the Quasar facility is 65 micrograms/cubic meter.
- Odor impacts of H_2S are expected to be significant in localized high terrain areas around the Exxon West Dry Basin and East Dry Basin plants, and as far as 6 km (3.6 miles) from Quasar's Buckhorn plant because the maximum predicted concentrations from these facilities are 12, 7, and 65 micrograms/cubic meter, respectively, which exceed the odor significance criterion of 6.5 micrograms/cubic meter.

Soils and Vegetation

Implementation of the Buckhorn Alternative would result in the disturbance of 12,983 acres (Table 4-66).

TABLE 4-66
POTENTIAL CONSTRUCTION DISTURBANCE BY VEGETATION TYPE BUCKHORN ALTERNATIVE (ACRES)

	Vegetation Types[1]															
	BS	SC	MS	MDS	Sa	G	MP	SF	D	A	C	R	P/H	Gr	Di	Total
Well Field																
Roads	208	196	4	0	0	70	124	29	18	34	9	29	36	0	0	757
Wells	294	284	7	0	0	90	245	48	18	49	18	0	49	0	0	1,102
Gathering System	549	403	10	0	0	207	452	106	32	107	38	106	89	10	0	2,109
Total	1,051	883	21	0	0	367	821	183	68	190	65	135	174	10	0	3,968
Corridors																
Railroads	22	0	0	31	18	0	0	0	0	0	0	2	0	8	4	85
Transmission Lines	967	0	0	31	110	46	0	0	0	0	0	14	41	19	0	1,228
Pipelines	3,803	62	0	31	145	35	0	0	0	0	0	61	31	89	0	4,257
Sulfur Pipeline	459	46	0	8	53	12	0	0	0	0	0	6	31	13	0	628
Access Roads	14	0	0	0	3	0	0	0	0	0	0	0	0	0	0	17
Total	5,265	108	0	101	329	93	0	0	0	0	0	83	103	129	4	6,215
Plant Sites																
Buckhorn	640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	640
West Dry Basin	605	30	0	0	0	5	0	0	0	0	0	0	0	0	0	640
East Dry Basin	483	0	0	0	157	0	0	0	0	0	0	0	0	0	0	640
Craven Creek	496	0	0	144	0	0	0	0	0	0	0	0	0	0	0	640
Sulfur Loadout	22	0	0	0	125	0	0	0	0	0	0	34	0	0	59	240
Total	2,246	30	0	144	282	5	0	0	0	0	0	34	0	0	59	2,800
Grand Total	8,562	1,021	21	245	611	465	821	183	68	190	65	252	277	139	63	12,983

[1] BS = Big Sagebrush
SC = Sagebrush Complex
MS = Mountain Shrub
MDS = Mixed Desert Shrub
Sa = Saltbush
G = Grassland
MP = Mixed Pine
SF = Spruce Fir
D = Douglas-fir
A = Aspen
C = Clearcut
R = Riparian
P/H = Pasture/Hayfield
Gr = Greasewood
Di = Disturbed

Of this disturbance total, 74 percent (9,583 acres) would occur in sagebrush-dominated communities. Anticipated impacts in the well field are the same as those described under the Proposed Action.

Based on the applicants' plans to reclaim rights-of-way and well pads after construction, a total of 4,164 acres (Table 1-13) would remain in use (unreclaimed) after operations are initiated. Operation of the Buckhorn Alternative would not affect any additional vegetation or sensitive rehabilitation units.

Plant Sites

A total of 2,800 acres would be disturbed by construction of the plant sites and sulfur loadout facility. Of this disturbance, 81 percent (2,276 acres) would occur in sagebrush-dominated communities (Table 4-66). The remainder of the plant site disturbance would affect 282 acres (10 percent) of the saltbush community, 144 acres (5 percent) of the mixed desert shrub community, and 5 acres (less than 1 percent) of the greasewood community. The sulfur loadout facility would remove 34 acres of riparian vegetation along the Hams Fork River (same as the Proposed Action). This would be a significant impact based on the significance criteria.

Construction of the proposed plant sites would affect approximately 95 acres of steep, shaly areas at West Dry Basin, East Dry Basin, Buckhorn, and the sulfur loadout facility. In addition, 254 acres of highly saline-alkaline soils would be affected (see Table 4-67). Rehabilitation considerations for these units are shown in Appendix C and are discussed in detail in the Soils, Vegetation, and Reclamation Technical Report.

Based on anticipated emissions from the proposed treatment plants and well field operations, there would not be significant acute or chronic effects on plant growth resulting from exposure to SO_2 or NO_x.

Linear Facilities

A total of 6,215 acres would be potentially disturbed by corridor construction; 79 percent of the disturbance

TABLE 4-67
AREAS (ACRES) OF POTENTIAL CONSTRUCTION DISTURBANCE ON SENSITIVE REHABILITATION UNITS[1]
BUCKHORN ALTERNATIVE

	A2	A4	B3	C2	C4	D4	D5	Total
Well Field (Overall Potential Disturbance: 3,968 acres)								
Roads	0	0	113	50	66	32	125	386
Wells	0	0	84	64	63	38	145	394
Gathering System	10	0	155	55	93	73	301	687
Subtotal	10	0	352	169	222	143	571	1,467
Plant Sites (Overall Potential Disturbance: 2,800 acres)								
Buckhorn (Quasar)	0	0	0	0	0	0	0	0
West Dry Basin (Exxon)	0	40	0	0	0	0	0	40
East Dry Basin (Exxon)	70	30	0	0	0	0	0	100
Craven Creek (Northwest)	144	0	0	0	0	0	0	144
Sulfur Loadout (Exxon)	40	25	0	0	0	0	0	65
Subtotal	254	95	0	0	0	0	0	349
Linear Facilities (Overall Potential Disturbance: 6,214 acres)								
Railroads	58	0	0	0	0	0	0	58
Transmission Line	200	132	113	0	0	0	0	445
Pipeline	481	505	0	0	0	0	0	986
Sulfur Pipeline	139	47	0	0	0	0	0	186
Access Roads	1	0	0	0	0	0	0	1
Subtotal	879	684	113	0	0	0	0	1,676
Total	1,143	779	465	169	222	143	571	3,492

[1]Sensitive Rehabilitation Units are identified in Appendix C (Table C.3).

would be associated with pipelines (Table 4-66). A total of 1,676 acres of soils classified as sensitive rehabilitation units would be affected by corridor construction. Vegetation communities potentially disturbed include sagebrush (5,373 acres or 86 percent); saltbush (329 acres or 5 percent); greasewood (129 acres or 2 percent); pasture/hay land (103 acres of 2 percent); mixed desert shrub (101 acres or 2 percent); grassland (93 acres or 1 percent); and riparian (83 acres or 1 percent). The mixed desert shrub community is an indicator of potentially unstable soils (dunes). The mixed desert shurb community would be affected primarily by the installation of the railroad, transmission lines, and pipelines. Significant long-term productivity losses are expected on 2 acres of the riparian community resulting from railroad bed construction. Approximately 14 acres of access roads would remain in use after abandonment. No impacts to known populations of listed threatened or endangered plant species are anticipated for this alternative, since there are no known records for federally protected species and no potential habitat is present. Additional detail on rare plants is provided in the Soils, Vegetation, and Reclamation Technical Report. Impacts to soils are not anticipated to be significant given the small area affected relative to the regional resource and required rehabilitation measures.

Abandonment of the Buckhorn Alternative would affect similar sensitive rehabilitation units as discussed for the Proposed Action. At completion of the project, a total of 633 acres (Table 1-13) would remain in use, a long-term impact. The residual unreclaimed acreage is similar to that discussed for the Proposed Action, and includes roads (628 acres) and a 15-foot railroad right-of-way (13 acres) from Craven Creek to Opal that would not be reclaimed.

Summary

Construction and operation of the Buckhorn Alternative would affect 12,983 acres of vegetation and soils. This disturbance includes 3,492 acres of sensitive rehabilitation units. No significant impacts are anticipated for soils, assuming compliance with the recommended soil protection measures (Appendix B). A total of 252 acres of riparian vegetation would be removed of this total, a reduction in long-term vegetative productivity is anticipated on 65 acres of riparian areas as a result of construction of the access roads in the well field, the rail spur to Opal, and the sulfur loadout facility. Based on the significance criteria, this is a significant impact. In addition, 606 acres of well field and 14 acres of plant site access roads would remain in use after abandonment, and 13 acres of the railroad route would be abandoned and unreclaimed (Table 1-13). Of the 12,983 acres disturbed, a total of 635 acres would be removed for the life of the project. These land use conversions constitute a reduction in the rangeland or forest land resource, and represent an insignificant (less than 1 percent) reduction in the total regional resource. No known populations of threatened or endangered species would be affected.

Visual Resources

Well Field

Well field impacts would be the same as described for the Proposed Action.

Plant Sites

As in the Proposed Action, plants at East Dry Basin, West Dry Basin, and Craven Creek would cause significant adverse impacts due to their extreme size and industrial character, and the visibility conditions at these sites.

The Buckhorn plant site, while of the same size and character, would be insignificant in its impact due to its lack of visibility. The Buckhorn plant site lies in a low resource value landscape and is unseen from sensitive viewing locations. Facility impacts are shown on Map 4-3 and are summarized in Table 4-68.

Linear Facilities

Construction. Buried pipelines would create 9.75 miles of significant impact and 0.25-mile of highly significant impact. Impact areas different from the Proposed Action include the two sour gas pipeline crossings of the Green River.

The sulfur pipeline would result in 38 miles of significant impact and 9.75 miles of highly significant impact. New areas of impact include the portion of pipeline paralleling Highway 189 north of LaBarge and the Green River and Reardon Draw bluff crossings.

The transmission line in this alternative would produce 10.5 miles of highly significant impact. With this alternative, no impacts would occur at the Big Mesa escarpment. However, new areas of impact would arise at the Green River and Reardon Draw bluff crossings.

TABLE 4-68
VISUAL RESOURCE IMPACT SUMMARY BUCKHORN, SHUTE CREEK, AND NORTHERN ALTERNATIVES

	Buckhorn		Shute Creek		Northern	
	Highly Significant[1]	Significant[1]	Highly Significant[1]	Significant[1]	Highly Significant[1]	Significant[1]
Plant Sites[2]						
Big Mesa					X	
West Dry Basin		X				X
East Dry Basin		X				X
Craven Creek		X		X		
Shute Creek				X		
Williams Maintenance Facility	X		X		X	
Well Sites (Same as Proposed Action)						
Gathering Pipelines (Same as Proposed Action)						
Access Roads (Same as Proposed Action)						
Sour Gas Trunkline	0	2.00	0	2.00	0	2.00
Transmission Line	10.50	0	10.50	0	12.00	0
Sulfur Pipeline	9.75	38.00	9.75	34.75	10.25	38.00
CO_2/Sales Gas Pipeline	0.25	7.75	0	5.50	0.25	7.75
Water Pipeline	0	0.50	0	0.50	0	0.50

[1] See Significance Criteria.

[2] Buckhorn has no significant impacts.

Operation. As in the Proposed Action, impacts in most areas would remain high for buried pipelines only in the early years of operation due to revegetation. However, escarpment crossings would show visual contrast indefinitely due to the lack of vegetation. The impacts of the sulfur pipeline and transmission line during operation in this alternative are high throughout operation because of the structures of these facilities.

Abandonment. As in the Proposed Action, abandonment of buried pipelines would reduce impacts in all areas but escarpments due to revegetation. The sulfur pipeline would be removed with abandonment, eliminating structure contrasts and most visual impacts. However, the impact at the bluff crossings would remain high.

Summary

Facility impacts are summarized in Table 4-68 and shown on Map 4-3. Table 4-69 summarizes the combined visual effects of this alternative. The combined visual change is the same as in the Proposed Action; however, an additional three residences would experience a highly significant change. These residences are in the Green River Valley near Reardon Draw and would be affected by the numerous facilities crossing the Green River.

Cultural Resources

Based on a 100 percent survey, the West Dry Basin plant site possesses no NRHP eligible resources. The Buckhorn and East Dry Basin plant sites are incompletely evaluated for resources. The Craven Creek plant site has been surveyed, but the results have not been released by Northwest Pipeline. A total of 130 potentially NRHP eligible archeological sites are located in the alternative's facility corridors; 15 of these sites would be directly impacted, and 92 would be indirectly impacted. The potential impact on the remaining 23 sites has not been determined. The Applicants' transmission line would impact 24 identified sites. Most of the corridor rights-of-way are unsurveyed for cultural resources. All 11 historic trails as discussed under the Proposed Action would also be impacted by the proposed Buckhorn Alternative facilities.

Agriculture/Grazing

Construction of the Buckhorn Alternative would disturb 7,739 acres and result in the loss of 713 AUMs (Table 4-70). This is a less than 1 percent decrease in the total number of AUMs on affected allotments. As under the Proposed Action the Piney Unit Fenced (21 percent), Beaver Creek Ind. (5 percent), Beaver Meadows (100 percent), and LaBarge Ind. (9 percent) allotments would be significantly impacted. The Slate Creek Sheep Trail would be crossed by Northwest's proposed sour gas trunk line and water pipeline, Exxon sulfur pipeline, and the American Quasar/Exxon transmission line. The significant impacts associated with construction on the Piney Unit Fenced, Beaver Meadows, and LaBarge Ind. allotments would continue during project operation, though the total loss of 213 AUMs during operation would be insignificant. During operation, only the Exxon sulfur pipeline could possibly conflict with use of the Slate Creek Sheep Trail.

Transportation

The change in transportation operations induced by the Buckhorn site is localized in nature. Traffic that under the Proposed Action turned left from U.S. 189 to East Dry Basin, would now turn right from U.S. 189 onto a plant access road leading to the Buckhorn site. The shift in traffic demand would improve the operation of the County Road 23-134 intersection with U.S. 189. The regional oriented traffic demands on the highway network are assumed to be the same for the Buckhorn and Proposed Action alternatives due to the common employee home origin distributions and the general similarity of transportation corridor configurations.

Land Use Plans, Controls, and Constraints

Although the Buckhorn Alternative replaces the Big Mesa plant site with the Buckhorn plant site, existing zoning at both locations is the same. Consequently, the conflicts with existing Sublette County and Rock Springs zoning would be the same as those described under the Proposed Action.

The Buckhorn Alternative would have one multi-facility corridor and one CO_2 and sales gas pipeline corridor to the Buckhorn plant site. Although the amount of conflict with Pinedale Resource Area Management Framework Plan guidelines would be relatively small, other corridors under the Buckhorn Alternative repeat the conflicts described under the Proposed Action. The Buckhorn Alternative also introduces a redundant corridor for the CO_2 and sales gas pipelines south from the Buckhorn Plant site. Of the 122.5 miles of the transmission system, 101.5 miles are not in a shared corridor.

SHUTE CREEK ALTERNATIVE

For the following environmental disciplines, implementation of the Shute Creek Alternative would result in impacts the same as those described for the Proposed Action:

- Water Resources
- Recreation
- Timber
- Wilderness
- Noise

The following discussions focus on those disciplines for which the effects would differ by implementing the Shute Creek Alternative.

TABLE 4-69
COMBINED VISUAL CHANGE IMPACTS BUCKHORN, SHUTE CREEK, AND NORTHERN ALTERNATIVES

	Buckhorn Alternative		Shute Creek Alternative		Northern Alternative		
Viewer Location	Combined Visual Change Significance Level[1]	Miles Residences	Combined Visual Change Significance Level[1]	Miles Residences	Combined Visual Change Significance Level[1]	Miles Residences	Combined Visual Change[2]
Opal Cutoff (Hwy.240)	Significant	12 Miles	Significant	12 miles	--	--	C-N to M-D
Slate Creek Ranch	Significant	1 Ranch	Significant	1 Ranch	Significant	1 Ranch	C-N to M-N fixed vpt.
Fontenelle Creek Road	Significant	12 Miles	Significant	12 Miles	Significant	12 Miles	S-N to M-N mix
Fontenelle Creek Ranches	Highly Significant	6 Ranches	Highly Significant	6 Ranches	Highly Significant	6 Ranches	S-N to M-N fixed vpt.
East LaBarge Creek Road	Significant	6 Miles	Significant	6 Miles	Significant	6 Miles	M-N mix to M-D
East LaBarge Creek Ranches	Significant	6 Ranches	Significant	6 Ranches	Significant	6 Ranches	M-N mix to M-D
Hwy. 189 - Labarge Creek to Dry Piney Creek	Significant	16 Miles	Significant	16 Miles	Significant	16 Miles	M-N mix to M-D
Ranches along 189- LaBarge to Dry Piney Creek	Significant	3 Ranches	Significant	3 Ranches	Significant	3 Ranches	M-N mix to M-D
Residences along along 189 - South of Dry Piney Creek	Highly Significant	2 Residences	Highly Significant	2 Residences	Highly Significant	2 Residences	S-N to M-N mix fixed vpt.
Upper Green River Ranches	Highly Significant	3 Ranches	Highly Significant	3 Ranches	Highly Significant	3 Ranches	S-N to M-N fixed vpt.
Calpet Road - North of Fogarty Creek to 189	Significant	10 Miles	--	--	Significant	10 Miles	M-N mix to M-D
Pine Grove Ridge Road	Significant	12 Miles	Significant	12 Miles	Significant	12 Miles	M-N mix to M-D
Upper Beaver Dam Creek Road	Significant	4 Miles	Significant	4 Miles	Significant	4 Miles	S-N to M-N mix
Middle Piney Road	Significant	26 Miles	Significant	26 Miles	Significant	26 Miles	S-N to M-N mix
Indian/Coal Creek Road	Highly Significant	10 Miles	Highly Significant	10 Miles	Highly Significant	10 Miles	S-N to M-D
South Piney Road	Highly Significant	16 Miles	Highly Significant	16 Miles	Highly Significant	16 Miles	S-N to M-D
Fish Creek Road	Significant	3 Miles	Significant	3 Miles	Significant	3 Miles	S-N to M-N mix
Wyoming Trail	Significant	2 Miles	Significant	2 Miles	Significant	2 Miles	S-N to M-N mix
Beaver Creek Ranches	Highly Significant	2 Ranches	Highly Significant	2 Ranches	Highly Significant	2 Ranches	S-N to M-N fixed vpt.
Piney Creek Ranches	Highly Significant	24 Ranches	Highly Significant	24 Ranches	Highly Significant	24 Ranches	S-N to M-N mix fixed vpt.

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[1] See Significance Criteria.

[2] S-N = Scenic Natural, C-N = Common Natural, M-N = Man Natural Mix, M-D = Man Dominated, vpt. = viewpoint.

TABLE 4-70
TOTAL ACRES DISTURBED AND AUMs LOST DURING CONSTRUCTION BY GRAZING ALLOTMENT FOR EACH SITING ALTERNATIVE[1]

	Siting Alternative					
	Buckhorn		Shute Creek		Northern	
Allotment	Acres	AUMs[2]	Acres	AUMs[2]	Acres	AUMs[2]
Slate Creek	897	43	1,069	51	163	8
Highway	109	7	36	2	136	9
Coyote Springs	16	1	24	2	0	0
Cumberland Unita	18	2	27	4	7	1
Cow Hollow	171	17	170	17	160	16
Robinson Creek	6	1	9	1	0	0
Reardon Canyon	45	2	30	2	50	2
18 Mile	139	12	52	4	223	19
Lombard	51	4	17	1	64	5
Figure Four	104	7	29	2	132	9
Rock Springs	246	14	1,089	61	246	14
N. LaBarge Com.	3,222	293	1,901	173	3,348	304
S. LaBarge Com.	56	5	74	7	42	4
Eubank	10	1	14	2	7	1
Bondurant	1	<1	1	<1	1	<1
Dry Piney	0	0	0	0	24	1
S. Piney Ind.	0	0	0	0	41	4
LaBarge Unit	0	0	0	0	24	5
LaBarge Crk. Rch.	9	1	12	2	6	1
Indian Springman	97	12	97	12	97	12
S. Piney S & G	11	1	11	1	11	1
Mt. Darby S & G	62	8	62	8	62	8
Fish Creek	107	13	107	13	107	13
Snider Basin	507	63	507	63	507	63
LaBarge Creek	102	13	102	13	102	13
LaBarge Roundup	413	52	413	52	413	52
W. Unit Ind.	5	1	5	1	5	1
Piney Unit Fenced	33	4	33	4	33	4
Johnson Ridge	17	4	17	4	17	4
Star Coral	7	1	7	1	7	1
Springman Creek	18	2	18	2	18	2
Budd Fish Creek	23	2	23	2	23	2
W. Fish Creek	42	5	42	5	42	5
Beaver Creek Ind	78	7[3]	78	7[3]	78	7[3]
Beaver Meadows	58	7	58	7	58	7
LaBarge Ind.	154	30	154	30	154	30
Jory	9	1	9	1	9	1
Yose Ind.	8	1	8	168		1
Upper N. LaBarge	198	25	198	25	198	25
Carter Lease	18	2	18	2	18	2
Desert Canyon	672	48	672	48	672	48
Total	7,739	713	7,193	634	7,313	706

Source: ERT 1982

[1] Total acreage includes losses from the well field roads, gathering lines and well pads, as well as from all corridors and plant sites.

[2] Lost AUMs (Animal Unit Months) were calculated by applying ROW widths to component mileages and determining acres disturbed; acres disturbed was then divided by the average number of acres per AUM for each allotment. If no data were available, 8 acres was used for high elevation allotments and 15 acres for lower areas.

[3] Calculations of the AUMs lost is based on the number of acres disturbed, hence, the percentage lost can exceed 100.

Socioeconomics

Employment

Table 4-71 presents the projected impacts on the mean annual labor force, employment, and unemployment rates for Lincoln, Sublette, and Sweetwater Counties under the Shute Creek Alternative.

Table 4-72 presents the employment opportunities by sector for the three counties that would be associated with the Shute Creek Alternative. Under this alternative most of the impacts from the Riley Ridge Project would be located in Lincoln County. During the peak year (1986), the Shute Creek Alternative would result in an additional 3,200 jobs, about 45 percent more than expected under the baseline (Table 4-72).

Population

The projected annual increases in population for Lincoln, Sublette, and Sweetwater Counties, respectively, under the Shute Creek Alternative are shown in Table 4-73. It is estimated that the Lincoln County

TABLE 4-71
PROJECTED INCREASES IN ANNUAL AVERAGE LABOR FORCE, AND EMPLOYMENT, AND CHANGE IN UNEMPLOYMENT RATE SHUTE CREEK ALTERNATIVE

County/Community	1985	1986	1990	2000
Lincoln County				
Labor Force	2,224	2,460	1,292	1,013
Number Employed	2,220	2,445	1,210	947
Unemployment Rate	1.7	1.7	0.0	0.0
Sublette County				
Labor Force	1,104	985	554	452
Number Employed	1,080	953	526	438
Unemployment Rate	0.0	0.0	0.4	0.0
Sweetwater County				
Labor Force	768	796	304	79
Number Employed	748	762	222	77
Unemployment Rate	0.0	0.0	0.3	0.0

Source: Western Research Corporation 1982

TABLE 4-72
PROJECTED ANNUAL EMPLOYMENT OPPORTUNITIES ASSOCIATED WITH THE DEVELOPMENT OF THE RILEY RIDGE PROJECT SHUTE CREEK ALTERNATIVE

Category	1985	1986	1990	2000
LINCOLN COUNTY				
Direct Employment				
Mining	134	143	98	93
Construction	1,299	1,279	285	0
Manufacturing	39	180	406	526
Transportation, Communications, and Public Utilities	9	43	52	57
Total Direct Employment	1,481	1,645	841	676
Total Indirect Employment	1,435	1,555	716	526
Total Employment Opportunities	2,916	3,200	1,557	1,202
SUBLETTE COUNTY				
Direct Employment				
Mining	274	292	204	182
Construction	599	401	57	0
Manufacturing	14	65	132	138
Transportation, Communications, and Public Utilities	8	35	50	50
Total Direct Employment	895	793	443	370
Total Indirect Employment	240	208	107	88
Total Employment Opportunities	1,135	1,001	550	458
SWEETWATER COUNTY				
Direct Employment				
Mining	35	38	25	26
Construction	414	413	93	0
Manufacturing	1	7	15	20
Transportation, Communications, and Public Utilities	0	1	2	2
Total Direct Employment	450	459	135	48
Total Indirect Employment	383	390	112	36
Total Employment Opportunities	833	849	247	84

Source: Western Research Corporation 1982

population would increase by approximately 30 percent from 1982 to 1990, about four times the growth expected under the baseline. The major changes in the population distributions within Lincoln County from those observed in the projected population under the baseline occur in the Towns of LaBarge and Diamondville. Under the baseline in 1990, LaBarge and Diamondville account for approximately 2.5 percent and 8.2 percent of the projected county population, respectively, compared to a 4.7 and 11.2 percent share, respectively, under this alternative. In the peak years of net population impacts, LaBarge accounts for approximately 6.5 percent of the total county population (1985) and Diamondville accounts for about 13.6 percent (1986) of the total population. This is an increase of approximately 265 and 136 percent in the projected populations for the Towns of LaBarge and Diamondville, respectively, over the projected populations under the baseline in those years.

The projected population for Sublette County exhibits an increase of nearly 25 percent from 1982 to 1990 under this alternative, compared to the almost zero rate of change expected under the baseline. The total net population increase in the peak year (1985) is estimated at 2,349 people, which is an increase of approximately 49 percent in the total county population for that same year over the estimated population under the baseline.

The Towns of Big Piney and Marbleton experience the greatest degree of impact in terms of total population growth, increasing in population from 1982 to 1990 by approximately 55 percent and 50 percent, respectively. This results in a change in the 1990 relative size of these towns from about 12 percent of the total county population in each town under the baseline to about 14 percent of the total population for each town under the Shute Creek Alternative.

Expected population impacts for Sweetwater County remain small under the Shute Creek Alternative, with total county population growth through 1990 projected at approximately 12.1 percent, compared to an estimated 10.7 percent increase under the baseline. The major impact of population growth under this alternative is expected to occur in the Town of Granger, where the total population is projected to increase by approximately 39 percent from 1982 to 1990, compared to the 10 percent increase projected under the baseline. The total net population impact for Granger is estimated at 145 people in 1986 (the peak year), a 76 percent increase in population over the baseline estimate for that year.

Personal Earnings

Total projected personal earnings in constant 1980 dollars under the Shute Creek Alternative are presented in Table 4-74 for Lincoln, Sublette, and Sweetwater Counties. The net economic impacts are the greatest in Lincoln County where total constant dollar earnings increase by nearly 44 percent from 1982 to 1990 compared to a projected 5 percent increase under the baseline. Total personal earnings are estimated to increase from $107.2 million in 1982

TABLE 4-73
PROJECTED POPULATION INCREASE WITHIN THE RILEY RIDGE STUDY AREA - SHUTE CREEK ALTERNATIVE

County/Community[1]	1985	1986	1990	2000
Lincoln County	5,445	6,024	3,163	2,480
Afton	20	22	12	9
Thayne	6	5	3	3
Diamondville	1,374	1,598	818	619
Kemmerer	2,396	2,764	1,421	1,081
LaBarge	928	843	493	439
Cokeville	63	68	36	29
Rural	658	724	381	300
Frontier	122	120	87	68
Opal	83	82	59	46
Construction Camp	102	165	0	0
Sublette County	2,349	2,094	1,179	964
Big Piney	609	540	305	250
Marbleton	564	501	283	232
Pinedale	124	114	63	51
Rural	1,052	939	529	432
Calpet	28	24	14	11
Daniel	17	16	9	7
Sweetwater County	1,536	1,592	608	157
Granger	134	145	54	14
Green River	608	632	241	62
Rock Springs	491	505	194	50
South Superior	35	35	13	4
Wamsutter	15	15	6	2
Rural	253	261	100	26

Source: Western Research Corporation 1982

[1] The county population is the sum of the town populations plus the rural population.

TABLE 4-74
PROJECTED INCREASE IN TOTAL ANNUAL PERSONAL EARNINGS[1] SHUTE CREEK ALTERNATIVE

Jurisdiction	1985	1986	1990	2000
Lincoln County	$80,481	$88,177	$42,347	$28,131
Sublette County	38,812	33,774	17,433	13,969
Sweetwater County	25,440	27,690	8,886	2,270

Source: Western Research Corporation 1982

[1] In thousands of constant 1980 dollars.

to $154.4 million in 1990, with a peak in personal earnings of approximately $194.9 million in 1986. This is nearly an 83 percent increase in projected earnings for that year over the baseline. The net impact in constant 1980 dollar earnings for 1986 is estimated at nearly $88 million.

In Sublette County total constant dollar earnings peak at approximately $73 million in 1985, resulting in a positive net impact of almost $39 million for that year. This is an increase of approximately 113 percent in personal earnings for Sublette County in 1985 over the projected level under the baseline. Net increases in constant dollar personal earnings for Sublette County should remain over $14 million after the year 1990 under this alternative.

In Sweetwater County the peak net impact in personal earnings is estimated at approximately $27.7 million in 1986, an increase of approximately 6 percent over the projected personal earnings under the baseline. Over 9 percent of the increase in total personal earnings in Sweetwater County under the Shute Creek Alternative would occur in the Town of Granger.

Housing

The housing demands that would be associated with the Shute Creek Alternative are given in Tables 4-75 and 4-76. While developers may build in response to the long-term demand (that shown for years 1990 and beyond) the increases shown for the 1980s are short-term demand that is not likely to be met by increased numbers of permanent housing units. This unmet demand would create the need for temporary housing but also have the effect of increasing pressure on the existing housing market that would be seen in increased local housing prices, increases in rental prices, and increases in the average number of persons per dwelling.

Lincoln County. The Shute Creek Alternative would result in a 1986 peak housing demand that is 55 percent above the baseline projection for Lincoln County. This would be a significant increase, 2,529 units above projected baseline demand.

Kemmerer and Diamondville would experience increases of 72 and 136 percent, respectively, during 1986. LaBargė is projected to reach its peak net impact which is 264 percent above baseline in 1985.

Sublette County. The Shute Creek Alternative would result in a total peak housing demand of 2,124 units in 1985 (Table 4-76), 77 percent higher than the 1,199 units of demand projected without the project.

Housing demand in Big Piney and Marbleton is expected to be almost 68 percent more than the baseline projections in 1985. Pinedale is expected to need 11 percent more housing in 1985 than in the baseline and about 4 percent above baseline in 2000.

Town of Granger, Sweetwater County. The housing demand associated with the Riley Ridge Project in Granger would increase to 56 units with the Shute Creek Alternative in the peak year, 1986. This alternative represents a 133 percent increase in housing demand above the baseline.

TABLE 4-75
PROJECTED INCREASE IN HOUSING DEMAND FOR LINCOLN, COUNTY, KEMMERER, DIAMONDVILLE, AND LABARGE SHUTE CREEK ALTERNATIVE

Location/Housing Type	1985	1986	1990	2000
Lincoln County				
Single Family	917	1,124	634	497
Mobile Home	433	340	250	196
Multi-Family	128	122	76	59
Other	632	943	62	49
TOTAL	2,110	2,529	1,022	801
Kemmerer				
Single Family	598	691	345	262
Mobile Home	156	180	90	68
Multi-Family	115	133	68	52
Other	81	94	48	36
TOTAL	950	1,098	551	418
Diamondville				
Single Family	219	256	130	98
Mobile Home	245	284	145	110
Multi-Family	23	28	14	10
Other	2	3	1	1
TOTAL	489	571	290	219
LaBarge				
Single Family	203	184	107	95
Mobile Home	136	123	72	64
Multi-Family	24	23	12	11
Other	0	0	0	0
TOTAL	363	330	191	170

Source: Western Research Corporation 1982

Wildlife and Fisheries

Well Field

The wildlife and fisheries impacts of well field construction, operation, and abandonment would be the same as the Proposed Action for all alternatives.

Plant Sites

Construction at the Buckhorn, Shute Creek, and Craven Creek plant sites and the sulfur loadout facility would remove 2,160 acres of wildlife habitat from production (see Environmental Consequences-Vegetation Section). Exxon would consolidate two northern plant sites into the one Shute Creek site. There would not be any big game critical winter range disturbances on any of the sites, therefore, no big game population reductions or productivity losses

TABLE 4-76
PROJECTED INCREASE IN HOUSING DEMAND FOR SUBLETTE COUNTY, BIG PINEY, MARBLETON, PINEDALE, AND GRANGER SHUTE CREEK ALTERNATIVE

Location/Housing Type	1985	1986	1990	2000
Sublette County				
Single Family	318	336	253	207
Mobile Home	396	312	124	101
Multi-Family	107	101	64	52
Other	104	76	23	19
TOTAL	925	825	464	379
Big Piney				
Single Family	164	147	86	67
Mobile Home	66	59	34	28
Multi-Family	24	22	13	11
Other	1	1	1	1
TOTAL	255	229	134	107
Marbleton				
Single Family	91	81	46	37
Mobile Home	87	78	45	37
Multi-Family	9	9	5	4
Other	0	0	0	0
TOTAL	187	168	96	78
Pinedale				
Single Family	17	18	14	11
Mobile Home	21	17	7	5
Multi-Family	6	5	3	3
Other	5	4	1	1
TOTAL	49	44	25	20
Sweetwater County				
Granger				
Single Family	21	21	11	6
Mobile Home	24	27	13	7
Multi-Family	4	4	4	1
Other	3	4	0	0
TOTAL	52	56	28	14

Source: Western Research Corporation 1982

would occur on the sites (Table 4-58). About 900 acres of pronghorn critical summer range would be removed (60 acres at Shute Creek, 640 acres at Craven Creek, and 200 acres at the sulfur loadout), however, critical summer range designation is dependent on water availability and range reductions cannot be reliably correlated to population impacts. Plant site construction would remove 163 acres of prairie dog towns with impacts similar to those described for the Proposed Action.

The magnitude of human population increases and increases in human disturbance to wildife would be similar to the Proposed Action, however, population distribution would be such that there would be 49 percent (2,349/4,809) growth in Sublette County, 42 percent (6,024/14,333) in Lincoln County and 4 percent (1,592/45,292) in Sweetwater County during peak construction (see Environmental Consequences-Socioeconomics Section). This represents a relatively uniform population spread. Increases in human disturbance to wildlife, such as poaching, wanton killing, and harassment would also be expected to increase in those proportions. Therefore, significant human disturbance impacts on wildlife would occur in Sublette and Lincoln Counties (see Significance Criteria).

Impacts of poaching, vehicle-wildlife collisions, and other human disturbance causes would continue through operation but gradually decrease as temporary construction workers are replaced with long-term oil company and contractor employees. By 2000, project-related population would decrease as temporary construction workers are replaced with long-term oil company and contractor employees. By 2000, project-related population would decrease to 20 (964/4,896), 15 (2,480/16,784), and less than 1 percent (157/60,896) over baseline in Sublette, Lincoln, and Sweetwater Counties, respectively (see Environmental Consequences-Socioeconomics Section). Human disturbance impacts would decrease accordingly.

Vehicle-wildlife collision impacts from project-related traffic of the Shute Creek Alternative on Highway 189 between Big Piney and Fontenelle Reservoir would be 66 mule deer and 9 pronghorn per year during peak construction, a 53 percent increase over baseline. During operation, highway traffic and big game mortality would decrease to 10 mule deer and 2 pronghorn per year over baseline on this segment. Road kill data are unavailable for other highway segments within the project area but this segment represents a high impact potential based on its relation to big game winter range.

As in the Proposed Action and the Buckhorn Alternative, with increased traffic there is a proportionately increased chance of a vehicle striking a black-footed ferret should they inhabit the project area. Increased traffic and resulting road kills would also increase the chance of vehicles striking and killing wintering bald eagles and other raptors feeding on roadside carrion.

Access roads and worker traffic to and from the plant sites would not pass through important wildlife areas for the Shute Creek or Craven Creek sites. Buckhorn site access would pass through pronghorn critical winter range and mule deer critical winter range (Maps 3-2 and 3-3, see Map Pocket).

Other impacts, including the potential effects of the 30-acre wastewater pond at the Craven Creek site, would be similar to the Proposed Action and Buckhorn Alternative.

The Shute Creek plant site would not impact perennial streams or aquatic resources during construction, operation or abandonment. Impacts associated with construction of the plant sites would be similar to those described for the Proposed Action including increased legal and illegal fishing pressure associated with increases in population. Significant increases in legal and illegal fishing would occur in Sublette and Lincoln Counties (48 percent and 42 percent, respectively).

Linear Facilities

The construction of roads, pipelines, transmission lines, and other linear facilities would disturb 5,987 acres of wildlife habitat or 49 percent of the total 12,115 disturbed acres in the Shute Creek Alternative (see Environmental Consequences-Vegetation Section). Corridor disturbance to critical range would include 1,468 acres of mule deer critical winter range, 1,342 acres of pronghorn critical winter range, 778 acres of pronghorn critical summer range, 666 acres of elk critical winter range, and 165 acres of moose critical winter range (Table 4-58).

As in the Proposed Action, construction of these linear facilities would take place over several years so that not all of these acreages would be disturbed at any one time. Big game population reductions and productivity losses are not expected. In this alternative, sales gas and CO_2 pipelines from the Shute Creek Plant would cross approximately 2.5 miles of the Seedskadee National Wildlife Refuge temporarily disrupting wildlife use and causing a short-term disturbance to riparian habitat.

There would be 901 acres of prairie dog towns disturbed during corridor construction resulting in a signficant impact as discussed under the Proposed Action.

Potential wildlife impacts from transmission lines would be similar to those discussed for the Proposed Action. The potential for bird wire-strike incidents would be higher where the transmission line crosses the Green River in the Shute Creek Alternative in addition to the sensitive areas of Fontenelle Creek and LaBarge Creek discussed for the Proposed Action.

Impacts to fisheries would be similar to those discussed for linear facilities under the Proposed Action except that the sales gas/CO_2 pipelines from the Shute Creek plant site would cross the Green River in a different location, within the Seedskadee National Wildlife Refuge (Table 4-77). Pipeline construction would result in a temporary increase in downstream sedimentation and a small loss of stream bottom habitats. The Green River supports a productive rainbow and brown trout fishery at this location. If construction occurred in late fall, brown trout moving upstream to spawn could be temporarily blocked. However, given the short construction period (2 weeks) spawning would not be significantly affected. A rupture or leak of the sales gas or CO_2 pipeline at the Green River would temporarily block fish movement. Sales gas and CO_2 are not toxic to aquatic resources and significant impacts would not be expected (see Proposed Action). A pipeline rupture is not likely in the life of the project.

Health and Safety

The Shute Creek Alternative includes three major sour gas trunk lines: Quasar's 36-inch, 25-mile trunk line to the Buckhorn plant site, Exxon's 30-inch, 43-mile trunk line to Shute Creek, and Northwest's 30-inch, 43-mile trunk line to Craven Creek. Quasar and Exxon propose a 10-mile block valve spacing for their trunk lines; Northwest proposes a 5-mile block valve spacing in rural areas and a 2.5-mile block valve spacing where the line passes populated areas.

The estimated probability of ruptures for Northwest's and Quasar's trunk lines was described for the Proposed Action and the Buckhorn Alternative, respectively. The estimated probability of ruptures for Exxon's trunk line to the Shute Creek plant site is shown below. It was assumed for Exxon's trunk line that the downwind distances for significant and lethal doses are the same as for Quasar's 30-inch trunk line with 10-mile block valve spacing. (See the Health and Safety Technical Report for a more detailed discussion of the trunk line sensitivity analysis.)

The modeling analysis was completed as described for the Proposed Action, and a corresponding risk assessment for the Shute Creek Alternative was performed to assess the risk of H_2S exposure in the populated areas of LaBarge, Big Piney, Calpet, and the Fontenelle Recreation Area. The results are shown in Table 4-78. It was found that only Calpet and LaBarge would risk exposure to lethal levels from a trunk line rupture. LaBarge's annual individual risk is smaller than the annual risk of death from an automobile accident. The remaining populated areas are at risk of discomfort only during light wind stable meteorological conditions. A total of 0.08 people would be at risk of lethal exposure from trunk line rupture each year, while 1.19 people would be at risk of discomfort level exposure.

Air Quality

Air quality impacts for the Shute Creek Alternative are summarized in Table 4-79 for all pollutants except SO_2, which is summarized in Table 4-80. Significant air quality impacts are indicated for H_2S. Concentrations of all other pollutants are below significance

Miles of Trunk Line	Probability of One or More Ruptures In a Year	Mile-Years	Probability of One or More Ruptures During Life of Project	Expected Number of Ruptures During Project Lifetime
43	0.86%	1,290	22.7%	0.26

TABLE 4-77
STREAMS AND FISHERY RESOURCES AFFECTED BY LINEAR FACILITIES FOR THE SHUTE CREEK ALTERNATIVE

Streams	Sulfur Pipeline	Transmission Lines	Sour Gas Pipeline	Sales Gas & CO_2 Pipeline
North Piney Creek[1]				
Middle Piney Creek[1]				
South Piney Creek(1)				
Dry Piney Creek[2]	X		X	
Upper Green River[1]				
LaBarge Creek(1)	X	X	X	
Muddy Creek(3)	X			
Fontenelle Creek(1)	X	X	X	
Slate Creek(3)	X	X	X	
Green River (Seedskadee)[1]				X
Hams Fork (Opal)[3]		X		
Willow Creek[1]		X		
Alkali Creek[4]		X		
Big Sandy River[1]				X
Jensen Wash(3)				X
Bitter Creek[4]				X
Blacks Fork[1]				X

[1] These streams are Class II cold water game fish streams that generally contain rainbow, brown, brook and cutthroat trout. Parentheses () indicate stream is not officially classified but supports a fishery similar to that indicated by the footnote number.

[2] Dry Piney near crossing supports a marginal trout population.

[3] These streams are Class III that support primarily nongame fish (suckers and minnows) population.

[4] These streams support marginal non-game fisheries or are Class IV streams (incapable of supporting fish).

TABLE 4-78
ANNUAL RISK TO POPULATED AREAS FROM SHUTE CREEK ALTERNATIVE

Populated Area	Individual Annual Risk of Lethal Exposure[1]	Individual Annual Risk of Significant Impact[2]	Approximate Number of People (in 1990)[3]
LaBarge	0.000068	0.00033	864
Big Piney	negligible[4]	0.00040	861
Marbleton	negligible[4]	negligible[4]	845
Calpet	0.00048	0.00093	40
Fontenelle Recreation Area	negligible	0.00043	1,210

[1] Risk values shown in this table, such as 0.00033, mean 33 chances per 100,000.

[2] Significant exposures are those that would cause eye irritation, coughing, loss of smell, or other discomfort.

[3] Includes people in incorporated and unincorporated areas.

[4] Negligible means that the modeling analysis indicates **no** risk.

TABLE 4-79
SUMMARY OF TOTAL MAXIMUM CONCENTRATIONS[1] FROM CONSTRUCTION AND OPERATING ACTIVITIES SHUTE CREEK ALTERNATIVE

Pollutant	Averaging Time	Type of Significance Criterion	Significance Criterion	Shute Creek	
				Max Conc	Percent Criterion
NO_2[2]	Annual	NAAQS/WAAQS	100	66	66
NO_2[3]	Annual	NAAQS/WAAQS	100	11	11
TSP[2]	Annual	NAAQS/WAAQS	60	48	80
TSP[4]	Annual	NAAQS/WAAQS	60	47	78
H_2S[3]	Half-hour	WAAQS	40	65	163
H_2S	Instantaneous	Odor	6.5	3.7 mi.[5]	N/A
COS[3]	Annual	MEG	800	10	1
COS[3]	8-Hour	Toxicological	60,000	91	<1
CO_2[3]	Annual	TLV	$11 g/m^3$	0.2	2
CO[3]	1-Hour	NAAQS/WAAQS	40,000	3,906	10
CO[3]	8-Hour	NAAQS/WAAQS	10,000	1,805	18
He	Instantaneous	Asphyxiant	30,000 ppm	<30,000 ppm	N/A

[1] All concentrations are based on modeling with actual offsite meteorological data. All numbers shown are micrograms/cubic meter unless otherwise noted. Values underscored are above applicable significance criteria.

[2] From well drilling operations.

[3] From operation of the gas treatment plants.

[4] From construction activities.

[5] The odor significance criterion is exceeded out to about 3.7 mi. from the Buckhorn facility.

TABLE 4-80
SUMMARY OF TOTAL MAXIMUM SO_2 CONCENTRATIONS[1] FROM CONSTRUCTION AND OPERATING ACTIVITIES SHUTE CREEK ALTERNATIVE

Type of Criterion	Averaging Time	Criterion	Shute Creek	
			Max Conc	Percent Criterion
NAAQS/WAAQS[2]	Annual	80	21	26
NAAQS/WAAQS[3]	Annual	80	12	15
	24-Hour	365	67	18
	3-Hour	1,300	277	21
PSD Class II[3]	Annual	20	9	45
	24-Hour	91	52	57
	3-Hour	512	207	40
PSD Class I[3]	Annual	2	0.4	40
	24-Hour	5	5.3[4]	106
	3-Hour	25	20.4	82

[1] All concentrations are based on modeling with actual off-site meteorological data. All numbers shown are micrograms/cubic meter. Concentrations underscored are above applicable significance criteria.

[2] From well drilling operations.

[3] From operation of the gas treatment plants.

[4] This concentration would result from combined plant SO_2 emissions. Even though the maximum concentration exceeds the significance criterion, the highest second-highest concentration does not, therefore SO_2 impacts are not considered significant. The highest second-highest value is 4.3 micrograms per cubic meter.

levels. Readers interested in details for pollutants for which no significant impacts are noted should consult the Air Resources Technical Report.

Sulfur Dioxide

Predicted SO_2 impacts in Class II areas from individual plant operations and the applicable PSD increments are displayed in Table 4-81 for the Shute Creek Alternative. Results show that all impacts are below the significance levels. For the 3- and 24-hour impacts, maximum combined concentrations do not exceed the individual impacts displayed. For Exxon's facility at Shute Creek, the maximum predicted 3-hour and 24-hour SO_2 concentrations occurred a little more than 4 kilometers (2.4 miles) to the south of the Shute Creek plant site. Quasar's 3-hour and 24-hour impacts from the Buckhorn facility occur at the same locations as described in the Buckhorn Alternative. Northwest's 3-hour and 24-hour SO_2 impacts from the Craven Creek plant occur at the same locations as described in the Proposed Action.

For annual averages, multiple plume interaction can occur producing higher combined impacts. For the Shute Creek Alternative, the combined annual average SO_2 impact is predicted to be 9 micrograms/cubic meter, below the Class II PSD increment of 20 micrograms/cubic meter at a distance of a little more than 5 kilometers (3 miles) to the east-northeast of the Shute Creek plant site.

Table 4-82 shows the combined SO_2 impacts at proposed and existing Class I areas. Insignificant impacts are predicted for all existing Class I areas; but SO_2 impacts at Scab Creek and Fossil Butte National

TABLE 4-81
INDIVIDUAL GAS TREATMENT PLANT SO_2 IMPACTS IN CLASS II AREAS
SHUTE CREEK ALTERNATIVE

			Maximum SO_2 Concentrations/SO_2 Increments (micrograms/cubic meter)					
			3-Hour		24-Hour		Annual	
Company	Plant Site	Capacity (Million CFD)	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment
Exxon	Shute Creek	1,200	207	512	39	91	7	20
Quasar	Buckhorn	1,200	37	512	14	91	7	20
Northwest	Craven Creek	400	159	512	50	91	4	20

[1] Increments can be exceeded once per year.

TABLE 4-82
COMBINED SO_2 IMPACTS IN EXISTING AND PROPOSED PSD CLASS I AREAS
SHUTE CREEK ALTERNATIVE
(MICROGRAMS/CUBIC METER)

	Maximum SO_2 Concentrations/SO_2 Increments					
	3-Hour		24-Hour		Annual	
Area	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment
Bridger Wilderness (existing Class I area)	17.9	25	3.7	5	0.3	2
Teton Wilderness (existing Class I area)	5.4	25	0.8	5	0.1	2
Teton National Park (existing Class I area)	4.0	25	0.9	5	0.04	2
Scab Creek Primitive Area (proposed Class I area)	20.4	25	5.1[2]	5	0.4	2
Fossil Butte National Monument (proposed Class I area)	18.5	25	5.3[2]	5	0.3	2

[1] Increments can be exceeded once per year.

[2] The listed values represent the maximum predicted concentrations. The highest second-highest values (used to determine compliance with PSD increments) is 4.3 micrograms per cubic meter at Scab Creek and 3.9 micrograms per cubic meter at Fossil Butte.

Monument (proposed Class I areas) are predicted to exceed to Class I PSD increment for a 24-hour average. However, the highest second-highest 24-hour value at Scab Creek, is 4.3 micrograms/cubic meter and 3.9 micrograms/cubic meter at Fossil Butte. Since these values are used to determine compliance with the PSD increment and are below the increment, no significant SO_2 impacts in Class I areas are expected.

For the Shute Creek Alternative, the locations of the maximum 3-hour, 24-hour, and annual SO_2 impacts in all proposed and existing Class I areas are the same as those described in the Proposed Action with the exception of the Bridger Wilderness. The maximum predicted impacts for all time averages occur at a distance of about 116 kilometers (69.6 miles) to the north-northeast of the Shute Creek plant site.

The locations of the predicted maximum 24-hour SO_2 impacts in Class II areas, and in the proposed and existing Class I areas, are presented in Map 4-7. Since 24-hour average impacts are ususally more limiting than 3-hour and annual impacts, the locations of the maximum 24-hour impacts are helpful in illustrating the extent of the SO_2 impacts.

Hydrogen Sulfide

Air quality impacts from H_2S emissions for all facilities are summarized in Table 4-83. Concentrations above the WAAQS significant impact levels are predicted for the Quasar facility at Buckhorn but not for the Exxon or Northwest plants. This can be attributed to the lower buoyancy of the Quasar plumes as compared to the Exxon and Northwest plumes and because Quasar emits more H_2S.

H_2S impacts are not deemed significant unless the WAAQS are exceeded more frequently than allowed. The predicted H_2S impacts from the Quasar plant exceed the 40 micrograms/cubic meter WAAQS more than twice in five days. The 70 micrograms/cubic meter WAAQS was not predicted to be exceeded. Therefore, H_2S impacts are expected to be significant at Buckhorn, but not at other sites.

H_2S emissions also are predicted to exceed the 6.5 micrograms/cubic meter odor threshold in a 6-kilometer (3.6-mile) area surrounding Buckhorn. For Shute Creek and Craven Creek, this odor threshold would not be exceeded. Therefore, significant odor impacts are expected for the Buckhorn plant. H_2S impacts are predicted to be below the odor threshold at the Towns of Big Piney, Marbleton, LaBarge, Calpet, Opal, and Kemmerer.

Carbon Dioxide

Emissions of CO_2 are not expected to cause a general climatic warming, although considerable uncertainty exists regarding the potential for the "greenhouse effect".

Acid Deposition in Class I Areas

Table 4-84 presents the potential changes to lake water chemistry at sensitive lakes in the Bridger Wilderness. A range of pH values for each lake is presented, based on an assumed range of 50 to 100 percent of possible acid input from the melting snowpack. Impacts are predicted to be greatest at Clear Lake (south), with pH decreases ranging from 0.07 to 0.13. The minimum expected pH is 6.32, well above the level of significant impact, i.e., a pH of 6.0. Therefore, insignificant impact is expected to sensitive fish in sensitive high altitude lakes in all Class I areas from acid deposition.

Visibility Impairment in Class I Areas

Calculation of contrast parameters at all Class I areas indicate the significance criteria of 0.1 would not be exceeded. Therefore, no significant visibility impacts are expected from this alternative.

Vegetation Impacts in PSD Class I Areas

Impacts in Class I areas to sensitive vegetation, i.e., lichens, from SO_2 and particulate would be insignificant and the same as described in the Proposed Action.

TABLE 4-83
MAXIMUM MODELED H_2S POLLUTANT IMPACTS
SHUTE CREEK ALTERNATIVE

Pollutant	Averaging Time	Plant Site	Maximum Concentration ($\mu g/m^3$)[1]	WAAQS Significance Level ($\mu g/m^3$)	Odor Significance Level ($\mu g/m^3$)
Hydrogen Sulfide	0.5 Hour	Shute Creek	4	40[2] 70[3]	6.5
		Buckhorn	65	40[2] 70[3]	6.5
		Craven Creek	3	40[2] 70[3]	6.5

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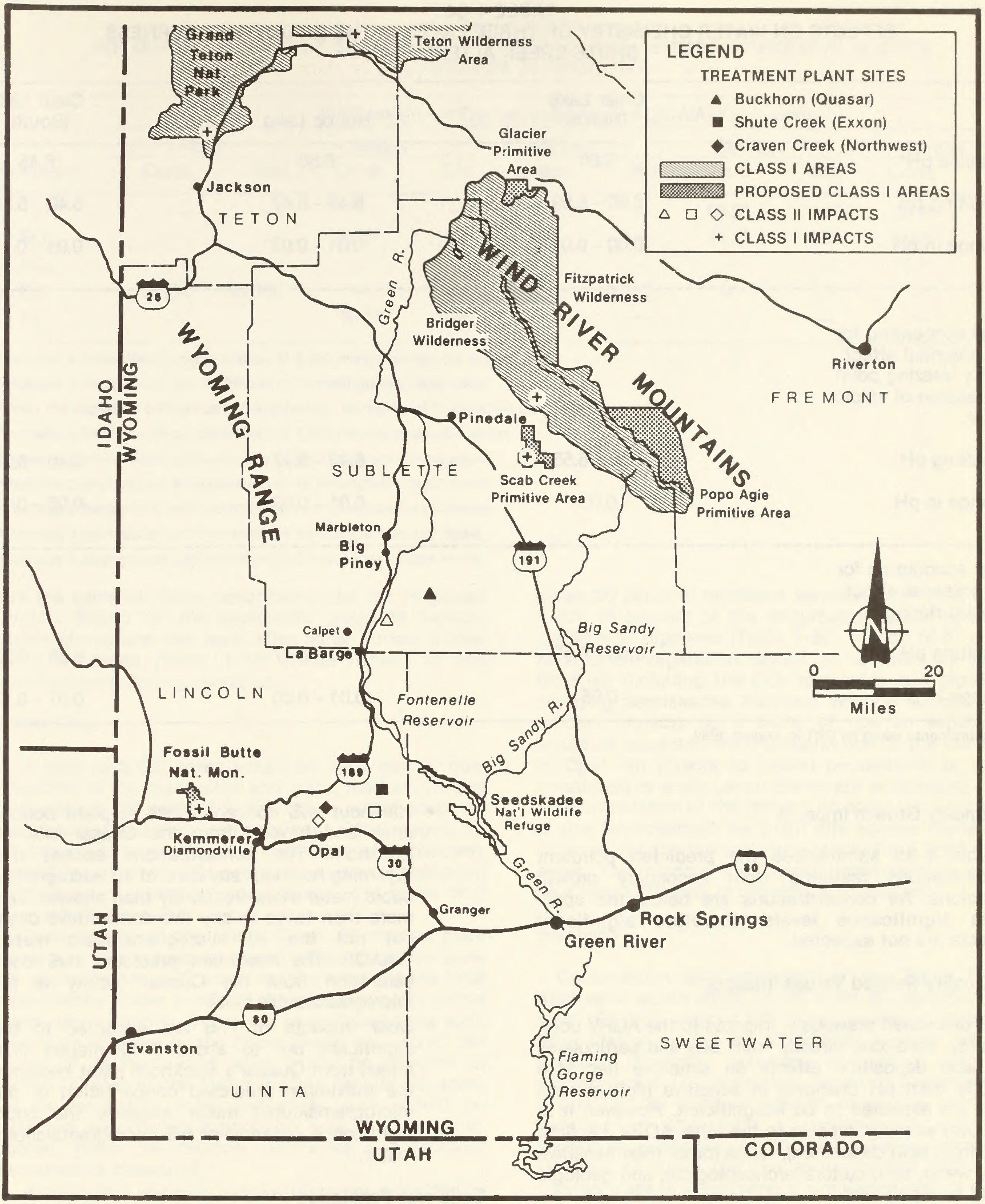
[1] Impacts predicted using actual off-site meteorology. Underscore represents exceedance of WAAQS.

[2] WAAQS. Two exceedances allowed every five days.

[3] WAAQS. Two exceedances allowed per year.



MAP 4-7 LOCATIONS OF MAXIMUM 24-HOUR AVERAGE SO_2 CONCENTRATIONS IN PSD CLASS I AND CLASS II AREAS FOR THE SHUTE CREEK ALTERNATIVE

TABLE 4-84
EFFECTS ON WATER CHEMISTRY OF THREE LAKES IN THE BRIDGER WILDERNESS
SHUTE CREEK ALTERNATIVE

	Clear Lake (North)	Hobbs Lake	Clear Lake (South)
Baseline pH[1]	6.60	6.50	6.45
Resulting pH	6.60 - 6.59	6.49 - 6.47	6.40 - 6.34
Change in pH	0.00 - 0.01	0.01 - 0.03	0.05 - 0.11
After accounting for the potential effect of the freezing point depression of acidic snow:			
Resulting pH	6.55 - 6.55	6.49 - 6.47	6.40 - 6.34
Change in pH	0.05	0.01 - 0.03	0.05 - 0.11
After accounting for the potential effect of plant flaring:			
Resulting pH	6.55 - 6.55	6.49 - 6.47	6.38 - 6.32
Change in pH	0.05	0.01 - 0.03	0.07 - 0.13

[1] Measurements taken by ERT in August 1982.

Secondary Growth Impacts

Table 4-85 summarizes the predicted pollutant concentrations resulting from secondary growth emissions. All concentrations are below the applicable significance levels; therefore significant impacts are not expected.

Air Quality Related Values Impacts

As discussed previously, impacts to the AQRV odor, visibility, flora (due directly from SO_2 and particulate), and acid deposition effects on sensitive fish (due directly from pH changes) in sensitive high altitude lakes are expected to be insignificant. However, it is unknown whether impacts to the other AQRV, i.e, flora (e.g., from acid deposition), fauna (other than sensitive fish), water, soil, cultural/archoeological, and geologic would be significant.

Summary

In summary, operation of the Shute Creek Alternative is expected to result in insignificant air quality impacts except for the following:

- Half-hour H_2S concentrations at plant boundaries and beyond from the Quasar site at Buckhorn. The concentrations exceed the Wyoming half-hour standard of 40 micrograms/cubic meter more frequently than allowed, i.e., more than twice in any five consecutive days but not the 70 micrograms/cubic meter WAAQS. The maximum predicted H_2S concentration from the Quasar facility is 65 micrograms/cubic meter.
- Odor impacts of H_2S are expected to be significant out to about 6 kilometers (3.6 miles) from Quasar's Buckhorn plant because the maximum predicted concentation of 65 micrograms/cubic meter exceeds the odor signficance criterion of 6.5 micrograms/cubic meter.

Soils and Vegetation

Implementation of the Shute Creek Alternative would result in the potential disturbance of 12,115 acres (Table 4-86). Of this disturbance, 64 percent (7,763 acres) would occur in sagebrush-dominated communities. Anticipated impacts in the well field

TABLE 4-85
AIR QUALITY IMPACT OF SECONDARY GROWTH ON THE KEMMER-DIAMONDVILLE AREA SHUTE CREEK ALTERNATIVE

	Total Maximum Concentrations/NAAQS/WAAQS ($\mu g/m^3$)									
	1-Hour		3-Hour		8-Hour		24-Hour		Annual	
Pollutant	Conc.	Std	Conc	Std	Conc	Std	Conc	Std	Conc	Std
TSP	--	--	--	--	--	--	62.9[5]	150	30.8[7]	60
SO_2	--	--	70.3[2]	1,300	--	--	15.1[6]	365	3.03[8]	80
NO_x	--	--	--	--	--	--	--	--	9.4[9]	100
CO	3,654[1]	40,000	--	--	1,614[4]	10,000	--	--	--	--
HC	--	--	10.3[3]	160	--	--	--	--	--	--

[1] Includes a background concentration of 3,500 micrograms/cubic meter.

[2] Includes a background concentration of 70 micrograms/cubic meter.

[3] Does not include a background concentration. Background is unknown but probably very low.

[4] Includes a background concentration of 1,500 micrograms/cubic meter.

[5] Includes a background concentration of 60 micrograms/cubic meter.

[6] Includes a background concentration of 15 micrograms/cubic meter.

[7] Includes a background concentration of 30 micrograms/cubic meter.

[8] Includes a background concentration of 3 micrograms/cubic meter.

[9] Includes a background concentration of 9 micrograms/cubic meter.

are the same as those described under the Proposed Action. Based on the applicants' plans to reclaim rights-of-way and well pads after construction, a total of 3,620 acres (Table 1-15) would remain in use (unreclaimed) during operation.

Plant Sites

A total of 2,160 acres would be disturbed by construction of the plant sites and sulfur loadout. Of this disturbance, 52 percent (1,158 acres) would occur on sagebrush-dominated communities. Other types affected would be bunchgrass (463 acres or 21 percent), mixed desert shrub (321 acres or 14 percent), saltbush (125 acres or 6 percent), and riparian (34 acres or 2 percent) (Table 4-86).

Construction of the Shute Creek Alternative plant sites and sulfur loadout would affect sensitive soils on approximately 849 acres or 39 percent of the total disturbance (Table 4-87). Of the sensitive units within plant site locations, 640 acres of saline-alkaline soils would be affected by the Shute Creek site. About 144 acres of saline-alkaline soils would be affected at Craven Creek. At the sulfur loadout facility, 65 acres of saline-alkaline soils and shaly soils would be affected. Significant impacts to soils are not anticipated, given the regional resources and required reclamation measures.

Air pollution impacts to vegetation are projected to be insignificant. See discussion under the Proposed Action.

Linear Facilities

A total of 5,987 acres would be potentially disturbed by corridor construction (Table 4-86) of which 1,800 acres (30 percent) represent sensitive soils (see Table 4-87); 76 percent of the disturbance would be associated with pipelines (Table 4-86). A total of 67 acres of riparian vegetation would be affected by linear facilities including the CO_2 and sales gas pipelines crossing Seedskadee National Wildlife Refuge. Significant impacts on 2 acres of riparian vegetation would be expected from construction of the rail spur to Opal. No effects to known populations of listed threatened or endangered plants are anticipated.

At completion of the project, 85 acres would remain in use (unreclaimed) for plant site access roads and 13 acres for the railroad right-of-way for a total of 98 acres. The impacts from unreclaimed acreage would be a long-term loss in vegetative productivity.

Summary

Construction and operation of the Shute Creek Alternative would affect 12,115 acres of vegetation and soils. Of this area, 4,130 acres represent sensitive rehabilitation units. No significant impacts are anticipated for soils, assuming compliance with the recommended soil protection measures (Appendix B). A total of 236 acres of riparian vegetation would be removed, of this total a reduction in long-term vegetative productivity on 65 acres resulting from construction of roads and the sulfur loadout facility on riparian areas is anticipated, a significant impact. In addition, 606 acres of well field access roads would remain in use, and 13 acres of the railroad route and 85 acres of plant site roads would be abandoned and unreclaimed (Table 1-15). Of the 12,115 acres disturbed, a total of 704 acres would remain unreclaimed after abandonment. These land use conversions constitute a reduction in the rangeland or forest land resource,

TABLE 4-86
POTENTIAL CONSTRUCTION DISTURBANCE BY VEGETATION TYPE SHUTE CREEK ALTERNATIVE (ACRES)

	Vegetation Types[1]														
	BS	SC	MS	MDS	Sa	G	MP	SF	D	A	C	R	P/H	Gr	Di	Total
Well Field																
Roads	208	196	4	0	0	70	124	29	18	34	9	29	36	0	0	757
Wells	294	284	7	0	0	90	245	48	18	49	18	0	49	0	0	1,102
Gathering System	549	403	10	0	0	207	452	106	32	107	38	106	89	10	0	2,109
Total	1,051	883	21	0	0	367	821	183	68	190	65	135	174	10	0	3,968
Linear Facilities																
Railroads	22	0	0	31	18	0	0	0	0	0	0	2	0	8	4	85
Transmission Lines	926	0	0	69	136	50	0	0	0	0	0	14	41	25	0	1,261
Pipelines	3,069	164	0	114	317	55	0	0	0	0	0	45	36	75	0	3,875
Sulfur Pipeline	422	0	0	43	119	16	0	0	0	0	0	6	41	13	0	660
Access Roads	68	0	0	5	24	5	0	0	0	0	0	0	0	4	0	106
Total	4,507	164	0	262	614	126	0	0	0	0	0	67	118	125	4	5,987
Plant Sites																
Buckhorn	640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	640
Shute Creek	0	0	0	177	0	463	0	0	0	0	0	0	0	0	0	640
Craven Creek	496	0	0	144	0	0	0	0	0	0	0	0	0	0	0	640
Sulfur Loadout	22	0	0	0	125	0	0	0	0	0	0	34	0	0	59	240
Total	1,158	0	0	321	125	463	0	0	0	0	0	34	0	0	59	2,160
Grand Total	6,716	1,047	21	583	739	956	821	183	68	190	65	236	292	135	63	12,115

[1]BS = Big Sagebrush
SC = Sagebrush Complex
MS = Mountain Shrub
MDS = Mixed Desert Shrub
Sa = Saltbush
G = Grassland
MP = Mixed Pine
SF = Spruce Fir
D = Douglas-fir
A = Aspen
C = Clearcut
R = Riparian
P/H = Pasture/Hayfield
Gr = Greasewood
Di = Disturbed

and represent an insignificant (less than 1 percent) reduction in the total regional resource. No known populations of threatened or endangered species would be affected.

Visual Resources

Plant Sites

As indicated previously, the Craven Creek plant site would cause significant adverse impact (see Table 4-68), while the Buckhorn plant would cause insignificant impact. The Shute Creek plant would be seen in the far distance (9 to 11 miles) from Highway 189 and the Opal Cutoff. For this reason, impacts of the plant in this location would remain significant based upon plume visibility as judged from existing similar plants.

The plant sites in this alternative would result in only two significant impacts: the Craven Creek and Shute Creek site, with no highly significant impacts. Facility impacts are summarized in Table 4-68.

Linear Facilities

Buried pipelines would result in 7.5 miles of significant impact. The sulfur pipeline would create 34.75 miles of significant impact and 9.75 miles of highly significant impact, while the transmission line in this alternative would result in 10.5 miles of highly significant impact. Locations of these impacts are shown on Map 4-3 and summarized in Table 4-68. Corridor impacts would not affect any areas not already identified for either the Proposed Action or Buckhorn Alternative.

Combined visual impacts under this alternative would be the same as identified for the Proposed Action with the following exceptions: the Calpet Road north of Fogarty Creek would not have a significant adverse combined visual impact as there would be no plant sites in that area. Also, three residences in the Green River Valley near Reardon Draw would experience a highly significant change due to facilities crossing the Green River. Impacts are shown on Map 4-3 and summarized in Table 4-69.

TABLE 4-87
AREAS (ACRES) OF POTENTIAL CONSTRUCTION DISTURBANCE ON SENSITIVE REHABILITATION UNITS[1]
SHUTE CREEK ALTERNATIVE

	A2	A4	B3	C2	C4	D4	D5	Total
Well Field (Overall Potential Disturbance: 3,968 acres)								
Roads	0	0	113	50	66	32	125	386
Wells	0	0	84	64	63	38	145	394
Gathering System	10	0	155	55	93	73	301	687
Subtotal	10	0	352	169	222	143	571	1,467
Plant Sites (Overall Potential Disturbance: 2,160 acres)								
Buckhorn (Quasar)	0	0	0	0	0	0	0	0
Shute Creek (Exxon)	640	0	0	0	0	0	0	640
Craven Creek (Northwest)	144	0	0	0	0	0	0	144
Sulfur Loadout (Exxon)	40	25	0	0	0	0	0	65
Subtotal	824	25	0	0	0	0	0	849
Linear Facilities (Overall Potential Disturbance: 5,987 acres)								
Railroads	58	0	0	0	0	0	0	58
Transmission Line	170	132	113	0	0	0	0	415
Pipeline	663	348	0	0	0	0	0	1,011
Sulfur Pipeline	218	47	0	0	0	0	0	265
Access Roads	61	4	0	0	0	0	0	65
Subtotal	1,170	531	113	0	0	0	0	1,814
Total	2,004	556	465	169	222	143	571	4,130

[1] Sensitive Rehabilitation Units are identified in Appendix C (Table C.3).

Cultural Resources

Proposed plant sites under the Shute Creek Alternative are unevaluated for cultural resources. The limited surveys conducted within the facility corridors have identified 168 (potentially NRHP eligible) archeological sites, 27 of which would be directly impacted, and 106 of which would be indirectly impacted. The potential impact of the remaining 35 sites has not been determined. The sulfur pipeline would impact identified sites and the Applicants' transmission line would impact 26 previously identified sites. Most of the right-of-way is unsurveyed for cultural resources. Eleven historic trails including the Sublette Cutoff of the Oregon Trail and the Opal Stage Road would be impacted by the Shute Creek Alternative's rights-of-way.

Agriculture/Grazing

During construction, the Shute Creek Alternative would disturb 7,193 acres of federal grazing land. There would be a loss of 634 AUMs (Table 4-70) and significant impacts to the same allotments and of the same magnitude as for the Proposed Action. The Shute Creek Sheep Trail would be crossed by Northwest's proposed sour gas trunk line and water pipeline; Exxon's sour gas trunk line, plant access road, and sulfur pipeline; and the American Quasar transmission line. The Piney Unit Fenced, Beaver Meadows, and LaBarge Ind. allotments would continue to experience significant impacts during project operation, though impacts to agriculture in total would be insignificant. Project operations would result in the loss of 175 AUMs, less than 1 percent of the AUMs in the project area. Exxon's access road and sulfur pipeline would cross the Slate Creek Sheep Trail during project operation and could conflict with use of the trail.

Transportation

Construction

The geographic location of the Exxon plant site in this alternative would cause greatest impact during the 1986 analysis year due to the changes in construction worker travel patterns. Table 4-88 summarizes the peak hour demand volumes that could result from the Shute Creek Alternative. Those roadway segments that would experience significant impacts because of traffic volumes in excess of Level of Service C are underlined. The most significant impacts would occur on U.S. 30 between Kemmerer and Opal. During the construction worker commuter peak hour, the Craven Creek and Shute Creek plant development would generate approximately 1,375 vehicle trips on

TABLE 4-88
PROJECTED 1986 HIGHWAY PEAK-HOUR TRAFFIC DEMAND SHUTE CREEK ALTERNATIVE

Highway Location	Projected 1986 Baseline Hourly Demand Estimates[1]	Riley Ridge Development Generated Auto and Truck Traffic	Total Peak Hour Demand	Percentage Projected Project Projected Baseline	Level of Service B Volumes[2]	Level of of Service C Volumes[3]
U.S. 189 between Kemmerer and State Route 240	205	95	300	61	465	725
U.S. 189 between State Route 240 and LaBarge	290	275	565	95	465	725
U.S. 189 between LaBarge and County Road 23-134	290	390	680	134	465	725
U.S. 189 at Big Piney	290	615	905	212	465	725
U.S. 191 West of Pinedale	580	70	650	12	505	785
U.S. 30 between Kemmerer and Opal	550	1,375	1,925[4]	250	425	665
U.S. 30 East of Opal	750	490	1,240	65	425	665
State Route 240 north of Opal	50	1,485	1,535	*	590	920
I-80 East of U.S. 30	1,930	235	2,165	12	(2,000)**	(2,500)**

[1] Projected 1986 baseline hourly demand computed from 1982 traffic demands using WSHD growth factors. Hourly demands are representative of recreation season travel.

[2] Level of Service B is preferred traffic operating standard of WSHD for rural highways.

[3] Level of Service C is tolerable traffic operating standard of WSHD for high volume rural highways.

[4] Underscore Represents exceedence of level of Service C traffic volumes.

*Percentage increase not meaningful indicator due to low baseline hourly demand estimate.

**Directional capacity of limited access highway with 2 lanes per direction.

U.S 30 between the plant sites and Kemmerer. The U.S. 30 segment of the regional highway network would experience the highest peak hour demands in 1986 due to the combined baseline and project-generated traffic volumes, far in excess of the Level of Service C stable volume standard of the WSHD. Significant traffic impacts would also occur on State Route 240 due to the demand generated by the plant sites at Craven Creek and Shute Creek. Traffic volumes would result in a Level of Service F on U.S. 30 between Kemmerer and Opal and on State Route 240 north of Opal. Level of Service E would exist on U.S. 30 east of Opal. Because of the traffic volume on these two roads, the intersection of State Route 240 and U.S. 30 would experience significant traffic flow problems. Additional accidents on the regional highway network throughout project construction for the Shute Creek Alternative are projected to total 145 on an annual basis.

Operation

During project operation, peak hour traffic demand would be 945 vehicles on U.S. 30 between Kemmerer and Opal, and 1,020 vehicles on U.S. 30 east of Opal. These volumes would result in significant impacts with conditions in both cases dropping to a Level of Service E. Of the traffic between Kemmerer and Opal, approximately 23 percent (220 vehicles) would be due to the Riley Ridge Project; east of Opal, only 3 percent (35 vehicles) of the peak traffic volume would be project related. Annual traffic accidents during project operations would be 48 above baseline conditions.

Land Use Plans, Controls, and Constraints

Under the Shute Creek Alternative only one combined plant-construction camp site would require rezoning from a Resource Conservation (RC) district to a Heavy Industry (I-H) district. Plants and construction camps are permitted uses in Lincoln County's Development District VII where both Shute Creek Alternative plant sites and a separate construction camp are located.

The Shute Creek Alternative has a relatively simple corridor pattern in the northern part of the project area and thus few conflicts with the BLM Pinedale Resource Area Management Framework Plan corridor guidelines. There are substantial conflicts with the guidelines of the Kemmerer Resource Area Management Framework Plan because of the number of corridors and the redundancy of some of those corridors in the Craven Creek-Shute Creek area.

The Exxon CO_2 and sales gas pipelines from the Shute Creek plant site conflict with USFWS plans for the Seedskadee Wildlife Refuge because they cross the Green River in an area planned for wetlands reconstruction. This conflict would result from the proposed 2 miles of construction and, once installed, would not preclude development of wetland habitat on the surface. The conflict of the sales and CO_2 gas pipeline corridor with Rock Springs planned growth area would be the same as described under the Proposed Action. For the 125 miles of the transmission system, 104 are outside of existing corridors.

NORTHERN ALTERNATIVE

For the following environmental disciplines, implementation of the Northern Alternative would result in impacts the same as those described for the Proposed Action.

- Timber
- Noise

The following discussions focus on those disciplines which would be affected differently from the Proposed Action by implementing the Northern Alternative.

Socioeconomics

Table 4-89 presents projected increases in mean annual labor force, employment, and unemployment rates for Lincoln, Sublette, and Sweetwater Counties under the Northern Alternative. The labor force in Lincoln County would be expected to increase by approximately 13.5 percent between 1982 and 1990, compared to an estimated 2.4 percent increase under the baseline. The rate of unemployment would decrease to about 4.8 percent during the development period (1984 to 1986), compared to an estimated 6.5 percent unemployment rate under the baseline.

The total labor force in Sublette County is projected to increase significantly (by nearly 51 percent) between 1982 and 1990 under this alternative.

There is a slight increase in the growth in labor force and employment in Sweetwater County under the Northern Alternative compared to the baseline. The total labor force is projected to increase by 11.5 percent from 1982 to 1990, compared to a 10.7 percent increase under the baseline. The primary difference between the baseline and the Northern Alternative is a very slight increase in unemployment in the late 1980s as construction activiites on the Riley Ridge Project are completed.

Table 4-90 presents the net employment effects associated with project development for the three counties under the Northern Alternative. Under this alternative most of the expected regional impacts from the Riley Ridge development after 1985 are located in Sublette County. Prior to 1985 most of the regional impacts are located in Lincoln County. During the peak year (1986) employment opportunities in Sublette County from the Northern Alternative result in an additional 2,115 jobs, 84 percent more than expected under the baseline. In 1990 the total employment opportunities are increased by over 47 percent compared to the baseline for Sublette County.

TABLE 4-89
PROJECTED INCREASE IN ANNUAL AVERAGE LABOR FORCE, EMPLOYMENT, AND CHANGE IN UNEMPLOYMENT RATES NORTHERN ALTERNATIVE

County/Community	1985	1986	1990	2000
Lincoln County				
Labor Force	1,602	1,644	669	482
Number Employed	1,627	1,584	627	451
Unemployment Rate	-1.7	-0.6	0.0	0.0
Sublette County				
Labor Force	1,884	2,035	1,180	905
Number Employed	1,843	2,015	1,132	876
Unemployment Rate	0.0	-0.0	0.4	0.0
Sweetwater County				
Labor Force	536	482	189	48
Number Employed	521	465	112	46
Unemployment Rate	0.0	0.0	0.3	0.0

Source: Western Research Corporation 1982

The Northern Alternative has its peak net employment opportunity change in Lincoln County in 1985 (2,139 jobs). These jobs represent a 31 percent increase over the employment opportunity in the baseline.

Population

Table 4-91 presents the net annual population effects for Lincoln, Sublette, and Sweetwater Counties under the Northern Alternative. Under this alternative, the total Lincoln County population is projected to increase by approximately 19 percent from 1982 to 1990, versus the 7.5 percent growth expected under the baseline. The major changes in the population distributions within Lincoln County from those observed under the baseline occur in the Town of LaBarge. Under the baseline, LaBarge accounts for approximately 2.5 percent of the projected county population, compared to an 11 percent share in 1986 under this alternative. This is an increase of approximately 472 percent in the projected population (2,024) for the Town of LaBarge over the projected population (354) under the baseline in that year. The total population increase for this town from 1982 to 1990 is estimated at approximately 251 percent.

TABLE 4-90
PROJECT-RELATED ANNUAL EMPLOYMENT OPPORTUNITIES NORTHERN ALTERNATIVE

Category	1985	1986	1990	2000
LINCOLN COUNTY				
Direct Employment				
Mining	134	143	98	93
Construction	929	815	146	0
Manufacturing	13	62	136	168
Transportation, Communications, and Public Utilities	9	43	52	57
Total Direct Employment	1,085	1,063	432	318
Total Indirect Employment	1,054	1,014	378	259
Total Employment Opportunities	2,139	2,077	810	577
SUBLETTE COUNTY				
Direct Employment				
Mining	274	292	204	181
Construction	1,204	1,161	285	0
Manufacturing	41	189	417	516
Transportation, Communications, and Public Utilities	8	35	50	51
Total Direct Employment	1,527	1,677	956	748
Total Indirect Employment	408	438	228	166
Total Employment Opportunities	1,935	2,115	1,184	914
SWEETWATER COUNTY				
Direct Employment				
Mining	35	38	25	26
Construction	278	241	41	0
Manufacturing	0	0	0	0
Transportation, Communications, and Public Utilities	0	1	2	2
Total Direct Employment	313	280	68	28
Total Indirect Employment	266	238	57	23
Total Employment Opportunities	579	518	125	51

Source: Western Research Corporation 1982

The projected population for Sublette County exhibits an increase of nearly 53 percent from 1982 to 1990 under this alternative, compared to the almost zero rate of change expected under the baseline. The total net population increase in the peak year (1986) is estimated at 4,328 people, which is an increase of approximately 89 percent in the total county population for that same year over the estimated population under the baseline. The Towns of Big Piney and Marbleton experience the greatest degree of impact in terms of total population growth, increasing in population from 1982 to 1990 by approximately 119 percent and 108 percent, respectively. This results in a change in the relative size of these towns from about 12 percent of the total county population in each town under the baseline to about 17 percent of the total county population in each town under the Northern Alternative. Pinedale's population is projected to be 18 percent above the baseline in 1986. By 1990, Pinedale is expected to grow 8 percent above the baseline under the Northern Alternative.

Personal Earnings

The impacts on total projected personal earnings in constant 1980 dollars under the Northern Alternative are presented in Table 4-92 for Lincoln, Sublette, and Sweetwater Counties. The net economic impacts are the greatest in Sublette County with total constant dollar earnings increasing by 124 percent from 1982 to 1990 compared to a slight decline under the baseline. Total personal earnings are estimated to increase from $34.8 million in 1982 to $69.9 million in 1990, with a peak in personal earnings of approximately $104.1 million in 1986. This is nearly a 202 percent increase in projected earnings for that year over the baseline. The net impact in constant 1980 dollar earnings for 1986 is estimated at nearly $70 million.

Total personal earnings in Lincoln County are projected to increase by approximately 26 percent from 1982 to 1990 under the Northern Alternative compared to a 4 percent increase in constant dollar earnings under the baseline. Under the Northern Alternative,

TABLE 4-91
PROJECTED POPULATION INCREASE WITHIN THE RILEY RIDGE STUDY AREA NORTHERN ALTERNATIVE

County/Community[1]	1985	1986	1990	2000
Lincoln County	3,922	4,025	1,639	1,181
Afton	18	19	9	6
Thayne	7	7	4	2
Diamondville	643	600	176	134
Kemmerer	1,220	1,163	374	281
LaBarge	1,488	1,670	841	588
Cokeville	52	55	24	17
Rural	494	510	212	152
Frontier	107	110	44	32
Opal	73	75	30	22
Sublette County	4,009	4,328	2,511	1,926
Big Piney	1,053	1,138	661	507
Marbleton	970	1,048	609	467
Pinedale	195	209	120	92
Rural	1,791	1,933	1,121	860
Calpet	44	46	30	23
Daniel	27	29	17	13
Construction camp	102	165	0	0
Sweetwater County	1,072	964	378	95
Granger	73	63	22	6
Green River	416	373	145	37
Rock Springs	360	326	130	33
South Superior	28	26	11	3
Wamsutter	14	13	6	1
Rural	181	163	65	16

Source: Western Research Corporation 1982

[1] The county population is the sum of the town populations plus the rural population.

TABLE 4-92
PROJECTED INCREASE IN TOTAL ANNUAL PERSONAL EARNINGS[1] NORTHERN ALTERNATIVE

County	1985	1986	1990	2000
Lincoln County	$60,362	$58,634	$22,799	$13,856
Sublette County	64,964	69,621	36,525	25,490
Sweetwater County	17,719	17,111	4,433	1,365

Source: Western Research Corporation 1982

[1] In thousands of constant 1980 dollars.

projected personal earnings increase from approximately $107.2 million in 1982 to $134.8 million in 1990. Total constant dollar earnings peak at approximately $164.8 million in 1986, resulting in a positive net impact of almost $59 million for that year alone. This is an increase of approximately 55 percent in personal earnings for Lincoln County in 1986 over the projected level under the baseline. Net increases in constant dollar personal earnings for Lincoln County should be over $22 million by the year 1990 and about $14 million in 1995 under this alternative.

Housing

The Northern Alternative would result in a 1986 peak housing demand that is 27 percent above the baseline for Lincoln County. This is an increase of 1,298 units (Table 4-93) above the baseline.

TABLE 4-93
PROJECTED INCREASE IN HOUSING DEMAND FOR LINCOLN, COUNTY, KEMMERER, DIAMONDVILLE, AND LABARGE NORTHERN ALTERNATIVE

Location	1985	1986	1990	2000
Lincoln County				
Single Family	620	665	332	282
Mobile Home	419	410	122	58
Multi-Family	111	112	43	29
Other	115	111	31	12
TOTAL	1,265	1,298	528	381
Kemmerer				
Single Family	248	236	75	58
Mobile Home	65	62	20	15
Multi-Family	47	45	15	11
Other	33	32	10	7
TOTAL	393	375	120	91
Diamondville				
Single Family	93	86	26	19
Mobile Home	103	96	28	22
Multi-Family	10	9	3	2
Other	1	1	0	0
TOTAL	207	192	57	43
LaBarge				
Single Family	268	301	151	106
Mobile Home	179	201	102	71
Multi-Family	33	37	18	13
Other	0	0	0	0
TOTAL	480	539	271	190

Source: Western Research Corporation 1982

In Sublette County the alternative results in a peak housing demand of 2,208 units in 1986 (Table 4-94) which is 16 percent higher than the 1,907 units of demand projected without the project. Total housing demand in Big Piney and Marbleton is expected to increase 89 percent above the baseline projections in 1986. The 1990 housing demand is projected to be over 70 percent above the baseline for both towns. Pinedale is projected to need 18 percent more housing units in 1986 under this alternative than in the baseline; by 2000, Pinedale's housing demand is expected to be 8 percent above the baseline.

These increased demands would aggravate the impacts to public services and facilities discussed under the Proposed Action. Because the county has not approved the optional 1 percent sales tax, it would not be eligible for state aid to assist in meeting short-term service deficiencies.

The peak housing demand associated with the Northern Alternative in Granger is 28 units in the peak year, 1985. This alternative also represents a 37 percent increase in housing demand above the baseline. By 1990, the net increase of 9 units is 11 percent of the housing demand without the project.

TABLE 4-94
PROJECTED INCREASE IN HOUSING DEMAND FOR SUBLETTE, COUNTY, BIG PINEY, MARBLETON, PINEDALE AND GRANGER NORTHERN ALTERNATIVE

Location	1985	1986	1990	2000
Sublette County				
Single Family	469	517	518	490
Mobile Home	597	560	289	149
Multi-Family	157	162	129	108
Other	670	969	56	14
TOTAL	1,893	2,208	992	761
Big Piney				
Single Family	265	286	166	127
Mobile Home	108	117	68	52
Multi-Family	41	44	26	20
Other	2	2	1	1
TOTAL	416	449	261	200
Marbleton				
Single Family	186	199	117	90
Mobile Home	177	192	112	86
Multi-Family	20	22	12	9
Other	0	0	0	0
TOTAL	383	413	241	185
Pinedale				
Single Family	23	25	25	23
Mobile Home	29	27	14	7
Multi-Family	8	8	6	5
Other	15	22	5	2
TOTAL	75	82	50	37
Sweetwater County				
Granger				
Single Family	16	14	5	1
Mobile Home	11	9	3	1
Multi-Family	1	1	1	0
Other	0	0	0	0
TOTAL	28	24	9	2

Source: Western Research Corporation 1982

Wildlife and Fisheries

Well Field

The wildlife and fisheries impacts of well field construction, operation, and abandonment would be the same as the Proposed Action for all alternatives.

Plant Sites

The Northern Alternative would concentrate all four treatment plants on plant sites in the northern portion of the project area. These sites are West Dry Basin, East Dry Basin, Big Mesa, and Buckhorn, all of which were part of the Proposed Action or other alternatives. As the Northern Alternative, construction at these sites and the sulfur loadout facility would remove 2,800 acres of wildlife habitat from production (see Environmental Consequences-Vegetation Section). Critical ranges within these sites would be affected with the long-term disturbance of 1,060 acres of mule deer critical winter range (640 acres at East Dry Basin and 420 acres at Big Mesa), 640 acres of pronghorn critical winter range (East Dry Basin), and 200 acres of pronghorn critical summer range (sulfur loadout). (Table 4-58, Maps 3-2 and 3-3, see Map Pocket).

These critical range disturbances would result in a population reduction of 145 mule deer during plant site construction and operation. This reduction would cause a productivity loss of 1,523 deer for the 35-year plant life. After abandonment, the deer population reduction would drop to 76 with an additional productivity loss of 326. In a similar manner, pronghorn critical winter range disturbances would reduce the pronghorn population by 28 during construction and operation and 14 during abandonment, and cause productivity losses of 482 pronghorn during construction and operation and 103 during abandonment. The loss of pronghorn critical summer range cannot be reliably correlated to population reductions or productivity losses. Plant site construciton would remove 123 acres of prairie dog towns (Table 4-58), resulting in impacts similar to those described for the Proposed Action.

The magnitude of human population increases and increases in human disturbance to wildlife would be similar to the Proposed Action; however, human population distribution would be concentrated in the north (Sublette County) so that there would be an 89 percent (4,328/4,844) growth in Sublette County, 28 percent (4,025/14,333) in Lincoln County, and 2 percent (1,072/44,583) in Sweetwater County during peak construction (see Environmental Consequences-Socioeconomics Section). Increases in human disturbance to wildlife as poaching, wanton killing, and harassment would also be expected to increase in those proportions. Therefore, significant human disturbance impacts on wildlife would occur in Sublette and Lincoln Counties (see Significance Criteria).

Impacts of poaching, vehicle-wildlife collisions, and other human disturbance causes would continue through operation but gradually decrease as temporary construction workers are replaced with long-term oil company and contractor employees. By 2000, projected-related population would decrease to 39 (1,926/4,876), 7 (1,181/16,784), and less than 1 percent (95/60,896) over baseline in Sublette, Lincoln, and Sweetwater Counties, respectively (see Socioeconomics Section). Human disturbance impacts would decrease accordingly.

Vehicle-wildlife collision impacts from project-related traffic of the Northern Alternative on Highway 189 between Big Piney and Fontenelle Reservoir would be 216 mule deer and 31 pronghorn per year during peak construction, a 173 percent increase over baseline. During operation, highway traffic and big game mortality would decrease to 41 mule deer and 6 pronghorn per year over baseline on this segment. Road kill data are unavailable for other highway segments within the project area but this segment represents a high impact potential based on its relation to big game winter range.

As in the Proposed Action, with increased traffic there is a proportionately increased chance of a vehicle striking a black-footed ferret should they inhabit the project area. Increased traffic and resulting road kills would also increase the chance of vehicles striking and killing wintering bald eagles and other raptors feeding on roadside carrion.

Access roads and worker traffic to and from the plant sites would pass through many categories of important wildlife areas (Maps 3-2 and 3-3, see Map Pocket) resulting in many road kills annually. Plant site access through critical ranges would also increase the opportunity of human disturbance impacts of poaching, wanton killing, and harassment. In this alternative, Northwest's plant at East Dry Basin would contain a toxic wastewater evaporation pond with potential impacts as discussed under the Proposed Action.

The Northern Alternative plant sites would not impact perennial streams or aquatic resources during construction, operation, or abandonment. Impacts associated with construction of the plant sites would be similar to those described for the Proposed Action including increased legal and illegal fishing pressure associated with increases in population. Fishing pressure would be concentrated in the Big Piney/Marbleton area with this alternative. Significant increases in legal and illegal fishing would occur in Sublette and Lincoln Counties (89 and 28 percent).

Linear Facilities

The construction of roads, pipelines, transmission lines, and other linear facilities would disturb 6,282 acres of wildlife habitat or 48 percent of the total 13,050 disturbed acres in the Northern Alternative (see Vegetation Section). Corridor disturbance to critical range would include 1,818 acres of mule deer critical winter range, 1,704 acres of pronghorn critical winter range, 935 acres of pronghorn critical summer range, 336 acres of elk critical winter range, and 308 acres of moose critical winter range (Table 4-58).

As in the Proposed Action, construction of these linear facilities would take place over several years so that not all of these acreages would be disturbed at any one time. Big game population reductions and productivity losses are not expected.

There would be 417 acres of prairie dog towns disturbed during corridor construction resulting in a significant impact as discussed under the Proposed Action.

Potential wildlife impacts from transmission lines would be similar to those discussed for the Proposed Action. The potential for bird wire-strike incidents would be high where the transmission line crosses the Green River in the Northern Alternative in addition to the sensitive areas of Fontenelle Creek and LaBarge Creek discussed for the Proposed Action.

Impacts to fishery resources would be similar to those discussed for linear facilities under the Proposed Action. Streams and fisheries resources affected by linear facilities for the Northern Alternative are shown in Table 4-95. Sales gas pipelines, transmission lines, the sulfur pipeline and sour gas trunk line would cross the Green River which contains a rainbow, brown, brook, and cutthroat trout fishery. A water supply pipeline would not be constructed for this alternative and crossings of the Black's Fork would not be necessary.

A rupture or leak in the sour gas line crossing the Green River could significantly affect fisheries resources. A rupture or leak in the sour gas line would result in an immediate fish kill (see Proposed Action). A rupture in the sales gas and CO_2 pipelines crossing the Green River could temporarily block fish movement but impacts would not be significant. A pipeline rupture is not likely in the life of the project.

Health and Safety

The Northern Alternative includes two major sour gas trunk lines: Quasar's 36-inch, 25-mile trunk line to the Buckhorn plant site and Northwest's 30-inch, 8-mile trunk line to East Dry Basin. Quasar proposes a 10-mile block valve spacing for its trunk line; Northwest proposes a 5-mile block valve spacing in rural areas and a 2.5-mile block valve spacing where the line passes populated areas.

The estimated probability of ruptures for Quasar's trunk line was described for the Buckhorn Alternative.

TABLE 4-95
STREAMS AND FISHERY RESOURCES AFFECTED BY LINEAR FACILITIES FOR THE NORTHERN ALTERNATIVE

Streams	Sulfur Pipeline	Transmission Lines	Sour Gas Pipeline	Sales Gas & CO_2 Pipeline
North Piney Creek[1]				
Middle Piney Creek[1]				
South Piney Creek(1)				
Dry Piney Creek[2]	X		X	X
Upper Green River[1]	X	X	X	X
LaBarge Creek(1)	X	X		
Muddy Creek(3)				
Fontenelle Creek(1)	X	X		
Slate Creek(3)	X	X		
Upper Hams Fork[1]		X		
Hams Fork (Opal)[3]		X		
Willow Creek[1]				
Alkali Creek[4]		X		
Bitter Creek[4]				X
Jensen Wash(3)				X
Big Sandy River[1]				X
North Fork Dry Piney Creek[4]	X			

[1] These streams are Class II cold water game fish streams that generally contain rainbow, brown, brook and cutthroat trout. Parentheses () indicate stream is not officially classified but supports a fishery similar to that indicated by the footnote number.

[2] Dry Piney near crossing supports a marginal trout fishery.

[3] These streams are Class III that support primarily nongame fish (suckers and minnows) population.

[4] These streams support marginal non-game fisheries or are Class IV streams (incapable of supporting fish).

The estimated probability of ruptures for Northwest's trunk line to the East Dry Basin plant site is shown below. (See the Health and Safety Technical Report for a more detailed discussion of the trunk line sensitivity analysis.)

The modeling analysis was made as described for the Proposed Action, and a corresponding risk assessment for the Northern Alternative was performed to assess the risk of H_2S exposure in the populated areas of LaBarge, Marbleton, Big Piney, Calpet, and the Fontenelle Recreation Area. The results are shown in Table 4-96. It was found that none of the populated areas would risk exposure to lethal levels from a trunk line rupture. Big Piney alone would be at risk of discomfort, only during light wind stable meteorological conditions. A negligible number of people would be at risk of lethal exposure from trunk line rupture each year, while 0.49 people would be at risk of discomfort level exposure.

Water Resources

Northwest's gas treatment plant would be located at East Dry Basin and would utilize groundwater for plant operation. Water requirements would be approximately 81 acre-feet/year. No significant impacts to

Miles of Trunk Line	Probability of One or More Ruptures	Mile-Years	Probability of One or More Ruptures During Life of Project	Expected Number of Ruptures During Project Lifetime
8	0.16%	240	4.7%	0.05

TABLE 4-96
ANNUAL RISK TO POPULATED AREAS FROM NORTHERN ALTERNATIVE

Populated Area	Individual Annual Risk of Lethal Exposure[1]	Individual Annual Risk of Significant Impact[2]	Approximate Number of People (in 1990)[3]
LaBarge	negligible[4]	negligible	1,212
Big Piney	negligible	0.00040	1,217
Marbleton	negligible	negligible	1,171
Calpet	negiligible	negligible	56
Fontenelle Recreation Area	negligible	negligible	1,210

[1] Risk values shown in this table, such as 0.00040, mean 40 chances per 100,000.

[2] Significant exposures are those that would cause eye irritation, coughing, loss of smell, or other discomfort.

[3] Includes people in incorporated and unincorporated areas.

[4] Negligible means that the modeling analysis indicates **no** risk.

groundwater resources are expected from this relatively small water requirement. Wells in the area are currently producing considerably more than the 50 gpm required by the Northwest plant. Other impacts to water resources are expected to be the same as those described for the Proposed Action.

Air Quality

Air quality impacts for the Northern Alternative are summarized in Table 4-97 for all pollutants except SO_2, which is summarized in Table 4-98. Significant air quality impacts are indicated for H_2S. Concentrations of all other pollutants are below significance levels. Readers interested in details for pollutants for which no significant impacts are noted should consult the Air Resources Technical Report.

Sulfur Dioxide

Predicted SO_2 impacts in Class II areas from individual plant operations and the applicable PSD increments are displayed in Table 4-99. Results show that all impacts are below the significance levels. For the 3- and 24-hour impacts, maximum combined concentrations do not exceed the individual impacts displayed. For Northwest's facility at East Dry Basin, the maximum predicted 3-hour SO_2 concentrations occurred almost 4 kilometers (2.4 miles) to the southwest of the plant in high terrain. The maximum 24-hour average SO_2 concentration was predicted to occur a little more than 1 kilometer (0.6 miles) to the southeast of the plant site in high terrain. Exxon's maximum predicted 3-hour and 24-hour SO_2 concentrations from the Big Mesa and West Dry Basin plants occur at the same locations as those described in the Proposed Action. Quasar's maximum predicted 3-hour and 24-hour SO_2 concentrations from the Buckhorn plant occur at the same locations as those described in the Buckhorn Alternative.

For annual averages, multiple plume interaction can occur producing higher combined impacts. For the Northern Alternative, the combined annual average SO_2 impact is predicted to be 8.5 micrograms/cubic meter at a location a little more than 1 kilometer (0.6 miles) to the southeast of Northwest's East Dry Basin plant site, and is below the Class II PSD increment of 20 micrograms/cubic meter. Thus, no significant impact would result.

Table 4-100 shows the combined SO_2 impacts at proposed and existing Class I areas. Insignificant impacts are predicted for all existing and proposed Class I areas, except for 24-hour averages at Scab Creek and the Bridger Wilderness. However, the highest second-highest 24-hour value at Scab Creek is 4.7 micrograms/cubic meter, and is 3.9 micrograms/cubic meter at Bridger. Since these values are used to determine compliance with the PSD increment and are below the increment, no significant impacts in existing or proposed Class I areas are expected.

For the Northern Alternative, the locations of the maximum 3-hour, 24-hour, and annual SO_2 impacts in all proposed and existing Class I areas are the same as those described in the Proposed Action.

The locations of the predicted maximum 24-hour SO_2 impacts in Class II areas, and in the proposed and existing Class I areas are presented in Map 4-8. Since 24-hour average impacts are usually more limiting than 3-hour and annual impacts, the locations of the maximum 24-hour impacts are helpful in illustrating the extent of the SO_2 impacts.

Hydrogen Sulfide

Air quality impacts from H_2S emissions for all facilities are summarized in Table 4-101. Concentrations above the WAAQS significant impacts levels are predicted for Quasar at Buckhorn but not for the Exxon or Northwest plants. This can be attributed to

TABLE 4-97
SUMMARY OF TOTAL MAXIMUM CONCENTRATIONS[1] FROM CONSTRUCTION AND OPERATING ACTIVITIES NORTHERN ALTERNATIVE

				Northern Alternative	
Pollutant	Averaging Time	Type of Significance Criterion	Significance Criterion	Max Conc	Percent Criterion
NO_2[2]	Annual	NAAQS/WAAQS	100	66	66
NO_2[3]	Annual	NAAQS/WAAQS	100	12	12
TSP[2]	Annual	NAAQS/WAAQS	60	48	80
TSP[4]	Annual	NAAQS/WAAQS	60	47	78
H_2S[3]	Half-hour	WAAQS	40	65	163
H_2S	Instantaneous	Odor	6.5	HT & 3.7 mi.[5]	N/A
COS[3]	Annual	MEG	800	10	1
COS[3]	8-Hour	Toxicological	60,000	225	<1
CO_2[3]	Annual	TLV	11g/m^3	0.2	2
CO[3]	1-Hour	NAAQS/WAAQS	40,000	3,906	10
CO[3]	8-Hour	NAAQS/WAAQS	10,000	1,805	18
He	Instantaneous	Asphyxiant	30,000 ppm	<30,000 ppm	N/A

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[1] All concentrations are based on modeling with actual offsite meteorological data. All numbers shown are micrograms/cubic meter unless otherwise noted. Values underscored are above applicable significance criteria.

[2] From well drilling operations.

[3] From operation of the gas treatment plants.

[4] From construction activities.

[5] The odor significance criterion is exceeded in high terrain areas surrounding Big Mesa, West Dry Basin, and East Dry Basin, and out to about 3.7 mi. from the Buckhorn facility.

TABLE 4-98
SUMMARY OF TOTAL MAXIMUM SO_2 CONCENTRATIONS[1] FROM CONSTRUCTION AND OPERATING ACTIVITIES NORTHERN ALTERNATIVE

			Northern Alternative	
Type of Criterion	Averaging Time	Criterion	Max Conc	Percent Criterion
NAAQS/WAAQS[2]	Annual	80	21	26
NAAQS/WAAQS[3]	Annual	80	11	14
	24-Hour	365	83	23
	3-Hour	1,300	348	27
PSD Class II[3]	Annual	20	9	45
	24-Hour	91	68	75
	3-Hour	512	278	54
PSD Class I[3]	Annual	2	0.9	45
	24-Hour	5	6.5[4]	130
	3-Hour	25	21.5	86

---

[1] All concentrations are based on modeling with actual off-site meteorological data. All numbers shown are micrograms/cubic meter. Concentrations underscored are above applicable significance criteria.

[2] From well drilling operations.

[3] From operation of the gas treatment plants.

[4] This concentration would result from combined plant SO_2 emissions. Even though the maximum concentration exceeds the significance criterion, the highest second-highest concentration does not, therefore SO_2 impacts are not considered significant. The highest second-highest value is 4.7 micrograms per cubic meter.

TABLE 4-99
INDIVIDUAL GAS TREATMENT PLANT SO_2 IMPACTS IN CLASS II AREAS NORTHERN ALTERNATIVE

			Maximum SO_2 Concentrations/SO_2 Increments (micrograms/cubic meter)					
			3-Hour		24-Hour		Annual	
Company	Plant Site	Capacity (Million CFD)	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment
Exxon	Big Mesa	600	141	512	30	91	2	20
Exxon	West Dry Basin	600	278	512	62	91	6	20
Quasar	Buckhorn	1,200	37	512	14	91	7	20
Northwest	East Dry Basin	400	276	512	68	91	8	20

[1] Increments can be exceeded once per year.

TABLE 4-100
COMBINED SO_2 IMPACTS IN EXISTING AND PROPOSED PSD CLASS I AREAS NORTHERN ALTERNATIVE (MICROGRAMS/CUBIC METER)

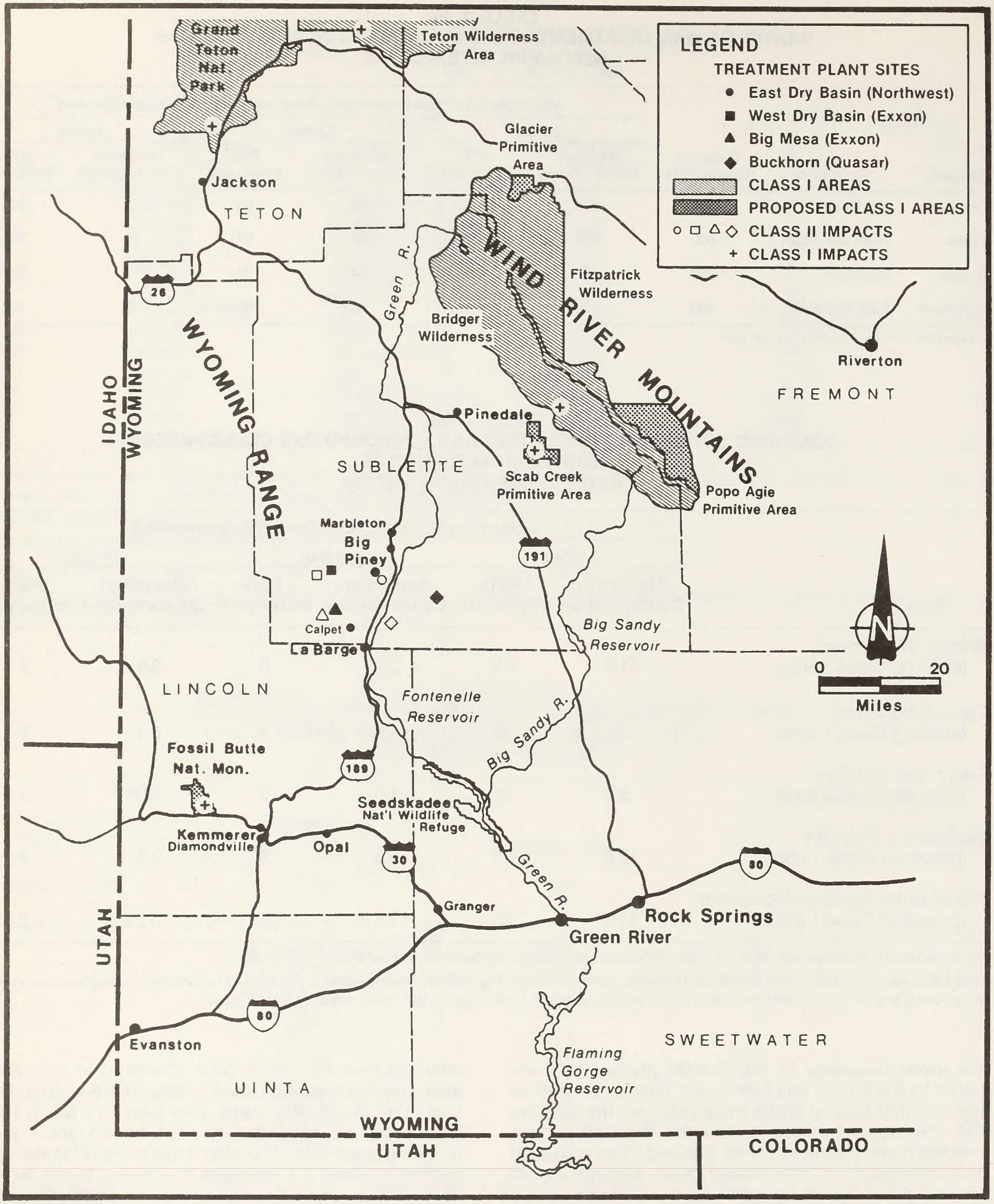
	Maximum SO_2 Concentrations/SO_2 Increments					
	3-Hour		24-Hour		Annual	
Area	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment[1]	Maximum Concentration	PSD Increment
Bridger Wilderness (existing Class I area)	21.5	25	5.5[2]	5	0.6	2
Teton Wilderness (existing Class I area)	7.1	25	1.0	5	0.1	2
Teton National Park (existing Class I area)	5.6	25	1.0	5	0.05	2
Scab Creek Primitive (proposed Class I area)	18.8	25	6.5[2]	5	0.9	2
Fossil Butte National Monument (proposed Class I area)	11.8	25	2.4	5	0.2	2

[1] Increments can be exceeded once per year. Underscore represents exceedance of PSD Class I increment.

[2] The listed value represents the maximum predicted concentrations. The highest second-highest value (used to determine compliance with PSD increments) are 3.9 micrograms per cubic meter at Bridger and 4.7 micrograms per cubic meter at Scab Creek.

the lower buoyancy of the Quasar plumes as compared to the Exxon and Northwest plumes as well as the fact that Quasar emits more H_2S. H_2S impacts are not deemed significant unless the WAAQS are exceeded more frequently than allowed. The predicted H_2S impacts from the Quasar plant exceed the 40 micrograms/cubic meter WAAQS more than twice in five days. The 70 micrograms/cubic meter WAAQS was not predicted to be exceeded. Therefore, H_2S impacts are expected to be significant at Buckhorn, but not at other sites.

H_2S emissions also are predicted to exceed the 6.5 micrograms/cubic meter odor threshold in a limited area surrounding each facility (see Table 4-101). For West Dry Basin, Big Mesa, and East Dry Basin this limit could be exceeded in high terrain areas surrounding each site. The high terrain significantly impacted is about 3 kilometers (1.8 miles) to the west-southwest of West Dry Basin, about 4 kilometers (2.4 miles) to the southwest of Big Mesa, and about 2 kilometers (1.2 miles) to the southeast of East Dry Basin. Therefore, significant odor impacts are expected in these local high terrain areas. At Buckhorn, this limit is exceeded out to about 6 kilometers (3.6



MAP 4-8 LOCATIONS OF MAXIMUM 24-HOUR AVERAGE SO_2 CONCENTRATIONS IN PSD CLASS I AND CLASS II AREAS FOR THE NORTHERN ALTERNATIVE

TABLE 4-101
MAXIMUM MODELED H_2S POLLUTANT IMPACTS
NORTHERN ALTERNATIVE

Pollutant	Averaging Time	Plant Site	Maximum Concentration $(\mu g/m^3)$[1]	WAAQS Significance Level $(\mu g/m^3)$	Odor Significance Level $(\mu g/m^3)$
Hydrogen Sulfide	0.5 Hour	West Dry Basin	$\underline{12}$	40[2] 70[3]	6.5
		Big Mesa	$\underline{7}$	40[2] 70[3]	6.5
		Buckhorn	$\underline{65}$	40[2] 70[3]	6.5
		East Dry Basin	$\underline{9}$	40[2] 70[3]	6.5

[1] Impacts predicted using actual off-site meteorology. Underscore represents exceedance of WAAQS.

[2] WAAQS. Two exceedances allowed every five days.

[3] WAAQS. Two exceedances allowed per year.

miles). H_2S impacts are predicted to be below the odor threshold at the Towns of Big Piney, Marbleton, LaBarge, Calpet, and Opal.

Carbon Dioxide

Emissions of CO_2 are not expected to cause a general climatic warming, although considerable uncertainty exists regarding the potential for the "greenhouse effect".

Acid Deposition in Class I Areas

Table 4-102 presents the potential changes to lake water chemistry at sensitive lakes in the Bridger Wilderness. A range of pH values for each lake is presented, based on an assumed range of 50 to 100 percent of possible acid input from the melting snowpack. Impacts are predicted to be greatest at Clear Lake (south), with pH decreases ranging from 0.10 to 0.20. The minimum expected pH is 6.25, well above the level of significant impact, i.e., a pH of 6.0. Therefore, insignificant impact is expected in all Class I areas from acid deposition.

Visibility Impairment in Class I Areas

Calculation of contrast parameters at all Class I areas indicate the significance criterion of 0.1 would not be exceeded. Therefore, no significant visibility impacts are expected from this alternative.

Vegetation Impacts in PSD Class I Areas

Impacts in Class I areas to sensitive vegetation from SO_2 and particulate would be insignificant and the same as described for the Proposed Action.

Secondary Growth Impacts

Table 4-103 summarizes the predicted pollutant concentrations resulting from secondary growth emissions. All concentrations are below the applicable significance levels, and no significant impacts would result.

Air Quality Related Values Impacts

As discussed above, impacts to the AQRV odor, visibility, flora (due directly from SO_2 and particulate), and acid deposition effects on sensitive fish (due directly from pH changes) in sensitive high altitude lakes are expected to be insignificant. However, it is unknown whether impacts to the other AQRV, i.e., flora (e.g., from acid deposition), fauna (other than sensitive fish), water, soil, cultural/archeological, and geologic would be significant.

Summary

In summary, operation of the Northern Alternative is expected to result in insignificant air quality impacts except for the following:

- Half-hour H_2S concentrations at plant boundaries and beyond from the Quasar plant at Buckhorn. These concentrations exceed the Wyoming half-hour standards of 40 micrograms/cubic meter more frequently than allowed, i.e., more than twice in any five consecutive days, but not the 70 micrograms/cubic meter WAAQS. The maximum predicted H_2S concentration from the Quasar facility is 65 micrograms/cubic meter.
- Odor impacts of H_2S are expected to be significant in localized high terrain areas around the Exxon West Dry Basin and Big Mesa plants, around the Northwest East Dry Basin plant, as well as out to about 6 kilometers (3.6 miles) from Quasar's Buckhorn plant because the maximum predicted H_2S concentrations from these facilities are 12, 7, 9, and 65 micrograms/cubic meter, respectively, which exceed the odor significance criterion of 6.5 micrograms/cubic meter.

TABLE 4-102
EFFECTS ON WATER CHEMISTRY OF THREE LAKES IN THE BRIDGER WILDERNESS NORTHERN ALTERNATIVE

	Clear Lake (North)	Hobbs Lake	Clear Lake (South)
Baseline pH[1]	6.60	6.50	6.45
Resulting pH	6.59 - 6.59	6.49 - 6.46	6.37 - 6.27
Change in pH	0.01	0.01 - 0.04	0.08 - 0.18
After accounting for the potential effect of the freezing point depression of acidic snow:			
Resulting pH	6.55 - 6.55	6.49 - 6.46	6.37 - 6.27
Change in pH	0.05	0.01 - 0.04	0.08 - 0.18
After accounting for the potential effect of plant flaring:			
Resulting pH	6.55 - 6.55	6.49 - 6.46	6.35 - 6.25
Change in pH	0.05	0.01 - 0.04	0.10 - 0.20

[1] Measurements taken by ERT in August 1982.

TABLE 4-103
AIR QUALITY IMPACT OF SECONDARY GROWTH ON THE BIG PINEY/MARBLETON AREA NORTHERN ALTERNATIVE

	Total Maximum Concentrations/NAAQS/WAAQS ($\mu g/m^3$)									
	1-Hour		3-Hour		8-Hour		24-Hour		Annual	
Pollutant	Conc	Std	Conc	Std	Conc	Std	Conc	Std	Conc	Std
TSP	--	--	--	--	--	--	61.5[5]	150	30.4[7]	60
SO_2	--	--	70.2[2]	1,300	--	--	15.1[6]	365	3.02[8]	80
NO_X	--	--	--	--	--	--	--	--	9.2[9]	100
CO	3,577[1]	40,000	--	--	1,558[4]	10,000	--	--	--	--
HC	--	--	5.2[3]	160	--	--	--	--	--	--

[1] Includes a background concentration of 3,500 micrograms/cubic meter.

[2] Includes a background concentration of 70 micrograms/cubic meter.

[3] Does not include a background concentration. Background is unknown but probably very low.

[4] Includes a background concentration of 1,500 micrograms/cubic meter.

[5] Includes a background concentration of 60 micrograms/cubic meter.

[6] Includes a background concentration of 15 micrograms/cubic meter.

[7] Includes a background concentration of 30 micrograms/cubic meter.

[8] Includes a background concentration of 3 micrograms/cubic meter.

[9] Includes a background concentration of 9 micrograms/cubic meter.

Soils and Vegetation

Implementation of the Northern Alternative would result in the potential disturbance of 13,050 acres (Table 4-104). Of this disturbance, 75 percent (9,804 acres) would occur in sagebrush-dominated communities. Based on the applicants' plans to reclaim right-of-ways and well pads after construction, a total of 4,028 acres (Table 1-17) would remain in use after long-term operation is initiated. Anticipated impacts in the well field are the same as those discussed under the Proposed Action.

Plant Sites

A total of 2,800 acres of vegetation would be disturbed by construction of the plant sites and sulfur loadout facility (Table 4-104). Of this disturbance, (2,286 acres or 82 percent) would occur in sagebrush-dominated communities, 282 acres (10 percent) in saltbush, 113 acres (4 percent) in grassland, and 26 acres (1 percent) in mountain shrub communities. Thirty-four acres of riparian areas would be affected at the sulfur loadout facility. Potential long-term productivity losses on these 34 acres are anticipated. Of 825 acres of sensitive rehabilitation units on the plant sites, 600 acres of saline-alkaline lands would be affected at East Dry Basin (Northwest), and 40 acres at the sulfur loadout (see Table 4-105). About 40 acres, 120 acres, and 25 acres of steep, shaly lands would occur within the West Dry Basin, Big Mesa, and sulfur loadout sites, respectively. Rehabilitation considerations for these sensitive units are shown in Appendix C.

Air pollution impacts to vegetation are projected to be insignificant. See discussion under the Proposed Action.

Linear Facilities

A total of 6,282 acres would be potentially disturbed by corridor construction including 36 acres of potentially unstable dune communities and 88 acres of riparian vegetation; 83 percent of the disturbance

TABLE 4-104
POTENTIAL CONSTRUCTION DISTURBANCE BY VEGETATION TYPE NORTHERN ALTERNATIVE (ACRES)

	Vegetation Types[1]														
	BS	SC	MS	MDS	Sa	G	MP	SF	D	A	C	R	P/H	Gr	Di	Total
Well Field																
Roads	208	196	4	0	0	70	124	29	18	34	9	29	36	0	0	757
Wells	294	284	7	0	0	90	245	48	18	49	18	0	49	0	0	1,102
Gathering System	549	403	10	0	0	207	452	106	32	107	38	106	89	10	0	2,109
Total	1,051	883	21	0	0	367	821	183	68	190	65	135	174	10	0	3,968
Linear Facilities																
Railroads	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Lines	837	0	0	0	80	44	0	0	0	0	0	10	33	14	0	1,018
Pipelines	4,106	93	0	28	102	40	0	0	0	0	0	72	7	138	0	4,586
Sulfur Pipeline	472	49	0	8	56	13	0	0	0	0	0	6	33	14	0	651
Access Roads	22	5	0	0	0	0	0	0	0	0	0	0	0	0	0	27
Total	5,437	147	0	36	238	97	0	0	0	0	0	88	73	166	0	6,282
Plant Sites																
Buckhorn	640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	640
West Dry Basin	605	30	0	0	0	5	0	0	0	0	0	0	0	0	0	640
Big Mesa	506	0	26	0	0	108	0	0	0	0	0	0	0	0	0	640
East Dry Basin	483	0	0	0	157	0	0	0	0	0	0	0	0	0	0	640
Sulfur Loadout	22	0	0	0	125	0	0	0	0	0	0	34	0	0	59	240
Total	2,256	30	26	0	282	113	0	0	0	0	0	34	0	0	59	2,800
Grand Total	8,744	1,060	47	36	520	577	821	183	68	190	65	257	247	176	59	13,050

[1] BS = Big Sagebrush
SC = Sagebrush Complex
MS = Mountain Shrub
MDS = Mixed Desert Shrub
Sa = Saltbush
G = Grassland
MP = Mixed Pine
SF = Spruce Fir
D = Douglas-fir
A = Aspen
C = Clearcut
R = Riparian
P/H = Pasture/Hayfield
Gr = Greasewood
Di = Disturbed

TABLE 4-105
AREAS (ACRES) OF POTENTIAL CONSTRUCTION DISTURBANCE ON SENSITIVE REHABILITATION UNITS[1]
NORTHERN ALTERNATIVE

	A2	A4	B3	C2	C4	D4	D5	Total
Well Field (Overall Potential Disturbance: 3,968 acres)								
Roads	0	0	113	50	66	32	125	386
Wells	0	0	84	64	63	38	145	394
Gathering System	10	0	155	55	93	73	301	687
Subtotal	10	0	352	169	222	143	571	1,467
Plant Sites (Overall Potential Disturbance: 2,800 acres)								
Buckhorn (Quasar)	0	0	0	0	0	0	0	0
West Dry Basin (Exxon)	0	40	0	0	0	0	0	40
Big Mesa (Exxon)	0	120	0	0	0	0	0	120
East Dry Basin (Northwest)	600	0	0	0	0	0	0	600
Sulfur Loadout (Exxon)	40	25	0	0	0	0	0	65
Subtotal	640	185	0	0	0	0	0	825
Linear Facilities (Overall Potential Disturbance: 6,282 acres)								
Railroads	0	0	0	0	0	0	0	0
Transmission Line	200	147	59	0	0	0	0	326
Pipeline	481	424	450	0	0	0	0	874
Sulfur Pipeline	149	49	0	0	0	0	0	198
Access Roads	0	0	0	0	0	0	0	0
Subtotal	693	646	59	0	0	0	0	1,398
Total	1,343	831	411	169	222	143	571	3,690

[1] Sensitive Rehabilitation Units are identified in Appendix C (Table C.3).

would be associated with pipelines (Table 4-104). Impacts to riparian communities from pipeline construction would be short term since riparian vegetation would eventually reestablish on pipeline and transmission line corridors. Construction of the Northern Alternative would affect about 1,398 acres of sensitive soils along linear facilities (see Table 4-105).

At completion of the project, a total of 628 acres (Table 1-18) would remain in use (unreclaimed) for access roads. This would be a long-term loss of vegetative productivity.

Summary

Construction and operation of the Northern Alternative would affect 13,050 acres of vegetation and soils. No significant impacts are anticipated for soils, assuming compliance with the recommended soil protection measures. A total of 257 acres of riparian vegetation would be removed, of this total, a reduction in long-term vegetative productivity on 63 acres resulting from construction of roads and the sulfur loadout facility on riparian vegetation is anticipated, a significant impact. In addition, 606 acres of well field access roads would remain in use (Table 1-18). Of the 13,050 acres disturbed, a total of 628 acres would be removed for the life of the project. These land use conversions constitute a reduction in the rangeland or forest land resource, and represent an insignificant (less than 1 percent) reduction in the total regional resource (see Environmental Consequences-Timber and Agriculture/Grazing). No known populations of threatened or endangered species would be affected.

Visual Resources

Plant Sites

The Northern Alternative has two plant sites with significant impacts (East and West Dry Basin) and one plant site with a highly significant impact (Big Mesa) which have been described under the Proposed Action.

Linear Facilities

Buried pipelines would result in 9.75 miles of significant impact and 0.25 mile of highly significant impact. The sulfur pipeline would result in 38 miles of significant impact and 10.25 miles of highly significant impact. The transmission line in this alternative would have 12 miles of highly significant impact. Facility impacts are shown on Map 4-3 and summarized in Table 4-68. Corridor impacts would not affect any areas not already identified for either the Proposed Action or Buckhorn Alternative.

The combined change impacts for this alternative would be the same as identified for the Proposed Action with the following exceptions (see Table 4-69): viewers along the Opal Cutoff (Highway 240) would not experience a significant visual change because the Craven Creek plant site would not exist with this alternative. Three residences along the Green River near Reardon Draw; however, would experience a highly significant change due to facilities crossing the Green River.

Cultural Resources

Although the West Dry Basin plant site possesses no NRHP eligible resources, the other three plant sites in this alternative remain unsurveyed. A total of 94 possibly NRHP eligible archeological sites are located in the alternative's corridors, of which 13 would be directly impacted and 63 would be indirectly impacted. The potential impact of the remaining 18 sites has not been determined. The applicants' transmission line would impact 19 identified sites. Most major cutoffs of the Oregon Trail, as well as the Opal Stage Road would be impacted by the Northern Alternative's rights-of-way. All 11 historic trails discussed under the Proposed Action would also be impacted by the Northern Alternative.

Recreation

The Northern Alternative would have recreation impacts similar to the Proposed Action, except that more adverse wildlife impacts are projected. It would, therefore, have a greater adverse impact on hunting. Future recreation use patterns and demand would also be similar except for the greater concentration of users in and around the well field area.

Wilderness

Project-induced growth during the construction and operation phases of the Northern Alternative would occur in Pinedale, Big Piney, and LaBarge, Wyoming. Impacts to the wilderness resource and quality of the wilderness experience within the wilderness impact area would occur to an unquantifiable degree due to the large permanent work force that would reside in communities close to the affected wilderness areas.

Agriculture/Grazing

The Northern Alternative would disturb 7,313 acres (Table 4-70). The total loss of AUMs would be 706, with significant impacts to the same allotments as noted under the Proposed Action. The Slate Creek Sheep Trail would be crossed by Exxon's sulfur pipeline and the transmission line serving all the applicants.

Significant impacts of the same magnitude as associated with construction would continue during operation on the Piney Unit Fenced, Beaver Meadows, and LaBarge Ind. allotments; operation impacts throughout the project area, however, under the Northern Alternative would be insignificant. The loss of 203 AUMs is less than 1 percent of the AUMs in allotments that would be affected by the project. The only crossing which could conflict with use of the Slate Creek Sheep Trail would be Exxon's sulfur pipeline.

Transportation

Construction

Under the Northern Alternative, all four plant sites would be located to the east of the well field area between LaBarge and Big Piney. The net effect of this alternative would be to concentrate the regional highway demand on U.S. 189. Table 4-106 summarizes the peak hour traffic demands and indicates where signficant impacts would occur under the Northern Alternative as a result of 1986 project construction and operations activity. Riley Ridge vehicle loadings on the segment of U.S. 189 between LaBarge and Big Piney are significant and range between 1,145 and 1,425 vehicles during the construction worker commuter peak hour. The combined 1986 baseline and project-related traffic would result in a total peak hour demand that would result in Level of Service E between LaBarge and County Road 23-134 and Level of Service F at Big Piney.

Maximum project loadings on U.S. 30 range between 190 and 245 vehicles per hour. This would create significant impacts with traffic operating at a Level of Service D between Kemmerer and Opal and Level of Service E east of Opal. Primarily due to anticipated baseline traffic, the segment of U.S. 30 between Kemmerer and I-80 is projected to operate below the Level of Service stable flow volume standard and therefore not experience significant impacts. The Northern Alternative would generate approximately 190 additional accidents annually during the years of project construction.

Operation

Traffic demand resulting from project operations under the Northern Alternative would exceed Level of Service C volumes on U.S. 189 at Big Piney and on U.S. 30 between Kemmerer and Opal. The peak demand of 790 vehicles on U.S. 189 and 745 vehicles on U.S. 30 would reduce roadway conditions in both cases to a Level of Service D. Of the traffic demand on U.S. 189 at Big Piney 51 percent (405 vehicles) would be project-related. On U.S. 30 between Kemmerer and Opal the Level of Service C would be exceeded largely because of anticipated baseline traffic; only 20 vehicles of the 745 would be project related. Annual traffic accidents due to increased project-related travel would be 62 during project operation.

Land Use Plans, Controls, and Constraints

The Northern Alternative would generate substantial conflict with Sublette County zoning because all four plant sites would be located in county Resource

TABLE 4-106
PROJECTED 1986 HIGHWAY PEAK-HOUR TRAFFIC DEMAND
NORTHERN ALTERNATIVE

Highway Location	Projected 1986 Baseline Hourly Demand Estimates[1]	Riley Ridge Development Generated Auto and Truck Traffic	Total Peak Hour Demand	Percentage Projected Project Projected Baseline	Level of Service B Volumes[2]	Level of of Service C Volumes[3]
U.S. 189 between Kemmerer and State Route 240	205	440	645	215	465	725
U.S. 189 between State Route 240 and LaBarge	290	675	965	233	465	725
U.S. 189 between LaBarge and County Road 23-134	290	1,145	1,435[4]	395	465	725
U.S. 189 at Big Piney	290	1,425	1,715	491	465	725
U.S. 191 West of Pinedale	580	135	715	23	505	785
U.S. 30 between Kemmerer and Opal	550	190	740	35	425	665
U.S. 30 East of Opal	750	245	995	33	425	665
State Route 240 north of Opal	50	60	110	*	590	920
I-80 East of U.S. 30	1,930	45	1,975	2	(2,000)**	(2,500)**

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[1] Projected 1986 baseline hourly demand computed from 1982 traffic demands using WSHD growth factors. Hourly demands are representative of recreation season travel.

[2] Level of Service B is preferred traffic operating standard of WSHD for rural highways.

[3] Level of Service C is tolerable traffic operating standard of WSHD for high volume rural highways.

[4] Underscore Represents exceedence of level of Service C traffic volumes.

*Percentage increase not meaningful indicator due to low baseline hourly demand estimate.

**Directional capacity of limited access highway with 2 lanes per direction.

Conservation (RC) zone districts which do not permit industrial uses. As described under the Proposed Action, it is anticipated that Sublette County would approve the requisite changes to I-H zoning for the plant sites which would resolve the conflict (Wise 1982, personal communication).

The Northern Alternative has relatively little conflict with BLM Kemmerer Resource Area Management Framework Plan corridor guidelines because of its simplified corridor pattern in Lincoln County. There is, however, increased duplication of corridors and hence greater conflict with the BLM Pinedale Resource Area Management Framework Plan. The sales and CO_2 pipeline corridor conflict with Rock Springs' planned growth area would be the same under the Northern Alternative as described for the Proposed Action. Of the 84.0 miles of transmission lines, 9.5 would be in a shared corridor.

NO ACTION ALTERNATIVES

Denial of Entire Project

Under this alternative, the requests for federal rights-of-way and actions within the well field would be denied. Denial would preclude the companies from developing their projects. Consequently, the social and environmental impacts from the Proposed Action would not occur. However, other impacts would occur and are discussed below:

- The project's purpose would not be fulfilled. The loss of 2.8 billion cfd capacity to produce 576 million cfd of natural gas to consumers would occur, thus not contributing domestic natural gas to reduce the national dependence on foreign supplies.

- Leaseholders (lessees) would be denied their legal rights for development of their various leases. The first premise of federal oil and gas leases, under the Minerals Leasing Act of 1920, as amended, is that the oil and gas lease between the U.S. Government (lessor) and lessee constitutes a contractual agreement with given rights and restrictions, subject to relevant laws and regulations. This is supported in the Department of the Interior. Further, the Regional Solicitor states that the Secretary of the Interior does not have the power to deny APDs strictly on environmental grounds, absent specific stipulations in the lease or the passage of a law applicable to pre-existing leases, Solicitors Opinion M-36910 (Supp.), The BLM Wilderness Review and Valid Existing Rights 88 I.D. 909 October 5, 1981). A review of the leases within the project reveals that site-specific APDs can be denied on environmental grounds, but drilling must be allowed at some location on the lease, with reasonable mitigation measures.

  In these particular instances, a blanket denial of APDs (as under this alternative) would constitute a cancellation of the leases, and therefore a breach of contract, not within the powers of the Secretary of the Interior.

  Such lease cancellation may require that just compensation be paid to the lessees, since the lease is viewed as property. This would create an undetermined financial burden on the U.S. Government directly, and the private taxpayer, indirectly.
- All leaseholders in the Riley Ridge field would be adversely affected equally, including those that are not proponents of this project. The Riley Ridge area is almost entirely leased. An argument could be made that only those lessees in the western part of the well field would be adversely affected by a denial decision, since known shallow, sweet gas reserves exist in the eastern portion of the field. Therefore, the lessees in the eastern areas would still be given the right to exercise their lease rights. However, the leases read: "The lessee is granted the exclusive right and privilege to drill for, mine, extract, remove, and dispose of all the oil and gas deposits, except helium gas, in the lands leased..." Therefore, denial would adversely affect all leaseholders in the Riley Ridge field and create an undetermined financial burden on the leaseholders.

MITIGATION MEASURES

The mitigation measures included in this chapter of the EIS are specific requirements with which the applicants will have to comply. The BLM and FS have committed to these measures and are responsible for their enforcement. These requirements will be included in the applicants' right-of-way grants, approved APDs, and other permits in the well field. Mitigation measures which state or local agencies may require but which the federal agencies cannot require are included as "uncommitted measures" in Appendix D. In the event of a delay in project implementation, mitigation measures will be reviewed by the agencies at the time of grant development to ensure their applicability and to ensure that all appropriate and necessary mitigation measures are applied as stipulations. This will prevent impacts from exceeding the worst-case analyzed and mitigated in this EIS. Implementation, of such stipulations will be in a timely manner based on the companies schedule of development activities.

SOCIOECONOMICS

S-1 *Measure:* Temporary worker camps near each approved plant site will be required to house construction workers. Sites for the worker camps will be selected from those sites analyzed in the EIS, if possible.

Effectiveness: Provision of construction work camps would help relieve the demand for single status housing throughout the project area. However, due to the presence of family status workers, these camps would not totally eliminate the significant housing impacts that would be associated with the project. Demand for single-family homes, multi-family units, and mobile home lots may still exceed the response capabilities of local area developers. Additional measures that would induce developers from outside the region to produce housing and/or the provision of other forms of temporary housing such as modular condominiums or apartments may be required to fully meet projected housing demand. The absence of sufficient numbers of housing units could otherwise result in an unquantifiable amount of temporary occupancy of area public lands ("squatting"), particularly in the vicinity of Big Piney, Marbleton, and LaBarge.

Application: This measure will be applied to the Proposed Action and all of the siting alternatives.

WILDLIFE AND FISHERIES

WF-1 *Measure:* State wildlife laws and regulations will be posted in conspicuous places at the job sites and work camps.

Effectiveness: Posting laws and regulations may help to reduce wildlife violation incidences or at least eliminate the violator's excuse of ignorance of wildlife laws.

Application: This measure will be applied to the Proposed Action and all alternatives.

WF-2 *Measure:* During construction and operation phases, dogs, excepting guard dogs or seeing-eye dogs, will be prohibited from well sites and construction sites.

Effectiveness: This measure would reduce harassment to wildlife species.

Application: This measure will be applied to the Proposed Action and all siting and component alternatives.

WF-3 *Measure:* The location of the well in the Graphite Unit, Sec. 22, T.27N., R.114W. will be relocated and approved by the Authorized Officer. Offset drilling or other measures may be required at the time of approval.

Effectiveness: Relocating this well to the northeast would reduce critical winter range losses and associated human disturbances to elk wintering in the Graphite Hollow area, and would slightly decrease predicted elk population reductions and productivity losses.

Application: This measure will be applied to the Proposed Action and all alternatives.

WF-4 *Measure:* Construction of any pipelines in the Seedskadee National Wildlife Refuge would be in accordance with any seasonal and other restrictions determined by the Fish and Wildlife Service.

Effectiveness: Implementation of this measure would decrease human disturbance impacts to sensitive species.

Application: This measure will be applied to the Shute Creek Alternative sales gas and CO_2 line which Exxon has identified.

WF-5 *Measure:* Where the Authorized Officer determines that rehabilitation of temporarily disturbed areas within critical wildlife habitat on federal land will not be successful within five years from disturbance, the company will be required to compensate for the lost habitat. Temporarily disturbed areas do not include those covered by permanent facilities like road beds, well site equipment, etc. Such critical wildlife habitat will be determined by the Authorized Officer in conjunction with Wyoming Game and Fish. Compensation will include continued rehabilitation efforts on the disturbed areas and development and implementation of an off-site mitigation plan for similar critical habitat on federal land within the species use area that is in poor condition due to natural or man-made causes. The plan must be approved by the Authorized Officer who will coordinate with Wyoming Game and Fish.

Effectiveness: Implementation of this measure will have only limited effectiveness in mitigating impacts to wildlife critical range. "Successful rehabilitation within five years," as used above applies primarily to soils and vegetation criteria for defining success in rehabilitation. Big game critical ranges are generally dependent upon shrub habitats which provide forage during critical winter periods when grasses and forbs are covered by snow. Successful rehabilitation of critical range to shrub habitats would take from 10 to 50 years depending upon shrub species, soils, moisture, and a variety of other factors. Rehabilitation of disturbed areas to soils and vegetation success standards is a necessary first step in successful reestablishment of critical ranges.

Secondarily, even when critical range shrub habitats are reestablished along road and well pad edges, their value to wildlife will be limited due to wildlife's behavioral reaction to continued human activity.

In addition, the mitigation measure specifies off-site mitigation for similar critical range "within the species use area". This terminology would unnecessarily limit the measure's effectiveness by not specifying mitigation possibilities for other species.

Application: This measure will be applied to the Proposed Action and all siting and component alternatives.

WF-6 *Measure:* The plant water evaporation pond at Northwest Pipeline's treatment facility will be fenced with small mesh wire to protect terrestrial wildlife. It must have sufficient deterrents to keep waterfowl and birds out of the pit. These could include beaded cables which are studded with plastic "whirlers", or other mechanical devices which would frighten birds; placing pond near human activity or stationing a person to frighten birds during migration; or other methodologies which must be approved by the Authorized Officer.

Effectiveness: Implementation of this measure would preclude small animals and big game using the pond as a drinking water source and being harmed or killed by ingesting the wastewater.

This measure would mitigate the potential for impacts to waterfowl, shorebirds, or other birds which may be attracted to the evaporation pond.

Application: This measure will be applied to the Proposed Action and all alternatives.

WF-7 *Measure:* Colored markers will be hung on transmission lines to increase visibility of wires over river crossings within known bald eagle concentration areas in order to reduce eagle and sandhill/whooping crane collisions with wires.

Effectiveness: As written, this measure would reduce the potential for eagles, whooping cranes, sandhill cranes, and waterfowl striking wires where they cross the river. This measure would not be effective in reducing potential wire-strikes in the other sensitive areas of Fontenelle Creek and LaBarge Creek.

Application: This measure will be applied to the Buckhorn, Shute Creek, and Northern Alternatives.

WF-8 *Measure:* The critical ranges and other important wildlife areas will be avoided during the periods listed below during construction of linear facilities unless direction is otherwise given from the Authorized Officer. (See Wildlife Technical Report wildlife maps for location of specific areas.)

Area	*Period*
Elk critical winter range	Nov. 15 to April 1
Deer critical winter range	Nov. 15 to April 1
Sage grouse leks	March 1 to June 30
Golden eagle nests (within ½ mile)	February 1 to July 15
Osprey nests (within ½ mile)	April 15 to August 15
Prairie falcon nests (within ½ mile)	March 15 to August 1
Merlin nests (within ½ mile)	April 15 to August 15
Ferruginous hawk nests (within ½ mile)	March 15 to July 15
Cooper's hawk nests (within ½ mile)	April 1 to August 15
Burrowing owl nests (within ½ mile)	April 15 to July 15
Swainson's hawk nests (within ½ mile)	April 1 to July 15

Effectiveness: Avoiding the areas listed above would eliminate many of the potential impacts to species of concern.

Application: This measure will be applied to the Proposed Action and all alternatives.

WF-9 *Measure:* Staging areas for stream crossing equipment will be located outside of the stream's riparian zone in order to reduce the possibility of silt entering into streams and to reduce disturbance to vegetation in the riparian zone. A maximum construction right-of-way of 25 feet would be used in riparian areas to reduce disturbance. Variances to this must be approved by the Authorized Officer.

Effectiveness: This measure will reduce the total amount of riparian vegetation removed during construction, minimizing loss of stream bank cover, eroded material available to the stream, and habitat degradation from suspended solids and turbidity.

Application: This measure will be applied to the Proposed Action and all alternatives.

WF-10 *Measure:* Well pads and all other facilities, currently and in the future, planned for the riparian zone shall be offset from the stream bank and/or out of alluvial soils or soils with poor drainage as approved by the Authorized Officer. The distance should be at least 500 feet wherever topographically possible.

Effectiveness: This measure will minimize loss of stream bank cover and reduce sediment available to streams. It will also reduce the potential for accidental spills of toxic substances reaching the stream and may also reduce the potential for contamination of surface water resulting from leaks in casing.

Application: This measure will be applied to the Proposed Action and all alternatives.

WF-11 *Measure:* Crossings of the Green River will be conducted during the fall low flow period. Major crossings for the sales gas, sour gas, molten sulfur, and CO_2 lines will be placed at islands if such are identified within 1 mile of the centerline as identified in the Construction and Use Plan.

Effectiveness: Crossing the Green River at low flow will minimize habitat degradation by minimizing the amount of suspended solids and turbidity generated during in-stream construction. Constructing the lines across islands will also minimize stream disturbance, since equipment can be kept out of the stream and coffer dams can be used to divert water between channels, eliminating barriers to fish movement and minimizing suspended solids and turbidity. Crossing at low flow would also minimize impacts on critical life stages of trout.

Application: This measure will be applied to the Proposed Action, Exxon and American Quasar CO_2 and sales gas pipelines; Buckhorn Alternative, American Quasar, and Williams sour gas pipelines, molten sulfur pipeline, Exxon sales gas and CO_2 pipelines; Shute Creek Alternative, American Quasar sour gas pipeline, molten sulfur pipeline, Exxon sales gas and CO_2 pipelines; Northern Alternative, American Quasar molten sulfur pipeline, sour gas pipeline, Exxon sales gas and CO_2 pipelines.

WF-12 *Measure:* The intake structure on the Green River for the proposed Craven Creek water supply pipeline (and any others) will be constructed in accordance with design specifications provided or approved by Wyoming Game and Fish.

Effectiveness: Having design specifications for the intake structure approved by Wyoming Game and Fish should eliminate any significant adverse impacts to fisheries associated with impingement, entrainment, reduced flows, or habitat loss.

Application: This measure will be applied to the water supply pipeline for the Craven Creek site, and all alternatives with the Craven Creek plant site.

WF-13 *Measure:* The companies will be required to develop and implement a sediment monitoring plan to be approved by the Authorized Officer. The specific streams recommended for monitoring are Trail Ridge Creek, South Beaver Creek, and South Piney Creek just below its confluence with Coal Creek.

Effectiveness: The sediment monitoring program will help identify and quantify adverse impacts in the wellfield but it will not eliminate any impacts related to sedimentation, unless it results in additional corrective action (special erosion control) in severely affected streams.

Application: This measure will be applied to the Proposed Action and all alternatives.

WF-14 *Measure:* In the event an applicant finds it necessary to remove a beaver pond which has flooded an existing road, the applicant will initiate consultation with WGF and BLM or the FS.

Effectiveness: If alternative measures can be found to eliminate the beaver pond, loss of critical fisheries habitat will be minimized.

Application: This measure will be applied to the Proposed Action and all alternatives.

HEALTH AND SAFETY

H-1 *Measure:* Companies will be required to provide automatic shut down systems on sour gas trunk lines for all block valves.

Effectiveness: Automatic operation of block valves was assumed in the modeling conducted for H_2S releases from trunk line ruptures. Automatic block valves are effective in limiting the amount of sour gas released during a pipeline rupture.

Application: This measure will be applied to the Proposed Action and all alternatives.

H-2 *Measure:* Companies will be required to have automatic shut down systems for all sour gas wells within the Riley Ridge well field.

Effectiveness: This measure will reduce the amount of sour gas released in the event of a gathering pipeline leak or rupture and will allow a well to be shut-in without exposing people to potentially high levels of H_2S.

Application: This measure will be applied to the Proposed Action and all alternatives.

H-3 *Measure:* Companies will develop community contingency and evacuation plans for Calpet, LaBarge, Big Piney, and Marbleton in coordination with the public safety organizations including community civil defense organizations, sheriff, highway patrol, and fire departments, etc., for accidental release of H_2S and in accordance with appropriate federal and state regulations. Plans will include early warning and mass alert systems.

Effectiveness: Community evacuation measures would be effective in alerting the populations of communities near the sour gas trunk lines of possible H_2S hazards; however, they would not eliminate the possibility of some people being exposed to significant or lethal levels of H_2S.

Application: This measure will be applied to the Proposed Action and all alternatives.

H-4 *Measure:* For any section of sour gas trunk lines less than 5 miles from Big Piney, Calpet, and LaBarge, block valve spacing will be between 1 and 2.5 miles. Final valve spacing will be determined by the Authorized Officer.

Effectiveness: This measure will reduce the possibility of exposure to both discomfort and lethal levels of H_2S in the event of a trunk line rupture. The annual risk of lethal exposure could be reduced to effectively zero (less than 0.0001) in LaBarge and by up to 25 percent in Calpet, depending on alternative and valve spacing. The annual risk of discomfort exposure could be reduced to effectively zero in LaBarge and by up to 45 percent in Calpet, depending on alternative and valve spacing. See Appendix C.6 for a complete discussion of the effectiveness of this mitigation measure.

Application: This measure would be applied to the sour gas trunk lines in the Proposed Action and all alternatives, specifically Northwest Pipeline's 30-inch diameter line, American Quasar's 30 and 36-inch diameter lines, and Exxon's 30-inch line for the Shute Creek Alternative.

H-5 *Measure:* Drilling operators will be required to identify in their H_2S contingency plans readily available sources of fuel gas in the area during drilling operations. This gas could be added at the flare stack to burn the H_2S in the event of an uncontrolled blowout.

Effectiveness: This measure would reduce the risk of exposure to both discomfort and lethal levels of H_2S in the event of a blowout. The flaring would convert the H_2S to less harmful SO_2.

Application: This measure will be applied to the Proposed Action and all alternatives.

WATER RESOURCES

W-1 *Measure:* Because of the data gaps in the EIS on composition of water to be injected, injection procedures, and surface and bottom locations, all injection wells on federal lands to be used for plant waste water are not covered in sufficient detail by this EIS. Consequently, all injection wells for plant waste water disposal on federal lands, including those on plant rights-of-way, will need an EA or other NEPA compliance prior to approval. This may be facilitated by the applicant for Wyoming DEQ permits also submitting that information to the BLM for analysis.

Effectiveness: The drilling of all injection wells in compliance with State of Wyoming requirements will help minimize the degradation of aquifers.

Application: This measure will be applied to the Proposed Action and all alternatives.

W-2 *Measure:* All injection wells must be designed in accordance with the Wyoming DEQ and the Wyoming Oil and Gas Commission. In addition, those on Federal minerals must have the approval of the BLM Minerals Division.

Effectiveness: Cementation of the annular space surrounding the well casing would greatly reduce the possibility of contaminating aquifers penetrated by the well. Poor quality waters from saline aquifers, or leaked from poorly constructed or corroded casing would be prevented from migrating vertically along this annular space to aquifers which contain good quality water.

Application: This measure will be applied to the Proposed Action and all alternatives.

AIR QUALITY

AQ-1 *Measure:* The companies will be required to fund, at least in part, a long-term acid deposition monitoring and analysis program to track potential impacts to Class I areas within the region. The most likely areas to be monitored are the Bridger and Fitzpatrick Wildernesses within the Wind River Range. Based on the Air Quality Technical Report prepared by ERT for the Riley Ridge EIS, the Forest Service will develop a program which will be at least partially funded by the Companies at a level to be determined by the Forest Service. Such a level will be determined, among other considerations, by the actual number and placement of plants. Participation by a particular company would be contingent upon its receiving a plant right-of-way grant and the timing of its activities with that grant.

Effectiveness: Baseline and post construction data in the Bridger and Fitzpatrick Wildernesses relating to the short- and long-term effects on water quality, soils, flora, and fauna will provide valuable information for documenting existing conditions, the effects, and determining which environmental parameters are principally involved in acid deposition. Conceptual monitoring recommendations are delineated in Appendix E.

Application: This measure will be applied to the Proposed Action and all alternatives.

AQ-2 *Measure:* In order to comply with the requirements of a PSD Permit, American Quasar would be required to implement technology for control of H_2S and SO_2 emissions at the East Dry Basin plant site and for control of H_2S at the Buckhorn plant site. One technique for H_2S and SO_2 control would employ a system to feed the sweetened gas to a catalytic hydrolysis reactor where residual COS would be converted to H_2S following acid gas removal. The H_2S would then be removed in a trim H_2S contactor using lean selexol solvent. Prior to committing to a particular control technology, American Quasar would have to evaluate this system along with other processes to determine the additional SO_2 control generated by this technology.

Effectiveness: A minimum sulfur removal of 99.72 percent is required in order to comply with PSD increments at East Dry Basin. While BLM does not regulate compliance with air quality regulations and cannot require specific control technology, compliance with PSD Permit requirements will be necessary for issuance of a BLM right-of-way grant. While the control level is technologically feasible, cost considerations may prevent certain technologies from being implemented.

Application: This measure will be applied to the Proposed Action for SO_2 control and the Proposed Action and all alternatives for H_2S control.

SOILS AND VEGETATION

SV-1 *Measure:* All new well field pipelines and transmission lines will be required to use common rights-of-way when economically and technically feasible. The exact locations will be determined as necessary by the Authorized Officer.

Effectiveness: Although this measure will not eliminate loss of vegetation for new facilities, it will concentrate development to designated areas limiting impacts on land use and wildlife. Maintenance and erosion control will probably be accomplished more easily with corridors confined to the same vicinity; it may also eliminate excessive cut and fill for new roads.

Application: This measure will be applied to the Proposed Action and all alternatives.

SV-2 *Measure:* Development will avoid or minimize disturbance to highly saline-alkaline sites and sand dunes. An example of a saline-alkaline site is the "white alkali" Soapholes area north and east of Big Piney. Locations to be avoided would be determined by the Authorized Officer.

Effectiveness: Avoiding and minimizing disturbance to sand dunes and alkali areas will eliminate problems in revegetating saline soils and stabilizing eroding dunes.

Application: This measure will be applied to the Proposed Action and all alternatives.

SV-3 *Measure:* During transmission line construction, brush (shrub) clearing along access trails and at tower assembly areas will be limited to trimming and/or crushing to avoid disturbing root systems. (Not yet committed.)

Effectiveness: This measure will be effective in limiting the amount of shrub vegetation disturbed along the transmission line right-of-way. By not disturbing the root system, crushed or clipped shrubs will resprout and revegetate the right-of-way more quickly. This will reduce soil erosion and speed restoration of wildlife habitat.

Application: This measure will be applied to the Proposed Action and all alternatives.

SV-4 *Measure:* All areas not needed for production on the well pads must be recontoured and rehabilitated following the drilling phase for each well. The determination on necessary area for operation will be made by the Authorized Officer in consultation with the operator.

Effectiveness: This measure will be effective in revegetating the well pad area and will reduce soil erosion as well as speed restoration of wildlife habitat.

Application: This measure will apply to the Proposed Action and all alternatives (applicable to Williams well pads only).

VISUAL RESOURCES

V-1 *Measure:* The following gathering pipeline segment will be relocated off the steep forested slopes: the pipeline from the well in Section 13, T.29N., R.115W., will be rerouted to follow the road to the proposed well in Section 18 T.29N., R.114W.

Effectiveness: Relocation of the pipeline would eliminate the most visually prominent pipeline cuts, and have a noticeable effect on reducing the combined visual change as seen from South Piney Creek Road and Snider Basin.

Application: This measure will be applied to the Proposed Action and all alternatives.

V-2 *Measure:* In forested areas, pipelines will cross existing roads in a configuration that provides visibility of only short segments of the corridor by making a jog soon before and after crossing. Deviations or exceptions based on slope or other technical problems must be approved by the Authorized Officer.

Effectiveness: This measure would reduce the extent of visibility of project facilities adjacent to sensitive viewpoints.

Application: This measure will be applied to the Proposed Action and all alternatives.

V-3 *Measure:* Where possible, power distribution lines in the well fields will be placed underground and located in the pipeline or road rights-of-way within ½ mile of sensitive viewpoints, including: Middle Piney Creek Road, South Piney Creek Road (including Snider Basin), Indian Creek/Coal Creek Road, Pine Grove Ridge Road and upper Beaver Dam Creek Road (in Section 3, 4, and 5, R.114W., T.27N.). Others may be determined by the Authorized Officer.

Effectiveness: This measure would reduce the negative influence created by a scattered maze of wood poles and electrical lines, such as now exists in portions of the well field presently under development. Undergrounding would have a significant effects in reducing the cumulative adverse visual change that would otherwise occur.

Application: This measure will be applied to the Proposed Action and all alternatives.

V-4 *Measure:* Wires, conductors, insulators, and towers of transmission lines will have a dull finish to reduce reflection and visibility of the structures. However, if the authorized officer determines that certain distribution lines should use nonreflective materials, then it may be required.

Effectiveness: This measure would reduce the visual contrast of proposed structures, particularly as seen from middleground and background viewing areas.

Application: This measure will be applied to the Proposed Action and all alternatives.

V-5 *Measure:* Where possible within the analyzed mile-wide corridors, transmission lines located along valley floors will be situated such that the structures follow the landform break or vegetative change between the valley floor and sideslopes to reduce the visibility of the structures.

Effectiveness: Such an alignment would make the lines less prominent and therefore, reduce both the facility and combined visual change impacts.

Application: This measure will be applied to the Proposed Action and all alternatives.

V-6 *Measure:* The UP&L transmission line segment running from the proposed Big Mesa plant site to the proposed substation will be relocated off the prominent ridge top location. It will run northeast from the proposed Big Mesa plant site to the Dry Piney Creek Road and follow the road to the substation site.

Effectiveness: Removing the line from this extensive and prominent landscape feature would greatly reduce the visibility of the transmission line. Facility impacts would be reduced to insignificant, and the combined visual change impacts in this area would also be diminished.

Application: This measure will be applied to the UP&L transmission alternative.

V-7 *Measure:* The companies will be required to remove litter including broken equipment, work trash, and other man-produced material, from well field units, plant sites, and other areas of operation. Litter will be disposed of in approved sites.

Effectiveness: This measure will minimize adverse visual impacts from litter in the Project area.

Application: This measure will be applied to the Proposed Action and all alternatives.

AGRICULTURE/GRAZING

AG-1 *Measure:* Construction will be scheduled during the months of April, May, and October to avoid conflicts with trailing sheep herds on the Slate Creek Sheep Trail. Timing will be determined by the Authorized Officer.

Effectiveness: This measure will reduce harassment to livestock and reduce the potential for livestock loss.

Application: This measure would be applied to the construction of all pipeline and transmission lines that would cross the Slate Creek Sheep Trail. These will include the following:

Proposed Action - Northwest's sour gas pipeline and plant water pipeline; Exxon's sulfur pipeline; and Exxon's and Quasar's transmission line.

Buckhorn - Same as Proposed Action.

Shute Creek - Northwest's sour gas pipeline and plant water pipeline; Exxon's sour gas pipeline, sulfur pipeline; and plant access road; and Exxon and Quasar's transmission line.

Northern - Exxon's sulfur pipeline and all companies' transmission line.

TRANSPORTATION

T-1 *Measure:* The companies will schedule their own and their contractors' large truck activities to avoid the following high recreation demand weekends. This will normally cover three-day periods.

- Memorial Day
- Independence Day
- Pioneer Day (July 24)
- Labor Day
- First two weekends of big game season

Effectiveness: This measure would eliminate the potential conflict between project vehicle activity and peak daily recreation travel demand associated with the high activity holiday weekends.

Application: This measure will be applied to the Proposed Action and all alternatives.

T-2 *Measure:* In spring and fall months when road moisture content is high, as determined by the Authorized Officer, the companies and their contractors will limit large truck activity in the well field to periods of frozen road conditions to protect the road beds.

Effectiveness: This measure will help preserve the stability of road beds and maintenance of travel surfaces.

Application: This measure will be applied to the Proposed Action and all alternatives.

T-3 *Measure:* The companies and their contractors will use front and rear vehicle escorts in the well field for oversized, overweight loads to maximize safety, as determined by the Authorized Officer.

Effectiveness: This procedure will help maximize the operational safety of equipment transport in the well field.

Application: This measure will be applied to the Proposed Action and all alternatives.

T-4 *Measure:* On federally permitted roads, stop signs and advance warning signs will be installed in areas of intersecting traffic, construction, or conditions of dangerous operation.

Effectiveness: The traffic control and informational signing will help minimize the potential for accidents at intersecting roadways.

Application: This measure will be applied to the Proposed Action and all alternatives.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

L-1 *Measure:* The railroad sulfur transport system will be located outside of the Seedskadee National Wildlife Refuge.

Effectiveness: Relocation of the proposed railroad would eliminate the impacts to riparian habitat within the Seedskadee National Wildlife Refuge and eliminate the conflicts with the habitat enhancement objectives of the Refuge.

Application: This measure will be applied to the Railroad Sulfur Transport Alternative for Exxon and American Quasar.

L-2 *Measure:* As determined by the Authorized Officer, the following will be required: the sulfur pipeline will be located along or as near as possible to existing roads or trails. Following construction, the right-of-way will be reclaimed in accordance with the Erosion Control, Revegetation, and Restoration Guidelines (Appendix B.7). Operation of the pipeline includes: (1) Monitoring—which will be limited to fixed-wing and helicopter patrol, vehicle via existing roads and foot patrol; and (2) Maintenance—which will be limited to four-wheel drive vehicle during summer and snow equipment during during periods of snow via closest existing road to pipeline segment needing maintenance. In the event required maintenance occurs during wet periods, causing soil/vegetation disturbance, reclamation of such areas will be required as soon as weather and seasonal conditions permit.

Effectiveness: Locating the sulfur pipeline along or as near as possible to existing roads or trails will greatly reduce and eliminate potential impacts to soils and vegetation. Monitoring and maintenance access requirements will also help eliminate associated potential soil, erosion, and vegetation impacts.

Application: This measure will be applied to the Proposed Action and all alternatives.

UNAVOIDABLE ADVERSE IMPACTS

Implementation of the BLM and FS-committed mitigation measures and the required federal measures (Appendix B) would reduce impacts associated with the project as proposed. Those impacts that would remain following mitigation are described below. Where there is no change in impacts from those described earlier in this chapter, discussion of the discipline is omitted (Wilderness, Recreation, and Cultural Resources).

SOCIOECONOMICS

Socioeconomic impacts which would be unavoidable stem from the differential effects of the project on different components of the population. Because the economic impacts of the project would affect different population groups in varying degrees, it is extremely difficult to accurately project such effects.

Some elderly individuals in the indigenous population of the area may suffer from price increases and additional competition for available housing and services. Likewise, some members of the agricultural and service sectors of the local economy may find it difficult to compete with the energy industry for skilled labor because of the variation of the wage levels.

Local businesses may find it difficult to hire and maintain employees given the increased competition for labor and the transient nature of many of the construction craftsmen. That is, even if a construction worker brings his family to the community, depending on the longevity of his work, other employed members of the family would leave the community when he does. This results in the additional problems of student turnover in the local schools.

The unavoidable adverse socioeconomic impacts are the provision of housing, public services, and human services in an adequate and timely manner for a somewhat transitory population. While many of the new residents of the region would remain to become employees in the operation and maintenance of the facilities, the construction work force would exceed the ultimate operational work force by approximately 2,000 workers in the peak years of 1985 and 1986. Adequate provision of services for this transient population must be managed. Service capacities in many areas (such as water, sewer, etc.) would have to be developed to at least marginally supply the needs of the peak population and this could result in excess capacity in the long term.

WILDLIFE AND FISHERIES

Mitigation measures would help to reduce the long-term impacts of habitat loss, poaching and wildlife harassment, direct mortality of wildlife and fishes, sedimentation of streams, and decreases in wildlife and fish populations. They would also speed the recovery of disturbed areas following construction and abandonment. However, mitigation measures are not expected to eliminate any of the significant impacts which have been identified. Impacts to wildlife and fisheries resulting from the combined effects of project activities are still expected to be significant and would be unavoidable.

HEALTH AND SAFETY

Health and safety mitigation measures would be effective in reducing the amount of H_2S released by a well blowout or pipeline rupture and the number of people potentially exposed to the H_2S. However, they would not reduce the frequency of well blowouts or pipeline ruptures. Therefore, an unquantifiable number of people could still be exposed to lethal or discomfort-causing doses of H_2S. This would be an unavoidable adverse import.

WATER RESOURCES

Mitigation measures for water resources are designed to reduce contamination of groundwater aquifers from the construction and operation of waste water reinjection wells and sedimentation of streams by runoff from construction sites. These measures would be effective in reducing potential impacts to surface and groundwater quality, but such impacts are not expected to be completely eliminated. Some unavoidable adverse impacts to water resources would remain.

AIR QUALITY

Operation of the Quasar gas treatment plant at the East Dry Basin site is expected to result in significant 24-hour average SO_2 impacts. Operation of the Quasar gas treatment plant at either the East Dry Basin or Buckhorn sites is also expected to result in significant half-hour average H_2S impacts. These impacts would be avoidable by applying additional sulfur removal techniques at the plant. BLM will stipulate compliance with PSD permit requirements as a condition of the right-of-way for the plant site.

Operation of all gas treatment plants could result in significant odor impacts (above 6.5 milligrams/cubic meter), depending on where the plants are sited (Northwest at East Dry Basin; Exxon at West Dry Basin, East Dry Basin and Big Mesa; and Quasar at East Dry Basin and Buckhorn). These odor impacts would be unavoidable.

SOILS AND VEGETATION

Mitigation measures to prevent disturbance of sensitive vegetation types (riparian) and rehabilitation units (saline-alkaline sites and sand dunes) would reduce adverse impacts to these resources. All disturbance can not be prevented, so some unavoidable adverse impact would still occur. However, any reduction in the number of acres disturbed would translate into a direct reduction in significant impacts.

Some vegetation loss and soil erosion along transmission line corridors would still occur with mitigation and would be an unavoidable adverse impact.

VISUAL RESOURCES

Proposed mitigation measures would reduce but not eliminate the visual impacts associated with pipelines and transmission lines. All visual impacts associated with the plant facilities, sulfur pipeline, employee housing, and the sulfur railroad would be unchanged. The potential visual maze created by transmission lines and pipeline cuts would be reduced but the residual impact from the project would still change the character of the study area, particularly in the northwest. The intensified oil and gas related changes in the Big Piney area would remain and create significant impacts to an area that is now appreciated for its scenic and natural features.

TRANSPORTATION

Significant transportation impacts are due largely to the amount of vehicle traffic generated by project activities, including truck transport of building materials as well as employee travel. The proposed mitigation measures would do little to reduce the absolute amount of this traffic. Traffic volumes during construction would still exceed roadway capacity and result in general slowdown of traffic and congestion at highway intersections along significantly impact roadway segments.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

The use of common rights-of-way would eliminate conflicts with BLM Management Framework Plans for Kemmerer, Pinedale, and Big Sandy Resource Areas. In areas where shared corridors are not economically feasible conflicts would remain. Corridors for which sharing would be appropriate have been only partially identified.

Proposed plans continue to conflict with the Comprehensive Plan for the City of Rock Springs and Sublette County. Zoning changes from these jurisdictions would be required before the project could proceed.

Mitigation measures would be effective in eliminating conflicts with management plans for the Seedskadee National Wildlife Refuge.

LONG TERM ENVIRONMENTAL CONSEQUENCES

TRENDS

Development of the Riley Ridge Project would move northward in the Western Overthrust Belt, those activities which are already underway to the south along this oil and gas-rich geological formation. Two recently completed gas treatment plants are located southwest of the study area, while other gas processing facilities are permitted and ready to begin construction or are in the process of having permit applications prepared. The proposed well field activities would take place along with on-going sweet gas and oil development as well as timber harvesting, both of which would continue to disturb lands during the early years of the Riley Ridge Project. The area is currently crossed by a variety of gas gathering lines and electric distribution lines with still others proposed. The oil and gas resources of the area are extensive and the commitment to extract them is fostered by the country's need for natural gas and a desire to be independent of foreign energy sources.

BENEFITS AND TRADE-OFFS

Short term is defined as the construction period of the project plus five years for site and right-of-way restoration. Long-term is defined as the remaining life of the project through abandonment and reclamation. Following completion of the project and reclamation of well sites, plant sites, and rights-of-way, no significant decreases in the productivity of the project area are expected. However, lands which are converted to permanent uses such as housing and roads would remain out of production. Many of the long-term impacts mentioned above would cease to be significant following project termination and reclamation. Those which would not be are discussed in the following section.

Benefits

- As proposed, the project would eventually produce 576 million cubic feet of gas per day that would be sold for commercial and residential uses.
- By products of the production process would be sulfur and CO_2. The CO_2 may be used as a medium for transporting coal or for enhanced oil recovery.
- The potential recovery of helium would increase this country's reserve of this rare commodity.
- Construction of the project would provide direct employment for 3,075 workers and employment in service and support sectors for an additional 2,000 workers. Permanent project employment would total approximately 1,000.
- Taxes generated by the project would be paid to the state and affected local area jurisdictions. These include severance taxes as well as property taxes. For those jurisdictions that would experience large increases in assessed valuation, the current mil rate could be reduced thereby lowering taxes paid by residents. Alternatively, the increased revenues could be used to improve local service systems.
- A relatively small percentage of the study area has been surveyed for cultural resource sites. Information gained during the project-generated inventory would contribute to knowledge of the area's history.
- Construction of roads in the well field would improve access to areas scheduled for timber harvest. The reduced cost of harvesting would benefit both commercial and private groups.

- The federal government and ultimately, the state of Wyoming and local communities would receive royalties from the production and sales of natural gas and sulfur. In addition, royalties from the sales of CO_2 would be recovered if an economic CO_2 market is identified.

Trade-Offs

- The increased population would require that local areas increase their numbers of administrative and service personnel. The increased demand for public services and facilities would increase local area expenditures.
- The project would temporarily affect 10,287 acres of critical big game range.
- Increased traffic due to truck activity and employee travel would result in increased traffic accidents. These accidents could involve project personnel as well as non-project, local area residents.
- The visual character of the project area, particularly in the northwest would be significantly changed. The changes would impact area residents and those who enjoy the area for its scenic and wilderness aspects.
- Development in the well field would result in long-term reduction in the amount of semi-primitive land. More lands would be classified as roaded-natural and show increasing evidence of human presence.
- Materials and energy consumed in project construction and operation would not be available for other uses.
- Project activities could potentially destroy some unknown historical or archeological resources.

IRREVERSIBLE/IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction and operation of the Riley Ridge Project and all alternatives could result in either the irreversible or irretrievable commitment of certain resources. An irreversible commitment of a resource is one which cannot be changed once it occurs; an irretrievable commitment means that the resource cannot be recovered or reused. Irreversible and irretrievable impacts are summarized in Table 4-107.

TABLE 4-107
SHORT-TERM AND LONG-TERM IMPACTS RESULTING FROM THE PROPOSED ACTION OR ALTERNATIVES

Resource	Irreversible Impacts	Irretrievable Impacts	Relationship of Short-Term Use of Environment and Long-Term Productivity
Wildlife & Fisheries	No	Yes	Big game production would be irretrievably lost during project construction, operation, and abandonment. This would amount to approximately 681 elk; 2,243 mule deer; 67 moose; and 585 pronghorn. In addition, an unquantifiable number of animals would be lost to poaching and road kills. Long-term losses in productivity, following reclamation are not expected to be significant.
Water Resources	Yes	Yes	Water utilized for well drilling and gas treatment plant operation would be irreversibly and irretrievably lost for all practical purposes. Water contaminated during the gas sweetening process could only be made suitable for other uses by expensive water treatment processes.
Air Quality	No	No	The emissions from the Riley Ridge Project would deteriorate the existing air quality in the project area, but not by any overall significant level.
Soils & Vegetation	No	Yes	Soils lost to increased erosion and vegetation production lost to conversion of land uses would be irretrievable losses. Soil erosion is expected to be limited to the first 5 years following construction due to implementation of reclamation measures. Vegetation production would be lost during construction, operation, and for 2 to 5 years following abandonment and reclamation. Significant long-term impairment of productivity is not expected.
Visual Resources	No	No	Significant visual impacts would exist for the life of the project or longer until structures are removed and revegetation is complete. Removal of structures and rehabilitation of the landscape could restore the natural landscape following project abandonment.
Cultural	Yes	Yes	Disturbance of historic trails or disruption of cultural sites could result in the permanent loss of historical data.
Recreation	No	Yes	Recreational opportunities in the short term would be altered due to increased demand from a larger local population. Hunting and fishing would be the activities most noticeably impacted. Following completion of project construction and the associated decline in population, crowding of local areas should diminish and opportunities for enjoyment of the area's natural resources restored.
Wilderness	No	Yes	The quality of the wilderness experience would be decreased in the short term, but through long-term restoration of vegetation and decreased presence of humans, wilderness values would be restored.
Agricultural	No	Yes	Temporary destruction of forage and change in grazing patterns could alter allotment plans. Long termed productivity would not be impaired.
Timber	No	Yes	Removal of timber would be a temporary impact. Following abandonment and reseeding productivity would be restored.

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GLOSSARY

ACRE-FOOT - The amount of water necessary to cover 1 acre to a depth of 1 foot, equalling 43,560 cubic feet.

ANIMAL UNIT MONTH - The amount of forage a cow and a calf (6 months of age and under) would consume in 1 month. This unit is used to calculate carrying capacity and serves as a basis for grazing fees.

ANTICLINE - A fold or arch of rock strata dipping in opposite directions from an axis.

APPLICANTS - In this environmental impact statement, "applicants" refers to American Quasar, Exxon, Mobil, Northwest Pipeline, and Williams Exploration.

AQUIFER - One or more formations that contain sufficient permeable material to yield significant quantities of water to wells and springs.

BACKFILL - Earth replaced after being excavated during construction.

BASELINE - Air quality, water quality, meteorological, wildlife, etc. data used as a starting point in estimating impacts.

BENTHIC - A bottom-dwelling species.

BENTHIC MACROINVERTEBRATE - An animal that can be seen with the naked eye, that does not have a backbone, and lives in or on the bottom of a body of water.

BERM - A slightly rounded crown of soil provided over the pipeline trench to compensate for settling of the backfill.

BENTONITIC CLAY - An absorptive and colloidal clay used as a filler.

BLOCK VALVE - A valve that can be shut off automatically, manually, or remotely to prevent flow in either direction, as in a pipeline.

BLOWDOWN - The process whereby 5 to 10 percent of the water within a wet-type cooling tower is continually drained off and replenished with a fresh supply to prevent excessive concentration of certain salts, minerals, and other constituents within the system.

BLOWOUT - The high pressure, sometimes violent, and uncontrolled ejection of water, gas, or oil from a borehole.

BORROW PIT - A pit from which earthen materials are excavated for use elsewhere.

CATEGORICAL EXCLUSION - A category of actions which do not individually or cumulatively have a significant effect on the human environment and which have been found to have no such effect in procedures adopted by a federal agency in implementation of these regulations and for which, therefore, neither an Environmental Assessment nor Environmental Impact Statement is required.

CATALYST - A substance that initiates a chemical reaction and enables it to proceed under milder conditions than otherwise possible.

CATHODICALLY PROTECTED - Protected against corrosion by means of a weak electric current applied to the pipeline to offset the galvanic action causing metal corrosion.

COATING - A field operation for preparing a pipeline to be lowered into the ditch. The line is coated with an inert material, then spiral-wrapped with a tough, inert wrapper. Machines ride the pipe, and coat and wrap in one continuous operation. This process protects the pipeline from corrosion. For some pipeline jobs the pipe may be coated and wrapped at a mill or construction yard site. Any damage to the coating from transportation or handling can be corrected before the pipe is installed.

CONTRAST - The difference between adjacent parts in color and form, as used in BLM VRM System.

CONTRAST RATING, BLM - A method of determining the extent of visual impact for an existing or proposed activity that will modify any landscape feature (land and water form, vegetation, and structures).

CORRIDOR - For purposes of this EIS, a mile-wide strip of land within which a proposed facility would be located.

CULTURAL RESOURCES - Remains of human activity, occupation, or endeavor, as reflected in sites, buildings, artifacts, ruins, etc.

DECIBEL - A unit for expressing the relative intensity of sounds on a scale from 0 (for the average least perceptible sound) to about 130 (for the average pain level).

DISPERSED RECREATION - Camping in undeveloped sites and informal daytime recreation.

EMISSIONS - A discharge of pollutants into the environment, generally used in regard to release of gaseous or particulate materials into the atmosphere.

ENDANGERED - Any species that is in danger of extinction throughout all or a significant portion of its range (Endangered Species Act 1978).

EPHEMERAL STREAM - A stream that flows only in direct response to precipitation in the immediate watershed or in response to the melting of a cover of snow and ice, and which has a channel bottom that is always above the local water table.

FAULT (Geotechnical) - Fracture in the earth's crust accompanied by a potential shifting of one side of the fracture in relation to the other side.

FAULTING - The process of producing a fault, a surface or zone of rock fracture along which there has been displacement. Faulting generally extends into unconsolidated sediments on top of the faulted rock.

FREE WATER KNOCKOUT - Removal of liquid water from the gas stream.

FLUME - An inclined chute for carrying water.

FUGITIVE DUST - Airborne particulate matter composed of soil resulting from industrial activity.

HYDROSTATIC TESTING - Filling a pipeline with water under pressure to test for tensile strength (its ability to hold pressure without rupturing).

IMPACT - The results of an action on the environment; the impact may be primary (direct) or secondary (indirect).

INERT GASES - Gases with few or no active properties.

INFRASTRUCTURE - The facilities, equipment, and services needed for a community to function. It includes roads, sewers, waterlines, police and fire protection, schools, etc.

INHIBITOR FLUID - Fluid which represses corrosion.

INJECTION WELL - A well to inject waste water into a deep geologic strata.

INTAKE - The place at which a liquid (primarily water) is taken into a pipe, channel, etc.

INTERMITTENT STREAM -

a. A stream or reach of a stream that drains a watershed of at least one square mile, or
b. A stream or reach of a stream that is below the local water table for at least some part of the year, and obtains its flow from both surface runoff and ground-water discharge.

LINEAR FACILITIES - Access roads, pipelines, railroads, and electric trans mission lines which are part of the Riley Ridge Project.

LOW-BTU GAS - (British thermal unit - a unit of heat equal to about 252 calories). Gas which contains less than 900 BTUs per standard cubic foot. Sour gas from a Riley Ridge well contains approximately 250 BTUs/SCF.

LOW GRADIENT STREAMS - Characterized by the majority of the stream having a moderate to slow current.

MACROINVERTEBRATE - A species without a backbone which can be observed without the aid of a microscope.

MACROPHYTE - A plant large enough to be seen by the naked eye, especially one in an aquatic habitat.

MANAGEMENT FRAMEWORK PLAN - A Bureau of Land Management land use planning document.

MICROGRAM - One millionth of a gram.

MITIGATION - Includes:

a. Avoiding the impact altogether by not taking a certain action or part of an action.
b. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
c. Rectifying the impacts by repairing, rehabilitating, or restoring the affected environment.

MULCH - Materials such as wood chips or straw on the soil surface to prevent evaporation or erosion or to enrich the soil.

NATIONAL REGISTER OF HISTORIC PLACES - A list of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture.

NATIONAL WILDERNESS PRESERVATION SYSTEM - A national listing of undeveloped federal lands, designated by Congress, to protect and preserve its wilderness resource values.

NEPA - National Environmental Policy Act.

NONATTAINMENT AREA - A "prevention of significant deterioration" area designated by EPA that exceeds the national ambient air quality standards for any of the six criterion pollutants.

OLIGOTROPHIC - Deficient in plant nutrients.

OVERTHRUST BELT - A portion of the North American Overthrust Belt whose proven and potential oil and gas resources lie in a generally north- south direction extending from Canada to Mexico, specifically, through Montana and along the western boundaries of Wyoming, Colorado, and northern Utah.

PERENNIAL STREAM - A stream or part of a stream that flows continuously during all of the calendar year as a result of groundwater discharge or surface runoff. The term does not include *intermittent stream* or *ephemeral stream*.

PHOTOCHEMICAL OXIDATION - A chemical reaction influenced or initiated by light, particularly ultraviolet light.

POTABLE - Drinkable.

POTENTIOMETRIC HEAD - A surface that represents the static water level in an aquifer.

PROVEN RESERVES - The current estimated quantity of gas which geologic and engineering data demonstrate to be recoverable from known reservoirs under existing economic and operating conditions.

RADIOGRAPHIC EXAMINATION - An X-ray or gamma ray photograph.

RAPTOR - Predatory bird, such as the eagle, hawk, and owl.

RARE - Species classified by the State of Wyoming and reviewed by State agencies in categories implying potential extinction throughout all or a significant portion of its range, especially extirpation within the respective State.

RECREATION RESOURCES - Formally designated areas and informal dispersed areas that are managed by federal, state and local agencies in order to preserve and further their use for play, amusement, or relaxation.

RECREATION VISITOR DAY - A 12-hour period of recreation.

REHABILITATION UNIT - A theoretical unit of land identifiable by similar response to use and management. Rehabilitation units are determined by similarities in sets of soils, slopes, climatic regimes (both temperature and precipitation), and geomorphic position. The concept is somewhat similar to that of the Land Capability Classification system developed by the Soil Conservation Service.

RIPARIAN HABITAT - A vegetative habitat comprised of trees, shrubs, grasses, or forbs distributed in narrow strands on the banks or floodplains of streams or rivers.

RIPRAP - A foundation or erosion control devise consisting of rocks thrown together without order.

SALINE SOIL - A soil containing soluble salts in a concentration that impairs growth of plants.

SCENIC QUALITY CLASS, BLM - The value (A, B, or C) assigned a scenic quality rating unit by applying the scenic quality evaluation key factors which indicate the relative visual importance of the unit to the other units within the physiographic region in which it is located.

SCOPING MEETING - A public meeting designed to determine significant environmental issues and concerns related to a proposed action.

SCOUR ACTION - Water's ability to remove ground through flow of a powerful current.

SEEN AREA - That portion of the landscape which can be viewed from one or more observer positions. The extent or area that can be viewed is normally limited by land form, vegetation, or distance.

SELEXOL UNIT - A unit for physically separating sour gas into sweet gas (CH_4 and N_2) and acid gas (H_2S and CO_2) streams. The process is proprietary.

SENSITIVE - Species not yet officially listed as rare under the Rare and Endangered Species Act but which are undergoing a status review or are proposed for listing according to *Federal Register* notices published by the Secretary of the Interior or the Secretary of Commerce, or according to comparable state documents published by state officials.

Species whose populations are consistently small and widely dispersed, or whose ranges are restricted to a few localities, such that any appreciable reduction in numbers, habitat availability, or habitat condition might lead toward extinction and require effective and aggressive programs to help minimize the chance of official listing.

SHALLOW SOIL - A soil overlying bedrock that is within 20 inches of the surface.

SHUT-IN WELL - A well which is not currently producing natural gas but which may be brought into production in the future.

SPREAD - A group of construction personnel and equipment assembled to do a major construction job. The workers and equipment are dispersed along the right-of-way.

STIPULATION - A legal requirement.

STRINGING PIPE - Placing sections of pipe end to end along a pipeline right-of-way in preparation for welding the joints together to form a pipeline.

STRUTTING GROUND - A specific geographic area where a group of male sage grouse perform courtship displays in the presence of a group of females. Strutting grounds are typically used many years in succession.

TAIL GAS - A gaseous stream flowing out of the piece of equipment being discussed.

THREATENED - Any animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

TOPSOIL - The surface tilled layer in cultivated areas or the uppermost layer of soil containing organic material (A horizon).

TOPSOIL STRIPPING - Removal of topsoil so that it can be saved (stockpiled) for future reclamation.

TURBID - Muddy or cloudy water resulting from disturbance of the sediment and its suspension in the water column.

UNDERSTORY - An underlying layer of low growing vegetation.

VARIETY CLASS, USFS - A particular level of visual variety or diversity of landscape character.

VIEWER CONDITION - Measure of number of viewers and their concern for an area. (Sensitivity level -BLM, USFS.)

VISUAL QUALITY OBJECTIVE, USFS - A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

VISUAL RESOURCE MANAGEMENT - The planning, design, and implementation of management objectives to provide acceptable levels of visual impacts for all resource management activities.

VISUAL RESOURCE MANAGEMENT CLASS, BLM -The degree of visual change that is acceptable within the characteristic landscape. It is based upon the physical and sociological characteristics of any given homogeneous area and serves as a management objective.

VISUAL SENSITIVITY LEVEL(S) - An index of the relative degree of user interest in scenic quality and concern and attitude for existing or proposed changes in the landscape features of an area in relation to other areas in the planning unit.

WILDERNESS - An area formally designated by Congress as part of the National Wilderness Preservation System.

WILDERNESS OPPORTUNITY SPECTRUM (WOS)- Provides a framework for defining the types of wilderness recreation opportunities the public might desire (i.e., pristine, primitive, semi-primitive, and transitional).

WILDERNESS STUDY AREA - A roadless area or island that has been inventoried and found to have wilderness characteristics (on public lands administered by the Bureau of Land Management) as described in Section 603 of the Federal Land Policy and Management Act of 1976 and Section 2(c) of the Wilderness Act of 1964 (78 Stat. 891).

WIND ROSE - A 360-degree circle broken into 16 equal sectors used for displaying frequency distributions of wind speed and direction.

Abbreviations

AADT -Annual average daily traffic.
ACEC -Area of critical environmental concern.
ACGIH -American Council of Governmental Industrial Hygienists.
ADT -Average daily traffic.
APD -Application for a permit to drill.
AQRV -Air quality related values.
AUM -Animal unit month.
BLM -Bureau of Land Management.
BuRec -Bureau of Reclamation.
cfd -Cubic feet per day.
CFR -Code of Federal Regulations.
CO -Carbon monoxide.
COE -Army Corps of Engineers.
COS -Carbonyl sulfide.
CU Plan -Construction and Use Plan.
dBA -Decibels on the A-weighted scale.
DEIS -Draft Environmental Impact Statement.
DEQ -Department of Environmental Quality (Wyoming).
EA -Environmental Assessment.
EPA -U.S. Environmental Protection Agency.
ERT -Environmental Research & Technology, Inc.
FEIS -Final Environmental Impact Statement.
FS -Forest Service.
FWS -Fish and Wildlife Service.
He -Helium.
H_2S -Hydrogen sulfide.
HCs -Hydrocarbons (non-methane).
HF -Hydrogen fluoride.
HQI -Habitat quality index.
ISA -Instant study area.
MEG -Multimedia Environmental Goal.
MFP -Management Framework Plan.
mg -Milligrams.
MMS -Minerals Management Service.
MOU -Memorandum of Understanding.
MW -Megawatt.
NA -Not applicable.
NAAQS -National Ambient Air Quality Standards.
NEPA -National Environmental Policy Act.
NO_x -Nitrogen oxides.
NO_2 -Nitrogen dioxide.
NPDES -National pollutant discharge elimination system.
NPS -National Park Service.
NRHP -National Register of Historic Places.
NWPS -National Wilderness Preservation System.
ORV -Off-road vehicle.
PSD -Prevention of significant deterioration.
RARE II -Second Roadless Area Review and Evaluation.
RN -Roaded natural.
ROS -Recreation opportunity spectrum.
ROW -Right-of-way.
RVD -Recreational visitor day.
SCS -Soil Conservation Service.
SHPO -State Historic Preservation Office.
SO_2 -Sulfur dioxide.
SPM -Semi-primitive, motorized.
TEG -Triethylene glycol.
TLV -Threshold Limit Value
TSP -Total suspended particulates.
μG -Microgram.
UP -Union Pacific Railroad.
UP&L -Utah Power and Electric.
USGS -U.S. Geological Survey.
USLE -Universal Soil Loss Equation.
VMR -Visual Management Resource.
VMT -Vehicle miles traveled.
VOC -Volatile organic componds.
VRM -Visual Resource Management.
WAAQS -Wyoming Ambient Air Quality Standards.
WGF -Wyoming Game and Fish Department.
WOS -Wilderness Opportunity Spectrum.
WRC -Western Research Corporation, Inc.
WSA -Wilderness Study Area.
WSHD -Wyoming State Historical Department.

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APPENDICES

APPENDIX A

CONSULTATION AND COORDINATION

SUMMARY OF PROJECT SCOPING

An EIS must be prepared when a federal government agency considers approving an action within its jurisdiction which may result in significant impacts to the human environment. EISs aid federal officials in making decisions by presenting the environmental facts on a proposed project and its alternatives. The first step in preparing an EIS is to determine the scope of the project and the range of actions, alternatives, and impacts to be included in the document.

The Council on Environmental Quality regulations (40 CFR, Parts 1500–1508) require an early scoping process to determine the significant issues related to the proposed action and alternatives which should be addressed in the EIS. The principal purpose of the scoping process is to identify important issues, concerns, and potential impacts that require detailed analysis in the EIS and to eliminate insignificant issues and alternatives from detailed analysis. Scoping makes the EIS process more efficient by reducing paperwork and time spent on unimportant areas while focusing on the important ones.

METHOD OF SCOPING

The scoping process for the Riley Ridge Project consisted of public meetings, agency meetings, mailouts for written comments, and informal conversations with interested parties within the affected area. With the assistance of federal and state agencies, local entities, and private individuals, the significant issues and concerns were identified for analysis in the EIS. Insignificant issues were also identified so that they could be eliminated from the scope of the EIS.

In the early stages of the project (September 1981), informative discussions were held with local residents in the project area (Big Piney and Pinedale). As a result of these discussions, preliminary issues were identified, and attendance at the forthcoming public meetings was encouraged. The dates and times for Riley Ridge Project public scoping meetings and the availability of background information were publicized within the affected area through newspaper, radio, and television. This information was also published in the *Federal Register*. Notification of the meetings was sent to federal and state government organizations and other potentially interested groups within the area.

Detailed questionnaires were mailed to federal and state agencies having concerns in the area of the proposed project. These questionnaires were used to determine what action, if any, each agency would be taking, and the laws, regulations, and authorities under which a specific action would be taken. The questionnaires also requested information on any proposed regulations which could affect the project, alternatives which the agencies felt should be considered, and issues which they felt were significant. A meeting with the involved agencies and the companies was held in Cheyenne prior to the public meetings to discuss the various actions, regulations, and issues which could affect the scope of the EIS.

Public meetings were then conducted in Cheyenne, Kemmerer, Pinedale, and Big Piney, Wyoming on November 2, 3, 4, and 5, 1981, respectively. Interested individuals, groups, and local agencies were given the opportunity to voice their concerns and raise issues which they felt merited consideration in the EIS.

The basic format of the scoping meetings consisted of a description of the EIS and scoping processes, a description of the Riley Ridge Project, and a question and answer session. An information packet covering the major points of the project was given to each attendee. After the initial presentation, attendees formed work groups to discuss issues associated with the project. Each group recorded all issues raised on flip charts. Then each individual listed on work sheets the three issues he/she felt were most significant. These sheets were collected at the end of the meeting and used to define the scope of the EIS.

In addition to the public scoping meetings, a scoping session (open to the public) consisting of a field trip and meeting was held with the Rock Springs BLM District Multiple Use Advisory Board on November 4 and 5. Issues were also identified by board members.

The size of the Riley Ridge Project expanded considerably after these scoping meetings were held. Therefore, the Wyoming State Office of the BLM mailed out news releases and revised project descriptions describing the changes in the project and inviting more public comments regarding the project scope, issues, and concerns. This information was sent to all interested persons as well as all attendees of the public scoping meetings. Responses were received from this mail-out around July 1, 1982, and were included in the determination of the scope of the EIS.

RESULTS OF SCOPING

The results of the scoping process along with further input from various federal and state agencies identified the most significant issues associated with the project; these issues have been covered in detail in the EIS. In identifying issues, individuals were asked to prioritize their issues into what they thought were of first, second, and third importance. In addition, other issues were also raised which were not given priorities. This information was consolidated, grouped by resource topic, and put in tabular form. Within each resource topic, the issues were listed in order of importance as determined by the number of persons indicating the issue as a high priority. Finally, the total number of votes given that resource topic as a high priority issue was calculated.

From these results it was determined that the most significant issues were within the following resource topics (listed in order of overall significance):

1. Socioeconomics
2. Wildlife
3. Health and Safety

Under socioeconomics, effects to communities and people within the study area from project activities (construction personnel, etc.) were identified as a significant issue. The area has experienced boom-type growth in the past from energy development and is thus sensitive to any similar future developments.

Under wildlife, effects to wildlife and wildlife habitat (especially within the well field) are a major concern to the FS, BLM, Fish and Wildlife Service, Wyoming Game and Fish Department, and the general public. The well field lies in an area which is critical habitat (i.e., winter range, calving areas, etc.) for elk, deer, and moose. Hunting is an important recreational activity in Wyoming. Development of all types has reduced the amount of winter habitat for big game. Feed grounds have been utilized to compensate for lost habitat; however, the quantity and quality of big game herds has been affected. The well field area encompasses one of the last natural wintering areas in the Upper Green River Valley for elk.

Under health and safety, effects to the health and safety of humans from the presence of hydrogen sulfide (H_2S) is an issue to the general public and the BLM. The sour gas, as taken from the wells, contains a small percentage of H_2S which is toxic. A recent blowout at one of the exploratory wells has raised the public consciousness to the dangers of handling H_2S. Potential areas where hazards from H_2S are possible are at the wells, pipelines, and treatment plants.

Results of this scoping effort are published in a report entitled *Public Concerns and Scope of EIS*, which is available from BLM, Division of EIS Services, 555 Zang Street, First Floor East, Denver, Colorado, 80228.

PUBLIC INVOLVEMENT

In the course of preparation of the draft EIS for the Riley Ridge Project, the joint lead agencies (BLM and FS) have communicated with and received input from many federal, state, and local agencies; elected representatives; environmental and citizens groups; industries; and individuals. Many of these people participated in the public scoping meetings which were held in November 1981. The following agencies, groups, and individuals have provided input and/or will receive copies of the DEIS.

FEDERAL GOVERNMENT AGENCIES

Department of Agriculture
  Soil Conservation Service
Department of the Army
  Corps of Engineers
Department of Commerce
  National Oceanic and Atmospheric Administration
Department of Energy
Department of Housing and Urban Development
Department of the Interior
  Bureau of Indian Affairs
  Bureau of Mines
  Bureau of Reclamation
  Fish and Wildlife Service
  National Park Service
  Geological Survey
Department of Transportation
Federal Energy Regulatory Commission
Interstate Commerce Commission
Environmental Protection Agency
Advisory Council on Historic Preservation

STATE GOVERNMENT AGENCIES

Wyoming:
  Conservation Commission
  Department of Agriculture
  Department of Economic Planning and Development
  Department of Environmental Quality
    Air Quality Division
    Solid Waste Management
    Water Quality Division
  Energy Conservation Office
  Geological Survey
  Office of the Governor
  Office of Industrial Siting Administration
  Oil and Gas Conservation Commission
  Public Service Commission
  Recreation Commission
  State Engineer's Office
  State Forestry Division
  State Game and Fish Department
  State Highway Department

State Historical Preservation Office
State Planning Coordinator's Office
Water Development Commission

LOCAL GOVERNMENTS

- Lincoln County:
  - Board of Commissioners
  - Planning Office
  - Representatives
  - Lincoln-Uinta Association of Governments
  - South Lincoln County Public Health Nurse
  - Town of Kemmerer
  - Town of Opal
- Sublette County:
  - Commissioner
  - School District #9
  - Sheriff
  - Superintendent of Schools
  - Zoning Office
  - Town of Big Piney
  - Town of Marbleton
  - Town of Pinedale
- Sweetwater County
  - Town of Granger

U.S. SENATORS AND REPRESENTATIVES FOR WYOMING

WYOMING STATE LEGISLATURE

ENVIRONMENTAL GROUPS

Defenders of Wildlife
Sierra Club
Sweetwater County Wildlife Association
Wyoming Outdoor Council
Wyoming Wildlife Federation

INDUSTRIES AND INDIVIDUALS

(Detailed list available upon request from Janis VanWyhe, BLM, Division of EIS Services, Denver, CO)

APPENDIX B

REQUIRED FEDERAL MEASURES AND APPLICANTS' STANDARD OPERATING PROCEDURES DESIGNED TO REDUCE ENVIRONMENTAL IMPACTS

B.1 APPLICANTS' STANDARD OPERATING PROCEDURES

The applicants have stated that the following procedures will be followed in the construction, operation, and abandonment of the proposed Riley Ridge Project.

- *Drilling.*

  Solid wastes generated during drilling operations and testing would be incinerated as approved by the regulatory agencies or trucked to an approved sanitary landfill. At the conclusion of the drilling operation, or as needed, ash would be removed from the incinerator and placed in an approved sanitary landfill with non-combustible wastes. Any scrap metal would be sold to a recycling firm. Sewage would be handled according to state sanitary codes. At the conclusion of drilling operations, all sewage and waste would be removed from the site and taken to an approved sewage treatment plant or sanitary landfill.
- All above-ground facilities, foundations, and salvageable materials would be removed. Soil material would be restored over the well and the site returned to its original contour as soon as the well abandonment was completed. Each completed well site would be reseeded by the next growing season using techniques and methods described in the Erosion Control, Revegetation and Reclamation Program.
- Cement plugs would be placed at designated depths in the well to prevent migration of water or hydrocarbons and to protect any freshwater aquifers from contamination in accordance with applicable state and federal regulations.
- *Pipeline Construction.*

  Construction activities would be confined to the construction right-of-way along the length of the gathering lines, trunk lines, and sales lines. Only those portions of the right-of-way needed for construction would be cleared of obstacles and debris.
- Blading of the right-of-way would only be done as necessary for access for machinery and equipment, or for the trenching required for the installation of pipe. To further ensure vehicle safety, it may be necessary to construct temporary bridges or culverts across creeks and gullies on the working side of the right-of-way. Excavation and grading may be necessary to decrease the gradient and increase the stability of unstable slopes, especially in the steep terrain found in the well field. Grading and cut-and-fill excavation would be performed in a manner minimizing effects on natural drainage and slope stability. On steep terrain or in wet areas where the right-of-way must be graded at two elevations, or where diversion dams must be built to facilitate construction, the areas would be stabilized and restored upon completion of construction to resemble their original condition, or as required by the surface management agency or private landowner.
- Where fences are encountered along the right-of-way, adequate bracing would be installed at each edge of the right-of-way prior to cutting the wires and installing temporary gates. The opening would subsequently be controlled as necessary during construction. No gates or cattleguards on established roads over public land would be locked, blocked, or closed by the applicants. Any cattleguard damaged would be repaired to its original condition or replaced. If a natural barrier used for livestock control were damaged during construction, the applicant would adequately fence the area to prevent the escape of livestock.
- The depth of the pipeline ditch would vary with the conditions encountered. The cover from the top of the pipe to the ground level would generally be 2.5 to 5 feet. However, in areas where rocks would be removed by blasting, the cover would be 24 inches in populated areas and 18 inches in open country. At railroad and road crossings, specifications require a minimum of 3 feet of cover over the pipe at the drainage ditches along the roadbed. Working areas of approximately 100 by 350 feet would be needed on each side of road and railroad crossings.
- Generally, ditching operations would employ ditching machines in open areas and backhoes near rivers or in areas providing little working space; however, subsurface conditions may require different types of excavation. In areas where loose or unconsolidated rock is encountered, the ditch line may be ripped mechanically. If material encountered could not be ripped, it would be blasted. Blasting would be kept to a minimum and used only when necessary. An exception to mechanical excavation would be hand-digging to locate buried utilities such as other pipelines and cables.
- If blasting is necessary, the following safety precautions would be adhered to:

  1) In areas of human use, shots would be blanketed (matted).
  2) Landowners or tenants in proximity to the shot would be notified in advance so that livestock and other property could be adequately protected.

3) Before detonation, a clearance would be made to ensure that construction personnel and equipment and local residents are in no danger.
4) Fire protection measures would be implemented.

- Where buried utilities are encountered, representatives from the utilities would be consulted regarding the proposed route of the pipeline right-of-way.
- When crossing canals or irrigation ditches that are dredged to maintain depth, the pipeline would either span overhead or be buried underneath to a depth that would permit safe dredging operations.
- Roadbeds that support railroads would be crossed by boring a hole beneath the bed, rather than by ditching across the surface. All paved and improved roads would be crossed by boring where conditions permit. Other infrequently used, unimproved roads would be ditched and restored.
- Where the pipeline crosses rivers, the river crossing points would be carefully selected to minimize disturbance of riverbeds or banks.
- Creek flow would be maintained during pipeline construction. When crossing creeks with muddy bottoms, downstream sedimentation would be minimized by implementation of the following techniques: (1) Creeks flowing in areas where the channel is narrow would have the flow diverted around the construction area by blocking the channel upstream of the crossing site and diverting the flow through the use of pumps and/or flumes; (2) Creeks flowing in relatively flat areas where the channel is wide would have the flow diverted around the construction area by blocking a portion of the channel upstream of the crossing site. After construction is completed in that portion of the channel and the creek bottom is restored, then that portion of the channel would be reopened and the other portion blocked for construction.
- Every effort would be made to minimize the effects of construction on water flow. Upon completion of construction, the gradient of the stream would be restored as nearly as practical. Stream banks would be restored to resemble original grade, and breakers or riprap would be placed along riverbanks where necessary to control erosion.
- During construction of river crossings, the drainage or storm runoff from riverbank staging areas would be controlled via detention basins, evaporation pits, or straw bale filters to ensure that levels of suspended solids, grease, or oil would not exceed receiving water standards.
- Once the ditch has been backfilled, the right-of-way and other disturbed areas would be cleared of trash, brush, and other debris to prevent fire hazards. Some brush would be used to assist in stabilization and rehabilitation of the right-of-way. The right-of-way would be graded where needed, and all disturbed surfaces would be restored approximately to the preconstruction grade.
- Completed construction areas (including the right-of-way) and temporary access roads would be returned as nearly as practicable to the original condition or to that condition agreed upon between the applicant and the landowners or the authorized officer of the applicable agency. Right-of-way restoration techniques would be the same for federal, state, and private lands. All reasonable efforts would be made to control erosion and soil damage resulting from construction, rehabilitation, or maintenance and operations, including (but not limited to) construction of terraces, water bars, or other water diversion structures, and implementation of soil stabilization measures in erosion-prone areas.
- Routine aerial reconnaissance flights along pipelines would continue for the life of the project to check for erosion problems and revegetation success as well as possible gas leaks.
- *Sulfur Pipeline.*

  Overhead clearance warning structures would be placed on secondary roads prior to the sulfur pipeline crossings.
- Specific construction techniques would be selected for each creek crossing that would minimize erosion and siltation. Where the creek has a solid gravel base, permission would be requested for vehicle crossings; where an access road is in proximity, the existing access road would be used. Where the flow is too deep for vehicles to cross or the creek has a muddy bottom and there is no access road in proximity, flume pipes would be installed in the creek bottom and a roadway constructed on top for vehicle passage.

  Where the pipeline would cross creeks, the supports would be located and would be of such a depth, that high water would not affect the pipeline through scour action. Construction of creek crossings would be made in a manner that minimizes the effects of construction on water flow. The gradient of the stream would be maintained by removing all spoil from the creek bed upon completion of construction, and the creek banks would be restored.
- The right-of-way would be rehabilitated following construction. During the operation phase of the project, the right-of-way would be allowed to revegetate with shrubs; however,

trees growing where they could fall across the pipeline would be removed as necessary.

- *Other.*
  Other warning vehicles would accompany mobile heavy equipment on roads used by the public; signs would be installed warning the public of equipment operation areas.
- Quasar, Exxon, and Northwest would dispose of miscellaneous solid waste in an off-site approved sanitary landfill which has not been identified. Scrap metal produced by project construction would be sold to a recycling firm. Used oils, lubricants, and solvents generated during both the construction and operations phase of the project would be collected in tanks on the plant site until sufficient quantities are accumulated to sell these wastes to a re-refining firm.
- When the transmission line is complete, work areas would be cleaned and all trash collected. Dirt piles would be smoothed out; areas which have been cleared may be scratched and reseeded, if needed; and any access roads would be reclaimed.
- Operation of the transmission lines would involve patrolling the lines every month by fixed-wing aircraft, every six months by helicopter, and every year by foot patrol.

B.2 FEDERAL REGULATIONS: TERMS AND CONDITIONS

CODE OF FEDERAL REGULATIONS (CFR)

These (right-of-way, permits, leases and/or unit operations - APDs) will be subject to all applicable regulations contained in 43 CFR 2800, 2880, 3100 and 30 CFR 221 as they now exist or as they may hereafter be revised. The titles of the specific regulatory sections are as follows:

43 CFR
- 2800 - Rights-of-Way, General.
- 2801 - Terms and Conditions of Rights-of-Way Grants and Temporary Use Permits.
- 2880 - Oil and Natural Gas Pipelines and Related Facilities, General.
- 2881 - Terms and Conditions of Rights-of-Way Grants, and Temporary Use Permits.
- 3100 - Oil and Gas Leasing.

30 CFR
- 221 - Oil and Gas Operating Regulations.

The holder/operator will abide by these regulations and is fully responsible for the action of his/her subcontractors. The subject regulation terms and conditions are listed in part for the benefit of the reviewing public.

43 CFR
PART 2800 - RIGHTS-OF-WAY, PRINCIPLES AND PROCEDURES
Subpart 2800 - Rights-of-Way, General.
Subpart 2801 - Terms and Conditions of Rights-of-Way Grants and Temporary Use Permits.
2801.1 Nature of Interest.
2801.101 Nature of Right-of-Way Interest.

A. All rights in public lands subject to be a right-of-way grant or temporary use permit not expressly granted are retained and may be exercised by the United States. These rights include, but are not limited to:

   1. A continuing right of access onto the public lands covered by the right-of-way grant or temporary use permit, and upon reasonable notice to the holder, access and entry to any facility constructed on the right-of-way or permit area.
   2. The right to require common use of the right-of-way and the right to authorize use of the right-of-way for compatible uses (including the subsurface and air space).

B. A right-of-way grant or temporary use permit may be used only for the purpose specified in the authorization. The holder may allow others to use the land as his/her agent in exercising the rights granted.

C. All right-of-way grants and temporary use permits shall be issued subject to valid existing rights.

D. A right-of-way grant or temporary use permit shall not give or authorize the holder to take from the public lands any mineral or vegetative material, including timber, without securing authorization under the Materials Act (30 U.S.C. 60 et seq.), and paying in advance the fair market value of the material cut, removed, used, or destroyed. However, common varieties of stone and soil necessarily removed in the construction of a project may be used elsewhere along the same right-of-way or permit area in the construction of the project without additional authorization and payment.

E. A holder of a right-of-way grant or temporary use permit may assign a grant or permit to another, provided the holder obtains the written approval of the authorized officer.

F. The holder of a right-of-way grant may authorize other parties to use a facility constructed, except for roads, on the right-of-way with the prior written consent of the authorized officer and charge for such use. In any such arrangement, the holder shall continue to be responsible for compliance with all conditions of the grant. This paragraph does not limit in any way the authority of the authorized officer to issue additional right-of-way grants or temporary use permits for compatible uses on or adjacent to the right-of-way, nor does it authorize the holder to impose charges for the use of lands made subject to such additional right-of-way grants or temporary use permits.

I. Each grant issued for a term of 20 years or more shall contain a provision requiring periodic review of the grant at the end of the twentieth year and at regular intervals thereafter not to exceed 10 years.

J. Each grant shall have a provision stating whether it is renewable or not and if renewable, the terms and conditions applicable to the renewal.

K. Each grant shall not only comply with the regulations of this part, but also, comply with the provisions of any other applicable law and implementing regulations as appropriate.

2801.1-2 Reciprocal Grants

When the authorized officer determines from an analysis of land use plans or other management decisions that a right-of-way for an access road is or shall be needed by the United States across lands directly or indirectly owned or controlled by an applicant for a right-of-way grant, he or she shall, if it is determined to be in the public interest, require the applicant, as a condition to receiving a right-of-way grant, to grant the United States an equivalent right-of-way that is adequate in duration and rights.

2801.2 Terms and Conditions of Interest Granted

A. An applicant by accepting a right-of-way grant, temporary use permit, assignment, amendment or renewal agrees and consents to comply with and be bound by the following terms and conditions, excepting those which the secretary may waive in a particular case:

1. To the extent possible, all state and federal laws applicable to the authorized use and such additional state and federal laws, along with the implementing regulations, that may be enacted and issued during the term of the grant or permit.
2. That in the construction, operation, maintenance, and termination of the authorized use, there shall be no discrimination against any employee or applicant for employment because of race, creed, color, sex, or national origin and all subcontracts shall include an identical provision.
3. To rebuild and repair roads, fences, and established trails that may be destroyed or damaged by construction, operation, or maintenance of the project and to build and maintain suitable crossings for existing roads and significant trails that intersect the project.
4. To do everything reasonable within his or her power, both independently and upon request of the authorized office, to prevent and suppress fires on or in the immediate vicinity of the right-of-way or permit area. This includes making available such construction and maintenance forces as may be reasonably obtained for the suppression of fires.

B. All right-of-way grants and temporary use permits issued, renewed, amended or assigned under these regulations shall contain such terms, conditions, and stipulations as may be required by the authorized officer regarding extent, duration, survey, location, construction, operation, maintenance, use, and termination. The authorized officer shall impose stipulations which shall include, but shall not be limited to:

1. Requirements for restoration, revegetation, and curtailment of erosion of the surface of the land, or any other rehabilitation measure determined necessary.
2. Requirements to ensure that activities in connection with the grant or permit shall not violate applicable air and water quality standards or related facility siting standards established by or pursuant to applicable Federal or State law.
3. Requirements designed to control or prevent damage to scenic, aesthetic, cultural, and environmental values (including damage to fish and wildlife habitat), damage to federal property and hazards to public health and safety.
4. Requirements to protect the interests of individuals living in the general area who rely on the fish, wildlife, and biotic resources of the area for subsistence purposes.
5. Requirements to ensure that the facilities to be constructed, used, and operated on the prescribed location are maintained and operated in a manner consistent with the grant or permit.
6. Requirements for compliance with State standards for public health and safety, environmental protection and siting, construction, operation, and maintenance when those standards are more stringent than Federal standards.

2801.8 Unauthorized Occupancy

Any occupancy or use of the public lands, other than casual use as set forth in 2800.0–5(m) and 2802.1 (d) of this title, without authorization shall be considered a trespass and shall subject the trespasser to prosecution and liability for the trespass. This provision applies to all unauthorized use of the public lands and precludes the issuance of a right-of-way grant of temporary use permit until the trespass case has been settled. Once the trespass case has been settled, a new grant or permit may be made by the authorized officer in accordance with the procedures set forth in this part.

PART 2880 · RIGHT-OF-WAY UNDER THE MINERAL LEASING ACT

Subpart 2880 · Oil and Natural Gas Pipelines and Related Facilities, General.

Subpart 2881 · Terms and Conditions of Rights-of-Way Grants and Temporary Use Permits.

2881.1 Nature of Interest

2881.1-1 Nature of Right-of-Way Interest

A. The United States retains a right to use a right-of-way and temporary use permit area or authorize the use of it to others in any manner not inconsistent with pipeline construction, operation, maintenance, and termination. The holder of a right-of-way grant or temporary use permit has no right to any of the product of the land including, but not limited to, timber, forage, mineral, and animal resources. The holder may not allow the use of a right-of-way or temporary use permit area by others except its contractors, subcontractors, employees, agents or servants for purposes of construction, operation, maintenance, or termination of the pipeline.

B. A holder shall not use a right-of-way and temporary use permit area for any purpose other than for the construction, operation, maintenance, and termination of the pipeline specified in the holders right-of-way grant. A holder shall not locate or construct any other pipelines, including looping lines, or other improvements within a right-of-way without first securing appropriate authorization therefore.

C. The width of a right-of-way shall not exceed 50 feet, plus the ground occupied by the pipeline (that is, the pipe and related facilities) unless the authorized officer finds and records the reasons for his finding, that a wider right-of-way is necessary for operation and maintenance after construction, or to protect the environment or public safety.

D. An applicant may apply to the authorized officer for a wider right-of-way in limited areas if necessary.

1. For the operation and maintenance of the project after construction.
2. To protect the environment.
3. To provide for the public safety. If the authorized officer finds that the additional width is necessary for one of the above reasons, he may authorize a wider width. Such authorization shall include a written report recording the reasons why the additional width is necessary.

G. No purported transfer of an interest in a right-of-way grant, a right-of-way, or any portion of a pipeline system located within a right-of-way shall be valid without the prior written approval of the authorized officer. Applications for such approval shall be directed to the authorized officer. A transferee shall meet all the requirements of an original pipeline right-of-way. Grantee is bound by and shall assume all of the transferor's responsibility to the United States with respect to the transferred interest and shall agree to be bound by all terms of any outstanding right-of-way grant or temporary use permit. Applications for a transfer of interest shall be accompanied by a nonrefundable fee of $50.

2881.1-2 Nature of Temporary Use Permit Interest

A. A temporary use permit does not grant any interest in land and is revocable at will by the authorized officer.

B. The area covered by a temporary use permit shall be no greater than is necessary to accommodate the authorized use or to protect the environment or provide for public safety.

D. A temporary use permit may be renewed at the discretion of the authorized officer, but the permittee has no right of renewal. The authorized officer may modify the terms and conditions of the temporary use permit at the time of renewal.

E. A temporary use permit may be assigned at the discretion of the authorized officer, provided the use for which the permit was issued continues.

2881.1-3 Reservation of Rights to the United States.

All rights in Federal lands subject to a right-of-way grant or temporary use permit not expressly granted are retained by the United States. These rights include, but are not limited to:

A. A continuing right of access across right-of-way and temporary use permit areas to all Federal lands (including the subsurface and air space).

B. A continuing right of physical entry to any part of the pipeline system for inspection, monitoring, or for any other purpose or reason consistent with any right or obligation of the United States under any law or regulation.

C. The right to make, issue, or grant right-of-way grants, temporary use permits, easements, leases, licenses, contracts, patents, permits, and other authorizations to or with third parties for compatible uses on, under, above, or adjacent to the federal lands subject to a right-of-way grant or temporary use permit.

2881.2 Terms and Conditions of Interest Granted.

A. An applicant, by accepting a right-of-way grant or a temporary use permit, agrees and consents to comply with and be bound by the following terms and conditions, excepting those which the Secretary may waive in a particular case.

1. To the extent practicable, all state and federal laws applicable to the pipeline system construction, operation, and maintenance which is authorized and all such additional state and federal law, along with the implementing regulations, that may be enacted and issued during the term of the grant or permit.

2. That the pipeline and related facilities be subject to the express covenant that they will be modified, adapted, or discontinued within the provisions of the Act and without liability to the United States, if found by the Secretary that the use of the land for pipeline and related facility purposes conflicts with any future proposed use or occupancy of the land when it is determined that the proposal will better serve the national interest.
3. That in the construction, operation, and maintenance of the pipeline and related facilities, there shall be no discrimination against any employee or applicant for employment because of race, creed, color, sex, or national origin and all subcontracts shall include an identical provision.
4. To build and repair roads, fences, and trails that may be destroyed or damaged by construction, operation, or maintenance of the pipeline and related facilities and to build and maintain suitable crossings for roads and trails that intersect the right-of-way and related facilities.
5. To do everything reasonably within his or her power, both independently and upon request of the authorized officer, to prevent and suppress fires on or near the right-of-way and related facilities. This includes making available such construction and maintenance forces as may be reasonably obtained for the suppression of fires.

B. All right-of-way grants and temporary use permits issued, renewed, or amended under these regulations shall contain such terms, conditions, and stipulations as may be prescribed by the authorized officer regarding extent, duration, survey, location, construction, operation, maintenance, use, and termination. The authorized officer shall impose stipulations which shall include, but shall not be limited to:

1. Requirements for restoration, revegetation, and curtailment of erosion of the surface of the land.
2. Requirements to insure that activities in connection with the right-of-way grant or temporary use permit shall not violate applicable air and water quality standards or related facility siting standards established by or pursuant to applicable Federal and State law.
3. Requirements designed to control or prevent damage to the environment (including damage to fish and wildlife habitat), damage to public or private property, and hazards to public health and safety.
4. Requirements to protect the interests of individuals living in the general vicinity of the right-of-way or temporary use permit area who rely on the fish, wildlife, and biotic resources of the area for subsistence purposes.

C. Right-of-way grants or temporary use permits issued, renewed or amended under this title shall include requirements which comply with applicable Federal and State law that will protect the safety and health of pipeline workers and the general public, including, but not limited to protection against the sudden rupture and slow degradation of the pipeline. Applicants and holders shall design, construct, operate, and maintain all facilities in accordance with applicable Federal and State law governing pipelines and pipeline construction.

2881.3 Unauthorized Occupancy

No holder of a right-of-way grant or temporary use permit shall use or knowingly allow any other person to use the right-of-way or temporary use permit area for any purpose not authorized by the right-of-way grant or temporary use permit. Any person occupying or using Federal lands without authorization may be subject to prosecution under applicable law.

PART 3100 · OIL AND GAS LEASING

Subpart 3105 · Cooperative Conservation Provisions

3105.4–1 Rights-of-Way

Rights-of-way for oil and gas pipelines may be granted as provided for in Group 2800 of this chapter.

Subpart 3109 · Surface Management Requirements

3109.2–1 Bureau of Land Management Stipulations

The Bureau of Land Management may require such special stipulations as are necessary for the protection of the lands embraced in any permit or lease. (See Montana Power Decision A 30310 December 3, 1965, I.M. No. 85-500 December 23, 1966).

30 CFR

PART 221 · OIL AND GAS OPERATING REGULATIONS

Part 221.1 · Purpose and Scope

The regulations in this part govern operations associated with the exploration, development, and production of oil and gas deposits from leases issued or approved by the United States, restricted Indian land leases, and those under the jurisdiction of the Secretary of the Interior by law or administrative arrangement, including the National Petroleum Reserve in Alaska. They are intended to promote the orderly and efficent exploration, development, and production of oil and gas.

Part 221.20 General Requirements

The lessee shall comply with applicable laws and regulations; with the lease terms, Onshore Oil and Gas Orders, NTLs; and with other orders and instructions of the supervisor. These include, but are not limited to, conducting all operations in a manner which ensures the proper handling, measurement, disposition, and site security of leasehold production; which protects other natural resources and environmental quality; which protects life and property; and which results in maximum ultimate economic recovery of oil and gas with minimum waste and with minimum adverse effect on ultimate recovery of other mineral resources.

Part 221.30 Environmental Obligations

A. The lessee shall conduct operations in a manner which protects the mineral resources, other natural resources, and environmental quality. In that respect, the lessee shall comply with the pertinent orders of the Supervisor and other standards and procedures as set forth in the applicable laws, regulations, lease terms and conditions, and the approved drilling plan or subsequent operations plan. Before approving any Application for Permit to Drill submitted pursuant to Part 221.23, or other plan requiring environmental review, the Supervisor shall prepare an environ mental record of review or an environmental assessment, as appropriate. These environmental documents will be used in determining whether or not an environmental impact statement is required and in determining any appropriate terms and conditions of approval of the submitted plan.

B. The lessee shall exercise due care and diligence to assure that leasehold operations do not result in undue damage to surface or subsurface resources or surface improvements. All produced water must be disposed of by injection into the subsurface, by approved pits, or by other methods which have been approved by the Supervisor. Upon the conclusion of operations, the lessee shall restore or rehabilitate the disturbed surface in a manner approved or reasonably prescribed by the Supervisor.

C. All spills or leakages of oil, gas, produced water, toxic liquids, or waste materials, blowouts, fires, personal injuries, and fatalities shall be reported by the lessee in accordance with these regulations and as prescribed in applicable order or notices. The lessee shall exercise due diligence in taking necessary measures, subject to approval by the Supervisor, to control and remove pollutants and to extinguish fires. A lessee's compliance with the requirements of the regulations in this part shall not relieve the lessee of the obligation to comply with other applicable laws and regulations.

D. When reasonably required by the Supervisor, a contingency plan shall be submitted describing procedures to be implemented to protect life, property, and the environment.

E. The lessee's liability for damages to third parties shall be governed by applicable law.

Part 221.31 Safety Precautions

The lessee shall perform operations and maintain equipment in a safe and workmanlike manner. The lessee shall take all precautions necessary to provide adequate protection for the health and safety of life and the protection of property. Compliance with health and safety requirements prescribed by the Supervisor shall not relieve the lessee of the responsibility for compliance with other pertinent health and safety requirements under applicable laws or regulations.

B.3 CURRENT LEASE STIPULATIONS ON OCCUPANCY

The leases within the proposed Riley Ridge well field which would be restricted by stipulations on occupancy are listed by location in the following table. These stipulations are designed to protect surface resources such as soils, water, and wildlife by restricting periods of activity and areas of disturbance.

SPECIAL LEASE STIPULATIONS

Lease Locations	Special Stipulations
T24N, R113W Sec 8, Lots 2,3	(1) No occupancy/surface disturbance within 300 feet of irrigation ditch
T26N, R115W Sec 1, NE¼SW¼, S½SW¼ Sec 2, Lots 5,6,11,12, S½NE¼, N½SE¼ Sec 12, Lots 1,2,3,4, W½E½, E½W½, NW¼NW¼ Sec 13, Lots 1,5,6,8, NW¼NE¼, SW¼SE¼	(2) No occupancy/surface disturbance on slopes in excess of 35 percent (3) No exploration/development activity from April 1 to May 14 (does not apply to operation/maintenance of producing wells)
T27N, R114W Sec 5, Lots 17,18,22 Sec 8, Lot 1	(3)' (4) No occupancy/surface disturbance on slopes in excess of 25 percent
T27N, R114W Sec 8, Lots 7,14, SW¼NE¼, W½SE¼ Sec 9, SW¼SW¼	(5) No occupancy/surface disturbance on slopes in excess of 40 percent (6) No exploration/development activity from November 1 to April 30 (7) No occupancy/activity on Sec 8, W½SW¼SE¼
T27N, R114W Sec 17, Lot 8 Sec 21, E½, S½SW¼ Sec 28, all Sec 29, Lots 1,10,11,20	(2) (3)
T27N, R114W Sec 22, SW¼NE¼, NW¼NW¼, S½NW¼, SW¼, W½SE¼	(5) (6)
T28N, R114W Sec 8, Lot 1	(5) (8) No exploration or development activity from March 1 to May 31 (9) No drilling within 1,000 feet of live water
T28N, R114W Sec 9, S½ Sec 10, SW¼	(10) No occupancy/surface disturbance (rare and endangered fish area)
T28N, R114W Sec 21, SW¼NW¼	(8) (11) No occupancy/surface disturbance within 1,000 feet of Sawmill or Hagarty Creeks
T28N, R114W Sec 27, SW¼	(8) (12) No drilling/surface disturbance within 1,000 feet of Black Canyon Creek
T29N, R114W Sec 1, Lots 1,2,3,4, S½NW¼, N½SW¼ Sec 2, Lots 1,4, SE¼NE¼, SW¼NW¼, NE¼SW¼ Sec 11, SW¼NE¼, SE¼ Sec 12, NW¼SW¼, S½S½ Sec 13, all	(8) (13) No occupancy/surface disturbance within 1,320 feet of the Lander Cutoff-Oregon Trail (14) No occupancy/surface disturbance within 1,000 feet of South Piney, Fish, or Spring Creeks
T29N, R114W Sec 3, Lots 1,2,3,4, S½N½, SW¼ Sec 4, Lots 1,2,3, SE¼NW¼	(5) (8) (13) (15) No use of Lander Cutoff as access road

SPECIAL LEASE STIPULATIONS—continued

Lease Locations	Special Stipulations
T29N, R114W Sec 4, Lot 4, S½NE¼, SW¼NW¼, S½ Sec 5, Lots 1,2,3, S½N½, S½	(8) (13) (15) (16) No occupancy/surface disturbance within 1,000 feet of South Piney Creek
T29N, R114W Sec 5, Lot 4 Sec 6, Lots 1,2, S½NE¼, SE¼ Sec 7, E½ Sec 9, SE¼SE¼ Sec 17, all Sec 18, SE¼ Sec 19 E½	(5) (17) No occupancy/surface disturbance within 500 feet of Spring and South Piney Creeks
T29N, R114W Sec 9, N½ Sec 14, E½	(5) (8) (15) (18) No occupancy/surface disturbance within 500 feet of South Piney Creek
T29N, R114W Sec 9, SW¼, N½SE¼, SW¼SE¼ Sec 15, W½	(5) (8) (13) (15)
T29N, R114W Sec 10, all Sec 15, E½	(16) (19) May prohibit exploration/development during wet or heavy snow periods
T29N, R114W Sec 10, all Sec 15, E½	(16) (19)
T29N, R114W Sec 11, NE¼NW¼	(18)
T29N, R114W Sec 14, W½	(16) (19)
T29N, R114W Sec 18, NE¼ Sec 20, allof Spring Creek	(20) No occupancy/surface disturbance within 500 feet
T29N, R114W Sec 19, Lots 1,2,3,4, E½W½ Sec 30, Lots 1,2,3,4, E½W½	(3) (4) (20)
T29N, R114W Sec 21, all Sec 28, all Sec 29, all	(5) (17)
T29N, R114W Sec 22, all Sec 23, W½ Sec 27, N½	(5) (8)
T29N, R114W Sec 23, E½	(5) (17)
T29N, R114W Sec 24, NW¼, S½SE¼	(8) (9) (21) No occupancy/surface activity on S½SE¼
T29N, R114W Sec 25, W½NE¼, W½	(8) (19) (22) No timber cut to install mud sumps or drill site locations

SPECIAL LEASE STIPULATIONS—continued

Lease Locations	Special Stipulations
T29N, R114W Sec 27, S½	(5) (8)
T29N, R115W Sec 1, all Sec 2, all Sec 11, E½, E½W½ Sec 14, NE¼, E½NW¼, S½	(23) No surface occupancy of Sec 11, E½, E½W½ (24) Unstable soils restriction (25) No surface occupancy within: a. 500 feet of roads/highway centerline; b. 200 feet of trails centerline; c. 500 feet of high water line of streams, lakes, ponds, reservoirs; d. 400 feet of springs; e. 400 feet of improvements.
T29N, R115W Sec 12, all	(25)
T29N, R115W Sec 13, all	(25)
T30N, R114W Sec 1, Lots 3,4, SW¼	(26) No exploration/development December 1 to March 31
T30N, R114W Sec 2, Lot 2, SW¼NE¼, SW¼, W½SE¼ Sec 3, Lots 1,2, S½NE¼, SW¼, S½SE¼, NW¼SE¼	(8)
T30N, R114W Sec 2, Lots 3,4, S½NW¼ Sec 3, Lots 3,4, S½NW¼	(8)
T30N, R114W Sec 10, N½, N½S½, S½SW¼, SW¼SE¼	(8)
T30N, R114W Sec 11, NW¼	(27) No exploration/development from November 16 to May 14
T30N, R114W Sec 11, SE¼ Sec 12, SE¼NE¼, S½NW¼, W½, SW¼, SE¼SW¼, S½SE¼	(28) No occupancy/surface activity from December 1 to April 30 (29) No occupancy/activity on Sec 12, SE¼NE¼, S½SE¼
T30N, R114W Sec 12, N½NW¼	(8)
T31N, R114W Sec 28, SE¼SW¼	(19) (30) No occupancy/surface disturbance within 1,000 feet of North Piney Creek
T30N, R114W Sec 13, S½SE¼ Sec 14, E½NE¼	(6)
T30N, R114W Sec 14, NW¼NE¼, NE¼NW¼, E½SE¼	(28)
T30N, R114W Sec 15, S½NE¼ Sec 17, SW¼ Sec 20, N½, SW¼ Sec 23, S½SW¼ Sec 26, E½, NE¼NW¼	(6)
T30N, R114W Sec 23, SW¼SE¼ Sec 24, NE¼, NE¼NW¼ Sec 35, NE¼, E½NW¼, NE¼SW¼, E½SE¼, NW¼SE¼	(8) (31) No occupancy/surface disturbance within 1,000 feet of Middle Piney or Fish Creeks
T30N, R114W Sec 26, NW¼NW¼, S½NW¼, SW¼ Sec 30, SE¼NE¼	(2) (3)
T30N, R114W Sec 27, S½N½, N½S½, S½SE¼	(32) No drilling or storage facilities within 500 feet of live water or the reservoir

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[1] Stipulations are described as they first appear in the table; thereafter, they are referenced by number.

B.4 WELL FIELD OIL AND GAS OPERATING MEASURES

1. There shall be no deviation from the proposed drilling and/or workover program as approved. Safe drilling and operating practices must be observed. All wells, whether drilling, producing, suspended, or abandoned, shall be identified in accordance with 30 CFR 221.24. Any changes in operations must have prior approval of the Authorized Officer. Pressure tests are required before drilling out from under all casing strings set and cemented in place. Blowout preventer (BOP) controls must be installed prior to drilling the surface casing plug and will remain in use until the well is completed or abandoned. BOPs will be inspected and operated at least daily to insure good mechanical working order, and this inspection recorded on the daily drilling report. BOPs will be pressure tested before drilling casing cement plugs. All BOP pressure tests must be recorded on the daily drilling report. The Authorized Officer's designated representative will be notified in advance of pressure tests.

2. All shows of fresh water and minerals will be reported and protected. A sample will be taken of any water flows and furnished the Authorized Officer for analysis. All oil and gas shows will be adequately tested for commercial possibilities, reported, and protected.

3. No location will be constructed or moved, no well will be plugged, and no drilling or workover equipment will be removed from a well to be placed in a suspended status without prior approval of the Authorized Officer. If operations are to be suspended for more than 30 days, prior approval must be obtained and notification given before resumption of operations.

4. In the event abandonment of the hole is desired, an oral request may be granted but must be followed within 15 days with a "Notice of Intention to Abandon" (Form 9-331). Unless the plugging is to take place immediately upon receipt of oral approval, the Authorized Officer must be notified at least 48 hours in advance of the plugging of the well, in order that a representative may witness plugging operation. The "Subsequent Report of Abandonment" (Form 9-331) must be submitted within 15 days after the actual plugging of the well bore, reporting where the plugs were placed, and the current status of the surface restoration. If surface restoration has not been completed at that time, a follow-up report on Form 9-331 should be filed when all surface restoration work has been completed and the location is considered ready for final inspection.

5. The spud date will be reported orally to the Authorized Officer within 48 hours after spudding. If the spudding occurs on a weekend or holiday, wait until the following regular workday to make this report. Periodic drilling progress reports must be filed directly with the Authorized Officer on a frequency and form or method as may be acceptable.

6. In accordance with "Notice to Lessee - Procedures for Reporting and Accounting for Royalties" (NTL-1) each well must be reported on Form 9-239 "Monthly Report of Operations and Production", starting with the month in which operations commence and continuing each month until the well is physically plugged and abandoned. This report should be filed in duplicate directly with the Minerals Management Service - Royalty Accounting Office in Casper, Wyoming.

7. Any change in the program must be approved by the Authorized Officer. "Sundry Notices and Reports on Wells" (Form 9-331) must be filed for all changes of plans and other operations in accordance with 30 CFR 221.27 and .2. Emergency approval may be obtained orally, but such approval does not waive the written report requirement. Any additional construction, reconstruction, or alterations of facilities, including roads, gathering lines, batteries, etc., which will result in the disturbance of new ground will require the filing of a suitable plan pursuant to "Notice to Lessee - Approval of Operations" (NTL-6) and prior approval by the Authorized Officer.

8. Whether the wells are completed as dry holes or as producers, the "Well Completion and Recompletion Report and Log" (Form 9-330) will be submitted not later than 15 days after completion of the well or after completion of operations being performed, in accordance with 30 CFR 221.32(b). Two copies of all logs run, core descriptions, core analyses, well-test data, geologic summaries, sample descriptions, and all other surveys or data obtained and compiled during the drilling, workover, and/or completion operations, will be filed with Form 9-330. Samples (cuttings, fluid, and/or gas) will be submitted only when requested by the Authorized Officer.

9. Significant surface values are involved at these locations. Accordingly, the operator must notify the Authorized Officer's representative at least

24 hours prior to commencing field operations to allow him/her to be present for consultation during the construction of roads and well pads.

10. If a replacement rig is contemplated for completion operations, a "Sundry Notice" (Form 9-331) to that effect must be filed for prior approval of the Authorized Officer, and all conditions of the APD are applicable during all operations conducted with the replacement rig.

11. Pursuant to "Notice to Lessee - Disposal of Produced Water" (NTL-2B) requirements for new wells, these APDs are authorization for unlined pit disposal of the water produced from these wells for a period of 90 days from the date of initial production for sales purposes. During this period, an application for approval of the permanent disposal method, along with the required water analysis and other information must be submitted for the Authorized Officer's approval.

12. APDs will be valid for a period of one year from the date of approval. If the permit terminates, any surface disturbance created under the APD must be rehabilitated in accordance with the approved plan.

13. All tank batteries constructed must be surrounded by a fire wall of sufficient capacity to contain the storage capacity of the batteries adequately.

14. Discharges, spills, fires, accidents, or blowouts must be reported to the Authorized Officer in accordance with "Notice to Lessee - Reporting of Undesirable Events" (NTL-3A).

15. Venting or flaring of hydrocarbons will be in accordance with "Notice to Lessee - Venting or Flaring of Gas or Oil" (NTL-4A) and must receive prior approval of the Authorized Officer.

16. The Authorized Officer should be notified sufficiently in advance of actual well plugging work so that a representative may have an opportunity to witness the well plugging operation.

17. Upon completion of approved plugging, the operator will erect the regulation marker in accordance with 30 CFR 221.24(b) and clean up the location. The marker should not be less than 4 inches in diameter, 10 feet in length with approximately 4 feet above general ground level, and the top plugged or capped. All necessary pits or holes, including the cellar, must be backfilled immediately upon abandonment.

18. The following minimum information shall be permanently placed on the marker with a plate, cap, or beaded-on with a welding torch:

    - Name of the Operator.
    - Lease serial number.
    - Well number.
    - Well location by 1/4 1/4 section or footage, township, and range.

19. Final release from liability will be issued by the Authorized Officer when all the provisions of the APD, including incorporation of the Erosion Control, Revegetation, and Restoration Guidelines (Appendix B-E), and Surface Owner's Rehabilitation Plan are complete.

20. Holder shall give immediate notice of any spill or leakage, in violation of 43 CFR 110.5, of oil or other pollutant from the pipeline to: (1) the Authorized Officer; and (2) such other federal and state officials as are required by law to be given such notice. Any oral notice shall be confirmed in writing within 72 hours of any occurrence.

B.5 GENERAL MEASURES

1. A Notice to Proceed requirement will be appended to these (rights-of-way, grants, permits) stipulating that no construction or use shall occur until detailed construction and use plans have been received and approved by the authorized officer.

2. All activities associated with the project will be conducted in a manner that will avoid or minimize degradation of air, land, and water quality. In the construction, operation, maintenance, and termination of the projects, activities will be performed in accordance with applicable air and water quality standards, and related plans of implementation, including but not limited to, the Clean Air Act, as amended (42 USC 1321) and the Clean Water Act as amended (USC 1251).

3. Permittees and other regular users of public lands affected by construction of the projects will be notified in advance of any construction activity that may affect their businesses or operations. This will include, but not be limited to, signing of temporary road closures, and notification of proposed removal and/or cutting of fences, and disturbances to range improvements or other use-related structures.

4. During the final survey of the linear facilities (pipelines, transmission lines, etc.), the centerline and outside boundaries of the linear facilities will be staked and flagged. Stakes will be no more than 200 yards apart on open rangelands and a maximum of 100 feet apart on forested lands. Holder/operator name and station numbers of the survey will be written on each stake or hub. Where the linear facilities parallel an existing line, the existing line will be flagged where necessary to avoid disturbance of the existing line. The Authorized Officer reserves the right to make adjustments in right-of-way alignment as may be necessary to minimize environmental impacts.

5. The Company shall, at all times during construction, maintenance, and operation, maintain satisfactory spark arrestors on all steam and internal combustion engines and on all flues used in operations under this grant.

6. The Company shall furnish the Authorized Officer with engineering drawings of the existing ground profile and plan, and profile views of the facilities to be constructed. These drawings must portray typical cross sections (i.e., cut, fill, bench sections, etc.) at representative points along or within the right-of-way.

7. Prior to placing the pipeline system in operation, the Holder shall inspect all new main line girth welds using radiographic or other techniques approved by the Authorized Officer.

   Holder agrees that any welding required on the converted line on Federal lands shall be inspected using radiographic or other techniques approved by the Authorized Officer.

   Holder shall provide for inspection of pipeline system construction to ensure compliance with the approved design specifications and these stipulations.

8. At least one year prior to termination or to abandonment of the facilities authorized by this grant, the Holder shall contact the Authorized Officer to arrange a joint inspection of the right-of-way. The inspection will be held to agree on an acceptable abandonment and rehabilitation plan. The Authorized Officer must approve the plan in writing prior to the Holder commencing any abandonment and/or rehabilitation activities. The plan may include removal of drainage structures or surface material; recontouring; replacement of topsoil; seeding, mulching, etc.

9. The Company shall install and use Federal Communication Commission approved radio equipment in such a way that it will not interfere with the operation of other users' equipment. If, however, there is a radio or electronic interference with other users' operation which is traceable to the grantee's equipment, the Company shall immediately make such modifications to its equipment as shall eliminate the cause of interference at no cost to the Government or will discontinue use of said equipment until cause of interference has been eliminated.

10. Prior to the beginning of operations, the Holder shall submit to the Authorized Officer a certification of construction, verifying that the facility has been constructed and tested in accordance with the terms of the right-of-way grant, and in compliance with the required *plans and specifications*, and applicable federal and state laws and regulations. An "as built" survey map will be submitted to the Authorized Officer within 60 days after construction is completed.

11. Upon receipt of a certification of construction, when all development and rehabilitation have been completed, a joint compliance check of the right-of-way shall be made by the Company and the Authorized Officer or designated representative to determine compliance with the terms and

conditions of the grant. The Company shall perform, at its own expense, any required modifications or additional reclamation work for compliance with the terms of the grant.

12. The Company shall conduct all activities directly or indirectly associated with the construction, operation, and maintenance of this facility within the limits of these (rights-of-way, permits). In the event that areas outside of the (rights-of-way, permits) are needed, the Company shall obtain a separate authorization for that use.

13. The Holder shall comply with the applicable federal and state laws and regulations concerning the use of pesticides (i.e., insecticides, herbicides, fungicides, rodenticides, and other similar substances) in all activities/operations under this Grant. The Holder shall obtain from the Authorized Officer approval of a written plan prior to the use of such substances. The plan should be submitted no later than December 1 of any calendar year that covers the proposed activities for the next fiscal year (i.e., December 1, 1983, deadline for a fiscal year 1985 action). If need for emergency use of pesticides is identified, the use must be approved by the Authorized Officer. The use of substances on or near the right-of-way shall be in accordance with the approved plan. A pesticide shall not be used if the Secretary of the Interior has prohibited its use. A pesticide shall be used only in accordance with its registered uses and within other limitations if the Secretary has imposed limitations. Pesticides shall not be permanently stored on public lands authorized for use under this Grant.

14. The Company shall construct, operate, and maintain the facilities and structures within these (grants, permits) in strict conformity with the descriptive and technical data which was furnished the BLM or the FS in connection with the application for these (grants, permits). Any relocation, additional construction, or use which is not in accord with such data may not be initiated without the prior written approval of the Authorized Officer. A copy of the complete application and a copy of the (grant, permit) stipulations shall be available on location during construction and rehabilitation to all supervisory personnel and to the Authorized Officer. Noncompliance with the above will be grounds for the Authorized Officer to shut down the operation until compliance is obtained.

15. The Company shall schedule and attend a preconstruction conference with the Authorized Officer and his representative prior to commencing any construction activities on these (rights-of-way, permits). The Company or his representative and all of his contractors or agents involved with construction under these (rights-of-way, permits) shall attend this conference. The Company shall contact the Authorized Officer or his representative at least 10 working days (2 weeks) prior to the anticipated start of construction to schedule this conference.

16. The requirements within the Erosion Control, Revegetation, and Reclamation Guidelines and FS-BLM Roading Guidelines for Oil and Gas Development will be followed in the development of the CU Plans and in developing procedures for the APDs.

17. Holder shall conduct all construction, operation, and maintenance activities in a manner that will avoid or minimize degradation of air, land, and water quality. Toxic material shall not be released in any lake or water drainage. All construction work and subsequent use of the right-of-way shall be consistent with applicable federal, state, and local laws and regulations relating to safety, water quality, and public health. Unless otherwise approved in writing by the Authorized Officer, dikes or cofferdams shall be installed to separate concrete work areas from lakes or streams during construction. Mobile ground equipment shall be kept within the right-of-way and out of the waters of lakes, streams or rivers except as permitted by the Authorized Officer.

18. It shall be the responsibility of the Holder to comply with the construction practices and mitigating measures established by 33 CFR 323.4 which set forth the parameters of the "nationwide permit" required by Section 404 of the Federal Water Pollution Control Act. If the proposed action exceeds the parameters of the nationwide permit, the Holder shall obtain an "individual permit" from the appropriate office of the Corps of Engineers and provide BLM a copy of that permit prior to commencing actual construction. Failure to comply with this requirement shall be cause for revocation of this right-of-way grant.

19. The power transmission and distribution lines shall be designed and constructed in accordance with accepted standards and specifications for power transmission lines of similar voltage, capacity, and purpose. The Company shall place and maintain suitable structures and devices to reduce to a reasonable degree, the liability of contact between its power transmission line and telegraph, telephone, signal, or other power transmission lines heretofore constructed and shall also place and maintain suitable structures and devices to reduce to a reasonable degree, the liability of any structures or wires falling or obstructing traffic or endangering life on highways or roads.

20. Natural phenomena which occur on government land, such as avalanches, rising waters, high

winds, falling limbs or trees, and other hazards, present risks to the Company's property which the Company assumes. The Company has the responsibility of inspecting the site, right-of-way, and immediate adjoining area for dangerous trees, hanging limbs, and other evidence of hazardous conditions and, after securing permission from the FS or BLM, of removing such hazards in order to protect the Company's improvements.

21. The Company shall perform all work with explosives and flammable materials in such a manner as not to endanger life or property. All storage places for explosives and flammable material shall be marked "**DANGEROUS**". The method of storing and handling explosives and flammable materials shall conform to recommended procedures contained in the "Blasters Handbook" published by E. I. du Pont de Nemours and Company, and in all federal, state, and local laws and regulations.

22. These (rights-of-way, permits) do not convey access across private, patented, state or fee lands. These (rights-of-way, permits) are issued on the condition that the Company has secured or will secure the necessary additional rights-of-way. The Company shall be required to show that they have secured consent for access across private, patented, state, or fee land prior to BLM-FS granting rights-of-way or permits.

23. No signs or advertising devices shall be erected on the area designated by this permit or highways leading thereto, without prior approval by the FS or BLM as to location, design, size, color, and message. Erected signs shall meet standards provided by the Authorized Officer and be maintained or renewed as necessary.

24. The Company shall protect all survey monuments, witness corners, reference monuments, and bearing trees within these (rights-of-way, permits) against disturbance during construction, operation, maintenance, and rehabilitation. If any monuments, corners, or accessories are destroyed, obliterated, or damaged during construction, operation, or maintenance, Holder shall secure the services of a Registered Land Surveyor to restore the disturbed monuments, corners, or accessories, at the same location, using surveying procedures found in the *Manual of Surveying Instructions for the Survey of the Public Lands of the United States*, latest edition. Holder shall record such survey in the appropriate county and shall send a copy to the Wyoming State BLM Office, P.O. Box 1828, Cheyenne, Wyoming 82001.

25. Garbage and other refuse will be stored in containers at all times and disposed of at least once a week in authroized county-approved sanitary site or landfill. Used engine oil which is changed on federal lands will be stored in suitable containers and delivered to secondary refineries. No fuel, oil, or other hydrocarbon spills are permitted. If such a spill accidentally occurs, the Authorized Officer will be notified immediately and corrective measures undertaken as directed.

26. Within 30 days after conclusion of construction and operation, all construction materials related litter and debris shall be disposed of in accordance with instructions from the Authorized Officer.

27. Under the terms of the Endangered Species Act of 1973, the Company will conduct surveys, no more than one year prior to disturbance, to determine if listed species or their habitats might be present on areas to be disturbed by any of the proposed action, or alternatives, regardless of land ownership. If it is determined that listed species or their habitats might be present and could be affected by the proposals, appropriate consultations with the U.S. Fish and Wildlife Service will be conducted by the federal authorizing agency. No activities will be authorized until consultation is complete as specified by Section 7(c) of the consultation process which would specify the mitigation measures to be carried out. The Biological Opinion issued by the Fish and Wildlife Service as a result of the consultation process will specify the mitigation measures to be carried out by the Company.

    The Holder shall develop a conservation plan consistent with the FWS Biological Opinion that will ensure the continued existence of threatened or endangered species is not jeopardized or that their critical habitat is not destroyed or adversely modified.

28. Any active golden eagle nest found within 1 mile of project activities will be protected from harassment during the critical nesting period because of provisions established by the Bald Eagle Protection Act which requires protection of the golden eagle and its nests.

29. For transmission or powerlines, the Company shall meet all requirements contained in *Suggested Practices for Raptor Protection on Powerlines*. Prior to construction, the Company shall provide the Authorized Officer with drawings which show phase spacings, configurations, and grounding practices for this power distribution line. The Company shall modify any structures not in conformance with *Suggested Practices for Raptor Protection on Powerlines* as determined by the Authorized Officer.

30. All reserve and produced water pits will be fenced. Reserve pits will be fenced on three sides during drilling operations. The fourth side will be

fenced following release of the drilling rig. All fences will be constructed and maintained in accordance with design standards appended to each permit by the Authorized Officer. All reserve and produced water pits will be dye-tested for leaking into streams when deemed necessary by the Authorized Officer.

31. All river, stream, and wash crossings required for access to project facilities will be at existing roads or bridges, except at locations designated by the Authorized Officer. Culverts or bridges will be installed at points where new permanent access roads cross live streams to allow fish unobstructed passage. Where temporary roads cross drainages or dirt fills, culverts will be installed during construction and removed upon completion of the project. Any construction activity in a perennial stream is prohibited unless specifically allowed by the Authorized Officer. All stream channels and washes will be returned to their natural state as quickly as possible. Such construction, when it would occur on National Forest Land, will be managed under the restrictions in the Forest Service and Department of Agriculture Policy Statement No. 2019, dated July 8, 1980. All construction for stream crossings will also follow the Stream Protection section of the Erosion Control, Revegetation, and Restoration Guidelines stipulation.

32. The riparian zone of stream crossings shall be rehabilitated immediately after construction is completed. Until riparian vegetation is established, the disturbed area shall be protected on each side of the stream to prevent sediment contamination of the stream and/or erosion of the banks.

33. A buffer strip of terrestrial vegetation will be left between staging areas and riparian vegetation adjacent to the stream. Riparian vegetation will not be counted upon as a buffer strip because silt collected by the riparian vegetation might enter the stream during high water periods.

34. Areas subject to mudflows, landslides, mudslides, avalanches, rock falls, and other types of mass movement will be avoided where practical when locating linear facilities. Where avoidance is not practical, the design, based upon detailed field investigations and analyses, will provide measures to prevent the occurrence of mass movements.

35. Watering or other approved dust abatement procedures will be done to prevent severe wind erosion and loss of soil materials during construction.

36. In compliance with the CU Plan, the Company will reclaim the surface of disturbed areas to conform with adjacent terrain by replacing fills in the original cuts, replacing soil material, water barring, and revegetating the surface.

37. In right-of-way or permit clearing in timbered areas, all tree stumps will be cut as low as practical, but not higher than 14 inches. The trees will be limbed and stacked adjacent to the right-of-way. During cleanup, all clearing and grubbing debris (slash), excluding stumps and useable products will be piled for burning or buried as specified by the Authorized Officer.

38. Preclearing of mountain brush and tree-covered areas prior to dozer and maintenance blade work will be required. Preclearing will involve hand cutting brush and trees and removing them to designated areas.

39. The clearing of timber, to reduce fire hazard, will be limited to the right-of-way.

40. Right-of-way clearing in timbered, dense shrub, and scenic areas shall be done in accordance with the approved clearing plan and shall be limited to a minimum width necessary to prevent interference of trees and other vegetation with the facility construction. Authorized Officer may require clearing to be "feathered or graded" with curved or undulating boundaries to lessen visual "tunnel" effect. In locations where the right-of-way enters timber, including dense shrub, from meadows or other open areas, the Authorized Officer may require clearing to be "feathered" into the timber in order to retain maximum natural vegetative patterns. Authorized Officer may require a landscape architect to assist in the design of the clearing plan. Right-of-way clearing in canyons spanned by power lines will be limited to that required to build the line and maintain clearance with the conductor. Trees and shrubs will be cleared by hand on fragile steep slopes and rock areas as identified by the Authorized Officer prior to construction. *If any merchantable timber is involved in right-of-way clearing, it must be harvested in accordance with the terms of the BLM/FS timber sale contract.*

41. A plan to minimize visual impacts from structures will be required as a part of the CU Plan. The holder will design the pipeline routes and ancillary structures to blend into the existing environment so as to meet the minimum degree of contrast acceptable for the Visual Resources Management Class and Visual Quality Objectives in which the structures would be located. The Authorized Officer will evaluate and approve measures before construction begins.

42. The Company shall paint all permanent structures (on site for a period longer than 90 days after construction) a flat, noncontrasting color that is harmonious with the adjacent landscape. Exceptions to this requirement would be small

structures that are not readily visible from a distance of approximately 0.25 mile, or structures which require safety coloration in accordance with Occupational Safety and Health Administration requirements. Prior to use, color selection will be approved by the Authorized Officer.

43. Prior to any surface disturbing activity, the Company, in consultation with the Authorized Officer and the Wyoming State Historic Preservation Officer, shall make an inventory of all archaeological and historical sites within these (rights-of-way, permits) areas if it has not previously been done. The Company shall develop a cultural resources plan to locate cultural resources which would be directly affected by the project through the use of a Class III field survey. The plan will define inventory extent and intensity of the site-specific surveys.

44. Any cultural resource (historic or prehistoric site or object) discovered by the Company or any person working on his behalf, shall be immediately reported to the Authorized Officer. The Company shall suspend all operations in the area of such discovery until written authorization to proceed is issued by the Authroized Officer. An evaluation of the discovery will be made by the Authorized Officer and state to determine appropriate actions to prevent the loss of significant cultural values. The Company will be responsible for the cost of evaluations and for mitigation. Mitigation may include rerouting or excavation, and any decision as to proper mitigation measures will be made by the Authorized Officer after consulting with the Holder.

45. The Company will provide an approved archaeologist to execute and monitor surveys and discoveries during construction of all project facilities.

46. The Company will provide a qualified paleontologist who would be approved by the Authorized Officer. The paleontologist will conduct an intensive survey of all areas to be disturbed according to the significance and mitigation needs. The paleontologist will be available, as needed, during surface disturbance. If the paleontologist determines that values will be disturbed, construction will be halted until appropriate action can be taken.

47. The Company will be required to control off-road vehicular use within these (rights-of-way, permits).

During construction, the Holder shall regulate access and vehicular traffic as required to protect the public, wildlife, and livestock from hazards associated with the project. The Holder shall permit free and unrestricted public access to and upon the right-of-way except in areas designated as restricted by the Holder. All restricted areas shall be approved in advance in writing by the Authorized Officer.

The Holder shall be allowed, with prior written approval from the Authorized Officer, to close the road to public access for limited periods during the construction phase of the project should it be necessary to do so to protect and insure public health and safety. At all other times, the Holder shall permit free and unrestricted public access to and upon the right-of-way.

48. Disturbance of improvements such as fences, roads, and watering facilities during the construction and maintenance of the rights-of-way must be kept to an absolute minimum. Immediate restoration of any damage to improvements to at least their former state will be required. Functional use of these improvements must be maintained at all times. When necessary to pass through a fence line, the fence shall be braced on both sides of the passageway prior to cutting of the fence. A gate acceptable to the Authorized Officer shall be installed in the gate opening and kept closed when not in actual use. Where a permanent road is to be constructed or maintained, cattle guards shall be placed at all fence crossings.

49. If a natural barrier used for livestock control is broken during construction, the holder will adequately fence the area to prevent drift of livestock. In pronghorn antelope ranges, the fence may have to be constructed in a manner which allows for animal passage. All fencing constructed by the Company will meet FS and BLM design requirements with input from Wyoming Game and Fish Department. Fence specifications will be determined on a case-by-case basis.

50. During construction the Company shall regulate access and vehicular traffic as required to protect the public, wildlife, and livestock from hazards associated with the project. The Company shall permit free and unrestricted public access to and upon the (right-of-way, permit) except in areas designated as restricted by the Holder or Authorizing Officer. All restricted areas shall be approved in writing by the Authorized Officer.

51. A transportation plan will be submitted as part of the CU Plan. This plan will cover approval of temporary, reconstructed, and newly constructed roads and will include clearing work, signing, rehabilitation, and uses associated with transportation needs. Overland access could be specified in lieu of road construction or reconstruction.

Whenever practical "cross country" access will be utilized without clearing vegetation or grading a roadbed. All construction and vehicular traffic is to be confined to the right-of-way or designated access routes, roads, or trails unless otherwise authorized. All temporary work roads to be used for construction will be rehabilitated after construction in accordance with the approved rehabilitation plan. Only one road or access route will be permitted to each site requiring access. Any existing transportation or utility rights-of-way will be used wherever practicable to minimize adverse environmental impacts and the proliferation of separate rights-of-way.

52. Access roads necessary for operation and maintenance of the project will be clearly identified. Some of these access roads may be designated by the authorizing agency as closed for public use, including but not limited to, off-road vehicular travel.

53. The Company shall obtain necessary access permits from the county and Wyoming Highway Department for approach to a county, state, or U.S. highway prior to commencing any construction activity associated with the (grant, permit).

54. The Company shall be responsible for preventive and corrective road maintenance from the beginning to completion of operations under this (grant, permit). This may include, but not be limited to, blading roadway, cleaning ditches and drainage facilities, dust abatement, or other requirements as directed by the Authorized Officer.

B.6 ROADING GUIDELINES FOR GAS EXPLORATION AND DEVELOPMENT WITHIN THE RILEY RIDGE FIELD

APPLICABLE ROAD STANDARDS

The primary road access that an operator will be using will be either a county road or FS/BLM arterial, collector, or local road, or combination of these. In most cases, the actual work site will be some distance removed from the nearest road. The operator may gain access to the work site by locating, designing, and constructing a "temporary road" from a FS or BLM development road to the work site.

The existing FS/BLM and county roads are usually inadequate to facilitate the type and volume of traffic required for exploration and/or development of oil or gas reserves. Prior to use by an operator, the road must be upgraded at the operator's expense to the standard compatible with the proposed road use and FS and BLM classification.

FOREST AND BLM DEVELOPMENT ROADS

Arterials. For purposes of the Riley Ridge Project EIS well field, these are roads that service the entire well field or primary access to plant sites. A FS/BLM or other arterial shall be a double-lane, graded, drained, and surfaced road. The roadbed shall be crowned on tangents and superelevated on curves. The traveled way shall be between 20 and 24 feet in width, depending on the total anticipated traffic and environmental considerations on a site-specific basis. The minimum surface depth on all roads shall be 4 inches of crushed aggregate base or 6 inches of pit run gravel. The typical cross section for a double-lane road is as shown in the "typical sections." Culverts or bridges shall be installed at all minor stream crossings.

Collectors. For purposes of the EIS, these are roads that service several wells. A FS/BLM or other collector shall be either a 14-foot single-lane road with turnouts or a 20 to 24-foot double-lane road. The anticipated traffic volumes will be the basis for determination of the particular standard for a specific road. In many instances, the operator's proposed additional traffic will be sufficient to require upgrading the existing road to a higher standard. If the projected average daily traffic (public, commerical, administrative, operator) exceeds 100 vehicles per day, a double-lane facility will be required.

Locals. For purposes of the Riley Ridge Project EIS, these are roads that service one well. A FS or BLM road shall be a 14-foot wide single-lane road with intervisible turnouts.

Before construction, the FS or BLM (depending upon land status) will determine whether a local road will be obliterated and reclaimed at the completion of the exploration work, assuming a dry-hole is encountered, or whether it will be retained by the FS or BLM and added to the Forest Development Transportation System or the BLM District Transportation Plan. In the latter instance, the road will be constructed with turnouts. However, if it is not to be retained, it may be constructed without turnouts depending on the operator's proposed activities and FS or BLM recommendations as to management.

TEMPORARY ROADS

The term "temporary road" should not be interpreted to imply a lesser standard of construction. Policy is to require that road access to drill sites be properly located, designed, constructed, and maintained by the leasee and/or drilling operator. Such things as FS or BLM directional signs, bridge guard rails, and reduced numbers of turnouts (with appropriate management guidelines) can be designed. A temporary road *will* be obliterated, if the hole is dry, to requirements that will be described in the EIS/EA process.

PERIOD OF USE

The complexities of drilling in the Overthrust require that the design of roads accommodate all seasons of use unless the operator is willing to accept road closures due to weather. This means designing roads for all-weather access from frost heave to wet soils to dry conditions. The surfacing requirements on any road used by the operator will be dependent upon the type of soils on which the road is constructed. If snow removal will be required on graveled surfaces, additional thickness for anticipated loss must be included.

ROAD LOCATION

Access to work sites may require the construction of temporary roads and/or reconstruction of Forest Development Roads or BLM/county. Proper initial location of these roads will expedite approval of the operator's lease or permit. Some of the factors which must be considered during location are:

Environmental Considerations. Select wildlife habitat, riparian zones, unstable soil areas, threatened and endangered plant locations, side slopes over 40 percent, wetlands, archaeological sites, and watershed areas should be avoided when possible during location studies.

Geotechnical Considerations. Unstable areas, potentially unstable areas, and areas showing evidence of high moisture or free water should be identified and avoided. Soil classification samples should be collected and processed during this period for future road surfacing determinations. Aggregate sources should be identified, tested, and mapped. Roadway excavation areas should be tested to determine the steepest stable cut slopes that could be constructed.

Geometric Considerations. The geometric standards for each particular road must be considered during location. The standards are shown in Table B-6a.

PRELIMINARY SURVEYS

The preliminary survey shall closely traverse along a line previously flagged by the operator and approved by the appropriate FS or BLM representative. Certain areas such as benches, wet areas, etc. may require exact conformance to flagged lines. Bisecting cross sections shall be taken at breaks in terrain, drainage areas, and at 100-foot intervals sufficiently wide to cover the entire clearing limits of the future road. Complete terrain cover, drainage systems, soil type, and land ownership shall be noted during the Preliminary Centerline Survey. A complete site survey shall be made at each major stream crossing. Any existing facilities, either operating or abandoned, crossed by the Preliminary Centerline shall be documented by station and orientation. Examples are powerlines, pipelines, roads, trails, fences, etc.

The class of survey required shall be defined by the BLM District Engineer and/or FS Engineer.

TABLE B-6a
GUIDE FOR MINIMUM GEOMETRIC DESIGN STANDARDS FOR OIL AND GAS ROADS
(FOREST DEVELOPMENT ROADS AND TEMPORARY ROADS)

	Single Lane Roads			Two Lane Roads		
Anticipated ADT		Less Than 100		<250	250-500	Over 400
Design Speed	10	15	20	30	30	30
Horizontal Curvature	58°	53°	29°	15°	15°	15°
Radius	75[1]	100	200	380	380	380
Traveled Way	14	14	14	20-24	20-24	24
Super-elevation		Remove crown			AASHO Blue Book Guides	
Runoff Distance			50			
Crown (Graveled)		Outsloped 2%			2%	
(Paved)					2%	
Stopping Sight Distance	50	85	120	200	200	200
Maximum Grade		8%			8%	
Maximum Pitch		10% for 500′			8%	
Turnout Spacing		Intervisible[2]			Not Required	
Drainage Dip or Culvert Spacing[3]		$D = 300/p^{0.40}$			----	
Curve Widening		400/R			400/R	

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[1] Unless specifically approved on a site-specific basis, the minimum radius of curvature shall be not less than 75 feet.

[2] Intervisible unless EA process, management concerns, or terrain features dictate otherwise.

[3] D = distance in feet between installations.
p = road grade in percent
R = Radius

DESIGN

Roads shall be designed by or under the direct supervision of a Registered Professional Engineer. BLM may on a case-by-case situation, waiver this option "out on the flats". It will be followed where any ridges and side slopes are involved. *All* roads will be laid out *at least* by an experienced land surveyor on BLM lands.

General geometric design criteria are shown in Table B-6a.

Roads should be designed with the purpose of fitting the roadway to the terrain. This procedure will result in minimizing earthwork and disturbed area. The designer shall attempt to create a balanced earthwork project, thus avoiding the need for borrow areas and waste areas. Special care must be taken to compensate for the incremental grade on all switchbacks by holding a maximum centerline grade of four percent throughout the length of the switchbacks.

SLOPE SELECTION

The cut and fill slopes shown in Table B-6b, should be used as a guide only. The slopes shall be adjusted to uneven ratios in transition sections to prevent a zigzag appearance at the slope catch points. The top of cut or toe of fill line should be a smooth line with gentle curves. Slope ratios shall not exceed the maximum stable slope as determined by the geotechnical investigation. In areas where cut or fill will be the construction method, cross sections will be required in the plans.

TABLE B-6b
CUT AND FILL SELECTION TABLE

Height (ft.)	Slope Ratio
0-5	3:1 (minimum) - BLM may require 6:1 ratio or larger
5-20	2:1
Over 10	1½:1

PAVEMENT STRUCTURE

The type and amount (depth) of road surfacing shall be determined by the engineer through a procedure based on projected traffic loadings, bearing capacity of the subgrade soils, and the anticipated loss due to traffic use and maintenance. A further factor which is to be considered is the time period in which the operator will be using the road. Section *Period of Use* of this document defines the consideration which must be given this factor. The surfacing analysis shall be documented and shall become a part of the "road package" submitted to the FS or BLM for review and concurrence. If the minimum surfacing as stated under *Forest and BLM Development Roads* for arterials is used, documentation of this determination is not required.

An acceptable analysis may be as simple as comparing like soil types and structure depths (that are based on firm data from previous projects) to full laboratory analysis of subgrade materials using California Bearing Ratio (CBR) or R value tests. The level of analysis should be that necessary to assure the pavement structure depths will support the type of vehicle and volume of use anticipated. The depth of rock courses can be varied along the road to accommodate changes in subgrade bearing capacity.

TRAVELED WAY WIDTH

The width of the traveled way, i.e., the lane width plus shoulder width, is determined from Table B-7a. Accurate traffic projections combined with design speed or the facility are the determining factors for traveled way widths. The operator should establish the factors even prior to the time when road location efforts are undertaken, and review with and receive concurrence from the FS Engineer or BLM Authorized Officer prior to proceeding with the work. This information must be included in the road package when submitted to the FS or BLM (depending on land status) for review.

Curve widening shall be applied to the traveled way widths as required to accommodate the tracking characteristics of the design vehicle. The design vehicle shall be that vehicle commonly referred to as 3-3 or WB-50 as defined as AASHO.

CLEARING

Selective clearing may be required during earthwork to remove trees damaged by construction, particularly large trees at the top of cut slopes whose root systems protrude into the excavation zone. Care shall be exercised to prevent marring of trees by equipment. The Company will buy all timber on the road right-of-way.

All cleared material shall be disposed of through methods approved by the FS or BLM. Methods which may be approved are burning, burying outside the construction limits, decking of material for removal by the public for firewood, chipping, sale of merchantable timber to a mill, or other appropriate means, as suggested by the operator. The method to be utilized shall be identified in the construction plans and specifications.

DRAINAGE

Permanent drainage structures shall be installed to protect the road and adjacent watershed. Single lane roads shall have, as a minimum, armored drainage dips constructed in the roadbed to prevent water from channeling the road surface. Bridges, or occasionally culverts, shall be constructed in low flow drainages where stream and roadway geometrics permit. Culvert cross-drains shall be installed in all double-lane roads (drainage dips shall not be constructed on double-lane roads). They shall be located to accommodate natural drainage patterns and as ditch relief pipes. Culvert inlet basins will be required to install ditch relief pipes. The inlets shall have metal end sections and occasional elbows to provide proper installation. These pipes will extend to the toe of the fill slopes and erosion control devices or energy dissipators shall be utilized at the outlets.

Dips will be designed so that it will be apparent at the time the road is maintained that the dip is a permanent necessary feature of the road and is not an irregularity that can be smoothed out with a grader. Dips must be designed and not added as an afterthought. Slopes at the discharge point may need protection and should be greater than the slope of the road to prevent dips from filling with silt.

Where large natural drainage systems are encountered, a complete hydrological study of the system must be performed to predict the anticipated runoff.

As a minimum, culverts shall be designed for a 10-year flood (flow of 10- year recurrence interval) without a head at the entrance. They should also be designed to carry a 50-year flood without exceeding the allowable headwater. The allowable headwater is the maximum water elevation for which the resulting flood damages are considered to be acceptable. Major culverts (end area greater than 35 square feet) and minor bridges (spans on the order of 30 feet or less) should be designed for a 20-year flood and checked for a 50-year flood. All other bridges should be designed to pass a 50-year flood and checked for a 100-year flood.

The hydrological study shall be included in the road package upon submittal to the FS or BLM for review and concurrence. After the road design is approved, five copies of the plans will be prepared and given to the FS or BLM.

CONSTRUCTION

STAKING

Construction controls will be staked on the ground for all roads. Staking will be in accordance with standard practices and include a marked centerline, Points of Intersection, clearing limits, cut and fill stakes, drainage structures, and reference *hubs*. The degree of construction staking will be determined by the FS engineer or BLM Authorized Officer. Minimum staking should include a referenced centerline, staked culverts and dips, and the cut catch point on slopes over 40 percent. Construction staking shall be done as described in *Forest Service Standard Specifications for Roads and Bridges*. No work shall commence until Forest Service or BLM approval of construction staking is completed.

QUALITY CONTROL

The operator has the responsibility to ensure that each road is constructed according to plans and specifications approved by the FS or BLM. *Forest Service Standard Specifications for the Construction of Roads and Bridges* shall be utilized to establish and maintain construction standards. Copies are available from the Forest Supervisor's Office. The degree of construction control should complement the survey and design methods utilized. Lower standard surveys and designs may require more intensive construction engineering to assure an acceptable end product.

The FS or BLM will make periodic inspections to ensure that each road is properly constructed, at which time control tests and charts maintained by the operator shall be made available for review. This shall include density tests, aggregate gradations, photographs showing construction techniques, daily diaries, etc.

The normally accepted tolerances between the designed and constructed road are as shown in Forest Service Standard Specification 203.

Tolerances should be indicated on the project plans.

ROAD MAINTENANCE

The lessee's Operations Plan shall include a maintenance plan for all roads constructed or used by the lessee.

Users of Forest Development Roads shall pay their fair share of maintenance costs, and use of Forest Roads will be approved by FS road permits. This includes roads which lead to the area where additional access is needed. Lessees may either perform actual maintenance activities or pay cooperative deposits as the FS approves. Before a bond release is signed, all road damage caused by the user shall be repaired in a manner approved by the FS (this will not apply to BLM lands).

The maintenance plan should have definite provisions for preventing undercutting of cut banks and the unnecessary removal of established stabilizing vegetation on fill side of road (operators should be given special instructions).

OBLITERATION OF TEMPORARY ROADS

Upon abandonment and prior to when a bond release is signed, temporary roads shall be obliterated. All or part of the obliteration techniques that follow could be used depending on the EIS/EA direction. Obliteration shall commence by stripping the gravel course from the roadway surface by means of a scraper or by windrowing with a motor patrol and removal with a loader and trucks. The gravel may be stockpiled at approved sites. After stripping the ground, obliteration shall consist of rough grading, ripping or scarifying, cross ditching, and opening drainages to prevent erosion and encourage revegetation. The work shall not commence until after the temporary road is no longer needed to serve traffic.

After rough grading and ripping have been completed, the abandoned roadway shall be cross ditched.

Live streams and other drainages shall be opened by removing the abandoned structures and grading the approach fills so they will not impair the stream flow.

Abandoned structures shall be disposed of in agreed locations.

All obliterated areas shall be revegetated by applying seed and fertilizer mixtures as approved by the FS or BLM.

Roadways to be obliterated in high scenic quality areas will require more intensive procedures than those described above and may include such work as refilling cut slopes, removing fills, transplanting trees and shrubs, and other techniques deemed necessary to completely restore the area.

Culverts, bridges, construction signs, and other materials furnished by the operator will remain the property of the operator on obliterated roads.

B.7 EROSION CONTROL, REVEGETATION, AND RESTORATION GUIDELINES

Standard procedures for the Company will include implementation of erosion control and revegetation measures to assure that lands disturbed by construction and operation activities will be restored to a stable, productive, and aesthetically acceptable condition.

A detailed, site-specific reclamation plan will be developed and become part of the Construction and Use (CU) Plan submitted by each company under the requirements of the rights-of-way grants. Because the proposed rights-of-way are composed of many types of terrain, soils, vegetation, land uses, and climatic conditions, the detailed plan will include sets of techniques and measures tailored to each condition encountered. Preparation of the plans will use existing soils and geologic data and where determined necessary by the Authorized Officer, additional data will be collected. Local expertise and locally effective reclamation methods will be followed when the site-specific procedures for the detailed reclamation plan are developed. The Erosion Control, Revegetation, and Restoration Guidelines and CU Plan will be implemented under the direction of the appropriate agency official.

Detailed information regarding applicable techniques and technical assistance to private landowners concerning erosion control measures and reclamation procedures will be obtained from the Soil Conservation Service through local Soil Conservation Districts. Technical assistance and approval of written plans for federal lands would be obtained from the BLM and FS prior to any construction.

During construction, operation, and abandonment of the project, applicants will provide an experienced reclamation specialist for (1) liaison with private landowners, federal agencies, and local government; (2) direction for timely restoration requirements; and (3) favorable public relations.

General erosion control and restoration measures have been developed for the following areas and will be included as part of the CU Plan:

- Right-of-Way and Site Clearing.
- Site Preparation, Trenching, and Preservation of Topsoil.
- Backfilling and Grading.
- Land Preparation and Cultivation.
- Revegetation.
- Maintenance and Monitoring.
- Use of Biochemicals.
- Construction Timing.
- Stream Protection.

RIGHT-OF-WAY AND SITE CLEARING

Emphasis will be placed on protecting existing vegetation and minimizing disturbance of the existing environment.

- Land grading will be done only on the area required for construction.

- Existing roads will be used for vehicle traffic where possible; vehicles and equipment will not be allowed in streambeds unless specified by the authorizing agency.

- Sidehill cuts will be kept to a minimum to ensure resource protection and a safe and stable plane for efficient equipment use. The authorizing agency will provide assistance and will approve sidehill cuts prior to construction.

- Existing ground cover such as grasses, leaves, roots, brush, and tree trimmings will be cleared and piled only to the extent necessary. Slash will be piled and later shredded and chipped for use in restoration operations or disposed of at the discretion of the authorized agency official.

- Trees and shrubs on the right-of-way that are not cleared will be protected from damage during construction.

- Where the right-of-way crosses streams and other water bodies, the banks will be stabilized to prevent erosion. Construction techniques will minimize damage to shorelines, recreational areas, and fish and wildlife habitat. A channel stability evaluation will be completed before stream crossing locations are finalized. Channel stability ratings of 1 or 2 shall be avoided (Forest Service 1978b).

- Care will be taken to avoid oil spills and other types of pollution in all areas, including streams and other water bodies and in their immediate drainages. All spills will be immediately cleaned up following notification of applicable State and Federal agencies.

- Design and construction of all temporary and permanent roads will be based on an approved transportation plan and will ensure proper drainage, minimize soil erosion, and preserve topsoil. After abandonment, these roads will be closed and areas restored without undue delay or maintained at the discretion of the landowners. Restoration, including redistribution of topsoil and establishment of natural surface drainage patterns, will be to the satisfaction of the landowner and/or authorizing official.

- During adverse weather conditions, as determined by the on-site reclamation specialist and federal agency officials, the authorizing agency will issue stop and start orders to prevent rutting or excessive tracking of soil and deterioration of vegetation in the right-of-way area.

- During construction activities in or near streams or lakes, sedimentation (detention) basins and/or straw bale filters will be constructed to prevent suspended sediments from reaching downstream water courses or lakes as required by the authorizing officer.
- If construction through extensive wetland areas is deemed necessary, construction will occur during the driest period of the year and/or erosion control mats will be used to minimize erosion damage to wetland sites, as required by the Authorizing Officer.
- Actual construction activities and implementation of erosion control measures will immediately follow clearing operations, especially in areas with soils that are highly susceptible to wind or water erosion and other special areas.

SITE PREPARATION, TRENCHING, AND PRESERVATION OF TOPSOIL

Site Preparation and trenching methods and techniques will ensure that:

- Topsoil is removed from the trench area by double-ditching (i.e., windrowed separately, protected, and replaced last during backfilling). This procedure and the depth of such topsoil removal will be specified by the Authorizing Officer.
- Topsoil will be removed from facility site areas (e.g., drill pads and roads) and stored for replacement on disturbed surface areas after final backfilling and grading.
- Remaining unearthed materials are removed and stored in a manner that facilitates backfilling procedures, uses a minimum amount of right-of-way area, and protects the excavated material from vehicular and equipment traffic.
- A specific trenching and excavated material stockpiling procedure will be used on steep-sloping and rough, broken terrain to ensure minimum disturbance as outlined in the CU Plan. This procedure will be developed by both the Authorized Officer and applicant.

BACKFILLING AND GRADING

The following backfilling and grading techniques will be used:

- Backfill will be replaced in a sequence and density similar to the preconstruction soil condition.
- Backfilling operations will be conducted in a manner that would minimize further disturbance of vegetation.
- The contour of the ground will be restored to permit normal surface drainage.
- In strongly sloping and steep terrain, erosion control structures such as water bars, diversion channels, and terraces will be constructed to divert water away from the pipeline trench and reduce soil erosion along the right-of-way and other adjoining areas disturbed during construction.
- All structures such as terraces, levees, underground drainage systems, irrigation pipelines and canals will be restored to preconstruction conditions so that they will function as originally intended.
- The surface will be graded to conform to the existing surface of the adjoining areas except for a slight crown over the trench to compensate for natural subsidence. In cropland areas, especially border and furrow irrigated cropland, the soils will be compacted and the crown will be smoothed to match the bordering area to allow surface irrigation.
- Topsoil will be uniformly replaced over the trench fill and other disturbed areas to restore productivity to its preconstruction condition.
- Materials unsuitable for backfilling or excess backfill material will be disposed of as arranged by the authorizing officials.
- Temporary work space areas used at stream and highway crossings and other special sites will be restored to approximate preconstruction conditions and to the satisfaction of the authorizing officials.
- The right-of-way at stream crossings will be restored to preconstruction conditions. The upland areas and banks will be revegetated to preconstruction conditions. Where this is not possible, they will be mulched with rock. The size of the rock mulch will be larger in diameter than materials excavated from the trench. The streambed will be returned to its original contours with sediments like those that were excavated.
- Well sites will be restored without undue delay and maintained at the discretion of the landowners. Restoration including grading and

redistribution of topsoil, will be to the satisfaction of the landowner and/or Authorized Officer.

LAND PREPARATION FOR SEEDING AND CULTIVATION

Construction, backfilling, and grading activities commonly cause compaction and alter soil conditions that affect soil productivity and/or seeding success in the right-of-way area. The following practices and techniques will be used to improve these soil conditions, protect soil from erosion, and provide a favorable seedbed:

- In cropland areas, as required by the authorizing agency or landowner, subsoiling or chiseling will be used to ensure that soil compaction is reduced and preconstruction soil permeability is restored.
- Chiseling will be used, unless objected to by the landowner or authorizing agency, in rangeland areas to reduce compaction and improve soil permeability. Pitting and contour furrowing as directed by the authorizing agency or landowner will be done on steep slopes of disturbed areas to increase infiltration and to reduce runoff and erosion.
- Suitable mulches and other soil stabilizing practices will be used on all regraded and topsoiled areas to protect unvegetated soil from wind and water erosion and to improve water absorption.
- Special mulching practices or matting will be used, as necessary, in critical areas where wind and water are serious erosion hazards to protect seeding, seedlings after germination, and plantings.
- Commercial fertilizers will be applied to soil areas with low inherent fertility to maintain crop yields and establish grass seedings. Application rates will be commensurate with annual precipitation and available irrigation water.
- Seedbeds for areas seeded to grass will be prepared to provide a firm and friable condition suitable for the establishment of vegetation.
- Rock mulches will be used in steep-sloping rock outcrop areas and low precipitation areas to reduce erosion and promote vegetal growth.
- Cultivation and land preparation operations on steeply sloping areas will be done on the contour to minimize erosion.
- Soil area with rock fragments, such as very coarse gravel, cobble, or stone scattered on the surface, will be restored to the original preconstruction surface condition to blend with the adjoining area, to avoid a smooth surface right-of-way area, and to control accelerated erosion.

REVEGETATION (RESEEDING AND PLANTING)

The loss of vegetation from lands disturbed by pipeline construction can be mitigated only by satisfactory revegetation. To ensure a successful revegetation program, methods and procedures will be consistent with local climate and soil conditions and will follow recommendations and directions of local experts. Revegetation efforts will be continued until a satisfactory vegetative cover is established. The following practices and techniques will be used in areas where reseeding is suitable as determined by the authorizing agency:

- A firm seedbed will be prepared prior to seeding. This will include a mulch of plant residues or other suitable materials. A cover crop will be used as necessary in larger disturbed areas.
- Seed will be planted by drilling, broadcasting, or hydroseeding. Drilling is the preferred method because it is usually most successful. Drill seeding with a grass drill equipped with depth bands will be used where topography and soil conditions allow operation of equipment to meet the seeding requirements of the species being planted. Broadcast seeding will be used for inaccessible or small areas. Seed will be covered by raking or harrowing. Hydroseeding will be done in critical areas determined by the reclamation specialist or authorizing officer.
- Only species adaptable to local soil and climatic conditions will be used. Generally, these will be native species. However, introduced species may be considered for specific conditions when approved by the landowner and regulatory authority. Seeding rates in critical area plantings and generally throughout the right-of-way will be increased 100 percent over regular seeding rates to allow for seed mortality due to adverse growing conditions.
- Seed testing will be conducted to meet state, federal, and agency seed requirements.
- Seeding will be done when seasonal or weather conditions are most favorable, as determined by the landowner or authorizing officer.

- Grazing or mowing may be delayed at least one season after seeding to provide time for vegetation to become established, especially in highly erodible areas, unless objected to by the landowner or lessee. Protective fencing may be necessary in special areas and will be constructed, maintained, and removed according to authorizing agency specifications.

- In areas of low annual precipitation (generally less than 8 to 10 inches), where reseeding is not suitable or as successful, erosion control structures and measures will be applied on sloping areas to reduce accelerated erosion, to allow re-establishment of preconstruction surface soil conditions, and to allow natural revegetation.

- Trees and shrubs will be reestablished in areas as specified in the revegetation plan. Temporary and/or permanent barriers to off-road vehicle access will be installed by the Company at specific locations along the right-of-way and other disturbed sites to prevent off-road vehicle access as specified by the authorizing agency.

MAINTENANCE AND MONITORING

Joint inspection of the right-of-way by the applicant and authorizing agency will be conducted to monitor the success and maintenance of erosion control measures and revegetation programs on disturbed land for two growing seasons, or for a period determined by the landowner on private land, or the authorized agency official on state or federal land. The monitoring program will identify problem areas and corrective measures to ensure vegetation cover and erosion control. Certification of successful revegetation and erosion control will be determined by the landowner or authorized agency official.

USE OF BIOCHEMICALS

The use of biochemicals such as herbicides, fungicides, and fertilizers will comply with state and federal laws, regulations, and policies regarding the use of poisonous, hazardous, or persistent substances. State and federal wildlife agencies will be contacted if application of any of these substances will be on or near sensitive wildlife areas. Application of these substances will be by ground methods or by helicopter as approved by landowner and authorizing officer. Prior to the use of such substances on or near the permit or grant area, the applicant will obtain approval of a written plan for such use from the authorizing officer, landowner, and appropriate wildlife agency. The plan will outline the kind of chemical, method of application, purpose of application, and other information as required, and will be considered as the authorized procedure for all applications until revoked by the Authorized Officer, landowner, or appropriate wildlife agency. This plan will become part of the CU Plan.

CONSTRUCTION TIMING

Pipeline construction activities on irrigated hay or cropland will be timed, as possible, to avoid disruption of irrigation delivery systems during the major irrigation season to reduce effects on crop production in areas of construction as well as adjoining irrigated cropland areas served by the systems.

Pipeline construction activities in narrow floodplain areas subject to high erosion hazards would be timed to avoid high water flows as much as possible, this would reduce the effects of construction on erosion and sedimentation.

STREAM PROTECTION

To maintain stream bank stability, preserve stream channel and flood plain effectiveness, and minimize adverse changes in stream water chemistry, physical properties, or associated aquatic organisms, the following will be emphasized:

- The natural drainage channels of any stream will be maintained during construction activities wherever possible.

- Clear water diversion methods will be employed whenever construction activities such as pipeline trenching must pass through a stream channel.

- Tree or shrub vegetation, which give greater stability due to rooting structure, will be replaced during the revegetation of channel banks following construction.

- Construction staging and equipment service areas will be located outside of riparian areas.

- Following construction activities, the stream channel will be returned to as nearly the original width, depth, gradient, and curvature as possible.

APPENDIX C

METHODOLOGIES

C.1 BASELINE DEFINITION FOR ANALYSIS

Ongoing sweet gas and oil development and timber harvesting in the well field would continue to disturb land throughout the early years of the development of the Riley Ridge Project. Thus in order to analyze impacts from sour gas development, it is necessary to adjust certain baseline conditions to reflect ongoing activities. The following assumptions were developed to allow resource specialists to account for changes in vegetation type or losses in wildlife habitat resulting from ongoing development.

1. All surface disturbance from the construction of Riley Ridge facilities would occur by 1990.
2. From 1983 to 1990, 70 sweet gas or oil wells would be drilled each year in the Riley Ridge area.
3. Of these wells, 30 percent (21 wells per year) would be drilled within the Riley Ridge well field.
4. Each well would disturb 10 acres for the well pad and access road.
5. No existing sweet gas or oil wells would be abandoned and reclaimed during this period (1983–1990).
6. New wells would affect the sensitive resource in proportion to its occurrence within the well field. For example, if 6 percent of the well field is covered by riparian vegetation, the 6 percent of the ongoing development would disturb riparian areas.
7. Based on the above assumptions, sweet gas and oil development in the well field between 1983 and 1990 would disturb an additional 1,680 acres.
8. Each year, 100 acres of mixed pine vegetation type within the well field would be clearcut. This would result in a maximum of 800 acres being disturbed between 1983 and 1990.

For the most part, baseline data reflects conditions which existed in the study area in 1982. Information for some resources has been updated by field programs which extended into the winter and spring of 1983. Ongoing sweet gas and oil development and timber harvesting in the Big Piney area are of concern to both the land management agencies and the general public. These activities have been considered as part of the baseline conditions. For example, people employed in sweet gas well drilling are considered to be part of the existing labor force. For other resources such as vegetation and wildlife, land disturbances from these activities over the next 8 years (1983–1990) were factored into the baseline conditions to provide an accurate base against which to analyze impacts.

C.2 VISUAL RESOURCE INVENTORY AND ANALYSIS PROCESS

INTRODUCTION

The purpose of this appendix is to provide a more detailed discussion of the Bureau of Land Management (BLM) and Forest Service (FS) visual resource inventory and assessment procedures, and their application in the Riley Ridge Project.

The inventory process used in the Riley Ridge study followed closely the standardized BLM and FS visual resource program. The impact assessment process, however, was specifically tailored to the study needs and represents a streamlined process utilizing some procedures of the BLM system, some procedures from the FS system, and some newly developed techniques.

AGENCY VISUAL INVENTORY PROCESS OVERVIEW

The standardized inventory processes used by the BLM and FS are conceptually identical, differing only in the application of specific criteria. Each system considers three inventory components, which together determine various levels of resource value, each of which has established guidelines for protecting and managing the visual resource. The respective agency terminology for these various components is identified in Figure C-1.

The following section identifies in some detail the respective agency visual inventory processes, as well as a discussion of any variations in these systems as applied to the Riley Ridge study.

SCENIC QUALITY (BLM), VARIETY CLASS (FS)

Rating the scenic values of the landscape first requires dividing it into subunits that appear homogeneous, generally in terms of landform and vegetation. In the BLM system, each area is then rated by seven key factors: landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modification. The FS system considers land and rock form, water form, and vegetation. Three levels are determined and mapped under each system as follows:

- *Class A (BLM), Distinctive (FS):* Areas that combine the most outstanding characteristics of each rating factor.
- *Class B (BLM), Common (FS):* Areas in which there is a combination of some outstanding features and some that are fairly common to the physiographic region.
- *Class C (BLM), Minimal (FS):* Areas in which the features are fairly common to the physiographic region.

Ratings for each of the variable factors is made within the perspective and context of the regional landscape conditions. The source of this perspective is the descriptions of physiographic provinces by Nevin M. Fenneman (1931).

VISUAL SENSITIVITY (BLM AND FS)

Visual sensitivity in both the BLM and FS systems is determined through two variables: use volume and user concern. Use volume is relatively straightforward. User concerns, however, are not.

Although landscapes do have common elements that can be measured, there is obviously still a subjective dimension to landscape aesthetics. Each viewer brings perceptions formed by individual influences: culture, visual training, familiarity with local geography, and personal values. The BLM and FS systems vary most in the inventory of visual sensitivity and are, therefore, discussed separately below.

BLM

- Use Volume. Frequency of travel through an area (by road, trail, river) and use of that area (for recreation, camping, events) are tabulated. The area is then assigned a high, medium, or low rating according to predetermined classifications.
- User or Public Reaction. Public groups and/or agency represen tatives are familiarized with the area (if necessary) and asked to respond to activities that will modify that landscape. The concern they express about proposed changes in scenic quality is also rated high, medium, or low.

The various combinations of Use Volume and User Reaction for each area are combined by a matrix to an overall Sensitivity Rating of high, medium, or low.

FS

- Sensitivity Level 1 includes all seen areas from PRIMARY travel routes, use areas, and water bodies where, as a minimum, at least one-fourth of the Forest visitors have a MAJOR concern for the scenic qualities.

  Sensitivity Level 1 also includes all seen areas from SECONDARY travel routes, use areas, and water bodies where at least three-fourths of the Forest visitors have a MAJOR concern for the scenic qualities.
- Sensitivity Level 2 includes all seen areas from PRIMARY travel routes, use areas, and water bodies where fewer than one-fourth of the Forest visitors have a major concern for scenic qualities.

  Level 2 also includes all seen areas from SECONDARY travel routes, use areas, and water bodies where at least one-fourth, and

Inventory Components

Inventory of the inherent scenic quality of the landscape

BLM	FS
Scenic Quality	Variety Class

Inventory of the number of viewers and their concern for scenic quality

BLM	FS
Visual Sensitivity	Visual Sensitivity

Inventory of areas seen by viewers and their distance relationship to them

BLM	FS
Distance Zones	Distance Zones

Synthesis of the inventory components

Inventory Results

Visual resource value designations and associated management guidelines

BLM	FS
Visual Resource Management Classes	Visual Quality Levels

FIGURE C-1. STANDARDIZED AGENCY VISUAL INVENTORY TERMINOLOGY not more than three-fourths, of the Forest visitors have a MAJOR concern for scenic qualities.

- Level 3 includes all seen areas from SECONDARY travel routes, use areas, and water bodies where less than one-fourth of the Forest visitors have a MAJOR concern for scenic qualities. (Level 3 does not include any areas seen from PRIMARY routes or areas.)

DISTANCE ZONES (BLM AND FS)

The visual quality of a landscape (and user reaction) may be magnified or diminished by the visibility of the landscape from major viewing routes and key observation points. Thus, distance plays a key part in visual quality management and allows consideration of the proximity of the observer and the landscape. Under the BLM system, landscape scene is divided into three basic Distance Zones: foreground/middleground (0 to 3-5 miles), background (3-5 to 15 miles) and seldom-seen (15+ miles or unseen areas). The FS system also divides the landscape into three Distance Zones: foreground (0 to 0.25-0.50 mile), middleground (0.25-0.50 mile to 3-5 miles), and background (3-5 miles to infinity).

VISUAL RESOURCE MANAGEMENT CLASS (BLM), VISUAL QUALITY LEVEL (FS)

Management Class and Visual Quality Level designations are derived from an overlay technique that combines the maps of Scenic Quality/Variety Class, Sensitivity Levels, and Distance Zones. The overlays are used to identify areas with similar combinations of factors which result in one of five designations. Management objectives are associated with the Classes and Levels which describe the different degrees of modification allowed to the basic elements of the landscape.

- *Class I (BLM), Preservation (FS):* This visual quality objective allows ecological changes only. Management activities, except for very low visual impact recreation facilities, are prohibited. This objective applies to Wilderness areas, primitive areas, and other special classified areas.
- *Class II (BLM), Retention (FS):* This visual quality objective provides for management activities which are not visually evident. Contrasts may be seen but should not attract attention.
- *Class III (BLM), Partial Retention (FS):* Management activities remain visually subordinate to the characteristic landscape when managed according to this designation, although they can be evident.
- *Class IV (BLM), Modification (FS):* Under this objective, management activities may visually dominate the original characteristic landscape. However, activities of vegetative and landform alteration must borrow from naturally established form, line, color, or texture so completely and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area or character type.
- *Maximum Modification (FS Only):* Management activities of vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background, the visual characteristics must be those of natural occurrences within the surrounding area or character type.
- *Class V (BLM), Unacceptable Modification (FS):* This classification is applied to areas where the natural character of the landscape has been disturbed to a point where rehabilitation is needed to bring it up to one of the higher designations.

These designations and the associated guidelines or objectives establish the basis for management of the visual resource and provide the basis to judge the acceptability of landscape modifications from a visual perspective.

EXISTING VISUAL CONDITION (FS Only)

The FS Visual Management System (VMS) process does not consider man-made modifications in the Variety Class inventory as does the BLM Scenic Quality inventory.

As a result, a separate inventory process has been established to document the extent of man's influence on the natural landscape. It is measured in degrees of deviation from the natural appearing landscape.

AGENCY VISUAL IMPACT ASSESSMENT OVERVIEW

The BLM and FS standardized impact assessment procedures are not as similar as are their inventory procedures. Only at the most conceptual level are they similar. At this level each system considers the conditions of the land, the viewer, and the proposed facility to determine the degree of alteration or visual contrast that would be seen. This level of modification is compared to the visual management class (BLM) or visual quality level (FS) for that area to determine the degree of compliance or impact. The systems are not discussed in significant detail, because neither was used in its standard form in the impact assessment for the Riley Ridge study.

BLM VISUAL ASSESSMENT PROCESS

To evaluate specific proposed projects, a Contrast Rating System is used to measure the degree of contrast between the proposed activity and the existing landscape. This score is compared with allowable levels of contrast for the appropriate Management Class. The comparison will determine if mitigation is required to reduce visual impacts.

The process first segregates a landscape into its major features (land/water surface, vegetation, structures) and each feature, in turn, into its basic elements (form, line, color, texture). Each element is assigned a weighted value based on its significance in the landscape. The Contrast Rating compares the proposed activity with existing conditions element by element, feature by feature, according to the degree of contrast.

The Contrast Rating quickly reveals the existing features and their respective elements that will result in the greatest visual impact by comparing the resulting score to the appropriate Management Class guidelines to determine if contrast totals are acceptable. If the proposed project exceeds the allowable contrast, mitigation measures are stipulated to reduce critical impacts.

FS VISUAL IMPACT ASSESSMENT PROCESS

The standardized FS VMS impact assessment process utilizes the visual absorption capability (VAC) methodology. VAC is an estimate of the relative ability of a landscape to accept management manipulations without significantly affecting its visual character. It is a measure of the relative capability of the land to absorb visual change.

Visual absorption capability assessment provides an objective basis for predicting how difficult it will be for management manipulations of the landscape to meet recommended or adopted visual quality objectives.

Appropriate absorption factors may include slope, landscape complexity or diversity, soil color contrast, vegetative screening, and vegetative regeneration potential. Application of these factors to a landscape, when weighted for importance as the system prescribes, results in three ratings - high, intermediate, and low. The areas mapped high are those with the highest absorptive capability for visual change - the easiest, lowest-cost areas in which to work from the visual resource standpoint. Low areas are those which will visually absorb little or no change and are difficult and costly for projects to meet management objectives.

Visual quality objectives and visual absorption capability maps can be interfaced and combined to indicate in each land unit both the management objective and the relative effort required to meet it.

VISUAL IMPACT ASSESSMENT DEVELOPED FOR THE RILEY RIDGE PROJECT

Two types of visual impact assessment were developed for the Riley Ridge project. The first is referred to as a Facility Impact Assessment. This process was developed to evaluate the visual impact of the various component facilities, such as individual pipeline and transmission line segments or well sites, from specific viewer locations.

The second type of assessment is referred to as the Combined Visual Change Assessment. The purpose of this assessment is to identify the extent of overall visual change that would take place as a result of the Riley Ridge Project, as seen from generalized viewpoints such as major highway segments.

In the application of the Facility Impact Assessment, the approach to the BLM and FS-managed lands was nearly identical. Specific criteria within this framework, however, were treated somewhat differently as a result of differences in data base information. As a result, they are discussed separately below. The Combined Visual Change assessment, however, was applied uniformly on BLM and FS-managed lands.

BLM FACILITY IMPACT ASSESSMENT

The facility impact assessment involved a consideration of the visibility of the proposed project facilities in the various landscape settings in which they were proposed. The first step in executing this assessment was to collect data about the viewers. During the field inventory, an attempt was made to identify all sensitive viewpoints and record a variety of information about them. The number of viewers and their duration of view determines the degree of exposure an area gets to viewing. The degree of exposure is then compared against the type of viewers (use association) to determine the sensitivity of views. The results of this comparison are combined to get a visibility index rating.

The second major aspect was the determination of landscape units within which the physical response to disturbance could be predicted. The only differences in visual contrast within any one of these landscape units would be due to differences in how they are seen (as determined by the visibility index).

General criteria were developed for identifying areas of high, moderate, or low landscape sensitivity to disturbance. Landscape considerations were separated into the general categories of landform, vegetation, and structures for this purpose. The visibility index units and landscape type units were then mapped at 0.5 inch = 1 mile for the corridors and 1:24,000 for the BLM portions of the well field. These conditions were combined in matrix form with the various proposed facilities. The body of the matrix was filled in using BLM management class designations which indicated the predicted degree of visual evidence or dominance each facility type would have in each landscape/viewer situation. This designation, therefore, indicates the highest management class in which this combination could occur without causing an unacceptable modification.

This matrix formed the basis on which to judge impacts of specific proposed facilities. The landscape and visibility conditions of each facility (or facility segment) were identified (based upon previously mapped data). The predicted management class compatability level was identified from the matrix and compared to the actual management class designation for that area to determine impacts. Impact levels were then mapped for all facilities within the BLM study area at a scale of 1:24,000 for the well fields and 0.5 inch = 1 mile for the corridors.

FS FACILITY IMPACT ASSESSMENT

As indicated earlier, the impact assessment process used for the FS lands was conceptually identical to that used for BLM lands. The primary differences had to do with the data used to develop the visibility index and the landscape types. The following discussion is, therefore, limited to differences from the process as used on BLM-managed lands.

The first difference is in the development of the visibility index. Although the same process was followed here as on BLM-managed lands, the specific criteria are somewhat different. To determine "exposure", the results of the manual times-seen analysis were compared to aspect relative to viewer position. This was then compared to previously inventoried sensitivity levels data to develop a view sensitivity map. The view sensitivity data was overlaid with the distance zone data to determine the final visibility index map at a scale of 1:24,000 for all FS lands in the proposed well field.

A difference which should be stressed between the BLM and FS approach is that BLM designations of High, Moderate, and Low indicate levels of problem. With the FS approach, however, designations of High, Moderate, and Low comply with the standardized Visual Absorption Capability (VAC) concept of ability to absorb change. Therefore, High means high ability to absorb change (low visibility or low problem area), while Low means low ability to absorb change (highly visible or high potential problem area). As a result, if a comparison of the visibility index results were made along the FS/BLM boundary, a High (visibility) designation on the BLM-managed side should have a corresponding designation of Low (ability to absorb change due to High visibility) on the FS-managed side.

The landscape type development on FS lands was also different in the respect to reversed terminology, as well as in other ways, from the BLM process. The FS process used the results of a computer-generated slope map from which slope complexity was also determined.

The slope and slope complexity data were combined to determine landform patterns and mapped at a scale of 1:24,000. Vegetation was classified by types meaningful for visual analysis. Categories included conifer, aspen, mosaic, and short (several vegetative types of 8 feet or less in size). These types were mapped and directly combined with the landform pattern results to form final landscape types. Facility impacts were then assessed in the same manner as discussed for BLM lands.

COMBINED VISUAL CHANGE IMPACT ASSESSMENT

The facility impact assessment process indicates the degree of visual impact that would result from the individual facilities. The larger issue, however, is how the overall visual character of this area would be changed by the combined effects of all proposed facilities. The assessment process was conducted in four steps: (1) characterize the current landscape character, (2) identify the extent of proposed facilities that would be in view from general viewing locations in the study area, (3) characterize the predicted landscape character, and (4) evaluate the degree of change and its significance.

First, major viewing areas were identified, such as towns, highway segments with similar character, and groups of rural residences in similar settings. Next, the viewshed or seen-area around these viewpoints was mapped. Within this area, the existing landscape character was described noting the overall landscape condition, significant landscape features, and the extent of man-made modifications. Following this, a designation of Man Dominated, Man-Natural Mix, Natural Scenic Dominated or Natural Common Dominated was given to the area.

All proposed facilities within view of this viewpoint(s) were identified by type and extent or number according to the distance zone in which they would be seen. Following this, a description of the landscape character as it would appear with the modifications was written. The difference in this rating and the rating given the existing landscape was used as the basis to judge the impacts of combined visual change. Special consideration was given to fixed viewing locations (primarily residences) because of the extended and more critical viewing duration. From a fixed viewing location a small change could be seen more clearly than from a highway.

All generalized viewpoints and routes were evaluated by this process regardless of agency. The combined effect of the proposed project was judged based upon the results of change as seen from the combination of these viewpoint and route ratings.

C.3 SOIL REHABILITATION UNITS
AND
C.4 WATER EROSION RATES ASSOCIATED WITH SEVERAL SOIL EROSION TREATMENT SCENARIOS

INTRODUCTION

Achieving successful reclamation and erosion control on lands disturbed by project development and operation in the Riley Ridge Project area would require an intensive reclamation program. As part of the overall impact evaluation for the project, site-specific environmental constraints have been compared to the reclamation plans proposed by each of the applicants and agency land use objectives. Environmental constraints were determined from site-specific soil surveys, vegetation mapping, on-site inspections, literature reviews, and interviews with various agency specialists. Land use objectives were determined based on existing practices and plans expressed by agency personnel and in various documents [BLM Unit Resource Area (URA) - Management Framework Plans, FS, Forest Planning Units].

In order to provide a framework for identifying sensitive lands within the project area, and to develop reclamation recommendations for these areas, data from the soils and vegetation inventories were used to devise a set of 'rehabilitation units". Rehabilitation units, which are groups of soils that are similar in suitability for plant growth and respond to the same kind of soil management, were identified on the basis of soils, slope, climate, and geomorphic position. By grouping similar areas under these factors, and incorporating vegetation data, rehabilitation recommendations can be made. The rehabilitation unit should be viewed as a land management tool developed from a compilation of resource inventories and interpretations. It provides general guidance to site conditions and erosion control and revegetation techniques and materials pertaining to the Riley Ridge Project area. The rehabilitation units designed for the Riley Ridge Project area are presented in Table C.3. Additional detail on reclamation constraints and revegetation recommendations is included in the Soils, Vegetation, and Reclamation Technical Report.

Based on calculations of soil loss using the USLE equation (see Table C.4), the successful application of good engineering design, effective erosion control and rehabilitation techniques will stabilize disturbed sites within the project area to within limits established by the Bridger-Teton National Forest and BLM lands.

In order to evaluate whether compliance with the federal stipulations and the Erosion Control, Revegetation, and Restoration Guidelines (Appendix B.7) would ensure successful reclamation, calculations of potential soil loss and the effect of different control techniques were done for several representative soils in the well field (see Table C.4). Based on compliance with federal stipulations and the the Erosion Control, Revegetation, and Restoration Guidelines contained in Appendix B.7, no significant impacts to soils on disturbed sites are anticipated.

C.3 REHABILITATION UNITS

CLIMATIC ZONE A: COOL, DRY SOUTHERN BASINS.
7-9" PRECIPITATION ZONE, MEAN ANNUAL AIR
TEMPERATURE 38-43°F, GROWING SEASON 85-100 DAYS

Rehab.[1] Unit	Soils	Textural Type	Dominant Slope Range[2] (%)	Rooting Depth	Salinity/ Alkalinity	Erosion Hazard	Present Vegetation Type	Rehabilitation		
								Rating	Considerations	Suggested Techniques
A1	Deep, wet soils formed in streamlain alluvium on perennial stream drainageways and river bottoms. Corridor Soil Association 101	Loamy over sand and gravel	0-5	60" +	Slight	Moderate: some channel scouring, cutbanks cave.	Pasture/ Hayfield	Fair	Wetness, stoniness at depth, restoration of intensive land uses, potential for stream crossings, flooding.	Control cutbank erosion via mechanical techniques (riprap,etc.) where necessary. Late fall seeding with fertilization. Transplant shrub seedlings. Drill or broadcast adapted species, depending on wetness.
*A2	Deep and moderately deep, saline-alkaline soils formed in alluvium on dry drainageways and stream terraces. includes small areas of geographically associated sand dunes. Corridor Soil Associations 102, 104, 105, 107. Bio/West Units 41, 42, 43.	Loamy to clayey, minor sandy	5-15	20-60"	Severe	Slight, some run-on, severe wind erosion hazard over limited areas	Greasewood, Saltbush, Mixed Desert Shrub	Poor	High salts, compaction, drouthiness SENSITIVE REHABILITATION UNIT	Spring-tooth harrow. Add organic seedbed amendments. Use of salt-tolerant plant species, warm and cool season. Broadcast seeding in late fall. Clean hay mulch crimped in @ 2-4 T/a. Fertilize 2-3 years after seedling establishment.

C.3 REHABILITATION UNITS (continued)

CLIMATIC ZONE A: COOL, DRY SOUTHERN BASINS. 7-9" PRECIPITATION ZONE, MEAN ANNUAL AIR TEMPERATURE 38-43°F, GROWING SEASON 85-100 DAYS

Rehab.[1] Unit	Soils	Textural Type	Dominant Slope Range[2] (%)	Rooting Depth	Salinity/ Alkalinity	Erosion Hazard	Present Vegetation Type	Rehabilitation		
								Rating	Considerations	Suggested Techniques
A3	Deep and moderately deep soils forming on upland alluvial fans, pediments, and plateaus. Corridor Soil Associations 103, 203, 206. Bio/West Units 39, 44, 45.	Loamy	5-15	20-60"	Moderate	Slight	Big sagebrush, bunchgrass, few irrigated fields near Big Piney	Good	Drouthiness, some salinity	Drill seeding. Use of drought-tolerant plant species, warm and cool season. Clean straw/hay mulch crimped in @ 2-4 T/a. Fertilize 2-3 years after seedling establishment.
*A4	Shallow to deep, eroding soils on pediments, truncated uplands, badlands, and escarpments. Corridor Soil Associations 204, 207, 224.	Loamy to clayey	15-50	10-40"	Moderate	Severe	Big sagebrush, Saltbush, Bunchgrass	Poor	Steep slopes, drouthiness, depth to bedrock SENSITIVE REHABILITATION UNIT	Add organic seedbed amendments. Contour furrowing. Closely-spaced water bars. Plant adapted warm and cool-season species via broadcast or drill, depending on access. Clean straw/hay mulch applied @ 2-4 T/a. Mulch tackifiers, erosion control netting.

CLIMATIC ZONE B: COOL, DRY BASINS NORTH AND WEST 10-14" PRECIPITATION ZONE, MEAN ANNUAL AIR TEMPERATURE 37-40°F, GROWING SEASON 75-90 DAYS

Rehab.[1] Unit	Soils	Textural Type	Dominant Slope Range[2] (%)	Rooting Depth	Salinity/ Alkalinity	Erosion Hazard	Present Vegetation Type	Rehabilitation		
								Rating	Considerations	Suggested Techniques
B1	Deep, wet soils formed in streamlain alluvium on bottomlands. Generally colder than normal for this zone, due to wetness and topography trapping cold air. Well Field Soil Units 71, 72, 73. Bio/West Units 9, 23.	Loamy over sand and gravel	0-5	60" +	Slight	Moderate: cutbanks cave, some channel scouring	Pasture/ Hayfield Willow Meadow	Fair	Wetness, stoniness at depth, restoration of intensive land uses, potential for stream crossings, flooding.	See Rehabilitation Unit A1
*B2	Deep and moderately deep, soils on alluvial fans, high terraces, and pediments. Corridor Soil Association 109. Well Field Soil Units 62, 74, 81D, 84D, 99. Bio/West Units 2, 3, 5, 6, 30, 31, 32, 37.	Loamy to clayey,	5-15	30-60"	Moderate	Slight	Big sagebrush, Sagebrush, complex, Bunchgrass	Good	Drouthiness, some salinity	See Rehabilitation Unit A3
*B3	Shallow to moderately deep soils on ridgeslopes, hillsides, folded and faulted lands. Corridor Soil Associations 309, 310. Well Field Soil Units 82, 84 86. Includes minor areas of deep soils in Well Field Soil Units 81E, 81F. Bio/West Units 1, 14, 34, 35, 36.	Loamy to clayey	15-30 +	10-40"	Moderate	Severe	Big sagebrush, Bunchgrass, some mountain shrub	poor	Drouthiness, depth to bedrock, high probability of extensive cuts and fills, avoid moist slopes to minimize erosion and slumping SENSITIVE REHABILITATION UNIT	See Rehabilitatoin Unit A4

C.3 REHABILITATION UNITS (continued)

CLIMATIC ZONE C: COOL, MOIST FOOTHILLS,
15–19″ PRECIPITATION ZONE, MEAN ANNUAL AIR
TEMPERATURE 34–37°F, GROWING SEASON 70–85 DAYS

Rehab.[1] Unit	Soils	Textural Type	Dominant Slope Range[2] (%)	Rooting Depth	Salinity/ Alkalinity	Erosion Hazard	Present Vegetation Type	Rehabilitation		
								Rating	Considerations	Suggested Techniques
C1	Deep, wet soils formed in streamlain alluvium in drainageways. Well Field Soil Unit 70. Bio/West Unit 16.	Loamy	2–8	60″ +	Slight	Moderate: cutbanks cave, some channel scouring	Pasture Willow	Fair	Wetness, channel crossings, possible disturbance of associated springs and seeps.	See Rehabilitation Unit A1
•C2	Drouthy, shallow and deep, gravelly soils on ridge crests and sideslopes. Well Field Soil Units 50E, 50F, 51E, 51F, 52, 53, 54, 64. Bio/West Units 7, 13, 21.	Loamy with high rock content	15–30 +	10–60″	Moderate	Slight	Bunchgrass, Mountain shrub Douglas fir	Poor	Depth to hard bedrock, stoniness, slope, drouthiness SENSITIVE REHABILITATION UNIT	Seed drought-tolerant species adapted to shallow stony sites. Restore gravelly surface. Broadcast seed, fertilize 2–3 years after seedling establishment
C3	Deep, gravelly soils on rolling ridgeslopes and fans. Well Field Soil Units 66D, 75, 92. Bio/West Units 4, 8, 11, 15, 17, 18, 19.	Loamy to clayey, with high rock content	5–15	60″	Moderate	Slight to moderate	Sage Complex, Mountain brush, Aspen	Fair	Stoniness, some salinity, some clayey textures	Drill seed cool-season species, transplant containerized shrub seedlings. Clean straw/hay mulch crimped in @ 2 T/a. Fertilize 1–2 years after seedling establishment.
•C4	Deep, gravelly soils on steep ridgeslopes. Well Field Soil Units 66E, 66F, 77E, 77F, 85, 91. Bio/West Units 12, 20, 22.	Loamy to clayey, with high rock content	15–30 +	60″	Moderate	Severe gullying	Big sagebrush, Mountain shrub, Aspen	Poor	Slope, stoniness, moist slopes surface erode or slump, need for extensive cuts and fills. SENSITIVE REHABILITATION UNIT	Avoid slump-prone areas. Closely-spaced water bars, other drainage diversions. Mulches, erosion control nets. Broadcast or drill seed according to access. Fertilize 1–2 years after seedling establishment. Transplant containerized shrub seedlings. Use mechanical stabilization techniques such as gabions where necessary.

CLIMATIC ZONE D: COOL, MOIST FOOTHILLS,
20″ + PRECIPITATION ZONE, MEAN ANNUAL AIR
TEMPERATURE 32–35°F, GROWING SEASON 60–75 DAYS

Rehab.[1] Unit	Soils	Textural Type	Dominant Slope Range[2] (%)	Rooting Depth	Salinity/ Alkalinity	Erosion Hazard	Present Vegetation Type	Rehabilitation		
								Rating	Considerations	Suggested Techniques
D1	Deep, well drained to poorly drained soils intermixed on alluvial fans and stream terraces. USFS Units 103A, 103B, 106.	Loamy to sandy, occ. high rock content	0–15	60″ +	Slight	Slight to Moderate	Willow, Mountain Shrub	Fair	Wetness, some stoniness, potential for stream crossings, flooding, shortness of growing season.	Control cutback erosion via mechanical techniques (rip-rap, etc.) where necessary. Spring or fall seeding with fertilization. Transplant shrub seedlings. Drill or broadcast adapted species, depending on wetness.
D2	Deep, gravelly soils on mountain benches. ERT Well Field Soil Units 88, 94, 95. USFS Units 107, 120A, 120B, 124A, 154B, 200B, 203B, 220B, 221B, 360B, 650B, 675B, 702B.	Loamy to clayey, with high rock content	5–15	60″	None	Slight	Mixed Pine Spruce/Subalpine fir, Douglas fir, Clearcut	Good	Shortness of growing season, stoniness, some soil acidity, areas of heavy clay.	Transplant containerized seedlings for trees, shrubs. Spring-tooth harrow. Broadcast adapted cool-season grass species.

C.3 REHABILITATION UNITS (continued)

**CLIMATIC ZONE D: COOL, MOIST FOOTHILLS,
20" + PRECIPITATION ZONE, MEAN ANNUAL AIR
TEMPERATURE 32-35°F, GROWING SEASON 60-75 DAYS**

Rehab.[1] Unit	Soils	Textural Type	Dominant Slope Range[2] (%)	Rooting Depth	Salinity/ Alkalinity	Erosion Hazard	Present Vegetation Type	Rehabilitation		
								Rating	Considerations	Suggested Techniques
D3	Deep, gravelly soils on mountain sideslopes. ERT Well Field Soil Units 90, 93E. USGS Units 103C, 120C, 124B, 154C, 200C, 203C, 220C, 221C, 255A, 255B, 360C, 360B, 492A, 492B, 492C, 650C, 660C, 675C, 702C, 711C.	Loamy to clayey, with high rock content	15-30	60"	None	Moderate	Mixed Pine Spruce/Subalpine fir, Douglas fir, Clearcut. Mountain Shrub.	Fair	Shortness of growing season, stoniness, some soil acidity, areas of heavy clay	Transplant containerized seedlings. Closely spaced water bars, other drainage diversions. Broadcast adapted cool-season grass species. Mulch w/tackifier or erosion control net.
*D4	Deep, well drained gravelly and non-gravelly soils on steep to extremely steep ridges and mountain sideslopes. USFS Units 154D, 200D, 220D, 221D, 225, 255C, 360D, 391, 492C, 650D, 660D, 675D, 702D, 710, 711D, 712C.	Loamy to clayey, with occ. high rock content	30 +	60"	None to slight	Severe	Mixed Pine, Spruce/Subalpine fir, Clearcut, Mountain Shrub.	Poor	Steep to extremely steep slopes, shortness of growing season, need for extensive cuts and fills. SENSITIVE REHABILITATION UNIT	Transplant containerized seedlings for trees, shrubs. Broadcast adapted grass species. Use mechanical stabilization and control structures where necessary. Avoid slump-prone areas.
*D5	Deep and shallow, gravelly soils with rock outcrop on steep mountain sideslopes. Well Field Units 55, 93F, 96, 97, 98. Bio/West Unit 10. USFS Units 203D, 355, 492D, 502, 701, 710, 712B, 713, 714, 715.	Loamy with high rock content	15-50 +	10-60"	Moderate to slight	Severe	Mixed Pine, Spruce/Subalpine fir, Douglas fir, Mountain shrub, Clearcut	Poor	Slope, shortness of growing season, erosion hazard, stoniness, depth to hard bed-rock, need for extensive cuts and fills. SENSITIVE REHABILITATION UNIT	Transplant containerized seedlings for trees, shrubs. See Rehabilitation Unit D4.

Note: See Soils, Vegetation, and Reclamation Technical Report.

[1] Asterisk (*) indicates a sensitive rehabilitation unit.

[2] Slope ranges shown are the dominant slopes; inclusions of flatter or steeper slopes occur within the units. Inclusions of 30 to 50 + percent slopes will require very intensive rehabilitation procedures if disturbed.

TABLE C.4
WATER EROSION RATES ASSOCIATED WITH SEVERAL SOIL EROSION TREATMENT SCENARIOS[1]

Soil Series and Vegetation Condition	Condition, Erosion Treatment, and Revegetation Scenario	Erosion Rates[2] (Tons/Acre/Year)
Heath Variant Soil - Deep soils with loamy surface textures and clayey subsoils, 25 percent rock fragments on the surface. Annual precipitation - 15 to 19 inches. Slope –10 percent, 300 feet long. Vegetation Cover - 35 percent, in alkali sagebrush. Part of ERT Map Unit 75, Heath Variant - Jerry - Brownsto complex, 5 to 15 percent slopes.	Current Condition	2.3
	Exposed Compacted Soil[3]	25.0
	Erosion Control Measures	
	- 100-foot interval water bars	14.6
	- 2-ton/acre mulch	1.1
	- 1 ton/acre mulch	3.4
	- 100-foot interval water bars plus 2 ton/acre mulch	0.7
	- 100-foot interval water bars plus 1 ton/acre mulch	2.0
	Reseeding (seedling establishment to 10 percent cover, grass)	
	- No erosion control measures	6.1
	- 100-foot interval water bars	3.6
	- 100-foot interval water bars plus contouring[4]	2.15
Farlow Soil - Deep, loamy, very gravelly soils, 35 percent rock fragments on surface. Annual precipitation - over 20 inches. Slope - 35 percent, 200 feet long. Vegetative Cover 50 percent, in mountain shrub.	Current Condition	6.9
	Exposed Compacted Soil[3]	149.0
	Erosion Control Measures	
	- 100-foot interval water bars	98.2
	- 2 ton/acre mulch plus plastic netting	4.6
	- 1 ton/acre mulch plus plastic netting	11.4
	- 100-foot interval water bars plus 2 ton/acre	

TABLE C.4
WATER EROSION RATES ASSOCIATED WITH SEVERAL SOIL EROSION TREATMENT SCENARIOS[1]

Soil Series and Vegetation Condition	Condition, Erosion Treatment, and Revegetation Scenario	Erosion Rates[2] (Tons/Acre/Year)
Part of ERT Map Unit 96, Farlow - Starley very gravelly loams, 25 to 50 percent slopes, in Sensitive Rehabilitation Unit D5.	mulch plus netting	3.0
	- 100-foot interval water bars plus 1 ton/acre mulch plus netting	7.5
	Reseeding (seedling establishment to 10 percent cover, grass)	
	- No erosion control measures	36.7
	- 100-foot interval water bars	24.2
	- 100-foot interval water bars plus contouring[4]	24.2
	Reseeding (grass plus containerized shrub seedlings, establishment to 50 percent cover with 25 percent low canopy)	
	- 100-foot interval water bars plus contouring[4]	4.5
Unnamed 1Be Soil - Deep, loamy, non-gravelly soil under coniferous forest on USFS lands. Annual precipitation - over 20 inches. Slope -20 percent, 200 feet long. Vegetation Cover - 75 percent canopy with 100 percent litter cover, in mixed pine. Part of USFS Map Unit 154, Phase C, 15 to 30 percent slopes.	Current Condition	0.1
	Exposed Compacted Soil	51.1
	Erosion Control Measures	
	- 100-foot interval water bars	33.7
	- 2 ton/acre mulch plus plastic netting	1.6
	- 1 ton/acre mulch plus plastic netting	3.9
	- 100-foot interval water bars plus 2 ton/acre mulch plus plastic netting	1.0
	- 100-foot interval water bars plus 1 ton/acre mulch plus plastic netting	2.6
	Reseeding (seedling establishment to 20 percent cover, grass)[5]	
	- No erosion control measures	7.9
	- 100-foot interval water bars plus contouring	4.7
Moyerson Soil - Shallow, clayey soil 10 to 20 inches deep over shale bedrock. Annual precipitation - 12 inches. Slope - 20 percent, 100 feet long. Vegetation Cover - bunchgrass, saltbush. Representative part of ERT Soil Unit 310, in Sensitive Rehabilitation Unit B3.	Current Condition	4.5
	Exposed Compacted Soil	18.2
	Erosion Control Measures	
	- 50-feet interval water bars	12.0
	- 2 ton/acre mulch plus jute or plastic netting	0.6
	- 1 ton/acre mulch plus jute or plastic netting	1.4
	- 50-foot interval water bars plus 2 ton/acre mulch plus jute or plastic netting	0.4
	- 50-foot interval water bars plus 1 ton/acre mulch plus jute or plastic netting	0.9
	Reseeding (seedling establishment to 10 percent cover, grass)	
	- No erosion control measures	4.5
	- 50-foot interval water bars plus contouring	2.7

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[1] Based on laboratory data and other information contained in the Soils, Vegetation, and Reclamation Technical Report.

[2] Based on Universal Soil Loss Equation factors and concepts (SCS 1977b, Clyde et al. 1978, Patric 1982, SCS and EPA 1977). Soil loss estimates are speculative above slopes of 24 percent, as these values are projected beyond available research data.

[3] Based on barren topsoil compacted by a bulldozer up and down the slope.

[4] Topsoil spreading and seedbed preparation done on the contour.

[5] Long-term re-establishment of forest canopy not accounted for.

Conclusions

These estimated erosion rates demonstrate the effectiveness of the various erosion control and revegetation measures. For example, the use of mulches on well pad cuts and fills and on sidehill road cuts is effective for temporary stabilization of disturbed sites. This practice becomes still more effective when applied in conjunction with water bars or other mechanical erosion control practices as outlined in the Soils, Vegetation, and Reclamation Technical Report.

Soil loss tolerances (the loss allowable with productivity level maintained) for the Heath variant, Farlow, and Unnamed 1Be soils are about 5 tons/acre/year each. The Moyerson soil has a soil loss tolerance of 1 ton/acre/year. It should be noted that successful revegetation and mechanical treatments are both needed to reach or even approximate these limits in a re-established land use system.

C.5 SEDIMENT YIELD METHODS

The method used to estimate on-site erosion in the North Beaver Creek drainage was developed by the USDA Forest Service (Megahan 1974 and Leaf 1974). Application of the method results in time-dependent erosion indices for a given area. The process equation is:

(1) $E_t = 0.28\,\tau + 401.3\,(1 - e^{-0.085t})$

Where: E = Cumulative on-site eroson (feet^3/acre) at time t.

t = Elapsed time (years) since initial disturbance.

The coefficients in equation (1) were developed from research conducted in the Fraser Experimental Forest.

The equation used to calculate sediment available to adjacent streams is:

(2) $S = AE$

Where S = Total available sediment attributable to disturbed areas (feet^3).

A = Disturbed area (acres).

E = Cumulative erosion from disturbed areas (feet^3/acre) from equation (1).

Equation (2) was applied for the year following construction and for five additional years. The annual sediment increments were routed to the stream channel with no assumed deposition outside the stream channel. The size fraction finer than 0.002 millimeter was assumed to be suspended, while the remainder was assumed to be deposited. Erosion was assumed to occur at a constant annual rate, and was assumed to be delivered uniformly along the stream's length. Grain size distribution was calculated from soil surveys in the North Beaver Creek area.

Estimates of average annual sediment deposition depths were made by assuming that deposition occurred uniformly within a 5-foot wide channel. Estimates of average annual suspended sediment concentrations were made by assuming that sediment was delivered at a uniform annual rate to a stream flowing at a constant 2.5 feet^3/second.

EFFECTS OF NEW ROAD AND DRILL PAD CONSTRUCTION ON NORTH BEAVER CREEK

Area = 1.47 square miles
Total Road Length = 4.0 miles
Total Stream Length = 4.1 miles
Number of Pads = 4
Pad Area = 4 pads X 1.5 acres/pad = 6.0 acres
Road Width = 40 feet including cut and fill

Year Following Construction	Eroded Material (Feet^3/Year)	Deposited Sediment		Suspended Sediment	
		Feet^3/Year	Inches/Year[1]	Feet^3/Year	parts/million[2]
1	838	612	.07	226	2.9
2	770	562	.06	208	2.6
3	709	518	.06	191	2.4
4	650	475	.05	176	2.2
5	597	436	.05	161	2.0
6	551	402	.05	149	1.9

[1] Assumes 5-foot wide main channel.

[2] Assumes constant discharge of 2.5 feet^3/second.

C.6 SOUR GAS TRUNK LINE MITIGATION MEASURES

One measure available to mitigate H_2S impacts from trunk line ruptures would be the use of block valves to seal off a segment of ruptured pipeline. Block valves react to changes in pipeline pressure and close in a period ranging from a few seconds to a few minutes, depending on pipeline diameter. A quantitative risk assessment was conducted using the trunk line block valve spacings as specified by the applicants, as well as additional block valve spacing along trunk line segments near populated areas. The results are presented below.

PROPOSED ACTION WITH ADDITIONAL BLOCK VALVES

For the Proposed Action, the Quasar trunk line was modeled with 10-mile block valve spacing (as proposed) away from the designated populated areas. In addition, 2-mile block valve spacing near population areas was investigated to explore possible mitigation measures. Northwest's trunk line was modeled, as proposed, with 5-mile block valve spacing away from the population areas, and 2.5-mile block valve spacing near the population areas. In addition, 1-mile block valve spacing near populated areas was investigated to explore possible mitigation measures. Northwest's trunk line was modeled with shorter block valve spacings because the gas has a higher average H_2S content than is expected to occur in Quasar's gas field.

The modeling analysis was carried out as described in the Health & Safety Technical Report, and a corresponding risk assessment was performed for the Proposed Action with mitigation by additional block valves. The population areas considered were LaBarge, Big Piney/Marbleton, Calpet, and the Fontenelle Recreation Area. The results are shown in Table C.6-1. It was found that only Calpet would be at risk of exposure to lethal levels from a trunk line rupture, and that the use of additional block valves reduces the annual risk of lethal exposure by about 25 percent (from 0.00023 to 0.00018). The annual risk of discomfort exposure is reduced even more, about 33 percent (from 0.00037 to 0.00025). With this additional block valve spacing near the populated areas of LaBarge, Big Piney/Marbleton, and the Fontenelle Recreation Area, the annual risk of discomfort exposure declines to negligible.

BUCKHORN ALTERNATIVE WITH ADDITIONAL BLOCK VALVES

For the Buckhorn Alternative, the Quasar trunk line was modeled with 10-mile block valve spacing (as proposed) away from the designated populated areas. In addition, 2-mile block valve spacing near the population areas was investigated to explore possible mitigation measures. Northwest's trunk line was modeled with 5-mile valve spacing (as proposed) away from the population areas and 2.5-mile near populated areas. In addition, 1-mile block valve spacing near the population areas was investigated as a possible mitigation measure.

The modeling analyses were carried out and a corresponding risk assessment was performed for the Buckhorn Alternative, with mitigation by additional block valves. The results, shown in Table C.6-2, are

TABLE C.6-1
ANNUAL RISK TO POPULATED AREAS FROM PROPOSED ACTION WITH ADDITIONAL BLOCK VALVES

Populated Area	Individual Risk of Lethal Exposure[1]	Individual Annual Risk of Significant Impact[2]	Approximate Number of People (1990)[3]
LaBarge	negligible[4]	negligible	1,206
Big Piney	negligible	negligible	1,177
Marbleton	negligible	negligible	1,134
Calpet	0.00018	0.00025	54
Fontenelle Recreation Area	negligible	negligible	1,210

[1] Risk values shown in this table, such as 0.00025, mean 25 chances per 100,000.

[2] Significant exposures are those that would cause eye irritation, coughing, loss of smell, or other discomfort.

[3] Includes people in incorporated and unincorporated area.

[4] Neglible means that the modeling analysis indicates *no* risk.

TABLE C.6-2
ANNUAL RISK TO POPULATED AREAS FROM BUCKHORN ALTERNATIVE WITH ADDITIONAL BLOCK VALVES

Populated Area	Individual Risk of Lethal Exposure[1]	Individual Annual Risk of Significant Impact[2]	Approximate Number of People (1990)[3]
LaBarge	negligible[4]	negligible	1,206
Big Piney	negligible	negligible	1,177
Marbleton	negligible	negligible	1,134
Calpet	0.00018	0.00025	54
Fontenelle Recreation Area	negligible	negligible	1,210

[1] Risk values shown in this table, such as 0.00025, mean 25 chances per 100,000.

[2] Significant exposures are those that would cause eye irritation, coughing, loss of smell, or other discomfort.

[3] Includes people in incorporated and unincorporated area.

[4] Neglible means that the modeling analysis indicates *no* risk.

identical to those described above for the Proposed Action with additional block valves.

SHUTE CREEK ALTERNATIVE WITH ADDITIONAL BLOCK VALVES

For the Shute Creek Alternative, the Quasar and Exxon trunk lines were modeled with 10-mile block valve spacing (as proposed) away from the designated populated areas. As before, additional 2-mile block valve spacing near the population areas was explored as a possible mitigation measure. Northwest's trunk line was modeled with 5-mile block valve spacing (as proposed) away from the population areas, 2.5-mile near populated areas, and also as before, with additional 1-mile block valve spacing near the population areas.

The modeling analyses were carried out and a corresponding risk assessment was performed for the Shute Creek Alternative with mitigation by additional block valves. The results are shown in Table C.6-3. It was found that only Calpet would be at risk of exposure to lethal levels from a trunk line rupture. The annual risk of lethal exposure at LaBarge declines to negligible. The use of additional block valves reduces the annual risk of lethal exposure at Calpet by about 23 percent (from 0.00048 to 0.00037). The annual risk of discomfort exposure at Calpet is reduced even more, about 45 percent (from 0.00093 to 0.00053) with this additional block valve spacing. The annual risk of discomfort exposure declines to negligible at Big Piney/Marbleton and the Fontenelle Recreation Area, and declines by about 80 percent (from 0.00033 to 0.000068) at LaBarge.

NORTHERN ALTERNATIVE WITH ADDITIONAL BLOCK VALVES

For the Northern Alternative the Quasar trunk line was modeled with 10-mile block valve spacing (as proposed) away from the designated populated areas, and as before with additional 2-mile block valve spacing near the population areas. Northwest's trunk line was modeled with 5-mile block valve spacing (as proposed) away from the population areas, 2.5-mile near populated areas, and as before, with additional 1-mile block spacing near the population areas.

The modeling analyses were carried out and a corresponding risk assessment was performed for the Northern Alternative with mitigation by additional block valves. The results are shown in Table C.6-4. It was found that, with these additional block valves, none of the population areas would be at annual risk of significant exposures.

EFFECTS OF ADDITIONAL BLOCK VALVES ON EXPOSURE DISTANCES

Table C.6-5 shows the effects of additional block valves on the downwind distances for significant H_2S exposure from trunk line ruptures. Exposure distances would depend not only on block valve spacing but also on pipeline diameter and atmospheric conditions. These parameters are summarized for all trunk lines (30 inches and larger) for each applicant and alterantive.

TABLE C.6-3
ANNUAL RISK TO POPULATED AREAS FROM SHUTE CREEK ALTERNATIVE WITH ADDITIONAL BLOCK VALVES

Populated Area	Individual Risk of Lethal Exposure[1]	Individual Annual Risk of Significant Impact[2]	Approximate Number of People (1990)[3]
LaBarge	negligible[4]	0.000068	864
Big Piney	negligible	negligible	861
Marbleton	negligible	negligible	845
Calpet	0.00037	0.00053	40
Fontenelle Recreation Area	negligible	negligible	1,210

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[1] Risk values shown in this table, such as 0.00053, mean 53 chances per 100,000.

[2] Significant exposures are those that would cause eye irritation, coughing, loss of smell, or other discomfort.

[3] Includes people in incorporated and unincorporated area.

[4] Neglible means that the modeling analysis indicates *no* risk.

TABLE C.6-4
ANNUAL RISK TO POPULATED AREAS FROM NORTHERN ALTERNATIVE WITH ADDITIONAL BLOCK VALVES

Populated Area	Individual Risk of Lethal Exposure	Individual Annual Risk of Significant Impact[1]	Approximate Number of People (1990)[2]
LaBarge	negligible[3]	negligible	1,212
Big Piney	negligible	negligible	1,217
Marbleton	negligible	negligible	1,171
Calpet	0.00018	0.00025	56
Fontenelle Recreation Area	negligible	negligible	1,210

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[1] Significant exposures are those that would cause eye irritation, coughing, loss of smell, or other discomfort.

[2] Includes people in incorporated and unincorporated area.

[3] Neglible means that the modeling analysis indicates *no* risk.

TABLE C.6-5
DOWNWIND DISTANCES FOR SIGNIFICANT H_2S EXPOSURES FROM RUPTURES OF PROPOSED TRUNK LINES

Applicant	Trunk Line Diameter (inches)	Block Valve Spacing (miles)	Downwind Distance for Lethal Dose (miles)		
			Stable Atmosphere	Neutral Atmosphere	Unstable Atmosphere
Quasar (Proposed Action) and Exxon (Shute Creek Alternative	30	10	2.5	0.9	0.4
	30	2[1]	1.7	0.8	0.4
Quasar (Buckhorn, Shute Creek, and Northern Alternatives)	36	10	3.5	1.2	0.6
	36	2[1]	2.1	1.1	0.4
Northwest (All Alternatives)	30	5	2.9	1.1	0.5
	30	2.5	2.2	0.9	0.4
	30	1[1]	1.6	0.8	0.3
			Downwind Distance for Significant Dose (miles)		
Quasar (Proposed Action) and Exxon (Shute Creek Alternative	30	10	6.8	1.4	0.7
	30	2[1]	2.5	1.2	0.4
Quasar (Buckhorn, Shute Creek, and Northern Alternatives)	36	10	9.9	1.9	0.8
	36	2[1]	3.2	1.6	0.6
Northwest (All Alternatives)	30	5	5.6	1.7	0.7
	30	2.5	3.4	1.5	0.6
	30	1[1]	2.2	1.2	0.4

[1] Mitigation block valve spacing.

CONCLUSION

Use of additional block valves along trunk line segments near population areas can appreciably reduce the risk of significant impacts from the Proposed or Alternative Actions:

- The small community of Calpet is expected to experience an appreciably smaller risk of lethal exposure under the Proposed Action, Buckhorn Alternative, or Shute Creek Alternative. It is expected that none of the other population areas would experience an annual risk of lethal dose.
- Under either the Proposed Action, the Buckhorn Alternative, or the Shute Creek Alternative the risks of discomfort exposure at LaBarge, Big Piney/Marbleton, and the Fontenelle Recreation Area are reduced effectively to zero (except for LaBarge under the Shute Creek Alternative).
- Under the Northern Alternative, no risks of significant exposures are expected at any of the population areas.

APPENDIX D

UNCOMMITTED MITIGATION MEASURES

The following measures are possibilities for mitigation. Some cannot or would not be required by the BLM or FS but may be possible for a state or county agency to implement if they choose. Others are measures which cannot be required by the BLM or FS, but which were conclusions stemming from the impact analysis of the proposed action. The socioeconomic measures are under the jurisdiction of the Wyoming Industrial Siting Council. Since this permit process will adequately consider socioeconomic mitigation, only the issues related to development of these measures, as well as a limited set of measures, are discussed below.

Development of socioeconomic mitigation measures requires not just the identification of anticipated project related service shortfalls, but an analysis that considers the following as well:

1) The uncertainty of applicant construction and operation schedules. Previous research has shown that the variation between these schedules and actual construction and operation have been extreme, generally due to events that could not have been anticipated at the start of the permitting process.

2) The fiscal condition of the affected jurisdiction, including the annual project related revenues, expenditures, and net balance, as well as the cumulative net balance generated during the life of the project.

3) The duration of the impact, whether relatively short term and restricted to the project's construction phase, or relatively long term and likely to exist throughout project operation.

4) The severity of the impact and the standard that was used to identify the service shortfall. There is wide variation in the ratios of service personnel to population reflecting differences in organization of delivery systems and differences in services provided by staff.

5) The need to allow for local preferences and hence local choice in what services should be provided, and how they should be provided.

Consideration of any of these issues alone can lead to an inappropriate mitigation strategy. For example, having identified the service deficiency, duration of impact will dictate the mitigation measures. A one-year shortage of classrooms due to construction activities would suggest use of temporary trailer space, whereas a ten-year shortage due to operations activities would suggest building a new school. The consideration of the net revenue a project will contribute to a local area will indicate if the funds from taxes will flow to the affected jurisdiction at the right time. If the revenues are forthcoming but after the need first arises, then various strategies to synchronize service needs and revenue flow can be devised. Lastly, a local area has the right to choose how it will be managed. Towns vary, for example, in the number of service providers per 1000 population. This reflects in part different preferences for services. In identifying service deficiencies, the basis used can be local standards, state standards, or national standards. Use of any one only indicates the potential for a problem. Depending on local preference and availability of personnel, a town may choose to not fill that need, or to fill it in a way not currently done. The requirement to fill a service deficiency by hiring additional staff would remove the exercise of local preference.

The sum total of these considerations suggests that socioeconomic mitigation measures should not necessarily be one for one replacement of identified potential service deficiencies. Rather, service deficiencies and their duration should be identified and a determination made of the funds flowing to a community from a proposed project. If funds fall far short of need, then a consideration should be given to service replacement. If the project generates substantial revenues and the problem is one of a mismatch in the timing of needs and revenues, the appropriate mitigation measure would attempt to match the timing of revenues and needs.

The Riley Ridge Project falls into the latter category of projects. Over the life of the project, it generates substantial net revenues for affected jurisdictions. It also generates service impacts which in some cases occur before the jurisdiction can afford to pay for them. Here it would be appropriate for the applicants to consider financing arrangements that would help match service needs and revenues, particularly when the need is for a large capital facility. Applicant funding of operating expenses, in particular, support of additional personnel, is not an appropriate consideration as payment for operating expenses is already taken care of by the taxes paid by project related personnel who live in the area.

One area of impact that falls outside this general framework is housing, and that is largely because it is a private sector activity and there is not a balancing of service needs and local revenues. Having identified a housing need, the question is one of an assessment of duration and the willingness of the private market to respond to this need. For long term housing needs, it can be anticipated that workers will want permanent housing and that builders will provide the needed units. When the need is short term, workers neither want permanent housing, nor is there the likelihood that builders would respond, hence the appropriateness of the applicants providing temporary housing.

In addition to this EIS, the applicants for this project must either individually or collectively submit an application to the Wyoming Industrial Siting Council that identifies anticipated social, economic, and environmental impacts and plans and programs for alleviating these impacts. In the area of socioeconomics, the regulations stress that the application contain a mitigation plan committed to by the applicants that was developed jointly by the applicants and local government. The mitigation plan must be in sufficient detail that it sets forth a time schedule for implementation that is tied to construction milestones. Funding for the mitigation program is not the sole responsibility of the applicants but rather can come from a variety of sources, including federal and state governments, city and county governments, as well as fees to residents and businesses expected to benefit from the proposed project. Responsibility for implementation of the plan lies with the applicants. Along with this, there will be requirements for monitoring, which will allow for more accurate determination of local service deficiencies and joint community-applicant mitigation.

Consistent with the issues involved in developing socioeconomic mitigation measures and the anticipated impacts of the Riley Ridge Project, the following measures are possibilities for mitigation.

- The companies could promote construction of modular condominiums or apartments in the communities which have an affected housing segment.
- The companies could provide financial assistance to the counties in the form of front-end financing to assist in the provision of capital improvements in advance of actual development.
- The companies could provide mortgage loan subsidies to employees and assist in obtaining financing for low to moderate income housing under Federal programs.

Mitigation measures affecting impacts to other resources are listed below.

- If fishing pressure were to result in abuse of the special regulations and management areas for Colorado cutthroat trout, WGF could reconsider their management of the Colorado cutthroat trout including changing or implementing stocking programs and penalties. This could be in conjunction with a concurrent reassessment by the BLM and FS of their stream management strategies.
- In order to protect one of the few pure populations of Colorado River cutthroat trout in Wyoming, North Beaver Creek could be closed to fishing. Closure to fishing would allow this population to be undisturbed, serve as a control to compare with populations from other streams, and minimize impacts to management plans and scientific research currently underway.
- Mitigation measures dealing with an increased regional population could include limiting the number of hunting licenses, modification of length of season, imposition of bag limits, limited quota hunting, stocking of local streams, increased numbers and use of game wardens, or stricter enforcement of existing regulations. These measures, if implemented, would control but not eliminate the significant recreation impacts.
- The companies could work with the federal land managing agencies and WGF to develop an Environmental Awareness Program to provide positive reinforcement of constructive public attitudes and actions toward preserving and protecting the environment. The companies with Riley Ridge activities could jointly fund such a program. This program could include establishment of local conservation clubs, involvement of employees and their families in conservation projects and programs, and annual awards to conservation minded staff or to those who report problems related to management of the environment.

Other resources which could benefit from this program are recreation, fisheries, and timber resources. The fisheries aspect could explain the sensitive nature of the area's streams, how to identify the trout species and the WGF fisheries regulations. The recreation aspect could include a program to inform employees and other community inhabitants of recreational opportunities, regulations, and ways to help reduce impacts of overuse. The timber resource aspect could include information on opportunities and regulations pertaining to fuel wood, posts and poles, and Christmas trees.

- Speeds along well field access roads could be limited to 25 mph unless otherwise indicated. Speed limit signs could be posted as appropriate. If speed limits are abused, speed bumps could be installed.
- During peak years of project construction from 1984 to 1990, the companies could jointly finance two additional temporary WGF game wardens for the local region. After construction declines and local populations decrease, one permanent warden could be funded for the life of the project or as determined necessary by WGF.
- The companies and their contractors could consider conviction of a job-related game violation as grounds for dismissal.

- The companies could discourage off-road vehicle use during non-working hours through employee educational programs. The Federal off-road regulations would be provided to the employees through such programs.

- Guns could be prohibited on all job sites.

- Companies could contribute funds to land managing agencies to augment maintenance of developed and dispersed recreational areas.

- Companies could develop an anti-vandalism program for personnel with regards to existing range improvements and other structures on federal lands, and could ensure disciplinary action in the event such vandalism were to occur.

- To reduce vehicle/animal collisions, as well as general disturbance, dust, and high traffic volumes, comprehensive ride sharing programs could be implemented by the companies. These would include use of buses, van pools, and car pools to transport workers to construction sites.

- The companies could schedule the construction work shifts so that peak arrival and departure time are not coincident with peak recreational travel.

- If site-specific problems with high volume traffic flows arise during project construction or operation, the Wyoming Highway Patrol may deem it necessary to allocate additional manpower to the Big Piney and/or Opal areas.

APPENDIX E

MONITORING PROGRAMS

E.1 RECOMMENDATIONS FOR GROUNDWATER MONITORING

POTENTIAL IMPACTS

Groundwater resources in the Riley Ridge Project area could be adversely impacted by a number of sources:

1) Drilling muds and chemical additives used as aids in drilling gas wells and waste water injection wells could contaminate fresh water aquifers.

2) Gas wells and waste water injection wells could act as conduits which allow the intermixing of freshwater aquifers with saline or contaminated aquifers.

3) Leaking well casings could allow hydrogen sulfide or saline water to escape from gas wells and waste water injection wells and contaminate fresh water aquifers.

4) Contents of leaky reserve pits and waste water ponds could migrate to shallow water table aquifers.

5) Drawdown in wells for the various sites could interfere with nearby wells and springs, reducing spring flows and necessitating lowering of pumps or deepening wells.

6) Pressure buildups in waste injection wells could cause rupture of casing or of confining units permitting the wastes to migrate to unintended aquifers.

7) The wastes could be incompatible with the rocks or the water in the injection zones, permitting clogging the zones and excessive pressure buildups.

8) Clogging or pressure buildup could alter the flow pattern of water in the formations receiving wastes and thereby forcing inferior water to the surface or into other aquifers.

In order to detect adverse groundwater impacts it may be necessary to implement a groundwater monitoring program.

MONITORING PROGRAM CONSIDERATIONS

A comprehensive groundwater monitoring program should take into consideration:

1) The site-specific identification of all water-bearing formations;

2) The type of activity present at the site, (gas well, waste water injection well, water supply well, waste water treatment);

3) The local aquifer continuity, direction of flow, and hydraulic interconnections;

4) The local aquifer water users, including water wells and spring discharges;

5) The regional geology and groundwater movement; and

6) The regional locations of activities which could potentially impact the groundwater system.

7) The quality of the water in the various formations for possible use as potable water or for compatibility with waste water.

8) Periodic measurement of heads of nearby wells or discharges of springs.

9) The static water levels and production levels of water wells especially in relation to nearby wells or springs.

10) The relative heads of the water in the formations penetrated by water wells or injection wells.

11) Continuous measurement of the pressure under which injection is done. Abrupt changes may signal clogging or ruptures.

The collection of hydrogeologic information and the design and implementation of a groundwater monitoring program should be conducted in conjunction with interested state and federal agencies including the U.S. Geological Survey, the Bureau of Land Management, the Wyoming State Engineer, the Wyoming Oil and Gas Conservation Commission, and the Wyoming Department of Environmental Quality.

Various regulations, including those administered by the Wyoming Department of Environmental Quality and the Wyoming Oil and Gas Conservation Commission, are designed to prevent or mitigate that potential adverse impacts. These regulations require:

1) Permits be obtained for the drilling of gas wells and waste water injection wells.
2) Gas wells and waste water injection wells be cased and the annular space cemented from the surface to a depth below all utilizable fresh water levels.
3) Casing in waste water injection wells be pressure tested prior to beginning operation and at least once very five years during operation.
4) The inside casing diameter of gas wells and waste water injection wells be plugged with cement over designated intervals prior to abandonment.
5) A monitoring program be conducted whenever wastes are discharged to groundwaters.

Other than general regulations protecting groundwaters from contamination, no specific regulations have been promulgated on the control of drilling muds and chemical additives used in drilling wells, or on the protection of groundwaters from seepage from reserve pits or production waste water holding and evaporation ponds. In applying these rules and regulations the regulatory authorities are given a good deal of discretionary power. The information required to be submitted in permit applications; the procedures and materials permitted to be used in construction, operation, and abandonment; and the type and amount of monitoring required are all determined by the regulatory authorities.

MONITORING PROGRAMS

Several alternative groundwater monitoring scenarios are described below which would require different levels of monitoring effort.

REGIONAL MONITORING ALTERNATIVE

A regional groundwater monitoring program which measures general changes in groundwater quality, static water levels, and water movement in all identified fresh water aquifers in the region would allow the detection of changes in the groundwater system but may not be able to detect problems in time to prevent significant impact, or be able to identify the source of the problem.

SITE-SPECIFIC MONITORING ALTERNATIVE

A site-specific monitoring program aimed at measuring any changes in groundwater quality, static water level, and groundwater movement in freshwater aquifers identified at a particular site would have advantages in pinpointing problems quickly, but could require an extremely high level of effort if all potential sources of impact are monitored.

REGIONAL AND SITE-SPECIFIC MONITORING ALTERNATIVE

In this monitoring scenario, selected activities or selected locations which are considered to be of a higher risk could be monitored on a site-specific basis. A regional monitoring program would be used to measure changes in the groundwater system for the remaining areas.

NO ACTION MONITORING ALTERNATIVE

In this scenario, no coordinated groundwater monitoring would take place. It may be determined that the existing safeguards of regulations and stipulations covering the design, construction, operation, and abandonment of the gas field are adequate to protect the groundwater resources in the area, or that the geology of the area is too complicated to implement a groundwater monitoring program. In the latter situation, attention may be focused instead on coordinating regulatory efforts and developing guidelines on the design, construction, operation, and abandonment of these facilities.

EXISTING HYDROGEOLOGIC INFORMATION

Information on regional geology and groundwater resources is available from a number of U.S. Geological Survey publications, (Lines and Glass 1975; Privasky 1963: Oriel 1969: Rubey, Oriel, and Tracy 1975; Welder 1968). These sources are valuable in gaining a general understanding of the stratigraphy of geologic formations in the region, the locations of major faults, and the quantities and quality of water expected in water-bearing formations. However, these sources do not give the detailed information on aquifer locations, aquifer characteristics, and directions of groundwater flow needed to design a groundwater monitoring program.

RECOMMENDED ADDITIONAL STUDY

It is recommended that a detailed geologic study be undertaken to define the area hydrogeologic system. The objectives of this study would be to:

- Gather sufficient information on the hydrogeology of the area to develop a hydrogeologic model. Information should be gathered from published geologic reports, discussions with well drillers and government personnel knowledgeable in this area, and the review of drilling log data.
- Formulate a general groundwater monitoring program, or alternatively, determine that additional aquifer testing is necessary before a detailed groundwater monitoring program can be formulated, or determine that a groundwater monitoring program is infeasible. Information on the location of proposed facilities may be necessary to develop a monitoring program.

REFERENCES

Lines, G. C. and W. R. Glass. 1975. Water resources of the Thrust Belt of western Wyoming. U.S.G.S. Hydrologic Investigations Atlas HA-539.

Oriel, S. S. 1969. Geology of the Fort Hill quadrangle. Lincoln County, Wyoming. U.S.G.S. Professional Paper 594-M.

Privrosky, N. C. 1963. Geology of the Big Piney area. Sublette County, Wyoming. U.S.G.S. Oil and Gas Investigations Map OM-205.

Rubey, W. W., S. S. Oriel, and J. I. Tracey Jr. 1975. Geology of the sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming. U.S.G.S. Professional Paper 855.

Welder, G. E. 1968. Ground-water reconnaissance of the Green River Basin Southwestern Wyoming. U.S.G.S. Hydrologic Investigations Atlas HA-290.

E.2 ADDITIONAL MONITORING

AIR QUALITY MONITORING

The FS is currently developing an action plan to identify and monitor sensitive receptors, if any, for each air quality related value in the Bridger and Fitzpatrick Wilderness and the Popo Agie Primitive Area. The plan will include identification and monitoring of sensitive vegetation species (possibly lichens), sensitive lakes and associated fauna (possibly golden trout, phytoplankton, zooplankton, and salamanders), views within the areas representing the visual resources, etc. Some soil analysis will probably be done in conjunction with the lake sensitivity analysis. This plan is being developed in response to the FS responsibilities under the Clean Air Act.

This action plan will be in this appendix for the FEIS.

FISHERIES MONITORING

To be provided in the FEIS.

SURFACE WATER MONITORING

To be provided in the FEIS.

APPENDIX F

ENDANGERED SPECIES

RECEIVED

JUN 14 1982

EIS OFFICE

SE June 10, 1982

Mr. Reid Jackson
Forest Supervisor
Bridger-Teton National Forest
P.O. Box 1888
Jackson, WY 83001

Dear Mr. Jackson:

As requested in your June 1, 1982, letter, we have reviewed the area added to the Riley Ridge Project in southwestern Wyoming. No revisions to the species list dated November 9, 1981, are necessary. The endangered species list noted in that memorandum is current and covers the additional area.

Thank you for contacting us regarding this project area modification.

Sincerely,

Wally Steucke
Area Manager

cc: Chief, Environmental Impact Statement Office, BLM, Denver, CO ✓

RACrete/sh

Bridger-Teton National Forest
PO Box 1888
Jackson, WY 83001

RECEIVED
JUN 4 1982
EIS OFFICE

1950
2670

JUN 1 1982

Fish and Wildlife Service
Area Manager
Billings, MT

Gentlemen:

The area of concern for the Riley Ridge project in southwestern Wyoming has been expanded slightly (see attached maps). Therefore, we request a revised (if necessary) list of threatened and endangered species in the area.

Sincerely,

REED JACKSON
Forest Supervisor

Enclosure

JWeaver:jm
CC: Weaver, D. Turner, J. Bowles ✓
C. Hauson
2820 file

OPTIONAL FORM NO. 10
JULY 1973 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

JV 12 19

RECEIVED

TO : Chief, Environmental Impact Statement Office
Bureau of Land Management, Denver, CO

DATE: November 9, 1981

FROM : Area Manager, Fish and Wildlife Service, Billings (SE)

SUBJECT: Riley Ridge Project - Request for list of species

This responds to your October 21, 1981, memorandum regarding the proposed Riley Ridge Project in southwestern Wyoming.

In accordance with Section 7(c) of the Endangered Species Act as amended, we have determined that the following listed and proposed threatened and endangered species may be present in the project area.

Listed Species	Expected Occurrence
Bald eagle (Haliaeetus leucocephalus)	Winter, migration, possible nesting
Peregrine falcon (Falco peregrinus)	Migration, possible nesting
Black-footed ferret (Mustela nigripes)	Possible resident in prairie dog towns.
Whooping crane (Grus americana)	Late spring/summer

Proposed Species

None

No critical habitat has been designated in Wyoming.

Section 7(c) of the Act requires that you prepare a biological assessment to determine if the proposed project will affect the above species. If not initiated within 90 days, the list should be verified with the FWS before the assessment is begun. The biological assessment should be completed within 180 days of initiation but can be extended by mutual agreement between your agency and the FWS.

F-4
5010-110

Upon completion of your assessment, if you determine that the project will affect any of the above listed species, formal consultation with the FWS Area Manager, Billings, should be initiated. If you determine that any proposed species may be affected, an informal conference with the Endangered Species Team, Billings Area Office, (406)657-6059 (FTS 585-6059) should be initiated to discuss measures that can be taken. Section 7(d) of the Act requires that during the consultation process, the Federal agency and the permit or license applicant shall not make any irreversible or irretrievable commitment of resources which would preclude the formulation of reasonable and prudent alternatives.

A partial bibliography and a list of individuals who may be able to provide you with information or additional contacts for information on specific use by these species in the project area is attached. Due to the extensive amount of copying involved, we are unable to include copies of all the literature on these species in our files. You are welcome to make use of the information here in Billings; however, such information is likely to be available at your State Office in Cheyenne.

Please contact us if we can be of further assistance.

Wally Steucke

attachments

Species Contacts

Bald Eagle

Dr. James Grier, Leader
Northern States Bald Eagle Recovery Team
Zoology Department
North Dakota State University
Fargo, ND 58105
(701)237-8444

Howard Hunt
State Office
Bureau of Land Management
P.O. Box 1828
Cheyenne, WY 82001
(307)778-2220

Alan Jenkins
U.S. Fish & Wildlife Service
Denver Wildlife Research Center
Denver Federal Center
Building 16
Denver, CO 80225
(303)234-2283

Bob Oakleaf
Wyoming Game & Fish Department
260 Buena Vista
Lander, WY 82520
(307)332-2688

John Weaver
Bridger-Teton National Forest
Forest Service Building
Jackson, WY 83001
(307)733-2752

Peregrine Falcon

Howard Hunt (see above)
Alan Jenkins (see above)
Bob Oakleaf (see above)
John Weaver (see above)

Gerald Craig, Leader
American Peregrine Falcon Recovery Team, Rocky Mountain/Southwest
Colorado Division of Wildlife
6060 Broadway
Ft. Collins, CO 80225
(303) 482-6575

Black-Footed Ferret

Tim Clark
Biota Research and Consulting
P.O. Box 2705
Jackson, WY 83001
(307)733-6856

Hary Harju
Wyoming Game & Fish Department
Cheyenne, WY 82002
(307)777-7604

Raymond Linder, Leader
Black-footed Ferret Recovery Plan
South Dakota Cooperative Wildlife Research Unit
South Dakota University
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(605)688-6121

Max Schroeder
U.S. Fish & Wildlife Service
Denver Wildlife Research Center
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Whooping Crane

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(202)343-7533

Mark Stromberg
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Cheyenne, WY 82001
(307)634-9629

Linder, Jeffrey, L., William S. Clark, Maurice N. LeFrane, Jr. 1979. Working bibliography of the bald eagle. National Wildlife Federation Scientific & Technical Series 2. 244 pp.

☆U.S. GOVERNMENT PRINTING OFFICE:1983—676-071 / 1001

PUBLIC HEARINGS REGISTRATION FORM

First public hearings on the draft Riley Ridge Project Environmental Impact Statement

(Please Print)

To: Janis L. VanWyhe, Division of EIS Services,
First Floor East,
555 Zang Street,
Denver, Colorado 80228

From: Name ______________________________

Street Address ______________________________

City, State ______________________ Zip Code ____________

Representing ______________________________

I wish to appear at the ____________ public hearing on ____________
(town)

1983, to express my views on the adequacy of the EIS.

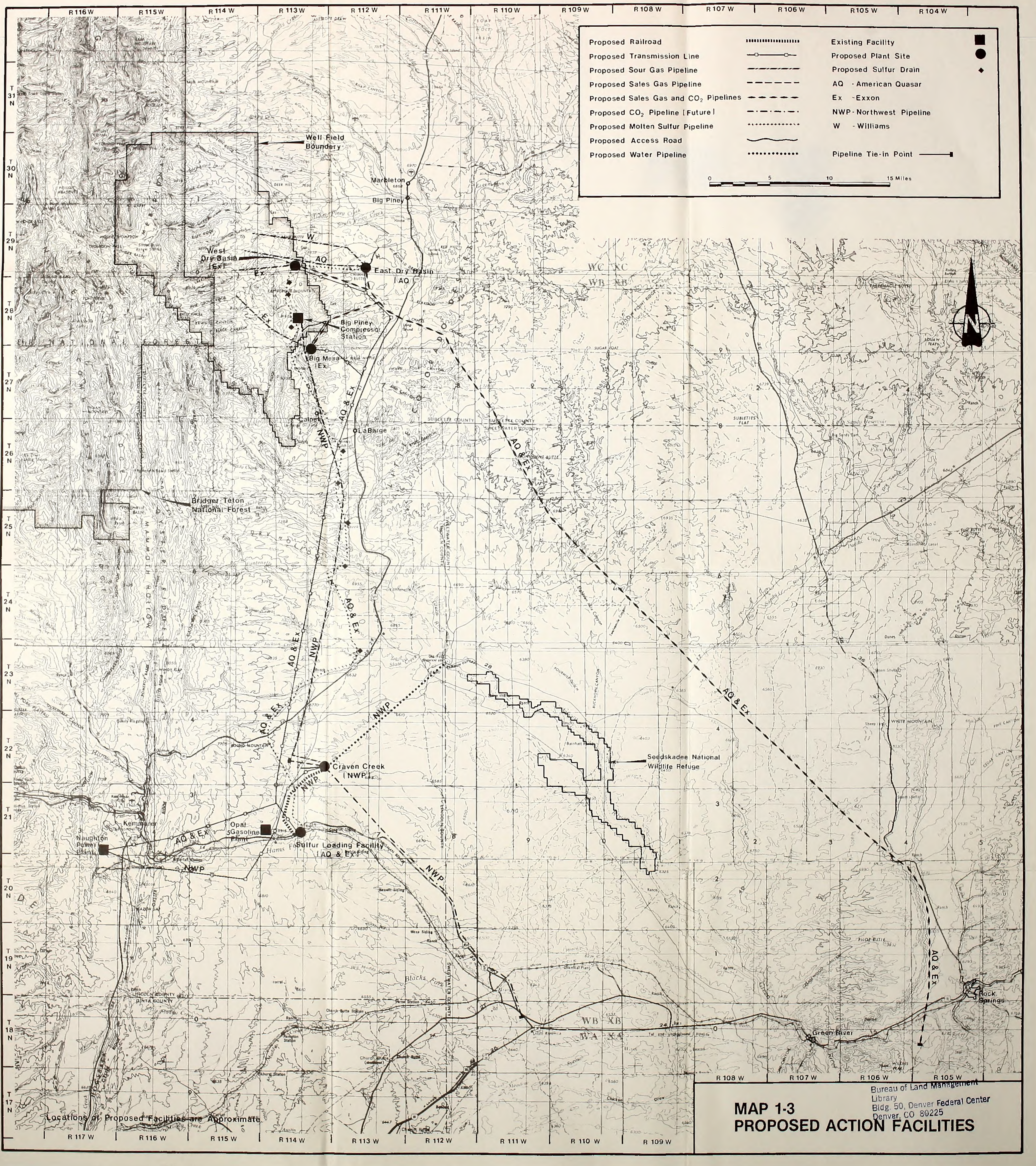
I intend to submit written documentation: Yes ____________ No ____________

____
Signature

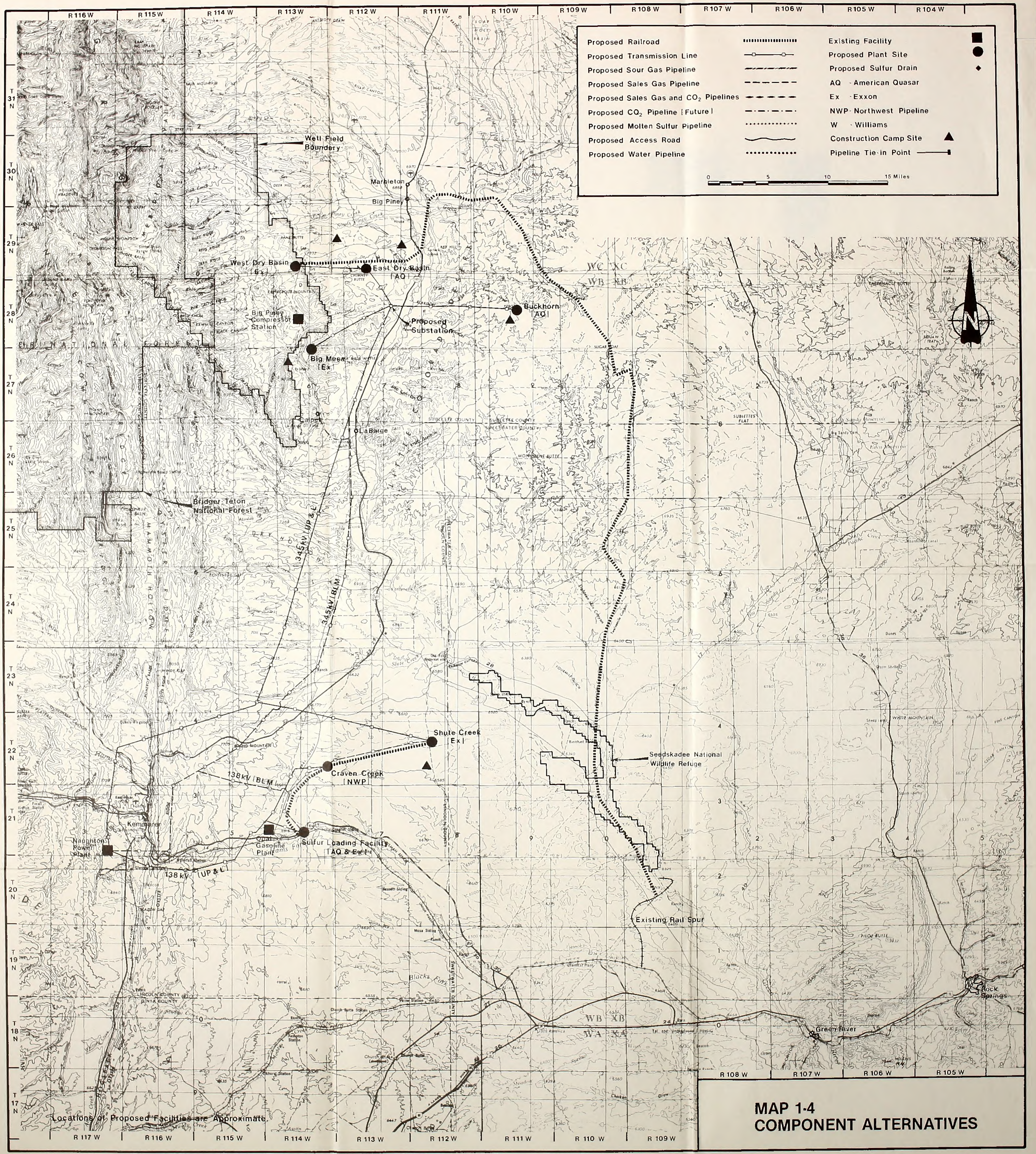
Verbal testimony will be limited to 10 minutes; written testimony and registration forms will be accepted at the above address until close of business on June 20, 1983. Registration will also be accepted at the door for each hearing.

MAPS
1-2
1-3
1-4

MAP 1-2
WELL FIELD MAP

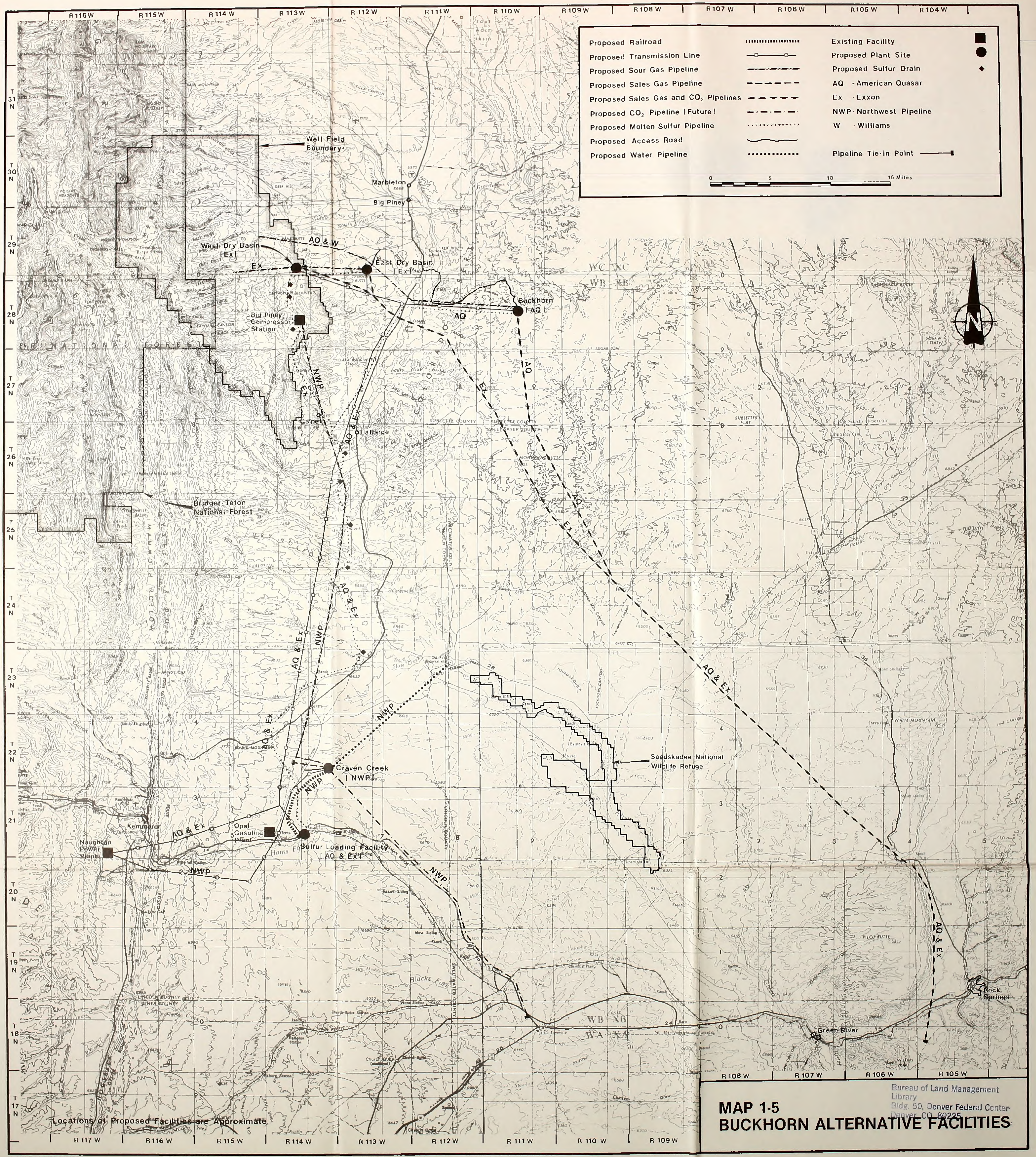


MAP 1-3
PROPOSED ACTION FACILITIES

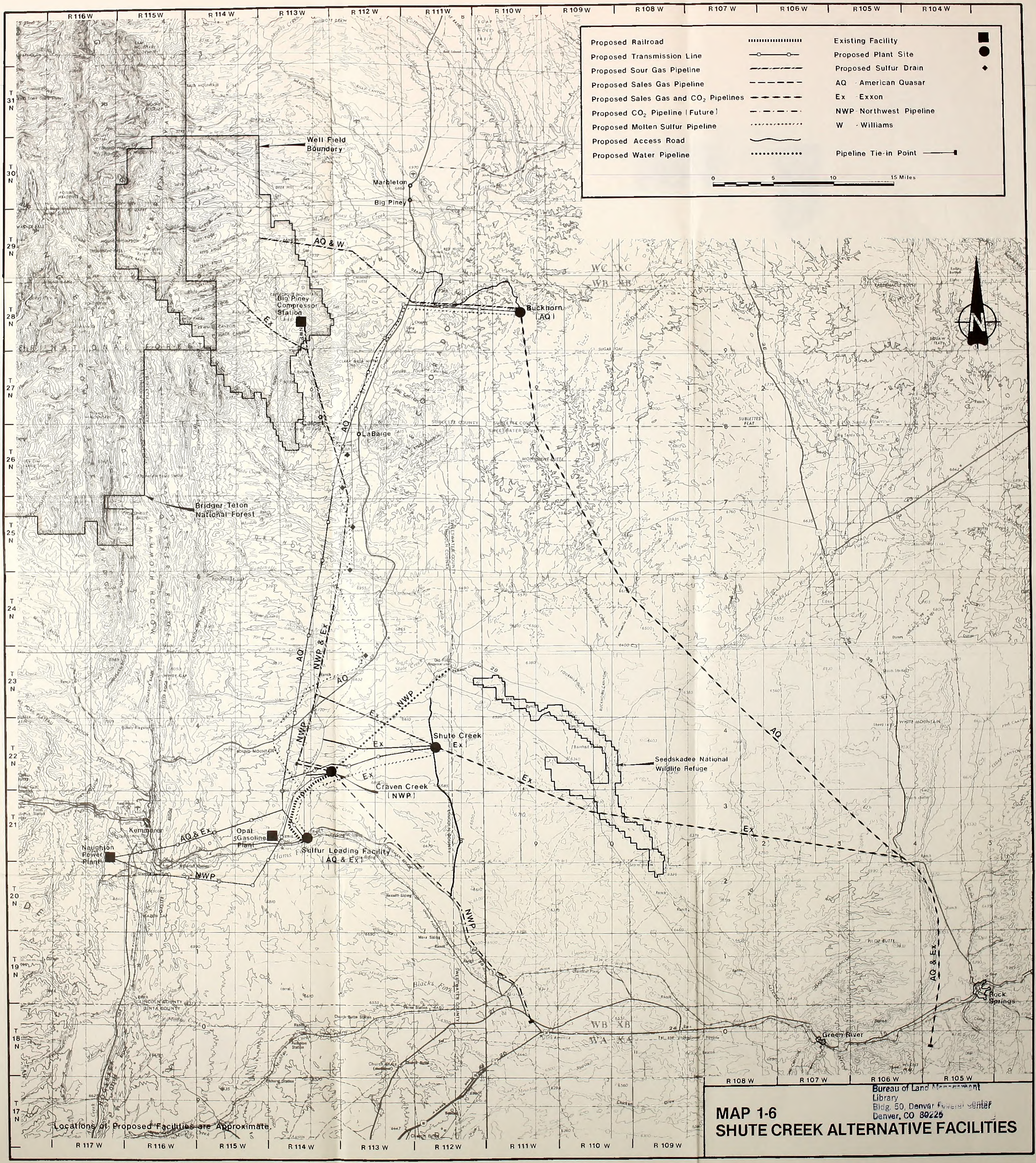


MAP 1-4
COMPONENT ALTERNATIVES

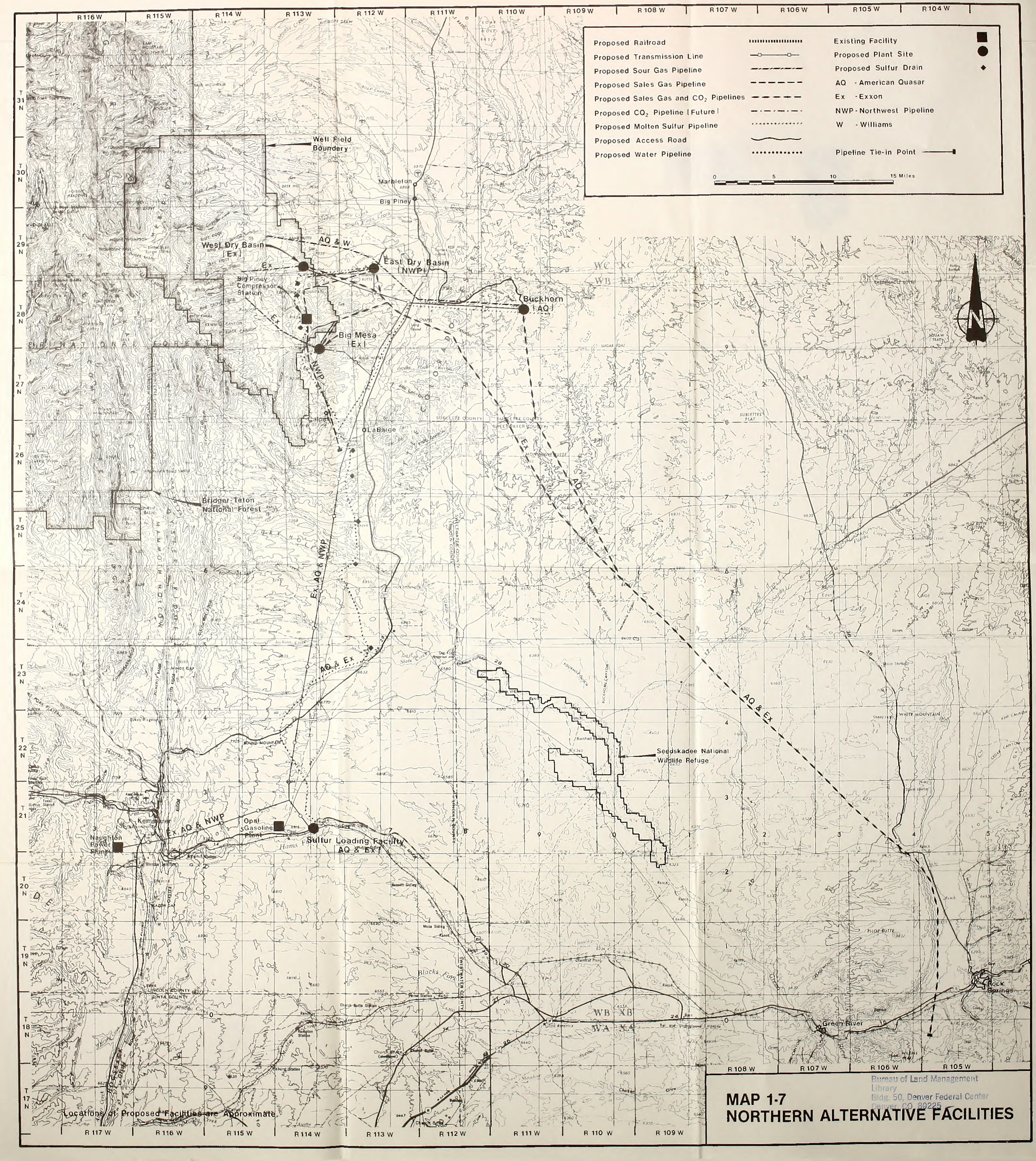
MAPS
1-5
1-6
1-7



MAP 1-5
BUCKHORN ALTERNATIVE FACILITIES



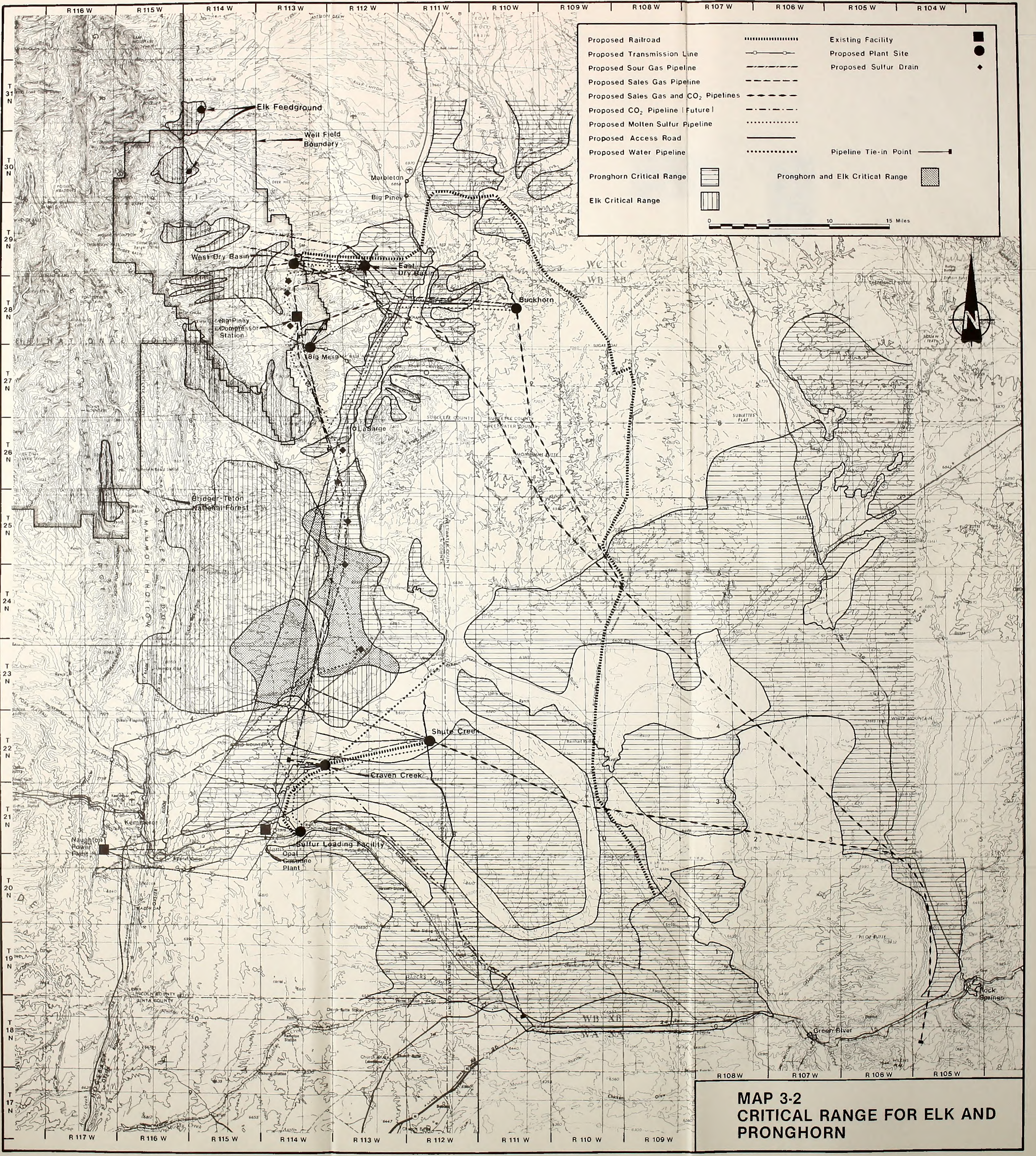
MAP 1-6
SHUTE CREEK ALTERNATIVE FACILITIES



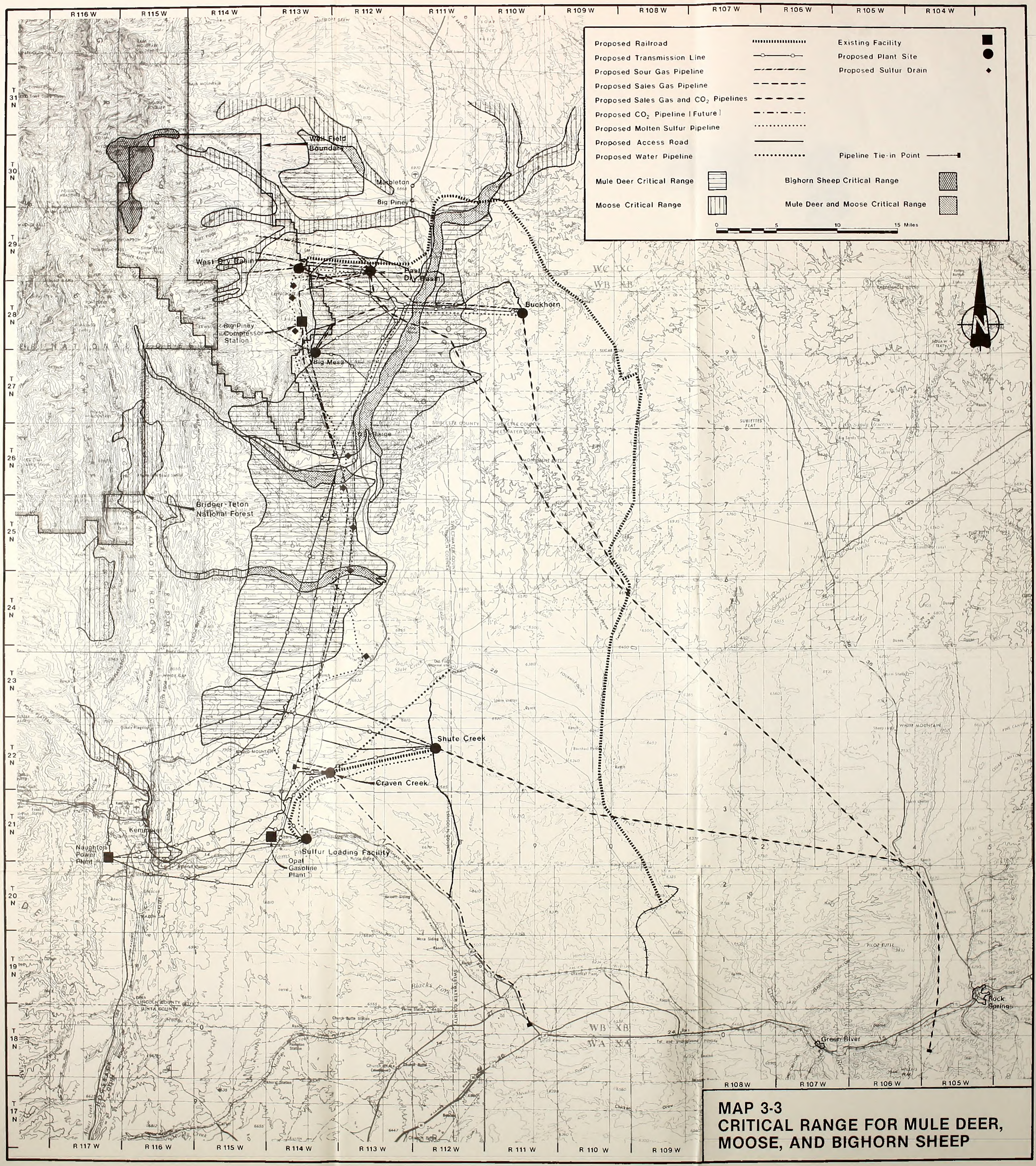
Locations of Proposed Facilities are Approximate.

MAP 1-7
NORTHERN ALTERNATIVE FACILITIES

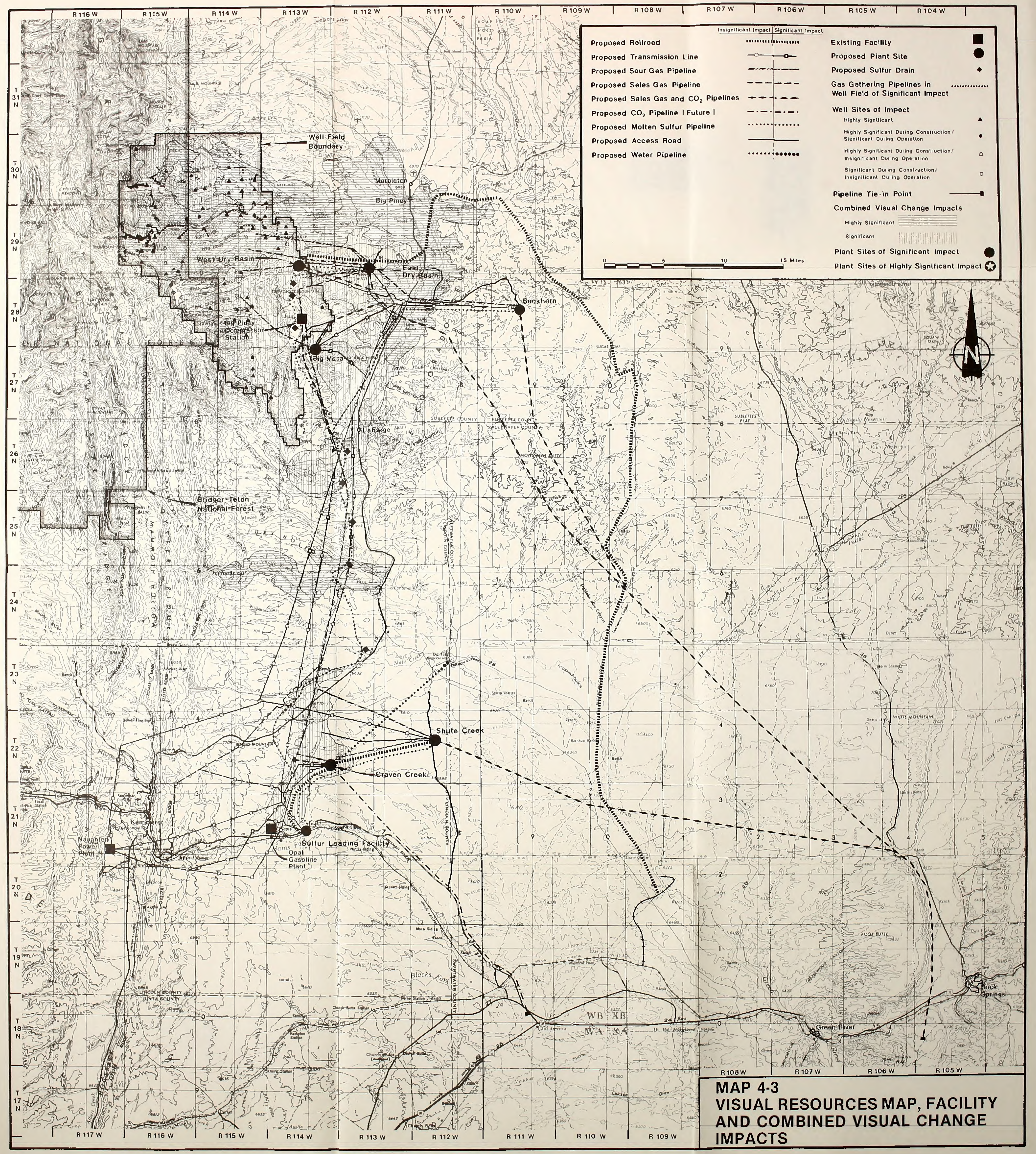
MAPS
3-2
3-3
4-3



MAP 3-2
CRITICAL RANGE FOR ELK AND PRONGHORN



MAP 3-3
CRITICAL RANGE FOR MULE DEER, MOOSE, AND BIGHORN SHEEP



MAP 4-3
VISUAL RESOURCES MAP, FACILITY AND COMBINED VISUAL CHANGE IMPACTS

BLM-YA-ES - 83-004-1792