CHAPTER 3
ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

INTRODUCTION

The analysis developed in this chapter is an assessment of impacts that would result from development of coal on the proposed Buckskin project. Impacts are quantified by time periods 1980, 1985, 1990, and end of mine life. Quantification may be stated as an increment for the time period or as a cumulative total at the end of each time period. The method of quantification that best describes the impact will be used.

Mining and reclamation plans for the proposed Buckskin Mine, as well as for mines currently operating or pending approval and already under study in separate environmental statements (ESs), were submitted prior to passage of the Surface Mining Control and Reclamation Act of 1977 (SMCRA), PL 95-87. Therefore, the plans may not reflect all the requirements of the law. All plans must be modified by the respective companies to meet SMCRA requirements. In the case of Buckskin, prior to final approval of the authorizing agencies, the modified plan will be reevaluated to insure (1) that it satisfies the requirements of SMCRA and the resultant federal regulations, and (2) that the potential impacts of mining have been covered by environmental analysis. This procedure will allow timely consideration of Shell's application to mine (which is complete in other respects), while the requirements of SMCRA are still evolving.

Chapter 3 of the regional analysis, Planning and Environmental Controls, refers to provisions of SMCRA which are applicable to the coal mining in the region. These were considered in the following impact analysis to the extent possible. However, some of the impacts described may be precluded by eventual implementation of the new law.

ANALYSIS GUIDELINES

An analysis of impacts requires establishing guidelines for coal-related development. The following narrative and tables were developed to establish such guidelines for the proposed Buckskin project.

Guidelines

1. Impacts are analyzed for four time points (1980, 1985, 1990, and end of mine life).
2. Reclamation on an area is considered complete when disturbed lands have been backfilled, graded, contoured, revegetated, approved, and bond is released in accordance with an approved reclamation plan (Wyoming Land Quality Rules and Regulations 1975, and the Surface Mining Control and Reclamation Act of 1977).
3. Any impacts lasting after closure of the mine and release of bond will be considered long-term impacts.
4. Acreage and water requirements are assumed using guidelines set forth in Table BU3-1, unless the information is specified by the applicant.

The following tables are presented to provide an overview of total land disturbance that would occur by the development of the Buckskin project. Table BU3-2 portrays the areas of land disturbed and reclaimed during each designated time period by various activities related to the project. Table BU3-3 portrays the disturbance and reclamation of the same acreage as cumulative totals for each time period by activities.

CLIMATE

It is not expected that mining activities at the proposed Buckskin Mine site would affect precipitation. Possible changes in the radiation balance due to changes in the character of the soil would be undetectable. The alteration of the terrain may change onsite wind patterns, but this impact would be undetectable beyond a local level. The extent to which onsite updrafts increase or decrease in intensity would be difficult to determine; however, any changes would probably be insignificant.

AIR QUALITY

Emissions from the Proposed Mine

Nine major sources of fugitive dust would be associated with the proposed mine: haul road traffic, shovel/truck loading, blasting, truck dumping, drilling, topsoil removal, front-end loading, access road traffic, and wind erosion from exposed areas. Two point sources would be the coal crusher and the load-out facility. Table BU3-4 lists these emissions sources and the corresponding emission factors.

The annual emissions from the proposed site (Table BU3-5) were calculated using the emission factors listed in Table BU3-4. The operational parameters were obtained from the mining and reclamation plan and personal communications with mining representatives. Emission

TABLE BU3-1

Acreage Requirements

Facility	Approximate Acres Required
Power line	6 per mile
Railroad spur (100-foot right-of-way)	12 per mile
Roads (100-foot right-of-way)	12 per mile
Population increase	100 per 1,000 people
Coal mining (includes mine facilities, ancillary facilities)	140 per mine

Water Requirements

Facility	Acre-Feet
Per 1,000 population increase (urban)	190 per year*
Mine operations	20 per million tons coal**

* Based on present water use by the city of Gillette.

** ES team estimate

TABLE BU3-2

Acreage Disturbed by Activity and Acreage
Reclaimed Over Periods of Time
(Noncumulative)

ACTIVITY	TIME PERIODS 1980	1985	1990	1990+*	TOTAL
Mining	21	236	120	281	658
Mine facilities	140	0	0	0	140
Access road**	72	0	0	0	72
Railroad Spur***	72	0	0	0	72
Stockpiles****	129	0	0	0	129
Subtotal	434	236	120	281	1,071
Population*****	45	0	0	0	45
Total	479	236	120	281	1,116
Acres Reclaimed	0	0	14	1,057	1,071

* To end of mine life which is estimated to be the year 2000.
** 200-foot right-of-way with 100-foot usable width.
*** 100-foot right-of-way.
**** Topsoil stockpiles in continual use, years -2 to 21, no breakdown attempted. Overburden stockpiles are within the mining area.
***** Assumed using Table BU3-1.

TABLE BU3-3

Acreage Disturbed by Activity and Acreage
Reclaimed Over Periods of Time
(Cumulative)

ACTIVITY	TIME PERIODS 1980	1985	1990	1990+*
Mining	21	257	377	658
Mine facilities	140	140	140	140
Access road**	72	72	72	72
Railroad spur***	72	72	72	72
Stockpiles****	129	129	129	129
Subtotal	434	670	790	1,071
Population*****	45	45	45	45
Total	479	715	835	1,116
Acres Reclaimed	0	0	14	1,071

* To end of mine life which is estimated to the year 2000.
** 200-foot right-of-way, with 100-foot usable width.
*** 100-foot right-of-way.
**** Topsoil stockpiles in continual use, years -2 to 21, no breakdown attempted. Overburden stockpiles are within the mining area.
***** Assumed using Table BU3-1.

TABLE BU3-4

FUGITIVE AND POINT SOURCES IDENTIFIED AT THE PROPOSED MINE WITH CORRESPONDING EMISSION FACTORS

Emission Source	Emission Factor
FUGITIVE:	
1. Haul Roads	4.3 lb/vehicle mile traveled
2. Shovel/Truck Loading	
a. Coal	0.0035 lb/ton loaded
b. Overburden	0.037 lb/ton loaded
3. Blasting	17 tons/1,000,000 tons of coal mined
4. Truck Dumping	
a. Coal	0.007 lb/ton dumped
b. Overburden	0.002 lb/ton dumped
5. Drilling	
a. Coal	0.22 lb/hole drilled
b. Overburden	1.5 lb/hole drilled
6. Topsoil Removal	
a. Scraping	0.35 lb/cubic yard scraped
b. Dumping	0.03 lb/cubic yard dumped
7. Front-end Loading	0.12 lb/ton of coal loaded
8. Access Road Traffic	5.16 lb/vehicle mine traveled*
9. Exposed Areas (wind erosion)	0.4 ton/acre/year**
POINT SOURCES:	
1. Coal Crusher	0.005 lb/ton crushed
2. Load-Out Facility	0.0002 lb/ton loaded

Source: PEDCo Environmental, Inc. 1978a, except as noted.
* Calculated from formula in U.S. Environmental Protection Agency 1976a.
** Calculated from formula by Midwest Research Institute 1974.

TABLE BU3-5

ANNUAL EMISSIONS FROM THE PROPOSED BUCKSKIN MINE SITE

Emission Source	Tons per Year 1980	1985	1990	1999*
FUGITIVE DUST				
1. Haul Roads (with watering)	262	575	664	333
2. Shovel/Truck Loading	28	134	147	122
3. Blasting	68	68	68	68
4. Truck Dumping	15	21	22	20
5. Drilling	2	4	4	4
6. Topsoil Removal	55	47	39	107
7. Front-End Loading	24	24	24	24
8. Access Roads	206	206	206	206
9. Exposed Areas (wind erosion)	101	95	100	94
10. Load-Out Facility	<1	<1	<1	<1
11. Crusher	1	1	1	1
TOTAL FUGITIVE DUST	763	1,176	1,276	980
GASEOUS POLLUTANTS				
1. Vehicles				
Carbon Monoxide	6.2	9.0	6.2	3.6
Hydrocarbons	0.7	0.8	0.7	0.4
Nitrogen Oxides	1.6	3.4	1.7	1.0
Sulfur Oxides	0.3	0.8	0.9	0.5

* Last active year of mining.

inventories were performed for the mining years of 1980, 1985, 1990, and 1999, which would be the last active year of mining. These inventories are the best approximations of the complex interaction of variables.

The only potential air pollution source identified at the Buckskin Mine site other than fugitive dust sources would be exhaust emissions from diesel-powered haul trucks and from employee motor vehicles on mine access roads. Emission factors for vehicular travel were obtained from the Environmental Protection Agency's (EPA's) most recent compilation of mobile source emission factors, and they reflect current legislation relative to future emission standards in high altitude areas (EPA 1978).

Estimated emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x) and sulfur oxides (SO_x) are shown in Table BU3-5. These emissions are from both employee travel on the mine site and haul trucks.

Emission rates shown in the table reflect the measures proposed by Shell Oil Company in its mining and reclamation plan.

Impact on Air Quality

The impact of the above annual emissions on the nearby ambient total suspended particulate (TSP) concentrations was determined by use of the Modified Climatological Dispersion Model-Version 3 (MCDM-V3) (PEDCo Environmental, Inc. 1976). The model performs both annual averaging and worst-case 24-hour periods. Source data input consists of the following: source locations; source emission rates; emission heights; locations where ground-level pollutant estimates are desired; frequency of occurrence of each of sixteen wind directions, six wind speeds, and six stability classes; and particulate fallout functions. Climatological data were collected at the Moorcroft weather station, because the weather station at Gillette does not have a stability rose (STAR) data deck compiled. The STAR data is necessary for modeling ambient air concentrations of pollutants from the mine.

Figures BU3-1 through BU3-4 show the annual predicted and resulting ambient TSP concentrations for the years 1980, 1985, 1990, and 1999, as determined by the model. Figures BU3-5 through BU3-8 show the worst-case 24-hour predicted and resulting ambient TSP concentrations for the same years. Concentrations in both situations are shown to decrease rapidly with distance.

Figures BU3-1 through BU3-4 show there would be no violations of the annual Wyoming state standard of 60 micrograms per cubic meter ($\mu g/m^3$) beyond the boundary of the proposed mine site for all four study years. The exception to this would be the air quality in close proximity to the access road as a result of employees arriving at and leaving the mine each work day. However, 0.3 miles from the access road, annual concentrations may be violated northwest and southeast of the mine site as a result of predominant wind directions, but even in these areas, resulting ambient TSP concentrations would decrease rapidly such that impact from the proposed facility would be essentially negligible (10 $\mu g/m^3$) 2.2 miles from the mine property boundary.

Figures BU3-5 through BU3-8 indicate that no violations of the worst-case 24-hour Wyoming state standard of 150 $\mu g/m^3$ would occur beyond the mine boundary. As was the case with annual concentration, the exception would be air quality in close proximity to the access road. However, no violations would occur beyond 0.3 miles from the access road.

Note that the above TSP violations include the fugitive dust generated by the mine and vehicular traffic. Because the new prevention of significant deterioration of air quality regulations (43 CFR 118) exclude most of these emissions, no violations would occur. In fact, air quality at the mine would be well within the applicable national ambient air quality standards.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the proposed facility. Predicted concentrations of these pollutants were not modeled due to the lack of detailed data on vehicle use and applicable background data. However, recent studies (U.S. Department of the Interior 1976) on the impact of vehicle emissions associated with western coal mines estimate the probable range of impact to be insignificant. Assuming similar vehicle activity for the proposed mine, ambient concentrations of gaseous pollutants would be minimal and insignificant compared to their respective standards.

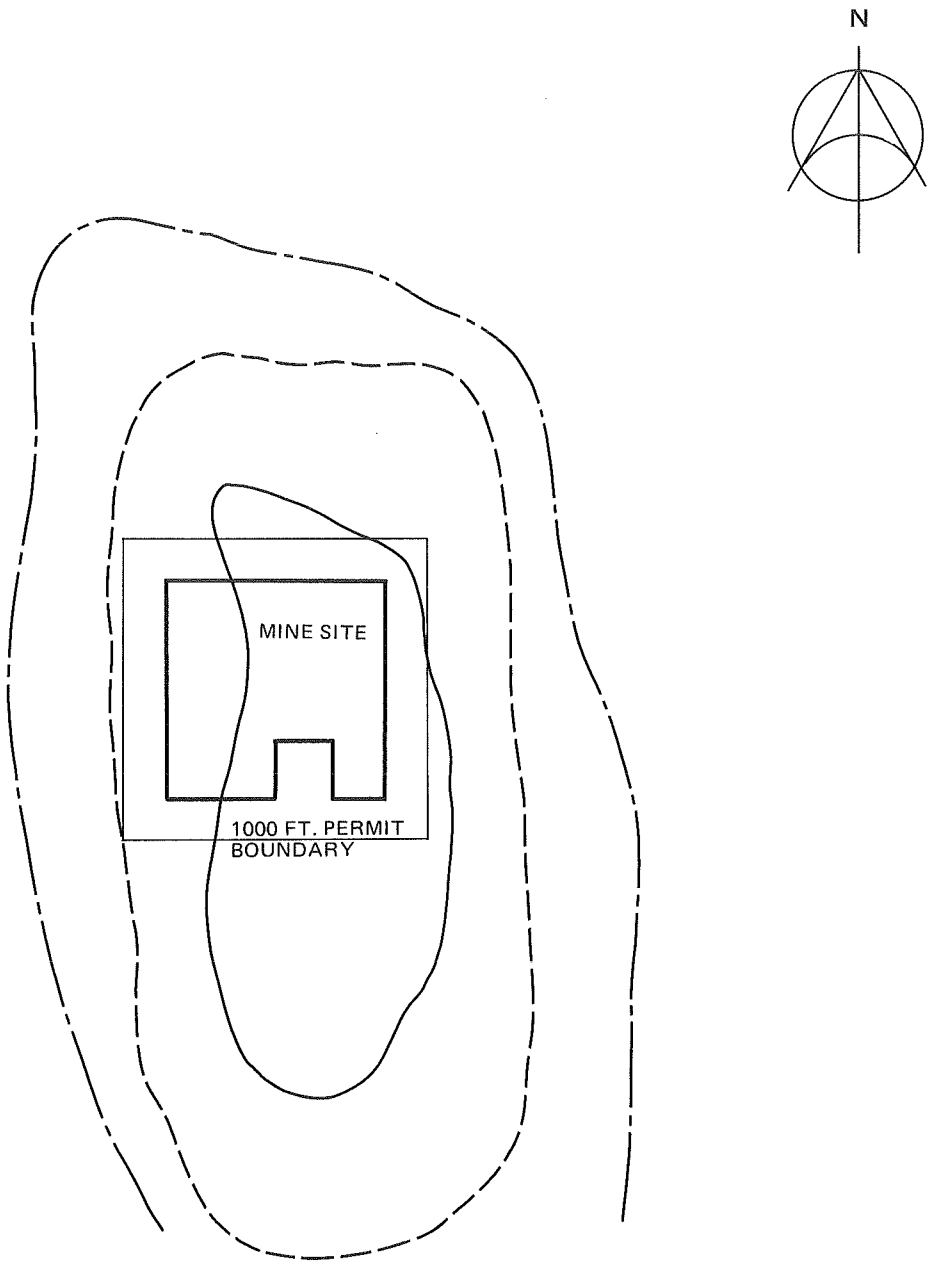
Visibility

The addition of particulates to the atmosphere would reduce visibility in the area. However, considering the extremely low predicted concentrations from the proposed facility, no perceptible visibility changes would be anticipated. Visibility would be expected to continue to exceed 60 miles at times and average between 26 to 47 miles, depending on climatological conditions such as fog, rain, or snow.

TOPOGRAPHY

During mining, the topography at the proposed mine site would be characterized by open pits, steep slopes, spoil piles, and haul roads.

When mining is completed, backfilling and grading efforts would restore the topography to a large, smooth-sloped, open-ended depression with new drainage patterns as shown on Figure BU3-9. When reclamation is completed in 2001, Shell estimates that the topography would be an average of 75 feet lower than it is now.



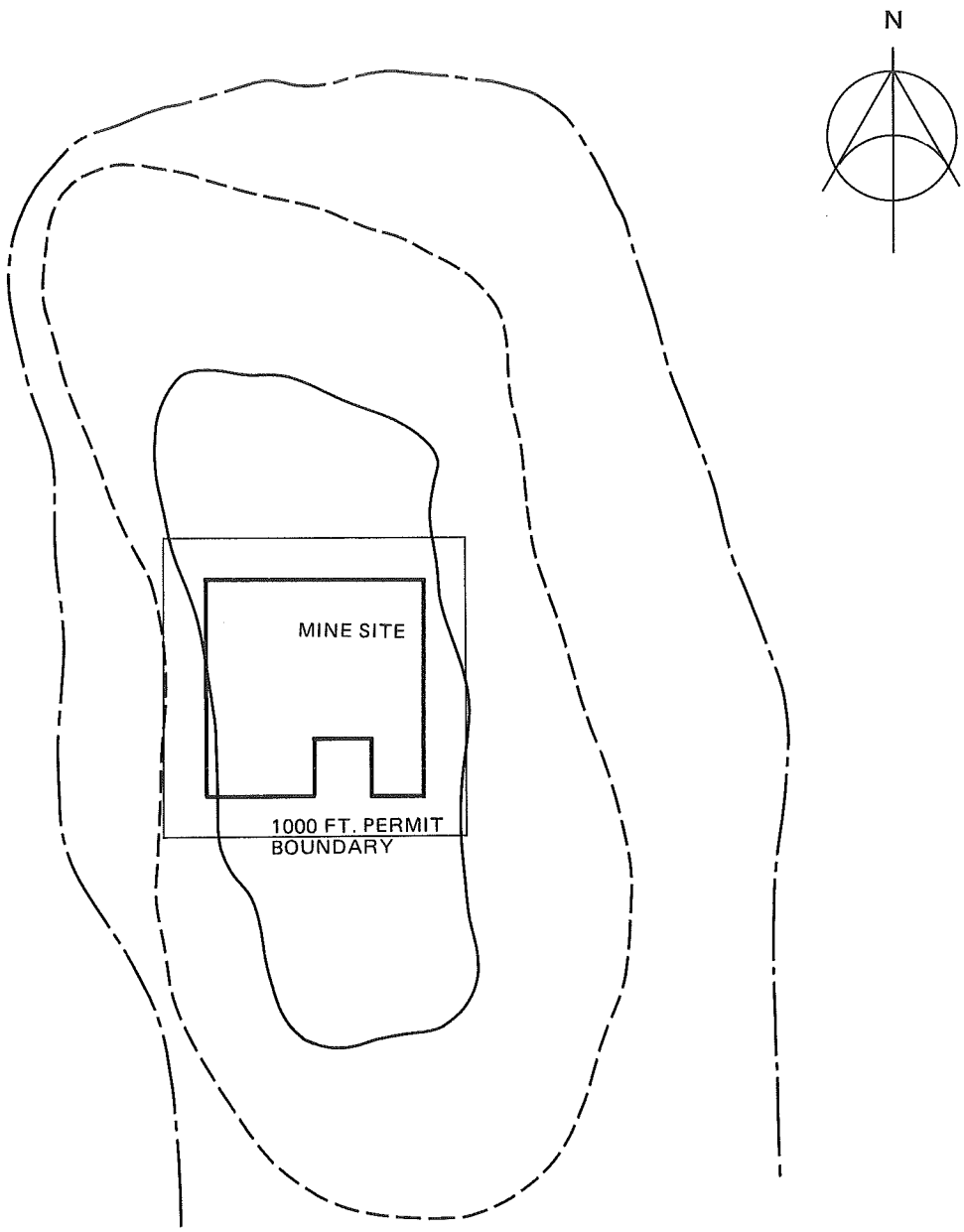
SOURCE: PEDCo, 1978

5 μg/m³ (17 μg/m³)
10 μg/m³ (22 μg/m³)
20 μg/m³ (32 μg/m³)

Resulting ambient concentration is in parentheses

Figure BU3-1

ISOPLETH DIAGRAM SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1980



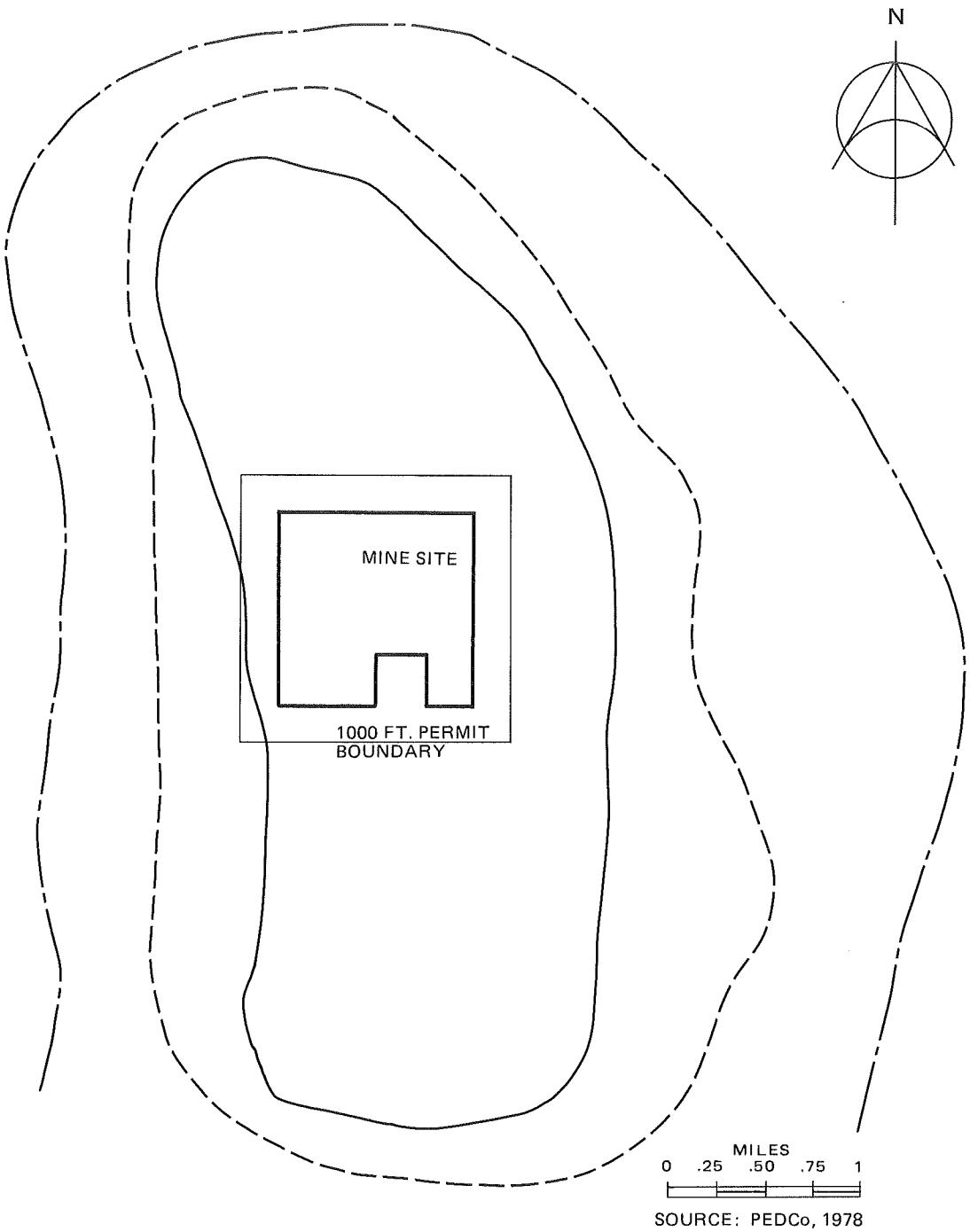
SOURCE: PEDCo, 1978

- - - - - - 2 μg/m³ (14 μg/m³)
— — — — 5 μg/m³ (17 μg/m³)
———— 10 μg/m³ (22 μg/m³)

Resulting ambient concentration is in parentheses

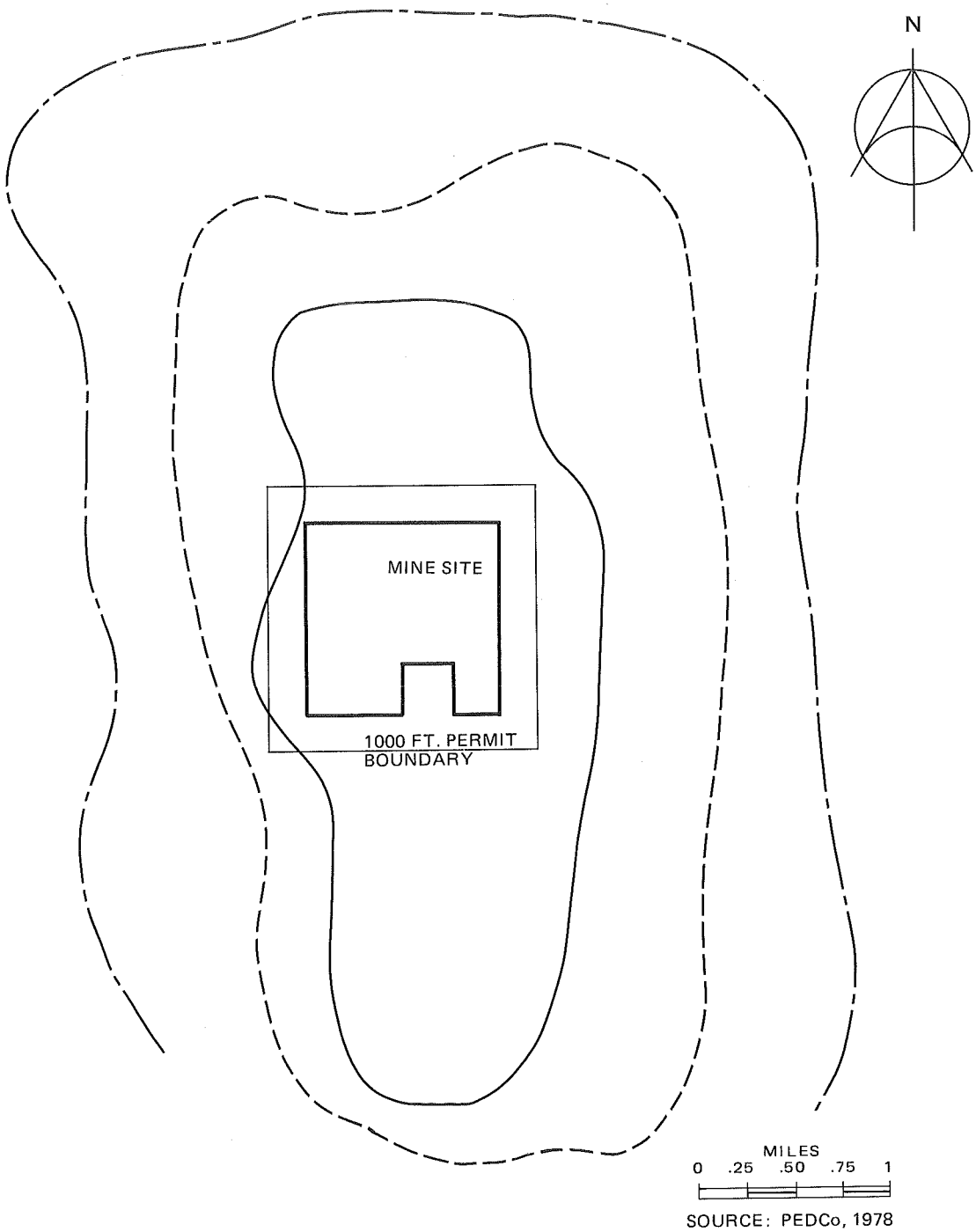
Figure BU3-2

ISOPLETH DIAGRAM SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1985



2 μg/m³ (14 μg/m³)
5 μg/m³ (17 μg/m³)
10 μg/m³ (22 μg/m³)
Resulting ambient concentration is in parentheses

Figure BU3-3
ISOPLETH DIAGRAM SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1990

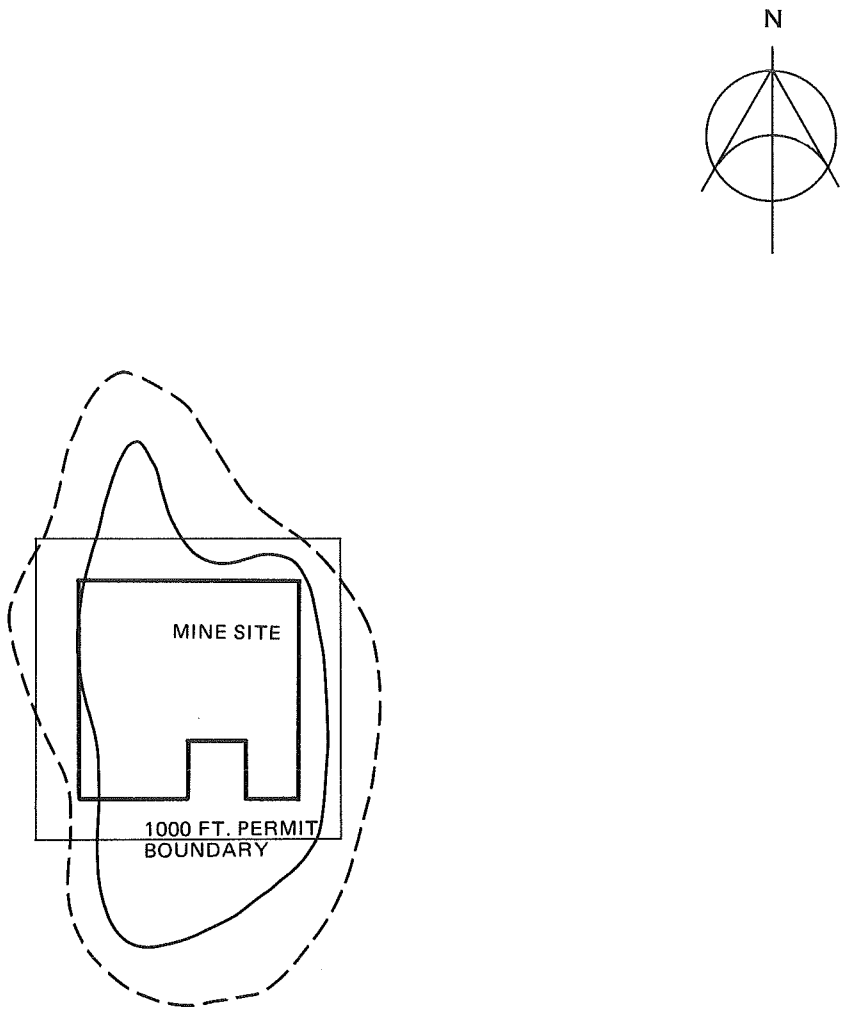


2 μg/m³ (14 μg/m³)
5 μg/m³ (17 μg/m³)
10 μg/m³ (22 μg/m³)

Resulting ambient concentration is in parentheses

Figure BU3-4

ISOPLETH DIAGRAM SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1999



MILES
0 .25 .50 .75 1

SOURCE: PEDCo, 1978

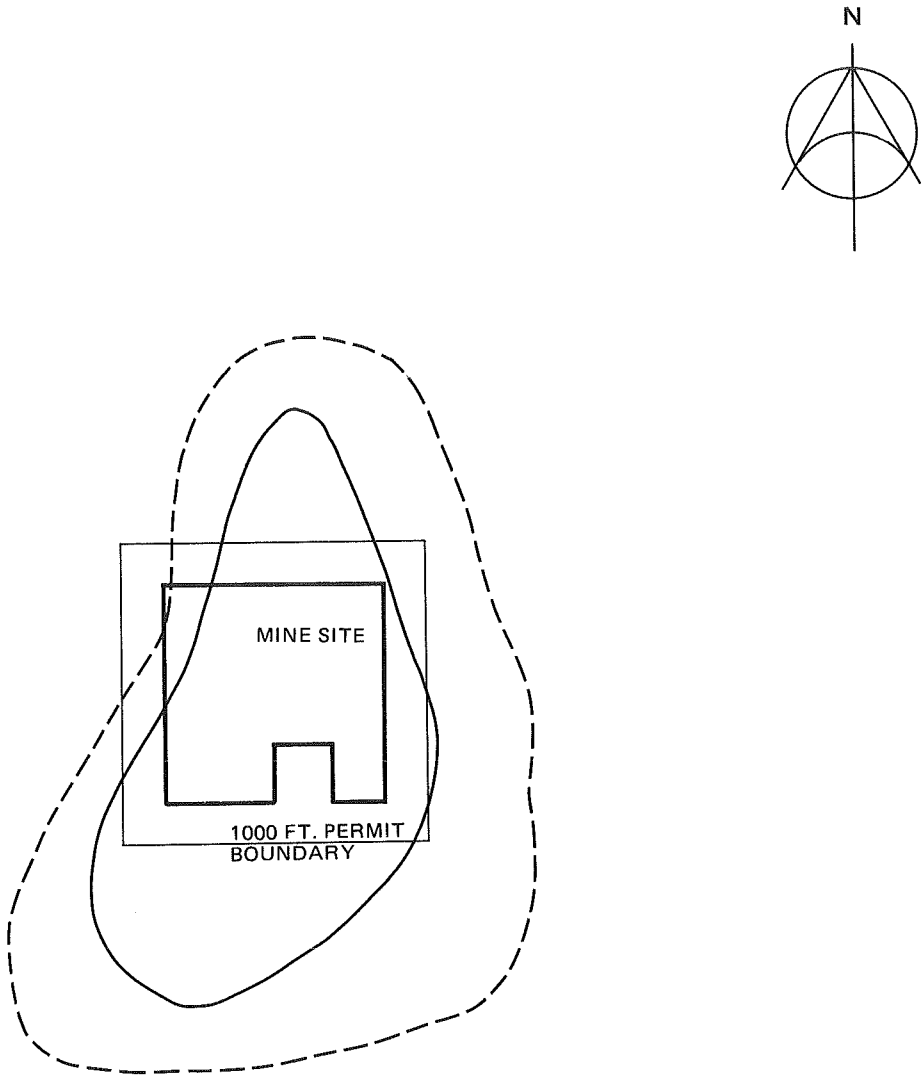
— — — — — 20 μg/m³ (32 μg/m³)

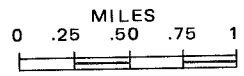
——————— 50 μg/m³ (62 μg/m³)

Resulting ambient concentration is in parentheses

Figure BU3-5

ISOPLETH DIAGRAM SHOWING 24 - HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1980





SOURCE: PEDCo, 1978

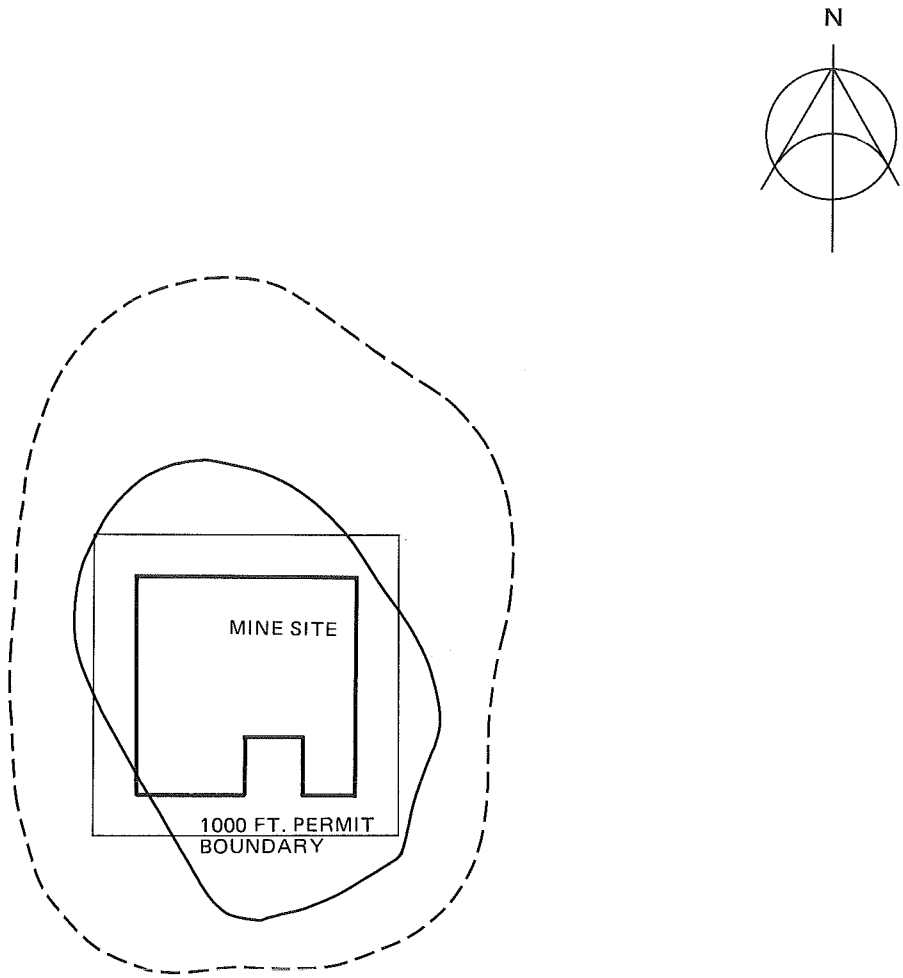
- - - - - - 15 μg/m³ (27 μg/m³)

——————— 30 μg/m³ (42 μg/m³)

Resulting ambient concentration is in parentheses

Figure BU3-6

ISOPLETH DIAGRAM SHOWING 24 - HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1985



SOURCE: PEDCo, 1978

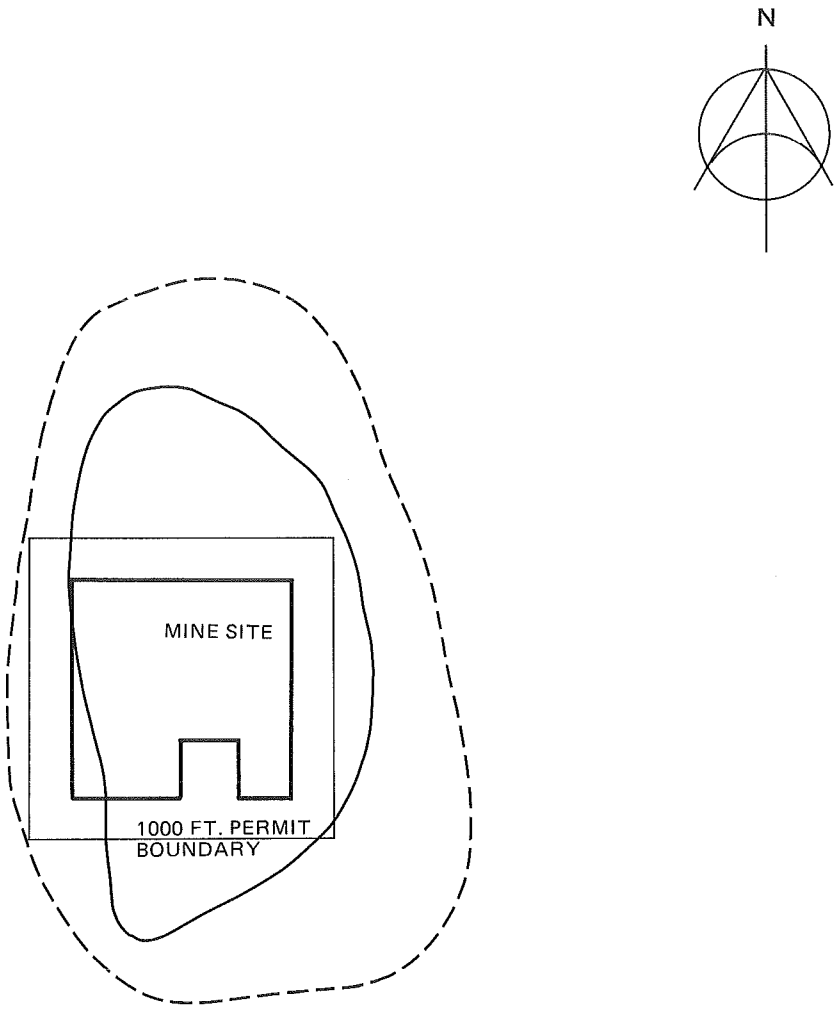
— — — — — 20 μg/m³ (32 μg/m³)

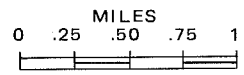
——————— 50 μg/m³ (62 μg/m³)

Resulting ambient concentration is in parentheses

Figure BU 3-7

ISOPLETH DIAGRAM SHOWING 24 - HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1990





SOURCE: PEDCo, 1978

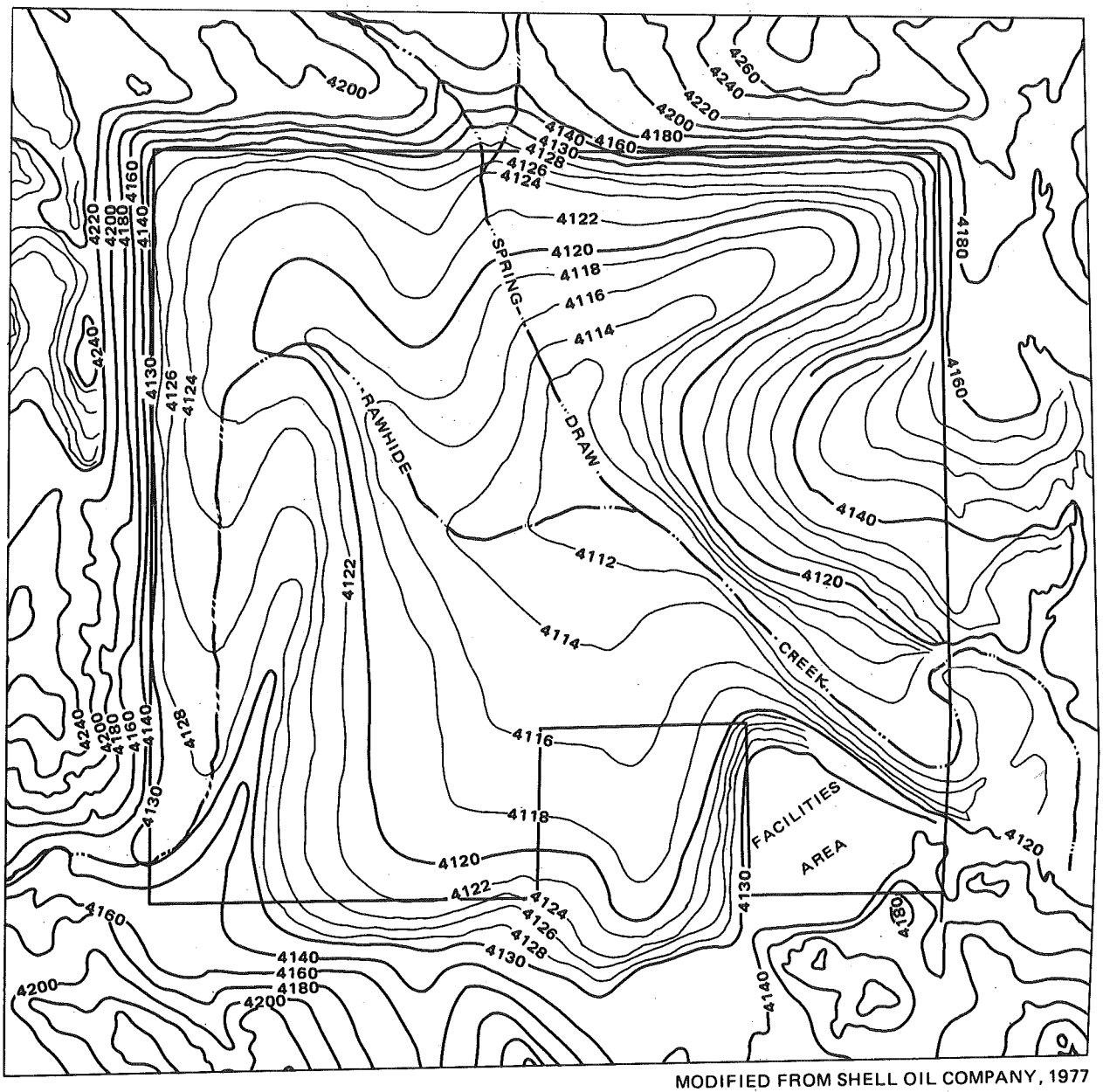
— — — — — 20 μg/m³ (32 μg/m³)

———— 50 μg/m³ (62 μg/m³)

Resulting ambient concentration is in parentheses

Figure BU3-8

ISOPLETH DIAGRAM SHOWING 24 - HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1999



MODIFIED FROM SHELL OIL COMPANY, 1977

Figure BU3-9

TOPOGRAPHY OF THE MINE SITE AFTER RECLAMATION

GEOLOGY

Strip mining at the Buckskin Mine would result in the loss of the geologic record. On the area which would actually be mined, an average of 208 feet of strata, including the coal, would be lost over an area of 21 acres by 1980, 257 acres by 1985, 377 acres by 1990, and ultimately 658 acres by the end of mine life. In addition to physical loss of strata, about 2 miles of contacts between the coal and the overlying and underlying formations, which are the basis for geologic mapping, would be covered by fill and thus lost to future observation and study. A beneficial impact would be exposure of geologic sections during mining that would otherwise never have been available for scientific examination.

About 1½ miles of alluvial valley floor, as defined by the Surface Mining Control and Reclamation Act, would be disturbed (see Figure BU2-4).

Because replaced spoil settles over time, ground stability is altered where surface mining has occurred. Ground stability would be altered to an average depth of 125 feet over an area of 658 acres by 2001 when reclamation is complete. This could affect both future construction on and seismic exploration for deeper mineral resources through the reclaimed fill (see Chapter 4, Geology, of the regional analysis).

Considering the small percentage of area that would be disturbed at the site compared to the total Eastern Powder River Basin (.01% by 2001), both loss of geologic record and decreased ground stability seem insignificant.

Paleontology

Potential fossil-bearing formations that would be affected by mining are the two coal seams and a few feet of interburden (totaling about 107 feet) at the top of the Fort Union Formation, as much as 215 feet at the lower part of the Wasatch Formation, and all Quaternary deposits. Paleontological loss would probably include pollen and plants, especially in association with the coal, and possibly some invertebrates and vertebrates in the Fort Union and Wasatch formations. Plant remains are relatively abundant in both these formations. Invertebrate and vertebrate remains that might be uncovered would not have been available for scientific examination prior to mining.

Quaternary fossils, both invertebrate and vertebrate, could be disturbed or lost at the site during overburden removal. Fossils of these ages are often discovered by excavating operations—road and dam building, gravel pits, etc.—and it is possible that mining operations could result in discoveries of Quaternary fossils.

Paleontological material throughout the region could be lost due to increased unauthorized fossil collecting and vandalism as a result of increased regional population. The extent of this impact cannot be presently assessed due to a lack of specific data on such activities.

Due to the present lack of data and accepted evaluatory criteria for determination of significance, no meaningful assessment can be presently made as to the extent and nature of the loss of these paleontological values to science or education, or hence to the significance of potential impacts on the fossil record.

SOILS

All developments (surface mining facilities, access road, railroad spur, and population increases) would cumulatively disturb soils on 715 acres by 1985; 835 acres by 1990; and 1,116 acres by the end of mine life (2000). The disturbance on 1,071 acres would be of a temporary nature, since the land would eventually be reclaimed. The loss of soil productivity would be permanent on 45 acres by the end of mine life.

Mining activities would impact soils by alteration of existing soil properties through disturbance and mixing of soil. These properties include soil microorganism composition, structure, texture, organic matter content, infiltration rate, permeability, water-holding capacity, nutrient level, soil-climatic relationships, and productivity that have developed over geologic time (Brady 1974, U.S. Department of the Interior 1975, 1976a). Stockpiling surface material would degrade biological, chemical, and physical properties, causing reductions in productivity when used in reclamation (Monsen 1975). The established levels of soil productivity would be lost and would not fully recover to present levels in the long term based on analysis of the Buckskin site.

Mining could expose material which contains chemical constituents (such as selenium, boron, or uranium) that would be harmful to plants and animals. These materials could exist in the overburden material. According to drilling logs and overburden analyses, these materials are absent or present in very low amounts on the Buckskin site. This data seems reasonable in light of other information collected in the region. Other soil materials found in the area that would hamper reclamation include those of high alkalinity or salinity; sand or clay-textured material; and material with low cation exchange capacities (see Chapter 2 for identification of these soils).

Accidental spills of oil, gasoline, and other toxic materials could contaminate and sterilize the soil horizons, rendering the affected soil unusable for reclamation, but these occurrences would be localized and of little relative significance. Any such contaminated material would be buried as required by the Surface Mining Control and Reclamation Act (SMCRA).

An accelerated rate of wind erosion would occur on areas disturbed and being reclaimed, where vegetative cover is absent. The amount of annual soil loss to wind erosion from the Buckskin site after mining begins would range from 85 to 110 tons, which is an increase of 70 to 90 tons per year over erosion rates from the undisturbed site.

Between the time the land is reshaped during reclamation and the time when vegetation is reestablished, soil would be subject to an accelerated rate of water erosion. The rate of water erosion on areas with recently redistributed topsoil would range from 10 to 30 tons per acre

per year (calculated using Musgrave's Equation, Bureau of Land Management Manual 7317.22A) depending on such variables as slope and climatic conditions. This is an increase of 5 to 25 tons per acre per year over rates for undisturbed land.

If a 10-, 25-, 50-, or 100-year flood were to occur when areas are in the process of being reclaimed, additional erosion would occur, resulting in large amounts of soil loss and postponement of successful revegetation.

Reclamation of surface mining and associated facility areas would cumulatively occur on an estimated 790 acres by 1990 and an estimated 28 acres yearly thereafter (refer to Table BU1-3). Suitable topsoil material, steep slopes, aspect, surface manipulations, and climate are important variables of reclamation success. The limited amount of good to fair soil material, moderately steep slopes, and soils that are poor for reclamation are evident on the Buckskin project in a number of mapping units (refer to Chapter 2, Soils).

During reclamation, topsoil would be evenly spread over the disturbed areas. Thus, areas deficient in topsoil prior to mining would gain topsoil from sources with a surplus. The result would be some increase in soil productivity in these deficient areas but not enough to offset reduction of soil productivity on the major portions of disturbed acreage.

In all likelihood, based on reclamation efforts at nearby sites in Montana and Wyoming, there would be a strong response by seeded vegetation on the reclaimed area during the first decade or two after reclamation, if climatic conditions are average or above average during this period. The ground cover of living plants on the revegetated area should equal or exceed 90% of the ground cover of the reference area (a control plot of undisturbed ground) for more than two growing seasons during these early years as required under regulations of the Surface Mining Control and Reclamation Act. However, there would probably be a long decline in productivity in later decades as the vigor of the planted species declines on the overall thinner soil than existed prior to mining (see Table BU3-8). Since there are few soil-forming processes going on in the Powder River Basin under today's climate, overall soil productivity on the Buckskin site in later decades would remain at 94% of premining productivity for an indefinite future period.

The quality and quantity of "topsoiling"material and change in soil productivity after reclamation are quantifiable through the land capability and range site systems. The land capability and range site classification systems are nationally accepted methods for determining agricultural land potential prior to major disturbance, such as mining.

The use of these systems in analyzing the Buckskin reclamation plan is based on the assumption that the restored landforms and recreated soils will perform like soils which occur naturally in the existing environment. This assumption has not been proved or disproved on mined land as yet due to the short time period that these systems have been applied to mined lands.

The calculation of postmining productivity requires an assessment of the existing natural soils to determine how many acre-feet of suitable material are available for reclamation use (see Tables BU3-6 through BU3-8). Our analysis, using these systems, indicates that *long-term* soil productivity on the Buckskin site would be 94% of premining productivity. We therefore disagree with Shell's contention that they can recreate 100% soil productivity.

For a more complete discussion of the land capability and range site systems, see Chapter 2, Soils, of the regional analysis.

WATER RESOURCES

Groundwater

The assessment of impacts on groundwater is based on a mine plan written before enactment of the Surface Mining Control and Reclamation Act of 1977. Alluvial valley floors as defined by the act occur on the leasehold; therefore, stripping of the floors would have to comply with the standards established by the act.

Two types of impacts would result from mining: those that are a direct result of mining and those that occur after reclamation. Impacts related to mining are those caused by the removal of existing aquifers and the increased use of groundwater by industry and municipalities.

The shallowest aquifers, or potential aquifers, in the area are the alluvium, overburden, and coal. These would be removed during mining, and water levels in adjoining, undisturbed beds would be lowered as the mine would become a discharge point. The groundwater flow into the mine predicted by the applicant is reproduced in Table BU3-9. Two of the assumptions on which the flow was estimated are that the cone of depression in the coal would extend approximately 3 miles, and that the cone of depression in the sandstone (overburden) aquifer would extend 1,000 to 1,500 feet. Approximately 40,000 gallons per day of the flow would be required for dust suppression. The remainder of the inflow would be pumped into Rawhide Creek (or its bypass channel) via settling ponds. The quality of water pumped into Rawhide Creek would be the same as that of the groundwater (see Tables BUA-1 through BUA-5 in the Appendix). The present quality of water in Rawhide Creek is compared with applicable standards in Table BUA-6, Appendix.

Additional groundwater supplies would be developed for potable water (4,655 gallons per day (gpd)), fire protection, and plant water (55,000 gpd). Increased water use of about 100,000 gpd during the life of the mine is expected. The water for potable supply would probably be from the Fort Union Formation. The cone of depression around the well would be negligible because of the small quantity of water required (less than 5 gallons per minute). The fire protection and plant water probably would be drawn from the same well, but a deeper well in the Lance Formation and Fox Hills Sandstone could be used. Withdrawal of water for fire protection and plant uses would not affect public or domestic supplies,

TABLE BU3-6

VOLUME AND QUALITY OF TOPSOIL MATERIALS BEFORE MINING

Series	%	Acreage	Topsoil Volume (acre-feet) Good	Fair	Poor
Arvada	6	64		21	299
Bankard	3	32		0	160
Bowbac	36	387	127	903	
Haverson	6	64	32	224	64
Olney	19	203		879	0
Renohill	9	96		48	144
Shingle	7	75	25		98
Samsil	7	75		30	63
Rock Outcrop	7	75	---	-----	---
	100	1,071	184*	2,105*	828*

* A total of 3,117 acre-feet of good, fair, and poor "topsoil" exists on the mine site, of which approximately 70% is recoverable. This yields 2,182 acre-feet of "topsoil" to be spread over entire reclaimed area or 2 feet of "topsoil" over the entire reclaimed area. "Topsoil" as used in this analysis refers to both the surface soil and subsoil, that is, the A, B, and usually the C horizons in soil morphological terms. Approximately 70% of the "topsoil" is considered recoverable due to the undulating nature of the contact between soil material and overburden and the usual result when the soil salvage operation is carried out with large machinery.

TABLE BU3-7

LAND CAPABILITY AND RANGE SITE COMPARISON

Land Capability Classification	Acres	
	Present	After Reclamation
IV	96	
VI	750	1,071
VII	150	
VIII	75	
Total Acres	1,071	1,071

Range Site	Present	After Reclamation
Clayey	96	
Lowland	96	
Sandy	590	
Saline	64	
Shallow clayey	75	
Shallow loamy	75	1,071
Rock outcrop	75	
Total Acres	1,071	1,071

TABLE BU3-8

POTENTIAL FORAGE PRODUCTION AT PRESENT

Range Site	Yield (lb/ac/yr)*	Acres	Total Yield (lb/yr)**
Clayey	1,300	96	124,800
Lowland	2,500	96	240,000
Sandy	1,600	590	944,000
Saline lowland	500	64	32,000
Shallow clayey	900	75	67,500
Shallow loamy	900	75	67,500
Rock outcrop	0	75	0
			1,475,800***

POTENTIAL FORAGE PRODUCTION AFTER RECLAMATION

Range Site	Yield (lb/ac/yr)*	Acres	Total Yield (lb/yr)**
Shallow loamy	1,300****	1,071	1,392,300***

* Pounds per acre per year.

** Pounds per year.

*** The difference between these total yields represents a 6% loss in productivity after reclamation.

**** The average yield for a shallow loamy range site is 1500 lb/ac/yr of air-dry forage. This reclaimed site may produce a forage comparable to the lower end of a loamy range site due to the altered nature of the replaced overburden. At this time, we cannot project exactly how plant root growth, plant nutrient availability, and water movement would respond to the altered overburden.

TABLE BU3-9

ESTIMATED GROUNDWATER INFLOW TO BUCKSKIN MINE FOR VARIOUS STAGES OF DEVELOPMENT
(Data furnished by applicant.)

Development Stage (Year)	Water Level Altitude (Feet)	Pit Floor Altitude (Feet)	Range In Gradient (Feet/Mile)	Estimated Water Inflow (Gallons/Minute)
1-2	4140-4150	3990	50-100	220
3-4	4150-4160	3975-3980	40-160	400
12	4130-4140	3940	60-70	190
16	4130	3920	70	260

since no well supplying these needs are at similar depth near the mine site.

During the first year of operation, coal production would be 2 million tons per year, after which it would increase to a maximum of 4 million tons per year for the 20-year life of the mine. Assuming 18.25 acre-feet per year per million tons of coal mined, water use would be 73 acre-feet per year.

There would also be an increase in demand for water for municipal supplies to provide for the increased population. The present well field for Gillette, the major population center, is capable of supplying the present population. The city is currently studying the feasibility of developing water from the Madison Limestone about 40 miles northeast of town.

When the mined area is reclaimed, the spoil would become at least partly saturated and constitute a new water table aquifer, and groundwater flow would be generally similar to the present system. Because the land surface would be significantly lower throughout the area, the water table would be closer to the surface in some places, increasing the area in which there is a potential for discharge from groundwater by evapotranspiration. The water table gradient would remain towards the creek; however, flow paths would be affected by the location of haul roads if they are constructed so that highly compacted, fine-grained material is nearly continuous in the vertical.

Rahn (1976, p. 54) states,

> Water in spoils was found to be significantly more highly mineralized than natural ground water in terms of total dissolved solids, calcium, magnesium, and sulfate. Spoils water exceeds the recommended drinking water limits in these and other ions (manganese and cadmium), and it is doubtful that the water could be used for long-term irrigation.

If there is increased evapotranspiration from groundwater, this would cause an additional increase in dissolved solids in the water.

Water levels in the coal in unmined areas would probably recover to nearly their former levels, because the face of the unmined coal would be covered with overburden that may have a transmissivity similar to that of the coal it replaces. However, water levels in the overburden at elevations above 4,120 feet would be permanently depressed, because this is the elevation to which much of the area would be reclaimed.

Surface Water

Soil which is broken up and streams carrying higher sediment loads leave more soil surface exposed to the leaching and dissolving process of the water. Surface flow seeping from spoils and flow carrying added sediment from spoil would most likely contain higher levels of dissolved minerals than premining water. Surface flow originating on the mine area during the life of the mine would probably cause only minor impact downstream from the mine. Such surface flow could originate as seepage from overburden storage piles and temporary water impoundments, and as runoff from heavy rainfall or snowmelt. It would probably be heavily laden with sediment and be of very poor chemical quality. The amount of this flow, however, would be small compared to the total flow running through the area via Rawhide Creek.

Little or no increase in stream sediment is expected due to the approximately 13% increase in channel velocity between the natural and the bypass channels, as long as the design flood of about 1,000 cubic feet per second (cfs) is not exceeded. A flood of this magnitude, however, has almost a 10% chance of occurring in any one year (mean of computations according to Lowham 1976 and Hodson et al. 1973), or a chance of occurrence of 52% by 1985, 72% by 1990, or 91% before mining is completed.

If overtopping of the bypass channel should occur, the channel could be breached, causing flooding of the mine area and subsequent escape of heavy silt-laden flow on down the natural channel. Sudden sediment loads beyond the carrying capacity of the natural channel during a particular flood would be deposited in the channel. This may cause increased flooding downstream (due to lowered channel capacity) and increase the silt supply, which would be picked up by subsequent larger floods, thereby causing possible channel changes (resulting in loss of fields in crops, animals, buildings, etc., due to bank cave-ins) and increased silt deposits on fields when flows break out of their channels (causing loss of crops and pasturage). Flooding of the mine area might also carry accumulated chemical contaminants on downstream, possibly causing toxicity of crops and meadows, and subsequently affecting stock.

Increased water use of about 100,000 gallons per day (gpd) during the life of the mine is believed insufficient to impact the area. The increased water use of the expected 133 mine employees and the resulting wastes are expected to contribute to the total regional impacts. No impact in the area of the mine is foreseen, however.

Mining would eliminate the present groundwater system down to the bottom of the coal. The postmined water table is expected to be slightly farther below the land surface than the natural water table, according to the applicant. The former horizontal, more permeable rock shelves and lenses, which used to divert small quantities of water to the stream bed, would be destroyed. These two conditions point to the probability of the destruction of the premining stock and wildlife point-watering sources. This would, in turn, eliminate or discourage grazing within the area, thereby lowering the beneficial yield of the land, and consequently not bringing the land back to its full premining productivity.

If the postmined water table is above the land surface (or if settlement causes the land surface to sink below the water table), the resulting pond or lake would probably fill with water of very poor chemical quality. The total dissolved solids in groundwater seepage in the premined creek bed vary between 4,000 and more than 6,000 milligrams per liter (mg/l) between flushing by storm flows. This is generally higher than that recommended for

stock watering. The postmining water could be of poorer quality.

Overburden settlement is not believed to be a problem until mining is complete and the reclaimed topography is finished. The mining and reclamation plan shows no large shallow ponding; however, our analysis indicates that over a period of time (undeterminable), the overburden would settle, causing a depression varying from about 35 acres to 40 acres due to about a 3-foot settlement (value furnished by applicant). Ponding in this depression would be ephemeral (would occur as a result of streamflow from precipitation only) if above the groundwater table, and water would not be available for long periods as it had been formerly. In this case the water would be of better quality than before mining. Ponding would occur for longer periods if the ground surface settles below the water table. In this latter case, the pond most likely would amount to a leaching pond of very high mineral content, and the water would probably be of much poorer quality than before mining.

The pond also would amount to a silt trap which would lower the sediment discharge downstream from the mine for many years to come. Rawhide Creek and Spring Draw channels within the depression would probably start filling with the silt eroded from gullies (started at the interface of the reclaimed and undisturbed land) and with the silt normally carried off the undisturbed drainages. This would cause the channels to readjust to new paths across the mined basin. Silt trapped by the pond (which normally would have been carried on downstream if the stream had been in its natural state) could initiate an increased downcutting or eroding cycle downstream from the mine, since the silt-carrying potential of the high flows would be increased. An abrading stream bed normally will initiate downcutting of tributaries and cause gullying along its banks. Another impact of such erosion downstream would be the partial loss of fields and hay meadows at a rate faster than that occurring naturally.

Before any permanent impoundment can be left on reclaimed land, determinations of water quality and quantity must be made, and the impoundment must be part of the approved reclamation plan.

VEGETATION

Terrestrial Vegetation

During the 20-year life of the Buckskin Mine, vegetation would be disturbed on a total of 1,116 acres (includes 45 acres disturbed due to population increase). Vegetation would be affected as shown in Table BU3-10. Vegetative types that would be disturbed by the different activities are shown in Table BU3-11.

Haul road dust and fugitive coal dust from coal mining, blasting, transporting, processing, and loading may be deposited on vegetation adjacent to the activity areas. Dust-covered vegetation would be less palatable to livestock and wildlife.

There would be an increased risk of man-caused fires due to equipment and workers in the area.

The length of impact of vegetation loss would depend on the success of reclamation. Due to soil texture, toxicity, or other factors, some small areas might be impossible to revegetate, making loss of vegetation a permanent impact. In some years, climatic conditions might prevent revegetation success, extending impacts of vegetative loss. As discussed in the regional analysis (Chapter 4, Vegetation), initial reclamation attempts have met with apparent success in other locations in the region. The Belle Ayr and Cordero mines, for example, report success ratios of 90% to better than 100% of premining productivity, which meets the standards established by the Surface Mining Control and Reclamation Act. These reports are for plantings which began no earlier than 1973.

The same result may be expected for the Buckskin Mine for the first decade or two. However, a 6% loss in *long-term* productivity of vegetation has been projected based on a 6% loss in soil productivity. (See Chapter 3, Soils, for an explanation of this prediction.)

Vegetative type conversion to grassland from the other types is likely to occur on the reclaimed areas, since it would be difficult to reestablish the plant species indigenous to the area. The forage production capability of this grassland type is expected to be 94% of premining level for livestock grazing and 15% to 20% for wildlife habitat. The 6% reduction of grazing capacity for livestock would be due to the loss of soil productivity, and the 80% to 85% reduction for wildlife habitat would be due to loss of native shrubs and forbs. Reestablishment of native species is expected to occur through natural succession in not less than 30 years (University of Wyoming, Black Thunder Project Research Team 1976).

Hydrologic studies of the applicant's proposal indicate that an additional long-term impact to vegetation could occur from overburden settlement. Over a period of time (undeterminable) the overburden would settle, causing a pond varying from about 35 to 40 acres due to about a 3-foot settlement (value furnished by applicant).

Aquatic Vegetation

The proposed project would destroy the aquatic vegetation in Spring Draw and Rawhide Creek, if these areas are mined. Although the Buckskin mining and reclamation plan proposes to restore these drainages, it is unlikely that aquatic vegetation can be restored to premining conditions.

Surface runoff from disturbed areas would increase the sediment load in the restored or unmined portions of Rawhide Creek and Spring Draw. This increase would adversely impact the aquatic community by the suffocating and abrasive effects of increased siltation.

Endangered and/or Threatened Species

No plants which have been identified as threatened or endangered, or are proposed for such designation, are

TABLE BU3-10

ACREAGE OF VEGETATION DISTURBED BY ACTIVITY AND ACREAGE RECLAIMED

Activity	Time Periods 1980	1985	1990	1990+*
Mining	21	257	377	658
Mine facilities	140	140	140	140
Access road	72	72	72	72
Railroad spur	72	72	72	72
Stockpiles	129	129	129	129
Population needs	45	45	45	45
Total	479	715	835	1,116
Acres reclaimed	0	0	14	1,071

* To end of mine life which is estimated to be the year 2000.

TABLE BU3-11

VEGETATION TYPES AND AMOUNT TO BE DISTURBED BY ACTIVITY (APPROXIMATE ACRES)

Activity	Playa Grassland	Sandhills Grassland	Big Sagebrush	Silver Sagebrush	Riparian	Cultivated	Total
Mining		111	266	177	52	52	658
Mine facilities	2	18	47	38	5	30	140
Access roads		5	33	20	2	12	72
Railroad spurs		1	44	14	5	8	72
Stockpiles	2	14	57	29	8	19	129
Total	4	149	447	278	72	121	1,071*

* An additional 45 acres of vegetation will be disturbed due to population increase, but it is impossible to quantify the vegetation types affected.

known to exist on the mine site (see Chapter 2); hence, no effect from mining would be expected.

FISH AND WILDLIFE

Habitat Loss

By the end of mining, native vegetation would be stripped from 1,071 acres at the mine site; an additional 45 acres (probably near Gillette) would be permanently lost to urban expansion to accommodate population growth. The habitat losses that would occur at the mine site are: 447 acres of sagebrush-grassland (big sagebrush), 278 acres of silver sagebrush, 72 acres of riparian, 149 acres of sandhills grassland, 4 acres of playa grassland, and 121 acres of cultivated land. The 45 acres permanently lost because of population growth would most likely occur in the sagebrush-grassland habitat type. The impacts to fish and wildlife habitat and populations are summarized in Table BU3-12.

Fishery

The population of fathead minnows in Rawhide Creek would be lost. The effect this would have on game fish downstream is unknown. Any increase in sediment load during high runoff periods would have adverse effects downstream on fish populations.

The loss of the original stream channel would probably have a long-term negative effect. Studies in Idaho indicate that if a section of stream is diverted or channelized, productivity in the new channel is a small fraction of the predisturbance productivity (Heimer 1977). Since a portion of Rawhide Creek would be diverted, it is expected that productivity for fish, aquatic invertebrates, amphibians, and obligate terrestrial fauna would be drastically reduced along the reclaimed stream channel. Disturbance to the groundwater system in the area may preclude the formation of perennial pools like those that currently exist in the streambed.

Wildlife

The impact of the proposed action on various groups or species of wildlife is represented in Tables BU3-13 through BU3-15. Numbers were calculated by multiplying the acreage to be disturbed by each species' estimated density per acre (see Chapter 2, Fish and Wildlife).

Playa Grassland

Due to the small amount of acreage lost from this habitat type, losses to wildlife populations would be insignificant.

Sandhills Grassland

This habitat type would be changed from one containing almost 19% sagebrush to a reclaimed habitat with little brush and no sagebrush. Most grass species proposed for reseeding are different than those currently growing in this habitat type. Loss of brush cover and vegetative diversity would be the major impact to this type.

Big Sagebrush

This type would be completely changed after mining. The valuable cover provided by sagebrush to numerous species would be lost and essentially not replaced. Pronghorn and mule deer would lose their major fall and winter food source. Sage grouse would lose the most important species in their diet. The diversity of vegetative species would also be lost.

Silver Sagebrush

Loss of this type would be most adverse for nongame birds and mammals. Habitat features lost would be the same as those lost in the big sagebrush habitat type.

Riparian

The loss of riparian and aquatic vegetation would be detrimental to numerous nongame and game species. This habitat type supports the highest density and diversity of vertebrate wildlife species on the site. The groundwater system which supports this habitat type may be premanently lost once it is disturbed by mining, so this habitat type may be lost permanently.

Cultivated Land

The loss of cultivated land would have an unknown effect on wildlife. Reclamation would result in a vegetative type very similar to the one presently existing.

Other Impacts to Habitat

The loss of edges between vegetative types would also be a negative impact. The habitat types currently on the site do not have straight, uniform boundaries, but instead are well intermingled. This condition is favorable for wildlife abundance and species diversity. The reclaimed habitat would have no edges, except where it borders undisturbed areas adjacent to the mine site. Here the edge would be almost a straight line with little or no intermingling of the reclaimed and undisturbed habitats. Currently, there are 24.67 miles of edge between the major habitat types on the site (including the 1,000-foot strip around the lease). Postmining edge would be 9.56 miles, a 61.25% decrease.

Some areas of rocky outcroppings would be destroyed and not replaced during reclamation. These rocky areas

TABLE BU3-12

SUMMARY OF IMPACTS ON FISH AND WILDLIFE RESOURCES ON THE PROPOSED BUCKSKIN MINE SITE

Classification of Impacts	Anticipated Impact of the Proposed Mine			
	None	Minor	Moderate	Major
Fish and Wildlife Habitat				x
Carrying Capacity for Fish and Wildlife				x
Fish and Wildlife Populations				
Fishery				
Nongame		x		
Game	x			
Endangered and/or threatened	x			
Wildlife				
Birds				
Nongame				x
Raptors			x	
Game		x		
Endangered and/or threatened	x			
Mammals				
Nongame				x
Furbearers/Predators			x	
Game			x	
Endangered and/or threatened	x			
Amphibians and Reptiles				
General			x	
Endangered and/or threatened	x			

TABLE BU3-13

HABITAT DISTURBANCE DUE TO BUCKSKIN MINE

	1980	1985	1990	1990+
Playa Grassland	2	2	2	4
Sandhills Grassland	45	78	95	149
Big Sagebrush	232	331	381	492
Silver Sagebrush	111	172	203	278
Riparian	22	38	46	72
Cultivated	67	94	108	121
	479	715	835	1,116

Note: Acreages approximate for each habitat type for each benchmark date except 1990+. It was assumed that all 45 acres of habitat loss due to population increase were lost in the big sagebrush habitat type.

TABLE BU3-14

PROJECTED WILDLIFE LOSSES ON THE BUCKSKIN MINE SITE

	1980	1985	1990	1990+
BIRDS				
Nongame	595	912	1,072	1,488
Raptors	4	5	6	8
Game				
Mourning Dove	6	9	12	18
Waterfowl	5	7	9	11
Sage Grouse		No losses can be predicted		
Sharp-tailed Grouse		No losses can be predicted		
Gray Partridge		No losses can be predicted		
MAMMALS				
Nongame				
Rodents	2,141	3,333	3,937	5,528
White-tailed Jackrabbit	4	6	7	9
Furbearers/Predators				
Muskrat		No losses can be predicted		
Badger	1	1	1	2
Coyote		No losses can be predicted		
Red Fox	0	0	1	1
Raccoon		No losses can be predicted		
Small Game				
Desert Cottontail	2	4	4	6
Big Game				
Pronghorn	7	10	12	16
Mule Deer	0	1	1	1

TABLE BU3-15

SUMMARY OF INDIVIDUALS AND THEIR PROGENY LOST

	1980	1985	1990	1990+
BIRDS				
Nongame	694	1,824	3,041	6,711
Raptors	4	7	11	21
Game				
Mourning Dove	7	18	34	82
Waterfowl	5	11	19	34
Sage Grouse*				
Sharp-tailed Grouse*				
Gray Partridge*				
MAMMALS				
Nongame				
Rodents	2,740	8,899	15,984	37,811
White-tailed Jackrabbit	5	13	22	47
Furbearers/Predators				
Muskrat*				
Badger	1	2	3	9
Coyote*				
Red Fox	0	0	3	4
Raccoon*				
Small Game				
Desert Cottontail	2	9	13	31
Big Game				
Pronghorn	8	16	25	50
Mule Deer	0	1	2	3

Note: See Table R4-11 and R4-13 in regional analysis for figure derivation method.

* Animals ovserved on the site for which no density data were gathered.

provide habitat for least chipmunks, desert cottontails, rock wrens, cliff swallows, and other species.

The loss of point-watering sources would be adverse to all wildlife.

Birds

Projected bird losses are shown on Tables BU3-14 and BU3-15. Birds on the mine site would be displaced by destruction of their habitat to adjacent areas, where most would die due to competition for food and cover.

Nongame. The nongame species that would be most adversely affected are the western meadowlark, Brewer's sparrow, lark bunting, vesper sparrow, horned lark, and Say's phoebe. All of these species are found in both sagebrush types and sandhills grassland. The sandhills grassland contains approximately 19% silver sagebrush, and the reclaimed habitat would contain little or no sagebrush of any kind. Thus it is likely Brewer's sparrows would be virtually eliminated from the reclaimed habitat. Western meadowlarks and Say's phoebes are more numerous in the sagebrush types than in the sandhills grassland type and would likely be less abundant in the reclaimed habitat. Lark buntings, vesper sparrows, and horned larks are more abundant in the sandhills grassland than the sagebrush types. However, the lack of sagebrush in the reclaimed habitat may reduce the abundance of these three species in the reclaimed habitat.

In addition, the mixture of grasses to be seeded on the reclaimed areas includes only one species (western wheatgrass) currently found on the site in abundance. How nongame birds and other wildlife species would adapt to these new species is unknown.

Raptors. Raptors would be affected by the loss of their prey base on the site. Over half of the mine site would be reclaimed during the last year of the mine, so a large area of disturbance would exist throughout much of the mines existence. Furthermore, noise and human activity in close proximity to reclaimed areas may discourage raptor use of them. Raptor use of reclaimed areas also would depend on how rapidly reclaimed land is recolonized by prey species. No data are available to quantify the rate of recolonization or the postreclamation densities of prey.

The red-tailed hawks' nest on the site would be destroyed around 1987. An active great horned owl nest is located approximately ½ mile south of the proposed railroad spur. It is not known if construction and operation of the rail spur would cause the owls to abandon their nest site.

Game. Mourning doves are the most common upland game bird on the mine site. They would be the most adversely affected game bird. Doves would probably be able to use reclaimed areas, but fewer individuals would be present in comparison to premining abundance.

Sage grouse and sharp-tailed grouse have been observed on the site but were not abundant enough to be censused, so effects on these two birds should be negligible. Gray partridge were observed along Rawhide Creek during the winter of 1978-79 but not previously censused, so it is unlikely the species would be adversely impacted.

Waterfowl would be adversely affected due to the loss of the pools along Rawhide Creek, and the loss of aquatic and riparian vegetation associated with the stream channel. Mallards would be the main waterfowl species affected.

Sensitive Species. No adverse impact is anticipated to any state-listed sensitive species.

Endangered and/or Threatened Species. Because no endangered or threatened species are known to occur on the site, no adverse impact would be anticipated from the proposed project. In the event that such species are identified on the site at a later time, immediate consultation by the operator with the U.S. Fish and Wildlife Service would be required under Section 7 of the Endangered Species Act.

Mammals

Nongame. All of the small nongame mammals which are unable to flee, or which retreat to burrows for safety, would be destroyed by earth-moving equipment. Other species which are able to flee would move into areas adjacent to the mine site, where most would die due to competition for available food and cover. Small mammal species most adversely affected by the proposed mine would be the deer mouse, thirteen-lined ground squirrel, northern grasshopper mouse, and the least chipmunk.

Furbearers/Predators. The major effect on this group of animals would be the loss of its prey base. Muskrats are the only herbivorous species in this group. Muskrats would be adversely affected by the loss of the riparian and aquatic vegetation.

Game. Mining activity would destroy antelope habitat and displace the antelope presently occupying the site. The number of antelope displaced would probably be lost due to competition for available food and cover. Entanglement in fence wires may cause additional antelope loss. The applicant has agreed to implement mitigating measure E (see Chapter 4 of the regional analysis). The construction of fences to allow passage of pronghorn and mule deer would greatly reduce losses due to fence entanglement. The increase in human population attributable to the Buckskin Mine would increase, by a small amount, possible antelope losses from collisions with vehicles, poaching, and predation by domestic pets.

Impacts to mule deer would not be as significant as those on pronghorn since they are not as abundant. The loss of brush and the general smoothing out of the land surface during reclamation would greatly reduce the value of the reclaimed habitat for mule deer. Population monitoring by the Wyoming Game and Fish Department could help prevent major losses by identifying problems before they become critical.

Endangered and/or Threatened Species. Because no endangered or threatened species are known to occur on the site, no adverse impact would be anticipated from the proposed project. In the event that such species are identified on the site at a later time, immediate consultation by the operator with the U.S. Fish and Wildlife

Service would be required under Section 7 of the Endangered Species Act.

Amphibians and Reptiles

Amphibians and reptiles on the site are not highly mobile and would be lost during the initial removal of topsoil.

Frog and turtle species might be able to recolonize the reclaimed stream channel areas. However, the lack of aquatic and riparian vegetation may preclude reestablishment of these species in the reclaimed area. Snake species should be able to recolonize reclaimed areas if sufficient cover and prey are available.

Endangered and/or Threatened Species. No adverse impact to any endangered or threatened species would be anticipated on the proposed Buckskin Mine site, since such species are unknown in the region.

CULTURAL RESOURCES

Prehistoric sites (48 CA 16 and 48 CA 17) lying within the area that would be mined have been tested, and data has been collected from them. Neither site is considered to be of National Register quality by the archeological survey crew (Zeimens et al. 1978).

Prehistoric sites (48 CA 89 and 48 CA 130), which lie in the proposed railroad right-of-way, have been tested. It is determined that both sites are eligible for nomination to the National Register of Historic Places (Zeimens et al. 1978).

Impact to these sites could range from total destruction by mining to partial destruction resulting from construction of the railroad and additional damage by vehicular traffic and vandalism as access is made easier.

Protective stipulations to mitigate potential impact to sites 48 CA 89 and 48 CA 130 have been proposed by the Wyoming State Archeologist and the Bureau of Land Management. (See Chapter 4.) During consultation among the Bureau of Land Management, Wyoming State Historic Preservation Officer, and the Advisory Council on Historic Preservation, it will be determined if these stipulations are adequate or if additional or substitute measures shall be applied.

Overburden stripping at the mine site could destroy buried prehistoric sites of unknown significance.

Population increases in the region could lead to increased destruction of cultural resources due to unauthorized collection and vandalism; however, the actual regional impacts caused by this proposed mine cannot be adequately assessed at this time.

VISUAL RESOURCES

The impacts of the proposed Buckskin Mine on visual resources were determined using the Bureau of Land Management (BLM) contrast rating system. Contrast ratings describe how the proposed project would affect the existing landscape features (land surface, vegetation, and structures) as seen from U.S. Highway 14/16. Contrasts were evaluated for both the life of the mine and after reclamation. (See Table BUA-7, Appendix, for Buckskin project contrast rating, and regional analysis, Appendix B for discussion of visual resource management (VRM) classes.)

During the life of the mine, the contrast ratings for the land surface would exceed the limits of VRM Class IV. Contrasts with the natural landscape would be the open pit, service roads, railroad cuts and fills, power lines, and unshaped overburden. Soil color on roads and spoil piles and the exposed black coal seam would contrast with existing colors.

Contrast ratings for vegetation and structures would be acceptable for Class IV during the life of the mine. Unnatural edges of newly seeded areas and color variation in vegetation would cause only moderate contrasts. The surface facilities for the mine would be in the southeast corner of the permit area, and hence not visible from the highway. Only haul trucks and loaders at the western edge of the mine would be seen.

For the life of the mine, the permit area would be designated Class V, which is an interim classification indicating that rehabilitation is needed to restore an area to its natural character.

After mining is completed and reclamation is successful, contrasts would no longer exceed the limits for Class IV, and the area could be restored to its original class.

Changes in visual resources caused by the Buckskin Mine would not be isolated, but rather an extension of changes caused by other mines nearby. For example, Rawhide and Eagle Butte mines will already be operating 2 and 4 miles south of the Buckskin site respectively. Hence the impact of Buckskin would be considerably less than if it were the only intrusion in an otherwise open plain.

RECREATION RESOURCES

The most important impact of the proposed action on the recreation resources in Campbell County would be more people participating in and demanding recreation opportunities.

As a result of the proposed action, the population of the county is expected to increase by about 630 by 1990. Along with an increased population, the median family income in Campbell County by 1990 is projected to be 36% higher than the state average (Wyoming Recreation Commission 1975). Increases in population and income would mean increased stress on recreation facilities, which are already considered inadequate in Gillette (Table R2-23 in the regional analysis). As a result, more services would have to be planned and managed in order to maintain an acceptable recreation experience. Maintenance costs would increase, as would costs of visitor safety measures and resource protection.

Also, overcrowding of city parks and facilities and increased use of the open plains by hunters, off-road vehi-

cle users, and sightseers would decrease the quality of the recreation experience.

Therefore, although the population increase attributable to Buckskin would be minor (5%) compared to overall population growth in Campbell County by 1990, its impact would be significant.

On the Buckskin site itself, recreation opportunities are negligible now and would be little changed by mining. A minor reduction of huntable wildlife numbers would be the primary impact.

AGRICULTURE

Livestock Production

The construction of roads, fences, the railroad, the mine, and ancillary facilities would disrupt grazing on approximately 80% of the total permit area of 1,760 acres during the life of the mine. A total of 5,120 animal unit months (AUMs) of production would be lost during the life of the mine, with an average annual loss of 256 AUMs. The impact of grazing loss would be distributed between two operators.

The current operators have been bought out by industrial concerns but have leased back the land for grazing purposes. Once the Buckskin and other mining operations commence, the operators expect to continue their operations on adjacent land and on the 20% of the permit area that will still be available.

Once mining is completed, and if reclamation of the area is successfully accomplished, the stocking rate and grazing pattern are expected to return to near premining standards. This is consistent with the Shell Oil land use plan for the area, which assumes that the land would be returned to grazing use. However, forage production studies (Chapter 3, Soils) indicate that the potential forage production after reclamation would be 6% lower than present forage production. This would be a long-term impact. Current annual production is estimated to be 1,475,800 pounds of air-dry forage compared to an estimated 1,392,300 pounds after reclamation.

Surface water hydrology studies (Chapter 3) indicate that overburden settling would cause a pond to be formed varying from 35 to 40 acres due to a 3-foot settlement. This could cause an additional change in potential forage production after reclamation from the figure listed above, which was calculated without the pond. If the 35- to 40-acre lake is formed, total forage production would be reduced to 1,352,300 pounds per year of air-dry forage. This is a reduction of 17% from premining production and would be a long-term loss.

Haul road dust and fugitive coal dust from mining, blasting, transporting, processing, and loading may be deposited on vegetation adjacent to the mine. Dust-covered and damaged vegetation would be less palatable to livestock and wildlife.

The rail spur, access roads, and mine developments would divide grazing areas that are presently used as one continuous pasture. These obstacles to livestock movement could cause trailing (excessive use parallel to the obstacles) and overuse at points where the livestock are moved across to unused range.

The impact on range improvements would be primarily to watering facilities in Rawhide Creek and Spring Draw since mining activities would remove them. For reasons discussed in Chapter 3, Water Resources, it is unlikely that natural point-watering sources in Rawhide Creek and Spring Draw would redevelop in the recreated stream channels.

The alteration of flow of natural springs and the destruction of the riparian zones of Rawhide Creek and Spring Draw would affect the grazing of livestock and wildlife on these watershed areas. The degree of impact would vary according to the location of alternate water sources that may be developed.

Heavy sediment loads combined with flooding (Chapter 3, Water Resources) and possible channel changes could result in loss of crop fields and pasturage and increased silt deposits on fields downstream, resulting in further forage loss.

Farming

Disturbance of scattered areas currently used for cropland production is expected to amount to 121 acres. The 34 acres of barley and wheat production and the 87 acres of hay production are expected to be lost for the life of the mining project. This represents a loss of 960 bushels of barley, 60 bushels of wheat, and 26 tons of hay per year. The total loss would amount to 19,200 bushels of barley, 1,200 bushels of wheat, and 520 tons of hay during the life of the project. Shell Oil's current land use plans do not contemplate the restoration of these farming areas. The Surface Mining Control and Reclamation Act (SMCRA) requires disturbed areas to be restored to a condition which would be capable of supporting the premining use. Any alternative use must be approved by the regulatory authority. Shell Oil may be required to modify their reclamation plan.

MINERAL RESOURCES

The impact of mining to the mineral resources of the site would be the consumption of the coal resource. During the 20-year life of the mine, an estimated 80 million tons of coal would be removed, 1.4 million tons would be left in the lease boundary highwalls, and an additional 2.6 million tons would be lost due to lack of recovery by present mining methods. An estimated 2 million tons would be removed by 1980, 22 million tons by 1985, and 42 million tons by 1990.

An unquantifiable amount of scoria, sand, and gravel would be used for mine facilities and possibly urban construction.

TRANSPORTATION NETWORKS

Railroads

A 6-mile private railroad spur to the Buckskin Mine site would be constructed from the terminus of the Burlington Northern-(BN)-owned portion of the 11-mile line originating at Donkey Creek, east of Gillette. One 100-car train per day would be required in 1980 to haul coal produced at Buckskin. Two trains per day would be required in 1985 and 1990. (Each car would carry 100 tons of coal.)

The proposed railroad spur would pass under State Highway 59 and intersect some tertiary roads where it could cause crossing hazards.

With increased rail movement from the mining site, noise levels would increase above existing levels.

Highways

Access to the proposed Buckskin Mine would be provided by construction of a 2-mile improved road from U.S. Highway 14/16 to the southeast corner of the lease. Commuter traffic on U.S. Highway 14/16 between the Buckskin Mine and Gillette would increase traffic flow and may increase the rate of highway deterioration. Based upon peak mine-related population increases (843) and a current vehicle registration rate of 945 per 1,000 population, the number of registered vehicles in Campbell, Converse, and Crook counties should increase by 794 by 1990 because of the Buckskin Mine (personal communication, Dee Herber, Wyoming State Department of Revenue 1977). No existing roads would be relocated during mining operations.

Other

The Gillette-Campbell County Airport could expect increased air operations (total departures and arrivals) because of traffic associated with the proposed Buckskin Mine. The mine-related peak population increase expected in Campbell County would be 730. This would mean an increase in both individual and corporate air operations and further strain the already inadequate passenger and freight capabilities of the airport. It is estimated that annual operations would increase by approximately 3,796 due to the approval of the proposed action. This is based on a 1976 total air operations to county population ratio of 5.2.

Power for the Buckskin Mine would be generated at the 330-Mw Wyodak Power Plant. There would be no disturbances to existing transmission lines from the mining operations, but 6 miles of new 69-kv power line would be constructed along Buckskin's railroad spur from the Rawhide Mines power line.

Given the capabilities of the present telephone system and the small increase in population due to Buckskin, the impact would be negligible.

SOCIOECONOMIC CONDITIONS

Introduction

The Buckskin Mine is only part of the development of coal (about 2% of that produced by 1990) and other energy resources possible in the Eastern Powder River Basin. It is important to remember that by their very nature, socioeconomic impacts may be of a regional scope, and not limited to a geographically defined site-specific area. Each individual energy development's socioeconomic impacts, when viewed alone, may be negligible, but its effect on cumulative impacts can be very significant. Thus, it is crucial for the reader to view this or any other site-specific analysis not only by itself, but also in terms of cumulative regional impacts.

Sociocultural Impacts

Population increases associated with the Buckskin Mine would contribute, particularly in Gillette, to regional social problems and changes in life-style already occurring. See Chapters 2 and 4 of the regional analysis for a discussion of these sociocultural changes.

Economic Impacts

Population

Table BU3-16 compares population projections with and without the Buckskin Mine. Measurable population impacts due to Buckskin would be expected only in Gillette, Douglas, and Moorcroft. A handful of workers and their families might elect to live in the unincorporated settlement of Wright in Campbell County.

These projections reflect employment at Buckskin in the years 1980, 1985, and 1990, the years selected for analysis. Fluctuations in employment figures for other years, particularly regarding the construction work force, should not substantially alter the nature or magnitude of the impacts discussed below.

Virtually all of the Buckskin-related population growth (92% as of 1980, 83% as of 1985, and 87% as of 1990) is projected to reside in Campbell County, primarily in Gillette. Much of the population increase in Douglas would be attributable to increased railroad employment generated by coal shipments from Buckskin. In addition, some Buckskin workers and their families would be expected to reside in Moorcroft.

TABLE BU3-16

PROJECTED POPULATION IMPACTS OF BUCKSKIN MINE

County City	1980 Population Without Buckskin	1980 Population With Buckskin	1980 Increment Attributable to Buckskin	1985 Population Without Buckskin	1985 Population With Buckskin	1985 Increment Attributable to Buckskin	1990 Population Without Buckskin	1990 Population With Buckskin	1990 Increment Attributable to Buckskin
Campbell	28,125	28,222	97	33,828	34,261	383	38,853	39,583	730
Gillette	22,258	22,353	95	28,008	28,383	375	32,983	33,705	722
Other Areas*	5,867	5,869	2	5,870	5,878	8	5,870	5,878	8
Converse	13,019	13,021	2	21,065	21,114	49	19,726	19,811	85
Douglas	8,368	8,370	2	15,006	15,055	49	13,595	13,680	85
Glenrock	3,137	3,137	0	4,542	4,542	0	4,614	4,614	0
Other Areas	1,514	1,514	0	1,517	1,517	0	1,517	1,517	0
Crook	5,434	5,438	4	6,292	6,319	27	6,809	6,837	28
Moorcroft	1,482	1,486	4	2,334	2,361	27	2,851	2,879	28
Other Areas	3,952	3,952	0	3,958	3,958	0	3,958	3,958	0
Total 3 Counties	46,578	46,681	103	61,235	61,694	459	65,388	66,231	843

Source: University of Wyoming 1978.

* Includes unincorporated settlement of Wright.

Employment

Projected employment impacts of Buckskin Mine would be felt in three counties: Campbell, Converse, and Crook. The bulk of the employment would consist of workers at Buckskin, although by 1990 indirect and induced employment in the railroad, construction, services, and government sectors would make up a large share of the total.

Permanent employment at Buckskin would reach 133 by 1990, of whom 125 (94%) would be expected to reside in Campbell County, with the remainder commuting from neighboring Crook County. The construction work force at the mine, which would peak at 262 during the third quarter of the first full year of construction and average 197 for the year, would probably show approximately the same percentage distribution between Campbell and Crook counties as shown above. Shipments of coal from Buckskin would lead to a 25-person increase in railroad employment by 1990. About two-thirds of this additional rail employment would be expected in Converse County, and the remainder in Campbell County. In addition to employment at the mine and on the railroad, the creation of 134 additional jobs in the construction, services, and government sectors would be expected; 112 would be in Campbell County.

Compared with regional employment projections, employment associated with Buckskin would represent a 2% increase in Campbell County, and less than a 1% increment in Converse and Crook counties. After 1980, many of the additional jobs created would probably be filled by immigrants from outside the region, due to the already extremely low local unemployment rates.

Income

Beginning in 1980, the Buckskin Mine would cause a relatively small but measurable increase in local earnings in Campbell, Converse, and Crook counties. Table BU3-17 summarizes the income impacts of Buckskin by county.

In 1980, the mine is expected to generate $7.1 million in additional earnings (measured in 1975 dollars) in the three counties affected, a 1% increase over earning levels foreseen without Buckskin. Virtually all of this increase would be accounted for by direct operating and construction manpower requirements at the Buckskin Mine, and it would be primarily restricted to Campbell County.

By 1985, earnings attributable to the mine (including railroad earnings) would reach $9.1 million (1975 dollars), approximately 1% above the earnings forecast without Buckskin. Almost nine-tenths of this incremental income would be concentrated in Campbell County, with the remainder divided between Converse and Crook counties.

In 1990, direct, indirect, and induced earnings attributable to Buckskin would be $14.2 million (1975 dollars), including railroad earnings. This would represent a 1.2% increase above the 1990 earnings forecast without the mine. Only $5.6 million, or 39% of the total, would be direct mine earnings; the remainder would consist of indirect and induced earnings in other sectors. More than 90% of all mine-related earnings would accrue to Campbell County.

Public Sector Impacts

Local Government

Buckskin-related population increases would increase the revenues at the disposal of local governments, while simultaneously increasing their operating and capital outlay requirements.

Principally due to the large property tax base at their disposal, local county governments and school districts should be able to meet the additional service and educational requirements of the Buckskin-related population. For municipal governments, the outlook would be mixed. Gillette's projected operating revenues appear sufficient to meet the city's operating requirements through 1990, both with and without Buckskin. However, Douglas would face a maximum operating shortfall of $1 million annually by 1985 without Buckskin. Moorcroft could be short by as much as $25,000 annually by 1990. Buckskin would have a minor additional adverse impact on Douglas' and Moorcroft's operating budgets.

Municipal governments vary in their ability to meet the capital costs of additional facilities, as discussed in Chapter 4 of the regional analysis. Population increases attributable to Buckskin are not expected to necessitate any additional capital expenditures.

Local Services

Some local services (e.g., police and fire protection, water supplies, and sewage treatment) in Campbell, Converse, and Crook counties are already inadequate. The additional population growth attributable to the Buckskin Mine would, in some cases, cause additional marginal adverse impacts on these services.

Nearly all of the Buckskin-related population would be expected to reside in the incorporated areas of Gillette, Douglas, and Moorcroft. The marginal impact of Buckskin on county law enforcement and fire protection services would therefore be small.

Gillette is the only one of the three municipalities under consideration which would experience discernible service impacts as a result of the Buckskin Mine. However, these impacts would be quite marginal when compared with the impacts of the total population forecast. For example, without any new coal development, 29 additional police officers and ten additional police cars would be required by 1990; the incremental population attributable to Buckskin would create a need for a thirteenth new officer by 1990, but no new police cars.

To ensure adequate fire protection for the projected population, Gillette would need additional pumper trucks with a total capacity of 1,500 gallons per minute plus six more full-time firemen (or eighteen volunteers) by 1990. These requirements would not be affected by Buckskin.

TABLE BU3-17

INCREMENTAL EARNINGS ASSOCIATED WITH THE BUCKSKIN MINE, 1980-1990
(Millions of 1975 Dollars)

	Campbell			Converse			Crook			Three-County Total		
	1980	1985	1990	1980	1985	1990	1980	1985	1990	1980	1985	1990
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Minerals Extraction	2.2	4.3	5.5	0	0	0	0.1	0.1	0.1	2.3	4.4	5.6
Construction	4.5	0	1.2	0	0	0	0.3	0	0	4.8	0	1.2
Manufacturing	0	0	0	0	0	0	0	0	0	0	0	0
Railroads	0	0.1	0.1	0	0.2	0.2	0	0	0	0	0.3	0.3
Business/Consumer Services	0	2.8	4.0	0	0.2	0.2	0	0.2	0.6	0	3.0	4.8
Government/Education	0	1.0	2.0	0	0.1	0.1	0	0.1	0.2	0	1.1	2.3
Military	0	0	0	0	0	0	0	0	0	0	0	0
Totals	6.7	8.2	12.8	0	0.5	0.5	0.4	0.4	0.9	7.1	9.1	14.2

Source: University of Wyoming 1978.

Note: Excludes corporate income.

Likewise, Gillette's water and sewage treatment needs, although substantial in themselves, would not be significantly affected by Buckskin. By 1990, the city would need to increase its combined water supply and treatment capacity to 15.2 million gallons per day. Its current sewage treatment capacity (1.4 mgd) would have to be expanded to some 5.7 mgd by 1990 to meet the demands of the projected population.

Even without new coal development, Douglas would be faced with the problem of planning services for over 15,000 people by 1985 which would not result in long-term overcapacity when the population declines to under 13,700 after 1985. Further population increases due to the Buckskin Mine would not necessitate any increments to peak service levels. Conversely, the additional Buckskin-related population would not be sufficient to have any significant cushioning effect when the population declines after 1985.

The small increments in Moorcroft's population attributable to Buckskin would not appear to warrant any significant changes in the level of police or fire coverage, or any expansion of the town's water supply or sewage treatment facilities beyond already projected needs.

Health Care

Table BU3-18 contains projections of the number of physicians, registered nurses, and dentists necessary to provide adequate health care to the populations of Campbell, Converse, and Crook counties. The impact of Buckskin-related population growth on these requirements would be insignificant. Despite the recent success of the Campbell County Hospital Board in recruiting five more doctors, the shortage of doctors would probably remain a critical problem in the three counties.

The shortage of doctors is one reason why the underutilization of hospital facilities in the three counties is expected to continue. Another reason is the relatively small size of the hospitals, which precludes offering some types of sophisticated treatment. (Hospital bed occupancy rates in Campbell, Converse, and Crook counties are 51%, 48%, and 16% respectively, compared with the nationwide average of 77%.) Many local residents travel to Casper, or even outside the region, for hospital care. For this reason, although Campbell County is currently building a new 55-bed hospital, hospital needs must be assessed on a regionwide basis.

Based on the current average regional hospital occupancy rate of 46%, the region would have an adequate supply of hospital beds through 1980. However, even with planned local hospital expansions, the region as a whole would experience a shortfall of 183 beds by 1990 (186 including Buckskin).

Education

Three school districts would experience Buckskin-related impacts on student enrollments: the Campbell County School District; Converse County School District No. 1; and the Crook County School District. The incremental impacts of Buckskin Mine on these three school districts are shown in Table BU3-19. These impacts are quite minor when viewed in the context of overall projected enrollment increases: an increment of 1.6% in Campbell County, 0.5% in Converse County No. 1, and 0.5% in Crook County.

These enrollment increases would not have any major effect on the capital facility requirements of the three school districts (see Chapter 4 of the regional analysis).

Enrollment due to Buckskin would necessitate Campbell County's hiring up to 7 additional teachers by 1990. In Douglas and Crook County, the impact of Buckskin-related enrollment on long-term additional teacher requirements would be negligible.

Private Sector Impacts

Housing

Table BU3-20 shows projected housing demand with and without the Buckskin Mine in Gillette, Douglas, and Moorcroft. The incremental growth in housing demand attributable to Buckskin would vary from 0% to 0.4% annually, depending on the locality and the type of housing.

Based on comparisons with historical rates of growth in the local single-family housing stock, local builders appear capable of meeting the demand for single-family homes through 1990. However, Table BU3-20 measures only effective demand, i.e., households desiring *and* able to afford the high cost of single-family housing. In Gillette, the number of households desiring, but unable to afford, single-family housing is estimated at approximately 750 by 1990 (775 including Buckskin). In Douglas it is anticipated that 350 households (360 including Buckskin) would be unable to afford the single-family homes they desire by 1985. (If Douglas' population declines after 1985 as projected, it may cause a significant drop in housing costs, increasing the availability of single-family homes.) In Moorcroft, approximately 160 households by 1990 (no significant incremental impacts due to Buckskin) would be prevented from buying the single-family homes they desire by high housing costs.

Even at inflated production costs, the majority of the new mining employees would be able to qualify for single-family homes. Table BU3-21 summarizes the anticipated wage distribution of the workers at the proposed Buckskin Mine. More than half would have household incomes of over $20,000 per year, even if there are no second wage earners in the households. Most of the new employees in the service sector jobs indirectly resulting from the mine would be able to afford single-family units only if there are two or more full-time wage earners in the household and/or the cost of new housing is reduced.

The population growth directly and indirectly resulting from Buckskin would also increase demand for, and thus the likelihood of shortages in rental apartments, transient accommodations, and mobile home spaces.

TABLE BU3-18

PROJECTED HEALTH MANPOWER REQUIREMENTS

	1977 Physicians	Physicians Recommended Level*			1977 Registered Nurses	Registered Nurses Recommended Level**			1977 Dentists	Dentists Recommended Level***		
		1980	1985	1990		1980	1985	1990		1980	1985	1990
Campbell	9	28	34	39	53	99	120	134	4	18	21	25
Converse	6	13	21	20	29	46	74	70	2	8	13	12
Crook	2	5	6	7	11	19	22	24	1	3	4	4

Source: Wyoming Department of Health and Social Services 1977; personal communication, Larry Bertilson, State Health Planning Manager, 1978.

* Based on recommended standard of 1,000 persons per physician.
** Based on recommended standard of 285 persons per registered nurse.
*** Based on recommended standard of 1,600 persons per dentist.

TABLE BU3-19

SCHOOL DISTRICT ENROLLMENT PROJECTIONS

Enrollment Projections Without Buckskin

	1980				1985				1990			
	Elem.	J. H.	H. S.	Total	Elem.	J. H.	H. S.	Total	Elem.	J. H.	H. S.	Total
Campbell Gillette	2,813	1,125	844	6,782	3,388	1,355	1,016	5,759	3,885	1,554	1,165	6,604
Converse Douglas	1,312	469	375	2,156	2,243	801	640	3,684	2,046	730	584	3,360
Crook Sundance	714	359	334	1,407	826	415	388	1,629	894	450	419	1,763

Enrollment Projections With Buckskin

	1980				1985				1990			
	Elem.	J. H.	H. S.	Total	Elem.	J. H.	H. S.	Total	Elem.	J. H.	H. S.	Total
Campbell Gillette	2,822	1,129	847	4,748	3,476	1,370	1,028	5,824	3,948	1,599	1,184	6,711
Converse Douglas	1,312	469	375	2,156	2,248	803	642	3,193	2,055	784	587	3,876
Crook Sundance	713	359	335	1,408	829	417	389	1,637	897	451	421	1,771

Source: University of Wyoming 1978.

TABLE BU3-20

PROJECTED HOUSING DEMAND, 1977-1990

Community Housing Type	1977 Housing Stock	Average Annual Growth Rate of Housing Stock, 1970-77	Additional Demand for Housing Units, 1977-1990			
			Without Buckskin		With Buckskin	
			No. of Units	Average Annual Growth in Housing Stock	No. of Units	Average Annual Growth in Housing Stock
Gillette*						
Single Family	1,623	5.2%	1,857	6.0%	2,007	6.4%
Multi-Unit	680	6.3%	486	4.2%	513	4.4%
Mobile	1,542	13.3%	1,492	5.3%	1,573	5.6%
TOTAL ALL TYPES	3,845	8.1%	3,835	5.5%	4,093	5.7%
Douglas						
Single Family	1,232	6.5%	721	3.6%	728	3.6%
Multi-Unit	207	0.7%	350	7.9%	353	8.0%
Mobile	349	24.8%	1,206	12.2%	1,228	12.3%
TOTAL ALL TYPES	1,788	8.2%	2,277	6.5%	2,309	6.6%
Moorcroft						
Single Family	147	NA	285	8.6%	296	8.9%
Multi-Unit	0	NA	63	---	65	---
Mobile	150	NA	230	7.4%	233	7.5%
TOTAL ALL TYPES	297	NA	578	8.7%	594	8.8%

Note: Two major factors were taken into account in compiling Table BU3-20: workers' personal preferences for different types of housing and their ability to pay for the type of housing desired. See notes for Table R4-24 in the regional analysis for an explanation of these factors.

* 1977 data for Gillette do not include housing located outside city limits since compatable data for 1970 were not obtainable. Consequently, average growth rate in Gillette's housing stock 1970-77 is probably understated.

NA = not available.

TABLE BU3-21

ANTICIPATED INCOME DISTRIBUTION FOR EMPLOYEES AT THE PROPOSED MINE

Annual Income	Percent of Total Employees
$30,000 and above	2.5
$25,000-$30,000	12.5
$20,000-$25,000	50
$15,000-$20,000	25
$15,000 and below	10
Total	100

Source: Shell Oil Company 1977.

TABLE BU3-22

APPLICABILITY OF SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA) PROVISIONS TO IMPACTS OF THE PROPOSED ACTION

Reference Number	Description of Impact of Proposed Action	SMCRA Performance Standards Bear on Impact
Air Quality		
AQ-1	Generation of fugitive dust emissions would cause an increase in total suspended particulates (TSP)	No
AQ-2	Visibility would be reduced by increased TSP	No
AQ-3	Vehicle emissions would be generated	No
Topography		
TO-1	Smooth depression would result after mining	No
TO-2	Landforms would be altered during mining	No
TO-3	Some railroad and road cuts may remain after mining	No
Geology		
GE-1	Part of the geologic record would be lost	No
GE-2	Ground stability would be decreased	No
GE-3	Rock hunting would increase	No
Paleontology		
PA-1	Potential fossil-bearing strata would be lost	No
PA-2	Unauthorized fossil collecting would increase	No

TABLE BU3-22
(cont'd)
APPLICABILITY OF SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA) PROVISIONS
TO IMPACTS OF THE PROPOSED ACTION

Reference Number	Description of Impact of Proposed Action	SMCRA Performance Standards Bear on Impact
Soils		
SO-1	Soil productivity would be reduced after reclamation	Yes (30 CFR 715.13)
SO-2	Soil productivity would be lost for new urban areas	No
SO-3	Soil productivity would be lost while areas are being mined	No
SO-4	Topsoil would be lost to erosion	Yes (30 CFR 715.16 and 715.20)
SO-5	Topsoil could be contaminated by toxic materials	Yes (30 CFR 715.16)
Groundwater		
GW-1	Water quality would be lowered in spoils after reclamation	Yes (30 CFR 715.17)
GW-2	Water levels would be lowered in adjacent aquifers during mining	Yes (30 CFR 715.17)
GW-3	A valley which has been designated as alluvial could be disturbed	Yes (30 CFR 715.17)
GW-4	Water levels would be nearer the surface in spoils	Yes (30 CFR 715.17 and 715.14)
GS-5	Infiltration and recharge would be altered in the spoil after reclamation	Yes (30 CFR 715.17)
GS-6	Coal and overburden aquifers would be destroyed by mining	No
GS-7	Consumptive use of groundwater could affect other users	Yes (30 CFR 715.17)

TABLE BU3-22
(cont'd)
APPLICABILITY OF SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA) PROVISIONS
TO IMPACTS OF THE PROPOSED ACTION

Reference Number	Description of Impact of Proposed Action	SMCRA Performance Standards Bear on Impact
Surface Water		
SW-1	Surface water system would be destroyed by mining, water would be diverted around the mine	Yes (30 CFR 715.17)
SW-2	After reclamation, surface water system would be altered from existing characteristics	Yes (30 CFR 715.13, 715.14, 715.17)
SW-3	Shallow ponding could result after reclamation	Unknown
SW-4	Peripheral gullying could result after reclamation	Yes (30 CFR 715.13, 715.14, 715.17)
SW-5	During flooding, sedimentation would increase due to high stream velocities	No
SW-6	Breaching of bypass channel and impoundment would release low quality water downstream	Yes (30 CFR 715.17)
SW-7	Leachate and surface runoff could enter the surface water system during mining	Yes (30 CFR 715.17)
SW-8	Increased surface water use by new population would occur	No
SW-9	Water quality could be lowered by sewage effluents	No
Vegetation		
VG-1	Vegetative productivity would be reduced after reclamation	Yes (30 CFR 715.13 and 715.20)
VG-2	Vegetative productivity would be lost for new urban areas	No
VG-3	Vegetative productivity would be lost while areas are being mined	No

TABLE BU3-22
(cont'd)
APPLICABILITY OF SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA) PROVISIONS
TO IMPACTS OF THE PROPOSED ACTION

Reference Number	Description of Impact of Proposed Action	SMCRA Performance Standards Bear on Impact
Vegetation (cont'd)		
VG-4	Species variety would be reduced	Yes (30 CFR 715.20)
VG-5	Vegetative productivity could be reduced by dust deposition during mining	No
VG-6	Fire hazard would be increased during mining	No
VG-7	Aquatic vegetation would be adversely affected	Yes (30 CFR 715.13, 715.14, 715.17)
VG-8	Vegetative productivity could be reduced by topsoil erosion	Yes (30 CFR 715.16 and 715.20)
Wildlife		
WL-1	Wildlife habitat quality would be reduced after reclamation (affecting populations and carrying capacity)	Yes (30 CFR 715.13)
WL-2	Wildlife habitat would be lost during mining	No
WL-3	Carrying capacity would be lost during mining	No
WL-4	Wildlife populations would be reduced	No
Cultural Resources		
CR-1	Known cultural sites could be damaged by mining activities	No
CR-2	Unknown sites could be uncovered and/or damaged by mining activities	No
CR-3	Cultural artifacts could be damaged or lost by increased unauthorized collecting	No

TABLE BU3-22
(cont'd)
APPLICABILITY OF SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA) PROVISIONS
TO IMPACTS OF THE PROPOSED ACTION

Reference Number	Description of Impact of Proposed Action	SMCRA Performance Standards Bear on Impact
Visual Resources		
VR-1	Visual quality on the mine site would be reduced from Class IV to Class V	No
VR-2	Visual quality in new urban areas would be reduced from Classes II, III, or IV to Class V	No
Recreation Resources		
RR-1	Use of recreation facilities would be intensified	No
RR-2	"Primitive" recreation quality would be reduced	No
RR-3	Conflicts between landowners and recreationists would increase	No
RR-4	Numbers of huntable wildlife would be reduced	No
RR-5	Mining and urban expansion would reduce the land use base	No
RR-6	Sightseeing of natural landscapes would be reduced	No
Agriculture		
AG-1	AUMs (carrying capacity) would be reduced after reclamation	Yes (30 CFR 715.13)
AG-2	AUMs would be lost while areas are being mined	No
AG-3	AUMs would be lost for new urban areas	No
AG-4	Forage productivity could be reduced by dust fallout	No
AG-5	Animal harassment and unintentional openings of enclosures would increase	No

TABLE BU3-22
(cont'd)
APPLICABILITY OF SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA) PROVISIONS
TO IMPACTS OF THE PROPOSED ACTION

Reference Number	Description of Impact of Proposed Action	SMCRA Performance Standards Bear on Impact
Agriculture (cont'd)		
AG-6	New rail and road access could split pastures and interrupt agricultural operations	No
AG-7	Surface water system alteration would affect agricultural operations	Yes (30 CFR 715.13, 715.19)
AG-8	Increased sediment release during floods would affect productivities	Yes (30 CFR 715.17)
AG-9	121 acres of cropland would be destroyed and not reestablished by reclamation	Yes (30 CFR 715.13)
Mineral Resources		
MR-1	Coal would be converted to electrical energy	No
MR-2	Some coal would not be recovered	No
MR-3	Sand, gravel, and scoria would be consumed in construction activities	No
Transportation Networks		
TR-1	Rail traffic would increase	No
TR-2	Street and highway traffic would increase	No
TR-3	Traffic and use of the Gillette airport would increase	No
Socioeconomic Conditions		
SE-1	City of Gillette would experience increased fiscal stress	No
SE-2	Housing requirements and needs would intensify	No
SE-3	Quality of life and character of Gillette and Campbell County would be changed	No
SE-4	Employment and wages would increase	No