draft environmental statement

proposed coal leasing

CARBON BASIN AREA

IN REPLY REFER TO
1792 (920)

United States Department of the Interior

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

The Carbon Basin Draft Environmental Statement (DES) analyzes the potential impacts of leasing federal coal in the Carbon Basin area. The area is located in the northeastern part of the southcentral coal region of Wyoming. Approximately 6,160 acres of federal land is involved in the lease.

To reduce ES printing costs, this DES may not be reprinted. If no major changes are necessary, all or parts of the DES may be incorporated by reference into a separate volume containing the changes. Together, the two volumes would constitute the final environmental statement. Please keep this DES so that changes may be made in the event the DES is not totally reprinted.

Please review and comment on the Carbon Basin DES. We would appreciate receiving your written comments no later than April 16, 1979, so they may be considered in preparation of the final environmental statement. All comments should be mailed to the following address:

Team Leader
Coal ES Team
P.O. Box 670
Rawlins, WY 82301

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DEPARTMENT OF THE INTERIOR

DRAFT

ENVIRONMENTAL STATEMENT

PROPOSED

COAL LEASING

IN

CARBON BASIN AREA WYOMING

Prepared by the

DEPARTMENT OF THE INTERIOR

State Director, Wyoming State Office
Bureau of Land Management

SUMMARY

Draft (X) Final ( ) Environmental Statement

Department of the Interior, Bureau of Land Management

1. Type of Action: Administrative (X) Legislative ( )

2. Brief Description of Action: The proposed Carbon Basin action is based on a application for leasing of federal coal. This environmental statement is developed as an analysis of impacts of potential coal development on a specific site included in the lease application. Following are the federal actions involved:

A. Offering a competitive lease for federal coal.

B. Offering associated rights-of-way and special land use permits for one railroad spur, one telephone line, one access road, and one relocation of a county road.

3. Summary of Environmental Impacts by 1990

A. Air quality would be lowered in terms of all presently regulated pollutant standards. Visibility would also be reduced. Maximum predicted concentrations of carbon monoxide, nitrogen oxides, sulfer dioxide, and hydrocarbons would be less than 10% of the federal and state standards.

B. Parts of some geologic formations would be disturbed and would be exposed for study. Some fossils would be destroyed; others would be revealed.

C. The natural contour of 2,149 acres would be modified; most would be returned to the original contour.

D. Existing soil profiles on 2,149 acres would be destroyed; soil productivity would be lowered until reclamation were completed.

E. Water use would be increased in the region by a maximum 960 acre feet per year by approximately 1986 and then drop to 860 acre feet per year for the remainder of the mine life. Some sediment loads might be reduced from existing levels.

F. Vegetation on 2,341 acres would be disturbed, 192 acres would be used for housing support service facilities, and 2,149 acres would be utilized in the project development and reclaimed.

G. Wildlife habitat and some populations would be lost or disrupted on 1,175 acres during surface mine operations and on 956 acres for the life of the mine.

H. Some subsurface cultural resources could be destroyed.

I. The present visual quality would decrease as a result of mining, transporation facilities, transmission lines, mine structures, and urban expansion.

J. The quality of outdoor recreation would decrease; urban recreation facilities would not meet the needs of the increased population.

K. Social support facilities would not keep pace with population increases. Small towns would lose their small town atmosphere. A total of 1,035 new jobs due to the proposed actions would reduce unemploy ment but would lead to a population increase. Increased construction wages and investments would increase personal income, retail sales, and property values, but the inflationary pressures would result in hardship to persons on fixed incomes. All transportation arteries including rail lines would experience heavier average daily traffic loading.

4. Alternatives Considered:

Five alternatives are assessed in Chapter 8 of this statement as follows: No action, Underground Mining Only, and Surface Mining Only.

5. Comments on the draft environmental statement have been requested from various agencies, state clearing houses, and interest groups: see Chapter 9.

6. Date draft statement was made available to EPA and to the public:

Attachment A

COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

Comments on the draft environmental statement will be requested from the following agencies and state clearing houses.

Federal

Advisory Council on Historic Preservation
Department of Agriculture
 Soil Conservation Service
 Forest Service
Department of Commerce
Department of Energy
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
 Bureau of Mines
 Bureau of Reclamation
 Fish and Wildlife Service
 Heritage Conservation and Recreation Service
 National Park Service
 Office of Surface Mining
Department of Labor
 Mining Safety and Health Administration
 Occupational Safety and Health Administration
Department of Transportation
Federal Protection Agency
Federal Energy Regulatory Commission
Interstate Commerce Commission
Mountain Plains Federal Regional Council
Office of Economic Opportunity

State

The State of Wyoming Clearing House will coordinate comments from all interested agencies.

Local

Carbon County Commissioners
Carbon County Council of Governments
Carbon County Planning Commission
City of Rawlins
Town of Hanna
Town of Saratoga
Town of Encampment
Town of Sinclair
Town of Medicine Bow

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FOR

CARBON BASIN ENVIRONMENTAL

STATEMENT

CHAPTER 1

DESCRIPTION OF THE PROPOSED ACTION

INTRODUCTION

Carbon Basin is a large geological structure located in the northeastern part of the Southcentral Coal Region of Wyoming. The area is located 12 miles southeast of Hanna, Wyoming, and is separated from the Hanna Basin by the Saddleback Hills (Figures CA1-1 and CA1-2). Carbon Basin is within the Medicine Bow Resource Area of Rawlins Bureau of Land Management District.

Proposed Action

The components of the federal action include the offer for competitive bidding a federal coal lease and the granting of associated rights-of-way and special land-use permits. Issuing the coal lease would enable approval of technically and administratively complete mine plans which would allow maximum economic recovery of the coal resource.

The Carbon Basin area has been identified by the Geological Survey (GS) as a Known Recoverable Coal Resource Area (KRCRA) and has been identified by BLM as an area for possible leasing and development (Map CA1-1). Due to the ownership pattern (alternating sections of public and private), all coal would have to be developed to complete a logical mining unit. As a result of the identification of this area for possible coal development, lease application W-50061 is on file with the BLM.

The Carbon Basin area is extensively underlain by numerous coal beds at various depths. Interest in coal development as expressed in lease application W-50061 is in the southern part of the basin (Map CA1-1). Considering present technology, the Johnson, Blue, and Finch beds, located in the area, may be minable.

These beds contain a high quality, low sulfur coal in demand by power companies for use in power generation. Current data indicate the Johnson bed would be minable. Further information is necessary to determine the feasibility of mining either the Blue or Finch groups. Specific data and recommendations concerning the feasibility of mining the Blue and Finch groups will be supplied to BLM by GS.

Interpretation by BLM geologist of exploration data indicates that there are approximately 400 million tons of federal and private coal reserves in the Carbon Basin project area (Table CA1-1); however, further exploration is needed to obtain a more accurate estimate. Leasing of the area will be deferred until GS provides data concerning the amount of coal that can be economically recovered. These data will be furnished at a later date, prior to leasing. Since the total recoverable reserve of coal has not yet been established, a projected date for the end of mine life cannot be determined at this time. Mine life is expected to be beyond the 40 years stated in the mine and reclamation report.

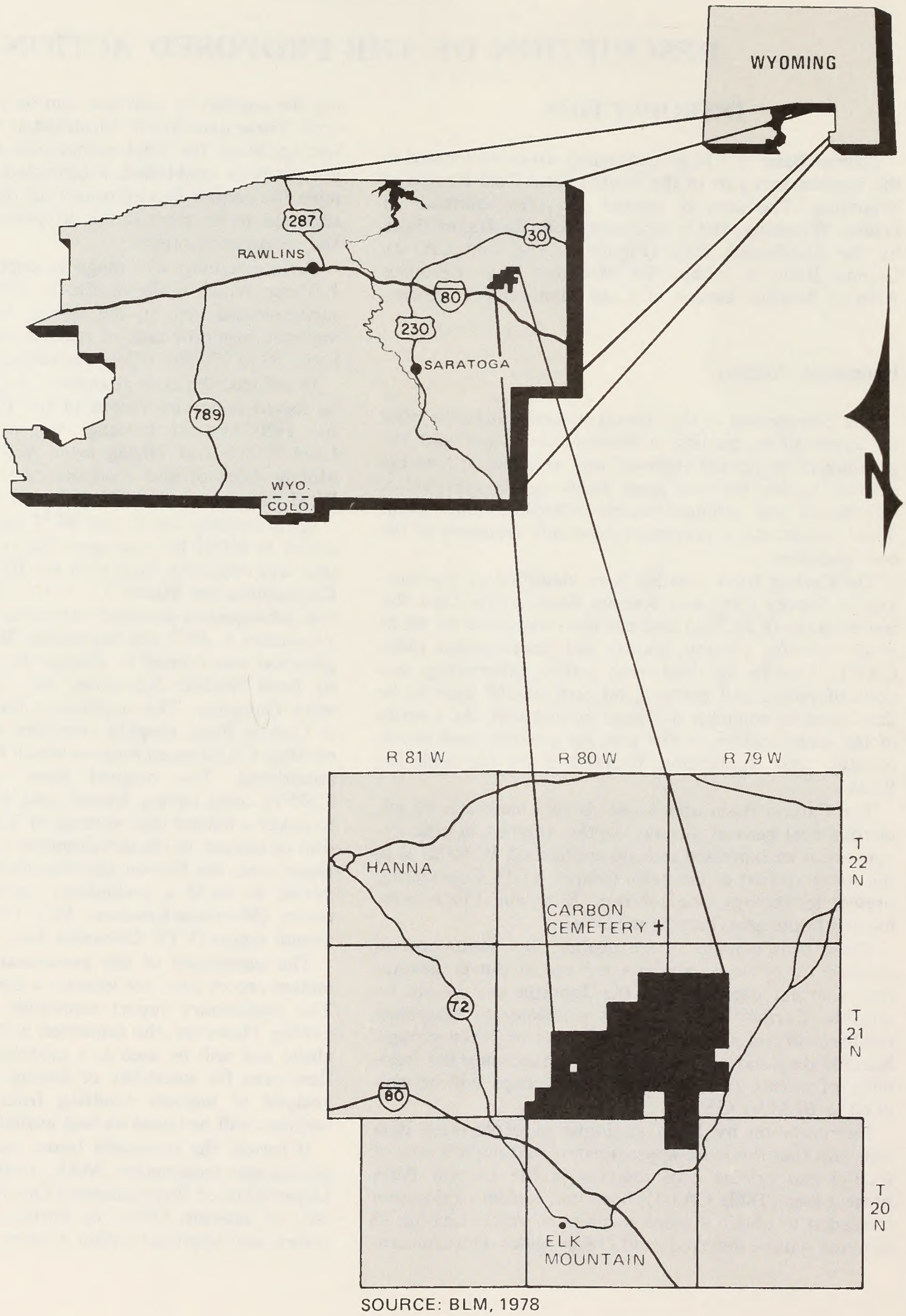
Surface mining will range in depth between 150 and 170 feet, which is the maximum economic recovery for surface-mined coal in the region. Underground mining methods would be used to recover coal at depths greater than 150 to 170 feet below the surface.

If offered, the coal resources of Carbon Basin would be leased under provisions of the following authorities: the 1920 Mineral Leasing Act, as amended; Federal Land Policy and Management Act (FLPMA); Surface Mining Control and Reclamation Act (SMCRA); and BLM Regulations 43 CFR 3500 and 3041.

As previously stated, the BLM has on file lease application W-50061 for leasing of federal coal. This application was originally filed with the BLM by CF & I Steel Corporation on March 17, 1975. The lease application was subsequently assigned to Nuclear Resources, Inc., on September 1, 1977. On September 28, 1977, the lease application was revised to change the name of the company from Nuclear Resources, Inc., to Edison Development Company. This application for the leasing of coal in Carbon Basin roughly coincides with the area shown on Map CA1-2 as an area on which future leasing will be considered. The original lease application covered 8,205.78 acres having federal coal. It was later amended to cover a federal coal acreage of 7,145.75. As an expression of interest in the development of coal in the Carbon Basin area, the Edison Development Company has submitted to BLM a preliminary mining and reclamation report (Morrison-Knudsen, May 1978) and an environmental report (VTN Colorado, Inc., January 1978).

The submission of this preliminary mining and reclamation report does not indicate a commitment to leasing. The preliminary report represents only a scenario of mining. However, the submitted preliminary report is realistic and will be used as a guideline for analysis of the lease area for suitability of leasing of federal coal. The analysis of impacts resulting from proposed ancillary facilities will be based on best available data.

If leased, the successful lessee must submit a plan for mining and reclamation (M&R) to the state of Wyoming Department of Environmental Quality (DEQ) and Secretary of Interior, Office of Surface Mining (OSM), for review and approval within 3 years after leasing. Bureau



SOURCE: BLM, 1978

Figure CA1-1
GENERAL LOCATION MAP

Carbon Basin

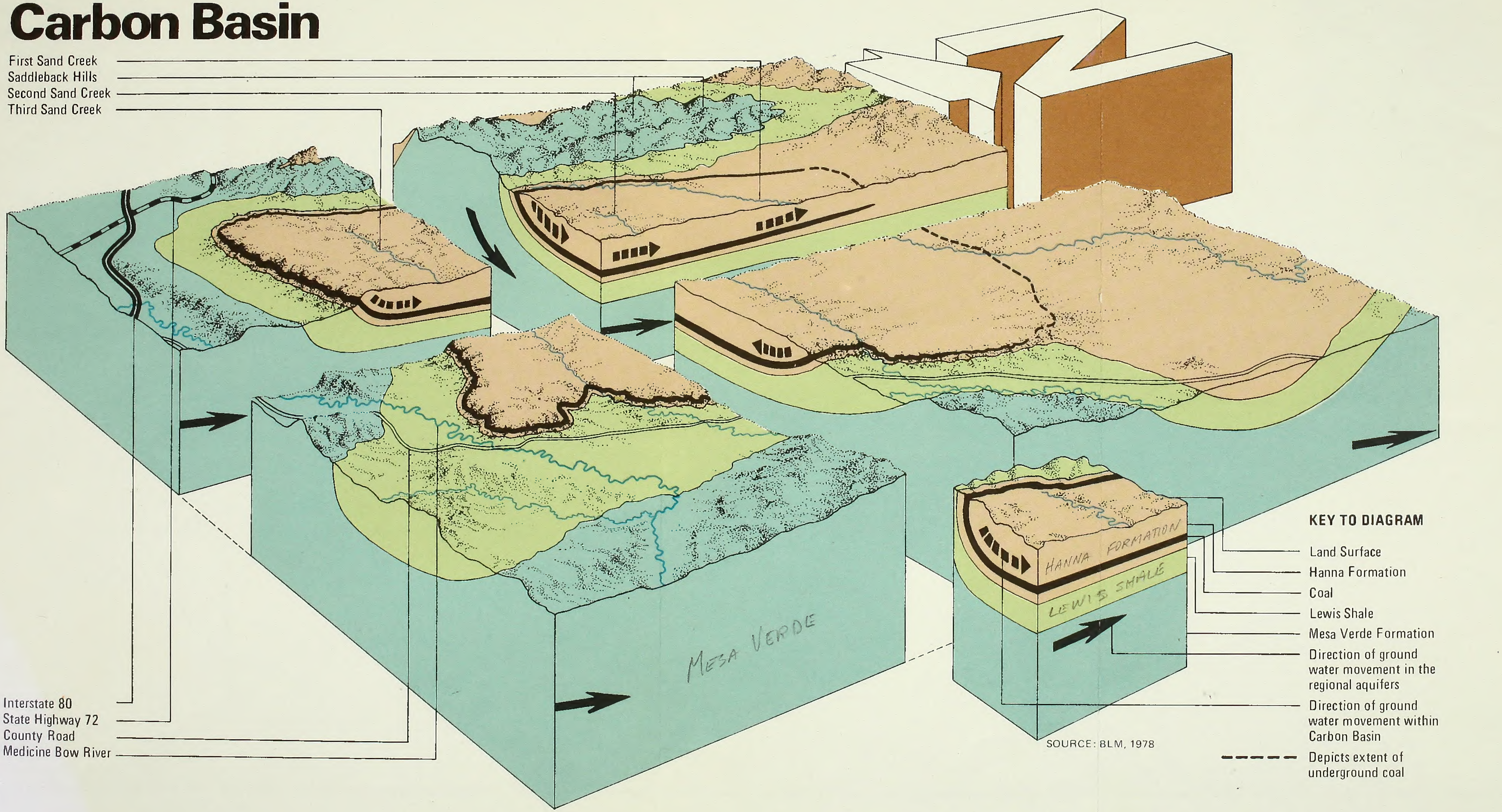
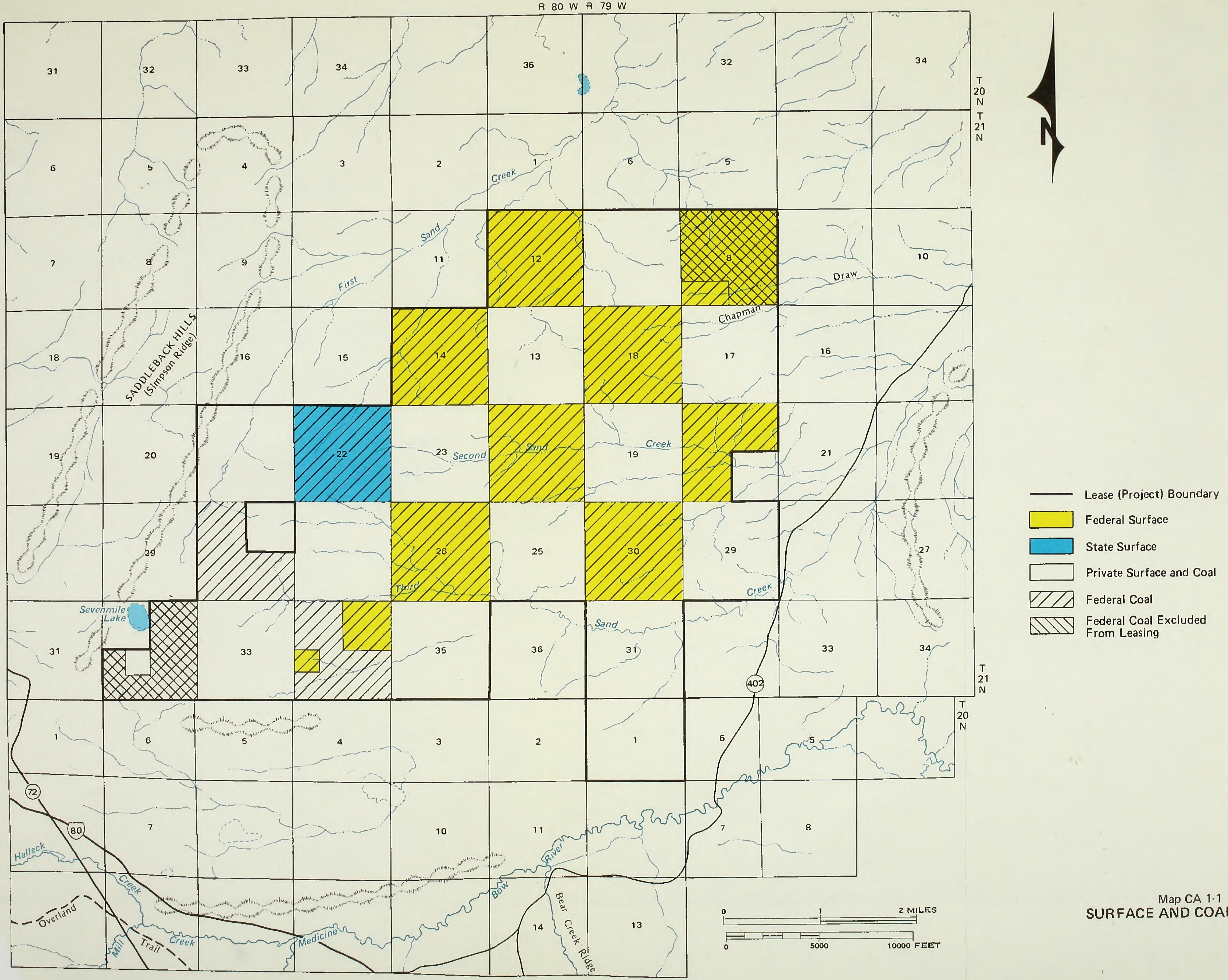


Figure CA1-2
ISOMETRIC AQUIFER SYSTEM OF CARBON BASIN



SOURCE: BLM, 1978

Map CA 1-1
SURFACE AND COAL STATUS

Table CA1-1

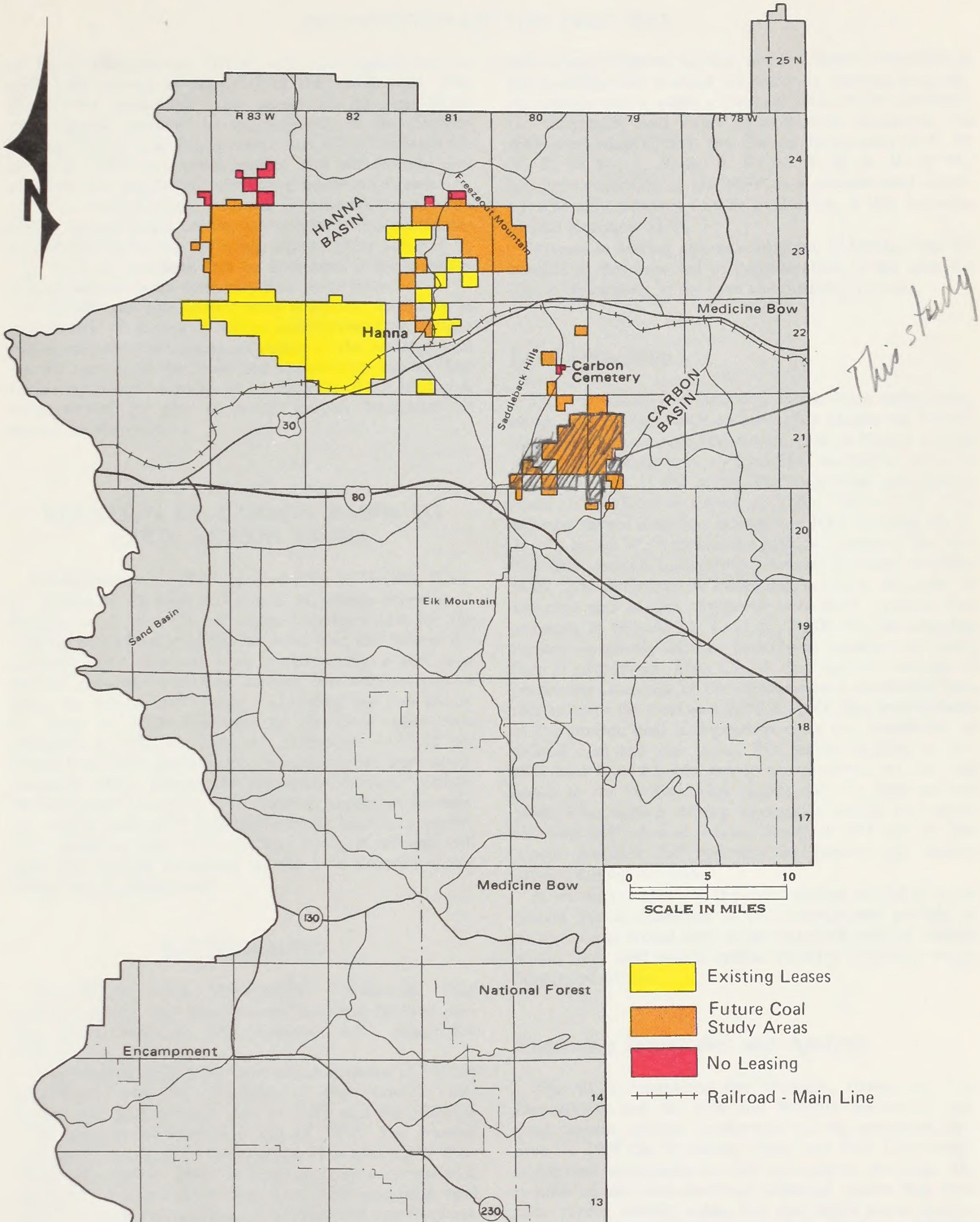
APPROXIMATE COAL RESERVES AND ANALYSIS DATA
FOR COAL GROUPS IN CARBON BASIN PROJECT AREA

Item	Coal Group		
	Johnson	Blue	Finch
Coal Thickness*, Feet (Maximum)	32	5	13
Coal Reserves, Million Tons	250	30	120
Moisture, Percent	9.06-12.50	**	8.41
Ash, Percent	9.19-10.98	**	6.51
Volatile matter, Percent	37.86-39.39	**	43.83
Fixed Carbon, Percent	42.10-42.68	**	41.25
Sulfur, Percent	0.57- 0.60	**	0.52
BTU/lb.	10,980-11,280	**	11,680

* Coal reserves are estimated from data presently available. Future drilling may provide information significantly altering the quantities presented.

** Analysis not available for the Blue group.

Source: Nuclear Resources, Carbon Basin Mine Report.



Map CA 1-2
COAL LEASING

SOURCE: BLM, 1978

of Land Management (BLM) and Geological Survey (GS) will concur in approval of the M&R plan. The plan, when submitted, must satisfy all the regulations promulgated pursuant to requirements of the Surface Mining Control and Reclamation Act of 1977 (SMCRA); all lease conditions, requirements, and stipulations; and all applicable regulations developed under state laws.

Of the federal lands included in lease application W-50061, certain lands are being excluded from consideration of leasing for the following reasons (Map CA1-1):

1. Lack of complete data to determine if the quantity of coal present is economically feasible to mine.

2. Insufficient data to determine economic feasibility or practicality of extending either underground or surface mining beyond the boundaries shown in the underground mining section of the mine and reclamation report. The remaining federal acreage to be considered for leasing is encompassed by the proposed project boundary as shown on Map CA1-1.

RELATION OF CARBON BASIN TO CIVIL ACTION 75-1749

On September 27, 1977, in Civil Action 75-1749, Natural Resources Defense Council et al. versus Rayston C. Hughes et al., the United States District Court for the District of Columbia issued an order that the federal defendants were enjoined from implementing a new coal leasing program including calling for nominations of tracts for federal coal leasing and issuing any coal leases. On June 14, 1978, the order of this civil action was amended as follows: "Federal defendents are not enjoined from fully processing competitive coal lease application W-50061, Edison Development Company" Edison Development Company is the leading candidate for leasing, and as such their proposal is being used as a model. The leasing of coal in the Carbon Basin, if offered, will meet the criteria contained in the U.S. District Court Order and its amendment.

BACKGROUND

The Hanna Area Management Framework Plan (MFP) contains land management decisions for that portion of the Medicine Bow Resource Area which lies within Carbon County.

The planning within this unit was completed in 1977 in accordance with the standards of the Federal Land Policy and Management Act of 1975 and the Federal Coal Leasing Amendments Act of 1975. The present land use in the Carbon Basin primarily is grazing by livestock and wildlife. There is some secondary recreational use, most of which is hunting. The MFP long-term land use decision is for continuing management for livestock grazing, wildlife use, and recreation. Any post-mining land use on public lands within the proposed lease area would be required to meet these management objectives. The MFP multiple use objective for coal is to allow continued identification, leasing, and development for coal in the planning unit to assist the nation in meeting its growing energy needs while providing adequate environmental safeguards and strict rehabilitation standards. As shown on Map CA1-2, the Carbon Basin tract in T. 21 N., R. 79 W., T. 20 N., R. 80 W., T. 21 N., R. 80 W., has been identified in the MFP as a possible coal development area pending further evaluation in this environmental statement (ES).

Interest in leasing and development of known coal resources in this area led to consideration of the area for coal development in the land use planning process.

Land Ownership

The remaining land included in the lease application, along with private lands intermingled among the federal lands, includes an area that would make a logical mining unit. This mining unit, or "project area"(Map CA1-1), would contain 15,494 acres. The ownership distribution (coal and surface) is shown in Table CA1-2. The total acreage shown does not include the NE¼, Section 28, T. 21 N., R. 80 W., because the private owner of the surface and minerals has reserved the acreage from development. The difference in ownership is due to diversity of minerals and surface rights on individual sections. For example, in Section 22, T. 21 N., R. 80 W., the state has surface ownership and the underlying minerals are under federal ownership. Map CA1-1 displays this overlap of ownership. Because of the checkerboard ownership pattern of both the coal and surface lands, the development of the private coal is dependent upon the availability of federal coal and vise versa. The surface mining on private land would occur due to the proximity of the coal seams to the surface. This occurs only on these private lands. The surface mining operations would also allow for recovery of coal whose depth of 170 feet or less would preclude full recovery by present day underground mining methods.

A secondary effect of the surface mine would be to facilitate the development of the underground portals, as no new areas would have to be disturbed and the surface mined high wall would suffice as entry locations to underground seams.

Preleasing Inventories and Analysis

The BLM contracted the Wyoming Game and Fish Department and the Fish and Wildlife Service to conduct various wildlife inventories on the proposed lease area. In 1974 the Wyoming Game and Fish Department conducted inventories on and adjacent to the area. The wildlife inventories identified whitetail prairie dog colonies, raptor nesting areas, big and small game species, birds, and nongame mammals. The Fish and Wildlife Service conducted a comprehensive search for black-footed ferrets on the project area in August 1978, covering an estimated 2,744 acres of prairie dog colonies.

Table CA1-2

SURFACE AND COAL OWNERSHIP WITHIN PROJECT AREA

	Surface Acres	Coal Acres	Excluded Coal Acres
Federal*	5,626	6,146	1,000
State	640	0	0
Private	9,228	8,348	0
Total	15,494	14,494	1,000

Source: BLM 1978

* Federal denotes public lands in relation to surface acres and Federal coal in relation to coal acres.

A search by Fish and Wildlife Service and BLM biologists located 15 golden eagle nests on and adjacent to the area, 3 of which were active in the spring of 1978. On May 15, 1978, a letter was written to the Fish and Wildlife Service to initiate formal consultation concerning these nests.

The BLM contracted an Order III soil survey that was conducted on the area by the Soil Conservation Service. An Order II survey has been conducted by Edison Development Company on Sections 1, 29, 31, and 35. Edison Development Company has also provided an analysis of the overburden material made for physical and chemical properties.

A cultural inventory has been conducted on approximately 19% of the Carbon Basin project area. The State Historic Preservation Officer (SHPO) was consulted concerning any National Register sites within the project area. Compliance with Section 106 of the National Historic Preservation Act of 1966 will be completed for all sites listed on the National Register or determined by the SHPO and the Keeper of the National Register of Historic Places to be eligible for inclusion in the National Register prior to approval of any operation.

Specific inventories were conducted by VTN Colorado, Inc. under the direction of Commonwealth Edison, in consultation with the BLM and the Wyoming Game and Fish Department, on threatened or endangered plants and animals and on raptor nesting sites and with the SHPO on archeological sites, historical sites, and paleontological locations.

Presently, the BLM is investigating the lands on and adjacent to the area to determine unsuitability coal development. All coal unsuitability criteria have been reviewed; those that are applicable to this proposed action are as follows: Rights-of-way and easements; historic lands and sites; federally listed endangered species; bald and golden eagle nests; falcon cliff nesting sites; migratory birds; state resident fish and wildlife; prime farmlands; alluvial valley floors; and reclaimability. Applicable unsuitability criteria are discussed in Chapters 1, 2, 3 or 4.

The following constraints and restrictions applicable to coal development in Carbon Basin are included in the Hanna MFP:

1. The Carbon Cemetary (120 acres tract) will be excluded from leasing (see Figure CA1-2 for general location).

2. Any projects considered for development in wildlife winter ranges will be designed to minimize impacts and to benefit the wildlife species involved.

3. The critical antelope winter habitat will be managed to support the existing antelope population in the planning unit.

4. Mineral leasing stipulations will include restoration of disturbed wildlife habitat.

5. Nesting and hunting habitats for all raptors that are identified through surveys will be maintained and protected.

6. All multiple use activities within critical wildlife habitat (including that of endangered species) will be evaluated and regulated to protect that habitat.

7. All livestock grazing will be removed from the mine project area of Carbon Basin.

RELATION OF CARBON BASIN TO SOUTHCENTRAL ES

The possible development of coal in the Carbon Basin area is recognized in the Environmental Statement, Development of Coal Resources in Southcentral Wyoming and is included in the regional assessment section as part of the Hanna area of interest (Southcentral ES, Regional, Chapter 8, High Level Development). The Hanna area of interest, which includes Carbon Basin, is shown on Southcentral ES, Regional, Map 1, Surface Ownership and Coal Action Areas. The analysis of the impacts resulting from development of all the areas of interest of which Carbon Basin is a part is included in the high level scenario (Southcentral ES, Regional, Chapter 8).

The Southcentral ES includes in its regional proposed action the coal mines now in operation and the three proposed coal mines on existing federal coal leases. The magnitude of developments in the Carbon Basin ES is in addition to the existing and proposed developments presented in Southcentral ES, Chapter 1.

AUTHORIZING ACTIONS

This section identifies governmental authorizations which would be required to fully implement the proposal.

Federal

Bureau of Land Management (BLM)

The BLM, in consultation with the Geologic Survey (GS) and Office of Surface Mining (OSM), may issue the leases for federal coal for the Department of the Interior. The BLM will develop special requirements for management and protection of all resources other than coal and for the post-mining use of the affected lands. These special requirements will be included in the federal coal leases and reclamation plans.

BLM will also be responsible for granting various rights-of-ways for ancillary facilities.

Office of Surface Mining (OSM)

OSM, with the concurrence of the Wyoming Department of Environmental Quality (DEQ), BLM and GS, has the authority to approve the mining and permit applications which include the mining and reclamation plan.

Geological Survey

GS is responsible for development, production, and maximum economic coal resource recovery requirements included in the mining permit.

State

Wyoming Department of Environmental Quality (DEQ)

DEQ and OSM will jointly review for compliance the mining and reclamation plans and permits that are authorized under a federal coal lease.

The Land Quality Division will issue a permit and license to mine after approval of a mining and reclamation plan.

Air Quality Division will review all applications for air contaminate data, controls and monitoring. The Air Quality Division will issue permits to construct and operate facilities that could affect air quality.

The Water Quality Division would issue permits to construct waste water systems; they would also issue National Pollutant Discharge Elimination System (NPDES) permits for discharging waste water.

The Solid Waste Division would issue construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation.

The cooperative agreement between the state of Wyoming and the Department of Interior concerning cooperative proposed regulation of surface coal mining and reclamation operation on federal lands within the state of Wyoming was signed on October 26, 1978. The purpose of the agreement is to prevent duality of administration and enforcement of mining and reclamation requirements by providing for state regulation on surface coal mining and reclamation operations on federal lands within the state.

Wyoming State Engineer

Any storage, impoundment, or use of surface or groundwater for mining and coal processing operations would require a permit from the State Engineer.

County

The Carbon County government would review and approve the site plan submitted by the applicant and issue building permits for mining structures.

MINE AND RECLAMATION DESCRIPTION

Typical Operation of Surface Facilities

The preliminary mine and reclamation reports propose the development of both a surface and underground mine for the annual production of 5 million tons of coal. The surface mine is designed to recover approximately 10 million tons of coal located on private lands. This coal lies within 150 feet of the surface, and most coal is not recoverable by underground mining methods. The underground mine would be developed concurrently with the surface mine and would permit recovery of federal and private coal (up to 400 million tons) lying 150 to 900 feet below the surface. Three portals would be constructed to serve the main underground mine operation. An underground training mine is proposed to be worked in Section 1, T. 20 N., R. 80 W. Proposed mine and ancillary facilities would serve both the surface and underground mining operations.

Mine Facilities

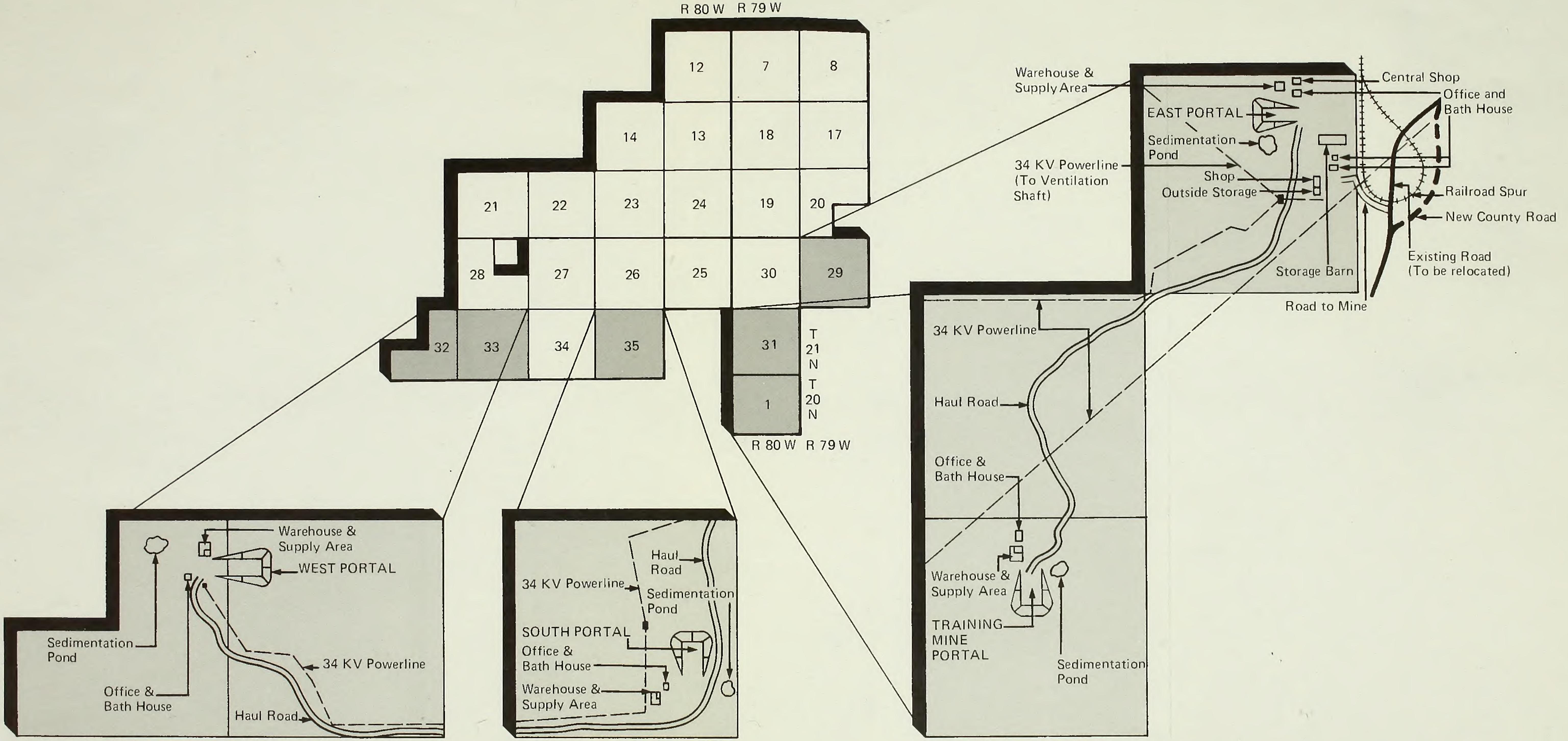
The proposed mine facilities would be primarily for development of the underground mines but would also serve the needs of the surface operations. These facilities would be located on private lands as shown on Figure CA1-3. They are divided into four individual groups: the main mine facilities and east portal would be located in Section 29, T. 21 N., R. 79 W.; the surface mine facilities and south portal would be located in Section 35, T. 21 N., R. 80 W.; the surface mine facilities and training mine would be located in Section 1, T. 20 N., R. 79 W.; and the west portal would be located in Section 32, T. 21 N., R. 80 W.

A ventilation shaft is located on private land in Section 13, T. 21 N., R. 80 W. The construction of this shaft would disturb approximately 10 acres of land. Access to the shaft area would be by existing secondary roads from the east portal, a distance of approximately 5 miles. A security fence with a locked gate would surround the shaft site.

Electrical power would be provided by Carbon Power and Light, Incorporated, from the 34.5-kv transmission line which crosses the property. The main substation would be located near the main office. Portable substations would be located throughout the project area to serve the three portals of the main mine, the training mine portal, the ventilation shaft facilities, and the surface mining operations. Approximately 12 miles of line would be constructed; 10 miles would serve underground mining facilities and would remain for the life of the mine. Two miles of line would serve surface mining operations and would be removed upon completion of mining. All mine-related power lines would be constructed in accordance with standards established in the U.S. Department of Agriculture bulletin, REA 61-10, to reduce accidental electrocution of raptors.

Ancillary Facilities

A 13-mile railroad spur requiring a right-of-way (application W-57224) would be constructed by the Union Pacific Railroad Company. The spur would begin at the



SOURCE: BLM, 1978

Figure CA1-3
SURFACE AND UNDERGROUND FACILITY LOCATIONS

Union Pacific track in Section 15, T. 22 N., R. 78 W., and terminate in a loop track in Section 28, T. 21 N., R. 79 W., 6th P.M. (see Map CA1-3). The spur would disturb 485 acres: 258 acres of public and 227 acres of state and private land. A short-wave radio base station would be constructed at the office building to facilitate communication in and around the mining area. The proposed telephone line would extend from Elk Mountain to the east portal site for a distance of approximately 8 miles. As no right-of-way application is on file, the exact location of the line has not been determined, but it is estimated that approximately 10 acres (5 acres public, 5 acres private) would be disturbed.

Access Roads

A short section of access road would be constructed from the county road (Carbon County 402) along the east side. The access road would be constructed along natural land surfaces where possible, avoiding unnecessary cuts and fills. Ditches and culverts would be used to control surface runoff. In accordance with the coal unsuitability criteria on rights-of-way and easements, the relocation of this portion of County Road 402 is acceptable. To secure the general plant and facilities area, fencing or a security station would be provided. The access road would occupy 2 acres of public land and no private land.

A portion of County Road 402 would have to be relocated to avoid the planned route of the railroad spur (Map CA1-3). The relocation of the road would disturb approximately 9 acres of public land. As the exact location of the proposed county road has not been determined, no right-of-way application is on file.

Table CA1-3 depicts a summation of the proposed ancillary facilities for the Carbon Basin Mine.

Surface Mining and Reclamation Operations

The typical operation description for the Carbon Basin project is confined to the areas shown on Figure CA1-4. The ownership of these areas is private surface and private minerals.

Topsoil Removal and Disposition

Topsoil would be removed in advance of the stripping operations and prior to the construction of waste dumps (see Figure CA1-4). The A, B, and C horizons of soils, designated as suitable, would be stripped and stockpiled. Topsoil stripping would be an ongoing process throughout the mine life. Topsoil stockpiles would be temporary and would be seeded with quick-growing grasses to control erosion.

Watercourse Diversions

All runoff water would be diverted above disturbed areas and returned to natural waterways below the mine. The reclamation program would reestablish the natural waterways as much as possible. Erosion in disturbed areas would be controlled prior to reestablishment of vegetation by building water bars (berms to impede the flow of water across an erodible surface). Any runoff from reclaimed mine areas which would not drain into the mine would be collected in settling ponds. Within the mine, itself, groundwater, rain, and snowmelt would be collected at a low point and pumped to settling ponds. These ponds would be located as required by mining and reclaimed when no longer needed. Some of the water collected in the settling ponds might be used for dust control on haul and service roads and in working areas as needed to maintain air quality. If, in practice, it was found to be impossible or impractical to prevent discharges, applicable permits would be obtained, and the water would be monitored and treated before being released and monitored after being released.

Temporary diversion ditches would be built. The bottoms would be seeded with approved grasses where appropriate. Culverts or bridges would be installed where necessary. In no case would diversion ditches discharge directly upon topsoil storage areas, spoil piles, or other unconsolidated material. Surface water diversions will meet all state and federal standards.

Overburden Removal and Disposition

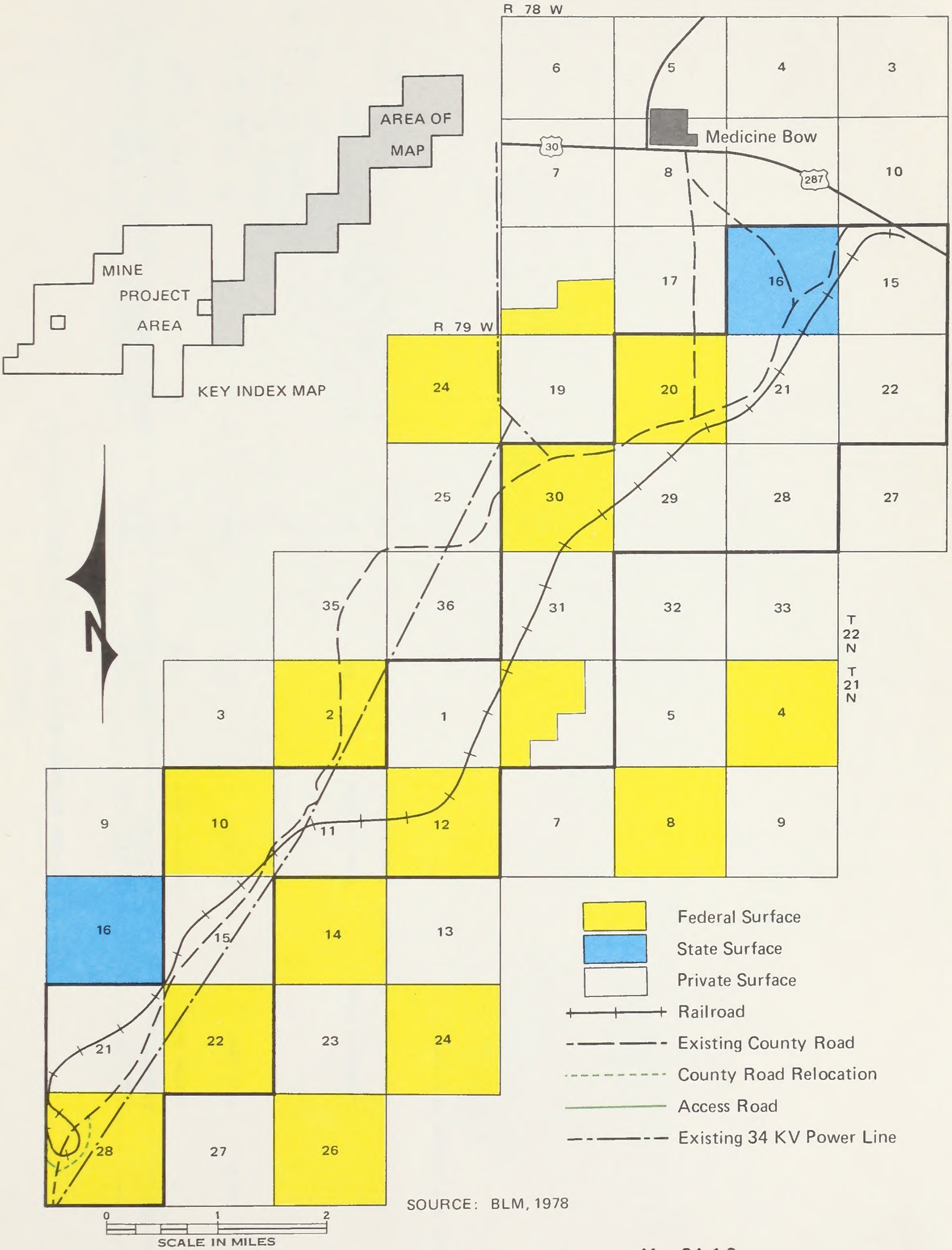
After topsoil material (A, B, C horizons) were removed and stock-piled together, overburden would be drilled and blasted. The broken material would be loaded by electric shovels onto rear-dump trucks for haulage to either disposal dumps or pit backfilling areas located behind the advancing coal face. Overburden disposal sites would be designed to meet state and federal standards. Those portions of the overburden having suitable characteristics for soil development and plant growing capabilties would be saved.

Coal Removal

Exposed coal would be drilled and blasted. Broken coal would be loaded by front-end loaders onto trucks for haulage to the coal handling and load-out facilities located at the proposed rail spur on the eastern side of the property. Coal production from the surface mine would total 10 million tons. Production rate would be approximately 1.0 million tons per year for 10 years. Surface disturbance would occur at the rate of approximately 140 acres a year while reclamation would be initiated at a rate of approximately 120 acres per year. Some areas disturbed by surface mining would be reshaped and utilized as mine facility sites.

Backfilling and Grading of Overburden

Overburden removed during initial surface mining would be dumped east and southeast of pit I (Figure CA1-4). Other overburden would be dumped into a small waste dump south of the outcrop line. As soon as



Map CA 1-3
GENERAL ACCESS AND UTILITIES

Table CA 1-3

PROPOSED ANCILLARY FACILITIES FOR THE CARBON BASIN MINE

Applicant	Proposed Facility	Application Number	Total Length (miles)	Width (feet)	Acres Required Public	Acres Required Private or State	Location of Public Land Affected
	Access Road	None to Date	.19	66	1.5	0	Section 28, T.21N., R.79W.
Union Pacific	Rail Spur	W-57224	13.4	200	97	226	Section 20, 30, T.22N., R.78W. Section 6, T.21N., R.78W. Section 10, 12, 22, 28, T.21N., R.79W.
	Telephone Line	None to Date	8*	10	5*	5*	Undetermined
	County Road (Relocation)	None to Date	.74	100	9	0	Section 28, T.21N., R.79W.

* Length and acreage estimated

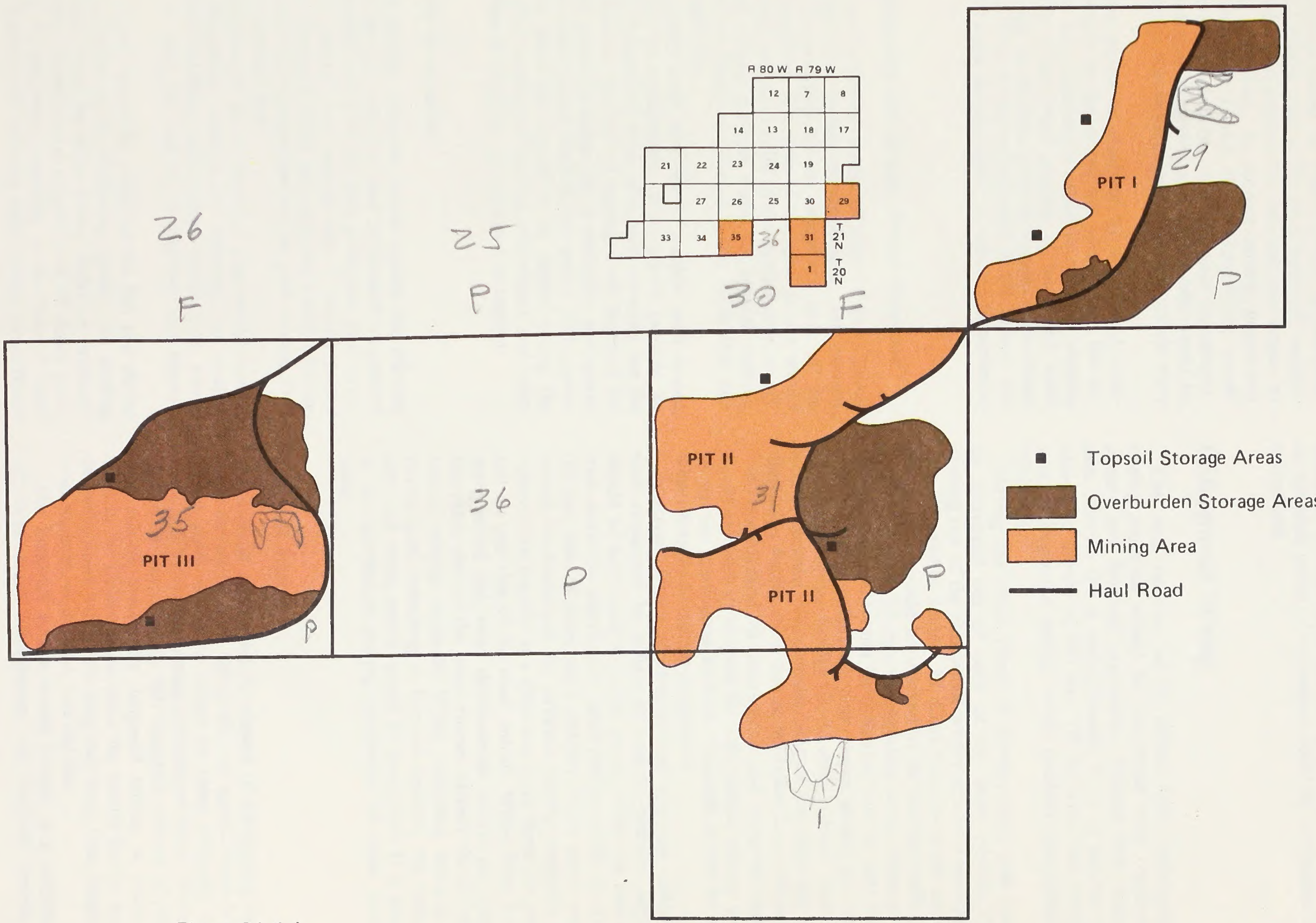


Figure CA 1-4
SURFACE MINING AND OVERBURDEN AND TOPSOIL STORAGE LOCATIONS

sufficient room were available, backfilling of the mined out area would commence.

Since the access portal for mine I would be located in the exposed Johnson seam in the pit I highwall, backfilling is scheduled and planned for minimal interference to underground operations. As surface mining progressed southward into pits I and II, pit backfilling would follow, generally conforming to the original topography. At the completion of surface mining, the pits would be backfilled except where underground access portals were located.

Overburden would be removed by shovel and transported by trucks to the mined out area behind the advancing coal face. Bulldozers would be used for shaping the backfilled areas. Final grading of backfilled areas would be done by graders prior to topsoil replacement and seeding. Prior to the replacement of the topsoil, the slopes of the waste dumps would be reduced to minimize erosion.

Topsoil Replacement and Erosion Control Measures

Because of the sloping nature of some of the Carbon Basin project area, surface manipulations that prevent runoff would probably be an important part of the seedbed preparation. The tops of the spoil dumps would be manipulated to form swales to divert excessive runoff. Graded and shaped surfaces ready for topsoil replacement would be disced to enhance water infiltration and reduce compaction.

Approximately 2,049 acre feet of suitable soils would be available for reclamation. This would provide an average of 12 inches or more of topsoil covering for the reclaimed areas at the end of mining. Soils required for revegetation would be taken out of stockpiles and spread over graded and shaped areas in the spring. This procedure would allow the topsoil to lie fallow during the summer before seeding in the fall. Fertilizers and other soil amendments would be incorporated as needed.

Planting and Revegetation

The coal mining operation would restore the affected lands to a diverse, effective, and permanent vegetative cover of species native to the area or species that would support the planned post mining use. A mining permit will not be approved unless the applicant's mine plan has demonstrated that reclamation to the post mining land use can be accomplished.

Implementation of the reclamation plan would include seedbed preparation, seeding and planting, and evaluation. Topsoil handling and seedbed preparation would conform to state and federal regulations and requirements.

Grass mixture would be seeded in the fall, and shrubs would be planted for the following spring. All seeding and planting would be done during times of favorable soil moisture. Supplemental irrigation of all shrub plantings would be required, especially at the time of initial planting. Seeding and planting rates would be sufficient to assure establishment and selfgeneration of the desired vegetation. The revegetated lands would be fenced to eliminate grazing by range animals and pronghorn until an adequate cover of vegetation could be established and maintained.

Underground Mining

The coal reserves to be mined with underground mining methods would be recovered with continuous miners and longwall equipment. Present data indicate coal reserves dip at approximately 11 to 16 degrees and extend to depths of 900 feet. Of the total coal production, underground mining would produce approximately 95%-98%.

During the initial phase of development, coal would be conveyed out of each of the three portals. Coal coming out of the east portal would go into a storage facility located in Section 29. Coal from the south and the west portals would be trucked to the storage facility located in Section 29. After completion of the initial development, all coal would be conveyed out the east portal into the storage facility. Unit trains would be loaded from the storage facility. A 13-mile railroad spur and loop is planned. This would connect the mine site with the Union Pacific main line at Medicine Bow, Wyoming.

A combination of continuous and longwall mining would be used to recover the coal. Initial mining would be by the continuous method, longwall would be used where feasible as mining progressed.

A series of parallel underground openings called entries (separated by pillars of coal to provide support) would be developed from the portal. After the main entries were first developed, panel entries would be driven off one side of these main entries. These panel entries would be developed by advance mining methods in a consecutive manner in a direction away from the portals and on one side of the main entries. When these portals were mined out, mine development would progress on the other side of the main entries toward the portal by retreat mining methods. While retreating towards the portal, coal remaining in barriers between the main entries and room panels would be recovered. It is planned to use continuous mining equipment for mine development.

Longwall Mining

Longwall mining would consist of developing one or more entries or gates 500 to 600 feet apart. Pillars left between gates would be mined by using longwall equipment and by retreat mining procedures. Most of the coal would be recovered by this longwall method of mining. The retreat system for longwall mining is commonly used in the United States since the entries do not have to be maintained behind the longwall face, thus simplifying roof support, ventilation, and the like.

The longwall system would consist of a combination of three basic components; the support system, the mining machine, and the haulage system. These components are shown in Figure CA1-5.

The support system would consist of interconnected hydraulic jacks with roof and floor bars, would be self advancing, and would be capable of advancing the face conveyor.

Two types of mining machines are used in this country— the planer and the shearer. It is probable that a planer would be used. The planer or plow would rest on the bottom and would be pulled along the face in front of the armored conveyor with a chain. Non-rotating bits would cut a thin layer of coal and deflect it onto the conveyor. Figure CA1-5 illustrates a coal planer.

The primary function of the face conveyor would be to haul coal; however, it would also be flexible to allow snaking the conveyor and would have sufficient strength to support the shearer which slide atop it. The longwall shearer would cut the coal from the face and discharge it onto the face conveyor which would discharge onto a stage loader to provide an even flow of coal onto the panel belt conveyor. At the head entry side of the face, the face conveyor would discharge onto an intermediate haul unit that would either piggyback or side dump onto a panel belt. Continuous miners would be used in all development work and in room and pillar sections in areas where faulting is known or suspected to occur and where long-wall mining is not applicable. A section would consist of a continuous miner, two shuttle cars, a roof bolter, and a rock duster. The continuous miners would cut the coal and simultaneously load it into a shuttle car. The shuttle cars would haul the coal to the belt line and dump it into a ratio feeder equipped with a breaker (Figure CA1-5).

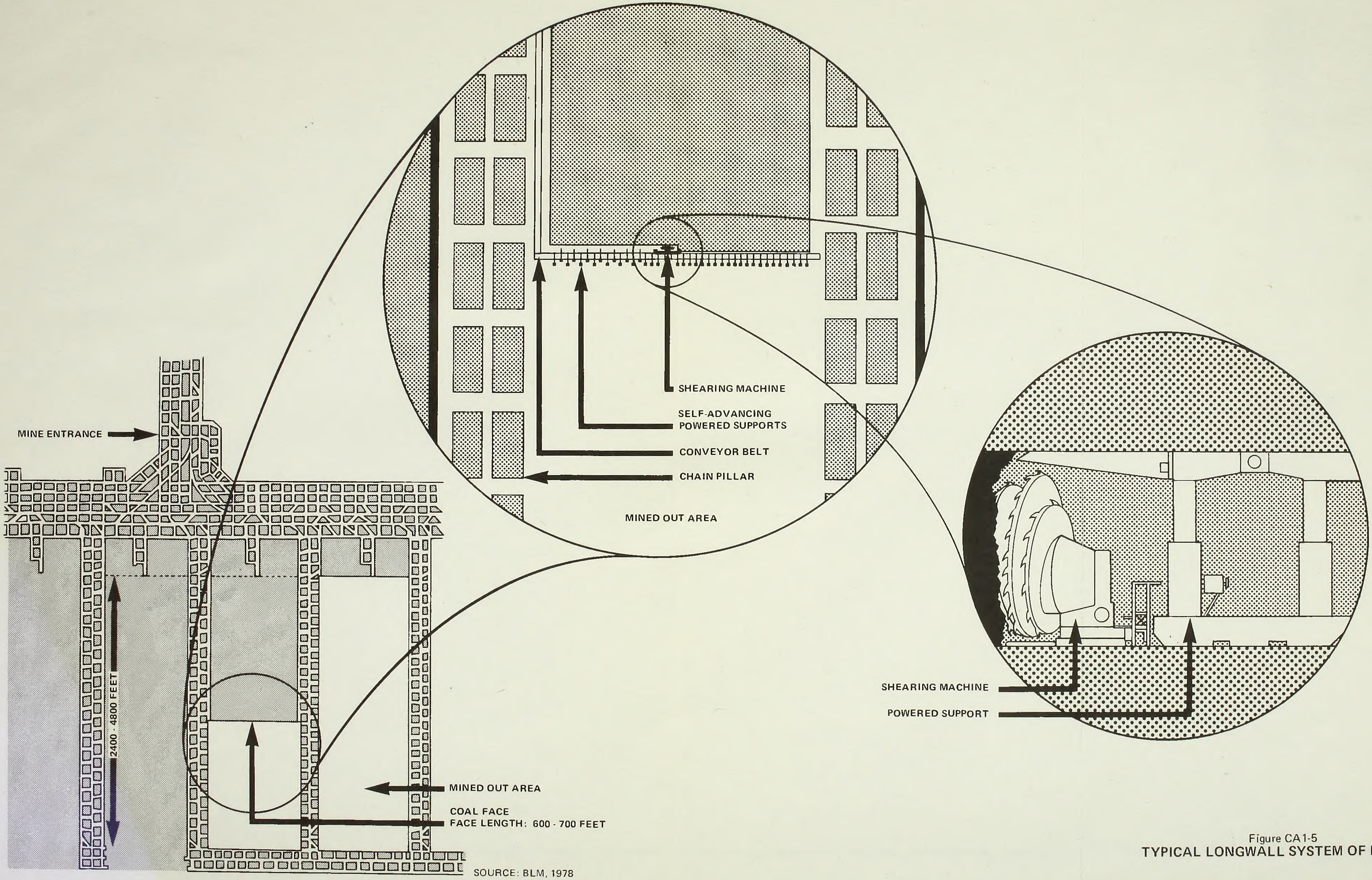
Subsidence

After coal extraction, the openings or mined-out panels would eventually close by gravitational forces. Convergence of the roof would gradually work towards the surface.

Predictable and planned subsidence is desirable since subsidence relieves stresses within the rock caused by coal removal. Overloading of underground structures are thus reduced, and a maximum recovery of the reserves is possible.

A baseline elevation survey of the project area would be performed before the mining operations would commence. Permanent survey stations would be established for the area and would be described in maps and aerial photographs with reference coordinates, elevations, and a geological summary. Engineering data, based on mine design and investigations on rock mechanics, would be used to predict and check the indications of the occurrence of subsidence. The data provided would be used to predict the magnitude and affects of subsidence and to prepare a reclamation plan for the affected areas.

The subsidence monitoring would consist of two major parts: setting up a rock mechanics study to evaluate the rock properties and establishing a grid system of fixed stations over the first areas to be mined. The stations would be located in reference to the underground mining operations. The location of the stations would be at given distances away from the underground workings and at given intervals over the underground workings. Such data as vertical and horizontal displacement of the surface stations, the depth of cover at each station, the mining height in the area, and the mine design in the area would be recorded. Measurements in this operating phase of the monitoring program would be made with conventional surveying equipment and would be periodically photographed by aerial methods.



SOURCE: BLM, 1978

Figure CA1-5
TYPICAL LONGWALL SYSTEM OF MINING

CHAPTER 2

DESCRIPTION OF THE EXISTING ENVIRONMENT

CLIMATE

The climate of southcentral Wyoming is characterized by dry air masses, which are modified Pacific air masses moving eastward over the Rocky Mountains. Westerly winds provide most of the precipitation. In the summer, most of the precipitation in the area is a result of thunderstorms.

The proposed Carbon Basin project area is located about 12 miles southeast of Hanna in Carbon County. Temperatures at the site average about 45°F annually. Temperatures of 89°F or above occur in July while January is the coldest month with frequent daily minimum temperatures of 0°F or below (Becker 1964). The average frost-free season (32°F or above) at the Carbon Basin Mine site is estimated to be 113 days (National Oceanic and Atmospheric Administration 1974). Annual precipitation is low, averaging about 10 inches per year, most of which is the result of spring and early summer thunderstorm activity, with March, April and May being the months when most precipitation occurs (Southcentral ES, Regional, Chapter 2, Table R2-3). The mean annual lake evaporation is estimated to be about 36 to 42 inches. Winds are generally out of the southwest and west for much of the year with an average speed of 11 miles per hour (Figure CA2-1). Stable atmospheric conditions prevail about 80% of the time because of the cold temperatures and moderately strong winds. In this area, surface-based inversions are very frequent despite the high average wind speeds. They occur in the mornings between 75% and 85% of the time annually; most frequently in summer, least frequently in spring. During afternoons, they are uncommon except in winter where they are observed about one-third of the time (Southcentral ES, Regional, Chapter 2, Climate).

AIR QUALITY

Particulate air quality in undeveloped areas of southcentral Wyoming ranges from 19 to 31 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean as recorded at five state and privately operated particulate sampling sites. The mean concentration at the five samplers is 25 $\mu g/m^3$ and the median is 24 $\mu g/m^3$.

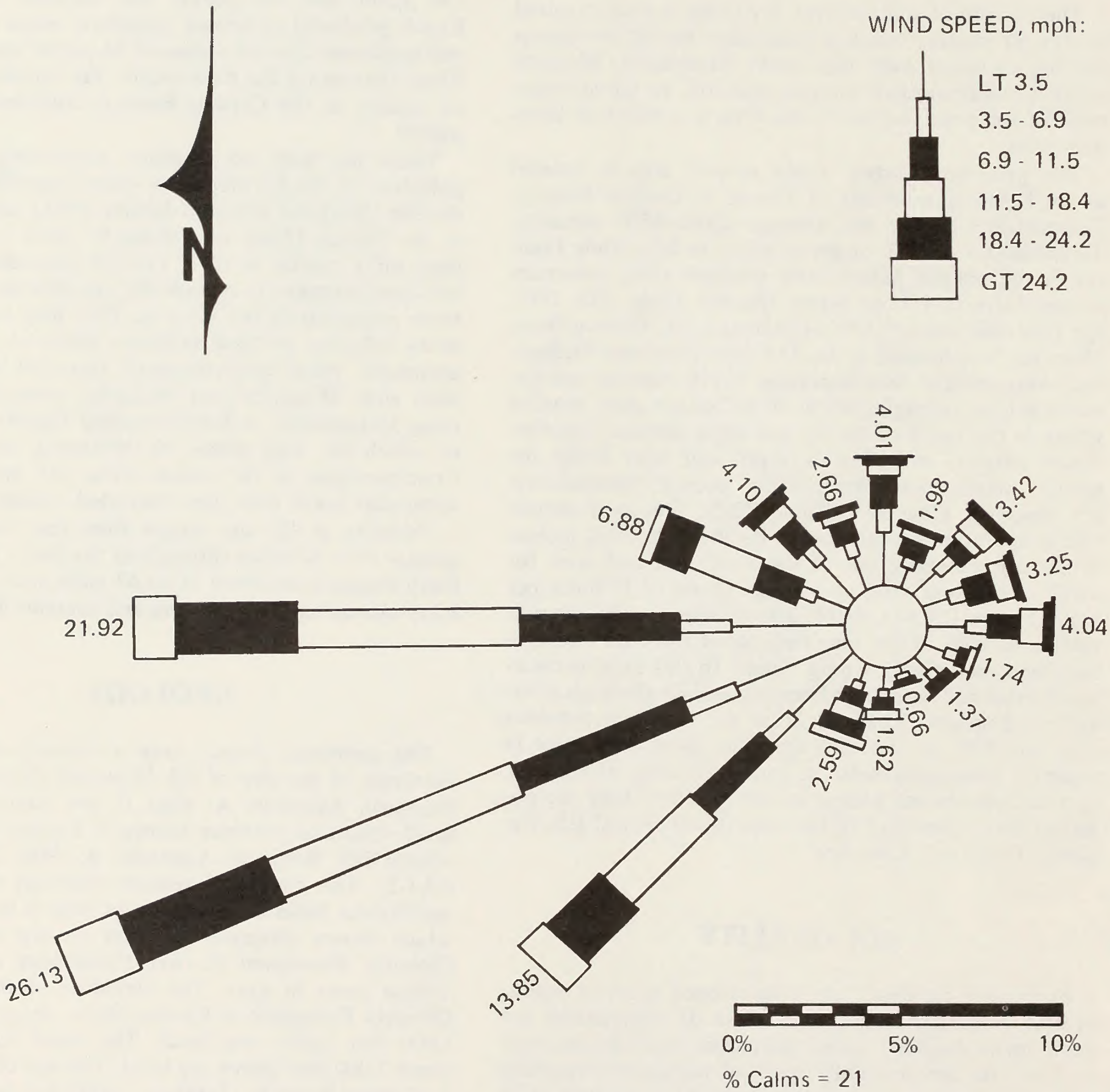
Two samplers were operated by Rocky Mountain Energy in Carbon County from January through December of 1977. These samplers were located at the Adams Ranch (27 miles south of Creston Junction) and at the Curry Ranch (1 mile northwest of Medicine Bow). The sampler at the Adams Ranch recorded an annual geometric mean of 31 $\mu g/m^3$ and maximum 24-hour values of 136 $\mu g/m^3$ and 106 $\mu g/m^3$. The sampler at the Curry Ranch produced an annual geometric mean of 30 $\mu g/m^3$ and maximum 24-hour values of 86 $\mu g/m^3$ and 71 $\mu g/m^3$. These data being the most recent, the existing particulate air quality at the Carbon Basin is considered to be 31 $\mu g/m^3$.

There has been no intensive monitoring of gaseous pollutants in the ES area. The nearest sampling for sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) was conducted at the Patrick Draw site (about 67 miles west of Rawlins), for 3 months in 1976. Though these data are not of sufficient duration to specifically quantify the presence of these pollutants in the ES area, they may be interpreted as an indicator of these pollutant levels at the site. The arithmetic mean concentrations recorded for SO_2 and NO_2 were 26 $\mu g/m^3$ and 19 $\mu g/m^3$ respectively (Wyoming Department of Environmental Quality 1977), both of which are well below the Wyoming State standard. Concentrations at the remote mine site are most likely somewhat lower than these recorded concentrations.

Visibility at the site ranges from less than 1 mile to greater than 60 miles throughout the year. Average visibility ranges from about 26 to 47 miles with greatest visibility occurring during spring and summer months.

GEOLOGY

The proposed project area is located about 6 miles northeast of the city of Elk Mountain (Southcentral ES, Regional, Appendix A, Map 1) and covers much of a small structural province known as Carbon Basin (Southcentral ES, Regional Appendix A, Map 4 and Figure CA1-2). The structural relation between Carbon Basin and Hanna Basin is illustrated on Map 4 in Appendix A which shows elevation contours on top of the buried Cloverly Formation (Lower Cretaceous or about 120 million years in age). The elevation of the top of the Cloverly Formation in Carbon Basin varies from 4,000 to 7,000 feet below sea level. The basin land surface is about 7,000 feet above sea level. The top of the Cloverly in Carbon Basin is 11,000 to 14,000 feet below the surface, and in the form of a small basin between the Simpson Ridge and the Big Medicine Bow anticline. Thus, 14,000 feet of post-Lower Cretaceous strata overlie the Cloverly Formation in Carbon Basin, the uppermost of which is the Hanna Formation which crops out over most of the proposed mining area. The Hanna Formation



SOURCE: NATIONAL CLIMATIC CENTER, STAR PROGRAM FOR SELECTED U. S. CITIES, 1968. (RAWLINS, WYOMING)

Figure CA2-1
ANNUAL WIND ROSE FOR RAWLINS

is composed of conglomerates, sandstones, claystones, shales, and many coal seams. The coal seams dip toward the center similar to the surface of the Cloverly Formation and are not interrupted by faulting to the extent that exists in the Hanna Basin.

On some private company geologic maps such as one of Carbon Basin released by Intrasearch (1976), the project area is mapped as the Dutton Creek Formation as opposed to the Hanna FormationAppendix AMap 4. The Dutton Creek Formation was named by Hyden and others (1965) to describe a 200-foot thick section of coarse conglomerates 12 miles southwest of Carbon Basin.

The section is now regarded as part of the Hanna Formation, and the name Dutton Creek Formation was abandoned by the Geological Survey in 1969 (Gill et al. 1970).

Coal

Coal reserves in the Carbon Basin are predominantly contained in the Hanna Formation of Paleocene-Eocene Age. Approximately 30 coal horizons have been identified. Of these seams, three groups may have commercial potential and are described below.

Johnson Bed

The lower most bed in the Hanna Formation is the Johnson, which has a maximum thickness of 32 feet near the center of the project area. Along the western edge, the Johnson seam averages 22 feet in thickness and thins westward to 14 feet in thickness. The Johnson thins locally to 8 feet in thickness and increases to 10 to 14 feet in thickness along the eastern edge. The Johnson Bed appears to be a single, continuous bed of coal over most of the area, but small splits may occur locally near the top and base of the seam. Inplace reserves in the Johnson Bed—measured and inferred—are estimated by the company to be approximately 220 million tons. The Johnson Bed is classified as subbituminous A and B.

Blue Group

The Blue Group is identified as a coal zone overlying the Johnson Bed. Locally, the Blue Group contains seams in excess of five feet in thickness in the central, eastern and southeastern parts of the area.

Finch Group

The Finch Group is subdivided into upper and lower subgroups which overlay the Blue Group. Maximum thicknesses are developed in the western and central portions of the project area. Locally, the Finch Group consists of seams in excess of 13 feet in thickness.

Other Mineral Resources

Sand and Gravel

Reserves of sand and gravel suitable for concrete aggregate are unknown. There is a small deposit in the northeast corner of the project which is located on both federal and private lands. There are also numerous deposits along the Medicine Bow River south of the project area which could be utilized.

Scoria

Scoria (clinker) deposits for road construction have not been identified in or near the proj ect area.

Paleontology

A preliminary survey of outcrops of the Hanna Formation within the project area was conducted by McGrew (1976). A general summary of the principal fossiliferous formations, ages, number of known fossil localities, and general fossil types in the proposed project area is presented in Table CA2-1.

TOPOGRAPHY

The average elevation of the proposed project area is about 7,200 feet above sea level and the local relief is about 400 feet. The local relief consists of a northeast trending ridge that has been dissected by the Second Sand and Third Sand Creeks which drain the area to the east. These creeks are tributaries of the Medicine Bow River (Southcentral ES, Regional, Appendix A, Map 1). There is no relation between the surface topography and the geologic structure of Carbon Basin.

SOILS

Soil data for the Carbon Basin project area were taken from an Order III soil survey report (Map CA2-1) done by the Soil Conservation Service (SCS) for the Bureau of Land Management in the summer of 1977 (USDA, SCS 1978). Additional data over Sections 1, 29, 31, and 35 were correlated from the survey done by VTN Colorado Inc. in the fall of 1977 (VTN 1978). The soils information by VTN over Sections 35, 1, 31, and 29 is an Order II survey and its map (Map CA2-2) and soil associations were used for calculations of disturbance and available topsoil material for reclamation of surface mining. The soil survey of the Carbon Basin project area conforms to the latest accepted practices of the National Cooperative Soil Survey Program using the new Soil Taxonomy, USDA, 1975. Mapping units are based upon soil types with similar properties. Separation is at family, association, complex, or series level. Additional units

Table CA 2-1

SUMMARY OF FOSSIL LOCALITIES IN THE AREA OF THE PROPOSED CARBON BASIN MINE

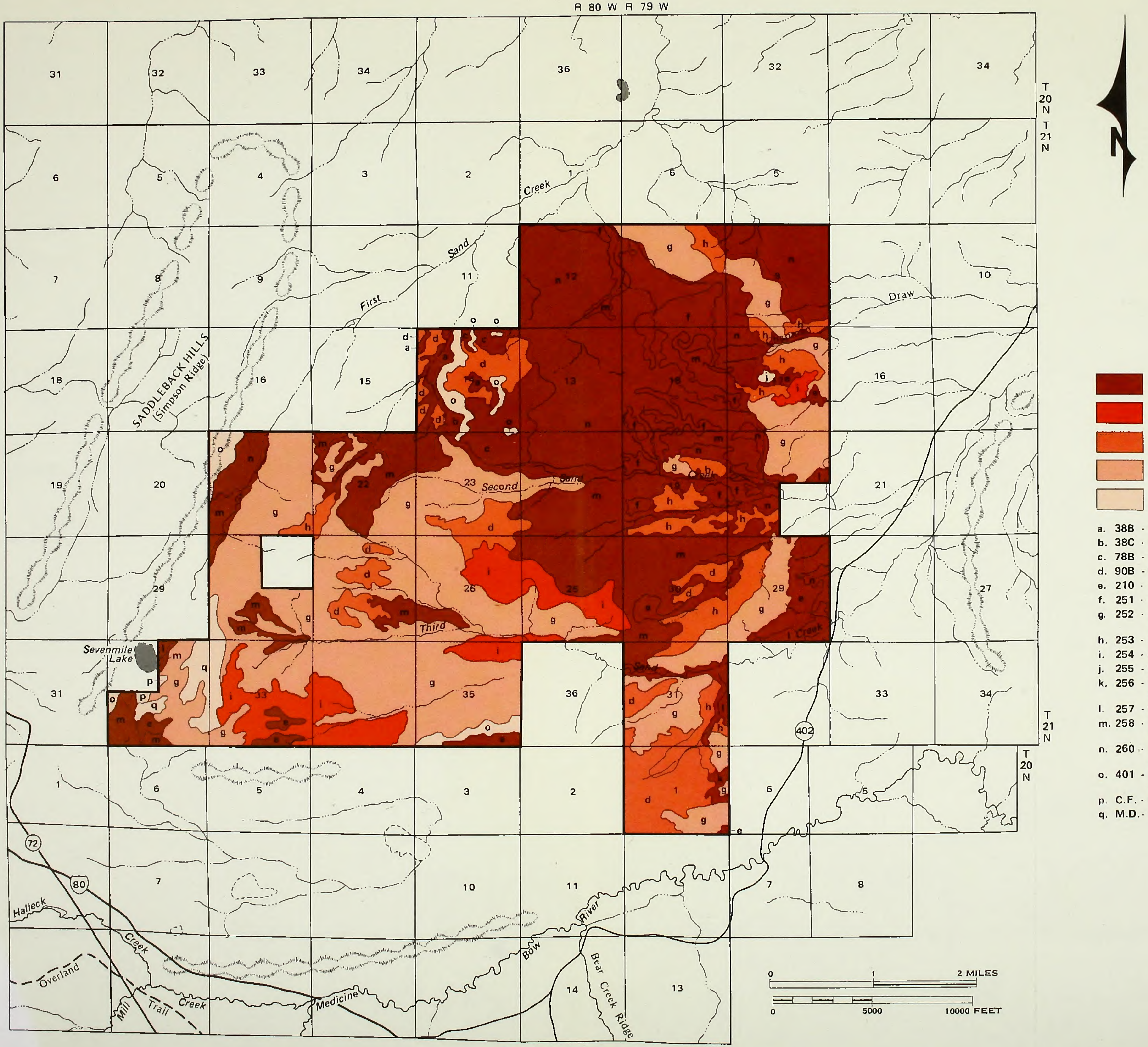
Formation	Period	Known Fossil Localities	Type of Fossils
Hanna	Upper Paleocene/ Lower Eocene	General	V, I, P
Lewis Shale	Upper Cretaceous	General	I

General = Formation contains fossils throughout; specific localities are not identified.

V = Vertebrate

I = Invertebrate

P = Paleobotanical

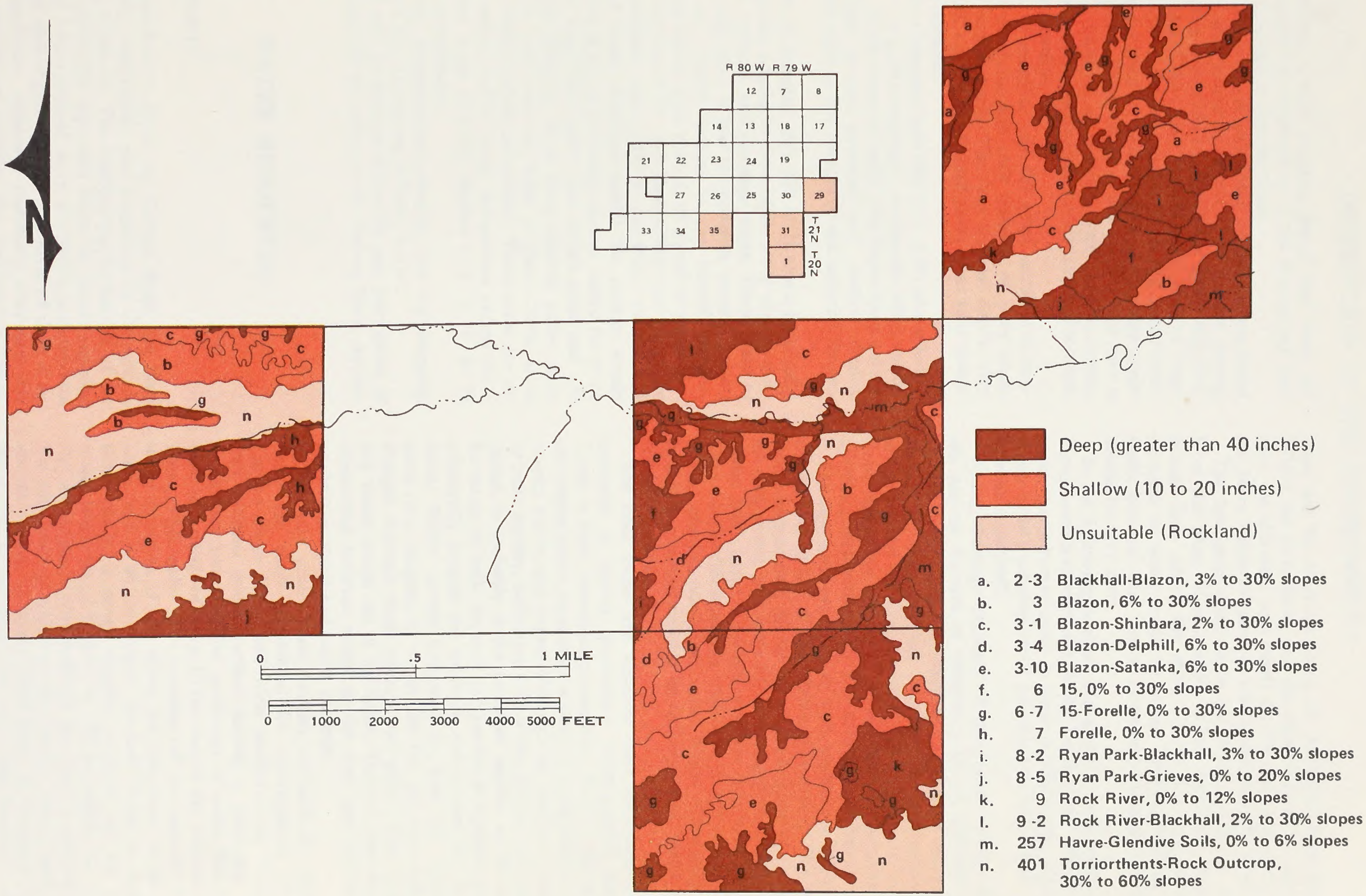


SOURCE: SCS, 1978; BLM, 1978

- Deep (greater than 40 inches)
- Moderately Deep (20 to 40 inches)
- Shallow (10 to 20 inches)
- Very Shallow (less than 10 inches)
- Unsuitable (Playa, Rockland, Disturbed Lands)

a. 38B - Rock River Sandy Loam, 2% to 6% slopes
b. 38C - Rock River Sandy Loam, 6% to 12% slopes
c. 78B - Ryan Park Sandy Loam, 2% to 6% slopes
d. 90B - Blazon Loam, 5% to 15% slopes
e. 210 - Ravalli-Forelle-15 Complex, 0% to 6% slopes
f. 251 - Grieves-Blackhall Association, 2% to 20% slopes
g. 252 - Shinbara-Blazon-Rock Outcrop Complex, 6% to 30% slopes
h. 253 - Blazon-Satanka Association, 2% to 15% slopes
i. 254 - Bullock-Blazon Complex, 0% to 6% slopes
j. 255 - Playa
k. 256 - McFadden-Rock River Complex, 0% to 20% slopes
l. 257 - Havre-Glendive Soils, 0% to 6% slopes
m. 258 - Rock River-Satanka Association, 0% to 12% slopes
n. 260 - Ryan Park-Rock River Association, 2% to 20% slopes
o. 401 - Torriorthents-Rock Outcrop Complex, 30% to 60% slopes
p. C.F. - Cut and Fill
q. M.D. - Mine Dump

Map CA 2-1
ORDER III SOILS MAP



SOURCE: USDA SCS, 1978; VTN, 1978; BLM, 1978

Map CA 2-2
ORDER II SOILS MAP

were not shown in each mapping unit if they were too small or complex to delineate or if the soil survey was not detailed enough to describe them.

Some of the principal soils found on the Carbon Basin project area that would be disturbed by surface mining are in mapping units 252 (3-1, 3-10); 401 (401); 90B (3-1, 3-10); (see Map CA2-1 and Map CA2-2). Soils of mapping unit 252 characteristically occur on moderately steep and steep residual uplands with sharp ridge crests and slope breaks. These loams to fine sandy loams have a high erosion potential, steep slopes, very shallow depths, and rock outcrops, making them poor sources of soil material for reclamation.

The soils of mapping unit 401 (401) occur as a complex of Torriorthents and rock outcrop on very steep, rough, and broken lands. The very shallow depth, very severe runoff, and erosion hazard make these soils unsuitable for reclamation.

The soils of mapping unit 90B (3-1, 3-10) characteristically occur on gently sloping to moderately steep residual uplands. These loams to sandy clay loams have a moderate to high erosion potential and shallow depths, making them poor to fair sources of soil material for reclamation.

The soils of mapping unit 210 (6-7) characteristically occur on gently sloping to moderately steep slopes on alluvial fans, terraces, and drainage ways. These loam to clay loam soils have a low to moderate erosion hazard potential, and subsoil sodium in the Ravalli portion, making them fair to good sources of topsoil material.

The application of the coal unsuitability criteria to the narrow floodplain soils (257) in the First, Second and Third Sand Creek drainages within the project would identify these areas as not being alluvial valley floors or prime farm land. The buffer zone (1-3/4 miles and 1/4 mile) for the Medicine Bow River alluvial valley floor would cross over into the mine project. These areas would be entirely on private surface. These areas are acceptable pending further study designation except for a small portion in the SE¼SE¼, Section 1, T. 20 N., R. 79 W., which is unsuitable.

A soil use interpretation summary for the mapping units (Map CA2-1) is shown in Table CA2-2.

Detailed soil use interpretations for and description of the mapping units are given in the Carbon Basin Appendix A.

WATER RESOURCES

Groundwater

The groundwater system in Carbon Basin has been studied only superficially and properties of the system are largely unknown. The coal-bearing formations of the basin are essentially separated from the broad regional aquifers by a bowl-shaped layer of relative semipervious Lewis shale (see Figure CA1-2). The layer of shale is especially significant because it essentially eliminates any hydraulic connection between the coal-bearing formations and the alluvium along the Medicine Bow River. Where the river flows past the south side of the project area, the alluvium rests partly on the shale and partly on the Mesa Verde Formation, which underlies the shale.

The hydraulic gradient in the Mesa Verde is away from the river. If any water is lost from the river, it would flow under the shale. Small, but insignificant, amounts of water could be forced upward through the shale, however, the rate of movement through the shale would be very slow.

In the following analysis, the word basin is applied to those formations enclosed by the Lewis shale. Within the basin, groundwater exists in three aquifer types; alluvial, water table (including some possible perched zones), and artesian (confined).

Along drainage channels of ephemeral streams there are narrow deposits of quaternary fluvial alluvium that contain water. Depth to bedrock varies from outcrop at the surface to near 25 feet. The level of the groundwater in the alluvial fill fluctuates in direct response to surface flow, indicating hydraulic communication between the alluvial groundwater table and surface water flow.

The coal beds are overlain with sandstones, clays, siltstones, and shales of the Hanna Formation. The sandstones immediately above the coal are generally saturated with water and form localized aquifers, which exist under both water table and artesian conditions. Where clays overlie the saturated sandstone in substantial thicknesses, artesian conditions exist. Where the aquifer approaches outcrops toward its recharge area, water table conditions exist.

The coal seams and adjacent sand and shale layers comprise a poorly productive multi-aquifer system. There is little interstitial permeability in coal, but water movement exists because of secondary permeability from cracks, joints, and cleats. Although the coal is a relatively poor aquifer, delivering only a few gallons per minute (gpm), it probably is the principal aquifer in the basin. Recharge to both the coal and sandstone aquifers occurs principally around the southern and eastern rim of the basin. Water moves northeasterly from the recharge areas on a gradient of about 100 feet per mile and discharges through small springs and seeps. Very little if any water drains out of the basin. There is very limited connection between water in the coal and that in the sandstones above and below the coal.

The only groundwater studies available for Carbon Basin are those conducted for development of the Carbon Basin Mine, and these studies cover only the four sections where surface mining is proposed. The studies are based on five groupings of wells that penetrate to a depth of 60 or 70 feet below the Johnson coal seam. The wells were constructed to measure static water levels at 33 feet above the coal seam, in the coal seam, and at 66 feet below the coal. Water at each of these places is under artesian pressure, and the static water levels range from 67 to 372 feet above the top of the respective aquifer in which the water is encountered. No data were provided on the level at which water was encountered or on static water levels in sandstone layers more than 33 feet above the coal seam. However, it appears that most of the overburden is relatively dry and that wells will yield very little water.

Table CA2-2

SOIL INTERPRETATION SUMMARY - CARBON BASIN

Soil Unit Symbol	Soil Unit % Slopes	Erosion Hazard Potential[1] Water	Erosion Hazard Potential[1] Wind	PSIAC[2] Rating	PSIAC[2] Ac Ft/SqMi/Yr	PSIAC[2] Ton/Ac/Yr	Suitability for Final Cover for Mined Land[3] In. Avail.	Suitability for Final Cover for Mined Land[3] Suitability	Range Site[4]	Capability Group[4] Dryland	Capability Group[4] Irrigated	Estimated Acres in Project Area Acres	Estimated Acres in Project Area Percentage	Vegetative Type[5]
38B	2-6	L	M	24-29	0.20-0.24	0.6-0.8	12-60	M-H	Loamy	VIe5	IIIe	126	0.8	4
38C	6-12	M	N	26-33	0.21-0.27	0.7-0.9	12-60	M-H	Loamy	VIe5	IVe	36	0.2	4
78B	2-6	L	H	24-31	0.20-0.25	0.06-0.08	26-60	H	Sandy	VIe2	IIIe	360	2.3	4
90B	5-15	H	M	31-41	0.25-0.36	0.8-1.2	0-6	L	Sh. Loamy	VIIe14		1,055	6.8	4
210	0-3	L	M	24-29	0.20-0.24	0.6-0.8	14-60	M-H	Saline Upland	VIIs71	VIs71	398	2.6	14, 4
	3-6	M	M						Loamy	VIe2	IIIe2			
251	2-6	M	M	27-37	0.22-0.31	0.7-1.0	4-60	L-H	Sandy	VIe5		515	3.3	4
	6-15	M	H						Sh. Sandy	VIIe14				
	15-20	H	H											
252	6-15	M	M	51-61	0.52-0.74	1.7-2.4	0-6	L	Sh. Loamy	VIIs17		5,007	32.3	4
	15-30	H	M						Very Shallow	VIIe14				
253	2-6	M	M	37-47	0.31-0.45	1.0-1.4	6-27	L-M	Sh. Loamy	VIIe14		832	5.4	4
	6-15	M	M						Loamy	VIe2				
254	0-3	L	M	23-27	0.18-0.22	0.6-0.7	6-10	L	Impervious Clay	VIe1		917	5.9	4a
	3-6	M	M						Sh. Loamy	VIIe14				
255	0-3	L	H									6	0.04	1
256	0-3	L	H						Sandy	VIe5		27	0.2	4
	3-6	M	H	26-37	0.21-0.31	0.7-1.0	13-60	L-H	Loamy		6-15 M	H		

Table CA2-2 (Continued)

SOIL INTERPRETATION SUMMARY - CARBON BASIN

Soil Unit		Erosion Hazard Potential [1]		PSIAC [2]			Suitability for Final Cover for Mined Land [3]		Range Site [4]	Capability Group [4]		Estimated Acres in Project Area		Vegetative Type [5]
Symbol	% Slopes	Water	Wind	Rating	Ac Ft/SqMi/Yr	Ton/Ac/Yr	In. Avail.	Suitability		Dryland	Irrigated	Acres	Percentage	
257	0-3	L	M	14-19	0.13-0.16	0.4-0.5	6-60	M-H	Lowland Lowland	VIe2 VIe5	IIIe2 IIIe5	251	1.6	14, 4
258	0-3 3-6 6-12	L L M	M M M	24-32	0.20-0.27	0.6-0.9	17-60	M-H	Loamy Loamy	VIe2 VIe2		2,634	17.0	4
260	2-6 6-15 15-20	L M H	H H H	26-33	0.21-0.27	0.7-0.9	12-60	M-H	Sandy Loamy	VIe5 VIe2		2,890	18.6	4
401	30-60	H	H	61-75	0.74-1.2	2.4-3.5	0	L	Very Shallow	VIIIs		214	1.4	4, 4a
C.F.	Cut and Fill				(Disturbed Land)							15	0.1	
M.D.	Mine Dump				(Disturbed Land)							225	1.4	

1. Erosion hazard classes or susceptibility of the soil to erosion when no cover is present from BLM 7317.1 and soil profile descriptions in USDA, SCSI978, 1977, 1976, and 1972. L--Low (Slight) M--Moderate H--(Severe).
2. Estimated present erosion rates (Pacific Southwest Inter-Agency Committee 1968).
3. Estimated soil suitability for reclamation of mined land (BLM 7312); L--Low (Poor), M--Moderate (Fair), and H--High (Good).
4. Soil survey legend and interpretations and mapping unit descriptions SSA630 (January 1978)
5. Vegetative types adapted to and likely to occur on soil types (see Vegetative section).

Water moves through the aquifer very slowly and large drawdowns are required to produce small amounts of water. At one well in Section 29, T. 21 N., R. 79 W., the artesian head in the coal was pumped off in 9 minutes. The drawdown for a yield of 3 gpm was 205 feet. Two adjacent observation wells, which bottom in sandstones above and below the coal, showed no response in the 39 minute pumping time. The transmissivity in the coal was computed to be less than 100 gallons per day per foot (gpd/ft); transmissivities as low as 0.1 gpd/ft were measured in the sandstones by slug testing the observation wells. The actual transmissivity for the multiple aquifer is probably somewhere in the range from 0.1 to 100 gpd/ft. The low transmissivity is probably representitive of that in all sandstone and coal aquifers of the basin, but there may be some pockets that will produce larger quantities of water. The hydraulic gradient is toward the northeast from recharge areas around the southern and western rims of the basins. The gradient is 100 feet per mile.

No data are available regarding static water levels or artesian pressure in the sections proposed for underground mining, but by extrapolating data from the studied area it has been estimated that static water levels will generally be 100 to 200 feet below land surface. The artesian pressure head in the coal is probably a maximum of about 700 to 800 feet near the center of the basin. Such a head represents a pressure of 300 pounds per square inch (psi). This head would be dissipated quickly during pumping.

Surface Water

Most of the project area is drained by three ephemeral streams; First Sand, Second Sand, and Third Sand Creeks (see Map CA2-3). All three have deep arroyo type channels with flat sand beds and nearly vertical banks (Figure CA2-2). Second and Third Sand Creeks drain to the Medicine Bow River; First Sand Creek drains to Allen Lake, a closed basin at the northeast corner of Carbon Basin.

Mesilla Valley Engineers (1978) monitored the flow of Third Sand Creek during 1977. Flow was found in Third Sand Creek on March 7 and April 13. This should not be construed to mean that the stream flowed continuously during the intervening period. Panborne (personal communication), a hydrologist who regularly visits a GS gaging station on Third Sand Creek estimated that the stream flows on an average of 10 to 15 days per year. First and Second Sand Creeks probably flow about the same amount.

Peak flows of Third Sand Creek have been measured since 1965 at the county road crossing in Section 28, T. 21 N., R. 79 W., where the drainage area is 10.8 square miles. The maximum discharge is 1,560 cubic feet per second (cfs). This flow was confined to the channel. There is no record of any recent flood exceeding the capacity of the channel. Table CA2-3 shows the probability of a flood having a given discharge occurring in any given year. In terms of percentages these figures mean that there is a 90% chance that the maximum discharge in any given year will exceed 100 cfs, a 50% chance that it will exceed 320 cfs, and a 10% chance that it will exceed 1,200 cfs. A fair estimate of flood discharges for other points in the project area can be estimated by multiplying the values for Third Sand Creek by a factor that is equal to the ratio raised to the 0.35 power of the drainage area at the point of interest to that at the Third Sand Creek or by using equations developed by Lowham (1976). Mean discharge for the three principal streams as estimated from procedures by Lowham (1976) are First Sand Creek—2 cfs, Second Sand Creek—1 cfs, and Third Sand Creek—1 cfs.

The southern edge of the coal outcrop is near the brink of a hillside having no defined channels. The water that originates on this hillside ends up having no defined channels. The water that originates on this hillside ends up in a closed basin and forms a playa on an old terrace above the livestock, but has no vegetation around it that would provide wildlife habitat.

Several small springs, which are little more than seeps, exist in the basin. The springs are fed by aquifers that are small in areal extent and have little ability to transport water.

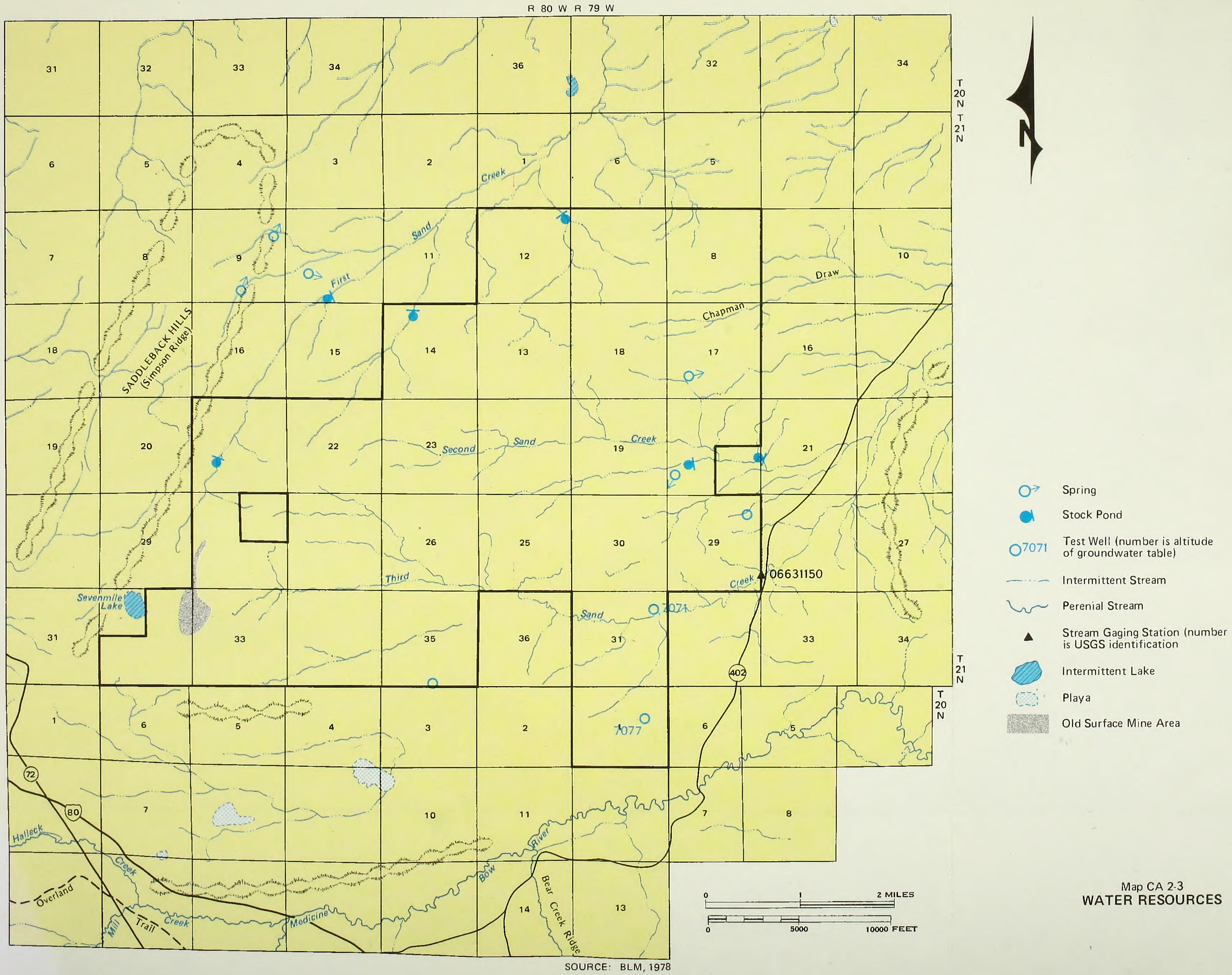
Quality

Groundwater in the four sections proposed for surface mining was tested for 25 elements or ions by Mesilla Valley Engineers (1978). The total dissolved solids (TDS) concentrations ranged from 672 to 3,904 milligrams per liter (mg/l) in March; 1,160 to 2,936 mg/l in May; 1,124 to 8,084 mg/l in August; and 960 to 7,104 mg/l in December. Water having TDS concentrations of less than 1,000 mg/l is considered acceptable for human consumption.

Water from all wells had a strong hydrogen sulfide odor. Water is acceptable for livestock and wildlife, but is very borderline for human consumption.

Mesilla Valley Engineers (1978) tested waters from Third Sand Creek, Second Sand Creek, and Medicine Bow River for those constituents prescribed by Guideline 4, November 1976, Wyoming Department of Environmental Quality. The pH of waters in the two Sand Creeks ranged from 7.93 to 8.35 and TDS ranged from 788 mg/l on Third Sand Creek in April to 2,700 mg/l in Second Sand Creek in May. The waters were high in calcium, magnesium, and sulfate. The water is acceptable for wildlife, livestock, and irrigation. When the quality is best, during periods of snow melt, it is also acceptable for human consumption. No sediment analyses were made nor were any chemical analyses made for flows resulting from intense summer rains. These summer flows probably carry sediment loads of several thousand mg/l.

During the period April to August, the TDS content in the Medicine Bow River ranged from 76 mg/l in May at site MB2, upstream from the project area, to 3,092 mg/l in August at site MB3, downstream from Second



Map CA 2-3
WATER RESOURCES

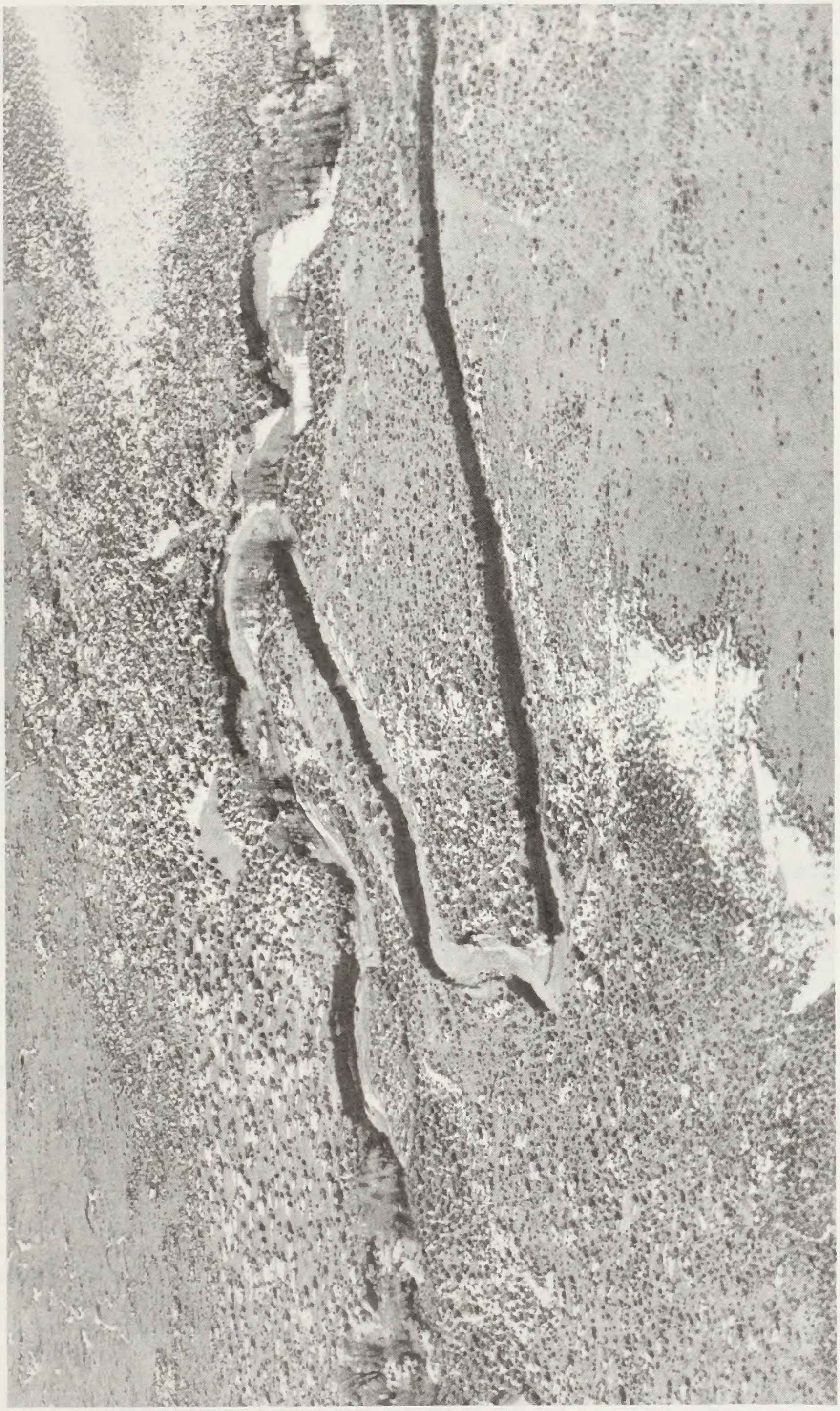


Figure CA2-2

STEEP ARROYO TYPE BANKS AND SAND BED ON THIRD SAND CREEK

FLOW IS FROM RIGHT TO LEFT

Table CA2-3

PROBABILITIES FOR DISCHARGES

Discharge in cfs	Probability
100	.9
320	.5
1,200	.1
2,000	.04

Sand Creek. Each set of monthly samples showed a marked increase in dissolved solids between the two sampling points.

Water Use

Water rights for livestock reservoirs and irrigation diversions in the project area consist of rights for one well, seven livestock reservoirs, and two surface diversions. No other uses of water are known.

Numerous other water rights exist for diversions and wells along the Medicine Bow River. As stated above, there is essentially no hydraulic connection between Carbon Basin and waters in the Medicine Bow River valley.

VEGETATION

Terrestrial

The vegetative cover on the Carbon Basin project area is comprised of four vegetative types. The geographic locations, acreage, and percent distribution of the vegetative types and the disturbed area caused by previous mining are shown on Map CA2-4.

The sagebrush-grass type (Type 4) is the predominant vegetation type on the project area. It is located primarily on the shallow to moderate slopes of the hills and in the drainages. The vegetative composition within the type varies widely due to the variation of the soils within the type site. This composition variance can range from a 90% shrub/10% grass and forb ratio to a 30% shrub/70% grass and forb ratio; the average is approximately 60% shrub/40% grass and forb. The dominant shrubs include big sagebrush *(Artemisia tridentata)*, rabbitbrush *(Chrysothamnus viscidiflorus)* and snowberry *(Symphoricarpos spp.)*. Dominant grasses are western wheatgrass *(Agropyron smithii)*, bluebunch wheatgrass *(Agropyron spicatum)*, Indian ricegrass *(Oryzopsis hyminoides)*, and bluegrass *(Poa spp.)*. Vegetative production of this type ranges from approximately 600 pounds to 850 pounds of air dry vegetation per acre.

The birdfoot sagewort type (Type 4a) is generally located on the flat hilltops and upland flat swales. Due to the low growth characteristic of vegetation of this type, the areas may appear as grasslands from a distance. Shrub composition is primarily birdfoot sagewort *(Artimisia pedatifida)*, shadscale *(Atriplex confertifolia)*, and winterfat *(Eurotia lanata)*. The dominant grass species are western wheatgrass, Indian ricegrass, and bluegrasses. Vegetative production of this type ranges from approximately 200 pounds to 350 pounds of air dry forage per acre.

The greasewood type (Type 14) is limited to the bottoms of the main drainages, primarily along Third Sand Creek and to a lesser extent on Second Sand Creek. The dominant shrub species are greasewood *(Sarcobatus vermiculatus)*, big sagebrush, and snowberry *(Symphoricarpos albus)*. The understory cover of grasses includes Sandberg bluegrass *(Poa secunda)*, bottlebrush squirreltail *(Sitanion hystrix)*, and various species of wheatgrasses *(Agropyron spp.)*.

The mountain shrub type (Type 5) is limited in extent and is generally associated with rocky outcrops. It also occurs within the sagebrush-grass type as small isolated patches that are smaller in size than the minimum mapping unit. Although the areas are scattered and small in size, the type is important as wildlife habitat since it contains species preferred by wildlife. The dominant shrub species are mountain mahogany *(Cercocarpus montanus)*, big sagebrush, snowberry, and rabbitbrush. The understory cover of grasses includes Indian ricegrass, wheatgrasses, and bluegrasses.

The disturbed area includes the acreage that was mined in the early 1900s. Vegetative cover on the mined and spoil pile areas is very sparce and consists primarily of native shrubs that have invaded onto the area.

Riparian

There is no riparian vegetation on the proposed project area.

Aquatic

Due to the intermittent characteristics of the drainages, there is no aquatic habitat on the project area.

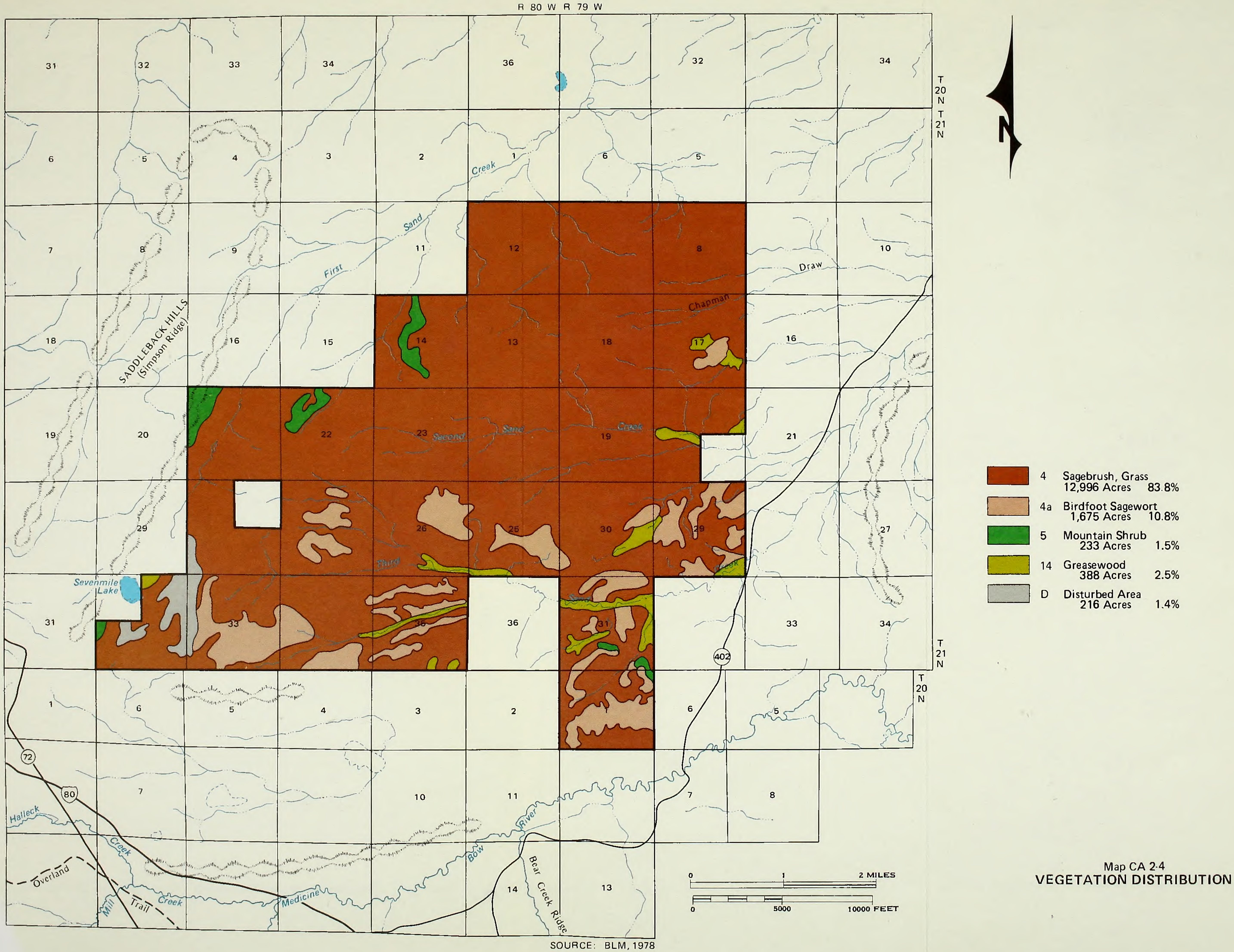
Endangered and Threatened

There is no record of, nor did a field examination conducted in May, 1977 by Robert Dorn of the BLM, reveal, the existence of any plant species that are proposed for threatened or endangered status in the Carbon Basin project area.

The field examination was conducted in a manner that satisfies unsuitability criteria examinations. Due to the soil types that exist in the area, it was concluded that the chance of any threatened or endangered plants being present is near zero (BLM Memorandum, 4510 (932) dated 7/22/77). Therefore, the area is acceptable under unsuitability criteria for threatened or endangered species.

Reclamation

Reclamation activity on coal mines in the Hanna Basin area is fairly recent. The Open Cut Law of 1969 and the Environmental Quality Act of 1973 were among the first laws establishing regulations for reclamation in Wyoming. The reclamation activity has generally been a trial and error basis and has not been very successful. This lack of successful reclamation is due in part to poor reclamation practices, the short time frames involved in reclamation activity, and the absence of any previous good



Map CA 2-4
VEGETATION DISTRIBUTION

reclamation efforts in the area to guide new efforts. Examples of poor reclamation practices are the failure to separate and bury unsuitable overburden (carbonaceous shale, parting material) material beneath suitable overburden material, replacement of insufficient topsoil amounts, lack of contouring, lack of shrub replacement (started in Hanna Basin, fall 1976), lack of fencing to control grazing by livestock and wildlife, and lack of mulching. Other important variables are the severe climatic conditions; low precipitation, low humidity, 80 to 100 day growing season, and sustained high winds. Since 1975, the coal companies' reclamation efforts have been improving and have been conducted under regulations existing prior to the new SMCRA regulations. Past reclamation efforts have resulted in areas in various stages of revegetative development, but to date DEQ has not released from bonding any area in the Hanna Basin area as being completely reclaimed. An estimated 3,653 acres are in the process of being reclaimed through initial seeding on five of the six existing mines in the Hanna Basin area.

FISH AND WILDLIFE

General Information

Habitat Types

Primary vegetative habitat types found on the project area and the major species of wildlife that occur in these various types are listed below. A partial listing of wildlife species that could occur on the project site can be obtained from the Rawlins District Office of the BLM.

Aquatic. There is no aquatic habitat adequate to support fish life located on the project area. All streams in the area are intermittent or ephemeral. Allen Lake, an ephemeral lake, furnishes water only for terrestrial wildlife and only for intermittent periods during the year. There are also seven livestock reserviors on the project area that are used by wildlife, but these reservoirs also do not hold water year-round.

Terrestrial

Sagebrush (12,966 acres). This vegetative type supports a great variety of wildlife species including pronghorn antelope, mule deer, desert cottontail, whitetail jackrabbit, coyote, whitetail prairie dog, Uinta ground squirrel, Richardson's ground squirrel, deer mouse, Great Basin pocket mouse, sage grouse, Brewer's sparrow, sage sparrow, vesper sparrow, sage thrasher, green-tailed towhee, and horned lark.

Birdfoot Sagewort (1,675 acres). This vegetative type will generally support the same species of wildlife that occur in the big sagebrush type. The major wildlife species found in this type are listed above in the section on sagebrush.

Greasewood (388 acres). This vegetative habitat will generally support the following major species of wildlife; pronghorn antelope, mule deer, desert cottontail, whitetail jackrabbit, coyote, whitetail prairie dog, Richardson's ground squirrel, least chipmunk, deer mouse, sage sparrow, sage thrasher, sage grouse, Brewer's sparrow, vesper sparrow, and horned lark.

Mountain Shrub (233 acres). The mountain shrub type is known to support the following major species of wildlife; mule deer, mountain cottontail, deer mouse, least chipmunk, coyote, Brewer's sparrow, green-tailed towhee, mountain bluebird, and loggerhead shrike.

Disturbed Area (216 acres). This old mined area is being used by many species of wildlife only as travel area and will not support wildlife.

General. The project area is used as both nesting and hunting habitat for several species of raptors. The most commonly observed raptors are; Swainson's hawk, marsh hawk, red-tailed hawk, American kestrel, and golden eagle.

Wildlife

Birds

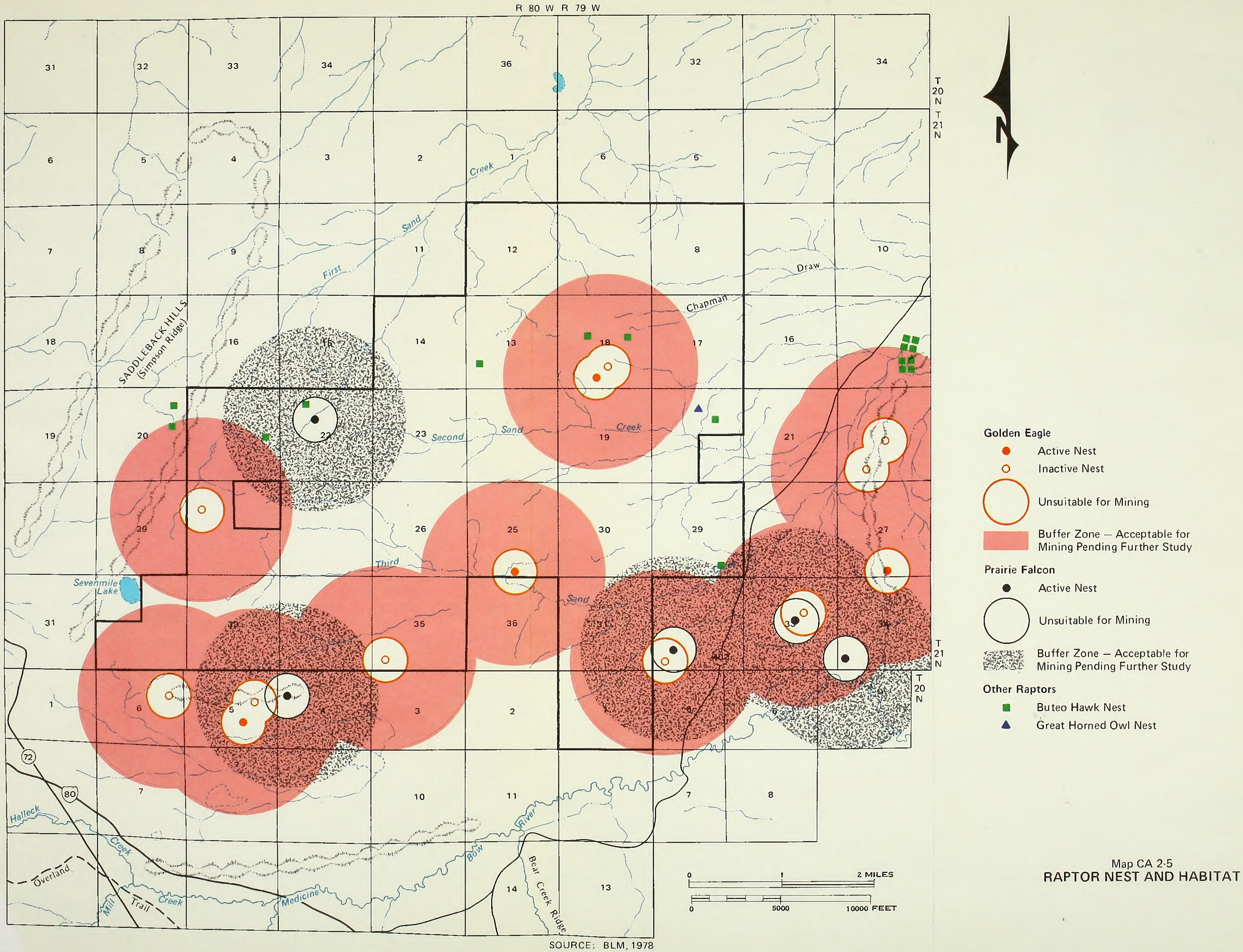
Nongame. The major small nongame birds species found on the project area are listed under various habitat types at the beginning of this section. There are at least 43 species of small songbirds that could occur on the proposed project area. At the present time, best estimates of density of small birds indicate that there are about 21 breeding pairs of birds per 100 acres when averaged over these vegetative types (personal communication, Max Schroeder, FWS, March 1978). The raptor population on and adjacent to the project area was inventoried by BLM and Fish and Wildlife Service biologists in April and May, 1978, in a manner that satisfies unsuitability criteria concerning golden eagle nests. This inventory indicated that the area is acceptable for coal mining pending further study of the golden eagle nest locations. In addition, unsuitability criteria concerning bald and golden eagle roost and concentration areas were applied to available data and the area is acceptable for coal mining pending further studies.

The general raptor inventory completed in 1978 also identified prairie falcon nests on and in the vicinity of the proposed mine. This inventory also indicated that through unsuitability criteria the area was acceptable pending further studies.

Round-wing or buteo hawk nests were also inventoried according to unsuitability criteria for migratory birds and the area was determined to be acceptable pending further studies of these nest sites (see Map CA2-5).

A formal request for coordination with the Fish and Wildlife Service covering the golden eagle nests on the project area was initiated by letter dated May 15, 1978.

Game. The entire project area of 15,494 acres is classified by the Wyoming Game and Fish Department as year-round sage grouse habitat. Two strutting grounds or leks are located in the eastern portion of the area and



Map CA 2-5
RAPTOR NEST AND HABITAT

one lek is located immediately adjacent to the site to the northwest (see Map CA2-6). The entire east half of the area contains critical sage grouse nesting areas that are associated with the strutting grounds. Critical nesting habitat is that area located within a 2-mile radius of the strutting ground where the bulk of the nesting takes place (Wallestad 1975). The majority of this project area is used as critical winter range by sage grouse. The Wyoming Game and Fish Department lists this area as some of the best sage grouse habitat and one of the best hunting areas in the state.

Sevenmile Lake and East Allen Lake, both small intermittent lakes adjacent to the project area, are utilized by waterfowl (mallards, redheads, scaups, pintails, and sandpipers) as a resting area during spring migrations, but there is no riparian vegetation that could be used as nesting habitat.

Mammals

Nongame. According to sightings and a search of current literature (Burt and Grossenheider 1976), there are at least 21 species of small nongame rodents that could occur on the project area during some portion of the year. Some of the more common species are; deer mouse, least chipmunk, Richardson's ground squirrel, and whitetail jackrabbit. Numerous whitetail prairie dogs are present on an estimated 2,744 acres of active colonies on the site based upon a 1978 survey by the Fish and Wildlife Service (see Map CA2-6). A listing of small nongame mammals that could occur on the area can be obtained from the Rawlins District Office of the BLM.

Game. The pronghorn habitat on 15,292 acres of the project area is classi-fied as winter/year-round range with the exception of about 3,200 acres which has been determined to be critical winter/year-round habitat. There are about 250 pronghorns that winter on site and a significant amount of fawning and rearing of young takes place on the area. Pronghorns occur throughout the project area for much of the year, but tend to concentrate along County Road 402 from Spade Flats to the crossing of the Medicine Bow River in winter (see Map CA2-7).

The project area supports a year-round resident population of mule deer totaling about 50 head. All of the deer range is classed as winter/year-round range; none is listed as critical deer range. These deer tend to congregate along Simpson Ridge to the west and in the rocky hills at the head of Third Sand Creek for much of the year. During the winter, they usually are found near Kyle Junction or along Third Sand Creek (see Map CA2-7).

The desert cottontail rabbit is a very common small game mammal on the project area. The Wyoming Game and Fish Department estimates that there are about five rabbits per acre in the vegetative types found on the project area.

Reptiles and Amphibians

General. Reptile and amphibian numbers appear to be low on the project area. Some of the more common species that could be expected to occur on the site are; northern sideblotched lizard, northern shorthorned lizard, and the western rattlesnake. There is little riparian vegetation and very little free water on the area which would provide habitat for any kind of amphibian.

Feral (Wild) Horses

Feral horses do not occur on the project area (see Southcentral ES, Regional, Appendix A, Map 9).

Endangered and/or Threatened

Habitat for the black-footed ferret exists on the site in the presence of large numbers of whitetail prairie dog colonies (see Map CA2-6). Several of these colonies occur in Section 29, T. 21 N., R. 79 W. and in Section 1, T. 20 N., R. 79 W. which are proposed to be surface mined.

There have been several historical sightings of ferrets in an area about 16 miles southwest of the proposed mine site (Southcentral ES, Regional, Appendix A, Map 8B). A letter requesting formal consultation with the Fish and Wildlife Service concerning the possibility of black-footed ferrets occurring on the project area was sent on September 26, 1978. The response to this letter stated that the results were negative and that ferrets are not likely to occur on the proposed mine site.

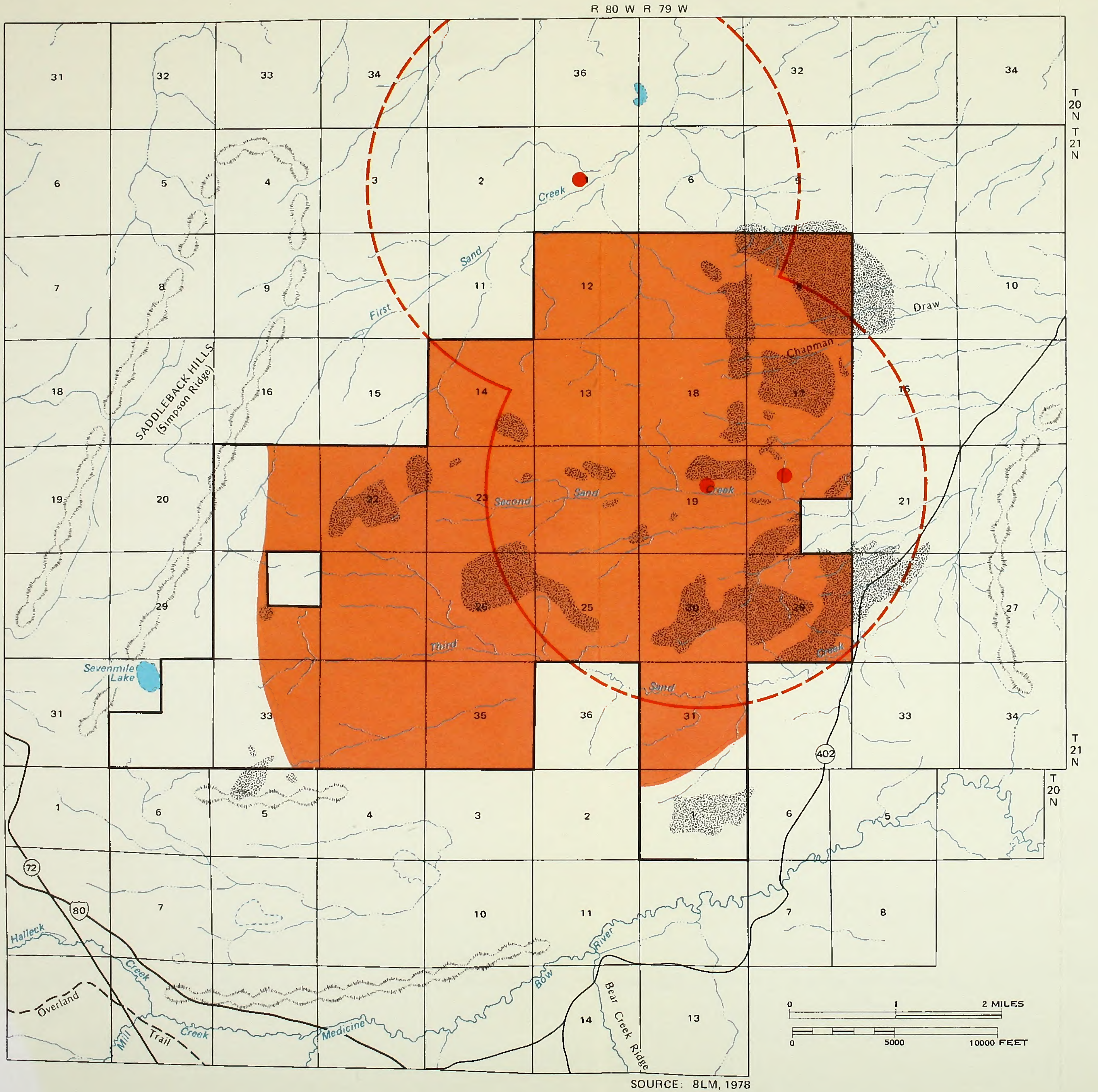
At the present time, there are no other known federally listed endangered or threatened species found on the project area. Therefore the area is acceptable for mining under unsuitability criteria for threatened and endangered species.

CULTURAL RESOURCES

No sites in the Carbon Basin project area are currently listed on the Wyoming Historic Preservation Plan or on the National Register of Historic Places.

Archeological

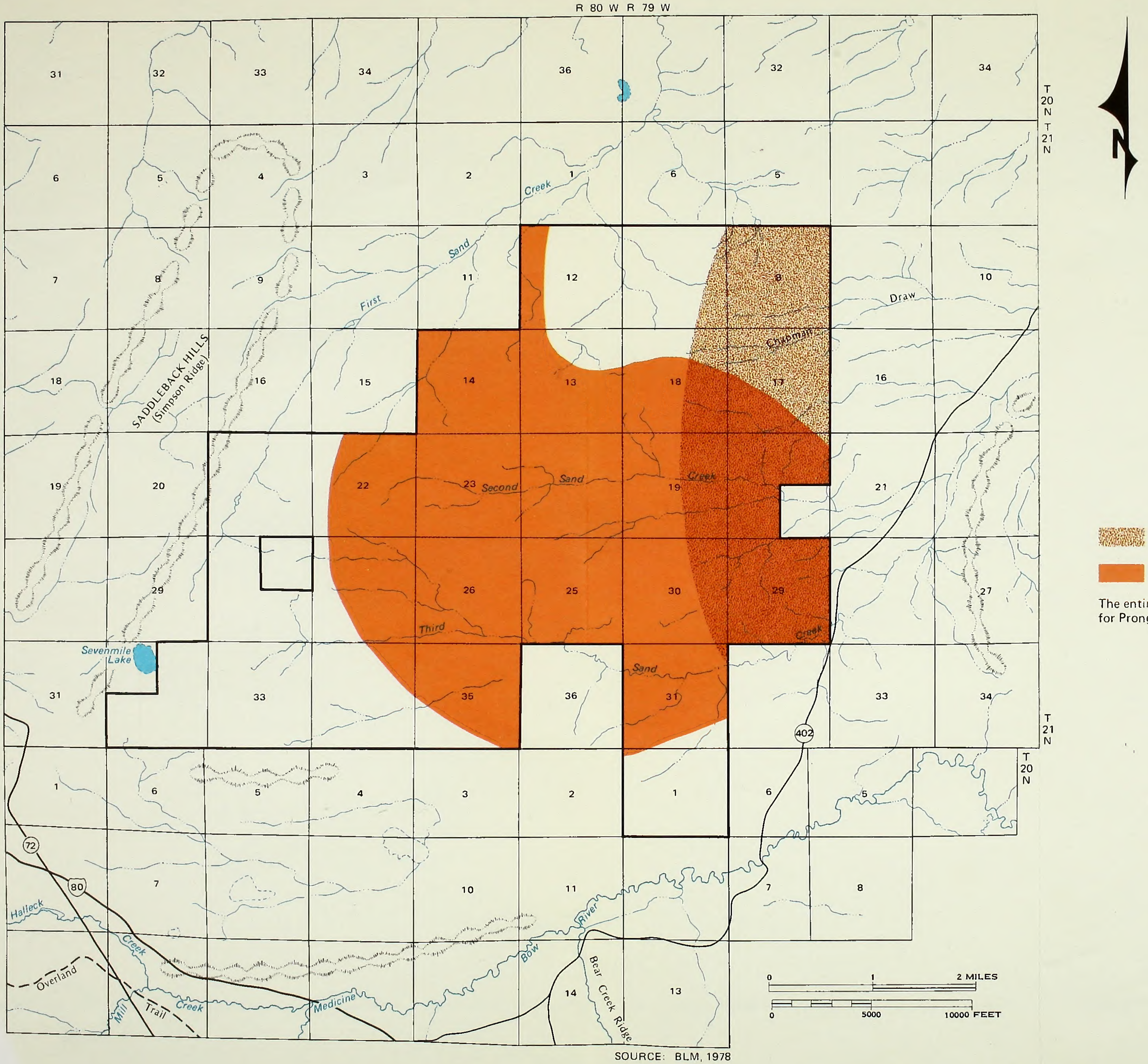
Approximately 19% of the Carbon Basin project area was surveyed for cultural resources by Western Wyoming College (Metcalf 1977). No sites were located within the project area during this survey; however, one site was located immediately outside the project boundaries. An additional four sites and three isolated finds have been recorded in the portion of the project area which remains to be intensively surveyed. Four sites were also recorded along the proposed rail spur during a survey done by the University of Wyoming (Zeimens 1977). See Table CA2-4 for a listing of site types found



- Sage Grouse Strutting Grounds
- Sage Grouse Critical Nesting Area
- Sage Grouse Critical Winter Area
- Whitetail Prairie Dog Colony

The entire area is year-round habitat for Sage Grouse

Map CA 2·6
BIRD AND SMALL MAMMAL DISTRIBUTION



Pronghorn Antelope Critical Winter Area

Mule Deer Winter Area

The entire area is year-round range for Pronghorn Antelope and Mule Deer

Map CA 2-7
BIG GAME DISTRIBUTION

Table CA 2-4

CULTURAL RESOURCES

Site Number	Within Project	Outside Project	Along Proposed Rail Spur	Campsite	Stone Ring	Chipped Stone	Isolated Artifact	Bone/ Shell	Cultural Period
1		1							
2		2		2					
3	3				3				
4	4					4			
5	5					5			
6	6						6		
7	7						7		
8	8						8		
9		9			9				LP
10			10	10				10	
11			11	11					
12			12	12				12	
13			13	13				13	

in the project area. Prior to the issuance of the lease, the remaining 81% of the project area will have to be surveyed by the lessee.

The potential for subsurface sites also exists within the entire project area, particularly in areas of windblown or alluvial deposits.

Historical

No historical resources have been located within the Carbon Basin project area based upon consultation with the State Historic Preservation Officer.

VISUAL RESOURCES

A visual resources classification was conducted by the Bureau of Land Management (BLM) on and adjacent to the project area using BLM visual resource inventory and evaluation procedures as explained in BLM Manual 6300. Map CA2-8 illustrates the classification zones.

The visual management classes that have been identified within the project area are Class III—15,292 acres and Class V—216 acres.

The characteristic landscape (Figure CA2-3) of the project area is also typical of adjacent land. The land consists of rolling terrain covered with low growing sagebrush, mountain shrub, greasewood, and rock outcrops. The principal drainage features in the area are the Sand Creeks, which are ephemeral streams with little scenic value.

The project area is crossed by seasonal, unimproved dirt roads and fences. These intrusions can be seen throughout the project area, but they do not reduce the value of the management class. A good view of the project area can be seen from two locations along the county road which passes just east of the project area. The road is of importance to the visual sensitivity. The project area cannot be viewed from Interstate 80 or State Highway 72.

RECREATION RESOURCES

Visitor Use Data

Table CA2-5 depicts the estimated visitor use by activity in the proposed project area.

Hunting

During the summer, hunting is limited to ground squirrels and prairie dogs. In mid-September, the hunting season begins to draw hunters to the field. This area has good sage grouse and antelope populations for hunting purposes.

Rabbit hunters travel to the area to pursue cottontails, normally after the big game and bird hunting seasons are over. This season lasts from early fall until the end of February.

In recent years the value of coyote hides has increased from approximately $35 for a prime hide in 1975 and 1976 to $65 in 1977. This has encouraged people to travel to the area in winter to pursue coyote.

Off-Road Vehicles

There are several mineral exploration and ranching associated roads located in the project area. These roads are used extensively by persons with four-wheel drive vehicles during the hunting season.

Wilderness Values

There are no areas in or near the proposed project area with identified wilderness values which meet the criteria set in Section 603 of the Federal Land Policy Act of 1976.

Sightseeing

The old town site of Carbon and cemetary (Figure CA1-1) is visited frequently during the summer months. Although the site is not within the project boundary, people do traverse the proposed mine going to and from the old town.

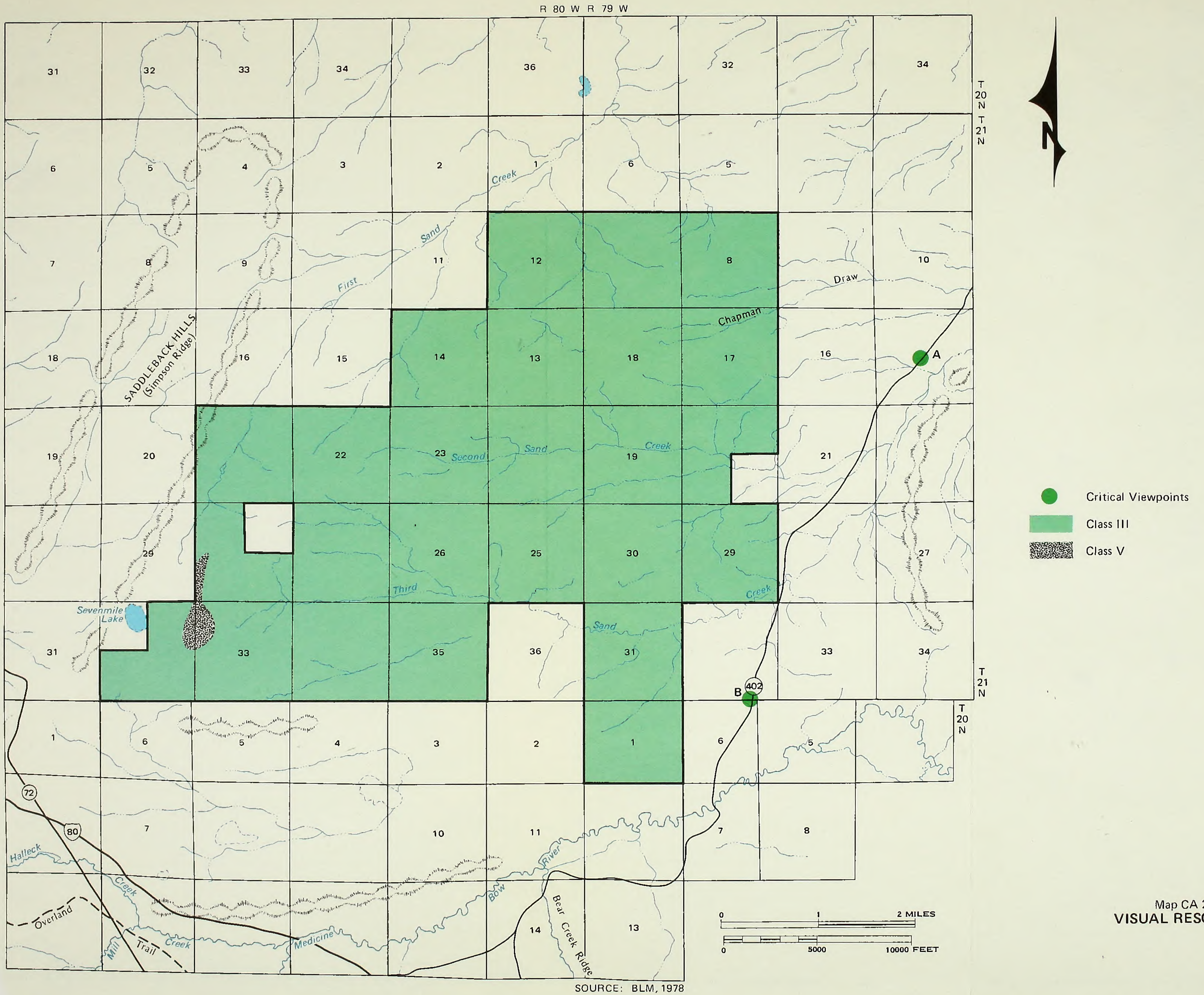
AGRICULTURE

Livestock Grazing

The Carbon Basin project area is located in the southwest corner of the North Anschutz grazing allotment. The allotment contains 48,841 acres (17,049 acres public lands; 1,730 acres state lands; and 30,062 acres private lands). All the private lands are owned by Edison Development Company (except the NE¼ Section 26). The project area involves 15,494 acres (approximately 32%) of this allotment. The planned surface mining area involves approximately 4% of the allotment acreage, located along the south allotment boundary.

Grazing use on the allotment in the past has been by cattle, involving two operators. The use by one ranch operation involves public lands only and is limited to 455 animal unit months (AUMs) of grazing during a 3 month summer period. The other grazing potential on the allotment totals 7,866 AUMs.

That part of the allotment covered by the project area of approximately 1,551 AUMs is distributed as follows; public lands—656 AUMs, state lands—64 AUMs, and private lands—831 AUMs. In contrast to past use, the



Map CA 2-8
VISUAL RESOURCES

Figure CA2-3

CLASS V AREA (FOREGROUND) NEAR THE SOUTHWEST CORNER OF THE PROJECT;

ELK MOUNTAIN IN THE BACKGROUND

Table CA2-5

ESTIMATED VISITOR DAYS BY ACTIVITY IN THE CARBON BASIN AREA

Activity	Visitor Days
Hunting (Big Game)	60
Hunting (Small Game)	Not Available
Sightseeing	5
Off-Road Vehicle	10
Total	75(+)

Note: Visitor day considered to be 12 hours.

present use pattern provides for the grazing of the project area (1,551 AUMs) by the Edison Development Company. The 455 AUM allocation for the other ranch operation was transferred to an adjacent portion of the allotment. There was no loss of federal AUMs in the use adjustment.

Water rights on the project area consist of seven stockwater ponds and one well. Inventory data show locations of five stockwater ponds on the project area and two adjacent to or near the project area boundary. Two springs are known to exist on the project area.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

A large number of separate governmental agencies (Federal, State and County) exercise certain types of land and resource use controls in Carbon County. The Carbon Basin project area includes public, state, and private lands. The federal sector includes the Bureau of Land Management (public lands and mineral estate under certain private lands). Development, management, use, and control of use on these public lands has been delegated to this agency.

Controls are effected through issuance or nonissuance of a variety of leases, permits, licenses, etc. Each authorization to use public lands contains provisions to control that use. Controls exercised by the federal government for the subsurface estate are governed by the statutes authorizing the disposition and use of that estate. Foremost among these statutes is the authority for leasing coal deposits and authority to require, as a condition of such leases, an operation-management plan and a reclamation-restoration plan. Management policy has been extended in greater detail by the National Environmental Policy Act of 1969, the Federal Land Policy and Management Act of 1976 and the Surface Mining Control and Reclamation Act of 1977. In certain situations, there is a joint or multiagency sharing of particular management and control functions and responsibilities, such as the cooperative agreement between the Department of the Interior and the state of Wyoming that allows the state to administer reclamation operations of an approved mine and reclamation plan on federal leases in Wyoming. The subsurface estate vested in private or state ownership would normally be governed by applicable state of Wyoming statutes.

A number of state agencies have development and administrative authority over state of Wyoming owned lands. Additionally, under state of Wyoming statutes, the state is authorized to perform and administer certain surface land use, planning and development activities on state, county, municipal, and privately-owned properties. Two pieces of legislation passed by the 1975 Wyoming Legislature which could have a significant effect on land use are: The Wyoming State Land Use Planning Act and The Industrial Development Information and Siting Act. The Land Use Planning Act requires completion of county land use plans by 1978, and these plans could conflict with or modify some of the energy proposals. The Industrial Siting Act requires furnishing extensive information and a state permit before certain facilities can be constructed. This act would affect developments which include gasification or electric generation proposals. Control does not apply to public properties except as provided by law.

Except where controls have specifically been delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over state owned and privately owned lands. Use and control of state owned lands (including mineral leasing, rights-of-way, etc.) is governed by Wyoming law. The Carbon Basin project area includes 640 acres of state lands.

Control over mineral uses is vested in the state of Wyoming under the Wyoming Environmental Quality Act of 1973. This act also authorized the state to control air quality, water quality, and solid waste management.

Where a county or city lacks a specific authority, provisions of the Wyoming Joint Powers Act are available to enable joint exercise of power, privilege, or authority. This legislation enables two or more agencies to jointly plan, create, finance, and operate (control) water, sewage, or solid waste facilities; fire protection agency facilities; transportation systems facilities; and public school facilities.

Carbon County has developed and adopted comprehensive plans. Additionally, they have passed zoning ordinances throughout their boundaries to control land use. The land in the Carbon Basin project area is zoned for ranching, agriculture, and mining.

Cities have authority to effect a master plan, zoning, and other regulatory controls. Cities do not have statutory authority to effect controls over mineral extraction or production within their corporate limits. Furthermore, the Wyoming Environmental Quality Act of 1973 would preempt cities; authority to regulate and control air, water, solid waste, and land quality standards except where specifically delegated to a municipality.

In summary, all of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

SOCIOECONOMICS

Demographics

Population

The 1977 population of Carbon County was 18,137. The population of Rawlins was 10,500; Saratoga's population was 2,050 and Hanna's population was 1,300 (Table CA2-6).

Employment

Total Carbon County employment was 8,067 in 1977 (Table CA2-7). The 1977 unemployment rate for Carbon County was 3%.

Table CA2-6

POPULATION TRENDS IN CARBON COUNTY
(1940-1977)

County City	1940	1950	1960	1970	1973	1975	1977
				YEAR			
Carbon County	12,644	15,742	14,937	13,354	15,430	16,745	18,137
Rawlins**	5,531	7,415	8,968	7,855	8,685	9,592	10,500
Sinclair**	604	775	621	445	480	526	550
Hanna**	1,127	1,326	625	460	543	642	1,300
Elmo**	134	213	91	53	58	69	200
Elk Mountain**	107	196	190	127	146	181	220
Medicine Bow**	338	328	392	455	665	744	750
Saratoga**	810	926	1,133	1,181	1,400	1,539	2,050
Encampment	331	288	333	321	403	463	500
Dixon, Baggs, Savery*	315	330	307	218	254	297	440
Wamsutter (Sweetwater County)	169	103	110	139	162	219	315

* These three communities are located in close proximity and are therefore shown combined. Savery is unincorporated and its population (perhaps 50 people) is not included in the figures shown.

**Will probably be affected by proposed development.

Sources: 1940, 1950, 1960, 1970, U.S. Department of Commerce, Bureau of the Census, Census of Population, Volume I, "Characteristics of the Population", Wyoming, U.S. Government Printing Office, Washington, D.C.

1973, 1975, U.S. Department of the Commerce, Bureau of the Census, Current Population Reports, Population Estimates and Projections, Series P-25, No. 698, U.S. Government Printing Office, Washington, D.C., April, 1977.

1977, Estimates made using the North Platte River Basin Economic Simulation Model, Water Resource Research Institute, University of Wyoming, 1978.

Table CA2-7

EMPLOYMENT BY SECTOR
CARBON COUNTY

Sector	1977	% of Total
Farm	526	6.5
Manufacturing	360	4.5
Mining	1,658	20.5
Contract Construction	715	8.9
Government	919	11.4
Farm and Forest Processing	46	0.6
Railroads	480	6.0
Business Services	1,415	17.5
Consumer Services	1,948	24.1
TOTAL	8,067	100.0%

Source: North Platte River Basin Economic Simulation Model, Water Resources Research Institute, University of Wyoming, March 1978.

Income

The total 1977 personal income (in constant 1977 dollars) in Carbon County was $147.1 million. The major contributors to this income were mining (28.4%), business services (19.7%), consumers services (13.5%), and construction (13.5%). Per capita personal income was $6,348 in 1975. Average weekly wages (Table CA2-8) have been the highest in the mining and manufacturing sectors of the economy.

Infrastructure

Private Sector

Total taxable sales in Carbon County were $67.5 million in 1977. Wholesale trade ($7.9 million), retail trade ($46.7 million), and services ($12.9 million) make up this total.

Local Government

Current (1977) assessed values, mill levies, and bonded indebtedness for the region are shown on Table CA2-9. The bond ceiling, which is the maximum amount of debt that a jurisdiction may incur, is based on the assessed value for the current year. Communities may not issue general revenue bonds for greater than 4% of assessed valuation and sewer bonds for an additional 4%. There is no bond ceiling for water bonds. Counties are limited to 2% of assessed value and school districts are limited to 10%.

Housing

There were 6,160 housing units in Carbon County in 1976; 16% were mobile homes. In 1977 there were 3,428 housing units in Rawlins. Of these 20% were mobile homes (Table CA2-10).

Education

The 1977 school enrollment for District 1 (Rawlins, Sinclair, Baggs, Bairoil) was 2,668. Building capacity in District 1 is 3,368. The 1977 school enrollment for District 2 (Saratoga, Encampment, Hanna, Elk Mountain, Medicine Bow, Shirley Basin, McFadden) was 1,658. Building capacity in District 2 is 2,430 (Table CA2-11). The expenditures per average daily membership (ADM) in District 1 was $1,695 for 1976. In District 2, the expenditures per ADM was $2,554; the statewide average expenditures per ADM was $1,721 (Wyoming Department of Education 1977).

Health Care

In 1977 there were 2,015 people for each physician in Carbon County. The established standard is 1,000 population per physician. The standard for dentists is 1,60_ population per dentist and for registered nurses it is 285 population per nurse. In Carbon County there were 2,591 people for each dentist and 263 for each registered nurse (Wyoming Department of Health and Social Services 1976, 1978).

Local Services

The Carbon County Sheriff's Office is currently adequately meeting demands and recent increases in workload (drug arrests increased 250% and number of prisoners handled increased 30% in the past year) are not resulting in decreases in the quality of service (Personal Communication Hansen 1978). A significant proportion of the Carbon County Volunteer Fire Department equipment dates from the 1940s and 1950s and is in need of replacement. The major inadequacy of the department is its inability to extinguish major fires requiring chemical or foam equipment.

The major problem with the Rawlins Police Department is inadequate facilities. The department is also considered understaffed and staff turnover because of high wages paid to miners adds to personnel problems (Personal Communication DeHerrera 1978). The largest potential problem in fire protection service in Rawlins is low pressure in the water system, particularly during the summer when demands for water peak. Rawlins' fire protection rating is seven which is considered adequate (Insurance Services Office 1978). Current improvements underway in Rawlins' water system are designed to meet water needs of the city until the year 2000, based on current growth rate (Personal Communication Paris 1978). Rawlins' present sewer system is being improved to correct major inadequacies. These improvements will significantly upgrade the system, however the system will continue to have problems with old, undersized sewer lines that are overloaded and with groundwater seeping into older lines (Personal Communication Yamashiro 1978).

Police and fire protection in Sinclair are both considered adequate. Peak water demands can presently be met. A study is underway to determine future needs resulting from potential population growth.

Turnover in the Hanna Police Department is an ongoing problem since those hired frequently quit to work in the mines. Hanna's fire protection rating is nine which is considered inadequate by the Insurance Services Office in Denver, Colorado. Hanna is currently improving its water system to meet current demands.

Elmo has no fire or police department. These services are provided by the town of Hanna and Carbon County. Elmo's water is supplied by Hanna. A 10,000 gallon storage tank has recently been built to solve the town's low water pressure problems.

Elk Mountain's fire protection rating is ten which is considered inadequate (Insurance Services Office 1978). The town's water system is considered adequate only for present needs. Elk Mountain is the only incorporated area in the county which relies on septic tanks foı

Table CA2-8

AVERAGE WEEKLY WAGE BY NON-AGRICULTURAL SECTOR - CARBON COUNTY

Sector			YEAR				Average Annual Change (%)
	1970	1973	1974	1975	1976	1977*	
Manufacturing	161.16	187.81	229.69	264.84	312.96	273.15	11.7
Mining	196.22	233.27	269.67	332.75	377.24	389.94	12.1
Contract Construction	139.55	204.38	221.39	241.05	245.85	255.16	10.6
Wholesale Trade	110.58	126.25	177.75	170.04	182.00	191.58	8.7
Retail Trade	70.08	72.96	93.18	114.21	113.44	115.99	8.5
Finance, Insurance & Real Estate	105.82	122.27	142.29	173.01	175.76	188.81	8.8
Trans., Comm., & Public Utilities	146.31	180.30	188.34	232.06	244.53	258.22	8.9
Services, including Agriculture, Forestry and Fisheries	65.40	80.33	86.57	98.96	106.30	124.05	8.4

* Based on monthly data for January 1977 through June 1977.

Sources: Wyoming Employment Security Commission, Administrative Services Division, Research and Analysis Section, Casper, Wyoming.

Table CA2-9

FINANCIAL CHARACTERISTICS
1977

County City	Assessed Valuation	Mill Levy (per $1,000 assessed) Valuation	Bonded Indebtedness
Carbon County	188,630,804	12.61	$ 159,100
Rawlins	14,505,124	14.76	2,993,000
Baggs	255,290	8.00	None
Dixon	63,843	8.00	20,500
Elk Mountain	202,399	13.00	27,000
Elmo	96,963	12.26	144,000
Encampment	528,175	17.28	43,000
Hanna	1,403,186	11.40	133,000
Medicine Bow	631,144	8.00	40,000
Saratoga	2,584,955	8.00	282,000
Sinclair	4,721,591	8.00	None
Wamsutter (Sweetwater County)	303,480	48.53	198,000

Sources: 1. Assessed Valuation, Mill Levy - Wyoming Taxpayers Association, Wyoming Property Tax Rates, 1977, Cheyenne, August, 1977.

2. Bonded Indebtedness - Community budgets and/or phone conversation with city clerk.

Table CA2-10

HOUSING IN INCORPORATED AREAS
TOTAL AND BY TYPE
1977

County Community	Total year Round Units	Single Family	Type of Unit Multiple Family	Mobile Home
Carbon County				
Rawlins	3,428	2,034 (.60)	700 (.20)	694 (.20)
Sinclair	203	198 (.97)	0 (.00)	5 (.03)
Hanna	510	325 (.64)	0 (.00)	185 (.36)
Elmo	77	35 (.45)	0 (.00)	42 (.55)
Elk Mountain	95	70 (.74)	0 (.00)	25 (.26)
Medicine Bow	246	100 (.41)	6 (.02)	140 (.57)
Saratoga	765	477 (.62)	87 (.11)	201 (.26)
Encampment	241	155 (.64)	2 (.01)	84 (.35)
Total Housing In Incorporated Areas	5,747	3,473 (.60)	795 (.14)	1,479 (.26)

Note: Figures in parentheses are the fraction of total housing units. These figures may not add to 100 due to rounding.

Source: Except for the towns of Rawlins, Hanna and Medicine Bow, the data on housing has been taken from Land Use Plans submitted by the communities to the Carbon County of Governments in the fall of 1977. Although the figure on the total housing units in Rawlins was taken from a Land Use Plan, data on the type of housing was estimated from conversations with local officials. Housing figures for Hanna reflect estimates reported by the local town clerk. Total housing units for Medicine Bow reflect the results of a survey conducted by the local high school students in the spring of 1977. Figures on the type of units in Medicine Bow were estimated based on conversations with local officials.

Table CA2-11

PUBLIC SCHOOL CHARACTERISTICS
1977-78

School District School (Grade)	Student Enrollment	Full-Time Equivalent Teachers	Student/ Teacher Ratio	Building Design Capacity
School District #1				
Mountain View (K-6)	368	18	20.4	460
Pershing (K-6)	282	15	18.8	370
Sunnyside-Central (K-6)	465	14	33.2	488
Baggs-Morrow	213	16	13.3	275
Bairoil (K-8)	65	6	10.8	110
Sinclair (K-6)	65	3.5	18.6	140
Rawlins Jr. High (7-8)	387	22	17.6	525
Rawlins Sr. High (9-12)	823	47	17.5	1,000
School District #1 Total	2,668	141.5	18.8	3,368
School District #2				
Elk Mountain (K-6)	39	3	13.0	140
Encampment (K-12)	214	14	15.3	300
Hanna (K-6)	276	13	21.2	100
McFadden (K-8)	16	3	5.3	100
Medicine Bow (K-6)	114	7.5	15.2	150
Platte Valley (K-6)	275	16.5	16.6	300
Shirley Basin (K-6)	79	7.5	10.5	140
Beer Mug (1-6)	2	1	2.0	--
Hanna-Elk Mountain Junior-Senior High (7-12)	200	15	13.3	300
Medicine Bow-Shirley Basin Junior-Senior High (7-12)	153	13	11.7	400
Platte Valley Junior High (7-8)	91	6.5	14.0	
Platte Valley Senior High (9-12)	199	10	20.0	300
District #2 Total	1,658	110	13.1	2,430
Carbon County Total	4,326	251.5	16.0	5,798

Sources: Wyoming State of, Department of Education, Division of Planning, Evaluation and Information Services, Fall Report of Staff/Teachers/Pupils/Enrollments 1977, "Statistical Report Series, No. 2", 1977, Cheyenne, Wyoming.

Wyoming, State of, Department of Education, Communications Services, Wyoming Education Directory, 1977-78, Cheyenne, Wyoming, 1977.

Telephone conversations with Hugh Simmons, School Superintendent, District #1, March 22, 1978; and John Tynon, School Superintendent, District #2, March 22, 1978.

sewage treatment. With the current population, septic tank leachate is not considered a major problem.

Water service has been the most critical problem in the delivery of local services in Medicine Bow. By mid-summer of 1978, current improvements to the water system should correct water supply problems. The town's new sewage treatment lagoon is more than adequate to serve current needs. Medicine Bow's fire protection rating is nine which is considered inadequate (Insurance Services Office 1978).

Saratoga is in the process of making improvments to its water and sewer systems. These improvements allowed the town to lift a 15-month moratorium on building caused by inadequacies in its water system. The town's sewage lagoon, however, cannot adequately treat the amount of sewage generated by the town and it's currently operating at about 105% of capacity. Police and fire protection are adequate to meet the community's needs.

Transportation and Utilities

Interstate 80, which is one of the principal interstate routes crossing the United States, is the most heavily traveled road.

A major Union Pacific railroad main line passes through southcentral Wyoming. In 1977 freight traffic through Rawlins averaged 50 trains per day carrying a wide variety of products between eastern and western markets. In addition, current coal production in the Hanna Basin added 6 trains per day (loaded and empty return) to transport coal to market.

Amtrak provides passenger railroad service from Rawlins. There is one eastbound and one westbound train daily.

There are four airports in Carbon County. The Rawlins airport runway is paved; its length is 5,500 feet. The Saratoga airport runway is also paved, with a length of 8,400 feet. Regularly scheduled air service is provided to these airports by Trans Mountain Airlines. In addition, the Rawlins airport is served by Star Airways. The other two airports, located just outside Hanna and Dixon, both have unpaved runways and are used only by private planes (Personal Communication Donnelly Corporation 1978).

Interstate bus service is available on a daily basis. The bus depot in Rawlins is served by Continental Trailways, Greyhound, Central Wyoming Transportation, and Zanetti Bus and Fast Express (Russel's Railway and Motor Bus Company Guide 1977).

Carbon County is served by four electric utilities; Pacific Power and Light, Carbon Power and Light, Hot Springs REA, and Yampa Valley Electric.

The Northern Gas and the Mountain Fuel Supply Company distribute natural gas to the county.

Attitudes and Expectations

The attitudes reflected in this section were derived from the Hanna and Overland Planning Unit Planning Area Analyses and some limited opinion surveys that have been completed in the region.

General Attitudes

In October 1974, the Wyoming Conservation and Land Use Planning Commission published a resident survey done as preliminary work in formulating a land use program in Wyoming.

From the replies it could be seen that in 1974 the people of Carbon County wanted land use planning and that both economic and environmental effects should be considered in that planning. They also preferred attracting non-mineral industries over mineral industries, and did not want any development to be at the expense of unique scenic beauty.

In 1975, T. A. Bougsty sampled opinion of residents in the Hanna Basin. This study, done for the Wyoming State Department of Economic Planning and Development, explored residents' preference on the size of their communities and satisfaction with various community services. It was found that 73% of the residents of Elk Mountain prefer no growth, while residents of Hanna and Elmo would tolerate some growth. Satisfaction with community services varied somewhat between communities and the Hanna Basin as a whole, with medical services, natural gas supply, streets and roads, community beautification, and recreation facilities being those services the residents were most dissatisfied with.

Information regarding the attitudes of residents in other areas of the Hanna Planning Unit is not presently available.

A resident survey covering the Overland Planning Unit was done in 1976 by Bickert, Browne, Coddington, and Associates. Among other things, residents were asked to rate adequacy of various community services. The results showed that only five services were rated 'very adequate' by 10% or more of the sample. These were fire protection, schools, utilities, roads and highways, and trash disposal.

Specific Attitudes

The following attitudes were derived from material contained in the Overland and Hanna Planning Area Analyses:

1. Forest Management: The timber industry, including the Wyoming Wood Producers Association, supports a continued timber sale program.

2. Access: Hunting and recreation groups strongly support a program to obtain access in checkerboard land areas and other areas where private lands block access to public lands. Groups such as the Carbon County Conservation Club and the Wyoming Game and Fish Department support programs to obtain access.

3. Livestock organizations support a freeze or cutback of grazing fees on public lands. Most operators desire to have increased flexibility with respect to use of grazing allotments, in terms of class of stock, numbers of stock, season of use, etc. Most operators favor predator control

and strongly favor management of feral horses and return of feral horse numbers to 1971 levels.

Lifestyles

Lifestyle means an internally consistent way of life or style of living that reflects the attitudes and values of an individual or a culture. It is influenced by infrastructure (housing, health care, educational system, police and fire protection, etc.) existing at the time.

Many changes are already occurring in the lifestyles of the region's residents. These changes are most evident in Rawlins, which has grown 34% since 1970. This is an annual growth rate of approximately 5%. Any community growth of 5% or more is problematic, and could be considered a boom situation (Gilmore and Duff 1974).

As identified in the Construction Worker Profile Final Report, 1975, one of the adjustments communities have made in response to this growth has been in the area of role switching. This role switching can take several forms: (1) New roles are created; (2) More positions within existing roles are created; (3) Old roles are redefined in light of changing needs; and (4) Newcomers replace oldtimers in existing roles.

The most common creation of new roles was in the local economic order, as business people started businesses not previously present in the community.

Positions Are Created Within Existing Roles

More people are hired to increase employment in occupations already existing in the community. More teachers are hired as enrollment picks up, more waitresses are hired as business increases, etc.

As institutional responsibilities change, old roles get redefined. A merchant's role is changed as he or she is forced to update merchandising, advertising, or financing. Social workers suddenly find themselves confronted with problems they never encountered before. In many cases these changes are such that former role occupants can not or will not make the change and vacate the role.

In some communities, the oldtimers are unable or unwilling to keep up with the changes demanded of them. Very often a newcomer to the community will take over the role.

Cultural changes are also occurring in the region's communities. As the towns grow larger, they become less relaxed, friendly, traditional, isolated, harmonious, and more run down. At the same time they become more expensive, difficult, progressive, and competitive. The communities are becoming more diverse culturally as new people bring in new ideas. In addition, more professionalism and respect for expertise occurs along with specialization and more complex bureaucratization. People begin to hold the belief that big is better as well as more efficient and cheaper. The workings of the profit motive become more evident. People complain about their neighbors chasing the almighty dollar, or increasing prices to whatever the market will bear. People begin to rely on institutions more. Problems that used to be solved at the family level are now brought to social workers for solution. At the same time, residents become more demanding of institutions. In areas where the lack of medical care had always been a fact, residents are now demanding such care.

The nature of social life is such that people, institutions, and culture are all intricately bound up with one another, are a system, and when one component changes, other components must change as well. Among long time residents the cultural and social changes take their toll. In some cases these responses are pathological; in Rock Springs, for example, the mental health clinic shows an eightfold increase in caseload over 5 years ago, and its director says much of that increase is from long time residents. Among long time residents, at least three ways of responding to the changes in their communities have been observed.

Make The Change. For the largest number of people, taking the changes in stride has been the response. The overworked social worker accepts the larger caseload and works harder. The police chief starts keeping better records, sends his employees to in-service training, and in general updates the department. The shopowner realizes that he/she should remodel the shop if he/she wishes to attract the expanded market. The long time resident goes next door and welcomes the newcomer to the community.

Maintain The Status Quo. Some impact community residents seem to be taking the approach of doing things as they always have, while also mourning the passing of a way of life (which may or may not have been romanticized). If these people are in business, they have not expanded or remodeled, if in government, they have not held more meetings or hired more staff. Such persons are the ones most likely to find themselves relieved of their roles by newcomers or other people more willing to make adjustments to the new demands.

Leave The Situation. Flight has always been one of the options persons have open to them in uncomfortable situations. Flight from the bad situation can take the form of leaving the role that is changing (e.g., sell the store, resign from public office), or it can take a more extreme form of leaving the community entirely.

For newcomers the reaction to living in a boom town is based, not on what the town used to be before the boom, but what the town they came from was like. Their reactions are also based on their reasons for moving to the new community. For example, a family fleeing the pace of a big city to the small town life may be extremely happy; they may be nearly oblivious to the urbanization of the town and may see any lack of facilities or goods as a minor inconvenience more than compensated for by cleanliness, neighborliness, and space. Another family moving from a big city only because the company transferred them may hate the town and may feel the lack of goods and services to be a constant irritant. Finding themselves strangers in a place where large numbers of people know each other may increase their feelings of loneliness. Those who move to towns as large as Rawlins from smaller towns may find the pace too fast, the culture too urban.

DESCRIPTION OF THE ENVIRONMENT

While long time residents who are unhappy blame the boom (or occasionally the newcomers or some "element"among the newcomers), the newcomers blame the town itself. Thus, those newcomers who are unhappy tend to isolate themselves from the town, from its organizations, groups, politics, etc. This is particularly easy since the newcomers have other newcomers with whom to socialize. The extreme of this behavior can be seen in those newcomers who know they will be leaving soon, and who socialize almost exclusively with others who work for their company, who will also leave soon. Newcomers who like the town are much more likely to cross the old/new barrier and participate in the social life of the community.

Change in the physical environment also has affected lifestyles in the region. One change perceived almost universally is an increase in noise, which to many small town residents must certainly symbolize the shift from a small town way of life toward the way of life that characterizes big cities. The overcrowding that some respondents noticed probably means to them the same thing. In places where physical growth has been most extensive, the pattern has been unmistakably suburban; that is the physical appearance and ambience of the new areas are not western or small town. The new areas look like new areas in the surrounding suburbs of any big city: strip commercial developments, car orientation (e.g., large parking lots, many drive-in facilities), tract homes, chain stores, and residential areas with cul-de-sacs and curving lanes. Thus as the culture of the communities changes from that of small town to that of mass society, the physical appearance of the towns undergoes the same change, starting to resemble, if not urban areas, as least suburban ones.

DECRIPTION OF ENVIRONMENT—FUTURE

The future environment would be approximately the same as it is today without issuance of the federal coal leases or of rights-of-way for ancillary facilities. Without these approvals, the project would be more costly and no logical mining unit would be feasible due to the "checkerboard"land pattern of public and private lands. Because of this, only about 50% of the coal would be available for mining, the railroad spur could not be built, and coal would have to be hauled to the railroad main line at Medicine Bow.

Land use recommendations are to maintain wildlife habitat and livestock grazing on the area. The present populations of prairie dogs and eagles in the area would not be disturbed.

The population in those portions of the region that would be impacted by the Carbon Basin project would increase dramatically even without the project. The population of Carbon County would increase 62% to a total of 29,530 by 1990. Rawlins would increase 90%, Hanna/Elmo would increase 56%, and Saratoga would increase 13%. Employment, income, housing demand, school-age populations, etc., would increase in a like manner through 1990.

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

ASSUMPTIONS AND GUIDELINES

The analysis developed in this chapter is an assessment of impacts that would result from the development of coal within the Carbon Basin project area. The development of the Carbon Basin project consists of two phases which employ different mining methods, namely surface and underground. The development of each phase would be accomplished concurrently. The mining operations are independent of each other except for some mine facilities (shop, office, coal handling, etc.) and ancillary facilities (rail spur, access road, etc.) which are common to both.

The following narrative and table were developed to establish assumptions and guidelines for analysis of the proposed Carbon Basin project.

Assumptions

Complete data on reclamation success in the southcentral region are not available. Preliminary success, based on observations of seedings on reclaimed areas less than 4 years old, has been minimal and in some cases a total failure. These minimal results are attributed primarily to climatic conditions (low precipitation, low humidity, strong winds, etc.); also to the method of handling overburden, parting material and topsoil, and the minimal use of seed mixture, contour furrowing, and mulching (Reference Southcentral ES, Regional, Chapter 2, Vegetation).

Based on field observations of other reclaimed areas such as roadside cuts and fills, barrow areas, consultation with others, etc., it is estimated that reclamation would occur as outlined in items 2 and 3 that follow, assuming that proper mitigating measures will be applied.

Guidelines

1. Impacts are analyzed for two time points 1990 and end of mine life.
2. Preliminary reclamation on an area is considered complete when disturbed lands have been backfilled, graded, contoured, and seeded.
3. Complete reclamation of an area will occur on the following schedule:
   a. 1½ years for filling, shaping, contouring, seedbed preparation, and seeding.

   b. 4½ years would be required for establishment of vegetative cover of the seeded species which would support small game animals, rodents, and limited deer use.

   c. Establishment of a desirable shrub cover would require 15 to 20 years.
4. One out of three seedings will fail due to climatic conditions.
5. All livestock grazing on the project area will be deferred during the life of the mine.
6. The extent, magnitude, and length of time subsidence could occur is unknown at this time. Subsidence will be affected by the mining method used, depths of beds mined, and the number of beds mined. The type of rock strata, or "roof"rock over the beds will also influence subsidence. Subsidence could range from 0-50 feet (the maximum amount, assuming complete recovery of coal in the Blue and Finch groups and the Johnson seam). In reality surface expression of subsidence would most likely range from 0 feet (no surface sxpression) to a maximum of 25 feet over the whole area.

The following table is presented to provide an overview of the total land disturbance. The location of these possible facilities and the acreage associated with each cannot be determined without additional data. Table CA3-1 portrays the acres of land disturbed and reclaimed during each designated time period by various activities related to the development of the Johnson coal seam. Table CA3-2 depicts the relationship of the Carbon Basin project to the energy related developments (proposed mines, existing mines, and non-coal development) discussed in the Southcentral Regional Coal ES.

CLIMATE

It is not expected that the mining activities at the proposed Carbon Basin Mine site would affect the frequency or amount of showers or thunderstorm activity, from which the bulk of the precipitation is derived. Possible changes in the radiation balance due to character of the soil would be undetectable. The alternation of the terrain may change local drainage wind patterns but this impact beyond a local level would be undetectable.

AIR QUALITY

Emissions from the Proposed Mine

Typical mining activities in Carbon Basin would produce large quantities of particulate emissions. Only a small portion of the total particulate emissions from a mine can be applied to existing national ambient air qual-

Table CA3-1*

ACREAGE DISTURBED BY ACTIVITY AND ACREAGE RECLAIMED OVER PERIODS OF TIME

Activity	Time Periods 1990	1990+**	Total
Final Contour	1,416	0	1,416
Mine Pit Areas	(807)	(0)	(807)
Overburden Storage	(437)	(0)	(437)
Haul Roads	(172)	(0)	(172)
Mine Facilities a.	209	18	227
b.	(241)***		(241)***
Ancillary Facilities	500	0	500
Relocation (County Road)	6	0	6
Subtotal	2,131	18	2,149
Population	192	0	192
Total	2,232	18	2,341
Acres Reclaimed	833	1,316	2,149
Underground Mining	1,282	11,240	12,522

* This table does not include the acreage of surface disturbance that could occur with the development of the Blue and Finch coal seams.

** 1990+ refers to end of mine life.

*** The 241 acres would be first surface mined, then partially reclaimed and utilized as mine facility construction sites. This acreage is included in the final contour acreage of 1,416.

Table CA3-2

PROJECTED CUMULATIVE SOUTHCENTRAL REGIONAL SURFACE ACRES TO BE DISTURBED AND RECLAIMED AND OTHER DEVELOPMENT DATA ON PROPOSED MINES: EXISTING MINES AND NON-COAL RELATED DEVELOPMENTS: AND CARBON BASIN PROJECT BY 1990

Activity or Project	Proposed Mines	Existing Mines and non-coal dev.[9/]	Carbon Carbon Basin	Total	% Increase in Region[8/]
Final Contour[1] (Acres Disturbed)	4,605	10,286	1,416	16,307	9.5
Mine Facilities[2] (Acres Disturbed)	349	61	209	619	51.0
Ancillary Facilities[3] (Acres Disturbed)	400	23	500	923	118.2
Facility Relocation[4] (Acres Disturbed)	206	--	6	212	2.9
Housing and Support Facilities (Acres Disturbed)	344	111	192	647	42.2
Non-Coal Related Disturbance[5] (Acres)		2,375		2,375	
Acres Reclaimed[6]	2,497	10,450	833	13,780	
Water Use ac ft/yr (noncumulative)	910	295,210	860	296,980	0.3
Number Coal Mines	3	6	1	10	
Tons of Coal Produced (Millions)	46	158	31	235	15.2
Number Oil and Gas Wells	--	408	--	408	
Employment Increase	385	1,131	1,323	2,839	87.3
New Power Lines (Miles)[7]	45	70	0	115	
New Rail Spur[7]	8	3	13.4	24.4	
New Pipelines (All Kinds)[7]	3	182	--	185	
New Access Roads[7]	9	0	.19	9.19	
New Telephone Lines	4	0	8	12	

1 Includes mine pit area, haul roads, topsoil and overburden storage areas.

2 Includes surface facilities, rail spur, access road, power lines, telephone lines and water storage areas inside project boundary.

3 Includes access roads, haul road, rail spur, power lines, telephone lines, pipelines, coal conveyor and water storage outside project boundary.

4 Includes power line, telephone line and Highway 789 relocation.

5 Includes areas disturbed by oil and gas production, uranium, sand and gravel, prison construction, housing, support facilities, etc.

6 Areas on which topsoil has been replaced and shaped, seedbed prepared and seeded.

7 Future estimates based on past occurrences.

8 Percent of increase from Carbon Basin.

9 Non-coal development includes oil and gas, uranium, sand and gravel, etc.

ity standards (NAAQS). Fugitive dusts (native soil uncontaminated by pollutants resulting from industrial activity) are excluded from assessment as part of the NAAQS and prevention of significant deterioration (PSD) standards (43 CFR 118). They are however, considered as an impact for purposes of cumulative impact assessment. Fugitive dusts are controlled through best management practices (includes all procedures that can be reasonably used to control fugitive dusts) on a case-by-case basis. In any event, the worst case mine scenario is discussed, and best management practices (addressed in Chapter IV mitigation and discussed in detail in Appendix A) would produce fewer and less intense impacts.

Ten major sources of fugitive dust would be associated with the potential mining facility: haul road traffic, truck dumping, shovel/truck loading, front-end loading, drilling, blasting, topsoil removal, stockpiling, access road traffic, and wind erosion from exposed areas. Two point sources would be coal crushing and train loading. Table CA3-3 lists these emission sources and the corresponding emission factors. The annual emissions from the proposed site were calculated using the emission factors listed in the table. The operational parameters were obtained from the typical mining and reclamation report for Carbon Basin.

Emission inventories were performed for the mining years 1990 and the end of mine life. These inventories are the best approximations of the complex interaction of variables. Table CA3-4 presents the annual emissions from each source for the designated years.

Other potential air pollution sources identified are exhaust emissions from diesel-powered haul trucks and employer/employee motor vehicles. Emission factors for vehicular travel were obtained from EPA's most recent compilation of mobile source emission factors and 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 CA3-5. These emissions are from both employer/employee travel on the typical mine site and haul trucks.

Impact on Air Quality

The impact of the above annual emission on the nearby ambient total suspended particulate (TSP) concentration were determined by use of the Modified Climatological Dispersion Model-Version 3 (MCDM-V3), (PEDCo Environmental, Inc. 1976).

The model performs both annual and worst case 24-hour averaging period. Source data input consist of the following: source locations; source emissions rates; emission heights; locations where ground level pollutant concentrations are desired; and frequency of occurrence of each of sixteen wind directions, six wind speeds, and six stability classes.

MCDM determines long and short-term quasi-stable pollutant concentrations at any ground-level receptor using average emission rates from point and area sources and a joint frequency distribution of wind direction, wind speed, and stability for the same period. Climatological input data are in the form of a Stability Rose (STAR) deck. The STAR deck used for modeling the Carbon Basin typical mine was generated from data collected at the Rawlins, Wyoming weather station. Also included in the program is a particulate fallout function to simulate the deposition of the large suspended particulate as it disperses downwind. The fallout rates incorporated in the model were based on sampling data from several western coal mines and are functions of wind speed, atmospheric stability, and particulate size (PEDCo Environmental, Inc. 1978).

Maps CA3-1 and CA3-2 show the annual predicted and resulting ambient TSP concentrations for the years 1990 and end of mine life as determined by the model. Maps CA3-3 and CA3-4 show the worst case 24-hour predicted and resulting ambient TSP concentrations for the same study years. Concentrations in both situations are shown to decrease rapidly with distance.

Maps CA3-1 and CA3-2 and Table CA3-4 indicate that fugitive dust emissions from overburden removal and access road traffic dominate the resultant ambient particulate concentration.

The majority of the air quality impact would be centered around the mine access road and haul roads and the prevailing winds would cause the impact to take place mostly to the east and northeast of these sources. By comparing Maps CA3-1 to CA3-2, the haul road impacts can be distinguished somewhat from the access road impact since at the end of mine life the haul road usage would be at a minimum. Annual particulate concentrations of 46 micrograms per cubic meter ($\mu g/m^3$) and above 50 $\mu g/m^3$ 24-hour worst case would be predicted as far northeast as 14 miles and 10 miles east of the Carbon Basin typical mine.

Stationary sources of particulate emissions at the Carbon Basin typical mine are not expected to violate the annual and 24-hour NAAQS nor the Class II increments (Based on 43 CFR 118). However, fugitive dusts, to be controlled under best management procedures, are still the most significant impact of surface mining. Chapter 4 discussed additional mitigating measures which can significantly reduce fugitive dust impacts.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the typical facility (see Table CA3-5). Federal and state regulations include limitations on ambient air concentrations of the vehicle-related pollutants CO, HC, nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). Predicted concentrations of these pollutants were not modeled due to the lack of detailed data on vehicle

Table CA3-3

FUGITIVE AND POINT SOURCES IDENTIFIED AT THE CARBON BASIN TYPICAL MINE WITH CORRESPONDING EMISSION FACTORS*

Source	Emission factor
FUGITIVE:	
1. Haul roads	6.8 lb/vehicle mile traveled
2. Truck dumping	
a. Coal	0.02 lb/ton dumped
b. Overburden	0.002 lb/ton dumped
3. Shovel/truck loading	
a. Coal	0.007 lb/ton loaded
b. Overburden	0.037 lb/ton loaded
4. Front-end loading	0.12 lb/ton loaded
5. Drilling	
a. Coal	0.22 lb/hole drilled
b. Overburden	1.5 lb/hole drilled
6. Blasting	
a. Coal	72.4 lb/blast
b. Overburden	85.3 lb/blast
7. Topsoil removal	
a. Scraping	0.35 lb/yd^3 scraped
b. Dumping	0.03 lb/yd^3 dumped
8. Stockpile	8.64 lb/acre-hr
9. Access road	5.11 lb/vehicle mile traveled**
10. Exposed areas (wind erosion)	0.42 tons/acre-year***
POINT SOURCES:	
1. Coal crushing	0.005 lb/ton crushed
2. Train loading	0.0002 lb/ton loaded

*Emission factors from PEDCo Environmental Inc. 1978, except as noted.
**Calculated from formula in U.S. Environmental Protection Agency, 1975.
***Calculated from formula by Midwest Research Institute, 1975.

Table CA3-4

ANNUAL EMISSIONS FROM EACH MAJOR SOURCE
FOR EACH STUDY YEAR

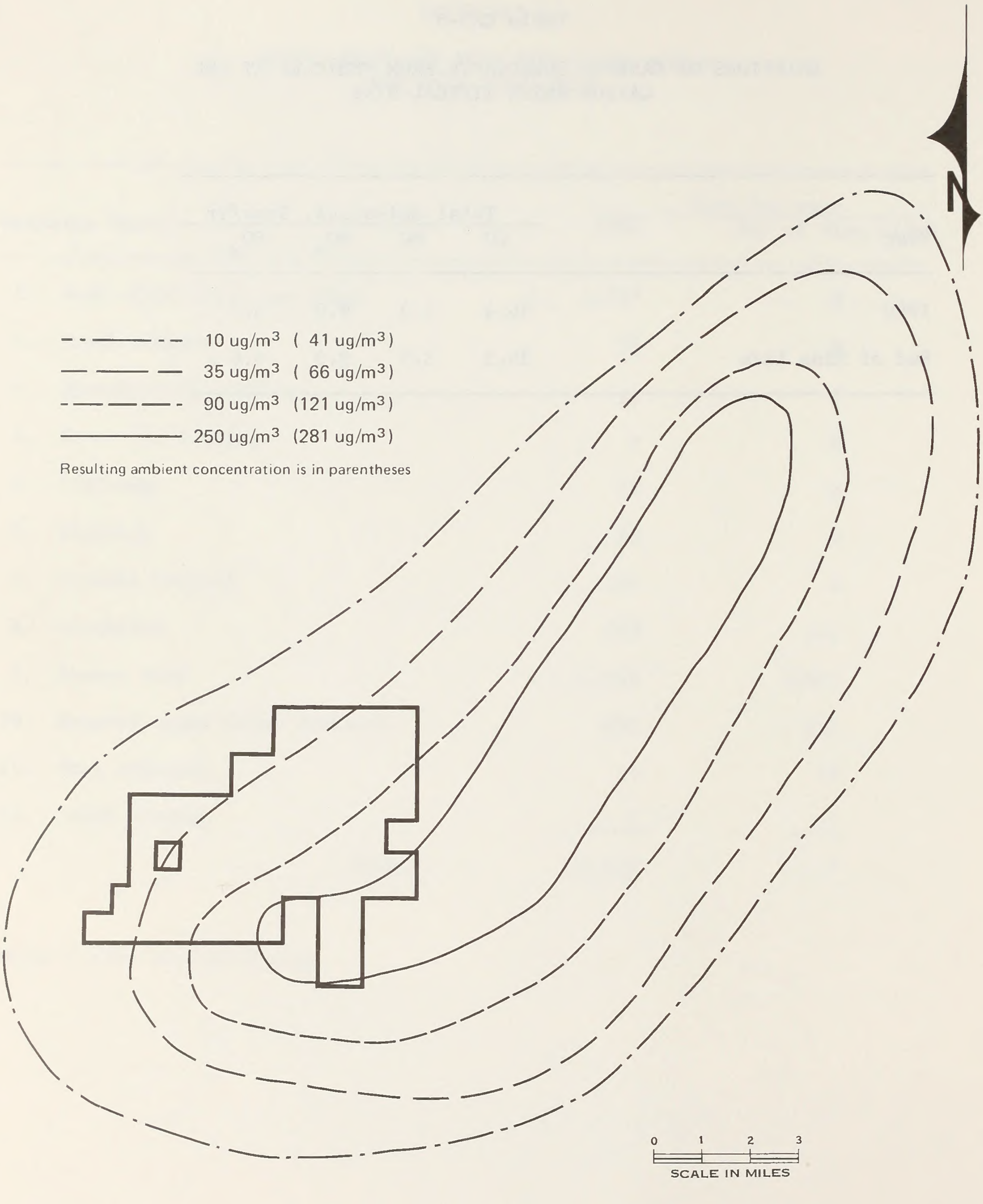
Emission Source	Tons per year	
	1990	End of Mine Life*
1. Haul roads (with watering)	6,917	0
2. Truck dumping	51	0
3. Shovel/truck loading	671	0
4. Front-end loading	9	0
5. Drilling	11	0
6. Blasting	20	0
7. Topsoil removal	186	0
8. Stockpile	240	240
9. Access road	4,599	3,679
10. Exposed areas (wind erosion)	631	217
11. Coal crushing	13	10
12. Train loading	1	1
Total	13,349	4,147

*Last Active Year of Mining

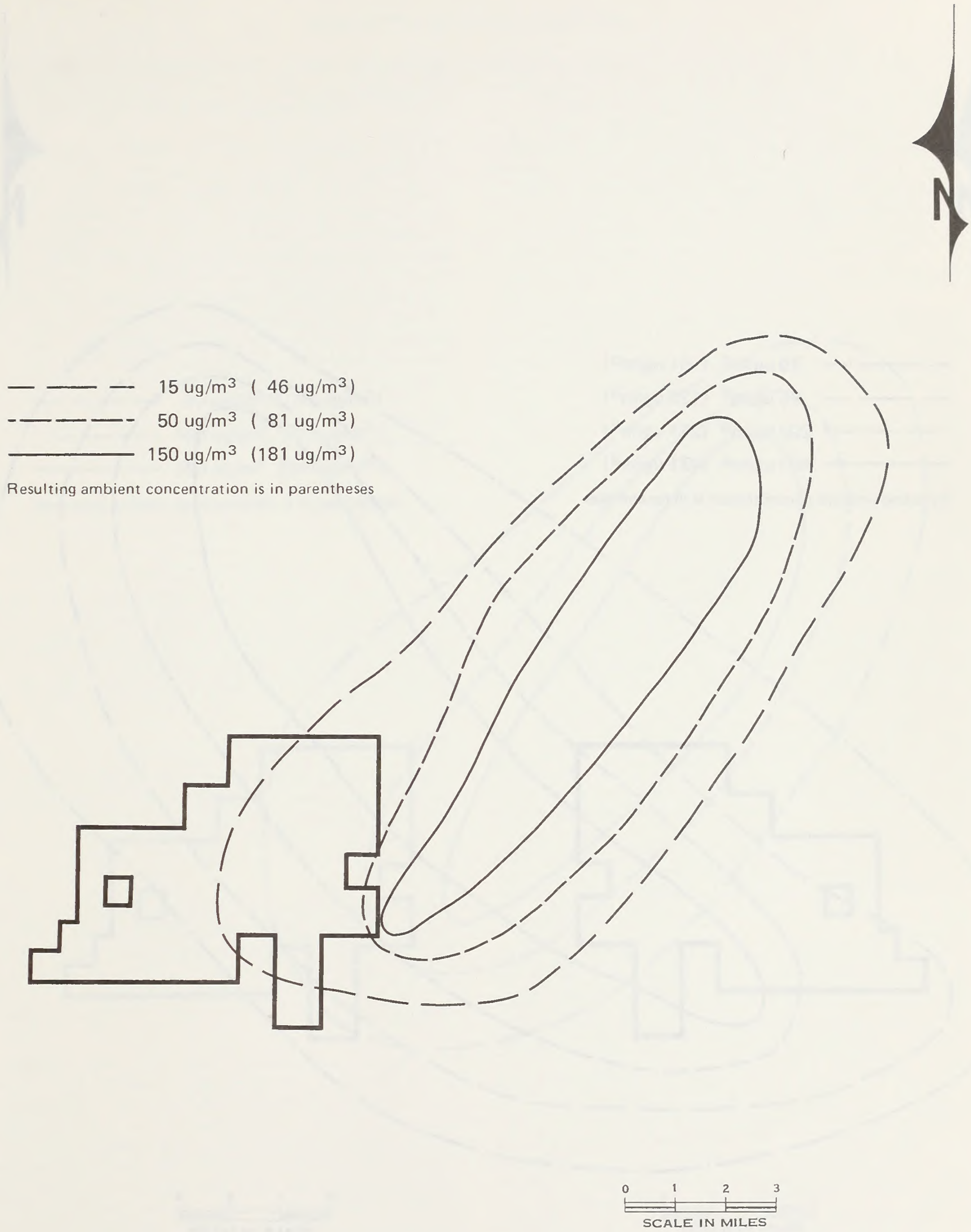
Table CA3-5

EMISSIONS OF GASEOUS POLLUTANTS FROM VEHICLES AT THE CARBON BASIN TYPICAL MINE

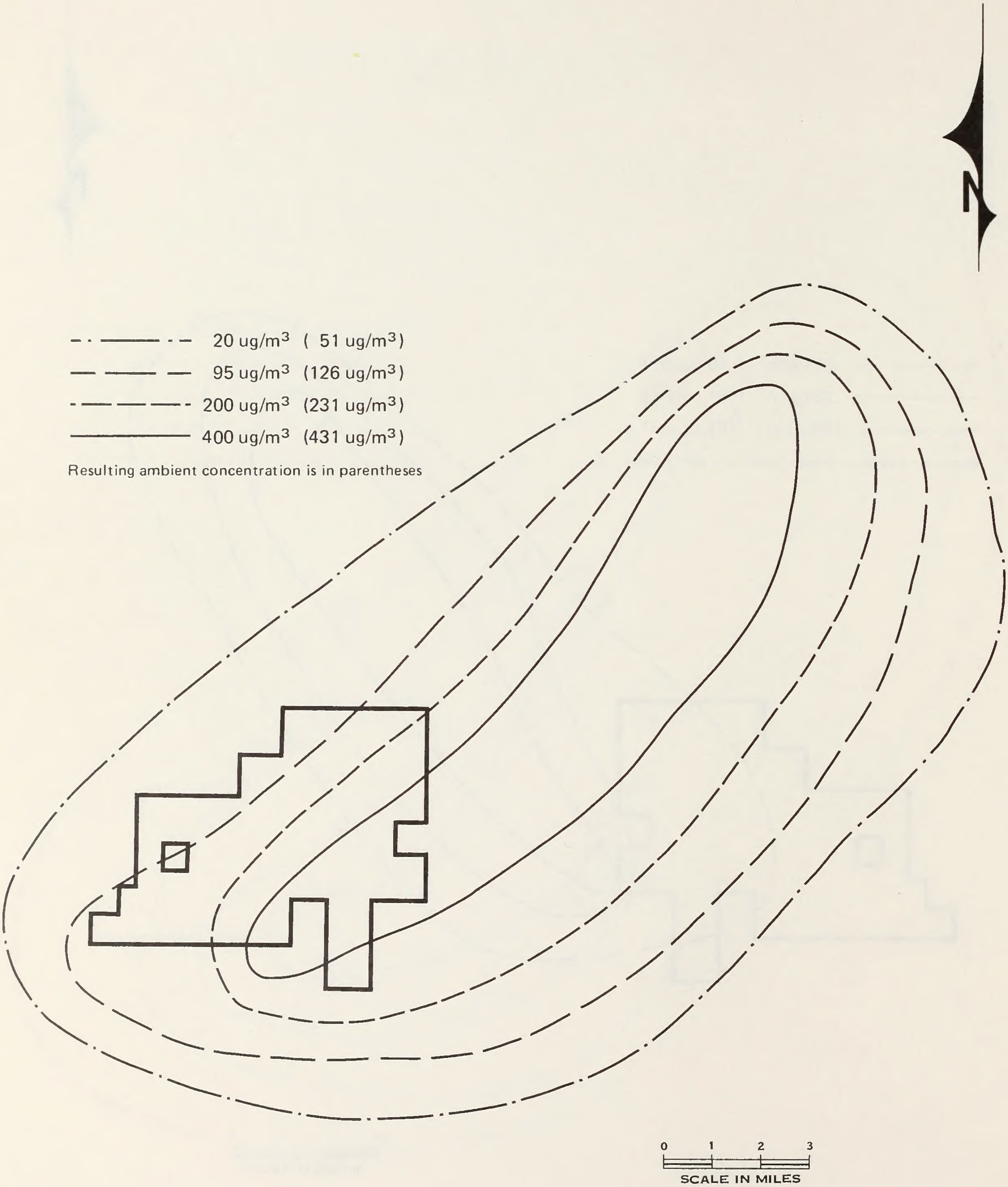
Year	Total Emissions, Tons/Yr			
	CO	HC	NO_x	SO_x
1990	36.4	3.9	9.9	3.7
End of Mine Life	35.3	3.5	9.3	0.6



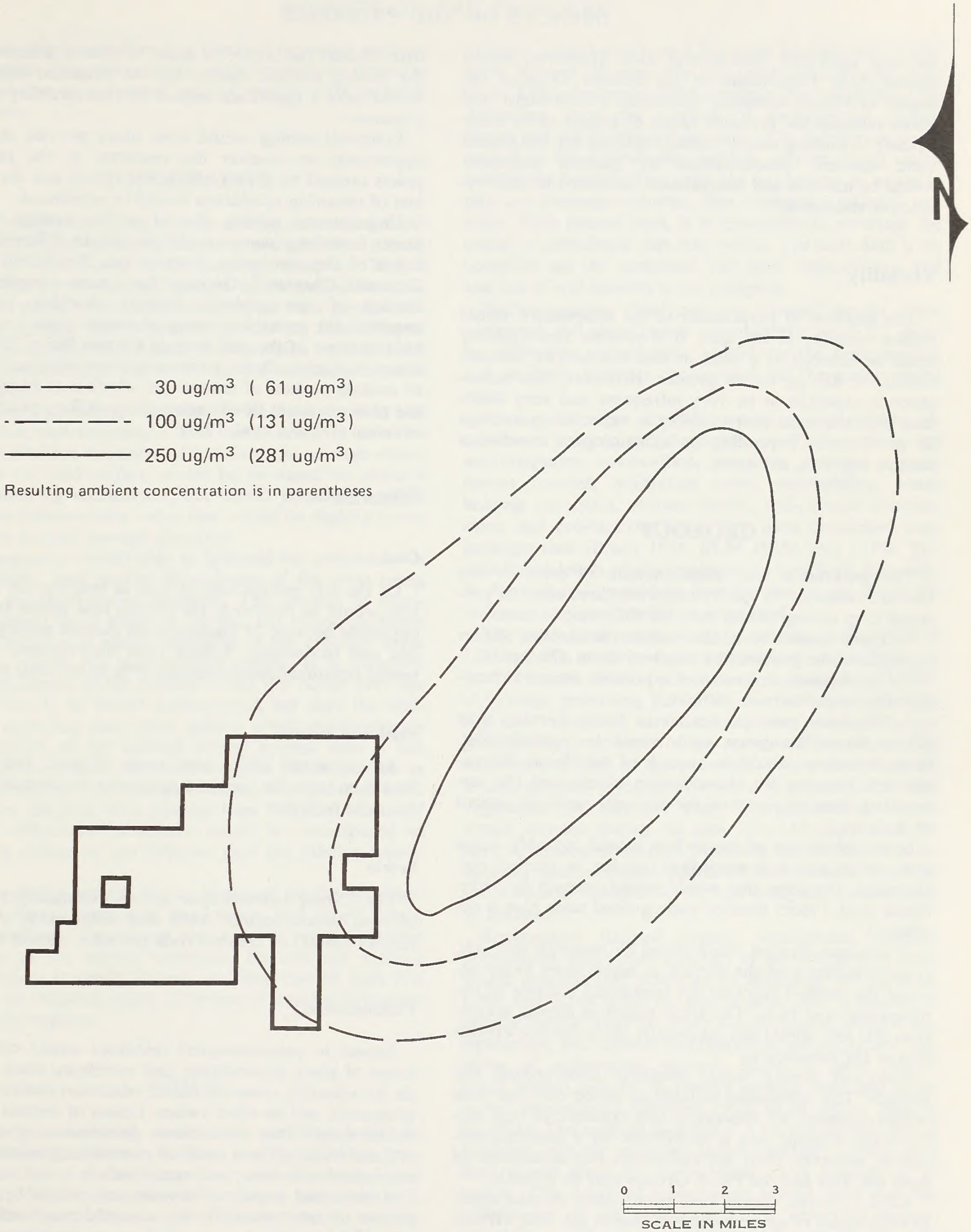
Map CA 3-1
ISOPLETH MAP SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1990



Map CA 3-2
ISOPLETH MAP SHOWING ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR THE END OF MINE LIFE



Map CA 3-3
ISOPLETH MAP SHOWING 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR 1990



Map CA 3-4

ISOPLETH MAP SHOWING 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS FOR THE END OF MINE LIFE

use and applicable background data. However, recent studies (U.S. Department of the Interior 1976) of 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 typical 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. It is possible that visibility could be reduced to 4 miles or less, due to TSP concentration of 400 $\mu g/m^3$ or greater. However, this occurrence is expected to be very infrequent and very localized. For the most part visibility is expected to average 26 to 47 miles depending on climatological conditions such as fog, rain, and snow.

GEOLOGY

The excavation and transformation of parts of the Hanna Formation to spoil piles in the three areas of proposed strip mining would have the following impacts:

1. There would be a decrease in the stability (shear strength) of the ground to a depth of about 170 feet.
2. Geophysical exploration for possible deeper mineral deposits would be more difficult.
3. The local geologic history in Early Tertiary time (40 to 60 million years ago) would be partially lost. However, there would be enough of the Hanna Formation left between the three mining blocks and the surrounding area to preserve the regional geologic record of the area.

Some subsidence of the surface would probably occur over areas where underground mining is carried out. However, the areas that would subside cannot be determined until a more detailed underground mine plan is developed.

In the case of areas being mined by longwall methods, rapid subsidence of the surface is much more likely because the method involves the intentional collapse of the mined-out coal beds. The areas mined at depths greater than 300 feet would not necessarily show surface expression of the subsidence.

Longwall mining would minimize underground fire hazards. The intentional collapse of mined out coal beds would minimize air movement and exposure of coal surface area. Present data is insufficient for a final determination, however, there are indications that some areas of both the Blue and the Finch Groups may be minable.

Drill core data shows local occurrences of coal seams in thicknesses of approximately 5 feet in the Blue Group, and approximately 10 feet in the Finch Group. Further data will be supplied to the BLM by GS regarding the feasibility of mining these seams. If these seams prove minable, plans would be made to recover the resource concurrent with the proposed mining, or at some future date. Should the choice be made to mine at a future date the mining method chosen for the proposed operation would have a significant impact on recoverability of this resource.

Longwall mining would most likely provide the best opportunity to recover the resource, as the pressure points created by pillars would not occur, and the problem of recurring subsidence would be minimized.

Underground mining of coal in the western United States sometimes causes rockburst due to differential releases of the continuing pressure (see Southcentral ES, Regional, Chapter 3, Geology for a more complete discussion of this geologic hazard). Another geologic impact is the probable venting of natural gases known to exist in some of the coal beds in Carbon Basin. The coal seams in Carbon Basin are known from previous mining to contain pockets of natural gas which may blow out if the pressure is not slowly released by drilling prior to excavation (Dobbin et al. 1929).

Minerals

Coal

Of the 400 million tons of coal in reserve, 206 million tons would be removed; 194 million tons would be unrecoverable because of limitations on current mining methods and technology. Losses from underground mining would constitute approximately 99% of the total loss.

Sand and Gravel

An estimated 2,000 cubic yards of sand and gravel would be used for concrete aggregate in construction of the mine facilities.

Scoria

The 13-mile railroad spur and approximately 14 miles of road would require 6,600 and 6,000 cubic yards of scoria (clinker) or crushed rock per mile, respectively.

Paleontology

Impact to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses of various degree would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

All exposed fossiliferous formations within the area could also be affected by 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 general lack of specific data on such activities.

TOPOGRAPHY

The temporary effect of strip mining on existing landforms (1,244 acres) during the proposed period of mining (1978 to 1990) would be the moving cut up to 170 feet deep, and the increasing piles of spoils behind the cut. The net effect after reclamation would be a gently rolling topography that would be similar to, but different than the existing land surface. A depression would be left in the final cut area that would have a maximum slope of 16 degrees.

Taking an average thickness of the Johnson coal bed of 20 feet, and assuming a 20% swell factor for an average overburden thickness of 130 feet, the average elevation of the land surface would be increased by about 6 feet following reclamation, but would gradually resettle to some indeterminate value that would be slightly lower than the present average elevation.

Topography would also be affected by subsidence in the existing land surface above some of the areas being mined by underground methods. The amount of subsidence could be as much as 20 feet, but would probably be less because of elastic expansion of the geologic strata directly above the underground cavity. It is expected that subsidence of the surface would not occur over the entire area to be mined underground, but only the shallower parts less than some critical depth depending on the strength of the existing strata. Present data is not adequate to predict the critical depth, but it may be as low as 300 feet over the short term, or as great as 1,000 feet over the long term (greater than 50 years). Areas of abrupt differential subsidence would be recontoured so as to be similar to, but different than the existing topography.

Topography would also be impacted by the construction of the railroad spur, haul roads, and access roads, but the effects of necessary cuts and fills would be minor relative to the mining operation. Because the existing land surface is gently sloping, no deep cuts or high fills would be required. Some diversion of existing drainages would be required.

SOILS

Underground mining would cause soil disturbance by the construction of mine facilities (surface buildings, portals, ventilation shafts, power lines, and telephone lines), ancillary facilities (access road, rail spur, water storage), and relocation of county road. This disturbance cumulatively would occur on 956 acres by 1990 and 974 acres by end of mine life. An additional 192 acres would be utilized by mine-related population needs (see Table CA3-1 and CA3-2). Some expected surface subsidence resulting from underground mining could cause soil disturbance cumulatively on 1,282 acres by 1990 and 12,522 acres by end of mine life or continuing into the long term. This subsidence could continue after mine life ends depending upon the method of underground mining (room and pillar versus long wall). The subsidence is expected to be a gradually uniform process (long wall). Subsidence would effect soils due to changes in topography and drainage patterns, thus changing erosional patterns. With present data, it is impossible to ascertain the extent of subsidence that may occur. The soils data is incomplete on the proposed rail spur right-of-way and analysis of soil impacts is not complete.

Surface mining (final contour acreage) would cause additional soil disturbance cumulatively on 1,175 acres by 1990. The surface mine would use the same surface and ancillary facilities constructed for the underground mine.

Mining and other activities would impact soils by alteration of existing soil characteristics. These include soil microorganism composition, structure, textures, organic matter content, infiltration rates, permeability, water holding capacities, nutrient levels, soil-climatic relationships, and productivity levels that have developed over geologic time (Brady 1974; BLM 1975a; Bay 1976). The established levels of soil productivity (see Soils Appendix A Agricultural) would be lost for the period from disturbance until reclamation is successful.

The loss of soil productivity (premining average 250 to 1,200 pounds air dry vegetation per acre per year) levels on 2,149 acres would be reclaimed to approximate 100% of average premining levels. At the time of initial seeding and vegetative establishment, the post-mining soil productivity over most of the reclaimed areas would be an estimated 75% of the potential. This potential would be an estimated average 250 to 1,200 pounds of air dry vegetation per acre per year. The productivity levels would increase during the next 10 to 15 years after the start of initial reclamation, primarily due to proper management and increased microbial, interactions. Physical and chemical changes in the soil ecosystem would also be initiated.

Reclamation (shaped, topsoil replacement, seedbed preparation, and initial seeding) of surface mining areas would cumulatively occur on an estimated 833 acres by 1990; and 2,149 acres by end of mine life. Amounts of suitable topsoil material, steep slopes, aspect, surface manipulations, and climate (precipitation) are important variables of reclamation success. Some of these factors could impact soils by increasing erosion rates and losses in soil productivity (Monsen 1975; BLM 1975a, May et al. 1971). The analysis in Table CA3-6 shows amounts of available suitable material (approximately 2,049.2 acre feet) would allow for replacement of an average of 12 inches. This depth of replacement would allow for reestablishment of soil productivity and reduction in erosional losses. The lack of suitable soil material, the soils characteristically poor for reclamation aspect, and moderately steep to steep slopes are evident on Carbon Basin in mapping unit 401 and 3-1 (see Soil Map CA2-2). The disturbance of these soils (in 401 and 3-1) could lead to an improvement in soil productivity, since soil depths and slopes would be improved.

Mining would involve the excavation and storage of topsoil (6 storage areas) and the storage (437 acres) of usable and unusable overburden material. Increased wind and water erosion would occur from stockpiled materials. Mining activities would also increase soil loss from increased fugitive dust levels, especially haul road dust.

Mining would expose materials in the Hanna formation that could hamper reclamation. The paucity of overburden data (4 test holes) over surface mining area limits the impact analysis. Additional overburden analysis data would be required from any successful lessee with their submission of mining and reclamation plan. The limited overburden data does identify that surface mining operations would expose overburden parting materials that would be unsuitable for reclamation (see Table CA3-7). This includes material with high pH, salinity (E.C.), alkalinity (SAR), high levels of Boron (4.01 ppm) and material with high amounts of clay (greater than 40%). This material would have to be separated and buried beneath the suitable overburden. The soil survey (VTN 1978; USDA, SCS 1978) over the project area shows a moderate or high accumulation of salinity and/or alkalinity in subsoil (below 6 inches) in mapping unit 257. The high salinity and alkalinity levels would make localized portions of the subsoil of 257 soils unsuitable for topsoil reclamation material.

The exposure, compaction, burial, stockpiling, disturbance, and contamination of surface soil would cause reductions in the current levels of soil productivity and increase soil loss from wind and water erosion. The stockpiling of surface soil would degrade the biological, chemical, and physical properties, causing temporary reductions in productivity when used as reclamation topsoil material (Monsen 1975; BLM 1975a; Singleton and Cline 1976). Accidental spills of oil, gasoline, and other toxic materials would contaminate soil profiles, especially around mine facilities. This spillage would contaminate and sterilize soil horizons, rendering the affected soil unusable for reclamation.

All of the mining disturbances would result in accelerated erosion by wind and water upon presently existing soils, soil material, and overburden spoilpiles, due to exposure and increased activity (Monsen 1975). Wind action, which is fairly constant over the area, would cause fine particles to be lifted from the exposed surfaces and blown away. Wind erosion from the exposed areas would be an estimated 0.42 tons/acre/year. Prior to revegetation of exposed, disturbed, and stockpiled soils, high intensity storms (possibly occurring about 1 year in 10, to 1 year in 25 years and usually in late May or June) could lead to increased water erosion (Lowham 1976; Becker and Alyea 1964). The increased erosion would result from the disturbed soils not having any protective cover and the reduction of soil infiltration rates (resulting from compaction and steep slopes) causing increased runoff (Dollhopf et al. 1977). The erosional rates over the final contour areas prior to revegetation would be an estimated 2.4 to 5.0 tons/acre/ year.

Alterations of soil horizons due to mining, subsidence, culverts, drainage ditches, diversions, and changes in topography (slope) could increase flow velocities from unprotected surfaces and could accelerate sheet, rill, and gully erosion. The areas of concern would be on reclaimed areas where loss of protective ground cover would subject surfaces to increased erosion, and diversions on Third Sand Creek (Mapping unit 257).

Off-road vehicle (ORV) use by the increased population would cause soil loss through disturbance and erosion of sensitive surface soil horizons (USDA SCS 1978 and BLM 1975a).

All developments (surface mining, mine facilities, ancillary construction, and mine associated increased population needs) would cumulatively disturb soils on 2,323 acres by 1990; and 2,341 acres thereafter (1990). The disturbance on 2,149 acres would be of a temporary nature since it would be eventually reclaimed. The loss of soil productivity would be permanent on 192 acres by the end of mine life, since urban facilities would be retained. The 2,149 acres disturbed by surface mining and mine facility construction (surface and underground) would be approximately 14% of the project area.

WATER RESOURCES

Groundwater

Although insufficient data are available to permit an accurate numerical assessment of impacts, the types of impacts can be predicted.

The aquifers in Carbon Basin are separate from regional aquifers; therefore, all impacts on groundwater would be confined to the basin and would be minimal. Not more than 10% of the recharge area around the rim of the basin would be disturbed and replaced by spoils as a result of surface mining.

The coal, which is a principal aquifer of the basin, would be removed through underground mining. In its place would be left either an open or fractured zone that would transmit water at a faster rate than the coal. Both surface and underground mining, but especially underground, would intercept small quantities of water that move through the coal (Mesilla Valley Engineers—1978 estimate a maximum drainage of 40,000 gallons per day—gpd to surface pits) and could disturb relatively unimportant aquifers lying above and below the coal. The aquifers above the coal could be dewatered through downward drainage to the underground mine. The drainage could be intensified by fracturing that resulted from subsidence. Aquifers below the coal could be dewatered by upward movement of water into the mine. Although pressures of 200 to 300 pounds per square inch (psi) may exist, the pressure would dissipate rapidly and there would be little potential for mine floors to buckle.

After mining ceased, water levels would gradually return to the premining level in aquifers immediately above and below the mined area. Complete recovery would take at least 40 years; therefore, aquifers would be

Table CA3-6

VOLUME OF USABLE TOPSOIL MATERIAL

Map Unit[1]	Composition of Unit[2]	Disturbed Acres[3]	Average Depth Of Usable Soil (Inches)[4]	Volume of Usable Soil (ac-ft)[5]
2-3	Blackhall (50%)	16	4-10	2.7-6.7
	Blazon (30%)		6	2.4
3	Blazon (75%)	34	6	12.7
3-1	Blazon (40%)	380	6	60.0
	Shinbara (30%)		0	--
3-4	Blazon (50%)	37	6	9.2
	Delphill (30%)		27	25.0
3-10	Blazon (40%)	199	6	40.0
	Satanka (30%)		13	65.0
6	#15 (75%)	56	20-60	70.0-210
6-7	#15 (40%)	172	20-60	115.0-344.0
	Forelle (40%)		29-60	166.3-344.0
7	Forelle (75%)	53	29-60	96.1-198.7
	#15 (25%)		20-60	22.1-66.2
8-2	Ryan Park (40%)	25	17-60	14.2-50
	Blackhall (30%)		4-10	2.5-6.2
8-5	Ryan Park (40%)	82	17-60	46.5-164.0
	Grieves (30%)		12-60	24.6-123.0
9	Rock River (75%)	16	12-60	12.0-60.0
	Satanka (25%)		13	4.3
9-2	Rock River (40%)	17	12-60	6.8-34.0
	Blackhall (20%)		4-10	1.1-2.8
257	Havre (85%) Glendive	52	6-60	22.1-221.0
401	Torriorthents-Rock Outcrop	341	0	--
	TOTAL	1,480		820.6-2,049.2

Table CA3-6
(Continued)

VOLUME OF USEABLE TOPSOIL MATERIAL

1 Mapping units from soil Map CA2-2

2 Composition of mapping units are those of the dominant soil series: minor soils comprising a part of soil associations are not included in this table; therefore, the composition does not total 100% for each association.

3 Acres disturbed are those acres in Sections 35, 31, 1, and 29 that would be disturbed by surface mining and construction of mine facilities (both surface and underground).

4 Estimated usable depths of usable topsoil material in each association (includes A, B, and C horizons).

5 Volume of soil material available in acre feet based upon acres disturbed, % in soil association, and inches available in each.

Sources: VTN 1978; USDA SCS 1978; BLM 1978

Table CA3-7

OVERBURDEN ANALYSIS FOR SUITABILITY AS SOIL MATERIAL

Test Hole No.	Depth of Level (feet)	Limiting Factor*
35-12-3	10- 20	Low pH, clay
	20- 65	Clay
	65- 80	High pH, clay
	80-100	High pH, clay
1-19-6	25- 30	E.C., clay
	80-105	Clay
	100-115	SAR
	115-135	High pH
31-38-1	0- 5	Clay
	25- 30	Boron
	55- 80	Clay
	80- 95	Clay SAR
29-20-2	5- 10	Clay
	15- 35	Clay
	75- 80	Clay
	85- 90	Clay
	100-110	Clay
	110-120	Clay SAR
	120-130	Clay

*Limiting Factors--The overburden with limiting parameters would have to be separated and buried beneath suitable overburden material.
Low pH--acidic material; High pH--alkaline material;
E.C.--salinity; SAR--alkalinity and/or salinity;
Clay--high clay content >40%; and Boron (4.01 ppm).

Source: VTN 1978 Overburden Analysis; BLM 1978 non-productive for about 80 years. Aquifers lying higher above the mined area might never recover to present levels. Complete loss of aquifers in Carbon Basin would cause very little impact on any phase of the regional economy.

The aquifers, which are small in areal extent, are unimportant because they contribute little to the regional water supply and are essentially undeveloped. Loss of the aquifers would cause no hardship on nearby users, but could cause some springs used by wildlife to go dry. These springs are not primary water sources for the animals; therefore, their loss would also cause little impact.

Surface Water

Surface mining would alter the drainage pattern of several small ephemeral streams. The drainages would be partially restored after surface operations were completed, leaving no lasting impact. Even during mining there would be no impact outside the project area. Surface patterns may also be altered as a result of subsidence caused by underground mining. Subsidence may also cause sufficient fracturing to allow water to drain from stream channels into the mined out area.

Third Sand Creek and its tributaries flow through an area where surface mining is feasible; therefore short reaches of these streams probably would be diverted around mine pits through temporary diversion channels and water would be treated in sedimentation ponds that meet the minimum legal requirements. Downstream from the ponds, channels would adjust to the amount of water they were required to carry (see Map CA3-5). The magnitude of the changes would depend on the amount of water released. The normal change occurring, when discharge is reduced and the cleaning effect of flood is eliminated, is for banks to cave and become vegetated causing a narrower less defined channel. Neither the impoundment of water nor the resultant channel changes would have any impact on the general economy of the region and there are no downstream users to be impacted.

The rail spur would cross Second Sand Creek and a plain, on which are few defined channels. The impact on water resources from the rail spur would be negligible.

Quality

The isolated nature of Carbon Basin precludes any impact on water quality outside of the basin. Waters within the basin are moderately to highly mineralized, but showed no tendency to be acidic or toxic. Also there are no dangerous quantities of acid or toxic producing elements in the overburden. Therefore, no significant changes in quality of groundwater are anticipated.

Water released from the ponds would of necessity be of better quality than that now carried by the undisturbed streams. The sediment load delivered to the Medicine Bow River during the period of sedimentation pond operation would be significantly less than the load delivered by undisturbed streams; however, if clean water were released at a rate sufficient to cause scour as described above, the net amount of sediment reaching the river would not differ appreciably from what now reaches the river.

The chance of a pond failure releasing a large slug of sediment to the Medicine Bow River, during the 16 year period required to complete surface mining, reclamation, and revegetation was estimated to be about 5%, whereas the chance of a similar slug of sediment coming from the undisturbed basin in the same time period was estimated to be about 30% to 40%.

Water Use

An increase in municipal water needs, because of the population influx, would be the most significant impact on water resources that would result from the proposed mine. Maximum impact would occur about 1990.

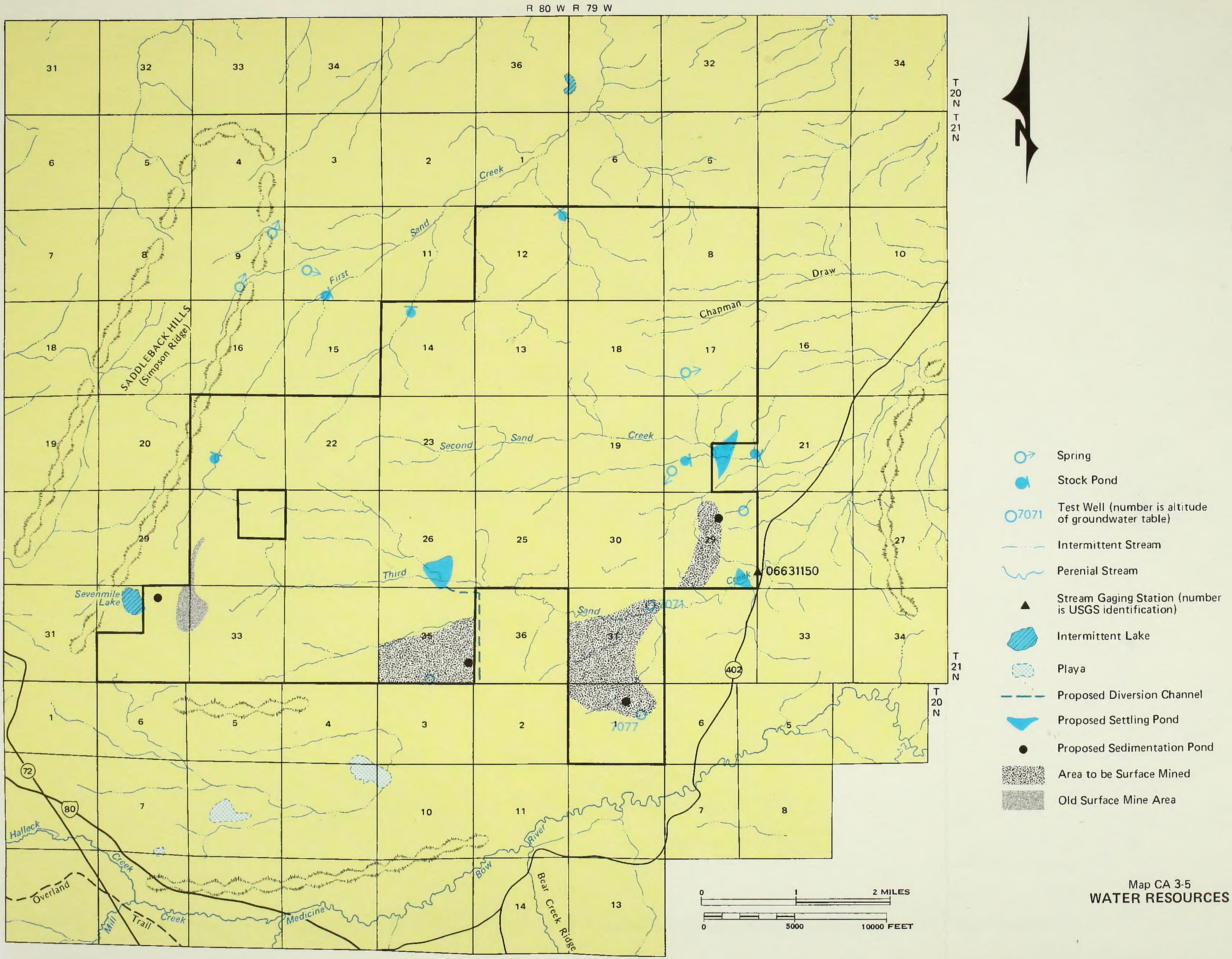
A mine the size of the typical mine would increase the municipal use in the southcentral Wyoming coal region (BLM 1978) by 600 acre feet per year (ac ft/yr) or about 10% over what it would otherwise be in 1990. A Carbon Basin mine added to those discussed in the Southcentral ES would increase total usage from the 1977 level of 3,600 ac ft/yr to 4,800 ac ft/yr in 1990.

The largest numerical increase would occur at Rawlins, but large percentage increases would occur at Elk Mountain and Medicine Bow (Table CA3-8).

Distribution systems in all towns would be overtaxed; however, the systems will all need to be enlarged to provide for the natural population increase. The additional facilities required to meet the demand imposed by the Carbon Basin Mine would add little to the cost of the enlargement. Sources of municipal water, and capacity of existing systems are given in the Southcentral Regional ES.

Increased water use would also increase sewage to be treated by local communities. Hanna and Medicine Bow treatment facilities have the capacity to handle the estimated amount of effluent, but the facilities in other towns do not. The treatment facilities to be constructed for Rawlins in 1979 will provide adequate capacity. The facilities in other towns will need to be enlarged even if no Carbon Basin Mine is developed. As with water, increasing the capacity to handle the load imposed by the Carbon Basin Mine would be relatively inexpensive.

Surface mines would use water at a rate of about 50 ac ft/yr for dust suppression and equipment washing. The underground mines would use about 150 gpd (less than 1 ac ft/yr) for cooling equipment and suppressing dust where coal was transferred from one conveyor belt to another (personal communication, W. Fisher, Morrison-Knudsen). In addition, the mine would require about 3 million gallons per year (mgy) of potable water in bath houses and other sanitary facilities.



SOURCE: BLM, 1978

Map CA 3-5
WATER RESOURCES

Table CA3-8

INCREASE IN MUNICIPAL WATER USE THAT WOULD BE CAUSED BY A CARBON BASIN MINE*
(1990)

Community	Increase ac ft/yr	Increase percent
Rawlins	420	11
Sinclair	10	10
Hanna	60	14
Elk Mountain	20	30
Medicine Bow	60	33
Saratoga	40	9

*Increase over and above what would be used in 1990 without a Carbon Basin mine, but with other mines that are proposed for existing coal leases (see Southcentral ES).

VEGETATION

Terrestrial

As stated in the Assumption and Guideline section, the development of the surface mine and the underground mine would be done concurrently. The development of these mines would cause disturbance to 2,323 acres by 1990 and 2,341 by the end of the mine life (Table CA3-1). Table CA3-2 shows the relationship of this project to times discussed in the ES such as final contour, mine facilities, ancillary facilities, etc.

The acreage of vegetative disturbance attributed to the surface mine would be the disturbance in excess of that caused by the underground mining. This acreage would be composed of the mine pits, haul road, overburden storage areas, topsoil stockpiles and totals 1,175 acres. As the surface mine would have a life of approximately 10 years, this disturbance is expected to occur in the 1980's.

The underground mine development would cause a vegetative disturbance of 1,148 acres by 1990 and 1,166 by the end of the mine life. This total acreage is composed of 468 acres of mine facilities, 500 acres of ancillary facilities, 6 acres for county road relocation and 192 acres for housing and support facility site for the increase in population (Table CA3-1). This disturbed acreage would be out of production for the life of the mine which is expected to be 40 years or more.

Preliminary reclamation of surface mine acres (1,175) would be accomplished within 2 years after the areas have been mined. The areas that are first surface mined and subsequently used for mine facilities (241 acres) would be reclaimed to a limited degree at the time of facility construction, and would undergo final reclamation at the end of mine life. Since reclamation would progress at approximately the same rate as surface mining, the maximum unreclaimed disturbed acreage that would exist at any one time would be 150 acres more or less. The cumulative acreage that would be primarily reclaimed (shaped, seedbed prepared, and seeded) would be 833 acres by 1990 and 2,149 acres within 2 years after the end of the mine life. Complete reclamation would be accomplished 10 to 15 years after preliminary reclamation measures are established.

FISH AND WILDLIFE

General Information

The impacts to the wildlife resource can be broken down into two general categories: (1) loss of wildlife habitat and the associated wildlife carrying capacity of that habitat; and (2) the actual loss of wildlife populations for the entire period of mining activities.

The mine project area would involve a total of 15,495 acres of wildlife habitat. The various vegetative types that could be disturbed by surface and underground mining would include: sagebrush—12,996; birdfoot sagewort—1,675; greasewood—388 acres; mountain shrub—233 acres; and disturbed area—216 acres.

Habitat Losses

The mining proposal would result in both direct and indirect losses of wildlife habitat. Direct losses include habitat that is actually destroyed by the mining operation and construction of ancillary facilities. Losses of habitat that would be classed as indirect would be those areas of habitat that would not be physically destroyed, but are areas that are outside the mined area that would become temporarily unusable by wildlife because of isolation, noise, dust, etc. These areas of indirect loss could also be called a "zone of influence"around mining areas. Direct losses of habitat on the project area, the railroad spur and the county road relocation would be 2,131 acres by 1990 which is composed of 1,175 acres which is attributed to surface mining and an additional 956 acres disturbed by activities attributed to underground mining. By about the year 2,010, reclamation of the 1,175 acres will be completed. From that time on until the end of mine life, a total of 974 acres (includes 18 acres disturbed after 1990 for a ventilation shaft and associated facilities) will remain disturbed due to underground mine activities.

As identified further on in this chapter, the Carbon Basin project area is classified as critical range for pronghorn and sage grouse. As provided for in the Hanna Area MFP, critical habitats will be regulated to the degree necessary to protect these habitats.

State resident wildlife species which are of high state interest were inventoried in a manner acceptable to coal unsuitability criteria concerning these species (pronghorn and sage grouse in this instance). Mining activities in this area will not significantly impact essential habitat for these species if stipulations are followed in the Hanna MFP for protection of wildlife habitat. Therefore, the area can be classed as acceptable for coal mining, pending acceptance of mitigation measures identified in Chapter 4.

Wildlife Population Losses

Introduction

Wildlife populations in the project area would be lost or reduced with the advent of mining activities. These losses would increase as the size of the disturbed area increases during the period of mine life.

Wildlife

Birds

Nongame. The major small nongame songbirds that would be lost or displaced by the loss of 2,149 acres of habitat would be: horned larks, sage sparrows, sage thrashers, Brewer's sparrows, vesper sparrows, and green-tailed towhees. The best available bird population density estimate that is presently available for the project area is an average of 21 breeding pairs per 100 acres with the population turning over or replacing itself every 3 years and each nesting pair fledging an average of three young per nest (personal communication, Max Schroeder, USFWS, March 1978). It is not possible to calculate a population estimate for small birds because there are not enough natural mortality data available from the literature to enable a computer simulation to be completed. However; if it is assumed that small birds occur equally spaced over the entire project area, estimates of small bird losses may total 2% of the bird population on the project area. Additionally, this loss is estimated to be less than 1% of the regional bird population.

If development occurs in accordance with the typical mining operation described in Chapter 1, the buffer zone around two active and seven inactive golden eagle nests would be disturbed because of their close proximity to the mine area. In addition, 12 other raptor nests and one great-horned owl nest would also be disturbed by mining activities and recreational pursuits of people visiting and working in the area (see Map CA2-5). These studies will be completed according to coal unsuitability criteria.

Game. Sage grouse are the only game bird that would be significantly impacted by the proposed action. The proposed mining operation would physically disturb 529 acres of critical nesting habitat associated with the two strutting grounds (leks) located on the project area and the one lek located just northwest of the northern portion of the project area. Of the 529 acres of critical nesting habitat disturbed, an estimated 344 acres would be disturbed due to surface mining activities, while the remaining 185 acres would be disturbed by the underground mining operations (see Map CA3-6).

According to sage grouse population analysis techniques provided by the Wyoming Game and Fish Department, the three leks in and around the mining area would have 19,235 acres of critical nesting habitat associated with them, 9,066 acres of which would be located on the project area. Of these 9,066 acres of critical nesting habitat, an estimated 499 acres would be destroyed by surface mining, construction of portals, and ancillary facilities, thus reducing critical nesting habitat by 5.5% on the project area.

Since the mine project area is an important sage grouse production area, protection of the critical nesting habitat associated with the two sage grouse strutting grounds on the proposed lease is essential. This habitat can be protected by restricting public access to the area during the critical nesting period. Closure of these areas to vehicle use during this period is covered in the Hanna Area MFP.

In addition to critical nesting areas that would be affected on the project area, there are about 30 acres of critical nesting habitat outside the project area that would be destroyed by construction of the railroad spur. In total then, about 529 acres of critical nesting habitat would be destroyed until reclamation was completed at the end of mine life and the habitat was returned to vegetation capable of supporting premining use.

Mammals

Nongame. The principal small nongame rodents found on the project area include; deer mice, least chipmunks, Richardson's ground squirrels, and whitetail jackrabbits. The removal of topsoil and its storage for later reclamation would cause direct mortality to small burrowing rodents. Losses due to these factors, plus other mine related activities would also reult in direct losses to small rodents.

Quantification of these losses by computer simulation is not possible at the present time because published mortality data for small rodents are rare, and not available at all for southcentral Wyoming. Losses of small rodents on 2,149 acres over the life of the mine would be heavy, but the high reproductive potential of these species indicate that repopulation of reclaimed mine areas would be rapid. If it is assumed that small rodents space themselves equally over the project area, estimates of losses would be about 2% of the rodent population on the project area.

Game. The pronghorn habitat on the mine project area totals about 15,494 acres which is classified as year-round range by the Wyoming Game and Fish Department. Included in this acreage total is 3,607 acres which are classed as critical winter range for pronghorns (see Map CA2-7).

An estimated 468 acres of the critical pronghorn winter range would be destroyed by various mining activities until the end of mine life and the reclamation period. This destruction of crucial winter range would displace wintering pronghorns into surrounding areas of habitat, but with little or no detrimental effects upon the herd because of the small area involved.

Since the entire mine project area is an important pronghorn fawning area, protection of the habitat from undue harassment by vehicles during the critical fawning period is essential. In Chapter 1, measures are recommended that would eliminate disturbance of these areas through modification of the Hanna Area MFP.

The mine project area supports a year-round resident herd of about 50 mule deer. The entire project area is classed as year-round deer range, and of this area an estimated 9,923 acres are classified as winter range for deer. There is no critical range for deer on the project area. Of the 9,923 acres of winter range, it is estimated that 2,149 acres would be lost until the end of mine life and the reclamation period because of construction of portals, ancillary facilities, and access roads. Displacement of the deer using this portion of the winter range is not anticipated to result in a significant loss because of the small area involved plus the small number of deer using the area.

The destruction of 2,149 acres of brushland habitat would result in a population loss to desert cottontails on the project area. In this habitat type, the Wyoming Game and Fish Department estimates that there are about five rabbits per acre on the average. Cumulative

Map CA 3-6
CRITICAL SAGE GROUSE NESTING AREAS DISTURBED BY MINING

losses of cottontails cannot be simulated since natural mortality data needed for a computer simulation run are not available. However, if it is assumed that cottontail rabbits occur equally over the project area, it can be estimated that losses due to mining would total 2% of the cottontail population on the project area. In addition, this loss would be less than 1% of the rabbit population in the region. While these losses could be heavy, the high reproductive potential of this species would enable it to quickly repopulate the area after reclamation is completed.

Reptiles and Amphibians

General. The principal reptile species that could possibly be impacted by the project include; eastern shorthorned lizards, northern side-blotched lizards, and northern plateau lizards. The lack of free surface water and riparian vegetation limits the occurrence of amphibians in the project area, so no impacts are anticipated to this class of animal.

CULTURAL RESOURCES

If sites of National Register quality are identifed within the project area, compliance with Section 106 of the Historic Preservation Act will be undertaken, and appropriate mitigation developed in accordance with procedures outlined in 36 CFR 800. Approximately 19% of the proposed project area has been surveyed by Western Wyoming College (1977). In accordance with the coal unsuitability criteria concerning historic lands and sites the area is acceptable pending a survey of the remaining 81% of the project area.

Subsurface sites which cannot be located prior to mining may be impacted by mining operations.

Subsidence of the ground surface in areas of underground mining may affect sites by disturbing spatial distribution of the site, and possibly increasing erosion.

VISUAL RESOURCES

Visual resources contrast ratings were derived for the Carbon Basin project area using points along County Road 402 as critical viewpoints (Map CA2-8). These contrast ratings, summarized in Table CA3-9, are available for review at the Rawlins District Office of the BLM. Further explanation of the Visual Resource Contrast Rating System (BLM Manual 6320) is available in the library of the Rawlins District Office of the BLM.

Contrast ratings are assessed in terms of how the proposed action would affect the basic elements (form, line, color, and texture) of the existing landscape features; landform, vegetative pattern, and structures (e.g., power lines and buildings). Resultant contrast ratings are then compared to the maximum acceptable impact limit for the visual resource management (VRM) class as seen from a viewpoint. Two time periods (during active mining and post reclamation) were used for the Carbon Basin site contrast ratings.

Viewpoints A and B

From these viewpoints, the east side of the project area is visible. Surface mining activities and structures in the Class III area (which could be seen) would create a contrast to all basic elements. The visual resource management class would change to a Class V in the actual suface mining area and where structures are located.

RECREATION RESOURCES

Visitor Use Data

Table CA3-10 depicts estimated resident visitor use changes by activity due to coal mining in the year 1990. The changes are those which would occur in the region and result from increased population in Carbon County. Data used to calculate use are available in the files at the BLM Rawlins District Office.

Hunting

Impacts to hunting would result when restricted access or displacement occurs to antelope, rabbit, rodent, coyote, and game bird populations. This would result as construction and mining destroy wildlife habitat (see Fish and Wildlife). With an increased number of people in the area, some ranches would restrict access across private lands. Increased human population would induce a greater demand for hunting and decrease the quality of the hunting experience in the area.

Sightseeing

The construction and mining would cause minor impacts to existing recreational sightseeing values in the area because few people pass through the site. Some access would be blocked causing people to use other routes to see the old town of Carbon. There would be opportunities for geological and industrial interpretation as the mining operations draw people in to view the area.

Specialized Activities

Off-road vehicle use would be restricted from the mining area, thus causing inconveniences to hunters in the area.

Table CA3-9

SUMMARY OF VISUAL CONTRAST RATINGS

Views from Critical Viewpoint	A	B
Visual Management Class	III	III
During Active Mining (Land)	3/20	3/20
Post Reclamation (Land)	2/17	2/17
During Active Mining (Vegetation)	3/30	3/30
Post Reclamation (Vegetation)	2/15	3/20
During Active Mining (Structure)	2/20	2/20
Post Reclamation (Structure)	1/10	1/10

Visual Management Class	Maximum Acceptable Impact
Class III	2/16

Table CA3-10

ESTIMATED RESIDENT VISITOR DAYS CHANGE DUE TO POPULATION CHANGE FOR 1990

	Fishing	General**	Hunting	Off-road vehicles	Urban recreation***	Water Sports****	Winter Sports*****
1990 (population 3,158)*							
without proposed action	129,341	170,684	38,389	4,725	92,429	65,261	20,081
increase due to proposed action	13,832	18,253	4,105	505	9,885	6,979	2,147
total projection	143,173	188,937	42,494	5,230	102,314	72,240	22,228
% of projection due to proposed action	9.7%	9.7%	9.7%	9.7%	9.7%	9.7%	9.7%

* Population changes due to project (socioeconomic section)

** General includes camping, picnicing, sightseeing, etc.

*** Urban includes rodeos, golfing and attending athletic events

**** Water Sports includes boating, swimming and water skiing

***** Winter Sports includes only skiing

General

With an increased visitor use due to increased population in Carbon County, there would be a general lowering of the quality of the outdoor recreation experience in the area. There would also be increased use in urban recreation areas in the city of Rawlins and the towns of Hanna, Elk Mountain, Medicine Bow and Saratoga. The municipalities currently do not have enough urban recreation facilties to adequately support the existing populations according to standards set by the National Recreation and Park Association.

AGRICULTURE

Livestock Grazing

The project area is located in the North Anchutz allotment which has a grazing capacity of 8,321 animal unit months (AUMs) of grazing. Of the 8,321 AUMs, 1,551 are contained within the project area.

The MFP provides for removing all livestock grazing from the mine project during the life of the mine. Under the principle of managing the project area for the benefit of wildlife during the life of the mine, the annual grazing loss would be approximately 1,551 AUMs. This annual loss would be sustained for the life of the mine and until all reclaimed areas support adequate vegetation to support the post mining use. Nonuse of the project area by livestock during the mine life would benefit the undisturbed acres, since it would permit the range to improve because use would be limited to that of wildlife species. Over the years, improvement would occur in range vegetative composition, plant vigor, and quality of wildlife habitat. Opportunities would also be present to study the unused area to measure trend, changes in condition, and establishment and monitoring of wildlife habitat improvement techniques.

SOCIOECONOMICS

Demographics

Population

The proposed Carbon Basin project would result in a population increase of 3,158 people in the region. The new population would reside primarily in Rawlins, the Hanna/Elmo area, Saratoga, Elk Mountain, and Medicine Bow (Table CA3-11). Rawlins, which is located 40 miles west of the project area, would receive 69% of the population increase. With the project, the 1990 population in Rawlins would be about 10.9% greater than the 1990 population of 19,959 which is expected without further federal coal actions. Population in the Hanna/Elmo area, which is approximately 15 miles northwest of the project, would be 9.1% greater than the 1990 population of 2,347 which is expected without further federal coal actions. The population of Elk Mountain, which is in the immediate vicinity of the project, would be 23.8% greater than the 1990 population of 275 which is expected without further federal coal actions.

Employment

Construction on the Carbon Basin project would take place during the 1980's. By 1990, the permanent work force would total approximately 1,035 employees.

Miners and mine-related construction workers receive higher wages than employees in other sectors of the economy, so the Carbon Basin project would be in a favorable situation to compete with other employers in the region for the available labor supply. This may actually lead to a slower growth in employment in other sectors of the economy for the years immediately following the mine employment increases. By the mid 1980's there would be 885 people employed at the mine. However, total employment in the region would only increase by 880 workers, so the mine employment would cause a net decline of 5 workers in other sectors of the economy (Table CA3-12). This impact would be felt most strongly in agriculture, retail trade, services, and some local government departments (e.g., police and fire) where wages are traditionally low. This would be a temporary situation which would disappear when migration increases the available labor supply sufficiently to supply all potential employers.

In a report by F.L. Leistritz and T.A. Hertsgaard, it was shown that when industry (coal development) moves into a rural area, farm and ranch operators are faced with the necessity of offering higher wages or reorganizing their farms or both. Operators of small farms and ranches who have been underemployed in their farm or ranch business may take advantage of the new off-farm job opportunities that coal development provides.

Operators who are fully employed with adequate incomes from agriculture and who do not hire much extra labor would be least affected by increased competition for labor. Those operating large farms and ranches requiring large amounts of labor would be likely to make significant adjustments in their operations. These adjustments would likely include dropping certain labor-intensive enterprises, adopting labor-saving technologies, and perhaps even reducing the size of their operation.

New mining activity creates a need for additional employment in industries which serve the mine (e.g., mine supply firms) and in businesses and organizations which serve the new mine and mine-related employment (e.g., merchants, store-keepers, and school teachers). By 1990, the Carbon Basin project would create 1,323 new jobs in the Carbon County economy, which represents a total employment to direct mine employment ratio of about 1.28. In the "normal"economy, an additional mine worker creates about 1.6 total additional workers, indicating that by 1990 the regional economy would not have fully adjusted to the employment increase resulting from the Carbon Basin Mine. In the early 1990s, when

Table CA3-11

SOUTHCENTRAL WYOMING POPULATION ESTIMATES

County City	1977 Population	Mid 1980's Total	Mid 1980's Increment of the proposed Action	1990 Total	1990 Increment of the proposed Action
Carbon County*	18,137	27,861	1,958	32,688	3,158
Rawlins	10,500	18,150	1,278	22,148	2,189
Sinclair	550	610	41	632	56
Hanna/Elmo**	1,500	2,347	219	2,661	314
Elk Mountain	220	324	61	361	86
Medicine Bow	750	1,137	219	1,280	314
Saratoga	2,050	2,389	140	2,515	199

*In addition, population in Rock River (Albany County) will increase by 41 in mid 1980's and 56 in 1990. The population of Rock River was 344 at the time of the 1970 census.

**These towns are located several miles apart and share some community infrastructure (e.g., a water system). They have been considered as a single community when making population estimates.

Source: Water Resources Research Institute Economic Simulation Model, University of Wyoming, Water Resources Research Institute, Laramie, 1978. Regional totals have been allocated to communities based on historical trends, gravity model proportions and interviews with local officials and employers.

Table CA3-12

SOUTHCENTRAL WYOMING EMPLOYMENT

Sector	1977 Total Employment	Mid 1980's Total with the Proposed Action	Mid 1980's Impact of the Proposed Action	1990 Total with the Proposed Action	1990 Impact of the Proposed Action
Farm	526	525	0	525	0
Manufacturing	360	427	0	525	0
Mining	1,658	3,687	+885	3,763	+1,035
Construction	715	1,126	-6	1,514	+26
Government	919	1,421	+2	1,844	+90
Farm and Forest Processing	46	48	0	49	0
Railroads	480	680	0	780	0
Business Services	1,415	2,001	-4	2,493	+60
Consumer Services	1,948	2,479	+3	2,989	+112
Total Employment	8,067	12,394	+800	14,425	+1,323

Note: The impact of the proposed action is the difference between total employment with the proposed action and total without the proposed action.

Source: Water Resources Research Institute Economic Simulation Model, Water Resources Research Institute, University of Wyoming, 1978.

the economy has adjusted to the Carbon Basin Mine employment, total additional employment would be expected to grow to about 1,656 workers, which is about 25% greater than the number of additional workers in 1990 (Centaur 1978).

The increased employment opportunities created by the Carbon Basin project would tend to hold the unemployment rate at or near the current 3% level.

Income

The Carbon Basin project would increase annual personal income in the region $48.2 million (in constant 1977 dollars) by 1990 because of increased wage earnings $29.7 million and proprietor's income $18.5 million. This would be an increase of 33% over the 1990 income expected without the project. With 1,323 additional workers employed in 1990 as a result of the project, the $29.7 million rise in wage and salary income represents an increase of $22,400 (in constant 1977 dollars) per additional worker.

This increase in income would create local inflationary pressures. This would occur because the miners and mine-related employees would have more money to spend on goods and services than would others. This would affect those on fixed incomes (retirees, welfare recipients, etc.) more than anyone else. As incomes and prices rise rapidly, their incomes do not. This effectively reduces their buying power.

Infrastructure

Private Sector

The increase in personal income in the region that would result from the Carbon Basin project would generate additional wholesale and retail sales. These additional annual sales would be $12.3 million in 1985 and $21.9 million in 1990 (in constant 1977 dollars) (Centaur 1978).

Along with these increased sales, there would be diversification of business types to take advantage of the new sales opportunities. New businesses would locate in the region that have not been represented in the local economy previously.

Although only 69% of the population increase resulting from the Carbon Basin project would live in Rawlins, a much higher percentage of sales and new businesses would occur there because of Rawlins' position as the major trade center in the region.

Housing

The Carbon Basin project would create an additional housing demand of 1,214 units (858 single family units) by 1990 (Centaur 1978). About 69% of this demand would be felt in Rawlins. Housing demand is based on the historical relationship of 2.7 persons per housing unit in Carbon County. Housing shortages, which would be reflected by occupancy rates greater than 2.7 persons per housing unit are difficult to anticipate. No major constraints to rapid expansion of mobile homes are known—trailer parks can be built quickly and financing has not been unduly difficult to obtain. Water and sewer moratoriums in several communities have been lifted due to new construction which has increased capacities. Some new residents are likely to rent rooms in existing homes, live temporarily in motels, or share rental units with others, either because they prefer those alternatives to mobile homes or they are waiting for other housing to become available.

Demand for single family homes is estimated based on the expected preferences of new residents and long-time residents. New residents are often reluctant to purchase or build homes, so they would exhibit fewer demands for single family homes than those who have lived in the community for a number of years. The supply of single family homes is not expected to increase sufficiently to meet this increased demand. Single family shortages now exist (partially the result of past construction moratoriums) and would likely become larger as a result of the proposed action.

Education

The school-age population in District 1 would increase by 625 students by 1990. School-age population in District 2 would increase by 250 students (Centaur 1978).

Capacity expansion would be necessary in School District 1 to handle this increase in school-age population. Rawlins would require a new elementary school (in addition to those required without the project) and junior high/high school space to accommodate an additional 250 to 300 students. School District 2 would be affected to a lesser degree than District 1 as a result of the proposed action. The increase in school-age population in this district would be proportionately larger than those expected in District 1, but with current excess school capacity District 2, should experience no difficulty in absorbing the enrollment increases resulting from development of the Carbon Basin Mine. The largest increases in students would occur in Hanna/Elmo, Medicine Bow, and Saratoga.

The assessed valuation of School District 2 would be increased by the value of the mine property.

Health Care and Safety

The level of health care in the region is currently inadequate, with fewer physicians and dentists available than are needed by the existing (1977) population. With the proposed action, the present inadequate availability of health care specialists would worsen slightly.

By 1990, the Carbon Basin project would lead to a need for an additional three physicians, two dentists, eleven registered nurses, and one professional mental health counselor (Centaur 1978).

The Memorial Hospital of Carbon County, located in Rawlins, presently has a capacity to provide medical services for a population of 29,000 to 33,000. Even with the additional people that would come into the region the hospital would still have excess capacity.

In 1974, the incidence of work-related injury or illness in Wyoming for all industries was 10.4 cases per 100 full-time workers. (This is the same incidence rate as for the United States as a whole—U.S. Department of Labor 1976.) Underground mining is much more dangerous (anthracite mining, which is primarily underground, has an incidence rate of 22.3 cases per 100 full-time workers). If the incidence rate for injury and illness for underground mining holds in the future, the coal mining at the Carbon Basin Mine would increase injury and illness by an average of 231 cases per year. An unquantifiable number of these would be fatal or debilitating.

Because underground coal mining appears more dangerous than the average industry, this increase in injury or illness would be more than would be expected from employment increases in other sectors of the economy.

Local Services

Several communities (including Rawlins, Hanna/Elmo, Elk Mountain, Medicine Bow, and Saratoga) would have heavy demands placed on their services (water, sewer, police, fire protection, solid waste). For many communities, this would require substantial investment in new water and sewer systems, increased staffing of police and fire departments, and expanded solid waste programs.

Transportation and Utilities

Highway access to the Carbon Basin project is via Interstate 80 and the County Road 402, which is adjacent to the project.

Local access roads would receive the largest increase in travel. Congestion would be most severe at the time of shift changes. Accidents would also be expected to increase as the numbers of vehicles on the road increase.

The Carbon Basin project would result in an annual coal production level of about 5 million tons. In Table CA3-13, Carbon Basin coal production is shown in relation to local existing mines, the Southcentral Region and the Southwest Region by 1990. Table CA3-14 presents anticipated daily train volumes for the region. Weekly unit train activity is estimated by dividing annual coal production levels by 10,000 tons (the capacity of a unit train) and then by 52 (the number of weeks in a year). This figure is then doubled to account for return traffic of empty cars. Train activity from the mine would add 2.7 trains per day, or 3.8% of the total train volume. Air pollution, noise emissions, and traffic delays at railroad crossings would increase significantly. Currently, rail traffic causes delays and inconveniences in a number of Nebraska communities. The projected increase even without the proposed action would place a severe burden on the communities of Sidney and Grand Island, Nebraska and Julesburg, Colorado if grade separations are not constructed. Traffic delays at railroad crossings would increase 15 minutes per day as a result of the proposed action. All coal from this project would be shipped eastward to markets in the Chicago, Illinois area. A 13 mile railroad spur from the main Union Pacific tracks near Medicine Bow would be required.

Approximately 3 miles of a 34.5-kv power line crosses the east side of the project area. Power for the mine would be acquired from this line. Service to existing customers is not expected to be interrupted.

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income), they would resent the increased population and urbanization that would occur, even though those increases would be slight due to this one mine (see Population). Those persons who would benefit from the mine directly (e.g., mine employees and local merchants) would welcome the employment opportunities and higher wages. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining section (Abt Associates 1977 and Gilmore 1974).

Lifestyles

The changes currently occurring in the lifestyles of Carbon County residents (see Chapter 2, Lifestyles) would continue with or without this project. The Carbon Basin Mine would reinforce and possibly speed up those changes in the impacted portions of the region. The magnitude of the impact that would be due to the Carbon Basin Mine is not quantifiable.

Table CA3-13

PROJECTED ANNUAL COAL PRODUCTION IN SOUTHERN WYOMING BY 1990

Source	Projected Production (MM Tons)	% of Total
Carbon Basin	5.0	9.3
Existing Mines (Southcentral ES Region)	11.8	21.8
Proposed Mines (Southcentral ES Region)	6.0	11.1
Proposed Existing (Southwest ES Region)	31.2	57.8
Total	54.0	100.0%

Table CA3-14

DAILY TRAIN VOLUME PROJECTIONS FOR THE STUDY REGION*

Train Type	Mid 1980's		1990	
	Number of Trains**	Percent of Total	Number of Trains**	Percent of Total
Total Coal Trains:	13.9	21.6	14.2	20.0
Carbon Basin Mine	2.2	3.4	2.7	3.8
Hanna Basin Coal Trains***	6.7	10.4	6.5	9.2
Southwestern Wyoming Coal Trains****	5.0	7.8	5.0	7.0
Non-coal Freight Trains	50.6	78.4	56.7	80.0
Total Coal and Non-coal Freight Trains	64.5	100.0	70.9	100.0
Percent Increase from 1977 Total Train Volume Excluding Carbon Basin Mine	+24.6		+36.4	
Percent Increase from 1977 Total Train Volume Including Carbon Basin Mine	+29.0		+41.8	

* These figures represent the average train volume projected on the Union Pacific mainlines east of Rawlins.
** Reflects both loaded and empty train traffic.
*** Reflects production and related train activity from the following mines: Carbon County, Medicine Bow, Rosebud, Seminoe I, Seminoe II, and Vanguard-Rimrock.
**** Estimated from Data on Transportation of Coal by Railroad from Southwest Wyoming, Union Pacific Railroad Company, May 1978 and conversation with Ron Dutton, ABT Associates, Englewood, Colorado, May 18, 1978.

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

This chapter includes mitigating measures, stipulations and regulations designed to lessen the potential impacts of the proposed action upon the existing environment and to provide for mitigation of impacts as required by SMCRA and other regulations. These measures provide the basis for the analysis of effectiveness and in determining the remaining unavoidable impacts. The stipulations and regulations contained herein are to be made part of the conditions for leasing and, if leased, will be included in the mine and reclamation plan for the operation of the mine and the associated right-of-way.

Reclamation

In order to meet the requirements of SMCRA in regard to land reclamation, the measures outlined herein would be incorporated into the reclamation plan. Those measures listed as recommended would not be required, but if adopted would aid in establishment of vegetative cover. These measures would: (1) reduce the time required for successful reclamation to about 10 to 15 years, (2) establish an approximate natural vegetative species composition for use by livestock and wildlife, (3) establish a more dense vegetative cover which would reduce wind and water erosion, and (4) provide for the protection of reclaimed areas from grazing until desired vegetative cover is established.

Reclamation can be considered complete when the following criteria are met: (1) production from acceptable grass species on a reclaimed area averages 500 to 600 lbs of air dry forage per acre, providing the production from the upper 1/3 of the slope average 200 lbs of air dry forage per acre, and (2) established shrub species 2 years of age or older would be at or greater than a density of 400 shrubs per acre.

Since successful reclamation has not been fully demonstrated on the existing coal mines in the Hanna Basin area, the company will provide data to prove that reclamation is feasible. This data will be provided along with the specific details of the reclamation plan. The details will include new baseline environmental data on the proposed railspur, as well as the reclamation thereof. With the application of the measures contained herein, and the new reclamation data submitted by the lessee, reclamation of the disturbed land would be in a manner that would be acceptable under the provisions of the coal unsuitability criteria.

Lease Stipulations to Provide Mitigation

Stipulations 1, 2, 6, 7, 12, 14, and 15 exceed the minimum requirements of SMCRA regulations.

1. Unsuitable overburden, parting material, and toxic material shall be separated, stored, and buried beneath overburden suitable for sustaining plant growth. All unsuitable material shall be buried to a depth of no less than 8 feet.
2. All topsoil material (plant growth medium) comprising "A" "B"and "C"horizons will be replaced to a depth of 12 inches or more.
3. All seedbed preparations, beginning with topsoil replacement, seeding, planting, and all conservation practices initiated will be done on the contour.
4. Contour terraces, furrows, or other soil and water conservation structures will be constructed on all slopes recommended by, and to the specifications and design of the appropriate agency.
5. If climatic or soil conditions are such that perennial stands of grass are not likely to become established, all regraded and topsoiled slopes having exposure to southerly or westerly prevailing wind should be planted with an annual cover crop such as spring wheat, annual rye, or oats. The cover crop should be planted prior to June 1 to take advantage of any late spring moisture.
6. Native hay or straw used as mulch or for snow catchment must be certified as noxious weed free, and will be applied to seeded areas at a minimum rate of 2 tons per acre.
7. All mulch will be anchored to the ground by crimping with a notched coulter to a depth of 5 inches or more.
8. All drill seeding will be done with a rangeland drill with depth bands attached.
9. Seeding will be done at a minimum rate of 13 to 15 pounds of pure live seed (PLS) per acre. Recommended seed mixture and seeding ratio (pounds PLS/acre) is shown on Table CA4-1.
10. When soil conditions are favorable, all seeding shall be done after October 1st and before May 15th.
11. All areas that are too steep to be seeded by rangeland drill will be seeded by broadcast method at a minimum rate of 1½ times the drill seeding rate. Mulch will be manually applied and anchored with a netting, wire mesh, or other suitable material.
12. Plants of potted shrubs will be done in a random manner in accordance with Table CA4-2. Shrubs and/or plugs will be planted in early spring (prior to May 15) as soon as soil moisture and soil temperature conditions permit.

Table CA4-1

RECOMMENDED SEED MIXTURE

Species Name	Ratio of Seeding*
Rosana western wheatgrass	3 to 4 pounds PLS/acre
Sodar streambank wheatgrass	1 to 2 pounds PLS/acre
Indian ricegrass	1 to 2 pounds PLS/acre
Bluebunch wheatgrass	1 to 2 pounds PLS/acre
Critana thickspike wheatgrass	1 to 2 pounds PLS/acre
Sweetclover	0.5 to 1 pounds PLS/acre
Four-wing saltbush	2 to 3 pounds PLS/acre
Winterfat	1 to 2 pounds PLS/acre

*Ratio of seeding indicates the range in pounds PLS/acre for individual species that may be used to determine a seed mixture of 13 to 15 lbs PLS/acre (see Item 9).

Table CA4-2

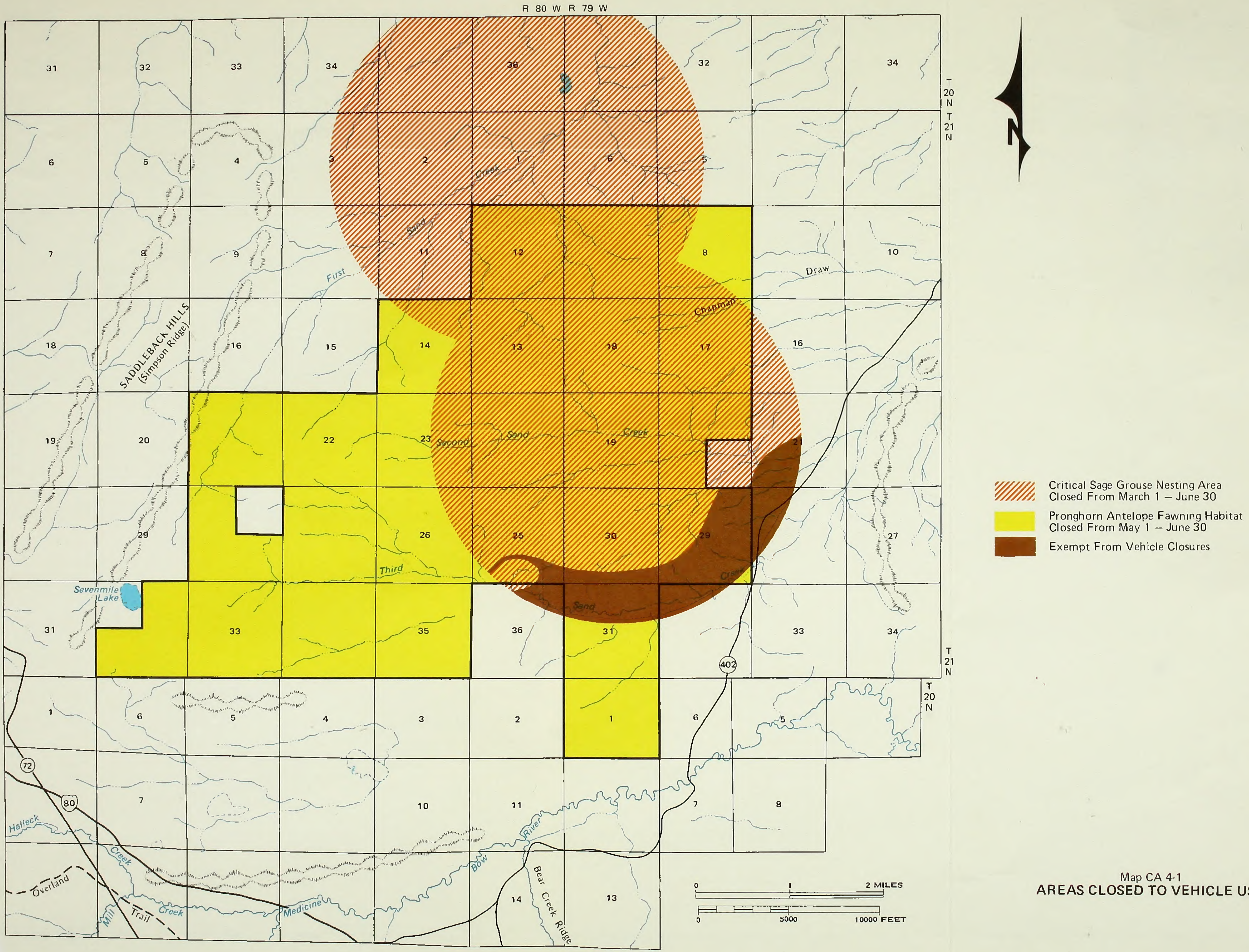
POTTED SHRUB PLANTING DENSITIES

Plant Species***	Level Areas	Aspect along terraces, contours, catchment basins, special areas*	North and East Slopes		
			Upper Third	Mid Third	Lower Third
Big Sagebrush	250**	350	250	300	400
Bitterbrush	200	150	200	150	---
Little Rabbitbrush	100	100	100	75	---

* Special areas may include construction draws, swales, leeward side of snow catching structures.

** Planting rate is number of potted shrubs per acre.

*** Based upon shrubs available from commercial nurseries.



SOURCE: BLM, 1978

Map CA 4-1
AREAS CLOSED TO VEHICLE USE

13. Open areas between contour furrows or contour terraces on south or west facing slopes will be planted with seed mixture only and will not receive potted shrubs.

14. All potted shrubs will be watered while the plant is being planted with an amount to saturate the planting root zone to avoid root dehydration and insure soil-root contact. Minimum application will be 1 gallon per plant. A water soluable fertilizer-root stimulant shall be added to the manufacturer's recommended rate to the water used for shrub plantings. Additional watering will be done over the next 2 growing seasons when soil moisture conditions indicate need for plant survival.

15. Shrub planting along contour furrows or contour terraces shall be of a width extending 1 foot above and 2 feet below the furrow or terrace.

16. All topsoil storage piles of three months or longer duration during growing season will be seeded with sodar streambank wheatgrass or similar grass types at the rate of 12 PLS per acre and a cover crop of fall rye (biennial plant) at a rate of 10 pound PLS per acre.

17. All reclaimed areas will be temporarily fenced in a manner that would exclude livestock and pronghorn and not be a hazard to wildlife.

18. The project area will be fenced to control trespass livestock onto the project area during the life of the mine. The existing fence on the north and west side of the project area will be considered the project boundary.

Additional Lease Stipulations

The following recommendations, if applied, would increase the probability of successful reclamation or result in a vegetative type of greater diversity. These recommendations are presented as measures to be included in the lease provisions at the discretion of the land management agency and in consultation with other regulatory authorities.

1. On selected areas, plugs with native vegetation could be placed with a minimum spacing of 3 to 7 per acre in lieu of potted shrub. Plugs would be 5 feet by 5 feet in size with a minimum depth of 3 feet. Plugs will be removed from areas planned to be stripped of topsoil. All plugging will be done during the months of February through May. Other times and methods of planting may be done with prior approval of the managing agency.

2. All seed would be prilled to aid in seed distribution and germination.

3. All seed would be treated with a repellant to prevent seed damage by rodents or birds.

4. Snow fence panels (5 to 6 feet in length and 3 feet high) or bales of hay set on the cut edge will be placed perpendicular to the prevailing wind at random intervals over reclaimed areas having 3% or less slopes. Placement of snow catchment structures will not be less than 60 per acre. After bales have been in place through two winters, they will be used as mulch in newly reclaimed areas.

5. All slopes consisting of fine-loamy or fine surface soil textures will be regraded so that the slope does not exceed a 7:1 (horizontal to vertical) ratio.

6. The replacement of topsoil shall be done so that an average 4 inches of topsoil will be disced into the regraded and contoured overburden before the final application of topsoil. The final application of topsoil will be a depth of 8 inches or more.

As noted in Chapter 3, 19% of the area has been surveyed for archeological resources. Prior to start of operations, the remaining 81% will be surveyed by an Archeologist approved by BLM.

According to standards included in the coal unsuitability criteria related to golden eagle nests, there will be a stipulation in the lease that no mining activities of any kind will be allowed within ¼ mile of any active or inactive golden eagle nest (see Map CA2-5) located on or adjacent to the project area. In addition, active prairie falcon nests on and near the project area will also be protected from all types of mining activities to a distance of ¼ mile in accordance with provisions contained in the unsuitability criteria concerned with falcon cliff nesting sites. Studies of any migratory birds effected by mining will be completed according to coal unsuitability criteria.

Protection of the sage grouse nesting areas and the pronghorn fawning habitat will be accomplished by applying vehicle restrictions listed in the Hanna Area MFP. Areas to be closed are shown in Map CA4-1, along with dates recommended classed as suitable for mining. Some vehicle use of the closed areas during the initial periods will be necessary for maintenance and operation of mine facilities. Travel necessary for administrative purposes throughout the area will also be allowed.

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

The proposed project would result in a projected regional population increase of 3,158 people and would be felt primarily in Rawlins, Hanna/Elmo area, Saratoga, Elk Mountain and Medicine Bow. Temporary, but locally severe, impacts would include shortage or workers in other industries, housing shortages, added loads on all local community services, and need for capital expansions of local facilities. The growth movement for Rawlins is estimated at nearly 11% (on a 1990 base of about 20,000); for Elk Mountain the growth increment would be about 24% (on a 1990 base of 275). It is expected that over a period of several years, the communities' services would adapt to the increased populations, but there would be changes in community makeup, intercommunity relationships and services. Higher wages, resulting from increased competition for scarce labor, would result in local inflationary pressures on people of fixed incomes.

Air and noise pollution would increase along the route from the Carbon Basin project to the marketplace in Illinois. Congestion, especially during shift changes, and traffic delays would increase on local access roads and at railroad crossings along the route.

The principal air quality degradation is expected to be from particulates. Total annual suspended particulates (TSP) emissions are projected at 4,872 tons per year in 1990 and 778 tons per year at end of mine life with the proposed best management practices (BMPs). This contrasts with possible levels of 13,349 and 4,147 tons per year if BMPs were not required. About 98% of the TSP emissions would be fugitive dusts and would be excluded from air quality assessment (43 CFR 118). The Carbon Basin model would not be expected to exceed NAAQS or the Class II increment under this review procedure. Since present levels of SO_2, NO_2, CO, and HC emissions are far below standards and only insignificant amounts of these pollutants would be released during the operation, no significant air quality impacts from these is expected. Visibility is expected to average 26 to 47 miles but could under worst case conditions be reduced to 7 miles near the mine site and access roads under BMP or 4 miles if BMP were not required.

Destruction of anticipated cultural resources would occur where these resources were present in the mining area but not recognized prior to mining. Significant losses in scientific knowledge could occur if unique sites were in fact present but not recognized prior to destruction.

There would be an estimated soil loss of 0.42 ton-acre-year due to wind erosion on disturbed areas. Prior to revegetation, soil loss on final contour areas resulting from water erosion would be an estimated 2.4-5.0 tons-acre-year. An estimated 25% of this water erosion would remain and would not be excessive as it would be within limits of premining erosional levels. An unknown amount of subsidence and the resulting effects to soil surfaces on 12,522 acres of underground mined lands could occur.

The average elevation would be decreased over the balance of the project area mined by underground methods, but the elevation would probably change locally less than 25 feet on the areas affected.

Several changes would occur in the hydrologic regime, but the impacts from these changes would be minimal and would be confined basically to Carbon Basin because the hydrologic regime of the basin is largely independent of the regime in neighboring areas. The following changes would occur: (1) about 10% of the area supplying recharge to Carbon Basin aquifers would be disturbed resulting in reduced recharges; (2) the coal which serves as an aquifer would be removed, and water flowing in the coal adjacent aquifers would be intercepted by the mine; (3) surface mine pits would interrupt the underflow of Third Sand Creek; (4) drainage patterns of several small ephemeral drainages would be altered; and (5) some springs would dry up.

The mine would use about 50 acre feet of water per year (ac ft/yr) during the period of surface mining (1981 to 1990). The use would drop to about 8 ac ft/yr thereafter.

The population increase resulting from the mine would require 860 ac ft/yr in 1990 and thereafter until the end of mine life. The water demand would reach a maximum of 960 ac ft/yr in 1986.

Impacts to the paleontological resources might include destruction by activities in the mining area and increased unauthorized collecting from sites elsewhere in the region. Significant losses in scientific knowledge could occur if unique sites were present and not recognized prior to destruction.

All impacts to wildlife identified in Chapter 3 would be mitigated if measures detailed in Chapter 4 were implemented. If these measures were not implemented, the following adverse impacts would occur:

Destruction of 2,149 acres of wildlife habitat would occur during mining operations. Over 15,000 acres of wildlife habitat would be affected by increased activity during mining operations. Three sage grouse leks could be disturbed during mining, reducing critical nesting habitat in the area by 5.5%. About 468 acres of critical pronghorn winter range would be disturbed, displacing wintering pronghorns onto adjacent areas, but the impact on total herd size would probably be light because of the small acreage involved. Some displacement of the 50 mule deer using the area could be expected, but the loss would not be considered significant. Rodent, songbird, rabbit, and other small wildlife losses could total 2% of the local populations. If the area were successfully reclaimed to suitable wildlife habitat upon completion of mining, wildlife carrying capacities could recover to or above premining levels.

The exclusion of livestock grazing from the project area would result in an annual loss of 1,551 animal unit months (AUMs) of grazing for the life of the mine.

In the area to be disturbed by surface mining (final contour, construction of mine and ancillary facilities), soil profiles and properties that have developed over geologic time would be destroyed on 2,149 acres. The existing soil biota and soil forming process would be drastically reduced. The loss of soil productivity, vegetative production, and wildlife habitat on this 2,149 acres would be lost during the life of the mine and reclamation period. Conventional surface strip mining would destroy approximately 150 acres a year, with additional exposed acres for mine facilities construction.

There would be a 9.7% increase in use of all urban and outdoor recreation facilities throughout the area due to the Carbon Basin project. These impacts would likely continue after the end of mine life.

Approximately 10% of the Class III visual resource management area would be changed to Class V in the area of surface mining.

CHAPTER 6

SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

The issuance of the coal lease would enable approval of technically and administratively complete mining plans which would allow maximum economic recovery of the coal resource. Coal was mined on the southwest corner of the project during the early 1900s. Mining, if approved, would be new to the remainder of the area.

The Carbon Basin area is presently used for livestock grazing, wildlife habitat, and oil exploration. The area could return to premining land uses after reclamation of the site.

The short-term use of the mine site would expose or disturb over 2,149 acres of land surface over the life of the mine. The air pollution caused by the mining operation during coal extraction would be a short-term event which would cease at the end of the mine life. The largest potential threat to long-term productivity in terms of air quality would be the failure of complete reclamation of the exposed and disturbed acreage. Wind erosion could continue to generate fugitive dust emissions from the mine site until a proper vegetative cover were established. With successful land reclamation no long-term problems from wind erosion would be expected. Since the land would be returned to grazing, the long-term effects of mining would be nonexistent.

The major portion of particulate air quality impact from the Carbon Basin Mine site would be to the east and northeast of the mine site. Annual particulate concentrations of 46 micrograms per cubic meter ($\mu g/m^3$) and above 50 $\mu g/m^3$ 24-hours worst case would be predicted as far northeast as 14 miles and 10 miles east of the Carbon Basin Mine site. At the present time, however, no active mining is taking place nor has any interest been shown in these areas. Therefore no interaction or cumulative effects would be predicted between Carbon Basin and other mine sites or areas of interest.

Short-term use of the soil resource resulting from construction of mine facilities, ancillary facilities, and mining operations (final contour) would disrupt the productivity, destroy existing soil profiles, and increase soil erosion losses on 2,149 acres. Potential soil productivity levels over the long term would be restored to an estimated 100% of average premining levels with successful reclamation. The long-term commitment of 192 acres for urban needs would utilize the soil resource for an alternate use.

Water used at the mine and by municipalities to meet population increases resulting from the mine would not be available for other uses. At present, there is no competitive use for this water. Seven springs could be dewatered due to subsidence affecting the long-term productivity of those springs.

The development of the Carbon Basin project would result in short-term losses of native vegetation of 2,149 acres. The productivity on the 2,149 acres would be regained within the 10 to 15 year reclamation period. This short-term loss would be borne in order to gain the benefits received through the development of the project.

The development of 192 acres for housing and support service sites would be a conversion of land use for the long term from lands supporting vegetative cover to land supporting housing and business enterprises. Productivity in relation to vegetation would be lost, but productivity as measured in benefits to other categories, such as people, would be enhanced for the long term.

Short-term losses of wildlife shrub habitat would be that vegetation destroyed on 2,149 acres of mined area and ancillary facility locations. After completion of surface mining, 1,175 acres would be reclaimed to a native and native-like vegetation which would begin to furnish some wildlife habitat after the grass was established. Under the proposed action, underground mining would continue for 40 years or more, at which time the remaining 974 acres of disturbed area would be reclaimed.

There would also be heavy unquantifiable losses over the short-term, of small rodents, cottontail rabbits, small songbirds, mourning doves, and reptiles over the 2,149 acres of surface mine, mine facilities and ancillary facilities. Under the proposed mine development, short-term benefits to wildlife would occur since livestock would be removed from the project area for the life of the mine.

A long-term commitment of cultural resources would result from the destruction of sites, whether by unknowingly destroying subsurface sites, or through converting in situ cultural resource to cultural resouce data. Sites could also be partially destroyed through the effects of subsidence. If all sites were left in situ, more information could possibly be extracted from the site by new techniques and data demands in the future.

Short-term improvements to Class V areas could be achieved when mined areas were reclaimed. Long-term improvement would be achieved by reclamation and natural plant succession; removal of mine equipment, rail spur, and power lines; and restoration of waste disposal areas. The area could be reclaimed to a Class III.

Development of the proposed mine would change the nature of the primary recreational activity (hunting), since most of the reclaimed areas would not be suitable for wildlife habitat for the life of the mine (see Vegetation section). As human activity increases at the mine, disturbance to all recreation activities would occur in the short term, owing to the loss of the recreation land base. In the long term, recreation use on the area could resume with removal of mining equipment, successful reclamation, and reestablishment of wildlife species.

A short-term trend would be the tendency for recreational visitors to go elsewhere in the region, thus impacting other areas.

As livestock grazing would be eliminated from the project area during the life of the mine, the short-term loss to grazing would be 1,551 AUMs annually. The impact of this grazing loss would be cushioned by the benefits received from developing the mine and the secondary benefits received from nonuse of the range resource. These benefits of improved vegetative composition, increased vigor, and enhanced wildlife habitat would extend into the long term. Additional benefits would be afforded with the opportunities being presented to measure range condition and trend under a nonuse situation and opportunities to establish and monitor various techniques of improving both livestock range and wildlife habitat. There would be no long term loss as livestock grazing would be one of the post mining uses of the area.

The major trade-off in mineral resources would be between the short-term use of the coal, sand, gravel, scoria, oil, and diesel fuel and long-term availability of these resources. The primary long-term commitment of resources would be the coal produced during the life of the mine. Present data is insufficient to accurately predict the amount of coal that would be produced over the life of the mine. It is possible that the entire Johnson Bed and portions of both the Blue and Finch Groups would be mined.

In the short-term, the increased employment at the Carbon Basin project would create labor shortages in other regional sectors of the economy. In the long-term, as more people move into the region, a labor force of sufficient size to meet the needs of all employers would be available. In addition, this increased employment would tend to hold the unemployment rate at its current low level.

Increased wage earnings and higher per capita income would in turn increase retail and wholesale trade over the life of the mine. This would be a short-term gain while the loss of buying power of people on fixed incomes would be long term.

In the short term, housing prices would rise and crowded conditions would occur. However, over the long term the housing stock would increase, allowing such crowded conditions to subside.

Crowding and increased student/teacher ratios would occur in the short-term but better, new facilities would be built over the long-term, more teachers would be hired, and the tax base and royalties from federal coal would increase to pay for these needs.

Health care in this region may never be considered up to standard, but over the long term the population/ health care specialist ratios would return to at least the current levels.

Although there would be short-term overtaxing of some local services (water, sewer, police and fire protection, solid waste) this situation would be corrected as new sewer and water systems are built, more policemen and firemen are hired, and new solid waste disposal sites are developed in the long-term.

Impacts directly associated with mining of coal (congestion on access roads, traffic delay at railroad crossings, air and noise pollution) would be short-term in nature and would disappear when the mining ceased at the project.

Work-related injury and illness would be a short-term loss due to the proposed action. Those injuries or illnesses which are fatal or debilitating would reduce long-term human productivity. Since underground mining is much more dangerous than the average for all industries, more injuries and illness would be expected due to the Carbon Basin Mine than if other industry came into the region.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Implementation of the project would result in commitments to use the area more intensively and would significantly alter the use of various resources. Some use and consumption of land and resources would be irreversible or irretrievable. Irreversible refers to use and impact trends which, once initiated, could not be reversed for a long time, if at all. Irretrievable refers to permanent loss of resources for other uses. Some commitments are both irreversible and irretrievable.

Soils, vegetation, wildlife, and present land uses on the proposed project area would be irreversibly committed during the life of the project and thereafter until reclaimed. Air and water would be irreversibly committed during the life of the project to the extent that air quality would be degraded and water used by the project would not be available for other uses. A major irretrievable commitment would be the removal of approximately 400 million tons of coal which would not be available to future generations. Cultural values, construction materials, fuels, and any loss of human life would also be irretrievable if the project should be implemented.

During the active life of the Carbon Basin Mine, air quality at the mine site and some closely surrounding areas would be slightly degraded. During this period the loss of air quality such as existed previous to mining activities would be irretrievable. However, upon completion of mining activities, the air quality would return to the premining level if successful reclamation occurred. Any reductions in visibility during the mine life would also be irretrievable; however, visibility would increase to normal distances at the termination of mining activities.

Changes in contours and surface characteristics would irreversibly alter the wind field and surface heating of the air. Changes in the composition of topsoil and vegetation could alter the specific heat of the surface material, which in turn would alter the absorption and radiation of solar heat. Although these potential climatological changes would be irreversible, their adverse impact, if any, would be very minimal. The climatological changes would be contained within the mine site and probably would not be noticed.

An irretrievable commitment of an undetermined number of uninventoried exposed and unexposed fossil localities would result from mining, as well as an increase in unauthorized fossil collecting. The destruction resulting to the resources would be an irretrievable commitment.

The destruction of existing soil profiles on 2,341 acres by mining, mining facilities, ancillary facilities, and associated urban needs would be an irretrievable utilization of soil resource. Any loss of soil by erosion (unquantifiable) caused by mining activities, as well as the soil surface disruption caused by increased activity, would be an irretrievable utilization of the soil resource.

The occurrence of subsidence could result in the draining of aquifers that supply water in seven springs. Once drained these aquifers might not be recharged again, especially if the aquifers were drained because of fracturing.

The development of housing and support service facilities on 192 acres at various regional population centers would irreversibly and irretrievably commit the existing native vegetative cover to facilities of higher use.

The destruction of sites, either unknowingly or through converting in-situ cultural resources to cultural resource data, would be an irreversible and irretrievable commitment of the resource.

Because of soil variations, slopes, and climate, vegetative reclamation scars would be evident on the project area; however, the area could be returned to a Class III.

The 61,400 cubic yards of sand, gravel, scoria, and other types of aggregate material for railroad spur, road, and mine facility construction would for all practical purposes be irretrievable because replacement under prevailing natural conditions could take centuries.

Coal produced over the life of the mine would be committed to use at power sites. It is not known if it is economically feasible to mine the Blue and Finch coal groups. If it were feasible to mine either or both of these groups, mining only the Johnson Bed could result in the loss of reserves in these beds due to technical problems associated with mining at a later date (see Chapter 3).

The coal-related population increases would impact recreational activities (especially urban). Although some of the coal-related population would leave once mining were completed, the regional population increase would cause an irreversible impact on recreation resources.

The Carbon Basin project would irreversibly reduce the buying power of persons on fixed incomes. The buying power they would lose during times of inflation would never be regained.

Fatal or debilitating injuries and illnesses would be an irreplaceable loss of the human resource. Based upon nationwide figures (1976), surface mining operations would result in approximately 12.6 injuries per year per million tons of coal mined. The proposed underground mine would result in approximately 367.75 injuries per year, assuming 5 million tons were mined annually. Surface mining would result in approximately .06 fatalities per year, while underground mining fatalities would approximate 1.95 if 5 million tons were mined annually.

Community expansion would lead to an irreversible change in land use from rangeland to residential around and near those communities receiving additional population from this mine.

CHAPTER 8

ALTERNATIVES

The BLM has on file lease application W-50061. Under the provisions of the amended court order 75-1749 (dated June 14, 1978), NRDC vs. Hughes is submitting a proposal for consideration of approval to the Secretary. This proposal is to offer federal coal in Carbon Basin for leasing on a competitive basis. The Secretary's actions may be approval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing laws and regulations. He may also defer decision pending submission of additional data, completion of required studies or for other specific reasons.

Even after the lease has been issued and a mining and reclamation plan is submitted and approved, the regulations and lease terms require that all subsequently proposed departures and deviations therefrom be approved in advance by the Secretary.

NO-ACTION

Under the no-action alternative, if a federal coal lease were not granted and no rights-of-way were granted for ancillary facilities, the Carbon Basin project would not be developed because it would not be economically feasible to mine private coal separately from federal coal.

In this case, all environmental elements on the project area would remain very much the same as they presently exist. Other sources of coal would have to be obtained to substitute for the production from the Carbon Basin project.

UNDERGROUND MINING ONLY

Under this alternative, a maximum of approximately 11.0 million tons of strippable coal would not be mined. However, 2 to 4 million tons of these strippable reserves could probably be recovered by underground mining methods.

The development of the mine portals, entryways, conveyor system, etc., would probably be accelerated in order to meet the desired production schedule. This would reduce the period of truck hauling of coal by approximately 1 year. Surface disturbance would be confined to areas needed for mine and ancillary facilities which would be 641 acres and 500 acres respectively or a total of 1,141. Since employment levels would be the same as the proposed action over the long term, 192 acres of land in or adjacent to population centers of the region would be developed for housing and support service facilities.

The impacts of this alternative on the resources of the area would be the same as the proposed action as related to variety, but would be less in magnitude. The impacts that would be lessened to the greatest degree would be those that would be related to soil, vegetative and wildlife resources. Impacts to wildlife and alluvial valley floors that are identified as being affected by unsuitability criteria would not occur under this alternative (Chapters 2 and 3). This would be a direct result of eliminating the surface mine area on private land of the proposed action.

The reduction of surface disturbance under this alternative would be a benefit in potential habitat for threatened and endangered wildlife. Reducing surface disturbance by 1,008 acres would translate into a 47% reduction of disturbance to prairie dog habitat.

An additional irreversible and irretrievable commitment of resources over and above the proposed action would be the loss of strippable coal that would remain after underground mining had been completed. This loss could vary from 7 to 10.8 million tons of coal.

Impacts to the water resource are the same as those identified in Chapter 3 in relation to underground mining.

SURFACE MINING ONLY

Surface mining only is not considered feasible at this site due to the steeply dipping nature of the coal seams. The amount of coal available to surface mining methods only would not be economical to develop.

CHAPTER 9

CONSULTATION AND COORDINATION

TEAM ORGANIZATION

The Wyoming State Director of the BLM was assigned the lead responsibility for preparation of this draft environmental statement. The primary interagency effort involved the BLM and the Geological Survey (GS).

PUBLIC COMMENTS AND RESPONSES

On December 15, 1976, a public coal issues meeting was held at Jeffery Center in Rawlins to discuss proposed coal development in southcentral Wyoming. A coal issues brochure and two news releases were published to solicit attendance at this meeting and input to the environmental process. About 60 people attended and significant issues were raised at the meeting.

Representatives from the coal industry mentioned their need for assured coal supplies to meet their obligations to supply power generation facilities in other areas of the country. Agricultural representatives were concerned about the possible losses of agricultural land, water, and life style resulting from mining operations. Spokespersons for conservation organizations expressed concern over mining's possible impacts on local wildlife, overall environmental quality levels, as well as the real need for more coal leasing at this time. A third press release, dated January 24, 1977, was issued to encourage public comments.

Public meetings will be scheduled to receive comment on this draft environmental statement in Rawlins, and in Cheyenne, Wyoming. News releases, Federal Register notices, and special postings will be issued on specific hearing dates.

Copies of this draft ES are available from the BLM Rawlins District Office and Cheyenne State Office upon request until supplies are depleted.

CONSULTATION AND COORDINATION IN THE PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT

During preparation of this draft environmental statement, federal, state, county, and local agencies; private industry; and individuals and organizations with special expertise relating to the proposed actions were contacted to gain information and close data gaps. The substantive results of these consultation and coordination efforts follow. Various federal and state agencies provided contract data or cooperated in preparation of the ES.

Federal Agencies

U.S. Department of Agriculture (USDA), Forest Service

The Forest Service provided information on range and timber types, snow hydrology, soil types, recreation use, and wildlife distribution within the Medicine Bow National Forest. The Shrub Science Laboratory in Provo, Utah provided information on reclamation methods.

USDA, Soil Conservation Service

The Upper Colorado Environmental Plant Center (Douglas Creek and White River Conservation Districts, Rio Blanco County) provided information on reclamation procedures and success. The SCS in Boseman, Montana also provided information on these subjects.

U.S. Department of the Interior (USDI), Fish and Wildlife Service

The FWS was contacted for consultation under the Endangered Species Act, for coordination under the Bald Eagle Protection Act and for assistance under the Migratory Bird Treaty Act.

Environmental Protection Agency

The EPA provided tabulations of water quality data.

State Agencies

Wyoming Recreation Commission, State Historic Preservation Officer

The office of the SHPO provided information on historic sites and a listing of National Register sites.

Wyoming Department of Agriculture

The Department of Agriculture provided information on agricultural water use.

Wyoming State Engineer

The State Engineer's office provided information on water studies, water rights, and water decrees.

Wyoming Department of Environmental Quality

The DEQ provided information on water quality, air quality, and reclamation.

County and Local Entities

Carbon County Planning Commission

The planning commission provided data on zoning within the county.

City of Rawlins

The city provided information on present water supply and future development.

Private Industries

Union Pacific Railroad

The company provided information on train traffic.

Edison Development Company

The company provided a mine and reclamation report.

COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

Comments on the draft environmental statement will be requested from the following agencies, state clearing houses, and interest groups.

Federal

Advisory Council on Historic Preservation
Department of Agriculture
  Soil Conservation Service
  Forest Service
Department of Commerce
Department of Energy
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
  Bureau of Mines
  Bureau of Reclamation
  Fish and Wildlife Service
  Heritage Conservation and Recreation Service
  National Park Service
  Office of Surface Mining
Department of Labor
  Mining Safety and Health Administration
  Occupational Safety and Health Administration
Department of Transportation
Environmental Protection Agency
Federal Energy Regulatory Commission
Interstate Commerce Commission
Mountain Plains Federal Regional Council
Office of Economic Opportunity

State

The State of Wyoming Clearing House will coordinate comments from all interested agencies.

Local

Carbon County Commissioners
Carbon County Council of Governments
Carbon County Planning Commission
City of Rawlins
Town of Hanna
Town of Saratoga
Town of Encampment
Town of Sinclair
Town of Medicine Bow

Nongovernmental Organizations

Alpine Chapter, Audubon Society
American Horse Protective Association
American Electric Power Service Corporation
Amercian Institute of Mining Engineers
American Sportsman's Club
Carbon County Woolgrowers
Defenders of Wildlife
ENACT
Environmental Citizen's Lobby
Friends of the Earth
International Society for the Protection of Mustangs and Burros
Izaak Walton League
League of Women Voters
National Audubon Society
National Coal Association
National Council of Public Land Users
National Energy Law and Policy Institute
National Environmental Health Association
National Resources and Environmental Council
National Wildlife Federation
Natural Resources Defense Council
Northern Great Plains Chapter, Sierra Club
Powder River Basin Resource Council
Society for Range Management
The Wilderness Society

Trout Unlimited
Wild Horse Organized Assistance
Wyoming Outdoor Council
Wyoming Petroleum Association
Wyoming Woolgrowers
Wyoming Stockgrowers Association
Wyoming Wildlife Federation

WHERE COPIES MAY BE INSPECTED

Bureau of Land Management

Buffalo Resource Area
Buffalo, Wyoming 82834
(307) 684-5586

Casper District Office
951 Union Blvd.
Casper, Wyoming 82601
(307) 265-5550

Cody Resource Area
1131 13th Street
Federal Building
Cody, Wyoming 82414
(307) 587-2216

Denver Service Center Library
Bldg. 50, Denver Service Center
Denver, Colorado 80225
(303) 234-4578

Kemmerer Resource Area
Diamondville, Wyoming 82116
(307) 877-3933

Lander Resource Area
Lander, Wyoming 82520
(307) 332-4220

Newcastle Resource Area
Highway 16 Bypass (P.O. Box 757)
Newcastle, Wyoming 82701
(307) 746-4453

Pinedale Resource Area
Molyneux Building
Pinedale, Wyoming 82941
(307) 367-4358

Rawlins District Office
1300 Third Street
Rawlins, Wyoming 82301
(307) 324-7171

Rock Springs District Office
Highway 187N
Rock Springs, Wyoming 82901
(307) 382-5350

Washington Office of Public Affairs
18th and C Streets, N.W.
Washington, D.C. 20240
(202) 343-4151

Worland District Office
1700 Robertson Avenue
Worland, Wyoming 82401
(307) 347-6151

Wyoming State Office
2515 Warren (Lea Building)
Cheyenne, Wyoming 82001
(307) 778-2220, Ext. 2385

Geological Survey

District Mining Office
Federal Building
Casper, Wyoming 82601
(307) 265-5550

Director's Office National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092
(703) 860-7411

District Mining Supervisor's Office
126 Elk Street (Rear)
Rock Springs, Wyoming 82901
(307) 362-7350

Regional Manager's Office
7200 W. Alameda Avenue (Villa Italia)
Lakewood, Colorado 80226
(303) 234-2855

Area Mining Supervisor
Building 25
Denver Federal Center
Denver, Colorado 80225
(303) 234-4435

Public Libraries

Albany County Library
405 Grand Avenue
Laramie, Wyoming 82070

CONSULTATION AND COORDINATION

Carbon County Library
Courthouse
Rawlins, Wyoming 82301

Casper College Library
125 College Drive
Casper, Wyoming 82601

Encampment Branch Library
Encampment, Wyoming 82325

Fremont County Library
451 North Second Street
Lander, Wyoming 82520

Laramie County Community College Library
1400 East College Drive
Cheyenne, Wyoming 82001

Laramie County Library
2800 Central Avenue
Cheyenne, Wyoming 82001

Library of Natrona County
307 East Second
Casper, Wyoming 82601

Lincoln County Library
Courthouse
Kemmerer, Wyoming 82101

Rock Springs Public Library
400 "C"Street
Rock Springs, Wyoming 82901

Saratoga Public Library
104 West Elm
Saratoga, Wyoming 82331

Sweetwater County Library
177 North Center
Green River, Wyoming 82935

University of Wyoming Library
University Station
Box 3334
Laramie, Wyoming 82070

Western Wyoming Community College Library
Rock Springs, Wyoming 82901

Wyoming State Library
Government Publications
Supreme Court & State Library Building
Cheyenne, Wyoming

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APPENDIX A

RESOURCE DATA

AIR QUALITY

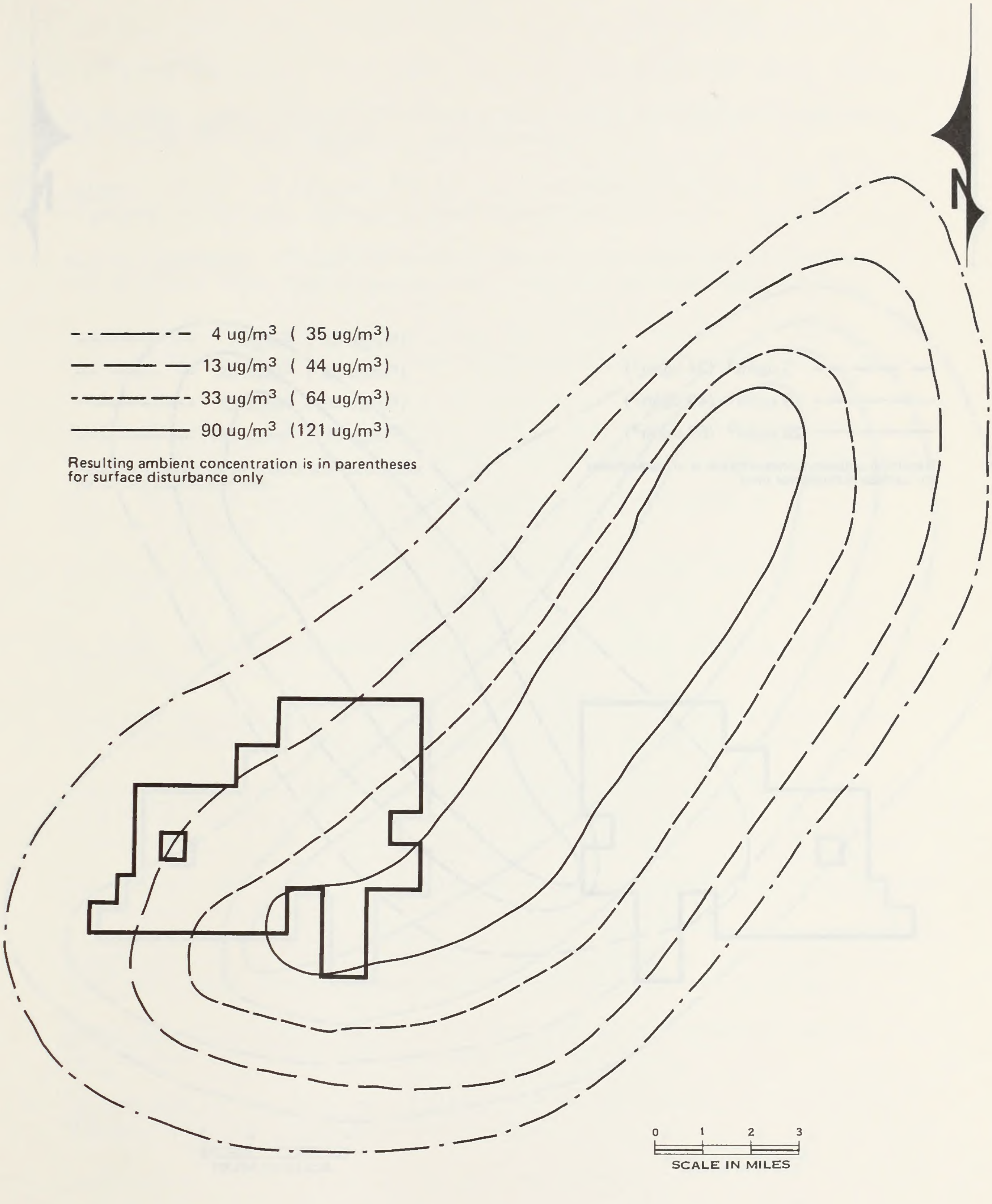
With application of the best management practices (see Chapter 4) major reductions in TSP impacts result, as discussed in Chapter 3. Table CA A-1 shows the total annual TSP emissions for each study year, as well as the total reduction in annual emissions and the total annual emissions expected if the alternatives were employed (Chapter 3). An average control effectiveness of 62.2% for chemical stabilization was used in making the calculations.

The reduction in annual emissions as shown in Table CA A-1 would result in a significant decrease in air quality impact. Maps CA A-1 through CA A-4 show the annual and 24-hour worst case predicted and resulting particulate concentrations that would be expected for each study year if the best management practices were employed. As can be seen from the maps, air quality impact would be significantly less than that predicted in Chapter 3. There would still be a significant impact from overburden removal in 1990 because of the substantially greater volume to be removed than is normally economically feasible for a strip mine (2,594 tons/year). Access road impacts would be comparable to those of shovel/ truck loading and exposed areas (690, 671, and 631 tons/year respectively for 1990). At the end of mine life, the major sources of TSP impact would be the access road and exposed areas (552 and 217 tons/year respectively).

Table CA A-1

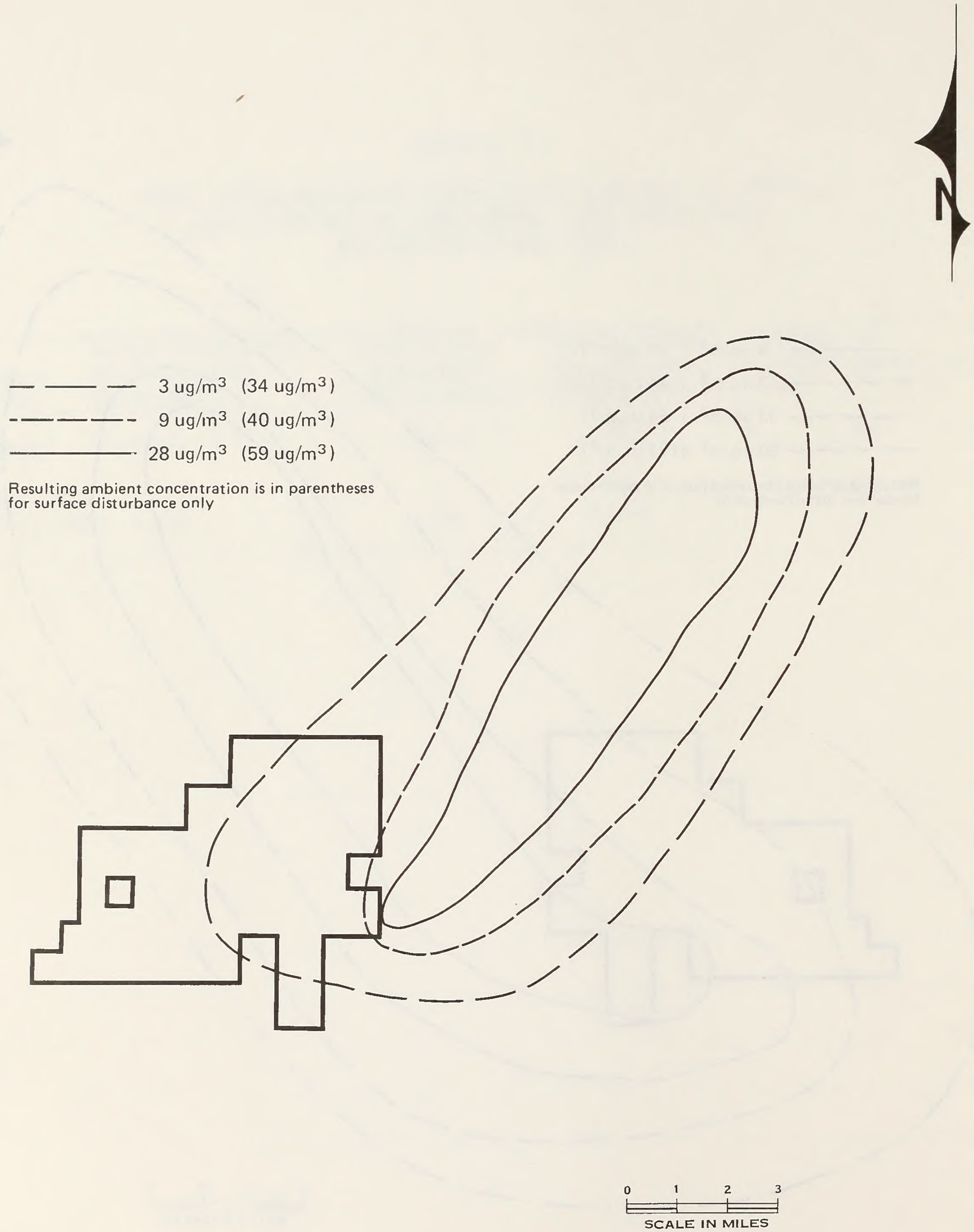
TOTAL ANNUAL EMISSIONS PREDICTED AS A RESULT OF CHEMICAL STABILIZATION OF HAUL ROADS, PAVED ACCESS ROAD, AND ENCLOSED COAL STORAGE

Study Year	Annual Chapter 3 TSP Emissions (tons/year)	Annual Best Management TSP Emissions	Reduction in TSP Emissions (tons/year)	Reduction in TSP Emissions (%)
1990	13,349	4,872	8,477	64
End of Mine Life	4,147	778	3,369	81

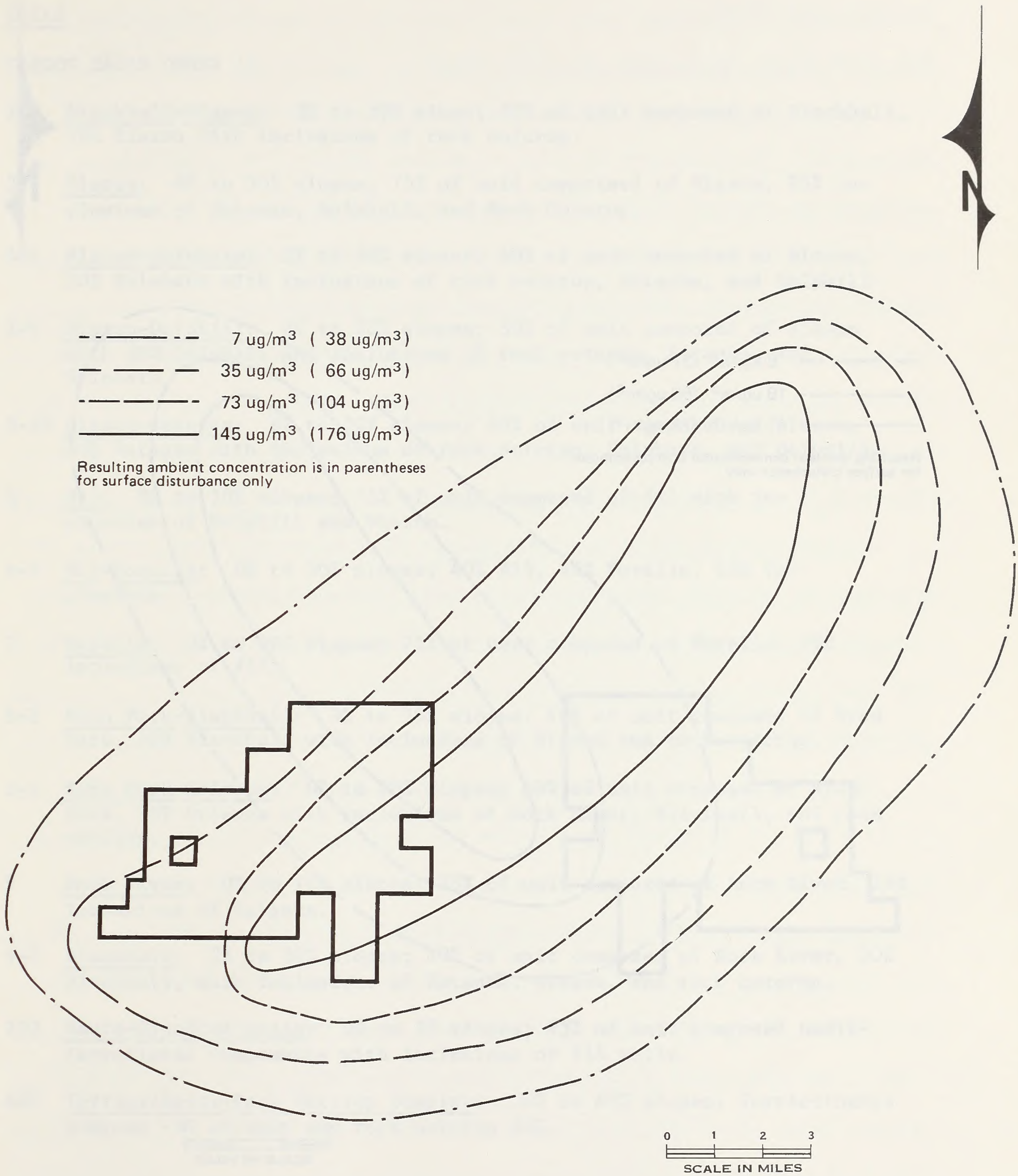


Map CA A-1

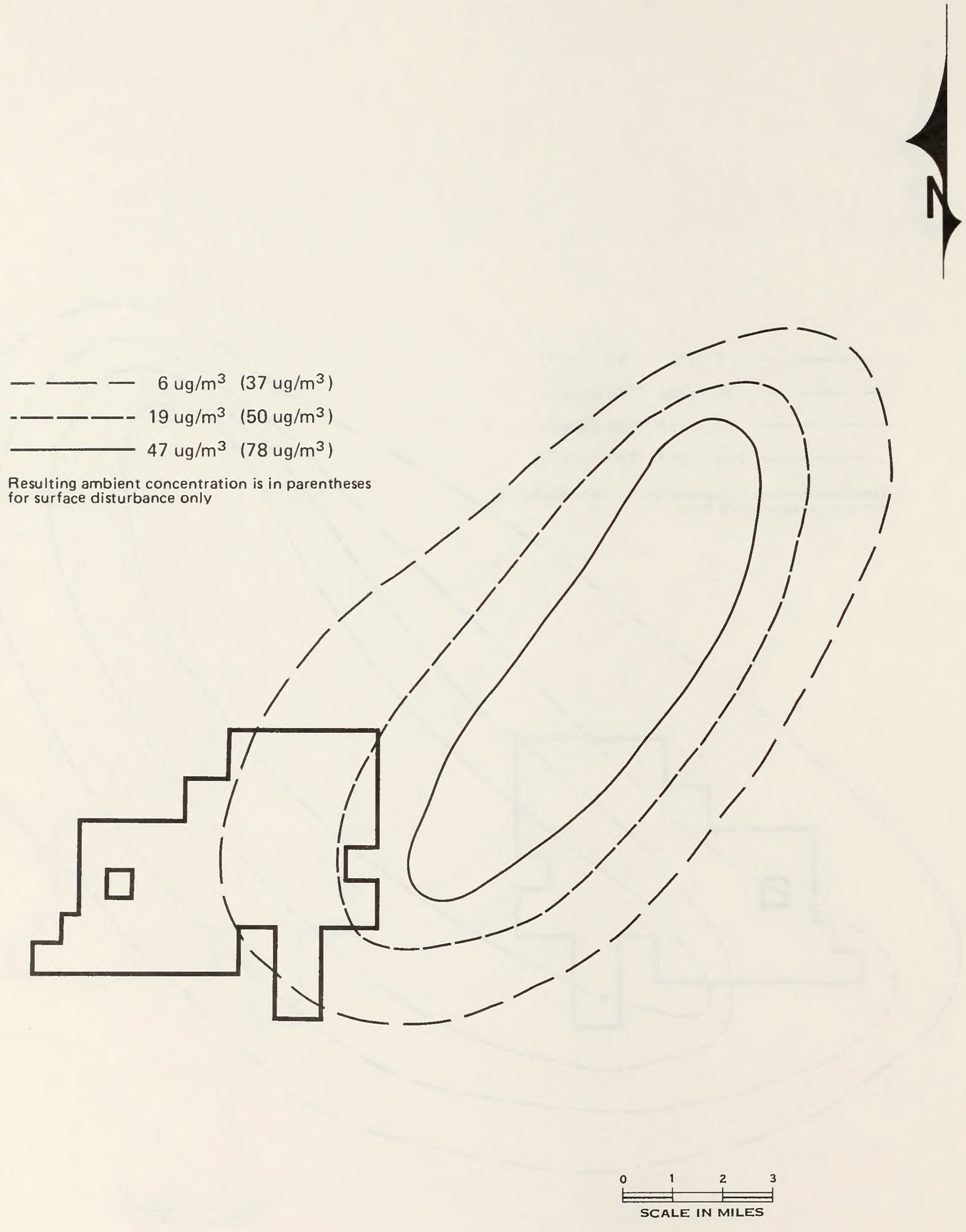
ISOPLETH MAP SHOWING THE ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS EXPECTED FOR 1990 IF THE DESCRIBED BEST MANAGEMENT PRACTICES WERE EMPLOYED



Map CA A-2
ISOPLETH MAP SHOWING THE ANNUAL PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS EXPECTED FOR THE END OF MINE LIFE IF THE DESCRIBED BEST MANAGEMENT PRACTICES WERE EMPLOYED



Map CA A-3
ISOPLETH MAP SHOWING THE 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS EXPECTED FOR 1990 IF THE DESCRIBED BEST MANAGEMENT PRACTICES WERE EMPLOYED



Map CA A-4

ISOPLETH MAP SHOWING THE 24-HOUR WORST CASE PREDICTED AND RESULTING AMBIENT PARTICULATE CONCENTRATIONS EXPECTED FOR THE END OF MINE LIFE IF THE DESCRIBED BEST MANAGEMENT PRACTICES WERE EMPLOYED

SOILS

CARBON BASIN ORDER II

2-3 Blackhall-Blazon: 3% to 30% slope; 50% of unit composed of Blackhall, 30% Blazon with inclusions of rock outcrop.

3 Blazon: 6% to 30% slopes; 75% of unit comprised of Blazon, 25% inclusions of Satanka, Delphill, and Rock Outcrop.

3-1 Blazon-Shinbara: 2% to 30% slopes; 40% of unit composed of Blazon, 30% Shinbara with inclusions of rock outcrop, Satanka, and Delphill.

3-4 Blazon-Delphill: 6% to 30% slopes; 50% of unit composed of Blazon with 30% Delphill and inclusions of rock outcrop, Satanka, and Shinbara.

3-10 Blazon-Satanka: 6% to 30% slopes; 40% of unit composed of Blazon, 30% Satanka with inclusions of rock outcrop, Shinbara, and Delphill.

6 #15: 0% to 30% slopes; 75% of unit composed of #15 with inclusions of Delphill and Blazon.

6-7 #15-Forelle: 0% to 30% slopes; 40% #15, 40% Forelle, 20% inclusions.

7 Forelle: 0% to 30% slopes; 75% of unit composed of Forelle, 25% inclusions of #15.

8-2 Ryan Park-Blackhall: 3% to 30% slopes; 40% of unit composed of Ryan Park, 30% Blackhall with inclusions of Blazon and rock outcrop.

8-5 Ryan Park-Grieves: 0% to 20% slopes; 40% of unit composed of Ryan Park, 30% Grieves with inclusions of Rock River, Blackhall, and rock outcrop.

9 Rock River: 0% to 12% slopes; 75% of unit composed of Rock River, 25% inclusions of Satanka.

9-2 Blackhall: 2% to 30% slopes; 40% of unit composed of Rock River, 20% Blackhall, with inclusions of Satanka, Blazon, and rock outcrop.

257 Havre-Glendive soils: 0% to 3% slopes; 85% of unit composed undifferentiated components with inclusions of #15 soils.

401 Torriorthents-Rock Outcrop Complex: 30% to 60% slopes; Torriorthents compose 75% of unit and rock outcrop 25%.

CARBON BASIN ORDER III

38B--Rock River sandy loam, 2% to 6% slopes

This is a deep, well drained, loamy soil that occurs throughout the survey area. It developed in alluvium derived mainly from calcareous sandstone on alluvial fans. Though the slopes range from 2% to 6%, they are mostly about 4%. Small areas of Ryan Park and Satanka soils were included in mapping. The Rock River soil is a deep-well drained soil. Typically the surface layer is brown sandy loam about 2 inches thick. The subsoil is brown sandy clay loam about 10 inches thick. The substratum is calcareous, yellowish brown sandy loam to a depth of 60 inches.

38C--Rock River sandy loam, 6% to 12% slopes

This is a deep, loamy soil that occurs throughout the survey area. It developed in alluvium derived mainly from calcareous sandstone. Though the slopes range from 6% to 12%, they are mostly about 8%. Small areas of Ryan Park and Satanka soils were included in mapping.

78B--Ryan Park sandy loam, 2% to 6% slopes

This is a deep, well drained, sandy soil that occurs throughout the survey area. It developed in alluvium mainly from sandstone on alluvial fans. Though the slopes range from 2% to 6%, they are mostly about 4%. Small areas of Rock River and Grieves soils were included in mapping. The Ryan Park typically has a surface layer that is brown sandy loam about 1 inch thick. The subsoil is yellowish brown sandy loam about 16 inches thick. The upper part of the substratum is pale brown sandy loam about 25 inches thick. The lower part of the substratum is yellowish brown sandy loam to a depth of 60 inches.

90B--Blazon loam, 5% to 15% slopes

These gently sloping to moderately steep soils occur throughout the survey area. The slopes range from 5% to 15%, but are mostly about 10%. Small areas of Shinbara and Satanka soils and rock outcrop are included in this mapping unit.

The Blazon series is a shallow, well drained soil. It is formed in shallow loamy deposits weathered from interbedded sandstone and shale. Typically the surface layer is a brown, moderately alkaline clay loam about 5 inches thick. The substratum is a pale brown, moderately alkaline clay loam about 11 inches thick. Interbedded sandstone and shale deposits occur at 16 inches.

210--Ravalli-Forelle-15 complex, 0% to 6% slopes

These nearly level and gently sloping soils are on alluvial fans, terraces, and drainageways. The Ravalli soil makes up about 30% of the mapping unit, the Forelle soil about 30% and the 15 soil about 25%. The Ravalli soil differs from the Forelle and 15 soils by having a higher sodium content in the subsoil. The Forelle soil differs from the 15 soil by having a distinct clay accumulation in the subsoil. About 15% of the unit is Bullock and Rock River soils.

The Ravalli series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is yellowish brown, mildly alkaline sandy loam about 2 inches thick. The upper part of the subsoil is yellowish brown, moderately alkaline loam about 3 inches thick. The center part of the subsoil is brown, moderately alkaline loam about 9 inches thick. The lower part of the subsoil is very pale borwn, very strongly alkaline clay loam about 6 inches thick. The upper part of the substratum is pale brown, very strongly alkaline loam about 5 inches thick. The lower part of the substratum is pale brown, very strongly alkaline very fine sandy loam to 60 inches or more.

The Forelle series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is grayish brown, mildly alkaline loam about 4 inches thick. The upper part of the subsoil is yellowish brown, mildly alkaline clay loam about 11 inches thick. The center part of the subsoil is yellowish brown, mildly alkaline clay loam about 14 inches thick. The lower part of the subsoil is pale brown, moderately alkaline clay loam about 16 inches thick. The substratum is pale brown, moderately alkaline loam extending to 60 inches or more.

The 15 series is a deep, well drained soil. It formed in alluvium from sedimentary uplands. Typically the surface layer is pale brown, moderately alkaline loam about 2 inches thick. The subsoil alkaline loam about 2 inches thick. The subsoil is light yellowish brown, moderately alkaline loam about 6 inches thick. The upper part of the substratum is pale brown, moderately alkaline loam about 37 inches thick. The lower part of the substratum is brown, moderately alkaline sandy loam to a depth of 60 inches or more.

251--Grieves-Blackhall association, 2% to 20% slopes

This association consists of sloping to moderately steep upper slopes and ridge crests. Grieves sandy loam makes up about 55% of the mapping unit and Blackhall sandy loam makes up about 30%. Grieves soils occur on alluvial fans and gently sloping uplands. Blackhall soils occur on sloping to moderately steep upper slopes and ridge crests. Included in this unit are areas of Carmody soils and rock outcrop. These inclusions make up about 15% of the total acreage.

The Grieves soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 5 inches thick. The subsurface layer is brown sandy loam about 6 inches thick. The substratum is pale brown sandy loam to a depth of 60 inches.

The Blackhall soil is a shallow, well drained, soil forming over soft sandstone residuum. Typically, the surface layer is brown sandy loam about 2 inches thick. The substratum is light yellowish brown sandy loam to a depth of 17 inches. Soft, pale yellow, calcareous sandstone occurs at 17 inches.

<u>252--Shinbara-Blazon-Rock Outcrop complex, 6% to 30% slopes</u>

These sloping to steep soils are on bedrock controlled uplands. The Shinbara soil makes up about 35% of the mapping unit, the Blazon soil about 30% and Rock outcrops about 25%. The Shinbara soils differ from the Blazon soils by being shallower to bedrock. About 10% of the unit is Delphill and Tasselman soils.

The Shinbara series is a very shallow, excessively drained soil. It formed in a very shallow loamy deposits weathered from shale interbedded with sandstone. Typically the surface layer is brown, strongly alkaline loam about 3 inches thick. The substratum is strongly alkaline silty clay loam about 3 inches thick. Soft fractured shale and coal occurs at 6 inches.

The Blazon series is a shallow, well drained soil. It formed in shallow loamy deposits weathered from interbedded sandstone and shale. Typically the surface layer is brown, moderately alkaline clay loam about 5 inches thick. The substratum is pale brown, moderately alkaline clay loam about 11 inches thick. Interbedded sandstone and shale deposits occur at 16 inches.

<u>253--Blazon-Satanka association, 2% to 15% slopes</u>

This association consists of gently sloping to moderatley steep residual uplands. Blazon loam makes up about 40% of the mapping unit and Satanka sandy loam makes up about 35%. Blazon soils occur on ridge crests and upper slope areas. Satanka soils occur on concave midslope and lower slope areas. Included in this unit are areas of Delphill and Shinbara soils and rock outcrop. These inclusions make up about 15% of the total acreage.

The Satanka soil is a moderately deep, well drained, soil forming over interbedded sandstone, siltstone, and shale residuum. Typically, the surface layer is brown sandy loam about 3 inches thick. The upper part of the subsoil is brown sandy clay loam about 7 inches thick. The lower part of the subsoil is pale brown loam about 3 inches thick. The upper part of the substratum is very pale brown loam about 14 inches thick. The lower part of the substratum is gray silty clay about 8 inches thick. Soft, calcareous, interbedded sandstone, siltstone, and shale occurs at 35 inches.

254--Bullock-Blazon complex, 0% to 6% slopes

These nearly level and gently sloping soils are adjacent to upland drainageways. The Bullock soil makes up about 45% of the mapping unit and the Blazon soil about 35%. The Bullock soil differs from the Blazon soil by being deeper to bedrock and having distinct structure in the subsoil. About 20% of the unit is Ravalli and 15 soils. The Bullock series is a moderately deep, well drained soil. It formed in loamy deposits weathered from shale interbedded with sandstone.

Typically the surface layer is light gray, moderately alkaline sandy loam about 3 inches thick. The upper subsoil is yellowish brown, moderately strongly alkaline silty clay about 13 inches thick. The substratum is dark grayish brown, moderately alkaline silty clay abut 6 inches thick. Soft shale and coal occurs at about 32 inches.

255--Playa Land Type

256--McFadden-Rock River complex, 0% to 20% slopes

These nearly level to moderately steep soils are on high river terraces and slope breaks on alluvial fans. The McFadden soil makes up about 50 percent of the mapping unit and the Rock River soil about 30 percent. The

McFadden soil differs from the Rock River soil by having more carbonates and coarse fragments in the soil profile. About 20 percent of the mapping unit is 15 soils and soils that are moderately deep to bedrock.

The McFadden series is a deep well drained soil. It formed in gravelly calcareous alluvium. Typically the surface layer is brown, moderately alkaline gravelly sandy loam about 4 inches thick. The subsoil is brown, moderately alkaline gravelly sandy loam about 9 inches thick. The substratum is pale brown, strongly alkaline sandy loam to a depth of 60 inches or more.

257--Havre and Glendive soils, 0% to 3% slopes

This undifferentiated unit consists of soils in narrow flooding drainageways. Each component of this mapping unit may occur in each delineated area, or they may occur separately. Included in this unit are areas of 15 soils. The inclusions make up about 15% of the total acreage.

The Havre soil is a deep, well drained, soil forming in stratified alluvium. Typically the surface layer is grayish brown loam about 3 inches thick. The substratum is brown, silty clay loam to a depth of 60 inches.

The Glendive soil is a deep, well drained, soil forming in stratified alluvium. Typically, the surface layer is brown fine sandy loam about 4 inches thick. The substratum is pale brown fine sandy loam to a depth of 60 inches.

258--Rock River-Satanka association, 0% to 12%

This association consists of level to sloping alluvial fans and adjacent uplands. Rock River sandy loam makes up about 45% of the mapping unit and Satanka sandy loam makes up about 35%. Rock River soils occur on alluvial fans and narrow drainages. Satanka soils occur on the sloping ridges and concave upperslopes. Included in this unit are areas of Blazon and Blackhall soils and rock outcrop. These inclusions make up about 20% of the total acreage.

The Rock River soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 2 inches thick. The subsoil is brown sandy clay loam about 10 inches thick. The substratum is calcareous, yellowish brown sandy loam to a depth of 60 inches.

260--Ryan Park-Rock River association, 2% to 20% slopes

This mapping unit consists of gently sloping to moderately steep alluvial fans. Ryan Park sandy loam makes up about 45% of the mapping unit and Rock River sandy loam makes up about 30%. Ryan Park soils occur on the middle and upper portions of alluvial fans. Rock River soils occur on the lower portions of alluvial fans and alluvial bottoms. Included in this unit are areas of Grieves and Blackhall soils. These inclusions make up about 25% of the total acreage.

The Ryan Park soil is a deep, well drained, soil forming in alluvium. Typically, the surface layer is brown sandy loam about 1 inch thick. The subsoil is yellowish brown sandy loam about 16 inches thick. The upper part of the substratum is pale brown sandy loam about 25 inches thick. The lower part of the substratum is yellowish brown sandy loam to a depth of 60 inches.

401--Torriorthents-Rock Outcrop complex, 30% to 60% slopes

This complex consists of very steep rough broken lands. Torriorthents make up about 70% of the mapping unit and rock outcrop makes up about 30%. The torriorthents are intermingled in with the rock outcrop, but usually occur immediately below rock outcrops. This mapping unit is typically composed of Shinbara, Spool, Tassleman, and Blazon soils, however, none or all of them may occur in any one delineation.

C.F. Cut and Fill (Disturbed Land)

M.D. Mine Dump (Disturbed Land)

CARBON BASIN APPENDIX

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL[2]	CLASSIFICATION[3] DEPTHS (INCHES)	USDA	UNIFIED	AASHO	DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
Blackhall	251 2-3	Loamy, mixed (cal-careous), frigid, shallow Ustic Tor-riorthent	Residuum from soft sandstones	0-12 0-12	FSL,VFSL GR-VFSL	SM, SM-SC SM	A-4 A-2,A-4	10-20	0.6-2.0	Low	Low
Blazon	252,253, 254,2-3, 3,3-4 3-10	Loamy, mixed (calcar-cous), frigid, shallow Ustic Torriorthent	Interbedded sand-stone, loam stone and sandy shales	0-14 0-14 0-14	CL L GR-CL	CL ML, CL-ML GM	A-6 A-4 A-6	10-20	0.2-2.0	Low	Moderate Low Moderate
Bullock	254	Fine-loamy, mixed Borollic Natrargid	Residuum from interbedded soft sandstone and silty and clayey shales	0-4 0-4 4-9 9-22	FSL SIL, L SCL, CL, L SL, L, CL	SM,SM-SC,ML ML, CL-ML SC, CL SC,SM-SC,CL	A-4 A-4 A-4, A-6 A-4, A-6	20-40	0.6-2.0	Low	Low Low Moderate Moderate
Delphill	3-4	Fine-loamy, mixed (calcareous), frigid Ustic Torriorthent	Residuum from loamstone and sandy shales	0-2 3-27	L L,CL	CL-ML,CL,ML CL-ML,CL	A-4, A-5 A-4, A-6	20-40	0.6-2.0	Moderate	Low
Forelle	210,6-7 7	Fine-loamy, mixed Borollic Haplargid	Alluvium from sandstones and shales	0-4 4-20 20-60	L CL, L GR-SCL	CL-ML, ML CL GC, SC	A-4 A-6 A-2	>60	0.6-20	Moderate	Low Moderate Moderate
Glendive	257	Coarse-loamy, mixed (calcareous), frigid Ustic Torrifluvent	Sandy alluvium on flood plains	0-16 16-60	L,SIL,FSL SR-FSL-LFS	ML,CL-ML SM	A-4 A-4, A-2	>60	0.6-2.0	Moderate	Low
Grieves	251,8-5	Coarse-loamy, mixed (calcareous), frigid Ustic Torriorthent	Alluvium from calcareous sand-stone	0-14 14-60	FSL FSL	SM,SM-SC SM,SM-SC	A-0.6-2.0 A-4	>60	0.6-2.0	Low	Low

CARBON BASIN APPENDIX
(continued)

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL[2]	CLASSIFICATION[3] DEPTHS (INCHES)	USDA	UNIFIED	AASHO	DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
Harve	257	Fine-loamy, mixed (calcareous), frigid Ustic Torrifluvent	Stratified alluvium on flood plains and stream terraces	0-8 0-8 8-60	L SICL L,FSL	ML,CL,CL-ML CL ML	A-4 A-6 A-4	>60	0.2-0.6	Moderate	Low Moderate Low
McFadden	256	Coarse-loamy, mixed Borollic Calciorthid	Alluvium from gravelly sand-stones	0-4 4-13 13-25 25-60	GR-SL GR-SL SL SL	GM,SM GM,SM SM SM	A-2 A-2 A-2, A-4 A-2, A-4	>60	--	--	--
Ravalli	210	Fine-loamy, mixed Borollic Natrargid	Alluvium from alkaline shales	0-2 2-14 14-20 20-60	SL L CL L, VFSL	SM ML CL ML	A-4, A-2 A-4 A-6 A-4	>60	0.06-0.2	Low	Moderate
Rock River	258,9 260,9-2 256	Fine-loamy, mixed Borollic Haplargid	Alluvium from sandstone	0-3 3-19 19-60	SL SCL SL	SM SM, SM-SC SM	A-2 A-4 A-2	>60	0.6-2.0	Low	Low
Ryan Park	260 8-2 8-5	Coarse-loamy, mixed Borollic Haplargid	Alluvium from sandstone	0-4 4-18 18-60	LFS,SL,LS SL,FSL SL,LS	SM SM-SC SM	A-2 A-2, A-4 A-2, A-4	>60	2.0-6.0	Low	Low
Satanka	258, 253,3-10	Fine-loamy, mixed Borollic Haplargid	Residuum from soft sedimentary rocks	0-4 0-4 4-35	FSL GR-FSL SCL GR-SCL	SM GM, SM SC,GC	A-4 A-2 A-2, A-6	35	0.6-2.0	Low	Low
Shinbara	252,3-1	Loamy, mixed (calcar-eous), frigid, shallow Ustic Torriorthent	Residuum from siltstone and loamstone	0-8 0-8	L GR-L	CL-ML, ML CM-GC, GM	A-4 A-4	2-10	0.6-2.0	Low	Low

SOIL INTERPERTATION (CLASSIFICATION AND ENGINEERING)

SOIL SERIES	MAPPING UNIT #s	CLASSIFICATION SOIL TAXONOMY[1]	PARENT MATERIAL[2]	CLASSIFICATION[3]				DEPTH TO BEDROCK (INCHES)[4]	PREMEABILITY LEAST PERMEABLE LAYER (IN/HR)[5]	POTENTIAL FROST ACTION[6]	SHRINK/ SWELL POTENTIAL[7]
				DEPTHS (INCHES)	USDA	UNIFIED	AASHO				
#15	210,6 6-7	Fine-loamy mixed Borollic Camborthid	Alluvium	0-45 45-60	L SL	---	---	>60	---	---	---

1. Classification: Classification of each soil series (and tentative series) according to Soil Taxonomy USDA 1975.

2. Parent Material: Geologic material that soil developed from.

3. Classification: Depths are of soil profiles, USDA classification is the soil textural classification system, the unified and AASHO classifications are used by engineers unfamiliar with the USDA textural classification system.

4. Depth To Bedrock: Refers to the soil range in depth to bedrock.

5. Permeability: Refers to the rate at which water and air may move through the soil.

6. Potential Frost Action: Refers to the probable effects on structures resulting from the freezing and thawing of soils.

7. Shrink/Swell Potential: Refers to the quality of a soil that determines its volumemetic changes resulting from wetting and drying of soil profile.

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROOTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES)[3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION (#/AC. DRY WT)[5]	SOIL REACTION (pH)[6]	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNOFF[10]
Blackhall	10-20	Well to excessively drained	Very low 1.2-1.8	D	350-700	7.8-8.6	<2.0	Low	3	Medium to Rapid
Blazon	10-20	Well drained	Very Low to Low 2.7-3.1	D	500-1000	7.9-9.0	2.0-4.0	Low	4L	Rapid
Bullock	20-26	Well drained	Very Low to Low 2.14-3.52	D	420-720	6.6-9.0	<2.0-8.0	Low	6, 3	Slow
Dephill	27	Well drained	Low 4.3-5.4	C	600-1400	7.4-9.0	2.0-4.0	Moderate	3	Medium
Forelle	>60	Well drained	High 9.25-11.75	B	500-1000	7.0-8.8	<2.0	High	5	Slow
Glendive	>60	Well drained	High 8.4-10.24	B	900-1800	6.6-9.0	2.0-8.0	Moderate	5	Slow
Grieves	>40	Well drained	Moderately High 7.2-8.4	B	700-1500	7.4-9.0	<4.0	Moderate	3	Medium
Havre	>60	Well drained	High 8.4-12.0	B	700-1600	7.4-8.4	2.0-12.0	Moderate	3	Slow
McFadden	13-20	Well drained	Moderately High	B	700-1500	8.0-8.8	<2.0-4.0	Low	3	Medium
Ravalli	>60	Well drained	Moderately High --	C	400-750	7.6-9.6	<4.0	Low	5	Slow
Rock River	>60	Well drained	Moderately High 7.0-8.3	B	700-1500	6.6-9.0	<2.0-4.0	Moderate	3	Slow

CARBON BASIN APPENDIX
(Continued)

SOIL INTERPERTATION (AGRICULTURAL)

SOIL SERIES	DEPTH OF EFFECTIVE ROOTING ZONE (IN)[1]	DRAINAGE CLASS[2]	AVAILABLE WATER CAPACITY (INCHES)[3]	HYDROLOGIC SOIL GROUP[4]	POTENTIAL PRODUCTION[5] (#/AC. DRY WT)	SOIL REACTION (pH)[6]	SALINITY (mmhos/cm)[7]	INHERENT FERTILITY[8]	WIND ERODIBLE GROUP[9]	SURFACE RUNOFF[10]
Ryan Park	>60	Well drained	Low 3.6-4.9	B	700-1500	6.6-9.0	<4.0	Moderate	2	Medium
Santanka	35	Well drained	Low 3.5-5.5	B	600-1400	7.4-9.0	<2.0	Moderate	3	Medium
Shinbara	5-10	Somewhat excessively well drained	Very Low 0.75-2.0	D	250-600	8.2-8.8	2.0-4.0	Low	4L	Medium to Rapid
#15	>60	Well Drained	Moderately High	B	700-1200	8.0-8.4	----	Moderate	--	Medium

1. Depth of Effective Rooting Zone: Is an indicator of the depth to which plant roots would penetrate soil profile.
2. Drainage Class: Is an indication of soil profile-moisture relationships.
3. Available Water Capacity: Refers to the soil profiles potential water holding capacity for utilization by plants.
4. Hydrologic Soil Group: This grouping places soils to their potential to yield runoff; Group A being low and Group D being high.
5. Potential Production (#/ac. Dry Wt.): Refers to SCS Form 5 Potential Vegetative Production calculations from unfavorable to favorable years for each series.
6. Soil Reaction (pH): The degree of acidity or alkalinity of a soil expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: slightly acid, 6.1-6.5; neutral, 6.6-7.3; slightly alkaline, 7.4-7.8; moderately alkaline 7.9-8.4; strongly alkaline, 8.5-9.0; and very strongly alkaline, 9.1.
7. Salinity (mmhos/cm): Refers to the soluble salts in a soil, based on the electrical conductivity of the saturation extract, as expressed in millimhos per centimeter (mmhos/cm) at 25 C.

Salinity rating	mmhos/cm
Low	4
Moderate	4-8
High	8

8. Inherent Fertility: The following criteria were used for rating the soils.
   Low Soils low in available P or K, or with pH below 5.0 and above 9.0 in the A and upper B horizons, or soils having levels of moisture (A.W.H.C.), or growth of plants is severely limited.
   Moderate Soils intermediate between low and high in inherent fertility.
   High Soils high in available P and K, with pH of 5.5 or less than 8.4 in the A and upper B horizons, levels of moisture (A.W.H.C.), or alkalinity are such that choices or growth of plants are not limited.
9. Wind Erodable Group: Refers to the erodability of soil surface; rate 1-8 with 1 being the most erodable and 8 being non-erosive.
10. Runoff: Refers to the relative rate that water flows off soil surface 6 classes: Ponded, very slow, slow, medium, rapid, very rapid.

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