VOLUME III

FINAL ENVIRONMENTAL IMPACT STATEMENT

Eastern Powder River Coal Basin of Wyoming

CONTENTS

This is Volume III. It contains Parts II and III, the analyses of proposed railroad construction by Burlington Northern, Inc. and the Chicago and North Western Transporation Company, and proposed mining and reclamation by Atlantic Richfield Company.

SUMMARY TABLE OF CONTENTS

This environmental statement is presented in six parts as follows:

A detailed table of contents of this volume begins on the following page.

VOLUME III

PART II. ANALYSIS OF PROPOSED RAILROAD CONSTRUCTION AND OPERATION BY BURLINGTON NORTHERN INC. AND THE CHICAGO AND NORTH WESTERN TRANSPORTATION COMPANY

Chapter

PART III. ANALYSIS OF PROPOSED MINING AND RECLAMATION BY ATLANTIC RICHFIELD COMPANY

Chapter

CHAPTER

PART II

ANALYSIS OF PROPOSED RAILROAD CONSTRUCTION

CHAPTER I

DESCRIPTION OF PROPOSED ACTION

Background and History

Burlington Northern Inc. and Chicago and North Western Transportation Company have filed a joint application pursuant to Section I(18) of the Interstate Commerce Act for authorization to construct and operate a new railroad route located between Gillette and Douglas, Wyoming. The joint application was filed on February 2, 1974, as finance docket No. 27579 before the Interstate Commerce Commission.

The impact statement will consider two phases of activity, construction and on-line operations.

The construction stage will consist of an intensive program associated with new development of the railroad line and pertinent facilities. This will include design, engineering, staking, obtaining rights-of-way, construction of railroad bed, bridges, drainage structures, fences, maintaining facilities, etc. Extensive earthmoving will be required for construction.

The operation stage will involve those activities required for the heavy transportation schedule of coal by unit train. Operations will include long-term maintenance, and additional construction necessary for expanding functions of the railroad.

Purpose of proposed project

The purpose of the proposed railroad is to transport low sulfur subbituminous coal from mines located in the Eastern Powder River Basin to existing main lines at Gillette and Douglas, Wyoming, of both the Burlington

Northern and Chicago and North Western Railroads. The proposed line will also carry connecting traffic from BN/CNW main lines through Gillette and Douglas.

Low sulfur coal is already being transported to electric power plants located in the east, midwest, and southwest on existing railroads. Exportations of coal from Wyoming can be expected to increase significantly if the proposed line is completed.

Location

The route proposed by the companies and major alternative routes are shown on Map No. 12, Appendix A. Refer also to Part I, Chapters II and III.

Specific description

Right-of-way widths are based on the area necessary for cut and fill sections. Right-of-way width will vary from 150 to 600 feet. Total amount of land required for the right-of-way is approximately 2,400 acres. The line will be located on federal, state and private land ownerships. Approximately 80.2 miles of the proposed route will be located on private lands, 9.25 miles on state, and 22.7 miles on federal lands and .6 mile of Converse County lands. Total length of the proposed rail line is approximately 113 miles and together with sidings and mine spur lines, a total of 150 miles of railroad lines would eventually be constructed. Alternative routes of various lengths are being considered that will have differential effects on surface and subsurface resources.

Construction schedules indicate completion of the rail line in a little over two years, with major construction to occur the first two construction seasons (April through November). An average of 300 temporary construction workers are anticipated to be required to complete the railroad.

The proposed railroad will be a single tract structure with nine major sidings built parallel to the proposed line. Eight sidings are to be located adjacent to the new line and one will be constructed adjacent to the existing Amax Belle Ayr spur line. Sidings are to be spaced at 10- to 12-mile intervals along the route. Minor sidings would be added to the major sidings to handle disabled railcars.

It may be necessary owing to projected frequency of use to construct a second parallel track to carry the expected number of unit trains sometime in the future.

Railroad Construction

Initial preparation

Upon securing the necessary right-of-way, the initial activity will be construction of a right-of-way fence. (See section on right-of-way fence construction for details.) Initial right-of-way preparation will then commence for the construction "reaches." Each construction reach will be composed of a segment of right-of-way approximately five miles in length. The initial effort will consist of access and work road construction, installation of work roads to the top of the cut areas, clearing structures, disposal of debris, mulching sagebrush, and stripping and stockpiling topsoil from the road prism. During this interval, the contractor will also assemble equipment, order materials, and locate borrow pits, construct storage and marshalling yards, and arrange for water supplies along the construction corridor. Water wells are anticipated to be drilled and water tanks installed in those areas where existing wells are unavailable for construction use. Some use of impounded surface water may also supplement water well supplies, all in accordance with State of Wyoming rules and regulations.

Vegetation and structures cleared from the right-of-way will be burned on the right-of-way if permits can be secured from appropriate authorities. If air quality measures prohibit burning, the debris is to be hauled to suitable waste areas within the railroad corridor. Clearing is generally scheduled at least one mile ahead of the next stage of construction.

During the initial construction preparation, the contractor may open exploratory cuts within the right-of-way or leased borrow pits to inventory available materials for road building, culvert bedding and riprap.

Each construction "reach" will contain a "work group" unit which will be composed of earth-moving equipment and support personnel required to conduct the clearing and grading operations. Anticipated equipment will be one or two dozers for clearing and the possible use of scrapers or trucks to transport cleared debris to waste disposal sites. Several reaches and work groups will be active simultaneously along the railroad route. The number of reaches undergoing work will depend on that necessary to meet contract time schedules.

Drainage structures

Upon completion of the initial clearing, work will commence on the placement of drainage culverts and construction of bridges.

Site preparation and installation of culverts will require the following equipment: boom trucks or crane, vibratory rollers, hand tampers, dozers, front-end loader, dump trucks, and transport trucks.

Culverts will generally be asbestos-bonded, asphalt-coated corrugated metal pipe ranging from 24 to 48 inches in diameter. Forty-eight inch to 108-inch multiplate pipe will be used and above 108-inch diameter bridging will be used. Reinforced concrete pipe may be used where soil conditions govern final design. Three areas along the right-of-way will require extensive use of culverts and bridges. These are the (1) Caballo Creek-Belle Fourche River. (2) Antelope Creek and (3) Shawnee Creek areas. (See topographic description.) Approximately 220 culvert sites have been identified along the proposed route (Figure 1). Several "livestock passes" are also anticipated to serve as drainage ways.

Construction of bridge abutments and piers will commence at the same time as culvert installation. Bridges will consist of ballast decks placed on

Figure 1
Drainage Culvert Located on the Amax-Belle Ayr Spur Line; Campbell County.

Note rip-rap placed at the outlet.

steel girder spans supported by steel or concrete piers. Supporting piles will be driven by pile driving equipment. Pile drivers will be supported by crawler tractor or truck mounted cranes. This equipment will also be used to hoist and place bridge spans. Bridge piers are to be located outside of the principal stream channels to minimize obstruction of flood flows. Bridge openings between embankments are designed large enough to allow flood water to pass without excessive flow restriction.

Bridge materials will be hauled by truck from the nearest railroads or loading areas to each bridge location. Equipment requirements for bridge construction would consist of the following: cranes, truck or tractor mounted; pile drivers; dozers; graders; tampers; dump trucks; and transport trucks.

Preliminary railroad designs indicate that bridges will be constructed over Caballo Creek, Belle Fourche River, Coal Creek, Little Thunder Creek, Porcupine Creek, Antelope Creek, Dry Fork of the Cheyenne River, Mike's Draw, Box Creek, Lightning Creek, Shawnee Creek and possibly Walker Creek and several other drainages that may have calculated flood flows greater than culvert capacity.

Alteration of existing drainage ways may be necessary at stream crossings with broad flood plains where construction of the railway embankments necessitates that runoff be consolidated and concentrated at the bridge and culvert openings. Some changes in location of natural drainage channels to accommodate grade and curvature of the rail line will also be necessary. Suitable ditching will also be incorporated at each culvert site to route water flow away from the roadbed and into natural drainage channels. Riprap material will be placed at culvert inlets and outlets to serve as cutoff walls and aprons to control erosion around the pipe. Riprap will also be used to protect side slopes of altered drainage channels. Wherever possible local materials will be used for riprap. Some heavy riprap will be available from sandstone ledges and harder materials in the "scoria" areas. The smaller riprap materials will be utilized with wire mesh. It is anticipated that most heavy riprap materials may have to hauled in by rail from outside the study area.

Pipelines carrying flammable oil and gas will be crossed by the railroad route mainly in the Hilight oil field area. The standard procedure to protect against breakage is to encase all pipelines (encased in a double pipe).

Grading

Excavation and embankment construction will follow right-of-way clearing and installation of drainage structures. Excavation and embankment construction will involve movement of earth materials from excavation to embankment areas to the extent necessary to shape the railroad bed and obtain final grade elevation. This will be the major work item involved in construction of the rail line. Existing topography will be altered by railroad construction in order to meet alignment and proposed railroad company design criteria of 1 percent maximum grades and 3^{o} maximum curves.

The final railroad bed, including spur lines to mines, will conform to Burlington Northern's "main line standards," which provides for a 28-foot subgrade width at the top of the embankments and a 44-foot subgrade width within excavation areas for single track construction. Double track standards would require an additional 14 feet of subgrade width. Maximum depth of cut on the proposed line will be 102 feet and maximum height of embankments will be 85 feet. Additional proposed construction line characteristics are contained in Table 1. See Figure 2 for main line road bed characteristics. A total of 15 million cubic yards of excavation (grading) will be required to complete the railroad bed for the proposed route and sidings.

Excavation side slopes will be constructed to a maximum grade of 1.5 feet horizontal to 1.0 feet vertical rise which is approximately a 34^{o} angle from horizontal. Embankment side slopes will be constructed at a maximum steepness of no greater than 1.75 horizontal to 1.0 vertical or approximately 30^{o} from horizontal. Soils or other conditions may dictate that a more gentle slope be left. Burlington Northern's standard plan for main line roadbed sections is contained in Figure 2. Each construction segment will contain a typical work unit consisting of the following equipment: crawler tractor with ripper, crawler tractor with blade, 2 motor-patrols, 5 or 6 self-powered scrapers, push-cat, air compressor, powder magazine, wagon drill or crawler mounted drill, jackhammers, water truck, and rollers.

Several construction segments will be in operation simultaneously. The number of segments in operation at one time will depend on the construction pace necessary to keep contract time schedules.

The total cuts and fills are contained in Table 1, under grading. Excavation will commence with construction of access roads to the top of cuts. The initial cuts will be made with scraper and dozers. After initial grading and cutting with dozers, it may be necessary to use rippers to break up the more resistant materials. Scrapers used to excavate cut material are often assisted by a "push-cat" (crawler tractor unit). The scrapers will transport excavated material to a nearby fill area for placement. The contractor may, at his option, pre-irrigate cut material prior to excavation to assist in excavation and to obtain optimum soil moisture content for compaction of fills. This also assists in dust control.

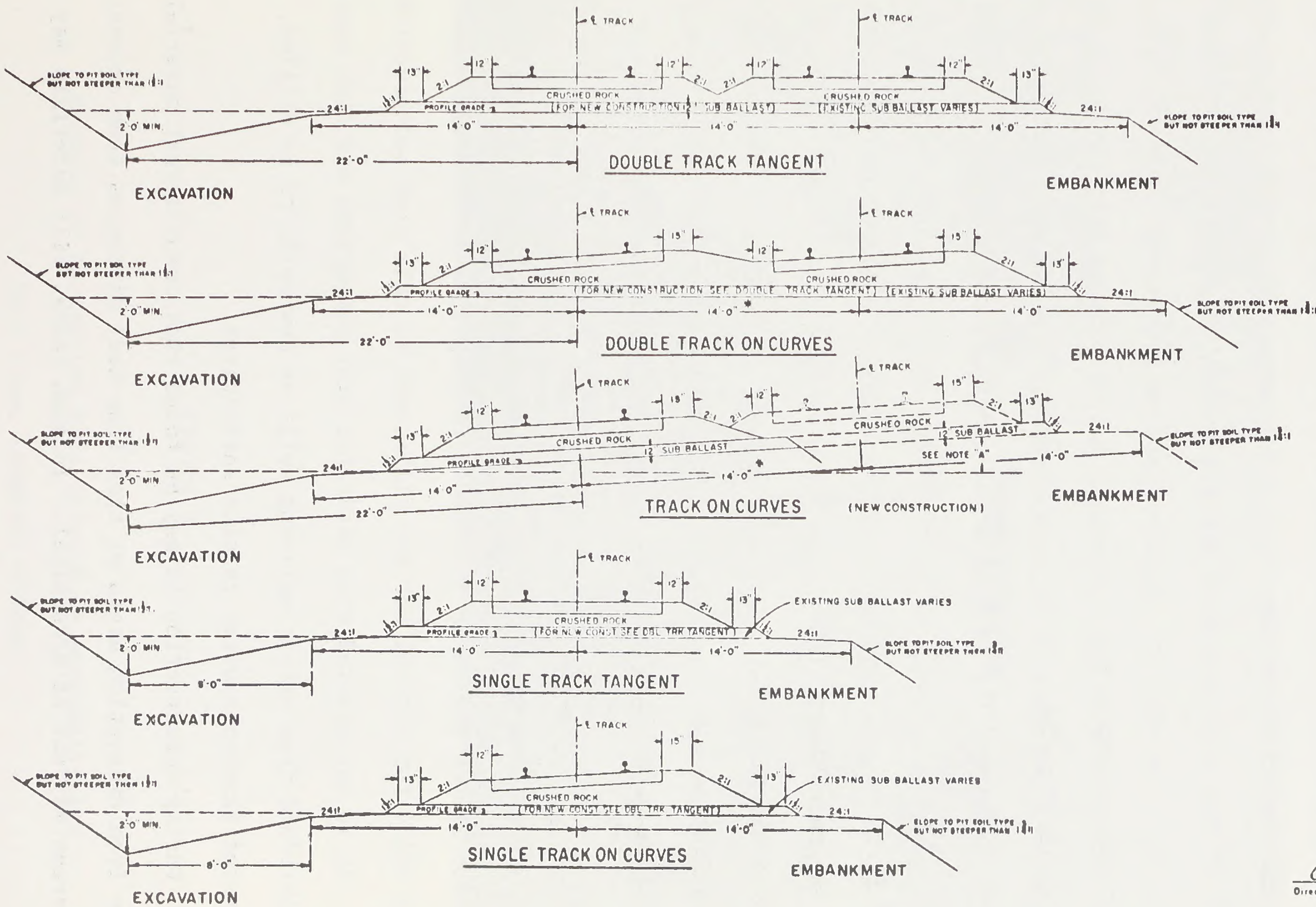
Table 1

Major Characteristics of the Proposed Gillette to Douglas Railroad Route

LINE CHARACTERISTICS

Length of Line	Miles	112.77
Grading	Cu. Yds.	15,000,000
Maximum Grade (Compensated)		1%
Total Dist. on Max. Grade, N'Bound Miles		17.04
Total Dist. on Max. Grade, S'Bound Miles		25.90
Rise	Feet	+196.4
Rise and Fall	Feet	1,759
Highest Subgrade Elevation		5,268
Lowest Subgrade Elevation		4,456
Maximum Height of Fill	Feet	85
Total Dist. on Fills Greater than 40'	Feet	9,400
Total Dist. on Fills Greater than 60'	Feet	1,850
Maximum Depth of Cut	Feet	102
Total Dist. in Cuts Greater than 40'	Feet	9,050
Total Dist. in Cuts Greater than 60'	Feet	1,800
Number of Curves		66
Maximum Degree of Curvature		3^{o}
Total Angle of Curves		$1,951^{o}$ - 31'
Number of Bridges (Anticipated)		17
Total Length of Bridges	Feet	4,670

Source: Burlington Northern Inc.



NOTE:

M/L TRACK CENTERS IN STATE OF OREGON SHALL BE 15'-0"

CTC AND COAL TRAIN SIDINGS SHALL BE CONSTRUCTED TO MAINLINE ROADBED SECTION STANDARDS.

FOR NEW CONSTRUCTION PROVIDE 12" SUB BALLAST.

FOR MAINTENANCE PROVIDE NEW BALLAST LIFT AS DIRECTED.

* INCREASE TO 15'-0" ON CURVES OVER 6 DEGREES.

NOTE "A": GRADING TO CONFORM TO SUPER ELEVATION OF CURVE.

CONSTRUCT PASSING TRACKS TO SAME SECTION AS DOUBLE TRACK EXCEPT TOP OF RAIL TO BE 6" LOWER AND BALLAST MATERIAL TO BE OF LESSER QUALITY.

CUBIC YARDS PER MILE OF TRACK		
LIFT	SINGLE TRACK	DOUBLE TRACK 14' CENTERS
4"	1800	3550
6"	2250	4500
8"	2750	5450
10"	3250	6400
12"	3800	7400

BURLINGTON NORTHERN INC
STANDARD PLAN

MAINLINE
ROADBED SECTIONS

ENGINEERING DIVISION, ST PAUL, MINN. NOV. 1973

Recommended
Director Track Engineering

Approved
Vice President, Operations

Asst. Vice President Engineering

Dwg. No. C-1000.2

Figure 2

In excavation where rock or shale (scoria) is encountered, it may be necessary to use a ripper drawn by a crawler tractor to loosen the materials. Occasionally, it may be necessary to drill and blast layers of sandstone or shale. Jackhammers can often be used to break up resistant rock layers to minimize the use of explosives.

All suitable excavated materials will be used as fill to form the embankments for the roadbed. Fill operations are accomplished by placing excavated materials from cuts or nearby borrow pits in thin layers or lifts of approximately 3 inches to 10 inches thick. A dozer or motor patrol will be used to distribute the fill material dumped by the scrapers. The fill material will be compacted as it is placed. Prior to compaction a water truck will wet the fill materials to facilitate maximum compaction. Sheeps-foot rollers, vibrator rollers or rubber tired rollers will be used as compactors. A 90-percent to 95-percent compaction density is desired on the roadbed fill. Quality control of the compaction will be monitored by collecting fill samples and performing standard compaction tests. Surveyors or "stake jumpers" set slope stakes for filling operation to control the grade line. During the operation proper side slopes can be obtained by controlling fill placements and slopes. Slopes are later finished with draglines or "Gradall" units. See Figures 3 and 4 for typical cut and fills used on rail line construction.

It is anticipated that water for fill compaction and dust control will be obtained from either existing wells or new wells to be drilled. Some use of stored reservoir water is also anticipated.

During construction it may be found that insufficient material is available from excavation areas or that long haul distances from excavations to fill areas may not be economical. In such cases, fill materials may be

Figure 3

Example of Excavation Cuts Located on Amax-Belle Ayr

Spur Line, Campbell County

Figure 4

Example of Railroad Embankment with Cut and Borrow Areas to the Center and Left of Photograph

Rail line is Amax Belle Ayr spur line, Campbell County.

obtained from borrow areas adjacent to the rail line. Operations in borrow pit areas must comply with regulations of the Wyoming Mined Land Act and federal regulations as well as contract requirements. Standard railroad contract specifications require that borrow pits must be left in a neat condition, shaped to conform to the natural surroundings and provided with drainage facilities.

Motor graders or dozers will be used to shape and smooth side slopes of excavation areas and to finish roadbed surface when the designed profile grade has been attained.

Depending upon location of existing drainages, interceptor ditches may be constructed at the top of cut slopes to reduce erosion of these slopes. The runoff flow is diverted away from the roadbed and to natural drainage channels.

Both grade crossings and larger livestock underpasses are available to permit access to either side of the track by landowners. In areas where land severance results in a hindrance to livestock grazing operation, suitable passes are planned to permit livestock to move from one side of the track to the other (Figures 5 and 6). The underpasses are designed to be of sufficient height for cattle and horses.

Sub-ballast

Upon completion of grading and shaping of the railroad bed, final preparations for laying the track are performed by surfacing of the roadway with sub-ballast material. The sub-ballast will consist of either pit-run gravel or "scoria."

Since suitable gravel is virtually non-existent along most of the proposed route, scoria will be used along the northern 75 miles of the route,

Figure 5

5' X 7' Concrete Livestock Underpass Structure, Amax Belle Ayr Spur Line, Campbell County

Figure 6

Culvert Type Livestock Underpass Structure 6'10" Span 9'11" Rise Located on Amax Belle Ayr Spur Line, Campbell County the remaining sub-ballast will be obtained from the Chicago and North Western Transportation Company's gravel pit at Irvine siding located east of Douglas. The sub-ballast material will be excavated from scoria located along the route by front-end loaders and placed in dump trucks for transportation to a rock crusher or screening plant. Burlington Northern and Chicago and North Western standards for sub-ballast allow for a maxiumum size of three-inch diameter rock. Therefore, crushing or screening of the ballast material may be required. The graded ballast is then loaded into 20- to 30-yard center dump trucks for hauling to the completed railroad bed. The dumped ballast is bladed into six-inch lifts and compacted by suitable compacting equipment. Two lifts will be necessary to obtain a sub-ballast base of 12 inches in depth. (Figure 2.)

Although the primary use of scoria for railroad construction will be as sub-ballast, other ancillary railroad facilities will require gravel for surfacing materials on access roads, grade crossings, underpasses, campsites and staging areas, etc. The total projected demand for scoria and gravel for all uses associated with railroad construction is 740,000 cubic yards.

The equipment requirements for sub-ballast operation will consist of the following: front-end loaders, crawler tractor, 20-30 cubic yard belly dump trucks, gravel crusher and sorter, motor graders, and rubber tired compactors.

Track laying

The Burlington Northern track will consist of 132 pounds per yard continuous rail which has been welded into lengths of one-quarter mile each. Treated wood ties will be used throughout the new line. At marshalling yards located near or on the proposed line, two tie plates will be fastened to each treated tie with holddown spikes at exact gauge of four feet, eight and one-half inches. The ties are distributed on the roadbed by hand or loaded into a tie distribution machine which is the preferred method. As the machine moves along the roadbed individual ties are deposited at correct spacing and proper alignment on the roadbed. The distribution machine is capable of laying approximately three miles of ties per day. (See Figure 7.)

After the ties have been positioned and aligned, the line is ready for the rails (Figure 8). The rails are furnished in one-quarter mile continuous welded lengths and transported to the site on a rail train of 26 flat cars. The rails are removed directly from the train to the ties, by means of a "straddle buggy" which pulls two rails simultaneously from the rail train (Figure 9). As rails are unloaded from the train, they come to rest on lightweight rollers and are pulled from the train to their full length. Two more quarter-mile rails are welded to the previous length so that four strings or one-half mile of rail are pulled onto the ties at the same time.

After the rail has come to rest on the tie plates following removal of the rollers, it is spiked at every fifth tie with rail spikes. This supports the rail so that the rail train can move ahead to distribute another half-mile of continuous welded rails.

In adverse weather, the contractor may use a tank-car equipped with a propane-type rail heater. The tank can either heat or cool the rail to comply with stringent temperature requirements ($55^{o}F$ to $75^{o}F$). Immediately following the tank car will be a tie-spacing car which will be used for the final positioning of ties and to correct for movement caused during the rail laying operations.

Figure 7

Tie Distribution Machine Placing Railroad Ties on Roadbed

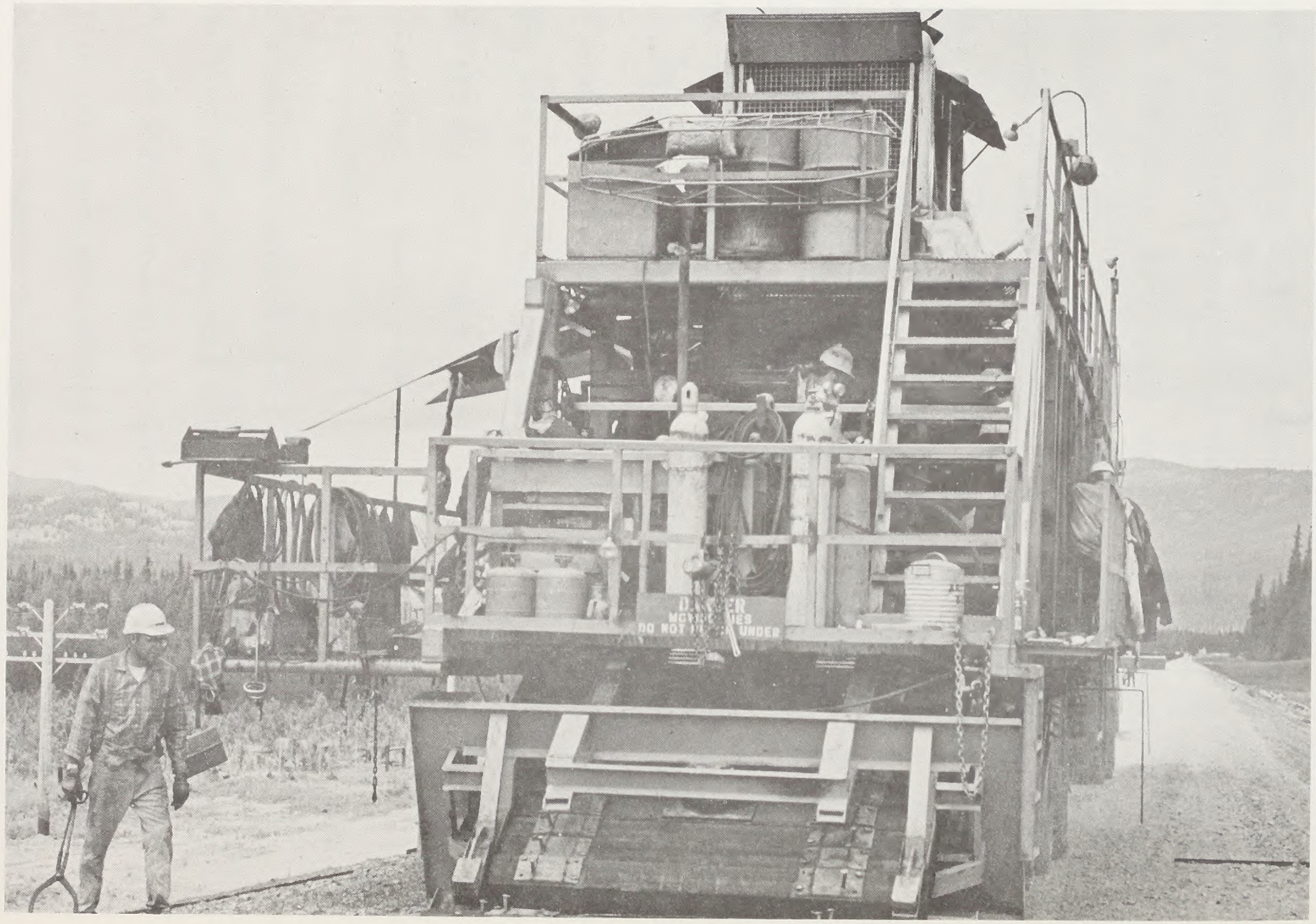
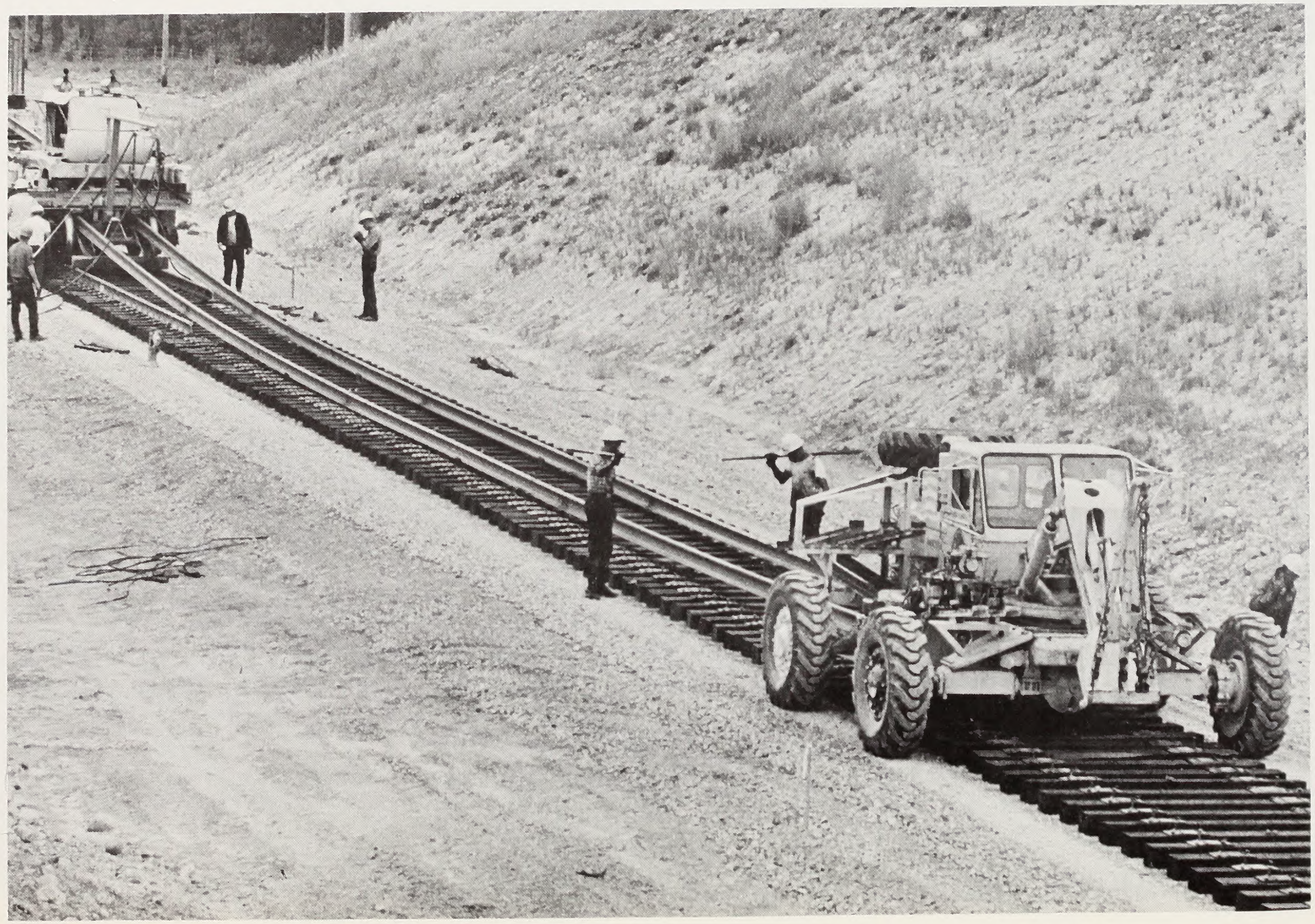


Figure 8

Work Crew Aligning Ties Prior to Placement of Rails

Figure 9

Rails Being Pulled From Rail Train by "Straddle Buggy"



Equipment requirements for track laying would include: Tie hauling trucks, tie distribution machine, 26-car rail train and locomotive, automatic rail spikers, straddle buggies, miscellaneous work crews, mechanic trucks, fuel trucks, light plants, welding equipment, pickup trucks, and transportation busses.

Primary ballast

The next major operation in railroad construction is the installation of the final or primary ballast. The primary ballast is composed of crushed rock which will be obtained from the Burlington Northern limestone quarry near Guernsey. The limestone will require crushing and screening.

The last major operation in the railroad construction is placing and tamping the primary ballast. A ballast train containing from 15 to 25 ballast cars will be pulled to the construction area. For the BN/CNW line, ballast will be obtained from the BN/Guernsey quarry located 40 miles southeast of Douglas and carried in ballast cars to the project site. Ballast is dumped from these cars in four- to six-inch lifts. A ballast sled will raise the ties and rails approximately 12 inches off the sub-ballast, while simultaneously smoothing and tamping the initial primary ballast lift. Sufficient ballast, to give the track a final lift of two inches, will be applied by a second pass of the ballast train. An automatic tamping and lining machine will then be used to reraise the track, tamp the ballast, set it down and align the track (Figure 10). This lift of ballast will fill the cribs between the ties and will give enough excess ballast to cover the shoulders of the roadbed. The total depth of sub-ballast will be approximately 12 inches and will require an estimated total of 570,000 cubic yards for the mainline, sidings and spurs.

Figure 10

Automatic Tamping and Track Lining Machine Lifting Track and Tamping Ballast

In addition to the train crew, the primary ballast operation requires six to eight men to operate the sleds, tampers and alignment equipment. Crews of approximately ten men are responsible for bolting the half-mile sections of track together and for placing rail spikes into final position.

Facilities

Access crossings

Railroad crossings of state and federal highways will be by grade separation structures (overpasses). Currently five grade separations are planned, with three separations being railroad overcrossings and two automobile overcrossings. Most of the private and county road crossings will be Burlington Northern standard grade crossings, designed to comply with the State and United States Class I railroad safety standards. The type of crossing depends upon topography, density of railroad and highway traffic, operating speeds of both railroad and highway. Grade crossings with standard warning signs, flashing lights, gates or grade separations may be necessary.

Railroad overpasses will be constructed simultaneously with bridges, prior to roadbed construction and track laying. Highway overpasses are normally treated timber trestle structures and railroad overpasses will be steel girder supported by steel piles on concrete piers. Timber trestle structures will be constructed after the roadbed has been built.

Approximately 19 grade crossings are presently identified for existing state highway and county maintained roads. These road crossings are listed in Table 2. Simple grade crossings will be constructed by excavation and backfilling necessary to install crossing approaches. Generally, crossing approaches are limited to four percent grade or less. The crossings are constructed of treated timber planks or prefabricated timber sections (Figure 11).

Table 2

County and State Highway Crossings Along the BN and C&NW Route

Road Description	Type of Crossing	Comments
Bishop Road	Grade crossing	
T-7 Road	Possible grade separation	
Hoadley Road	Railroad undercrossing or	3 mile road relocation
Lawver Road	Railroad undercrossing	1 mile road relocation
Hilight Road	Grade crossing	
Mills Road	Grade crossing	
Keeline Road	Grade crossing	
Sec. 14-23, T44N, R72W	Grade crossing	
Small road @ Station 2213+00	Grade crossing	
Gopher Booster Road	Grade crossing	
Antelope Road (Tekla)	Grade crossing	May require signals and road relocation
Edwards Road	Grade crossing	
Matheson Road	Grade crossing	Minor road relocation
Antelope Road	Grade crossing	
Forest Service Road (N. of Antelope Creek)	Grade crossing	
County Road 3-38, Sec. 35, T40N, R71W	railroad undercrossing	Possible road relocation to south
Highway 59 (4 miles N. of Bill)	Railroad undercrossing	
Tillard Road	Grade crossing	
Highway 59 (17 miles So. of Bill)	Railroad undercrossing	
Walker Creek Road	Grade crossing	
County Road, Sec. 2, T33N, R70W	Grade crossing	
County Road, Sec. 17-20, T33N, R69W	Grade crossing	
County road, Sec. 15, T32N, R69W	Grade crossing	
Highway 20	Railroad overcrossing	

Source: Adapted from Burlington Northern and Chicago and North Western Environmental Impact Analysis, 1974.

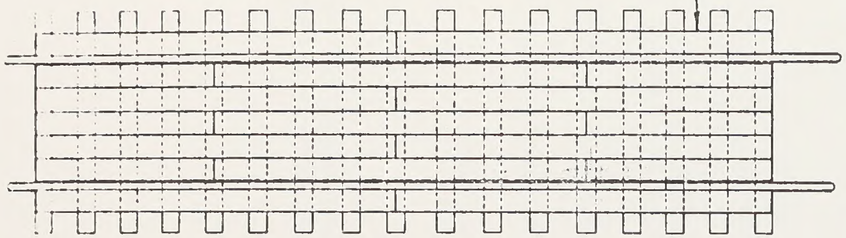
Figure 11

NOTE:
PLANKS TO BE NOMINAL 4"x10"x16'-0" Nº1 STRUCTURAL FIR, GUMWOOD RED OAK OR WHITE OAK PER W.C.L.A. RULE 16 PARA. 123 B OR N.H.L. RULE 1963 PAGE 82 AND SHALL BE TREATED 50/50 CREOSOTE OIL TO 8 LB. RETENTION. B.N. INC. CODE Nº 04-240-55508.

NOTE:
AT UNIMPORTANT PRIVATE CROSSING WHERE CONDITIONS WARRANT, THE 3 CENTER PLANKS MAY BE OMITTED, AND THE SPACE FILLED TO TRACK LEVEL WITH BALLAST MATERIAL.

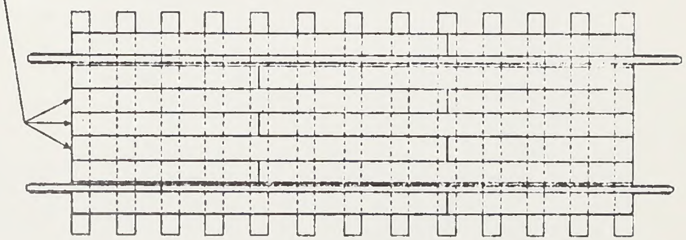
32' LAYOUT

STAGGER PLANKS AS SHOWN

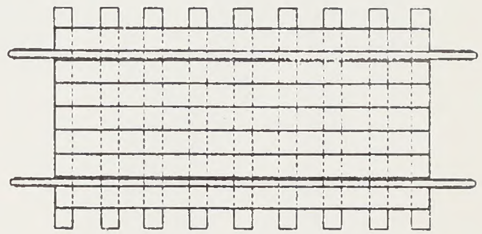


24' LAYOUT

STAGGER PLANKS AS SHOWN



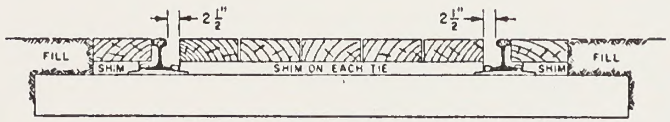
16' LAYOUT



NOTE:
ALL FIELD CUTS IN TIMBER SHALL BE TREATED WITH CREOSOTE

SPIKE PLANKS ON EVERY OTHER TIE USING ONE OF THE FOLLOWING LEWIS SEALTITE DOMEHEAD DRIVE SPIKES OR EQUAL.
10" x 3/4" DRIVE SPIKE TO BE USED WITH 85 LB. RAIL AND LIGHTER.
12" x 3/4" DRIVE SPIKE TO BE USED WITH 90 LB. THRU 119 LB. & 130 LB. Penn. Section.
13" x 3/4" DRIVE SPIKE TO BE USED WITH 129 LB. AND HEAVIER.

NOTE:
ENDS SHALL NOT PROJECT BEYOND SHIMS OR EDGE OF TIE.



SECTION

NOTE:
SHIMS TO BE FIR, PINE OR HEMLOCK WCLB RULE 16 PARAGRAPH 118B, OR EQUAL GRADE, TREATED 50-50 CREOSOTE 8 LB. RETENTION.

1"x8"x7'-0" B.N. INC. CODE Nº 04-226-06002
2"x8"x7'-0" B.N. INC. CODE Nº 04-240-39902

WIDTH OF PUBLIC CROSSINGS

PUBLIC CROSSING SHALL BE OF SUCH WIDTH AS PRESCRIBED BY LAW. BUT IN NO CASE SHALL THE WIDTH BE LESS THAN THAT OF THE GRADED ROADWAY APPROACH.

BURLINGTON NORTHERN INC.
STANDARD PLAN
PLANK CROSSING
FOR
PRIVATE ROADS
AND
UNIMPORTANT PUBLIC ROADS
ENGINEERING DIVISION, ST. PAUL, MINN. APR. 1972

Recommended [signature] Asst. Vice President Engineering

Approved [signature] Vice President, Operations

Occasionally, road relocation may be advantageous to avoid unnecessary crossings or to satisfy visibility standards for vehicles starting across a crossing from dead stops and for vehicles approaching at maximum speed limits. Figure 12 shows a typical grade crossing located on the Amax Belle Ayr Mine spur line in Campbell County. Figure 11 shows details of typical plank grade crossing.

Right-of-way fences

Fences will be constructed along most of the railroad right-of-way to prevent livestock and big game animals from straying onto the railroad. Burlington Northern's standard plan for right-of-way fences and gates is shown in Figure 13. Generally, sheeptight fence specifications will be similar to hogtight fences with suitable woven wire substitution for hogtight wire fence. Fence construction will commence prior to other construction activities.

Miscellaneous work and facilities

Final work will consist of a ballast-shaper and cleanup crews which follow the primary ballast work units. The functions of these crews are to broom the ballast from the ties and operate the shapers to contour the shoulders and dress up the ballast section.

Track insulator crews will eventually cut the rails at all switches and rail crossovers in order to prepare the track network for the Centralized Traffic Control System which operates in part from signals being transmitted via the rails.

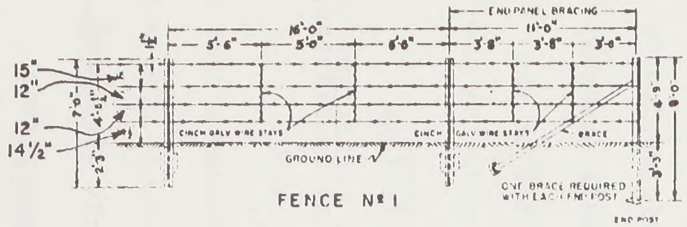
Some of the following appurtenances will be added to the BN/CNW line. These include:

Cattle guards at some grade crossings;

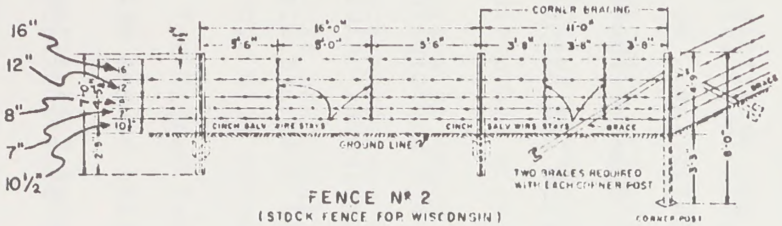
Installation of signs, mileposts, and markers;

Figure 12

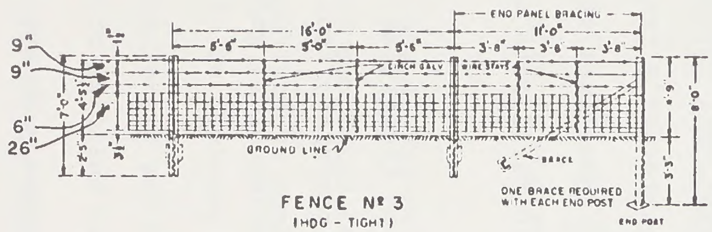
County Road Grade Crossing Located on Amax Belle Ayr Spur Line
Campbell County, Wyoming



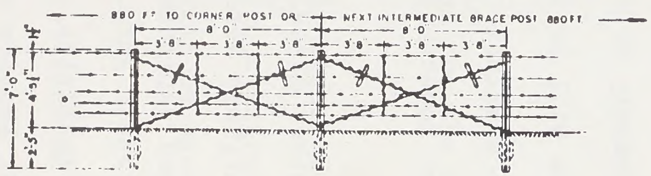
FENCE Nº 1



FENCE Nº 2
(STOCK FENCE FOR WISCONSIN)



FENCE Nº 3
(HOG - TIGHT)



BRACING EVERY 880 FEET

BILL OF MATERIAL FOR ONE MILE OF FENCE

(FENCE Nº 1)

336 T-TYPE STUDDED LINE POSTS WITH ANCHORS
FURNISH 4 WIRE CLAMPS PER POST.
21,120-FEET Nº 12½ GAGE GALVANIZED BARBED WIRE.
672-CINCH GALVANIZED WIRE STAYS 3'-6" LONG.

(FENCE Nº 2)

336-T-TYPE STUDDED LINE POSTS WITH ANCHORS
FURNISH 5 WIRE CLAMPS PER POST.
26,400-FEET Nº 12½ GAGE GALVANIZED BARBED WIRE.
672-CINCH GALVANIZED WIRE STAYS 4'-0" LONG

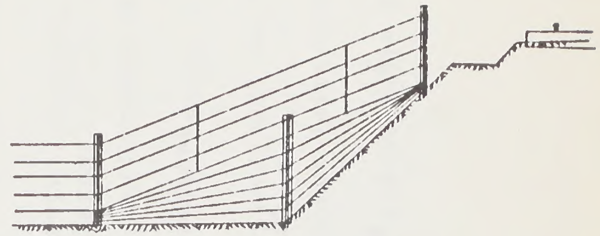
(FENCE Nº 3)

336-T-TYPE STUDDED LINE POSTS WITH ANCHORS
FURNISH 6 WIRE CLAMPS PER POST.
15,840 FEET Nº 12½ GAGE GALVANIZED BARBED WIRE.
5,280 FEET GALV STEEL 7-LINE HOG TIGHT WIRE FENCE 26" HIGH, 6" SPACING BETWEEN STAY WIRES. Nº 9 GAGE GALV STEEL STAY AND LINE WIRES.

NOTE:
DEDUCT ONE LINE POST FOR EACH CORNER POST USED.

(BRACING)

APPROXIMATELY 450 FT. Nº 9 GAGE GALV. STEEL WIRE.



WING FENCE ON EMBANKMENT

NOTE:
LINE POSTS SHALL BE MADE TO A.R.E.A. SPECIFICATIONS AND SHALL HAVE A NOMINAL WEIGHT OF 1.33 LBS PER FOOT.

BURLINGTON NORTHERN INC
STANDARD PLAN

RIGHT OF WAY FENCES

ENGINEERING DIVISION, ST PAUL, MINN DEC 1973

Recommended: [signature] Asst Vice President Engineering
Approved: [signature] Vice President, Operations

Figure 13

Installation of hot-box detectors and dragging equipment detectors;

Switches which can be cut into the main line to provide access to new spur lines or sidings;

Crossing gates and other automatic signaling devices which can be installed in heavy traffic areas;

Installation of Centralized Traffic Control Systems to operate and control major switches and signals.

Campsites and equipment and material storage sites will be necessary during construction. Construction storage is generally the contractor's responsibility. Burlington Northern's contract specifications will require the contractor maintain any campsites or similar areas in a satisfactory condition as to sanitation, oil spills, quality of ground and surface water and other environmental concerns, and conform to local, State and Federal Government regulations.

Access roads, haul roads and construction roads to the work area will be necessary to transport men, equipment and materials to the construction site. These will be the contractor's responsibilities. No information or planning is available as to these facilities. Some of these will probably remain after construction to facilitate operation and maintenance of the railroad.

Other miscellaneous facilities that are anticipated include temporary highway detours, temporary fences, equipment unloading facilities, temporary and permanent cattleguards, gates and standard signs.

Displaced facilities

It appears that no building or occupied houses will be displaced, however, several abandoned homesteads and attached facilities are within the right-of-way and may be displaced by the railroad. Utilities, similar facilities, county roads and private roads may have to be removed or relocated during construction and operation of the railroad. Livestock fences, reservoir dikes, irrigation ditches and wells are noted as being within the railroad right-of-way. These will possibly have to be either removed, relocated or modified.

<u>Hazard reduction and protection</u>

Dust and fire control problems are contemplated during construction. Temporary construction roads, haul roads, and work areas are to be maintained dust free by sprinkling, graveling, chemical treatment or temporary pavement.

The contractor is required to comply with all state and local laws pertaining to the prevention, control and fighting of fire and is to furnish firefighting equipment, supplies, and personnel required for fire suppression.

The construction contractor is also required to maintain construction and storage area free from waste material and rubbish.

<u>Revegetation and erosion control</u>

The following revegetation plan is contemplated for the railroad right-of-way and other disturbed areas.

Revegetation of those portions of the rail line right-of-way not used for the actual track structure will be completed following construction.

Where it is practical, topsoil to be removed will be saved in such a manner that will allow it to be replaced following construction. This will provide for higher fertility levels and a better seedbed for germination.

Recommendations made by soil testing laboratories are to be used to determine the analysis and quantity of fertilizer needed to obtain desired soil fertility to insure a good stand of grass in the area to be seeded. Fertilizer application will be made by spreader or aerial application. The type of equipment used will depend on the topography of the area to be seeded.

For reseeding the right-of-way, a mixture of grass species is contemplated. Further consultation with the Agronomy Department of the University of Wyoming, Soil Conservation Service & U.S. Forest Service will determine the mixture which will produce the optimum benefits.

The selection of grass species for the area to be seeded will be made with the objective of obtaining maximum benefit from the limited rainfall available in the region.

Seeding will be done in late fall to make best use of the limited moisture. Snow which accumulates during the winter will provide early spring moisture for seeding establishment. The annual spring precipitation is then relied on for sufficient moisture to provide the vegetation growth necessary to produce an acceptable stand of grass which will not be adversely affected by the windy or dry period of the year.

Seeding is planned to be with drill type equipment (such as a brillion seeder) to insure the seed is placed in the soil sufficiently deep to utilize available moisture for germination. On cuts and fills too steep for ground application, the seed will be broadcast and covered with a mulch. The mulch is applied to hold moisture and reduce erosion by either wind or rain.

Railroad Operations

Unit trains

The principal railroad use will be by unit coal trains. Unit trains will generally be made of 110 cars, however, as few as 40 cars and upwards to 300 car trains are possible. The number of diesel units will vary from four to seven with two or three slave units (locomotives positioned in center of train). Each railcar or "gondola" has the carrying capacity of 100 tons of coal. The average unit train of 110 cars would, therefore, carry 11,000 tons of coal. Most trains are kept together as a unit and operated solely for the purpose of transporting coal from a particular mine to a specific point of destination. Coal cars may be owned by the mining company, the utility company or, in some cases, by the railroad company. The coal becomes the property of the purchaser upon loading in the train.

A train of 110 cars and 5 diesel units would be 6,165 feet or roughly 1.2 miles in length. The average speed of the unit trains is anticipated to be 25 miles per hour. Operating at this speed an average unit train would pass a given point in approximately three minutes.

Coal shipments

The coal to be hauled from the Eastern Powder River Coal Basin over the proposed railroad is presented in Tables 3 and 4. These are presented by destination and receiver, mine origin, and including approximate tonnage to be shipped.

Table 3

Receiver Destination

Area 1 Receivers:	1. Interstate Power Co., Lansing, Ia.
Iowa	2. Iowa Power & Light, Council Bluffs, Ia.
Illinois	3. American Electric Power, Metropolis, Ill.
Indiana	4. American Electric Power, Sullivan, Ind.

Area 2 Receivers:	1. Public Service of Colorado, Pueblo, Colo.
Nebraska	2. Nebraska Public Power, Sutherland, Neb.
Colorado	3. Kansas Power & Light, Delia, Kans.
Kansas	4. Kansas City Power & Light, LaCygne, Kans.

Area 3 Receivers:	1. Southwestern Public Service, Amarillo, Tex.
Texas	2. Southwestern Electric Power, Carson, Tex.
Oklahoma	3. Southwestern Electric Power, Siloam Springs, Ark.
Arkansas	4. Oklahoma Gas & Electric, Muskogee, Okla.
Louisiana	5. Gulf States Utilities, La.
	6. Middle South Utilities, Redfield, Ark.

Table 4

Tons in Thousands

Mine Origin		1974	1975	1976	1977	1978	1979	1980
Amax	Area 1	-	2500	5200	7800	11600	12200	12200
	Area 2	2000	2400	3900	4400	6400	6400	8900
	Area 3	-	-	1750	1750	3500	3500	3500
ARCO	Area 1	None						
	Area 2	-	-	-	1800	1800	1800	1800
	Area 3	-	250	1000	2500	4250	5000	5000
Kerr-McGee	Area 1	None						
	Area 2	None						
	Area 3	-	-	-	1200	6500	9000	9000
Peabody	Area 1	None						
	Area 2	None						
	Area 3	-	-	-	-	-	-	2500
Carter	Area 1	-	-	750	4000	5000	5000	5000
	Area 2	None						
	Area 3	None						

Rail line capacities

The proposed rail line will consist of 113 miles of single track with 9 sidings located at ten to twelve mile intervals along the route. Assuming equal spacing of 12.5 mile intervals and average train speeds of 25 mph, trains could be dispatched hourly from each end. The theoretical capacity of the proposed line would be 24 loaded and 24 empty trains per day. Assuming a 365 operating day year, the yearly transportation capacity of the rail line would be 96 million tons a year. However, uneven cycling of trains to and from different destinations, smaller and larger capacity trains with varying speeds, transportation failures, load and unloading delays, and railroad maintenance would reduce rail line capacities significantly. The rail line saturation point could be obtained on any given day long before the theoretical daily capacities are reached.

Work force

The increase of unit train shipment of coal from Wyoming will require an additional railroad work force as new trains are added. The nature of railroad employment dictates that only a few individuals would be working exclusively with coal trains, the levels of employment in most crafts will be directly related to the number of coal trains that were in operation.

Table 5 estimates approximate number of Wyoming jobs presently created by unit coal train operations and those additional jobs that will be created by 1980. The 1980 projections are based partially on announced contracts between coal companies and utilities and partially on estimates of available markets for Wyoming coal, assuming that its development is allowed to continue on an economic basis and that facilities will be located as now planned.

Table 5

Employment Related to Unit Coal Train Operations

Wyoming Residents

Craft	Present Force	Additional Force by 1980	Total 1980 Projection
Engine Men	5	30	35
Conductors & Trainmen	10	75	85
Agents-Operators	--	10	16
Clerks	--	5	5
Carmen and Other Mechanical	--	5	5
Maintenance of Way	5	67	72
Signalmen	--	10	10
Supervisory	--	10	10
Total	20	212	232

Source: Burlington Northern Inc./Chicago and North Western Transportation Company

Accidents

Major and minor derailments involving unit coal trains will occur. Derailments are caused by human error, equipment, and road failure, track flaws, obstacles on the track, dragging equipment, and erosion of roadbeds. During derailment the cars will either remain upright or dump coal along the right-of-way. Dumped coal would be salvaged. Equipment loss would be by the railroad companies should the cars be lost or damaged. The railroads would also be responsible for damage to private or public property due to derailment.

Some vehicular collisions will inevitably occur due to the length of track, number of railroad crossings and the anticipated heavy unit train traffic. Some livestock and wildlife collisions with trains would also be expected to occur.

Unit train emissions

Exhaust emissions from diesel locomotives may be extensive in the vicinity of the railroad. Information as to exhaust stack emissions from an assumed typical unit train containing 5 locomotives of 3,000 horsepower (HP) and 110 cars is contained in Table 6. The fuel consumption for a 3,000 HP diesel locomotive is 5.0 gal/hr at idle and 152 gal/hr at full load.

More detailed information is available for various and different types of locomotives; however, EPA average locomotive emission factors based on nationwide statistics were used to calculate emissions per unit train. Diesel engine manufacturers are engaged in research and development programs to reduce both visible emissions and exhaust gas contaminants on current and future production engines and developing retrofit components for existing engines.

Table 6

Average Locomotive
Emissions Per Unit Train

	Average Locomotive * Emission Factors	Average Locomotive Emissions ** Per Unit Train/Per Round Trip
	Lb/10^3 gal.	Lb/Per Trip
Particulates	25	121
Sulfur Oxides (SO_x as SO_2)	57	277
Carbon Monoxide	130	633
Hydrocarbons	94	457
Nitrogen Oxides (NO_x as NO_2)	370	1801
Aldehydes (as HC HO)	5.5	27
Organic Acid	7	34

* Assumes train of 110 cars and 5 locomotives at 3,000 HP

** Assumes round trip of 4.3 hours with one-half the distance empty and one-half loaded.

Source: U. S. Environmental Protection Agency, Office of Air and Water Programs, Office of Air Quality Planning and Standards Research; Compilation of Air Pollutant Emission Factors, EPA Bulletin No. 42

Noise

Unit train noise level which is heard at a specific location is a function of distance between the railroad, location of and number of cars and locomotives, and the noise levels from each source. In most cases trains have higher noise levels than do trucks (Table 7).

Table 7

Vehicle	Noise Level (Decibels--50 ft. from Vehicle)
Railroads	
a. Diesel, Electric, Locomotives	88 - 98
b. Freight Cars	80 - 94
c. Passenger Cars	80 - 90
Trucks	
a. Light	70 - 85
b. Medium	80 - 89
c. Heavy Duty	85 - 95

Source: Kerber, Matthew J. 1973/74. Your Government and the Environment--A Supplemental Environmental Reference, Vol. 2-S. Output Systems Corporation.

Unit train frequencies will have a direct bearing on the constancy and amount of noise nuisance as well as the ambient noise level of the area involved.

Fire occurrence

Fires along railroad rights-of-way originate from both operation and maintenance of the rail line. These fires can be caused by sparks from locomotive emissions, hot-boxes, brake-shoes, and maintenance crew operations. Accumulations of combustible spilled coal along the right-of-way make wayside fires more of a concern along the proposed rail line. The Wyoming Public Service Commission has issued general order No. 41, imposing fireguard roles on railroad operations. Railroads and lightning have been identified as the two main causes of fire within Campbell and Converse Counties. The following table (Table 8) represents recorded fire occurrence in Converse and Campbell Counties as reported by Clarke-McNary (CM2) cooperating counties.

Table 8

Fire Occurrence

Campbell and Converse Counties*

1971 through 1973

Campbell County

Identified Cause	No. of Fires 1971	1972	1973	Acres Burned 1971	1972	1973
Railroad	21	17	26	664	961	238
Lightning	17	32	23	21,960	8,030	3,013
Other	11	30	20	2,066	1,015	184
Total	49	79	69	24,690	10,006	3,435

Converse County

Identified Cause	No. of Fires 1971	1972	1973	Acres Burned 1971	1972	1973
Railroad	22	11	6	499	1,801	4
Lightning	4	8	7	1	140	12
Other	2	4	1	-	5	-
Total	28	23	14	500	1,946	16

* Wyoming State Forestry Division

Note: These statistics are considered inconclusive by the State Forestry Division. It is estimated that another 20 percent to 30 percent of all fires are unreported.

Total railroad trackage within Campbell County is 56 miles and Converse 120 miles. Average fire frequency per mile of track for the recorded three-year period would be 0.38 fires/mile for Campbell County and 0.11 fires/mile for Converse County.

Where conditions necessitate, fireguards are installed on both sides of track. Current methods used for fireguard construction involve use of either a disc plow or dozer or aerial application of herbicides. Retention type spark arrestors are being installed on all diesel locomotive units. A spark arrestor installation program is to be completed in 1974. During the fire season, a fuel oil additive is added at all diesel fueling stations. This additive is specific in preventing carbon buildup and elimination of exhaust sparking. The use of this chemical additive was initiated three years ago. Turbo-chargers also act as spark arrestors. It is anticipated that most unit train locomotives will be turbo-charged in the future.

Weed control

Noxious weed control along railroad rights-of-way by chemical means is a general practice to comply with legal and safety regulations.

All chemical compounds presently used are rated at least a No. 4 rating on the USDA's Toxicity Rating Chart. Burlington Northern uses the Amine form of the chemical, 2,4-Dichlorophenoxyacetic Acid for the control of broadleaf weeds and is used at the rate of 2 to 4 pounds acid per acre dependent upon weed species. A combination of 2,4-D, and 2,4,5-T (Trichlorophenoxy-acetic acid) is used for the control of woody plants or brush species, and is used at the rate of 6 to 9 pounds acid per acre. Both formulations are diluted with water and applied at the rate of 50 to 300 gallons per acre of right-of-way infestations. Equipment used varies from 5-gallon back-pack sprayers, to 200-500 gallon capacity portable sprayers complete with 50 foot hose--reels and sprayguns. Application takes place in June and July.

Two procedures are employed for the treatment of roadbed ballast. On primary main tracks, siding, house and industry tracks, company-owned railbound spraycars equipped with either gasoline or diesel powered engines, pumps and spray booms use the above-described diluted chemical spray solutions under pressures varying from 8 to 30 pounds p.s.i., depending upon spray patterns employed. Chemical compounds are pre-diluted or tank mixed as required to conform to the chemical compound employed. These chemical combinations are employed after actual testing within the area where similar soil and climatic conditions are known to exist. All chemical compounds and formulations are furnished by railroad contractor which furnished the pre-diluted formulation in tankcar lots to correspond to useage. The contractor provides a licensed and experienced supervisor to accompany each spray unit employed in these programs.

Off-track truck spraying units equipped with a 1,500 gallon tank, mechanical agitation, engine, pump and spray booms apply from 30 to 50 gallons of spray solution per acre under prescribed spray patterns. Chemical combinations employed are pretested. All chemical compounds are furnished by the contractor who employs properly licensed and experienced operator/supervisor on each truck unit. This type of equipment is normally confined to branch lines, sidings, house, industry, yard tracks, and all major yards and/or terminals.

In 1973 Burlington Northern chemical formulation for primary main tracks consisted of the following:

5.00 lbs. Dupont's Krovar 1 (80% material)

2.00 lbs. Amchem's Amizol (90% material)

0.50 gal. Velsicol's Banvel 720 chemical

0.25% by volume - Triton X-114 surfactant

0.50 pint - Nalco's E-102 Drift Inhibitor

Water sufficient to produce fifty (50) gallons of diluted spray solution applied at the rate of fifty (50) gallons per acre.

It is tentatively planned to follow the same formulation in 1974 with the following two exceptions: (a) One (1) gallon of Amchem's Amdon 101 will replace the Banvel 720 and (b) six (6) pounds of Dupont's Karmex 80 percent material will replace the Krovar 1.

The 1973 Wyoming Legislature passed Enrolled Act 34 wherein all railroad rights-of-way would be inspected annually by a team comprised of

Wyoming State District Forester Representative, County Warden or County Commissioner Representative and Railroad Representative, which team will prescribe plowed or sterilized fire guards (1 side), plowed or sterilized fire guards (both sides), burn right-of-way (1 side), burn right-of-way (both sides), sterilize right-of-way (1 or both sides) herbicide treatment of right-of-way for fuel reduction (1 or both sides).

In the State of Wyoming primary weeds listed as noxious are: Field Bindweed, Leafy Spurge, Canada Thistle, Perennial Sow Thistle, Hoary Cress, Russian Knapweed, Horse Nettle, Quackgrass and Wild Mustard (3 species).

The right-of-way crossings are mowed in accordance with normal maintenance procedures to maintain proper sight distance of all public road crossings and other locations. Weed and brush growths are harmful to safe operation of trains, maintenance of right-of-way equipment and personnel whose duties compel them to travel or work on railroad rights-of-way.

Railroad Abandonment

Abandonment of the proposed railroad line is remote and not within the foreseeable future because of the extensive coal deposits that exist and the potential use of this line by Burlington Northern, Inc. as an interconnecting route between existing rail lines. Eventual relocation of the rail lines and spurs may be necessary where they overlie coal deposits at depths subject to surface mining.

There are several factors which are contemplated by the railroad prior to abandonment. In the case of the Douglas-Gillette line, profitability and use of the trackage by the railroad in furtherance of their common carrier obligations are considered. Use of this line for other than unit coal train traffic such as other rail oriented industry may be of significance and abandonment would not be considered.

Under existing law, it would be necessary for the railroad company to make application to the Interstate Commerce Commission to initiate abandonment proceedings. Section 1(18) of the Interstate Commerce Act, 49 USC 1(18), 49 Stat. 543 governs rail line abandonments. The legal standard applied by the Interstate Commerce Commission in determining whether the abandonment will be approved or denied is one of the present or future public convenience and necessity.

If abandonment is approved by the Interstate Commerce Commission, the track and structures are removed and salvaged. Bridges and culverts may be left in place at the request of adjacent landowners who assume responsibility for the maintenance of these structures. Railroad right-of-way may be offered to adjacent landowners for purchase.

Removal of track and structures is either accomplished by railroad company forces or a contract is awarded to private contractors. Contractors who perform this type work have the necessary equipment and qualified personnel to adequately assure the job is completed without damage to adjacent landowners. The primary consideration between company forces and a private contractor utilization for removal of trackage is that if the track and structures can be utilized by the railroad at another location, the rail line is salvaged.

CHAPTER II

DESCRIPTION OF THE EXISTING ENVIRONMENT

This chapter describes only those attributes of the environment along the railroad route that are not described in the regional analysis (Chapter IV, Part I) of this environmental statement. Additional data on all environmental components are found in that chapter.

Air Quality

The proposed 113-mile alignment of the railroad (proposed route) is located in the Casper Intrastate and Wyoming Intrastate Air Quality Control Regions. (See Figure 2, Chapter II, Part I.) Present air quality along this route is typical of that of the Eastern Powder River Coal Basin of Wyoming.

Ambient air quality standards for national and State of Wyoming air quality programs are given in Tables 1, 2, and 3 of Chapter VI, Part I, Mitigating Measures.

Topography

The topography along the proposed railroad route can be termed a relatively monotonous expanse of broadly rolling to gently sloping plains occasionally broken by major drainages that have cut into the landscape, creating areas of moderate to steeply sloping terrain. Alluvial plains of these drainages are moderate to steeply sloping depending on the width of the drainage. Adjacent to and flanking many drainages are narrow bands of sharply undulating hills formed by the numerous dissecting side drainages. There are no outstanding topographic features with the exception of a few buttes and escarpments located in the vicinity of the railroad route.

The route has been divided into several areas of similar topographic characteristics which are described below. The proposed railroad, with the exception of the Shawnee Creek area located at the southern extension of the route, crosses the topographic grain along the entire route. The topographic areas are listed from north to south.

Belle Fourche area

This area exhibits a greater amount of topographic relief for a short distance than any other area traversed by the railroad. Two significant drainages are crossed, the Belle Fourche River and Caballo Creek. Both streams flow from west to east and are located in relatively narrow valleys and in the short intermediate slopes and overflow plains or alluviated valley floors. Flanking hills rise sharply from the intermediate slopes and are dissected by many steeply graded side drainages that form dendritic patterns. The intervening hills after the intial rise from the valley floors are irregular and of moderate slope.

Hilight area

This area exhibits little topographic relief and consists mainly of low, rolling hills grading to gently sloping areas. The highpoint of this area is Hilight. There is a gradual rise from both the north and south to this point. The railroad route cuts across the upper reaches of Black Thunder Creek and its tributaries, which add little to the topographic relief. Several small closed basins form playas or "dry lake beds." Road construction is similar to the Bill area where roads are located in a straight line since topographic avoidance is not necessary. Some roads may run up to 24 miles in a relatively straight line without encountering topographic obstruction. Several clinker capped buttes and subdued hills border the western edge of the railroad route.

Antelope Creek-Cheyenne River area

The topography changes sharply from nearly flat to a significant amount of topographic relief, being dissected by numerous, deep-cut side drainages and sharply incised valleys. The route crosses this area at the lower reaches of these drainages and in an area where streambeds become more deeply incised into the landscape. Stream channels are meandered with sharply cut, steep embankments, and are arranged in a dendritic pattern trending west and south. The intermediate slopes rise at moderately steep angles to the surroundings hills.

The Antelope Creek Valley itself is a flat broad alluvial floor. To the south the topographic relief becomes somewhat subdued. Upon entering the Cheyenne River drainage the topography becomes much gentler than the Antelope Creek area.

Bill area

This area exhibits very little topographic relief which varies from broad, level flats to gently rolling hills and gentle, sloping surfaces between hills. Visibility is unobstructed, and a person can see for several miles if situated on one of the higher areas.

Roads and trails may be located in straight lines of over 12 miles.

Lightning Creek area

The topography of this area is created by large numbers of drainages that are tributaries of Lightning Creek and Walker Creek, Little Lightning and Box Creek. This area varies from sharply undulating hills in the south to a more broadly rolling area in the north. The hills along the railroad route are moderately steep and the intervening valleys are deep when compared to the Bill area.

Shawnee Creek area

The railroad route follows Shawnee Creek which is located in a short, broad alluviated valley that narrows rapidly at its northwestern point. The valley has a moderately steep grade flanked by sharply rising hills. The alluvium slopes rise gently from the creek bottom to the surrounding hills. Shawnee Creek flows southeastward into the North Platte river. The connecting tracks between the Chicago North Western and Burlington Northern Railroads are located on the broad level alluvium of the North Platte valley.

Soils

The proposed railroad right-of-way crosses many different physiographic landforms and various soil types in a north to south direction. This right-of-way will cross nearly 2,400 acres of land and eight soil associations which are identified and located on Map 7, Appendix A. Table 8, Soil Interpretations for Regional Soil Associations, of Chapter IV, Part I, lists soil characteristics, properties, suitabilities and limitations.

Soils situated within the proposed right-of-way, like many other soils of the semiarid part of the Great Plains, have developed from material weathered in place and are generally shallow over bedrock. On the gently rolling uplands, the slightly altered bedrock is usually not less than 36 inches below the surface; on the more rolling lands, the depth to bedrock is about 20 to 30 inches; and on steep slopes, only a few inches of soil or soil material overlies the partially weathered bedrock. Outcrops of rock are common on the steepest slopes.

The individual soil series that makeup the soil associations vary considerably in many internal and external characteristics. The soils within the right-of-way vary widely, ranging from the gently sloping, deep, loamy soils to shallow, rocky soils of the steeper slopes. Some soils are very sandy and clayey, while others--formed in shale--are clayey and occur extensively. Some have cool soil temperatures and thick, black surface layers rich in organic matter; e.g., the haploborolls. Others have much warmer temperatures and essentially no organic enriched surface layer; e.g., the Natrargids.

The properties of the soils (including their temperature and moisture content at critical periods) control their land use capabilities and behavior. Properties such as low soil moisture content, shallow rooting zone, high sodium content, or steep slopes limit uses and exert a strong influence on productivity, wind and water erosion, revegetation and construction of roads.

Past erosion has removed the thin layer of topsoil down to bedrock in soil associations 11, 13, and 20. Removal of vegetative cover and surface disturbance increases the erosion potential and loss of soil for the entire 113-mile length of the proposed right-of-way.

Soils located within the right-of-way have unique sets of properties that are determined by many aspects of the setting, including: (1) the nature of geologic material from which they weathered; (2) the seasonal precipitation and temperature as they influence runoff, infiltration, and the biota in a given kind of soil material; (3) the plants, animals, and micro-organisms in and on the soil that not only are determined by the chemical and physical properties and climatic parameters of the forming soil, influence the soil by adding organic material, mixing and loosening the soil, and redistributing the bases; and (4) the landform that influences the amount of runoff or accumulation of surface water. Thus, the soils developed within the right-of-way have unique qualities that determine their suitabilities and limitations for use in roadbed construction, fill material, revegetation and erosion control.

A soil association consists of two or three distinctly different soil taxonomic units (soil series) occurring in a regular repeating pattern upon the landscape. The soil associations were developed because adequate basic soil data is not available to locate or identify the individual soil series occurring within the right-of-way.

The productivity, potentials, and suitabilities of the different kinds of soil may vary widely on a small scale, but on a larger scale, the pattern of occurrence of the soils enables the land user to identify suitabilities, limitations and potentials of the soil for construction, rehabilitation, reclamation and land treatment practices.

The narrative discussion of soil association is designed to give a reasonably vivid and concise picture of the landscape and its soils, geology, climate, vegetation, current use, and general productivity, potentials, and limitations. Emphasis is given to a discussion of landform to provide a general impression of the nature of the area. A complete narrative description of the soil associations crossed by the proposed railroad is presented in Chapter IV, Part I. The proposed railroad right-of-way will cross soil associations 1, 3, 5, 8, 11, 13, 14 and 20, which are discussed below. It should be noted that the acreages and boundaries for each soil association are subject to change as detailed soil data becomes available.

The proposed railroad route will occupy approximately 50 acres in soil association 1. These soils occur in broad alluvial valley floors and flood plains along rivers and major streams. Although these soils are susceptible to flooding during spring and early summer, they are highly productive, yielding about 1,400 to 2,500 lbs/acre. The potential wind erosion hazard is high if vegetative cover is removed.

Approximately 975 acres of soil association 11 will be occupied by the right-of-way. These soils occur on moderately sloping to steep uplands underlain by shale and dissected by numerous small drainages. The shrink-swell potential ranges from moderate to high. Productivity is medium, yielding about 850 to 1,500 lbs/acre. Potential wind and water erosion is very high if vegetative cover and surface is disturbed.

Soil association 13 occupies a narrow band along the mountain foothills and stream terraces that are gullied and broken by rock outcrops. The railroad right-of-way will occupy nearly 150 acres of this soil association. Productivity is low to medium, yielding about 850 to 2,000 lbs/acre. The erosion hazard is moderate to severe if vegetative cover is removed.

Approximately 440 acres of soil association 14 will be occupied by the right-of-way. These soils occur on nearly level to gently sloping lands and are developed in alluvium. They are saline, impervious to water and contain alkali panspots. Productivity is low, yielding 450 to 1,200 lbs/acre. Erodibility is high if the protective cover is removed.

The proposed railroad right-of-way will occupy approximately 735 acres of soil association 20. These soils occur on rolling to steep slopes that are dissected by many small drainages. The soil depth is shallow (less than 10") and moderately alkaline. Productivity is medium, yielding 1,000 to 2,100 lbs/acre. These soils are highly susceptible to wind and water erosion if the surface protective cover is removed.

Approximately 50 acres of soil associations 3, 5, and 8 will be occupied by the right-of-way. These soils occur on rough broken lands, steep upland ridges and sidehills. Productivity ranges from low to medium yielding 450 to 1,400 lbs/acre. Susceptibility to wind and water erosion is high if the surface is disturbed.

Tables 10 thru 28 of Appendix C provides additional physical, chemical and limitations/suitabilities for construction, revegetation, topsoil, etc. for each of the soil associations.

Mineral Resources

The railroad route crosses sedimentary rocks that range in age from early Tertiary (Paleocene) through Pleistocene and Holocene.

Most of the route is upon Paleocene and Eocene strata composed of sandstone, siltstone, claystone, and shale with many beds of subbituminous coal. Middle and upper Tertiary rocks occur near the south end of the route. Pleistocene stream alluvium covers many valley floors, and local areas of Pleistocene windblown sand occur on some of the interstream divides. Holocene alluvium is found along modern stream channels, many of which are entrenched in the Pleistocene alluvial valley floors.

The Cretaceous and Tertiary rocks are best known, with respect to their areal distribution, lithology, petrography, and engineering characteristics. The Quaternary units, of both Pleistocene and Holocene ages, are not well known. Except for a few areas along the Belle Fourche River and its tributaries, they have not been mapped. Their age, distribution, and characteristics are known only from scattered personal observations and by extrapolation from other areas in the High Plains and Rocky Mountains (Osterwald 1974).

Folds

The route of the proposed railroad is on the east limb of the Powder River Basin syncline, so that beds along most of the route dip westward at low angles. Beds dip more steeply near the margin of the basin, in the vicinity of Orin Junction and Shawnee; dips of as much as 11° to the north and south occur at the south end of the railroad route (U.S. Geological Survey 1972). Dips of as much as 30°, toward the north and south, occur about seven miles west of Orin Junction, near the Burlington Northern station at Foster. Several small folds trend northeastward near Orin Junction and Shawnee. Other variations in strike and dip may be encountered along the wye connection to the Chicago North Western mainline. No other folds are known at the surface along the route of the proposed railroad, although subsurface folds probably exist in rocks below the coal bearing sequence (U.S. Geological Survey 1961, pp. 337-390).

Faults

Faults are known only at the south end of the railroad route between the Powder River Basin and the Hartville uplift. Other small faults, as yet unmapped, may be encountered along the route, similar to faults known in the southern Powder River uranium district (U.S. Geological Survey 1961, 1972).

Joints

There are no known detailed studies of the attitudes and spacings of joints in the Eastern Powder River Basin (Leggett 1939). Some predictions of joint directions along the railroad route can be made by inference from other areas in the Powder River Basin and the Great Plains. Throughout large areas of the Great Plains in eastern Nebraska two prominent joint sets, one striking northwest and the other northeast, cut resistant rock units at the surface and can be detected in nonresistant rock units on aerial photographs. Similarly, a northeast-trending set can be detected on aerial photomosaics of a large area of the Powder River Basin east of Buffalo, Wyoming. Similar trends probably will be encountered along the railroad route (U.S. Geological Survey 1961).

Seismicity

Eastern Wyoming, including the Powder River Basin, is in seismic risk zone 1 (Osterwald 1974). Four earthquakes of intensity V or greater have been recorded. Although epicentral locations of the early earthquakes probably are very poorly known because of lack of instrumentation and very sparse population, all of these probably occurred along faults bordering the Powder River Basin on the south. No earthquakes are known to have occurred near the northern part of the railroad alignment.

A description of the geologic formations that outcrop along the proposed route is given in Chapter IV, Part I.

Coal resources

Many coalbeds crop out near the proposed railroad route and the western alternate route (generally to the east of the routes). Other coalbeds crop out in the vicinity of the eastern alternate route. Many of these beds are minable under present economic conditions, and most must be considered valuable potential resources. The reserves of coal along the routes are enormous, but the largest reserves are between Bill and Wyodak. About 350 feet of coal, some of it in beds 100 feet thick, occurs in about 2,500 feet of stratigraphic section in the Gillette area. The proposed route crosses presently minable coal at two places, the right-of-way covering about 161 million tons of coal buried under less than 200 feet of overburden.

Oil and gas fields

Many oil and gas fields are near the railroad routes and the proposed route crosses the large Hilight Oil Field.

Uranium deposits

A few small uranium deposits, both disseminated deposits in sedimentary rocks and small veins along joints and faults, are known near the southern end of the proposed railroad route. Most of these deposits are in T. 32 N.,

Water Resources

Supply

Ground water resources along the proposed right-of-way include shallow aquifers in alluvium and in such formations as Wasatch, Fort Union, Arikaree and White River. Most of the route is underlain by the Wasatch Formation. About 18 miles of the north end of the route, including the Amax spur, and about 18 miles near the center of the route from 4 miles northwest of Bill northward is underlain by the Fort Union. Both connections of the route with the mainline east of Douglas are underlain by the Arikaree--about 1-1/2 miles of the west leg of the wye and about 3 miles of the east leg. North of the Arikaree is the White River Formation which underlies about 4 miles of the west leg and only one mile of the east leg of the wye. The north switch of the wye to 7 miles northward will be underlain by the Fort Union. All of these aquifers are considered to have potential for development of water resources. (Detailed information on the location, quantity, and quality of each aquifer is given in Chapter IV, Part I.)

The proposed route begins near Caballo Creek (tributary to Belle Fourche River) at the north terminus (Amax spur) and proceeds southerly crossing the upper Belle Fourche River and its tributaries, upper Cheyenne River tributaries, and finally Shawnee Creek, a tributary to North Platte River, at the wye of the south terminus. Surface water supplies are limited since most streams crossed by the route are ephemeral or intermittent rather than perennial. Such streams flow only as a result of direct runoff from snowmelt or rainfall. Beginning at the north terminus and proceeding south major streams which will be crossed by the route include Caballo Creek, Belle Fourche River, Coal Creek, Little Thunder Creek, Porcupine Creek, Antelope Creek, Dry Fork Cheyenne River,

R. 69 W. Ore was produced from two of these, one of vein type and one of disseminated type. Two of the deposits, including the disseminated one from which ore was produced, are in the Tullock Member of the Fort Union Formation; the others are in the White River and Arikaree Formations. Although other deposits of uranium may be discovered in the future along the railroad routes, they probably will also be small.

Sand and gravel

Sand and gravel for construction purposes is scarce in the area of the railroad route, and in some places is barely sufficient to supply present local needs for concrete aggregate. The only known sand and gravel deposits along the route occur in the channel and floodplain of the North Platte River at Orin Junction. Small ridges and benches along Lightning Creek locally contain pebbles of granite and quartzite up to two inches in maximum diameter. Sand deposits, in which the largest particles are about a quarter of an inch in diameter, occur in the stream channels of Antelope, Dry, and Sand Creeks. Deposits of sand and gravel occur principally along small stream terraces near the northern part of the railroad route, and other deposits occur along tributaries and in the headwaters of the Belle Fourche River. Some of these deposits are eight to ten feet thick. Pebbles in the gravel are mostly limestone, with some sandstone, limonite, quartzite, and chert. The gravel contains about 45 percent sand, and lenses of fine sand are interbedded with coarse gravel. Another deposit near the point where the proposed route crosses the Belle Fourche was about three to four feet thick and contained about 2,000 cubic yards of sand and gravel in 1946. Another deposit, two to three feet thick, near the point where the western alternate route crossed the Belle Fourche, was mapped in 1946; it contained about 1,500 cubic yards of sand and fine gravel (U.S. Geological Survey 1958).

Relationship between ground and surface water

All streams crossed by the proposed railroad route originate in the plains of the semiarid Powder River Basin and are mainly ephemeral, flowing only as a result of direct runoff from snowmelt or rainfall. Therefore, there is no contribution of groundwater to streamflow and, conversely, little recharge of alluvium aquifers from intermittent streamflow.

Uses and rights

Water uses will be limited to those described for the two-year construction period. Acquisition of the required amount of water is not considered to be a problem but must be in conformity with state water law.

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Quality

Chemical analyses of ground water from alluvium show dissolved solids range from about 500 to more than 2,000 milligrams per liter (mg/l), but more commonly range between 1,000 and 1,500 mg/l. Wasatch water contains dissolved solids from less than 500 to more than 2,000 mg/l, but commonly ranging between 500 and 1,500 mg/l. Fort Union aquifer analyses show dissolved solid ranges from about 300 to more than 1,500 mg/l, but commonly between 500 and 1,000 mg/l. Dissolved solids in waters of the Arikaree Formation are mostly about 300 mg/l while those of the White River Formation range from about 300 to more than 4,000 mg/l.

The quality of water in the Cheyenne and Belle Fourche Rivers and their tributaries is influenced by erosion and the amount of dissolved solids in sediment transported during intermittent flood runoffs. Both sheet and channel erosion contribute to moderate sediment loads in most streams. Since large amounts of the eroding soils are shale-derived and high in dissolved solids, runoff waters are estimated to contain a range of total dissolved solids (TDS) of 200 to 3,000 mg/l for the Belle Fourche River, and from 1,000 to 4,000 mg/l for the Cheyenne River. TDS values normally go down as volume of flow goes up and increase when flows get smaller. Sedimentation rates for streams crossed by the route are estimated to range from 0.15 acre-foot/square mile/year to as much as 1.0 acre-foot/square mile/year.

Relationship between ground and surface water

All streams crossed by the proposed railroad route originate in the plains of the semiarid Powder River Basin and are mainly ephemeral, flowing only as a result of direct runoff from snowmelt or rainfall. Therefore, there is no contribution of groundwater to streamflow and, conversely, little recharge of alluvium aquifers from intermittent streamflow.

Uses and rights

Water uses will be limited to those described for the two-year construction period. Acquisition of the required amount of water is not considered to be a problem but must be in conformity with state water law.

Vegetation

Terrestrial vegetation occupying the area along the 113 miles and 2,400 acres of proposed railroad right-of-way is predominantly a big sagebrush/ grass type. Three broad vegetation communities are found along the proposed route, but approximately 2,225 acres of the area are a shrub aspect-type (#4) dominated by big sagebrush. (See map 8, Appendix A.) The two minor communities consist of about 125 acres of a greasewood type (#5) and some 50 acres of broadleaf forest type (#10), and both are limited to the bottoms and floodplains of major streams crossed by the route.

Aquatic vegetation is almost nonexistent along the route since mainly ephemeral streams are found in the area.

Archeological and Paleontological Values

The right-of-way for the proposed railroad has not yet been intensively surveyed for archeological values. It is not known how many nor where the archeological sites exist within the right-of-way corridor.

Archeological sites recorded nearby (within 10 miles) indicate a high probability of sites occurring inside the railroad right-of-way. Nineteen sites have been reported on the Amax coal leases in a general archeological surface site survey by the University of Montana. A Kerr-McGee anthropology expert reports sites in a general surface survey of that lease. Dr. Frison from the University of Wyoming (State Archeologist) will soon begin an intensive site survey of the proposed railroad right-of-way and will finish intensive site surveys of the Atlantic and Sun Oil leases. He reports many sites from all these units and one of high scientific value from the Sun Oil tract which was recorded during preliminary field reconnaissance in preparation of research proposals (Frison 1974).

Dr. Frison indicates that archeological evidence is strong along the railroad right-of-way but sites have not yet been discovered. All the materials are typologically dated as early as 12,000 years ago.

The private collections of Llano materials and the single Altithermal site investigated ("Hawken" site - see Figure 36, Chapter IV, Part I) prove the cultures' existence in the Powder River Basin, possibly within the proposed right-of-way. This site is approximately 40 miles northeast of the proposed route.

Historical Values

No historic sites or structures exist along the proposed railroad routes (main, alternates, or spurs). The Douglas Corridor alternate route near Douglas, crosses a 150-foot strip of the Bozeman Trail where erosion has eradicated this segment of the trail. All historic sites and buildings of the region are out of range of the railroad proposals. Fort Fetterman the nearest site is 14 miles west of the proposed route.

Aesthetics

This is a description of the landscape along the proposed route from its junction with the Amax spur south to where it meets the main line at Shawnee Creek. As the route leaves the existing spur line and proceeds south, it climbs a gentle incline. The surrounding terrain is gently rolling. Vegetation is generally an even distribution of sagebrush and grass; with some exposed soil, part of which is the red clinker material. As the route drops into the Belle Fourche drainage, the landform becomes a little more rugged. The drainages are cut deeper, and there is a good deal more exposed red clinker material. As the route proceeds up Coal Creek, the terrain becomes more gently rolling again with more sage and grass cover and less exposed soil. Through the Hilight Oil Field, the land is generally very gently rolling with considerable sage and grass cover, and many intrusions from oil and gas development activities. Much of the area is criss-crossed by roads and pipelines with numerous oil pumps and gas wells. Immediately south of the Hilight gas plant there is a great deal of ranching activity and almost no sagebrush; the cover is almost entirely grass. About two miles south of the Hilight gas plant the route climbs a gentle incline and passes between several flat-topped, cone-shaped ridges with red clinker material exposed. After the route passes between the cones, the terrain opens into a very gently rolling topography with less exposed soil and mostly good cover of sage and grass. Drainages are shallow and fairly stable. Color is mostly of the low-growing vegetation. This evenly textured, gently rolling topography continues all the way down the route through Porcupine Creek and into the Antelope Creek drainage. As the route approaches Antelope Creek, there is less grass and more sage in the vegetation with not much exposed soil, and still very gentle slopes. As the route climbs out of Antelope Creek, sage dominates the vegetative cover and there is quite a lot of exposed soil. Here the soil color is the soft brown tone, almost ocher yellow, which contrasts with exposed clinker material along the red hills directly to the east of the line.

As the route crosses into the Dry Fork of the Cheyenne River, the drainages become steeper with sharply eroded cuts to the drainage bottom. The patterns of sagebrush are more scattered, there is more grass, and much more soil exposed. There are quite a few more sandstone outcrops along the ridges. The bottom of the Dry Fork drainage is fairly wide in this location with a number of scattered cottonwood trees.

As the route climbs out of the Dry Fork drainage toward Bill, it crosses State Highway 59. From this point south to where the route again leaves the highway, the landscape becomes very gently rolling with scattered grass and sagebrush mixed almost equally in broad patterns. The only intrusions in this area are a major pipeline, several minor pipelines, and a number of roads. There are a few farming and ranching operations at the valley bottoms, but very little to detract from the natural environment. Not much soil is exposed throughout this section, but what there is has a definite yellow ocher cast to it. Drainage bottoms are not nearly as deeply incised as those in the Dry Fork drainage, and they seem to be quite well healed.

As the route drops down into the Shawnee Creek drainage, the terrain again becomes steeper and more deeply eroded. Several flat-topped ridges flank the drainage on both sides, and a few scattered pines are visible on the ridges to the east. The drainage bottom itself again picks up a few scattered cottonwoods and maintains a fairly gentle grade all the way down to the junction with the main line. Due to the very gently rolling nature of the terrain along the entire route, the very slight contrasts in vegetative patterns and textures, and the generally muted tones of the colors throughout the area, the scenic values along this proposed route are generally very low.

Wildlife and Fish

Big game

Pronghorn antelope

With few exceptions, the antelope is the most common big game animal along the proposed route (Map 9, Appendix A); the area within five miles of Bill is an especially important wintering area. The lineal nature of the railroad right-of-way makes quantification difficult. Winter concentration areas, such as the area near Bill, probably support winter densities up to 50 animals per square mile. Antelope population is believed to be stable and probably at or near the carrying capacity of the habitat.

Important browse species utilized by antelope particularly during fall and winter months, include big sagebrush and rabbitbrush. Forbs and grasses are utilized in spring and early summer. The single most important forage species is big sagebrush which also serves as cover during adverse weather and fawning.

Extensive seasonal migration by antelope are not traditional in this area. Antelope seasonally disperse and often move several miles to more suitable winter ranges from surrounding areas. The extent and significance of these movements varies with the severity of the winter.

Mule deer

Mule deer are found primarily along drainage courses and areas of broken topography where there is brushy cover (see map 10, Appendix A). In some areas broken topography provides suitable cover. Extensive sagebrush-grass regions with gentle topography such as those making up most of the route support few deer.

Big sagebrush, rabbitbrush, skunkbush sumac, and a variety of forbs provide most of the mule deer forage.

<u>Other mammals</u>

Predators

Little information on predator use of the railroad area is available. No data on present populations or trends are available. Ranchers attempt to control predator populations in the general area to some degree. The currently high fur prices ($30-40 for coyotes and fox and $80-100 for bobcat) give predators economic importance.

Rabbits

Two species of hares (jackrabbits) and one species of rabbit (cottontail) may be found along the route. The white-tailed jackrabbit is fairly common, but populations vary in a more or less cyclic pattern. Black-tailed jackrabbits are present in small numbers in the general area.

The desert cottontail may be found along the entire route. As with the jackrabbits, populations of cottontails vary considerably from year to year. Cottontail densities are greatest along drainage courses which provide more abundant brushy cover. No data on present populations or trends for cottontails or jackrabbits are available. Both jackrabbits and cottontails are hunted, but hunter harvest is light.

Rodents

Although the presence of a variety of rodents is likely along the route, no data on densities, trends, or distribution are available. Species observed in similar habitats within a few miles of the route and, therefore, likely to occur along the railroad, include the deer mouse, whitefooted mouse, northern grasshopper mouse, thirteen-lined ground squirrel, Ord's kangaroo rat, sagebrush vole, olive-backed pocket mouse, western harvest mouse, and meadow vole (Sun Oil Co., 1974, p. 74; Peabody Coal Co. and Panhandle Eastern Pipeline Co., 1974, pp. 75-82). The northern pocket gopher, porcupine, plains pocket gopher, least chipmunk, black-tailed prairie dog, and white-tailed prairie dog can be expected to occur here. The Cheyenne and Belle Fourche Rivers and Antelope Creek support small numbers of muskrats and beaver.

Bats

No information concerning the presence of bats on the railroad is available. Species possibly occurring here include little brown myotis, long-legged myotis, Keen's myotis, long-eared myotis, hoary bat, Townsend's bat, and big brown bat.

Upland game birds

Sage grouse

The entire route is habitat for sage grouse. Estimated sage grouse density is 5-8 grouse per square mile. Sage grouse depend on abundant sagebrush for food and cover. The proposed route falls on or near crucial strutting (mating) and nesting areas. Available data only partially delineates such areas. Sage grouse are harvested as a game species.

Sharp-tailed grouse

Few sharp-tails are found along the proposed route. Where they occur (less than 5 per square mile), grassland in association with brushy cover provides habitat. Little or no hunter harvest is likely from the railroad route.

Hungarian (grey) partridge

Hungarian partridge occur throughout the area in a wide variety of habitat types. The population consists of small, widely scattered flocks. Harvest by hunters is very low.

Mourning dove

Little population data on the mourning dove is available. Doves nest throughout the area during summer months and migrate south out of Wyoming for wintering. Greatest nest densities are in riparian vegetation along drainage courses. A variety of seeds comprise the diet of doves. No data on hunter harvest is available.

Waterfowl

Waterfowl habitat along the proposed route is limited to a few small stockwater ponds, the Cheyenne and Belle Fourche Rivers, and Antelope Creek. Waters in the general area are used by waterfowl as rest areas during spring and fall migrations. Larger permanent waters are used for nesting and brood rearing. Species most likely in the area are the eared grebe, mallard, gadwell, and green-winged teal.

Other birds

Raptors

The most common raptors are red-tailed hawk, Swainson's hawk, rough-legged hawk, and American kestrel. All of these species nest in the general area and forage over the railroad area. During winter months, significant numbers of rough-legged hawks, bald eagles, and golden eagles move into the general area, probably from areas to the north where winters are more severe. Species present in lesser numbers include the ferruginous hawk, marsh hawk, prairie falcon, great-horned owl, and short-eared owl. Drainage courses with medium to large trees provide nesting habitat for many of the raptorial species.

Prey species include various rodents, cottontails, jackrabbits, birds, and insects. Most raptorial species found here prey primarily on small mammals.

Song birds

The number of species of song birds present at various times of the year probably exceeds 100. Almost no information on the occurrence of these species along specific sections of the railroad is available. Some of the more common species are the western meadowlark, the lark bunting, and the horned lark. The western meadowlark feeds primarily on insects and most migrate south for winters. Horned larks occur on the area throughout the year, feeding on insects and small seeds. Lark buntings, also migratory, feed primarily on seeds while their young utilize insects until fledging (leaving the nest). The greatest densities of birds at all seasons are along drainage courses where riparian vegetation provides greater habitat diversity.

Fish

Fish habitat along the route is limited to intermittent streams such as the Cheyenne River, Belle Fourche River, Antelope Creek, and Caballo Creek. Available information indicates that 10 to 15 species, mostly rough fish, may be found in these streams (Baxter and Simon, 1970). Included are the plains flathead minnow, sand shiner, plains minnow, black bullhead, plains killfish, green sunfish, creek chub, white sucker, and carp. Undependable supplies and quality of water reduce overall suitability of this habitat.

Reptiles and amphibians

Several species of reptiles and amphibians have been identified within a few miles of the proposed railroad and in similar habitat (Sun Oil Company 1974, p. 60). These include leopard frog, tiger salamander, eastern shorthorned lizard, plains hognose snake, wandering garter snake, and prairie rattlesnake. Reptile and amphibian populations are believed to be relatively low.

Invertebrates

Local insect populations are abundant. Representative groups include grasshoppers, beetles, ants, wasps, bees, and butterflies. Although most are plant eaters, some species are scavengers, predators, or parasites. A variety of spiders (mostly predators) is also present. Other invertebrate groups likely along the railroad include earthworms, leeches, and snails. (No information on species available.) All are most likely to be found along or in the intermittent streams.

Threatened species

Black-footed ferret

The black-footed ferret is on the U. S. Department of the Interior list of endangered species. (U. S. Bureau of Sport Fisheries and Wildlife 1972 p. 289). Available information indicates that prairie dogs are usually the primary food source for ferrets and prairie dog colonies the principal habitat. Some prairie dog colonies are in the vicinity of the railroad.

Peregrine falcon

This rare falcon may occur on the railroad area during periods of migration but is unlikely at other seasons.

Prairie falcon

Relatively rare in Wyoming, this falcon has not been sighted in the area of the proposed route. Prairie falcons are known to be present in the Powder River Basin and likely forage over the railroad area.

Recreation

The recreation opportunities along the proposed route are rather minimal due to the high, windswept ridges and hills. This route also is located at the heads of all major drainages and tributaries of the Powder, Belle Fourche, and Cheyenne Rivers. Because of this naturally high, unsheltered area (except for antelope), less opportunity exists for viewing and hunting wildlife or providing other forms of outdoor recreation.

The area east of this route, where some permanent water is located consists of large blocks of public land (National Grasslands - 344,000 acres) with good recreation opportunities (31,600 recreation visitor days in 1973). Additional access to those lands will result from constructing the railroad. Also, roads will be kept open for industrial and agriculture use.

Another recreation interest in the area is collecting. Local groups contacted indicated no significant concentrations of collectible gem stones and petrified wood, but opportunities to locate better sites is possible if public access is protected across the railroad. Construction of the proposed railroad may be interesting to the highway traveler along State Highway 59.

Agriculture

The railroad route proposed by Burlington Northern Inc./Chicago North Western Transportation Company will cross lands owned by 50 private landowners, the State, and Federal Government. The right-of-way will cross 80.6 miles of private surface, 9.2 miles owned by the State, 2 miles administered by the Bureau of Land Management, and 20.9 miles administered by the U.S. Forest Service.

Livestock grazing

Bureau of Land Management lands are leased to contiguous ranches for grazing purposes for periods up to ten years. These lands, due to the fragmented land pattern, are usually fenced with and used in conjunction with adjoining private lands.

The Forest Service lands which the route would cross, are located within the Thunder Basin National Grasslands.

The proposed route crosses lands included in 91 individually fenced pastures and fields which are part of the land base for 39 ranching operations. These ranch units derive the major portion of their income from the grazing of cattle or sheep, or a combination of both. These fields contain either native or introduced forage species. Over 90 percent of the land receives no irrigation. There is subirrigation along the Belle Fourche River and hay fields are irrigated in the Shawnee-Fisher area and north along Shawnee Creek.

Farming

The Powder River Basin is not noted for extensive farming activities and this is especially true along the proposed railroad route. Some dryland farming activity is located along the route, notably in the area of Bill.

Small grain production is basically limited to wheat and barley. Production is marginal and demands special management practices to be profitable. Soil management is mandatory and summer fallowing is practiced to reduce the probability of crop failure in drier years. Fields are left fallow every other year to increase and conserve soil moisture. Strip farming is also practiced to reduce erosion.

Wheat yields average 16.5 bushels per acre and barley averages 19 bushels per acre. Some oats may occasionally be grown along the route and production averages about 20 bushels per acre. These yield averages are dryland averages since no small grain is irrigated along the route.

Transportation Networks

The general vicinity of the proposed railroad route is traversed by only one designated highway, State Highway 59. Traffic flow along the highway is heaviest north of Reno Junction carrying 1,120 vehicles per day; but it is only lightly traveled at 380 vehicles per day south of the junction. (Wyoming State Highway Commission, 1972). Due to the light traffic flow along Highway 59 south of Reno Junction, it appears that very little daily commuting to work is going on between the two counties. The proposed railroad route is planned to cross Highway 59 at two points south of Reno Junction and each alternate route plans one crossing. Crossings are proposed to be accomplished via railroad undercrossings.

Many numerous lesser unimproved and graded dirt roads throughout the area provide access to many oil fields and ranch operations. These roads are to a large extent privately maintained although counties maintain a few but unknown number of the more significant roads. The proposed route crosses an estimated 50 of these lesser roads. Traffic flow figures on these roads are not generally available, but traffic can accurately be described as extremely light.

The proposed railroad route crosses 4 of the major pipelines shown on Figure 82, Chapter IV, Part I, and a limited but unknown number of lesser pipelines not shown. Major electric transmission lines in the area are shown on Figure 83, Chapter IV, Part I.

Socio-Economic Conditions

The existing conditions of the study area, which includes this proposed development, are discussed in Chapter IV, Part I.

CHAPTER III

PROBABLE IMPACT OF PROPOSED ACTION

Construction of a 113-mile railroad between Gillette and Douglas, will cause environmental impacts along the line of construction. Movement of an estimated 15,000,000 cubic yards of cut and fill material along the main track and sidings, placement of an estimated 220 culverts, 18 bridges and overpasses, mining of 740,000 cubic yards of clinker material for use as subballast, construction of access roads, construction camps, reservoirs, drilling wells and other associated activities will affect various environmental components.

Primary and secondary impacts will occur from railroad construction. Primary impacts will take place onsite, in a linear fashion along and adjacent to the 2,400 acre railroad corridor. Secondary impacts will occur offsite and will be related to population increases associated with employment of construction workers and permanent personnel for railroad operations. By 1990 an estimated 2,700 increase in population will occur as a direct result of railroad construction and operation within the Eastern Powder River Coal Basin. Other offsite impacts will be related to coal exportation via the railroad to distant places such as Lansing and Council Bluffs, Iowa; Pueblo, Colorado; Amarillo and Cason, Texas; Muskogee, Oklahoma; and Redfield, Arkansas. Transportation of coal to these locations will impact air quality, transportation networks, and populations. If new facilities are built to handle the rail transported coal or if other modes of coal transportation are contemplated, the environmental impacts of these facilities will be examined as appropriate under federal and state law.

A major secondary impact resulting from railroad construction within the Eastern Powder River Coal Basin is development and mining of the vast coal reserves. Coal development impacts are analyzed on a regional basis in Part I, and on a site specific basis in Parts III - VI of this statement.

Impacts analyzed here relate strictly to development of a single track, 113-mile railroad, with nine sidings, from Gillette to Douglas. Spur construction is considered part of mine development and is covered under Parts III - VI of this statement. Assuming precise scheduling, no mechanical failures and operating 365 days per year, the maximum capacity of this single track is estimated to be 48 trains per day (24 loaded and 24 empty). Based on projected coal exportation of 48 million tons per year by 1980 (24 trains per day), 68 million tons by 1985 (34 trains per day), and 93 million tons by 1990 (46 trains per day), the maximum capacity of the line would not be reached until 1990. However, in all practicality, allowing for mechanical problems, track maintenance, and staggered scheduling, the capacity will probably be reached sometime between 1980 and 1985. When this occurs and a second track is required, this portion of the environmental statement will need to be updated. However, provided the second track is located directly adjacent to the first track, the impacts, as analyzed here, will need only minor revision. Construction of a second tract would probably impact environmental components of soil, water, vegetation and agriculture more than the others.

Air Quality

Construction of the proposed rail line, involving disturbance of 2,400 acres during removal and hauling of approximately 15 million cubic yards of embankment, will create dust and wind blown particulate matter which will reduce air quality of the basin. Carbon monoxide and nitrogen oxide emissions from the various types of equipment (bulldozers, scrapers, rollers) used in construction activities will be increased in the immediate area of construction. Additional dust and particulate matter will be added to the atmosphere as result of construction of associated facilities such as access roads, powerlines, and construction camps. Burning of right-of-way material (grass, shrubs) will add pollutants to the air.

Besides the dust created by human activities, the constant and sometimes high winds experienced in this area will create additional dust and wind blown dirt particles from the exposed fine grained soils and parent materials. Dust will be produced along haul roads, access roads, fill areas, cut areas, borrow pits and from mining of clinker deposits for subballast.

Air quality will be reduced for an approximate period of two years as a result of construction activities. Some dust will be created by wind action for a longer period of time or until all disturbed areas are revegetated. Some of the steeper and deeper cuts may never be revegetated and will remain as a constant source of wind created dust and soil particles. Reduction in air quality will be localized to the immediate vicinity of the rail line construction. Where construction takes place near Highway 59, wind blown dust could reduce visibility and may increase probability of traffic accidents during periods of high wind.

Train emissions and coal dust created by loading facilities will cause long term impact on air quality. Each unit train (five diesel units and 110 cars) consumes an estimated 4,873 gallons of fuel per trainload of coal. Assuming an average load of 11,000 tons per train, the 1980 exported coal production (48 million tons) would require 4,364 trainloads and combustion of 21.3 million gallons of diesel fuel. The estimated annual emissions resulting from burning this amount of fuel is: 266 tons of particulates; 606 tons of sulfur dioxide; 3,937 tons of nitrogen oxides; 1,383 tons of carbon monoxide; and 1,000 tons of hydrocarbons (Environmental Protection Agency 1973, Table 3.2.2-1).

Forty one million gallons of diesel fuel will be required by 1990 to export 93 million tons of coal. The estimated annual emissions resulting from burning this amount of fuel are: 513 tons of particulates; 1,170 tons of sulfur dioxide; 7,597 tons of nitrogen oxides; 2,669 tons of carbon monoxide; and 1,930 tons of hydrocarbons.

The impact of these emissions on air quality levels is indeterminate. Because of strong winds and dilution effect, air quality degradation is not expected to be serious. However, these emissions will add to the overall decrease in air quality.

Minor long-term impacts on air quality will result from use of access roads to maintain the rail line and frequent accidental wildfires started by train operations (10 to 50 per year).

Topography

Major impacts to the existing topography will occur along the 113-mile, 2,400-acre right-of-way corridor. The topography along this linear area will be changed by moving an estimated 15,000,000 cubic yards of cut and fill material. Based on a maximum one percent grade, fills will vary from three feet high to a maximum of 85 feet. Cut depths will vary with a maximum depth of 102 feet occurring. Of the total length, 1.5 percent (1.7 miles) will be in cuts greater than 40 feet deep and 1.6 percent (1.8 miles) will be on fills greater than 40 feet high.

Cutting operations could remove prominent points of land and will create steep, unnatural slopes in areas where none existed before. Long fill slopes, which will be located in areas of low topographic relief, will create unnatural, elevated embankments. Minor drainages will be blocked by roadbed embankments, which will alter stream characteristics. Some drainages may be consolidated by diversion ditches to direct water flow into culverts and other drainage structures. The diversion ditches and cessation of flow in some channels will alter and create new topographic forms and shapes.

Major drainage channels may have to be altered to protect bridge abutments and embankments. Other drainage channels may need to be modified to accommodate the grade and curvature of the roadbed. Possible modification of major drainage channels may occur at the Belle Fourche and Cheyenne River crossings, and the Antelope, Lightning, Shawnee, Caballo, Coal, Little Thunder and Walker Creek crossings. These modifications all represent a change in existing topographic characteristics. Besides having a direct impact at the site of modification, these changes may increase or alter stream velocity. They could cause increased erosion and headcutting of the streams, creating new and deeper channels and topographic changes many miles upstream or downstream from the point of the primary impact.

Impact on topography will also result from opening of an unspecified number of clinker pits along the northern 75 miles of the proposed route to obtain the estimated 740,000 cubic yards of clinker required for subballast. An indeterminable amount of sand and gravel will be required for construction of concrete structures such as road bridges and underpasses. Part of the gravel will be obtained from existing gravel pits located at the Irvine siding. An estimated requirement of 311,000 cubic yards of top ballast will be obtained from the limestone quarry located at Guernsey, Wyoming. Extracting these materials from the gravel pit at Irvine, river and creek bottoms, the Guernsey quarry, and new clinker pits, will cause additional alterations of the topography. Borrow areas for supplying fill and waste disposal areas for disposing of unsuitable excavated material will be required. All of these actions will create depressions or steep slopes where none existed before. Obtaining the necessary material along the right-of-way will affect 1,500 acres in addition to the 2,400 acres within the right-of-way.

Alteration of topography on 3,900 acres represents approximately one-tenth of one percent of the regional area being considered for coal development. Viewed on an areawide basis, the topographic impact is not significant. However, the impact will be severe along the railroad corridor.

Soils

Impact on soils will result from disturbance of 2,400 acres within the right-of-way; removal of 1,100 acres from productivity by a cover of ballast, track, steep slopes, bridges, etc.; digging, moving, hauling of approximately 15 million cubic yards of soil material; compaction of topsoil and lower horizons by equipment; increased erosion from removal of vegetation, and deep cuts exposing fine grained soil and parent material; construction of access roads and construction camps; mining and removal of 740,000 cubic yards of clinker and material for use as subballast; and development and removal of soil from borrow pits along the right-of-way. The majority of these impacts will occur over the two-year span required for construction. The removal from productivity and exposure of soil to wind and water erosion on unvegetated steep cut slopes will be permanent impacts. Soil properties and characteristics which will be impacted are: erosion, sediment yield, soil moisture relationships, infiltration rates, available water holding capacity, permeability, bulk density, bearing capacity, soil structure, soil texture and chemical composition.

Table 1 provides the acreages to be disturbed and lost to productivity by soil associations. Map 7, Appendix A, shows the soil associations and a description of each is located in Part I, Chapter IV, of this impact statement.

Table 1

Acreage of Soil Associations Disturbed and Removed from Productivity by Railroad Construction within the Right-of-way

Association	Acres Disturbed	Acres Permanently Removed
1	50	23
3,5,8	50	23
11	975	447
13	150	69
14	440	202
20	735	336
Total	2,400	1,100

Surface disturbance will destroy present topsoil characteristics and microorganisms and will impact runoff and permeability rates. Permeability will be reduced and runoff increased, adding to existing sediment load of the various drainages crossed by the right-of-way. Productivity levels will be lowered until the soil has had time to reestablish its various structural and microorganism relationships.

Handling and disturbing 15 million cubic yards of soil material in cuts and fills will completely disrupt and destroy the present soil horizon relationships which have been established over a long geologic time span. All of the soil characteristics described above will be affected. Material which may be toxic (sodium chloride, sodium sulphate, magnesium sulphate and calcium sulphate) to plant growth could be brought to the surface and create revegetation problems. Erosion and sedimentation will be increased as permeability is decreased. Soil structure and texture will be completely destroyed. The end result of this action could result in formation of new soils with characteristics and properties completely unrelated to the present soils.

Compaction impacts will not be confined to the right-of-way proper. Use of access roads and movement of equipment into and out of the right-of-way will cause compaction on a wider area. Compaction will affect infiltration rates, permeability and available water holding capacity. These impacts will last beyond the two-year construction period and could affect vegetation growth and will affect runoff and sedimentation rates. The natural soil development process will be affected and set back in development to a prior, less developed stage.

Construction of bridges and placement of culverts and other types of drainage structures will require permanent and/or temporary alteration of natural drainage channels. Some major drainages to be crossed by the proposed right-of-way beginning at the north terminus are Caballo Creek, Belle Fourche River, Coal Creek, Little Thunder Creek, Porcupine Creek, Antelope Creek, Dry Fork Cheyenne River, Dry Creek, Box Creek, Lightning Creek and Shawnee Creek. These alterations will concentrate excessive amounts of water into one channel or area and deprive stream bottoms and drainageways of their natural amounts of water where streams are rechanneled or channels merged. The alteration of surface and subsurface soil moisture requirements has a direct long term impact on the natural soil development process and related soil-climatic-vegetation environment. The concentration of water in drainageways will accelerate soil loss and sedimentation.

Offsite impacts created by excavation of ballast and subballast material sites, development of disposal areas for liquid and solid wastes, construction of reservoirs to provide a source of water and control surface runoff or flooding, construction of work camps, equipment storage areas, construction of spur rail lines, access roads, service roads and power lines will impact approximately 1,500 acres, outside of the right-of-way.

Nearly 550 acres will not be reclaimed nor revegetated because of permanent structures.

A total of 3,900 acres of surface soil will be affected by railroad construction. This represents approximately one-tenth of one percent of the total surface soil area within the Eastern Powder River Coal Basin. The impact on soils from railroad construction, outside the right-of-way corridor is not considered to be significant.

Mineral Resources

Construction of the railroad will impact mineral resources in the area of construction as well as outside the right-of-way. The proposed route crosses an estimated 161 million tons of coal strippable under economic conditions of 1974. The route crosses an additional 195 million tons of coal covered by less than 400 feet of overburden.

Even though location of the railroad over coal will not cause a physical loss of coal resources, it can cause a deferral loss and inconvenience. When the adjacent coal is mined, a pillar of coal will have to be left to support the rail line. Some of the bypassed coal might be more expensive to mine or even economically nonrecoverable at that time.

Construction of the railroad through clinker deposits will cause an impact. The major impact on these deposits will result from the use of approximately 740,000 cubic yards for subballast material and an indeterminable amount for backfill, base material for structures, road surfacing, overpasses, underpasses, etc. Use and acquisition of clinker will impact soils and vegetation outside the right-of-way. The total area affected from this use is indeterminable. The estimated 311,000 cubic yards of top ballast required will be obtained from the Burlington Northern's Guernsey quarry located 40 miles southeast of Douglas. Use of this material will further deplete the availability of ballast for use on other projects. An undetermined amount of sand and gravel will be used in construction of six underpasses and overpasses. This material will probably be obtained locally from streambeds and banks and could affect water quality and fish life. The rail line construction will not impact any oil and gas operations. The right-of-way is not expected to cover or cause any measurable impact on uranium bearing material.

The impact on aggregate material is not significant. However, the impact on strippable coal reserve is approximately 1.3 percent of the total available. This is not a major impact, although the magnitude may be classified as low to medium.

Water Resources

Supply

Construction of railroad embankments for the 113-mile route (and sidings) will require water to be added to fill material for compaction purposes. An estimated 15,000,000 cubic yards of embankment will require a supply of water in the range of 60,000,000 to 350,000,000 gallons (185 to 1,075 acre-feet) over the two-year construction period. Additional water needs for consumptive purposes during construction include campsite uses, watering of haul roads for dust control, concrete construction, backfilling of bridges and culverts, and related uses. Excavation of deep cuts (up to 102 feet) along the northern 50 miles of the route would not intercept or drain shallow aquifers.

Sources of water for construction needs include existing wells, springs and reservoirs along the route. These waters are privately owned and would require acquisition. Development of additional water sources (wells, springs, reservoirs) may be necessary where existing sources are inadequate or unobtainable. Should new sources be developed during construction of the railroad, they would be beneficial to other local uses subsequent to completion of the railroad. Acquisition of the required amount of water is not considered to be a problem but must be in conformity with state water law.

The rail line as presently staked (March 1974) will destroy four water wells and one reservoir used for watering livestock. Loss of these water sources could impair grazing use in the area. Water needs for the railroad following construction will be minimal.

Quality

The quality of shallow aquifers may be adversely affected if construction wastes such as oils, chemicals, and sanitary wastes enter ground waters through percolation. Herbicides and their carriers used on maintenance of the right-of-way for selective vegetation control may be carried into ground water aquifers by percolation of surface waters. These contaminants would adversely affect ground water quality.

Surface waters of intermittent and ephemeral streams (Caballo Creek, Belle Fourche River, Coal Creek, Little Thunder Creek, Dry Fork Cheyenne River) crossed by the route may be adversely affected during construction of embankments and the installation of pilings, 12 bridges, and an estimated 220 culverts. Disturbed soils and open excavations will be subject to erosion should high intensity rainstorms occur during construction. This erosion would increase dissolved solids, turbidities and sediment concentrations in perennial, intermittent or ephemeral flows. Installation of drainage structures during periods of streamflow may increase turbidities if equipment is permitted to operate in the stream channel. Increased turbidities and sediment loads may also result from blockage and diversion of small drainages to adjacent major drainage structures. This would be caused when improper diversion structures increase erosion along diversion channels, and also in downstream channels due to larger than normal volumes of water. Abandonment or spills of oils, chemicals, sanitary wastes and other construction materials may occur, and these could add pollutants to streams from surface runoff. Herbicides used in selective control of right-of-way vegetation may be accidentally spilled, applied to, or carried into streams and would cause water pollution. Coal train accidents could cause accidental spilling of diesel fuel and coal into surface waters and drainages. Other rail traffic accidents could also spill cargo containing toxic materials into surface waters and drainageways. Extraction of sand and gravel from stream bottoms for construction purposes would cause increased turbidities and may increase sediment transport due to accelerated erosion.

Vegetation

Vegetation will be totally or partially removed on approximately 2,400 acres along the 113 mile right-of-way during the two-year construction period. Included in this acreage are 2,225 acres of big sagebrush/grass, 125 acres of greasewood, and 50 acres of broadleaf forest. Additional vegetation destruction outside the right-of-way would occur where embankment and clinker borrow areas are cleared during construction activities; access roads are built; staging areas and campsites are established; and where additional population associated with the railroad settles. Other vegetation would be damaged during construction of the project from off-road vehicle and equipment use on areas adjacent to the right-of-way. Construction of right-of-way fences will damage and remove varying amounts of vegetation.

Increase in population associated with construction and operation of the railroad will result in additional damage to and loss of vegetation. It is estimated that the following cumulative amounts of vegetation will be lost as a result of population increases: 95 acres by 1980; 124 acres by 1985; and 141 acres by 1990. Increased recreational use originating from this population will result in additional, indeterminable amount of damage to the vegetative resource within the study area. Most of the damage outside of the right-of-way would occur to the big sagebrush community and is estimated at 1,500 acres.

Construction and maintenance of fire guards for prevention of range fires would destroy up to 350 acres of big sagebrush/grass vegetation. Range fires started accidently by railroad or related operations may burn from 200 to 3,000 acres per year of sagebrush/grassland vegetation adjacent to the right-of-way. Of the total 3,900 acres of vegetation disturbed, an estimated 42 percent (1,650 acres) will be permanently lost to facilities such as the roadbed, ballast, siding tracks, steep cut slopes which do not readily adapt themseleves to revegetation, fire guards, population increases, and access roads.

Minor adverse effects to vegetation may occur along the railroad embankment where minor drainage areas are intercepted and diverted through major drainage structures. This damage will occur from inundation of vegetation on the upstream side of the right-of-way and from elimination of soil moisture normally supplied by flood irrigation on the downstream side of the embankment.

The use of herbicides to control certain types of vegetation along the right-of-way would damage target plant species as well as some non-target species. Wind drift off target areas could cause additional vegetative damage.

Archeological and Paleontological Values

Since a detailed archeological and paleontological survey of the proposed railroad right-of-way has not been conducted, it is difficult to analyze the impact of railroad construction on these scientific values. There will be 2,400 acres involved in the right-of-way and 1,500 acres disturbed outside of the right-of-way for borrow areas, subballast, access roads, campsites, etc. If sites do exist they will be destroyed. Construction of the proposed route will involve disturbing an estimated 15 million cubic yards of dirt. Several deep cuts (up to 102 feet deep) and fills (three to 85 feet deep) will occur. The cuts will destroy any archeological or paleontological values which may exist in the area. The fills will cover any potential archeological sites, making them unavailable for future study and salvage.

Besides the direct impact that railroad construction will have on any of these values which may be located in the area, indirect impacts will occur. The indirect impacts will be associated with the population increase expected to be generated by construction and operation of the railroad. Increased population will permanently remove and disturb additional acreage (141 acres by 1990) which could possibly contain archeological values. Recreational use associated with this population will impact known as well as unknown archeological sites throughout the study area. Arrowhead hunters, rock collectors, pot hunters and off-road vehicle users will all disturb additional surface acreage, destroying evidence which could provide information on archeological sites.

Historical Values

Construction of the railroad will not create any impacts on historical sites or values.

Aesthetics

Construction of the proposed railroad between Gillette and Douglas will impact existing elements (texture, lines, color, landform, intrusion) which collectively make up the visual resource (aesthetics).

Removal of vegetation in a linear strip, over 2,400 acres will impact the existing texture of the area (texture here consisting of a vegetative pattern). The removal of vegetation, fills and deep cuts created by the railroad will create a new vegetative texture. Part of the area will remain barren (1,100 acres of roadbed and 550 acres outside of the right-of-way), the remainder will be reclaimed with a different type of vegetation. These two results will change the existing texture. Reclamation, if successful, will produce a grass cover, with a height generally lower creating a contrasting texture with native vegetation outside the right-of-way.

The railroad will result in a sharp line across the landscape. Most lines in nature are not sharply defined but rather take a soft, irregular shape. The line created by the railroad will appear unnatural and contrast with natural lines in the area.

The natural color scheme of soft grays, greens and browns present in the area will be altered. The railroad will introduce a long, narrow band of different colors throughout the length of the line. The major contrast and impact will result from using the red colored clinker for a subballast. The rail line and unvegetated areas will also add different colors to the natural color scheme. The revegetated areas will add to the contrast of colors by the differing color of introduced vegetation with that of the surrounding native vegetation -- a mixture of various grasses, shrubs and brush.

Impact on existing landform will be caused by the cuts and fills. Some of the cuts will range in depth to 102 feet. These will create a new shape of landform in contrast with the natural landform. An estimated 15 million cubic yards of soil will be moved by railroad construction, so numerous cuts and fills will be required. Since the railroad, and required structures (bridges, culverts) generally have a low profile, the railroad will not have a significant impact on the natural landscape.

Any vertical structures which may be required by the railroad, such as powerlines or buildings along the right-of-way, will cause an impact. An intrustive impact will result whenever a train passes a viewer travelling this route. This impact will be compounded as the daily train frequency increases as a result of expanding coal production.

The major impact on the aesthetic quality of the landscape will occur in the stretch between the Amax spur line and a point just north of Bill (approximately 30 miles) where the proposed route joins roads in the Hilight Oil Field. This part of the area has had few disruptions and disturbances from construction of roads, powerlines, etc. The landscape along this part of the line is still in a natural state.

The impact on aesthetics from that portion of the line lying adjacent to Highway 59 will not be as great. This area has already been disturbed and developed as a utility corridor. Some impact may occur as a train blocks a highway traveler's view of the surrounding area.

Wildlife and Fish

Construction of the proposed railroad will result in removal or disturbance of up to 3,900 acres of big sagebrush and grass. Approximately 1,650 acres will be permanently removed from all types of aquatic or terrestrial habitat production. The area permanently removed will be occupied by railbed, ballast, slopes, access roads, fire guards and housing associated with the increased population induced by construction and operation of the railroad.

Fires caused by train operations and maintenance projects such as brush burning will retard re-establishment of habitat along the right-of-way. Habitat will also be destroyed or damaged by periodic fires off the right-of-way. Range fires started accidentally by railroad or related operations may burn from 200 to 3,000 acres of sagebrush/grassland habitat per year.

Train-animal collisions will occur despite right-of-way fencing. This will cause an indeterminable annual loss of all species.

There will be numerous specific biological impacts. Where the railroad crosses a stream, riparian habitat will be destroyed, particularly during construction activities. Box Creek and Porcupine Creek have well developed riparian "marsh" vegetation which could be destroyed by construction activities. Segments of other major streams that are crossed by the line (Shawnee Creek, Dry Fork of the Cheyenne River, Antelope Creek and the Belle Fourche River) have lesser amounts of riparian habitat which could be destroyed. Secondary impacts on downstream fish populations may result from sedimentation resulting from disturbance of 15 million cubic feet of material during construction activities.

Threatened species

No significant impact on peregrine or prairie falcons is anticipated. No impact on prairie dog towns is anticipated. The town in closest proximity to the railroad route (1¼ miles) is located near the Little Thunder Reservoir, while the next closest town lies approximately five miles from the railroad and no others were observed along the proposed railroad route (VTN, BN/CNW, Environmental Impact Analysis, 1974). However, the destruction of any prairie dog colonies could affect black-footed ferrets either directly or by reducing their food supply.

Big game

Approximately 25 percent, or 975 acres, of the total disturbed area is crucial antelope winter range. The proposed route also passes through summer and year long use areas of which construction will disturb 2,925 acres. The total impact of the action will result in an estimated loss of 75 antelope and loss or serious impairment of 3,900 acres of antelope habitat.

An estimated three deer per section of habitat rates the proposed route as a low concentration area. Approximately 1,200 acres of deer habitat will be lost or significantly disturbed. An estimated 10 to 20 deer will be lost through habitat disturbance and other factors including fencing and collisions.

Construction of the railroad, accompanied by intensive human activity during construction and later with use and maintenance of the route, and increasing human populations will force most deer and antelope away. Other impacts such as accelerated poaching by transient labor will result in higher mortality of deer and antelope.

In all probability the right-of-way will be sheep-tight fenced. Extensive use of culverts, bridges, and "cattle passes" would be utilized. Approximately 220 culvert sites, 12 bridge sites, and several cattle passes would be installed along the route. Some of these structures, although physically capable of allowing deer and antelope passage, should not be anticipated to be particularly effective for this purpose due to behavioral characteristics of both species. If the railroad is fenced to be "sheep-tight," with the exception of the bridges it could become a 113-mile barrier to antelope movement and, to a lesser degree, deer movement. The 3,900 acres directly affected by the railroad will be seriously reduced in value as deer and antelope habitat.

Lands occupied by the railroad and any needed access roads will be totally lost as available big game habitat. Resultant "grasses-only" rehabilitation efforts will not satisfy basic habitat requirements of antelope or deer.

Other mammals

Predators

Human activity will cause predators to avoid the railroad during construction. Coyotes, red foxes, and bobcats will experience few immediate impacts due to their wide ranging nature. Species such as raccoons, striped skunks, and badgers are less mobile and flexible. Direct habitat removal will initiate a decline in these species. Operation of the railroad will have a minor overall impact on predators.

Rodents and rabbits

Removal or damage of grasses and shrubs will result in initial adverse impact and elimination of the disturbed area as suitable habitat for rodents and rabbits. Stress tolerances are high in these species and population recovery will be relatively rapid following successful rehabilitation efforts. Long term effects from a total population standpoint, will be limited to actual habitat removal (about 1,650 acres).

Upland game birds

Destruction of vegetation during construction will remove disturbed areas from game bird habitat. An estimated 3,900 acres of sage grouse habitat will be affected. Sagebrush removal will eliminate the value of land for sage grouse for the life of the railroad. Periodic applications of herbicide for weed control, which also removes sagebrush, will eliminate sage grouse habitat indefinitely. This amount of habitat provides seasonal or year long habitat for at least 35 to 50 birds. Anticipated losses could be considerably in excess of the above figure due to the almost certain destruction or damage of mating and nesting areas along the proposed route.

Sharptail grouse may occur along the proposed route in the northern portions. Insufficient information is available to analyze impacts on this species. Where populations may exist an estimated density of less than five birds per section of habitat applies.

Actual operation of the railroad will result in an undetermined mortality of all game birds through "collisions."

Other birds

Disturbance during construction and operation will disrupt use by raptors and other species. Eventual "re-discovery" of lands adjacent to the railroad will depend on individual species tolerance of foreign intrusions as well as the availability of forage or prey species.

Fish

Drastic modification of drainages or loss of riparian vegetation will upset an already fragile situation. Crossings would be constructed over streams including Caballo Creek, Belle Fourche River, Coal Creek, Little Thunder Creek, Mike's Draw, Box Creek, Lightning Creek, Shawnee Creek and possibly Walker Creek. Many of these contain marginal to fair aquatic habitat for various species of fish. Extensive use of culverts will be required near Antelope and Shawnee Creeks. Changes resulting in habitat deterioration such as siltation and sedimentation, oil and grease spillage, would most probably occur during initial construction.

The line as staked (March 1974) passes through one stock pond reservoir, destroying any aquatic habitat associated with it.

Application of herbicides near aquatic habitat would result in damage to surface water quality and riparian habitat.

Reptiles and amphibians

Available information is not sufficient to allow a specific analysis of impacts. Refer to Part I of this statement.

Invertebrates

Permanent loss of vegetation will result in direct loss of invertebrates. The degree of reclamation success and habitat suitability will govern population reinvasions by invertebrates.

Recreation

Construction of the proposed rail link between Douglas and Gillette is not expected to have a significant impact on recreational use of the area. Only 20 percent of the proposed line crosses federally administered surface land. The remainder of the line would cross private and/or state land. A majority of the area is a popular antelope hunting area. The proposed route does cross approximately 21 miles of the Thunder Basin National Grasslands. The total recreational use (1973) occurring in the grasslands was approximately 31,600 visitor days.

The major impact of the railroad on recreation use is expected to occur from the point where it joins the present Amax spur line south of Gillette to the Hilight Oil Field (25 miles) and an additional 40 miles, of varying intervals, along the balance of the proposed route. These areas are basically uninhabited and served only by a few county roads and truck trails. Construction of the railroad in this area could cause an impact on recreational access. Construction will make east-west access more difficult for the recreational user, especially the hunter. Grade crossings will be limited to the major access routes with many of the minor truck trails cut off. The railroad right-of-way will tend to create a long, linear, north-south barrier through these undeveloped areas.

The acreage and vegetation that will be removed or disturbed by the railroad right-of-way (3,900 acres) will probably not significantly affect recreation use except for the acreage removed from productivity (1,650 acres) or disturbed aquatic habitat.

The noise from frequent trains, as many as 46 a day by 1990, will displace wildlife. Reductions of wildlife populations, noise of rail traffic, and the visible intrusion of the railroad will have a corresponding impact on hunters and hunting success ratios.

Train frequency through this area could also impact the recreational user in other ways. Over-the-grade crossings, expected rail traffic, hauling the estimated yearly production of 93 million tons of coal by 1990 will cause more inconvenience for those trying to cross the right-of-way. Also, an increased probability of train-recreation vehicle accidents can be expected. The noise of train operations will interrupt the peaceful solitude the recreationist now enjoys here.

Substitution of one type of sightseeing use for a different type along Highway 59 will probably occur. However, it is not possible to say if this would be an adverse impact or not. To some, it may be (those who prefer to see antelope) while to others (those who enjoy watching unit train operations) it may not be an adverse impact.

Construction, and especially operation, of the railroad will cause an increase in population and, therefore, increase recreation use levels. Population increases will more than likely remove additional land from productivity for wildlife and further impact the recreational use of hunting.

Total population increase as a direct result of railroad construction and operation is projected to be 2,820 by 1990, removing 141 acres for residential and service oriented needs. This would be a 15 percent increase over current population levels in Campbell and Converse Counties. The recreation use generated from this population increase could overload and deteriorate existing recreation facilities in or near Douglas and Gillette.

The overall impact of railroad construction on recreation is the restriction on recreationist access and the safety hazard. The barrier cuts off traditional access roads, hindering freedom of cross country travel or, in cases of emergency, impedes cross country travel.

Agriculture

Construction of the proposed railroad will have varying impacts on agricultural land use. Impacts will result from construction activities within and outside of the proposed 2,400-acre right-of-way. An additional 1,500 acres outside the right-of-way will be disturbed or required for access roads, borrow areas, campsites, staging areas. Secondary impacts will also occur and will be related to the increase in population brought in by construction and operation of the rail line.

Livestock grazing

Based on an average of 6.5 acres per animal unit month (AUM) and the assumption that the entire right-of-way will be fenced, there will be a permanent loss of 369 AUMs associated with the removal of 2,400 acres of land from grazing use. This total AUM loss involves 75 AUMs of grazing use on 160 acres of hay field after harvesting of the hay crop has occurred, and 160 AUMs produced on 345 acres of seeded pastureland. The total permanent loss of AUMs is approximately 0.04 percent of that produced in the study area.

Disturbance of the 1,500 acres outside the right-of-way will affect an estimated 231 AUMs. An estimated 550 acres of this will be a permanent loss (85 AUMs) due to access road construction, population increase and fire guards. The remainder will be a temporary loss for the two-year construction period. Use of an additional 9,530 acres, which furnishes 1,466 AUMs of forage, will be impaired. The rail line will sever this acreage from its water source. Without adequate livestock water this land may become unusable from a livestock grazing standpoint. In this case these AUMs may be considered a permanent loss.

The rail line as presently staked (March 1974) will destroy four water wells and one reservoir used for watering livestock. Loss of water sources will impair utilization of the adjoining rangeland and create an inconvenience and expense for the rancher who has to supply additional water sources for cattle. Some drainage patterns may be interrupted and rechanneled by the railroad grade. The rechanneling could increase water velocity and erosion. This could result in a loss of productive land surface and would increase sedimentation and siltation which would affect downstream stock water storage facilities. Diversion of water to different channels would also decrease infiltration which reduces the irrigation effect on forage adjacent to the channel and lowers grazing capacity in these areas.

Although less than ten percent of the acreage in the vicinity of the railroad is irrigated, this acreage plays an important role in livestock production by furnishing crucial winter supplemental feed. Some irrigation systems could be severed or disrupted by the railroad grade, including structures conveying water as well as flow of water in the severed fields. If this occurs, the productive capacity of the fields will be reduced as they become nonirrigated rangeland. An unknown number of these fields have been seeded to introduced species that cannot survive without irrigation. All production in these fields would be lost until native species become re-established and even then production would be lowered.

Impacts on ranching operations will also occur from severance of pastures by the railroad. It is difficult to assess this impact with the data presently available. Severance is complex and must be viewed in two forms; severance of units of economically manageable size, and those severed that are too small to be economically manageable. The proposed route will divide 65 pastures. When the right-of-way parallels the boundary of a pasture or the roads and highways along the route, the right-of-way boundary may not always be synonymous with the pasture fence or road. This will sever additional land, approximately 29 pastures, that may not be economically manageable. In five instances, headquarter facilities will be severed from a part of the ranch property. This will cause inconvenience to the ranchers in reaching their pastures and could increase their operating costs, which in the long term could make ranch operation uneconomical.

The railroad grade will change the freedom of and pattern of access in the area. The loss of free access could have a major effect on livestock grazing operations. Since access points will be limited, more travel on the part of the rancher will be required. Cattle will have further distances to travel to reach certain pastures. This could effect the weight gain of the cattle, as well as cause overgrazing in certain areas which would tend over time to reduce grazing capacity on the area adjacent to the railroad. The operation of the rail line will cause a certain amount of cattle death from train-cattle collisions, despite the fact that in all probability the right-of-way will be fenced to prevent this type of mortality.

Livestock drift with a storm during extreme blizzard conditions. Historically heavy livestock losses have occurred due to traps created by fences, deep-cut draws and other obstacles. The fenced railroad right-of-way would be an additional obstacle. Some additional livestock losses could be expected during these conditions.

As observed in other areas, railroad rights-of-way are susceptible to the establishment of invader species of plants through natural revegetation. The disturbed soil becomes more susceptible to this type of species invasion. The possibility also exists for seeds of invader species to be brought in by trains. The forage value of these species range from undesirable to poisonous. In any case they often spread, crowding out more desirable forage plants. If poisonous species become established and spread off the right-of-way, livestock death could occur.

Fills (maximum height of 85 feet) and cuts (maximum depth of 102 feet) will alter wind patterns in the immediate area. The area generally experiences drifting snow during winter months. New cuts and fills will have a tendency to cause snowdrifts downwind from the railroad grade. The drifts will occur in areas that have not previously experienced drifting and could alter the vegetation. Drifting could also cause fences to collapse, allowing livestock to drift between pastures and onto the rail line where they would be subject to mortality from trains.

Operation of trains occasionally starts fires along the right-of-way. Based on past fire statistics for this area, trains may cause 10 to 50 fires, burning from 200 to 3,000 acres per year. As frequency of trains increases with coal production, the fire frequency could also increase. Fires will cause a loss of livestock forage. Loss would be temporary for a period of one to two years until the area become revegetated.

Noise from construction activities and especially train operations after completion of construction could disturb cows and ewes during calving and lambing periods. Each train could produce noise in the 88- to 98-decibel range. With train frequency averaging 26 per day in 1980 and 46 per day in 1990, the noise level could be significant. The effect on cattle is not as pronounced, but ewes may leave their lambs if they are disturbed during lambing.

Herbicides are used to inhibit or prevent plant growth along the rail line. On occasions soil sterilants are used. If the herbicides drift off of the right-of-way, livestock forage could be reduced, with a resulting loss in AUMs. Long term use of soil sterilants and accumulation in the soil could in time inhibit all plant growth for some distance outside the right-of-way.

Farming

The proposed right-of-way will permanently remove from production 168 acres of cropland. Based on a ten-year average production, this will be a loss of 227 tons of annual hay production. Construction activities outside the right-of-way will cause a temporary (1 year) loss of 81 tons of hay production on 60 acres. The permanent loss is approximately 0.3 of one percent of the total production for the study area.

Hayland severed by division may be in parcels too small for economical management. This may occur in six fields. In two specific instances in the Shawnee Creek drainage, the homestead has been severed from the cropland by the right-of-way. Loss of access to homesteads may impede marketing of farm products and delivery of operation supplies. In all probability an inconvenience to the rancher will occur.

Transportation Networks

The proposed rail line will cross as many as 50 unimproved and graded dirt roads and many lesser roads which are all generally lightly used for access to ranches and oilfields. Most of the private, county and state roads which are intersected will be routed across the rails via a simple grade crossing. Approximately 18 grade crossings and five grade separations (bridges or underpasses) of county and state roads have been identified. Highway 59 will have a railroad undercrossing four miles north of Bill and 17 miles south of Bill. Highway 20 will have a railroad overcrossing. The grade crossing at Hoadley road will require a railroad undercrossing or a three-mile road relocation; at Matheson Road only minor road relocation will be required and the railroad undercrossing of county road 3-38 (sec. 35, T40N, R71W) may require road relocation to the south. Table 2 lists the possible crossings and type.

During construction activities traffic will have to be rerouted and will be subject to delays and reduced speed. This will cause an inconvenience for the traveler as well as ranchers and other users of the area. The impact at any one point is not expected to be of long duration. This type of inconvenience impact will not last beyond the two year construction period.

The possibility of increased snow drifting along Highway 59 on the downwind side of railroad fills looms as a strong possibility particularly when the railroad is located on the west side of the highway and most subject to influence by the prevailing westerly winds. The result would be hazardous driving and increased maintenance requirements by the State Highway Department. Furthermore, if roads at the grade crossings have pronounced slope depressions in them as they ascend or descend the grade they will have a tendency

Table 2

County and State Highway Crossings Along the BN and C&NW Route

Road Description	Type of Crossing	Comments
Bishop Road	Grade crossing	
T-7 Road	Possible grade separation	
Hoadley Road	Railroad undercrossing or	3 mile road relocation
Lawver Road	Railroad undercrossing	1 mile road relocation
Hilight Road	Grade crossing	
Mills Road	Grade crossing	
Keeline Road	Grade crossing	
Sec. 14-23, T44N, R72W	Grade crossing	
Small road @ Station 2213+00	Grade crossing	
Gopher Booster Road	Grade crossing	
Antelope Road (Tekla)	Grade crossing	May require signals and road relocation
Edwards Road	Grade crossing	
Matheson Road	Grade crossing	Minor road relocation
Antelope Road	Grade crossing	
Forest Service Road (N. of Antelope Creek)	Grade crossing	
County Road 3-38, Sec. 35, T40N, R71W	railroad undercrossing	Possible road relocation to south
Highway 59 (4 miles N. of Bill)	Railroad undercrossing	
Tillard Road	Grade crossing	
Highway 59 (17 miles So. of Bill)	Railroad undercrossing	
Walker Creek Road	Grade crossing	
County Road, Sec. 2, T33N, R70W	Grade crossing	
County Road, Sec. 17-20, T33N, R69W	Grade crossing	
County road, Sec. 15, T32N, R69W	Grade crossing	
Highway 20	Railroad overcrossing	

Source: Adapted from Burlington Northern and Chicago and North Western Environmental Impact Analysis, 1974.

to fill with drifting snow and thus impede public access across them and possibly block someone from access to his property.

Some minor relocations of electric transmission lines, water and oil pipelines may be required. These relocations can be made without causing any significant impacts on the utilizer of these facilities.

The major impact on transportation systems will arise from train operations over the proposed rail line and existing rail lines. Based on projected amounts of coal to be exported from this area of 48 million tons in 1980, 68 million tons in 1985 and 93 million tons in 1990, as many as 24, 34, and 46 unit trains per day may be expected to make the trip over the proposed line. These include loaded and unloaded trains. A train of 110 cars and 5 diesel units would be approximately 6,165 feet long (1.2 miles). One train operating at 20 miles per hours would pass any given point in 3½ minutes. Therefore, any given stretch of track, i.e., road crossing, would be occupied per day approximately 84 minutes in 1980, 119 minutes in 1985 and 161 minutes in 1990. Although the roads to be crossed by road crossings are less traveled than the state highways, some restriction of freedom of movement across the tracks will occur. There is also the potential for an indeterminable number of train-auto accidents at grade crossings to occur due to increased train traffic. A major problem and impact could occur on the existing mainline at Glendo where the tracks cross U.S. Highway 26 and 87. With increased train traffic at this road crossing, the Wyoming State Highway Department has indicated that a potential traffic tie-up problem could occur. At the present time (April 1974) a signal and gate is located at this crossing.

Increased unit coal train traffic across the existing mainline could cause a rapid deterioration of the mainline. The present mainline was not constructed to standards that would allow useage as projected to export the coal to be mined. Burlington Northern is planning and programming the upgrading of all lines that will experience coal train traffic.

Socio-Economic Conditions

This section does not reiterate any of the socio-economic impacts identified in Part I, but will describe the changes and impacts on employment, income, population and capital investment in Campbell and Converse Counties that are directly related to the railroad.

Projected employment for the railroad is based on the number of employees required per million tons of coal shipped. Railroad employment is estimated to be between 2.5 and 5.0 men per million tons of coal shipped, the variance being dependent on the shipping distance. The projected railroad employment for Campbell and Converse Counties is shown on Tables 4 and 5 in Appendix D and is based on the employment projection model used by the Northern Great Plains Resource Program (NGPRP)*. Combined railroad employment in the two counties is expected to increase from 17 in 1970 to 258 by 1980, 70 percent of which will be employed in Converse County. Projected employment is summarized in Table 3.

Table 3

Railroad Employment

	Actual	Projected			
	1970	1975	1980	1985	1990
Campbell County	11	11	77	91	91
Converse County	6	22	181	256	304
Total	17	33	258	347	395

An additional 300 temporary positions will be created during construction of the railroad, 85 percent of which the railroad estimates will be filled from local trade union personnel. Source of this labor will likely

*Developed by University of Wyoming, Water Resources Research Institute.

be by a combination of employing the presently unemployed, attraction from other employment sectors and importation of labor from outside the area. A beneficial impact of the new railroad employment will be provision of employment opportunities for the presently unemployed and allowing people to possibly move from lower paying jobs to higher ones. Resultant labor deficiencies in other employment sectors should labor demands exceed supply would be an adverse impact.

It is estimated that the average annual income to be paid to the 258 railroad employees in 1980 will be approximately $15,000.* This is nearly $3.9 million annually. The net impact of this income will be to raise per capita, mean and medium incomes in the two counties to a level above that of 1970 and higher than would have been expected without the new railroad employment. This annual income will be worth more to the economy than the salaried amounts because it will generate demands for additional goods and services both within and outside the two counties. This is generally know as the multiplier effect. It is not unrealistic for the income multiplier to be from 3 to 5 times the amount of disposable income originally created. The $3.9 million, less state and federal taxes, yields approximately $3.1 million in annual disposable income which could generate a total of $9.3 to $15.5 million disposable income to a broad market area.

The number of additional jobs required in the services sector of the economy to accommodate the increase in basic employment (railroad) can be estimated. Based on the ratios of basic employment to total employment used by

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*This derives from an estimated 1974 salary of $11,200 increased five percent per annum up to 1980.

the Water Resources Research Institute, University of Wyoming, for the Northern Great Plains Resource Program, each addition to basic employment in Campbell and Converse Counties will generate approximately two additional jobs in secondary employment sectors. This includes employment in new construction for housing, business and consumer services, education and government, the general impact of which is to create an increasing wider variety of job opportunities for the local populace. Table 4 summarizes this increase.

Table 4

Total Employment Increase Attributable to the Railroad*

	1975	1980	1985	1990
Campbell County				
Railroad Employment**	0	66	80	80
Secondary (Services) Employment	0	134	162	162
Converse County				
Railroad Employment**	16	175	250	298
Secondary (Services) Employment	32	355	506	605

*Based on model developed for NGPRP by Water Resources Research Institute, University of Wyoming.
**Base year 1970 existing railroad employment is not included.

Estimates for total population increase as a result of new railroad employment and induced secondary employment can be made and are summarized in Table 5.

Table 5

Total Employment and Associated Population Increase*

	1975	1980	1985	1990
Campbell County				
Total Employment**	0	200	242	242
Population (Rounded)	0	470	550	550
Converse County				
Total Employment**	48	530	756	903
Population (Rounded)	120	1,290	1,800	2,150

*Based on model developed for NGPRP by Water Resources Research Institute, University of Wyoming.

**Summation of new railroad employment and induced secondary employment.

Burlington Northern estimates its capital investment for the railroad will be nearly $35 million. The new rail mileage will add to the ad valorem tax base for Campbell and Converse County. Based on a report prepared for Burlington Northern by the University of Denver Research Institute, the additional tax base for Campbell County is estimated to be $50,000, and $98,000 for Converse County. Shipment of coal is intended for markets throughout the midwest with future potential markets in the southeast United States, Colorado and Texas. The shipment of coal to these markets will produce economic effects in those localities but they cannot be assessed or traced out at this time.

CHAPTER IV

MITIGATING MEASURES

Air Quality

Proper compliance with all applicable state and federal air quality laws, regulations and standards will be stipulated in the right-of-way, easements and other granted permits. Inclusion and enforcement of these stipulations will minimize adverse impacts to air quality. (See Chapter VI, Part I, Air Quality.)

Topography

Mitigating actions required to reduce topographic alterations and impacts due to railroad construction will require the prevention of unnecessary earthwork and repair of the altered land surfaces. Minimizing secondary impacts to soils, vegetation, water and scenic values are also dependent on mitigating topographic changes. The following stipulations are designed to mitigate impacts resulting from topographic alterations and may be incorporated in similar form into Interstate Commerce Commission and Forest Service permits and BLM right-of-way grants.

1. All operation shall be conducted so as not to change the character or cause pollution of streams, ponds, seeps, and marshes. Topographic alteration which may induce soil movements, water pollution and/or objectionable landforms shall be corrected to the satisfaction of the appropriate government agency.
2. Activities employing use of wheeled or tracked equipment shall be conducted in such a manner as to minimize surface damages. The

railroad company shall effect a minimum of topographic alterations consistent with practical construction operations. Drainage bottoms and high erosion hazard areas shall be avoided for use as borrow areas, waste disposal areas or material excavation sites. Approval of these sites shall be obtained from the appropriate government agency.

3. The railroad and their contractors shall avoid construction activities outside of the right-of-way boundaries during muddy or wet ground conditions.

4. Existing roads and trails shall be used whenever possible for access to construction and other sites. Construction of steep hillside roads shall be avoided. Ridge tops or level sites usually offer the best access routes. Road locations shall be approved by the appropriate government agency. In order to reduce additional access road development due to blockage of existing trails and roads, suitable crossings deemed necessary by the appropriate government agency shall be provided at locations on the rail line.

5. Drainages shall not be blocked by roadbeds or railroad embankments. Installation of drainage crossings, culverts, or bridges shall not cause siltation or accumulation of debris or materially alter the drainage course. Culverts shall not be installed in large drainages but shall be bridged as determined necessary by the appropriate government agency.

6. Permanent service roads shall be constructed and maintained in good condition for automotive vehicles. Adequate water drainage shall be provided to minimize erosion. Erosion of borrow pits of both

permanent service roads and railroad embankments shall be prevented by diverting water from the borrow pits at frequent intervals by culverts or cutouts. Erosion of road surfaces shall be prevented by installation of culverts, broad-based drainage dips, gravelling or as determined by the appropriate government agency.

7. Temporary access roads shall be rehabilitated upon abandonment. Spoil banks, windrowed soil, debris and fill material shall be replaced in the roadbed and graded to conform to original topography to the degree possible. Cut slopes should be reduced to a gentle grade consistent with the adjacent topography, waterbarred and left in a condition susceptible to revegetation by mechanical means.

8. The railroad company shall prevent the creation of shortcut trails and roads. Access needs shall be properly constructed for such purposes.

9. All cut slopes shall be constructed to as gentle a grade as is practical and consistent with construction requirements. Deep vertical cuts shall be avoided. Construction slopes on cuts of 40 feet or less shall be on a 3:1 slope. Those cuts greater than 40 feet shall not exceed a 2:1 slope. All construction areas shall be smoothed and graded to conform as near as practical to the adjacent terrain. Where deemed necessary by the appropriate government agency, slopes shall be protected by installation of waterbreaks, terraces or diversion ditches or protected from erosion. Construction sites or other areas within the construction zone that present problems such as erosion or bank sloughing will be corrected

by either contour furrowing, terracing, reduction of steep cut and fill slopes to an acceptable grade or corrected by other means.

10. All excavation sites such as clinker (scoria) pits, borrow areas and other such sites shall be closed by filling and grading to conform to and be compatible with the adjacent terrain. Final grading of backfills shall be performed to present a surface susceptible to revegetation. Water breaks and/or terracing will be required to prevent erosion of these sites.

11. Drainage alterations shall not change the character or cause unnatural erosion of water courses. Suitable rip-rap shall be used whenever drainage channels are altered and is to be placed at locations necessary to prevent bank sloughing, cutting or headcutting of the existing channels.

12. After cessation of use of any construction site, storage areas, or other ancillary sites required for construction purposes, that site or portion thereof no longer in use shall be restored to its original condition to the degree possible. Final grading and backfilling shall be performed so as to present a surface susceptible to revegetation and conform to the adjacent terrain. Erosion control on such sites shall be installed as determined by the appropriate government agency.

Soils

Impacts to soils can be minimized by including and enforcing protective stipulations in the right-of-way and other granted permits of the Federal Government (ICC, U.S. Forest Service, and U.S. Bureau of Land Management). The application of certain land treatment practices will minimize loss of topsoil and productivity; disruption of physical, chemical and biological properties; and soil loss by wind and water erosion and compaction. Mitigating measures will include stockpiling topsoil for later replacement on disturbed areas, cuts and fills. Mechanized equipment such as scrapers will be used to minimize soil mixing.

Ripping and tilling the soil surface prior to seeding will be required to minimize soil compaction effects. Restriction of unnecessary off-road vehicle use by equipment operators and employees will minimize soil compaction.

Soil erosion will be minimized by mulching, revegetation and development of erosion structures including waterbars, terraces, contour furrows, grassed waterways and interceptor ditches to divert running water away from unprotected disturbed areas. Wind erosion will be minimized by roughing up smooth, exposed soil areas with a disk or harrow.

Detailed soils inventories will be provided by Burlington Northern Inc. in accordance with standards designated by BLM and Forest Service to locate and identify each soil series situated within the right-of-way. Soil samples will be collected down to 60 inches for physical and chemical analysis. Chemical tests will include organic matter, pH, exchangeable sodium percentage, boron, sodium, chloride, calcium, selenium, nitrogen, phosphorus, potash, sulfur, base saturation, cation exchange capacity, and conductivity. Physical tests will include soil mechanical analysis and engineering properties. Soil mineralogy and moisture relationships will be determined. Additional soils information will be obtained after soil has been replaced and before seeding to determine profile, chemical, mechanical and mineralogy changes in the upper 60 inches. Results from current or past research studies on revegetation and reclamation of disturbed areas will be utilized.

Construction designs will include mechanical treatment practices such as contour furrows, terraces and mulches to retain moisture onsite to benefit revegetation and reduce soil loss. Design will include control measures such as diversion ditches, waterways and water spreaders to reduce sediment yield and runoff from compacted areas or concentration of runoff waters. Studies and investigations are necessary to identify productive downstream soil areas that are presently sustaining desirable vegetative communities from being deprived of soil moisture.

Suitable disposal areas that will not have detrimental effects upon the environment need to be selected and identified for solid and liquid wastes. Service haul roads; material sites for sand, gravel, and ballast; campsites; and equipment storage areas will be cleaned up, scarified, rehabilitated and revegetated. Contingency plans must include measures to cleanup accidental spillage of detrimental or toxic materials such as gasoline, oils and chemicals and restore damaged soil to a near natural condition.

Service and haul roads that are easily susceptible to producing dust and sediment will be surfaced or treated with a binder of water. Chemical binders and surfacing materials that meet state and federal approval must be used.

The edges or sides of all excavated material sites and borrow areas will be sloped to a minimum 3:1 slope to minimize sloughing and enable revegetation.

Water Resources

Proper compliance with state water laws and regulations will insure legal use and minimum consumption of water supplies along the railroad route.

Compliance with all applicable state and federal water quality standards and regulations will be stipulated in the right-of-way, easements and other granted permits (See Part I, Chapter VI). Inclusion and enforcement of stipulations will minimize adverse impacts to the quality of both ground and surface waters.

Through stipulations in granted easements and permits, specific requirements for protecting water quality will be effected. These include handling, storage and disposal of all wastes and the application of herbicides in a manner to keep them out of all waters; timely revegetation of all disturbed areas (excavation and embankment slopes, around bridge, underpass and culvert abutments, etc.); rip-rapping around bridge abutments; and restriction of equipment operations permitted in stream bottoms and in and around open waters.

Vegetation

Loss of vegetation will be minimized by including and enforcing protective stipulations in the right-of-way easements and other granted permits of the Federal Government (ICC, U.S. Forest Service, and U.S. Bureau of Land Management).

Rehabilitation of all disturbed areas (required by stipulation) on and adjacent to the right-of-way that are not covered by permanent facilities will provide replacement vegetation on 1,278 acres of right-of-way and up to 950 acres adjacent to the right-of-way. Revegetation plans will be subject to approval by the administering agency or surface owner.

On the National Grasslands, a revegetation plan including specific measures will be submitted in the easement application for approval by the Forest Service.

Control of off-road vehicles and other equipment during construction of the railroad will reduce damage to vegetation along the route.

Development and operation of a stipulated fire protection and fire rehabilitation program by the railroad companies to lower the incidence of vegetation damage from range fires will be required. Stipulated requirements for spark arrestors on all appropriate equipment operated on and adjacent to the right-of-way will decrease the chance of accidental range fires.

Archeological Preservation

Legislative authorities and obligations which guide issuance of a federal approval to develop the Powder River Coal Resources are the Antiquities Act of 1906, Wyoming Antiquities Act of 1957, Wyoming Environmental Quality Act of 1973, Reservoir Salvage Act of 1960, National Historic Preservation Act of 1966, National Environmental Protection Act of 1969, and Executive Order 11593, May 13, 1971. A brief description of the laws concerned with Archeological Preservation may be found in regional mitigation, Chapter VI, Part I.

Prior to granting the permit for construction of the railroad, which might effect cultural resources on federal or nonfederal lands, a program of inventory, evaluation and nomination of sites, districts, buildings and objects will be developed in cooperation with the Wyoming State Historic Preservation Officer.

No rights-of-way will be approved until the company has coordinated its archeological surveys with the Wyoming State Historic Preservation Officer. The company's survey report will be submitted to the State Historic Preservation Officer with a copy to agencies approving plans and permits. The report will be certified by the State Preservation Officer and forwarded to the approving agencies, with a statement that surveys have been conducted by competent, professional archeologists and a recommendation for required surveys before plans and permits are approved. These surveys may be necessary if significant surface evidence supports additional work.

It is recommended that the railroad companies share in the cost of establishing a full-time resident basin paleo-archeologist under the supervision of the State Historic Preservation Officer. The basin archeologist will aid in reducing lead time and development delays by performing advance surveys for support facilities, educating construction employees, sampling soils, responding to company discoveries and conducting salvage work. Pending the establishment of a basin paleo-archeologist, the railroad companies will be required to satisfy the requirements for a professional archeologist and surveys as described by the Wyoming State Historic Preservation Officer and if so stipulated by him, contracting the archeologist for examinations during construction.

Aesthetics

The right-of-way grant will contain stipulations guided by Departments of Interior and Agriculture visual resource standards contained in agency resource management guidelines.

Probably the most critical factor in reducing the impact of the lineal project is its location in relation to naturally occurring lines in the landscape. Therefore, the following stipulations will be made a condition of the approved permit.

Native grasses and shrubs will be seeded to hasten the return to natural unbroken patterns in the vegetation. Tilling and planting will be irregularly seeded into adjoining vegetation to break the unnatural lines of construction.

Nonreflective materials will be used on transmission lines, towers, and buildings located on federal lands and the right-of-way. Soil disturbance of the right-of-way and material sites will be the minimum necessary to meet the needs of construction. The tops of cut slopes and bottoms of fill slopes will be rounded and seeded to blend with adjoining natural slopes.

Wildlife and Fish

Reestablishment of a perennial grassland vegetative cover on disturbed areas occuring on federally managed surface will be required and would partially mitigate habitat losses for some species.

Right-of-way barriers (fencing) to wildlife movement must be minimized to the extent possible by constructing crossings or other structures which would encourage some degree of game movement. This is particularly true should right-of-way fencing be constructed to be "sheep-tight."

Engineering design of drainage facilities, such as culverts and bridge openings, must be sufficient to minimize modifications of existing drainage patterns and maintain or improve downstream water quality. Rapid revegetation of exposed cut and fill slopes will be accomplished to assist in reducing and checking soil erosion.

Proper control and disposal of maintenance wastes and protection of riparian vegetation and surface water from herbicides will be required to minimize surface water quality changes.

Recreation

In areas on National Grasslands where public access is minimal, existing truck trails with legal access will have crossings to allow recreationists and hunters a means of crossing the railroad.

Livestock grazing

All appropriate specifications for construction and rehabilitation will meet those required by local, state or federal authority. The local, state or federal official responsible for issuing and administering said permits, rights-of-way, etc., will be referred to as the authorized officer.

Mitigating measures should be undertaken during the construction of the proposed railroad since most measures taken will consist of additions or modifications to the railroad grade or attendant facilities.

Before fences between pastures are removed to facilitate clearing and construction activities, temporary fences will be erected parallel to both sides of the right-of-way, closing the pasture on each side of the right-of-way so that livestock cannot drift between pastures.

All ditches and canals will be bridged or culverted with pipes capable of transmitting total design volume in subgrade embankment areas. All ditch and canal flows in excavation areas will be transmitted via aqua-duct or flume structures across the excavations.

All ephemeral and intermittent streams will be culverted to allow passage of normal streamflow. All diverted drainages will have drop structures installed along diversion sections to prevent headcutting.

All vegetative material and litter resulting from construction clearing operations will be disposed of in a manner to be specified by the authorized officer to guard against occurrence of wildfire or pollution of water sources. The method used shall comply with EPA regulations.

All waste materials, other than those resulting from the clearing operations, will be stored in containers which will prevent accidental spillage or disposal and disposed of at a site and by a method to be determined by the authorized officer.

Water occurring on lands crossed will not be used for construction of railroad grade or attendant facilities or service of attendant facilities except in conformity with state water law and written authorization from the authorized officer or the land owner. Authorization to drill for water may be authorized by special permit when pertinent regulations of the State of Wyoming have been complied with. Provisions of special permits will require that completed wells capable of producing five gallons per minute or more will be permanently cased and appropriate measures taken to assure surface contamination cannot enter water-bearing strata. After construction use of any completed wells is terminated, the wells will be capped according to specifications. Unsuccessful well drilling attempts will be plugged according to specifications furnished by the authorized officer. Specifications used will equal or exceed the requirements of the State of Wyoming.

Any attendant facilities (corrals, loading chutes, etc.) that will be destroyed as a result of railroad construction activities will be replaced or the landowner reimbursed for the value thereof in a manner to be agreed upon before any permits, rights-of-way, etc., will be issued. The authorized officer will decide disputes commensurate with his authorities and normal appeals procedures.

The completed railroad will be fenced on the right-of-way boundaries according to specification furnished by the authorized officer. These specifications may equal or exceed the State of Wyoming fencing requirements.

Upon completion of all construction, the areas denuded by construction activities will be protected and revegetated in a manner and according to specifications furnished by the authorized officer.

The effect of blowing soil can be mitigated by watering denuded areas during all stages of construction. As a final step the denuded areas should be watered and disked to assure adequate penetration of water and given a final water sprinkling. This will tend to bind the soil into larger particles less susceptible to wind movement. Revegetation will slow soil movement.

Herbicides can be used to treat invader species that are poisonous to livestock or that may be classed as noxious weeds. Compliance with recommended use rates for chemicals recommended by EPA will mitigate possible harmful effects of certain herbicides.

Annual maintenance will be performed on the right-of-way fence to lessen the frequency of mortality to livestock drifting onto the rail line. This maintenance should commence as soon as practical each spring.

The construction permit should specify the above actions are taken with concurrences of the landowners.

Transportation Networks

Mitigative action will be taken to avoid locating road crossings of the railroad that may induce train-auto accidents due to poor visibility. All grade crossings will be located to provide adequate stopping distances for the speeds of travel on the railroad and highway. Road depressions at grade crossings should be avoided in favor of longer and gradual inclines and declines to avoid snow build up at road depressions. The existing railroad line will be upgraded to a standard comparable to that of construction on the new line to limit train accident probability.

Other

Statutory authority for imposing conditions or stipulations to mitigate potential adverse environmental impacts associated with the proposed railroad construction is contained in Section 1 (20) of the Interstate Commerce Act (49 Stat. 543; 49 U.S.C. 1 (20)). This section provides that the Commission shall have the power to attach to the issuance of a certificate authorizing the construction of a line of railroad such terms and conditions as in its judgment the public convenience and necessity may require. In addition, support for the imposition of environmentally related conditions may also be found under provisions of the National Environmental Policy Act of 1969 which has been held by various courts to make environmental protection a part of the mandate of every federal agency.

Unlike the other federal agencies participating in the preparation of this environmental impact statement, the mitigating authority of the Interstate Commerce Commission extends over the entire route of the proposed rail line. It is not restricted to those portions of the right-of-way with federal ownership of the surface estate, but extends to private and state land ownership as well. Utilization of the Section 1 (20) authority, therefore, would enable conditions and environmental control measures to be applied on a consistent basis over all portions of any authorized new construction.

While the Commission has authority to impose conditions, it is doubtful whether the Interstate Commerce Act grants the Commission any enforcement power or even the power to determine whether such provisions as may be attached to a certificate have in fact been violated. Instead, it provides that any construction, operation or abandonment contrary to the provisions of the Act may be enjoined by any court of competent jurisdiction at the suit of the United States, the Commission, any Commission or regulatory body of a state or states affected, or any other party in interest. Thus, an involved land-management agency, landowners adjacent to a proposed rail line, or conservation groups which can demonstrate the requisite standing may sue to enjoin a railroad's noncompliance with imposed environmental conditions.

CHAPTER V

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Air Quality

Impacts on air quality resulting from construction activities cannot be avoided. Air quality will be temporarily affected during the two-year construction period by dust from haul roads, access roads, fill areas, cut areas, borrow areas, and clinker pits (3,700 acres) during windy periods. Emissions resulting from construction activities will result in localized lowering of air quality.

Long-term unavoidable impacts will result from loading and hauling of up to 23 loaded coal trains per day by 1990. Frequent accidental fires, 10 to 50 per year, along the right-of-way will cause temporary air pollution. Despite the use of all available maintenance to reduce emissions on diesel locomotives, a certain level of emission will occur. Based on the 1990 coal exportation level (93 million tons), the amount of unavoidable diesel emission per year is: 513 tons of particulates, 1,170 tons of sulfur dioxide, 7,597 tons of nitrogen oxides, 2,669 tons of carbon monoxide, and 1,930 tons of hydrocarbons.

The projected train emissions take place in the Casper and adjacent Wyoming Intrastate Air Quality Control Regions. Table 1 compares projected unavoidable train emissions with the 1970 quantities for the two combined air quality control regions.

Table 1

Cumulative Unavoidable Train Emissions Versus 1970 Total Emissions
Casper and Adjacent Wyoming Intrastate Air Quality Regions
(Tons/Year)

Type	1970 Base	1980		1985		1990	
		Increase*	Percent Increase	Increase*	Percent Increase	Increase*	Percent Increase
Particulates	120,649	120,915	0.2%	121,033	0.3%	121,162	0.4%
Sulfur Dioxide	63,389	63,995	1.0%	64,264	1.4%	64,559	1.8%
Nitrogen Oxides	93,264	97,201	4.2%	98,943	6.1%	100,861	8.1%
Carbon Monoxide	323,614	324,997	0.4%	325,609	0.6%	326,283	0.8%
Hydrocarbons	67,362	68,362	1.5%	68,805	2.1%	69,292	2.9%

*Base plus train emissions.

Topography

Permanent alterations of topography associated with construction of the railroad bed embankments and moving of 15,000,000 cubic yards of materials will be unavoidable. Other topographic impacts will occur from the excavation and removal of 1,050,000 cubic yards of clinker, gravel, and crushed limestone from pits and quarries to provide ballast materials for the railroad. Extraction of an unknown amount of fill materials from borrow areas, construction and realignment of access roads, roadbed crossings and alteration of drainage systems will occur.

Removal of prominent points of land and creation of steep slopes where none existed before adversely changes the topographic shape. Creation of elevated embankments in low areas could cause changes in drainage patterns and create unavoidable impacts on them. Some alteration of stream channels for construction of bridges and placement of culverts will occur. These changes cannot be avoided and would be adverse to the extent that the drainage pattern is changed to the point where increased stream erosion occurs.

Soils

The major significant unavoidable adverse impact will be the loss of soil productivity on 1,100 acres of the right-of-way which will be covered by the railroad roadbed, ballast slopes, and associated structures and facilities.

Topsoil or upper soil layers containing plant nutrients and micro-organisms will be destroyed or disturbed on the entire 2,400 acres within the proposed right-of-way. This disruption will result in increased soil erosion, sediment yield, loss of soil moisture, and decrease in moisture infiltration and percolation during the anticipated two-year construction period.

Some increase in erosion and sedimentation during the construction period is unavoidable, especially during high wind periods and intensive rain storm occurrences. Alteration of some drainage channels during construction and resulting impact on depletion of soil moisture and increased sedimentation will be unavoidable during the construction period. Some permanent alterations will probably be made, resulting in a long-term impact on sedimentation and lost soil moisture.

Soil compaction, topsoil disturbance, and other off-site construction activities cannot be avoided. This will cover approximately 1,500 acres outside of the right-of-way. If the suggested mitigation measures are followed, this impact should be limited to just the construction period of two years. However, 550 acres will be lost permanently to structures, access roads, and clinker pits in addition to the 1,100 acres lost within the right-of-way.

Mineral Resources

Temporary denial of 161 million tons of strippable coal located under the proposed rail line cannot be avoided. Although not a physical loss, this deferral might be an additional economic loss as it may be more expensive to mine the coal at a later time than if it was mined in conjunction with the surrounding mine operations.

Water Resources

The short-term consumptive use of 185 to 1,075 acre-feet of water during construction of the railroad over a two-year period will be unavoidable.

Some oils, chemicals, sanitary wastes, and herbicides will enter ground and surface waters even though adequate stipulations are included in granted easements and permits.

Construction of embankments and drainage structures at stream crossings will temporarily cause increased turbidity when perennial or seasonal flows are present. Some pollution of surface waters will also occur from accidental spills of coal, toxic oils, chemicals, and similar cargo into streams and drainages.

Vegetation

The permanent loss of vegetation on 1,100 acres which will be occupied by right-of-way facilities (main rail line, sidings, ballast) will be unavoidable for the life of the project. The acreage permanently lost off the right-of-way, a total of 550 acres by 1990, will be unavoidable. Included in this acreage are 141 acres of vegetation lost to community expansion due to population increase.

The remaining 1,300 acres in the right-of-way and 950 acres adjacent to the right-of-way which will be disturbed will be revegetated; however, the short-term loss of this vegetation for a period of two to four years cannot be avoided. Even though revegetated, a return to present native composition will not occur for a period of from 20 to 50 years. Some deep cuts and fills may never be successfully revegetated, adding to the permanent vegetative loss.

Damage to vegetation from use of herbicides in maintenance operations, accidental fires (10 to 50 fires burning 200 to 300 acres each year), and off-site vehicle travel cannot be avoided.

Diversion of small drainages through major adjacent structures will cause some unavoidable loss of vegetation downstream because of a reduction in soil moisture normally provided by flood irrigation.

Archeological and Paleontological Values

If sites and values exist in the area of railroad construction, they will be destroyed. Increased population and recreational use and their impact on these values cannot be avoided. Even if sites are found during construction activities and examined and excavated, they will be eliminated from any further study in the future. The information that could have been provided by these potential sites in the future through the use of more refined examination techniques will be unavoidably lost.

Aesthetics

There will be considerable interruption in the landform in many areas, both in the excavation and embankment for the railroad bed and in the borrow and waste areas, which cannot be avoided. There will be an immediate short-term adverse impact, at least on vegetative texture, in all areas where soil is disturbed. This contrast will be reduced over time; however, it will take 20 to 50 years to return to the present composition. Some of the deeper excavations along the route will be very difficult, if not impossible, to entirely revegetate and will remain a contrast in both color and texture.

Although there are a number of existing intrusions along the proposed route, the railroad will provide one additional intrusion to the natural landscape. Where the railroad is in view of Highway 59, the adverse effect on many people is unavoidable. Furthermore, during construction of the railroad, it will be impossible to avoid visual intrusions created by construction camps, staging areas, storage areas, and additional facilities needed to support construction crews. Some people will find these unavoidable aesthetic impacts displeasing and objectionable.

Wildlife and Fish

The permanent loss of 1,650 acres of big sagebrush and grass habitat will be adverse and unavoidable. This acreage will be lost to permanent facilities such as housing, track, clinker pits, access roads, etc.

Destruction of additional habitat, mostly sagebrush and grass type, from an estimated 10 to 50 fires and 200 to 3,000 acres per year burned cannot be avoided. Riparian habitat will be destroyed during construction of the railroad, especially at Box Creek and Porcupine Creek.

Approximately 25 percent or 975 acres of crucial antelope winter range will be disturbed. The total unavoidable, adverse impact will be an estimated loss of 75 antelope from the base population and loss or serious impairment of 3,900 acres of antelope habitat.

Twelve hundred acres of deer habitat will be lost or significantly disturbed. An estimated 10 to 20 deer per year will be lost from this area due to habitat disturbance, fences, and collisions with trains.

The noise associated with train operations (up to 46 per day by 1990) will force animals away from the vicinity of the right-of-way. This will cause impacts from overuse on additional, indeterminable amounts of habitat.

Freedom of access across the right-of-way for animals will be restricted. This will change migration patterns and place more pressure on certain areas of habitat. This, in the long-term, could further reduce the carrying capacity of the habitat.

The loss of 3,900 acres of sage grouse habitat cannot be avoided. Even though part of the area will be reclaimed, sagebrush will have been eliminated. Herbicide treatment of the right-of-way will prevent reinvasion of sagebrush. Direct loss will probably be in the range of 35 to 50 birds from the base population. Total loss cannot be estimated as it is not known how many mating or nesting areas may be destroyed by the route.

Recreation

The major unavoidable adverse impacts on recreation involve restriction of freedom of access and loss of wildlife populations. Access across the right-of-way will be restricted to major road crossings. Operation of the railroad, especially the noise, will disrupt the solitude of the area for the recreationist while he is using the area. Increased population, controlled access, loss of wildlife habitat, and reduced game populations will result in fewer recreational opportunities.

Agriculture

Livestock forage

A permanent loss of grazing on the 2,400 acres of right-of-way (369 animal unit months-AUMs) cannot be avoided. Construction activity (access roads, clinker pits, construction camps) will cause a temporary loss of 950 acres (146 AUMs) adjacent to the right-of-way. Even though this area is reclaimed, full productivity will not be reestablished. Therefore, a long-term loss of an annual 73 AUMs will occur. An estimated 550 acres (85 AUMs) outside of the right-of-way will be permanently lost (access roads, housing, clinker pits).

The permanent loss of natural irrigation by small drainages severed by the railroad grade will lower the grazing capacity of some areas downstream from the grade. This adverse impact cannot be quantified.

Accelerated runoff and siltation that occurs between the start of construction and reestablishment of vegetation on the denuded areas cannot be avoided. Loss of free access use by livestock cannot be avoided. Installation of cattle passes converts free access to defined physical access and will result in overuse on some vegetation and less than proper use levels on other vegetation, depending on the location in a pasture.

Fires that may occur along the rail line (10 to 50 with 200 to 3,000 acres burned per year) will consume valuable livestock forage. This forage (31 to 462 AUMs) will be lost for a minimum period of two years until the area has been revegetated.

The noise of train operations (46 per day by 1990) will disturb cows and ewes during calving and lambing. Pastures adjacent to the rail line probably cannot be used for calving and lambing.

There will be an irreversible change in the normal operation of livestock enterprises as adjustments are made in the operation due to the severance of ranch units.

There will be a short-term loss of replaceable facilities destroyed by the rail line construction. The total effects of these losses are not quantifiable at the present time (April 1974).

Farming

There will be a permanent loss of production from 160 acres of cropland along the railroad right-of-way. During construction there could be a loss of production on approximately 60 additional acres. This will result in a loss of approximately 300 tons of hay for each of two years and a permanent loss of 216 tons of hay production.

There will be some cropland severed in parcels too small for economical management or unirrigable due to economic considerations. Six fields in the Shawnee Creek drainage have been identified in this category, but the total acreage affected cannot be quantified due to lack of data.

There will be increased maintenance of irrigation structures due to siltation during the construction period.

Some irrigated cropland may not be able to be irrigated during construction due to temporary severance of irrigation systems. The reduction in crop production during this period cannot be quantified.

Transportation Networks

Regardless of the location of the railroad and its design, it will produce some effects on local transportation that cannot be mitigated. Principally will be its effect on the relatively unrestricted travel across the numerous minor roads in the area. Since grade crossings cannot be provided for every minor road, local resident irritation and added mileage inconvenience will be created from having to cross the railroad at specified locations only.

Drifting of snow on State Highway 59 and on lesser roads due to railroad fills and grade elevation is unavoidable.

The deterioration of the mainline from increased coal train operations cannot be avoided, and the necessity of having to upgrade the mainline is unavoidable.

The increased potential for additional car-train collisions due to operations of 46 trains per day by 1990 cannot be avoided and could result in increased loss of life. (The amount is indeterminable.) Since the line will have a number of grade crossings, this impact may be higher than for a normal railroad.

Socio-Economic Conditions

Employment, income, population, and capital investment themselves do not pose adverse unavoidable impacts. The discrete effects of these produce unavoidable social and economic impacts. These have been analyzed on a cumulative basis and can be found in Chapters V and VII of Part I of this impact statement.

CHAPTER VI

ALTERNATIVES TO THE PROPOSED ACTION

No Development

The no development alternative means no construction of a rail line to haul coal out of the basin. The spur line to the proposed Carter and Amax North mines is part of the mining plan and is considered in the approval required for the mining operation. Therefore, under this alternative the 12 miles of spur lines required for those mines would still be considered.

Acceptance of this alternative would mean that the environmental impacts analyzed in Chapters III and V of this part will not occur.

However, other impacts are likely to occur onsite as well as offsite. As there is a high demand and economic need for the coal, the coal mines will eventually be developed although probably delayed for a period of time until alternative means of transportation are developed. Therefore, the impacts associated with these mines as discussed in Parts I, III and V may still occur, although delayed for a period of time and probably at a lesser scale.

The majority of the coal to be hauled by the railroad is for shipment out of state to midwest and eastern points of demand. The basin coal is low in sulfur content and is required by these power plants in order to meet current EPA and state air pollution regulations. Without this coal these power plants will need to obtain coal of higher sulfur content from other areas of the nation. Use of coal with a higher sulfur content will result in increased air pollution in the power plant areas, or inability to supply the electrical energy demands of their service areas with resultant environmental impacts created by lack of power, blackouts and brownouts.

Other means of transportation may have worse environmental consequences than the proposed rail line. These alternative means of transportation could include any combination of the following methods: trucks, conveyors, slurry pipelines, gasification plants and transportation of gas by pipelines and mine mouth power generating plants. Each of these methods is described in Alternative Section of Part I, Chapter VIII.

Alternate Routes

There are a number of possible routes that the rail line could be constructed on. Topographic limitations do exist, however. Lack of major barriers would allow construction along a large number of alternate routes. Many of the potential impacts would not vary significantly between these routes.

Three alternate routes were selected for analysis. Selections were based on significant differences in location, type of terrain crossed and amount of construction which would be required. These are shown on Map 12, Appendix A, and are: (1) Eastern route, (2) Western route and (3) Douglas corridor.

An impact analysis matrix was prepared for the proposed and selected alternate routes, Figure 1. The net residual impacts of the individual routes were analyzed and rated in accordance to the following system:

(O) - Negligible Impact

(L) - Low Impact

(M) - Medium Impact

(H) - High Impact

(+) - Beneficial Impact

(-) - Adverse Impact

<u>Eastern route</u>

Location Loop 1A

This route leaves the main line spur east of the Belle Ayr mine and goes generally east past Piney Ranch and across the Belle Fourche River to Four Horse Creek. It then turns generally south along the Campbell and

Figure 1

Analysis of Railroad Impacts
Alternative Routes

Environmental Component	Proposed	Eastern Alternate	Western Alternate	Douglas Corridor
Air Quality	-L	-L	-L	-L
Topography	-M	-H	-M	-L
Soils	-L	-H	-L	-M
Land Use				
Coal	-M	0	-L	0
Grazing	-M	-H	-L	-M
Recreation	+M	-H	0	-M
Hydrology				
Water Supply	-L	-M	-L	-L
Water Quality	-M	-H	-L	-L
Vegetation				
Aquatic	0	-L	0	0
Terrestrial	-M	-M	-M	-M
Wildlife				
Deer	-L	-M	-L	0
Antelope	-M	-H	-L	0
Elk	0	-H	0	0
Upland Game	-L	-M	-L	-L
Birds	0	-L	0	0
Aquatic	0	-L	0	0
Cultural Valves				
Archeological	-M	-H	-M	-M
Historical	0	0	0	-L
Aesthetics	-L	-H	-L	-L
Socio-Economic Conditions				
Population	-M	-M	-M	-M
Employment	+M	+M	+M	+M
Social Services	0	0	0	0
Living Conditions	0	0	0	-H

Weston County lines and east of the Rochelle Hills, crossing Black Thunder Creek below the confluence with Bacon Creek. It continues generally south, passing to the west of Rochelle and east of Dull Center. The route continues generally south along the Converse and Niobrara County line, staying east of the Miller Hills, thence turns southwest along Lightning Creek, passing to the northwest of Janet and then parallels the Walker Creek Road. It continues from Janet to Douglas to a point about one mile east of the Highway 59 - Walker Creek Road Junction. From this point, the route bears southeast down the west fork of Shawnee Creek about 12 miles to the point of confluence with the main fork of Shawnee Creek. Here the corridor forks, the eastern branch proceeding about five miles east to the BN/CNW main line at Shawnee and the southern branch going south about five miles to the BN/CNW main line two miles west of Fisher.

Engineering notes

This route is approximately 137 miles in length and will require 17 bridges with a total bridge length of 3,080 feet. The total southbound distance on a compensated maximum grade of one percent is approximately 24 miles and also 23 miles of maximum compensated grade if the travel is northbound. This route will require 11,488,000 cubic yards of grading, and alignment will require 109 curves with maximum curvature equalling three degrees. This data also includes the engineering notes on the portion known as the Douglas corridor.

Surface estate

Ownership of the surface estate of the approximately 137 miles in this route, from the Belle Ayr terminal to the southern terminus at Fisher and Shawnee, is:

Private	State of Wyoming	BLM	USFS	Total Miles
104	11	5	17	137

Location Loop 1B

This route is basically the same as loop 1A with the following route change. Approximately three miles east of Piney, the alternate turns southeast, crossing the Belle Fourche River, and turning southwest up the Whitetail Creek drainage. It crosses the eastern edge of the Wyodak outcrop on the divide between Whitetail and Bacon Creek, going in a southerly direction. It then turns southeast down the Bacon Creek drainage and rejoins loop 1A approximately four miles northwest of the Black Thunder Creek crossing. The remainder of this loop is identical to loop 1A.

Engineering notes

This route is approximately 138 miles in length and will require 16 bridges with a total bridge length of 3,090 feet. The total southbound distance on a compensated maximum grade of one percent is approximately 27.3 miles and 21 miles of compensated maximum grade if the travel is northbound. This route will require 14,385,000 cubic yards of grading, and alignment will require 124 curves with maximum curvature equalling three degrees. This information also includes the engineering notes on the portion known as the Douglas corridor.

Surface estate

The ownership of the surface estate of the 138 miles in this route, from the Belle Ayr terminus to the southern terminus at Fisher and Shawnee, is tabulated as follows:

Private	State of Wyoming	BLM	USFS	Total Miles
100	13	8	17	138

Impacts

This alternative would cause more unavoidable adverse impacts on air quality than the proposed route as it would require disturbance of a larger land area (2,700 acres) and result in more equipment and vehicular emissions because of longer construction and operation times and length. Loop 1A of this alternate encounters an area of sandy soils in T47N, R69W, which could be activated as sand dunes by construction. These may be artificially stabilized, but the risk of becoming active again is high. This would create a severe air quality problem from blowing sand, besides destroying the land surface by wind erosion and burial of existing vegetation.

The impact of this route on soils with the exception of loop 1A will be similar to the proposed route except for the larger amount of soil to be disturbed which is in direct relationship to the increased length of line. Loop 1A will cross lands that are severely eroded which has created many entrenched dissections and large gullies. Construction of this loop would significantly alter the landform and established drainage systems and could cause a substantial increase in erosion and sedimentation rates.

This route crosses a large number of drainages that originate in the Rochelle and Miller Hills and will require more culverts, drainage alterations and bridges. These structures will need to be designed to carry greater streamflows than similar structures upstream. A large number of cuts and fills would be required across the drainage basins of Cow Creek and Little Cow Creek. The route also follows the alluviated valleys of Lightning Creek for about ten miles and Walker Creek for 15 miles. This will require many long, but low fills to cross these areas. The fills would not only be subject to damage from flash floods but, if not properly designed, would also direct large amounts of runoff into different channels, resulting in serious erosion.

The eastern route passes east of the coal outcrop and therefore does not have the potential impact on coal resources as does the proposed and western routes. However, longer spur lines would be required to reach the mine properties, i.e., 11 miles to Atlantic Richfield and 10 to 13 miles to Sun. These spurs can be located so as to miss the major strippable coal deposits.

Problems of compaction and destruction of land surface are more pronounced on this route. Roads suitable for heavy construction equipment are not available. The clay soil crossed by this route when wet creates difficult travel conditions. Many of these problems could be overcome by properly designing and constructing access roads. Natural scoria (clinker) suitable for road surfacing is available a short distance west of the right-of-way. Mining of this scoria would create additional impacts on soil and aesthetics.

This part of the basin has a higher scenic quality than the western portion. The area crossed by this route is more remote with less access than other parts. The cuts and fills required to maintain the one percent railroad grade and the intrusion of frequent trains and attendant noise to this remote area would greatly affect the outdoor experience that can be found here. The rail line will be a permanent, linear intrusion upon a scenic area and will either inhibit or restrict recreational users' access unless proper crossing facilities are provided.

This line would impact livestock grazing to greater degree than the proposed route. Many large ranches are crossed by this route, and grazing patterns and ranch operations would be disrupted more than along the proposed route. Another impact on grazing would be the possibility of the route and required access roads providing a means for public access and creating increased public use of the area.

The eastern route has a greater potential for impacting the water quality than the routes further upstream because of more stream crossings, higher flows, increased turbidity and sedimentation.

The chance for an accidental coal spill into a major stream is also increased on this route. This would have a significant impact on water quality, aquatic life and attendant recreational use associated with this water resource.

A wider range of vegetative communities would be encountered on this route. (See vegetation type Map 8, Appendix A.) The impact on vegetation would be greater than the other routes because of the larger area which will be disturbed by construction (2,700 acres) and area permanently removed from vegetative growth (1,233 acres).

Wildlife populations and types are significantly different along this route than the proposed or western alternate route. Antelope habitat is similar to the other routes and total numbers are probably 30 to 40 percent less than the proposed route. The impact on antelope would be similar in nature and scope as discussed for proposed route. Since numbers are fewer, the impact could be less severe.

With the exception of the southernmost 20 miles, this alternative crosses high quality mule deer habitat. Exact quantification of numbers is not possible with existing information, but excellent deer populations are present and probably numbers 10 times the number along the proposed route.

Several herds of elk totaling about 90 head occupy three areas along the Campbell-Weston County line. Loop 1A would pass through two of these areas. Loop 1B would pass within five miles of the elk herds. Elk have been able to survive in these areas of sparse escape cover only because rough topography and lack of roads have prevented significant human activity.

This area is habitat for upland game birds, particularly sage grouse and sharp-tailed grouse. The populations of these probably number 20 percent and 30 percent more than the proposed route.

There is a possibility that several prairie dog colonies could be located within the area of construction activity. Additional field work would be required to locate these colonies accurately, and also to determine if they contain any black-footed ferrets.

The impact on wildlife of this route will be essentially the same in type as the proposed route. The magnitude of impact will be significantly increased because of higher populations for everything but antelope. The impact on the elk herds would be severe, in fact survival of the herds would be very unlikely. It is not likely that the elk could tolerate the disturbance of human activity, noise resulting from train operations and increased access. Other areas of suitable habitat are not available for the elk to relocate in.

Construction of this route could possibly have a greater impact on archeological values than other alternatives for several reasons: disturbance of more land area and the chance of values occurring in this part of the basin is greater than in the western portion. Evidences have been found (pictographs, artifacts and associated campsites) adjacent to this route.

Western route

Location

This route leaves the main line spur at the Belle Ayr mine and goes southwest approximately nine miles to a point adjacent to Highway 59 about 20 miles south of Gillette. It then turns generally south and parallels Highway 59 to a point approximately 11 miles northeast of Douglas. From this point the route bears southeast down the west fork of Shawnee Creek about 12 miles to the point of confluence with the main fork of the creek. Here the corridor forks, the eastern branch proceeding about five miles east to the BN/CNW main line at Shawnee and the southern branch going south about five miles to the BN/CNW main line two miles west of Fisher.

Engineering notes

This route is approximately 112 miles in length and will require 18 bridges with a total bridge length of 4,255 feet. The total southbound distance on a compensated maximum grade of one percent is approximately 35 miles and 25.2 miles of compensated maximum grade if the travel is northbound. This route will require 27,538,000 cubic yards of grading and alignment will require 51 curves with maximum curvature equalling three degrees.

This information also includes the engineering notes on the portion known as the Douglas corridor.

Surface estate

The ownership of the surface estate of the 112 miles in this route, from the Belle Ayr terminus to the southern terminus at Shawnee and Fisher, is tabulated as follows:

Private	State of Wyoming	BLM	USFS	Total Miles
90	10	2.0	10	112

This alternate route (112 miles) is approximately the same as the proposed route and the impact on air quality would be similar. Because of less land area disturbance and shorter operating distance, the impact may be slightly less than the proposed route.

The western route follows the same route as the proposed route along Highway 59 and Shawnee Creek. It would probably cause the least environmental disruption during construction because it is adjacent to Highway 59 for most of the route. Maintenance would be easier, and fewer and shorter access roads would be required.

Impacts

Impact on grazing and other land uses would be less than the proposed route from the junction of the Amax spur to Bill since this route would be located in an already disturbed access corridor and severance of ranches less severe. The western route would cross coal under less than 200 feet of overburden for only about two miles as compared to 14 miles of the proposed route. This would greatly reduce the amounts of mineable coal covered by the railroad. This route would cover large tonnages of coal under less than 500 feet of overburden, which could become mineable in the future, as does the proposed route. Construction of this route would require spurs of slightly longer length (one mile to Sun and nine miles to Atlantic Richfield) than the proposed route, but of shorter length than the eastern alternate. These spurs would cross additional economically mineable coal but could not be moved to allow for coal mining.

The western alternate route paralleling Wyoming Highway 59 would result in considerable larger amounts of construction grading ir the Antelope Creek and Dry Fork of the Cheyenne Valley areas. The route would cross the divide between the two valleys at a highter elevation than the proposed route which takes advantage of a natural low point in the divide by following Logan Draw. A minor adjustment can be made by diverting the western alternate line to the proposed route, bypassing the upper reaches of the Antelope Creek-Dry Fork drainages and then swinging back westward to the western alternate in the vicinity of Porcupine Creek. This would minimize impact on recreational use as it follows an already established access corridor and construction of crossings for county roads would provide for access across the rail right-of-way. The impact on aesthetics may be slightly worse than the proposed route, mainly due to the fact it will be in view of more people. However, general sightseeing use could be enhanced with increased unit train operation viewing opportunities.

Water quality impact would be slightly less than the proposed route and far less than the eastern alternative. As this route is more or less located on the backbone of the basin, fewer major streams will have to be crossed and drainage crossings will be smaller. Impact from turbidity and sediment load will be less than the proposed route.

Vegetative impacts would be the same as for the proposed route. The main line for the western alternative would involve disturbance of 2,200 acres. The spurs would be slightly longer involving more area than the spurs from the proposed line. However, the net result would be about equal in terms of vegetative disturbance. Soil impacts would be the same as for the proposed route.

This route would be slightly more detrimental than the proposed route to mule deer, cottontail rabbits, raptors and other birds and a variety of animals associated with the drainage bottom habitats. It infringes upon drainage bottom habitat at 18 or 15 sites as compared to nine sites along the proposed route. However, this route would have a significantly less severe impact upon antelope than the proposed route since it closely parallels the highway. Wyoming Game and Fish Department personnel report that the existing highway and right-of-way fencing presently creates an effective barrier to antelope movement east and west through the basin. The present antelope distribution and movement patterns appear to have, over time, adapted to this barrier. Construction of the railroad along this same barrier line would not create additional adverse impacts to antelope which will be associated with disruption of traditional and/or necessary use patterns and movements imposed by the proposed route creating a second new barrier line through 60 miles of antelope range.

There is little difference between impact from this route on archeological values than the proposed route.

Chance of flood damage and resulting impact would be less than the proposed route as it crosses drainages closer to their headwaters. Chance of impaired water quality resulting from accidental spills would also be lessened.

Douglas corridor

Location

The Douglas Corridor starts at a point approximately one mile east of the junction of Highway 59 and Walker Creek Road, this point being about 11 miles northeast of Douglas. From this point the corridor goes west across

Highway 59 and then bears southwest to a point on the BN/CNW main line track about two miles northwest of Douglas. The corridor roughly parallels Highway 59, ranging between one-half and 1-1/2 miles to the northwest of the highway.

Engineering notes

Not available. Based on map measurement, this corridor is approximately 12 miles in length.

Surface estate

The surface estate this corridor crosses is 100 percent privately owned.

Impacts

The Douglas corridor is a short stretch of some 12 miles. From a point north of Douglas, all of the other discussed routes could connect with the Douglas corridor. Therefore, this discussion will be limited to just this short stretch of rail line and impacts which would be different than those discussed for the other alternatives.

Use of this route for the main line would result in the shortest route possible when used in connection with the western alternate.

The impact on wildlife would be slightly less than the same segment of the proposed route. This is due to the fact it is shorter and would result in 200 to 300 acres less habitat lost and impaired for the species involved. The impact on mule deer would be even more reduced as it would bypass mule deer habitat completely.

There would be a significant impact on a large overnight campground located at the edge of Douglas near the North Platte. Increased unit train operation through this area would create severe noise pollution for campground users.

Branch route

Location

This route leaves the main line spur east of the Belle Ayr mine and follows the route previously described for the railroad location proposed by the Burlington Northern and Chicago and North Western. Instead of continuing south to a connection at Douglas it would terminate at the community of Tekla (T72N, R71W) and would constitute a branch rather than a main line. Through connecting spur trackage the branch would be able to transport coal from the Belle Fourche, Jacobs Ranch, Black Thunder, and Rochelle coal mine.

Operational notes

This route is approximately 37 miles in length. By terminating the line at Tekla, the branch would not provide a direct connection to any main or branch lines on the Chicago and North Western system. Since the route as applied for was to be jointly constructed by both participating railroads, the approval of the branch route may precipitate the filing of a construction application by the C&NW for a separate route, most likely similar to the eastern route alternative. Coal traffic on the branch would be directed north to Gillette and then over existing mainlines to consumptive points. This route traverses approximately 69 percent less mileage than the through route and would result in a proportional reduction in yards of grading, mileage of compensated grades, and bridge and culvert construction.

Impacts

The impacts on soil disturbance, drainage patterns, cuts and fills, and other land related factors would be of the same nature as those previously described for the applied for route. They would however be quantitatively reduced because of the shorter distance of the branch line.

Identified impacts on wildlife movements would be reduced. The line would no longer constitute an enclosed barrier for deer and antelope populations which may otherwise be confined between Route 59 and the applied for route. West-east migration would thus be possible across the area to the south of Tekla. North-south movement however may continue to be impaired due to the presence of connecting spur lines.

Termination at the community of Tekla may inhibit coal resource development from areas to the south which are covered by federal lease, prospecting permits, or pending preference right leases (see Map 5, Appendix A). These areas may be deprived of direct rail access for coal exportation. Development dependent upon coal slurry exportation or in-situ power conversion (such as power or gasification plants) would be essentially unaffected by this alternative.

If through service were to be available to Douglas, it was anticipated that coal traffic generated from the Rochelle, A.R.Co., and Kerr-McGee mines would be routed through Douglas to the convergence of the two Burlington Northern main lines at Alliance, Nebraska. Production from mines to the north of the three mentioned would be routed through Gillette regardless of the availability of a southern routing.

A branch status would thus involve more circuitous travel for coal from the three mines. The increase in rail mileage to Alliance would be approximately 51 miles for Kerr-McGee and A.R.Co. mines and 69 miles for the Rochelle mine. Using estimated 1980 export tonnage as a base point, routing through Gillette would increase ton-miles traveled by 510, 510, and 759 million respective, or a net increase of 1.779 billion ton-miles. This circuity would result in an estimated increase in fuel consumption of 8,096,300 gallons over the energy requirement for a connection through Douglas. In addition, the circuity would result in an estimated annual increase in air emissions as follows:

Pollutent	Total in Pounds
Carbon Monoxide	587,070
Hydrocarbons	425,960
Nitro Oxides	1,754,470
Total	2,767,500

There should be similar increases in emissions of particulates and sulfur dioxide. The above numbers likewise represent the net increase in emissions which would be expected from operations as previously defined for the applied for route.

CHAPTER VII

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Construction of the railroad involves long-term commitment of approximately 2,400 acres of productive land to use for transportation of coal and other materials. Operation of the railroad will result in a long-term impact on the air quality within the study area. By 1990 railroad operations will be increasing the total pollutants in the air (particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, hydrocarbons) by two percent on an annual basis over 1970 levels. Increase of these pollutants, particularly sulfur dioxide, has the potential for long-term impacts on vegetation. The exact relationship between sulfur dioxide content of the air and vegetative growth has yet to be established. Research is currently underway to determine what the long-term impact on vegetation may be.

In all practicability, once construction of the railroad is completed, the 2,400 acres will be lost forever to production of wildlife habitat. As a result of the railroad, there will be a long-term reduction in wildlife habitat productivity and in population numbers. Wildlife base populations will be reduced (75 antelope, 20 deer, 35 to 50 sage grouse). Since an unknown amount of sage grouse mating and nesting areas may be destroyed, the total reduction in sage grouse productivity is incalculable.

Long-term rangeland productivity will be reduced annually by 369 animal unit months (AUMs). Noise of operating trains will cause a further long-term reduction in productivity on areas adjacent to the right-of-way for both wildlife and livestock. Increased populations will also have long-term impacts on total productivity of the area.

CHAPTER VIII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The 2,400-acre right-of-way will be irreversibly committed to use as a transportation corridor. Normally, areas which are used for transportation never revert to their former use. Wildlife habitat and grazing values in this area will be irretrievably committed for the rest of time.

The materials used in construction of the railroad (sand, gravel, clinker, limestone, steel, manpower, fuel) will be consumed and lost to other uses. The consumptive use of 185 to 1,075 acre-feet of water during construction will not be available for use by other resources (agriculture, recreation, wildlife).

Operation of the railroad will consume vast quantities of diesel fuel. By 1990 an estimated 41.2 million gallons of diesel fuel will be consumed annually within the study area. This fuel will not be available for use by other means of transportation.

The estimated 161 million tons of coal to be covered by the proposed railroad is not considered an irreversible or irretrievable loss. The coal will not undergo a physical impact and will be available for mining in the future.

PART III

Analysis of Proposed Mining

Atlantic Richfield Co.

CHAPTER I

DESCRIPTION OF PROPOSED ACTION

Background and History

Coal lease W-2313, containing 5,884.31 acres, was offered for sale by competitive bidding on September 27, 1966. It is located about 42 miles southeast of Gillette (Figure 1) and embraces part or all of sections 2 and 3, T42N, R70W, sections 17, 20, 21, 22, 27, 28, 29, 33, 34, and 35, T42N, R70W, Campbell County, Wyoming (Figure 2).

Paul F. Faust from Denver, Colorado, was the successful bidder at $31.33 per acre. The total amount of the bid was $184,355.43. The lease was issued on December 1, 1966. A copy of the lease, including a legal description of the land, is included in Appendix D.

The lease was assigned to Atlantic Richfield on July 1, 1968. The original lease included 40 acres of acquired mineral lands in the NE¼SW¼ of section 22, T34N, R70W. On July 25, 1972, this tract was segregated and assigned a new lease number W-36094 (Acq.). The company doesn't propose to mine from this acquired land during the first 20 years of operation.

The lease with the Bureau of Land Management is a continuing lease subject to reasonable readjustment of terms on a 20-year basis. It provides for a royalty of 17-1/2 cents a ton of coal mined for the first 10 years of the lease and 20 cents a ton for the remainder of the first 20-year period of the lease. The annual rental is set at $0.25 per acre per year for the first year; $0.50 for the second, third, fourth and fifth years, respectively; and $1.00 per acre for the sixth and each succeeding year

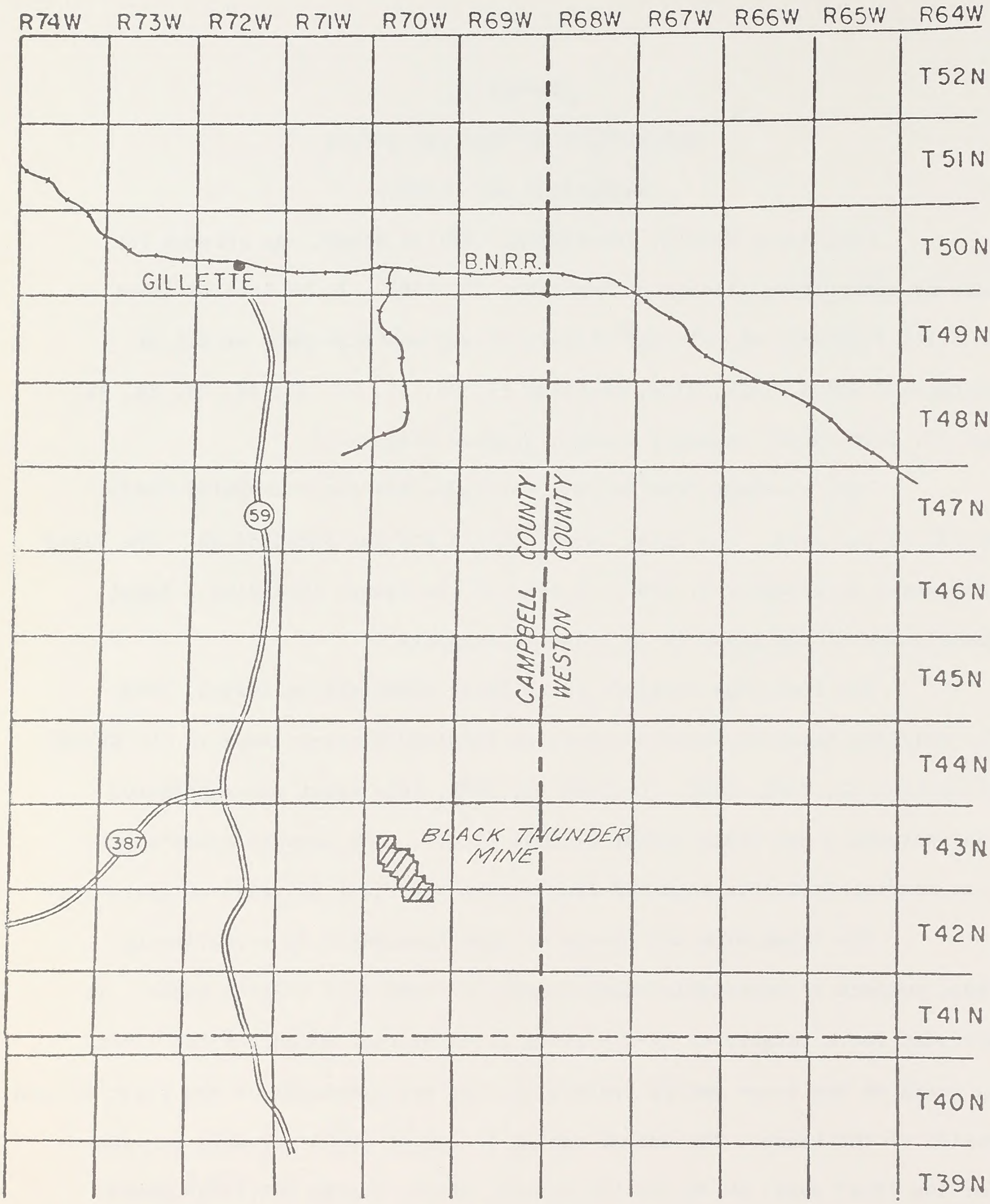


Figure 1

Location of the Black Thunder Coal Property, Atlantic Richfield Company, Campbell County, Wyoming.

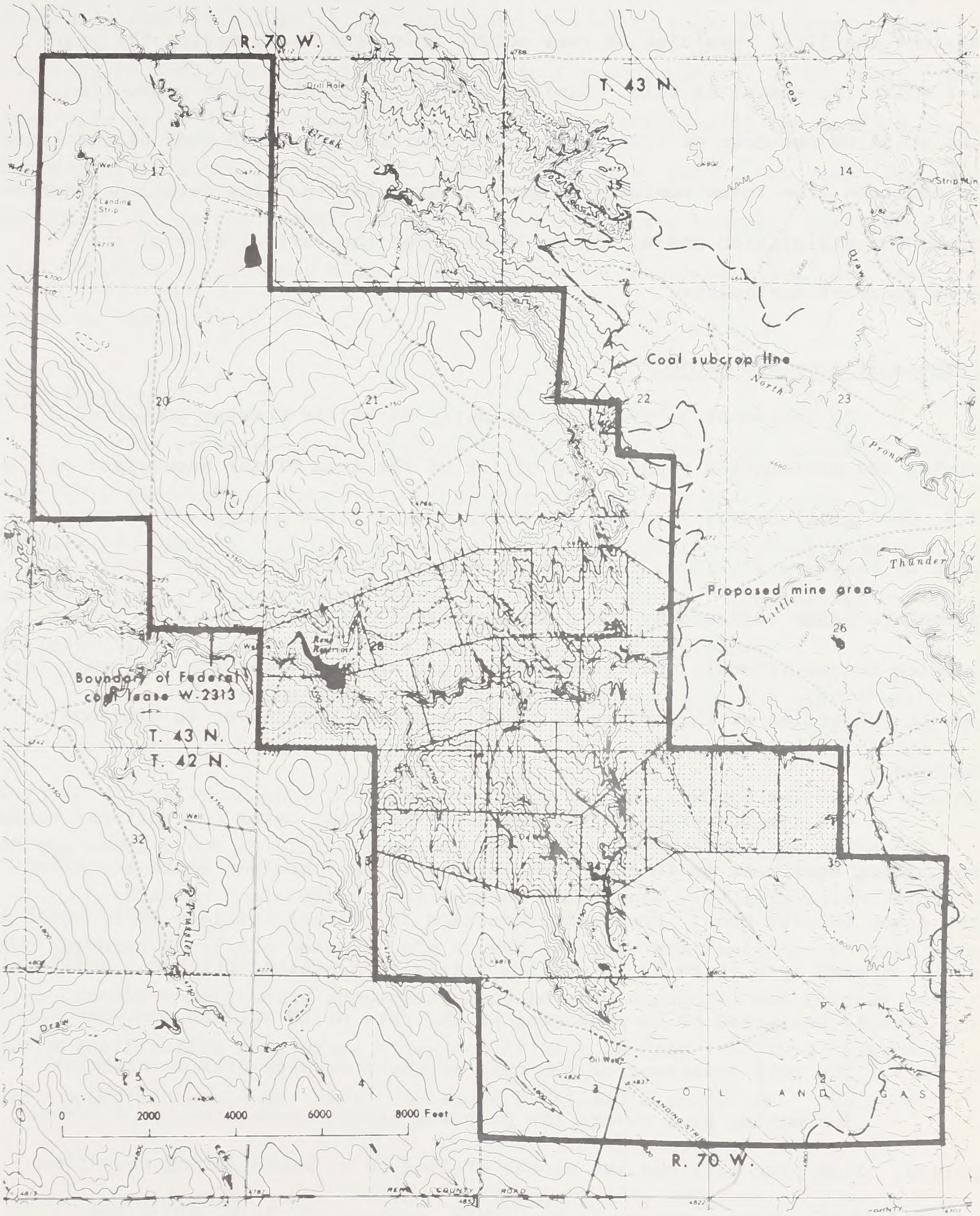


Figure 2
Map of the Black Thunder coal property, Atlantic Richfield Company, Campbell County, Wyoming

during the continuance of the lease. Rental for any year is to be credited against the first royalties as they accrue under the lease during the year for which the rental is paid. Minimum annual royalty based on production is set at $1.00 per acre or fraction thereof starting the sixth year of the lease. In addition, the lease contains 11 general stipulations plus detailed requirements for exploration and mining on lands under the jurisdiction of the Department of Agriculture.

Purpose of proposed project

On September 5, 1973, the Atlantic Richfield Company submitted a mining and reclamation plan to the office of the Area Mining Supervisor of the U.S. Geological Survey in Billings, Montana, and filed a supplement to this plan on February 27, 1974, followed by a revised plan on May 20, 1974. These plans are being reviewed by the U.S. Geological Survey and the U.S. Forest Service to see if additional requirements are necessary and are available for public inspection at the office of the area mining supervisor in Billings, Montana.

The company proposes to open a surface mine using conventional stripping and mining equipment on federal lease W-2313. The operation would be called the Black Thunder mine. Proposed production is planned for late 1975. Coal is to be shipped by unit train to utility plants in Nebraska, Oklahoma, and Texas. The mine is projected to be producing at the rate of 10 million tons per year by 1979. The only treatment of the coal at the mine site will be crushing.

The mining plan covers the proposed mining operations for a 20-year period. This plan outlines the blocks of land to be mined during this time period. Mining will commence in the W$\frac{1}{2}$NE$\frac{1}{4}$, section 27, T43N, R70W, and will move toward the western lease boundary. The mine will be about 2,000 feet wide when developed to its full width and will reach the western lease boundary in 1981. Mining will then move to the south where the adjacent 2,000-foot-wide strip will be mined in an easterly direction until the eastern lease boundary is reached in 1986. Two additional strips, each 2,000 feet wide, will be mined, one in the westerly direction and one in the easterly direction, which will complete the 20-year plan. The proposed blocks to be mined each year are shown in Figure 3.

Site location

The proposed mine operation in T43N, R70W, would be located 9 miles east of State Highway Number 59 which connects Gillette and Douglas, Wyoming (Figure 1). The initial mining area would be 52 miles by highway from Gillette and 89 miles by highway from Douglas in Campbell County. The population of Gillette in 1970 was 7,197 people and Douglas was 2,677 people.

Kerr-McGee Corporation has announced plans to open a mine (Part V of this statement) just north of the Atlantic Richfield mine on federal lease W-23928. A railroad spur track used by both companies would follow the drainage of the north prong of Little Thunder Creek which divides the two properties.

Peabody Coal Company has federal coal lease W-0321779 which adjoins the Atlantic Richfield lease on the south. Peabody and Panhandle Eastern Pipe Line Company have jointly announced plans to open a mine on the Peabody property for a gasification complex as discussed briefly in Part I of this statement. This operation would not affect Atlantic Richfield's operation.

Ownership of the mine area is shown below in acres.

	Surface	Coal
United States	3,844*	5,884
State of Wyoming	640	640
Private	2,040	0
Total	6,524	6,524

*Forest Service

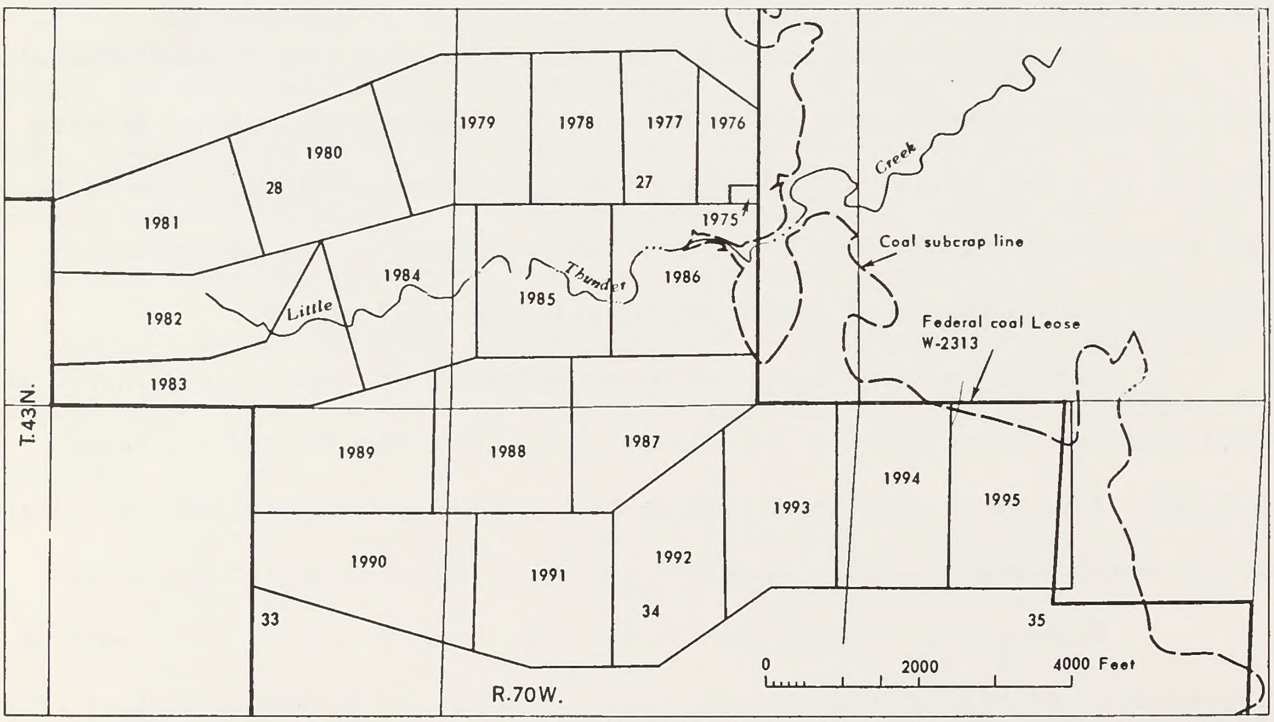


Figure 3

Atlantic Richfield Company's Black Thunder Mine
Showing Blocks to be Mined per Year on Federal Lease W-2313

Stages of Implementation

Mining procedures

The following description of mining and reclamation activities is taken, with modification, from the mining and reclamation plan submitted by A.R.Co.

Mining will commence in the SE¼SW¼NE¼ of section 27 (Figure 3). The overburden will be removed and the coal will be loaded with a 20- to 27-yard shovel into 100- to 180-ton dump trucks. The truck and shovel overburden removal method is depicted in the overburden removal portion of Figures 6 and 7, Chapter III, Part I, and the coal removal operation is shown in Figure 9, Chapter III, Part I.

The topsoil and overburden from the initial pit will be placed to the east of the pit.

Anticipated yearly production is as follows:

Year	Million Tons
1976	1.2
1977	3.8
1978	6.6
1979	10.0
1980	10.0

Additional coal purchase contracts may result in production increases to 15 or 20 million tons per year. At 20 million tons per year, the mine life is estimated to be 40 years. A coal mine in the Gillette area producing 10 million tons per year would probably employ between 200 to 250 men. At 20 million tons per year, 400 to 450 men would be needed.

The coalbed varies in thickness from 60 to 70 feet. Near the outcrop, the top part of the bed has generally been eroded and in places only 20 feet of coal remain. There has also been extensive burning of the coalbed near the outcrop. The shovel and truck mining method provides the flexibility necessary to mine along an irregular outcrop or burn line.

Soil material removal

Topsoil will be removed with self-loading and/or conventional rubber tired scrapers, front end loaders or other appropriate equipment prior to mining or construction. At the start of operations the topsoil will be stockpiled from the overburden dump area and from the original mining area. When backfilling of the mine commences, topsoil will be taken directly from the stripping operation, ahead of the highwall, and spread over the graded spoil behind the mining area. This will reduce the amount of topsoil that must be stockpiled and rehandled. The topsoil will be mulched as necessary to prevent wind or water erosion.

Overburden removal

Overburden will be loaded by shovel after drilling and blasting. In the initial mining area where softer overburden exists, only limited blasting may be required. As the overburden thickens over the coal, lenticular sandstone lenses will require blasting. All blasting will be done in accordance with applicable safety regulations.

The company proposes to use a truck and shovel stripping method (Figures 4 and 5) but does not exclude the possiblity of using a dragline or bucketwheel excavator at some time in the future.

The truck and shovel operation is readily adaptable to any type terrain and offers many advantages over other types of operations for moving overburden. Among the advantages of this type of operation are the following:

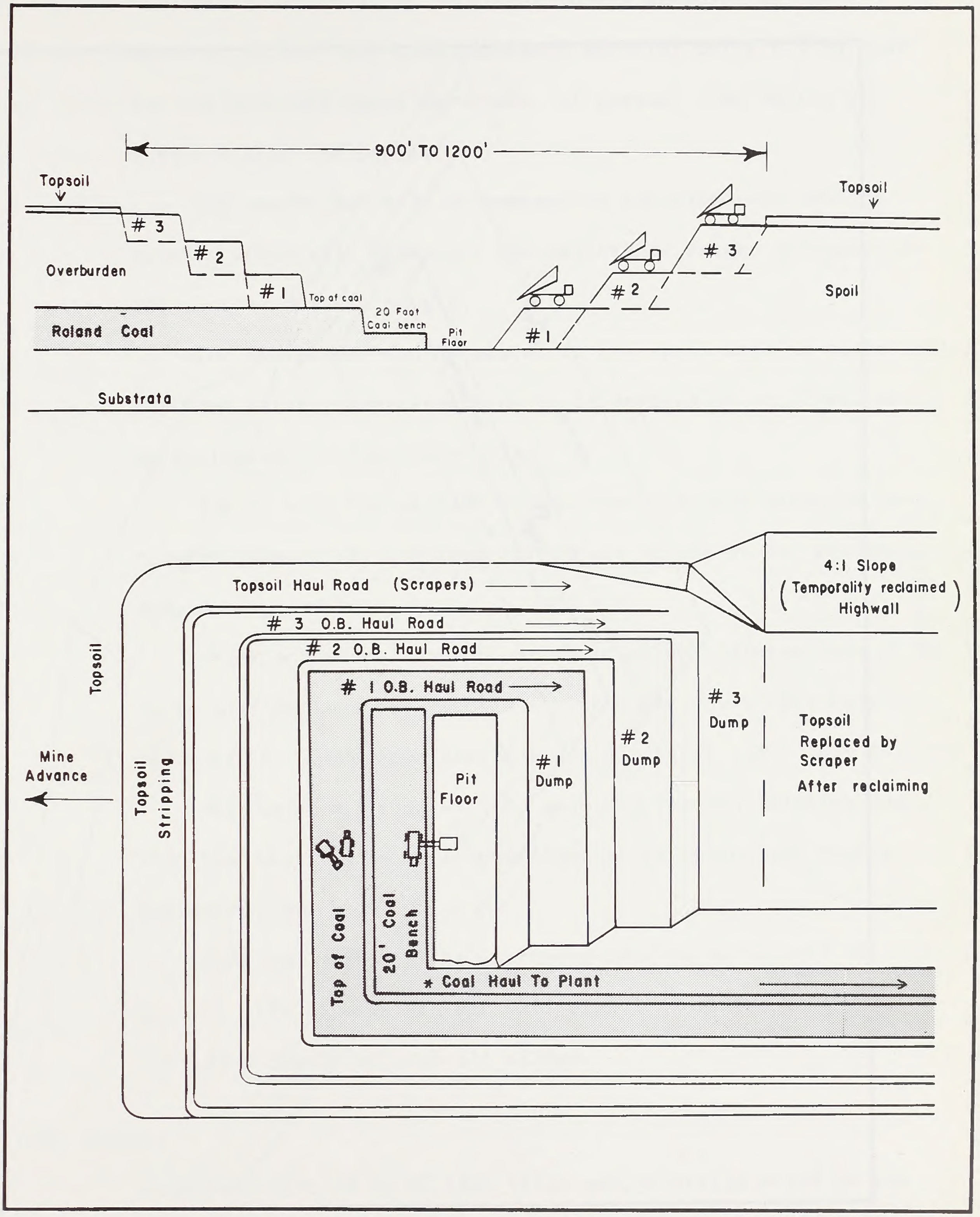


Figure 4
Schematic of Truck and Shovel Operation Showing Overburden and Coal Removal (from A.R.Co.)

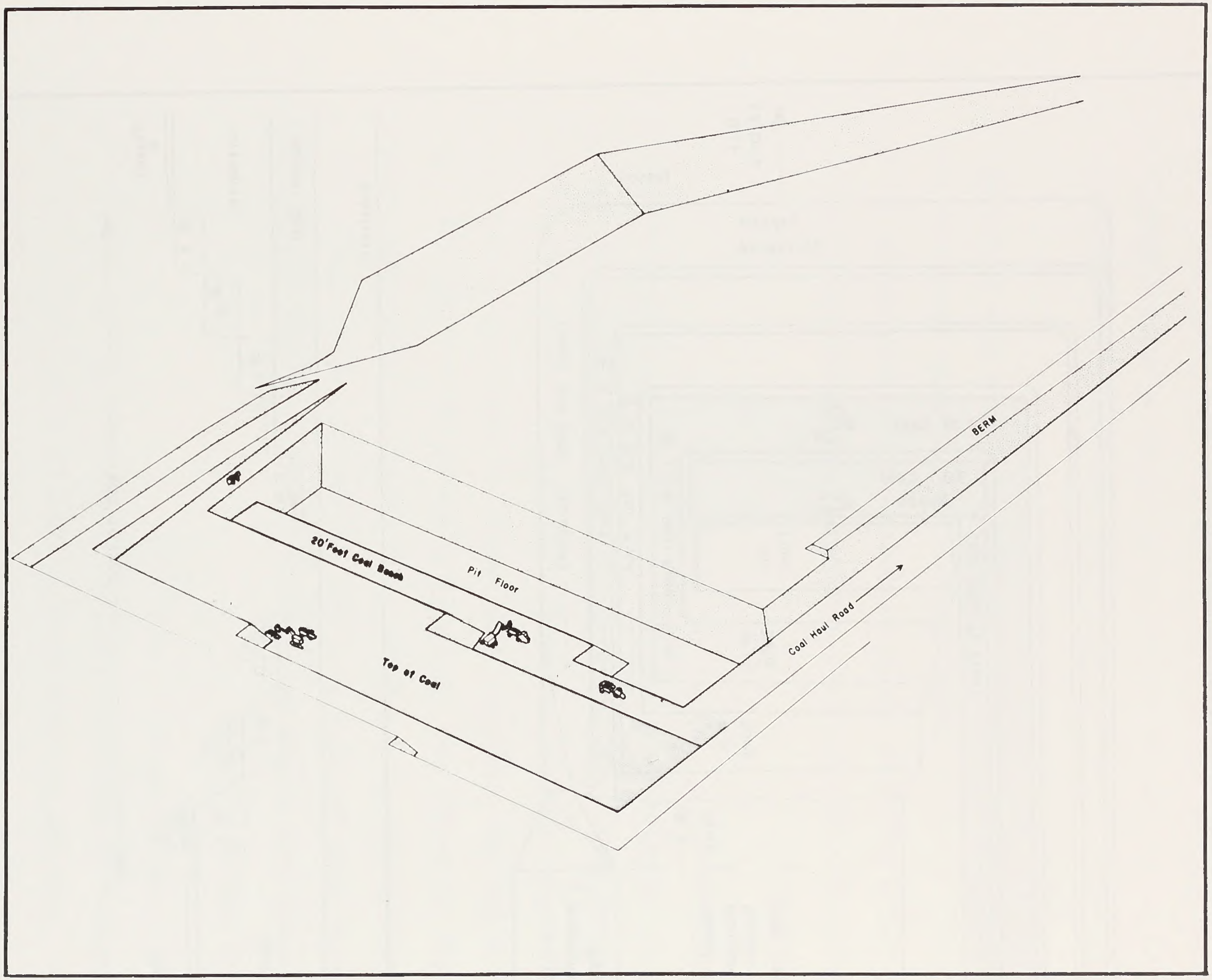


Figure 5

Perspective view of the mining area about 1978 at the Black Thunder Mine (from A.R.Co.)

The overburden can be placed in any sequence in the spoil piles with the more desirable material being placed near the surface; any toxic materials, if present, can easily be buried within the spoils;

The overburden will be removed in approximately 50-foot benches which will eliminate the additional danger of highwalls 200 feet or more in height;

The overburden can be placed in the spoil area in essentially the same stratigraphic sequence as it originally occurred, using approximately 50-foot intervals;

Trucks have the ability to haul spoil to low areas so that reestablishment of disturbed streambeds at the proper gradient should be possible;

Truck and shovel operations would allow a mining rate of up to 10 million tons per year in a single pit. (In this case the pit would be 2,000 feet wide and would advance 1,800 feet per year);

Only one haul road will be required for coal hauling and thus the land can be reclaimed immediately behind the mining operation; and

Coal recovery will be increased because no fenders of coal will be left to maintain highwall stability and no coal will be lost as a result of highwall slides.

Coal removal

Coal beds from 50 to 80 feet thick are generally mined in two benches at mines in Wyoming and Montana. This same method is proposed at the Black Thunder mine since equipment working near a 70-foot highwall of coal could endanger equipment operators. The coal will be loaded initially by the same 27-yard shovel which is used for overburden loading. The top bench of coal will be taken first, leaving a 20-foot lower bench to be mined immediately behind the top bench. The 100- to 180-ton trucks will dump their loads on a drive-through ramp into a hopper above the primary crusher.

Reclamation

The company proposes to begin rehabilitation efforts on disturbed lands as soon as possible after the coal has been removed. The plan is designed to allow concurrent use of much of the machinery for both mining and reclamation.

All reclamation activity at the proposed Black Thunder mine will conform to the stipulations and requirements of the federal coal lease (W-2312), applicable federal operating regulations, and the Wyoming Environmental Quality Act of 1973. Before any mining is started in Wyoming, the operator must obtain a permit from the state which entitles the operator to mine in conformance with an approved reclamation plan.

It is the policy of the Department of the Interior and the U.S. Geological Survey that the operation be conducted under the more stringent laws and regulations, whether federal or state.

About 2,040 surface acres on the lease are privately owned. The remainder of the surface is owned by the Federal Government and comes under the jurisdiction of the Department of Agriculture. Under the stipulations in the lease, officials of Atlantic Richfield Company have agreed to submit an annual operating plan to the forest supervisor. The plan will show the mine operating areas and the methods of operation planned for each area. It will also show the areas to be treated and detail the rehabilitation and revegetation measures to be initiated in the planning year to meet the stipulated requirements of the Forest Service. In addition, the Forest Service reserves the right to amend, alter, or otherwise change during the life of the lease, any and all stipulations necessary to meet the land management principles outlined in the lease agreement.

Surface land use on the coal lease is primarily for grazing of cattle. The Soil Conservation Service reports that the carrying capacity of this area would average four acres to graze one animal for one month with an average grazing season of 10.8 months. The Atlantic Richfield Company proposes that the land disturbed by surface mining activities be reshaped into low rolling hills with broad valleys. Existing topsoil will be saved, replaced on the reshaped land, and planted with a mixture of native and introduced grasses.

The company has employed the Wyoming Environmental Institute to conduct a comprehensive environmental study of the property. This group will conduct a research program in revegetation and will recommend alternatives for reclamation. These research workers are all from the University of Wyoming and will evaluate several alternatives in terms of environmental qualities.

Atlantic Richfield has also signed a cooperative agreement with the U.S. Forest Service for "Conducting Forest and Range Research" and "Ecological Study of Proposed Strip Mined Areas." The company's reclamation plan is based on the experience and recommendation of the Soil Conservation Service and the U.S. Forest Service.

Spoil reclamation

Initial spoil removed from the pit will be used as plant fill or contoured into areas in sections 26 and 27 north of Little Thunder Creek. These areas will be covered with topsoil and planted.

The fact that only a part of the coalbed is present along the outcrop will facilitate blending reclaimed mined land with surrounding terrain. When the full 60- to 70-foot seam is taken with an average of 50 feet of overburden, the surface of the reclaimed land will be lower than the original surface. The shovel-truck combination will provide flexibility in placing overburden to avoid low spots which might fill with water and to blend the reclaimed spoils into surrounding terrain.

During reclamation of the surface contours, attention will be paid to habitat requirements of wildlife. Shaping of contours has been demonstrated to be of importance to eagles and some hawks. The company plans to provide outlooks, feeding locations, and updrafts for some animal species, while others such as the pronghorn, will benefit from very long vistas and gently rolling topography.

Careful planning will, however, be required to achieve satisfactory reclamation of the mined lands. Reclamation will be simplified where the coalbed has thicker overburden cover. Advanced partial stripping of selected high overburden areas will also allow better reestablishment of the proximate contours in the lower overburden areas. A 10-million ton per year operation will disturb about 85 acres per year when the full bed is mined and an equal number of acres will be reshaped and planted.

Preliminary tests indicate the overburden contains only minor amounts of toxic trace metals. If toxic materials are encountered, a system of handling overburden will be devised so that undesirable materials are buried in the spoil piles.

Spoil piles will be shaped into low rolling hills with broad valleys. Overburden will be placed in its final position and the land reshaped within a few months after an area has been mined. The land will then immediately be graded, and topsoil will be returned in the most appropriate manner and season.

Backfilling of abandoned pits will follow within a few hundred feet of coal loading operations. Very little coal will be mined from areas with more than 100 feet of overburden during the first 14 years of mining. During the last 6 years outlined in the mining plan, overburden will generally range from 100 to 160 feet thick.

A coal haul road will be maintained in the spoils at the south side of the pit. Spoils can be used from areas of thick overburden and from proposed reservoir sites to reestablish old stream channels at their original elevation. Edges of the pit will be graded into the surrounding terrain on an acceptable slope. Prestripping may reduce the highwall slope which is envisioned to be about 4 to 1. The haul roads from the active pit will vary from 0 to 7 percent grade.

Drainage control

Little Thunder Creek flows to the east through the center of the lease, and the north fork of this stream cuts across the northern tip of the lease. This is an intermittent seasonal stream with a watershed of 23,800 acres.

Little Thunder Creek will be left in the original stream channel until 1981 when the pit will cut the stream channel. A berm 20 feet high would be carried in the spoil parallel to the haul road which the company reports will cause all surface runoff entering the spoils from the north to reestablish a drainage pattern in the spoil.

A diversion dike will be constructed on Little Thunder Creek in 1981 ahead of the mining area. The dike will remain south of the creek until 1988. It will divert water around the north edge of the pit where it will be allowed to flow into the reestablished streambed in the spoil. A 50-acre reservoir will be constructed in 1982-83 to replace the stock reservoir on the land to be mined.

It is planned that reservoir lakes will be constructed in the reclaimed mine area. They will hold approximately 11,000 acre-feet of water with a surface area of about 200 acres. If this proposed reclamation plan is not approved, the mining method and equipment to be used is such that other reasonable surface configurations can be established.

An initial settling pond to receive mine drainage will be constructed using overburden material stripped in 1976. This pond will have a capacity of 123 acre-feet which, it is estimated, is more than adequate for settling needs. The pond will be abandoned when this area is mined in 1978. This will be done after new settling ponds are constructed in the 1977 reclaimed spoil area.

All disturbed areas, including the plant site, will have interceptor ditches constructed to catch surface runoff water and direct it to small siltation ponds for settling and/or treatment.

Seeding and planting

The newly shaped surface for planting will be prepared in one or more of the following ways: deep harrowing with a long-shanked chisel plow along the topographic contour to loosen the soil to a depth of 8 to 10 inches; construction of temporary concavities 8 inches deep, 16 inches wide, and 24 inches long, spaced as closely as possible along the contour to create moisture retention basins; stubble mulching, probably with straw pressed into the surface with a disc, or by using mulches of other kinds, such as excelsior, rock chips, wood chips, etc., appropriately applied; and fertilizing with an appropriate grassland formula as indicated by soil analyses, such as 75 lbs/acre available nitrogen, 100 lbs/acre available phosphorous, 50 lbs/acre available potassium, spread using standard agronomic procedures.

The objective of such surface preparation is to roughen the surface, thereby increasing infiltration and reducing surface run-off. The micro-relief so produced increases soil water availability in the small depressions, creates shaded areas, and reduces wind action in the depressions.

Prepared surfaces will be planted in both early spring and late fall as these surfaces become available during the mining operation. Either a temporary cover crop will be seeded or a mixture of native and introduced plant species which will ultimately form the final vegetative cover. If a temporary cover crop is needed for erosion control, it will be replaced after one to two years with the final stable mixture. The objective is to achieve a self-sustaining vegetative cover of hardy grassland species.

The kinds of species to be used will be determined after appropriate field trials at the site and upon recommendation of recognized authorities in the area. The principal components of the seed mixtures will be grasses and forbs, but seedling trees and shrubs also will be planted in appropriate sites. Rehabilitation plans will conform to the stated goals of the federal agencies charged with managing the site.

The company proposes to follow the above reclamation and seeding plan but lists alternate reclamation plans for consideration. The alternatives are (1) farming, (2) introduced grass species, (3) woody plant species, (4) recreation-wildlife use area, and (5) multiple use area.

Under the farming plan, the land would be contoured into a series of broad, flat terraces suitable for dryland farming. The primary crops would probably be hay or wheat. The final cut could be converted to small reservoirs which might supply some water for irrigation.

Species of grasses from other parts of the country or world could be planted rather than species native to the area. It is questionable that introduced species would form a stable, self-perpetuating vegetation and as such may not be very desirable.

Some tree and shrub species are to be planted as part of the reclamation procedure proposed by the company. The trees and shrubs will be native to the area and will be planted for wildlife habitat and shelter.

A recreation-wildlife use area could be created in the mine area by providing small reservoirs for fishing and swimming.

The multiple use area approach would incorporate a combination of several single usage alternatives which would reclaim the land primarily for grazing and also provide for wildlife and recreation.

Surface facilities

Most of the proposed surface facilities are located on a 160-acre tract in the $E\frac{1}{2}SE\frac{1}{4}$ of section 22 and the $W\frac{1}{2}SW\frac{1}{4}$ of section 23 (Figure 6). The company has not yet finalized the sharing of the branch rail line and access road with the Kerr-McGee mining operation to the north nor established final plans for its railroad loop. However, work on these items is well underway.

Surface facilities will include the following: truck dump, hopper, primary crusher, secondary crusher, coal storage piles (4 acres), two train-loading facilities with sampling devices, office and shop buildings (5 acres), railroad loop, flood control and mine water facilities, electric power distribution system, and other miscellaneous buildings and structures.

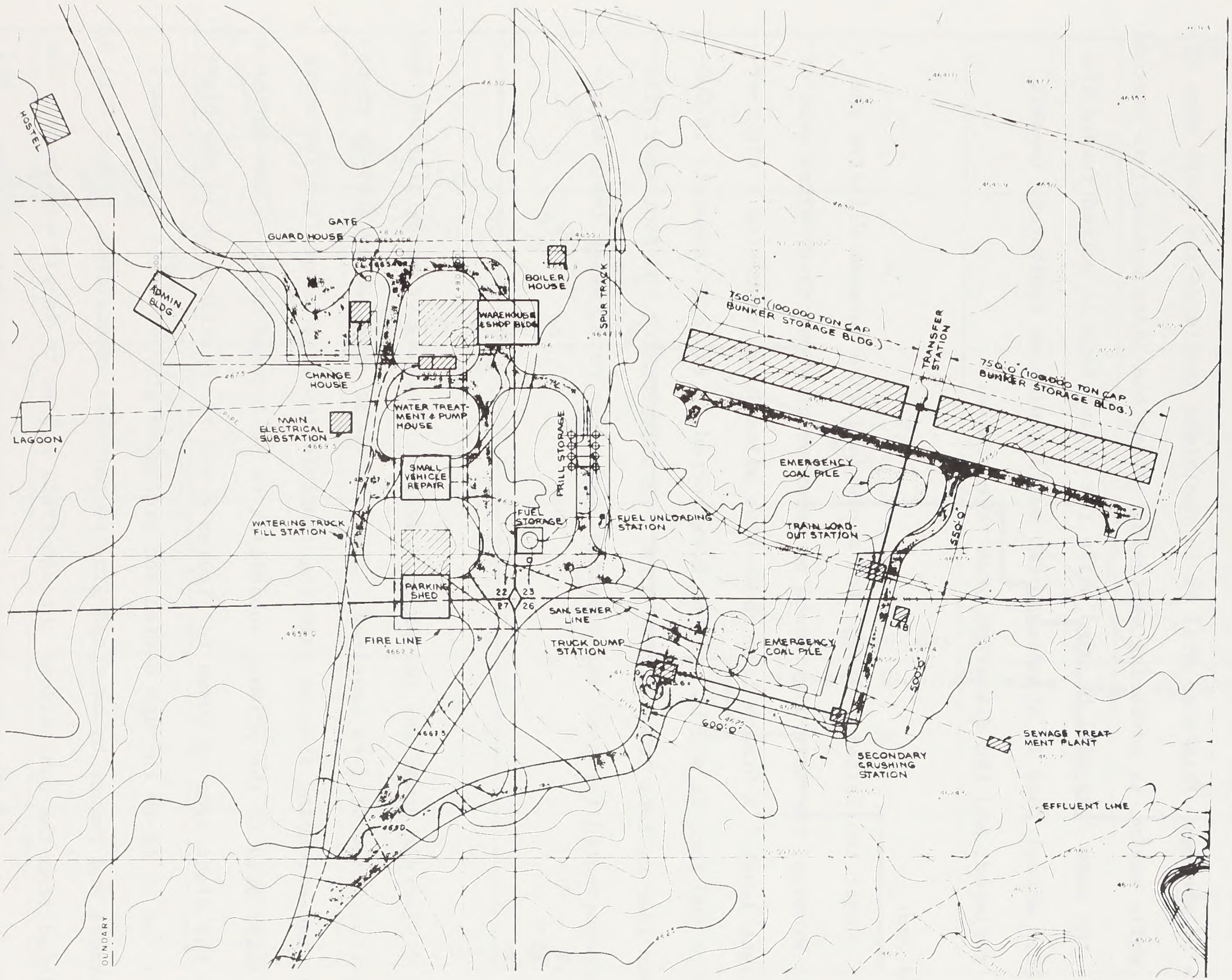


Figure 6

Surface Facilities at the Black Thunder Mine (from A.R.Co.)

Roads

Only two miles of main haul road will be constructed during the first 12 years of mining. This road will be in reclaimed spoils on the south edge of the pit while mining is advancing westward. After the lease boundary is reached in 1981, the same road will be used while the mining face is worked toward the east. When a haul road is abandoned, the surface will be contoured, topsoil will be replaced, and the disturbed area revegetated.

Railroad spur

Under the latest proposal for a new rail line between Gillette and Douglas, Wyoming, the main line would be constructed about three miles west of the present lease. A branch line about five miles long, requiring a right-of-way 200 to 400 feet in width, will be constructed to the approximately 18,000-foot spur line or loop track at the mine. An additional 3,400-foot spur line will be constructed for handling supplies, bad order cars, weigh train maneuvering, etc.

Power

Electric power for the shops, electric shovels, crushing station, and loading facilities will be required. Power is to be supplied by a 69-kv transmission line extending from an existing transmission line about 15 miles north of the lease area to the primary substation to be located north of the entrance road to the plant area as shown in Figures 6 and 7. Distribution in the plant area will be at 69-kv through buried and protected armored cable to secondary transformers and thence by overhead line to portable substations. Power will be transmitted from the substations through trail cables to in-pit equipment. The electric shovels and the mine plant will be the major consumers of power. The electrical load of each shovel will be about 800 kw and the mine plant will be about 5,000 kw.

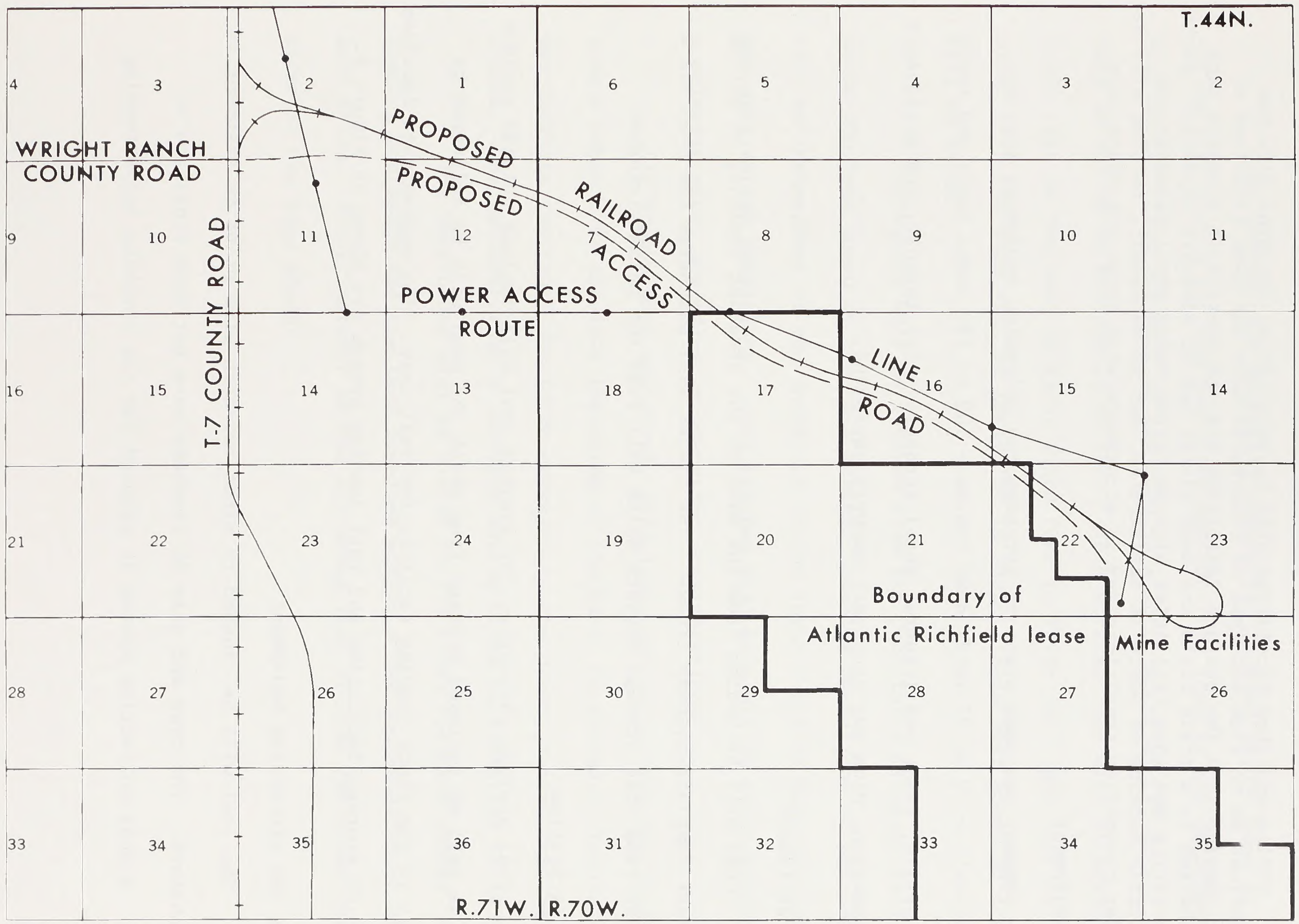


Figure 7

Proposed Access to Atlantic Richfield Mine Facilities

Office and shop

Office and shop facilities will be required at the mine site but specifications as to size and type of structures have not been finalized at present. Sewage from the surface facilities will be treated in a septic tank and discharged to a drain field and sand filter bed of adequate capacity. Waste from the office and shop facilities will be buried under spoil piles in the mine. Little burning of waste is anticipated, but if necessary, burning will be done under controlled conditions and in accordance with local and state laws.

Mining equipment

The company has made plans to purchase the following equipment for the mine: shovels - 20 to 27 yard, dump trucks - 100 to 180 tons, truck and track mounted drills, front end loaders, wheel scrapers - for topsoil, and bulldozers - for reclamation, plus any necessary support equipment.

Loading equipment

Coal will be hauled from the mine to the crushing facility by bottom and/or rear dump off-highway trucks. The trucks will discharge the coal via a drive-over ramp into storage hoppers which will feed the primary crusher.

Storage facilities

Coal storage facilities for crushed coal will include outside surface storage as well as enclosed storage from which the coal will be delivered by conveyors to the flood loading facility for rail cars. The approximate location and size of storage facilities and rail loading system are shown in Figure 6.

Crushing and processing equipment

The coal will be crushed to minus two-inch size prior to shipment to the purchasers. The type and size of crushers have not been finalized at present. A dust collection system is planned for the crushing and screening plant.

Mining Sequence

The company has presently contracted to mine 88,000 tons of coal during 1975 from a pit 250 feet wide and 400 feet long in the SE¼SW¼NE¼ of section 27. This pit will be expanded to a north-south mining face 2,000 feet long in the N½ of section 27 by 1977. This working face will be advanced 1,000 feet to the west in 1977; 1,200 feet in 1978; and 1,800 feet in 1979. After 1979 the pits will be irregular in shape. Each year about 83 acres will be mined.

Overburden will be removed from the coal for a minimum distance of about 300 feet ahead of the coal mining. Loading operations on the top bench will be independent of the operation on the lower bench to maintain coal quality and safe mining conditions. Coal benches will be mined in north-south strips at a selected width depending on operating considerations.

If proven more practical, efficient, and safe, coal may be mined in a single bench over the full thickness of the bed. Furthermore, future studies may indicate that coal should be conveyed to the plant, rather than hauled by trucks. The earliest that a conveyor system would be installed is 1979.

The overburden will be placed in its final position behind the coal loading operation and the land reshaped within a few months after an area has been mined. Ninety percent of the disturbed land will be reclaimed the year after it has been mined.

Monitoring

Two surface meteorological stations have been installed for one year and a third will be added in the area of the lease. All three will be maintained year around. They continuously record wind speed and direction, air temperature, precipitation, and relative humidity. The company also has plans to set up monitoring stations to record air quality data.

Twenty-five permanent ground water observation wells have been installed by Atlantic Richfield within the lease area. Ten of these wells have continuously operating water level recorders. Pumping tests have been and will continue to be carried out to determine the hydraulic conductivity and storage coefficients of the aquifers. Recording gauging stations will be established on Little Thunder Creek above and below the lease boundaries, and below the junction with North Prong - Little Thunder Creek. Data from all monitoring stations will be used by Atlantic Richfield, the U.S. Geological Survey and surface management agency to determine changes as mining progresses.

If additional mitigating measures, beyond those proposed, are needed, the mining and reclamation plan will be modified to show the changes.

Monitoring of herbage structure, production, and phenology is underway at the present time.

Transportation and Marketing

Coal will be loaded from storage and directly from the mine into 100-car unit trains for shipment. Southwestern Public Service Company will receive about two million tons of coal annually for its power plant in Amarillo, Texas; Oklahoma Gas and Electric will receive about three million tons annually for its power plant in Muskogee, Oklahoma; and Nebraska Public Power District will recieve about 1.8 million tons annually for its power plant in Sutherland, Nebraska. The first shipments to Amarillo, Texas, are scheduled for September 1975; however, because of anticipated delays in commencement of construction of mine and railroad facilities, actual deliveries may not take place until late 1975 or early 1976. Factors that may cause additional delays are weather conditions, equipment and materials delivery time, and manpower shortages.

CHAPTER II

DESCRIPTION OF THE EXISTING ENVIRONMENT

Climate

The description of general climate, temperature, and precipitation data in the Regional level report (Part I) adequately characterizes the climate on the Atlantic Richfield lease.

Data from the Rochelle 3E, Dull Center, and Reno weather stations, all of which are within 15 miles of the A.R.Co. lease, show the following ranges of climatic factors:

Temperature range	$-40^{o}F$ to $111^{o}F$
Mean monthly temperatures	$21^{o}F$ in January to $90^{o}F$ in July
Average $28^{o}F$ frost-free period, May 6 to September 30 - 147 days	
Chill factor in winter	$-60^{o}F$ to $-70^{o}F$ minimum
Relative humidity range	5 percent to 100 percent
Average relative humidity range	45 percent to 55 percent
Average wind speed	10 to 12 miles per hour
Average rainfall	12.72 inches per year
Average snowfall	33.6 inches per year

Tornadoes have occurred near the lease area.

In 1970 an unofficial precipitation gauge on a ranch three miles from the Atlantic lease measured six inches of precipitation (rain) in 12 hours. The accuracy of this measurement is unknown. No frequency can be assigned to the event.

Microclimate

Microclimatology is the study of slight differences in climate as between adjoining terrains due to slight differences in soil exposure, vegetation, etc. Studies conducted of microclimate are usually below the 4.5-foot level where standard weather stations are located. There are no known studies of microclimate on the Atlantic lease. The major effect on climate due to surface mining will occur in the microclimate. Changes in the microclimate may be the limiting factor in achieving revegetation success.

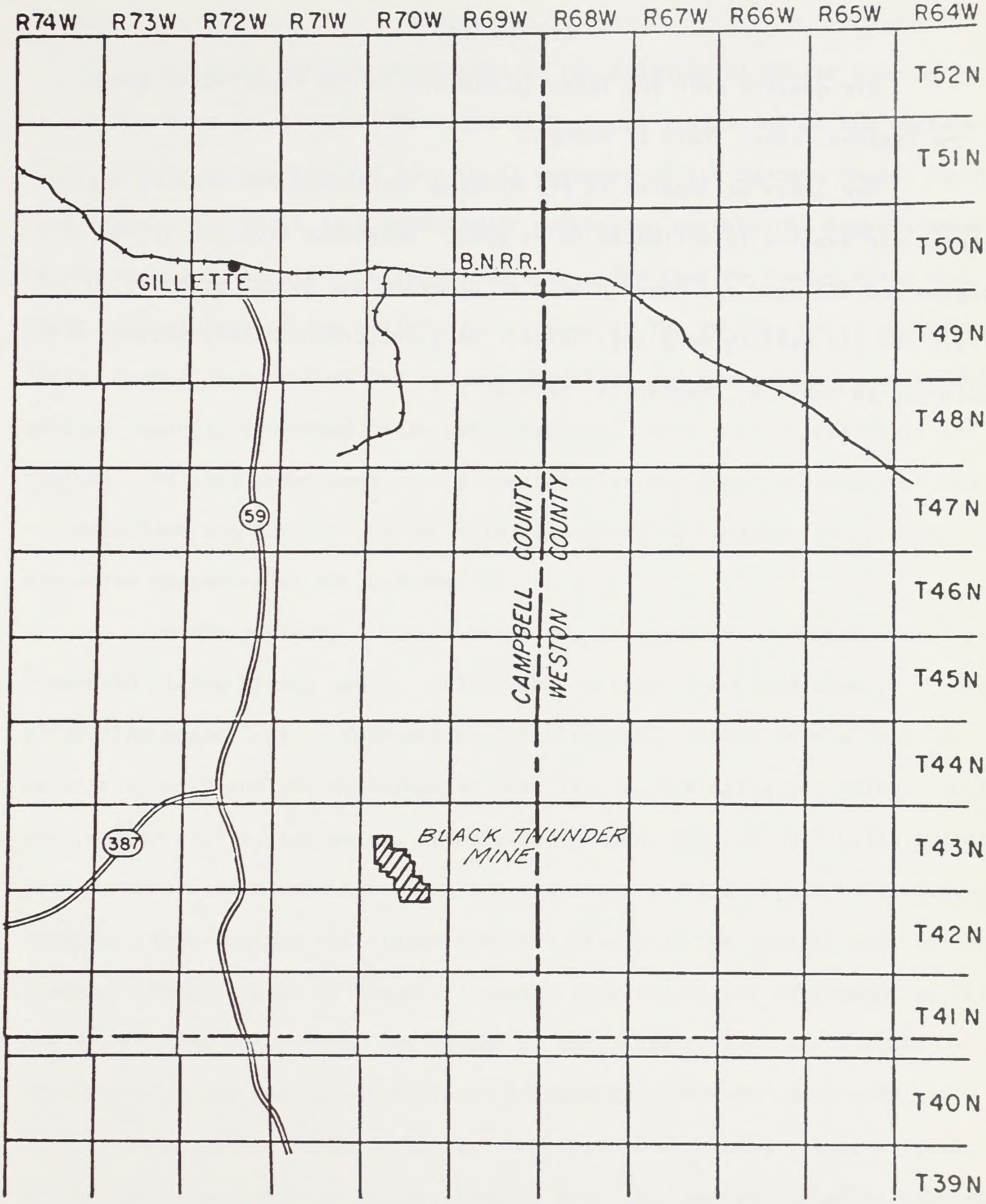


Figure 1

Location of the Black Thunder Coal Property, Atlantic Richfield Company, Campbell County, Wyoming.

Air Quality

Air quality over the lease is similar to the description given in the Regional level (Part I) report.

The lease is located in the Wyoming Intrastate Air Quality Region. Present air quality is estimated to be good. Emissions from the Cities of Douglas and Gillette and power plants at Glenrock and Wyodak probably do not affect the air quality over this lease. Data concerning mixing heights are contained in Table 6, Chapter IV, Part I.

Topography

The Black Thunder coal lease of the Atlantic Richfield Company is in the Northern Great Plains Province of Fenneman (1931) and on the eastern flank of the topographic and structural downwarp of the Eastern Powder River Coal Basin. The basin is a topographic depression between the Bighorn Mountains to the west and the Black Hills to the east. The Eastern Powder River Coal Basin is a plateau of low relief, interrupted by low rolling hills and grasslands, capped by sandstone and clinker deposits, and transected by steep-sided gulleys, washes, and broad, alluviated valleys. This part of the basin is typically rolling grasslands on a dissected plateau, local escarpments, and minor badland topography. Sparse vegetation, narrow ravines, sharp crests and pinnacles characterize the badlands.

In the vicinity of the lease site, the terrain is characterized by dissected plains having small, shallow intermittent ponds and lakes. These playa-like ponds form in depressions which probably result from a small structural warp and the differential settling of underlying deposits. To the east, steep bluffs, irregular, steep-sided ridges, and isolated hills typically form on interbedded sandstone lens and claystone and are capped by resistant clinker. These ridges and bluffs comprise breaks at the eastern edge of the plateau. Further east, a rugged, indented eastward-facing escarpment separates the upland from the smooth, low relief of the shale to the east (Figure 3). This striking and persistent feature, fringed by ponderosa pine trees, is locally known as the Rochelle Hills. The claystone forming the escarpment, the narrow ridges, and isolated buttes is protected and preserved by cappings of broken, porous red clinker. Slopes are steep or cliff-like in these areas.

The Black Thunder lease lies entirely within the drainage basin of Little Thunder Creek which flows eastward into the Cheyenne River. The creek has a narrow, meandering, steep-sided channel on the uplands that bisects the

Figure 3

Topography of the Proposed Black Thunder Mine Area.

lease and opens eastward into a wide, smooth-floored valley. Little Thunder Creek and its tributaries, North Prong and Trussler Creeks, flow intermittently.

Altitudes range from 4,847 feet in section 2 on the southeast side of the lease to about 4,630 feet where the creek enters the wide valley. The local relief averages about 250 feet. Slopes are less than 10 percent on the lease area but locally exceed 20 percent east of the burnline. The steepest topography on the lease site occurs on the southeast rim of North Prong Valley, near the northeast corner of Section 21.

Soils

This presentation of soil data for the A.R.Co. lease was taken from the Campbell County Reconnaissance Soil Survey. The field work was completed in 1939 and published by the USDA Soil Conservation Service in 1955. It must be realized that this survey is very general (Reconnaissance) although a number of series was identified. Each delineation also includes several other soil series or variations not mapped or mentioned due to minor amounts or the failure of identification according to modern concepts. Since the end of field work on this survey, major classification methods have passed through the Great Soil Group system (1938), the 7th Approximation (1964), and currently the New Soil Taxonomy (1971). Soils indentified and classified in 1939 bearing the same series name of today may not approach similarity. Interpretations are based on the modern concepts of the series identified offsite; therefore, the implied interpretations may be somewhat less desirable than the basic interpretation of 1939. Soils of the area have not changed significantly since 1939, but technology in the field of soil science has; therefore, soil inventories must be conducted on the lease area and adjacent lands in order to properly evaluate impacts on the land and the relationships to the existing environment.

A soil map showing the distribution of soil units within the lease is illustrated in Figure 4. Interpretations of the soil units are summarized in Table 1. Detailed interpretations of each soil unit are in Tables 10 through 28, Appendix C.

The following soil unit descriptions provide definition to the generalized distribution of soil on the included map for the lease area.

Ab-Arvada Clay loam

Arvada clay loam occupies sloping terraces and alluvial fans that have been formed by local alluvium from upland soils. The soil has alkaline

0 1 2
Scale in miles

LEGEND

Ab	Arvada Clay Loam
Ac	Arvada Loam
Mb	McKenzie Clay
Rb	Renohill Clay Loam
Re	Renohill Loam, Rolling Phase
Rf	Rough Broken Land
Rh	Rough Broken Land (Searing Soil Material)
Ub	Ulm Clay Loam, Shallow Phase
Uc	Ulm Loam
Ue	Ulm Loam, Rolling Phase
Wa	Wibaux-Searing Complex
Sb	Searing Gravelly Loam
	Boundary of Arco Coal Property

Figure 4
General soils map (Arco Coal Property)

Soil Unit		Erosion Hazard Potential		Revegetation Potential	Suitability for Sprinkler Irrigation	Suitability for Final Cover for Mined Land		Suitability for Transportation Routes	Suitability for Roadfill	Suitability for Sanitary Facilities: Septic-tank Absorption Fields	Suitability for Sanitary Facilities: Sewage Lagoons	Suitability for Sanitary Facilities: Sanitary Landfills (Trench)	Suitability for Small Commercial Buildings
Symbol	%Slope	** Water	Wind			In. Available	Suita-bility						
Ab	0-5	M	M	L	L	0	L	L	L	L	L	L	L
	5-10	H	M	L	L	0	L	L	L	L	M	L	L
Ac	0-5	M	M	L	L	0	L	L	L	L	H	L	L
	5-10	H	M	L	L	0	L	L	L	L	M	L	L
Mb	0-5	M	M	L	L	0	L	L	L	L	L	L	L
Rb	0-5	M	M	M	L	6	M	L	L	L	L	L	L
	5-19	H	M	M	L	6	M	L	L	L	L	L	L
Re	10-20	H	L	M	M	8	H	L	L	L	L	L	L
	20-30	H	L	M	L	8	H	L	L	L	L	L	L
	30-40	H	L	M	L	8	H	L	L	L	L	L	L
Rf	20-30	H	L	L	L	0	L	L	M	L	L	L	L
	30-40	H	L	L	L	0	L	L	L	L	L	L	L
	40-50	H	L	L	L	0	L	L	L	L	L	L	L
Rh	20-30	H	L	L	L	0	L	L	M	L	L	L	L
	30-40	H	L	L	L	0	L	L	L	L	L	L	L
	40-50	H	L	L	L	0	L	L	L	L	L	L	L
Ub	0-5	M	M	L	L	6	M	L	L	L	L	L	M
	5-10	H	M	L	L	6	M	L	L	L	L	L	M
Uc	0-5	M	M	M	M	16	M	M	M	L	L	L	M
	5-10	H	M	M	M	16	M	M	M	L	L	L	M
Ue	10-20	H	L	L	L	10	M	L	M	L	L	L	M
	20-30	H	L	L	L	10	M	L	M	L	L	L	L
	30-40	H	L	L	L	10	M	L	L	L	L	L	L
Wa	5-10	H	L	L	L	8	L	M	H	L	L	L	H
	10-20	H	L	L	L	8	L	L	H	L	L	L	M
	20-30	H	L	L	L	8	L	L	M	L	L	L	L
Sb	5-10	M	L	L	M	15	M	M	M	L	L	L	M
	10-20	H	L	L	M	15	M	M	M	L	L	L	M

*3 Classes: L = low, M = moderate, H = high.
**Estimated onsite erosion, bare soil conditions, L = 3.T./ac, M = 3-8T./ac., H = 8T./ac.
Source of interpretations: 1. Descriptions from Campbell County. 2. Soil Conservation Service soil profile descriptions. 3. SCS Form 5, Interpretation sheet. 4. Region 2, Forest Service Guidelines for Soil Interpretations, 5. SCS Guide for Interpreting Eng. Uses of soils.

Table 1

Soil Interpretation Summary*

or saline areas and bare spots where wind erosion has removed the surface and exposed the clay subsoil.

The surface horizon is light brownish gray friable clay loam about four inches thick. The soil reaction (pH) ranges from slightly to strongly alkaline. The subsoil is brown to gray clay to clay loam about 20 inches thick and has columnar to prismatic structure. The substratum is clay loam to clay to 60 inches or more. The soil reaction of the subsoil and substratum ranges from strongly to very strongly alkaline. The internal drainage is very slow. The exchangeable sodium percentage of the subsoil and substratum is high, more than 15 percent. There are an estimated 110 acres of these soils on the lease.

<u>Ac-Arvada loam</u>

Arvada loam occupies sloping terraces that have been formed by local alluvium. The soil has alkaline or saline areas and bare spots where wind erosion has removed the surface and exposed the clay subsoil. The surface horizon is 5 to 10 inches thick and ranges from sandy loam to loam. The subsoil is clay loam to clay and has columnar to prismatic structure. The substratum is clay to silty clay loam to 60 inches or more. The soil reaction of the subsoil and substratum ranges from strongly to very strongly alkaline. The internal drainage is very slow. The exchangeable sodium percentage of the subsoil and substratum is high, more than 15 percent. There are an estimated 380 acres of these soils on the lease.

<u>Mb-McKenzie clay</u>

McKenzie clay occurs in shallow, intermittent lakes on upland landforms. The soil consists of gray or dark gray clay materials which have eroded from upland soils. McKenzie clay varies in stage of development with carbonate bearing layers occurring from a few inches to several feet below the surface.

The surface layer is 2 to 5 inches thick and ranges from sandy loam to clay. The substratum is dominantly a massive, gray clay and may be more than 60 inches deep. Soil reaction is normally strongly to very strongly alkaline. Carbonate content is variable but usually increases with depth. Internal drainage is very slow. Saline and sodic salts are present in some locations. There are an estimated 140 acres of these soils on the lease.

Rb-Renohill clay loam

Renohill clay loam occupies gently sloping to rolling uplands. The parent material is weathered shale of the Wasatch, Lance, and Fort Union Formations. The clay loam surface horizon is 3 to 6 inches thick and has granular structure. The upper subsoil is clay to clay loam with prismatic and blocky structure. It normally contains no free calcium carbonate. The lower subsoil is clay loam and contains calcium carbonate. The clay loam substratum is calcareous extending to bedrock which occurs at depths of 20 to 40 inches. Soil reaction is normally neutral to moderately alkaline. The depth to calcareous material ranges from 6 to 20 inches. Internal drainage is slow. There are an estimated 510 acres of these soils on the lease.

Re-Renohill loam, rolling phase

This rolling phase differs from Renohill loam in topography, depth of soil, and degree of erosion. The topography is rolling to steep. The depth to bedrock ranges from less than 10 inches to 40 inches. Bedrock is exposed on some of the steeper slopes. Natural erosion has formed gullies in some areas. The parent material is weathered shale of the Wasatch, Lance, and Fort Union Formations. The loam to sandy loam surface layer is usually 3 to 6 inches thick. The upper subsoil is clay loam to clay with blocky and prismatic structure. It normally contains no free calcium carbonate. The lower subsoil is clay loam and contains calcium carbonate. The clay loam substratum is calcareous. Soil reaction is normally neutral to moderately alkaline. The depth to calcareous material ranges from 6 to 20 inches. Internal drainage is slow. There are an estimated 930 acres of these soils on the lease.

Rf-Rough broken land

Rough broken land consists of steep, eroded, strongly dissected areas along escarpments, steep-walled drainage channels, and rock outcrops. The parent material is interbedded shale, sandstone, and limestone. Small areas of shallow to deep soils are intermingled in rough broken land. The density of vegetation is quite variable, ranging from bare areas or sparse vegetation on rock outcrops to dense stands on the deeper soils. The physical and chemical properties of the unit are very variable. There are an estimated 750 acres of this land type on the lease.

Rh-Rough broken land, searing soil material

This unit is a complex of rough broken land and eroded areas of scoria. Rough broken land includes steep, eroded, strongly dissected areas along escarpments, steep-walled drainage channels, and rock outcrops. Scoria is a red or reddish colored shaly material and clinker produced by the heating and partial fusing of clays during burning of underlying coalbeds. Searing soil is characterized by a reddish brown gravelly loam surface horizon about five inches thick. The subsoil is a gravelly clay loam to loam which has blocky structure. The substratum is a friable, calcareous gravelly loam. Bedrock generally occurs at an average depth of two feet. This unit has fragments and blocks of red shale, stone, and clinker scattered on the surface. Internal drainage is good. There are an estimated 480 acres of this land type on the lease.

Sb-Searing gravelly loam

Searing gravelly loam is developing in scoria, the beds of burned shale and clinker that have been formed by the burning of underlying coalbeds. The scoria beds consist of red, hardened shales and red to nearly black clinkers. This soil occurs on undulating to rolling areas and includes scattered outcrops of scoria. The surface horizon is reddish brown gravelly loam about five inches thick. The subsoil is a reddish brown gravelly clay loam which has blocky structure. The substratum is friable, calcareous gravelly loam. Bedrock generally occurs at an average depth of two feet. Internal drainage is good. There are an estimated 250 acres of these soils on the lease.

Ub-Ulm clay loam, shallow phase

This phase differs from Ulm loam in topography, texture, and depth of soil. The topography is rolling and the depth to interbedded sedimentary bedrock ranges from 10 to 20 inches. The steeper slopes have some rock outcrops. The surface horizon is granular clay loam about six inches thick. The subsoil is calcareous silty clay loam with prismatic structure. The subsoil normally becomes more loamy and friable with depth. Internal drainage is moderate to slow. Soil reaction normally ranges from neutral to moderately alkaline. There are an estimated 10 acres of these soils on the lease.

Uc-Ulm loam

Ulm loam occupies gently sloping to rolling uplands. The parent material is interbedded sandstone, shale, and loamstone. The surface horizon is friable loam 3 to 7 inches thick. The subsoil ranges from sandy clay loam to clay loam and has prismatic structure. The calcareous substratum ranges from sandy loam to clay loam and extends to weathered bedrock at depths of 20 to 40 inches. Soil reaction normally ranges from neutral to moderately alkaline.

Internal drainage is good. There are an estimated 2,374 acres of these soils on the lease.

Ue-Ulm loam, rolling phase

This phase differs from Ulm loam in topography, texture, and depth to bedrock. The topography is rolling to steep and often strongly dissected. The depth to bedrock is usually less than 20 inches. Bedrock is exposed on some of the steeper slopes. The parent material is interbedded sandstone, shale, and loamstone. Gullies have formed in some areas. The soil is more friable and sandy than Ulm loam. Soil reaction normally ranges from neutral to moderately alkaline. Internal drainage is good. There are an estimated 330 acres of these soils on the lease.

Wa-Wibaux - Searing complex

This complex occupies rolling to hilly topography. It is characterized by numerous outcroppings or knolls of scoria which rise above the general surface of the land. Scoria is a reddish colored shaly material and clinker produced by the burning of underlying coalbeds. The very shallow to shallow Wibaux soils occur on the knolls and steep slopes. It includes knolls, mounds, and steep slopes where unweathered scoria is exposed. The texture is gravelly to very gravelly loam and sandy loam. The depth to bedrock is less than 10 inches to 20 inches.

Searing soil normally occurs between the knolls. The surface horizon is reddish-brown gravelly loam about five inches thick. The subsoil is a reddish-brown gravelly clay loam and has blocky structure. The substratum is friable, calcareous gravelly loam. Bedrock generally occurs at an average depth of two feet. There are an estimated 100 acres of these soils on the lease.

Stratigraphic and structural relations

The Atlantic Richfield Company's federal coal lease in T42 and 43N, R70W is on the gently dipping eastern flank of the Powder River Basin (Figure 12, Chapter IV of Part I). This broad regional downwarp contains nearly flat-lying rocks of Tertiary age in the center surrounded by Cretaceous and progressively older rocks that are upturned on the flanks of the bordering Precambrian-cored mountains--the Black Hills to the east, the Bighorn Mountains to the west, and the Laramie Range to the south (Figure 8, Chapter IV, Part I). Northward, the basin indistinctly blends into the Great Plains.

The lease is in the Gillette coal field. The following descriptions of the local geology and coal are summarized from the report of Dobbin and Barnett (U.S. Geological Survey 1927), from reports referred to in Part I of this report, and from material in the proposed mining and reclamation plans submitted by the Atlantic Richfield Company. The lease area is on the Wasatch Formation of Eocene age just west of its boundary with the underlying Fort Union Formation of Paleocene age (Figure 10, Chapter IV, Part I). The contact between the two formations is drawn at the top of the Wyodak coalbed. The coal is not exposed in the lease area; its subcrop is masked by alluvium or by the red, baked and fused rock, commonly called clinker, scoria, or porcellanite, that was formed when the coalbed burned sometime in the past. The Tongue River Member of the Fort Union Formation (U.S. Geological Survey 1927) is exposed just to the east of the lease area. It is underlain in turn by the Lebo and Tullock Members and then by the Cretaceous Lance Formation and Fox Hills Sandstone to a depth of about 3,000 feet. Increasingly older, sedimentary formations representing Mesozoic and Paleozoic ages lie below the Fox Hills Sandstone to a depth of about 14,500 feet below the surface where the top of the Pre-Cambrian igneous and metamorphic rock complex is located. Recent alluvium composed of unconsolidated sand and clay with thin gravel lenses occurs in the valleys of Little Thunder Creek and North Prong of Little Thunder Creek.

The Tongue River Member of Fort Union Formation is partially exposed on the low, east-facing escarpment east of the lease area. The Wyodak (Roland) coalbed at the top of the formation is as much as 73 feet thick in the lease area. Below the coalbed, the rocks are predominatly drab gray, brown, and dark gray to black carbonaceous clay shale and siltstone interbedded with light gray to yellowish gray, fine-grained, friable sandstone lenses and coalbeds of variable thickness. Nonpersistent beds of reddish-brown, coarse-grained, highly ferruginous sandstone and hard brown sandstone concretions form resistant ledges that are distinctive of the member. The following stratigraphic section was measured by Dobbin and Barnett (U.S. Geological Survey 1927, p. 10) about four miles east of the lease area:

Section of part of the Tongue River Member of the Fort Union Formation, between sec 21, T43N, R69W, and Little Thunder Creek in sec 34:

	Ft.	In.
Clinker of Wyodak (Roland) coalbed (top of Tongue River Member). (Bed is as much as 75 feet thick on the Atlantic Richfield lease area.)		
Shale, blue-gray, sandy	10	
Shale, carbonaceous, containing fossil leaves	6	
Coal		5
Shale, carbonaceous, and bone	1	9
Shale, blue-gray, carbonaceous	10	
Sandstone, gray, friable, with hard brown sandstone concretions containing fossil leaves	5	
Shale, carbonaceous	1	4
Shale, sandy, and sandstone, friable, with hard sandstone concretions	33	
Shale, dark, carbonaceous	9	
Shale, gray, sandy	7	

(Continued)

	Ft.	In.
Sandstone, gray, friable, with 1-inch concretionary band at top	15	
Shale, dark bluish gray, sandy, with a few hard brown sandstone concretions	16	
Sandstone, yellowish gray, friable, with a few bands of carbonaceous shale	38	
Shale, dark blue, with fossil leaves and with selenite crystals in upper part	7	
Shale, brown, carbonaceous, with fossil leaves and fragments of conifers		10
Shale, dark blue	1	2
Shale, bluish gray, with brown sandstone concretions	12	6
Sandstone, yellowish gray, friable		11
Shale, bluish gray		8
Shale, brown to black, with lenses of bright coal in upper part		2
Sandstone, yellowish, friable	6	
Shale, blue, with 1-foot lens of black carbonaceous shale near the middle	11	
Clay, yellow, sandy, with brown sandstone concretions near the base	5	
Shale, bluish gray	11	
Shale, brown, carbonaceous	10	
Concealed	6	
Sandstone, gray, friable, with 1-foot brown concretionary band at top	8	10
Largely covered but sandstone and shale exposed in places	108	
	341	7

The Wasatch Formation (the overburden to be stripped at the proposed Black Thunder mine) ranges from 15 feet thick along the eastern boundary of the lease block to 240 feet thick at the southwestern corner in sec. 3, T42N, R70W (Figure 5). Where it is not clinker in the lease area, the formation is about 80 percent drab gray clay shale and 20 percent yellowish-gray, fine-grained, poorly consolidated lenticular sandstone. Discontinuous impure coal-beds generally less than five feet thick and thinner and concretionary calcareous sandstone beds make up less than one percent. The general lithologic character of the Wasatch Formation is shown by the following logs of two core drill holes furnished by the Atlantic Richfield Company:

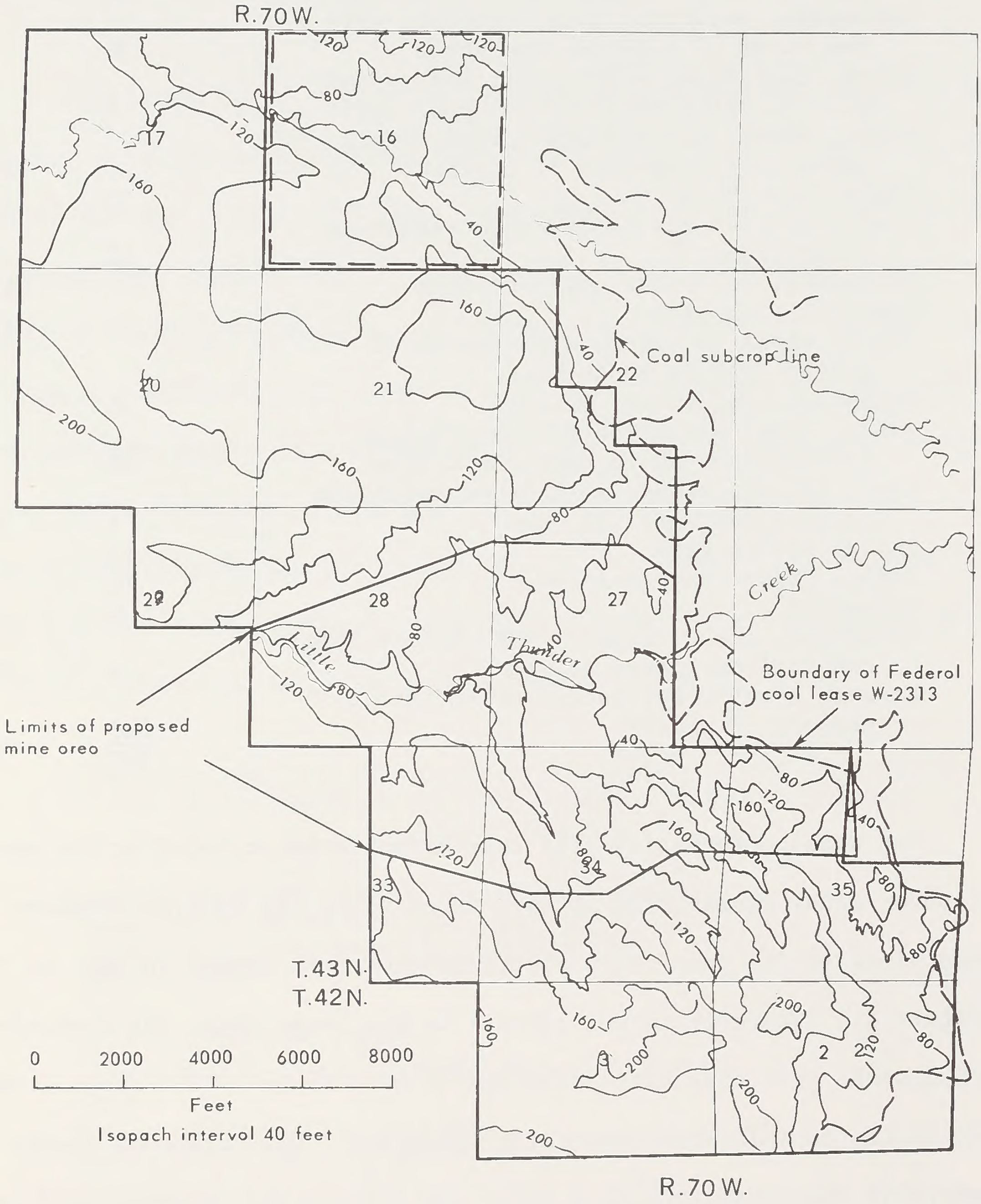


Figure 5

Thickness Map of Overburden at the Proposed
Black Thunder Mine

Sample No. *	Depth From	To	Description
Drill Hole BT-82A			(Center Sec. 34, T43N, R70W)
1	14'0"	31'7"	Clays, carbonaceous, dark gray-black, some sand and silt layers; 7' to 8' and 26'8" to 28' lost.
2	31'7"	33'9"	Sandstone, light gray, hard, calcerous.
3	33'9"	53'6"	Sands, silts, and clays, light gray, soft, 33'6" to 34' and 49' to 50' lost.
4	53'6"	56'3"	Limestone, light gray, hard, 53'8" to 56'3" lost.
5	56'3"	69'9"	Sands and silts, gray, 59'3" to 60' and 66'4" to 68' lost.
6	69'9"	82'1"	Sands, silts, and clays, gray.
7	82'1"	90'0"	Clays, gray.
8	90'0"	99'0"	Clays, carbonaceous, brownish-gray, 92' to 93'7" removed.
9	99'0"	106'2"	Clays, carbonaceous, brownish-gray, 102'7" to 104' removed.
Drill Hole BT-110 (near the northwest corner of Sec. 27, T43N, R70W).			
10	11'0"	26'8"	Clays, light to medium-gray, soft to medium hard.
11	26'8"	29'2"	Siltstone, calcareous, very hard, light gray.
12	29'2"	41'4"	Clays, light gray, some slightly carbonaceous, soft to hard.
13	41'4"	43'0"	Sandstone, very fine, very hard, light gray.
14	43'0"	46'2"	Clays, some silt, light gray, medium soft to hard.
15	46'2"	49'6"	Siltstone, moderate clay, light gray, medium soft to medium hard.

Drill Hole BT-110 (cont)

16	49'6"	52'9"	Clays, silty, some highly carbonaceous, light gray to dark gray, medium soft to medium hard.
17	52'9"	54'1"	Siltstone, very hard, slightly carbonaceous, light gray.
18	54'1"	77'11"	Clays, some silt, light gray to dark gray, soft to hard.
19	77'11"	82'11"	Clays, trending from silty to carbonaceous, soft to medium hard

* Numbers refer to analyses listed in Tables 2-5.

The cores were submitted to the Colorado School of Mines Research Institute for analyses to provide information on potential toxicity to plant growth and other revegetation problems that might be encountered if the material was placed at the top of the graded spoil piles in post-mining reclamation. The analyses by semiquantitative x-ray fluorescence spectrography are shown in Table 2; chemical analyses are reported in Tables 3 and 4. Water-holding capacities and settling characteristics are shown in Table 5. The analyses are in general normal for these types of sedimentary rocks (see section on trace elements in Chapter IV, Part I). However, the analyses indicate that the following potential problems to plant establishment and growth might arise if certain layers of the material became the soil zone:

Interval	Indicated Potential Problem
Drill Core BT-82A	
11'6" to 106'2"	deficiency of available phosphorous and nitrate
31'7" to 33'9"	extractable lead
53'6" to 106'2"	plant-available boron
99'0" to 106'2"	high exchangeable sodium percentage, i.e., poor physical properties in regard to water infiltration and erosion

Interval	Indicated Potential Problem
Drill Core BT-110	
11'0" to 82'11"	deficiency of available phosphorus and nitrate
11'0" to 26'8"	plant-available boron
26'8" to 29'2"	deficiency of available potassium and high ratio of chelatable iron to chelatable copper and zinc
41'4" to 43'0"	plant-available boron
46'2" to 49'6"	deficiency of available potassium
49'6" to 52'9"	plant-available boron
52'0" to 54'11"	high ratio of chelatable iron to chelatable copper and zinc
77'11" to 82'11"	plant-available boron and relatively poor physical properties

These problems are not of major consequence because the mining, reclamation, and rehabilitation plans as outlined by the Atlantic Richfield Company include methods of correction and control. The proposed truck and power shovel mining method facilitates selective removal, special handling and burial of any toxic material found in the overburden. Application of specially formulated fertilizers will correct the deficiencies of phosphorous, nitrate and potassium.

Table 2

Semiquantitative Spectrographic Analyses in Parts Per Million of Core Samples of Overburden in Drill Holes BT-82A and BT-110 at the Proposed Black Thunder Mine, Campbell County, Wyoming

Sample No.*	Cu	Zn	Pb	Fe	Ni	Rb	Ba	Sr	Ti	Zr	V	Nb	Cr	Mo	U	Mn	Y
Drill Hole BT-82A																	
1	80	220	400	44,000	30	160	1,500	260	2,500	430	-	-	-	-	50	410	90
2	60	150	80	17,000	-	220	1,500	240	1,500	170	-	-	-	-	-	210	70
3	30	90	90	11,000	60	140	930	180	1,800	620	-	-	70	-	70	220	90
4	70	120	280	20,000	90	50	1,100	180	1,800	630	-	-	-	-	-	300	40
5	90	120	60	23,000	30	170	990	120	2,100	580	310	50	-	30	80	200	100
6	20	140	-	38,000	60	140	1,300	110	2,500	230	-	-	-	-	-	280	40
7	20	200	220	33,000	100	230	1,200	160	2,600	310	230	30	-	-	80	110	20
8	110	180	350	15,000	120	290	770	160	3,300	270	-	-	80	-	-	-	40
9	120	120	60	16,000	40	210	880	150	3,500	320	-	30	-	-	-	160	100
Drill Hole BT-110																	
10	90	160	-	16,000	80	220	720	170	2,100	1,200	-	-	-	-	-	110	50
11	60	170	200	180,000	-	80	1,300	140	1,100	290	-	-	290	-	-	1,600	-
12	110	170	250	27,000	90	160	1,500	300	2,500	370	-	30	80	40	-	500	20
13	130	170	-	180,000	80	190	1,400	210	2,300	250	-	70	130	-	130	1,700	-
14	80	100	280	38,000	30	200	1,600	370	3,100	520	-	40	-	30	-	380	100
15	50	170	140	7,100	70	140	1,500	270	1,800	620	-	20	-	110	-	40	110
16	130	240	230	19,000	80	260	880	210	2,700	470	-	30	10	30	40	250	120
17	140	180	240	350,000	320	320	140	170	2,300	280	-	-	250	-	-	2,200	110
18	30	170	-	22,000	60	270	1,700	250	2,000	380	150	30	80	50	-	390	220
19	140	180	200	21,000	80	190	700	160	3,000	290	300	-	120	-	-	90	60

*See log of core for sample description.

Sample No.	depth From	depth To	pH Water (1)	pH 0.01 M $CaCl_2$ Solution (2)	Soluble Salts Extract Conductivity millimhos/cm (1)	Soluble Salts Extract Conductivity millimhos/cm (3)	Sodium Water Soluble (milliequivalents/100 g)	Sodium NH_4 Acetate Soluble (milliequivalents/100 g)	Cation Exchange Capacity (milliequivalents/100 g)	Exchangeable Sodium Percentage (4)	Potassium Available ppm	Phosphorus $NaHCO_3$ Soluble ppm	Organic Matter %	Nitrate ppm	Sulfide ppm
	Drill Hole BT-82A														
1	14'0"	31'7"	8.62	7.89	0.46	2.0	0.47	1.30	13.3	6.2	316	0.2	1.2	<2	<10
2	31'7"	33'9"	9.07	7.92	0.26	3.0	0.32	0.57	6.7	3.7	203	0.2	0.1	<2	20
3	33'9"	53'6"	8.36	7.58	0.33	2.0	0.42	0.73	8.7	3.6	239	0.1	0.5	<2	30
4	53'6"	56'3"	8.66	7.85	0.37	2.4	0.32	0.67	7.2	4.9	202	<0.1	0.6	<2	10
5	56'3"	69'9"	8.26	7.52	0.36	1.5	0.46	0.65	12.0	1.6	200	0.1	1.1	<2	40
6	69'9"	82'1"	8.04	7.22	0.36	2.1	0.32	0.70	6.3	6.0	197	<0.1	1.0	<2	50
7	82'1"	90'0"	8.34	7.95	0.46	1.6	0.53	1.74	14.6	8.3	443	0.3	1.8	<2	50
8	90'0"	99'0"	7.70	7.39	0.34	1.1	0.50	1.52	23.0	4.4	317	0.3	6.5	<2	30
9	99'0"	106'2"	8.02	7.70	0.26	0.9	0.26	2.00	9.8	17.8	426	0.7	2.2	<2	30
	Drill Hole BT-110														
10	11'0"	26'8"	6.81	6.27	1.00	3.5	0.70	1.43	25.2	2.9	385	0.9	1.7	<2	10
11	26'8"	29'2"	9.01	7.57	0.22	3.9	0.15	0.26	4.8	2.3	113	0.2	2.7	<2	60
12	29'2"	41'4"	8.36	7.47	0.52	1.9	0.63	1.30	15.9	4.2	336	0.4	1.4	<2	20
13	41'4"	43'0"	8.60	7.50	0.30	2.1	0.35	0.75	11.3	3.5	283	0.2	2.4	<2	30
14	43'0"	46'2"	8.63	7.56	0.44	1.8	0.42	1.03	15.9	3.8	271	0.4	0.4	<2	20
15	46'2"	49'6"	8.59	7.44	0.35	1.8	0.37	0.60	7.2	3.2	169	0.1	0.2	<2	20
16	49'6"	52'9"	8.23	7.26	0.52	1.9	0.63	1.30	19.1	3.5	358	0.1	1.5	<2	10
17	52'0"	54'1"	8.73	7.27	0.18	2.0	0.19	0.57	9.4	4.1	254	0.4	2.8	<2	30
18	54'1"	77'11"	8.10	7.42	0.57	2.2	0.59	1.13	18.5	2.9	394	0.2	0.6	<2	10
19	77'11"	82'11"	6.89	6.35	0.89	3.0	0.80	1.35	16.3	3.4	393	0.2	6.0	<2	20

1/ Sample/Extract Ratio: 1 to 2
2/ Sample/Extract Ratio: 1 to 5
3/ Calculated conductivity for a saturation extract; basis, 1 to 2 ratio conductivity and 1/3-bar water holding capacity data.
4/ Calculated from the equation exchangeable sodium percentage = $\frac{(100)(\text{Na, ammonium acetate soluble} - \text{Na, water soluble})}{(\text{cation exchange capacity})}$

Table 3

Chemical Analyses for Available Nutrients in Core Samples of Overburden from Drill Holes BT-82A and BT-110 at the Proposed Black Thunder Mine, Campbell County, Wyoming

Table 4

Chemical Analyses for Toxic Elements in Core Samples of Overburden from Drill Holes BT-82A and BT-110 at the Proposed Black Thunder Mine, Campbell County, Wyoming

Sample No.	Depth From	Depth To	DTPA Extractable Cu ppm	DTPA Extractable Fe ppm	DTPA Extractable Mn ppm	DTPA Extractable Zn ppm	Arsenic Total ppm	Boron Water Soluble ppm	Copper Total ppm	Fluoride Total ppm	Lead Total ppm	Lead, 2.5% Acetic Acid Soluble ppm	Mercury Total ppm	Molybdenum Total ppm	Selenium Available ppm	Uranium Total ppm	Uranium Water Soluble ppm
	Drill Hole BT-82A																
1	14'0"	31'7"	2.0	220	5.6	10.6	6	1.9	62	200	35	<5	0.16	0.8	0.03	3	<0.02
2	31'7"	33'9"	1.6	296	6.8	14.8	3	0.4	20	200	40	24	0.10	0.8	0.03	2	<0.02
3	33'9"	53'6"	2.2	312	9.2	8.8	6	1.4	17	100	32	<5	0.10	0.3	0.02	3	<0.02
4	53'6"	56'3"	1.6	288	7.2	11.2	5	<0.2	17	100	32	6	0.09	0.6	0.03	2	<0.02
5	56'3"	69'9"	2.0	360	10.4	10.6	5	2.7	20	100	35	<5	0.11	0.3	0.02	2	0.06
6	69'9"	82'2"	1.4	464	9.0	7.2	7	2.6	13	100	27	<5	0.09	0.5	0.02	2	<0.02
7	82'1"	90'0"	2.2	88	2.0	4.4	5	2.4	27	100	37	<5	0.18	0.3	0.03	5	<0.02
8	90'0"	99'0"	4.4	88	0.8	8.0	6	3.9	32	200	32	<5	0.16	0.3	0.03	3	0.02
9	99'0"	106'2"	2.8	88	1.0	5.2	5	2.6	32	200	40	<5	0.18	0.2	0.03	5	<0.02
	Drill Hole BT-110																
10	11'0"	26'8"	2.0	76	8.0	6.8	10	2.2	35	200	30	<5	0.17	0.6	0.03	4	0.10
11	26'8"	29'2"	0.8	564	15.6	2.0	4	1.6	12	200	27	6	0.07	1.4	0.02	<1	<0.02
12	29'2"	41'4"	6.4	152	6.8	28.6	6	1.9	30	200	57	<5	0.15	0.2	0.02	5	<0.02
13	41'4"	43'0"	3.2	408	14.8	4.4	4	2.2	20	200	35	<5	0.14	0.7	0.02	4	<0.02
14	43'0"	46'2"	2.0	152	6.6	5.2	8	1.2	20	100	33	<5	0.12	0.9	0.04	4	<0.02
15	46'2"	49'6"	0.8	76	2.2	5.2	7	1.1	17	100	27	<5	0.08	0.4	0.04	2	<0.02
16	49'6"	52'9"	1.4	112	4.8	5.0	10	3.0	30	200	59	<5	0.17	0.4	0.03	5	<0.02
17	52'0"	54'11"	0.8	556	16.8	1.0	8	0.6	18	300	37	<5	0.09	0.1	0.03	3	<0.02
18	54'1"	77'11"	2.0	132	4.6	6.0	10	0.9	28	300	35	<5	0.17	0.3	0.03	4	<0.02
19	77'11"	82'11"	6.4	176	8.4	12.4	6	2.8	57	300	37	<5	0.30	1.1	0.03	5	0.08

Table 5

Water Holding Capacities and Settling Characteristics of Core Samples of Overburden (Wasatch Formation) in Drill Holes BA-82A and BT-110 at the Proposed Black Thunder Mine, Campbell County, Wyoming

Sample No.	Depth From	Depth To	Water Holding Capacity* 1/3-Bar Section %(dry sample wt. basis)	Settling Characteristic** Final Pulp Volume, ml
	Drill hole BT-82A			
1	14'0"	31'7"	22.7	48
2	31'7"	33'9"	8.7	30
3	33'9"	53'6"	16.9	37
4	53'6"	56'3"	15.7	30
5	56'3"	69'9"	24.1	60
6	69'9"	82'1"	17.5	47
7	82'1"	90'0"	28.8	45
8	90'0"	99'0"	30.8	68
9	90'0"	106'2"	31.4	83
	Drill Hole BT-110			
10	11'0"	26'8"	28.5	40
11	26'8"	29'2"	5.7	30
12	29'2"	41'4"	27.3	53
13	41'4"	43'4"	14.7	30
14	43'0"	46'2"	24.7	62
15	46'2"	49'6"	19.3	60
16	49'6"	52'9"	27.6	50
17	52'0"	54'1"	9.0	30
18	54'1"	77'11"	26.0	70
19	77'11"	82'11"	30.2	90

*Ceramic permeable pressure-plate method, 80°F, deionized water.
**15 g sample dispersed in 1,000 ml deionized water; 3 gpl $CaCL_2$ added to water; 30 min settling time in 1-liter graduate.

The Wyoming Highway Department encountered no difficult engineering or construction problems in cuts for an interstate highway through the Fort Union and Wasatch Formations in Campbell County; however, all rocks were near surface and weathered and, thus, were rippable with standard road-building equipment, and blasting was not required (Sherman 1974). Unweathered bedrock commonly is found at depths less than 25 feet and has a bearing strength of 3 to 7 tons per square foot. Unweathered bedrock in surface mines probably will have to be blasted before removal. Landslides or other slope stability problems occur only locally in oversteepened cuts. Shale from the Fort Union and Wasatch Formations used in fills breaks down and deteriorates in less than one year. Consolidation and differential settling of the fill ranges from 10 to 20 percent; shale is unstable in slopes greater than 2:1; some clay is compressible, but no problems were encountered unless slope ratios exceeded 2:1 (Sherman 1974).

Strata on the lease area are essentially flat lying but do have imperceptable regional dip of about one degree to the west as shown by the structure contours on Figure 6. Minor local interruptions to the regional dip consist of shallow basins in the northern and southern parts of the lease separated by a high on the line between sections 21 and 28, T43N, R70W, just north of Little Thunder Creek (Figure 6).

Major faults are not known to offset the rocks in the lease area; faults with small displacement may be present, similar to those described by Osterwald and Dean (U.S. Geological Survey 1961, pl. 28). Detailed studies have not been made of the attitude and spacing of joints or fractures in rocks on the lease area; the joint system probably will be the same as regionally developed in the Great Plains; that is, two prominent sets, one striking northwest and the other northeast (U.S. Geological Survey 1961, pl. 28).

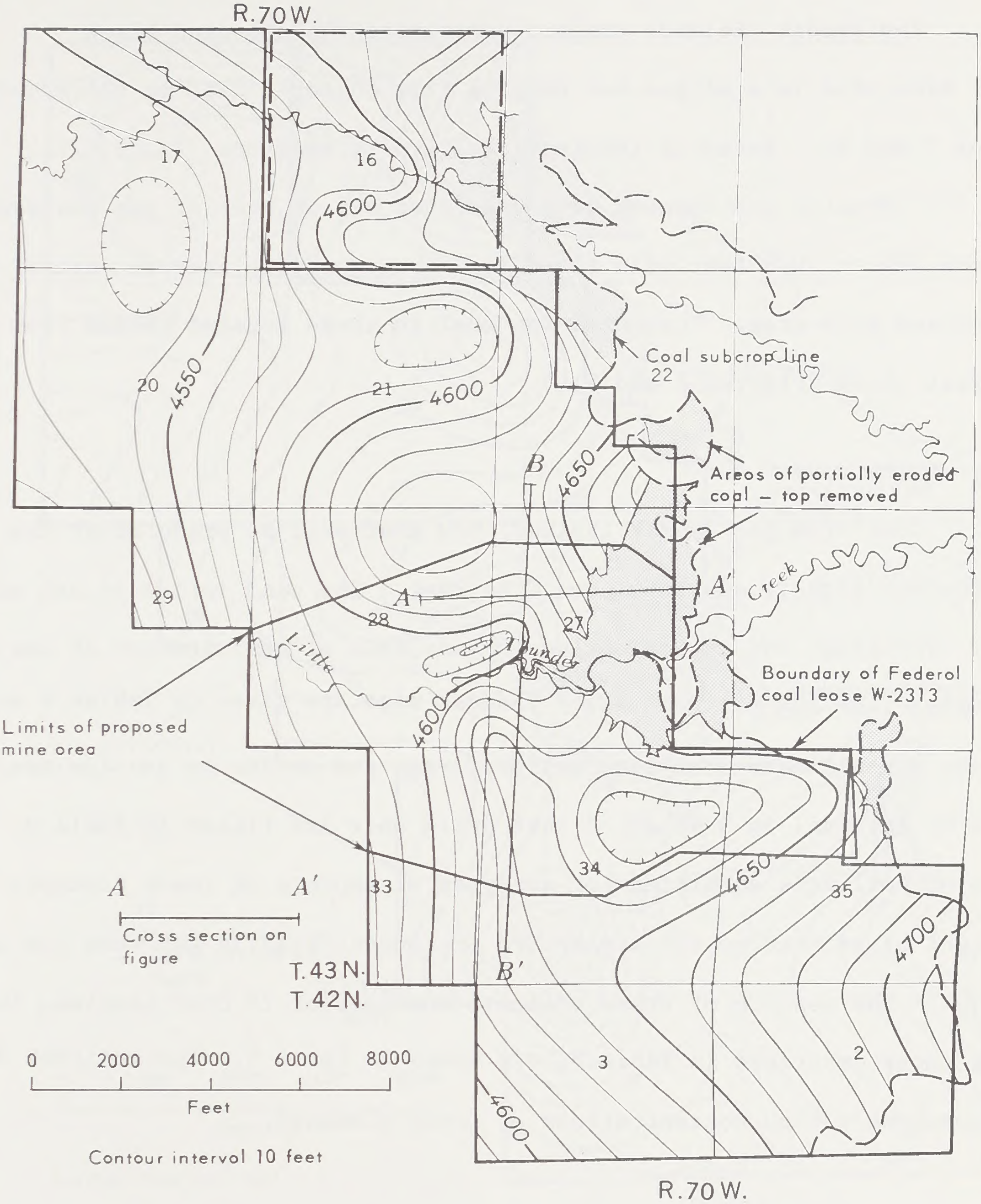


Figure 6
Structure Contour Map on Top of the Coalbed at the
Black Thunder Coal Property

Coal

The Wyodak (Roland) coalbed underlying the proposed Black Thunder mine area is a single bed ranging from 60 to 73 feet in thickness (Figures 7 and 8). Areas of thickest coal are in sections 17, 21, 27, 34 and 35. Erosion and burning have destroyed all or part of the coalbed in a zone 500 to 1000 feet wide along its subcrop on the eastern edge of the proposed mine area. The remaining coal in these locales ranges from zero to 60 feet thick (Figures 7 and 8).

Quality of the coal

Coal from the Wyodak (Roland) bed that will be produced at the Black Thunder mine is subbituminous C in rank. The coal is low in ash and sulfur. The range and typical values of analyses of coal and ash of coal in 102 samples from the proposed Black Thunder mine are given in Tables 6 and 7. Proximate and ultimate analyses, sulfur forms, and oxides in ash for coal samples by interval in a selected core drill hole are listed in Table 8. Samples of coal were submitted for analyses of amounts of trace elements that might be emitted to the atmosphere or concentrated in ash when the coal is burned. The results of trace elements analyses of 29 coal samples, including those described in Table 8, are shown in Table 9. The analyses do not show anomalously high concentrations of trace elements.

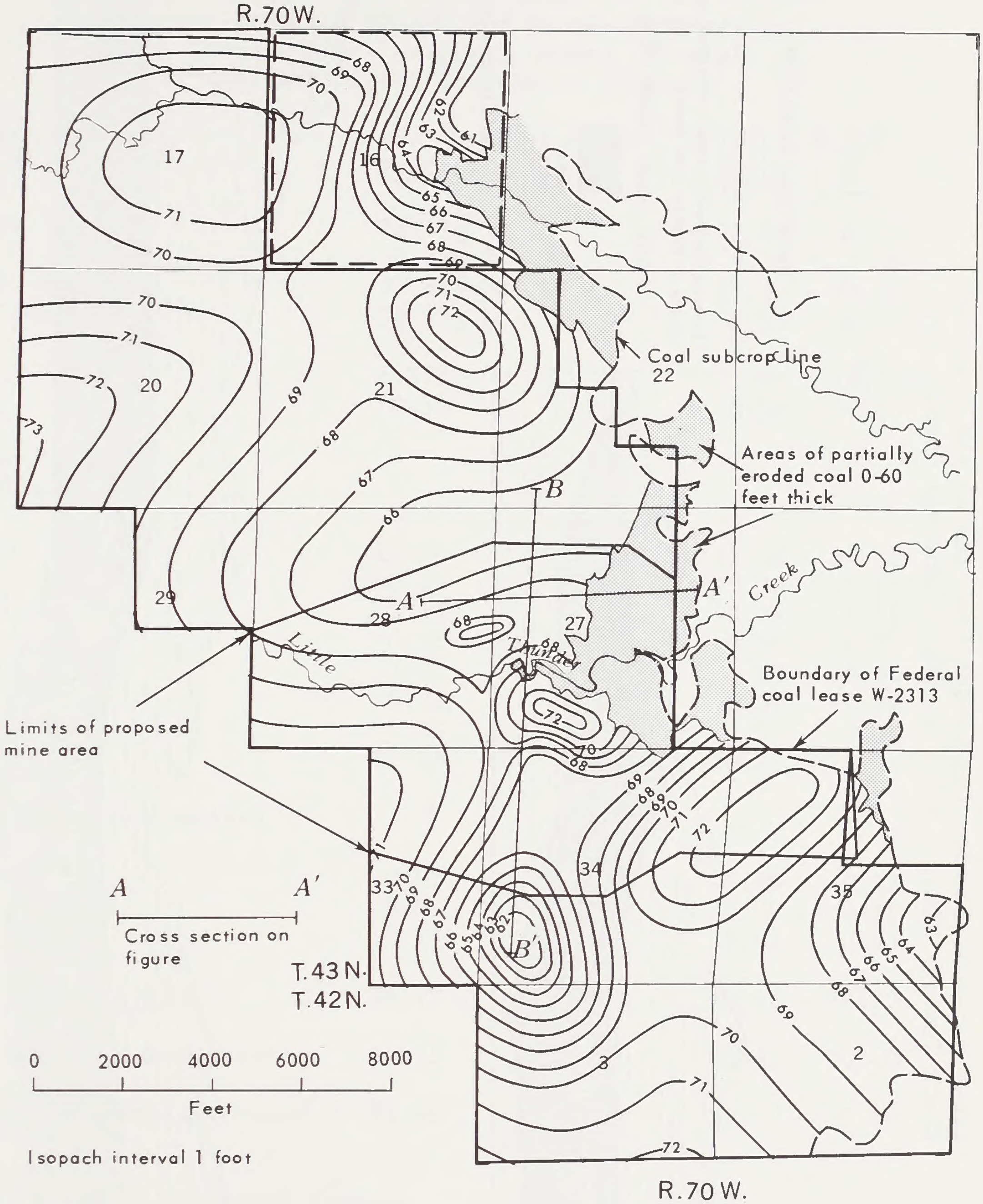


Figure 7

Thickness Map of Coalbed at the Black Thunder Property

Figure 8

Cross Sections Showing the Wyodak Coal Bed at the Proposed Black Thunder Mine, T.43N., R. 70W., Campbell County, Wyo.

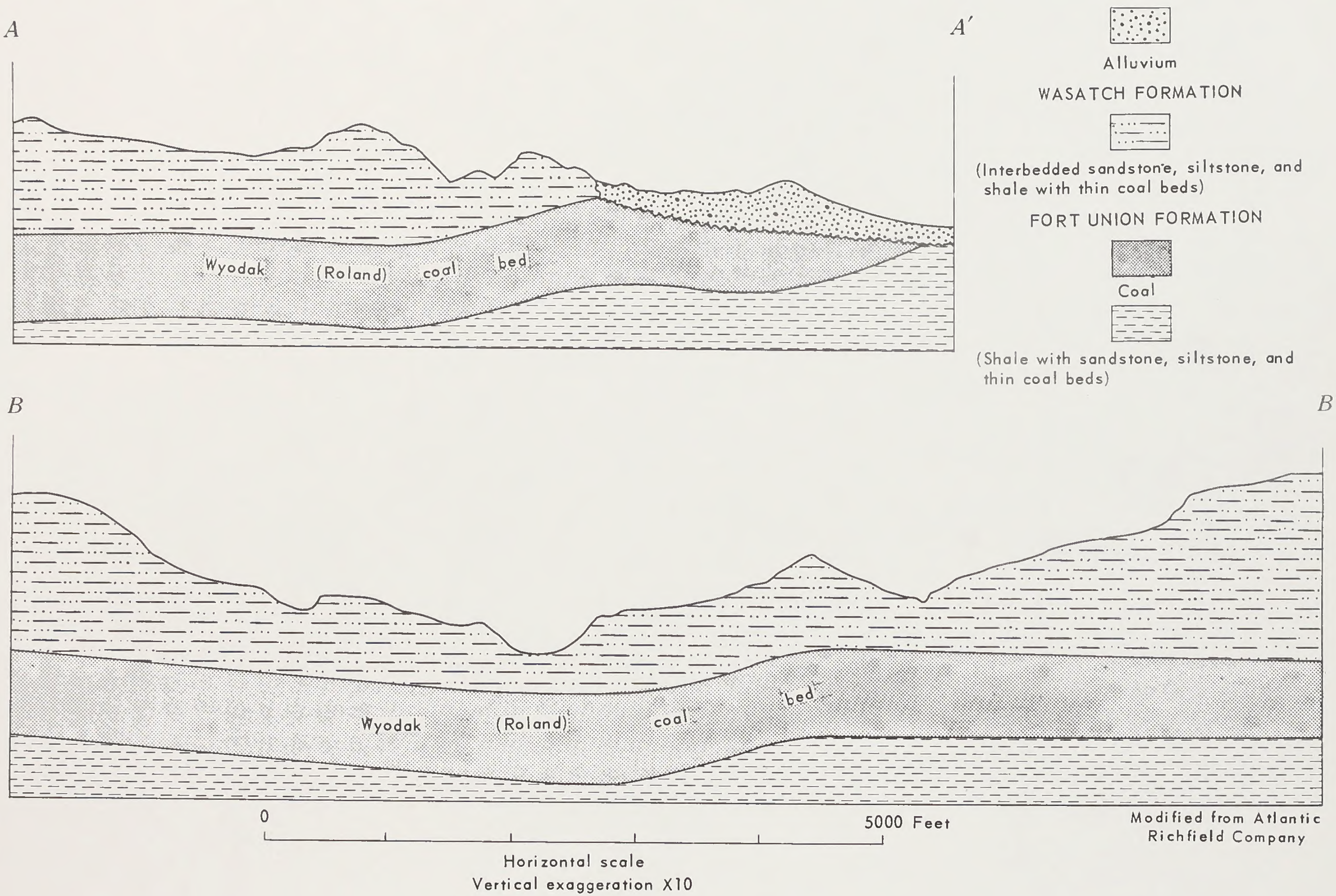


Table 6

Range and Typical Values of Analyses From 102 Samples of Coal From the Roland Bed at the Proposed Black Thunder Mine, Campbell County, Wyoming. (All analyses except Btu are in percent)

	Typical	Range
Proximate Analysis		
As Received		
Moisture	28.13	12.18 - 34.52
Ash	4.75	3.26 - 7.36
Volatile Matter	31.88 - 32.19	27.39 - 43.36
Fixed Carbon	34.93	30.96 - 40.02
Btu	8,622	7,765 - 10,590
Sulfur	0.33	0.09 - 0.59
Ultimate Analysis		
As Received		
Moisture	28.36	12.18 - 34.52
Carbon	50.19	45.76 - 61.19
Hydrogen	3.55	3.09 - 4.20
Nitrogen	0.71	0.49 - 1.02
Chlorine	0.01	0.00 - 0.04
Sulfur	0.33	0.09 - 0.59
Ash	4.75	3.26 - 7.36
Oxygen	12.31	10.25 - 16.44
Sulfur Forms (76 samples)		
Pyritic	0.05	0.00 - 0.17
Sulfate	0.02	0.00 - 0.11
Organic	0.25	0.01 - 0.45
Equilibrium Moisture	24.72	19.23 - 27.72
Btu at Equilibrium Moisture	9,031	8,539 - 9,740
Hardgrove Grindability Index	53.65	37.00 - 67.50

Source: Atlantic Richfield Company

Table 7

Range and Typical Values of Analyses of Ash From 90 Samples of Coal From the Roland Bed at the Proposed Black Thunder Mine, Campbell County, Wyoming

MINERAL ANALYSIS OF ASH
(Percent)

	Typical	Range
Phosphorous Pentoxide	0.94	0.07 - 2.80
Silica	29.51	19.64 - 43.31
Ferric Oxide	4.95	2.41 - 6.78
Alumina	15.49	10.57 - 19.73
Titania	1.19	0.11 - 1.59
Lime	23.93	14.70 - 34.40
Magnesia	4.85	3.22 - 7.43
Sulfur Trioxide	15.68	7.64 - 24.50
Potassium Oxide	0.33	0.05 - 1.67
Sodium Oxide	1.05	0.00 - 2.45
Undetermined	2.41	0.00 - 12.78
Alkalies as Na_2O, DCB	0.10	0.02 - 0.21
Silica Value	48.33	34.11 - 56.99

Fusion Temperature of Ash
(Degrees Fahrenheit)

	Reducing		Oxidizing	
	Typical	Range	Typical	Range
Initial Deformation	2160	1950 - 2610	2210	2020 - 2700
Softening (H=W)	2210	2045 - 2700	2258	2120 - 2700
Softening (H=1/2W)	2238	2080 - 2700	2289	2130 - 2700
Fluid	2284	2090 - 2700	2339	2140 - 2700

Source: Atlantic Richfield Company

Analysis Report Number:	72-15420		72-15421		72-15422		72-15423		72-15424		72-15425		72-15426	
	As Received	Moisture Free	As Received	Moisture Free	As Received	Moisture Free	As Received	Moisture Free	As Received	Moisture Free	As Received	Moisture Free	As Received	Moisture Free
PROXIMATE ANALYSIS														
Moisture	31.84	xxxxx	27.83	xxxxx	28.47	xxxxx	29.33	xxxxx	29.44	xxxxx	29.96	xxxxx	28.14	xxxxx
Ash	5.48	8.04	4.44	6.15	3.84	5.37	3.45	4.88	3.32	4.70	4.68	6.68	3.13	4.36
Volatile Matter	32.34	47.44	33.93	47.01	35.60	49.77	33.62	47.58	31.62	44.81	30.08	42.94	32.92	45.81
Fixed Carbon	30.34	44.52	33.80	46.84	32.09	44.86	33.60	47.54	35.62	50.49	35.28	50.38	35.81	49.83
Btu	8099	11882	8552	11850	8556	11962	8420	11915	8495	12040	8187	11689	8708	12118
Sulfur	0.60	0.88	0.38	0.53	0.16	0.23	0.08	0.11	0.04	0.06	0.13	0.18	0.13	0.18
ULTIMATE ANALYSIS														
Carbon	46.67	68.47	50.42	69.86	50.41	70.47	50.37	71.28	50.30	71.28	49.25	70.31	51.19	71.24
Hydrogen	3.42	5.02	3.51	4.86	3.58	5.01	3.43	4.86	3.44	4.88	3.31	4.73	3.38	4.71
Nitrogen	0.67	0.99	0.76	1.05	0.70	0.98	0.69	0.98	0.60	0.85	0.57	0.82	0.70	0.97
Chlorine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sulfur	0.60	0.88	0.38	0.53	0.16	0.23	0.08	0.11	0.04	0.06	0.13	0.18	0.13	0.18
Ash	5.48	8.04	4.44	6.15	3.84	5.37	3.45	4.88	3.32	4.70	4.68	6.68	3.13	4.35
Oxygen (diff.)	11.32	16.60	12.66	17.55	12.84	17.94	12.65	17.89	12.86	18.23	12.10	17.28	13.33	18.54
SULFUR FORMS														
Pyritic	0.01	0.01	0.04	0.06	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sulfate	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.03
Organic	0.58	0.85	0.33	0.45	0.14	0.20	0.06	0.09	0.03	0.05	0.12	0.17	0.10	0.14
FUSION TEMPERATURE OF ASH														
Degrees F.	Reducing	Oxidizing	Reducing	Oxidizing	Reducing	Oxidizing	Reducing	Oxidizing	Reducing	Oxidizing	Reducing	Oxidizing	Reducing	Oxidizing
Initial Deformation	2160	2225	2280	2370	2420	2445	2430	2455	2370	2415	2140	2220	2335	2345
Softening (H=W)	2180	2230	2320	2375	2425	2460	2435	2485	2405	2425	2160	2235	2350	2360
Softening (H=1/2W)	2190	2235	2340	2400	2435	2480	2440	2500	2440	2445	2180	2250	2375	2385
Fluid	2205	2495	2360	2440	2490	2500	2465	2520	2470	2480	2200	2410	2380	2390
OXIDE COMPOSITION OF ASH														
Phosphorous pentoxide, P_2O_5	1.79		1.47		0.54		0.83		0.68		1.80		1.75	
Silica, SiO_2	31.19		21.47		20.58		23.02		21.49		45.58		25.49	
Ferric oxide, Fe_2O_3	4.48		6.99		5.34		5.35		5.62		4.02		6.81	
Alumina, Al_2O_3	18.14		18.81		16.50		18.27		19.51		20.04		15.72	
Titania, TiO_2	1.20		0.65		1.92		1.35		1.30		1.86		0.60	
Lime, CaO	21.98		26.77		31.64		29.65		30.29		18.39		21.31	
Magnesia, MgO	3.81		5.56		6.39		6.94		5.82		4.69		7.26	
Sulfur trioxide, SO_3	14.45		14.68		13.30		11.14		11.15		1.21		17.17	
Potassium oxide, K_2O	0.72		0.72		0.73		0.80		0.85		0.47		1.11	
Sodium oxide, Na_2O	1.35		1.95		2.17		2.29		2.37		1.42		2.56	
Undetermined	0.89		0.93		0.89		0.36		0.92		0.52		0.22	
Alkalies as Na_2O, DCB	0.15		0.15		0.14		0.14		0.14		0.12		0.14	
THICKNESS OF COAL SAMPLED	Hole No. 8T-82 103' - 110'		Hole No. BT-82 111' - 121'		Hole No. 8T-82 121' - 131'		Hole No. 8T-82 131' - 141'		Hole No. 8T-82 141' - 151'		Hole No. 8T-82 151' - 161'		Hole No. 8T-82 161' - 173'	

SOURCE: Atlantic Richfield Company.

Table 8

Analyses of Coal and Ash of the Coal Sample by Interval in a Selected Core Hole from the Proposed Black Thunder Mine, Campbell County, Wyoming
(All values except Btu and fusion temperature are in percent. Analyses by Commercial Testing and Engineering Company.)

Table 9

Semiquantitative Spectrographic Analyses (in parts per million) of Core Samples from the Roland Coal Bed at the Proposed Black Thunder Mine, Campbell County, Wyoming

Hole Number:	BT-37	BT-34	BT-38	BT-56	BT-58	BT-61	BT-63	BT-64	BT-66	BT-68	BT-69	BT-71	BT-73	BT-75	BT-77
Interval Sampled: (Depth in feet)	181-251	111-180	132-202	47-116	59-129	60-132	36-58	78-146	24-91	40-85	85-152	22-72	21-76	65-132	24-84
Uranium	<0.13	<0.13	<0.13	--	0.3	.30	--	--	0.4	0.7	0.50	0.30	--	0.7	--
Thorium	0.72	<0.1	<0.1	--	0.6	0.63	0.72	0.70	1.0	1.7	1.2	0.72	--	2.5	--
Bismuth	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead	1.3	0.26	2.6	1.0	0.86	2.6	1.0	1.3	1.0	1.0	0.64	0.65	1.0	1.7	0.37
Thallium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	0.08	0.16	0.30	0.10	0.11	0.08	0.06	0.08	0.07	0.09	0.08	0.07	0.09	0.08	0.11
Tungsten	0.40	<0.1	0.27	0.27	0.4	0.40	0.40	0.27	--	0.4	0.4	0.4	0.4	0.30	0.8
Tantalum	0.76	1.8	0.76	--	--	--	--	--	--	0.3	0.5	--	--	--	0.2
Hafnium	0.23	1.5	<0.1	--	--	--	--	--	--	0.3	0.56	--	0.64	0.30	--
Lutecium	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--	--	--	--
Ytterbium	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	<0.15	--	--	--
Thulium	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--	--	--	--
Erbium	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--	--	--	--
Holmium	<0.1	<0.1	<0.1	--	--	--	--	--	--	--	--	--	--	--	--
Dysprosium	0.1	0.1	0.1	--	--	--	--	--	--	--	--	--	--	--	--
Terbium	<0.1	<0.1	<0.1	0.02	0.04	0.02	0.08	0.12	0.05	0.12	0.02	0.04	0.04	0.04	0.05
Gadolinium	<0.1	<0.1	<0.1	0.12	0.12	0.06	0.12	0.10	0.06	0.17	0.12	0.17	0.12	0.06	0.04
Europium	<0.1	<0.1	<0.1	0.02	0.06	0.02	0.02	0.02	0.06	0.02	0.02	0.02	0.02	0.02	0.02
Samarium	<0.1	<0.1	0.11	0.24	0.33	0.24	0.24	0.66	0.42	0.24	0.17	0.24	0.24	0.55	0.24
Neodymium	0.90	0.90	1.8	1.1	0.38	0.38	0.53	1.1	0.53	0.38	0.38	0.38	0.89	0.66	0.24
Praseodymium	0.20	0.15	0.30	1.0	0.2	0.15	0.24	0.24	0.86	0.24	0.24	0.24	0.24	0.67	0.30
Cerium	0.62	0.50	0.83	0.83	0.25	0.83	0.62	2.5	2.0	2.5	1.2	0.55	0.83	2.0	0.83
Lanthanum	0.78	0.39	0.87	0.87	0.39	0.39	0.87	3.1	1.3	1.3	1.3	0.78	0.78	2.6	0.31
Barium	27.0	27.0	4.6	11.0	11.0	20.0	30.0	100.0	30.0	68.0	30.0	25.0	44.0	40.0	30.0
Cesium	0.03	0.03	1.5	<0.1	0.12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	0.1	<0.1	<0.1
Iodine	0.15	0.15	0.15	0.38	0.14	0.05	0.38	0.03	0.26	0.02	0.05	0.14	0.06	0.26	0.23
Tellurium	<0.1	<0.1	<0.1	0.17	0.26	0.18	<0.1	<0.1	0.18	<0.1	<0.1	0.76	0.1	0.50	0.14
Antimony	1.8	0.27	0.05	0.07	<0.1	<0.1	<0.1	0.07	<0.1	0.07	<0.1	0.07	0.07	0.20	<0.1
Tin	0.20	0.04	0.04	0.32	0.20	0.2	0.32	2.0	0.32	3.2	0.40	0.89	0.89	0.89	0.32
Cadmium	0.01	0.01	0.02	0.43	0.44	0.44	1.2	0.41	0.34	0.41	0.43	1.2	0.18	2.3	4.3
Silver	0.01	0.02	0.06	0.21	0.08	0.09	0.85	0.20	0.08	0.56	0.24	0.25	0.24	0.06	0.23
Molybdenum	0.86	0.75	0.60	1.0	0.86	0.86	0.86	2.0	0.86	0.86	0.86	0.86	1.5	2.4	0.86
Niobium	0.48	0.60	0.81	0.60	0.24	0.53	0.32	1.9	0.80	1.6	0.8	0.53	0.81	1.9	0.54
Zirconium	3.2	3.2	3.2	6.3	3.2	2.5	2.5	2.5	7.0	7.0	7.0	3.5	5.0	7.0	25.0
Yttrium	0.61	0.41	1.2	0.61	0.61	0.61	0.41	1.5	1.5	1.8	0.61	0.61	0.61	1.8	0.61
Strontium	46.0	40.0	46.0	46.0	31.0	31.0	31.0	110.0	110.0	110.0	46.0	30.0	46.0	35.0	45.0
Rubidium	0.31	0.31	0.62	0.21	0.05	0.07	0.21	0.31	0.19	0.07	0.31	2.1	2.1	0.75	0.75
Bromine	1.3	1.3	2.9	0.09	0.04	0.04	0.04	0.10	0.10	0.10	0.10	0.10	0.10	0.32	0.10
Selenium	<0.1	<0.1	<0.1	0.84	1.3	0.37	0.36	0.29	0.29	0.29	0.65	0.37	0.42	4.3	0.65
Arsenic	1.5	0.3	1.0	0.50	2.3	0.73	0.98	3.0	2.3	1.0	1.4	0.65	2.0	5.0	1.5
Germanium	0.06	0.02	0.06	<0.1	<0.1	<0.1	0.04	0.02	0.02	0.06	0.24	<0.1	0.06	0.17	0.06
Gallium	0.45	<0.1	<0.1	1.8	0.65	0.81	1.6	1.8	2.7	1.8	2.7	1.6	2.7	6.5	1.6
Zinc	11.0	220.0	11.0	37.0	9.0	9.0	22.0	9.0	11.0	9.0	9.0	2.5	11.0	11.0	0.42
Copper	9.5	4.3	14.0	15.0	6.4	15.0	7.6	15.0	6.4	15.0	15.0	6.4	15.0	6.4	12.0
Nickel	2.6	0.21	7.1	0.71	0.71	1.1	0.71	2.6	1.1	2.6	2.6	0.25	3.2	6.4	1.1
Cobalt	1.6	2.5	0.82	2.0	4.9	2.0	1.6	5.4	5.4	2.0	5.4	2.0	2.5	5.4	2.0
Manganese	2.7	2.3	2.7	6.4	4.0	6.4	6.4	6.4	64.0	64.0	6.4	6.4	18.0	26.0	6.4
Chromium	12.0	7.2	9.0	12.0	8.0	8.0	3.6	9.0	8.0	12.0	12.0	8.0	7.2	9.0	2.9
Vanadium	5.6	5.6	5.6	5.6	4.4	4.4	2.2	12.0	4.4	12.0	4.4	4.4	12.0	5.5	4.5
Titanium	190.0	190.0	320.0	770.0	210.0	240.0	190.0	320.0	320.0	640.0	240.0	240.0	480.0	210.0	220.0
Scandium	0.26	0.52	2.6	0.62	0.62	0.62	0.17	1.7	0.62	0.62	0.62	0.62	0.78	1.7	0.63
Fluorine	36.0	36.0	180.0	72.0	70.0	140.0	140.0	140.0	70.0	70.0	60.0	150.0	60.0	40.0	60.0
Boron	33.0	22.0	33.0	25.0	80.0	20.0	10.0	15.0	20.0	20.0	20.0	20.0	13.0	15.0	22.0
Beryllium	0.96	3.2	2.1	0.48	0.27	0.77	0.24	0.27	0.48	0.27	0.27	0.38	0.27	0.27	0.83
Lithium	13.0	13.0	8.5	1.3	4.3	4.3	2.8	4.2	4.3	3.2	4.3	4.3	1.0	2.6	2.8

Other elements looked for but not detected: Gold, Platinum, Iridium, Osmium, Rhenium, Palladium, Rhodium, and Ruthenium.

-- Element less than detection limit.

Table 9 (Cont'd)

Semiquantitative Spectrographic Analyses (in parts per million) of Core Samples from the Roland Coal Bed at the Proposed Black Thunder Mine, Campbell County, Wyoming

Hole Number:	BT-80	BT-82	BT-82	BT-82	BT-82	BT-82	BT-82	BT-82	BT-92	BT-98	BT-100	BT-107	BT-109	BT-115
Interval Sampled: (Depth in feet)	130-198	103-110	111-121	121-131	131-141	141-151	151-161	161-173	64-134	127-197	86-144	149-218	102-175	130-197
Uranium	0.35	0.53	0.26	0.35	0.38	0.14	0.19	0.24	0.53	0.44	0.44	0.58	0.53	0.23
Thorium	1.8	1.5	0.72	1.5	1.3	0.48	1.4	0.96	1.8	0.8	2.1	1.5	1.1	1.9
Bismuth	<0.47	0.35	<0.35	<0.35	0.30	<0.23	0.19	<0.35	<0.35	<0.11	<0.23	<0.35	<0.35	<0.23
Lead	7.3	1.7	0.55	0.83	0.95	1.1	1.3	2.8	1.1	0.73	0.73	2.4	1.1	1.6
Thallium	0.8	2.6	<0.15	<0.15	--	--	--	<0.2	<0.15	--	<0.1	0.15	<0.15	<0.1
Mercury	0.07	<0.03	<0.03	0.07	<0.03	<0.03	<0.03	0.04	<0.03	0.12	0.13	<0.03	<0.03	0.07
Tungsten	2.2	1.4	0.93	1.4	0.66	1.9	1.5	1.2	0.7	1.9	<0.47	2.1	14.0	1.9
Tantalum	--	5.9	--	0.39	0.14	0.08	0.16	0.4	8.4	0.26	4.9	0.39	0.39	0.56
Hafnium	0.35	0.87	<0.22	0.87	0.38	<0.15	0.23	0.34	0.65	0.58	0.35	0.44	1.7	0.58
Lutecium	<0.47	<0.35	<0.35	<0.35	<0.3	<0.23	<0.18	<0.23	<0.35	0.23	<0.23	<0.35	<0.35	<0.23
Ytterbium	<1.5	<1.1	<1.1	<1.1	<1.0	<0.3	<0.6	<0.3	<1.1	0.75	0.75	<1.1	<1.1	<0.3
Thulium	<0.15	<0.11	<0.11	<0.11	<0.10	<0.08	<0.06	<0.08	<0.11	0.08	<0.08	<0.11	<0.11	<0.08
Erbium	<0.32	<0.24	<0.24	<0.24	0.28	<0.16	<0.13	<0.16	<0.24	0.16	0.27	<0.24	<0.21	<0.16
Holmium	<0.14	0.18	0.11	0.13	0.12	<0.07	<0.06	<0.07	0.11	0.11	0.09	0.13	<0.13	<0.07
Dysprosium	<0.9	1.2	<0.68	0.81	0.78	<0.45	<0.36	<0.45	0.68	0.9	<0.45	0.74	<0.68	<0.45
Terbium	<0.14	0.13	<0.11	<0.1	<0.1	<0.07	<0.06	<0.07	<0.11	0.11	0.09	<0.1	<0.1	<0.07
Gadolinium	<0.43	0.39	<0.33	<0.32	<0.28	<0.22	<0.17	<0.22	0.35	0.33	0.22	<0.32	<0.32	<0.22
Europium	<0.57	0.64	<0.43	0.46	0.40	<0.28	<0.23	<0.28	<0.43	<0.28	<0.28	<0.46	0.46	<0.28
Samarium	0.83	1.1	<0.63	0.63	<0.54	0.5	<0.33	<0.42	<0.63	0.5	<0.42	0.63	0.60	<0.42
Neodymium	21.0	13.0	9.5	3.8	6.6	4.2	15.0	8.2	24.0	8.5	18.0	24.0	27.0	5.1
Praseodymium	11.0	4.0	3.0	1.6	2.3	1.1	3.2	2.2	8.0	1.6	2.7	8.0	8.0	2.3
Cerium	8.0	10.0	6.0	4.3	0.43	3.3	5.3	5.0	3.8	2.9	6.7	10.0	20.0	6.7
Lanthanum	13.0	4.8	9.5	3.8	10.0	4.2	7.2	4.2	5.9	4.2	7.9	14.0	14.0	6.3
Barium	170.	96.	180.	220.	120.	100.	90.	180.	70.	21.	60.	140.	280.	45.
Cesium	0.3	0.11	0.02	0.15	0.02	0.01	0.008	0.04	0.004	0.005	<0.003	0.01	0.15	0.08
Iodine	0.8	0.9	0.68	1.4	0.43	0.3	0.48	0.90	0.9	0.6	1.0	0.9	0.54	0.36
Tellurium	0.07	0.05	<0.05	0.1	0.05	<0.03	0.05	0.08	<0.05	0.07	<0.03	0.1	0.05	0.07
Antimony	0.24	0.16	<0.11	0.16	<0.1	0.76	0.07	0.22	<0.11	0.14	<0.07	0.13	0.11	0.08
Tin	0.29	0.44	1.0	2.6	2.6	1.0	1.8	14.0	1.3	1.0	0.86	6.9	5.2	2.3
Cadmium	0.44	0.55	0.44	0.66	0.64	0.29	0.23	0.44	0.66	0.49	0.63	0.66	0.94	0.29
Silver	0.03	0.03	<0.02	0.03	<0.02	0.03	0.01	0.12	0.04	0.02	0.02	0.03	0.03	0.03
Molybdenum	35.0	20.0	5.6	13.0	11.0	3.7	2.6	7.0	13.0	8.7	4.3	13.0	13.0	8.7
Niobium	7.4	2.6	1.3	13.0	4.2	0.87	3.0	3.1	5.6	3.7	5.2	5.6	13.0	6.5
Zirconium	70.	70.	84.	140.	61.	47.	75.	52.	70.	160.	93.	140.	140.	47.
Yttrium	5.3	8.0	6.0	4.0	2.6	2.3	3.2	2.2	3.0	5.3	4.6	8.0	8.0	3.2
Strontium	350.	130.	110.	94.	98.	96.	280.	290.	200.	62.	180.	270.	530.	96.
Rubidium	0.52	0.14	0.26	0.39	1.0	0.03	0.07	0.26	0.11	0.17	0.07	1.3	1.3	0.26
Bromine	7.3	8.3	1.7	1.1	3.6	1.4	2.9	1.6	5.5	1.6	18.0	11.0	5.5	1.4
Selenium	0.74	0.28	0.37	0.37	0.27	0.15	0.20	<0.20	0.28	0.49	2.5	0.56	0.37	0.49
Arsenic	2.5	1.9	1.4	1.2	1.0	0.4	0.64	0.6	1.5	0.8	0.8	2.6	1.2	0.8
Germanium	0.45	0.27	0.14	0.27	0.39	0.09	0.10	0.12	0.27	0.26	0.6	0.39	0.09	0.18
Gallium	2.4	1.2	2.3	2.6	2.6	0.8	4.8	0.8	2.3	0.8	0.8	2.6	2.6	2.0
Zinc	4.8	1.2	0.58	0.36	1.5	0.4	1.6	1.6	0.43	0.46	0.23	2.0	0.95	0.8
Copper	32.0	2.4	16.0	34.0	59.0	19.0	14.0	5.4	40.0	19.0	23.0	40.0	16.0	23.0
Nickel	7.8	17.0	15.0	29.0	5.6	6.5	7.8	6.2	5.9	2.6	2.6	20.0	3.9	2.6
Cobalt	8.0	11.0	1.5	7.5	3.8	1.1	2.0	1.0	2.5	2.5	1.8	3.8	3.8	1.9
Manganese	32.0	11.0	15.0	23.0	19.0	12.0	11.0	8.4	34.0	13.0	28.0	27.0	19.0	13.0
Chromium	7.1	5.3	12.0	10.0	10.0	2.7	10.0	3.0	11.0	6.6	18.0	22.0	11.0	7.6
Vanadium	56.0	19.0	18.0	25.0	26.0	6.6	32.0	8.6	25.0	11.0	21.0	48.0	34.0	17.0
Titanium	1500.	490.	400.	1100.	840.	280.	670.	280.	770.	650.	1300.	1300.	2100.	830.
Scandium	5.9	3.8	2.9	4.5	2.5	0.9	1.6	2.1	3.3	2.0	1.9	5.3	5.0	2.0
Fluorine	240.	180.	180.	180.	160.	210.	96.	120.	210.	180.	110.	90.	140.	120.
Boron	75.	75.	45.	38.	39.	18.	24.	100.	38.	27.	30.	41.	150.	30.
Beryllium	0.84	0.32	0.84	0.25	0.73	0.30	0.22	1.0	0.32	0.17	0.56	0.63	0.84	0.56
Lithium	8.5	3.2	4.3	1.7	32.0	2.4	4.5	1.4	8.5	5.7	11.0	3.6	8.5	5.7

Other elements looked for but not detected: Gold, Platinum, Iridium, Osmium, Rhenium, Palladium, Rhodium and Ruthenium.

-- Element less than detection limit.

Quantity of Coal

Estimates of coal in the Wyodak (Roland) bed in the lease area of the Atlantic Richfield Company's Black Thunder mine are shown in Table 10. The recoverable coal of 724 million tons is more than adequate to fulfill projected production schedules. Overburden averages less than 150 feet thick over 414 million tons of recoverable coal and less than 100 feet thick over 262.5 million tons. Coal is under more than 200 feet of overburden only in small areas in sections 2 and 3, T42N, R70W, and section 20, T43N, R70W (Figure 5).

Table 10

Available Coal, in Thousands of Short Tons, at the Proposed Black Thunder Mine, T42 and 43N, R70W, Campbell County, Wyoming

Location	Area Acres	Average Coal Thickness (feet)	Coal in Place*	Recov- erable Coal**	Average Overburden Thickness (feet)
T42N, R70W					
Section 2	400	70	49,560	47,082	148
Section 3	480	70	59,472	56,498	189
T43N, R70W					
Section 16	640	67	75,898	72,103	78
Section 17	640	70	79,296	75,331	133
Section 20	640	71	80,429	76,408	174
Section 21	640	69	78,163	74,255	143
Section 22	240	68	28,886	27,442	128
Section 27	470	57	47,418	45,047	47
Section 28	640	68	77,030	73,178	98
Section 29	160	69	19,541	18,564	163
Section 33	320	69	39,082	37,128	133
Section 34	640	67	75,898	72,103	97
Section 35	430	68	51,755	49,167	108
Total	6,340	68	762,428	724,306	123

*Assuming 1,770 short tons of coal per acre-foot.

** Assuming 95 percent recovery of coal in place.

Other minerals

Occurrences of uranium or minerals other than coal are not known in the lease area.

Sand and gravel lenses, potentially useful for aggregate, occur locally on the lease area in alluvial fill along Little Thunder Creek and North Prong of Little Thunder Creek. Areas of clinker are sufficiently thick and widespread along the eastern edge of the lease to provide road material and ballast.

Oil and gas

The Atlantic Richfield Company's federal coal lease in T42 and 43N, R70W, presently has five producing oil wells in the Payne Oil field and two plugged and abandoned oil and gas test holes. The company's surface mining plan indicates that an area with existing oil wells will not be mined before the year 1991. By 1983 all wells on production in 1974 will be properly plugged and abandoned and conditioned for the eventual surface mining of the area. A competitive oil and gas lease is being offered for the SE¼ sec. 3, T42N, R70W, in early 1974. If such a lease is issued an application for approval to drill a new well on this acreage could be submitted within six months or so after lease issuance. State spacing rules would require a well on this competitive lease to be drilled in the center of SW¼SE¼ sec. 3, T42N, R70W, with 200 feet of surface tolerance. This location would be no less than 440 feet from the southern boundary of the lease. No other wells are known within the coal lease area but tests for oil and gas from other producing zones could be applied for within the area at any time. Data on the existing wells in the Atlantic Richfield Company's federal coal lease follow:

During November 1971, a well was drilled 1,960 feet from north line and 660 feet from west line (C SW$\frac{1}{4}$NW$\frac{1}{4}$) sec. 2, T42N, R70W, on a private oil and gas lease, ground elevation at 4,847 feet; 9 5/8-inch surface casing was set at 627 feet; 5$\frac{1}{2}$-inch production casing is cemented at 7,163 feet; total depth is 7,180 feet. Sussex Sandstone Member of the Steele Shale from 7,073 to 7,075 feet is the producing zone at an initial potential of 163 barrels of oil per day. Present rate of production is 24 barrels of oil per day.

During April and May 1970, a well was drilled 1,980 feet from north line and 1,980 feet from east line (C SW$\frac{1}{4}$NE$\frac{1}{4}$) sec. 3, T42N, R70W, on public oil and gas lease W-23778-A; ground elevation, 4,834 feet; 9 5/8-inch surface casing was set at 750 feet; 5$\frac{1}{2}$-inch production casing is cemented at 7,200 feet; total depth is 7,208 feet. Sussex Sandstone Member of the Steele Shale from 7,090 to 7,100 feet is the producing zone at an initial potential of 102 barrels of oil per day. Present rate of production is 11 barrels of oil per day.

During August 1971, a well was drilled and abandoned 677 feet from south line and 2,002 feet from east line (C SW$\frac{1}{4}$SE$\frac{1}{4}$) sec. 27, T43N, R70W, on public oil and gas lease W-9354: ground elevation is 4,664 feet; 8 5/8-inch surface casing was set by 797 feet; total depth is 6,921 feet in Steele Shale.

During May 1957, a well was drilled and abandoned 1,980 feet from north line and 1,980 feet from east line (C SW$\frac{1}{4}$NE$\frac{1}{4}$) sec. 34, T43N, R70W, on public oil and gas lease W-04564-B; ground elevation is 4,770 feet; 8 5/8-inch surface casing was set at 147 feet and total depth is 6,363 feet in Parkman Sandstone Member of the Mesaverde Formation.

During May and June 1969, a well was drilled 1,970 feet from north line and 2,135 feet from east line (NW$\frac{1}{4}$SW$\frac{1}{4}$NE$\frac{1}{4}$) sec 34, T43N, R70W, on public oil and gas lease W-10413; ground elevation is 4,745 feet; 8 5/8-inch surface casing was set at 709 feet; 4½-inch production casing is cemented at 7,364 feet; total depth is 7,373 feet. Sussex Sandstone Member of the Steele Shale from 6,968 feet to 6,974 feet is the producing zone at an initial potential of 185 barrels of oil per day. Present rate of production is 42 barrels of oil per day.

During May through August 1969, a well was drilled 1,985 feet from north line and 680 feet from west line (C SW¼NW¼) sec. 34, T43N, R70W, on public oil and gas lease W-9354; ground elevation is 4,717 feet; 8 5/8-inch surface casing was set at 715 feet; 4½-inch production casing is cemented at 7,023 feet; total depth is 9,743 feet and plugged back to 6,984 feet. Sussex Sandstone Member of the Steele Shale from 6,963 to 6,971 feet is the producing zone at an initial potential of 28 barrels of oil per day. Present rate of production is 7 barrels of oil per day.

During August and September 1969, a well was drilled 1,680 feet from south line and 2,100 feet from east line (SW¼SW¼SE¼) sec. 34, T43N, R70W, on a state oil and gas lease; ground elevation is 4,773 feet; 8 5/8-inch surface casing was set at 734 feet; 4½-inch production casing is cemented at 7,048 feet; total depth is 7,055 feet. Sussex Sandstone Member of the Steele Shale from 7,010 feet to 7,020 feet is the producing zone at an initial potential of 75 barrels of oil per day.

Water Resources

Ground water

Aquifers

Formations within about 5,000 feet of land surface in the vicinity of the A.R.Co. coal lease that contain aquifers are, in order of increasing depth below land surface, the Wasatch, Fort Union, Lance, and Fox Hills. The only aquifers that are expected to be affected by mining operations by A.R.Co. are the coal beds and the overlying aquifers in the Wasatch which is the overburden to be removed during mining operations.

In the southern half of Campbell County, the land surface slopes eastward. The beds within these formations, however, dip very gently westward toward the axis of the Powder River structural basin. Many separate water levels are present in the thick sequence of Tertiary and Upper Cretaceous rocks that underlie the land surface. The water levels in these rocks are at higher altitudes than are the altitudes of the rock outcrops farther to the east.

Water movement

The higher water levels in the center of the basin preclude water movement basinward from the outcrop areas. Recharge in southern Campbell County occurs from infiltration of local precipitation on the topographic higher areas in the central and southern parts of Campbell County, east of the A.R.Co. coal lease.

Surface water

Drainage and streamflow

The surface of the area leased by the Atlantic Richfield Company is drained by Little Thunder Creek and its tributaries. North Prong Little Thunder Creek flows southeast across the northern part of the leased area. This stream has a contributing drainage area of about 43 square miles upstream from the leased area. About 2.5 miles of its main channel and 7.9 miles of its minor tributaries lie within the leased area. About 21 percent (2.0 sq. mi.) of the leased area is drained by North Prong Little Thunder Creek.

Little Thunder Creek flows east across the middle of the leased area. This stream has a drainage area of about 58 sq. mi. upstream from the lease area. About 61 percent (5.6 sq. mi.) of the leased area is drained by Little Thunder Creek.

A total of about 1.6 sq. mi. of the area is made up of shallow closed basins which have no apparent outflow. The formation of these depressions may be due to the burning of underlying coalbeds or to the differential settling of underlying deposits.

The main channels of Little Thunder and North Prong Little Thunder Creeks are intermittent streams, whereas, the intervening tributaries are ephemeral. The major part (75 percent) of annual runoff occurs during the spring and summer months, generally as a result of convective storms. Culler (U.S. Geological Survey 1961a, p. 37) determined average summer runoff during 1951-54 to a stockpond located in the NE¼NE¼ Section 10, T42N, R70W, to be 5.2 acre-feet per year. Drainage area to the stockpond is 0.66 sq. mi. Minor tributaries of the area commonly have periods of several years with no flow.

Based on basin characteristics and channel-geometry features, North Prong Little Thunder is estimated to have a mean annual runoff of 1,100 acre-feet per year and a mean annual flood peak of 700 cfs (cubic feet per second) at the site of its intersection with the lease boundary.

Little Thunder Creek is estimated to have a mean annual runoff of 1,400 acre-feet per year and a mean annual flood peak of 900 cfs at the site of its intersection with the lease boundary.

The average slopes of the streambeds of Little Thunder and North Prong Little Thunder Creeks are 10.8- and 17.4-feet drop per mile, respectively. Average slopes of minor tributaries range from 92.8-feet drop per mile in the northwest part of the area to 148-feet drop per mile in the southeast part of the area.

Water uses

The major use of surface water is for consumption by domestic and wild animals. Numerous stockponds are constructed on minor tributaries, and detention and retention of flows is afforded by these man-made structures. Several water wells provide water that is stored in small reservoirs for use by livestock. Spreader systems are used for irrigation of hay meadows and pastures along the downstream reaches of Little Thunder and Black Thunder Creeks, but due to the large variation in annual runoff, water supplies are not dependable for irrigation.

Erosion and sedimentation

The highest rates of erosion are occurring in the minor tributaries that have steep slopes. A reservoir in the leased area on Little Thunder Creek causes many of the large sediment particles to deposit, but outflow from the reservoir has the ability to erode and transport fresh sediments in the downstream channel. Little erosion is occurring in the closed basins.

Water quality

Water originating in or flowing through the lease area contributes to flow in the Cheyenne River. Since a major portion of the drainage area upstream from the water quality sampling site near Spencer on the Cheyenne River is similar to the lease area, water quality sampled near Spencer should generally represent surface water quality in the lease area.

Dissolved solids concentration in the Cheyenne River near Spencer ranges from 1000 mg/l to 4000 mg/l, but concentration outside this range may occur in the lease area. The increase in sodium and sulfate concentrations at low flows observed near Spencer should also occur in the lease area.

Vegetation

On better drained upland sites, the vegetation of the A.R.Co. lease is characterized by shrub steppe plant communities dominated by big sagebrush (Artemisia tridentata) (Table 11 and Figure 9). Domestic livestock have grazed these communities since the middle 1800's so all are in an intermediate stage of plant succession. Heavy grazing is thought to increase the density of big sagebrush or allow it to invade into grasslands. However, site conditions and degree of grazing intensity where this takes place have not been defined for northeastern Wyoming, nor is a historical record available for the lease area to indicate if big sagebrush should be considered an endemic part of the natural plant communities of this area.

The shrub overstory of these plant communities is composed almost entirely of big sagebrush. The height of this layer generally does not exceed 18 to 24 inches. Density (plants per unit area) will range from scattered to moderately closely spaced, but the crowns of individual plants rarely touch. Canopy coverage is in the 20 to 40 percent range. Beneath the sagebrush overstory and mixed with it are species common to the Northern Great Plains to the east. Grasses and sedges predominate, but forbs are evident in the early part of the growing season (April-May).

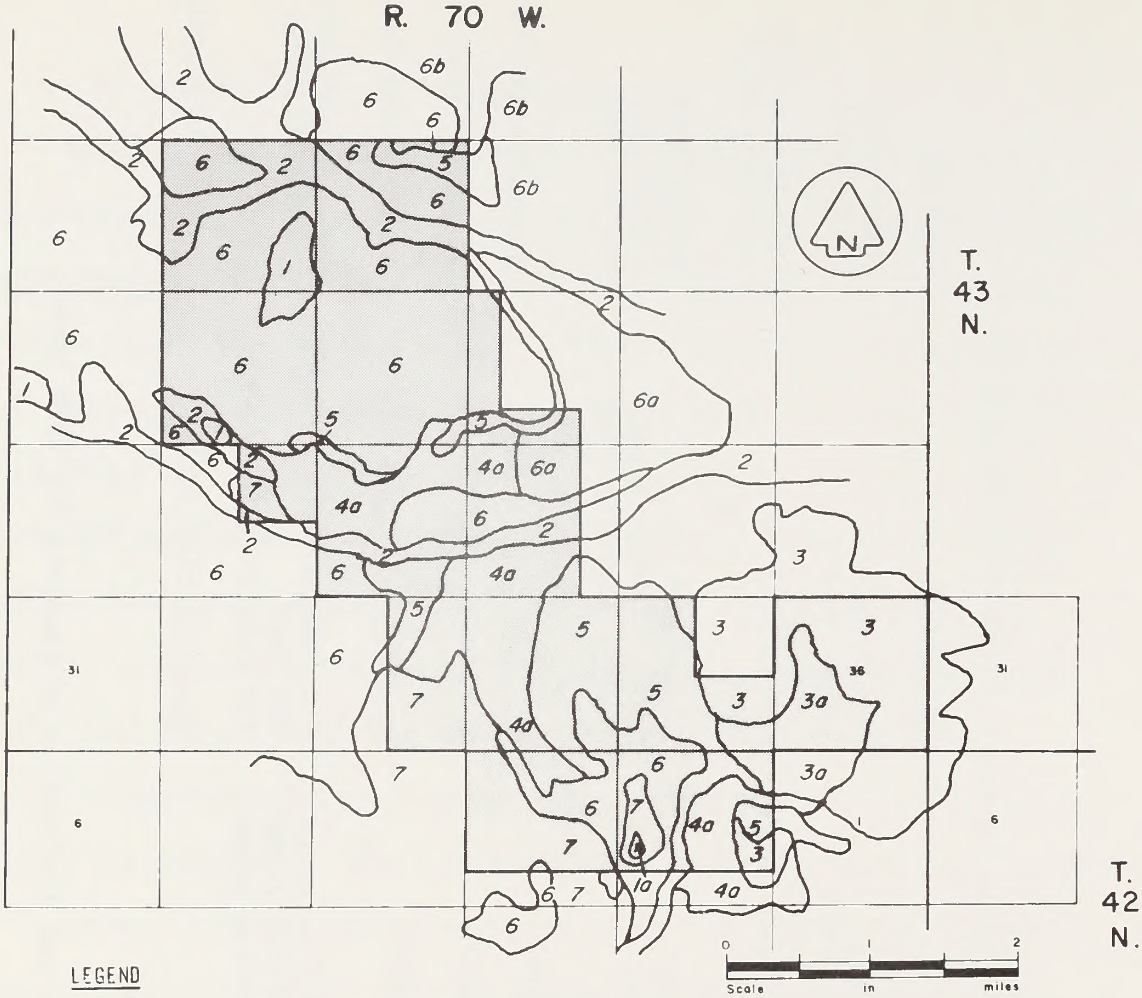
The greater amount of great plains species in the plant mixture is the most likely reason for the theory that big sagebrush is an invader into what should be grasslands similar to those of the Northern Great Plains. Areas of low sagebrush density certainly have the appearance similar to these grasslands. However, it is also possible that the communities dominated by big sagebrush represent the vegetational transition (ecotone) between the Northern Great Plains Grasslands to the east and the sagebrush shrubland more common to the west.

Ecological Relationships of the Atlantic Richfield Lease Area and Facility Site

No	Acres	Vegetation (Community type	Soil Series	Landform
1	130	Western wheatgrass-Foxtail barley	McKenzie clay	Playa (dry)
1a	10	Western wheatgrass-Slender Spikerush	McKenzie clay	Playa (wet)
2	520	Inland saltgrass-Western wheatgrass-Blue grama	Arvada clay loam Loam	Alluvial lowland (saline-alkali)
3	610	Bluebunch wheatgrass-Blue grama	Wibaux searing	Scoria land
3a	250	Bluebunch wheatgrass-Blue grama	Rough broken-searing	Scoria land
			Searing gravelly loam	Scoria land
4	20	Big sagebrush-Western wheatgrass-Blue grama	Renohill clay loam	Sideslope (rolling)
4a	1,030	Big sagebrush-Western wheatgrass-Blue grama	Renohill loam	Sideslope (rolling)
5	820	Big sagebrush-Western wheatgrass-Blue grama	Rough broken land	Rough broken land
6	2,474	Big sagebrush-Needleandthread-Blue grama	Ulm loam (reddish subsoil)	Upland (undulating)
6a	330	Big sagebrush-Needleandthread-Blue grama	Ulm loam	Upland (rolling)
6b	10	Big sagebrush-Needleandthread-Blue grama	Ulm clay loam (shallow)	Upland
7	510	Big sagebrush-Blue grama	Renohill clay loam	Upland (undulating)
Total	6,714			

Note: For detailed description of the ecosystem see description in appendix for this lease.

Table 11



LEGEND

- 1 — Western Wheatgrass-Foxtail Barley
- 1a — Western Wheatgrass-Slender Spikerush
- 2 — Inland Saltgrass-Western Wheatgrass
- 3 — Bluebunch Wheatgrass-Blue Grama*
- 3a — Bluebunch Wheatgrass-Blue Grama*
- 4 — Big Sagebrush/Western Wheatgrass-Blue Grama*
- 4a — Big Sagebrush/Western Wheatgrass-Blue Grama*
- 5 — Big Sagebrush/Western Wheatgrass-Blue Grama*
- 6 — Big Sagebrush/NeedleandThread-Blue Grama*
- 6a — Big Sagebrush/NeedleandThread-Blue Grama*
- 6b — Big Sagebrush/NeedleandThread-Blue Grama*
- 7 — Big Sagebrush/Blue Grama
- Boundary of Arco Coal Property

*Difference In Soils

Figure 9

Vegetation Community Boundaries (A.R.Co. Coal Property)

The following vegetative types have been identified on the leases:

Ecosystem No. 1: Western wheatgrass-foxtail barley grassland on playas with deep clayey soils.

This ecosystem is found on the playas which are present on nearly level uplands. Soils are deep, clayey, and subject to periodic inundation from runoff, but water does not remain above the surface for long periods. The general appearance of the vegetation is a sparsely vegetated grassland dominated by western wheatgrass. Shrubs or trees do not occur. When not inundated or muddy, this ecosystem can provide water for animals, and when inundated may be habitat for amphibians and aquatic birds.

Ecosystem No. 1a: Western wheatgrass-slender spikerush grassland on playas with deep clayey soils.

This grassland ecosystem is found on small playas which are present on nearly level uplands. Soils are deep, clayey, and subject to periodic inundation from runoff. The period of high water appears to be longer than in the western wheatgrass-foxtail barley ecosystem (No. 1) and the vegetative cover is greater, but the general appearance is still a grassland devoid of woody vegetation. When dry, this ecosystem can be grazed by livestock and wildlife; when wet it can provide water for animals and may be habitat for amphibians and other aquatic wildlife.

Ecosystem No. 2: Inland saltgrass-western wheatgrass, blue grama, riparian grassland on alluvial lowlands with deep saline-alkaline soils.

This ecosystem is confined to clayey alluvial soils in flat, narrow valleys of stream courses where saline salts accumulate. These valleys may be periodically flooded by runoff water. The vegetation is a grassland community type dominated by inland saltgrass. The ecosystem is grazed by both domestic livestock and wildlife.

Ecosystem No. 3: Bluebunch wheatgrass-blue grama grassland on scoria land with shallow, gravelly soils.

This ecosystem occurs on ridges and hills derived from reddish colored scoria. Soils are shallow and gravelly and tend to be droughty. The general physiognomy is a somewhat sparsely vegetated grassland characterized by scattered tussocks of bluebunch wheatgrass. The ecosystem provides grazing for livestock and wildlife, and the steeper outcrops may provide nesting or perching sites for owls, hawks, and other cliff-dwelling birds.

Ecosystem No. 3a: Bluebunch wheatgrass-blue grama grassland on scoria land with shallow to moderately deep soils.

This ecosystem occurs on ridges and hills derived from reddish colored scoria. It differs from Ecosystem No. 3 in that soils are shallow to moderately deep and tend to be less droughty. The general physiognomy is a somewhat sparsely vegetated grassland characterized by scattered tussocks of bluebunch wheatgrass (*Agropyron spicatum*). The ecosystem provides grazing for livestock and wildlife. The steeper outcrops may provide nesting or perching sites for owls, hawks, and other cliff-dwelling birds. It is present only on the Atlantic Richfield lease.

Ecosystem No. 4: Big sagebrush-western wheatgrass-blue grama shrub steppe on dissected sideslopes with moderately deep soils.

This ecosystem occurs on sideslope terrain which is somewhat dissected. Soils are shallow to moderately deep and tend to be clay loam or clayey in texture. The vegetation is a shrub steppe with big sagebrush (*Artemisia tridentata*) the shrub layer dominant. The herbaceous layer is characterized by western wheatgrass (*Agropyron smithii*) and blue grama (*Bouteloua gracilis*). It provides grazing for livestock and wildlife.

Ecosystem No. 4a: Big sagebrush-western wheatgrass-blue grama shrub steppe on dissected sideslopes with moderately deep soils with loamy surfaces.

This ecosystem occurs on sideslope terrain which is somewhat dissected. Soils are shallow to moderately deep and tend to be more loamy in texture than those in Ecosystem No. 4. The vegetation is a shrub steppe with big sagebrush (*Artemesia tridentata*) as the shrub layer dominant. The herbaceous layer is characterized by western wheatgrass (*Agropyron smithii*) and blue grama (*Bouteloua gracilis*). This is also a major ecosystem on the lease area. It provides grazing for livestock and wildlife.

Ecosystem No. 5: Big sagebrush-western wheatgrass-blue grama shrub steppe on rough broken land side slopes with shallow clayey soils.

This ecosystem is present on rough and broken topography. Soils are shallow; textures tend to be somewhat clayey, but drainage is not impeded. The vegetation is a very open shrub-steppe of big sagebrush (*Artemesia tridentata*) with a sparse herbaceous understory of grasses. It is grazed by both livestock and wildlife but is low in production of herbage.

Ecosystem No. 6: Big sagebrush-needleandthread-blue grama shrub steppe on nearly level to gently sloping uplands with moderately deep loamy soils.

This ecosystem is characterized by gently sloping to rolling uplands with moderately deep soil with texture loamy to sand. The vegetation is a shrub steppe community type with big sagebrush as the shrub-layer. The understory is composed of grasses and forbs common to the Great Plains area. It is used by both livestock and wildlife for grazing and is moderately productive.

Ecosystem No. 6a: Big sagebrush-needleandthread-blue grama shrub steppe on dissected sideslopes with shallow to moderately deep loamy soils.

This ecosystem occurs on dissected sideslope terrain. Soils are loamy in texture and shallow to moderately deep. The vegetation is a shrub steppe community type with big sagebrush as the shrub layer dominant. The understory is composed of grasses and forbs common to the Great Plains grassland. It is used by both livestock and wildlife for grazing and is moderately productive.

Ecosystem No. 6b: Big sagebrush-needleandthread-blue grama shrub steppe on gently sloping to rolling uplands with shallow loamy soils.

This ecosystem is characteristic of nearly level to gently sloping uplands with shallow loamy to sandy-textured soils. The vegetation is a shrub steppe community type with big sagebrush as the shrub-layer dominant. The understory is composed of grasses and forbs common to the Great Plains grassland. This is the most widely distributed ecosystem of the lease area. It is used by both livestock and wildlife for grazing and is moderately productive.

Ecosystem No. 7: Big sagebrush-blue grama shrub steppe on gently sloping uplands moderately deep clay loam soils.

This ecosystem is characteristic of nearly level to gently sloping uplands with clay loam textured soils. The vegetation is a

shrub steppe community type with big sagebrush as the shrub layer dominant. The herbaceous layer has blue grama as the major grass. Western wheatgrass and needleandthread are rare.
The ecosystem is used by both livestock and wildlife for grazing and is moderately productive.

Archeological and Paleontological Values

Six archeological or paleontological sites have been identified on the A.R.Co. lease site; two of these may be excavated. However, Dr. George Frison, Department of Anthropology, University of Wyoming, has been contracted by the Wyoming Environmental Institute and is proceeding with an environmental study of the area. This study should be completed some time in 1974.

The A.R.Co. lease area could produce a significant find but most await Dr. Frison's report for more specific possibilities. If a site is found, it must be properly assessed and excavated before the mining operation may proceed.

There is little known of the paleontology potential of the lease area, but the Wasatch and the Fort Union formations that lie on the lease area can be expected to yield some vertebrate remains.

Historical Values

The National Register of Historic Places, the State Historic Preservation Officer, and local references and people were consulted and no known significant sites, trails, or areas occur on this lease area. However, Indian tribes probably passed through and hunted buffalo and other game in the area. No campsites or other permanent habitation evidence by these tribes are known on the lease.

Homesteads were established on the area in the early 1900's. There was at least one homestead site in section 28, but only the foundation and a few boards are left as evidence of the original structure, and no historical significance can be placed on this site. Other sites probably existed, but no historical events or persons can be attributed to the area from knowledge available.

There were two major reasons for land abandonment.

(1) Many potential farm families settled on tracts of 160 to 640 acres that were physically and economically unfitted for cultivation.

(2) An even larger number of settlers either originally or subsequently attempted livestock production on units of one or two sections that proved to be inadequate for this type of operation.

Cultivated tracts were usually less than 160 acres in size. In some instances, the land was tilled only to comply with a provision of the Homestead Act. Homestead principles developed for a humid climate further east were misapplied to the semiarid plains.

Operators remaining in the area encountered grave financial difficulties. Tax delinquency was a serious problem. County governments were hard pressed to maintain schools, roads, and other government activities. The above history of the land gave reason for the following governmental programs.

Homesteading continued until 1934 when the public domain was closed to homestead entry. Considerable acreage of these old homestead lands were repurchased by the Federal Government in the 1930's.

The Thunder Basin National Grassland was initiated in 1934 as the Northeastern Wyoming Land Utilization Project under the Agricultural Adjustment Administration. The program since that time has been administered by the Resettlement and the Farm Security Administration, the Bureau of Agriculture Economics, and the Soil Conservation Service to the Forest Service in 1954.

While the project was started late in 1934, the purchasing of units was started in 1935 and the last of the purchases made in the early forties. The original project included the area now in the Thunder Basin Grazing Association and the Spring Creek Association. The area now in the Inyan Kara Grazing Association was organized in 1938 as a project.

The A.R.Co. lease area is within the boundaries of the Thunder Basin Grazing Association.

Aesthetics

The overall landform of the lease area is a result of sedimentary deposits from upper Cretaceous to recent geologic times and the natural weathering that has occurred since the deposition.

The landform on the Atlantic lease is similar to a wide portion of the Powder River Basin. Gently rolling uplands comprise approximately 60 percent of the lease area. This type of terrain gives a very weak form to the landscape character. The remaining 20 percent of the area is of an undulating, rolling uplands type between the gently rolling uplands and the dissected, rough broken lands. These give a moderate form to the landscape character.

The northern half of the lease area is of the gentle to moderately rolling landform, except for a strip of rough broken land that skirts the eastern edge of the area and turns to an east-west direction just north of Little Black Thunder Creek. The south half of the lease area is well dispersed with the three basic types of landform in the area, giving a good amount of form variety to the overall landscape character.

Textures are created by the vegetative patterns and degree of erosion on the land. The textures in the gently rolling uplands are smoother than those displayed in the rough, broken, eroded terrain. The natural vegetation, consisting mainly of sagebrush and native grasses fairly evenly mixed, gives a moderately roughened texture to the surface of the rolling landform. Textures in the dissected, rough broken land are generally rougher due to the heavily eroded soils and the sparse, more bunchy grouping of sagebrush.

Some small areas have been cultivated at various times in the past. These have since revegetated with wild grasses and forbs. The texture here is the smoothest found anywhere throughout the lease due to the one basic soft-textured vegetative type.

Line is subtly displayed where contrasting landform and large groups of vegetative types join. Line is most evident where man's activities have created contrasting vegetative changes. The cultivated areas and pipeline route are examples of this element. The horizon line is probably the most evident line that is displayed in this landscape.

The color within the area is muted tones of grays, greens, reds, and browns. The brightest colors occur in spring and early summer when the sage brush and grass is its greenest and wildflowers are in bloom. The most color contrast occurs in the wintertime when the white snowdrifts contrast with the darker tones of soils and winter vegetation. The predominant color tones for most of the year are light browns and light grays. These are displayed by the grass as the seasons progress from spring through the winter. Grays and light browns are displayed when soil is exposed by either erosion or disturbance. Reddish tones appear in the scoria soil zones, mostly in the southeastern corner of the lease.

In the gently rolling upland area with the low sagebrush and grass vegetation, it is very difficult for the observer to define distance or size. In the moderately rolling to rough broken land where the terrain is steeper, the observer can get more of a feeling of enclosure that enables him to relate to the sizes and distances in the landscape.

At present, few intrusions have been introduced into the general landscape. Fences, roads, windmills, oil wells, storage tanks, pipeline, and utility lines are the major intrusions found in the area. Fences, being normally three or four strand wire on wood and steel posts, are absorbed into the landscape beyond the foreground zone due to the vertical accent on an otherwise horizontal plane. Utility lines give the same relative effect on the landscape as fences. These intrusions are spaced at intervals that prevent them from being undesirable or discordant in the landscape.

The landscape quality of the lease area is considered to be relatively low when compared to areas of rugged, dissected, and colorful mountains with much variety in form, line, color, and texture. However, on the microscale one can find much variety in plants, insects, wildlife, and soils from one area of the lease to another. The element of water in the intermittent streams and the Reno Reservoir give additional interest and quality to this lease area.

Wildlife and Fish

The lease area is habitat for a wide variety of wildlife. A list of known animals is shown on Tables 29 to 32, Appendix C.

Big game

Mule deer

This is a fringe area for mule deer and not a critical habitat except for the few that have moved in from the main herd in the Rochelle Hills to the east. They stay close to cover and are usually found in brushy bottoms along streams and in nearby rough land. Most are in the Little Thunder Creek and the North Prong drainages.

Deer tend to remain yearlong in the same area, but move short distances when snow covers the food supply. Some move back into the ponderosa pine hills to the east for part of the winter.

Most of their water and forage requirements are met in the drainage bottoms. Grasses and forbs are available during the spring and summer and sagebrush is available in the drainage bottoms or on nearby uplands. A high percentage of the spring diet is made up of grasses, especially bluegrasses, sixweeks fescue, and cheatgrass, because they are the first plants to start growing. Grazing of forbs by deer reaches a peak in summer and decreases as the plants become unpalatable or unavailable. Then the deer begin to eat shrubs, mainly sagebrush.

Deer food habits conflict with livestock. Competition with livestock occurs in spring and summer when both types of animals graze succulent forage in the creek bottoms. Deer move from place to place to avoid livestock concentrations. Coyotes, bobcats, and eagles are predators on the deer.

The lease is in the Wyoming Game and Fish Department's Deer Management Area 21. For the last few years, deer hunting has been for either sex. The 1973 hunting season was October 1 to 21. Most deer are taken as a sideline to antelope hunting.

Pronghorn antelope

Approximately 50 to 65 antelope inhabit the lease during different seasons of the year. Their numbers have been increasing slightly. There is some use of forbs such as cushion eriogonum and rockcress. The few crested wheat fields on the lease area are used in early spring. Antelope begin to eat Douglas rabbitbrush in late spring and early summer before going back to sagebrush which provides the bulk of their diet. Big sagebrush is a crucial species for them but may be less important in this area where snowfall is light and does not remain on the ground long.

Suitable habitat is generally available throughout the lease area. There is cover for young fawns and for adults during severe storms. Much of the sagebrush is short, so antelope must go elsewhere to eat when snow cover remains for more than a week. Lack of water in outlying areas causes some winter concentration of the animals along Little Thunder Creek.

Antelope have adapted to domestic grazing and fencing patterns. They share range with both cattle and sheep. Competition for forage between antelope and sheep is not significant when sagebrush is available. The greatest competition for feed is in the spring when cattle, sheep, antelope, and other grazing animals eat the bluegrasses. Sheep use sagebrush from late fall through the winter, so there is some conflict when they are with antelope on winter range.

The A.R.Co. lease is in the south end of State Antelope Management Area 24 which covers the southeast corner of Campbell County, south of Gillette (Highway 16) and east of Highway 59. In 1971 and 1972, 750 hunting permits were issued in Area 24 for 20 to 30 days of October. In 1973, the season was October 1 to 21 and the number of permits was increased to 900.

Elk

Twelve elk were released in the hills east of this area in 1969. They spread out and have increased in number to about 45. These elk use the lease area sometimes but are not full-time residents on the lease.

Other mammals

Predators

Bobcats are solitary animals and are normally less plentiful than foxes and coyotes; however, their numbers are increasing. Rough topography of the land on the lease provides cover. Bobcats usually feed on small mammals or birds. They may eat young antelope, deer, lambs, and calves and have been known to attack adult animals.

As predators, bobcats usually do not receive quite as much attention as coyotes. They have been trapped recently for their fur. Pelts sold for an average of $85.00 or more (1973).

The coyote is of economic significance as a predator and a fur-bearer. An estimate of the coyote population is not available, but the animals are considered increasing in numbers which is causing the livestock operators some concern.

Coyotes are very adaptable and consume a wide variety of feeds, from vegetation, to small mammals to occasionally big game animals and livestock. Reports of livestock losses indicate coyotes are more numerous because of the 1972 ban on the use of toxicants for predator control. There is also a possibility that the increase is caused, in part, by an increase in rabbit populations. Control methods include trapping and shooting from the ground or from aircraft. Prices (1973) of up to $70.00 for pelts have encouraged control efforts.

The red fox seems to be increasing. Its main food items are small mammals and birds. Foxes have not been controlled as predators. Recently, fur prices have risen causing an increase in trapping. Fox pelts sold for up to $35.00.

Furbearers

Other furbearers on the lease include the long-tailed weasel, badger, skunk, and the raccoon. Badgers feed on burrowing rodents and on many other small animals, including ground nesting birds and their eggs. Weasels eat many of the same animals. Striped skunks feed on insects, fruits, mice, and other small rodents, also carrion if necessary. The spotted skunk eats insects, small rodents, lizards, salamanders, and snakes. Raccoons usually prefer a moist habitat with trees, such as along Little Thunder Creek. Their food includes crayfish, insects, grubs, roots, eggs, mice, fruit, and grain. All of these small furbearing predators are trapped on the lease for their fur, but most are taken while trapping for the more valuable furbearers.

Upland gamebirds

The only upland game bird known to be on the lease is the sage grouse. Its population is about 50. Its summer range is along Little Thunder Creek, North Prong, and around outlying small reservoirs where succulent vegetation, insects, and water are available for broods. The area north and south of Little Thunder provides sagebrush essential for food and cover the rest of the year. Strutting grounds on the lease area have not been identified and documented. Sage grouse management during the last few years has been directed toward opportunities for habitat improvement and a limited harvest. In 1973, the season was September 15 to 18.

Waterfowl

The 57-acre Reno Reservoir and smaller stockwater reservoirs scattered across the lease area provide a resting place for several species of waterfowl during migration. They include Canada geese, mallards, pintails, gadwalls, widgeons, teal, goldeneyes, mergansers, and coots.

An estimated 8 to 10 pairs of ducks summer in the vicinity of Reno Reservoir, and a few more pairs nest in other suitable locations. They include mallards, teal, and gadwalls. All are puddle ducks and primarily vegetarians. They travel long distances to grain fields in the fall. Canada geese were introduced on Little Thunder Reservoir in 1973 as the beginning of a resident flock. Ducks are providing an increased amount of hunting since they are available during the season.

<u>Other birds</u>

Raptors

Raptors found on the lease include the turkey vulture, marsh hawk, red-tailed hawk, Swainson's hawk, ferruginous rough-leg, golden eagle, bald eagle, and the sparrow hawk. Their habits are discussed in Chapter IV, Part I.

Shore birds

There are several shore birds associated with the small reservoirs, but little is known about them. The killdeer is common around the reservoirs and meadows and along streams. Snipes, gulls, the American avocet, the Wilson's phalarope, and the longbilled curlew may be found around the water holes.

Fish

The Reno Reservoir provides a warm water fishery of bass, bluegills, and bullheads. Fishing and other recreational use is increasing.

Reptiles and amphibians

Little is known about reptiles and amphibians, another animal group living on this area.

The Tiger salamander, chorus frog, and leopard frog frequent the playas, reservoir, and wet drainage bottoms. The great plains toad, lesser earless lizard, and short-horn lizard are present on the lease. The prairie rattlesnake and western terrestrial garter snake are common.

Threatened species

No threatened species have been reported as indigenous to the lease area.

Recreation

Recreation can best be described as people doing things for their physical or psychological well being. There are few activities that occur on this lease area that serve these needs.

Zoological

Fishing in the Reno Reservoir is probably the most active recreation present with approximately 100 visitor days of use per year estimated for this activity.

Hunting antelope, deer, cottontail, jackrabbits, sage grouse, and waterfowl is the second most participated in activity with an estimated total 75 visitor days use per year.

Other

Other activities such as sightseeing, artifact hunting, photography, and picnicking probably occur on the lease area in amounts of one to 20 visitor days per year.

Figure 10
Reno Reservoir

Agriculture

Livestock grazing

Cattle ranching is the most important agricultural activity in this area. Dryland crop production is interspersed with grazing in the general area but not on the lease area. Some dryland farming was tried on the lease area but was unsuccessful and abandoned in favor of native grass under natural conditions.

Surface mining on a 160-acre tract of the lease will affect the Stuart Brothers' ranch. The 160 acres are located in a summer pasture. Under the proposed mining plan, this area will not be disturbed until after the year 1990. Approximately 40 AUMs will be affected in section 17, T34N, R70W.

The Reno Livestock Company uses the remaining area in the lease (private, state, and federal lands) for grazing. Four pastures will be affected by the mining. Pasture #1 is a calving pasture which will be completely disrupted during the course of mining. It consists of 3,040 acres supporting 760 AUMs. In pasture #2 there are approximately 1,880 acres at the west end supporting 470 AUMs which will be disrupted. Pasture #3 is a lambing and winter pasture where approximately 960 acres and 240 AUMs will be disturbed. The area is located in the northwest corner of the pasture and is not planned for mining until 1995 or later. Pasture #4 is a large summer pasture where 480 acres and 120 AUMs will be disturbed by mining. A total of approximately 1,630 AUMs will be affected during the mining operations.

Facilities associated with grazing that will be affected by mining are dams and fences. There are three dams, all on private land:

Big Reno Reservoir	424 acre-feet
2 small reservoirs	(No volume recorded)

There are 8.25 miles of fence inside the lease area as follows:

Across National Grassland	3.00
Across Private	3.50
Between Private and National Grassland	1.75

Three and one-half miles of additional fence exist on the lease boundary:

Across National Grassland	1.00
Across Private	1.25
Between Private and National Grassland	1.25

Farming

There was some farming during the 1930's, but it was unsuccessful and the land was returned to native range. Total acreage which was utilized in this way is not available, but it was a very small part of the lease area. The only reliable method of obtaining a farm crop in this area is with irrigation.

Ownership

The lease area and facility site cover 6,714 acres of private, National Grassland, and State of Wyoming land surface as follows:

National Grassland	2,880
Stuart Brothers	160
Atlantic Richfield	1,080
Reno Livestock Corp.	1,314
State of Wyoming	1,280

Transportation

Primary access roads

State Highway 59 which connects Douglas and Gillette provides general access to the mining area. It is a narrow, two lane, black top road. A 15-mile segment of the road from Gillette south was improved in 1972. In 1973, approximately eight miles of road were improved from Douglas north, consisting of widening the travel lanes and road shoulders, and repaving.

Secondary access roads

Little Thunder County Road connects with Highway 59 in sec. 2, T43N, R72W, and extends to the east approximately 12 miles where it turns southeast for approximately six miles (at this point it is 2 miles east of the Atlantic lease). From there it continues east to the paved Clareton Highway, 38 miles west of Newcastle. The Little Thunder County Road was graveled in 1971.

Reno County road connects with Highway 59 in sec. 35, T43N, R72W, and dead ends at the Reno Livestock Company property. The Reno road is 0.25 miles south of the Atlantic Richfield lease, and was graveled in 1972-73.

National Grasslands roads

School Creek Road (#968) connects the Little Thunder and Reno County Roads three miles southeast of the lease. It was graveled in 1972.

Road #928 connects the Hilight and Little Thunder County Roads. This road passes through the center of the Atlantic lease. The road is used mainly by ranchers, hunters, and fishermen as access to Reno Reservoir.

Other roads

Woods Petroleum Co. constructed a road through the south end of the Atlantic Richfield lease for access to its producing oil wells.

There are a number of unimproved roads on the lease area that are used by the ranchers to maintain fences and care for livestock. The location of these is not critical to the livestock operation as alternate routes can be used.

Pipelines

The lease area has two oil pipelines that cross the area. Phillips' pipeline crosses sections 16, 17, and 22 which are located near the north end of the lease.

Belle Fourche pipeline crosses sections 16, 17, 21, 27, 28, 34, and 35 of T43N, R70W, and section 2 of T42N, R70W. This pipeline crosses the whole lease area from north to south (Figure 82, Chapter IV, Part I).

Socio-Economic Conditions

The existing conditions of the study area, which include this proposed development, are described in Part I, Chapter IV.

CHAPTER III

PROBABLE IMPACT OF PROPOSED ACTION

Development of the Atlantic mine property will impact various environmental components. The impact analysis covers the entire area, an estimated 6,524 acres. This acreage includes coal leased from the state as well as the federal coal lease. Construction of mine facilities will take place off of the leased area on federal surface to be leased from the U.S. Forest Service. The impact of these facilities is also discussed.

Construction of an access corridor involving a road, five miles of spur rail line, and a transmission line into the area will be required. To the extent that information as to location was available, the impact of this access corridor is analyzed.

For purposes of this analysis, it is assumed that all the coal mined will be exported via railroad. The impact of transportation of coal beyond the spur rail line is also covered in Part I of this statement. The impact of the offsite use of the exported coal is beyond the scope of this statement.

The impacts analyzed here relate only to this mining operation. Cumulative regional impacts are discussed in Part I.

Air Quality

Mining of an estimated 724.3 million tons of coal over a total of 6,524 acres will create an impact on air quality for the expected life of the mine, an estimated 40 to 74 years. Mining is planned to begin in late 1975 (88,000 tons) which will result in disturbance of 40 acres of surface area for the initial boxcut. Production per year will increase up to ten million tons per year in 1979. Plans for a 20 million ton production rate have been made by opening a second pit when market warrants. At the ten-million-ton production level, an estimated 90 surface acres and about 18 million cubic yards of overburden will be disturbed each year. Over the life of the mine, an estimated 1,368 million cubic yards of overburden will be removed and handled. Removal of vegetation and disturbance of topsoil and overburden will expose soil and parent material to wind action which is frequently quite strong. Soil particles will be lifted by the wind and carried into the atmosphere, causing a reduction in air quality and reducing visibility during periods of high wind. Coal dust from crushers, trucks, coal piles, and loading operations will also pollute the air during the frequent windy periods.

Construction of an access road and a sevenmile railroad spur to the mine site will disturb additional acreages, creating dust and wind-blown particulate matter. Spur rail line construction will involve soil disturbance on 147 acres, creating wind-blown dust. This rail line will be shared with the Kerr-McGee lease. Dust may be harmful to vegetation, animals, and people.

Emissions from machinery, vehicles, and trains will add particulate matter and odor to the air on and adjacent to the mine site. Emissions resulting from train operations over this spur line are shown in Table 1.

Table 1

Train Emissions Resulting from Transporting Atlantic Richfield Coal Production*

Year	Trains Per Year	Million Tons/Year	Fuel/Day 1,000 gals.	Emissions - Tons Per Year Particulates	SO_2	NO_x	CO	HC
1980	909**	10	12.1	55	126	820	288	208

*Emissions based on the maximum projected production of 10 million tons reached by 1979.

**909 loaded - 909 empty.

SO_2 - Sulfur dioxide
NO_x - Nitrogen oxides
CO - Carbon monoxide
HC - Hydrocarbons

Increased populations (2,760 by 1990) associated with the mine and its employees will generate increased vehicle traffic. Increased traffic and commuting to work will add additional emissions to the air, causing a further decrease in air quality. The cumulative impacts of this type of increased emissions are discussed in Part I.

With increased mining and coalbeds opened to the atmosphere, the chance of accidental coal fires will be increased. These will add particulate matter and other potentially toxic chemicals to the atmosphere. Increased train traffic and people on the area also increase the possibility of wildfire occurrences. These would cause a temporary lowering of air quality with the addition of smoke and particles to the air.

Inversion periods of two-day duration normally occur 15 times a year. These inversions will trap emissions. During inversion periods, respiratory conditions could be aggravated, asthmatics made worse, and lung diseases caused or made worse. During normal weather conditions, these pollutants will be carried downwind (to the east and southeast), dispersed, and diluted before reaching any population centers.

Reduction in air quality will begin in 1976, rise to a maximum in 1979 when production is doubled and continue at that level thereafter until the end of the mine life about the year 2050.

Topography

The factors that make mining economically feasible in the coal basin--thin overburden and thick coal--also cause a local topographic change. Removal of thick coalbeds having little overburden for backfill creates a discrepancy between the volume of coal removed and spoil returned to the mined area. Coalbed thicknesses in the mining area range from 60 feet to about 73 feet. Coal in areas near the burnline ranges in thickness from zero to 60 feet in distances of less than a thousand feet. Overburden thickness ranges from about 15 to 240 feet. The decrease in altitude over the lease area will range from a maximum of 63 feet to a minimum of 6 feet. The average drop in altitude for the entire area to be mined, where the average coal thickness is 68 feet and the average overburden thickness is 123 feet, will be about 43 feet. The maximum decrease in altitude will occur in the areas which have thick coal in relation to thin overburden. Topography at the Black Thunder mine before mining is shown in Figure 2, Chapter I. Mining will proceed westward from the burnline.

Mining-reclamation operation will be carried out by shovel and truck (see page I-472). Using this method, the final reshaped spoil will be not more than 500 feet behind coal removal; about 80 to 100 acres will be reclaimed each year. The land will be returned to the same existing general landform, low rolling hills; two major streams will be reestablished in about their original streambeds; and water impoundments, depending on water quality and state water laws, can be created in the channels of North Prong and Little Thunder Creeks while maintaining normal downstream flow. These proposed landforms will blend with the surrounding topography and be nearly indistinquishable from it once vegetation is reestablished on their surfaces.

Figure 1 shows the shape for this area when all mining and reclamation is finished. All prominent hills and depressions, as well as the important streams channels, will retain approximately their original alignment and location. Minor drainage also will be reestablished. Water impoundments, lacking dams, will not impede the downstream flow.

Figure 2 shows the initial operations advancing westward, the temporary highwall, and the extent of reclaimed spoils by 1980. Figure 2a shows the configuration of little Thunder Creek after the first 20 years of mining. The valley has been completely mined and reclaimed, including the temporary highwalls on both sides of the valleys. The irregular shape of the reservoir, bays, and islands protect the shoreline from excessive wind damage.

At completion of mining, remains of the highwall will be visible on the west side of the mined area. The highwalls, as illustrated in Figure 2, have not been reduced but can easily be drained into Little Thunder Creek. This mine pit will create a long, narrow, trough-like depression and will probably be the most visible indication that the topography of the area has been altered.

Topographic impacts will occur slowly and may be noticeable in a small portion of the mined area at any one time. Initially, the mining-reclamation model, including areas stripped, mined, rough and smoothed spoils, and reseeded, will cover about 100 acres. This area will increase to about 300 acres at the full annual rate of 10 million tons of coal. Until completion of mining, the most severe impact will be that of the highwall or active working mine face.

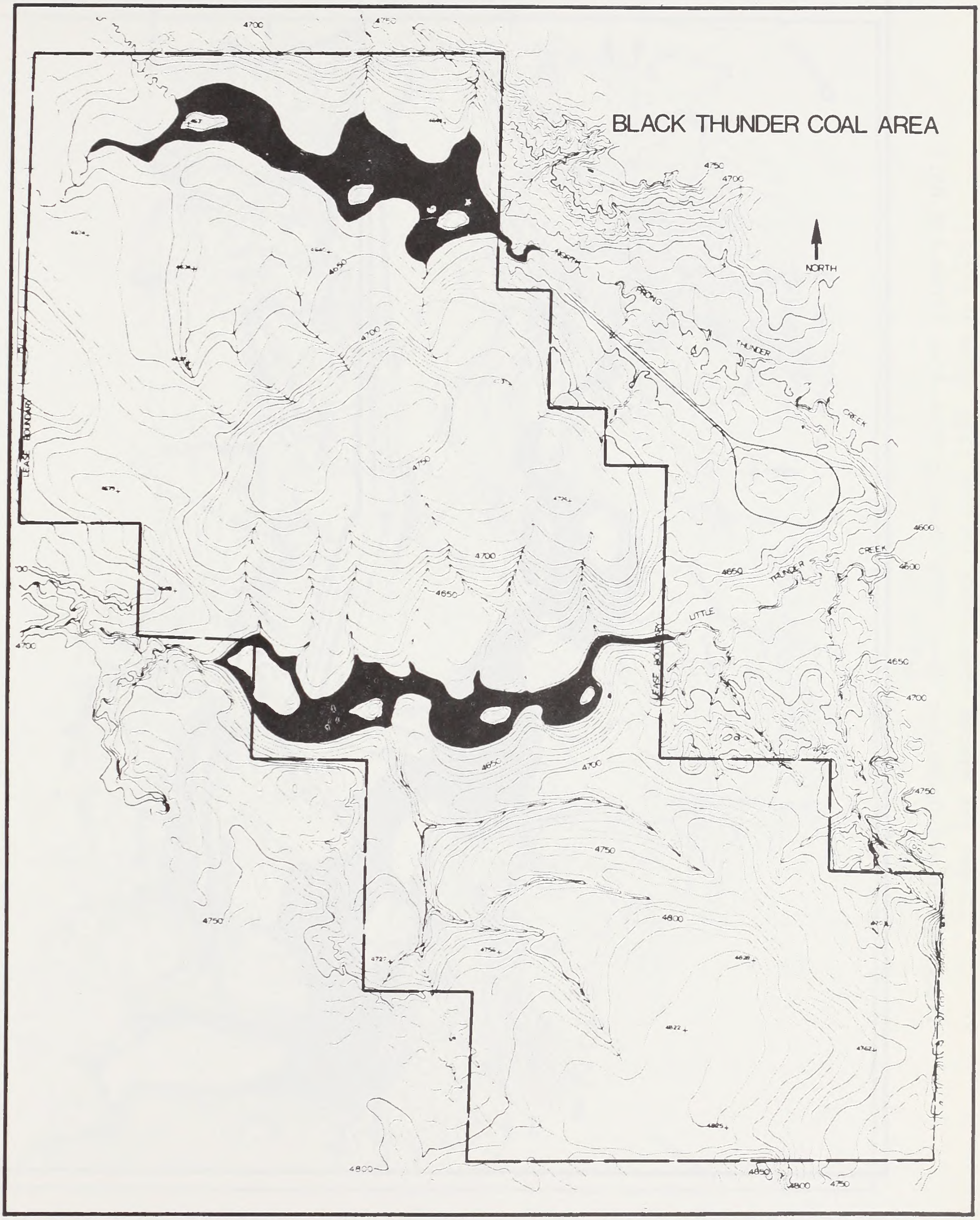
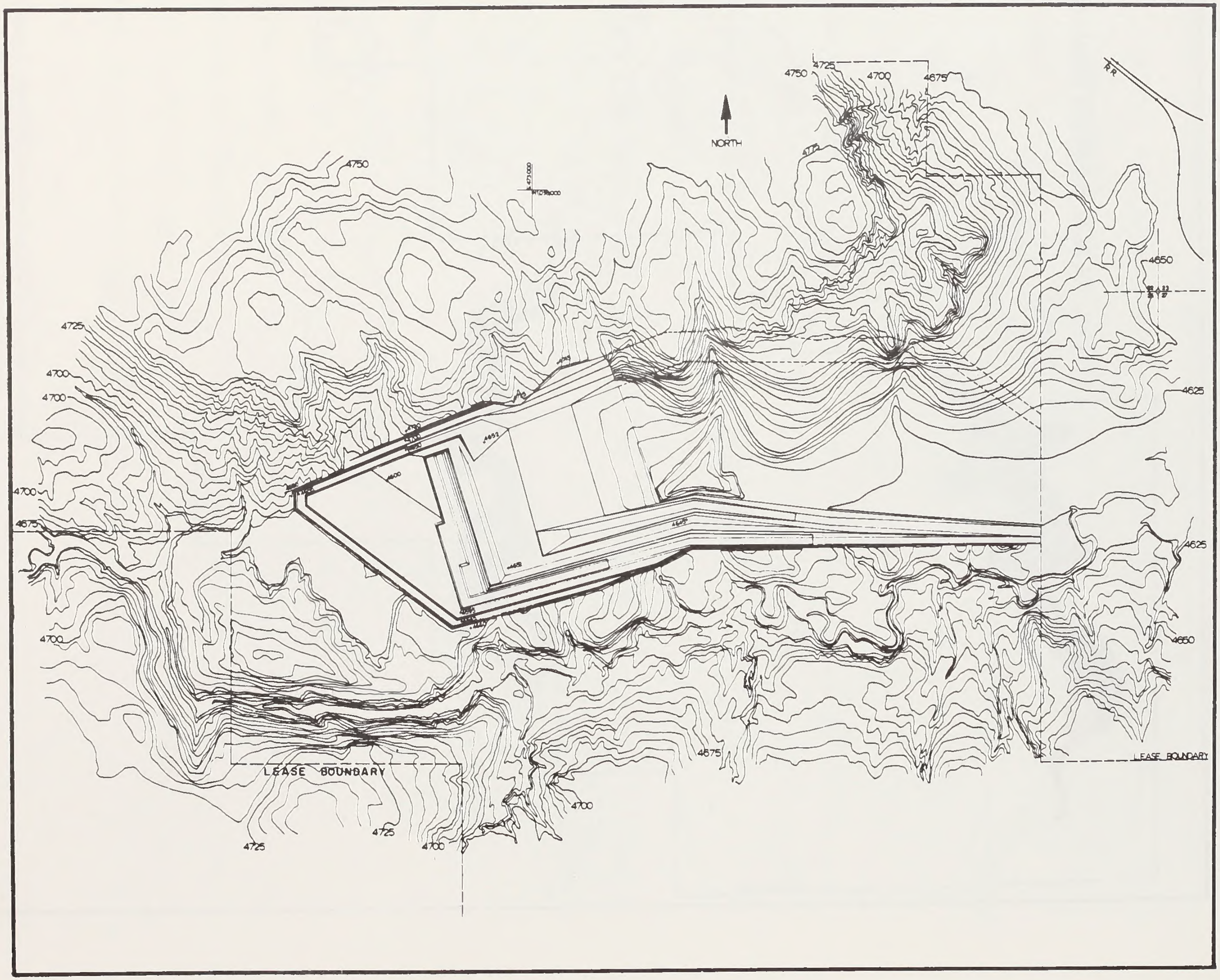


Figure 1
Topography after Mining Coal, Showing Finished Grades (from A.R.Co.)

Figure 2

Truck and Shovel Operation About 1980 Showing Mine Area (from A.R.Co.)



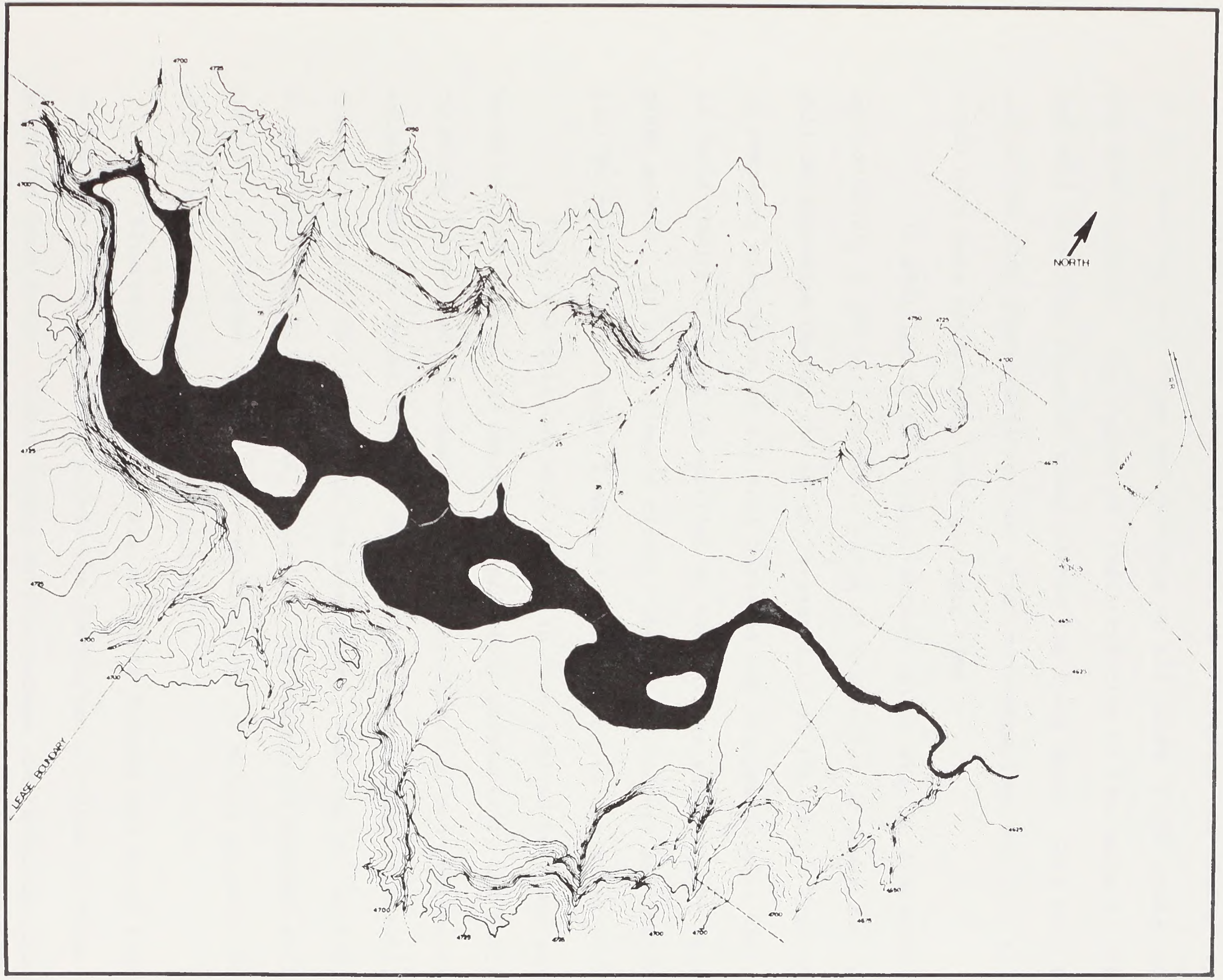


Figure 2a

... grades for mining operations through 1986 (from A.R.Co.)

Soils

Mining of the area will result in alteration and mixing together of all existing soil types and horizons on all lands (6,524 acres) within the mine property. The degree of redistribution of the soils is unknown and will vary from place to place within the lease area. This will change all of the soil characteristics and alter microorganisms and soil relationships which have been established over geologic time.

In addition to the topsoil acreage which will be disturbed by mining, approximately 1,368 million cubic yards of overburden or lower soil horizons will be excavated during the 40 to 74-year life of the mine. This will result in complete alteration of all soil horizons and changes in soil characteristics. It could result in bringing material to the surface which may be toxic to plant growth. At completion of mining, the soil structure and properties will be completely different from what exists prior to the start of mining.

These disturbances will result in fine-grained soil and parent material being exposed to wind and water actions. Soil permeability and infiltration rates may be reduced, increasing runoff, soil erosion, and sedimentation. Wind action, which is almost constant over the area, will cause fine soil, silt, and clay particles to be lifted into the atmosphere, reducing air quality and adding to soil loss. As all physical, chemical, and biological systems will be disrupted to an unknown degree, the overall result of mining action undoubtedly will be a lowering of soil productivity.

Alteration of the channels of Little Thunder and North Prong Creeks in the area of the mine will affect the downstream portions of these creeks and adjoining land areas. Channelizing stream courses and releasing production waters, including mine drainage, may cause increased flow velocities, resulting in accelerated erosion of streambeds and banks. This will increase the amount of soil loss in the immediate area as well as along the downstream channels. With alteration of stream channels, some areas may be deprived of soil moisture, thereby affecting soil productivity and vegetative growth.

Construction of mine facilities on approximately 200 acres outside of the area to be mined will disturb and permanently remove the soil from productivity. An access corridor will be developed for the mine area. This will include powerlines, access roads, and railroad spur.
The construction of the railroad spur will disturb approximately 147 acres of topsoil and permanently remove from production an estimated 68 acres covered by track, embankment, and associated facilities. The total amount of area involved in the access corridor, including the rail line, will be approximately 230 acres of which an estimated 110 acres will be permanently removed from production.

Additional offsite soil impacts will result from increased population associated with mine employment. Cumulative population increase is estimated to be 2,110 by 1980, 2,760 by 1985, and 2,760 by 1990 and would involve removing from productivity an estimated 138 acres of soil by 1990. Increased recreation use, solid waste disposal needs, schools, and other social facility needs will create additional unquantifiable soil impacts such as compaction, erosion, and sedimentation.

Construction and mining equipment crossing undisturbed soil areas susceptible to compaction will impact soil permeability and water infiltration rates. This will increase runoff, erosion, and sedimentation.

Mineral Resources

The most important impact is on coal. The removal and consumption of an estimated 724.3 million tons of coal from this area over the expected 40 to 74-year life of the mine will result in depletion of a nonrenewable energy source. The coal produced from this area will be exported to utility plants in Nebraska, Oklahoma, and Texas for production of electrical energy.

Some coal will be lost from production in the mining process, mostly due to dilution with waste material near the top and bottom of the bed, along the ends of a particular mining panel, and in areas where the coal is burned.

Sand and gravel beds, potentially useful for aggregate, occur on the lease area in alluvial fill along Little Thunder Creek and North Prong of Little Thunder Creek. Unless these sand and gravel deposits are removed prior to relocation of the streams and mining of the area, this resource will be lost. With the projected demand for this type of material, as discussed in Part I of this statement, loss of any part of the sand and gravel resource locally could be critical.

The existing producing oil wells in the area will be exhausted and abandoned before mine operations reach them. No impact on oil and gas resource is expected. Oil and gas drilling can be resumed after mining is completed.

Water Resources

Ground water

During mining and reclamation

Mining of a total of 724.3 million tons of coal over the life of the project (40 to 74 years), removal of 1,368 million cubic yards of overburden and disturbance of 6,340 acres during mining will destroy aquifers located within the area. Disruption of aquifers would cause a cessation of flow and a draining of water into the pit. Pumping for dewatering during mining operations and for consumptive use will lower water levels to the base of the coal in the pit. Either adequate aquifer-test data collected by monitoring a pumping well and nearby observation wells in the coal and the overburden deposits, or, the monitoring of water levels in properly spaced observation wells during actual mine dewatering operations will be necessary to determine accurately the effects of mine dewatering upon water levels in nearby aquifers. From limited data obtained from mine-dewatering operations now in progress in the Gillette area, an estimate of the effects of mine dewatering on nearby water levels is possible. It is estimated that the area of influence caused from mine dewatering could extend outward as much as two miles from the point or points of pumping. Most of the effects will be west of the mining operations. Within the area of influence caused by pumping, water levels will be lowered at increasingly greater depths toward the mine area. At the outer edge of the area of influence, water levels will be lowered insignificantly. Wells that derive water from shallow aquifers within the area of greater drawdown could be affected. Springs and seeps in the major area of influence may also dry up. Reduction in water levels could impact agricultural use and wildlife populations.

No significant flow can be expected to occur between aquifers as a result of mining the coal; however, the removal of considerable overburden could have an effect on the artesian pressure in the underlying aquifers. Reduced overburden (removed load) could cause a movement of water upward in the underlying aquifers because the artesian pressure could respond to the reduced load and the potentiometric surface (pressure) would rise. Stream drainages and some outcrop areas in the southern part of Campbell County are discharge areas. Thus, the removed overburden could also result in increased water discharged into the mine pit.

The area to be mined is a ground water discharge area. Recharge to deposits involved with mining occur west of the mine lease and, thus, would not be impacted.

After reclamation

Replacement of spoils into the pit will result in deposits with reduced permeability. This reduction may result in less water flowing into the aquifer and increase surface runoff which could increase erosion and sedimentation. However, as the overall altitude of the land could be reduced by 43 feet, this could result in less runoff in low areas where ponding may occur.

Quality

As the mined area is a point of discharge, reduction of quality of water in the aquifers will not occur while mining is taking place. After spoils have been returned to the pit, leaching could occur which may reduce the chemical quality of water in the aquifers. This water would eventually move down gradient toward discharge points along Burning Coal Draw. Some discharge as seeps also might occur along Little Thunder Creek or North Prong Little Thunder Creek. Discharge of this water could result in the lowering of surface water quality in these streams.

Surface water

Mining activities will destroy the existing drainage pattern in parts of the area. The channel of Little Thunder Creek will have to be diverted around the mine pit to carry its natural flow. This channelizing may decrease annual and low flows due to seepage loss to the pit. Peak flow will not be significantly affected unless protecting dikes breach and the flow is diverted to the pit. Characteristics of minor tributaries will be interrupted by mining until reclamation is complete.

Channelizing stream courses may cause increased flow velocities and result in accelerated erosion of streambeds and banks. In changing the course of the stream, its base level may be lowered, resulting in headcutting of tributaries. Release of production waters, including mine drainage, would alter flow characteristics, possibly resulting in accelerated erosion of streambeds and banks. The amount of release would govern the extent of erosion in a downstream direction.

Quality

Erosion and sedimentation will be increased during construction and operation of the mine as vegetation is removed. High sediment yields will occur from spoil piles until they have been reclaimed and a protective grass cover established. Increased erosion and sedimentation could lead to a further lowering of water quality in the streams.

Dissolved solids load in water downstream from the proposed mining site will increase during mining and reclamation, but changes in dissolved solids concentration will depend on the amount and concentration of water in receiving streams. Dissolved solids concentration in runoff from newly exposed surfaces will increase. Continuance of the increased dissolved solids loading in downstream waters after reclamation is completed will depend on the degree of success achieved in the reclamation effort to protect exposed surfaces from leaching and erosion.

Increased population associated with mine development could affect water quality through recreational use of the area and from adding additional untreated sewage to the ground water. A trailer camp is proposed for Reno Junction. Sewage from this area may contaminate both ground and surface water supplies unless it is properly disposed.

Vegetation

During the 40-to 74-year life of the mine, vegetation will be destroyed on 6,524 acres. Vegetation will be removed progressively as mining proceeds across the leased area. Vegetation affected during this period is shown in Table 2.

Table 2

Vegetation Types and Amount to be Disturbed

Vegetative Type	Acres
Western Wheatgrass - Foxtail Barley	130
Western Wheatgrass - Slender Spike Rush	10
Inland Saltgrass - Western Wheat - Blue Grama	520
Blue Bunch Wheatgrass - Blue Grama	860
Big Sagebrush - Western Wheat - Blue Grama	1,789
Big Sagebrush - Needleandthread - Blue Grama	2,705
Big Sagebrush - Blue Grama	510
Total	6,524

Additional detail on vegetative type and relationships to be disturbed and destroyed is in Appendix D.

With initiation of coal production in 1976, some 40 acres of vegetation will be lost from the initial pit (boxcut), topsoil storage areas, and spoil waste areas. This will increase to 90 acres in 1979 when mining increases to ten million tons per year. It is assumed that vegetative destruction per year will remain consistent from that point until the end of mining in 2050. After the first five years, approximately equal areas will be disturbed and reclaimed each year; at any one time after 1981, approximately 90 to 100 acres will be denuded.

Development of the access corridor, including a road, electric transmission lines, and a spur rail line, will disturb and destroy existing vegetation on an estimated 230 acres. Of this total, approximately 48 percent (110 acres) will be permanently destroyed. This area will be occupied by rail line bed and road surface. The remaining area will be disturbed temporarily, from one to two years before vegetation is replaced. The corridor extends northwest from the plant facilities through an inland saltgrass western wheatgrass type.

Construction of mine facilities which will take place outside of the area to be mined will permanently remove vegetative growth on an estimated 200 acres. The vegetative type removed on 200 acres will be big sagebrush-needleandthread-blue grama.

Population increase associated with mine employment will remove an estimated 138 acres of vegetation by 1990. Vegetative types removed are indeterminable as location of population cannot be determined at this time. An additional indeterminable amount of vegetation will be disturbed or destroyed by development of social facilities (schools, solid waste disposal area, etc.) to serve this increased population. Increased recreational use by the new expanded population, especially off-road vehicle use, will affect additional vegetative types and acreages within the total study area.

Haul road dust and fugitive coal dust from coal mining, blasting, transporting, processing, and unit train loading will be deposited on vegetation adjacent to the mine area. Toxic chemicals which could be present in the deposited dust may damage vegetation when wetted by dew and light rain.

Dust-covered and damaged vegetation may be less palatable and possibly toxic to livestock and wildlife.

Use of herbicides and soil sterilants for maintenance of powerline and rail spur rights-of-way will cause mortality of target species and may cause short-term damage to nontarget species. Drift off of the target area could cause additional vegetative damage.

Suitable vegetation may be difficult or impossible to reestablish on some of the mined area. Toxic or nonproductive material may be brought to the surface; microclimate will be changed; soil structure will be destroyed with loss of some topsoil. These effects of mining may individually or in combination make revegetation difficult or impossible in some areas. The climate and existing soil types of the area render prediction of reclamation success questionable. However, an assumed reclamation success in this area is explained in Part I, Chapter III, "Reclamation of Mined Lands."

Vegetation from reclamation will attract wildlife which like to graze on young shoots. This grazing will inhibit early growth and revegetation of the disturbed areas.

Archeological and Paleontological Values

An archeological survey is being conducted by personnel from the University of Wyoming Department of Anthropology. The survey and report have not been completed.

With unknown archeological-paleontological values, there could be significant impacts from strip mining. There will be nearly 6,524 acres involved in strip mining on this lease. Approximately 652 million cubic yards of overburden will be moved to mine the coal. Additional area (200 acres) will be occupied by facilities such as crushers, silos, railroad loading loop, roads, offices, and equipment-maintenance buildings. Moving overburden or establishing permanent structures will either destroy potential archeological sites or make them unavailable for study and salvage.

Besides direct impact of mining, there will be some indirect impacts associated with the population increase expected to be generated by construction and operation of the mine. Increased population will permanently remcve and disturb additional acreage (138 acres by 1990) which could possibly contain archeological values. Construction of the access corridor will disturb another 230 acres of which an estimated 110 acres will be permanently covered by structures.

Recreational use associated with this population could impact unknown archeological sites throughout the study area. Arrowhead hunters, rock collectors, pot hunters, and off-road vehicle users will all disturb additional surface acreage, destroying evidence which could provide information on archeological sites.

Historical Values

As there are no presently known sites of historical significance within the boundaries of the mine property, no impact is expected to occur (Woodward-Envicon, Inc. 1974, p. III-179).

Aesthetics

The impact on aesthetics will take place gradually over a period of time. Intrusions will be added to the landscape prior to and at the beginning of mining. Other changes will take place over a period of 40 to 74 years, the projected mine life. Changes to this one site are not significant when compared to the 4.9-million-acre study area. However, the impact of mining on this specific site could be very significant when viewed against the surrounding natural landscape backdrop.

The mining operation will impact existing landscape character by changing the form, line, color, and texture. Disturbance of vegetation, removal of overburden, and creation of new landforms cause a change in appearance of the landscape, i.e., landscape character.

A color contrast will be evident where the mixed soil from the mine joins the undisturbed natural soils and where the new vegetative cover on reclaimed land meets undisturbed sagebrush and grass.

Texture in vegetation and landform will change from a coarser to a smoother texture due to reshaping to a smooth landform and a softer-textured vegetation. The eroded, rough broken landform will be graded to more gentle slopes. This will all result in less variety and natural configuration in the landscape, reducing the overall quality of the landscape character.

Intrusions such as roads, powerlines, railroads, pipelines, base area buildings, and other structures will add discordant character to the natural landscape in form, color, line, and texture.

Other impacts on landscape character will be the general lowering of the profile in the mined area and the resultant highwall left at the edge of the mining operation. Also, where the mining operation meets other mining leases, a discordant landform will result if the two are not coordinated and planned together.

Wildlife and Fish

All wildlife will be displaced from the area as mining progresses. The smaller wildlife (reptiles, amphibians, invertebrates, rodents, and other burrowing animals) which are not able to flee will be destroyed. Populations which are displaced, such as the estimated 50 antelope and 50 sage grouse plus numerous birds and small mammals, will have to relocate on adjacent sites. It is assumed that surrounding areas are already supporting populations in balance with available habitat. Therefore, displaced wildlife may exist for awhile, but populations will eventually be lowered to remain in balance with available habitat unless mitigating measures are taken. Most of the displaced population may eventually be lost.

Aquatic habitat associated with the 57-acre Reno Reservoir will be lost as mining reaches the reservoir. This aquatic habitat presently supports a warm water fishery of bass, bluegills, and bullheads. Waterfowl which use this reservoir during periods of migration will be forced to use other bodies of water in the vicinity.

Loss of wildlife habitat will be a constant progression across the mined property. Once full production of 10 million tons per year is reached by 1979, an estimated 90 acres of vegetation will be destroyed annually. By the end of the mine life, a total of 6,524 acres of habitat will have been destroyed and reclaimed. In all probability, increased human activity and noise associated with mining operations will disturb and cause major wildlife species to leave the area prior to destruction of habitat.

Habitat for big game species (deer and antelope) and for sage grouse will be lost for a long time even though the area will be reclaimed. The projected time periods for return of the area to suitable habitat for various wildlife species groups is graphically shown in Figure 7 of Part 1, Chapter V. Some animals, especially those associated with a grass habitat (Richardson's and thirteen-lined ground squirrels, prairie dogs, mice, and other small rodents) will return to the area as it is reclaimed and vegetation reestablished. No satisfactory evidence is presently available which would suggest that surface mined areas can be satisfactorily revegetated with plant communities that will satisfy needs of deer and antelope.

Permanent habitat loss will total an estimated 450 acres, including that associated with construction of the access road, spur rail line, transmission lines, mine buildings, and increased populations. This will involve an indeterminable loss of various animal species. Increased recreation use will affect additional acres of habitat and increase pressure on wildlife populations by disturbance and displacement.

With increased vehicular use on the area and surrounding roads, road mortality of animals will increase. Mortality will also occur from train traffic. Construction of right-of-way fences and fences to protect the reclaimed area to allow vegetation to be reestablished may cause some impact on wildlife movement and migration. The greatest impact of fences will likely be on antelope and any east-west fencing will be most restrictive to their present seasonal movements.

Noise and human activity associated with this mining operation may impact the elk herd usually located east of the leased area. Elk in this type of habitat do not normally tolerate excessive human activity or noise. They may be forced from their present habitat which could in the long run result in their elimination.

Some food chains will be disrupted when habitat is lost, but it is difficult to estimate the species or the number of smaller animals and the effects on each.

Recreation

The proposed mining operation will disrupt present patterns of recreation activities on the lease and adjacent areas. The railroad spur will change present antelope, rabbit, and sage grouse hunting patterns.

The mining operation with the base plant site will eliminate approximately 500 acres of hunting area on an annual basis throughout the life of the mining lease. This will affect approximately 10 visitor days of use per year. Elimination of vegetation and reduction of wildlife habitat and populations could affect hunting quality on and adjacent to the mine property.

The loss of the 57-acre Reno Reservoir will eliminate 100 visitor days of fishing use per year. The potential for fishing on the reservoir is approximately 1,500 visitor days per year.

Access will be improved to the lease area, thereby permitting easier access for recreation activities. Hunting access can be expected to increase due to better roads and increased population.

Other activities can be expected to increase except for artifact hunting which will be slowly eliminated as mining progresses. Sightseeing will definitely increase because of interest in the mining activity and the desire to capture it on film.

Agriculture

Livestock forage

Grazing on the entire 6,524 acres of the mine area would be disrupted by the end of the mine life. A total of 1,630 AUMs (animal unit months) of annual production will be affected. The disruption will occur over time.

Throughout the life of the mine, critical pastures will be destroyed. Acreages and types of pastures are 640 acres summer pasture, 3,040 acres calving pasture, and 960 acres lambing and winter pasture. The remaining acreage of the area is used for grazing but is not as critical as the above named areas.

The access corridor will affect a total of 230 acres and 58 AUMs of annual production. Construction of mine plant facilities will disturb an additional 200 acres and 50 AUMs of annual production. Of the total acreage disturbed, an estimated 310 acres will be permanently removed from production. This area will be utilized by mine facilities, access road, and spur rail line. A total of 78 AUMs of annual production will be permanently lost.

Facilities which will be destroyed consist of Reno Reservoir (424 acre-feet), two small reservoirs (no volume recorded), and 11 3/4 miles of fences.

The ranchers presently using this area will be impacted to an unknown extent. Once mining is completed, they plan on continued utilization of the area for grazing purposes.

Transportation Networks

There will be 10 miles of single lane roads and two miles of National Grassland road #928 destroyed as the mining operation reaches these roads. These roads are used by ranchers for access to cattle pastures, by oil companies for access to oil wells, and by hunters and fishermen for access to Reno Reservoir and adjacent lands. Loss of these roads will cause an inconvenience to these users. There are a number of alternate roads that may be used when the above roads are destroyed.

Oil and gas pipelines that cross the surface mining area will have to be relocated or the mining plan altered to accommodate the retention of these pipelines. In relocating the pipelines, additional land outside the lease area will be disturbed. If they are not relocated, production of underlying coal will be deferred or lost.

Construction of the access road, spur rail line, and transmission lines may cause temporary inconvenience to the people who travel through the area. This impact will be minimal and of short duration, a year or less. The net result of construction of the access corridor will probably be beneficial since access to this area will be improved.

Increased traffic created by population increases and employment at the mine may impact existing roads. Without knowing where the population will settle, identification of which roads will receive increased use is not possible. Congestion and road deterioration may result from this increased use.

Socio-Economic Conditions

The primary socio-economic impacts will be those associated with increases in capital expenditures, employment, population, and income. Estimated capital expenditure at the mine will be 40 to 70 million dollars.

Construction of the mine site will employ about 200 people for one and one-half years. These people and their families will probably live in a trailer camp to be established near Reno Junction.

The following table shows estimates of employment, population, and wages induced by the mine. An average annual income of $17,793 in 1975 is expected.

	1975	1980	1985	1990
Mine employment	200	300	400	400
Other employment	400	600	800	800
Total population	1,440	2,110	2,760	2,760
Wages from mine employment only*	$3,558,600	$6,812,700	$11,593,200	$14,796,000

*Assume inflation = 5 percent per year.

Increases in population will increase the demand for services, protection, water supplies, sewage disposal facilities, and housing. Problems associated with more dense populations such as crime, mental illness, and unemployment, will probably increase. These impacts are discussed in Part I, Chapter V.

CHAPTER IV

MITIGATING MEASURES

Air Quality

All activities affecting air quality must comply with State and federal air quality laws as listed in Chapter VI, Part I.

The primary mitigating measures will be revegetation to control dust and emission control devices. Dust from denuded areas and roads will be minimized by reclaiming spoil piles as soon as possible after mining, treating roads to reduce dust, irrigating areas to hold dust on the ground and hasten revegetation, and placing chemical or physical covers over exposed areas to prevent dust from lifting into the air.

Coal piles should be minimized by shipping coal as soon as possible and limiting storage on site. This will reduce the chance of high winds blowing coal dust and reduce the opportunity for coal to burn on site.

Emission control devices will be used to reduce gaseous and particulate matter from vehicles, processing plants, and heating plants.

State, federal, and industrial fire prevention campaigns will reduce the number of fires. The construction of firebreaks along roads and railroads and around mining activities will limit the extent of fires. Firefighting equipment will be required on the site.

The use of spark arrestors on equipment will cut down on accidental range fires. On turbo-charged equipment and locomotives which cannot use spark arrestors, using a high quality diesel fuel will minimize sparks.

Topography

The mining and reclamation plan filed with the Federal Government, in conjunction with federal regulations, state laws, and the coal lease terms, requires actions to mitigate the adverse topographic effects of surface mining. Spoils will be graded to a rolling topography; the highwalls will be reduced. The final pits will be filled with material from adjacent spoil banks and highwalls. The spoil banks, highwalls, and final cuts will then be covered with a layer of soil material to facilitate revegetation. All exposed coal-beds will also be covered by at least three feet of soil material.

The Atlantic Richfield Company, in its revised mining and reclamation plan dated May 20, 1974, proposes to continously shape the surface disturbed by mining after a lag period of 10 to 12 months from the start of mining; reconstruct this surface by replacing spoils, using 50-foot increments, in the same stratigraphic sequence of the original overburden. Final slopes including the reclaimed highwall will have gradients no greater than 4:1 and will blend into the surrounding landscape to achieve a natural-appearing configuration. Lateral drainage will be maintained to control run-off and erosion during mining.

The restored landform shall be determined by consultations among the lessee, the appropriate land management agency, the State Department of Environmental Quality and the U.S. Geological Survey to assure that company plans conform to operating stipulations. Such consultations will be frequent enough so as not to impede the progress of the mining or reclamation. Prime consideration in grading and shaping shall be catching and holding of any waters falling on the area to improve the water table and catch and hold sediment in such a manner as to protect downstream areas from excessive sedimentation. During the shaping of the spoil into the final landform no closed interior ponds, such as upland playas, should be permitted to form.

Soils

The land will be reformed following mining and construction activity to assure proper vegetation as one of the major criterion. Topsoil will be stockpiled during the mining operation and replaced on the reformed land prior to revegetation.

Mechanized equipment, such as scrapers, which will minimize soil mixing will be used for both stockpiling and replacing topsoil. Productive soil will not be buried or mixed with unproductive or toxic material. Toxic or other undesirable material will be buried below the top 60 inches.

Soil erosion will be minimized by structures such as waterbars, terraces, contour furrows, etc. Soil compaction will be mitigated by restricting off-road vehicle use, ripping, and tilling. Soil protection will be insured by revegetating the disturbed areas or by insuring proper protective measures if other higher uses are made of the lands.

The leasee will provide the Forest Service detailed soils information on the mining area as follows to supplement the information now available and to insure that the above measures will be accomplished:

1. Detailed soils map of the lease area to standards designated by the Forest Service.
2. Take samples of soil from soil horizons and overburden formations down to coal seam for chemical tests to determine presence or absence of toxic or undesirable material and its depth and thickness.
   (a) Sample each individual soil horizon and the underlying geologic layers of the formations and record depth at which sample was taken.

(b) Chemical analysis to include organic matter, pH, exchangeable percentage, copper, manganese, iron, aluminum, magnesium, boron, sodium, chlorine, calcium, selenium, nitrogen, sulfur, phosphorus, arsenic, potassium, base saturation, cation exchange capacity, percent lime, conductivity.

(c) Determine at what level certain chemicals are toxic to plants used in rehabilitation work.

(d) Determine which ions or compounds become insoluble or more soluble when exposed to air, water, and other chemicals.

(e) Describe the character of the overburden material--stony, clayey, etc.

(f) Conduct soil mechanical analysis (particle size and distribution).

(g) Determine soil mineralogy.

3. Determine soil moisture relationships.

(a) Measure precipitation.

(b) Determine potential soil moisture holding capacity.

(c) Determine the amount of soil moisture which is actually available during growing season.

4. After soil has been replaced following mining and before planting, the following detailed information will be obtained:

(a) Soils map characterizing the upper 60 inches.

(b) Chemicals analysis of the top 60 inches.

(c) Conduct mechanical analysis of the upper 60 inches.

(d) Determine soil mineralogy of the upper 60 inches.

Water Resources

Availability of water from deeper aquifers

Water-well supplies affected by lowered water levels in the radius influenced by dewatering for mining could be replaced by deeper wells. The chemical quality of water in the Fort Union Formation is similar or of better quality than water in the overlying Wasatch Formation.

Monitoring programs

Monitoring programs are being established by companies planning to mine coal. A number of the monitoring programs are being planned in consultation with the Water Resources Division of the U.S. Geological Survey. The programs consist of establishing observation wells to determine water-level fluctuations in the coal and the overlying overburden. Water samples will be collected to determine the chemical quality of the water for detecting changes in water quality after mining begins. As mining progresses, observation wells will be established in backfill areas to monitor for leaching and movement of toxic materials.

Vegetation

The loss of vegetation on land disturbed by mining, and the construction of related facilities, will be mitigated by satisfactory revegetation. Initial measures will be started within one year following the reshaping of the land and the replacing of the topsoil. Revegetation efforts will continue until a satisfactory stand of grasses, shrubs, or trees of acceptable species is established and free to grow without irrigation.

Plans to revegetate disturbed land will be approved by the administering agencies. On the National Grasslands, one of the following five options, or combinations thereof, will be used:

1. Plant the reclaimed area with native species only.
2. Plant a mixture of native and introduced species of grasses and shrubs.
3. Plant native grasses, shrubs, and shelterbelts using mining water, treated as required, to maintain shelterbelts.
4. Plant only introduced species.
5. Plant species adaptable to new landforms, natural lakes, and reservoirs.

Following are examples of vegetative species which will be used (the [illegible]rs to the above options as indicated by the numbers shown):

Reference Number	Species
1, 2, and 3	Blue Grama (*Boutelous gracilis*)
1, 2, 3, and 5	Needleandthread (*Stipa comata*)
1, 2, 3, and 5	Western Wheatgrass (*Agropyron smithii*)
1 and 2	Sandberg Bluegrass (*Poa sandbergii*)
1 and 2	Green Needlegrass (*Stipa viridula*)

Reference Number	Species
2, 3, 4, and 5	Slender Wheatgrass (Agropyron trachycaulum)
2, 3, and 5	Rabbitbrush (Chrysothamnus viscidiflorus)
2, 3, 4, and 5	Winterfat (Eurotia lanata)
2, 3, and 5	Big Sagebrush (Artemisia tridentata)
2, 3, 4, and 5	Yellow Sweet Clover
2, 3, and 4	Crested Wheatgrass (Agropyron cristatum)
2, 3, 4, and 5	Sodar Streambank Wheatgrass
2, 3, and 4	Fall Rye, Oats, Barley Wheat
3, 4, and 5	Russian Olive
1, 3, and 5	Plains Cottonwood
3 and 4	Caragana
3	Yellow Pine
3	Juniper
3 and 4	Hackberry
5	Willow (peach leaf)
5	Hard Stem Bullrush
5	Cattails
5	Deep Water Duck Potato
3 and 5	Wild Duck Millet
3 and 5	Reed Canary Grass
5	Sago Pondweed

Specific revegetation measures will be recommended by the lessee in the mining and reclamation plan for approval by the Forest Service. When planning and approving revegetation, the lessee and the Forest Service will consider and use supplemental measures to aid revegetation when needed such as:

1. Irrigation, including treating water as necessary
2. Fertilization
3. Soil amendments
    - (a) Manure
    - (b) Gypsum
    - (c) Lime
    - (d) Treated sewage
    - (e) Sulfur
4. Tillage
5. Mulching
6. Correct time of year to seed or plant

Research studies will be planned and implemented to determine the effect of industrial emissions and dust on plants and animals. Reclamation plans will recognize the effects of landform, vegetation, soil color, and soil texture on the microclimate. Reclamation will be designed to create a microclimate favorable to revegetation.

Not enough is known about the macro- and microclimate on the lease area. These climates will be monitored to gather data such as air temperature, wind speed and direction, precipitation, solar radiation (total incoming and net), humidity, and evaporation. This data will be collected before mining as base line information, and during mining. A variety of situations will be sampled to depict the climatic character of the area.

The mining and reclamation plan will consider modifying the landform to provide a microclimate favorable to revegetation. Such landform modifications may include terraces, contours, minimizing the area in south-facing slopes, or other ideas which evolve during the course of the reclamation job.

The lessee will be responsible for the continued management of rehabilitated areas, including fencing which may be necessary to control use by livestock and wildlife, until the vegetation is satisfactorily reestablished.

The use of herbicides and soil sterilants in maintenance of rights-of-way will be controlled by applicable federal and state laws, and requirements of the surface owner.

Archeological Preservation

Legislative authorities and obligations which guide issuance of federal license to develop the Powder River coal resources are the statute commonly referred to as Antiquities Act of 1906 (34 Stat. 225, 16 U.S.C. 431-433); Wyoming statutes relating to archeological and paleontological sites (sections 36-11 to 56-13 and 18-330.7 W.S. 1957); Wyoming Environmental Quality Act of 1973 (Section 35-502.12(a)(v)); an act for salvage at reservoir sites (74 Stat. 220; 16 U.S.C. 469-469c); an act for historic preservation (80 Stat. 915, 16 U.S.C. 470-470m); National Environmental Policy Act of 1969 (83 Stat. 852, 42 U.S.C. 4321 et seq); and Executive Order 11593, May 13, 1971 (36 F.R.-8921).

Both federal and state antiquities acts regulate antiquities excavation and collections, and both protect historical values on public lands. They provide for fine and/or imprisonment for violators of their provisions. The Wyoming Environmental Quality Act protects areas of the state designated unique, irreplacable, historical, archeological, scenic or natural. The reservoir salvage act provides for recovery of historical and archeological data from areas to be inundated by certain water impoundment as a result of federal action. The Historic Preservation Act established a system of historic preservation in the nation and requires that certain federal undertakings be submitted for review by the National Advisory Council on Historic Preservation. NEPA states in Section 101(b)(4) that one objective of national environmental policy is to "preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment which supports diversity and variety of individual choice." Finally, Executive Order 11593 affects federal agencies most intimately in that they are instructed to cooperate with the nonfederal agencies, groups, and individuals and to insure that federal plans and programs contribute to the preservation and enhancement of nonfederally owned historic and cultural values. Agencies are directed to inventory, evaluate and nominate properties in their jurisdiction to the National Register of Historic Places.

Under the mandate of the Executive Order, federal agencies must insure that until inventories and evaluations are completed, the agencies will use caution to assure that federally owned properties which might qualify for nomination to the National Register of Historic Places are not inadvertently transferred, sold, demolished, or substantially altered and that federal plans and programs contribute to the preservation and enhancement of nonfederally owned sites.

The Antiquities Act of 1906 prohibits damage or excavation of plant and animal antiquities on federal lands without a permit (see 43 CFR Part 3). The Wyoming statutes require that permits be obtained before excavation of any archeological or paleontological deposits on either state or federal public lands (sec. 36-11 W.S. 1957).

Archeological and paleontological values on federal lands will be protected by surveys and salvage excavations. The Wyoming Antiquities Act similarly requires a permit for excavation of antiquities on public lands, permission to be granted by the State Board of Land Commissioners.

The Wyoming Environmental Quality Act requires approval of any application for a mining permit under the provisions of Section 35-502.24 (g)(iv) of this Act to assure that "...the proposed operation will not irreparably harm, destroy, or materially impair any area that has been designated by the Council to be of a unique or irreplaceable, historical, archaeological, scenic or natural value."

Surface surveys for evidence of archeological values in the alluvium are fundamental to establishing responsible stipulations for their protection. Therefore those stipulations in the mining plan and/or permit that require surveys will be followed to insure archeological and paleontological protection.

No mining plans, permits or rights-of-way will be approved until the company has coordinated its archeological surveys with the Wyoming State Historic Preservation Officer. Company survey reports will be submitted to the State Historic Preservation Officer with a copy to agencies approving plans and permits. The report will be certified by the Preservation Officer and forwarded to the approving agencies with a statement that surveys have been conducted by competent, professional archeologists and a recommendation for additional surveys to be required before plans and permits are approved. These additional surveys may be necessary if surface evidence indicates further evaluation is necessary. In addition, approvals will be conditioned to require notification to the Area Mining Supervisor of all archeological and paleontological sites discovered during mining prior to disturbance and notification to the appropriate officer of the surface administrating agency of sites discovered during right-of-way construction prior to disturbance. The Antiquities Act of 1906 and Wyoming statutes make it unlawful to excavate sites which are discovered without a permit.

Furthermore, it will be required that the alluvium to be displaced during the mining operation be surveyed and that all surveys be coordinated with the Wyoming State Historic Preservation Officer to insure competent, professional inventories, salvage, and preservation of archeological and paleontological data.

It is recommended that all present and future applicants share in the cost of establishing a full-time resident basin paleo-archeologist under the supervision of the Wyoming State Historic Preservation Officer. The basin archeologist will aid in reducing lead time and development delays by performing advance surveys for support facilities, educating construction employees, sampling soils, responding to company discoveries, and conducting salvage work.

Historical Values

A systematic evaluation of homestead sites and other locatable history shall be completed before the mining begins. If a significant site is located on the lease area, action as specified in Part I shall be taken by the agency having jurisdiction.

Aesthetics

The objectives for aesthetics are to create the least impact possible on the existing landscape character. This means that colors, form, lines, and textures on the rehabilitated land and of intrusions should correspond and blend with those of the natural, characteristic landscape. An exception to this is water features. Water features add interest and motion to a landscape, giving it added character in variety.

The annual operating plan of the A.R.Co. mine will be approved by the Forest Service. The following mitigatiing measures will be required for aesthetic considerations. The proposed mining plan now states that the topsoil will be stripped off and replaced on the reshaped landform. This will reduce or eliminate the color contrast that would otherwise be present.

The landform cannot be restored to the original contour and configuration, but reshaped land can be blended to the undisturbed land to reduce or eliminate the contrast in form, line, and textures at these locations around the lease area. In other words, smooth terrain will join smooth terrain and rough terrain will join rough terrain so that a gradual blending with the adjacent natural areas will take place.

Color, line, and texture contrast in vegetative changes will be reduced or eliminated by using a mixture of native species, including sagebrush, on the rehabilitated areas. On pipeline rights-of-way where long tangents usually occur, the line dominance will be reduced by planting sagebrush, on the right-of-way. Additional clearing in irregular patterns planted to grass will also be used to reduce the line dominance of pipeline rights-of-way.

Structures will be kept as low as possible on the skyline. To do this, they can be placed in natural depressions. Telephone lines and low voltage powerlines can be buried.

The earthy tones of muted grays, greens, browns, and reds will be used as colors for structures to blend with the natural colors in the landscape. Nonreflective materials for roofs and other parts of the structures at the plant site will reduce the visual disharmony.

The effects of the generally lowered profile of the mined area will be reduced by blending the contours at the edge of the mined area with the undisturbed land. The depressions that will be left from this measure will be planned where they can be filled with natural runoff water for an added landscape and recreation attraction.

The added structures, roads, utilities, and railroads cannot be completely blended into the landscape, so for the duration of mining operations, a certain amount of discordant intrusions will have to be accepted.

The mining operation itself will have up to 400 acres disturbed at any given time during its lifetime. This will be an ever-present visual discordant site that cannot be avoided.

Wildlife and Fish

The primary impact of habitat loss will be mitigated by increasing wildlife carrying capacity ahead of mining on areas adjacent to the lease. This will be accomplished by measures such as providing wildlife cover, improving vegetative species' composition, and providing water developments.

Industry will provide detailed ecological information on present populations of macrofauna and associated microfauna as to composition, movements, habitat, and food chains to support rehabilitation plans and the selection of alternate habitat areas.

Wildlife habitat will be considered in reclamation measures following mining and will be coordinated by the surface owner or agency administering surface values with the Wyoming Game and Fish Department.

Following are some examples of measures that should be taken to restore wildlife habitat. Include sagebrush, rabbitbrush, winterfat, and early season grasses in restoration plantings planned for the benefit of antelope and sage grouse. Include additional shrubs suited to the area for cover when deer habitat is involved. Plant and protect aquatic and emergent vegetation in reestablished water developments.

A reservoir with comparable fish and waterfowl habitat as Reno Reservoir will be constructed and established before the 57-acre Reno Reservoir is destroyed. This will be done in the general area of this existing reservoir.

Recreation

The primary mitigating measures for recreation will be prompt reclamation to retain aesthetic and wildlife values and the replacement of Reno Reservoir. Reclamation is discussed under the soil and vegetation sections of this chapter.

Reno Reservoir will be replaced with another reservoir before it is destroyed. This will be done at least five years before the destruction of Reno Reservoir so that the quality of the new fishery and waterfowl habitat will be similar to the present habitat.

Grazing

Existing fences, water wells, and reservoirs will be replaced after reclamation to the extent possible and in locations which will assure optimum grazing use of the reclaimed land. Industry will reimburse individuals and public agencies for any facilities which cannot be replaced due to mining and related development.

Impact of lost grazing, both temporary and permanent, will be mitigated. For example, more intensive grazing on or adjacent to the lease area could occur by improving species' composition, increasing water developments, fencing, and sagebrush eradication. Portions of the lease area will be grazed until mining actually occurs. Prompt reclamation will bring mined land back into production as quickly as possible.

Utilities and transportation facilities serving the area will be placed in corridors on National Grasslands to localize and minimize the grazing area they remove from production. Processing plants and buildings should also be designed to use a minimum surface area.

Where future developments are foreseeable, fill will be compacted during reclamation to provide a stable foundation and protect future developments from subsiding.

Transportation Networks

Powerline, telephone lines, pipelines, roads, railroad spurs, etc., on National Grassland will be authorized by issuance of a special use permit or easement by Forest Service. The authority and laws are covered under Institutional Arrangements.

A long-range transportation plan, including road design and location, needs to be developed by industry, county, state, and federal agencies to meet the needs now and for future uses.

Corridors will be designated for construction of facilities (roads, powerlines, etc.) on National Grasslands to reduce the impacts on other uses. The corridors have not been located and evaluated.

CHAPTER V

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Air Quality

The majority of the impacts on air quality resulting from development of the A.R.Co. mine property cannot be completely avoided. Some coal and soil dust created by mining 724.3 million tons of coal, disturbing a total of 6,671 acres (6,524 mined - 147 rail and access road construction) over the 40-to 74-year period will occur. About 90 surface acres will be disturbed in any one year and 300 to 400 acres may be occupied or bare at any one time.

Even with proper emission controls, emissions from vehicles, equipment and accidental fires will occur causing a reduction in air quality on the lease site and downwind. As there are no effective emission controls for diesel locomotives, emissions from train operations cannot be avoided. These emissions are expected to reach a peak by 1980 and remain fairly constant thereafter. Table 1 compares projected unavoidable train emissions with the 1970 emission quantities for the Wyoming Intrastate Air Quality Control Region.

Table I

Unavoidable Train Emissions Versus 1970 Total Emission for Wyoming Intrastate Air Quality Region (Tons/Year)

Type	1970 Base	1980 Increase*	1980 Percent Increase
Particulates	26,510	26,565	.2%
Sulfur Dioxide	38,202	38,328	.3%
Nitrogen Oxides	28,647	29,467	2.9%
Carbon Monoxide	122,428	122,716	.2%
Hydrocarbons	21,635	21,843	1.0%

*Train emissions plus base

Topography

A reduction in altitude caused by mining thick beds of coal with thin overburden cannot be avoided. The decrease in altitude over the lease area will range from a maximum of 63 feet to a minimum of 6 feet. The average drop will be about 43 feet.

Destruction of natural features of the landscape is unavoidable. Even though the general topography of the area can be restored at a lower altitude cliffs and abrupt breaks, presently a part of the topographic scene, cannot be restored. The exact slope and altitude of the present topography can only be restored within practical limits.

Temporary change in the drainage channel of Little Thunder Creek and its tributaries, North Prong and Trussler cannot be avoided.

Soils

Disturbance of topsoil on a total of 7,092 acres (6,524 mined - 200 mine facilities - 230 access corridor - 138 housing) cannot be avoided. Loss from productivity of 448 acres of soil (access road - railroad bed - mine facilities - housing) is unavoidable. The disturbance of topsoil may lower to some degree the natural soil productivity of the area by compaction, mixing natural soils and causing accelerated soil erosion.

On the area to be mined, 6,524 acres, the partial alteration of all soil horizons, parent material, and soil characteristics which have developed over long periods of geologic time cannot be avoided. The present soil biota and soil forming processes will be affected. Once mining is completed and the area reclaimed, soil development will have to start again. As an end result, new soils will be formed with characteristics totally unlike the ones existing prior to mining.

Mineral Resources

The mining and removal of coal cannot be avoided under present plans and proposals. The proposed mining activity will have an unavoidable adverse effect on the coalbeds, coal resources, and coal reserves in that a nonrenewable energy resource will be depleted. Based on company plans, an estimated 724.3 million tons of coal will have been mined by 2016 or 2050 which comprises 5.8 percent of the estimated economically recoverable coal reserves thus far identified in Campbell and Converse Counties. Loss of minor amounts of coal in mining, loading, and transportation operations is unavoidable.

Water Resources

The amount of water consumed in mine operations will be unavoidably lost. The amount cannot be quantified. Aquifers removed by mining will be permanently lost. However, the effect of this loss will be of local extent.

If the final pit is left as a pond it may deplete streamflows and will add to evaporational loss of water which then is not available for other uses (agriculture - stream habitat). A reduction in water quality from increased erosion and sedimentation will occur to some degree. The amount or degree cannot be estimated.

Vegetation

Vegetation will be temporarily destroyed on 6,646 acres and permanently removed on 446 acres. Losses associated with mine operations, rail spur construction and increased population cannot be avoided.

Reclamation of areas disturbed by rights-of-way will be undertaken shortly after disturbance. However, success of revegetating severely disturbed mined areas is unknown at this time.

All plant succession is unavoidably destroyed at the time of disturbance. Fifty years or more of plant succession will be required for these areas to return to their present state as existing soil structure and micro-climate have been changed and altered. Even on areas that are successfully reclaimed, a 50 percent loss in productivity is projected based on the Assumption and Analysis Guidelines contained in Chapter II, Part I.

Archeological and Paleontological Values

Subsurface material and sites will be damaged or destroyed under the most responsible mining program, with much more loss to indifference from surface activities of population expansion.

Some losses, removal of 138 acres to regional expansion, will be expected from lack of surface evidence, time, money and trained personnel to conduct regional surveys.

Aesthetics

The added structures, roads, rail lines, and powerlines will be discordant intrusions added to the natural landscape. The natural landscape (shape - texture - color) will be changed unavoidably. To some, this will be an adverse alteration of the natural landscape. Even after reclamation, the disturbed areas will be discernible for many years.

Wildlife and Fish

Loss of habitat and reduction in population will occur. The smaller wildlife (reptiles - amphibians - invertebrates - rodents - and other burrowing animals) which cannot flee will be destroyed. An estimated 50 antelope and 50 sage grouse will be displaced, and probably lost.

Destruction of 6,524 acres of existing habitat will reduce the carrying capacity of wildlife habitat in this area. Successful return of wildlife habitat for most animals will require a period of 20 to 50 years (Figure 7, Chapter V, Part I). The permanent removal of 448 acres of habitat will be unavoidable.

Increased population will intensify recreational use of the area. This will adversely impact wildlife habitat. Intensified use may also adversely affect the elk herd east of the lease area. The disturbance may cause the elk herd to move to unsuitable habitat, resulting in an unavoidable loss of the entire herd. The aquatic habitat and fish life associated with the 57-acre Reno Reservoir will be unavoidably lost if comparable habitat is not provided.

Recreation

Reduction of wildlife habitat, population, and quality will lessen hunter opportunities. Increased population will intensify recreational use, which could cause adverse reduction of recreation quality and deterioration of facilities.

Agriculture

Permanent loss of 310 acres of forage and 78 AUMs cannot be avoided. Destruction of the 424 acre-foot Reno Reservoir and two smaller reservoirs is unavoidable.

Temporary loss of forage during mining operations cannot be avoided. Reduction of an estimated 50 percent in carrying capacity for livestock after reclamation cannot be avoided. This will cause an annual overall yearly loss of 814 AUMs, assuming the entire area will be successfully revegetated.

Destruction of critical pastures (4,440 acres) and the necessity of the rancher having to provide pasture elsewhere is unavoidable. The added economic cost of the rancher having to provide new water sources for his livestock cannot be avoided. However, the company has stated that it intends to assume ahis responsibility (Letter comment to DES).

Transportation Networks

Increased traffic on all existing facilities cannot be avoided. The increase will begin in 1975. Road maintenance costs and frequency will increase and these costs cannot be avoided.

Temporary inconvenience and poor travel conditions caused during construction of such facilities as the rail line, access road, and transmission line are unavoidable. These impacts will be minor and occur only over a short time span. It is impossible to predict the possible increase in train-car accidents. With the number of trains required per day (6 by 1980), the increased probability of these accidents occurring cannot be avoided.

Relocation of the oil and gas pipeline across the area will occur. Some short term disruption of service could occur and be unavoidable.

Socio-Economic Conditions

Unavoidable adverse effects of this mine cannot be quantified at this level. The cumulative impacts are analyzed in Part I, Chapter VII.

CHAPTER VI

ALTERNATIVES TO THE PROPOSED ACTION

Reject Mining Plan

Rejection of the A.R.Co. mining plan would result in no environmental impact on the leased lands and they would continue in their present condition or be modified by the surface owner to meet other uses as may be determined. The Atlantic Richfield Company could submit a new mining plan, challenge the rejection, or abandon--at least temporarily--development of the lease. Should the mining plan be rejected, the development of alternate sources of energy or a reduction of energy consumption could be required.

A.R.Co. may begin mining operations on its 640-acre state lease on the north end of its holdings with the same primary and secondary impacts as those evolving from the mining of both federal and state coal. The state lease could sustain production at proposed levels for about nine years. This would result in a small mine on state owned lands leaving the federal coal untouched and would (1) increase extraction costs; (2) result in increased mining problems and costs if, following reclamation, the federally owned coal were later extracted; (3) could result in an increase to the state of royalty money from its lease; and (4) result in a loss to the state and county of a long-term tax base and a loss of the state's share of federal royalty revenue distributed in accordance with the Mineral Leasing Act. In addition, reclamation and enforcement requirements under state laws could be either more or less stringent than those required by the Federal Government thereby affecting the restoration of mined areas.

In the event A.R.Co. chose not to mine on state owned land as a consequence of rejection of a mining plan on the federal leasehold, coal for the power plants it is supplying would have to be obtained from another source.

Approve the Mining Plan After Modification

Some of the impacts identified and discussed in Chapter VII could be avoided if the mining plan were modified to require use of one or more of the alternatives discussed below. In addition, special stipulations could be added to the plan to mitigate some of the secondary effects of the mining. Such conditions must be reasonable and, if unacceptable to the lessee, could result in the lessee not developing the area with the resultant impacts discussed under the heading "No New Development of Coal" in Chapter VIII, Part I.

Different rate of production

Atlantic Richfield Company has existing contracts to supply 1.2 million tons of coal per year to power plants in Nebraska, Oklahoma, and Texas in 1976, escalating to 10 million tons by 1979 with the possibility of 20 million tons per year.

Any change in production rate, either upward or downward, would alter the rate or intensity of the environmental impacts discussed previously in this statement. If a reduction in proposed production rate were required, it would create a shortage of fuel at the power plants in the area of consumption and result in decreased power production when consumption is increasing unless substitute sources of supply were obtained. A reduction would also (1) prolong mining activity on the leasehold; (2) prolong the time until restoration is completed; (3) lessen employment at the mine; (4) lessen the acreage disturbed at any one time; and (5) lessen annual tax and royalty returns to the state and county from this lease. If the company were required to increase production above the level proposed, it would increase intensity and severity of the impacts described elsewhere in the statement, decrease the length of time for mining and reclamation, and increase annual tax and royalty returns from this lease.

Different methods of mining

Underground mining

Substitution of this method of mining would result in (1) less initial disturbance of the land surface, however, unsupported mine roofs between pillars would ultimately collapse because of the lack of structural strength in the thin overburden resulting in a partly subsided land surface degraded by numerous depressions and openings; (2) greater costs because underground mining would be more costly than surface mining; (3) a decrease in mine safety as indicated by the fatal accident rates in 1972 of 0.42 per million tons mined underground compared to 0.07 per million tons for surface mining; and (4) higher incidence of nonfatal accidents due to roof and coal falls, fires, explosions, and problems related to dust inhalation (black lung disease).

On A.R.Co.'s federal leasehold, the coalbed averages 70 feet in thickness. Assuming that a 10-foot section could be mined safely by underground methods, and that 50 percent of coal in the mined area was left in place to provide support and lessen the probability of surface subsidence, coal extracted would represent about seven percent of the available coal in place. This rate compares to an expected recovery of 90 to 95 percent of the available coal in place using surface mining methods.

In-situ production

Techniques for the economical burning of coal in-situ and the capture of the released volatile gases are still in experimental stages. Present knowledge indicates that energy recovery levels of in-situ production are low and the amount of surface subsidence in areas of thin overburden is highly unpredictable. Impacts associated with in-situ production would include the possibility of (1) destruction of coalbed aquifers; (2) pollution of ground water; and (3) air pollution from escaping gases.

For in-situ production to be a viable alternative technique, methods for increased recovery of volatile gases must be developed. Such increases could then allow in-situ production to compare favorably with the high recovery of coal by surface mining methods.

Auger mining

Auger mining should probably not be considered as a realistic or viable alternative to surface mining because it is not used except under specific conditions. Auger mining is used to recover coal along a highwall of an existing surface mine which has reached its maximum overburden limits. The effective penetration depth is limited to less than 200 feet and the auger diameter is presently limited to 84 inches. In beds thinner than seven feet, recovery is less than 40 percent and would be considerably less for A.R.Co's 70-foot total coal thickness. Auger mining is not applicable on A.R.Co's leasehold to sufficiently supply the quantities of coal demanded.

Different reclamation objectives

A description of alternate land uses and reclamation methods for the disturbed areas along with their attendent impacts are discussed in Chapter VIII, Part I.

Different utilization

Onsite power generation

Transportation and fuel costs for onsite electric power generation would be minimal and there would be less chance for coal spilling than during transportation to offsite power generation plants. However, a coal-burning electrical power generation plant would have to be constructed, transmission lines would have to be built, and the generating plant would have to be connected into the existing power distribution network.

For a water-cooled plant large volumes of water and water rights would have to be obtained and pipelines and storage facilities built to supply an onsite steam generating plant. The electrical stations in the area of consumption would lose the supply of coal for which they were designed unless coal of like quality from another mine in the area was substituted for the coal from the Black Thunder Mine.

The local environmental impacts that would result from onsite power generation would be degradation of air quality by stack emissions; land-use problems related to ash disposal; noise from the generating station; the large quantity of water needed must be diverted from other uses; degradation of scenery by the generating station, transmission lines, and support facilities; dust related to coal handling, processing, and ash disposal; loss of land used by the generating station and support facilities from other uses; and increased employment and related economic benefits. Impacts associated with mining and reclamation would remain the same.

Other offsite markets

To supply coal to other offsite electrical power generating plants would have the effect of transferring transportation and other end-use impacts elsewhere. These impacts have been described heretofore in the statement. The impacts associated with mining and reclamation would remain the same if the proposed production rate was not increased. If increased, the severity and duration of these would also be increased.

Non-energy uses for the coal

Coal is used by the chemical industry in the manufacture of synthetic materials and has been used as a soil conditioner which, when mixed with topsoil, darkens the soil, absorbs heat, and stimulates plant growth. Some types of lignite have been used in oil drilling muds, in water treatment, and in wood stains. The coal at the Black Thunder Mine is subbituminous and is not suitable for the latter uses but could be used by the chemical and soil conditioner industries, depending on its properties. If coal production were not increased, the impacts of mining and reclamation would remain the same. If the coal were used exclusively by the chemical and soil conditioner industries, the power plants dependent on the coal would have to locate substitute sources of fuel.

Different methods of coal transport

Pipeline transportation

Transporting coal in a pipeline as a slurry could be required as a possible alternative. An advantage would be less surface pollution by wind-blown or spilled coal from railroad cars. The time and capital cost of planning and constructing a pipeline from the Black Thunder Mine to the proposed mainline railroad is unknown. Based on the Black Mesa pipeline, however, the cost would be in excess of $128,000 per mile (Love 1969).

Impacts of this alternative would be (1) surface disturbance due to construction of the pipelines and in-line support facilities along the right-of-way to the proposed railroad; (2) the consumption of large volumes of water for slurry preparation and pipeline transportation, about 240 gallons of water per ton of coal; (3) the additional surface disturbance associated with the construction of water and slurry storage facilities, additional processing facilities at the mine to prepare the coal for transmission as a slurry and the dewatering facilities at the proposed railroad; (4) the influx of workers necessary to construct the pipeline and the resultant socio-economic effects on communities along the right-of-way; (5) the loss of a large tonnage of steel pipe to other uses; (6) the loss of the energy required to construct and run such a coal slurry pipeline to other uses; (7) the possibility of pipeline spillage and rupture which could degrade local areas; and (8) the construction, at the point of consumption, of facilities to remove wet or frozen coal from railroad cars.

Highway transportation

Substitution of truck haulage for railroad haulage would not cause additional surface disturbance at the proposed mine except in the vicinity of a truck loading facility. The load size of coal trucks for highway transportation would be limited. The maximum gross load limit for trucks on Wyoming highways is 79,900 pounds or 39.95 tons so truck size would have to be in the range of 30 to 35 tons. Above 79,900 pounds a special overload permit is required and a special use tax is assessed.

Existing county roads would have to be redesigned and rebuilt to withstand the stress of constant coal-loaded truck traffic.

The large number of trucks needed would create increased noise, air pollution from truck emissions, increased safety hazards for the public, and increased dust and spillage of transported coal.

Assuming that all proposed coal production would require truck transportation from the mines to loading points on the railroad, about 330,000 30-ton truckloads (1,400 per working day) or about 290,000 35-ton truckloads (1,200 per working day) would be necessary to transport the projected annual production of 10 million tons by 1979. This requirement would increase to 500,000 35-ton truckloads (about 2,100 per working day) necessary to transport the projected ultimate annual production of 17.5 million tons per year. If 100-ton trucks were used, the two tonnages could be hauled in 100,000 loads (proposed production) or 175,000 loads (projected ultimate production). These larger trucks would haul not more than about 730 loads per working day. Consumption of diesel fuel would be considerably greater by truck than the 0.002 gallons per ton-mile attainable by rail haulage.

CHAPTER VII

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Mining will result in the introduction of new roads, buildings, trackage, powerlines, and heavy equipment into an area not appreciably changed from its natural state except by oil and gas pipelines, transportation routes and the attendant structures associated with grazing and farming activities.

The lease area will be committed to coal production for a period of about 40 to 74 years, based on anticipated production levels. As the coal is mined, the overlying soil and rocks will be removed and the affected acreage will be lost to grazing and rangeland recreation for a period of five or six years.

The impacts arising from the short-term use of the environment will be minimized to the extent practicable consistent with modern mining and reclamation practices. Grading of spoils will reduce ridges to a rolling topography aesthetically consistent with surrounding undisturbed areas. Replacement of soil material and establishment of vegetative cover will return mined land to grazing as soon as possible following extraction of the coal.

Mining will temporarily disrupt the flow of surface water. Ground water levels may be lowered locally because of the removal of parts of aquifers in unconsolidated material, sandstone, and coalbeds. Rainwater and water flowing into the mined area will probably be retained by infiltration into the spoils, creating perched water tables.

The preceding indicates that the short-term use of parts of the leasehold for mining will be accompanied and followed by a period of reclamation and revegetation. Although the land's appearance will be permanently changed, its attractiveness should not be adversely affected. Other potential long-term land uses may be impaired by introduction of heavy industry, housing developments, and development of other resources. In addition, coal used for power generation will not be available for other uses or for future use.

Thirty-five to 162 additional acres will be disturbed by mining each year with an equal number of acres undergoing grading and planting. At any one time the total area disturbed will be about 500 to 600 acres. Since final reclamation of a particular area is estimated to lag about five years behind mining, wildlife and livestock will be displaced for at least that period of time.

In summary, land will be used for mining coal rather than for grazing and wildlife habitat for a period of five to ten years at which time the land should be restored to its former or other designated uses.

Disturbed land, presence of heavy equipment, other mine-related facilities, and associated noise, dust, and solid waste will be only of short duration. After mining, reclamation and revegetation is completed, the principal long-term changes will be local modification of the topography and of surface drainage systems, and loss or reduction of productive capacity.

It is estimated that the total productive capacity of the land will be reduced 50 percent over present levels even if revegetation is successful. Reclamation techniques in this semiarid climate have to be tested before any final predictions can be made as to success ratios.

Wildlife habitat for those animals which depend on a sagebrush type (antelope - sage grouse) will be destroyed for a period of 20 to 50 years. Figure 7 in Chapter V of Part I shows the time span from point of disturbance which is required for replacement of adequate habitat for various animals groups.

Mining of this area will involve a long-term loss in productivity. Under the climatic conditions which prevail for this area, the area may never regain its present productive capacity.

CHAPTER VIII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The major commitment of resources is the mining and consumption of 724.3 million tons of coal over the 40 to 74-year life of the mine. This loss represents about 5.8 percent of the economically strippable reserves of the Eastern Powder River Coal Basin.

Use of an indeterminable amount of sand and gravel and clinker for aggregate in the construction of mine facilities, railroad spur, and access road will occur. Clinker, sand and gravel deposits mined with the overburden and mixed with other spoil will be irretrievably lost if not selectively removed.

The only ground water aquifers that will be irreversibly committed are those aquifers that will be physically removed during mining. Adjacent parts of these aquifers will be affected during mining operations but water levels are expected to return to normal after mine dewatering stops. The chemical quality of water in the aquifers will not be changed.

The extraction of coal and reclamation of disturbed areas will require the use of electrical power, lubricants, liquid fuels including diesel fuel and gasoline, ammonium nitrate explosives, and structural materials for equipment construction and repair and surface buildings. Chemicals and materials used in mining and reclamation would also be lost for other uses.

Large amounts of diesel fuel will be used in transporting the coal via rail line. By 1980 the consumption of fuel just within the study area will amount to 4.4 million gallons per year. This fuel will be consumed and unavailable for future use.

Loss of life will occur both in the mining operations and associated with increased vehicular and train traffic. Based on fatal accident rates experienced in the strip mining industry during 1972, one employee will suffer a fatal accident for every 14.3 million tons of coal produced. Disabling injuries will occur at the rate of 9.24 per million man hours worked. Therefore, during the life of the mine an estimated 51 people will lose their lives. This will be an irretrievable commitment of human resources.

Any destruction of archeological and paleontological sites will be an irreversible commitment of resources, if not properly surveyed, excavated and recorded.

It is doubtful that total reestablishment of the complex native plant community is possible on disturbed areas of the mined area. Strip mining and associated activites will eliminate a portion of this life-support community which is the major irreversible impact to wildlife in the area.

Wildlife resources that may be irretrievably lost include individual animals and habitats that are destroyed. Animals and plants that would have reproduced in the affected habitats during the life of the mining operation may also be irretrievably lost. Most wildlife losses may be reversible if the species and habitat are not impacted to the point that their ability to reproduce is seriously impaired.

Full productive capacity of the land may not be possible on areas severely disrupted by strip mining. Any reduction in productive capacity of the revegetated land over the previous capacity has to be considered an irretrievable commitment of resources.

The annual forage production which the area could have produced will be lost during the time that mining takes place. Production could be lost on 300 to 500 acres annually. This increment of production lost is an irretrievable commitment of the livestock forage.