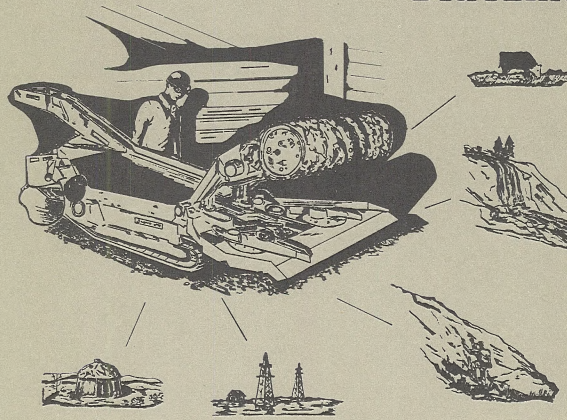
Volume 2

FINAL
West-Central Colorado Coal
Environmental Statement



U.S. Department of the Interior
Bureau of Land Management

VOLUME 2

TABLE OF CONTENTS

Mid-Continent Coal and Coke
Coal Canyon

ANSCHUTZ COAL CORPORATION:

NORTH THOMPSON CREEK
NO. 1 AND NO. 3 MINES

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

Proposal

The proposed federal action is the review and consideration for approval of a mining and reclamation (M&R) plan submitted by Anschutz Coal Corporation for the North Thompson Creek No. 1 and No. 3 mines. Approval of the M&R plan would allow Anschutz to extend the existing underground mine workings from private coal reserves onto adjacent federal coal lease C-08173. The plan was submitted in accordance with 30(CFR): 211 regulations to the Area Mining Supervisor, U.S. Geological Survey (USGS), Denver, Colorado, November 18, 1976, and modified April 17, 1978. The M&R plan has been accepted as suitable for use in preparing this environmental statement and is available for public review in that office.

This M&R plan was submitted for review prior to promulgation of the interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87) and has not been officially reviewed for compliance with that act. Therefore, the applicant's plan may not fully reflect the requirements of the interim regulations. However, in this statement the interim regulations are considered as federal requirements with which the M&R plan will have to comply as it will have to comply with all other applicable regulations. The M&R plan will be returned to the operator for revision in accordance with the applicable federal regulations. As soon as the applicant's plan is revised and returned to the Office of Surface Mining (OSM), it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations in 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

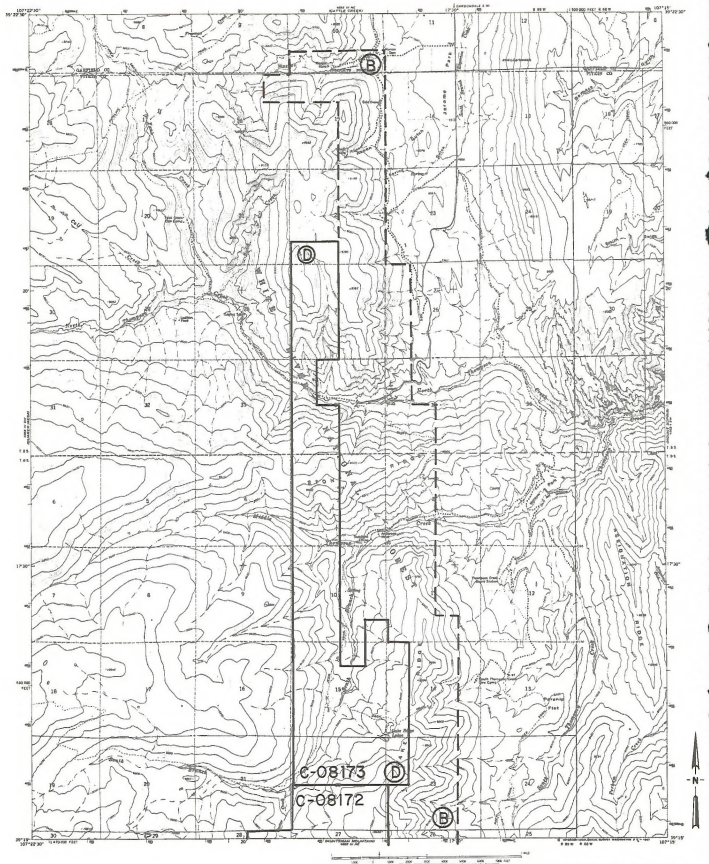
The North Thompson Creek mining operation is currently operating on private land (2,800 acres) located 12 miles southwest of Carbondale, Colorado, In Pitkin County. Anschutz is currently producing coal from mines which the company reopened in 1974. Under the M&R plan, Anschutz proposes to extend these existing workings onto a contiguous 1,200-acre parcel of land whose surface is administered by the U.S. Forest Service (USFS) and which is a portion of the existing federal coal lease C-08173 (containing a total of 2,480 acres; no M&R plan has been filed on the remainder). The total mine property, including both federal and private coal reserves, would involve approximately 4,000 acres. (Map A1-1 shows the leases; map 1 in the map packet in volume 3 shows the location of the operation with respect to the entire ES area.)

The operation would use advancing entries to establish longwall panels which would be extracted by retreating methods. The operation would produce approximately 1 million tons of coal per year, which would be transported by rail from Carbondale to supply metallurgical coal markets lying to the west. Anschutz has not disclosed the specific market for this coal. The life of the operation is estimated at 15 years if only private coal is mined and 30 years if the M&R plan is approved. Anschutz would use existing surface facilities on the company's private land.

History and Background

The Colorado Fuel and Iron Corporation (CF&I) operated in the Coal Basin area of North Thompson Creek from 1898 through 1904, producing 745,000 tons. In addition, CF&I operated both the Union Mine (1896 to 1902) and the Spring Mine (1887 to 1916), which lie in the area immediately north of the existing mining operations on North Thompson Creek (map A1-1 shows the location of the Union Mine). These mines produced 142,765 tons and 3,371,943 tons, respectively. The Thompson Creek Coal and Coke Corporation produced approximately 2 million tons of coal from the Thompson Creek No. 1, No. 2, No. 3, No. 4, and No. 5 mines located on private land during the period from 1951 to 1966.

Coal prospecting permits for the area covered by the federal lease were issued to Larson Mining of Denver, Colorado, in June 1954; they were extended to June 1958. On March 19, 1958, Larson Mining transferred the permits to Chactaw Mining Company, Inc., of Fort Smith, Arkansas. Preference right coal leases were issued to Chactaw, June 1, 1958. On June 5, 1964, Chactaw merged with Garland Coal and Mining Company of Fort Smith, Arkansas. On November 1, 1977, the Bureau of Land Management (BLM) transferred the lease



Ⓑ PRIVATE SURFACE, PRIVATE MINERAL
Ⓓ NATIONAL FOREST SYSTEMS LAND, FEDERAL MINERAL

——— FEDERAL LEASE
– – – PRIVATE LEASE

Map A1-1. Anschutz Coal Corporation's lease area

from Garland to Anschutz by mutual agreement between the companies. The lease conditions are subject to all current mining reclamation and related land use requirements and all laws and regulations affecting federal coal leases.

The Thompson Creek No. 1 and No 3 mines mentioned above were reopened by Anschutz Coal Corporation in 1974. Anschutz began construction of mine facilities on its private lands in 1974, with the expectation of reaching full production by 1980. In 1977, the operation produced 15,868 tons of coal from the private lands, using 112 employees. The production schedule indicates the mines will reach full production of 1 million tons per year from private coal reserves by 1980, with a full employment level of 320 people. Based on production from private coal only, the mine life is estimated to be fifteen years.

Anschutz proposes to mine the full height of the 7- to 10-foot-thick A seam of the Bowie Shale Member (No. 1 mine) and the 8- to 10-foot-thick Anderson seam of the Paonia Shale Member (No. 3 mine). The Bowie Shale is the lower coal-bearing member of the Upper Cretaceous Mesaverde formation, and the Paonia shale is the upper coal-bearing member. The seams are 800 feet apart vertically. Anschutz has indicated that the coal from the No. 1 and No. 3 mines will be blended in a 1:1 ratio. The blended coal will be of medium volatile, metallurgical (bituminous) quality. (Figure A1-1 is an aerial photograph of the North Thompson Creek No. 1 and No. 3 mines.)

MINE LAYOUT

Anschutz has engineered the mine layout so that the long direction of the longwall panels parallels the regional strike and the short direction lies on the full dip (or pitch) of the coal seam. Entries of the two mines will be columnated as nearly as practical. However, due to the 800-foot separation of the two seams to be mined, Anschutz believes that there will be no noticeable effect of either mining operation on the other. (Map A1-2 shows the mine layout. If the proposed M&R plan is not approved, the entries and longwall panels would, of course, not extend into federal coal, and Anschutz might have to redesign the mine layout somewhat for more efficient mining of private coal.)

From the No. 1 portal, two old main slope entries remaining from the previous mining operation have been used to access the A seam. At a distance of 95 feet in from the portal where the two old slope entries ended, three new main slope entries have been continued for a distance of 800 feet. These slope entries were developed approximately N 58 degrees W and lie at an angle of 15 degrees below the horizontal. From the No. 3 portal in the Anderson seam, three old main slope entries which initially extended 95 feet N 58 degrees W have been extended an additional 800 feet at an angle of 15 degrees below the horizontal. Final length of the main slope entries will be 4,900 feet and 9,200 feet for the No. 1 and No. 3 mines, respectively. The main slope entries are being developed by Alpine continuous miners and are 14 feet wide on 64- to 74-foot centers. Crosscuts in the main slope entries have also been developed by continous miners and are 10 feet wide on 100-foot centers.

Strike entries are being developed both north and south from the main entries, using a two-entry system on 64-foot centers. The strike entries are being developed off the main slope entries at regular intervals of about 630 feet. This interval is necessary to create 400-foot wide longwall panels. Strike entries run N 13 degrees W and are essentially horizontal. On the two-entry system, this puts the eastern entry approximately 35 feet higher than the western entry. Pillar and crosscut layout of the strike entries is the same as for the main slope entries. Strike entries are being developed with Alpine continuous miners. Crosscuts on the submain entries are being developed by drilling and blasting with permissible explosives.

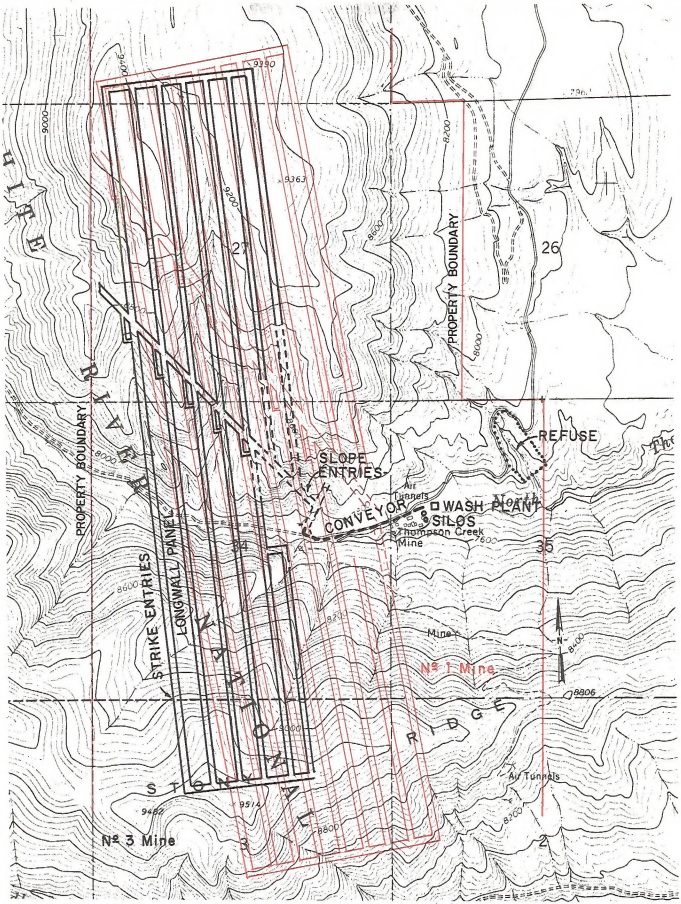
After development of two sets of strike entries, a pair of raise entries will be driven, directly at right angles to the strike entries, up the pitch of the seam between the upper entry of the lower set and the lower entry of the upper set (a distance of 400 feet). Raise entries will be 14- to 20-feet in width. Break throughs between raises will be on 100-foot centers. The 400-foot intervals between sets of strike entries will set longwall panels, which will be 400 feet wide and up to an optimum length of 8,000 feet. Longwall mining will be by retreat method using self-advancing hydraulic shields for roof support. (Other equipment is listed in table A1-1.) Coal will be brought to the surface by a belt conveyor.

Roof support will be by roof bolts supplemented by a single wooden timber on the high side of the entry, against which lagging will be placed to prevent sloughing of coal from the high rib. The roof control system must be approved by the Mine Safety and Health Administration (MSHA).

Coal dust underground will be controlled by spraying the face with water from nozzles mounted on the Alpine miner and on the longwall shearing drum. All transfer points within the mine also will be sprayed with water. Coal from the mines will contain an estimated 5 percent moisture.

The North Thompson Creek mines are ventilated by a system of axivane fans installed on the surface with a rated capacity of 150,000 cubic feet per minute. The fans operate on a pull-type exhaust system. Exhaust vents are located near each of the

Figure A1-1. Looking north at the North Thompson Creek No. 1 and No. 3 mines. Currently, the coal is hauled by truck approximately 13 miles to rail loadout facilities at Carbondale, Colorado. Kmv indicates the coal bearing Mesaverde formation, Kmvr the Rollins sandstone member of the Mesaverde, and Km the Mancos shale. Coal beds in the area dip at an angle of 27 to 30 degrees. The distance from A to A' is approximately 1 mile.



Map A1-2. Mine layout for Anschutz' proposed Thompson Creek No. 1 and No. 2 mines

OLD MINE WORKINGS
PROPOSED MINE ENTRIES

TABLE A1-1

UNDERGROUND EQUIPMENT TO BE USED
IN THE NORTH THOMPSON CREEK MINES

11	Alpine continuous miners	2	mantrip cars
6	chain conveyors	2	equipment carriers
5	belt conveyors	4	air compressors
2	8-ton locomotives	8	stoper
2	12-ton locomotives	4	coal drills
8	slushers	4	mine fans
2	brakeman cars	2	shearing machines
2	electric hoists	2	stage loaders
2	tugger hoists	166	longwall roof supports
25	bottom dump mine cars	2	longwall face conveyors
10	supply cars		

mine portals and on the south side of Stony Ridge. The ventilation plan must meet all MSHA standards.

SURFACE FACILITIES

All surface facilities are located on private land on North Thompson Creek (see map A1-2). The company estimates that during the previous mining operation (North Thompson Creek Coal and Coke Corporation) 46.48 acres were disturbed. Under the existing mining operation, 45.7 acres of this old disturbance are being used, leaving 0.78 acre of the previously disturbed area as yet unused or unreclaimed. According to Anschutz, the operation's refuse area encompasses 10.17 acres; sediment ponds at the toe of the refuse piles use 0.37 acre; portal area No. 1 uses 0.32 acre; portal area No. 3 uses 0.21 acre; all the offices and buildings occupy 0.56 acre; two slurry ponds take up 0.81 acre; three sewage ponds use 0.21 acre; and the remaining acreage is used for coal storage and other unspecified purposes. The office and shop is in a 16,000-square-foot building located near the preparation plant. In addition, if conditions warrant, Anschutz will construct a small irrigation pond at an undisclosed site near the mine facilities for storage of excess mine water. At this time, Anschutz estimates that the pond will disturb no more than 0.5 acre and have a maximum capacity of 8 million gallons. Other buildings will be needed for the operation, but no details have been provided by Anschutz. Most of the coal washing facilities are in an existing enclosed building.

The coal from the No. 3 Mine will be transported from the portal to a surge bin by a 0.5-mile, covered conveyor. From the surge bin, the coal will be transported to a 2,000-ton, raw-coal storage silo by a covered overland conveyor. Coal from the No. 1 Mine belt conveyor will be deposited directly into the raw coal silo. Raw coal will be conveyed for processing to the preparation (washing) plant. The processed or clean coal will be transferred to a 2,000-ton, clean-coal storage bin from which the coal will be loaded into 30-ton capacity tractor-trailers for haulage 12 miles to a railroad siding at Carbondale. Projected truck traffic over a five-year period is given in table A1-2. Anschutz presently hauls coal from private production at the site over a county road with vehicles adhering to speed limits imposed in cooperation with Pitkin County.

All transfer points on the overland conveyor and at the rotary breaker will be sprayed with water. A dust collecting device will be placed on the raw-coal bin to control dust if it develops. After leaving the washing plant, the clean coal will contain an estimated 7 percent moisture. If dust problems develop at the truck loadout, additional water spraying will be added. In truck haulage, the top of the coal will be treated with water and dust retardants, or the trailer unit will be covered to prevent fugitive dust. Road dust will be controlled by either spraying the road with water or treating it with a dust retardant. Permits for dust emission have been obtained from the state of Colorado.

During the proposed fifteen-year mine life, approximately 97,680 cubic yards of refuse from the operation will have to be disposed of annually. The refuse disposal site will occupy approximately 10.17 acres and will be used for approximately fifteen years.

Refuse will consist of coarse waste from the mine and waste that is up to 0.25 millimeter in size from the wash plant. The coarse waste will be stored at the portal and trucked to the disposal site periodically as necessary. The wash-plant waste will be pumped as a slurry to the settling ponds. The settling ponds will be cleaned periodically as necessary, and the solid material will then be trucked to the disposal site.

The waste material will be spread over the disposal area in 2-foot thick layers, and the coarse and fine material will be thoroughly mixed by a large track-type unit equipped with a ripper tooth. The unit will then be used to compact the layers until a height of 8 feet is reached; this will constitute one lift of waste disposal. The next lift will then be recessed 20 feet back from the lower lift edge. When the area is full, it will be graded to approximately its original contour, covered with topsoil, and planted with recommended vegetative cover in conformance with all regulations. A sediment retention pond will be constructed in the drainage below the refuse pile to catch and retain any material washed from the pile by runoff.

Combustible material from the operation, consisting of timber from the mine, rock-dust bags, etc., will be disposed of properly. Material other than timber will be disposed of in a sanitary land-fill.

Anschutz has designed a drainage plan for the area lying upslope from the mine surface facilities: it will be required to comply with federal regulations in 30(CFR): 717. The drainage plan for the upslope area will consist of a series of five retention ponds along the segment of the access road that runs from the refuse disposal area to the mine facilities. A pond will be located at each intersection of the road and a natural water drainage. Each pond will be constructed to hold all runoff water generated by a 25-year frequency storm.

In the event of a storm larger than a 25-year storm, a system of culverts and ditches will drain excess water from the ponds to the slurry ponds, which will double as a backup retention storage area. The on-site drainage system will consist of a series of terraces, which are sloped back toward a

ditch located at the toe of the next highest terrace. This ditch system is designed to channel runoff water from the 25-year frequency storm to the slurry retention ponds. All flood waters retained in these ponds will then be allowed to evaporate or infiltrate into the subsurface soil mantle.

Anschutz has prepared the facility site by leveling the flood plain area north of North Thompson Creek and using previous coal spoil as fill. They intend to protect the fill slopes from a 100-year flood by securing the spoil fill with at least 6-inch-diameter riprap, which will most likely be obtained off-site.

The total operation at designed production will consume an estimated 54 million gallons of water per year (194 acre-feet per year). The state of Colorado has decreed to Anschutz Corporation the rights to use the ground water found within the mines (applications W-2979 and W-2980, March 28, 1977). At present, approximately 107,000 gallons of water per day (93.75 acre-feet per year) are pumped from the mine and used in the wash plant. Any excess water pumped during the mining operation will be stored in an irrigation reservoir for future mine use.

Power facilities for the Thompson Creek mines are already on the property, constructed by the previous mining operation. No additional construction of power lines is contemplated at present. Power for the existing operation is supplied by the Public Service Company of Colorado: it enters the property at 23,000 volts alternating current.

The mine area is at the terminus of a county road, 12 miles from Carbondale. Traffic to and through the area is controlled, particularly when coal trucks are operating. The road will be improved according to an agreement between Anschutz and Pitkin County. Over a four-year period the program will include:

Year 1. Widening, grading, ditching, and gravel surfacing

Year 2. Aligning, widening, ditching, and gravel surfacing as required

Year 3. Improving road to specified standards

Year 4. Oil and chip surfacing to eliminate dust

In addition to the truck traffic projected in table A1-2, there will be traffic resulting from employee travel to and from the mine site, as shown in table A1-3.

As a condition of issuance of a special-use permit, Pitkin County required Anschutz to reclaim those areas disturbed by previous coal mining operations and such new construction areas as have been completed. A revegetation plan was submitted to Pitkin County, and Anschutz has begun reclamation. Disturbed areas are graded to approximately their original contour, covered with an agronomy blanket and planted with the recommended vegetative cover.

Anschutz removes and stores topsoil which will be used to cover the refuse pile periodically as a seal and to terrace the coal refuse dump before revegetation. With few exceptions, soil has not been stockpiled from previous operations. Anschutz plans to add new topsoil to banks left from previous operations which are unusually steep or have a high percentage of coal spoil.

In those locations where construction has been completed, Anschutz has graded all banks to approximately a 30-degree slope where physically possible. Certain stream bank areas and others too rocky for gradual sloping have not been graded. Grading, back-filling, and contouring have proceeded in three phases to coincide with the revegetation program. Phase 1 was completed in October 1976 and phase 2 in October 1977; phase 3 is scheduled to be finished in October 1978. In addition, Anschutz obtained a mined land reclamation permit from the state of Colorado for their operations in January of 1978.

The Anschutz North Thompson Creek No. 1 and No. 3 mining operations will be required by federal regulation to reclaim all disturbed lands to a condition equal to or better than the pre-mining land use.

Predisturbance Inventories and Analyses

Specific inventories have been conducted or are pending under the direction or cooperation of the Anschutz Coal Corporation in consultation with the USFS concerning threatened or endangered plants, archeological sites, historical sites, and paleontological locations. A detailed literature search and herbarium survey indicated that none of the federally proposed endangered or threatened plants within the region are known to have occurred historically in the area of the Thompson Creek mines. Historical research by Athearn (1977) revealed no historical sites on project area lands. A review of geologic and paleontological literature revealed that it would be extremely unlikely that fossil vertebrates would be disturbed by Thompson Creek mining. Under a contract with the Department of Energy, Anschutz will install equipment on the mine property in order to study the subsidence which results from their retreating longwall operation in the steeply dipping coal seams of the Thompson Creek area.

Anschutz' Proposed M&R Plan

According to the M&R plan, Anschutz proposes to extend the existing underground mine workings (which the company is developing on private coal reserves as described under History and Background above) onto adjacent federal coal lease C-

TABLE A1-2

PROJECTED COAL HAULAGE SCHEDULE

Year	Tons of Coal Per Day	Truck Loads of Coal Per Day
1978	157	6
1979	250	26
1980	320	130
1985	320	130
1990	320	130

Note: Assume 255 working days per year.

TABLE A1-3

EMPLOYEE VEHICLE TRIPS

Year	Number of Employees	Daily No. of Cars Per Production Shift
1978	160	32
1979	250	50
1980	320	64
1985	320	64
1985	320	64
1990	320	64

Note: Assume 2.5 people per car.

08173 by 1990. The operation would continue the production of 1 million tons of coal per year reached by 1980 on private coal, with a full employment level of 320 people. Estimated mine life would be 30 years.

The mine layout would be the same as described above under History and Background, except that the workings would be extended into the federal coal beginning by 1980 (see map A1-2). Anschutz would use the surface facilities, including conveyors and loadout facilities, which the company is developing on private lands, as described under History and Background.

The proposed drainage plan described under history and Background must comply with federal regulations in 30(CFR): 717 before the M&R plan could be approved.

During the proposed 30-year mine life, Anschutz would have to dispose of approximately 97,680 cubic yards of refuse per year from the operation. Anschutz would use the refuse disposal site described under History and Background. It will occupy approximately 10.17 acres and is proposed to be used for about fifteen years. Other areas may be considered for future refuse disposal if needed after the initial fifteen-year period.

Anschutz will be required to reclaim all disturbed lands to a condition capable of supporting the pre-mining land use or better. A mining permit will not be approved until Anschutz has demonstrated that the reclamation plan contained in the M&R plan can restore the affected land areas to the proposed post-mining land use.

Authorizing Actions

This M&R plan was submitted for review prior to promulgation of interim regulations, 30(CFR): 700, required under Section 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87). Therefore, this plan does not fully reflect the requirements of the interim regulations. However, in this statement the applicable interim regulations are being included as federal requirements in chapter 1 as if the plan had been designed using the requirements of the interim regulations. Before the plan will be considered for approval by the Department of the Interior, it will be returned to the mining company for redesign to incorporate the applicable initial regulations. As soon as the applicant's plan is revised and returned to OSM, it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations in 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

The regulations contained in 30(CFR): 717 deal specifically with the performance standards required for approval of underground mining such as that proposed in this plan. In addition, refuse disposal of mine waste materials is governed by the regulation 30(CFR): 715.15.

The standards and measures described in the above regulations are required measures and the impacts from the proposed action have been analyzed on that basis.

Federal Agencies

ASSISTANT SECRETARY OF ENERGY AND MINERALS

The Assistant Secretary must approve the mining permit application, including the proposed M&R plan, and significant modifications or amendments to it before the mining company can commence mining operations.

OFFICE OF SURFACE MINING (OSM)

OSM, with concurrence of the surface managing agency (BLM or USFS) and USGS, recommends approval or disapproval of M&R plans to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a State-Federal Cooperative Agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and the Department of the Interior authorized to take final actions on the permit.

U.S. GEOLOGICAL SURVEY (USGS)

The USGS is responsible for development, production, and coal resources recovery requirements included in the mining permit.

BUREAU OF LAND MANAGEMENT (BLM)

The BLM develops the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected public lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on public lands.

U.S. FOREST SERVICE (USFS)

The USFS developes requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected forest lands. The USFS is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power

lines, communication lines, and railroad spurs on forest lands.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

The USFWS is responsible for protection of migratory birds, including eagles, and threatened or endangered species and their habitats. Coordination is required with the USFWS under provisions of the Fish and Wildlife Coordination Act, the Bald Eagle Act, and the Endangered Species Act.

State Agencies

STATE OF COLORADO

Anschutz has obtained the necessary air quality and water quality, required by the state of Colorado for the existing operation. Anschutz does not have a mining permit from the Colorado Mined Land Reclamation Board; the M&R plan has been approved, but the performance bond has not yet been submitted. Anschutz has obtained ground water rights for their proposed usage of mine water from the Colorado State Engineer.

County Agencies

Anschutz has obtained necessary permits from Pitkin County.

Interrelationships

Relationship to Other Present and Potential Actions

Mid-Continent Coal and Coke Company is presently the only other operator actively mining coal in the general area. The company operates the following mines in Coal Basin: Bear Creek Mine, Coal Basin Mine, Dutch Creek No. 1 Mine, Dutch Creek No. 2 Mine, and L. S. Wood Mine. All of these mines are located 5 miles west of Redstone, Colorado, and 8 miles southwest of the proposed Anschutz operation (see map 1 in volume 3 map packet). Coal from both operations is trucked to Denver and Rio Grande Western Railroad loadout facilities in Carbondale.

U.S. Steel Corporation holds eight inactive coal leases in the general area. In addition, Thompson Creek, Garland Coal Company, and Mid-Continent Coal and Coke Company each hold one inactive federal lease. (Map 1 in the volume 3 map packet shows the location of these leases in relation to the Anschutz operation.) In general, the coal reserves on these leases are considered to be under a minimum of 2,000 feet of overburden. No activity is currently projected for these leases, but diligent development and continuous operation requirements will require these leases to be developed before 1986.

Exploration for natural gas is in progress approximately 3 to 6 miles west of the Thompson Creek mines. In addition, Rocky Mountain Natural Gas Company uses old gas wells approximately 4 miles west of the mines as storage reservoirs. The gas is used during peak periods from November to April. (Map 1 in volume 3 shows the position of the existing leases and gas transmission lines.)

Institutional Relationships

OFFICE OF SURFACE MINING

OSM, in consultation with Surface Managing Agency (BLM and USFS), USGS, or (where applicable) the state regulatory authority, recommends approval or denial of surface coal mining permit applications to the Assistant Secretary of Energy and Minerals. OSM (as lead agency) is the federal regulatory authority responsible for reviewing coal M&R plans (permit application), enforcement of all environmental protection and reclamation standards included in an approved mining permit, the monitoring of both on- and off-site effects of the mining operation, and abandonment operations within the area of operation of a federal lease.

OSM is the principal contact for all coal mining activities within the area of operation. OSM will conduct as many inspections as are deemed necessary but no less than one partial inspection quarterly and at least one complete inspection every six months (30[CFR]: 721.14[c]).

OSM, after consultation with BLM, USGS, and the operator establishes the boundaries of the permit area for the proposed mine and approves the locations of all the mine facilities located within this boundary.

Section 523 of SMCRA requires the Federal Lands Program to adopt those state performance standards which the Secretary determines are more stringent than the federal standards. The Federal Lands Program means a program established by the Secretary pursuant to Section 523, SMCRA, to regulate surface coal mining and reclamation operations on federal lands. Therefore, the performance standards enforced by OSM on a federal leasehold should be at least as stringent as those required under state law or regulations.

The Department of the Interior is negotiating a cooperative agreement pursuant to Section 523(c) SMCRA with the state of Colorado and other states. Whenever this agreement is consummated with the state, the OSM's functions and responsibilities specified in this agreement will be delegated to the state regulatory authority. Under this agreement, OSM and the state regulatory authority will jointly review and act on mining permit applications and recommend approval or disapproval to

the officials authorized to take final action on the application. The Secretary is prohibited by law from delegating his authority to approve mining plans on federal lands.

U.S. GEOLOGICAL SURVEY

The USGS is responsible for reviewing M&R plans for development, production, and coal resource recovery requirements on a federal leasehold. USGS is responsible for the maximum economic recovery of the federal coal resource and for the federal government receiving fair market value for the coal resource.

BUREAU OF LAND MANAGEMENT

The BLM formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of public lands.

The BLM, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, and railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The BLM is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on public lands within a leasehold.

U.S. FOREST SERVICE

The USFS formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of national forest systems land.

The USFS, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, railroad spurs proposed by a mining company on forest lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The USFS is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on forest lands within a leasehold.

Relationship to U.S. Forest Service Plans

The national forest systems land included in the M&R plan is administered by the White River National Forest. It is subject to objectives developed in the Draft Environmental Statement: Thompson Creek Land Use Plan (U.S. Department of Agriculture 1976). The draft land use plan formulates three goals for the Thompson Creek planning unit:

1. Provide for orderly development or use in the Thompson Creek planning unit in a manner which will maintain the present environment with regard to scenery, air and water quality, wildlife and open space values;

2. Accommodate growth and development in a manner which will strengthen the local, state, and national economy; and

3. Promote and achieve a pattern of natural resource uses that will best meet the needs of the people now and in the future. The proposed plan selected on the basis of the draft land use plan as most likely to meet the above goals establishes the following objectives for the planning unit:

1. Permit energy development with recognition of all laws, regulations, and statutes;

2. Produce 9,700 AUMs of forage to support local livestock industry and enhance associated rural atmosphere;

3. Provide for orderly management of 16,000 acres of timber at a sustained annual harvest of 4.5 million board feet;

4. Provide for 19,500 recreation-visitor-days use at developed sites along the Crystal River;

5. Provide for development opportunities to serve 6,000 skiers at one time;

6. Provide 25,300 dispersed-recreation-visit opportunities to meet the projected local valley growth as well as tourist needs;

7. Identify 16,400 acres of wildlife habitat for enhancement of wildlife values;

8. Retain the state of Colorado water quality standards; and

9. Develop a transportation system consisting of 19 additional miles of roadway, to serve resources and commodities.

In addition, through its roadless area review and evaluation (RARE II) program, the USFS has identified a roadless area adjacent to the proposed

mining area, overlapping part of the lease that is not presently proposed for development. The USFS has recommended that the roadless area be managed for dispersed recreation and studied for wilderness status.

The BLM's propoised Thompson Creek Natural Environment Area is adjacent to the lease site on the east. It may also be studied for wilderness status as a roadless area.

Relationship to State and Local Planning

For a discussion of State of Colorado and Garfield and Pitkin county planning, see regional chapter 1, Land Use Plans, Controls, and Constraints.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

The description of the existing environment covers the physical, biological, cultural resources, and the socioeconomic conditions which constitute the site-specific environment in which Anschutz Coal Corporation proposes to develop federal coal and adjacent private coal. The description focuses on environmental details most likely to be affected by Anschutz' proposed action and alternatives. The concluding section of this chapter describes the anticipated future environment in 1980, 1985, and 1990 if the mining and reclamation (M&R) plan is not approved and implemented.

EXISTING ENVIRONMENT

Climate

The Thompson Creek mines are located in a mountainous area of the White River National Forest. The site is south of North Thompson Creek at an elevation of 7,400 feet. Temperatures at the site average 39 degrees Fahrenheit annually. The growing season is estimated to be 45 days (based on 32-degree freeze-threshold data).

No reliable precipitation data are available for the lease area but vegetation indicates an annual average precipitation of at least 15 inches at the mine facilities on North Thompson Creek and probably 20 to 25 inches on the high ridges in the northern and southern parts of the lease area. Winter snows and summer showers or thunderstorms result in a fairly even distribution of precipitation throughout the year.

Winds are assumed to be from the west and to follow an up-valley/down-valley orientation along North Thompson Creek with an average speed of 8 miles per hour (figure A2-1). No on-site data are available; data from Grand Junction weather station were utilized and adjusted to fit the profile of the valley for this proposed site.

Air Quality

Particulate air quality in the ES area ranges from 20 to 132 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean as recorded at sixteen state, municipal, and privately operated particulate sampling sites. In undeveloped sections, particulate concentrations range from 20 to 40 $\mu g/m^3$.

The available particulate sampling data which best represent existing particulate air quality at the proposed Thompson Creek mines are from three sampling sites located in remote mountainous areas of west-central Colorado. The annual geometric mean concentrations recorded at these sites range from 20 to 29 $\mu g/m^3$. The Thompson Creek mines are already in operation on private land, and the proposed development of this site-specific is an expansion of this operation onto federal land. Thus, existing particulate air quality at this site is background concentration (20 to 29 $\mu g/m^3$) plus the impact from the operating mine.

There has been no measurement of carbon monoxide, hydrocarbon, nitrogen oxides, sulfur dioxide, or other gaseous pollutants near the proposed site. Since no major sources of these pollutants exist in the surrounding area, concentrations are considered to be at background or natural levels.

Visibility at the site ranges from less than 1 mile to approximately 100 miles throughout the year. Average visibility is about 54 miles, with greatest visibility occurring during spring and summer months.

Geologic and Geographic Setting

Topography

The site of the Thompson Creek No. 1 and No. 3 mines is about 13 miles west of the Roaring Fork River and the Roaring Fork Creek Valley. The site lies astride North Thompson Creek, which flows east through the lease area (see map A1-1 in chapter 1).

The major ridge system in the area lies west of the Anschutz leases. It trends east-west, and its highest peaks approach 11,000 feet. The lease area lies on the lower, eastern slopes of this ridge system. Slopes face predominantly north or south; however, in the northeast corner the dominant slope direction is east at the very toe of the slope. Elevation in the lease area ranges from 9,514 feet along Stony Ridge to 7,360 feet along North Thompson Creek. Slopes range from 72 percent to 4 percent along North Thompson Creek; the average slope is about 30 percent.

Anschutz currently uses the 10-acre refuse disposal area (map A1-2) for the company's operations

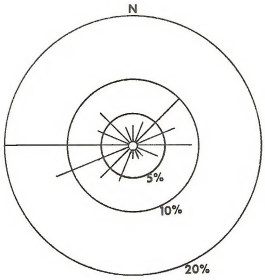


Figure A2-1 Annual wind frequency at the Thompson Creek mine site

on private coal leases. The site shows signs of historical use as a dump area. Slopes in the area vary from 40 percent (south-facing slopes) to 60 percent (north-facing slopes) with some short steeper sections.

Landforms

The landforms on the lease area have been formed by the differing rates at which the geologic formations and structures have eroded. High ridges (such as Stony Ridge) define the drainage basis, and the valleys are narrow and V-shaped. Alluvial floodplain deposits are narrowly confined to the valleys.

Structure

The North Thompson Creek property lies along the southern end of the Grand Monocline. Most of the coal beds on the lease area dip westward 27 degrees to 30 degrees unless deflected by smaller local structures.

A west-trending anticline underlies the divide between Middle Thompson and North Thompson creeks just west of the lease area. It breaks the regional syncline into two synclinal structures. On the southern side, the coal beds along and north of Lake Ridge dip westward from the outcrop to a north-plunging syncline. The other plunging syncline trends northeasterly to west from the south end of the property toward the South Branch of Middle Thompson Creek. It adjoins the north flank of the Coal Basin anticlinal dome where the coal beds dip northward toward the syncline. There are no major faults in the area of the North Thompson Creek No. 1 and No. 3 mines, although there are a few relatively minor faults with displacements of a few inches to several feet. These minor faults affect mine planning but are not severe obstacles to the mining of the coal.

Stratigraphy

The exposed stratigraphic sequence on the North Thompson Creek property is of Upper Cretaceous and Tertiary ages. In ascending order (that is, oldest to youngest) outcropping formations are the Upper Cretaceous Mancos shale and Mesaverde formations, the Tertiary Ohio Creek and Wasatch formations, and the Tertiary volcanic conglomerates.

In the lease area the Mancos shale occupies the lowest topographic positions, lying at the bottom of major stream channels such as North Thompson Creek. The Mancos in the area consists of soft gray marine shales with total thickness of 4,000 feet.

The Mesaverde Formation is overlain by the Ohio Creek and Wasatch formations. The contact between the Mesaverde and the overlying Ohio Creek conglomerate is a regional low-angle unconformity. Remnants of volcanic conglomerates are irregularly distributed over the Wasatch along Stony Ridge and in the headwaters of Middle Thompson Creek.

The Mesaverde Formation conformably overlies the Mancos shale. in this area, the Mesaverde consists of the following four members in ascending order: the Rollins sandstone member, the Bowie shale member, the Paonia shale member, and the upper (or barren) member. The economically mineable coal beds are located in the 850-foot Bowie member and the 600-foot Paonia member of the Mesaverde Formation. The lower 125 feet of the Bowie member contain three coal seams: A, B, and C (in ascending order). The Paonia member contains up to five irregularly distributed coal seams: Sunshine, Anderson, Lake Ridge, Thompson, and Stony Ridge (in ascending order). Table A2-1 lists the seams in each member, their thickness, and their distance apart. Figure A2-2 is a schematic of the coal seams at the Anschutz mines.

Coal beds considered by the U.S. Geological Survey (USGS) to be of commercial thickness are restricted to the Bowie shale member (A and B seams) and Paonia shale member (Anderson and Sunshine seams). Anschutz considers only the A and Anderson seams to be of commercial thickness at this time. (See Mineral Resources for further discussion.)

Paleontology

The principal fossil-bearing formations in the lease area, ages, number of known fossil localities, and general fossil types normally found in the formations are summarized in table A2-2. Due to the present lack of data and accepted criteria for determining significance, the importance of these paleontological resources to science, education, and other values cannot presently be assessed.

Mineral Resources

Coal

Anschutz proposes to mine the A seam through the Thompson Creek No. 1 mine and the Anderson seam through the Thompson Creek No. 3 mine. The two seams are 800 feet apart vertically. Overburden in the mining area will vary from 0 feet at the outcrop of the Anderson and A seams, to a minimum of 1,500 feet over the Anderson seam at the east boundary of lease C-08173, to over 3,000 feet over the Anderson seam at the west boundary of the lease. The company considers the other coal seams uneconomical to recover at this time.

The A seam is 7 to 10 feet thick in the area of the proposed project with a proximate analysis of 12,640 BTUs, 0.90 percent sulfur, 16.4 percent ash, 2.1 percent moisture, 60.6 percent fixed carbon,

TABLE A2-1

COAL SEAMS ON PROPOSED ANSCHUTZ LEASE AREA

Coal Seams in Descending Order	Thickness (feet)	Height above Next Lower Seam (feet)
Paonia Member:		
Stony Ridge	3.60 to 5.10	50
Thompson	4.00 to 5.00	20 to 140
Lake Ridge	4.00 to 7.00	10 to 40
Anderson	8.00 to 10.00	60
Sunshine	2.00 to 6.00	--
Bowie Member:		
C	+2.00	25 to 50
B	4.70 to 5.75	30 to 40
A	7.00 to 10.00	--

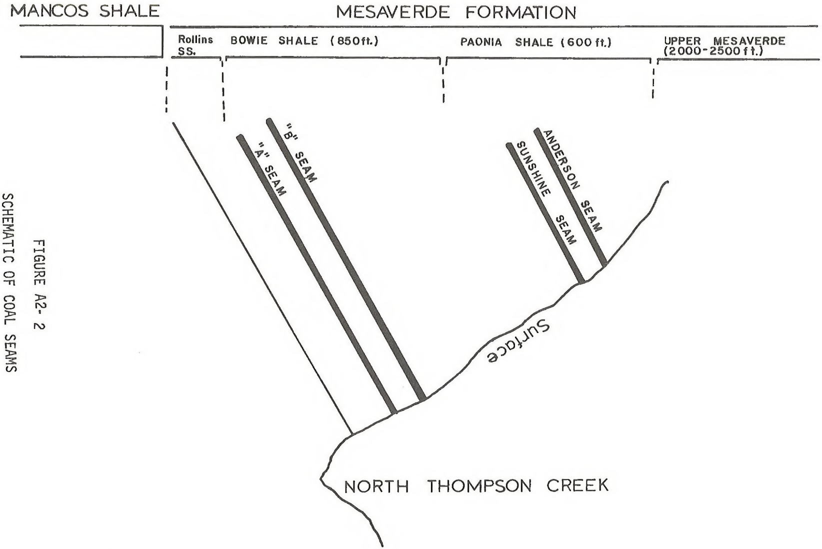


FIGURE A2- 2
SCHEMATIC OF COAL SEAMS

TABLE A2-2

SUMMARY OF FOSSIL-BEARING FORMATIONS IN THE AREA OF THE PROPOSED ANSCHUTZ MINE

Formation	Period	Known Fossil Localities a/	Type of Fossils
Maroon	Triassic	General	V, I, P
Entrada	Jurassic	General	V, I, P
Morrison	Jurassic	General	V, I, P
Dakota	Late Cretaceous	General	V, I, P
Mancos	Late Cretaceous	General	V, I, P
Mesaverde	Late Cretaceous	General	V, I, P
Ruby	Tertiary	General	V, I, P

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

I = invertebrate; V = vertebrate; P = paleobotanical.

and 33.65 percent volatile matter. Coal from this seam has been used successfully as a blending coal in the manufacture of high temperature metallurgical coke. The Anderson seam is 10 feet thick with a proximate analysis of 13,745 BTUs, 0.90 percent sulfur, 7.85 percent ash, 2.95 percent moisture, 58.5 percent fixed carbon, and 30.56 percent volatile matter.

Oil and Gas

There is little potential for oil and gas under the proposed project area. Exploration for natural gas is in progress approximately 3 to 6 miles west of the North Thompson Creek mines. The Wolf Creek gas field, located approximately 4 miles west of the area, is used primarily for gas storage by the Rocky Mountain Natural Gas Company.

Water Resources

Hydrologic Setting

The North Thompson Creek mine area lies on the lower dissected mountain slopes west of the Crystal River in an area where north-trending, steeply-dipping beds are crossed at approximately right angles by east-flowing perennial streams tributary to the Crystal River. At the mine site, North Thompson Creek flows across a thick sequence of interbedded sandstone, siltstone, shale, and coal beds that dip 27 to 30 degrees westward or upstream. In the absence of mining, these beds would be saturated below the level of North Thompson Creek, which represents the base level of saturation in the area. Ground-water movement in the mine area is generally along the direction of strike, either northward or southward toward North Thompson Creek.

No adequate precipitation data are available for the lease area. The vegetation indicates an annual precipitation of at least 15 inches on North Thompson Creek at the mine facilities and probably 20 to 25 inches on the high ridges in the northern and southern parts of the lease area. The seasonal pattern of precipitation showing approximately uniform monthly distribution should be similar to that at nearby National Weather Service stations in the ES area.

Ground Water

The occurrence of ground water in the North Thompson Creek mine area is controlled largely by the combination of geologic structure, stratigraphy, and topography, in that order of importance. Ground-water recharge to the steeply dipping beds occurs primarily along the crests of the ridges that mark the outcrop areas of the upturned strata. Movement is then downdip and laterally along the direction of strike towards the lowest point of outcrop where the beds underlie the alluvium along the bottom of North Thompson Creek Valley. Prior to active mining below the level of the valley floor, this ground water then either discharged into North Thompson Creek, which is a gaining stream throughout most of its length, or, depending on the local continuity of the beds, appeared along the steep valley side slopes as small springs or seeps.

With the onset of mining below stream level, pumping to dewater the mine has created a local cone of depression in the saturated zone toward which ground water now moves. Consequent lowering of the water table in the immediate vicinity of the No. 1 and No. 3 mines has not only reduced local ground-water discharge to the stream, but undoubtedly has induced some water loss from North Thompson Creek. The amount of that loss is not known, but it probably does not exceed 10 gallons per minute (gpm).

Records show that 60 gpm currently are pumped from the North Thompson Creek No. 1 Mine. Of this total, about 48 gpm are used in the coal washing plant, about 3 gpm are used on other treatment operations, and the remainder of about 9 gpm is discharged into North Thompson Creek under National Pollution Discharge Elimination System (NPDES) permit No. CO-0029599 dated August 30, 1977. This water is a sodium, calcium, bicarbonate, sulfate type (table A2-3) and contains 900 to 1,300 milligrams per liter (mg/l) dissolved solids, exhibiting seasonal variations that suggest at least fair hydraulic connection with the surface-water resource. Simultaneously, about 18 gpm are pumped from the No. 3 Mine, approximately 2 gpm of which are treated and used for showers and potable supplies. The remainder is discharged to North Thompson Creek under the NPDES permit described above. This water is also a sodium, calcium, bicarbonate, sulfate type and contains 800 to 1,000 mg/l dissolved solids. Total discharge to North Thompson Creek is about 25.3 gpm or about 40 acre-feet per year. The added salt load contributed to North Thompson Creek is about 55 tons per year.

Anschutz Coal Corporation filed application nos. W-2979 and W-2980, dated May 28, 1976, in the District Court in and for Water Division No. 5, State of Colorado, for rights to use the ground water pumped from the company's No. 1 and No. 3 mines. Decrees dated June 21, 1977, subsequently were granted to the company for the use of 0.2222 cubic foot per second (99.7 gpm) from their No. 1 Mine and 0.0462 cubic foot per second (20.7 gpm) from their No. 3 Mine, with appropriation dates of June 30, 1963, and December 31, 1962, respectively.

Two small springs have been identified on the lease area. One issues on the north valley slope and

TABLE A2-3

GROUND WATER DATA FROM ANSCHUTZ MINE
(COLORADO DEPARTMENT OF HEALTH, JANUARY AND FEBRUARY 1976)

Parameter	Units a/	Amount
pH	--	7.7
Dissolved solids	mg/l	1,123.0
Specific Conductance	micromhos/cm	2,625.0
Alkalivity	mg/l	495.0
Hardness	mg/l as $CaCO_3$	538.0
Calcium	mg/l	115.0
Iron	micrograms/liter	0.5
Sulfate	mg/l	320.0

a/ mg/l = milligrams per liter; micromhos/cm = micromhos per centimer; $CaCo_3$ = calcium carbonate.

the other on the south valley slope a short distance downstream from the No. 3 Mine. Both discharge about 0.5 gpm. No. 1 spring yields water that is a sodium bicarbonate type with a dissolved-solids concentration of about 675 mg/l. No. 2 spring yields water that is a calcium bicarbonate type with a dissolved-solids concentration of about 340 mg/l.

No wells are known to exist on the lease tract, and no observation wells have been constructed as yet to monitor the effects of mining on the groundwater resource.

Surface Water

The Anschutz complex is in the Thompson Creek subdrainage, which is tributary to the Crystal River (the Roaring Fork subbasin, which includes the Crystal River, is described in chapter 2 of the regional volume). Thompson Creek drains an area of approximately 76 square miles (sq mi), producing an estimated average annual discharge of 31,600 acre-feet (ac-ft). The Anschutz lease area lies athwart North Thompson Creek about 7 miles upstream from its mouth. Records from a USGS gaging station (No. 09082800) on North Thompson Creek about 2.2 miles upstream from the mine site show that annual runoff from the 26.8 sq mi watershed averages about 12,600 ac-ft, which represents an average discharge of about 17 cubic feet per second (cfs) and an average annual runoff of about 8.8 inches. Maximum discharge during the period of record was 365 cfs. It occurred on May 22, 1970. Minimum discharge was 0.09 cfs on September 6 to 7, 1967. Spring snowmelt has produced peak flows as high as 272 cfs (May 20, 1970), but the average monthly discharges for May and June are 92 and 64 cfs, respectively. Stream flow between August and April is generally less than 5 cfs, with flows of less than 1 cfs being common.

The discharge at the mine complex should be slightly higher than at the gaging station because of the larger drainage area of 32.2 sq mi. Only three ephemeral streams enter North Thompson Creek between the mine site and the gaging station, however, so the gaging station record should be generally representative of flow conditions through the mine complex.

All water used in support of the current mining operation comes from ground water pumped from the mines. Anschutz uses no water from North Thompson Creek and has no right to divert and use any surface water in the area. The company expects to obtain all water required by their ongoing operations from ground water pumped from the mines and has indicated no intention of acquiring any surface-water rights.

The Anschutz operation is located between two sampling sites on North Thompson Creek from which the U.S. Forest Service (USFS) has collected baseline water-quality data (U.S. Department of Argriculture 1976a). The quality of North Thompson Creek can be classified as generally good above the mine complex. The water is a calcium, magnesium, bicarbonate type with minor amounts of sodium and sulfate. Dissolved-solids concentrations are generally less than 150 mg/l during all but periods of low flow when concentrations may increase to 300 mg/l. Turbidity is moderate during periods of storm or snowmelt runoff.

Downstream from the mine complex, water quality depends on the amount of stream flow. During medium and high flows, the comparatively small amount of mine discharge has little or no significant effect on the chemical characteristics of the water. Some increase in turbidity has been observed, however, as a result of the pick up of coal dust in the reach traversing the mine complex. Conversely, during periods of low flow, turbidity increases in the downstream direction are minimal, but the effect of mine discharge may significantly alter the water type and could increase dissolved-solids concentrations as much as two-fold. For example, at a flow of 0.09 cfs (40.4 gpm), such as occurred on September 6 to 7, 1967, discharge from the mine at the current rate of 0.06 cfs (25.3 gpm) would increase dissolved-solids concentration from about 300 to almost 600 mg/l. Sodium would become a major cation, and sulfate concentrations could increase to more than 100 mg/l, with consequent impacts downstream on aquatic biology.

Table A2-4 summarizes water-quality data for two samples, one collected upstream and one downstream from the mine complex. These data show that dissolved-solids concentration as indicated by specific conductance increased about 48 percent; total hardness increased about 39 percent; and sulfate concentrations increased about 600 percent.

The Colorado Department of Health, in accordance with the provisions of the Federal Water Pollution Control Act (as amended, 33 USC 1251 et seq.) and the Colorado Water Quality Control Act (25-8-101 et seq.; CRS, 1973 as amended), has placed limits on Anschutz to control the concentrations of total suspended solids, total iron, etc., that are discharged into North Thompson Creek (see table A2-5). The special discharge permit, number C-0029599, is dated August 26, 1977. Violation of these effluent limits may result in the closure of the mining operation, a fine, or both by the state of Colorado or the Environmental Protection Agency. It is stressed, however, that these restrictions will have no effect on the dissolved solids load in the mine-water discharge and the consequent degradation of water quality in North Thompson Creek described above.

TABLE A2-4

SELECTED WATER QUALITY DATA FOR NORTH THOMPSON CREEK

Parameter	Units a/	Sample Locations: NW¼NW¼SE¼ Section 28, b/ T. 8S., R. 89W.	Sample Locations: SE¼NE¼NW¼ Section 36, c/ T. 8S., R. 89W.
Turbidity	JTU	16.0	19.8
Specific Conductance	micromhos/cm	178	262
pH		--	8.4
Total alkalivity	mg/l	80	81
Total hardness	mg/l as $CaCO_3$	70	97
Calcium hardness	mg/l as $CaCO_3$	50	68
Magnesium hardness	mg/l as $CaCO_3$	16	30
Sulfate	mg/l	4	31

Source: U.S. Department of Agriculture 1976a.
a/ JTU = Jackson Turbidity Units; micromhos/cm = micromhos per centimeter; mg/l = milligrams per liter; $CaCo_3$ = calcium carbonate.
b/ Upstream from mine complex.
c/ Downstream from mine complex.

TABLE A2-5

EFFLUENT LIMITS ESTABLISHED FOR ANSCHUTZ COAL OPERATION IN NORTH THOMPSON CREEK BY PITKIN COUNTY AND COLORADO DEPARTMENT OF HEALTH

Parameter	Maximum Concentration (milligrams per liter) 30-day Average	7-day Average	Daily Maximum
BOD_5 a/	30	45	NA
Total Suspended Solids a/	N/A	N/A	30
Fecal Coliforms (No./100 ml) a/	6,000	12,000	NA
Total Residual Chlorine a/	NA	NA	0.03
Total Iron a/	3.5	NA	7.00
Oil and Grease a/	NA	NA	10.00
Total Suspended Solids b/	NA	NA	30.00
Total Iron b/	3.5	NA	7.00
Oil and Grease b/	NA	NA	10.00

Note: BOD_5 = five-day biological oxygen demand.

NA = not applicable.

a/ Outfall from sewage treatment plant and Mine No. 1.

b/ Outfall from coal washing plant settling pond and Mine No. 3.

Flood Hazard

Anschutz is located on the valley floor adjacent to the channel of North Thompson Creek. No existing records indicate what peak discharge might be expected from a large infrequent storm, such as the 100-year storm. However, using the Department of Agriculture's method of computing peak flows (U.S. Department of Agriculture 1972), the hydrologic consulting firm of Briscoe, Maphis, Murray, Lamont, Inc., Boulder, Colorado, engaged by Anschutz to prepare a site drainage and storm runoff management plan, estimated peak discharge from a 100-year/24-year storm event, with a precipitation of 3 inches, to be 4,337 cfs at the mine complex. Using that same method, ES team members estimated peak discharge from the 100-year storm to be about 600 cfs. The much lower value obtained is attributed to the use of infiltrometer data collected in this general area to approximate rainfall-runoff relationships, rather than the assumption of a value that could be considerably in error. Computation of peak discharge from the 100-year storm using the method adopted by the Colorado Water Conservation Board (1976) indicated a flood magnitude between 615 and 690 cfs at the mine complex. Thus, it appears probable that the 100-year flood at the mine complex would not exceed 1,000 cfs. If so, the existing channel should carry that flow with no serious damage to the ongoing operations.

Erosion and Sedimentation

Data are not available from which to adequately approximate sediment yields from the watershed upstream from the mine complex or to appraise the effectiveness of current measures to control sediment yield from the surface area disturbed by ongoing mining operations. Water samples collected upstream and downstream from the mine complex in April 1975 showed 435 mg/l and 373 mg/l, respectively. The water was turbid and the flow was moderate to high, although no discharge measurement was made. An apparent decrease in sediment load across the mine area is attributed to normal sampling variations rather than to local deposition of sediment within the channel. Similar samples collected at low flow during March 1976 showed 38 mg/l suspended solids upstream from the mine complex and 110 mg/l downstream. This increase also may reflect sampling variations and does not necessarily indicate increased sediment yield locally as a result of mining. Based on these meager data, sediment yield from the watershed is estimated to be about 5,000 tons per year or about 150 tons per year per square mile.

Alluvial Valley Floors

The Anschutz mine complex lies adjacent to the stream channel on the bottom of North Thompson Creek Valley. This setting is on an alluvial valley floor as defined in 30 (CFR): 710.5. Mining restrictions applicable to alluvial valley floors do not apply to Anschutz' operations, however, because the company was in production in the year preceding August 3, 1977. Also, the pre-mining land use of the valley floor was undeveloped rangeland.

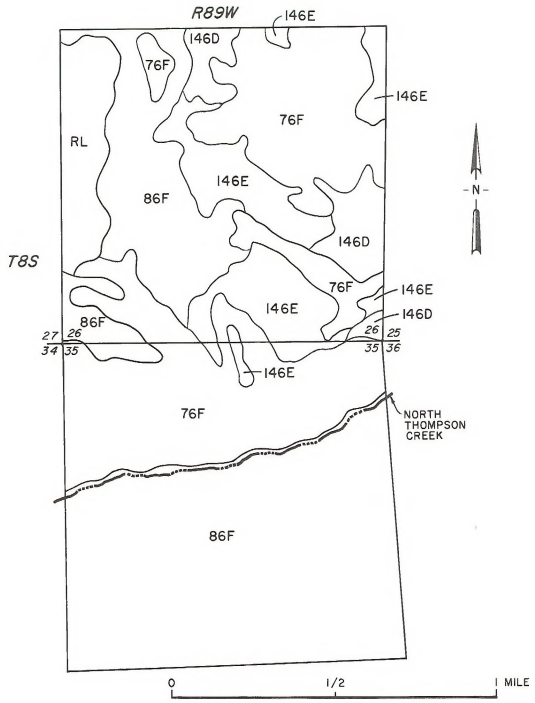
Soils

Soils in the general area of existing surface activity are shown in figure A2-3. Individual mapping units range from very shallow soils and rock outcrops on the steep upland slopes to deep soils formed in heavy-textured alluvial deposits on lower slopes and in valleys. In addition, several areas within the mine site contain spoil and coal waste material brought to the surface during previous mining operations. This material is presently eroding and will complicate present and future reclamation efforts. Other specific soil features of importance in assessing reclamation are rated in table A2-6; brief explanations of each rating are given in the footnotes (see also Water Resources, Erosion and Sedimentation).

Vegetation

There are seven vegetation types within the coal lease area: mountain shrub, aspen, Douglas fir, spruce-fir, pinyon-juniper, sagebrush, and riparian (see map A2-1). Mountain shrub, which is dominated by gambel oak and serviceberry, is the most widespread type. Douglas fir and aspen grow along the North Fork of Thompson Creek near the existing Anschutz mines, and on the north-facing slope immediately south of the mine. The pinyon-juniper type occurs on dry, southern exposures in the northern part of the coal lease area and on the rocky slope south of the mine. Large sagebrush flats occur northeast of the existing mine, at elevations below 8,000 feet; big sagebrush is the dominant plant in this type. The riparian vegetation along North Thompson Creek consists mainly of Douglas fir, willows, and alder. No data are available on aquatic vegetation in the proposed lease area.

A more detailed discussion of the plant species composition of these vegetation types, as well as their relationships to climatic and topographic features and to each other, can be found in the regional analysis. Scientific names of the plants are listed in the appendix, volume 3.



76F Dollard - unnamed silty clay loam - shale outcrop, steep - very steep
86F Jerry loam, 25-65% slopes
146D Unnamed silty clay loam, 6-12% slopes
146E Unnamed silty clay loam, 12-25% slopes
RL Torriorthent - rock outcrop, 25-65+% slopes

Figure A2-3. Soil units in the area of the proposed Thompson Creek No. 1 and No. 3 mines

TABLE A2-6

SOIL FEATURES FOR ANSCHUTZ MINING AREA

Mapping Unit No.	Name	Hydrologic Group a/	Erosion Hazard b/	Topsoil Rating c/	Reclamation Limitations d/
76F	Dollard-Unnamed-Shale outcrop complex				
	Dollard	D	High	Poor	Severe
	Unnamed silty clay loam	C	High	Fair	Severe
	Shale outcrop	-	-	-	-
86F	Jerry loam	C	Moderate	Poor	Moderate
146D	Unnamed silty clay loam	C	Moderate	Fair	Moderate
146E	Unnamed silty clay loam	C	Moderate	Fair	Moderate
RL	Torriorthent-Rock outcrop				
	Torriorthents	D	High	Poor	Severe
	Rock outcrop	-	-	-	-

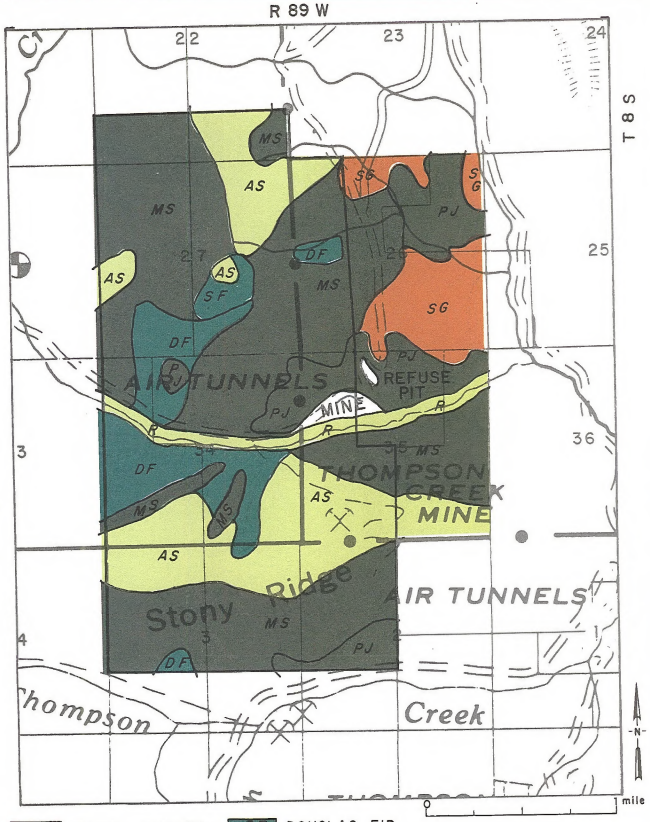
Source: Adapted from data compiled by the U.S. Department of Agriculture, Soil Conservation Service (Glenwood Springs, Colorado), for the Aspen-Gypsum Area Soil Survey (unpublished).

a/ Hydrologic soil groups (A, B, C, D) are based on the rate at which water enters the soil surface (infiltration) and the rate at which water moves within the soil (transmission). When both infiltration and transmission rates are high, little surface runoff occurs (Hydrologic Soil Group A). In contrast, low infiltration and transmission rates produce high surface runoff (Hydrologic Soil Group D). Groups B and C are intermediate.

b/ Erosion hazard refers to the potential for surface soil loss when existing cover is removed or seriously disturbed.

c/ Topsoil is rated both on suitability as a seedbed material and on ability to sustain plant growth. Factors considered include soil depth, texture, amount of coarse fragments, and the presence of excess soluble salts which may inhibit plant growth.

d/ Hydrologic soil groups, erosion hazard, and topsoil rating, along with climatic information, are considered jointly to determine an overall rating of the limitations for reclamation. Specific degrees of limitation are interpreted as follows: Slight - indicates either no significant limitations or those limitations which can be remedied through planning and management choices, such as species selection, time of seeding, or short-term exclusion of livestock and certain forms of wildlife. Moderate - indicates significant limitations which must be recognized but which generally can be overcome through established measures to conserve natural moisture, reduce erosion, and augment available nutrient supplies. Severe - indicates serious deficiencies in natural moisture and in the amount and quality of topsoil; may also indicate topographic conditions which produce extreme surface erosion or landslide hazards.



Map A2-1. Vegetative types in the area of the proposed Thompson Creek No. 1 and No. 2 mines

Endangered or Threatened Species

Information on the location of plants within the region that are proposed to be officially listed as endangered or threatened in the *Federal Register* (see Vegetation in the regional chapter 2 for a list of the plants) was obtained from detailed literature searches (Rollins 1941; Barneby 1964; Higgins 1971; Hitchcock 1950; Arp 1972, 1973; Reveal 1969; Keck 1937; Howell 1944; Benson 1961, 1962, 1966; Weber 1961) and extensive herbarium surveys (University of Colorado, Colorado State University, Colorado College, Denver Botanic Gardens, Western State College, Rocky Mountain Biological Lab, Black Canyon National Monument, Colorado National Monument, and Grand Mesa/Uncompahgre National Forest Headquarters). This research has revealed that none of the plants are known to have occurred historically in the area of the North Thompson Creek Mines. The results of the literature and herbarium studies may be seen at the BLM Montrose District Office. No on-the-ground floristic or endangered and threatened plant inventory has been conducted in the area of the North Thompson Creek Mines, since no additional surface disturbance will occur.

Wildlife

In the USFS draft Thompson Creek Land Use Plan (1976a), which includes the Anschutz lease area, protection of summer big game habitat is a critical element in the alternative selected for management of the area. Existing and new roads will be closed, and public access will be restricted in the middle and south branches of Thompson Creek. Timber harvest will enhance big game forage.

The mine portals and the coal washing and loading facilities have already been constructed and are in operation. This portal area is no longer used by the larger, more mobile species, such as deer, elk, black bear, and coyotes. Smaller animals' use of the area has been curtailed, although there have been some population increases among species closely associated with human beings. A listing of terrestrial fauna known or expected to occur in the North Thompson Creek area is available at the BLM Montrose District Office.

Big Game

Mule Deer

Mule deer are found throughout the area, most of which is summer range. There is also winter range to the north, but crucial winter range is generally below the Anschutz lease area (see map A2-2). Winter is considered to be the limiting season of the year because the land area, forage, and water distribution are considered inferior to those used during the summer. Levels of use during the winter vary from 14 to 23 deer days per acre, with crucial areas receiving as high as 59 deer days per acre. Previous mining operations have taken approximately 46 acres, which would have supported 6 deer.

Mule deer populations may fluctuate greatly from year to year as well as seasonally within the year, and population estimates are based on average numbers. Mule deer winter populations have been estimated at about 50 deer per square mile. This would indicate a total deer population within the Anschutz lease area of about 235 animals during the winter months.

Elk

Elk occur throughout the area, which has both summer and winter ranges. There are a number of crucial winter concentration or calving areas (map A2-2). Calving areas are particularly important because they have been selected over time and offer the best combination of food, water, cover, seclusion, and aspect for calving. Colorado Division of Wildlife (DOW) transects from 1969 to 1977 indicate an average of 23 elk days per acre around the lease tract. Previous mining operations have taken 46 acres, which would have supported 18 elk.

Elk winter population estimates in the Anschutz area indicate about 8 elk per square mile. This would result in about 32 elk inhabiting the area during an average winter.

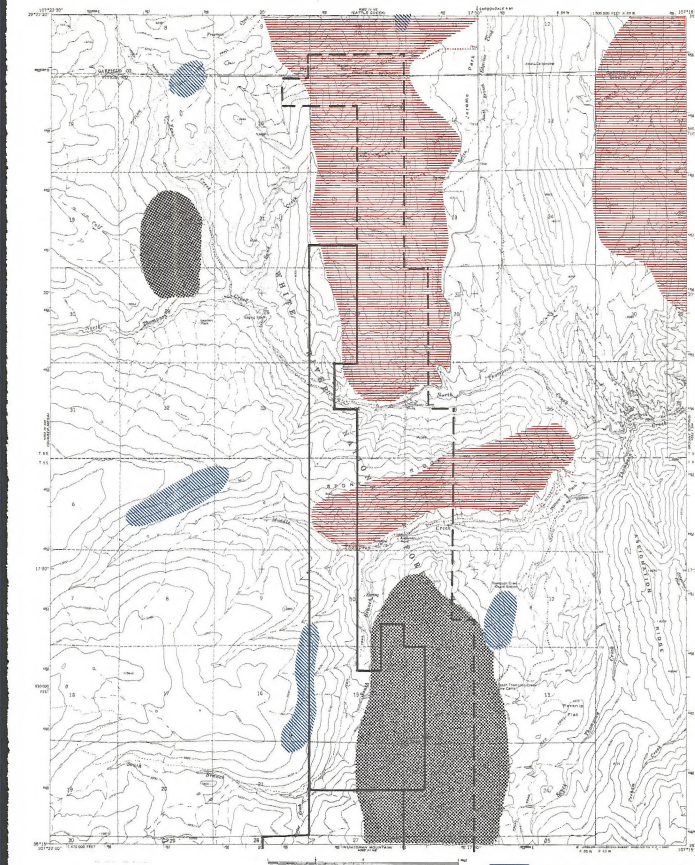
Black Bear and Mountain Lion

Black bear occur throughout the lease area, particularly in the mountain shrub, spruce-fir, and aspen habitat types. Mountain lion, although not particularly common, occasionally occur in the lease area.

Small Mammals

There is a great variety of small mammals on the area. Beaver and raccoon occur along most of the small streams. The beaver utilize willow and aspen for food and dam materials. Red squirrels, voles, snowshoe hares, and martens can be found in the dense spruce-fir forest. In the mountain shrub habitat at lower elevations, Colorado and least chipmunks, cottontail rabbits, rock squirrels, and deer mice commonly occur.

Small mammals are occasionally considered pests, damaging buildings, crops, and native vegetation, and they may be carriers of disease. At other times, many of these same small species provide entertainment for visitors and residents. Overall, this group is important for its place in the food chain.



Map A2-2. Wildlife habitat in the area of the proposed Thompson Creek No. 1 and No. 2 mines: deer, elk, and turkey

Game Birds

Four species of game birds occur regularly on the lease area: turkey, mourning dove, bandtailed pigeon, and blue grouse. (A fifth game species, the white-tailed ptarmigan, may occur on alpine habitat in the southwest portion of the area.)

In 1973, a winter population of 75 turkeys was estimated for the Crystal River drainage in Pitkin County. Several regular summering areas have been identified (map A2-2), although turkey can be found almost anywhere within mountain shrub, meadow, or aspen habitat types. Winter is considered the most critical time for turkey in the area; not only are food, grit, and cover less abundant, but fewer roost trees are available.

The mourning dove and band-tailed pigeon are migratory species not present in the winter. During the summer nesting season, the mourning dove is most common at lower elevations in the pinyon-juniper and sagebrush types. The band-tailed pigeon is found at the high elevations in the spruce-fir and aspen types. Blue grouse occur throughout the area, utilizing all types for at least part of the year. The most crucial types for blue grouse are riparian and mountain shrub, which they utilize for brood rearing.

Waterfowl use is limited by the small amount of open water in the area. Ducks, primarily mallards, occur along the larger streams, lakes, and ponds. North and Middle Thompson creeks and Lake Ridge lakes are the primary areas of waterfowl use.

Other Birds

Bird species associated with the spruce-fir and aspen habitat types are common to the area. Raptors most commonly found are tree nesters and include the kestrel, red-tailed hawk, Coopers hawk, goshawk, golden eagle, and several species of owl.

Amphibians and Reptiles

Amphibians and reptiles are not numerous in this area, because cold-blooded species are not tolerant of the generally cool temperatures. The tiger salamander, leopard frog, chorus frog, and several species of toad are found near water. The most common snakes are the wandering garter gopher snakes; the most common lizards are the eastern fence and plateau lizards.

Endangered or Threatened Species

No state or federally listed threatened or endangered terrestrial species are known to occur in the mine area. However, the cliffs along the Crystal River near Redstone and the surrounding area contain the essential habitat components for peregrine falcon. Presently there is no evidence that peregrines live in the area, although it is thought that peregrines probably nested here in the past. If these cliffs are reoccupied, the open meadow and park on the lease area would be well within the normal hunting range of peregrines. Consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act of 1973 and the Bald and Golden Eagle Protection Act (16 USC 668-668d) will be initiated and completed prior to authorization of any action that may affect a listed species or a golden eagle.

Aquatic Biology

North Thompson Creek crosses 0.25 mile of national forest systems land and 0.75 mile of private land within the lease area. Below the lease area, the stream flows through 1 mile of private land and 4 miles of public land to the confluence with the Crystal River. All of the Anschutz Mine facilities lie along the stream on the private land within the lease area. The facilities which are in a position to impact the stream in this section include mine portals, roads, water treatment facilities, a coal washing plant, sediment and sewage ponds, and a refuse disposal area.

Before 1970, ground water from the mines and coal refuse was dumped directly into the stream, causing extensive degradation of the aquatic habitat. The mines were shut down for several years, and when they were reopened in 1974, large amounts of ground water high in iron, total dissolved solids, and sulfate were pumped from the mines into the stream, again degrading the habitat. In 1975, studies of aquatic insects by the BLM indicated that a large decrease in species and population numbers had occurred due to mining operations. Since 1975, the mines have been pumped out, and the volume of mine water discharged has decreased.

Since the development of a site drainage plan, a sewage treatment system, and a series of retention and evaporation ponds, the impact on the stream habitat has changed considerably. Presently the mine water is discharged to North Thompson Creek under NPDES permit No. CO-0029599 authorized by the Environmental Protection Agency and the Colorado Water Quality Control Division. Outfall No. 002 discharges water from Mine No. 3, outfall No. 003 discharges from the coal washing plant and the site drainage system via the settling pond overflow, and outfall No. 004 discharges from the sewage treatment lagoon overflow and Mine No. 1.

Under natural conditions, North Thompson Creek has good water quality and provides good cold water aquatic habitat for trout. The stream presently supports rainbow, brook, and cutthroat trout. Mayfly, stonefly, caddisfly, beetle, and cranefly nymphs make up the majority of the aquatic

insect population. They occurred at a density of 62 per square foot in October 1977. Sculpin, dace, and suckers are also found in the stream. The stream is stocked annually by the DOW with 800 catchable-sized rainbow trout. Access to the stream is well developed, and it receives approximately 300 angler days of use annually.

As discussed in Water Resources, the North Thompson Creek flow shows a pattern of less than 5 cfs between August and April, with flow of less than 1 cfs being common. The flow for the month of September is historically less than 1 cfs, and one period of 0.09 cfs flow occurred in September 1967. This low flow makes the aquatic organisms extremely vulnerable to variations in water quality during certain months, including pollution from mine discharges.

The 4 miles of stream on public land below the mine are included in BLM's proposed Thompson Creek Natural Environment Area, and thus maintenance of the aquatic habitat is especially important. Anglers in this area catch cutthroat, rainbow, and brook trout. DOW has recommended a minimum stream flow of 7 cfs from May to September and 3 cfs from October to April for maintenance of fisheries.

The Crystal River is the receiving water for Thompson Creek. It is one of Colorado's major stream fisheries, providing excellent trout habitat below the confluence with Thompson Creek (that portion affected by discharges from the Anschutz mines). The stream is privately owned in this reach, but public access is generally permitted. Summer flow ranges from 80 to 100 cfs, and habitat is optimum. The DOW stocks 20,000 catchable-sized rainbow trout annually in this portion of stream. Fish species include rainbow, cutthroat, brown, and brook trout; whitefish, sculpin, and dace. The numbers and diversity of aquatic invertebrates sampled in this stream indicate that the aquatic environment is healthy and unstressed.

Endangered or Threatened Species

There are no endangered or threatened aquatic species in the mine area watersheds.

Cultural Resources

Archeology

No inventory has been conducted on the lease area because no additional surface disturbing activities will take place on this land. Due to the lack of survey, no archeological sites have been identified; however, sites have been found in the surrounding vicinity, indicating prehistoric use in the area.

Historic Resources

Historical research by Athearn (1977) revealed no historical sites on project area lands. However, several historic properties are known to be in the general area of the proposed action: the Coke Ovens at Marion Gulch (Union Mine), the cemetary at Marion Gulch, and portions of the Aspen and Western Railroad railbed running from Thompson Creek toward Glenwood Springs. These sites were recorded in 1977 (Athearn 1977). With the exception of the cemetary, these sites all appear to qualify for the National Register of Historic Places (36[CFR]: 800.10).

Land Use

The North Thompson Creek mine area has been used for livestock grazing, wildlife habitat, fisheries habitat, timber production, watershed, and recreation such as hunting, fishing, and hiking. As explained in chapter 1 History and Background, the Thompson Creek area has a history of coal mining activity dating back to the late 1800s, and the Anschutz Coal Corporation is currently developing a mining operation on private lands along North Thompson Creek.

Mid-Continent Coal and Coke Company is presently the only other operator actively mining coal near the North Thompson Creek mines. The company operates five mines located 5 miles west of Redstone, Colorado, and 8 miles southwest of the Anschutz mines. In addition, U.S. Steel Corporation holds eight inactive federal coal leases in the area, and Thompson Creek, Garland Coal, and Mid-Continent Coal and Coke companies each hold one inactive federal lease.

Substantial portions of Garfield and Pitkin counties in the larger, general area around the Anschutz mines are undeveloped mountainous regions whose primary land use is wildlife habitat. The White River National Forest encompasses a large portion of the area to the south and west. The major human uses of the land are recreation (which is particularly important to the area's economy), ranching, and mining.

Urban development is limited in the general area to a number of small towns. The nearest town to the North Thompson Creek mines is Carbondale, which is approximately 12 miles by gravel road from the mine site. Other communities in the vicinity include Glenwood Springs, New Castle, Silt, and Rifle in Garfield County, Basalt in Eagle County, and Aspen in Pitkin County.

The national forest systems lands in the area of the mines are subject to guidelines developed in the Draft Environmental Statement: Thompson Creek Land Use Plan (U.S. Department of Agriculture 1976); see chapter 1, Interrelationships. For a dis-

cussion of Garfield and Pitkin county land-use planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints.

Transportation

HIGHWAYS

The major highway nearest to the North Thompson Creek mines is State Highway 82, which links Glenwood Springs, Carbondale, and Aspen. State Highway 133 is south of Carbondale and crosses McClure Pass into the North Fork Valley. During average peak hours, State Highway 82 is operating at less than 15 percent of capacity, and State Highway 133 is operating at 75 percent of capacity. The present hazard rating at the rail crossing 0.4 mile south of State Highway 82 is 0.63 accident per five years. The accident rate for State Highway 82 between Glenwood Springs and the junction with State Highway 133 is approximately 1.6 accidents per million miles traveled. About eight school bus routes use State Highways 133 and 82.

The North Thompson Creek mines are located 12 miles southwest of Carbondale on a county road. This road is classed as a primitive road by Pitkin County, but it has been much upgraded to accommodate coal trucks. Trucks with 30-ton capacity trailers are used to transport the coal from the preparation plant at the mines to a rail loading facility near Carbondale (see figure A2-4).

RAILROADS

A branch line of the Denver and Rio Grande Western Railroad running from Glenwood Springs to Aspen is the closest rail facility to the mines. Coal is shipped from the area in unit trains. Two unit trains per week will be necessary to move the coal. (See figure A2-5.)

AIRPORTS

There are several small airports near the mines. Sardy Field near Aspen is the closest commercial airport. It is served by Aspen and Rocky Mountain Airways. Private flights are also served by airports in Carbondale and Glenwood Springs. Walker Field near Grand Junction is the major airport in western Colorado, but it is over 100 miles from the mines.

Livestock Grazing

Cattle are the primary class of livestock grazed on the coal lease area, although some horses and sheep are also grazed. The USFS portion of the allotment produces 350 animal unit months (AUMs), with 290 AUMs designated for cattle, 50 for horses, and 10 for sheep. This is less than the potential of 432 AUMs because some areas are inaccessible and some forage is unsuitable for livestock. The 2,800 acres of private land within the Anschutz lease area are also used primarily for cattle grazing; they provide 196 AUMs (actual use). The range condition and forage value of the private land are approximately equivalent to that of the adjacent USFS land. In all, 280 AUMs are produced annually on the 4,000 acres within the North Thompson Creek mine area.

Recreation

The Anschutz lease site includes 1,200 acres of the White River National Forest. Although there are no recreational facilities in the proposed mining area, the lease area is suitable for dispersed activities, such as hunting, fishing, and hiking. Game species, such as elk, mule deer, blue grouse, and cottontail rabbit, provide opportunities for hunting and viewing. (Refer to the wildlife section of this chapter for the extent of the resource.) The lease site is located within Big Game Management Unit 43, which provided 14,252 hunter days of recreation in 1976, and Small Game Management Unit 54, which provided 21,914 hunter days in 1977; tables A2-7 and A2-8 provide a further breakdown of hunter use.

As discussed in Aquatic Biology, North Thompson Creek has native cutthroat, brook, and rainbow trout populations and is stocked by the DOW with 800 catchable-sized rainbow trout each year. Fishing on North Thompson Creek provides 300 angler days annually.

Through its roadless area review and evaluation (RARE II) program, the USFS has identified a roadless area adjacent to the proposed mining area, overlapping part of the lease that is not presently proposed for development (see map A2-3). The USFS has recommended that the roadless area be managed for dispersed recreation and studied for wilderness status.

The BLM's proposed Thompson Creek Natural Environment Area is adjacent to the lease site on the east. It may also be studied for wilderness status as a roadless area (see map A2-3).

Recreational facilities are located in nearby Glenwood Springs and Carbondale. The world's largest hot springs pool is located in Glenwood Springs. The city also has a swimming pool, ten tennis courts, two nine-hole golf courses, and a softball program. Carbondale recently established a recreation commission, which provides programs in basketball, softball, volleyball, and soccer. The commission also operates tennis and basketball courts, a playground park, and softball diamond. Glenwood Springs and Carbondale provided no recreational use information; however, summer use of facilities has been observed to be high.

Figure A2-4

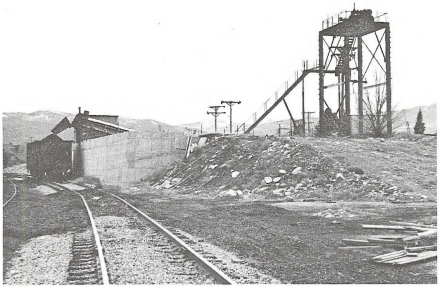


Figure A2-5

Coal from Anschutz' mine is trucked to temporary rail loadout facilities at Carbondale.

TABLE A2-7

BIG GAME HUNTING IN BIG GAME MANAGEMENT UNIT 43

	Deer	Elk	Bear	Mountain Lion	Totals
Hunters	1,237	1,904	127	-	a/
Recreation days b/	4,878	8,508	866	-	14,252

Source: Colorado Division of Wildlife, 1976 Big Game Harvest.

a/ Hunter totals are not provided because hunting and trapping of more than one species are allowed.

b/ All or part of a day.

TABLE A2-8

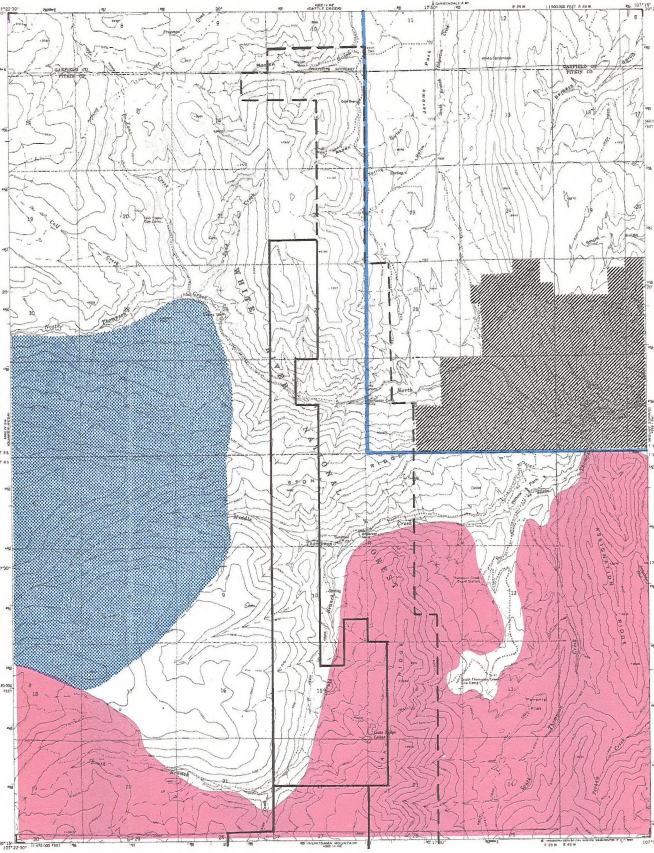
SMALL GAME HUNTING AND TRAPPING IN SMALL GAME MANAGEMENT UNIT 54

Animal	Hunters	Recreation Days a/	Animal	Trappers	Recreation Days a/
Ducks	475	2,078	Badgers	10	289
Geese	29	142	Beavers	17	394
Doves & pigeons	132	433	Bobcats	12	619
Turkeys	38	0	Coyotes	25	732
Grouse	1,516	4,971	Foxes	5	314
Ptarmigans	171	303	Martens	2	68
Rabbits	1,295	6,333	Minks	2	14
Squirrels	169	468	Muskrats	14	377
Coyotes	269	1,576	Raccoons	12	388
Marmots	367	1,095	Skunks	7	206
Porcupines	160	278	Weasels	2	2
Raccoons	29	119			
Prairie dogs	29	168			
Magpies	176	474			
Crows	37	73			
Total	b/	18,511		b/	3,403

Source: Colorado Division of Wildlife, 1975 Colorado Small Game, Furbearer, Varmint Harvest.

a/ All or part of a day.

b/ Hunter totals not provided as hunting and trapping or more than one species is allowed.



Map A2-3. Recreational resources in the area of the proposed Thompson Creek No. 1 and No. 2 mines

Visual Resources

The landform in the vicinity of the North Thompson Creek mines is characterized by steep hills and valleys. The slopes around the mines are intermittently steep or moderately sloping as they ascend from Thompson Creek to the adjacent land heights, such as Stony Ridge. Some rock cliffs occasionally outcrop along the northern slope, but they are not strong visual elements.

Conifers grow on the darker, north-facing slopes, and aspens on the higher, flatter ground, while mountain shrubs are intermixed on all the slopes. The warmer, south-facing slopes support a sparse pinyon-juniper cover.

Occasional vistas of Mt. Sopris and the limited areas of human modification of the landscape help support the overall primitive character of the Thompson Creek area. The dirt access road to the site crosses Jerome Park, a wide valley, which has some agricultural development. The existing Anschutz mines are located in a low spot, which restricts viewing to a small visual area, but they are a major landscape modification along the North Thompson Creek drainage.

The present facilities are located in a temporary VRM Class V (see appendix, volume 3 for VRM class descriptions), which indicates the need for reclamation prior to the landscape's achieving its Class III potential. Figure A2-6 shows the site area.

Socioeconomic Conditions

Demography

The Anschutz mine site is located within Pitkin County, but the only access to the site is through Garfield County and the town of Carbondale, which is approximately 12 miles by gravel road from the mine site. Other communities within the vicinity of the mine site include Glenwood Springs, New Castle, Silt, and Rifle in Garfield County; Basalt in Eagle County; and Aspen in Pitkin County.

Population information on all of these communities is included in table A2-9. The table indicates that the area in and around Carbondale has experienced very rapid growth in the last seven years, much of it as a result of new coal mining in the Coal Basin area of Pitkin County. The growth in recreation, especially skiing in the Aspen area, has also contributed significantly to growth in Carbondale. All other communities in the area have experienced some population growth since 1970. Aspen, Basalt, and Silt have all grown rapidly, primarily because of recreation in Aspen and Basalt and highway construction in Silt.

The declining median age of the population indicates an in-migration of primarily young persons to the area, which is common for recreation-oriented areas. Only New Castle and Rifle have significant concentrations of elderly people.

Community Attitudes and Lifestyle

Communities in the Roaring Fork River Valley (Aspen, Basalt, Carbondale, and Glenwood Springs) have evolved from dependence on a mining and ranching economy to dependence primarily on the recreation industry. In the transition, many younger, well-educated people have migrated into the area from all parts of the country, to take advantage of the recreational opportunities. Residents emphasize preserving the environmental quality of the area, both the recreational value and the quality of life for its inhabitants.

Noise

The North Thompson Creek Mine lies in the middle of a narrow strip of land owned or leased by Anschutz and surrounded by national forest systems land and public lands. There are no residences in the area. A few cow camps on the national forest systems land may be within the range of audibility of surface operations. However, since most of the surface facilities are in a valley with steep wooded sides, horizontal transmission of sound is minimized. Principal noise sources are the mine ventilating systems and coal truck traffic. Current noise levels are approximately 63 decibels (dBA) at 50 feet from the road and 54 dBA at 200 feet from the road. Noise levels for individual trucks at boundaries of federal land are probably less than 55 dBA.

Community Facilities

Many of the towns and cities in Garfield County have either recently expanded the capacity of water and sewage treatment systems or plan to in the near future. (The towns and capacity of the improved systems are shown in table A2-10.) The county and towns cooperate to provide sanitary landfills; only Glenwood Springs provides pickup service. Most of the areas are served by volunteer fire departments. Rifle needs to expand or replace its fire station, police headquarters, library, and city hall. Carbondale needs a new city hall (see figure A2-7). Revenue figures show that Garfield County would be able to provide the necessary facilities.

Housing

The Colorado Division of Housing estimated that total housing stock increased by 29 percent in Garfield County and 105 percent in Pitkin County between 1970 and 1976. In Garfield County, the housing stock increased at a rate similar to the population increase. Also, mobile homes in the county increased from 13 percent of the total housing stock to 19 percent.

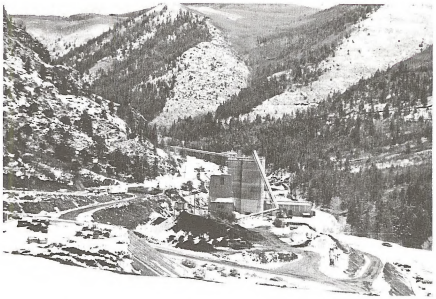


Figure A2-6. The existing Anschutz mine is located in the North Thompson Creek valley, where it dominates a restricted landscape.

TABLE A2-9

POPULATION STATISTICS

Community	Total Population 1970	Total Population 1977	Percent Change 1970-1977	Median Age 1970	Median Age 1977	Percent of Population Over 65 Years 1977
Garfield County:	14,821	18,800	27	30.0	28.4	10
Carbondale	726	1,644	126	-	25.6	5
Glenwood Springs	4,106	4,091	-	35.0	31.0	14
Glenwood Springs Area	8,729	11,109	27	28.3	27.5	8
New Castle	499	543	9	-	30.5	18
Silt	434	859	98	-	28.8	11
New Castle Area	1,976	3,278	66	34.3	28.4	10
Rifle	2,150	2,244	4	33.5	34.1	17
Rifle Area	3,297	3,555	8	32.7	32.0	14
Eagle County:	7,498	10,257*	37	-	-	-
Basalt	419	518*	24	-	-	-
Pitkin County:	6,185	8,765*	42	27.0	-	-
Aspen	2,437	3,346	37	26.4	-	-

Source: U.S. Bureau of the Census, 1970 Population Census, 1977 Special Population Census.

* 1975 figure.

TABLE A2-10

GARFIELD COUNTY: POPULATION CAPACITY OF IMPROVED WATER AND SEWAGE TREATMENT SYSTEMS

Town or City	Water	Sewer
Rifle	5,000	10,000
Silt	1,600	1,600
Glenwood Springs	10,000	14,500
Carbondale	8,000	6,000
Grand Valley	160 taps	130 taps
New Castle	Plans to expand present systems	

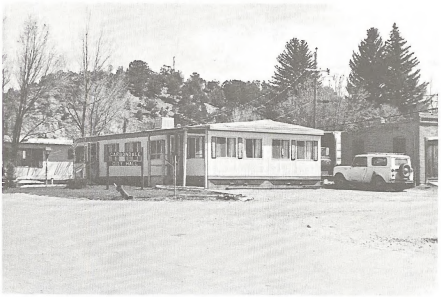


Figure A2-7. Carbondale city hall.

In Pitkin County, the housing stock increased much more rapidly than the total permanent population, indicating the addition of many second homes and condominium units to serve the resort community. Mobile homes in Pitkin County decreased as a percentage of the total housing stock between 1970 and 1976, making it the only county in the ES area where that was the case.

Available housing in the Roaring Fork Valley is very limited. Housing prices, both rentals and sales, are significantly higher in this area than in other parts of the ES area because of its proximity to the major resort town of Aspen.

Education

The Roaring Fork RE-1(J) and the Garfield RE-2 school districts serve the area of Garfield County within the vicinity of the Anschutz site. The Roaring Fork district also includes that portion of Pitkin County where the Anschutz lease is located.

The Roaring Fork School District had 3,206 students in school year 1975-76 and a pupil teacher ratio of 21 to 1. The district operated four elementary schools, three junior high schools, and three high schools and was operating at 80 percent of design capacity.

The Garfield School District had 1,549 students in 1975-76 and a pupil teacher ratio of 18 to 1. The district operates three elementary schools, two junior high schools, and one high school and is at 90 percent of capacity. More detailed information is available in the regional volume; a map of the district boundaries may be found in the appendixes, volume 3.

Health Care

Primary health care for the area is provided by the Aspen Valley Hospital in Aspen and the Valley View Hospital in Glenwood Springs. Both hospitals are presently operating at about 80 percent of capacity. The Clagett Memorial Hospital in Rifle serves the central and western portions of Garfield County. It is presently operating at only 40 percent of capacity. Ambulance service is available from all of the other smaller communities in the area to one of these three hospitals.

Both Glenwood Springs and Aspen have an abnormally high number of physicians for their population sizes. Additional information on health care services in this area can be found in the regional volume, chapter 2, Socioeconomic Conditions.

Employment

The two most important sectors in Pitkin County are services and trade, reflecting the importance of the recreation industry there. Most of the Anschutz employees live in Garfield County, where trade, services, and government are also important. More detailed information about employment in these counties is available in the regional volume. Employment data for individual towns and cities are not available.

Income

Pitkin County, where the Anschutz mine is located, has the highest income levels in the seven-county ES area. In 1974, per capita income was $7,896, well above the state average of $5,514 and the national average of $5,449. Over half of the personal income in the county is generated by two sectors; wholesale and retail trade at 24.9 percent and services at 33.8 percent. This indicates the importance of the tourist and ski industries in the county. Other sectors and the proportion of income produced are contract construction, 13.8 percent; finance, insurance, and real estate, 11.3 percent; government, 8.8 percent; transportation, communication, and public utilities, 4.7 percent; manufacturing, 1.9 percent; agriculture, 0.4 percent; mining, 0.4 percent; and other industries, 0.3 percent.

The road to the Anschutz mine comes from Carbondale in Garfield County. Garfield County has the second highest income level in the ES area, with a 1974 per capita income of $5,106. However, per capita income in Carbondale in 1974 was only $4,049. Average income of Anschutz' mine employees is estimated by the company at $16,600 per year. (The regional volume contains further information about income in the area.)

FUTURE ENVIRONMENT WITHOUT THE PROPOSAL

The following sections describe the possible future environment by 1980, 1985, and 1990 if the M&R plan proposed in chapter 1 is not approved and implemented. They deal only with the resources or land uses described in the preceding sections of chapter 2 which are expected to change in the future.

For the purposes of this analysis, it has been assumed that the North Thompson Creek mining operations will comply with the applicable regulations of 30(CFR): 700. Although the mining operation was not in compliance with the interim regulations published on December 13, 1977, by the May 3, 1978, deadline, it has been assumed that the operation must be in compliance by 1980. In addition, it was assumed that Anschutz will bring the operation into compliance with the requirements of the permanent program in a timely fashion.

If the proposed M&R plan is not implemented, the existing North Thompson Creek mines will continue in operation on private lands until 1993. At that time, the private coal reserves, consisting of an estimated 15 million tons of recoverable coal,

will be exhausted. The production and employment schedules shown in tables A1-2 and A1-3 in chapter 1 will remain largely the same. The existing surface facilities will continue in use unchanged. The unit train loadout facility will be built by 1980 to transport the private coal.

However, the mine layout and mining sequence shown in map A1-2 and discussed in chapter 1 History and Background may have to be redesigned to restrict the operation to private land. As a result, the proportions of coal produced by each mine might be changed, the characteristics of coal created by blending the production from each mine would change, and finally, the prospective market for the coal would change. Anschutz has not submitted information concerning the mining sequence, mine layout, or market if the proposed M&R plan is not implemented.

Air Quality

Emissions from the Proposed Mine

Mining activity at underground coal mines usually produces dust, an air pollutant, in environmentally significant amounts. Dust that is generated within the mine is not considered to have an environmental impact since it is continuously controlled and contained in the mine. However, surface facilities at these mines also generate some dust which is released into the ambient air. Most of the dust is from fugitive emission sources; the term "fugitive" connotes that the dust escapes from an unenclosed surface as a result of wind erosion or mechanical action, as opposed to being released from a stack or process vent.

The potential fugitive dust sources identified at the North Thompson Creek mines include conveyors, transfer points, haul and access roads, and wind erosion of refuse piles. Some common sources of fugitive dust at underground mines are not projected for the Thompson Creek mines: crushing and sizing should produce negligible emissions because a wet process will be used; raw and clean coal will be stored in silos rather than in open storage piles.

The procedure used to estimate emissions from each of the potential sources was to (1) determine the activity rate of the pollution-producing operation, (2) multiply that activity rate by an emission factor based on sampling of similar operations, and (3) reduce the calculated emissions by an appropriate amount to account for control equipment or dust suppression measures to be employed on the operation. Activity rates and control measures were assumed to be same as those described in the proposed M&R plan since Anschutz will still mine 1 million tons per year, using the same surface facilities on the company's private land. Emission factors for individual mining operations were obtained from Colorado Air Pollution Control Division (Colorado APCD 1978) and a recent study of emissions from mining (Axetell 1978).

Table A2-11 presents estimates of fugitive dust emissions at the North Thompson Creek mines from each of the identified sources in 1980, 1985, 1990, and 1993 (end of mine life). These values are annual emissions, even though the activities are not continuous or uniform throughout the year. The estimates are judged to be accurate within a factor of two (Axetell 1978). The emissions in table A2-11 represent initial emission rates (tons per year) of suspended particulate from the operations. Some of these suspended particles fall out of the dust plume after they are emitted. This deposition is discussed further below.

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

Estimated emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), and sulfur oxides (SO_x) are shown in table A2-12. These emissions are based upon rates per mile of travel (emission factors) which would decrease after 1980. In the case of the North Thompson Creek mines, the reduced emission rates will result in substantially lower total emissions in later years of the mines' operation. These emissions are from both employee travel and haul trucks on the road to Carbondale.

The emissions of gaseous pollutants will not result in significant ambient concentrations on or near the proposed mine site, especially since they are distributed uniformly over the 12-mile length of the road.

Annual Average Air Quality

In order to assess the effect of air pollutant emissions on the environment, ambient concentrations of suspended particulate were predicted with an atmospheric dispersion model. The model used to predict average concentrations that will result from the mines' emissions was the Climatological Dispersion Model (CDM) (EPA 1973).

CDM is designed for use in level terrain. This application of CDM is subject to larger error and uncertainty than more routine applications, but it represents the best predictive modeling technique available. Because of the irregular topography at

the proposed site, CDM is really only capable of predicting concentrations in the valleys near where mining emissions occur. The basic CDM model has been modified to incorporate a fallout function to simulate the deposition of the large suspended particulate as it disperses downwind. The fallout rates incorporated in the model were based on sampling data from several western coal mines and are functions of wind speed, atmospheric stability, and particle size.

The following input data are required for CDM: source locations; source emission rates; emission heights; locations where ground-level pollutant concentrations are desired; and frequency of occurrence of each of sixteen wind directions, six wind speeds, and six stability classes. Predicted concentrations are usually accurate within a factor of three.

Since there are no wind data available for the North Thompson Creek area (see Existing Environment), the wind and stability data required for the model were obtained by modifying that from Grand Junction airport to reflect the up-valley/down-valley or east/west orientation at this site. This wind rose was previously shown in figure A2-1 (Existing Environment). Emission data were presented in table A2-11.

Predicted increases in ambient concentrations resulting from Anschutz' private operation in 1980, 1985, and 1990 are shown on map A2-4. According to the isopleths on this map, the mines will increase annual average particulate concentrations by 40 micrograms per cubic meter ($\mu g/m^3$) in only a very small area on the mine site northeast of the preparation plant and parallel to a short section of haul road. Concentrations are predicted to increase by at least 20 $\mu g/m^3$ on both sides of the haul road. Concentrations would decrease rapidly with distance from the haul road. Concentrations of 10 $\mu g/m^3$ are predicted at distances of 0.7 to 1.5 miles from the haul road.

The predicted ambient concentrations produced by the mines is less than the primary and secondary air quality standards for suspended particulate of 75 and 60 $\mu g/m^3$, respectively. In a very limited area, it will exceed the total air quality increment of 19 $\mu g/m^3$ allowable for Class II areas under the federal law concerning prevention of significant deterioration (PSD). However, coal mines are not a source category requiring analysis under current PSD regulations.

Maximum Short-term Air Quality

The dispersion model used to predict maximum 24-hour particulate concentrations was a subroutine of the CDM model which employs a statistical prediction method to relate average and maximum air pollutant concentrations. Because of this procedure, the predicted maximum 24-hour concentrations at different locations on and near the mines fall in the same relative order as the predicted annual average concentrations. The highest 24-hour concentrations of 159 $\mu g/m^3$ and 132 $\mu g/m^3$ are predicted to occur northeast of the preparation plant and near the haul road (at the location of the 40 $\mu g/m^3$ isopleth on map A2-4). Maximum concentrations will decrease rapidly with distance from the haul road. At 1 mile on either side of the road, predicted maximum concentrations are in the range of 30 to 40 $\mu g/m^3$.

These concentrations are less than the 24-hour primary air quality standard of 260 $\mu g/m^3$, but in one case exceed the secondary standard of 150 $\mu g/m^3$. However, the area with the very high short-term concentrations is quite small.

Visibility

The addition of particulates into the atmosphere as a result of emissions from the mines will reduce visibility in the area. A calculation of the degree of visibility reduction depends on several parameters for which data are not available, the most important being size distribution of the particles. However, a rough approximation of visibility can be made based on suspended particulate concentrations. A relationship between these two variables in rural west-central Colorado has been empirically determined by Ettinger and Royer (1972) as shown in figure A2-8.

It should be emphasized that this relationship was developed with uniform atmospheric particulate concentrations, not near a plume of fugitive dust containing relatively large diameter particles. Also, it does not consider visibility reductions due to precipitation. Therefore, the equation is more likely to predict visual range over an averaging period of a year than for a short-term period such as 24 hours.

As indicated on map A2-4, particulate concentrations will be increased to a distance of at least 4 miles north of the surface facilities. Along a line of sight to the north, concentrations would be increased an average of about 20 $\mu g/m^3$ over this distance. Using the equation above and a background particulate concentration of 24 $\mu g/m^3$, the estimated reduction in visual range at the mines as a result of mining emissions will be about 18 miles on an annual basis. However, along any other line of sight (east, west, or south) concentrations will be increased an average of about 8 $\mu g/m^3$ over the same distance, and therefore visibility reduction will be about 9 miles.

TABLE A2-11

FUGITIVE DUST EMISSIONS AT THE PROPOSED THOMPSON CREEK MINE SITE

Emission source	Emissions, ton/yr 1980	1985	1990 & EML
Conveyor - 7 sections	100.6	100.6	100.6
Transfer points - 5 points	215.6	215.6	215.6
Preparation plant - wet process	neg	neg	neg
Truck loadout	0.1	0.1	0.1
Open storage - raw coal	neg	neg	neg
- clean coal	neg	neg	neg
Haul roads - coal	2402.6	2402.6	2402.6
- refuse	8.5	8.5	8.5
Access roads	906.2	906.2	906.2
Exposed areas - refuse	1.9	1.9	1.9
- rail (off site)	12.2	12.2	12.2
TOTAL	3647.7	3647.7	3647.7

TABLE A2-12

EMISSIONS OF GASEOUS POLLUTANTS FROM THE PROPOSED THOMPSON CREEK MINE SITE

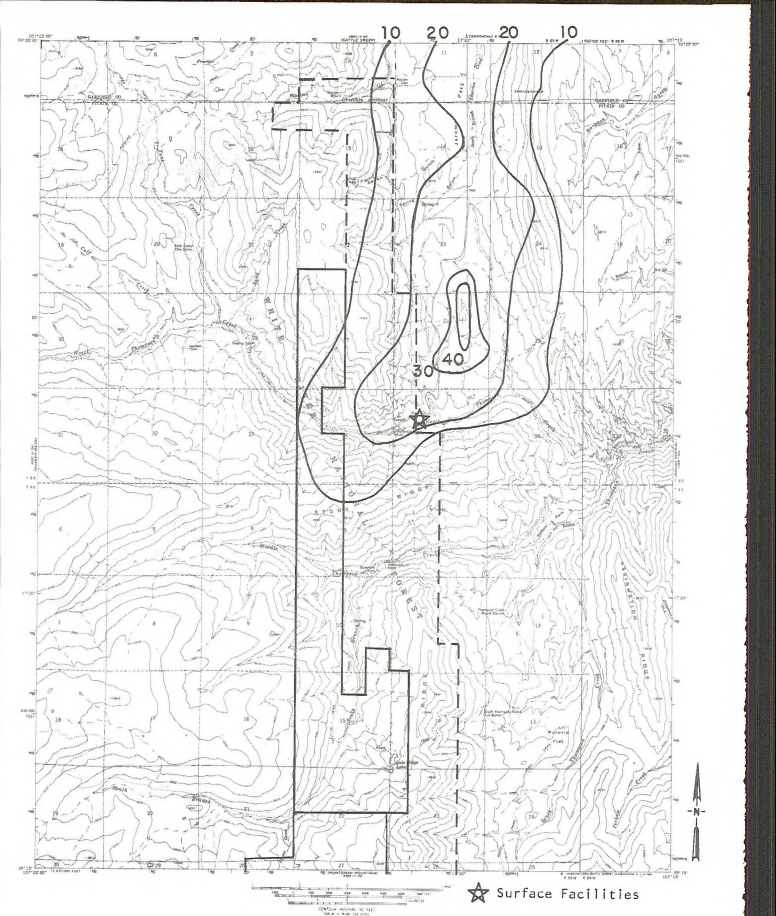
Year	Total emissions from vehicles, ton/yr CO	HC	NO_x	SO_x
1980	92.0	8.3	14.3	2.8
1985	55.3	5.3	14.8	2.8
1990	32.1	3.4	8.7	2.8

$$L_V = \frac{24}{0.2 + 0.007\ M}, \text{ where}$$

L_V = Average visual range, miles

M = Average particulate concentration (micrograms per cubic meter)

Figure A2-8 Relationship between visibility and suspended particulate concentrations in rural west-central Colorado (Ettinger and Royal 1972).



Map A2-4. Predicted increases in ambient concentrations in 1980, 1985, and 1990 (micrograms per cubic meter)

Geologic and Geographic Setting

Although it is uncertain that Anschutz would use the same mine layout as that submitted in the M&R plan, the impacts which would result from mining the private reserves would be similar to those that will occur with layout in map A1-2, chapter 1.

The retreat of longwall panels is scheduled to begin in 1980 at the extreme north end of the No. 3 Mine and at the extreme south end of the No. 1 Mine. Panels will be retreated toward North Thompson Creek. Surface subsidence from retreat mining will be minimal until the area underlying North Thompson Creek is mined. Because of the shallow overburden underlying the stream, approximately 6.5 feet of vertical subsidence could occur from mining of Panel No. 4 in the No. 3 Mine (scheduled to be mined after 1982) and Panel No. 2 in the No. 1 Mine (scheduled to be mined in 1981-82). The rest of the longwall panels lying south of the slope entries in both mines cross North Thompson Creek, and retreat mining of these panels could cause as much as 5 feet of vertical subsidence. In general, the amount of subsidence will decrease as panels on the eastern part of the property (near the outcrop) are mined out and the depth of overburden increases.

As a result of the vertical subsidence described above, tension cracks can be expected to migrate through the overburden and appear on the surface. These cracks, which occur when the pillar is not strong enough to support the entire weight of the overburden, will orient parallel or perpendicular to the length of the pillar. For example, tension cracks could be expected to trend approximately N 13 degrees W (parallel to the barrier pillars left to protect the strike entries) or N 77 degrees E (at 90 degrees to the strike entries). The tension cracks would be most prominent along North Thompson Creek, although they might extend for long distances both to the north and south.

Because of the depth of colluvium or soil throughout the property, tension cracks could be rapidly erased by the effects of erosion. In some cases, cracks may never appear at the surface because of the bridging effect of these materials. However, in time circular depression pits may form through the collapse of the soil into the underlying crack. The actual formation of a depression pit may be rapid and may occur without warning.

In addition, subsidence induced by mining could increase air circulation at depth through fracturing. Increased circulation of the air at depth would allow spontaneous heating and combustion of the coal beds including the seam being mined and all of the overlying seams. The burning of coal beds in the Bowie area has been found to have occurred naturally under overburden depths as great as 600 feet (Louis Gaspar, Coors Beer Company, oral communication). Dunrud and Osterwald (1978) have noted that these fires are common in operational coal mines in Colorado and Utah. Once begun fires frequently continue to burn for years after the mines have been sealed. In some cases danger may exist that the fire will reach the surface and cause wildfires there. A danger also exists that any fire in an underground mine may spread and consume large areas of adjacent coal reserves.

Paleontology

As a result of coal mining activities, unauthorized collection, and vandalism, an undetermined number of fossils will be lost for scientific research, public education (interpretive programs), etc. On the other hand, as a result of development, some fossil materials will also be exposed for scientific examination and collection.

Mineral Resources

Without the proposed action, Anschutz will mine 15.5 million tons of coal from private lands.

Water Resources

Ground Water

Mining of the private coal in conjunction with ongoing operations will eventually reach a maximum depth of about 1,500 feet below the level of North Thompson Creek before reaching federal coal. Ground water entering the mines will increase with increasing depth similar to the manner in which increasing the drawdown imposed on a well will increase its yield. The rate of inflow to the mines and, thus, the volume of water that must be pumped to the surface and consumed or otherwise disposed of, depends on the hydraulic characteristics of the rocks composing the Mesaverde formation in this area, the lateral extent of fracturing associated with longwall mining, the amount of subsidence in the steeply dipping beds, and the opportunity for ground-water recharge at the surface.

Experience derived from other mines indicates that ground-water inflow to the No. 1 and No. 3 mines will not increase uniformly with increasing depth, but will increase abruptly upon interception of fractures or other permeable zones, followed by periods of declining flows as local dewatering occurs until the next surge is encountered. The net effect, however, will be to progressively increase the average inflow with increasing mine depth. Based on the inflow to the current operations, average water yield should be no less than 450 gpm (about 1 cfs) at the maximum depth penetrated. Extensive fracturing associated with subsidence could increase this inflow to as much as 2 cfs with even higher rates for short periods.

Reduction of inflow to the mines with time as encompassing rocks are dewatered should be only minor. Assuming an average specific yield of only 0.01 for these rocks, an estimated pumping rate of 0.7 cfs (315 gpm) would be required over a period of fifteen years (the projected life of private coal reserves) to dewater only the rocks that lie vertically above the mined areas. Lateral movement of ground water from adjacent rocks and surface recharge would increase this amount accordingly.

Initially, surplus water should be minimal and presumably could be discharged to North Thompson Creek with no increase in current impacts. Assuming that 0.5 cfs (225 gpm) could be used in coal processing and other mining operations at full production, excess water pumped from the mines will probably average 1.0 cfs (450 gpm) by 1990. Consumption of water in excess of 0.2622 cfs (118 gpm) would, of course, require that Anschutz obtain additional water rights on the mine discharge.

Water pumped from the mines will probably be a sodium, sulfate, bicarbonate type with only minor amounts of calcium or magnesium ions. Dissolved-solids concentration should be about 1,200 to 1,400 mg/l, pH should be 7.0 to 7.5, and no excessive concentrations of iron, manganese, heavy metals, or trace elements are expected.

On completion of mining, the dewatered area will once again become saturated over a period of several years, and ground-water discharge eventually will resume from the mine area to North Thompson Creek at slightly more than the premining rate because of additional ground-water recharge as a result of increased fracturing and possible local subsidence at the surface. Some increase in dissolved-solids concentration may also occur because of added leaching in the shallow fractured rocks as water percolates downward to the saturated zone. The changes are expected to be relatively insignificant in relation to the surface-water system, however, and should have little or no measurable effect on the quantity or quality of flow in North Thompson Creek.

Surface Water

The ongoing mining operation will not intentionally divert any water from North Thompson Creek nor obstruct the flow in any way over the life of the mines. Removal of the coal beneath the channel by longwall methods, however, will probably induce fracturing to the surface at a minimum and could result in actual subsidence athwart the stream channel. If so, the effect would be to intercept and divert runoff into the mines with consequent increase in the volume of water pumped from the mines. Significant flow losses would be temporary, however, as sedimentation and the sealing action of clay particles in suspension would soon clog any openings that might occur. Nevertheless, low flows could be largely or entirely intercepted by newly formed fractures for a period sufficiently long to severely impact aquatic biology downstream.

Excess water pumped from the mines presents a potentially serious impact to the environment. Pitkin County opposes any discharge from the mine to North Thompson Creek and expects Anschutz to stop all discharge in the near future, either by using the mine discharge in their mining and processing operations or by piping the excess to an evaporation pond. Those solutions to the problem might be feasible for the next year or two, but by the early 1980s the amount of water in excess of consumptive uses will probably require an evaporation pond with a surface area of several hundred acres. Net evaporation (total evaporation less annual precipitation) in this area probably does not exceed 25 inches. An average discharge of 1 cfs (450 gpm), therefore, would require an evaporation pond with a surface area of more than 350 acres. Construction of a pond or ponds having that large a surface area would create a serious environmental impact in itself.

Use of excess mine water for irrigation would be impractical because of the high sodium content. The sodium absorption ratio of this water would probably exceed 50, and the dissolved-solids concentration would be unsuitable for most soil conditions.

Discharge of the excess water to North Thompson Creek would greatly alter the chemical characteristics of the stream during low flow. The water type would change from a calcium, magnesium, bicarbonate type to a sodium, sulfate, bicarbonate type with an increase in dissolved solids concentration to more than 1,000 mg/l. Sodium would probably exceed 200 mg/l and sulfate may exceed 300 mg/l. Added dissolved solids load to the river net would probably increase to about 650 tons annually by 1985 and to as much as 1,300 tons annually by 1990. The effect could be to increase the dissolved-solids concentration in the Colorado River below Hoover Dam by about 0.03 mg/l (0.004 percent) by 1985 and about 0.5 mg/l (0.007 percent) by 1990. These impacts, however, would continue only during the life of the mining operation; thereafter, stream flow and water-quality characteristics should return to essentially pre-mining conditions within a few years.

The increased population in the Carbondale and Glenwood Springs areas in Garfield County as a result of the Anschutz operations is estimated to be 1,250 persons by 1980; 1,250 persons by 1985; and 1,750 persons by 1990 (Socioeconomic Conditions). Assuming an average water use of 200 gallons per

day per person (gal/day/person), sewage effluent of 60 gal/day/person, and an increase in dissolved solids of 200 mg/l in sewage effluent, water and sewage treatment requirements and the increase in dissolved solids load to the river are summarized in table A2-13. The recently expanded water and sewage treatment facilities at Carbondale will be more than adequate to accommodate this increased population.

Based on the foregoing assumptions and derived values, the small increase in salt load contributed to the Roaring Fork and Colorado Rivers by the added sewage effluent attributable to increased population should have no significant impact on aquatic biology downstream. The inferred effect on the salinity of the Colorado River is summarized in table A2-14.

Erosion and Sedimentation

Ongoing operations at Anschutz must comply with provisions of 30(CFR): 717.17(a), which limit total suspended solids in runoff from surface areas disturbed by activities associated with underground mining to 45 mg/l maximum allowable, except for discharge from a precipitation event larger than 10-year/24-hour recurrence interval. The average of daily values for 30 consecutive discharge days cannot exceed 30 mg/l. Sediment control structures installed to meet these effluent standards at the mine complex reportedly were designed to safely discharge runoff from a precipitation event with a 25-year recurrence interval. Current operations, however, channel all runoff from the disturbed areas and runoff intercepted by the access road through two slurry ponds that have a combined capacity of only 2.2 ac-ft. Thus, runoff in excess of 0.2 inch, which is probably less than a 10-year flood, will necessitate overflow from the slurry ponds into North Thompson Creek. Because of the comparatively low specific gravity of coal slurry, any spill from the ponds could carry large amounts of fine-grained coal particles into the stream. Even assuming compliance with effluent limitations established by 30(CFR): 717:17(a), under the present site drainage system severe pollution of North Thompson Creek by coal washings could occur in response to all storms exceeding a 10-year/24-hour recurrence interval.

A short-term increase in sediment yield to the river net will occur from construction of housing and related urbanization to accommodate the increased population. Approximately 106 acres will be disturbed by 1980, 106 acres by 1985, and 149 acres by 1990. It is estimated that sediment yield to the river net would be increased about 1 ton per acre disturbed for the first one to two years after construction. Thereafter, sediment yield would decrease to about half the predisturbance rate. The initial increase in sediment yield, therefore, should be more than offset by the long-term reduction in sediment yield over the life of the structures. Any temporal adverse or beneficial impacts to the river net from this comparatively small change in sediment yield should be insignificant.

Soils

Ongoing operations without the proposed action would not increase the acres of disturbance at the mine site. However, approximately 40 acres of new disturbance would occur for construction of a loadout facility in Carbondale.

Revegetation should be complete on approximately 20 acres of the mine site. Due to the low quality and quantity of existing topsoil, the high amount of coal spoil and waste material on the surface, and the often steep slopes, successful revegetation will no doubt require repeated efforts.

Off-site disturbance due to mine-related population increases will have occurred on about 68 acres. Any temporary increase in erosion should not extend more than a few years at most beyond initial disturbance.

Vegetation

Anschutz would continue to use the existing facilities to mine private coal. The only additional surface disturbance will be from the construction of a rail loadout facility at Carbondale, which will disturb 40 acres of irrigated and nonirrigated hayland and pasture.

Anschutz will be required to revegetate the 46 acres of existing disturbance at the North Thompson Creek mines upon abandonment, and will be required to revegetate the rail loadout site if that is abandoned. Specific revegetation measures that will be required by the federal coal mining regulations are stated in 30(CFR): 717.20, and 30(CFR): 211.40, 211.41, and 211.62, in the *Federal Register* (vol. 42, no. 239 and vol. 41, no. 96). These regulations cover Anschutz' responsibility and length of liability for revegetation. They state that "a diverse vegetative cover capable of self-regeneration and plant succession and at least equal in density to the natural vegetation, shall be established on regraded and other affected lands" (30[CFR]: 211.40[a][13][i]).

Insufficient precipitation is not expected to be a serious problem which will limit revegetation at the North Thompson Creek mine site. That successful revegetation can be achieved at the 15-inch per year annual precipitation level has been proven in the region. Colorado Westmoreland's Orchard Valley Mine has revegetated a site with nearly the same altitude and annual precipitation as the North Thompson Creek mines. However, sophisticated

TABLE A2-13

WATER AND SEWAGE TREATMENT REQUIREMENTS AND SALT LOAD RETURNED TO THE ROARING FORK RIVER

Item	1980	1985	1990
Population Increase (persons)	1,250	1,250	1,750
Required Increase in Treated Water Supply (ac-ft/yr)	280	280	390
Required Increase in Sewage Treated (ac-ft/yr)	80	80	120
Consumptive Use (initial use less sewage effluent)(ac-ft/yr)	200	200	270
Increased Salt Load Returned to the River (tons/yr)	23	23	32

TABLE A2-14

INFERRED EFFECT OF ANSCHUTZ OPERATIONS ON THE SALINITY OF THE COLORADO RIVER BELOW HOOVER DAM

Item	1980		1985		1910	
	(mg/l)	(percent)	(mg/l)	(percent)	(mg/l)	(percent)
Increase in dissolved-solids concentration attributable to increased population	0.012	0.002	0.012	0.0017	0.016	0.0024
Increase in dissolved-solids concentration if excess mine effluent is discharged to North Thompson Creek	--	--	0.012	0.0017	0.023	0.0034
Increase in dissolved-solids concentration from combined effects of increased population and effluent	0.012	0.002	0.023	0.0034	0.039	0.0057

revegetation methods involving soil preparation to correct chemical imbalances and deficiencies adverse to plant growth, weed control, mulching, and the use of adapted plant species will be required for successful revegetation. Problems which may hinder revegetation efforts at the North Thompson Creek mines are a low quality and quantity of topsoil, a high amount of coal spoil and waste material on the surface, steep slopes in some areas, and weed infestation.

Urban expansion due to population increases as a result of operation of the North Thompson Creek mines will result in the disturbance of an estimated 106 acres by 1980, increasing to 149 acres by 1990. It is probable that much of this disturbance will be on agricultural land surrounding existing population centers (see Livestock Grazing).

Increased population in the area will result in some additional disturbance of native vegetation, particularly by off-road vehicle (ORV) use (see Recreation). This disturbance would lessen the productivity of native vegetation for livestock and wildlife forage. The problem will be most serious in low-altitude Mancos shale hills and in alpine areas above timberline.

Wildlife

Currently 46 acres of habitat have been disturbed, and no further disturbances are projected through 1990. This 46 acres will be lost to wildlife for the life of the mine. It would normally support a winter population of 6 deer per year (based on 18.5 deer days of use per acre), and 18 elk per year. (See table A2-15 for the total number of deer and elk the area would support.) Increased human and mechanical activity will also reduce mule deer and elk use by an average of 50 percent on an adjacent 240 acres (assuming that impacts would be progressively less, the farther the habitat is from the disturbance).

The railroad loadout in Carbondale on 40 acres of agricultural land will primarily affect the small game and those nongame species associated with rural and agricultural settings, such as song birds, skunks, pheasant, and mourning dove.

It is difficult to predict to what extent 5 to 6.5 feet of subsidence might affect wildlife because of lack of information about the effects of subsidence. In general, it can be expected that animals will avoid using an area which is subsiding, because of its instability. Wildlife will gradually develop trails through the areas.

Deer on winter range will be disturbed by increased vehicle traffic through the area (260 vehicles per day plus 286 coal truck trips per day). The possibility of deer/vehicle collisions will increase in proportion to the increases in vehicle traffic (see regional chapter 4).

Temporary reductions of downstream flows (see Water Resources) will reduce the quantity and quality of habitat available to aquatic mammals and species associated with riparian habitats. This habitat reduction could cause relocation of the animals and birds and subsequent death of these animals if suitable habitats are not available or are overcrowded already.

Increased human population due to increased employment will cause expansion of urban areas onto agricultural lands and some crucial winter range; increased vehicular traffic, resulting in an increase in vehicle/animal collisions; and increased recreational use of the area, causing an additional stress on the animals and increasing legal and illegal harvest of animals.

Aquatic Biology

Water yield from the mines due to ground-water inflow will increase from 0.5 cfs in 1985 to 1.0 to possibly 2.0 cfs in 1990. This rate of inflow will remain fairly constant for the operating life of the mine. The water will be discharged at approximately 1 cfs to the North Fork of Thompson Creek at the mine site. Thompson Creek flows at 1 cfs during low flow months and a historical low flow of 0.09 has been recorded. Discharge of mine ground water during low flow period on North Thompson Creek will drastically affect the chemical water quality of the stream. The water type would change from a calcium, magnesium, bicarbonate type to a sodium, sulfate, bicarbonate type. The mine discharge water would have a dissolved-solids concentration of 1,200 to 1,400 mg/l which would increase the dissolved-solids concentration of North Thompson in low flow periods to 1,000 mg/l. Sulfate concentrations would increase to over 300 mg/l and sodium concentrations would increase to over 200 mg/l. This would have a serious effect on the aquatic ecosystem of North Thompson Creek. In the United States, of waters that support a good mixed fish fauna, 5 percent have a dissolved-solids concentration below 72 mg/l, 50 percent have a dissolved-solids concentration below 169 mg/l, and 75 percent of the waters have a dissolved-solids concentration below 400 mg/l (W. B. Hart, P. Doudoroff, and J. Greenbank). Similar surveys indicate that in good fishery waters in the United States, 5 percent have a sodium content of less than 6 mg/l and a sulfate content of less than 11 mg/l, 50 percent have a sodium content less than 10 mg/l and a sulfate content of less than 32 mg/l, and 95 percent have a sodium content less than 85 mg/l and a sulfate content less than 90 mg/l. The levels of dissolved-

TABLE A2-15

EFFECTS ON WILDLIFE

Year	Total Disturbed Acres	Number of Animals that These Acres Could Support					Additional Acres Disturbed	Additional Animals that Could be Supported		
		DDA	D	EDA	E	WH		D 50%	E 50%	WH 50%
1977	46	18.5	6	23	18	-	240	14	47	-
1980	86	18.5	6	23	18	-	240	14	47	-
1985	86	18.5	6	23	18	-	240	14	47	-
1990	86	18.5	6	23	18	-	240	14	47	-

Note: DDA = deer days per acre; EDA = elk days per acre; D = deer; E = elk; WH = wild horses.

solids concentration, sulfate and sodium in North Thompson Creek during low flow periods will probably be high enough to limit the reproduction of trout species in the stream. This will cause a loss of the stream fishery except for the summer stocking of hatchery fish. There will not be a problem of acid mine drainage or metal toxicity to aquatic organisms because of the high pH and buffering capacity of the waters.

Upon cessation of the mining operation, water quality in North Thompson will return to premining conditions and the stream ecosystem will recover within several years. Very minor increases in long-term ground-water discharge to the stream will have no effect on the aquatic ecosystem.

Subsidence or fracturing may temporarily totally divert the stream flow into the mine. If the water flow is cut off for more than a week, the majority of the trout in the stream will perish. Aquatic insects will survive slightly longer. Alteration of the stream flow will be temporary and fish and aquatic insect populations will begin to recover quickly, but two to three years will be required for total recovery. Recruitment from upstream areas and hatchery stocking would enhance stream recovery.

With the present size and design of the drainage and retention pond system the probability of a precipitation event occurring which would cause retention pond overflow is very high. Such an event will carry low specific gravity, fine-grained coal sediments and other liquid and solid mine waste into North Thompson Creek. The impact of such an event will be very severe. Fine sediment particles will cement the gravel stream bottom, destroying fish spawning sites and suffocating the majority of the aquatic insect life. Physical abrasion on gill membranes of fish could cause outright mortalities. Habitat for trout and cold water aquatic insects will be degraded to such an extent by a single pond overflow event that it will take several years for population levels and habitat conditions to recover. The Crystal River, the Roaring Fork River, and the Colorado River downstream support some of Colorado's best trout fisheries and the introduction of any quantity of coal sediments or waste will be extremely detrimental to these fisheries.

Increases in water consumption and surface disturbance due to a human population increase of 1,750 by 1990 will not have a measurable affect on the aquatic habitat and fishery resource. Fishing pressure on the Crystal River will increase with approximately 350 new fishermen living in the area.

Cultural Resources

Archeology

Surface disturbance from mine activities and rail loadout consrtruction could result in the destruction or displacement of archeological values. However, the 46 acres on which the mine-site facilities are located have already been disturbed, and the rail loadout facility near Carbondale would be located on 40 acres of land already disturbed by agricultural activity. With the natural integrity of the area destroyed, further disturbance of archeological values would be minimal.

Although subsidence of the mine property is expected to be slight (6.5 feet at most; see Topography), any alteration of the surface from slumping or breaking could result in the displacement or damage of archeological values.

Although, no archeological sites have been identified in the lease area, sites have been located in the surrounding areas, indicating prehistoric use of the area. Therefore, increased population in Pitkin County and the upgrading of the roads into the lease area could contribute to an increase in vandalism to as yet undiscovered sites. With controlled access, however, vandalism within the site-specific area should remain a minimal impact, although the presence of 320 mine-associated workers (by 1980 and on through 1990) would mean increased exposure of existing archeological values to public passage.

Historic Resources

Nearby historic sites, including the coke ovens and a cemetary at Marion Gulch and the Aspen and Western Railroad line from North Thompson Creek, would not be directly affected by mining. However, due to increased traffic and the high visibility of the sites, there could be an increase in visitor use and vandalism associated with such use.

Land Use

The North Thompson Creek mine site will continue to be characterized by industrial development through 1990. The general area will also continue to be used for livestock grazing and terrestrial wildlife habitat. The fisheries habitat may be severly degraded through 1990 (see Aquatic Biology), resulting in a greatly decreased quality of fishing on North Thompson Creek below the mines. Increased coal-related vehicle use on the access road may interfere with sightseeing along the road and with recreational access to lands beyond the mine site. The final designations given to the USFS RARE II wilderness area south of the mines and the BLM proposed Thompson Creek Natural Envi-

ronment Area to the east may restrict vehicular recreational use of those areas.

Mid-Continent will continue to mine in the Coal Basin area through 1990. No activity is currently projected for the eleven inactive federal leases in the vicinity of the Anschutz' mines, but diligent development and continuous operations requirements will require these leases to be developed before 1986.

Recreation would continue to be a major human land use in the general area, which could ultimately overtax the area's natural and recreational potential. The USFS proposed plan for the Thompson Creek area within the White River National Forest calls for various degrees of development in the area, such as timber management, recreational development, and energy development (Draft Environmental Statement: Thompson Creek Land Use Plan 1976). Development will likely take place over a large portion of the Thompson Creek area because of its energy potential, and if energy consumption and development trends continue. Once the demand for energy is established, a chain of events is set in motion which commits resources to meet these priority public demands. Once these types of commitments are made, the area will usually not be the same. These assumptions are probably true for the larger region around the North Thompson Creek areas as well.

Urban expansion due to population increases resulting from Anschutz employment will disturb an estimated 106 acres by 1980 and 149 acres by 1990. Most of this disturbance is likely to occur on agricultural land surrounding existing population centers. Overall population in Garfield County is expected to grow at a rapid rate to 33,000 people in 1980; 36,650 people in 1985; and 45,100 in 1990, primarily in western and central Garfield County as a result of the developing oil shale industry. Rifle and Glenwood Springs would have to absorb most of this growth. Most of the growth would convert agricultural lands and possibly some crucial winter wildlife range to housing areas and other forms of urban development. To a large extent, the location of this urban development would depend on future land use planning and zoning in Garfield County.

Transportation

HIGHWAYS

Increased population in the Carbondale area resulting from the Anschutz mines will increase traffic on State Highways 82 and 133. Drops in service levels will occur more frequently and for longer periods. Accidents will increase approximately 10 percent because of greater vehicle miles traveled. Conflicts between mine traffic and school bus traffic may occur.

Access to the mines is on a county road with very little public traffic, although the road is occasionally used as a sightseeing route. At full production, employee traffic will reach 260 vehicles per day. Most congestion will be just before and after shift changes. Trucks hauling coal to the rail loading facilities will make 286 trips a day. Since most of this would occur during an estimated twelve-hour hauling shift, it is equivalent to one truck every three minutes. The increased use could increase the possibility of accidents for recreational users of the road.

RAILROADS

Shipping the coal on the Denver and Rio Grande Western Railroad will increase congestion on the railroad's facilities. At full production, about two unit trains per week hauling 10,000 tons will be required to move the coal. The small increase in rail traffic will not increase the grade crossing hazard rate significantly (less than 0.5 accident per five years). Congestion will increase in eastern Colorado cities where trains with coal from the Anschutz mines will meet trains from other coal producing areas.

AIRLINES

Passenger traffic at local airports will increase as a result of growth in the area. However, because of the small size of the airports and the distance from the Anschutz mines, this increase will be minimal.

Livestock

Urban expansion due to population increases resulting from operation of the Thompson Creek mines will result in the disturbance of an estimated 106 acres by 1980, increasing to 149 acres by 1990. It is probable that much of this disturbance will be on irrigated and nonirrigated hayland and pasture around existing population centers. These lands are used as livestock wintering areas and the hay harvested from them in the summer is used to feed livestock during winter. The loss of them may result in hardship on some livestock operators.

Recreation

The influx of additional population due to the Anschutz mines and the subsequently increased demand for recreational opportunities could have an impact on existing recreational resources and facilities. The 1976 Colorado Comprehensive Outdoor Recreation Plan identifies a need for several types of recreational facilities in this state planning region, particularly community facilities; therefore, increased use will result in overuse of the present facilities. This overuse will lead to their deteriora-

tion and lower their capacity to provide enjoyable recreation. The community facilities needed to meet the increased demand and prevent overuse are projected in table A2-16, which shows a need for 2.6 acres of active/improved park land by 1980, 2.6 acres by 1985, and 4.3 acres by 1990. Capital investments to provide these facilities are also projected in table A2-16.

The increased demand for dispersed recreation opportunities (e.g., hunting, hiking, ORV) should not adversely affect the recreation resource; however, concentrated use, such as an ORV rally, could lead to vegetative deterioration and lower the recreational experience on that site. BLM is currently in the process of determining an open, restricted, or closed designation for its public lands which should help to control ORV use on those lands. Increased use of recreational facilities (such as USFS camp grounds) would lead to increased maintenance costs for the managing agencies. The extent of increased cost is not known.

The county road leading to the Anschutz mines is presently used as a sightseeing route and as access to lands beyond the mine site. The aesthetic quality along the roadway will be reduced due to the increased coal-related use (260 vehicle trips by employees and 286 coal truck trips per day by the fifth year). The increased use and associated road deterioration will also increase probability of accidents for recreational users on this route.

The quality of fishing will be greatly reduced on North Thompson Creek throughout the life of the mines as a result of increased levels of dissolved-solids concentration, sulfates, sodium, and coal sediments, as well as possible temporary losses of waterflow due to subsidence or fracturing. Fishing may also be reduced in the Crystal, Roaring Fork, and Colorado rivers due to introduction of coal sediments (see Aquatic Biology).

The USFS has a RARE II wilderness study area just south of the proposed mining area, and BLM has the proposed Thompson Creek Natural Environment Area adjacent on the east which will also be a wilderness study area. The final designations given to these areas will affect recreation there. Should wilderness designations be given, travel and recreation will be restricted to nonmotorized forms. Further development of Anschutz' mines should not significantly affect these areas.

Visual Resources

The North Thompson Creek site is already characterized by industrial development, with coal silos, portal, surface facilities, parking, etc., so that the proposed increase of coal production and employment at the Anschutz mines will be an expansion of the existing activity. The location of the site in the stream bottom restricts visual access to occasional viewers passing by on the county road.

The terracing of the refuse site will create a parallel, horizontal plane configuration which will be unique for the existing visual composition of the area; therefore, the disposal site will not blend with the landform, especially with color and vegetation differences. The severity of this contrast could be mitigated by revegetation. (See the appendix, volume 3 for visual contrast rating.)

During the operation phase, coal-hauling trucks will make 286 trips per day between the mines and Carbondale, which will reduce the scenic quality of Jerome Park and lessen its recreational appeal. Road dust and other forms of air pollution will reduce visibility, especially for the valley north of the mine site. This haze layer will degrade the visual clarity of the local air (see Air Quality).

Socioeconomic Conditions

Demography

Garfield County is projected to grow at a rapid rate to 33,000 people in 1980; 36,650 people in 1985; and 45,100 people in 1990, primarily because of the developing oil shale industry. Population growth from oil shale development, however, would occur mostly in western and central Garfield County, especially in and around the Rifle area. Glenwood Springs, because of its ability to absorb more population growth than other communities in the area, would also grow significantly from oil shale development.

Development of the North Thompson Creek mines will increase Anschutz' total employment from the 112 workers employed in 1977 to about 320 employees by 1980. It is anticipated that almost all of these new employees will reside in Garfield County, in either Carbondale or Glenwood Springs. These new employees will generate a total population growth in Garfield County of 1,250 persons by 1980, and 1985 and 1,750 persons by 1990. This population, directly attributable to Anschutz, will account for only about 5.4 percent of the total projected population growth in Garfield County by 1990. It will, however, contribute significantly to population growth in the southern part of the county, particularly in the Carbondale area.

Community Attitudes and Lifestyles

Coal mining has been a way of life in the Carbondale area for a long time. More recently, the area has been influenced by increased tourism and the expanding recreation industry in nearby Aspen. These two industries, although different in orientation, have co-existed well in the past. It is expected that coal mining and recreation can remain compatible, even as both continue to expand.

TABLE A2-16

ANSCHUTZ: ADDITIONAL COMMUNITY RECREATION FACILITIES DEMAND

	1980	1985	1990
Population growth	800	800	1,300
Active/improved parks a/ (3.3 acres per 1,000)	2.6	2.6	4.3
Capital investment ($66,666 per 1,000)	$53,333	$53,333	$86,666

Source: Bickert, Browne, Coddington, and Associates, Inc., Boomtown Financing Study, Vol. II (July 1976).

a/ Ballfields, tennis courts, playgrounds, etc.

Noise

Truck traffic probably will be the main noise source for off-site locations. Under full operation the equivalent noise level (L_{eq}) values at distances of 50 and 200 feet from the road would be 68 to 59 dBA respectively during periods of truck operation. At these levels there may be some disturbance of speech.

There will be construction noise during the development of Anschutz' unit-train loadout facility about 2.5 miles north of Carbondale.

Community Facilities and Services

The community facility requirements associated with the development of the Anschutz mines are listed in table A2-17. These figures were derived in a similar manner to those contained in the regional volume, Socioeconomic Conditions, chapter 4. These figures do not take into consideration the substantial increase in water and sewer utility capacity which has recently been added in Carbondale. Providing that much of the new population associated with Anschutz resides in Carbondale, there will be adequate water and sewer facilities in place to provide for their needs. It should be kept in mind that the community is relying on increased revenues from that population growth to pay for the new facilities.

Pitkin County will receive considerable property tax revenue from this mine. Of the mine facilities, only the train loadout is located in Garfield County. Property taxes on the mine facility will be $377,220 per year. Property taxes on coal mined will be $26,840 in 1980, and $109,540 in 1985 and 1990.

Garfield County will receive increased tax revenues from the loadout facilities and from population growth in the county. County-wide revenues from property taxes on new homes and businesses, the loadout, sales tax, and water and sewer service fees will be $568,450 in 1980, $696,330 in 1985, and $949,760 in 1990. Table A2-18 shows how these revenues will be distributed among the various recipients in the county. Even though the Anschutz mines are located in Pitkin County they are within the boundaries of the Roaring Fork School District, which will receive $787,020 in 1980; $832,680 in 1985; and $1,244,130 in 1990.

Comparing these revenues with the yearly operating expenses and amortized capital expenses ($402,440 combined) shows that Garfield County, as a whole, will be capable of providing for the expected increase in local government costs from locally derived revenues. These figures do not, however, consider the unavoidable lag period which exists between the time that new population arrives and the first ad valorem property revenues are realized.

Housing

The demand for new housing as a result of the population growth in Garfield County attributed to the Anschutz mines is listed in table A2-19. These figures are based on the assumption that average household size would be 3 persons and that a constant mix of 65 percent single-family units, 25 percent mobile-home units, and 10 percent multifamily units would be maintained.

The projected new housing requirements associated with Anschutz amounts to 5 percent of the total projected new housing requirements for the county by 1990. About 106 acres of vacant land will be necessary to support community expansion requirements by 1980 and 1985 and 149 acres by 1990.

At the present time, some of the housing in the Carbondale area is occupied by service workers from the Aspen area. An increased demand for housing in Carbondale on the part of coal mine employees will cause the price of housing to rise, displacing these service workers as well as others on low or fixed incomes.

Education

The expected increase in school-aged population due to development of the Anschutz mines is shown in table A2-20, along with the increase in school capital requirements and operating costs expected from that population increase.

The Roaring Fork School District RE-1(J), in Garfield County will absorb most of these increased costs. The district, because it includes that portion of Pitkin County where the Anschutz lease is located, will benefit from the $13.3 million in assessed valuation that is expected to be derived from the Anschutz mines and the railroad loadout facilities. Combined with an additional $3.5 million projected increase in residential and commercial assessed valuation, the Anschutz development will increase the district's bonding capacity by about $3.4 million by 1990. That increase in school bonding capacity is more than adequate to compensate for projected capital requirements.

Health Care

Population growth from the Anschutz mine development is expected to increase the demand for health care services in Garfield County. The nearest hospital and most of the physicians in the vicinity are located in Glenwood Springs, and they will be relied upon to provide for increased demand for health care. The health care services available in Glenwood Springs will also be called upon to provide for oil shale-related population growth in the county. In order to meet the total future requirements for health care services, it will be necessary

TABLE A2-17

REQUIREMENTS FOR COMMUNITY FACILITIES IN GARFIELD COUNTY

	Water Treatment	Sewage Treatment	Police Protection	Fire Protection	Streets and Roads	General Government	Libraries	Total Costs
Physical Plant Requirements	0.35 mgd	0.11 mgd	1 vehicle & 700 sq. ft.	1 vehicle & 1750 sq. ft.	41 acres	440 sq. ft. space	960 sq. ft. and 5250 volumes	
Capital Costs a/	$306,092	$346,500	$54,900	$145,000	$1,321,020	$28,340	$70,950	$2,272,800
Operating Costs a/								
1980	$ 15,650 per year	$ 12,080 per year	$50,000 per year	-	$ 28,130 per year	$40,180 per year	-	$ 146,040 per year
1985	$ 15,650 per year	$ 12,080 per year	$50,000 per year	-	$ 28,130 per year	$40,180 per year	-	$ 146,040 per year
1990	$ 21,910 per year	$ 16,910 per year	$70,000 per year	-	$ 39,770 per year	$55,700 per year	-	$ 204,290 per year

Note: mgd = million gallons per day; sq. ft. = square feet.
a/ Constant 1978 dollars.

TABLE A2-18

DISTRIBUTION OF ANSCHUTZ PROPERTY TAX REVENUE TO GARFIELD COUNTY

Year	County	Municipalities	Special Districts	School Districts
1980	$294,590	$ 43,810	$19,710	$ 737,020
1985	369,010	91,560	25,360	922,680
1990	497,650	123,460	34,190	1,244,130

TABLE A2- 19

ANSCHUTZ: NEW HOUSING REQUIREMENTS IN GARFIELD COUNTY

Year	Single Family Units	Mobile Homes	Multi-Family Units	Total Units
1980	208	167	42	417
1985	271	104	42	417
1990	379	146	58	583

TABLE A2- 20

ANSCHUTZ: SCHOOL REQUIREMENTS IN GARFIELD COUNTY

	1980	1985	1990
Total Increase in Students	306	306	420
Facility Requirements	42,840 sq.ft.	42,840 sq.ft.	58,800 sq.ft.
Facility Costs	$1,927,800	$1,927,800	$2,646,000
Operating and Maintenance Costs	$371,380 per year	$376,380 per year	$516,600 per year

Note: sq.ft. = square feet.

to expand the facilities in Glenwood Springs, or build additional facilities in the Carbondale area.

Employment

Even though the Anschutz mines are located in Pitkin County, the social and economic effects of development are expected to occur in Garfield County, particularly the Carbondale area. By 1980 the mines will be at full employment of 320 persons. These people will generate jobs in other sectors resulting in an increase in total employment in the county of 637 persons by 1980 and 1985 and 875 persons by 1990. By 1990 the Anschutz mines will cause an 11.2 percent increase in total employment over the 1977 level.

Income

The average income of mine personnel as outlined by Anschutz will be $16,600 annually, as compared with the 1975 median family incomes of $11,565 in Garfield County and $15,643 in Pitkin County. The total payroll of the Anschutz operation, with 320 employees, will be $5,312,000 at peak production. The multiplier effect (explained in the regional volume) will result in a total regional income increase of $8,075,200.

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This mining and reclamation plan (M&R plan) was submitted for review prior to promulgation of interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), and it does not fully reflect the requirements of the regulations. However, in this environmental statement (ES) the applicable interim regulations are included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of the interim regulations. The M&R plan will not be considered for approval by the Department of the Interior until Anschutz Coal Corporation has redesigned it to incorporate the requirements of 30(CFR): 211 and 30(CFR): 700. Therefore, to the extent possible at this time, impacts have been analyzed using the assumption that the M&R plan will comply with the appropriate provisions of the Surface Mining Control and Reclamation Act. Impacts are analyzed at three time points: 1980, 1985, and 1990.

Air Quality

Implementation of the proposed M&R plan would continue all of the effects described in chapter 2, Future without the Proposed Action, through the year 2008.

Geologic and Geographic Setting

Topography

Topographic impacts to the North Thompson Creek mine property from the proposed action would be minimal. Surface facilities supporting the operation are either completed or currently under construction. Therefore, the only sources of further topographic impacts would be long-term use of the refuse disposal area and surface subsidence.

Long-term use of the phase I refuse disposal area would produce a small area of steepened slopes approaching 33 degrees along the downhill section of the area and a larger area of gentle backslopes. The refuse area occupies 10 acres or 0.25 percent of the North Thompson Creek mine property.

As the mining operation moves down dip and onto federal lease C-08173 the overburden thickness increases to a minimum of nearly 900 feet. At that depth a maximum vertical subsidence of 3.5 feet could occur as the first panels on the federal lease are mined. Subsidence produced by retreat mining further down dip would be expected to be even smaller. At depths of more than 2,000 feet, mining would be expected to produce less than 1 vertical foot of subsidence.

One of the most significant impacts of subsidence, normally, is the migration of tension cracks through the overburden to the surface. However, because of the overburden thickness on the federal lease and the thicknesses of colluvial and soil materials, the appearance of tension cracks on the surface of the federal lease area would be unlikely.

Paleontology

Plant, invertebrate, and vertebrate fossil materials would be destroyed, disturbed, or removed as a result of coal mining activities, unauthorized collection, and vandalism. The primary impact would probably result directly from the mining operation. Given the overall character of the stratigraphic column, it is probable that some fossils would be destroyed. However, this stratigraphic section is only moderately likely to yield significant fossils when compared with other parts of the ES area.

As a result of the above disturbance, an undetermined number of fossils would be lost for scientific research, public education (interpretive programs), etc. On the other hand, as a result of development, some fossil materials would also be exposed for scientific examination and collection. Due to lack of data and accepted criteria for determining significance, the importance of these impacts cannot presently be assessed.

Mineral Resources

Anschutz estimates that 33 million tons of coal (a nonrenewable mineral resource) would be recovered from the Thompson Creek No. 1 and No.3 mines over a 30-year period: 12.5 million tons from the No. 3 mine and 5 million tons from the No. 1 mine, all from lease C-08173, plus 15.5 million tons of private coal from the No. 1 mine. The metallurgical grade coal is expected to be exported from the area to western markets.

Subsidence resulting from the development of the A seam, through the Thompson Creek No. 1 Mine, would have no effect on the Anderson seam, developed through the Thompson Creek No. 3 Mine, because of the 800-foot stratigraphic distance between the two seams. Subsidence after mining of the Anderson seam would have little effect on the Sunshine seam because the Sunshine seam lies 60 feet below the Anderson.

The longwall method of mining would result in the recovery of approximately 80 percent of the Anderson and A seams(the two seams presently projected for mining). The overall recovery would be approximately 50 percent of the total reserves on the property, although all reserves are not presently projected to be mined. The longwall mining method is the most efficient method to recover the leased coal.

Water Resources

Under Anschutz's proposed M&R plan, the ongoing mining operations on private coal would continue onto federal coal with no change in production rates, support facilities, or labor force. Impacts stemming from mining the federal coal, therefore, should be essentially the same as the effects of mining private coal described in chapter 2 under Future Environment without the Proposal. Under the proposal, these impacts would be continued for an additional period of approximately fifteen years.

Possibly, mining to a greater depth to remove the federal coal could increase ground-water inflow to the mine to as much as 2 cubic feet per second (cfs). If so, excess water pumped to the surface and not used in the mining operation could be as much as 1.5 cfs, increasing accordingly the magnitude of the impacts previously described. Any such increase would occur after 1990.

On completion of mining and removal of all surface facilities, ground-water and surface-water occurrence should return to approximately pre-mining conditions. The only notable exception would be the reclaimed refuse disposal areas, only the first of which is currently identified. When the sediment control impoundment downstream from that disposal area is removed following reclamation, erosion on the steeper slopes initiated by high-intensity storms could significantly increase sediment yield to the nearby North Thompson Creek. The Office of Surface Mining (OSM) recognizes this hazard and is currently considering special performance standards for fills in areas of low annual precipitation or special topographic setting.

Soils

Implementation of the proposed action would result in continued operation of the mine surface facilities through the year 2008. The only significant difference in soil impacts due to the extended mine life would result from the need for one or more additional refuse disposal areas. This need would probably not come until after 1990.

Vegetation

Anschutz plans to use existing mine portals and surface facilities, and no additional surface disturbance would occur as a result of implementation of the proposed M&R plan.

Anschutz would be required to revegetate the 46 acres of existing disturbance at the Thompson Creek site upon abandonment of the mines, as discussed in the vegetation section of chapter 2, Future without the Proposed Action. However, mine life wuld be approximately fifteen years longer if the M&R plan is implemented. In addition, if other refuse areas are developed because of the longer mine plan, Anschutz would be required to revegetate these areas as well.

Endangered or Threatened Species

No threatened or endangered vegetation species would be impacted by the proposed action.

Wildlife

As a result of the proposed action, loss of 46 acres as wildlife habitat due to surface facilities would continue for an additional 15 years. These areas could have supported 6 deer and 18 elk annually. Reduced wildlife use on an additional adjacent 240 acres would continue as well. Increased disturbance of deer on winter range and increased possibility of deer/vehicle collisions would also continue.

Endangered or Threatened Species

No endangered or threatened terrestrial wildlife species would be impacted by the proposed action.

Aquatic Biology

The proposed action would continue all of the effects described in chapter 2, Future Without the Proposed Action, through the year 2008. In addition, ground-water discharge to North Thompson Creek could increase to 1.5 cfs, increasing accordingly the magnitude of the impacts previously described due to the effects of increased dissolved-solids concentration, SO_4, and Na during low-flow periods. These impacts would occur after 1990.

When mining is completed and all facilities are removed, the stream flow regime would very closely resemble pre-mining conditions. Water quality would again be good, and the aquatic habitat would support a diversity of aquatic insects and trout species. Acid mine drainage or toxicity problems from leaching would not occur.

Following the removal of all coal mining and processing structures and the revegetation of refuse piles and disturbed areas according to regulations, the aquatic habitat of North Thompson Creek would support a normal assemblage of cold water biota. The success of the revegetation efforts in limiting the erosion of areas containing coal refuse would be critical to the health of the North Thompson Creek ecosystem. If revegetation cannot adequately control refuse pile sedimentation then the aquatic habitat would suffer continuing impacts.

Endangered or Threatened Species

No endangered or threatened aquatic species would be impacted by the proposed action.

Cultural Resources

Archeology

The major impact to archeological values due to the proposed action would result from subsidence. Although subsidence of the mine property is expected to be slight (3.5 feet at most; see Topography), any alteration of the surface from slumping or breaking could result in the displacement or damage of archeological values.

A Class III survey will be required in subsidence impact areas (see chapter 4, Mitigating Measure 3) and in areas where any additional disturbance is planned. Compliance procedures as outlined in the Historic Preservation Act of 1966, as amended, in accordance with 36(CFR): 800, will be met prior to the approval of the proposed action.

In addition, approval and implementation of the proposed M&R plan would extend Anschutz' mining operations through 2008. Therefore, archeological values would continue to be exposed to public passage and possible vandalism beyond 1990.

Land Use

Impacts on land use if the M&R plan is approved would be an extension of the land uses related to Anschutz' private coal development, as discussed in chapter 2, Future Environment without the Proposed Action, through 2008.

Transportation

Transportation impacts due to mining federal coal would be an extension through 2008 of the effects of mining private coal, as outlined in chapter 2, Future Environment without the Proposed Action.

Livestock Grazing

There would be no loss of livestock forage at the mine site due to the proposed action, since no additional surface disturbance would occur.

Recreation

Fishing opportunities could continue to be adversely impacted after 1990 due to increased dissolved-solids concentration, sulfates, and sodium discharged into North Thompson Creek as a result of the proposed action. There would be no additional impacts to recreation from the proposed action.

Impacts on the nearby USFS RARE II wilderness study area and the BLM Thompson Creek Natural Environment Area as a result of mining federal coal should not be singnificantly increased from the efects of mining private coal.

Visual Resources

There would be no additional impacts on visual resources as a result of the proposed action, except that the existing VRM Class V would be continued through 2008.

Socioeconomic Conditions

Approving and implementing Anschutz' proposed M&R plan would extend the socioeconomic effects of private development through 2008. The primary impact of this extension would be continued coal-related employment and continued tax revenues beyond 1990. As a result, Anschutz would become a more stable part of the economic community in the area.

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

The mitigating measures proposed in this chapter are measures which will be taken to minimize or eliminate specific adverse impacts identified in chapter 3 which would result from approval and implementation of Anschutz Coal Corporation's mining and reclamation (M&R) plan. They do not include federal regulations, such as 30(CFR): 700, which are considered to be requirements with which the M&R plan will have to comply before it can be considered for approval. Neither do they include any mitigating measures already developed by Anschutz as part of the M&R plan; these have been described and analyzed as part of the proposed project in chapters 1 and 3.

All mitigating measures proposed in this chapter must be "real and committed," by definition in Bureau of Land Management (BLM) Manual 1792. "Real" means that the measures must be legally enforceable and actually workable for the area and situation being assessed. "Committed" means that the agency requiring the measures (in this case, BLM) will ensure that they become part of the authorizing document and will take the necessary steps to see that the measures are in fact implemented as part of the proposed project. Thus, if Anschutz' M&R plan is approved, all measures proposed in this chapter will be required in addition to the federal, state, and county requirements discussed in chapter 1, Authorizing Actions.

In the case of mitigating measures for air quality, those measures identified below are for major potential air pollution sources at the mine. However, Best Available Control Technology (BACT) will be required on all significant fugitive dust sources identified in table A2-11, chapter 2, Future Environment Without the Proposal. Accordingly, additional controls beyond those specified below may be required by the U.S. Environmental Protection Agency in its review for prevention of significant deterioration (PSD) or by the Office of Surface Mining in the air quality analysis of its permit review. The controls required herein as mitigating measures are BACT for those sources, but BACT may not be specified on all sources identified at the proposed mines if air quality impact is judged to be mitigated.

Any additional reasonable measures for alleviating impacts of the proposed action which would change the design of the proposal, which could cause major impacts of their own, or which cannot be considered real and committed are analyzed as alternatives in chapter 8.

North Thompson Creek Mitigating Measure 1

A surfactant will be added to the water spray used on the conveyors and transfer points.

In the M&R plan, Anschutz proposes that the conveyors and transfer points be controlled by water spray, with an estimated 50 percent efficiency. By adding a surfactant to the spray system for longer-duration dust suppression, an estimated 95 percent efficiency can be achieved. The use of a surfactant would reduce emissions from these two sources by 212 tons per year.

North Thompson Creek Mitigating Measure 2

The 10-mile section of existing unpaved haul road/access road between the mines and Carbondale will be paved or treated with an appropriate stabilization chemical.

The 10-mile section of unpaved road would be watered frequently under the proposed M&R plan, with an estimated 50 percent efficiency. If the road is treated with an appropriate stabilization chemical, efficiency would improve to about 85 percent. The 10-mile section of road would emit 3,172 tons per year with watering alone, 952 tons per year with chemical stabilization.

North Thompson Creek Mitigating Measure 3

Prior to the approval of the proposed action a concurrence of approval will be developed by the BLM, USFS, and Anschutz to outline Anschutz' responsibility for the protection of cultural resources. Anschutz will provide for a Class III cultural inventory on any additional areas proposed for surface disturbance and will allow for work

stoppage and compliance should archeological resources be identified after the proposed action has been initiated.

An archeological survey will be required in areas likely to be impacted by surface subsidence. Due to the unpredictibility of subsidence and the lack of information available concerning the effects of subsidence on archeological sites, an overburden of 300 feet or less will be used as a parameter to define potential impact areas to archeological values. Cracks and breaks in the surface are known to occur rarely with overburdens of more than 300 feet (Morgan 1978, Personal Communication). Anschutz will be required to define areas with an overburden of 300 feet or less and will provide for archeological survey of these areas. Archeological sites located by these surveys will be mitigated prior to any disturbance and future monitoring of these sites would provide valuable information concerning subsidence and its effect on archeological sites.

Identification, evaluation, and preservation of data from archeological sites before potentially damaging actions would mitigate the loss of archeological resources. The results of the Class III survey, as a 100 percent surface inventory of the impact areas, are considered to be representative of the archeological values in that area. The efficiency of the Class III survey as an identification process would depend on topography, vegetation, and past land use on each site. These factors would account for the possibility that hidden and subsurface sites would remain undetected and unaccounted for in developing any further necessary mitigating actions.

Any archeological values which are located and evaluated through this survey could be preserved through one or more of the following mitigating measures, depending upon the significance of a site: (1) avoidance of the site through redesign of the project; (2) descriptive and photographic records, or surface collecting; or (3) excavation according to a specific research design or as a salvage effort.

Collection and excavation are only partial mitigations. While they preserve artifacts which might otherwise be destroyed, the in-place value of those artifacts is lost. Destruction of the site would mean the loss of information which might otherwise be gained by further techniques and interpretive methods.

Should archeological sites be identified in the survey effort and determined eligible for the National Register as part of the archeological district or as individual sites, compliance procedures required by Section 106 of the 1966 National Historic Preservation Act, amended 1976, and outlined in 36(CFR): 800.4-9, will be met.

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Chapter 5 discusses unavoidable adverse impacts which would be caused by the approval and implementation of Anschutz Coal Corporation's proposed M&R plan for the North Thompson Creek mines. These impacts include the residual impacts after application of any mitigating measures discussed in chapter 4.

Overall, approval of the proposed M&R plan would prolong adverse impacts stemming from the ongoing operations for an additional period of about fifteen years, or until the year 2008. Adverse impacts which would be continued as a result of approval of the M&R plan are as follows.

Air Quality

Annual average concentrations for the ES study area were predicted with the model discussed in chapter 3, substituting the reduced emissions obtained with the mitigating measures developed in chapter 4. (Table A5-1 presents the total annual expected emissions for 1980, 1985, and 1990 with and without mitigating measures 1 and 2.) Since the conveyor, transfer points, and haul/access roads represent the major proportion (91 percent) of emissions and because these sources are spread out over such a large area, a total impact reduction of 67 percent would be realized over the entire area. Maximum 24-hour impacts would decrease to 52.5 micrograms per cubic meter ($\mu g/m^3$), while maximum annual impacts would be reduced to 15.5 $\mu g/m^3$.

Geologic and Geographic Setting

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot presently be assessed because of the lack of data and evaluatory criteria.

Mineral Resources

The mining of the coal under the Anschutz proposal would deplete a nonrenewable energy deposit. Production of the estimated 33 million tons of recoverable private and federal coal under the Anschutz proposal would represent approximately 9.9 percent of the total reserves over 42 inches thick of the Carbondale field. Because of the nature of underground caving and resultant high contamination from mining, future recovery of the unrecoverable 50 percent of the Anderson and A seams reserves is not considered feasible under present mining technology, and therefore those coal reserves would be lost.

Water Resources

Excess water pumped from the mines must be discharged into North Thompson Creek or stored in impoundments and evaporated. Discharge of the excess water to North Thompson Creek would probably increase the dissolved solids fivefold during periods of low flow and change the water type sufficiently to have serious deleterious effects on aquatic biology downstream. The salt load added to the river net would probably increase to as much as 650 tons annually, increasing the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.02 milligrams per line (mg/l) or about 0.003 percent. Evaporation of the excess water would require large impoundments with a total surface area of several hundred acres. Such impoundments must be located off the lease area and would create serious environmental impacts in themselves.

The increased population would continue consumptive use of water at about 275 acre-feet of water per year with approximately 32 tons of salts added to the river net in sewage effluent. The effect would be to increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.016 mg/l or about 0.002 percent.

Locally severe pollution of North Thompson Creek by coal refuse could occur in response to all storms exceeding a 10-year/24-hour recurrence interval.

Soils

Existing disturbance on approximately 46 acres at the mine site would cause continued erosion and a deterioration of soil structure and biological activity, leading to a temporary reduction in soil pro-

ductivity. Any such reduction could prolong the efforts necessary to achieve successful reclamation.

Vegetation

Extending the mine life beyond 1990 would mean that complete revegetation of some disturbed areas (facility sites) would not occur until after 2008.

Wildlife

As the result of surface facilities, wildlife habitat on 46 acres would be lost through 2008. These areas could have supported six deer and eighteen elk annually. Reduced wildlife use would occur on an additional adjacent 240 acres through 2008.

Aquatic Biology

Continuing the mine water discharge of 1.0 to 1.5 cfs would seriously reduce the trout fishery in North Thompson Creek. This impact would be unavoidable unless Anschutz builds and operates an adequate evaporation reservoir.

Any precipitation event greater than a 10-year/24-hour storm event would wash large amounts of fine-grained coal sediment through and out of the retention ponds into North Thompson Creek. The majority of the aquatic biota would be lost, and it would take several years for complete habitat recovery. Similar severe losses of aquatic insects and fish habitat would occur downstream in the Crystal River, but the extent of the impact would depend on the size and location of the storm event.

Cultural Resources

Archeology

Unavoidable adverse impacts could occur by damage to unknown sites from surface disturbance due to subsidence and through loss of information as a result of vandalism and illegal collecting.

Historic Resources

Those sites located in the vicinity of the mine (Union Mine Coke Ovens, Aspen and Western Railroad, etc.) would be impacted by vandalism and visitor use.

Land Use

Transportation

Traffic on the road to the mine could reach 260 trips by employees and 286 coal truck trips per day through 2008. Rail traffic and congestion of two trains per week would also continue through 2008.

Recreation

The lowering of the scenic quality along the coal haulage route and the increased hazards to recreational users on this route would continue through 2008.

Visual Resources

Plant and refuse areas would remain apparent in the landscape for the life of the mine.

TABLE A5-1

TOTAL ANNUAL PARTICULATE EMISSIONS

(ton/yr)

Study year	Without mitigating measures	With mitigating measures	Percent reduction
1980	3631	1199	67
1985	3631	1199	67
1990	3631	1199	67

CHAPTER 6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 33 million tons of coal would result in short-term and long-term alteration of natural resources and the human environment.

There would be the following alterations over the short term, a period beginning with on-site construction and ending with end of mine life (about 2008) and post-mining reclamation:

1. An estimated 33 million tons of coal would be exported to the west for metallurgical use.

2. There would be a continued loss of soil and vegetative productivity on 86 acres through 2008.

3. Wildlife habitat on 46 acres, which would have supported 6 deer and 18 elk annually, would continue to be lost through 2008.

4. Impacts stemming from ongoing mining operations would be prolonged through 2008. These include a change in water type and possibly a fivefold increase in dissolved-solids concentrations during periods of low flow if excess water pumped from the mines is discharged into North Thompson Creek. Evaporation of the excess water would require constuction of large impoundments offsite having a total surface area of several hundred acres. Such impoundments would create serious environmental impacts in themselves. The increased population would continue consumptive use of about 275 acre-feet of water per year with approximately 32 tons of salts added to the river net in sewage effluent. The combined effect of the increased population and discharge of excess water from the mines into the river net would be to continue the increase in dissolved-solids concentration in the Colorado River below Hoover Dam of as much as 0.04 mg/l (0.006 percent) through the life of the mine.

5. Rail traffic and congestion would increase by two trains per week as a result of private development, and these increases would be prolonged through 2008.

6. Plant and refuse areas would remain visible in the landscape through 2008.

7. The socioeconomic effects of Anschutz' private development, particularly continued coal-related employment and tax revenues would be continued through 2008.

8. Impacts stemming from ongoing operations would be prolonged through 2008. These include an increase in the level of concentration by a maximum of 16 micrograms per cubic meter ($\mu g/m^3$) in a small area on-site, and 1 to 5 $\mu g/m^3$ surrounding the mine site and along the haul road. Based on these concentrations, total annual average concentrations are predicted to reach a maximum of 40 $\mu g/m^3$. The predicted concentrations are well below the primary and secondary air quality standards for suspended particulates of 75 and 60 $\mu g/m^3$, respectively.

9. There would be an increase in noise levels in the area 2 to 3 miles northwest of Carbondale during the construction of a unit train loading facility. Equivalent noise levels along the road between the mine and the loading facility would increase by 5 decibels due primarily to heavy truck traffic.

10. The trout fishery in the stream would be lost over the short term if discharges of ground water are not mitigated by the construction of an evaporation reservoir system. Overflows from the retention ponds during storm events larger than 10-year/24-hour would cause losses of the aquatic habitat in North Thompson Creek and possibly in the Crystal River and downstream.

Residual effects of mining (after post-mining reclamation) on long-term productivity would be as follows:

1. An undetermined number of uninventoried exposed and unexposed fossil resources would be impaired or destroyed.

2. An unquantifiable gain in knowledge would result from surveys and exposure of fossil resources which might never have been found without development.

3. An estimated 33 million tons of coal, a nonrenewable energy resource, would be depleted after 2008.

4. On completion of mining and reclamation, ground-water and surface-water occurrence should return to approximately premining condi-

tions over a period of several years. A slight increase in ground-water discharge to North Thompson Creek may occur as a result of increased ground-water recharge caused by fracturing associated with subsidence, but the change should have little or no measurable effect on the quantity or quality of flow in North Thompson Creek.

5. Surface flows would approximate premining conditions, and the aquatic ecosystem would recover within several years. Retention ponds would be removed and successful revegetation would stabilize sedimentation rates. Natural high flows would eventually flush North Thompson Creek and a natural association of aquatic biota would return.

6. Surface construction, subsidence, and vandalism would disturb or destroy an unquantifiable number of nonrenewable cultural resources.

7. Archeological survey and excavation could provide gains in understanding of prehistoric use in the area.

8. Those historic sites located in the vicinity of the mine (Union Mine Coke Ovens, Aspen and Western Railroad, etc.) would be impacted by vandalism and visitor use.

9. Anschutz would be required by federal regulations to revegetate the disturbed portions of the lease area. If sophisticated techniques to promote revegetation are used, Anschutz should be able to revegetate the area successfully, so that it would be available for wildlife, recreational, or other appropriate uses determined by the managing agencies

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Approximately 33 million tons of coal would be recovered from the Anschutz mines. About 33 million tons would be lost due to current mining methods.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing machinery and buildings would not be recycled and thus would be lost.

An undetermined number of uninventoried fossils would be lost or disturbed.

Soil and vegetative production would be irretrievably lost on 86 acres for the life of the mine. If revegetation is successful, this loss would not be irreversible.

Wildlife habitat on 46 acres, which could have supported 6 deer and 18 elk per year, would be irretrievably lost for the life of the mine. If revegetation is successful, this loss would not be irreversible.

Anything other than in-place preservation of archeological artifacts involves an irreversible, irretrievable commitment of the resource. Damage from surface disturbance or vandalism would result in a permanent loss of information and would remove archeological values from future research considerations.

Those historic sites in the vicinity of the mine (Union Mine Coke Ovens, Aspen and Western Railroad, etc.) could suffer irreversible damage by vandalism.

During low-flow months, North Thompson Creek would be vulnerable to loss of fisheries due to changes in water quality. If the mines continue to discharge up to 1.0 cubic foot per second, the stream aquatic habitat would be degraded by increased TDS, Na, and SO_4. Occasional increases in turbidity in the stream from old coal spoils piles and from surface runoff from facilities and mine roads would decrease the productivity of aquatic insects and trout species.

A refuse water evaporation reservoir has been proposed and if it is built it would eliminate direct discharge of mine water to the stream. This would return the aquatic habitat to a more normal condition. The potential for extensive degradation of North Thompson Creek from retention structure overflow would exist as long as the facilities remain on the site. Once mining has ceased, surface flows would approximate premining conditions, and the aquatic ecosystem would recover within several years.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

Pursuant to implied covenants of both the federal mineral leasing laws and the existing lease agreements, the Department of the Interior is obligated to respond to a legitimate application to conduct mining operations on a valid lease, provided that all terms and conditions thereunder have been met. The Department's action with regard to Anschutz Coal Corporation's mining and reclamation (M&R) plan for the North Thompson Creek No. 1 and No. 3 mines may be approval as proposed, rejection on various environmental or other grounds, approval or rejection in part, or approval subject to such additional requirements or modifications as the Department may impose under existing laws and regulations. The Department may also defer decision pending submittal of additional data, completion of required studies, or for other specific reasons. If there are serious environmental concerns as to the coal development, the Department may prevent further development of the leases by exercising the Secretary's exchange authority as to the federal coal rights, or seeking congressional action to cancel federal leases involved.

Development of alternative sources of energy, energy conservation, federal development of the coal, and emphasis on coal development in other regions of the United States are more appropriate for consideration on a program rather than a regional basis. These evaluations were made in the previous coal programmatic statement (U.S. Department of the Interior 1975) and will be updated and revised as necessary in the new coal programmatic statement now under way (to be completed in 1979).

Anschutz M&R plan for the North Thompson Creek mines has not been reviewed for compliance with the interim regulations 30(CFR): 700 required under Sections 502 and 503 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (PL 95-87), and it does not fully reflect the requirements of the interim regulations. The M&R plan will be returned to the applicant for revision in accordance with the appropriate federal regulations. When it is resubmitted to the Office of Surface Mining (OSM), it will be evaluated for compliance with all appropriate federal regulations by OSM in conjunction with the U.S. Geological Survey (USGS). In addition, the Bureau of Land Management (BLM) must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA.

APPROVAL AS PROPOSED

The Department has the choice of approving the M&R plan as proposed. However, as pointed out above, Anschutz' M&R plan has not been reviewed for compliance with the interim regulations. Therefore, it cannot be considered for approval until it has been revised to comply with all appropriate federal regulations.

REJECTION ON ENVIRONMENTAL OR OTHER GROUNDS

The Department may reject any M&R plan that does not meet the prescriptions of applicable law and regulations under the Department's authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly differently designed course of action by the lessee (operator). In addition, BLM must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA. Except when an M&R plan does not comply with existing regulations, the Department cannot under present circumstances reject the proposed plans to the extent that a de facto cancellation of a lease results unless the Secretary seeks and obtains additional authority from Congress.

Rejection of Anschutz Coal Corporation's proposed M&R plan would result in no additional environmental impacts from coal mining on the federal leased lands. Since these lands are public lands and national forest systems land, surface use would be governed by BLM and U.S. Forest Service (USFS) policy and management guidelines and decisions. Anschutz could submit a new M&R plan, challenge the rejection, or abandon development of the lease. Should Anschutz submit a new M&R plan, that plan would require both environmental assessment and review for compliance with applicable regulations. It is very probable that the company would still mine 15.5 million tons of coal through 1990 from its private coal (5,326 acres)

since no federal action would be required. Coal from both private and federal reserves under the M&R plan is intended to supply 33 million tons of coal to western metallurgical markets. The 15.5 million tons produced from private reserves would supply only half of these markets. Therefore, other coal would have to be acquired, which would create a shortage for other coal markets. The effects on other resources of mining private coal would be the same as discussed in chapter 2, Future Environment Without the Proposal.

APPROVAL OR REJECTION IN PART

The Department has the choice of approving or rejecting part of a particular M&R plan, based on projected adverse environmental impacts.

Restrict Development on Existing Leases

The subject leases convey the right to develop, produce, and market the federal coal resource thereon if all other terms and conditions have been met by the lessee. In general, the Department does not possess the authority to arbitrarily constrict development if all other requirements of the lease have been met. However, various measures that may tend to restrict development may be taken by the Department at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations (for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, etc.). Similarly, the Department could permit only selective exploration and development of existing leaseholds if analysis indicates wholly unacceptable environmental impacts that could not be reduced to an acceptable level.

Adoption of this alternative would reduce adverse impacts by reducing the area in which the impacting activities could take place. At the same time, application of this alternative would not permit maximum recovery of the coal resources and would thus be contrary to principles of conservation embodied in the legislation which authorizes the leasing of these lands for the purposes described. It is entirely possible that such selective mining would leave isolated blocks of coal that might never be recovered owing to the high costs of mining such remnant areas at a later date.

Phased Development

Phased development of coal mines as a means of lessening socioeconomic impacts of coal development in the ES area is discussed as the Diligent Development and Continuous Operations alternative under Approval or Rejection in Part of chapter 8 in volume 1. The restrictions discussed under that alternative could be applied to the Anschutz operation alone. However, to do so would not reduce socioeconomic impacts in Garfield County, since Anschutz would continue to mine 1 million tons per year through 1990 from private coal reserves.

APPROVAL SUBJECT TO ADDITIONAL REQUIREMENTS OR MODIFICATIONS

Subject to existing laws and regulations, the Department has the choice of approving an M&R plan with additional stipulations or changes to lessen adverse environmental impacts. For example, operational, transportation, or other alternatives could be adopted when such alternatives would reduce adverse impacts.

Operational Alternatives

Excess water pumped from the North Thompson Creek mines presents a potentially serious impact to the environment. Discharge of the excess water to North Thompson Creek would greatly alter the chemical characteristics of the stream during low flow. The water type would change from a calcium, magnesium, bicarbonate type to a sodium, sulfate, bicarbonate type with an increase in dissolved solids concentration to more than 1,000 milligrams per liter (mg/l). Sodium would probably exceed 200 mg/l and sulfate may exceed 300 mg/l. Added dissolved solids load to the river net would probably increase to about 650 tons annually by 1985 and to as much as 1,300 tons annually by 1990. The effect could be to increase the dissolved-solids concentration in the Colorado River below Hoover Dam by about 0.03 mg/l (0.004 percent) by 1985 and about 0.5 mg/l (0.007 percent) by 1990. These impacts would continue only during the life of the mining operation; thereafter, stream flow and water-quality characteristics should return to essentially pre-mining conditions within a few years. However, the levels of dissolved-solids concentration sulfate, and sodium in North Thompson Creek during low-flow periods would probably be high enough to limit the reproduction of trout species in the stream. This would cause a loss of the stream fishery except for the summer stocking of hatchery fish.

Pitkin County opposes any discharge from the mine to North Thompson Creek and expects Anschutz to stop all discharge in the near future, either by using the mine discharge in their mining and processing operations or by piping the excess to an evaportation pond. Those solutions to the problem

might be feasible for the next year or two, but by the early 1980s the amount of water in excess of consumptive uses would probably require an evaporation pond with a surface area of several hundred acres. Net evaporation (total evaporation less annual precipitation) in this area probably does not exceed 25 inches. An average discharge of 1 cubic foot per second (450 gallons per minute), therefore, would require an evaporation pond with a surface area of more than 350 acres. Construction of a pond or ponds having that large a surface area would probably not be feasible since that amount of land is not avilable in the mountainous terrain in the vicinity of the Anschutz operation.

An alternative solution to the problem would be the construction of a combined storage-evaporation reservoir with suggested storage capacity of 720 acre-feet and a surface capacity of 150 acres. Excess water would be stored in this facility during low-flow periods. Assuming a net evaporation of 25 inches, 310 acre-feet per year would be disposed of through evaporation, the the remaining 410 acre-feet would be discharged into North Thompson Creek during spring high flow. Anschutz would have to obtain appropriate federal, state, and local permits to discharge this water.

Implementation of this alternative would prevent the discharge of large quantities of mine water into the creek during low-flow periods when it would be harmful to fisheries. Discharge during high-flow periods would not be harmful to aquatic life. Because less water would be discharged to the stream increases in dissolved-solids concentrations would be less than these increases projected above.

No other reasonable operational alternatives have been identified which would significantly reduce adverse impacts of coal mining or increase resource recovery. Surface mining is not feasible due to the geology and geographic characteristics of the area. Federal regulations (30[CFR]: 211) require M&R plans be designed to ensure maximum economic recovery of the coal resource.

Transportation Alternatives

Coal Transport

Anschutz proposes to transport the coal from the mine site by truck to a rail loadout facility near Carbondale. No resonable alternatives to this proposal have been identified. See volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Coal Transportation Alternatives, for a general discussion of truck transport and slurry pipelines. See also Reduction of Wildlife Road Kills, below.

Busing of Mine Employees

Busing of employees to the mine site could reduce the traffic impacts discussed in chapter 3. This alternative has also been proposed as a regional alternative in volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Busing of Coal Mine Employees.

Reduction of Wildlife Road Kills

Road kills due to vehicle animal collisions currently exceed the legal harvest of deer in the state of Colorado. If the number of road kills involving Anschutz coal trucks increases significantly along the haul road, measures to protect the animals may have to be considered. Anschutz could be required to haul coal only during daylight hours, rather than during the two consecutive eight-hour shifts proposed by Anschutz. However, concentrating coal haulage into daylight hours (somewhat longer in the summertime) would increase daytime traffic congestion on the county road leading to the mines, which is used as a sightseeing route and which provides access to lands beyond the mine site. Increased congestion could also increase the possibility of traffic accidents, during the day, although it might decrease nighttime accident potential. Other alternatives which could be considered include highway lighting, fencing, and other measures currently under study by the Colorado Division of Wildlife.

DEFER ACTION

For proper cause, the Department may defer final action on a proposed M&R plan. Reasons for deferring action can include, but are not limited to, the need and time required for:

1. Modification of a proposal to correct administrative or technologic deficiencies;
2. Redesign to reduce or avoid environmental impact;
3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation;
4. Further evaluation of a proposal and/or alternatives.

The principal effect of deferring action on a proposed M&R plan on these grounds would be a comparatively short-term delay in the occurrence of all related impacts of a proposal (both adverse and beneficial). To the extent that an M&R plan can be redesigned to alleviate adverse impacts, those impacts would be lessened.

As pointed out at the beginning of this chapter, Anschutz' M&R plan for the North Thompson Creek mines has not been reviewed for compliance

with the interim regulations, and the Department will not consider the plan for approval until it is brought into compliance with all applicable federal requirements.

Refuse Disposal Site

Anschutz' M&R plan indicates that the existing refuse site is adequate for 15 years. If the M&R plan is approved, mine life would be 30 years, and another site would be needed. The U.S. forest Service (USFS) has expressed concern (comment letter 4 in chapter 9, volume 3) that impacts of this site cannot be evaluated since a location has not been proposed by Anschutz in the M&R plan. A solution would be to defer approval of the M&R plan until the phase 2 refuse disposal site has been identified by Anschutz and evaluated and approved by OSM, BLM, and USFS.

Control of Runoff and Salinity

Approval of the M&R plan could be deferred until it has been evaluated with regard to best management practices for nonpoint sources of water pollution and the guidelines of the Colorado River Salinity Forum. See chapter 2, Future Environment Without the Proposal, Water Resources, and chapter 3, Water Resources, for discussions of projected effects on water quality due to mining at the Anschutz operation.

Additionally, approval of the M&R plan could be deferred until Anschutz develops a reasonable proposal for disposing of excess ground water from the mines. See Operational Alternatives (under Approval Subject to Additional Requirements or Modifications earlier in this chapter) for one suggested method of disposal.

PREVENTION OF FURTHER DEVELOPMENT

No Action Alternative

"No action" on proposals for extention of existing private mining operations onto federal coal would equate to prevention of further development. Under existing regulations, operations may not proceed in the absence of approved M&R plans and related permits. The alternative of rejecting the M&R plans is discussed earlier in this chapter.

Relinquishment of Leases

The BLM is reviewing nonproducing existing leases. Nonproducing leases are to be reviewed in accordance with planning standards and in compliance with the proposed unsuitability criteria developed pursuant to the requirements of section 522(b) of SMCRA.

Under Congressional Bill S3189 (October 13, 1978), the Secretary may exchange leased lands that are determined and/or proven to be unmineable for an equivalent area of unleased land. In addition, the Federal Land Policy and Management Act of 1976 (PL 94-579), Section 206, gives the Secretary general authority to dispose of public lands by exchange, subject to applicable laws, when the Secretary "determines that the public interest will be well served by making that exchange: *Provided,* That when considering public interest the Secretary concerned shall give full consideration to better Federal land management and the needs of State and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife and the Secretary concerned finds that the values and the objectives which Federal lands or interests to be conveyed may serve if retained in Federal ownership are not more than the values of the non-Federal lands or interests and the public objectives they could serve if aquired."

CHAPTER 9

Consultation and Coordination

See volume 3, chapter 9, for a discussion of consultation and coordination carried out for the West-Central ES.

ATLANTIC RICHFIELD COMPANY:

MT. GUNNISON NO. 1 MINE

Chapter 1

DESCRIPTION OF THE PROPOSAL

Proposed Action

The proposed action is the review and consideration for approval of a mining and reclamation plan (M&R plan) submitted by Atlantic Richfield Company (ARCO) to the Area Mining Supervisor of the U.S. Geological Survey (USGS) Denver, Colorado, on August 4, 1976. In this plan, ARCO has described a proposed new underground mine, the Mt. Gunnison No. 1 Mine. The M&R plan has been accepted by the USGS as suitable for use in preparing this environmental statement (ES) and is available for public review at the Area Mining Supervisor's Office in Denver.

This M&R plan was submitted for review prior to promulgation of the interim regulations (30[CFR]: 700 required under Section 502 and 523 of the Surface Mining Control and Reclamation Act [SMCRA] of 1977 [PL 95-87]) and has not been officially reviewed for compliance with those regulations. Therefore, the applicant's plan may not fully reflect the requirements of the interim regulations. However, in this statement the interim regulations are considered as federal requirements with which the M&R plan will have to comply just as it must comply with all other applicable regulations.

The M&R plan will be returned to the operator for revision in accordance with the applicable federal regulations. As soon as the applicant's plan is revised and returned to the Office of Surface Mining (OSM), it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations in 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

The plan describes the proposed Mt. Gunnison No. 1 Mine, which would be located approximately 1 mile east of the town of Somerset in Gunnison County, Colorado (see map AR1-1). The Mt. Gunnison No. 1 Mine would be a new underground bituminous coal mine with an anticipated annual production of 2.5 million tons and a mine life of 27 years, employing 565 people at full production. Production would be from existing federal coal leases C-1362, C-0117192, D-044569, and adjacent private coal leases totaling 12,579 acres.

As yet, no commitment for sale of the coal from the Mt. Gunnison No. 1 Mine has been made; however, marketing of the coal is being actively pursued. It is anticipated that ARCO would secure a contract for the coal from an unspecified electrical utility. The coal would be transported from the mine to its market by rail.

History and Background

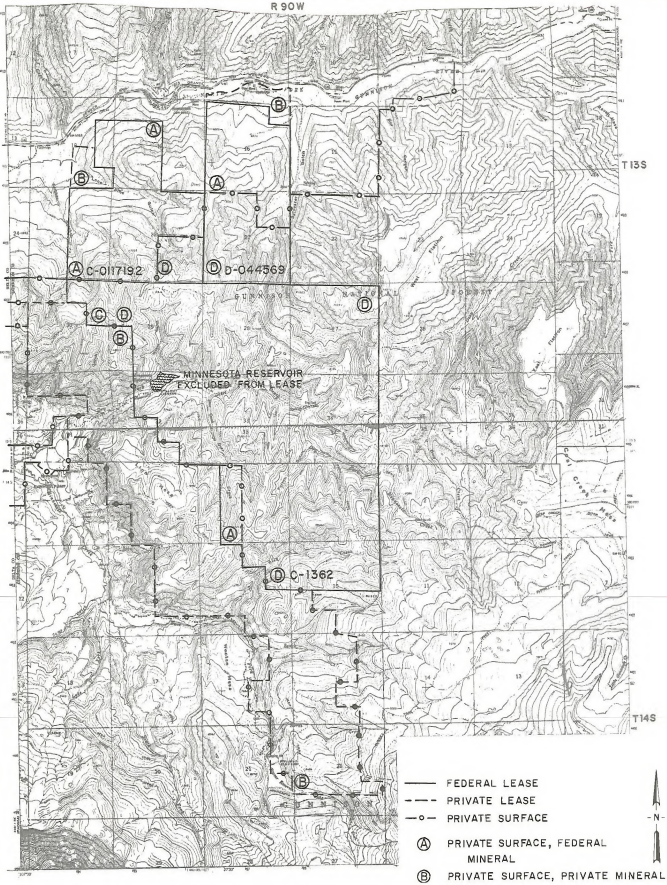
On September 1, 1967, ARCO was awarded federal coal lease C-1362, containing approximately 4,835 acres in the North Fork Valley Area. On April 1, 1969, ARCO acquired by assignment federal coal lease C-0117192, containing approximately 1,245 acres adjacent to C-1362. This lease was originally issued to Harrison Eiteljorg on June 1, 1965, and subsequently assigned to Reliable Coal and Mining Company on January 1, 1967.

In late 1969, ARCO began negotiations with the Bear Coal Company to acquire federal lease D-044569, issued to Bear Coal Company in August 1934. Agreement was reached in January 1970, and ARCO acquired an option for the Bear surface and leasehold estate, containing approximately 1,380 acres. The option was exercised in January 1971, and the lease was assigned to ARCO effective April 1, 1971. An additional 230 acres of private land were also purchased. By acquiring federal lease D-044569, ARCO obtained access to rail and highway facilities in the North Fork Valley, suitable land for future plant facilities, and additional coal reserves.

In 1974, ARCO obtained a lease from Mt. Gunnison Fuel Company for 3,800 acres of private coal reserves contiguous to the three federal leases. From 1972 to 1976, ARCO acquired an additional 120 acres of private surface and mineral rights and 1,370 acres of surface rights overlying both its federal and private coal reserves. In sum, the total acreage held by ARCO is now approximately 12,578 acres.

The federal lease conditions are subject to all current surface mining reclamation and related land use requirements and all laws and regulations affecting federal coal leases.

The Bear Mine, currently the only mine producing from the Mt. Gunnison properties, began production in 1932 and has produced continuously



Map AR1-1. Atlantic Richfield Company's lease area

since that time. The Bear Mine is currently operating on federal coal lease D-044569 under an "assignment of operating interests" from ARCO. Total production from 1932 to 1976 was 2,871,747 tons. In 1976, ARCO extended an abandoned prospect entry in Sylvester Gulch as a test project to obtain a bulk-coal sample and to study roof and floor conditions. Information gained from that test project was used to plan the proposed mining operation.

Predisturbance Inventories and Analysis

Ecology Consultants, Inc., Fort Collins, Colorado, completed an ecological study of the Mt. Gunnison No. 1 Mine area for ARCO from October 1975 through July 1976; the final report was submitted September 1977. The report covered inventories for rare and endangered plants, wildlife, and aquatic life and found no listed species on the area. The U.S. Soil Conservation Service has completed mapping of private and public land in the Paonia-Somerset area (Upper North Fork Valley), but results have not yet been published. Soils of the U.S. Forest Service land in the area have not been mapped as yet. An archeological and historic resources inventory in areas proposed for surface disturbing activities (construction of support facilities, drill site, and access road) was conducted by the Department of Anthropology, Fort Lewis College, Durango, Colorado; the report was submitted March 1977.

ARCO's Proposed M&R Plan

ARCO proposes to begin producing 500,000 tons of coal per year by 1982. During the first project year (1980), approximately 80 employees would be used to start construction of the portal and surface facilities. Construction would continue through the second project year (1981), and preliminary development of the mine would start about the middle of the year; approximately 175 employees would be needed. Production would increase stepwise until the seventh year (1986), when the anticipated annual production of 2.5 million tons would be reached. At full production, the Mt. Gunnison No. 1 Mine would employ approximately 565 people.

ARCO intends to mine the full thickness of the 5- to 8-foot F seam of the Paonia Shale Member of the Upper Cretaceous Mesaverde Formation. After they have concluded mining in the F seam, they anticipate mining two of the five underlying mineable coal seams: the E seam (10 to 20 feet) and the B seam (10 to 26 feet). ARCO proposes to use the longwall mining method primarily, and the room-and-pillar method in certain areas. ARCO has also stated that advances in mining technology may allow them to mine more coal seams than the three they currently anticipate mining.

MINE LAYOUT

The initial development of the main entries would begin at the outcrop just west of the property line between Sections 15 and 16 (see map AR1-2). Eight entries would be driven in a southerly direction adjacent to the section line. At 4,500 feet in from the portal, six bleeder entries would be turned to the west. The first set of submain entries would be developed about 3,000 feet from the end of the bleeders, with the first production panels developed from these submain entries.

The main entries would continue south along the property line for approximately another 4,000 feet, leaving a square block of coal in Section 16 for longwall panels. At this point, the main entries would be turned southwest and driven updip. From here, all workings would be parallel to and perpendicular to the main entries. The headgate and tailgate entries would be driven downdip and panels retreated updip.

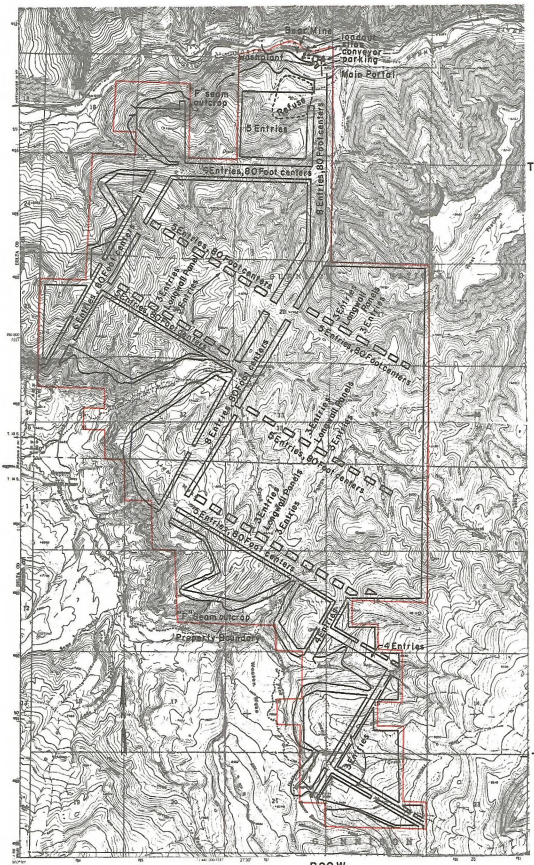
Tentatively, the center-to-center dimensions of the pillars would range between 60 and 100 feet, with entry widths varying between 14 and 18 feet. Both pillar and entry designs may be subject to unforeseen underground conditions which could cause deviation from the designated plan.

Roof control in the Mt. Gunnison No. 1 Mine would be achieved by beam action and arching. Roof support practices which may be incorporated into the plan include mechanical roof bolts, roof trusses, resin anchored bolts, timbers, steel cross bars, guniting, yieldable arches, crossbars, and wire mesh. To provide support on longwall sections, powered, self-moving hydraulic jacks with roof canopies or shields would be used together with timbering and roof bolting in the development entries.

Each working section of the mine would have an approved roof support plan to provide protection under the anticipated conditions. This plan would be supplemented by additional support if loose or badly sagging roof is detected or where unconformities are discovered. For support of long-life haulways, air courses, substations, overcasts, track intersections, and other permanent or semi-permanent places, additional support would be installed as required because contact with the atmosphere causes the roof to weaken.

One area of intense design would be support for the main entries under areas of low overburden. Because of potential problems with sloughing and poor roof bolt anchorage, the first 200 feet of main entries would probably be protected with additional support.

Panel orientation would parallel the major fracture system of the area. The resulting horizontal stresses, measured in the C seam, should enhance



Map AR1-2. Mine layout for Atlantic Richfield's proposed Mt. Gunnison No. 1 Mine

SCALE

caving behind the longwall face and improve mining conditions, recovery, and safety.

The first longwall system would go into operation after development of the first longwall panel. Full anticipated production would be reached with the development of the second longwall panel. Barrier pillars, located in various sections of the mine, would be extracted in the retreat phase of the mining sequence.

The following is a listing of the major mine equipment:

Continuous miner
Shuttle car
Roof bolter
Feeder breaker
Auxiliary fan
Rock dusters
Longwall shearer
Pan conveyor
Hydraulic power supply
Stage loader
Water pump
Panel conveyor
Submain conveyor
Mantrip
Personnel carrier
Supply locomotives
Jitney
Miscellaneous equipment
Mine fan
Main conveyor
Longwall supports

The longwall supports would be hydraulic. All of the rest of the equipment would be electrically powered.

Ventilation

The majority of ventilation air would enter the mine through the initial development entries. Axial exhaust fans would be installed at the portal. As the mine advances to the south, additional intake openings are planned. (See Ventilation Portals, under Surface Facilities.)

The fresh air would travel through three intake entries of the main entry system and split as required at the submains. The submain entries would provide two intake airways to the panel entries, which would provide one fresh air intake during development and two fresh air intakes during longwall production. In the development sections, the air would split into two returns to minimize the time that a miner would be exposed to dust from equipment operation. The air would be regulated on each return split at the sections. The return air would move from the production sections, and through the submain returns, through the main returns to the primary mine fan(s).

The anticipated ventilating pressure requirement would be in excess of 10 inches of water to provide approximately 321,000 cubic feet of air per minute. Additional fans may be installed at remote points as needed.

Face ventilation would be improved by providing brattice or auxiliary fans with tubing. All intake entries would be separated from return entries by permanent stoppings, with doors where required, overcasts, and undercasts. All intake escapeways and belt entries would be isolated by plastered block stoppings or the equivalent. Conveyor entries would be ventilated by a separate split of low velocity air.

Haulage System

Coal would be transported from the working sections to the surface via conveyor belts. Tentatively, panel conveyors would be standard 42-inch-belt width, and each would be limited in length to assure effective tensions and motor size within acceptable limits. An effective belt control system is planned to assure that the submain conveyors would not be overloaded by coal from more than one section. The main line conveyor would be of sufficient capacity to handle material from the submain conveyors. Favorable grades would prevail throughout the main line haul.

Dust would be suppressed by water sprays located over critical areas of the conveyor. Spillage would be controlled by good housekeeping and by proper design. Fire detection and suppression equipment would be located along the conveyors to ensure adequate protection. State and federal regulations concerning belt safety and protection would be complied with. For accessibility and safety, crossovers and walkways would be established along the conveyor; riding the belt would be prohibited.

During the first year of production a supply track system, using a direct current trolley, would be started in an entry generally adjacent to the belt conveyor entry; it would be maintained throughout the life of the mine. Battery-powered supply locomotives and personnel carriers would be available for major equipment moves and emergencies. The supply track would be constructed with proper grading and ballast to handle large equipment and other heavy loads. Battery-powered personnel carriers would be provided for construction crews, supervisors, and mechanics.

SURFACE FACILITIES

Approximately 140 acres would be required for surface facilities, which would include support buildings, a preparation plant, loadout facilities, a refuse disposal area, an electrical substation and 115-Mw transmission line, a water and sewage

treatment plant, access roads, and additional portals. In addition, a supply storage yard and a parking facility of 3 to 4 acres would be constructed. The majority of the required acreage would be on private land. Of this acreage, 77 acres would be disturbed by 1980, 91 acres by 1985, and 106 acres by 1990; disturbance of the total 140 acres would not occur until after 1990.

Support Building

The mine office, bathhouse, warehouse, and shop buildings would be constructed near the portal area using standard engineering practices. The office building would be approximately 13,000 square feet in size and located below the portal facilities.

Preparation Plant

To fulfill coal contract requirements, ARCO plans to construct a coal preparation plant capable of handling 2.5 million tons of raw coal per year. The plant would cover approximately 15 acres. Coal from the F seam would be transported by belt conveyor to an appropriately sized bin on the surface. The coal would be moved by belt conveyor from under the bin to the top of two raw-coal silos adjacent to the preparation plant. A tramp-iron magnet, located above the conveyor drive pulley, would remove scrap iron mixed with the coal. From the bottom of the silos, coal would be fed into surge bins large enough to provide an even flow of raw coal into the preparation system.

Coal from the surge bins would be fed at a constant rate by vibrating feeders onto a vibrating grizzly (sizing screens) for initial 1.5-inch size separation. The minus 1.5-inch material would go directly as raw coal to single-deck, dry sizing screens. The plus 1.5-inch material would be crushed in a rotary breaker. Any plus 1.5-inch material remaining after this process would go to the refuse bin. Crushed material then would go to the dry sizing screens. The plus 0.25-inch material from the screens would pass directly to a jig for further processing; the minus 0.25-inch material from the screens would go directly to the coal storage silos.

Jigging would separate the material into two products; wet coal with associated fines and refuse. The wet coal then would be conveyed to vibrating screens for dewatering and sizing into plus and minus 0.25-inch fractions. The plus 0.25-inch coal would be fed to a crusher for reduction to minus 0.25 inches and then be conveyed to the clean coal silos. The minus 0.25-inch coal from the jig would be fed to mechanical dewatering centrifuges for removal of surface moisture before being conveyed to clean coal storage. Refuse produced from the jig would be screened for two products: oversized material, which would go to the refuse bin, and undersized material, which would enter the thickener.

The thickener would receive undersized waste from the centrifuge and waste water from the screens. Overflow (clarified water) from the thickener would reenter the preparation water cycle, and the underflow would enter a filter for dewatering before disposal in the refuse pile. Water from the filter would enter the thickener for reuse.

The system described above would reuse water from previous washing in a closed circuit cycle. The only water loss from the plant would be moisture in coal and refuse. Make-up water would be added to the system as necessary from the storage facilities, making it a net-user system. However, should an unforeseen malfunction release process water into the environment, a catch basin would divert the accidentally released discharge into settling ponds to be constructed near the preparation plant. If it should become necessary to empty thickeners, filters, etc., for maintenance, the effluent would be emptied into the lagoon located near the plant. This effluent would be treated as necessary to prevent degradation of the environment.

Dust would be controlled to within state and federal air quality standards. Dust suppression and/or collection equipment would be located at potential sources of airborne dust, such as belt transfer points, crushing stations, and raw coal screens.

Production schedules and the need to use unit trains would also require construction of two steel-reinforced concrete storage silos to hold coal temporarily at the mine site.

Loadout Facilities

Coal from the preparation plant would be taken by conveyor to two 10,000-ton storage silos to be located just south of the North Fork River. Coal would be conveyed across the river to a sampling house and railroad car loadout station positioned over the rail siding. The loadout facilities would cover approximately 15 acres.

Railroad Siding

The proposed mine area is currently served by an existing spur line owned and operated by the Denver and Rio Grande Western Railroad Company (D&RGW). As part of the coal-handling facilities, a new railroad siding approximately 10,000 feet long, covering approximately 23 acres, would be constructed. The new siding would be built within the existing D&RGW railroad right-of-way between Highway 135 and the North Fork. The siding trackage would be of standard design, conforming to American Railroad Engineering Association standards. The need for acquiring an additional right-of-way would be determined after further negotiations with the railroad company.

Refuse Disposal

The total volume of F-seam refuse would be approximately 8 million tons or 186,364,537 cubic feet over the 27-year life of the F seam mine. The total refuse produced per year is not expected to exceed 400,000 tons. This is a calculated 14-percent-by-weight of run-of-mine coal. The refuse disposal area would cover approximately 50 acres in Section 16.

Refuse would be conveyed by belt conveyor from the preparation plant to a large flat plateau 650 feet above the North Fork. The refuse disposal area would cover approximately 29 acres by 1990. The refuse would be laid down, spread, and compacted in maximum 2-foot lifts; particular attention would be paid to compacting the edges. Fine refuse would be blended with coarse refuse to fill voids during compaction and prevent oxidation. Twenty-five lifts would make up a stage, approximately 50 feet in depth. Additional stages would be offset from the front edge of preceding lower stages by 150 feet, reducing the ultimate slope and providing terracing along the face of the refuse pile for vegetation and rehabilitation. Each lift would be sloped at 3 degrees into the hillside to diversion ditches to control runoff water during construction of the embankment. Each terrace would be sloped at 2 degrees into the base of the next layer to form a water collection ditch. The slope angle between terraces would not exceed 27 degrees (51 percent), the maximum allowed by law without providing an added safety factor.

Certain safety features would prevent sliding of the refuse pile. The large area of low-degree slope at the foot of the embankment should greatly increase its inherent stability. Under the toe of the initial stage, a blanket drain arrangement approximately 10 feet deep would be keyed into the hillside. This drain would provide a filter for any water draining through the pile, providing sediment control as well as stability for the toe of the bank. A 10-foot-deep by 10-foot-wide trench across the hill at the base of the embankment would prevent the bank from creeping. The excavated rock would be utilized to form a wall in front of the trench, and the trench would be filled with crushed rock as filter material. Slope stability under all adverse conditions would be fully analyzed during final engineering.

Surface runoff is expected during storm activity and snowmelt periods. Drains under the stages and across the terraces would empty into encircling ditches around the entire disposal area to minimize water infiltration into the embankment and to reduce the possibility of acidic leaching of the embankment material. Measures would be taken to prevent any drainage water force from undermining the embankment structure. Temporary diversion ditches would be constructed on the uphill side of the embankment to minimize water flow into the refuse. The drainage system would be designed to handle 6-hour/100-year storms, as suggested by the Mine Safety and Health Administration, to prevent impounding of water behind the embankment. This water from the watershed would normally empty into the North Fork. All hydraulic facilities would be designed in compliance with the federal and state regulations.

Water runoff from the embankment itself and from the drains would be monitored and, if necessary, treated before being discharged into the North Fork. Therefore, these facilities would be designed to divert the runoff directly to the water treatment plant if necessary, with temporary storage planned for excess amounts during storms. After completion of embankment construction, a permanent drainage diversion system would be incorporated.

Water Supply and Distribution

At the designed production level of 2.5 million tons of coal per year, the Mt. Gunnison No. 1 Mine would require 960 acre-feet of water annually. In order to meet this water need, ARCO has obtained water rights from the sources listed in table AR1-1.

Water would be pumped from the source to storage facilities. These facilities would provide a continuous supply of water for the mining operations in addition to a reserve capacity. Water from storage would be circulated throughout the mine in high pressure lines ranging from 75 to 250 pounds per square inch. High pressure flow would be provided by gravity or pumps.

A potable water treatment plant may be constructed to provide potable water for mine and plant use.

Preparation plant water and contaminated drainage water would be treated, if necessary, to meet all applicable federal and state discharge regulations. Probable treatment would be in the form of an appropriately sized package aeration plant, or aerated sewage lagoons. The sewage treatment facilities would produce clarified water and sludge. The clarified water would most likely be chlorinated and discharged into the North Fork of the Gunnison River.

Power Facilities

The power for underground use would be transformed from 115 KV to 13.2 KV for distribution. The necessary substation transformers and switch gear would be located on the plant site close to the major load centers. The electric power would be supplied to the site by a new 115 KV transmission

TABLE AR1-1

ARCO WATER RIGHTS

Source	Water	Quantity (Acre-Feet)
Mt. Gunnison Pipeline	15.00 cfs	10,859.50
Mott Land and E. L. Brown Ditch	0.50 cfs	198.40
Roeber Reservoir No. 2	44.00 ac-ft	44.0
Lucas Cline Reservoir	9.50 ac-ft	9.5
Turner Ditch Company	89.0 inch	916.40
Lone Cabin and Reservoir Company	1,000 Shares of stock	0.25
	Total	12,028.05

ac-ft = acre-feet
cfs = cubic feet per second
inches = miners inch

system of the Delta-Montrose Electric Association. This high voltage power would be reduced to appropriate lower voltages at the point of use.

Access Roads

Currently, there is no all-weather access road to the proposed Mt. Gunnison No. 1 Mine location. ARCO plans to construct 1 to 1.5 miles of all-weather road on a standard 24- to 32-foot-wide section in accordance with applicable standards. The road would be limited to a vertical grade of 8 percent or less and would be paved with asphaltic concrete. The proposed access road would leave Colorado State Highway 133 and cross to the south side of the North Fork of the Gunnison River approximately 1.1 miles east of Somerset.

In-plant roads would be constructed with variable dimensions and specifications depending on their intended purpose. Permanent roads probably would not be paved unless maintenance costs versus capital costs, traffic volume, personnel safety, etc., indicate the need for paving.

Ventilation Portals

Two additional ventilation portals would be broken out in the Minnesota Creek drainage, one portal in 1983 and the other in 1990. Both portals would be used for intake air only. No equipment is anticipated at either portal; therefore, no roads would be needed. Both portals would disturb an area that should not exceed a total of several hundred square feet.

SURFACE RECLAMATION

For surface disturbance resulting from coal mining operations at Mt. Gunnison No. 1, pursuant to 30(CFR): 717.11 and 30(CFR): 715.13, coal mining operations will be required, as a minimum, to restore the surface areas disturbed to a condition capable of supporting the use which it was capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood. A mining permit will not be approved unless the applicant has demonstrated that reclamation to the proposed post-mining land use can be accomplished under the reclamation plan contained in the M&R plan.

The land within and adjacent to the proposed ARCO project area is used primarily for livestock grazing, wildlife habitat, and outdoor recreation. The objective of the ARCO proposed reclamation plan is to restore land disturbed by mining to a use equivalent to or better than the highest previous use. Future use of the site is expected to involve livestock grazing and wildlife habitat at a level the land was capable of supporting before any mining occurred.

At the time of service-road and mine construction, topsoil would be removed and stockpiled for use in reclaiming the areas disturbed. After stockpiling, the top soil would be contoured and planted to native or adapted varieties of grasses to control erosion and help prevent deterioration of the soil.

When the Mt. Gunnison No. 1 Mine is abandoned all surface structures would be removed and either salvaged or buried. The site would be graded to conform to the natural terrain, topdressed with a suitable material, and seeded.

Authorizing Actions

This M&R plan was submitted for review prior to promulgation of interim regulations, 30(CFR): 700, required under Section 502 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87). Therefore, this plan does not fully reflect the requirements of the initial regulations. However, in this statement the applicable interim regulations are being included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of the interim regulations. Before the plan will be considered for approval by the Secretary of the Interior, it will be returned to the mining company for redesign to incorporate the applicable regulations.

As soon as the applicant's plan is revised and returned to OSM, it will be evaluated in conjunction with USGS, the Bureau of Land Management, and the U.S. Forest Service, to determine compliance with the requirements of federal regulations at 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

The regulations contained in 30(CFR): 717 deal specifically with the performance standards required for approval of underground mining such as that proposed in this plan. In addition, refuse disposal of mine waste materials is governed by the regulation 30(CFR): 715.15.

The standards and measures described in the above regulations are considered as required measures and the impacts from the proposed action have been analyzed on that basis.

Federal Agencies

ASSISTANT SECRETARY OF ENERGY AND MINERALS

The Assistant Secretary must approve the mining permit application, including the proposed M&R plan, and significant modifications or amendments to it before the mining company can commence mining operations.

OFFICE OF SURFACE MINING (OSM)

OSM, with concurrence of the surface managing agency (BLM or USFS) and USGS, recommends approval or disapproval of M&R plans to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a State-Federal Cooperative Agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and the Department of the Interior authorized to take final actions on the permit.

U.S. GEOLOGICAL SURVEY (USGS)

The USGS is responsible for development, production, and coal resources recovery requirements included in the mining permit.

BUREAU OF LAND MANAGEMENT (BLM)

The BLM develops the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected public lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on public lands.

U.S. FOREST SERVICE (USFS)

The USFS develops requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected forest lands. The USFS is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on forest lands.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

The USFWS is responsible for protection of migratory birds, including eagles, and threatened or endangered species and their habitats. Coordination is required with the USFWS under provisions of the Fish and Wildlife Coordination Act, the Bald Eagle Act, and the Endangered Species Act.

State Agencies

STATE OF COLORADO

Air quality, solid-waste disposal, and water quality must comply with rules and regulations administered by the various divisions within the Department of Health. Plans, permits, and licenses to mine coal must be obtained from the state of Colorado.

Interrelationships

Relationship to Other Existing and Proposed Development

Presently five companies mine coal in the North Fork Valley. All five of these mining operations lie within an 8-mile radius of the proposed Mt. Gunnison No. 1 Mine. Table AR1-2 lists the five mines and their recorded or projected production for the years 1977, 1980, 1985, and 1990. The projected production for the Mt. Gunnison Mine is also shown for comparison. Production from the Mt. Gunnison Mine would constitute 40 and 45 percent of the total production for the North Fork Valley in the years 1985 and 1990 respectively.

Of the existing operations, only the Bear Mine would be directly affected by the Mt. Gunnison Mine. Bear Coal Company operates the Bear Mine under an "assignment of operating interests" on federal coal lease D-044569, which is held by ARCO. Annual production from the Bear Mine for 1977 was 226,220 tons of coal. Surface facilities for the Mt. Gunnison Mine would partially replace those now used by the Bear Mine, and production from the Bear Mine would be stopped after construction of new facilities is begun. The areas would then either be reclaimed or converted for use by the new mine.

In addition, U.S. Steel, Empire Energy, and Gulf Mineral corporations hold currently inactive federal coal leases (see table AR1-3) in the North Fork Valley. The Federal Coal Leasing Amendment Act of 1975 requires that inactive federal coal leases be developed or forfeited. Diligent and continuous development criteria must be met by June 1, 1986. Table AR1-3 sets out minimum production requirements for these leases. Development of these leases would increase the mining activities in the area. Several coal companies also own private coal reserves in the area and have expressed their intention to expand any future operations onto adjacent federal coal. Table AR1-4 summarizes proposed production from the area.

All of the operating mines currently ship most of the coal produced out of the area by way of the D&RGW rail spur in the North Fork Valley. An average of seven unit trains and numerous multiple coal-car trains leave the North Fork Valley each week. Production from the Mt. Gunnison No. 1 Mine would increase the number of unit trains from seven to twelve each week.

All vehicular traffic in the area, as well as livestock, currently use Colorado State Highway 133 as a major artery. Employee and service vehicular traffic related to the Mt. Gunnison Mine would increase the use of this highway. The Colorado Division of Highways is currently designing a new highway in the immediate area of the proposed

TABLE AR1-2

RECORDED AND PROJECTED MID-LEVEL PRODUCTION FROM THE NORTH FORK VALLEY FOR THE YEARS 1977, 1980, 1985, and 1990

Company	Mine Name	1977 Recorded Production (tons/year)	1980 Projected Production (tons/year)	1985 Projected Production (tons/year)	1990 Projected Production (tons/year)
Sunflower Energy Corp.	Blue Ribbon Mine	8,320	70,000	70,000	0
U.S. Steel Corp.	Somerset Mine	914,552	937,000	937,000	937,000
Western Slope Carbon	Hawksnest East Mine	190,349	600,000	750,000	750,000
	Hawksnest No. 3 Mine	12,362	0	0	0
Colorado Westmoreland Inc.	Orchard Valley Mine	286,129	700,000	700,000	700,000
Anchor Coal Company	Edwards Mine	0	125,000	125,000	125,000
Bear Coal Company	The Bear Mine	226,220	240,000	0	0
	Subtotal:	1,637,932	2,672,000	2,582,000	2,512,000
Atlantic Richfield Co.	Mt. Gunnison No. 1 Mine	0	0	2,130,000	2,436,000
	Total:	1,637,932	2,672,000	4,712,000	4,948,000

TABLE AR1-3

DILIGENT DEVELOPMENT CRITERIA FOR NORTH FORK INACTIVE LEASES

Lessee	Lease Number	Recoverable LMU* Reserves (tons)	Production before June 1, 1986 (tons)	First Year Production (tons)	Second Year Production (tons)	Annual Average Production (tons)
U.S. Steel	C-051669	14,775,000	369,375	147,750	147,750	147,750
	C-068389	7,563,000	189,075	75,630	75,630	75,630
	0-052558	3,780,000	94,500	37,800	37,800	37,800
Gulf Minerals	0-036955	2,800,000	70,000	28,000	28,000	28,000
		Totals:	722,950	289,180	289,180	289,180

Note: LMU = logical mining unit.

TABLE AR1-4

SUMMARY OF REPORTED AND PROJECTED COAL PRODUCTION FROM THE NORTH FORK VALLEY
IN THE AREA OF THE PROPOSED MT. GUNNISON MINE

Development	Reported Production (tons) 1977	Projected Production (tons) 1980	1985	1990
1. Existing mining operations on private and federal coal leases (5 operations). See table AR1-2 a/.	1,637,932	2,672,000	2,582,000	2,512,000
2. Minimum production requirements for inactive federal leases. See table AR1-3.	0	0	0	629,380
3. Projected production from ARCO's proposed Mt. Gunnison Mine.	0	0	2,130,000	2,436,000
Total:	1,637,932	2,672,000	4,712,000	5,577,380

a/ In addition to the five companies listed in table AR1-2, several companies have announced their intent to develop private coal reserves which they currently lease or own. In some cases development of these private reserves is dependent upon leasing of additional federal coal.

mine. The existing highway has a very low safety rating, and in several places the D&RGW railroad crosses the highway, disrupting and blocking traffic flow.

Limited transportation, housing, and service facilities exist in the area, and development potential is small. The Mt. Gunnison Mine could be expected to compete with other mining operations in the area for the limited facilities available, particularly with Colorado Westmoreland, Inc., in the Paonia area. (Figure AR1-1 is an aerial photograph showing some of the mines and leases in the area.)

Institutional Relationships

OFFICE OF SURFACE MINING

OSM, in consultation with Surface Managing Agency (BLM and USFS), USGS, or (where applicable) the state regulatory authority, recommends approval or denial of surface coal mining permit applications to the Assistant Secretary of Energy and Minerals. OSM (as lead agency) is the federal regulatory authority responsible for reviewing coal M&R plans (permit application), enforcement of all environmental protection and reclamation standards included in an approved mining permit, the monitoring of both on- and off-site effects of the mining operation, and abandonment operations within the area of operation of a federal lease.

OSM is the principal contact for all coal mining activities within the area of operation. OSM will conduct as many inspections as are deemed necessary but no less than one partial inspection quarterly and at least one complete inspection every six months (30[CFR]: 721.14[c]).

OSM, after consultation with BLM, USGS, and the operator establishes the boundaries of the permit area for the proposed mine and approves the locations of all the mine facilities located within this boundary.

Section 523 of SMCRA requires the Federal Lands Program to adopt those state performance standards which the Secretary determines are more stringent than the federal standards. The Federal Lands Program means a program established by the Secretary pursuant to Section 523, SMCRA, to regulate surface coal mining and reclamation operations on federal lands. Therefore, the performance standards enforced by OSM on a federal leasehold should be at least as stringent as those required under state law or regulations.

The Department of the Interior is negotiating a cooperative agreement pursuant to Section 523(c) of SMCRA with the state of Colorado and other states. Whenever this agreement is consummated with the state, the OSM's functions and responsibilities specified in this agreement will be delegated to the state regulatory authority. Under this agreement, OSM and the state regulatory authority will jointly review and act on mining permit applications and recommend approval or disapproval to the official authorized to take final action on the application. The Secretary is prohibited by law from delegating his authority to approve mining plans on federal lands.

U.S. GEOLOGICAL SURVEY

The USGS is responsible for reviewing M&R plans for development, production, and coal resource recovery requirements on a federal leasehold. USGS is responsible for the maximum economic recovery of the federal coal resource and for the federal government receiving fair market value for the coal resource.

BUREAU OF LAND MANAGEMENT

The BLM formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of public lands.

The BLM, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, and railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The BLM is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on public lands within a leasehold.

U.S. FOREST SERVICE

The USFS formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of national forest systems land.

The USFS, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted

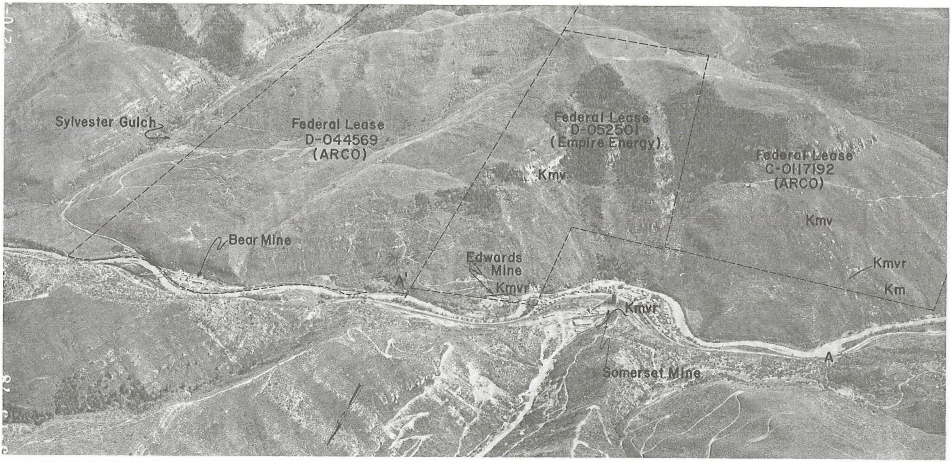


Figure AR1-1. Looking southeast at Somerset, Colorado, the Bear Mine (Bear Coal Company and the Somerset Mine (U.S. Steel Corporation) on the North Fork of the Gunnison River. In the foreground, the area lying north of the river consists of the private coal leases of U.S. Steel. The two federal leases shown in the background (D-044569 and C-0117192), a third lease lying off the top of the photo, plus additional private coal leases constitute Atlantic Richfield's Mt. Gunnison Mine property. Federal coal lease D-52501 (Empire Energy) and the Edwards Mine also lie in the vicinity of Somerset. Kmv marks the coal-bearing Mesaverde formation, Km the Mancos shale, and Kmvr the Rollins sandstone member (basal) of the Mesaverde. The distance from A to A' is approximately 1 mile.

Figure AR1-2 Aerial photo looking northeast up the North Fork Valley from 3 miles north of Paonia, Colorado. The following five existing mines are shown: A - Orchard Valley Mine (Colorado Westmoreland, Inc.), E - Blue Ribbon Mine (Sunflower Energy Corporation), F - Somerset Mine (U.S. Steel Corporation), H - Bear Mine (Bear Coal Company), and I - Hawknest No. 3 and East mines (Western Slope Carbon). In addition, the following four anticipated mining operations are shown: B - Farmers Mine (Gulf Minerals), C - Terror Creek (Empire Energy). D - Bowie or Kine Mine (Coors Beer Company, I - Raven Gulch (A.T. Massey). The distance from point A to point I is approximately 10 miles.

pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The USFS is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on forest lands within a leasehold.

Relationship to BLM and USFS Management Plans

The area covered by ARCO's proposed M&R plan includes 1,818 acres of private surface with underlying federal coal; 5,547 acres of national forest systems land administered by the U.S. Forest Service (USFS) with underlying coal administered by BLM; and 96 acres of public lands administered by the Montrose District of BLM.

The national forest systems land included in the M&R plan is administered by the Grand Mesa-Uncompahgre-Gunnison National Forest. Approximately 1,200 acres of the surface area administered by the USFS has been recently identified as having roadless area characteristics.

The BLM's Alkali-North Fork MFP (completed in June 1976) is the principal land use plan for the subsurface mineral resource leased by ARCO. The following management objectives developed in the MFP pertain to the lease area:

1. Lands

a. Dispose of public lands determined to be valuable for rural permanent residential use only when the supply of suitable land in the private sector is exhausted or when a private exchange can be arranged whereby the federal government would obtain lands essential to public purposes programs and then only if adequate planning and zoning is in effect. Each tract will be evaluated on a case-by-case basis. Any such disposals must meet the provisions of Senate Bill 35 and other state legislation and local subdivision regulations.

b. Consider applications by local governmental agencies and local interest groups for lease or sale upon completion of their development plan, land which has recreation or public purposes potential. This should be done on a case-by-case basis, considering all resource values and social, economic and environmental trade-offs.

c. Continue multiple-use management on these lands identified in Step I. If at some time in the future sufficient irrigation water is available and when irrigable land presently under private ownership is in agricultural production, tracts of public lands will be considered on a case-by-case basis for possible transfer to private ownership for agricultural purposes.

d. Coordinate with Delta and Gunnison counties, USFS, U.S. Bureau of Reclamation, and utility companies in establishing right-of-way corridors for all utilities where practical. Require power transmission and telephone lines be buried in corridors whenever feasible.

2. Range

a. Implement 22 AMPs with full grazing systems designed around the key species to improve range condition follwing completion of Uncompahgre Grazing ES and in accordance with its findings. Any increases in forage production in crucial wildlife habitat areas will be allocated equally to wildlife and livestock.

b. Implement range improvement projects identified in approved AMPs and in accordance with the findings of the Uncompahgre Grazing ES.

3. Wildlife

a. Design all fences so they will not restrict big game movements. Design specifications will require a 42-inch maximum height with the bottom wire being at least 16 inches above the ground (Type D fence).

b. Range reseeding for watershed improvement should include shrub and forb seeds.

c. Do not allow road construction on public lands until the following is completed and only then if it is determined that such action will not have a significant adverse effect on the environment: (1) determine if there is an actual necessity for the road; (2) research alternative routes if any; (3) complete an approved EAR on the proposed road and alternatives with input from all resources, particularly from the District Wildlife Biologist.

d. Maintain a wide variety of interspersed vegetative types in the planning unit.

e. Locate all road contruction to allow a buffer zone around all known raptor nest sites.

f. Manage the overall watersheds to maximize desirable vegetative cover.

g. Allow no stream channelization or alterations except on an emergency basis.

h. With the exception of rare instances, such as critical waterfowl nesting areas, etc., fencing of streambanks, ponds, and reservoirs should not be encouraged at the present time. Fencing will be done only when included in an approved AMP or HMP and in accordance with the findings of the Uncompahgre Grazing ES.

4. Recreation

a. Permit ORV use on public lands in the planning unit as provided by Executive Order 11644 (37 FR 2877) and regulations promulgated thereunder. Regularly assess ORV use in the area to determine incipient resource damage as early as possible and, if necessary, initiate action to correct the problem. Final decisions and their implementation will be accomplished pursuant to criteria and procedures contained in final regulations governing ORV use and/or as provided by 43 CFR 6010.4.

Relationship to State and County Planning

For a discussion of state of Colorado and Gunnison and Delta county land use planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

The description of the existing environment covers the physical, biological, and cultural resources and the socioeconomic conditions which constitute the site-specific environment in which Atlantic Richfield Company (ARCO) proposes to develop federal coal and adjacent private coal. The description focuses on environmental details most likely to be affected by ARCO's proposed mining and reclamation plan (M&R plan) and alternatives. The concluding section of this chapter describes the anticipated future environment if the proposed M&R plan is not implemented.

EXISTING ENVIRONMENT

Climate

The proposed Mt. Gunnison mine site is located about 10 miles east-northeast of Paonia in the North Fork Valley. The valley is quite narrow with steep sides and is oriented generally east-west at this point. Elevation at the proposed mine site is 6,280 feet.

Wind directions are not in line with the valley orientation because a smaller valley, Sylvester Gulch, empties into the North Fork Valley at the eastern edge of the site, lending a south-southeasterly pattern to the air flow (figure AR2-1). On-site meteorological data recorded wind speed during a six-month period of about 8 miles per hour. Wind speed and wind direction at the proposed mine site are very similar to those reported at the Grand Junction weather station.

Temperatures recorded at the Paonia station average 49 degrees Fahrenheit annually, and precipitation measures about 16 inches annually. The vegetation at the least site indicates somewhat higher annual precipitation than 16 inches, but the seasonal pattern should be very similar to that around the Paonia station. Annual precipitation at the north edge of the tract is estimated to be about 18 inches, increasing to 25 to 30 inches on the lower slopes of Mt. Gunnison in the southern part of the tract.

The growing season near Paonia is approximately 138 days each year (based on 32 degree freeze threshold data) and would be somewhat shorter at the mine site due to its higher elevation.

Air Quality

Particulate air quality in the study area ranges from 20 to 132 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean as recorded at sixteen state, municipal, and privately operated particulate sampling sites. In undeveloped sections, particulate concentrations range from 20 to 40 $\mu g/m^3$.

The available particulate sampling data which best represent existing particulate air quality at the proposed Mt. Gunnison Mine are from an on-site privately operated sampler. The annual geometric mean concentrations recorded at the sampling site in 1977 were 28 $\mu g/m^3$, with first and second maximum 24-hour concentrations of 94 and 69 $\mu g/m^3$, respectively.

There has been no measurement of carbon monoxide, hydrocarbon, nitrogen oxides, sulfur dioxide, or other gaseous pollutants near the proposed site. Since no major sources of these pollutants exist in the surrounding area, concentrations are considered to be at background or natural levels.

Visibility at the site ranges from less than 1 mile to approximately 100 miles throughout the year. Average visibility is about 54 miles with greatest visibility occurring during spring and summer months.

Geologic and Geographic Setting

Topography

The federal and private coal leases that make up the Mt. Gunnison No. 1 Mine property lie on the northwest edge of the West Elk Mountains (see map AR1-1 in chapter 1). These leases extend from the northern boundary on the North Fork of the Gunnison River to the intermediate slopes of Mt. Gunnison on the northern edge of the West Elks. Elevation varies from 5,900 feet along the North Fork River to over 9,200 feet at the southeast edge of the leases. Mt. Gunnison rises to 12,719 feet 2.5 miles southeast of the leases.

Along this portion of the North Fork River, the river is narrowly confined by the steep slopes of Grand Mesa to the north and the West Elk Mountains to the south. The lease area, lying completely south of the North Fork, consists of a major northwest trending ridge system with secondary north-

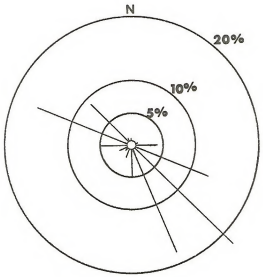


Figure AR2-1 Annual wind frequency at the Mt. Gunnison mine site

east or southwest trending ridges. The ridges are separated by narrow gulches or canyons containing intermittent and ephemeral streams. These streams flow either north into the North Fork of the Gunnison River or south into Minnesota Creek and Dry Fork of Minnesota Creek.

The maximum relief on the lease area is generally found along the escarpments of the North Fork River where slopes may reach up to 85 percent. The mesas along the western lease boundary provide the least relief with slopes at a minimum of 10 percent. The average slope throughout the lease area is approximately 30 percent.

Landforms

The landforms present on the lease area are largely the result of the differential erosion of the Mesaverde Formation (sedimentary rock strata). Thick resistant sandstones, such as the Rollins Sandstone Member of the Mesaverde Formation, form vertical to steep cliffs and escarpments. Shales and other less resistant beds form gentle slopes between the cliffs and ledges. Because of the predominance of sandstones in the Mesaverde Formation, escarpments, sharp ridges, and narrowly cut canyons are the major erosional landforms of the area.

In addition, there are several landforms on the lease which represent both erosional and depositional processes. Along the North Fork River, a narrow flood plain is restricted to a narrow V-shaped canyon. Alluvial sediments, primarily sand and gravel, have been deposited in the flood plain. At slightly higher elevations along the river canyon above the flood plain lie alluvial terraces or pediments, which are the erosional remnants of ancient river levels left high above the current river.

Finally, several massive slump features are evident along the western and northern edges of the lease area. These features are the result of mass movement of blocks of consolidated rock and unconsolidated soil. Although it is somewhat difficult to differentiate between slumps and old terraces, slumps occur primarily on moist, steep, generally north-facing slopes.

Structure

The structural geology of the lease areas appears to be quite simple. The sedimentary strata of the Mesaverde Formation (the coal-bearing strata) are relatively flat-lying with a regional dip of 3.5 degrees to the north-northeast. Local dips of up to 6.25 degrees are found.

There are three sets of fracture systems found in the area, reflected in the drainage system. The most prominent set trends northwest-southeast and northeast-southwest. The less pronounced system runs north-south and east-west and is seen only locally. The least prominent set is a joint system and is best expressed by the cleat system of the coal. Where exposed by mining in both the B and C seams, the cleat system trends south 75 degrees west.

Stratigraphy

The main coal beds on the lease area are found in the Upper Cretaceous Mesaverde Formation which is overlain by the early Tertiary Ohio Creek Conglomerate and underlain by the Upper Cretaceous Mancos Shale. Locally the Mesaverde is about 2,500 feet thick and comprises (in ascending order) the Rollins Sandstone Member, the Bowie Shale Member, the Paonia Shale Member, and the barren member. Figure AR2-2 presents a stratigraphic column of the coal-bearing Mesaverde Formation in the northern end of the area.

The Rollins member is a conspicuous white to buff, cliff-forming sandstone and ranges in thickness from 150 feet to over 200 feet. Although this sandstone forms a good regional subsurface marker for coal, it is a poor local marker because of lateral facies changes into shale. The Bowie Shale Member is composed of 50 to 180 feet of interbedded sandstone, shale, and coal overlain by an irregular sandstone bed 50 to 100 feet thick. The member contains the A, B, and C coal seams. The Bear Mine, which operates currently on the northern portion of the ARCO federal coal leases, produces from the C seam. The Paonia Shale Member consists of interbedded sandstone, shale, and coal similar to the lower coal member except the beds are more lenticular. This member ranges from 250 to 350 feet in thickness and is capped by a thick sandstone. The D, E, and F seams are found in this member. The Mt. Gunnison No. 1 Mine would mine completely in the F seam; see Mineral Resources for further discussion. Above the Paonia Shale Member there is a thick sandstone-shale sequence which does not contain coal. Figure AR2-3 shows the outcrop of the B, E, and F seams.

The F seam outcrops (although exposures are rare) on the northern side of the ARCO lease area along the North Fork of the Gunnison River and on the western side of the lease area along the East Fork of Minnesota Creek. Limited exposures of the F seam are also found along the northern portions of Sylvester Gulch. The best exposures are along the west and south-facing escarpments from just north of Dry Fork to south of Lick Creek. The remainder of the outcrop shows significant vegetation cover. Burn areas are predominantly on south and west-facing slopes. Burn is neither extensive nor continuous along the outcrop.

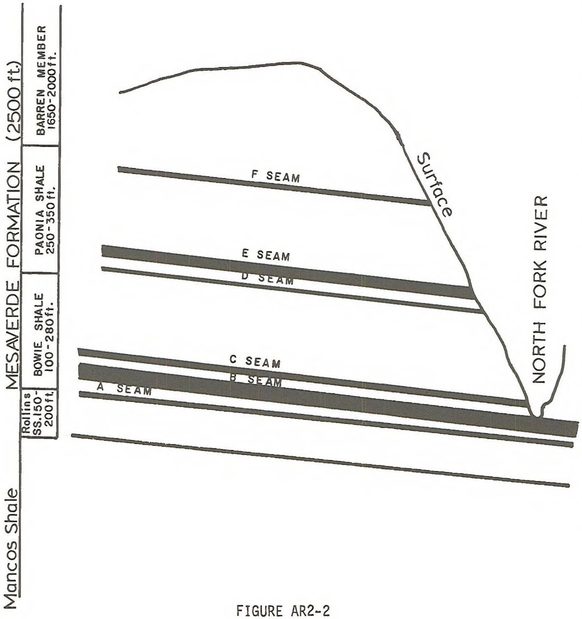


FIGURE AR2-2

SCHEMATIC OF COAL SEAMS

Figure AR2-3. Outcrop of the B, E, and F coal seams at the Mt. Gunnison No. 1 Mine

Paleontology

The principal fossil-bearing formations in the lease area, ages, number of known fossil localities, and general fossil types normally found in the formations are summarized in table AR2-1. Due to the present lack of data and accepted criteria for determining significance, the importance of these paleontological resources to science, education, etc., cannot presently be assessed.

Mineral Resources

Coal

Within ARCO's proposed lease area, there are seven major coal seams that vary from 4 to 26 feet thick in the Mesaverde Formation: the B, C, E, two E rider seams, F, and one F rider seam. Several other seams average about or less than 3 feet thick. The F seam overburden varies from about 500 feet to about 1,500 feet, averaging about 800 feet.

ARCO's M&R plan details the mining of only the F seam, which ranges in thickness from 5 to 8 feet, averaging 7 feet. Average weighed quality of the F seam coal was given as 11,846 BTUs, 0.47 percent sulfur, 10.44 percent moisture, 4.53 percent ash, 48.62 percent fixed carbon, and 36.26 percent volatile matter.

Total in-place coal reserves for the federal leases in the Mt. Gunnison No. 1 M&R plan were estimated by the U.S. Geological Survey (USGS) at 405.9 million tons. The company estimated that the F seam contains 118.7 million tons of coal reserves under 9,258 acres of both federal and private leases. Details of the coal reserves in the other coal seams were not given in the M&R plan.

Oil and Gas

The potential for the discovery of oil and gas under the leased area is very slight. Dry wells have been drilled a few miles to the southwest and to the northeast; these wells tested the Dakota Sandstone.

Water Resources

Hydrologic Setting

The proposed mine area lies on the moderately dissected northwest slope of Mount Gunnison and drains generally northward or northwestward to the North Fork Gunnison River, which in turn flows westward in a deeply incised valley along the north edge of the lease tract. Streams heading on Mount Gunnison are generally perennial or intermittent. Streams heading on the lease area are generally ephemeral, although some are intermittent and flow during wet years or during the spring months in most years.

The lease area is underlain to below the level of the North Fork River by a thick sequence of interbedded sandstone, siltstone, shale, and coal beds that dip about 3.5 degrees north-northeastward toward the valley cut by the North Fork River. Thus, the F seam, which would be mined under this proposal, slopes downward towards the North Fork Valley and crops out in an elongate band high on the steep valley sideslopes south of and about 600 to 700 feet above the river level.

No adequate precipitation data are available for the lease area. The vegetation indicates somewhat higher annual precipitation than the 16 inches measured at the Paonia station, but the seasonal pattern should be very similar. It is estimated that annual precipitation in the North Fork Valley at the north edge of the tract is about 18 inches, increasing to 25 to 30 inches on the lower slopes of Mount Gunnison in the southern part of the tract.

Ground Water

The occurrence of ground water in the proposed mine area is controlled largely by the combination of topography, stratigraphy, and geologic structure. Recharge on the lease area tends to accumulate in those permeable materials that immediately underlie the surface. Movement is downward to the first relatively impermeable or "perching" layer, which is generally shale, but may be siltstone or sandstone beds that have very little porosity and fracturing. This perched water then tends to move downdip and laterally towards discharge areas along nearby valley sideslopes, giving rise to numerous springs and seep areas. A comparatively small amount of this recharge percolates downward through the perching layers, probably through fractures, to recharge underlying aquifer systems such as the F seam which ARCO proposes to mine. These deeper aquifers also tend to drain downdip and discharge where they are exposed in the steep slopes along the south side of North Fork Valley and along the east side of Minnesota Creek Valley (figure AR2-3).

ARCO has identified and measured the flow of 114 springs and seeps on or immediately adjacent to their lease tract. Of these, only 14 flowed more than 5 gallons per minute (gpm) at some time during the period of record (1975-77), 7 exceeded 10 gpm, and 1 exceeded 50 gpm. Typically, flows were highest during the spring and early summer months of wet years and declined rapidly during the late summer and fall months and in dry years. For example, in May 1977, following a winter of minimal snowpack, only 38 of the 114 springs and seeps had measurable flow. The largest discharge was 4.7 gpm, and the average flow was 0.9 gpm. By September 1977 only 19 springs had measurable flow. The largest discharge was 3.0 gpm, and the

TABLE AR2-1

SUMMARY OF FOSSIL-BEARING FORMATIONS IN THE AREA
OF THE PROPOSED ARCO MINE

Formation	Period	Known Fossil Localities a/	Type of Fossils b/
Mancos	Late Cretaceous	General	V, I
Mesaverde	Late Cretaceous	General	V, I, P
Ohio Creek	Tertiary	General	V, I, P
Wasatch	Tertiary	General	V, I, P

a/ General: Formation contains fossils throughout; specific localities are not identified.

b/ V = vertebrate; I = invertebrate; P = paleobotanical.

average flow was 0.9 gpm. These data indicate that most springs reflect very local recharge with minimal ground-water storage and consequent rapid fluctuation in flow in response to seasonal precipitation.

ARCO has drilled seventeen observation wells on the lease tract. Seven are equipped with automatic water-level recorders; the others are measured at monthly intervals. These data show that water levels in the alluvium of the North Fork River closely reflect the level of the nearby river. In contrast, water levels in the alluvium of Sylvester Gulch fluctuate by as much as 38 feet, reflecting the amount of recharge that occurs seasonally from runoff in Sylvester Creek, which flows only intermittently. In wells penetrating bedrock, seasonal water-level fluctuations as much as 113 feet occur in the uppermost, or barren, member of the Mesaverde Formation, reflecting the local topographic relief and rapid recharge-discharge relationships that may be attributable to local fracturing. The magnitude of seasonal fluctuations decreases progressively with increasing depth and is only about 4 feet in the A-seam, which is the lowermost coal seam penetrated. Maximum water-level fluctuations in wells penetrating the coal seams are as shown in table AR2-2.

Well data also show that head decreases rapidly with increasing depth, indicating poor hydraulic connection between the different coal beds. The water level in the F seam stands about 190 feet higher than that in the E seam and about 390 feet higher than the water level in the B seam. The hydraulic gradient is northeastward downdip at a slope of about 300 feet per mile (ft/mi).

Water quality analyses of samples collected from nine wells and nine springs show that ground water in the alluvium of both the North Fork River and Sylvester Gulch is a sodium, calcium, bicarbonate type with generally less than 600 milligrams per liter (mg/l) total dissolved solids (TDS). Springs issuing from the uppermost or barren member of the Mesaverde Formation yield water that is typically a calcium, sodium, bicarbonate type with less than 400 mg/l TDS. Wells tapping the barren member generally yield a sodium bicarbonate water with TDS concentrations of 1,000 to 1,500 mg/l. Water in the coal beds is also generally a sodium bicarbonate type with TDS concentrations of 900 to 1,700 mg/l. Water samples from the abandoned area of the Bear Mine and from the return air course showed TDS concentrations of 2,736 and 2,753 mg/l, respectively. Chemical constituents were not determined for these two samples.

Although the data furnished by ARCO are not adequate for a quantitative appraisal of ground-water discharge from the lease area to the North Fork River, a rough approximation is possible. Aquifer tests on coal beds at the Energy Fuels Mine near Steamboat Springs, Colorado, where steep hydraulic gradients average 300 to 500 ft/mi indicate a hydraulic conductivity of about 1.0. Using that value, an average thickness of 7 feet for the F seam, a hydraulic gradient of 300 ft/mi, and a width of the tract of about 3.5 miles, total ground-water discharge from the F coal seam where it crops out high on the south slopes of the North Fork Valley should average about 40 gpm. Spread across 3.5 miles of outcrop, this small amount of water is dissipated by evapotranspiration and none reaches the North Fork River. A similar statement can be made for the other coal beds underlying the lease area.

Cumulative measured discharge from all springs on and adjacent to the tract is estimated to have been about 500 acre-feet (ac-ft) in 1975 during a wet year and about 40 ac-ft in 1977 during a dry year. Assuming that half of this water is dissipated by evapotranspiration, which is probably very conservative, average annual ground-water yield from the lease area to the river net probably does not exceed 135 ac-ft per year. Assuming an average TDS concentration of about 500 mg/l, the annual salt load contributed to the North Fork River from this source would be less than 100 tons.

Surface Water

The proposed mine and processing facilities would be located within the North Fork drainage which drains generally westward to the Gunnison River and subsequently into the Colorado River. The North Fork subdrainage ranges in altitude from 5,500 feet to 12,000 feet and drains 1,253 square miles, producing an average annual discharge of 469,300 ac-ft, or an average discharge of about 650 cubic feet per second (cfs) (Department of Agriculture 1962). The average annual discharge of the North Fork River adjacent to the mine site is 315,200 ac-ft, or an average discharge of 435 cfs (U.S. Geological Survey 1976). Peak flows generally occur in May as a result of snowmelt and minimum flows occur during the winter months. Maximum discharge for the period of record (43 years) was 7,860 cfs on June 4, 1957; minimum daily discharge of 17 cfs occurred on November 10, 1950.

Surface drainage on the lease tract is either directly to the North Fork River or to Minnesota Creek, which roughly parallels the western margin of the tract and flows northwestward, entering the North Fork at Paonia. The northern part of the tract is drained by a number of comparatively small steep watersheds that empty directly into the North Fork River. The largest of these are Sylvester, Lone Pine, and Gribble gulches. All have ephemeral stream flow except Sylvester Gulch, which is the largest and has a small seasonal inter-

TABLE AR 2-2

WATER LEVEL FLUCTUATIONS IN WELLS
MT. GUNNISON SITE

Coal	Period of record	Water-level fluctuation (feet)
F seam	12/3/74 to 5/30/78	29.6
E seam	11/5/74 to 5/30/78	25.3
B seam	11/5/74 to 5/30/78	6.1
A seam	12/3/75 to 5/30/78	4.0

mittent flow during most years. Based on one year of record (table AR2-3), runoff from the northern part of the lease tract should be about 0.6 inch annually.

The central part of the tract is drained by the Dry Fork of Minnesota Creek, which heads on Mount Gunnison and flows generally westward to Minnesota Creek. Runoff in the Dry Fork watershed is supplemented by water diverted from Deep, West Gunnison, and Little Gunnison creeks, via the Deep Creek Ditch. This diversion is used to fill an irrigation reservoir (Minnesota Reservoir) on Dry Fork in the central part of the lease tract (map AR2-1). Because of the imported water and the impoundment of runoff in Minnesota Reservoir, Dry Fork's flow has been greatly altered from its natural state. Although gaging stations have been established by ARCO upstream and downstream from Minnesota Reservoir (map AR2-1), only one year of record is available (table AR2-3). These records are also affected by transbasin diversion of flow through Deep Creek Ditch and by storage in Minnesota Reservoir. The water yields of Deep Creek Ditch and Minnesota Reservoir are presented later in this discussion in conjunction with the Beaver Reservoir, which also regulates flow on Minnesota Creek.

The southern part of the lease area is drained by the East Fork of Minnesota Creek and its tributaries. The largest of these are Lick, South Prong, and Horse creeks. Available runoff data for these streams are given in table AR2-3. Flow in the East Fork of Minnesota Creek is regulated by Beaver Reservoir, outflow from which is used for irrigation downstream in the North Fork Valley. Because of uncontrolled tributaries entering downstream from the reservoir, East Fork still experiences high flows during the spring snowmelt period. Spring flows average about 100 cfs, decreasing to about 5 cfs during late summer and early fall.

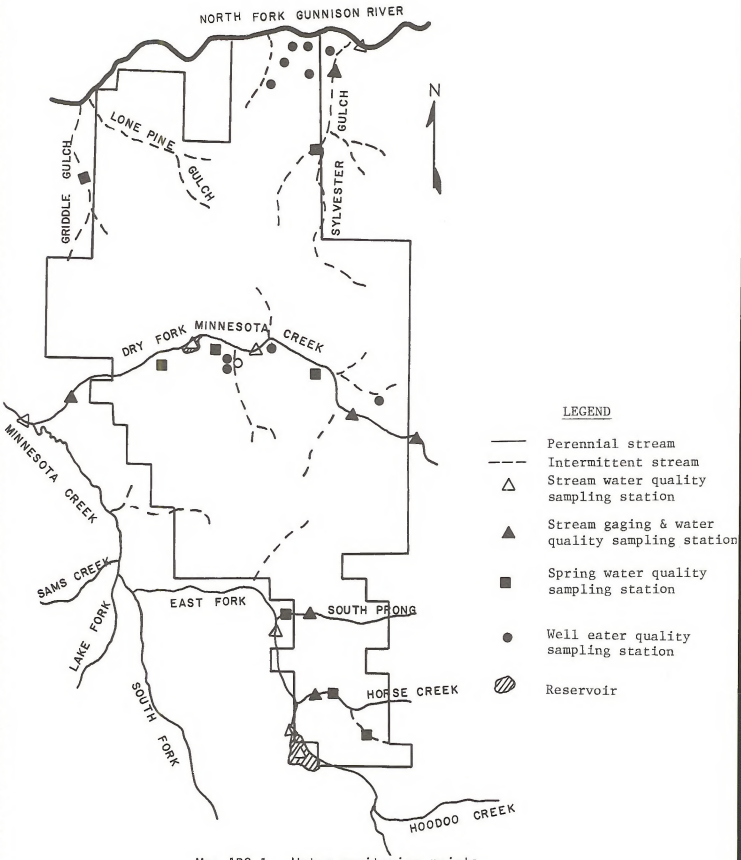
Minnesota Reservoir on the Dry Fork of Minnesota Creek is owned and operated by the Minnesota Canal and Reservoir Company. It has a decreed capacity of 1,285.28 ac-ft according to the Colorado State Engineer's water rights tabulation. Sedimentation, however, has reduced the actual reservoir capacity to about 500 ac-ft (Woodward-Clyde Consultants, written communication, July 1978). Table AR2-4 gives the historical water diversions through the Deep Creek Ditch and the volume yielded by Minnesota Creek for downstream irrigation. The average yield of the Deep Creek Ditch for the period 1950-77 was about 1,100 ac-ft/yr. During the same period, the average yield of Minnesota Reservoir was approximately 590 ac-ft/yr. Thus, during an average year almost half the water diverted into the reservoir through Deep Creek Ditch is lost to evapotranspiration.

Beaver Reservoir on the East Fork of Minnesota Creek is owned and operated by the Beaver Ditch and Reservoir Company and the Minnesota Canal and Reservoir Company. Records of the Colorado State Engineer show that it has a decreed capacity of 1,620.2 ac-ft of which 551.7 ac-ft is a conditional decree. Severe leakage below the dam has caused the state of Colorado to restrict the amount of water that can be stored to 1,330 ac-ft (a maximum depth of 80 feet) until the dam is repaired. The Colorado Division of Wildlife holds a 20-acre-foot conservation pool for a fisheries habitat, which means that the usable capacity of the reservoir is 1,126 ac-ft. The yield of Beaver Reservoir for the period 1950-77 is given in table AR2-5. During this period the average reservoir yield was approximately 680 ac-ft/yr.

A discussion of the water quality of the North Fork of the Gunnison River can be found in the regional analysis. In general, the North Fork is slightly alkaline with dissolved solids concentrations increasing downstream primarily due to agricultural return flows. Nutrient levels (ammonia, nitrite, nitrate, and phosphate) are not excessively high. With the exception of occasional high iron levels, there is no evidence of a serious dissolved metals content. In fact, the Colorado Department of Health classifies the North Fork of the Gunnison River as a B_1 quality water system.

Water quality data collected by Woodward-Clyde Consultants, Denver, Colorado, and by Ecology Consultants, Inc., Fort Collins, Colorado, for ARCO show that surface runoff from the lease area is generally good quality. Water in the upper Dry Fork of Minnesota Creek is a calcium, sodium, bicarbonate, sulfate type containing less than 200 mg/l dissolved solids. Water in Minnesota Reservoir is a calcium bicarbonate type containing 150 to 200 mg/l dissolved solids. Water in Dry Fork downstream from the reservoir, however, increases dramatically in TDS concentrations to as much as 1,100 mg/l, probably reflecting ground-water contributions and leaching by seepage from the reservoir. Magnesium content increases significantly and sulfate replaces bicarbonate as the dominant anion. The water is a calcium sulfate type with significant amounts of sodium, magnesium, and bicarbonate.

Water in Lick Creek is also a calcium, sodium, bicarbonate, sulfate type similar to that in the adjacent upper Dry Creek watershed. Dissolved solids concentrations range from 200 to 300 mg/l. South Prong and East Fork Minnesta creeks both have calcium bicarbonate waters containing 60 to 350 mg/l dissolved solids. Runoff in Sylvester Gulch contains 300 to 400 mg/l and is a sodium, bicarbonate, sulfate type. Water in the North Fork River is



Map AR2-1. Water monitoring points

TABLE AR2-3

HYDROLOGIC DATA FOR STREAMS DRAINING
THE MT. GUNNISON MINE LEASE AREA

Station	Station Number	Drainage Area (sq mi)	Average Annual Runoff (ac-ft)	(ac-ft/ sq mi)	(inches)	Peak Discharge (cfs)	(cfs/ sq mi)	Minimum Discharge (cfs)	Annual Suspended Sediment Load (tons)	(tons/ sq mi)
North Fork Gunnison River, North of Somerset, Colorado	09132500	531	315,200	593	11.00	7,860	15.00	17.00	17,506 b/	33
South Prong Creek, North of Beaver Reservoir a/	-	3.27	668	204	3.82	7.73	2.36	0.06	70 b/	21
Horse Creek, North of Beaver Reservoir a/	-	1.75	437	250	4.68	3.62	2.07	0.12	53 b/	30
Lick Creek, North of Beaver Reservoir a/	-	1.84	458	249	4.67	10.05	5.46	0	-	-
Upper Dry Fork, Above Minnesota Reservoir a,c/	-	1.02	187	184	3.45	9.96	9.76	0	10 b/	10
Lower Dry Fork, Below Minnesota Reservoir a,d/	-	7.53	258	34	0.64	7.74	0.51	0	53 b/	7
Sylvester Gulch, Above confluence of the North Fork Gunnison River a/	-	4.25	132	31	0.58	1.40	0.33	0	-	-

Note: sq mi = square mile; ac-ft = acre-feet; cfs = cubic feet per second.

a/ Only one year of record available (June 1977 through May 1978).

b/ Estimated from random grab samples.

c/ Natural flow of stream affected by transbasin diversion into the basin through the Deep Creek Ditch.

d/ Natural flow of stream affected by transbasin diversion into Ory Fork Basin through the Deep Creek Oitch and by storage in Minnesota Reservoir.

TABLE AR2-4

YIELD OF DEEP CREEK DITCH
AND MINNESOTA RESERVOIR

1950 - 1977

Year	Deep Creek Ditch Dates Used	Deep Creek Ditch Yield (acre-feet)	Minnesota Reservoir Dates Used	Minnesota Reservoir Yield (acre-feet)
1950	4/25-9/1	3,064	7/19-8/29	780
1951	5/10-9/15	1,524	7/16-9/10	778
1952	5/20-9/12	1,840	7/29-9/29	824
1953	5/10-8/21	1,236	7/15-9/9	666
1954	No records		6/25-8/2	591
1955	4/26-8/10	1,480	7/15-9/6	790
1956	4/20-9/1	1,534	7/15-9/7	662
1957	4/15-8/3	1,534	8/27-10/3	846
1958	5/1-8/10	634	7/16-9/9	604
1959	5/15-7/29	686	7/6-8/25	526
1960	4/1-7/10	920	8/7-9/19	584
1961	5/1-7/20	576	No records	
1962	4/28-8/10	1,150	8/17-9/5	480
1963	4/20-8/16	1,002	8/26-8/29	1,092
1964	5/1-9/2	864	8/23-9/13	562
1965	4/15-9/30	1,442	9/6-9/22	352
1966	4/10-8/25	1,864	8/7-9/11	438
1967	4/30-/8/30	1,326	8/20-9/9	120
1968	5/19-8/18	1,760	8/19-9/6	444
1969	5/1-9/7	1,243	8/15-9/7	474
1970	5/25-9/9	885	8/12-9/9	572
1971	8/1-9/30	169	7/14-8/3	475
1972	5/11-8/31	858	8/13-9/1	500
1973	6/11-10/31	639	8/16-9/14	441
1974	5/6-9/30	962	8/3-9/5	440
1975	7/7-9/15	196	8/23-10/31	1,386
1976	6/16-8/10	293	8/10-9/3	456
1977	5/2-6/16	89	6/20-6/26	79
	Average =	1,103 ac-ft.	Average =	591 ac-ft.

Data from Colorado State Engineer.

TABLE AR2- 5

YIELD OF BEAVER RESERVOIR

1950 - 1977

Date	Dates Used	Yield (acre-feet)
1950	5/20-11/1	244
1951	5/4-10/24	560
1952	5/1-11/15	523
1953	6/1-10/31	261
1954	4/10-10/31	406
1955	4/10-10/31	424
1956	5/1-9/7	480
1957	5/1-10/31	618
1958	5/1-10/31	412
1959	5/5-10/31	398
1960	4/15-10/31	424
1961	7/1-9/11	905
1962	7/16-9/9	885
1963	6/20-9/10	1,261
1964	7/4-9/30	349
1965	7/25-9/9	988
1966	6/30-9/6	818
1967	7/25-9/9	1,881
1968	7/7-9/28	1,064
1969	7/23-9/4	700
1970	7/17-9/20	796
1971	7/14-8/3	475
1972	6/15-9/8	123
1973	7/27-9/25	824
1974	6/21-9/10	860
1975	7/18-9/16	990
1976	7/2-9/11	1,119
1977	5/3-8/25	146
	Average =	676 ac-ft.

Data from Colorado State Engineer.

a calcium bicarbonate type with a dissolved solids concentration of less than 150 mg/l. No abnormal concentrations of trace elements were found in any of the above streams.

Erosion and Sedimentation

A combination of moderately permeable soils and a good protective plant cover, coupled with moderate grazing use, results in only moderate erosion on the lease area, despite the characteristically steep slopes. The minimal data available (table AR2-3) indicates an annual sediment yield from the tract of 20 to 30 tons per square mile. This is consistent with sediment yields measured from similar watersheds in coal areas in northwestern Colorado. On that basis, total sediment yield from the lease area should be about 500 tons annually. Since a large part of the sediment yielded by the Dry Fork of Minnesota Creek watershed is trapped in Minnesota Reservoir, sediment yield from the lease area to the North Fork River probably does not greatly exceed 400 tons per year.

Alluvial Valley Floors

The ARCO lease area extends northward to the south bank of the North Fork River and includes that part of the valley that lies south of the river. The lease area, therefore, includes a narrow strip of bottomland that qualifies as an alluvial valley floor as defined in 30(CFR): 710.5. Mining restrictions applicable to alluvial valley floors would not apply to ARCO's proposed operations, however, because the pre-mining land use on this part of the lease is the ongoing coal-mining operations of the Bear Mine and not farming or other agricultural activities.

Very probably the Dry Fork of Minnesota Creek, Lick Creek, South Prong Creek, and Horse Creek flow on alluvial valley floors within the lease area. These valley reaches would almost certainly be impacted by subsidence induced by mining, but they would not be disturbed by surface mining operations and their current and past use has been undeveloped rangeland. Mining restrictions applicable to alluvial valley floors, therefore, also would not apply to these parts of the lease area.

Soils

Soil units in the area of proposed surface disturbance are shown in figure AR2-4. Individual mapping units range from deep, relatively flat-lying alluvial deposits along the North Fork to shallow soils and rock outcrops on the steep side-slopes. Specific soil features of importance in assessing reclamation are rated in table AR2-6; the footnotes contain brief explanations of each rating. (See Water Resources for a discussion of erosion).

Vegetation

The vegetation within the coal lease area consists of six types: mountain shrub, Douglas fir, aspen, sagebrush, juniper, and riparian. The mountain shrub type is the most widespread and is present in all parts of the coal lease area. It is replaced at higher elevations by aspen, and on north and northeast slopes by Douglas fir. Aspen occurs generally above 8,000 feet, but may extend lower on northern slopes or along drainage bottoms. The sagebrush type is infrequent in the coal lease area; where present, it occurs on gentle slopes with well-developed, deep soil. A small area consisting of Utah juniper is present near the east fork of Minnesota Creek, on south and east-facing shale and sandstone outcroppings.

Mountain meadows are scattered throughout the lease tract. They consist of natural openings within the mountain shrub or aspen types or past clearings of native vegetation for dryland pasture.

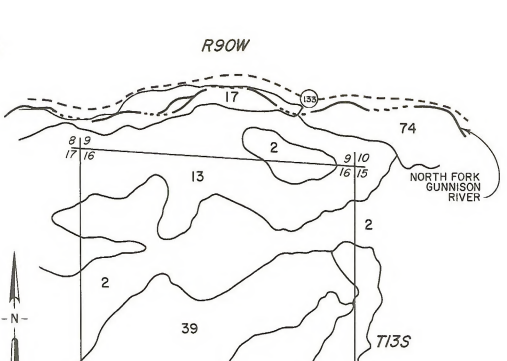
The riparian vegetation type occurs in drainage bottoms, and is characterized by narrow leaf cottonwood, box elder, and various species of willows. See Aquatic Biology for a discussion of aquatic habitat in the proposed mine area.

Map AR2-2 shows the general vegetation on the ARCO lease tract. A more detailed vegetation map of the lease tract may be reviewed in BLM's Montrose District Office.

A more detailed discussion of the plant species composition of these vegetation types, as well as their relationship to climatic and topographic features and to each other, can be found in the regional analysis. Scientific names of the plants are listed in the appendix, volume 3.

Endangered or Threatened Species

Information on the location of plants within the region that are proposed to be officially listed as endangered or threatened in the *Federal Register* (see table R2-10 in the regional chapter 2 for a list of the plants) was obtained from detailed literature searches (Rollins 1941; Barneby 1964; Higgins 1971; Hitchcock 1950; Arp 1972, 1973; Reveal 1969; Keck 1937; Howell 1944; Benson 1961, 1962, 1966; Weber 1961) and extensive herbarium surveys (University of Colorado, Colorado State University, Colorado College, Denver Botanic Gardens, Western State College, Rocky Mountain Biological Lab, Black Canyon National Monument, Colorado National Monument, and Grand Mesa/Uncompahgre National Forest Headquarters). This research has revealed that none of the plants are known to have occurred historically in the area of



MAPPING UNITS

- 2 Absarokee-Work loams, 6-25% slopes
- 13 Beenom-Absarokee Assoc., 20-60% slopes
- 17 Breece loam, 1-6% slopes
- 39 Fughes loam, 25-60% slopes
- 74 Torriorthents-Haplargids complex, very stony
- 75 Torriorthents-Rock outcrop, Sandstone, complex

Figure AR2-4. Soil units in the area of the proposed Mt. Gunnison No. 1 Mine

TABLE AR2-6

SOIL FEATURES FOR ARCO MINING AREA

Mapping Unit No.	Name	Hydrologic Group a/	Erosion Hazard b/	Topsoil Rating c/	Reclamation Limitations d/
2	Absarokee-Work loams, 6-25% slopes				
	Absarokee part	C	Moderate	Fair	Moderate
	Work part	C	Moderate-High	Fair	Moderate
13	Beenom-Absarokee assoc., 20-60% slopes				
	Beenom part	D	High	Poor	Severe
	Absarokee part	C	High	Fair	Severe
17	Breece loam, 1-6% slopes	B	Low-Moderate	Good	Slight
39	Fughes loam, 25-65% slopes	C	High	Fair	Severe
74	Torriorthents-Haplargid complex, very stony				
	Torriorthents part	B	Low-Moderate	Poor	Moderate
	Haplargids part	B	Moderate	Poor	Moderate
75	Torriorthents-Rock outcrop, sandstone, complex				
	Torriorthents part	D	High	Poor	Severe
	Rock outcrop part	-	-	-	-

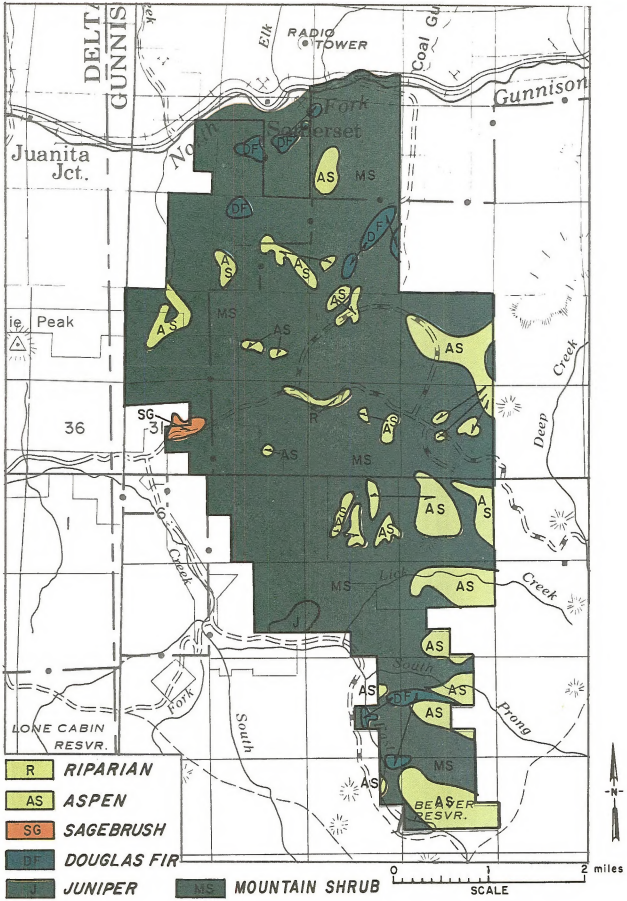
Note: Adapted from U.S. Dept. of Agriculture, Soil Conservation Service (Delta, Colorado), Paonia Area Soil Survey Report (Draft).

a/ Hydrologic soil groups (A, B, C, D) are based on the rate at which water enters the soil surface (infiltration) and the rate at which water moves within the soil (transmission). When both infiltration and transmission rates are high, little surface runoff occurs (Hydrologic Soil Group A). In contrast, low infiltration and transmission rates produce high surface runoff (Hydrologic Soil Group D). Groups B and C are intermediate.

b/ Erosion hazard refers to the potential for surface soil loss when existing cover is removed or seriously disturbed.

c/ Topsoil is rated both on suitability as a seedbed material and on ability to sustain plant growth. Factors considered include soil depth, texture, amount of coarse fragments, and the presence of excess soluble salts which may inhibit plant growth.

d/ Hydrologic soil groups, erosion hazard, and topsoil rating, along with climatic information, are considered jointly to determine an overall rating of the limitations for reclamation. Specific degrees of limitation are interpreted as follows: Slight - indicates either no significant limitations or those limitations which can be remedied through planning and management choices, such as species selection, time of seeding, or short-term exclusion of livestock and certain forms of wildlife. Moderate - indicates significant limitations which must be recognized but which generally can be overcome through established measures to conserve natural moisture, reduce erosion, and augment available nutrient supplies. Severe - indicates serious deficiencies in natural moisture and in the amount and quality of topsoil; may also indicate topographic and soil conditions which produce extreme surface erosion or landslide hazards.



Map AR2-2. Vegetative types in the area of the proposed Mt. Gunnison No. 1 Mine

the Mt. Gunnison Mine. The results of the literature and herbarium studies may be reviewed at the BLM Montrose District Office. A detailed floristic and endangered and threatened plant inventory of the natural vegetation that is expected to be disturbed by the Mt. Gunnison Mine facilities and roads has revealed that no endangered or threatened plants are present. The results of this inventory are available for public review at the Montrose District Office.

Wildlife

A listing of terrestrial species known or expected to occur on the tract is available from BLM's Montrose District Office.

Big Game

MULE DEER

The majority of ARCO's lease area is classified as mule deer summer range; there is also a small crucial wintering area in the lower reaches of Minnesota Creek (see map AR2-3). The greatest number of deer occurs on the lease area during the fall and spring migrations. Colorado Division of Wildlife (DOW) transects in the wintering area (Porter Flats) indicate the following deer days per acre: 1973--235; 1974--35; 1975--128; and 1976--111; average--99. The year of lightest use (1974) was such a severe winter that the deer were forced out of this area as well as the higher elevations.

Populations may fluctuate greatly from year to year as well as seasonally within the year, and population estimates are based on average numbers. Mule deer winter populations have been estimated at about 50 deer per square mile. This would indicate a total deer population within the ARCO lease area of about 150 animals during the winter months. Populations on the lease area appear to be on an increasing trend.

Mule deer use the mountain shrub, aspen, and spruce habitat types during the summer and primarily the mountain shrub type in the winter. The browse species in the wintering area are generally in very poor condition, especially on the south-facing slopes, which are most utilized by deer because of shallow snow depth in the winter and early melting in the spring. Some use is made of north-facing slopes during the winter months primarily by small resident herds of 5 to 10 animals.

ELK

Elk use the lease area primarily in winter, although there is a small summer range around Beaver Reservoir (see map AR2-4). Normally, over 200 animals winter on the lease area. DOW transects for five years show an average of 3.6 elk days of use per acre. Dry Fork of Minnesota Creek and the ridge to the north are usually the major concentration areas. The habitat types utilized by elk include mountain shrub, aspen, and spruce-fir year-round. The elk move off the lease tract to East Flatiron Mesa and the head of South Range Creek prior to calving in July.

Elk populations appear to be on a generally increasing trend in recent years. Elk winter population estimates in the general area of the ARCO lease indicate about 8 elk per square mile. This would result in about 1,606 elk inhabiting the general area during an average winter.

BLACK BEAR

Black bear generally utilize the riparian, aspen, and coniferous habitat types, which provide the best food and cover. The greatest concentration of bear is south of the main ridge between the Dry Fork of Minnesota Creek and the North Fork of the Gunnison River (map AR2-3). The rocky slopes in the vicinity of Minnesota Reservoir contain numerous caves, which are used for winter hibernation.

MOUNTAIN LION

Mountain lions are occasionally reported in the North Fork area. Although there have been no recent reports in the lease area, lions could occasionally use the area.

Small Mammals

The aquatic and riparian vegetation provides habitat for beaver and muskrat along the North Fork and the Dry Fork of Minnesota Creek. Raccoon, striped skunk, and weasel are associated with the riparian habitat.

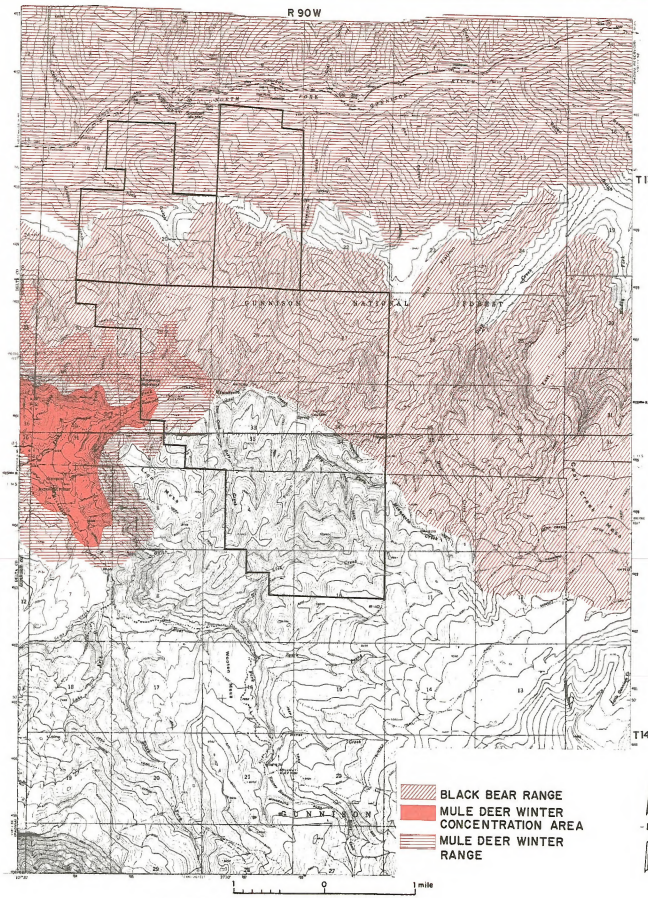
Cottontail rabbits are common in the drainage bottoms, utilizing sagebrush flats and pinyon-juniper hillsides. Snowshoe hares occur at higher elevations in the aspen, Douglas fir, and mountain shrub types.

Coyotes are common throughout the area; bobcat and badger are present but in fewer numbers. Ringtail cat, marten, and mink probably occur sporadically in the lease area.

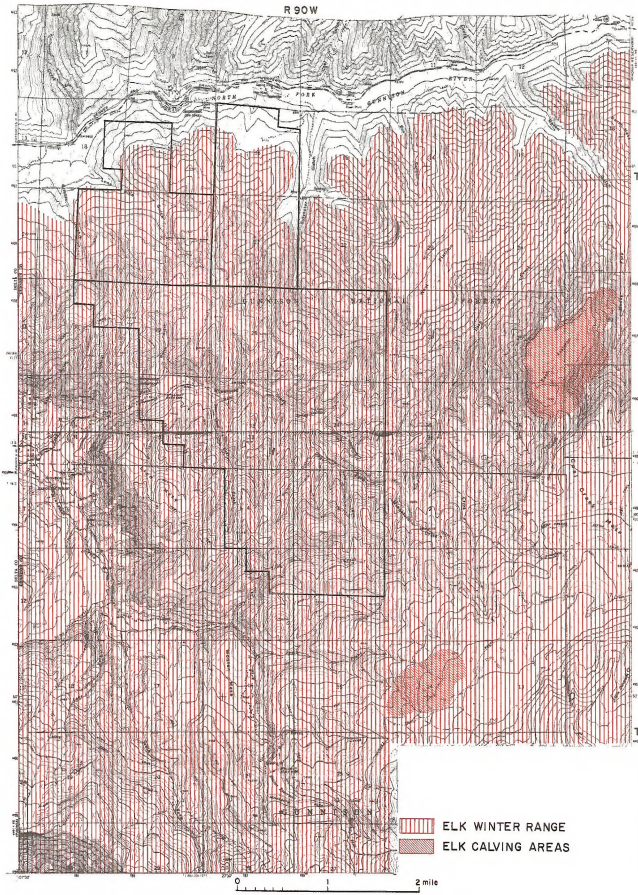
Trapping studies conducted in a variety of habitat types found the following small mammals in order of abundance: deer mouse, long-tailed vole, golden-mantled ground squirrel, least chipmunk, red-backed vole, rock squirrel, and western jumping mouse. The deer mouse was most abundant in mountain shrub habitat, while the golden-mantled ground squirrel was most abundant in upland big meadow habitat.

Game Birds

The mourning dove is the most common game bird in the lease area. It is present only during the



Map AR2-3. Wildlife ranges in the area of the proposed Mt. Gunnison No. 1 Mine: mule deer, bear



Map AR2-4. Wildlife ranges in the area of the proposed Mt. Gunnison No. 1 Mine: elk

summer, generally at lower elevations. Blue grouse occur at higher elevations, using stream courses as brood rearing habitat.

Waterfowl are limited to the North Fork of the Gunnison River and the East and Dry forks of Minnesota Creek. Mallards would be the primary breeding species, while common mergansers and common goldeneye would be the major winter users of the Gunnison River.

Other Birds

During the breeding season, eight species of raptors are found in the area; nesting activity has been confirmed for five species. The red-tailed hawk and Cooper's hawk are the most abundant breeding species. One golden eagle nest has been located on the tract on the south slope of Jumbo Mountain. During the winter, the red-tailed hawk and golden eagle have been most commonly observed, and bald eagles use the riparian community along the North Fork (see map AR2-5).

Over 50 species of songbirds have been observed on the tract. The aspen and riparian habitat types contain the greatest variety of bird life. Summer populations are greater than winter, with the robin and dark-eyed junco the most common winter residents, and the blue-gray gnatcatcher, yellow warbler, green-tailed towhee, and rufous-sided towhee the most abundant summer residents.

Amphibians and Reptiles

The number and abundance of amphibians and reptiles are relatively low on the lease tract. Few cold-blooded species can survive at the elevation and in the climate of the lease area. The sagebrush lizard and the eastern fence lizard are the most common reptiles. The gopher snake and the wandering garter snake are also expected to occur. The only amphibian that has been found is the chorus frog along the Dry and East forks of Minnesota Creek.

Endangered or Threatened Species

Bald eagles use the area primarily during the winter in the riparian vegetation along the North Fork. Although observations have been made of bald eagles during the time they would be nesting, no nest sites have been located.

Aquatic Biology

The ARCO site lies along the North Fork of the Gunnison River near Somerset. The tract boundary fronts on the south bank of the river for a mile. The tributaries of Minnesota Creek--the Dry Fork; Lick, Hoodoo, Horse, and South Prong creeks; and the East Fork--are the major drainages of the tract. Two reservoirs, Minnesota and Beaver, are also in the lease area. All of these resources are discussed below.

North Fork of the Gunnison River

The North Fork of the Gunnison River begins at the confluence of Anthracite and Muddy creeks, approximately 4 miles upstream from the proposed lease area. The river flows from east to west along ARCO's northern property boundary through a deeply incised canyon. With the exception of 1.2 miles of stream which cross national forest systems land and public land on or near the lease site, the North Fork channel is entirely privately owned.

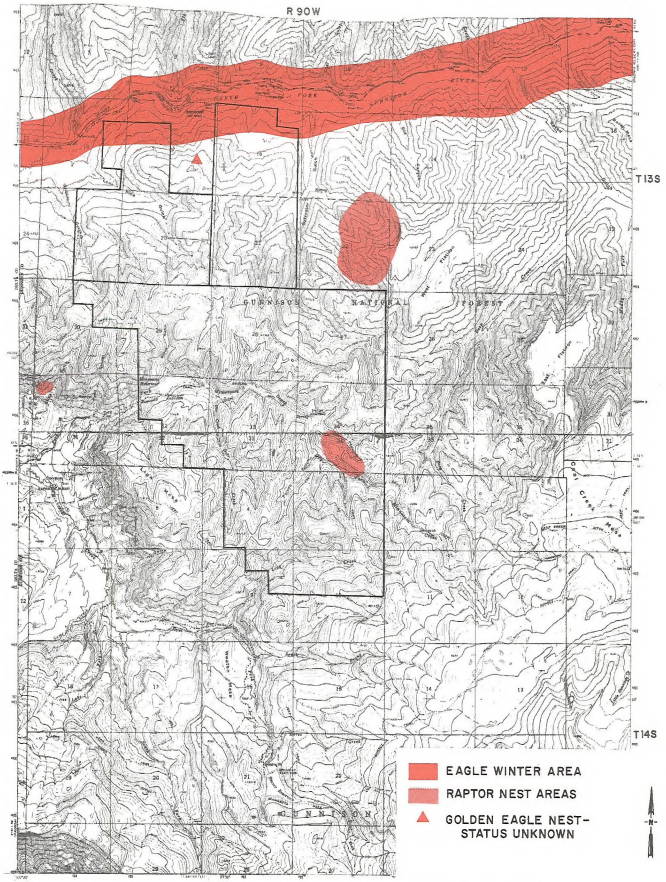
Surveys assessing the condition of the aquatic environment as indicated by macroinvertebrate populations show that the section of stream above Somerset is in good condition. Both numbers and species of aquatic organisms indicate an unstressed environment. Less than 1 mile below Somerset an irrigation diversion for the Fire Mountain Canal dewaters the river during low-flow periods. The water quality and physical habitat condition of the river from Somerset to Paonia could still support a fishery if a minimum stream flow were ever obtained for this section. Below Paonia the aquatic habitat is only in fair condition due to partial dewatering for irrigation and return of poor quality irrigation drainage water to the system.

Fish species in the North Fork vary with the location in the stream. From Paonia Reservoir downstream 5 miles to Somerset, the DOW stocks 2,000 catchable-sized rainbow trout annually. On downstream toward Paonia, cutthroat, rainbow, and brown trout occur, along with suckers, sculpin, dace, and northern pike (originally planted by DOW in Paonia Reservoir).

Below Paonia, the fish fauna shifts predominantly to suckers and minnows, with dace, sunfish, and northern pike occurring in reduced numbers. Below the Hotchkiss National Fish Hatchery and at the confluence with the main stem of the Gunnison there are popular fishing spots. Rainbow trout and brown trout along with a variety of other species are taken in these areas. The North Fork supports an estimated 2,000 angler days annually in the Paonia Reservoir-to-Somerset section and approximately 500 angler days annually throughout the rest of the river. (See regional chapter 2, Aquatic Biology, for more information.)

Dry Fork of Minnesota Creek

The Dry Fork is the northernmost tributary of Minnesota Creek and drains the middle region of the lease area. An irrigation control reservoir, Minnesota Reservoir, is located on the Dry Fork. Because the Dry Fork is a small watershed, most of the water used to fill Minnesota Reservoir each spring is diverted from Little Gunnison Creek, via



Map AR2-5. Wildlife ranges in the area of the proposed Mt. Gunnison No. 1 Mine: raptors

Deep Creek Ditch. Stream flows in the Dry Fork are greatly modified in terms of quality and time of discharge as a result of the diverted water.

There are 2 miles of stream channel below Minnesota Reservoir, 1 mile on private land and 1 mile on public lands. Due to the Dry Fork's extreme fluctuations in stream flow and its poor habitat, there are no resident fish populations nor does the DOW stock the stream. The limited invertebrate populations also reflect the poor quality of the environment.

Lick, Hoodoo, Horse, and South Prong Creeks

Lick, Hoodoo, Horse, and South Prong creeks are tributaries of the East Fork of Minnesota Creek which drain the southernmost region of the lease area. The creeks run through 3 miles of private land and 6 miles of national forest systems land. They are high gradient streams with substrates composed of large rubble to boulder-sized sedimentary rock; as a result, their stream flows consist of a series of rapids and small falls. Pool habitat is limited to small pools on the downstream side of large boulders, and, in general, the pools are too small and shallow to support fish. Summer stream flows in these streams are near 1 cfs. The main fishery value of these steams is the quality of water they discharge into waters downstream. Invertebrate surveys done on Horse and South Prong creeks show that the aquatic environment in these streams is good and not unduly stressed.

East Fork of Minnesota Creek

The East Fork of Minnesota Creek is the major drainage from the tract. Four miles of the stream channel are on national forest systems land, 0.5 mile is on public land, and the remaining 9.5 miles are on private land. However, 22 percent of the watershed is on public land. Beaver Reservoir, a small irrigation impoundment, is located on the East Fork just below Hoodoo Creek.

Stream elevations range from 9,400 feet at the headwaters of the East Fork to 6,042 feet at the confluence with the North Fork of the Gunnison River, giving an average gradient of 5 percent. Average spring discharge flows are 100 cfs; late summer and early fall flows, 5 cfs.

The fishery habitat of the East Fork is generally in good condition. Riparian growth provides good cover and shading; bank stability, pool quality, and substrate materials are excellent. Fish in the stream include minnows, suckers, and rainbow trout at lower elevations, sculpin, rainbow, cutthroat, and brook trout at middle and upper elevations. No fish are stocked in the stream by DOW; however, trout stocked in upstream irrigation reservoirs migrate downstream. Even though the stream has good roadside access throughout most of its length, angler use is light, with fewer than 500 angler days annually spent on the stream.

Reservoirs

The 17-acre Minnesota Reservoir is located on the Dry Fork of Minnesota Creek. It has a maximum depth of 50 feet and a storage capacity of 1,285 acre-feet; the lake has no fish.

The 80-acre Beaver Reservoir is located on the East Fork of Minnesota Creek. At design storage capacity (1,620 acre-feet), Beaver Reservoir would have a maximum depth of 86 feet; however, because of leakage, the maximum depth is restricted to 80 feet. Its maximum storage capacity is 1,330 acre-feet. To supplement the natural population of brook trout, the DOW stocks 3,200 rainbow trout fingerlings annually in the reservoir.

Both reservoirs are owned by irrigation companies. Because they are irrigation reservoirs, they have extreme seasonal fluctuations. They are at maximum level in late spring and early summer, are drawn down during late summer, and remain at a low level until the following spring. During the fall, winter, and spring, the surface area of each reservoir is often less than 3 acres. The DOW holds a 20 acre-foot conservation pool in Beaver Reservoir, but Minnesota Reservoir is occasionally drawn down nearly dry.

Endangered or Threatened Species

There are no endangered or threatened aquatic species in the proposed ARCO lease area watersheds.

Cultural Resources

Archeological Resources

An archeological inventory was completed on all areas that would be impacted as a result of dirt-moving procedures (Applegarth 1977). No archeological values were located. The lack of identified archeological values and the environmental constraints of the area indicate low site density for the Mt. Gunnison Mine lease area (Applegarth 1977).

Historic Resources

Areas of projected disturbance at the Mt. Gunnison Mine have been inventoried, and two historic homesteads have been located (Applegarth 1977). Neither site is considered eligible for the National Register of Historic Places; the State Historic Preservation Officer has concurred in this finding.

Land Use

The existing land use character of the North Fork Valley is an approximate balance of natural scenery and human development, with a gradual trend toward more development. The predominant

human land uses in the valley are agriculture, coal mining, recreation, and a small amount of urban development. Limited transportation, housing, and service facilities exist in the valley, and development potential is limited because of limited land surface. In addition, the Gunnison National Forest encompasses much of the mountainous region southeast of the valley.

The least developed portion of the valley is its narrow, winding eastern end, where the proposed Mt. Gunnison Mine would be located. The major developments at that end of the valley are four operating coal mines located on up the valley from the proposed ARCO site: the Blue Ribbon Mine (Sunflower Energy Corporation), the Somerset Mine (U.S. Steel Corporation), and the Hawksnest East and No. 3 Mines (Western Slope Carbon). In addition, in the general area of the proposed Mt. Gunnison Mine, U.S. Steel, Empire Energy, and Gulf Mineral corporations hold currently inactive federal coal leases, and several coal companies own private coal reserves. Nevertheless, much of the area still retains a predominantly natural, scenic character.

The land on which ARCO proposes to develop the Mt. Gunnison No. 1 Mine has been primarily used for livestock grazing, wildlife habitat, and some hunting. The Bear Mine (Bear Coal Company) is located on part of the land; it has been producing coal continuously since 1932.

West of the ARCO leasehold, townsites at Somerset and Paonia alternate with rural-agricultural land uses, as well as with old and new coal mines such as the Orchard Valley Mine (Colorado Westmoreland, Inc.). The valley widens as it goes west, and agriculture becomes the dominant land use, including irrigated cropland, pastureland, hayland, and some rangeland. The major residential-commercial developments at this end of the valley are centered around Hotchkiss and Delta.

Overall, agriculture, particularly orchards, is the major land use in the North Fork Valley. Delta County is one of the major fruit-producing areas in the state of Colorado.) All of the orchard land in the area may qualify as unique farmland, and some of this land in Delta County is in area which could meet the definitions of Prime and Unique Farmland under Agriculture in prime farmland (see the regional volume).

For a discussion of Delta County planning, see regional chapter 3, Land Use Plans, Controls, and Constraints. For a discussion of BLM and USFS planning relevant to the leasehold, see Interrelationships in chapter 1 earlier in this site-specific analysis.

Transportation

HIGHWAYS

The proposed Mt. Gunnison Mine site is located in the North Fork Valley near the town of Somerset. The nearest highway is State Highway 133, which is on the opposite side of the North Fork River from the proposed facilities. Plans have been made to improve this road in the vicinity of the ARCO property. In 1976 average daily traffic was 900 vehicles west of Somerset and 550 east of Somerset.

RAILROADS

A branch line of the Denver and Rio Grande Western Railroad (D&RGW) parallels State Highway 133 in the portion of the North Fork Canyon near the proposed mine. The branch serves other mines in the area, presently seven coal trains per week leave the North Fork. This branch connects with the D&RGW mainline near Grand Junction. Centralized traffic control would upgrade it to mainline capacity.

AIRPORTS

Montrose has the closest airport to the proposed mine with regularly scheduled airline service. Frontier Airlines and Aspen Airways provide flights to Denver; Frontier also flies to Grand Junction. The Grand Junction airport is also nearby and is served by Frontier and United Airlines. Smaller airports are located at Delta and between Hotchkiss and Paonia.

Livestock Grazing

The national forest systems land within the ARCO coal lease tract is part of the Dry Fork grazing allotment. Cattle are grazed on this allotment between June 16 and October 15 of each year.

Small parcels of public land within the coal lease tract are part of the Jumbo Mountain BLM grazing allotment. Cattle are grazed on this allotment from May 11 until June 15, when they are turned onto the forest.

The grazing privileges on ARCO's private surface are leased to Harold Ross and Neal Rinehart. They graze cattle on the land between June 16 and November 1.

The total animal unit months (AUMs) of grazing on the public, national forest, and private land are 1,793 AUMs for 12,578 acres. This is equivalent to 7 acres per AUM of grazing.

Recreation

Approximately 5,600 acres of the lease site are in the Gunnison National Forest. Approximately 1,200 acres of this area, on the eastern edge of the

lease, are being considered for inclusion into the U.S. Forest Service wilderness system (see map AR2-6).

There are no recreational facilities on the lease site. However, the site provides opportunities for dispersed activities, such as hiking, camping, hunting, fishing, and snowmobiling. The lease site is located within Big Game Management Unit 53, which provided 16,748 hunter days in 1976; table AR2-7 lists hunter days and numbers as well as species hunted. The lease site is also within Small Game Management Unit 66; table AR2-8 lists hunter days, etc.; however, because of the large size of the unit, figures may not indicate specific use on the lease site. (Refer to Wildlife in this chapter for the extent of the resource.)

The North Fork of the Gunnison provides a trout fishery, with populations of rainbows, cutthroats, and browns. The DOW stocks rainbow trout in Beaver Reservoir, and the East Fork of the Minnesota Creek derives a small fisheries potential from the stocked fish. (Refer to Aquatic Biology in this chapter for the extent of the resource.) The North Fork of the Gunnison has potential for river floating during the spring high water period, but during most of the year the water level is too low for such use (Colorado Division of Parks and Outdoor Recreation.

The Paonia State Recreation Area, located 8 miles east of the lease site, is operated by the Colorado Division of Parks and Outdoor Recreation. The main access to the area is north of the lease site and has a view of the proposed facilities location. The area provides a boat launch, picnic tables, camping sites, and vault-type toilets. The Paonia State Recreation Area had 15,225 visitors from July 1976 to June 1977 (Colorado Division of Parks and Outdoor Recreation 1977).

The nearby town of Paonia operates a park with a children's playground, a picnic area, and a basketball court. The school system maintains a softball field, a football field, and two tennis courts. The town is currently developing a large park adjacent to the Apple Valley estates. The town of Somerset is fixing up a building and yard for a community center and playground. Visitor use information for the Paonia-Somerset community facilities is not available.

For a comprehensive discussion of the recreational resources in the region, refer to regional analysis, chapter 2, Recreation.

Visual Resources

The existing landscape character of the North Fork Valley is a combination of natural scenery and cultural (coal) modification. The landform shape is a narrow river valley with sloping, partially terraced side slopes and steep escarpments. River benches and old alluvial formations make up the flatter areas adjacent to the North Fork River. Rock outcrops with horizontal stratification punctuate the vegetative cover at various elevations, displaying a dark tan color in the landscape. The vegetative cover is mixed, with riparian communities (cottonwoods near the river), mountain shrubs and pinyon-juniper on the lower slopes, and some aspen and Douglas fir stands on the higher slopes. The seasonal color change of the primarily deciduous vegetative cover is most vibrant in the fall.

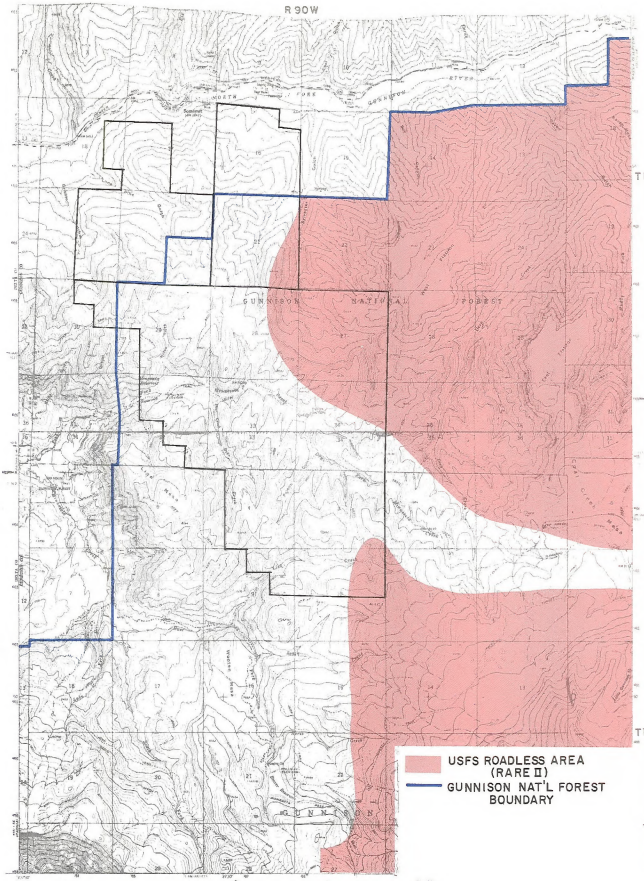
The landscape character of the project area is a heavily modified mountain landscape. At this stage of development, the natural and modified environments are in a rough balance. Although the houses, mine sites, and other structures (see figure AR2-5) are major landscape ingredients within the narrow valley environment, they do not as yet dominate the landscape because the building sizes are relatively small and in scale with the landscape and there has not been the major landscape alteration associated with large scale operations, such as cut-and-fill terracing. In addition, not all of the mines and equipment are visible from any one point on Highway 133, so that natural and modified vistas are intermingled. Nevertheless, the coal emphasis is beginning to dominate the landscape as new structures (loadout facilities, parking areas, storage silos, preparation plants, conveyors, etc.) are built. Moreover, the mines do attract visual scrutiny because they contrast with the local mountain landscapes and because the conveyors, mine portals, etc., can be interesting to those unfamiliar with mining operations.

The combination of mountain scenery, water presence, and foreground viewing zone has placed the eastern end of the North Fork Valley in a visual resource management (VRM) Class II, but the landscape that surrounds the Bear Mine complex has been isolated as a VRM Class V. This designation indicates the need for site reclamation prior to achieving Class II potential.

Socioeconomic Conditions

Demography

The Mt. Gunnison Mine site is located within Gunnison County about 1 mile east of the small, unincorporated area of Somerset. The steep terrain of this eastern portion of the North Fork River Valley has limited its development as a residential area. Somerset was originally established as a company town to serve what is now the U.S. Steel Somerset Mine. The 63 residences which constitute Somerset are now individually owned. Because almost all the land at Somerset which could be built upon is already occupied, the population has remained relatively stable for some time.



Map AR2-6. Recreational resources in the area of the proposed Mt. Gunnison No. 1 Mine

TABLE AR2-7

BIG GAME HUNTING IN BIG GAME MANAGEMENT UNIT 53

	Deer	Elk	Bear	Mountain Lion	Totals
Hunters	1,926	1,501	190	-	a/
Recreation days b/	7,801	7,422	1,525	-	16,748

Source: Colorado Division of Wildlife, 1976 Big Game Harvest.

a/ Hunter totals are not provided because hunting and trapping of more than one species are allowed.

b/ All or part of a day.

TABLE AR2-8

SMALL GAME HUNTING AND TRAPPING IN SMALL GAME MANAGEMENT UNIT 66

Animal	Hunters	Recreation Days a/	Animal	Trappers	Recreation Days a/
Ducks	249	977	Badgers	2	2
Doves and pigeons	366	1,093	Beavers	12	747
Pheasants	102	603	Bobcats	14	648
Grouse	830	1,890	Coyotes	25	886
Ptarmigans	131	349	Foxes	7	112
Rabbits	1,187	3,622	Martens	2	2
Squirrels	131	622	Muskrats	30	1,114
Coyotes	487	3,671	Raccoons	9	180
Marmots	346	649	Skunks	5	146
Porcupines	198	1,450			
Prairie dogs	267	1,527			
Magpies	213	1,501			
Crows	169	1,591			
Total	b/	19,585		b/	3,837

Source: Colorado Division of Wildlife, 1975 Colorado Small Game, Furbearer, Varmint Harvest.

a/ All or part of a day.

b/ Hunter totals are not provided because hunting and trapping of more than one species are allowed.

Figure AR2-5. Atlantic Richfield's proposed Mt. Gunnison Mine would be located on the slopes behind the existing Bear Mine.

All other populated areas within the vicinity of the ARCO site are in Delta County. Table AR2-9 lists the population for each incorporated town and each county census area within Delta County, for the 1970 and 1977 censuses. The table indicates that Cedaredge and Orchard City experienced the most rapid rate of population growth in the county over the past seven years, although many parts of the county grew rapidly. The table also shows that the median age of the population is falling throughout the county, indicating an inmigration of predominantly young people. However, older, retired residents are still a significant portion of the county population. While those 65 years or older are only about 8.5 percent of the total state population, they constitute 20 to 30 percent of the total population in most areas of Delta County.

It should be noted that the smaller towns and rural areas of the county have grown the fastest. This supports the idea that many persons are migrating to Delta County to live in a rural setting. That trend is also indicated by the number of large lot housing sites which have been developed throughout the county.

Community Attitudes and Lifestyle

The lifestyles in Delta County are of the American rural-village/open-country type. Low per capita incomes and remoteness from urban areas preclude elaborate lifestyles. Day-to-day life revolves around the family, jobs or farms, schools, school activities, civic organizations, and churches and church auxiliary activities. Recreational activities consist mainly of hunting, fishing, snowmobiling, skiing, attending high school sports events, T.V. viewing, driving cars or pickups for pleasure, and attending movies.

The rural, western attitudes of independence and self-reliance are prominent among county residents. Norms of neighborly cooperation and respect for neighbors' rights also exist. Cooperation is most conspicuous during times of crisis, e.g., family or natural disasters. In addition, the county residents have a great respect for the natural beauty, fertility, and remoteness of their valley.

Results of the Delta County Opinion Survey conducted in 1974 are discussed in the socioeconomic section of the regional volume.

Community Facilities

The unincorporated areas of Delta County have absorbed much recent growth. Many of these receive water from small independent water companies and have individual septic systems. The three landfills in Delta County are privately operated.

The present water facilities in Delta are being upgraded to improve service, and project 7 will greatly increase the supply of treated water. Improvement of the city's sewage treatment system is under study. The city operates its own electrical generating facility.

The town of Cedaredge is presently upgrading water facilities to serve an additional 2,800 people. The sewage treatment system is presently adequate for 2,800 people.

Hotchkiss is presently upgrading its water facilities to serve 3,000 persons. The present sewage treatment system is adequate for a population of 750.

Paonia is carrying out improvements to supply enough water for 2,900 additional people. Studies of the sewage treatment system are in progress. The town operates a volunteer fire department.

Community facilities in Delta County are discussed further in the regional volume. Figures AR2-6 and AR2-7 show the business districts of Delta and Paonia.

Housing

The Colorado Division of Housing estimates that housing units in Delta County totaled 6,610 in April 1976. The housing stock increased between 1970 and 1976 by about 12 percent or 735 additional units (see table R2-34, regional volume). Almost two-thirds of the increase in total housing units were mobile homes. Rental units constitute about 22 percent of the available housing units in Delta County. Local real estate people estimate that up to 200, or 3.5 percent, of the conventional houses are for sale. The 1977 special census listed 698 housing units as unoccupied; many of these, however, are in a deteriorated condition and unfit for habitation. Most communities in Delta County have limited area for new housing development within their existing boundaries.

In Paonia, Pan American Properties holds 83 acres, which they plan to develop in four phases, for a total of 240 new units. Presently, about two dozen homes have been completed or are under construction within the subdivision. Single family homes range in price from $35,000 to $38,000. The company plans to include some townhouse units, which will have a base price of $26,000.

In addition to this major subdivision, a number of other developments are in progress in and around Paonia. The Bonine Construction Company is building about 11 units on their property northwest of town. These units are designed as low-to-moderate-income units, priced between $25,000 and $30,000. Site development work has almost been completed on a 22-unit mobile home park north of town. There will be 19 homes available in the Fire Mountain Estates subdivision, now under construction on Pitkin Mesa. There are also plans for the construction of 24 single-family homes on the Bond property, south of town.

TABLE AR2-9

POPULATION STATISTICS

	Total Population 1970	Total Population 1977	Percent Change 1970-1977	Median Age 1970	Median Age 1977	Percent of Population Over 65 Years Old 1977
Delta County	15,286	18,949	24	39.6	35.2	18
Cedaredge	581	966	66	--	55.7	33
Cedaredge Area	2,992	4,347	45	45.6	43.5	23
Crawford	171	261	53	--	41.9	26
Delta	3,694	3,705	0	43.4	35.6	22
Delta Area	7,201	8,290	15	36.1	32.3	17
Hotchkiss	507	728	43	--	39.0	26
Hotchkiss Area	2,684	3,499	30	40.6	34.6	17
Orchard City	1,163	1,815	56	48.4	44.1	25
Paonia	1,161	1,276	10	47.1	37.1	22
Paonia Area	2,409	2,813	17	41.0	33.6	15
Somerset Area	264			48.5		15*

Source: U.S. Bueau of the Census, Special Census for Six Western Colorado Counties, 1977.

*1970 figure

Figure AR2-6. Business district of Delta, Colorado.

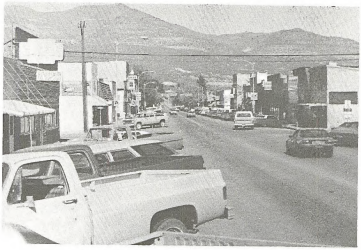


Figure AR2-7. Business district of Paonia, Colorado.

ARCO has purchased the Mott Ranch, south of the town of Paonia and outside corporate limits. The purchase included water rights, which were transferred to the town of Paonia in return for the provision of 400 water taps as they are required for development of the property. According to company representatives, housing development on the Mott Ranch will proceed only after other housing in the area has been exhausted.

Paonia, according to the city manager, does not have much vacant land within its boundaries which is suitable for new subdivisions. However, filling existing lots could provide some expansion of the housing supply. Paonia does not have a zoning ordinance.

Hotchkiss has recently annexed the Willow Heights Subdivision, which has 55 lots available in its second phase of development. Homes within this subdivision range in price from $26,000 to $50,000.

Housing in the town of Cedaredge has been expanding at the rate of three to five new homes per month over the past few years. Cedaredge is different from most towns in Delta County in that it has available land within town for substantial new housing development. Some 300 to 400 lots are now for sale. The Applewood Subdivision, with 74 mobile home sites, is under construction.

Near the city of Delta, there is significant housing development southeast of town on Garnet Mesa, where approximately 100 new houses are planned in two subdivisions over the next few years. Delta has also approved the Bonine Annexation; once subdivided, it will add about 160 homes in Delta.

The county is trying to restrict the development of county areas to large-lot subdivisions. The need for adequate water and sewer service should place more restrictions on the development of rural lands than there has been in the past.

Education

Public education is important within the individual communities. Each town takes pride in its own high school and the extracurricular activities offered there. The district-wide dropout rate is 6 percent, much lower than the national average of 25 percent. Many county residents are also taking advantage of the courses offered by the recently opened Delta-Montrose Area Vocational-Technical School.

Delta County School District 50(J) includes all of Delta County and small portions of Montrose and Gunnison counties, including the Somerset area. In spite of the expressed pride in the schools by area residents, District 50(J) does not have adequate facilities for the current enrollment. Many of the schools are over 50 years old and are overcrowed (see table AR2-10). The district has proposed the consolidation of some of the schools in the four communities into fewer sites, but the idea was defeated on a referendum vote. An $8 million bond issue for capital facilities construction was also defeated by nearly a two to one margin in the spring of 1976. The district is now employing a study group from the University of Northern Colorado to prepare a capital facilities improvement plan.

The district's mill levy (38.84 mills) is presently in the lowest 10 percent of school district mill levies statewide. The district has a bonding capacity of over $9 million, while outstanding debt is $61,000. The district's per pupil expenditure level is also low, compared to other school districts in the study area. The poor success of the district in generating more revenue locally is due to the refusal of voters, many of whom have low and/or fixed incomes, to authorize any increase in taxes.

Many of the facilities in the Paonia schools are inadequate to provide satisfactory education for the students. The elementary school consists of a metal building and three mobile home units that were erected in 1947. In the elementary school, the corridors are used for small groups; there are no central library, audio-visual, or media centers; or any indoor physical education facilities. In the junior high and high schools in Paonia, science facilities are less than minimum for adequate teaching, no art classes are offered, physical education facilities (including shower and storage facilities) are inadequate or nonexistent, and media and library facilities are limited. The cafeteria and outdoor facilities are used by all schools. Mobile home units relieve some of the overcrowding pressures on classroom facilities.

The schools in Hotchkiss are generally less crowded than those in Paonia. However, the elementary school has two grades at capacity and two over capacity, and one class meets all day in the corridor. In the junior/senior high school, the science area is inadequate, and the library facility is rudimentary. All grades from elementary through high school use the same cafeteria in the high school and the same outside play area.

The Crawford School, for elementary grades only, was built in 1913 for 120 students and has an enrollment of 130. The first and second graders meet in one overcrowded classroom, and all other grades are at capacity. Due to the age of the building, many of the wooden frame windows will not open; some of the electrical wiring is quite old; and outside woodwork, cement steps, and sidewalks need repair. The cesspools overflow every spring.

TABLE AR2-10

DISTRICT 50(J) SCHOOL FACILITIES

School	Building Age (Years)	School Site	September 1976 Enrollment	Design Capacity	Excess Enrollment
Garnet Mesa Elementary in Delta	18	12 acres	650	550	100
Lincoln Elementary in Delta	70	1 block	292	290	2
Delta Junior High	12	17 acres site for Junior and Senior Highs	360	290	70
Delta Senior High	57		715	625	90
Cedaredge Elementary	18	--	202	220	--
Eckert Elementary	66	--	144	100	44
Cedaredge Junior and Senior High	57	20 acres site for Elementary-High School	371	281	90
Hotchkiss Elementary	18	--	240	300	--
Hotchkiss Junior and Senior High	54	15 acres site for Elementary-High School	300	300	--
Crawford Elementary	65	--	121	120	1
Paonia Elementary	30	--	233	200	33
Paonia Junior High	73	--	247	225	22
Paonia High	18	6 acres site for Elementary-High School	322	230	92

Health Care

The Delta County Memorial Hospital District serves all of Delta County with a 32-bed hospital located just east of the city of Delta. The hospital is newly constructed, having opened its doors in December 1975. The current capital debt of the hospital district is $1.25 million, which is due to be retired in 1993. All county residents are assessed a 2.30 mill property tax levy for the purpose of retiring the debt on the hospital.

The hospital is supported by a staff of ten general practioners, all located in Delta County, and ten other doctors who offer part-time specialized services at the hospital. These part-time specialists reside primarily in Grand Junction or Montrose. The hospital also has a staff of sixteen full-time and eight part-time registered nurses (RNs), plus two RNs for surgery and one RN who works as an operating room technician. The hospital needs more family practice physicians, and has an informal arrangement with hospitals in Grand Junction and Montrose to handle cases which it cannot accommodate.

The average daily occupancy rate of the hospital has steadily increased since it opened. The hospital administration estimated that the occupancy rate will averaged 75 percent of capacity during 1977. Plans are being made to add fifteen beds to the hospital by the end of 1979.

Two doctors attached to the hospital reside in the Cedaredge area, and two other doctors operate the North Fork Clinic, with an office in Hotchkiss and one in Paonia. In addition, the county employs two public health nurses, who provide health services to the public schools and patients in their homes.

Three separate ambulance services operate out of Delta, Cedaredge, and the North Fork, with two vehicles each. These services are staffed with volunteers, trained in emergency medical procedures.

Delta County has three nursing homes which have a total of 170 beds for long-term care.

Mental health needs are served by offices of the Midwestern Colorado Mental Health Center, which has a main office located in Montrose. They have an office in Delta and a part-time office in Paonia. They offer out-patient services for a range of mental health problems including specialized services for children and the elderly.

Employment

Major employers in Gunnison County are government, trade, services, and mining. Agriculture has declined in importance since 1970 while other sectors have grown.

In Delta County, where most of ARCO's employees would live, agriculture is the largest employer. Other important sectors are government, trade, and services.

More detailed information about employment in these counties is contained in the regional volume. Data are not available on employment in political subdivisions smaller than the county.

Income

The proposed Mt. Gunnison No. 1 Mine would be located just east of Somerset in Gunnison County, Colorado. There is no information available on incomes in Somerset; however, the area is economically dependent upon Delta County. Per capita income in Gunnison County was $3,483 in 1974, the lowest in the seven-county ES area, and $330 less than Delta County's $3,813. Per capita incomes of both counties are substantially below the state level of $5,514 and the national level of $5,449. In Delta County, median family income at $7,550 was the lowest in the region, and 19.4 percent of the families were living on incomes below the poverty level.

Gunnison County is very dependent upon government (30.3 percent) and mining (24.0 percent) as sources of personal income. Wholesale and retail trade (16.7 percent) and services (11.8 percent) are also important. Other sectors and their proportional shares are: contract construction--4.4 percent; finance, insurance, and real estate--4.4 percent; agriculture--4.1 percent; transportation, communication, and public utilities--2.3 percent; manufacturing--2.0 percent; and other industries--0.3 percent.

People in Delta County are very dependent upon agriculture and government as sources of income. Government at all levels supplies 23.2 percent of personal income and agriculture supplies 22.1 percent. Other important sectors are wholesale and retail trade with 17.2 percent, services with 11.6 percent, and manufacturing with 10.0 percent. Other sectors of less importance are contract construction--5.7 percent; finance, insurance, and real estate--4.6 percent; transportation, communication, and public utilities--3.6 percent; mining--2.1 percent; and other industries--0.3 percent.

The regional economy and the relationship of Delta and Gunnison counties to other counties in the ES area are discussed in the regional volume.

FUTURE ENVIRONMENT WITHOUT THE PROPOSAL

If ARCO's proposed M&R plan is not approved and implemented, the Bear Mine, which is currently operating on federal lease D-044569 under an "assignment of operating interests" from ARCO, would continue its operation indefinitely. At the current rate of production, the mineable reserves "assigned" to Bear will be exhausted by 1981.

However, ARCO has indicated that additional reserves would be made available to Bear if ARCO's proposed M&R plan is not implemented. No information has been submitted concerning the specific changes in the existing operation which would be necessary if additional coal reserves are mined by Bear. It can be assumed that by 1980 the mining operation at Bear Mine will be required to comply with the environmental protection performance standards as required by the interim regulations of 30(CFR): 700, and that the operation will also comply with the regulations of the permanent program.

Additional facilities and employees could conceivably be required for Bear Mine to continue operations after 1981. However, the potential effects of this development cannot be predicted, since no information is available concerning possible specific changes. If, as is reasonably likely, the existing surface facilities are adequate for the support of underground mining and employment and production schedules remain at the 1977 level through 1990, then the land use around the mine would remain similar to present land uses, and air quality, water, soils, vegetative, wildlife, aquatic, and other resources would remain much the same. In addition, the following changes can be predicted.

The public land within the ARCO lease area would be converted to a three-treatment rest-rotation grazing system of livestock production, seed trampling, and rest, as proposed in the Jumbo Mountain allotment management plan.

The RARE II roadless area identified by the USFS (see map AR2-6 under Recreation, Existing Environment) may be classified as wilderness, which would allow only nonmotorized travel and recreation in that area.

Through 1990, vandalism and erosion would be the two major factors causing the loss of archeological values. It is doubtful that additional monies or employees would be available to retard this loss, although the Federal Land Policy and Management Act of 1976 will provide BLM with more protective enforcement authority.

Agriculture would probably remain an important part of the valley's land use, but coal mining would also increase somewhat. Several coal companies owning private coal reserves in the area may expand future operations onto adjacent federal coal. In addition, the Federal Coal Leasing Amendment Act of 1975 requires that inactive federal coal leases be developed or forfeited; diligent and continuous development criteria must be met by June 1, 1986. Therefore, U.S. Steel, Empire Energy, and Gulf Mineral corporations are likely to begin developing their inactive federal leases in the area by 1985 to at least meet diligent development-continuous operation requirements.

Delta County population is expected to continue to grow at a moderate rate to 20,600 people by 1980; 22,900 people by 1985; and 24,800 people by 1990. This growth would primarily be due to general improvement in the overall economic base of the county, to increases in the number of retired persons moving to the area, and to coal development. Unemployment is expected to remain a serious problem. Although incomes are expected to increase, most likely they will remain substantially below state and national averages.

With projected moderate growth, Delta County would be able to maintain an adequate level of public facilities and services. An additional 22.6 acres of community recreational facilities would be required in towns other than Paonia, which is cooperating with the Historic Conservation Recreation service to develop a recreation site near town. Some urban development may absorb agricultural land around population centers in the valley, but this expansion would depend largely on future planning and zoning on the part of Delta County.

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This mining and reclamation plan (M&R plan) was submitted for review prior to promulgation of interim regulations 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), and it does not fully reflect the requirements of the regulations. However, in this environmental statement (ES) the applicable interim regulations are being included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of the regulations. The Department of the Interior will not consider the M&R plan until Atlantic Richfield Company (ARCO) has redesigned it to incorporate the requirements of 30(CFR): 211 and 30(CFR): 700. Therefore, to the extent possible at this time, the following impact analysis assumes that the M&R plan will comply with the appropriate provisions of the Surface Mining Control and Reclamation Act. Impacts are analyzed at three time points: 1980, 1985, and 1990.

Air Quality

Emissions from the Proposed Mine

Mining activity at underground coal mines usually produces dust, an air pollutant, in environmentally significant amounts. Dust that is generated within the mine is not considered to have an environmental impact since it is continuously controlled and contained in the mine. However, surface facilities at mines also generate some dust which is released into the ambient air. Most of the dust is from fugitive emission sources; the term "fugitive" connotes that the dust escapes from an unenclosed surface as a result of wind erosion or mechanical action, as opposed to being released from a stack or process vent.

The potential sources of fugitive process emissions identified at the proposed Mt. Gunnison Mine include conveyors, transfer points, coal preparation plant, and train loadout of coal; and fugitive dust from the employee access road and wind erosion of the refuse pile. A common source of fugitive dust at underground mines not projected for the Mt. Gunnison Mine is haul roads; trucks are currently not planned to transport the coal.

The procedure used to estimate emissions from each of the potential sources was to (1) determine the activity rate of the pollution-producing operation, (2) multiply that activity rate by an emission factor based on sampling of similar operations, and (3) reduce the calculated emissions by an appropriate amount to account for control equipment or dust suppression measures to be employed on the operation. Activity rates and control measures were described in the Mt. Gunnison M&R plan. Emission factors for individual mining operations were obtained from Colorado Air Pollution Control Division (Colorado APCD 1978).

Table AR3-1 presents estimates of fugitive dust emissions at the Mt. Gunnison site from each of the identified sources in 1985, 1990, and 2007 (end of mine life). These values are annual emissions, even though the activities would not be continuous or uniform throughout the year. The estimates are judged to be accurate within a factor of two (Axetell 1978). The emissions in table AR3-1 represent initial emission rates (tons per year) of suspended particulate from the operations. Some of these suspended particles would fall out of the dust plume after they are emitted. This deposition is discussed further below.

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

Estimated emissions of carbon monoxide (CO), hydrocarbon (HC), oxides of nitrogen (NO_x), and sulfur oxides (SO_x) are shown in table AR3-2. These emissions are based upon rates per mile of travel (emission factors) which would decrease between 1985 and subsequent study years. In the case of Mt. Gunnison, the reduced emission rates would partially offset increased activity rates projected when the mine would be at full production in 1990.

The emissions of gaseous pollutants would not result in significant ambient concentrations on or near the proposed mine site.

Annual Average Air Quality Impacts

In order to assess the impact of air pollutant emissions on the environment, ambient concentrations of suspended particulate were predicted with an atmospheric dispersion model. The model used to predict average concentrations that would result from the mine's emissions was the Climatological Dispersion Model (CDM) (EPA 1973).

CDM is designed for use in level terrain. This application of CDM is subject to larger error and uncertainty than more routine applications, but it represents the best predictive modeling technique available. Because of the irregular topography at the proposed site, CDM is really only capable of predicting concentrations in the canyon or valley near where mining emissions would occur. The site-specific meteorological data reflected the prevalence of pollutant transport up and down the canyon from the mine. Because of the greater influence of the canyon on maximum concentrations near the mine, a separate model which considers reflection of the plume was used to predict maximum 24-hour concentrations. This short-term model is described in the next section.

The basic CDM model has been modified to incorporate a fallout function to simulate the deposition of the large suspended particulate as it disperses downwind. The fallout rates incorporated in the model were based on sampling data from several western coal mines and are functions of wind speed, atmospheric stability, and particle size.

The following input data are required for CDM: source locations; source emission rates; emission heights; locations where ground-level pollutant concentrations are desired; and frequency of occurrence of each of sixteen wind directions, six wind speeds, and six stability classes. Emission data were previously presented in table AR3-1. The six months of wind data collected at the Mt. Gunnison site were insufficient for modeling purposes (see chapter 2). Therefore, wind and stability data required for the model were obtained from the Grand Junction airport, which also has a prevailing wind direction from the east-southeast and strong east-west channeling.

Predicted increases in ambient concentrations resulting from Mt. Gunnison's operation in 1990 are shown on map AR3-1; map AR3-2 shows predicted cumulative concentration in the North Fork Valley. According to the isopleths on this map, the mine would increase annual average particulate concentrations by 5 micrograms per cubic meter ($\mu g/m^3$) in only a small area on the mine site near the preparation plant; concentrations are predicted to increase by at least 1 $\mu g/m^3$ for a distance of 0.3 mile north and south and 0.8 mile east and west from the surface facilities. Predicted impacts in 1985 would be slightly lower but are shown to occur in these same areas. Based on these concentrations, it is not anticipated that the emissions would cause significant increases in annual average concentrations outside the North Fork Valley.

The predicted impact of the mine would be much less than the primary and secondary air quality standards for suspended particulate of 75 and 60 $\mu g/m^3$, respectively. It would also be much less than the total air quality increment of 19 $\mu g/m^3$ allowable in Class II areas under the federal law concerning prevention of significant deterioration (PSD).

Maximum Short-term Air Quality Impacts

The dispersion model used to predict maximum 24-hour particulate concentrations assumed Gaussian distribution of particulates away from the plume centerline, a constant wind direction, and complete reflection of the plume off both canyon walls. The basic dispersion equation is described in detail in Turner 1970.

Several locations (receptors) up and down North Fork Valley from the proposed mine were specified in the model for prediction of ground-level concentrations. At each receptor, the contribution caused by each emission source at Mt. Gunnison was calculated separately; individual source contributions were summed to determine the total concentration at the receptor resulting from the mining operations.

Wind data taken at the mine site reveal that winds rarely blow up or down the valley for the entire 24 hours, but have a pronounced diurnal (daily) shift. The winds blew from a single quadrant only one day out of the six months of sampling. A 24-hour period with constant wind direction was assumed to produce the highest concentrations since downwind receptors would be in the plume almost continuously. Stable atmospheric conditions and moderate wind speeds (9 miles per hour during the day and 6.7 miles per hour at night) were also assumed for simulating maximum 24-hour concentrations.

The annual average emission rates from table AR3-1 were also used to predict maximum concentrations because no information was available on seasonal variations in production. Although it is expected that emission rates would vary somewhat throughout the year, the sources at Mt. Gunnison Mine would not be subject to great increases in emissions due to equipment malfunction or high wind speeds. Also, increased emissions at different sources would occur independently rather than simultaneously and would probably not occur at the same time as the most adverse meteorological conditions.

Predicted maximum concentrations from the mine in 1990 are shown in map AR3-3. With winds from the west, a concentration of 19 $\mu g/m^3$ is projected to occur about 0.2 mile up the canyon, near the eastern property line. Higher concentrations predicted at even closer distances are a result of simplifications made in the modeling exercise. At 1.3 miles downwind, maximum concentrations are predicted to be 1 $\mu g/m^3$. With winds from the east the maximum concentration is predicted to be 14 $\mu g/m^3$ (at 0.2 mile). These concentrations would be considerably less than the 24-hour primary air quality standard of 260 $\mu g/m^3$ and the secondary standard of 150 $\mu g/m^3$, and they are projected to occur only in the immediate vicinity of the mine. Maximum concentrations in 1985 would be 16 $\mu g/m^3$.

Because the short-term dispersion model involves prediction of extreme conditions for meteorology and emission rates, it is probably less accurate than the annual model.

Impact on Visibility

The addition of particulates into the atmosphere as a result of emissions from the mine would reduce visibility in the area. A calculation of the degree of visibility reduction depends on several parameters for which data are not available, the most important being size distribution of the particles. However, a rough approximation of visibility can be made based on suspended particulate concentrations. A relationship between these two variables in rural west-central Colorado has been empirically determined by Ettinger and Royer (1972); it is shown in figure AR3-1.

It should be emphasized that this relationship was developed with uniform atmospheric particulate concentrations, not near a plume of fugitive dust containing relatively large diameter particles. Also, it does not consider visibility reductions due to precipitation. Therefore, the equation is more likely to predict visual range over an averaging period of a year than for a short-term period such as 24 hours.

As indicated on map AR3-1, particulate concentrations in 1990 would be increased to a distance of 0.8 mile up or down the valley from the surface facilities. Along a line of sight up or down the valley from the mine buildings, concentrations would be increased an average of about 3.5 $\mu g/m^3$ over this limited distance. Using the equation above and a background particulate concentration of 28 $\mu g/m^3$, the estimated reduction in visual range on the mine site as a result of mining emissions would be about 4 miles on an annual basis. Because of the limited area of air quality impact, average visibility would not be affected significantly outside this 1.6 mile reach of the valley. Visibility reductions in 1985 would be even less than in 1990.

Geologic and Geographic Setting

Topography

Impacts of the proposed mining operation on the topography of the mine property would be minimal. The three major sources of topographic impacts would be excavation and earthmoving during construction of surface facilities; long-term use of the refuse disposal area; and surface subsidence due to subsurface withdrawal of coal reserves.

Excavation and earthmoving during site preparation for construction of surface facilities (including the refuse disposal area) would alter the natural topography of 77 acres by 1980, 91 acres by 1985, and 106 acres by 1990. These acreages represent 0.6 percent, 0.9 percent, and 1 percent respectively of the total project acres. The major impact would occur along the northern portion of the lease area where slopes are steep and north-facing; relief may approach 1,000 feet. Benching, grading, and leveling would be required. In addition, some areas may require blasting and cliff scaling. Level surfaces and cut-and-fill structures would replace the steep natural slopes for the 27-year mine life. The modified surfaces created would alter the drainage characteristics of the area, and both erosion and runoff would probably increase (see Water Resources and Soils). In addition, noise and vibration would add to the landslide and rockslide potential of the area.

Long-term use of the refuse area would gradually alter the surface topography of 14 acres by 1985 and 29 acres by 1990 (this acreage was included in the acreage disturbed by earth work, as discussed above). Currently, the relief over the area is 175 feet, and the average slope is 10 percent. Use of the refuse disposal area for the 27-year mine life would produce a small area of steepened (approaching 27 degrees) north-facing slopes and a larger area of gentle backslopes (less than 5 degrees). The maximum increase in surface elevation would be 150 feet, which would occur along the northern edge of the refuse disposal area.

A more significant impact on the mine property would be the subsidence caused by the mining operation. ARCO proposes to use room-and-pillar and longwall mining techniques in the Mt. Gunnison No. 1 Mine (see map AR1-2). Subsidence features would be similar in nature, if somewhat different in intensity. Where differences in impacts resulting from the different mining methods can be predicted, they are noted.

Approximately 9,528 acres (or 76 percent) of the mine property are underlain by recoverable reserves of the F seam. All of that area would be subject to the effects of subsidence. For the most

TABLE AR3-1

FUGITIVE DUST EMISSIONS AT THE PROPOSED MT. GUNNISON MINE SITE

Emission source	Emissions, ton/yr	
	1985	1990 & EML
Conveyor - 4 sections	52.5	60.1
Transfer points - 1 point	1.6	1.8
Preparation plant	1.3	1.4
Train loadout	0.3	0.4
Access roads	0.8	1.5
Exposed areas - refuse	6.0	8.6
- mine facilities (paved)	neg	neg
TOTAL	62.5	73.8

TABLE AR3-2

EMISSIONS OF GASEOUS POLLUTANTS FROM THE PROPOSED MT. GUNNISON MINE SITE

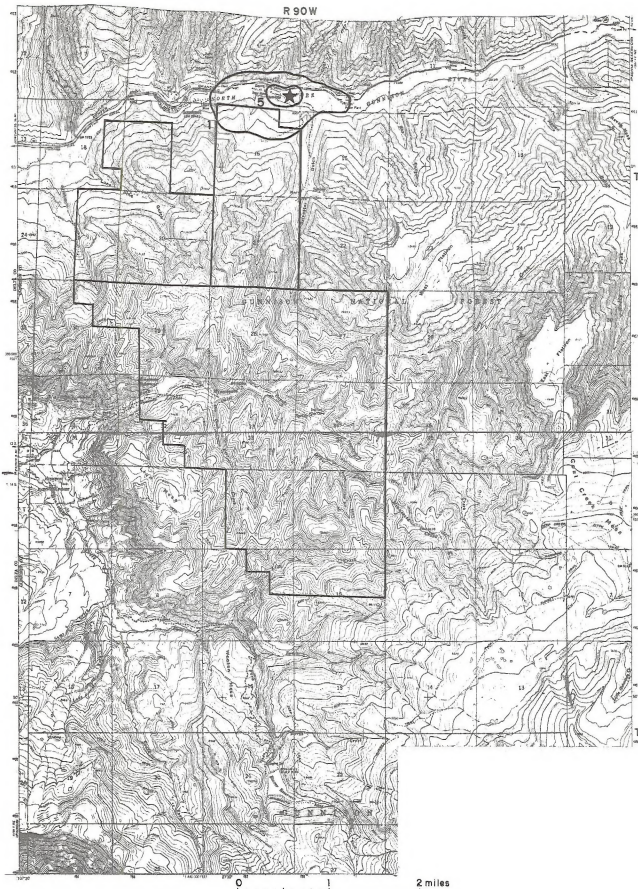
Year	Total emissions from vehicles, ton/yr			
	CO	HC	NO_x	SO_x
1985	2.0	0.2	0.3	neg
1990	2.1	0.2	0.6	neg

$$L_V = \frac{24}{0.2 + 0.007\,M}$$, where

L_V = Average visual range, miles

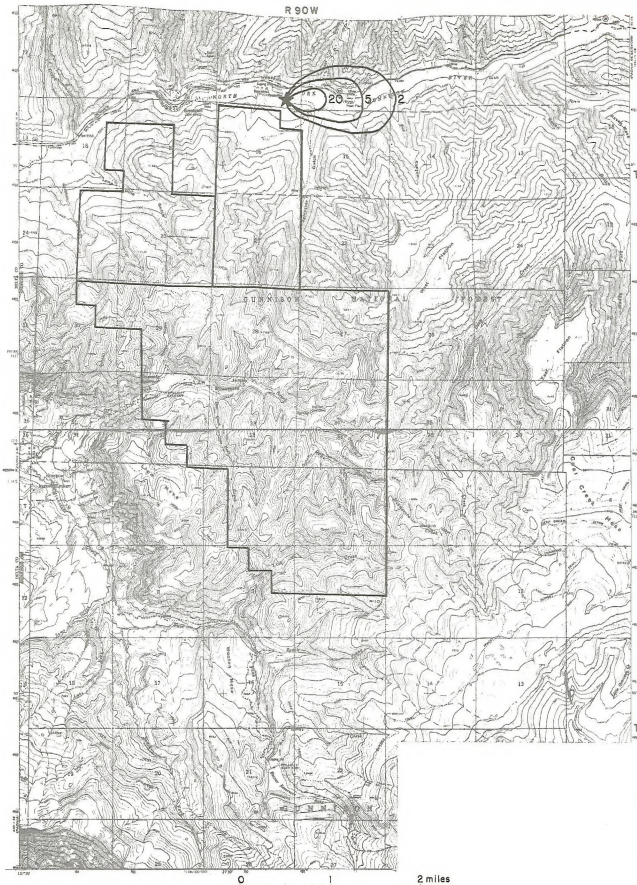
M = Average particulate concentration (micrograms per cubic meter)

Figure AR3-1 Relationship between visibility and suspended particulate concentrations in rural west-central Colorado (Ettinger and Royal 1972).



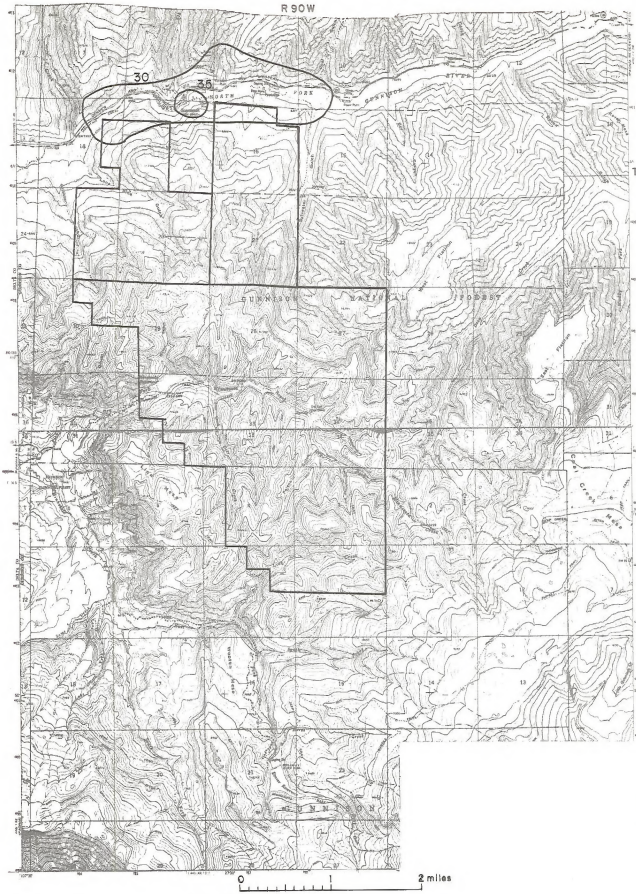
Map AR3-1. Predicted increases in ambient concentrations in 1990 (micrograms per cubic meter)

★ Surface Facilities



Map AR3-2. Cumulative concentrations from proposed actions in the North Fork Valley (micrograms per cubic meter)

★ Surface Facilities



Map AR3-3. Predicted maximum 24-hour concentrations in 1990 (micrograms per cubic meter)

part, subsidence features would develop over the period of several months to several years following the completion of mining in an area. However, these features, which would probably be permanent, could continue to develop for a period of decades after mining is completed.

For those areas in which longwall mining has been proposed, the maximum amount of vertical subsidence from mining the F seam was predicted using procedures outlined in the *Subsidence Engineer's Handbook* (1975). In areas where the overburden is shallow, that is less than 500 feet, a maximum subsidence of about 5.5 feet is expected. For the most part areas which lie under less than 500 feet of overburden are occupied by stream drainages or low ridges. Examples of these areas are the upper reaches of Lone Pine Gulch and Dry Fork of Minnesota Creek above Minnesota Reservoir and its upper tributaries. Because of the shallow overburden in these areas and the length of the longwall panels (from 3,000 to 6,000 feet) a large part of these areas could experience the maximum amount of subsidence. In areas underlying major ridges where overburden reaches thicknesses of from 1,000 to 1,500 feet, the maximum amount of subsidence is estimated to be approximately 2.5 feet.

It is more difficult to predict the maximum subsidence that would occur as a result of the room-and-pillar mining proposed for irregular areas along the coal outcrop. However, a study (Dunrud & Osterwald, 1978) of the subsidence occurring at the Somerset Mine just 2 miles west of the proposed mine site shows that the maximum subsidence on completion of room-and-pillar mining is approximately 70 percent of the thickness of the coal mined. In this case, the maximum amount of subsidence could then be expected to be about 5 feet. This estimate is approximate because the Somerset Mine is operating in the B seam, which lies 400 feet stratigraphically below the F seam.

Subsidence impacts would occur in the coal seam, through the overburden, and the surface. Among these impacts would be the rubblization of the beds overlying the coal seam, the fracturing of overlying strata, and the appearance of tension cracks and compression features at the surface. These features are discussed below.

The most significant surface subsidence features would be the formation of tension cracks. These cracks would extend upward from the mined area to the surface above barrier pillars or wherever coal has been left in place during the mining operation. Cracks occur because the pillars are not strong enough to support the weight of the overburden completely. They tend to orient either parallel or perpendicular to the length of the barrier pillar. Studies of the Somerset area show the existence of cracks up to a maximum of 1.5 feet wide and several thousand feet long. Similar features in the surface overlying the Sunnyside Mine in Utah are 3.5 feet wide. On the Mt. Gunnison Mine property, subsidence cracks could be expected to migrate to the surface and appear generally above the barrier pillars through about 500 feet of overburden. Cracks should appear above both the longwall and room-and-pillar mining areas. Figure AR1-2 shows the proposed location of barrier pillars to be left during longwall mining. Although the position and widths of pillars to be left by the room-and-pillar mining have not been shown on Figure AR1-2, pillars can be expected to be more numerous, more regular, and not as wide as in longwall mining. Greater numbers of expansion cracks would be expected to occur above the room-and-pillar areas. These cracks would begin forming a few months after the onset of mining and would continue for several years after mining has been completed.

It should be noted that concentration of tension cracks commonly occur in areas where the amount (maximum) of subsidence changes rapidly over short distances--that is, where overburden thickens rapidly as on steep slopes adjacent to drainages that also coincide with the position of barrier pillars. In these cases, not only could the cracks be more numerous and wider but some offset of the sides could also be expected.

In areas which have several feet of soil or colluvium, subsidence cracks may be rapidly erased by erosion of these materials. In some cases, the cracks may never appear at the surface because of the bridging effect of overlying materials. However, in time depression pits may form by collapse of soil into underlying cracks. Depression pits are usually circular in form and as deep as overlying soil. Studies in the Somerset area indicate that they commonly appear a year or two after mining, but may take much longer. The actual formation of a subsidence pit may be very rapid and may occur without warning.

While these cracks are forming at the surface, impacts would also be occurring in the under-lying strata. The Mt. Gunnison Mine has been designed so that the long direction of the longwall panels approximately parallels the major joint system of the area. This orientation provides the operation certain advantages at the working face. However, stresses caused during mining could be accommodated by movement along the existing joint system rather than creating new fractures. Overlying strata could be more responsive to these stresses because the overburden would be less structurally cohesive. More overall movement could occur: the entire joint system in the overlying strata would be realigned extensively as a result. This could cause

major impacts to the groundwater system in the area.

In addition, subsidence induced by mining could increase air circulation at depth through fracturing. Increased circulation of the air at depth would allow spontaneous heating and combustion of the coal beds including the seam being mined and all the overlying seams. The burning of coal beds in the Bowie area has occurred naturally under overburden depths as great as 600 feet (Louis Gaspar, Coors Beer Company, personal communication). Dunrud and Osterwald (1978) have noted that these fires are common in operational coal mines in Colorado and Utah. Once begun, fires frequently continue burning for years after the mines have been sealed. In some cases danger may exist that the fire will reach the surface and cause wildfires there. A danger also exists that any fire in an underground mine may spread and consume large areas of adjacent coal reserves.

Finally, a potential exists that subsidence on unstable slopes would induce landslides (that is rockfalls, slides, slumps, and earthflows). The Mt. Gunnison Mine property, especially along its northern portion, shows some indications of mass movement. Subsidence may aggravate natural processes in this area. If landslides did occur, the transfer of weight caused may trigger further local subsidence.

Paleontology

Plant, invertebrate, and vertebrate fossil materials would be destroyed, disturbed, or removed as a result of coal mining activities, unauthorized collection, and vandalism. The primary impact would probably result directly from the mining operation. Given the overall character of the stratigraphic column, it is probable that some fossils would be destroyed. However, this stratigraphic section is only moderately likely to yield significant fossils when compared with other parts of the ES area.

All exposed fossil-bearing formations within the region could also be affected by increased regional population. The extent of this impact cannot presently be assessed due to a lack of information on such activities.

As a result of the above impacts, an undetermined number of fossils would be lost for scientific research, public education (interpretive programs), etc. On the other hand, as a result of development, some fossil materials would also be exposed for scientific examination and collection. Due to the present lack of data and accepted criteria for determining significance, the importance of these impacts cannot presently be assessed.

Mineral Resources

Coal

The mining of 59.4 million tons of recoverable coal reserves over an estimated 27-year mine life would result in the depletion of a nonrenewable energy resource. The longwall method of mining would result in the recovery of 80 to 100 percent of the longwall panels with an overall reserve recovery of 50 to 60 percent of the in-place coal reserves (118.7 million tons) in F seam. The coal is expected to be transported out of the area to utility plants for the production of electrical energy.

Oil and Gas

If oil and gas are discovered under the leased land, a settlement must be reached between the well owners and the owners of the coal leases as to which nonrenewable energy source would be produced first.

Water Resources

Ground Water

Observation wells show that the F coal seam is saturated away from the outcrop and that groundwater movement is northeastward downdip. Discharge through the proposed mine area is estimated to be about 40 gallons per minute (gpm), all of which is dissipated near the outcrop area by evapotranspiration. The Bear Mine currently intercepts 10 to 15 gpm in the underlying C coal seam which, because of its greater depth, should receive less ground-water recharge than the overlying F seam.

Initially, the mine should intercept very little ground water, the amount increasing progressively to the inferred 40 gpm as development progresses and the entries for the longwall panels are completed. It is very possible that somewhat more than 40 gpm could be obtained from fractures that may intercept water from overlying aquifers. Because of the decreasing head with increasing depth, however, it is highly unlikely that any water would enter the mine from aquifers underlying the F seam. Use of all the water intercepted during the early stages of mining through 1985 and possibly until 1990 should have little or no effect on the surface-water resource, either in Minnesota Creek and its tributaries or in the North Fork River.

As mining progresses, however, and longwall panels are mined to their maximum length, the induced caving would almost certainly cause extensive fracturing of overlying rocks followed by some subsidence at the surface. The development of open cracks to the surface (Dunrud 1976) would intercept ground water in overlying aquifers and may even divert surface runoff directly into the mine. Alignment of the longwall panels with their

maximum length northeastward (map AR1-2 in chapter 1), coinciding approximately to one of the principal directions of fracturing in the area, can be expected to significantly increase the probability of subsidence and the extension of elongate fractures to the surface. The location of longwall panels beneath the Dry Fork of Minnesota Creek upstream from Minnesota Reservoir and their orientation transverse to the direction of streamflow would almost certainly cause subsidence and fracturing that would largely disrupt the flow in that stream. Similarly, major disruptions of flow can be expected on Lick, South Prong, and Horse creeks. Because the F seam crops out in valley side slopes above the levels of Minnesota and Beaver reservoirs, no subsidence or fracturing as a result of the proposed mining operations should threaten the stability of these structures. Subsequent mining and removal of the underlying E, C, and B coal seams would very probably severely impact these structures, but those beds would not be disturbed under this proposal.

Ground water entering the mine during the development phase should be a sodium bicarbonate type with dissolved-solids concentrations of 1,000 to 1,500 milligrams per liter (mg/l). Discharge probably would not greatly exceed 40 gpm through 1985. Presumably, ARCO would obtain a water right and use all of this water in its mining operations. Discharge into the mine can be expected to increase progressively as mining progresses and fracturing of the overlying aquifers occurs. Inflow by 1990 would probably not greatly exceed 1 cubic foot per second (cfs) or about 450 gpm. Dissolved-solids concentration should not change appreciably from that described above. Calcium, magnesium, and sulfate can be expected to increase at the expense of sodium and bicarbonate. ARCO probably would continue using all of this water with no adverse impacts on the North Fork River or on other streams traversing the lease area. As mining progresses after 1990, however, open fractures would probably reach the surface and actually intercept surface runoff. Also, many springs would probably cease flowing as water is diverted into the mine. The effect would be to increase discharge from the mine significantly, possibly to as much as 10 cfs. This water probably would be a sodium, calcium, magnesium, bicarbonate, sulfate type containing 500 to 1,000 mg/l dissolved solids. Since most of this water must be discharged to the North Fork River, the effects would be both beneficial and adverse. A significant amount of water previously lost to evapotranspiration would be conserved and used to augment flow in the North Fork River. However, that water would introduce as much as 2,000 tons of salts into the river system annually, thereby increasing salinity problems downstream.

On completion of mining, cracks exposed at the surface would fill with sediment, especially in the bottoms of drainage courses, and fine-grained particles would effectively reduce infiltration at the surface. At depth, however, the fractures would continue to drain overlying aquifers into the highly permeable rubble zone left by mining. The loss of springs would generally be permanent. Flow from the mine probably would decrease to 1 to 2 cfs, but the dissolved-solids concentration can be expected to increase to about 2,500 mg/l as overlying rocks are partially drained and thereby subject to increased leaching as the ground-water environment is locally changed from reducing to oxidizing conditions. The effect would be to add about 3,000 tons of salts annually to the river system over the long term. The impact on the North Fork River is discussed under Surface Water.

Mining would have no effect on the level of saturation in aquifers underlying the F seam or in alluvium along the North Fork River or along Minnesota Creek downstream from the lease boundaries. Therefore, no existing wells would be adversely affected by the proposed action.

Surface Water

ARCO has conditional water rights from the state of Colorado for 12,028.05 acre-feet per year (ac-ft/yr) or an average flow of 16.6 cfs from the North Fork drainage (table AR1-1 in chapter 1). In addition, the company intends to apply for water rights on any ground water intercepted by the mine (written communication, ARCO, October 1978). At maximum production, however, total water consumption by the mining operation would be about 960 ac-ft/yr, which is an average flow of only 1.33 cfs or about 600 gpm. Because the surface water rights are junior to those of other downstream users, the company cannot divert water from the river during low flow. It proposes, therefore, to divert water only during the high-flow stage and to store that water in facilities located on the lease tract. If so, any impact on aquatic biology or water use downstream should be insignificant. More probably, the company would need additional water only during the initial stages of development. Thereafter, ground-water discharge from the mine should be more than adequate for the proposed operation.

Interception and diversion of surface water into the mine as a result of subsidence and associated fracturing of strata overlying the F seam are discussed under ground-water impacts. Depletion of surface runoff in all streams on the lease area should be minimal prior to 1990. Thus, ARCO would have an adequate period to monitor the

flow in these streams as required by 30(CFR): 717.17(b). Mitigating measures could be initiated as soon as any reduction in surface flow is apparent in an affected watershed. Despite these mitigating measures, however, it is possible that flow in any given stream could be entirely depleted for a period of weeks or months following local subsidence. This could significantly reduce the amount of runoff reaching Minnesota Reservoir and annual discharge in Minnesota Creek during a critical runoff period. Beaver Reservoir should not be impacted inasmuch as mining would not occur beneath any of its contributing streams. It is stressed here, however, that ARCO must replace the water supply of all owners of interest in real property who obtain all or part of their water supply from underground or surface sources where that supply has been affected by contamination, diminution, or interruption proximately resulting from coal mining operations by the company (30[CFR]: 717.17[i]).

The principal long-term impact of mining on surface water, other than to existing water rights as described above, would be the perennial discharge from the mine and plant area to the North Fork River. Required treatment consistent with the requirements of a National Pollution Discharge Elimination System (NPDES) permit and effluent standards set by 30(CFR): 717.17(a) would effectively control all but the increase in dissolved-solids concentration. The effect of increased salinity on the river would be insignificant during high flow, but during low flow the dissolved-solids concentration of the river could increase from less than 200 mg/l to as much as 400 mg/l. Water type would probably change from calcium bicarbonate to sodium, calcium, bicarbonate, sulfate with a corresponding increase in the sodium absorption ratio and possible adverse impacts on downstream use.

Construction of the access road south of the North Fork River may impose a potentially severe impact on the river water. The proposed asphaltic concrete surface should minimize erosion and consequent sediment loading of the river, but oil and grease concentrations may increase in the river, depending on the condition of vehicles using the road. Old leaky cars and trucks would drip more oil along the roadway than newer clean cars and trucks.

Population increases in the North Fork Valley attributable directly and indirectly to the proposed mining operation are estimated to be 400 persons by 1980; 1,800 persons by 1985; and 3,100 persons by 1990 (Socioeconomic Conditions). Assuming an average water use of 200 gallons per day per person, sewage effluent of 60 gallons per day per person, and an increase in dissolved solids of 200 mg/l in the sewage effluent, water and sewage treatment requirements and the increase in the dissolved-solids load to the river are summarized in table AR3-3. Paonia has an excess capacity of about 625 acre-feet of municipal water over current needs and, therefore, could probably accommodate the projected population increase without serious impact to its facilities.

Based on the foregoing assumptions and computations, the proposed mine should have a negligible impact on the salinity of the North Fork and Colorado rivers by 1990. With the onset of subsidence and ground-water drainage from the mine to the North Fork River, however, the dissolved-solids concentration in the Colorado River below Hoover Dam can be expected to increase by as much as 0.21 mg/l, which would be an increase of about 0.03 percent. As small as this amount may seem, any increase in the salinity of the lower Colorado River water is regarded as a serious impact.

Erosion and Sedimentation

Regulations 30(CFR): 717.17(a) limit the total suspended solids in runoff from areas disturbed by underground mining to 45 mg/l maximum allowable except for discharge from a precipitation event larger than 10-year/24-hour recurrence intervals. The average of daily values for 30 consecutive discharge days cannot exceed 30 mg/l. Sediment control structures installed to meet these effluent standards must be designed, constructed, and monitored so as not to fail during the expected life of the operation. At a minimum, spillway systems must safely discharge runoff from a precipitation event with a 25-year recurrence interval or larger event as specified by the regulatory authority (30[CFR]: 717.17[e][4]).

Approximately 77 acres would be disturbed for surface facilities by 1980, 91 acres by 1995, and 106 acres by 1990, with a total disturbance of 140 acres after 1990. Premining sediment yield from 140 acres on the lease tract is estimated to be about 5 to 10 tons per year. Sediment control structures should reduce that amount to less than half a ton per year over the life of the mine. The beneficial impact of this small reduction in sediment yield to the North Fork River would be negligible.

The effects of local subsidence on erosion and consequent increased sediment yield downstream are highly speculative. Increased erosion may occur along the steepened sides of subsidence areas and gullies may develop along fractures, but the derived sediment would probably be deposited in local depressions caused by the subsidence, with no significant impacts downstream.

Construction of a railroad siding between Colorado State Highway 135 and the North Fork River must be done so as to prevent additional contributions of suspended solids to the river to the extent possible, using the best technology currently availa-

TABLE AR3-3

WATER AND SEWAGE TREATMENT REQUIREMENTS AND SALT LOAD RETURNED TO NORTH FORK RIVER

Item	1980	1985	1990
Population Increase (persons)	400	1,800	3,100
Required Increase in Treated Water Supply (ac-ft/yr)	90	400	700
Required Increase in Sewage Treatment Facilities (ac-ft/yr)	27	120	210
Consumptive Use (initial use less sewage effluent)(ac-ft/yr)	63	280	490
Increased Salt Load Returned to River (tons/yr)	7	33	57

ble (30[CFR]: 717.17[k]). Thus, increased sediment yield to the river should be minor and should be limited to the construction phase.

Perhaps the largest unmitigated short-term source of sediment yielded to the river net as a result of the proposed mining operations would occur off-site in conjunction with housing and related construction to accommodate the increased population. Approximately 34 acres would be disturbed by 1980, 153 acres by 1985, and 264 acres by 1990. It is estimated that sediment yield to the river net would be increased about 1 ton per acre disturbed for the first one to two years after construction. Thereafter, sediment yield would decrease to about half the predisturbance rate. The initial increase in sediment yield, therefore, should be more than offset by the long-term reduction in sediment yield over the life of the structures. Any temporal adverse or beneficial impacts stemming from this comparatively small change in sediment yield to the North Fork River would be insignificant.

On completion of mining and reclamation of disturbed areas, erosion and sedimentation should return to essentially premining rates. Location of the refuse disposal area away from any water courses, coupled with the proposed stabilizing measures, should be adequate to insure essentially long-term stabilization. Very little sediment from this source should enter the North Fork River over the long term.

Flood Hazard

There is no danger of flash flooding in the area of the proposed Mt. Gunnison Mine facilities. The mine would be situated up on a bench 40 to 200 feet above the North Fork River with no gullies or drainage channels running through the area.

Soils

Soil impacts would result from surface subsidence, from the construction and operation of mine surface facilities, and from urban area expansion due to increased employment.

Coal removal could cause an estimated maximum surface subsidence of 5.5 feet (see Topography). Soil impacts would be minimal where no breaks occurred in the surface mantle. However, surface cracks could expose narrow bands of bare soil material; surface runoff could then be redirected, causing accelerated erosion.

The construction and operation of surface facilities would affect approximately 77 acres by 1980, 91 acres by 1985, and 106 acres by 1990. Erosion rates would temporarily increase in response to surface disturbance. Within soil unit 2 (see figure AR2-4, in chapter 2, Soils), which covers much of the proposed portal and refuse disposal sites, erosion could increase by as much as 10 times over the low natural rate. Units 17 and 74, where the preparation plant and loadout facilities are proposed, could show up to a fivefold increase. Much of this increase, however, would be contained on-site through sediment control structures (30[CFR]: 717.17[a]).

The net effect of increased erosion, along with a deterioration in soil structure, would be a reduction in soil productivity. Any such reduction, although unquantifiable, would complicate but should not preclude successful reclamation.

Off-site disturbances due to mine-related population increases would amount to 34 acres by 1980, 153 acres by 1985, and 264 acres by 1990. The exact location of these acres cannot be predicted, although at least some portion would likely come from croplands (including prime and unique farmlands) in Delta County. To this extent, crop production capacity would be permanently lost (see also Water Resources, Erosion and Sedimentation).

Vegetation

Construction and operation of the proposed mine portal facilities, preparation plant, refuse pile, and access road would disturb 77 acres of natural vegetation on land owned or leased by ARCO by 1980, 91 acres by 1985, and 106 acres by 1990. The acreage disturbed by 1990 would be largely in the mountain shrub type (60 percent--64 acres). Other vegetation types that would be disturbed to a lesser extent include aspen (1 percent--7 acres), agricultural land (8 percent--8.4 acres), and dry meadows (25 percent--26.6 acres). The dry meadows are either natural openings within the mountain shrub or aspen types (usually on exposed slopes or ridges) or past clearings of the native vegetation for dryland pastures. The agricultural land consists of irrigated and dryland pastures or of cropland usually planted in alfalfa. The impacts of the disturbance would be to reduce the visual aesthetics of the area, increase soil erosion, and reduce the numbers of wildlife and livestock in the area (discussed in the appropriate sections).

ARCO would be required to revegetate the 106 acres of disturbance at the Mt. Gunnison Mine site when the disturbed areas are no longer needed for mining operations. Revegetation would be an ongoing process, although the majority of the disturbance would not be revegetated until abandonment of the mine. Specific revegetation measures that would be required are stated in 30(CFR): 717.20, and 30(CFR): 211.40, 211.41, and 211.62, in the *Federal Register* (Vol. 42, No. 239, and Vol. 41, No. 96). These regulations are discussed in detail in the regional volume, chapter 4, Vegetation.

It is not expected that revegetation of the ARCO Mine site would be particularly difficult, due to its favorable conditions for plant growth. Annual precipitation is high, averaging approximately 18 to 25 inches per year over the least tract. The areas that would be disturbed are on a north-facing slope, where adequate topsoil is present and conditions of evaporation and insulation are rather low. Much of the annual precipitation comes in the form of snow, which stays on the north slope throughout the winter.

Colorado Westmoreland's (CWI's) Orchard Valley Mine at Paonia has demonstrated that successful revegetation can be accomplished in the North Fork Valley (see photo in regional analysis). CWI has successfully revegetated steep, south-facing slopes with a mixture of grasses and forbs. The company plans to establish shrubs in the revegetated areas at a later date. A number of revegetation techniques were tried on a trial basis, and the greatest success was achieved when an excelsior erosion-control mat was placed over a slope that was hydroseeded and mulched with hay. It was found that on extremely steep slopes (3:1) jute mesh in combination with mulches and hydroseeding worked best (Randall and Blake, 1977). The disturbed areas were all broadcast seeded, since the steep slopes prohibited use of rangeland drills. Precipitation at Paonia is about 16 inches annually.

ARCO plans to use a combination of grasses, forbs, and shrubs to revegetate disturbed areas at the Mt. Gunnison Mine, so as to satisfy the post-mining land uses of livestock and wildlife range.

Natural revegetation would occur at the Mt. Gunnison Mine if the reclaimed soils were stable and did not contain materials toxic to plant growth. Weedy annuals such as Russian thistle would be the first to invade the disturbed areas, followed by a succession of longer-lived plants until a persisting (climax) plant community of adapted herbaceous and woody perennial species similar to adjacent undistured areas became established. This natural succession process may take anywhere from 20 to 30 years, depending on varying microenvironmental conditions such as slope, distance from undisturbed communities, etc.

Some vegetation may be disturbed by subsidence over the mined areas. Coal removal could cause an estimated maximum subsidence of 5.5 feet (see Topography). If bare soil were exposed, an unquantifiable amount of vegetation would be disturbed. It is expected that loss of livestock or wildlife forage would be minimal.

Construction of the additional 8,000 feet of railroad spur would eliminate the riparian habitat along the river in an area that has already lost large sections of riparian habitat to roads, railroads, and loadout facilities.

It is anticipated that the 1.33 cfs of water ARCO might divert from the North Fork of the Gunnison River during initial development would have no effect on the riparian vegetation along the river. This amount is a very small part of the 435 cfs average annual discharge of the North Fork adjacent to the mine site.

Urban expansion caused by population increases related to coal mining would result in the disturbance of an estimated 34 acres of vegetation by 1980, 153 acres by 1985, and 264 acres by 1990. It is probable that much of this disturance would be on agricultural land surrounding existing population centers and crop production capacity on these lands would be permanently lost.

Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road-vehicle use (see Recreation). This disturbance would lessen the productivity of native vegetation for livestock and wildlife forage. The problem would be most serious in low altitude Mancos shale hills and in alpine areas above timberline.

Wildlife

The proposed development would not impact most of the wildlife habitat on the site. However, construction of mine portals, aboveground facilities, roads, and the waste disposal site would destroy 77 acres of habitat by 1980, 91 acres by 1985, and 106 acres by 1990; this habitat is not considered crucial winter range for deer or elk. (See table AR3-4 for the total number of deer and elk which would be affected.) The 106 acres would include 8 acres of agricultural land, 64 acres of mountain shrub, 7 acres of aspen, and 27 acres of mountain meadows. Deer mice and golden-mantled ground squirrels would also be deprived of habitat on these acres. Small mammal dens would be destroyed along with the immobile or slower species of animals that inhabit the area.

In addition, approximately 260 acres immediately adjacent to these facilities would be used less by big game species due to increased human and mechanical activity. This reduction would be an average of 50 percent on these adjacent 260 acres (assuming that impacts would be progressively less, the farther the habitat is from the disturbance).

It is difficult to predict to what extent subsidence would affect wildlife because of lack of information about the effects of subsidence. To a large extent however, wildlife would gradually develop trails through the areas.

Increased traffic on Highway 133, bringing miners and supplies to the ARCO site, could increase vehicle-deer collisions from eight to twenty (see table R4-21)and increase the loss of small mam-

TABLE AR3-4

IMPACTS ON WILDLIFE

Year	Total Disturbed Acres	Number of Animals that These Acres Could Support					Additional Acres Disturbed	Additional Animals that Could be Supported		
		DDA	D	EDA	E	WH		D 50%	E 50%	WH 50%
1977	0	99	0	3.6	0	-	-	-	-	-
1980	77	99	46	3.6	5	-	260	78	8	-
1985	91	99	56	3.6	6	-	260	78	8	-
1990	106	99	65	3.6	7	-	260	78	8	-

Note: DDA = deer days per acre; EDA = elk days per acre; D = deer; E = elk; WH = wild horses.

mals and birds. Improved roads could also result in increased harassment and poaching of animals.

Construction of the additional 10,000 feet of railroad spur would eliminate the riparian habitat along the river in an area that has already lost large sections of riparian habitat to roads, railroads, and coal loadout facilities. Further disruption of segments of riparian habitat may discourage waterfowl, aquatic mammals, and raptors from using any of the riparian habitat along the North Fork in the mining area. In addition, increased activity along the Gunnison River would adversely affect waterfowl which winter along the river, along with many songbirds and small mammals attracted to the riparian zone. This activity would affect about 0.5 mile of river bottom not presently impacted by existing mine activity.

Power lines to the mine would be physical hazards to raptors in flight. If not properly designed, power lines could also be electrocution hazards to the large hawks and eagles in the area.

Secondary impacts from the proposed action would include increased human population, resulting in expansion of urban areas onto agricultural lands and some crucial winter range; increased vehicular traffic, resulting in an increase in vehicle/animal collisions; and increased recreational use of the area, causing an additional stress on the animals and increasing legal and illegal harvest.

Endangered or Threatened Species

The increased activity along the Gunnison River mentioned above could also affect the bald eagles. The presence of people is enough to discourage the bald eagles' use of that stretch of river. The extent of this disturbance would depend on the frequency of human activity and its duration. Coordination has been initiated and completed with the U.S. Fish and Wildlife Service (USFWS) under provisions of the Fish and Wildlife Coordination Act, the Bald Act, and The Endangered Species Act. USFWS' comments can be found in chapter 9.

Aquatic Biology

Assuming ARCO would utilize the 1 cubic foot per second (cfs) of ground water produced in the mine up until 1990, there would be no significant discharge to the river and no impact on the aquatic biology of the river from mine-water discharge. With the occurrence of fracturing and subsidence on completion of mining there would be a permanent increased ground-water discharge of 1 to 2 cfs to the North Fork. This inflow would increase the total dissolved solids (TDS) in the North Fork from 200 mg/l to 400 mg/l during low flow periods. This could have an impact on the aquatic ecosystem of the river. Research studies have shown that among inland waters in the United States supporting a good mixed fish fauna about 5 percent have a TDS concentration under 72 mg/l, about 50 percent have under 169 mg/l, and about 95 percent have under 400 mg/l (W. B. Hart, P. Doudoroff, and J. Greenbank). Some intolerant aquatic species such as trout may be less likely to survive while more tolerant species such as suckers would be favored. Woodling (1975) speculated that the high TDS concentrations in the North Fork River below Hotchkiss may have an inhibitory effect on the river fishery.

Due to the quantity of ground water available on the ARCO site, most of the mine-water needs should be satisfied from this source. ARCO has a conditional water right for 16.6 cfs from the North Fork but this right would not provide water during low-flow periods. The water in the North Fork is presently overallocated to the extent that below the Fire Mountain Canal diversion adjacent to Somerset the river is completely dewatered during low-flow periods. The water which ARCO can legally divert must be taken during periods of high flow and stored; thus it should not significantly affect the aquatic ecosystem of the river. Due to the increased ground-water flow induced by mine development, fish and wildlife habitats on the North Fork would not be damaged due to further dewatering by consumptive use of water either at the mine or by increased domestic use in the Paonia area. Changes in water quantity of the North Fork due to ARCO's development would be insignificant.

Discharge from sewage treatment ponds on the site may potentially increase ammonia and decrease the dissolved oxygen concentration in the North Fork River system. These parameters are presently near the limiting concentration for aquatic life in the lower North Fork and the Gunnison River near Delta. Any additional ammonia could cause fish kills in the river at Delta. The low dissolved oxygen and high pH of these waters increases the toxicity of ammonia.

Increased population would add additional stress to existing municipal waste-water treatment facilities. Sewage-treatment systems in Delta and in the North Fork Valley are presently inadequate; therefore, ammonia would increase and dissolved oxygen would decrease in the river until planned improvements in waste-water treatment facilities are built and operational. One hundred thirty acre-feet of new sewage treatment capability would be required by 1990 for the aquatic habitat to be maintained in its present condition.

Increased populations would add 1300 new licensed fishermen to the local area by 1990. Increased fishing pressure on accessible waters usually increases the dependence on hatchery trout and decreases wild trout populations unless special regulations are used. The lakes on Grand Mesa, the

Gunnison River in the Gunnison Gorge area, and Anthracite Creek are the nearest quality fisheries and these would receive substantial increases in fishing pressure. Construction of coal mining facilities adjacent to the North Fork of the Gunnison would discourage fishermen from using the area.

The ARCO M&R plan does not present a site-drainage plan to contain sediment and runoff from all construction and operation areas. It is assumed that they will design a plan in conformance with 30(CFR): 717.17; such a system would control sediment from the site if properly designed. Any discharge of water from areas disturbed by underground mining must be limited to 45 mg/l for total suspended solids. This should adequately protect the aquatic environment in the North Fork River from sediments coming from the mine site.

Several factors would affect the sediment load of the North Fork River. A railroad spur approximately 8,000 feet long would be constructed between Highway 135 and the North Fork. Best available technologies would be used and sediment entering the river should be minimized. There are some areas on the lease site where subsidence may increase the erosion, but this cannot be accurately predicted. One definite but short-term cause for sedimentation in the river would be the disturbance of 225 acres for new housing by 1990. A short-term increase of 1 ton per acre per year is predicted until these areas stabilize.

Increased sediment would have a slight adverse impact on aquatic insects and trout in the North Fork. Particles of sediment settling into the stream bed would fill the interstices between the gravel and reduce the natural habitat of stream insects. Gravel areas of the stream bed essential for trout spawning would become filled with sediments and spawning and egg incubation would be impaired. The habitat would favor species other than trout which are more tolerant of stream sedimentation. These impacts would be short-term, and upon completion of construction and reclamation the aquatic habitat would return to pre-mining conditions.

Endangered or Threatened Species

No endangered or threatened aquatic species would be affected by the proposed action.

Cultural Resources

Archeological Resources

Although prehistoric use is not unknown in the North Fork Valley, the lack of identified archeological values within the Mt. Gunnison No. 1 Mine area suggests that there should be no impacts to archeological values from the construction activities.

Subsidence, as it results in cracking and slumping of the surface, could affect 9,528 acres of the mine property, causing displacement of and damage to any existing archeological values. The completion of a class III survey in subsidence impact areas (see Mitigating Measure 5, chapter 4) will help mitigate possible losses due to subsidence.

Should any archeological sites remain undetected by the class III survey, they would not be protected and could be susceptible to damage and displacement from mine activities.

With controlled access into the lease area, vandalism should remain a minimal impact within the site-specific area, although the presence of 565 mine-associated workers in the leased area (by 1990) would mean increased exposure of existing archeological values to public passage.

Historic Resources

Since there are no known historic sites in the mine area which are eligible for the National Register of Historic Places, there would be no direct impacts due to mining. Should sites be found in the course of mining activity, they would be reported to the Area Mining Supervisor and evaluated and protected under the terms of the Historic Preservation Act according to the procedures outlined in 36(CFR):800.

Land Use

Construction of surface facilities and roads on the ARCO site would absorb approximately 106 acres by 1990, of which 9 acres are currently agricultural land (irrigated and dryland pastures or cropland usually planted in alfalfa, 64 acres are mountain shrub, 7 acres are aspen, and 27 acres are mountain meadow. As discussed in the appropriate resource sections, this development would increase soil erosion, reduce wildlife and livestock use, and decrease the scenic quality of the area. When mining is completed, ARCO would be required (30[CFR]: 717 and 30[CFR]: 211) to revegetate this acreage to a land use comparable to or better than pre-mining use.

Housing and related construction to accommodate increased population in Delta County due to ARCO's mine would absorb approximately 34 acres by 1980, 153 acres by 1985, and 264 acres by 1990. The exact location of these acreage losses cannot be predicted, but much of it is likely to affect agricultural land surrounding existing population centers, and also possibly som crucial winter wildlife range. Some orchard land, considered to be unique farmland, may be impacted by urban development; much of the orchard land in the Delta County is also in areas which meet the definition of prime farmland. To a large extent, howev-

er, the location of this urban development would depend on future land use planning and zoning by Delta County.

Additional coal development in the valley would be accompanied by more power lines, roads, and bridges, increased vehicle and railroad traffic, as well as expanded urban developent. Overall, ARCO's proposed mine, particularly when combined with other existing and likely coal development in the North Fork Valley, would establish coal mining as a major land use in the valley and would accelerate the trend toward urban/industrial development, with consequently reduced agricultural, wildlife, recreational, and scenic potentials. Increased population would probably increase recreational activity in the area, which could in turn overtax some of the area's natural and recreational resources.

Transportation

HIGHWAYS

When State Highway 133 is reconstructed as planned, it would be adequate to handle any increase in traffic generated by the Mt. Gunnison Mine. The major impact on transportation would be the increased traffic generated by workers traveling to and from the mine. This could be as many as 750 trips per day. There would be an increase in the number of accidents due to the heavier traffic on the road. Congestion would also increase travel time through the area. The greatest congestion would be just before and after shift changes at the mine. An access road to the mine from Highway 133 would have to be constructed; this road would cross the North Fork River east of Somerset to the south side of the canyon.

RAILROADS

Coal from the Mt. Gunnison Mine would be shipped over the existing Denver and Rio Grande Western lines in unit trains. Supplies to the mine would arrive by rail. An 8,000 foot extension on the existing siding is planned as part of the proposed loading facilities. At full production, from four to five unit trains per week would be required to move the coal. This would increase the possibility of auto-train collisions at crossings on the line and would increase the average delay at crossings. This delay could affect emergency vehicles using the system. It would also increase train congestion at Paonia, Hotchkiss, Delta, and Grand Junction and at other cities the trains pass through.

AIRPORTS

Both the Montrose and Grand Junction airports would experience an increase in passengers as a result of the population increase associated with this mine. No upgrading of facilities would be necessary.

Livestock Grazing

Construction of the proposed surface facilities and refuse pile would disturb 77 acres of mountain shrub, aspen, and dry meadows by 1980, 91 acres by 1985, and 106 acres by 1990. As a result, 11 animal unit months (AUMs) of livestock forage would be lost annually by 1980, 13 AUMs by 1985, and 15 AUMs by 1990. This reduction in AUMs would be less than 1 percent of the total AUMs on the lease tract, and would not result in severe hardship to the livestock operators using the tract.

The disturbed area would be revegetated after the mine is abandoned (approximately 28 years after first production.) A revegetation cover consisting mainly of grasses, as indicated in ARCO's reclamation plan, would provide 43 AUMs per year in the disturbed area, a net increase of 25 AUMs after revegetation is completed.

It is very likely that some of the acreage disturbance resulting from urban expansion due to increased population (34 acres in 1980, 153 acres in 1985, and 264 acres in 1990) would be on irrigated and nonirrigated hayland and pasture. This would adversely impact the livestock industry because these lands are used as livestock wintering areas, and the hay harvested from them in the summer is used to feed the livestock during winter.

Recreation

The influx of additional population due to the ARCO project and the subsequently increased need for recreational facilities may have an impact on the surrounding communities (see table AR3-5). The 1976 Colorado Comprehensive Outdoor Recreation Plan identifies a need for active, improved parks (e.g., ball fields and tennis courts), so increased demand would require construction of new facilities: approximately 1.3 acres of active-improved park land by 1980, 5.9 acres by 1985, and 10.2 acres by 1990. Capital investments to provide these facilities are projected in table AR3-5. If additional facilities are not provided, the overuse of present facilities could lead to deterioration and lower capacity to provide enjoyable recreation.

The construction of mining facilities would remove 77 acres of land suitable for dispersed recreation (some hunting) by 1980, 91 acres by 1985, and 106 acres by 1990. This impact is considered insignificant, however, because the acreage is presently lightly used and this type of land is available throughout the region. This increased demand for dispersed activities would not by itself overtax the existing resources; however, when combined with additional demands resulting from other population

TABLE AR3-5

ARCO: ADDITIONAL COMMUNITY RECREATION FACILITIES DEMAND

	1980	1985	1990
Population growth	400	1,800	3,100
Active/improved parks a/ (3.3 acres per 1,000 residents)	1.3 acres	5.9 acres	10.2 acres
Capital investment (66,666 per 1,000 residents)	$26,666	$120,000	$206,665

Source: Bickert, Browne, Coddington, and Associates, Inc., Boomtown Financing Study, Vol. II, July 1976.

a/ Ballfields, tennis courts, playgrounds, etc.

increases in the region, there could be a cumulative adverse impact (see Recreation in the regional analysis). Increased ORV use due to increased population in the area would disturb native vegetation. However, BLM is currently in the process of determining open, restricted, and closed designations for public lands which should help to alleviate this problem.

The increased use of recreation or facilities could be offset by providing additional facilities. The Heritage Conservation and Recreation Service, through the Land and Water Conservation Fund Act (PL 88-578), could provide monies for this purpose if matching funds are provided by a local agency. The mineral leasing funds (Colo. SB No. 35, Sect. 2, 34-63-102), which can be used for public facilities and services, could also be used for recreation facilities. In addition, BLM could provide lands for these recreation facilities under the Recreation and Public Purposes Act, 43(CFR): 2740, which allows nonprofit associations to acquire lands for recreation purposes consistent with their creating authority. These actions, however, cannot be required by the Department of the Interior; therefore, the initiative for taking these courses of action would be up to the local agencies and the success of mitigation would depend on their commitment to it.

The impact of the ARCO project on the visual resource could also be a recreation impact for sightseers. State Highway 133 is the main access road to the Paonia State Recreation Area and portions of the Gunnison National Forest; it received approximately 210 vehicles per day in 1976 (Colorado Division of Highways 1976). See Visual Resources for the significance of this impact.

The placement of ventilation shaft openings within the area indicated by the USFS as a RARE II area would disturb only a few hundred square feet and should not have a significant impact on this area's potential wilderness character.

Visual Resources

The addition of a coal preparation plant, conveyor systems, storage silos, surge bins, rail loadout facilities, and other surface facilities as proposed by ARCO would establish a large, industrial operation to replace the Bear Mine. Cut-and-fill sites and large structures constructed on the valley floor would reduce any balance that presently exists between the natural and modified environments. The increased scale of mining operations would introduce its own textures, lines, and colors that would dominate the immediate landscape.

In particular, the continuous vegetative texture of the surrounding hills would be interrupted by the 50-acre refuse area on the terrace above the central facility which would create a new landform on a high piece of ground. The combined effects of surface facilities would intensify the landscape's VRM Class V designation, which stipulates the need for rehabilitation prior to reclassification. Regulations in 30(CFR): 717 and 30(CFR): 211 require revegetation upon completion of mining, as discussed in Vegetation.

The expansion of the plant facilities would be accompanied by more power lines, roads, and bridges, and increased vehicle and railroad traffic, in the narrow valley. The associated visual changes would locally transform the valley landscape into an urban/industrial corridor with reduced scenic potentials.

Socioeconomic Conditions

Demography

The ARCO operation is expected to add, directly and indirectly (secondary growth), about 400 persons to the county population by 1980; about 1,800 persons by 1985; and a total of 3,100 persons by 1990. This additional population would account for about 2 percent of the total county population by 1980 and about 7 percent by 1985 and 1990.

Community Attitudes and Lifestyle

The discussion of changes in community attitudes and lifestyles contained in the regional volume, chapter 4, is applicable to the area affected by the ARCO proposal. This particular operation, more than any other single proposal evaluated in the ES, would serve to establish coal mining as the dominant economic force and way of life in the North Fork Valley.

Noise

During the period of portal preparation and construction of surface facilities there woud be an increase in noise levels. Once the mine is in operation, the major noise sources would be underground.

Presently noise from the operation of the Bear Mine cannot be detected in Somerset, where the equivalent noise level (L_{eq}) in the evening hours during the absence of truck traffic is 55 dBA. There are no other residences closer to the proposed mine site. Therefore, based on measurements made in the vicinity of the Bear Mine and GEX Colorado Company's Roadside Mine, it is estimated that the noise level from operations at the proposed Mt. Gunnison No. 1 Mine, measured at the east edge of Somerset, would be approximately 50 dBA.

Worker traffic is estimated to increase traffic by as much as 750 trips per day. This would increase noise levels, primarily around shift change time. However, over the entire day the contribution of

this traffic to the overall noise background would not be significant.

Community Facilities and Services

The community facility requirements associated with the ARCO operation are listed in table AR3-6. These figures were derived in a similar manner to those contained in the regional volume in table R4-36.

ARCO hopes that the majority of the company's workers can reside in the Paonia area. This may happen if property the company owns south of Paonia is developed for residential use. The town's treated water system, with the improvements under way, would allow growth in the community to about 2,900 persons, enough to accommodate the ARCO workforce and their families, and most other population growth attributable to the ARCO development. Attaining this level of population would more than double the existing size of the town and require expansion of the town's sewage treatment system.

Both the town of Hotchkiss and the city of Delta would be directly affected by population growth due to the ARCO mining operation. These areas would have to absorb the people who were not able to settle in Paonia. Both Hotchkiss and Delta would have to upgrade their sewage treatment systems to handle the increased populations. Improvement of Delta's sewage treatment system is under study. In addition, as recent experience has shown, some of the new people would settle in the unincorporated areas of Delta County.

Increases in local property and sales tax revenues and service fees attributed to the ARCO development are listed in table AR3-7. These property tax revenues are based on a county-wide average mill levy which includes the school district mill levy. If the school district share is taken out, the property and sales tax and service fee revenues which would be expected to flow to county, municipal, or special districts would be $97,950 in 1980; $440,730 in 1985; and $745,560 in 1990. These revenues would be enought to cover operating expenses for the county, city, and special district entities.

Part of the money paid by ARCO as royalties and taxes would be available to Delta and Gunnison counties. Chapter 3 of the regional volume explains the various laws that allocate money to the counties. Revenue that the counties would receive is outlined below.

The price of coal is assumed to be $20 per ton, and the royalty is assumed to be 8 percent. Table AR3-8 shows royalty payments for the three years allocated. Money from royalties would go to Gunnison County. The possibility exists that Delta County would receive some of money from the local government mineral impact fund explained in the regional volume.

The Colorado State Severance Tax is $0.30 per ton with the first 8,000 tons per quarter exempted; table AR3-9 shows what receipts would be from this project. Money from the local government severance tax fund is distributed to various local governments to help develop public facilities and provide public services. Fifteen percent of this fund is allocated to impacted cities and towns according to the percentage of employees of the mine living within the boundaries of the municipality or in the unincorporated area of the county. Delta County and the towns in the North Fork area are expected to receive this money.

As explained in chapter 4 of the regional volume, $36 of investment is estimated to be required to produce a ton of coal. This would make the total investment for the ARCO project $87,696,000, the assessed value of which would be $26,308,800. Property taxes on this mine would be $1,249,400 per year in 1985 and 1990.

In addition, ARCO would pay property tax on the coal the company mines: $11,910 in 1980; $253,900 in 1985; and $290,240 in 1990. Total property tax from the Mt. Gunnison Mine would eventually reach $1,539,640.

Delta County would also realize increased revenues from the new people moving to the area in the form of sales taxes and water and sewer tap and service fees. Tap fees would be a one time source of revenue and would total $138,320 in 1980; $624,000 in 1985; and $1,274,320 in 1990. Annual revenues realized from the other sources would amount to $31,721 in 1980; $142,770 in 1985; and $245,880 in 1990.

Housing

The demand for new housing as a result of the population growth in Delta County attributed to the ARCO operation is listed in table AR3-10, which is based on the assumptions that the average household size would be 3.0 persons and that a constant mix of 65 percent single-family units, 25 percent mobile-home units, and 10 percent multifamily units would be maintained (the same assumptions are used in the regional analysis). The projected housing requirements associated with the ARCO project amount to 25 percent of the total projected housing requirements for the county in 1980 and 1985. The vacant land necessary to support these housing requirements is estimated at 34 acres by 1980, 153 acres by 1985, and 264 acres by 1990. The land estimates include land for roadways.

TABLE AR3-6

ARCO: REQUIREMENTS FOR COMMUNITY FACILITIES IN OELTA COUNTY (BY 1990)

	Water Treatment	Sewage Treatment	Police Protection	Fire Protection	Streets and Roads	General Government	Libraries	Total Costs
Physical Plant Requirements	0.62 mgd	0.19 mgd	2 vehicles and 1,200 sq.ft.	1 vehicle and 3,000 sq.ft.	73 acres	750 sq.ft.	1,700 sq.ft. and 9,300 books	
Capital Costs	$542,220	$613,800	$80,400	$195,000	$2,352,100	$48,300	$125,650	$3,957,470
Operating Costs (per year)								
1980	$ 5,010	$ 3,860	$ 40,000	Volunteer	$ 8,730	$36,000	$ 3,320	$ 96,920
1985	22,410	17,290	110,000	Volunteer	40,740	90,000	14,940	295,380
1990	38,810	29,950	120,000	Volunteer	70,810	97,200	25,730	382,500

Note: mgd = million gallons per day; sq.ft. = square feet.

TABLE AR3-7

ARCO: INCREASED REVENUES FOR DELTA COUNTY

Oelta County	1980	1985	1990
Increased Assessed Valuation	$1,483,720	$6,674,920	$11,081,750
Mill Levy	0.06296	0.06296	0.06296
Property Tax	$93,420	$420,260	$697,710
Sales Tax	$30,400	$136,800	$235,600
Service Fees	$ 1,320	$ 5,970	$ 10,280
Total Revenue	$125,140	$563,030	$943,590

TABLE AR3-8

ROYALTY PAYMENTS TO GUNNISON COUNTY

Year	Royalty Receipts	Public Schools	Conservation	Impact Fund	Counties
1980	$ 80,000	$ 20,000	$ 8,000	$ 12,000	$ 40,000
1985	1,704,800	1,078,600	170,480	255,720	200,000 a/
1990	1,948,800	1,261,600	199,880	292,320	200,000 a/

a/ Revenue to a county is limited to $200,000 in any one year. The rest of the 50 percent goes into the State School Fund.

TABLE AR3-9

RECEIPTS TO STATE AND COUNTIES FROM STATE SEVERANCE TAX

Year	Total Receipts	State General Fund	State Severance Tax Trust Fund	To Local Government Severance Tax Fund
1980	$ 20,400	$5,100	$ 6,120	$9,180
1985	629,000	0	0	0
1990	721,000	0	721,000	0

Education

The expected increase in school-aged population due to the development of the Mt. Gunnison Mine is shown in table AR3-11, along with the increase in school capital requirements and operating costs expected from that population increase.

The school district would benefit from the $32.4 million in assessed valuation that is expected to be derived from the ARCO project. Combined with an additional $11.1 million (see table AR3-7) projected increase in residential and commercial assessed valuation, the ARCO development would increase the district's bonding capacity by about $12.5 million by 1990.

Health Care

Population growth from the ARCO development is expected to increase the demand for health care services in Delta County. Table AR3-12 lists the capital facility requirements associated with this expected increase in demand for health care services.

These cost figures assume that most of the increase in health care services demand can be met by upgrading the hospital in Delta. However, other aspects of the health care service system would also be affected. More doctors would have to be brought into the area, mental health services would be expanded, and more extensive emergency services would be provided in the North Fork area to handle both mining-related and other health emergencies.

Some of the expected costs associated with increased health care needs would be paid for by fees collected from patients. The county hospital relies on a levy of 2.3 mills to generate revenue for much of its capital requirements. The hospital's taxing jurisdiction includes only Delta County, which means that the hospital would not receive any benefits from the $32.4 million expected assessed valuation that results from the ARCO project. The only increased tax base accruing to Delta County from ARCO would be that from new residential and commercial development resulting from population growth. Yearly revenues which would be generated from the present county hospital mill levy would be $3,410 in 1980; $15,350 in 1985; and $25,490 in 1990.

To debt finance the estimated $455,000 capital requirement for health care facilities, over twenty years at 6 percent interest, the yearly premium would amount to over $39,600, or nearly 1.5 times the expected property tax revenues.

Employment

Even though the Mt. Gunnison Mine would be located in Gunnison County, the social and economic impacts are expected to occur in Delta County, particularly in the Paonia area. In 1977, the ARCO exploration and planning effort is estimated to have increased employment in Delta County by 13 persons. By 1980, if the proposed schedule is followed, there would be 100 employees at the mine, and total employment in Delta County would increase by 200 people. By 1985, employment at the mine would be stabilized at 565 people. Total employment in the county would increase by 1,010 persons by 1985 and by 1,545 persons by 1990. In 1976, total employment in Delta County was 5,942. By 1990, the ARCO project would cause a 26 percent increase in total employment in an area with a record of high unemployment.

Income

An operation of the magnitude proposed by ARCO would have a significant impact on regional income. The average income of mine personnel is projected by ARCO to be $13,600, considerably higher than the 1974 median family incomes of $7,550 in Delta County and $9,530 in Gunnison County.

At full production, the Mt. Gunnison Mine would employ 565 persons. Total payroll for the mine is projected by ARCO to be $7,716,500. As explained in the regional volume, the circulation of this money through the region would generate another $4,012,600. Total direct, indirect, and induced regional income from the ARCO development would be $11,679,680. Table AR3-13 shows the number of employees, the payroll, and the total regional income generated.

Noise

During the period of portal preparation and construction of surface facilities there would be an increase in noise levels. Once the mine is in operation, the major noise sources would be underground.

Presently noise from the operation of the Bear Mine cannot be detected in Somerset, where the equivalent noise level (L_{eq}) in the evening hours during the absence of truck traffic is 55 dBA. There are no other residences closer to the proposed mine site. Therefore, based on measurements made in the vicinity of the Bear Mine and GEX Colorado Company's Roadside Mine, it is estimated that the noise level from operations at the proposed Mt. Gunnison No. 1 Mine, measured at the east edge of Somerset, would be approximately 50 dBA.

Worker traffic is estimated to increase traffic by as much as 750 trips per day. This would increase noise levels, primarily around shift change time. However, over the entire day the contribution of this traffic to the overall noise background would not be significant.

TABLE AR3- 10

ARCO: NEW HOUSING REQUIREMENTS IN DELTA COUNTY

Year	Single Family Units	Mobile Homes	Multi-Family Units	Total Units
1980	87	33	13	133
1985	390	150	60	600
1990	672	258	103	1,033

TABLE AR3-11

ARCO: SCHOOL REQUIREMENTS IN DELTA COUNTY

District 50(J)	1980	1985	1990
Increase in Students	96	430	742
Facility Requirements	13,440 sq.ft.	60,200 sq.ft.	103,880 sq.ft.
Facility Costs	$604,800	$2,709,000	$4,674,600
Operating and Maintenance Costs	$118,080 per year	$528,900 per year	$912,660 per year

Note: sq.ft. = square feet.

TABLE AR3-12

ARCO: PROJECTED HEALTH CARE FACILITY REQUIREMENTS IN DELTA COUNTY

Delta County	1980	1985	1990
Facility Requirements	1 hospital bed	5 hospital beds	8 hospital beds and 1 emergency vehicle
Costs	$55,000	$275,000	$455,000

TABLE AR3-13

ARCO: EMPLOYMENT, PAYROLL, AND TOTAL REGIONAL INCOME

Year	Employment	Payroll (dollars)	Regional Income (dollars)
1980	190	2,584,000	3,927,680
1985	565	7,684,000	11,679,680
1990	565	7,684,000	11,679,680

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

The mitigating measures proposed in this chapter are measures which will be taken to minimize or eliminate specific adverse impacts identified in chapter 3 which would result from approval and implementation of Atlantic-Richfield Company's (ARCO's) mining and reclamation (M&R) plan. They do not include federal regulations, such as 30(CFR): 700, which are considered to be requirements with which the M&R plan will have to comply before it can be considered for approval. Neither do they include any mitigating measures already developed by ARCO as part of the M&R plan; these have been described and analyzed as part of the proposed project in chapters 1 and 3.

All mitigating measures proposed in this chapter must be "real and committed," by definition in Bureau of Land Management (BLM) Manual 1792. "Real" means that the measures must be legally enforceable and actually workable for the area and situation being assessed. "Committed" means that the agency requiring the measures (in this case, BLM) will ensure that they become part of the authorizing document and will take the necessary steps to see that the measures are in fact implemented as part of the proposed project. Thus, if ARCO's M&R plan is approved, all measures proposed in this chapter will be required in addition to the federal, state, and county requirements discussed in chapter 1, Authorizing Actions.

No reasonable mitigating measures for air quality have been identified which would significantly reduce impacts identified in chapter 3. However, Best Available Control Technology (BACT) will be required on all significant fugitive dust sources identified in table AR3-1, chapter 3. Accordingly, additional controls may be required by the U.S. Environmental Protection Agency in its review for prevention of significant deterioration (PSD) or by the Office of Surface Mining in the air quality analysis of its permit review.

Any additional reasonable measures for alleviating impacts of the proposed action which would change the design of the proposal, which could cause major impacts of their own, or which cannot be considered real and committed are analyzed as alternatives in chapter 8.

Mt. Gunnison Mitigating Measure 1

Power lines and asociated poles will be raptor-proofed in accordance with BLM standards as outlined in BLM Manual 2850 and Instructional Memorandum No. C078-30 (February 10, 1978). Raptor-proofing power poles would prevent electrocution of eagles and other large birds.

Mt. Gunnison Mitigating Measure 2

Prior to the approval of the proposed action, a concurrence of approval will be developed between the BLM and ARCO to outline ARCO's responsibility for the protection of cultural resources. ARCO will provide for a Class III cultural inventory should any additional areas be proposed for surface disturbance and will allow for work stoppage and compliance should archeological resources be identified after the proposed action has been initiated.

An archeological survey will be required in areas likely to be impacted by surface subsidence. Due to the unpredictibility of subsidence and the lack of information available concerning the effects of subsidence on archeological sites, an overburden of 300 feet or less will be used as a parameter to define potential impact areas to archeological values. Cracks and breaks in the surface are known to occur rarely with overburdens of more than 300 feet (Morgan 1978, Personal Communication). ARCO will be required to define areas with an overburden of 300 feet or less and will provide for archeological survey of these areas. Archeological sites located by these surveys will be evaluated and mitigated prior to any disturbance and future monitoring of these sites would provide valuable information concerning subsidence and effect on archeological sites.

Identification, evaluation, and preservation of data from archeological sites before potentially damaging actions would mitigate the loss of archeological resources. The results of the Class III survey, a 100 percent surface inventory of the impact areas, are considered to be representative of the archeological values in that area. The efficiency of the Class III survey as an identification proc-

ess would depend on topography, vegetation, and past land use on each site. These factors would account for the possibility that hidden and subsurface sites would remain undetected and unaccounted for in developing any further necessary mitigating actions.

Any archeological values which are located and evaluated through this survey could be preserved through one or more of the following mitigating measures, depending upon the significance of a site: (1) avoidance of the site through redesign of the project; (2) descriptive and photographic records, or surface collecting; or (3) excavation according to a specific research design or as a salvage effort.

Collection and excavation are only partial mitigations. While they preserve artifacts which might otherwise be destroyed, the in-place value of those artifacts is lost. Destruction of the site would mean the loss of information which might otherwise be gained by further techniques and interpretive methods.

Should additional archeological sites be identified in the survey effort and determined eligible for the National Register as part of the archeological district or as individual sites, compliance procedures required by Section 106 of the 1966 National Historic Preservation Act, amended 1976, and outlined in 36(CFR): 800.4-9, will be met.

CHAPTER 5 ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Chapter 5 discusses unavoidable adverse impacts which would be caused by the approval and implementation of Atlantic Richfield Corporation's (ARCO's) proposed M&R plan for the Mt. Gunnison No. 1 Mine. These impacts include the residual impacts after application of any mitigating measures discussed in chapter 4.

Air Quality

The Mt. Gunnison No. 1 Mine would increase annual average particulate concentrations 5 micrograms per cubic meter ($\mu g/m^3$) by 1990 in a small area on the mine site near the preparation plant. Concentrations are predicted to increase by 1 $\mu g/m^3$ within 0.3 mile north and south and 0.8 mile east and west from the surface facilities. With winds from the west, a maximum concentration of 19 $\mu g/m^3$ is projected to occur about 0.2 mile up the canyon near the eastern property line. With winds from the east, the maximum concentration is predicted to be 14 $\mu g/m^3$ at 0.2 mile. Visibility would be reduced by about 4 miles on an annual basis in 1990; the reduction in visibility would be less in 1985.

Geologic and Geographic Setting

Topography

The proposed mining operation would result in minor alterations of the surface from installation, use, and removal of surface facilities and the subsequent reclamation of the area.

Approximately 9,528 acres (or 76 percent) or the mine property are underlain by recoverable reserves of the F seam. All of that area would be subject to the effects of subsidence. For those areas in which longwall mining has been proposed, a maximum subsidence of about 5.5 feet is expected in areas where the overburden is shallow, that is, less than 500 feet. For the most part areas which lie under less that 500 feet of overburden are occupied by stream drainages or low ridges. Examples of these areas are the upper reaches of Lone Pine Gulch and the Dry Fork of Minnesota Creek above Minnesota Reservoir and its upper tributaries. Because of the shallow overburden in these areas and the length of the longwall panels (from 3,000 to 6,000 feet), a large part of these areas could experience the maximum amount of subsidence. In areas underlying major ridges where overburden reaches thicknesses of from 1,000 to 1,500 feet, the maximum amount of subsidence is estimated to be approximately 2.5 feet. The maximum subsidence on completion of room-and-pillar mining could be expected to be about 5 feet.

The most significant surface subsidence features would be tension cracks and depression pits. Additionally, in underlying strata, stresses caused during mining could be accommodated by movement along the existing joint system rather than creating new fractures. Overlying strata could be more responsive to these stresses because the overburden would be less structurally cohesive. More overall movement could occur: the entire joint system in the overlying strata would be realigned extensively as a result.

In adition, subsidence induced by mining could increase air circulation at depth through fracturing which would allow spontaneous heating and combustion of the coal beds including the seam being mined and all the overlying seams. Once begun, such fires could continue burning for years after the mines have been sealed. In some cases, there is a danger that fire could reach the surface and cause wildfires there, or that it may spread underground and consume large areas of adjacent coal reserves.

Subsidence on unstable slopes could induce landslides (that is rockfalls, slides, slumps, and earthflows). If landslides did occur, the transfer of weight may trigger further local subsidence.

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot presently be assessed because of the lack of data and evaluatory criteria

Mineral Resources

The mining of coal under the Mt. Gunnison No. 1 M&R plan would deplete deposits of a nonrenewable energy source. Approximately 59.4 mil-

lion tons of coal would be mined from the F seam by 2007, representing about 14.6 percent of total lease reserves or about 1.9 percent of the total Somerset area coal reserves over 42 inches in thickness. Because of the nature of underground caving and resultant high contamination from mining, future recovery of the unrecoverable 50 percent of the F seam coal reserves is not considered feasible under present mining technology and therefore those reserves must be considered lost

Water Resources

Initially, flow in the North Fork of the Gunnison River would be decreased by several cubic feet per second (cfs) during periods of high stage because of consumptive use by the proposed mine. Since no water would be diverted from the river during periods of low flow, this impact should be minimal. By about 1990, and thereafter over the life of the operation, ground-water discharge from the mine should be adequate to meet all anticipated consumptive uses in mining and processing the coal.

The population increase attributable to the proposal would increase consumptive use of municipal water by about 60 acre-feet by 1980, 280 acre-feet by 1985, and 490 acre-feet by 1990. Consumptive use is total municipal use less return flow from sewage-treatment facilities.

Dissolved solids entering the North Fork River from the mining operation and in return sewage flow should have little or no significant effect on salinity of the North Fork, Gunnison, or Colorado rivers prior to 1990. With expected increase in ground-water discharge from the mine after 1990, however, the long-term effect could be to increase the dissolved-solids concentration in the North Fork River from less than 200 milligrans per liter (mg/l) to as much as 400 mg/l during periods of low flow. The dissolved-solids concentration in the Colorado River below Hoover Dam could be expected to increase about 0.21 mg/l or about 0.03 percent. Any increase in the salinity of the Colorado River is regarded as a serious impact.

Minor local erosion and sedimentation would occur locally off-site because of construction related to population increases. Net sediment yield to the North Fork River over the life of the mine, however, should not be significantly different from pre-mining rates.

Soils

Surface disturbance on approximately 77 acres by 1980, 91 acres by 1985, and 106 acres by 1990 at the mine site would cause an increase in erosion and a deterioration of soil structure and biological activity, leading to a temporary reduction in soil productivity. Any such reduction would prolong the efforts necessary to achieve successful reclamation.

Urban area expansion would permanently remove 34 acres by 1980, 153 acres by 1985, and 264 acres by 1990 from a production function. Although exact locations are not known, some of this acreage would likely come from lands either now classified or eligible for classification as prime or unique farmland.

Vegetation

Vegetation would be lost at the mine site on 77 acres in 1980, 91 acres in 1985, and 106 acres in 1990. If parts of the disturbed areas are revegetated before abandonment of the mine (on refuse piles, road cutbanks, etc.), the actual acreage lost would be slightly less than these figures. In addition, natural vegetation would be lost off site on 34 acres by 1980, 153 acres by 1985, and 264 acres by 1990 on lands disturbed by community expansion

Wildlife

There would be 77 acres of wildlife habitat lost in 1980, 91 acres in 1985, and 106 acres in 1990 and reduced wildlife use on an additional 260 acres. The increased activity along the Gunnison River could cause some reduction of hunting areas for bald eagles; reduced waterfowl nesting and resting; and stress and harassment of big game species. Construction of 10,000 feet of railroad spur would eliminate the riparian habitat in this area.

Increased human populations could result in expansion of urban areas onto some crucial wildlife winter range, increased vehicle/animal collisions, increased poaching, and additional stress on wildlife species.

Aquatic Biology

As much as 1.0 to 2.0 cfs of mine gound water with a total dissolved solid concentration (TDS) of 2,500 mg/l would be discharged to the North Fork of the Gunnison River after 1990. The TDS concentration of the river during low flow periods would double from 200 mg/l to 400 mg/l. Sensitive aquatic species, primarily trout, may be adversely affected by this permanent discharge. Most aquatic insects are not affected by this level of dissolved solids. Below Hotchkiss, where normal average TDS levels are 500 mg/l, the river would be even more unsuitable for sensitive coldwater trout species. These levels of TDS would virtually assure the permanent elimination of trout reproduction in this segment.

Increased fishing pressure from 1,300 new fishermen by 1990 would further stress the existing fisheries as previously described in chapter 3.

Cultural Resources

Archeological Resources

Undiscovered sites could be damaged during surface disturbing activities and by subsidence. Information could be lost as a result of vandalism and illegal collecting and through salvage excavation procedures where any information no recorded would be permanently lost.

Land Use

Transportation

The most serious impact would be increased accidents from greater train and automobile traffic. Congestion and more trains would also cause delays and slow traffic flow in eastern-slope cities.

Livestock Grazing

The following livestock forage would be lost: 11 animal unit months (AUMs) per year due to disturbance of 77 acres in 1980, 13 AUMs per year due to disturbance of 91 acres in 1985, and 15 AUMs per year due to the disturbance of 106 acres in 1990. Increased off-road vehicle use would decrease productivity of natural vegetation by an unquantifiable amount. Agricultural lands disturbed by urban expansion would result in the loss of an unquantifiable amount of livestock forage and livestock wintering areas.

Recreation

If the community recreation facilities needed to prevent deterioration of existing facilities are not provided, this deterioration would be an unmitigated impact.

Visual Resources

During the mining period, there would be a definite alteration of the present landscape since visually incongruous elements of the proposed action cannot be mitigated. Cut-and-fill scars, refuse overburden, vegetation cuts, and new structures would remain apparent in the landscape for the life of the mine. Offsite land-use alterations for employee housing would contribute to an urbanization process which would also remove lands from their natural condition. The post-mine reclamation process would rehabilitate some of the affected landscapes, but those acres used for community development would be permanent landscape changes.

Socioeconomic Conditions

The development of the ARCO project would have a pronounced effect upon the rate of population growth in Delta County, especially in the North Fork area. New population directly and indirectly (secondary growth) attributable to the ARCO project would be 400 people by 1980; 1,800 people by 1985; and 3,100 people by 1990 and would account for over 9 percent of the total county population by 1985.

If most of this new population is concentrated in the North Fork area, it would more than double the size of the small communities of Paonia and Hotchkiss. The large influx of outsiders into the North Fork Valley would destroy some of the rural character of the area, which is valued highly by existing residents. It would also place strong pressures for rapid growth and development on a political and social structure which has voiced a strong concern for preserving a high level of environmental quality.

Higher incomes among miners than among present residents would cause increases in the cost of living in the area. People on fixed incomes would be hard pressed. In addition, the industrialization and rapid population growth associated with the coal mine may discourage the migration of retirees and others to the area, who have come primarily because of the existing environment and lifestyle. Rapid growth would also cause higher crime rates and higher divorce rates.

The communities of Paonia, Hotchkiss, and Delta are expected to be most burdened financially, since they would receive little increase in tax base but would be required to provide greatly expanded services to the new population. Providing adequate water and sewage treatment services would be a major problem in Delta and Hotchkiss if a large portion of the new population settles in those communities.

Providing adequate health care services to the mine and the communities in the North Fork would require additional facilities in that area. At a minimum, more emergency medical services would be needed in the North Fork, along with more physicians located in the area.

The conversion of land from agricultural use to urban use to provide for population increase is an adverse effect in the opinion of most Delta County residents. This conversion would diminish the area's agricultural base and increase the economic dependence on coal mining. It is estimated that about 34 acres of land would need to be converted to urbanized use to support population resulting from ARCO by 1980, 153 acres by 1985, and 264 acres by 1990.

There would be some increase in noise levels throughout the valley due to increased population, increased train traffic, and increased vehicular traffic around shift change times.

CHAPTER 6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 59.4 million tons of coal would result in short-term and long-term alteration of natural resources and the human environment.

There would be the following alterations in the short term, a period beginning with on-site construction and ending with end of mine life (about 2009) and post-mining reclamation:

1. An estimated 59.4 million tons of coal would be mined for use in the production of electrical energy.

2. Annual average particulate concentrations would increase by 5 micrograms per cubic meter ($\mu g/m^3$) near the mine site and by 1 $\mu g/m^3$ within 0.3 mile north and south and 0.8 mile east and west through 1990. Maximum concentrations about 2 miles up the canyon would be 14 to 19 $\mu g/m^3$.

3. Subsidence induced by mining could increase air circulation at depth through fracturing. Increased circulation of the air at depth would allow spontaneous heating and combustion of the coal beds including the seam being mined and all the overlying seams.

4. A potential exists that subsidence on unstable slopes would induce landslides (that is rockfalls, slides, slumps, and earthflows). If landslides did occur, the transfer of weight caused may trigger further local subsidence.

5. Beginning in about 1990, subsidence and associated fracturing would intercept and divert into the mine surface runoff in streams traversing the mined area. Existing downstream water rights would be threatened and probably would require replacement of lost water to existing irrigation reservoirs.

6. Municipal consumption of water would increase to about 490 acre-feet per year; consumption of water by the mining operation would average about 960 acre-feet per year at full production.

7. Increases in ground-water discharge from the mine after about 1990 could increase the dissolved-solids concentration in the North Fork River during low flow from less than 200 milligrams per liter (mg/l) to as much as 400 mg/l. Dissolved solids concentration in the Colorado River below Hoover Dam could increase about 0.21 mg/l, or about 0.03 percent.

8. There would be loss of soil productivity on 106 acres through 2009 due to increased erosion, deterioration of soil structure, and reduced biological activity, and there would be loss of vegetation on those 106 acres through 2009 due to loss of soil productivity.

9. Wildlife habitat on 106 acres, which could have supported 65 deer and 7 elk annually would be completely lost through 2009.

10. Short-term increases in the NH_3 and lowered dissolved oxygen levels in the North Fork River would occur from the increased sewage load on inadequate facilities. Fish kills may result until facilities are brought up to required state standards.

11. Aquatic habitats in the North Fork would be degraded by increased sediment yield from rail spur, mine facility and housing construction. Aquatic habitats would recover when disturbed areas are stabilized.

12. Accidents and equivalent noise levels would increase as a result of greater train, automobile, and truck traffic.

13. Approximately 15 animal unit months (AUMs) of livestock forage would be lost annually through 2007.

14. During the mining period, there would be a definite alteration of the natural landscape since visually incongruous elements of the proposed action cannot be mitigated. Cut-and-fill scars, refuse overburden, vegetation cuts, and new structures would remain apparent in the landscape through 2009.

15. Higher incomes among miners than among present residents would cause increases in the cost of living in the area. People on fixed incomes would be hard pressed. In addition, the industrialization and rapid population growth associated with the coal mine may discourage the migration of retirees and others to the area, who have come primarily because of the existing environment and lifestyle. Rapid growth could also

cause higher crime rates and higher divorce rates.

16. Total direct, indirect, and induced regional income from the ARCO development would be $11,679,680.

Residual effects of mining (after post-mining reclamation) on long-term productivity would be as follows:

1. An undetermined number of uninventoried exposed and unexposed fossil resources would be impaired or destroyed.

2. An unquantifiable gain in knowledge would result from surveys and exposure of fossil resources which might never have been found without development.

3. An estimated 59.4 million tons of coal, a nonrenewable energy resource, would be depleted after 2009.

4. Increases in ground-water discharge from the mine after about 1990 could increase the dissolved-solids concentration in the North Fork River during low flow from less than 200 milligrams per liter (mg/l) to as much as 400 mg/l. Dissolved-solids concentration in the Colorado River below Hoover Dam could increase about 0.21 mg/l, or about 0.03 percent.

5. Soil and natural vegetative productivity would be permanently lost on 255 acres due to urban expansion.

6. A long-term increase of TDS to 400 mg/l in the river due to the 1 to 2 cubic feet per second of mine water discharge during low-flow periods would permanently lower the quality of the aquatic habitat, especially for all species of trout.

7. An increase of 1,300 new fishermen would increase the pressure and decrease the quality of existing fisheries.

8. The removal of 8,000 feet of riparian habitat for construction of a rail spur would decrease the number of waterfowl, aquatic mammals and raptors using the river corridor.

9. Surface construction, subsidence, and vandalism would disturb or destroy an unquantifiable number of nonrenewable cultural resources.

10. Archeological survey and excavation could provide gains in understanding of prehistoric use in the area.

11. If additional recreational facilities are provided to meet the increased demand, they would remain for long-term use; conversely, if additional facilities are not provided, the deterioration of present facilities would be a long-term adverse impact.

12. Approximately 43 AUMs of livestock forage per year would be restored on the lease area upon reclamation after the mine is abandoned. Wildlife forage would also be restored.

13. Offsite land use alterations for employee housing would contribute to an urbanization process which would also remove lands from their natural condition. The post-mine reclamation process would rehabilitate some of the affected landscapes, but those acres used for community development would be permanent landscape changes.

14. At least 264 acres of land would be permanently converted to urban use by 2009, which would diminish Delta County's agricultural base and increase economic dependence on coal mining.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Approximately 59.4 million tons of coal would be recovered from the Mt. Gunnison Mine. About 59.3 million tons would be unrecoverable by current mining methods.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing machinery and buildings would not be recycled and thus would be lost.

An undetermined number of uninventoried fossils would be lost or disturbed.

Approximately 1,500 acre-feet of water would be diverted annually from the North Fork River and consumed by the mining operation and the consequent increased population.

Ground-water flow from the mine after about 1990 would add an estimated 2,500 to 3,000 tons of salt annually to the North Fork River. Dissolved solids concentration in the Colorado River below Hoover Dam could increase by 0.21 milligrams per liter or about 0.03 percent.

Soil and vegetative production would be irretrievably lost on 106 acres for the life of the mine. This loss would not be irreversible if revegetation is successful.

Wildlife habitat on 106 acres, which could have supported 65 deer and 7 elk annually would be irretrievably lost for the life of the mine. This loss would not be irreversible if revegetation is successful.

An increase of TDS in the North Fork to 400 mg/l during low flow periods due to the 1 to 2 cubic feet per second discharge from the mine even after abandonment would permanently lower the quality of the aquatic habitat, especially for all species of trout.

An increase of 1,300 new fishermen would increase the pressure and decrease the quality of existing fisheries.

The removal of 8,000 feet of riparian habitat for the construction of a rail spur would decrease the numbers of water fowl, aquatic mammals and raptors using the river corridor.

Approximately 15 animal unit months of livestock forage would be irretrievably lost for the life of the mine. An unquantifiable amount of livestock forage and livestock wintering areas would be irreversibly lost due to disturbance of agricultural lands by urban expansion.

Anything other than in-place preservation of archeological resources would be an irreversible, irretrievable commitment of the resource. Damage from surface disturbance or vandalism would result in permanent loss of information and would remove those archeological values from future research consideration.

An irretrievable commitment of capital and land (at least 264 acres) would be required to support population growth.

Particulate air quality at the proposed mine site and for a very limited area surrounding the mine would be subject to a slight increase in concentrations. Air quality would be temporarily degraded during the mine life, but the change would not be irreversible. With termination of mining activity in 2007, air quality would return to the premining level of about 20 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean from the levels during mining of 20 to 25 $\mu g/m^3$.

Reduction in visibility would occur in proportion to the increased particulate concentrations. Average visibility is presently about 54 miles. Given the limited increase in predicted concentrations resulting from mining activity, visibility would not be greatly affected (50 miles) and the loss would be reversible. However, secondary development related to the proposed action would result in some permanent degradation of visibility over the surrounding area.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

Pursuant to implied covenants of both the federal mineral leasing laws and the existing lease agreements, the Department of the Interior is obligated to respond to a legitimate application to conduct mining operations on a valid lease, provided that all terms and conditions thereunder have been met. The Department's action with regard to Atlantic Richfield Company's (ARCO's) mining and reclamation (M&R plan) for the Mt. Gunnison No. 1 Mine may be approval as proposed, rejection on various environmental or other grounds, approval or rejection in part, or approval subject to such additional requirements or modifications as the Department may impose under existing laws and regulations. The Department may also defer decision pending submittal of additional data, completion of required studies, or for other specific reasons. If there are serious environmental concerns as to the coal development, the Department may prevent further development of the leases by exercising the Secretary's exchange authority as to the federal coal rights, or seeking congressional action to cancel federal leases involved.

Development of alternative sources of energy, energy conservation, federal development of the coal, and emphasis on coal development in other regions of the United States are more appropriate for consideration on a program rather than a regional basis. These evaluations were made in the previous coal programmatic statement (U.S. Department of the Interior 1975) and will be updated and revised as necessary in the new coal programmatic statement now under way (to be completed in 1979).

ARCO's M&R plan for the Mt. Gunnison No. 1 Mine has not been reviewed for compliance with the interim regulations 30(CFR): 700 required under Sections 502 and 503 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (PL 95-87), and it does not fully reflect the requirements of the interim regulations. The M&R plan will be returned to the applicant for revision in accordance with the appropriate federal regulations. When it is resubmitted to the Office of Surface Mining (OSM), it will be evaluated for compliance with all appropriate federal regulations by OSM in conjunction with the U.S. Geological Survey (USGS). In addition, the Bureau of Land Management (BLM) must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA.

APPROVAL AS PROPOSED

The Department has the choice of approving the M&R plan as proposed. However, as pointed out above, ARCO's M&R plan has not been reviewed for compliance with the interim regulations. Therefore, it cannot be considered for approval until it has been revised to comply with all appropriate federal regulations.

REJECTION ON ENVIRONMENTAL OR OTHER GROUNDS

The Department may reject any M&R plan that does not meet the prescriptions of applicable law and regulations under the Department's authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly differently designed course of action by the lessee (operator). In addition, BLM must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA. Except when an M&R plan does not comply with existing regulations, the Department cannot under present circumstances reject the proposed plans to the extent that a de facto cancellation of a lease results unless the Secretary seeks and obtains additional authority from Congress.

Rejection of ARCO's proposed M&R plan would result in no additional environmental impacts from coal mining on the federal leased lands. Since these lands are public lands, surface use would be governed by BLM policy and management guidelines and decisions. ARCO could submit a new M&R plan, challenge the rejection, or abandon development of the lease. Should ARCO submit a new M&R plan, it would require both environmental assessment and review for compliance with applicable regulations.

Mining at the proposed Mt. Gunnison Mine is intended to supply 54.9 million tons of coal to utility plants for use in the production of electrical energy. Without the Mt. Gunnison Mine, other

coal would have to be acquired to supply these markets. Such a substitution could create a shortage for other coal markets.

The primary use of the vegetation would be livestock and wildlife forage. The public land within the ARCO tract would be converted to a three-treatment rest-rotation grazing system of livestock production, seed trampling, and rest, as proposed in the Jumbo Mountain allotment management plan.

Continuing human population growth in Delta County would still cause impacts to wildlife: expansion of urban areas onto agricultural lands and some winter range; increased recreational use of wildlife species, primarily hunting; and increased poaching of big game species.

Natural weathering and vandalism would continue to be the major causes of loss of archeological and historical values, but there should be no additional contributing factors to such loss at the site if the M&R plan is rejected. Paleontological resources would be impacted both adversely and beneficially in approximate proportion to the level of regional development and the area disturbed.

The population of Delta County would increase to 20,600 people in 1980; 22,900 people in 1985; and 24,800 people in 1990. The area would remain basically dependent upon agriculture and tourism, but coal mining in the valley would increase somewhat, too. Incomes would remain much below the state and national levels, and unemployment would continue to be a problem.

Gunnison and Delta counties, towns, special districts, and the school district would not receive the increases in revenue from royalties, property taxes, sales taxes, etc., discussed in chapter 3 (Socioeconomic Conditions). On the other hand, expenditures to provide facilities and services to accommodate population increases associated with ARCO would not have to be made.

If ARCO's proposed M&R plan is not approved and implemented, the Bear Mine, which is currently operating on federal lease D-044569 under an 'assignment of operating interests" from ARCO, would continue its operation indefinitely. At the current rate of production, the mineable reserves "assigned" to Bear would be exhausted by 1981. However, ARCO has indicated that additional reserves would be made available to Bear if its proposed M&R plan is not implemented. No information has been submitted concerning the specific changes in the existing operation which would be necessary if additional coal reserves are mined by Bear. It can be assumed that by 1980 the mining operation at Bear Mine would be required to comply with the environmental protection performance standards as required by the interim regulations of 30(CFR): 700, and that the operation would also comply with the regulations of the permanent program. If, as is reasonably likely, the existing surface facilities are adequate for the support of underground mining and employment and production schedules remain at the 1977 level through 1990, then the continued operation of the Bear Mine would cause no additional adverse impacts.

APPROVAL OR REJECTION IN PART

The Department has the choice of approving or rejecting part of a particular M&R plan, based on projected adverse environmental impacts.

Restrict Development on Existing Leases

The subject leases convey the right to develop, produce, and market the federal coal resource thereon if all other terms and conditions have been met by the lessee. In general, the Department does not possess the authority to arbitrarily constrict development if all other requirements of the lease have been met. However, various measures that may tend to restrict development may be taken by the Department at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations (for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, etc.). Similarly, the Department could permit only selective exploration and development of existing leaseholds if analysis indicates wholly unacceptable environmental impacts that could not be reduced to an acceptable level.

Adoption of this alternative would reduce adverse impacts by reducing the area in which the impacting activities could take place. At the same time, application of this alternative would not permit maximum recovery of the coal resources and would thus be contrary to principles of conservation embodied in the legislation which authorizes the leasing of these lands for the purposes described. It is entirely possible that such selective mining would leave isolated blocks of coal that might never be recovered owing to the high costs of mining such remnant areas at a later date.

Phased Development

Phased development of coal mines as a means of lessening socioeconomic impacts of coal development in the ES area is discussed as the Diligent Development and Continuous Operations alternative under Approval or Rejection in Part of chapter 8 in volume 1. The restrictions discussed under that alternative could be applied to the ARCO operation alone. However, to do so would prob-

ably not significantly reduce socioeconomic impacts in Delta County, since other coal mines in the North Valley could continue to develop at a rapid rate. To be effective, phased development would have to be applied uniformly to coal projects throughout the ES area.

APPROVAL SUBJECT TO ADDITIONAL REQUIREMENTS OR MODIFICATIONS

Subject to existing laws and regulations, the Department has the choice of approving an M&R plan with additional stipulations or changes to lessen adverse environmental impacts. For example, operational, transportation, or other alternatives could be adopted when such alternatives would reduce adverse impacts.

Operational Alternatives

Barrier Pillars

Removing the F seam by longwall methods oriented to one of the principal directions of fracturing would result in maximum surface subsidence of 5.5 feet (worst case) over 13,000 feet of Dry Fork Minnesota Creek and over 6,500 feet of Lick Creek. Surface subsidence cracks would develop along 5,400 feet of South Prong Creek and 5,800 feet of Horse Creek as a result of room-and-pillar mining. The disturbance of the surface would in effect disrupt and divert any water from these streams into the mine workings. The seams rest at such an angle that any water draining into the mine workings would drain from the portal. (See Geologic, and Geographic Setting and Water Resources in chapter 3.)

To lessen or prevent subsidence that interrupts the hydrologic balance of the streams (30[CFR]: 717.17), the M&R plan would have to be designed to leave barrier pillars that protect Dry Fork Minnesota Creek and Lick Creek. South Prong Creek and Horse Creek could be protected only by not allowing mining.

Redesigning the M&R plan to leave protective barrier pillars would have little, if any, affect on the production schedule as outlined. An estimated 700,000 tons of recoverable reserves would be left in the barrier pillars. However, prevention of mining under South Prong and Horse creeks would lessen maximum resource recovery. (See also the following alternative.)

Mining of B and C Seams

As mining progresses and longwall panels are mined to their maximum length, the induced caving would almost certainly cause extensive fracturing of overlying rocks followed by some subsidence at the surface. The development of open cracks to the surface (Dunrud 1976) would intercept ground water in overlying aquifers and may even divert surface runoff directly into the mine. Alignment of the longwall panels with their maximum length northeastward (map AR1-2 in chapter 1), coinciding approximately to one of the principal directions of fracturing in the area, can be expected to significantly increase the probability of subsidence and the extension of elongate fractures to the surface. The location of longwall panels beneath the Dry Fork of Minnesota Creek upstream from Minnesota Reservoir and their orientation transverse to the direction of streamflow would almost certainly cause subsidence and fracturing that would largely disrupt the flow in that stream. Similarly, major disruptions of flow can be expected on Lick, South Prong, and Horse creeks. Because the F seam crops out in valley side slopes above the levels of Minnesota and Beaver reservoirs, no subsidence or fracturing as a result of the proposed mining operations should threaten the stability of these structures. Subsequent mining and removal of the underlying E, C, and B coal seams would very probably severly impact these structures, but those beds would not be disturbed under this proposal. (See Geologic and Geographic Setting and Water Resources in chapter 3.)

Consideration could be given to requiring ARCO to mine the B and C seams rather than the F seam. (The Bear Mine, which currently operates on the northern portion of ARCO's federal coal leases, produces from the C seam.) Mining the B and C seams would greatly reduce the possibility of long-term impact to the hydrologic systems, as long as the F seam was left in place. It would also reduce or eliminate the possibility of damage to Minnesota and Beaver reservoirs if the E, C, and B seams were mined after the F seam (mining of those three seams is not proposed in ARCO's M&R plan, however). Adoption of this alternative would require determination of the quality and quantity of coal available in the B and C seams, as well as environmental assessment of possible resource and socioeconomic impacts.

Other Operational Alternatives

No other reasonable operational alternatives have been identified which would significantly reduce adverse impacts of coal mining or increase resource recovery. Surface mining is not feasible due to the geology and geographic characteristics of the area. Federal regulations (30[CFR]: 211) require M&R plans be designed to ensure maximum economic recovery of the coal resource.

Transportation Alternatives

Coal Transport

ARCO proposes to transport coal from the Mt. Gunnison Mine by rail. No reasonable alternatives to this proposal have been identified. See volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Coal Transportation Alternatives, for a general discussion of truck transport and slurry pipelines.

Busing of Mine Employees

Busing of employees to the mine site could reduce the traffic impacts discussed in chapter 3. This measure has been proposed as a regional alternative in volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Busing of Coal Mine Employees.

Alternatives Available to Other Agencies

The land use and socioeconomic analyses in chapter 3 identified adverse impacts to Delta County due to development of the Mt. Gunnison No. 1 Mine. In addition to the Diligent Development and Continuous Operations alternative which addresses such impacts on a regional basis (see Restrict Development on Existing Leases earlier in this chapter and in chapter 8, volume 1), the regional volume also discusses actions which may be available to state, county, and community governments which might lessen or control socioeconomic and land use impacts. See Socioeconomic Alternatives Available to State and Local Governments, chapter 8, volume 1.

Construction of Alternative Rail Crossings

HIGHWAY CROSSINGS

At present, there are ten railroad/highway grade crossings on the D&RGW line between the Oliver power plant and Delta. There are also grade crossings within the city limits of Hotchkiss and Paonia. Some of the crossings are protected by automated signal lights, while others have wooden crossarms (see table AR8-1).

Present train movement above Paonia averages slightly over two trains per day. With approval of the Mt. Gunnison Mine and production increases from other mines, traffic would average five loaded trains per day, or ten movements past a given crossing per day. Also, switching operations or multiple crossings in short highway segments could magnify potential crossing problems.

Projected accident rate increases, traffic delays, alternative facilities, and estimated costs are presented in table AR8-1. However these suggested improvements would have to be coordinated and financed by state and local entities and various mining companies.

The use of 100-car unit trains would cause traffic delays and increase potential accident rates at all crossings along the line. The magnitudes of the impacts would depend on motor vehicle traffic and speed at the crossing, visibility at the crossing, sequence of crossings, and direction of car/train traffic.

The Colorado Department of Highway's proposal to reroute Colorado 133 from Hotchkiss to Colorado 135 (Project RS-133[5]) would not eliminate any grade crossings, but would improve the angle of approach on some. However, the net effect of the project on grade crossing safety would be an increased chance of accidents, since the vehicle speed limit would be increased.

Although highway overpasses would eliminate grade crossing accidents, certain engineering problems would be encountered in design and construction. For example, a unit train on the first three grade crossings below Somerset would compound traffic problems, depending upon direction of movement. However, the first two crossings are in a narrow canyon that contains a canal and the North Fork of the Gunnison River as well as the highway and rail line. Very little room exists for construction of overpasses, and extensive coordinated design would be required. Also, large amounts of fill material would be needed, including some from off-site areas.

The grade crossings on either side of Hotchkiss (east and west) present another type of problem. A 100-car unit train could block both crossings for up to 1.3 minutes, effectively isolating the town. Construction of the east overpass could cause some traffic problems at the intersection of High Street and Colorado 133. The west overpass (Colorado 92) would also conflict with city streets.

On some crossings, such as that 6 miles below Hotchkiss, construction of automated signal arms would reduce the hazard potential, but would not reduce traffic delays.

Where the rail line crosses U.S. 50 in Delta, extensive delays could be caused by both more train traffic and by switching operations in the Delta yards. However, an overpass would conflict with the intersection of U.S. 50 and Colorado 92 and with businesses on Main Street.

WITHIN CITY LIMITS CROSSINGS

Increased train traffic through two towns in the area (Hotchkiss and Paonia) could cause a number of impacts. Delays could be caused by both train movement and switching. Such delays could hamper emergency and school bus traffic and would increase accidnt rates. In the case of Paonia, the town could be bisected for two to three min-

TABLE AR 8-1

ALTERNATIVE RAIL CROSSINGS

Crossing on Highway	Present Facilities	Projected Accident Rate Increase	Projected Delays (Traffic Direction) Motor Vehicles Against Trains	Motor Vehicles Against Trains	Alternative Facilities	Estimated Cost Colo. State Highway Dept.	Engineering Problems
1. Just below Bear Mine	Wooden crossarms	340%	37 min.	37 min.	Overpass	$ 694,000	Limited area, need for extensive fill.
2. 2.5 mi. below Somerset	Wooden crossarms	340%	6 to 10 min.	6 to 10 min.	Overpass	$ 734,000	Narrow canyon with rail line, highway, canal zone together.
3. 2.8 mi. below Somerset	Wooden crossarms	340%	6 to 9 min.	5 to 6 min.	Overpass	$ 660,000	Narrow canyon - need for extensive fill.
4. 3.4 mi. below Somerset (Juanita Junction)	Wooden crossarms	5%	8 to 12 min.	5 to 6 min.	Overpass	$ 640,000	Need to move highway, need for extensive fill.
5. Hotchkiss, east (Colo. 133)	Automated signal lights	1,000%	8 to 10 min.	5 to 6 min.	Overpass	$ 640,000	Need for extensive fill, traffic congestion at foot of ramp.
6. Hotchkiss, west (Colo. 92)	Automated signal lights	2,800%	8 to 10 min.	5 to 6 min.	Overpass	$ 725,000	Need for extensive fill, conflict with city streets.
7. 6 mi. below Hotchkiss	Automated signal lights	2,800%	2 to 3 min.	2 to 3 min.	Automated signal arms	N/A	
8. Austin	Wooden crossarms	250%	2 to 11 min.	2 to 11 min.	Automated signal arms	N/A	
9. Colo. 65, 4.5 mi. east of Delta	Automated signal lights	1,500%	2 to 3 min.	3 to 4 min.	Automated signal arms	N/A	
					Overpass North ramp	$ 375,000	Need for extensive modification of existing highway.
					South ramp	$1,460,000	
10. Delta	Automated signal lights	62%	5 to 18 min.	5 to 18 min.	Overpass	$1,186,000	Conflict with existing city streets.
Crossing in town							
1. Hotchkiss							
8 street	Wooden crossarms		4 to 6 min.		Automated signal arms	N/A	
2nd street	Wooden crossarms		4 to 11 min.		Automated signal arms		
4th street	Wooden crossarms		4 to 16 min.		Overpass, Automated signal arms	$ 675,000 N/A	
2. Paonia							
2nd street			5 to 16 min.		Overpass with pedrestrian walkway	$ 833,000	
3rd street			5 to 11 min.		Pedrestrian walkway	$ 183,000	
Onarga Ave.			5 to 11 min.		Overpass, traffic only	$ 780,000	
3. County road 1.25 mi. SW of Paonia			3 to 4 min.		Automated signal arms	N/A	

N/A = not available

utes. Overpasses constructed at main grade crossings within city limits could eliminte traffic delays and safety problems.

Construction of overpasses within city limits would cause conflicts with existing streets and residences. Also, overpasses tend to be slicker than other streets during bad weather, and accident rates could increase on them

DEFER ACTION

For proper cause, the Department may defer final action on a proposed M&R plan. Reasons for deferring action can include, but are not limited to, the need and time required for:

1. Modification of a proposal to correct administrative or technologic deficiencies;
2. Redesign to reduce or avoid environmental impact;
3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation;
4. Further evaluation of a proposal and/or alternatives.

The principal effect of deferring action on a proposed M&R plan on these grounds would be a comparatively short-term delay in the occurrence of all related impacts of a proposal (both adverse and beneficial). To the extent that an M&R plan can be redesigned to alleviate adverse impacts, those impacts would be lessened.

As pointed out at the beginning of this chapter, ARCO's M&R plan for the Mt. Gunnison No. 1 Mine has not been reviewed for compliance with the interim regulations, and the Department will not consider the plan for approval until it is brought into compliance with all applicable federal requirements.

Control of Runoff and Salinity

Approval of the M&R plan could be deferred until it has been evaluated with regard to best management practices for nonpoint sources of water pollution and the guidelines of the Colorado River Salinity Forum. See Water Resources in chapter 3 for a discussion of projected long-term adverse impacts on water quality.

Additionally, approval of the M&R plan could be deferred until ARCO develops proposals for adequate monitoring of subsidence and mitigation of the reduced surface flow predicted as a long-term impact of subsidence in chapter 3, Water Resources.

PREVENTION OF FURTHER DEVELOPMENT

No Action Alternative

"No action" on a mining proposal for the initial development of existing leases would equate to maintaining the status quo on those leases. Under existing regulations, operations may not proceed in the absence of approved M&R plans and related permits. The alternative of rejecting the M&R plans is discussed earlier in this chapter.

Relinquishment of Leases

The BLM is reviewing nonproducing existing leases. Nonproducing leases are to be reviewed in accordance with planning standards and in compliance with the proposed unsuitability criteria developed pursuant to the requirements of section 522(b) of SMCRA.

Under Congressional Bill S3189 (October 13, 1978), the Secretary may exchange leased lands that are determined and/or proven to be unmineable for an equivalent area of unleased land. In addition, the Federal Land Policy and Management Act of 1976 (PL 94-579), Section 206, gives the Secretary general authority to dispose of public lands by exchange, subject to applicable laws, when the Secretary "determines that the public interest will be well served by making that exchange: *Provided,* That when considering public interest the Secretary concerned shall give full consideration to better Federal land management and the needs of State and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife and the Secretary concerned finds that the values and the objectives which Federal lands or interests to be conveyed may serve if retained in Federal ownership are not more than the values of the non-Federal lands or interests and the public objectives they could serve if aquired."

CHAPTER 9

Consultation and Coordination

See volume 3, chapter 9, for a discussion of consultation and coordination carried out for the West-Central ES.

MID-CONTINENT COAL AND COKE:

COAL CANYON MINE

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

Proposed Action

The proposed action is the review and consideration for approval of a mining and reclamation plan (M&R plan) submitted October 13, 1977, to the Office of the Area Mining Supervisor, U.S. Geological Survey (USGS), Denver, Colorado, by Mid-Continent Coal and Coke Company (Mid-Continent) for Mid-Continent Limestone Company. The plan, which describes the proposed Coal Canyon Mine, has been accepted by the USGS as suitable for use in preparing this environmental statement (ES) and is available for public review at the Area Mining Supervisor's Office in Denver. The Coal Canyon Mine would be primarily an underground mining operation, although approximately 40 acres are proposed for auger mining (see Mine Layout later in this chapter).

This M&R plan was submitted for review prior to promulgation of the interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (PL 95-87) and has not been officially reviewed for compliance with that act. Therefore, the applicant's plan may not fully reflect the requirements of the interim regulations. However, in this statement the interim regulations are considered as federal requirements with the M&R plan and will have to comply just as it must comply with all other applicable regulations.

The M&R plan will be returned to the operator for revision in accordance with the applicable federal regulations. As soon as the applicant's plan is revised and returned to the Office of Surface Mining (OSM), it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

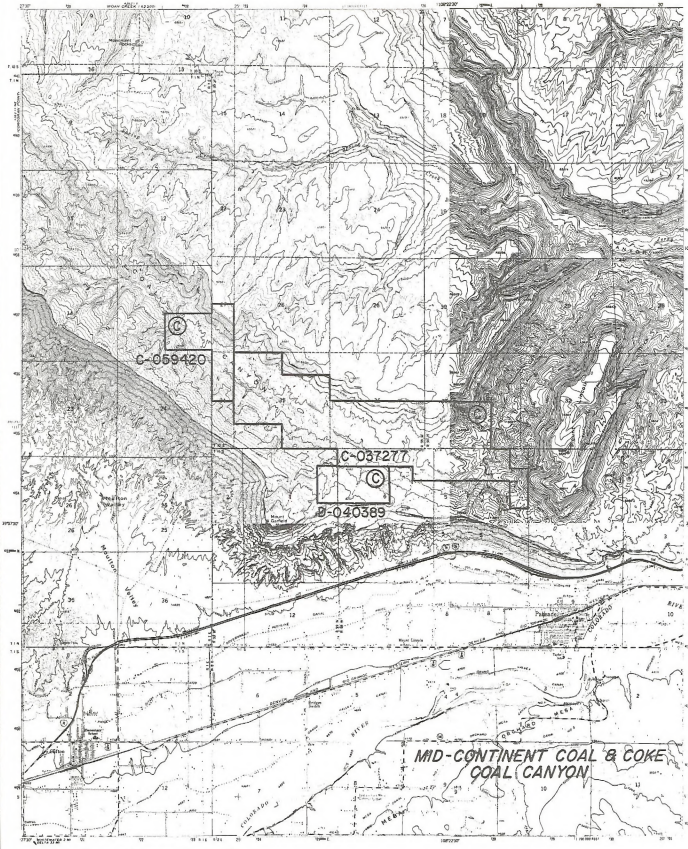
The proposed Coal Canyon Mine would be a new underground mine located approximately 15 miles northeast of Grand Junction, Colorad, and approximately 4.5 miles north of Palisade, Colorado. The proposed mine would lie in Mesa County. All production would be from existing federal coal leases C-037277, C-059420, and C-040389, containing a total of 2,020 acres. (Map MA1-1 shows the location of the 3 leases). The federal lease conditions are subject to all current mining reclamation and related land use requirements and all laws and regulations affecting federal coal leases.

The Coal Canyon Mine is designed to produce 500,000 tons of coal per year for an anticipated mine life of 15 to 25 years. At full production approximately 200 people would be employed. The seam which Mid-Continent proposes to mine is the Cameo B seam of the Mt. Garfield Formation of the Upper Cretaceous Mesaverde Group. The Cameo B seam averages 9.1 feet in thickness in the Coal Canyon area and contains a total of 8 million tons of recoverable coal. The coal would be transported from rail loadout facilities located near the mine, to an unspecified electrical utility market.

History and Background

Mid-Continent proposes to mine three existing federal coal leases which lie in the Coal Canyon area. Coal lease C-037277 consists of 1,471 acres; it was issued to Coal Canyon, Inc., October 1, 1962, and assigned to Mid-Continent Limestone Company in November 1972. Coal lease C-059420 consists of 308 acres; it was issued to Coal Canyon, Inc., on October 1, 1965, and assigned to Mid-Continent Limestone Company in November 1972. Coal lease D-040389 consists of 241 acres reassigned to Mid-Continent Limestone Company in May 1932 (see map MA1-1).

Production from the Little Bookcliffs area was first recorded in 1888 from the Mesa Mine. Numerous mines have operated in the Coal Canyon area since 1890. These include the Mt. Lincoln Mine (1890 to 1942), the Gearhart Mine (1930 to 1968), the Palisade Mine, and the Riverside Mine. The largest historical producer in the Little Bookcliffs coal field was the Cameo Mine which operated in the mouth of Coal Canyon. This mine, which operated from 1899 to 1969, produced 4.2 million tons of coal. Most recently, the Coal Canyon Strip Mine operated in 1963, 1968, and 1969, producing 69,152 tons by both strip and auger methods from the Cameo-Carbonera interval of the Palisade seam.



FEDERAL LEASE

© PUBLIC LAND SURFACE, FEDERAL MINERAL

-N-

Map MA1-1. Mid-Continent Coal and Coke's Coal Canyon lease area

Predisturbance Inventories and Analyses

The entire area of the Coal Canyon Mine lies within the proposed Little Bookcliffs Wild Horse Area. The U.S. Soil Conservation Service has mapped the mine area even though the area is outside the Mesa County Soil Survey (in press). The Bureau of Land Management (BLM) has completed an endangered and threatened plant literature search and herbarium survey. Also, BLM conducted an extensive floristic and endangered and threatened pland field inventory of the proposed mine site. The Colorado Division of Wildlife has completed an inventory and study of the area for rare and endangered species.

Mid-Continent's Proposed M&R Plan

Mid-Continent estimates that initial construction on the Coal Canyon Mine would begin in 1983 using a work force of 75 employees including construction workers. Initial coal production would be 100,000 tons with a work force of 25 persons in the second project year (1984). Production would increase to 200,000 tons in 1985, and the work force would increase to 60 employees. Full design production of 500,000 tons per year would be attained in 1989, and annual production would remain at that amount, with the work force remaining constant at approximately 200 employees. The mine life is estimated at 15 to 25 years. Figure MA1-1 is an aerial photograph of the proposed mine site.

MINE LAYOUT

The Coal Canyon property has been divided into two sections by Mid-Continent. The two areas are separated by a fault trending northeast in Section 36, T. 10S., R. 99W. The normal rotational fault, with downthrow to the east, has a displacement of approximately 40 feet at the outcrop, increasing to 95 feet where it crosses the northern boundary of the lease at 1,650 feet from the outcrop.

Two different mining methods are proposed for the two areas. (Map MA1-2 shows the proposed mine layout). Mining in the area east of the fault would be by retreating longwall units following development by continuous miners. In this area four to five portal entries would be developed using a modified punch mine concept. The area west of the fault does not appear to be suitable for the use of longwall mining techniques due to projected dip increases. In addition, the short north-south length of the lease and the limited access to the area would severely restrict the size of the longwall panels. Therefore, the area west of the fault would be mined with conventional room-and-pillar methods using continuous miner units. Mining in the west area would commence after the end of the development phase in the east area.

Finally, auger mining would be used along outcrop areas where the coal is too shallow for underground mining. (Areas for auger mining along the outcrop are shown on map MA1-2.) After auger mining, the coal face would be backfilled for safety and fire prevention; complete outcrop covering would be done after mining. Mining in both the east and west areas would be done in a manner to preserve future access to coal reserves lying north of the existing federal leases. All main entries in the mine would be three-entry systems with entries 16 to 20 feet wide on 80-foot centers. The full height of the seam would be mined.

A continuous miner section would consist of a continuous miner, two shuttle cars (or continuous haulage belts), a feeder-breaker, a power center, and a roof-bolting machine. Coal haulage from the section to the portals would be by belt conveyor. Secondary mining would be by longwall methods and/or continuous miners generally using fully retreating methods.

Roof support plans would be designed and submitted to the Mine Safety and Health Administration (MSHA) for approval. Exact details would depend largely on early mining experience. Drill hole data show that there is geologic variation in the Cameo seam area; as a result, there may be roof control and bottom heaving problems. Conditions would be continually evaluated as mining proceeds. Normal safety and roof support procedures and details would be followed.

East of the Fault

Development mining would be done with continuous miners; secondary mining would be done by retreat of longwall panels. Areas in the southeast and northwest corners would be extracted by room-and-pillar methods using continuous miners (see map MA1-2). A significant area is believed to be burned out in the southwest corner of the block. This burned out area would be explored by continuous miners to define the extent of the burn.

Longwall panels would range from 2,000 to 3,600 feet in depth with a 500-foot mining face. Mining would be initiated in this area with development of the 1st west mains, followed by development of the 101 and 102 longwall panels. Longwall retreat mining would commence in the 101 panel and continue on sequence. Development would then proceed to the 2nd west mains, then to the 3rd west mains, and continue westward until the east area is completely developed. A corridor between the 3rd and 4th west mains (map MA1-2) would allow future access to coal located north of the present leases. However, no plans have been developed for mining this coal since it is outside the lease boundary.

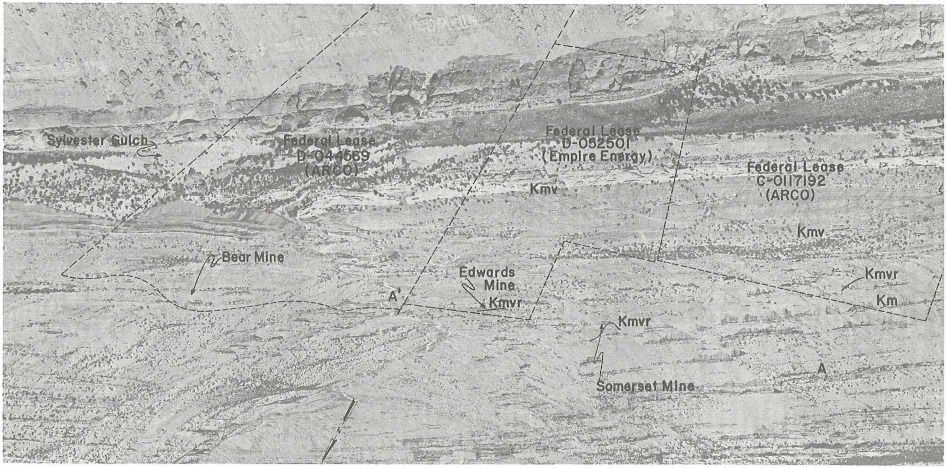
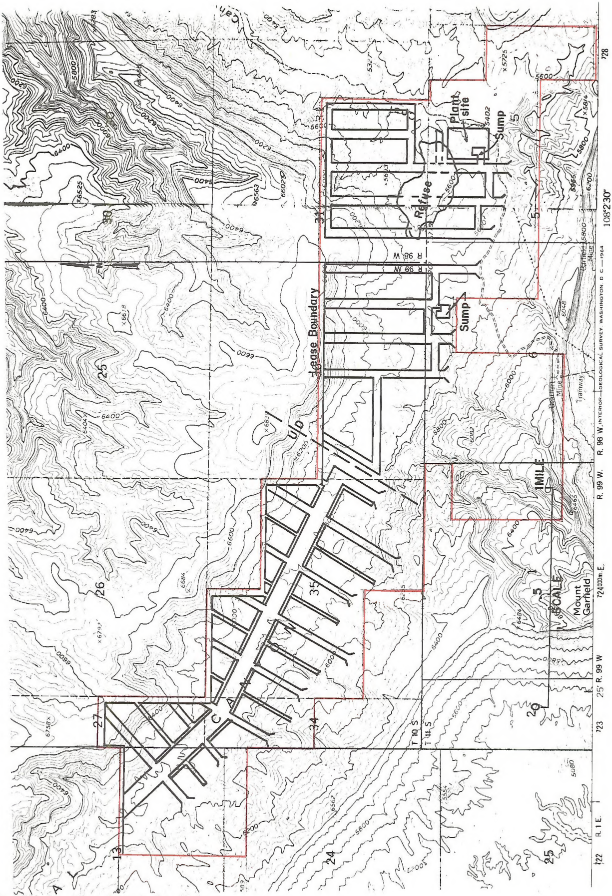


Figure MA1-1. Looking northeast from the Little Bookcliffs escarpment into Coal Canyon at the abandoned Coal Canyon Strip Mine and Mid-Continent Coal and Coke's proposed Coal Canyon Mine site. Mid-Continent proposes to construct facilities at point A and portals at each of the points marked B. Kmvr indicates the Rollins sandstone, the bottom member of the coal-bearing Mt. Garfield formation. The Cameo coal zone lies directly on top of the Rollins sandstone.



Map MA1-2. Mine layout for Mid-Continent's proposed Coal Canyon Mine

Depending on needed production balances, there probably would be two continuous miner sections and one longwall section at full production east of the fault.

West of the Fault

Development mining would be by continuous miners west of the fault. Secondary mining would be by standard room-and-pillar methods using continuous miners. Continuous miner room-and-pillar panels would range up to 2,000 feet long with rooms 20 feet wide and about 500 feet deep.

Access to this area would be limited because the outcrop is south of Coal Creek. Mine layout would be dictated by access and the increasingly steeper dip toward the west.

A corridor for future deep mining of coal north of the leased area is located just west of the fault. No plans have been developed for mining this coal.

Ventilation

The mines would be ventilated by fans at each main exhaust portal as mining progresses toward the west. The fans would be axial exhaust type. Detailed ventilation plans would depend on several factors, some of which must be determined by actual mining. Ventilation plans would be approved by MSHA.

Haulage System

Coal would be hauled from the sections to the portals by belt conveyors. The section belt-conveyors would be 36 inches wide with the main belt-conveyors being either 42 or 40 inches wide. Supply and personnel transportation in the mine would be by MSHA-approved electric and/or diesel powered equipment. The main supply system most likely would be by electric locomotive track haulage.

SURFACE FACILITIES

Approximately 99 acres would be required for surface facilities, which would include portal support structures, raw-coal storage facilities, preparation plant and dryer, loadout facilities, refuse disposal system, water supply system, power lines, and access roads.

Support Structures

A service area covering approximately 20 acres would be constructed in the northwest portion of Section 5. The facilities might include, but would not necessarily be limited to the following:

Offices
Shops
Parking lots
Bathhouse-locker
Lunchroom
Water storage
Waste-water disposal
Laboratory
Warehouse
Substations

Some facilities would also be required adjacent to the other mine portals in Coal Canyon. These facilities might include, but would not necessarily be limited to the following:

Offices
Parking lots
Coal bins
Portals
Hoist or trolley house
Fans

Exact locations, size, and design of such facilities would be dictated by numerous factors, but they would cover about 14 acres total in the portal areas. All facilities would be built to conform with all applicable regulations existing at the time they are constructed.

Raw-coal storage bins would be located along the mine road adjacent to the portals. One bin would serve two portals. Surface conveyors would carry the raw coal from the mine portal to the bins, and trucks or conveyors would transport it to the preparation plant site.

Preparation Plant and Dryer

A proposed preparation plant and dryer unit covering approximately 7 acres would be constructed within the service area in the northwest portion of Section 5 near the east end of the property. The plant would be designed to handle in excess of 500,000 tons of coal per year. It would have standard sizing and washing equipment with a closed water loop, together with all normal and necessary safety and pollution control facilities. The plant would meet all applicable codes and regulations existing at the time it is built. Two products would be discharged from the plant: (1) clean coal, which would be transported by truck to a rail loadout facility and (2) refuse, which would go to a disposal site.

Loadout Facilities

A clean-coal storage facility would be constructed adjacent to the preparation plant. It would include a clean-coal bin, a surgepile, feeders, a scale, etc., and would meet all applicable codes and regulations existing at the time it is built. The clean coal would be transported by trucks to a unit-train loadout facility to be located north of the Cameo power plant. The unit train facility which Mid-Continent proposes to use is being constructed by GEX Colorado Company.

Refuse Disposal

Shale, bone coal, parting material, and similiar refuse would be removed from mine-run coal at the preparation plant. This refuse would probably amount to over 150,000 tons per year at planned mine capacity. It would be used at first as fill material to aid in development of the property and then would be disposed of in a 47-acre disposal area in the northern part of Section 5, T. 11S., R. 98W., and the southern portion of Section 31, T. 10S., R. 98W.

Water Supply and Distribution

The preparation plant would require make-up water, the mine would require water for fire protection and dust control, and surface area dust control may require some water. Total water requirements are estimated at 36.8 acre-feet per year. It is estimated that 5 to 8 million gallons of water per year would be required for the preparation plant.

The system for nonpotable water storage and use would be supplied by water from the mine. It is estimated that 3 acre-feet of water may be purchased from local water utilities for domestic purposes, or treated mine water may be used. If the mine has more water than could be used, water storage/evaporation ponds would be constructed so that there would be no objectionable discharge of mine water. Berms and dikes would be constructed, and surface facilities and the refuse disposal area would be designed so that any contaminated surface runoff that resulted from precipitation could be contained. This water would go to storage/evaporation ponds and could be used to supplement the nonpotable water system. Drainage and settling ponds would be maintained at all times to prevent discharge to natural drainage.

Power Lines

Power for the property would be supplied by Public Service Company of Colorado. A main substation would be built in the north portion of Section 5. Primary power lines would be constructed by Public Service Company; secondary power lines would be constructed by Mid-Continent and would run from the main substation to the various facilities required on the site. The power system would meet all applicable safety and design requirements existing at the time of construction.

Access Roads

The existing access road to the property follows Coal Canyon, originating near the Cameo power plant in Section 34, T. 10S., R. 98W. This road was used for hauling coal from the Coal Canyon Strip Mine and for access to the Gearhart and Garfield mines. The road is currently used as a power line maintenance road.

This existing road would be upgraded through Sections 27, 28, 29, 31, and 32, T. 10S., R. 98W., and into Section 5, T. 11S., R. 98W., a distance of about 4.3 miles. The road would be widened to about 20 to 25 feet and designed for 30- to 45-mile-per-hour traffic. It would have a heavy-duty gravel or crushed rock surface. Approximately 13 acres would be disturbed by upgrading the road which would require right-of-way agreements and/or permits from GEX Colorado Company, Colorado Fuel and Iron, and Public Service Company of Colorado. Exact details of construction and road location would be dictated by field conditions and permit requirements. Vehicular traffic to and from the mine site would be primarily off-road coal-haul units, supply and equipment vehicles, and employees' personal vehicles.

To obtain access for the portals on the ledge forming the north wall of the canyon, Mid-Continent would build an access road along the coal outcrop line. This road would start at the existing main access road in the north-central part of Section 5 and continue westward as shown on map MA1-2. The disturbed area would be only wide enough to provide a 20- to 25-foot-wide roadway with adequate shoulder areas on both sides, and approximately 6 acres would be disturbed. The road surface probably would be heavy-duty gravel or crushed rock. Exact details of construction would be developed in cooperation with the Mesa County Commissioners. Vehicular traffic would be primarily coal trucks and vehicles carrying supplies and personnel to and from the mine portals. In addition, about 900 feet of the mine access road along the coal outcrop would lie in a portion of Section 6 that is outside the lease area. A right-of-way from BLM for this portion of the road would be required.

Portions of the Gearhart Mine road and an existing jeep trail in the canyon bottom should receive only minimal use by company personnel, and no improvements are anticipated.

SURFACE RECLAMATION

Topsoil would be removed and stockpiled for future use. When the mine is abandoned, all portals would be sealed properly, and surface structures would be removed entirely, including concrete foundations. The portal area would be graded to approximately its original contour. The areas would be topsoiled and seeded with either native species or adapted domestic species. The refuse pile would be graded to match the surrounding terrain, topsoiled, and seeded properly. Roads and other disturbed areas would be reclaimed, topsoiled, and seeded.

Authorizing Actions

This M&R plan was submitted for review prior to promulgation of interim regulations, 30(CFR): 700, required under Section 502 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87). Therefore, the plan does not fully reflect the requirements of the interim regulations. However, in this statement the applicable interim regulations are being included as federal requirements in chapter 1 as if the M&R plan was designed using the requirements of the regulations. Before the plan will be considered for approval by the Secretary of the Interior, it will be returned to the mining company for redesign to incorporate the applicable federal regulations. As soon as the applicant's plan is revised and returned to OSM, it will be evaluated in conjunction with USGS Mining (OSM) to determine compliance with the requirements of federal regulations in 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

The regulations contained in 30(CFR): 717 deal specifically with the performance standards required for approval of underground mining such as that proposed in this plan. In addition, refuse disposal of mine waste materials is governed by the regulation 30(CFR): 715.15. The standards and measures described in those regulations are considered as required measures and the impacts from the proposed action have been analyzed on that basis.

Federal Agencies

ASSISTANT SECRETARY OF ENERGY AND MINERALS

The Assistant Secretary must approve the mining permit application, including the proposed M&R plan, and significant modifications or amendments to it before the mining company can commence mining operations.

OFFICE OF SURFACE MINING (OSM)

OSM, with concurrence of the surface managing agency (BLM or USFS) and USGS, recommends approval or disapproval of M&R plans to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a State-Federal Cooperative Agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and the Department of the Interior authorized to take final actions on the permit.

U.S. GEOLOGICAL SURVEY (USGS)

The USGS is responsible for development, production, and coal resources recovery requirements included in the mining permit.

BUREAU OF LAND MANAGEMENT (BLM)

The BLM develops the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected public lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on public lands.

U.S. FOREST SERVICE (USFS)

The USFS developes requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected forest lands. The USFS is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on forest lands.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

The USFWS is responsible for protection of migratory birds, including eagles, and threatened or endangered species and their habitats. Coordination is required with the USFWS under provisions of the Fish and Wildlife Coordination Act, the Bald Eagle Act, and the Endangered Species Act.

State Agencies

STATE OF COLORADO

Air quality, solid-waste disposal, and water quality must comply with rules and regulations administered by the various divisions within the Department of Health. Approval of the M&R plan, permits, and licenses to mine coal must be obtained from the state of Colorado. Mid-Continent would also have to obtain rights from the State Engineer to use any mine water in their operations.

County Agencies

Mid-Continent would have to obtain a special-use permit from Mesa County and comply with stipulations required by the county.

Interrelationships

Relationships to Other Existing and Proposed Developments

The Roadside and Cameo No. 1 mines, both operated by GEX Colorado, a subsidiary of Gener-

al Exploration Company are the only active mines in the area of the proposed Coal Canyon Mine and are approximately 2.5 miles east. Annual production from the Roadside in 1977 was 300,200 tons of coal from both private and federal leases. Production from the Cameo No. 1 Mine is scheduled to begin from private coal reserves by late 1978 or early 1979. The coal produced by both mining operations is to be conveyed to unit train loadout facilities near the Cameo No. 1 Mine which were constructed in 1978. Mid-Continent also proposes to use this facility for the Coal Canyon operation.

The Denver & Rio Grande Western Railroad (D&RGW) main line, which parallels Interstate 70 and the Colorado River in DeBeque Canyon, is approximately 4.5 miles by road east of the proposed Coal Canyon mining operation.

Housing and service facilities exist in the area in Palisade and in Grand Junction. Experienced labor is in short supply in the area because agriculture is the mainstay of the area.

Institutional Relationships

OFFICE OF SURFACE MINING

OSM, in consultation with Surface Managing Agency (BLM and USFS), USGS, or (where applicable) the state regulatory authority, recommends approval or denial of surface coal mining permit applications to the Assistant Secretary of Energy and Minerals. OSM (as lead agency) is the federal regulatory authority responsible for reviewing coal M&R plans (permit application), enforcement of all environmental protection and reclamation standards included in an approved mining permit, the monitoring of both on- and off-site effects of the mining operation, and abandonment operations within the area of operation of a federal lease.

OSM is the principal contact for all coal mining activities within the area of operation. OSM will conduct as many inspections as are deemed necessary but no less than one partial inspection quarterly and at least one complete inspection every six months (30[CFR]: 721.14[c]).

OSM, after consultation with BLM, USGS, and the operator establishes the boundaries of the permit area for the proposed mine and approves the locations of all the mine facilities located within this boundary.

Section 523 of SMCRA requires the Federal Lands Program to adopt those state performance standards which the Secretary determines are more stringent than the federal standards. The Federal Lands Program means a program established by the Secretary pursuant to Section 523, SMCRA, to regulate surface coal mining and reclamation operations on federal lands. Therefore, the performance standards enforced by OSM on a federal leasehold should be at least as stringent as those required under state law or regulations.

The Department of the Interior is negotiating a cooperative agreement pursuant to Section 523(c) of SMCRA with the state of Colorado and other states. Whenever this agreement is consummated with the state, the OSM's functions and responsibilities specified in this agreement will be delegated to the state regulatory authority. Under this agreement, OSM and the state regulatory authority will jointly review and act on mining permit applications and recommend approval or disapproval to the officials authorized to take final action on the application. The Secretary is prohibited by law from delegating his authority to approve mining plans on federal lands.

U.S. GEOLOGICAL SURVEY

The USGS is responsible for reviewing M&R plans for development, production, and coal resource recovery requirements on a federal leasehold. USGS is responsible for the maximum economic recovery of the federal coal resource and for the federal government receiving fair market value for the coal resource.

BUREAU OF LAND MANAGEMENT

The BLM formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of public lands.

The BLM, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, and railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The BLM is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on public lands within a leasehold.

U.S. FOREST SERVICE

The USFS formulates special requirements to be included in a lease or mining permit application

related to the management and protection of all resources (other than coal) and the post-mining land use of national forest systems land.

The USFS, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The USFS is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on forest lands within a leasehold.

Relationship to BLM Land Use Plans

The 2,020 acres of public lands included in this M&R plan are administered by the BLM's Grand Junction District. They are subject to the management guidelines that were developed in the Roan Creek-Uinta Flats management framework plan (MFP) completed in January 1971, and the Whitewater Area Coal Update MFP, completed in September 1977.

The surface overlying Mid-Continent's lease holdings is included in the Little Bookcliffs Wild Horse Area. The 1977 MFP update designated the Little Bookcliffs Wild Horse Area as a "wildland study area." No development is to be allowed that will alter the character of the land use as it now exists until the study determines the area's wildland values. The suitability study is to be completed by 1982, and final recommendation regarding official designation of the area as a wilderness should be based upon the information and recommendations contained in the study.

As long as the area is a wildland study area, uses of the land are governed by the Wilderness Act (PL88-577) and the Federal Land Policy and Management Act of 1976. To protect the area until a decision is made on its potential as a wilderness area, the following interim management guidelines were developed in the Whitewater Coal Update MFP:

1. Motorized transportaion shall be restricted to existing seasonal use and primitive four-wheel drive roads.

2. No new roads shall be authorized within the area.

3. Future development of existing leases for coal and/or oil and gas may entail some construction and other surface disturbing activity. The BLM will impose the strictest possible stipulations on any such development to ensure that no unalterable change is made in the character of the land. Mitigating measures will be imposed to bring disturbed areas back to their original state as nearly as possible. Except as outlined under item 8 below, no other construction of any kind will be permitted.

4. Grazing of domestic livestock will be permitted subject to special conditions and restrictions necessary to preserve wildland values.

5. Hunting and fishing are permitted.

6. Motorized equipment will be permitted.

7. Aircraft will be allowed to land in the area.

8. Water storage projects may be permitted under conditions and restrictions deemed necessary to preserve wildland values.

9. Rights-of-way will not be granted.

10. Wildfire will be controlled as necessary to prevent unacceptable loss of wildland values, loss of life, damage to property, and the spread of wildfire to lands outside the study area.

11. Insect and disease control programs shall be permitted to the extent they impact only minimally upon wildland values and other components of the ecosystem.

12. Public use of the area will be permitted consistent with the maintenance of wildland values.

13. Commercial recreation services may be permitted in the area if carefully monitored.

14. Commercial timber harvesting will not be permitted.

15. Mining and prospecting will be permitted.

16. Other proposed uses and programs not specifically mentioned above will be assessed in terms of their possible impacts on wild land and ecologic values. The District Recreation Planner shall assist the Area Manager with the interpretation of the interim management policy.

In addition, the following general management guidelines pertain to the Little bookcliffs area (Roan Creek-Uinta Flats MFP 1971; Whitewater Coal Update MFP 1977):

1. Recreation

a. Maintain the character of the entire area to meet the Visual Management Class II standards.

b. Identify and protect cultural resources to avoid loss or destruction of any sites; conduct a Class II Cultural Resources Inventory of all unsurveyed public land to be impacted by coal development.

2. Wildlife

a. Provide permanent watersites (upland game bird guzzlers) in Coal Canyon and the chukar habitat as needed.

b. Develop a road and vehicle use plan for the Little Bookcliffs area to improve mountain lion habitat by maintaining or increasing general remoteness.

c. Exclude all mountain lion hunting within the Little Bookcliffs Wild Horse Area through cooperation with the Colorado Division of Wildlife.

d. Protect raptor nest sites by limiting human activity within 0.5 mille from March 1 to July 1; prohibit physical distrubance on rock cliffs and maintain a 100-foot buffer area around tree nests.

3. Watershed and Water Quality

a. Maintain the current Soil Surface Factor and reduce to next lower classification if possible.

b. Require coal-lease holders to install and maintain a water monitoring network within their lease area; an adequate water monitoring network should be addressed prior to approval of any mining or exploration plan as appropriate.

4. Range

a. Formally designate the Little Bookcliffs Wild Horse Area through the Secretary of the Interior as the third National Wild Horse Range.

5. Minerals

a. Allow no surface occupancy on new leases within the proposed Little Bookcliffs study area until a decision has been made as to its wildland-roadless potential.

If the Little Bookcliffs Wild Horse Area is classified as a wilderness area, use of the land would be governed by the provisions of the Wilderness Act. Mining of an existing lease might be allowed, but it would be subject to appropriate conditions and terms set by the Secretary of the Interior to carry out his overall duty to manage public resources in the public interest as well as his specific duties under such statutes as the Federal Land Policy and management Act of 1976 (FLPMA). Any existing lease would have to be examined to determine the nature of the rights conveyed by the United States to the lessee, to what extent those rights would be impaired by stipulations designed to protect the area's wilderness character, whether development of the lease would be allowed, and (if development is not allowed) what actions are available or necessary to prevent development or (if development is allowed) how that development would be regulated.

If the Little Bookcliffs Wild Horse Area is not classified as wilderness, but is classified as National Wild Horse Range, presumably guidelines similar to the interim guidelines would be developed. Mining of an existing lease (including construction of surface facilities) would not necessarily be excluded, but no irreversible changes in the character of the land would be allowed, and disturbed areas would have to be returned to their pre-mining condition (the latter is also required by 30 [CFR]: 717 and 30 [CFR]: 211 regulations). If the Little Bookcliffs Wild Horse Area is not classified as either wilderness or National Wild Horse Range, the BLM would still manage the area in ways which would protect the wild horses and their habitat, perhaps accoridng to guidelines similar to the interim guidelines.

Major BLM policy guidelines to be followed for the management of wild free-roaming horses and burros on public lands are as follows:

1. Administration of public lands must provide for the management protection, and control of wild free-roaming horses and burros.

2. Wild free-roaming horses and burros are to be protected from unauthorized capture, branding, harassment, or death.

3. Wild free-roaming horses and burros must be managed in a manner that is designed to achieve and maintain a thriving natural ecological balance on the public lands.

4. All management activities must be at a minimum feasible level and carried out in consultation with the wildlife agency of the state in which such lands are located in order to protect the natural ecological balance of all wildlife species which inhabit such lands, particularly endangered wildlife species.

5. Adjustments in forage allocation on any such land must take into consideration the needs of wildlife species and authorized livestock which inhabit such lands.

6. Wild horse and burro populations shoudl be maintained at the 1971 level whre resource damage is occurring.

7. Management of wild free-roaming horses and burros will not be assigned to any private individual or association through grazing license, lease or permit.

8. BLM will resort to supplemental feeding only in unusual and exreme circumstances when total herd populations are threatened.

9. Aircraft and motorized vehicles may be used in the enforcement and inventorying aspects of the program. Only helicopters and ground personnel may be used in acutal round-ups. Motorizd vehicles may only be used for transporting captured animals.

Relationship to State and Local Planning

For a discussion of state of Colorado and Mesa and Garfield county land use planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

The description of the existing environment covers the physical, biological, and cultural resources and the socioeconomic conditions which constitute the site-specific environment in which Mid-Continent Coal and Coke Company proposes to develop federal coal. The description focuses on environmental details most likely to be affected by Mid- Continent's proposed action and alternatives. The concluding section of this chapter describes the anticipated future environment through 1990 if the proposed M&R plan is not approved and implemented.

EXISTING ENVIRONMENT

Climate

The climate of west-central Colorado is characterized by dry air masses, which are modified Pacific air masses that move eastward across the Rocky Mountains. Winter snows and summer showers or thunder storms result in unusually even distribution of precipitation throughout the year. Prevailing winds vary greatly throughout the Upper Colorado River Basin, and are markedly affected by differences in elevation and by the orientation of mountain ranges and valleys with respect to general air movements.

Five years of upper air observations at Grand Junction show that surface based inversions occur on 84 percent of the mornings. During the afternoons they are not as common, occurring 11 percent of the time in winter but less than 3 percent of the time in other seasons. The area is subject to a relatively high frequency of stagnation situations, mostly in winter.

The proposed Coal Canyon Mine site is located north of the Colorado River near the mouth of DeBeque Canyon, about 15 miles northeast of Grand Junction. Elevation at the site ranges between 5,200 and 6,800 feet. No meteorological measurements have been made on site. Data from the Grand Junction weather station indicate that the average annual temperature is 53 degrees Fahrenheit, and annual precipitation is about 10 inches. The growing season is 188 days (based on 32-degree freeze threshold data). Evaporation is estimated to be about 45 inches annually.

Prevailing wind at this site is influenced by its location in Coal Canyon. No wind measurements have been made on site. It has been assumed that prevailing wind direction is down valley or from the northeast. The wind rose from the nearby Grand Junction weather station has been rotated to reflect the major canyon axis, as shown in figure MA2-1. Average wind speed at the Grand Junction station is 8.1 miles per hour.

Air Quality

Particulate air quality in the study area ranges from 20 to 132 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean as recorded at sixteen state, municipal, and privately operated particulate sampling sites. In undeveloped sections, particulate concentrations range from 20 to 40 $\mu g/m^3$.

A detailed air quality analysis determined that particulate concentrations in the Grand Valley in areas away from any sources were approximately 40 $\mu g/m^3$ annual geometric mean (PEDCo 1977). The calculated first and second maximum 24-hour concentrations were 130 and 112 $\mu g/m^3$, respectively. Although particulate concentrations on the lease area are lower than applicable air quality standards, the site is partially within the designated boundaries of the Grand Junction nonattainment area.

There has been no measurement of carbon monoxide, hydrocarbon, nitrogen oxides, sulfur dioxide, or other gaseous pollutant concentrations in the vicinity of the proposed mine. The Cameo power plant and motor vehicle emissions near the mine site probably raise concentrations of these pollutants slightly above background or natural levels.

Visibility at the site ranges from less than 1 mile to approximately 100 miles throughout the year. Average visibility is about 54 miles with greatest visibility occurring during spring and summer months.

Geologic and Geographic Setting

Topography

The federal coal leases that compose the proposed Coal Canyon Mine property lie northeast of (or behind) the Little Bookcliffs escarpment. The

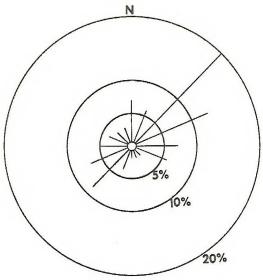


Figure MA2-1 Annual wind frequency at the Coal Canyon mine site

entire property lies along the steep embankments that form Coal Canyon, a tributary of the Colorado River. Elevation varies from 5,280 feet along the bottom of Coal Canyon at the eastern boundary to 6,600 feet along the northern boundary. Mount Garfield lies immediately south of the lease area along the Little Bookcliffs escarpment. It rises to 6,765 feet, forming a topographic high for the area.

Topographically, the area is quite rugged (see map MA1-1 in chapter 1). The stream in Coal Canyon has become deeply entrenched through thick sedimentary strata. The entire mine property occupies the steep canyon walls which face either southwest or northeast except along the very eastern boundary of the lease area. The steep canyon walls are notched every few thousand feet by small ephemeral streams draining into Coal Canyon.

The maximum relief on the lease property is generally found along the northern canyon walls where slopes may reach up to 85 percent.

Geomorphology

The lease area lying south of Coal Creek is dominated by the dip slope of the Cozette Sandstone (basal sandstone of the Iles Formation) and, toward the west end of the properties, the dip slope of the Rollins Sandstone. This slope dips to the northeast about 13 degrees and is cut by numerous ephemeral stream valleys. In the vicinity of the Gearhardt Mine portal, two very large blocks of Cozette Sandstone have slumped or were faulted down, forming a secondary bench on the Little Bookcliffs escarpment.

To the north of Coal Creek, the Rollins Sandstone forms a prominent bench, the bottom of which controls the course of Coal Creek throughout most of the property. Above the Rollins Sandstone, the Cameo-Carbonera coal interval and related soft sediments of the Cameo Member form a belt of relatively subdued topography from 0.25 to 0.5 mile in width. Above this zone, the more resistant sandstones of the Hunter Canyon Member form a steep escarpment 600 to 1,000 feet above the coal-bearing strata.

Structure

Structurally the Coal Canyon area is fairly simple. The axis of a synclinal flexure superimposed on the Little Bookcliffs monocline roughly parallels Coal Creek and plunges to the east, with dips as great as 12 to 18 degrees on the south side diminishing to 3.7 degrees near the northeast corner of the properties. In addition, a normal rotational fault down to the east is present to the center of the lease area. Displacement at the outcrop is 40 feet, increasing to 95 feet along the lease boundary 1,650 feet from the outcrop. Another small normal fault, possibly related to cliff-face sloughing, is present in the underground workings of the Gearhardt Mine.

Stratigraphy

The stratigraphic formations which outcrop on the Coal Canyon property are restricted entirely to Upper Cretaceous sedimentary rocks and Pleistocene or recent colluvial and alluvial deposits. The Upper Cretaceous sedimentary series comprises the Mancos Shale and the Mesaverde Group, and coals of commercial quality in the Little Bookcliffs area are restricted to these two units. These formations and their coal-bearing units are described in ascending order.

The lowest and oldest formation on the property is the Mancos Shale. The uppermost member of the Mancos, the Anchor Mine Tongue, occurs interbedded with the Sego Sandstone, the lowest member of the Mesaverde Group (see figure MA2-2). The Anchor coal seam, which occurs in the Anchor Mine Tongue, is not significant in this area.

The base of the Mesaverde Group is at the bottom of the Sego Sandstone. The group is divided into two formations: the Mt. Garfield Formation and the overlying Hunter Canyon Formation. The three coal-bearing zones are confined to the Mt. Garfield Formation; in ascending order they are the Palisade, Cameo, and Carbonera seams (see figure MA2-2).

The Palisade seam varies from 3.67 to 7.83 feet in thickness and averages 5.99 feet. Erratic thicknesses and partings together with excessive overburden may preclude the mining of the Palisade seam in this area, and Mid-Continent does not propose to mine this seam.

The Cameo coal seam is notable for the thickness of its seams and its great extent. It has been the most productive zone in the Little Bookcliffs coal field. One of the chief characteristics of the Cameo coal is the relatively large amount of bone coal whose ash content exceeds 50 percent. Another distinctive feature is the presence of sandstone dikes. These dikes vary from several inches to several feet in thickness and may intrude into all or only part of a seam. They occur wherever the Cameo is mined but appear to occur most frequently in the Mount Lincoln area.

The Cameo has been divided into two benches, the A and B; where the coal benches come together, the seam is considered the Cameo B. In the Coal Canyon area, the Cameo B varies from 0.67 to 20.42 feet in thickness, averaging 9.11 feet. The Cameo A varies from 0.17 inch to 12.34 feet, averaging 3.60 feet. The interval commonly contains one or more splits; partings are included in the thickness above. The split between the two seams varies from 0 to 20.17 feet thick.

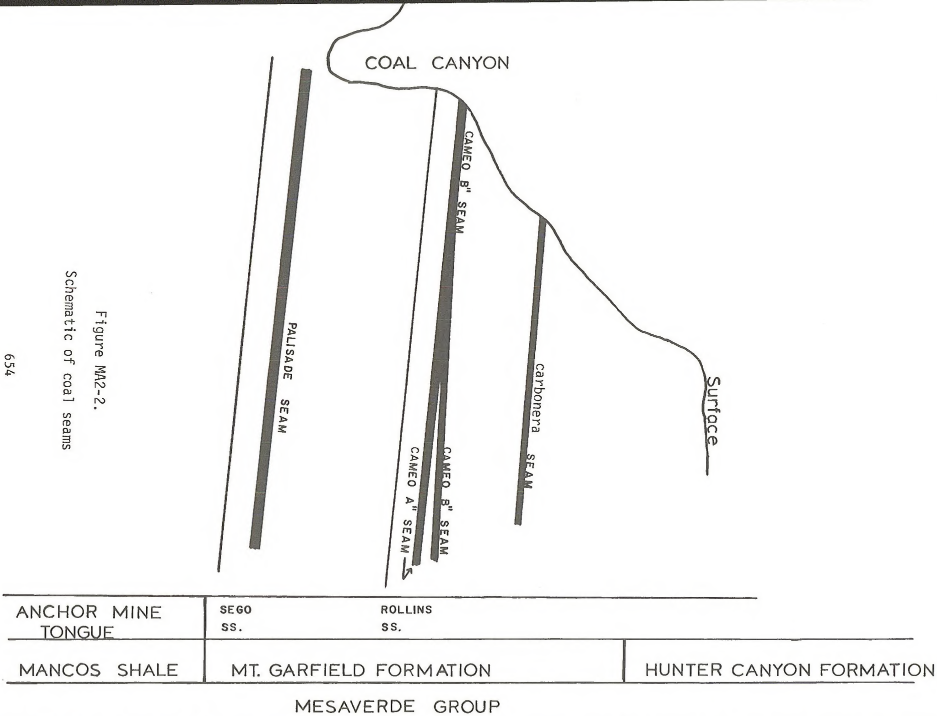


Figure MA2-2.
Schematic of coal seams

The Carbonera coal seam overlies the Cameo at distances of 21 to 99 feet, averaging 53 feet. Throughout its extent, the Carbonera appears to be a series of detached coal seams and lenses rather than a distinctive bed, making correlation difficult. The Carbonera seam contains from one to ten beds and is commonly split by multiple partings. The Carbonera varies from 0 to 11.58 feet thick, averaging 3.5 feet. This average thickness together with the multiple partings precludes mining in the Carbonera in the Coal Canyon area.

Recent deposits consist primarily of large blocks of sandstone which have weathered, broken off cliff faces and ledges, and either slid or rolled down slope from their original position. These blocks range up to several tens of feet in largest dimensions. Sheet wash, made up mostly of small rock fragments, sand, and clay, makes up the base for generally poorly developed thin soils in the remainder of the area. Minor mud-flow deposition has occurred along the course of Coal Creek.

Paleontology

The principal fossil-bearing formations in the lease area, ages, number of known fossil localities, and general fossil types normally found in the formations are summarized in table MA2-1. Due to the present lack of data and accepted criteria for determining significance, the importance of these paleontological resources to science, education, etc., cannot presently be assessed.

Mineral Resources

Coal

A northeast trending fault divides the area of the proposed project into two sections. The area east of the fault would be mined by the retreating longwall method. The area west of the fault would be mined by the room-and-pillar method. Between 40 and 50 percent of the coal reserves of the Coal Canyon area would be recovered.

The Cameo seam outcrops in Coal Canyon, but has been burned back from the outcrop for variable distances up to 1,000 feet. The maximum overburden in the east block is about 1,200 feet, averaging about 500 feet. Overburden where the facilities and refuse pile would be averages about 130 feet, varying from 80 feet to 200 feet. Maximum overburden in the next block is about 1,300 feet, averaging about 700 feet.

Table MA2-2 gives the proximate analyses and company reserve data of the coal seams under the proposed Coal Canyon project. (See the stratigraphy section of Geologic and Geographic Setting for further discussion of the coal seams.)

Oil and Gas

There is a slight potential for oil and gas under the leased area of the Coal Canyon project. In the near future, a well is to be spudded-in approximately 2.5 miles southeast of the leased area.

Water Resources

Hydrologic Setting

The proposed mine area covers the bottom and side slopes of Coal Canyon through a reach about 4.5 miles long in the area immediately north of Mount Garfield and west of Mount Lincoln. North and west of the tract, Coal Canyon is a strike valley cut into moderately dipping beds that strike southeastward and dip 10 to 18 degrees northeast. Drainage is southeastward along strike to near the east margin of the tract where the valley turns abruptly northeastward, crossing the upturned beds at approximately right angles for a distance of about 2.5 miles where it again turns southeastward about 2 miles to the Colorado River. Thus, the Cameo coal seam, which would be mined under this proposal, underlies the canyon floor at relatively shallow depth in the western part of the tract and crops out both on strike in the canyon side slopes in the eastern part of the tract and downdip in the canyon reach northeast of the tract.

No precipitation data are available for the lease area. The vegetation indicates an annual precipitation of about 10 inches. Seasonal patterns of occurrence should be essentially the same as at the National Weather Service station in Grand Junction.

Characteristically steep, poorly vegetated slopes indicate rapid runoff in response to summer thunderstorms and high rates of erosion and consequent sediment yield downstream.

Ground Water

No test wells have been drilled by Mid-Continent on or adjacent to the tract, and no springs or seeps were found during a field examination of the area. A test hole adjacent to the road about a mile downstream from the tract was 39.8 feet deep and had 8.1 feet of water in the bottom of the hole at the time of the measurement on October 26, 1978. The water had a specific conductance of 2,300 micromhos per centimeter, which indicates a dissolved-solids concentration of about 1,600 milligrams per liter (mg/l).

In the virtual absence of ground-water data, any appraisal of the resource must necessarily be speculative and based on interpretation of the effects of the local structure, stratigraphy, topography, and opportunity for ground-water recharge. On that basis, the controlling factor is probably the northeast-trending fault described under Geologic and Geographic Setting. This fault divides the lease

TABLE MA2-1

SUMMARY OF FOSSIL-BEARING FORMATIONS
IN THE AREA OF THE PROPOSED COAL CANYON MINE

Formation	Period	Known Fossil Localities a/	Type of Fossils b/
Mancos Shale	Upper Cretaceous	General	I, V
Mt. Garfield	Upper Cretaceous	General	I, V, P
Hunter Canyon	Upper Cretaceous	General	I, V, P

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

b/ I = invertebrate; V = vertebrate; P = paleobotanical.

TABLE MA2-2

PROXIMATE ANALYSES OF COAL SEAMS IN PROPOSED COAL CANYON PROJECT

Bed	Acres	Average Thickness	In-Place Reserves (million tons)	Recoverable Reserves (million tons)	BTU	Sulfur (Percent)	Moisture (Percent)	Ash (Percent)	Fixed Carbon (Percent)	Volatile Matter (Percent)
Palisade	1,010	5.99	10.54	5.27	11,161	1.07	7.58	15.11	48.08	36.80
Cameo A		3.60	-	-		No Data Given				
Cameo B	1,000	9.11	15.87	7.36	10,244	0.92	7.68	19.71	44.43	35.85
Carbonera		3.5	-	-	10,426	0.87	7.16	20.12	43.84	36.05

about in half and very probably forms an effective ground-water barrier to any movement of ground water downvalley in the direction of strike. East of this fault the Cameo coal seam and the underlying Rollins sandstone are almost certainly drained in the area that would be mined. Otherwise some discharge would be apparent along the valley slopes and in the channel where these beds are exposed downdip from the lease tract. West of this fault, the Cameo coal seam and encompassing beds may be saturated under confined conditions. The opportunity for ground-water recharge to these rocks is minimal, however, and, assuming even moderate permeability these beds are more probably drained downdip to below the level that would be reached by mining. Should the coal and underlying Rollins sandstone be locally saturated, it is highly unlikely that the sustained yield of these potential aquifers would exceed 5 to 10 gallons per minute.

Any water in shallow aquifers underlying the lease tract would probably be moderately hard with a dissolved-solids concentration of about 1,500 mg/l. The water type is expected to be a calcium, magnesium, bicarbonate, sulfate type.

Surface Water

The lease area is drained by Coal Creek and its tributaries, all of which are ephemeral and flow less than one month each calendar year, usually after high-intensity thunderstorms. The watershed has a total drainage area of 11.7 square miles (sq mi) that discharges directly into the Colorado River. The watershed upstream from the mine has an area of about 7.7 sq mi. Coal Creek has an average gradient of 2.4 percent (1.37 degrees) within the lease area. Tributary streams are characteristically steep with slopes in the headwater areas of up to 85 percent.

No runoff or quality of water data are available for Coal Creek or any of its tributaries. Hydrologic studies in Badger Wash near Fruita on similar soils with slightly less annual precipitation show an average annual runoff of about 0.5 inch (Lusby 1978). On that basis annual runoff in Coal Canyon would probably average about 0.6 inch or about 32 acre-feet per square mile (ac-ft/sq mi). Runoff can be expected to be a calcium, magnesium, sulfate water with a pH of 8.0 to 8.5 and a dissolved-solids concentration of 1,000 to 2,000 mg/l. Efflorescence, a whitish powdery crust of salts, occurs throughout much of the length of the Coal Creek channel.

Flood Hazard

Because of the steep gradient of Coal Creek, the precipitous canyon side slopes, and the combination of thin, fine-grained soils and minimal plant cover, runoff in response to high-intensity storms is characteristically rapid, generating high peak discharges with comparatively short flow durations. On July 18, 1974, a high-intensity thunderstorm caused the stream to flow at bankfull stage. Subsequent measurements by the U.S. Geological Survey, Water Resources Division, using indirect methods, showed the peak discharge to have been about 3,440 cubic feet per second (cfs) at a section about 0.9 mile upstream from the mouth. On that basis, peak discharge of Coal Creek at the mine site probably was 2,200 to 2,500 cfs.

Using the Department of Agriculture (1972) method for predicting flood peaks, the discharge from a 100-year/24-hour storm, with a precipitation rate of 3 inches, is estimated to be about 3,900 cfs at the mine site. Peak flows of this magnitude, even though of short duration, are highly erosive and especially damaging to flooded roadways and stream crossings.

Erosion and Sedimentation

No sediment sampling data are available for any flows in the Coal Creek watershed. The area obviously is actively eroding, however, and contributing large volumes of sediment to the Colorado River. Measured sediment yields from small watersheds in Badger Wash with similar runoff characteristics (Lusby 1978) show an average annual rate for the period 1953-73 of 1.80 ac-ft/sq mi (approximately 2,750 tons/sq mi/yr). Because of the steep slopes in the mine area, local rates of sediment yield could exceed those reported for Badger Wash by a factor of two. With increasing size of watershed, however, unit rates of sediment yield normally decrease (Hadley and Schumm 1961) so that annual sediment contribution from Coal Canyon to the Colorado River should not greatly exceed 1.0 to 1.5 ac-ft/sq mi.

Alluvial Valley Floors

Coal Creek is ephemeral throughout its length and yields insufficient water on a regular basis to support subirrigation or flood irrigation agricultural activities. No alluvial valley floors, therefore, occur on or adjacent to the proposed mine area.

Soils

The entire area of proposed mine surface activity is contained within a single soil mapping unit. This unit consists mostly of rock outcrops on very steep slopes intermingled with generally stony or gravelly soils. Landslide areas and small pockets of shallow and very shallow soils are also included. Specific soil features of importance in assessing reclamation are rated in table MA2-3; brief explanations of each rating are contained in the footnotes. See

TABLE MA2-3

SOIL FEATURES FOR MID-CONTINENT: COAL CANYON MINING AREA

Mapping Unit Name	Hydrologic Group a/	Erosion Hazard b/	Topsoil Rating c/	Reclamation Limitations d/
Rock Outcrop				
Rock Component	-	-	-	-
Deep Stony Component	B	Moderate	Poor	Severe
Shallow Component	D	High	Poor	Severe

Note: Adapted from U.S. Dept. of Agriculture, Soil Conservation Service (Grand Junction, Colo.), Mesa County Area Soil Survey (unpublished).

a/ Hydrologic soil groups (A, B, C, D) are based on the rate at which water enters the soil surface (infiltration) and the rate at which water moves within the soil (transmission). When both infiltration and transmission rates are high, little surface runoff occurs (Hydrologic Soil Group A). In contrast, low infiltration and transmission rates produce high surface runoff (Hydrologic Soil Group D). Groups B and C are intermediate.

b/ Erosion hazard refers to the potential for surface soil loss when existing cover is removed or seriously disturbed.

c/ Topsoil is rated both on suitability as a seedbed material and on ability to sustain plant growth. Factors considered include soil depth, texture, amount of coarse fragments, and the presence of excess soluble salts which may inhibit plant growth.

d/ Hydrologic soil groups, erosion hazard, and topsoil rating, along with climatic information, are considered jointly to determine an overall rating of the limitations for reclamation. Specific degrees of limitation are interpreted as follows: Slight - indicates either no significant limitations or those limitations which can be remedied through planning and management choices, such as species selection, time of seeding, or short-term exclusion of livestock and certain forms of wildlife. Moderate - indicates significant limitations which must be recognized but which generally can be overcome through established measures to conserve natural moisture, reduce erosion, and augment available nutrient supplies. Severe - indicates serious deficiencies in natural moisture and in the amount and quality of topsoil; may also indicate topographic and soil conditions which produce extreme surface erosion or landslide hazards.

Water Resources, Erosion and Sedimentation, for a discussion of erosion in the area.

Vegetation

The coal lease tract is divided into two broad vegetation types: saltbush and pinyon-juniper, (see map MA2-1). The saltbush type covers 67 percent of the lease area, amounting to 1,354 acres. It is dominated by shadscale and galleta grass. Mormon tea, four-wing saltbush, sagebrush, Indian ricegrass, and ryegrass are locally abundant within the saltbush type.

The pinyon-juniper type covers 33 percent of the lease tract (666 acres) and is dominated by Utah juniper. Understory is sparse, consisting of Indian ricegrass, western wheatgrass, galleta grass, bottlebrush squirreltail, cheatgrass, and various forbs. Big sagebrush and rabbitbrush are scattered within the pinyon-juniper type.

The separation between the saltbush and pinyon-juniper types is maintained by a distinct rain-shadow effect, with the south slopes being dryer because of a higher evapotranspiration rate than the north exposures. The saltbush type can tolerate lower moisture levels than pinyon-juniper and consequently inhabits the south slopes, while pinyon-juniper inhabits the north slopes.

Small stands of greasewood occur sporadically on the lower drainages within the lease area, mainly along Coal Creek. In addition, some of the very steep, southern exposures are almost totally devoid of vegetation, due to the extreme dryness. There is no aquatic vegetation in the area proposed for mining.

A more detailed discussion of the plant species composition of the vegetation types mentioned, as well as their relationship to climatic and topographic features and to each other may be found in the regional analysis. Scientific names of the plants are listed in the appendix, volume 3.

Endangered or Threatened Species

Information on the location of plants within the region that are proposed to be officially listed as endangered or threatened in the *Federal Register* (see Vegetation in the regional chapter 2 for a list of the plants) was obtained from detailed literature searches (Rollins 1941; Barneby 1964; Higgins 1971; Hitchcock 1950; Arp 1972, 1973; Reveal 1969; Keck 1937; Howell 1944; Benson 1961, 1962, 1966; Weber 1961) and extensive herbarium surveys (University of Colorado, Colorado State University, Colorado College, Denver Botanic Gardens, Western State College, Rocky Mountain Biological Lab, Black Canyon National Monument, Colorado National Monument, and Grand Mesa/Uncompahgre National Forest Headquarters). This research has revealed that none of the plants are known to have occurred historically in the area of the proposed Coal Canyon Mine. The results of the literature and herbarium studies may be reviewed at the BLM Montrose District Office. A detailed floristic and endangered and threatened plant inventory of the natural vegetation that is expected to be disturbed by the Coal Canyon mine facilities and roads has revealed that no endangered or threatened plants are present. The results of this inventory are available for public review at the Grand Junction District Office.

Wildlife

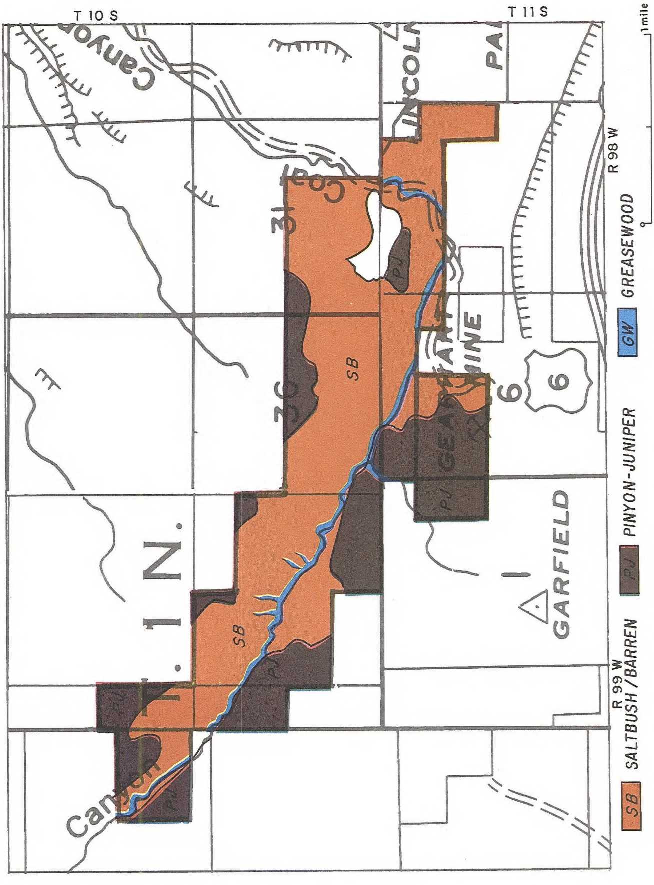
A listing of terrestrial species known or expected to occur in the Coal Canyon area is available at the Montrose BLM District Office.

Wild Horses

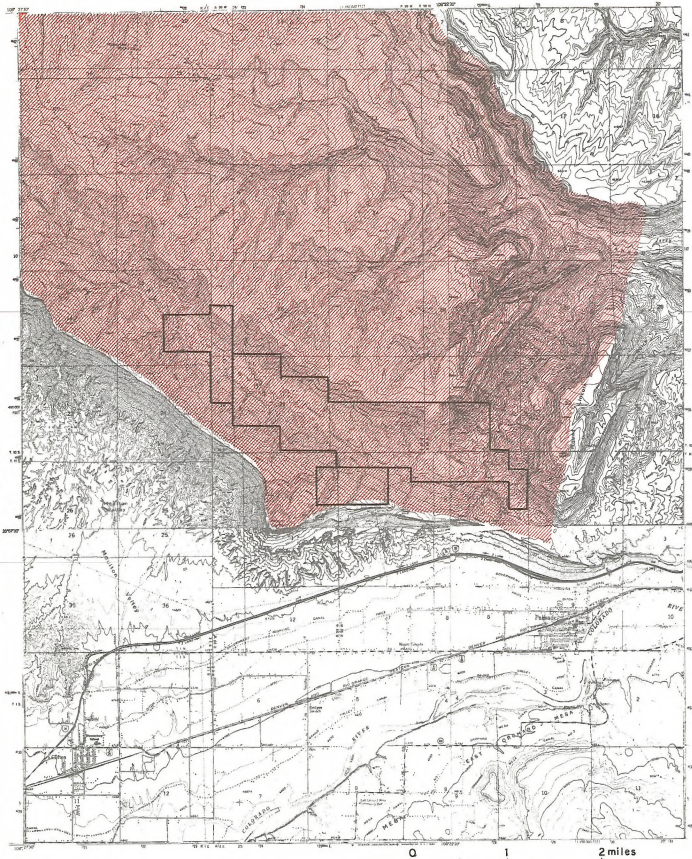
The Little Bookcliffs Wild Horse Area is shown on map MA2-2. The area was established in 1974 by a general management agreement. Formal designation of the area as a National Wild Horse range by the Secretary of the Interior is being considered; in addition, the area is a wildland study area. A management objective is to maintain the area in a relatively natural state and minimize harassment of horses (see chapter 1, Relationship to BLM Land Use Plans).

The current population is approximately 70 horses, following the removal of 40 horses in the fall of 1977. The annual increase is about 20 percent and the population can build rapidly. Coal Canyon is primarily winter range; in the summer, horses move to the north where water and feed are more plentiful. In 1975-76, 45 horses wintered in the Coal Canyon drainage, primarily using the south-facing slopes where snow does not accumulate. This winter population is expected to drop now that 40 horses have been removed, but horses will still winter in Coal Canyon because of their habitual use of the area and the suitability of topography. During the summer, there is no water in Coal Canyon, and the area gets summer and early fall rest from horse use. The current forage production for horses in the Coal Canyon area is 25 acres per animal unit month (AUM).

The topography of Coal Canyon influences the amount of use various sections of the canyon receive from the wild horses. At present this use is restricted to the bottom of the canyon and the immediate area along the bottom where the land is relatively flat and travel is easiest. The remainder of the canyon to the northeast of the proposed mine site is too rocky and steep for the horses to use.



Map MA2-1. Vegetative types in the area of the proposed Coal Canyon Mine



Map MA2-2. Little Bookcliffs Wild Horse Area

LITTLE BOOKCLIFFS WILD HORSE AREA AND RESOURCE STUDY AREA

Big Game

MULE DEER

Coal Canyon is on the lower extreme of the Roan Creek deer herd's winter range. Based on pellet group transects, 1.17 deer days of use per acre occur in the lower half of Coal Canyon. Deer normally move into this area in mid-November and remain until April, when they gradually migrate north to higher elevations (see map MA2-3).

Populations may fluctuate greatly from year to year as well as seasonally within the year, and population estimates are based on average numbers. Mule deer winter populations have been estimated at about 50 deer per square mile. This would indicate a total deer population within the Coal Canyon lease area of about 150 animals during the winter months.

MOUNTAIN LION

Coal Canyon offers the kind of rough canyon land and isolated habitat found within the Little Bookcliffs, which supports a good population of lions. If mountain lions occupy Coal Canyon, their greatest period of use would be winter, when mule deer and horses move into the area.

Small Mammals

Species composition is typical of the pinyon-juniper, sagebrush, and saltbush habitats in western Colorado. Cottontail rabbits, chipmunks, mice, and rock squirrels are some of the more common species. Small mammals closely associated with aquatic habitat, such as beaver, muskrat, and raccoon, occur along the Colorado River. There is no aquatic or riparian habitat in Coal Canyon. Coyote, bobcat, and ringtail cat are predatory species found in Coal Canyon.

Game Birds

Mourning doves are the most common game birds found throughout the Coal Canyon area. During the summer, doves nest throughout the area, utilizing trees or the ground as nest sites. They concentrate around weed patches, road shoulders, and small seeps or stock ponds.

Chukars, an introduced species, are found throughout the canyon. Steep rocky slopes and cheatgrass (*Bromus tectorum*) are important habitat components for this species. Three guzzlers (watering devices) have been installed in Coal Canyon to improve summer water distribution for chukars and other small mammals and birds.

Mallards and Canadian geese nest and raise their young along the Colorado River in DeBeque Canyon. During spring and fall migration and the winter months, a much greater variety of waterfowl is present on the river, with the common merganser and common goldeneye two of the most abundant species.

Other Birds

Currently no raptor species have been located in the Coal Canyon area. The abundance of cliff faces and the height of the canyon walls provide excellent potential nesting habitat for golden eagles, prairie falcons, and redtailed hawks. These species do nest outside Coal Canyon, and they would be expected to spend time hunting within the Coal Canyon drainage since the area is within normal hunting limits of known aerie sites.

The greatest variety of songbirds occurs in the riparian zone along the Colorado River. Species would be more limited in the pinyon-juniper and saltbush habitat within Coal Canyon; pinyon jay, horned lark, chipping sparrow, and whitethroated swift would be some of the more common summer residents.

Endangered or Threatened Species

Within the nearby DeBeque Canyon area, an active peregrine falcon aerie was discovered in July 1977 (Enderson 1977). The aerie will have to be observed for one or more years to determine whether the falcons will continue to use this nesting cliff or possibly a complex of cliffs in the general area.

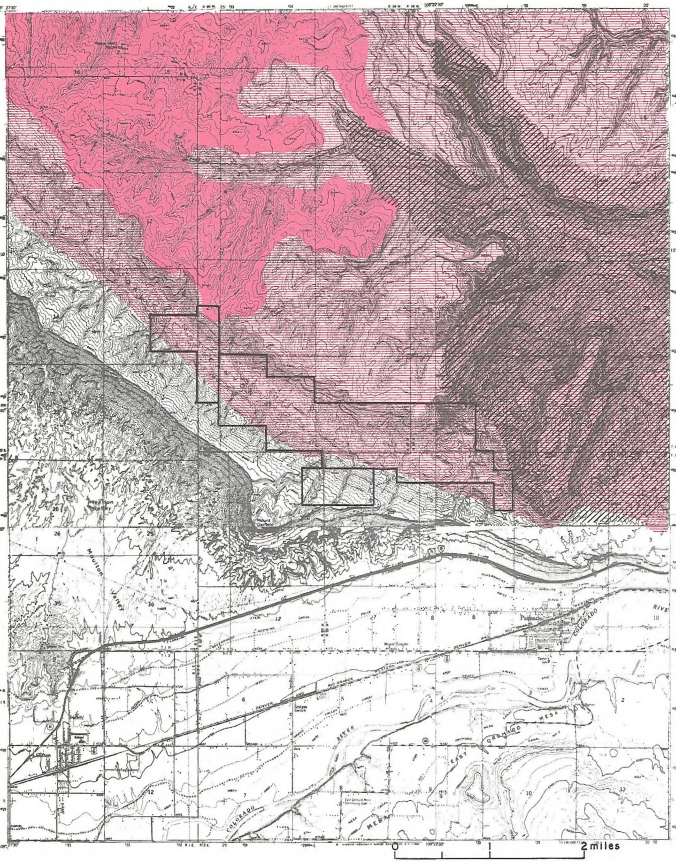
Peregrines are not able to tolerate a high level of temporary human activity within 0.25 mile of their nest, particularly between March 1 and August 1, or a high level of permanent human activity within 0.5 mile of nest sites (Gerald Craig 1978, personal communication). The Colorado River and areas adjacent to riparian habitats are suspected to be important hunting areas because of the abundance of peregrine prey in this area. Habitat in this type is being destroyed by changing land use, particularly on-going coal development (see map MA2-3).

Bald eagles are commonly seen along the Colorado River in DeBeque Canyon throughout the winter months. Birds are frequently observed on hunting forays along the river or perched in cottonwood trees.

Aquatic Biology

Coal Canyon is the major drainage on the lease site. The stream is ephemeral and does not support any aquatic habitat. It is characterized by rapid, heavy runoff for short periods during precipitation events. Runoff water is typically high in sulfates, carbonates, total dissolved solids, and suspended sediments.

A coal spoils pile from previous mining is adjacent to the site of the proposed Coal Canyon facilities development. In the past coal refuse was



Map MA2-3. Wildlife ranges in the area of the proposed Coal Canyon Mine: deer, endangered species

MULE DEER WINTER RANGE

MULE DEER WINTER CRUCIAL RANGE

ENDANGERED SPECIES (Peregrine Falcon)

dumped from an old mine bench above the Coal Canyon stream channel to form a spoils embankment which intersects the southern edge of the stream channel at its base. Minor erosion at the foot of this pile has occurred. Small amounts of coal spoil from this pile have been washed to the Colorado River in the past and will continue to be in larger precipitation events. In some places the coal seam outcrops in the stream channel. Minor amounts of coal have always been washed to the Colorado River from these outcrops.

The lease site is adjacent to the Colorado River, and all site drainage enters directly into the river. The Colorado River at this location is considered a warm-water fishery. Channel catfish, large mouth bass, sunfish, and bullheads dominate the game fish population, while numerous nongame fish species including roundtail chub, sand shiner, carp, flannelmouth sucker, bluehead sucker, speckled dace, redfin shiner, and others are found here.

Endangered or Threatened Species

From below the confluence of Plateau Creek, this section of the Colorado River is habitat for three species of threatened and endangered fish. The Colorado squawfish, the razorback sucker, and the humpback chub are presently known to exist in the river directly adjacent to the mine area. The USFWS has recommended this section of river as critical habitat for the Colorado squawfish (see Aquatic Biology, chapter 2, regional analysis).

Cultural Resources

Archeological Resources

No inventory has been completed for the Coal Canyon site, although a Class III survey is required prior to approval of the proposed M&R plan. As part of the regional predictibility model an east-west transect was surveyed approximately 0.5 mile north of the Coal Canyon lease boundary. As a representative sample for this area, no sites were identified, although ten isolated artifacts were found. With lack of permanent water source and the rugged terrain, "it seems likely that the low site density found within the survey tracts will be maintained in the areas as a whole" (Hibbets et al. 1978, p. IV-38). The completion of the Class III survey within the lease site will further test this hypothesis for this area north of the Grand Valley.

Historic Resources

No formal inventory has been conducted on the Coal Canyon site, although one is planned. There are two small mines on this site which produced from 1930 until the 1960s. These mines were among the last developed in the region and as such are not historically significant.

Land Use

Mid-Continent's leasehold is located almost entirely within the Little Bookcliffs Wild Horse Area. Land use is subject to the various guidelines and objectives discussed in chapter 1, Interrelationships.

Coal Canyon also provides habitat for various species of wildlife (see Wildlife in this chapter) and offers some hunting opportunities. Access to the canyon and lease area is limited to one nonmaintained road.

GEX Colorado Company's Cameo No. 1 Mine is located approximately 2.5 miles northeast of Coal Canyon. The area between is also used to some extent by wildlife and provides limited recreational opportunities (primarily four-wheel driving, hiking, and hunting).

The Cameo operation fronts on DeBeque Canyon, which is extensively industrialized in that area. The Public Service Company's Cameo power plant is located just southwest of the Cameo No. 1 Mine, and Gex Colorado's Roadside Mine is prominent on the other side of the canyon. Interstate Highway 70 (I-70) and U.S. Highway 6 are major transportation and travel routes through the canyon, and the Denver and Rio Grande Western Railroad (D&RGW) main line runs parallel to I-70 in the vicinity of the Cameo operation. GEX Colorado Company is currently constructing rail loadout facilities to serve the Cameo and Roadside mines.

Island Acres Recreation Area, which is managed by the Colorado Division of Parks and Outdoor Recreation, is located on the Colorado River about 1 mile upriver from proposed loadout facility. Island Acres provides recreational facilities for about 100,000 campers, picnickers, and swimmers annually. The Colorado River is considered a warm-water fishery in the general area of the Cameo operation.

Southwest of DeBeque Canyon, the land uses become predominantly agricultural and residential. From just east of Palisade on down the Grand Valley toward Grand Junction, there is much irrigated cropland (including orchards), pastureland, hayland, and some rangeland. Lands producing fruit and vegetables may be designated unique farmlands and some of the orchard land is in areas which meet the definition of prime farmland (see Prime and Unique Farmlands under Agriculture in the regional volume).

The valley becomes more urban and residential as it approaches Grand Junction. As Grand Junction continues to grow, urban development may encroach on agricultural lands in the area, although the extent of encroachment will depend on county and local planning for the area.

For a discussion of Mesa and Garfield county planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints. BLM planning relevant to the leasehold area is discussed under Interrelationships in chapter 1 earlier in this site-specific analysis.

Transportation

HIGHWAYS

I-70 is the major highway nearest to the proposed Coal Canyon Mine. At present the highway is operating at 4 percent of capacity during peak traffic hours. The interchange at Cameo is running at 8 percent of capacity during peak hours. U.S. Highway 6 also serves the same area but goes through the towns rather than around them. Access to the lease area is limited to one nonmaintained road.

RAILROADS

The D&RGW main line lies parallel to I-70 in the vicinity of the Coal Canyon property. This is a major rail line that connects Denver and Salt Lake City and serves many of the coal areas in Colorado and Utah.

AIRPORTS

Walker Field near Grand Junction is the major airport in the ES area and the largest airport in western Colorado. It is served daily by Frontier and United airlines.

Livestock Grazing

The entire coal lease tract is part of the Little Bookcliffs Wild Horse Area, and no livestock are grazed on it.

Recreation

The Coal Canyon lease site lies almost entirely within the Little Bookcliffs Wild Horse Area (see map MA2-2). The BLM's Whitewater Coal Update MFP (completed in September 1977) recommends that the area be managed as a wildland study area until its potential for wilderness status has been evaluated (see chapter 1, Interrelationships, for management guidelines and objectives). Access to the wild horse area is limited to two nonmaintained roads, one of which passes through Coal Canyon and the lease area.

Although there are no recreational facilities in the proposed mining area, the lease site provides hunting opportunities for game, such as mule deer and chukar. Coal Creek is an ephemeral stream and offers no fishing (refer to Wildlife and Aquatic Biology in this chapter for the extent of the resources). The lease site is located within Big Game Management Unit 30, which provided 3,364 recreation days in 1976, and Small Game Management Unit 58, which provided 35,723 recreation days in 1975. (Tables MA2-4 and MA2-5 list hunter days by species and game management units.)

The Colorado Division of Parks and Outdoor Recreation manages the Island Acres Recreation Area, which is located on the Colorado River about 1 mile upstream from Mid-Continent's proposed coal train loading facility. Island Acres provides opportunities for camping, picnicking, and swimming. The area provided recreation for 102,578 visitors in 1977.

The majority of the population increase due to mining activity would occur in the Grand Junction-Palisade area. Grand Junction provides city-sponsored leagues for softball, basketball, and volleyball. Facilities in the Grand Junction area include eleven parks, fourteen swimming pools, and sixteen tennis courts. The Grand Junction Recreation Department feels that use of its facilities is now maximum; people have to be turned away from the programs, especially league activities. The department also states that only 40 percent of this use is from city residents, which indicates that the city's programs are a major recreational outlet for the surrounding area. The city of Palisade provides a park with playground, two tennis courts, and a basketball court.

For a comprehensive look at the recreational resources of the region, refer to chapter 2 of the regional analysis, Recreation.

Visual Resources

Coal Canyon is a dry, highly eroded, V-shaped drainage (see figure MA2-3). Its rock walls tower 1,200 feet over the bed of the Coal Creek, with the eastern slope forming the base of Mount Lincoln. Layered rock strata form exposed cliff faces and taluses which support sparse vegetative communities. Dark coal layers are intermixed with stratified rock in the lower levels of the exposed wall and further emphasize the horizontal, linear nature of the canyon landform.

The light tans of the rock strata are the dominant colors in the canyon, but the sidewalls, exposed erosional cuts, and jagged cliffs generate a diverse pattern of shadows. Vegetation colors are muted except for scattered gray-green junipers which grow randomly in the canyon. The combination of grass tufts, mountain brush, and junipers creates a spotty texture over the terraced landforms.

A single-lane dirt road runs along the bottom of the canyon, serving as an access road, formerly for old mines and now for a single-pole transmission line. Some terraces have been graded and leveled at scattered points, but the canyon landscape is primarily natural.

TABLE MA2-4

BIG GAME HUNTING IN BIG GAME MANAGEMENT UNIT 30

	Deer	Elk	Bear	Mountain Lion	Total
Hunters	854	-	20	9	a/
Recreation days b/	3,122	-	151	91	3,364

Source: Colorado Division of Wildlife, 1976 Colorado Big Game Harvest.

a/ Hunter totals are not provided because hunting and trapping of more than one species are allowed.

b/ All or part of a day.

TABLE MA2-5

SMALL GAME HUNTING AND TRAPPING IN SMALL GAME MANAGEMENT UNIT 58

Animal	Hunters	Recreation Days a/	Animal	Trappers	Recreation Days a/
Ducks	1,166	9,794	Badgers	9	757
Geese	423	1,950	Beavers	17	426
Doves and pigeons	1,106	6,251	Bobcats	30	1,918
Pheasants	2,021	7,203	Ringtailed cats	3	310
Chukars	500	1,123	Coyotes	21	2,086
Grouses	261	814	Foxes	29	1,235
Ptarmigans	7	0	Muskrats	32	1,203
Rabbits	3,952	28,789	Raccoons	20	509
Squirrels	53	225	Skunks	7	144
Foxes	38	72			
Coyotes	386	4,529			
Marmots	98	299			
Prairie dogs	550	4,140			
Magpies	352	5,283			
Total	b/	70,472		b/	8,588

Source: Colorado Division of Wildlife, 1975 Colorado Small Game, Furbearer, Varmint Harvest.

a/ All or part of a day.

b/ Hunter totals are not included because hunting and trapping of more than one species are allowed.

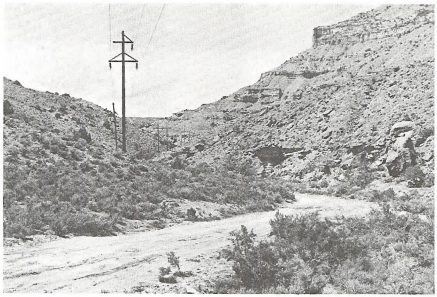


Figure MA2-3. The sidewalls of Coal Canyon create a "U"-shaped landform.

Coal Canyon has a VRM Class II rating (see the appendix, volume 3, for VRM methodology), which requires that visual changes in the canyon not be evident in the landscape. The visual dominance of the cliffs is the primary reason for the Scenic Quality Class 'B' rating which represents a strong scenic potential for the public.

Coal Canyon's inclusion in a wildland study area (Little Bookcliffs Wild Horse Area) puts it under the control of interim management guidelines (see chapter 1, Interrelationships) which supplement the Class II management objectives. No irreversible changes in the landscape are to be allowed, and disturbed areas are to be returned to their original state.

Socioeconomic Conditions

Demography

Table MA2-6 lists the population for each incorporated town and each county census area within Mesa County and western Garfield County, for the 1970 and 1977 censuses. Grand Junction and vicinity is the most heavily populated community between the Denver and Salt Lake City metropolitan areas. As such, it serves as a regional center of commercial and industrial activity for most of western Colorado and eastern Utah. Recent growth in the Grand Junction area has been caused by a variety of economic factors, including the expectation that the area's mineral resources will develop rapidly in the near future. Corporations and government agencies involved in mineral resource development over a wide area have located regional headquarters in Grand Junction. Table MA2-6 indicates that most areas around Grand Junction have grown at a moderate rate, averaging between 3 and 5 percent per year since 1970.

The median age of the population in Mesa County is higher, but not significantly higher, than the Colorado median age of 26.2 years. The Palisade area has a relatively older population than the rest of the county, and a much higher concentration of persons over 65 years of age.

The small communities of DeBeque, Collbran, and Grand Valley are similar in size, and all contain a population whose median age is higher than the Colorado median. Collbran is somewhat different from most communities in western Colorado in that the median age of its population increased between 1970 and 1977. The DeBeque and Grand Valley areas have experienced growth due to the location of the Occidental Oil Shale test site outside of DeBeque and the Paraho Oil Shale site east of Grand Valley.

Community Attitudes and Lifestyles

According to the Mesa County Development Department, a majority of the new residents in the Grand Junction area moved there because they liked it as a place to live. The Grand Junction area is more urban than most other areas of western Colorado, but it is still small enough to retain attributes of small town living. Residents place a high value on the casual atmosphere and lack of congestion associated with life in Grand Junction. However, there is also a desire to attract economic growth to the area and improve job opportunities for residents.

As a population center, Grand Junction provides its residents opportunities not available in most other communities in western Colorado. Mesa College offers courses of study in many subject areas, college athletic events, and dramatic performances. There is a larger selection of stores, restaurants, and movie theatres than in other towns. Airline and bus service to metropolitan areas is regularly available, and an interstate highway links Grand Junction to Denver and Salt Lake City.

Community attitudes towards growth and development were documented in a survey conducted by Bickert, Browne, Coddington and Associates, Inc., in July 1973. Results of that survey are discussed in the regional volume.

Community Facilities

Most of the developed areas around Grand Junction receive water from the Ute Water Conservancy District which provides water to other districts and to individuals. The district is currently developing additional water resources. There are many special districts in the county providing various services including water, sewer, fire protection, pest control, hospital services, cemetary services, and flood control. There are two sanitary landfills in the county. Police services outside of town is provided by the county sheriff.

Grand Junction, Fruita, Collbran, Palisade, and DeBeque are improving or plan to improve their water and sewage treatment systems. More detailed information about facilities in the county is included in the regional volume.

Housing

Table MA2-7 lists the housing units available in Mesa County and western Garfield County, according to the 1977 special population censuses. The total housing stock in Garfield County increased by 22 percent between 1970 and 1976. About 40 percent of that increase was mobile homes.

The Colorado Division of Housing (1976) estimates that there was a total of 24,914 housing units in Mesa County in April 1976, an increase of 6,116

TABLE MA2-6

POPULATION STATISTICS

	1970 Population	1977 Population	Percent Change 1970-1977	Median Age-1970 (Years)	Median Age-1977 (Years)	Percent Population Over 65 Years
Mesa County:	54,374	66,848	+ 23	30.2	29.4	+ 11
Clifton area	3,554	5,913	+ 66	30.2	26.8	+ 9
Fruita	1,822	2,328	+ 28	34.1	28.5	+ 15
Fruita area	5,837	7,709	+ 32	29.4	28.4	+ 10
Grand Junction	24,043	25,398	+ 5	32.1	30.2	+ 15
Grand Junction area	28,527	35,871	+ 26	30.0	29.3	+ 13
Orchard Mesa area	6,890	5,012	- 27	28.6	29.6	+ 8
Palisade	874	1,038	+ 19	-	46.9	+ 31
Palisade area	1,964	2,178	+ 10	41.8	38.8	+ 21
Redlands area	4,446	6,826	+ 53	29.9	30.6	+ 6
Whitewater area	605	751	+ 24	36.1	32.6	+ 12
Collbran	225	293	+ 30	-	36.9	+ 20
Collbran area	1,428	1,364	- 4	31.4	33.6	+ 14
DeBeque	155	264	+ 70	-	32.5	+ 14
DeBeque area	306	427	+ 40	42.1	33.5	+ 14
Garfield County:						
Grand Valley	270	377	+ 40	-	30.0	+ 18
Grand Valley area	819	858	+ 5	32.1	30.9	+ 14

Source: U.S. Bureau of the Census, 1970 Population Census and 1977 Special Census for Mesa and Garfield Counties.

TABLE MA2-7

EXISTING HOUSING IN PROPOSED ACTION AREA

County	Total Housing Units	
	Occupied	Vacant
Mesa County:		
Collbran	119	13
DeBeque	100	11
Fruita	788	41
Grand Junction	10,129	596
Palisade	418	23
Unincorporated areas	12,321	759
Garfield County:		
Grand Valley	138	19

Source: U. S. Bureau of the Census, Special Population Censuses for Mesa and Garfield Counties, 1977.

units (or 32 percent) from 1970. Over one-third of the total increase in housing stock was mobile home units. In recent years, duplexes and multi-family units have constituted about 30 percent of the new housing starts. High prices for single-family dwellings and the unavailability of rental units are contributing to an increase in multi-family and mobile home units throughout the county. The county has an above average need for low to moderate income housing, because (1) the median family income is over $3,000 less than the state median and (2) Mesa County has an above average number of elderly persons.

Education

Education in the areas around the proposed Coal Canyon Mine is provided by four public school districts: Mesa County Valley School District 51, DeBeque School District RE49 (JT), Plateau Valley School District 50, and Grand Valley School District 16. Mesa County Valley is by far the largest with 96 percent of the combined enrollment. In general, the school districts all have some excess capacity to absorb new students. Mesa County Valley has some problem with capacity of its junior high schools but plans to expand in the future. Table MA2-8 summarizes the situations of the four districts.

Health Care

The level of health care services in and around Grand Junction is The highest in the ES area. The four hospitals located in Grand Junction provide specialized services to much of western Colorado. In addition, the Fruita area is served by a small hospital located in town. There are more physicians located in Grand Junction than in the remainder of the ES area combined. Many of these physicians are specialists, who provide their services to patients from a wide area. Ambulance services to the area are good; both Fruita and Grand Junction operate ambulance services connected with their fire deparments. Mental health services are provided to the area by the Colorado West Regional Mental Health Center, which is headquartered at Glenwood Springs but has offices in Grand Junction. The Mesa County Department of Public Health has a staff of six public health nurses who provide generalized health education and preventive health services in addition to specialized activities in tuberculosis control, mental retardation, venereal disease, and handicapped children's programs.

Health care in eastern Mesa County is limited. Collbran supports the Plateau Valley Hospital and Nursing Home. The hospital has six beds, three of which conform to federal standards. The nursing home has thirteen long-term care beds. A single doctor provides most of the service to patients in the Collbran area.

DeBeque and Grand Valley have no health care facilities in town. The nearest doctor for DeBeque residents is in Palisade, 22 miles away, and hospital care is available in Grand Junction. The closest physicians and hospital for Grand Valley residents are in Rifle, about 16 miles away.

Employment

In Mesa County, where most of Coal Canyon's employees would live, employment grew at an annual rate of 6.1 percent between 1973 and 1976. The total number of persons employed increased from 24,030 to 28,622 during this period. As shown in table MA2-9 the increase was all in nonagricultural employment; agricultural employment declined by 11.6 percent. A comparison of employment by sector shows that all sectors showed some growth, but the mining, transportation, finance, insurance, real estate, and contract construction sectors had the largest percentage increases. The increase of 130 percent in mining employment can be attributed to new mining activity in the Uravan uranium belt and coal mining in western Garfield County. Oil shale test projects near DeBeque and Grand Valley have also added to employment in the mining sector. In terms of number of employees, the service trade and mining sectors showed the greatest increase.

Table MA2-9 also shows that the trade, service, and government sectors are the largest employers in the Mesa County economy and that, in spite of the fast growth rate, the finance, insurance, and real estate sectors and the mining sector are the smallest. The sectors with the largest employment in Garfield County are also trade, services, and government. Almost all sectors have grown since 1970.

The regional volume gives more detail on employment in Mesa and Garfield counties. Employment data for specific towns and cities are not available.

Income

The proposed Coal Canyon Mine is located in Mesa County, 2.5 miles east of the town of Palisade. According to the U. S. Department of Commerce (1974), 1974 per capita income in Palisade was $4,324. This was substantially below the county average of $4,799, which in turn was lower than the Colorado average of $5,514. Mesa County ranked fourth in the seven-county ES area.

Median family income in Mesa County was estimated to be $11,130, third highest in the region but lower than state and national averages. In 1975, 11.4 percent of the families in the county had incomes below the poverty level.

TABLE MA2-8

CHARACTERISTICS OF AFFECTED SCHOOL DISTRICTS

School District	1977 Enrollment	Schools	Design Capacity	Excess Capacity	Teachers	Student: Teacher Ratio	Bonding Capacity (dollars)	Outstanding Debt (dollars)
Mesa County Valley (51)	14,025	30	15,561	1,536	678	20:1	32,043,730	2,500,000
DeBeque (RE49(JT))	160	2	195	35	16	11:1	260,000	130,000
Plateau Valley (50)	284	3	350	66	14	20:1	1,200,000	19,000
Grand Valley (16)	180	1	250	70	17	10:1	800,000	184,000

TABLE MA2-9

GROWTH OF EMPLOYMENT BY SECTOR
IN MESA COUNTY, 1973-1976

Sector	1973	1976	Increase	Percent Change
Agriculture	3,030	1,790	- 240	- 11.8
Mining	390	900	+ 510	+ 130.8
Contract Construction	1,330	1,730	+ 400	+ 30.1
Manufacturing	2,280	2,440	+ 160	+ 7.0
Transportation	1,420	1,680	+ 460	+ 32.4
Wholesale and Retail Trade	5,040	5,710	+ 670	+ 13.3
Finance, Insurance, and Real Estate	630	820	+ 190	+ 30.2
Service	3,420	4,410	+ 990	+ 28.9
Government	4,140	4,470	+ 330	+ 8.0

Source: Colorado Division of Employment, Research and Analysis, February 1977.

Note: This information does not include self-employed workers, other than in agriculture, unpaid family, and domestic workers.

In 1974, government (21.0 percent) and wholesale and retail trade (20.6 percent) were the largest sources of personal income. Other sectors and the share they produced were services--15.7 percent; contract construction--10.2 percent; transportation, communication, and public utilities--9.9 percent; manufacturing--8.9 percent; agriculture--6.9 percent; finance, insurance, and real estate--3.6 percent; mining--3.3 percent; and other industries--0.4 percent. This breakdown indicates the importance of the trade sector in the economy of the county and the role of Grand Junction as a regional center. For a discussion of regional incomes, see the income section in the regional volume.

FUTURE ENVIRONMENT WITHOUT THE PROPOSAL

If the M&R plan proposed in chapter 1 is not approved and implemented, the following changes could be expected to occur in Coal Canyon and the general area beyond.

The Little Bookcliffs Wild Horse Area would continue to be managed accoriding to objectives and guidelines similar to thoses discussed in chapter 1, Interrelationships. Land use would be wild horse and wildlife habitat, with perhaps increased recreational use since visitors could be attracted to the area to view the wild horses and wildlife.

The vegetative condition of the coal lease tract, which at present is unsatisfactory with a downward trend, may improve in the future. The wild horse herd was reduced to 70 head in the fall of 1977 in order to alleviate the severe overgrazing of the range. The long-term effects of this herd decrease will be an increase in the desireable forage plants on the lease tract, namely western wheatgrass, Indian ricegrass, and galleta grass.

The management plan for the Little Bookcliffs Wild Horse Area proposes to maintain the herd within the carrying capacity of the area, which would keep use at an acceptable level.

This area is also covered by the Roan Creek Habitat Management Plan, and its objective for mule deer is to increase the herd to where the average utilization on sagebrush (*Artemisia*) would be 40 percent and then maintain the herd at that level. All other wildlife uses would be about the same as present.

Through the year 1990, vandalism and erosion would be the two major factors causing the loss of any archeological values in the area. It is doubtful that additional monies or employees would be available to retard this loss, although the Federal Land Policy and Management Act of 1976 will provide BLM with more protective enforcement authority.

If the Little Bookcliffs Wild Horse Area is classified as a wilderness area, recreation and travel would be restricted to nonmotorized means.

The Cameo No. 1 Mine northeast of Coal Canyon would continue to operate at least through 1980. If GEX Colorado Company's M&R plan for the Cameo No. 1 and No. 2 mines is approved (see the Cameo site-specific analysis in this volume), the operation would continue mining through 1990. If Mid-Continent's M&R plan for the Cottonwood Creek mines (located south of the Cameo operation) is approved, that operation would mine through 1990 (see Cottonwood Creek site-specific analysis in this volume). Combined with GEX Colorado's Roadside Mine, which would continue mining through 1985, these operations would continue and expand the industrialized land use of this portion of DeBeque Canyon. Traffic on I-70 would increase as a result of mine personnel going to and from work, and train traffice would increase as coal is shipped out of the area from these mines. Ambient particulate concentrations may increase as a result of these new sources. The reduction in noise around the Island Acres Recreation Area, located upstream from the unit train loading faciity, will be more than offset by the predicted increase in train and vehicular traffic through DeBeque Canyon.

If the Cameo No. 2 and Cottonwood Creek mines are developed, these operations would increase populations in Mesa County by 3,750 people by 1985 and 4,150 people by 1990 and would increase populations in Garfield County by 600 people by 1985 and 900 people by 1990. In addition, development of oil shale and uranium would by themselves cause rapid population expansions in both Delta County (20,600 people by 1980; 22,900 people by 1985; and 24,800 people by 1990) and Garfield County (33,000 people by 1980; 38,650 people by 1985; and 45,100 people by 1990).

It can be assumed that those communities closest tomajor project sites would experience the most immediate population growth. The small communities of Rifle, Sitl, New Castle, Grand Valley, and DeBeque, all within a relatively short commuting distance from major oil shale projects, should have most of their available living spaces occupied as soon as major construction activity begins. Even if additional housing units can be supplied as they are needed, these towns can only accommodate about an additional 4,500 people before major new additions would be needed to their water and sewer systems. As a result, it would be necessary for communities such as Grand Junction, Fruita, and Glenwood Springs to absorb much of the rapid population growth expected in Garfield and Mesa counties. Some of the resulting residential and urban expansion would probably encroach on agri-

cultural land, although to some extend the location of this urbanization will depend on future county and local planning and zoning. In addition, the terraces and benches along the Colorado River would probably receive residential development by 1990, since they offer good views, existing access, and proximity to population centers.

Due primarily to the expected population growth from oil shale development, existing community facilities in Garfield and Mesa counties would be forced to operate at or beyond their capacity. This is especially true of the smaller towns of DeBeque, Grand Valley, Rifle, Silt, and New Castle. Both the Grand Junction and Glenwood Springs communities now have or are building improvements which will allow them to greatly expand water and sewer service. As a result, much population growth in Mesa and Garfield counties should be attracted to these two communities.

Growth in Mesa County would require additional recreational facilities by 1990, including 116.2 acres of additional community active/improved park land (e.g., ballfields, playgrounds, tennis courts) to prevent overuse and deterioration of existing facilities (Bickert, Browne, Coddington, and Associates, Inc. 1977.

The proposed U.S. Bureau of Reclamation (USBR) Dominguez Dam, just south of Grand Junction (see figure MA2-4) would provide water-based recreation such as boating, fishing, and swimming. The USBR estimates that the dam would provide 300,000 to 500,000 recreation days in its first year of use, which would help to relieve some of the projected need for this type of recreation identified by the 1976 Colorado Comprehensive Outdoor Recreation Plan (see regional analysis, chapter 2, Recreation).

Incomes and employment are expected to be higher as a result of increased industrialization and mining. Agriculture could become a less important part of the local economy, and this decline could accelerate the shift from agricultural to residential-industrial land uses. The expected increase in job opportunities could also accelerate the current trends of in-migration to the area by persons who like the living conditions.

If oil shale and molybdenum projects are developed according to schedule, the influx of larage construction work forces can be expected to cause some change in Mesa and Garfield counties. The influx of similar large work forces in other rural areas of the West has led to a number of sociological changes which are commonly referred to as the "boom town syndrome." The more commonly documented changes include rising rates of divorce, increased cases of alcoholism and mental illness, and decreased levels of job productivity. Also, and probably more importantly, there tends to be a polarization in small communities between the long-time residents and the more transient newcomers, which causes difficulty in accomplishing needed reforms. In many communities, the general trend will, at the least, be toward more urbanized lifesyles.

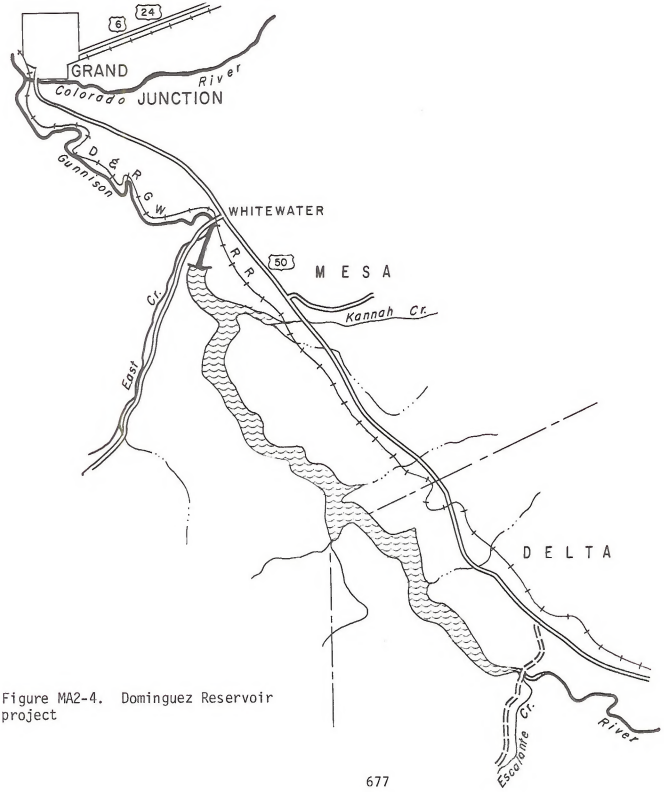


Figure MA2-4. Dominguez Reservoir project

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

The suitability study to determine the wildland values of the Little Bookcliffs Wild Horse Area is scheduled to be completed by 1982. Final determination of whether the area should be designated a wilderness area should be based on the information and recommendations contained in the study. Sometime after 1982, the results of this study and recommendations based on it would be sent to the President; based on the President's decisions, recommendations would then be sent to Congress. An area can be designated as a wilderness area only by an Act of Congress (Wilderness Act [PL 88-577]).

As long as the area is a wildland study area, uses of the land are governed by the Wilderness Act and by Section 603 of the Federal Land Policy and Management Act of 1976 (FLPMA). Mining of an existing lease is not necessarily excluded, but any lease that is not presently being worked or that is not logically a continuation of an ongoing operation is subject to regulation to prevent impairment of the area's suitability for preservation as a wilderness and according to FLPMA (Section 603[c]), "to prevent unnecessary or undue degradation of the lands and their resources or to afford environmental protection."

The following impacts of the proposed mining and reclamation (M&R) plan could conflict with FLPMA or with the interim management guidelines established by the BLM Grand Junction District to protect the possible wilderness characteristics of this wildland study area (see chapter 1, Interrelationships). These impacts are analyzed in the appropriate resource sections of this chapter.

1. Rehabilitation of disturbed acreage (as required by Section 515 of SMCRA, and 30[CFR]: 717.20, and 30[CFR]: 211) may be difficult because of low annual precipitation, steep slopes, highly erosive soils, lack of topsoil, and possible destruction of seedlings by wildlife. The refuse pile may be particularly difficult to revegetate because of such factors as high acidity, deficiencies in nitrogen or phosphorous, and excess soluble salts and sodium; in addition, the refuse pile would be in an area highly subject to post-mining subsidence and erosion. Natural revegetation would occur where the soils are stable and do not contain materials toxic to plant growth, but natural succession would take from 30 to 60 years or more.

2. Mid-Continent proposes to upgrade the existing road along the Coal Creek bottom. Regulations 30(CFR): 717.17(d) probably would require instead the construction of a new roadway away from the Coal Creek channel. Such a road could require extensive development work because of the rocky, steep, gullied topography in the canyon. Furthermore, if revegetation is unsuccessful, the road could cause long-term changes in the character of the land.

3. Post-mining subsidence could cause local changes in topography. Large open fractures and broken surfaces would probably occur, erosion would increase, and subsequent use of the area would be restricted.

4. The proposed project would generate landscape changes which could lower the area's scenic quality below VRM Class II standards, at least for the life of the mine. Whether this visual change would be long term would depend on the success of post-mining rehabilitation.

5. Mining activities could impact the wild horses and their habitat, which are part of the natural environment of the area. Coal Canyon is one of two winter ranges used by the wild horses. A total of 99 acres would be lost due to development of surface facilities, at least for the life of the mine, and perhaps longer if rehabilitation is not successful. The horses could also be cut off from an additional 4,000 acres because the road, which is their main travel route down into the canyon, would no longer be available and because the surface facilities and human activity would exclude them from some other areas of the canyon.

In addition, if water is impounded in the canyon, and is available to the horses, they could stay in the canyon for a longer period of time and use winter forage in the summer. Forage would be reduced, thus eventually decreasing the number of horses that the area could support. Alternatively, the presence of people and their activity could harass the horses so much that they would not use this wintering area at all. In that case, they would be forced into the other wintering area, where they could possibly over-

use the forage. Because of legal mandates to maintain a healthy, viable herd (see chapter 1, Interrelationships), the BLM would then have to reduce the herd artificially to keep it within the carrying capacity of the range.

If the area is designated as a wilderness area, uses of the land would also be governed by the Wilderness Act. Again, mining of an existing lease might be allowed, but it would be subject to appropriate conditions and terms set by the Secretary of the Interior to carry out his overall duty to manage public resources in the public interest as well as his specific duties under such statutes as FLPMA. Any existing lease would have to be examined to determine the nature of the rights conveyed by the United States to the lessee, to what extent those rights would be impaired by stipulations designed to protect the area's wilderness character, whether development of the lease would be allowed, and (if development is not allowed) what actions are available or necessary to prevent development or (if development is allowed) how that development would be regulated.

If the Little Bookcliffs Wild Horse Area is not classified as wilderness, but is classified as National Wild Horse Range, presumably guidelines similar to the interim guidelines would be developed. Mining (including construction of surface facilities) would not necessarily be excluded, but no irreversible changes in the character of the land would be allowed, and disturbed areas would have to be returned to their pre-mining condition (the latter is also required by 30[CFR]: 717 and 30[CFR]: 211 regulations).

If the Little Bookcliffs Wild Horse Area is not classified as either wilderness or National Wild Horse Range, the BLM would still manage the area to protect the wild horses and their habitat. If mining is allowed, BLM would impose stipulations to maintain the natural ecological balance of the area.

If mining is allowed in Coal Canyon and if Mid-Continent's M&R plan is approved and implemented, then impacts of this action would be as analyzed in the rest of this chapter. Impacts are analyzed at three time points: 1980, 1985, and 1990. If the M&R plan is approved but if approval is for any reason deferred or delayed (for example, until a decision is made as to the area's wilderness suitability), then implementation and impacts would also be delayed for an equal period of time.

This M&R plan was submitted for review prior to promulgation of interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), and it does not fully reflect the requirements of the interim regulations. However, in this environmental statement (ES) the applicable interim regulations, are included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of the regulations. The Department of the Interior will not consider the M&R plan for approval until Mid-Continent Coal and Coke Company has redesigned it to incorporate the requirements of 30(CFR): 211 and 30(CFR): 700. Therefore, to the extent possible at this time, the impacts have been analyzed using the assumption that the M&R plan will comply with provisions of SMCRA.

Air Quality

Emissions from the Proposed Mine

Mining activity at underground coal mines usually produces dust, an air pollutant, in environmentally significant amounts. Dust that is generated within the mine is not considered to have an environmental impact since it is continuously controlled and contained in the mine. However, surface facilities at these mines also generate some dust which is released into the ambient air. Most of the dust is from fugitive emission sources; the term "fugitive" connotes that the dust escapes from an unenclosed surface as a result of wind erosion or mechanical action, as opposed to being released from a stack or process vent.

The potential fugitive dust sources identified at the proposed Coal Canyon Mine include conveyors, transfer points, truck loadout of coal, open storage piles, haul roads, access roads, and wind erosion of refuse piles and other exposed areas at the mine. A common source of fugitive dust at underground mines not projected for the Coal Canyon Mine is crushing and sizing, which should produce negligible emissions because a wet process would be used.

The procedure used to estimate emissions from each of the potential sources was to (1) determine the activity rate of the pollution-producing operation, (2) multiply that activity rate by an emission factor based on sampling of similar operations, and (3) reduce the calculated emissions by an appropriate amount to account for control equipment or dust suppression measures to be employed on the operation. Activity rates and control measures were described in the Coal Canyon M&R plan. Emission factors for individual mining operations were obtained from Colorado Air Pollution Control Division and a recent study of emissions from mining (Colorado APCD 1978, Axetell 1978).

Table MA3-1 presents estimates of fugitive dust emissions at the Coal Canyon site from each of the identified sources in 1985, 1990, and at end of mine life. These values are annual emissions, even though the activities would not be continuous or uniform throughout the year. The estimates are

judged to be accurate within a factor of two (Axetell 1978). The emissions in table MA3-1 represent initial emission rates (tons per year) of suspended particulate from the operations. Some of these suspended particles fall out of the dust plume after they are emitted. This deposition is discussed further below.

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

Estimated emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), and sulfur oxides (SO_x) are shown in table MA3-2. These emissions are based upon rates per mile of travel (emission factors) which would decrease between 1985 and subsequent study years. In the case of Coal Canyon, the reduced emission rates would partially offset increased activity rates projected when the mine would be at full production in 1990. These emissions would be from both employee travel on the mine site and haul trucks.

The emissions of gaseous pollutants would not result in significant ambient concentrations on or near the proposed mine site.

Annual Average Air Quality Impacts

In order to assess the impact of air pollutant emissions on the environment, ambient concentrations of suspended particulate were predicted with an atmospheric dispersion model. The model used to predict average concentrations that would result from the mine's emissions was the Climatological Dispersion Model (CDM) (EPA 1973).

CDM is designed for use in level terrain. This application of CDM is subject to larger error and uncertainty than more routine applications, but it represents the best predictive modeling technique available. Because of the irregular topography at the proposed site, CDM is really only capable of predicting concentrations in the canyon or valley near where mining emissions occur. The site specific meteorological data reflected the prevalence of transport of the pollutants up and down the canyon from the mine. Because of the greater influence of the canyon on maximum concentrations near the mine, a separate model which considers reflection of the plume was used to predict maximum 24-hour concentrations. This short-term model is described in the following section.

The basic CDM model has been modified to incorporate a fallout function to simulate the deposition of the large suspended particulate as it disperses downwind. The fallout rates incorporated in the model were based on sampling data from several western coal mines and are functions of wind speed, atmospheric stability, and particle size.

The following input data are required for CDM: source locations; source emission rates; emission heights; locations where ground-level pollutant concentrations are desired; and frequency of occurrence of each of sixteen wind directions, six wind speeds, and six stability classes. Predicted concentrations are usually accurate within a factor of three.

Since there are no wind data available for the Coal Canyon area (see chapter 2), the wind and stability data required for the model were obtained by modifying that from Grand Junction airport to reflect orientation of Coal Canyon. This wind rose was previously shown in figure MA2-1. Emission data were presented in table MA3-1.

Predicted increases in ambient concentrations resulting from Coal Canyon's operation in 1990 are shown in map MA3-1; map MA3-2 shows cumulative concentrations. According to the isopleths on this map, the mine would increase annual average particulate concentrations by 3 micrograms per cubic meter ($\mu g/m^3$) in only a small area on the mine site near the preparation plant, refuse pile, and haul road; concentrations are predicted to increase by 1 $\mu g/m^3$ for a distance of about 0.5 mile east to west and 1.75 miles north to south from the surface facilities. Predicted impacts in 1985 are slightly lower but are shown to occur in these same areas. Based on these concentrations, it is not anticipated that the emissions would cause significant increases in annual average concentrations outside the canyon area.

The predicted impact of the mine would be much less than the primary and secondary air quality standards for suspended particulate of 75 and 60 $\mu g/m^3$, respectively. It would also be much less than the total air quality increment of 19 $\mu g/m^3$ allowable for Class II areas under the federal law concerning prevention of significant deterioration (PSD).

Maximum Short-term Air Quality Impacts

The dispersion model used to predict maximum 24-hour particulate concentrations assumed Gaussian distribution of particulates away from the plume centerline, a constant wind direction, and complete reflection of the plume off both canyon walls. The basic dispersion equation is described in detail in Turner 1970. The fallout function was not incorporated in the short-term model.

Several locations (receptors) up and down Coal Canyon from the mine were specified in the model for prediction of ground-level concentrations. At

each receptor, the contribution caused by each emission source at Coal Canyon was calculated separately; individual source contributions were summed to determine the total concentration at the receptor resulting from the mining operations.

Wind data from the Mt. Logan to Mt. Callahan reach of DeBeque Canyon, which has nearly the same orientation as Coal Canyon near the mine, indicated that winds blew from the south-southwest, or up canyon, for all 24 hours on five different days in one year and from the north-northeast, or down canyon, on two entire days. These time periods were assumed to produce the highest concentrations since downwind receptors would be in the plume continuously. From these 24-hour periods, the two days (one with south winds and one with north winds) with the lowest average wind speeds and most stable atmospheric conditions provided the meteorological input for modeling.

The annual average emission rates from the CDM model were also used to predict maximum concentrations because no information was available on seasonal variations in production. Although it is expected that emission rates would vary somewhat throughout the year, the sources at Coal Canyon mine are not subject to great increases in emissions due to equipment malfunction or high wind speeds. Also, increased emissions at different sources would occur independently rather than simultaneously and would probably not occur at the same time as the most adverse meteorological conditions.

Predicted maximum 24-hour concentrations from the mine in 1990 are shown on map MA3-3. With winds from the north, a maximum concentration of 33 $\mu g/m^3$ is projected to occur directly east of the preparation plant. At the south end of the canyon, concentrations on the worst day would be about 24 $\mu g/m^3$. With winds from the south, the maximum concentration is predicted to be 25 $\mu g/m^3$ 0.8 mile up the canyon and 10 $\mu g/m^3$ 2.5 miles up the canyon. These concentrations would be considerably less than the 24-hour primary air quality standard of 260 $\mu g/m^3$ and the secondary standard of 150 $\mu g/m^3$, and they are projected to occur only in the immediate vicinity of the mine. Maximum concentrations in 1985 would be about half this magnitude.

Because the short-term dispersion model involves prediction of extreme conditions for meteorology and emission rates, it is probably slightly less accurate than the annual model.

Impact on Visibility

The addition of particulates into the atmosphere as a result of emissions from the mine would reduce visibility in the area. A calculation of the degree of visibility reduction depends on several parameters for which data are not available, the most important being size distribution of the particles. However, a rough approximation of visibility can be made based on suspended particulate concentrations. A relationship between these two variables in rural west-central Colorado has been empirically determined by Ettinger and Royer (1972); it is shown in figure MA3-1.

It should be emphasized that this relationship was developed with uniform atmospheric particulate concentrations, not near a plume of fugitive dust containing relatively large diameter particles. Also, it does not consider visibility reductions due to precipitation. Therefore, the equation is more likely to predict visual range over an averaging period of a year than for a short-term period such as 24 hours.

As indicated on map MA3-1, particulate concentrations in 1990 would be increased to a distance of 0.5 to 2 miles from the surface facilities. Along a line of sight down Coal Canyon, concentrations would be increased an average of about 3 $\mu g/m^3$. Using the equation above and a background particulate concentration of 40 $\mu g/m^3$, the estimated reduction in visual range on the mine site as a result of mining emissions would be about 2 miles on an annual basis. Because of the limited area of air quality impact, average visibility would not be affected significantly off site. Visibility reductions in 1985 would be less than in 1990.

Geologic and Geographic Setting

Topography

Impacts of the proposed action on the topography of the mine property would be extensive. Three aspects of the mining operation would produce some alteration of the existing surface topography: excavation and earthmoving in preparation for construction of surface facilities; long-term use of the refuse disposal site; and surface subsidence.

Excavation and earthmoving associated with construction of surface facilities would cause minor alterations of the existing topography of the mine property. Approximately 99 acres, or 5 percent, of the mine property would be altered as roads, mine facilities, and the refuse disposal site are constructed. The majority of the change would occur in preparation for the mine offices, bathhouses, warehouses, refuse disposal area, etc. Existing slopes in the area average 25 percent (or 15 degrees). Benching, grading, and leveling would be required. In addition, blasting and cliff sealing may be necessary. Level surface and cut-and-fill structures would replace the steep natural slopes for the 15- to 25-year mine life. The modified surfaces created would alter the drainage characteristics of the area, increasing erosion and runoff. In addition, noise

TABLE MA3-1

FUGITIVE DUST EMISSIONS AT THE PROPOSED COAL CANYON MINE SITE

Emission source	Emissions, ton/yr	
	1985	1990 & EML
Conveyor - 4 sections	3.8	9.4
Transfer points - 3 points	8.4	21.1
Preparation plant - wet process	neg	neg
Truck loadout	neg	0.1
Open storage - surge pile	6.8	6.8
Haul roads - clean coal	74.8	187.0
- refuse	0.1	0.3
Access roads	73.2	73.2
Exposed areas - refuse	9.0	9.0
- rail/mine facilities	4.8	4.8
TOTAL	180.9	311.7

TABLE MA3-2

EMISSIONS OF GASEOUS POLLUTANTS FROM THE PROPOSED COAL CANYON MINE SITE

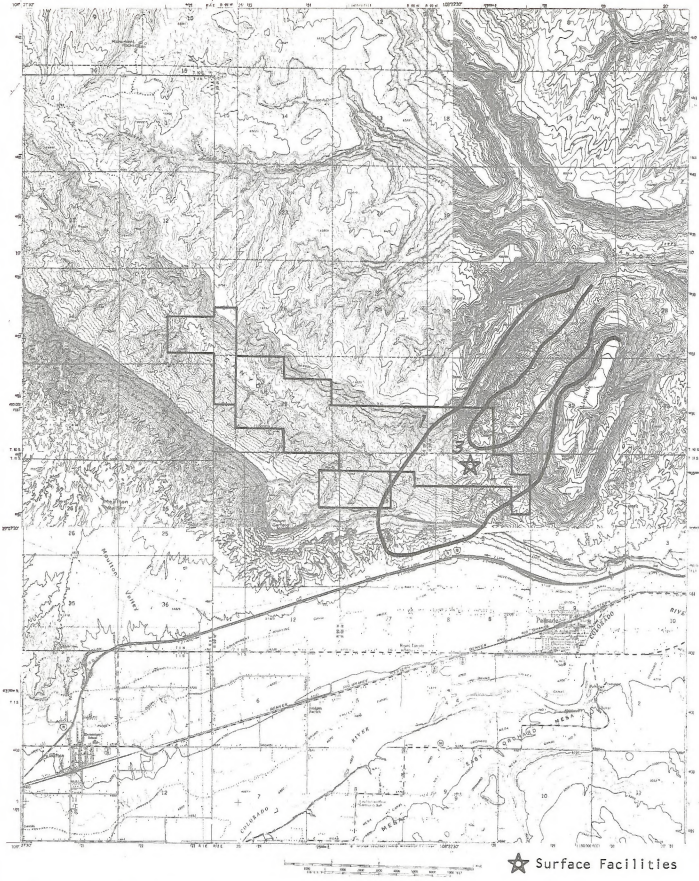
Year	Total emissions from vehicles, ton/yr			
	CO	HC	NO_x	SO_x
1985	7.0	0.7	1.6	0.3
1990	6.0	0.6	1.6	0.6

$L_v = \frac{24}{0.2 + 0.007\ M}$, where

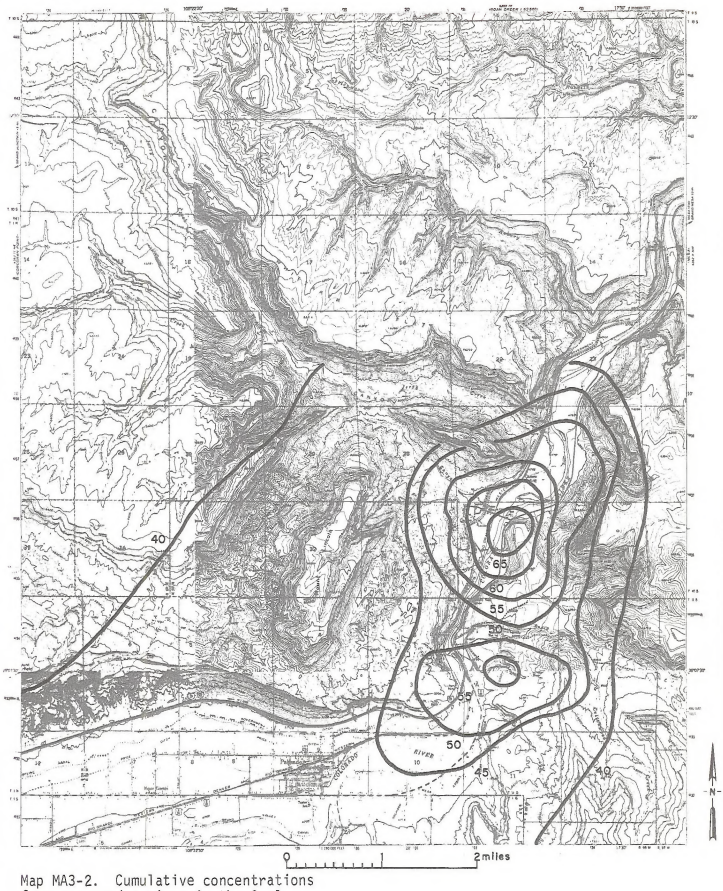
L_v = Average visual range, miles

M = Average particulate concentration (micrograms per cubic meter)

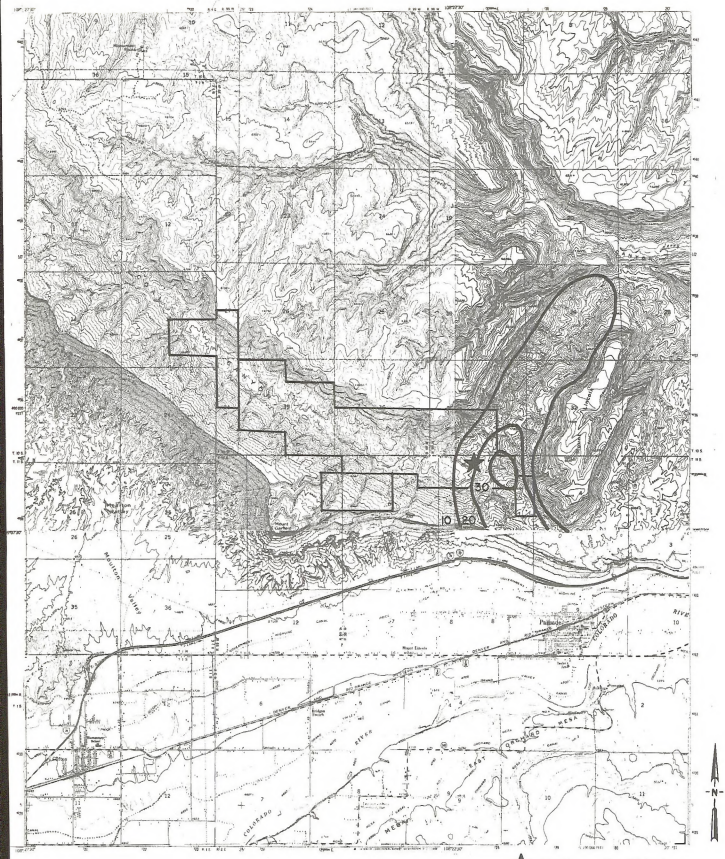
Figure MA3-1 Relationship between visibility and suspended particulate concentrations in rural west-central Colorado (Ettinger and Royal 1972).



Map MA3-1. Predicted increases in ambient concentrations in 1990 (micrograms per cubic meter)



Map MA3-2. Cumulative concentrations from proposed actions in the Coal Canyon-DeBeque Canyon area (micrograms per cubic meter)



Map MA3-3. Predicted maximum 24-hour concentrations in 1990 (micrograms per cubic meter)

and vibration would add to the landslide and rockslide potential of the area (see Soils for further discussion).

Use of the refuse disposal area would gradually alter the existing topography of 46 acres (or 2 percent) of mine property over the 15- to 25-year mine life. (Note: these 46 acres are included in the 99 acres above). No detailed information concerning the refuse disposal site or its projected final topography was provided. At this time it is only possible to project that the existing topography would be smoothed and the elevation of the downhill portion would be raised.

A much more significant impact of the proposed mining operation would be subsidence. Three mining methods have been proposed for use on the mine property: retreating longwall mining; conventional room-and-pillar by continuous mining units; auger mining. Auger mining would cause no subsidence on the property. The type of impacts produced by longwall and room-and-pillar mining would be similar but different in magnitude.

Conventional room-and-pillar mining methods are proposed for more than 800 acres of the mine property. Overburden varies from 0 at the outcrop to approximately 1,300 feet at the northern boundary of the area. Subsidence in the area can be predicted to be a maximum of approximately 6.5 feet, under "worst case" conditions.

Longwall mining on retreat is proposed for less than 200 acres of the mine property. The *Subsidence Engineer's Handbook* was used to predict a maximum of about 7 feet of subsidence in the area. This maximum subsidence could occur over a large portion of the 200 acres. Because the mining would occur at shallow depths throughout most of this area, large open fractures, step-like areas, and cave-ins could occur above mined areas. Rupturing, collapse, rotation, and twisting of the surface could occur on large areas (see Soils).

An area of particular vulnerability would be the refuse disposal site in Section 31, T. 10S, R. 98W., 6th P.M. The entire area would be undermined by longwall mining methods. Overburden in the area is shallow, and the maximum subsidence would occur over most of the 47 acres occupied by the site. If only vertical subsidence occurred, impacts to the site could be limited to disrupting established drainage. However, twisting and rotation of surface blocks during settling could result in erosion hazards. Fires could begin if air is able to circulate through the refuse because of fracturing and collapse of the underlying surface. Fires in refuse disposal areas are difficult to suppress and may continue smoldering for long periods. Air quality in the area may be severely affected.

Extensive surface subsidence would promote landslides (or rockfalls, slides, and slumps).

Paleontology

Plant, invertebrate, and vertebrate fossil materials would be destroyed, disturbed, or removed as a result of coal mining activities, unauthorized collection, and vandalism. The primary impact would probably result directly from the mining operation. Given the overall character of the stratigraphic column, it is probable that some fossils would be destroyed. However, this stratigraphic section is only moderately likely to yield significant fossils when compared with other parts of the ES area.

All exposed fossil-bearing formations within the region could also be affected by increased vandalism and unauthorized fossil collecting as a result of increased regional population. The extent of this impact cannot presently be assessed due to a lack of information on such activities.

As a result of the above impacts, an undetermined number of fossils would be lost for scientific research, public education (interpretive programs), etc. On the other hand, as a result of development, some fossil materials would also be exposed for scientific examination and collection. Due to the present lack of data and accepted criteria for determining significance, the importance of these impacts cannot presently be assessed.

Mineral Resources

Coal

The mining of an estimated 8 million tons of coal from the proposed Coal Canyon project over an estimated 15- to 25-year period would result in the depletion of a nonrenewable energy resource. The coal is expected to be exported out of the area to utility plants for production of electrical energy.

The underground mining of the coal seams by the proposed mining methods could recover approximately 30 percent of the coal reserves. However, the faulting in the area and the rotation of the fault blocks may have caused fracturing and zones of weakness within the coal seam. This could cause difficulty in mining and roof control, resulting in a high loss of coal reserves.

Coal in the Cameo A seam, up to 12.34 feet thick, must be considered as lost in this analysis as a result of mining coal in the Cameo B seam. The difference between the two seams, up to 20.17 feet, is too thin to allow design of a mine plan to recover the A seam.

Oil and Gas

If oil and gas are discovered under the leased area, a settlement between well owners and the owners of the leased coal would have to be reached as to which nonrenewable energy resource would be produced first.

Water Resources

Ground Water

Mid-Continent expects to intercept sufficient ground water in the mining operation to meet all consumptive uses except potable supplies for personnel (3 acre-feet annually), which would be purchased from local water utilities. Total water requirements are estimated by the company to be 36.8 acre-feet per year (ac-ft/yr) or about 0.07 acre-feet per 1,000 tons of coal mined. This would be less than half the consumptive use normally required by underground mines when coal processing is necessary (see the regional analysis, chapter 1). It appears more realistic to assume that the proposed Coal Canyon operation would consume about 85 acre-feet of water annually.

As stated in chapter 2, Description of the Existing Environment, the Cameo coal seam and the underlying Rollins Sandstone east of the fault in the eastern half of the mine area are almost certainly drained and would yield little or no water to a mine. West of the fault, these beds may be water-bearing, but more probably they are also drained near the outcrop in the area to be mined. In the event that they are locally saturated, sustained water yield would be small, probably not exceeding 10 ac-ft/yr. Interception and use of this ground water in the mining operation would have no impact on the regional ground-water system and, so far as could be determined, would have no significant impact on any wells or springs in areas adjacent to the lease.

More important, the company almost certainly cannot obtain the required amount of water for their proposed operation from the shallow ground-water resource in or adjacent to their lease area. An alternative source of water must be developed, either by drilling a deep well to tap aquifers underlying the Mancos Shale at a depth of more than 4,000 feet or by utilizing surface runoff. A deep well of the required capacity should not impact the regional or local ground-water systems over the life of the mine, but some question exists as to whether the dissolved-solids concentration of the water thus obtained would be too high for the intended use. Any development of the ground-water resource would, of course, require application for necessary permits and water rights.

The long-term effect of the proposed mining on the ground-water resource should introduce no significant impacts. Recharge-discharge equilibrium would become reestablished, depending on the extent of local fracturing and subsidence and consequent increased interception of surface water. Increased recharge would very probably be reflected by correspondingly increased discharge to Coal Creek in the reach immediately downstream from the mined area. This additional water would be rapidly dissipated by evapotranspiration with no significant adverse impacts on the environment. Any increase in salt load to the stream would be minor compared with the efflorescence or whitish crust of salts presently lining much of the channel bottom.

Surface Water

Impacts to the surface-water system in and adjacent to the lease area as a result of the proposed mining should be minor. The only direct disturbance to the main channel of Coal Creek would occur from construction of the main access road up Coal Canyon to the lease area and from construction of roads connecting the several portals that would provide access to the various sections of the mine (map MA1-2, chapter 1). Enforcement of regulations 30(CFR): 717.17(j) should minimize channel disturbances from this road construction. Any temporal increase in local erosion, however, would probably not measurably increase total sediment yield from the watershed to the Colorado River because of the extreme upland and channel erosion that currently is occurring throughout the watershed.

Disruption of stream channels within the lease area by subsidence would have a very transient effect on runoff. The large volumes of sediment normally transported by runoff would rapidly fill and seal the bottoms of any depressions thus formed, possibly decreasing runoff slightly and reducing annual sediment yield to the Colorado River for a relatively short period. Following the completion of mining and reclamation, runoff characteristics of the watershed should rapidly return to essentially pre-mining conditions. No significant short- or long-term increase in salt load to the Colorado River is anticipated.

The increased population in the Palisade and Grand Junction areas in Mesa County as a result of the proposed operations is estimated to be 0 persons by 1980; 350 persons by 1985; and 1,250 persons by 1990 (Socioeconomic Conditions). Assuming an average water use of 200 gallons per day per person (gal/day/person), sewage effluent of 60 gal/day/person, and an increase in dissolved solids of 200 milligrams per liter (mg/l) in sewage effluent, water and sewage treatment requirements and the increase in dissolved-solids load to the Colorado River are summarized in table MA3-3. Most of the increased demand for water-treatment facilities would probably occur in Palisade and Grand Junction. Some domestic supplies may be obtained from wells, but the only suitable aquifer in this general area is alluvium bordering the Colorado River and its local tributaries. Wells, therefore, would be hydraulically connected to the surface streams and

TABLE MA3-3

WATER AND SEWAGE TREATMENT REQUIREMENTS
AND SALT LOAD RETURNED TO THE COLORADO RIVER

Item	1980	1985	1990
Population increase (persons)	0	350	1,250
Required increase in treated water supply (ac-ft/yr)	--	78	280
Required increase in sewage treated (ac-ft/yr)	--	23	84
Consumptive use (initial use less sewage effluent (ac-ft/yr)	--	55	196
Increased salt load returned to the Colorado River (tons/yr)	--	6	23

would have only slightly less effect than direct diversion of surface water for the needed supplies.

The small increase in salt load contributed to the Colorado River by the added sewage effluent attributable to increased population as a result of the proposed mine should have no significant impact on aquatic biology downstream. Consumptive use of water and the increased salt load returned to the river in sewage effluent, however, could increase the dissolved-solids concentration in the Colorado River below Hoover Dam by about 0.001 mg/l (0.0002 percent) by 1985, and 0.005 mg/l (0.0007 percent) by 1990. As small as this amount may seem, any increase in the salinity of the lower Colorado River water is regarded as a serious impact.

Should water rights be obtained and water for the mining operation be diverted from the Colorado River, an additional very small increase in the salinity of the lower Colorado River would occur. That increase could be as much as 0.001 mg/l (0.0002 percent).

Flood Hazard

All facilities and portals would be located on benches sufficiently far above Coal Creek that floods should present no hazard to life or property. Because the channel of Coal Creek is deeply entrenched through most of its length, all peak discharges from storms of less than 100-year/24-hour recurrence interval should be contained within the present channel.

The Description of the Proposal (chapter 1) indicates that the main access road to the mine would follow and upgrade the present road, which is used for power line maintenance. This road crosses the channel of Coal Creek eighteen times between the lease area and the Colorado River and is subject to flooding at a number of locations. Regulations 30(CFR): 717.17(d) probably would require construction of a new roadway away from the Coal Creek channel.

Erosion and Sedimentation

The proposed operations would disturb a total surface area of 99 acres. Regulations 30(CFR): 717.17(a) require that runoff from this disturbed area be routed through sedimentation ponds or other control structures that would limit total suspended solids in any effluent to 45 mg/l maximum allowable, except for discharge from a precipitation event larger than 10-year/24-hour recurrence interval. The average of daily values for 30 consecutive discharge days cannot exceed 30 mg/l. The effect would be to reduce sediment yielded to Coal Creek from the disturbed areas by an estimated 0.25 ac-ft/yr. That amount would be insignificant in the Coal Creek watershed where any effluent from sediment control reservoirs would immediately pick up a new sediment load by scouring the banks and bed of the Coal Creek channel.

The largest short-term source of sediment yielded to the Colorado River as a result of the proposed mining operations would occur off site in conjunction with housing and related construction to accommodate the increased population. Approximately 30 acres would be disturbed by 1985 and 106 acres by 1990. It is estimated that sediment yield to the river net would be increased about 1 ton per acre disturbed for the first one to two years after construction. Thereafter, sediment yield would decrease to about half the predisturbance rate. The initial increase in sediment yield, therefore, should be more than offset by the long-term reduction in sediment yield over the life of the structures. Any temporal adverse or beneficial impacts to the Colorado River from this comparatively small change in sediment yield should be insignificant.

On completion of mining and reclamation, the refuse disposal area, which would overlie the mined out area, may eventually be disturbed by subsidence and subject to local erosion. Location of the disposal area as proposed away from any significant drainage courses, however, should minimize any long-term increase in sediment yield to Coal Creek from this source. The Office of Surface Mining (OSM) recognizes the difficulties inherent in attempting to stabilize refuse disposal sites in areas of low annual precipitation such as the Coal Canyon site and is currently considering special performance standards for these areas.

Soils

Soil impacts would result from surface subsidence, from the construction and operation of mine surface facilities, and from urban area expansion due to increased employment.

Coal removal could cause an estimated maximum surface subsidence of about 7 feet (see Topography). Soil impacts would be minimal where no breaks occurred in the surface mantle. However, surface cracks could expose narrow bands of bare soil material; surface runoff could then be redirected, causing accelerated erosion.

The construction and operation of surface facilities would affect 99 acres by 1985, with no further change through 1990. Erosion rates would temporarily increase in response to surface disturbance. An estimated twofold to threefold increase could occur in the already high natural erosion rate. Most of this erosion, however, would be contained on site by sediment control structures (30[CFR]: 717.17[a]).

The net effect of increased erosion, along with a deterioration in soil structure, would be a reduction in soil productivity. Any such reduction, although unquantifiable at present, would intensify inherent revegetation problems of low natural moisture, poor topsoil, and often steep terrain. These problems would prolong the efforts necessary to achieve successful reclamation (see Vegetation).

Off-site disturbances due to mine-related population increases would amount to 30 acres by 1985 and 106 acres by 1990. The exact location of these acres cannot be predicted, although at least some portion would likely come from croplands (including prime farmlands) in Mesa County. To this extent, crop production capacity would be permanently lost (see also Water Resources, Erosion and Sedimentation).

Vegetation

Approximately 99 acres would be disturbed by the proposed mine portals and associated facilities for the life of the mine, beginning by 1985 and extending through 1990. The bulk of the disturbance would be in saltbush type, although a small amount of the greasewood type may be disturbed by the improvement of the road in Coal Canyon. The impacts of the disturbance would be a reduction in the visual aesthetics of the area, increased soil erosion, and reduction in the numbers of wildlife in the area (discussed in the appropriate sections).

Mid-Continent would be required to revegetate the 99 acres of disturbance when they are no longer needed for mining operations. The majority of the disturbance would not be revegetated until abandonment of the mine. Specific revegetation measures that would be required are stated in 30(CFR): 717.20, and 30(CFR): 211.40, 211.41, and 211.62, in the *Federal Register* (Vol. 42, No. 239, and Vol. 41, No. 96). These regulations are discussed in detail in the regional volume, chapter 4, Vegetation.

Revegetation Problems and Probability of Success

The revegetation of disturbed areas would be difficult, due to many factors. Climatic conditions are severe with extremes in temperature and wind and low annual precipitation (approximately 10 inches). Insufficient moisture is the main factor hampering successful revegetation (Cook, Hyde, and Sims 1974; Hassel 1977; Hodder 1977). There also may be periods of drought, such as in 1976 when the annual precipitation was as low as 5 inches. Other revegetation problems which may be encountered are steep slopes; soil conditions which are detrimental to plant life (see Soils); competition for moisture, nutrients, and light from undesirable weedy plant species; low germination rates of seeds; and destruction of seedlings by wildlife.

Various revegetation techniques have been developed to counter such problems; they are discussed in detail in the regional volume, chapter 4, Vegetation. The use of many of these techniques may be necessary to establish on the disturbed mine site "a diverse vegetative cover capable of self-regenation and plant succession and at least equal in density to the natural vegetation," as required by the federal regulations 30(CFR): 211.40(a)(13)(i).

Hassell (1977) states that in desert areas conditions favorable for establishing vegetation come every four to six years. As discussed in the regional chapter 4, numerous researchers have indicated that irrigation may be necessary for establishment of seedlings in areas which receive 10 inches or less annual precipitation (Aldon 1977; Bengson 1977; Hassell 1977; Cook, Hyde, and Simms 1974; DeReemer and Bach 1977). Aldon, DeReemer and Bach, and Bengson (all 1977) have had success with drip irrigation techniques in arid environments yet even if drip irrigation would prove to be a feasible method for revegetating rangeland in the Grand Valley area, a source of water for irrigation at the Coal Canyon Mine site is not assured. Ground water brought up from the mine is expected to be just 10 acre-feet/year (see Water Resources). In addition, the ground water would have a high sodium content and high dissolved-solids concentration, making it marginal for use as irrigation water.

Hodder (1977, 1977) has developed several methods for retaining soil moisture in semi-arid environment through techniques such as pitting or gouging the soil surface, moisture collars, or condensation traps. These techniques could eventually prove to be useful for reestablishing vegetation on dry rangeland in air environments.

Past revegetation attempts in the arid Grand Valley (at or less than 10 inches annual precipitation) have met with little success. Based on conversations with the Soil Conservation Service and the Colorado Department of Highways in Grand Junction, the only successful revegetation in the area has been along Highway 70 west of Loma. The highway right-of-way was seeded six years ago, and a good stand of crested wheatgrass, western wheatgrass and Indian ricegrass is present now. The spring following the seeding had much higher than normal precipitation amounts (U.S. Weather Service data for Fruita). The Highway 70 right-of-way between the Clifton interchange and Walker Field in Grand Junction has been seeded three times without any success.

In spite of the fact that various revegetation techniques involving both dryland revegetation and

irrigation show potential for successful revegetation in arid environments, many of these techniques are yet in the research stage, and their feasibility for use in the Grand Valley has not been proven. Because of this, and the only marginal success of past revegetation efforts in the Grand Valley area, successful revegetation of disturbed land at the Coal Canyon Mine site is not certain except in years of higher than normal winter or spring precipitation.

Other serious problems at the proposed Coal Canyon Mine which may affect successful revegetation are steep slopes and the lack of topsoil. Steep south-facing slopes (such as those present at the mine site) may not be seeded successfully due to extremely droughthy conditions (Dahlquist 1977). There is minimal topsoil and subsoil at the mine site. Consequently even if all the soil material is stockpiled and reapplied to the disturbed areas upon abandonment of the mine, a sufficiently deep plant growth medium for reestablishment of vegetation may not be present. According to most researchers, to successfully revegetate disturbed areas, a plant growth medium to a depth of at least 18 to 24 inches is required (Cook 1974).

A deficiency exists in the revegetation section of Mid-Continent's Coal Canyon M&R plan which may affect successful revegetation. The use of a mulch is not discussed. In arid environments mulching is necessary for the reestablishment of vegetation on disturbed areas (Cook Hyde, and Simms 1974).

Three plant species are listed for revegetation at the Coal Canyon Mine: Norden crested wheatgrass, Arriba western wheatgrass, and Paloma Indian ricegrass.

The use of only grasses for revegetation is not consistent with post-mining land uses. The reestablishment of a mixture of adapted shrubs, grasses, and forbs would best satisfy the post-mining land uses of wild horse and big game habitat. Deer utilize mostly shrubs, while wild horses graze most grasses. Both utilize forbs to a certain extent, mainly in the early spring. Information contained in the appendix, volume 3, shows plant species occuring naturally within the region which have proved useful for revegetation. Those species shown as adapted to the saltbush type would be particularly well adapted for revegetation at the Coal Canyon Mine.

Natural revegetation would occur at the Coal Canyon Mine site if the soils are stable and do not contain materials toxic to plant growth. Weedy annuals such as Russian thistle would be the first to invade the disturbed areas, followed by a succession of longer-lived plants until a persisting (climax) plant community of adapted perennial species similar to adjacent undisturbed areas exists. This natural succession process may take anywhere from 30 to 60 or more years depending on varying microenvironmental conditions such as slope, distance from undisturbed communities, etc.

Some vegetation may be disturbed by subsidence over the mined areas. Coal removal could cause an estimated maximum subsidence of about 7 feet (see Topography). The effect of this disturbance would be an increased soil erosion (see Soils). Loss of livestock and wildlife forage would be minimal.

Population-Related Impacts

Urban expansion caused by population increase related to coal mining would result in the disturbance of an estimated 30 acres of vegetation by 1985 and 106 acres by 1990. It is probable that much of this disturbance would be on agricultural land surrounding existing population centers; the capacity of these land to produce crops would be permanently lost.

Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road-vehicle use (see Recreation). This disturbance would lessen the productivity of native vegetation for livestock and wildlife forage. The problem would be most serious in low altitude Mancos Shale hills and in alpine areas above timberline.

Wildlife

A total of 99 acres of saltbush (and possibly some greasewood) would be lost due to the construction of mine portals, facilities, and the disposal area by 1985, and this would be the extent of the disturbance through 1990. Small mammal and reptile populations would be destroyed, and the larger, mobile species of mammals and birds would move off the area.

Increased human and mechanical activity along the road and around mine portals and the plant site would also influence animal use for a distance of 1 mile from these areas. This impact would amount to an average of 50 percent reduced use on approximately 4,000 acres (see table MA3-4), assuming that mule deer, wild horses, mountain lion, bobcats, and coyotes are species which would be affected.

It is difficult to predict to what extent subsidence would affect wildlife because of the lack of information about the effects of subsidence. In general, it can be expected that animals would avoid using an area which is subsiding, because of its instability. To some large extent, however, wildlife would gradually develop trails through the areas.

Impacts to specific species would be as folows.

TABLE MA3-4

IMPACTS ON WILDLIFE

Year	Total Disturbed Acres	Number of Animals that These Acres Could Support					Additional Acres Disturbed	Additional Animals that Could be Supported		
		DDA	D	EDA	E	WH		D 50%	E 50%	WH 50%
1977	0	1.17	0	-	-	0	-	-	-	-
1980	0	1.17	0	-	-	0	-	-	-	-
1985	99	1.17	1	-	-	2	4,000	14	-	16
1990	99	1.17	1	-	-	2	4,000	14	-	16

Note: DDA = deer days per acre; EDA = elk days per acre; D = deer; E = elk; WH = wild horses.

Wild Horses

Wild horses winter throughout Coal Canyon; and it is one of the two areas that horses from the Little Bookcliffs herd are forced into by severe winter snows. If water is impounded in the canyon and is available to the horses, they could stay in the canyon for a longer period of time and use winter forage in the summer. Forage would be reduced, thus eventually decreasing the number of horses that the area could support. The probable reduction in wild horse use is given in table MA3-4.

In addition, the presence of people and their activity could greatly influence horse use. They could be harassed enough that they would not use this wintering area at all. In that case, they would be forced into the other wintering area, where they could possibly overuse the forage. Because of legal mandates to maintain a healthy, viable herd (see chapter 1, Interrelationships), the BLM would then have to reduce the herd artificially to keep it within the carrying capacity of the range.

If the access road is constructed in the bottom, as proposed in the M&R plan, this area would be eliminated from wild horse use. Since the surrounding terrain is too rocky and steep for the wild horses to use, the entire canyon would then be lost to the horses. This loss would include the canyon bottom northwest of the support facilities because of the portals and associated activity. The loss would amount to 4,000 acres of habitat.

If regulations 30(CFR): 717.17(d) require construction of a new roadway away from the Coal Creek channel, such a road might require extensive development work because of the rocky, steep, heavily eroded terrain in the canyon. This could disrupt other parts of the wild horse habitat. If a roadway is located away from the bottom, the horses might be able to continue using the bottom as a travel route.

The eastern 2 miles of access road (as proposed) would be within the wild horse area. Occasional vehicle collisions with horses could occur.

In Coal Canyon the 7 feet of subsidence (worst case) would occur on the south and southwest-facing slopes where the horses winter. With room-and-pillar mining, subsidence could occur for many years after the mine is abandoned. The horses would probably not use the area until the land had settled, and even then, because of the large drop that could occur, they still would not use the area to the fullest.

Mule Deer

Mule deer also winter throughout Coal Canyon. The probable reduction in mule deer populations as a result of the proposed action is given in table MA3-4.

Occasional vehicle/deer collisions could occur on the eastern 2 miles of access road, which would be within the mule deer winter range.

Birds

A system of power lines to various surface and underground facilities would be an electrocution hazard to the larger raptors, such as golden or bald eagles, red-tailed hawks, and great horned owls, if the lines are not properly designed. In addition, they would be a physical hazard to flying birds.

Off-Site Impacts

If the Coal Canyon operation uses the GEX Colorado Company loadout facilities on the Colorado River, some waterfowl nestings and brood rearings in the vicinity of the loadout could be disrupted and even eliminated by the human activity close to the river. Activities could impede movement of chukars to watering areas near the highline Canal.

Secondary impacts from the proposed action would include increased human population, resulting in expansion of urban areas onto agricultural lands and some crucial winter range; increased vehicular traffic, resulting in an increase in vehicle/animal collisions; and increased recreational use of the area, causing an additional stress on the animals and increasing legal and illegal harvest.

Endangered or Threatened Species

It is possible that in the vicinity of the Colorado River, truck traffic and unit train loading facilities would disrupt hunting activities for two endangered raptors, the bald eagle and the peregrine falcon. The site for the loading facilities, on private land, has already been cleared of its vegetative cover, eliminating most of its value to raptors. Further clearance or disturbance in the riparian type adjacent to the Colorado River could further diminish the amount and quality of hunting areas for these two species, since the prey for both species is generally found in riparian or aquatic habitats.

Consultation with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act of 1973 and the Bald and Golden Eagle Protection Act (16 USC 668-668d) has been completed. USFWS comments can be found in chapter 9.

Aquatic Biology

Increased consumptive use of 281 acre-feet of water yearly (mine and mine-related population) by 1990 would further deplete the amount of water available for fishery habitat in the Colorado River system. This consumption alone would be insignificant when compared with the Colorado River, but

it gains in importance when considered with all the development projects in the region.

All runoff from the surface areas disturbed by mine construction and operation would be retained in sediment ponds as required by 30(CFR): 717.17. Sediment retention ponds would contain all runoff from a storm event up to and including a 10-year/24-hour storm. Spillways on ponds would be designed to safely pass a 25-year storm event. Discharges of water from these ponds, should they be necessary under normal conditions, may not exceed 45 mg/l total suspended solids, and the 30-day average discharge may not exceed 30 mg/l. This concentration of suspended solids would not adversely effect the aquatic ecosystem of the Colorado River downstream from the lease site. During the majority of the operation it is unlikely that water would be discharged to the Colorado River.

Sediment retention ponds may legally spill in a precipitation event larger than a 10-year/24-hour storm. In such a case, some coal dust and other fine sediments from the ponds would flow into Coal Canyon and subsequently to the Colorado River. Total sediment yield from the highly erosive Coal Canyon watershed and other similar watersheds adjacent to the Colorado River would be so large that sediment coming from the retention pond overflow would be unmeasurable in the river and have insignificant impacts. Also, the increased dilution in the Colorado River during a large storm would largely decrease the concentration of all water quality parameters. No adverse effects on the aquatic habitat or the threatened and endangered fish species are expected. Aquatic organisms in this part of the Colorado River must be capable of withstanding a total suspended solids concentration ranging from 59 to 4,420 parts per million (ppm) and averaging 2,270 ppm and a total dissolved solids averaging 200 to 250 mg/l in the spring and 600 to 650 mg/l in normal low-flow periods.

The coal refuse pile would be constructed in compliance with 30(CFR): 717.17. Location away from the drainage, proper construction, and phased revegetation would prevent materials in the refuse pile from being washed into the Colorado River and impacting the aquatic ecosystem. However, as pointed out in vegetation, revegetation of the refuse pile may be difficult. Acid mine drainage and increased metal concentrations would not exist in this area due to the high pH and buffering capacity of the waters and the low sulfur in the coal.

Threatened or Endangered Species

No adverse impacts to threatened and endangered species in the Colorado River are projected as a result of the proposed project. Coordination with the USFWS under Section 7 of the Endangered Species Act of 1973 has been completed. USFWS comments can be found in chapter 9.

Cultural Resources

Archeological Resources

While no archeological values have as yet been identified in the Coal Canyon area, archeological sites in the adjacent areas indicate the presence of prehistoric inhabitants. A total of 99 acres (by 1985 and through 1990) would undergo surface and subsurface disturbance, which could result in the destruction or damage of unidentified archeological values. The possibility of subsidence occurring on 1,000 acres of the mine property could result in the displacement and damage of existing archeological sites. Alteration of the surface, whether in the form of slumping and bulging or fractures and twisting would impact archeological values.

Controlled access into the lease area should keep vandalism within the site-specific area at a minimal level, although the presence of 200 mine workers by 1985 (and on through 1990) would increase exposure of existing archeological values to public passage (refer to chapter 4, regional volume for further discussion).

Historic Resources

Because the extent of historic sites in the mine area is not fully known, the following impacts may occur. Surface disturbing activities, such as mining or construction of facilities and roads, could disturb buried sites or destroy sites that might be considered worthless by the project's engineers. Because of the intrusion of buildings, roads, fences, etc., some sites might lose the aesthetic integrity which is important to the overall quality of the site, as outlined in 36(CFR): 800.9. Sites remaining near or at the project might be vandalized due to increased access or human use; damage could include 'stripping' of wood, removal of artifacts, etc.

Land Use

Approximately 99 acres in Coal Canyon would be used for Mid-Continent's surface facilities, including road development. At least for the life of the mine, this acreage would not be available for wild horse and mule deer habitat. The wild horses would also probably no longer be able to use an additional 4,000 acres in the canyon because the facilities and human activity around the mine would exclude them from certain areas and because the road would no longer be available as their main access down into the canyon. If human activity greatly disturbs the wild horses, they may no longer use this wintering area at all.

Revegetation of disturbed acreage may be difficult because of lack of moisture, steep terrain, highly erosive soils, etc. Unsuccessful rehabilitation, combined with additional erosion and postmining subsidence, could cause some long-term changes in local topography and land character. Natural revegetation would occur (after mining has ended) where soils are stable and do not contain materials toxic to plant growth, but it would take at least 30 years and perhaps more than 60 years. Until the disturbed acreage has been revegetated, either mechanically or naturally, it would presumably not be available as wild horse and mule deer habitat.

The Coal Canyon operation, along with GEX Colorado Company's nearby Cameo and Roadside mines and Public Service Company of Colorado's Cameo Power Plant, would contribute to the trend toward industrialized land use in the general area. Traffic on I-70 in DeBeque Canyon would increase as a result of mine personnel going to and from work, and train traffic would increase as coal is shipped to market.

As a result of the Coal Canyon Mine, population in Mesa County would increase by 300 people by 1985 and 1,050 people by 1990, and population in Garfield County would increase by 50 people by 1985 and 200 people by 1990. Some of the resulting residential and urban expansion would probably encroach on agricultural land and wildlife habitat. The orchard land in the Grand Valley is considered unique farmland, and much of it is in areas which meet the definition of prime farmland. However, the actual location of urban development would to some extent depend on future county and community land use planning and zoning.

GEX Colorado Company's Cameo No. 2 Mine and Mid-Continent's Cottonwood Creek mines may also be developed in DeBeque Canyon, and extensive oil shale and uranium development are likely to occur in the general area. These developments would contribute significantly to population growth in Mesa and Garfield counties and would accelerate changes from agricultural and wildlife land uses to urban and industrialized land uses in those two counties.

Transportation

HIGHWAYS

Development of the Coal Canyon Mine would increase traffic by as much as 270 vehicles per day on U.S. 6 and I-70 between the towns in the Grand Valley and the mine site. No impacts on the highway capacity are anticipated because I-70 is being upgraded to interstate standards (including a grade separation). The highway is also presently operating below capacity. No impacts are projected for the Cameo interchange. The number of auto accidents would increase slightly because of increased traffic.

According to the M&R plan, coal would be trucked on a private road from the preparation plant near the mine to a rail loading facility being built by GEX Colorado Company north of the Cameo power plant. Regulations 30(CFR): 717.17(d) probably would require construction of a new roadway away from the Coal Creek channel. The coal trucks would not cause increased traffic on public roads.

RAILROADS

Coal produced at the proposed Coal Canyon Mine would be shipped to the point of use in unit trains using the Denver and Rio Grande Western Railroad (D&RGW) facilities. Approximately one unit train per week would be required to handle the coal. This would increase congestion through the major eastern Colorado cities where coal from other producing areas also passes.

AIRPORTS

The only impact on airports would be increased passenger traffic at Walker Field. Facilities are capable of handling this increased load.

Recreation

The influx of additional population due to the proposed Coal Canyon mine and the subsequently increased demand for recreational opportunities could have an impact on existing receation resources and facilities, particularly community facilities in the Grand Junction-Palisade area. Since Grand Junction's recreational facilities are now fully utilized (Grand Junction Recreation Department 1977), increased use would result in overuse which would lead to their deterioration and lower their capacity to provide enjoyable recreation. The community facilities needed to meet the increased demand and prevent overuse are projected in table MA3-5, which shows a need for 1.2 acres of active/improved park land by 1985 and 4.1 acres by 1990. Capital investments to provide the facilities are also projected in table MA3-5.

The increased demand for dispersed recreation opportunities (e.g., hunting, hiking, ORV use) should not adversely affect the recreational resource; however, concentrated use, such as an ORV rally, could lead to vegetative deterioration and reduce the recreation experience on that site. BLM is in the process of determining open, restricted, and closed designations for public lands, which should hslp alleviate this problem. Increased use of recreational facilities (such as Island Acres Recreation Area) would lead to increased mainte-

TABLE MA3- 5

COAL CANYON: ADDITIONAL COMMUNITY RECREATION FACILITIES DEMAND

	1980	1985	1990
Population growth	0	350	1,250
Active/improved parks a/ (3.3 acres per 1,000 residents)	0	1.2 acres	4.1 acres
Capital investment ($66,666 per 1,000 residents)	0	$23,333	$83,332

Source: Bickert, Browne, Coddington, and Associates, Inc., Boomtown Financing Study, Vol. II (July 1976).

a/ Ballfields, tennis courts, playgrounds, etc.

nance costs for the managing agencies. The extents of the increased usage and costs are not known.

The increased use of recreational facilities could be offset by providing additional facilities. The Heritage Conservation Service, through the Land and Water Conservation Fund Act (PL 88-578), could provide monies for this purpose if matching funds are provided by the local agency. The mineral leasing funds (Colo. S.B. No. 35, Sect. 2, 34-63-102), which can be used for public facilities and services, could also be used for recreation facilities. In addition, BLM could provide lands for these recreational facilities under the Recreation and Public Purposes Act, 43 (CFR): 2740, which allows nonprofit associations to acquire lands for recreational purposes consistent with their creating authority. These actions, however, cannot be required by the Department of the Interior; therefore, the initiative for taking these courses of action would be up to the local agencies and the success of mitigation would depend on their commitment to it.

The development of roads and mining facilities in Coal Canyon on the Little Bookcliffs Wild Horse Area (and wildland study area) would conflict with BLM's wildland study area management guidelines if reclamation is not successful (see Soils and Vegetation for probability of success; see chapter 1, Interrelationships for discussion of guidelines). These conflicts could prevent the area from being included in the wilderness system.

The Coal Canyon area is winter range for the wild horses and mule deer; when concentrated in winter they provide recreation in the form of viewing and photography. Mining in the canyon could reduce the wildlife population, resulting in a corresponding loss of recreation opportunities (see Wildlife for a discussion of possible impacts to wild horses and mule deer).

Visual Resources

The most significant visual changes caused by the construction of the mining complex would result from the leveling and grading for surface facilities, portals, evaporation ponds, and refuse sites. Landfill to provide a base for mine portal roads would establish a unique landform and linear component on the landscape. The existing canyon access road follows the bottom of the canyon with minimal disruption. Widening this road or constructing a new road would involve cut-and-fill alterations that would significantly contrast with the present landform. All of these modifications would interrupt the sparse vegetative cover, altering that surface texture and inhibiting the visual integration of the proposed facilities into the landscape. In addition, the dark-colored coal refuse would at first be defined noticeably against the light-colored rocks and soils and would, therefore, disrupt the natural landscape.

The combined form, line, and texture changes would be readily visible on the steep side slopes because of the lack of terrain or vegetative masking in the canyon. The recreation potential of the Little Bookcliffs Wild Horse Area, in which Coal Canyon is included, requires the preservation of its present scenic quality (Class 'B' and VRM Class II). The proposed project would generate landscape changes that would lower the canyon's aesthetic quality and degrade its recreation potential for the growing Mesa County population (1975--62,822, 1990--116,134). Since Coal Canyon is in the Little Bookcliffs wildland study area, the modification of its scenic values could decrease its suitability for designation as wilderness.

Socioeconomic Conditions

Demography

In calculating the population growth associated with the Coal Canyon Mine, it was assumed that 80 percent of the mine employees would reside in Mesa County and the remaining 20 percent would reside in Garfield County. This assumption was based upon the commuting distance between the proposed mine and existing communities and on the anticipated growth rates of those communities, especially as the rates affect the availability of housing. In Mesa County, the Coal Canyon operation would result in a population increase of 300 people by 1985 and 1,050 people by 1990. In Garfield County, the difference in population due to the Coal Canyon Mine would be about 50 people by 1985 and 200 people by 1990.

The community of Palisade, in Mesa County, is the closest town to this mine site, as well as to Mid-Continent's Cottonwood Creek and GEX Colorado Company's Cameo mine sites. As a result, Palisade would experience a great deal of growth pressure; however, actual growth in Palisade would be limited because of its small size and water and sewage treatment capacities. As chapter 2 points out, both the water and sewage treatment facilities in Palisade are being upgraded to accommodate about an additional 1,500 people.

Most of the in-migrating population associated with the Coal Canyon Mine which does not settle in Palisade is expected to settle in the Grand Junction area. The small communities of DeBeque and Collbran would also receive some population influx as a result of the Coal Canyon project.

Grand Valley and Rifle are the closest communities in Garfield County to the Coal Canyon site. Since these two communities are expected to experience strong growth pressures from the numerous oil shale development operations in the same area,

as well as the Cottonwood Creek and GEX Colorado mines, available housing would be at a premium. This may result in a scattering of Coal Canyon-related population growth throughout Garfield County.

Community Attitudes and Lifestyles

The combined development of the Coal Canyon, Cottonwood Creek, and Cameo mines may have a pronounced effect upon the small community of Palisade. Palisade has remained a stable, agricultural community with a relatively high concentration of older persons for some time. A rapid influx of new population would certainly threaten the present character and social structure of the community. It would also place a burden on the elderly residents as the cost of living rises due to the demand for increased local government services. General changes expected in attitude and lifestyle due to increased coal mining in the area are discussed in the regional volume.

Noise

Because of the mine's isolated location and the high ridge separating the mine surface activities from the Colorado River, it is anticipated that there would be no noise impact on any residences.

Commuter traffic on I-70 as a result of the mine's operation is predicted to be 5 percent of the 1976 traffic volume on the highway. When compared with estimated future traffic on I-70, this employee traffic would not add significantly to noise levels along the highway. However, it is possible that the noise impact of aditional commuter traffic may cause problems within neighboring communities, particularly before and after shift changes. There would be some increase in noise levels at the Island Acres Recreation Area due to truck traffic to the unit-train loadout facility, but this is estimated to be less than 3 decibels (dBA).

The additional one coal train per week to carry coal to the east would add little to the noise levels along the Colorado River when compared with the total number of coal trains predicted for 1985 and 1990 due to all coal development in the area (see table R1-3, chapter 1, volume 1). Even the impact of all of the mines in DeBeque Canyon would not become significant. In 1977 there were no coal trains from the area; in 1980, 160 trains per year are predicted; in 1985, 220 trains; and in 1990, 310 trains. These represent slightly less than one-fourth of the coal trains leaving the ES area and would result in an increase of 2 dBA.

Community Facilities and Services

The projected community facility requirements for Mesa and Garfield counties associated with the Col Canyon operation are listed in table MA3-6. These figures were derived in a similar manner to those contained in the regional volume, chapter 4, Socioeconomic Conditions.

These cost figures do not reflect the major capital expenditures which are being made in both Mesa and Garfield counties to upgrade community facilities and services. Local governments would be dependent upon a portion of new revenues generated by the proposed action to assist in paying for projects like the $5 million water system expansion program and the $14 million sewage system expansion program planned for Grand Junction (see chapter 2, regional volume).

The local property and sales tax revenues attributed to the Coal Canyon development are listed in table MA3-7. These revenues represent the total property and sales tax revenues expected to flow to all local government entities. Since the estimated increases in community facility expenditures would be borne by county, municipal, or special district units of local government, it is necessary to subtract the school district share of the revenues in order to make a comparison. If this done, it decreases the locally derived revenues available for county, municipal, and special district purposes. In Mesa County the amount available would be an estimated $199,460 in 1985 and $400,560 in 1990. Comparing these revenues with the yearly operating expenses and amortized (assuming debt financing at 6 percent interest for twenty years) capital expenses of $169,330 per year shows that Mesa County would experience a revenue surplus from the Coal Canyon Mine.

Locally derived revenues available for county, municipal, and special district purposes in Garfield County are estimated to be $14,670 in 1985 and $58,180 in 1990. Comparing these revenues with the yearly operating expenses and amortized capital expenses of $22,700 per year shows that Garfield County would also experience a revenue deficit in the early years of operation. That would change to a revenue surplus by 1990.

The Coal Canyon Mine at full production would produce 500,000 tons of coal a year. As explained in chapter 4 of the regional volume, it is estimated that this would require an investment of $18,000,000. Property taxes on this would be $355,430 a year. Property taxes on the coal mined would be $33,030 in 1985 and $82,570 in 1990. Total property taxes could reach $438,010 in 1990. Of this, $109,281 would go to Mesa County; $312,424 would go to the local school district; and $17,633 would go to special service districts. Table MA3-8 shows how the property tax revenues would be distributed among the various uses.

TABLE MA3-6

COAL CANYON: ADDITIONAL REQUIREMENTS FOR COMMUNITY FACILITIES

Facility	Mesa County					Garfield County				
	Physical Plant Requirements	Capital Costs (dollars) 1990	Operating Costs per Year (dollars) 1980	1985	1990	Physical Plant Requirements	Capital Costs (dollars) 1990	Operating Costs per Year (dollars) 1980	1985	1990
Water treatment	0.27 mgd	183,660	0	3,760	13,150	0.04 mgd	34,980	0	630	2,500
Sewage treatment	0.06 mgd	207,900	0	2,900	10,140	0.01 mgd	39,600	0	480	1,930
Police protection	1 vehicle & 420 sq.ft.	36,140	0	12,000	42,000	80 sq.ft.	5,360	0	2,000	8,000
Fire protection	1,050 sq.ft.	42,000	0	6,000	21,000	200 sq.ft.	8,000	0	Volunteer	Volunteer
Streets and roads	25 acres	805,500	0	6,790	24,250	5 acres	161,100	0	970	4,850
General government	260 sq.ft.	16,740	0	9,720	33,700	50 sq.ft.	3,220	0	1,300	6,480
Libraries	3,150 books & 580 sq.ft.	42,800	0	2,490	8,720	600 books & 110 sq.ft.	8,125	0	420	1,660
Total	-	1,334,740	0	43,660	152,960	-	260,385	0	5,800	25,420

Note: mgd = million gallons per day; sq.ft. = square feet of space.

TABLE MA3-7

COAL CANYON: INCREASED REVENUES TO GARFIELD AND MESA COUNTIES

	1980	1985	1990
Garfield County			
Property Tax			
Homes	--	$ 13,800	$ 53,960
Businesses	--	4,280	17,120
Sales Tax	--	8,270	33,080
Service Fees	--	150	580
TOTAL	--	$ 26,500	$104,740
Mesa County			
Property Tax			
Homes	--	$ 78,020	$273,380
Businesses	--	16,500	57,740
Mines	--	388,460	438,010
Sales Tax	--	37,380	130,830
Service Fees	--	1,250	4,380
TOTAL	--	$521,610	$904,340

TABLE MA3-8

COAL CANYON: DISTRIBUTION OF PROPERTY TAXES

Year	County	Municipalities	Districts	Schools
Garfield County:				
1980	$ --	$ --	$ --	$ --
1985	4,740	1,180	330	11,840
1990	18,620	4,620	1,280	46,560
Mesa County:				
1980	--	--	--	--
1985	112,350	31,880	!6,420	322,150
1990	179,210	50,760	26,150	513,010

Housing

The projected demand for new housing in Mesa and Garfield counties as a result of population growth attributed to the Coal Canyon operation is summarized in table MA3-9. The assumptions regarding housing mix and family size that were used in the regional volume were also used in these calculations.

The housing requirements associated with the Coal Canyon Mine represent about 3 percent of the total projected new housing requirements in Mesa County and about 1 percent of the projected new housing requirements in Garfield County by 1990. This housing and its related roadway requirements would use approximately 26 acres of land in Mesa County by 1985 and 89 acres by 1990, and approximately 4 acres of land in Garfield County by 1985 and 17 acres in 1990.

Education

The expected increase in school-aged population due to the development of the Coal Canyon Mine is shown in table MA3-10, along with the increase in school district capital requirements and operating costs anticipated from that population increase.

Most of the increase in school-aged population within Mesa County due to the Coal Canyon Mine development would occur within School District 51. Since the mine itself is also located within the jurisdictional boundaries of School District 51, that district would receive an additional $10.4 million in assessed valuation from the facility by 1990. That increase in assessed valuation would allow the district to increase its bonded indebtedness by $2.1 million, which is in excess of the projected capital facility requirements.

School District 49(JT) in DeBeque would be required to provide for some of the increase in Mesa County school population associated with Coal Canyon. Even though District 49(JT) would not benefit from any of the increase in property tax base from the Coal Canyon Mine, the tax base increase it is expected to receive from the Sheridan Mine would be more than sufficient to meet its capital requirements. The increases in school operating costs projected for Mesa County as a result of the Coal Canyon development would be met by increased school district revenues without an increase in tax rates.

In Garfield County, the increases in school-aged population from Coal Canyon would occur in the Grand Valley District 16 and the Garfield District RE-2. The total expected increase in property tax base in Garfield County by 1990 from the Coal Canyon Mine would be approximately $0.9 million. That increase would allow the Garfield County school districts to raise their bonded debt by $180,000 or about $154,000 less than the estimated requirement for school capital facility needs.

Health Care

Population growth associated with the Coal Canyon Mine is expected to increase the demand for health care facilities in the Grand Junction area and the Rifle area. Due to their proximity to the Grand Junction area, neither the Coal Canyon Mine nor its two neighbors, the Cottonwood Creek and Cameo No. 1 mines, are likely to have significant adverse effects on the area's health care facilities individually. However, since population growth as a result of these three operations would affect the same area, the cumulative effect on health care service delivery is important. There would most likely be a need for expanded health care services in the town of Palisade, especially emergency services, to serve all three operations. Table MA3-11 is an estimate of the capital facilities needed in Mesa and Garfield counties to meet the projected increase in demand for health care services from all three mines in the Cameo area.

Most of the existing health care facilities in the area are supported by fees collected for services performed instead of through local tax revenues.

Employment

Development of the Coal Canyon Mine would affect employment in Mesa and Garfield counties. In 1985, 60 persons would be employed, which would increase total employment by 150 in Mesa County and by 20 in Garfield County. By 1990, total employment would increase by 520 in Mesa County and by 150 in Garfield County.

Income

The eventual employment of 200 people at the Coal Canyon Mine would have a significant impact on income in Mesa County. Because no information was given by Mid-Continent about expected payroll, an average income of $16,600 per employee is assumed for analysis. Average income at the mine would be considerably higher than Mesa County's 1975 median family income of $11,130.

The total payroll for the mine would be $3,320,000 at full production. In the regional economy, this would generate another $1,726,400 for a total direct, indirect, and induced income increase of $5,046,400 in the region. Table MA3-12 shows employment, payroll, and total regional income generated annually by the Coal Canyon Mine.

TABLE MA3-9

COAL CANYON: NEW HOUSING REQUIREMENTS

Housing Units	Mesa County			Garfield County		
	1980	1985	1990	1980	1985	1990
Single Family Units	0	65	228	0	11	43
Mobile Homes	0	25	87	0	4	17
Multi-family Units	0	10	35	0	2	7
TOTAL	0	100	350	0	17	67

TABLE MA3-10

COAL CANYON: SCHOOL DISTRICT FACILITY REQUIREMENTS

County	Year	Increased School-age Population	Facility Requirements (square feet)	Facility (dollars)	Operating and Maintenance Costs (dollars/year)
Mesa	1980	-0-	-0-	$ -0-	$ -0-
	1985	72	10,080	453,600	88,560
	1990	248	34,720	1,562,400	305,040
Garfield	1980	-0-	-0-	-0-	-0-
	1985	11	1,540	69,300	13,530
	1990	53	7,420	333,900	65,190

TABLE MA3-11

COAL CANYON, COTTONWOOD CREEK, CAMEO NO. 1:
PROJECTED HEALTH CARE FACILITY REQUIREMENTS

County and Year	Facility Requirements	Facility Cost (dollars)
Mesa:		
1980	0	$ 0
1985	16 hospital beds and 1 emergency vehicle	895,000
1990	18 hospital beds and 1 emergency vehicle	1,005,000
Garfield:		
1980	0	0
1985	2 hospital beds	110,000
1990	3 hospital beds	165,000

TABLE MA3-12

COAL CANYON: EMPLOYMENT, PAYROLL, AND REGIONAL INCOME

Year	Employment	Payroll	Regional Income
1980	0	$ 0	$ 0
1985	60	996,000	1,513,920
1990	200	3,320,000	5,046,000

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

The mitigating measures proposed in this chapter are measures which will be taken to minimize or eliminate specific adverse impacts identified in chapter 3 which would result from approval and implementation of Mid-Continent Coal and Coke Company's Coal Canyon mining and reclamation (M&R) plan. They do not include federal regulations, such as 30(CFR): 700, which are considered to be requirements with which the M&R plan will have to comply before it can be considered for approval. Neither do they include any mitigating measures already developed by Mid-Continent as part of the M&R plan; these have been described and analyzed as part of the proposed project in chapters 1 and 3.

All mitigating measures proposed in this chapter must be "real and committed," by definition in Bureau of Land Management (BLM) Manual 1792. "Real" means that the measures must be legally enforceable and actually workable for the area and situation being assessed. "Committed" means that the agency requiring the measures (in this case, BLM) will ensure that they become part of the authorizing document and will take the necessary steps to see that the measures are in fact implemented as part of the proposed project. Thus, if Mid-Continent's M&R plan is approved, all measures proposed in this chapter will be required in addition to the federal, state, and county requirements discussed in chapter 1, Authorizing Actions.

No reasonable mitigating measures for air quality have been identified which would significantly reduce impacts identified in chapter 3. However, Best Available Control Technology (BACT) will be required on all significant fugitive dust sources identified in table MA3-1, chapter 3. Accordingly, additional controls may be required by the U.S. Environmental Protection Agency in its review for prevention of significant deterioration (PSD) or by the Office of Surface Mining in the air quality analysis of its permit review.

Any additional reasonable measures for alleviating impacts of the proposed action which would change the design of the proposal, which could cause major impacts of their own, or which cannot be considered real and committed are analyzed as alternatives in chapter 8.

Coal Canyon Mitigating Measure 1

Power lines and asociated poles will be raptor-proofed in accordance with BLM standards as outlined in BLM Manual 2850 and Instructional Memorandum No. C078-30 (February 10, 1978). Raptor-proofing power poles would prevent electrocution of eagles and other large birds.

Coal Canyon Mitigating Measure 2

Water impoundments within the canyon will be fenced. Fencing water impoundments within the canyon would prevent wild horses from using them and as a result would prevent overutilization of the habitat.

Coal Canyon Mitigating Measure 3

Prior to the approval of the proposed action, a concurrence of approval will be developed between the BLM and Mid-Continent to outline Mid-Continent's responsibility for the protection of cultural resources. Mid-Continent will provide for a Class III cultural inventory should any additional areas be proposed for surface disturbance and will allow for work stoppage and compliance should archeological resources be identified after the proposed action has been initiated.

An archeological survey will be required in areas likely to be impacted by surface subsidence. Due to the unpredictibility of subsidence and the lack of information available concerning the effects of subsidence on archeological sites, an overburden of 300 feet or less will be used as a parameter to define potential impact areas to archeological values. Cracks and breaks in the surface are known to occur rarely with overburdens of more than 300 feet (Morgan 1978, Personal Communication). Mid-Continent will be required to define areas with an overburden of 300 feet or less and will provide for archeological survey of these areas. Archeological sites located by these surveys will be evaluated and mitigated prior to any disturbance and future monitoring of these sites would provide valuable infor-

mation concerning subsidence and its effect on archeological sites.

Identification, evaluation, and preservation of data from archeological sites before potentially damaging actions would mitigate the loss of archeological resources. The results of the Class III survey, as a 100 percent surface inventory of the impact areas, are considered to be representative of the archeological values in that area. The efficiency of the Class III survey as an identification process would depend on topography, vegetation, and past land use on each site. These factors would account for the possibility that hidden and subsurface sites would remain undetected and unaccounted for in developing any further necessary mitigating actions.

Any archeological values which are located and evaluated through this survey could be preserved through one or more of the following mitigating measures, depending upon the significance of a site: (1) avoidance of the site through redesign of the project; (2) descriptive and photographic records, or surface collecting; or (3) excavation according to a specific research design or as a salvage effort.

Collection and excavation are only partial mitigations. While they preserve artifacts which might otherwise be destroyed, the in-place value of those artifacts is lost. Destruction of the site would mean the loss of information which might otherwise be gained by further techniques and interpretive methods.

Should additional archeological sites be identified in the survey effort and determined eligible for the National Register as part of the archeological district or as individual sites, compliance procedures required by Section 106 of the 1966 National Historic Preservation Act, amended 1976, and outlined in 36(CFR): 800.4-9, will be met.

Coal Canyon Mitigating Measure 4

A mixture of adapted shrubs, grasses, and forbs will be used in revegetation of disturbed sites.

Three plant species are listed for revegetaion at the Coal Canyon Mine: Norden crested wheatgrass, Arriba western wheatgrass, and Paloma Indian ricegrass. The use of only grasses for revegetation is not consistent with post-mining land uses. The reestablishment of a mixture of adapted shrubs, grasses, and forbs would best satisfy the post-mining land uses of wild horse and big game habitat, since deer utilize mostly shrubs while wild horses graze most grasses. Both utilize forbs to a certain extent, mainly in the early spring.

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Chapter 5 discusses unavoidable adverse impacts which would be caused by the approval and implementation of Mid-Continent Coal and Coke Company's M&R plan for the proposed Coal Canyon Mine. These impacts include the residual impacts after application of any mitigating measures discussed in chapter 4.

Air Quality

The Coal Canyon Mine would increase annual average particulate concentrations by 3 micrograms per cubic meter ($\mu g/m^3$) in a small area on the mine site near the preparation plant, refuse pile, and haul road. Concentrations are predicted to increase by 1 $\mu g/m^3$ within 0.5 mile east to west and 1.75 miles north to south. Maximum 24-hour concentrations from the mine in 1990 directly east of the preparation plant would be 33 $\mu g/m^3$ directly east of the preparation plant and 24 $\mu g/m^3$ at the south end of the canyon. Visibility in the canyon would be reduced by about 2 miles by 1990; the reduction in visibility would be less in 1985.

Geologic and Geographic Setting

Topography

Minor alteration of the existing surface topography on the mine property would occur due to excavation during construction and use of the refuse disposal area.

A maximum of 7 feet of subsidence is predicted to occur over a large portion of the nearly 200 acres proposed for longwall mining. A maximum of 6.5 feet of subsidence is predicted for parts of the 800 acres proposed for room-and-pillar mining.

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot presently be assessed because of the lack of data and evaluatory criteria.

Mineral Resources

Mining an estimated 8 million tons of coal from the Coal Canyon Mine would deplete deposits of a nonrenewable energy source. Because of underground caving and resultant high contamination after mining is complete. Future recovery of the abandoned 70 percent of the coal reserves under the lease area is not considered feasible with present technology, and therefore these reserves must be considered lost.

In addition, the faulting in the area and the rotation of the fault blocks may have caused fracturing and zones of weakness within the coal seams. This could cause difficulty in mining and roof control, resulting in a high loss of coal reserves.

Water Resources

Ground water obtained from the mine almost certainly would not be adequate to meet the needs of the proposed operation. If the required water supply of about 85 acre-feet per year (ac-ft/yr) is obtained from the Colorado River, assuming that appropriate water rights can be obtained, water now available for other uses would be reduced accordingly. Reduction of flow in the Colorado River by 95 ac-ft/yr could increase the dissolved-solids concentration in the river below Hoover Dam by as much as 0.001 milligrams per liter (mg/l) or about 0.0002 percent.

Consumptive use of river water by the increased population would be about 55 ac-ft/yr by 1985 and 196 ac-ft/yr by 1990. The reduction in flow downstream, coupled with the increased salt load in sewage effluent, could increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.001 mg/l (0.0002 percent) by 1985 and 0.005 mg/l (0.0007 percent) by 1990. Any increase in the salinity of the lower Colorado River is regarded as a serious impact.

Minor local erosion and sedimentation would occur off site because of construction related to population increases. Net sediment yield to the Colorado Rover over the life of the mine, however, should not be significantly different from predisturbance rates.

Soils

Surface disturbance at the mine site on approximately 99 acres by 1985 and on through 1990 would cause an increase in erosion and a deterioration of soil structure and biological activity, lead-

ing to a temporary reduction in soil productivity. Any such reduction would prolong the efforts necessary to achieve successful reclamation.

Urban area expansion would permanently remove 30 acres by 1985 and 106 acres by 1990 from a production function. Although exact locations are not known, some of this acreage would likely come from lands either now classified or eligible for classification as prime or unique farmland.

Vegetation

Vegetation would be lost at the mine site on 99 acres by 1985 and on through 1990. If parts of the disturbed areas are revegetated before abandonment of the mine (on refuse piles, road cutbanks, etc.), the actual acreage lost would be slightly less than these figures. However, successful revegetation of disturbed lands at the Coal Canyon Mine is very uncertain except in years of higher than normal winter or spring precipitation. The refuse area may be particularly difficult to revegetate because of high acidity, deficiencies in nitrogen or phosphorus, excess soluble salts and sodium, and post-mining subsidence and erosion. Natural vegetation would be lost from 30 acres by 1985 and 106 acres by 1990 due to community expansion.

Wildlife

A loss of 99 acres of wildlife habitat by 1985 and on through 1990 would result from construction of surface facilities. On an additional 4,000 acres, use by deer and wild horses would decrease an average of 50 percent. This entire canyon could be lost as a winter area for both deer and wild horses due to the mining activity.

If the Coal Canyon operation uses the GEX Colorado Company loadout facilities on the Colorado River, some waterfowl nestings and brood rearings in the vicinity of the loadout could be disrupted and even eliminated by the human activity close to the river. Activities could impede movement of chukars to watering areas near the Highline Canal.

Increased human population could result in expansion of urban areas onto some crucial winter range. Increased vehicle/animal collisions, additional stress on wildlife, and increased poaching could occur.

Aquatic Biology

Increased consumptive use of 281 acre-feet of water yearly (mine and mine-related population) by 1990 would further deplete the amount of water available for fishery habitat in the Colorado River system. This consumption alone would be insignificant when compared with the Colorado River, but it gains in importance when considered with all the development projects in the region.

Cultural Resources

Archeological Resources

Undiscovered sites could be damaged during surface disturbing activities and by subsidence. Information could be lost as a result of vandalism and illegal collecting and through salvage excavation procedures where any information not recorded would be permanently lost.

Land Use

As long as the area is a wildland study area, uses of the land are governed by the Wilderness Act and by Section 603 of the Federal Land Policy and Management Act of 1976 (FLPMA). The following impacts of the proposed mining and reclamation (M&R) plan could conflict with FLPMA or with the interim management guidelines established by the BLM Grand Junction District to protect the possible wilderness characteristics of this wildland study area (see chapter 1).

1. Rehabilitation of disturbed acreage, particularly the refuse site, may be difficult because of low annual precipitation, steep slopes, highly erosive soils, lack of topsoil, and possible destruction of seedlings by wildlife. Natural revegetation would occur where the soils are stable and do not contain materials toxic to plant growth, but natural succession would take from 30 to 60 years or more.

2. If postmining revegetation is unsuccessful, the proposed road could cause long-term changes in the land character.

3. Post-mining subsidence could cause local changes in topography. Large open fractures and broken surfaces would probably occur, erosion would increase, and subsequent use of the area would be restricted.

4. The proposed project would generate landscape changes which could lower the area's scenic quality below VRM Class II standards, at least for the life of the mine. Whether this visual change would be long term would depend on the success of post-mining rehabilitation.

5. Mining activities could impact the wild horses and their habitat, which are part of the natural environment of the area. Coal Canyon is one of two winter ranges used by the wild horses. A total of 99 acres would be lost due to development of surface facilities, at least for the life of the mine, and perhaps longer if rehabilitation is not successful. The horses could also be cut off from an additional 4,000 acres because

the road, which is their main travel route down into the canyon, would no longer be available and because the surface facilities and human activity would exclude them from some other areas of the canyon.

6. In addition, if mining and other human activity drive the horses out of the canyon altogether, they would be forced into the other wintering area, where they could possibly overuse the forage. Because of legal mandates to maintain a healthy, viable herd, the BLM would then have to reduce the herd artificially to keep it within the carrying capacity of the range.

Transportation

Development of the Coal Canyon Mine would increase traffic by 270 vehicles per day on U.S. 6 and I-70 between the towns in the Grand Valley and the mine site. Greater rail traffic would increase congestion in eastern-slope cities.

Upgrading of the existing road or development of a new road (if required by the Office of Surface Mining) could cause long-term changes in the land character of the canyon, particularly if rehabilitation is not successful.

Recreation

If the community recreation facilities needed to prevent deterioration of existing facilities are not provided, this deterioration would be an unmitigated impact.

If the reclamation of surface facilities and roads within the wildland study area is not successful, this would preclude the area from wilderness status.

Visual Resources

The location of an industrial and mining complex adjacent to a natural landscape would create an unavoidable visual conflict. The presence of the proposed mine would be a definite alteration of the natural landscape character since visually incongruous elements of the proposed action could not be mitigated, and mine facilities would not blend into the surrounding landscape. For the Coal Canyon site, this conflict would eliminate that area's scenic contribution to the Little Bookcliffs Wild Horse Area, which is proposed for wilderness study.

The proposed refuse disposal site would add flat and terraced slopes onto the existing sloping landform. The lack of rainfall in Coal Canyon decreases the chances for successful rehabilitation, and this soil deposition area would remain visible for an extended period of time. Regraded slopes from the reclamation process would also remain visible because of the slow revegetation potential in the canyon.

Employee traffic and supply traffic to the Coal Canyon site would increase the I-70 traffic flow and intersection use. Trucks hauling coal to the Cameo loadout facilities would unavoidably change this area's landscape to an industrial character.

Socioeconomic Conditions

Population influx from the development of the Coal Canyon Mine and its two neighbors, the Cottonwood Creek and Cameo No. 1 and No. 2 mines, would have the greatest effect upon the community of Palisade. The resulting social changes which are anticipated in Palisade such as loss of small town atmosphere, inflation, and conflicts between new and long-time residents, would be unavoidable unless a stance is taken by the community to discourage growth.

New population in Mesa and Garfield counties from the Coal Canyon Mine would be 350 people by 1985 and 1,250 people by 1990. These increases are only a small portion of the total growth expected in the area. The entire Grand Junction area's ability to absorb population growth is expected to be severely strained between 1978 and 1985, with the new population brought in by these three mines compounding the problem.

The revenue generated from Coal Canyon by local property and sales taxes in Garfield County would lag behind the increased expenditures needed for community facilities in the first few years of operation.

In Mesa County about 26 acres of land by 1985 and 89 acres by 1990 would be required for housing the residents resulting from the Coal Canyon Mine. In Garfield County, 4 acres would be required by 1985 and 17 acres by 1990.

CHAPTER 6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 8 million tons of coal would result in short-term and long-term alteration of natural resources and the human environment. There would be the following alterations in the short term, a period beginning with on-site construction and ending with end of mine life (about 2008) and post-mining reclamation:

1. An estimated 8 million tons of coal would be exported to electric-generating plants outside Colorado.

2. Annual average particulate concentrations would increase by 3 micrograms per cubic meter ($\mu g/m^3$) in a small area on site and by 1 $\mu g/m^3$ within 0.5 mile east and west and 1.75 miles north and south by 1990. Maximum 24-hour concentrations directly east of the preparation plant would be 33 $\mu g/m^3$ in 1990.

Predicted maximum particulate concentrations in the DeBeque Canyon area would be 69 $\mu g/m^3$. This maximum concentration would occur in the vicinity of the loadout facility near the Colorado River and would be aggravated by the coal-hauling activities of the Coal Canyon Mine. Estimated source contributions of approximately 3 of the 69 $\mu g/m^3$ would be caused by the Coal Canyon Mine, 40 are due to background, 2 are due to existing sources, 4 would be caused by the Cameo No. 1 and No. 2 mines, and 20 would be caused by the Cottonwood Creek mines. The maximum concentration of 69 $\mu g/m^3$ is below the primary standard of 75 $\mu g/m^3$, but 9 $\mu g/m^3$ above the secondary standard of 60 $\mu g/m^3$. The area exceeding the secondary standard would be less than 1 square mile, centered around the combined loadout facility.

3. Impacts to the water resources occurring during the life of the Coal Canyon Mine would be minimal both on site and off site. The increased population as a result of the proposed mine would consume no potable water by 1980, about 55 acre-feet per year (ac-ft/yr) by 1985, and 196 ac-ft/yr by 1990. The effect could be to increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.001 milligrams per liter (mg/l) (0.0002 percent) by 1985, and 0.005 mg/l (0.0007 percent) by 1990.

4. Minor local erosion and sedimentation would occur off site because of construction related to population increases, but net sediment yield to the Colorado River over the life of the mine from on-site and off-site disturbances should not be significantly different from premining rates.

5. There would be loss of soil productivity on 99 acres through 2008 due to increased erosion, deterioration of soil structure, and reduced biological activity, and there would be loss of vegetation on those 99 acres through 2008 due to loss of soil productivity.

6. Upgrading the existing road (as proposed by Mid-Continent) or constructing a new road (as may be required by 30[CFR]: 717.17[d]) could require extensive development work because of the steep terrain in the canyon.

7. Wildlife habitat on 99 acres, which could have supported one deer annually, would be completely lost through 2008.

8. Wild horse range would be completely lost on 99 acres through 2008. The horses could also be cut off from an additional 4,000 acres because the road, which is their main travel route down into the canyon, would no longer be available and because the surface facilities and human activity would exclude them from some other portions of the canyon.

Mining and other human activity could cause the horses to stop using this area altogether. In that case, they would be forced into their only other wintering area where they could overuse the forage. The BLM would then have to reduce the herd artificially to keep it within the carrying capacity of the range.

9. Increased traffic on I-70 would increase congestion and the number of accidents.

10. The location of an industrial and mining complex adjacent to a natural landscape would create an unavoidable visual conflict. The presence of the proposed mine would be a definite alteration of the natural landscape character

since visually incongruous elements of the proposed action could not be mitigated, and mine facilities would not blend into the surrounding landscape. These landscape changes could lower the area's scenic quality below VRM Class II standards, at least for the life of the mine.

11. Total direct, indirect, and induced income generated by this project would be $5,046,400 by 1990.

12. With the simultaneous development of several mines in the Cameo area, there would be an increase in vehicular and coal train traffic. However, the traffic increase on I-70 caused by other activities would make the contribution of the Cameo area activities insignificant. The increase in traffic predicted by 1990 should increase equivalent noise levels along the highway by as much as 5 decibels. Before and after shift changes there may be elevated noise levels within communities where workers live.

13. A number of the short-term impacts to the Coal Canyon area listed above may conflict with the interim management guidelines established by the BLM Grand Junction District Office to protect the possible wilderness characteristics of this area as long as it is a wildland study area.

Residual effects of mining (after post-mining reclamation) productivity would be as follows:

1. An undetermined number of uninventoried exposed and unexposed fossil resources would be impaired or destroyed.

2. An unquantifiable gain in knowledge would result from surveys and exposure of fossil resources which might never have been found without development.

3. An estimated 8 million tons of coal, a nonrenewable energy resource, would be depleted after 2008.

4. On completion of mining and reclamation, ground-water and surface-water occurrence in the mined and adjacent areas should return to approximately pre-mining conditions over a period of several years with no significant long-term impacts on the environment except the continuing use of water by the increased population, which can be expected to remain in the area beyond the projected life of the mine. The effect of that continued use of water on the salinity of the lower Colorado River would also be long term.

5. Soil and natural vegetative productivity would be permanently lost on 106 acres due to urban expansion.

6. Surface construction, subsidence, and vandalism would disturb or destroy an unquantifiable number of nonrenewable cultural resources.

7. Archeological surveys and excavation could provide gains in understanding of prehistoric use in the area.

8. If additional recreational facilities are provided to meet the increased demand, they would remain for long-term use; conversely, if additional facilities are not provided, the deterioration of present facilities would be a long-term adverse impact.

9. Rehabilitation of disturbed acreage, particularly the refuse pile, may be difficult because of low annual precipitation, steep slopes, highly-erosive soils, lack of topsoil, and possible destruction of seedlings by wildlife. Natural revegetation would occur where the soils are stable and do not contain materials toxic to plant growth, but natural succession would take from 30 to 60 years or more.

If successful revegetation is difficult to achieve, the proposed road, refuse pile, etc., could remain as visible alterations in the landscape until natural revegetation occurs, which could lower the area's scenic quality below VRM Class II standards over the long term. In addition, post-mining wildlife and wild horse use of the area could be postponed for an extended period of time. All of these impacts could conflict with the area's potential wilderness characteristics.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Approximately 8 million tons of coal would be recovered from the Coal Canyon Mine. This would be approximately 30 percent of the coal reserves. Because of underground caving and resultant high contamination after mining is complete, future recovery of the abandoned reserves may be difficult or impossible. In addition, the faulting in the area and the rotation of the fault blocks may have caused fracturing and zones of weakness within the coal seams. This could cause difficulty in mining and roof control, resulting in a high loss of coal reserves.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing machinery and buildings would not be recycled and thus would be lost.

An undetermined number of uninventoried fossils would be lost or disturbed.

Anything other than in-place preservation of archeological resources would be an irreversible, irretrievable commitment of the resource. Damage from surface disturbance or vandalism would result in permanent loss of information and would remove those archeological values from future research consideration

Soil and vegetative production would be irretrievably lost on 99 acres for the life of the mine. This loss may be difficult to reverse because of the uncertainty of successful revegetation at the mine site, although natural revegetation would eventually occur.

Wildlife habitat on 99 acres, which could have supported one deer per year, would be irretrievably lost for the life of the mine. Wild horse range would also be lost on these 99 acres and may be lost on an additional 4,000 acres during mine life. If the wild horses are driven from this canyon altogether, the herd may have to be artifically reduced to prevent overgrazing of the horses' only other winter range. These losses may be difficult to reverse because of the uncertainty of successful revegetation at the mine site, although natural revegetation would eventually occur.

Particulate air quality at the proposed mine site and for a very limited area surrounding the mine would be subject to a slight increase in concentrations. Air quality would be temporarily degraded during the mine life, but the change would not be irreversible. With termination of mining activity, air quality would return to the pre-mining level of about 40 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean from the levels during mining of 40 to 43 $\mu g/m^3$.

Reduction in visibility would occur in proportion to the increased particulate concentrations. Average visibility is presently about 54 miles. Given the limited increase in predicted concentrations resulting from mining activity, visibility would not be greatly affected (52 miles) and the limited loss would be reversible. However, secondary development related to the proposed action would result in some permanent degradation of visibility in the Grand Valley area.

Approximately 55 to 196 acre-feet of water would be diverted annually from the Colorado River system and consumed by the increased population. An additional estimated 85 acre-feet of water annually must be obtained from deep aquifers or from the Colorado River for mine use. Water rights must be obtained to enable any use of this additional water in the mining operation. Use of water in the mining operation would end on completion of mining. Use of water by the increased population, however, would probably continue beyond the projected life of the mine.

An irretrievable commitment of capital and land (at least 106 acres) would be required to support population growth.

If mining causes long-term or irreversible changes in Coal Canyon, these changes may degrade the area's potential wilderness characteristics.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

Pursuant to implied covenants of both the federal mineral leasing laws and the existing lease agreements, the Department of the Interior is obligated to respond to a legitimate application to conduct mining operations on a valid lease, provided that all terms and conditions thereunder have been met. The Department's action with regard to Mid-Continent Coal and Coke's mining and reclamation (M&R plan) for the proposed Coal Canyon Mine may be approval as proposed, rejection on various environmental or other grounds, approval or rejection in part, or approval subject to such additional requirements or modifications as the Department may impose under existing laws and regulations. The Department may also defer decision pending submittal of additional data, completion of required studies, or for other specific reasons. If there are serious environmental concerns as to the coal development, the Department may prevent further development of the leases by exercising the Secretary's exchange authority as to the federal coal rights, or seeking congressional action to cancel federal leases involved.

Development of alternative sources of energy, energy conservation, federal development of the coal, and emphasis on coal development in other regions of the United States are more appropriate for consideration on a program rather than a regional basis. These evaluations were made in the previous coal programmatic statement (U.S. Department of the Interior 1975) and will be updated and revised as necessary in the new coal programmatic statement now under way (to be completed in 1979).

Mid-Continent's M&R plan for the Coal Canyon Mine has not been reviewed for compliance with the interim regulations 30(CFR): 700 required under Sections 502 and 503 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (PL 95-87), and it does not fully reflect the requirements of the interim regulations. The M&R plan will be returned to the applicant for revision in accordance with the appropriate federal regulations. When it is resubmitted to the Office of Surface Mining (OSM), it will be evaluated for compliance with all appropriate federal regulations by OSM in conjunction with the U.S. Geological Survey (USGS). In addition, the Bureau of Land Management (BLM) must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA.

APPROVAL AS PROPOSED

The Department has the choice of approving the M&R plan as proposed. However, as pointed out above, Mid-Continent's M&R plan has not been reviewed for compliance with the interim regulations. Therefore, it cannot be considered for approval until it has been revised to comply with all appropriate federal regulations.

REJECTION ON ENVIRONMENTAL OR OTHER GROUNDS

The Department may reject any M&R plan that does not meet the prescriptions of applicable law and regulations under the Department's authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly differently designed course of action by the lessee (operator). In addition, BLM must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA. Except when an M&R plan does not comply with existing regulations, the Department cannot under present circumstances reject the proposed plans to the extent that a de facto cancellation of a lease results unless the Secretary seeks and obtains additional authority from Congress.

Rejection of Mid-Continent's proposed M&R plan would result in no additional environmental impacts from coal mining on the federal leased lands. Since these lands are public lands, surface use would be governed by BLM policy and management guidelines and decisions. Mid-Continent could submit a new M&R plan, challenge the rejection, or abandon development of the lease. Should Mid-Continent submit a new M&R plan, it would require both environmental assessment and review for compliance with applicable regulations.

Mining at the proposed Coal Canyon Mine is intended to supply 7.36 million tons of coal to utility plants outside Colorado. Without the Coal Canyon Mine other coal would have to be ac-

quired to supply these markets. Such a substitution could create a shortage for other coal markets.

The natural vegetation on the coal lease tract would remain undisturbed. The vegetative condition, which at present is unsatisfactory with a downward trend, may improve in the future. The coal lease tract is part of the 26,268-acre Little Bookcliffs Wild Horse Area. The wild horse herd was reduced to 70 head in the fall of 1977 in order to alleviate the severe overgrazing of the range. The long-term effects of this herd decrease will be an increase in the desireable forage plants on the lease tract (western wheatgrass, Indian ricegrass, and galleta grass).

The Little Bookcliffs Wild Horse Area may in the future be designated as a Wilderness Area and/or a National Wild Horse Range. Management of the area would then be subject to the Wilderness Act and/or other guidelines established to protect the wild horses and their habitat.

Continuing human population growth in Mesa County would still cause impacts to wildlife in the county: expansion of urban areas onto agricultural lands and some winter range; increased recreational use of wildlife species, primarily hunting; and increased poaching of big game species.

Natural weathering and vandalism would continue to be the major causes of loss of archeological and historical values, but there should be no additional contributing factors to such loss at the site if the M&R plan is rejected. Paleontological resources would be impacted both adversely and beneficially in approximate proportion to the level of regional development and the area disturbed.

The population of Mesa County would still increase at a rapid rate to 91,750 people by 1980 and 106,000 people by 1985, and then decrease to 94,800 people by 1990. Development of oil shale and uranium and the area's role as a regional center would account for the growth. Garfield County is also projected to grow at a rapid rate to 33,100 people in 1980; 38,650 people in 1985; and 45,100 people in 1990, also primarily as a result of oil shale development.

Mesa and Garfield counties, towns, special districts, and the school district would not receive increases in revenue from the Coal Canyon Mine. On the other hand expenditures to provide facilities and services to accommodate population increases associated with the mine would not have to be made.

APPROVAL OR REJECTION IN PART

The Department has the choice of approving or rejecting part of a particular M&R plan, based on projected adverse environmental impacts.

Restrict Development on Existing Leases

The subject leases convey the right to develop, produce, and market the federal coal resource thereon if all other terms and conditions have been met by the lessee. In general, the Department does not possess the authority to arbitrarily constrict development if all other requirements of the lease have been met. However, various measures that may tend to restrict development may be taken by the Department at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations (for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, etc.). Similarly, the Department could permit only selective exploration and development of existing leaseholds if analysis indicates wholly unacceptable environmental impacts that could not be reduced to an acceptable level.

Adoption of this alternative would reduce adverse impacts by reducing the area in which the impacting activities could take place. At the same time, application of this alternative would not permit maximum recovery of the coal resources and would thus be contrary to principles of conservation embodied in the legislation which authorizes the leasing of these lands for the purposes described. It is entirely possible that such selective mining would leave isolated blocks of coal that might never be recovered owing to the high costs of mining such remnant areas at a later date.

Phased Development

Phased development of coal mines as a means of lessening socioeconomic impacts of coal development in the ES area is discussed as the Diligent Development and Continuous Operations alternative under Approval or Rejection in Part of chapter 8 in volume 1. The restrictions discussed under that alternative could be applied to the Coal Canyon operation alone. However, to do so would probably not significantly reduce socioeconomic impacts in Mesa County, since other coal mines in the area could continue to develop at a rapid rate, and most of the adverse socioeconomic impacts in Mesa County would result from multiple development of mineral resources over a short period of time (see the impact analysis in volume 1, chapter 4, Socioeconomic Conditions). To be effective, phased development would have to be applied uniformly to coal projects throughout the ES area.

APPROVAL SUBJECT TO ADDITIONAL REQUIREMENTS OR MODIFICATIONS

Subject to existing laws and regulations, the Department has the choice of approving an M&R plan with additional stipulations or changes to lessen adverse environmental impacts. For example, operational, transportation, or other alternatives could be adopted when such alternatives would reduce adverse impacts.

Operational Alternatives

The refuse disposal site in Section 31, T. 10S., R. 98W., 6th P.M., would be undermined by longwall mining methods. Overburden in the area is shallow, and the maximum subsidence (7 feet) would occur over most of the 47 acres occupied by the site. If only vertical subsidence occurred, impacts to the site could be limited to disrupting established drainage. However, twisting and rotation of surface blocks during settling could result in erosion hazards. Fires could begin if air is able to circulate through the refuse because of fracturing and collapse of the underlying surface. Fires in refuse disposal areas are difficult to suppress and may continue smoldering for long periods. Air quality in the area may be severely affected.

If an alternative site for the refuse pile could be developed, where it would not be as vulnerable to subsidence, then the above impacts could be reduced or eliminated. The site would be less subject to erosion, which would improve the chances for successful revegetation. The site would also be less subject to fire hazard. However, it is possible that the rough terrain in Coal Canyon could preclude a satisfactory alternative location for the site.

No other reasonable operational alternatives have been identified which would significantly reduce adverse impacts of coal mining or increase resource recovery. Surface mining is not feasible due to the geology and geographic characteristics of the area. Federal regulations (30[CFR]: 211) require M&R plans be designed to ensure maximum economic recovery of the coal resource.

Transportation Alternatives

Coal Transport

Mid-Continent proposes to transport coal by truck from both the Coal Canyon and Cottonwood Creek mines to GEX Colorado Company's loadout facility on the Colorado River. However, as pointed out in the Cottonwood Creek site specific, no binding agreement has been reached between Mid-Continent and GEX Colorado for the use of the latter's loadout facility. In October 1978, Mid-Continent submitted a transportation alternative for Cottonwood Creek which does not involve GEX Colorado. As described in chapter 8 of the Cottonwood site specific (see Transportation Alternatives under Approval Subject to Additional Requirements or Modifications), Mid-Continent proposes to construct a rail loadout facility on the southwest side of the Colorado River (see map MB8-1 in the Cottonwood chapter 8).

If this alternative were implemented by Mid-Continent, then presumably coal from the Coal Canyon Mine would also be transported to the proposed loadout facility rather than to GEX Colorado's loadout. Transportation of the raw coal would have to involve either a trucking operation or a conveyor system.

Trucking the coal could interfere with GEX Colorado's operation at the Cameo mines. It would also require construction of a suitable overpass to cross the Denver and Rio Grande Western main line in DeBeque Canyon and improvement of the present bridge over the Colorado River. The operation would add considerable traffic to I-70, increasing the possibility of accidents and possibly causing deterioration of the highway. (See also the first two alternatives under Protection of Wild Horses and Wildlife below.)

A conveyor system over Mt. Garfield or Mt. Lincoln would be the other possible means of transporting the coal, but the steep south-facing slopes might make this alternative impractical. A modified chute system might be developed, but the gradient would be too steep to adequately control the coal reaching the bottom. A tramway was tried at the Gearhart Mine but proved uneconomical.

Although either of these alternatives would reduce activity at the Cameo loadout, they would not reduce activity in the general vicinity of peregrine falcon nesting sites. Therefore, essential peregrine falcon habitat could still be adversely affected.

No other reasonable methods of transporting coal have been identified. See volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Coal Transportation Alternatives, for a general discussion of truck transport and slurry pipelines.

Busing of Mine Employees

Busing of employees to the mine site could reduce the traffic impacts discussed in chapter 3. This measure has been proposed as a regional alternative in volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Busing of Coal Mine Employees.

Protection of Wild Horses and Wildlife

A total of 99 acres would be lost as wild horse winter range due to development of surface facilities, at least for the life of the mine, and perhaps longer if rehabilitation is not successful. The horses could also be cut off from an additional 4,000 acres because the road, which is their main travel route down into the canyon, would no longer be available and because the surface facilities and human activity would exclude them from some other areas of the canyon. Mine traffic on the road would also increase the likelihood of horse/vehicle collisions.

The access road and surface facilities could be fenced with materials designed to minimize injury to the horses. Such fencing might allow the horses to move around the mine to the range located south of the fenced area. A 50-foot right-of-way (13 acres disturbed) would be needed to provide adequate passing and pullouts for vehicles.

Even with the fencing, the horses might not use the southern part of the canyon. The area out of the canyon bottom (where the existing road is located) is very rocky and steep and might be impassable to the horses. The activity at the mine might also discourage the horses from traveling in the mine's vicinity. Although wild horses might tolerate human activity on unconfined range, little is known about how they would react to extensive human presence in a narrow, rocky area such as Coal Canyon.

Fencing would eliminate horse/vehicle collisions but would provide little or no deterrence to harassment of horses. Also, mule deer/vehicle collisions could still occur, since the fencing would not be the type to prevent mule deer entry to the right-of-way.

Reduction of Wildlife Road Kills

Road kills due to vehicle/animal collisions currently exceed the legal harvest of deer in the state of Colorado. If the number of road kills involving Mid-Continent's coal trucks increases significantly along the haul road, measures to protect the animals may have to be considered. Mid-Continent could be required to haul coal only during daylight hours.

Concentrating coal haulage into daylight hours (somewhat longer in the summertime) would decrease wild horse as well as mule deer road kills. It would also increase daytime traffic congestion near the Cameo mines and along I-70 if Mid-Continent develops its own loadout facility on the Colorado River (see Transportation Alternatives above). If Mid-Continent uses GEX Colorado Company's loadout facility as proposed in the M&R plan, adoption of this alternative could increase congestion at the loadout during the hauling shift and perhaps decrease loadout efficiency.

Other alternatives which could be considered include highway lighting, fencing, and other measures currently under study by the Colorado Division of Wildlife.

Protection of Peregrine Falcons

Human activity in the area of Mid-Continent's Coal Canyon Mine and GEX Colorado Company's Cameo mines could seriously disturb nesting peregrine falcons in the vicinity of these operations. Several actions are available which could minimize this disturbance. Public travel in Coal Canyon could be discouraged during the peregrine falcon nesting season. All vehicles could be restricted to existing roads. Motorcycles, trail bikes, dune buggies, and other all-terrain vehicles could be prohibited from entering the canyon during the nesting season. Construction of permanent buildings could be kept to a minimum. Power line construction could follow the guidelines established in BLM Manual 2850 (this measure is provided for in chapter 4). The Rural Electrification Administration standards for prevention of raptor electrocution, as addressed in the 1975 publication *Suggested Practices for Raptor Protection on Power Lines,* also could be consulted. Power lines could be 300 yards from roads except for a minimum number of access points. If peregrine falcons do not return to one of the known eyries, efforts should be made to survey the canyon cliffs for alternate nest occupancy.

Protection of Endangered Fish Species

As discussed in Water Resources, chapter 3, Mid-Continent is unlikely to be able to obtain the required amount of water for its proposed Coal Canyon operation from the shallow ground-water resource in or adjacent to their lease area. An alternative source of water must be developed, either by drilling a deep well to tap aquifers underlying the Mancos Shale at a depth of more than 4,000 feet or by utilizing surface runoff. A deep well of the required capacity should not impact the regional or local ground-water systems over the life of the mine, but some question exists as to whether the dissolved-solids concentration of the water thus obtained would be too high for the intended use. Should water rights be obtained and water for the mining operation be diverted from the Colorado River, an additional very small increase in the salinity of the lower Colorado River would occur. That increase could be as much as 0.001 milligrams per liter (0.0002 percent).

The U.S. Fish and Wildlife Service (USFWS) has expressed concern (see comment letter 11 in chapter 9, volume 3) about cumulative impacts to the Colorado River system if supplemental water

must be obtained from the river by several mining companies. A stipulation could be added to Mid-Continent's M&R plan that, if the company seeks water rights to divert water from the Colorado River for the Coal Canyon operation, formal consultation with the USFWS should be reinitiated to determine the impacts of the action.

Other Alternatives

The land use and socioeconomic analyses in chapter 3 identified adverse impacts to Mesa County due to development of the Coal Canyon Mine. In addition to the Diligent Development and Continuous Operations alternative which addresses such impacts on a regional basis (see Restrict Development on Existing Leases earlier in this chapter and in chapter 8, volume 1), the regional volume also discusses actions which may be available to state, county, and community governments which might lessen or control socioeconomic and land use impacts. See Socioeconomic Alternatives Available to State and Local Governments, chapter 8, volume 1.

DEFER ACTION

For proper cause, the Department may defer final action on a proposed M&R plan. Reasons for deferring action can include, but are not limited to, the need and time required for:

1. Modification of a proposal to correct administrative or technologic deficiencies;
2. Redesign to reduce or avoid environmental impact;
3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation;
4. Further evaluation of a proposal and/or alternatives.

The principal effect of deferring action on a proposed M&R plan on these grounds would be a comparatively short-term delay in the occurrence of all related impacts of a proposal (both adverse and beneficial). To the extent that an M&R plan can be redesigned to alleviate adverse impacts, those impacts would be lessened.

As pointed out at the beginning of this chapter, Mid-Continent's M&R plan for the Coal Canyon Mine has not been reviewed for compliance with the interim regulations, and the Department will not consider the plan for approval until it is brought into compliance with all applicable federal requirements.

Wildland Study Area

As long as the Little Bookcliffs Wild Horse Area (including Coal Canyon) is a wildland study area, uses of the land are governed by the Wilderness Act and by Section 603 of the Federal Land Policy and Management Act of 1976 (FLPMA). Mining of an existing lease is not necessarily excluded, but any lease that is not presently being worked or that is not logically a continuation of an ongoing operation is subject to regulation to prevent impairment of the area's suitability for preservation as a wilderness and according to FLPMA (Section 603[c]), "to prevent unnecessary or undue degradation of the lands and their resources or to afford environmental protection."

The suitability study to determine the wildland values of the Little Bookcliffs Wild Horse Area is scheduled to be completed by 1982. Final determination of whether the area should be designated a wilderness area should be based on the information and recommendations contained in the study. Sometime after 1982, the results of this study and recommendations based on it would be sent to the President; based on the President's decisions, recommendations would then be sent to Congress. An area can be designated as a wilderness area only by an Act of Congress (Wilderness Act [PL. 88-577]).

Final action on Mid-Continent's M&R plan for the Coal Canyon Mine could be deferred until a decision has been made on the wilderness status of the Little Bookcliffs Wild Horse Area. Should this alternative be adopted, possible development of the coal resources, changes in land use or character, and associated impacts to the area's resources would be deferred for four or more years.

If the area is designated as a wilderness area, uses of the land would also be governed by the Wilderness Act. Mining of an existing lease might be allowed, but it would be subject to appropriate conditions and terms set by the Secretary of the Interior to carry out his overall duty to manage public resources in the public interest as well as his specific duties under such statutes as FLPMA. Any existing lease would have to be examined to determine the nature of the rights conveyed by the United States to the lessee, to what extent those rights would be impaired by stipulations designed to protect the area's wilderness character, whether development of the lease would be allowed, and (if development is not allowed) what actions are available or necessary to prevent development or (if development is allowed) how that development would be regulated.

If Coal Canyon is not designated as part of a wilderness area and mining is allowed as proposed in Mid-Continent's M&R plan, the net result would be a deferral of all impacts discussed in chapter 3. (See also the next alternative, National Wild Horse Range, and the alternative of Lease Exchange under Prevention of Further Devlopment at the end of this chapter.)

National Wild Horse Range

The Little Bookcliffs Wild Horse Area has also been proposed for designation as a National Wild Horse Range. Final action on Mid-Continent's M&R plan for the Coal Canyon Mine could be deferred until a decision has been made on this proposal. Should this alternative be adopted, possible development of the coal resources, changes in land use or charcter, and associated impacts to the area's resources would be deferred for four or more years.

If the Little Bookcliffs Wild Horse Area is not classified as wilderness, but is classified as National Wild Horse Range, final guidelines for management of the area would be developed. Mining (including construction of surface facilities) might not be excluded, but no irreversible changes in the character of the land would be allowed, and disturbed areas would have to be returned to their pre-mining condition (the latter is also required by 30[CFR]: 717 and 30[CFR]: 211 regulations). Mid-Continent's M&R plan would have to be evaluated in relationship to these final guidelines.

If Coal Canyon is not designated as part of a National Wild Horse Range and mining is allowed as proposed in Mid-Continent's M&R plan, the net result would be a deferral of all impacts discussed in chapter 3. (See also the alternative of Lease Exchange under Prevention of Further Development, below.)

Peregrine Falcon Habitat

The proposed Coal Canyon Mine would result in increased activity in the general vicinity of peregrine falcon nesting sites. When combined with ongoing activities at GEX Colorado Company's Cameo mines and proposed use of GEX Colorado's loadout facility by Mid-Continent (for both the Coal Canyon and Cottonwood Creek mines), such activity could adversely affect essential peregrine falcon habitat.

Approval of Mid-Continent's M&R plan for the proposed Coal Canyon Mine could be deferred until the Cameo mines have ceased operation. If the GEX Colorado M&R plan for the Cameo mines is approved, this would be after the year 2025. If GEX Colorado's M&R plan is not approved and implemented, mining of private coal at the Cameo No. 1 Mine would continue through 1982 and use of the loadout facility through 1985 (when the company's Roadside Mine is predicted to exhust its coal reserves).

Adoption of this alternative would in effect mean either that Mid-Continent would have to buy GEX Colorado's loadout facility once that company has finished with it or that Mid-Continent would have to develop a loadout facility of its own at such time as the M&R plan was reconsidered for approval. (See, for example, the Transportation Alternatives earlier in this chapter and in chapter 8 of the Cottonwood Creek site specific.) In addition, coal mining in Coal Canyon would be deferred for at least 7 years and possibly 45 to 50 years. All related impacts of mining as described in chapter 3 would be deferred a comparable period of time. This also means that coal mining would be ongoing in the area for a much longer period of time than if the mines are operating concurrently. Coal from the mine is intended to supply electric-generating plants outside Colorado; other coal would have to be acquired by these plants. (See also the alternative of Lease Exchange under Prevention of Further Development, below.)

Control of Runoff and Salinity

Approval of the M&R plan could be deferred until it has been evaluated with regard to best management practices for nonpoint sources of water pollution and the guidelines of the Colorado River Salinity Forum. As far as can be determined at the present time, however, mining at the Coal Canyon operation would produce few adverse impacts to water quality (see Water Resources, chapter 3).

PREVENTION OF FURTHER DEVELOPMENT

No Action Alternative

"No action" on a mining proposal for the initial development of existing leases would equate to maintaining the status quo on those leases. Under existing regulations, operations may not proceed in the absence of approved M&R plans and related permits. The alternative of rejecting the M&R plans is discussed earlier in this chapter.

Relinquishment of Leases

BLM is reviewing nonproducing existing leases. Nonproducing leases are to be reviewed in accordance with planning standards and in compliance with the proposed unsuitability criteria developed pursuant to the requirements of section 522(b) of SMCRA.

Lease Exchange

The following impacts of Mid-Continent's M&R plan could conflict with FLPMA, with the interim management guidelines established by the BLM Grand Junction District to protect the possible wilderness characteristics of this wildland study area (see chapter 1, Interrelationships), with the Wilderness Act, or with guidelines to protect wild horses.

1. Rehabilitation of disturbed acreage (as required by Section 515 of SMCRA, and 30[CFR]: 717.20 and 30[CFR]: 211) may be difficult because of low annual precipitation, steep slopes, highly erosive soils, lack of topsoil, and possible destruction of seedlings by wildlife. The refuse pile may be particularly difficult to revegetate because of such factors as high acidity, deficiencies in nitrogen or phosphorous, and excess soluble salts and sodium; in addition, the refuse pile would be in an area highly subject to post-mining subsidence and erosion. Natural revegetation would occur where the soils are stable and do not contain materials toxic to plant growth, but natural succession would take from 30 to 60 years or more.

2. Mid-Continent proposes to upgrade the existing road along the Coal Creek bottom. Regulations 30(CFR): 717.17(d) probably would require instead the construction of a new roadway away from the Coal Creek channel. Such a road could require extensive development work because of the rocky, steep, gullied topography in the canyon. Furthermore, if revegetation is unsuccessful, the road could cause long-term changes in the character of the land.

3. Post-mining subsidence could cause local changes in topography. Large open fractures and broken surfaces would probably occur, erosion would increase, and subsequent use of the area would be severely restricted.

4. The proposed project would generate landscape changes which could lower the area's scenic quality below VRM Class II standards, at least for the life of the mine. Whether this visual change would be long term would depend on the success of post-mining rehabilitation.

5. Mining activities could impact the wild horses and their habitat, which are part of the natural environment of the area. Coal Canyon is one of two winter ranges used by the wild horses. A total of 99 acres would be lost due to development of surface facilities, at least for the life of the mine, and perhaps longer if rehabilitation is not successful. The horses could also be cut off from an additional 4,000 acres because the road, which is their main travel route down into the canyon, would no longer be available and because the surface facilities and human activity would exclude them from some other areas of the canyon.

In addition, if water is impounded in the canyon, and is available to the horses, they could stay in the canyon for a longer period of time and use winter forage in the summer. (This impact could be mitigated by Coal Canyon Mitigating Measure 2; see chapter 4.) Forage would be reduced, thus eventually decreasing the number of horses that the area could support. Alternatively, the presence of people and their activity could harass the horses so much that they would not use this wintering area at all. In that case, they would be forced into the other wintering area, where they could possibly overuse the forage. Because of legal mandates to maintain a healthy, viable herd (see chapter 1, Interrelationships), the BLM would then have to reduce the herd artificially to keep it within the carrying capacity of the range.

In addition to the above impacts on the lease area, the proposed Coal Canyon Mine would result in increased activity in the general vicinity of peregrine falcon nesting sites. When combined with onging activities at GEX Colorado Company's Cameo mines and proposed use of GEX Colorado's loadout facility by Mid-Continent (for both the Coal Canyon and Cottonwood Creek mines), such activity could adversely affect essential peregrine falcon habitat.

Furthermore, the faulting in the area and the rotation of the fault blocks has most likely caused fracturing and zones of weakness within the coal seam. This could cause difficulty in mining and roof control, resulting in a high loss of coal reserves.

Under Congressional Bill S3189 (October 13, 1978), the Secretary may exchange leased lands that are determined and/or proven to be unmineable for an equivalent area of unleased land. In addition, the Federal Land Policy and Management Act of 1976 (PL 94-579), Section 206, gives the Secretary general authority to dispose of public lands by exchange, subject to applicable laws, when the Secretary "determines that the public interest will be well served by making that exchange: *Provided,* That when considering public interest the Secretary concerned shall give full consideration to better Federal land management and the needs of State and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife and the Secretary concerned finds that the values and the objectives which Federal lands or interests to be conveyed may serve if retained in Federal ownership are not more than the values of the non-Federal lands or interests and the public objectives they could serve if aquired."

If the above impacts are considered sufficient to prevent mining of the leased coal, the possibility of exchange could be assessed. Should this alternative be adopted, the lease area would continue in its present condition, but subject to further modification by natural processes and such land uses as may be imposed by the managing agency. Impacts of this alternative would be the same as the impacts of Rejection on Environmental or Other Grounds discussed earlier in this chapter.

CHAPTER 9

Consultation and Coordination

See volume 3, chapter 9, for a discussion of consultation and coordination carried out for the West-Central ES.

MID-CONTINENT COAL AND COKE:

COTTONWOOD CREEK
NO. 1 AND NO. 2 MINES

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

Proposed Action

The proposed action is the review and consideration for approval of a mining and reclamation (M&R) plan submitted September 1, 1977, to the Office of the Area Mining Supervisor, U.S. Geological Survey (USGS), Denver, Colorado, by Mid-Continent Coal and Coke Company. The M&R plan for the Cottonwood Creek No. 1 and No. 2 mines has been accepted by the USGS as suitable for use in preparing this environmental statement (ES) and is available for public review at the Area Mining Supervisor's office in Denver. This M&R plan was submitted for review prior to promulgation of the interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87) and has not been officially reviewed for compliance with that act. Therefore, the applicant's plan may not fully reflect the requirements of the interim regulations. However, in this statement the interim regulations are considered federal requirements with which the M&R plan will have to comply, just as it must comply with all other applicable regulations.

The M&R plan will be returned to the operator for revision in accordance with applicable regulations. As soon as the applicant's plan is revised and returned to the Office of Surface Mining (OSM), it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations in 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

The plan describes the proposed Cottonwood Creek No. 1 and No. 2 mines to be located on the southeast side of the Colorado River at the mouth of DeBeque Canyon, approximately 14 miles northeast of Grand Junction (see figure MB1-1). The Cottonwood Creek Mine property consists of federal coal leases C-020740, C-024998, and C-029889, totaling 5,113 acres, as well as three adjacent private coal leases: the Lekas tracts, the Blue Flame tract, and the Midwest Red Arrow tract, totaling 454 acres (see map MB1-1). Although the company does not control any of the three federal leases, it is negotiating with the lessees to reach an agreement whereby it could develop the leases.

The Cottonwood Creek No. 1 and No. 2 mines would be new underground bituminous coal mines with an anticipated combined annual production of 1 million tons, with potential reserves (62 million tons estimated) for a mine life exceeding 25 years. At full production, the mines would employ 400 persons. The coal to be produced would be steam coal and most likely would be shipped by rail to electric-generating companies.

The federal lease conditions are subject to all current mining reclamation and related land use requirements and all laws and regulations affecting federal coal leases.

History and Background

This M&R plan was submitted by Mid-Continent in August of 1977 to meet the deadlines for the West-Central Colorado Coal Environmental Statement. At that time, Mid-Continent was negotiating with a number of parties to combine their various interests to form a single new mining operation to be called the Cottonwood Creek Mines. Under this plan the coal properties of Pitkin Iron Corporation, James Brothers Coal Company, Mid-Continent Limestone, Alvin Aul, and Kermit and Richard James would be combined into one mine property. The initial two to three years of mining and coal processing would be done by GEX Colorado Company through the existing facilities of the Roadside Mine. As production from the property increases separate facilities for the Cottonwood Creek mines would be constructed as shown on map MB1-2. All coal produced at the Cottonwood Creek mines would be transported to market via the rail loadout facilities of GEX Colorado Company.

The M&R plan described above dealt only briefly with the possibility that the parties involved would fail to reach a satisfactory agreement. In October of 1978, Mid-Continent submitted more detailed information on how the development of the Cottonwood Creek mines would occur if the Roadside Mine and GEX Colorado Company were not involved. That information is contained in transportation alternative 1 in chapter 8.

There are three small abandoned mines on the Cottonwood Creek properties, all primarily on private land: the Midwest (and its extension, the Midwest-Red Arrow), the Blue Flame, and the Winger.

Figure MB1-1. Looking northeast up DeBeque Canyon from just south of Palisade, Colorado. The Little Bookcliffs escarpment and the abandoned Mt. Lincoln Mine are in the foreground. Point A indicates the location of the Cottonwood Creek surface facilities. Point B indicates GEX Colorado Company's Roadside Mine. The existing portals of the Cameo No. 1 Mine lie just off the upper left-hand corner of the photo.

FEDERAL LEASE
PRIVATE LEASE

(A) PRIVATE SURFACE, FEDERAL MINERAL
(B) PRIVATE SURFACE, PRIVATE MINERAL
(C) PUBLIC LAND SURFACE, FEDERAL MINERAL

Map MB1-1. Mid-Continent Coal and Coke's Cottonwood Creek lease area

The Midwest Mine produced 158,456 tons of coal from the Palisade seam from 1908 to 1944. About 5.5 feet of an 8-foot-thick seam were mined at the Blue Flame from 1933 to 1968, producing 97,984 tons of coal. The mine is located on 80 acres of private land currently owned by James Brothers Coal Company. The Winger Mine, also known as the New Grand Mesa (1911-12) and the Go-Boy (1961-68), operated from 1911 to 1968. From 4 to 9 feet of a 9- to 12-foot-thick seam were mined, producing 148,402 tons of coal. The mine is located on a 120-acre private tract owned by Pitkin Iron Corporation, adjacent to and south of the Blue Flame tract.

Predisturbance Inventories and Analyses

An archeological inventory of drill sites CC-76-1 through CC-76-77 was conducted by the Historical Museum and Institute of Western Colorado, Grand Junction, Colorado. The soils of the mine area are identified in the Mesa County Soil Survey (in press). The Bureau of Land Management (BLM) has completed an endangered and threatened plant literature search and an herbarium survey. Also, BLM has conducted an extensive floristic and endangered and threatened plant field inventory of the proposed mine site. The Colorado Division of Wildlife has completed an inventory and study of the area for rare and endangered animals and birds.

Mid-Continent's Proposed M&R Plan

Development of the Cottonwood Creek property is planned in three phases. During the first phase, entries which have been driven south from the Roadside Mine would be extended south and east in the Cameo seam; rock tunnels would be driven up into the Carbonera seam, where initial mining would start; and entries in the Carbonera would be driven to the outcrop to establish portals. During this phase mining would be done by GEX Colorado Company and coal would be processed through their facilities at the Roadside Mine. Construction of surface facilities necessary for the second phase would be under way. This initial phase could last for as long as two to three years.

During the second phase mining in the Carbonera seam would be more intensive and production would increase. Ventilation and access via the 1 West and 2 West Carbonera entries would be established. Coal would be processed through the Roadside Mine.

The third phase would begin on completion of the preparation plant. At that point the mining operation of the Cottonwood Creek Mine would be completely independent of the Roadside Mine. Clean coal would be transported by truck to a unit train loadout facility of GEX Colorado Company.

During the first year, the production level would be at 100,000 to 200,000 tons of coal. Production would increase stepwise until the design production rate of 1 million tons of coal annually is reached in the fifth project year. The work force at that time would be approximately 400 people. A mine life exceeding 25 years is projected. (Table MB1-1 summarizes the employment and production schedule.)

MINE LAYOUT

The Cottonwood Creek No. 1 Mine would lie in the Carbonera coal seam and the No. 2 Mine would lie in the Cameo seam. The Carbonera seam overlies the Cameo seam by 38 to 93 feet in the Cottonwood Creek area. The Carbonera seam averages 8 feet in thickness but is commonly split into as many as ten partings and may be too thin to mine in the northern portion of the mine property. The Cameo seam averages 6.5 feet in thickness over the property.

For their initial access to the property, Mid-Continent would use Roadside Mine ventilation shafts and entries which would be established on the Cottonwood Creek property (see map MB1-2).

Development would next proceed south to a point near the south end of the Winger Mine (map MB1-2). From this point, short entries would be driven east; then rock tunnels would be driven north, upslope to establish the No. 1 Mine in the Carbonera seam; then the Carbonera 2 West entry would be driven to the outcrop. Ventilation and access would be established at the 2 West Carbonera entry, and later at the 1 West Carbonera entry after it is completed.

As initial development of the 1 North entry continues south, additional development would be started to the east in the Cameo seam along the North Bleeder, 6 East, and 5 East entries.

Development work would be done with continuous miner units, each consisting of a continuous miner, two shuttle cars, a feeder-breaker, a section power center, and a roof-bolting machine. Early development would use the extensible belts and shuttle cars for section haulage through the Roadside Mine.

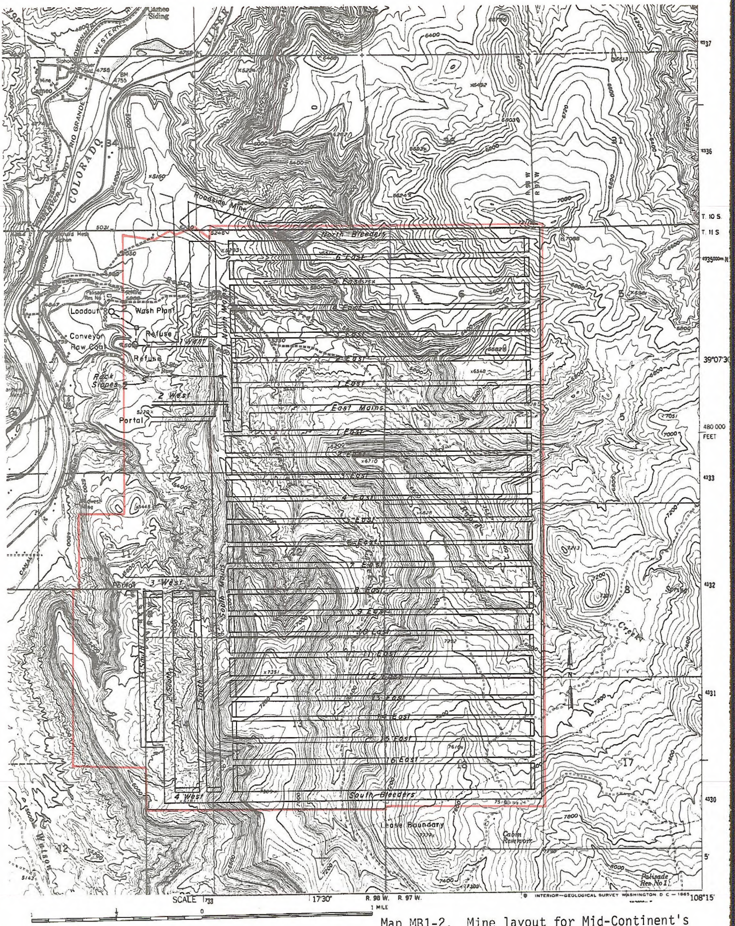
After development work, longwall methods on a fully retreating system would be in general use. In areas west of the north-south mains, it is expected that coal between the outcrops and the mains would be removed by room-and-pillar methods by retreat mining. Coal from this development would be processed through the Roadside Mine facilities.

Support pillar-and-entry widths would be designed for optimum roof support and maximum coal recovery, depending on ground conditions as mining progresses. At present, the Roadside Mine

TABLE MB1-1

COTTONWOOD CREEK:
EMPLOYMENT AND PRODUCTION SCHEDULE

Year	Employment	Production
1982	50	0
1983	95	100,000
1984	220	200,000
1985	400	400,000
1986	400	550,000
1987	400	700,000
1988	400	1,000,000
1989	400	1,000,000
1990	400	1,000,000



Map MB1-2. Mine layout for Mid-Continent's proposed Cottonwood No. 1 and No. 2 Mines

is developing entries in the Cameo seam with 100-by-100-foot support pillars.

Roof support plans would be developed and submitted to the Mine Safety and Health Administration (MSHA) for approval. Exact details would depend largely on early mining experience. Drill-hole data indicate that control conditions may be highly variable; there may be roof control and even bottom-heaving problems. Conditions would be evaluated as mining progresses, and normal safety and support procedures would be followed as specified in 30(CFR): 75.

Ventilation System

The mines would be ventilated by axial exhaust fans at the portals. Experience in the Cameo seam at the Roadside Mine indicates that methane probably would not be present; therefore, very large quantities of air normally required in a gaseous mine would not be necessary. Exact ventilation designs would depend on the actual location of mining sections and mining sequences. Ventilation plans would be approved by MSHA.

Haulage System

Coal would be hauled from the producing sections to the portals by belt conveyors. Transportation in the mine would be by MSHA-approved electric and/or diesel-powered equipment. The main supply systems probably would be by electric locomotive and mine track.

SURFACE FACILITIES

During the initial development phases, the surface facilities of the Roadside Mine would be used to process the coal from the Cottonwood Creek Mines. After the 2 West Carbonera entry is developed to the outcrop, surface facilities to support a large underground mine operation would be constructed to conform with all applicable regulations. The facilities would cover approximately 16 acres. The area shown in map MB1-2 would be used as a service area for the mine and mine site. Facilities incidental to normal underground mining activity would be constructed. The facilities may include, but would not necessarily be limited to the following:

Offices
Shops
Parking lots
Bathhouse-locker
Lunchroom
Water storage
Portals
Hoist or trolley house
Fans
Waste water disposal
Laboratory

Warehouse

Construction would probably begin with portal work and ventilating fans after the 2 West Carbonera entry is broken out. Most facilities would be completed at about the same time as the preparation plant. The portal facilities would cover approximately 7 acres.

Preparation Plant

Mid-Continent proposes to construct a preparation plant covering approximately 2.5 acres in the general area shown on map MB1-2. The plant would be large enough to handle in excess of 1 million tons of coal per year. The plant would have standard sizing and washing equipment with a closed water loop and all normal and necessary safety and pollution control facilities. In addition, a dryer may be constructed. Two products would be discharged from the plant: (1) clean coal, which would be hauled by truck to the GEX Colorado rail loadout facility north of Public Service Company of Colorado's Cameo Plant, and (2) refuse, which would go to a disposal site.

Loadout Facilities

A clean-coal storage facility of less than 1 acre would be constructed. The proposed facility would include a clean-coal bin, a clean-coal surgepile, feeders, and a scale. There would also be a truck turnaround and parking area. The facility would be designed to meet all applicable zoning, safety, and environmental requirements. The clean coal would be transported by trucks to the GEX Colorado unit-train loadout facility.

Refuse Disposal

Combustible materials (primarily paper, wood, and garbage) from the service area and from the mine would either be disposed of on site or transported to applicable disposal facilities. If disposal is on site, all pertinent regulations would be followed.

Shale, bone coal, parting material, and similar refuse would be removed from mine-run coal at the preparation plant. This refuse would probably amount to over 300,000 tons per year at planned mine capacity. It first would be used for fill material to aid in development of the mine site and then would be disposed of in the approximately 35-acre area shown on map MB1-2.

Water System

Mid-Continent proposes a system that would use up to 46 acre-feet of nonpotable water per year. The preparation plant would use 10 to 15 million gallons of water per year. The system would be supplied by water from the mine, supplemented if necessary from local water utilities. If the mine has more water than can be used in the preparation

plant, water storage/evaporation ponds covering approximately 2 acres would be constructed so that there would be no discharge of mine water. Berms and dikes would be constructed, and surface facilities and the refuse-disposal area would be designed so that any contaminated surface runoff from precipitation could be contained. This water would go to storage/evaporation ponds and could be used in the above water system. Drainage facilities and settling ponds would be maintained at all times so that no water from the mine site would be discharged. Settling ponds would be made impervious by the use of bentonite, clay, or other additives.

Mid-Continent expects to purchase 6.1 acre-feet of domestic water from either the Palisade Reservoir No. 1 or the proposed Ute District pumping plant. Domestic water would be piped to the site.

Power Facilities

Power for the mine would be supplied by the Cameo Plant of Public Service Company of Colorado. During initial development, most of the underground power requirements would be supplied from facilities of the Roadside Mine. Mid-Continent would build a main substation in the vicinity of the 2 West Carbonera entry and use a 7,200-volt line from the Public Service Company of Colorado. Secondary power lines would be run from the main substation to the various facilities required on the property; existing secondary power lines and poles used for the Winger Mine (Go-Boy) would be used where possible.

Access Roads

Existing roads, used in the past for mine access and coal haulage, are presently used for access to private residences, orchards, and two water storage and treatment facilities. For proper access to the mine property, it would be necessary to construct 1,000 to 2,000 feet of new paved road. Mid-Continent would work with Mesa County officials on the location, funding, and type of access road needed, as well as on any improvements needed for the road from the Interstate 70 service road to the access road. Total road relocation and upgrading would disturb approximately 10 acres.

The road on company property would follow an existing dirt road used for access to the Go-Boy Mine. This road would require some relocation and would be improved (including paving) for safety, drainage, etc. Abandoned sections of the road would be reclaimed.

The clean-coal haul road would follow an existing road used to haul coal from the Winger Mine. This road also would be improved. Improvements off company property would be coordinated with Mesa County officials for alignment, funding, etc.

Several dirt roads and jeep trails provide access over the property. Company personnel would seldom use these roads, and no improvements are anticipated.

SURFACE RECLAMATION

When the mineable coal reserves are exhausted and the facilities are no longer needed, the lands would be prepared for permanent abandonment. All mine portals would be sealed with reinforced concrete and back-filled to the surface. Surface structures, including concrete foundations, would be removed entirely. The areas would be graded, covered with soil, and seeded. Refuse and spoil disposal areas would be covered with topsoil and seeded. The disturbed areas would be restored to the original use.

Authorizing Actions

This M&R plan was submitted for review prior to promulgation of the interim regulations, 30(CFR): 700, required under Section 502 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87). Therefore, this plan does not fully reflect the requirements of the interim regulations. However, in this statement the applicable interim regulations are being included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of the regulations. Before the plan will be considered for approval by the Secretary of the Interior, it will be returned to the mining company for redesign to incorporate the applicable federal regulations.

As soon as the applicant's plan is revised and returned to OSM, it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations at 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

The regulations contained in 30(CFR): 717 deal specifically with the performance standards required for approval of underground mining such as that proposed in this plan. In addition, refuse disposal of mine waste materials is governed by the regulation 30(CFR): 715.15.

The standards and measures described in those regulations are considered as required measures and the impacts from the proposed action have been analyzed on that basis.

Federal Agencies

ASSISTANT SECRETARY OF ENERGY AND MINERALS

The Assistant Secretary must approve the mining permit application, including the proposed M&R plan, and significant modifications or amendments

to it before the mining company can commence mining operations.

OFFICE OF SURFACE MINING (OSM)

OSM, with concurrence of the surface managing agency (BLM or USFS) and USGS, recommends approval or disapproval of M&R plans to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a State-Federal Cooperative Agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and the Department of the Interior authorized to take final actions on the permit.

U.S. GEOLOGICAL SURVEY (USGS)

The USGS is responsible for development, production, and coal resources recovery requirements included in the mining permit.

BUREAU OF LAND MANAGEMENT (BLM)

The BLM develops the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected public lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on public lands.

U.S. FOREST SERVICE (USFS)

The USFS developes requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected forest lands. The USFS is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on forest lands.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

The USFWS is responsible for protection of migratory birds, including eagles, and threatened or endangered species and their habitats. Coordination is required with the USFWS under provisions of the Fish and Wildlife Coordination Act, the Bald Eagle Act, and the Endangered Species Act.

State Agencies

STATE OF COLORADO

Air quality, solid-waste disposal, and water quality must comply with rules and regulations administered by the various divisions within the Department of Health. Approval of the M&R plan and permits and licenses to mine coal must be obtained from the state of Colorado. Mid-Continent would also have to obtain rights to use any mine water in their operations from the State Engineer.

County Agencies

Mid-Continent would have to obtain a special-use permit from Mesa County and comply with stipulations required by the county.

Interrelationships

Relationship to Other Existing and Proposed Developments

The Roadside Mine and Cameo No. 1 mines, operated by GEX Colorado Company, are the only active mines in the area of the proposed Mid-Continent Cottonwood Creek Mines. (See map 1, volume 3 map packet.) They lie approximately 1.5 to 2 miles north of the proposed Cottonwood Creek mines. Annual production from the Roadside in 1977 was 300,200 tons of coal from both private and federal leases. Production from the Cameo No. 2 Mine is scheduled to begin from private coal reserves by late 1978. The coal from both mines is to be conveyed to unit train loadout facilities constructed in 1978.

Mid-Continent has proposed that initial development of the Cottonwood Creek No. 1 and No. 2 mines would be done by GEX Colorado from the existing Roadside Mine. This initial development would utilize three ventilation shafts and entries that were developed by GEX Colorado through federal lease C-020740. In addition, coal preparation and haulage would use surface facilities of the Roadside Mine until the third project year.

The Cameo steam electric plant of the Public Service Company of Colorado is approximately 1 mile north of the proposed Cottonwood Creek Mine portals.

The Denver & Rio Grande Western Railroad (D&RGW) main line, which parallels Interstate 70 and the north bank of the Colorado River, is approximately 3 miles by road east of the Mid-Continent operation. In 1978 GEX Colorado Company constructed a railroad loadout facility on the north side of the Colorado River which Mid-Continent proposes to use to transport the coal to its market. The loadout facility is a short spur off the main line of D&RGW in DeBeque Canyon. (Figure MB1-2 is a photograph of the proposed loadout facility.)

Housing and service facilities exist in the area. The Cottonwood Creek mines would be approximately 2 miles northeast of Palisade, which is approximately 12 miles east of Grand Junction. Expe-

rienced labor is in short supply in the area because agriculture is the mainstay of the area.

Institutional Relationships

OFFICE OF SURFACE MINING

OSM, in consultation with Surface Managing Agency (BLM and USFS), USGS, or (where applicable) the state regulatory authority, recommends approval or denial of surface coal mining permit applications to the Assistant Secretary of Energy and Minerals. OSM (as lead agency) is the federal regulatory authority responsible for reviewing coal M&R plans (permit application), enforcement of all environmental protection and reclamation standards included in an approved mining permit, the monitoring of both on- and off-site effects of the mining operation, and abandonment operations within the area of operation of a federal lease.

OSM is the principal contact for all coal mining activities within the area of operation. OSM will conduct as many inspections as are deemed necessary but no less than one partial inspection quarterly and at least one complete inspection every six months (30[CFR]: 721.14[c]).

OSM, after consultation with BLM, USGS, and the operator establishes the boundaries of the permit area for the proposed mine and approves the locations of all the mine facilities located within this boundary.

Section 523 of SMCRA requires the Federal Lands Program to adopt those state performance standards which the Secretary determines are more stringent than the federal standards. The Federal Lands Program means a program established by the Secretary pursuant to Section 523, SMCRA, to regulate surface coal mining and reclamation operations on federal lands. Therefore, the performance standards enforced by OSM on a federal leasehold should be at least as stringent as those required under state law or regulations.

The Department of the Interior is negotiating a cooperative agreement pursuant to Section 523(c) of SMCRA with the state of Colorado and other states. Whenever this agreement is consummated with the state, the OSM's functions and responsibilities specified in this agreement will be delegated to the state regulatory authority. Under this agreement, OSM and the state regulatory authority will jointly review and act on mining permit applications and recommend approval or disapproval to the officials authorized to take final action on the application. The Secretary is prohibited by law from delegating his authority to approve mining plans on federal lands.

U.S. GEOLOGICAL SURVEY

The USGS is responsible for reviewing M&R plans for development, production, and coal resource recovery requirements on a federal leasehold. USGS is responsible for the maximum economic recovery of the federal coal resource and for the federal government receiving fair market value for the coal resource.

BUREAU OF LAND MANAGEMENT

The BLM formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of public lands.

The BLM, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, and railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The BLM is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on public lands within a leasehold.

U.S. FOREST SERVICE

The USFS formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of national forest systems land.

The USFS, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by

43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The USFS is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on forest lands within a leasehold.

Relationship to BLM Land Use Plans

The 5,113 acres of public lands included in this M&R plan are administered by the BLM's Grand Junction District. They are subject to the following management guidelines developed in the Whitewater Management Framework Plan (MFP), completed in April 1977, and the Whitewater Coal Update MFP, completed in September 1977:

1. Wildlife

a. Reestablish peregrine falcon breeding populations in the Colorado River Canyon.

b. Protect raptor nest sites by limiting human activity within 0.5 mile from March 1 to July 1, prohibiting physical disturbance on rock cliffs, and maintaining a 100-foot buffer area around nest trees.

c. Maintain groves of cottonwood trees along the Gunnison, Colorado, and Dolores rivers and Plateau Creek.

d. Maintain cover in pinyon-juniper and mountain shrub types at minimum intervals of 400 yards.

e. Maintain at least 50 percent of the vegetative composition as shrubs in sagebrush and mountain shrub types.

f. When ecologically feasible, include browse and forbs in the seed mixture for all seedings and rehabilitation plantings.

g. Maintain pinyon-juniper and oak brush on elk winter range with openings not more than 400 yards wide.

h. Maintain a mixture of 40 percent shrubs, 40 percent grass, and 20 percent forbs on elk winter range.

2. Recreation

a. Adopt visual quality objective classes to be used as a tool when developing intensive resource management plans and other authorizing actions involving public lands management.

b. Identify and protect cultural resources to avoid loss or destruction of any sites; conduct a Class II Cultural Resources Inventory of all unsurveyed public lands to be impacted by coal development.

c. Develop limited access to public lands east of Palisade up to the confluence of Cottonwood and Rapid creeks and from Mesa, Colorado.

3. Watershed and Water Quality

a. Require coal-lease holders to install and maintain a water monitoring network within their lease area; an adequate water-monitoring network should be addressed prior to approval of any mining or exploration plan as appropriate.

b. Be very selective about authorizing any surface-disturbing activities on the Palisade watershed area. All surface-disturbing action within the Palisade watershed should provide for the mitigation of impacts to the watershed area or to its distribution or storage facilities through the environmental assessment process. Certain actions that cannot be sufficiently mitigated should not be allowed in the area.

Relationship to State and Local Planning

For a discussion of state of Colorado and Mesa and Garfield county land-use planning, see regional chapter 3, Land Use Plans, Controls, and Constraints.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

The description of the existing environment covers the physical, biological, and cultural resources and the socioeconomic conditions which constitute the site-specific environment in which Mid-Continent Coal and Coke Company proposes to develop federal coal. The description focuses on environmental details most likely to be affected by Mid-Continent's proposed action and alternatives. The concluding section of this chapter describes the anticipated future environment through 1990 if the proposed mining and reclamation (M&R) plan is not approved and implemented.

EXISTING ENVIRONMENT

Climate

The climate of west-central Colorado is characterized by dry air masses, which are modified Pacific air masses that move eastward across the Rocky Mountains. Winter snows and summer showers or thunderstorms result in unusually even distribution of precipitation throughout the year. Prevailing winds vary greatly throughout the Upper Colorado River Basin, and are markedly affected by differences in elevation and by the orientation of mountain ranges and valleys with respect to general air movements.

Five years of upper air observations at Grand Junction show that surface-based inversions occur on 84 percent of the mornings. During the afternoons they are not as common, occurring 11 percent of the time in winter but less than 3 percent of the time in other seasons. The area is subject to a relatively high frequency of stagnation situations, mostly in winter.

The proposed Cottonwood Creek Mine site is located east of the Colorado River at the mouth of DeBeque Canyon. No meteorological measurements are made on-site. Elevation at the site ranges from 500 to 3,000 feet higher than nearby Palisade where National Weather Service records indicate an average annual precipitation of 9.1 inches. Vegetation on the proposed mine site indicates an annual precipitation of about 10 inches at the proposed surface facilities site in the western part of the lease area and about 15 inches on the high ridges in the southeastern part of the lease area. The seasonal pattern of precipitation should be similar to the approximately uniform monthly distribution recorded at the Palisade station. Evaporation is estimated to be about 45 inches annually.

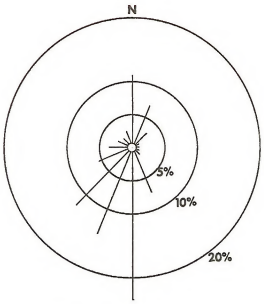
Wind data were collected in the Mt. Logan-Mt. Callahan reach of DeBeque Canyon northeast of the proposed site. The data showed high wind speeds (greater than 12 miles per hour 41 percent of the time) with apparent strong channeling up and down valley. However, the difference in elevation at this monitoring site and the Cottonwood Creek site--8,800 feet versus 5,200 feet--makes it uncertain whether meteorological conditions at the higher elevation are necessarily representative of conditions near the mouth of the canyon. For this reason, the Grand Junction wind rose was used and adjusted to reflect the northeast wind direction of DeBeque Canyon. Prevailing wind direction is down valley or from the northeast with an average speed of 8 miles per hour (figure MB2-1).

Air Quality

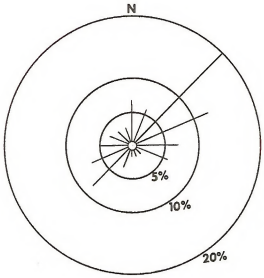
Particulate air quality in the study area ranges from 20 to 132 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean as recorded at sixteen state, municipal, and privately operated particulate sampling sites. In undeveloped sections, particulate concentrations vary from 20 to 40 $\mu g/m^3$.

The available particulate sampling data which best represent existing particulate air quality at the proposed Cottonwood Creek site are from a state-operated sampler located about 1 mile north of the proposed mine site. The annual geometric mean concentration recorded at the sampling site was 42 $\mu g/m^3$ with first and second maximum 24-hour concentrations of 158 and 132 $\mu g/m^3$, respectively. These concentrations presumably include the impact of an existing mine (Roadside) and a power plant in the same vicinity. Although particulate concentrations on the lease area are lower than applicable air quality standards, the site is partially within the designated boundaries of the Grand Junction nonattainment area.

There has been no measurement of carbon monoxide, hydrocarbon, nitrogen oxides, sulfur dioxide, or other gaseous pollutant concentrations in the vicinity of the proposed mine site. The Cameo



Upper DeBeque Canyon



Lower DeBeque Canyon

Figure MB2-1. Annual wind frequency in upper DeBeque Canyon and near the proposed Cottonwood Creek site

power plant is likely to affect concentrations at the mine site, however, the degree of impact is unknown.

Visibility at the site ranges from less than 1 mile to approximately 100 miles throughout the year. Average visibility is about 54 miles with greatest visibility occurring during spring and summer months.

Geologic and Geographic Setting

Topography

The proposed site of the Cottonwood Creek No. 1 and No. 2 mines lies immediately east of the Colorado River. The lease area occupies the eastern rim of DeBeque Canyon and the northern slopes of Grand Mesa. (See map MB1-1). The Little Bookcliffs escarpment lies just north of the Colorado River.

The lease area consists of northwest- and north-trending ridges separated by deeply-cut intermittent stream drainages. These small streams drain to the northwest directly into the Colorado River. North of the leases, the Colorado is narrowly confined to a small steep-sided valley (DeBeque Canyon) by resistant sandstone beds. However, to the west of the leases where the Colorado has eroded through the sandstones and onto soft shales, the valley rapidly broadens. The broader valley, the Grand Valley, is over 30 miles wide near Grand Junction, Colorado.

Elevations on the lease area vary from about 4,820 feet in the gulch just south of the Midwest-Red Arrow Mine to 7,675 feet at the south end of the property near Cabin Reservoir. Slopes on the lease area range from 7 percent along terraces adjacent to the Colorado River to 75 percent near the southern boundary. In some small areas on the leases, resistant sandstone benches have formed vertical cliffs.

Cottonwood and Rapid creeks drain the lease area. The gradient of Cottonwood Creek is 9.5 percent for the 3.45 miles of the stream within the property boundary. Rapid Creek averages 9.2 percent for the 3.5 miles of stream within the property boundary.

Landforms

The lower areas of the lease area are dominated by a large bench formed by the erosion of the Cameo-Carbonera coal interval directly over the Rollins Sandstone, which forms major cliffs.

Structure

Structurally the Cottonwood area is quite simple. A general dip of 2 degrees to 3 degrees north-northeast was determined, although dips as high as 5 degrees occur in the northwest corner of the lease area. In addition, a small, very slight anticlinal flexure exists in the center of the lease area. There is no known faulting.

Stratigraphy

Outcrops of rock strata on the lease area are restricted to for mations of Upper Cretaceous, Tertiary, and Quaternary ages. In ascending order, the formations present are the Mesaverde Group of Upper Cretaceous age; the Ohio Creek and Wasatch formations of Tertiary age; and Quaternary colluvial deposits. These formations will be described in ascending order (that is, from oldest to youngest).

The Mesaverde Group of Upper Cretaceous age consists of the Mt. Garfield Formation and the overlying Hunter Canyon Formation. The only coal on the Cottonwood Creek property occurs in the Mt. Garfield Formation, which contains three coal seams of economic significance: the Palisade, the Cameo, and the Carbonera seams (see figure MB2-2).

Mid-Continent reports that, according to drill data, the Palisade seam is 3 to 4 feet thick near the old Midwest Mine, but thins rapidly to the west, south, and east. The average thickness over the entire lease area is 2.58 feet.

The Cameo coal seam overlies the Palisade by 400 to 450 feet and (according to company estimates) covers approximately 4,040 acres of the property. The Cameo is the most productive seam of the Little Bookcliffs coal field. It is characterized by a relatively large quantity of high ash bone coal, occasional carbonaceous shale beds, and sandstone dikes. The Cameo ranges from 5.66 to 9.51 feet and averages 6.46 feet. The company reports the Cameo is thickest in the northern and western parts of the lease area and thins to the southeast.

The Carbonera seam overlies the Cameo seam at distances of 38 to 93 feet on the Cottonwood property, covering approximately 4,850 acres according to company estimates. It is a series of detached seams rather than a single bed. The company reports that the Carbonera appears to thicken and become considerably cleaner toward the southern end of the property. The Carbonera ranges from 6.79 to 13.31 feet, averaging 9 feet.

The remaining 200 to 400 feet of the Mt. Garfield Formation consists of interbedded to laminated carbonaceous, silty, fine- to very fine- grained sandstones, and carbonaceous sandy siltstones.

Paleontology

The principal fossil-bearing formations in the lease area, ages, number of known fossil localities, and general fossil types normally found in the formations are summarized in table MB2-1. Due to the present lack of data and accepted criteria for deter-

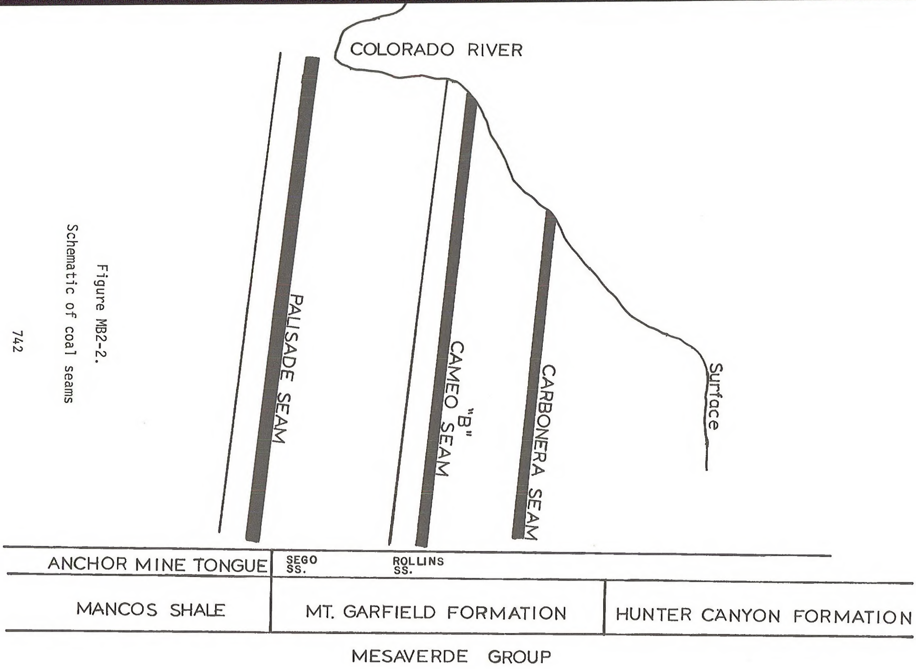


Figure MB2-2.
Schematic of coal seams

TABLE MB2-1

SUMMARY OF FOSSIL-BEARING FORMATIONS IN THE AREA
OF THE PROPOSED COTTONWOOD CREEK MINE

Formation	Period	Known Fossil Localities a/	Type of Fossils b/
Mancos shale	Upper Cretaceous	General	I, V,
Mt. Garfield	Upper Cretaceous	General	I, V, P
Hunter Canyon	Upper Cretaceous	General	I, V, P

a/ General = formation contains fossils throughout; specific localities are not identified.

b/ I = invertebrate; V = vertebrate; P = paleobotanical

mining significance, the importance of these paleontological resources to science, education, etc., cannot presently be assessed.

Mineral Resources

Coal

Mid-Continent estimates 13 million tons of coal for the Palisade seam on the property; however, this coal would be uneconomical to recover under present mining tecniques. The Cameo seam contains an estimated 57 million tons of which 28.5 million tons would be recoverable under present mining techniques. At present, the Carbonera seam is estimated by the company to contain 68 million tons of coal, of which 34 million tons would be recoverable under present mining techniques. Because of the many splits within the Carbonera, correlation is difficult and the reserves may be much smaller.

Both the Cameo and Carbonera seams outcrop along the western side of the Cottonwood property. There is a maximum overburden of about 1,700 feet over the Cameo, averaging about 850 feet, and 1,635 feet over the Carbonera.

Table MB2-2 lists the in-place and recoverable reserves estimated by the USGS and coal quality by seam on federal leases C-020740, C-024889, and C-024998 and private coal leases.

Oil and Gas

A potential for oil and gas exists under the coal reserve block of Cottonwood Creek. A well is soon to be spudded-in approximately 1.5 miles southwest of the southwestern property boundaries.

Water Resources

Hydrologic Setting

The proposed mine area lies on the moderately dissected northwest slopes of Grand Mesa overlooking the Colorado River, which flows generally southward through DeBeque Canyon, entering the broad expanse of Grand Valley about a mile west of the tract. The river then turns abruptly westward across the broad Mancos shale outcrop into which Grand Valley is cut. Beds underlying the lease area strike west-northwest and dip 2 to 3 degrees north-northeast upvalley, crossing the Colorado River north of the tract. Thus, the coal sequence to be mined and the encompassing beds are exposed near the west margin of the lease area in the precipitous east slopes of DeBeque Canyon. The Cameo B and Carbonera coal seams dip below river level about a mile northwest of the tract. The proposed mining operations, therefore, would not extend below river level. Surface-water and ground-water drainage on and adjacent to the lease area is generally northwestward to the Colorado River, which locally represents the base level below which all permeable rocks are saturated.

No precipitation data are available for the lease area, which ranges from 500 to 3,000 feet higher than nearby Palisade where records collected by the National Weather Service show an average annual precipitation of 9.1 inches. Vegetation on the lease area indicates an annual precipitation of about 10 inches at the proposed facilities complex in the western part of the lease area and about 15 inches on the high ridges in the southeastern part of the lease area. The seasonal pattern of precipitation of approximately uniform monthly distribution should be similar to that at the Palisade station.

Ground Water

The occurrence of ground water in the proposed mine area is controlled largely by the local combination of topography, stratigraphy, and geologic structure. Ground-water recharge on the lease area initially accumulates in those permeable materials that underlie the surface, primarily along the flat-topped ridges bordering Cottonwood and Rapid creeks. Movement is downward to the first relatively impermeable bed, which acts as a perching layer. This perched water then migrates downdip northeastward and laterally towards discharge areas along the nearby valley side slopes where seepage is dissipated by evapotranspiration. A comparatively small amount of ground water percolates downward through the perching layers, probably through small joints and fractures, to recharge underlying beds such as the Carbonera and Cameo B coal seams which Mid-Continent proposes to mine. These deeper aquifers also tend to drain downdip and discharge to the Colorado River at their lowest point of outcrop.

Mid-Continent has identified no springs or wells on the lease area, and no springs or wells are shown on the U.S. Geological Survey 7.5 minute quadrangles covering the area. A small amount of water was reported in most coal-test holes penetrating the Rollins Sandstone, but significant inflow occurred into only one hole, which was drilled near the outcrop in the west-central part of the tract where a moderately permeable sandstone would be expected to be drained. Occasional channel sands above the Carbonera seam also yielded water briefly to test holes, but no significant or extended flows were found. Apparently, no coal-test holes were completed as monitoring wells, and no water samples were collected for water-quality analyses.

Mid-Continent also reports that the Go-Boy Mine in the Cameo B seam is flooded in the lower or northern part of the old workings. Downdip about 0.5 mile farther north, the Blue Flame Mine,

TABLE M82-2

RESERVES AND COAL QUALITY OF THE COTTONWOOD PROPERTY

Seam	Acres Covered in M & RP	Average Thickness (feet)	In-Place Reserves (million tons)	Recoverable Reserves (million tons)	BTUs	S (percent)	Ash (percent)	Moisture (percent)	Fixed Carbon (percent)	Volatile Matter (percent)
Palisade	3,000	2.5	13.0	Uneconomical	11,161	1.07	15.11	7.58	48.08	36.80
Cameo	4,040	7.65	57.37	28.69	10,426	0.87	15.6	7.2	43.8	35.85
Carbonera	4,850	8.2	65.85	32.93	10,675	0.85	20.1	7.8	38.6	36.05

also in the Cameo B seam, is reported to be flooded below an altitude of about 4,975 feet, while the southern or highest part of the mine is dry. Still farther downdip on the Cameo B seam, about a mile north of the Blue Flame Mine, the currently active Roadside Mine intercepts an undetermined, comparatively small amount of water, all of which is used in the mining operation. This apparent anomaly, whereby inactive mines updip from the ongoing Roadside Mine are partially flooded while the latter intercepts comparatively little water, is attributed to low permeability of the Cameo B seam. Field observations indicate that the primary source of water in the two inactive mines appears to be from surface runoff into the open portals. Similarly, it is doubtful that the Rollins Sandstone is moderately permeable in this general area; if it were, it would be drained to approximately the level of the Colorado River. The coal-test hole described above, that seemingly obtained an appreciable yield from the Rollins Sandstone, probably intercepted a local, open fracture system of limited areal extent that functions as a small reservoir and does not readily drain to the nearby outcrop where the full thickness of the sandstone is exposed in the side of DeBeque Canyon.

The absence of springs in the lease area, coupled with the minimal opportunity for appreciable ground-water recharge to depth and the inferred low permeability of the Carbonera and Cameo B coal seams and the underlying Rollins Sandstone, strongly suggest that these beds are marginal aquifers at best and would yield comparatively little water to the proposed mines.

Any water obtained from the coal beds and from the underlying Rollins Sandstone would very probably be a sodium bicarbonate type with a dissolved solids concentration of about 1,500 milligrams per liter (mg/l).

Surface Water

The lease area is drained largely by Rapid and Cottonwood creeks, which head on the northwestern slopes of Grand Mesa and flow generally northwestward to their juncture near the northwestern corner of the lease area. From this confluence, Rapid Creek flows westward about 1.2 miles to the Colorado River. Both streams are intermittent during most years, but they do flow continuously during wet years. No data are available on the quantity or quality of runoff in these streams. Annual runoff from the lease area probably averages 0.5 to 1.0 inch (27 to 53 acre-feet per square mile).

Runoff records for the Colorado River are collected by the U.S. Geological Survey at a gaging station (No. 09095500) located about 7 miles upstream or northeast of Cameo, Colorado. These records show that the river has an average annual discharge of 3,850 cubic feet per second (cfs) or 2,789,000 acre-feet per year (ac-ft/yr). Maximum discharge of 36,000 cfs occurred on June 16, 1935; minimum daily discharge of 700 cfs occurred on December 29, 1939. Flows in excess of 11,000 cfs commonly occur during May and June in response to melting snowpacks. During spring runoff, the water is a calcium, sodium, bicarbonate, sulfate type with a dissolved-solids concentration of about 200 to 250 mg/l. During low flow, the water is a sodium chloride type with a dissolved-solids concentration of 600 to 650 mg/l.

The city of Palisade obtains its water supply from springs in the headwater areas of Rapid and Cottonwood creeks southeast of the lease area (figure MB2-3). Most of the springs, which initially discharged to Rapid Creek, now flow through pipelines to Cabin Reservoir near the southeast corner about 500 feet outside the lease tract. Outflow from Cabin Reservoir, which has a current capacity of about 120 acre-feet, is through a 6-inch diameter pipeline increasing about midway to an 8-inch pipeline, which follows the course of Cottonwood Creek to a water-treatment plant located near Rapid Creek in the northwestern corner of the lease area. A 6-inch pipeline following the course of Rapid Creek collects flow from two springs east of the lease area (figure MB2-3) and joins the Cottonwood Creek pipeline near the juncture of Rapid and Cottonwood creeks. All existing pipelines on the lease tract are cast iron and are reported to be old and susceptible to breakage.

Flood Hazard

The proposed mine facilities on the lease area are located about 0.4 mile south of and 40 to 60 feet higher than the level of Rapid Creek. Therefore, essentially no flood hazard to these facilities exists.

Possible flooding could occur to existing unit-train coal-loadout facilities on the flood plain of the Colorado River immediately north of the Cameo power plant. Upstream storage reservoirs, however, reduce peak flows along the Colorado River to the extent that any such flooding is highly improbable.

Erosion and Sedimentation

No sediment sampling data are available for any of the streams in the lease area. The tract obviously is actively eroding, however, and contributing large volumes of sediment to the Colorado River. Measured sediment yields from small watersheds in Badger Wash near Fruita, Colorado, with similar runoff characteristics show an average annual rate for the period 1953-73 of 1.80 ac-ft/sq-mi (approximately 2,750 tons/sq-mi/yr). Because of the steep slopes in the mine area, local rates of sediment

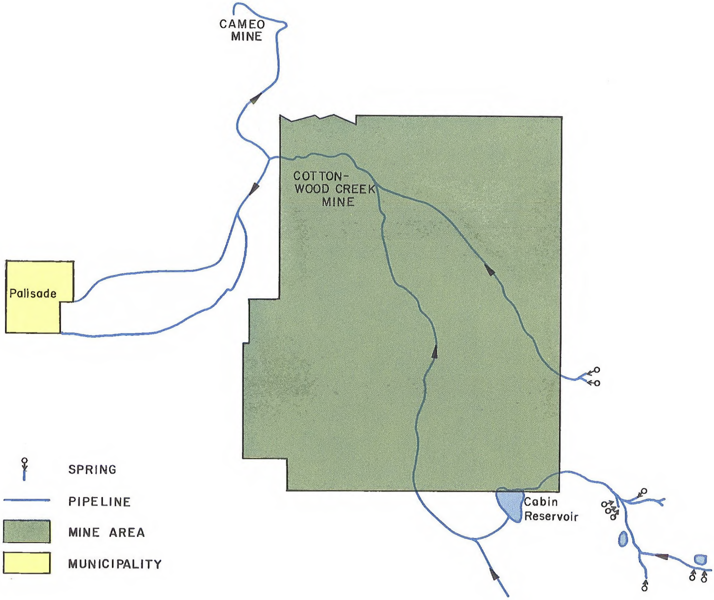


Figure MB2-3. Relationship between Palisade, Cabin Reservoir, and the Cottonwood lease area

yield could exceed those reported for Badger Wash by a factor of two. With increasing size of watershed, however, unit rates of sediment yield normally decrease (Hadley and Schumm 1961) so that annual sediment contribution from the Rapid and Cottonwood creek watersheds to the Colorado River should not greatly exceed 1.0 to 1.5 ac-ft/sq-mi.

Alluvial Valley Floors

Rapid and Cottonwood creeks are intermittent throughout their length and yield insufficient water on a regular basis to support subirrigation or flood-irrigation agricultural activities. No alluvial valley floors, therefore, occur on or adjacent to the proposed mine area. The existing unit-train coal-loadout facilities on the flood plain of the Colorado River are on an alluvial valley floor as defined in 30(CFR): 710.5. Mining restrictions applicable to alluvial valley floors would not apply to these existing facilities, however, because they are being used by the Roadside Mine, which was in production in the year preceding August 3, 1977. Also, the pre-mining land use of this valley floor area was undeveloped rangeland.

Soils

The entire area of proposed mine surface activity is contained within a single soil mapping unit. This unit consists mostly of rock outcrops on very steep slopes with nondelineated soil inclusions that are generally stony or gravelly. Also included are landslide areas and small pockets of shallow and very shallow soils. Specific soil features of importance in assessing reclamation are rated in table MB2-3; brief explanations of each rating are contained in the footnotes.

Vegetation

The vegetation on the coal lease area consists of greasewood, saltbush, sagebrush, pinyon-juniper, and mountain shrub types (see map MB2-1). Greasewood is found along Cottonwood and Rapid creeks, the major drainages which transect the coal lease tract. It is supported by the high water table beneath these two creeks. Plants commonly associated with the greasewood stands are saltcedar, summer-cyprus, Russian thistle, and snakeweed.

Saltbush is located in the western part of the lease area, on the arid, rolling hills immediately east of Palisade. The primary species in the saltbush type are shadscale, galleta grass, snakeweed, and prickly pear cactus. Scattered bunchgrass stands of beardless wheatgrass are found, as well as a few small stands of big sagebrush.

Large stands of big sagebrush are found in the southeastern part of the lease tract, between the pinyon-juniper and mountain brush types. They occur on relatively level mesas which have deeper soil deposits than the adjacent rocky slopes.

Pinyon-juniper is the most widespread vegetation type, occupying most of the eastern two-thirds of the tract. The understory is characteristically sparse, consisting mainly of cheatgrass, snakeweed, galleta grass, and Indian ricegrass.

Mountain shrub occurs in the southeastern part of the lease tract, alternating with the large sage parks that are also present there. The most abundant plants in this type are gambel oak and serviceberry; many other shrubs and herbaceous understory plants are associated with them.

Some south-facing slopes of the lease area are almost totally devoid of vegetation, as a result of the high evapotranspiration rate of southern exposures and the low water-holding capacity of the steep Mancos shale slopes. The area between the coal lease area and the town of Palisade is agricultural land, planted mainly with fruit trees.

A more detailed discussion of the plant species composition of the vegetation types mentioned, as well as their relationship to climatic and topographic features and to each other, may be found in chapter 2 of the regional analysis. Scientific names of the plants discussed are listed in the appendix, volume 3.

Endangered or Threatened Species

Information on the location of plants within the region that are proposed to be officially listed as endangered or threatened in the *Federal Register* (see the regional chapter 2, Vegetation, for a list of the plants) was obtained from detailed literature searches (Rollins 1941; Barneby 1964; Higgins 1971; Hitchcock 1950; Arp 1972, 1973; Reveal 1969; Keck 1937; Howell 1944; Benson 1961, 1962, 1966; Weber 1961) and extensive herbarium surveys (University of Colorado, Colorado State University, Colorado College, Denver Botanic Gardens, Western State College, Rocky Mountain Biological Lab, Black Canyon National Monument, Colorado National Monument, and Grand Mesa/Uncompahgre National Forest Headquarters). This research has revealed that none of the plants are known to have occurred historically in the area of the Cottonwood Creek mine. The results of the literature and herbarium studies may be seen at the Bureau of Land Management Montrose District Office. A detailed floristic and endangered and threatened plant inventory of the natural vegetation that is expected to be disturbed by the Cottonwood Creek facilities and roads has revealed that no endangered or threatened plants are present. The results of this inventory are available for public review at the Grand Junction BLM District Office.

TABLE MB2- 3

SOIL FEATURES FOR MID-CONTINENT: COTTONWOOD CREEK MINING AREA

Mapping Unit Name	Hydrologic Group a/	Erosion Hazard b/	Topsoil Rating c/	Reclamation Limitations d/
Rock Outcrop				
Rock Component	-	-	-	-
Deep Stony Component	B	Moderate	Poor	Severe
Shallow Component	D	High	Poor	Severe

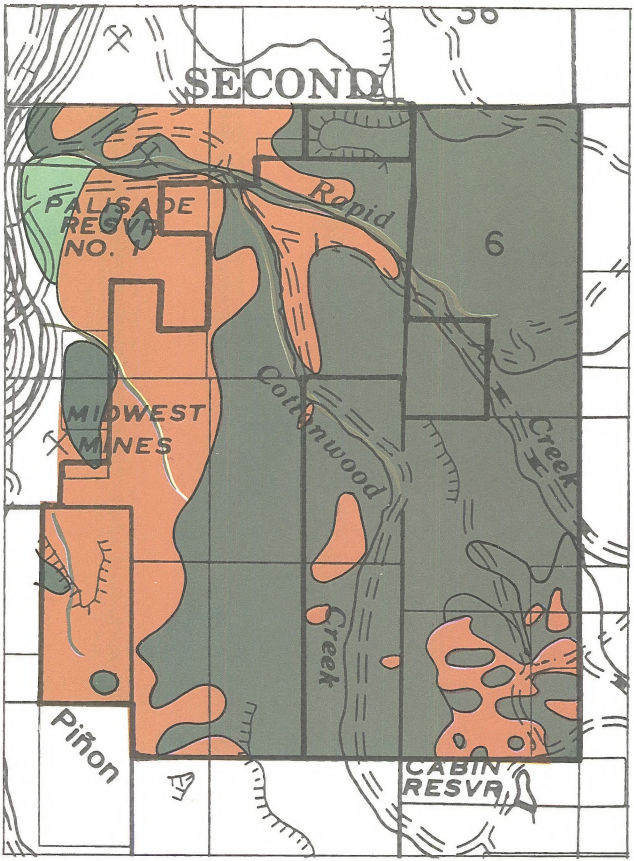
Note: Adapted from U.S. Dept. of Agriculture, Soil Conservation Service (Grand Junction, Colo.), Mesa County Area Soil Survey, unpublished.

a/ Hydrologic soil groups (A, B, C, D) are based on the rate at which water enters the soil surface (infiltration) and the rate at which water moves within the soil (transmission). When both infiltration and transmission rates are high, little surface runoff occurs (Hydrologic Soil Group A). In contrast, low infiltration and transmission rates produce high surface runoff (Hydrologic Soil Group D). Groups B and C are intermediate.

b/ Erosion hazard refers to the potential for surface soil loss when existing cover is removed or seriously disturbed.

c/ Topsoil is rated both on suitability as a seedbed material and on ability to sustain plant growth. Factors considered include soil depth, texture, amount of coarse fragments, and the presence of excess soluble salts which may inhibit plant growth.

d/ Hydrologic soil groups, erosion hazard, and topsoil rating, along with climatic information, are considered jointly to determine an overall rating of the limitations for reclamation. Specific degrees of limitation are interpreted as follows: Slight - indicates either no significant limitations or those limitations which can be remedied through planning and management choices, such as species selection, time of seeding, or short-term exclusion of livestock and certain forms of wildlife. Moderate - indicates significant limitations which must be recognized but which generally can be overcome through established measures to conserve natural moisture, reduce erosion, and augment available nutrient supplies. Severe - indicates serious deficiencies in natural moisture and in the amount and quality of topsoil; may also indicate topographic and soil conditions which produce extreme surface erosion or landslide hazards.



Map MB2-1. Vegetative types in the area of the proposed Cottonwood No. 1 and No. 2 mines

Wildlife

A listing of terrestrial species known or expected to occur in the Cottonwood Creek lease area is available at the BLM Montrose District Office.

Big Game

MULE DEER

The Cottonwood Creek area is mule deer winter range, with the lower portions of Cottonwood and Rapid creeks considered to be crucial winter range (map MB2-2). Deer remain on the winter range from October or November until early April and then gradually move to higher elevations as snow melts and new vegetative growth becomes available. They summer on the Grand Mesa National Forest, away from the lease area. Pellet group transects in the Cottonwood Creek area indicate an average of 56 deer days of use per acre in this crucial habitat.

Populations may fluctuate greatly from year to year as well as seasonally within the year, and population estimates are based on average numbers. Mule deer winter populations have been estimated at about 50 deer per square mile. This would indicate a total deer population within the Cottonwood Creek lease area of about 455 animals during the winter months.

ELK

The lower limit of elk winter range extends midway down Cottonwood and Rapid creeks (map MB2-2). Elk use the lease area in midwinter only in years of greater than normal snow depths at higher elevations. Pellet group transects indicate an average of 1.6 elk days of use per acre in the upper portions of the lease area. Elk winter population estimates in the Cottonwood Creek area indicate about 8 elk per square mile. This would result in about 8 elk inhabiting the site during an average winter.

BLACK BEAR

The upper portions of the lease area are black bear habitat. Black bear commonly wander to lower elevations in the early spring in search of food and may use the pinyon-juniper habitat type, (see map MB2-2).

MOUNTAIN LION

Mountain lions could use the lease tract occasionally because the rough canyons, isolation, and winter deer population offer excellent mountain lion habitat and food sources (see map MB2-2).

Small Mammals

Species composition is typical of the saltbush, sagebrush, pinyon-juniper, and mountain shrub habitat types. Common species include cottontail rabbits, rock squirrels, wood rats, Colorado and least chipmunks, mice, coyotes, and striped skunks. Small mammals closely associated with aquatic habitat, such as beaver, muskrat, and raccoon, occur along the Colorado River.

Game Birds

Mourning doves are the most common game birds occurring throughout the area during the summer months. Chukars are also found throughout the area, most frequently using rocky slopes and patches of annual cheatgrass. On the higher ridges of the lease area, blue grouse can be found in the summer in the mountain shrub type. A small population of turkey occasionally utilizes the upper portions of the lease area during the winter. Gambel quail occur in the general vicinity, utilizing brushy thickets adjacent to fruit orchards and along the Colorado River and Rapid Creek.

Mallards and Canadian geese nest and raise their young along the Colorado River in DeBeque Canyon. During spring and fall migration and the winter months, a much greater variety of waterfowl is present on the river, with the common merganser and common goldeneye two of the most abundant species.

Other Birds

The rocky cliffs on the lease area provide several miles of suitable raptor nesting habitat. No active nests have been identified, but active golden eagle and prairie falcon aeries are in DeBeque Canyon (see map MB2-3) and around Grand Mesa.

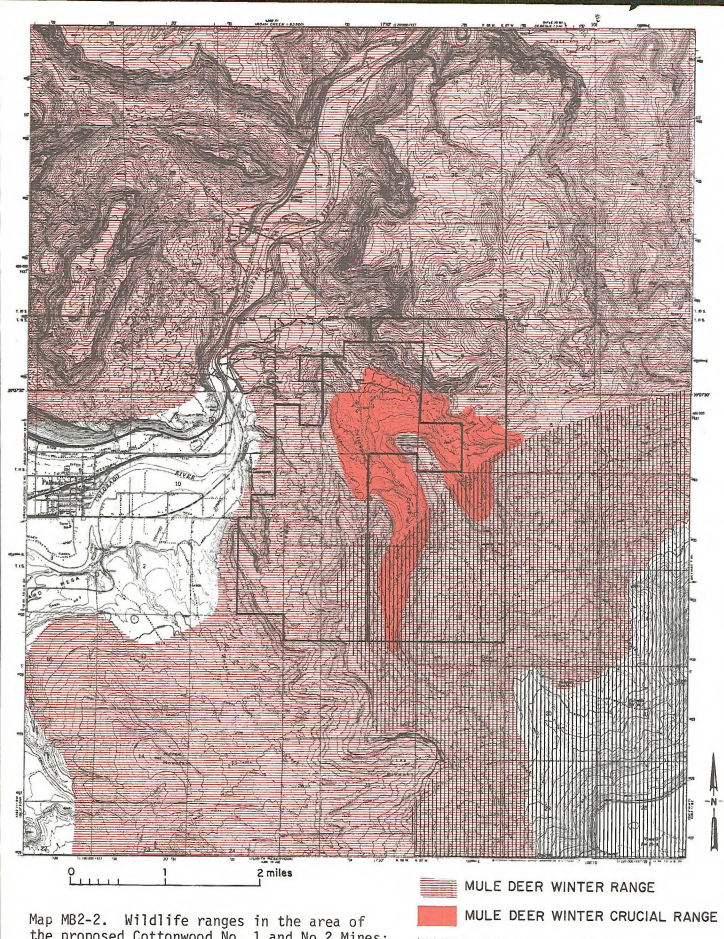
Endangered or Threatened Species

Bald eagles are commonly seen along the Colorado River in DeBeque Canyon throughout the winter months. Birds are frequently observed on hunting forays along the river or perched in cottonwood trees. This lease area, including mine buildings and loadout facilities, is also within the normal hunting range of the peregrine falcon aerie in DeBeque Canyon (see map MB2-3).

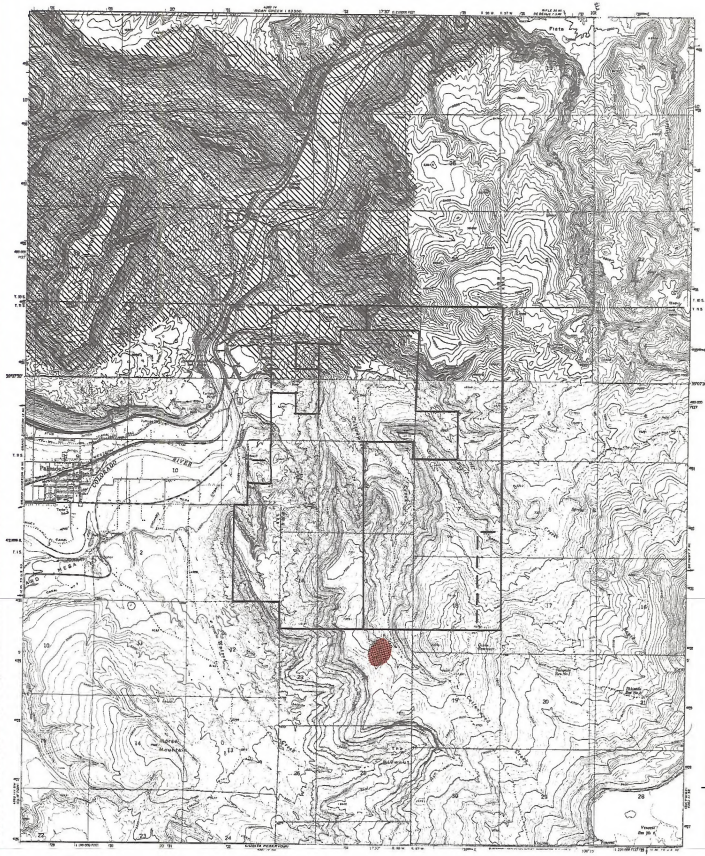
Aquatic Biology

All drainages on the Cottonwood Creek lease site contain intermittent streams; thus, there is no aquatic habitat on the site. Cottonwood and Rapid creeks characteristically flow only during significant precipitation events. Runoff water is typically very high in sulfates, carbonates, total dissolved solids, and suspended sediments.

The lease site is adjacent to the Colorado River and all site drainage enters directly into the river. The Colorado River at this location is considered a warm-water fishery. Channel catfish, large mouth bass, sunfish, and bullheads dominate the game fish



Map MB2-2. Wildlife ranges in the area of the proposed Cottonwood No. 1 and No.2 Mines: mule deer, elk, bear



Map MB2-3. Wildlife ranges in the area of the proposed Cottonwood No. 1 and No. 2 Mines golden eagle, endangered species

population while numerous nongame fish species including roundtail chub, sand shiner, carp, flannelmouth sucker, bluehead sucker, speckled dace, redfin shiner, and carp are found here.

Endangered or Threatened Species

From below the confluence of Plateau Creek, this section of the Colorado River is habitat for three species of threatened and endangered fish. The Colorado squawfish, the razorback sucker, and the humpback chub are presently known to exist in the river directly adjacent to the mine area. The USFWS has recommended this section of river as critical habitat for the Colorado squawfish (see Aquatic Biology, chapter 2, regional analysis).

Cultural Resources

Archeological Resources

An inventory was performed on a series of drill holes for the Cottonwood Creek site (Connors 1976). No archeological values were located.

As a result of the West-Central Colorado Coal Survey (see appendix, volume 3), 26 sites were located within the Cottonwood boundary: 16 lithic sites, 4 campsites, 2 rockshelters, 1 petroglyph, and 3 historic sites. Transect 7, which is a representative sample for Area 7 (northwest slope of Grand Mesa), runs north-south, intersecting the Cottonwood lease area. Seventy-one of the 90 sites and 104 of the 155 isolated finds identified by the survey were found within transect 7. With a site density of 6.5 sites per section and 9.5 isolated finds per section, this area represents a heavily utilized zone of prehistoric occupation from Paleo-Indian (8,000 BC) on through historic settlement. The variety of site types viewed against a diverse ecological background indicates continuous utilization of this area temporally and spatially. As a result of the inventory, Transect 7 is recommended for nomination to the National Register of Historic Places as an archeological district.

Historic Resources

The Cottonwood Creek site has not been formally inventoried, but a survey is planned. This site contains three small mines that date from 1908 (Grand View Mine). Because these mines were of a later development period (1908-1940) along the Little Bookcliffs, they are not of any significant historic value.

Land Use

Mid-Continent's proposed Cottonwood Creek No. 1 and No. 2 mines would be located on the southeast side of the Colorado River approximately 1.5 to 2 miles south of GEX Colorado Company's Roadside and Cameo No. 1 mines and 14 miles northeast of Grand Junction. The surface overlying Mid-Continent's lease holdings has been primarily used for livestock grazing and wildlife habitat. There has been very little public recreation use of the area because of a lack of legal public access. The privately owned sections of this area have been mined for coal for a number of years (see chapter 1, History and Background).

In the immediate vicinity of the lease area, there is a mixed pattern of land use, with houses, roads, agricultural buildings, orchards, and farmland. However, DeBeque Canyon is extensively industrialized not far upriver from the proposed Cottonwood Creek operation, with the Cameo No. 1 Mine, the Public Service Company's Cameo power plant, and the Roadside Mine in the vicinity. I-70 and U.S. Highway 6 are major transportation and travel routes through the canyon, and the Denver and Rio Grande Western Railroad (D&RGW) main line runs parallel to I-70 in the vicinity of the Cameo operation. GEX Colorado is currently constructing rail loadout facilities to serve the Cameo and Roadside mines.

Southwest of DeBeque Canyon, the land uses become predominantly agricultural and residential. From just east of Palisade on down the Grand Valley toward Grand Junction, there is much irrigated cropland including pastureland, hayland, and some rangeland. Lands producing fruit and vegetables may be designated unique farmlands, and some of the orchard land is in areas which could meet the definition of prime farmland (see Prime and Unique Farmlands under Agriculture in the regional volume).

The valley becomes more urban and residential as it approaches Grand Junction. As Grand Junction continues to grow, urban development may encroach on agricultural lands in the area, although the extent of encroachment will depend on county and local planning for the area.

For a discussion of Mesa and Garfield county planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints. BLM planning relevant to the leasehold area is discussed under Interrelationships in chapter 1 earlier in this site-specific analysis.

Transportation

HIGHWAYS

The closest highway to the proposed Cottonwood Creek mines is I-70, the major route between Denver and Los Angeles. At present the completed sections of the highway are operating at 4 percent of capacity during peak hours. The interchange at Cameo is running at 8 percent of capacity at peak hours. Average daily traffic in the Cameo area is 5,550 vehicles. The accident rate is

presently 1.57 per million miles travelled. U.S. 6 parallels I-70 through the populated area but passes through the towns.

RAILROADS

The main line of the Denver and Rio Grande Western Railroad passes near the proposed Cottonwood site and lies parallel to I-70 in this area. The railroad serves the mines currently operating in the Cameo area. Loading facilities are under construction north of the Cameo power plant.

AIRPORTS

Walker Field near Grand Junction is the closest airport to the proposed mines. It is served daily by Frontier and United airlines. This is the major airport in western Colorado.

Livestock Grazing

The coal lease tract is currently part of the Cottonwood-Rapid Creek and Lloyd grazing allotments, both of which consist totally of public land. The grazing rights are leased to W. R. Lloyd, who grazes 108 cattle between April 15 and May 15, and 20 cattle between May 16 and October 31, which is equivalent to 218 animal unit months (AUMs) per year. This is below the total of 278 AUMs of forage annually produced on the allotments. Only 3,153 of the 5,785 acres in these two allotments are grazeable by livestock; the rest are inaccessible because of steepness or unavailability of water. The 3,153 usable acres are overutilized by both livestock and wildlife. A new allotment management plan is proposed to alleviate overgrazing and to stabilize the downward range trend.

Recreation

The public lands of the Cottonwood Creek lease site are not used for recreation because there is no legal public access. Roads through the lease site provide BLM management access and access to several reservoirs controlled by the city of Palisade for its water supply; however, the public is not permitted to use the reservoirs.

The lease site is located within Big Game Management Unit 30, which provided 3,364 recreation days in 1976, and Small Game Management Unit 60, which provided 8,529 recreation days in 1975. Tables MB2-4 and MB2-5 list hunter days by species and game management unit. Cottonwood and Rapid creeks, which run through the lease site, are intermittent streams and provide no fisheries value (see Aquatic Biology).

The Colorado Division of Parks and Outdoor Recreation manages the Island Acres Recreation Area, which is located on the Colorado River about 1 mile upstream from Mid-Continent's proposed coal train loading facility (owned by GEX Colorado Company). Island Acres provides opportunities for camping, picnicking, and swimming. The area provided recreation for 102,578 visitors from July 1976 to June 1977 (Colorado Division of Parks and Outdoor Recreation 1977).

Most of the population increase due to mining activity at the Cottonwood Creek site would occur in the Grand Junction-Palisade area. Grand Junction provides city-sponsored leagues for softball, basketball, and volleyball. The city's facilities include eleven parks, fourteen swimming pools, and sixteen tennis courts. The Grand Junction Recreation Department feels that use of its facilities is now maximum; people have to be turned away from the programs, especially league activities. The department also states that only 40 percent of this use is from city residents, which indicates that the city's programs are a major recreation outlet for the surrounding area. The city of Palisade provides a park with a playground, two tennis courts, and a basketball court.

For a comprehensive discussion of the recreational resources of the region refer to chapter 2 of the regional analysis, Recreation.

Visual Resources

A series of terraces and buttes serves as the transition between the Colorado River (elevation 4,700 feet) and Grand Mesa (elevation 10,000 to 11,000 feet). The vertical elements of these geologic formations are steep taluses and rock cliffs showing horizontal rock strata that form the base of Grand Mesa. The edges of the terraces and rock strata establish a strong linear pattern in the landscape (see figure MB2-4). Red and tan rock colors emphasize this pattern and are augmented by sharp shadow patterns during the day. The contrast of the cliff faces and flatter terraces extending in the ascent to Grand Mesa creates a dramatic landscape that is visually dominated by a landform which has been eroded into a rough texture of dissected valleys and flat-topped buttes. The west-facing slopes have a pinyon-juniper and mountain brush vegetative cover which adds a multi-colored, spotty texture to the land surface.

There is an intermixed pattern of land use in the vicinity of the proposed Mid-Continent facility. Residences, roads, agricultural buildings, orchards, and cultivated fields have moderately altered the natural landscape, but these cultural modifications are visually dominated by the background cliffs and terraces.

The exposed cliff faces and the diverse vegetative community, which are both visible from I-70, have resulted in a visual resource management (VRM) Class II (see appendix, volume 3, methodology description) for the I-70 corridor adjacent to the proposed site. The proposed facility area is

TABLE MB2-4

BIG GAME HUNTING IN BIG GAME MANAGEMENT UNIT 41

	Deer	Elk	Bear	Mountain Lion	Total
Hunters	894	818	31	-	a/
Recreation days b/	3,803	4,091	176	3	8,073

Source: Colorado Division of Wildlife, 1976 Big Game Harvest.

a/ Hunter totals are not included because hunting and trapping of more than one species are allowed.

b/ All or part of a day.

TABLE MB2-5

SMALL GAME HUNTING AND TRAPPING IN SMALL GAME MANAGEMENT UNIT 60

	Hunters	Recreation Days a/	Animal	Trappers	Recreation Days a/
Ducks	111	589	Badgers	3	246
Geese	75	295	Beavers	2	43
Doves and pigeons	160	512	Bobcats	7	202
Pheasants	317	1,297	Ringtailed cats	2	189
Quails	78	190	Coyotes	9	375
Chukars	98	312	Muskrats	5	157
Grouse	104	240	Raccoons	5	203
Rabbits	488	2,822	Skunks	7	519
Coyotes	77	268			
Prairie dogs	36	70			
Total	b/	6,595		b/	1,934

Source: Colorado Division of Wildlife, 1975 Colorado Small Game, Furbearer, Varmint Harvest.

a/ All or part of a day.

b/ Hunter totals are not provided because hunting and trapping of more than one species are allowed.

Figure MB2-4. The terrace features at the Cottonwood site establish a line pattern in the DeBeque Canyon landscape.

rated as a Class IV, which represents the lowered public sensitivity to landscape changes because of restricted visual access to this area.

The landscape character of the southern extremity of DeBeque Canyon verges on rural-industrial. The predominantly agricultural and residential land use is not visually disruptive. Added to this land use pattern, however, are the more intensive industrial developments of the Roadside Mine, Cameo power plant, the D&RGW Railroad, power lines, commercial areas, and the four-lane highway.

Socioeconomic Conditions

Demography

Table MB2-6 lists the population for each incorporated town and each county census area within Mesa County and western Garfield County, for the 1970 and 1977 censuses. Grand Junction and vicinity is the most heavily populated community between the Denver and Salt Lake City metropolitan areas. As such, it serves as a regional center of commercial and industrial activity for most of western Colorado and eastern Utah. Recent growth in the Grand Junction area has been caused by a variety of economic factors, including the expectation that the area's mineral resources will develop rapidly in the near future. Corporations and government agencies involved in mineral resource development over a wide area have located regional headquarters in Grand Junction. Table MB2-6 indicates that most areas around Grand Junction have grown at a moderate rate, averaging between 3 and 5 percent per year since 1970.

The median age of the population in Mesa County is higher, but not significantly higher, than the Colorado median age of 26.2 years. The Palisade area has a relatively older population than the rest of the county, and a much higher concentration of persons over 65 years of age.

The small communities of DeBeque, Collbran, and Grand Valley are similar in size, and all have a population whose median age is higher than the Colorado median. Collbran is somewhat different from most communities in western Colorado in that the median age of its population increased between 1970 and 1977. The DeBeque and Grand Valley areas have experienced growth due to the location of the Occidential Oil Shale test site outside of DeBeque and the Paraho Oil Shale site east of Grand Valley.

Community Attitudes and Lifestyles

According to the Mesa County Development Department, a majority of the new residents in the Grand Junction area moved there because they liked it as a place to live. The Grand Junction area is more urban than most other areas of western Colorado, but it is still small enough to retain attributes of small town living. Residents place a high value on the casual atmosphere and lack of congestion associated with life in Grand Junction. However, there is also a desire to attract economic growth to the area and improve job opportunities for residents.

As a population center, Grand Junction provides its residents opportunities not available in most other communities in western Colorado. Mesa College offers courses of study in many subject areas, college athletic events, and dramatic performances. There is a larger selection of stores, restaurants, and movie theatres than in other towns. Airline and bus service to metropolitan areas is regularly available, and an interstate highway links Grand Junction to Denver and Salt Lake City.

Community attitudes towards growth and development were documented in a survey conducted by Bickert, Brown, Coddington, and Associates, Inc., in July 1973. Results of that survey are discussed in the regional volume.

Community Facilities

Most of the developed areas around Grand Junction receive water from the Ute Water Conservancy District, which provides water to other districts and to individuals. The district is currently developing additional water resources. There are many special districts in the county providing various services including water, sewer, fire protection, pest control, hospital services, cemetary services, and flood control. There are two sanitary landfills in the county. Police service outside of town is provided by the county sheriff.

Grand Junction, Fruita, Collbran, Palisade, and DeBeque are improving or plan to improve their water and sewage treatment systems. More detailed information about facilities in the county is included in the regional volume.

Housing

Table MB2-7 lists the housing units available in Mesa County and western Garfield County, according to the 1977 special population censuses. The total housing stock in Garfield County increased by 22 percent between 1970 and 1976. About 40 percent of that increase was mobile homes.

The Colorado Division of Housing (1976) estimates that there was a total of 24,914 housing units in Mesa County in April 1976, an increase of 6,116 units (or 32 percent) from 1970. Over one-third of the total increase in housing stock was mobile home units. In recent years, duplexes and multi-family units have constituted about 30 percent of the new housing starts. High prices for single-family dwellings and the unavailability of rental

TABLE MB2-6

POPULATION STATISTICS

	1970 Population	1977 Population	Percent Change 1970-1977	Median Age-1970 (Years)	Median Age-1977 (Years)	Percent Population Over 65 Years
Mesa County:	54,374	66,848	+ 23	30.2	29.4	+ 11
Clifton area	3,554	5,913	+ 66	30.2	26.8	+ 9
Fruita	1,822	2,328	+280	34.1	28.5	+ 15
Fruita area	5,837	7,709	+ 32	29.4	28.4	+ 10
Grand Junction	24,043	25,398	+ 5	32.1	30.2	+ 15
Grand Junction area	28,527	35,871	+ 26	30.0	29.3	+ 13
Orchard Mesa area	6,890	5,012	- 27	28.6	29.6	+ 8
Palisade	874	1,038	+ 19	-	46.9	+ 31
Palisade area	1,964	2,178	+ 10	41.8	38.8	+ 21
Redlands area	4,446	6,826	+ 53	29.9	30.6	+ 6
Whitewater area	605	751	+ 24	36.1	32.6	+ 12
Collbran	225	293	+ 30	-	36.9	+ 20
Collbran area	1,428	1,364	- 4	31.4	33.6	+ 14
DeBeque	155	264	+ 70	-	32.5	+ 14
DeBeque area	306	427	+ 40	42.1	33.5	+ 14
Garfield County:						
Grand Valley	270	377	+ 40	-	30.0	+ 18
Grand Valley area	819	858	+ 5	32.1	30.9	+ 14

Source: U.S. Bureau of the Census, 1970 Population Census and 1977 Special Census for Mesa and Garfield Counties.

TABLE MB2-7

EXISTING HOUSING IN PROPOSED ACTION AREA

County	Total Housing Units	
	Occupied	Vacant
Mesa County:		
Collbran	119	13
DeBeque	100	11
Fruita	788	41
Grand Junction	10,129	596
Palisade	418	23
Unincorporated areas	12,321	759
Garfield County:		
Grand Valley	138	19

Source: U.S. Bureau of the Census, Special Population Census for Mesa and Garfield Counties, 1977.

units are contributing to an increase in multi-family and mobile home units throughout the county. The county has an above average need for low to moderate income housing, because the median family income is more than $3,000 less than the state median and Mesa County has an above average number of elderly persons.

Education

Education in the areas around the proposed Cottonwood Creek mines is provided by four public school districts: Mesa County Valley School District 51, DeBeque School District RE49(JT), Plateau Valley School District 50, and Grand Valley School District 16. Mesa County Valley is by far the largest with 96 percent of the combined enrollment. In general, the school districts all have some excess capacity to absorb new students. Mesa County Valley has some problem with capacity of its junior high schools but plans to expand in the future. Table MB2-8 summarizes the situations of the four districts.

Health Care

The level of health care services in and around Grand Junction is the highest in the ES area. The four hospitals located in Grand Junction provide specialized services to much of western Colorado. In addition, the Fruita area is served by a small hospital located in town. There are more physicians located in Grand Junction than in the remainder of the ES area combined. Many of these physicians are specialists, who provide their services to patients from a wide area. Ambulance service to the area is good; both Fruita and Grand Junction operate ambulance services connected with their fire departments.

Mental health services are provided to the area by the Colorado West Regional Mental Health Center, which is headquartered at Glenwood Springs and has offices in Grand Junction.

The Mesa County Department of Public Health has a staff of six public health nurses who provide generalized health eduction and preventative health services in addition to specialized activities in tuberculosis control, mental retardation, venereal disease, and handicapped children's programs.

Health care in eastern Mesa County is limited. Collbran supports the Plateau Valley Hospital and Nursing Home. The hospital has six beds, three of which conform to federal standards. The nursing home has thirteen long-term care beds. A single doctor provides most of the service to patients in the Collbran area.

DeBeque and Grand Valley have no health care facilities in town. The nearest doctor for DeBeque residents is in Palisade, 22 miles away, and hospital care is available in Grand Junction. The closest physicians and hospital for Grand Valley residents are in Rifle, about 16 miles away.

Employment

In Mesa County, where most of Cottonwood Creek's employees would live, employment grew at an annual rate of 6.1 percent between 1973 and 1976. The total number of persons employed increased from 24,030 to 28,622 during this period. As shown in table MB2-9 the increase was all in nonagricultural employment; agricultural employment declined by 11.6 percent. A comparison of employment by sector shows that all sectors showed some growth, but the mining; transportation; finance, insurance, real estate; and contract construction sectors had the largest percentage increases. The increase of 130 percent in mining employment can be attributed to new mining activity in the Uravan uranium belt and coal mining in western Garfield County. Oil shale test projects near DeBeque and Grand Valley have also added to employment in the mining sector. In terms of number of employees, the service trade and mining sectors showed the greatest increase.

Table MB2-9 also shows that the trade, service, and government sectors are the largest employers in the Mesa County economy and that, in spite of the fast growth rate, the finance, insurance, and real estate sector and the mining sector are the smallest. The sectors with the largest employment in Garfield County are also trade, services, and government. Almost all sectors have grown since 1970.

The regional volume gives more detail about employment in Mesa and Garfield counties. Employment data for specific towns and cities are not available.

Income

The proposed Cottonwood Creek property is located in Mesa County, 2.5 miles east of the town of Palisade. According to the U. S. Department of Commerce (1974), 1974 per capita income in Palisade was $4,324. This was substantially below the county average of $4,799, which in turn was lower than the Colorado average of $5,514. Mesa county ranked fourth in the seven-county ES area.

Median family income in Mesa County was estimated to be $11,130, third highest in the region but lower than state and national averages. In 1975, 11.4 percent of the families in the county had incomes below the poverty level.

In 1974, government (21.0 percent) and wholesale and retail trade (20.6 percent) were the largest sources of personal income. Other sectors and the share they produced were services--15.7 percent; contract construction--10.2 percent; transportation, communication, and public utilities--9.9 percent;

TABLE MB2-8

CHARACTERISTICS OF AFFECTED SCHOOL DISTRICTS

School District	1977 Enrollment	Schools	Design Capacity	Excess Capacity	Teachers	Student: Teacher Ratio	Bonding Capacity (dollars)	Outstanding Debt (dollars)
Mesa County Valley (51)	14,025	30	15,561	1,536	678	20:1	32,043,730	2,500,000
DeBeque (RE49(JT))	160	2	195	35	16	11:1	260,000	130,000
Plateau Valley (50)	284	3	350	66	14	20:1	1,200,000	19,000
Grand Valley (16)	180	1	250	70	17	10:1	800,000	184,000

TABLE MB2-9

GROWTH OF EMPLOYMENT BY SECTOR
IN MESA COUNTY, 1973-1976

Sector	1973	1976	Increase	Percent Change
Agriculture	3,030	1,790	- 240	- 11.8
Mining	390	900	+ 510	+ 130.8
Contract Construction	1,330	1,730	+ 400	+ 30.1
Manufacturing	2,280	2,440	+ 160	+ 7.0
Transportation	1,420	1,680	+ 460	+ 32.4
Wholesale and Retail Trade	5,040	5,710	+ 670	+ 13.3
Finance, Insurance, and Real Estate	630	820	+ 190	+ 30.2
Service	3,420	4,410	+ 990	+ 28.9
Government	4,140	4,470	+ 330	+ 8.0

Source: Colorado Division of Employment, Research and Analysis, February 1977.

Note: This information does not include self-employed workers, other than in agriculture, unpaid family, and domestic workers.

manufacturing--8.9 percent; agriculture--6.9 percent; finance, insurance, and real estate--3.6 percent; mining--3.3 percent; and other industries--0.4 percent. This breakdown indicates the importance of the trade sector in the economy of the county and the role of Grand Junction as a regional center. For a discussion of regional incomes, see the income section in the regional volume.

FUTURE ENVIRONMENT WITHOUT THE PROPOSAL

If the M&R plan proposed in chapter 1 is not approved and implemented, Mid-Continent has tentative plans to mine private coal reserves on private land in the northwestern part of the lease area (map MB1-1, chapter 1). Conventional room-and-pillar methods would be used, but no other information is available from the company on the scope or duration of these possible future operations.

If these operations are carried out, the following general changes can be expected to occur at the mine site. Ambient particulate concentrations could be expected to increase slightly. Soils, vegetative, wildlife, and cultural resources would be affected in proportion to the amount of surface disturbance required by facilities construction and the number of people working in the area. Since no subsidence is expected as a result of these future operations, no significant impact to the ground- or surface-water resources should occur on or adjacent to the mined area. Increased population would increase use of municipal water and discharge of sewage effluent to the Colorado River in the Palisade and Grand Junction areas, but the magnitude of these impacts cannot be appraised without detailed information on the scope and duration of the operation. Traffic on I-70 would increase as a result of people going to and from work.

In the absence of additional mining on the lease area, vandalism and erosion would be the two major factors causing the loss of archeological values through 1990. It is doubtful that additional monies or employees would be available to retard this loss, although the Federal Land Policy and Management Act of 1976 will provide BLM with more protective enforcement authority. There will be some increase in noise levels in the area due to the increase in vehicular traffic on I-70, railroad traffic, and operation of the Cameo No. 2 Mine. Increase in equivalent noise levels at individual residences is estimated to be from 0 to 3 dBA. Other resources in the lease area will change only to the extent that they are affected by the developments discussed in the following paragraphs.

The grazing system on the Cottonwood-Rapid Creek and Lloyd Alotments would be considerably changed as a result of a new allotment management plan (AMP) that has been proposed to alleviate overgrazing by livestock. The two allotments would be combined into one, and a rest-rotation grazing system would be adopted. The sequence of grazing would result in maximum livestock production, along with increased plant density (western wheatgrass, galleta grass, and big sagebrush), vigor, and litter, and an accompanying increase in soil fertility and slowing in soil erosion. Seven reservoirs, four water catchments, 1 mile of stock trail, 0.8 mile of fence, and 2.6 miles of access road are proposed to implement the grazing system described above. The reservoirs and water catchments would distribute the cattle more evenly over the waterless areas of the allotment, particularly the dry ridges. The roads and stock trails would provide access for livestock and people. If the AMP is implemented, wildlife (primarily big game) use could increase due to improved water distribution, better forage, and less competition with livestock.

The city of Palisade, Colorado, is currently planning improvements to its municipal water system within and adjacent the lease area. These improvements include expansion of Cabin Reservoir from a capacity of 120 acre-feet to approximately 750 acre-feet by raising the dam from 45 feet in height to 85 feet. Also, a new 12-inch pipeline will be built to carry water from Cabin Reservoir to the treatment facility in the northwestern part of the lease area. The enlarged reservoir would impound water at maximum stage to approximately the southern boundary of the lease tract.

The BLM has identified a need for public access to the public lands east of Palisade. The Whitewater MFP recommends developing limited access to the area up to the confluence of Cottonwood and Rapid creek and from the community of Mesa. (Refer to map 19 in volume 3 for location of the public lands and access routes.) The public lands could provide dispersed recreation, such as hunting, hiking, and wildlife viewing.

GEX Colorado Company's Cameo No. 1 and Roadside mines north of the Cottonwood Creek lease area would continue to operate through 1980 and 1985, respectively. If the proposed M&R plans for Gex Colorado's Cameo No. 1 and No. 2 mines and Mid-Continent's Coal Canyon Mine are approved, those operations would mine through 1990. Taken together, these operations would continue and expand the industrialized land use of this portion of DeBeque Canyon. Traffic on I-70 would increase as a result of mine persnnel going to and from work, and train traffic would increase as coal is shipped out of the area from these mines. Ambient particulate concentrations may increase as a result of these new sources.

Noise levels are expected to rise along the Colorado River due to increased rail and vehicular traffic. This will cause some problems for residential areas along the Colorado river. It should be noted that coal from all the mines proposed and operating in the DeBeque Canyon area would account for less than one-fourth of the unit trains predicted to be operating out of the ES area in 1985 and 1990. By 1985 the number of unit trains passing through the DeBeque Canyon will be four times the number predicted in 1980 if the proposed action is approved (see table R1-3, chapter 1, volume 1). Vehicular traffic increases on I-70 are expected to raise equivalent noise levels in the vicinity of the highway by as much as 5 dBA by 1990.

If the Cameo and Coal Canyon mines are developed, these operations would increase populations in Mesa County by 2,050 people by 1985 and 3,150 people by 1990 and would increase populations in Garfield County by 350 people by 1985 and 650 people by 1990. In addition, development of oil shale and uranium would by themselves cause rapid population expansions in both Mesa and Garfield counties. Population in Mesa County is expected to increase to 106,000 people by 1985 and then decrease to 94,800 people by 1990. Garfield County population is expected to grow to 45,100 by 1990.

It can be assumed that those communities closest to major project sites would experience the most immediate population growth. The small communities of Rifle, Silt, New Castle, Grand Valley, and DeBeque, all within a relatively short commuting distance from major oil shale projects, should have most of their available living spaces occupied as soon as major construction activity begins. Even if additional housing units can be supplied as they are needed, these towns can only accommodate about an additional 4,500 peopld before major new additions would be needed for their water and sewer systems. As a result, it would be necessary for communities such as Grand Junction, Fruita, and Glenwood Springs to absorb much of the rapid population growth expected in Garfield and Mesa counties. Some of the resulting residential and urban expansion would probably encroach on agricultural land, although to some extent the location of this urbanization will depend on future county and local planning and zoning. In addition, the terraces and benches along the Colorado River would probably receive residential development by 1990, since they offer good views, existing access, and proximity to population centers.

Due primarily to the expected population growth from oil shale development, existing community facilities in Garfield and Mesa counties would be forced to operate at or beyond their capacity. This is especially true of the smaller towns of DeBeque, Grand Valley, Rifle, Silt, and New Castle. Both the Grand Junction and Glenwood springs communities now have or are building improvements which will allow them to greatly expand water and sewer service. As a result, much population growth in Mesa and Garfield counties should be attracted to these two communities.

Growth in Mesa County would require additional recreational facilities by 1990, including 116.2 acres of additional community active/improved park land (e.g., ballfields, playgrounds, tennis courts) to prevent overuse and deterioration of existing facilities (Bickert, Browne, Coddington, and Associates, Inc., 1977). The proposed U.S. Bureau of Reclamation (USBR) Dominguez Dam, just south of Grand Junction (see figure MB2-5) would provide water-based recreation such as boating, fishing, and swimming. The USBR estimates that the dam would provide 300,000 to 500,000 recreation days in its first year of use, which would help to relieve some of the projected need for this type of recreation identified by the 1976 Colorado Comprehensive Outdoor Recreation Plan (see regional analysis, chapter 2, Recreation).

Incomes and employment are expected to be higher as a result of increased industrialization and mining. Agriculture could become a less important part of the local economy, and this decline could accelerate the shift from agricultural to residential-industrial land uses. The expected increase in job opportunities could also accelerate the current trends of in-migration to the area by persons who like the living conditions.

If oil shale and molybdenum projects are developed according to schedule, the influx of large construction work forces can be expected to cause some change in Mesa and Garfield counties. The influx of similar large work forces in other rural areas of the west has led to a number of sociological changes which are commonly referred to as the "boom town syndrome." The more commonly documented changes include rising rates of divorce, increased cases of alcoholism and mental illness, and decreased levels of job productivity. Also, and probably more importantly, there tends to be a polarization in small communities between the long-time residents and the more transient newcomers, which causes difficulty in accomplishing needed reforms. In many communities, the general trend will, at the least, be toward more urbanized lifestyles.

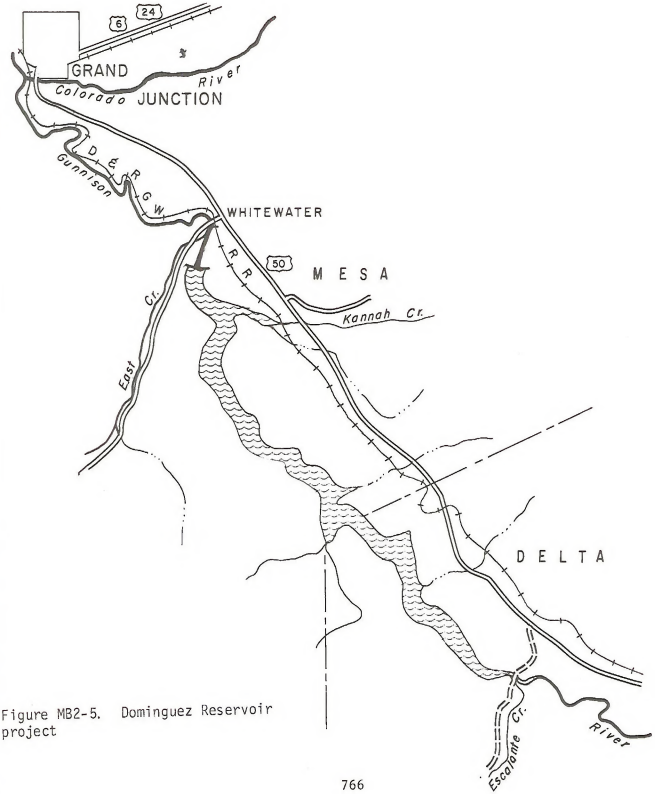


Figure MB2-5. Dominguez Reservoir project

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This mining and reclamation plan (M&R plan) was submitted for review prior to promulgation of interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), and it does not fully reflect the requirements of the interim regulations. However, in this ES the applicable interim regulations are included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of these regulations. The Department of the Interior will not consider the M&R plan for approval until Mid-Continent Coal and Coke Company has redesigned it to incorporate the applicable federal requirements. Therefore, to the extent possible at this time, the following impact analysis assumes that the provisions of the Surface Mining Control and Reclamation Act will be incorporated into the proposed M&R plan before it will be considered for approval. Impacts are analyzed at three time points: 1980, 1985, and 1990.

Air Quality

Emissions from the Proposed Mines

Mining activity at underground coal mines usually produces dust, an air pollutant, in environmentally significant amounts. Dust that is generated within the mine is not considered to have an environmental impact since it is continuously controlled and contained in the mine. However, surface facilities at these mines also generate some dust which is released into the ambient air. Most of the dust is from fugitive emission sources; the term "fugitive" connotes that the dust escapes from an unenclosed surface as a result of wind erosion or mechanical action, as opposed to being released from a stack or process vent.

The potential fugitive dust sources identified at the proposed Cottonwood Creek mines include conveyors, transfer points, open storage piles, haul roads for coal and refuse, employee traffic on mine access roads, and wind erosion of refuse piles and other exposed areas at the mines. A common source of fugitive dust at underground mines that is not projected for the Cottonwood Creek mines is crushing and sizing at the preparation plant. These operations should produce negligible emissions because a wet process would be used.

The procedure used to estimate emissions from each of the potential sources was to (1) determine the activity rate of the pollution-producing operation, (2) multiply that activity rate by an emission factor based on sampling of similar operations, and (3) reduce the calculated emissions by an appropriate amount to account for control equipment or dust suppression measures to be employed on the operation. Activity rates and control measures were described in the Cottonwood Creek M&R plan. Emission factors for individual mining operations were obtained from Colorado Air Pollution Control Division and a recent study of emissions from mining (Colorado APCD 1978, Axetell 1978).

Table MB3-1 presents estimates of fugitive dust emissions at the Cottonwood Creek site from each of the identified sources in 1985, 1990, and at end of mine life. These values are annual emissions, even though the activities would not be continuous or uniform throughout the year. The estimates are judged to be accurate within a factor of two (Axetell 1978). The emissions in table MB3-1 represent initial emission rates (tons per year) of suspended particulate from the operations. Some of these suspended particles would fall out of the dust plume after they are emitted. This deposition is discussed further below.

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

Estimated emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), and sulfur oxides (SO_x) are shown in table MB3-2. These emissions are based upon rates per mile of travel (emission factors) which would decrease between 1985 and subsequent study years. In the case of Cottonwood Creek, the reduced emission rates would partially offset increased activity rates projected when the mines would be at full production in 1990. These emissions are from both employee travel on the mine site and haul trucks.

The emissions of gaseous pollutants would not result in significant ambient concentrations on or near the proposed mine site.

TABLE MB3-1

FUGITIVE DUST EMISSIONS AT THE PROPOSED COTTONWOOD CREEK MINE SITE

Emission source	Emissions, ton/yr 1985	1990 & EML
Conveyor - 2 sections	3.9	9.8
Transfer points - 1 point	5.8	14.6
Preparation plant - wet process	neg	neg
Truck loadout	neg	0.1
Open storage - raw coal	10.1	10.1
- surge pile	6.7	6.7
Haul roads - clean coal	124.0	310.0
- refuse	2.4	6.1
Access roads	25.5	50.9
Exposed areas - refuse	6.8	6.8
- mine facilities	2.2	2.2
TOTAL	187.4	417.3

TABLE MB3-2

EMISSIONS OF GASEOUS POLLUTANTS FROM THE PROPOSED COTTONWOOD CREEK MINE SITE

Year	Total emissions from vehicles, ton/yr CO	HC	NO_x	SO_x
1985	5.4	0.5	1.8	0.4
1990	7.5	0.8	2.0	1.0

$$L_V = \frac{24}{0.2 + 0.007\,M}$$, where

L_V = Average visual range, miles

M = Average particulate concentration (micrograms per cubic meter)

Figure MB3-1 Relationship between visibility and suspended particulate concentrations in rural west-central Colorado (Ettinger and Royal 1972).

Annual Average Air Quality Impacts

In order to assess the impact of air pollutant emissions on the environment, ambient concentrations of suspended particulate were predicted with an atmospheric dispersion model. The model used to predict average concentrations that would result from the mines emissions was the Climatological Dispersion Model (CDM) (EPA 1973).

CDM is designed for use in level terrain. This application of CDM is subject to larger error and uncertainty than more routine applications, but it represents the best predictive modeling technique available. Because of the irregular topography at the proposed site, CDM is really only capable of predicting concentrations in the canyon or valley near where mining emissions occur. The site-specific meteorological data reflected the prevalence of transport of the pollutants up and down the canyon from the mine. Because of the greater influence of the canyon on maximum concentrations near the mine, a separate model which considers reflection of the plume was used to predict maximum 24-hour concentrations. This short-term model is described in the following section.

The basic CDM model has been modified to incorporate a fallout function to simulate the deposition of the large suspended particulate as it disperses downwind. The fallout rates incorporated in the model were based on sampling data from several western coal mines and are functions of wind speed, atmospheric stability, and particle size.

The following input data are required for CDM: source locations; source emission rates; emission heights; locations where ground-level pollutant concentrations are desired; and frequency of occurrence of each of sixteen wind directions, six wind speeds, and six stability classes. Predicted concentrations are usually accurate within a factor of three.

Since there are no wind data available for the lower DeBeque Canyon area (see chapter 2), the wind and stability data required for the model were obtained by modifying that from Grand Junction airport to reflect orientation of DeBeque Canyon. This wind rose was previously shown in figure MB2-1. Emission data were presented in table MB3-1.

Predicted increases in ambient concentrations resulting from Cottonwood Creek's operation in 1990 are shown on map MB3-1. According to the isopleths on this map, the mines would increase annual average particulate concentrations by 20 micrograms per cubic meter ($\mu g/m^3$) in a small area along the coal haul road just west of the mine boundary. Concentrations are predicted to increase by 10 $\mu g/m^3$ for a distance of about 1 mile from the surface facilities and along the haul road north toward Cameo. Predicted impact in 1985 would be about half that of 1990 but is shown to occur in the same areas. (Map MB3-2 depicts cumulative concentrations from all of the proposed actions in the Debeque Canyon area, i.e., Mid-Continent: Coal Canyon Mine and Cottonwood Creek No. 1 and No. 2 mines, and Cameo No. 1 and No. 2 mines.) The modeling results indicate that emissions would not cause significant increases in annual average concentrations outside the canyon area.

The predicted impact of the mines would be less than the primary and secondary air quality standards for suspended particulate of 75 and 60 $\mu g/m^3$, respectively. Off site, it would also be less than the total air quality increment of 19 $\mu g/m^3$ for Class II areas allowable under federal law concerning prevention of significant deterioration (PSD).

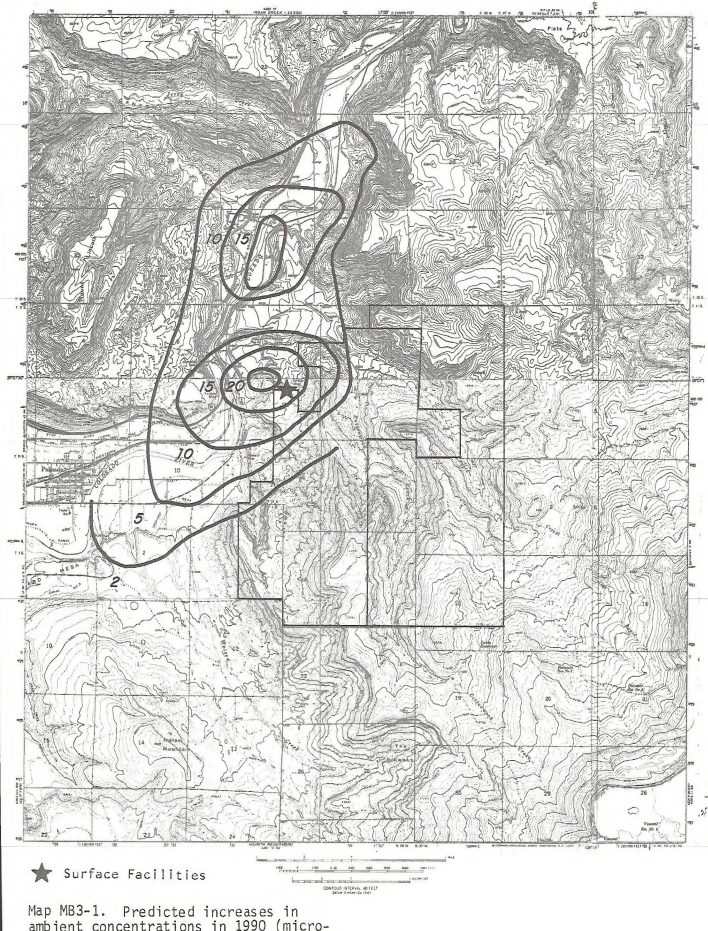
Maximum Short-term Air Quality Impacts

The dispersion model used to predict maximum 24-hour particulate concentrations assumed Gaussian distribution of particulates away from the plume centerline, a constant wind direction, and complete reflection of the plume off both canyon walls. The basic dispersion equation is described in detail in Turner 1970. The fallout function was not incorporated in the short-term model.

Several locations (receptors) up and down DeBeque Canyon from Cottonwood Creek were specified in the model for prediction of ground-level concentrations. At each receptor, the contribution caused by each emission source at Cottonwood Creek was calculated separately; individual source contributions were summed to determine the total concentration at the receptor resulting from the mining operations.

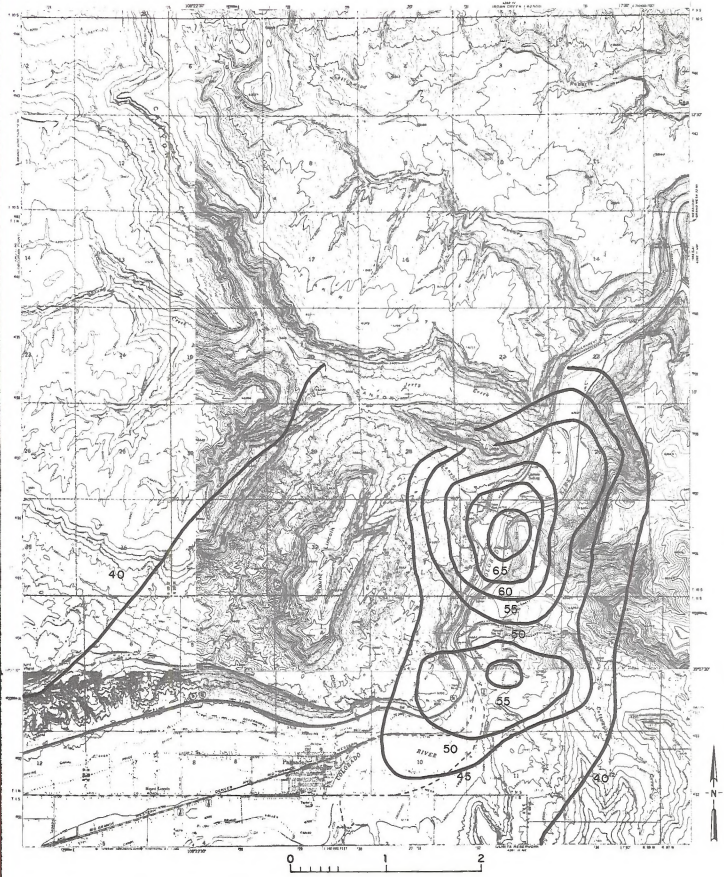
Wind data from the Mt. Logan-Mt. Callahan reach of DeBeque Canyon (see chapter 2) indicated that winds blew from the south-southwest, or up canyon, for all 24 hours on five different days in one year and from the north-northeast, or down canyon, on two entire days. These time periods were assumed to produce the highest concentrations since downwind receptors would be in the plume continuously. From these 24-hour periods, the two days (one with south winds and one with north winds) with the lowest average wind speeds and most stable atmospheric conditions provided the meteorological input for modeling.

The annual average emission rates were also used to predict maximum concentrations because no information was available on seasonal variations in production. Although it is expected that emission rates would vary somewhat throughout the year, the sources at Cottonwood Creek mines are not subject to great increases in emissions due to equipment malfunction or high wind speeds. Also, increased emissions at different sources would



★ Surface Facilities

Map MB3-1. Predicted increases in ambient concentrations in 1990 (micrograms per cubic meter)



Map MB3-2. Cumulative concentrations from proposed actions in the DeBeque Canyon area (micrograms per cubic meter)

occur independently rather than simultaneously and would probably not occur at the same time as the most adverse meteorological conditions.

Predicted maximum concentrations from the mine in 1990 are shown on map MB3-3. With winds from the north, a maximum concentration of about 100 $\mu g/m^3$ is projected to occur just west of the surface facilities. The impact from Cottonwood Creek mines would extend well out into the Grand Valley (at least 5 miles). With winds from the south, the maximum concentration is predicted to be 85 $\mu g/m^3$. These concentrations would be less than the 24-hour primary air quality standard of 260 $\mu g/m^3$ and the secondary standard of 150 $\mu g/m^3$, and the very high concentrations are projected to occur only in the immediate vicinity of the mine. The maximum 24-hour concentration in 1985 would be 49 $\mu g/m^3$.

Because the short-term dispersion model involves prediction of extreme conditions for meteorology and emission rates, it is probably slightly less accurate than the annual model.

Impact on Visibility

The addition of particulates into the atmosphere as a result of emissions from the mine would reduce visibility in the area. A calculation of the degree of visibility reduction depends on several parameters for which data are not available, the most important being size distribution of the particles. However, a rough approximation of visibility can be made based on suspended particulate concentrations. A relationship between these two variables in rural west-central Colorado has been empirically determined by Ettinger and Royer (1972); it is shown in figure MB3-1.

It should be emphasized that this relationship was developed with uniform atmospheric particulate concentrations, not near a plume of fugitive dust containing relatively large diameter particles. Also, it does not consider visibility reductions due to precipitation. Therefore, the equation is more likely to predict visual range over an averaging period of a year than for a short-term period such as 24 hours.

As indicated on map MB3-1, particulate concentrations in 1990 would be increased to a distance of at least 3 miles from the surface facilities. Along a line of sight from the main mine buildings to the north or southwest, concentrations would be increased an average of about 9.5 $\mu g/m^3$ over this 3 mile distance. Using the equation above and a background particulate concentration of 42 $\mu g/m^3$, the estimated reduction in visual range on the mine site as a result of mining emissions would be about 6 miles on an annual basis. Because of the limited area of air quality impact, average visibility would probably only be affected at the extreme eastern end of the Grand Valley. Visibility reductions in 1985 would be about half of those predicted for 1990.

Geologic and Geographic Setting

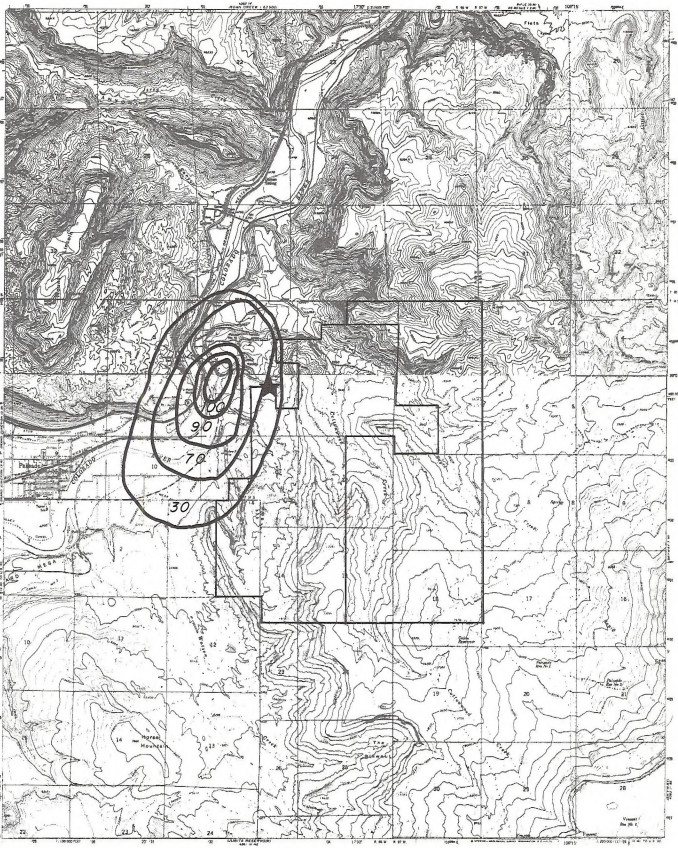
Topography

Impacts to the topography of the Cottonwood Creek mine property would be minimal. Three aspects of the mining operation would introduce alterations of the existing topography: excavation and earthmoving associated with construction of surface facilities; long-term use of the refuse disposal area; and surface subsidence.

The excavation and earthmoving in preparation for construction of surface facilities would alter the existing topography of 61 acres (or 1 percent) of the surface topography of the mine site. In the area where most disturbance would occur for construction of mine offices, bathhouses, warehouses, etc., natural slopes average approximately 12 percent (or 7 degrees). The area designated for refuse disposal varies from 5 percent to 25 percent (or 3 degrees to 14 degrees). No information concerning the projected topography for the 25 year or longer mine life was provided. However, benching, grading, and leveling would be required. In addition, some areas could require blasting and cliff scaling. Level surfaces and cut-and-fill slopes would replace the natural steep slopes. The modified surfaces would alter the drainage characteristics of the area, and both erosion and runoff could increase. In addition, noise and vibration would add to the landslide and rockslide potential of the area (see Soils for further discussion).

Long-term use of the refuse disposal area would gradually alter the surface topography of 31 acres (or 0.6 percent) of the mine property. (Note: these 31 acres are included in the 61 acres above). Natural topography is discussed above for the site. No information concerning the projected final topography of the area has been provided by the company. The company has stated that 300,000 tons of mine refuse would be deposited at the refuse disposal site annually. At this time, it is only possible to predict that the surface elevation of the area would be raised.

A more significant impact of the proposed mining operation would be surface subsidence. A total of 5,040 acres (or 91 percent) could be subject to surface subsidence. Based on the *Subsidence Engineer's Handbook*, a maximum of 12 feet of surface subsidence could occur on the mine property. Subsidence in most areas could be significantly less. Surface subsidence could induce open fractures, broken surfaces, and hummocky terrain over the surface. This subsidence may change the drainage characteristics of the area; small changes in the



Map MB3-3. Predicted maximum 24-hour concentrations in 1990 (micrograms per cubic meter)

water table and in water courses could occur. In addition, erosion and sedimentation from the area could increase.

Three subsidence profiles were computed for areas which could be particularly vulnerable to the effects of subsidence. These were areas underlying Cabin Reservoir and the water collection and storage facilities of the town of Palisade. These profiles indicate that because of Cabin Reservoir's distance from the area to be mined, no subsidence can be predicted within 100 feet of the dam and no strain should result to the dam. However, drainage characteristics of the upstream area could be changed.

Due to the shallow overburden present on the northern boundary of the lease area, subsidence could affect the area. A maximum of 12 feet of surface subsidence could occur in the area. This maximum subsidence is predicted for the center of the longwall panel with subsidence decreasing as the distance from the center of the longwall panel increases. Surface strain resulting from subsidence would be significant to buildings and pipelines in the area. Pipelines without angling and telescoping joints would fracture and rupture as the surface subsides.

No subsidence has been reported in the area from mine workings which have existed since the early 1900s. All of the mining in the area has been room-and-pillar; up to this point, no longwall mining has occurred. The lack of subsidence could be attributable to a 25- to 30-foot resistant "beam" or sandstone bed 40 feet above the Cameo seam. Although the presence of this resistant sandstone would not affect subsidence from the mining of the Carbonera coal seam which overlies it, it would significantly reduce the total subsidence in the area. It is doubtful that this sandstone has the ability to withstand the stresses induced by longwall mining.

In addition, subsidence induced by mining could increase air circulation at depth through fracturing, allowing spontaneous combustion of the coal beds. Burning of coal beds is thought to have occurred naturally under as much as 2,000 feet of overburden in the Terror Creek area of nearby Delta County, Colorado (Louis Gaspar, mining engineer, Coors Beer Company, 1977, personal communication). In addition to causing a loss of the coal resource, burning reduces the volume of coal and therefore may induce more subsidence above the seam.

Paleontology

Plant, invertebrate, and vertebrate fossil materials would be destroyed, disturbed, or removed as a result of coal mining activities, unauthorized collection, and vandalism. The primary impact would probably result directly from the mining operation. Given the overall character of the stratigraphic column, it is probable that some fossils would be destroyed. However, this stratigraphic section is only moderately likely to yield significant fossils when compared with other parts of the ES area.

All exposed fossil-bearing formations within the region could also be affected by increased regional population. The extent of this impact cannot presently be assessed due to a lack of information on such activities.

As a result of the above impacts, an undetermined number of fossils would be lost for scientific research, public education (interpretive programs), etc. On the other hand, as a result of development, some fossil materials would also be exposed for scientific examination and collection. Due to the present lack of data and accepted criteria for determining significance, the importance of these impacts cannot presently be assessed.

Mineral Resources

Coal

The mining and consumption of an estimated 61.6 million tons of coal under the Cottonwood Creek proposal, over an estimated mine life of 25 years or more, would deplete a nonrenewable energy source. The coal produced is expected to be exported from the area to utility plants for the production of electricity.

The underground mining of the coal seams by the proposed mining method would result in the recovery of approximately 50 percent of the in-place reserves of coal, amounting to 125 million tons. The longwall mining method would be the most efficient method to recover the leased coal.

The Cottonwood No. 1 Mine should be developed and mined before development of the Cottonwood No. 2 Mine is started, except for that portion from the Roadside Mine to the rock slope tunnels. If the Cameo seam, which lies 38 to 93 feet below the Carbonera, is mined first, subsidence from the fully retreating longwall method may cause some mining problems in the Carbonera. Normally, the Carbonera seam should be mined before mining is started in the Cameo seam. The two seams could be mined simultaneously with mining in the Carbonera being in advance of mining in the Cameo (see 30[CFR]: 211.32).

Oil and Gas

If oil and gas are discovered under the leased land, a settlement between well owners and owners of the leased coal would have to be reached as to which nonrenewable energy resource would be exploited first.

Water Resources

Ground Water

Mid-Continent hopes to intercept sufficient ground water in their mining operations to meet all consumptive uses except potable water for personnel (6.1 acre-feet annually) which would be purchased from local water utilities and piped to the site. Presumably, water rights would be obtained to permit the consumptive use of water obtained from the proposed mines. Should that supply be inadequate, supplemental water would be purchased from the local utilities. Total nonpotable water requirements are estimated by the company to be about 46 acre-feet per year (ac-ft/yr) or about 0.05 acre-feet per 1,000 tons of coal mined. This would be less than a third of the consumptive use normally required by underground mines when coal processing is necessary (regional analysis, chapter 1). It appears more realistic to assume that the proposed operations would consume about 170 acre-feet of water annually.

As stated in chapter 2, Description of the Existing Environment, the Carbonera and Cameo B coal seams and the underlying Rollins Sandstone appear to be only slightly permeable and are not regarded as potential aquifers in the proposed mine area. It is very doubtful, therefore, that the Cottonwood No. 1 and No. 2 mines would intercept more than 5 to 10 gallons per minute (gpm) (8 to 16 ac-ft/yr) during the initial stages of development and production through 1990. Thereafter, inflow to the mine may increase significantly as caving in conjunction with longwall mining causes fracturing of the overlying beds and promotes ground-water drainage into the mines. Even so, total ground-water discharge from the two mines would probably not exceed consumptive use by the mining operation until the fractures reach the surface (Dunrud 1976) and intercept runoff in Rapid and Cottonwood creeks. Alignment of the longwall panels with their maximum length eastward (map MB1-2) across the courses of both Rapid and Cottonwood creeks can be expected to promote east-west fracturing and to eventually interrupt these channels for a period of days or weeks until the fractures are grouted or become naturally sealed with fine-grained sediments. Although inflow to the mine could be as much as 1 cubic foot per second (cfs) (448 gpm) for brief periods, mine effluent would probably not exceed potential consumptive uses to the extent that effluent must be discharged to the Colorado River.

The proposed mining operations should cause no significant long-term impacts to the ground-water resource in or adjacent to the lease area. Recharge-discharge equilibrium would become reestablished as fractures intercepting the surface are eventually plugged with fine-grained sediments and streams once again contribute minimally to ground-water recharge. Any post-mining ground-water discharge from the mined interval should be small and would probably be dissipated by evapotranspiration before reaching the Colorado River.

Surface Water

With the onset of longwall mining at full production after 1985, open fractures and compression bulges can be expected to disrupt surface channels (Dunrud 1976), followed eventually by local subsidence at the surface. Runoff in these disrupted channels would tend to be diverted into the mines through the open fractures until the openings are eventually sealed by grouting or by sediment carried by the streams. Subsidence could create local depressions that would tend to pond water with consequent reduction in downstream flows. These surfacial disruptions are all temporary, however, and eventually would be eliminated by natural geomorphic processes.

More important, subsidence tension and compression forces induced by longwall mining would almost certainly break the old cast-iron water-supply lines that parallel Rapid and Cottonwood creeks through the lease area and provide water for the municipality of Palisade, Colorado. Consequent interruption of the municipal water supply would probably not occur until after 1990, but once started, these interruptions could be frequent and could continue for decades after mining operations are completed. Impact on the new line that Palisade proposes to build from Cabin Reservoir to their treatment facilities in the northwestern part of the lease area would depend on the design and construction of that line.

Permanent disruption of Palisade's water supply by subsidence-related fracturing that could divert some of their springs into the mines is a possibility, but the source of ground water feeding these springs is almost certainly from the south and east. It is highly unlikely, therefore, that fracturing would extend sufficiently far outside the lease area to intercept or reduce the flow of any of Palisade's developed springs. A small possibility also exists that fracturing could impact Cabin Reservoir, the upper reaches of which are only about 500 feet outside the lease area. At worst, however, some minor leakage might occur into the mines for a brief period until fine-grained sediments reseal the reservoir bottom. Calculations indicate that no subsidence or shear stresses should occur at the dam, which is 1,100 feet from the lease area at its closest point. A generally parallel statement can be made for an enlarged Cabin Reservoir.

Longwall mining would not extend beneath Palisade Reservoir No. 1 or the nearby water-treatment facility in the northwestern corner of the

tract. Neither of these structures, therefore, should be damaged by subsidence.

In any event, should the proposed mining operations adversely affect Palisade's water supply by contamination, diminution, or interruption, Mid-Continent must replace the water supply (30 [CFR]: 717.17[i]).

The increased population in Garfield and Mesa counties as a result of the proposed operations is estimated to be 2,300 persons by 1985 and 2,500 persons by 1990 (Socioeconomic Conditions). Assuming an average water use of 200 gallons per day per person (gal/day/person), sewage effluent of 60 gal/day/person, and an increase in dissolved solids of 200 milligrams per liter (mg/l) in sewage effluent, water and sewage treatment requirements and the increase in dissolved-solids load to the Colorado River are summarized in table MB3-3. Most of the increased demand for water would probably be placed on existing treatment facilities in Palisade and Grand Junction. Some domestic supplies may be obtained from wells, but the only suitable aquifer in the general area is alluvium bordering the Colorado River and its local tributaries. Wells, therefore, would be hydraulically connected to the surface streams and would have only slightly less effect than direct diversion of surface water for the needed supplies.

The small increase in salt load contributed to the Colorado River by the added sewage effluent attributable to increased population as a result of the proposed mine should have no significant impact on aquatic biology downstream. Consumptive use of water in the mining operation and by the increased population, coupled with the increased salt load returned to the river in sewage effluent, however, could increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0 mg/l by 1980, 0.026 mg/l (0.004 percent) by 1985, and 0.030 mg/l (0.00045 percent) by 1990. As small as this amount may seem, any increase in the salinity of the lower Colorado River water is regarded as a serious impact.

Flood Hazard

The portals and proposed facilities for the Cottonwood No. 1 and No. 2 mines are located near the head of a small unnamed ephemeral stream where flooding should be minimal and should present no danger to life or property.

Flooding on the Colorado River is also improbable because of upstream storage reservoirs. Any flood damage to the existing unit-train coal-loadout facilities near Cameo, therefore, should be minimal and should present no significant impacts to downstream areas or to the water resource.

Erosion and Sedimentation

The proposed operations would disturb a total surface area of 61 acres. Regulations 30 (CFR): 717.17(a) require that runoff from this disturbed area be routed through sedimentation ponds or other control structures that would limit total suspended solids in any effluent to 45 mg/l maximum allowable, except for discharge from a precipitation event larger than 10-year/24-hour recurrence interval. The average of daily values for 30 consecutive discharge days cannot exceed 30 mg/l. The effect would be to reduce sediment yielded to the Colorado River from the disturbed areas by an estimated 200 tons/yr. That amount would be insignificant in the Colorado River, which has an annual sediment load in this area in excess of a million tons/yr. (Iorns et al. 1965).

The largest unmitigated short-term source of sediment yielded to the Colorado River as a result of the proposed mining operations would occur off site in conjunction with housing and related construction to accommodate the increased population. Approximately 196 acres would be disturbed by 1985 and 212 acres by 1990. It is estimated that sediment yield to the river net would be increased about 1 ton per acre disturbed for the first one to two years after construction. Thereafter, sediment yield would decrease to about half the predisturbance rate. The initial increase in sediment yield, therefore, should be more than offset by the long-term reduction in sediment yield over the life of the structures. Any temporal adverse or beneficial impacts to the Colorado River from this comparatively small change in sediment yield should be insignificant.

Location of the disposal area away from any significant drainage courses as proposed should minimize any long-term increase in sediment yield to the Colorado River from this source. The Office of Surface Mining (OSM) recognizes the difficulties inherent in attempting to stabilize refuse disposal sites in areas of low annual precipitation such as at the Cottonwood Creek site and is currently considering special performance standards for these areas.

Soils

Soil impacts would result from surface subsidence, from the construction and operation of mine surface facilities, and from urban area expansion due to increased employment.

Coal removal could cause an estimated maximum surface subsidence of 12 feet (see Topography). Soil impacts would be minimal where no breaks occurred in the surface mantle. However, any sur-

TABLE MB3-3

WATER AND SEWAGE TREATMENT REQUIREMENTS
AND SALT LOAD RETURNED TO THE COLORADO RIVER

Item	1980	1985	1990
Population increase (persons)	0	2,300	2,500
Required increase in treated water supply (ac-ft/yr)	0	520	560
Required increase in sewage treatment (ac-ft/yr)	0	150	170
Consumptive use (initial use less sewage effluent (ac-ft/yr)	0	370	390
Increased salt load returned to the Colorado River (tons/yr)	0	42	46

face cracks could expose narrow bands of bare soil material; surface runoff could then be redirected, causing accelerated erosion.

The construction and operation of surface facilities would affect 61 acres by 1985 with no further change through 1990. Erosion rates would temporarily increase in response to surface disturbance. An estimated twofold to threefold increase could occur in the already high natural erosion rate. Most of this erosion, however, would be contained on site by drainage systems and other sediment control measures.

The net effect of increased erosion, along with a deterioration in soil structure, would be a reduction in soil productivity. Any such reduction, although unquantifiable at present, would intensify inherent revegetation problems of low natural moisture, poor topsoil, and often steep terrain. These problems would prolong the efforts necessary to achieve successful reclamation (see Vegetation).

Off-site disturbances due to mine-related population increases would amount to 196 acres by 1985 and 212 acres by 1990. The exact location of these acres cannot be predicted, although at least some portion would likely come from croplands (including prime farmland) in Mesa County. To this extent, crop production capacity would be permanently lost (see also Water Resources, Erosion and Sedimentation).

Vegetation

The bulk of the surface disturbance resulting from the mine portals and associated surface facilities would be in the arid saltbush hills immediately west of Palisade. Approximately 61 acres of rangeland dominated by shadscale, galleta grass, snakeweed, and prickly pear cactus would be disturbed by 1985 due to the development of the surface facilities, with no additional disturbance through 1990. The impacts of the disturbance would be a reduction of the visual aesthetics of the area, increased soil erosion, and a reduction of the numbers of wildlife and livestock in the area (discussed in the appropriate sections).

Mid-Continent would be required to revegetate the 61 acres of disturbance at the Cottonwood Creek site when the disturbed areas are no longer needed. The majority of the disturbance would not be revegetated until abandonment of the mine. Specific revegetation measures that would be required are stated in 30 (CFR): 717.20 and 30 (CFR): 211.40, 211.41, and 211.62, in the *Federal Register* (Vol. 42, No. 239, and Vol. 41, No. 96). These regulations are discussed in detail in the regional volume, chapter 4, Vegetation.

Revegetation Problems and Probability of Success

The revegetation of disturbed areas would be difficult, due to many factors. Climatic conditions are severe with extremes in temperature and wind, and a low annual precipitation (approximately 10 inches). Insufficient moisture is the main factor hampering successful revegetation (Cook, Hyde, and Sims 1974; Hassel 1977; Hodder 1977). There also may be periods of drought, such as in 1976 when the annual precipitation was as low as 5 inches. Other revegetation problems which may be encountered are steep slopes; soil conditions which are detrimental to plant life (see Soils); competition for moisture, nutrients, and light from undesirable weedy plant species; low germination rates of seeds; and destruction of seedlings by wildlife.

Various revegetation techniques have been developed to counter such problems. They are discussed in the regional volume, chapter 4. The use of many of these techniques may be necessary to establish "a diverse vegetative cover capable of self-regenation and plant succession and at least equal in density to the natural vegetation," as required by the federal regulations (30 [CFR]: 211.40[a][13][i]).

Hassell (1977) states that in desert areas conditions favorable for establishing vegetation come every four to six years. Numerous researchers have indicated that irrigation may be necessary for establishment of seedlings on disturbed arid sites which receive 20 inches or less annual precipitation (Aldon 1977; Bengson 1977; Hassell 1977; Cook, Hyde, and Simms 1974; DeReemer and Bach 1977). Aldon, DeReemer and Bach, and Bengson (all 1977) have had success with drip irrigation techniques in arid environments. However, even if drip irrigation should prove should prove to be a feasible method for revegetating rangeland in the Grand Valley area, it is not assured that a sufficient source of water would be available for irrigation. To date, Mid-Continent does not have water rights for ground water or for water from the Colorado River. The company plans to buy water for their mining operations from public utilities at the town of Palisade (see Water Resources). Some of this water could possibly be used for irrigation of disturbed land upon cessation of mining operations.

Hodder (1976, 1977) has developed several methods for retaining soil moisture in a semi-arid environment through techniques such as pitting or gouging the soil surface, moisture collars, or condemsation traps. These techniques could eventually prove to be useful for reestablishing vegetation on dry rangeland in arid environments.

Past revegetation attempts in the arid Grand Valley (at or less than 10 inches annual precipitation) have met with little success. According to

conversations with the Soil Conservation Service and the Colorado Department of Highways in Grand Junction, the only successful revegetation in the area has been along Highway 70 west of Loma. The highway right-of-way was seeded six years ago, and a good stand of crested wheatgrass, western wheatgrass and Indian ricegrass is present now. The sping following the seeding had much higher than normal precipitation (U.S. Weather Service Data for Fruita). The Highway 70 right-of-way between the Clifton interchange and Walker Field in Grand Junction has been seeded three times without any success.

In spite of the fact that various revegetation techniques involving both dryland revegetation and irrigation show potential for successful revegetation in arid environments, many of these techniques are yet in the research stage, and their feasibility for use in the Grand Valley has not been proven. Because of this, and the only marginal success of past revegetation efforts in the Grand Valley, successful revegetation of disturbed land at the Cottonwood Creek site is not certain except in years of higher than normal winter or spring precipitation.

Other serious problems at the Cottonwood Creek mines which may affect successful revegetation are steep slopes and the unavailability of topsoil. Steep south-facing slopes may be resistant to seeding attemps due to extremely droughty conditions (Dahlquest 1977). There is minimal topsoil and subsoil at the mine site. Consequently even if all the soil material is stockpiled and reapplied to the disturbed areas upon abandonment of the mines, a sufficiently deep plant growth medium for reestablishment of vegetation may not be present. According to most researches, to successfully revegetate disturbed areas, a plant growth medium to a depth of at least 18 to 24 inches is required (Cook 1974).

A deficiency exists in the revegetation section of Mid-Continent's Cottonwood Creek M&R plan which may affect sucessful revegetation. The use of a mulch is not discussed. In arid environments mulching is necessary for the reestablishment of vegetation on disturbed areas (Cook, Hyde, and Simms 1974).

Three plant species listed for revegetation at the Cottonwood Creek mine are: Norden crested wheatgrass, Arriba western wheatgrass, and Paloma Indian ricegrass. The use of only grasses for revegetation is not consistent with post-mining land use. The reestablishment of a mixture of adapted shrubs, grasses and forbs would best satisfy the post-mining land uses of wildlife habitat and livestock range. Wildlife (particularly big game) utilize mostly shrubs, while livestock graze mostly grasses. Both utilize forbs to a certain extent, mainly in the early spring. Information in the appendix, volume 3 shows plant species occuring naturally within the region which have proved useful for revegetation. Those species shown as adapted to the saltbush type would be particularly well adapted for revegetation at the Cottonwood Creek mines.

Natural revegetation would occur where the soils are stable and do not contain materials toxic to plant growth. Weedy annuals such as Russian thistle would be the first to invade the disturbed areas, followed by a succession of longer lived plants until a persisting (climax) plant community of adapted perennial species similar to adjacent undisturbed areas exists. This natural succession process may take anywhere from 30 to 60 or more years depending on varying microenvironmental conditions such as slope, distance from undisturbed communities, etc.

Population-Related Impacts

Urban expansion caused by population increase related to coal mining would result in the disturbance of an estimated 196 acres by 1985 and 212 acres by 1990. It is probable that much of this disturbance would be on agricultural land surrounding existing population centers. This is discussed further under Soils.

Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road-vheicle use (see Recreation). This disturbance would lessen the productivity of native vegetation for livestock and wildlife forage. The probem would be most serious in low altitude Mancos shale hills and in alpine areas above timberline.

Wildlife

Development of surface facilities and waste disposal sites would disturb a total of 61 acres of saltbush by 1985, and this would be the extent of the disturbance through 1990. Something less than 61 acres would be disturbed at any given time because more than half (35 acres) of the disturbance would result from waste disposal, which would be done in steps. Small mammals and reptiles on the 61 acres would be killed during development and operation of the mine. In addition, the surface facilities would be developed on crucial mule deer winter range, which would therefore support fewer deer through the five-month winter season (table MB3-4). Deer use would decrease by 21 deer per year and elk use by 2 elk per year, from 1985 to 1990. Increased human and mechanical activity would also reduce mule deer and elk use by an average of 50 percent on an adjacent 300 acres (assuming that impacts would be progressively less, the farther the habitat is from the disturbance). Other species which would be less likely to

TABLE MB3-4

IMPACTS ON WILDLIFE

Year	Total Disturbed Acres	Number of Animals that These Acres Could Support					Additional Acres Disturbed	Additional Animals that Could be Supported		
		DDA	D	EDA	E	WH		D 50%	E 50%	WH 50%
1977	0	56	0	1.6	0	-	-	-	-	-
1980	0	56	0	1.6	0	-	-	-	-	-
1985	61	56	21	1.6	2	-	300	51	4	-
1990	61	56	21	1.6	2	-	300	51	4	-

Note: DDA = deer days per acre; EDA = elk days per acre; D = deer; E = elk; WH = wild horses.

use the area include coyotes, bobcats, golden eagles, and prairie falcons. The overall impacts are summarized in table MB3-4.

It is difficult to predict to what extent subsidence would affect wildlife because of lack of information about the effects of subsidence. In general, it can be expected that animals would avoid using an area which is subsiding, because of its instability. To large extent, wildlife would gradually develop trails through the areas.

On the Cottonwood Creek property, the 12 feet of subsidence (worst case) could substantially impact the deer and elk wintering areas along Cottonwood and Rapid creeks and could cause the loss of this area to the wintering animals until the ground has stopped settling. However, even then, because of the 12 feet of topography changes, this area would not support the number of animals that it does now.

Increased road kills of small rodents and birds, and possibly mule deer in the winter, could result from mine traffic and coal trucks on the site. Off the lease area, vehicle traffic for the most part would be on I-70 or through orchard and residential lands. Because existing traffic is high, little impact is expected as a result of increases due to coal mining.

New power lines could be a physical hazard to birds in flight. Poles and substations, if not properly designed, would be electrocution hazards to the larger raptors.

The cliffs lying above the Blue Flame and Go-Boy tracts are suitable for use by cliff-nesting species, such as golden eagle and prairie falcon, which are known to utilize cliffs in the vicinity. Approximately 1 mile of cliff face would no longer be usable habitat due to the mine activity planned on the bench at the foot of these cliffs.

Some waterfowl nestings and brood rearings in the vicinity of the loadout could be disrupted and even eliminated by the human activity close to the river. Activities could impede movement of chukars to watering areas near the Highline Canal.

Secondary impacts from the proposed action would include increased human population, resulting in expansion of urban areas onto agricultural lands and some crucial winter range; increased vehicular traffic, resulting in an increase in vehicle/animal collisions; and increased recreational use of the area, causing an additional stress on the animals and increasing legal and illegal harvest of animals.

Endangered or Threatened Species

In the vicinity of the Colorado River, increased truck traffic and unit-train loading facilities could disrupt hunting activities for two important raptors, the bald eagle and the peregrine falcon. The site for the loading facilities, on private land, has already been cleared of its vegetative cover, eliminating most of its value to raptors. Further clearance or disturbance in the riparian type adjacent to the Colorado River could further diminish the amount and quality of hunting areas for these two species, since the prey for both species is generally found in riparian or aquatic habitats. Coordination with the U.S. Fish and Wildlife Service (USFWS), under Section 7 of the Endangered Species Act of 1973 and the Bald and Golden Eagle Protection Act (16 USC 668-668d) has been completed. USFWS comments can be found in chapter 9.

Aquatic Biology

Increased consumptive use of 540 acre feet of water per year by the coal processing activities and by 2,500 new people in the area by 1990 would further deplete the amount of water available for fish and aquatic wildlife habitat in the Colorado River. This consumption alone is not significant when compared with the annual average discharge of the Colorado River of 2,789,000 acre-feet per year. However, it gains in significance when all water uses and developments in the basin are compared with the quantities of water available to support fish and wildlife habitats during yearly low-flow periods (see regional volume).

All ground water intercepted in the mining operation would be used in coal processing and mine operations. Discharge of mine water to the Colorado River would not take place and poses no threat to the aquatic habitat.

All runoff from surface areas disturbed by mine construction and operation would be retained in sediment ponds as required by 30(CFR): 717.17. Sediment retention ponds would contain all runoff from a storm event up to a 10-year/24-hour storm. Spillways on ponds would be designed to safely pass a 25-year storm event. Discharges of water from these ponds, should they be necessary under normal conditions, may not exceed 45 mg/l total suspended solids and the 30-day average discharge may not exceed 30 mg/l. A discharge of this concentration of suspended solids, should it occur, would not adversely affect the aquatic ecosystem of the Colorado River downstream from the lease site.

Sediment retention ponds may legally spill in a precipitation event larger than a 10-year/24-hour storm. In such a case some coal dust and other fine sediments from the ponds might flow into the Colorado River. In a 10-year/24-hour storm, total sediment yield from the many highly erosive watersheds adjacent to the Colorado River would be so large that the amount of sediment coming from the retention pond spillway would be unmeasurable

in the river and have insignificant impacts. Also, the increased dilution in the Colorado River during a large storm would largely decrease the concentration of all water quality parameters. No adverse effects on the aquatic habitat or the threatened and endangered fish species are presently projected. Aquatic organisms presently living in this part of the Colorado River normally withstand a total suspended solid concentration ranging from 59 to 4,420 parts per million (ppm), with an average of 2,270 ppm and a total dissolved solid content averaging 200 to 250 mg/l in the spring and 600 to 650 mg/l during low flow periods.

The sediment retention ponds would be near the head of a small ephemeral tributary to the Colorado River. There would be a minimal chance of these ponds overflowing to the Colorado River. Water from the ponds would be evaporated or used for revegetation, thus there would be no impact on the aquatic habitat of the Colorado River.

The coal refuse pile would be constructed on a large flat area away from any significant drainage. Proper construction in compliance with 30(CFR): 717.17, and phased revegetation would prevent materials in the refuse pile from being washed into the Colorado River and impacting the aquatic ecosystem. Acid mine drainage and increased metal concentrations would not exist in this area due to the high pH and buffering capacity of local waters and the low sulfur content in the coal.

Threatened or Endangered Species

As discussed above, no adverse impacts to the threatened and endangered fish species in the Colorado River are presently projected. Coordination with the USFWS, under Section 7 of the Endangered Species Act of 1973 has been completed. USFWS comments can be found in chapter 9.

Cultural Resources

Archeological Resources

The results of the West-Central Colorado Coal Lease Survey have demonstrated the significance of the Cottonwood lease area in prehistoric settlement patterns. With approximately half the lease area surveyed as part of the sample transect, similar site distribution would be expected throughout the lease property. Evidence of continuous occupation indicates the possibility of subsurface sites in addition to the 26 previously recorded.

Surface disturbance from construction and mine activities could destroy, remove, or alter any archeological sites existing within the 61 acres proposed for surface disturbing actions. Subsidence, as it could effect 5,040 acres, could result in surface disturbance. Alteration of the surface and immediate subsurface strata from slumping and cracking could result in the displacement and damage of cultural values. In addition, subsidence, as it could affect the topographical setting of a site, might destroy important environmental information relevent to archeological interpretation.

Population increases in the Grand Valley as a result of the proposed action and regional development may make this area more susceptible to vandalism due to its proximity to population centers. Sites located in the lease area do display evidence of human visitation and disturbance (Hibbets 1978). With controlled access, vandalism from the proposed action should remain a minimal impact, although the presence of 400 mine-associated employees on the lease property (by 1990) would mean increased exposure of archeological values to public passage.

The recommendation of Transect 7 for inclusion into the National Register emphasizes the importance of preservation of the total area rather than of individual sites. Reconstruction of prehistoric settlement in this area would require examination of the relationship between the location and types of sites and the various environmental zones and resources within which they are found. Any disruption to the natural and cultural integrity of this area from the mine development could result in the loss of valuable data essential to the understanding of prehistoric utilization of this area and its relationship to settlement in the ES area as a whole.

Historic Resources

Because the extent of historic sites in the mine area is not fully known, the following impacts may occur. Surface-disturbing activities, such as mining or construction of facilities and roads, could disturb buried sites or destroy sites that might be considered unimportant by the project's engineers. Because of the intrusion of buildings, roads, fences, etc., some sites might lose the aesthetic integrity which is important to the overall quality of the site (as outlined in 36[CFR]: 800.9). Sites remaining near or at the project might be vandalized due to increased access or human use; damage could include "stripping" of wood, removal of artifacts, etc.

Land Use

Approximately 61 acres on the lease area would be used for surface facilities. At least for the life of the mine, this acreage would not be available for wildlife habitat or livestock range. Revegetation of the disturbed acreage may be difficult because of lack of moisture, steep terrain, and the unavailability of topsoil. Natural revegetation would occur (after mining has ended) where soils are stable and

do not contin elements toxic to plants, but it would take at least 30 years and perhaps more than 60 years. Until the disturbed acreage has been revegetated, either mechanically or naturally, it would presumably be unavailable for wildlife or livestock use.

In addition, increased human activity would reduce mule deer and elk use during mine-life by an average of 50 percent on an adjacent 300 acres, and approximately 1 mile of cliff face would no longer be usable raptor habitat because of mine activity at the bench of the cliff.

None of the mining activities would affect implementation of the Cottonwood Creek-Lloyd allotment management plan (see chapter 2, Future Without the Proposal).

The Cottonwood Creek operation, along with GEX Colorado Company's nearby Cameo and Roadside mines and Public Service Company of Colorado's Cameo power plant, would contribute to the trend toward industrialized land use in De-Beque Canyon. Traffic on I-70 would increase as a result of mine personnel going to and from work, and train traffic would increase as coal is shipped to market.

As a result of the Cottonwood Creek mines, population in Mesa County would increase by 2,000 people by 1985 and 2,050 people by 1990, and population in Garfield County would increase by 300 people by 1985 and 450 people by 1990. Some of the resulting residential and urban expansion would probably encroach on agricultural land and wildlife habitat. Orchard land in the Grand Valley is considered unique farmland, and much of it is in areas which meet the definition of prime farmland. However, the actual location of this urban development would to some extent depend on future county and community land use planning and zoning.

GEX Colorado Company's Cameo No. 2 Mine and Mid-Continent's Coal Canyon Mine may also be developed, and extensive oil shale and uranium development is likely to occur in the general area. These developments would contribute significantly to population growth in Mesa and Garfield counties and would accelerate changes from agricultural and wildlife land uses to urban and industrialized land uses in those two counties.

Transportation

HIGHWAYS

Traffic on I-70 would increase as a result of mine personnel going to and from work. The work force of 400 people could increase daily traffic by as much as 530 vehicles per day. This would be about a 10 percent increase over 1976 levels. No impacts on the highway capacity are anticipated because I-70 is being upgraded to interstate standards (including a grade separaion). The highway is also presently operating below capacity. No impacts are projected for the Cameo interchange. There would be a slight increased in the number of accidents as a result of greater traffic volumes.

Coal would be trucked on a private road from the coal preparation plant near the mine to the railloadout facilities near the Cameo power plant. There would be no coal truck traffic on I-70.

RAILROADS

According to the proposed M&R plan, coal from the Cottonwood Creek mines would be transported from the loading facilities near the Cameo power plant to the consumer in unit trains using the Denver and Rio Grande Western Railroad facilities. At full production of 1 million tons per year, one or two trains per week would be required to move the coal. The M&R plan mentions no specific market, but assumes it would be a utility company outside Colorado. These two trains per week would add to the congestion in eastern slope cities where coal from other producing areas also passes.

AIRPORTS

Passenger traffic at Walker Field would increase as a result of the Cottonwood Creek Mine development. Facilities at the airport are adequate to handle this increase.

Livestock Grazing

Approximately 6 animal unit months (AUMs) of forage would be lost annually during the life of the mines, beginning in 1985 and continuing through 1990, due to the disturbance of 61 acres of the saltbush type (see Vegetation). This disturbance would result from the construction of the mine portals and associated surface facilities. The livestock qualifications (maximum livestock use permitted) on the public land disturbed would have to be reduced due to this loss of livestock forage. However, the reduction in AUMs would only be 2.16 percent of the total before the mine (qualifications = 278 AUMs) and would not result in severe hardship to the livestock operator grazing the Cottonwood-Rapid Creek and Lloyd allotments.

It cannot be assumed that the 6 AUMs of livestock forage lost would be restored upon abandonment of the mine. This is because revegetation of the disturbed areas is not certain, due to conditions at the mine site which in most years are unfavorable for revegetation (see Vegetation). However, if successful revegetation can be accomplished approximately 12 AUMs per year would be restored to the disturbed areas after abandonment of the

mine. This assumption was made because the species mixture used in revegetation would consist mostly of grasses.

None of the range improvements proposed in the new allotment management plan for the Lloyd and Cottonwood-Rapid Creek allotments would be affected by the proposed surface facilities.

It is very likely that some of the acreage disturbance resulting from urban expansion due to increased population (196 acres in 1985 and 212 in 1990) would be on irrigated and nonirrigated hayland and pasture. This would adversely affect the livestock industry because these lands are used as livestock wintering areas, and the hay harvested from them in the summer is used to feed the livestock during winter.

Recreation

The influx of additional population due to the Cottonwood Creek site and the subsequently increased demand for recreational opportunities could have an impact on existing recreation resources and facilities, particularly community facilities in the Grand Junction-Palisade area. Since Grand Junction's recreational facilities are now fully utilized (Grand Junction Recreation Department 1977), increased use would result in overuse which would lead to their deterioration and lower their capacity to provide enjoyable recreation. The community facilities needed to meet the increased demand and prevent overuse are projected in table MB3-5, which shows a need for 7.6 acres of active/improved park land by 1985 and 8.2 acres by 1990. Capital investment needs to provide the facilities are also projected in table MB3-5.

The increased demand for dispersed recreation opportunities (e.g., hunting, hiking, ORV use) should not adversely affect the recreation resource; however, concentrated use, such as an ORV rally, could lead to vegetative deterioration and reduce the recreational experience on that site. BLM is in the process of determining open, restricted, and closed designations for public lands, which should help alleviate this problem. Increased use of recreational facilities (such as Island Acres Recreation Area) would lead to increased maintenance costs for the managing agencies. The extent of the increased usage and costs are not known.

The increased use of recreational facilities could be offset by providing additional facilities. The Heritage Conservation and Recreation Service through the Land and Water Conservation Fund Act (PL 88-578), could provide monies for this purpose if matching funds are provided by the local agency. The Mineral Leasing Funds (Co. S.B. No. 35, Section 2, 34-63-102), which can be used for public facilities and services, could also be used for recreation facilities. In addition, BLM could provide lands for these recreation facilities under the Recreation and Public Purposes Act, 43(CFR): 2740, which allows nonprofit associations to acquire lands for recreation purposes consistent with their creating authority. These actions, however, cannot be required by the Department of the Interior; therefore, the initiative for taking these courses of action would be up to the local agencies and the success of mitigation would depend on their commitment to it.

The lands of the Cottonwood Creek lease site are not now proposed for any wilderness study and, due to the presence of existing roads, are not expected to be studied.

Visual Resources

Construction of offices, shops, etc., would be a change in land use, resulting in some disturbance of landforms and vegetation (see the appendix, volume 3, for contrast ratings.) The site would be difficult to see because it is located above I-70 and is masked by a small hill. Thus, it would be visible only to eastbound traffic and only for approximately 22 seconds. The present visual resource management (VRM) Class IV rating for the area stipulates that changes may dominate the original landscape, but that they should reflect what could be a natural occurrence. The roads, wash plant, etc., would dominate the site but could never be interpreted as natural. Given this criterion, the VRM Class IV would have to be reevaluated and probably changed to a Class V to incorporate rehabilitation objectives for the post-mining landscape.

The refuse disposal site is situated at the base of a steep hill. The severity of the visual impact of 300,000 tons of refuse annually would depend on the color of the material and the success of the revegetation program. The refuse would alter the landform shape and the existing vegetative pattern, and it would eventually add an approximately 35-acre surface that would look unnatural due to the required terracing. Terrain masking would obscure the lower portions of this refuse area for I-70 travelers.

The coal haulage trucks, employee traffic, power lines, etc., resulting from the mine would further change the general landscape character of the southern end of DeBeque Canyon; air pollution would reduce visability by an average of 6 miles for the extreme eastern end of the Grand Valley. The visual attractiveness of the canyon has been modified by the existing Roadside Mine operation, Cameo power plant area, power lines, etc. If this industrial land use is expanded by the Mid-Continent proposal, the visual resource of the canyon would be further degraded. The current VRM Class II rating for most of DeBeque Canyon would

TABLE MB3-5

COTTONWOOD CREEK: ADDITIONAL COMMUNITY RECREATION FACILITIES DEMAND

	1980	1985	1990
Population growth	260	2,300	2,500
Active/improved parks a/ (3.3 acres per 1,000 residents)	0	7.6 acres	8.2 acres
Capital investment ($66,666 per 1,000 residents)	0	$153,332	$166,665

Source: Bickert, Browne, Coddington, and Associates, Inc., Boomtown Financing Study, Vol. II, (July 1976).

a/ Ballfields, tennis courts, playgrounds, etc.

be further reduced by the continued development in the canyon.

Socioeconomic Conditions

Demography

In calculating the population growth associated with the Cottonwood Creek mines, the same assumptions were used as were used with the Coal Canyon Mine, that is, that 80 percent of the employees would reside in Mesa County and the remaining 20 percent would reside in Garfield County. The Cottonwood Creek operation would increase Mesa County's population by 2,000 persons by 1985 and 2,050 persons by 1990. In Garfield County the increase in population due to the Cottonwood Creek mines would be about 300 people by 1985 and 450 people by 1990.

The community of Palisade, in Mesa County, is the closest town to this mine site, as well as to the Coal Canyon and GEX Colorado Company's Cameo mine sites. As a result, Palisade would experience a great deal of growth pressure; however, actual growth in Palisade would be limited because of its small size and water and sewage treatment design capacities. As chapter 2 points out, both the water and sewage treatment facilities in Palisade are being upgraded to accommodate about an additional 1,500 people.

Most of the in-migrating population associated with the Cottonwood Creek mines which does not settle in Palisade is expected to settle in the Grand Junction area. The small communities of DeBeque and Collbran would also receive some population influx as a result of Cottonwood Creek.

Grand Valley and Rifle are the closest communities in Garfield County to the Cottonwood Creek site. Since these two communities are expected to experience strong growth pressures from the numerous oil shale development operations in the same area, as well as the Coal Canyon and Cameo mines, available housing would be at a premium. This may result in a scattering of population growth from the Cottonwood Creek mines throughout Gafield County.

Community Attitudes and Lifestyles

The combined development of the Coal Canyon, Cottonwood Creek, and Cameo mines may have a pronounced effect upon the small community of Palisade. Palisade has remained a stable, agricultural community, with a relatively high concentration of older persons, for some time. A rapid influx of new population would certainly disrupt the present character and social structure of the community. It would also place a burden on the elderly residents as the cost of living rises due to the demand for increased local government services. General changes expected in attitude and lifestyle due to increased coal mining in the area are discussed in the regional volume.

Noise

A group of twenty residences northeast of Palisade is located along a road which is proposed as the access road to the Cottonwood mines. Daytime equivalent noise levels (L_{eq}) through this neighborhood vary from 57 to 48 decibels (dBA), the principal sources of noise being interstate highway and railroad traffic. Since the proposed access road is narrow, tortuous, and steep, it is estimated that daytime values of L_{eq} would vary between 62 and 70 dBA at residences within 200 feet of the access road. This assumes a work force of 400 and traffic spread over a twelve-hour period.

Because of the current attitude of the community toward the project, it is probable that the community reaction would be "severe". The interference with speech would be disturbing to a community oriented toward outdoor activities for both occupational and recreational purposes. The sound levels are not high enough to be considered a contributor to hearing loss, but sleep interruption would be a problem if mine traffic continues into normal sleeping hours.

Community Facilities and Services

The projected minimum community facility requirements for Mesa and Garfield counties associated with the Cottonwood Creek operation are listed in table MB3-6. These figures were derived in a similar manner to those contained in the regional volume, chapter 4, Socioeconomic Conditions.

Table MB3-6 does not reflect the major capital expenditures which are now being made in many communities in both Mesa and Garfield counties. These cost figures represent needed capital requirements over and above any facilities which exist or which are under development.

Increases in the local property and sales tax revenues attributed to the Cottonwood Creek development are listed in table MB3-7. These revenues represent the total property and sales tax revenues expected to flow to all local government entities. Since the estimated increases in community facility expenditures would be borne by county, municipal, or special district units of local government, it is necessary to subtract the school district share of the revenues in order to make a comparison. If this is done, it decreases the locally derived revenues available for county, municipal, and special district purposes in Mesa County to an estimated $726,010 in 1985 and $770,650 in 1990. Comparing these

TABLE M83-6

COTTONWOOD CREEK: ADDITIONAL REQUIREMENTS FOR COMMUNITY FACILITIES

Facility	Mesa County					Garfield County				
	Physical Plant Requirements	Capital Costs 1990	Operating Costs/Year 1980	1985	1990	Physical Plant Requirements	Capital Costs 1990	Operating Costs/Year 1980	1985	1990
Water treatment	0.41 mgd	$ 358,570	$ 0	$ 25,040	$ 25,670	0.09 mgd	$ 78,710	$ 0	$ 3,760	$ 5,360
Sewage treatment	0.12 mgd	$ 401,800	$ 0	$ 19,320	$ 19,800	0.03 mgd	$ 89,100	$ 0	$ 2,900	$ 4,350
Police protection	1 vehicle & 820 sq.ft.	$ 55,740	$ 0	$ 80,000	$ 82,000	180 sq.ft.	$ 12,060	$ 0	$12,000	$18,000
Fire protection	1 vehicle & 2,050 sq.ft.	$ 100,000	$ 0	$ 41,000	$ 41,000	450 sq.ft.	$ 18,000		Volunteer	
Streets and roads	48 acres	$1,546,560	$ 0	$ 45,590	$ 46,560	11 acres	$354,420	$ 0	$ 6,790	$10,670
General government	510 sq.ft.	$ 26,010	$ 0	$ 64,800	$ 66,100	110 sq.ft.	$ 7,080	$ 0	$10,370	$14,260
Libraries	6,150 books & 1,130 sq.ft.	$ 83,430	$ 0	$ 16,600	$ 17,020	1,350 books & 250 sq.ft.	$ 18,430	$ 0	$ 2,490	$ 3,740
Total	-	$2,572,110	$ 0	$292,350	$298,150		$586,800	$ 0	$38,310	$56,650

Note: mgd = million gallons per day; sq.ft. = square feet of space.

TABLE MB3-7

COTTONWOOD CREEK: INCREASED REVENUES TO GARFIELD AND MESA COUNTIES

	1980	1985	1990
Garfield County:			
Property Tax			
Homes	$ 0	$ 81,000	$112,820
Businesses	0	25,670	38,510
Sales Tax	0	49,620	74,430
Service Fees	0	860	1,290
Total	$ 0	$157,150	$227,050
Mesa County:			
Property Tax			
Homes	$ 0	$ 520,540	$ 532,850
Businesses	0	109,980	112,730
Mine	0	776,910	876,000
Sales Tax	0	249,200	255,430
Service Fees	0	8,340	8,540
Total	$ 0	$1,664,970	$1,785,550

revenues with the yearly operating expenses and amortized (at 6 percent interest over twenty years) capital expenses of $522,400 per year shows that Mesa County would experience a revenue surplus from the Cottonwood Creek mines.

Locally derived revenues available for county, municipal, and special district purposes in Garfield County are estimated to be $87,280 in 1985 and $127,930 in 1990. Comparing these revenues with the yearly operating expenses and amortized capital expenses of $107,810 per year shows that Garfield County would experience a revenue deficit in the early years of operation, but that would change to a surplus by 1990.

The Cottonwood Creek mines would pay large amounts to various levels of government in the form of royalties and taxes. Chapter 4 of the regional volume explains in detail what the programs are and how they work.

Royalties would be paid to the federal government when Mid-Continent mines federal coal. In 1985, this would amount to $640,000, of which the state of Colorado would receive $320,000. Mesa County would receive half of this amount, or $160,000. However, receipts from all royalty payments to any county are limited by Colorado law to $200,000. Mesa County likely would reach this limit, considering the other mineral developments in the county.

Although the state severance tax was originated partially to help impacted counties deal with growth, this law would provide very little relief to Mesa County. Presently, 45 percent of the severance tax paid by a coal mine goes into a local government severance tax fund and is used to help impacted counties. After June 30, 1981, however, all severance taxes are assigned into the state severance tax trust fund. Proceeds from the investment of this fund would go to the state general fund. Unless future legislative action amends the law, severance tax funds will provide little relief to Mesa County.

As explained in chapter 3 of the regional volume, investment in this mine is expected to be $36,000,000. Property taxes on this amount would be $710,860 per year in 1985 and 1990. Table MB3-8 shows how the property tax revenues would be distributed among the various recipients.

Housing

The projected demand for new housing in Mesa and Garfield counties as a result of population growth attributed to the Cottonwood Creek operation is summarized in table MB3-9. The assumptions regarding housing mix and family size that were used in the regional volume were also used in these calculations.

The housing requirements associated with the Cottonwood Creek mines represent about 5 percent of the total projected new housing requirements in Mesa County by 1990 and about 1 percent of the projected new housing requirements in Garfield County by 1990. This housing and its related roadway requirements would use approximately 170 acres in Mesa County by 1985 and 174 acres by 1990, and approximately 26 acres in Garfield County by 1985 and 38 acres by 1990.

Schools

The expected increase in school-aged population due to the development of the Cottonwood Creek mines is shown in table MB3-10, along with the increase in school district capital requirements and operating costs anticipated from that population increase.

Most of the increase in school-aged population within Mesa County due to the Cottonwood Creek mines development would occur within School District 51. Since the mine itself is also located within the jurisdictional boundaries of School District 51, that district would receive an additional $10.8 million in assessed valuation from the facility itself by 1990. That increase in assessed valuation would allow the district to increase its bonded indebtedness by $2.2 million, which is in excess of the annual capital facility, operation, and maintenance requirements of $882,510.

School District 49(JT) in DeBeque would be required to provide for some of the increase in Mesa County school population associated with Cottonwood Creek. Even though District 49(JT) would not benefit from any increase in property tax base from the Cottonwood Creek mines, the tax base increase it is expected to receive from Sheridan Enterprises Loma project would be more than sufficient to meet its capital requirements. The increases in school operating costs projected for Mesa County, as a result of the Cottonwood Creek development, would be met by increased school district revenues without an increase in tax rates.

In Garfield County, increases in school-aged population from Cottonwood Creek would occur in the Grand Valley District 16 and the Garfield District RE-2. The total expected increase in property tax base in Garfield County by 1990 from the Cottonwood Creek mines is $1,980,520. That increase would allow the Garfield County school districts to raise their bonded debt by $396,100 or about twice the estimated requirement for school capital facilities, operations, and maintenance.

Health Care

Population growth associated with the Cottonwood Creek mines is expected to increase the

TABLE MB3-8

COTTONWOOD CREEK: DISTRIBUTION OF PROPERTY TAX REVENUES

Year	County	Municipalities	Special Districts	Schools
Garfield County:				
1980	$ 0	$ 0	$ 0	$ 0
1985	27,950	6,430	1,920	69,870
1990	39,650	9,840	2,720	99,120
Mesa County:				
1980	$ 0	$ 0	$ 0	$ 0
1985	327,930	92,890	47,850	938,760
1990	354,530	100,420	51,730	1,014,890

TABLE MB3-9

COTTONWOOD CREEK: NEW HOUSING REQUIREMENTS

	Mesa County			Garfield County		
Housing Units	1980	1985	1990	1980	1985	1990
Single-family units	0	434	444	0	65	98
Mobile Homes	0	167	171	0	25	37
Multi-family units	0	667	683	0	100	15
Total	0	667	683	0	100	150

TABLE MB3-10

COTTONWOOD CREEK: SCHOOL DISTRICT FACILITY REQUIREMENTS

County and year	Increase in School-Aged Population	Facility Requirements (square feet)	Facility Costs (dollars)	Operating and Maintenance Costs (dollars/year)
Mesa:				
1980	0	0	$ 0	$ 0
1985	478	66,920	3,011,400	587,940
1990	496	69,440	3,124,800	610,080
Garfield:				
1980	0	0	0	0
1985	76	10,640	478,800	93,480
1990	105	14,700	661,500	129,150

demand for health care-facilities in the Grand Junction area and the Rifle area. Due to their proximity to the Grand Junction area, neither the Cottonwood Creek mines nor their two neighbors, the Coal Canyon and Cameo mines, are likely to have significant adverse effects on the area's health-care facilities individually. However, since population growth as a result of these three operations would affect the same area, the cumulative effect on health service delivery is important. There would most likely be a need for expanded health care services in the town of Palisade, especially emergency services, because of all three operations. Table MB3-11 is an estimate of the capital facilities needed in Mesa and Garfield counties to meet the projected increase in demand for health care services from all three mines in the Cameo area.

Most of the existing health care facilities in the area are supported by fees collected for services performed instead of through local tax revenues.

Employment

Development of the Cottonwood Creek mines would increase employment in Mesa and Garfield counties. In 1985, employment at the mine is projected to reach 400 persons, which would increase total employment by 1,000 in Mesa County and by 160 in Garfield County. In 1990, total employment would increase by 1,030 in Mesa County and by 220 in Garfield County.

Income

An operation the size of the Cottonwood Creek mines, employing 400 people at full production, would significantly increase income in Mesa County. In 1975, median family income in Mesa County was $11,130, whereas average income among mine personnel is expected to be $16,600 per year. Table MB3-12 shows employment, payroll, and regional income that would be generated by the Cottonwood Creek mines.

TABLE MB3-11

COAL CANYON, COTTONWOOD CREEK, CAMEO NO. 1:
PROJECTED HEALTH CARE FACILITY REQUIREMENTS

County and Year	Facility Requirements	Facility Cost (dollars)
Mesa:		
1980	0	$ 0
1985	16 hospital beds and 1 emergency vehicle	895,000
1990	18 hospital beds and 1 emergency vehicle	1,005,000
Garfield:		
1980	0	0
1985	2 hospital beds	110,000
1990	3 hospital beds	165,000

TABLE MB3-12

COTTONWOOD CREEK: EMPLOYMENT, PAYROLL, AND REGIONAL INCOME

Year	Employment	Payroll	Regional Income
1980	0	$ 0	$ 0
1985	400	6,640,000	10,092,800
1990	400	6,640,000	10,092,800

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

The mitigating measures proposed in this chapter are measures which will be taken to minimize or eliminate specific adverse impacts identified in chapter 3 which would result from approval and implementation of Mid-Continent Coal and Coke Company's Cottonwood Creek mining and reclamation (M&R) plan. They do not include federal regulations, such as 30(CFR): 700, which are considered to be requirements with which the M&R plan will have to comply before it can be considered for approval. Neither do they include any mitigating measures already developed by Mid-Continent as part of the M&R plan; these have been described and analyzed as part of the proposed project in chapters 1 and 3.

All mitigating measures proposed in this chapter must be "real and committed," by definition in Bureau of Land Management (BLM) Manual 1792. "Real" means that the measures must be legally enforceable and actually workable for the area and situation being assessed. "Committed" means that the agency requiring the measures (in this case, BLM) will ensure that they become part of the authorizing document and will take the necessary steps to see that the measures are in fact implemented as part of the proposed project. Thus, if Mid-Continent's M&R plan is approved, all measures proposed in this chapter will be required in addition to the federal, state, and county requirements discussed in chapter 1, Authorizing Actions.

In the case of mitigating measures for air quality, those measures identified below are for major potential air pollution sources at the mine. However, Best Available Control Technology (BACT) will be required on all significant fugitive dust sources identified in table MB3-1, chapter 3. Accordingly, additional controls beyond those specified below may be required by the U.S. Environmental Protection Agency in its review for prevention of significant deterioration (PSD) or by the Office of Surface Mining in the air quality analysis of its permit review. The controls required herein as mitigating measures are BACT for those sources, but BACT may not be specified on all sources identified at the proposed mines if air quality impact is judged to be mitigated.

Any additional reasonable measures for alleviating impacts of the proposed action which would change the design of the proposal, which could cause major impacts of their own, or which cannot be considered real and committed are analyzed as alternatives in chapter 8.

Cottonwood Mitigating Measure 1

Power lines and associated poles will be raptor-proofed in accordance with BLM standards as outlined in BLM Manual 2850 and Instructional Memorandum No. CO78-30 (February 10, 1978). Raptor-proofing poles would prevent electrocution of eagles and other large birds.

Cottonwood Creek Mitigating Measure 2

Should sections of the Cottonwood lease, as part of Transect 7, be considered eligible for the National Register of Historic Places, compliance with Section 106 of the 1966 National Historic Preservation Act, amended 1976, will be met. Prior to the approval of the proposed action, procedures, as outlined in 36(CFR): 800.4-9, will be followed in consultation with the State Historic Preservation Officer and Advisory Council on Historic Preservation. Mitigating methods will be determined to ensure the protection of cultural values within the archeological district. These could include: complete avoidance of the area by the proposed action, more extensive inventory in order to define the boundaries of the district, test excavations, surface collection, research excavation, and analysis of site distribution through site catchment study, seasonal migration movement, and other interpretive and statistical tools.

If the proposed action is approved, a concurrence of approval will be developed between the BLM and Mid-Continent outlining Mid-Continent's responsibility for the protection of cultural resources. Mid-Continent will provide for a Class III survey on proposed impact areas (as supported by 1971 Presidential Executive Order 11593 and 1966 National Historic Preservation Act, amended 1976). Work stoppage and compliance is required

should cultural values be identified after initiation of the proposed action.

An archeological survey will be required in areas likely to be impacted by surface subsidence. Due to the unpredictibility of subsidence and the lack of information available concerning the effects of subsidence on archeological sites, an overburden of 300 feet or less will be used as a parameter to define potential impact areas to archeological values. Cracks and breaks in the surface are known to occur rarely with overburdens of more than 300 feet (Morgan 1978, Personal Communication). Mid-Continent will be required to define areas with an overburden of 300 feet or less and will provide for archeological survey of these areas. Archeological sites located by these surveys will be evaluated and mitigated prior to any disturbance and sites will be monitored to check the effect of subsidence on the archeological values.

Identification, evaluation, and preservation of data from archeological sites before potentially damaging actions would mitigate the loss of archeological resources. The results of the Class III survey, as a 100 percent surface inventory of the impact areas, are considered to be representative of the archeological values in that area. The efficiency of the Class III survey as an identification process would depend on topography, vegetation, and past land use on each site. These factors would account for the possibility that hidden and subsurface sites would remain undetected and unaccounted for in developing any further necessary mitigating actions.

Any archeological values which are located and evaluated through this survey could be preserved through one or more of the following mitigating measures, depending upon the significance of a site: (1) avoidance of the site through redesign of the project; (2) descriptive and photographic records, or surface collecting; or (3) excavation according to a specific research design or as a salvage effort.

Collection and excavation are only partial mitigations. While they preserve artifacts which might otherwise be destroyed, the in-place value of those artifacts is lost. Destruction of the site would mean the loss of information which might otherwise be gained by further techniques and interpretive methods.

Should additional archeological sites be identified in the survey effort and determined eligible for the National Register as part of the archeological district or as individual sites, compliance procedures required by Section 106 of the 1966 National Historic Preservation Act, amended 1976, and outlined in 36(CFR): 800.4-9, will be met.

Cottonwood Mitigating Measure 3

A surfactant will be added to the water spray on the conveyors and transfer points.

In the mining plan, Mid-Continent proposes that the conveyors and transfer points be controlled by water spray, with an estimated 50 percent control efficiency. By adding a surfactant to the spray system for longer-duration dust suppression, an estimated 85 percent efficiency can be achieved. The use of a surfactant would reduce projected 1985 emissions from these two sources by 23 tons per year and 1990 emissions by 57 tons per year.

Cottonwood Mitigating Measure 4

Paving of on-site access roads, tentatively proposed by the mining company, will be required as a condition for BLM concurrence with the mining plan.

The mining plan states that on-site roads will be paved, oiled, or sprayed with water. In determining the impact of the mine initially, it was assumed that both haul roads and access roads would be oiled except where existing roads are already paved. Paving of haul roads would not result in futher emission reductions, but paving of on-site employee access roads would increase the control efficiency from 85 to 99 percent. This would reduce projected emissions by 24 tons per year in 1985 and 48 tons per year in 1990.

Cottonwood Mitigating Measure 5

A mixture of adapted shrubs, grasses, and forbs will be used in revegetation of disturbed sites.

Three plant species are listed for revegetation at Cottonwood Creek: Norden crested wheatgrass, Arriba western wheatgrass, and Paloma Indian ricegrass. The use of only grasses for revegetation is not consistent with post-mining land use. The reestablishment of a mixture of adapted shrubs, grasses and forbs would best satisfy the post-mining land uses of wildlife habitat and livestock range. Wildlife (particularly big game) utilize mostly shrubs, while livestock graze mostly grasses. Both utilize forbs to a certain extent, mainly in the early spring.

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Chapter 5 discusses unavoidable adverse impacts which would be caused by the approval and implementation of Mid-Continent Coal and Coke Company's M&R plan for the proposed Cottonwood Creek mines. These impacts include the residual impacts after application of any mitigating measures discussed in chapter 4.

Air Quality

Annual average concentrations for the area were predicted with the model discussed in chapter 3, substituting the reduced emissions from the mitigating measures. (Table MB5-1 presents the total annual particulate emissions for 1985 and 1990 with and without the mitigating measures). Due to the location of the section of access road subject to the mitigating measures, local impact reductions of approximately 70 percent would occur near the mine facilities while total reductions over the entire area would be almost imperceptible. Maximum 24-hour concentrations would decrease to 88 micrograms per cubic meter ($\mu g/m^3$), while maximum annual concentration would be reduced to 20.4 $\mu g/m^3$.

Geologic and Geographic Setting

Topography

Minor alterations to the land surface would result from installation, use, and removal of surface facilities, and the subsequent reclamation of the area.

Subsidence of a maximum of 12 feet of surface could occur over the coal bed under "worst case" conditions; a total of 5,040 acres could be subject to surface subsidence. Surface strain resulting from subsidence on the northern boundary of the lease area could affect pipelines without angling and telescoping joints and any buildings in the area. Subsidence induced by mining could increase air circulation at depth through fracturing, allowing spontaneous combustion of the coal beds. In addition to causing a loss of the coal resource, burning reduces the volume of coal and therefore may induce more subsidence above the seam.

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot presently be assessed because of the lack of data and evaluatory criteria.

Mineral Resources

The mining of an estimated 61.6 million tons of coal under the Cottonwood Creek proposal would would deplete a nonrenewable mineral commodity. Production would represent approximately 24 percent of the total Grand Mesa coal field reserves in Mesa County. Because of the nature of underground caving and resultant high contamination after mining is complete, future recovery of the abandoned (approximately 50 percent) coal reserves under the lease area is not considered feasible with present technology, and therefore these reserves must be considered lost.

Water Resources

Ground water obtained from the mine almost certainly would not be adequate to meet the needs of the proposed operation until after 1990 when extensive subsidence fracturing may intercept and divert surface water into the mines. Purchase of 100 to 170 acre-feet of water annually from local municipalities and consumptive use of that water in the mining operation would reduce accordingly the amount of water available for other uses downstream. Additional consumptive use of municipal water by the increased population would be about 370 acre-feet per year (ac-ft/yr) by 1985 and 390 ac-ft/yr by 1990. The reduction in flow downstream attributable to this consumptive use, coupled with the increased salt load in sewage effluent, could increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.026 mg/l (0.004 percent) by 1985 and 0.030 mg/l (0.00045 percent) by 1990. Any increase in the salinity of the lower Colorado River is regarded as a serious adverse impact.

Subsidence induced by longwall mining is expected to cause open fractures and bulges in rocks at the surface after 1990. Flows in Rapid and Cottonwood creeks could be partially diverted into the

TABLE MB5-1

TOTAL ANNUAL PARTICULATE EMISSIONS

(ton/yr)

Study year	Without mitigating measures	With mitigating measures	Percent reduction
1985	188	164	13
1990	418	370	12

mines, reducing flow to downstream users. The old cast-iron water-supply pipeline for the municipality of Palisade, Colorado, would almost certainly be broken. Interruptions in Palisade's water supply could be frequent and could continue for decades after mining operations are ended.

Minor local erosion and sedimentation would occur off site because of construction related to population increases. Net sediment yield to the Colorado River over the life of the mine, however, should not be significantly different from predisturbance rates.

Soils

Surface disturbance on approximately 61 acres by 1985 and on through 1990 at the mine site would cause an increase in erosion and a deterioration of soil structure and biological activity, leading to a temporary reduction in soil productivity. Any such reduction would prolong the efforts necessary to achieve successful reclamation.

Urban area expansion would permanently remove 196 acres by 1985 and 212 acres by 1990 from a production function. Although exact locations are not known, some of this acreage would likely come from lands either now classified or eligible for classification as prime or unique farmland.

Vegetation

Vegetation would be lost at the mine site on 61 acres in 1985 and on through 1990. If parts of the disturbed areas are revegetated before abandonment of the mine (on refuse piles, road cutbanks, etc.), the actual acreage lost would be slightly less than these figures. However, successful revegetation of disturbved land at the Cottonwood Creek site is uncertain except in years of higher than normal winter or spring precipitation.

Natural vegetation would be lost on 196 acres by 1980 and 212 acres by 1990 due to community growth.

Wildlife

Construction of surface facilities would destroy wildlife habitat on 61 acres for the life of the mine beginning in 1985. This area could support 21 deer and 2 elk annually. During construction, small immobile animals, dens, and reptiles would be destroyed. On the lands adjacent to mining facilities (300 acres), deer use would be reduced by an average of 50 percent, and a portion of crucial winter range would be destroyed if facilities are constructed in the proposed location. Approximately 1 mile of cliff would be lost as potential nesting habitat for the golden eagle and the prairie falcon.

If the Cottonwood Creek operation uses the GEX Colorado Company loadout facilities on the Colorado River, some waterfowl nestings and brood rearings in the vicinity of the loadout could be disrupted and even eliminated by the human activity close to the river. Activities could impede movement of chukars to watering areas near the Highline Canal.

Increased human population could result in expansion of urban areas onto some crucial winter range. Increased vehicle/animal collisions, additional stress on wildlife, and increased poaching could occur.

Aquatic Biology

Increased consumptive use of 540 acre feet of water per year by the coal processing activities and by 2,050 new people in the area by 1990 would further deplete the amount of water available for fish and aquatic wildlife habitat in the Colorado River. This consumption alone is not significant, but it gains in significance when all water uses and developments in the basin are compared with the quantities of water available to support fish and wildlife habitats during yearly low-flow periods.

Cultural Resources

Archeological Resources

Undiscovered sites could be damaged during surface disturbing activities and by subsidence. In addition, information about sites could be lost as a result of vandalism and illegal collecting or as a result of salvage excavation procedures where any information not recorded would be permanently lost.

Land Use

Transportation

Traffic on I-70 would increase by as much as 530 vehicles per day as a result of mine personnel going to and from work. In addition, increased rail traffic would increase congestion in eastern-slope cities.

Livestock Grazing

Six animal unit months (AUMs) per year would be lost due to the disturbance of 61 acres beginning in 1985 and continuing through 1990. Increased off-road vehicle use would decrease productivity of natural vegetation by an unquantifiable amount. Agricultural lands disturbed by urban expansion would result in the loss of an unquantifiable amount of livestock forage and livestock wintering areas.

Recreation

If the community recreation facilities needed to prevent deterioration of existing facilities are not provided, this deterioration would be an unmitigated impact.

Visual Resources

The addition of another mine in DeBeque Canyon and the construction of associated utilities and roads would unavoidably expand and emphasize the industrial character of the landscape in the southern end of the canyon. Additional employee and service traffic would produce additional vehicle traffic and intersection delays on the local road system, which would subsequently influence the visual perception of the area.

The deposition of mine refuse would establish new slopes and terrain features on the existing topography. If revegetation and rehabilitation of the site is slow or unsuccessful, then this landform change may not eventually blend into the existing topography.

Socioeconomic Conditions

Population influx from the development of the Cottonwood Creek mines and its neighbors, the Coal Canyon and Cameo No. 1 and No. 2 mines, would have the greatest effect upon the community of Palisade. The resulting social changes which are anticipated in Palisade, such as loss of small town atmosphere, inflation, and conflicts between new and long-time residents, would be unavoidable unless a stance is taken by the community to discourage growth. New population from the Cottonwood Creek mines would be 2,000 people by 1985 and 2,050 people by 1990 in Mesa and Garfield counties.

These increases are only a small portion of the total growth expected in the area. In fact, the entire Grand Junction area's ability to absorb population growth is expected to be severely strained between 1978 and 1985, with the new population brought in by these mines compounding the problem.

The revenue generated from Coal Canyon by local property and sales taxes Garfield County would lag behind the increased expenditures needed for community facilities in the first few years of operation.

In Mesa County about 170 acres of land would be required for housing by 1985 and 174 acres by 1990. In Garfield County, 26 acres would be required by 1985 and 38 acres by 1990.

A group of residences northeast of Palisade would be subjected to noise levels which could be considered disruptive and annoying, but which should not offer problems associated with health or permanent hearing impairment.

CHAPTER 6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 61.6 million tons of coal would result in short-term and long-term alteration of natural resources and the human environment.

There would be the following alterations in the short-term, a period beginning with on-site construction and ending with end of mine life (about 2008) and post-mining reclamation:

1. An estimated 61.6 tons of coal would be exported to electric-generating companies outside Colorado.

2. Mining activity would increase particulate air quality concentrations by a maximum of 20 micrograms per cubic meter ($\mu g/m^3$) in a small area near the bridge over the Colorado River at Cameo. Concentrations are predicted to increase by 10 $\mu g/m^3$ for a distance of about 1 mile from the surface facilities and along the haul road north toward the loadout facility. Annual average concentrations due to the mine, existing sources, and background are predicted to reach a maximum of 62 $\mu g/m^3$ in 1990, which is below primary and secondary air quality standards. Predicted maximum 24-hour concentrations in the DeBeque Canyon area would be about 150 $\mu g/m^3$ and would occur near the Cottonwood Creek site.

The maximum particulate concentration for the DeBeque Canyon area would be 69 $\mu g/m^3$. This maximum concentration would occur in the vicinity of the bridge across the Colorado River and would be aggravated by the coal hauling activities of the Cottonwood Creek mines. Estimated source contributions of approximately 20 of the 69 mines, $\mu g/m^3$ would be caused by the Cottonwood Creek mines, 40 are due to background, 2 are due to existing sources, 3 would be caused by the Cameo No. 1 and 2 mines, and 4 would be caused by the Coal Canyon Mine. The maximum concentration of 69 $\mu g/m^3$ is below the primary standard of 75 $\mu g/m^3$, but 9 $\mu g/m^3$ above the secondary standard of 60 $\mu g/m^3$. The area exceeding the secondary standard would be less than 1 square mile, centered around the bridge crossing.

3. Use of water in the mining operations and by the increased population would consume about 0 acre-feet per year (ac-ft/yr) by 1980, 460 ac-ft/yr by 1985, and 540 ac-ft/yr by 1990. The effect could be to increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0 milligrams per liter (mg/l) by 1980, 0.026 mg/l (0.004 percent) by 1985, and 0.030 mg/l (0.00045 percent) by 1990.

4. Subsidence caused by the mining operations would very probably disrupt the water supply for the municipality of Palisade, Colorado.

5. Minor local erosion and sedimentation would occur off site because of construction related to population increases.

6. There would be loss of soil productivity on 61 acres through 2008 due to increased erosion, deterioration of soil structure, and reduced biological activity, and there would be loss of vegetation on those 61 acres due to loss of soil productivity.

7. Wildlife habitat on 61 acres, which could have supported 21 deer and 2 elk annually, would be completely lost.

8. Increased traffic on I-70 would increase the number of road accidents.

9. Approximately 6 animal unit months (AUMs) of livestock forage would be lost annually for the life of the mine.

10. The addition of another mine in DeBeque Canyon and the construction of associated utilities and roads would unavoidably expand and emphasize the industrial character of the landscape in the southern end of the canyon. Additional employee and service traffic would produce additional vehicle traffic and intersection delays on the local road system, which would subsequently influence the visual perception of the area.

11. Garfield County would experience a revenue deficit in the early years of the Cottonwood Creek operation, but that would change to a surplus by 1990.

12. Total direct, indirect, and induced income generated by this project would be $10,092,800 by 1990.

13. There would be an increase in noise levels in local communities due to increases in population, some of which may be attributed to operation of the mine. Before and after shift changes significant increases in traffic volume can be expected along Highway 6 west of the mine. However, ambient noise levels should be less than 63 decibels measured 50 feet from the main line of traffic.

Residual effects of mining (after post-mining reclamation) on long-term productivity would be as follows:

1. An undetermined number of uninventoried exposed and unexposed fossil resources would be impaired or destroyed.

2. An unquantifiable gain in knowledge would result from surveys and exposure of fossil resources which might never have been found without development.

3. An estimated 61.6 million tons of coal, a nonrenewable energy resource, would be depleted.

4. On completion of mining and reclamation, ground-water and surface-water occurrence in the mined and adjacent areas should return to approximately pre-mining conditions over a period of several years. Use of water by the increased population, which can be expected to remain in the area beyond the projected life of the mine, should continue at the rate of about 390 ac-ft/yr. The effect of that continued use of water on the salinity of the lower Colorado River would also be long term.

Subsidence can be expected to continue for decades after mining operations are ended. Disruption of the Palisade's municipal water supply, therefore, would very probably be long term.

5. Soil and natural vegetative productivity would be permanently lost on 212 acres due to urban expansion.

6. Surface construction, subsidence, and vandalism would disturb or destroy an unquantifiable number of nonrenewable cultural resources.

7. Archeological survey and excavation could provide gains in understanding of prehistoric use in the area.

8. Approximately 12 AUMs of livestock forage per year would be restored on the lease area upon revegetation after the mine is abandoned, if successful revegetation can be accomplished.

9. If additional recreational facilities are provided to meet the increased demand, they would remain for long-term use; conversely, if additional facilities are not provided, the deterioration of present facilities would be a long-term adverse impact.

10. The deposition of mine refuse would establish new slopes and terrain features on the existing topography. If revegetation and rehabilitation of the site is slow or unsuccessful, then this landform change may not eventually blend into the existing topography.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Approximately 61.6 million tons of coal would be recovered from the Cottonwood Creek mines. About 6.1 million tons would be lost due to current mining methods.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing machinery and buildings would not be recycled and thus would be lost.

An undetermined number of uninventoried fossils would be lost or disturbed.

Soil and vegetative production would be irretrievably lost on 61 acres for the life of the mine. This loss may be difficult to reverse because of the uncertainty of successful revegetation at the mine site, although natural revegetation would eventually occur.

Wildlife habitat on 61 acres, which could have supported 21 deer and 2 elk per year, would be irretrievably lost for the life of the mine. This loss may be difficult to reverse because of the uncertainty of successful revegetation at the mine site, although natural revegetation would occur eventually.

Approximately 6 animal unit months of livestock forage would be irretrievably lost for the life of the mine. An unquantifiable amount of livestock forage and livestock wintering areas would be irreversibly lost due to disturbance of agricultural lands by urban expansion.

Anything other than in-place preservation of archeological artifacts involves an irreversible, irretrievable commitment of the resource. Damage from surface disturbance or vandalism would result in a permanent loss of information and would remove archeological values from future research considerations.

An irretrievable commitment of capital and land (at least 212 acres) would be required to support population growth.

Particulate air quality at the proposed mine site would be subject to an increase in concentrations. Air quality would be temporarily degraded during the mine life, but the change would not be irreversible. With termination of mining activity, air quality would return to the pre-mining level of about 42 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean from the levels during mining of 47 to 62 $\mu g/m^3$.

Reduction in visibility would occur in proportion to the increased particulate concentrations. Average visibility is presently about 54 miles. The higher level of particulate during mining activity would decrease visibility somewhat (to 48 miles), but this loss would also be reversible. However, secondary development related to the proposed action would result in some permanent degradation of visibility in the Grand Valley area.

Approximately 460 to 540 are-feet of water would be diverted annually from the Colorado River system and consumed by the mining operations and the increased population. Use of water in the mining operations would end on completion of mining. Use of water by the increased population, however, would continue beyond the projected life of the mine.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

Pursuant to implied covenants of both the federal mineral leasing laws and the existing lease agreements, the Department of the Interior is obligated to respond to a legitimate application to conduct mining operations on a valid lease, provided that all terms and conditions thereunder have been met. The Department's action with regard to Mid-Continent Coal and Coke's mining and reclamation (M&R plan) for the Cottonwood Creek mines may be approval as proposed, rejection on various environmental or other grounds, approval or rejection in part, or approval subject to such additional requirements or modifications as the Department may impose under existing laws and regulations. The Department may also defer decision pending submittal of additional data, completion of required studies, or for other specific reasons. If there are serious environmental concerns as to the coal development, the Department may prevent further development of the leases by exercising the Secretary's exchange authority as to the federal coal rights, or seeking congressional action to cancel federal leases involved.

Development of alternative sources of energy, energy conservation, federal development of the coal, and emphasis on coal development in other regions of the United States are more appropriate for consideration on a program rather than a regional basis. These evaluations were made in the previous coal programmatic statement (U.S. Department of the Interior 1975) and will be updated and revised as necessary in the new coal programmatic statement now under way (to be completed in 1979).

Mid-Continent's M&R plan for the Cottonwood Creek mines has not been reviewed for compliance with the interim regulations 30(CFR): 700 required under Sections 502 and 503 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (PL 95-87), and it does not fully reflect the requirments of the interim regulations. The M&R plan will be returned to the applicant for revision in accordance with the appropriate federal regulations. When it is resubmitted to the Office of Surface Mining (OSM), it will be evaluated for compliance with all appropriate federal regulations by OSM in conjunction with the U.S. Geological Survey (USGS). In addition, the Bureau of Land Management (BLM) must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA.

APPROVAL AS PROPOSED

The Department has the choice of approving the M&R plan as proposed. However, as pointed out above, Mid-Continent's M&R plan has not been reviewed for compliance with the interim regulations. Therefore, it cannot be considered for approval until it has been revised to comply with all appropriate federal regulations.

REJECTION ON ENVIRONMENTAL OR OTHER GROUNDS

The Department may reject any M&R plan that does not meet the prescriptions of applicable law and regulations under the Department's authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly differently designed course of action by the lessee (operator). In addition, BLM must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA. Except when an M&R plan does not comply with existing regulations, the Department cannot under present circumstances reject the proposed plans to the extent that a de facto cancellation of a lease results unless the Secretary seeks and obtains additional authority from Congress.

Rejection of Mid-Continent Coal and Coke's proposed M&R plan for the Cottonwood Creek mines would result in no additional environmental impact from coal mining on the federal leased lands. Since these lands are public lands surface use would be governed by BLM policy and management guidelines and decisions. Mid-Continent could submit a new M&R plan, challenge the rejection, or abandon development of the lease. Should Mid-Continent submit a new M&R plan, that plan would require both environmental assessment and review for compliance with applicable regulations.

If the M&R plan is not approved, Mid-Continent has tentative plans to mine private coal reserves on private land in the northwestern part of the lease

area (map MB1-1, chapter 1). Conventional room-and-pillar methods would be used, but no other information is available from the company on the scope or duration of these possible future operations.

If these operations are carried out, the following general changes can be expected to occur at that mine site. Ambient particulate concentrations could be expected to increase slightly. Soils, vegetative, wildlife, and cultural resources would be affected in proportion to the amount of surface disturbance required by facilities construction and the number of people working in the area. Since no subsidence is expected as a result of these future operations, no significant impact to the ground- or surface-water resources should occur on or adjacent to the mined area. Increased population would increase use of municipal water and discharge of sewage effluent to the Colorado River in the Palisade and Grand Junction areas, but the magnitude of these impacts cannot be appraised without detailed information on the scope and duration of the operation. Traffic on I-70 would increase as a result of people going to and from work.

Coal from the proposed Cottonwood Creek Mine is intended to supply 61.6 million tons of coal to electric-generating companies outside Colorado. Without the Cottonwood Creek mines, other coal would have to be acquired to supply these markets. Such a substitution could create a shortage for other coal markets.

The Cameo power plant is likely to cause slightly higher particulate concentrations than presently exist, but how much more is unknown.

The vegetation on the lease area would remain in its present undisturbed state, with the exception of approximately 15 acres which would be disturbed by the construction of seven reservoirs, four water catchments, 2.6 miles of access road, and 1 mile of stock trail as part of a proposed allotment management plan (AMP). The AMP would combine the Lloyd and Cottonwood-Rapid Creek allotments into the Lloyd allotment, and institute a rest rotation grazing system. The number of cattle run on the allotment would be decreased from 128 to 86, but the cattle would be kept on the allotment a longer period of time; therefore, the total animal unit months of forage would remain 278. Implementation of the proposed AMP may improve the vegetative condition of the coal lease area by increasing the density of key species (western wheatgrass, galleta grass, and big sagebrush). The primary use of the vegetation would remain livestock and wildlife forage.

Continuing human population growth in Mesa County would still cause impacts to wildlife: expansion of urban areas onto agricultural lands and some winter range; increased recreational use of wildlife species, primarily hunting; and increased poaching of big game species.

Natural weathering and vandalism would continue to be the major causes of loss of archeological and historical values, but there should be no additional contributing factors to such loss at the site if the M&R plan is rejected. Paleontological resources would be impacted both adversely and beneficially in approximate proportion to the level of regional development and the area disturbed.

The population of Mesa County would still increase at a rapid rate to 91,750 people by 1980 and 106,000 people by 1985, and then decrease to 94,800 people by 1990. Development of oil shale and uranium and the area's role as a regional center account for the growth. Garfield County is also projected to grow at a rapid rate to 33,000 people in 1980; 38,650 people in 1985; and 45,100 people in 1990, also primarily as a result of oil shale development.

Mesa and Garfield counties, towns, special districts, and the school district would not receive increases in revenue from the mines, but expenditures to provide facilities and services to accommodate population increases associated with Cottonwood would not have to be made.

APPROVAL OR REJECTION IN PART

The Department has the choice of approving or rejecting part of a particular M&R plan, based on projected adverse environmental impacts.

Restrict Development on Existing Leases

The subject leases convey the right to develop, produce, and market the federal coal resource thereon if all other terms and conditions have been met by the lessee. In general, the Department does not possess the authority to arbitrarily constrict development if all other requirements of the lease have been met. However, various measures that may tend to restrict development may be taken by the Department at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations (for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, etc.). Similarly, the Department could permit only selective exploration and development of existing leaseholds if analysis indicates wholly unacceptable environmental impacts that could not be reduced to an acceptable level.

Adoption of this alternative would reduce adverse impacts by reducing the area in which the impacting activities could take place. At the same time, application of this alternative would not

permit maximum recovery of the coal resources and would thus be contrary to principles of conservation embodied in the legislation which authorizes the leasing of these lands for the purposes described. It is entirely possible that such selective mining would leave isolated blocks of coal that might never be recovered owing to the high costs of mining such remnant areas at a later date.

Phased Development

Phased development of coal mines as a means of lessening socioeconomic impacts of coal development in the ES area is discussed as the Diligent Development and Continuous Operations alternative under Approval or Rejection in Part of chapter 8 in volume 1. The restrictions discussed under that alternative could be applied to the Cottonwood Creek operation alone. However, to do so would probably not significantly reduce socioeconomic impacts in Mesa County, since other coal mines in the area could continue to develop at a rapid rate. To be effective, phased development would have to be applied uniformly to coal projects throughout the ES area.

APPROVAL SUBJECT TO ADDITIONAL REQUIREMENTS OR MODIFICATIONS

Subject to existing laws and regulations, the Department has the choice of approving an M&R plan with additional stipulations or changes to lessen adverse environmental impacts. For example, operational, transportation, or other alternatives could be adopted when such alternatives would reduce adverse impacts.

Operational Alternatives

With the onset of longwall mining at full production after 1985, open fractures and compression bulges can be expected to disrupt surface channels (Dunrud 1976), followed eventually by local subsidence at the surface. Runoff in these disrupted channels would tend to be diverted into the mines through the open fractures until the openings are eventually sealed by grouting or by sediment carried by the streams. Subsidence could create local depressions that would tend to pond water with consequent reduction in downstream flows. These surfacial disruptions are all temporary, however, and eventually would be eliminated by natural geomorphic processes. However, the old cast-iron water-supply pipeline for the municipality of Palisade, Colorado, would almost certainly be broken. Interruptions in Palisade's water supply could be frequent and could continue for decades after mining operations are ended.

To control any water draining from the mine, the M&R plan would have to be redesigned to lay out the longwall panels along the strike instead of across the strike as originally indicated. In addition, barrier pillars would have to be left to protect the hydrologic balance of both Cottonwood and Rapid creeks (30[CFR]: 715.17).

Redesigning the longwall panels would have little, if any effect on the production rate but would reduce available recoverable reserves by approximately 1.5 million tons.

Moreover, it is questionable whether this redesign would adequately protect Palisade's water pipelines. Tension cracks could still form upward from the mined area to the surface above barrier pillars or wherever coal has been left in place during the mining operation. Cracks occur because the pillars are not strong enough to support the weight of the overburden completely. They tend to orient either parallel or perpendicular to the length of the barrier pillar. In any case, subsidence tension could break the pipelines and disrupt Palisade's water supply. Should the proposed mining operation adversely affect Palisade's water supply by contamination, diminution, or interruption, Mid-Continent must replace the water supply (30[CFR]: 717.17[i]).

No other reasonable operational alternatives have been identified which would significantly reduce adverse impacts of coal mining or increase resource recovery. Surface mining is not feasible due to the geology and geographic characteristics of the area. Federal regulations (30[CFR]: 211) require M&R plans be designed to ensure maximum economic recovery of the coal resource.

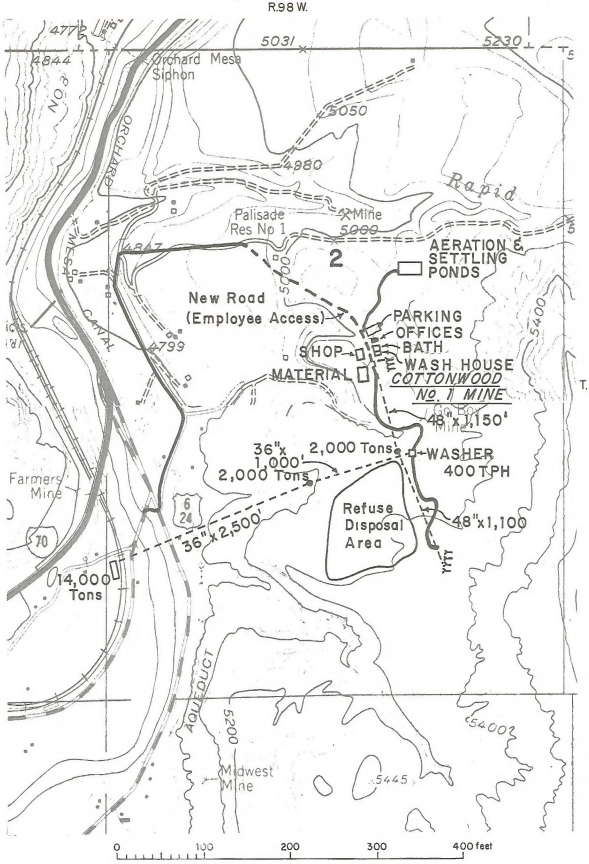
Transportation Alternatives

Conveyor System to Proposed New Rail Loadout

The M&R plan submitted in August 1977 and analyzed in chapters 1 through 7 was based on two assumptions: (1) the initial two to three years of coal mining and processing would be done by GEX Colorado Company through the existing facilities of the Roadside Mine and (2) all coal produced at the Cottonwood No. 1 and No. 2 mines would be trucked to GEX Colorado Company's rail loadout facilities and transported to market from there. However, no agreement has been reached with GEX Colorado to use Roadside Mine facilities or the Cameo loadout. In October 1978, Mid-Continent submitted a transportation alternative which does not involve GEX Colorado Company and the Roadside Mine.

DESCRIPTION

Map MB8-1 shows the locations of the proposed surface facilities, conveyor system, rail loadout



Map MB8-1. Transportation alternative: proposed conveyor system, rail loadout, and other facilities

facilities, and employee access road described in this alternative.

A 48-inch covered conveyor system would move the coal from the mine mouths to the raw coal storage silo. The conveyor from the No. 1 Mine would be 1,150 feet long, and the conveyor from the No. 2 Mine would be 1,100 feet long. With a 50-foot right-of-way, the conveyor system would disturb 2.6 acres of private surface.

From the storage silo the coal would be conveyed 50 feet to the preparation plant (400-tons-per-hour capacity). The silo and the plant would be located approximately midway between the Cottonwood No. 1 and No. 2 mines, as shown on map MB8-1. They would disturb 1.4 acres of private surface. The preparation plant is overdesigned for the capacity of the one silo; a second storage silo may have to be added, which would disturb an additional 0.3 acre.

The clean coal from the preparation plant would be transported by a 36-inch covered conveyor to a rail loadout on the west side of the Colorado River. The conveyor would be 3,500 feet long, with a 2,000-ton surge bin at 1,000 feet from the preparation plant. The surge bin would be at the top of a 300-foot bench, which has a face slope of 23 percent over 1,300 feet. The conveyor would leave the ground at this point and be mounted on supports to carry it down the slope.

The conveyor would cross a buried natural gas pipeline 1,200 feet from the surge bin. About 1,850 feet from the proposed bin, the conveyor would cross U. S. Highway 6, using an overpass to be constructed by Mid-Continent. The conveyor would cross the Colorado River at 2,100 feet from the bin; a tube-type bridge for the conveyor would be built over the river using existing bridge abutments. The conveyor would overpass a county road and overpass the Denver and Rio Grande Western (D&RGW) main line at 2,400 feet from the bin. The conveyor, including the surge bin, would disturb a total of 3.8 acres of private, county, and federally-controlled land from the preparation plant to the rail loadout.

Mid-Continent would construct a 14,000-ton storage facility at the loadout site, disturbing 2.3 acres of private surface. Most of the storage facility would be buried below ground. A 300-foot covered conveyor for loading the coal would disturb an additional 0.4 acre.

Mid-Continent would also construct 3,100 feet of double-track and 2,800 feet of single-track, as shown on map MB8-1. This additional railroad construction would disturb 6.3 acres of railroad right-of-way. The half of the double-track closer to the river would be used as part of the D&RGW main line. The present main line and the 2,800-foot single-track would be used for unit train loading. The other half of the double-track would be used for empty coal-car storage.

The refuse disposal area for reject from the preparation plant and mines would be located northwest of the No. 2 Mine, as shown on map MB8-1. The configuration of the refuse area would be slightly different from that in the proposed action. It would cover approximately 31 acres, mostly federal (lease C-024998) and some private surface.

As shown on map MB8-1, the proposed new employee access road would follow the existing road leading to the Palisade treatment facilities for a distance of about 1,500 feet. At that point, Mid-Continent would build approximately 2,000 feet of additional road going southeast from the original road and leading to the mine facilities. The road would be 20 feet wide, requiring a 35-foot right-of-way. The new roads would disturb 1.7 acres. On-site access roads would be paved, and the existing road would have to be improved to accommodate the additional traffic. Improvements off company property would be coordinated with Mesa County officials for alignment, funding, etc.

The work force using the access road would number 400 people in 1985 and 1990. Mid-Continent is considering busing employees from Palisade and Grand Junction but so far has made no firm commitment to do so.

All other surface facilities would be the same as proposed in the M&R plan and described in chapter 1.

AUTHORIZING ACTIONS

Mid-Continent would need to obtain easements from the owners of private lands crossed by the conveyor and private land affected by the 14,000-ton buried storage facility. The overpass affecting U. S. Highway 6 would have to meet the requirements of the Department of Transportation's (DOT's) Federal Highway Administration. The Department of the Army Corps of Engineers would have to approve plans to cross the Colorado River. The overpass affecting the county road would have to be approved by Mesa County officials. The overpass affecting the D&RGW main line would have to be approved by D&RGW and the DOT's Railroad Administration. Construction of the additional trackage would require approval from D&RGW and possibly from the Colorado Public Utilities Commission and the Colorado State Highway Department. It may require a certificate from the Interstate Commerce commission under the Interstate Commerce Act (49 USCI [18]); however, certain spur, industrial, team, switching, or sidetracks located entirely within one state are exempted from this authority, and the proposed new trackage may fit one of these exempted categories. Because the town of Palisade plans to de-

velop a new 12-inch industrial feeder main as part of the proposed improvements to its water system, Mid-Continent would also have to reach an agreement with the town of Palisade so that road improvements and use would not damage the proposed main.

IMPACTS

Before this transportation alternative could be considered for approval, Mid-Continent would need to submit more detailed information on construction of the proposed new facilities, and additional environmental assessment would be necessary. However, based on the information now available, the following impacts can be predicted to occur.

Air Quality

Annual average particulate levels would increase by 7 micrograms per cubic meter ($\mu g/m^3$) in a small area near the surface facilities. Concentrations would increase approximately 1 to 4 $\mu g/m^3$ in an area extending west from the surface facilities to the rail loadout facilities.

Vegetation

Approximately 47 acres of the saltbush type would be disturbed by the proposed conveyor system from the mine mouth to the raw coal storage area, the refuse pile, the preparation plant, storage facilities, and employee access raod. The conveyor from the preparation plant to the proposed rail loadout facility would disturb an additional 3.8 acres of mostly saltbush, although some pasture land would also be disturbed near the Colorado River. The coal storage facility and loadout site would disturb approximately 2.7 acres of mostly fruit orchards. The 6.3 acres disturbed by the construction of new railroad lines would all be within the railroad right-of-way, and very little natural vegetation other than annual weeds or greasewood would be affected. The impacts of the vegetation disturbance would be a loss in wildlife and livestock forage, an increase in soil erosion, and a decrease in the visual aesthetics of the area.

Mid-Continent would be required to revegetate the disturbed land when it is no longer needed for mining operations. Revegetation techniques, problems, and probability of success would be similar to those discussed in chapter 3 under Vegetation.

Wildlife

Construction of the conveyor system would eliminate about 50 acres of saltbush, sagebrush, pinyon-juniper, and agricultural land as habitat for small mammals and reptiles and some animals could be lost during the construction phase. This area is not considered to be crucial deer winter range although deer do use the area during the winter months. Migration routes would be affected by the conveyor routes on the bench. However, due to the amount of activity that would be present in this area, i.e., the access road, surface facilities, and refuse disposal pile, it is doubtful if these migration routes would be used even without the conveyors.

Essentially the acreage below the access road to the cliff edge, former deer winter range, would be lost to wintering mule deer. This is primarily sagebrush and pinyon-juniper vegetation types. It is possible that deer would continue to use this area if they can get around the surface facilities but the use would be decreased due to the lack of cover and individual animal intolerance to noise and harassment.

Rail line and loadout facilities construction would impact wildlife habitats that are already severely impacted by agricultural development, highways, and existing rail lines. The species affected most would be the small mammal and bird species associated with orchards and human structures.

If Mid-Continent does not use GEX Colorado's loadout facility, this would lessen activity at that site and might reduce potential impacts to peregrine falcons nesting in cliffs in the vicinity.

Livestock

Approximately 4 animal unit months (AUMs) of vegetation would be annually lost as a result of the disturbance of approximately 40 acres of saltbush type. However this loss of AUMs is minimal when compared with the AUMs in the vicinity (Lloyd Allotment = 278 AUMs) and would not result in hardship for the livestock operators grazing the disturbed areas.

The small amount of pasture land (approximately 1 acre) disturbed by the conveyor belt from the preparation plant to the rail loadout facility would result in a loss of livestock forage. However, the amount lost would be small, and would not result in hardship for the livestock operator.

Visual Resources

The potential use of a conveyor system for transporting coal to a new rail loadout facility would establish a strong, linear focal element in the terraced landscape. This enclosed linkage could not borrow from existing, natural landscape lines, because of its alignment, so that it would not blend within the existing configuration of the VRM Class II landscape.

The addition of the pipeline structure would represent an industrial modification in an agricultural and natural setting. The structures necessary for crossing the Colorado River and existing road and railroad corridor would create focal points for I-70

and U.S. 6 travelers. Termination in a rail loadout facility would emphasize the contrast between agricultural and industrial land uses which would affect the dominant character or feel of the landscape. Industrial land uses currently dominate the landscape around the Cameo power plant, and this land-use influence would be enlarged by proposed developments such as the conveyor line in DeBeque Canyon

The alignment of a 36-inch diameter conveyor line allows a strong potential for camouflaging the structure. By blending the colors of the structure with the ground colors and using partial earth form control, the pipe structure's visual presence could be reduced especially for I-70 viewers.

The rail loadout facility would become a dominant focal element, especially for viewers traveling along the river. Rail cars waiting to be loaded, the conveyor's crossing the river, and the structures for loading would attract attention. These additions would affect some viewers--primarily east bound--on I-70, but view duration and terrain masking would reduce the severity of impact.

The construction of a 2,000-foot access road would also add linear modification of a natural landscape; cut-and-fill slopes could emphasize the presence of this road, but this could be reduced by use of existing landscape treatments. Terrain working would also hide this road corridor from travelers on I-70 and U.S. 6.

The location of plant facilities, parking, etc., would be high enough so that existing land forms limit visual access to this industrial site. The use of non-specular materials and paints, especially if they match the ground colors, would further decrease the visual influence of this industrial development.

The deposition of refuse materials would retain the potential to dominate the landscape and to, therefore, draw attention to the site. Surface deposition, especially of dark colored materials, would establish color contrasts that would stand out on the terraced slopes. This impact can also be partially controlled by terrain utilization and mulching covers.

Cultural Resources

Approximately 18.3 acres of additional surface disturbance would result from the implementation of this transportation alternative. While some of the acreage included in the proposal has undergone previous disturbance, existing archeological resources located in potential impact areas would be exposed to damaging activity. Although archeological sites might remain undetected by a Class III survey, the completion of a cultural inventory will allow for the identification and mitigation of vunerable sites.

Noise

If this alternative is adopted, there would be some noise impact on about nine residences in the vicinity during the construction phase. However, once the conveyor is in operation, there should be no noise impact on any of the residences, assuming that the conveyor operates at the same noise level as the one in operation at the Roadside Mine.

Three farm houses are located within 400 feet of the proposed loading facility. All of these residences currently are located close enough to the D&RGW right-of-way and I-70 that it cannot be determined at this time if the operation of the loading facility would have a significant noise effect on these families.

Other Resource Impacts

Based on the information available on the alternative at this time, all other impacts would be the same as described in chapter 3.

Truck Haulage to Proposed New Rail Loadout

If the conveyor system proposed in the preceding alternative is determined to be infeasible or environmentally unacceptable, another transporation method is possible.

Under this second alternative, the clean coal would be transported by trucks to the proposed rail laodout facility described in the preceding alternative (shown on map MB8-1). The clean-coal haul road would follow an existing road which begins about 150 feet north of the proposed preparation plant site (see map MB8-1). This road would require considerable improvement, including safety exits and probably resloping and recurving. From this road, the coal would be trucked over the U.S. Highway 6 service road, across U.S. Highway 6 by means of an overpass to be constructed by Mid-Continent, and across the Colorado River and the D&RGW main line to the proposed loadout facility.

Under this alternative, all other facilities would be the same as proposed in the first transportation alternative, except that there would be no conveyor from the preparation plant to the rail loadout.

If such an alternative transportation route were proposed, Mid-Continent would be required to submit detailed information on upgrading the road, and further environmental analysis would be required. However, basically, such an alternative would result in 53 coal truck trips per day in 1985 and 131 coal truck trips per day in 1990 on the haul road, the service road, overpassing U.S. Highway 6, and crossing the D&RGW main line. This heavy use would be detrimental to the existing roads, which might require extensive improvements, such as surfacing and widening. Increases in accident rates could be expected due to the in-

creased coal truck traffic. Increased truck-train accidents could occur at the D&RGW crossing.

Annual average particulate levels would increase by 8 micrograms per cubic meter ($\mu g/m^3$) in a small area along the coal haul road just north of the mine. Concentrations would increase by 5 $\mu g/m^3$ along the roads between the mine and the proposed rail loadout.

Seven or eight residences east of the river would be impacted by truck noise, based on truck traffic spread over an 8-hour period. The three houses on the west side of the river would be subjected to an equivalent noise level of 55 to 59 decibles.

Road improvments on that section of surface from the preparation plant to the overpass system would require expanded cut-and-fill slopes. These surface alterations would initially stand out until revegetation could help them blend with the surrounding textures and colors.

A conveyor system from the mine mouth to the raw coal storage area, preparation plant, storage facilities, railroad loadout facility, and employee access road as described in the preceding alternative would also be part of this alternative. Impacts of these facilities on vegetation, wildlife, livestock, visual resources, and cultural resources would be the same as described in the preceding alternative. Other impacts of the mine would be the same as those discussed in chapter 3.

Other Coal Transportation Alternatives

No other reasonable methods of transporting coal have been identified. See volume 1, chapter 8, Approval Subject to Additional Requirements or Modification, Coal Transportation Alternatives, for a general discussion of truck transport and slurry pipelines.

Busing of Mine Employees

Busing of employees to the mine site could reduce the traffic impacts discussed in chapter 3. This measure has been proposed as a regional alternative in volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Busing of Coal Mine Employees.

Reduction of Wildlife Road Kills

Road kills due to vehicle/animal collisions currently exceed the legal harvest of deer in the state of Colorado. If the numbers of road kills involving Mid-Continent coal trucks increase significantly along the haul road, measures to protect the animals may have to be considered. Mid-Continent could be required to haul coal only during daylight hours.

Concentrating coal haulage into daylight hours (somewhat longer in the summertime) would decrease wildlife road kills. It would also minimize the noise impact of the operation on residences during normal evening social and recreational activities and during normal sleeping hours. Principal noise sources would be mine ventilation systems and rail and interstate vehicular traffic. Nightime equivalent noise levels would be 53 decibles or less, based on observations made in the area.

Limiting truck haulage to daylight hours would also increase daytime traffic congestion along haul roads, which could increase the possibility of traffic accidents. It might also increase congestion at loadout facilities during the hauling shift and perhaps decrease loadout efficiency.

Other alternatives which could be considered include roadway lighting, fencing, and other measures currently under study by the Colorado Division of Wildlife.

Protection of Endangered Fish Species

As discussed in Water Resources, chapter 3, Mid-Continent hopes to intercept sufficient ground water in its mining operations to meet all consumptive uses except potable water for personnel (6.1 acre-feet annually) which would be purchased from local water utilities and piped to the site. Presumably, water rights would be obtained to permit the consumptive use of water obtained from the proposed mines. Should that supply be inadequate, supplemental water would be purchased from the local utilities. Total nonpotable water requirements are estimated by the company to be about 46 acre-feet per year (ac-ft/yr) or about 0.05 acre-feet per 1,000 tons of coal mined. This would be less than a third of the consumptive use normally required by underground mines when coal processing is necessary (regional analysis, chapter 1). It appears more realistic to assume that the proposed operations would consume about 170 ac-ft/yr.

The U.S. Fish and Wildlife Service (USFWS) has expressed concern (see comment letter 11 in chapter 9, volume 3) about cumulative impacts to the Colorado River system if supplemental water must be obtained from the river by several mining companies. A stipulation could be added to Mid-Continent's M&R plant that, if the company seeks water rights to divert water from the Colorado River for the Cottonwood Creek operation, formal consultation with the USFWS should be reinitiated to determine the impacts of the actions.

Other Alternatives

The land use and socioeconomic analyses in chapter 3 identified adverse impacts to Mesa County due to development of the Cottonwood Creek Mines. In addition to the Diligent Development and Continuous Operations alternative which

addresses such impacts on a regional basis (see Restrict Development on Existing Leases earlier in this chapter and in chapter 8, volume 1), the regional volume also discusses actions which may be available to state, county, and community governments which might lessen or control socioeconomic and land use impacts. See Socioeconomic Alternatives Available to State and Local Governments, chapter 8, volume 1.

DEFER ACTION

For proper cause, the Department may defer final action on a proposed M&R plan. Reasons for deferring action can include, but are not limited to, the need and time required for:

1. Modification of a proposal to correct administrative or technologic deficiencies;
2. Redesign to reduce or avoid environmental impact;
3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation;
4. Further evaluation of a proposal and/or alternatives.

The principal effect of deferring action on a proposed M&R plan on these grounds would be a comparatively short-term delay in the occurrence of all related impacts of a proposal (both adverse and beneficial). To the extent that an M&R plan can be redesigned to alleviate adverse impacts, those impacts would be lessened.

As pointed out at the beginning of this chapter, Mid-Continent's M&R plan for the Cottonwood Creek mines has not been reviewed for compliance with the interim regulations, and the Department will not consider the plan for approval until it is brought into compliance with all applicable federal requirements.

Protection of Peregrine Falcon Habitat

Use of GEX Colorado's loadout facilities as proposed in Mid-Continent's M&R plan for the Cottonwood Creek mines would increase human activity in the general vicinity of peregrine falcon nesting sites, particularly if Mid-Continent also uses the loadout for its Coal Canyon Mine. Such activity would adversely affect essential peregrine falcon habitat.

Approval of Mid-Continent's M&R plan for the proposed Cottonwood Creek mines could be deferred so that all three mines would not be operating concurrently. Approval of either GEX Colorado Company's M&R plan for the Cameo mines or Mid-Continent's M&R plan for the Coal Canyon Mine would also have to be deferred. However, GEX Colorado would still probably continue to mine private coal from the Cameo No. 1 Mine through 1982, and its loadout facilities would continue to be used by the company's Roadside Mine through 1985.

Adoption of this alternative would mean that coal mining at the Cottonwood Creek mines would be deferred for at least 7 years (until GEX Colorado's private coal reserves are exhausted) and possibly 45 to 50 years (until GEX Colorado's private and federal reserves run out) or longer (if the Coal Canyon M&R plan were approved and implemented first). All related impacts of mining as described in chapter 3 would be deferred a comparable period of time. Coal from the mine is intended to supply electric-generating plants outside Colorado; other coal would have to be acquired by these plants. In addition, Mid-Continent would have to develop a loadout facility of its own or buy GEX Colorado's loadout facility when that company has finished with it.

Since Mid-Continent has already proposed development of its own loadout facility as an alternative to using GEX Colorado's facility (see Transportation Alternatives earlier in this chapter), another means of reducing impacts to peregrine falcon habitat is available. Approval of Mid-Continent's M&R plan for the Cottonwood Creek mines could be deferred until the company has provided more detailed information on construction of the proposed conveyor system and rail loadout, so that additional environmental assessment could be carried out. The net result would be a deferral of impacts discussed in chapter 3 for a brief period of time. In addition, Mid-Continent's Cottonwood Creek operation would have no impact on peregrine falcon habitat in the vicinity of the Cameo and Coal Canyon mines.

Control of Runoff and Salinity

Approval of the M&R plan could be deferred until it has been evaluated with regard to best management practices for nonpoint sources of water pollution and the guidelines of the Colorado River Salinity Forum. As far as can be determined at the present time, however, mining at the Cottonwood Creek operation would produce few adverse impacts to water quality (see Water Resources, chapter 3).

PREVENTION OF FURTHER DEVELOPMENT

No Action Alternative

"No action" on a mining proposal for the initial development of existing leases would equate to maintaining the status quo on those leases. Under existing regulations, operations may not proceed in the absence of approved M&R plans and related

permits. The alternative of rejecting the M&R plans is discussed earlier in this chapter.

Relinquishment of Leases

The BLM is reviewing nonproducing existing leases. Nonproducing leases are to be reviewed in accordance with planning standards and in compliance with the proposed unsuitability criteria developed pursuant to the requirements of section 522(b) of SMCRA.

Under Congressional Bill S3189 (October 13, 1978), the Secretary may exchange leased lands that are determined and/or proven to be unmineable for an equivalent area of unleased land. In addition, the Federal Land Policy and Management Act of 1976 (PL 94-579), Section 206, gives the Secretary general authority to dispose of public lands by exchange, subject to applicable laws, when the Secretary "determines that the public interest will be well served by making that exchange: *Provided,* That when considering public interest the Secretary concerned shall give full consideration to better Federal land management and the needs of State and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife and the Secretary concerned finds that the values and the objectives which Federal lands or interests to be conveyed may serve if retained in Federal ownership are not more than the values of the non-Federal lands or interests and the public objectives they could serve if aquired." F0131

CHAPTER 9

Consultation and Coordination

See volume 3, chapter 9, for a discussion of consultation and coordination carried out for the West-Central ES.

GEX COLORADO COMPANY:

CAMEO NO. 1 AND NO. 2 MINES

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

Proposed Action

The proposed action is the review and consideration for approval of a mining and reclamation plan (M&R plan) submitted by GEX Colorado Company for the Cameo No. 1 and No. 2 mines. GEX Colorado Company proposes to extend the existing underground mine workings of the Cameo No. 1 Mine onto adjacent federal coal lease C-01538 and to later open a second underground mine, the Cameo No. 2, on the same federal coal lease. The plan was submitted on February 22, 1978, to the Area Mining Supervisor of the U.S. Geological Survey (USGS), Denver, Colorado. The M&R plan has been accepted by the USGS as suitable for use in preparing this environmental statement (ES) and is available for public review at the Area Mining Supervisor's Office in Denver.

This M&R plan was submitted for review after promulgation of the interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), but has not been officially reviewed for compliance with that act. The applicant's plan may not fully reflect the requirements of the interim regulations. However, in this statement the interim regulations are considered requirements with which the M&R plan will have to comply just as it must comply with all other applicable regulations.

The M&R plan will be returned to the operator for revision in accordance with the applicable federal regulations. As soon as the applicant's plan is revised and returned to the Office of Surface Mining (OSM), it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations in 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

The plan describes the Cameo No. 1 and Cameo No. 2 mines. The Cameo mine property is located about 3 miles northeast of Palisade, Colorado, in Mesa County. At full production the underground coal mining operation would produce 1.6 million tons of coal annually, using an estimated 400 employees. Coal would be mined from the Cameo B coal seam from federal coal lease C-01538 and adjacent private reserves totaling 4,814.72 acres (see map G1-1). The federal lease conditions are subject to all current mining reclamation and related land use requirements and all laws and regulations affecting federal coal leases.

Total estimated federal coal reserves recoverable by underground mining methods are 22.91 million tons. The estimated mine life would be approximately 47 years. Coal produced from the mines would be transported by rail to Mississippi Power Company, Jackson County, Mississippi.

History and Background

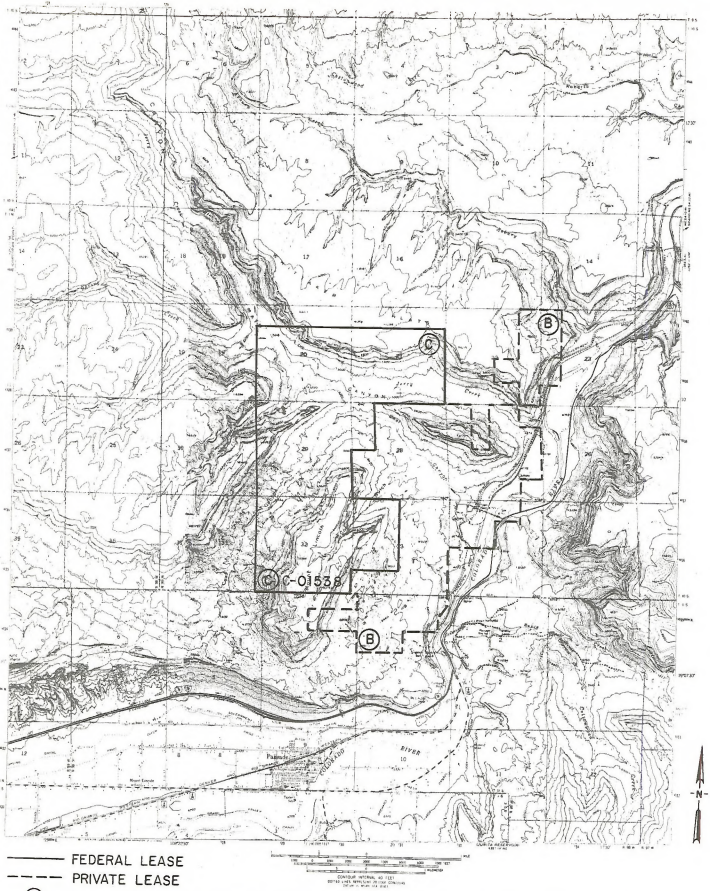
Production from the Little Bookcliffs area was first recorded in 1890. Several underground mines produced 900,422 tons from the Palisade seam through 1969, including the Mount Lincoln Mine, the Gearhart Mine, the Garfield Mine, the Palisade Mine, and the Riverside Mine. Most recently the Coal Canyon Strip Mine operated in 1963, 1968, and 1969, producing 69,152 tons by both strip and auger methods from the Cameo-Carbonera interval of the Palisade seam. The largest past producer was the Cameo Mine, which produced 4.2 million tons from 1899 to 1969.

Cameo No. 1 Mine

GEX Colorado proposes to begin producing, by room-and-pillar methods, approximately 200,000 tons of coal late in 1978 or early in 1979 from private reserves through the Cameo No. 1 Mine, using approximately 100 employees. By 1980, the operation will reach 800,000 tons per year, with approximately 213 employees. The company would continue to produce 800,000 tons per year to about 1982, when the private reserves will probably be exhausted.

Coal will be produced from the Cameo B seam of the Mt. Garfield Formation in the Upper Cretaceous Mesaverde Group. The nearby Roadside Mine also operates in the Cameo B seam. In this area the Cameo B seam averages 9 feet in thickness.

In December 1977, GEX Colorado began construction of the Cameo No. 1 Mine opencast incline approximately 600 feet north-south by 380 feet east-west is Section 27 T. 10S. R. 98 W. 6th P.M. The portal is located approximately 1,700 feet



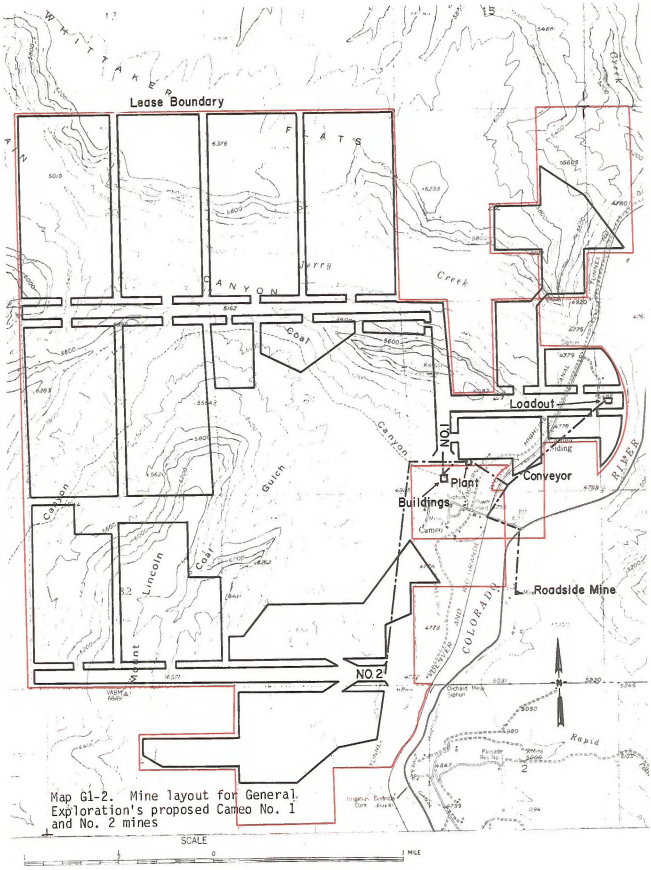
——— FEDERAL LEASE

– – – – PRIVATE LEASE

Ⓑ PRIVATE SURFACE, PRIVATE MINERAL

Ⓒ PUBLIC LAND SURFACE, FEDERAL MINERAL

Map G1-1. General Exploration's Cameo lease area



Map G1-2. Mine layout for General Exploration's proposed Cameo No. 1 and No. 2 mines

clude support buildings, unit train loadout, rail spur, conveyor system, electrical power supply system, and an industrial area, all of which will be used by both the Cameo and Roadside mining operations. In addition a preparation plant and access roads will be constructed for use by only the Cameo mining operations. The initial disturbance will be approximately 143 acres (map G1-2 depicts locations of the facilities).

Data for a water supply system and sewage treatment facility will be submitted at a later date. GEX Colorado does have a water right of 56 acre-feet per year from the Colorado River.

At the present time, GEX Colorado has not designed a drainage system for the mine site. The system will have to comply with regulations in 30(CFR): 717.

Approximately 43.5 acres will be temporarily disturbed by the preparation plant, accompanying support buildings, and the Cameo No. 1 Mine portal facilities. Long-term disturbance of about 19 acres will be due to a security building, parking area, administration building, repair shop, storage yard, bathhouse, warehouse, and portal facilities. In addition, approximately 6.7 acres would be disturbed during mine life by the 10,000 ton raw coal storage pile, preparation plant, conveyor system, refuse bin, and clean coal storage bin.

The covered conveyor from the preparation plant will tie into the covered conveyor from the Roadside Mine. Less than 1 acre of disturbance will be involved.

The railroad spur from the Denver and Rio Grande Western main line (D&RGW), unit-train loadout facilities, and covered conveyor from the Roadside Mine (presently under construction) will temporarily disturb about 86 acres. Approximately 11.3 acres of this will be disturbed for the life of the mine.

An industrial park, consisting of warehouses, storage yards, and parking area will disturb an additional 11.5 acres during mine-life.

Surface Reclamation

Prior to disturbance of any area, all available topsoil will be removed and stockpiled where possible. If required, the top soil stockpiles will be planted with an annual and/or perennial seed mix.

After mining is completed, the property will be prepared for abandonment by removal of all structures, backfilling of portals (after sealing) and decline areas, grading of all disturbed areas to approximate original contour, scarifying of all access and maintenance roads, replacing all available topsoil, fertilizing if necessary, and revegetating the disturbed areas with approved seed and plant mixtures. The Cameo No. 1 mining operations will be required to reclaim all disturbed lands to a condition equal to or better than pre-mining land use.

Predisturbance Inventories and Analyses

At the request of GEX Colorado, the U.S. Department of Agriculture's Soil Conservation Service has completed an inventory of the soils and vegetation on the Cameo No. 1 and No. 2 mine areas to be disturbed. The Bureau of Land Management (BLM) has completed a vegetative study of the area along with a threatened and endangered plant literature search and herbarium inventory. The Colorado Division of Wildlife has completed a wildlife study and survey. An archeological survey has been completed in proposed activity areas of Coal Canyon and Coal Gulch by the Antiquities Research Division, Historical Museum and Institute, Grand Junction, Colorado.

GEX Colorado Company's Proposed M&R Plan

Under the M&R plan, GEX Colorado proposes to extend the existing underground workings of the Cameo No. 1 Mine onto adjacent federal coal lease C-01538 and to later open a second underground mine, the Cameo No. 2, on the same federal coal lease. Full production from both mines (1.6 million tons per year) would be reached in 1989 and would require approximately 400 employees.

During 1981, the development of the main in the Cameo No. 1 Mine and the extraction panels lying north of this main would extend onto the federal lease. Production would increase stepwise until 1989, when a level of 1.2 million tons per year would be reached from the Cameo No. 1 Mine.

The construction of the portal and the main entries for the Cameo No. 2 Mine would begin in 1982. Production that initial year would be limited to 50,000 tons, but would increase to the maximum level of 400,000 tons per year by 1984. All production from the Cameo No. 2 Mine would be from the federal coal lease.

Coal would be produced from the Cameo B seam of the Mt. Garfield Formation in the Upper Cretaceous Mesaverde Group. The nearby Roadside Mine also operates in the Cameo B seam. In this area the Cameo B seam averages 9 feet in thickness.

MINE LAYOUT

Initial development of the Cameo No. 1 Mine is described under History and Background. As described in that section, about 3,400 feet from the portal along the No. 1 North Main, a three-entry system will be turned west to develop a small room-and-pillar panel. Under the M&R plan, just north of this panel, at a distance of 4,200 feet from the portal, the No. 2 West Main would be driven for 11,300 feet to a barrier pillar to be left at the

property boundary. Although no specifications for the No. 2 West Main have been given, the entries and crosscuts would probably be 20 feet wide on 150-by-80-foot centers, leaving 130-by-60-foot chain pillars. Four sets of five-entry mains would be driven north from the No. 2 West Main at distances of 2,000, 4,600, 7,300, and 9,000 feet from the No. 1 North Main. Each of these four sets of five-entry mains would be used to develop large room-and-pillar panels (approximately 3,600 by 2,400 feet). South of the No. 2 West Main the pattern of room-and-pillar panels would be more irregular. At a distance of 3,300 feet along the No. 2 West Main, a five-entry main would be driven south to develop a small room-and-pillar panel. A second small room-and-pillar panel would be developed through a three-entry main at a distance of 5,400 feet along the No. 2 West Main. Finally, at distances of 7,200 and 9,800 feet along the No. 2 West Main, two sets of five-entry mains would be driven south to allow mining of two 3,600-by-2,400-foot panels (map G1-2 shows the mine plan).

All development of the Cameo No. 1 Mine would be done on advance, all room-and-pillar panel pillars would be mined on retreat, and all main entry barrier and chain pillars would be mined on retreat from the mine.

CAMEO NO. 2 MINE

The location for the portal of the Cameo No. 2 Mine is not yet fixed precisely. However, an area approximately 4,300 feet southwest of the abandoned Cameo Mine has been tentatively chosen. The Cameo No. 2 Mine would enter the Cameo B seam with a set of three horizontal entries from the seam outcrop. These three main entries would be increased to seven main entries in the wishbone pattern similar to that at the Cameo No. 1 Mine (see figure G1-1). From the seven initial main entries which are to be driven west, at a distance of 1,000 feet from the portal, five entries would be driven off at a 60-degree angle to both north and south. Both sets of five entries would be used to develop large odd-shaped panels for room-and-pillar mining. Along the initial seven entries at a distance of 6,100 feet from the portals, a second set of five entries would be driven directly north. These entries would be used to develop a 2,000-by-2,800-foot panel for room-and-pillar mining. At a distance of about 7,000 feet from the portal, a third set of five entries would be driven north to develop a 3,500-by-2,000-foot panel.

Roof control would be by use of both standard and resin-type roof bolts on not more than 5-foot centers in all areas. Additional roof support would be by use of wood-header blocks, wood logging, wire mesh, and aluminum cross bars not less than 15 feet in length.

All development in the Cameo No. 2 Mine would be on advance and the coal mined on retreat. Main entry barrier and chain pillars would be mined on retreat.

Ventilation

Ventilation for the Cameo No. 1 Mine is described under History and Background. Ventilation for the Cameo No. 2 Mine would be similar to that of the Cameo No. 1, except that the Cameo No. 2 Mine ventilation would be horizontal entry with the fan offset from the right (return) entry. Also, an exhaust shaft is not anticipated for the Cameo No. 2 Mine.

Haulage System

The haulage system for the Cameo No. 1 Mine is described under History and Background. Coal from Cameo No. 2 would be handled similarly to that from Cameo No. 1, with the coal being transported from the Cameo No. 2 portal by conveyor and deposited on the raw coal storage pile.

SURFACE FACILITIES

Surface facilities developed for the Cameo No. 1 Mine (see History and Background) would be used for the Cameo No. 2 Mine. In addition, approximately 90 acres would be disturbed by development of the Cameo No. 2 portal area, a refuse disposal area, and a test plot.

Approximately 10 acres of surface would be disturbed during mine life at the portal site and by a covered conveyor and maintenance road from the Cameo No. 2 Mine to the raw coal storage pile at the Cameo No. 1 Mine; approximately 0.7 acre would be required for the portal facilities.

Approximately 55 acres would be disturbed for disposal of refuse from the mining operations and the preparation plant. The refuse pile would be constructed so that slopes would be a maximum of 27.5 degrees to avoid slides, refuse pile slippage, or stream pollution and would comply with 30(CFR): 700 regulations.

Approximately 8.3 acres of a 25-acre test plot would be disturbed during mine life by an office building, parking area, and testing building.

At the present time, GEX Colorado has not designed a drainage system for the mine site. Before the M&R plan can be approved, the company will have to design a system to comply with regulations in 30(CFR): 717.

Data for a water supply system and sewage treatment facility have not been submitted but will be at a later date. GEX Colorado does have a water right of 56 acre-feet per year from the Colorado River.

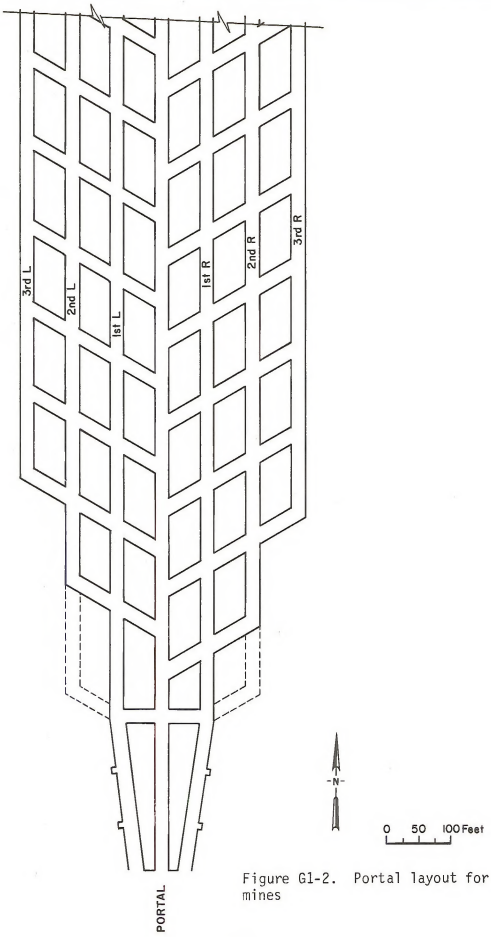


Figure G1-2. Portal layout for Cameo mines

SURFACE RECLAMATION

Prior to disturbance of any area, all available topsoil would be removed and stockpiled where possible. If required, the topsoil stockpiles would be planted with an annual and/or perennial seed mix.

After mining is completed, the property would be prepared for abandonment by removal of all structures, backfilling of portals (after sealing) and decline areas, grading of all disturbed areas to approximate original contour, scarifying of all access and maintenance roads, replacing all available topsoil, fertilizing if necessary, and revegetating the disturbed areas with approved seed and plant mixtures. The Cameo No. 1 and No. 2 mining operations will be required to reclaim all disturbed lands to a condition equal to or better than the premining land use. A mining permit cannot be approved until the applicant has demonstrated that the reclamation plan contained in the M&R plan can restore the land areas affected to the proposed post-mining land use.

Authorizing Actions

This M&R plan was submitted for review after promulgation of interim regulations, 30(CFR): 700, required under Section 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), but it does not fully reflect the requirements of the interim regulations. However, in this statement the applicable interim regulations are being included as federal requirements in chapter 1 as if the plan had been designed using the requirements of the regulations. Before the plan will be considered for approval by the Department of the Interior, it will be returned to the mining company for redesign to incorporate the applicable regulations. As soon as the applicant's plan is revised and returned to the OSM, it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations at 30(CFR): 211 and 30(CFR): 700. The mining and reclamation plan cannot be approved until it conforms to all applicable federal requirements.

The regulations contained in 30(CFR): 717 deal specifically with the performance standards required for approval of underground mining such as that proposed in this plan. In addition, refuse disposal of mine waste materials is governed by the regulation 30(CFR): 715.15. The standards and measures described in these regulations are considered as required measures and the impacts from the proposed action have been analyzed on that basis.

Federal Agencies

ASSISTANT SECRETARY OF ENERGY AND MINERALS

The Assistant Secretary must approve the mining permit application, including the proposed M&R plan, and significant modifications or amendments to it before the mining company can commence mining operations.

OFFICE OF SURFACE MINING (OSM)

OSM, with concurrence of the surface managing agency (BLM or USFS) and USGS, recommends approval or disapproval of M&R plans to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a State-Federal Cooperative Agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and the Department of the Interior authorized to take final actions on the permit.

U.S. GEOLOGICAL SURVEY (USGS)

The USGS is responsible for development, production, and coal resources recovery requirements included in the mining permit.

BUREAU OF LAND MANAGEMENT (BLM)

The BLM develops the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected public lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on public lands.

U.S. FOREST SERVICE (USFS)

The USFS developes requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected forest lands. The USFS is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on forest lands.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

The USFWS is responsible for protection of migratory birds, including eagles, and threatened or endangered species and their habitats. Coordination is required with the USFWS under provisions of

the Fish and Wildlife Coordination Act, the Bald Eagle Act, and the Endangered Species Act.

State Agencies

STATE OF COLORADO

Air quality, solid-waste disposal, and water quality must comply with rules and regulations administered by the various divisions within the Department of Health. GEX Colorado has already obtained air quality and NPDES permits from the state of Colorado; however, approval of the M&R plan, and some additional permits and licenses must be obtained from the state of Colorado in order to mine coal.

County Agencies

GEX Colorado would have to obtain necessary permits from Mesa County and comply with stipulations required by the county.

Interrelationships

Relationship to Other Existing and Proposed Developments

The Roadside Mine, which is also operated by GEX Colorado, lies approximately 0.5 to 0.75 mile southeast of the Cameo mine property and is the only active mine in the area of the property. Annual production from the Roadside Mine was 300,200 tons of coal from both private and federal leases in 1977. Construction of a covered overland conveyor from the existing Roadside Mine to the new unit train loadout facilities for the proposed Cameo mines is under way. Further discussion of new facilities is provided in the proposed action. Currently coal is transported by conveyor belt from the mine to the unit-train loadout facility.

The Cameo steam electric plant of the Public Service Company of Colorado is adjacent to the proposed Cameo mines.

Besides the proposed Cameo mines, two additional proposed new mining operations to be located in the Palisade area are being considered in separate site-specific volumes of this ES. The first, the proposed Cottonwood Creek No. 1 and 2 mines, lies approximately 1.25 miles south of the Cameo site. As proposed by Mid-Continent, the initial development for the Cottonwood Creek mines would be from the existing Roadside Mine, but this plan is still being negotiated with GEX Colorado. This mine is scheduled to produce 1 million tons per year by 1985. The second, the proposed Coal Canyon Mine, lies approximately 2.5 miles southwest of the proposed Cameo mines. The Coal Canyon Mine is scheduled to produce 500,000 tons per year by 1989.

The D&RGW main line, which parallels Interstate 70 and the north bank of the Colorado River, is immediately adjacent to the Cameo property. The unit train loadout facility which GEX Colorado is constructing could also be used by both the proposed Mid-Continent mines but plans to do so are still being negotiated by GEX Colorado and Mid-Continent (figure G1-2 shows the loadout site).

Housing and service facilities are available in Palisade and Grand Junction. Experienced labor is in short supply in the area because agriculture is the mainstay of the area.

Institutional Relationships

OFFICE OF SURFACE MINING

OSM, in consultation with Surface Managing Agency (BLM and USFS), USGS, or (where applicable) the state regulatory authority, recommends approval or denial of surface coal mining permit applications to the Assistant Secretary of Energy and Minerals. OSM (as lead agency) is the federal regulatory authority responsible for reviewing coal M&R plans (permit application), enforcement of all environmental protection and reclamation standards included in an approved mining permit, the monitoring of both on- and off-site effects of the mining operation, and abandonment operations within the area of operation of a federal lease.

OSM is the principal contact for all coal mining activities within the area of operation. OSM will conduct as many inspections as are deemed necessary but no less than one partial inspection quarterly and at least one complete inspection every six months (30[CFR]: 721.14[c]).

OSM, after consultation with BLM, USGS, and the operator establishes the boundaries of the permit area for the proposed mine and approves the locations of all the mine facilities located within this boundary.

Section 523 of SMCRA requires the Federal Lands Program to adopt those state performance standards which the Secretary determines are more stringent than the federal standards. The Federal Lands Program means a program established by the Secretary pursuant to Section 523, SMCRA, to regulate surface coal mining and reclamation operations on federal lands. Therefore, the performance standards enforced by OSM on a federal leasehold should be at least as stringent as those required under state law or regulations.

The Department of the Interior is negotiating a cooperative agreement pursuant to Section 523(c) of SMCRA with the state of Colorado and other states. Whenever this agreement is consummated with the state, the OSM's functions and responsibil-

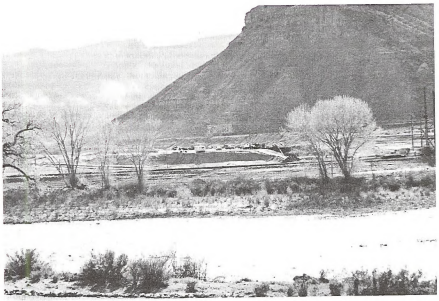


Figure G1-2. The loadout facilities being constructed by General Exploration in the Cameo area would be used for the company's Cameo mines

ities specified in this agreement will be delegated to the state regulatory authority. Under this agreement, OSM and the state regulatory authority will jointly review and act on mining permit applications and recommend approval or disapproval to the officials authorized to take final action on the application. The Secretary is prohibited by law from delegating his authority to approve mining plans on federal lands.

U.S. GEOLOGICAL SURVEY

The USGS is responsible for reviewing M&R plans for development, production, and coal resource recovery requirements on a federal leasehold. USGS is responsible for the maximum economic recovery of the federal coal resource and for the federal government receiving fair market value for the coal resource.

BUREAU OF LAND MANAGEMENT

The BLM formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of public lands.

The BLM, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, and railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The BLM is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on public lands within a leasehold.

U.S. FOREST SERVICE

The USFS formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of national forest systems land.

The USFS, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The USFS is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on forest lands within a leasehold.

Relationship to BLM Land Use Plans

The 2,560 acres of public lands included in this M&R plan are administered by the BLM's Grand Junction District. They are subject to the following management guidelines that were developed in the Roan Creek-Uinta Flats management framework plan (MFP) completed in January 1971, and the Grand Junction Resource Area Coal Update MFP, completed in September 1977:

1. Recreation
   a. Maintain the character of the entire wild horse area to meet the Visual Management Class II standards.
   b. Identify and protect cultural resources to avoid loss or destruction of any sites; conduct a Class II Cultural Resources Inventory of all unsurveyed public land to be impaired by coal development.
   c. Photograph and mold pictograph AR-05-07-159; take steps to protect sites during proposed preservation study.
   d. Have site AR-05-07-159 evaluated concerning its eligibility for inclusion in National Register (within next 5 years); protect resource during interim.
2. Wildlife
   a. Provide permanent watersites (upland game bird guzzlers) in Coal Canyon and the remainder of the chukar habitat as needed.
   b. Exclude all mountain lion hunting within the Little Bookcliffs Wild Horse Area through cooperation with the Colorado Division of Wildlife
   c. Protect raptor nest sites by limiting human activity within 0.5 mile from March 1 to July 1; prohibit physical disturbance on rock cliffs and maintain a 100-foot buffer area around tree nests.
3. Watershed and Water Quality
   a. Maintain the current Soil Surface Factor and reduce to next lower classification if possible.

b. Require coal-lease holders to install and maintain a water-monitoring network within their lease area; an adequate water-monitoring network should be addressed prior to approval of any mining or exploration plan as appropriate.

4. Range

a. Formally designate the Little Bookcliffs Wild Horse Area through the Secretary of the Interior as the third National Wild Horse Range.

5. Minerals

a. Allow the extraction of minerals (primarily coal) in accordance with 43(CFR): 23.

The western portion of GEX Colorado's leasehold overlaps the Little Bookcliffs Wild Horse Area, which is also a BLM wildland study area. That portion of the lease is subject to the following interim guidlelines for protection of the wildland study area (Whitewater Coal Update MFP 1977):

1. Motorized transportation shall be restricted to existing seasonal use and primitive four-wheel drive roads.

2. No new roads shall be authorized within the area.

3. Future development of existing leases for coal and/or oil and gas may entail some construction and other surface disturbing activity. The BLM will impose the strictest possible stipulations on any such development to ensure that no unalterable change is made in the character of the land. Mitigating measures will be imposed to bring disturbed areas back to their original state as nearly as possible. Except as outlined under item 8 below, no other construction of any kind will be permitted.

4. Grazing of domestic livestock will be permitted subject to special conditions and restrictions necessary to preserve wildland values.

5. Hunting and fishing are permitted.

6. Motorized equipment will be permitted.

7. Aircraft will be allowed to land in the area.

8. Water storage projects may be permitted under conditions and restrictions deemed necessary to preserve wildland values.

9. Rights-of-way will not be granted.

10. Wildfire will be controlled as necessary to prevent unacceptable loss of wildland values, loss of life, damage to property, and the spread of wildfire to lands outside the study area.

11. Insect and disease control programs shall be permitted to the extent they impact only minimally upon wildland values and other components of the ecosystem.

12. Public use of the area will be permitted consistent with the maintenance of wildland values.

13. Commercial recreation services may be permitted in the area if carefully monitored.

14. Commercial timber harvesting will not be permitted.

15. Mining and prospecting will be permitted.

16. Other proposed uses and programs not specifically mentioned above will be assessed in terms of their possible impacts on wildland and ecologic values. The District Recreation Planner shall assist the Area Manager with the interpretation of the interim management policy.

Relationship to State and Local Planning

For a discussion of state of Colorado and Mesa and Garfield county land use planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

The description of the existing environment covers the physical, biological, and cultural resources and the socioeconomic conditions which constitute the site-specific environment in which GEX Colorado Company proposes to develop federal coal and adjacent private coal. The description focuses on environmental details most likely to be affected by GEX Colorado's proposed M&R plan and alternatives. The concluding section of this chapter describes the anticipated future environment through 1990 if the proposed M&R plan is not approved and implemented.

EXISTING ENVIRONMENT

Climate

The climate of west-central Colorado is characterized by dry air masses, which are modified Pacific air masses that move eastward across the Rocky Mountains. Winter snows and summer showers or thunderstorms result in unusually even distribution of precipitation throughout the year. Prevailing winds vary greatly throughout the Upper Colorado River Basin, and are markedly affected by differences in elevation and by the orientation of mountain ranges and valleys with respect to general air movements.

Five years of upper air observations at Grand Junction show that surface-based inversions occur on 84 percent of the mornings. During the afternoons they are not as common, occurring 11 percent of the time in winter but less than 3 percent of the time in other seasons. The area is subject to a relatively high frequency of stagnation situations, mostly in winter.

The proposed Cameo site is located at the mouth of DeBeque Canyon about 3.5 miles northeast of Palisade, Colorado, on the edge of Grand Valley. Elevation at the site ranges between 4,800 and 5,200 feet. No meteorological measurements are made on site. National Weather Service records for Palisade indicate an average annual precipitation of 9.1 inches. Vegetation on the lease area indicates annual precipitation of about 10 inches at Cameo adjacent to the Colorado River at an altitude of 4,800 feet. Vegetation on Mount Lincoln and Whittaker Flats at an elevation of about 6,000 feet indicates annual precipitation of possibly 11 to 12 inches. Evaporation is estimated to be about 45 inches annually.

Prevailing wind at this site is influenced by its location in DeBeque Canyon. No wind measurements are made on site. It has been assumed that prevailing wind direction is down valley or from the northeast. The wind rose from the nearby Grand Junction weather station has been rotated to reflect the major canyon axis, as shown in figure G2-1. Average wind speed at the Grand Junction station is 8.1 miles per hour.

Air Quality

Particulate air quality in the study area ranges from 20 to 132 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean as recorded at sixteen state, municipal, and privately operated particulate sampling sites. In undeveloped sections, particulate concentrations range from 20 to 40 $\mu g/m^3$.

The available particulate sampling data which best represent existing particulate air quality at the proposed Cameo mines are from a state-operated sampler located about one mile northeast of the site in DeBeque Canyon. The annual geometric mean concentration recorded at the sampling site is 42 $\mu g/m^3$ with first and second maximum 24-hour concentrations of 158 and 132 $\mu g/m^3$, respectively. These concentrations also reflect the impact of an existing mine (Roadside) and the power plant located nearby. Although particulate concentrations on the site are lower than applicable air quality standards, the site is partially within the designated boundaries of the Grand Junction nonattainment area.

There has been no measurement of carbon monoxide, hydrocarbon, nitrogen oxides, sulfur dioxide, or other gaseous pollutants near the proposed site. The power plant and motor vehicle emissions near the mine site are likely to affect concentrations of these pollutants. However, the degree of impact is unknown.

Visibility at the site ranges from less than 1 mile to approximately 100 miles throughout the year. Average visibility is about 54 miles with greatest visibility occurring during spring and summer months.

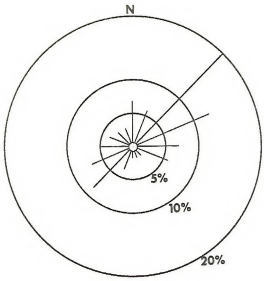


Figure G2-1. Annual wind frequency at the Cameo mine site

Geologic and Geographic Setting

Topography

The private and federal coal leases that compose the Cameo mine property lie northeast of the Little Bookcliffs and Grand Valley. These leases extend from DeBeque Canyon (and the Colorado River) to just west of Mount Lincoln. Elevation varies from 4,760 feet along the Colorado River on the southeastern property boundary to 6,649 feet on the summit of Mount Lincoln on the southwest property boundary.

Along the portion of its course that occupies DeBeque Canyon, the Colorado River is bound by steep V-shaped canyon walls. Local relief along the canyon walls may approach 1,200 feet. South of the Colorado River lie the northern slopes of Grand Mesa, and north of the river lies the southern end of the Little Bookcliffs escarpment. The mine property consists of a predominantly northeast trending ridge system dissected by two major drainages, Main Canyon and Coal Canyon. At intervals the canyon walls are notched by small, ephemeral stream channels. Both Jerry Creek (lying in Main Canyon) and Coal Canyon Creek are tributaries of the Colorado River.

The maximum relief on the mine property occurs along the escarpments of DeBeque Canyon and Main Canyon. Slopes may reach up to 75 percent on the canyon walls, and for short segments vertical cliffs are not uncommon. The average slope throughout the lease area is 55 percent. Along major stream channels slope may be as little as 4 to 5 percent.

Landforms

The landforms present on the lease area are largely the result of the differential erosion of the sedimentary strata of the Mt. Garfield Formation. Thick resistant sandstones form vertical cliffs and escarpments. Shales and other less resistant beds form gentle slopes between the cliffs and ledges. Because of the predominance of sandstones in the Mt. Garfield, narrowly cut canyons and steep slopes are the major landforms in the area.

Structure

The structural geology of the mine property of the lease area is relatively simple. The sedimentary strata of the Mesaverde Formation dip to the north-northeast at an angle of 3 degrees in the vicinity of the Cameo mine property. No major faults have been identified in the area.

Sandstone dikes or rock spars are characteristic of the Cameo coal zone in the Palisade area. They appear unpredictably in the old Cameo Mine and are present in other mines in the area. The dikes are extremely hard, cemented sandstone, requiring drilling and blasting for removal. Although usually only a few inches thick, they sometimes reach several feet in thickness. The dikes are thickest at the base, tapering generally to the top of the seam. Their attitude is nearly vertical, and their direction is random with no distinct orientation. Although creating an occasional nuisance to the mining operations with interruptions in the mining cycle, the dikes do not present an insurmountable obstacle and can be handled effectively when encountered if the mining equipment is properly designed.

Stratigraphy

The main coal beds on the lease area are found in the Upper Cretaceous Mesaverde Group which is overlain by the early Tertiary Ohio Creek conglomerate and underlain by the Upper Cretaceous Mancos Shale. Locally the Mesaverde is 4,100 feet thick and is composed of the Mt. Garfield Formation and the overlying Hunter Canyon Formation.

There are four coal zones containing workable coal seams in the Palisade area. These are, in ascending order, the Anchor and Palisade coal zones of the Mancos Shale and the Cameo and Carbonera coal zones of the Mt. Garfield Formation (see figure G2-2). Of the four zones present in the area, the company states that only the Cameo coal zone can be considered mineable under the Cameo mine property at this time. The Cameo coal zone is the lowest coal zone of the Mt. Garfield Formation and lies directly on the Rollins Sandstone, the bottom member of the Mt. Garfield Formation. The Cameo coal zone consists of the Cameo B and C seams; where the two coalesce, the seam is called the B seam. GEX Colorado proposes to mine only the B seam. The overlying coal seams of the Carbonera are considered too lenticular and discontinuous to be mineable. Data from exploration drill holes indicate that the roof would be sandstone, shale, or unmined bony or shaley coal. This suggests that roof conditions would be generally favorable.

Paleontology

The principal fossil-bearing formations in the lease area, ages, number of known fossil localities, and general fossil types normally found in the formations are summarized in table G2-1. Due to the present lack of data and accepted criteria for determining significance, the importance of these paleontological resources to science, education, and other values cannot presently be assessed.

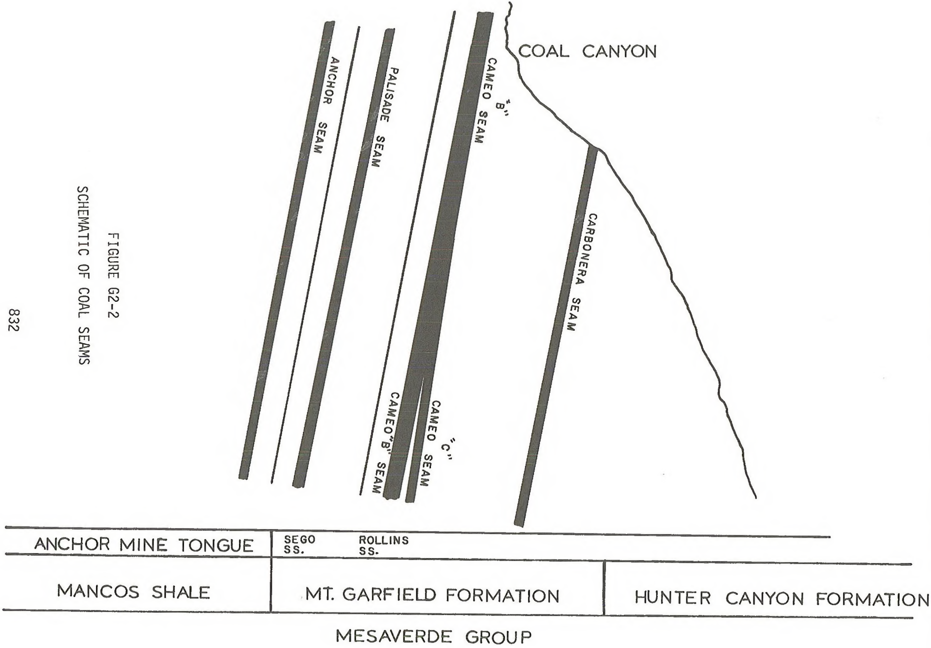


FIGURE G2-2
SCHEMATIC OF COAL SEAMS

TABLE G2-1

SUMMARY OF FOSSIL-BEARING FORMATIONS IN THE AREA
OF THE PROPOSED GENERAL EXPLORATION MINE

Formation	Period	Known Fossil Localities a/	Type of Fossils b/
Mancos Shale	Cretaceous	General	I, V, P
Mt. Garfield	Cretaceous	General	I, V, P
Hunter Canyon	Cretaceous	General	I, V, P
Ohio Creek	Tertiary	General	I, V, P
Wasatch	Tertiary	General	I, V, P

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

b/ I = Invertebrate; V = vertebrate; P = paleo botanical.

Mineral Resources

Coal

The Cameo B seam, which GEX Colorado proposes to mine, ranges from 6 to 16 feet with an average thickness of 9 feet. Reports by the U.S. Bureau of Mines on the abandoned Cameo Mine show that the weighted average on as-received mine-run coal was 11,773 BTUs, 0.64 percent sulfur, 7.92 percent moisture, 9.58 percent ash, 46.94 percent fixed carbon, and 35.56 percent volatile matter. The USGS estimated total in-place coal reserves for the federal lease (C-01538) at 73.78 million tons. No estimate of the reserves on the private leases is available.

Oil and Gas

A slight potential exists for oil and gas under the leased land. A well is to be spudded-in in the near future approximately 3.5 miles to the southwest.

Water Resources

Hydrologic Setting

The proposed mine area lies on the west side of DeBeque Canyon in the section extending northward from Mount Lincoln to Whittaker Flats and including the lower reaches of Coal and Main canyons. Beds underlying the lease area strike east-southeastward and dip about 3 degrees north-northeast, crossing DeBeque Canyon and the Colorado River at approximately right angles. Thus, the Cameo B coal bed to be mined under the proposal is exposed in the precipitous slopes of De Beque Canyon in the southern half of the tract and dips upstream below river level in the northern half of the tract. The Cameo No. 1 Mine would operate primarily below river level; the Cameo No. 2 Mine would be above river level.

The Colorado River locally represents the base level of saturation below which all permeable rocks are water-bearing. Both ground-water and surface-water drainage in the lease area are toward the Colorado River, which is perennial. All other streams traversing the tract are ephemeral and flow less than one month of each calendar year and only in direct response to precipitation.

No precipitation data are available for the lease area, which is about 3.5 miles northeast of Palisade, Colorado, where National Weather Service records show an average annual precipitation of 9.1 inches. Vegetation on the tract indicates an annual precipitation of about 10 inches at Cameo adjacent to the Colorado River at an altitude of about 4,800 feet and possibly 11 to 12 inches on Mount Lincoln and Whittaker Flats at an altitude above 6,000 feet. The seasonal pattern of precipitation showing approximately uniform monthly distribution should be similar to that at the Palisade station.

Ground Water

The occurrence of ground water in the lease area is controlled largely by the local combination of topography, stratigraphy, and geologic structure. Ground-water recharge on the tract initially accumulates in those permeable materials that underlie the surface at shallow depth. Movement is then downward to the first relatively impermeable bed, which acts as a "perching" layer. This perched water then migrates downdip northeastward and laterally toward discharge areas along valley side slopes where the beds intersect the surface. All seepage in the lease area is dissipated by evapotranspiration; no springs occur in the lease area. A comparatively small amount of ground water percolates downward through the perching layers, probably through small joints and fractures, to recharge underlying beds such as the Cameo B coal seam, which GEX Colorado Company proposes to mine. These deeper beds also tend to drain downdip and discharge to the Colorado River at their lowest point of outcrop. It is emphasized that the Cameo B coal seam in the lease area would normally discharge to the Colorado River in the absence of excessive pumpage, either from mines or wells penetrating this bed. Recharge from the river can occur only when the level of saturation in the coal is lowered to below river level.

GEX Colorado has drilled at least twelve coal-test holes in the lease area, but no hydrologic data for any of these holes have been furnished to the ES team. So far as is known, none of the test holes has been completed as a monitoring well. The currently active Roadside Mine operated by GEX Colorado immediately east of the tract in the Cameo B coal seam reportedly intercepts an undetermined, comparatively small amount of water, all of which is used in the mining operation. No water quality data are available for ground water in the Roadside Mine.

The Cameo No. 1 Mine is currently being developed by GEX Colorado adjacent to the flood plain of the Colorado River in the east-central part of the tract just east of the old Cameo Mine. The No. 1 Mine extends below river level and has appreciable ground-water inflow. The company currently pumps about 75 gallons per minute (gpm) for an average of three hours per day through Coal Creek into the Colorado River under National Pollution Discharge Elimination System (NPDES) Permit No. CO-0035467. Maximum allowable disharge under this permit is 1.44 million gallons per day

(4.4 acre-feet per day [ac-ft/day]); current discharge is about 13,500 gallons per day (0.04 ac-ft/day). The water has a pH of 7.6, a dissolved-solids concentration of 2,680 milligrams per liter (mg/l), 4.4 mg/l suspended solids, 1.4 mg/l oil, and 0.44 mg/l total iron. Annual salt load contributed to the Colorado River from this source is about 55 tons. Water of this poor quality undoubtedly is entering the Cameo No. 1 portal from the flooded portion of the nearby old Cameo Mine. Ground water derived from the Colorado River or the underlying alluvial aquifer would be expected to contain less than 1,000 mg/l dissolved solids. Similarly, ground water obtained from the Cameo B coal seam in this general area normally contains about 1,500 mg/l.

Data analyzed in conjunction with the hydrologic appraisal of the Cottonwood Creek No. 1 and No. 2 mines described previously in this volume indicate that the Cameo B coal seam and the underlying Rollins Sandstone are marginal aquifers in this general area and yield comparatively little water to wells or mines on a sustained basis. Data are not adequate, however, to quantify the hydraulic characteristics of these beds. Observations suggest that ground water in the Cameo B coal seam and in encompassing rocks probably occurs under confined conditions in the western and northern parts of the tract away from their respective outcrop areas. The top of the zone of saturation is expected to slope toward and be graded to the lowest point of outcrop where these beds cross the Colorado River. If so, the coal should be largely drained in that part of the tract that would be developed by the Cameo No. 2 Mine and should yield water under confined conditions to the Cameo No. 1 Mine.

Water obtained from the Cameo B coal seam and encompassing rocks once the old Cameo Mine workings are drained should be a sodium bicarbonate type with a dissolved-solids concentration of about 1,500 mg/l.

Ground water in the alluvium bottoming DeBeque Canyon is recharged primarily by the Colorado River with comparatively small recharge from the adjacent bedrock formations. As such, water-table fluctuations can be expected to closely reflect changes in river level, and water quality should be similar to that of the river water. Wells drilled on the flood plain could probably obtain yields of more than 1,000 gpm, but because of the close hydraulic connection between the river and the alluvium, the effect on river flow would be essentially the same as pumping directly from the river.

Surface Water

The lease area is bordered on the east by the southward-flowing Colorado River and is traversed by Coal and Jerry creeks, both of which are ephemeral and drain generally southeastward in deeply-incised canyons to the river. The Government Highline Canal carries river water down the west side of DeBeque Canyon with siphons beneath the channels of Coal and Jerry creeks (map G1-2, chapter 1).

Runoff records for the Colorado River are collected by the (USGS) at a gaging station (No. 09095500) located about 7 miles upstream or northeast of Cameo, Colorado. These records show that the river has an annual average discharge of 3,850 cubic feet per second (cfs) or 2,789,000 acre-feet per year (ac-ft/yr). Maximum discharge of 36,000 cfs occurred on June 16, 1935; minimum daily discharge of 700 cfs occurred on December 29, 1939. Flows in excess of 11,000 cfs commonly occur during May and June in response to melting snowpacks. During spring runoff, the water is a calcium, sodium, bicarbonate, sulfate type with a dissolved-solids concentration of about 200 to 250 mg/l. During low flow, the water is a sodium chloride type with a dissolved-solids concentration of 600 to 650 mg/l. A general description of the Colorado River is given in the regional volume.

Flows in the Government Highline Canal are diverted from the river primarily during the summer irrigation season. Water quality is essentially the same as river water.

Flows in Coal and Jerry creeks occur primarily in response to high-intensity thunderstorms and are characterized by high peak discharges, short flow durations, and poor quality water. Both streams are ephemeral and flow less than one month each calendar year.

Coal Creek drains an area of 11.7 square miles and has an average gradient of 2.2 percent (1.4 degrees) within the lease area. Tributary streams are characteristically steep with slopes in the headwater areas exceeding 100 percent. Although no runoff or water quality data are available for Coal Creek, hydrologic studies in Badger Wash near Fruita, Colorado, on similar soils with only slightly less annual precipitation show an average annual runoff of about 0.5 inch (Lusby 1978). On that basis annual runoff in Coal Canyon would probably average about 0.6 inch (32 acre-feet per square mile [ac-ft/sq mi]). Runoff can be expected to be a calcium, magnesium sulfate water with a pH of 8.0 to 8.5 and a dissolved-solids concentration of 1,000 to 2,000 mg/l. Efflorescence, a white powdery crust of salt occurs throughout much of the length of Coal Creek channel in the lease area.

Jerry Creek drains an area of 68.8 square miles and has an average gradient of 1.5 percent (0.8 degrees) within the lease area. Watershed characteristics are very similar to those of the Coal Creek drainage; runoff characteristics, therefore, also should be similar for the two basins.

Flood Hazard

The mine support facilities (unit-train loadout, railspur, conveyor system, etc.), which GEX Colorado is developing for the Cameo and Roadside mines, are on an alluvial outwash deposit at the mouth of Coal Canyon which merges onto the flood plain of the Colorado River. According to studies in the Palisade area (U.S. Army Corps of Engineers 1976), all facilities except the railroad, conveyor, and loadout are above the projected level of the 100-year flood. The latter facilities could be submerged to a depth of several feet, but that possibility is unlikely because of the numerous diversion structures and storage reservoirs on the Colorado River upstream. It is very doubtful that the peak flow of 36,000 cfs, which occurred in 1935 prior to construction of many, if not most, of the current control structures, would occur again in this area.

Coal and Jerry creeks, because of their steep slopes, tight soils, and minimal plant cover, are subject to extreme flooding characterized by high peak discharges for comparatively brief periods. On July 18, 1974, a high-intensity thunderstorm caused Coal and Jerry creeks to flow at bank-full stage. Subsequent measurements by the USGS, Water Resources Division, using indirect methods showed peak discharges of 3,440 cfs (287 cfs/sq mi) in Coal Creek at a point about 0.9 mile upstream from its mouth and 12,000 cfs (175 cfs/sq mi) in Jerry Creek at a point about 0.5 mile upstream from its mouth.

Erosion and Sedimentation

No long-term data are available on the annual sediment load of the Colorado River near Cameo, Colorado. Partial records for the years 1951-54 show concentrations ranging from 59 to 4,420 parts per million (ppm) and daily loads ranging from 852 to 212,400 tons/day. Iorns et al. (1965) reported the weighted average concentration of suspended sediment in the river to be 2,270 ppm. This is equivalent to an annual load of about 8,610,000 tons or about 1,070 tons/sq mi for the watershed.

No sediment sampling data are available for any flows in Coal and Jerry creeks. Their respective watersheds obviously are actively eroding, however, and contributing large volumes of sediment to the Colorado River. Measured sediment yields from Badger Wash near Fruita, Colorado, with similar runoff and erosion characteristics (Lusby 1978) show an average annual rate for the period 1953-73 of 1.80 ac-ft/sq mi (approximately 2,750 tons/sq mi/yr). Because of the steep slopes in the mine area, local rates of sediment yield could exceed those reported for Badger Wash by a factor of two. With increasing size of a watershed, however, unit rates of sediment yield normally decrease (Hadley and Schumm 1961) so that annual sediment contribution from the Coal Creek and Jerry Creek watersheds to the Colorado River should not greatly exceed 1.0 to 1.5 ac-ft/sq-mi.

Alluvial Valley Floors

The flood plain of the Colorado River is an alluvial valley floor as defined in 30(CFR): 710.5. Mining restrictions applicable to alluvial valley floors would not apply to these existing facilities, however, because they are currently being used by the Roadside Mine, which was in production in the year preceding August 3, 1977. Also, the premining land use of this valley floor area was undeveloped rangeland.

Coal and Jerry creeks are ephemeral throughout their length and yield insufficient water on a regular basis to support subirrigation or flood-irrigation agricultural activities. No parts of these valley bottoms, therefore, qualify as alluvial valley floors.

Soils

Soil mapping units in areas of existing and proposed surface disturbance are delineated in figure G2-3.

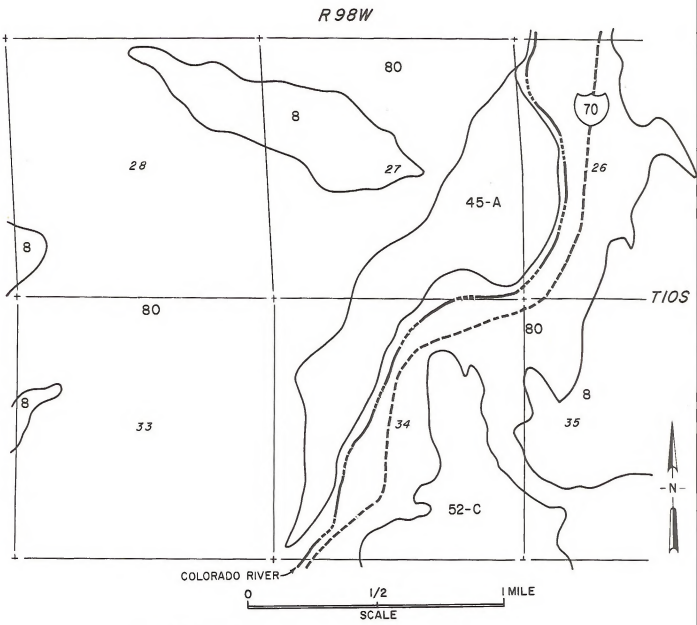
Existing disturbance consists of approximately 57 acres within mapping unit 80 (rough, broken, and stony land) and 86 acres in unit 45-A (Green River loam, 0 to 3 percent). New disturbance would be limited to approximately 90 acres in unit 80.

Unit 80 is not strictly defined, but includes various components ranging from shallow loamy soils and rock outcrops on steep side slopes to deep, fine-textured soils on flatter valley bottoms. Unit 45-A is a moderately coarse-textured alluvial soil on the Colorado River flood plain; this series is commonly used as irrigated cropland and under existing criteria will likely qualify as prime farmland.

Specific soil features of importance in assessing reclamation are rated in table G2-2; brief explanations of each rating are contained in the footnotes (see also Water Resources, Erosion and Sedimentation).

Vegetation

The vegetation on the coal lease tract consists of five vegetation types: pinyon-juniper, saltbush, sagebrush, riparian, and greasewood (see map G2-1). Pinyon-juniper and saltbush are the most widespread types in the lease area. Pinyon-juniper occurs on level mesas and north-facing slopes, while saltbush occurs in canyons and on south-facing slopes. The dominant species within the saltbush type is shadscale; galleta and snakeweed are locally abundant. Some steep, rocky south-facing



MAPPING UNITS

8	Rock outcrop
45A	Green River loam, 0-3% slopes
52C	Utaline stony loam, 3-25% slopes
80	Rough broken and stony land

Figure G2-3. Soil units in the area of the proposed Cameo No. 1 and No. 2 mines

TABLE G2-2

SOIL FEATURES

Mapping Unit No.	Name	Hydrologic Group a/	Erosion Hazard b/	Topsoil Rating c/	Reclamation Limitations d/
45A	Green River Loam, 0-3% slopes	B	Slight	Good	Slight
52C	Utaline stony loam, 3-25% slopes	B	Moderate-High	Poor	Severe
80	Rough broken and stony land				
	Rock outcrop	--	--	--	--
	Lazear	D	High	Poor	Severe
	Scholle	B	Moderate	Fair	Moderate
	Saraton	B	Moderate	Fair-Poor	Severe

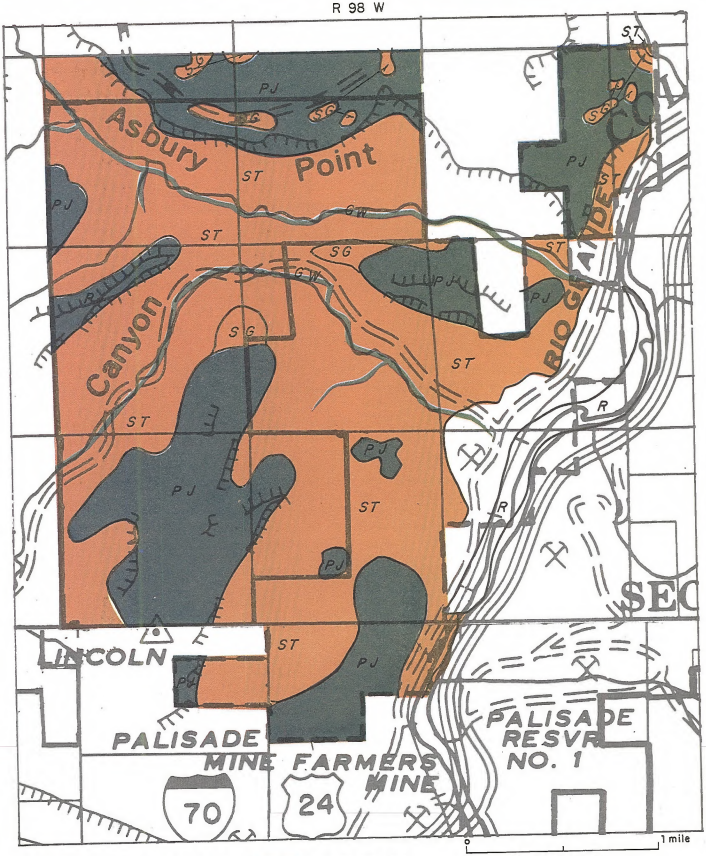
Note: Adapted from data provided by U. S. Department of Agriculture, Soil Conservation Service, Grand Junction, Colorado.

a/ Hydrologic soil groups (A, B, C, D) are based on the rate at which water enters the soil surface (infiltration) and the rate at which water moves within the soil (transmission). When both infiltration and transmission rates are high, little surface runoff occurs (Hydrologic Soil Group A). In contrast, low infiltration and transmission rates produce high surface runoff (Hydrologic Soil Group D). Groups B and C are intermediate.

b/ Erosion hazard refers to the potential for surface soil loss when existing cover is removed or seriously disturbed.

c/ Topsoil is rated both on suitability as a seedbed material and on ability to sustain plant growth. Factors considered include soil depth, texture, amount of coarse fragments, and the presence of excess soluble salts which may inhibit plant growth.

d/ Hydrologic soil groups, erosion hazard, and topsoil rating, along with climatic information, are considered jointly to determine an overall rating of the limitations for reclamation. Specific degrees of limitation are interpreted as follows: Slight - indicates either no significant limitations or those limitations which can be remedied through planning and management choices, such as species selection, time of seeding, or short-term exclusion of livestock and certain forms of wildlife. Moderate - indicates significant limitations which must be recognized but which generally can be overcome through established measures to conserve natural moisture, reduce erosion, and augment available nutrient supplies. Severe - indicates serious deficiencies in natural moisture and in the amount and quality of topsoil; may also indicate topographic soil conditions which produce extreme surface erosion or landslide hazards.



Map G2-1. Vegetative types in the area of the proposed Cameo No. 1 and No. 2 mines

slopes in the saltbush type are nearly barren of vegetation.

Level areas with well-developed soil support extensive stands of big sagebrush in the coal lease area. These sage parks are usually bordered by pinyon-juniper woodlands.

The riparian vegetation is on the flood plain of the Colorado River. It is composed of cottonwoods, willows, saltcedar, and a number of herbaceous grasses and forbs. The greasewood type occurs sporadically along the drainages of Coal Canyon, Coal Gulch, and Jerry Creek. The dominant plant is black greasewood. There is no aquatic vegetation in the area proposed for mining.

The land where the mine portals and associated surface facilities would be constructed is currently disturbed and contains no natural vegetation other than weedy species, with the exception of the proposed refuse area, which is in the saltbush type.

A more detailed discussion of the plant species composition of these vegetation types as well as their relationships to climatic and topographic features and to each other can be found in the regional analysis. Scientific names of the plants discussed are listed in the appendix, volume 3.

Endangered or Threatened Species

Information on the location of plants within the region that are proposed to be officially listed as endangered or threatened in the *Federal Register* (see the regional chapter 2, Vegetation, for a list of the plants) was obtained from detailed literature searches (Rollins 1941; Barneby 1964; Higgins 1971; Hitchcock 1950; Arp 1972, 1973; Reveal 1969; Keck 1937; Howell 1944; Benson 1961, 1962, 1966; Weber 1961) and extensive herbarium surveys (University of Colorado, Colorado State University, Colorado College, Denver Botanic Gardens, Western State College, Rocky Mountain Biological Lab, Black Canyon National Monument, Colorado National Monument, and Grand Mesa/ Uncompahgre National Forest Headquarters). This research has revealed that none of the plants are known to have occurred historically in the area of the proposed Cameo mines. The results of the literature and herbarium studies may be reviewed at the BLM Montrose District Office. A detailed floristic and endangered and threatened plant inventory of the natural vegetation that is expected to be disturbed by the Cameo mine facilities and roads has revealed that no endangered or threatened plants are present. The results of this inventory are available for public review at the Grand Junction District Office.

Wildlife

A listing of all terrestrial species known or expected to occur in the Cameo area is available at the Montrose BLM District Office. The area for the Cameo No. 1 portal and for the loadout facility have already been cleared and construction is under way.

Wild Horses

The Little Bookcliffs Wild Horse Area is west of the Cameo facilities, and some underground operations would occur within the Wild Horse Area. The horses do occasionally winter in Main Canyon in the northwest corner of the lease tract. The current population of horses is around 70 animals, following the removal of 40 head in the fall of 1977. South-facing slopes are the areas most used by the horses due to the lack of snow accumulation (see map G2-2).

Big Game

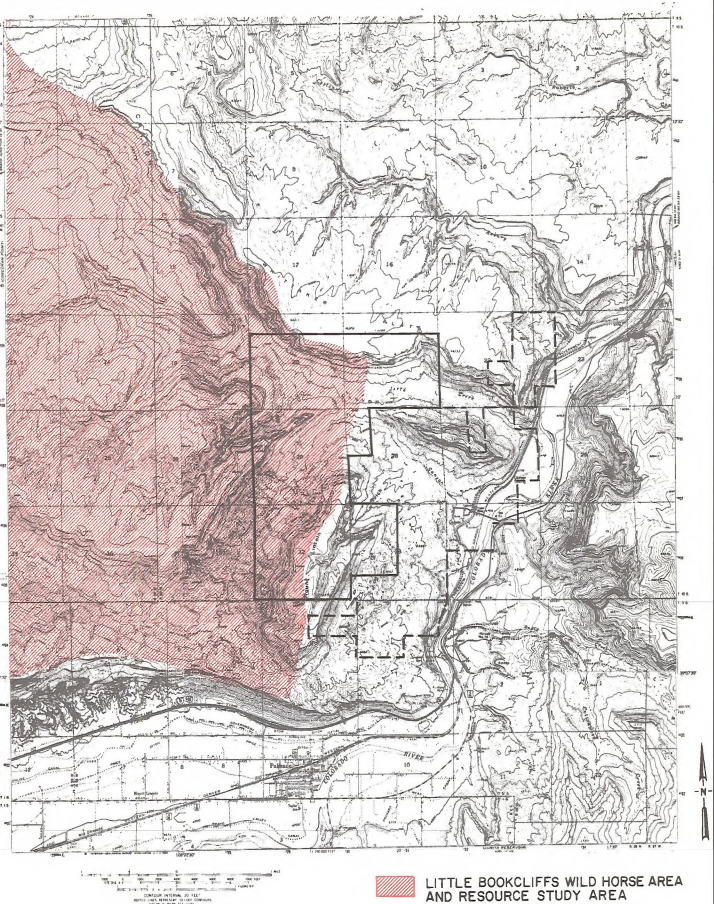
MULE DEER

Coal Canyon, Main Canyon, and Jerry Creek are on the southern edge of the Roan Creek deer herd's winter range (see map G2-3). Based on pellet group transects, 29.8 deer days of use per acre occur near the Cameo lease. Deer normally move into this area in mid-November and remain until April, when they gradually migrate to higher elevations. Use adjacent to the Cameo No. 1 facilities is generally restricted to this seasonal migration and movements to water. This is because of the highway, railroad, Public Service Company power plant, and the ongoing construction by GEX Colorado.

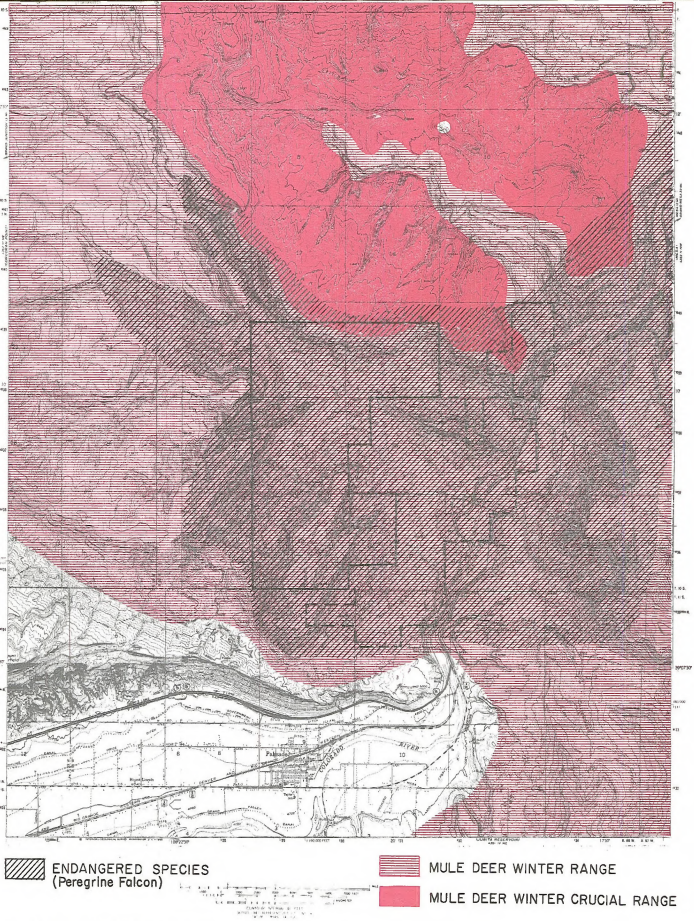
Populations may fluctuate greatly from year to year as well as seasonally within the year, and population estimates are based on average numbers. Mule deer winter populations have been estimated at about 50 deer per square mile. This would indicate a total deer population within the Cameo lease area of about 375 animals during the winter months.

Small Mammals

Due to the ongoing construction of Cameo No. 1 facilities and the loadout, there are very few small mammals remaining in these two areas; and those there are adapted to human presence. The remaining areas of the Cameo lease have species composition that is typical of the pinyon-juniper, sagebrush, and saltbush habitats in western Colorado. Cottontail rabbits, chipmunks, mice, and rock squirrels are some of the more common species. Small mammals closely associated with aquatic habitat, such as beaver, muskrat, and raccoon, occur along the Colorado River. Coyote, bobcat, and ringtailed cat



Map G2-2. Little Bookcliffs Wild Horse Area



Map G2-3. Wildlife ranges in the area of the proposed Cameo No. 1 and No. 2 mines: deer, endangered species

are the predatory species found in the vicinity of the lease.

Game Birds

Mourning doves are the most common game birds found in the area. During the summer, doves nest throughout the area, utilizing trees or the ground as nest sites. They concentrate around weed patches, road shoulders, and small seeps or stock ponds.

Chukars, an introduced species, are found throughout the canyon. Steep rocky slopes, cheatgrass (Bromus tectorum) and water sources are important habitat components for this species.

Sage grouse are also found in the vicinity of the lease. Sagebrush parks with a mixture of different heights of sagebrush are essential to the survival of this species because of their dependence on sagebrush leaves for food.

Mallards and Canadian geese nest and raise their young along the Colorado River in DeBeque Canyon. During spring and fall migration and the winter months, a much greater variety of waterfowl is present on the river, with the common merganser and common goldeneye two of the most abundant species.

Other Birds

The abundance of cliff faces and the height of the canyon walls provide excellent nesting habitat for golden eagles, prairie falcons, and redtailed hawks. These species do nest outside Coal Canyon, and they would be expected to spend time hunting within the Coal Canyon drainage since the area is within normal hunting limits of known aerie sites.

The greatest variety of songbirds occurs in the riparian zone along the Colorado River. Species would be more limited in the pinyon-juniper and saltbush habitat; pinyon jay, horned lark, chipping sparrow, and whitethroated swift would be some of the more common summer residents. Hummingbirds and wrens are also found in the most numbers in the summer months.

Threatened or Endangered Species

Within the DeBeque Canyon area, an active peregrine falcon aerie was discovered in July 1977 (Enderson 1977). The aerie will have to be observed for one or more years to determine whether the falcons will continue to use this nesting cliff or possibly a complex of cliffs in the general area (see map G2-3).

Peregrines are apparently able to tolerate a high level of human activity for short durations within 0.25 mile of their nest and a low level of human activity 0.5 to 1 mile from the cliffs they use (Craig 1978, personal communication). The Colorado River and areas adjacent to riparian habitats are suspected to be important hunting areas because of the abundance of peregrine prey in this area. Habitat in this type is being destroyed by changing land use, particularly coal development, such as the ongoing construction of the Cameo loadout facilities.

Bald eagles are commonly seen along the Colorado River in DeBeque Canyon throughout the winter months. Birds are frequently observed on hunting forays along the river or perched in cottonwood trees. Hunting areas for the species have been reduced by the ongoing development of the Cameo loadout facilities.

Aquatic Biology

The ephemeral tributaries which flow through the mine site to the Colorado River are Asbury Creek, Coal Creek, and Jerry Creek. These tributaries are dry washes more than 95 percent of the time. When they do flow, water levels rise and fall rapidly, and they normally flow only as a result of heavy spring snowmelt or severe thunderstorms. Water quality is naturally poor because the drainages are highly erosive. Runoff water is typically very high in sulfates, carbonates, total dissolved solids, and suspended sediments. Aquatic life is not present in any of the tributaries on the Cameo mining site.

The lease site is adjacent to the Colorado River and all site drainage enters directly into the river. The Colorado River at this location is considered a warm water fishery. Channel catfish, largemouth bass, sunfish, and bullheads dominate the gamefish population while numerous nongame fish species including roundtail chub, sand shiner, carp, flannelmouth sucker, bullhead sucker, speckled dace, redfin shiner, and others are found here.

Threatened or Endangered Species

From below the confluence of Plateau Creek this section of the Colorado River is habitat for three species of threatened and endangered fish. The Colorado squawfish, the razorback sucker, and the humpback chub are presently known to exist in the river directly adjacent to the mine area. The U.S. Fish and Wildlife Service has recommended this section of river as critical habitat for the Colorado squawfish (see Aquatic Biology, chapter 2, regional analysis).

Cultural Resources

Archeological Resources

A Class III inventory was conducted on approximately 350 acres of the Cameo mine property (Connor 1977). Although prehistoric use has been noted in the Palisade area, no archeological values were identified within the survey bounds aries.

Sites AR-05-07-159 (a pictograph site) and AR-05-07-615 are located within the lease area but should remain outside the areas of surface activity.

Historic Resources

In a survey performed in April 1977, no historic sites of significance were discovered in the area. The Government Highline Canal, built in 1912, was noted; however, it would not be affected by the proposed action.

Land Use

The Cameo operation is located on a restricted area of flat land bounded on the west by 1,000-foot cliffs and terraced hills that border the junction of Coal and Debeque canyons and on the east by the Colorado River. The surface overlying GEX Colorado Company's lease holdings has been used for livestock grazing in the past, but no livestock are grazed at the present time. Some recreation occurs in the form of four-wheel driving, hiking, and hunting. As pointed out in chapter 1, History and Background, coal has been mined in this area for a number of years, and GEX Colorado is currently developing the Cameo No. 1 Mine on the company's private holdings.

The areas to the north and east are used to some extent by wildlife. Coal, Main, and Jerry canyons are on the southern edge of the Roan Creek deer herd's winter range, but use adjacent to the Cameo No. 1 Mine facilities is generally restricted to spring and fall migration and movements to water.

The high canyon walls and cliff faces provide potentially excellent nesting habitat for golden eagles, prairie falcons, and redtailed hawks, and the Coal Canyon drainage is within the normal hunting limits of known aerie sites outside the canyon area. An active peregrine falcon aerie was discovered within the DeBeque Canyon area in 1977, but it is not known at this time whether falcons will continue to nest in the cliffs in the general area. The Colorado River and areas adjacent to riparian habitats may be important hunting areas for peregrine falcons.

The Little Bookcliffs Wild Horse Area is west of the Cameo facilities. The horses do occasionally winter in Main Canyon in the northwest corner of the leasehold.

DeBeque Canyon is extensively industrialized in the vicinity of the Cameo operation. The Public Service Company's Cameo power plant is located just southwest of where the Cameo No. 1 Mine is being developed, and GEX Colorado's Roadside Mine is prominent on the other side of the canyon. Interstate Highway 70 (I-70) and U.S. Highway 6 are major transportation and travel routes through the canyon, and the Denver and Rio Grande Western Railroad (D&RGW) main line runs parallel to I-70 in the vicinity of the Cameo operation. GEX Colorado is currently constructing rail loadout facilities to serve the Cameo and Roadside mines. The Land Use Map (Soil Conservation Service 1973) classifies the land in this vicinity as rangeland or non-irrigated pastureland.

Island Acres Recreation Area, which is managed by the Colorado Division of Parks and Outdoor Recreation, is located on the Colorado River about 1 mile upriver from proposed loadout facility. Island Acres provides recreational facilities for about 100,000 campers, picnickers, and swimmers annually. The Colorado River is considered a warm-water fishery in the general area of the Cameo operation.

Southwest of DeBeque Canyon, the land uses become predominantly agricultural and residential. From just east of Palisade on down the Grand Valley toward Grand Junction, there is much irrigated cropland (including orchards), pastureland, hayland, and some rangeland. Lands producing fruit and vegetables may be designated unique farmlands, and some of the orchard land is in areas which could meet the definition of prime farmland (see Prime and Unique Farmlands under Agriculture in the regional volume). The valley becomes more urban and residential as it approaches Grand Junction.

For a discussion of Mesa and Garfield county planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints. BLM planning relevant to the leasehold area is discussed under Interrelationships in chapter 1 earlier in this site-specific analysis.

Transportation

HIGHWAYS

The proposed Cameo mines are located close to I-70. In 1976 average daily traffic on this stretch of I-70 was 5,500 vehicles. The highway is presently running at 4 percent of capacity during peak traffic hours. The Cameo interchange is running at 8 percent of capacity during peak hours. The accident rate is presently 1.57 per million miles travelled. U.S. Highway 6 diverges from I-70 just west of the mine site and serves much of the inter-city local traffic in the area.

RAILROADS

The main line of the Denver and Rio Grande Western Railroad lies parallel to I-70 in the vicinity of the Cameo mines. This is the major rail line between Denver and Salt Lake City and serves many of the coal producing areas in Colorado and Utah. Loading facilities are now being built by GEX Colorado to serve mines in the Cameo area.

AIRPORTS

Grand Junction's Walker Field is the major airport in western Colorado and is served daily by Frontier and United airlines. There is a large amount of room at the airport for expansion.

Livestock Grazing

No livestock are grazed in the area of the proposed action due to ongoing operations at the Cameo No. 1 Mine.

Recreation

The Cameo lease site contains no recreational facilities; however, it does provide opportunities for dispersed recreation such as hunting and hiking. Species which provide hunting and viewing potential include mule deer, cottontail rabbits, and chukar. Coal Creek, which runs through the lease site, is an ephemeral stream and offers little recreational value (refer to Wildlife and Aquatic Biology in this chapter for the extent of these resources). The lease site is located within Big Game Management Unit 30, which provided 3,364 recreation days in 1976, and Small Game Management Unit 58, which provided 35,723 recreation days in 1975. Tables G2-3 and G2-4 provide recreation days by species. The western portion of the lease site overlaps the Little Bookcliffs Wild Horse Area (see map G2-2), which is also a BLM wildland study area. Management of this area would be subject to the interim guidelines listed in chapter 1, Interrelationships.

The Colorado Division of Parks and Outdoor Recreation manages the Island Acres Recreation Area, which is located on the Colorado River about 1 mile upstream from GEX Colorado's proposed coal train loading facility. Island Acres provided opportunities for camping, picnicking, and swimming for 102,578 visitors in 1977.

The majority of the population increase due to mining activity would occur in the Grand Junction-Palisade area. Grand Junction provides city-sponsored leagues for softball, basketball, and volleyball. Facilities in the Grand Junction area include eleven parks, fourteen swimming pools, and sixteen tennis courts. The Grand Junction Recreation Department feels that use of its facilities is now maximum; people have to be turned away from the programs, especially league activities. The department also states that only 40 percent of this use is from city residents, which indicates that the city's programs are a major recreational outlet for the surrounding area. The city of Palisade provides a park with playground, two tennis courts, and a basketball court.

For a comprehensive discussion of the recreational resources of the region, refer to chapter 2 of the regional analysis, Recreation.

Visual Resources

The Cameo No. 1 and No. 2 mines would be located in a restricted area surrounded by 1,000-foot cliffs and terraced hills that border the junction of Coal and DeBeque canyons. The limited expanse of flat land is bounded by the Colorado River on the east and buff-colored rock cliffs on the west. A strong horizontal line is produced in the landscape by the cleavages and rock colors of the cliff faces, which serve as the horizon line for canyon travelers. The Colorado River creates a second linear ingredient which is emphasized by adjacent riparian vegetation, the railroad track, and the I-70 corridor. The landscape is form dominant, because of the lack of vegetative cover, and natural and culturally modified surfaces and volumes are readily apparent in the landscape.

The natural landscape has been modified by numerous developments that dominate the character of the limited viewing area. The large size and broad land coverage of the Cameo power plant, the rail alignment and loadout facilities, and the I-70 corridor are focal elements in this section of DeBeque Canyon (see figure G2-4) and they establish an industrial landscape character. The extent of these landscape modifications is represented by a VRM Class V (see the appendix, volume 3, for an explanation of the VRM classification process) which denotes a severe modification of the natural landscape.

Socioeconomic Conditions

Demography

Table G2-5 lists the population for each incorporated town and each county census area within Mesa County and western Garfield County, for the 1970 and 1977 censuses. Grand Junction and vicinity is the most heavily populated community between the Denver and Salt Lake City metropolitan areas. As such, it serves as a regional center of commercial and industrial activity for most of western Colorado and eastern Utah. Recent growth in the Grand Junction area has been caused by a variety of economic factors, including the expectation that the area's mineral resources will develop rapidly in the near future. Corporations and government agencies involved in mineral resource development over a wide area have located regional headquarters in Grand Junction. Table G2-5 indicates that most areas around Grand Junction have grown at a moderate rate, averaging between 3 and 5 percent per year since 1970.

The median age of the population in Mesa County is higher, but not significantly higher, than the Colorado median age of 26.2 years. The Palisade area has a relatively older population than the

TABLE G2-3

BIG GAME HUNTING IN BIG GAME MANAGEMENT UNIT 30

	Deer	Elk	Bear	Mountain Lion	Total
Hunters	854	-	20	9	a/
Recreation days b;	3,122	-	151	91	3,364

Source: Colorado Division of Wildlife, 1976 Colorado Big Game Harvest.

a/ Hunter totals are not provided because hunting and trapping of more than one species are allowed.

b/ All or part of a day.

TABLE G2-4

SMALL GAME HUNTING AND TRAPPING IN SMALL GAME MANAGEMENT UNIT 58

Animal	Hunters	Recreation Days a/	Animal	Trappers	Recreation Days a/
Ducks	1,166	9,794	Badgers	9	757
Geese	423	1,950	Beavers	17	426
Doves and pigeons	1,106	6,251	Bobcats	30	1,918
Pheasants	2,021	7,203	Ringtailed cats	3	310
Chukars	500	1,123	Coyotes	21	2,086
Grouses	261	814	Foxes	29	1,235
Ptarmigans	7	0	Muskrats	32	1,203
Rabbits	3,952	28,789	Raccoons	20	509
Squirrels	53	225	Skunks	7	144
Foxes	38	72			
Coyotes	386	4,529			
Marmots	98	299			
Prairie dogs	550	4,140			
Magpies	352	5,283			
Total	b/	70,472		b/	8,588

Source: Colorado Division of Wildlife, 1975 Colorado Small Game, Furbearer, Varmint Harvest.

a/ All or part of a day.

b/ Hunter totals are not included because hunting and trapping of more than one species are allowed.

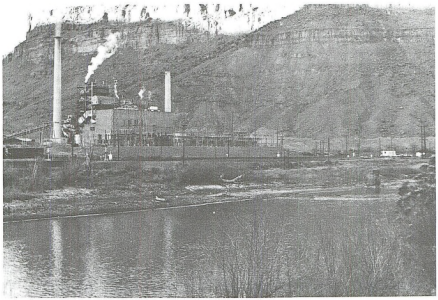


Figure G2-4. The Cameo mine sites are visually influenced by the Cameo Power Plant.

TABLE G2-5

POPULATION STATISTICS

	1970 Population	1977 Population	Percent Change 1970-1977	Median Age-1970 (Years)	Median Age-1977 (Years)	Percent Population Over 65 Years
Mesa County:	54,374	66,848	+ 23	30.2	29.4	+ 11
Clifton area	3,554	5,913	+ 66	30.2	26.8	+ 9
Fruita	1,822	2,328	+ 28	34.1	28.5	+ 15
Fruita area	5,837	7,709	+ 32	29.4	28.4	+ 10
Grand Junction	24,043	25,398	+ 5	32.1	30.2	+ 15
Grand Junction area	28,527	35,871	+ 26	30.0	29.3	+ 13
Orchard Mesa area	6,890	5,012	- 27	28.6	29.6	+ 8
Palisade	874	1,038	+ 19	-	46.9	+ 31
Palisade area	1,964	2,178	+ 10	41.8	38.8	+ 21
Redlands area	4,446	6,826	+ 53	29.9	30.6	+ 6
Whitewater area	605	751	+ 24	36.1	32.6	+ 12
Collbran	225	293	+ 30	-	36.9	+ 20
Collbran area	1,428	1,364	- 4	31.4	33.6	+ 14
DeBeque	155	264	+ 70	-	32.5	+ 14
DeBeque area	306	427	+ 40	42.1	33.5	+ 14
Garfield County:						
Grand Valley	270	377	+ 40	-	30.0	+ 18
Grand Valley area	819	858	+ 5	32.1	30.9	+ 14

Source: U.S. Bureau of the Census, 1970 Population Census and 1977 Special Census for Mesa and Garfield Counties.

rest of the county, and a much higher concentration of persons over 65 years of age.

The small communities of DeBeque, Collbran, and Grand Valley are similar in size, and all contain a population whose median age is higher than the Colorado median. Collbran is somewhat different from most communities in western Colorado in that the median age of its population increased between 1970 and 1977. The DeBeque and Grand Valley areas have experienced growth due to the location of the Occidental Oil Shale test site outside of DeBeque and the Paraho Oil Shale site east of Grand Valley.

Community Attitudes and Lifestyles

According to the Mesa County Development Department, a majority of the new residents in the Grand Junction area moved there because they liked it as a place to live. The Grand Junction area is more urban than most other areas of western Colorado, but it is still small enough to retain attributes of small town living. Residents place a high value on the casual atmosphere and lack of congestion associated with life in Grand Junction. However, there is also a desire to attract economic growth to the area and improve job opportunities for residents.

As a population center, Grand Junction provides its residents opportunities not available in most other communities in western Colorado. Mesa College offers courses of study in many subject areas, college athletic events, and dramatic performances. There is a larger selection of stores, restaurants, and movie theatres than in other towns. Airline and bus service to metropolitan areas is regularly available, and an interstate highway links Grand Junction to Denver and Salt Lake City.

Community attitudes towards growth and development were documented in a survey conducted by Bickert, Browne, Coddington and Associates, Inc., in July 1973. Results of that survey are discussed in the regional volume.

Community Facilities

Most of the developed areas around Grand Junction receive water from the Ute Water Conservancy District which provides water to other districts and to individuals. The district is currently developing additional water resources. There are many special districts in the county providing various services including water, sewer, fire protection, pest control, hospital services, cemetary services, and flood control. There are two sanitary landfills in the county. Police service outside of town is provided by the county sheriff.

Grand Junction, Fruita, Collbran, Palisade, and DeBeque are improving or plan to improve their water and sewage treatment systems. More detailed information about facilities in the county is included in the regional volume.

Housing

Table G2-6 lists the housing units available in Mesa County and western Garfield County, according to the 1977 special population censuses. The total housing stock in Garfield County increased by 22 percent between 1970 and 1976. About 40 percent of that increase was mobile homes.

The Colorado Division of Housing (1976) estimates that there was a total of 24,914 housing units in Mesa County in April 1976, an increase of 6,116 units (or 32 percent) from 1970. Over one-third of the total increase in housing stock was mobile home units. In recent years, duplexes and multi-family units have constituted about 30 percent of the new housing starts.

High prices for single-family dwellings and the unavailability of rental units are contributing to an increase in multi-family and mobile home units throughout the county. The county has an above average need for low to moderate income housing, because the median family income is more than $3,000 less than the state median and Mesa County has an above average number of elderly persons.

Education

Education in the areas around the proposed Cameo mines is provided by four public school districts: Mesa County Valley School District 51, DeBeque School District RE49(JT), Plateau Valley School District 50, and Grand Valley School District 16. Mesa County Valley is by far the largest with 96 percent of the combined enrollment. In general, the school districts all have some excess capacity to absorb new students. Mesa County Valley has some problem with capacity of its junior high schools, but plans to expand in the future. Table G2-7 summarizes the situations of the four districts.

Health Care

The level of health care services in and around Grand Junction is the highest in the ES area. The four hospitals located in Grand Junction provide specialized services to much of western Colorado. In addition, the Fruita area is served by a small hospital located in town. There are more physicians located in Grand Junction than in the remainder of the ES area combined. Many of these physicians are specialists, who provide their services to patients from a wide area. Ambulance services to the area are good; both Fruita and Grand Junction operate ambulance services connected with their fire departments. Mental health services are provided to the area by the Colorado West Regional

TABLE G2-6

EXISTING HOUSING IN PROPOSED ACTION AREA

County	Total Housing Units	
	Occupied	Vacant
Mesa County:		
Collbran	119	13
DeBeque	100	11
Fruita	788	41
Grand Junction	10,129	596
Palisade	418	23
Unincorporated areas	12,321	759
Garfield County:		
Grand Valley	138	19

Source: U. S. Bureau of the Census, Special Population Censuses for Mesa and Garfield counties, 1977.

TABLE G2-7

CHARACTERISTICS OF AFFECTED SCHOOL DISTRICTS

School District	1977 Enrollment	Schools	Design Capacity	Excess Capacity	Teachers	Student: Teacher Ratio	Bonding Capacity (dollars)	Outstanding Debt (dollars)
Mesa County Valley (51)	14,025	30	15,561	1,536	678	20:1	32,043,730	2,500,000
DeBeque (RE49(JT))	160	2	195	35	16	11:1	260,000	130,000
Plateau Valley (50)	284	3	350	66	14	20:1	1,200,000	19,000
Grand Valley (16)	180	1	250	70	17	10:1	800,000	184,000

Mental Health Center, which is headquartered at Glenwood Springs but has offices in Grand Junction. The Mesa County Department of Public Health has a staff of six public health nurses who provide generalized health education and preventative health services in addition to specialized activities in tuberculosis control, mental retardation, venereal disease, and handicapped children's programs.

Health care in eastern Mesa County is limited. Collbran supports the Plateau Valley Hospital and Nursing Home. The hospital has six beds, three of which conform to federal standards. The nursing home has thirteen long-term care beds. A single doctor provides most of the service to patients in the Collbran area.

DeBeque and Grand Valley have no health care facilities in town. The nearest doctor for DeBeque residents is in Palisade, 22 miles away, and hospital care is available in Grand Junction. The closest physicians and hospital for Grand Valley residents are in Rifle, about 16 miles away.

Employment

In Mesa County, where most of Cameo's employees would live, employment grew at an annual rate of 6.1 percent between 1973 and 1976. The total number of persons employed increased from 24,030 to 28,622 during this period. As shown in table G2-8 the increase was all in nonagricultural employment; agricultural employment declined by 11.6 percent. A comparison of employment by sector shows that all sectors showed some growth, but the mining, the transportation, the finance, insurance, and real estate, and the contract construction sectors had the largest percentage increases. The increase of 130 percent in mining employment can be attributed to new mining activity in the Uravan uranium belt and coal mining in western Garfield County. Oil shale test projects near DeBeque and Grand Valley have also added to employment in the mining sector. In terms of number of employees, the service trade and mining sectors showed the greatest increase.

Table G2-8 also shows that the trade, service, and government sectors are the largest employers in the Mesa County economy and that, in spite of the fast growth rate, the finance, insurance, and real estate sector and the mining sector are the smallest. The sectors with the largest employment in Garfield County are also trade, services, and government. Almost all sectors have grown since 1970.

The regional volume gives more detail on employment in Mesa and Garfield counties. Employment data for specific towns and cities are not available.

Income

The proposed Cameo Mine property is located in Mesa County, 2.5 miles east of the town of Palisade. According to the U.S. Department of Commerce, Bureau of the Census (1974), 1974 per capita income in Palisade was $4,324. This was substantially below the county average of $4,799, which in turn was lower than the Colorado average of $5,514. Mesa County ranked fourth in the seven-county ES area.

Median family income in Mesa County was estimated to be $11,130, third highest in the region but lower than state and national averages. In 1975, 11.4 percent of the families in the county had incomes below the poverty level.

In 1974, government (21.0 percent) and wholesale and retail trade (20.6 percent) were the largest sources of personal income. Other sectors and the share they produced were services--15.7 percent; contract construction--10.2 percent; transportation, communication, and public utilities--9.9 percent; manufacturing--8.9 percent; agriculture--6.9 percent; finance, insurance, and real estate--3.6 percent; mining--3.3 percent; and other industries--0.4 percent. This breakdown indicates the importance of the trade sector in the economy of the county and the role of Grand Junction as a regional center. For a discussion of regional incomes, see the income section in the regional volume.

FUTURE ENVIRONMENT WITHOUT THE PROPOSAL

If the mining and reclamation (M&R) plan proposed in chapter 1 is not approved and implemented, GEX Colorado Company will continue mining private coal from the Cameo No. 1 Mine through 1980. The operation will use the same mine layout and surface facilities described in chapter 1, History and Background. The company will begin producing, by room-and-pillar methods, approximately 200,000 tons of coal in late 1978 or early 1979, using approximately 100 employees. By 1980, the operation will produce 300,000 tons of coal annually, using 213 employees. The company's private coal reserves at the Cameo site will probably be exhausted by 1982. However, the Roadside Mine will continue to operate through 1985 and will probably continue to use the Cameo loadout facilities during that time.

If GEX Colorado goes ahead with plans to mine coal through the Cameo No. 1 Mine, the operation can be expected to have the following effects on water resources, soils, vegetation, wildlife, aquatic biology, archeological resources, land use, and socioeconomic conditions.

TABLE G2-8

GROWTH OF EMPLOYMENT BY SECTOR
IN MESA COUNTY, 1973-1976

Sector	1973	1976	Increase	Percent Change
Agriculture	3,030	1,790	- 240	- 11.8
Mining	390	900	+ 510	+ 130.8
Contract Construction	1,330	1,730	+ 400	+ 30.1
Manufacturing	2,280	2,440	+ 160	+ 7.0
Transportation	1,420	1,680	+ 460	+ 32.4
Wholesale and Retail Trade	5,040	5,710	+ 670	+ 13.3
Finance, Insurance, and Real Estate	630	820	+ 190	+ 30.2
Service	3,420	4,410	+ 990	+ 28.9
Government	4,140	4,470	+ 330	+ 8.0

Source: Colorado Division of Employment, Research and Analysis, February 1977.

Note: This information does not include self-employed workers, other than in agriculture, unpaid family, and domestic workers.

Geologic and Geographic Setting

Topography

Approximately 180 acres of the mine property could be subject to effects from subsidence. A precise calculation of possible subsidence is not available. However, subsidence could not exceed a maximum of 9 feet, since that is the height of the coal seam which would be mined. Subsidence from conventional mining methods may be incomplete for decades after mining, and surface collapse may be sudden, irregular, and unpredictable. Open fractures, broken ground, and a hummocky terrain may result.

In the discussion of surface subsidence in the Cameo mine plan, GEX Colorado cites a long history (exceeding 70 years) of coal mining in the Palisade area with no evidence of surface subsidence to date. The presence of a massive, competent sandstone member 35 to 40 feet above the Cameo B seam may prevent subsidence from migrating to the surface (Skidmore, mining engineer, GEX Colorado 1978, personal communication). This observation is particularly important because the subsidence characteristics of one area of a coal field seem to remain uniform throughout the coal field (Morgan, Bureau of Mines, 1978, oral communication). At this time it would appear that the 9 feet maximum subsidence, open fractures, and broken surface discussed above, constitute a worst case possibility that could result from the proposed action. The subsidence that would actually result from the mining operation may vary from none to a maximum of 9 feet.

If subsidence did occur, increased air circulation through deep fractures may cause spontaneous combustion of the coal seam. A potential loss of the coal resource, in addition to further subsidence, would occur.

Paleontology

Plant, invertebrate, and vertebrate fossil materials would be destroyed, disturbed, or removed as a result of coal mining activities, unauthorized collection, and vandalism. The primary disturbance would probably result directly from the mining operation. Given the overall character of the stratigraphic column, it is probable that some fossils would be destroyed. However, this stratigraphic section is only moderately likely to yield significant fossils when compared with other parts of the ES area.

All exposed fossil-bearing formations within the region could also be affected by increased vandalism and unauthorized fossil collecting as a result of increased regional population.

As a result of the above disturbance, an undetermined number of fossils would be lost for scientific research, public education (interpretive programs), etc. On the other hand, as a result of development, some fossil materials would also be exposed for scientific examination and collection.

Water Resources

Ground Water

Mining of the private coal in conjunction with ongoing operations will eventually reach a maximum depth of about 400 feet below the level of the Colorado River. Mining, however, will not actually extend beneath the river or its flood plain. Ground-water inflow to the Cameo No. 1 Mine can be expected to continue at the current rate of at least 10 gallons per minute (gpm) until the adjacent old Cameo Mine is dewatered. The water supply thus obtained should be of suitable quality and more than adequate for initial mining and coal-processing operations. The company, of course, must obtain appropriate water rights before any water pumped from the Cameo No. 1 Mine can be used in its operations.

As the old Cameo Mine is drained, inflow to the Cameo No. 1 Mine from that source will decrease progressively while ground-water inflow from the coal and the underlying Rollins Sandstone can be expected to increase progressively with increasing depth of the mine below river level. The net effect will probably be to increase total inflow to the mine to at least 20 gpm (32 acre-feet per year [ac-ft/yr]). Appreciable inflow is not expected, however, because subsidence fractures induced by room-and-pillar mining methods should be minimal. Very probably, water pumped from the mine by 1980 will not be adequate for consumptive uses attributable to increased coal production. Therefore, 50 to 100 ac-ft/yr of supplemental water will have to be diverted from the river under GEX Colorado's existing water rights and by purchase from utilities in the area. No measurable impact from the ongoing mining operations should occur to the ground-water resources outside the lease area.

Private coal reserves on the lease tract should be exhausted by 1982. If at that time operations are not extended onto federal coal and the Cameo No. 1 Mine is closed, the abandoned workings will eventually fill with water over a period of several years to approximately river level, after which ground-water discharge should resume to the river at essentially the pre-mining rate. Water quality also should be essentially the same as that of water discharging from the old Cameo Mine to the river prior to dewatering.

Surface Water

GEX Colorado has not yet designed or constructed a site drainage control system for the on-

going operations. Runoff from disturbed lands, therefore, enters the Colorado River either directly or through Coal Creek without any appreciable controls in apparent violation of Public Law 95-87 (30 USC 1201) subsections 502(c) and 515(b)(10)(B)(i). Very probably compliance with the provisions of this law will be enforced in the near future. In the interim, current activities will disturb only about 143 acres, primarily on alluvial soils that are subject to much less runoff than the adjacent steep, barren slopes of Coal and DeBeque canyons. Consequent increased runoff and pollutant effects on the Colorado River as a result of the ongoing operations, therefore, may be locally apparent, but they are probably so small as to be unmeasureable in relation to total runoff from the lease area. Because appreciable subsidence at the surface is considered unlikely, no surface drainages should be disrupted by the Cameo No. 1 Mine.

As mining on private coal progresses, all water entering the mine will probably be used, thereby eliminating the current discharge to the river under NPDES Permit No. CO-0035467. The effect will be to reduce the salt load contributed to the Colorado River by about 55 tons per year.

The projected increase in population in Garfield and Mesa counties as a result of current activities is estimated to be 850 persons by 1980, 900 persons by 1981, and 500 persons by 1982, at which time the private coal reserves would be exhausted (Socioeconomic Conditions). Assuming an average water use of 200 gallons per day per person (gal/day/person), sewage effluent of 60 gal/day/person, and an increase in dissolved-solids of 200 milligrams per liter (mg/l) in sewage effluent, water and sewage treatment requirements and the increase in dissolved solids load to the river are summarized in table G2-9. Most of the increased demand for water would probably be placed on existing treatment facilities in Palisade and Grand Junction. Some domestic supplies may be obtained from wells, but the only suitable aquifer in the general area is alluvium bordering the Colorado River and its local tributaries. Wells, therefore, would be hydraulically connected to the surface streams and would have slightly less effect than direct diversion of surface water for the needed supplies.

The small increase in salt load contributed to the Colorado River by the added sewage effluent attributable to increased population as a result of the ongoing mining operations should have no significant impact on aquatic biology downstream. Consumptive use of water in the mining operations and by the higher population, together with the added salt load returned to the river in sewage effluent, however, could increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.008 mg/l (0.0012 percent) by 1980, 0.010 mg/l (0.0015 percent) by 1981, and 0.004 mg/l (0.0006 percent) by 1982.

Flood Hazard

Possible flooding of the conveyor belt and unit-train coal-loadout facilities could occur in response to a flood of 100-year recurrence interval or larger, but that prospect is held unlikely because of upstream storage reservoirs and water-diversion structures. Any damage to the facilities in the event of such flooding and any consequent problems downstream should be minor.

Erosion and Sedimentation

Ongoing operations will disturb a total surface area of about 143 acres. In the absence of sediment-control structures, it is estimated that the increased sediment load to the Colorado River from the plant and portal areas will be minimal, probably not exceeding 25 to 50 tons/yr. Conversely, location of the refuse disposal area of about 10 acres so as to block the channel in Coal Gulch, as proposed by GEX Colorado, would probably cause a moderate long-term increase in sediment yield to the Colorado River, averaging several hundred tons or more per year. Placement of waste materials from coal-processing operations in valley or head-of-hollow fills, however, would be in violation of regulation 30CFR: 715.15(b) and would not be permitted by the Office of Surface Mining (OSM). Therefore, GEX Colorado must select an alternate location for a refuse disposal area.

Housing and related construction off site to accommodate the increased population due to the Cameo operation will contribute an unmitigated short-term amount of sediment to the Colorado River. Approximately 72 acres would be disturbed by 1980, 76 acres by 1981, and no further increase by 1982. It is estimated that sediment yield to the river would be increased about 1 ton per acre disturbed for the first year or two after construction. Thereafter, sediment yield would decrease to about half the predisturbance rate. The initial increase in sediment yield, therefore, should be more than offset by the long-term reduction in sediment yield over the life of the structures.

Soils

Soils would be affected primarily by construction and operation of mine facilities and by urban expansion in the area due to increased population.

Ongoing construction activities have disturbed approximately 143 acres. Erosion will temporarily increase by two to three times the natural rate in response to this disturbance, and in the absence of sediment-control structures, soil is being lost from

TABLE G2-9

WATER AND SEWAGE TREATMENT REQUIREMENTS
AND SALT LOAD RETURNED TO THE COLORADO RIVER

Item	1980	1985	1990
Population increase (persons)	850	900	500
Required increase in treated water supply (ac-ft/yr)	190	200	110
Required increase in sewage treatment (ac-ft/yr)	57	60	34
Consumptive use (initial use less sewage effluent (ac-ft/yr)	133	140	76
Increased salt load returned to the Colorado River (tons/yr)	16	16	9

the site. When GEX Colorado builds control structures to comply with Public Law 95-87 (30 USC 1201) and 30(CFR): 717.17, most of this erosion would be contained on site (see also Water Resources, Erosion and Sedimentation).

The net effect of increased erosion, along with a deterioration of soil structure, would be a reduction in soil productivity. Any such reduction, although unquantifiable at present, would intensify the inherent revegetation problems of low natural moisture and poor topsoil. These problems would prolong the efforts necessary to achieve successful reclamation (see Vegetation).

Housing and related development to accommodate the increased population will disturb approximately 72 acres by 1980 and 76 acres by 1981. The exact location of these acres cannot be predicted, although at least some portion would likely come from croplands (including prime farmland) in Mesa County. To this extent, crop production capacity would be permanently lost (see also Water Resources, Erosion and Sedimentation).

Vegetation

Approximately 143 acres, mainly of the saltbush vegetation type, are being disturbed by the Cameo surface facilities, which will be completed in late 1978 or early 1979. GEX Colorado will be required to rehabilitate this disturbed acreage upon abandonment of the mine and associated facilities (30[CFR]: 717.20 and 30[CFR]: 211.40, 211.41, and 211.62). The company's proposed revegetation plan indicates that most of the acreage would be revegetated for livestock and some wildlife use.

Successful revegetation of most of this land is likely to be difficult because of low annual precipitation (approximately 10 inches); erosion; lack of topsoil; competition for moisture, nutrients, and light from weedy plant species; low germination rates of seeds; and possible destruction of seedlings by wildlife. The use of special revegetation techniques, such as those discussed in the regional chapter 4 under Vegetation, may be needed to rehabilitate the disturbed acreage to meet the requirements of 30(CFR): 211.40 (a)(13)(i). However, in semi-arid areas such as most of the Cameo site, conditions favorable for the establishment of vegetation come only every four to six years. Moreover, past revegetation attempts in the Grand Valley area where similar conditions prevail have not been particularly successful. The land would eventually revegetate itself, but natural succession would take 30 to 60 years after abandonment of the mine.

The lands adjacent to the Colorado River which GEX Colorado plans to return to alfalfa production will receive continuous irrigation. Therefore, successful revegetation should not be a problem.

Wildlife

Mule deer and small mammals will continue to be excluded from 143 acres by ongoing construction and mining activity. Whether wildlife will be able to use the land after mining is completed will depend on the success of GEX Colorado's revegetation plan. Moreover, if the land is rehabilitated primarily for livestock range, mule deer use would be limited since livestock graze primarily grasses, while mule deer for the most part utilize forbs.

Human activity near the cliffs in DeBeque Canyon may cause peregrine falcons to abandon nesting sites. Whether the birds would return to the area after mining has ceased is not known.

Some waterfowl nesting and brood-rearing areas could be disrupted by human activity close to the river. These activities could also impede movements of chukar to watering areas near the Highline Canal. In addition, ongoing construction and use of loadout facilities will further reduce peregrine falcon and bald eagle hunting areas along the river.

Increased recreational use of the area would cause additional stress to wildlife and increase legal and illegal harvest of animals. Additional traffic would increase vehicle/animal collisions.

Aquatic Biology

If all of the 20 gpm of ground water intercepted in the mining operation is used in coal processing and mine operations, there will be no discharge of mine water to the Colorado River and consequently no impact on the aquatic habitat. Cameo does hold a NPDES water discharge permit that would allow 1.44 million gpd to be released to Coal Canyon approximately 1,000 feet from the Colorado River should it become necessary. The mining plan states that if water quality becomes so bad that water cannot be discharged to Coal Creek, it will be passed through the coal-plant water-clarification system. This type of treatment would have to bring the discharge water quality into compliance with state and federal water quality standards. This would adequately protect the aquatic ecosystem of the Colorado River.

In addition, it is likely that the 32 acre-feet per year yield of mine water will have to be supplemented by 50 to 100 acre feet per year of water diverted or purchased from Colorado River water rights. Increased consumptive use of 270 acre-feet of water per year by the coal-processing activities, and by 900 new people in the area by 1981 will further deplete the amount of water available for fish and aquatic wildlife habitat in the Colorado

River. This consumption alone is not significant when compared with the annual average discharge of the Colorado River of nearly 2.8 million acre-feet per year. It gains in significance when all water uses and developments in the basin are compared with the quantities of water available to support fish and wildlife habitats during yearly low flow periods (see regional volume, chapter 4, Aquatic Biology).

Until Cameo implements a site-drainage system, runoff from the disturbed areas will flow directly to the Coal Canyon drainage and into the Colorado River. This untreated flow may be harmful to the aquatic organisms and fish, but due to the large dilution factor of the Colorado River it is unlikely.

The Cameo mining operation must comply with Office of Surface Mining regulations. All runoff from surface areas disturbed by mine construction and operations must be retained in sediment ponds as required by 30(CFR): 717.17. Sediment retention ponds will contain all runoff from a storm event up to a 10-year/24-hour storm. Spillways on ponds will be designed to safely pass a 25-year storm event. Discharges of water from these ponds, should they be necessary under normal conditions, may not exceed 45 mg/l total suspended solids, and the 30-day average discharge may not exceed 30 mg/l. A discharge of this concentration of suspended solids, should it occur, will not adversely affect the aquatic ecosystem of the Colorado River downstream from the lease site.

Sediment retention ponds may legally spill in a precipitation event larger than a 10-year/24-hour storm. In such a case some coal dust and other fine sediments from the ponds might flow into the Colorado River. In an event larger than a 20-year/24-hour storm, total sediment yield from the many highly erosive watersheds adjacent to the Colorado River would be so large that the amount of sediment coming from the retention pond spillway would be unmeasurable in the river and have insignificant impacts. Also, the increased dilution in the Colorado River during a large storm would largely decrease the concentration of all water quality parameters. No adverse effects on the aquatic habitat or the threatened and endangered fish species are presently projected. Aquatic organisms presently living in this part of the Colorado River normally withstand a total suspended-solid concentration ranging from 59 to 4,420 parts per million (ppm), with an average of 2,270 ppm, and a total dissolved-solid content averaging 200 to 250 mg/l in the spring, and 600 to 650 mg/l during low-flow periods.

Placement of the coal refuse pile in Coal Gulch will cause several hundred tons of coal refuse and sediments to enter the Colorado River each year. Continuous erosion of the refuse pile in all precipitation events would have a negative impact on benthic insects, algae, aquatic plants, and possibly on the reproduction of some fish species. Increased suffocation of benthic organisms may result. Research on the direct effects of western coal sediments on warm-water fish habitats is lacking, but in almost all other cases introduction of large amounts of foreign substances and sediments to aquatic ecosystems proves detrimental to some species and to the system as a whole. The placement of the refuse pile is not in compliance with 30(CFR): 717.17. This problem would continue for many years after the private coal reserves are exhausted in 1982.

Archeological Resources

Vandalism and erosion would be the two major factors causing the loss of any archeological values in the area. It is doubtful that additional monies or employees would be available to retard this loss, although the Federal Land Policy and Management Act of 1976 will provide BLM with more protective enforcement authority.

Land Use

The Cameo site will continue to be used for coal mining to at least 1982, and the loadout would continue to be used through 1985. Post-mining land use will depend to a large extent on the success of revegetation, although the area would probably revegetate itself eventually (30 to 60 years after conclusion of mining). If revegetation is successful, the land will probably become livestock range, with some wildlife use as well.

The Cameo No. 1 Mine will continue the industrialized land use in the DeBeque Canyon area, along with such operations as the Public Service Company of Colorado's Cameo power plant and GEX Colorado's Roadside Mine. If Mid-Continent Coal and Coke Company's proposed Coal Canyon and Cottonwood Creek mines are developed they would continue this industrialization past 1990. Traffic on I-70 would increase as mine employees travel to and from work, and train traffic would increase as more coal is shipped to market.

All of these operations taken together, when combined with predicted oil shale and uranium development in the general region, would cause significant population increases in Mesa and Garfield counties, although Palisade and Grand Junction would have to absorb much of the population growth due to the new coal mining. Some of the resulting residential and urban expansion would probably encroach on agricultural land (including some prime farmland) and wildlife wintering areas. It is also likely that the terraces and benches along the Colorado River would be developed for housing. However, to some extent, the location of this

urbanization would depend on future county and community land use planning and zoning.

Recreation

Growth in Mesa County would require additional recreational facilities by 1990, including 116.2 acres of additional community active/improved park land (e.g., ballfields, playgrounds, tennis courts) to prevent overuse and deterioration of existing facilities (Bickert, Browne, Coddington, and Associates, Inc., 1977).

The proposed U.S. Bureau of Reclamation (USBR) Dominguez Dam, just south of Grand Junction (see figure G2-5) would provide water-based recreation such as swimming, fishing, and boating as well as camping and hiking. The USBR estimates that the dam would provide 300,000 to 500,000 recreation days its first year of use. This would help relieve some of the deficit in recreational facilities identified by the 1976 Colorado Comprehensive Outdoor Recreation Plan (see regional analysis, Recreation, chapter 2).

The Little Bookcliffs Wild Horse Area may be classified as a wilderness area. Use of the area would then be restricted to nonmotorized recreational activities.

Visual Resources

The landscape character of the viewshed would continue to be dominated by the Cameo power plant, the rail facilities, and the road network. The VRM Class V would remain for this Scenic Quality Unit because of these modifications and this visual node would remain as a significant contrast to the natural canyon spaces.

Land rehabilitation at the Roadside Mine would initiate the restoration of the natural environment and its visual quality. These improvements would reduce visual contrasts and could, eventually, become a part of the VRM Class II potential of the DeBeque Canyon corridor.

Socioeconomic Conditions

The development of the Cameo No. 1 Mine would cause Mesa County population to increase by 680 people by 1980, 720 people by 1981, and 300 people by 1982 and would cause Garfield County population to increase by 170 by 1980, 180 by 1981, and 100 by 1982. The Coal Canyon and Cottonwood Creek mines, if developed, would increase population in Mesa County by 2,300 people by 1985 and 3,100 people by 1990, and in Garfield County by 350 people by 1985, and by 650 people by 1990. In addition, development of oil shale and uranium would by themselves cause rapid population expansions in both Delta County (total populations of 20,600 people by 1980; 22,900 people by 1985; and 24,800 people by 1990) and Garfield County (total populations of 33,000 people by 1980; 38,650 people by 1985; and 45,100 people by 1990).

It can be assumed that those communities closest to major project sites would experience the most immediate population growth. Palisade and Grand Junction would absorb most of the growth from coal development in DeBeque Canyon. The small communities of Rifle, Silt, New Castle, Grand Valley, and DeBeque, all within a relatively short commuting distance from major oil shale projects, should have most of their available living spaces occupied as soon as major construction activity begins. Even if additional housing units can be supplied as they are needed, these towns can only accommodate about an additional 4,500 people before major new additions would be needed for their water and sewer systems. As a result, it would be necessary for communities such as Grand Junction, Fruita, and Glenwood Springs to absorb much of the rapid population growth expected in Garfield and Mesa counties.

Continued operation of the Cameo No. 1 Mine would cause minimal problems for existing community facilities. However, the expected population growth from oil shale development would force existing community facilities in Garfield and Mesa counties to operate at or beyond their capacity. This is especially true of the smaller towns of DeBeque, Grand Valley, Rifle, Silt, and New Castle. Both the Grand Junction and Glenwood Springs communities now have or are building improvements which will allow them to greatly expand water and sewer service. As a result, much population growth in Mesa and Garfield counties should be attracted to these two communities.

Incomes and employment are expected to be higher as a result of increased industrialization and mining. Agriculture could become a less important part of the local economy, and this decline could accelerate the shift from agricultural to residential-industrial land uses. The expected increase in job opportunities could also accelerate the current trends of in-migration to the area by persons who like the living conditions.

If oil shale and molybdenum projects are developed according to schedule, the influx of large construction work forces can be expected to cause some change in Mesa and Garfield counties. The influx of similar large work forces in other rural areas of the west has led to a number of sociological changes which are commonly referred to as the "boom town syndrome." The more commonly documented changes include rising rates of divorce, increased cases of alcoholism and mental illness, and decreased levels of job productivity. Also, and probably more importantly, there tends to be a polarization in small communities between the

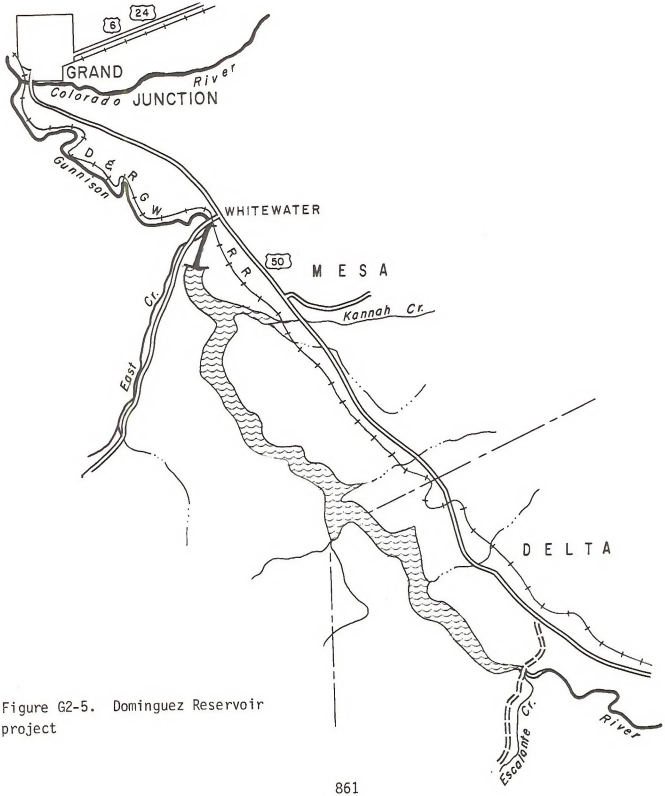


Figure G2-5. Dominguez Reservoir project

long-time residents and the more transient newcomers, which causes difficulty in accomplishing needed reforms. In many communities, the general trend will, at the least, be toward more urbanized lifestyles.

Due to the increase in population and mining activity, there will be an increase in noise levels in the DeBeque Canyon area. With the exhaustion of private coal reserves at the Cameo No. 1 Mine before 1985, the production of coal from the Cameo area from the other mines existing and proposed for the area would remain at a level of 80 to 150 unit trains per year through 1990. The increase in vehicular and train traffic through the Cameo area should be sufficient to outweigh any reduction in noise levels due to the reduced operation at the Cameo operation.

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This mining and reclamation plan (M&R plan) was submitted for review after promulgation of interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), but it does not fully reflect the requirements of the interim regulations. However, in this environmental statement (ES) the applicable interim regulations are included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of these regulations. The Department of the Interior will not consider the M&R plan for approval until GEX Colorado Company has redesigned it to incorporate the requirements of 30(CFR): 211 and 30(CFR): 700. Therefore, to the extent possible at this time, the following impact analysis is based on the assumption that the M&R plan will comply with the appropriate provisions of the Surface Mining Control and Reclamation Act. Impacts are analyzed at three time points: 1980, 1985, and 1990.

Air Quality

Emissions from the Proposed Mine

Mining activity at underground coal mines usually produces dust, an air pollutant, in environmentally significant amounts. Dust that is generated within the mine is not considered to have an environmental impact since it is continuously controlled and contained in the mine. However, surface facilities at these mines also generate some dust which is released into the ambient air. Most of the dust is from fugitive emission sources; the term "fugitive" connotes that the dust escapes from an unenclosed surface as a result of wind erosion or mechanical action, as opposed to being released from a stack or process vent.

The potential fugitive dust sources identified at the proposed Cameo mines include conveyors, transfer points, train loadout of coal, open storage piles, haul roads for refuse, and wind erosion of refuse piles and other exposed areas at the mine. Some common sources of fugitive dust at underground mines are not projected for the Cameo mines: crushing and sizing should produce negligible emissions because a wet process would be used; haul trucks would not be used to transport coal; and there would be no major employee travel on unpaved access roads.

The procedure used to estimate emissions from each of the potential sources was to (1) determine the activity rate of the pollution-producing operation, (2) multiply that activity rate by an emission factor based on sampling of similar operations, and (3) reduce the calculated emissions by an appropriate amount to account for control equipment or dust suppression measures to be employed on the operation. Activity rates and control measures were described in the Cameo M&R plan. Emission factors for individual mining operations were obtained from Colorado Air Pollution Control Division and a recent study of emissions from mining (Colorado APCD 1978, Axetell 1978).

Table G3-1 presents estimates of fugitive dust emissions at the Cameo site from each of the identified sources in 1980, 1985, 1990, and at the end of mine life. These values are annual emissions, even though the activities would not be continuous or uniform throughout the year. The estimates are judged to be accurate within a factor of two (Axetell 1978). The emissions in table G3-1 represent initial emission rates (tons per year) of suspended particulate from the operations. Some of these suspended particles would fall out of the dust plume after they are emitted. This deposition is discussed further below.

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

Estimated emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), and sulfur oxides (SO_x) are shown in table G3-2. These emissions are based upon rates per mile of travel (emission factors) which would decrease between 1980 and subsequent study years. In the case of Cameo, the reduced emission rates would partially offset increased activity rates projected when the mine would be at full production in 1990. These

TABLE G3-1

FUGITIVE DUST EMISSIONS AT THE PROPOSED CAMEO MINE SITE

Emission source	Emissions, ton/yr		
	1980	1985	1990 & EML
Conveyor - 4 sections	5.0	6.2	7.5
Transfer points - 4 points	15.0	18.7	22.5
Preparation plant - wet process	neg	neg	neg
Train loadout	0.1	0.1	0.1
Open storage - raw coal	10.1	10.1	10.1
- surge pile	1.5	1.4	1.4
Haul roads (refuse only)	13.5	17.0	33.9
Access roads	0.5	0.5	0.5
Exposed areas - refuse	4.0	4.0	4.0
- rail/mine facilities	2.0	2.1	2.1
TOTAL	51.7	60.1	82.1

TABLE G3-2

EMISSIONS OF GASEOUS POLLUTANTS FROM THE PROPOSED CAMEO MINE SITE

Year	Total emissions from vehicles, ton/yr			
	CO	HC	NO_x	SO_x
1980	0.4	0.1	0.2	neg
1985	0.5	neg	0.2	0.1
1990	0.6	0.1	0.2	0.1

$$L_v = \frac{24}{0.2 + 0.007\ M}$$, where

L_v = Average visual range, miles

M = Average particulate concentration (micrograms per cubic meter)

Figure G3-1. Relationship between visibility and suspended particulate concentrations in rural west-central Colorado (Ettinger and Royal 1972).

emissions are from both employee travel on the mine site and haul trucks.

The emissions of gaseous pollutants would not result in significant ambient concentrations on or near the proposed mine site.

Annual Average Air Quality Impacts

In order to assess the impact of air pollutant emissions on the environment, ambient concentrations of suspended particulate were predicted with an atmospheric dispersion model. The model used to predict average concentrations that would result from the mines' emissions was the Climatological Dispersion Model (CDM) (EPA 1973).

CDM is designed for use in level terrain. This application of CDM is subject to larger error and uncertainty than more routine applications, but it represents the best predictive modeling technique available. Because of the irregular topography at the proposed site, CDM is really only capable of predicting concentrations in the canyon or valley near where mining emissions occur. The site-specific meteorological data reflected the prevalence of transport of the pollutants up and down the canyon from the mines. Because of the greater influence of the canyon on maximum concentrations near the mines, a separate model which considers reflection of the plume was used to predict maximum 24-hour concentrations. This short-term model is described in the following section.

The basic CDM model has been modified to incorporate a fallout function to simulate the deposition of the large suspended particulate as it disperses downwind. The fallout rates incorporated in the model were based on sampling data from several western coal mines and are functions of wind speed, atmospheric stability, and particle size.

The following input data are required for CDM: source locations; source emission rates; emission heights; locations where ground-level pollutant concentrations are desired; and frequency of occurrence of each of sixteen wind directions, six wind speeds, and six stability classes. Predicted concentrations are usually accurate within a factor of three.

Since there are no wind data available for the lower DeBeque Canyon area (see chapter 2), the wind and stability data required for the model were obtained by modifying those from the Grand Junction airport to reflect orientation of DeBeque Canyon. This wind rose was previously shown in figure G2-1. Emission data were presented in table G3-1.

Predicted increases in ambient concentrations resulting from Cameo's operation in 1990 are shown on map G3-1; map G3-2 shows cumulative concentrations from proposed development in the Coal Canyon-DeBeque Canyon area. According to the isopleths on this map, the mines would increase annual average particulate concentrations by 4 micrograms per cubic meter ($\mu g/m^3$) in only a small area on the mine site near the preparation plant and refuse pile; concentrations are predicted to increase by at least 1 $\mu g/m^3$ for a distance of 0.5 to 1 mile from the surface facilities. Predicted impacts in 1980 and 1985 would be slightly lower but are shown to occur in these same areas. Based on these concentrations, it is not anticipated that the emissions would cause significant increases in annual average concentrations outside the canyon area.

The predicted impact of the mines would be much less than the primary and secondary air quality standards for suspended particulate of 75 and 60 $\mu g/m^3$, respectively. It would also be much less than the total air quality increment of 19 $\mu g/m^3$ allowable for Class II areas under the federal law concerning prevention of significant deterioration (PSD).

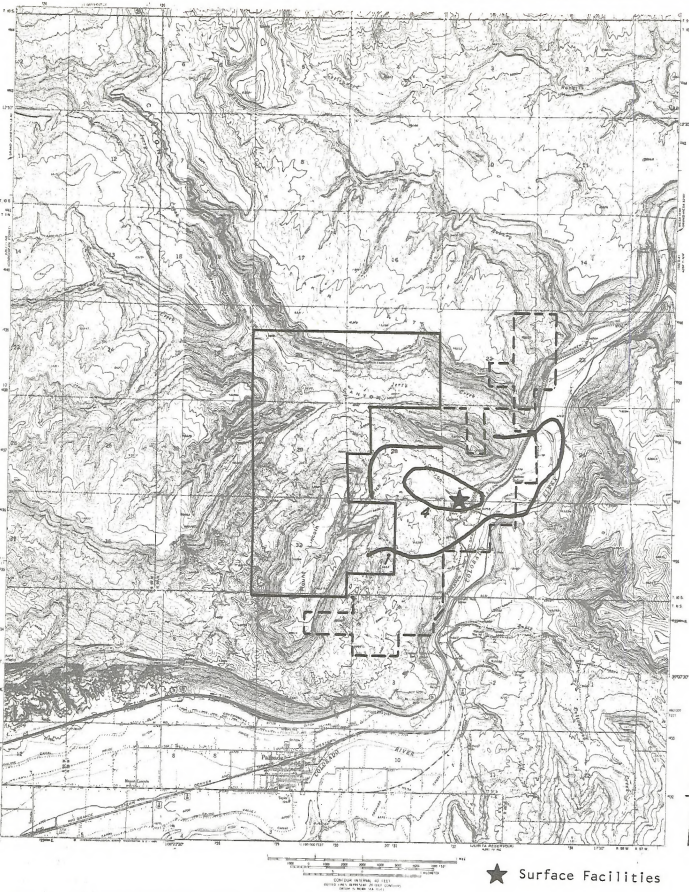
Maximum Short-term Air Quality Impacts

The dispersion model used to predict maximum 24-hour particulate concentrations assumed Gaussian distribution of particulates away from the plume centerline, a constant wind direction, and complete reflection of the plume off both canyon walls. The basic dispersion equation is described in detail in Turner (1970). The fallout function was not incorporated in the short-term model.

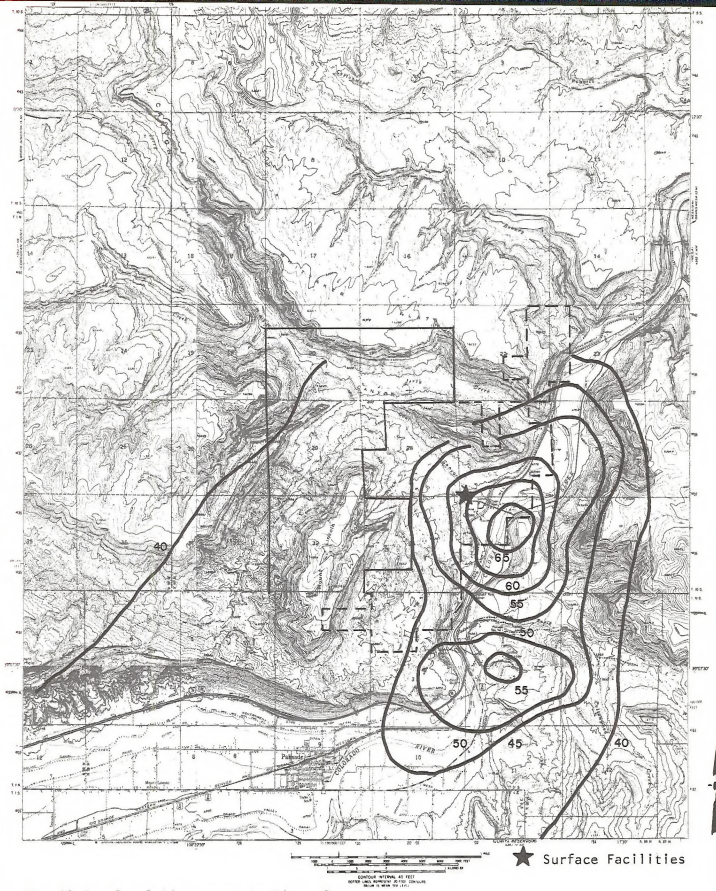
Several locations (receptors) up and down DeBeque Canyon from Cameo were specified in the model for prediction of ground-level concentrations. At each receptor, the contribution caused by each emission source at Cameo was calculated separately; individual source contributions were summed to determine the total concentration at the receptor resulting from the mining operations.

Wind data from the Mt. Logan-Mt. Callahan reach of DeBeque Canyon (see chapter 2) indicated that winds blew from the south-southwest, or up canyon, for all 24 hours on five different days in one year and from the north-northeast, or down canyon, on two entire days. These time periods were assumed to produce the highest concentrations since downwind receptors would be in the plume continuously. From these 24-hour periods, the two days (one with south winds and one with north winds) with the lowest average wind speeds and most stable atmospheric conditions provided the meteorological input for modeling.

The annual average emission rates from the CDM model were also used to predict maximum concentrations because no information was available on seasonal variations in production. Although it is expected that emission rates would vary somewhat throughout the year, the sources at Cameo mine are not subject to great increases in emissions



Map G3-1. Predicted increases in ambient concentrations in 1990 (micrograms per cubic meter)



Map G3-2. Cumulative concentrations from proposed actions in the Coal Canyon-DeBeque Canyon area (micrograms per cubic meter)

due to equipment malfunction or high wind speeds. Also, increased emissions at different sources would occur independently rather than simultaneously and would probably not occur at the same time as the most adverse meteorological conditions.

Predicted maximum concentrations from the mine in 1990 are shown on map G3-3. With winds from the north, a maximum concentration of 24 $\mu g/m^3$ is projected to occur about 0.5 mile down the canyon. At the mouth of the canyon (2 miles), concentrations on the worst day would be about 3 $\mu g/m^3$. With winds from the south, the maximum concentration is predicted to be 18 $\mu g/m^3$. These concentrations would be considerably less than the 24-hour primary air quality standard of 260 $\mu g/m^3$ and the secondary standard of 150 $\mu g/m^3$, and they are projected to occur only in the immediate vicinity of the mines. Maximum concentrations in 1980 and 1985 would be 20 and 23 $\mu g/m^3$, respectively.

Because the short-term dispersion model involves prediction of extreme conditions for meteorology and emission rates, it is probably slightly less accurate than the annual model.

Impact on Visibility

The addition of particulates into the atmosphere as a result of emissions from the mine would reduce visibility in the area. A calculation of the degree of visibility reduction depends on several parameters for which data are not available, the most important being size distribution of the particles. However, a rough approximation of visibility can be made based on suspended particulate concentrations. A relationship between these two variables in rural west-central Colorado has been empirically determined by Ettinger and Royer (1972); it is shown in figure G3-1.

It should be emphasized that this relationship was developed with uniform atmospheric particulate concentrations, not near a plume of fugitive dust containing relatively large diameter particles. Also, it does not consider visibility reductions due to precipitation. Therefore, the equation is more likely to predict visual range over an averaging period of a year than for a short-term period such as 24 hours.

As indicated on map G3-1, particulate concentrations in 1990 would be increased to a distance of 0.5 to 1 mile from the surface facilities. Along any line of sight from the main mine buildings, concentrations would be increased an average of about 2.5 $\mu g/m^3$ over this limited distance. Using the equation above and a background particulate concentration of 42 $\mu g/m^3$, the estimated reduction in visual range on the mine site as a result of mining emissions would be less than 2 miles on an annual basis. Because of the limited area of air quality impact, average visibility would not be affected significantly off site. Visibility reductions in 1980 and 1985 would be less than in 1990.

Geologic and Geographic Setting

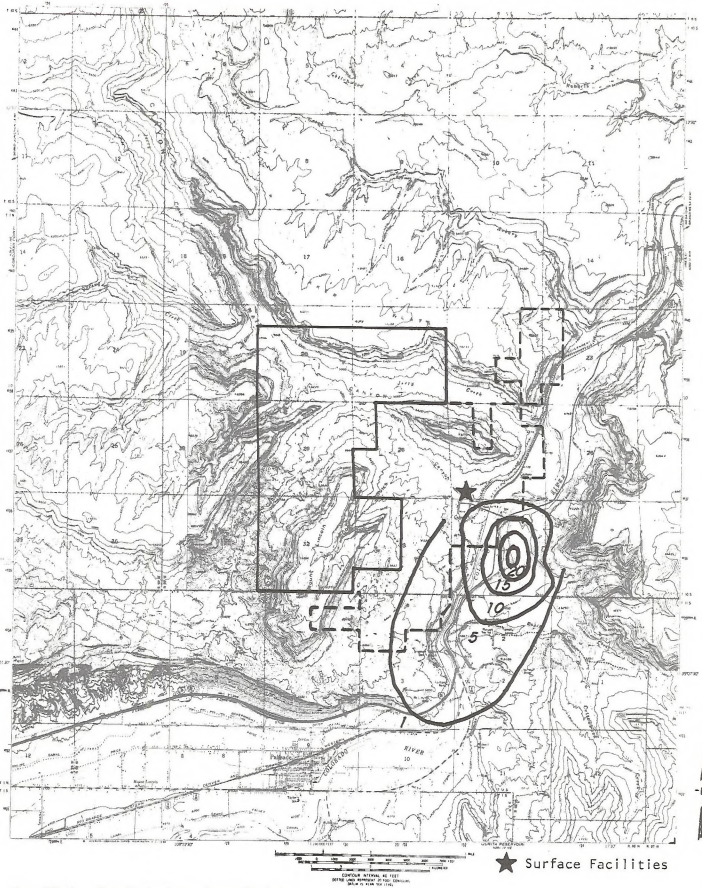
Topography

Impacts to the topography of the Cameo mine property which would result from the proposed action would be minimal. GEX Colorado Company, has already begun construction of surface facilities needed so that mining on the private coal leases can begin. The two aspects of the proposed action that would produce impacts are the long-term use of the refuse disposal area and subsidence.

Use of the refuse disposal area for the 47-year mine life would gradually alter the surface topography of the 55-acre area. The 55 acres represents approximately 1 percent of the total project acreage. Natural slopes at the site vary from 9 percent to 40 percent (or 5 degrees to 21 degrees) and local relief is approximately 270 feet. Final slope would be 7 percent. No details concerning the amount of refuse to be deposited at the site were provided by GEX Colorado.

A more significant impact of the proposed mining operation would be the subsidence over approximately 2,560 acres (100 percent of the federal lease) of the mine property. A precise calculation of possible subsidence is not available. However, subsidence could not exceed a maximum of 8 feet, since that is the height of the coal seam which would be mined. Subsidence from conventional mining methods may be incomplete for decades after mining, and surface collapse may be sudden, irregular, and unpredictable. Open fractures, broken ground, and a hummocky terrain may result.

In the discussion of surface subsidence in the Cameo mine plan, GEX Colorado cites a long history (exceeding 70 years) of coal mining in the Palisade area with no evidence of surface subsidence to date. The presence of a massive, competent sandstone member 35 to 40 feet above the Cameo B seam may prevent subsidence from migrating to the surface (Skidmore, mining engineer, GEX Colorado 1978, personal communication). This observation is particularly important because the subsidence characteristics of one area of a coal field seem to remain uniform throughout the coal field (Morgan, Bureau of Mines, 1978, oral communication). At this time it would appear that the 8 feet maximum subsidence, open fractures, and broken surface discussed above, constitute a worst case possibility that could result from the proposed action. The impact that would actually result from the mining operation may vary from no subsidence to a maximum of 8 feet.



Map G3-3. Predicted maximum 24-hour concentrations in 1990 (micrograms per cubic meter)

If subsidence did occur, increased air circulation through deep fractures may cause spontaneous combustion of the coal seam. A potential loss of the coal resource, in addition to further subsidence, would occur.

Paleontology

Plant, invertebrate, and vertebrate fossil materials would be destroyed, disturbed, or removed as a result of coal mining activities, unauthorized collection, and vandalism. The primary impact would probably result directly from the mining operation. Given the overall character of the stratigraphic column, it is probable that some fossils would be destroyed. However, this stratigraphic section is only moderately likely to yield significant fossils when compared with other parts of the ES area.

All exposed fossil-bearing formations within the region could also be affected by increased vandalism and unauthorized fossil collecting as a result of increased regional population. The extent of this impact cannot presently be assessed due to a lack of information on such activities.

As a result of the above disturbance, an undetermined number of fossils would be lost for scientific research, public education (interpretive programs), etc. On the other hand, as a result of development, some fossil materials would also be exposed for scientific examination and collection. Due to lack of data and accepted criteria for determining significance, the importance of these impacts cannot presently be assessed.

Mineral Resources

Coal

The mining of an estimated 22.91 million tons of coal from the proposed project area over an estimated 47-year mine-life period would result in the depletion of a nonrenewable energy source. The mined coal is expected to be exported to midwestern utility plants for use in the production of electrical energy.

The underground mining of the coal by the proposed room-and-pillar method would result in the recovery of approximately 30 percent of the in-place coal reserves (totalling 73.78 million tons). This would the most efficient method of mining the leased coal. Because of the nature of underground caving and resultant high contamination, future recovery of the abandoned approximately 50 percent of the coal reserves is not considered feasible with present technology. These reserves, therefore, must be considered lost.

Oil and Gas

If oil and gas are discovered under the leased land, a settlement between the well owners and owners of the coal lease would have to be reached as to which nonrenewable energy resource would be produced first.

Water Resources

Ground Water

Under GEX Colorado Company's proposed M&R plan, the ongoing mining operations on private coal in the Cameo No. 1 Mine would be extended westward onto federal coal, and the Cameo No. 2 Mine would be opened. Production would be increased from about 800,000 tons per year (tons/yr) in 1981 to 1,600,000 tons/yr by 1988. Impacts to the ground-water resource would increase very little over those described in chapter 2, Future Environment Without the Proposal.

Mining the federal coal in the Cameo No. 1 Mine would extend the ongoing operations westward in the direction of strike rather than downdip. Thus, the depth of the mine below the level of the Colorado River would not increase, and ground-water inflow to the mine should remain essentially the same as that occurring from mining the private coal.

The Cameo B coal seam in the area to be developed by the Cameo No. 2 Mine is entirely above river level and should be largely drained. Groundwater inflow to the Cameo No. 2 Mine, therefore, should not greatly exceed about 10 gallons per minute (gpm) or 16 acre-feet per year ac-ft/yr. Combined inflow to the two mines should not exceed 50 gpm (80 ac-ft/yr), all of which would be used in the mining and coal processing operations, assuming that appropriate water rights can be obtained.

No measurable impact from the proposed operations on federal coal should occur to the groundwater resources outside the lease area. When the coal reserves are exhausted and the mines are closed, the abandoned workings would eventually fill with water over a period of years to approximately river level, after which ground-water discharge should resume to the river at approximately the pre-mining rate. The quality of this water should not be significantly different from premining discharge from the lease area to the river.

Surface Water

Proper design and construction of surface runoff control and treatment facilities as required by 30(CFR): 717.17 would prevent or minimize any pollution of the Colorado River as a result of the proposed operations, which for the most part would utilize existing plant, coal-processing, and loadout facilities. Moreover, no physical disruption of any streams is expected because no appreciable

subsidence at the surface should occur from room-and-pillar mining in this area.

Inadequate ground-water supplies would probably necessitate the use of supplemental surface water in the proposed operations. If so, no mine effluent discharge to the Colorado River under NPDES Permit No. CO-003546 would occur while mining on federal coal. This would continue for the life of the mines the reduction in salt load to the river of about 55 tons per year currently being discharged to the river in mine effluent. At full production of 1.6 million tons per year, it is estimated (regional, chapter 1) that total water consumption would be about 270 ac-ft/yr, of which an estimated 200 ac-ft/yr must be obtained from surface water supplies. This would decrease accordingly the amount of water available for other uses downstream.

The increased population in Garfield and Mesa counties as a result of the proposed mining on federal coal is estimated to be 2,050 persons by 1985 and 2,550 persons by 1990. Assuming an average water use of 200 gallons per day per person (gal/day/person), sewage effluent of 60 gal/day/person, and an increase in dissolved solids of 200 milligrams per liter (mg/l) in sewage effluent, water and sewage treatment requirements and the increase in dissolved solids load to the Colorado River are summarized in table G3-3. Most of the increased demand for water would be placed on existing treatment facilities in Palisade and Grand Junction. Some domestic supplies may be obtained from wells, but the only suitable aquifer in this general area is alluvium bordering the Colorado River and its local tributaries. Wells, therefore, would be hydraulically connected to the surface streams and would have only slightly less effect than direct diversion of surface water for the needed supplies.

The small increase in salt load contributed to the Colorado River by the added sewage effluent attributable to the higher population as a result of the proposed action should have no significant impact on aquatic biology downstream. Increased consumptive use of water in the expanded mining operations and by the consequent larger population, together with the added salt load returned to the river in sewage effluent, however, could increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0 mg/l by 1980, 0.026 mg/l (0.0038 percent) by 1985, and by 0.0312 mg/l (0.0046) percent by 1990. Any increase in the salinity of the lower Colorado River is regarded as a serious impact because the quality of the river water is already marginal for most current uses.

Flood Hazard

Because extention of mining operations onto federal coal would not require any expansion of existing facilities on the flood plain of the Colorado River, the flood hazard associated with the proposed action would be the same as that described in chapter 2, Future Environment Without the Proposal.

Erosion and Sedimentation

GEX Colorado's proposed operations on federal coal would disturb an additional 90 acres, about half of which would be used for the refuse disposal area in Coal Gulch and the remainder for the Cameo No. 2 portal area and for test facilities adjacent to the plant area. Regulation 30(CFR): 717.17(a) requires that runoff from this disturbed area be routed through sedimentation ponds or other control structures that would limit total suspended solids in any effluent to 45 mg/l maximum allowable, except for discharge from a precipitation event larger than 10-year/24-hour recurrence interval. The average of daily values for 30 consecutive discharge days cannot exceed 30 mg/l. The effect would be to reduce sediment yielded to the Colorado River from the disturbed areas by an estimated 35 to 50 ton/yr. That amount would be insignificant in the Colorado River, which has an annual sediment load in this area of about 8 million tons per year.

Housing and related construction off site in Garfield and Mesa counties would contribute an unmitigated short-term amount of sediment to the Colorado River. Approximately 175 acres would be disturbed by 1985 and 217 acres by 1990. It is estimated that sediment yield to the river would be increased about 1 ton per acre disturbed for the first year or two after construction. Thereafter, sediment yield would decrease to about half the predisturbance rate. The initial increase in sediment yield, therefore, should be more than offset by the long-term reduction in sediment yield over the life of the structures.

Erosion of the refuse materials placed in the proposed disposal area in Coal Gulch (see chapter 2, Future Environment Without the Proposal, Water Resources) could be controlled by continuing, diligent efforts during the life of the mines, but no reclamation methods could prevent the ultimate channelization of this refuse area if it obstructs the existing channel as shown in GEX Colorado's mine plan. Obstruction of the natural drainage would constitute a valley fill, and Regulation 30(CFR): 715.15(b) prohibits disposal of waste materials in valley or head-of-hollow fills. Therefore, GEX Colorado must select an alternate location for a refuse disposal area. The Office of Surface Mining (OSM) recognizes the difficulties inherent in at-

TABLE G3-3

WATER AND SEWAGE TREATMENT REQUIREMENTS
AND SALT LOAD RETURNED TO THE COLORADO RIVER

Item	1980	1985	1990
Population increase (persons)	0	2,050	2,550
Required increase in treated water supply (ac-ft/yr)	0	460	570
Required increase in sewage treatment (ac-ft/yr)	0	140	170
Consumptive use (initial use less sewage effluent (ac-ft/yr)	0	320	400
Increased salt load returned to the Colorado River (tons/yr)	0	37	47

tempting to stabilize refuse disposal sites in areas of low annual precipitation and high natural erosion such as the Cameo area and is currently considering special performance standards for these areas.

Relationship of Hydrologic Impacts from Independent Development of Private and Federal Coal

In the foregoing appraisal, impacts stemming from the development of federal coal within the lease area were necessarily described separately from those attributed to development of private coal because GEX Colorado is currently in the process of opening its Cameo No. 1 Mine on private coal. In this case, the magnitude of the impacts assessed for a given time frame depends on the rate of production and not coal ownership. Impacts over the life of the mine would be virtually the same regardless of whether the private coal is mined first as described in chapter 2, Future Environment Without the Proposal, or whether the private and federal coal are mined simultaneously, so long as total production reaches 800,000 tons/yr by 1981 and 1.6 million tons/yr by 1988.

Soils

Soil impacts due to mining of federal coal would result from surface subsidence, from the construction and operation of mine surface facilities, and from urban area expansion due to increased employment. These impacts would be similar to the effects of mining private coal (discussed in chapter 2, Future Without the Proposal). However, the magnitude and duration of impacts would be greater.

Coal removal could cause an estimated maximum subsidence of 8 feet (see Topography). Soil impacts would be minimal where no breaks occurred in the surface mantle. However, any surface cracks could expose narrow bands of bare soil material; surface runoff could then be redirected, causing accelerated erosion.

Construction activities and associated surface disturbances due to the prosposed mining of federal coal would occur on approximately 90 acres by 1980. There would be no further disturbance through 1990. Localized erosion would temporarily increase perhaps two to three times the natural rate in response to this disturbance. Most of this erosion would be contained on site by sediment control structures, which must comply with 30(CFR): 717.17(a).

The net effect of increased erosion, along with a deterioration of soil structure, would be a reduction in soil productivity. Any such reduction, although unquantifiable at present, would intensify the inherent revegetation problems of low natural moisture and poor topsoil. These problems would prolong the efforts necessary to achieve successful reclamation (see Vegetation).

Off-site disturbances from population increases due to the proposed action would amount to 175 acres by 1985 and 217 acres by 1990. The exact location of these acres cannot be predicted, although at least some portion would likely come from croplands (including prime farmland) in Mesa County. To this extent, crop production capacity would be permanently lost (See also Water Resources, Erosion and Sedimentation).

Vegetation

The bulk of GEX Colorado's mining operations would be on land that is currently disturbed by the company's present mining of private coal. An additional 90 acres would be disturbed by 1980, due to a refuse pile, the Cameo No. 2 portal, and a test site. This disturbance would be largely in the saltbush type, although scattered stands of sage and isolated junipers are also present. The impacts of the disturbance would be to reduce the visual aesthetics of the area, increase soil erosion, and reduce the numbers of wildlife and livestock in the area (discussed in the appropriate sections).

GEX Colorado would be required to revegetate the 90 acres of disturbance due to the proposed action (as well as the 143 acres disturbed by private development) when no longer needed for mining operations. The majority of the disturbance would not be revegetated until abandonment of the mine, which under the proposed action would not occur until after 1990. Specific revegetation measures that would be required are stated in 30(CFR): 717.20, and 30(CFR): 211.40, 211.41, and 211.62, in the *Federal Register* (Vol. 42, No. 239, and Vol. 41, No. 96). These regulations are discussed in detail in the regional volume, chapter 4, Vegetation.

Revegetation Problems and Probability of Success

The revegetation of disturbed areas would be difficult, due to many factors. Climatic conditions are severe with extremes in temperature and wind, and low annual precipitation (approximately 10 inches). Insufficient moisture is the main factor hampering successful revegetation (Cook, Hyde, and Sims 1974; Hassel 1977; Hodder 1977). There also may be periods of drought, such as in 1976 when the annual precipitation was as low as 5 inches. Other revegetation problems which may be encountered are steep slopes; soil conditions which are detrimental to plant life (see Soils); competition for moisture, nutrients, and light from undesirable weedy plant species; low germination rates of seeds; and destruction of seedlings by wildlife.

Various revegetation techniques have been developed to counter such problems. They are discussed in detail in the regional volume, chapter 4, Vegetation. The use of many of these techniques may be necessary to establish on the disturbed mine site "a diverse vegetative cover capable of self-regenation and plant succession and at least equal in density to the natural vegetation," as required by the federal regulations (30[CFR]: 211.40[a][13][i]).

Hassell (1977) states that in desert areas conditions favorable for establishing vegetation come every four to six years.

Numerous researchers have indicated that irrigation may be necessary for establishment of seedlings in areas which receive 10 inches or less annual precipitation (Aldon 1977; Bengson 1977; Hassell 1977; Cook, Hyde, and Simms 1974; DeReemer and Bach 1977). Aldon, DeReemer and Bach, and Bengson (all 1977) have had success with drip irrigation techniques in arid environments. If irrigation would prove to be essential for establishemnt of vegetation at the Cameo mine site, sufficient water would probably be available for irrigation due to Cameo's 56 acre-foot water allotment from the Colorado River.

Hodder (1977) has developed several methods for retaining soil moisture in semi-arid environments. These methods are pitting or gouging the soil surface, moisture collars, or condensation traps.

The proposed revegetation plan indicates that mainly grasses would be used for revegetation, which would be consistent with probable post-mining land use of livestock grazing. However, pre-mining use was also partly wildlife habitat. Therefore, revegetating with shrubs, grasses, and forbs would provide a plant community which resembles the composition found in the natural environment, and which would satisfy post-mining wildlife and livestock uses. Wildlife (particularly big game) utilize mostly shrubs while livestock graze mostly grasses. Both utilize forbs to a certain extent, mainly in the early spring.

Past revegetation attempts in the arid Grand Valley (at or less than 10 inches annual precipitation) have met with little success. Based on conversations with the Soil Conservation Service and the Colorado Department of Highways in Grand Junction, the only successful revegetation in the area has been along Highway 70 west of Loma. The highway right-of-way was seeded six years ago, and a good stand of crested wheatgrass, western wheatgrass and Indian ricegrass is present now. The spring following the seeding had much higher than normal precipitation (U.S. Weather Service data for Fruita). The Highway 70 right-of-way between the Clifton interchange and Walker Field in Grand Junction has been seeded three times without any success.

In spite of the fact that various revegetation techniques involving both dryland revegetation and irrigation show potential for successful revegetation in arid environments, many of these techniques are yet in the research stage, and their feasibility for use in the Grand Valley has not been proven. Because of this, and the only marginal success of past revegetation efforts in the Grand Valley, successful revegetation of the Cameo site is not certain except in years of higher than normal winter or spring precipitation.

The above discussion is intended for sites which would be returned to rangeland, and would be sustained by natural precipitation amounts. Those plots of land adjacent to the Colorado River which GEX Colorado plants to return to alfalfa production would not exhibit the problems inherent to reestablishing range plants on disturbed arid sites. These plots would continually receive irrigation, and it is not expected that revegetation would be a problem.

Natural revegetation would occur at the Cameo mines if the soils are stable and do not contain materials toxic to plant growth. Weedy annuals such as Russian thistle would be the first to invade the disturbed areas, followed by a succession of longer lived plants until a persisting (climax) plant community of adapted perennial species similar to adjacent undisturbed areas exists. This natural succession process may take anywhere from 30 to 60 or more years depending on varying microenvironmental conditions such as slope, distance from undisturbed communities, etc.

Some vegetation may be disturbed by subsidence over the mined areas. Coal removal could cause an estimated maximum subsidence of 8 feet (see Topography). The effects of this disturbance would be an increase in soil erosion (see Soils). Loss of livestock and wildlife forage would be minimal.

Population-Related Impacts

Urban expansion caused by population increase related to coal mining would result in the disturbance of an estimated 175 acres by 1985 and 217 acres by 1990. It is probable that much of this disturbance would be on agricultural land surrounding existing population centers. This is discussed further under Soils.

Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road-vheicle use. This disturbance would lessen the productivity of native vegetation for livestock and wildlife forage. The probem would be most serious in low altitude Mancos shale hills and in alpine areas above timberline.

Wildlife

The development of federal coal would affect wildlife much the same as development of private coal, but the duration and possibly the magnitude of impacts would be greater.

Mule Deer

Approximately 143 acres of habitat have been destroyed due to development on private surface, and an additional 90 acres of saltbush would be destroyed by 1980 as a result of the proposed action. The total 233 acres would have supported 43 deer, based on 29.8 deer days per acre. Future use of these acres would depend on the success of revegetation plans after mine abandonment (see Vegetation). The area of active use by GEX Colorado is not considered to be crucial mule deer winter range. Animal/vehicle collisions would increase due to increased vehicular traffic.

Wild Horses

It is not anticipated that this operation as proposed would impact the wild horses.

Game Birds

Some waterfowl nestings and brood rearings in the vicinity of the loadout could be disrupted and even eliminated by the human activity close to the river. Activities could impede movement of chukars to watering areas near the Highline Canal.

Secondary Impacts

Secondary impacts from the proposed action would include increased human population resulting in expansion of urban areas onto agricultural land and some crucial winter range; increased vehicular traffic resulting in an increase in vehicle/animal collisions; and increased recreational use of the area causing an additional stress on the animals and increasing legal and illegal harvest of animals.

Threatened and Endangered Species

Two species could be affected by the development of this lease, the peregrine falcon and the bald eagle. Hunting areas in the riparian zone for both species may be reduced by human activity around the loadout facilities. A more serious impact could be disturbance of nesting peregrine falcons. Disturbances around nests have caused the birds to abandon the nest site in other areas and this could occur at the nest in DeBeque Canyon due to increased human activity near cliffs.

Coordination with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act of 1973 and the Bald and Golden Eagle Protection Act (16 USC 668-668d) has been completed. USFWS comments can be found in chapter 9.

Aquatic Biology

By 1990 the total ground water intercepted in the mining operation should be 50 gpm. If all of this water is used in coal processing and mine operations, there would be no discharge of mine water to the Colorado River and consequently no impact on the aquatic habitat. GEX Colorado does have an NPDES water-discharge permit that would allow 1.44 million gpd to be released to Coal Canyon approximately 1,000 feet from the Colorado River should it become necessary. The M&R plan states that if water quality becomes so bad that water cannot be discharged to Coal Creek, then it would be passed through the coal-plant's water-clarification system. This type of treatment would have to bring the discharge water quality into compliance with state and federal water quality standards. This would adequately protect the aquatic ecosystem of the Colorado River.

It is unlikely that a discharge of mine water would take place. In fact, by 1990, the 80 acre-feet per year yield of mine water would have to be supplemented by 200 acre-feet per year of water diverted and purchased from Colorado River water rights. Increased annual consumptive use of 600 acre-feet of water by 1985 and 680 acre-feet by 1990 due to the coal-processing activities and the increased population in the area (2,050 people by 1985 and 2,550 people by 1990) would further deplete the amount of water available for fish and aquatic wildlife habitat in the Colorado River. This consumption alone would not be significant when compared with the annual average discharge of the Colorado River of nearly 2.8 million acre-feet per year. It gains in significance when all water uses and developments in the basin are compared with the quantities of water available to support fish and wildlife habitats during yearly low-flow periods (see regional volume).

Until GEX Colorado implements a site-drainage system, runoff from the disturbed areas would flow directly to Coal Canyon drainage and into the Colorado River. This untreated flow may be harmful to the aquatic organisms and fish, but due to the large dilution factor of the Colorado River it is unlikely.

Before the GEX Colorado M&R plan is approved, the operation must comply with OSM regulations. All runoff from surface areas disturbed by mine construction and operations must be retained in sediment ponds as required by 30(CFR): 717.17. Sediment retention ponds would contain all runoff from a storm event up to a 10-year/24-hour storm. Spillways on ponds would be designed to safely pass a 25-year storm event. Discharges of water from these ponds, should they be necessary under normal conditions, may not exceed 45 mg/l total

suspended solids, and the 30-day average discharge may not exceed 30 mg/l. A discharge of this concentration of suspended solids, should it occur, would not adversely affect the aquatic ecosystem of the Colorado River downstream from the lease site.

Sediment retention ponds may legally spill in a precipitation event larger than a 10-year/24-hour storm. In such a case, some coal dust and other fine sediments from the ponds might flow into the Colorado River. However, in an event larger than a 10-year/24-hour storm, total sediment yield from the many highly erosive watersheds adjacent to the Colorado River would be so large that the amount of sediment coming from the retention pond spillway would be unmeasurable in the river and have insignificant impacts. Also, the increased dilution in the Colorado River during a large storm would largely decrease the concentration of all water quality parameters. No adverse effects on the aquatic habitat or the threatened and endangered fish species are presently known. Aquatic organisms presently living in this part of the Colorado River normally withstand a total suspended solid concentration ranging from 59 to 4,420 parts per million (ppm), with an average of 2,270 ppm and a total dissolved solid content averaging 200 to 250 mg/l in the spring and 600 to 650 mg/l during low-flow periods.

Placement of the coal refuse pile in Coal Gulch would cause over a thousand tons per year of coal refuse and sediments to enter the Colorado River each year. Continuous erosion of the refuse pile in all precipitation events would have a negative impact on benthic insects, algae, aquatic plants, and possibly on the reproduction of some fish species. Increased suffocation of benthic organisms may result. Research on the direct effects of western coal sediments on warm water fish habitats is lacking, but in almost all other cases introduction of large amounts of foreign substances and sediments to aquatic ecosystems proves detrimental to some species and to the system as a whole. The placement of the refuse pile is not in compliance with 30(CFR): 717.17. This impact would continue for many years after the private and federal coal reserves are exhausted.

The type of impacts from development of federal coal versus private coal on the Cameo site would be the same, although the magnitude and duration would be increased as the federal coal is developed.

Threatened and Endangered Species

No adverse impacts to endangered fish species in the Colorado River are projected. Coordination with USFWS under Section 7 of the Threatened and Endangered Species Act of 1973 has been completed. USFWS comments can be found in chapter 9.

Cultural Resources

Archeological Resources

The lack of identified archeological values within proposed activity areas of Coal Gulch and Coal Canyon (Connor 1977) suggest that there should be no impacts to archeological resources within the surveyed area. Approximately 143 of the 233 acres at the proposed Cameo site have already been disturbed. With the natural integrity of these areas destroyed, furthur impacts to archeological values should be minimal. Should any sites remain undetected by the Class III survey, they would remain unprotected and would be susceptible to damage and displacement from mine activities. Subsidence due to room-and-pillar mining is expected to be minimal, but any subsidence which does occur might displace or damage unidentified archeological sites.

Although sites AR-05-07-615 and AR-05-07-159 lie outside the area of construction activity, they could be impacted by subsidence which might result from the proposed action. Increased vandalism could also occur. Compliance with 36(CFR): 800 and with section 106 of the National Historic Preservation Act 1966, as amended, should the sites be determined eligible for the National Register, will insure protection of these sites and mitigate the possible losses.

With controlled access to the lease area, vandalism should remain a minimal impact, although the presence of 400 mine employees on the site by 1990 would mean increased exposure of archeological sites to public passage.

Historic Resources

Since there are no known historic sites in the study area there would be no direct impacts due to mining. Should sites be found in the course of mining activity, they would be reported to the Area Mining Supervisor and would be evaluated and protected under the Historic Preservation Act according to procedures outlined in 36(CFR): 800.

Land Use

The Cameo lease area would continue to be used for coal mining through 1990. Post-mining land use would depend to a large extent on the success of revegetation, although the area would probably revegetate itself eventually (30 to 60 years after conclusion of mining). If revegetation is successful, the land would probably become livestock range, with some wildlife use as well.

The Cameo mines would continue and increase the industrialization of the DeBeque Canyon area, along with such operations as the Public Service Company of Colorado's Cameo power plant, GEX Colorado's Roadside Mine, and Mid-Continent Coal and Coke Company's proposed Cottonwood Creek and Coal Canyon mines. Traffic on Interstate 70 (I-70) would increase as mine employees travel to and from work, and train traffic would increase as more coal is shipped to market.

All of these operations taken together plus predicted oil shale and uranium development in the general region, would cause significant population increases in Mesa and Garfield counties, although Palisade and Grand Junction would have to absorb much of the population growth due to the new coal mining. Some of the resulting residental and urban expansion would probably encroach on agricultural land (including some prime farmland) and wildlife wintering areas. It is also likely that the terraces and benches along the Colorado River would be developed for housing. However to some extent, the location of this urbanization would depend on future county and community land use planning and zoning.

Transportation

HIGHWAYS

Development of the Cameo mines would result in increased traffic on U.S. Highway 6 and I-70. Traffic could increase by as much as 266 vehicles, or 532 round trips, per day. This would be an 11 percent increase in traffic. No impacts on the highway capacity are anticipated because I-70 is being upgraded to interstate standards (including a grade separation). The highway is also presently operating below capacity. No impacts are projected for the Cameo interchange. Some increase in accidents could be expected because of increased traffic.

RAILROADS

Coal produced at the Cameo mines would be loaded onto unit trains at a loading facility now being constructed near the mines. At peak production from two to three unit trains per week would be required to move the coal. This would increase congestion on the D&RGW main line and through major cities in eastern Colorado where coal from other producing areas in the West must also pass.

Airports

Some increase in passenger traffic at Walker Field would result from the greater population in the area.

Livestock Grazing

Although the 90 acres which would be disturbed by the proposed action are not currently grazed by livestock, there is an indication in GEX Colorado's reclamation plan that livestock grazing would be part of the post-mining land use. It is not assured though, that livestock forage would be restored on the disturbed land upon abandonment on the mine. This is because revegetation of the disturbed areas is not certain, due to conditions at the mine site which in most years are unfavorable for revegetation (see Vegetation). However, assuming successful revegetation can be accomplished, approximately 18 animal unit months (AUMs) per year would be restored to the disturbed areas after abandonment of the mine. This assumption is made because the species mixture used in revegetation would consist mostly of grasses.

It is very likely that some of the acreage disturbance resulting from urban expansion due to increased population (175 acres in 1985 and 217 acres in 1990) would be on irrigated and nonirrigated hayland and pasture. This would adversely impact the livestock industry because these lands are used as livestock wintering areas, and the hay harvested from them in the summer is used to feed the livestock during winter.

Recreation

The influx of additional population due to the Cameo mining operation and the subsequently increased demand for recreational opportunities could have an impact on existing recreational resources and facilities, particularly community facilities, in the Grand Junction-Palisade area. Since Grand Junction's recreational facilities are now fully utilized (Grand Junction Recreation Department 1977), increased use would result in overuse, which would lead to their deterioration and lower their capacity to provide enjoyable recreation. The community facilities needed to meet the increased demand and prevent overuse are projected in table G3-4, which shows a need for 6.8 acres of active/improved park land by 1988.4nd 5.8 acres by 1990. Capital investment to provide the facilities is also projected in table G3-4.

The increased demand for dispersed recreational opportunities (e.g., hunting, hiking, ORV use) should not adversely affect the recreational resource; however, concentrated use, such as an ORV rally, could lead to vegetative deterioration and a lower quality recreation experience on that site. BLM is in the process of developing open, restricted, or closed desingations for public lands, which should help alleviate this problem. Increased use of recreation facilities (such as Island Acres Recreation Area) would lead to increased mainte-

TABLE G3-4

GEX-CAMEO: ADDITIONAL COMMUNITY RECREATION FACILITIES DEMAND

	1980	1985	1990
Population Growth	-	2,050	2,550
Active/improved parks a/ (3.3 acres per 1,000 residents)	-	6.8 acres	8.4 acres
Capital investment ($66,666 per 1,000 residents)	-	$136,665	$169,998

Source: Bickert, Browne, Coddington, and Associates, Inc., 1976.

a/ Ballfields, tennis courts, playgrounds, etc.

nance cost for the managing agencies. The extent of the increased use and costs are not known.

The increased use of recreational facilities could be offset by providing additional facilities. The Heritage Conservation Recreation Service, through the Land and Water Conservation Fund Act (PL 88-578), could provide monies for this purpose if matching funds are provided by the local agency. The mineral leasing funds (Colo. S.B. No. 35, Section 2, 34-63-102), which can be used for public facilities and services, could also be used for recreation facilities. In addition, BLM could provide lands for these recreational facilities under the Recreation and Public Purposes Act, 43(CFR): 2740, which allows nonprofit associations to acquire lands for recreational purposes consistent with their creating authority. These actions, however, cannot be required by the Department of the Interior; therefore, the initiative for taking these courses of action would be up to the local agencies and the success of mitigation would depend on their commitment to it.

The Cameo mining operation is not expected to impact the wilderness values of the Little Bookcliffs Wild Horse Area since mining on this portion of the lease would be underground with no surface facilities planned and subsidence unlikely.

Visual Resources

The influence of Cameo No. 1 and No. 2 mines on the landscape character would be minimal because of the extent of existing surface disturbance. Little visual contrast (see the appendix, volume 3, for contrast tabulations) would result from the addition of further modifications within this landscape. The Cameo power plant and associated facilities would continue to dominate the landscape character.

Socioeconomic Conditions

Demography

In calculating the population growth associated with the Cameo mines, it was assumed that 80 percent of the new employees would reside in Mesa County and 20 percent would reside in Garfield County. As a result of the Cameo mines, there would be an increase in total population of 1,750 persons by 1985 and 2,100 persons by 1990 in Mesa County. In Garfield County the increase in population due to the Cameo mines is estimated to be 300 persons by 1985 and 450 persons by 1990. The distribution of this population would parallel the distribution of population associated with the Coal Canyon and Cottonwood Creek mines, a discussion of which is contained in the Coal Canyon and Cottonwood Creek site-specific analyses.

The combined development of the Coal Canyon, Cottonwood Creek, and Cameo mines may have a pronounced effect upon the small community of Palisade. Palisade has remained a stable, agricultural community with a relatively high concentration of older persons for some time. A rapid influx of new population would certainly threaten the present character and social structure of the community. It would also place a burden on the elderly residents as the cost of living rises due to the demand for increased local government services. General changes expected in attitude and lifestyle due to increased coal mining in the area are discussed in the regional volume.

Community Facilities and Services

The projected minimum community facility requirements for Mesa and Garfield counties associated with the Cameo mines are listed in table G3-5. These figures were derived in a similar manner to those contained in the regional volume, chapter 4, Socioeconomic Conditions.

Table G3-5 does not reflect the major capital expenditures which are now being made in many communities in both Mesa and Garfield counties. These cost figures represent needed capital requirements over and above any facilities which exist or which are under development.

Increases in the local property and sales tax revenues attributed to the Cameo development are listed in table G3-6. These revenues represent the total property and sales tax revenues expected to flow to all local government entities. Since the estimated increases in community facility expenditures would be born by county, municipal, or special district units of local government, it is necessary to subtract the school district share of the revenues in order to make a comparison. If this is done, it decreases the locally derived revenues available for county, municipal and special district purposes in Mesa County to an estimated $887,610 in 1985 and $1,003,400 in 1990. Comparing these revenues with the yearly operating expenses and amortized (assumes debt financing over twenty years at 6 percent interest) capital expenses of $545,830 per year shows that Mesa County should experience a revenue surplus from the Cameo Mines, starting soon after the mines are operational.

Locally derived revenues available for county, municipal and special district purposes in Garfield County are estimated to be $83,210 in 1985 and $116,530 in 1990. Comparing these revenues with the yearly operating and amortized capital expense of $105,610 per year shows that Garfield County should receive adequate revenue to provide for the population increase.

TABLE G3-5

ADDITIONAL REQUIREMENTS FOR COMMUNITY FACILITIES-CAMEO # 1

	Water Treatment	Sewage Treatment	Police Protection	Fire Protection	Streets and Roads	General Government	Libraries	Total
Mesa County:								
Physical Plant Requirements (1990)	0.42 mgd	0.13 mgd	840 S.F. of space 1 vehicle	1,430 S.F. of space 1 vehicle	50 acres	530 S.F. of space	1,160 S.F. of space 6,300 volumes	
Capital Costs (1990)	$367,310	$415,800	$64,280	$159,000	$1,611,000	$ 34,130	$85,600	$2,737,120
Operating Costs								
1980	0	0	0		0	-		0
1985	$21,910/year	$16,910/year	$70,000/year	$35,000/year	$39,770/year	$57,020/year	$14,530/year	$255,140/year
1990	$26,290/year	$20,290/year	$84,000/year	$42,000/year	$48,500/year	$68,690/year	$17,430/year	$307,200/year
Garfield County:								
Physical Plant Requirements (1990)	0.09 mgd	0.03 mgd	180 S.F. of space	450 S.F. of space	11 acres	110 S.F. of space	250 S.F. of space 1,350 volumes	
Capital Costs (1990)	$ 78,710	$ 89,100	$12,060	$18,000	$354,420	$7,080	$18,430	$561,600
Operating Costs								
1980	0	0	0	volunteer	0	0	0	
1985	$3,760/year	$2,900/year	$12,000/year	-	$6,790/year	$9,720/year	$2,490/year	$37,660/year
1990	$5,630/year	$4,350/year	$18,000/year	-	$10,670/year	$14,260/year	$3,740/year	$56,650/year

TABLE G3-6

INCREASED REVENUE TO GARFIELD AND MESA COUNTIES FROM THE CAMEO MINES

	1980	1985	1990
Garfield County			
Property Tax			
Homes	-	$ 81,000	$ 121,820
Businesses	-	25,670	38,510
Sales Tax	-	46,620	74,430
Service Fees	-	860	1,290
Total	-	$ 154,150	$ 236,050
Mesa County			
Property Tax			
Mines	-	$1,368,560	$1,401,590
Homes	-	454,830	607,540
Businesses	-	96,230	115,480
Sales Tax	-	218,050	261,660
Service Fees	-	7,290	8,750
Total	-	$2,144,960	$2,395,020

TABLE G3-7

NEW HOUSING REQUIREMENTS - CAMEO #1

	Single-Family Units	Mobile Homes	Multi-family Units	Total Units
Mesa County				
1980	0	0	0	0
1985	379	146	58	583
1990	455	175	70	700
Garfield County				
1980	0	0	0	0
1985	65	25	10	100
1990	98	37	15	150

Housing

The projected demand for new housing in Mesa and Garfield counties as a result of population growth attributed to the Cameo mines is listed in table G3-7. The same assumptions regarding housing mix and family size that were used in the regional analysis were used in these calculations.

The new housing requirements associated with increased populations would use about 150 acres in Mesa County and 25 acres in Garfield County by 1980 and 179 acres in Mesa County and 38 acres in Garfield County by 1990. The 1990 requirements represent about 5 percent of the total projected new housing requirements in Mesa County and about 1 percent of the new housing requirements in Garfield County by that year.

Schools

The expected increase in school-aged population due to the development of the Cameo mines is shown in table G3-8, and the increase in school district capital requirements and operating costs anticipated from that population increase are shown in table G3-6.

Most of the increase in school-aged population within Mesa County due to the Cameo mines development would occur within School District 51. Since the mine itself is also located within the jurisdictional boundaries of School District 51, that district would receive an additional $20.8 million in assessed valuation from the facility itself by 1985 and $21.3 million in 1990. That increase in assessed valuation would allow the district to increase its bonded indebtedness by $4.2 million, which is in excess of the projected capital facility requirements. School District 49(JT) in DeBeque would also be required to provide for some of the increase in Mesa County school-aged population associated with Cameo mines. Even though District 49(JT) would not benefit from any of the increase in property tax base from the Cameo mines, the tax base increase it is expected to receive from the Sheridan Enterprises Loma project (if developed) would be more than sufficient to meet its capital requirements. The increases in school operating costs projected for Mesa County as a result of the Cameo mine development would be met by increased school district revenues without an increase in tax rates.

In Garfield County, the increases in school-aged population from Cameo mines should occur in the Grand Valley District 16 and the Garfield District RE-2. The total expected increase in property tax base in Garfield County from new population associated with the Cameo mines would be $1.3 million in 1995, and $2.0 million in 1990. That increase would allow the Garfield County school districts to raise their bonded debt by $400,000 or four times the estimated annual requirement for school capital facility needs.

Health Care

Population growth associated with the Cameo mines is expected to increase the demand for health care facilities in the Grand Junction area and the Rifle area. Due to their proximity to the Grand Junction area, neither the Cameo mines nor their two neighbors, the Cottonwood Creek and Coal Canyon mines, are likely to have significant adverse effects on the area's health care facilities individually. However, since population growth as a result of these three operations would affect the same area, the cumulative effect on health care service delivery is important. There would most likely be a need for expanded health care services in the town of Palisade, especially emergency services, to serve all three operations. Table G3-10 is an estimate of the capital facilities needed in Mesa and Garfield counties to meet the projected increase in demand for health care services from all three mines in the Cameo area. Most of the existing health care facilities in the area are supported by fees collected for services performed instead of through local tax revenue.

Employment

Development of the Cameo mines would affect employment in Mesa and Garfield counties. In 1985 mine employment would be 355 persons, which would increase total employment by 883 persons in Mesa County and 141 persons in Garfield County. In 1990, 400 persons would be employed at the mines, causing a total employment change of 1,047 persons in Mesa County and 217 persons in Garfield County.

Income

The eventual employment of 400 people at the Cameo mines would have a significant impact on income in Mesa County. Because no information was given by GEX Colorado on expected payroll, an average income of $16,600 per employee is assumed for analysis. Average income at the mine would be considerably higher than Mesa County's 1975 median family income of $11,130. Mine employment, payroll, and the total change in regional income due to the Cameo mines are shown in table G3-11.

Noise

During development of the Cameo No. 2 Mine, there would be some noise impact on a community of twenty homes across the river from the mine portal. Once the mine is in operation, the increase in ambient noise levels in this residential area may

TABLE G3-8

GEX-CAMEO NO. 1: INCREASE IN SCHOOL AGE POPULATION

	1980	1985	1990
Mesa County	0	424	512
Garfield County	0	68	105

TABLE G3-9

SCHOOL DISTRICT FACILITY REQUIREMENTS

	1980	1985	1990
Mesa County:			
Facility Requirements	0	59,360 sq.ft.	71,680 sq.ft.
Facility Costs	0	$2,671,200	$3,225,600
Operating and Maintenance Costs	0	$521,520/year	$629,760/year
Garfield County:			
Facility Requirements	0	9,520 sq.ft.	14,700 sq.ft.
Facility Costs	0	$428,400	$661,500
Operating and Maintenance Costs	0	$83,640/year	$129,150/year

TABLE G3-10

COAL CANYON, COTTONWOOD CREEK, CAMEO NO. 1:
PROJECTED HEALTH CARE FACILITY REQUIREMENTS

County and Year	Facility Requirements	Facility Costs (dollars)
Mesa:		
1980	0	0
1985	16 hospital beds and 1 emergency vehicle	895,000
1990	18 hospital beds and 1 emergency vehicle	1,005,000
Garfield:		
1980	0	0
1985	2 hospital beds	110,000
1990	3 hospital beds	165,000

TABLE G3-11

CAMEO INCOME

Year	Employment	Payroll	Total Regional Income
1980	0	$ 0	$ 0
1985	355	5,893,000	8,957,360
1990	399	6,623,400	10,667,570

increase slightly, depending upon the location of the residence.

Assuming that operating noises from the Cameo No. 2 Mine would have the same intensity as that from the Roadside Mine, the average noise level at the residence closest to the mine is predicted to be 54 dBA. At this location the Roadside Mine noise is recognizable only when the ambient noise level drops to 48 dBA. However, train and I-70 vehicular traffic produces an equivalent noise level (L_{eq}) of 57 dBA at this point. The anticipated increase in noise at this location due to increased traffic on I-70 therefore makes any effect of mine operation on residences insignificant.

The Cameo No. 1 Mine is located so that its operation would have no impact on any residential or recreational area. It is improbable that it would have any impact on wildlife due to the long period of activity in the area in connection with the Cameo power plant and the noise of truck traffic from the proposed Coal Canyon Mine.

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

The mitigating measures proposed in this chapter are measures which will be taken to minimize or eliminate specific adverse impacts identified in chapter 3 which would result from approval and implementation of GEX Colorado Company's mining and reclamation (M&R) plan. They do not include federal regulations, such as 30(CFR): 700, which are considered to be requirements with which the M&R plan will have to comply before it can be considered for approval. Neither do they include any mitigating measures already developed by GEX Colorado as part of the M&R plan; these have been described and analyzed as part of the proposed project in chapters 1 and 3.

All mitigating measures proposed in this chapter must be "real and committed," by definition in Bureau of Land Management (BLM) Manual 1792. "Real" means that the measures must be legally enforceable and actually workable for the area and situation being assessed. "Committed" means that the agency requiring the measures (in this case, BLM) will ensure that they become part of the authorizing document and will take the necessary steps to see that the measures are in fact implemented as part of the proposed project. Thus, if GEX Colorado's M&R plan is approved, all measures proposed in this chapter will be required in addition to the federal, state, and county requirements discussed in chapter 1, Authorizing Actions.

In the case of mitigating measures for air quality, those measures identified below are for major potential air pollution sources at the mine. However, Best Available Control Technology (BACT) will be required on all significant fugitive dust sources identified in table G3-1, chapter 3. Accordingly, additional controls beyond those specified below may be required by the U.S. Environmental Protection Agency in its review for prevention of significant deterioration (PSD) or by the Office of Surface Mining in the air quality analysis of its permit review. The controls required herein as mitigating measures are BACT for those sources, but BACT may not be specified on all sources identified at the proposed mines if air quality impact is judged to be mitigated.

Any additional reasonable measures for alleviating impacts of the proposed action which would change the design of the proposal, which could cause major impacts of their own, or which cannot be considered real and committed are analyzed as alternatives in chapter 8.

Cameo Mitigating Measure 1

Guzzlers will be constructed in Coal Gulch and Coal Creek for chukars. The guzzlers would allow the chukars access to water away from the High-line Canal and thereby reduce the possibility of the birds being disturbed by the mining activity.

Cameo Mitigating Measure 2

Application of surfactant or foam to coal entering the raw storage pile at the Cameo mines will be required as a condition for concurrence by BLM with the M&R plan.

GEX Colorado proposes to control air pollution from the storage pile by watering. The use of surfactant or foam would increase control efficiency from 50 percent (for watering) to approximately 90 percent. This would reduce emissions by 8 tons per year.

Cameo Mitigating Measure 3

Prior to the approval of the proposed action, a concurrence of approval will be developed between the BLM and GEX Colorado to outline GEX Colorado's responsibility for the protection of cultural resources. GEX Colorado will provide for a Class III (100 percent) cultural inventory should any additional areas be proposed for surface disturbance and will allow for work stoppage and compliance should archeological resources be identified after the proposed action has been initiated.

An archeological survey will be required in areas likely to be impacted by surface subsidence. Due to the unpredictibility of subsidence and the lack of information available concerning the effects of subsidence on archeological sites, an overburden of 300 feet or less will be used as a parameter to define potential impact areas to archeological values. Cracks and breaks in the surface are known

to occur rarely with overburdens of more than 300 feet (Morgan 1978, Personal Communication). GEX Colorado will be required to define areas with an overburden of 300 feet or less and will provide for archeological survey of these areas. Archeological sites located by these surveys will be evaluated and mitigated prior to any disturbance and future monitoring of these sites would provide valuable information concerning subsidence and its effect on archeological sites.

Identification, evaluation, and preservation of data from archeological sites before potentially damaging actions would mitigate the loss of archeological resources. The results of the Class III survey, as a 100 percent surface inventory of the impact areas, are considered to be representative of the archeological values in that area. The efficiency of the Class III survey as an identification process would depend on topography, vegetation, and past land use on each site. These factors would account for the possibility that hidden and subsurface sites would remain undetected and unaccounted for in developing any further necessary mitigating actions.

Any archeological values which are located and evaluated through this survey could be preserved through one or more of the following mitigating measures, depending upon the significance of a site: (1) avoidance of the site through redesign of the project; (2) descriptive and photographic records, or surface collecting; or (3) excavation according to a specific research design or as a salvage effort.

Collection and excavation are only partial mitigations. While they preserve artifacts which might otherwise be destroyed, the in-place value of those artifacts is lost. Destruction of the site would mean the loss of information which might otherwise be gained by further techniques and interpretive methods.

Should additional archeological sites be identified in the survey effort and determined eligible for the National Register as part of the archeological district or as individual sites, compliance procedures required by Section 106 of the 1966 National Historic Preservation Act, amended 1976, and outlined in 36(CFR): 800.4-9, will be met.

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Chapter 5 discusses unavoidable adverse impacts which would be caused by approval and implementation of GEX Colorado Company's proposed M&R plan for the Cameo mines. These impacts include the residual impacts after application of any mitigating measures discussed in chapter 4.

Air Quality

Table G5-1 presents the total annual particulate emissions for 1980, 1985, and 1990 with and without mitigating measures. The Cameo mines would increase annual average particulate concentrations by 4 micrograms per cubic meter ($\mu g/m^3$) in a small area on the mine site near the preparation plant and refuse pile. Concentrations are predicted to increase by at least 1 $\mu g/m^3$ for a distance of 0.5 to 1 mile from the surface facilities. Maximum 24-hour concentrations from the mine about 0.5 mile down the canyon would be 20 $\mu g/m^3$ in 1980, 23 $\mu g/m^3$ in 1985, and 24 $\mu g/m^3$ in 1990. Visibility would be reduced less than 2 miles on an annual oasis by 1990.

Geologic and Geographic Setting

Topography

Installation and use of the refuse disposal area would cause minor alteration of the land surface. Under worst case conditions, a maximum of 8 feet of subsidence may cause fracturing and slumping of the surface resulting in an erosion hazard and a danger to any surface use of the area; such subsidence could also increase air circulation at depth, causing spontaneous combusion of the coal seam.

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot presently be assessed because of the lack of data and evaluatory criteria.

Mineral Resources

The mining of an estimated 22.91 million tons of coal from the proposed Cameo mines would deplete portions of a nonrenewable energy deposit. The 22.91 million tons of coal would constitute approximately 2.1 percent of the total coal reserves over 42 inches of thickness in the Mesa County portion of the Colorado section of the Little Bookcliffs coal field. Because of the nature of underground caving and resultant high contamination, future recovery of the abandoned (approximately 50 percent) coal reserves is not considered feasible with present technology, and therefore those reserves must be considered lost.

Water Resources

Ground water obtained from the Cameo No. 1 and No. 2 mines very probably would not be adequate to meet the needs of the proposed operation, and an estimated 200 acre-feet per year (ac-ft/yr) additional water would have to be obtained from surface-water supplies. This would decrease accordingly the amount of surface water available for other uses downstream. Additional consumptive use of municipal water by the increased population would be about 320 ac-ft/yr by 1985 and 400 ac-ft/yr by 1990. The reduction in flow downstream attributable to this consumptive use, coupled with the increased salt load in sewage effluent, would increase the dissolved solids concentration in the Colorado River below Hoover Dam by about 0.026 milligrams per liter (0.0038 percent) by 1985, and by 0.031 milligrams per liter (0.0046 percent) by 1990. Any increase in the salinity of the lower Colorado River is regarded as a serious impact because the quality of the river water is already marginal for most current uses.

Minor local erosion would occur off site because of construction related to population increase. Net sediment yield over the life of the mine, however, should not be significantly different from predisturbance rates.

Soils

Surface disturbance at the mine site on approximately 90 acres by 1980 would cause an increase in erosion and a deterioration of soil structure and biological activity, leading to a temporary reduction in soil productivity. Any such reduction would prolong the efforts necessary to achieve successful reclamation.

TABLE G5-1

TOTAL ANNUAL PARTICULATE EMISSIONS

(ton/yr)

Study year	Without mitigating measures	With mitigating measures	Percent reduction
1980	52	44	15
1985	60	52	13
1990	82	74	10

Urban area expansion would permanently remove from a production function approximately 175 acres by 1985 and 217 acres by 1990. Although exact locations are not known, some of this acreage would likely come from lands either now classified or eligible for classification as prime or unique farmland.

Vegetation

Vegetation would be lost at the mine site on 90 acres through 1990. If parts of the disturbed areas are revegetated before abandonment of the mine (on refuse piles, road cutbanks, etc.), the actual acreage lost would be slightly less than these figures. However, successful revegetation of the Cameo site is uncertain except in years of higher than normal winter or spring precipitation. Natural vegetation would be disturbed on 175 acres by 1985 and 217 acres by 1990 due to community growth.

Wildlife

Approximately 233 acres of habitat (143 acres of existing disturbance due to development of private coal and 90 acres to be disturbed due to development of federal coal), which would have supported 43 deer, would be lost through 1990.

Activity near the mine has already caused loss of hunting habitat for the peregrine falcon, and further disturbance of this habitat could cause additional stress on the birds. In addition, human activity around the cliffs could cause their abandonment as nesting habitat and the subsequent loss of the birds.

Aquatic Biology

Increased annual consumptive use of 600 acre-feet of water by 1985 and 680 acre-feet by 1990 due to the coal-processing activities and the increased population in the area (2,050 people by 1985 and 2,550 people by 1990) would further deplete the amount of water available for fish and aquatic wildlife habitat in the Colorado River. This consumption alone would not be significant, but it could be significant when combined with other water uses and development in the area.

Cultural Resources

Archeological Resources

Undiscovered sites could be damaged by surface-disturbing activities and by subsidence. Information could be lost as a result of vandalism and illegal collecting and through salvage excavation procedures where any information not recorded would be permanently lost.

Land Use

Transportation

Greater traffic on U.S. Highway 6 and I-70 would increase accidents and congestion. The two to three unit trains moving the coal to the consumer would increase congestion on rail facilities in eastern-slope cities.

Livestock Grazing

Increased off-road vehicle use would decrease productivity of natural vegetation by an unquantifiable amount. Agricultural lands disturbed by urban expansion would result in the loss of an unquantifiable amount of livestock forage and livestock wintering areas.

Recreation

If the community recreational facilities needed to prevent deterioration of existing facilities are not provided, this deterioration would be an unavoidable adverse impact.

Visual Resources

The expansion and visual intensification of the Cameo industrial area would further degrade the natural appeal of DeBeque Canyon, and additional surface disturbance would expand the visual influence of the industrial landscape character.

Socioeconomic Conditions

The Grand Junction area would receive population resulting from the Coal Canyon, Cottonwood Creek, and Cameo mines, but that population would be only a small portion of the total population increase expected in Grand Junction. The entire Grand Junction area's ability to absorb population growth is expected to be severely strained between 1978 and 1985, with the new population brought in by these three mines compounding the problem. New populations in Mesa and Garfield counties from the Cameo mines would be 2,050 people by 1985 and 2,550 people by 1990.

In Mesa County about 150 acres of land by 1985 and 179 acres of land by 1990 would have to be converted to residential use to accommodate increased population resulting from the Cameo mines. About 25 acres by 1985 and 38 acres by 1990 would be needed in Garfield County.

CHAPTER 6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 22.91 million tons of coal would result in short-term and long-term alteration of natural resources and the human environment.

There would be the following alterations in the short term, a period beginning with on-site construction and ending with end of mine life (about 2025) and the post-mining reclamation:

1. An estimated 22.91 million tons of coal would be exported to midwestern utility plants for use in the production of electrical energy.

2. Annual average particulate concentrations would increase by 4 micrograms per cubic meter ($\mu g/m^3$) near the preparation plant and refuse pile and by 1 $\mu g/m^3$ for a distance of 0.5 to 1 mile from the surface facilities. Maximum 24-hour concentrations from the mine about 0.5 mile down the canyon would be 24 $\mu g/m^3$. Visibility would be reduced less than 2 miles on an annual basis.

Predicted maximum 24-hour concentrations in the DeBeque Canyon area would be about 150 $\mu g/m^3$ and would occur near the Cottonwood Creek site. The maximum particulate concentrations in the DeBeque Canyon area would be 69 $\mu g/m^3$. This maximum concentration would occur in the vicinity of the bridge across the Colorado River and would be aggravated by the coal hauling activities of the Cottonwood Creek mines. Estimated source contributions of approximately 4 of the 69 $\mu g/m^3$ would be caused by the Cameo mines, 40 are due to background, 2 are due to existing sources, 3 would be caused by the Coal Canyon Mine, and 20 would be caused by Cottonwood Creek mines. The maximum concentration of 69 $\mu g/m^3$ is below the primary standard of 75 $\mu g/m^3$, but 9 $\mu g/m^3$ above the secondary standard of 60 $\mu g/m^3$. The area exceeding the secondary standard would be less than 1 square mile, centered around the combined loadout facility.

3. Use of water in the mining operations and by the increased population would consume about 0 acre-feet per year (ac-ft/yr) by 1980, 320 ac-ft/yr by 1985, and 400 ac-ft/yr by 1990. The effect would be to increase the dissolved-solids concentration in the Colorado River below Hoover Dam by 0 milligrams per liter (mg/l) by 1980, about 0.026 mg/l (0.0038 percent) by 1985, and by 0.031 mg/l (0.0046 percent) by 1990.

Minor local erosion and sedimentation would occur offsite because of construction related to population increases.

4. There would be continued loss of soil productivity on 233 acres through 2025 due to increased erosion, deterioration of soil structure, and reduced biological activity, and there would be continued loss of vegetation on those 233 acres through 2025 due to loss of soil productivity. (Approximately 90 acres would be due to the proposed action; the remaining 143 acres are due to ongoing private development.)

5. Wildlife habitat on 233 acres, which could have supported 43 deer annually, would continue to be lost through 2030.

6. Increased traffic from coal haulage and from employees would increase the number of road accidents.

7. Six unit trains per week would increase congestion on area rail facilities. This represents about one-seventh of the coal train traffic eastbound through DeBeque Canyon, and the contribution of train traffic from the Cameo mines to ambient noise levels when compared with the total effect of all eastbound traffic would be insignificant.

9. Total direct, indirect, and induced income generated by the Cameo mines would be $10,667,570 by 1990.

Residual effects of mining (after post-mining reclamation) on long-term productivity would be as follows:

1. An undetermined number of uninventoried exposed and unexposed fossil resources would be impaired or destroyed.

2. An unquantifiable gain in knowledge would result from surveys and exposure of fossil resources which might never have been found without development.

3. An estimated 22.91 million tons of coal, a nonrenewable energy resource, would be depleted after 2030.

4. On completion of mining and reclamation, ground-water and surface-water occurrence in the lease tract and adjacent areas should return to approximately premining conditions over a period of several years.

5. Post-mining land use of the lease area (livestock and wildlife range) would depend on the success of revegetation, which may be difficult except in years of higher than normal winter or spring precipitation. Natural revegetation would occur eventually (30 to 60 years after conclusion of mining).

6. Soil and natural vegetative productivity would be permanently lost on 169 acres due to urban expansion.

7. Surface construction subsidence, and vandalism would disturb or destroy an unquantifiable number of nonrenewable cultural resources.

8. Archeological survey and excavation could provide gains in understanding of prehistoric use in the area.

9. If peregrine falcons are forced to abandon their nest sites near the mines, their long-term productivity could decrease.

10. If additional recreational facilities are provided to meet the increased demand, they would remain for long-term use; conversely, if additional facilities are not provided, the deterioration of present facilities would be a long-term adverse impact.

11. The development of the coal mines would intensify the existing industrial image of the landscape, and some facilities would become permanent modifications. Long-term rehabilitation would improve some acreage, but the landscape image would change only marginally as long as the Cameo Power Plant and facilities are functioning.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Approximately 22.91 million tons of coal would be recovered from the Cameo mines. About 22.91 million tons would be lost due to current mining methods.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing machinery and buildings would not be recycled and thus would be lost.

An undetermined number of uninventoried fossils would be lost or disturbed.

Soil and vegetative production would be irretrievably lost on 233 acres for the life of the mine. This loss may be difficult to reverse because of the uncertainty of successful revegetation at the mine site, although natural revegetation would eventually occur.

Wildlife habitat on 233 acres, which would have supported 43 deer annually, would be irretrievably lost for the life of the mine. This loss may be difficult to reverse because of the uncertainty of successful revegetation at the mine site, although natural revegetation would eventually occur.

The commitment of this area to mining could cause an irretrievable loss of peregrine falcons and their nesting habitat and subsequent loss of the birds nesting in this area.

Anything other than in-place preservation of archeological resources would be an irreversible, irretrievable commitment of the resource. Damage from surface disturbance or vandalism would result in permanent loss of information and would remove those archeological values from future research consideration.

The expansion of the Cameo industrial complex would further commit the landscape to a form of industrial development. Future populations would be committed to this alteration and its influence on the total DeBeque Canyon visual environment.

An irretrievable commitment of capital and land (at least 217 acres) would be required to support population growth.

Particulate air quality at the proposed mine site would be subject to an increase in concentrations. Air quality would be temporarily degraded during the mine life, but the change would not be irreversible. With termination of mining activity, air quality would return to premining levels.

Reduction in visibility would occur in proportion to the increased particulate concentrations, but this loss would also be reversible. However, secondary development related to the proposed action would result in some permanent degradation of visibility in the Grand Valley area.

Approximately 200 acre-feet per year (ac-ft/yr) of surface water would be diverted annually from the Colorado River system and used in the mining and coal-processing operations. An additional 320 to 400 ac-ft/yr of surface water would be consumed by the increased population. Use of water in the mining operations would end on completion of mining. Use of water by the increased population, however, would probably continue beyond the projected life of the mine.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

Pursuant to implied covenants of both the federal mineral leasing laws and the existing lease agreements, the Department of the Interior is obligated to respond to a legitimate application to conduct mining operations on a valid lease, provided that all terms and conditions thereunder have been met. The Department's action with regard to GEX Colorado Company's mining and reclamation (M&R plan) for the Cameo mines may be approval as proposed, rejection on various environmental or other grounds, approval or rejection in part, or approval subject to such additional requirements or modifications as the Department may impose under existing laws and regulations. The Department may also defer decision pending submittal of additional data, completion of required studies, or for other specific reasons. If there are serious environmental concerns as to the coal development, the Department may prevent further development of the leases by exercising the Secretary's exchange authority as to the federal coal rights, or seeking congressional action to cancel federal leases involved.

Development of alternative sources of energy, energy conservation, federal development of the coal, and emphasis on coal development in other regions of the United States are more appropriate for consideration on a program rather than a regional basis. These evaluations were made in the previous coal programmatic statement (U.S. Department of the Interior 1975) and will be updated and revised as necessary in the new coal programmatic statement now under way (to be completed in 1979).

GEX Colorado's M&R plan for the Cameo mines has not been reviewed for compliance with the interim regulations 30(CFR): 700 required under Sections 502 and 503 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (PL 95-87), and it does not fully reflect the requirements of the interim regulations. The M&R plan will be returned to the applicant for revision in accordance with the appropriate federal regulations. When it is resubmitted to the Office of Surface Mining (OSM), it will be evaluated for compliance with all appropriate federal regulations by OSM in conjunction with the U.S. Geological Survey (USGS). In addition, the Bureau of Land Management (BLM) must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA.

APPROVAL AS PROPOSED

The Department has the choice of approving the M&R plan as proposed. However, as pointed out above, GEX Colorado's M&R plan has not been reviewed for compliance with the interim regulations. Therefore, it cannot be considered for approval until it has been revised to comply with all appropriate federal regulations.

REJECTION ON ENVIRONMENTAL OR OTHER GROUNDS

The Department may reject any M&R plan that does not meet the prescriptions of applicable law and regulations under the Department's authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly differently designed course of action by the lessee (operator). In addition, BLM must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA. Except when an M&R plan does not comply with existing regulations, the Department cannot under present circumstances reject the proposed plans to the extent that a de facto cancellation of a lease results unless the Secretary seeks and obtains additional authority from Congress.

Rejection of GEX Colorado Company's proposed M&R plan would result in no environmental impacts from coal mining on the federal leased lands. Since these lands are public lands, surface use would be governed by BLM policy and management guidelines and decisions. GEX Colorado could submit a new M&R plan, challenge the rejection, or abandon development of the lease. Should GEX Colorado submit a new M&R plan, it would require both environmental assessment and review for compliance with applicable regulations.

Since GEX Colorado's mining plan involves other adjacent private holdings, the company would still develop private coal from the Cameo No. 1 Mine. The company would begin producing

approximately 200,000 tons in late 1978 or early 1979 and reach full production of 300,000 tons per year by 1980. As currently projected the private coal reserves of the Cameo Mine property would be exhausted by 1982.

Coal from the proposed Cameo mines is intended to supply 22.9 million tons of coal to midwestern utility plants for use in the production of electrical energy. Potentially, production from private reserves in the Cameo No. 1 would not be sufficient to supply these markets. The effects on other resources of mining private coal would be the same as discussed in chapter 2, Future Environment Without the Proposal.

APPROVAL OR REJECTION IN PART

The Department has the choice of approving or rejecting part of a particular M&R plan, based on projected adverse environmental impacts.

Restrict Development on Existing Leases

The subject leases convey the right to develop, produce, and market the federal coal resource thereon if all other terms and conditions have been met by the lessee. In general, the Department does not possess the authority to arbitrarily constrict development if all other requirements of the lease have been met. However, various measures that may tend to restrict development may be taken by the Department at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations (for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, etc.). Similarly, the Department could permit only selective exploration and development of existing leaseholds if analysis indicates wholly unacceptable environmental impacts that could not be reduced to an acceptable level.

Phased Development

Phased development of coal mines as a means of lessening socioeconomic impacts of coal development in the ES area is discussed as the Diligent Development and Continuous Operations alternative under Approval or Rejection in Part of chapter 8 in volume 1. The restrictions discussed under that alternative could be applied to the GEX Colorado operation alone. However, to do so would probably not significantly reduce socioeconomic impacts in Mesa County, since other coal mines in the area could continue to develop at a rapid rate, and most of the adverse socioeconomic impacts in Mesa County would result from multiple development of mineral resources over a short period of time (see the impact analysis in volume 1, chapter 4, Socioeconomic Conditions). To be effective, phased development would have to be applied uniformly to coal projects throughout the ES area.

APPROVAL SUBJECT TO ADDITIONAL REQUIREMENTS OR MODIFICATIONS

Subject to existing laws and regulations, the Department has the choice of approving an M&R plan with additional stipulations or changes to lessen adverse environmental impacts. For example, operational, transportation, or other alternatives could be adopted when such alternatives would reduce adverse impacts.

Operational Alternatives

No reasonable operational alternatives have been identified which would significantly reduce adverse impacts of coal mining or increase resource recovery. Surface mining is not feasible due to the geology and geographic characteristics of the area. Federal regulations (30[CFR]: 211) require M&R plans be designed to ensure maximum economic recovery of the coal resource.

Transportation Alternatives

Coal Transport

GEX Colorado Company proposes to transport coal by covered conveyor from the preparation plant to the company's loadout facility on the Colorado River. No reasonable alternative to this proposal has been identified. See volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Coal Transportation Alternatives, for a general discussion of truck transport and slurry pipelines.

Busing of Mine Employees

Busing of employees to the mine site could reduce the traffic impacts discussed in chapter 3. This measure has been proposed as a regional alternative in volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Busing of Coal Mine Employees.

Protection of Peregrine Falcons

Human activity in the area of GEX Colorado's Cameo mines and Mid-Continent Coal and Coke Company's Coal Canyon Mine could seriously disturb nesting peregrine falcons in the vicinity of these operations. Several actions are available which could minimize this disturbance. Public travel in Coal Canyon could be discouraged during

the peregrine falcon nesting season. All vehicles could be restricted to existing roads. Motorcycles, trail bikes, dune buggies, and other all-terrain vehicles could be prohibited from entering the canyon during the nesting season. Construction of permanent buildings could be kept to a minimum. Power line construction could follow the guidelines established in BLM Manual 2850 (this measure is provided for in chapter 4). The Rural Electrification Administration standards for prevention of raptor electrocution, as addressed in the 1975 publication, *Suggested Practices for Raptor Protection on Power Lines*, also could be consulted. Power lines could be 300 yards from roads except for a minimum number of access points. If peregrine falcons do not return to one of the known eyries, efforts should be made to survey the canyon cliffs for alternate nest occupancy.

Protection of Endangered Fish Species

As discussed in Water Resources, chapter 3, inadequate ground-water supplies would probably necessitate the use of supplemental surface water in the proposed Cameo operation. At full production of 1.6 million tons per year, it is estimated (regional, chapter 1) that total water consumption would be about 270 ac-ft/yr, of which an estimated 200 ac-ft/yr must be obtained from surface water supplies. This would decrease accordingly the amount of water available for other uses downstream.

The U.S. Fish and Wildlife Service (USFWS) has expressed concern (see comment letter 11 in chapter 9, volume 3) about cumulative impacts to the Colorado River system if supplemental water must be obtained from the river by several mining companies. A stipulation could be added to GEX Colorado's M&R plan that, if the company seeks water rights to divert water from the Colorado River for the Cameo operation, formal consultation with the USFWS should be reinitiated to determine the impacts of the actions.

Other Alternatives

The land use and socioeconomic analyses in chapter 3 identified adverse impacts to Mesa County due to development of the Cameo mines. In addition to the Diligent Development and Continuous Operations alternative which addresses such impacts on a regional basis (see Restrict Development on Existing Leases earlier in this chapter and in chapter 8, volume 1), the regional volume also discusses actions which may be available to state, county, and community governments which might lessen or control socioeconomic and land use impacts. See Socioeconomic Alternatives Available to State and Local Governments, chapter 8, volume 1.

DEFER ACTION

For proper cause, the Department may defer final action on a proposed M&R plan. Reasons for deferring action can include, but are not limited to, the need and time required for:

1. Modification of a proposal to correct administrative or technologic deficiencies;
2. Redesign to reduce or avoid environmental impact;
3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation;
4. Further evaluation of a proposal and/or alternatives.

The principal effect of deferring action on a proposed M&R plan on these grounds would be a comparatively short-term delay in the occurrence of all related impacts of a proposal (both adverse and beneficial). To the extent that an M&R plan can be redesigned to alleviate adverse impacts, those impacts would be lessened.

As pointed out at the beginning of this chapter, GEX Colorado's M&R plan for the Cameo mines has not been reviewed for compliance with the interim regulations, and the Department will not consider the plan for approval until it is brought into compliance with all applicable federal requirements.

Peregrine Falcon Habitat

The concurrent development of three proposed projects--Mid-Continent Coal and Coke Company's Coal Canyon and Cottonwood Creek mines and GEX Colorado Company's Cameo mines (which would be an extension of GEX Colorado's private operation onto federal coal)--could adversely affect essential peregrine falcon habitat in the vicinity. Approval of GEX Colorado's M&R plan could be deferred to prevent concurrent operation of the three operations. However, GEX Colorado intends to produce coal from private reserves at the Cameo No. 1 Mine through 1982, and the company's existing Roadside Mine would continue to produce coal through 1985; both mines would use the company's rail loadout facilities near the Cameo No. 1 Mine. In effect, then, adoption of this alternative would mean deferral of the Coal Canyon and Cottonwood Creek proposals through 1985, and continued deferral of the Cameo proposal through the year 2000 (based on a minimum mine life for the Coal Canyon Mine of 15 years) or through 2010 (based on maximum mine life of 25 years for either the Coal Canyon Mine or the Cottonwood Creek mines) or through 2035 (based on the combined mine lives of the two Mid-Continent operations if developed consecutively). This would mean that mining at the Cameo operation would be

interrupted for a period of 15 to 50 years, which could have serious economic consequences for GEX Colorado and could hamper efficient maximum recovery of the federal coal.

Control of Runoff and Salinity

Approval of the M&R plan could be deferred until it has been evaluated with regard to best management practices for nonpoint sources of water pollution and the guidelines of the Colorado River Salinity Forum. See chapter 2, Future Environment Without the Proposal, Water Resources, and chapter 3, Water Resources, for a discussion of projected effects on water quality due to mining at the Cameo operation.

PREVENTION OF FURTHER DEVELOPMENT

No Action Alternative

"No action" on proposals for extention of existing private mining operations onto federal coal would equate to prevention of that further development. Under existing regulations, operations may not proceed in the absence of approved M&R plans and related permits. The alternative of rejecting the M&R plans is discussed earlier in this chapter.

Relinquishment of Leases

The BLM is reviewing nonproducing existing leases. Nonproducing leases are to be reviewed in accordance with planning standards and in compliance with the proposed unsuitability criteria developed pursuant to the requirements of section 522(b) of SMCRA.

Under Congressional Bill S3189 (October 13, 1978), the Secretary may exchange leased lands that are determined and/or proven to be unmineable for an equivalent area of unleased land. In addition, the Federal Land Policy and Management Act of 1976 (PL 94-579), Section 206, gives the Secretary general authority to dispose of public lands by exchange, subject to applicable laws, when the Secretary "determines that the public interest will be well served by making that exchange: *Provided,* That when considering public interest the Secretary concerned shall give full consideration to better Federal land management and the needs of State and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife and the Secretary concerned finds that the values and the objectives which Federal lands or interests to be conveyed may serve if retained in Federal ownership are not more than the values of the non-Federal lands or interests and the public objectives they could serve if aquired."

CHAPTER 9

Consultation and Coordination

See volume 3, chapter 9, for a discussion of consultation and coordination carried out for the West-Central ES.

SHERIDAN ENTERPRISES:

LOMA PROJECT

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

Proposed Action

The proposed action is the review and consideration for approval of a mining and reclamation plan (M&R plan) submitted by Sheridan Enterprises, Inc., to the Area Mining Supervisor of the U.S. Geological Survey (USGS), Denver, Colorado, on March 14, 1978. The plan describes the proposed Loma Project, a new underground mining operation. The M&R plan has been accepted by the USGS as suitable for use in preparing this environmental statement (ES) and is available for public review at the Area Mining Supervisor's Office in Denver.

This M&R plan was submitted for review after promulgation of the interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), but it has not been officially reviewed for compliance with that act. The applicant's plan may not fully reflect the requirements of the interim regulations. However, in this statement the interim regulations are considered as requirements with which the M&R plan will have to comply just as it must comply with all other applicable regulations.

The M&R plan will be returned to the operator for revision in accordance with the applicable interim regulations. As soon as the applicant's plan is revised and returned to the Office of Surface Mining (OSM), it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations in 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be approved until it conforms to all applicable federal requirements.

The mining complex, designated as the Loma Project (map S1-1) would be located about 35 miles northwest of Grand Junction, Colorado, in western Garfield County, in the Colorado portion of the Little Bookcliffs coal field. The Loma property consists of federal coal leases C-0125436, C-0125437, C-0125438, C-0125439, C-0125515, and C-0125516 (totalling 14,929.23 acres), located in the Douglas Pass area of western Garfield County, Colorado. The federal lease conditions are subject to all current mining reclamation and related land use requirements and all laws and regulations affecting federal coal leases.

The proposed Loma Project would consist of six new underground, bituminous coal mines with an anticipated annual production of 5 million tons of coal per year and an employment level of approximately 900 at full production. Each mine may vary as to size, production, equipment, and mining systems, depending on location, coal quality, mining conditions, and markets. Recoverable reserves of the total project are estimated to be 100 million tons. The mine life would be approximately 25 years.

Coal produced by the Loma Project would most likely be transported by rail from the mine to electrical utility markets in the midwest and southwest.

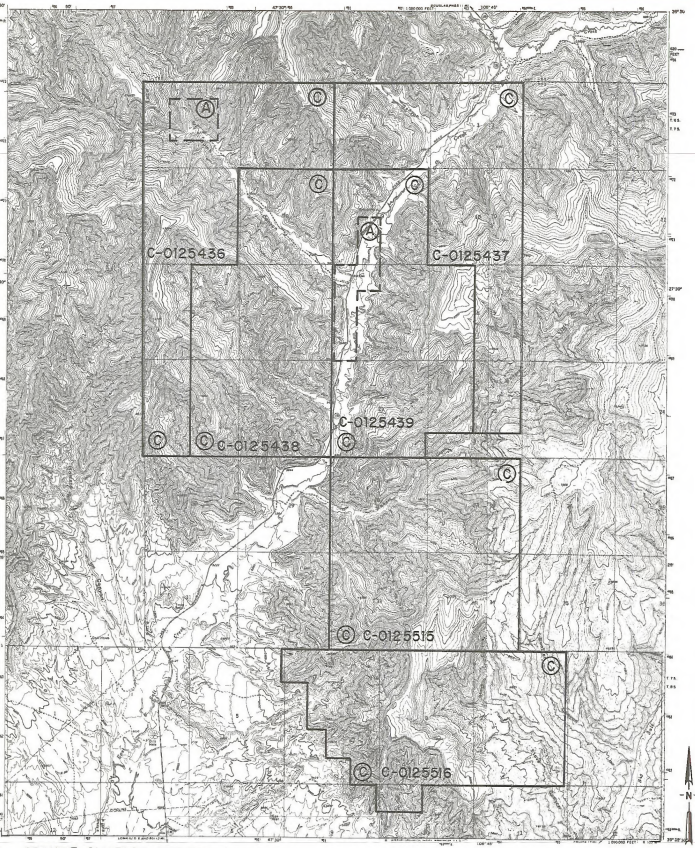
Mining at the Loma Project would be primarily in the 7 to 23 foot thick Cameo coal seam of the Mt. Garfield Formation in the Upper Cretaceous Mesaverde Group. An upper, unnamed seam (tentatively called the 'Loma' seam) which is also in the Mt. Garfield Formation would also be mined.

History and Background

Historically, there have been small coal mining operations in the Douglas Pass area as can be ascertained from opened coal seams, derelict mining structures, and small refuse sites. There are, however, no records or information regarding previous in mining operations in the project area. The abandoned McKinley Mine, located approximately 12 miles southeast of the area, is the nearest coal mine of record to the proposed mining operation.

In 1966, prospecting permits were issued to Industrial Resources, Inc., for exploration in the Douglas Pass area. In 1968, after the USGS had determined that a commercial coal deposit had been discovered, preference right leases C-0125436, C-0125437, C-0125438, C-0125439, C-0125515, and C-0125516 were issued to Industrial Resources. These leases were assigned to Sheridan Enterprises, Inc., on January 1, 1978.

On December 1, 1975, the USGS Area Mining Supervisor approved a prospecting development and mining plan submitted by Sheridan Enterprises for Industrial Resources for operations on these leases. The underground exploration work is designed to provide test data to confirm whether



(A) PRIVATE SURFACE, FEDERAL MINERAL
(B) PRIVATE SURFACE, PRIVATE MINERAL
(C) PUBLIC LAND SURFACE, FEDERAL MINERAL

FEDERAL LEASE
PRIVATE LEASE

Map S1-1. Sheridan Enterprise's Loma project lease area

there are sufficient economically recoverable resources to support a viable mining operation. No subsequent commercial operations have been authorized or approved.

The exploration work involves driving sets of five exploratory entries for a distance of 5,000 feet at four different locations. Each set of entries is to be located in a geomorphically distinct area of the leases. Test data on coal quality and variations, roof conditions and necessary support methods, ground water conditions, gas emissions, equipment capabilities, and other mining conditions will be obtained. Coal produced by the exploration mining is being test burned by various potential customers, such as electric utilities and industrial companies. Bulk samples are being tested for their beneficiation characteristics. All of the surface facilities at each of the exploration mining sites would be temporary.

In mid-1977, test mining was started at a site in McClane Canyon in Section 21, T. 7S., R. 102W. Another test mine was started at a site in Munger Canyon in Section 27, T. 7S., R. 102W. in late 1977; figure S1-1 is an aerial photograph of that site.

Predisturbance Inventories and Analyses

In early 1978, the Bureau of Land Management (BLM) in cooperation with Sheridan Enterprises completed a vegetative study of the areas that would be disturbed by the Loma Project. Also, R. V. Lord & Associates, Inc., Boulder, Colorado, made a soil, vegetation, and wildlife reconnaissance of the McClane and Munger sites and one proposed site in Spink Canyon.

An archeological inventory was conducted by Antiquities Research Division, Historical Museum and Institute, Grand Junction, Colorado, on roads and lands used in connection with exploratory drilling operations.

Sheridan's Proposed M&R Plan

Since beginning its exploration activities in 1977, Sheridan Enterprises has developed two of five of the approved exploration adits: one in Munger Canyon and a second in McClane Canyon. Exploration mining activities will continue until all five test portals have been developed. These test adits would be developed to permanent portal sites once the full mining operation is begun (map S1-2).

Sheridan proposes to begin construction of the mine support buildings and the access and main haulage roads in 1980, with construction estimated to be completed by late 1982. Construction of the central processing facilities (map 20 in the appendix volume) and the rail spur (map S1-3) would begin in 1980 with completion scheduled by mid to late 1982. A work force of 173 employees is proposed during the construction period.

The initial two mines to be located in McClane and Munger canyons would begin production in late 1982 and would reach production capacity of 3.5 million tons of coal per year by 1985, at which time the work force would be increased to approximately 472 employees. Additional new mines up to a total of five may be started at intervals to meet the demand.

The complete project would be operating in 1990 and would consist of six mines, producing about 5 million tons of coal annually with a work force of approximately 900 employees. The company estimates its employment would increase at the rate of 100 employees per year from 1985 to full production in 1990.

Mine Layout

The initial development of the main entries of each mine would begin at the coal outcrop. Mine portals are proposed at the locations shown on map S1-2.

Development of the main entries would utilize a five-entry system. The outside two entries would be utilized as main ventilating returns, allowing a split ventilation system. The inner three entries would be used for fresh intake air, main belt conveyor, haulageway for materials, and miner access.

Development of the bleeder system entries would utilize three and four entries with one entry as a return airway, one as a belt conveyor entry, and one or two entries for fresh air intake, materials haulage, and access.

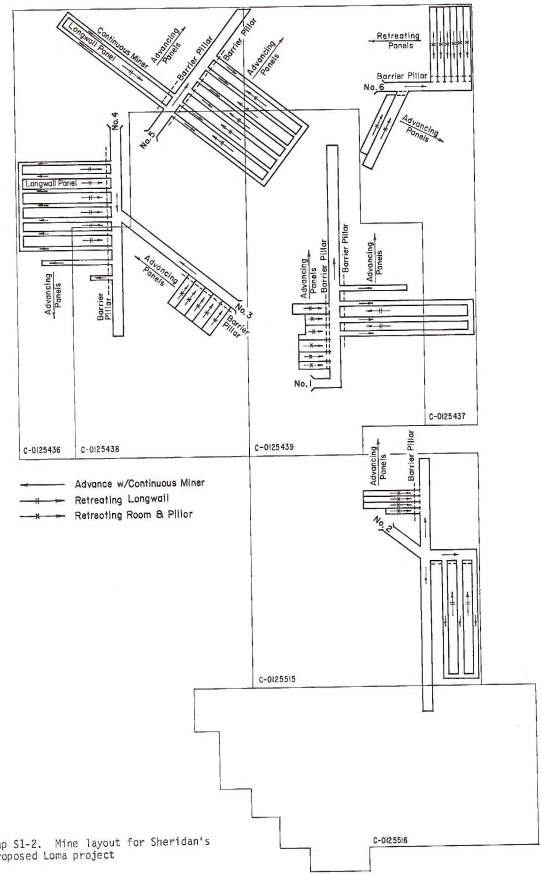
Development for both longwall panels and room-and-pillar panels would utilize a three-entry system which would provide for a return airway, belt conveyor entry, intake airway, material haulage, and access.

Adequate barrier pillars, 100 to 200 feet in width, would be provided to protect the bleeders and main entries. All entries would be 18 to 20 feet wide on 70- to 90-foot centers, with crosscuts on 100-foot centers for the full seam thickness up to a maximum of 12 feet of coal. All development work would be accomplished with continuous miner units.

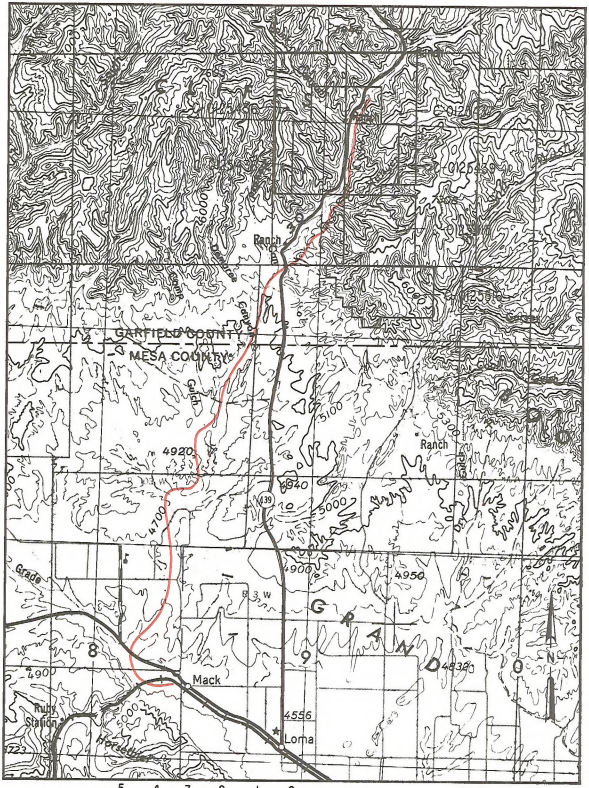
Longwall mine panels would employ a retreat mining method with longwall shearing beginning at the barrier pillar of the bleeder entries and mining toward the main entries. Panel lengths would vary from 5,000 to 7,000 feet with face widths varying from 500 to 600 feet. A maximum height of 14 feet is proposed for longwall mining.

Room-and-pillar mining would be accomplished by continuous miner units. Panel entries would be driven off the main entries at intervals, to provide rooms 340 feet long on one side of the panel en-

Figure S1-1. Looking southeast at the Munger Canyon exploration adit operated by Sheridan Enterprises. At the completion of exploration activities, Sheridan proposes to convert this adit into a producing mine.



Map S1-2. Mine layout for Sheridan's proposed Loma project



Map S1-3. Sheridan's proposed utility corridor

tries. The rooms would be mined 20 feet wide on 45-foot centers to room depth (length); pillars would be extracted on retreat. Full seam thickness would be mined to a height of 12 to 14 feet.

Each of the mines would have, at one time, up to five mining units, that is, up to four continuous miners and one longwall unit. Table S1-1 lists typical mining equipment to be used.

A minimum roof control plan has been formulated for normal roof conditions using the mining methods described. The support practices which may be involved include mechanical roof bolts, steel mats, timber, wooden crossbars, and resin anchored bolts. In areas where subnormal roof conditions are encountered or anticipated, additional support methods may necessitate changes in roof control; the roof control plan would be modified and approval would be obtained from the Mine Safety and Health Administration (MSHA) before the new method was implemented. Ventilation and safety plans must also have MSHA approval.

No. 1 Mine

In the No. 1 Mine, with portals in McClane Canyon, Sheridan has developed five exploration entries eastward from the Cameo seam outcrop for a distance of about 1,400 feet, where a fault was encountered. The mining plan proposes these entries to be used as permanent main entries. These mains would be turned north just before the fault and developed northerly for about 11,000 feet. Longwall panels would commence on the east side of the north mains at 2,000 feet north of the fault. The longwall panels would be successively developed by advancing entries, then mined on retreat. The longwall panels would be developed successively to the northern limits of the north mains on 700-foot centers.

Room-and-pillar panels would be developed to the west of the north mains with room panels extending until bad coal is found, or to the burn line in the outcrop zone. Room-and-pillar panels would be mined successively beginning at the 200-foot barrier from the east mains and progressing north to the limits of the north main entries.

Main entry barrier and chain pillars would be mined on retreat by continuous miner units upon completion of the longwall and the room-and-pillar mining.

No. 2 Mine

At the No. 2 Mine, with portals in Munger Canyon, five entries are being developed from the Cameo seam outcrop during ongoing exploration. Sheridan proposes to develop them as permanent main entries. These mains would be developed about 2,000 feet southeast and then about 2,400 feet east to the property barrier pillar.

At 2,000 feet inside the portals, a main entry system would be turned south and developed about 12,500 feet until bad coal is found or until the south lease boundary barrier pillar is reached. A main entry system would also be turned north and developed for about 4,000 feet to the property barrier pillar. Longwall mining would be done south and north from the east mains and east of the north mains and south mains. Room-and-pillar panels would be developed on the west of the north main toward the coal outcrop zone; longwall mining may be done west of the south mains. Main entry barrier and chain pillars would be mined on retreat by continuous mining units upon completion of the longwall and the room-and-pillar mining.

No. 3 Mine

Sheridan proposes to open a five-main entry system at the No. 3 Mine with portals in the Cameo seam of East Salt Creek. The system would be in the coal outcrop on a relatively narrow mountain ridge formed by two separate, local drainage features about 4,000 feet apart. The Cameo seam is extensively burned along the outcrop in this area, making the mineable area unsuitable for longwall mining. Therefore, only room-and-pillar mining methods would be utilized. The main entries would be developed about 6,000 feet toward the northwest.

Room-and-pillar panel entries, in sets of three entries on 70-foot centers, would be turned toward the southwest beginning about 200 feet inside the portals, or at a greater distance if necessary to encounter saleable coal inside any burn line. These panels would be developed successively on 520-foot centers to provide panels with 340-foot rooms. The room panels would be developed about 1,600 feet in length or to the burn line. Room-and-pillar panels would be mined on retreat to the main entry barrier pillar. It is assumed that room-and-pillar panels would be mined on the southwest of the main entries to the burn line by retreat panel mining beginning at the inside end of the main entries by the same mining sequence. Main entry barrier and chain pillars would be recovered by retreat methods upon completion of mining of the room-and-pillar panels.

No. 4 Mine

Sheridan proposes to open a five main entry system for the No. 4 Mine in the Cameo seam outcrop on the south side of Spink Canyon. The main entries would be developed south for a distance of 9,400 feet by continuous miner units. Longwall panels would be developed west about 4,200 feet from the mains to the lease boundary barrier with extractions of the coal by retreat toward the mains. The longwall panels would be

TABLE S1-1

TYPICAL MINING EQUIPMENT LIST FOR LOMA PROJECT

Face Equipment	General Underground Equipment
Development Sections and Room-and-Pillar Sections:	Main line belts for coal haulage to surface
Continuous miner	Track (no trolley wire)
Diesel haulage cars	Diesel/battery supply - miner haulage vehicles
Roof bolter	Roof bolter
Battery scoop	Rock duster
Transformer	Pump stations
Panel belts - 36" and 42"	Supply cars
Rock duster	Air compression station
Face ventilation fans	Fire car station
Feeder-breaker	Battery/diesel cleanup vehicles
Diesel fuel storage tanks	
Longwall Section:	
Shield supports	
Double-ended ranging drum shearer	
Armoured face conveyor	
Master control station	
State loader	
Transformer and electric boxes	
Panel belt - 42 inches	
Power-pack system	
Rock duster	

developed by the advancing entries. The area to the east of the main entries would be mined from the No. 3 Mine. Main entry barrier pillars and chain pillars would be recovered by retreat methods upon completion of the longwall panel mining.

No. 5 Mine

The No. 5 Mine portals would be in the Cameo seam outcrop on the north side of Spink Canyon. The five main entries would be developed to the northeast for about 7,000 feet to the barrier pillar at the north boundary of the lease lands. Longwall panels about 5,400 feet in length would be developed to the southeast of the main entries. Longwall panels northwest of the main entries would be developed over varying lengths of 1,000 to 6,200 feet. Main entry barrier pillars and chain pillars would be recovered by retreat methods upon completion of longwall mining.

No. 6 Mine

The No. 6 Mine, with portals in the Loma seam of East Salt Creek, would be opened at the coal outcrop in the only area on the lease lands currently known to contain the seam in mineable quantity and quality.

The five-main entry system would be developed about 4,000 feet east from the portal to the boundary barrier pillar. The area containing mineable coal is not suitable for longwall mining; therefore, the entire block of coal would be mined by the room-and-pillar method. Panels would be developed north from the main entries beginning at the boundary barrier pillar. The panels would be 3,500 feet in length with rooms 340 feet deep. Each panel would be mined on retreat toward the portal area. Room-and-pillar panels of variable lengths would be developed toward the southwest south of the mains. These panels would be mined by advancing panel methods. Main-entry barrier pillars and chain pillars would be mined by retreat methods upon completion of the room-and-pillar mining.

Ventilation

At each mine, a main ventilating fan would be installed on the surface and offset not less than 15 feet from the nearest mine opening. The fan would be installed in fireproof housing and connected to the mine opening by fireproof air ducts. The fan would be equipped with a pressure-recording gauge and an automatic alarm device should the fan slow or stop. The fan would be powered by an electric motor on a separate power supply that would be independent of any other mine circuit.

The intake and return entries would be separated by permanent, substantial, incombustible stoppings to and including the third crosscut out from a working face. Separation of the entries inside this point would be by check curtains. Line brattice would be installed to the last support in each entry that has not been cut through. Coal would not be permitted to accumulate at the outside end of the face equipment to the extent that ventilation of the working face is restricted.

Haulage Systems

Coal would be transported from a working face to the main underground conveyor belt by diesel-powered shuttle cars. From the conveyor belt, the coal would enter a surge bin on the surface, then be transported to the central processing facilities by 55-ton coal haulers. Dust would be controlled by water sprays at the working face, at all loading points, and at all transfer points.

SURFACE FACILITIES

Approximately 676 acres would be required for facilities, which would include access and haul roads, office/shop/warehouse complex, processing plant complex, railroad and utility corridor, water and sewage treatment complex, mine portal complexes, and a refuse disposal site. (Map 20 in the appendix volume shows the proposed surface facilities; figure S1-2 is an aerial photo of the site.)

Roads

The main access road to the Loma Project is Colorado Highway 139 (Douglas Pass Road) from Loma, Colorado. Primary access to the project would be over graveled roads a minimum of 30 feet wide.

The on-site haul roads that would be used for coal haulage from the various mine-portal areas to the central processing facilities would be graveled roads, 50 feet wide. Those roads that would be used for both coal haulage and for refuse disposal would be graveled roads, 80 feet wide. Table S1-2 shows the surface disturbance of the various access and haul roads that would be constructed on the Loma Project.

Approximately 3,000 feet of access road in McClane Canyon already exist and would be widened to 50 feet for coal haulage. About 4,300 feet of access road exist in Munger Canyon and would be lengthened and widened to 50 feet for coal haulage.

Construction of the access and haulage roads would be by private contractors. Estimates were given that the access road construction would take approximately two months per mile per ten-worker crew, and the haul road construction would take three months per mile per ten- worker crew.

Office/Shop/Warehouse Complex

Approximately 6.2 acres would be disturbed by the office/shop/warehouse complex. The complex

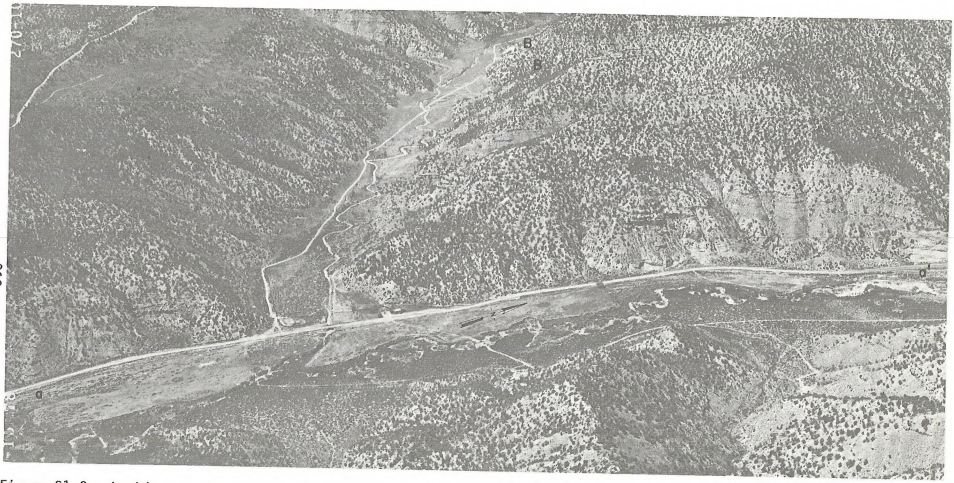


Figure S1-2. Looking northwest up Spink Canyon from East Salt Wash. Central facilities for Sheridan's Loma project will be located in East Salt Wash in the foreground. B marks the proposed site of two portals for the Loma project. The distance from point a to a' is approximately 1 mile.

TABLE S1-2

SURFACE DISTURBANCE OF LOMA PROJECT ROADS

Area	Access (length, feet)	Access (width, feet)	Haul (length, feet)	Haul (width, feet)	Total Acres
Mine No. 1 (McClane Canyon)	-	-	3,000	50	3.4
Mine No. 2 (Munger Canyon)	-	-	9,000	50	10.3
Mine No. 3 (East Salt Creek)	-	-	3,000	80	3.4
Mine No. 4 (Spink Canyon)	1,000	30	8,000	50	10.6
Mine No. 5 (Spink Canyon)	1,000	30	-	-	0.7
Mine No. 6 (East Salt Creek)	-	-	220	50	2.6
Central Facilities (East Salt Creek)	2,000	30	9,000	80	17.9
				Total	48.9

TABLE S1-3

AREAS TO BE DISTURBED BY MINE PORTAL SITES

Mine	Acreage Disturbed
No. 1	1.7
No. 2	2.6
No. 3	3.0
No. 4	4.0
No. 5	7.0
No. 6	6.2
Total	24.5

would consist of a main office building, major repair shop, analytical laboratory, supply yard, underground fuel storage tanks, water supply and treatment facilities, sewage treatment facility, and parking area.

Central Processing Complex

The central processing facilities would disturb approximately 13.2 acres. These facilities would include a coal processing plant, 20,000-ton raw coal storage area, 20,000-ton clean coal storage area, 20-foot diameter refuse bin, railroad loadout facility, conveyor system, water supply and treatment facility, sewage treatment facility, bathhouse, power distribution system, and parking area.

Railroad and Utility Corridor

The 200-foot railroad and utility corridor for the Loma Project would start approximately 1 mile west of Mack, Colorado. The corridor would contain the railroad spur, power line, and water line. It would follow the East Salt Creek drainage, extending approximately 20.5 miles to the loadout area of the project (see map S1-3). Approximately 497 acres would be disturbed. A power substation would have to be constructed within the corridor near Mack, Colorado, because none now exists. Sheridan has not yet applied for a right-of-way for this corridor over the public lands, but is in the process of negotiating for rights-of-way over private lands. Although the exact location of the corridor is not firmly committed, the corridor has been included in this ES for purposes of preliminary impact analysis. Once the route has been finally selected and the railroad spur has been designed, additional environmental assessment may be required.

Water and Sewage Treatment

The company estimates that approximately 10 cubic feet per second of water would be acquired for the Loma operation. The water would be diverted from the Colorado River approximately 2.5 miles south of Loma. The water would be pumped via an 8- to 10-inch pipeline along U.S. Highways 6 and 50 rights-of-way, through the utility corridor, to the project area.

Sewage treatment would be by a septic-tank and leach-field system at each of the portal sites, at the office/shop/warehouse complex, and the central facilities.

Mine Portals

Approximately 24.5 acres would be disturbed during the life of the mine for construction and maintenance of portal areas. The areas to be disturbed by the mine portal sites are listed in table S1-3.

Refuse Disposal

Approximately 40 acres of surface would be disturbed in the proposed refuse disposal area. Coarse refuse in solid form and fine refuse in slurry form would be disposed of in the refuse pile. Specific details of the construction of the refuse pile were not given in the M&R plan. However, the refuse would be disposed of in compliance with 30(CFR): 211 and 30(CFR): 700 regulations.

All suitable and available topsoil would be removed from disturbed areas by conventional rubber-tired scrapers and stockpiled near the place of removal. The stockpiles would be compacted by multiple passes of the scrapers to obtain a density conducive to soil stability. The stockpiles would be mulched and seeded with approved mixtures to minimize erosion. Sedimentation ditches would be constructed on the down-gradient side of the stockpiles. Sediment cleaned from the ditches would be placed back on the stockpiles.

SURFACE RECLAMATION

Abandonment of the Loma Project at the completion of mining would consist of removing all structures, pads, temporary diversion structures, and sedimentation ponds; regrading and recontouring all affected areas (except the refuse area) to approximately the original contour; and scarifying these areas. The topsoil would be replaced, fertilized if necessary, and seeded by seed-drilling or broadcasting with an approved seed mixture. All portals would be sealed in accordance with applicable federal and state requirements. The area would be returned to its former use in a manner that is suitable to that use as required by 30(CFR): 700.

Authorizing Actions

This M&R plan was submitted for review after promulgation of interim regulations, 30(CFR): 700, required under Section 502 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), but it does not fully reflect the requirements of the interim regulations. However, in this statement the applicable interim regulations are being included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of the regulations. Before the plan will be considered for approval by the Secretary of the Interior, it will be returned to the mining company for redesign to incorporate the applicable federal regulations.

As soon as the applicant's plan is revised and returned to OSM8, it will be evaluated in conjunction with USGS to determine compliance with the requirements of federal regulations in 30(CFR): 211 and 30(CFR): 700. The M&R plan cannot be ap-

proved until it conforms to all applicable federal requirements.

The regulations contained in 30(CFR): 717 deal specifically with the performance standards required for approval of underground mining such as that proposed in this plan. The standards and measures described in those regulations are considered as required measures and the impacts from the proposed action have been analyzed on that basis.

Federal Agencies

ASSISTANT SECRETARY OF ENERGY AND MINERALS

The Assistant Secretary must approve the mining permit application, including the proposed M&R plan, and significant modifications or amendments to it before the mining company can commence mining operations.

OFFICE OF SURFACE MINING (OSM)

OSM, with concurrence of the surface managing agency (BLM or USFS) and USGS, recommends approval or disapproval of M&R plans to the Assistant Secretary of Energy and Minerals. Whenever a state has entered into a State-Federal Cooperative Agreement with the Secretary of the Interior, pursuant to section 523(c) of SMCRA, the state regulatory authority and OSM will jointly review exploration plans on existing leases and mining and permit applications. Both agencies will recommend approval or disapproval to the officials of the state and the Department of the Interior authorized to take final actions on the permit.

U.S. GEOLOGICAL SURVEY (USGS)

The USGS is responsible for development, production, and coal resources recovery requirements included in the mining permit.

BUREAU OF LAND MANAGEMENT (BLM)

The BLM develops the special requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected public lands. BLM is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on public lands.

U.S. FOREST SERVICE (USFS)

The USFS developes requirements to be included in federal coal leases and reclamation plans related to management and protection of all resources (other than coal) and the post-mining land use of the affected forest lands. The USFS is also responsible for granting various rights-of-way for ancillary facilities, such as access roads, power lines, communication lines, and railroad spurs on forest lands.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

The USFWS is responsible for protection of migratory birds, including eagles, and threatened or endangered species and their habitats. Coordination is required with the USFWS under provisions of the Fish and Wildlife Coordination Act, the Bald Eagle Act, and the Endangered Species Act.

CORPS OF ENGINEERS

The Department of Army Corps of Engineers is responsible for ensuring compliance with Section 404 of the Federal Water Pollution Control Act and Section 10 of the River and Harbor Act of 1899. These regulations are contained in 33(CFR): 209.12 and require issuance of permits for a wide variety of actions relating to crossings of navigable streams and alteration of stream beds.

State Agencies

STATE OF COLORADO

Air quality, solid-waste disposal, and water quality must comply with rules and regulations administered by the various divisions within the Colorado Department of Health. Approval of the M&R plan, permits, and licenses to mine coal must be obtained from the state of Colorado.

County Agencies

Sheridan has obtained the necessary permits from Garfield County for conducting a mining operation. Sheridan will have to obtain necessary authorization from Mesa County for its pumping station on the Colorado River and associated water line to the Loma Project.

Interrelationships

Relationship to Other Developments

At present no other operators mine coal in the immediate area of the Sheridan Enterprises, Inc., federal coal leases. The proposed Loma Project would be the first coal mining operation in the Douglas Pass area. Coal Fuels Corporation currently owns 380 acres of scattered private coal reserves, including the old Farmers Mine site, 12 miles south of the Loma project. In addition, Coal Fuels holds preference right lease applications for lands located adjacent to and north of their private reserves. In 1978 Dorchester Colomine, the assigned operator for Coal Fuels, began development of the Farmers Mine on the private reserves. Production, estimated to begin late 1978 or early 1979, will be approximately 200,000 tons annually from private coal.

The Douglas Pass area contains two known oil and gas containing geologic structures, or producing oil and gas areas: the Coal Gulch and South Canyon fields. (Map 1 in the map packet in volume 3 shows the relationship of these fields to the Loma Project.) In addition, oil and gas exploration work north and west of the leases is ongoing at this time. The area is still given wildcat, or nonproducing, status. Currently there is no direct conflict for land between Sheridan Enterprises and the gas exploration companies. As exploration continues, the area of the leases may be drilled and possible conflicts may arise. Currently the Sheridan Enterprises operation in Spink Canyon uses 8 miles of road built by Petrolewis for access to exploration areas north of the leases.

Colorado Highway 139 (the Douglas Pass Road) bisects the Loma Project leases. Major existing transportation facilities, including the main line of the Denver and Rio Grande Western Railroad (D&RGW), Interstate 70, and U.S. Highways 6 and 50, are 20 miles to the south of the area (see map S1-1).

Institutional Relationships

OFFICE OF SURFACE MINING

OSM, in consultation with Surface Managing Agency (BLM and USFS), USGS, or (where applicable) the state regulatory authority, recommends approval or denial of surface coal mining permit applications to the Assistant Secretary of Energy and Minerals. OSM (as lead agency) is the federal regulatory authority responsible for reviewing coal M&R plans (permit application), enforcement of all environmental protection and reclamation standards included in an approved mining permit, the monitoring of both on- and off-site effects of the mining operation, and abandonment operations within the area of operation of a federal lease.

OSM is the principal contact for all coal mining activities within the area of operation. OSM will conduct as many inspections as are deemed necessary but no less than one partial inspection quarterly and at least one complete inspection every six months (30[CFR]: 721.14[c]).

OSM, after consultation with BLM, USGS, and the operator establishes the boundaries of the permit area for the proposed mine and approves the locations of all the mine facilities located within this boundary.

Section 523 of SMCRA requires the Federal Lands Program to adopt those state performance standards which the Secretary determines are more stringent than the federal standards. The Federal Lands Program means a program established by the Secretary pursuant to Section 523, SMCRA, to regulate surface coal mining and reclamation operations on federal lands. Therefore, the performance standards enforced by OSM on a federal leasehold should be at least as stringent as those required under state law or regulations.

The Department of the Interior is negotiating a cooperative agreement pursuant to Section 523(c) of SMCRA with the state of Colorado and other states. Whenever this agreement is consummated with the state, the OSM's functions and responsibilities specified in this agreement will be delegated to the state regulatory authority. Under this agreement, OSM and the state regulatory authority will jointly review and act on mining permit applications and recommend approval or disapproval to the officials authorized to take final action on the application. The Secretary is prohibited by law from delegating his authority to approve mining plans on federal lands.

U.S. GEOLOGICAL SURVEY

The USGS is responsible for reviewing M&R plans for development, production, and coal resource recovery requirements on a federal leasehold. USGS is responsible for the maximum economic recovery of the federal coal resource and for the federal government receiving fair market value for the federal coal resource.

BUREAU OF LAND MANAGEMENT

The BLM formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of public lands.

The BLM, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, and railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The BLM is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on public lands within a leasehold.

U.S. FOREST SERVICE

The USFS formulates special requirements to be included in a lease or mining permit application related to the management and protection of all resources (other than coal) and the post-mining land use of national forest systems land.

The USFS, after consultation with USGS and OSM, is responsible for the authorization of various ancillary facilities such as access roads, power lines, communication lines, railroad spurs proposed by a mining company on federal lands outside of the permit area. Rights-of-way can only be granted pursuant to Title V of the Federal Land Policy and Management Act of 1976 (PL 579, 90 Stat. 2743). The rights-of-way would be approved after consultation with OSM and USGS subject to standard requirements for duration of the grant, rights-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants. The terms and conditions applicable to the rights-of-way are determined by 43(CFR): 2800, the Land Use Plan, and by an on-the-ground evaluation.

The USFS is the lead agency, in coordination with USGS and OSM, for all proposed uses other than coal mining on forest lands within a leasehold.

Relationship to BLM Land Use Plans

The 14,928 acres of public lands included in the M&R plan are administered by the BLM's Grand Junction District. They are subject to the following general management guidelines developed in the Baxter-Douglas-Glade Park management framework plan (MFP), completed in January 1970, and the Whitewater Coal Update MFP, completed in September 1977:

1. Manage the planning unit for multiple resource activities.
2. Lands
   a. Establish corridors for major rights-of-way actions.
   b. Encourage exchanges to block public land to improve management and access where needed.
   c. Identify and eliminate land use trespass.
   d. Identify and mark public lands' boundaries.
   e. Add roads to road system if needed for public values to allow for development and management of the unit resources and for public use and enjoyment. New road locations and construction standards will be prescribed by BLM.
   f. Seasonal road closures may be necessary to protect resource values.
3. Minerals
   a. Identify and eliminate mineral trespass.
   b. Identify hazards to humans and wildlife on public lands caused by mineral activity.
4. Timber
   a. Allow harvest of timber products where conflicts have been resolved with other resources.
   b. Manage resource to maintain productivity and a variety of successional types.
5. Range
   a. Continue grazing use at a level consistent with available forage and other resource values.
   b. Develop and implement allotment management plans (AMPs) on all areas having significant livestock use.
   c. Initiate intensive grazing management through AMPs on Big Salt and Garr Mesa allotments.
6. Watershed
   a. Apply soil and watershed conservation measures to all activities as necessary to minimize soil erosion and maintain water quality.
   b. Locate all new roads to avoid critical soil problem areas and facilitate multiple use management objectives.
   c. Require coal-lease holders to install and maintain a water-monitoring network within their lease area; an adequate water-monitoring network should be addressed prior to approval of any mining or exploration plan as appropriate.
7. Wildlife
   a. Give special attention to management of big game winter range.
   b. Adjust management activities along Highway 139 to maintain visual quality of the landscape.
   c. Seek retention of landscape character.
   d. Identify and protect cultural resources to avoid loss or destruction of any sites; conduct a Class II Cultural Resources Inventory of all unsurveyed public land that would be impacted by coal development.

General resource objectives for the planning unit are as follows:

1. Write management plans for all resource activities occurring on public land.
2. Develop AMP with good grazing systems on all public lands suitable for grazing.
3. Set up wood harvesting areas.
4. Provide access where needed to fit long-term objectives.
5. Provide fire protection for all facilities on public lands.
6. Initiate land trades to meet BLM needs.
7. Manage minerals to meet energy needs and requirements of nonfuel minerals.

8. Stabilize watershed and maximize useable vegetative production.

9. Multiple-use management is overall objective with primary uses identified to specific lands or areas.

In addition, Sheridan's proposal to construct a rail-and-utility corridor from Mack would disturb public lands that are not leased to the company, as well as private lands. So far, Sheridan has not applied to BLM for a right-of-way.

Relationship to State and Local Planning

For a discussion of state of Colorado and Garfield and Mesa county land-use planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

The description of the existing environment covers the physical, biological, and cultural resources and the socioeconomic conditions which constitute the site-specific environment in which Sheridan Enterprises, Inc., proposes to develop federal coal. The description focuses on environmental details most likely to be affected by Sheridan's proposed M&R plan and alternatives. The concluding section of this chapter describes the anticipated future environment through 1990 if the proposed M&R plan is not approved and implemented.

EXISTING ENVIRONMENT

Climate

The climate of west-central Colorado is characterized by dry air masses, which are modified Pacific air masses that move eastward across the Rocky Mountains. Winter snows and summer showers or thunderstorms result in unusually even distribution of precipitation throughout the year. Prevailing winds vary greatly throughout the Upper Colorado River Basin, and are markedly affected by differences in elevation and by the orientation of mountain ranges and valleys with respect to general air movements.

Five years of upper air observations at Grand Junction show that surface based inversions occur on 84 percent of the mornings. During the afternoons they are not as common, occurring 11 percent of the time in winter but less than 3 percent of the time in other seasons. The area is subject to a relatively high frequency of stagnation situations, mostly in winter.

The proposed Loma site is located north of the Grand Valley about 20 miles north-northwest of the town of Fruita, Colorado. Mine portals are situated up short canyons off the East Salt Creek Canyon, which traverses the site in a north-northeast/south-southwest direction.

A meteorological station has been set up at the confluence of East Salt Creek and Spink Canyons. However, it has not been in operation long enough to provide adequate data. National Weather Service Records at Fruita indicate an annual average precipitation of 8.8 inches. Vegetation on the tract suggests an annual precipitation of approximately 11 inches at the bottom of East Salt Creek Valley and perhaps 15 inches on the higher ridges above 7,000 feet. Evaporation is estimated to be about 45 inches annually.

In the absence of on-site wind measurements, it has been assumed that prevailing wind direction is along the major canyon or from the north-northeast. The wind rose from Grand Junction weather station has been rotated to reflect the major canyon axis, as shown in figure S2-1. Average wind speed at the Grand Junction station is 8.1 mph.

Air Quality

Particulate air quality in the study area ranges from 20 to 132 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean as recorded at sixteen state, municipal, and privately operated particulate sampling sites. In undeveloped sections, particulate concentrations range from 20 to 40 $\mu g/m^3$.

A detailed air quality analysis determined that particulate concentrations in the Grand Valley in areas away from any sources were approximately 40 $\mu g/m^3$ annual geometric mean (PEDCo 1977). The calculated first and second maximum 24-hour concentrations were 130 and 112 $\mu g/m^3$, respectively.

There has been no measurement of carbon monoxide, hydrocarbon, nitrogen oxides, sulfur dioxide, or other gaseous pollutant concentrations in the vicinity of the proposed mine. Motor vehicle emissions along state highway 139 which crosses the mine site would probably raise concentrations of carbon monoxide, hydrocarbon, and nitrogen oxides slightly above background or natural levels.

Visibility at the site ranges from less than 1 mile to approximately 100 miles throughout the year. Average visibility is about 54 miles with greatest visibility occurring during spring and summer months.

Geologic and Geographic Setting

Topography

The federal coal leases controlled by Sheridan Enterprises lie along the Little Bookcliffs escarpment overlooking the Grand Valley to the south.

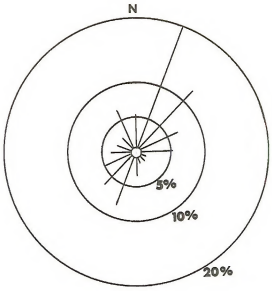


Figure S2-1. Annual wind frequency at the Loma mine site.

The topography of the lease area is extremely rugged (see map S1-1). The major drainage, East Salt Creek, bisects the northern portion of the lease area, and with its tributaries divides the lease area into a series of sharp ridges and deeply-cut canyons. The creek flows 20 miles southwest to the Colorado River.

Elevation on the lease area ranges from a minimum of 5,364 feet along the bottom of East Salt Creek to a maximum of 7,380 feet along the eastern boundary of the lease area. The elevation in the area rises sharply to the north-northeast due to the Little Bookcliffs escarpment. Slopes range from a minimum of 1 percent along East Salt Creek Valley to almost vertical along sections of the Little Bookcliffs. The average slope on the lease area is about 40 percent.

Landforms

In the lease area, landforms are rugged due to the differential erosion of massive resistant sandstones. Valleys are V-shaped and narrow; ridges are sharp. In addition, ribs, spurs, reentrants, and box canyons occur frequently through the area.

Structure

Strata in the lease area dip in a northeasterly direction in the range of 1 to 3 degrees with a north-northwest strike. Sheridan Enterprises reports the presence of two faults in the area which are not noted elsewhere. The first is a north trending fault which runs along the east side of East Salt Creek. The second fault parallels Spink Canyon and is located along the south canyon slope. It extends east and across the Douglas Pass Road.

Stratigraphy

Stratigraphic formations present on the lease area include the late Cretaceous Mancos Shale and Mesaverde Group as well as the Tertiary Ohio Creek, Wasatch, and Green River formations. Quaternary and recent surficial deposits are also present.

The principal coal beds through the general area and on the federal leases occur in the lower part of the Mount Garfield Formation of the Mesaverde Group and possibly in the Anchor Mine Tongue of the Mancos Shale. At present, there is no evidence that the Anchor Mine Tongue underlies the lease area.

The Mount Garfield Formation contains four coal seams (figure S2-2). In ascending order, they are the Palisade, the Cameo, the Carbonera, and a seam which Sheridan calls the "Loma seam" for identification purposes. The Palisade coal seam lies just above the Sego Sandstone, the bottom member of the Mount Garfield Formation. The Palisade consists of a series of three or four normally thin overlapping lenses in a thick carbonaceous shale sequence. The seam thickness varies from 3.2 to 7 feet, contains numerous partings, and splits into two benches.

The Cameo coal seam, in which the proposed Loma Project would operate, lies about 350 feet above the top of the Sego Sandstone. In the leased area, the Cameo seam is reported to be the only persistent seam of mineable thickness. Seam thickness varies from 7 feet in the northern part of the lease area to a maximum of over 23 feet on the southern edge. An estimated 100 million tons of recoverable reserves lie on the 14,929 acre lease area.

The coals of the Carbonera seam are the highest of the Mount Garfield Formation and the highest of the Little Bookcliffs. The Carbonera lies approximately 460 feet above the top of the Sego Sandstone and from 60 to 100 feet above the Cameo coal seam. The Carbonera seam contains a number of individual beds (usually from one to three) of limited areal extent, which are characteristically lenticular, overlapping, and of erratic quality.

From drill hole exploration, Sheridan Enterprises has determined that most of the economic coals in the project area are in the Cameo seam. The Loma seam, however, appears to be of economic importance in the extreme northeastern portion of the lease area.

These four coal seams lie in the lower section of the Mount Garfield Formation. Although the upper portion of the Mount Garfield is lithologically similar to the lower portion, it is barren of coal. Both the upper and lower portions of the Mount Garfield contain sandstones, siltstones, shales, and carbonaceous shales. The Hunter Canyon Formation, which consists of massive brown-buff and gray sandstones and gray shale, conformably overlies the Mount Garfield Formation. The Hunter Canyon is the highest formation of the Mesaverde Group.

Above the Mesaverde Group, the Tertiary (Eocene) Series begins. At the base lies the Ohio Creek Formation, which is a conglomeratic sandstone. Above the Ohio Creek lie the sandstones, siltstones, and shales of the Wasatch Formation. Above the Wasatch lies the Douglas Creek Member of the Green River Formation which consists of sandstones, siltstones, limestones, and shales. The Douglas Creek caps the highest ridges and peaks on the lease area. The Mahogany oil shale bed lies in Parachute Creek Member of the Green River Formation, overlying the Douglas Creek Member. The Mahogany bed is absent throughout the lease area.

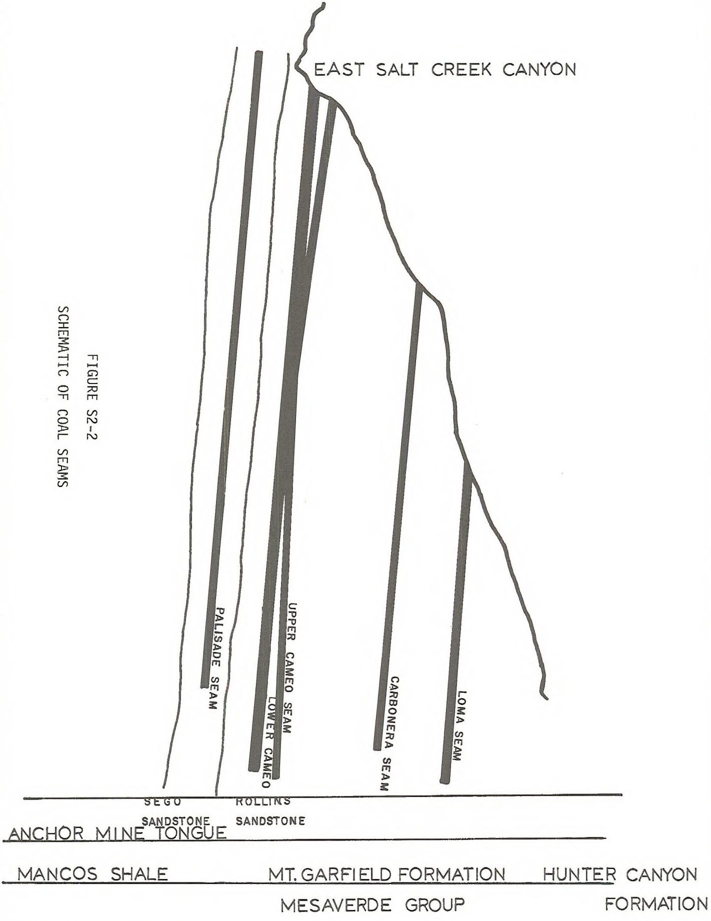


FIGURE S2-2
SCHEMATIC OF COAL SEAMS

Paleontology

The principal fossil-bearing formations in the lease area, ages, number of known fossil localities, and general fossil types normally found in the formations are summarized in table S2-1. Due to the present lack of data and accepted criteria for determining significance, the importance of these paleontological resources to science, education, and other values cannot presently be assessed.

Mineral Resources

Coal

Sheridan Enterprises proposes to mine the Palisade, Cameo, Carbonera, and Loma (designated as such by the company) seams (see map S1-2 in chapter 1). The in-place reserves are approximately 250 million tons of coal with approximately 100 million tons of coal recoverable. Coal quality ranges are as follows: 10,500 to 11,000 BTUs, 12 to 16 percent ash, 7 to 8 percent moisture, 0.5 percent sulphur, 32 to 33 percent volatile matter, and 43 to 45 percent carbon content.

Oil and Gas

Except for the large coal reserves, oil and gas are the only potential mineral resources in the area of the proposed Loma Project. The Garmesa gas field, approximately 2 miles southwest of the project area, is producing gas and is also used for gas storage. There are also four producing gas wells approximately 4 miles west and five approximately 5 miles north of the project area. All of the wells are producing gas from either the Dakota Sandstone, Morrison Formation, or Entrada Sandstone. A number of plugged and abandoned gas wells are approximately 2 miles west of the project area; they were used for testing the above producing formations.

There is a slight potential for gas production in the project area from the Dakota Sandstone, Morrison Formation, and Entrada Sandstone. There is only a possibility for oil production in the project area from the Dakota Sandstone.

Water Resources

Hydrologic Setting

The proposed mine area lies north of Grand Valley in the rugged terrain drained by East Salt Creek and its deeply incised tributaries. East Salt Creek is a perennial stream that flows generally southwestward through the lease area to the Colorado River, a distance of about 20 miles. All tributaries of East Salt Creek traversing the lease area are ephemeral, flowing less than one month of each calendar year and only in direct response to precipitation.

Strata underlying the lease area strike north-northwestward and dip 1 to 3 degrees northeastward upvalley in the opposite direction to stream-flow. Thus, the Cameo coal seam, which would be mined under the proposed action, is exposed in the precipitous slopes bordering East Salt Creek and its tributaries in all but the northeastern part of the lease area upstream from the mouth of Spink Canyon. There, the Cameo bed dips below the floor of East Salt Creek Valley and reaches a depth of about 300 feet below the level of the valley floor at the northeast corner of the tract. The Loma coal seam occurs above the level of East Salt Creek in the lease area.

Salt Creek locally represents the base level of saturation below which all permeable rocks are water-bearing. Both ground-water and surface-water drainage within the lease area are toward East Salt Creek. Permeable beds above stream level tend to be drained; permeable beds below stream level should be water bearing. Thus, the Cameo coal seam is inferred to be saturated in the northeastern part of the tract where it dips below the level of East Salt Creek.

No precipitation data are available for the lease area, which is about 20 miles north-northwest of Fruita, Colorado, where National Weather Service records show an average annual precipitation of 8.8 inches. Vegetation on the tract indicates an annual precipitation of about 11 inches at the bottom of East Salt Creek Valley and possibly 15 inches on the higher ridges above 7,000 feet.

Ground Water

The occurrence of ground water in the lease area is controlled largely by the local combination of topography, stratigraphy, and geologic structure. Ground-water recharge on the tract initially accumulates in those permeable materials that underlie the surface at shallow depth. Movement is then downward to the first relatively impermeable bed, which acts as a "perching" layer. This perched water then tends to migrate downdip northeastward and also laterally toward discharge areas along the valley side slopes where the beds intersect the surface. All seepage in the lease area apparently is dissipated by evapotranspiration since no springs are known to occur on the tract. A comparatively small amount of ground water percolates downward through the perching layers, probably through small joints and fractures, to recharge underlying beds such as the Loma and Cameo coal seams, which Sheridan Enterprises proposes to mine. These deeper beds also tend to drain downdip and discharge to East Salt Creek at their lowest point of outcrop.

Sheridan Enterprises has completed six monitoring wells in the alluvium underlying East Salt

TABLE S2-1

SUMMARY OF FOSSIL-BEARING FORMATIONS IN THE AREA OF THE PROPOSED SHERIDAN MINE

Formation	Period	Known Fossil Localities a/	Type of Fossils b/
Mancos shale	Upper Cretaceous	General	V, I
Mt. Garfield	Upper Cretaceous	General	V, I, P
Hunter Canyon	Upper Cretaceous	General	V, I, P
Ohio Creek and Wasatch	Tertiary	General	V, I, P
Green River	Tertiary	General	V, I, P

a/ General = formation contains fossils throughout; specific localities are not identified.

b/ I = invertebrate; V = vertebrate; P = paleobotanical

Creek Valley. No monitoring wells have been completed in the bedrock formations, and no data on the occurrence of ground water in the bedrock have been furnished to the ES team other than the observation that current exploration activities have encountered very little water in the Cameo coal seam. Field observations by the ES team in October 1978 confirmed that the Cameo bed appears to be largely drained. A small pool of water near the working face in test entry No. 1 in McClane Canyon had a specific conductance of 2,850 micromhos per centimeter (approximately 2,000 milligrams per liter [mg/l] dissolved-solids). Inflow was less than 1 gallon per minute (gpm). On that basis, it appears that the Cameo seam and encompassing rocks should be largely drained in all but the extreme northeastern corner of the lease area where these beds extend below the level of East Salt Creek. Where saturated, the Cameo seam can be expected to yield water to a mine. Coal beds, however, are typically regarded as only fair aquifers at best in this general area. If inflow to mines from coal beds penetrated at shallow depth elsewhere in western Colorado is indicative, the sustained yield from coal beds mined anywhere on the lease area probably would not greatly exceed 10 gpm. The water thus obtained would probably be a sodium, sulfate, bicarbonate type containing 2,000 to 3,000 mg/l dissolved solids.

Of the six monitoring wells in the alluvium adjacent to East Salt Creek, three were dry on December 30, 1977. Water samples collected by Sheridan Enterprises from the three wells containing water were analyzed by Grand Junction Laboratories. Results show that ground water in the alluvium is a sodium sulfate type containing 4,000 to 6,000 mg/l dissolved solids. These limited data suggest an increase in both dissolved-solids concentration and sodium sulfate in the downstream direction. If so, ground water discharging to East Salt Creek within the lease area is of extremely poor quality and is dominantly a sodium sulfate type. Since water discharging from coal beds in this area is expected to be a sodium, sulfate, bicarbonate type and should not contain in excess of 3,000 mg/l, the primary source of ground-water discharge to East Salt Creek appears to be from interbedded sandstone and shale aquifers rather than from coal.

The quantity of water flowing in the alluvial aquifer underlying East Salt Creek is not known. However, a rough approximation is possible. Sheridan's monitoring wells indicate a hydraulic gradient of about 80 feet per mile. Assuming the transmissivity of the saturated thickness of alluvium to be about 1,000 square feet per day and the average aquifer width to be about 500 feet, ground-water discharge should be about 40 gpm (64 acre-feet per year [ac-ft/yr]).

Surface Water

East Salt Creek heads on the Roan Cliffs in the area southeast of Douglas Pass and drains southwestward about 28 miles, entering West Salt Creek about a mile upstream from its confluence with the Colorado River. A stream gaging and water-quality sampling station (No. 09163310) operated by the U.S. Geological Survey, Water Resources Division, on East Salt Creek about 5 miles upstream from its mouth shows perennial flow ranging from 0.08 cubic foot per second (cfs) minimum daily discharge on March 30, 1975, to a maximum discharge of 2,630 cfs on July 18, 1974. Drainage area at the station is 197 square miles. Although records are of insufficient length to determine average flow conditions, total runoff in the 1976 water year was 1,320 acre-feet with a mean discharge of 1.82 cfs.

Water quality in East Salt Creek ranges widely, but again the record is too short to permit computation of meaningful averages. Maximum specific conductance, which provides a measure of dissolved-solids concentration, was 13,500 micromhos per centimeter (micromhos/cm) on April 26, 1974. A minimum value of 779 micromhos/cm occurred on May 21, 1975. These extremes represent dissolved-solids concentrations of about 10,000 and 600 mg/l, respectively. Water containing 10,000 mg/l dissolved solids is too saline for virtually all uses, especially when the dominant anion is sulfate. Analyses for the 1976 water year show that dissolved-solids concentrations ranged from a low of 1,740 mg/l in February during a period of rapid snowmelt runoff to a high of 5,610 mg/l in January during low flow of 0.28 cfs. During winter months the water is typically a sodium, calcium, magnesium, sulfate type. With increased runoff in the spring, magnesium concentrations increase at the expense of calcium and the water changes slightly to a sodium, magnesium, calcium, sulfate type. During the summer and fall, calcium concentrations increase notably and the water changes to a calcium, sodium, magnesium, sulfate type. Most importantly, the dominant cation remains sulfate year round, and the name East Salt Creek appropriately describes the high salinity of the stream.

Comparatively little data are available for East Salt Creek on the lease area. The stream flows in a channel incised 15 to 20 feet below the level of the old valley floor, evidencing a recent period of active valley trenching followed by channel widening from processes of bank cutting and meandering. The present channel has an average gradient through the lease area of about 1.07 percent (0.61 degree).

So far as can be determined, no recording surface-water monitoring stations have been established by Sheridan Enterprises in conjunction with

their proposed mining operations, although the proposed M&R plan states that baseline monitoring of both surface and subsurface waters is underway. Similarly, no random discharge measurements have been reported on East Salt Creek or any of its tributaries. Company personnel, however, do report that the stream was dry during the summer of 1977. Two water samples were collected from East Salt Creek by Sheridan in 1977, one at the mouth of Spink Canyon on January 27, 1977, and one at the mouth of McClane Canyon on May 7, 1977. The first sample had a dissolved-solids concentration of 4,260 mg/l and was a magnesium, sodium, calcium, sulfate type. The second sample contained 3,107 mg/l dissolved solids and was a sodium sulfate type similar to ground water in the underlying alluvial aquifer.

All tributaries of East Salt Creek traversing the lease area are ephemeral, flowing less than one month of each calendar year, usually in response to rapid snowmelt or high-intensity summer storms. Channel gradients are characteristically steep, averaging more than 2 percent (1.15 degrees) in their lower reaches and more than 30 percent (18 degrees) in their headwater areas. No discharge or water-quality data are available for any of these tributary streams.

Flood Hazard

Because of the steep valley side slopes, high channel gradients, fine-grained soils, and minimal plant cover, runoff in East Salt Creek and its ephemeral tributaries is generally rapid, generating flood flows characterized by high peak discharges of short duration. Estimated peak discharges for floods having recurrence intervals of 10 years, 25 years, 50 years, and 100 years at selected locations in the lease area are shown in table S2-2.

The principal hazard of flooding in and adjacent to the lease area is to the stream crossings on the access roads to portals No. 1 and 2 in McClane and Munger canyons. These crossings would probably be washed away in a 10-year or larger flood event. The deeply incised channel of East Salt Creek should carry at least a 50-year flood without submerging Colorado Highway 139. No serious flood hazard exists to portals No. 1 and No. 2.

Erosion and Sedimentation

No sediment sampling data are available for any flows in the lease area. The tract obviously is actively eroding, however, and contributing large volumes of sediment to East Salt Creek. Measured sediment yields from small watersheds with similar runoff characteristics in Badger Wash near Fruita about 15 miles southwest of the lease area (Lusby 1978) show an average annual rate for the period 1953-73 of 1.80 acre-feet per square mile (ac-ft/sq-mi) or approximately 4.3 tons per acre per year (tons/acre/yr). Because of the steep slopes in the lease area, rates of sediment yield from the tract could exceed those reported for Badger Wash. More probably, however, annual sediment yield from the tract will not greatly exceed 1 ac-ft/sq mi (2.4 tons per acre) because unit sediment yield normally decreases with increasing size of a watershed (Hadley and Schumm 1961), and the lease area is much larger than the study basins in Badger Wash.

Alluvial Valley Floors

The old valley floor bordering the incised channel of East Salt Creek is very probably an alluvial valley floor as defined in 30(CFR): 710.5, although some question may exist as to the suitability of both the surface- and ground-water resources in the lease area for sustained agricultural activities. Sheridan Enterprises states in its M&R plan that hay meadows developed for alfalfa production occur just south of the lease area, but no such fields occur within the lease area. The Land Use Map (Soil Conservation Service 1973) for Garfield County, however, shows irrigated hay meadows on the valley floor within the lease area. Past agricultural activities at the mouth of Spink Canyon are also clearly shown on figure S1-2 (chapter 1).

Soils

Soils in the areas of proposed surface disturbance are delineated in figure S2-3. In general, the area consists of shallow, poorly developed soils and rock outcrops on the steep lands bordering East Salt Creek and various side drainages. The flatter-lying soils in the drainage bottoms range from very gravelly or sandy components to much finer textured soils with excessive amounts of soluble salts. Specific soil features of importance in assessing reclamation are rated in table S2-3; brief explanations of each rating are contained in footnotes.

Vegetation

There is a mosaic of six vegetation types on the coal lease area: saltbush, pinyon-juniper, mountain shrub, greasewood, sagebrush, and riparian. Their distribution is largely determined by annual precipitation and the moisture content of the soil, which in turn are affected by other environmental factors, such as exposure and the nature of the substrate. (Map S2-1 shows the vegetation types in the lease tract.)

The saltbush type occurs at the south end of the lease tract, on dry, steep slopes that have a southern exposure. Pinyon-juniper is found on north slopes in this same area. It also occurs farther north, where it begins to appear on both north- and south-facing slopes. Mountain shrub replaces

TABLE S2-2

ESTIMATED PEAK DISCHARGES IN STREAMS
TRAVERSING THE LOMA PROJECT

Watershed	Drainage Area (sq.mi.)	Discharge in Cubic Feet per Second for the Indicated Recurrence Intervals 1/			
		10-Year	25-Year	50-Year	100-Year
East Salt Creek at USGS gaging station	197	5,900	8,200	11,400	13,700
East Salt Creek at mouth of Spink Canyon	100	4,100	6,100	8,300	9,800
Spink Canyon at mouth	14	630	1,000	1,400	1,700
Munger Creek at mouth	7.5	350	600	820	980
Unnamed tributary of Munger Creek at Portal No. 2	1.1	71	100	160	200
Unnamed drainage in which waste materials would be disposed	2.0	120	180	250	300

1/ Computed using the method described by the U.S. Department of Agriculture (1972).

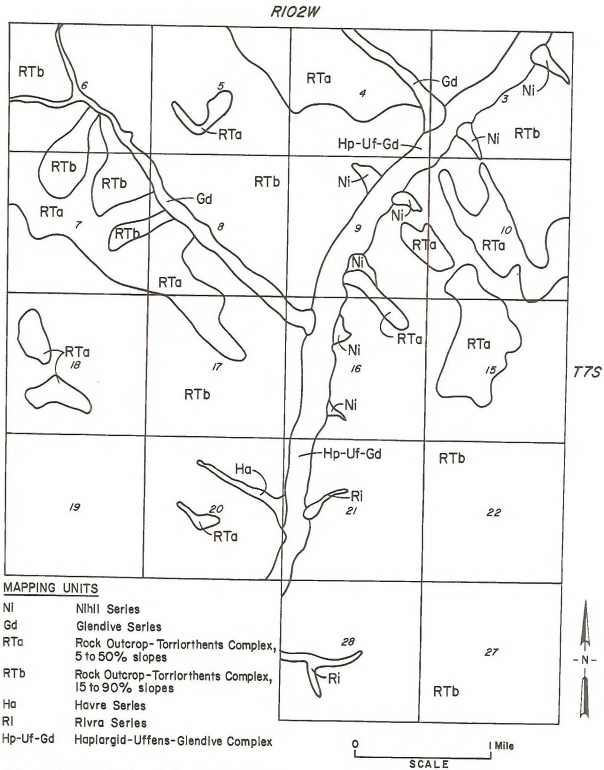


Figure S2-3. Soil units in area of the proposed Loma project

TABLE S2-3

SOIL FEATURES FOR SHERIDAN MINING AREA

Mapping Unit Symbol	Mapping Unit Name	Hydrologic Group a/	Erosion Hazard b/	Topsoil Rating c/	Reclamation Limitations d/
Gd	Glendive	B	Slight-moderate	Fair	Moderate
Ha	Havre	B	Moderate	Fair	Moderate
Hp-Uf-Gd	Haplargid-Uffens-Glendive Complex				
	Haplargid	C	Slight-Moderate	Fair	Moderate
	Uffens	D	Slight-Moderate	Poor	Severe
	Glendive	B	Slight-Moderate	Fair	Moderate
Ni	Nihill	B	Slight-Moderate	Poor	Severe
Ri	Rivra	A	Slight	Poor	Severe
RTa	Rock Outcrop-Torriorthents Complex 5-50% slopes	-	High	Poor	Severe
RTb	Rock Outcrop-Torriorthents Complex 15-90% slopes	-	High	Poor	Severe

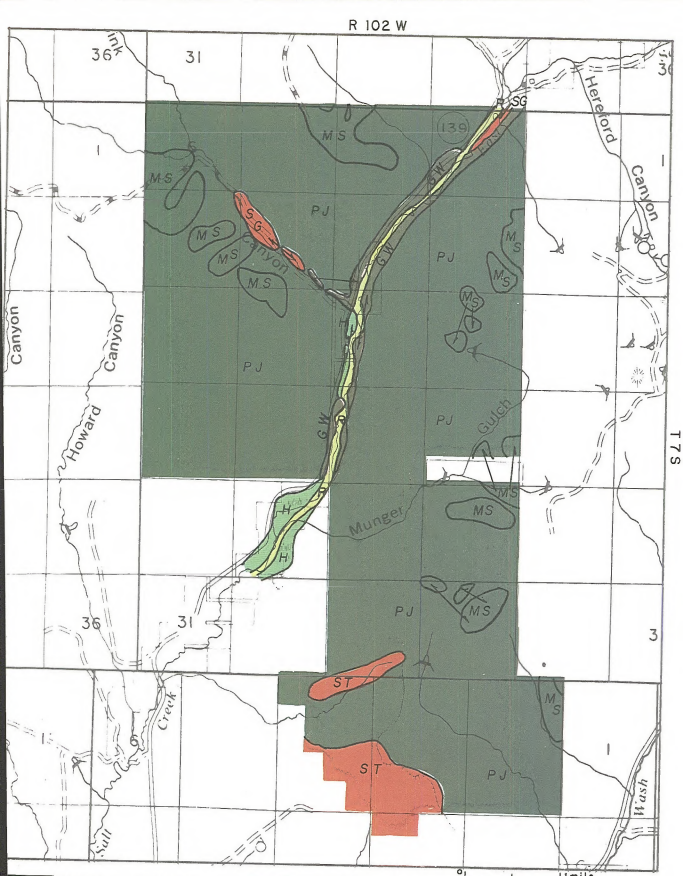
Source: Adapted from data provided by U.S. Department of Agriculture, Soil Conservation Service, Grand Junction, Colorado.

a/ Hydrologic soil groups (A, B, C, D) are based on the rate at which water enters the soil surface (infiltration) and the rate at which water moves within the soil (transmission). When both infiltration and transmission rates are high, little surface runoff occurs (Hydrologic Soil Group A). In contrast, low infiltration and transmission rates produce high surface runoff (Hydrologic Soil Group D). Groups B and C are intermediate.

b/ Erosion hazard refers to the potential for surface soil loss when existing cover is removed or seriously disturbed.

c/ Topsoil is rated both on suitability as a seedbed material and on ability to sustain plant growth. Factors considered include soil depth, texture, amount of coarse fragments, and the presence of excess soluble salts which may inhibit plant growth.

d/ Hydrologic soil groups, erosion hazard, and topsoil rating, along with climatic information, are considered jointly to determine an overall rating of the limitations for reclamation. Specific degrees of limitation are interpreted as follows: Slight - indicates either no significant limitations or those limitations which can be remedied through planning and management choices, such as species selection, time of seeding, or short-term exclusion of livestock and certain forms of wildlife. Moderate - indicates significant limitations which must be recognized but which generally can be overcome through established measures to conserve natural moisture, reduce erosion, and augment available nutrient supplies. Severe - indicates serious deficiencies in natural moisture and in the amount and quality of topsoil; may also indicate topographic conditions which produce extreme surface erosion or landslide hazards.



PJ PINYON-JUNIPER
ST SALTBUSH/BARREN
H IRRIGATED HAYLAND
MS MOUNTAIN SHRUB
SG SAGEBRUSH
GW GREASEWOOD
R RIPARIAN

Map S2-1. Vegetative types in the area of the proposed Loma project

pinyon-juniper in the north end of the lease tract. It is first evident only on the north slopes; then at higher elevations it also is found on southern exposures. This gradual transition of vegetation types results from increasing soil moisture content in the lease area from south to north and from lower to higher elevations. Vegetation types with low moisture requirements are replaced by types with higher moisture requirements.

The greasewood type is very limited in the coal lease area, occurring discontinuously along Salt and Spink creeks. Sagebrush also is found in the valleys of Salt and Spink creeks and on level mesas; both areas have deep, well-developed soils. The sagebrush and greasewood have been cleared on approximately 50 acres along Salt Creek and the lower part of Spink Creek. On Salt Creek, the land is now irrigated farmland; in Spink Canyon, the land is covered with annual weeds and grasses. Riparian vegetation along Salt Creek consists mainly of cottonwoods, running for the entire length of the lease tract. Little aquatic vegetation occurs in the lease area because of poor water quality.

The land south of the lease area, between the Loma site and the town of Loma, consists of saltbush or greasewood where it is publicly owned, and of agricultural land where it is privately owned.

A more detailed discussion of the plant species composition of these vegetation types, as well as their relationship to climatic and topographic features and to each other can be found in the regional analysis. Scientific names of the plants discussed above are listed in the appendix, volume 3.

Endangered or Threatened Species

Information on the location of plants within the region that are proposed to be officially listed as endangered or threatened in the *Federal Register* (see the regional chapter 2, Vegetation, for a list of the plants) was obtained from detailed literature searches (Rollins 1941; Barneby 1964; Higgins 1971; Hitchcock 1950; Arp 1972, 1973; Reveal 1969; Keck 1937; Howell 1944; Benson 1961, 1962, 1966; Weber 1961) and extensive herbarium surveys (University of Colorado, Colorado State University, Colorado College, Denver Botanic Gardens, Western State College, Rocky Mountain Biological Lab, Black Canyon National Monument, Colorado National Monument, and Grand Mesa/Uncompahgre National Forest Headquarters). This research has revealed that none of the plants are known to have occurred historically in the area of the Loma Project. The results of the literature and herbarium studies may be reviewed at the BLM's Montrose District Office. A detailed floristic and endangered and threatened plant inventory of the natural vegetation that is expected to be disturbed by the Loma Project facilities and portals has revealed that no endangered or threatened plants are present. The results of this inventory are available for public review at the Grand Junction District Office.

Cryptantha elata, a proposed threatened plant in the *Federal Register* was found in 1978 in the Mancos shale north of Loma (Wm. Weber collection). This plant could occur in the area of Sheridan's proposed railroad and water line right-of-way. *Cryptantha elata* is apparently restricted in range to dry saltbush covered hills of the Mancos shale formations in Mesa County, Colorado, and adjacent Grand County, Utah.

Wildlife

A listing of terrestrial species known or expected to occur on the East Salt Creek drainage and on the desert and farmland to the south is available at the Montrose BLM District Office.

Big Game

MULE DEER

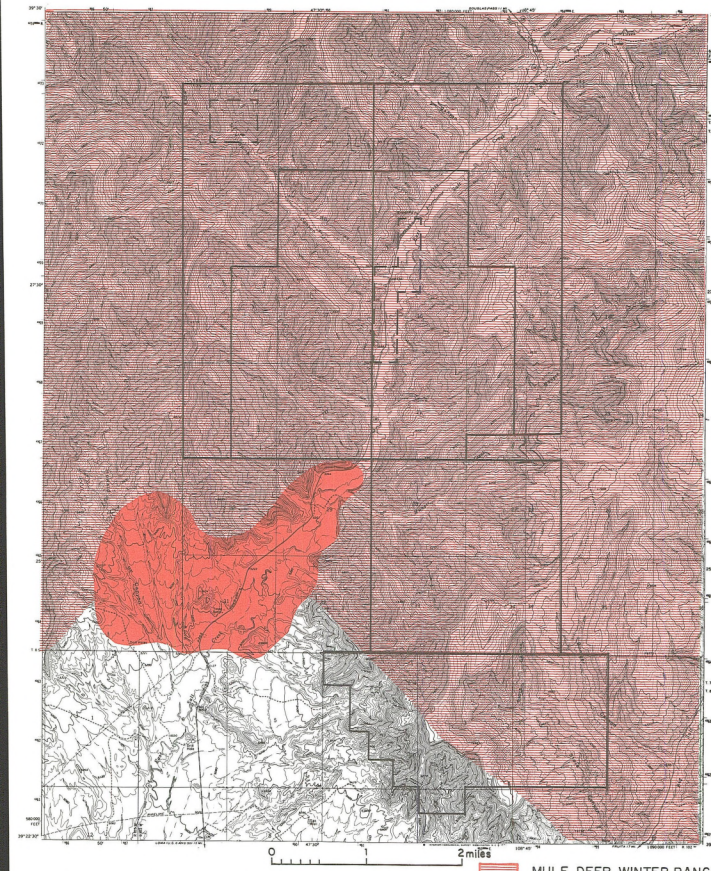
The entire Sheridan lease area is mule deer winter range. Deer summer in the Douglas Pass area to the north, migrate during November and December in a southerly direction to lower elevations, and remain there through the winter months. Lower limits of the winter range extend to the base of the Little Bookcliffs and include the lower end of East Salt Creek, Howard Canyon, and East Branch (map S2-2), which is an area where deer concentrate. Major habitats utilized by deer are pinyon-juniper types on canyon sides and sagebrush and greasewood types in the drainage bottoms. Pellet group transects indicate an average of 42 deer days of use per acre in the area near the lease tracts.

The irrigated alfalfa fields are also important to deer in this area. Deer use them most heavily in the early spring when the fields are just beginning to green up, although a few deer occur around the fields yearlong.

Populations may fluctuate greatly from year to year as well as seasonally within the year, and population estimates are based on average numbers. Mule deer winter populations have been estimated at about 50 deer per square mile. This would indicate a total deer population within the Sheridan lease area of about 700 animals during the winter months. In recent years, deer populations have been stable but greatly reduced from the 1960s.

ANTELOPE

In the early 1960s, the Colorado Division of Wildlife (DOW) released 50 antelope in the desert



Map S2-2. wildlife ranges in the area of the proposed Loma project: mule deer

country north of the Highline Canal. In recent years, the population has been stable; present population is estimated at 35 to 50 animals. Current distribution is shown on map S2-3.

ELK

In recent years, several small groups of elk have spent the winter in the upper reaches of East Salt Creek. Occurrence of elk in this area is sporadic, and the number of animals is very small.

MOUNTAIN LION

The Little Bookcliffs support one of the highest populations of mountain lion in western Colorado. The DOW estimates that Game Management Unit 30 (see Recreation) supports a population of approximately 40 lions. Occupied habitat (shown on map S2-3) corresponds to mule deer habitat, and seasonal movements of mule deer influence lion distribution. The coniferous and riparian vegetation, mule deer populations, and rough broken topography provide the essential habitat components of cover, food, and isolated living space preferred by mountain lions.

BLACK BEAR

Black bear are found above 7,000 feet in the riparian, aspen, and coniferous types. During the spring and fall, black bear occasionally venture into the pinyon-juniper habitat type below 7,000 feet in search of food. The upper (northern) portions of Sheridan's lease is occupied black bear habitat (map S2-3).

Small Mammals

Mammal species present are typical of the saltbush, sagebrush, mountain shrub, and pinyon-juniper habitat types in western Colorado. Species common within the Little Bookcliffs include cottontail rabbit, rock squirrel, deer mouse, white-tailed antelope squirrel, coyote, and bobcat. On the desert between the Little Bookcliffs and the Highline Canal, white-tailed prairie dog colonies are common. Locations of towns and numbers of burrows can be found in prairie dog inventories on file in the Grand Junction District Office of the BLM.

Game Birds

Mourning doves are the most common game birds occurring throughout the Little Bookcliffs area. Doves arrive in the spring, nest through the summer months, and begin migrating to the south by late August.

Chukar, a species introduced in the 1950s, has become established throughout the lower canyons and rocky slopes of the Little Bookcliffs. During the summer, birds are concentrated within 1 or 2 miles of areas with available water; at other times of the year, the birds are widely dispersed.

Blue grouse are found at higher elevations in the Little Bookcliffs. They utilize mountain shrub, aspen, and spruce-fir habitat types. Within the agricultural areas, pheasant and gambel quail have been introduced.

Waterfowl utilize the Colorado River, farm ponds, and several nearby larger reservoirs for nesting. During the spring and fall, large numbers of migrating birds can be found nesting and feeding on practically all water bodies in the area. Agricultural lands provide food for mallards and Canadian geese through the winter. The Colorado River and Highline Lake are primary waterfowl resting areas through the winter, particularly after smaller water bodies have frozen up.

Other Birds

A raptor inventory conducted in 1977 identified seven active and three suspected golden eagle aeries and eight active and six suspected prairie falcon aeries on the main face of the Little Bookcliffs from the Colorado state line to DeBeque Canyon (Enderson 1977). The sheer faces of the Little Bookcliffs and the large expanse of open country between the base of the cliffs and the Highline Canal provide some of the most productive nesting and hunting habitat for these two species in western Colorado (see map S2-3.).

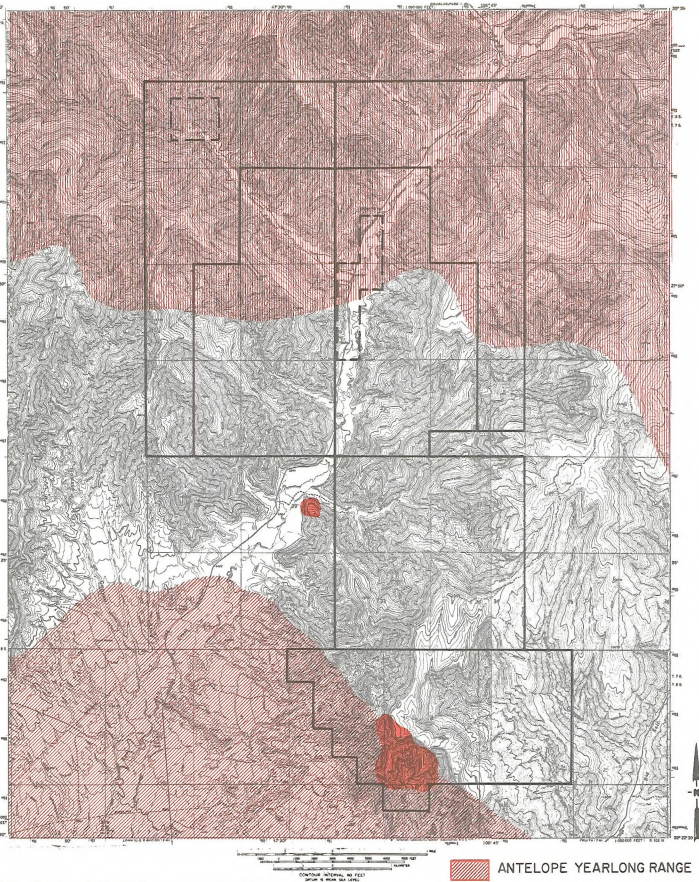
A wide variety of nongame birds occurs throughout the various habitat types and seasons. During spring migration, greater sandhill cranes pass through western Colorado. Cranes have been observed stopping over in the vicinity of Highline Lake and along East Salt Wash in the open desert area.

East Salt Creek is a focal point of wildlife activity during much of the year on the desert area between the Highline Canal and the Little Bookcliffs. Although East Salt Creek is not a perennial stream, water is often available along the wash after other waterholes on the desert have dried up. The cottonwood trees and limited amount of other riparian vegetation provide unique habitat that attracts many small birds and mammals.

Amphibians and Reptiles

Common amphibians, such as Rocky Mountain toad, the red-backed toad, and the leopard frog, and common reptiles, such as the collared lizard, the sagebrush lizard, the gopher snake, and the wandering garter snake, have been found within the Grand Valley (Thorne Ecological Institute 1976).

A subspecies of the prairie rattlesnake, the midget-faded rattlesnake, is worth mentioning because of its apparent rarity in the region. Although



Map S2-3. Wildlife ranges in the area of the proposed Loma project: antelope, bear, raptors

the snake is not officially designated as threatened or endangered, few specimens are reported from Colorado. It does occur in the Little Bookcliffs and out into the desert floor.

Threatened and Endangered Species

The desert floor between the base of the Little Bookcliffs and the Highline Canal currently supports a population of white-tailed prairie dogs. These animals provide the necessary habitat requirement for the black-footed ferret, which is thought to have occurred historically in the area. A BLM management objective is to maintain a prairie-dog population for the eventual reintroduction of ferret.

Bald eagles spend the winter along the Colorado River feeding on waterfowl and fish. Highline Lake and surrounding agricultural lands also attract bald eagles because waterfowl and carrion are available food sources.

The sandhill cranes stopping over in the vicinity of Highline Lake and East Salt Wash may be part of the Grey's Lake (Idaho) nesting population that is being used as foster parents for endangered whooping cranes. These birds migrate between their nesting habitat at Grey's Lake National Wildlife Refuge (NWR) and their winter range at Bosque del Apache NWR (New Mexico) with intermediate stops at Ouray NWR (Utah) and Monte Viste NWR (Colorado). Foster whooping cranes have been observed at these and other locations along this route. The proposed project lies in a direct line between Ouray and Monte Vista NWR.

Aquatic Biology

Approximately 6 miles of the headwaters of East Salt Creek are within the Sheridan lease site. About 90 percent of the channel is publicly owned.

The drainage area and tributaries forming East Salt Creek receive very little precipitation and the stream flow is usually about 1 cfs or less. During a short period of spring snowmelt and during severe thunderstorms stream flows rise rapidly. Water quality is naturally poor because of the highly erosive type of drainage. Runoff is typically very high in sulfates, chlorides, total dissolved soilds, and suspended sediments. No significant aquatic life is present in any of the tributaries on the Sheridan lease site.

The mining site is approximately 20 miles from the Colorado River, and all site drainage would reach the river during a precipitation event. The Colorado River at this location is considered a warm water fishery. Channel catfish, largemouth bass, sunfish, and bullheads dominate the gamefish population while numerous nongame fish species including roundtail chub, sand shiner, carp, flannelmouth sucker, bluehead sucker, speckled dace, redfin shiner, and others are found here.

Endangered or Threatened Species

From below the confluence of Plateau Creek this section of the Colorado River is habitat for three species of threatened and endangered fish. The Colorado squawfish, the razorback sucker, and the humpback chub are presently known to exist in the river. The U.S. Fish and Wildlife Service has recommended this section of river as critical habitat for the Colorado squawfish (see Aquatic Biology, chapter 2, regional analysis).

Cultural Resources

Archeological Resources

Several inventories have been completed for drill holes and access roads (Connor 1975, 1977). No archeological resources were located. A Class III survey is required prior to approval of the proposed action.

Petroglyph 5GF168 is located within the lease area. This site includes a Ute-style panel of mud-painted horse and rider and hunted animal. In addition, there are historic panels with names, dates, and female and animal figures.

As part of the regional predictability model (see the appendix, volume 3), two transects were surveyed as a representative sample for Area 7 which includes the Sheridan lease. Transect 2a crosses through the northern section of the lease area resulting in a site density of 0.54 site per section. Two lithic sites were identified and one historic water diversion system. This site, 5GF113, lies within private land on the lease area. Transect 2b, with a site density of 0.26 site per section, includes two sites, an historic sheep camp and a wickiup site. The three prehistoric sites located in these transects have been attributed to Ute occupation. "The paucity of earlier cultural manifestation in Area 2 and the rough terrain . . . suggest that the more rugged regions were not occupied prior to Ute occupancy" (Hibbets et al. 1978, p. IV-32). The completion of a Class III survey within the lease area will provide additional data with which to test this hypothesis of low site density in these areas north of the Grand Valley.

Historic Resources

Limited cultural resource surveys (Buckles 1975 and Connor 1977) have been conducted on specific test holes and access roads at this site. A mine dating from 1938 was recorded, but it does not appear to have any historic significance. Other areas that would be directly impacted will be surveyed prior to surface disturbance.

Land Use

Historically, there has been little coal mining in the Douglas Pass area. The surface overlying Sheridan's lease holdings has largely been used for livestock grazing, wildlife habitat, and hunting. The 1973 Land Use Map (Soil Conservation Service) shows pockets of irrigated farmland on the valley floor within the lease area. Sheridan's M&R plan indicates that there are hay meadows (alfalfa production) just south of the lease area, but no such fields occur within the lease area. Agricultural activity also occurred in the past at the mouth of Spink Canyon.

The lands over which Sheridan would have to acquire rights-of-way are largely a mixture of farmlands near Mack and desert grazing lands for the ramaining distance. The farmlands are privately owned, while the desert area is public land administered by the BLM. Some public lands are intermingled with the privately owned parcels.

Southward toward Mack, Loma, and Fruita, land use is a mixture of open rangeland, cultivated fields, and dispersed residential areas. East of Fruita, in the Grand Junction area, land uses are primarily urban and residential, but the surrounding countryside is still extensively used for irrigated cropland (including orchards), pastureland, hayland, and some rangeland. Lands producing fruits and vegetable may be designated unique farmlands, and some of the orchard land is in areas which could meet the definition of prime farmland (see Prime and Unique Farmlands under Agriculture in the regional chapter 2).

For a discussion of Mesa and Garfield county land-use planning, see the regional chapter 3, Land Use Plans, Controls, and Constraints. For a discussion of BLM planning see Interrelationships, chapter 1 of this site-specific.

Transportation

HIGHWAYS

The proposed Loma Project would be located close to State Highway 139, the Douglas Pass Road, which connects Loma and Rangely. The road is paved and is presently running at approximately 11 percent of capacity during peak hours. There were mine accidents on this road in 1977, none of which was fatal. In 1976, average daily traffic at Douglas Pass was 500 vehicles. Two school bus routes use State Highway 139.

The interchange of I-70 and State Highway 139 is currently handling traffic volumes at 8 percent of capacity during peak traffic hours.

RAILROADS

There is no direct rail line to or near the Sheridan site. The closest rail line is the Denver and Rio Grande Western main line at Loma. The grade crossing located 0.03 mile south of State Highway 6 at Loma has a current hazard rating of 0.15 accidents per five years.

AIRPORTS

Walker Field at Grand Junction is the closest airport to the proposed operation. This is the major airport in western Colorado and is served on a regular basis by Frontier and United airlines.

Livestock Grazing

The Sheridan coal lease tract is part of three BLM grazing allotments: the Garr Mesa, East Salt Creek, and Big Salt allotments (see table S2-4 for acreages, AUMs, class of livestock, and season of use for each allotment, and map S2-4 for allotment boundaries). There are a number of range improvements within the lease area: four stock reservoirs, three cattleguards, approximately 6 miles of fence, and 7 miles of stock trail.

Recreation

There are no recreational facilities on the Sheridan lease site. However, the canyons of the lease site provide wintering grounds for mule deer as well as habitat for various species of small game, including chukar (refer to Wildlife in this chapter for the extent of the resource . The lease site is located within Big Game Management Unit 30, which provided 3,364 recreation days in 1976, and Small Game Management Unit 58, which provided 35,723 recreation days in 1975 (tables S2-5 and S2-6 list recreation days by hunters, species, and game management units). The streams on the lease site are ephemeral and provide no fisheries (refer to Aquatic Biology in this chapter).

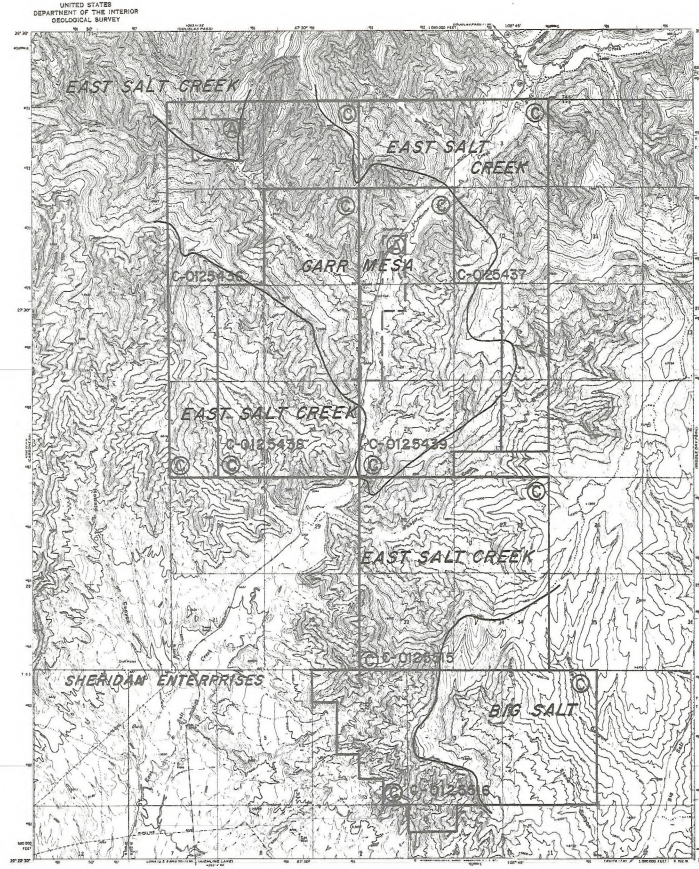
State Highway 139 passes through the lease site in a general north-south direction. This highway is a major route to Dinosaur National Monument and the scenic Douglas Pass area. Traffic on the highway averaged 500 vehicles per day in 1976. The portion of this volume which can be attributed to recreation is not known (Colorado State Department of Highways 1976).

Most of the population increase due to mining at the lease site would occur in the Grand Junction-Fruita area, where a wide range of recreation opportunities exist. Grand Junction has city-sponsored leagues for softball, basketball, and volleyball. Facilities include eleven parks, fourteen swimming pools, and sixteen tennis courts. The Grand Junction Recreation Department feels that use of its facilities is now maximum; people have to be turned away from the programs, especially league activities. The department also states that only 40 percent of this use is by city residents, which indicates that the city's programs are a major recrea-

TABLE S2-4

ALLOTMENTS AND LIVESTOCK USE WITHIN
SHERIDAN COAL LEASE TRACT

Allotment	Acres Within Coal Lease Tract	Animal Unit Months (AUM) of Forage Within Coal Lease Tract	Acres Per AUM	Class of Livestock	Season of Use
East Salt Allotment	8,298	901	9.2	Cattle Horses	03/01 to 02/29 cattle (yearlong) 06/01 to 02/29
Garr Mesa Allotment	4,762	553	8.6	Cattle	05/01 to 05/31 10/01 to 12/02
Big Salt Allotment	1,875	84	22.3	Cattle	03/01 to 02/28 (yearlong)



Map S2-4. Garr Mesa, East Salt Creek, and Big Salt livestock grazing allotment boundaries

TABLE S2-5

BIG GAME HUNTING IN BIG GAME MANAGEMENT UNIT 30

	Deer	Elk	Bear	Mountain Lion	Total
Hunters	854	-	20	9	a/
Recreation days b/	3,122	-	151	91	3,364

Source: Colorado Division of Wildlife, 1976 Colorado Big Game Harvest.

a/ Hunter totals are not provided because hunting and trapping of more than one species are not allowed.

b/ All or part of a day.

TABLE S2-6

SMALL GAME HUNTING AND TRAPPING IN SMALL GAME MANAGEMENT UNIT 58

Animal	Hunters	Recreation Days a/	Animal	Trappers	Recreation Days a/
Ducks	1,166	9,794	Badgers	9	757
Geese	423	1,950	Beavers	17	426
Doves and pigeons	1,106	6,251	Bobcats	30	1,918
Pheasants	2,021	7,203	Ringtailed cats	3	310
Chukars	500	1,123	Coyotes	21	2,086
Grouses	261	814	Foxes	29	1,235
Ptarmigans	7	0	Muskrats	32	1,203
Rabbits	3,952	28,789	Raccoons	20	509
Squirrels	53	225	Skunks	7	144
Foxes	38	72			
Coyotes	386	4,529			
Marmots	98	299			
Prairie dogs	550	4,140			
Magpies	352	5,283			
Total	b/	70,472		b/	8,588

Source: Colorado Division of Wildlife, 1975 Colorado Small Game, Furbearer, Varmint Harvest.

a/ All or part of a day.

b/ Hunter totals are not included because hunting and trapping of more than one species are allowed.

tion outlet for the surrounding area. Fruita provides leagues for softball and football and has three parks and a pool.

For a comprehensive discussion of the recreational resources of the area, refer to chapter 2 of the regional analysis, Recreation.

Visual Resources

East Salt Creek

The 500-foot-wide East Salt Creek Valley is confined by steeply sloping hills and cliffs that range from 800 feet to more than 1,000 feet above the valley. The U-shaped valley narrows toward its north end, becoming V-shaped. Any long view of the valley is restricted by the adjoining hills; instead, the viewer moves through a sequence of smaller, apparently separate vistas, finding elements such as unexpected geologic formations in one vista but not in the next.

The side slopes expose horizontal stratifications which establish a linear component in the composition of the valley landform. Rock overhangs create shadow patterns; combined with the different rock colors, they emphasize the linear, horizontal pattern in the side slopes.

The side-hill cover is a sparse mixture of pinyon and juniper, which gives these slopes a spotty texture (see figure S2-4). The tan hues of the exposed rock and soil are a light background, which contrasts strongly with the darker juniper trees and other landscape components, further defining the vegetative texture of this landscape.

Grasses and shrubs cover the flatter valley floor with a more continuous surface, but the irrigated lands interrupt this native vegetation. Riparian vegetation along East Salt Creek follows the valley alignment, and this ribbon of vegetation is emphasized by the seasonal color changes of deciduous trees. An edge condition is created along the valley floor where the habitat boundaries of the plant communities reinforce the bottom-land and side-slope boundary.

Highway 139 follows the curves and bends of the valley, and this linear pattern is duplicated by adjoining fence lines. The irrigation channels and the isolated cabins, outbuildings, corrals, and fences are normally perceived as embellishments to the landscape rather than undesirable intrusions.

Spink Canyon, Munger Canyon, McLane Canyon, and an unnamed canyon that Sheridan would use for refuse disposal all drain into East Salt Creek. Each has a unique character formed by a specific combination of landform, vegetation, and human modification.

Spink Canyon

Spink Canyon is a relatively undisturbed, narrow, U-shaped formation with exposed rock outcrops. Pinyon-juniper vegetation partially covers the side slopes; it is denser in the drainage courses. Grasses, sages, and shrubs dominate the valley floor cover and establish intermittent open and rough surface textures.

A dirt road winds through the valley to a trail junction. It is fenced off at the Highway 139 junction, preventing access to the casual viewer.

Munger Canyon

Munger Canyon is a narrow, deep, V-shaped drainage, which has minimal flatland along the bottom. Sparse vegetation and some rock outcrops occur on the side slopes, but the steep slopes are the primary element of the canyon.

Exploratory mining in the eastern portion of the canyon has altered the south slope. The single-lane road has left cut-and-fill scars on the side slope; terraces at the portal location are additional landform alterations that detract from the natural appearance of the canyon.

McLane Canyon

Cliffs and steep taluses along the McLane drainage create a dramatic canyon landscape. The cliff faces display horizontal cleavage lines, overhangs, and terrace features. Juniper bushes are sparsely scattered on the slopes along with grasses, sage, etc., but the vegetation remains visually subordinate to the landform.

Other than a recently bulldozed road paralleling a deep erosion channel, there are few human alterations evident until the eastern portion of the canyon, which terminates in a semicircle of cliffs. Mine portals and ventilation and exploration shafts penetrate the exposed coal seam and have bulldozed terraces at their entrances. These alterations have leveled the limited ground space and show no evidence of revegetation.

Refuse Canyon

The valley that is directly west of McLane Canyon would be used for refuse disposal. The valley is approximately 300 feet wide and flat at the East Salt Creek end, but narrows within a mile. The north slope of the valley is well marked by terraces, rock outcrops, and cliffs, while the south slope is gently rippled by rounded drainage depressions. Horizontal lines are moderately evident on the north slope, while lateral lines caused by vegetation changes follow the drainages across the south slope.

The pinyon-juniper vegetation establishes a continuous green texture on the southern slope until it intermingles with the grass and forb cover of the

Figure S2-4. The steeply sloping hills of East Salt Creek Valley are covered with a sparse mixture of pinyon and juniper

Figure S2-5. Cut-and fill construction along a road -- Loma project

valley bottom. The texture change and the "edge" boundary are difinitive visual elements of the landscape.

Railroad Right-of-way

Alluvial bottomlands with moderate terraces characterize the landform between Mack and the proposed central facility site along East Salt Creek. Light buff and gray soil colors form a continuous hue which is only broken by some darker soil colors in the irrigated fields. The mixed vegetation cover of native grasses and cultivated crops accentuates the topography by the darker, irrigated field patterns following the valley bottoms; the lighter, native grasses grow on the side slopes and terrace tops.

The natural valley landscape has been modified by many human alterations for varying land uses. Agricultural utilization has created fields, access roads, irrigation and fence lines; power and telephone lines follow the road corridors to the scattered residences in the area. The visual influence of the alterations on the natural landscape has been the development of a pastoral landscape character in this portion of the Grand Valley.

VRM Classifications

The inherent scenic quality of the East Salt Creek Valley has been rated (see appendix F) as a "B," which represents a diversity of landform, vegetation, and colors. The undeveloped status of the area and the moderate sensitivity level of Route 139 (450 vehicles per day in 1976) have resulted in a VRM Class II rating (see appendix F). According to the visual planning objective of this rating, human modifications of the landscape's form, line, color, and texture should not be evident on the characteristic landscape. The existing, natural landscape character is a relatively undeveloped valley that offers recreational landscape viewing and sequential vistas of rock escarpments, small ranching operations, and native vegetation.

The East Salt Creek VRM Class II overlaps into the adjacent canyons. Beyond the areas that are visible from Route 139, however, the VRM class changes to a IV, because fewer people see these canyons. The Class IV designation specifies that landscape changes may dominate the original landscape composition but that these changes should reflect what could be a natural occurrence.

Socioeconomic Conditions

Demography

Although the Sheridan site is in Garfield County, the nearest population centers are in Mesa County. Table S2-7 lists the population for each incorporated town and each county census area within Mesa County, for the 1970 and 1977 censuses. The table indicates that most areas around Grand Junction have grown at a moderate rate, averaging between 3 and 5 percent per year since 1970.

The median age of the population in Mesa County is higher, but not significantly higher, than the Colorado median age of 26.2 years. The Palisade area has a relatively older population than the rest of the county, and a much higher concentration of persons over 65 years of age.

Grand Junction and vicinity is the most heavily populated community between the Denver and Salt Lake City metropolitan areas. As such, it serves as a regional center of commercial and industrial activity for most of western Colorado and eastern Utah. Recent growth in the Grand Junction area has been caused by a variety of economic factors, including the expectation that the area's mineral resources will develop rapidly. Corporations and government agencies involved in mineral resource development over a wide area have located regional headquarters in Grand Junction.

Community Attitudes and Lifestyle

According to the Mesa County Development Department, a majority of the new residents in the Grand Junction area moved there because they liked it as a place to live. The Grand Junction area is more urban than most other areas of western Colorado, but it is still small enough to retain attributes of small town living. Residents place a high value on the casual atmosphere and lack of congestion associated with life in Grand Junction. However, there is also a desire to attract economic growth to the area and improve job opportunities for residents.

As a population center, Grand Junction provides its residents opportunities not available in most other communities in western Colorado. Mesa College offers courses of study in many subject areas, college athletic events, and dramatic performances. There is a larger selection of stores, restaurants, and movie theatres than in other towns. Airline and bus service to metropolitan areas is regularly available, and an interstate highway links Grand Junction to Denver and Salt Lake City.

Community attitudes towards growth and development were documented in a survey conducted by Bickert, Brown, and Coddington and Associates, Inc., in July 1973. Results of that survey are discussed in the regional volume.

Community Facilties

Most of the developed areas around Grand Junction receive water from the Ute Water Conservancy District which provides water to other districts and to individuals. The district is currently developing additional water resources. There are many

TABLE S2-7

POPULATION STATISTICS

Area	1970 Population	1977 Population	Percent Change 1970-1977	Median Age 1970 (Years)	Median Age 1977 (Years)	Percent Population Over 65 Years
Mesa County	54,374	66,848	+23	30.2	29.4	+11
Clifton Area	3,554	5,913	+66	30.2	26.8	+ 9
Fruita	1,822	2,328	+28	34.1	28.5	+15
Fruita Area	5,837	7,709	+32	29.4	28.4	+10
Grand Junction	24,043	25,398	+ 5	32.1	30.2	+15
Grand Junction Area	28,527	35,871	+26	30.0	29.3	+13
Orchard Mesa Area	6,890	5,012	-27	28.6	29.6	+ 8
Palisade	874	1,038	+19	--	46.9	+31
Palisade Area	1,964	2,178	+10	41.8	38.8	+21
Redlands Area	4,446	6,826	+53	29.9	30.6	+ 6
Whitewater Area	605	751	+24	36.1	32.6	+12

special districts in the county providing various services including water, sewer, fire protection, pest control, hospital services, cemetery services, and flood control. There are two sanitary land fills in the county. Police service outside of town is provided by the county sheriff.

Grand Junction, Fruita, Collbran, Palisade, and DeBeque are improving or plan to improve their water and sewage treatment systems. More detailed information about facilities in the county is included in the regional volume.

Housing

The Colorado Division of Housing estimates that there was a total of 24,914 housing units in Mesa County in April 1976, an increase of 6,116 units (or 32 percent) from 1970. Over one-third of the total increase in housing stock was mobile home units. In recent years, duplexes and multi-family units have constituted about 30 percent of the new housing starts. (Table S2-8 lists the total number of housing units in each of the incorporated areas of the county as counted in the 1977 special population census.) High prices for single-family dwellings and the unavailability of rental units are contributing to an increase in multi-family and mobile home units throughout the county. The county has an above average need for low to moderate income housing, because (1) the median family income is more than $3,000 less than the state median and (2) Mesa County has an above average number of elderly persons.

Education

The Mesa County Valley School District 51 provides public education to most of Mesa County, excluding the DeBeque and Collbran areas. District 51 operates 24 elementary schools, 6 junior high schools, 4 high schools, 2 vocational schools, and an occupational school. The average daily membership was 13,233 in the 1975-76 school year. Even though total population has steadily increased in the area, enrollment was slightly lower in 1975-1976 than in 1970-1971, which reflects the national trend in decreasing school enrollments.

Table S2-9 shows that the school district has some excess capacity in existing schools. The schools which have the most limited capacity are the junior high schools. The district is presently considering a new bond issue to finance some remodeling and the construction of two new elementary schools, a new junior high school, a vocational-technical building, and a special education building. The total cost of this work is estimated to be $14 million.

The district presently has about $2.5 million in outstanding debt from two previous bond issues. Total outstanding debt is due to be retired in 1981 from property tax collections.

The district's total mill levy of 45.68 mills is about 5 mills higher than the average for districts across the state. The authorized revenue base per pupil for the district, which is set by the state, is about $200 less than the state average.

The district has a staff of 678 teachers, or a student-teacher ratio of 20 to 1. Teachers' salaries vary from $8,500 to $17,270. The district also has special education programs for the deaf, blind, emotionally disturbed, and mentally handicapped.

Health Care

The level of health care services in and around Grand Junction is the highest in the ES area. The four hospitals located in Grand Junction provide specialized services to much of western Colorado. In addition, the Fruita area is served by a small hospital located in town. There are more physicians located in Grand Junction than in the remainder of the ES area combined. Many of these physicians are specialists, who provide their services to patients from a wide area. Ambulance service to the area is good; both Fruita and Grand Junction operate ambulance services connected with their fire deparments.

Mental health services are provided to the area by the Colorado West Regional Mental Health Center, which is headquartered at Glenwood Springs but has offices in Grand Junction.

The Mesa County Department of Public Health has a staff of six public health nurses who provide generalized health education and preventative health services in addition to specialized activities in tuberculosis control, mental retardation, venereal disease, and handicapped children's programs.

Employment

In Mesa County, where virtually all of Sheridan's employees would live, employment grew at an annual rate of 6.1 percent between 1973 and 1976. The total number of persons employed increased from 24,030 to 28,622 during this period. As shown in table S2-10, the increase was all in nonagricultural employment; agricultural employment declined by 11.6 percent. A comparison of employment by sector shows that all sectors showed some growth, but the mining, the transportation, the finance, insurance, and real estate, and the contract construction sectors had the largest percentage increases. The increase of 130 percent in mining employment can be attributed to new mining activity in the Uravan uranium belt and coal mining in western Garfield County. Oil shale test projects near DeBeque and Grand Valley have also added to employment in the mining sector. In

TABLE S2-8

EXISTING HOUSING IN MESA COUNTY

Town	Total Housing Units	
	Occupied	Vacant
Collbran	119	13
DeBeque	100	11
Fruita	788	41
Grand Junction	10,129	596
Palisade	418	23
Unincorporated areas	12,321	759

Source: U.S. Bureau of the Census, Special Population Census for Mesa County, 1977.

TABLE S2-9

MESA COUNTY VALLEY SCHOOL DISTRICT
SCHOOL CAPACITIES

	1977 Enrollment	Design Capacity	Excess Capacity
Elementary Schools			
Appleton	255	330	75
Broadway	653	630	- 23
Chatfield	381	420	(Expanding to 620)
Clifton	534	630	96
Columbine	419	420	1
Columbus	440	420	- 20
Fruita	340	350	10
Fruitvale	514	550	36
Gateway	32	75	43
Lincoln, Orchard Mesa	545	570	25
Lincoln Park	335	400	65
Loma	186	200	14
Nisley	432	475	43
Orchard Avenue	343	420	77
Pomona	369	420	51
Riverside	59	96	37
Scenic	403	420	17
Shellady	233	240	17
Taylor	355	420	65
Tope	380	420	40
Subtotal	7,208	8,106	898
Junior High Schools			
Bookcliff	752	700	- 52
East	588	625	37
Fruita	784	750	- 34
Gateway (Jr. & Sr. High)	25	30	5
Orchard Mesa	663	725	62
West	577	625	48
Subtotal	3,389	3,455	66
High Schools			
Central	911	1,100	189
Fruita Monument	838	1,000	162
Grand Junction	1,252	1,400	148
Palisade (Jr. & Sr. High)	427	500	73
Subtotal	3,428	4,000	572
Total	14,025	15,561	1,536

Source: Mesa County Valley School District, November 9, 1977.

terms of number of employees, the service trade and mining sectors showed the greatest increase.

Table S2-10 also shows that the trade, service, and government sectors are the largest employers in the Mesa County economy and that, in spite of the fast growth rate, the finance, insurance, and real estate sector and the mining sector are the smallest. The sectors with the largest employment in Garfield County are also trade, services, and government. Almost all sectors have grown since 1970.

The regional volume gives more detail about employment in Mesa and Garfield counties. Employment data for specific towns and cities are not available.

Income

There are no towns in Garfield County near the proposed Sheridan site, which is on the Douglas Pass road north of Loma. Any growth because of this project could be expected to occur in Mesa County.

The 1974 per capita income in both Garfield and Mesa counties was lower than the Colorado state average of $5,514, but Garfield County at $5,106 was higher than Mesa County at $4,799. More information about incomes in the counties and the area may be found in the regional volume, chapter 2, Socioeconomic Conditions.

FUTURE ENVIRONMENT WITHOUT THE PROPOSAL

If the proposed M&R plan discussed in chapter 1 is not approved and implemented, Sheridan Enterprises would continue exploration mining activities through 1980, employing about 40 people. The primary land uses on the lease area would remain livestock range and wildlife habitat.

Sheridan would be required to revegetate approximately 40 acres of existing disturbance when exploration activities are finished. Successful revegetation may require several tries, given the area's low annual precipitation and lack of topsoil.

The implementation of a new allotment management plan (AMP) for the Garr Mesa allotment is being considered in the Grand Junction Grazing ES; publication of the draft ES is scheduled for March 1979. If the AMP is approved, the part of the Garr Mesa allotment within the coal lease tract would be placed in a two-pasture cycle of spring and fall use one year, and fall use the next year. The vegetative condition may improve due to an increase in density of the key species (galleta grass, Indian ricegrass, Colorado Wildrye, and western wheatgrass). A decrease in the hedging of serviceberry would also be expected. Wildlife habitat conditions should also improve if the AMP is implemented.

Ongoing exploration activities by Sheridan Enterprises in the lease area should have no significant effect on the ground-water resources in this general area. The only effect on the surface water would be increased erosion in disturbed areas adjacent to the exploration portals and access roads with consequent increase sediment yield downstream. On completion of exploration activities and reclamation of disturbed areas, erosion and sediment yield shoud return to approximately premining conditions.

Through the year 1990, vandalism and erosion would be the two major factors causing the loss of archeological values. It is doubtful that additional monies or employees would be available to retard this loss, although the Federal Land Policy and Management Act of 1976 will provide BLM with more protective enforcement authority.

The potential development of natural gas wells by 1990 in the vicinity of Douglas Pass could leave a residue of vehicle access corridors, well-platform sites, and gas pipeline rights-of-way in the area. The upper portion of East Salt Creek should retain a relatively rural character for the next decade, although the lower portion may see some residential development. The visual and land use quality of the East Salt Creek drainage would therefore remain a natural landscape with moderate cultural modification due to grazing, pipeline rights-of-way, and gas well sites. The valley could serve also as an adequate recreation drive for sightseers.

Noise levels along the Highway 139 will continue to increase with increased oil shale development in the Piceance Basin. The possibility of intensified oil and gas exploration might also add to noise levels in the area. Based on Colorado Department of Highways estimates on traffic volume, it is estimated that equivalent noise levels along Highway 139 will increase by 3 to 4 dBA by 1990 (see the noise section of Socioeconomic Conditions, chapter 4, volume 1).

Garfield County is projected to grow at a rapid rate to 45,100 people by 1990 primarily because of the developing oil shale industry. Population growth from oil shale development, however, would occur mostly in western and central Garfield County, especially in and around the Rifle area. Glenwood Springs, because of its ability to absorb more population growth than other communities in the area, would also grow significantly from oil shale development.

Population of Mesa County is expected to grow at a rapid rate to 106,000 people by 1985 and then decrease to 94,800 people by 1990. Development of oil shale and uranium and the area's role as a regional center account for the growth; completion

TABLE S2-10

GROWTH OF EMPLOYMENT BY SECTOR
IN MESA COUNTY, 1973-1976

Sector	1973	1976	Increase	Percent Change
Agriculture	3,030	1,790	- 240	- 11.8
Mining	390	900	+ 510	+ 130.8
Contract Construction	1,330	1,730	+ 400	+ 30.1
Manufacturing	2,280	2,440	+ 160	+ 7.0
Transportation	1,420	1,680	+ 460	+ 32.4
Wholesale and Retail Trade	5,040	5,710	+ 670	+ 13.3
Finance, Insurance, and Real Estate	630	820	+ 190	+ 30.2
Service	3,420	4,410	+ 990	+ 28.9
Government	4,140	4,470	+ 330	+ 8.0

Source: Colorado Division of Employment, Research and Analysis, February 1977.

Note: This information does not include self-employed workers, other than in agriculture, unpaid family, and domestic workers.

of oil shale construction work would cause the decrease. The Grand Junction area will become more urbanized resulting in the continued decline in the importance of agriculture in the local economy. Incomes are expected to be higher. Some of the residential expansion will probably encroach on agricultural lands in the Grand Valley (possibly including prime farmlands). However, the exact location of this growth would depend to some extent on future local land use planning and zoning.

Growth in Mesa County would require 116.2 acres of additional community active/improved park land (e.g., ballfields, playgrounds, tennis courts) to prevent overuse and deterioration of existing facilities (Bickert, Browne, Coddington, and Associates, Inc. 1977). The proposed U.S. Bureau of Reclamation's (USBR) Dominguez Dam, just south of Grand Junction (see figure S2-6) would provide water-based recreation such as boating, fishing, and swimming. The USBR estimates that the dam would provide 300,000 to 500,000 recreation days in its first year of use, which would help to relieve some of the projected need for this type of recreation identified by the 1976 Colorado Comprehensive Outdoor Recreation Plan (see regional volume, chapter 2, Recreation).

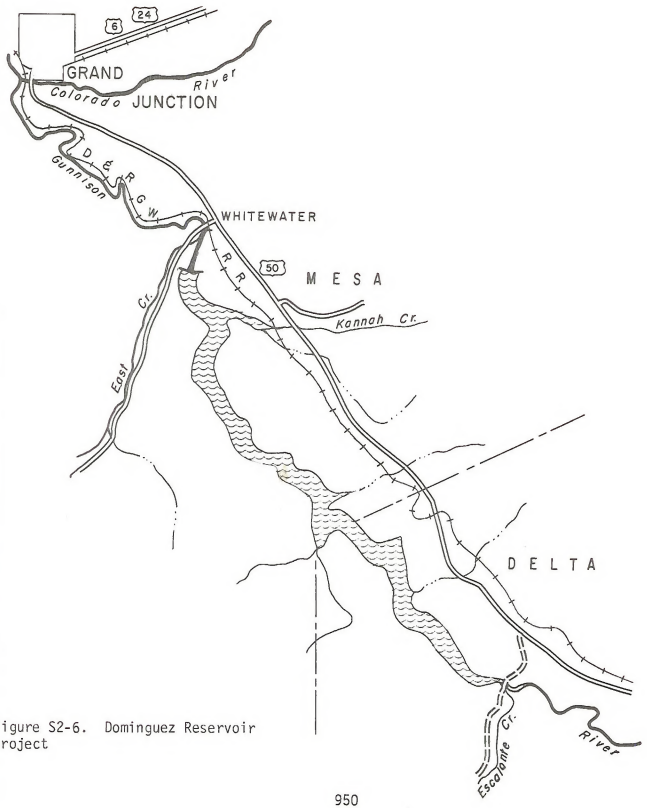


Figure S2-6. Dominguez Reservoir project

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This mining and reclamation plan (M&R plan) was submitted for review after promulgation of interim regulations, 30(CFR): 700, required under Sections 502 and 523 of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87), but it does not fully reflect the requirements of the interim regulations. However, in this environmental statement (ES) the applicable interim regulations are included as federal requirements in chapter 1 as if the M&R plan had been designed using the requirements of the regulations. The Department of the Interior will not consider the M&R plan for approval until Sheridan Enterprises has redesigned it to incorporate the requirements of 30(CFR): 211 and 30(CFR): 700. Therefore, to the extent possible at this time, impact analysis assumes that the M&R plan will comply with the appropriate provisions of the Surface Mining Control and Reclamation Act. Impacts are analyzed at three time points: 1980, 1985, and 1990.

Air Quality

Emissions from the Proposed Mine

Mining activity at underground coal mines usually produces dust, an air pollutant, in environmentally significant amounts. Dust that is generated within the mine is not considered to have an environmental impact since it is continuously controlled and contained in the mine. However, surface facilities at these mines also generate some dust which is released into the ambient air. Most of the dust is from fugitive emission sources; the term "fugitive" connotes that the dust escapes from an unenclosed surface as a result of wind erosion or mechanical action, as opposed to being released from a stack or process vent.

The potential fugitive dust sources identified at the proposed Loma Project include conveyors, transfer points, truck loadout (through 1982), train loadout of coal (1983 to end of mine life), open storage piles, access and haul roads, and wind erosion of refuse piles and other exposed areas at the mine. A common source of fugitive dust at underground mines that is not projected for the Loma Project is crushing and sizing at the preparation plant. These operations should produce negligible emissions because a wet process would be used.

The procedure used to estimate emissions from each of the potential sources was to (1) determine the activity rate of the pollution-producing operation, (2) multiply that aclivity rate by an emission factor based on sampling of similar operations, and (3) reduce the calculated emissions by an appropriate amount to account for control equipment or dust suppression measures to be employed on the operation. Activity rates and control measures were described in the Loma M & R plan. Emission factors for individual mining operations were obtained from Colorado Air Pollution Control Division and a recent study of emissions from mining (Colorado APCD 1978, Axetell 1978).

Table S3-1 presents estimates of fugitive dust emissions at the Loma site from each of the identified sources in 1980, 1985, 1990, and 2005 (end of mine life). These values are annual emissions, even though the activities would not be continuous or uniform throughout the year. The estimates are judged to be accurate within a factor of two (Axetell 1978). The emissions in table S3-1 represent initial emission rates (tons per year) of suspended particulate from the operations. Some of these suspended particles would fall out of the dust plume after they are emitted. This deposition is discussed further below.

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

Emission rates per mile of travel are shown to decrease between 1980 and subsequent study years. In the case of Loma, these reduced emission rates would more than offset increased activity rates projected when the mine would be at full production in 1990. Estimated emissions of carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), and sulfur oxides (SO_x) are shown in table S3-2. These emissions would be from both employee travel on the mine site and haul trucks.

TABLE S3-1

FUGITIVE DUST EMISSIONS AT THE PROPOSED LOMA MINE SITE

Emission source	Emissions, ton/yr 1980	1985	1990 & EML
Conveyor - 2 sections	22.8	109.4	156.3
Transfer points - 1 points	34.2	164.1	234.3
Preparation plant - wet process	neg	neg	neg
Truck loadout	0.1	-	-
Train loadout	-	0.5	0.8
Open storage - raw coal	11.3	11.3	11.3
- surge pile	11.3	11.3	11.3
Haul roads - raw coal	96.4	462.5	551.7
- clean coal	1102.0	-	-
- refuse	11.5	55.2	78.8
Access roads	4.1	11.3	21.6
Exposed areas - refuse	9.8	9.8	9.8
- railroad	67.9	67.9	67.9
- mine facilities	17.4	17.4	17.4
TOTAL	1388.8	920.7	1161.2

TABLE S3-2

EMISSIONS OF GASEOUS POLLUTANTS FROM THE PROPOSED LOMA SHERIDAN MINE SITE

Year	Total emissions from vehicles, ton/yr CO	HC	NO_x	SO_x
1980	74.1	8.0	17.1	3.8
1985	62.3	6.1	13.1	1.9
1990	60.9	6.2	16.2	2.5

$$L_V = \frac{24}{0.2 + 0.007\,M}$$, where

L_V = Average visual range, miles

M = Average particulate concentration (micrograms per cubic meter)

Figure S3-1 Relationship between visibility and suspended particulate concentrations in rural west-central Colorado (Ettinger and Royal 1972).

The emissions of gaseous pollutants would not result in significant ambient concentrations on or near the proposed mine site. Although there would be at least 60 tons per year of CO emitted in each of the study years, this pollutant must be present in relatively high concentrations (10,000 $\mu g/m^3$ vs 150 $\mu g/m^3$ for particulate) before it is harmful.

Annual Average Air Quality Impacts

In order to assess the impact of air pollutant emissions on the environment, ambient concentrations of suspended particulate were predicted with an atmospheric dispersion model. The model used to predict average concentrations that would result from the mines' emissions was the Climatological Dispersion Model (CDM) (EPA 1973).

CDM is designed for use in level terrain. This application of CDM is subject to larger error and uncertainty than more routine applications, but it represents the best predictive modeling technique available. Because of the irregular topography at the proposed site, CDM is really only capable of predicting concentrations in the main canyon or valley near where mining emissions would occur. The site-specific meteorological data reflected the prevalence of transport of the pollutants up and down the canyon from the mines. Because of the greater influence of the canyon on maximum concentrations near the mines, a separate model which considers reflection of the plume was used to predict maximum 24-hour concentrations. This short-term model is described in the following section.

The basic CDM model has been modified to incorporate a fallout function to simulate the deposition of the large suspended particulate as it disperses downwind. The fallout rates incorporated in the model were based on sampling data from several western coal mines and are functions of wind speed, atmospheric stability, and particle size.

The following input data are required for CDM: source locations; source emission rates; emission heights; locations where ground-level pollutant concentrations are desired; and frequency of occurrence of each of sixteen wind directions, six wind speeds, and six stability classes. Predicted concentrations are usually accurate within a factor of three.

The wind speed and direction data being collected at the mine site are not yet sufficient for modeling purposes (see chapter 2). Therefore, wind and stability data required for the model were obtained by modifying that from the Grand Junction airport to reflect orientation of the East Salt Creek Canyon. This wind rose was previously shown in figure S2-1. Emission data were presented in table S3-1.

Predicted increases in ambient concentrations resulting from Loma's operation in 1980 are shown on map S3-1. According to the isopleths on this map, the mines would increase annual average particulate concentrations by 20 micrograms per cubic meter ($\mu g/m^3$) in a small area on the mine site near that section of haul road used for both raw and clean coal transport. Concentrations are predicted to increase by 5 $\mu g/m^3$ within 0.5 mile of either side of the section of haul road used to haul clean coal to the loading facility.

In future years, haul trucks would not be used to transport clean coal off-site to the loading facility. As a result, total emissions from mining operations would be decreased significantly. Map S3-2 shows the predicted increases in ambient concentrations from the Loma operation in 1990. According to the isopleths on this map, the mine would increase annual average particulate concentrations by 10 $\mu g/m^3$ in only a small area on the mine site. Concentrations are predicted to increase by at least 1 $\mu g/m^3$ for a distance of 2.5 miles north and south of the surface facilities within East Salt Creek Canyon. Predicted impacts for 1985 would be approximately the same as for 1990, except that concentrations in Spink Canyon would be lower in 1985 because portals 4 and 5 would not yet be producing.

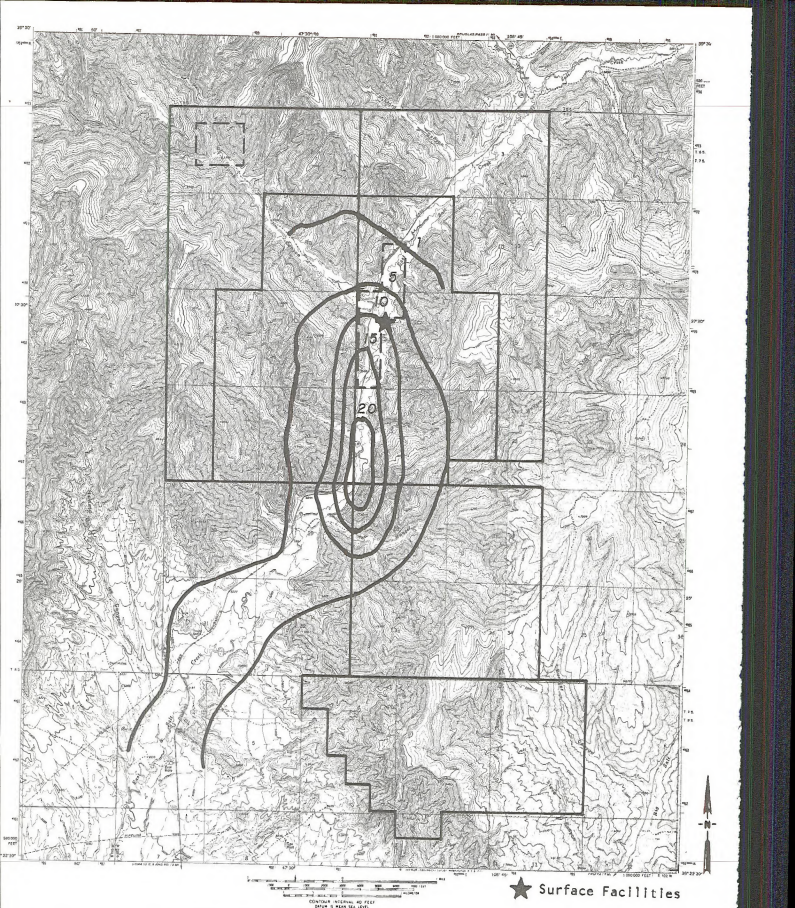
The predicted impact of the mines is less than the primary and secondary air quality standards for suspended particulate of 75 and 60 $\mu g/m^3$, respectively. It is also less than the total air quality increment of 19 $\mu g/m^3$ allowable for Class II areas under the federal law concerning prevention of significant deterioration (PSD), except for a 1 mile section near the main haul road in 1980.

Maximum Short-term Air Quality Impacts

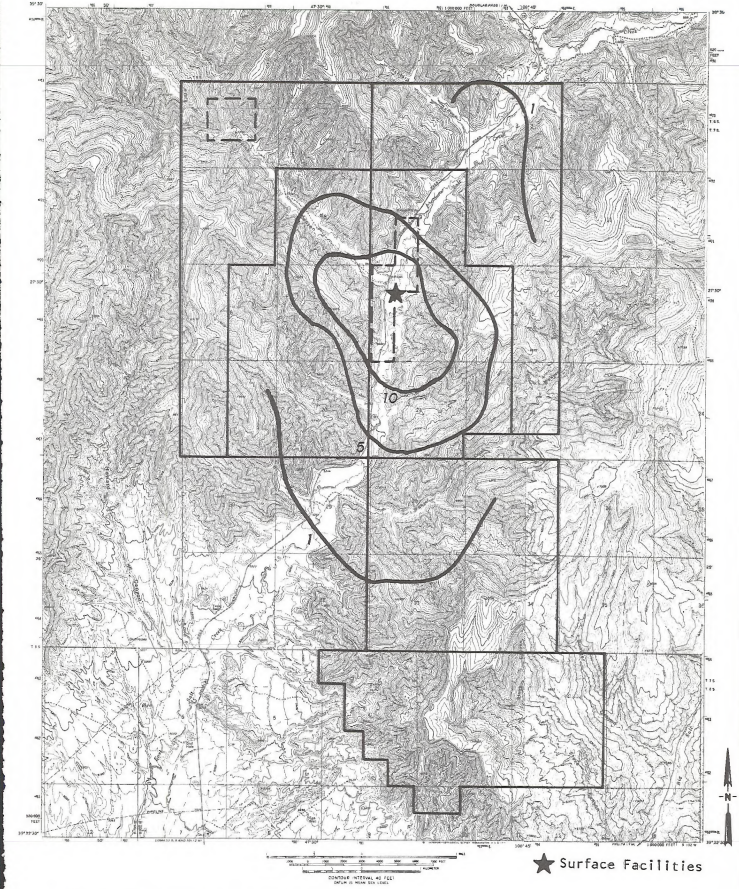
The dispersion model used to predict maximum 24-hour particulate concentrations assumed Gaussian distribution of particulates away from the plume centerline, a constant wind direction, and complete reflection of the plume off both canyon walls. The basic dispersion equation is described in detail in Turner (1970). The fallout function was not incorporated in the short-term model.

Several locations (receptors) up and down East Salt Creek Canyon were specified in the model for prediction of ground-level concentrations. At each receptor, the contribution caused by each emission source at Loma was calculated separately; individual source contributions were summed to determine the total concentration at the receptor resulting from the mining operations.

It was assumed that highest concentrations would occur when winds blew up or down the canyon for all 24 hours so the downwind receptors would be in the plume continuously. The annual average emission rates from table S3-1 were also used to predict maximum concentrations because



Map S3-1 Predicted increases in ambient concentrations in 1980 (micrograms per cubic meter)



Map S3-2. Predicted increases in ambient concentrations in 1990 (micrograms per cubic meter)

no information was available on seasonal variations in production. Although it is expected that emission rates would vary somewhat throughout the year, the sources at Loma Project would not be subject to great increases in emissions due to equipment malfunction or high wind speeds. Also, increased emissions at different sources would occur independently rather than simultaneously and would probably not occur at the same time as the most adverse meteorological conditions.

Predicted maximum 24-hour concentrations from the mines in 1990 are shown on map S3-3. With winds from the north, a maximum impact slightly above 90 $\mu g/m^3$ is projected to occur directly south of the surface facilities. At the mouth of the canyon (3 miles), the increase in concentrations on the worst day would be about 40 $\mu g/m^3$. With winds from the south, the maximum impact is predicted to be 65 $\mu g/m^3$. These concentrations would be less than the 24-hour primary air quality standard of 260 $\mu g/m^3$ and the secondary standard of 150 $\mu g/m^3$, and they are projected to occur only in the immediate vicinity of the mining operations. Maximum concentrations in 1980 and 1985 would be 66 and 78 $\mu g/m^3$, respectively.

Because the short-term dispersion model involves prediction of extreme conditions for meteorology and emission rates, it is probably slightly less accurate than the annual model.

Impact on Visibility

The addition of particulates into the atmosphere as a result of emissions from the mines would reduce visibility in the area. A calculation of the degree of visibility reduction depends on several parameters for which data are not available, the most important being size distribution of the particles. However, a rough approximation of visibility can be made based on suspended particulate concentrations. A relationship between these two variables in rural west-central Colorado has been empirically determined by Ettinger and Royer (1972); it is shown in figure S3-1.

It should be emphasized that this relationship was developed with uniform atmospheric particulate concentrations, not near a plume of fugitive dust containing relatively large diameter particles. Also, it does not consider visibility reductions due to precipitation. Therefore, the equation is more likely to predict visual range over an averaging period of a year than for a short-term period such as 24 hours.

As indicated on map S3-1, particulate concentrations in 1980 would be increased to a distance of over 5 miles to the south-southwest from the surface facilities. Along a line of sight down East Salt Creek Canyon, concentrations would be increased an average of about 8.6 $\mu g/m^3$ over this distance. Using the equation above and a background particulate concentration of 40 $\mu g/m^3$, the estimated reduction in visual range in the canyon as a result of mining emissions would be about 6 miles on an annual basis. Because of the limited area of air quality impact, average visibility would not be affected as much outside the canyon. For example, visibility would only be reduced an average of about 1 mile along an east-west line of sight from State Highway 139 south of the mine site. Visibility reductions in 1985 and 1990 would be less than in 1980.

Geologic and Geographic Setting

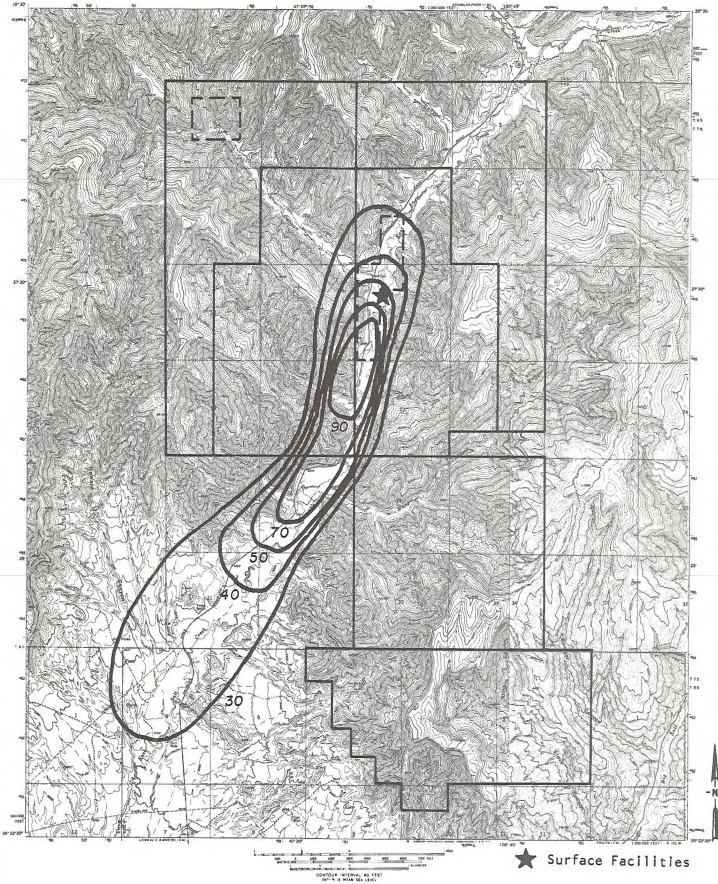
Topography

Impacts to the topography which would occur as the result of the proposed action would occur over the broad area from the Colorado River to the Little Bookcliffs where the coal leases lie, approximately 25 miles to the north. Three aspects of the mining operation would alter the natural contours of the area. These are the excavation and earthmoving associated with construction of surface facilities, long-term use of the refuse disposal area, and surface subsidence.

A total of 676 acres would be disturbed by excavation and earthmoving in order to implement the project. Of this total, approximately 497 acres would be disturbed by the 20-mile railroad and utility corridor: the remainder would be disturbed by exploration work, portal development, surface facilities, and haul and access roads. The majority of the disturbance (649) acres would occur by 1985. The effect which site preparation would have on topography is dependent upon the existing natural contour. Maximum disturbance would occur where large cut-and-fill structures would be needed for leveling, such as the portal sites at Munger Canyon and Spink Canyon. In other areas, such as the site proposed for the central facilities, cut-and-fill structures would be minimal because the existing slope is less than 10 percent (See Soils).

Long-term use of the refuse disposal area would mean gradual disturbance by continuous use of 30 acres in 1985 and 40 acres in 1990. This represents approximately 0.2 percent of the total project acres. No design plan for the refuse disposal area has been submitted, and final topography of the area is impossible to predict.

Surface subsidence of the area could be a more significant impact. Surface subsidence may occur over areas which have been mined out or burned out. A maximum of 8 feet of subsidence could occur over a maximum of 12,500 acres of the lease area. The burning of overlying coal beds could occur following initial subsidence from mining as air circulation at depth is increased. In total, the



Map S3-3. Predicted maximum 24-hour concentrations in 1990 (micrograms per cubic meter)

results of both mining and burning of coal beds could induce approximately 20 feet of subsidence.

Paleontology

Plant, invertebrate, and vertebrate fossil materials would be destroyed, disturbed, or removed as a result of coal mining activities, unauthorized collection, and vandalism. The primary impact would probably result directly from the mining operation. Given the overall character of the stratigraphic column, it is probable that some fossils would be destroyed. However, this stratigraphic section is only moderately likely to yield significant fossils when compared with other parts of the ES area.

All exposed fossil-bearing formations within the region could also be affected by increased vandalism and unauthorized fossil collecting as a result of increased regional population. The extent of this impact cannot presently be assessed due to a lack of information on such activities.

As a result of the above disturbance, an undetermined number of fossils would be lost for scientific research, public education (interpretive programs), etc. On the other hand, as a result of development, some fossil materials would also be exposed for scientific examination and collection. Due to lack of data and accepted criteria for determining significance, the importance of these impacts cannot presently be assessed.

Mineral Resources

Coal

The mining of the estimated 100 million tons of recoverable coal reserves from the Loma Project over an estimated 25-year period would result in the depletion of a nonrenewable energy source. The coal produced is expected to be exported to utility plants in the Midwest and Southwest.

The Cameo seam occurs as a single unit 20 to 25 feet thick and as two splits with 70 to 80 feet of interburden between them; the lower split is about 8 to 10 feet thick and the upper split is about 5 to 13 feet thick. Mining of the two splits must be correlated since subsidence from mining the lower bench would have an affect on the upper bench. Either the upper bench should be mined before development in the lower bench or simultaneous development of both benches could be done if mining in the upper bench is carried approximately five degrees, vertically, ahead of mining in the lower bench.

The underground mining of the coal resources by the proposed mining methods would result in recovery of an estimated 40 percent of the in-place coal reserves which total 250 million tons. This would be the most efficient method of mining the leased coal. Because of the nature of underground caving and resultant high contamination, future recovery of the abandoned 50 to 60 percent of the coal reserves is not considered as feasible under present technology and, therefore, they must be considered lost. The estimated recoverable coal reserves under the Loma Project constitute approximately 12 percent of the total coal reserves over 42 inches in the Garfield County portion of the Colorado section of the Little Bookcliffs coal field.

Oil and Gas

If oil and gas are discovered under the Loma Project, settlement must be reached between the well owners and the owners of the coal lease, as to which of the nonrenewable energy resources would be produced. If an area of coal must be left unmined around the well, that coal resource would be lost, since it would be uneconomical to return to an area and mine isolated "blocks" or "pillars" of coal.

Water Resources

Ground Water

The Cameo coal seam should be saturated only in the extreme northeastern corner of the lease area in the lowest levels of Mine No. 5. The overlying Loma seam is probably drained even in the northeastern part of the tract. Mines 1, 2, 3, 4, and 6, therefore, should intercept very little ground water and should have virtually no impact on the ground-water resource, either within or adjacent to the lease area.

A small amount of ground-water inflow estimated to be no more than 10 gallons per minute (gpm) may be encountered in Mine No. 5. This water probably would be dissipated by mining operations with no discharge at the surface. No measurable impacts to the ground-water resource, either within or adjacent to the lease area should occur from the loss of this water.

Construction of plant facilities on the bottom of East Salt Creek Valley should have no significant impact on the alluvial aquifer other than to increase ground-water recharge from the proposed leach fields which would be constructed to dispose of sewage effluent. Any recharge from this source would be considerably lower in dissolved-solids concentration than the natural discharge in the alluvial aquifer, although transient pollutants such as nitrates and phosphates would be introduced into the system. The net effect downstream should be small and probably would be more beneficial than adverse.

It is possible that local subsidence and fracturing induced by longwall mining in Mines 1, 2, 4, and 5 could intercept perched ground water in overlying aquifers or ephemeral streams at the surface and

direct the flow into the mines. If so, it would be necessary to discharge this water to East Salt Creek or to evaporation ponds. Any water from this source, however, should be small, short-lived, and should be no poorer in quality than current runoff in East Salt Creek during most of the year. No mining would occur beneath East Salt Creek Valley.

On completion of mining and reclamation, ground-water recharge-discharge relationships and water quality should return to approximately pre-mining conditions with no long-term local or regional impacts.

Surface Water

Impacts to the surface-water system within and adjacent to the lease area as a result of the proposed mining operations should be very minor. The only direct disturbance to stream channels would be from road, railroad, and pipeline construction, especially the construction of stream crossings. Regulations 30(CFR): 717.17(j) and (k) should minimize these hydrologic impacts. Because of the current poor quality of water and inferred high sediment loads in East Salt Creek, any minor impacts to the system from construction activities would probably go undetected.

Disruption of ephemeral stream channels within the lease area by subsidence and related fracturing should have a very transient effect on runoff. The large volumes of sediment normally transported by runoff would tend to rapidly fill and seal the bottoms of any depressions or cracks thus formed in this steep terrain. Following the completion of mining and reclamation, runoff characteristics of the watershed should rapidly return to essentially pre-mining conditions.

All water used in the mining and coal-processing operations would be obtained from the Colorado River near Loma. Sheridan Enterprises has a first and prior right to 10 cubic feet per second (cfs) of water from the Mack Pumping Pipeline as set forth in C.A. No. 13368, Mesa County District Court by decree, April 13, 1972, and as modified May 29, 1974. The company anticipates that the point of diversion of this water would be in the NE 1/4 SE 1/4 SE 1/4, Sec. 11, T. 1 N., R. 3 W., Ute Principal Meridian, about 2.5 miles southeast of Loma, Colorado. From this point of diversion, the water would be pumped through an 8-inch to 10-inch pipeline to the lease area.

The company estimates water consumption to be about 1 to 2 cfs (725 to 1,450 acre-feet per year [ac-ft/yr]), which for a production rate of 5 million tons per year (tons/yr) is consistent with the consumptive use of water normally required by underground mines when coal processing is necessary (regional analysis, chapter 1, volume 1). Assuming a production rate of 1.7 million tons/yr by 1985 and 5 million tons/yr by 1990, consumptive use of water in the mining operations should be 0.4 cfs (290 ac-ft/yr) by 1985 and 1.2 cfs (850 ac-ft/yr) by 1990. Diversion of this comparatively small amount of water from the Colorado River, which at the Colorado-Utah state line has an average discharge of 5,797 cfs and a minimum daily discharge of 960 cfs, would have no measurable impact on the flow or the aquatic biology downstream. Any consumptive use of water by Sheridan Enterprises, however, would decrease accordingly the amount of water available for other uses downstream.

The increased population in Mesa County as a result of the proposed operations is estimated to be 350 persons by 1980; 2,900 persons by 1985; and 5,800 persons by 1990 (Socioeconomic Conditions). Assuming an average water use of 200 gallons per day per person (gal/day/person), sewage effluent of 60 gal/day/person, and an increase in dissolved solids of 200 milligrams per liter (mg/l) in sewage effluent, water and sewage treatment requirements and the increase in dissolved-solids load to the Colorado River are summarized in table S3-3. Most of the increased demand for water-treatment facilities would probably occur in Grand Junction with lesser pressures on the smaller communities such as Fruita, Loma, and Mack. Some domestic supplies may be obtained from wells, but the only suitable aquifer in the general area is alluvium bordering the Colorado River. Wells, therefore, would be hydraulically connected to the river and would have only slightly less effect than direct diversion of surface water for the needed supplies.

The small increase in salt load contributed to the Colorado River by the added sewage effluent attributable to the higher population as a result of the proposed action should have no significant impact on aquatic biology downstream. Increased consumptive use of water in the proposed mining operations and by the consequent larger population, together with the added salt load returned to the river in sewage effluent, however, could increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.0031 mg/l (0.0005 percent) by 1980, 0.023 mg/l (0.0034 percent) by 1985, and by 0.043 mg/l (0.0063 percent) by 1990. Any increase in the salinity of the lower Colorado River is regarded as a serious impact because the quality of the river water is already marginal for most current uses.

Flood Hazard

During the mine life of approximately 25 years, a peak discharge of about 6,100 cfs can be expected on East Salt Creek at the mouth of Spink Canyon where the plant complex would be located. No serious hazard to the plant facilities would be

TABLE S3-3

WATER AND SEWAGE TREATMENT REQUIREMENTS
AND SALT LOAD RETURNED TO THE COLORADO RIVER

Item	1980	1985	1990
Population increase (persons)	350	2,900	5,800
Required increase in treated water supply (ac-ft/yr)	78	650	1,300
Required increase in sewage treatment (ac-ft/yr)	24	200	390
Consumptive use (initial use less sewage effluent (ac-ft/yr)	54	450	910
Increased salt load returned to the Colorado River (tons/yr)	6	53	110

posed by a flood of this magnitude, because the present channel width and depth should be more than adequate to contain that discharge with little or no overbank flow. Channel crossings between the central facilities and the shop, lab, etc., and between the plant complex and the several portals (map 20, appendix volume), however, would be subject to severe erosion and failure unless they are adequately designed and stabilized.

Possible flooding of facilities at portals No. 1, 2, 5, and 6 could occur from 25-year or larger flood events in the absence of protective dikes, but that hazard could be minimized by appropriate structures.

Estimated peak discharges in excess of 100 cfs (table S2-2, chapter 2) would cause severe erosion of waste materials placed as proposed in the bottom of the unnamed ephemeral stream valley in the SW 1/4 SE 1/4, Sec. 20, T. 7 S., R. 105 W. Presumably, however, Sheridan Enterprises must select an alternate location for waste disposal, because regulation 30(CFR): 715.15(b) prohibits the disposal of waste material as valley fills.

Erosion and Sedimentation

The proposed operations would disturb a total of 676 acres by 1990 497 acres of which would be from the construction of a railroad spur, power line, and water pipeline from the plant facilities near the mouth of Spink Canyon to the Denver and Rio Grande Western main line and the Colorado River near Mack, Colorado. Construction of this railroad spur line and utility lines could increase erosion and/or induce sedimentation very locally until reclamation is completed, but any impacts should be very minor and short-lived. Sediment yield from the railroad and utility right-of-way over the life of the project should not be higher than the pre-mining rate from the affected lands and may be somewhat less, depending on the eroding character of the lands disturbed. Local rates of sediment yield from both undeveloped rangelands and irrigated farmlands, for example, may be several times higher than from the revegetated railroad and utility right-of-way.

Regulations 30(CFR): 717.17(a) require that runoff from lands disturbed on the lease area must be routed through sedimentation ponds or other control structures that would limit total suspended solids in any effluent to 45 mg/l maximum allowable, except for discharge from a precipitation event larger than 10-year/24-hour recurrence interval. The average of daily values for 30 consecutive discharge days cannot exceed 30 mg/l. The effect would be to reduce sediment yielded to East Salt Creek from the disturbed areas by an estimated 400 to 500 tons/yr. That amount would be insignificant in East Salt Creek, which has an estimated annual sediment yield of about 300,000 tons/yr from the watershed.

Housing and related construction off-site in Mesa County would contribute an unmitigated short-term amount of sediment to the Colorado River. Approximately 30 acres would be disturbed by 1980, 247 acres by 1985, and 493 acres by 1990. It is estimated that sediment yield to the river would be increased about 1 ton per acre disturbed for the first year or two after construction. Thereafter, sediment yield would decrease to about half the predisturbance rate. The initial increase in sediment yield, therefore, should be more than offset by the long-term reduction in sediment yield over the life of the structures.

Disposal of waste materials as proposed in the bottom of the unnamed ephemeral stream valley south of Mine No. 3 in the SW 1/4 NE 1/4, Sec. 20, T. 7 S., R. 105 W. (map 20, appendix volume) is prohibited by regulations 30(CFR): 715.15(b). Accordingly, Sheridan Enterprises must select an alternate disposal area for waste materials that does not constitute a valley or head-of-hollow fill. Placement of waste materials anywhere in the lease tract, however, poses reclamation problems because of the low annual precipitation and high natural erosion. The Office of Surface Mining (OSM) recognizes the difficulties inherent in attempting to stabilize refuse disposal sites in such areas and is currently considering special performance standards for these sites.

Soils

Soil impacts would result from surface subsidence, from the construction and operation of mine surface facilities, and from urban expansion due to increased employment.

Coal removal could cause an estimated maximum surface subsidence of 8 feet (see Topography). Soil impacts would be minimal where no breaks occurred in the surface mantle. However, any surface cracks could expose narrow bands of bare soil material; surface runoff could then be redirected, causing accelerated erosion.

The construction and operation of mine surface facilities would affect approximately 39 acres by 1980, 649 acres by 1985, and 676 acres by 1990. These values include 30 acres of existing disturbance due to exploration activities and, beginning in 1985, about 497 acres from the utility and rail corridor. Surface disturbance at the mine site could temporarily increase erosion rates by two to three times over the moderate to high natural rate. Most of this erosion, however, would be contained on site by sediment control structures (30 [CFR]: 717.17[a]).

The principal effect of increased erosion, along with a deterioration of soil structure, would be a reduction in soil productivity. Any such reduction, although unquantifiable at present, would intensify inherent revegetation problems of low natural moisture, poor topsoil, and often steep terrain. These problems would prolong the efforts necessary to achieve successful reclamation (see Vegetation).

The exact location of the rail/utility corridor is not yet committed. From available information, however, approximately 160 acres would likely lie south of the Highline Canal and would include some soil types which qualify as prime farmland. The degree of impact on such land would depend on design specification not yet submitted.

Off-site disturbances due to mine-related population increases would amount to 30 acres by 1980, 247 acres by 1985, and 493 acres by 1990. The exact location of these acres cannot be predicted, although at least some portion would likely come from croplands, including soil types which qualify as prime farmlands. To this extent, crop production capacity would be permanently lost.

Vegetation

Approximately 39 acres of vegetation are expected to be disturbed by the construction of the Loma Project by 1980, 649 acres by 1985, and 676 acres by 1990. The water pipeline and railroad from the Loma Project to the town of Loma would cause 432 acres of this disturbance by 1990. A maximum of 65 acres of this disturbance would be on agricultural land with the rest (approximately 368 acres) on rangeland sparsely covered with saltbush or greasewood.

The remaining 243 acres of the disturbance by 1990 would be due to the construction of the central facilities, the refuse pile, and the mine portals and associated facilities. Approximately 119 acres would be in the pinyon-juniper type, 28 in the greasewood type, 22 in the sagebrush type, 24 on sparsely vegetated (south-facing) slopes of the saltbush type, 48 acres on land that has previously been disturbed and currently consists of annual weeds and grasses, 1 acre on riparian vegetation consisting of cottonwoods, and 1 acre on irrigated farmland planted in hay. The impacts of the vegetation disturbance would be to reduce the visual aesthetics of the area, increase soil erosion, and reduce the numbers of wildlife and livestock in the area (discussed in the appropriate sections).

Sheridan Enterprises would be required to revegetate the 676 acres of disturbance at the Loma Project and railroad right-of-way when they are no longer needed. The majority of the disturbance would not be revegetated until abandonment of the mines. Specific revegetation measures that would be required are stated in 30(CFR): 717.20, and 30(CFR): 211.40, 211.41, and 211.62, in the *Federal Register* (Vol. 42, No. 239, and Vol. 41, No. 96). These regulations are discussed in detail in the regional volume, chapter 4, Vegetation.

Revegetation Problems and Probability of Success

The revegetation of disturbed areas would be difficult, due to many factors. Climatic conditions are severe with extremes in temperature and wind, and low annual precipitation (approximately 11 inches). Insufficient moisture is the main factor hampering successful revegetation (Cook, Hyde, and Sims 1974; Hassel 1977; Hodder 1977). There also may be periods of drought, such as in 1976 when the annual precipitation was considerably lower than normal. Other revegetation problems which may be encountered are steep slopes; soil conditions which are detrimental to plant life (see Soils); competition for moisture, nutrients, and light from undesirable weedy plant species; low germination rates of seeds; and destruction of seedlings by wildlife. Various revegetation techniques have been developed to counter such problems, and are discussed in detail in the regional volume, chapter 4, Vegetation. The use of many of these techniques may be necessary to establish on the disturbed mine site "a diverse vegetative cover capable of self-regeneration and plant succession and at least equal in density to the natural vegetation," as required by the federal regulations (30 [CFR]: 211.40[a][13][i]).

Hassell (1977) states that in desert areas conditions favorable for establishing vegetation come every four to six years. The harsher areas where revegetation may be most difficult due to extremely droughty conditions, are along the railroad and water line right-of-way, and on steep south-facing slopes. Much of the right-of-way is in an area that receives only 8 to 9 inches average annual precipitation.

Numerous researchers have indicated that irrigation may be necessary for establishment of seedlings in areas which receive 10 inches or less annual precipitation (Aldon 1977; Bengson 1977; Hassell 1977; Cook, Hyde, and Simms 1974; DeReemer and Bach 1977). Aldon, DeReemer and Bach, and Bengson (all 1977) have had success with drip irrigation techniques in arid environments. If irrigation proves to be essential for establishment of vegetation on the harsher disturbed sites at the Loma Project and railroad right-of-way, sufficient water would probably be available for irrigation due to Sheridan's 10 cfs water right from the Mack Pumping Pipeline.

Hodder (1977) has developed several methods for retaining soil moisture in semi-arid environ-

ments, which may prove useful for revegetation in arid environments. These methods are pitting or gouging the soil surface, moisture collars, or condensation traps.

A listing in the appendix (volume 3), shows plant species occuring naturally within the region that may be used for revegetation. The species shown as adapted to the saltbrush or pinyon-juniper types may be particularly suited to the Loma Project site and railroad right-of-way, since the disturbance would occur largely in, or very near those plant communities.

Revegetating with shrubs, grasses, and forbs would result in a plant community which would more closely resemble a composition found in the natural environment, and would better blend into the adjacent landscape. A diversity of shrubs, forbs, and grasses is also necessary to satisfy the plant composition requirements of the post-mining land uses (wildlife habitat and livestock range). Wildlife (particularly big game) utilize shrubs while livestock graze mostly on grasses. Both classes of animals utilize forbs to a certain extent, mainly in the early spring.

There is no mention in Sheridan's M&R plan of protecting the seeded areas from livestock or wildlife. Precautions such as fencing or other measures may be necessary to ensure that the revegetated areas are not utilized by livestock and wildlife before they can support such use without deterioration.

Past revegetation attempts in the arid Grand Valley (at or less than 10 inches annual precipitation) have met with little success. Based on conversations with the Soil Conservation Service and the Colorado Department of Highways in Grand Junction, the only successful revegetation in the area has been along Highway 70 west of Loma. The highway right-of-way was seeded six years ago, and a good stand of crested wheatgrass, western wheatgrass and Indian ricegrass is present now. The spring following the seeding had much higher than normal precipitation (U.S. Weather Service Data for Fruita). The Highway 70 right-of-way between the Clifton interchange and Walker Field in Grand Junction has been seeded three times without any success.

Despite the fact that various revegetation techniques involving both dryland revegetation and irrigation show potential for successful revegetation in arid environments, many of these techniques are yet in the research stage, and their feasibility for use in the Grand Valley has not been proven. Because of this, and the marginal success of past revegetation efforts in the Grand Valley, successful revegetation of the harshers sites (areas with less than 10 inches annual precipitation and steep south-facing slopes) on the Loma Project and railroad right-of-way is not certain, except in years of higher than normal winter or spring precipitation.

Other problems at the Loma Project and right-of-way which may hamper successful revegetation (particularly on steep slopes) are the unavailability of topsoil and high salinity of topsoil in the East Salt Creek floodplain.

Natural revegetation would occur at the Sheridan mines if the soils are stable and do not contain materials toxic to plant growth. Weedy annuals such as Russian thistle would be the first to invade the disturbed areas, followed by a succession of longer-lived plants until a persisting (climax) plant community of adapted perennial species similar to adjacent undisturbed areas exists. This natural succession process may take anywhere from 30 to 60 years or more, depending on varying micro-environmental conditions such as slope, distance from undisturbed communities, etc.

Some vegetation may be disturbed by subsidence over the mined areas. Coal removal could cause an estimated maximum subsidence of eight feet (see Topography). The effects of this disturbance would be an increase in soil erosion (see Soils). Loss of livestock and wildlife forage would be minimal.

Population-Related Impacts

Urban expansion caused by population increase related to coal mining would result in the disturbance of an estimated 30 acres of vegetation by 1980, 247 acres by 1985, and 493 acres by 1990. It is probable that much of this disturbance would be on agricultural land surrounding existing population centers.

Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road-vheicle use. This disturbance would lessen the productivity of native vegetation for livestock and wildlife forage. The problem would be most serious in low altitude Mancos shale hills and in alpine areas above timberline.

Endangered and Threatened Species

Sheridan's proposed railroad and water line would disturb approximately 184 acres of saltbush in the Mancos shale north of Loma. *Cryptantha elata*, a proposed threatened plant in the *Federal Register*, could potentially be impacted by the disturbance, since dry saltbush-covered Mancos shale hills in Mesa County, Colorado, and Grand County, Utah, are its potential habitat. *Cryptantha elata* has been found in the Mancos shale north of Loma and Fruita (Wm. Weber collections, 1955, 1978).

Detailed plant inventories would be conducted on the land that would be disturbed by the railroad and waterline, to determine the presence or ab-

sence of *Cryptantha elata*. If significant populations of *Cryptantha elata* are found, mitigation measures would be proposed to curtail or minimize the adverse effects on the plant. Possible mitigation measures would be rerouting the railroad and waterline so as to avoid *Cryptantha elata* populations.

The proposed railroad and waterline, even in a worst case impact situation, are not expected to jeopardize the continued existence of *Cryptantha elata. Cryptantha elata* range extends over a much larger area than just the vicinity of the railroad and waterline. Several widely separated populations of the plant have been found. It is likely that many more populations exist than have been discovered, due to the relatively little botanical inventorying that has been conducted in the Mancos shale of Mesa County, Colorado, and Grand County, Utah.

In the worst case, the proposed railroad and waterline might impact only portions of *Cryptantha elata* populations. The surface disturbance resulting from construction could be up to 200 feet wide (Sheridan's proposal) and would run for several miles through the Mancos shale. *Cryptantha elata* populations do not follow this type of arbitrary configuration; therefore, at most, the railroad and waterline would transect portions of *Cryptantha elata* populations.

Wildlife

Due to construction of mine portals and roads to permanent facilities, a rail and waterline corridor, disposal site, and permanent facilities for washing and loading coal, 39 acres of habitat would be destroyed by 1980, 649 acres by 1985, and 676 acres by 1990 (see Vegetation for vegetation types impacted). Smaller, less mobile animals and burrowing species would be killed outright during construction activities. Human activity and destruction of food and cover would eliminate habitat on this acreage for the larger species, such as mountain lion, black bear, and golden eagle, and to a lesser extent, mule deer, bobcat, coyote, and ringtailed cat. Pellet group transects which have been run near the tract indicate use of 42 deer days per acre; see table S3-4 for the number of deer that could be supported by these acres. Some habitat might remain for very tolerant species, such as deer mice, English sparrows, and mourning doves. Vehicle-animal collisions would increase with more traffic on the roads, primarily during the winter months.

In addition, approximately 4,000 acres of adjacent habitat would be degraded due to increased human activity. The degree of disturbance would vary, depending on proximity to mining facilities, topography, and vegetative cover. This would be an average reduction of 50 percent, assuming that impacts would be progressively less, the farther the habitat is from the disturbance. Mountain lion and black bear use is expected to cease in areas adjacent to the facilities because of their low tolerance of human activity. Other species that would be affected but not totally excluded from the 4,000 acres would be mule deer, golden eagle, coyote, bobcat, and ringtailed cat.

The number and location of air shafts that would be required is not currently known, but surface roads for construction and maintenance of ventilation facilities would increase the area affected by the above impacts. Seasonal mule deer migrations north and south through the area would be only slightly disrupted, but daily movements of mule deer would be affected by roads and conveyors connecting the mine portals and main loading and washing facilities. In addition, all big game species would be more susceptible to legal or illegal hunting as access is improved on the area.

It is difficult to predict to what extent subsidence would affect wildlife because of lack of information about the effects of subsidence. To a large extent, however, wildlife would gradually develop trails through the areas.

One active and one suspected nest site for golden eagles could be affected. The greatest threat to the continued use of these sites would be human activity above or at the base of the nesting cliffs. The March to July period would be the most critical. Nest sites are selected at the beginning of this period, and disturbance after that could cause the adults to abandon their young.

The open desert type is an important raptor hunting area, as demonstrated by the large number of golden eagles and prairie falcons which nest along the face of the Little Bookcliffs. Construction and operation of the railroad, pipeline, and power lines to the lease tract would reduce the prey base for raptors and carnivores in the general area of the route; during construction, prairie dogs, deer mice, Ord kangaroo rats, burrowing owls, and most reptiles would be killed along the route. Power lines would be a physical hazard to birds in flight and an electrocution hazard to the larger raptors. On the open desert, power poles would be especially attractive as perches, since fewer other sites are available. If electrocution hazards are minimized by proper pole design, raptor hunting opportunities would be enhanced by the addition of these perch sites.

Approximately 1 acre of riparian habitat, consisting of scattered cottonwoods along East Salt Creek, would be lost. Several species of toads, wandering garter snakes, and a number of passerine birds, partic ularly those that nest in tree cavities, would be lost from this area.

TABLE S3-4

IMPACTS ON WILDLIFE

Year	Total Disturbed Acres	Number of Animals that These Acres Could Support					Additional Acres Disturbed	Additional Animals that Could be Supported		
		DDA	D	EDA	E	WH		D 50%	E 50%	WH 50%
1977	20	42	5	-	-	-	4,000	509	-	-
1980	39	42	11	-	-	-	4,000	509	-	-
1985	649	42	171	-	-	-	4,000	509	-	-
1990	676	42	178	-	-	-	4,000	509	-	-

Note: DDA = deer days per acre; EDA = elk days per acre; D = deer; E = elk; WH = wild horses.

Antelope movements would be disrupted by train traffic. Movement could be blocked if the railroad right-of-way is fenced in a manner which does not allow passage of antelope. In addition, locating the railroad immediately adjacent to East Salt Creek would disrupt the activities of many animals often attracted to the water and riparian vegetation. Disturbance would occur during construction and continue for as long as the line is in use. Locating the railroad away from East Salt Creek in desert shrub type would lessen the total number of animals and species affected.

Locating the railroad on nonagricultural lands along East Salt, West Salt or Badger washes could conflict with Colorado Division of Wildlife (DOW) plans to obtain these lands as mitigation areas for another project (the lining of irrigation ditches by the Bureau of Reclamation under the Grand Valley Salinity Control Program). This project would cause a loss of game bird habitats, and mitigating measures are being developed to provide game cover interspersed through the agricultural lands.

Secondary impacts from the proposed action would include increased human population, resulting in expansion of urban areas onto agricultural and some crucial winter range; increased vehicular traffic, resulting in an increase in vehicle/animal collisions; and increased recreation use of the area, causing an additional stress on the animals and increasing legal and illegal harvest of animals.

Endangered or Threatened Species

No endangered or threatened species would be affected by the proposed action. Coordination with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act of 1973 and the Bald and Golden Eagle Protection Act (16 USC 668-668d) has been completed. USFWS comments can be found in chapter 9.

Aquatic Biology

All of the 10 gallons per minute of ground water intercepted in the mines would be used in the coal mining operations. No discharge of mine water to East Salt Creek or the Colorado River would take place, and there would be no change in the aquatic habitat from this source.

Approximately 1.2 cfs (850 ac-ft/yr) of water would be needed at the site. Sheridan Enterprises has water rights for 10 cfs from the Mack Pumping Pipeline. Any modification of the natural channel of the Colorado River in establishing the pipeline diversion or facilities would require a 404 permit from the Army Corps of Engineers. Once the pipeline begins operation, fish eggs and larvae from both sport fish and the Colorado River threatened and endangered fish species may suffer minor entrainment mortalities.

Increased consumptive use of 1,760 acre-feet of water per year by the coal-processing activities and by 5,800 new people in the area by 1990 would further deplete the amount of water available for fish and aquatic wildlife habitat in the Colorado River. This consumption alone is not significant to the aquatic habitat when compared with the 5,797 cfs average discharge and the 960 cfs average minimum daily discharge for the Colorado River at the Colorado-Utah state line. It gains in significance when all water uses and developments in the basin are compared with the quantities of water available to support fish and wildlife habitats during yearly low-flow periods.

Until Sheridan implements a site drainage system, runoff from the disturbed areas would flow directly into the East Salt Creek drainage and then into the Colorado River. This untreated flow may be harmful to Colorado River aquatic organisms and fish, but due to the poor natural water quality of East Salt Creek and the largi dilution factor of the Colorado River, any impact on aquatic organisms would be unlikely.

Before the Sheridan M&R plan could be approved, the operation must comply with OSM regulations. All runoff from surface areas disturbed by mine construction and operation must be retained in sediment ponds as required by 30(CFR): 717.17. Sediment retention ponds will contain all runoff from a storm event up to a 10-year/24-hour storm. Spillways on ponds will be designed to safely pass a 25-year storm event. Discharges of water from these ponds, should they be necessary under normal conditions, may not exceed 45 mg/l total suspended solids, and the 30-day average discharge may not exceed 30 mg/l. A discharge of this concentration of suspended solids, should it occur, would not adversely affect the aquatic ecosystem of the Colorado River downstream form the lease site.

Sediment retention ponds may legally spill in a precipitation event larger than a 10-year/24-hour storm. In such a case, some coal dust and other fine sediments from the ponds might flow into the Colorado River. In an event larger than a 10-year/24-hour storm, total sediment yield from the many highly erosive watersheds adjacent to the Colorado River would be so large that the amount of sediment coming from the retention pond spillway would be unmeasurable in the river and have insignificant impacts. Also, the increased dilution in the Colorado River during a large storm would largely decrease the concentration of all water-quality parameters. No adverse effects on the aquatic habitat on the threatened and endangered fish species are presently projected. Aquatic organisms presently

living in this part of the Colorado River normally withstand a total suspended-solid concentration ranging from 59 to 4,420 parts per million (ppm), with an average of 2,270 ppm, and a total dissolved-solid content averaging 200 to 250 mg/l in the spring and 600-650 mg/l during low-flow periods.

Threatened or Endangered Species

No adverse impacts to threatened or endangered aquatic species in the Colorado River are presently expected to occur due to the proposed mining operation. Coordination with USFWS under Section 7 of the Threatened and Endangered Species Act of 1973 has been completed. USFWS comments can be found in chapter 9.

Cultural Resources

Archeological Resources

Although no archeological sites were identified in the Class III survey (for drill holes and access roads), the presence of petroglyph 5GF168 within the lease area and the occurrence of archeological sites in the vicinity indicate the presence of prehistoric inhabitants. The potential for subsurface sites also exists (Connor 1977). Therefore, construction and operation activities affecting a total of 39 acres by 1980, 649 acres by 1985, and 676 acres by 1990 could result in the destruction and alteration of archeological data that remain undetected by archeological surveys. In addition, subsidence, as it could affect 12,500 acres of the lease property, would create surface disturbances which could displace or damage existing archeological values. The presence of 900 mine employees by 1990 would mean increased exposure of existing archeological values in the proposed area to public passage.

Site 5GF168 is situated within an area of proposed mining-related activity and would be impacted by the proposed action. Its location in a heavily trafficked area would make it susceptible to vandalism (refer to chapter 4, regional volume, for discussion of impacts of vandalism). In addition, alteration of the surrounding environment of the site would introduce physical elements that would disrupt the aesthetic integrity of the site as well as the ecological backdrop in which the site can best be viewed and understood.

The location of site 5GF113 near the Douglas Pass Road suggests that further impacts to the site should not result from the proposed action. The site has been determined as not eligible for the National Register of Historic Places.

Historic Resources

Because the extent of historical sites in the mine area is not fully known, the following impacts may occur. Surface-disturbing activities, such as mining or construction of facilities and roads, could disturb buried sites or destroy sites that might be considered unimportant by the project engineers. Because of the intrusion of buildings, roads, fences, etc., some sites might lose the aesthetic integrity which is important to the overall quality of the site, as outlined in 36(CFR): 800.9. Sites remaining near or at the project might be vandalized due to increased access or human use; damange could include "stripping" of wood, removal of artifacts, etc.

Land Use

The lease area would be used for coal mining through 1990. Livestock and wildlife use would be reduced on the areas directly disturbed by surface facilities and mining activity. In addition, wildlife use would be reduced an average of 50 percent on 4,000 acres of adjacent habitat. Lands on the valley floor, which are now primarily desert grazing lands, would be partly taken up by surface facilities, including buildings, parking lots, conveyors, coal storage silos, a rail loadout, and a rail spur line. The rail/utility corridor from the mines to Loma would also reduce farmland acreage slightly. Some of the land impacted by this corridor may qualify as prime farmland.

Most of the population increases due to the proposed mines are expected to occur in Fruita and Grand Junction, with some slight increases in Loma and Mack. Some of the resulting residential and urban expansion would probably encroach on agricultural land (indlucing some prime farmland) and wildlife wintering areas. However, to some extent, the location of this urbanization would depend on future county and community land use planning and zoning.

Transportation

HIGHWAYS

Sheridan proposes to construct a railroad spur from Loma to the mine site. Although completion of this spur is projected by 1982, no site has been selected and no right-of-way has been applied for. Until such a spur is built, all coal produced by the Sheridan mines would have to be hauled by truck on State Highway 139 to a railroad loadout near Mack. This traffic would be concentrated in an eight-hour daytime shift, resulting in heavy use which would be detrimental to the existing highway. The highway would require extensive improvements such as resurfacing and widening. Increases in noise levels and a 20 percent increase in accident rates along State Highway 139 could also be expected from frequent coal truck traffic. Once the rail spur has been completed, trucking of coal

would be discontinued and the above impacts would no longer occur.

Traffic on State Highway 139 would also increase because of the mine personnel driving to and from work. Assuming an average of 1.5 persons per car, this could generate as many as 332 trips per day with a corresponding number of return trips. Traffic would be heaviest just before and after shift changes.

RAILROADS

Because the route of Sheridan's proposed spur has not been selected, an analysis of the impacts associated with it is not possible. An environmental analysis of the spur will be completed before construction begins.

The mining operation would generate approximately 1.5 trains per day. The hazard rating for the grade crossing at Loma would increase by 0.5 accident per five years.

AIRLINES

Passenger loads into Walker Field at Grand Junction would increase. Facilities there would be adequate to handle the increase.

Livestock Grazing

Development of the central facilities, mine portals and associated facilities, refuse pile, water pipeline, and railroad would result in the loss of 3 animal unit months (AUMs) of livestock use annually on 39 acres of natural vegetation by 1980, 41 AUMs annually on 649 acres by 1985, and 48 AUMs on 676 acres by 1990. The livestock qualifications (maximum livestock use permitted) on the public land disturbed would be reduced due to the loss of livestock forage. However, the loss of AUMs represents 2.6 percent of the AUMs present on the coal lease tract and railroad corridor and would not cause severe hardship to the livestock operators concerned.

The disturbance of agricultural land by the water pipeline and railroad right-of-way (maximum of 160 acres) may adversely affect the livestock industry in the area because it is probable that much of the land disturbed would be irrigated and nonirrigated hayland and pasture. These lands are used as livestock wintering areas, and the hay harvested from them in the summer is used to feed livestock during winter. The loss of them may result in hardship on some livestock operators.

Approximately 80 AUMs per year would be restored to the coal lease tract and railroad corridor upon successful revegetation of the disturbed areas after the mine is abandoned. This would be a net increase of 32 AUMS per year over what the land currently provides. As discussed in Vegetation, however, successful revegetation is not certain, particularly on the harsher disturbed areas (steep south-facing slopes and areas with less than 10 inches average annual precipitation).

Some cattle may be killed by haul trucks going to and from the mine portals, the central facilities, and the refuse pile.

Urban expansion due to population increase from the proposed project would disturb 30 acres in 1980, 247 acres in 1985, and 493 acres in 1990. It is probable that much of this disturbance would be on irrigated and nonirrigated hayland and pasture, and it is unlikely that this land would be returned to agricultural use.

Recreation

The influx of additional population due to the Sheridan site and the subsequently increased demand for recreation opportunities could have an impact on existing recreation resources and facilities, particularly community facilities in the Grand Junction-Fruita area. Since Grand Junction's recreation facilities are now fully utilized (Grand Junction Recreation Department 1977), increased use would result in overuse which would lead to their deterioration and a lowering of capacity to provide enjoyable recreation. The community facilities needed to meet the increased demand and prevent overuse are projected in table S3-5 which shows a need for 1.2 acres of active/improved park lands by 1980, 9.6 acres by 1985, and 19.9 acres by 1990. Capital investments needed to provide these facilities are also projected in table S3-5.

The increased use of recreational facilities could be offset by providing additional facilities. The Heritage Conservation and Recreation Service, through the Land and Water Conservation Fund Act (PL 88-578), could provide monies for this purpose if matching funds are provided by the local agency. The Mineral Leasing Funds (CO SB No. 35, Sect. 2; 34-63-102), which can be used for public facilities and services, could also be used for recreation facilities. In addition, BLM could provide lands for these recreation facilities under the Recreation and Public Purposes Act, 43(CFR): 2740, which allows non-profit associations to acquire lands for recreation purposes consistent with their creating authority. These actions, however, cannot be required by the Department of the Interior. Therefore, the initiative for taking these courses of action would be up to the local agencies and the success of mitigation would depend on their commitment to it.

The increased demand for dispersed recreation opportunities (e.g., hunting, hiking, ORV use, etc.) should not adversely affect the recreation resource; however, concentrated use, such as an ORV rally, could lead to vegetative deterioration and a lower quality recreation experience on that site. BLM is

TABLE S3-5

SHERIDAN: ADDITIONAL COMMUNITY RECREATION FACILITIES DEMAND

	1980	1985	1990
Population Growth	350	2,900	5,800
Active/improved parks a/ (3.3 acres per 1,000 residents)	1.2 acres	9.6 acres	19.1 acres
Capital investment ($66,666 per 1,000 residents)	$23,333	$193,331	$386,663

Source: Bickert, Browne, Coddington, and Associates, Inc., 1976.

a/ Ballfields, tennis courts, playgrounds, etc.

in the process of determining open, restricted, or closed designations for public lands, which should help alleviate this problem. Increased use of recreation facilities (such as Highline Lake Recreation Area) would lead to increased maintenance costs for the managing agencies. The extents of the increased usage and costs are not known.

The Sheridan mining activity could have an impact on recreation users of State Highway 139, which goes through the lease site and would be the temporary coal truck haulage route. The highway is a major route to Dinosaur National Monument and the Douglas Pass area and had a traffic volume of 470 vehicles per day in 1976 (Colorado Division of Highways 1976). Employee traffic could increase congestion and accident rates.

The Sheridan lease site is not now identified for any wilderness study and due to the presence of existing roads is not expected to be so identified.

Visual Resources

EAST SALT CREEK

The open, natural setting of the East Salt Creek Valley would be significantly altered by construction of the proposed Sheridan central facilities and a portal entry. A radiating road network and power line grid would serve the central offices, wash plant, etc., and the nearby portals in Spink, McClane, and Munger canyons, so that specific landscape alterations would occur for about 3 miles along East Salt Creek. However, the associated visual changes would continue 20 miles south to the Loma area because of trucks hauling coal. In addition, visual clarity in the valley depression would be lowered by 6 miles because of increased particulate matter which would create an artificial haze condition.

The view characteristics of East Salt Creek focus maximum attention on the valley floor, so that buildings, parking lots, conveyors, and coal storage structures would be closely looked at and the individual components of the operation would be viewed together as a major complex of wires, roads, buildings, etc. Previous agricultural development was small scale and in harmony with the natural landscape; the proposed mining complex introduces a new, larger scale which contrasts significantly with existing landscape modifications.

The portal facility would also be visually dominant along East Salt Creek, changing the natural landscape character. Interruptions of vegetation textures, natural color zones, and existing linear components of the landscape would further emphasize the presence of the mining operation.

East Salt Creek has been designated as a VRM Class II (see the appendix, volume 3), which stipulates that changes on this landscape should not be evident nor disrupt the characteristic form, line, and color of this visual zone. A contrast evaluation of the proposed facilities indicates that the VRM Class II could not be maintained and would drop to a Class V for the life of the mining operation.

SPINK CANYON

The mine portal complex of office, raw coal bin, parking lot, electrical substation, etc., would introduce new forms into the undeveloped Spink Canyon. Landform alterations and interruptions of vegetation textures, soil colors, and rock strata lines would prevent the blending of this addition into the characteristic landscape.

Spink Canyon has been rated as a VRM Class IV, which allows landscape changes to dominate the existing visual character, but these changes should reflect a natural origin. A contrast rating of the proposed additions demonstrates that Class IV criteria could not be met; they would, therefore, be lowered to Class V.

MUNGER CANYON

The steep side slopes of Munger Canyon are presently altered by a single-lane access road and portal terraces. Additional road widening and terrace formation would leave a cut-and-fill scar; it is questionable whether the scar could be reclaimed, because of the fill requirements. The present VRM Class IV allows changes to dominate the existing visual character, but they should reflect a natural origin, which would not be possible. The resultant VRM Class V would be short term for the mine life and would require reclamation, which would be a long process for Munger Canyon; the lack of natural moisture and prohibitive fill requirements would generate a long-term visual impact.

MCCLANE CANYON

The flat-bottomed landform of McClane Canyon would absorb the proposed portal site without permanent disruption. Existing terraces and the road cut would accommodate portal expansion, but additional buildings and activity patterns would lower the existing VRM Class IV to a Class V because the visual contrasts could not reflect a natural origin. Changes in landform, texture, line, and color would be disruptive in this cliff-enclosed canyon, but the landform could be returned to approximately the original contours.

REFUSE CANYON

The deposition of mine waste in this unnamed drainage would permanently change its landform character. Soil colors, vegetation textures, and existing edge lines would be buried, which would establish a contrast that would require the existing VRM Class IV to drop to a Class V. Assuming the

refuse piles could be stabilized and revegetated, the major visual impact would be the landform change of the canyon.

RAILROAD RIGHT-OF-WAY

The development of a 20-mile railroad, pipeline, and power line corridor across the Grand Valley would add another linear land use to existing roads, power lines, ditches, and fences. As a new land form, the railroad embankment would have a weak to moderate contrast depending on the site-specific cut-and-fill requirements. The embankment would establish a barrier for vehicle circulation and, if it were fenced, would also affect livestock movement; these problems would influence the local perception of the rail corridor.

Other visual contrasts due to vegetative disruption and soil color contrasts would be created by the cuts-and-fills. These disturbances would eventually blend with the surrounding landscape as weathering and revegetation reduce the contrasts.

Rail activity on the spur corridor would also have visual implications, especially for local residents. Heavy utilization by long trains could have negative implications due to noise and intersection delays. The visual implications of the rail spur would be directly linked to the other problems it creates, which, if minor, would produce no major visual impacts.

Socioeconomic Conditions

Demography

Even though the Sheridan operation is located in Garfield County, all existing communities within the vicinity of the site are located in Mesa County. All population growth related to the development of the site is expected to occur in Mesa County. That population growth is projected to be 350 persons by 1980; 2,900 persons by 1985; and 5,800 persons by 1990.

Most of this population growth is expected to occur in either Fruita or the Grand Junction area, with a small percentage residing in the small communities of Loma and Mack. Fruita is the closest town to the site (figure S3-2), and it would be able to provide for 1,500 to 2,500 new residents, given the constraints on its water system. Grand Junction and its surrounding communities are all within a reasonable commuting distance of the site, so that available housing should determine, for the most part, where the new population would settle.

Community Attitudes and Lifestyle

General changes expected in attitudes and lifestyles due to increased coal mining in the area are discussed in the regional volume. Some of the most visible effects of the Sheridan development should be upon the small community of Loma, which would be subject to all the coal truck traffic between the mine and the railroad loadout activities. Significant growth in Fruita would make it a more viable community, decreasing its economic dependence on nearby Grand Junction.

Noise

During the period when coal would be trucked from the mines to Loma, the total truck traffic during the eight-hour period when coal is being hauled would produce equivalent noise levels of 74 and 65 decibels (dBA) at distances of 50 and 200 feet from the road. The 50 dBA contour would be about 2,000 feet from the road. In Loma, equivalent noise levels (L_{eq}) might be 3 dBA higher due to the reduced speed of the trucks and additional truck traffic on U.S. Highway 6. Excluding the coal truck traffic, the L_{eq} in Loma on Highway 6 would drop to 65 and 53 dBA at 50 and 200 feet from the highway.

The temporary high noise levels, together with other stresses placed on the community during a period of rapid growth, may produce an undesirable reaction within the community. There would be a significant disturbance of speech outdoors, and during the summer months this undesirable situation would be extended into homes and places of business. The school in Loma would suffer some interruption in teaching during warm weather, but outside levels should be acceptable when windows are closed. These problems would be eliminated when the railroad spur from Mack is operational.

The noise impact of the railroad spur in Mack should be minimal. The volume on the rail spur would be approximately 75 percent of westbound unit trains from the region by 1985, and the two volumes would be approximately equal by 1990. This does not take into consideration train traffic other than unit trains.

Community Facilities and Services

The projected community facility requirements for Mesa County associated with the Sheridan operation are listed in table S3-6. These figures were derived in a similar manner to those contained in the regional volume, chapter 4, Socioeconomic Conditions.

These cost figures do not reflect the major capital expenditures which are expected to be made in Mesa County to upgrade water and sewer treatment systems regardless of the proposed action. Local governments would be dependent upon a portion of new revenues generated by the proposed action to assist in paying for projects like the $5 million water system expansion program and the $14 million sewer system expansion program

Figure S3-2. Greater population pressures would affect the Fruita area.

TABLE S3-6

SHERIDAN: ADDITIONAL REQUIREMENTS FOR COMMUNITY FACILITIES IN MESA COUNTY

Facility	Physical Plant Requirements	Capital Costs - 1990	Operating Costs/Year 1980	1985	1990
Water treatment	1.16 mgd	$1,014,480	$ 4,380	$ 36,310	$ 72,620
Sewage treatment	0.35 mgd	1,148,400	3,380	28,010	56,030
Police protection	4 vehicles 2,320 sq. ft.	187,440	14,000	116,000	232,000
Fire protection	2 vehicles 5,800 sq. ft.	382,000	7,000	58,000	116,000
Streets and roads	137 acres	4,414.140	7.760	65,960	132,890
General Government	1,450 sq. ft.	93,380	11,400	94,610	187,920
Libraries	17,400 books 3,190 sq. ft.	235,630	2,190	24,070	48,140
Total	-	$7,475,470	$ 38,230	$422,960	$845,600

Note: mgd = million gallons per day; sq. ft. = square feet of space.

a/ If amortized at 6 percent over twenty years, the yearly cost would be $631,850.

planned for Grand Junction (see chapter 2 regional volume).

Projected increases in the local revenues attributed to the Sheridan development are listed in table S3-7. These revenues are based on increases in residential, commercial, and industrial property values, increased sales tax revenue resulting from population growth, and water and sewer service fees. Since the Sheridan operation itself would be located in Garfield County, that county would receive an increase in assessed valuation estimated to be $1.8 million in 1980, $62.8 million in 1985, and $66.5 million in 1990.

The revenues listed in table S3-7 reflect total revenues expected to flow to all local government entities. Since the estimated increases in community facility expenditures would be borne by county, municipal, or special district units of local government, the school district revenues were subtracted. This lowers the amount of locally derived revenue for county, municipal, and special district units of government to an estimated $79,070 in 1980; $688,630 in 1985; and $1,444,930 in 1990. These locally derived revenues should be almost sufficient to meet the projected annual community facility costs of $1,497,350 (amortized capital costs and operating costs) due to the development of the Sheridan site.

Substantial property taxes would accrue to Garfield County from this project. Using an investment level of $36 per annual ton of production, a total investment of $180,000,000 would be required. Assessed value of this amount would be $54,000,000. At a property tax levy of 75.65 mills, the tax would be $4,085,100. Property taxes on the coal produced would be $138,550 in 1980; $666,190 in 1985; and $948,990 in 1990. Total property taxes would reach $5,034,090 by 1990. Using 1976 tax rates, $1,409,550 of the 1990 total would go to the county; $3,523,860 would go to the school districts; and $100,680 would go to the special districts in the county.

Housing

The projected demand for new housing in Mesa County as a result of population growth attributed to the Sheridan operation is summarized in table S3-8. The same assumptions regarding household mix and family size that were used in the regional volume were used in these calculations.

These housing requirements associated with Sheridan represent about 7 percent of the total projected new housing requirements in Mesa County by 1990. This housing and its related roadway requirements would use approximately 30 acres in 1980; 247 acres in 1985; and 493 acres in 1990.

Education

The expected increase in school-aged population due to the development of the Sheridan operation is shown in table S3-9, along with the increase in school district capital requirements and operating costs anticipated from that population increase.

Almost all of the increase in school-aged population is expected to occur in School District 51 in Mesa County, which includes Fruita and the entire Grand Junction area. District 51 would receive an increase in its assessed valuation of approximately $23.4 million related to population growth from the Sheridan development. The district, however, would not benefit from the valuation of the Sheridan mine installation itself. An increased assessed valuation of $23.4 million would allow District 51 to bond itself for an additional $4.7 million, which would be much less than the projected need for additional capital facilities.

The Sheridan operation would be located in School District 49(JT), which has its only facilities in DeBeque. The addition of the mines to the DeBeque district should boost its present assessed valuation of $1.3 million by $66.5 million.

Health Care

Population growth associated with the mines is expected to increase the demand for health care services in the Grand Junction area. Table S3-10 is an estimate of the capital facilities needed to meet this increased demand for health care services.

Most of the existing health care facilities in the area are supported by fees collected for services performed instead of through local tax revenues.

Employment

Although the Sheridan operation would be located in Garfield County, impacts are expected to occur in Mesa County. In 1980, Sheridan expects to employ 177 people, which would increase total employment in Mesa County by 250. In 1985, employment at the mines is expected to reach 470, increasing total employment by 1,462. By 1990, 900 persons would be employed at the mines and total employment would increase by 2,907 which would be a 10 percent increase over 1976 total employment of 28,662.

Income

Because the proposed Sheridan operation is so large, it would have a major impact on income in the region. Sheridan did not estimate a potential payroll, but information from other companies indicates that an average income for mine personnel of $16,600 per year could be expected. In 1975 median family income in Mesa County was $11,130, and in Garfield County it was $11,565;

TABLE S3-7

PROJECTED INCREASES IN REVENUE TO MESA AND GARFIELD COUNTIES FROM SHERIDAN

	1980	1985	1990
Mesa County:			
Property Tax			
Homes	$ 79.310	$ 754.150	$1,507,420
Businesses	19,250	159,470	318,940
Sales Tax	43,610	361,340	722,680
Service Fees	1,460	12,090	42,160
Total	$143,630	$1,287,050	$2,641,200
Garfield County:			
Property Tax			
Mine	0	$4,085,100	$4,085,100
Coal Mined	$138,550	666,190	948,990
Total	$138,550	$4,751,290	$5,034,090

TABLE S3-8

SHERIDAN: NEW HOUSING REQUIREMENTS IN MESA COUNTY

Housing Units	1980	1985	1990
Single-family units	58	628	1,256
Mobile homes	47	242	483
Multi-family units	11	97	194
Total	117	967	1,933

TABLE S3-9

SHERIDAN: MESA COUNTY SCHOOL DISTRICT 51 FACILITY REQUIREMENTS

Year	Increase in School-Aged Population	Facility Requirements (square feet)	Facility Costs (dollars)	Operating and Maintenance Costs (dollars/year)
1980	81	11,340	$ 510,300	$ 99,630
1985	701	98,140	4,416,300	862,230
1990	1,395	195,300	8,788,500	1,715,850

TABLE S3-10

SHERIDAN: PROJECTED HEALTH CARE FACILITY REQUIREMENTS IN MESA COUNTY

Year	Facility Requirements	Facility Costs (dollars)
1980	1 hospital bed	$ 55,000
1985	12 hospital beds 1 emergency vehicle	675,000
1990	23 hospital beds 1 emergency vehicle	1,280,000

TABLE S3-11

SHERIDAN INCOME

Year	Employees	Payroll	Total Regional Income
1990	177	$ 2,938,200	$ 4,466,060
1985	470	7,802,000	11,859,040
1990	900	14,940,000	22,708,800

both are considerably lower than the projected income for miners.

Using the above rate, total payroll for the Sheridan operation would be $14,940,000 in 1990. The multiplier effect (explained in the regional volume) would add an additional $7,768,000 to the regional income. Total direct, indirect, and induced income from this project would be $22,708,800. Table S3-11 shows projected employment, payroll, and total regional income that would be generated annually for 1980, 1985, and 1990.

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

The mitigating measures proposed in this chapter are measures which will be taken to minimize or eliminate specific adverse impacts identified in chapter 3 which would result from approval and implementation of Sheridan Enterprises' mining and reclamation (M&R) plan. They do not include federal regulations, such as 30(CFR): 700, which are considered to be requirements with which the M&R plan will have to comply before it can be considered for approval. Neither do they include any mitigating measures which might have been developed by Sheridan as part of the M&R plan; these have been described and analyzed as part of the proposed project in chapters 1 and 3.

All mitigating measures proposed in this chapter must be "real and committed," by definition in Bureau of Land Management (BLM) Manual 1792. "Real" means that the measures must be legally enforceable and actually workable for the area and situation being assessed. "Committed" means that the agency requiring the measures (in this case, BLM) will ensure that they become part of the authorizing document and will take the necessary steps to see that the measures are in fact implemented as part of the proposed project. Thus, if Sheridan's M&R plan is approved, all measures proposed in this chapter will be required in addition to the federal, state, and county requirements discussed in chapter 1, Authorizing Actions.

In the case of mitigating measures for air quality, those measures identified below are for major potential air pollution sources at the mine. However, Best Available Control Technology (BACT) will be required on all significant fugitive dust sources identified in table S3-1, chapter 3. Accordingly, additional controls beyond those specified below may be required by the U.S. Environmental Protection Agency in its review for prevention of significant deterioration (PSD) or by the Office of Surface Mining in the air quality analysis of its permit review. The controls required herein as mitigating measures are BACT for those sources, but BACT may not be specified on all sources identified at the proposed mines if air quality impact is judged to be mitigated.

Any additional reasonable measures for alleviating impacts of the proposed action which would change the design of the proposal, which could cause major impacts of their own, or which cannot be considered real and committed are analyzed as alternatives in chapter 8.

Loma Project Mitigating Measure 1

Roads in the lease area will be used by authorized personnel only, in order to reduce the possibility of illegal hunting. Restricting use of access roads to authorized personnel would decrease the killing of animals by an unquantifiable amount.

Loma Project Mitigating Measure 2

Power poles will be raptor-proofed in accordance with BLM standards as outlined in BLM Manual 2850 and Instruction Memorandum No. C078-30. Raptor-proofing power poles would prevent electrocution of eagles or other large birds.

Loma Project Mitigating Measure 3

If rights-of-way are fenced, all fencing will comply with BLM fencing standards for antelope fence. Antelope fencing along the rights-of-way would allow the antelope to freely move across the rights-of-way and significantly reduce the possibility of the antelope getting caught in the fence.

Loma Project Mitigating Measure 4

Prior to the approval of the proposed action a concurrence of approval will be developed by the BLM and Sheridan to outline Sheridan's responsibility for the protection of cultural resources. Sheridan will provide for a Class III cultural inventory on areas proposed for surface disturbance (as supported in 1971 Presidential Executive Order 11593 nd 36(CCFR): 800.4a) and will allow for work stoppage and compliance should archeological resources be identified after the proposed action has been initiated.

An archeological survey will be required in areas likely to be impacted by surface subsidence. Due to the unpredictibility of subsidence and the lack of information available concerning the effects of sub-

sidence on archeological sites, an overburden of 300 feet or less will be used as a parameter to define potential impact areas to archeological values. Cracks and breaks in the surface are known to occur rarely with overburdens of more than 300 feet (Morgan 1978, Personal Communication). Sheridan will be required to define areas with an overburden of 300 feet or less and will provide for archeological survey of these areas. Archeological sites located by these surveys will be mitigated prior to any disturbance and future monitoring of these sites would provide valuable information concerning subsidence and its effect on archeological sites.

Identification, evaluation, and preservation of data from archeological sites prior to potentially damaging actions would mitigate the loss of archeological resources. The results of the Class III survey, as a 100 percent surface inventory of the impact areas, are considered to be representative of the archeological values in that area. The efficiency of the Class III survey as an identification process would depend on topography, vegetation, and past land use on each site. These factors would account for the possibility that hidden and subsurface sites would remain undetected and unaccounted for in developing any further necessary mitigating actions.

Any archeological values which are located and evaluated through this survey could be preserved through one or more of the following mitigating measures, depending upon the significance of a site: (1) avoidance of the site through redesign of the project; (2) descriptive and photographic records, or surface collecting; or (3) excavation according to a specific research design or as a salvage effort.

Collection and excavation are only partial mitigations. While they preserve artifacts which might otherwise be destroyed, the in-place value of those artifacts is lost. Destruction of the site would mean the loss of information which might otherwise be gained by further techniques and interpretive methods.

Should archeological sites be identified during the survey efforts and determined eligible for the National Register, compliance procedures required by Section 106 of the 1966 National Historic Preservation Act, amended 1976, and outlined in 36(CFR): 800.4-9, will be met.

Compliance procedures as stated above will be met concerning site 5GF168 in consultation with the State Historic Preservation Officer and with the approval of the Advisory Council on Historic Preservation.

Loma Project Mitigating Measure 5

Before any surface disturbance is initiated along the portion of the proposed railroad and water line right-of-way that transects saltbush-covered (*Atriplex*) Mancos shale, Sheridan will be required to conduct a vegetation inventory to determine the presence or absence of *Cryptantha elata* within the right-of-way (*Cryptantha elata* is proposed threatened in the *Federal Register*). The following measures will apply should *Cryptantha elata* be found by the inventory.

If significant populations of *Cryptantha elata* are found to occur within the proposed right-of-way, the right-of-way route will be redesigned to avoid *Cryptantha elata* populations. If adjustments of the proposed right-of-way to avoid *Cryptantha elata* are not feasible, the State Director of the BLM will determine whether the occurence (total range and abundance) of *Cryptantha elata* is sufficient to allow the right-of-way to proceed (BLM Instruction Memorandum 79-74).

Should *Cryptantha elata* receive a final listing as endangered or threatened in the *Federal Register,* the BLM would be required to initiate formal Section 7 consultation with the Fish and Wildlife Service concerning the effects of the proposed right-of-way on *Cryptantha elata.*

Conducting detailed vegetation inventories in the land to be disturbed by the proposed right-of-way would determine the presence or absence of *Cryptantha elata.* If *Cryptantha elata* is found, mitigation would curtail or minimize the adverse effects on its populations from the proposed right-of-way.

Loma Project Mitigating Measure 6

A surfactant will be added to the water spray on the conveyors and transfer points.

In the mining plan, Sheridan proposes that the conveyors and transfer points be controlled by water spray, with an estimated 50 percent control efficiency. By adding a surfactant to the spray system for longer-duration dust suppression, an estimated 85 percent efficiency can be achieved. The use of a surfactant would reduce projected 1980 emissions from these two sources by 40 tons per year, 1985 emissions by 191 tons per year, and 1990 emissions by 273 tons per year.

Loma Project Mitigating Measure 7

A chemical stabilization of the completed railroad bed will be required as a condition of approval of the right-of-way for the utility corridor.

Although no application for the right-of-way has been received and additional environmental assessment will be required for the utility corridor route, analysis in this ES identified a definite need for dust control of the railbed. No dust controls are indicated for any of the exposed areas along this right-of-way. Chemical stabilization of the completed roadbed would reduce wind erosion emissions by at least 54 tons per year.

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Chapter 5 discusses unavoidable adverse impacts which would be caused by the approval and implementation of Sheridan Enterprises' M&R plan for the proposed Loma Project. These impacts include the residual impacts after application of any mitigating measures discussed in chapter 4.

Air Quality

The Loma Project would increase annual average particulate concentrations by 20 micrograms per cubic meter (μg/m3) in a small area on the mine site near that section of the haul road used for both raw and clean coal transport. Concentrations are predicted to increase by 5 μg/m3 within one-half mile of either side of the section of haul road used to haul clean coal to the loading facility. Maximum 24-hour concentrations from the mine directly south of the facilities would be 66 μg/m3 in 1980, 78 μg/m3 in 1985, and from 65 μg/m3 (winds from the south) to 90 μg/m3 (winds from the north) in 1990. Visibility in the canyon would be reduced by about six miles in 1980; the reduction in visibility would be less in 1985 and 1990. (Table S5-1 presents the total annual expected emissions for 1980, 1985, 1990 with and without mitigating measures.)

Geologic and Geographic Setting

Topography

The proposed mining operation would result in minor alteration of the surface from installation, use, and removal of surface facilities and subsequent reclamation of the area. Subsidence of a maximum of 8 feet could occur as the result of mining. If overlying coal beds burn as a result of initial subsidence, an additional 12 feet of subsidence could occur.

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot presently be assessed because of the lack of data and evaluatory criteria.

Mineral Resources

Mining of an estimated 100 million tons of recoverable coal under the proposed Loma Project would deplete a portion of a nonrenewable energy source. The estimated recoverable coal reserves under the Loma Project constitute approximately 12 percent of the total coal reserves over 42 inches thick in the Garfield County portion of the Colorado section of the Little Bookcliffs coal field. Because of the nature of underground caving and resultant high contamination, future recovery of the abandoned 50 to 60 percent of the coal reserves is not considered feasible under present technology, and therefore those reserves must be considered lost.

Water Resources

Consumptive use of water diverted from the Colorado River by the proposed mining operations would be about 290 acre-feet per year (ac-ft/yr) by 1985 and about 850 ac-ft/yr by 1990. Additional consumptive use of municipal water by the increased population in Mesa County would be about 54 ac-ft/yr by 1980, 450 ac-ft/yr by 1985, and 910 ac-ft/yr by 1990. This would decrease accordingly the amount of surface water available for other uses downstream.

The reduction in flow downstream attributable to these consumptive uses, coupled with the increased salt load in sewage effluent, could increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.0031 mg/l (0.0005 percent) by 1980, 0.023 mg/l (0.0034 percent) by 1985, and 0.043 mg/l (0.0063 percent) by 1990. Any increase in the salinity of the lower Colorado River is regarded as a serious impact because the quality of the river water is already marginal for most current uses.

Minor local erosion would occur off site because of construction of the railroad spur, power line, and water pipeline from the plant complex to connection points near Mack, Colorado, and from construction related to population increase. Net sediment yield to the Colorado River from these sources, however, should not be significantly different over the life of the mines from predisturbance rates.

TABLE S5-1

TOTAL ANNUAL PARTICULATE EMISSIONS

(ton/yr)

Study year	Without mitigating measures	With mitigating measures	Percent reduction
1980	1389	1349	3
1985	921	676	27
1990	1161	834	28

Soils

Existing and proposed surface disturbance on approximately 39 acres by 1980, 649 acres by 1985, and 676 acres by 1990 at the mine site and within the utility corridor would cause an increase in erosion and a deterioration of soil structures and biological activity, leading to a temporary reduction in soil productivity. Any such reduction would prolong the efforts necessary to achieve successful reclamation.

Urban area expansion would permanently remove 30 acres from a production function by 1980, 274 acres by 1985, and 493 acres by 1990. Although exact locations are not known, some of this acreage would likely come from lands either now classified or eligible for classification as prime or unique farmland.

Vegetation

Vegetation would be lost at the mine site on 39 acres by 1980, 649 acres by 1985, and 676 acres by 1990. If parts of the disturbed areas are revegetated before abandonment of the mine (on refuse piles, road cutbanks, etc.), the actual acreage lost would be slightly less than those figures. However, revegetation of sites with less than 10 inches of annual precipitation and with steep south-facing slopes is uncertain except in years of higher than normal winter or spring precipitation. Natural vegetation would be lost from 30 acres by 1980, 247 acres by 1985, and 493 acres by 1990 due to urban growth.

Wildlife

Surface facilities covering 39 acres in 1980, 649 acres in 1985, and 676 acres in 1990 would partially or completely destroy wildlife habitat on this acreage for the life of the project. These acres would have supported 11 deer in 1980, 171 deer in 1985, and 178 deer in 1990. Reduced wildlife use would occur on an additional 4,000 acres through 1990.

Aquatic Biology

Increased consumptive use of 1,760 acre-feet of water per year by the coal-processing activities and by 5,800 new people in the area by 1990 would further deplete the amount of water available for fish and aquatic wildlife habitat in the Colorado River. This consumption alone is not significant to the aquatic habitat, but could become significant when combined with all water uses and developments in the basin.

Cultural Resources

Archeological Resources

Undiscovered sites could be damaged during surface disturbing activities. Information could be lost as a result of illegal collecting and vandalism and through incomplete excavation procedures where information not recorded would be permanently lost.

The integrity of petroglyph 5GF168 would be destroyed by the alteration of its physical setting by mine activities and by possible damage from vandalism.

Land Use

Transportation

Increased traffic on State Highway 139 from coal haulage and from employees would cause an increase in the number of accidents. Maintenance required on the roads would be much greater. Impacts due to trucking of coal would last until Sheridan constructs its proposed rail spur from the mine site to Loma. Ten unit trains per week would increase congestion on area rail facilities.

Livestock Grazing

The following livestock forage would be lost: 3 animal unit months (AUMs) per year due to disturbance of 39 acres in 1980; 41 AUMs on 649 acres in 1985; 48 AUMs on 676 acres in 1990. Increased off-road vehicle use would decrease productivity of natural vegetation by an unquantifiable amount. Agricultural lands disturbed by urban expansion would result in the loss of an unquantifiable amount of livestock forage and livestock wintering areas.

Recreation

If the community recreation facilities needed to prevent deterioration of existing facilities are not provided, this deterioration would be an unmitigated impact.

The hazards to recreational users of State Highway 139 from coal trucks would be an unmitigated impact until the proposed rail spur is complete.

Visual Resources

During the mining period, there would be a definite alteration of the natural landscape character since visually incongruous elements of the proposed action cannot be mitigated. Plant and refuse areas would remain apparent in the landscape for the life of the mine. Once all structures have been removed and the disturbed landforms have been regraded and revegetated, visual impacts would be minimal.

Socioeconomic Conditions

Population growth in Mesa County from the Loma Project would be 350 people by 1980; 2,900 people by 1985; and 5,800 people by 1990. Population influx resulting from the Sheridan development would have its greatest effect on the community of Fruita. Fruita has been growing at a rapid rate over the past few years, undergoing a change from an agricultural community to a diversified community whose economic base is the entire Grand Junction area. A rapid increase in population growth, however, is likely to detract from the rural, small-town character which still exists in Fruita. It is not expected that population growth from the Sheridan operation would have a similar pronounced effect upon Grand Junction, because the new population would be more easily absorbed by that community. However, the entire Grand Junction area's ability to absorb population growth is expected to be severely strained between 1978 and 1985.

Public school expenditures required to support the increased school-aged population generated by the Sheridan operation would exceed the School District 51's ability to pay for additional capital facilities.

The conversion of vacant land for urban purposes would preempt the future use of that land for any other purposes. About 30 acres of land by 1980, 247 acres by 1985, and 493 acres by 1990 would be converted to residential use in Mesa County to accommodate the population influx from Sheridan.

Noise levels in the project area would be elevated well above those produced by normal traffic between Loma and the area north of Douglas Pass. In canyons where 55-ton coal haulers are operating, the equivalent noise levels probably would be in the 70 to 75 decibel (dBA) range during periods of operation. At full operation, ten trains per week would be operating from the mine area and may add 2 dBA to the ambient noise levels produced by vehicular traffic.

CHAPTER 6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 100 million tons of coal would result in short-term and long-term alteration of natural resources and the human environment.

There would be the following alterations in the short term, a period beginning with on-site construction and ending with end of mine life (about 2000) and post-mining reclamation:

1. An estimated 100 million tons of coal would be exported to utility plants in the midwest and southwest for use in the production of electrical energy.

2. Annual average particulate concentrations would increase by 20 micrograms per cubic meter ($\mu g/m^3$) near the mine site and by 5 $\mu g/m^3$ within 0.5 mile of either side of State Highway 139 into Loma through 1990. Maximum 24-hour concentrations directly south of the mine would be 65 to 90 $\mu g/m^3$.

3. The mining operation and the increased population would consume about 54 acre-feet of water per year (ac-ft/yr) by 1980; 740 ac-ft/yr by 1985; and 1,760 ac-ft/yr by 1990. The effect would be to increase the dissolved-solids concentration in the Colorado River below Hoover Dam by as much as 0.0031 milligrams per liter (mg/l) (0.0005 percent) by 1980, 0.023 mg/l (0.0034 percent) by 1985, and 0.043 mg/l (0.0063 percent) by 1990.

4. Minor local erosion and sedimentation would occur off site because of the construction of a railroad, power line, and water pipeline from the plant complex to connection points near Mack, Colorado, and because of construction related to population increases.

5. There would be loss of soil productivity on 676 acres through 2000 due to increased erosion, deterioration of soil structure, and reduced biological activity, and there would be loss of vegetation of these 676 acres through 2000 due to loss of soil productivity.

6. Wildlife habitat on 676 acres, which could have supported 178 deer annually would be completely lost through 2000.

7. Increased traffic from coal haulage and from employees would increase the number of road accidents.

8. Six unit trains per week would increase congestion on area rail facilities.

9. Approximately 48 animal unit months (AUMs) of livestock forage would be lost annually throught 2000.

10. The scenic quality of this section of East Salt Creek would be reduced by the dominance of the surface facilities through 2000.

11. Population influx from the development of the Sheridan site would cause some growth related problems in the western portion of Mesa County over the short term, although locally derived revenues should be almost sufficient to meet the projected annual community facility costs due to development of the Loma Project.

12. Total direct, indirect, and induced income generated by this project would be $22,708,800 by 1990.

13. Noise levels in the canyon would approach state standards for industrial areas. On a short-term basis the town of Loma would be subjected to undesirable noise levels during daylight hours.

Residual effects of mining (after post-mining reclamation) on long-term productivity would be as follows:

1. An undetermined number of uninventoried exposed and unexposed fossil resources would be impaired or destroyed.

2. An unquantifiable gain in knowledge would result from surveys and exposure of fossil resources which might never have been found without development.

3. An estimated 100 million tons of coal, a nonrenewable energy resource, would be depleted after 2000.

4. On completion of mining and reclamation activities, ground-water and surface-water occurrence in the lease tract and adjacent areas should rapidly return to approximately pre-mining conditions. Long-term erosion and sedimentation should not be significantly different from predisturbance rates.

5. Soil and natural vegetative productivity would be permanently lost on 316 acres due to urban expansion.

6. Surface construction, subsidence, and vandalism would disturb or destroy an unquantifiable number of nonrenewable cultural resources.

7. Archeological surveys and excavation could provide gains in understanding of prehistoric use in the area.

8. Approximately 88 AUMs of livestock forage per year would be restored on the lease area upon revegetation after the mine is abandoned. However, successful revegetation at the mine site may be difficult except in years of higher than normal winter or spring precipitation.

9. If additional recreational facilities are provided to meet the increased demand, they would remain for long-term use; conversely, if additional facilities are not provided, the deterioration of present facilities would be a long-term adverse impact.

10. Following abondonment and reclamation, areas of altered topography, such as the terraced refuse pile and road cuts, would remain visible even after revegetation.

11. Rapid population growth in Fruita is likely to detract from its rural, small town character.

12. At least 493 acres would be committed for urban expansion.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Approximately 100 million tons of coal would be recovered from the Loma Project. About 100 million tons would be lost due to current mining methods.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing machinery and buildings would not be recycled and thus would be lost.

An undetermined number of uninventoried fossils would be lost or disturbed.

Consumptive use of water diverted from the Colorado River by the proposed mining operations would be zero acre-feet per year (ac-ft/yr) by 1980, about 290 ac-ft/yr by 1985, and about 850 ac-ft/yr by 1990. Additional consumptive use of municipal water by the increased population in Mesa County would be about 54 ac-ft/yr by 1980, 450 ac-ft/yr by 1985, and 910 ac-ft/yr by 1990. Use of water in the mining operations would end on completion of mining. Use of water by the increased population, however, would probably continue beyond the projected life of the mine.

Soil and vegetative production would be irretrievably lost on 676 acres for the life of the mine. This loss may be difficult to reverse because of the uncertainty of successful revegetation at the mine site, although natural revegetation would eventually occur.

Wildlife habitat on 676 acres, which could have supported 178 deer per year would be irretrievably lost for the life of the mine. This loss may be difficult to reverse because of the uncertainty of successful revegetation at the mine site, although natural revegetation would eventually occur.

Approximately 48 animal unit months of livestock forage would be irretrievably lost for the life of the mine. An unquantifiable amount of livestock forage and livestock wintering areas would be irreversibly lost due to disturbance of agricultural lands by urban expansion.

Anything other than in-place preservation of archeological artifacts involves an irreversible, irretrievable commitment of the resource. Damage from surface disturbance or vandalism would result in a permanent loss of information and would remove archeological values from future research considerations.

The development of a mining complex in and around East Salt Creek would establish an industrial landscape area in a relatively undisturbed portion of the Roan Plateau. The operation of the mines for over 20 years and the growth generated by a projected 900 employees would initiate a series of irreversible visual changes, and future generations would be committed to more developed landscapes.

Some changes are expected to take place in the rural community environment which now dominates western Mesa County. An irretrievable commitment of capital and lands (at least 493 acres) would be required to support population growth.

Particulate concentrations at the proposed mine site and for a very limited area surrounding the mine would increase slightly. Air quality would be degraded during the mine life, but the change would not be irreversible. With termination of the mining activity in about the year 2000, air quality would return to pre-mining levels.

Noise levels probably would increase above current levels as development of energy sources north of Douglas Pass continues and vehicular traffic on the Douglas Pass Road increases.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

Pursuant to implied covenants of both the federal mineral leasing laws and the existing lease agreements, the Department of the Interior is obligated to respond to a legitimate application to conduct mining operations on a valid lease, provided that all terms and conditions thereunder have been met. The Department's action with regard to Sheridan Enterprises' mining and reclamation (M&R plan) for the proposed Loma Project may be approval as proposed, rejection on various environmental or other grounds, approval or rejection in part, or approval subject to such additional requirements or modifications as the Department may impose under existing laws and regulations. The Department may also defer decision pending submittal of additional data, completion of required studies, or for other specific reasons. If there are serious environmental concerns as to the coal development, the Department may prevent further development of the leases by exercising the Secretary's exchange authority as to the federal coal rights, or seeking congressional action to cancel federal leases involved.

Development of alternative sources of energy, energy conservation, federal development of the coal, and emphasis on coal development in other regions of the United States are more appropriate for consideration on a program rather than a regional basis. These evaluations were made in the previous coal programmatic statement (U.S. Department of the Interior 1975) and will be updated and revised as necessary in the new coal programmatic statement now under way (to be completed in 1979).

Sheridan's M&R plan for the Loma Project has not been reviewed for compliance with the interim regulations 30(CFR): 700 required under Sections 502 and 503 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (PL 95-87), and it does not fully reflect the requirements of the interim regulations. The M&R plan will be returned to the applicant for revision in accordance with the appropriate federal regulations. When it is resubmitted to the Office of Surface Mining (OSM), it will be evaluated for compliance with all appropriate federal regulations by OSM in conjunction with the U.S. Geological Survey (USGS). In addition, the Bureau of Land Management (BLM) must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA.

APPROVAL AS PROPOSED

The Department has the choice of approving the M&R plan as proposed. However, as pointed out above, Sheridan's M&R plan has not been reviewed for compliance with the interim regulations. Therefore, it cannot be considered for approval until it has been revised to comply with all appropriate federal regulations.

REJECTION ON ENVIRONMENTAL OR OTHER GROUNDS

The Department may reject any M&R plan that does not meet the prescriptions of applicable law and regulations under the Department's authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly differently designed course of action by the lessee (operator). In addition, BLM must evaluate the M&R plan in relation to the Department's proposed unsuitability criteria developed in compliance with Section 522 of SMCRA. Except when an M&R plan does not comply with existing regulations, the Department cannot under present circumstances reject the proposed plans to the extent that a de facto cancellation of a lease results unless the Secretary seeks and obtains additional authority from Congress.

Rejection of Sheridan Enterprises' proposed M&R plan would result in no additional environmental impacts from coal mining on the federal leased lands. Since these lands are public lands, surface use would be governed by BLM policy and management guidelines and decisions. Sheridan Enterprises could submit a new M&R plan, challenge the rejection, or abandon development of the lease. Should Sheridan submit a new M&R plan, it would require both environmental assessment and review for compliance with applicable regulations.

Mining at the proposed Loma Project is intended to supply 100 million tons of coal to utility plants in the midwest and southwest for use in the production of electrical energy. Without the Loma

Project, other coal would have to be acquired to supply these markets. Such a substitution could create a shortage for other coal markets.

Without implementation of the Loma Project, future air quality at the Loma site is expected to be nearly the same as existing air quality, about 40 micrograms per cubic meter.

The primary use of the vegetation would be livestock and wildlife forage. Two stock reservoirs, three cattleguards, and approximately 0.5 mile of fence are proposed to be constructed on the area. If an allotment management plan (AMP) is implemented on the Garr Mesa Allotment, the part of the allotment within the lease area would be placed in a two-pasture cycle of spring and fall use one year and fall use the next year. If the AMP is implemented, vegetative condition may improve due to an increase in density of the key species (galleta grass, Indian ricegrass, Colorado wildrye, and western wheatgrass). A decrease in the hedging of serviceberry would also be expected.

Wildlife habitat conditions should improve if the Garr Mesa AMP is implemented. However continuing human population growth in Mesa County would still cause impacts to wildlife: expansion of urban areas onto agricultural lands and some winter range; increased recreational use of wildlife species, primarily hunting; and increased poaching of big game species.

The rejection of the M&R plan would lessen the projected use of existing recreational facilities in the area, and there would not be a need for an additional 19.9 acres of active/improved park land. There would be fewer hazards to recreational drivers on State Highway 139.

Without the proposed facilities, East Salt Creek and adjoining canyons would remain a predominantly rural landscape. Rehabilitation of the disturbance around the exploratory sites and the access roads would bring the affected landscapes back to a scenic quality Class B.

Natural weathering and vandalism would continue to be the major causes of loss of archeological and historical values, but there should be no additional contributing factors to such loss at the site if the M&R plan is rejected. Paleontological resources would be impacted both adversely and beneficially in approximate proportion to the level of regional development and the area disturbed.

The population of Mesa County would still increase at a rapid rate to 106,000 people by 1985 and 94,800 people in 1990. Development of oil shale and uranium and the area's role as a regional center account for the growth. Garfield County is also projected to grow at a rapid rate to 45,100 people by 1990, also primarily as a result of oil shale development.

APPROVAL OR REJECTION IN PART

The Department has the choice of approving or rejecting part of a particular M&R plan, based on projected adverse environmental impacts.

Restrict Development on Existing Leases

The subject leases convey the right to develop, produce, and market the federal coal resource thereon if all other terms and conditions have been met by the lessee. In general, the Department does not possess the authority to arbitrarily constrict development if all other requirements of the lease have been met. However, various measures that may tend to restrict development may be taken by the Department at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations (for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, etc.). Similarly, the Department could permit only selective exploration and development of existing leaseholds if analysis indicates wholly unacceptable environmental impacts that could not be reduced to an acceptable level.

Adoption of this alternative would reduce adverse impacts by reducing the area in which the impacting activities could take place. At the same time, application of this alternative would not permit maximum recovery of the coal resources and would thus be contrary to principles of conservation embodied in the legislation which authorizes the leasing of these lands for the purposes described. It is entirely possible that such selective mining would leave isolated blocks of coal that might never be recovered owing to the high costs of mining such remnant areas at a later date.

Phased Development

Phased development of coal mines as a means of lessening socioeconomic impacts of coal development in the ES area is discussed as the Diligent Development and Continuous Operations alternative under Approval or Rejection in Part of chapter 8 in volume 1. The restrictions discussed under that alternative could be applied to the Sheridan operation alone. However, to do so would probably not significantly reduce socioeconomic impacts in Mesa County, since other coal mines in the area could continue to develop at a rapid rate, and most of the adverse socioeconomic impacts result from multiple development of mineral resources over a short period of time (see the impact analysis in volume 1, chapter 4, Socioeconomic Conditions). To be effective, phased development would

have to be applied uniformly to coal projects throughout the ES area.

APPROVAL SUBJECT TO ADDITIONAL REQUIREMENTS OR MODIFICATIONS

Subject to existing laws and regulations, the Department has the choice of approving an M&R plan with additional stipulations or changes to lessen adverse environmental impacts. For example, operational, transportation, or other alternatives could be adopted when such alternatives would reduce adverse impacts.

Operational Alternatives

No reasonable operational alternatives have been identified which would significantly reduce adverse impacts of coal mining or increase resource recovery. Surface mining is not feasible due to the geology and geographic characteristics of the area. Federal regulations (30[CFR]: 211) require M&R plans be designed to ensure maximum economic recovery of the coal resource.

Transportation Alternatives

Coal Transport

Sheridan proposes initially to truck coal on State Highway 139 to a rail loadout near Mack. This traffic would be concentrated in an eight-hour daytime shift, which could be expected to increase accident rates, noise levels, and air pollution levels along the highway. This heavy use would also be detrimental to the existing highway, which would require extensive improvements such as resurfacing and widening.

Sheridan also proposes to construct a railroad spur from the mine site to Mack. Although this spur is projected to be completed by 1982, Sheridan has not yet applied for a right-of-way or proposed an exact site for the corridor. Once the rail spur has been completed, trucking of coal would be discontinued and the impacts to the highway described above would cease.

As an alternative, Sheridan could be required to postpone start-up of mining until a rail spur has been constructed and to transport all coal mined under the proposed M&R plan by rail. If this alternative is adopted, Sheridan would be required to submit a right-of-way application for the proposed corridor with sufficient information on siting, construction, etc., for environmental assessment of possible impacts. The proposed corridor would also have to be designed to comply with Loma Project Mitigating Measures 3, 5, and 7 (see chapter 4). If the right-of-way were approved, then impacts of the proposed M&R plan as discussed in chapter 3 would be deferred until the rail spur was completed, and the impacts of trucking coal would not occur.

No other reasonable transportation alternatives have been identified. See volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Coal Transportation Alternatives, for a general discussion of truck transport and slurry pipelines.

Busing of Mine Employees

Busing of employees to the mine site could reduce the traffic impacts discussed in chapter 3. This measure has been proposed as a regional alternative in volume 1, chapter 8, Approval Subject to Additional Requirements or Modifications, Busing of Coal Mine Employees.

Other Alternatives

The land use and socioeconomic analyses in chapter 3 identified adverse impacts to Mesa County due to development of the Loma Project. In addition to the Diligent Development and Continuous Operations alternative which addresses such impacts on a regional basis (see Restrict Development on Existing Leases earlier in this chapter and in chapter 8, volume 1), the regional volume also discusses actions which may be available to state, county, and community governments which might lessen or control socioeconomic and land use impacts. See Socioeconomic Alternatives Available to State and Local Governments, chapter 8, volume 1.

DEFER ACTION

For proper cause, the Department may defer final action on a proposed M&R plan. Reasons for deferring action can include, but are not limited to, the need and time required for:

1. Modification of a proposal to correct administrative or technologic deficiencies;
2. Redesign to reduce or avoid environmental impact;
3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation;
4. Further evaluation of a proposal and/or alternatives.

The principal effect of deferring action on a proposed M&R plan on these grounds would be a comparatively short-term delay in the occurrence of all related impacts of a proposal (both adverse and beneficial). To the extent that an M&R plan can be redesigned to alleviate adverse impacts, those impacts would be lessened.

As pointed out at the beginning of this chapter, Sheridan's M&R plan for the Loma Project has not

been reviewed for compliance with the interim regulations, and the Department will not consider the plan for approval until it is brought into compliance with all applicable federal requirements.

Control of Runoff and Salinity

Approval of the M&R plan could be deferred until it has been evaluated with regard to best management practices for nonpoint sources of water pollution and the guidelines of the Colorado River Salinity Forum. As far as can be determined at the present time, however, mining at the Loma Project operation would produce few adverse impacts to water quality (see Water Resources, chapter 3).

Rail Corridor Right-of-Way

Sheridan has not submitted a right-of-way application for its proposed rail corridor, nor has it submitted sufficient information for adequate analysis of impacts. Final action on Sheridan's proposed M&R plan could be deferred until the company has submitted an application for a right-of-way, including sufficient information for environmental assessment. If this alternative is adopted, all impacts described in chapter 3 would be deferred until such time as the M&R plan may be approved and implemented. (See also Transportation Alternatives under Approval Subject to Additional Requirements or Modifications, above.)

PREVENTION OF FURTHER DEVELOPMENT

No Action Alternative

"No action" on a mining proposal for the initial development of existing leases would equate to maintaining the status quo on those leases.

Under existing regulations, operations may not proceed in the absence of approved M&R plans and related permits. The alternative of rejecting the M&R plans is discussed earlier in this chapter.

Relinquishment of Leases

The BLM is reviewing nonproducing existing leases. Nonproducing leases are to be reviewed in accordance with planning standards and in compliance with the proposed unsuitability criteria developed pursuant to the requirements of section 522(b) of SMCRA.

Under Congressional Bill S3189 (October 13, 1978), the Secretary may exchange leased lands that are determined and/or proven to be unmineable for an equivalent area of unleased land. In addition, the Federal Land Policy and Management Act of 1976 (PL 94-579), Section 206, gives the Secretary general authority to dispose of public lands by exchange, subject to applicable laws, when the Secretary "determines that the public interest will be well served by making that exchange: *Provided,* That when considering public interest the Secretary concerned shall give full consideration to better Federal land management and the needs of State and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife and the Secretary concerned finds that the values and the objectives which Federal lands or interests to be conveyed may serve if retained in Federal ownership are not more than the values of the non-Federal lands or interests and the public objectives they could serve if aquired."

CHAPTER 9

Consultation and Coordination

See volume 3, chapter 9, for a discussion of consultation and coordination carried out for the West-Central ES.

* U.S. GOVERNMENT PRINTING OFFICE: 1979—678-991